A preview of the new USDA publication: *U.S. Agriculture and Forestry Greenhouse Gas Inventory*

Contribution of agriculture and forestry to greenhouse gas emissions, emissions reduction, and carbon sequestration

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Greenhouse Gas Emissions Inventories

- Atmospheric concentration of greenhouse gases (GHG's) have increased over the past 250 years.
- U.S. is party to the United Nations Framework Convention on Climate Change.
  - *Develop, periodically update, publish and make available to the Conference of the Parties…national inventories of anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol …*
- EPA prepares and submits the U.S. GHG Inventory to the UNFCCC every April with significant input from USDA on Agriculture and Forestry.

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Greenhouse Gases Covered

- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous oxide (N_2O)
- Hydroflourocarbons (HFC's)
- Clouroflourocarbons (CF's)
- Sulfur hexaflouride (SF_6)
- Perflourocarbons (PFCs)

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GHG Inventory Terminology

- Emissions = the release of GHG's to the atmosphere
- Sequestration = the removal of GHG's from the atmosphere
- Source = a process or activity that releases GHG's to the atmosphere
- Sink = a process or activity that removes GHG's from the atmosphere
- Global warming potential = relative impact of a GHG on radiative forcing ("warming")
- Tg CO_2 eq. = teragrams of carbon dioxide equivalents

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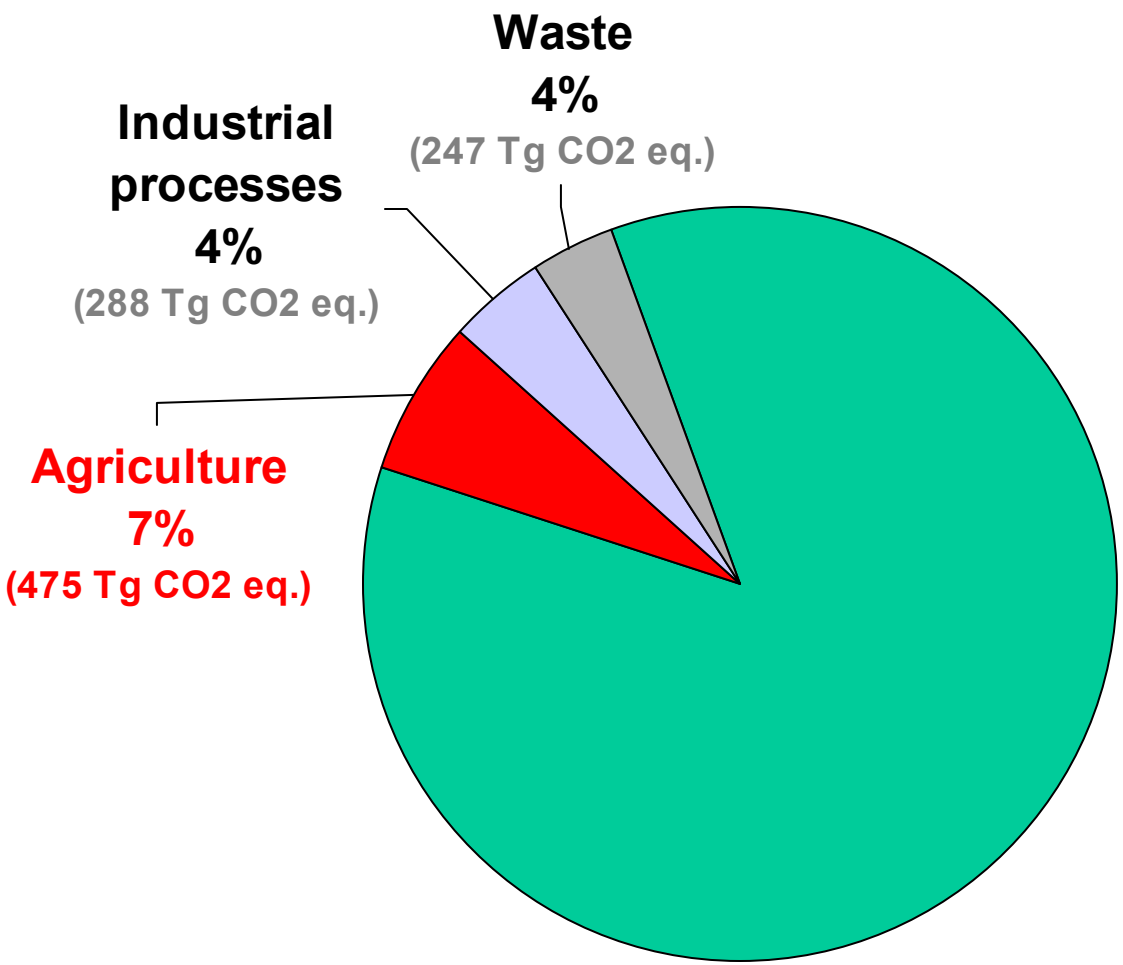
Agriculture's Contribution to Emissions



U.S. GHG emissions in 2001 were 6,937 Tg CO_2 eq.

111 Tg CO_2 eq. were from agricultural uses

Does not include sinks…

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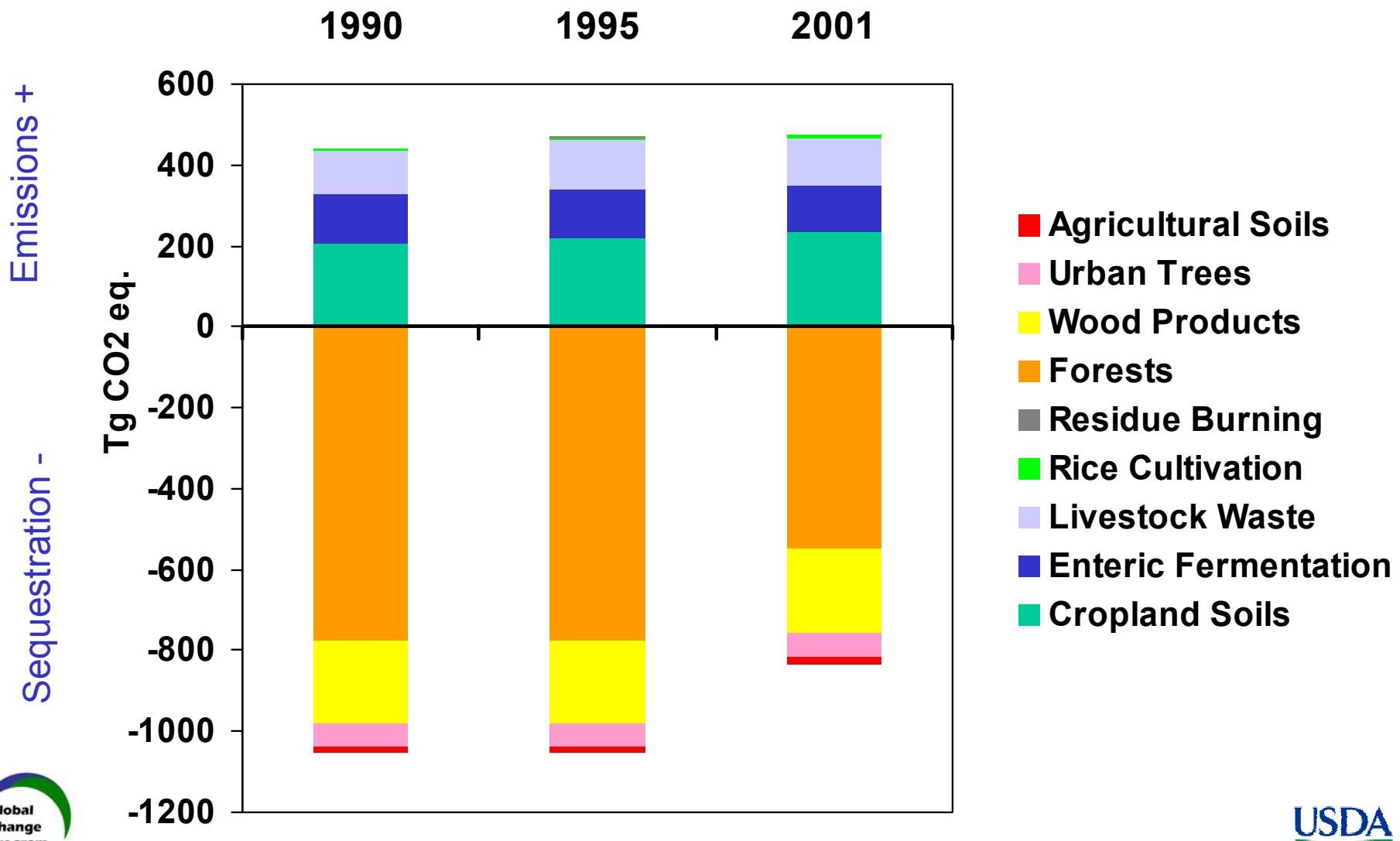
Overview of Sources and Sinks in Agriculture and Forestry



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Purposes of USDA GHG Inventory

- Provide data from the U.S. GHG Inventory at relevant scales (by region, state, ownership, livestock, crops, etc.)
- Organize information in meaningful way for landowners and technical service providers
- Help identify opportunities to reduce emissions and enhance sinks
- Identify key uncertainties and priorities for improving emissions estimates

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Organization of USDA GHG Inventory

Chapter 1: Introduction

Chapter 2: Livestock

Enteric fermentation ~ Livestock manure

Chapter 3: Crop Production

Cropland soils ~ Rice cultivation ~ Residue burning

Chapter 4: Forests

Forest biomass ~ Wood products ~ Urban trees

Chapter 5: Agriculture Energy Use

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Each Chapter Contains…

- Description of the source/sink and what causes it
- How emissions/sequestration from the source/sink are estimated
- Emissions/sequestration by relevant categories
  - for example: emissions by livestock, state, region, land ownership
- Details for 2001 and time series provided for 1990-2001

Overall: 95 maps, tables, figures of data

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Chapter 2: Livestock

Chapter	Source Category	2001 Tg CO_2 eq.
Livestock	Enteric fermentation (CH_4)	115
	Livestock waste (CH_4, N_2O)	116
Total		231

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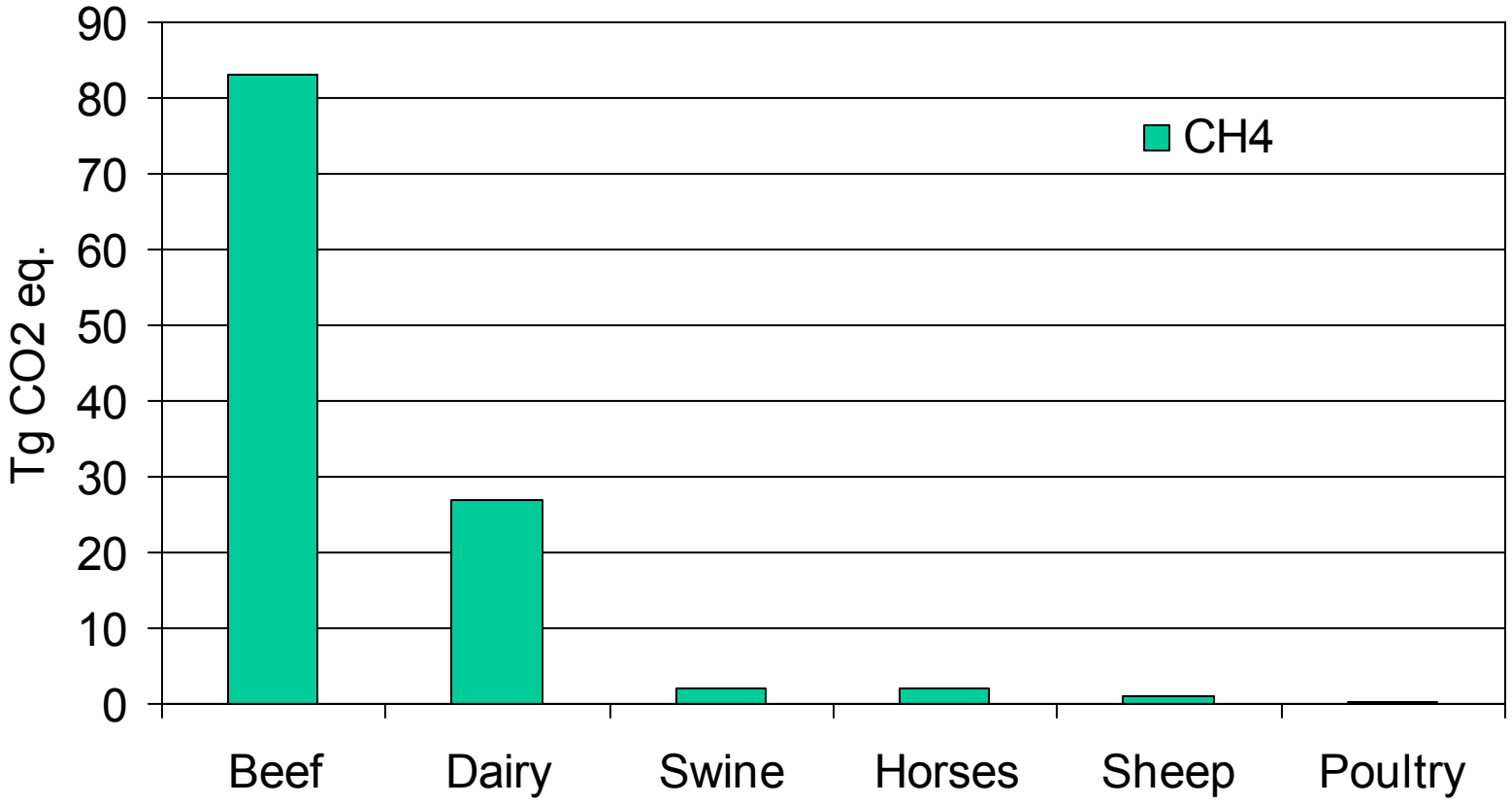
Chapter 2: Livestock

Enteric fermentation emissions in 2001 (CH_4)



	Beef	Dairy	Swine	Horses	Sheep	Poultry
million head	89	13	59	5	7	2

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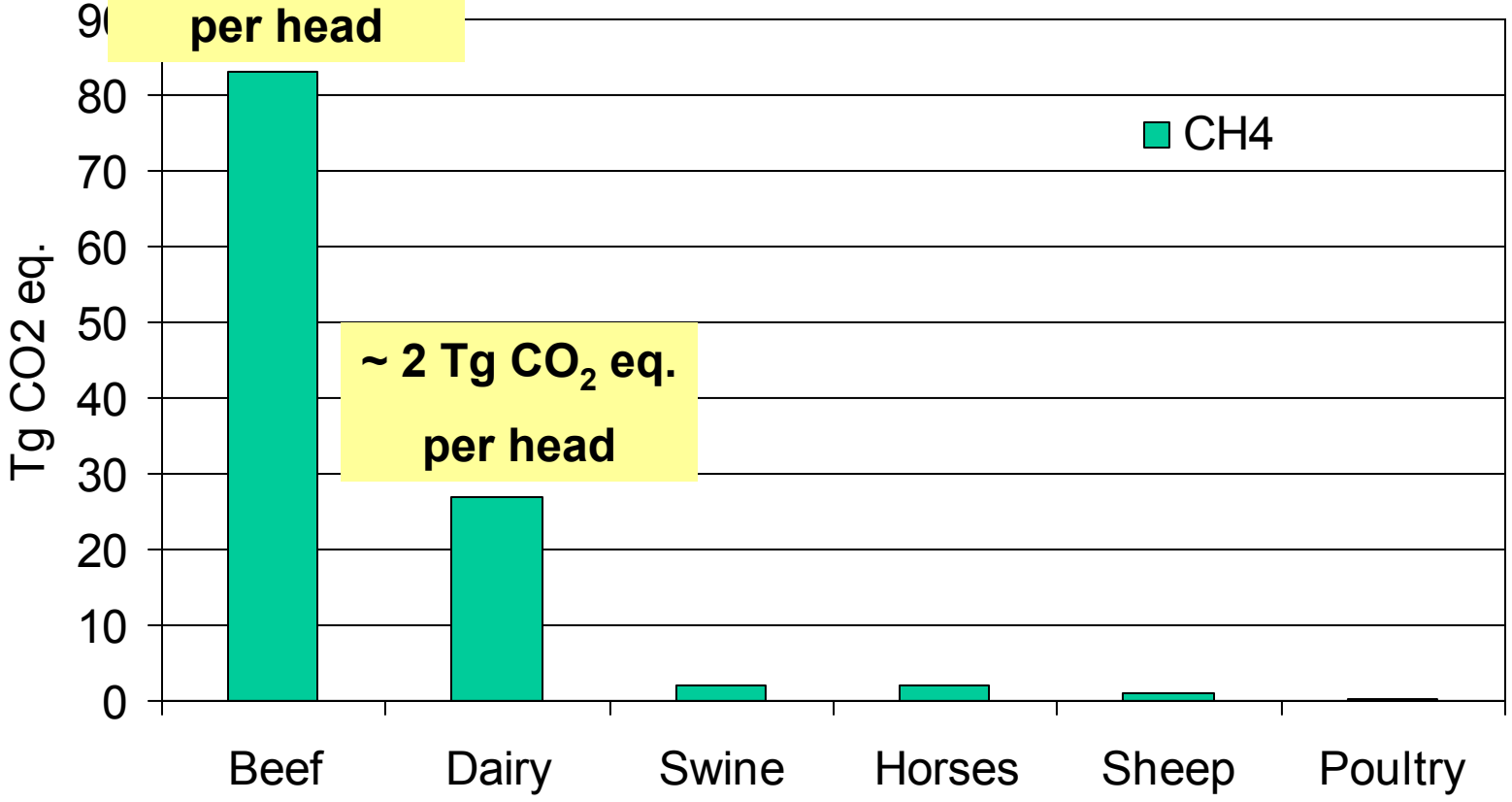
Chapter 2: Livestock

~ 1 Tg CO_2 eq. per head

~ 2 Tg CO_2 eq. per head



	Beef	Dairy	Swine	Horses	Sheep	Poultry
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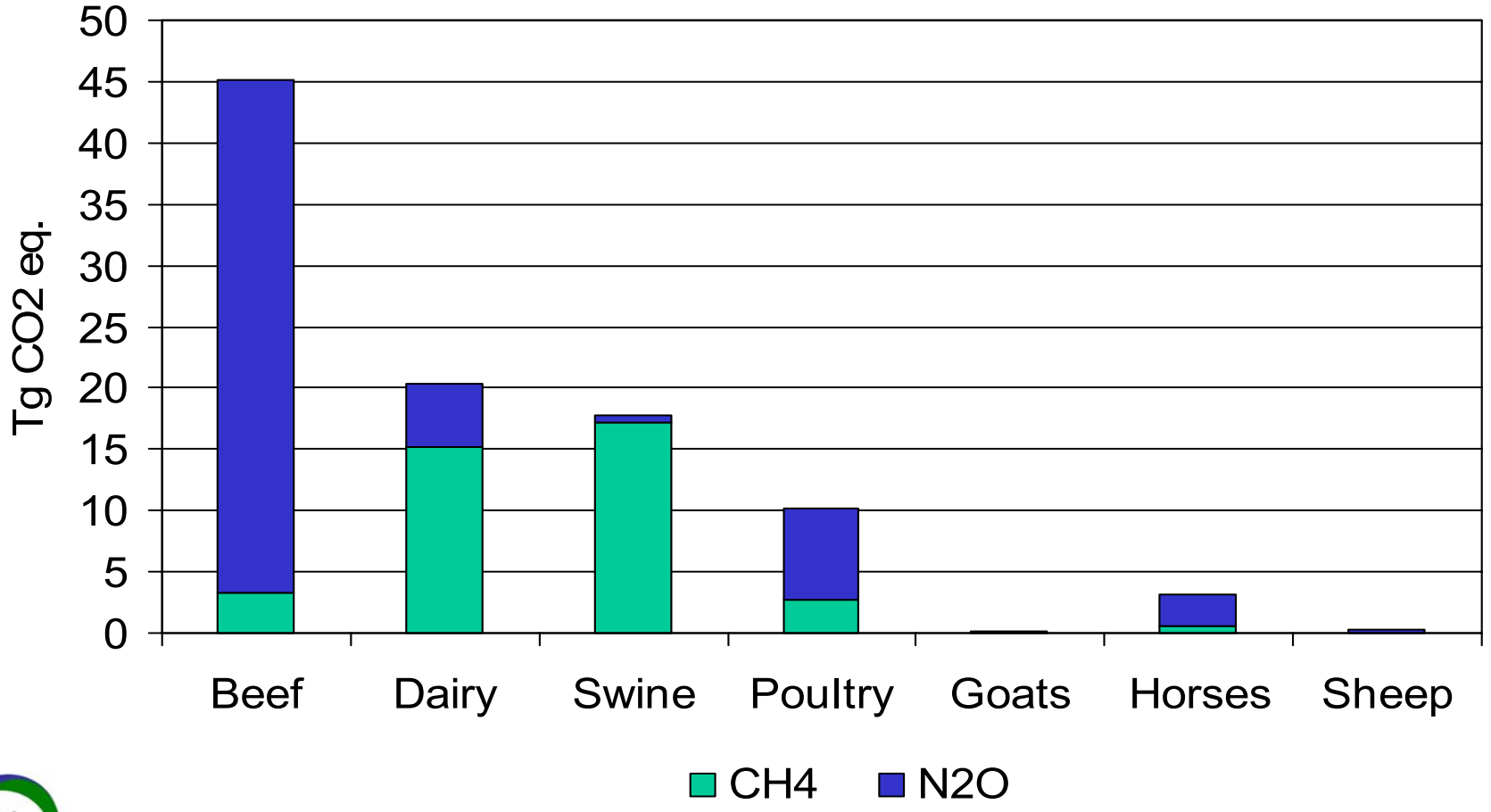
Chapter 2: Livestock

Livestock waste emissions in 2001 (CH_4, N_2O)



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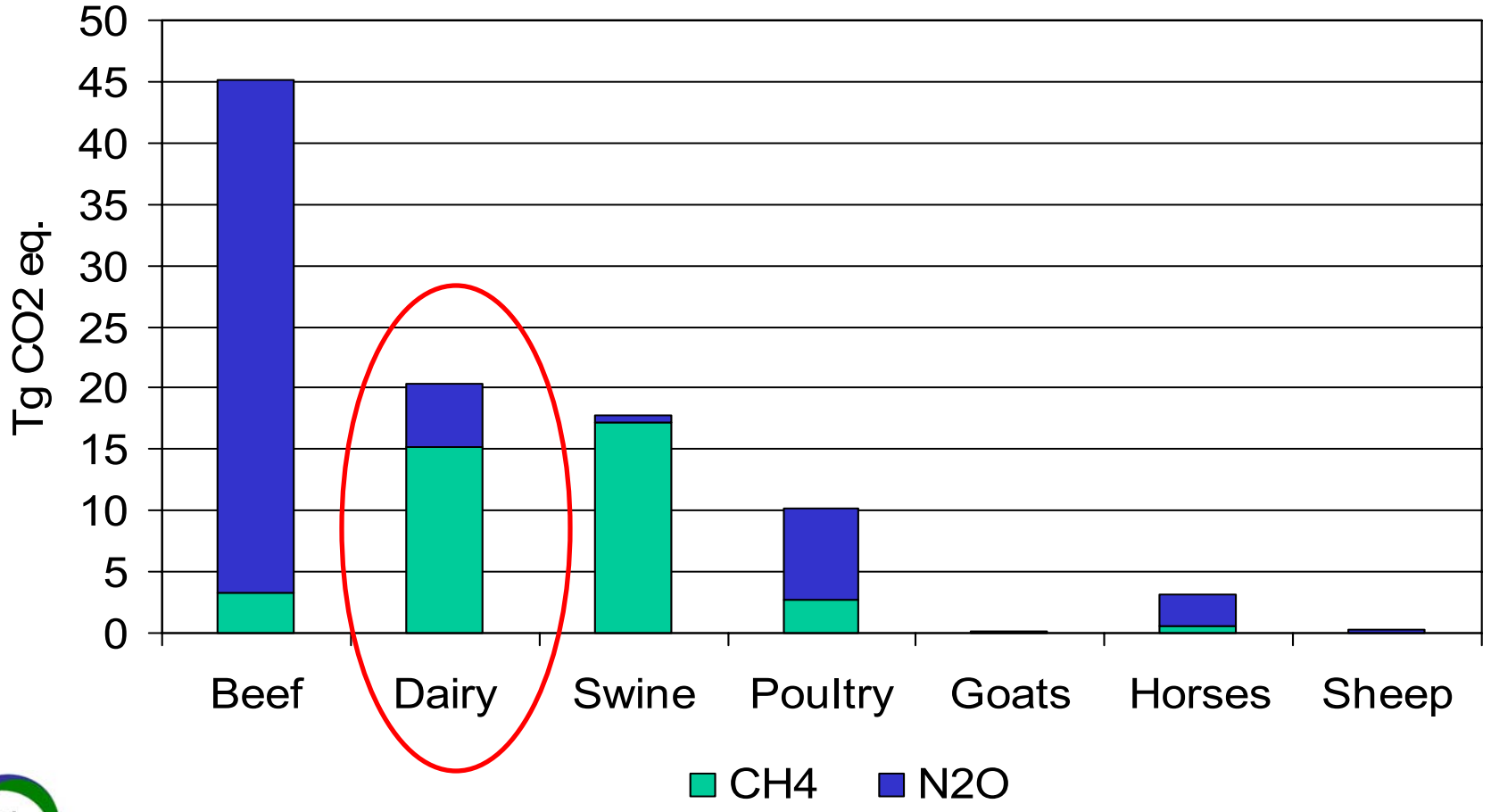
Chapter 2: Livestock

Livestock waste emissions in 2001 (CH_4, N_2O)



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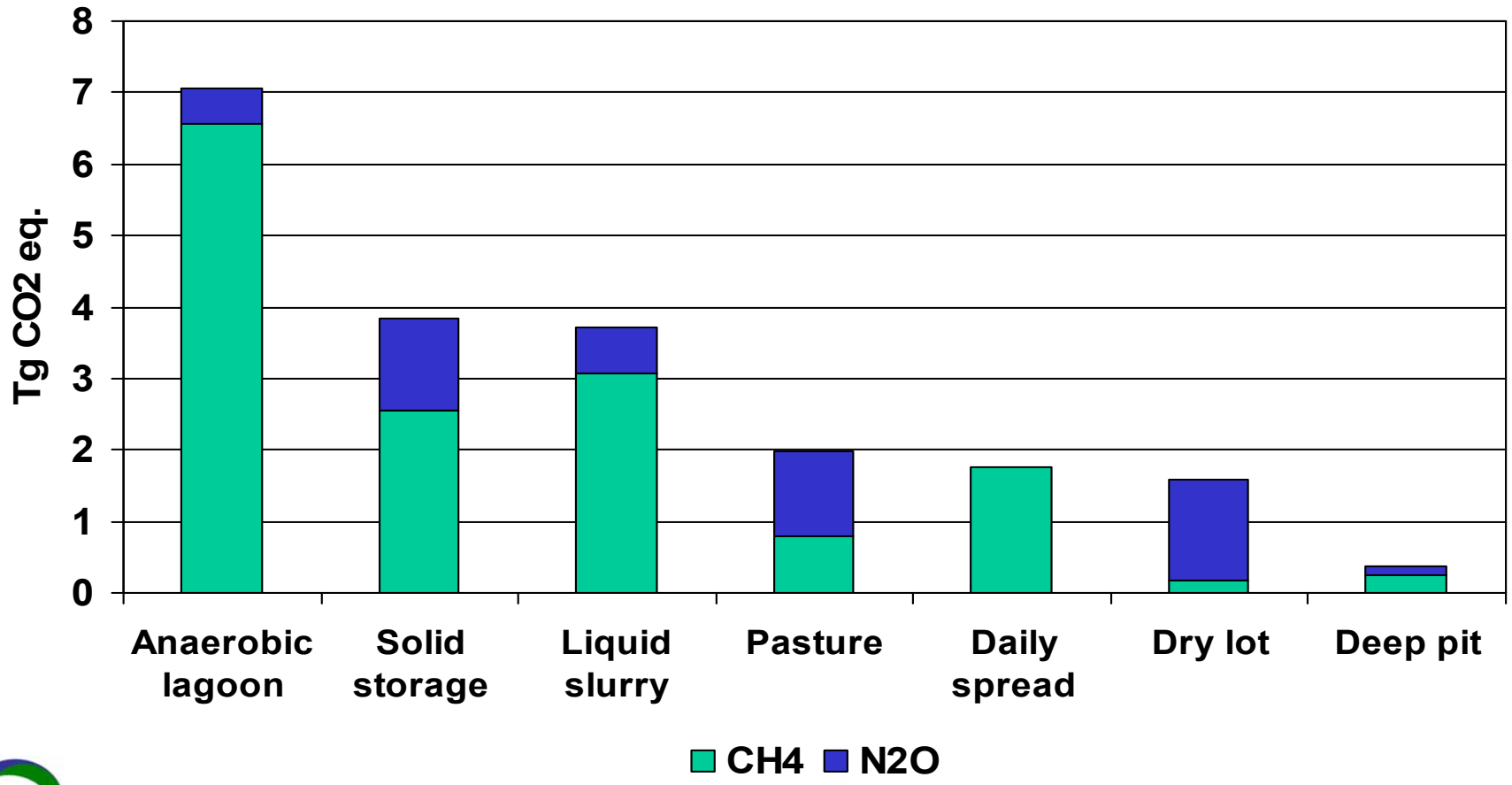
Chapter 2: Livestock

Dairy waste emissions by management system 2001



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Applications of Livestock Data

- CH_4 emissions are high in anaerobic lagoons.
- Large farms are likely to use different waste management approaches than small farms.
- Trend towards fewer, larger dairy and swine farms—how does this affect waste management and GHG emissions?
- Where are the opportunities to reduce emissions through technology applications?
  - anaerobic digesters

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Chapter 3: Crop Production

Chapter	Source/sink Category	2001 Tg CO_2 eq.
Crop Production	Cropland soils (N_2O)	235
	Cropland soils (CO_2)	(15)
	Rice cultivation (CH_4)	8
	Residue burning (CH_4, N_2O)	1
Total		229

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Chapter 3: Crop Production

N_2O Emissions from Cropland Soils

- N_2O from soils accounts for 50% of GHG emissions from agriculture.
- Sources of nitrogen include soil amendments (fertilizer, livestock manure, crop residues, and sewage sludge), legumes, and histosol cultivation.
- N_2O emissions are influenced by soil N-content, temperature, water content, pH, and texture.
- Current methodology is based on amount of N added to soils.
- Estimates have relatively high uncertainty.
- Methodological development is underway.

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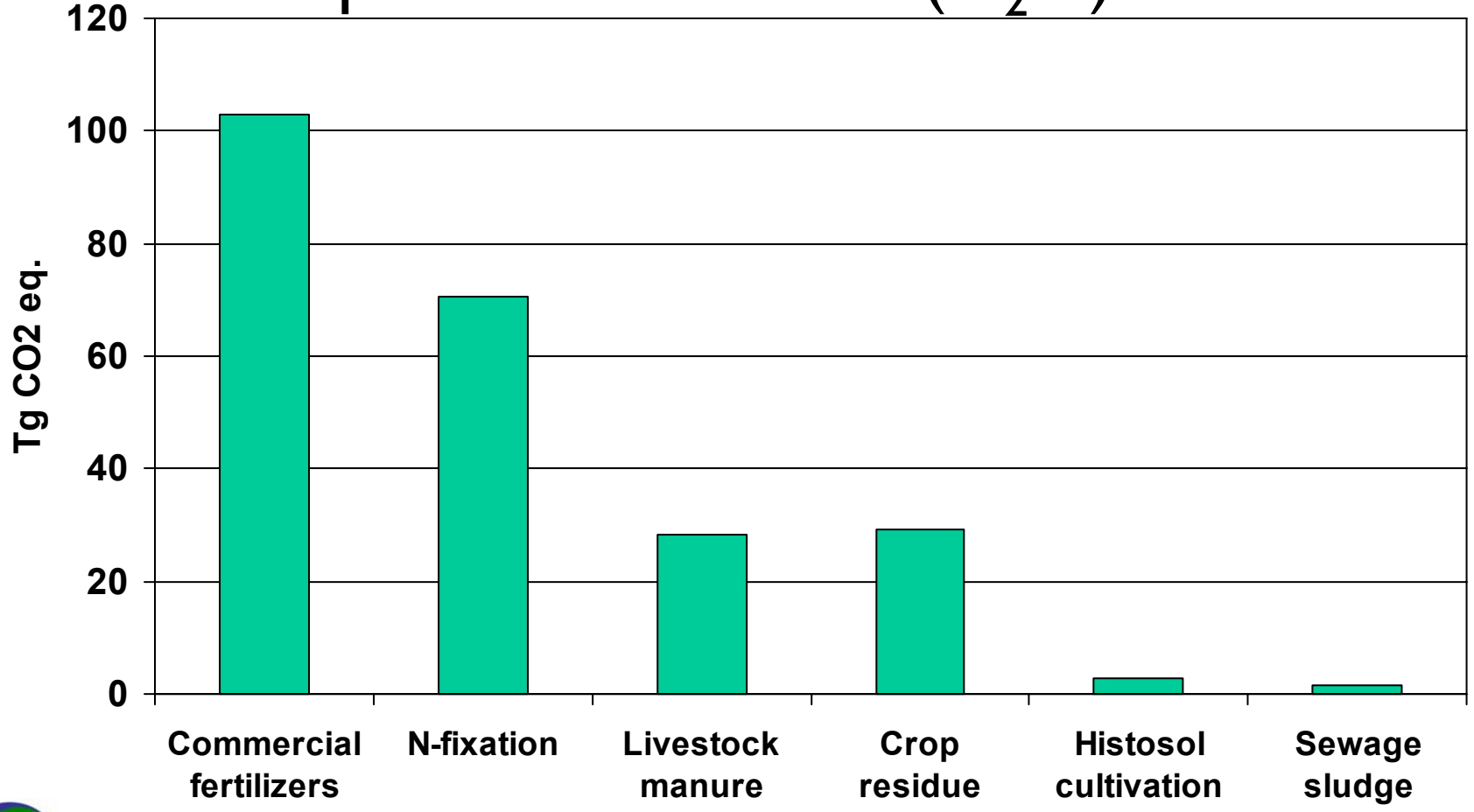
Cropland Soils in 2001 (N_2O)



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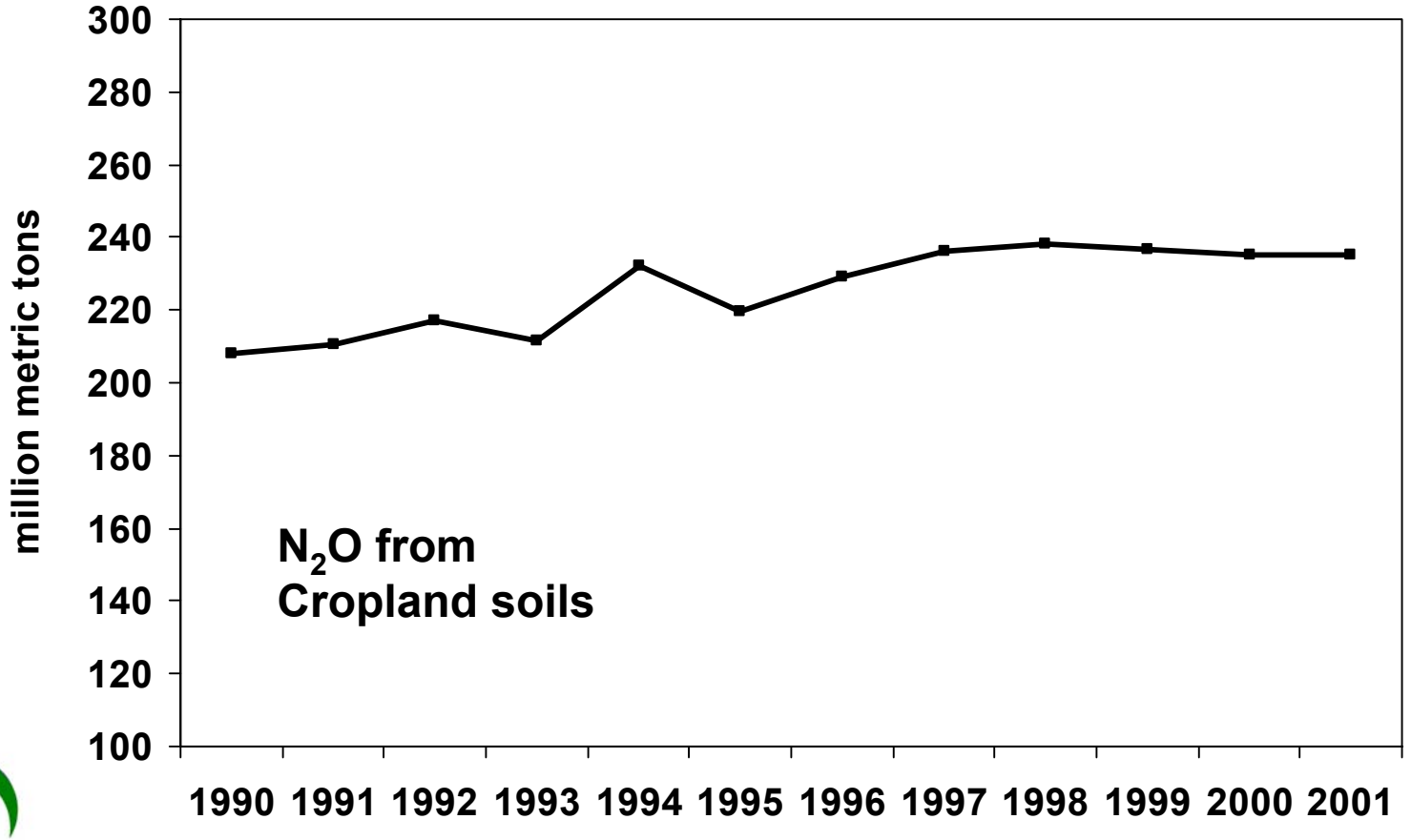
Chapter 3: Crop Production

N_2O emissions increased by 13% from 1990 to 2001



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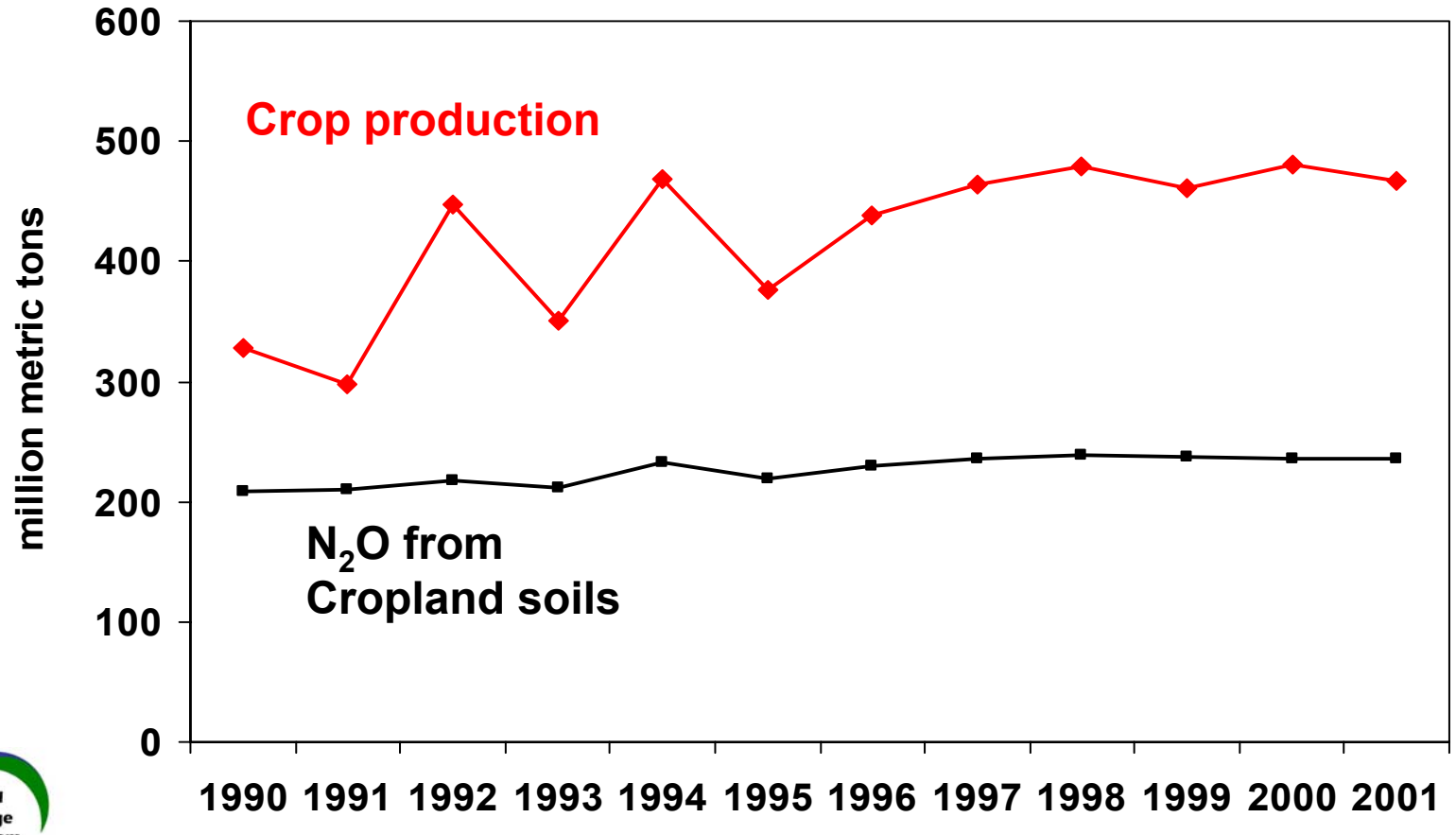
Applications of Crop Emissions Data

Corn, wheat, and soybean production increased by 42%, 1990-2001



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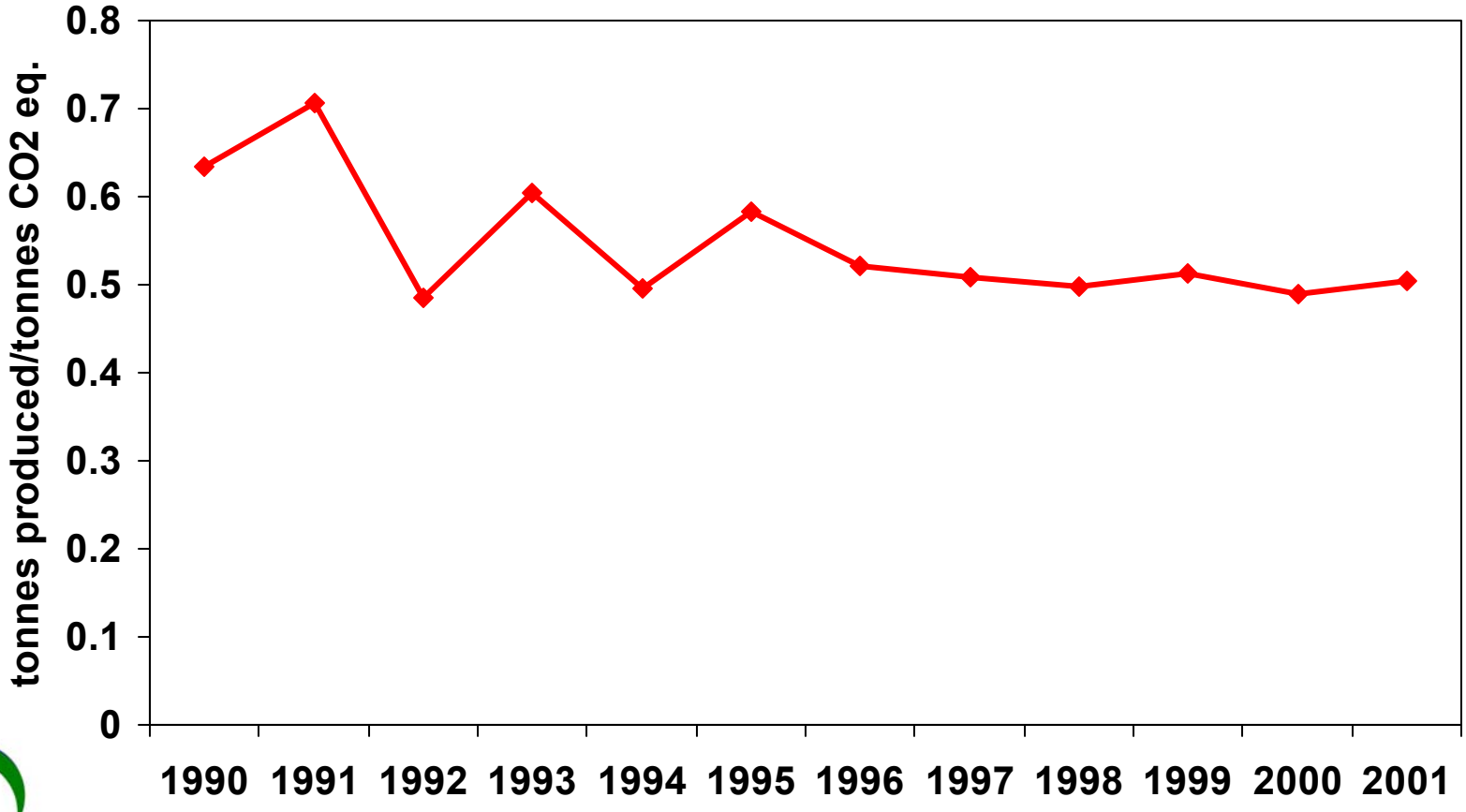
Applications of Crop Emissions Data

20% decline in emissions per unit of output, 1990-2001



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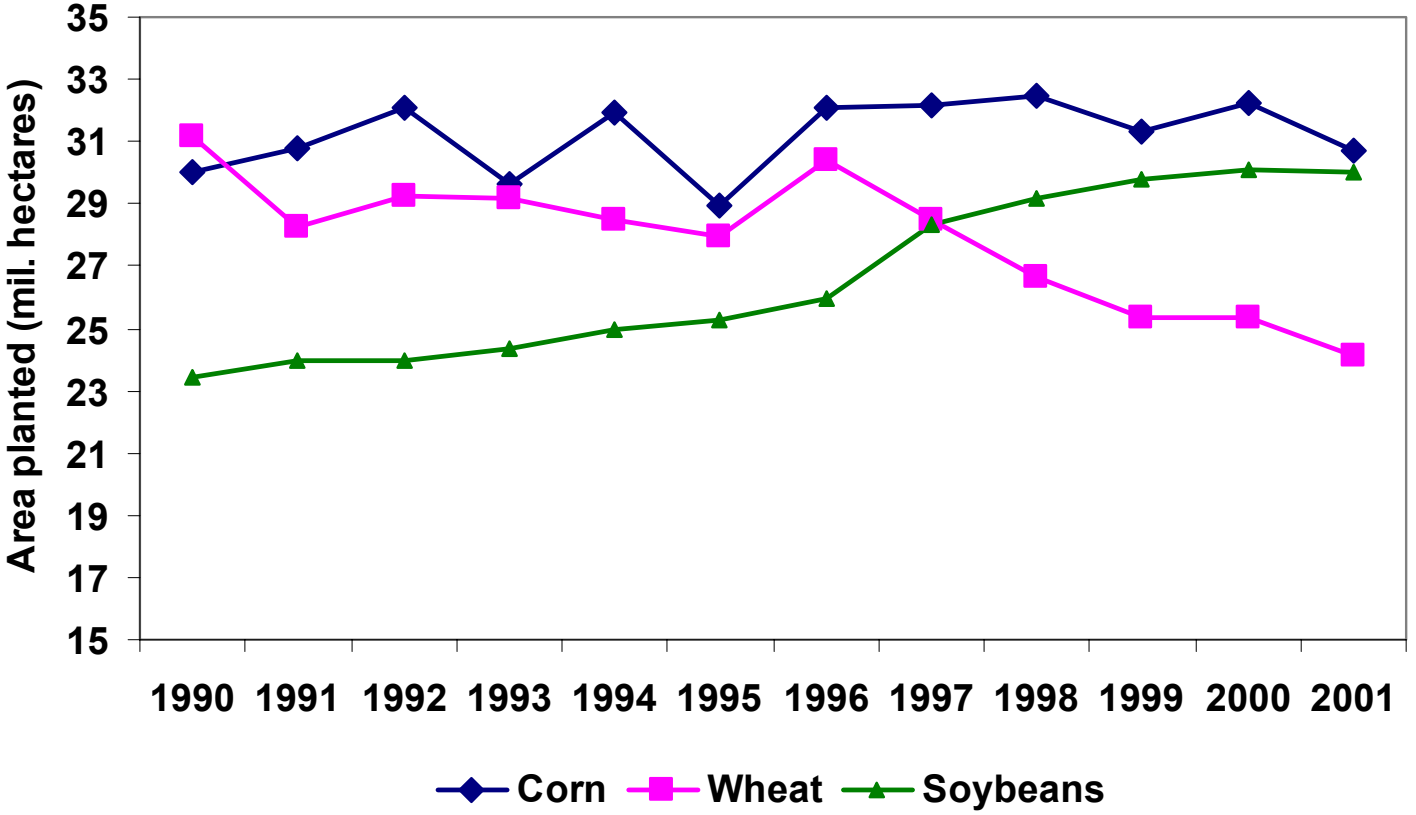
Applications of Crop Emissions Data

Nutrient application rates have remained relatively stable

Corn yields have increased dramatically



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Chapter 3: Crop Production

Historical Decline in Carbon Content of Soils

- Organic matter in soils was depleted in the early 20th century from intensive cultivation
- Carbon losses occur from soil erosion, and decomposition and mineralization of organic matter.
- In part, organic carbon losses resulted in CO_2 emissions
- Replenishing depleted carbon stocks in soils is also an opportunity to remove CO_2 from the atmosphere

Source: Lal, et al. 1998

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Chapter 3: Crop Production

Present Opportunity to Increase Soil Carbon

- Carbon is replaced through addition of organic matter to soils and the "humification" of organic matter
- Organic carbon derives from CO_2 fixed by photosynthesis in plants
- Net balance of inputs and losses determines if carbon is emitted or sequestered in soils.
- Management practices impact both inputs and losses and can facilitate carbon sequestration

Source: Lal, et al. 1998

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Chapter 3: Crop Production

Organic soils are an opportunity to target emissions reductions

Source/sink	Area (hectares)	2001 (Tg CO_2 eq.)	Emissions per area (Tg CO_2 eq./10^5 ha.)
Mineral soils	387,000,000	(59)	(0.02)
Organic soils	645,000	35	5.43
Liming	na	9	na
Total		(15)	

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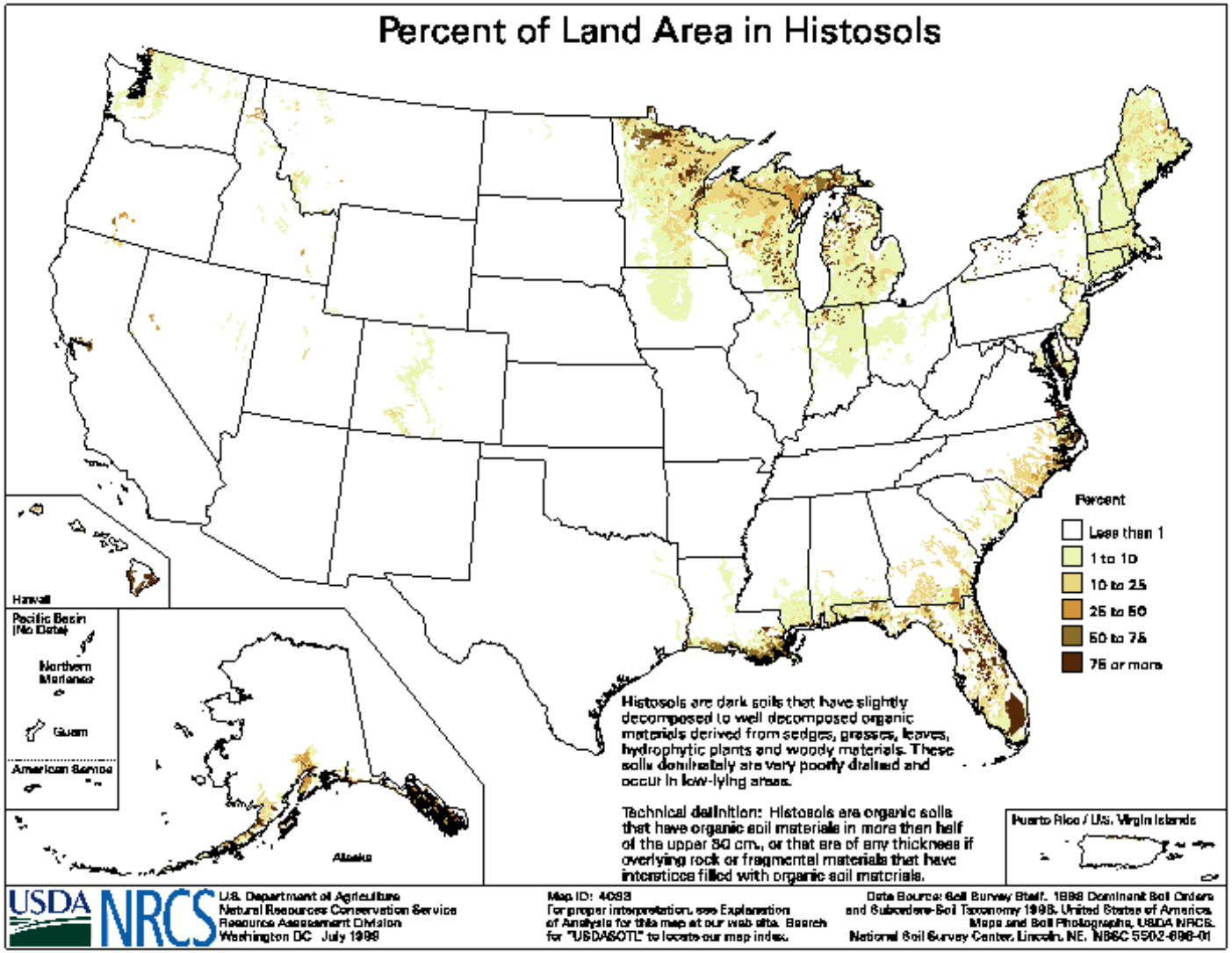
Distribution of Organic Soils



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Chapter 4: Forests

Chapter	Sink Category	2001 Tg CO_2 eq.
Forests	Forest Biomass (CO_2)	(547)
	Harvested Wood (CO_2)	(212)
	Urban trees(CO_2)	(59)
Total		(818)

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Chapter 4: Forests

CO_2 sinks ("carbon sequestration") in forests

- Photosynthesis fixes CO_2 as organic carbon, building the biomass and soil pools.
- Organic carbon is stored in long-lived biomass (trees).
- When trees are harvested, the carbon is also harvested
  - wood products store carbon until decomposition

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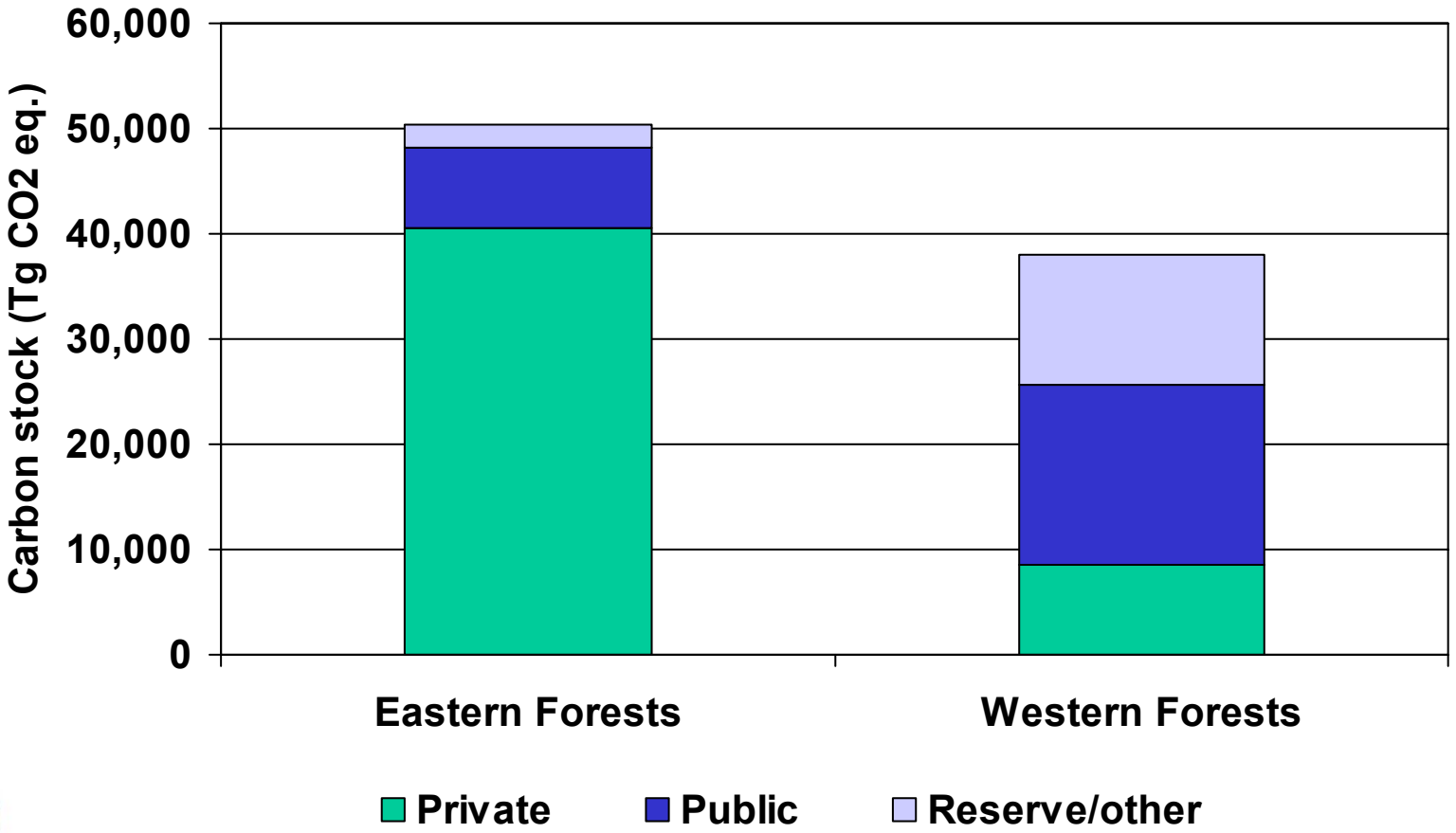
Chapter 4: Forests

Carbon stocks by region and land ownership, 2001



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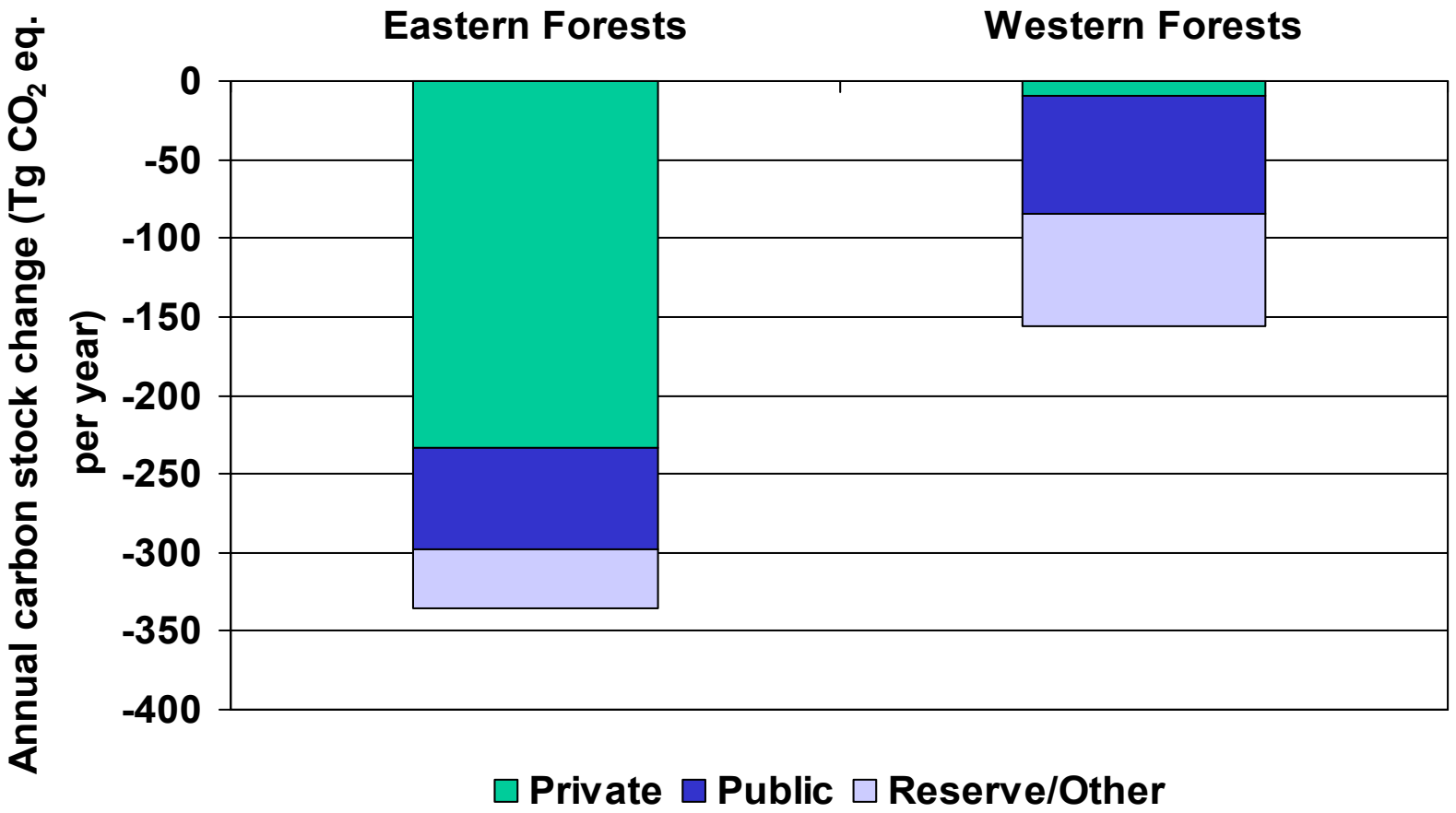
Chapter 4: Forests

Change in carbon stocks, 2000-2001



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Chapter 5: Agriculture Energy Use

Chapter	Source Category	2001 Tg CO_2 eq.
Energy	Electricity	59
	Diesel	35
	Gasoline	10
	LP gas	4
	Natural gas	3
Total		111

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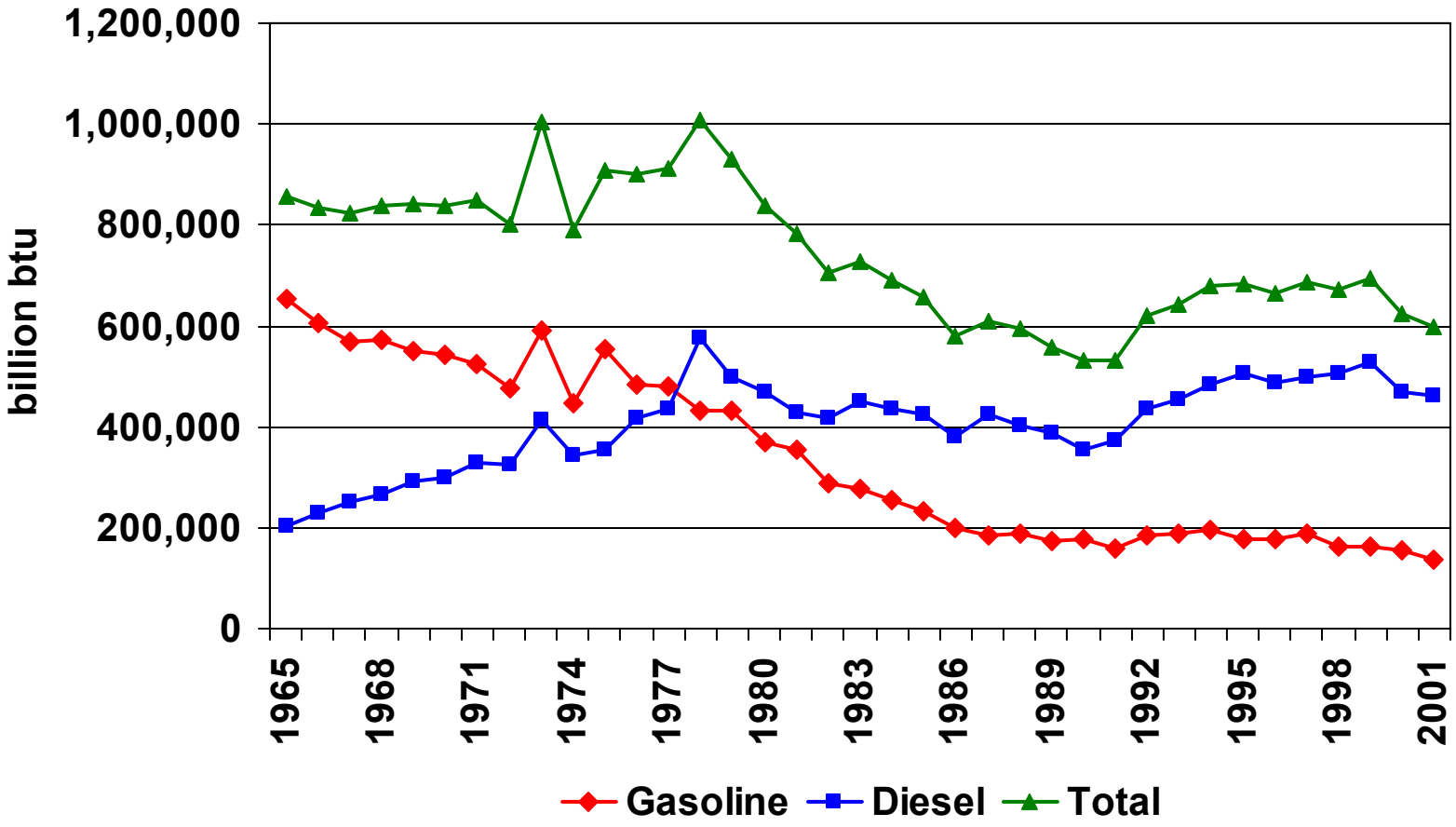
Chapter 5: Agriculture Energy Use



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Summary

- The USDA GHG Inventory is a prototype.
- The goal is to meet growing demands for information on GHG's in agriculture and forestry.
- Presents new levels of detail to serve the needs of land managers and resource professionals.
- Provides basis for further exploration of trends and mitigation opportunities.

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www.usda.gov/oce/gcpo

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