

COWS, CORN AND CRAP: CLIMATE CHANGE AND AGRICULTURE



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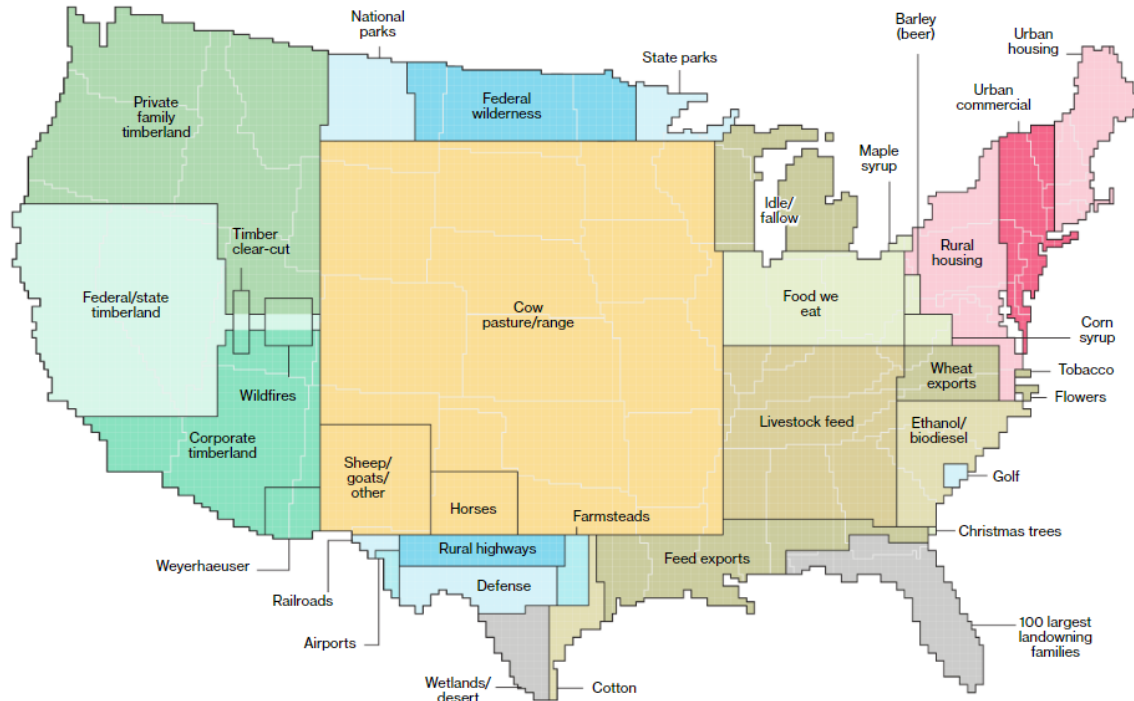


INDUSTRIAL AGRICULTURE PRODUCES A VAST AMOUNT OF INEXPENSIVE FOOD



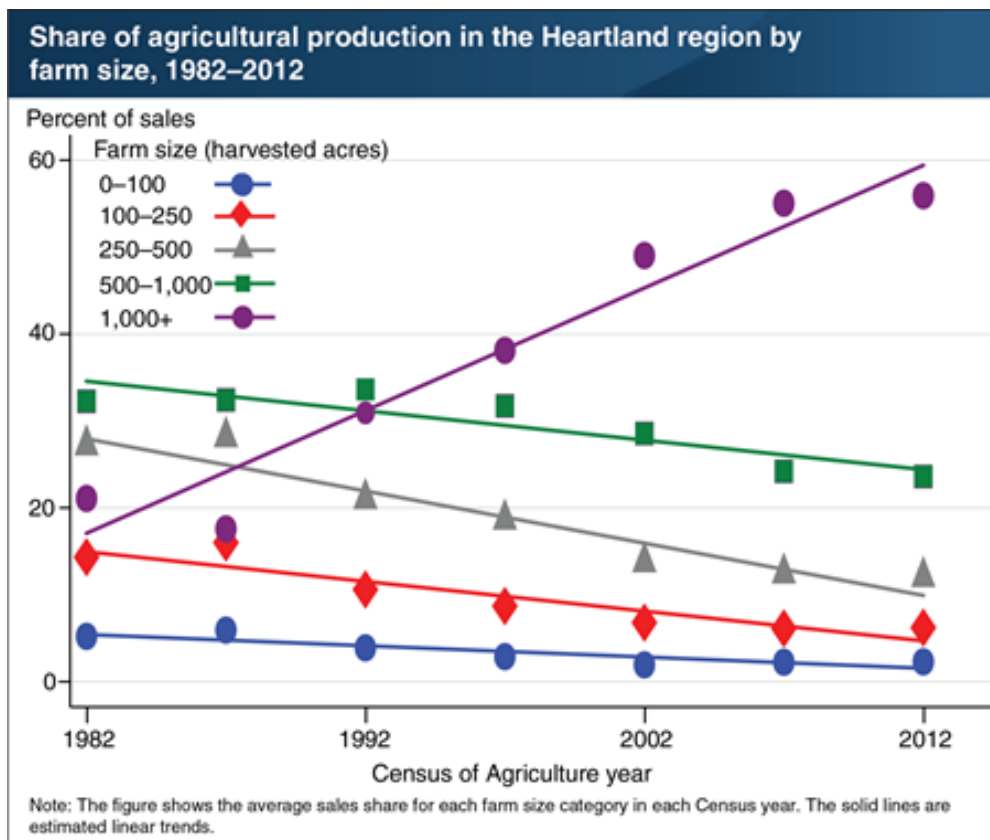
- **430 billion pounds** of food produced annually
 - **3,683 calories** / person / day (~2,200 recommended)
- **20%** of food produced exported
- **40%** of food produced is wasted
- Americans are paying **one third less** for their food than in 1980
- Farmers receive **7.8¢** per food \$

AGRICULTURE DRIVES U.S. LAND AND WATER USE



- **62%** of land use in continental U.S. is agricultural
- **391 million** acres of crops and **798 million** acres of grazing land
 - Only **20%** of land is used for food we directly eat
- **80%** of water use

INDUSTRIAL AGRICULTURE, LAND & LABOR: INCREASING CONCENTRATION AND DISPARITY



- **>70%** cropland acres are monoculture; **8%** of farms control **40%** of farmland
- **6%** of farms produce **90%** of meat, dairy, poultry
- **98%** of farmland owned by whites; **60%** of farm labor people of color
- Under 2% of US labor in agriculture (4M jobs)

INDUSTRIAL AGRICULTURE IMPACTS ON THE ENVIRONMENT AND PUBLIC HEALTH



PUBLIC HEALTH

- Diet-related diseases cost over \$1 trillion / year
- 70% American adults overweight or obese
- Major source of lead
- Antibiotics in feed → antibiotic resistance

WATER QUALITY IMPAIRMENT

- Water pollution & soil erosion >\$200B/year
- E.g. Gulf dead zone; Toledo drinking water
- **Unsafe nitrate levels** found in 1,500 utilities (serving 7.1 million people)



WILDLIFE CONFLICT

- Livestock grazing v. wolves & bears
- Loss of habitat – up to **7.8 million acres** converted to cropland between 2007-2012

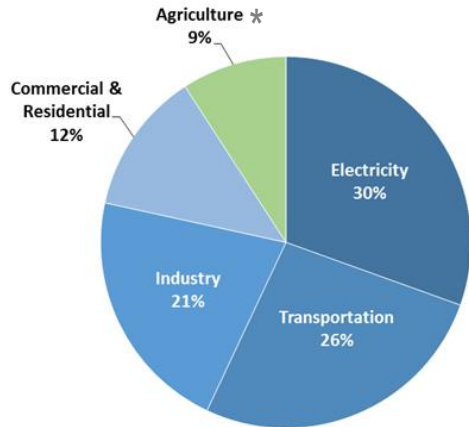


TOXIC CHEMICAL EXPOSURE

- Pesticide residues found on **85%** of tested foods
- **50 million** Americans drink water contaminated with agricultural chemicals



INDUSTRIAL AGRICULTURE CONTRIBUTES TO CLIMATE CHANGE



* Does not include GHG from land conversion, foregone sequestration; additional food system emissions from processing, refrigeration, cooking, transport, etc.

NITROUS OXIDE

- Excess fertilizer, animal manure
- ~91 coal-fired power plants



SOIL CARBON

- Forest and grassland conversion, tillage
 - ~14 coal-fired power plants
- 7.8M+ acres converted to cropland from 2008-2012



METHANE

- Cattle, animal manure
- ~68 coal-fired power plants
- Equal to emissions from entire oil and gas sector



CARBON DIOXIDE

- Fertilizer manufacture, on-farm energy, food waste in landfills
 - ~12 coal-fired power plants

CLIMATE CHANGE HARMS AGRICULTURE



EXTREME WEATHER

- Hurricanes and storms increase in frequency and severity
- Hurricane Maria: \$780M in ag losses
- CAFO overflows



PESTS, WEEDS, DISEASES

- More optimal living conditions for pests, parasites and fungi
- Invasive species expand and spread
- Reduced resilience to disease outbreak



HEAT WAVES AND WILDFIRES

- More frequent and severe
- Lead to yield declines
- Dangerous working conditions



FLOODS AND DROUGHTS

- Irregular and extreme precipitation events more frequent and severe
- 2016 CA Drought: \$603M in ag losses
- 2019 Midwest floods: 5-10M bushels corn and soy rotted; 19M acres left unplanted



CURRENT AGRICULTURE SYSTEM IS NOT THE ONLY OPTION



- Current system is profoundly shaped by policy (especially Farm Bill; environmental law exemptions)
- Industrial, chemical-dependent monoculture systems are not necessary to “feed the world”
 - Organic and agro-ecological practices are highly productive
- The “true cost” of food is **at least double** the market price when include environmental and health costs

AGROECOLOGICAL PRACTICES REDUCE CHEMICAL USE, POLLUTION, CLIMATE IMPACTS



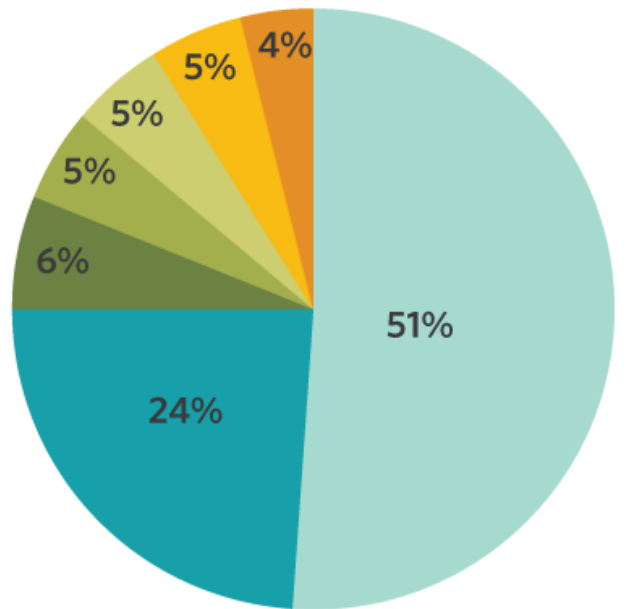
Annual crop root mass (left) vs. perennial crop root mass (right).

Greater root mass improves drought/flood resilience and nutrient uptake.

- **Organic and agroecological practices can provide ample nutritious food** while reducing fertilizer/pesticide needs and costs
- These proven practices include:
 - Perennial crops (see *image*)
 - Precision fertilizer management
 - Crop rotations (different yearly crops)
 - Cover crops (avoiding winter bare ground)
 - No-till, reduced till; prairie strips
 - Management intensive grazing
 - Agroforestry & silvopasture (trees)
 - Dry manure management
 - Organic fertilizer, compost, biochar
 - Riparian buffers

OPPORTUNITY: TECHNOLOGICAL INNOVATION

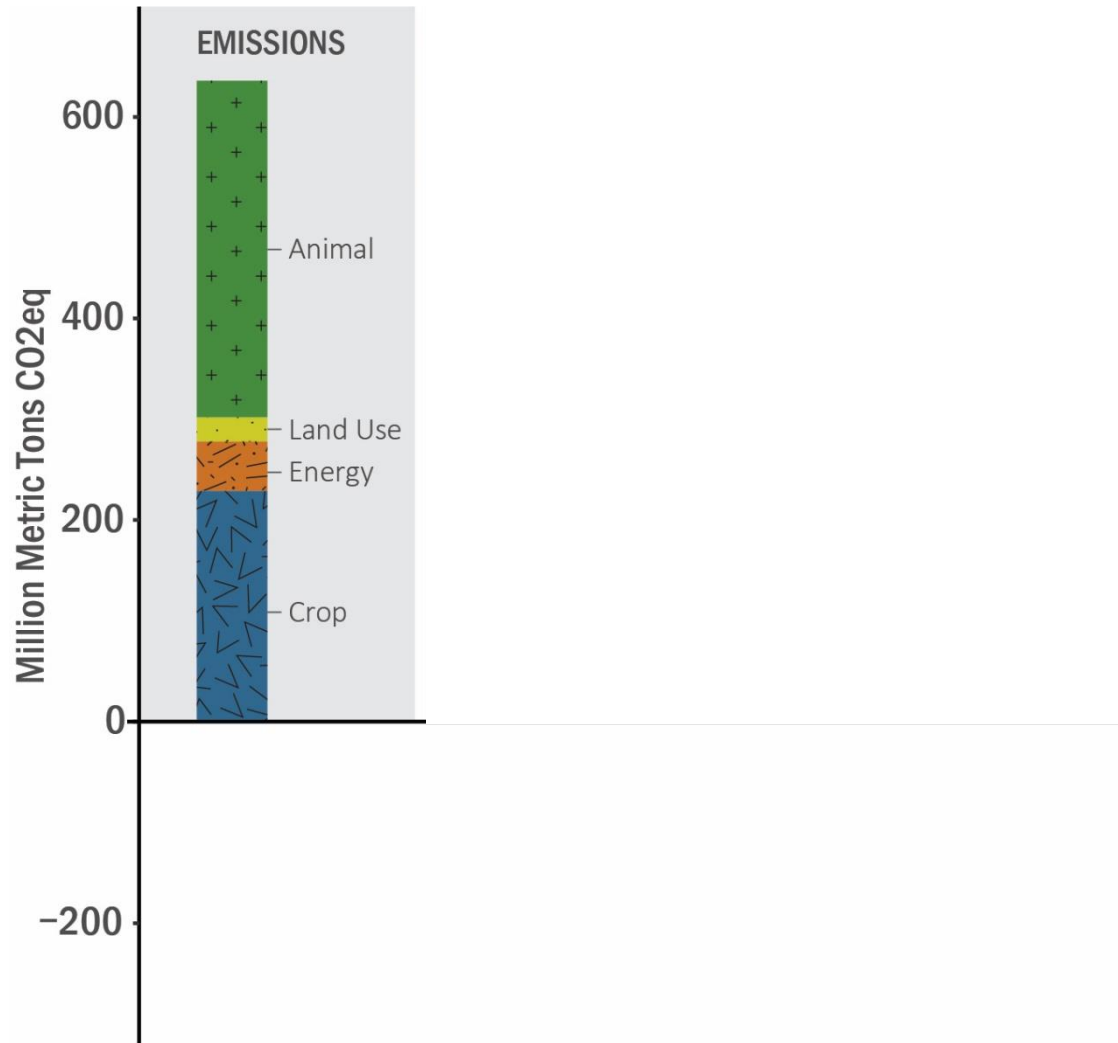
2014 AgTech Investments by Sub-Sector



- Food logistics
- Genomics
- Livestock & dairy
- Agriculture software
- Crop health
- Precision hardware
- Indoor cultivation systems

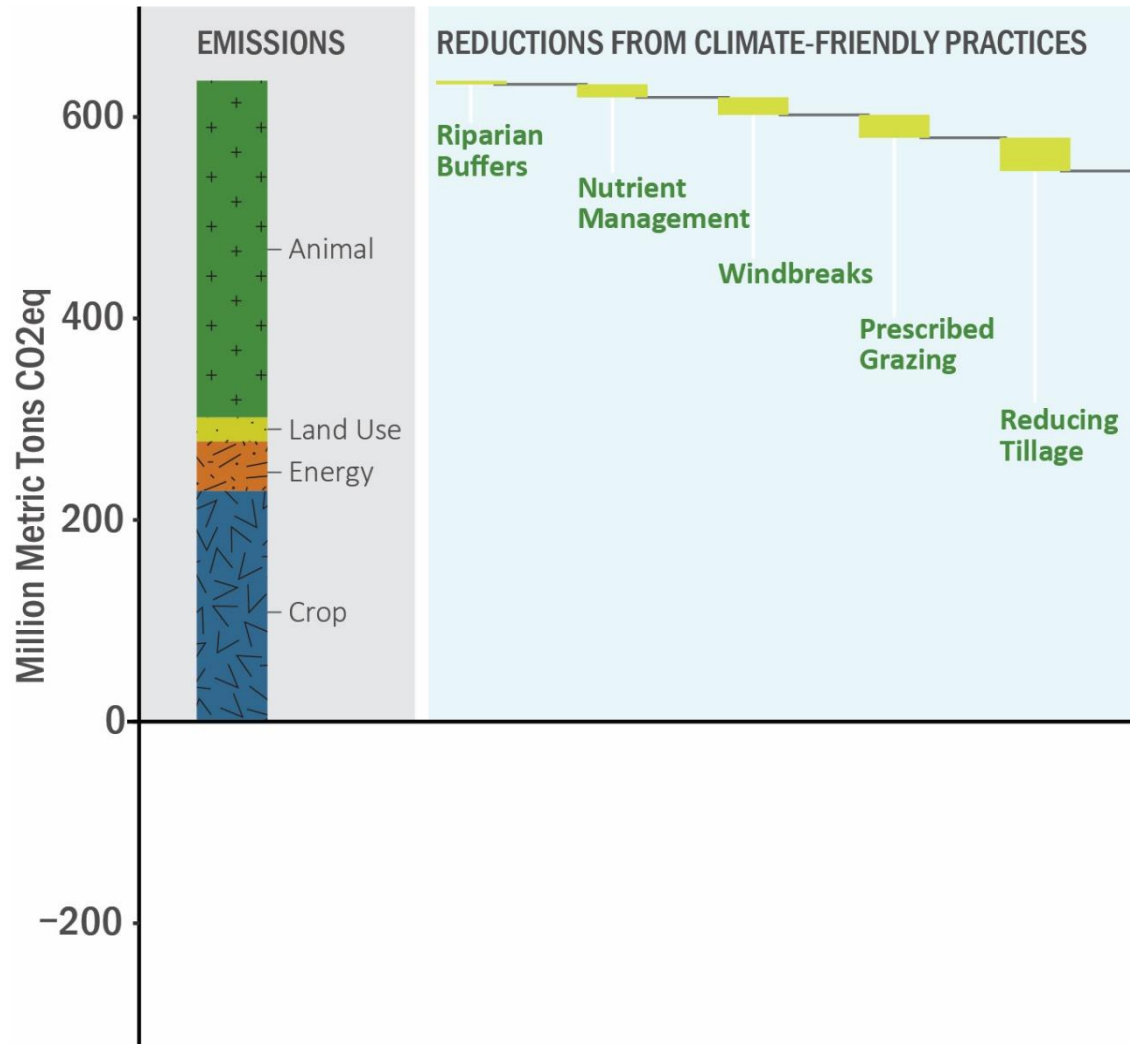
- AgTech investments grew at **63%** CAGR 2010 – 2015; > **\$4.6B** of investments in agricultural startups
 - Same growth rate as FinTech (65%)
- Examples:
 - Blue River Technology “see and spray” robots
 - Indoor vertical farms
 - Remote and drone sensing and drone pesticide delivery
 - Breeds, feed additives (e.g. seaweed to reduce methane)

WHY THIS MATTERS: HEALTHY SOIL PRACTICES CAN MAKE AGRICULTURE CARBON-NEUTRAL



Based on estimates from USDA NRCS COMETS planner.

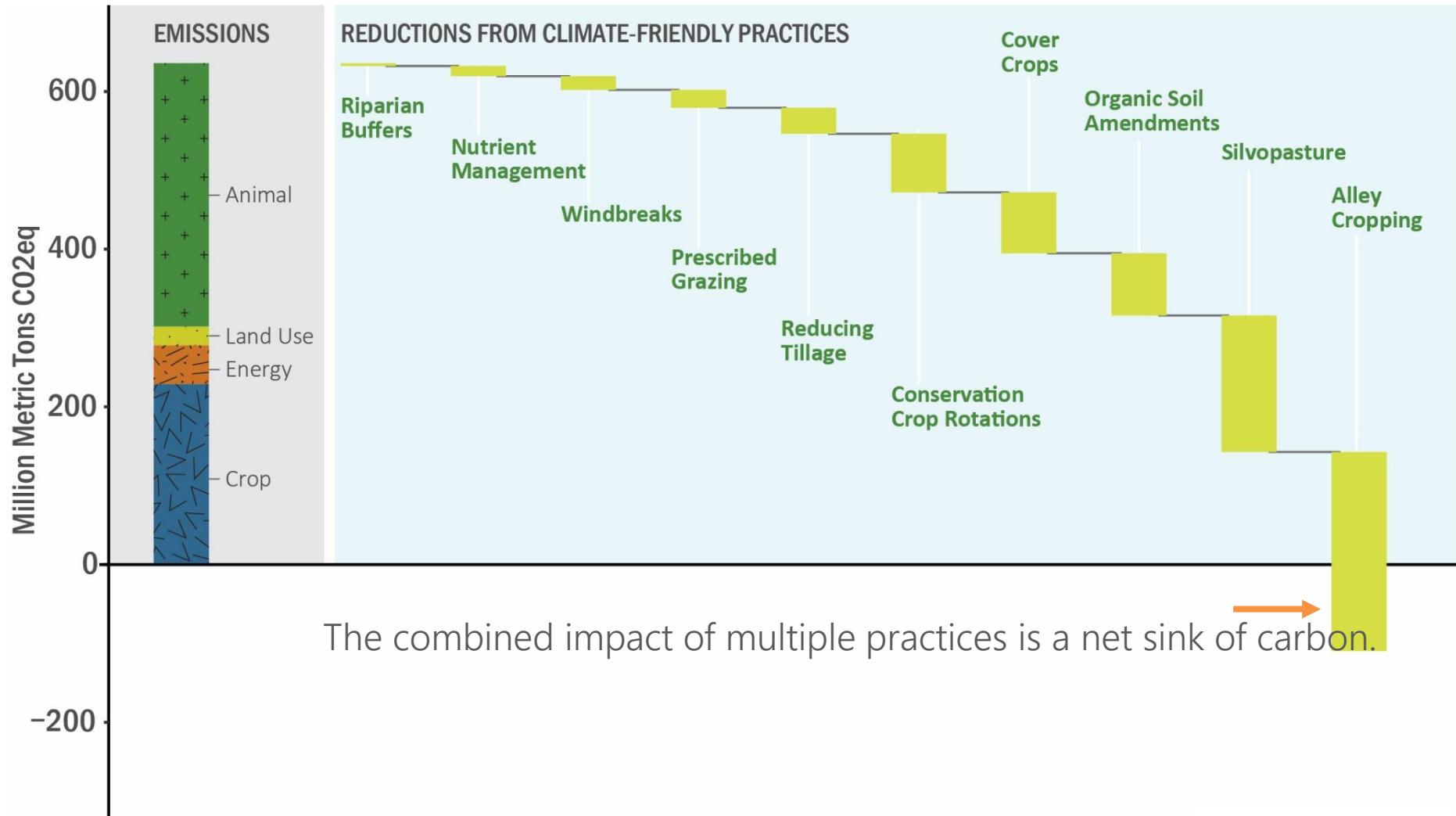
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Each practice counteracts emissions by storing carbon or reducing emissions.

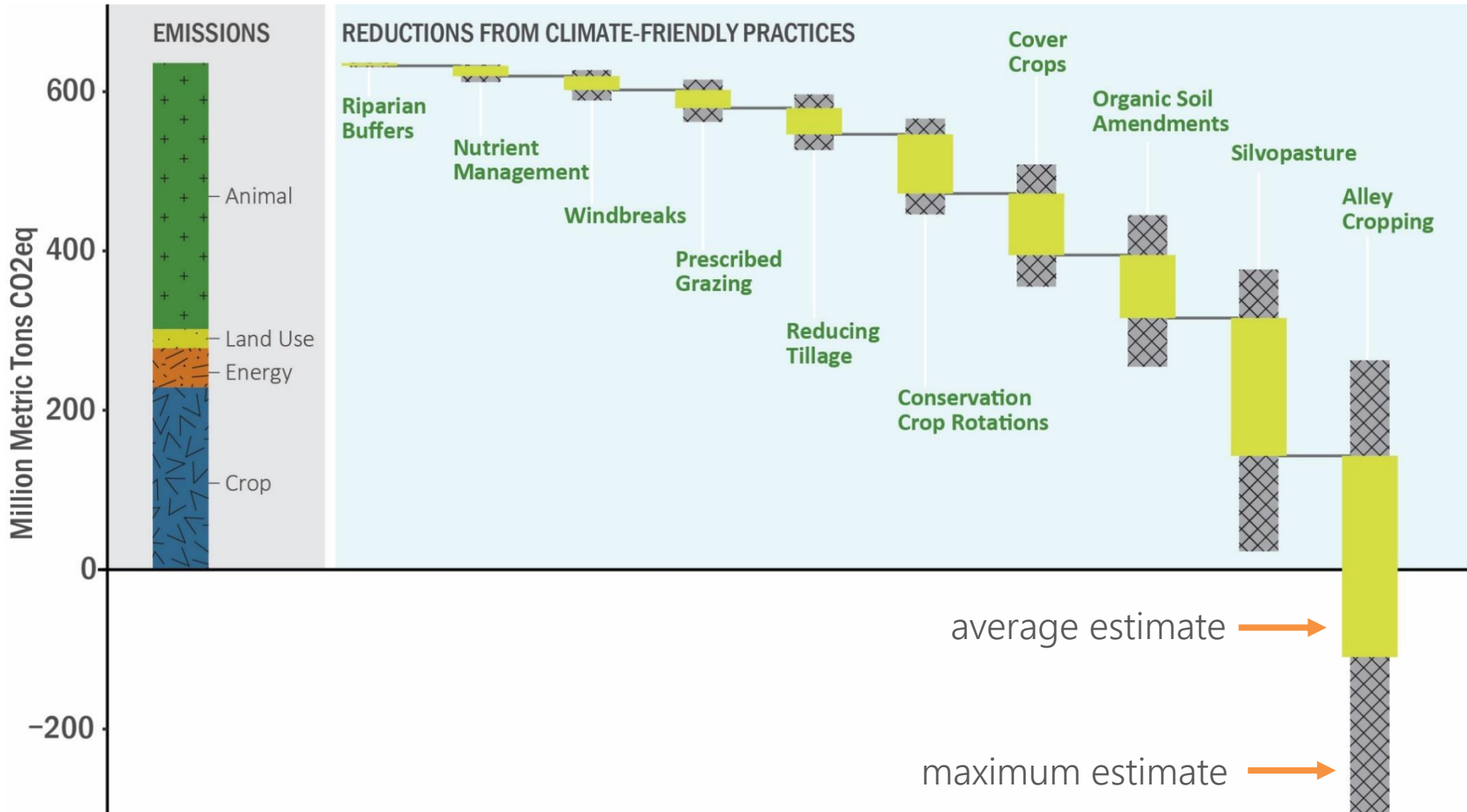
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WHY THIS MATTERS: HEALTHY SOIL PRACTICES CAN MAKE AGRICULTURE CARBON-NEUTRAL



The combined impact of multiple practices is a net sink of carbon.

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ALTERNATIVE PRACTICES NEED INCENTIVES TO INCREASE ADOPTION

- Agroecological practices are very effective, but not widely employed
 - **Universal barriers include:** knowledge and capacity, technical support, lack of site- or region-specific information, cultural attitudes, financial risks and opportunity costs...
 - **>85%** of USDA survey participants would NOT adopt structural conservation practices without outside funding

PRACTICE	U.S. ADOPTION RATE
Cover crops	~4% of all cropland acres
No-till	26% of all cropland acres*
Fertilizer management	6% of corn and 24% of cotton acreage meet all 4 criteria for good nitrogen management**
Crop rotations (>2 years)	~11% of all cropland acres
Residue grazed by livestock	12% of corn acreage
Certified organic	<1% of all US farms

*Less than a third of “no-till farms” are truly no-till.

**No fall application, optimal rate, some N after planting, incorporated below soil surface

STATUTORY AND ADMINISTRATIVE CHANGES NECESSARY

- **The Farm Bill**

- Expand and better target **conservation programs** to practices with climate change mitigation and resilience potential and away from practices with negative impacts
- Increase funding for **R&D** into climate-friendly practices, education, & outreach
- Reform **crop insurance and commodity payments** to avoid barriers to climate-friendly practices and create additional incentives

- **Energy policy and laws**

- Fix **renewable fuel standard** to reduce conversion of native grasslands to cropland
- Encourage **on-farm renewable energy** and energy efficiency

- **Pollution and land management statutes**

- Eliminate barriers and create incentives for management intensive grazing
- Increase information sharing and data availability
- Prioritize climate beneficial practices in other water and air quality programs (e.g. nonpoint source)

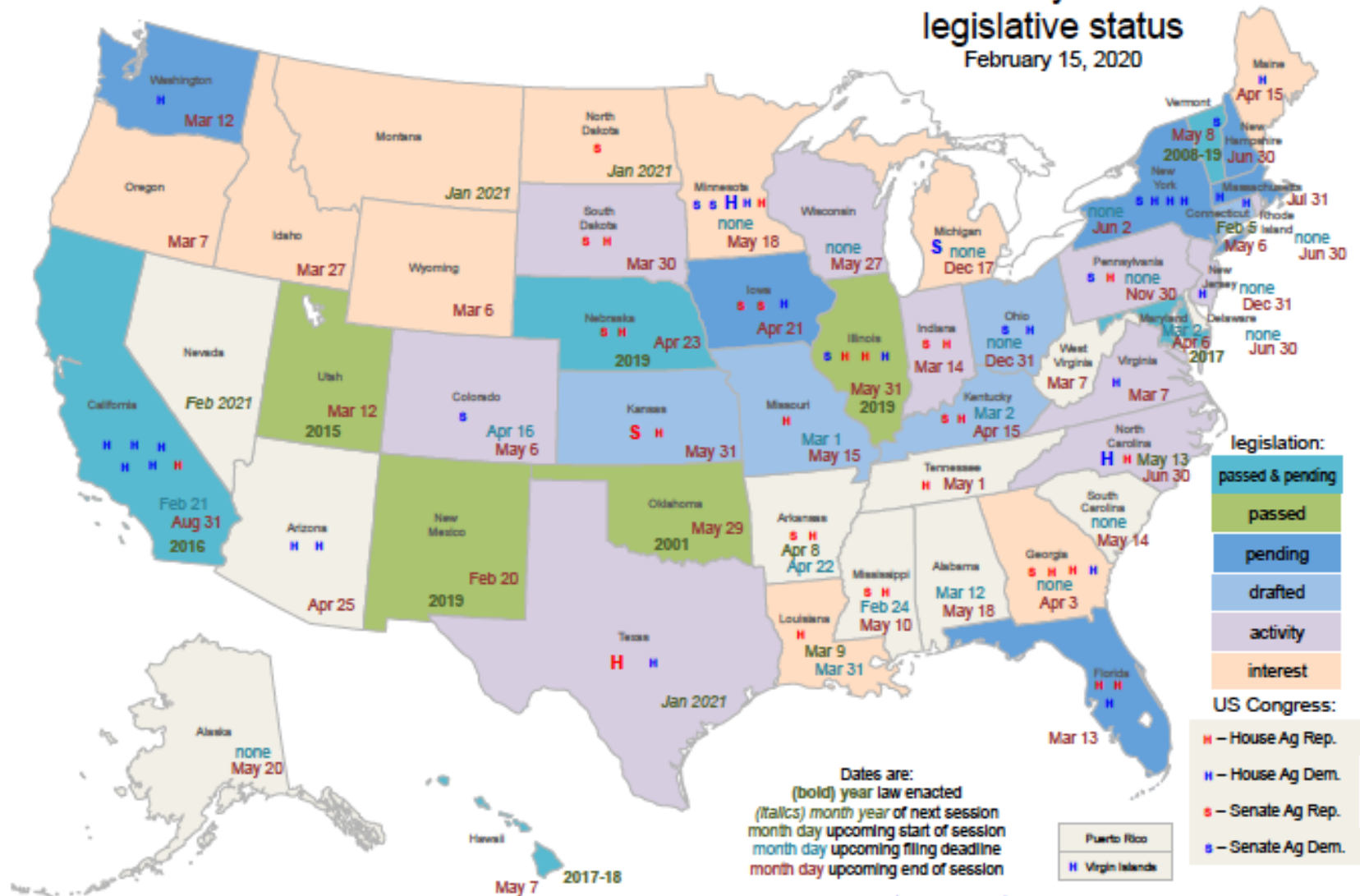
GROWING INTEREST IN FEDERAL GOVERNMENT

- 2018 Farm Bill contained some healthy soil provisions
- May 2019 Senate Agriculture Committee hearing
- House Select Committee on the Climate Crisis report
- USDA framework for reducing environmental footprint

- Agriculture Resilience Act H.R. 5861 (Pingree)
 - **Sets goals** on funding, food waste, year-round cover, advanced grazing, GHG emissions, energy, etc.
 - **Research & outreach** for regional Climate Hubs, regionally adopted breeds and crops, regional agroforestry centers
 - **Soil health** improvements to conservation programs, expanding conservation compliance to all states
 - **Farmland Preservation**
 - **Pasture-Based Livestock** - removes barriers & provides incentives
 - **On-Farm Renewable Energy** - audits and incentives
 - **Food Waste** - improves food date labels, composting

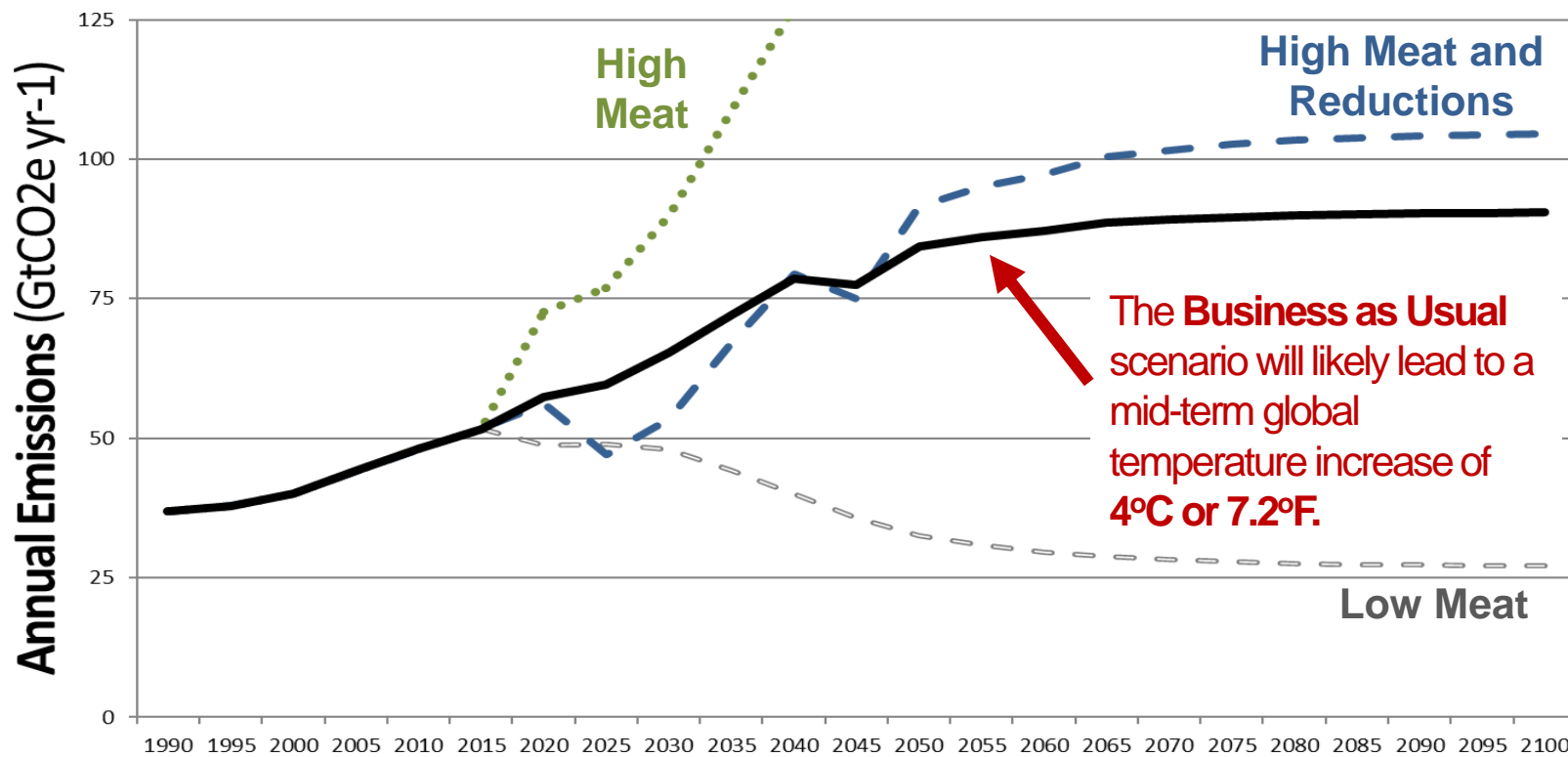
GROWING INTEREST AT STATE LEVEL TO PROMOTE HEALTHY SOILS

Healthy Soils legislative status February 15, 2020



IT'S NOT JUST *HOW* WE GROW FOOD, BUT *WHAT* WE GROW

- Diet drives both **climate change** and **land-use change**
 - If the entire world ate a Western diet, we would need another Canada of cropland



THANK YOU AND QUESTIONS

