Greenhouse Gases and Carbon Sequestration:

Agricultural Connections, and the USDA-NRCS

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Agriculture and Greenhouse Gases

Part of the Problem, A good part of the Solution

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Principal Greenhouse Gases (GHGs) with Agricultural Connections

- Water Vapor (up to 70% of total greenhouse effect)
- Carbon Dioxide (CO_2)
- Nitrous Oxide (N_2O)
- Methane (CH_4)

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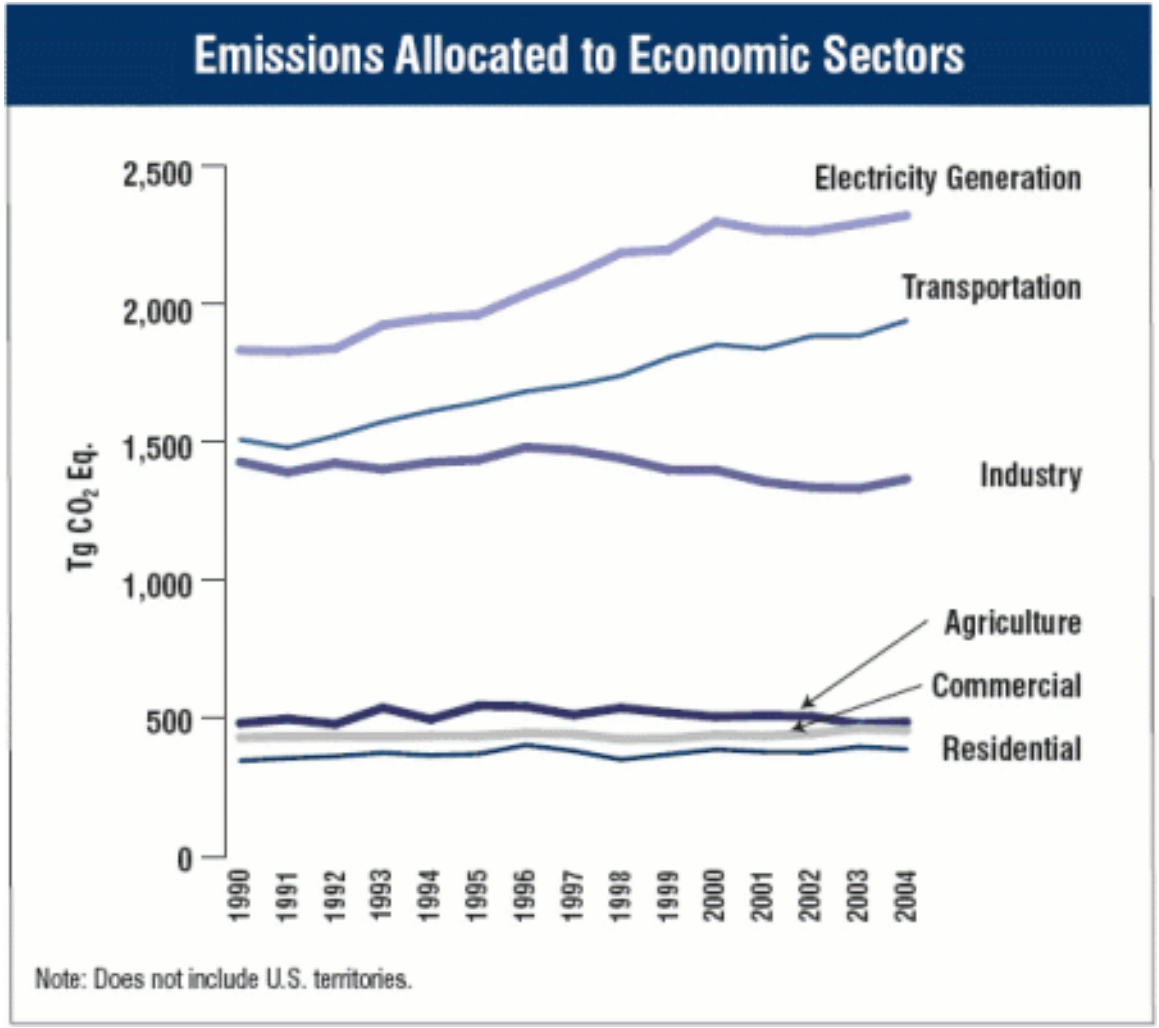
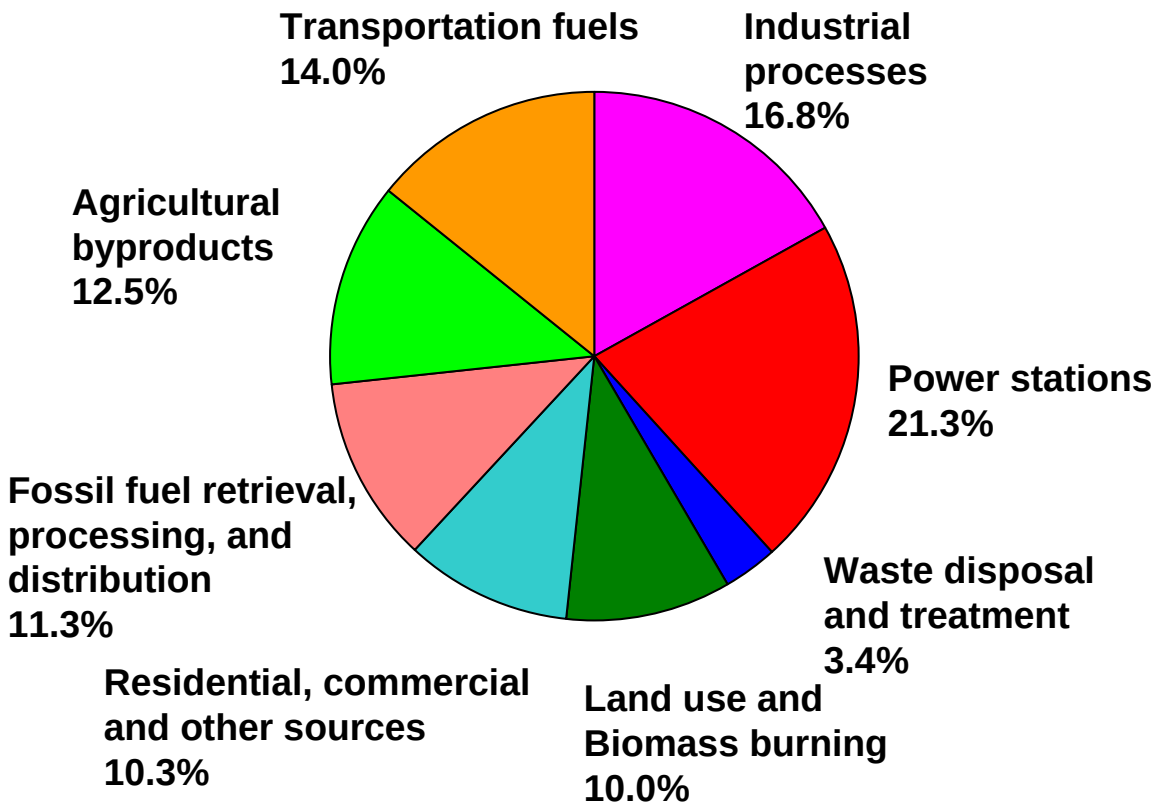


Total U.S. GHG Emissions (2004): 7074 Tg CO_2 Eq.

Total U.S. Agricultural GHG Emissions: 440.1 Tg CO_2 Eq.* (6%)

*Note: This value does not include ag-CO_2 emissions, emissions from liming, or residue burning

Annual Greenhouse Gas Emissions by Sector



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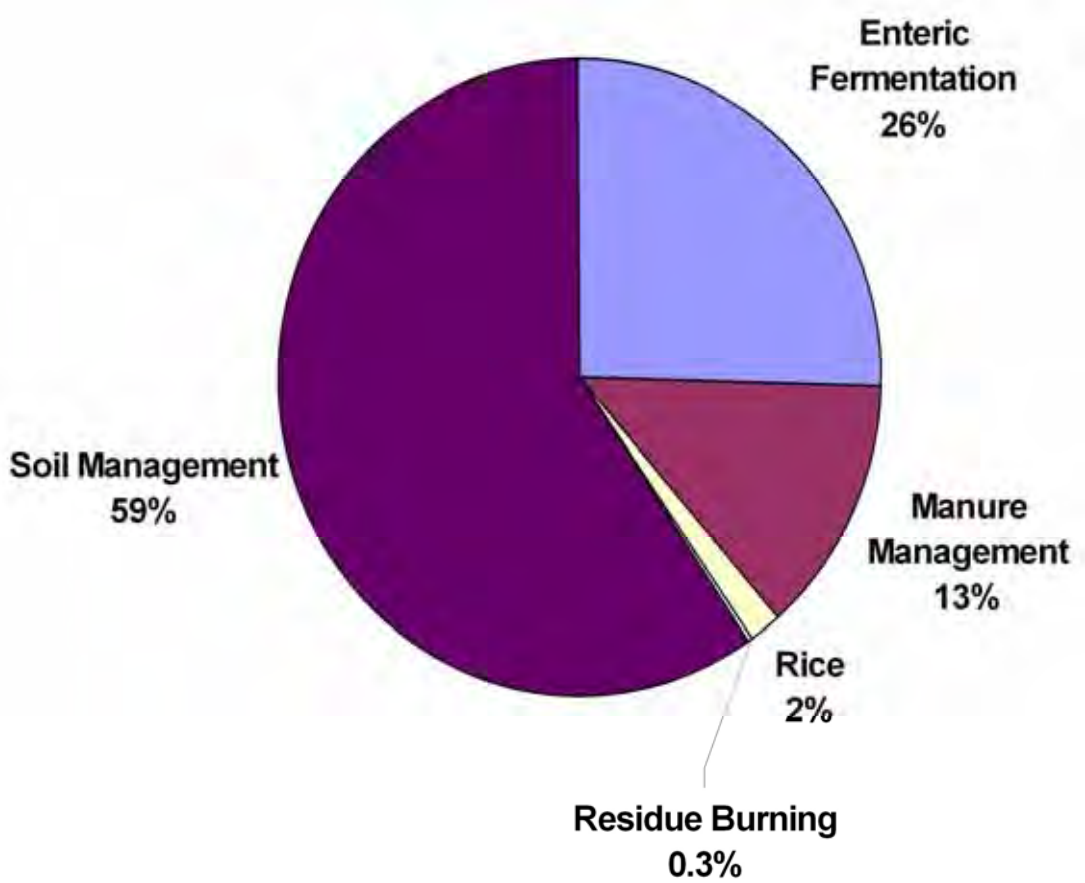
Agricultural GHG Emissions-Inventory Categories



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GHGs: Temporal Changes and Radiative Forcing

- CO_2: 280 (pre-industrial) to 380 ppm now; RF=1
- N_2O: 270 to 320 ppm; RF=296
- CH_4: 715 to 1775 ppm (growth rate declining); RF=23

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Trends in Agricultural GHGs

Total U.S. Emissions Up 16% Since 1990

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

CH_4 Up 2%; N_2O Down 1%

- Soil Management
  - N_2O Down 1.7%
- Enteric Fermentation
  - CH_4 Down 4.5%
- Manure Management
  - CH_4 Up 26.4%
  - N_2O Up 8.8%
- Rice
  - CH_4 Up 6.2%
- Residue Burning
  - CH_4 Up 27.2%
  - N_2O Up 38.5%
- Organic Soils:
  - CO_2 Up 1%
- Liming
  - CO_2 Down 15%
- Residue Burning
  - CO_2 Up 27%
- Mineral Soil C Sequestration Rate
  - Down 7%

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Greenhouse Gases and Ag

CO_2 (GWP=1)

- Fossil Fuels
- NH_3 Production
- Lime Manufacture
- May be Sequestered in Soils

N_2O (GWP=296)

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

CH_4 (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

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GHG "Atmospheric Fertilization" Effect on Agricultural Production

- Enhanced CO_2 can have an impact on plant growth
- Preferential growth changes in some plants versus others
- Free-Air CO_2 Enrichment (FACE) Experiment discerning how CO_2 and other GHG buildups may impact agriculture

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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

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Agricultural GHG Tools

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

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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)

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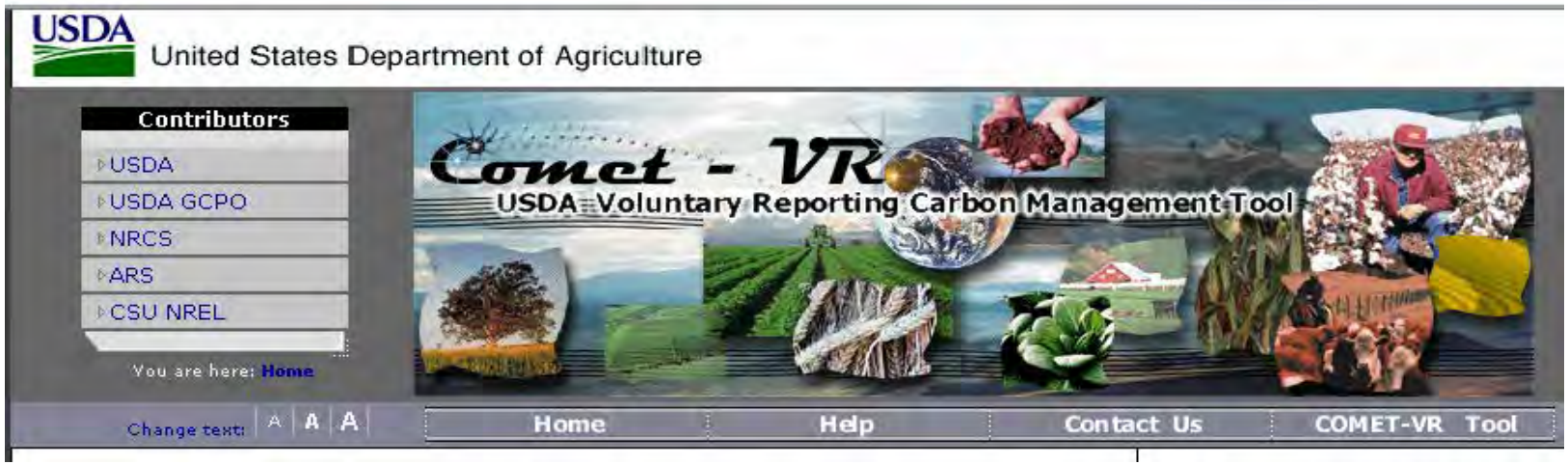
COMET-VR

www.cometvr.colostate.edu



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

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COMET-VR

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

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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

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