TOP 10

Things You Wanted to Know About Ag Carbon Markets

American Farmland Trust

SAVING THE LAND THAT SUSTAINS US

NOTE TO THE READER: The agricultural carbon markets are changing rapidly. Our goal is to deliver the best available information in an understandable and useful way, and to point you in the right direction for more resources. The prices in this guidebook are accurate as of the date they were referenced. We mention many ag carbon markets as examples, which should not be considered an American Farmland Trust (AFT) endorsement. In full transparency, AFT has projects with ADM, Cargill, IndigoAg, and Truterra and is a member of ESMC. While efforts are made to provide correct information, AFT expressly disclaims liability for errors and omissions. The information provided here is for informational purposes only and is not intended for commercial use or to provide financial, tax, or legal advice to any individual or entity.

ABOUT AMERICAN FARMLAND TRUST

American Farmland Trust (AFT) is the largest national organization dedicated to protecting farmland, promoting sound farming practices, and keeping farmers on the land. AFT unites farmers and environmentalists in developing practical solutions that protect farmland, farm viability, and the environment. We work from "kitchen tables to Congress," tailoring solutions that are effective for farmers and communities and can be magnified to have a greater impact. Since our founding, AFT has helped protect more than six and a half million acres of farmland and led the way for adopting conservation practices on millions more. AFT has a national office in Washington, D.C., and a network of offices across America where farmland is under threat. For more information, visit us at **farmland.org**.

AFT AUTHORS

Michelle Perez, *Water Initiative Director*
Bonnie McGill, *Senior Climate and Soil Health Scientist*
Emily Liss, *Farm Viability Policy Manager*
Jean Brokish, *Midwest Deputy Director*
Rachel Seman-Varner, *Senior Soil Health and Biochar Scientist*
Bianca Moebius-Clune, *Climate and Soil Health Initiative Director*

RECOMMENDED CITATION

Perez, M., McGill, B., Liss, E., Brokish, J., Seman-Varner, R., and Moebius-Clune, B. (2023). Top 10 Things You Wanted to Know About Ag Carbon Markets [Guidebook]. Washington, D.C.: American Farmland Trust.

This Guidebook and a two-page document summarizing the "Highlights" are available to the public in pdf format via this QR code and at this website: **farmlandinfo.org/publications/top-10-things-ag-carbon-markets**.

Cover photo: A cover crop mix interseeded with corn on the Macauley Farm in western New York. Interseeding during the cash crop growing season maximizes cover crop growth prior to the winter. The Macauleys participate in AFT's Genesee River Watershed Demonstration Farm Network.

TOP 10

Things You Wanted to Know About Ag Carbon Markets

Contents

Introduction 5

Background on How Ag Carbon Markets Work 9

1. What is an ag carbon market, and why are farmers being asked to join? 9
2. Just how many ag carbon markets are there, and how do they differ? 12
3. What the heck is additionality, why is it so important, and how does it affect me? 15
4. How is the government involved in agricultural carbon markets? 17

Top-Of-Mind Questions 19

5. Am I eligible to participate? 19
6. What are the current ag carbon markets paying for (practices or outcomes)? 21
7. They want to look at my *what?!* What information and access do I have to provide? 23
8. How long are the contracts & who's liable if something goes wrong? 24
9. Money matters: How can I make a market work for me? 26
10. How do I know which carbon market is right for me, and where can I get more information? 30

Conclusion 31

Supplementary Materials 32

Supplement 1. Co-benefits of climate-smart practices 32
Supplement 2. Which greenhouse gas emissions can climate-smart practices help reduce? 33
Supplement 3. Why is a carbon credit measured in t CO_2e and what are global warming potentials? 34

References 35

Glossary 37

RESOURCES

Box 1. What are climate-smart practices? 7
Table 1. Summary of the Climate-Smart Practice List from USDA NRCS 8
Figure 1. A Simple Schematic of Voluntary Carbon Markets 10
Figure 2. Timeline of launch years for carbon offset markets & recent agricultural carbon programs 12
Table 2. From a farmer's perspective, what's the difference between offset and inset programs? 14
Table 3. Ag carbon market prices can vary widely per credit or per acre 26
Box 2. How does a price per credit translate into a price per acre? 26

A rice field in Arkansas.

ALAMY/MARC BOETTCHER

ACKNOWLEDGMENTS

The authors would like to thank the reviewers who provided valuable feedback and thoughtful suggestions, which made this report stronger: Brian Brandt (AFT), Kent Bohnhoff (Retired NRCS-IL, AFT consultant), Alice Chang (Indigo Ag), Bryan Fairfull (M&M Service Company), Eric Hassel (Innovation Center for US Dairy), Jared Jacobs (Cargill RegenConnect), Bruce Knight (Strategic Conservation Solutions), Chris Kopman (Newtrient), Patty Larkin (Agricultural Consulting Services), Megan Miller (Illinois Soybean Association), Jen Nelligan (National Association of Conservation Districts), Rachel Orff (National Corn Growers Association), Robert Parkhurst (Sierra View Solutions), Frank Rademacher (The Nature Conservancy-Illinois), Kris Reynolds (AFT), Sarah Sellars (South Dakota State University), Steve Stierwalt (Champaign County, IL Soil and Water Conservation District), and Joel Wipperfurth (Truterra/Land O'Lakes).

All opinions, interpretations, and facts represented are those of the authors.

This guidebook was made possible by generous support from the Walton Family Foundation.

Introduction

This guidebook aims to help farmers, ag advisors, and conservation professionals better navigate emerging agricultural carbon market opportunities. Corporations with sustainability goals are trying to satisfy some of their targets by purchasing carbon credits, some of which can be generated by farmers who adopt "climate-smart practices" (see **Box 1** for a definition). However, these ag carbon markets have been repeatedly described as the "Wild West" because the programs are paying for different things in different ways, with different expectations.

This new set of opportunities is exciting but can cause confusion and concern. As of Fall 2022, 97% of 500 surveyed farmers said they were not ready to join an ag carbon market, though 93% were aware they exist (Urban & Skoczlas Cole, 2022).

With today's prices (about $20 per credit), farmers won't get rich by participating in the emerging ag carbon markets. However, farmers can take advantage of the financial support they offer to kick-start or continue their conservation journey. The top three climate-smart practices the programs are currently paying for are no-till or reduced tillage, cover crops, and nutrient management. These

LORI HAYS

Abigail Peterson, Director of Agronomy for the Illinois Soybean Association demonstrates the impacts of cover crops and reduced tillage on soil structure at a Vermilion Watershed Field Day in Livingston County IL.

practices offer numerous economic and environmental benefits to your farm, such as reduced input costs, increased yield stability, and greater soil health. Healthier soil can increase farm resilience in the face of increasingly erratic weather patterns and reduce soil, nutrient, and water runoff from fields, increasing carbon sequestration and lowering greenhouse gas emissions.

American Farmland Trust wanted to help farmers and advisors navigate this confounding new space. So, we assembled a list of 10 questions many farmers might have. Honestly, we have these questions too! Even though AFT has been working in agricultural conservation for over 40 years, we find this topic a head-scratcher.

The 10 questions are split into two sections. The first four questions are in the section titled **"Background on How Ag Carbon Markets Work,"** which covers topics that will help you understand why things are the way they are:

1. **What is an ag carbon market, and why are farmers being asked to join?**
2. **Just how many ag carbon markets are there, and how do they differ?**
3. **What the heck is additionality, why is it so important, and how does it affect me?**
4. **How is the government involved in agricultural carbon markets?**

Depending on your interest in the details, you may want to skim this stuff on your way to the second section, which covers more practical issues. Or you may want to grab a cup of coffee and immerse yourself from the beginning.

The following six questions are in the **"Questions That Are Top of Mind for Farmers"** section. Here, we dig into the practical questions that any business-minded producer would have:

5. **Am I eligible to participate?**
6. **What are the current ag carbon markets paying for (practices or outcomes)?**
7. **They want to look at my what?! What information and access do I have to provide?**
8. **How long are the contracts & who's liable if something goes wrong?**
9. **Money matters: How can I make a market work for me?**
10. **How do I know which carbon market is right for me, and where can I get more information?**

We know this is not an exhaustive list of questions, and we share several resources throughout the document to provide more insights, including infographics in the Supplementary Materials section and a Glossary of terms. We also produced a brief "**Highlights**" document summarizing the guidebook.

No-till soybeans developing in corn and cover crop residues. MARGARET BURLINGHAM/ADOBE STOCK

Box 1. What are climate-smart practices?

Before we get into identifying practices, let's start with climate-smart agriculture. According to USDA, "Climate-smart agriculture and forestry is an integrated approach that enables farmers, ranchers, and forest landowners to respond to climate change by reducing or removing greenhouse gas emissions (mitigation) and adapting and building resilience (adaptation), while sustainably increasing agricultural productivity and incomes." (USDA, 2023a)

USDA Natural Resources Conservation Service (NRCS) currently identifies 53 conservation practice standards with quantifiable climate mitigative benefits, i.e., the practices either reduce greenhouse gases or increase carbon sequestration (or both). NRCS grouped the practices into nine Climate-Smart Agriculture & Forestry (CSAF) Mitigation categories and a short description of each category is provided in the table below. There are many more enhancement activities on the USDA NRCS CSAF Mitigation Activities List, which are not shown in the table on page 8, that provide more options for implementing the practices. Many of these climate-smart practices offer other environmental benefits, too such as reduced soil erosion, improved water quality, improved wildlife habitat, and/or improved water use, often referred to as co-benefits (see **Supplement 1**).

CONTINUED ON NEXT PAGE

CONTINUED FROM PREVIOUS PAGE

Table 1. Summary of the Climate-Smart Practice List from USDA NRCS
(AS OF OCTOBER 2023)

9 Climate-Smart Agriculture & Forestry (CSAF) Mitigation Categories	Description	53 Climate-Smart Practices
SOIL HEALTH	Reducing emissions and enhancing soil carbon sequestration.	Conservation Cover (327), Conservation Crop Rotation (328), Residue and Tillage Management, No Till and Reduced Till (329 and 345), Contour Buffer Strips (332), Soil Carbon Amendment (336), Cover Crop (340), Field Border (386), Filter Strips (393), Grassed Waterways (412), Mulching (484), Stripcropping (585), Vegetative Barriers (601), Herbaceous Wind Barriers (603)
NITROGEN MANAGEMENT	Implementing the 4Rs of nitrogen management and reducing nitrous oxide emissions, a potent greenhouse gas. The 4Rs are Right Source, Right Rate, Right Time, and Right Place.	Nutrient Management (590)
LIVESTOCK PARTNERSHIP	Reducing potent methane emissions from manure.	Composting Facility (317), Waste Storage Facility (313), Anaerobic Digester (366), Roofs and Covers (367), Feed Management (592), Waste Separation Facility (632)
GRAZING AND PASTURE	Reducing emissions and building soil carbon stocks in grazing systems.	Brush Management (314), Herbaceous Weed Treatment (315), Prescribed Burning (338), Pasture and Hay Planting (512), Prescribed Grazing (528), Range Planting (550)
AGROFORESTRY, FORESTRY AND UPLAND WILDLIFE HABITAT	Building carbon stocks in perennial biomass and soils.	Alley Cropping (311), Critical Area Planting (342), Forest Farming (379), Windbreaks/Shelterbelt Establishment & Renovation (380), Silvopasture (381), Fuel Break (383), Woody Residue Treatment (384), Riparian Herbaceous Cover (390), Riparian Forest Buffer (391), Wildlife Habitat Planting (420), Hedgerow Planting (422), Tree/Shrub Establishment (612), Restoration of Rare or Declining Natural Communities (643), Forest Stand Improvement (666)
RESTORATION OF DISTURBED LANDS	Improving the quality of previously mined or degraded lands to increase soil and perennial biomass carbon stocks.	Land Reclamation, Landslide Treatment (453); Land Reclamation, Abandoned Mined Land (543)
ENERGY, COMBUSTION AND ELECTRICITY EFFICIENCY	Reducing emissions from agricultural operations and infrastructure through energy and fuel efficiency and system and operational improvements.	Combustion System Improvement (372); Energy Efficient Agricultural Operation (374); Irrigation Pipeline (430); Irrigation System, Microirrigation (441); Sprinkler System (442); Pumping Plant (533); Energy Efficient Building Envelope (672), Energy Efficient Lighting System (670)
WETLANDS	Restoring wetlands to enhance carbon storage in soils and vegetation.	Wetland Restoration (657)
RICE	Reducing methane emissions from rice fields through irrigation water management.	Irrigation Water Management (449)

Source: The definition of climate-smart agriculture was sourced from **this Climate Smart Agriculture and Forestry factsheet**. The practice list was sourced from the "**Climate-Smart Agriculture and Forestry (CSAF) Mitigation Activities List for FY2024**" on the NRCS website called "**NRCS Climate Smart Mitigation Activities List.**"

Background on How Ag Carbon Markets Work

1 What is an ag carbon market, and why are farmers being asked to join?

Agricultural carbon markets are a kind of environmental market[1] developed, in part, to help corporations and farmers satisfy mutually beneficial goals. Corporations can use ag carbon markets to meet some of their sustainability and climate goals by purchasing carbon credits. In turn, this helps farmers overcome financial barriers to the adoption of climate-smart practices, which can generate many economic and environmental benefits both on and off the farm. Simply put, an ag carbon market is a set of agreements and monetary transactions between buyers and sellers that a carbon market developer may facilitate:

Tillage radish growing under a canopy of silage corn. USDA-SARE/EDWIN REMSBERG

- **Buyers** are corporations who face mandatory regulations or have made voluntary commitments to lower their greenhouse gas (GHG) emissions and seek various options to do so as efficiently as possible.
- **Sellers**, in this case, are farmers who can implement climate-smart practices to achieve GHG reductions more cost-effectively than the buyer. Agriculture and forestry are the only economic sectors that naturally remove CO_2 from the air and store it as carbon in plants, trees, and soils.
- **Carbon market developers** serve as intermediaries between buyers and sellers to establish eligibility rules, contract terms, credit calculations, monitoring and verification, prices, etc.

Two notes about terminology:

1. The term "ag carbon markets" is commonly used as an umbrella term to cover not just the removal of carbon dioxide (CO_2) and carbon sequestration in the soil but also reductions in methane (CH_4) and nitrous oxide (N_2O). (See **Supplement 2** for an infographic showing which climate-smart practices address which agriculturally related GHG.)
2. In this guidebook, in addition to "ag carbon market," we will also use the term "ag carbon program" as an umbrella term to cover the many different private sector transactions between corporations and farmers: carbon registries, carbon offset markets (compliance and voluntary), carbon inset markets, and Scope 3 corporate climate sustainability programs (see **Section 2** for descriptions of the differences).

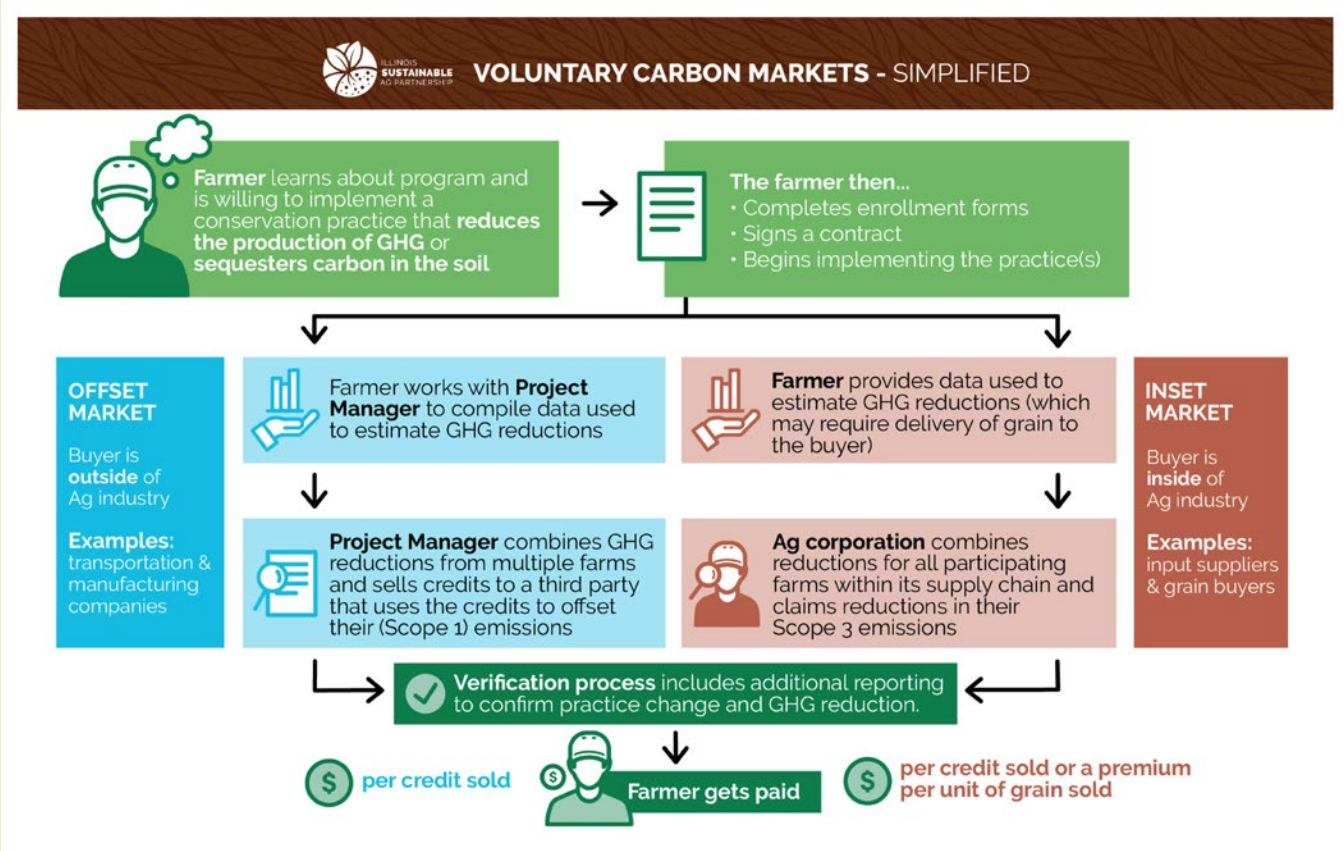
1. Other kinds of environmental markets include water quality trading markets (wherein buyers, such as wastewater treatment plants, pay sellers, such as farmers, to adopt practices that reduce nitrogen, phosphorus, and sediment runoff from farm fields) and wetlands mitigation banking programs (wherein corporations pay farmers to install wetlands on their properties to make up for the wetlands the corporations build on at their construction sites).

The unit of transaction in an environmental market is often a **credit,**[2] and though some ag carbon markets define credits differently, most equate one credit to one tonne (a metric ton) of carbon dioxide equivalent (t CO_2e) emissions reductions. Note a tonne weighs 2,204.6 pounds, while a US short ton weighs 2,000 pounds. (See **Supplement 3** for more on why "t CO_2e" is used as a unit of measurement.)

Currently, there are two types of ag carbon markets: **offsets** and **insets** (see Figure 1 from the Illinois Sustainable Agriculture Partnership (ISAP) for a simple schematic). These two markets are driven by:

- The source of GHG emissions corporations are trying to reduce.
- The type of corporation buying the credits (i.e., corporations that do not have agricultural products within their supply chain participate in ag offset markets, while corporations that do have ag products within their supply chain can participate in ag offset and ag inset markets).

Figure 1. A Simple Schematic of Voluntary Carbon Markets



Source: **An Overview of Voluntary Carbon Markets for Illinois Farmers** (ISAP, 2023).
Note: The above schematic is a simplified overview of carbon markets created to illustrate the different pathways a farmer could take based on carbon market type. For more detailed schematics for nine ag carbon markets, see "**How Do Data and Payments Flow Through Ag Carbon Programs**?" (Plastina, 2022)

2. Note that insetting programs that are aligned with SustainCert, the internationally recognized climate-impact verifier organization, are using the term "impact units" instead of credit to distinguish insetting from offsetting programs.

Red clover cover emerging in wheat residue. MARGARET BURLINGHAM/ADOBE STOCK

Additional stakeholders in ag carbon markets beyond what's depicted in Figure 1 can include:

- **Project aggregators** who advertise their ag carbon market program offerings to farmers, encourage participation and contract discussions, and then collect and manage farmer data and combine the outcomes from many farms,
- **Technical assistance providers** who help farmers adopt the climate-smart practices,
- **Third-party verifiers** who observe whether a practice is in place and working may conduct soil testing, and others who may check the computer-modeled estimates of credits, etc.

GHG emissions inventories are characterized into three source groups or "scopes:"

Scope 1 is direct emissions released from the **facilities** and **vehicles** a corporation owns or controls.

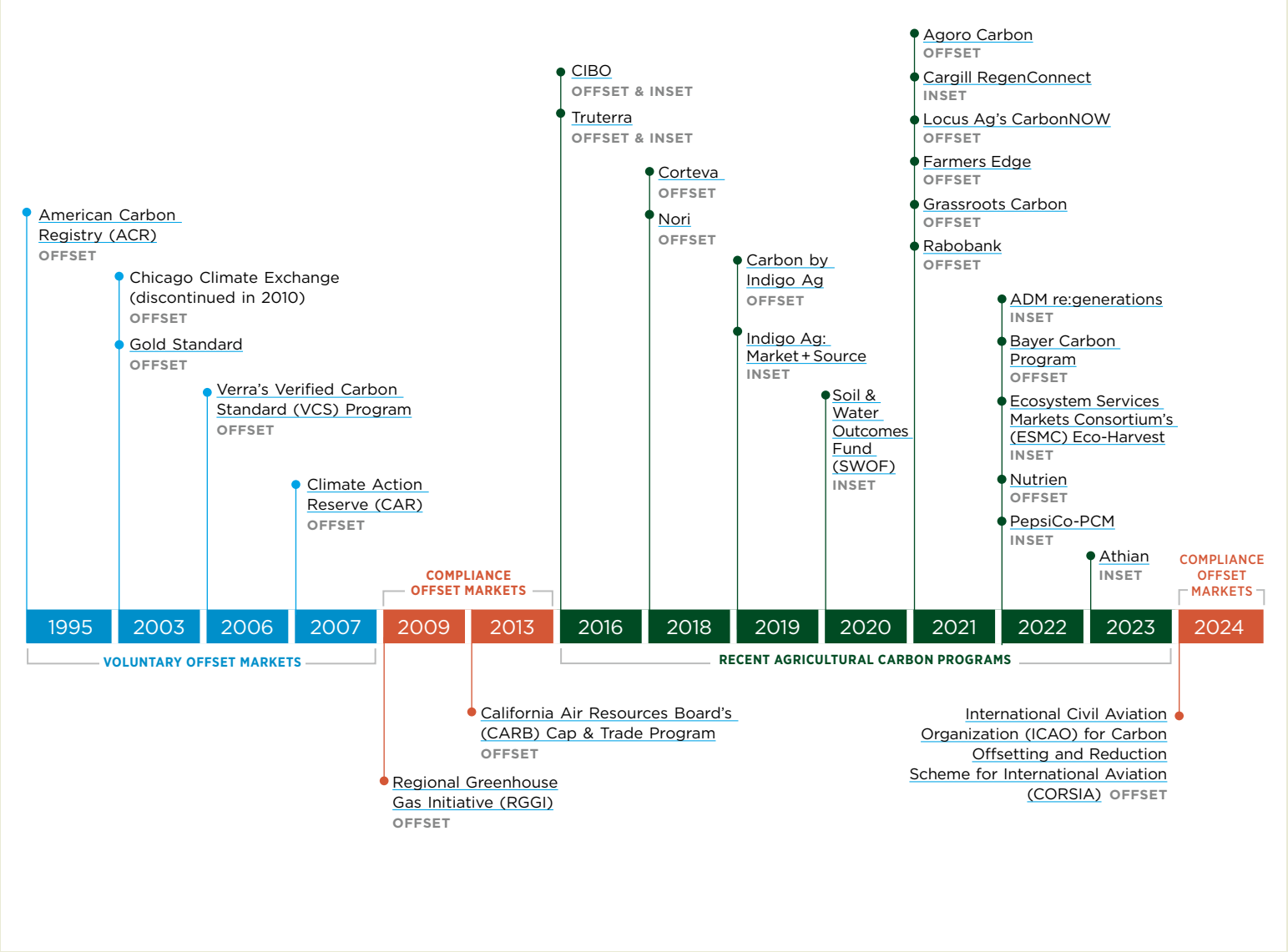
Scope 2 is indirect emissions from generation **of electricity, steam, heating, and cooling** purchased by a corporation.

Scope 3 includes all other indirect emissions that occur within a corporation's supply chain – and can be upstream from the corporation (e.g., emissions associated with **production of purchased goods and services**) — or downstream from them (e.g., emissions associated with **processing/manufacturing of products** sold by the reporting company into a finished product).

2 Just how many ag carbon markets are there, and how do they differ?

Did you know ag carbon markets have existed in the U.S. for nearly **30 years?** Although they are rapidly changing and being created and discontinued frequently, we've done our best to chronicle 27 in Figure 2. There are many different generations of carbon markets. We're calling the newest generation of offerings (since 2016) **"agricultural carbon programs"** because of how varied they are: most sell inset credits, others offer offset credits, and a few sell both; some pay by the acre while others pay by the tonne; and some are the sole buyer while others represent multiple buyers.

Figure 2. Timeline of launch years for carbon offset markets & recent agricultural carbon programs



Note: AFT created this infographic using the information provided in Box 1 from our **Agricultural Carbon Markets: From Chaos to Systems Change** paper (Parkhurst et al., 2023) and added three more programs featured in the United Soybean Board's online directory of **Carbon Market Programs** (2022) and a new livestock-focused ag carbon market.

Though ag carbon markets have existed for nearly 30 years, farmer participation has been low (Wozniacka, 2020). From 1996 to 2022, of the 1.7 billion credits generated in carbon markets through the four largest voluntary offset organizations[3] only 1% came from agricultural projects (So, Haya, & Elias, 2023).

Winter field pea sprout emerging from wheat residue in a no-till field in Wilbur, Washington.
USDA-SARE/EDWIN REMSBERG

Here are some highlights of what we're calling three generations of carbon markets and programs:

- Since **1995**, the **three voluntary offset markets** in the US (**American Carbon Registry or ACR**, **Verra's Verified Carbon Standard or VCS**, and the **Climate Action Reserve or CAR**)—which are also called **registries**—have all had limited success generating credits from the agricultural sector through their agricultural **protocols**. Most success has come from (a) manure management projects that reduce methane through manure storage and anaerobic digesters and (b) from rice projects that minimize nitrous oxide with precision fertilizer technologies. In 2010, the Chicago Climate Exchange (another voluntary offset market) *failed* after seven years, when low demand for offsets caused the price to drop and the market to collapse (Wozniacka, 2020). Many farmers remember this market failure and are wary of the new carbon market opportunities. Demand for offsets today is much higher than in 2010, evidenced by the fact that one-fifth of the world's largest publicly traded companies have set net-zero targets (Graham, 2021) and there is unprecedented government program and policy focus on climate-smart agriculture too.
- Since **2009**, there have been three **compliance offset markets** (**Regional Greenhouse Gas Initiative or RGGI**, **Cap-and-Trade Program by the California Air Resources Board or CARB**, and the **International Civil Aviation Organization (ICAO) Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA)**). These three offset markets are interchangeably called "regulatory markets" because they comply with a regional, state, or international regulation that has capped the GHG emissions of specific businesses or economic sectors. Only one compliance market, the California Cap-and-Trade program, has generated offsets from agriculture via manure lagoon methane trapping. Starting in 2026, California allows the volume of ag offset credits to increase significantly, though pressure is on to limit the credits allowed from manure digesters. The airline industry will likely become a buyer of agricultural credits in 2024 as the ICAO CORSIA takes off (pun intended!) (Parkhurst et al., 2023).
- The **newest generation of ag carbon programs** that are getting all the attention has only been around since **2016**. Eleven of 19 were launched as recently as 2021! Some offer offset credits, some offer a variety of inset programs, and others do both. Two things that these otherwise very different programs have in common are (1) they are mostly focusing on just two climate-smart practices (reduced tillage and cover crops) and (2) for now, most are only focusing on commodity row crop production systems (e.g., corn, soybeans, wheat) though there is one grasslands program.

It's important to recognize that the first two generations of ag carbon markets (voluntary and compliance offset markets) had well-established rules (often called **protocols**) that set high

3. ACR, VCS, CAR, and Gold Standard. Note that Gold Standard is an international voluntary offset organization that has generated more than 238 $MtCO_2e$ worth of GHG credits from 2,900 projects in over 100 countries (Gold Standard, n.d.). None of the 13,150 t CO2e of credits issued in the US were for agricultural practices (So, Haya, & Elias, 2023).

environmental standards and rigorous verification requirements. The newest generation of ag carbon inset markets (and several new offset markets) are still in their infancy. Their rules and standards have not yet been settled, and they use similar terms differently. There is considerable debate about how rigorous the standards for the inset programs should be (see **Section 3** for more on this).

With the understanding that not all offset markets nor all inset markets are identical, we attempted to compare 10 features of a "typical" offset market to a "typical" inset market (see Table 2) that may be of interest to a farmer.

Table 2. From a farmer's perspective, what's the difference between offset and inset programs?

	Typical Agricultural Offset Program	Typical Agricultural Inset Program
DEFINITION	A reduction of GHG emissions from an activity in one location that is sold as a credit to negate already-released GHG emissions occurring elsewhere. **The reduction activity is not within the buyer's supply chain.**	A reduction of GHG emissions from **an activity occurring within a corporation's supply chain** (for example, the production of grain) and used to reduce the corporation's indirect (Scope 3) GHG emissions.
BUYERS	Most often do not have agriculture in their supply chain—examples include transportation and manufacturing corporations—that use offset credits to negate emissions from their facilities (Scope 1 emissions).	Agricultural corporations—examples include input suppliers, grain buyers; food, beverage, and apparel corporations—that make inset payments to producers within their supply chain to reduce emissions (Scope 3 emissions).
VERIFICATION	Verified using a third-party company, with the number of credits determined by a variety of computer models that require extensive data input about the farm operation.	Varies but is typically verified through farmer self-reporting of crop and field data to determine if a practice was adopted.
	Additional verification may include soil sampling, remote sensing, photo and receipt documentation, and site visits.	
PAYMENT (SEE SECTION 9)	Based on the number of credits generated. The current range is $15 to $30/credit.	Often based on acres of practice adopted and varies widely from $1 to $34/acre.
CONTRACT LENGTH	Longer length. Common to see 10-year terms.	Shorter length. Many programs offer 1-year contracts that can be renewed.
POST CONTRACT OBLIGATION	Often, multiple-year obligation to retain practice and/or preserve carbon.	None.
LOOKBACK PERIOD*	Lookback period varies by program, with information typically used to prevent payment for practices previously adopted & for cropland that was converted from natural land within 10 to 20 years.	Lookback period varies by program, with some programs using the information to allow fields with previous practice adoption to participate and others using the information to exclude those fields.
ADDITIONALITY (SEE SECTION 3)	Practices must meet additionality requirements and be new within the contract term or newly adopted within the designated lookback period.	Some require additionality, and others don't. Payments may vary based on practice history (e.g., higher payment for new practices and lower payment for previously adopted practices).
GEOGRAPHY	Broad in geographic scope; limitations may be determined by the Project Manager.	Targeted geographic scope; typically limited to the supply shed of the corporation buying the credits.
ACREAGE REQUIREMENTS	Often require minimum acreage to enroll.	Typically, no minimum acreage requirement.

* Lookback period typically applies to the field(s) being enrolled.

3 What the heck is additionality, why is it so important, and how does it affect me?

Additionality is a complicated issue in ag carbon markets (and all environmental markets). It's hard to define, and reasonable people continue to disagree about it. We will define additionality from the perspective of the carbon credit buyers, the planet, and credit sellers.

From the **buyers' perspectives**, the price they pay per carbon credit represents a reduction in one tonne of CO_2e emissions. This payment serves as an incentive for farmers to accomplish this reduction through their adoption of new climate-smart practices. **Additionality is a criterion for carbon programs to ensure that a buyer's payment results in *new* GHG reductions or carbon sequestration beyond what would have occurred without their payment.**[4] Simply put, it is a way of determining that the buyer's carbon payment created a climate mitigation benefit.[5]

---

4. This definition is adapted from the Greenhouse Gas Protocol, the international recognized standard-setting body for GHG measurement and management which is led by World Resources Institute (WRI) and World Business Council for Sustainability (WBCSD). In 2005, they state: "Additionality is a criterion that says GHG reductions should only be recognized for project activities that would not have "happened anyway." (WBCSD & WRI, 2005)In 2022, they define additionality as, "The intervention (e.g., project or activity) reduces emissions or increases removals relative to the amount of emissions or removals that would have occurred without the incentives provided by the credit." (WRI & WBCSD, 2022)

5. If you're familiar with USDA's Environmental Quality Incentives Program (EQIP), you already know how additionality works: the program only pays for the adoption of new practices (USDA NRCS, 2017).

Jim Hershey of Hershey Farms in Elizabethtown PA with soybean plants emerging through corn residue.
USDA-SARE/EDWIN REMSBERG

A 12-seed cover crop mix grows in an Indiana field prior to corn being planted.
USDA-NRCS/BRANDON O'CONNOR

If corporations pay for an activity that would have happened regardless of their payment (i.e., not additional), then they cannot claim that they are taking action to mitigate their emissions. Additionality is necessary for voluntary or compliance carbon offsets to actually mitigate climate change.

From the **planet's perspective**, every new and additional climate-smart practice adopted and maintained by farmers can help reduce GHG emissions and sequester carbon in the soil to mitigate climate change. Maintaining already adopted practices is also very important so as not to lose those benefits, but new and additional climate-smart practices are needed to reduce climate change.

From the **seller's perspective**, additionality means implementing a climate-smart practice that is new for your farm (or new to some fields in your operation) to achieve additional reductions in GHG emissions and/or soil carbon sequestration beyond business as usual.

Here's the great news about additionality for most farmers: If you're one of the more than 95% of row crop commodity farmers who have not yet adopted cover crops (Wallender et al., 2021) or one of the two-thirds who haven't yet adopted reduced tillage practices (Pannell & Claassen, 2020), the emerging ag carbon markets want you! Why? Because if they were to pay you to adopt cover crops or no-till for the first time ever in your operation, the reduced GHGs and/or increased soil carbon sequestration resulting from those new practices are additional!

If you are a current user of cover crops or no-till, you are what is referred to as an "early adopter"—thank you for your efforts! Some of you started using no-till in the 1980s and some adopted cover crops within the last 10 years. You and society have been benefiting from these farm-viability and resilience-improving, food security-promoting, planet- and water-protecting practices. You have likely maintained these practices because you observed that they saved you time and fuel by making fewer field passes, helped reduce soil erosion and nutrient runoff, saved you money by reducing the need for fertilizers and herbicides, and increased or stabilized crop yields, especially in times of drought or excess rain, making you more resilient. (See **Supplement 1** for more details on the co-benefits of climate-smart practices.)

So, the ag carbon markets that account for additionality and only pay for new no-till and cover crops acres are not available for early adopters. Once the markets start paying for more mitigative practices, there will be more options to participate and continue making a difference! There are, after all, 53 climate-smart practices so far (see **Box 1**). Note that some ag-related corporate sustainability programs pay farmers that have already implemented practices (see **Section 9**). The rules about additionality for Scope 3 carbon markets are still in flux and the **Greenhouse Gas Protocol** will be releasing their latest guidance in 2024.

4 How is the government involved in agricultural carbon markets?

You might be wondering how the government is involved with all these different market types, protocols, rules, registries, and stakeholders. Here, we answer that question about the federal government and a few state programs.

In short, **the federal government does not have a *direct* role in carbon markets. There is no federal carbon market, and the federal government does not directly regulate existing markets** (Carpenter & Kuehn, 2023). There is also no federal requirement for corporations to reduce or offset their greenhouse gas emissions, like a cap-and-trade system, which would help spur demand for carbon credits, raise prices, and potentially increase payments to farmers.

However, this does not mean the federal government is not involved or will never be. In fact, the U.S. Securities and Exchange Commission was expected to release a final rule in the fall of 2023 (USSEC, 2022) that requires publicly traded corporations to describe how they are threatened by climate change and to take steps to reduce their risks. This rule may require corporations to report their Scope 1, 2, and 3 emissions (Vanderford, 2023). This stops short of requiring these corporations to reduce their carbon emissions—which would likely drive significant interest in participation in carbon markets—but it could lay the foundation for such future actions.

USDA headquarters in Washington, DC.
USDA

USDA almost created an ag carbon market back in 2021, when the agency proposed to create a "Carbon Bank." The idea was that federal funds could be used to purchase carbon credits from agricultural producers. It never came to fruition for political and financial reasons, but revealed interest in federal involvement in ag carbon markets.

Instead of the Carbon Bank, in 2022, USDA invested more than $3.1 billion into a newly created **Partnerships for Climate Smart Commodities** program. The program's goal is to "support the production and marketing of climate-smart commodities," defined as commodities that reduce emissions or sequester carbon. The program operates through partners (like farm trade associations, nonprofits, corporations, and universities) and has selected 141 pilot projects. Although the program is helping agriculture to be part of the climate solution, it is not a carbon market, nor is it purchasing credits. The climate and economic impacts of this massive investment are yet to be determined, and we do not yet know what effect the infusion of federal funds may have on carbon markets or carbon prices, whether positive or negative. Beyond getting more climate-smart practices on the ground, the program will help advance methods for monitoring and modeling the farm-level impacts of climate-smart practices.

Congress got involved in 2022 by passing the Growing Climate Solutions Act (GCSA) as part of the Consolidated Appropriations Act of 2023.[6] GCSA aimed to **increase the quality of agricultural**

6. Note that GCSA got renamed the "Greenhouse Gas Technical Assistance Provider and Third-Party Verifier Program" when it got rolled into the larger appropriations bill. Yes, it's a mouthful. Whoever comes up with the clever bill title acronyms was probably on vacation that day.

carbon credits to make them more attractive to buyers.[7] GCSA does not create a federal market, set a price on carbon, nor direct corporations to purchase carbon credits. Instead, the legislation directs USDA to:

1. Publish a list of widely accepted protocols for credit verification, measurement, and reporting and a list of methods to account for challenging issues such as additionality, permanence, and double counting of credits.[8]
2. Create an advisory council to regularly update the list of accepted protocols and answer questions such as how to **lower farmer participation barriers.**
3. Create a registry and public listing of carbon credit verifiers and technical assistance providers, specifying which regions these entities offer services and in what protocols they are proficient. **This registry would give farmers greater access to the support they need to engage with carbon markets.**

At the state level, California and a consortium of northeastern states play a role in compliance with carbon offset markets. California is the only state with a cap-and-trade system for greenhouse gas emissions, creating demand for offsets. Eligible agriculture-related offsets available for use by any California company to achieve compliance include forestry, rice cultivation, and manure management projects. Over 9.6 million tonnes of CO_2e have come from agriculture since 2012. Also, 11 northeastern states participate in the Regional Greenhouse Gas Initiative (RGGI), a cap-and-trade program specific to CO_2 emissions from power plants. RGGI does have agricultural protocols, but no ag-related credits have been generated, and only a small number of offsets in general have been sold through RGGI due to the low price ($10 to $12.73 per t CO_2e between 2021 and 2023) (Parkhurst et al., 2023).

7. GCSA directed USDA to send regular reports to Congress on the current state of environmental markets. The **October 2023 report** is available (USDA, 2023b).

8. Note that USDA will not be creating new protocols, or enforcing the use of the protocols that make it on the list.

The anaerobic digester at Pennwood Dairy Farms in Berlin, Pennsylvania helps to manage manure and produces energy for the dairy and the electric grid. USDA/BOB NICHOLS

Justin Buss plants soybeans into corn residue and wild mustard using tractor with a no-till planter in Vincennes, Indiana.

USDA/INDIANA NRCS/BRANDON O'CONNOR

Top-Of-Mind Questions

Now that you're more familiar with why carbon markets are the way they are grab a second cup of coffee and dig into the questions that are likely top-of-mind regarding your potential participation.

5 Am I eligible to participate?

Each program uses different criteria to determine if a farm operation and its field(s) are eligible to participate. Here are some of the common criteria and examples of a few program requirements:

- *Land ownership.* Most markets **do not specifically exclude leased or rented land** but may require that the landowner co-sign the carbon contract with the tenant or at least give written permission for the farmer renting their land to participate in the carbon contract. Loss of a land lease or ownership may result in default on the contract (Carpenter & Kuehn, 2023). Nearly 40% of farmland acres and over 25% of pastureland in the US are rented (Bigelow et al., 2016). Thus, information sharing between landowner and tenant will be critical when developing ag carbon contracts.
- *Acreage limits.* Only a few carbon programs have **minimum acreages for enrollment.** Those range from 10 acres per field (Bayer) to 150 acres (IndigoAg) to 500 acres (e.g., Agoro Carbon and CarbonNOW).
- *Location.* Some programs are **available nationally** (e.g., Nori, Nutrien, Truterra), while **some are limited to a few states or regions** (e.g., ADM re:generations, Soil and Water Outcomes Fund, PepsiCo-PCM).

- *Commodities.* Most programs are focused on **specific commodities** (e.g., ADM re:generations, Bayer Carbon Program). The first generation of voluntary and compliance ag offset markets was focused primarily on livestock and rice. In contrast, the recently emerging ag carbon programs are focused on corn, soybeans, and wheat. One program is focused on grasslands (Grassroots Carbon) and another programs is focused on livestock (Athian). As markets evolve, diverse production systems and specialty crops may be included.
- *Climate-smart practices.* Most programs are **structured around the implementation** of new climate-smart practices and carbon credit generation (see Section 3 above for more on additionality requirements). The most common practices are cover crops, reduced tillage and no-till, and nitrogen management. See Box 1 for a list of climate-smart practices.
- *Rules on participation in other government or private sector programs.* Some emerging carbon programs do not allow farmers receiving federal USDA conservation program funds to participate in their programs (e.g., Soil and Water Outcomes Fund). Other programs (e.g., ESMC & Truterra) encourage farmers to seek federal or state conservation financial assistance to supplement the private sector payments. None of the private sector programs allow farmers to join another private-sector program. See Section 9 for more on stacking payments.

In **Section 10**, we share additional resources that compare eligibility criteria for each ag carbon market.

Jim Ifft (holding shovel), Livingston County IL farmer, examines a field planted to a cover crop of (winter killed) oats. JEAN BROKISH

Marissa Vander Kooy at Harmony Dairy Farm in Mount Vernon, Washington. SHAWN LINEHAN

6 What are the current ag carbon markets paying for (practices or outcomes)?

The ag carbon markets may pay for one or multiple environmental outcomes, including carbon sequestration, the reduction of GHG emissions including carbon dioxide, methane, and nitrous oxide, and/or the reduction of a water pollutant such as nitrate. Currently, most markets are focused on carbon and GHGs, but SWOF pays for carbon and water quality benefits, and ESMC has plans to pay for water quality and water quantity outcomes.

Recall that markets are a tool to help corporations meet their climate change mitigation goals. Therefore, most payments are based on computer-estimated environmental outcomes (tonnes of GHG removed or nutrient reductions, in the case of water quality markets). When a payment is based on the per-acre implementation of a specific practice, the payment is based on the computer-modeled environmental outcomes that are expected to be achieved through the adoption of that practice on those acres.

Which practices will help achieve the required environmental outcomes?

Nearly all the carbon programs available today promote reduced tillage (including no-till and strip-till) and cover crops as tools to reduce GHG emissions and/or sequester carbon in soil. Nitrogen management, particularly improved nitrogen efficiency, is another commonly included practice.

Less common practices include perennial or diversified crop rotations (e.g., Nori, Carbon by Indigo), the use of biological or microbial additives to soil or livestock feed (e.g., CarbonNow, Athian), and increased biodiversity (e.g., Corteva).

Most markets *have a list of preferred practices (that their computer models can analyze for the GHG benefits) but* do not dictate which practice(s) a farmer needs to implement to achieve the desired outcomes. Knowing which practice(s) you are willing and able to commit to for contracting purposes is helpful. It is also important to ask your representative for an estimate of credits you can reasonably generate based on the model they are using. Many buyers include language in their contracts stating that the farmer must accept their modeled estimates (Carpenter & Kuehn, 2023).

Which production systems are the markets targeting?

Agricultural carbon markets are currently targeting large acreages of commodity row crops, particularly farms producing corn, soybeans, and wheat. The focus on large row crop acreage rather than grazing lands or specialty crops is driven largely by the larger number of practices with quantifiable climate mitigative benefits and a greater understanding of soil carbon dynamics in row crop systems, or rather, a more significant gap in understanding soil carbon dynamics in grazing and specialty crop systems.

Many of the **Partnerships for Climate Smart Commodities Projects** (see **Section 4**) focus on grazing and specialty crop production (as well as row crops), and USDA is making a $300 million investment in improving GHG measuring, monitoring, reporting, and verification (you may have heard of "MMRV") in agriculture and forestry (USDA NRCS, n.d.). Given these investments, new methods and data may help broaden the production systems included in agricultural carbon program protocols in the coming years.

Mt Toby Farm in Sunderland MA worked with NRCS to create a conservation plan that includes pasture and hay planting and reseeding their cover crop during the cool season. USDA/USDA.GOV

7 They want to look at my *what?!* What information and access do I have to provide?

Typically, farmers entering into a carbon contract must provide three to five years of historic field management data for each field they enroll in. Typical data requirements include:

- field boundaries—if you do not have these data, the carbon market program likely can help you get these using satellite imagery,
- planting information,
- chemical and fertilizer applications and organic amendments,
- harvest information,
- cover crops, and
- tillage practices (ISAP, 2023).

These records determine eligibility, including additionality (**Section 3**). Converting handwritten notes to electronic spreadsheets or documents will help streamline enrollment (ISA, 2022). Once enrolled, these data are used to document farming practices, calculate carbon credits generated, and improve the models used for carbon estimates (ISA, 2022).

Carbon contracts state the farmer must allow the creditor/buyer and any third-party service providers access to the data and land. In-person access can include verifying that the practices that have been reported are present, taking soil samples to monitor changes in soil carbon over time, and potentially inspecting records (Carpenter & Kuehn, 2023).

Here are a few data-related considerations to ask about when speaking with a carbon market representative:

- Detailed data are needed to verify carbon credits. Some contracts state that data produced through the contract are owned by the buyer, who could sell the data to a third party (Carpenter & Kuehn, 2023).
- Agribusinesses could also use access to digital agricultural data to expand their competitive advantage or improve market insights for major commodity traders (Kelloway, 2021).
- Some carbon programs require enrollees to subscribe (usually for a fee) and upload digital information to their private software platforms for the duration of the contract, which can be burdensome for farmers when data files are not interoperable among platforms.
- Some contracts require the farmer to buy and use the buyer's products or advice, but the buyer does not guarantee specific outcomes (Carpenter & Kuehn, 2023).

Government regulations around farmer data privacy and portability rights that make it easy for farmers to switch digital ag platforms could improve competition among ag retailers and their prices for farmers.

No-till corn growing in rye residue at sunset. MARGARET BURLINGHAM/ADOBE STOCK

8 How long are the contracts & who's liable if something goes wrong?

Carbon credit contracts range from:

- a single year (e.g., ADM re:generations, Cargill RegenConnect, Indigo Ag Market+ Source, and Nutrien)
- to three to five years (e.g., Corteva, ESMC Eco-Harvest, Gradable, and Rabobank)
- to 10 years (e.g., Bayer Carbon Program, FarmersEdge, Grassroots Carbon, and Nori).

Some, such as contracts through ESMC, are renewable for 20 years (ISAP, 2023) (USB, n.d.).

During the contract period, the farmer is responsible for implementing practices that remove carbon from the atmosphere, store the carbon in the soil, and *continue to protect* the carbon in their soil. For carbon credits to benefit the climate, they should represent long-term reductions, regardless of contract length, in GHG emissions or carbon removals from the atmosphere. The length of time a carbon removal remains locked away from the atmosphere is called **permanence** (Oldfield et al., 2021). This is especially important when carbon credits are bought as offsets for continued greenhouse gas emissions, i.e., if the carbon represented by the credit easily returns to the atmosphere, it's not actually offsetting other emissions.

The carbon is at risk of returning to the atmosphere (called a **reversal** of the carbon credit, which worsens climate change) in two ways:

Crimson clover and wheat growing in Ford County Illinois. WILL GLAZIK

1. An **unintentional reversal** is an "act of God," also known as *force majeure,* such as a wildfire, when carbon is unintentionally lost to the atmosphere. Carbon credit contracts usually make allowances for these unpreventable events (Carpenter & Kuehn, 2023). With the increasing frequency and intensity of rain events and droughts, some farmers think they need to till a field that is otherwise a no-till system, or their cover crop might not germinate. Be sure to check with a program representative whether management actions responding to extreme weather would be considered an unintentional reversal in a contract.
2. An **intentional reversal** is when the farmer changes course and reverts from an agreed upon climate-smart practice to one that removes carbon from the soil and/or increases other GHG emissions. These actions can put the farmer in default of the contract; they may forfeit future payments, and/or require payments returned to the buyer (Carpenter & Kuehn, 2023). For example, periodically tilling a "no-till" field will cause rapid decomposition of organic matter and CO_2 emissions from the soil—a reversal. If this is something you practice, be sure to discuss this with the program representative before enrolling to see if this is considered an intentional reversal in a contract. The contract holder may also face penalties if they sell or rent out the land within the contract period and the new farmer does not follow the agreed-upon climate-smart practices (Sellars et al., 2021).

A carbon market developer weighs the risk of reversal when determining the permanence of a carbon credit (Oldfield et al., 2021). Developers typically retain a fraction of their carbon credits from the market to use as a buffer against reversals that occur during or after the contract (Oldfield et al., 2021). Greater permanence could mean the carbon credit has greater value. After the contract period, the offset market project developer (rather than the farmer) is responsible for the registry for the permanence of the carbon credit.

9 Money matters: How can I make a market work for me?

How much are corporations paying for carbon?

Corporations pay for carbon and other GHG reductions based on one of two different units of measurement: carbon credits or acres of practice adoption. Currently, the average US price per agricultural carbon credit is around $20. In contrast, the price per acre of climate-smart practice is more variable, ranging from $1 to $34 per acre (see Table 3 for examples). To understand what a price per credit means on a per-acre basis, see Box 2.

Table 3. Ag carbon market prices can vary widely per credit or per acre

Unit	Sample Agricultural Carbon Market Program	Price
PRICES PER TON	Ecosystem Services Market Consortium (ESMC)	$15
	Agoro	$16.50 to $20
	Corteva	At least $20
	Carbon by Indigo	$30
PRICES PER ACRE	ADM	$1 to $25
	Bayer	$5 to $6
	CarbonNOW	$12
	Soil and Water Outcomes Fund (SWOF)	$34

Note: Prices in this table are from the June publication of **An Overview of Voluntary Carbon Markets for Illinois Farmers** (ISAP, 2023) , which provides prices for 15 ag carbon markets. Consult your market representative for the latest prices.

Box 2. How does a price per credit translate into a price per acre?

Since farmers run their business on a per-acre basis, to figure out what the credit prices mean per acre, let's walk through an example using information from Illinois. According to state average emissions reduction data for Illinois, a cover crop sequesters approximately 0.49 tonnes CO_2e per acre, and no-till sequesters approximately 0.73 tonnes of CO_2e per acre (Bruner et al., 2021) Thus, using the ag carbon program average price of $20 per credit (recall one credit = 1 tonne CO_2e), farmers in Illinois, on average can expect to generate roughly one credit for every two acres of cover crops—earning around $10 per acre. For no-till, they'd generate about one credit for every 1.3 acres of no-till—earning around $15 per acre. Please note that different ag carbon programs will use different data and calculations and that GHG emissions reduction potentials depend on practice specifications, location, climate, and soil type, among other factors, so these figures are very approximate.

You're probably wondering why the prices in **Table 3** are so different if they're all purchasing the same thing. Carbon prices vary based on many factors, but generally, the higher the price, the higher the credit "quality." A higher quality credit will be held to a higher standard of permanence (see Section 8), additionality (see **Section 3**), verification, etc. For instance, SWOF pays $34 per acre because it accounts for water outcomes and carbon offsets and conducts annual field visits to verify practices. On the other hand, Bayer pays $5 to $6 per acre and relies on farmer self-reported data.

In addition, note that **not all corporations**:

1. *Cover costs such as verification.* For instance, Nori expects farmers to cover the cost of verification themselves (Farm Foundation, 2022). There may also be other transaction fees subtracted from the credit's full price (Sellars et al., 2021).
2. *Guarantee payments.* Some contracts say that the buyer can cancel the contract or not pay if they can't sell the credit (Carpenter & Kuehn, 2023).
3. *Pay the same rate per tonne or acre over time.* While some buyers pay more over time (e.g., Agoro), some pay less over time (e.g., PepsiCo-PCM) (ISAP, 2023).

Rolling vetch at Brandon Farm in Essex County Virginia. BOB WARING

In short, make sure to triple-check the details of your contract!

Okay, let's say that I was only in this for the money. How would I maximize returns?

Let's start with the hard truth: The carbon market isn't going to make you rich—in fact, given prices these days and the fees programs take out to cover their costs (e.g., verification, risk insurance, etc.), the payment you receive from selling a credit may not even cover the cost of practice implementation.

Here are three ways to make the most out of the existing crop of carbon markets:

#1: Gain *some* financial support for adopting soil health practices. Selling carbon credits may be an option for farmers who want *some* financial assistance when adopting reduced tillage, cover crops, or nutrient management. Investment in these practices will build soil health, reduce the need for inputs, and, over time, can increase or stabilize yields in the face of increasingly erratic weather patterns. **AFT's Soil Health Economic Case Studies** and the **Factsheets by Soil Health Institute and the National Association of Conservation Districts** feature producers whose economic benefits associated with reduced tillage, cover crops, and nutrient management are greater than the cost of adoption.

#2: Get paid for things you've already done. Some corporations pay for practices that you've adopted in the recent past. For instance, Bayer pays $5 to $6 per acre of already adopted cover crops or conservation tillage, Truterra pays $15 to $30 per tonne of CO_2e for practices adopted in 2019–2022, IndigoAg: Market+c Source pays a "premium price per unit of commodity (e.g., bushel) depending on the specific buyer for producing crops with practices that reduce on-farm emissions and conserve natural resources" (ISAP, 2023).

#3: Stack carbon markets and government programs. Most emerging carbon programs allow farmers to simultaneously enroll in a federal or state conservation financial assistance program and

sell carbon credits, and USDA has no rule against enrolling in both[9] (ISAP, 2023). This means that you can get paid by the market AND the government simultaneously, for the same practice, on the same land.

Here's what this could look like: In Illinois, using the \$20/t CO_2e average agricultural carbon market price and standard GHG reduction coefficients for practices in Illinois, the market payment could be \$9.80/acre for cover crops and \$14.60/acre for no-till.[10] If you were able to get into the following federal programs, you could stack one of them (not both) with the above carbon payments:

- USDA's Environmental Quality Incentives Program (EQIP) pays farmers for the ***new adoption of conservation practices***. In Illinois, EQIP pays about \$62/acre for cover crops and about \$17/acre for no-till for a short-term contract (usually 1-3 years).[11]
  - Combined with the carbon payments, this is about \$72/acre for cover crops and about \$31/acre for no-till, totaling about \$102/acre.
- USDA's Conservation Stewardship Program (CSP), which pays farmers for ***maintaining suites of conservation practices long-term.*** In Illinois, CSP pays about \$8/acre for cover crops and about \$2/acre for no-till for five years (although the contracts are renewable).[12]
  - Combined with the carbon payments, this is about \$18/acre for cover crops and about \$17/acre for no-till, totaling about \$35/acre.

Though it is debatable if stacking these payments meets the *additionality* principle (see **Section 3**), the rationale at the moment that allows it is that each payment source is paying for different things—the state and federal programs pay for broader social benefits such as improved soil health, reduced soil erosion, and improved water quality, while the markets are paying for sequestered carbon and reduced GHG emissions. However, all ag carbon programs agree that you *cannot sell the same credit to multiple private markets.*

Some private ag carbon programs do not allow you to stack with public programs. SWOF, for example, already incorporates USDA funding into their payment structure, so it cannot be stacked with payments from government programs. Be sure to consult with your market representative to identify any stacking restrictions.

---

9. Excerpt from "Administrative Requirements for Conservation Programs, 16 U.S. Code § 3844: "(o) Environmental services market - The Secretary may not prohibit, through a contract, easement, or agreement under this chapter, a participant in a conservation program administered by the Secretary under this chapter from participating in, and receiving compensation from, an environmental services market if 1 of the purposes of the market is the facilitation of additional conservation benefits that are consistent with the purposes of the conservation program administered by the Secretary." (U.S. Code, 2018)

10. The carbon market prices in this scenario are based on an average market price of \$20/credit and assumes that on average, in Illinois, cover crops sequester 0.49 tonnes CO_2e/acre, and no-till sequesters 0.73 tonnes CO2e/acre (Bruner et al., 2021). Note that additional fees could be included making the payment a farmer receives less than \$20/credit.

11. The EQIP payments are from USDA NRCS, FY23 **EQIP Payment Schedule for Illinois**, (single species basic cover crop; no-till/ strip-till).

12. The CSP payments are from USDA NRCS, FY23 **CSP Payment Schedule for Illinois** (single species basic cover crop; no-till/ strip-till).

Will I make more money if I participate now, or should I wait?

Just like you, we can't predict the future. But here are some things you should consider:

REASONS TO PARTICIPATE NOW:

1. Some strict offset markets have a "common practice baseline" or an area-based cap on practice adoption (e.g., CAR's Soil Enrichment Protocol), meaning that if many of your neighbors have already adopted a practice like cover crops before you do, you may be ineligible for those programs.
2. In the future, other technologies could reduce the demand for agricultural credits. For instance, if carbon capture technologies become feasible, they may be more straightforward and attractive to buyers than credits from agriculture.
3. You will miss out on building the many co-benefits of climate-smart practices supporting soil and crop resilience, water quality, and biodiversity (see **Supplement 1**).

REASONS TO WAIT: OVER TIME…

1. More corporations may want to reduce their net emissions, which will increase demand for credits, potentially increasing the price they are willing to pay.
2. Researchers will develop more accurate and efficient ways to monitor and verify carbon sequestration and GHG reductions from farm practices, meaning that agricultural credits will become more reliable, increase credit quality and demand.
3. The federal government may get more involved, which could help to increase buyer confidence in agricultural credits in the future.

The rice crop at 3S Ranch, near El Campo, Texas. USDA/LANCE CHEUNG

10 How do I know which carbon market is right for me, and where can I get more information?

The market opportunity that is best for an individual farm operation depends on multiple factors, with payment rates, additionality rules, data requirements, and contract terms likely the top considerations for most farmers.

Farmers considering enrolling in a market should **review the website of the individual market program and speak with a representative to obtain the most up-to-date information**. Various resources have been created that list questions farmers should ask before signing a contract. One of the earliest and best resources tackling this topic is "**What Questions Should Farmers Ask about Selling Carbon Credits?**" from the University of Illinois (Sellars et al., 2021). This document lists common questions that every farmer in any state should ask as they consider which market is right for them based on their business goals.

If you want to scan and compare details across multiple programs, below is a description of such resources, with the most recently released reports listed first.

- (June 2023) The Illinois Sustainable Ag Partnership's "**An Overview of Carbon Market Opportunities for Illinois Farmers**" details 15 market opportunities available in the Midwest (ISAP, 2023). Tables list each market entity and website URL, whether the market offers an inset or an offset program, the year the market was established, the number of acres enrolled to date, and the states where the market is available. Company representatives vetted all information in the summary tables, and while this document was curated for Illinois farmers, information applies to any state where the market is operating.
- (March 2023) Iowa State University's "**How to Grow and Sell Carbon Credits in US Agriculture**" (Plastina & Wonpiyabovorn, 2023) summarizes the same 13 market entities covered above, with additional information listing eligible crops, payment currency, related carbon registry, and storage of carbon credits. The information was collected online and through interviews with representatives from some of the 13 carbon programs.
- (May 2022) The Farm Foundation's "**The U.S. Voluntary Agricultural Carbon Market: Where to From Here?**" defines key terms and provides an overview of nine of the markets also covered above (Farm Foundation, 2022). This report provides unique schematics with insight into how data, methods, carbon credits, and payments flow among farmers, project developers, verifiers, market programs, and buyers.
- (2022) The United Soybean Board published an online directory of **Carbon Market Programs** that provides information on 16 market entities (four of which are not covered in the above resources). The directory allows users to review information for individual markets or view a side-by-side comparison of all 16 markets per specific terms. For example, viewers can select "land tenure and control" to view a table summarizing ownership requirements for all 16 programs.

Farmers are also strongly encouraged to work with an attorney and to carefully read and understand all contract terms before signing. The Farmers Legal Action Group, Minnesota Farmers Union, and Minnesota Department of Agriculture published a 2023 primer on carbon market contracts titled "**Farmers' Guide to Carbon Market Contracts in Minnesota**" that includes excerpts from actual contracts and explains contract terms in plain language, a useful resource for Minnesotans and non-Minnesotans alike (Carpenter & Kuehn, 2023).

Conclusion

You made it through to the end—congratulations! We hope that you found this document helpful and that if you still have questions, you'll check out some of the resources listed above in Section 10 and below in the **References**.

As we said at the start, this information is evolving, as it's still early on in this recent generation of ag carbon markets and corporate sustainability programs. Some of you have already signed up, adopted new practices, and are part of the climate and soil health solution. The planet, your soil, and your local waterbodies all thank you!

Some of you might be holding off on joining until prices are higher, contract terms are more favorable, or other reasons. That's understandable. We're excited to see how the next generation of offset and inset markets unfolds. At AFT, we're working with ag carbon markets, federal and state conservation programs, and the agricultural conservation community to ensure farmer interests are reflected, environmental integrity upheld, and climate-smart agriculture is expanded.

With or without participation in private markets, we encourage you to consider the list of climate-smart practices that can help protect your productivity and make you more resilient to increasingly erratic weather patterns. We wish you success on your climate-smart journey.

Corn field, wildflowers, and tree on a hazy summer morning. MARGARET BURLINGHAM/ADOBE STOCK

Supplementary Materials

Supplement 1. Co-benefits of climate-smart practices

In addition to removing carbon dioxide from the atmosphere or reducing nitrous oxide or methane emissions, many climate-smart practices have many other economic and environmental co-benefits, such as:

Co-Benefits of Climate-Smart Practices

Sample Climate-Smart Practice	Economic & Quality of Life	Soil & Water Quality	Water Quantity	Biodiversity & Habitat
REDUCED TILLAGE PROTECTS SOIL CARBON	Saves time and fuel from fewer field passes; Less wear and tear on planting equipment	Reduces sheet, rill, and wind erosion; Maintains or increases soil health and organic matter content; improves soil function broadly, especially combined with other practices	Increases plant-available moisture; Increases infiltration, especially when combined with other practices, and thus resilience to drought and excess rain conditions	Surface residue provides habitat, nutrients, and energy for soil organisms; Moderates soil temperature and moisture during extreme conditions.
COVER CROPS INCREASE CARBON INPUTS FROM RESIDUES AND ROOT EXUDATES TO CONTRIBUTE TO SOIL CARBON STOCKS	Adds nitrogen and retains other nutrients, increases biodiversity, and reduces cost of agrichemical inputs. Also provides aesthetic value and cultural ecosystem services (i.e., it looks nicer than a bare field!)	Reduces compaction and erosion from wind and water; Improves water quality by reducing loss of nutrients to ground and surface water;	Increases infiltration; increases soil organic matter and aggregation, which can increase water holding capacity, drainage and infiltration, and thus resilience to drought and excess rain conditions	Provides food and escape cover for above ground wildlife; Reduces weed pressures and breaks pest cycles; Surface residue and decaying roots provide habitat, nutrients, and energy for soil organisms; Moderates soil temperature and more
NITROGEN MANAGEMENT REDUCES THE USE OF NITROGEN FERTILIZERS AND SHIFTS IN APPLICATION TIMING CAN IMPROVE NITROGEN USE EFFICIENCY	Reduces fertilizer costs	Minimizes nitrogen losses to surface and groundwater resources		System-adapted nitrogen management supports soil biological function and ecosystem biodiversity.

Supplement to Top 10 Things You Wanted to Know About Ag Carbon Markets (American Farmland Trust, 2023).

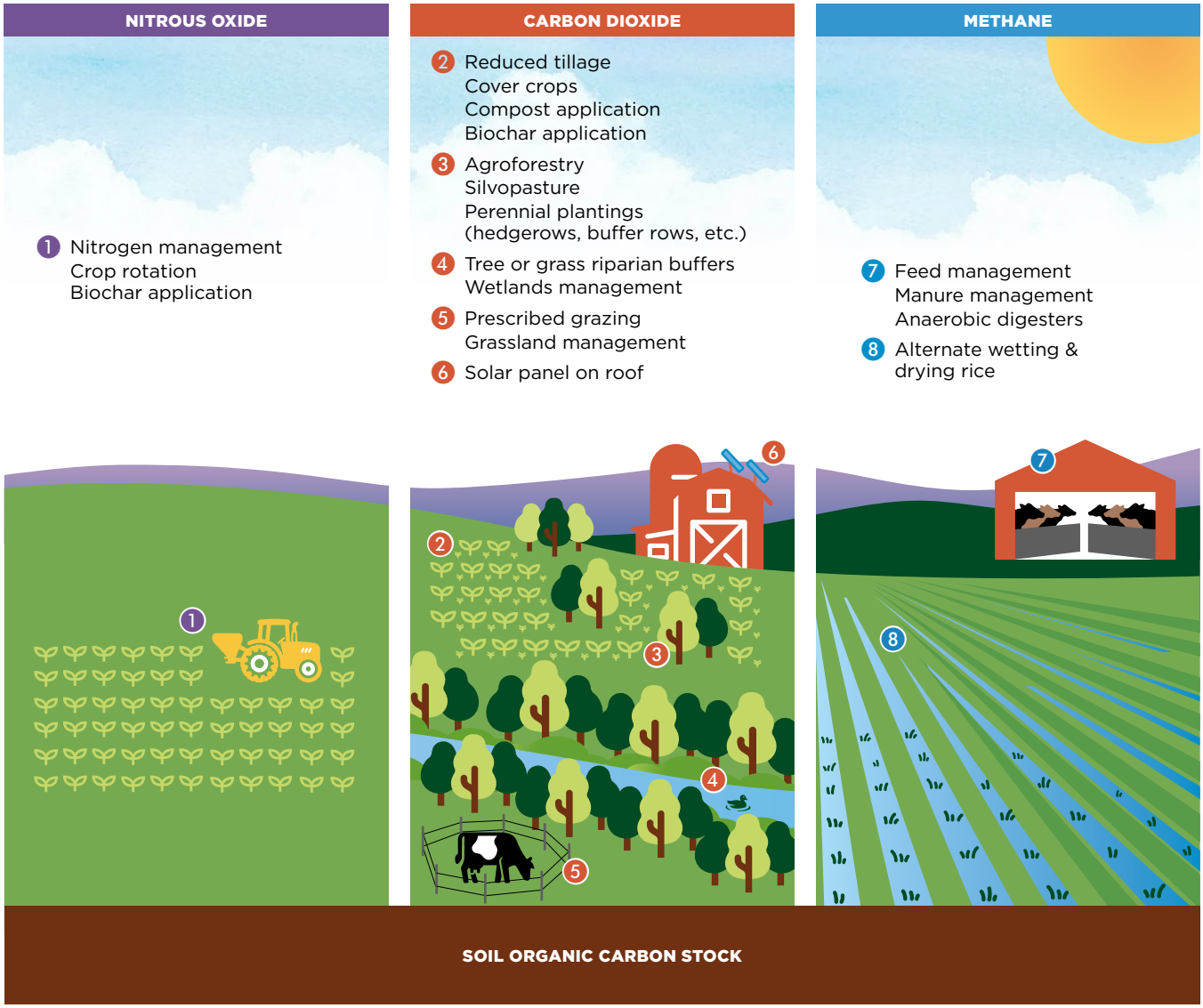
Note: The table above was adapted, in part, from the **United Soybean Board's Carbon Toolbox Farming Practices** website.

Supplement 2. Which greenhouse gas emissions can climate-smart practices help reduce?

Farmers can adopt and maintain climate-smart practices to:

a. Remove carbon dioxide emissions from the atmosphere and sequester the carbon in the soil, or
b. Reduce ag-related sources of nitrous oxide or methane emissions, or
c. Avoid these GHGs from being released from ag systems in the first place.

The infographic below offers a simplified review of just a handful of climate-smart practices and the greenhouse gases they reduce. And yes, some climate-smart practices can address more than one greenhouse gas at a time, like biochar that adds stable carbon and can reduce nitrous oxide emissions.

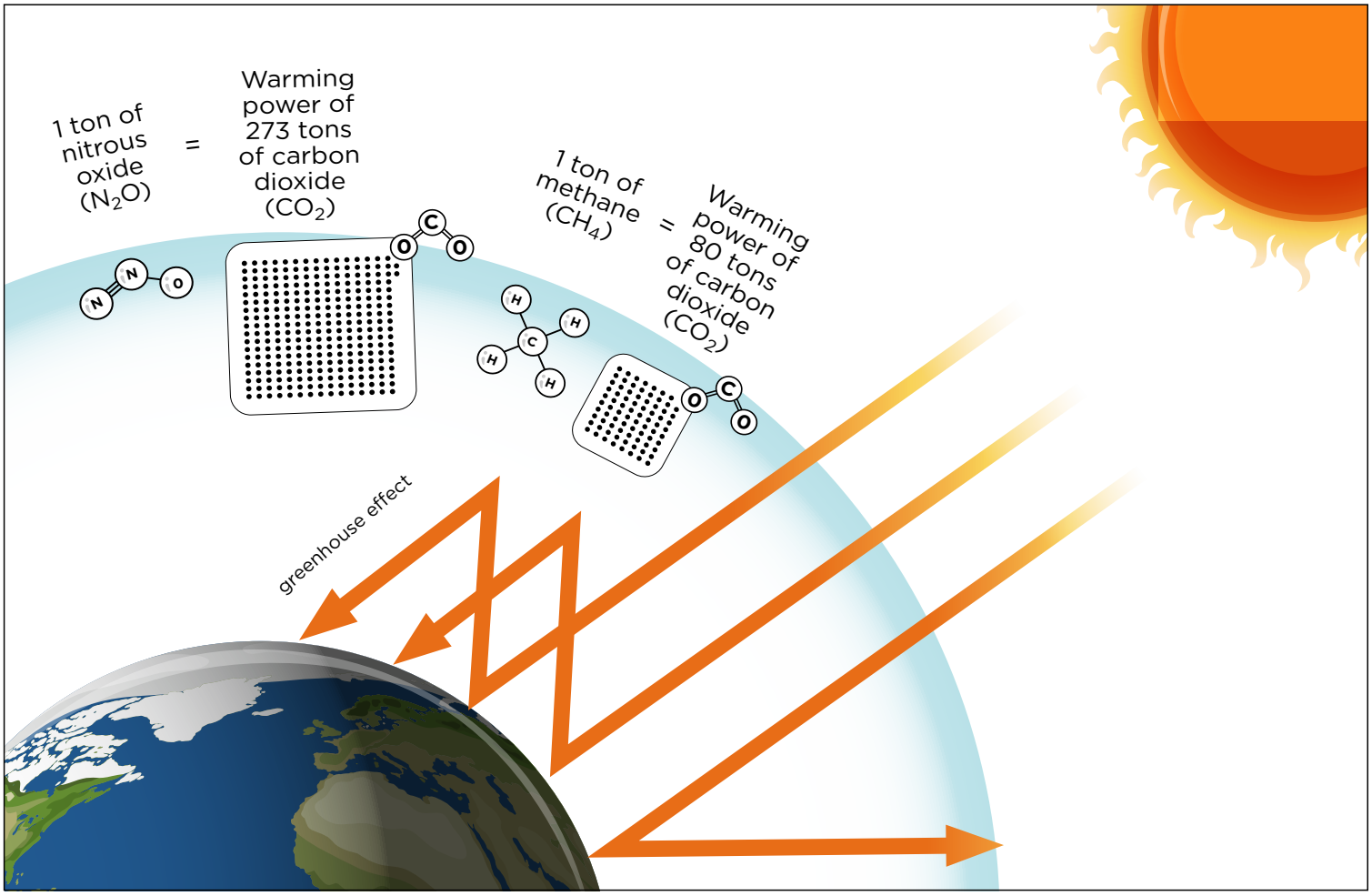


Supplement to Top 10 Things You Wanted to Know About Ag Carbon Markets (American Farmland Trust, 2023)

Supplement 3. Why is a carbon credit measured in t CO_2e and what are global warming potentials?

Carbon credits are frequently measured in tonnes of carbon dioxide equivalents and abbreviated to t CO_2e. The metric t CO_2e allows us to equate the varying impact of greenhouse gases on the planet. Each GHG has a different ability to trap heat in the atmosphere because of their unique molecular structures and amount of time each gas persists. Scientists have calculated each gas's warming potential in comparison to carbon dioxide.

The infographic below shows how nitrous oxide and methane have far greater global warming potentials than carbon dioxide. One tonne of nitrous oxide has a global warming potential of 273 tonnes of carbon dioxide. So, 1 tonne of N_2O can also be expressed as 273 tonnes of carbon dioxide equivalents or 273 t CO_2e (Forster et al., 2021). Furthermore, 1 tonne of methane can be expressed as 80 t CO_2e.



Supplement to Top 10 Things You Wanted to Know About Ag Carbon Markets (American Farmland Trust, 2023)

Note: This infographic reflects the 20-year time scale of global warming potential (Forster et al., 2023)

Source: Forster, P., T. Storelvmo, K. Armour, W. Collins, J.-L. Dufresne, D. Frame, D.J. Lunt, T. Mauritsen, M.D. Palmer, M. Watanabe, M. Wild, and H. Zhang, (2021). The Earth's Energy Budget, Climate Feedbacks, and Climate Sensitivity. In Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 923–1054, doi:10.1017/9781009157896.009.

References

Bigelow, D., Borchers, A., & Hubbs, T. (2016). *U.S. Farmland Ownership, Tenure, and Transfer* (Economic Information Bulletin 161). Economic Research Service. **https://www.ers.usda.gov/webdocs/publications/74672/eib-161.pdf?v=1902.7**

Bruner, E., Moore, J., Hunter, M., Roesch-McNally, G., Stein, T., & Sauerhaft, B. (2021). *Combatting Climate Change on US Cropland; Affirming the Technical Capacity of Cover Cropping and No-Till to Sequester Carbon and Reduce Greenhouse Gas Emissions*. American Farmland Trust. **https://farmlandinfo.org/publications/combating-climate-change-on-us-cropland/**

Carpenter, S., & Kuehn, L. (2023). *Farmers' Guide to Carbon Market Contracts in Minnesota* (First Edition). Farmers' Legal Action Group, Minnesota Department of Agriculture, & Minnesota Farmers Union. **http://www.flaginc.org/wp-content/uploads/2023/01/Farmers-Guide-Carbon-Market-Contracts-in-Minnesota-First-Edition-January-2023.pdf**

Farm Foundation. (2022). *The U.S. Voluntary Agricultural Carbon Market: Where to From Here?* **www.farmfoundation.org/wp-content/uploads/2022/05/FAF9017-01_Ag-Econ_issue_v2FINAL.pdf**

Forster, P., T. Storelvmo, K. Armour, W. Collins, J.-L. Dufresne, D. Frame, D.J. Lunt, T. Mauritsen, M.D. Palmer, M. Watanabe, M. Wild, and H. Zhang, (2021). The Earth's Energy Budget, Climate Feedbacks, and Climate Sensitivity. In Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 923–1054, doi:10.1017/9781009157896.009.

Graham, J. (2021, March 23). Net-zero emissions targets adopted by one-fifth of world's largest companies. *Reuters*. **https://www.reuters.com/article/us-global-climate-carbon-business-trfn/net-zero-emissions-targets-adopted-by-one-fifth-of-worlds-largest-companies-idUSKBN2BF2ZX/**

ISA. (2022). *Carbon & Data Guidebook*. Illinois Soybean Association. **https://www.ilsoyadvisor.com/carbon-data-guidebook/**

ISAP. (2023). *An Overview of Voluntary Carbon Markets for Illinois Farmers*. Illinois Sustainable Ag Partnership. **https://ilsustainableag.org/ecomarkets**

Kelloway, C. (2021, September 30). *Private Carbon Payment Programs Funnel Farm Data to Big Ag*. Food & Power. **https://www.foodandpower.net/latest/regen-connect-carbon-markets-big-data-9-21**

Oldfield, E. E., Eagle, A., Rubin, R., Rudek, J., Sanderman, J., & Gordon, D. (2021). *Agricultural Soil Carbon Credits: Making sense of protocols for carbon sequestration and net greenhouse gas removals*. Environmental Defense Fund. **https://www.edf.org/sites/default/files/content/agricultural-soil-carbon-credits-protocol-synthesis.pdf**

Pannell, D. J., & Claassen, R. (2020). The Roles of Adoption and Behavior Change. *Applied Economic Perspectives and Policy,* 31–41.

Parkhurst, R., Moore, L., Wright, R., & Perez, M. (2023). *Agricultural Carbon Markets: From Program Chaos to Systems Change*. Sierra View Solutions & American Farmland Trust. **https://farmlandinfo.org/publications/ag-carbon-programs-chaos-to-systems-change/**

Plastina, A. (2022). *How Do Data and Payments Flow Through Ag Carbon Programs?* Iowa State University Extension and Outreach; Ag Decision Maker. **https://www.extension.iastate.edu/agdm/crops/pdf/a1-77.pdf**

Plastina, A., & Wonpiyabovorn, O. (2023). *How to Grow and Sell Carbon Credits in US Agriculture*. Iowa State University Extension and Outreach; Ag Decision Maker. **https://www.extension.iastate.edu/agdm/crops/pdf/a1-76.pdf**

Sellars, S., Schnitkey, G., Zulauf, C., Swanson, K., & Paulson, N. (2021). *What Questions Should Farmers Ask about Selling Carbon Credits?* **https://farmdocdaily.illinois.edu/2021/04/what-questions-should-farmers-ask-about-selling-carbon-credits.html**

Urban, C., & Skoczlas Cole, A. (2022). *Ready or Not? Ag Carbon Markets and U.S. Farmers; A Farm Journal Trust in Food Discussion Paper*. Trust in Food, A Farm Journal Initiative. **https://www.trustinfood.com/wp-content/uploads/2022/10/2359_TIF_Carbon-Markets_DM13_LR.pdf**

U.S. Code. (2018). *Administrative Requirements for Conservation Programs, 16 U.S. Code § 3844. Title 16, Chapter 58, Subchapter V.* Legal Information Institute, Cornell Law. **https://www.law.cornell.edu/uscode/text/16/3844**

USB. (n.d.). *Carbon Market Programs*. United Soybean Board. **https://www.unitedsoybean.org/usb-carbon-toolbox/carbon-programs/**

USDA. (2023a). *Climate-Smart Agriculture & Forestry Factsheet*. United States Department of Agriculture; **farmers.gov/climate-smart**. **https://www.nrcs.usda.gov/sites/default/files/2023-04/Climate-Smart%20Agriculture%20and%20Forestry%20factsheet.pdf**

USDA. (2023b). *Report to Congress: A General Assessment of the Role of Agriculture and Forestry in U.S. Carbon Markets Written in support of the Greenhouse Gas Technical Assistance Provider and Third-Party Verifier Program.* **https://www.usda.gov/sites/default/files/documents/USDA-General-Assessment-of-the-Role-of-Agriculture-and-Forestry-in-US-Carbon-Markets.pdf**

USDA NRCS. (n.d.). *USDA Investment in Improved GHG Measurement, Monitoring, Reporting and Verification for Agriculture and Forestry through the Inflation Reduction Act*. **https://www.nrcs.usda.gov/sites/default/files/2023-07/nrcs-ira-mmrv-factsheet-23.pdf**

USDA NRCS. (2017). *FAQ - Environmental Quality Incentives Program* [Facsheet]. **https://www.nrcs.usda.gov/sites/default/files/2022-10/EQIP%20FAQ.pdf**

USSEC. (2022). *SEC Proposes Rules to Enhance and Standardize Climate-Related Disclosures for Investors*. U.S. Securities and Exchange Commission. **https://www.sec.gov/news/press-release/2022-46**

Vanderford, R. (2023, April 25). SEC's Climate-Disclosure Rule Isn't Here, but It May as Well Be, Many Businesses Say. *The Wall Street Journal*. **https://www.wsj.com/articles/secs-climate-disclosure-rule-isnt-here-but-it-may-as-well-be-many-businesses-say-854789bd**

Wallender, S., Smith, D., Bowman, M., & Claassen, R. (2021). *Cover Crop Trends, Programs, and Practices in the United States*. **https://www.ers.usda.gov/publications/pub-details/?pubid=100550**

WBCSD & WRI (Ed.). (2005). *The greenhouse gas protocol: The GHG protocol for project accounting*. World Business Council for Sustainable Development (WBCSD); World Resources Institute (WRI). **https://ghgprotocol.org/sites/default/files/standards/ghg_project_accounting.pdf**

Wozniacka, G. (2020, September 24). *Are Carbon Markets for Farmers Worth the Hype?* **https://civileats.com/2020/09/24/are-carbon-markets-for-farmers-worth-the-hype/**

WRI & WBCSD. (2011). *Corporate Value Chain (Scope 3) Accounting and Reporting Standard; Supplement to the GHG Protocol Corporate Accounting and Reporting Standard*. World Resources Institute and World Business Council for Sustainable Development. **https://ghgprotocol.org/sites/default/files/standards/Corporate-Value-Chain-Accounting-Reporing-Standard_041613_2.pdf**

WRI & WBCSD. (2022). *Land Sector and Removals Guidance Pilot Testing and Review Draft Part 1: Accounting and Reporting Requirements and Guidance; Supplement to the GHG Protocol Corporate Standard and Scope 3 Standard. Draft for Pilot Testing and Review (September 2022)*. **https://ghgprotocol.org/sites/default/files/2022-12/Land-Sector-and-Removals-Guidance-Pilot-Testing-and-Review-Draft-Part-1.pdf**

Glossary

Additionality: A criterion for carbon programs to ensure that a buyer's payment results in *new* GHG reductions or carbon sequestration beyond what would have occurred without their payment. In short, an ag carbon program is paying you to reduce *extra* greenhouse gas emissions or sequester *extra* carbon beyond business as usual, i.e., what you're already doing. This is one of the conditions that a verified carbon credit must meet.

Agricultural carbon market: An environmental market developed to help corporations meet climate and sustainability goals by paying farmers to adopt practices that reduce greenhouse gas emissions or sequester carbon. This paper uses the terms ag carbon market and ag carbon program interchangeably.

Buffer pool: Most offset programs hold onto (do not sell) some credits to use in case a reversal (see below) occurs. Also known as buffer reserves, these serve as an insurance mechanism to be drawn on to compensate for reversals from other projects or on the same project in future years.

Cap-and-Trade: A compliance market system for controlling greenhouse gas emissions wherein a government sets an emissions limit and issues a quantity of emissions allowances consistent with that cap. Qualifying corporations must hold emissions allowances for every ton of greenhouse gases they emit, or, if their emissions are more than their allowances, they must satisfy the limit by buying additional allowances that other emission-cutting corporations can sell. The idea is that the corporations or businesses (like farms, such as dairy farms in California) that can reduce their emissions more cost-effectively, will do so, allowing other corporations to purchase those credits rather than spending more to reduce a portion of their emissions.

Carbon credit:. A marketable, tradeable credit that represents a tonne of carbon dioxide equivalent that was sequestered or reduced due to the credit payment. In order to be valuable, the credit must be additional, verified, and permanent.

Carbon dioxide equivalent (CO_2e): A unit of measurement that standardizes the climate impact of various gases, i.e., it allows emissions and reductions of multiple kinds of greenhouse gases and soil carbon sequestration to be expressed in equivalent terms of their global warming potential. Different gases have different impacts on global warming. As you might guess, one tonne of carbon dioxide is 1 tonne of CO_2e, while 1 tonne of methane is 27 tonnes of CO_2e (if looking at the 100-year time frame), and 1 tonne of nitrous oxide is 273 tonnes of CO_2e. In other words, 1 tonne of nitrous oxide has 273 times the global warming power of 1 tonne of carbon dioxide.

Climate-smart practice: An agricultural practice that reduces greenhouse emissions or sequesters carbon. Popular examples include cover crops, no-till, and nutrient or, more specifically, nitrogen management. This term can also refer to practices that make farms more resilient to the impacts of climate change.

Compliance market: An offset market enforced by government regulations, also called a regulated market, where corporations are required to comply with mandatory greenhouse gas emissions thresholds. Cap-and-trade (see above) is a common type of regulated market. In the U.S., there are only two regulated offset markets: the Cap-and-Trade Market in California and the Regional Greenhouse Gas Initiative covering 11 northeastern states.

Corporation: For this paper, "corporation" refers to a business that wants to reduce its Scope 1 or 3 emissions through the purchase of credits from agricultural offset or inset markets.

Early adopter: A farmer who adopted a specific practice long enough ago that they are no longer eligible to generate a credit using that practice. We love early adopters! Thank you for your leadership.

Greenhouse Gas (GHG): A gas that, when it enters the earth's atmosphere, traps heat, driving the greenhouse effect. Climate change is the result of too many greenhouse gases in the atmosphere (we need some to keep the Earth warm enough). The GHGs from agriculture include carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O).

Inset: A payment made by a corporation for a GHG reduction within the corporation's supply chain (e.g., the production of grain) that is used to reduce the corporation's indirect (Scope 3) GHG emissions. For example, a breakfast cereal company pays grain producers to adopt cover crops.

Lookback period: This term is defined differently by different ag carbon programs. In general, it defines the number of years that a carbon program will consider for credit payment for past activities on a farm field. For example, some carbon programs with a 5-year lookback period will pay farmers for qualifying climate-smart practices that were already in place on the enrolling field during any of the past 5 years. In contrast, other carbon will use a 5-year lookback period to exclude a field if the practice was already adopted.

Mitigation: Actions that achieve reductions in greenhouse gas emissions or sequestration of carbon, thus contributing to solving the climate challenge.

Offset: A carbon credit that is purchased by a corporation from outside its own supply chain in order to compensate for ("offset") the direct (Scope 1) GHG emissions occurring from its facilities and vehicles. For example, a software company pays grain producers to adopt cover crops.

Permanence: The length of time a carbon removal remains locked away from the atmosphere. (Oldfield et al., 2021). In order for carbon credits to benefit the climate, they should represent long-term reductions, regardless of contract length, in greenhouse gas emissions or carbon removals from the atmosphere. In carbon markets, the carbon sequestered due to a carbon credit payment must remain sequestered for a certain amount of time specified by the market to be recognized as a verified carbon credit. Reductions in and avoided greenhouse gas emissions are typically considered permanent.

Reversal: When the carbon sequestered due to a carbon credit payment is released back into the atmosphere. This can be either unintentional (e.g., in the case of a wildfire), or intentional (e.g., if the farmer decides to discontinue the climate-smart practice).

Scope 1, 2, 3 emissions:

SCOPE 1. Emissions generated onsite from the activities a corporation owns or controls (e.g., emissions from a bread company's vehicles).

SCOPE 2. Indirect emissions generated from purchased energy (e.g., the electricity purchased for a bread company's office building or manufacturing plant).

SCOPE 3. Emissions that a firm is responsible for but which happen outside of its walls and are controlled by other parties up and down the value chain (e.g., the emissions from the farms that produce the wheat used in the bread).

Ton and tonne: A US ton is a unit of weight equivalent to 2,000 pounds, while a tonne (a "metric ton") is a metric unit of weight equivalent to 1,000 kilograms or 2,204.6 pounds. Most carbon markets use tonnes as their unit for credits, with one credit being a tonne. (There is a third ton, a British or Imperial ton, which weighs 2,240 pounds.)

Voluntary market: An offset market that is not driven by government regulation but by corporate climate mitigation and sustainability commitments. Arum delenim il iduci dendita spidipsunt re reseditatur, seque officima dis corro ex exerio moluptatem et adia con peditem culpa placcaestem autest dolecti corepro vidende liquiscia preptatem volorro vidunt aut lati conse doloribus.

Macauley Farm in western New York "planting green" into roller crimped 11 species cover crop mix. KEVIN KEENAN

American Farmland Trust
SAVING THE LAND THAT SUSTAINS US

1150 Connecticut Avenue NW, Suite 600
Washington, DC 20036
(202) 331-7300 • farmland.org