

# Greenhouse Gases and Carbon Sequestration: Agricultural Connections, and the USDA-NRCS

Greg Johnson

Leader, USDA-NRCS Air Quality &  
Atmospheric Change Technology  
Development Team

March 29, 2007





# Agriculture and Greenhouse Gases

---

***Part of the Problem, A good part  
of the Solution***

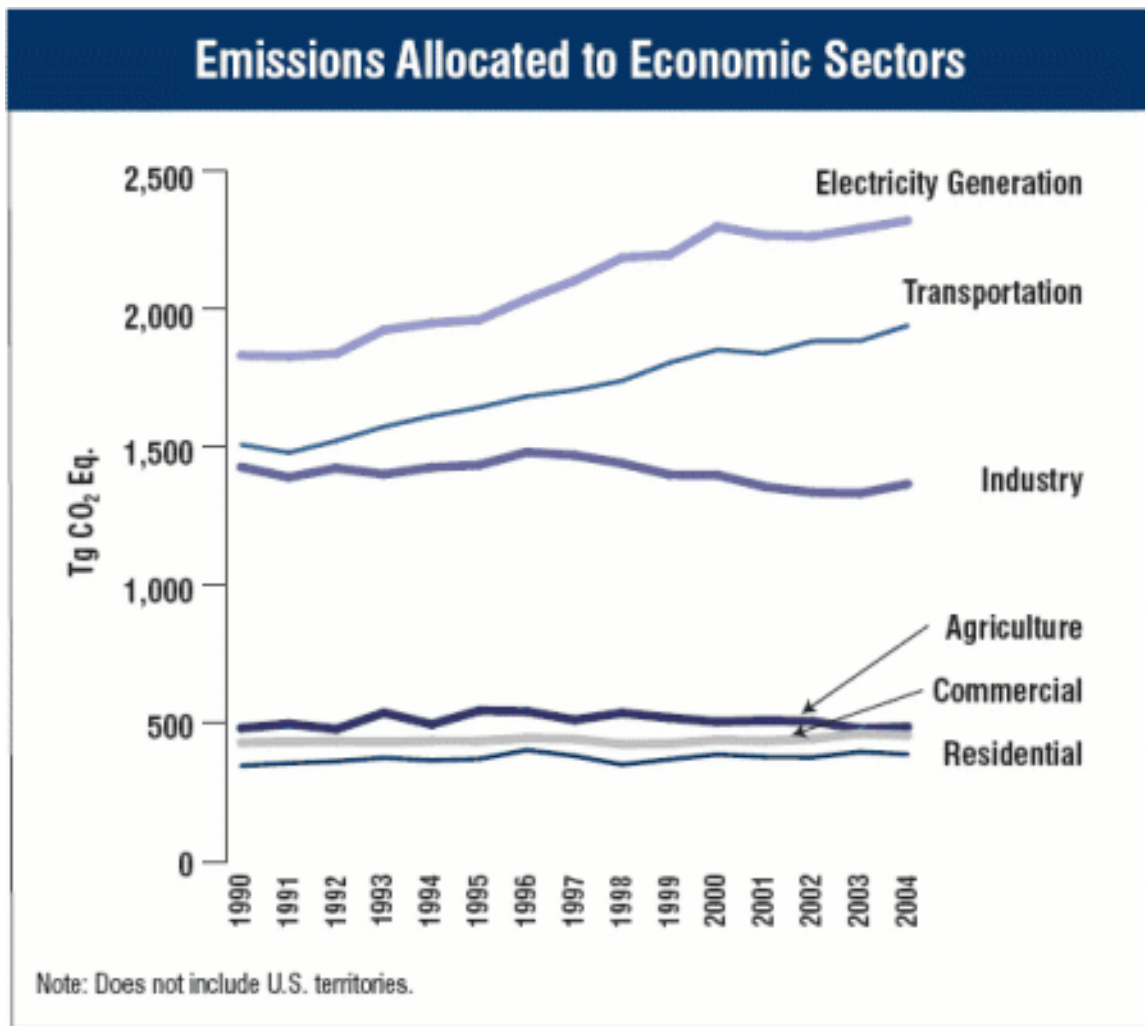




# Principal Greenhouse Gases (GHGs) with Agricultural Connections

---

- Water Vapor (up to 70% of total greenhouse effect)
- Carbon Dioxide (CO<sub>2</sub>)
- Nitrous Oxide (N<sub>2</sub>O)
- Methane (CH<sub>4</sub>)

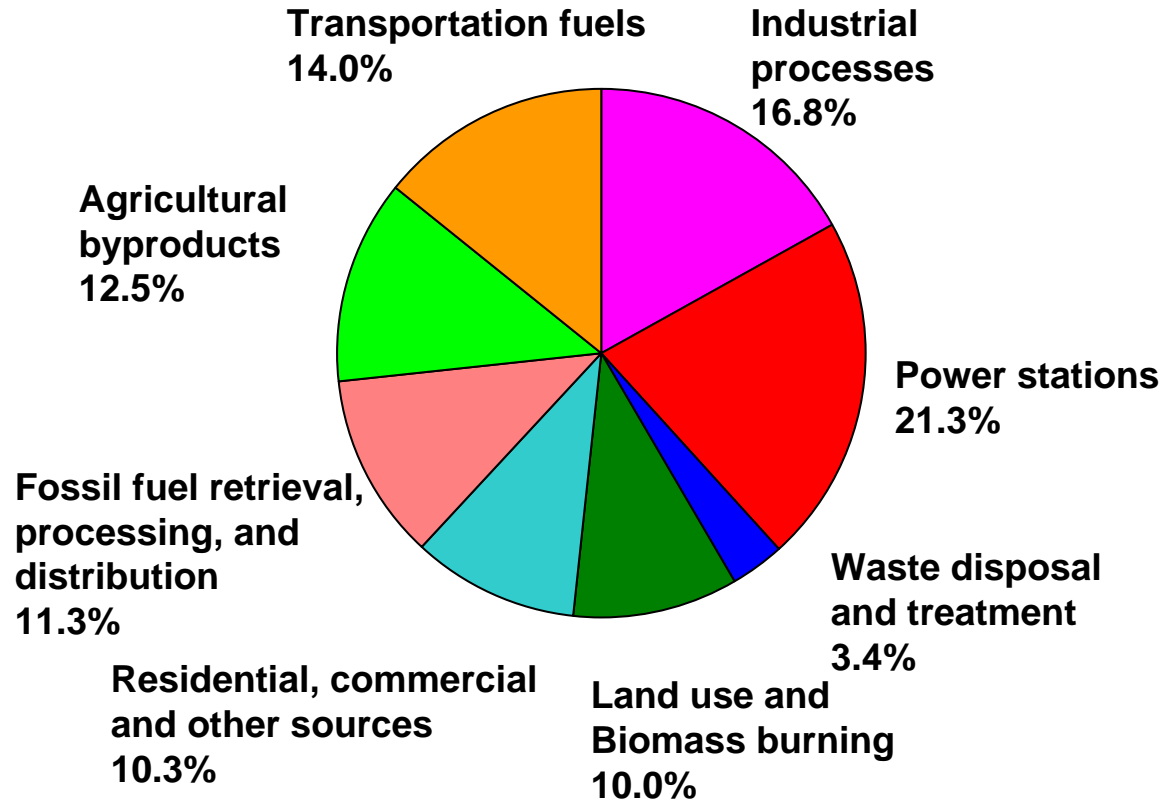


**Total U.S. GHG Emissions (2004): 7074 Tg CO<sub>2</sub> Eq.**

**Total U.S. Agricultural GHG Emissions: 440.1 Tg CO<sub>2</sub> Eq.\* (6%)**

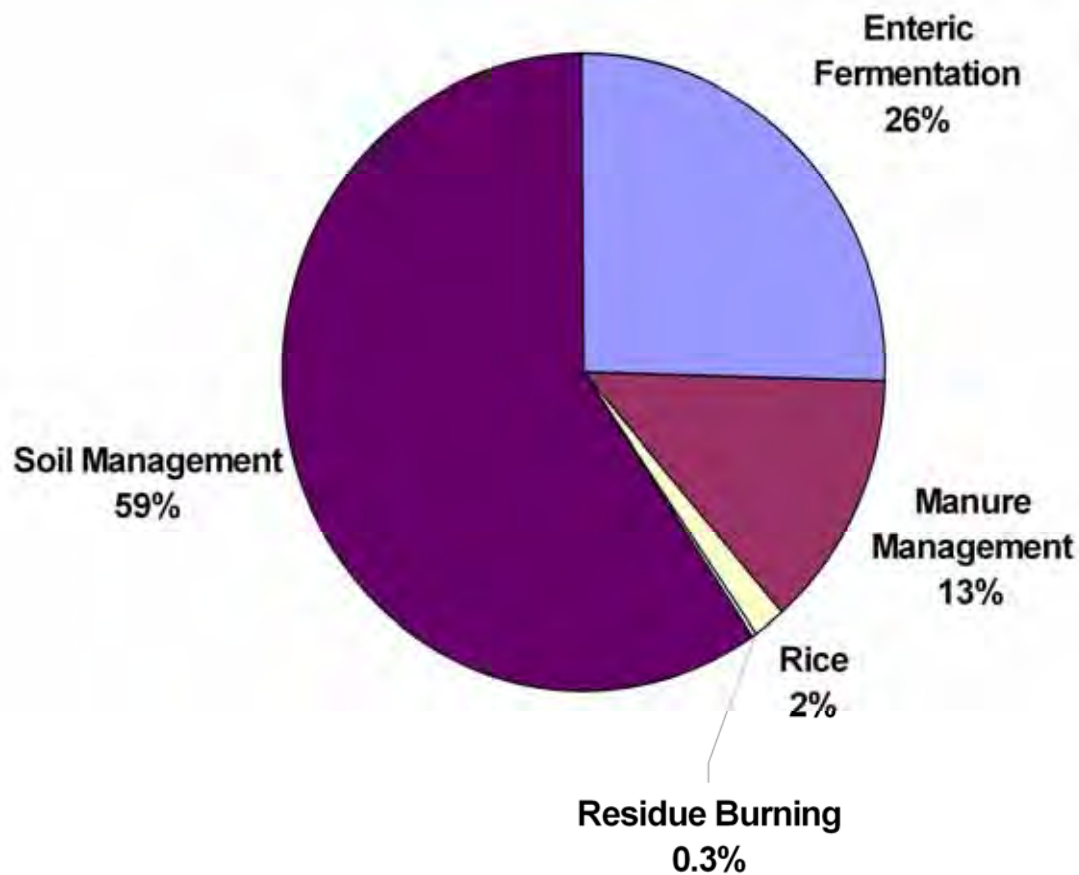
\*Note: This value does not include ag-CO<sub>2</sub> emissions, emissions from liming, or residue burning

# Annual Greenhouse Gas Emissions by Sector



# Agricultural GHG Emissions- Inventory Categories

---



# GHGs: Temporal Changes and Radiative Forcing

---

- CO<sub>2</sub>: 280 (pre-industrial) to 380 ppm now; RF=1
- N<sub>2</sub>O: 270 to 320 ppm; RF=296
- CH<sub>4</sub>: 715 to 1775 ppm (growth rate declining); RF=23

# Trends in Agricultural GHGs

**Total U.S. Emissions Up 16% Since 1990**

**Agricultural Emissions 6% of the U.S. Total; Up 0.1%**

**CH<sub>4</sub> Up 2%; N<sub>2</sub>O Down 1%**

- Soil Management
  - N<sub>2</sub>O Down 1.7%
- Enteric Fermentation
  - CH<sub>4</sub> Down 4.5%
- Manure Management
  - CH<sub>4</sub> Up 26.4%
  - N<sub>2</sub>O Up 8.8%
- Rice
  - CH<sub>4</sub> Up 6.2%
- Residue Burning
  - CH<sub>4</sub> Up 27.2%
  - N<sub>2</sub>O Up 38.5%
- Organic Soils:
  - CO<sub>2</sub> Up 1%
- Liming
  - CO<sub>2</sub> Down 15%
- Residue Burning
  - CO<sub>2</sub> Up 27%
- Mineral Soil C Sequestration Rate
  - Down 7%



# Greenhouse Gases and Ag

## **CO<sub>2</sub>** (GWP=1)

- Fossil Fuels
- NH<sub>3</sub> Production
- Lime Manufacture
- May be Sequestered in Soils

## **N<sub>2</sub>O** (GWP=296)

- Ag Soil Management
- Mobile Sources
- Manure Management
- Residue Burning

## **CH<sub>4</sub>** (GWP=23)

- Landfills
- Enteric Fermentation
- Manure Management
- Rice Cultivation
- Residue Burning



# Carbon Sequestration

---

- The capture and storage of carbon in agricultural soils
- Net carbon buildup in soils and biomass
  - Decreasing C emissions
  - Increasing storage of C

# GHG “Atmospheric Fertilization” Effect on Agricultural Production

---

- Enhanced CO<sub>2</sub> can have an impact on plant growth
- Preferential growth changes in some plants versus others
- Free-Air CO<sub>2</sub> Enrichment (FACE) Experiment discerning how CO<sub>2</sub> and other GHG buildups may impact agriculture

# Agricultural GHG Quantification

---

- The measurement or estimation of GHG emissions and sinks
- *Drivers:*
  - Market need (verify, reproduce)—ag is a potential sink, and partner
  - Voluntary registry of GHG emissions and sinks (DOE-EIA's 1605(b) Program)
  - Local to global accounting of GHGs





# Agricultural GHG Tools

---

- Direct measurement
- Estimation methods
  - Process-based models
  - Empirical equations and estimates

# Agricultural GHG Tools

---

- COMET-VR (Carbon Management Evaluation Tool for Voluntary Reporting)
- Developed by Colorado State Univ. and NRCS
- Web-based interface to Century model
- Decision support for agricultural producers, land managers, and other agricultural interests
- Official USDA tool for 1605(b)



# COMET-VR

[www.cometvr.colostate.edu](http://www.cometvr.colostate.edu)



The screenshot shows the website for COMET-VR, a USDA Voluntary Reporting Carbon Management Tool. The header features the USDA logo and the text "United States Department of Agriculture". Below the header is a navigation menu with "Contributors" listed as USDA, USDA GCPO, NRCS, ARS, and CSU NREL. The main content area displays the "Comet - VR" logo and the subtitle "USDA Voluntary Reporting Carbon Management Tool". The background of the main content area is a collage of agricultural images including a tree, a field, a globe, a person holding soil, a person in a red jacket, and a group of people. At the bottom of the page, there is a navigation bar with "Home", "Help", "Contact Us", and "COMET-VR Tool" buttons. A "Change text" link and font size controls are also visible.

- Easy to use web interface
- Minimum of inputs required
- Currently for cropland and rangeland
- Expanded version incl. agroforestry in summer '07



# COMET-VR

[www.cometvr.colostate.edu](http://www.cometvr.colostate.edu)

---

## ■ Outputs:

- Net soil carbon change per year over next 10 years
- Includes an uncertainty estimate
- Estimated on-farm fuel (diesel) and nitrogen fertilizer use





# USDA-NRCS Incentives

---

## ■ CSP

- COMET-VR on-farm scenario testing in 2006—900 producers, \$500 each
- Possible enhancement payment for C seq. and GHG emissions reductions in future CSP


## ■ EQIP

- Alternatives being discussed

## ■ Conservation Plans, Practices & Activities

- Conservation tillage, Agroforestry, Nutrient Management, Feed Management, Manure Management, Combined Operations, Biofuels





---

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.



**For More Information:**

**Greg Johnson**

**Leader, Air Quality & Atmos. Change Team**

**[greg.johnson@por.usda.gov](mailto:greg.johnson@por.usda.gov)**

**(503) 273-2424**

**[www.airquality.nrcs.usda.gov](http://www.airquality.nrcs.usda.gov)**

