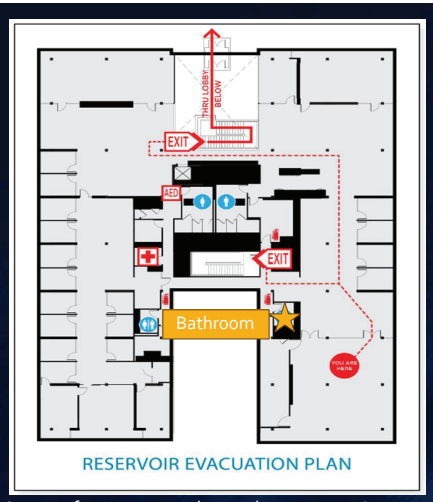
Welcome to Phosphorus Forum 2026!

Sustainable Phosphorus Alliance

Welcome to Phosphorus Forum 2026!

Source of Reflecting Pool Phosphorus



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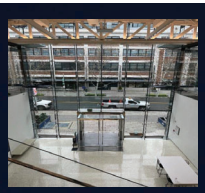
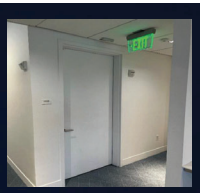


1st FLOOR NORTH



2ND FLOOR WEST

MEETING POINT: SOUTH SIDE OF BUILDING/ALONG ANACOSTIA RIVER

Ground Rules

Expected Behavior
We expect all participants to demonstrate respect, inclusivity, and professionalism. Indeed, we strongly promote collaboration and aim to make your experience with us enjoyable and conducive to productive interactions.

Prohibited Conduct
Harassment: Any unwelcome action towards another person, knowing it might cause hurt, humiliation, or intimidation. The Alliance does not permit any form of harassment, including harassment based on gender, gender expression, gender identity, race, religion, belief, nationality, ethnic origin, social origin, age, sexual orientation, marital status, disability, language, or any other reason.

Sexual Harassment: The Alliance strictly prohibits any unwelcome conduct of a sexual nature that might cause discomfort, disapproval, hurt, or humiliation. Examples include: demeaning comments about someone's sexual orientation, or gender identity, name-calling, slurs with a sexual connotation, sexual comments about appearance, clothing, or body parts, asking for sexual favors, staring in a sexually suggestive manner, unwelcome touching, inappropriate sexual gestures, sexual anecdotes/jokes, sending or sharing suggestive communications, images or videos, attempted or actual sexual assault, including rape.

Violence and Threats: All forms of physical aggression, verbal intimidation, or implied threats are prohibited.

Disruptive Behavior: Sustained disruption of talks or other events will be taken seriously and may lead to removal of disruptive individuals from the venue.

Made Possible by our Members

Members and Strategic Partners

OCP · NACWA · OSTARA · The Water Research Foundation · Nutrien · Mosaic · The Sustainability Consortium · ARVA Intelligence · PhosphoLutions · KOCH Agronomic Services · STEPS · GreenEdge GreenTechnologies, LLC · KASE Warbonnet Inc. · HUMA · S&F AGRITECH · CASFER Center for Advancing Sustainable and Distributed Fertilizer Production

Strategic Partners

Global Water Works · Water Environment Federation · AgStar · Freshwater Collaborative of Wisconsin · nebra · Lake Erie Foundation · ANPC · ASU Center for Agriculture and National Security, Arizona State University

Sustainable Phosphorus Alliance

9:00 am - 9:10 am	**Welcome** — Jim Elser, Speaker
9:10 am - 9:45 am	**National Nutrient Inventory Portfolio** — Robert Sabo, Speaker • General Presentation
9:45 am - 10:05 am	**Critical Minerals Policy** — Sarah Harvey, Speaker • General Presentation
10:05 am - 10:30 am	**Coffee and Networking Break** — Break
10:30 am - 11:45 pm	**Phosphorus Supply, Critical Minerals, and Recent Disruptions** — Matt Scholz, Moderator • Bela Spiller, Speaker • Justin Baker, Speaker • Sarah Harvey, Speaker • Ryan Bond, Speaker • Panel Discussion
11:45 am - 1:00 pm	**Lunch** — Meal Break
1:00 pm - 1:30 pm	**USDA Lessons in Nitrogen** — Kate Zook, Speaker • General Presentation
1:30 pm - 2:45 pm	**Impacts of Federal Policy on Phosphorus Use in Agriculture** — Shwetha Delanthamjalu, Moderator • Faith Parum, Speaker • Jonathan Coppess, Speaker • Hunter Swisher, Speaker • Abigail Edwards, Speaker • Panel Discussion
2:45 pm - 3:00 pm	**Coffee and Networking Break** — Break
3:00 pm - 3:45 pm	**Breakout Session: Supply Chain Resilience** — Breakout Room #1 — Add to My Agenda **Breakout Session: Use and Circularity** — Breakout Room #2 — Add to My Agenda
3:45 pm - 4:00 pm	**Share Out**
4:00 pm - 5:30 pm	**Sustainable Phosphorus Alliance Board of Directors Meeting** — Breakout Session
6:00 pm - 8:00 pm	**Social Event** — Jackie Restaurant • Meal Break

Today's Agenda

Access agenda online by taking a picture of this:

Tomorrow's Agenda

9:00 am - 9:15 am	**Welcome** — Jim Elser, Speaker • General Presentation
9:15 am - 9:45 am	**Energy, Waste, and Circularity** — Rebecca Muenich, Speaker • General Presentation
9:45 am - 11:00 am	**Circularity of Phosphorus in Manure Streams** — Ke'Shan Lighty, Moderator • Steve Levitsky, Speaker • Steph Kulesza, Speaker • Holly Porter, Speaker • Josh McGrath, Speaker • Panel Discussion
11:00 am - 11:15 am	**Coffee Break** — Break
11:15 am - 12:15 pm	**Breakout Session: Supply Chain Resilience** — Breakout Room #1 — Add to My Agenda **Breakout Session: Use and Circularity** — Breakout Room #2 — Add to My Agenda
12:15 pm - 12:30 pm	**Closing Remarks and Lunch** — Justin Baker, Speaker • Meal Break
12:30 pm - 1:30 pm	**Optional Breakout Session** — Breakout Room #1

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Sustainable Phosphorus Alliance

Happy 10th Birthday to the Alliance!

Ingredient	Assumed amount	Estimated fertilizer footprint	P contribution
Wheat flour	220 g	4 g P/kg	0.9 g
Sugar, including frosting	850 g	2 g P/kg	1.7 g
Cocoa powder	120 g	25 g P/kg	3.0 g
Eggs	100 g	12 g P/kg	1.2 g
Milk	300 g	3 g P/kg	0.9 g
Vegetable oil	110 g	5 g P/kg	0.6 g
Butter in frosting	115 g	25 g P/kg	2.9 g
Total			**11.1 g P**

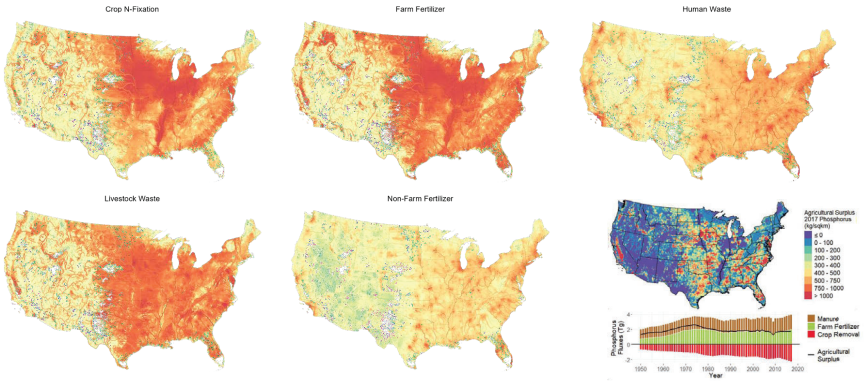
P actually present in the cake: 2.2 g
Cost to remove 2.2 g P at WWTP: $0.22 - $0.86
Cost for 2.2 g P as TSP: $0.01

P-RES Workshop: Dec. 1-2, 2026 (D.C.)

Resilient Phosphorus Supply Chains for National Security: A Workshop for Connecting Across Decision-Makers

- Establish a shared understanding of recent Executive Order and its implications for phosphorus and glyphosate supply chains, domestic production capacity, and national security priorities.
- Identify critical knowledge conflicts and knowledge gaps related to phosphorus reserves and resources in the U.S.
- Clarify and map out institutional roles and responsibilities among federal agencies, industry, NGOs, and academic researchers with respect to domestic phosphorus management.
- Develop research priorities and coordination, data sharing, and assessment of domestic phosphorus supplies and sustainability.
- Increase and sustain network connections between all stakeholders involved in domestic phosphorus management.

This workshop is supported by the National Science Foundation under Grant No. 2630851



EPA's National Nutrient Inventory Portfolio: Enhancing nutrient pollution reduction strategies through standardized tracking of agricultural and urban nutrient fluxes

Robert Sabo – EPA Office of Water
Meredith Brehob – EPA ORISE

The views expressed in this presentation are those of the authors and do not necessarily represent views or policies of the U.S. Environmental Protection Agency.

National Nutrient Inventory Team

Presenting today

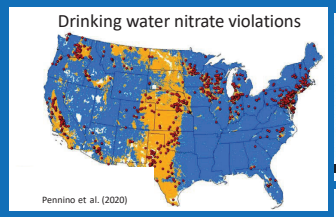
Presentation Agenda

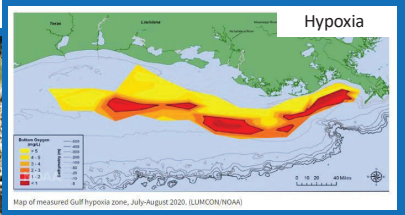
- **Introduction to the EPA's National Nutrient Inventory**
  - Overview and purpose
- **Status and Trends of the Nation's Nutrient Sources**
  - Emphasis on phosphorus (P) dynamics
- **Statistical & AI/ML Models Link the NNI to Water Quality Endpoints**
  - Key findings and implications
  - Trends
- **Facilitating Strategic, State-led Approaches**
  - Proactive solutions and next steps to support cooperative federalism

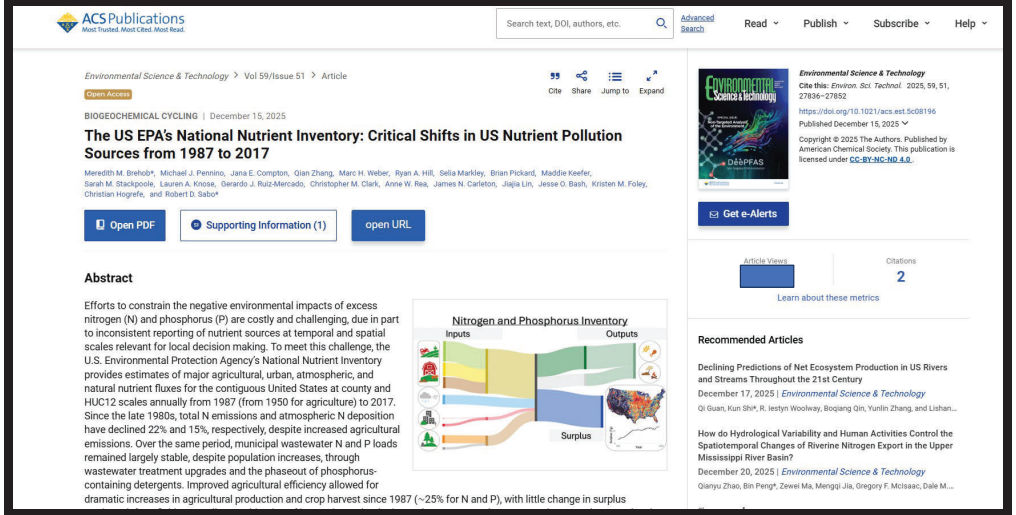
EPA United States Environmental Protection Agency

Introduction to the EPA's National Nutrient Inventory

Excess nitrogen and phosphorus are the predominant drivers of water quality degradation in United States.



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Environmental Science & Technology > Vol 59/Issue 51 > Article

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BIOGEOCHEMICAL CYCLING | December 15, 2025

The US EPA's National Nutrient Inventory: Critical Shifts in US Nutrient Pollution Sources from 1987 to 2017

Meredith M. Brehob*, Michael J. Pennino, Jana E. Compton, Qian Zhang, Marc H. Weber, Ryan A. Hill, Sella Markley, Brian Pickard, Maddie Keefer, Sarah M. Stackpoole, Lauren A. Knose, Gerardo J. Ruiz-Mercado, Christopher M. Clark, Anne W. Rea, James N. Carleton, Jiajia Lin, Jesse O. Bash, Kristen M. Foley, Christian Hogrefe, and Robert D. Sabo*

Open PDF | Supporting Information (1) | open URL

Abstract

Efforts to constrain the negative environmental impacts of excess nitrogen (N) and phosphorus (P) are costly and challenging, due in part to inconsistent reporting of nutrient sources at temporal and spatial scales relevant for local decision making. To meet this challenge, the U.S. Environmental Protection Agency's National Nutrient Inventory provides estimates of major agricultural, urban, atmospheric, and natural nutrient fluxes for the contiguous United States at county and HUC12 scales annually from 1987 (from 1950 for agriculture) to 2017. Since the late 1980s, total N emissions and atmospheric N deposition have declined 22% and 15%, respectively, despite increased agricultural emissions. Over the same period, municipal wastewater N and P loads remained largely stable, despite population increases, through wastewater treatment upgrades and the phaseout of phosphorus-containing detergents. Improved agricultural efficiency allowed for dramatic increases in agricultural production and crop harvest since 1987 (~25% for N and P), with little change in surplus

Nitrogen and Phosphorus Inventory
Inputs
Outputs
Surplus

Environmental Science & Technology
Cite this: Environ. Sci. Technol. 2025, 59, 51, 27836−27852
https://doi.org/10.1021/acs.est.5c08196
Published December 15, 2025
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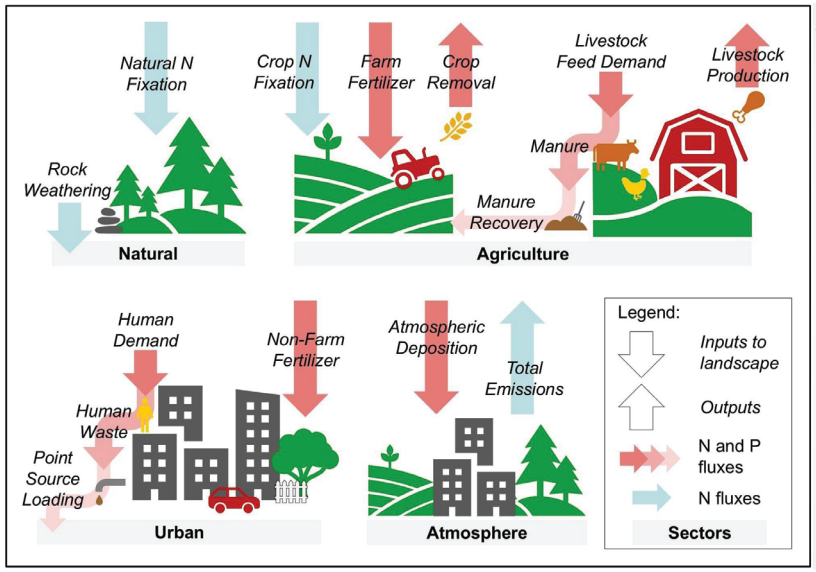


Conceptual figure of National Nutrient Inventory from Brehob et al. (2025)

Highlight → Inventory Data are largely **empirical** and often tied to localized data collection efforts like the US Census and the USDA Census of Agriculture.

EPA United States Environmental Protection Agency

Status and Trends of the Nation's Nutrient Sources

"A combination of innovative technologies and management has stemmed or even decreased major sources of nutrient pollution to the environment over the last several decades."

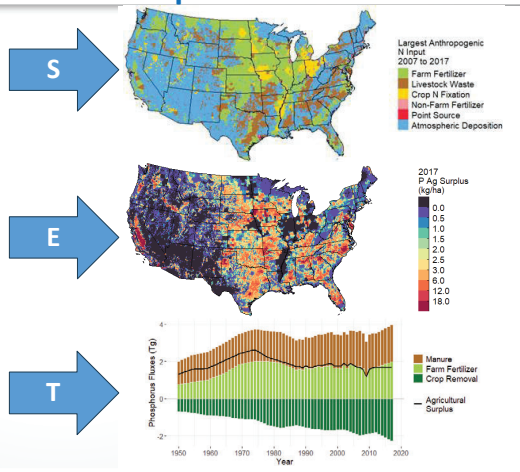
- Brehob et al. (2025)

Inventories provide actionable "SET" information about nutrient pollution sources

Source: Largest source of nutrient inputs into a watershed or other spatially defined unit

Extent/Magnitude: Magnitude and spatial extent of nutrient sources using management relevant metrics

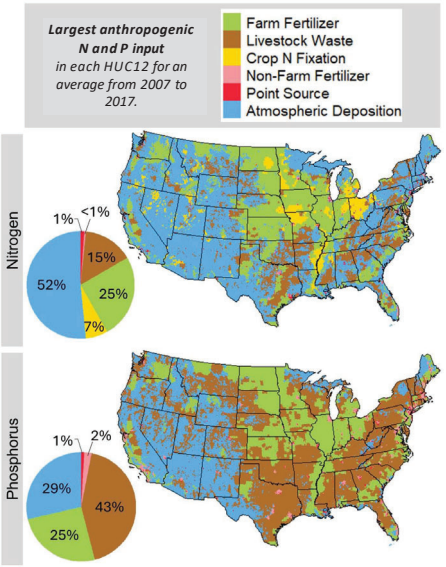
Trajectory: Changes in nutrient inputs over time



Figures from Brehob et al. (2025)

How do input sources vary spatially?

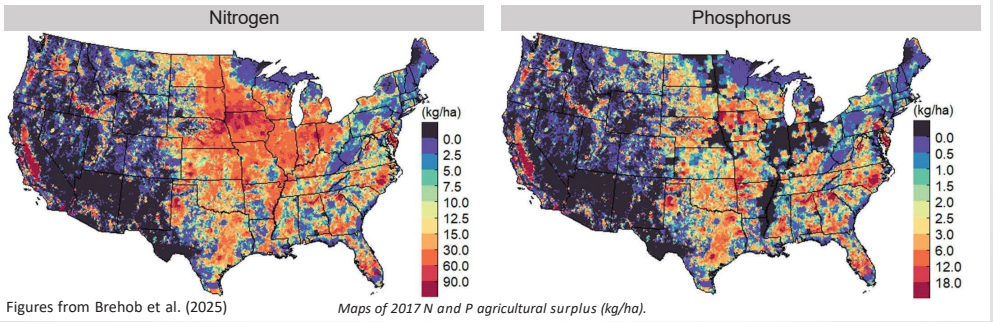
- High **fertilizer** and **crop N fixation** in agricultural regions
  - See Midwest and Mississippi River Alluvial Plain
- **Atmospheric deposition** larger for N than P; **manure** larger for P than N
  - See eastern and south-central US
- **Urban inputs** are regionally important



Figures from Brehob et al. (2025)

How do input metrics vary spatially?

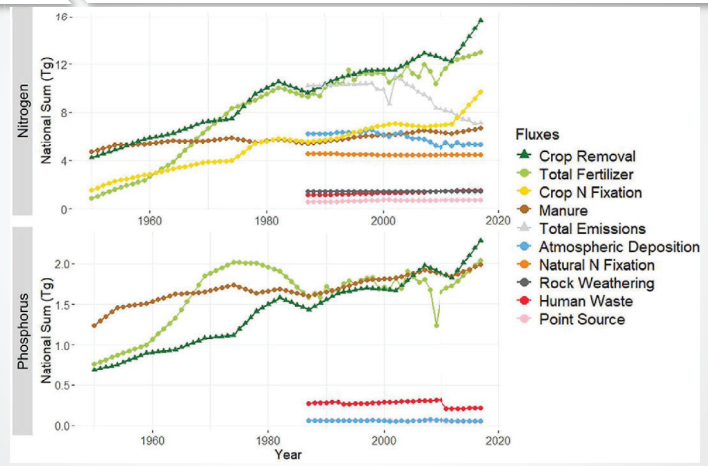
- Spatial extents of N and P agricultural surpluses differ
  - See eastern Midwest and Mississippi River Alluvial Plain



Figures from Brehob et al. (2025)

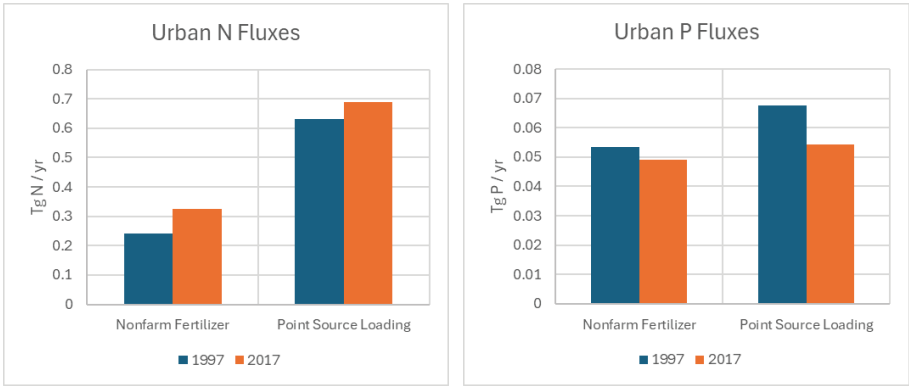
Maps of 2017 N and P agricultural surplus (kg/ha).

How do inputs and outputs vary through time?



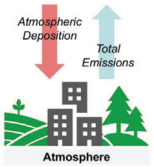
Figures from Brehob et al. (2025)

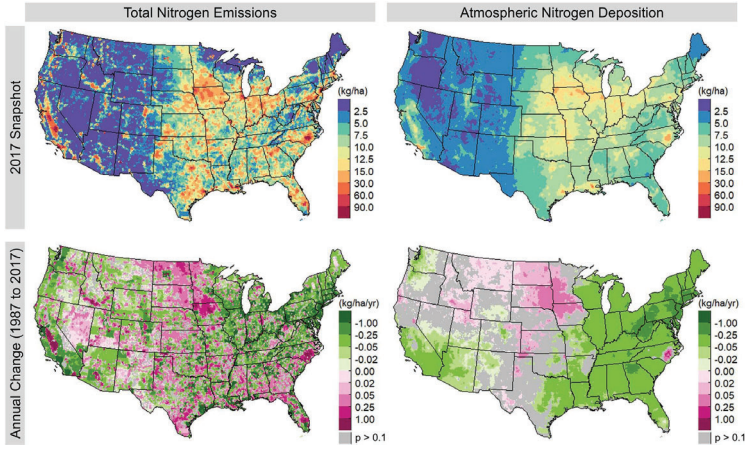
Urban nitrogen up, phosphorus down



National sums from Brehob et al. (2025)

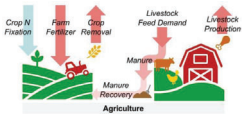
NO_x emission declines driving decreases in atmospheric deposition

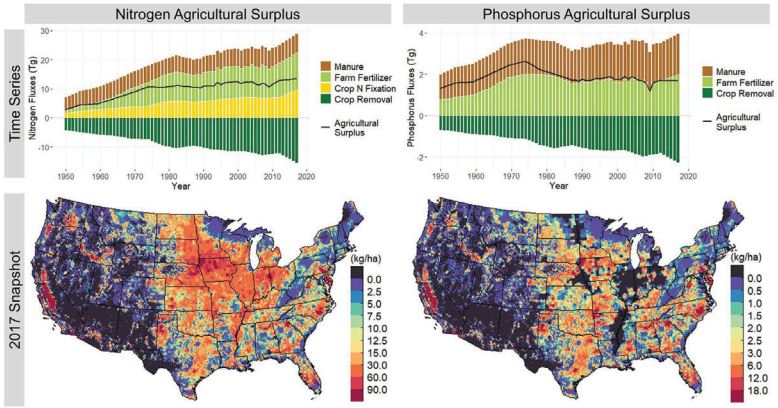




Figures from Brehob et al. (2025)

US farmers have increased their nutrient use efficiencies



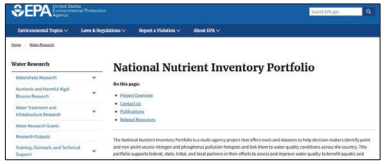


Figures from Brehob et al. (2025)

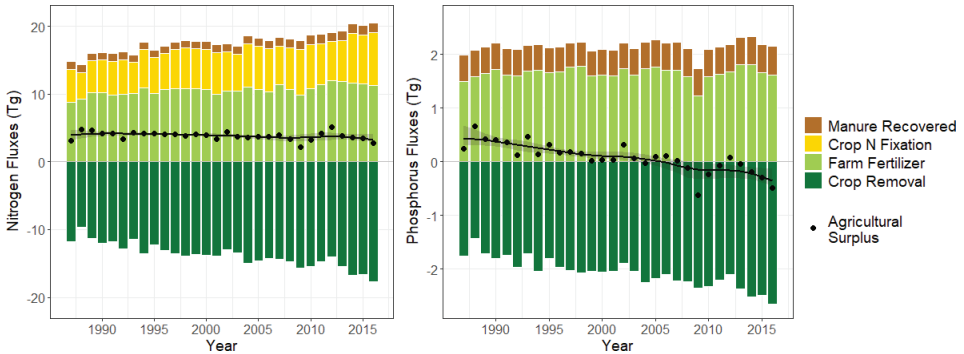
Evolving the NNI

Data gap from Brehob et al. (2025): "Additionally, after comparison to recently released state-level sales data, it was revealed that reported agricultural N and P surplus values (2013–2017) may be biased high due to overestimations in county-level fertilizer projections for 2017 (1.1 Tg for N, 0.3 Tg for P)."

Additional lines of evidence: NNI researchers work with partners to update inventories, incorporate additional data sources (e.g., The Fertilizer Institute's NuGIS), and improve estimation methodologies.



Agricultural N and P surplus declined nationally, while crop production increased >50%



Agricultural N surplus declined from ~4.0 Tg N in the mid-1980s to ~3.5 Tg N post-2010.

Agricultural P surplus declined throughout the period of record, becoming negative after 2006.

Figure from Sabo et al. (in review)

Agricultural P surplus declined in most states, and is largely negative or near zero in 2016—drawdown becoming the norm?

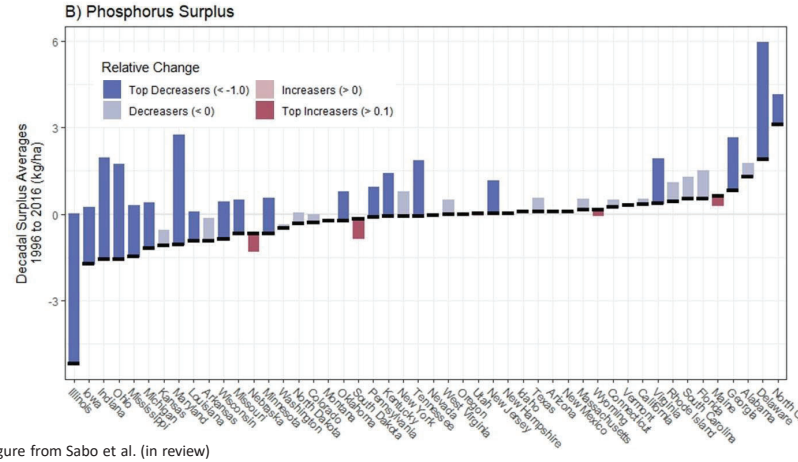


Figure from Sabo et al. (in review)

Farmers are largely improving NUE for P—how long will drawdown be maintained?

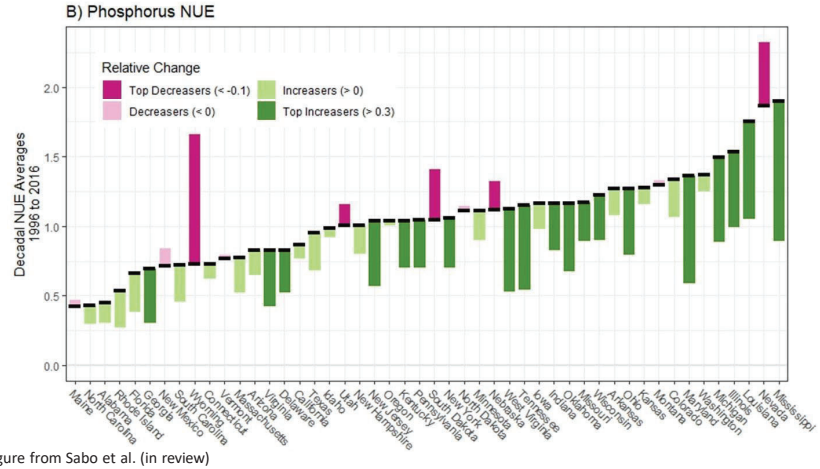


Figure from Sabo et al. (in review)

Positive progress, but critical challenges remain:

Fully leveraging agricultural legacy and manure P resources

NNI can help target areas for innovative solutions to **bolster agricultural operations** and boost the likelihood of **decreasing phosphorus loss to surface waters**.

Accumulated agricultural legacy P surplus highlights opportunities and challenges

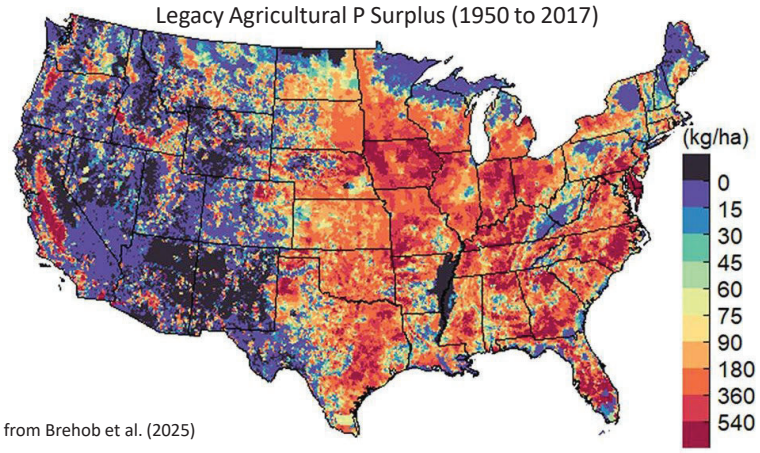
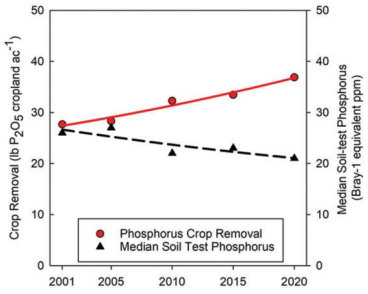
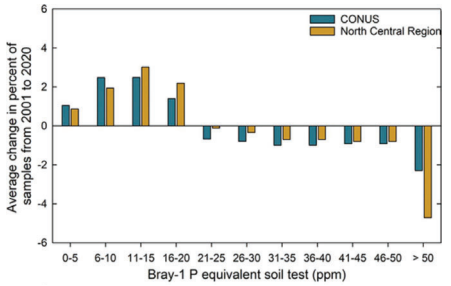


Figure from Brehob et al. (2025)

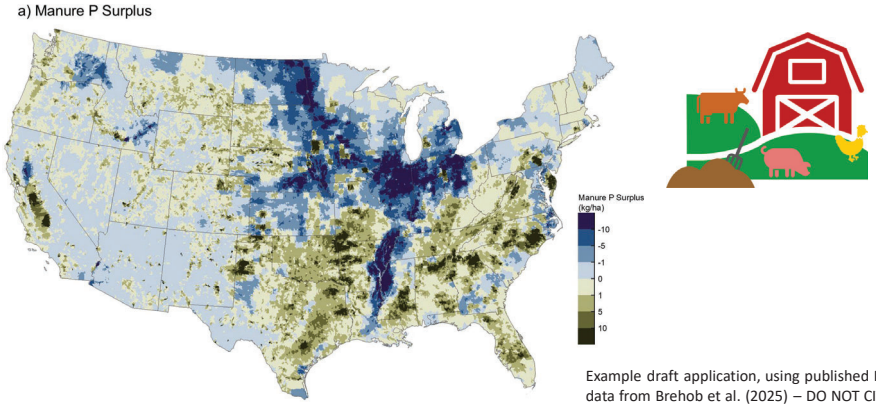
Many major crop producing regions can **drawdown** soil P concentrations to agronomic optima—and many already are making progress.





Jones et al. (2021)

Vertical integration and consolidation of livestock production requires innovative solutions to best leverage manure phosphorus resources and fulfill national security needs

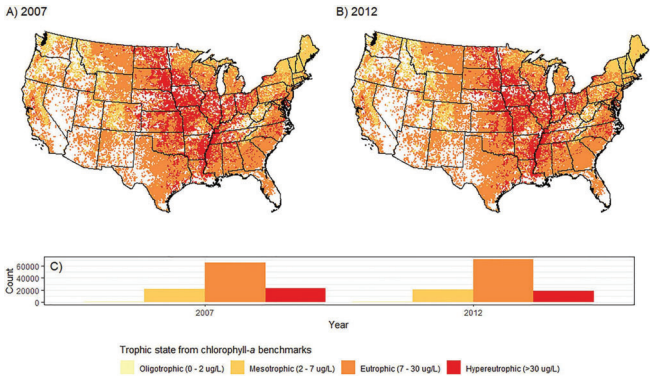


Example draft application, using published NNI data from Brehob et al. (2025) – DO NOT CITE

Statistical & AI/ML Models Link the NNI to Water Quality Endpoints

Data driven models enable faster, more flexible predictions that reduce computational costs, support scenario testing, and help optimize management strategies.

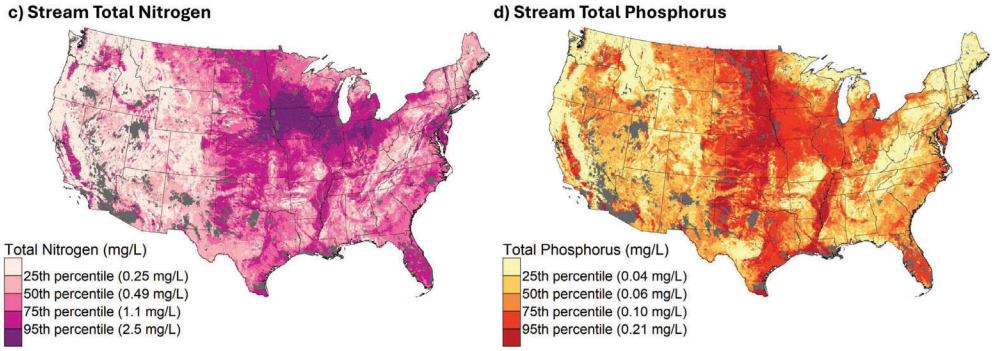
NNI can be used to help link sources to water quality outcomes and inform nutrient reduction strategies: Harmful Algal Blooms



Figures from Brehob et al. (2024)

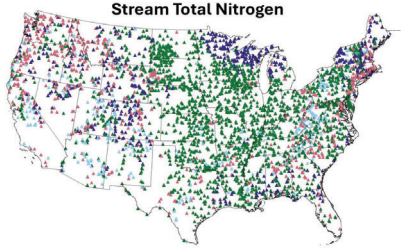
NNI Portfolio

NNI + NARS models predict nutrient concentrations for over 2.4 million stream segments

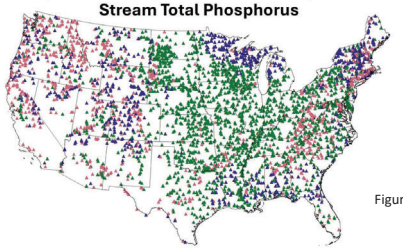


Figures from Brehob et al. (in review), which builds on Sabo et al. (2023) and Lin et al. (2021)
DO NOT CITE

a) Drivers of Higher Relative Site-Specific Stream Total Nitrogen



b) Drivers of Higher Relative Site-Specific Stream Total Phosphorus



Management-relevant drivers

- **Agricultural nutrient management**
  - Midwest and eastern CONUS
- **Atmospheric deposition**
  - Mountain regions with few other inputs
- **Urban nutrient management**
  - Cities and suburban areas
- **Wetland influence**
  - Complex nutrient dynamics

Figures from Brehob et al. (in review), which builds on Sabo et al. (2023) and Lin et al. (2021)
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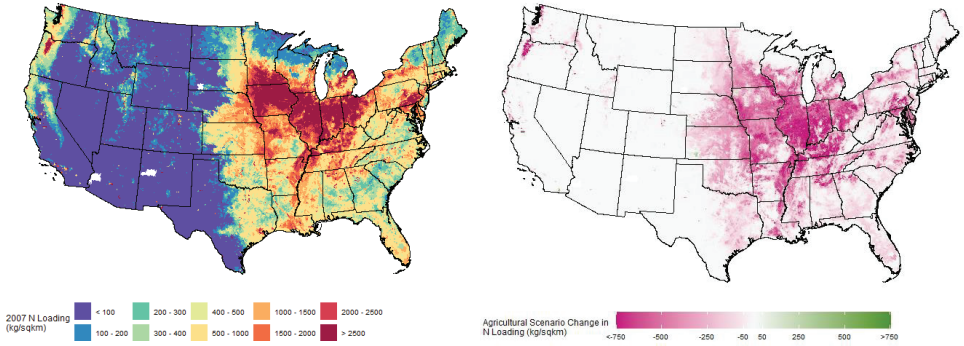
TESTING DIFFERENT SCENARIOS

What would happen if ag surplus was reduced by 50%?
N loads to waterways would decrease by 19% nationwide.



Example draft application, using published NNI data (Brehob et al. 2025) – DO NOT CITE

EPA United States Environmental Protection Agency

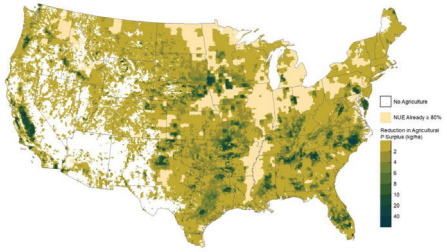
Facilitating Strategic, State-led Approaches

NNI offers an intuitive, outcome-oriented framework states and localities can tailor to set their strategic nutrient source reduction goals and prioritize watershed areas for scaling up the implementation of innovative management solutions to accelerate the pace and impact of resource conservation and restoration investments.

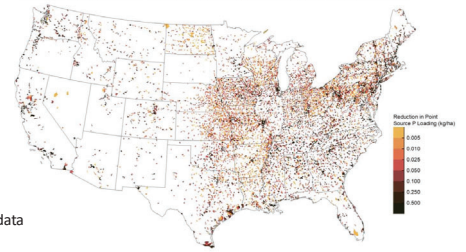
Facilitating Strategic, State-led Approaches

- Explore the impacts of potential improvements in agricultural nutrient use efficiency and wastewater treatment plant upgrades
- Can be used to prioritize areas for management and restoration—Nutrient Opportunity Zones

b) Change in Agricultural P Surplus Under 80% NUE Achievement Scenario



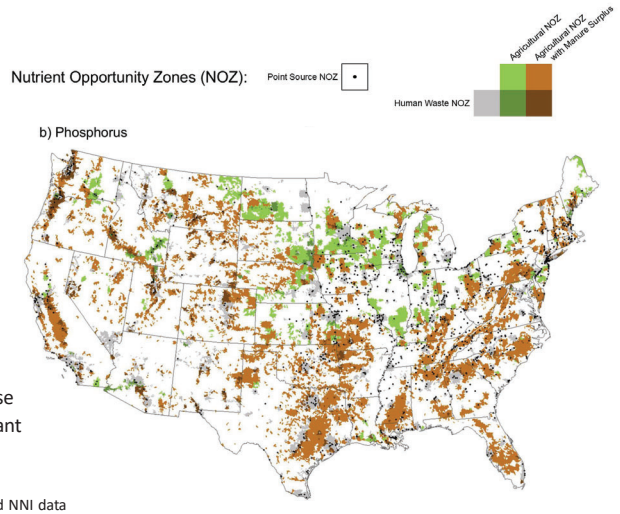
d) Change in Point Source P Loading Under 0.18 mg P / L Effluent Concentration Scenario



Example draft applications, using published NNI data (Brehob et al. 2025) – DO NOT CITE

Facilitating Strategic, State-led Approaches

- Can be used to prioritize areas for management and restoration—Nutrient Opportunity Zones
  - E.g., use NNI to investigate where maintenance of sewage transport infrastructure is critical
- States and local communities can use these types of analyses to set relevant and realistic targets.



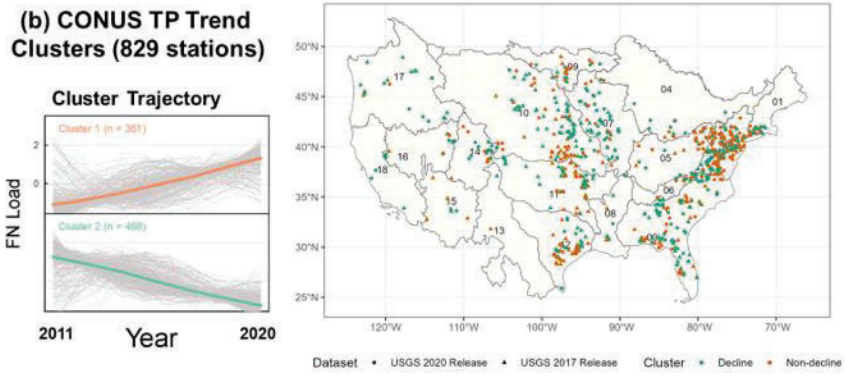
Example draft applications, using published NNI data (Brehob et al. 2025) – DO NOT CITE

EPA United States Environmental Protection Agency

Evidence that phosphorus loads and concentrations are decreasing

Progress is being made, but much work remains

Since ~2010, annual total phosphorus loads have declined across many parts of the United States



Figures from Zhang et al. (in review)

EPA's National Aquatic Resource Survey indicates improvement in P condition category since 2008-2009

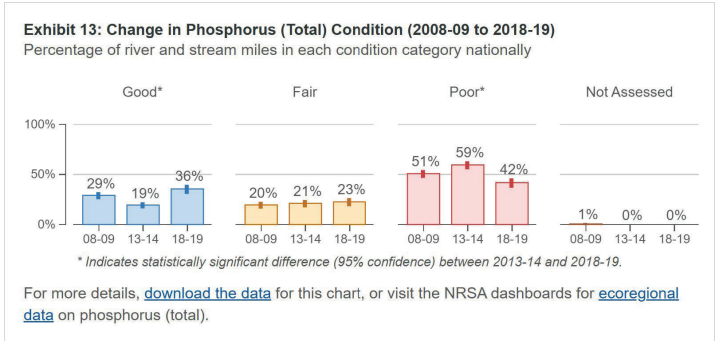


Figure from USEPA, 2024

Figure 2.4. Change in the percentage of the Nation's rivers and streams in each total phosphorus condition category for 2008-2009, 2013-2014, and 2018-2019.

Key Takeaways

- Nutrient pollution remains a major driver of U.S. water quality degradation.
- The National Nutrient Inventory (NNI) and related work deliver empirical "SET" data and water quality modeling information to local, state, and federal partners.
- Improved management of sources, particularly agricultural P management in many areas, coincides with emerging decreases in P loads and concentrations.
  - Innovative solutions to best leverage agricultural legacy and manure P resources
- The NNI can help to set and achieve state-tailored strategic goals to control N and P sources, to accelerate measurable improvements in water quality.

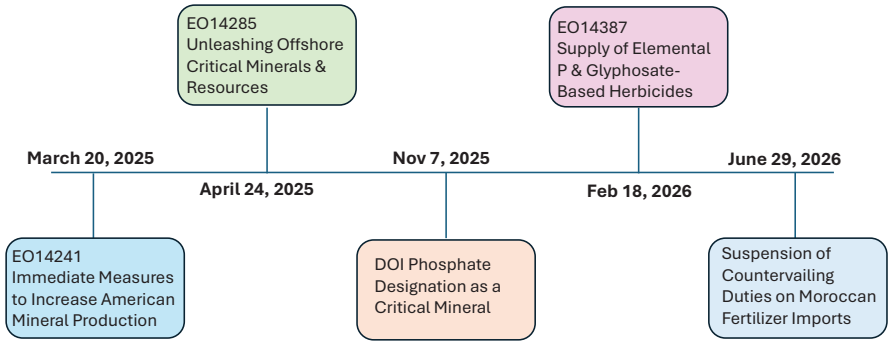
EPA United States Environmental Protection Agency

Question?

Contact:

Robert Sabo (sabo.robert@epa.gov)

Overview of Recent Actions



Our Workplan

Goal: To convene a targeted stakeholder network for information sharing and scenario development activities aimed at informing actions supportive of domestic P supply chain resiliency.

August 25th Webinar: "Understanding the Critical Mineral Designation for Phosphate"
- Provided background information and helped identify interested parties

Today's session/breakout
- Help us distill the most important questions and further identify essential stakeholders

December STEPS-led workshop: "Resilient Phosphorus Supply Chains for National Security"
- Develop a federal interagency stakeholder matrix and report summarizing discussions

Proposed 2027 "wargame" workshop – seeking support
- A tabletop exercise using a plausible disruption scenario to explore supply chain vulnerabilities and potential disruption responses and to further identify key stakeholders and coordination/policy gaps.

Sarah Harvey
Director, Science and Technology
US GAO

EXPLORING CRITICAL MINERALS AND PUBLIC POLICY

Sarah Harvey, Director of Technology Assessment, U.S. GAO

GAO'S ROLE

- INDEPENDENT, NON-PARTISAN AGENCY IN THE LEGISLATIVE BRANCH
- EXAMINES HOW TAXPAYER DOLLARS ARE SPENT
- PROVIDES CONGRESS WITH OBJECTIVE, FACT-BASED INFORMATION TO IMPROVE FEDERAL GOVERNMENT PERFORMANCE
- CONDUCTS RESEARCH, AS REQUESTED BY CONGRESS, TO AID IN OVERSIGHT AND FUNDING DECISIONS
- ASSESSES NEW AND EMERGING TECHNOLOGIES AND THE POLICY ENVIRONMENT TO INFORM POLICYMAKERS' DECISIONS

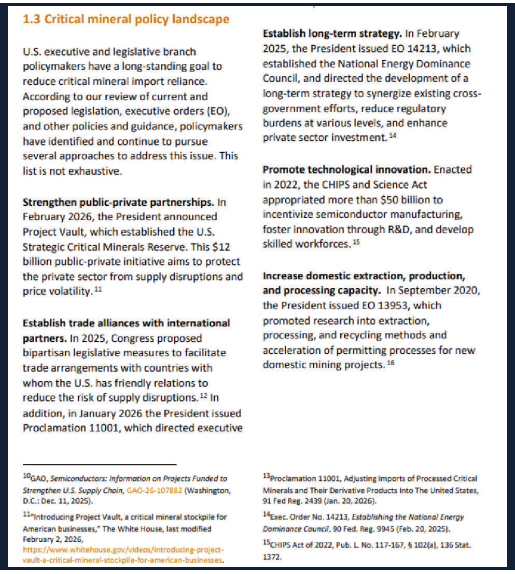
GAO'S STUDY OF CRITICAL MINERALS

POLICY LANDSCAPE & OPTIONS

- WHAT IS THE POLICY LANDSCAPE?
- WHO IS THE POLICYMAKER?
- CONTEXT, GOALS, AND OPTIONS
  - WHAT'S WHAT?
  - HOW DO YOU DECIDE?

CASE STUDY: REDUCING IMPORT RELIANCE

- U.S. executive and legislative branch policymakers have a long-standing goal to reduce critical mineral import reliance.
- Policymakers have identified and continue to pursue several approaches to address this issue.



1.3 Critical mineral policy landscape

U.S. executive and legislative branch policymakers have a long-standing goal to reduce critical mineral import reliance. According to our review of current and proposed legislation, executive orders (EO), and other policies and guidance, policymakers have identified and continue to pursue several approaches to address this issue. This list is not exhaustive.

Strengthen public-private partnerships. In February 2026, the President announced Project Vault, which established the U.S. Strategic Critical Minerals Reserve. This $12 billion public-private initiative aims to protect the private sector from supply disruptions and price volatility.[11]

Establish trade alliances with international partners. In 2025, Congress proposed bipartisan legislative measures to facilitate trade arrangements with countries with whom the U.S. has friendly relations to reduce the risk of supply disruptions.[12] In addition, in January 2026 the President issued Proclamation 11001, which directed executive

Establish long-term strategy. In February 2025, the President issued EO 14213, which established the National Energy Dominance Council, and directed the development of a long-term strategy to synergize existing cross-government efforts, reduce regulatory burdens at various levels, and enhance private sector investment.[14]

Promote technological innovation. Enacted in 2022, the CHIPS and Science Act appropriated more than $50 billion to incentivize semiconductor manufacturing, foster innovation through R&D, and develop skilled workforces.[15]

Increase domestic extraction, production, and processing capacity. In September 2020, the President issued EO 13953, which promoted research into extraction, processing, and recycling methods and acceleration of permitting processes for new domestic mining projects.[16]

[10]GAO, *Semiconductors: Information on Projects Funded to Strengthen U.S. Supply Chain*, GAO-26-107882 (Washington, D.C.: Dec. 11, 2025).

[11]"Introducing Project Vault, a critical mineral stockpile for American businesses," The White House, last modified February 2, 2026, https://www.whitehouse.gov/videos/introducing-project-vault-a-critical-mineral-stockpile-for-american-businesses.

[13]Proclamation 11001, Adjusting Imports of Processed Critical Minerals and Their Derivative Products Into The United States, 91 Fed Reg. 2439 (Jan. 20, 2026).

[14]Exec. Order No. 14213, *Establishing the National Energy Dominance Council*, 90 Fed. Reg. 9945 (Feb. 20, 2025).

[15]CHIPS Act of 2022, Pub. L. No. 117-167, § 102(a), 136 Stat. 1372.

Executive & Legislative Landscape

- Proposed Legislation
- Executive Orders (Eos)
- Agency Policies and Guidance

Who are the relevant policymakers:
- Congress?
- Federal agencies?
- State, local, and tribal governments?

1.3 Critical mineral policy landscape

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Goals and Options

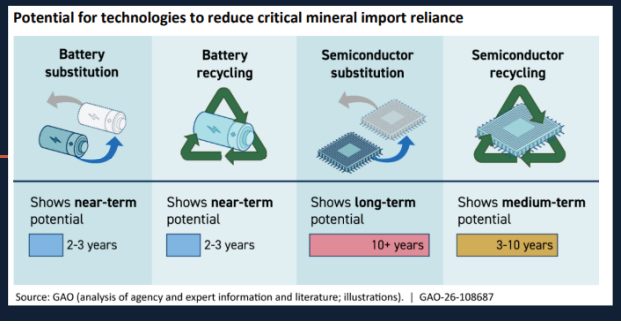
Two are primarily non-technological
- trade alliances
- long-term strategies

One is primarily technological
- technological innovation

Two span both categories
- public-private partnerships
- domestic extraction, production, & processing

GAO STUDY: TWO GOALS

- reduce critical mineral import reliance
- help address challenges to recycling and substitution technologies



POLICY OPTIONS

Establish domestic manufacturing capacity for viable substitutes	Build or repurpose existing manufacturing capacity to produce substitute technologies for batteries and semiconductors.	Technological and Non-technological
Establish domestic recycling capacity	Build domestic infrastructure to bolster the domestic capacity to recycle batteries and semiconductors.	Technological and Non-technological
Secure inputs for recycling	Support efforts to collect, sort, transport, and store manufacturing scrap and end-of-life devices for recycling and reuse.	Non-technological
Support research, development, and testing	Grow support for research, development, and testing of substitution and recycling technologies.	Technological

POTENTIAL IMPACTS

- Critical mineral supply is not determined by geology and technology alone.

- Government resources can influence whether resources become economically recoverable, whether companies invest in capacity, how supply chains respond to disruptions, and which industries may gain a competitive advantage.

IMPACTS OF POLICY OPTIONS

- We can't just assume every option is an auspicious panacea
- Implementation methods may vary
- Opportunities AND Considerations exist

Policy options to support reducing critical mineral import reliance and address challenges to substitution and recycling technologies

Policy options	Potential implementation approaches	Opportunities and considerations
Establish domestic manufacturing capacity for viable substitutes (report p. 23) Policymakers could consider building or repurposing existing manufacturing capacity to produce substitute technologies for batteries and semiconductors.	• Providing support for private capital investments in manufacturing plants for commercially available battery technologies. • Establishing facilities or partnerships to perform pilot-scale testing of semiconductor substitutes.	• Domestic manufacturing capacity could allow for near-term production of commercially available substitute technologies like lithium iron phosphate batteries, which could reduce import reliance on critical minerals like cobalt and nickel. • Battery and semiconductor production facilities are costly and tend to be specialized for the production of a particular technology.

IMPACTS: MARKETS, SUPPLY CHAINS, AND INDUSTRY

Policy options

Establish domestic manufacturing capacity for viable substitutes (report p. 23)

Policymakers could consider building or repurposing existing manufacturing capacity to produce substitute technologies for batteries and semiconductors.

MARKET IMPACTS:

- *Potential to* create competition between substitute and conventional materials

SUPPLY CHAIN IMPACTS:

- *Potential to* reduce dependence on specific, constrained minerals

INDUSTRY IMPACTS:

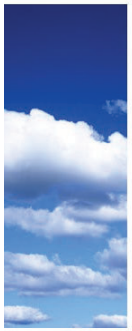
- *Potential to* encourage new manufacturing capabilities and shift competitive advantages between technologies

No guaranteed outcomes. *Actual effects will depend on prices, technology maturity, implementation approaches, global responses, and the availability of viable projects.*

POLICY OPTIONS: A DISCUSSION FRAMEWORK

FUNDAMENTAL QUESTIONS

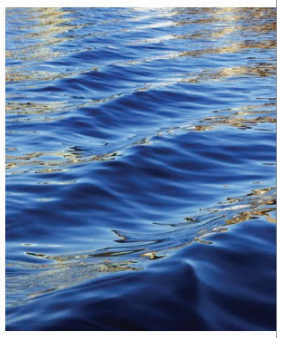
1. **MARKETS**: How can government correct barriers to investment and innovation without distorting competition or sustaining uneconomic production?
2. **SUPPY CHAIN**: How should the U.S. balance domestic extraction, recycling, substitution, and international partnerships?
3. **INDUSTRY**: Which combination of incentives will create sustainable capabilities?



USDA
Lessons Learned from Nitrogen Management Approaches

Kate Zook
USDA Office of the Chief Economist

These views are my own and do not reflect those of the Department



Overview

Bottom line:

1) What is the goal?

2) Who is paying, and why?

3) Is the policy working?

***Differences between nitrogen and phosphorous:

- Local impacts of externalities vs.
- Global impacts

Overview

Overview: Policy Approaches

- Public incentives
  - E.g. EQIP/CSP
  - Typically practice-based
- Market-based approaches
  - E.g. Water quality trading, carbon offsets, low-CI markets
  - More often outcome-based
- Outreach and Education
- Research

Farm Bill Policies

Farm Bill

- Note: only considering working-lands policies (not CRP)
- Environmental Quality Incentives Program (EQIP)/Conservation Stewardship Program (CSP)
- Many practices include a goal to "reduce water quality degradation due to excess nutrients"

USDA United States Department of Agriculture 590-CPS-1

Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

NUTRIENT MANAGEMENT

CODE 590

(ac)

DEFINITION

Manage rate, source, placement, and timing of plant nutrients and soil amendments while reducing environmental impacts.

PURPOSE

This practice is used to accomplish one or more of the following purposes:

- Improve plant health and productivity
- Reduce excess nutrients in surface and ground water
- Reduce emissions of objectionable odors
- Reduce emissions of particulate matter (PM) and PM precursors
- Reduce emissions of greenhouse gases (GHG)
- Reduce emissions of ozone precursors
- Reduce the risk of potential pathogens from manure, biosolids, or compost application from reaching surface and ground water
- Improve or maintain soil organic matter

DRAFT

Farm Bill Policies

Practice Standard 590
Nutrient Management
Definition: "Manage rate, source, placement, and timing of plant nutrients and soil amendments while reducing environmental impacts"

Practice Standard 340
Cover crop application
Definition: Grasses, legumes, and other forbs planted for seasonal vegetative cover.

Practice Standard 605
Denitrifying bioreactor
Definition: A structure that uses a carbon source to reduce the concentration of nitrate nitrogen in subsurface agricultural drainage flow through enhanced microbial denitrification.

Practice Standard 604
Saturated buffer
Definition: A subsurface, perforated distribution pipe used to reduce the concentration of nitrate in agricultural drainage water diverted beneath a vegetated buffer along its length and discharge channel.

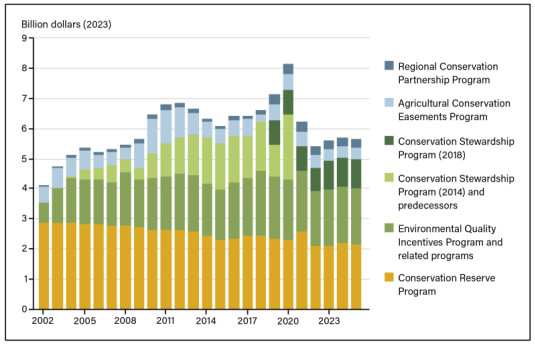
Practice Standard 592
Feed management
Definition: Manipulating and controlling the quantity and quality of available nutrients, feedstuffs, ingredients, or additives fed to livestock and poultry.

Practice Standard 328
Conservation crop rotation
Definition: A planned sequence of crops grown on the same ground over a period of time (i.e. the rotation cycle).

Farm Bill Policies

What are we investing?

Figure 1
Major USDA conservation program funding through Farm Bills, fiscal years 2002–2025, with estimated/budgeted 2024 and 2025 amounts



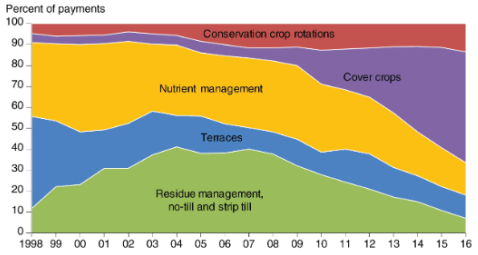
https://www.ers.usda.gov/media/20839/eb-49.pdf?v=68879

*Does not include the $19b in IRA funds for 2023-2031

Farm Bill Policies

What are we investing?

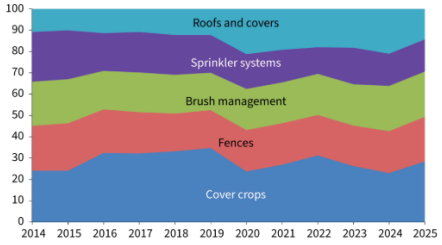
Spending from the Environmental Quality Incentives Program (EQIP) focused on five different crop management practices between 1998 and 2016



Note: Terraces are a structural practice designed to reduce runoff and soil erosion by constructing an earth embankment or ridge that is perpendicular to a field's slope. Between 1998 and 2016, total EQIP payments expanded from $18 million to $840 million.
Source: USDA, Economic Research Service using data from USDA, Natural Resources Conservation Service, EQIP practice suite payments in the United States.
https://www.ers.usda.gov/amber-waves/2019/august/conservation-trends-in-agriculture-reflect-policy-technology-and-other-factors

Share of top five conservation practices of USDA's EQIP, fiscal years 2014–25

Percent of payments among top five practices



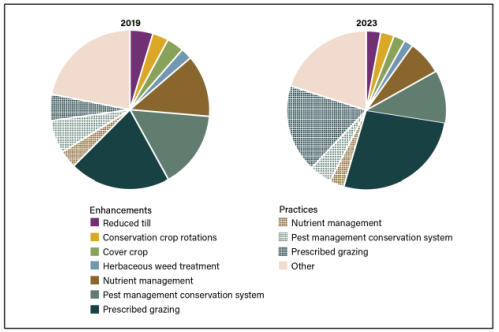
Note: EQIP = Environmental Quality Incentives Program. The top five practices are computed using total dollars obligated over all years.
Source: USDA, Economic Research Service using information from USDA, Natural Resources Conservation Service, 2026. Data are current through September 2025.

https://www.ers.usda.gov/topics/natural-resources-environment/conservation-programs

Farm Bill Policies

What are we investing?

Figure 5
Acres under top 10 Conservation Stewardship Program (CSP) practices, fiscal year 2019 and fiscal year 2023



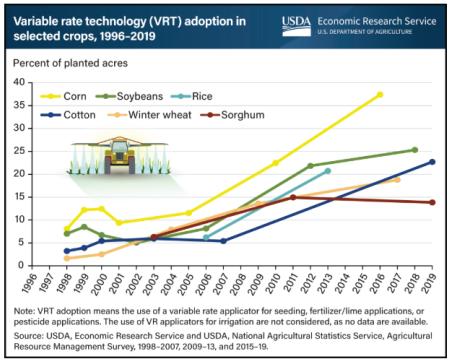
Note: Base practices are shown as patterned pie slices; enhancements are solid colors. All available years of data are reported. The "Other" category contains both base practices and enhancements.
Source: USDA, Economic Research Service using information from USDA, National Resources Conservation Service (2023a).

https://www.ers.usda.gov/media/20839/eb-49.pdf?v=68879

Farm Bill Policies

What are the general trends in adoption?

- VRT and precision agriculture are on the rise
- Cover crop adoption remains relatively low nationally, which variation regionally
- Conservation tillage has expanded substantially
- We still don't have a great handle on nitrogen use efficiency



Farm Bill Policies

Is the program working?

Methods of assessing effectiveness:

- Conservation Effects Assessment Project (CEAP)
  - A sampling and modeling approach drawing on natural resource data and farmer surveys. The farmer surveys are conducted jointly by USDA's NRCS and National Agricultural Statistics Service (NASS).
  - Nationally, the CEAP sample consists of about 18,700 points representing cropped acres.
- The National Resources Inventory (NRI)
  - Detailed data on soil properties and land use collected at a random sample of points.
  - Annual collections after 2000 are subsamples of about 72,000 segments selected from the 1997 iteration.
- USDA Survey Data (e.g. ARMS, Census)
- Conservation Practice Adoption Motivations Survey (CPAMS)

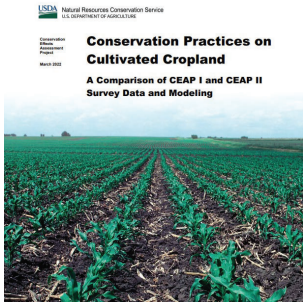
Farm Bill Policies

Is the program working?

NRCS released a report, "*Conservation Practices on Cultivated Cropland: A Comparison of CEAP I and CEAP II Survey Data and Modeling*" in 2022

Findings:

- Between 2006 and 2016, nitrogen and phosphorus losses through surface pathways declined by 3 and 6 percent, respectively. However, **subsurface nitrogen and soluble phosphorus losses increased by 13 and 11 percent, respectively.**

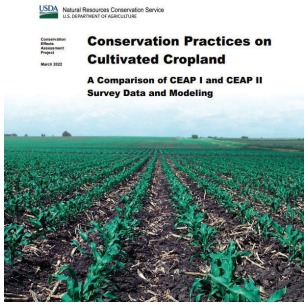


Farm Bill Policies

Is the program working?

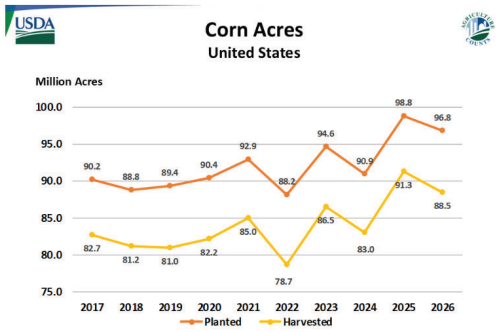
"While gains were made, shifts in crops, cropping patterns, and tillage systems outpaced nutrient application research and guidance and industry capacity to deliver and apply nutrients efficiently. Consequently, subsurface **losses of nitrogen and soluble phosphorus increased with the expansion of crops with higher nutrient demand and conservation tillage systems, which promote water infiltration and subsurface flow**. Transitioning to conservation tillage systems, particularly no-till, requires nutrient method and form adjustments to incorporate nutrients that previously may have been tilled into the soil under conventional systems."

- **Caveat**: this tells you what happened. It doesn't tell you what happened in the absence of conservation programs.
- **Lesson**: policies may achieve some goals and not others.



Farm Bill Policies

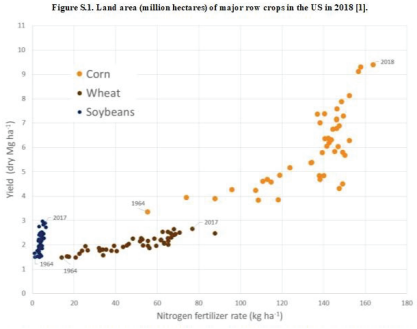
Corn acres have increased over time



https://www.nass.usda.gov/Charts_and_Maps/Field_Crops/cornac.php

Farm Bill Policies

More Corn: Increased Nitrogen Application Over Time, and Increased Yield



https://www.sciencedirect.com/science/article/pii/S0048969720371333?via%3Dihub#s0095

Farm Bill Policies

Is the program working?

"Recognizing the **variability in conservation treatment needs within fields** and **addressing soil health and nutrient management as a system** is critical to achieving the full benefits of advanced technology, tillage efficiency, and conservation measures. For example, in each CEAP survey period, a small proportion of acres accounted for most nutrient and sediment losses; in CEAP II, **73 percent of the subsurface nitrogen losses came from 28 percent of the acres**, generally smaller, vulnerable areas within larger fields."

- Lesson: targeting the most critical acres matters.

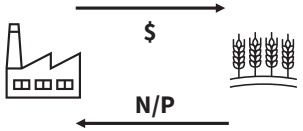
Outcome-Based Policies

Market-based Approaches

- Water quality trading
- Carbon offsets
- Markets for low-CI biofuel feedstocks
- Labels and claims

Water Quality Trading

- A regulated source of water pollution (such as a factory, wastewater treatment facility, or power plant) can pay an unregulated source, such as a farm operator, to reduce pollution rather than reducing its own discharges.

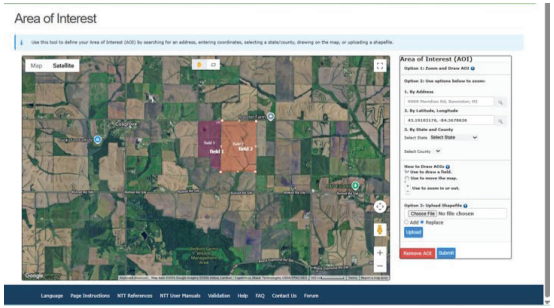


Water Quality Trading

- Chesapeake Bay
  - Maryland (only allows PS-NPS trades, but has had little to no trading activity)
  - Pennsylvania (allows PS-NPS trades, but all so far have been PS-PS)
  - Virginia (PS-PS trades only for wwtp's. For stormwater offsets, active purchases of NPS P credits)

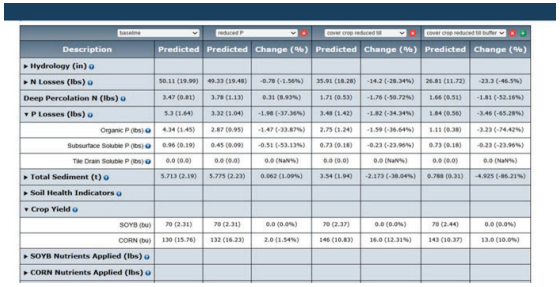
Quantification Example: the Nutrient Tracking Tool (NTT)

- Free, web-based tool supported by USDA and Texas Institute for Applied Environmental Research (TIAER)
- Allows for field-level quantification of nutrient and soil losses



Quantification Example: the Nutrient Tracking Tool (NTT)

- Free, web-based tool supported by USDA and Texas Institute for Applied Environmental Research (TIAER)
- Allows for field-level quantification of nutrient and soil losses



Description	Predicted	Predicted	Change (%)	Predicted	Change (%)	Predicted	Change (%)
▸ Hydrology (in)							
▸ N Losses (lbs)	50.11 (19.99)	49.33 (19.48)	-0.78 (-1.56%)	35.91 (18.28)	-14.2 (-28.34%)	26.81 (11.72)	-23.3 (-46.5%)
Deep Percolation N (lbs)	3.47 (0.81)	3.78 (1.13)	0.31 (8.93%)	1.71 (0.53)	-1.76 (-50.72%)	1.66 (0.51)	-1.81 (-52.16%)
▾ P Losses (lbs)	5.3 (1.64)	3.32 (1.04)	-1.98 (-37.36%)	3.48 (1.42)	-1.82 (-34.34%)	1.84 (0.56)	-3.46 (-65.28%)
Organic P (lbs)	4.34 (1.45)	2.87 (0.95)	-1.47 (-33.87%)	2.75 (1.24)	-1.59 (-36.64%)	1.11 (0.38)	-3.23 (-74.42%)
Subsurface Soluble P (lbs)	0.96 (0.19)	0.45 (0.09)	-0.51 (-53.13%)	0.73 (0.18)	-0.23 (-23.96%)	0.73 (0.18)	-0.23 (-23.96%)
Tile Drain Soluble P (lbs)	0.0 (0.0)	0.0 (0.0)	0.0 (NaN%)	0.0 (0.0)	0.0 (NaN%)	0.0 (0.0)	0.0 (NaN%)
▸ Total Sediment (t)	5.713 (2.19)	5.775 (2.23)	0.062 (1.09%)	3.54 (1.94)	-2.173 (-38.04%)	0.788 (0.31)	-4.925 (-86.21%)
▸ Soil Health Indicators							
▾ Crop Yield							
SOYB (bu)	70 (2.31)	70 (2.31)	0.0 (0.0%)	70 (2.37)	0.0 (0.0%)	70 (2.44)	0.0 (0.0%)
CORN (bu)	130 (15.76)	132 (16.23)	2.0 (1.54%)	146 (10.83)	16.0 (12.31%)	143 (10.37)	13.0 (10.0%)
▸ SOYB Nutrients Applied (lbs)							
▸ CORN Nutrients Applied (lbs)							

Water Quality Trading

Water Quality Trading: Lessons Learned

- The theory: reduced runoff at lower cost
- In practice: several barriers
  - Low demand from regulated entities for NPS credits
  - Limited capacity for states and local governments to run programs
  - Funding and staff needed to establish and maintain trading programs
- WQT has not taken off the way we thought it would 10 years ago
- Lesson: High cost of entry to establish a policy framework can limit success, even when the policy might reduce compliance costs.

Carbon Markets

Carbon Offset Markets

- Many agricultural protocols focus on soil carbon
  - Issue: reversibility/permanence
- N2O protocols do not have this issue (but only 1 exists!)
  - Climate Action Reserve's U.S. Nitrogen Management Protocol
  - Only 3 listed projects

Carbon Markets

Carbon Offset Markets

- Why haven't there been more projects?
  - High cost of implementation/high transaction costs, issues around additionality (would the farmer have reduced N anyway?), uncertainty around quantification/high bar to meet
- Lesson: if the policy is too complex and the transaction costs are too high, it won't work.

Reduced-CI Feedstocks

Leveraging policies for reduced carbon intensity (CI)

- 45Z
- USDA's Regenerative Biofuel Feedstock Rule

Reduced-CI Feedstocks

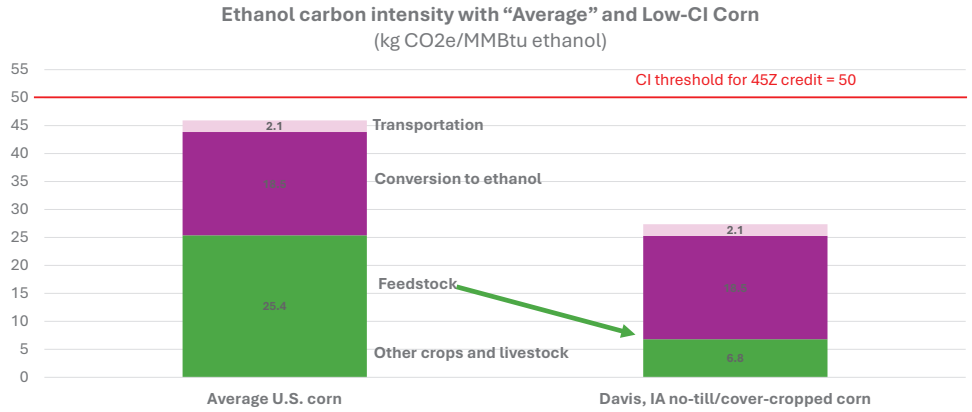
How does the 45Z tax credit work?

- The credit is eligible to producers of liquid transportation fuel in the U.S. (e.g. biofuel refiners)
- Fuels which meet a certain carbon intensity (CI) threshold are eligible to receive tax credits, up to $1/gallon
- Treasury issues rules for compliance; DOE issues the GREET CI calculator

Why is feedstock CI so important?

- The CI of feedstocks make up roughly 50% of the total fuel CI

Reduced-CI Feedstocks



Notes: Davis, Iowa corn CI is calculated assuming 200 bushels per acre, 200 pounds of synthetic nitrogen per acre, no nitrification inhibitors, and no manure application.
Source: 45ZCF-GREET 2026 and USDA FD-CIC version 1.

Reduced-CI Feedstocks

Covered Crops and Practices in the Final Rule	
Covered Crops	Corn, soy, sorghum, spring canola
Covered Practices	• No-till • Reduced-till • Cover crops • Nitrification inhibitors • Variable nitrogen and yield • Grazed cover crops • Manure application

USDA FD-CIC

The rule specifies the USDA Feedstock Carbon Intensity Calculator (USDA FD-CIC) as the mechanism for calculating the carbon intensity associated with biofuel feedstock crops.

- USDA FD-CIC:
  - Provides users with crop-specific carbon intensity (CI) values
  - Reports CI values as carbon dioxide equivalent (CO_2e) emissions per bushel
- USDA FD-CIC contains all low-carbon practices and crops covered under USDA's rule
- USDA worked with academic institutions and experts to develop USDA FD-CIC
- USDA FD-CIC underwent a rigorous academic peer review in August 2025 (required by the interagency as part of the interim rule clearance)
- USDA FD-CIC is available on USDA's website: https://www.usda.gov/usda-fdcic

USDA FD-CIC

USDA FD-CIC	Version 1.2
Date:	9/25/2026
Crop to Model:	Corn
Number of Management Units to Model: [Reset Inputs on All MUs]	1
	MU #1 [Reset MU #1 Inputs]
Management Unit Name (optional):	
Location - State	IL
Location - County	Menard
Management Unit Size (acres)	100
Actual average yield per acre (bushels/acre)	250
Expected yield per acre (bushels/acre)	225
Total Synthetic N Applied Per Acre (lbs/acre)	205
(click to navigate to terms Glossary)	
Management Practices	
1) Cover Crop	Cover crop
2) Tillage Practice	Reduced till
3) Percent of synthetic N receiving Nitrification Inhibitors (0%-100%)	0%
4) Applied Manure [N content guidance]	
4.1) Manure applied, Type 1	None
Amount of type 1 manure applied (1,000 gal/acre or ton/acre)	0
N content of type 1 manure (lbs/ton or lbs/1,000 gal)	0

User specifies crop (corn, soy, sorghum, spring canola) and number of management units

User specifies state and county, acreage, actual and expected yield, and N applied

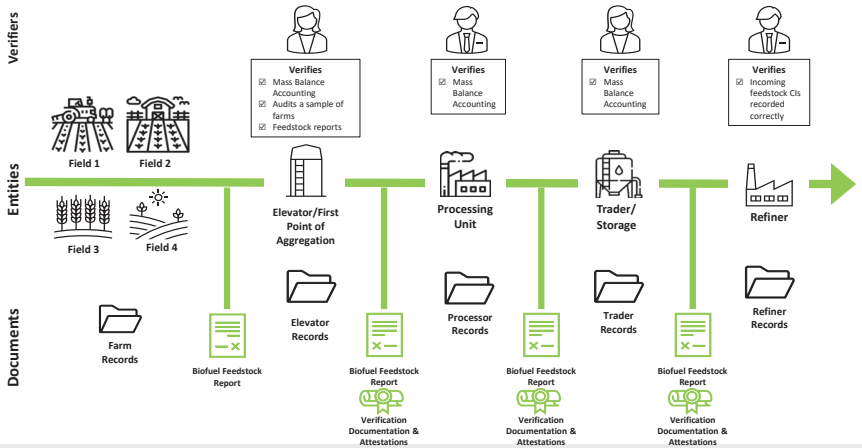
User specifies practices (cover crops, reduced or no-till, nitrification inhibitors applied, and manure applied)

USDA FD-CIC

Results (g CO_2e/bushel)	MU #1	Estimated National Average
Corn Carbon Intensity (CI) Score (g CO2e/bushel)	3,175	6,020
Carbon Intensity Score Elements (g CO_2e/bushel)		
Emissions from manufacture and transportation of N fertilizer	1,070	1,275
Soil carbon emissions/removals	-2,049	N/A
Total N_2O emissions	2,376	2,918
Emissions from on-farm energy consumption	806	815
Emissions from manufacture and transportation of other chemicals	475	475
CO_2 emissions from urea/lime	499	537
(click to navigate to terms Glossary)		
CI score relative to estimated national average:		
% change in g CO_2e/bushel	*-47.2%*	*0.0%*
Absolute change in g CO_2e/bushel	*-2844*	*0*

Change in Carbon Intensity is broken down by emissions category and compared to an estimated national average

Recordkeeping, Reporting, and Verification Standards



Reduced-CI Feedstocks

Lessons learned from reduced-CI market development:

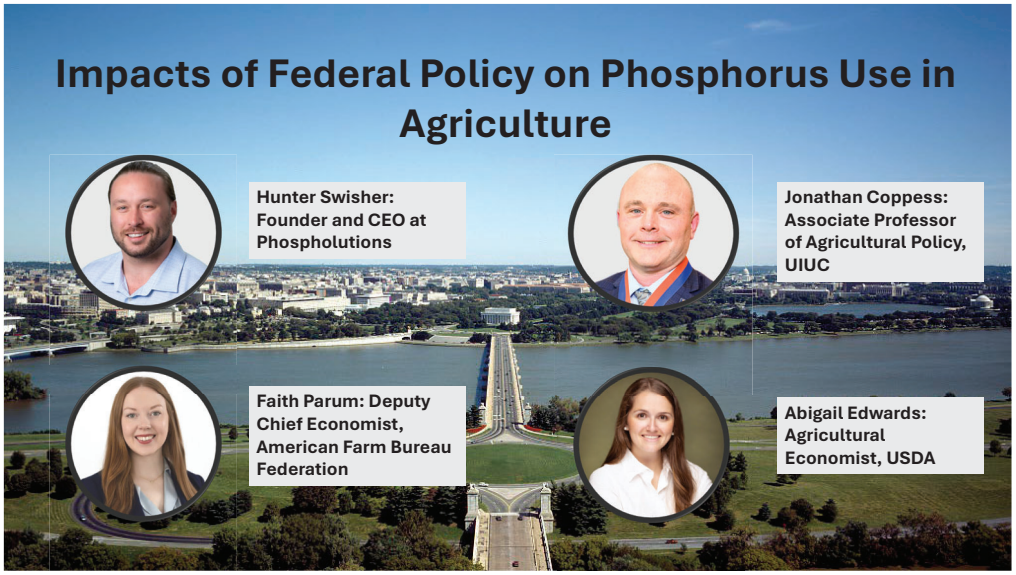
- Sometimes you need to be creative with the authorities you have, and try something new.
- Outcome-based nutrient management policy is possible.
- It won't be perfect.

USDA U.S. DEPARTMENT OF AGRICULTURE

Lessons Learned

Lessons Learned (Kate's Version):

- Policies may achieve some goals and not others.
- Targeting the most critical acres matters.
- High cost of entry to establish a policy framework can limit success, even when the policy might reduce compliance costs.
- If the policy is too complex and the transaction costs are too high, it won't work.
- Sometimes you need to be creative with the authorities you have, and try something new.
- Outcome-based nutrient management policy is possible.
- It won't be perfect.



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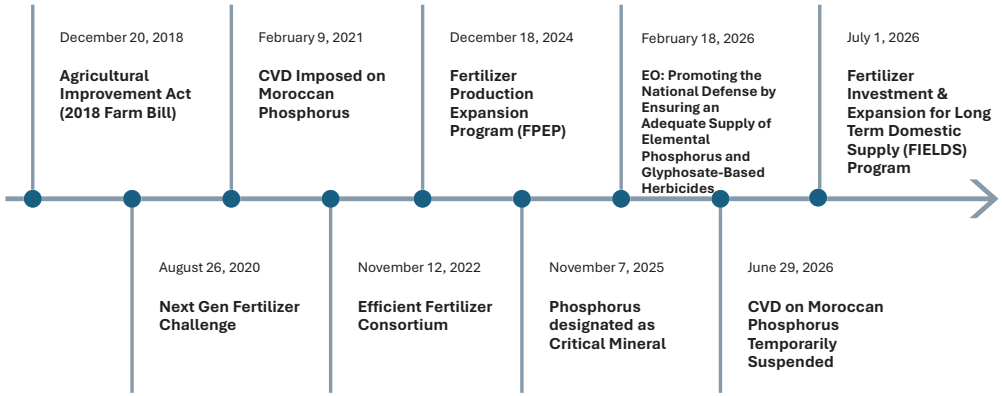
Policy Timeline: 2018 Farm Bill to Present



The last stops today:

- **Now:** Coffee and Networking Break: 2:45-3pm
- **Next:** Breakout Session: 3-3:45pm
  - Pick a room based on your interest or expertise

Multipurpose Room (where you are now):
P Use & Circularity (Farm Bill)
Facilitators: Shwetha & Clayr

Conference Room 3 (by the coffee):
P Supply & Critical Minerals
Facilitator: Justin

- **Then:** Reconvene & Share-out: 3:45pm