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FARM FOUNDATION® FORUM

CUSTOMER DEMAND FOR ENVIRONMENTAL REPORTING: A LOOK AT ENVIRONMENTAL IMPACT MEASUREMENT

JULY 19, 2022

Today's webinar is made possible by a grant from Farm Credit

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MARTHA KING

Vice President, Programs and Projects
Farm Foundation

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MEET FARM FOUNDATION

A 501(C)(3) NON-PROFIT AT THE INTERSECTION OF AGRICULTURE AND SOCIETY

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Farm Foundation is an
ACCELERATOR
of practical solutions for agriculture.

We accelerate
PEOPLE AND IDEAS
into
ACTION.

OUR MISSION AND VISION GUIDE OUR WORK

MISSION:

To **build** trust and understanding at the intersections of agriculture and society.

VISION:

To **build** a future for farmers, our communities, and our world.

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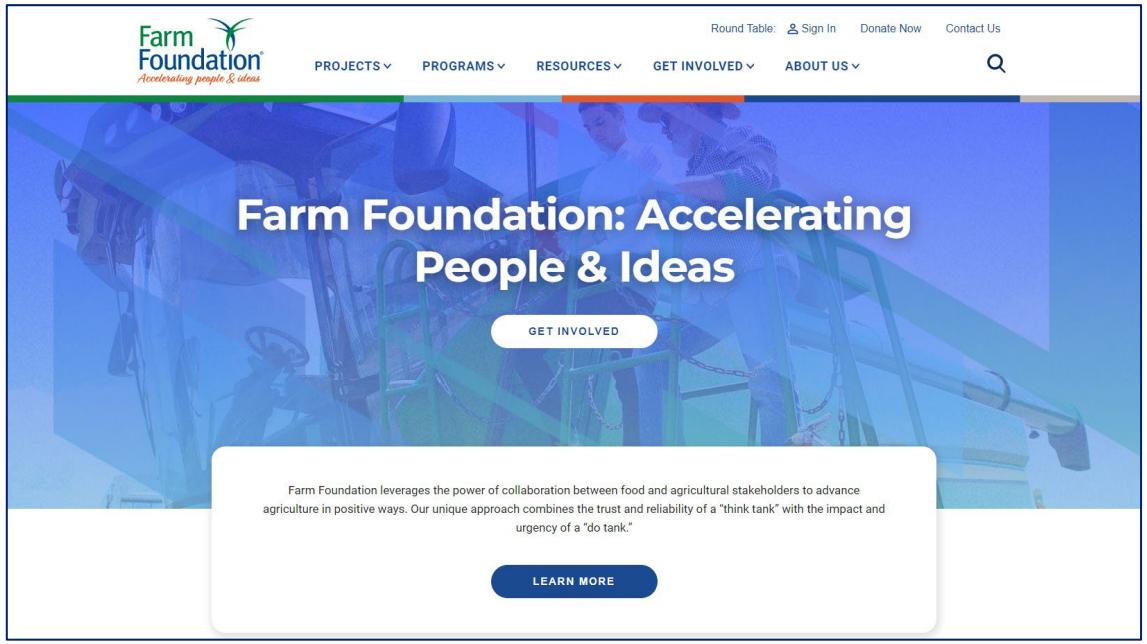

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IMPORTANT NOTES

- Submit questions by clicking on the **Q&A Button** at the bottom of your screen.
- Please **include your name and company** so questions may be contextually understood.
- Due to **time limits**, we may not be able to ask all questions submitted.
- This Forum is being recorded and will be posted on our website at **farmfoundation.org** as well as the Farm Foundation **YouTube** channel.
- Please take the **short survey** at the conclusion of the Forum.

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BRUCE KNIGHT

Moderator
Principal and Founder
Strategic Conservation Solutions

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KATE ZOOK

Senior Program Analyst
USDA Office of the Chief Economist
Office of Energy and Environmental Policy

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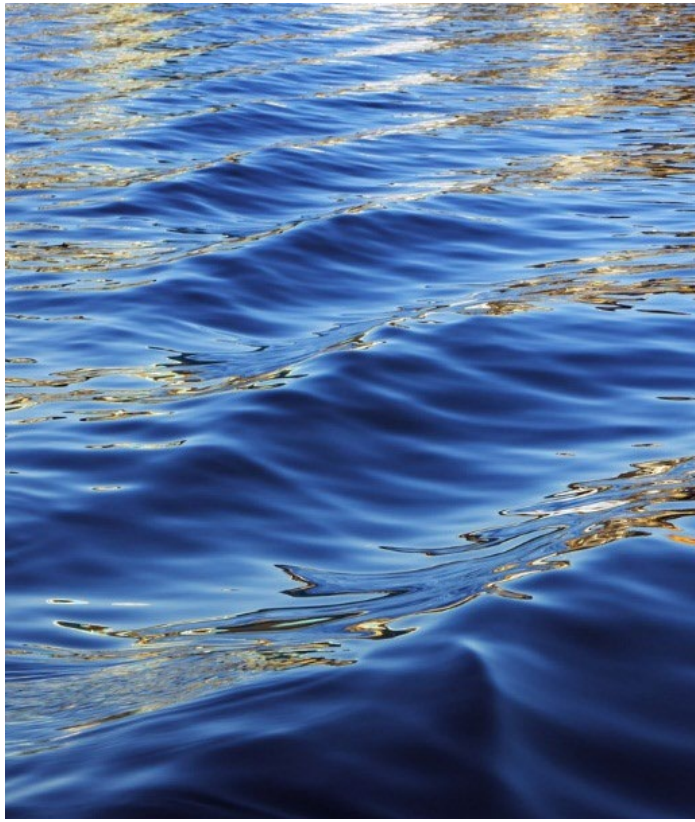
Environmental Impact Reporting: Climate Change Examples from Public Policy

Kate Zook

USDA Office of the Chief Economist

Office of Energy and Environmental Policy

July 19th, 2022

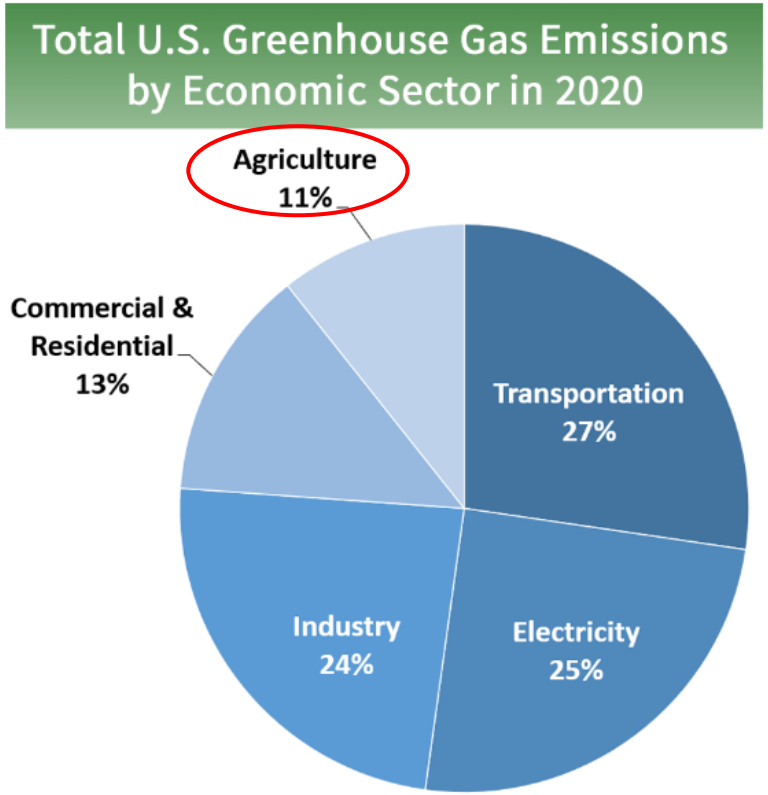


Topics to Cover

- Metrics on Multiple Scales: USDA's Greenhouse Gas Inventory and Assessment Program
- Supporting Science: Underpinning Credibility
- Public Policy: Intersections with Markets and Lessons-Learned

Agriculture's Contribution to Greenhouse Gas Emissions in the U.S.

- Agriculture contributes 11% of U.S. greenhouse gas emissions
  - Agricultural soil management (55%)
  - Enteric fermentation (29%)
  - Manure Management (13%)
  - Rice cultivation (2%)
  - Urea Fertilization (1%)
  - Liming (<1%)
  - Field burning of agricultural residue (<1%)
- Agriculture can sequester carbon and reduce emissions while providing benefits for the broader economy



Total Emissions in 2020 = 5,981 Million Metric Tons of CO2 equivalent. Percentages may not add up to 100% due to independent rounding.

From US EPA GHG Inventory 2020

Examples of Climate-Smart Agriculture and Forestry Practices

Cropland Management

- Reduce tillage and No-till
- Cover crops
- Organic amendments, including e.g., biochar
- Agroforestry, including e.g., multistory cropping and alley cropping
- Nutrient management, including e.g., seasonal timing shifts, split application, incorporation, enhanced efficiency fertilizers, organic forms, reduced rates and amounts, and precision agriculture practices
- Midseason drainage on rice

Grazing and Pasture

- Rotational and prescribed grazing
- Legume interseeding and improved forage plantings
- Nutrient management and organic amendments on pasture
- Silvopasture

Animal Systems

- Manure digesters, including e.g., covered lagoon with energy generation or flaring, complete mix digester, plug flow digester
- Composting with suitable bulking agents
- Solid separators
- Lagoon covers
- Ruminant feed management, including e.g., feed additives such as nitrates, lipids, monensin, tannins, 3NOP

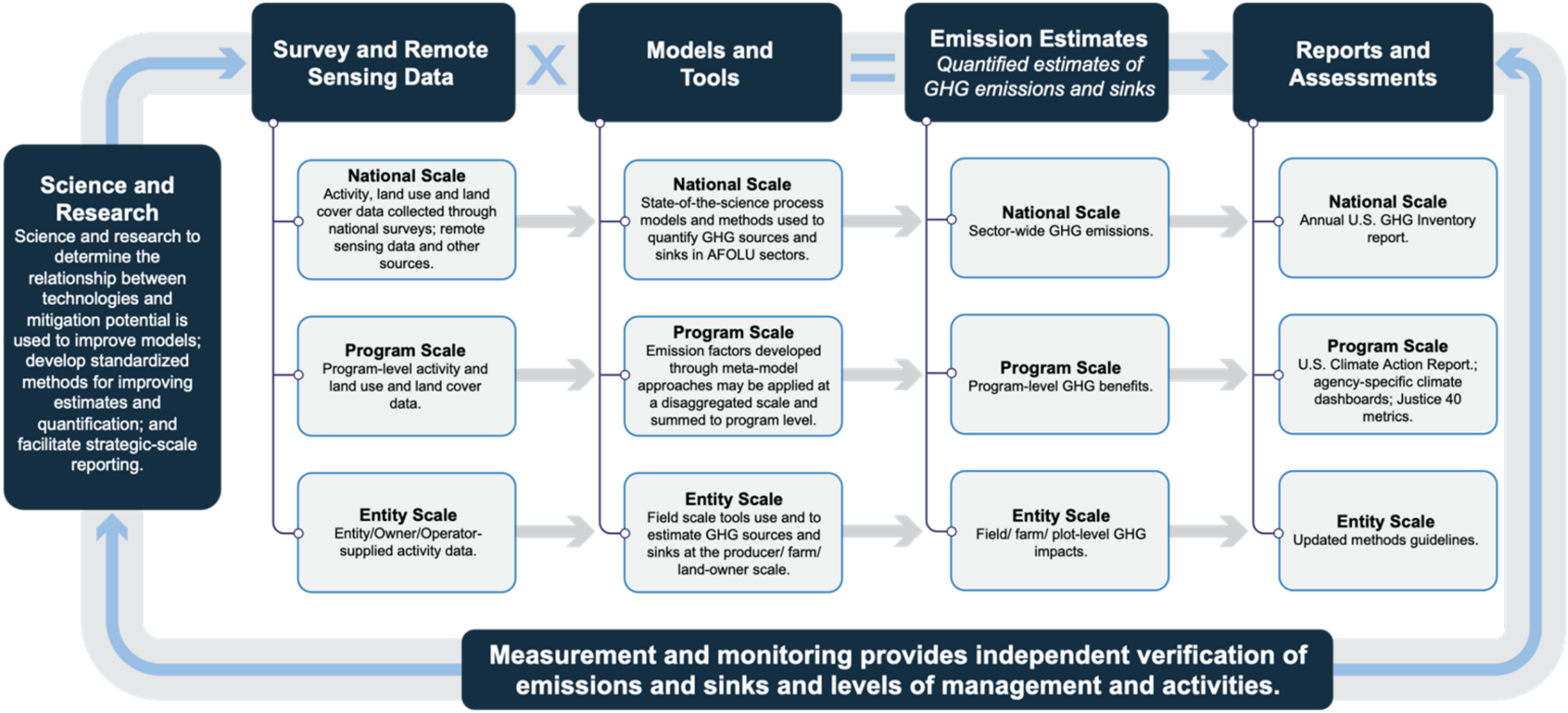
Land Use Change

- Establishment of woody plantings, including e.g., windbreaks, buffers, hedgerows, habitat establishment
- Establishment of herbaceous cover, including e.g., conservation cover, grassed waterways
- Retirement of cropland, including organic soils and heavily limed soils
- Conversion of pasture to tree cover
- Restoration of highly degraded lands
- Wetland restoration

On-Farm Energy

- Fuel efficiency improvements in farm equipment and use, including combustion system improvements and field operations emission reductions
- Electricity efficiency improvements in farm infrastructure, including energy efficient lighting and buildings

Quantifying and Tracking GHG Benefits of Agriculture at Various Scales



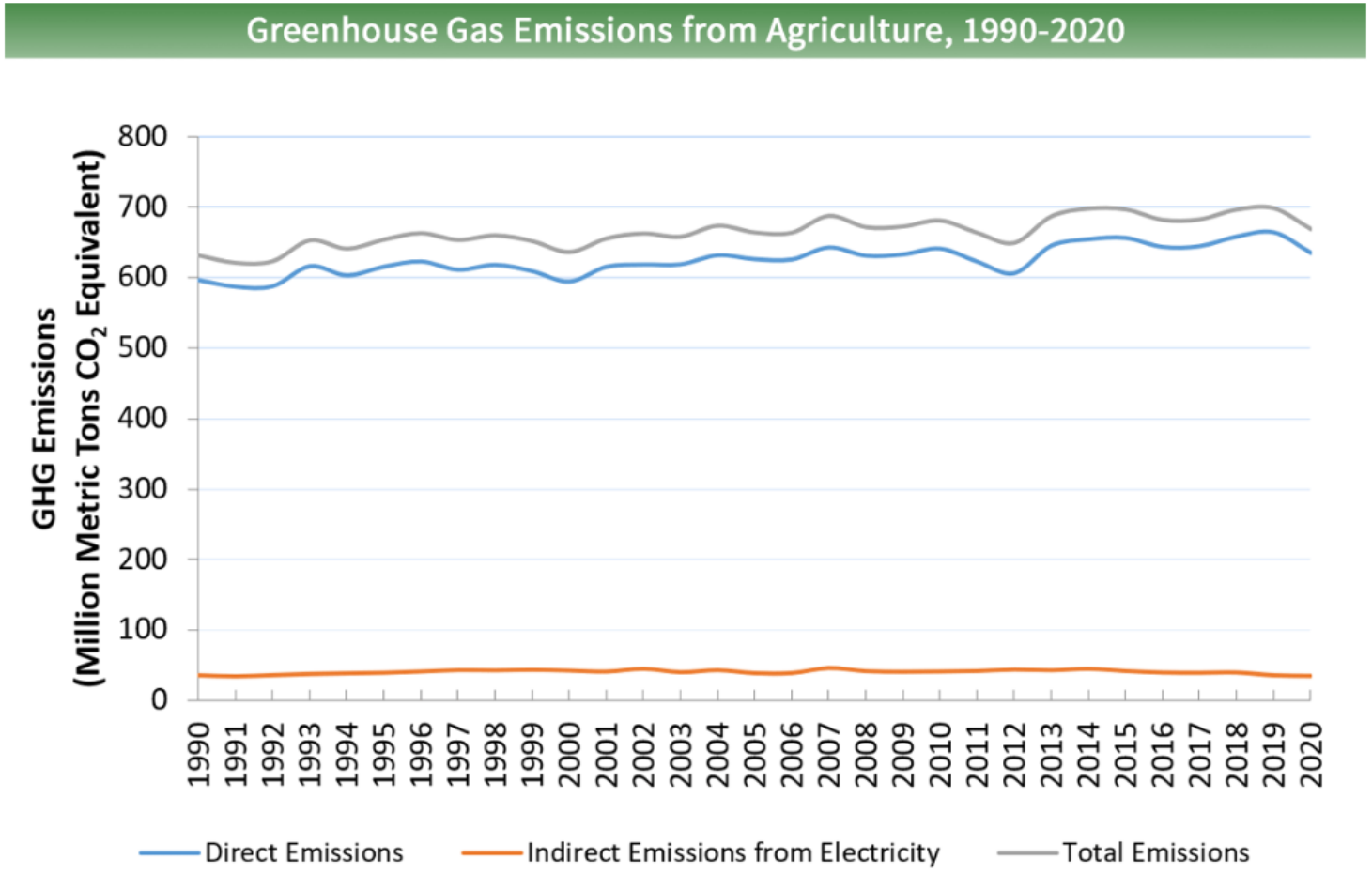
National Scale

GHG estimation: state of the science models and methods

Activity data: national surveys

Room for improvement:

- Data timeliness (frequency of collection)
- Data gaps (EEFs, biochar, pasture management, feed management, etc.)



All emission estimates from the *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2020.*

Program Scale

GHG estimation: state of the science models and methods

Activity data: actions taken with financial/technical assistance from USDA

Next steps:

- Developing USDA GHG Benefits Dashboard
- Timely estimates and reporting of GHG benefits achieved through USDA programs

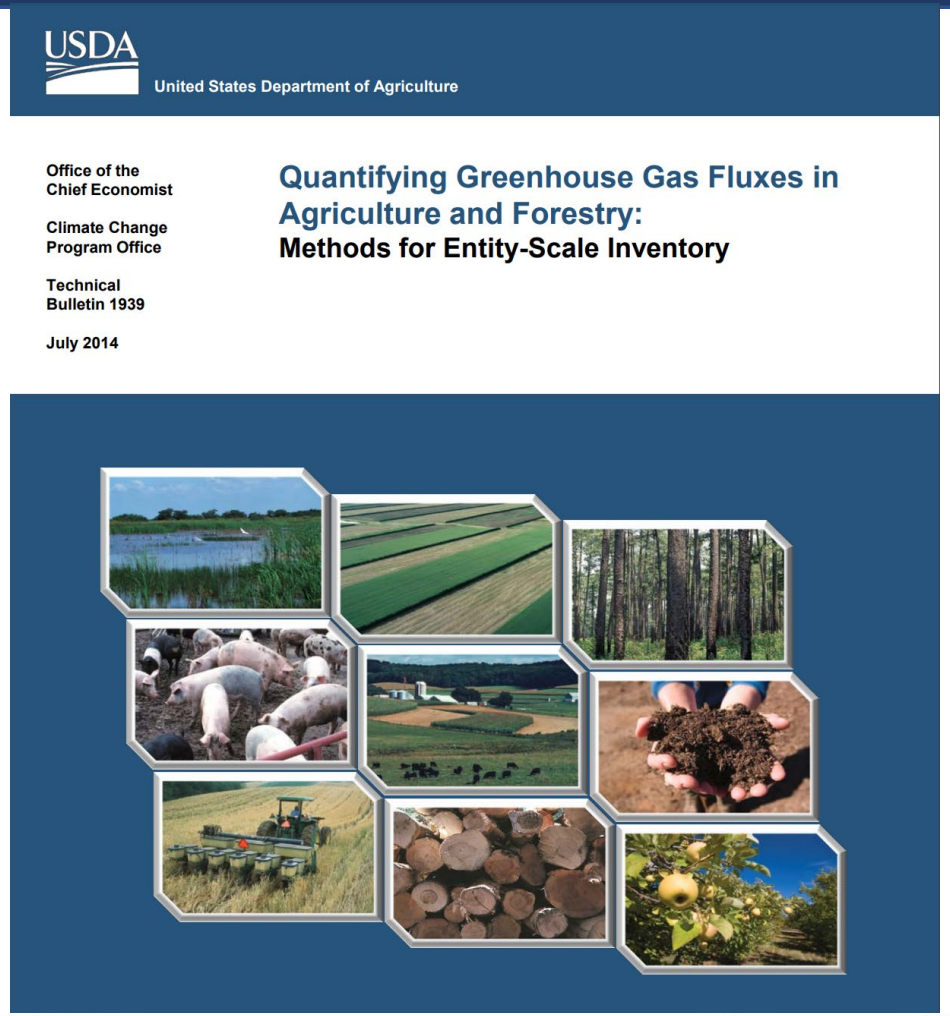
Entity Scale

USDA methods to estimate changes in GHG emissions and carbon storage at the entity-scale for croplands, grasslands, livestock, forestry, wetlands, and land use change

COMET tools: Free, online GHG estimation

Next steps:

- RFI on draft methods update late summer 2022
- Updated report for release by 2023



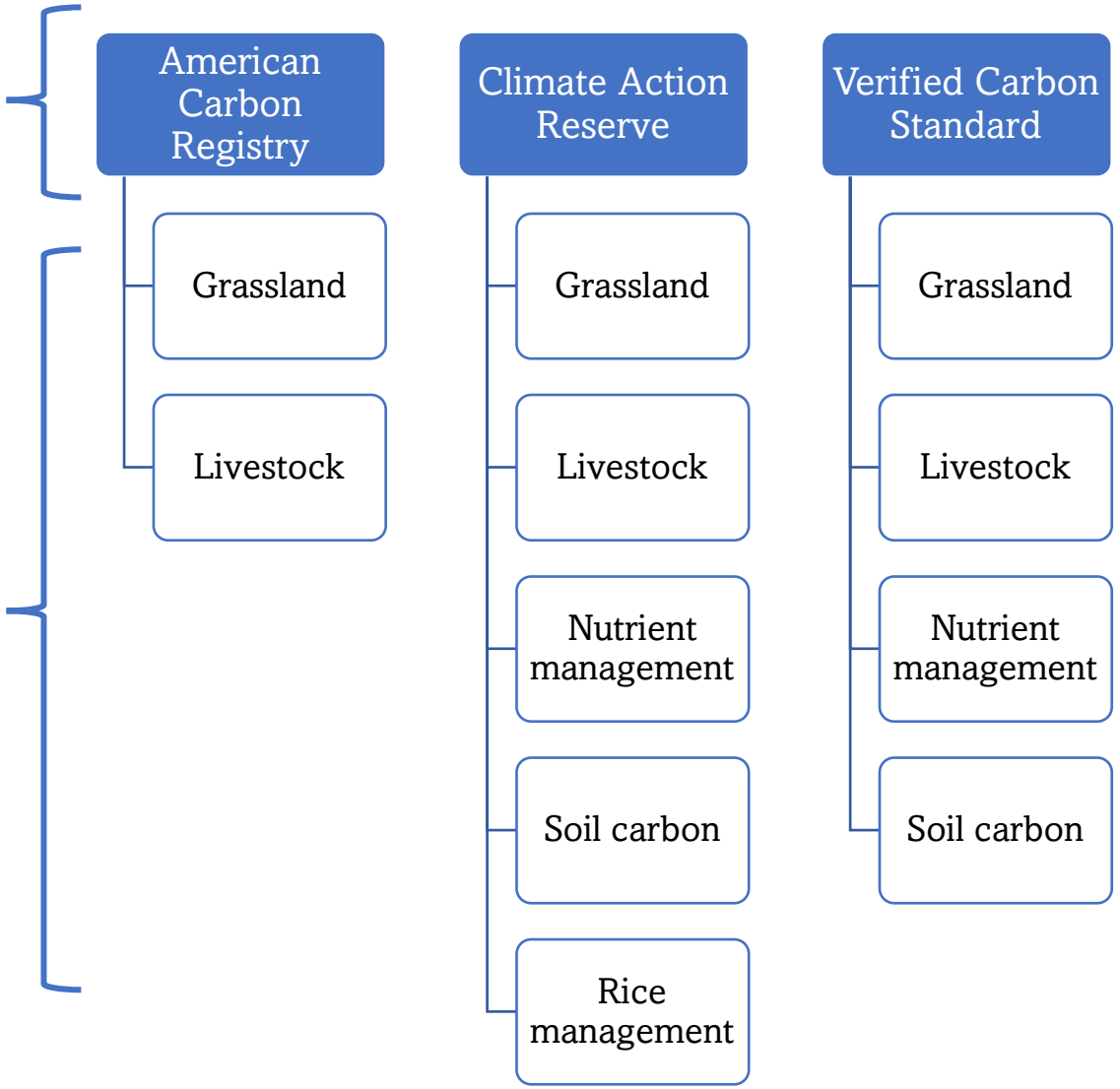
Underpinning Science: Soil Carbon Monitoring Network

- Geospatial and temporal referencing, including NRI points
- Consistent sampling and analysis protocols
- Robust, coordinated, site selection criteria for modeling and extrapolation
- Current activities:
  - Phase 1: Current CRP soil carbon evaluation/verification effort includes over 1,000 sites ($10m in 2021)
  - NRCS Rapid Carbon Assessment (RaCA) included over 6,000 sites (initiated in 2010)

Agricultural Carbon Market Protocols

Carbon **Registries**

develop **Protocols** for specific agricultural practices that sequester carbon/reduce GHGs



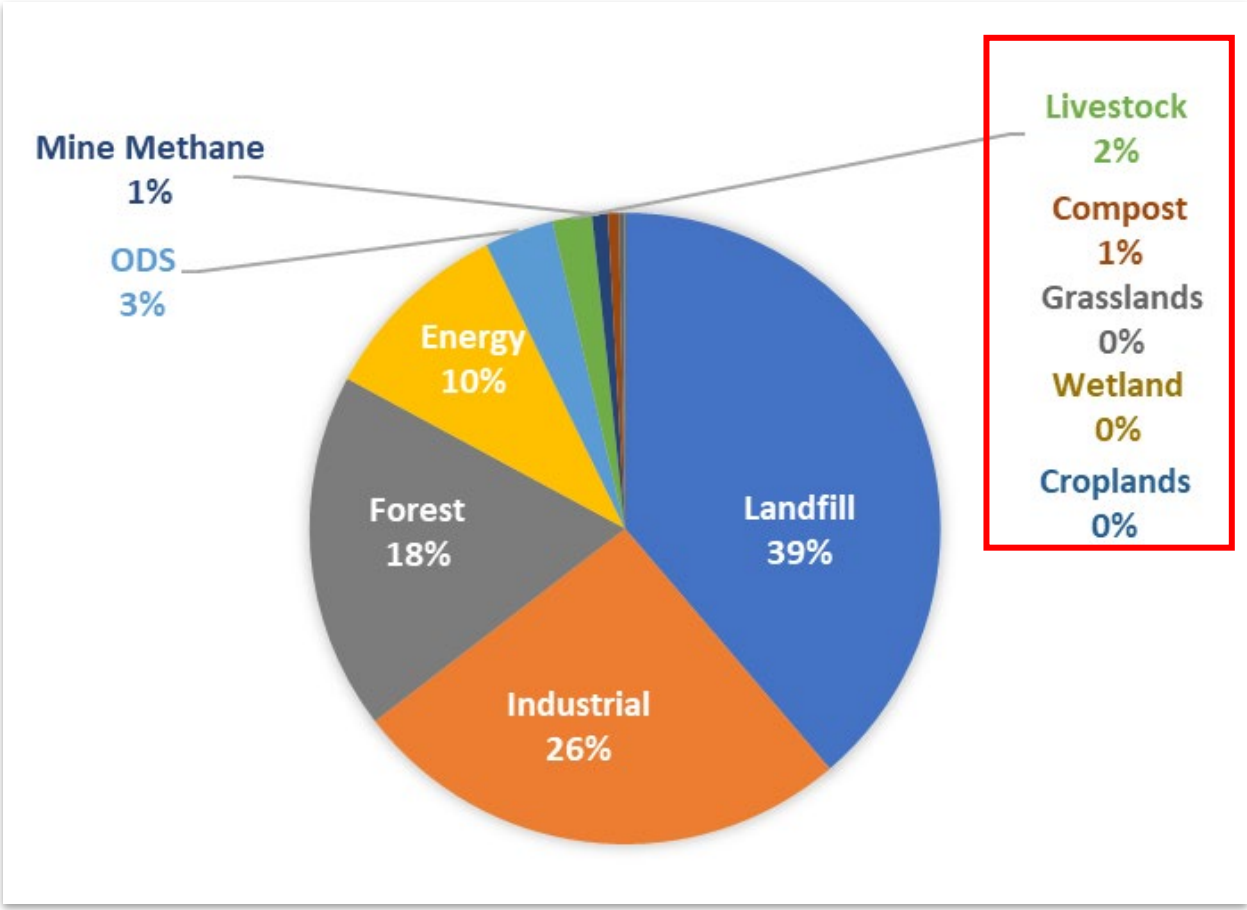
35 Agricultural protocols exist, but…

25 Agricultural protocols have **never generated an offset (credit)**

Barriers to Market Growth

- Scale
  - Agricultural offset projects are small and generate few credits per farm relative to other types of projects
- Transaction costs
  - Project development, monitoring, reporting, and verification costs are high relative to the value of the credits
  - Voluntary registries compete on "quality", raising reporting and verification burdens on producers
- Confusion in the marketplace
  - Lack of consistency among approaches to protocols
  - Multiple protocols for the same practice (e.g. grassland preservation)
  - No entity currently has authority to set rules/standards for protocols
- Limited demand
  - Limited financial benefit for farmers
- Farmers are not seeing benefits of the market

Percent of Voluntary Market Credits generated by source



Total number of credits: 119,814,962

Number of agricultural credits: 2,752,875

Source: American Carbon Registry, Verified Carbon Standard, Climate Action Reserve. Credits 2013-2021.

Upcoming Activities

USDA's Partnerships for Climate-Smart Commodities, Launched 2022

Projects will:

1) Pilot implementation of climate-smart agriculture and/or forestry practices on a large-scale, including meaningful involvement of small and/or historically underserved producers
2) Quantify, monitor, report and verify climate results
3) Develop markets and promote climate-smart commodities generated as a result of project activities

Partnerships for Climate-Smart Commodities Learning Network

USDA will establish a Climate-Smart Commodity Partnership Network to provide lessons-learned

Topics may include: approaches to quantification, measurement, monitoring and verification; options for supply chain traceability; approaches to marketing

Lessons-learned will be documented and shared publicly

Thank You!

Questions?

Email: Kathryn.Zook@usda.gov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KEITH PITTS

Chief Sustainability Officer and SVP, Regulatory and Government Affairs, Marrone Bio Innovations

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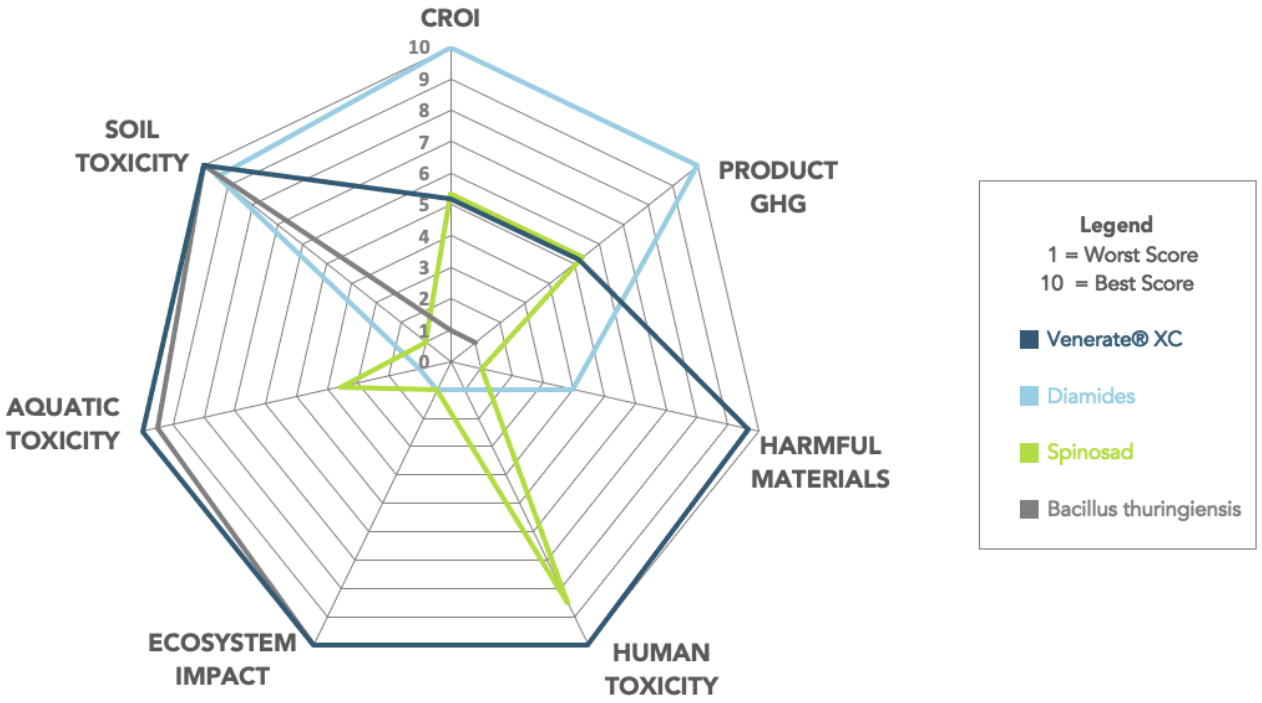
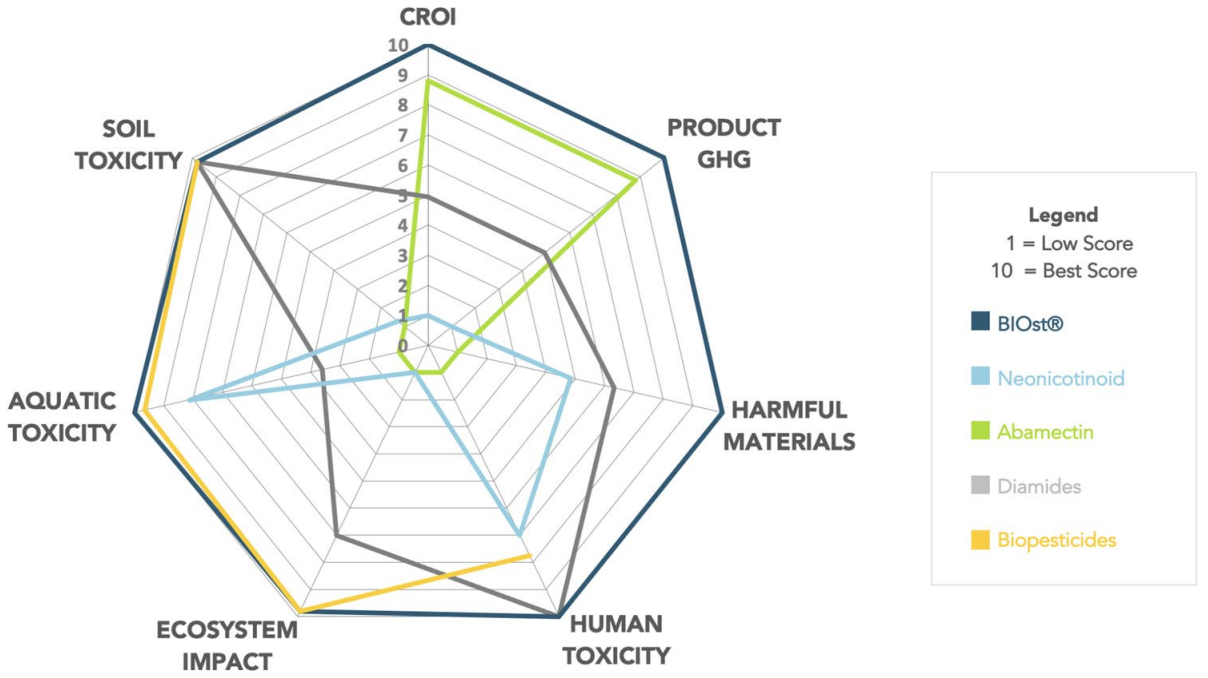
Industry Benchmarks for Venerate® XC and BIOst®



Venerate® XC
Scope 8.6/10



BIOst®
Score 9.9/10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MICHELE DEMERS

Founder and CEO,

Boundless Impact Research & Analytics

FERNANDA AVILA SWINBURN

Senior Research Analyst,

Boundless Impact Research & Analytics

Farm Foundation

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BOUNDLESS

IMPACT RESEARCH & ANALYTICS

Customer Demand for Environmental Reporting: A Look at Environmental Impact Measurement

July 19, 2022

BOUNDLESS IMPACT RESEARCH & ANALYTICS

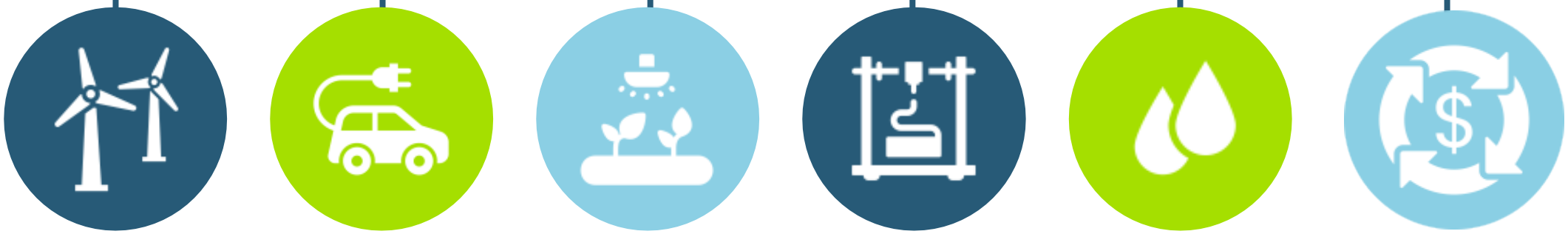
We are a frontier data and analytics provider to and about many fast growing industries.

ESG DATA MARKET

$1B ➜ $5B

by 2025

ESG DATA MARKET: NO STOPPING ITS RISE NOW (2021)



CLEAN ENERGY
$284B ➜ $452B
by 2027

TRANSPORT
$457B ➜ $571B
2020 - 2021

FOOD & AG
$495B ➜ $730B
by 2026

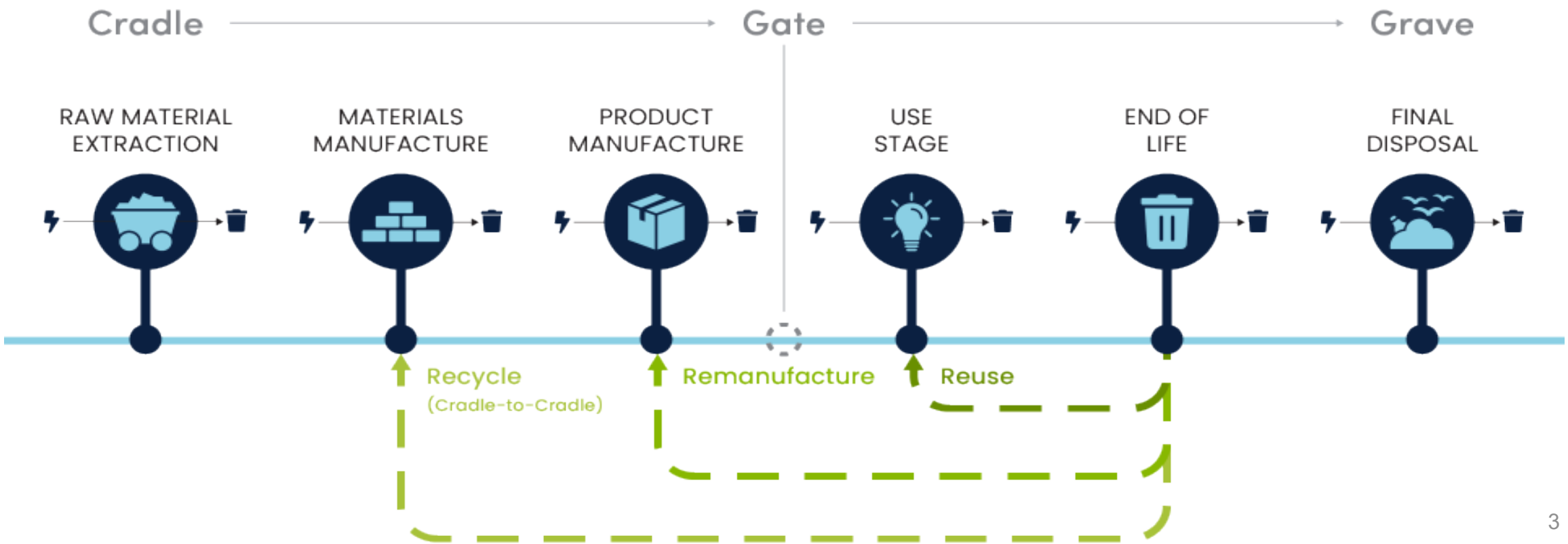
NEW MATERIALS
$13B ➜ $22B
by 2027

WATER
$86B
2022

Circular Economy
$457B ➜ $657B
by 2027

SCIENCE-BASED METHODOLOGY

Our methodology is based on Life Cycle Assessment. Sometimes we define the system boundary as "cradle to gate" and other times "cradle to grave."



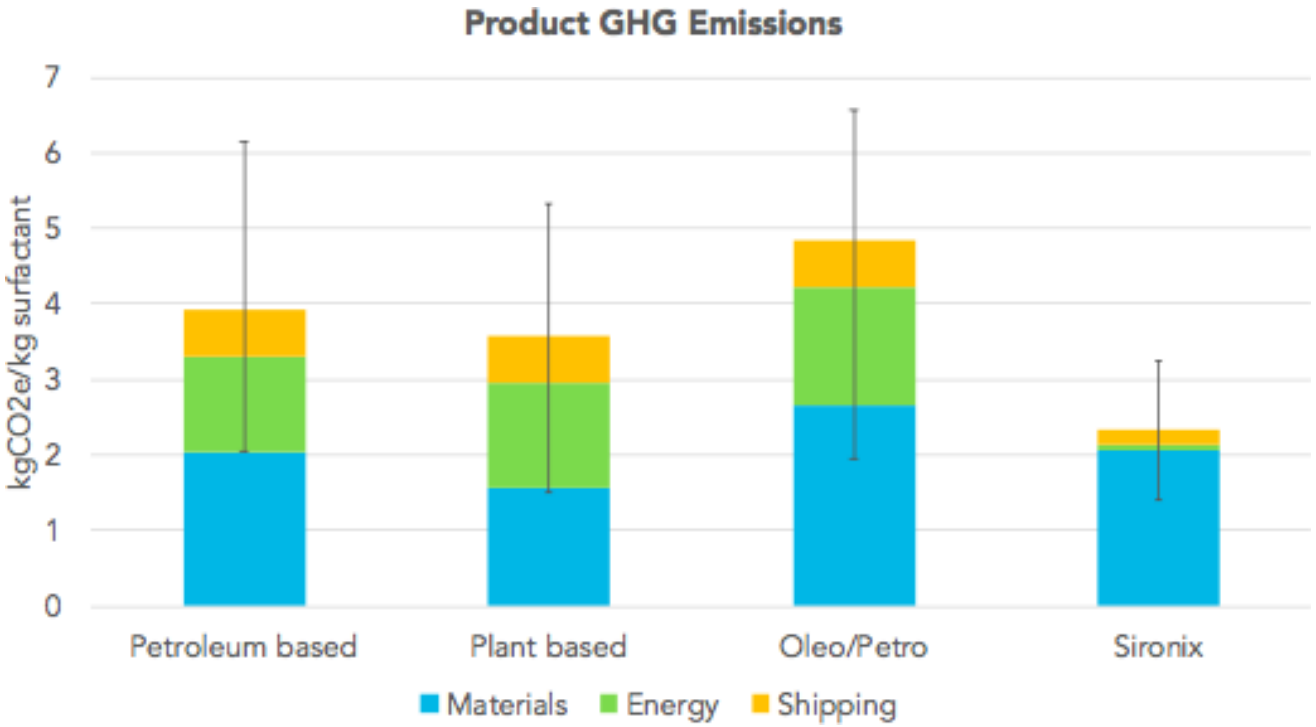
WE VALIDATE DATA, VERIFY SOURCES, AND PRODUCE ACCURATE RESULTS

Rapid Life Cycle Analysis (LCA)

Makes us the Product of Choice for Impact Diligence and Reporting

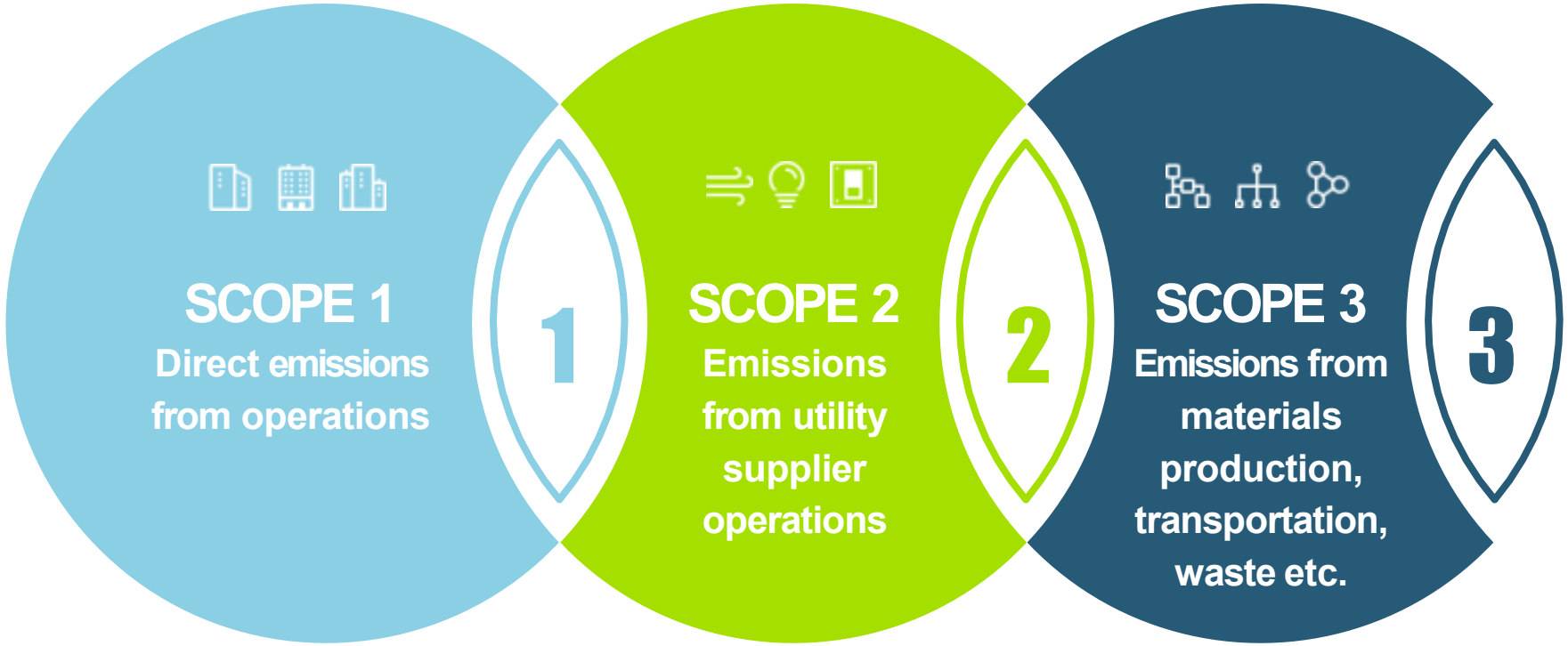
BOUNDLESS PROVIDES RELEVANT ENVIRONMENTAL PERFORMANCE DATA IN CONTEXT

- Relevant environmental metrics and benchmarks specific to each industry
- Straightforward “apples to apples” comparison of product performance across the competitive landscape
- Independent expert(s) hired to review the assessment



SCIENCE-BASED LCA IS THE ONLY WAY TO ACCURATELY MEASURE SCOPE 3 DATA*

Scope 3 activities account for up to 90% of most companies' GHG emissions**



*UN GHG Protocol established global standards for measuring and managing GHG emissions. The Scope 3 Standard is the only internationally accepted method for companies to account for full value chain emissions

** McKinsey & Company. Buying into a more sustainable value chain. September 2021.

WE HAVE VERY HAPPY CUSTOMERS

"The Boundless Profile is as valuable as our business plan because it provides a third-party perspective with solid climate metrics that stakeholders can use to assess our uniqueness."

Greg Semler, CEO - InPipe Energy
Renewable Energy & Smart Water Tech

"Boundless delivered an environmental impact assessment that allowed us to see hidden opportunities where we could significantly improve the footprint of our products and processes."

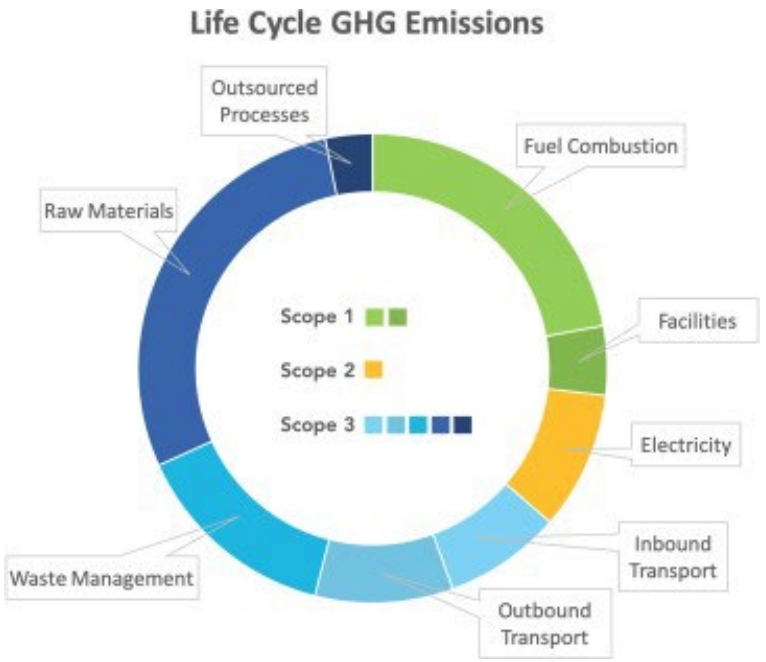
Adam Noble, CEO - Noblegen
Advanced Ingredients for Health Living Industry

ZincFive
bp ventures
NEW YORK STATE OF OPPORTUNITY. NYSERDA
LOCOMATION
RWDC INDUSTRIES
NOBLEGEN
TEMASEK
OGCI OIL AND GAS CLIMATE INITIATIVE
INPIPE ENERGY
enviva
Bellwether Coffee
eos
CERTIS
VICKERS
ALTERRA ENERGY
Marrone Bio Innovations
BlackRock.
SIRONIX RENEWABLES
GDI graphene development inc
gevo
ARDSLEY PARTNERS
DBL PARTNERS DOUBLE BOTTOM LINE VENTURE CAPITAL

LEVELS OF ANALYSIS

GHG Assessment

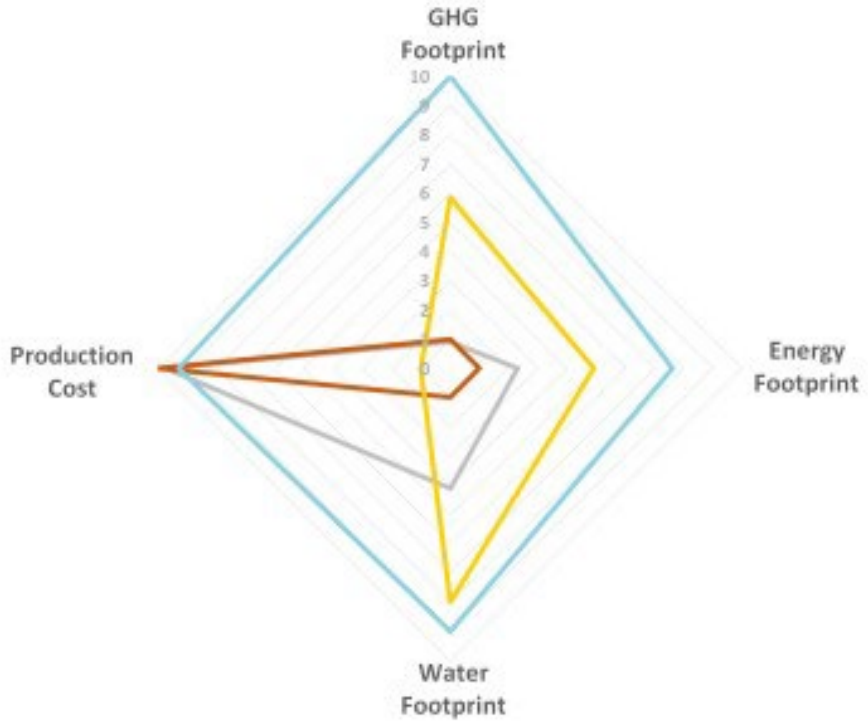
Calculates the GHG emissions of a product and projects savings on the target industry, comparing to industry peers



Turnaround: 3-4 weeks

Basic Environmental Impact Assessment

Data-driven **impact analysis**, customized for specific industries to facilitate smarter and more informed investment decisions

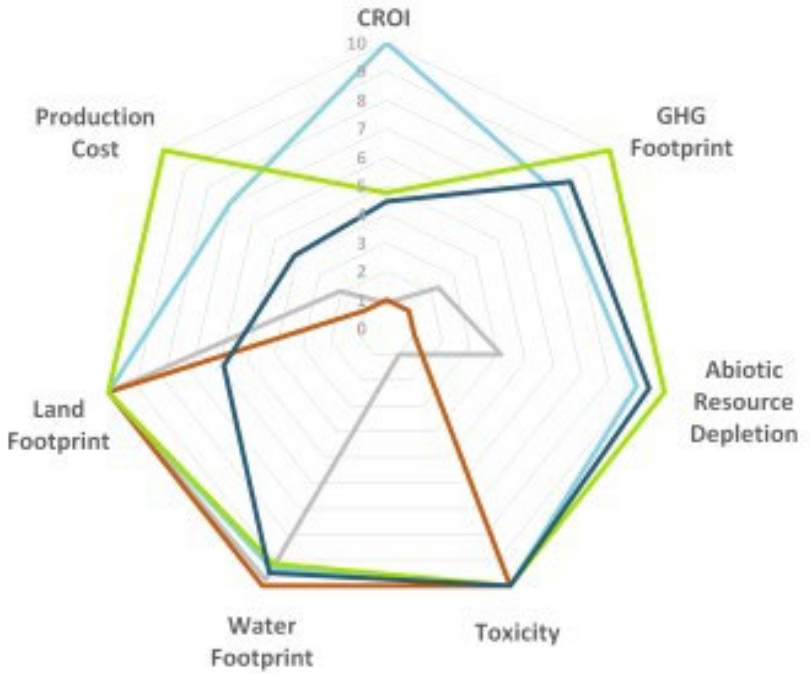


Turnaround: 4-6 weeks

LEVELS OF ANALYSIS

Full Environmental Impact Assessment

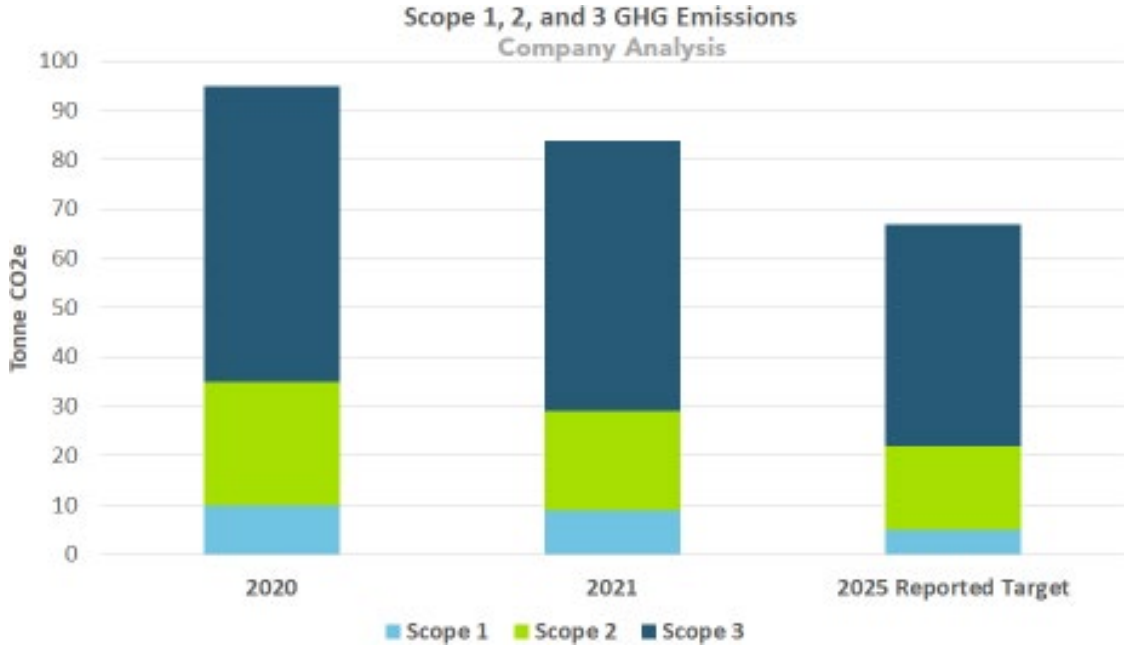
Rapid LCA and detailed analysis provides **valuable insights** into a technology's **environmental performance** and unique position in their industry.



Turnaround: 6-8 weeks

Scope 1, 2, and 3 Inventories

Detailed GHG emissions accounting of a public company's entire operation, including supply chain, waste and transportation.



Turnaround: Case Specific

USE CASE – FUNDRAISING

- **Used report to raise $15 million Series C**
- **Market report to their main customers -- data centers**
- **Scored high against lithium-ion, lead-acid and sodium sulfur batteries**

“Boundless’ Climate Impact Analysis provided a **first-of-its-kind quantification of climate impact** across competing battery chemistries. This enables our investors and customers alike, **to make data-driven decisions** based on sustainability criteria.”
-- Tim Hysell, ZincFive CEO

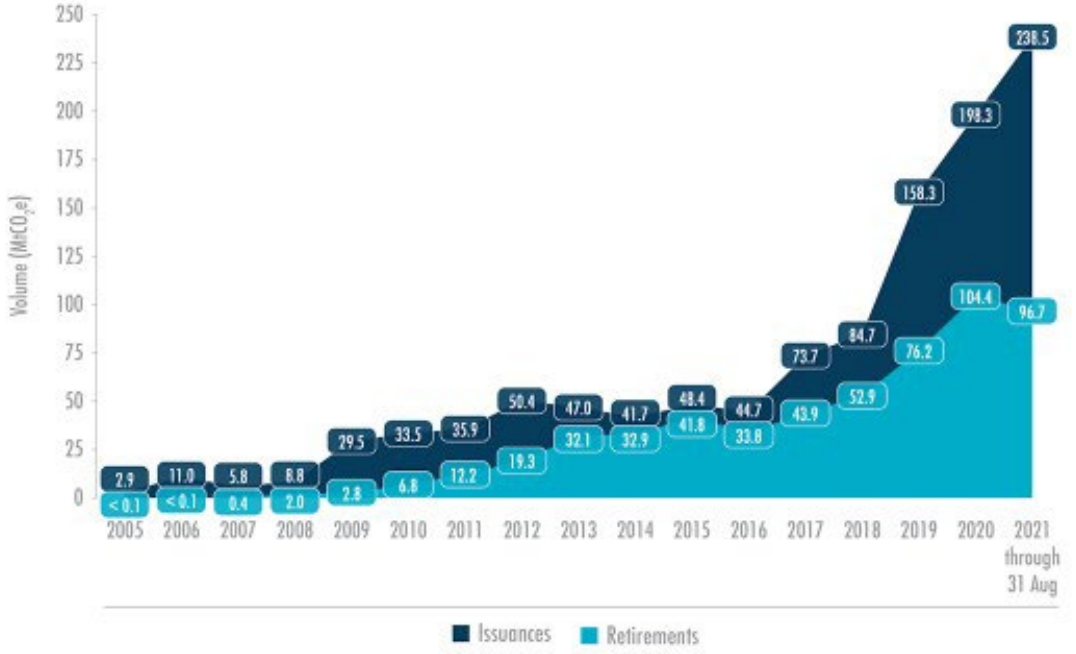
THE EXPLOSIVE GROWTH OF THE CARBON ECONOMY

- Voluntary carbon offsets market size is projected to have a 11.7% CAGR
- Overall, the market for carbon credits could be worth upward of $50 billion in 2030.
- There are currently 7 official carbon credit registries and 5 carbon credit exchanges globally.

Carbon offset prices set to increase tenfold by 2030

By **Michael Holder** June 14, 2021

Market Size by Voluntary Carbon Offset Issuances and Retirements, 2004 to 31 August 2021



Source: Forest Trends' Ecosystem Marketplace, 2021.

CARBON FARMING AND CARBON CREDITS

- Carbon Farming is a practice used to improve the rate at which CO_2 is removed from the atmosphere and stored in plant material and/or soil organic matter.
- The Department of Agriculture recommends establishing a carbon bank financed through the Commodity Credit Corporation (CCC) and controlled by the USDA.
- The USDA could purchasing carbon credits directly from farmers and forest owners

THERE IS A BIG PUSH TOWARD BIODIVERSITY AND CONSUMERS ARE DRIVING IT

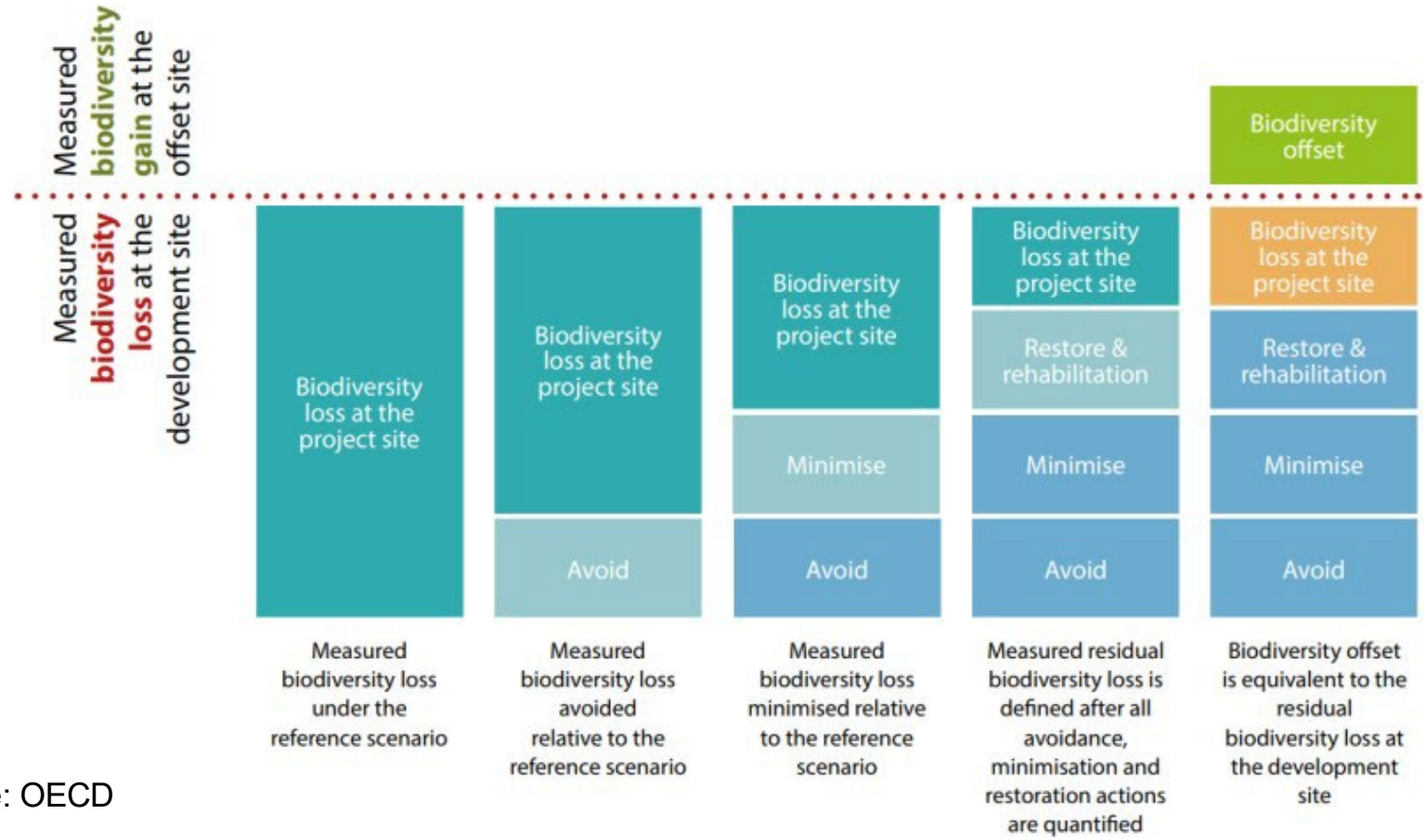
- More than **70%** of consumers surveyed suggested their trust is higher when a brand's commitment to ethical sourcing of biodiversity is independently verified.

- **82%** of respondents believe that companies have a moral obligation to ensure a positive impact on people and biodiversity

- **86%** of consumers try to avoid products that damage biodiversity

WHY BIODIVERSITY METRICS MATTER

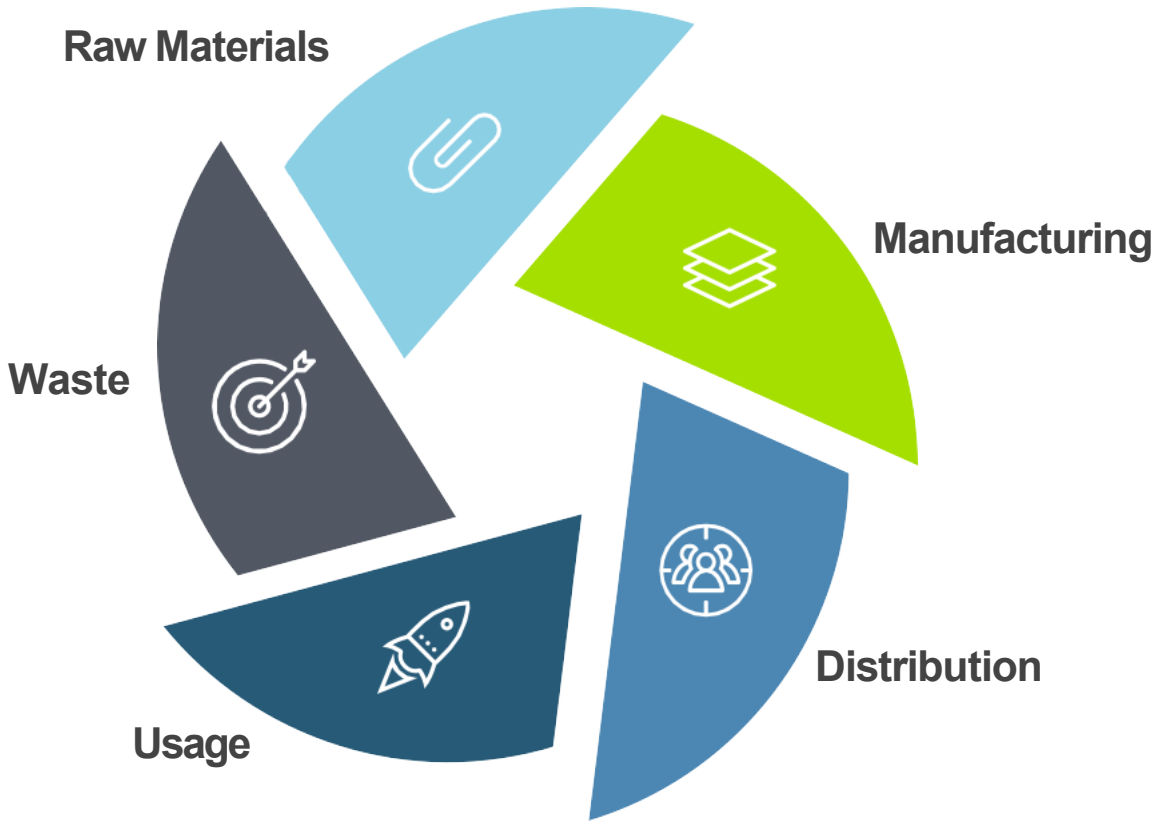
Biodiversity-focused credits, offsets, bonds and financial exchanges are emerging that will require the quantification of biodiversity metrics.



Source: OECD

Life Cycle Assessment for Crop Protection

Goal: Quantify the Greenhouse Gas (GHG) Footprint, and other environmental impacts of crop protection products.

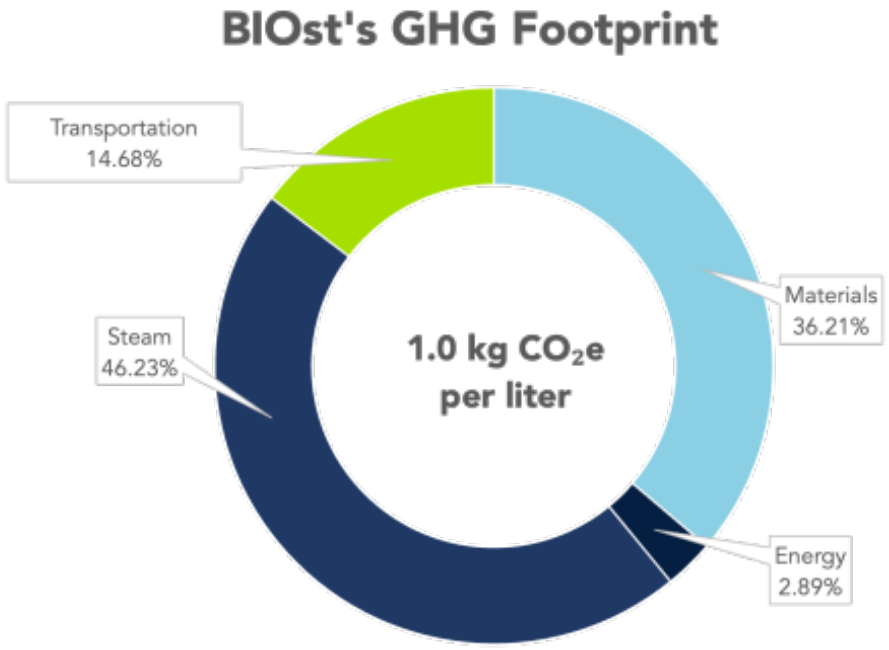


Environmental Key Performance Indicators (EKPIs)

EKPI	Unit of Measure
GHG Intensity	kgCO2e / hectare
Acute Human Toxicity Potential	Cumulative Toxicity Level
Pollinator Toxicity Potential	Toxicity Level
Aquatic Toxicity Potential	Toxicity Level
Soil Toxicity Potential	Toxicity Level
Carbon Return on Investment	$kgCO_2eq$ saved / $1M investment

MBI's BIOst Life Cycle Assessment

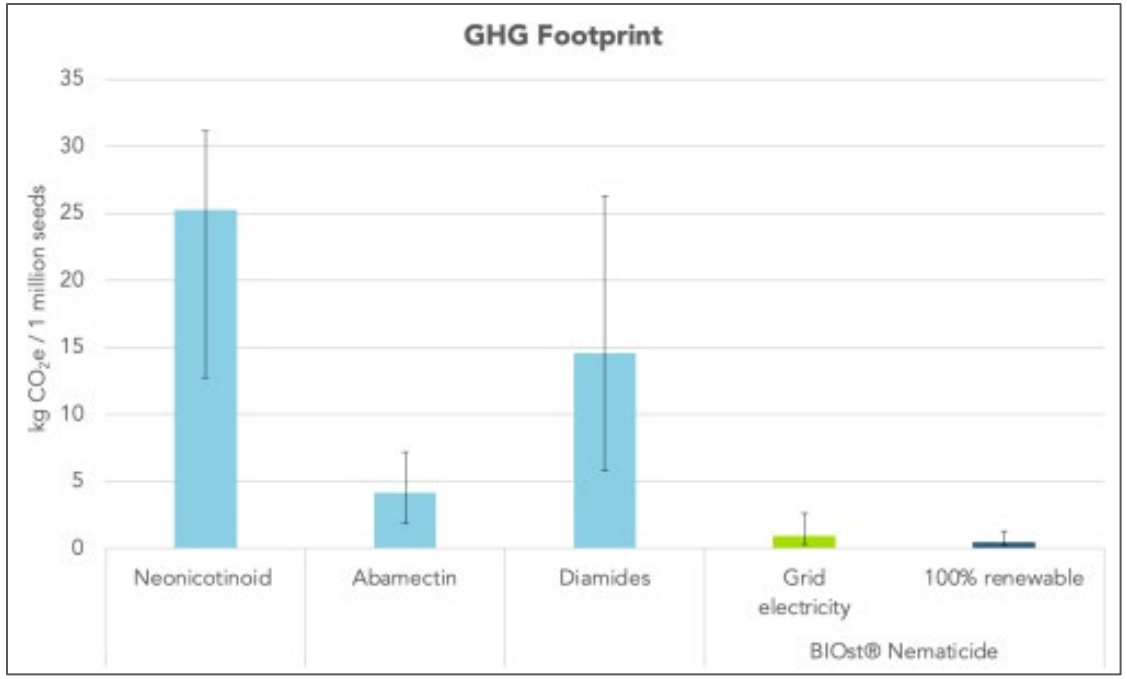
- **Scope:** Cradle to gate
- **Life Cycle Inventory:**
  - Origin of raw materials
  - Transportation
  - Energy and water inputs
- **Database**: Ecoinvent 3.71
- BIOst® has an estimate GHG Footprint of 1 kgCO_2e per kilogram of product. This translates to an average of **0.5 kg CO_2e per million seeds treated**.



GHG Footprint

GHG emissions were measured as CO_2 equivalent per hectare treated

- We select competitors considering our own research, the company experience and our independent expert opinion.
- We rely mostly on scientific publications, academic journals, and industry papers and reports to build industry benchmarks.
- We gather information from the company we are assessing and utilize EcoInvent to estimate the GHG Footprint of the product.

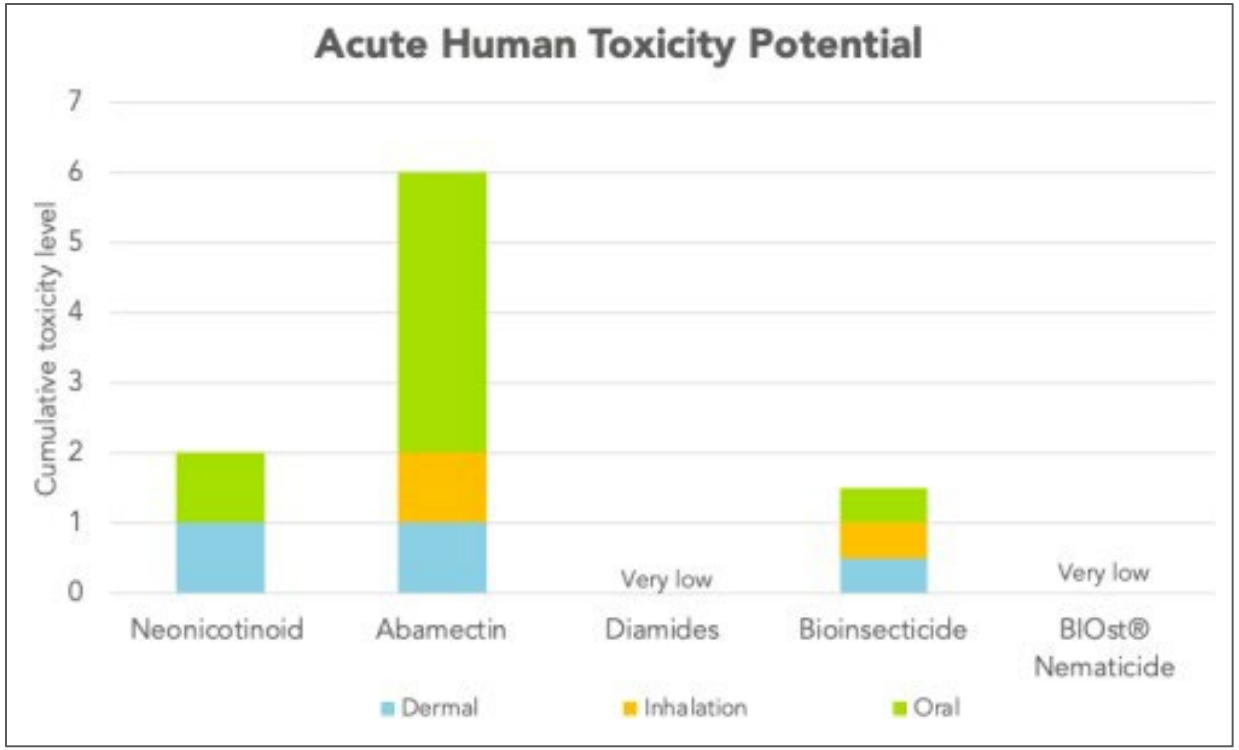


GHG emissions for the BIOst , under current grid electricity supply, ranged from 1.6 to 2.3 kg CO2 e per kilogram of product. This translates to an average of 0.9 kg CO2 e per million seeds treated with the product. Using wind energy to supply 100% of the facility electricity required to produce BIOst would reduce its GHG Footprint 47%.

Acute Human Toxicity Potential

This metric represents the level of toxicity of a chemical substance to humans, according to the Globally Harmonized System of Classification and Labeling of Chemicals.

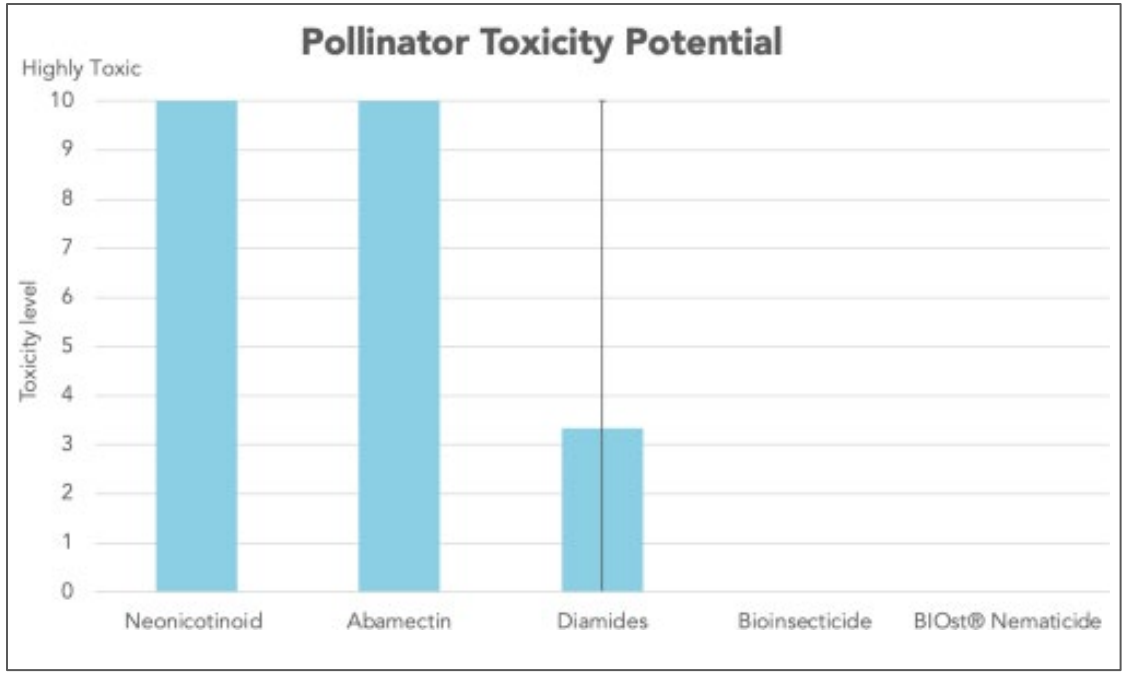
- We gather the acute oral, inhalation, and dermal toxicity information from safety data sheets.
- In this case, abamectin is the most toxic of the insecticides assessed, with considerable toxicity levels for all categories: low toxicity through inhalation, and moderate to high toxicity through oral and dermal exposure.



Pollinator Toxicity Potential

This metric measures the hazard to bees resulting from the use of the insecticide.

- This is based on the lethal dose that results in 50% mortality to bees, with 10 representing the highest level of toxicity (less than 2 micrograms per bee) and 0 representing almost nontoxicity to bees (greater than 11 micrograms per bee).
- We gather the ecotoxicology information from safety data sheets.

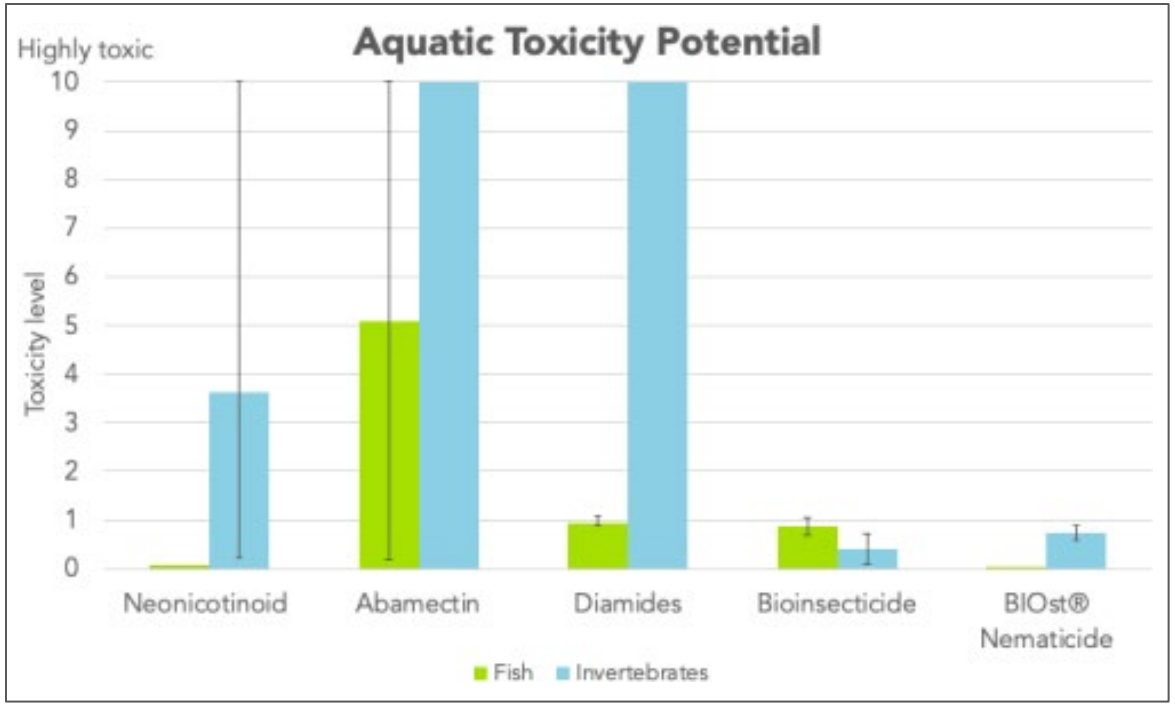


Neonicotinoids and abamectin can be toxic to bees. Small doses, between 0.016 to 0.54 micrograms of these types of nematicides, can easily kill these pollinators from topical applications.

Aquatic Toxicity Potential

This metric measures the hazard to fish and aquatic invertebrates from the use of the insecticide.

- This is based on the lethal dose that results in 50% mortality to fish and the lethal concentration that results in the immobilization of 50% of aquatic invertebrates, with 10 representing the highest level of toxicity (less than 1 milligram per liter) and 0 almost no toxicity (greater than 100 milligrams per liter).
- We gather the ecotoxicology information from safety data sheets.

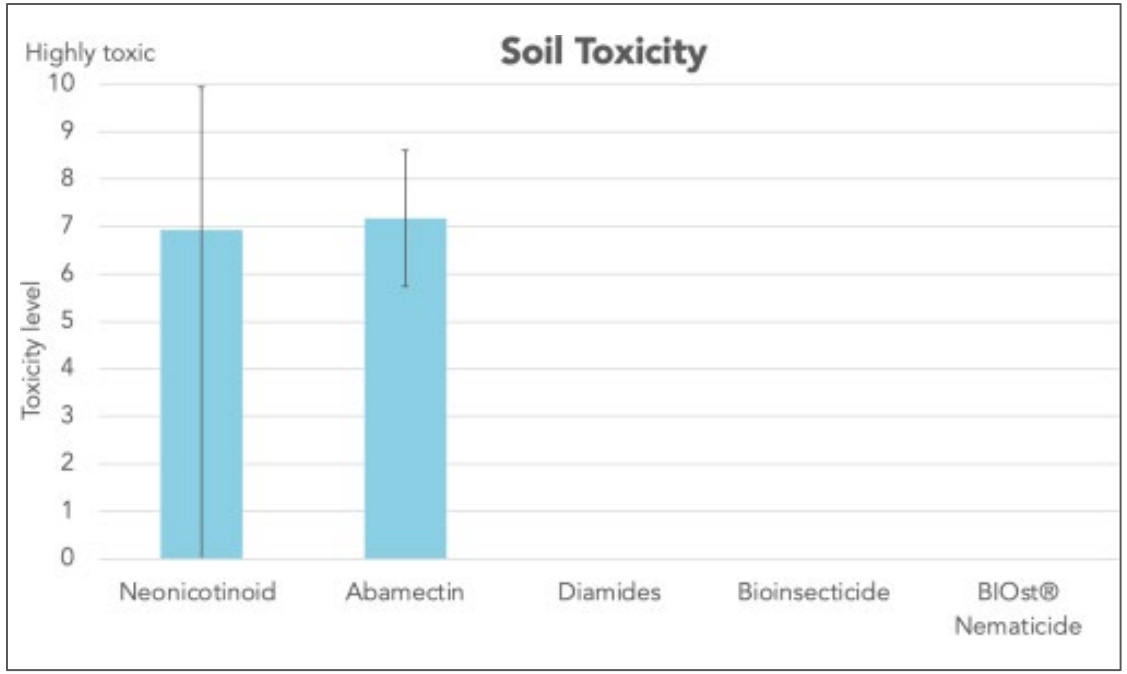


Neonicotinoids, abamectin, and diamides are considered toxic to aquatic life. The use of neonicotinoids, abamectin, and diamides can be considered a risk to aquatic invertebrates, which can affect the entire food supply chain.

Soil Toxicity Potential

This metric represents the hazard to soil-dwelling organisms from the use of the insecticide.

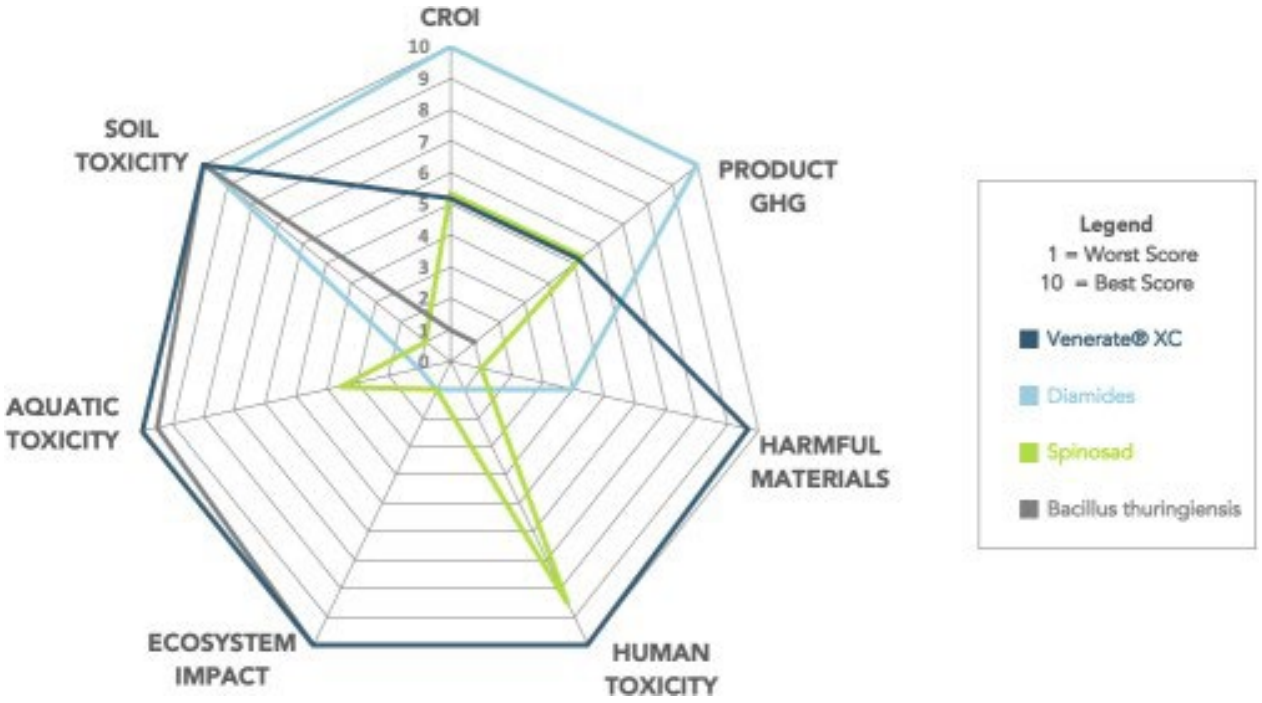
- This is based on the lethal concentration that results in 50% mortality to soil-dwelling nontarget organisms, with 10 representing the highest level of toxicity (less than 1 milligram per kilogram) and 0 almost no toxicity (> 1000 milligram per kilogram).
- In the absence of a more complex study, earthworms can be considered a good bioindicator for soil health, as their abundance can give valuable information on the fertility of soil.[1]



Abamectin poses moderate to high toxicity to earthworms, while neonicotinoids can present the highest risk to earthworms.

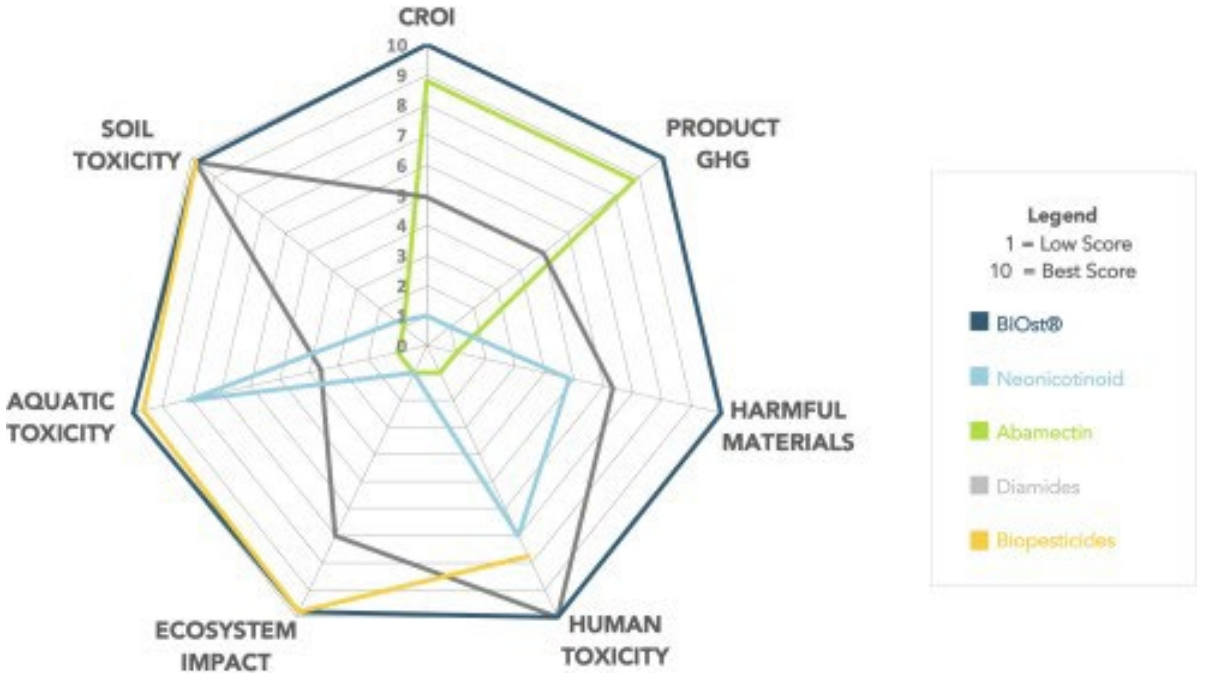
(1): Lackmann, C., Velki, M., Bjedov, D., et al. 2021. “Commercial Preparations of Pesticides Exert Higher Toxicity and Cause Changes at Subcellular Level in Earthworm Eisenia andrei.” Environmental Sciences Europe 33, no. 12. ********doi.org/10.1186/s12302-021-00455-5.

Industry Benchmarks



Venerate® XC

Score 8.6/10



BIOSt®

Score 9.9/10

Q & A

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Farm
Foundation®
Accelerating people & ideas

DR. DORN COX

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Project Lead, OpenTEAM

WOLFE'S NECK CENTER
FOR AGRICULTURE & THE ENVIRONMENT

OpenTEAM

Open Technology Ecosystem for Agricultural Management

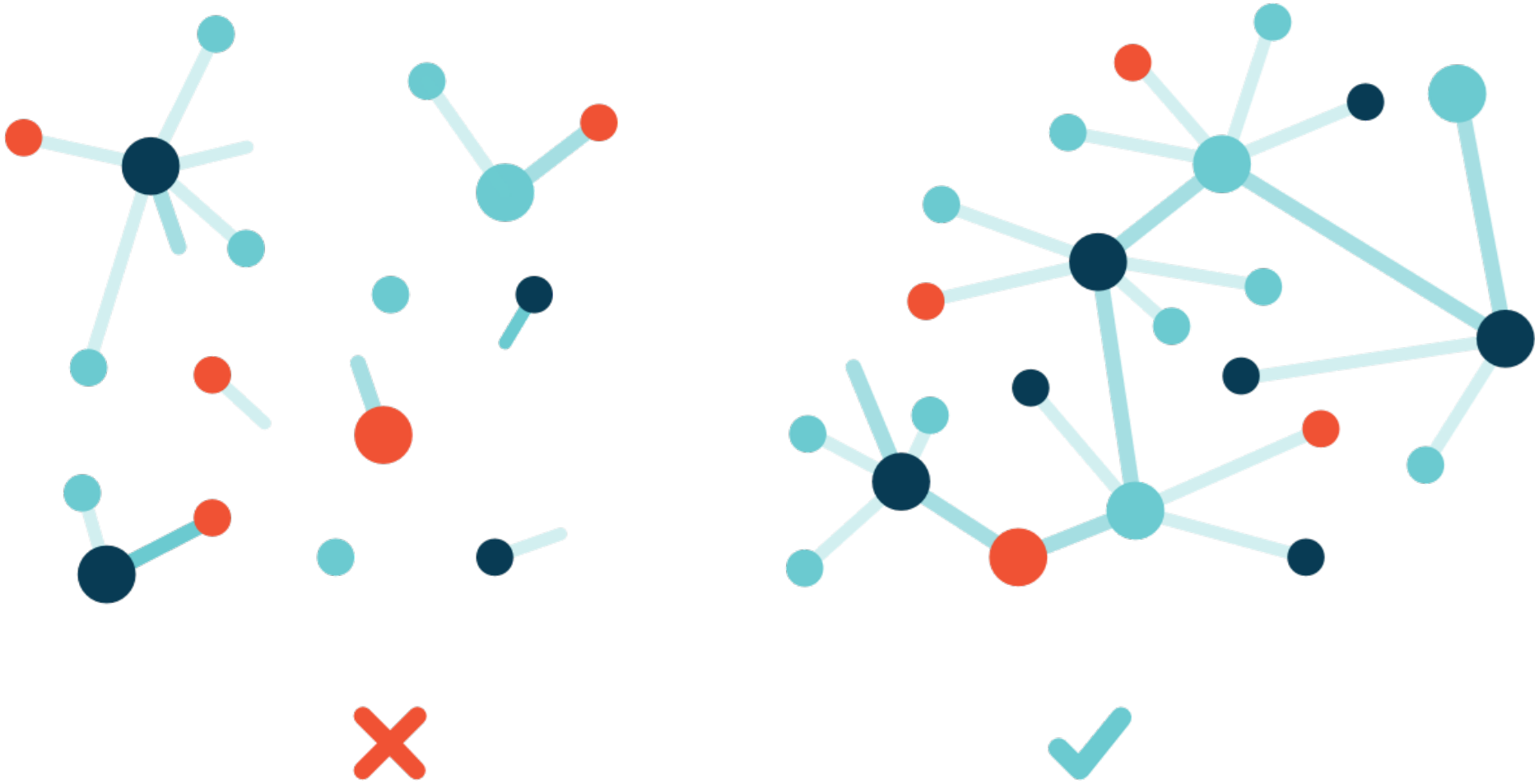
OpenTEAM Community - Co-Creating

Farm and Ranch Networks
Food Companies
Government Agencies
Technology providers
Marketplaces
Research Universities
Farmers
Ranchers
Technologists
Researchers

More than 45 Organizations

OpenTEAM

“Interoperability means working together”



OpenTEAM

Working Groups

The OpenTEAM community collaborates through these primary working groups:

Technology Working Group
Technology Review & Development

Identifying opportunities for co-development, prioritizing work packages, and supporting interoperability of technologies.

Field Methods Working Group
Science Review

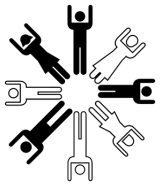
Bridging science with the available tools to create a versioned and tiered approach that will support needs of farmers/ranchers, researchers, and markets.

Hub & Network Working Group
Theory to Practice

Grounding and coordinating the other working groups across, scales, geographies, production systems through farmers, rancher, research and market networks.

Systems Centered Design Working Group
Social Review & Development

Focused on creating internal and external social feedback and design processes for the OpenTEAM community

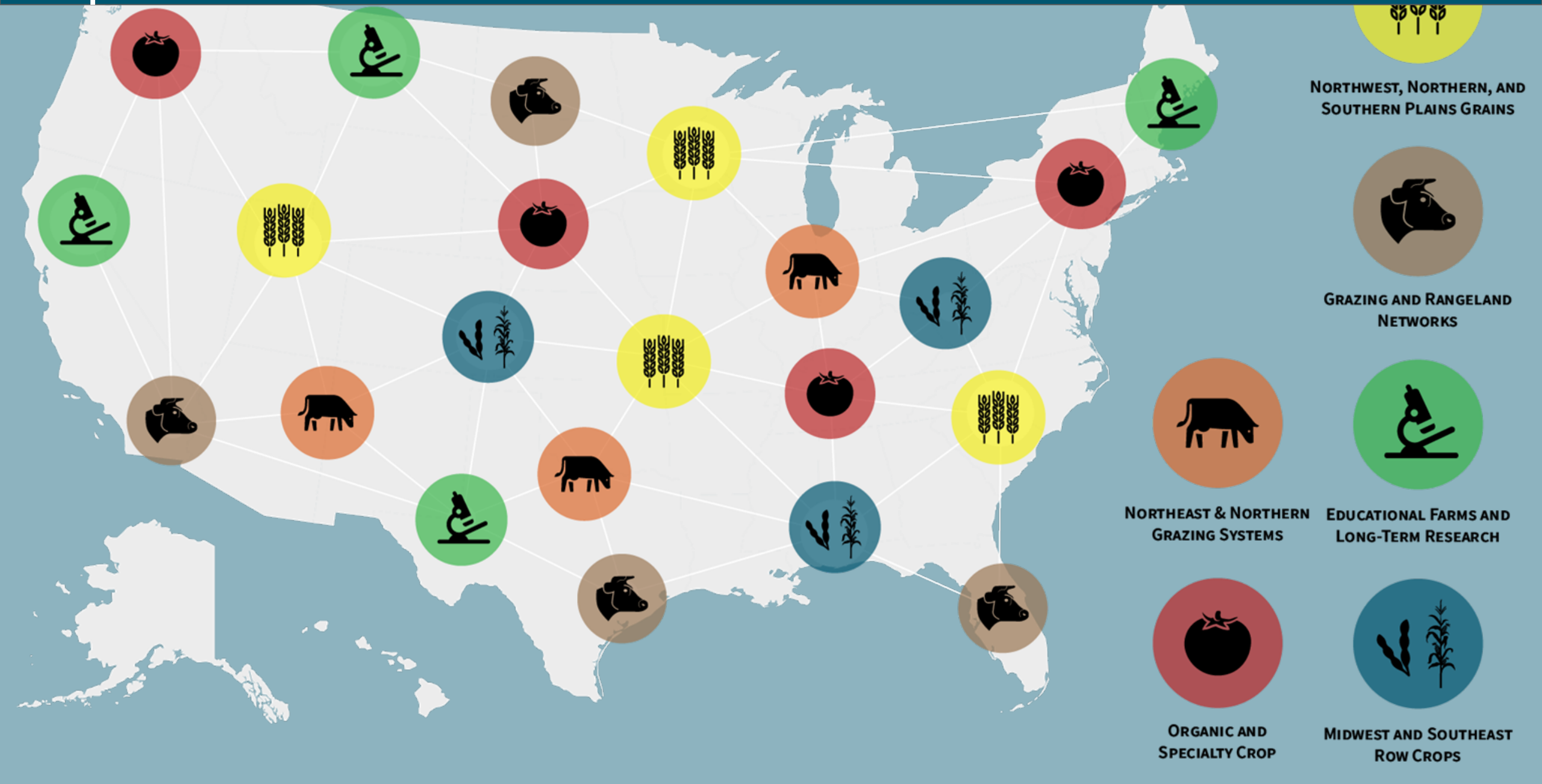


Equity in Technology and Practice
Outreach & Leadership Development

Amplifying the work of our members and supporting collaborative efforts toward racial equity and inclusion through OpenTEAM community members.

OpenTEAM

From Theory to Practice



OpenTEAM

Enter Data Once- Use many Times!

Public Science

Remote Sensing

Agroecosystem Models

Data Sovereignty

Observation Tools

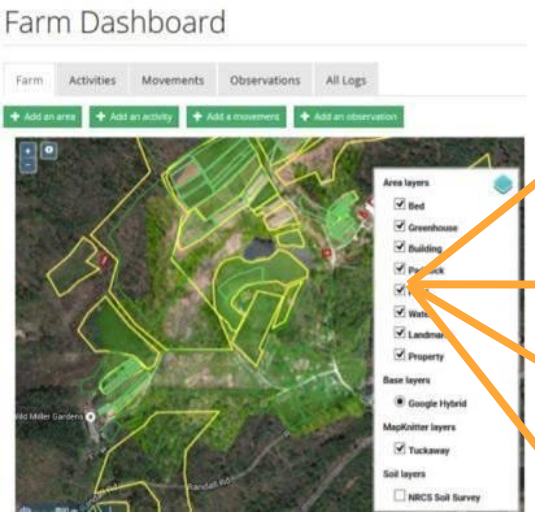
Decision Tools

Land Steward Ag Data Wallet

Private Enterprise

OpenTEAM

Data Wallet Compounds Value
Enter Once Use Many times!



Ecosystem Services Markets: enables secure, long term asset creation and trading for carbon, water quality/quantity, and biodiversity markets.

Certification (Government and supply chains): high quality & high resolution data improves accuracy and effectiveness of certification, government payments, crop insurance, and supply chain incentives.

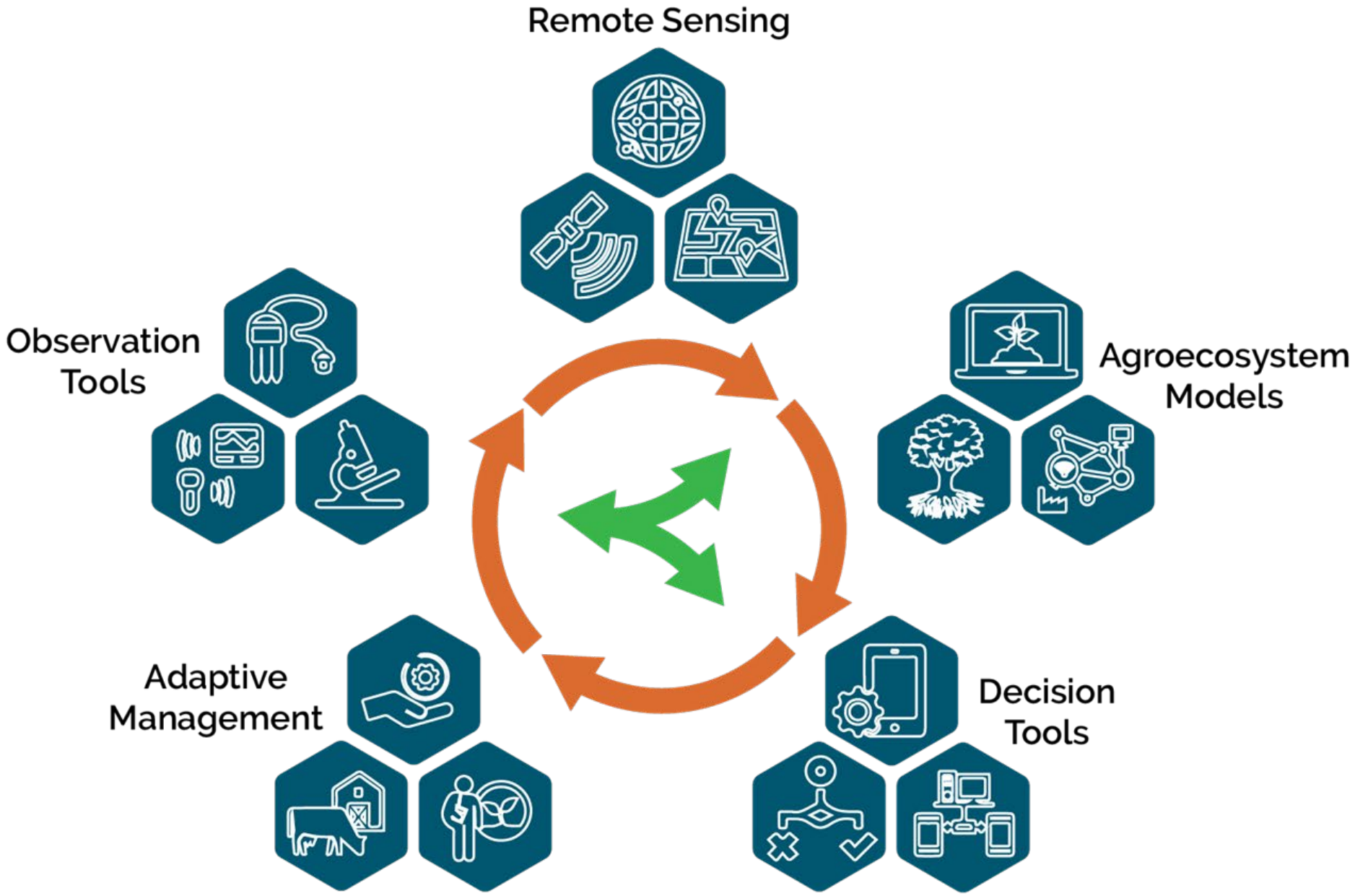
Research and development: high quality farm data on practices, conditions, and environmental performance feeds into tool and model design, calibration, and improvement.

Farm level: Site-specific decision support tools create agronomic value; improve farm gate profitability and resilience.

Data quality and value increase over time

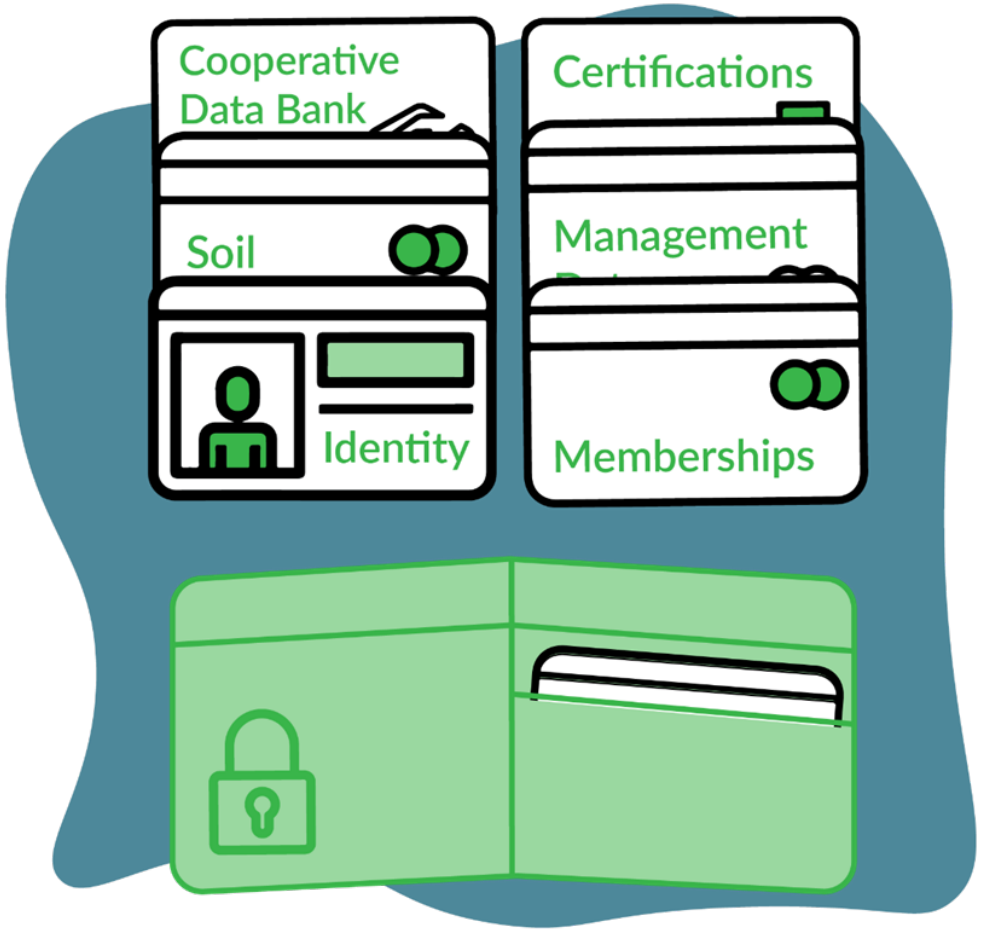
OpenTEAM

Data Wallet Compounds Value
Enter Once Use Many times!



Data Wallet Compounds Value
Enter Once Use Many times!

TRUST



Ag Data Wallet

OpenTEAM

Data Wallet Compounds Value
Enter Once Use Many times!

FARMERS AND THEIR TRUSTED ADVISORS COLLECT AND AGGREGATE FARM DATA

FARMERS FILL OUT THEIR PROFILES WITH THAT DATA AND ARE ONBOARDED TO THE TECHNOLOGY ECOSYSTEM

FARMERS SET PREFERENCES FOR HOW THEIR DATA IS STORED AND WHICH COOPERATIVE DATA BANKS THEY ARE WORKING WITH

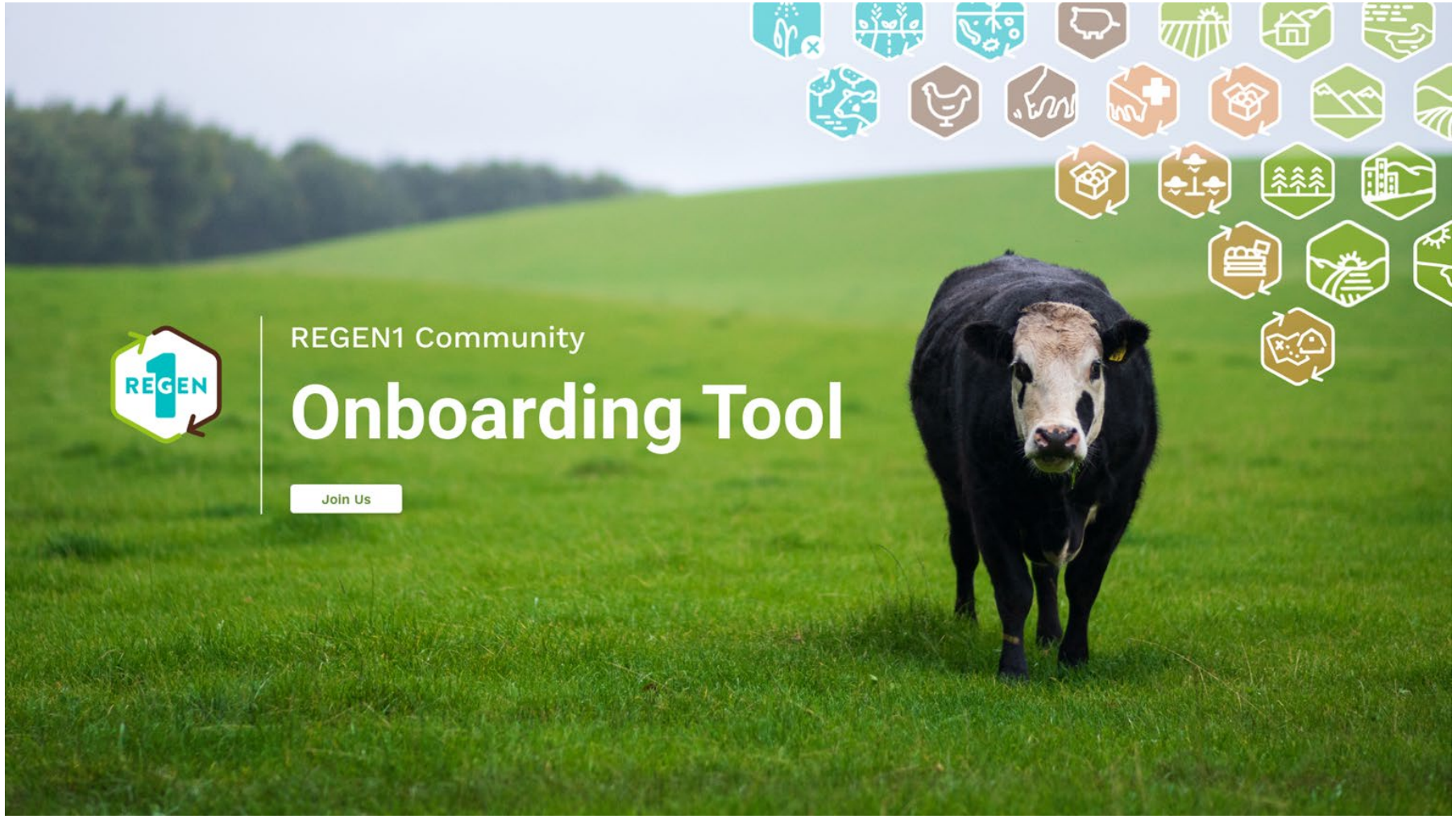
FARMER'S DATA IS STORED IN A SECURE "AG DATA WALLET"

FARMERS CHOOSE WHAT DATA TO SHARE

FARMERS DATA IS SHARED WITH PERMISSIONED WALLET ACCESS TO CROP ADVISORS, CERTIFIERS, MARKETS, GOVERNMENTAL AGENCIES, AND OTHER PRODUCERS.

REGEN1: ONBOARDING TOOL

REGEN1 has designed an onboarding tool that helps farmers and ranchers become members of the REGEN1 Community. The simple process gathers information on what these producers are doing and explains the ecosystem benefits they provide



Like a Credit Union - but for Digital Assets

Environmental Claims Clearinghouse

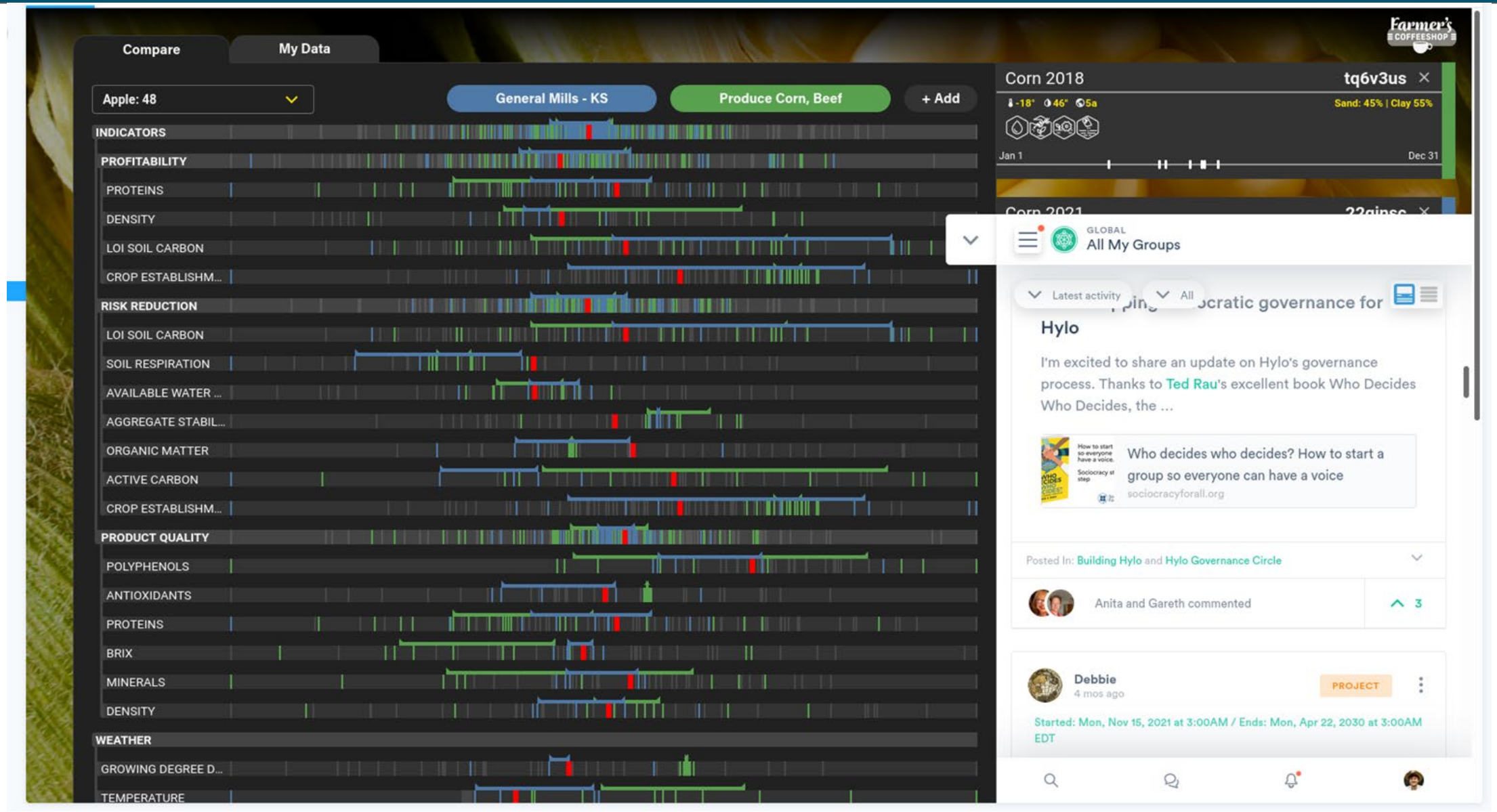
- Like a registry of deeds to enable stacking claims and creating a portfolio of environmental asset types without double counting
- Clear boundaries, duration, claimant, issuer, and claim type
- Digitally defined asset attributes and contract structure

Knowledge Commons

PUBLIC LAND LIBRARY

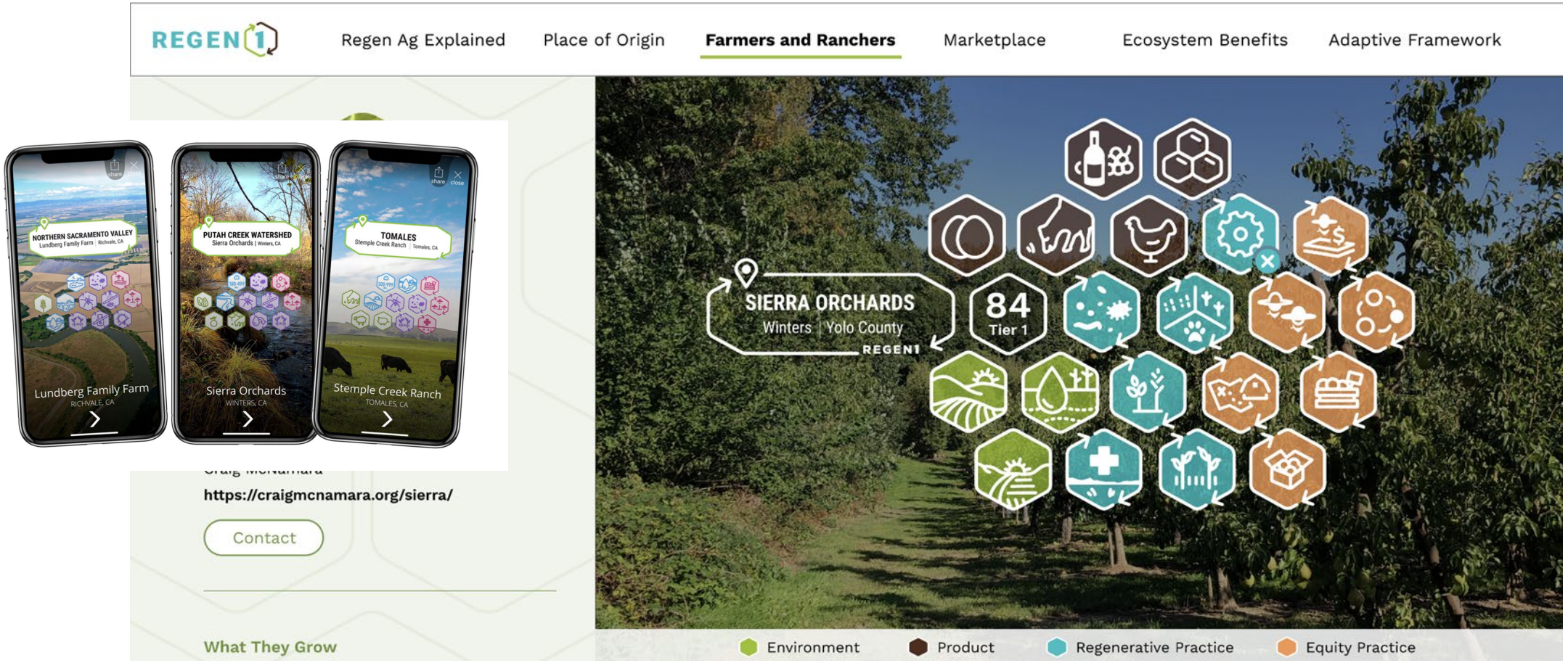
OpenTEAM

Digital Coffee Shop - Benchmark and Communications control panel



OpenTEAM

PRODUCER DASHBOARD / DIGITAL FINGERPRINT



Note: this tool is being built in collaboration with Open Team and Our/SCI's Survey Stack open source technology platform. All code created for this initiative will be made publicly available on GitHub in June 2021 under a Creative Commons license.

OpenTEAM

From packaging to global science based targets

SUSTAINABLE DEVELOPMENT GOALS

2 ZERO HUNGER

3 GOOD HEALTH AND WELL-BEING

6 CLEAN WATER AND SANITATION

10 REDUCED INEQUALITIES

11 SUSTAINABLE CITIES AND COMMUNITIES

12 RESPONSIBLE CONSUMPTION AND PRODUCTION

13 CLIMATE ACTION

15 LIFE ON LAND

WOLFE'S NECK CENTER
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OpenTEAM

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Learn more at openteam.community


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