ADDRESSING CLIMATE CHANGE WITH AGRICULTURE IN OUR OPEN SPACE

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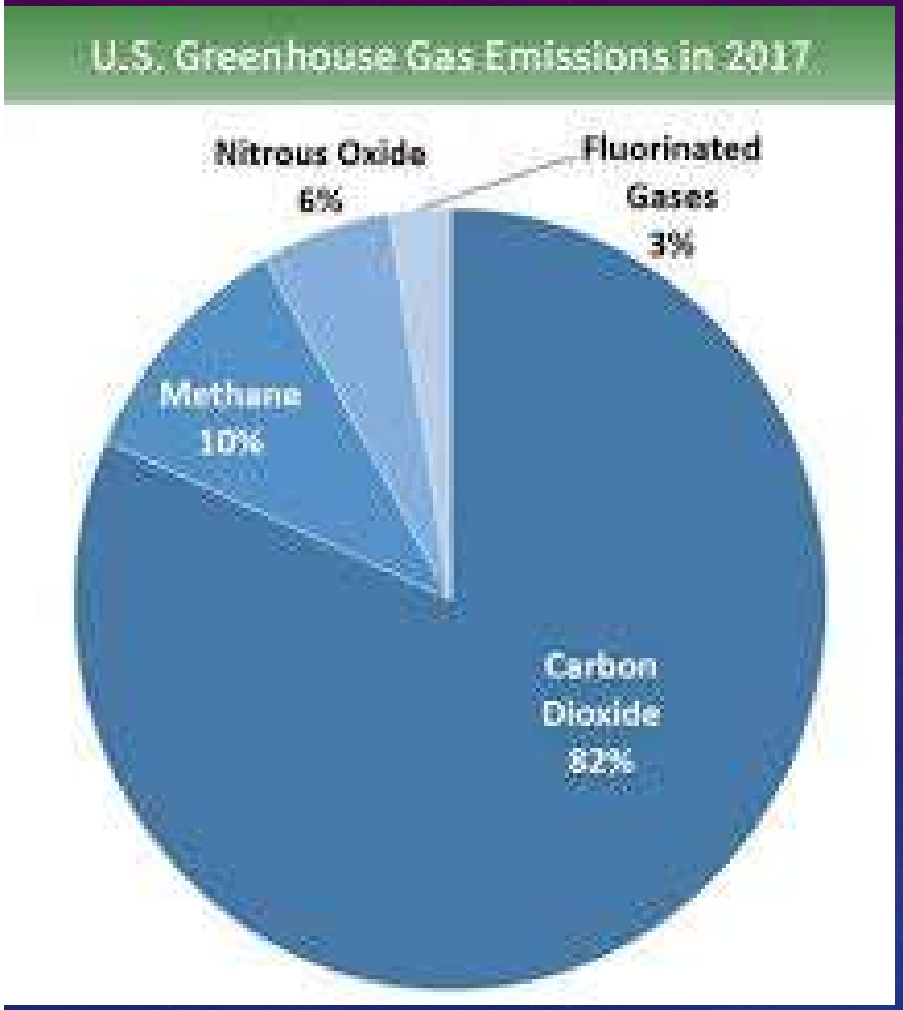
TODAY'S AGENDA

- **GREENHOUSE GASES OVERVIEW**

- **AGRICULTURE PRACTICES AS POTENTIAL SOURCES OF GREENHOUSE GASES,**

- **ADAPTING TO CLIMATE CHANGES TO PROVIDE FOR SUSTAINABLE FOOD PRODUCTION**



US GREENHOUSE GAS EMISSIONS

EPA 2017

A10

US AGRICULTURE =

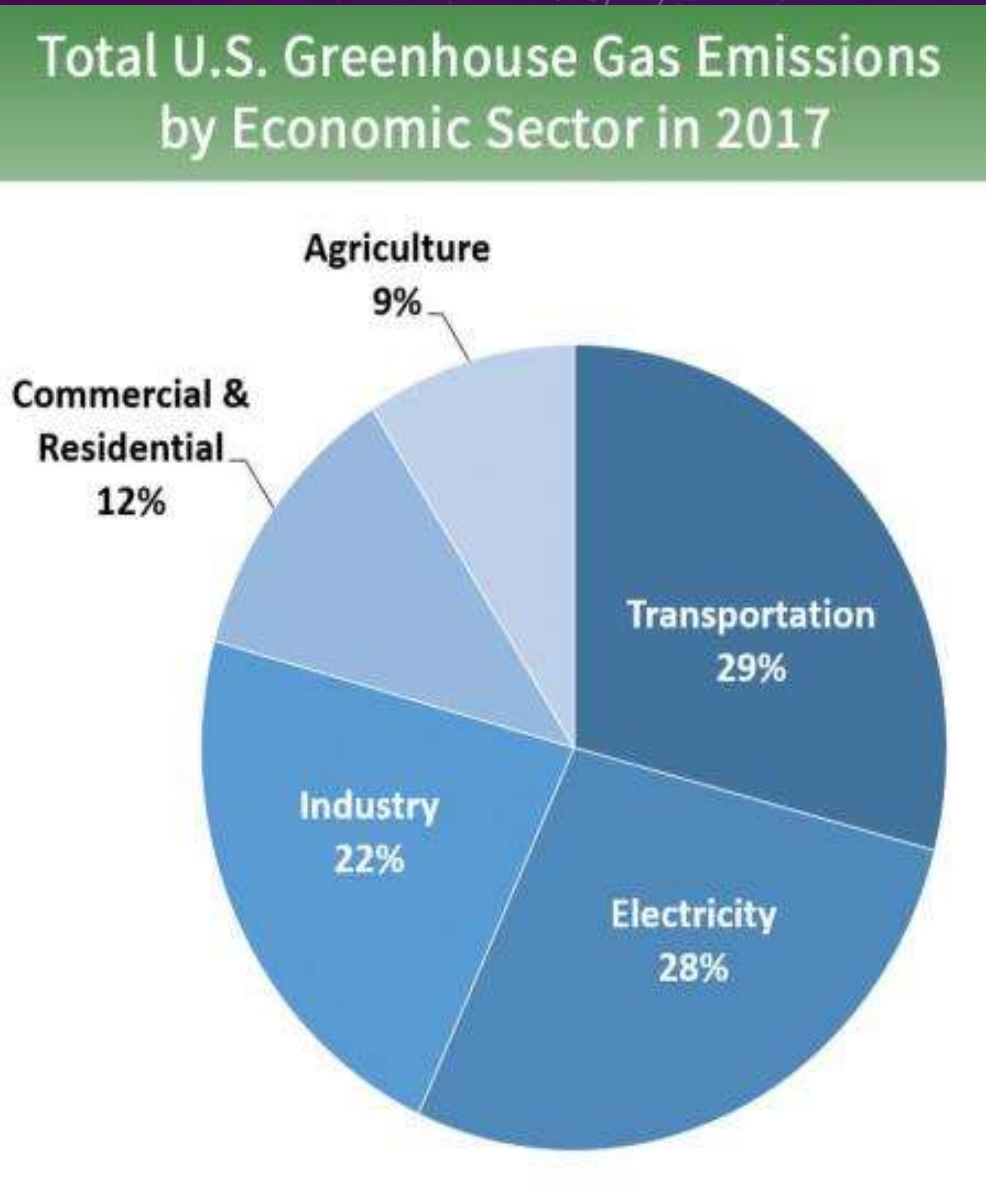
9% OF TOTAL U.S. GHG:

4.5% FERTILIZERS/ IRRIGATION (N2O)

3% BELCHING (METHANE)

1.5% MANURE STORAGE (N2O/ METHANE)

EPA 2017



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A10 Author, 3/7/2020

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INTERGOVERNMENTAL PANEL

ON

CLIMATE CHANGE

(IPCC)

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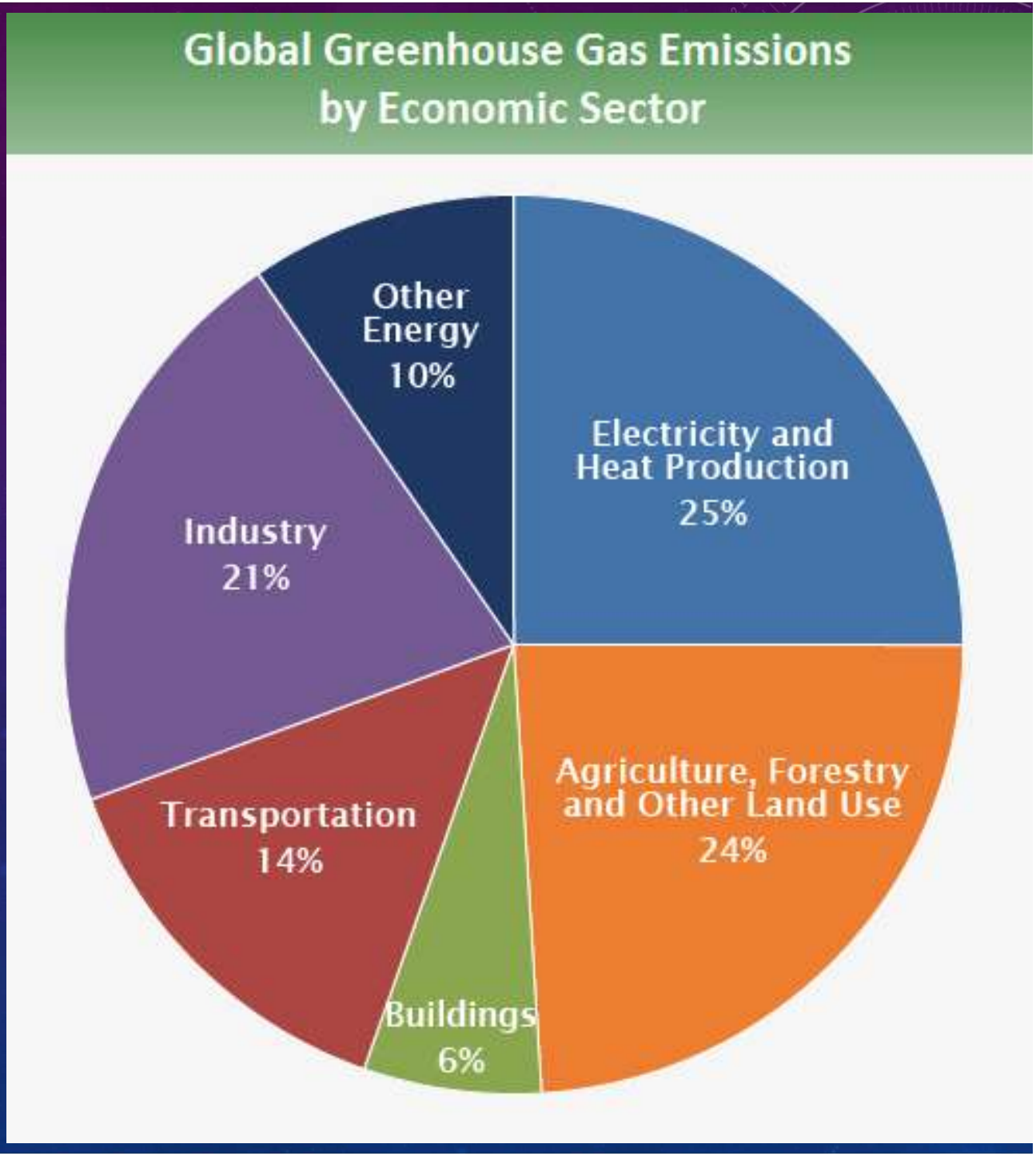
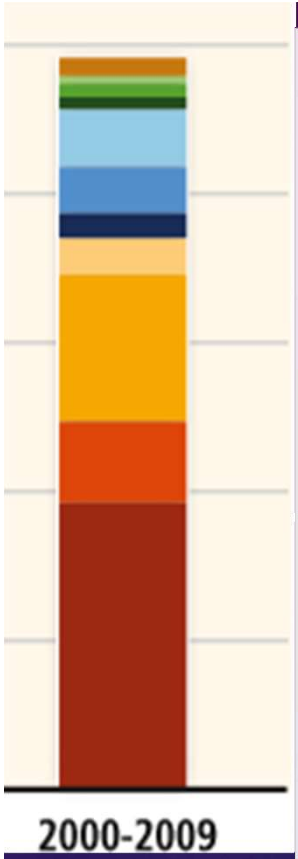
A6 Author, 3/4/2020

GLOBAL GHG

EPA 2015





AGRICULTURE EMISSIONS

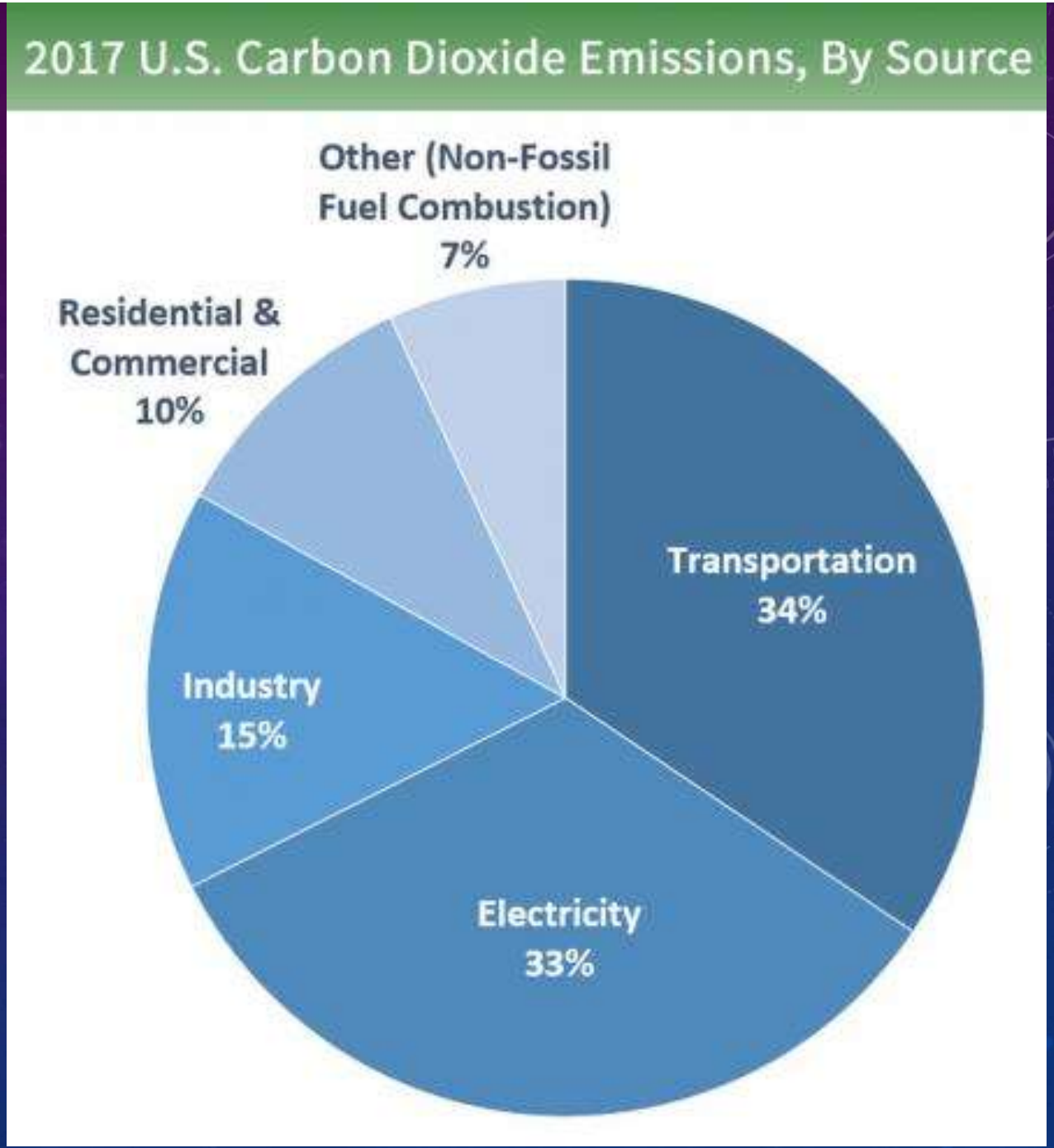
- Crop Residues and Savannah Burning (N_2O,CH_4)
- Cultivated Organic Soils (N_2O)
- Crop Residues (N_2O)
- Manure Applied to Soils (N_2O)
- Manure on Pasture (N_2O)
- Synthetic Fertilizers (N_2O)
- Manure Management (CH_4 and N_2O)
- Rice Cultivation (CH_4)
- Enteric Fermentation (CH_4)
- Drained Peat and Peat Fires (CO_2, N_2O, CH_4)
- Land Use Change and Forestry (CO_2)

Global Agriculture Emissions 2009

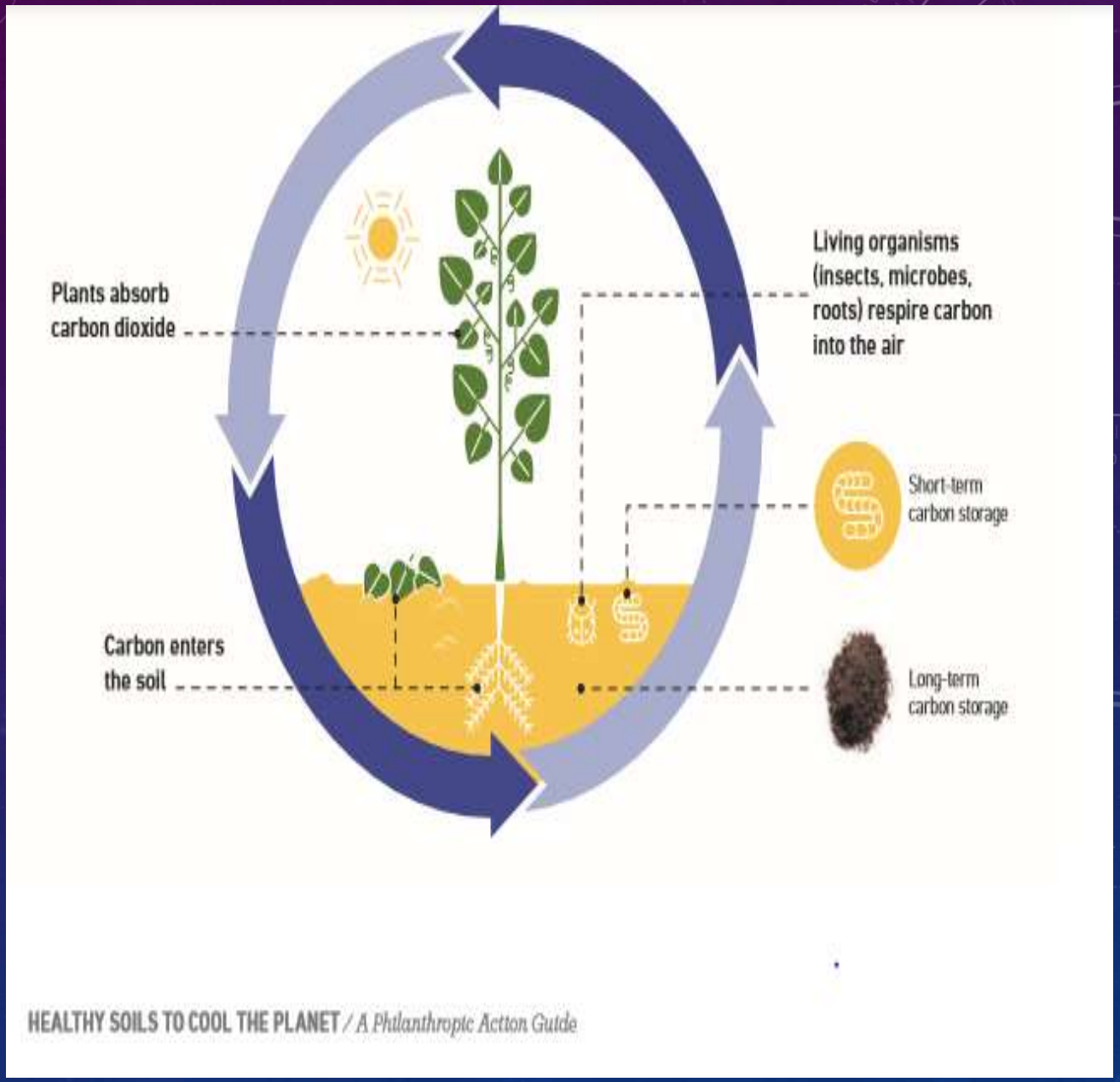
AR5 Climate Change 2014: Mitigation of Climate Change

U.S. CARBON DIOXIDE

EPA 2017



THE CARBON CYCLE



OPTIMIZING PLANT GROWTH/ ROOT HEALTH

SOIL TEXTURE (PER SOIL SURVEY)

SOIL ORGANIC MATTER (PER SOIL O.M. TESTS)

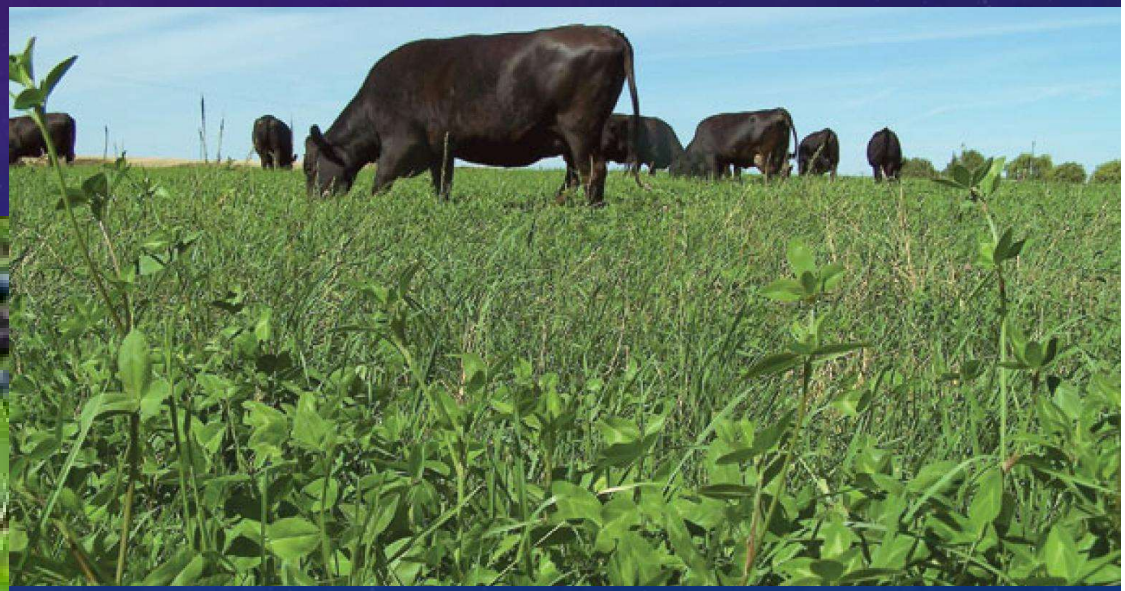
NUTRIENTS/ LIME APPLIED (PER SOIL TESTS)

IMPROVED CROP VARIETIES (PER TRIALS)

HARVESTING DECISIONS (PER ROOT STORAGE)

PERENNIALS grasses , legumes, fruits:

- **Extensive roots / soil organic matter**
- **Less planting/ harvesting and soil exposure**
- **Less machinery fuel burned for planting**



ANNUALS
CORN, SOYBEANS, VEGETABLES

Lots of nutrients per acre

BUT, Annual decomposition

SO, Cover crops important

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COVER CROPS

- PLANTS THAT KEEP THE SOIL COVERED
- INTER SEEDED INTO GROWING CROPS
-
- OR SEEDED AFTER THE HARVEST
- PLANTING DEADLINE OFTEN MISSED !

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A13 Author, 3/8/2020

LIVING ROOTS:

- A BIOLOGICAL COMMUNITY IN THE SOIL

- PROTECT SOIL FROM EROSION

- BUILD ORGANIC MATTER TO HOLD WATER

SOIL ORGANIC MATTER

A well structured soil

ROLE OF ORGANIC MATTER IN SOILS

- WATER HOLDING CAPACITY
- SOIL STRUCTURE (AIR/ WATER/ ROOTS)
- FEEDS MICROBES
- SLOW NUTRIENT RELEASE
- INCREASED PLANT YIELDS

A4

CARBON STORAGE

SOIL ORGANIC MATTER

50% BREAKS DOWN OVER

100 - 1000 YEARS

Unless……

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A4 Author, 3/1/2020

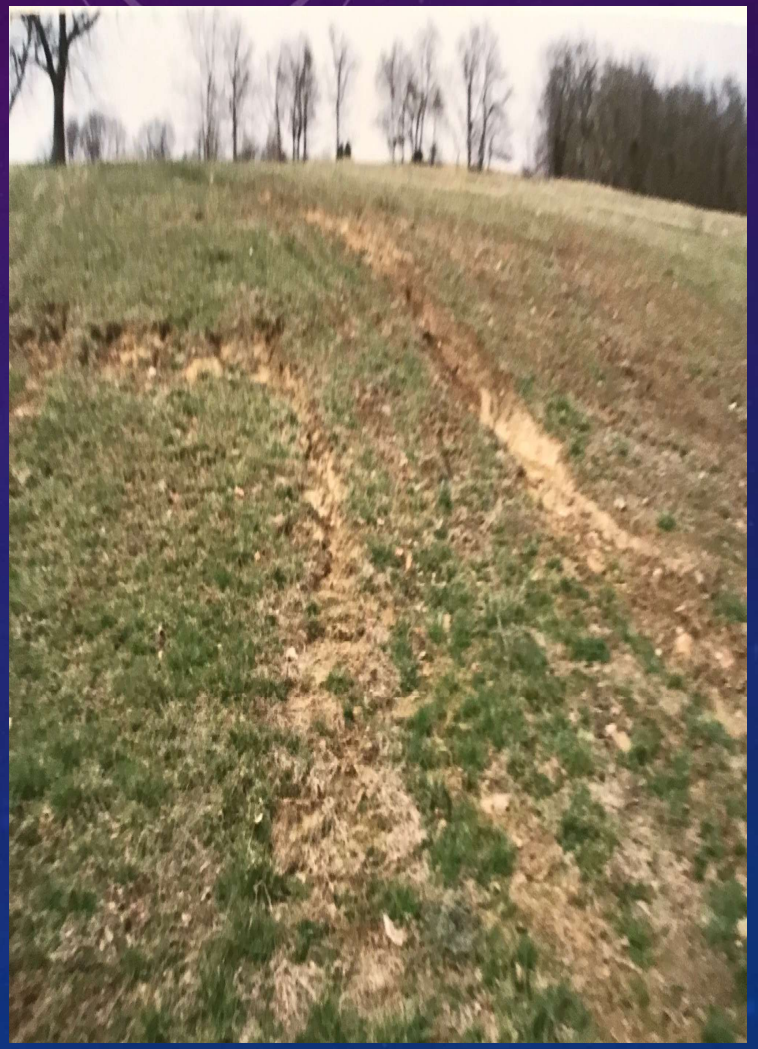
EXPOSURE TO OXYGEN

TILLAGE
BARE LAND
EROSION

Exposes organic matter

Speeds up decomposition

CO2 EMISSION



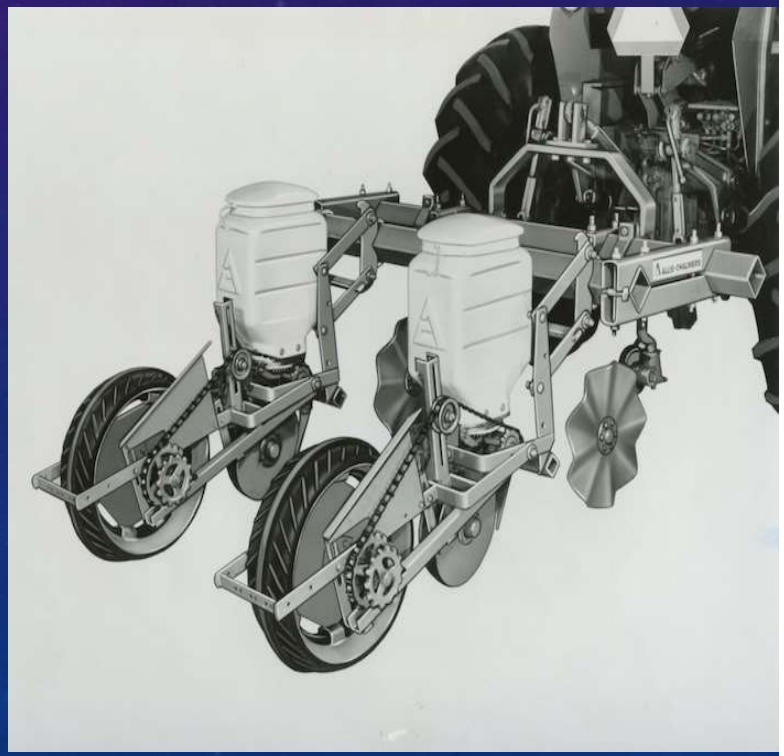
A2

NO TILL SEEDING

COULTERS OPEN SLIT

SEED TUBE
DEPOSITS SEED

PACKER WHEELS
CLOSE SLIT



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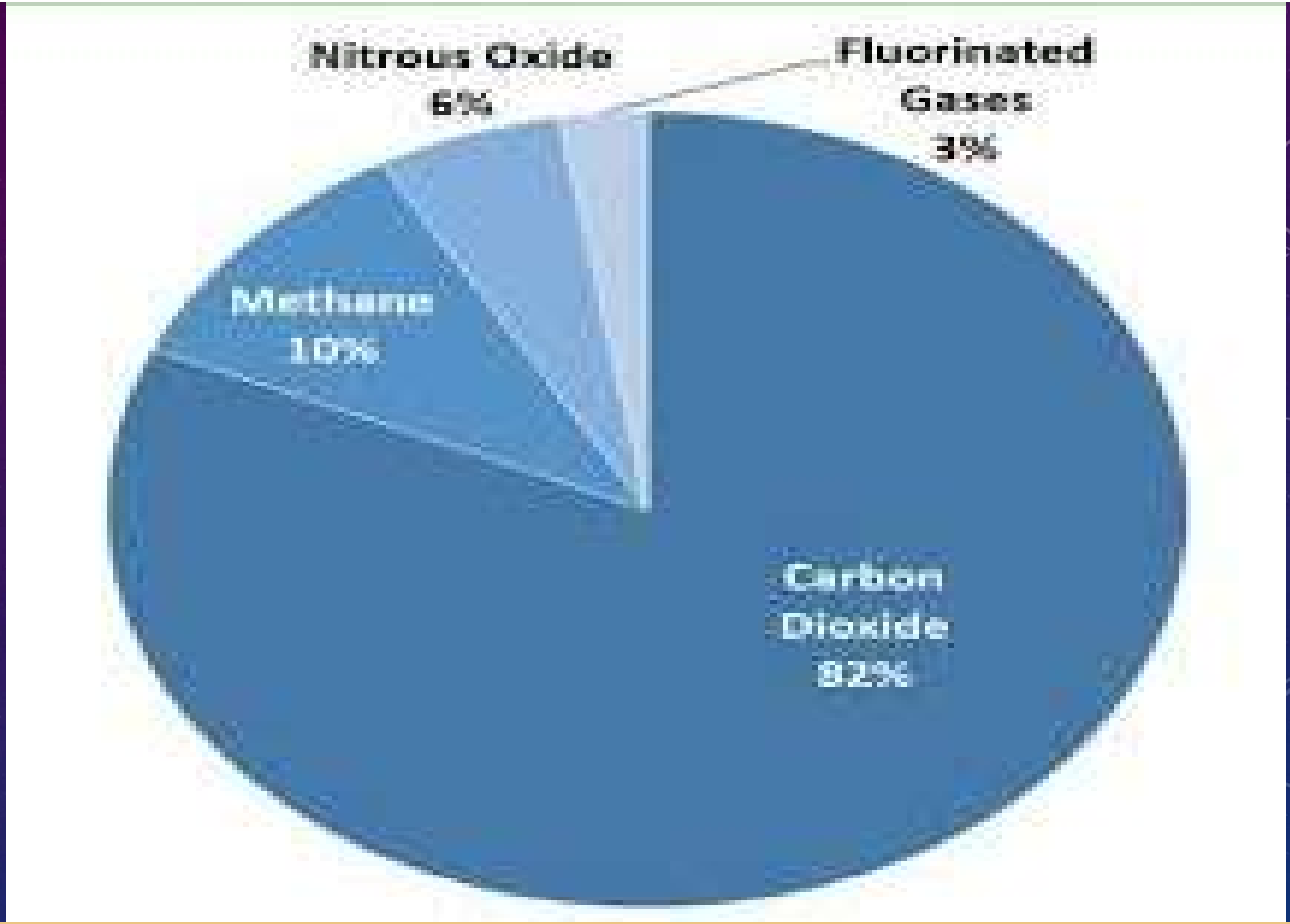
A2 Author, 2/22/2020

Organic matter saturation point

- Organic matter max = 15% in root zone

- Max reached up to 25 years after
  - tillage stops
  - root growth starts



US GREENHOUSE GAS EMISSIONS IN 2017

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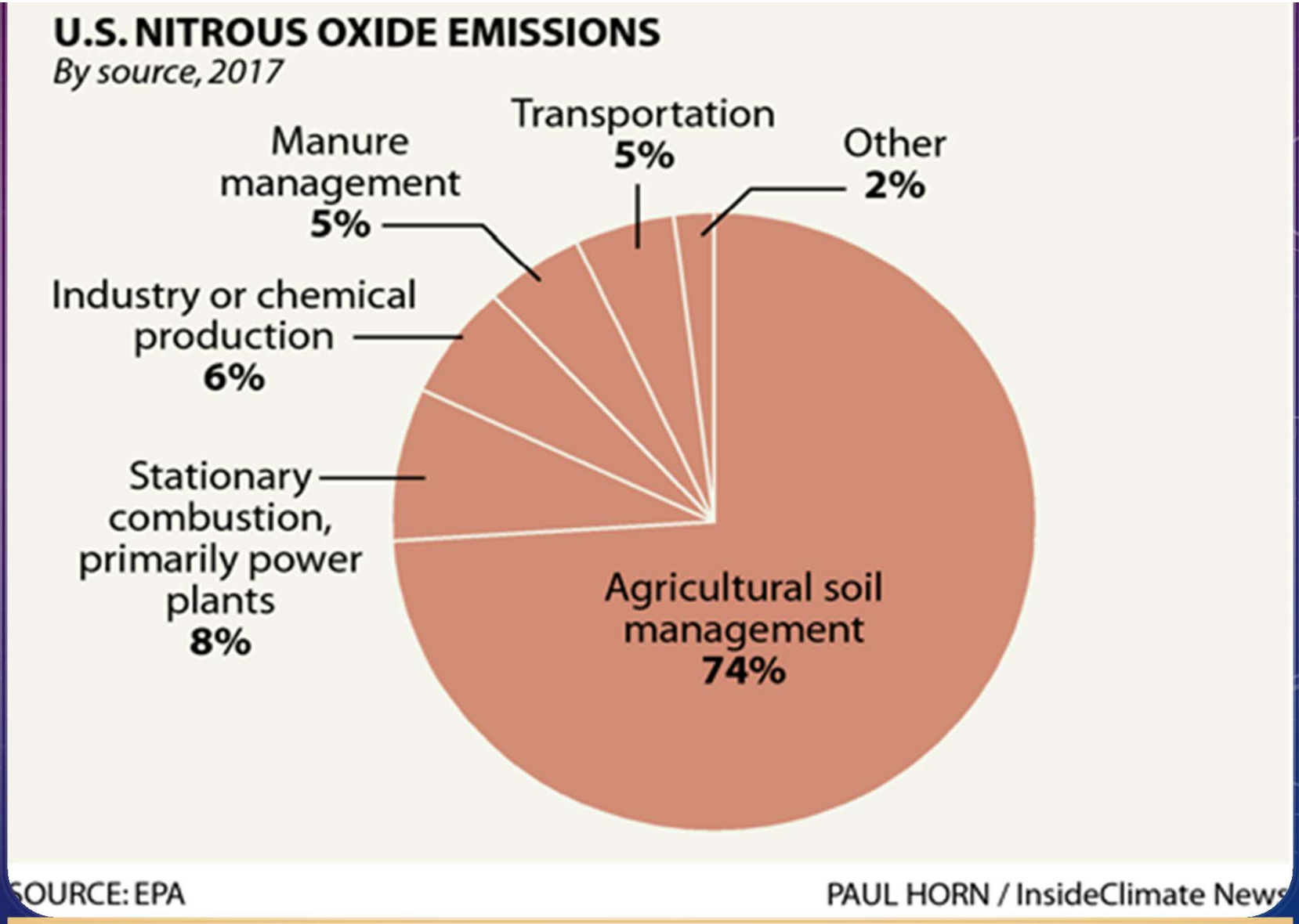

SOURCES OF NITROUS OXIDE

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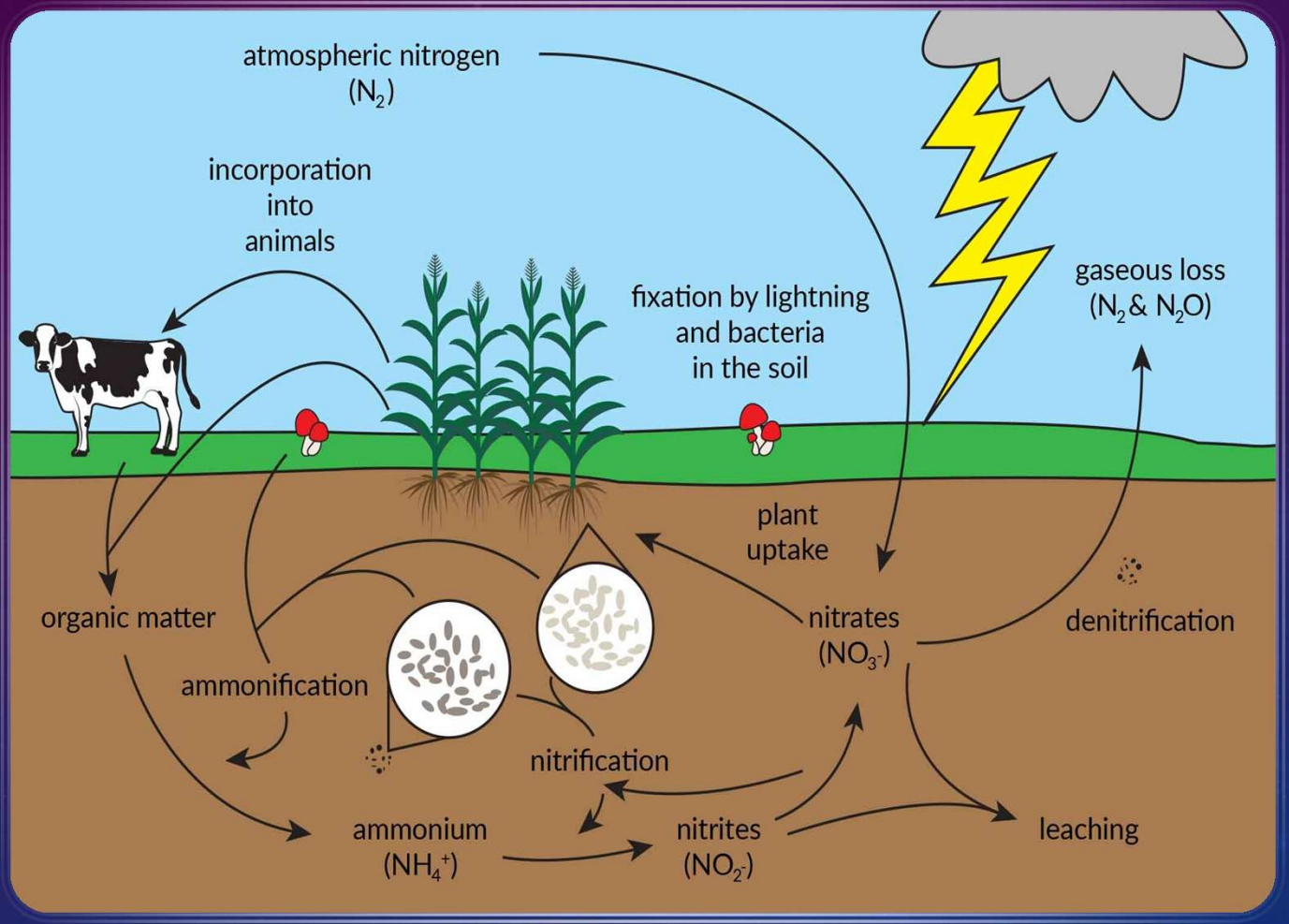
A7 Author, 3/6/2020

N CYCLE



Manure Manager, September, 2016, Maximizing the

NUTRIENT MANAGEMENT TO REDUCE N20 EMISSIONS

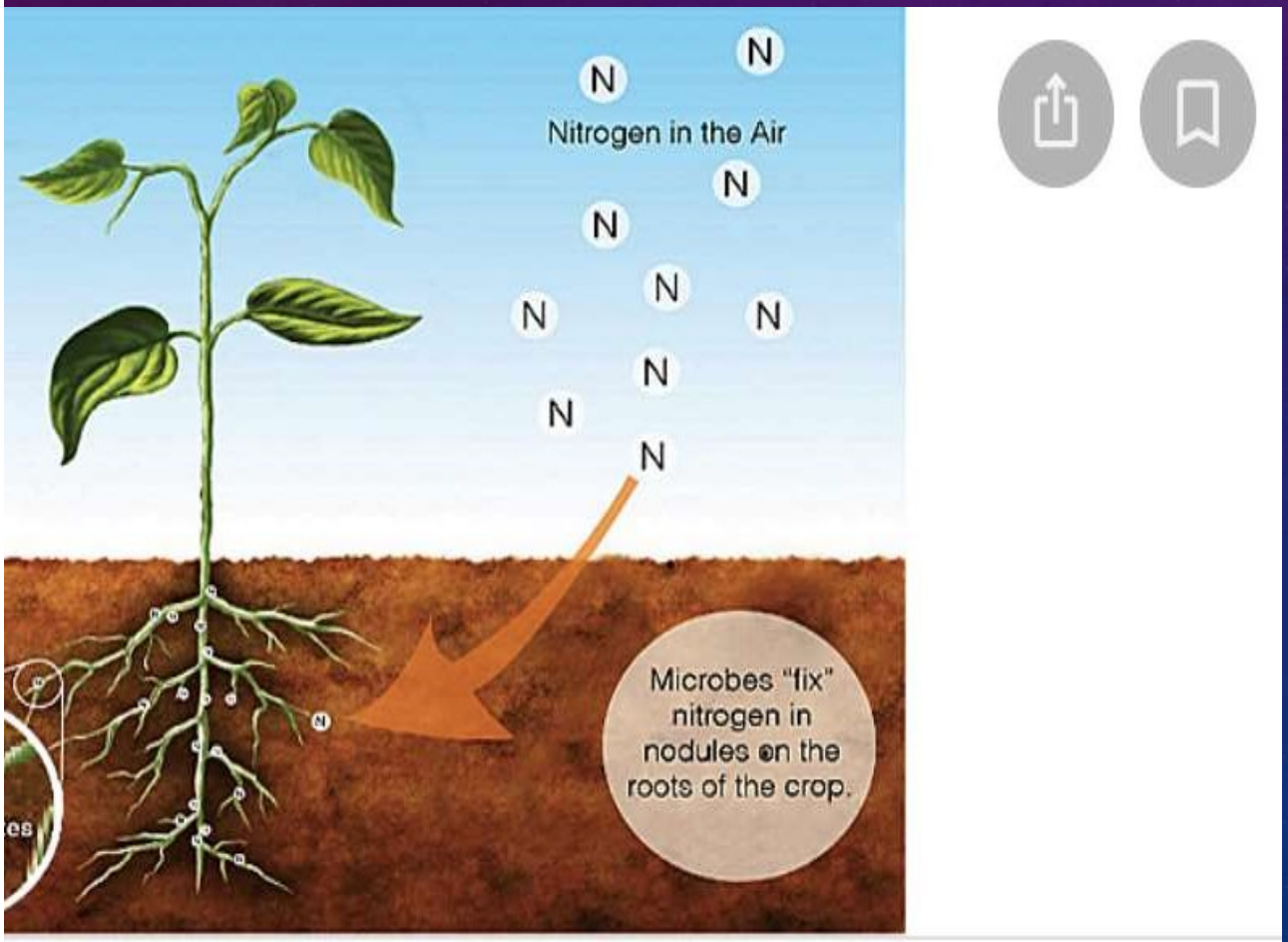
- *BALANCE RATIONS FOR N NEEDS*

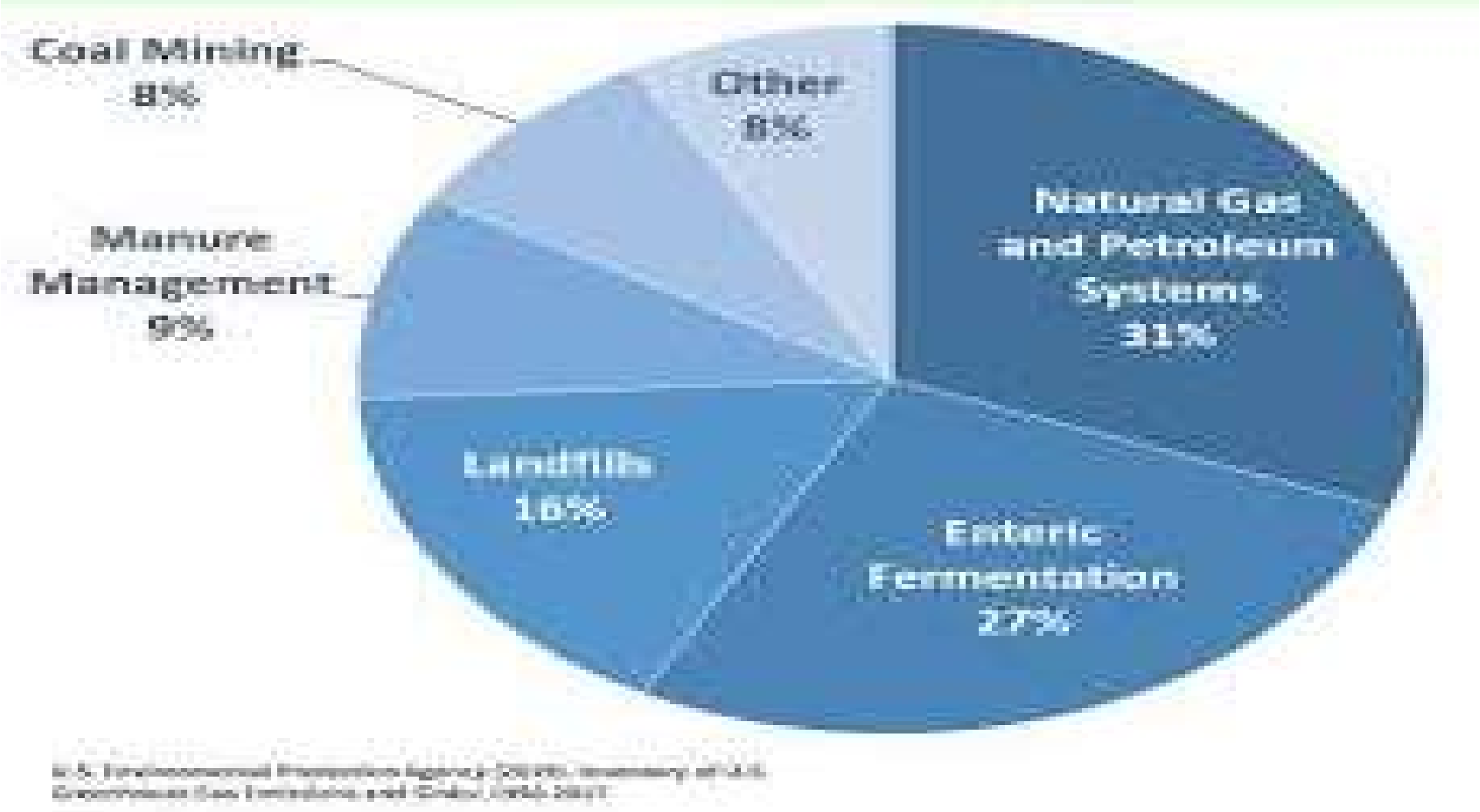
- *FERTILIZER TIMING / QUANTITY / SITE*

- *COVER CROPS REMOVE EXCESS SOIL N*

MICROBES FIX N IN LEGUME NODULES

SCHOOL OF PERMACULTURE



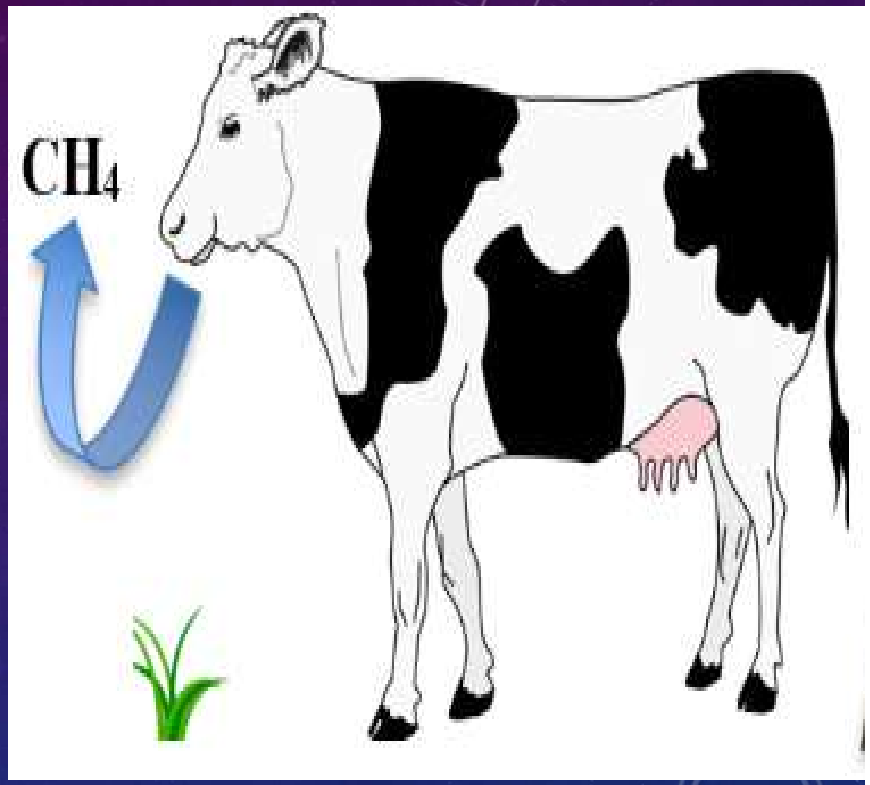


U.S. METHANE SOURCES

EPA, 2017

METHANE

BELCHING



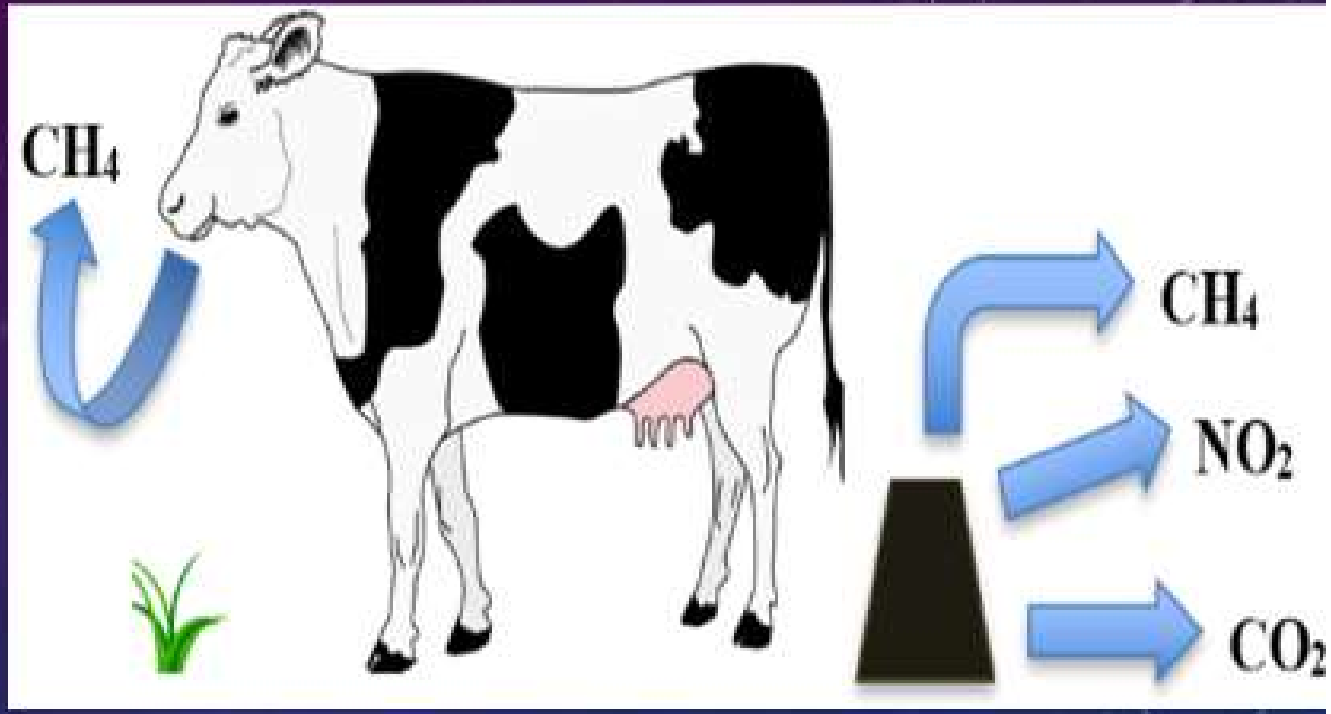
SOURCES OF METHANE

METHANE

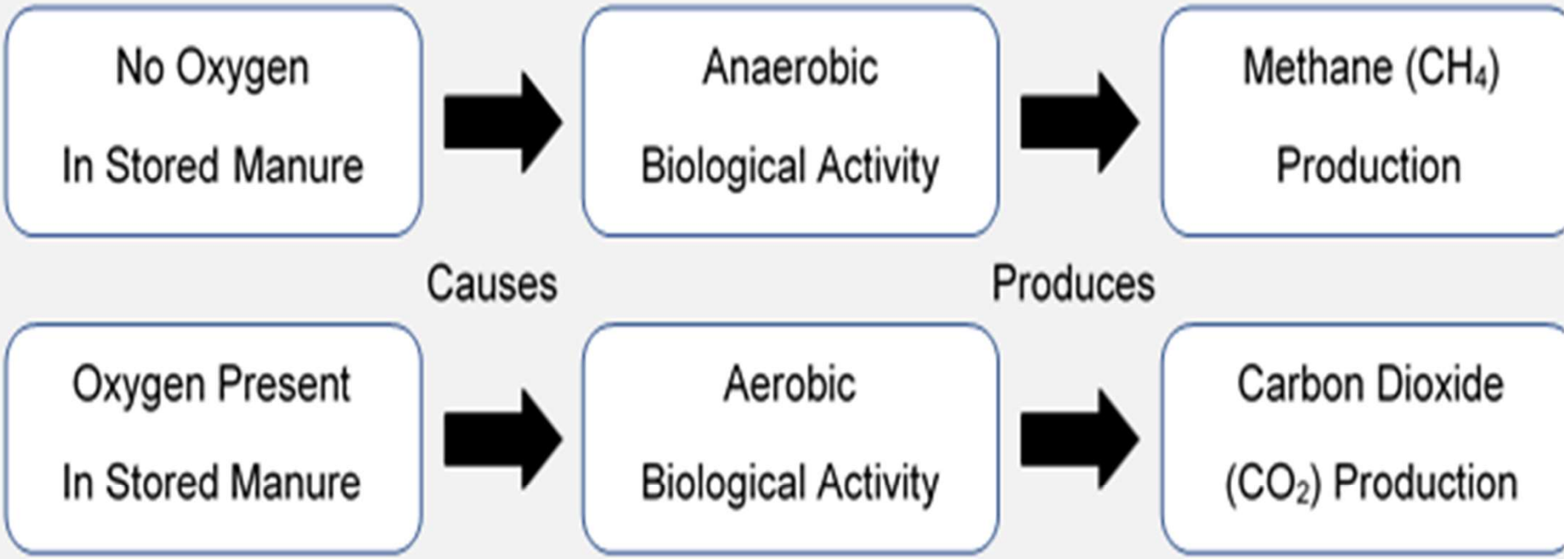
-BELCHING

-EXCRETION

-MANURE STORAGE AND APPLICATION



Biological Processes in Manure Breakdown



Although CO_2 is a GHG, aerobic processes that produce CO_2 are usually desired over anaerobic processes because CH_4 has 25 times the GHG effect.

METHANE FROM MANURE STORAGE

<1% OF U.S. GHG

ANAEROBIC (NO OXYGEN)

- SOLID STOCKPILES
- LIQUID LAGOONS

- DIGESTORS (NO EMISSION)

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A14 Author, 3/23/2020

A8

LIVESTOCK PRODUCTION EFFICIENCY REDUCES METHANE/ UNIT OF FOOD

- Animal health and genetics
- Livestock Nutrition
  - Improved forage quality
  - Healthy supplementation

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A8 Author, 3/7/2020

Improved Forage Quality

- High energy annual forage (c.silage,etc)
- Immature haylage or dry hay
- Rotationally grazed pastures (12 - 4” tall)

Forage Supplementation?

- Forage tested…..animal needs met?

- Supplemented for desired rate of gain/ product quality and yield

  Corn, small grains, food by-products

- Income above feedcosts determined

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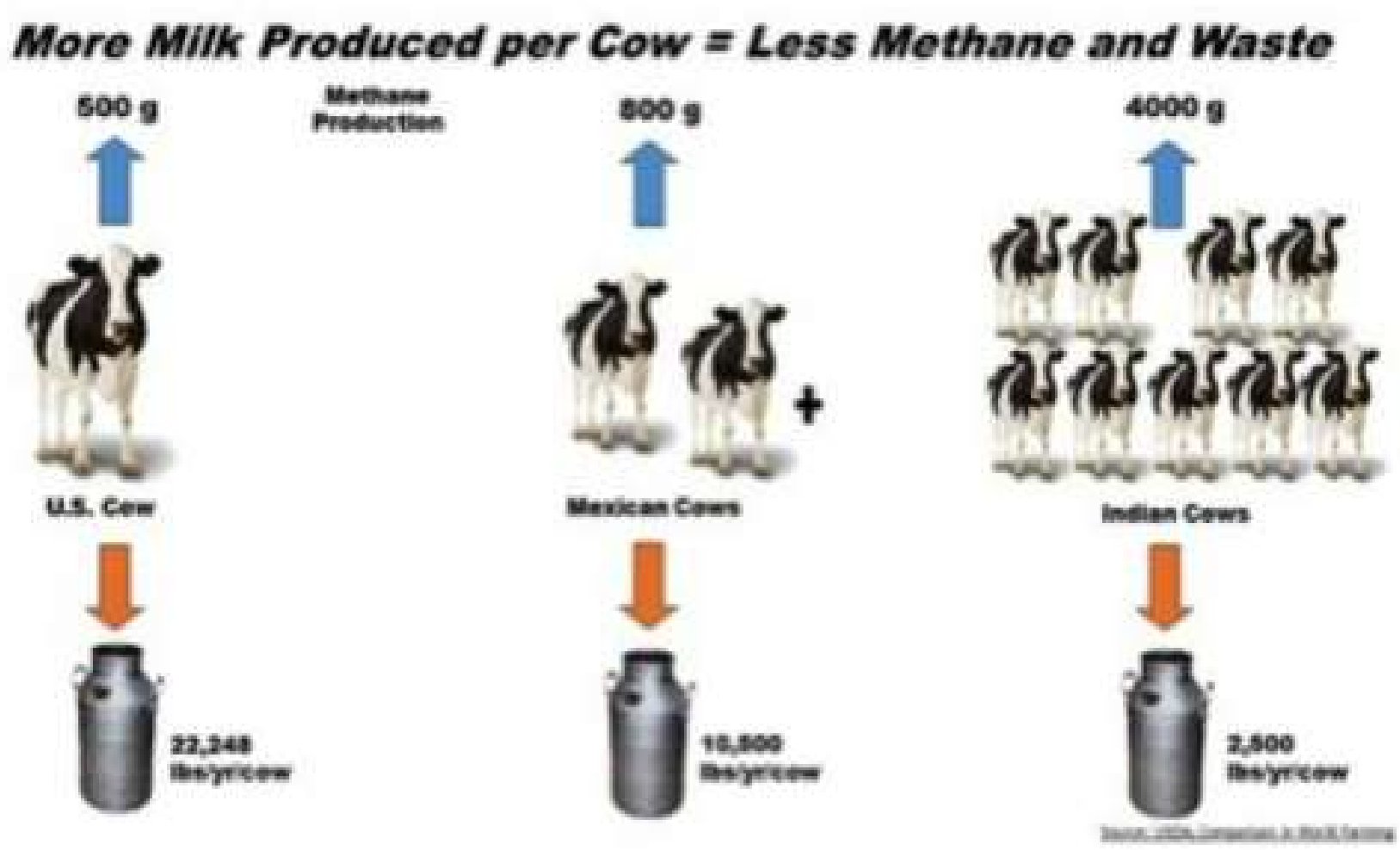
A11


More Milk Produced per Cow = Less Methane and Waste
500 g
Methane Production
800 g
4000 g
U.S. Cow
Mexican Cows
Indian Cows
22,249 lbs/yr/cow
10,500 lbs/yr/cow
2,500 lbs/yr/cow

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A5 Author, 3/3/2020

A11 Author, 3/7/2020

A15

GRASS FINISHING OF RUMINANTS

It Depends on Forage Quality!

Marbling of beef *requires over 2 lbs gain/day during finishing phase*

Lambs/ kids *need 0.25 lbs gain/day to reach desired 100 pounds yearling wt.*

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A15 Author, 4/2/2020

FINISHING PHASE	GRAIN	VS	GRASS
Average Daily Gain, lbs	4.0		2.0
Days of finishing	172		200
Carcass weight, lbs	900		600
Feed / gain	5.7		13.0
Acres per animal	0.6		1.0

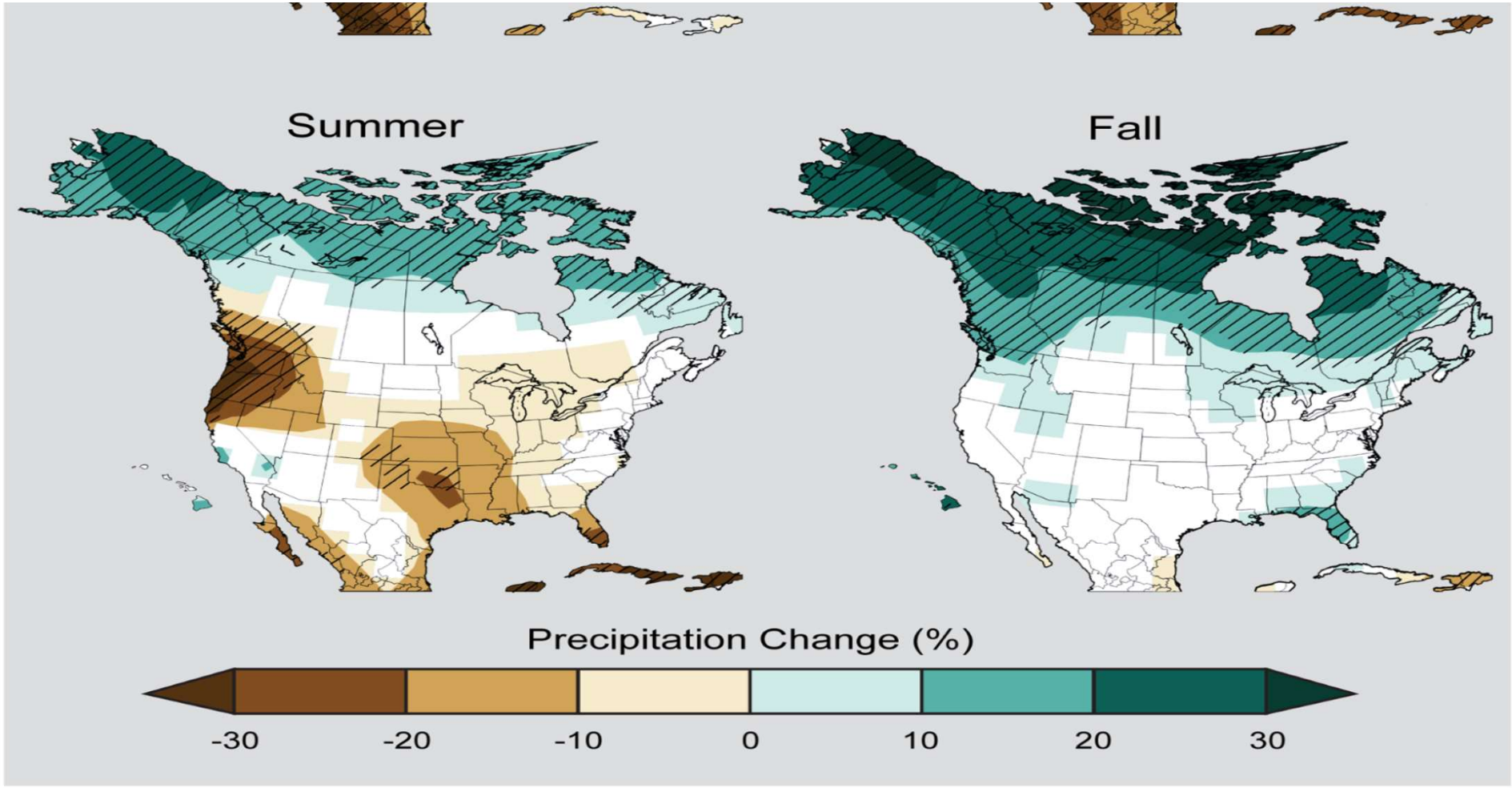
MICHIGAN STATE U., 2018 STUDY

Greenhouse Gas (lbs CO2e/lb carcass) FINISHING PHASE	GRAIN VS	ONLY FORAGE
Fuel emissions	+ 0.1	+ 0.2
Feed emissions	+ 2	+ 2
Manure emissions	+ 2	+2.5
Belching emissions	**+ 2**	**+ 5**
	+6.1	+9.7
Soil carbon sequestered	**0**	**-16.0**
Net, lb CO2 e/ *lb* carcass	+6.1	- 6.3
		*C sink

*Until Soil Organic Matter reaches saturation point

MICHIGAN STATE U., 2018

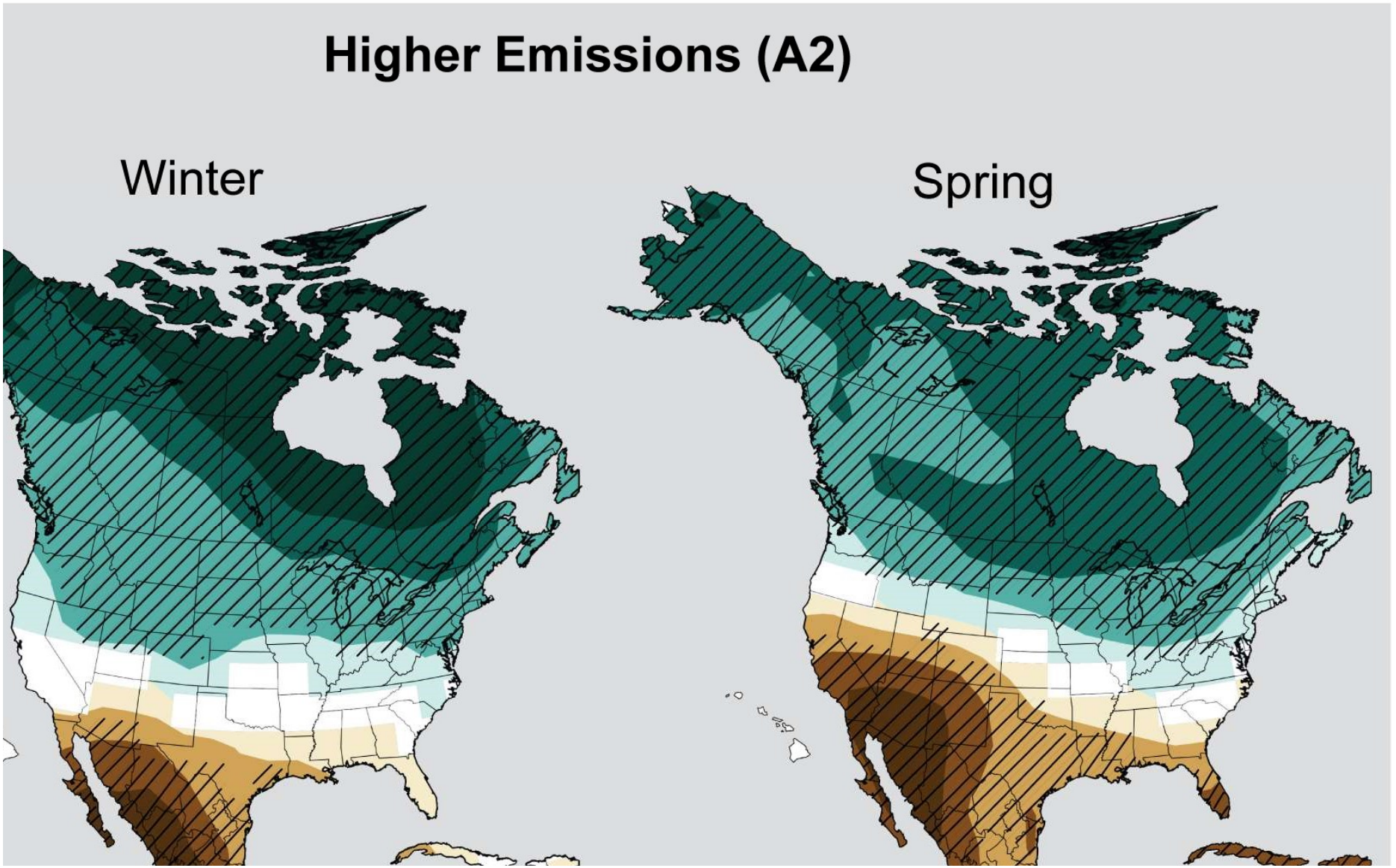
Alternative choices to reduce Greenhouse Gases	Action	Per year GHG savings CO_2 e,lbs
Diet vegetables reduced	180 days X 0.1/ per 8 oz	- 36
Diet cheese reduced	180 days X 1.5/ per 4 oz	- 270
Diet white meat reduced	180 days X 1.5/ per 4 oz	- 270
Diet beef reduced	180 days X 6.6 / per 4 oz	- 1200
Clothesline for drying		- 1200
Improve car efficiency,+5 mpg	10,000 mi	- 1200
Upgrade to Energy Star	Bulbs, boiler, fridge, windows replaced	- 5500



2070-2100

Climate Change Impacts in the US

Projected Precipitation Change by Season



How will farmers adapt to Summer Droughts?

1. Drought resistant species/ varieties

2. Soil moisture protected
   (conservation tillage, plastic)

3. Cover crops/perennials to increase OM

Continued:

4. Water sources upgraded (irrigation, waterers)

5. Emergency feed (barn feeding to rest pastures)

6. High tunnels / barns (protection from hot sun)

HOW WILL FARMERS ADAPT TO CLIMATE CHANGE?

Heavy Precipitation Events

1. Disease resistant species/ varieties
2. Select crops resistant to lodging
3. Slopes planted to perennial crops
4. Annual crops in flood prone areas

5. Drainage tiles on cropland

6. Drainage of livestock heavy use areas

7. High tunnels (for high value crops)

8. Surface protected with residue or cover crops

CONSERVATION_LEASES

DEVELOPING A WIN-WIN ARRANGEMENT

LAND LEASE

This lease made the _____ day of _____, 2020, between_____, owner, of _____, and _____, lessee, of _____,MA

Operation and Maintenance of Land:

"The land shall be continuously covered with growing perennial or annual crops, ensuring adequate soil organic matter . Winter cover crops will be seeded as the cash crop is harvested, with a deadline of _____ to protect land from erosion until spring seeding. Crops will be fertilized at proper rate and timing .

THANK YOU!

JOYCE MEADER

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