Sustainability from the Humble Soil Humus

Huber or Humungous?

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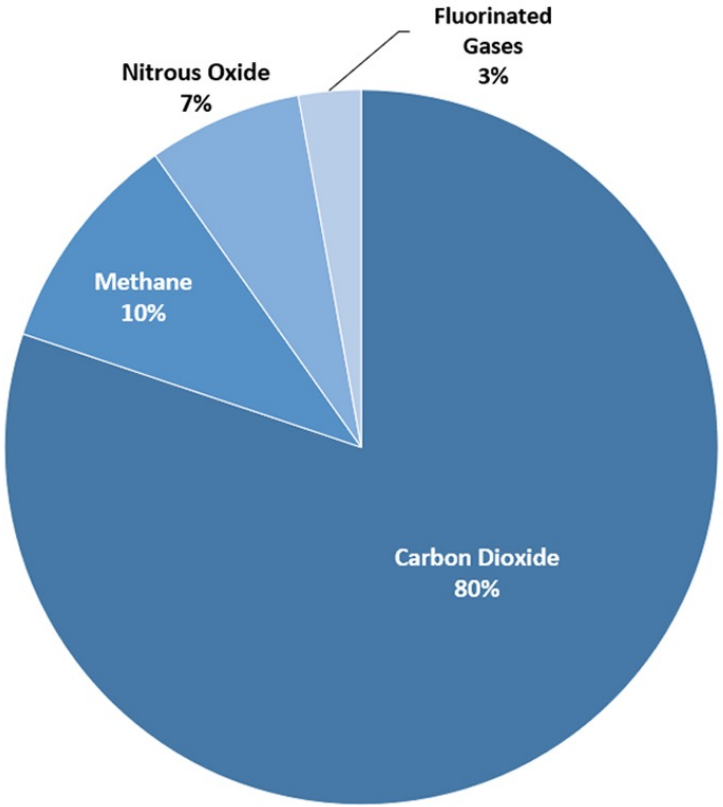
What is happening with our climate?

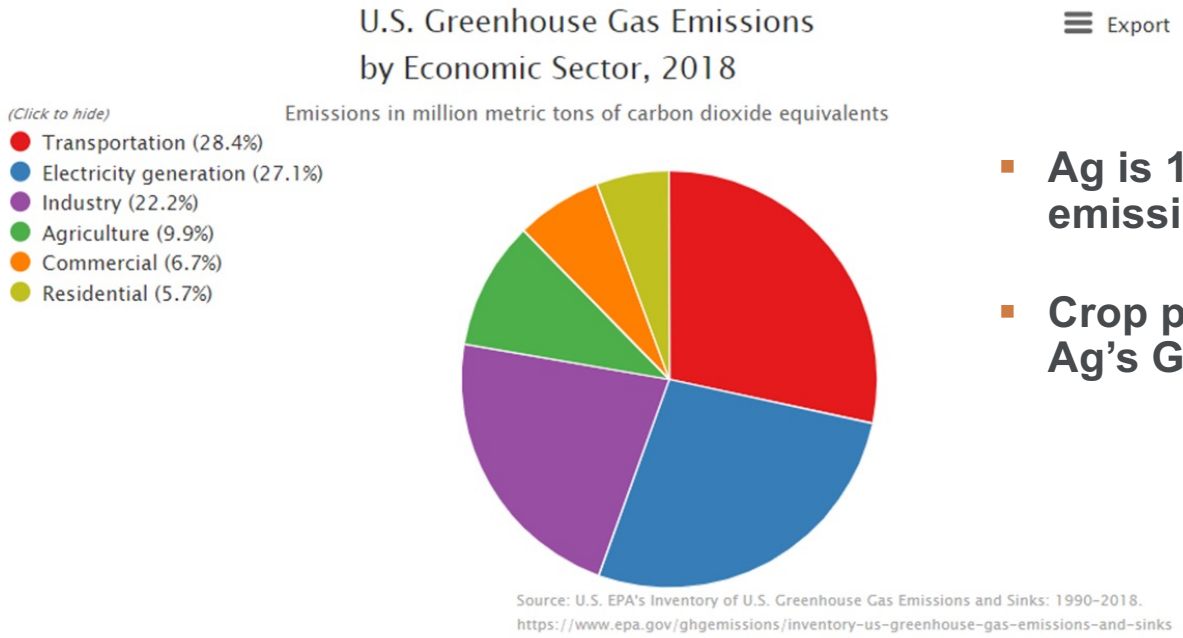
Overview of U.S. Greenhouse Gas Emissions in 2019



U.S. Environmental Protection Agency (2021). Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2019

Greenhouse gases are sometimes converted & referred to as "CO2e"

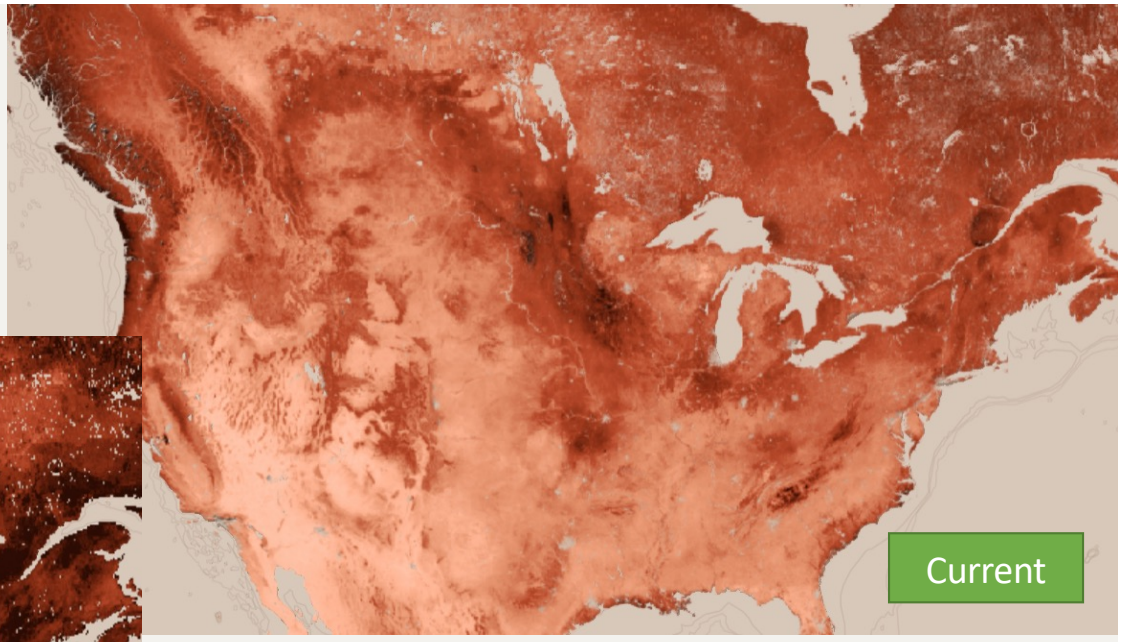
Ag industry accounts for 10% of total U.S. GHG emissions and provides one of the most immediate and cost-effective solutions

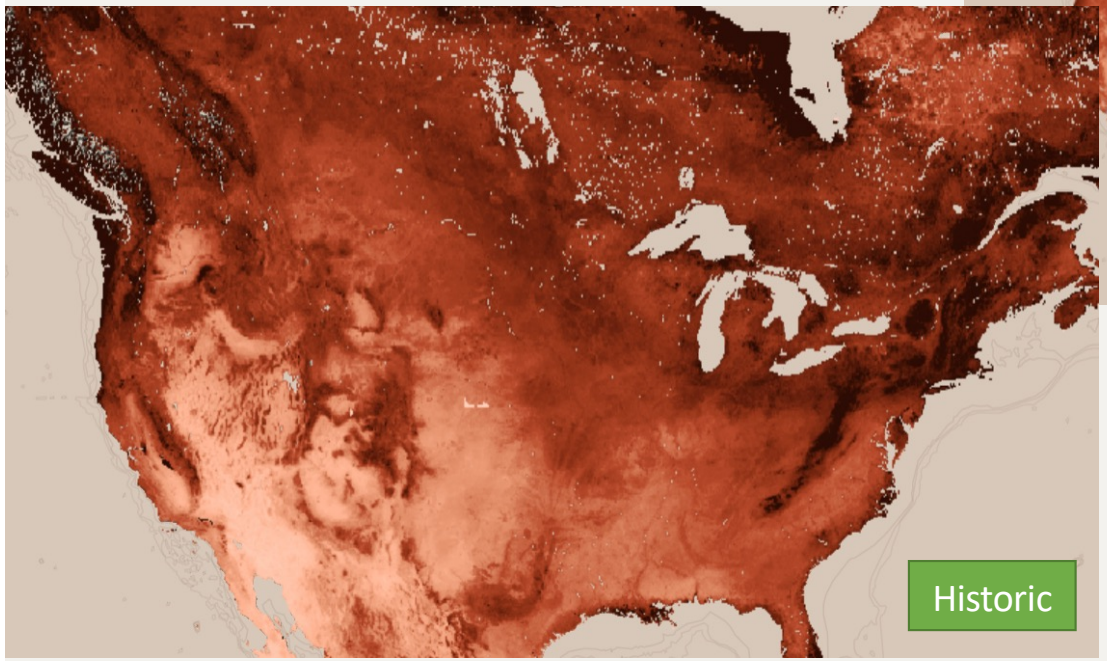


- **Ag is 10% of total U.S. GHG emissions (658MM tons/year)**
- **Crop production is 55% of Ag's GHG emissions**

Sources: U.S. EPA GHG data: Greenhouse Gas Inventory Data Explorer | US EPA

Carbon Stocks in agricultural soils have been significantly depleted





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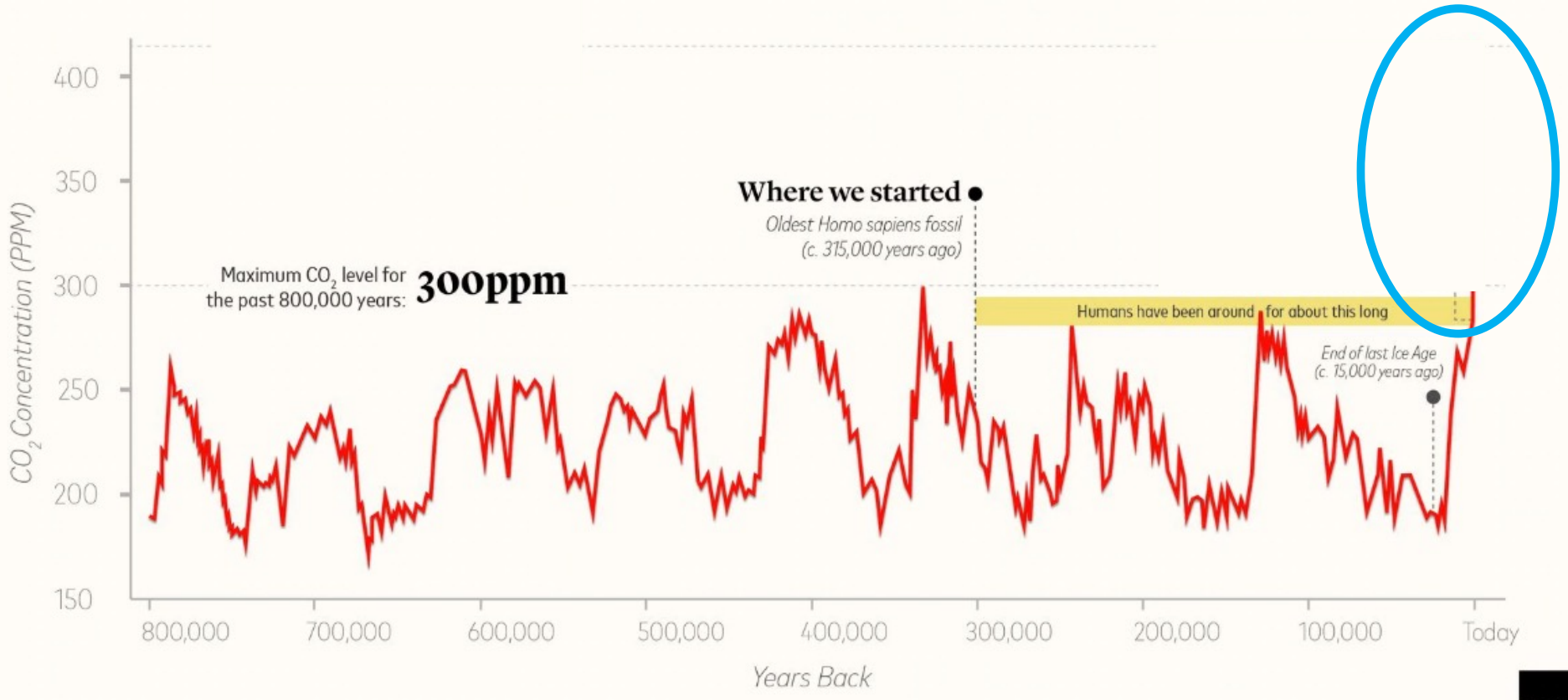
Source: https://soilsrevealed.org/

Carbon dioxide levels haven't been this high in human history.



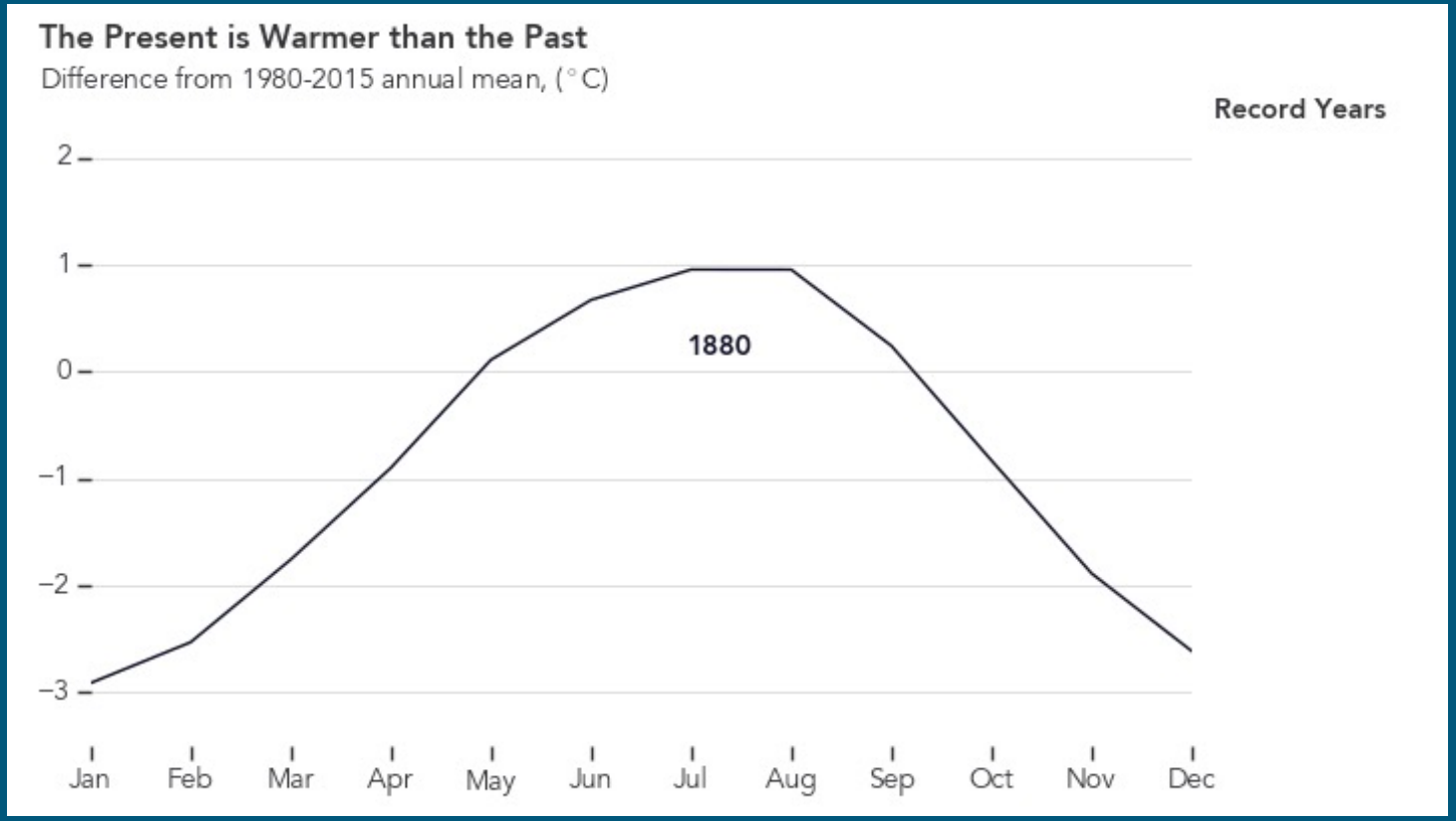
Data from the Scripps Institute of Oceanography at UC San Diego

POP SCI

Since 1880, the 7 Hottest Years on Record:

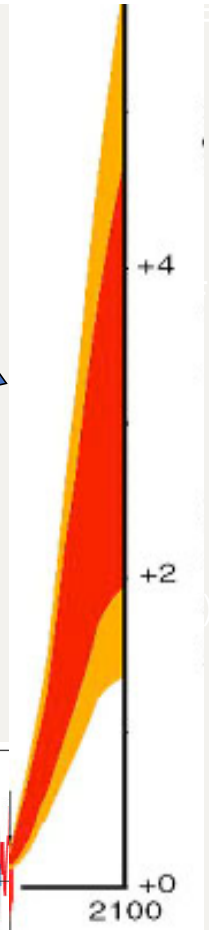
2014
2015
2016
2017
2018
2019
. . . and 2020

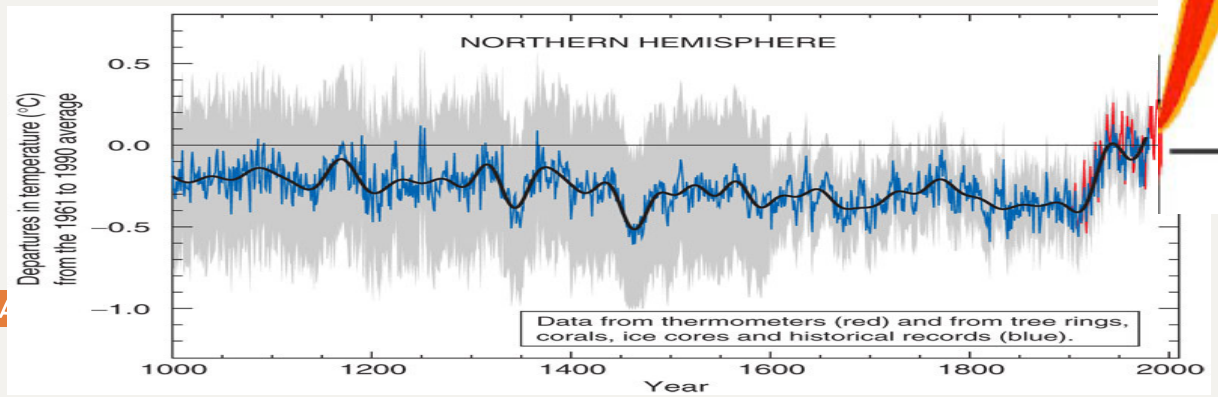
Annual global temperature difference from average, 1880 to 2018. (NASA)



Data Sources: NASA and NOAA; European Union Copernicus Climate Change Service

Estimated future global temperature increases





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Indiana Growing Season Temperatures

	Low	High	+1.5*C
Apr	41.2°F	62.9°F	
May	51.8°F	73.5°F	54.5-76.2
Jun	61.3°F	82.1°F	64-84.8
Jul	65.2°F	85.6°F	67.9-88.3
Aug	63.3°F	83.7°F	66-86.4
Sept	55.2°F	77.4°F	
Oct	43.6°F	65.6°F	

Table 21.2: Optimum and Failure Temperatures for Vegetative Growth and Reproduction

Crop	Optimum Growth	Failure for Growth	Optimum Reproduction	Failure for Reproduction
Corn	80°F	105°F	67°F	95°F
Soybean	86°F	101°F	72°F	102°F

Table 21.2: This table shows the temperatures at which corn and soybeans reach optimum growth and reproduction as well as the temperatures at which growth and reproduction fail.[50]

Source: 4th National Climate Assessment, 2018 https://nca2018.globalchange.gov/chapter/21/

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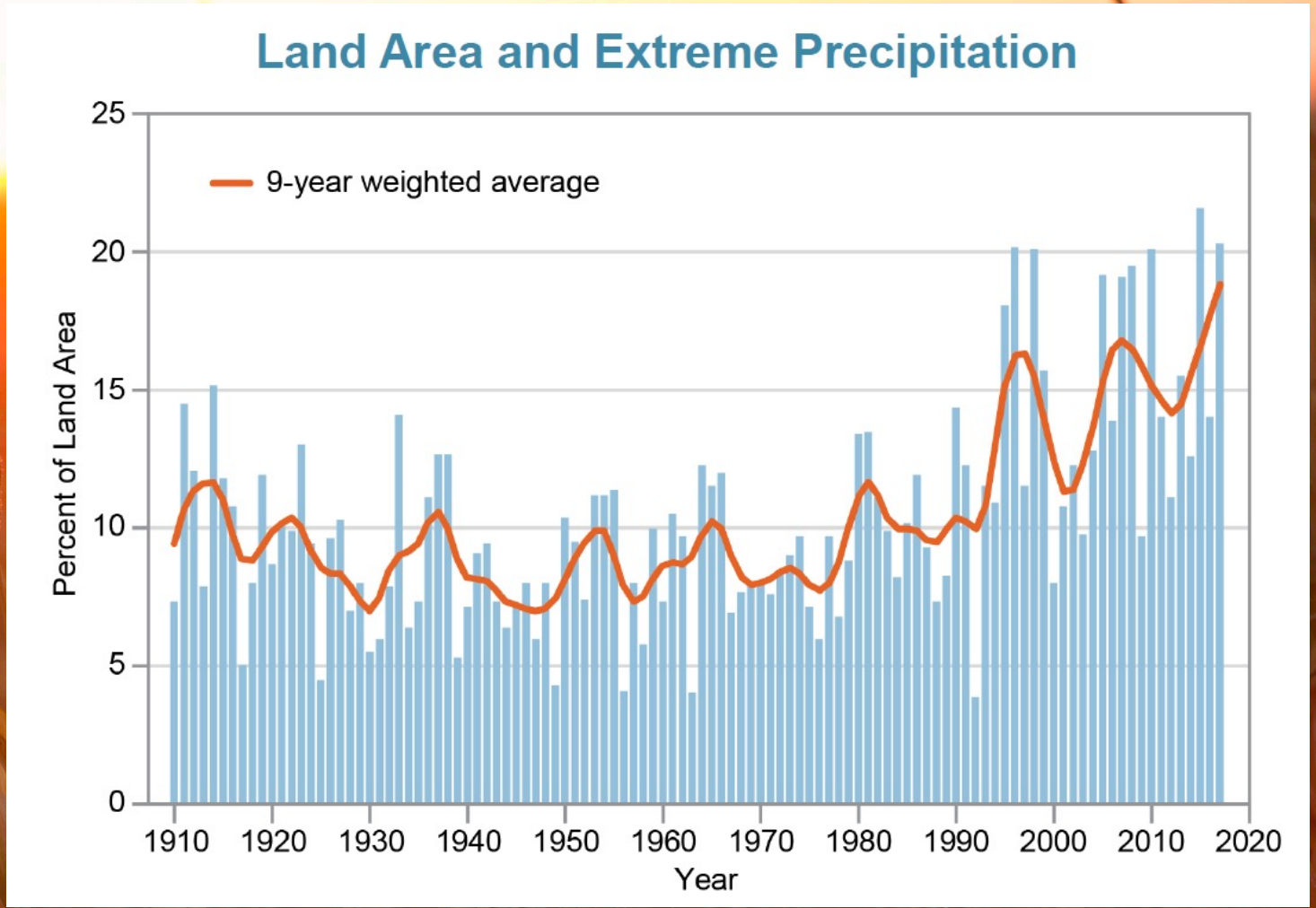
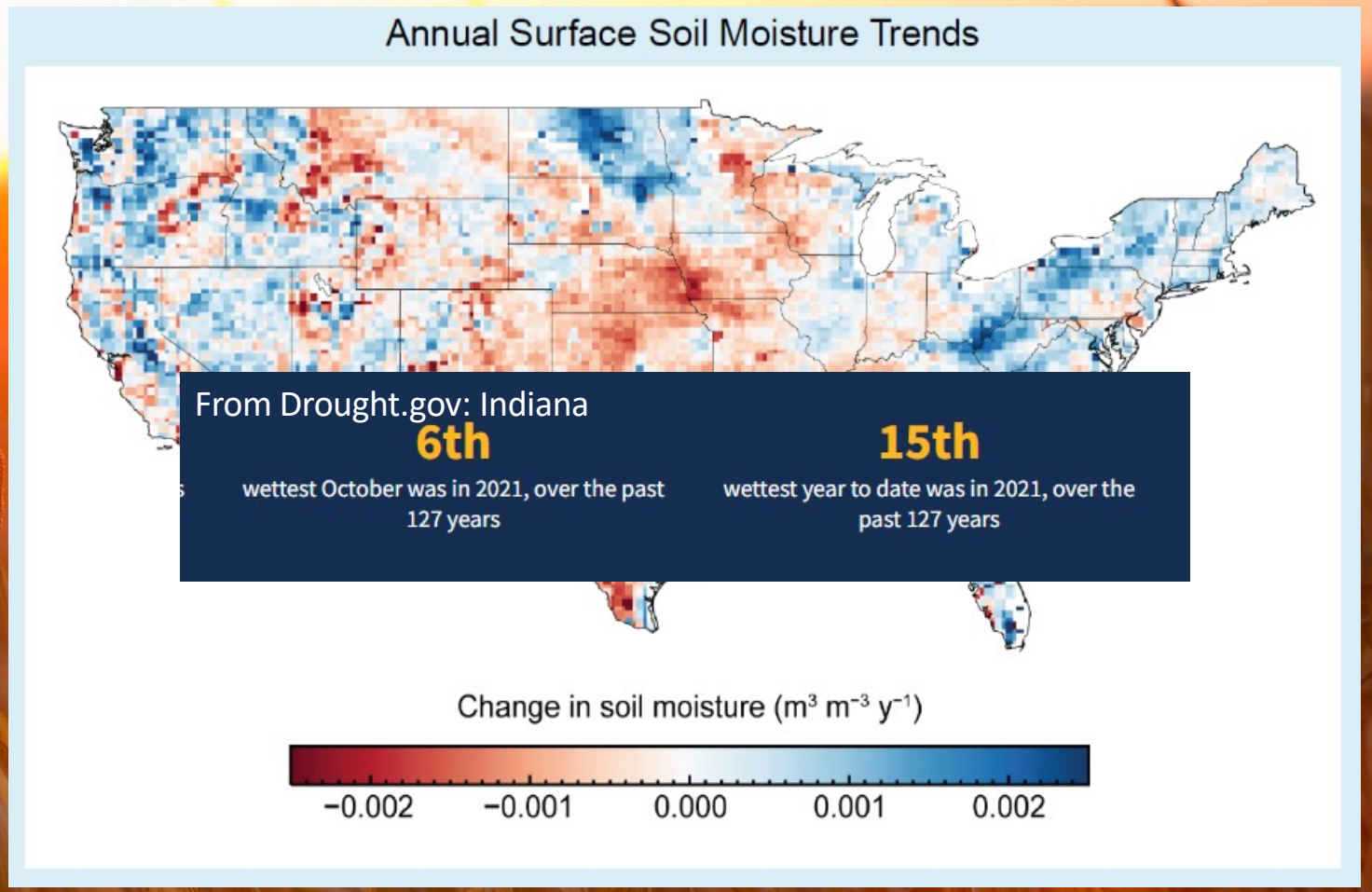
Extreme storms are more frequent



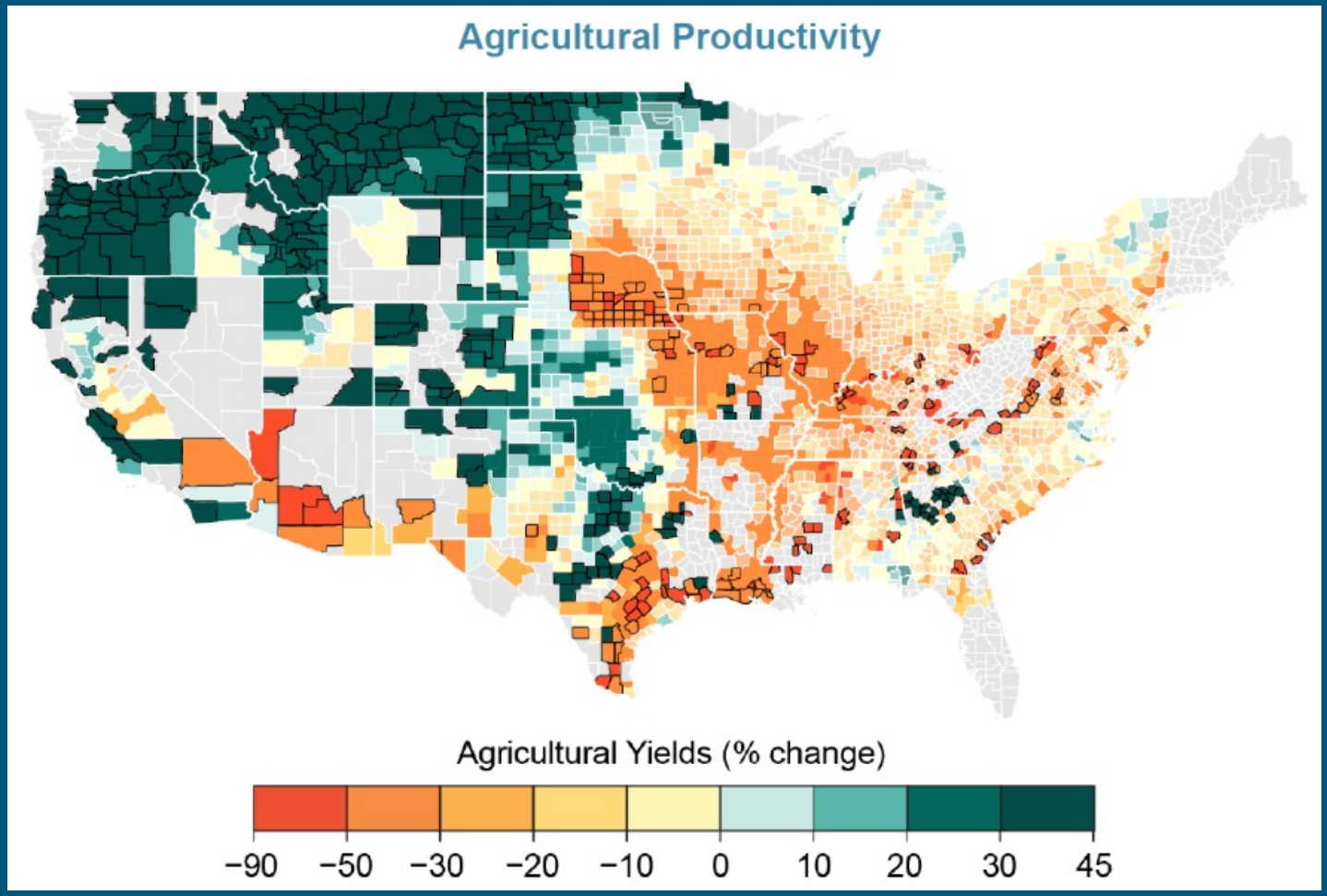
Source: 4th U.S. National Climate Assessment, U.S. Global Change Research Program, August 2018

Soils Moisture is Shifting … and Drying in the Grain Belt



Source: 3rd U.S. National Climate Assessment, U.S. Global Change Research Program, May 2014

Estimated Impacts in Ag Productivity by End of 21st Century



Source: 4th U.S. National Climate Assessment, U.S. Global Change Research Program, August 2018

Why are companies making pledges to battle climate change?

Major Market Drivers

Corporate Climate Goal Perspective:

- Access to Capital – Largest financial institutions in the world are making climate commitments and expecting the same of their portfolio companies
- Reputational Risk – With consumers both for environmental impacts and for perception of "greenwashing"
- Supply Chain Disruptions – Both acute (extreme weather impacts) and long-term (extended droughts)

Ag Perspective:

- Increasingly severe and unpredictable weather events directly impact producers
- Market opportunities today can become expectations, discounts, and/or regulations tomorrow

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“There is no company whose busines model won’t be profoundly affected by the transition to a net zero economy . . .

Companies that are not quickly preparing themselves will see their businesses and valuations suffer.”

- Larry Fink, CEO of BlackRock, Inc.

Companies are responding to consumer interests and investor demands opportunities.

Nutrien Launches New End-to-End Carbon Program

BAYER LAUNCHES CARBON INITIATIVE

REWARDS FOR FARMERS GENERATING CARBON CREDITS.

By Megan Schilling
7/21/2020

Bayer wants to be climate neutral by 2030.

BASF to deepen carbon emission cuts

German major tears up its 2019 target and commits $3.5 billion to its new low-carbon transition

FBN LAUNCHES GRO NETWORK TO LINK FARMERS WITH SUSTAINABLE BUYERS

GRAIN MARKETING PLATFORM IS INTENDED TO FIND A MARKET FOR 'LOW-CARBON' GRAIN.

By Bill Spiegel
9/1/2020

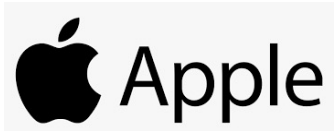
CORTEVA AGRISCIENCE CREATES NEW CARBON AND ECOSYSTEMS SERVICES PORTFOLIO

INITIATIVE FOCUSED ON MAKING AGRICULTURE MORE CLIMATE POSITIVE.

EDITORS' PICK | 7,484 views | Sep 3, 2020, 02:52pm EDT

Smithfield Pushes To Be America's First Carbon-Negative Meatpacker

Companies That Have Pledged To Go Carbon Neutral

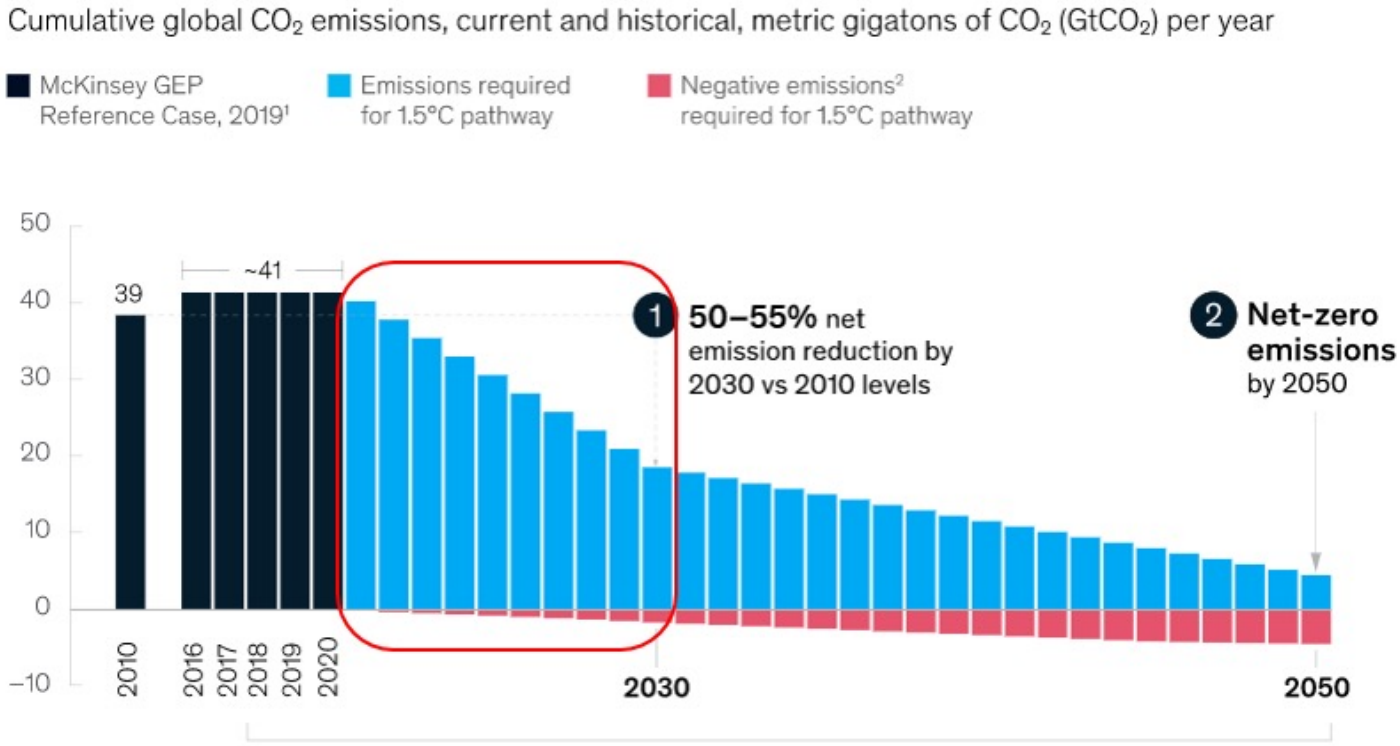


Carbon removal market est. $1.4 trillion by 2050, and current demand far exceeds supply

SCIENCE BASED TARGETS

DRIVING AMBITIOUS CORPORATE CLIMATE ACTION

More than 1,700 businesses are working with the Science Based Targets initiative (SBTi) to reduce their emissions in line with climate science



Sources: McKinsey & Company, Bloomberg, Science Based Targets Initiative

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Key Carbon Market Concepts

Compliance vs. Voluntary Markets:

- **Compliance**: Regulators establish emissions limits for regulated entities which must track their emissions and purchase credits or apply CI score – LCFS and cap-and-trade markets
- **Voluntary**: Not dependent on government regulations. Entities track their own emissions and voluntarily purchase credits to meet sustainability goals such as carbon neutrality.

Offsets vs. Insets

- **Offsets**: Exclusive carbon claim for customers in any industry that can be counted against their total emissions
- **Insets**: Exclusive carbon claim for customers that can be counted against their own supply chain emissions

Removal vs. Reduction

- **Removal**: Carbon is removed from the atmosphere and stored in soil, water, biomass, or underground, with some assurance of permanence
- **Reduction**: Carbon emissions are avoided by mitigating technologies, e.g., wind, air. Out of scope for this overview

Carbon Credit: One tradable metric ton CO2-equivalent

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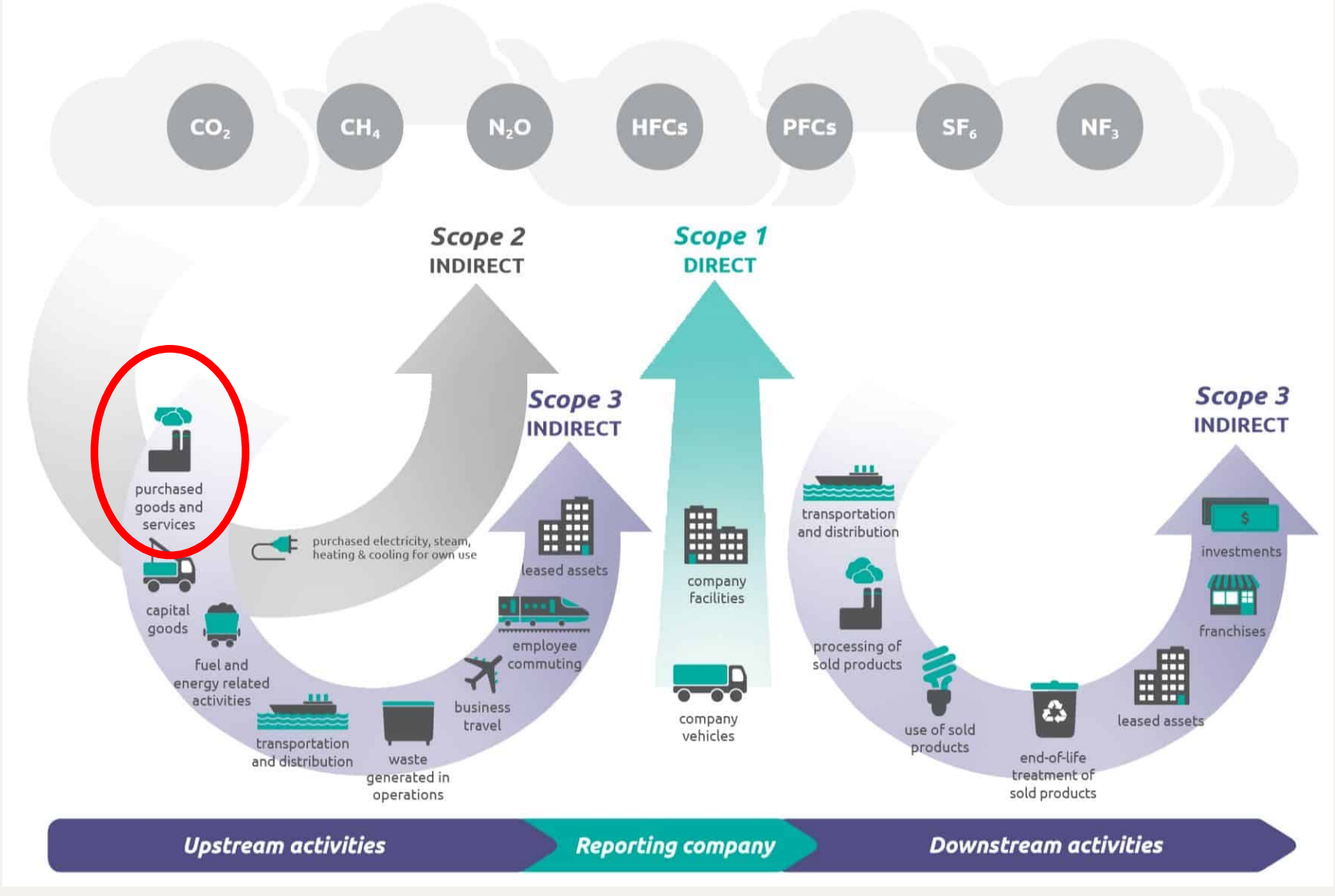
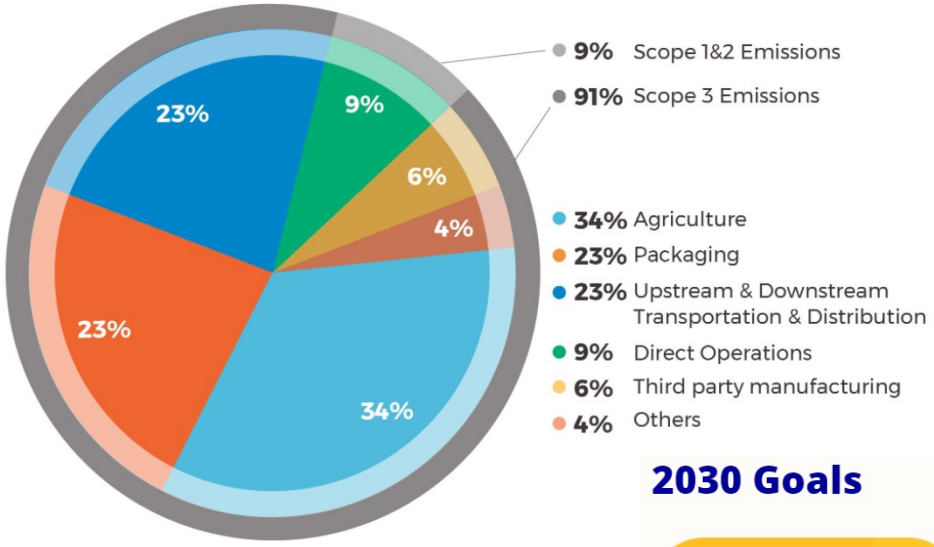
How does sustainable agriculture fit into this market?


CO_2
CH_4
N_2O
HFCs
PFCs
SF_6
NF_3
Scope 2
INDIRECT
Scope 1
DIRECT
Scope 3
INDIRECT
Scope 3
INDIRECT
purchased goods and services
capital goods
fuel and energy related activities
transportation and distribution
waste generated in operations
business travel
employee commuting
leased assets
purchased electricity, steam, heating & cooling for own use
company facilities
company vehicles
transportation and distribution
processing of sold products
use of sold products
end-of-life treatment of sold products
leased assets
franchises
investments
Upstream activities
Reporting company
Downstream activities

Net-Zero (by 2040) Company Profile: PepsiCo

OUR EMISSIONS FOOTPRINT



PepsiCo is actively investing in farms around the world to implement management practices that will help them to decarbonize their sourcing footprint in agriculture.

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2030 Goals

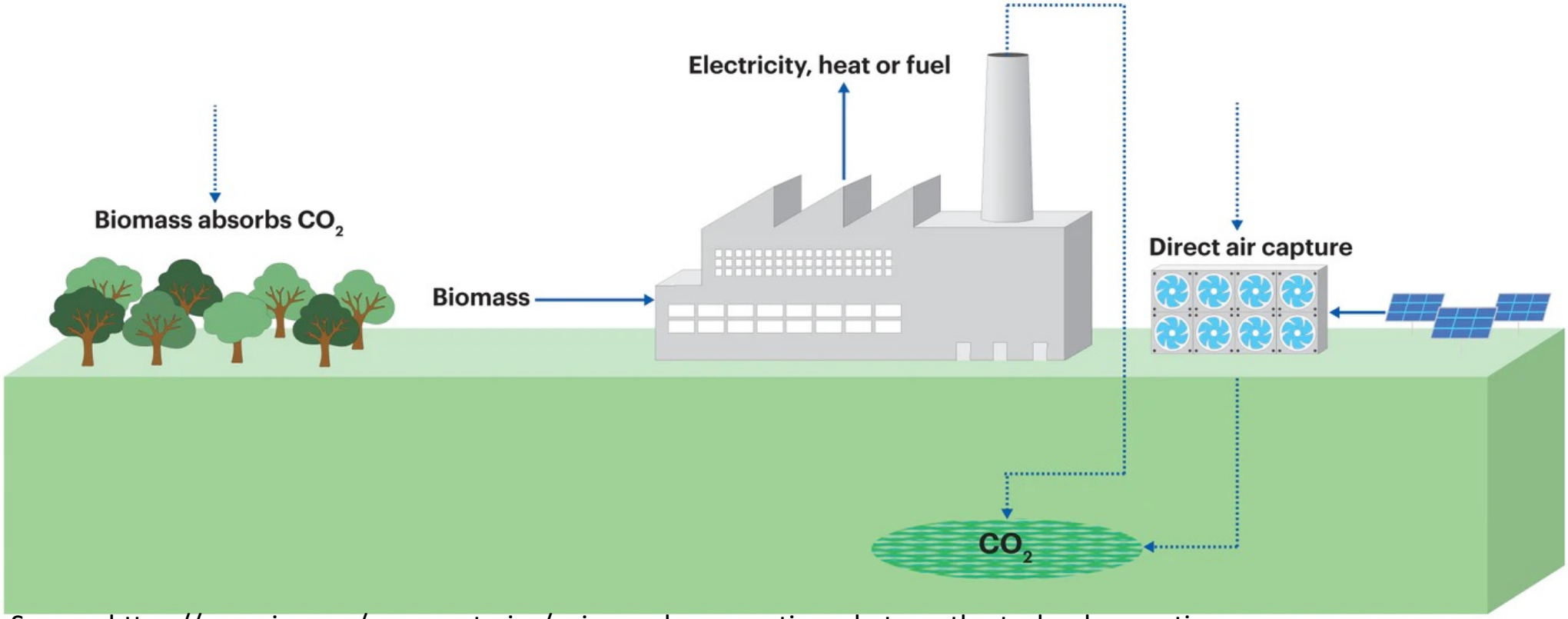
Spread regenerative farming practices across **7 million acres**

Eliminate **3 million tons** of greenhouse gas emissions

Improve the livelihoods of more than **250,000 people** in our agricultural supply chain

Sustainably source 100% of our key ingredients

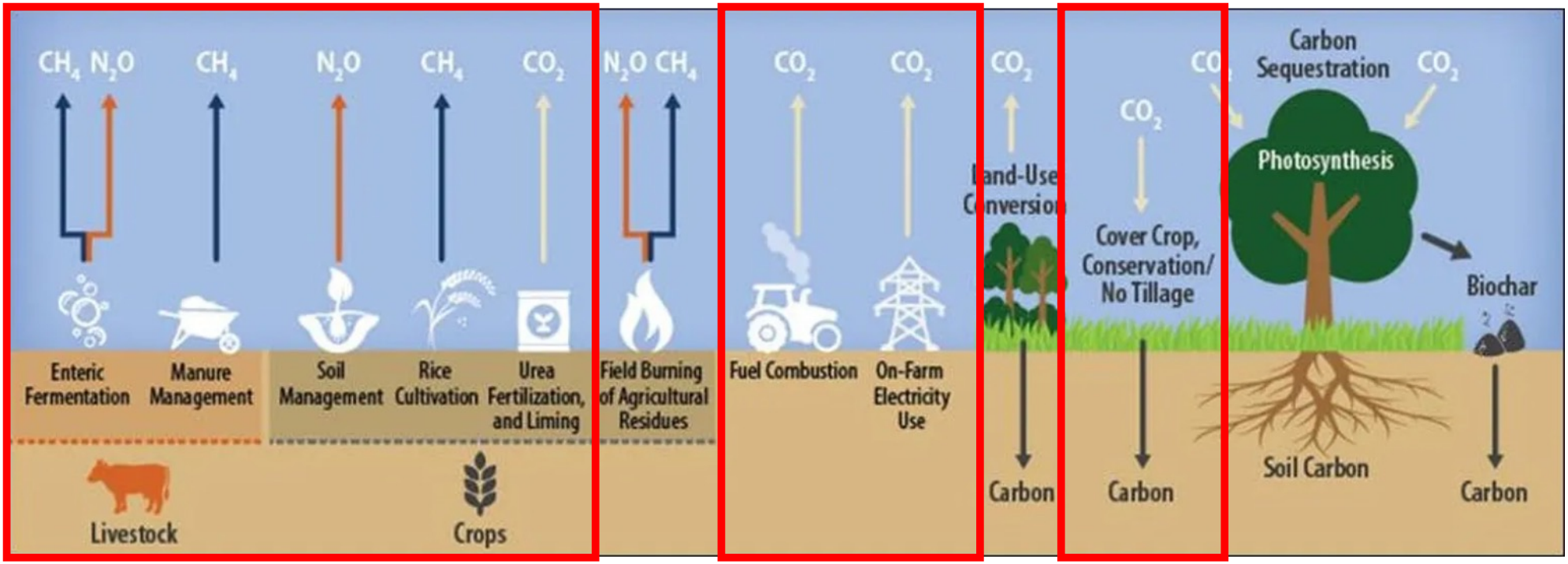
What are the options for credit generation?



Source: https://www.iea.org/commentaries/going-carbon-negative-what-are-the-technology-options


Climeworks

Developing a comprehensive services platform to address all opportunities to mitigate climate change.



Source: SC Times, Published Oct. 24, 2021

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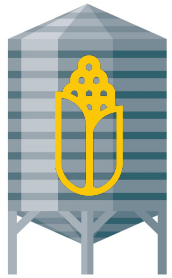
Farming Carbon



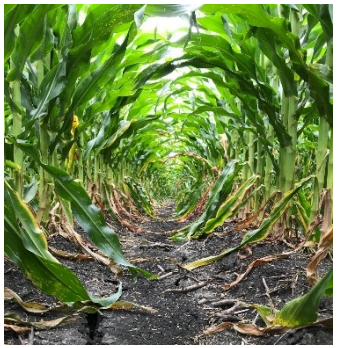
Bushels of grain

Tons of Carbon

Moving towards Greater Levels of Stewardship

Current state (majority of farms)

April-June



July-August

Sept-Oct

Nov-March

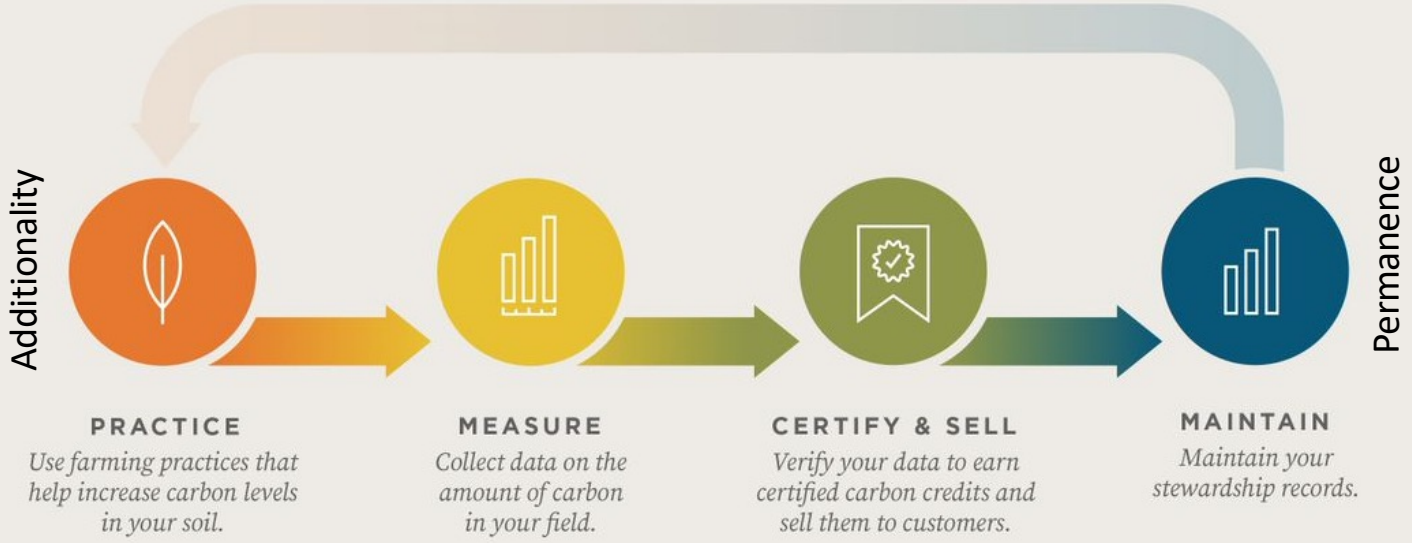
Soil health focused systems

Alright, we're in!
How do we get paid?

TRANSFORMING ON-FARM STEWARDSHIP

– into –

FARM-GENERATED CARBON CREDITS



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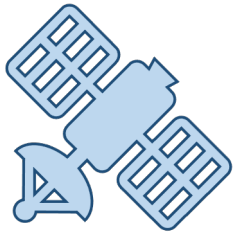
Additionality: What practices provide the biggest benefit?

Practices	Description	Impact: est. SOC CO2e (t/ac/yr)	N2O GHG Co-Benefit
No-till & other conservation tillage	Increasing carbon content of soil through land management practices	0.18 - 0.49	Yes
Incorporate winter cover crops	Plant cover crops during winter fallow months	0.54	Yes
Diversify crop rotations	Incorporate more diverse cash crops into a multi-year rotation	--	Yes
Incorporate or replace with perennials (alfalfa)	Over multi-year crop rotation, incorporate perennials such as alfalfa	0.21	Yes
Convert cropland to pasture	Convert marginal or low-yielding row crop acres to pasture and hay	0.97	Yes
Plant herbaceous buffers	Strategically site herbaceous cover (filter strips, grass waterways, field borders) to protect high-risk acres	0.80	Yes
Establish tree windbreaks and buffers	Plant trees as windbreaks around field borders and establish bottomland riparian forest buffers	0.34 - 2.78	No

Source: GHG Mitigation Potential of Agricultural Land Management in the United States: A Synthesis of the Literature. Nicholas Institute for Environmental Policy Solutions, Duke University, 2012

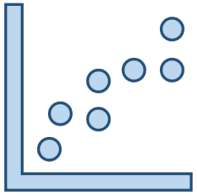
Quantifying Carbon

Soil Sampling



Remote Sensing

Farm Data



Modeling

Methods and labs are program-specific

Quality (value) of a credit can be based on intensity of measurement/data collection

Soil carbon is extremely spatially variable throughout fields

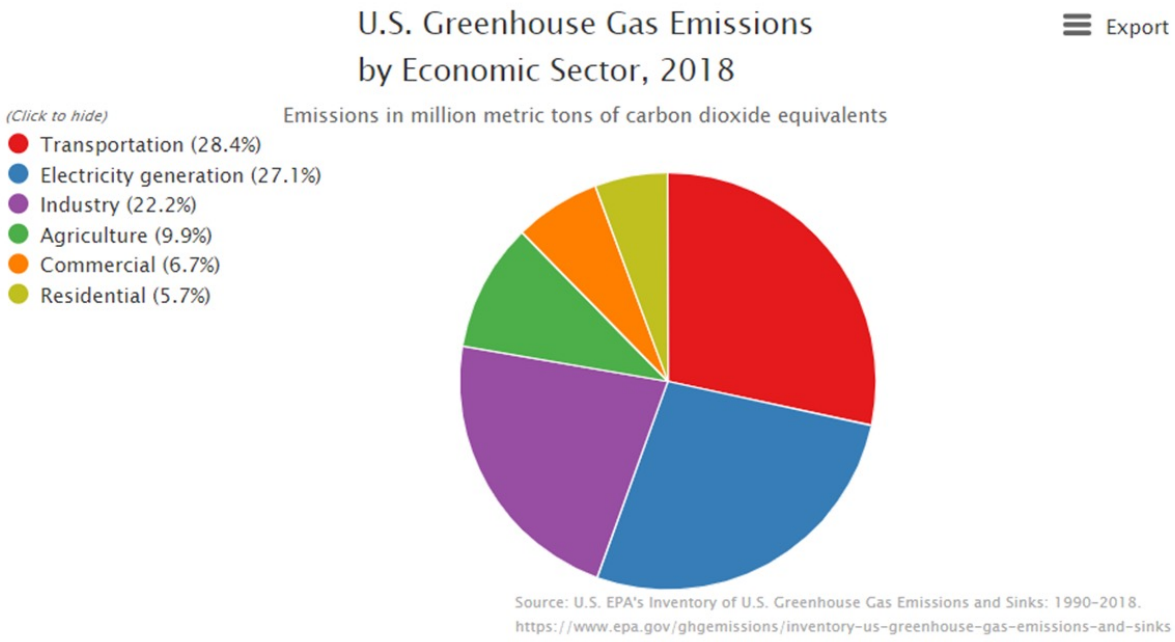
Sample values on their own are not valuable

Certification Bodies in the US

Certification/Registry Bodies:

- **Verra/VCS** – Largest voluntary carbon credit registry, released their methodology in July
- **Climate Action Reserve** – lesser known, approved new soil carbon methodology in Sept 2020
- **American Climate Registry** - California regulatory market verifier
- **Gold Standard** – Long-standing standard setter, more like **GHG Protocol** than fee-for-service verifiers

Ag industry accounts for 10% of total U.S. GHG emissions and provides one of the most immediate and cost-effective solutions



- Ag is 10% of total U.S. GHG emissions (658MM tons/year)
- Crop production is 55% of Ag's GHG emissions (360MM tons/year)
- Total opportunity in ag if all acres participate is ~168MM tons/year
- Market opportunity of $3-6 billion

Sources: U.S. EPA GHG data: Greenhouse Gas Inventory Data Explorer | US EPA

Indiana land use stats (1997)

- Nearly 2/3 of Indiana's 23 million acres are farmlands
  - 0.5 tons/acre = 7.5 MM tons per year = $151.8 MM opportunity?
- 5 out of 92 counties have >90% of land in farm use
- Only 6 counties have <30% of land in farm use

• Soil Carbon Market Opportunity

So, what does a carbon credit mean to a farmer?

- Current prices paid to farmers: $15-20/ton SOC***
- Carbon sequestration opportunity per acre: .2-.7 t/acre/yr
- $3-14/acre

Wait, why are we all so excited about this again?

- Practices that sequester carbon improve soil health and come with a variety of additional benefits
- To achieve global emissions targets, this is one of the most readily available and scalable technologies today
  - Estimated market $1.4 trillion by 2050

Don’t forget about where and why we started…

HIGHLIGHTS OF THE SOIL HEALTH INSTITUTE'S 9-STATE ECONOMIC ANALYSIS ON ADOPTING SOIL HEALTH MANAGEMENT SYSTEMS (SHMS)

100 farms assessed in states where 71% of the corn and 67% of the soybeans are grown in the U.S.

BACKGROUND AND SUMMARY OF FINDINGS ACROSS ALL 100 FARMS

97% reported increased crop resilience to extreme weather

85% Net income increased for 85% of farmers growing corn and 88% of farmers growing soybean

67% reported a higher yield than their conventional system

$24 Reduced the average cost to grow corn by $24/acre and soybean by $17/acre

$52 Increased net farm income by an average of $52/acre for corn and $45/acre for soybean

Source: https://soilhealthinstitute.org/economics/

Ohio, spring 2021 – neighboring fields after a large rain event

Farmer 1

No Till

14-Way Cover Crop Blend

Border Strips around field

Clean water in ditches

Farmer 2

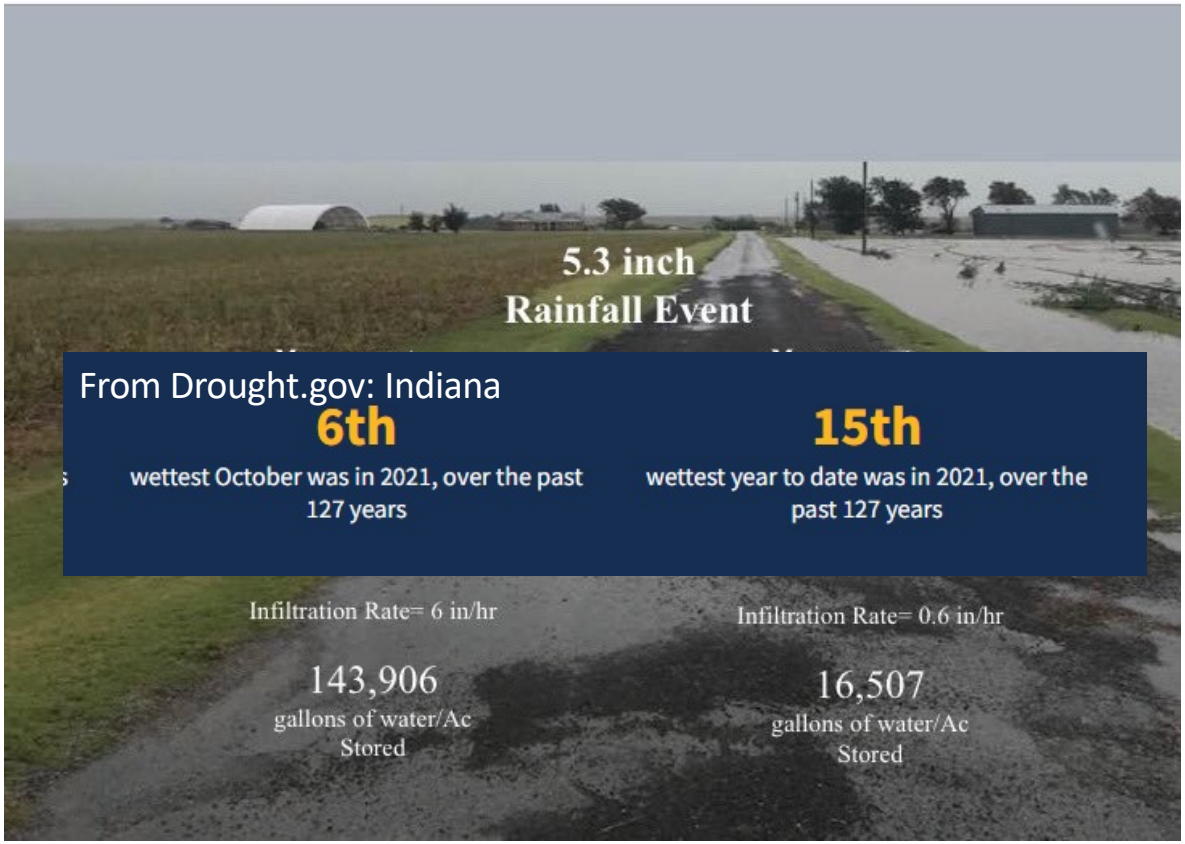
Multi-Pass Tillage

No Cover Crops

Farms up to the ditch

Soil & nutrients in ditches

Soil health enhances resiliency



Where do we go from here?

Keys to Success: Where farmers need support

Information and Education

- Practice Guidance:
  - What practices help them reach production goals AND sequester the most carbon?
  - How to make new practices successful long-term?
  - How can I take some risk out of year 1?
- Many programs available – what type of program should they be looking for?

Data Support

- Event-based metrics
- Historical data (up to 8 years)
- Tools to bring multiple data sets together

Thank you

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