Third Leg of the Environmental Milk Stool: Air Quality

For Dairy Practices Council
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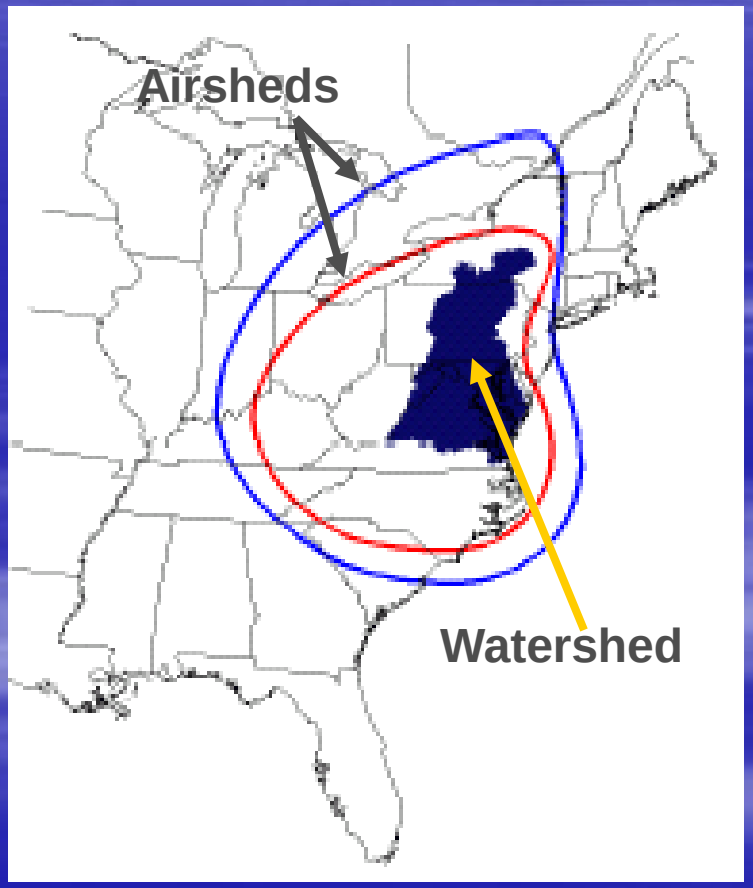
Shelburne Farm, VT

Air Quality Impact

- Concept of the “air-shed”
  - Part of the atmosphere that behaves in a coherent way with respect to the dispersion of emissions.

“water flows downhill” like…

“air pollutants flow downwind”



Chesapeake Air- & Water-sheds

Air Quality Regulated

- U.S. Environmental Protection Agency (EPA) is asking agriculture to “take its turn” in improving national air quality
  - manufacturing, transportation, energy, etc. have taken their “turns”

Donora, PA @ noon 29 Oct 1948

Image from Environment Canada

Agriculture Air Emissions appear to be more subtle

-- But what about haze?

-- Global warming?

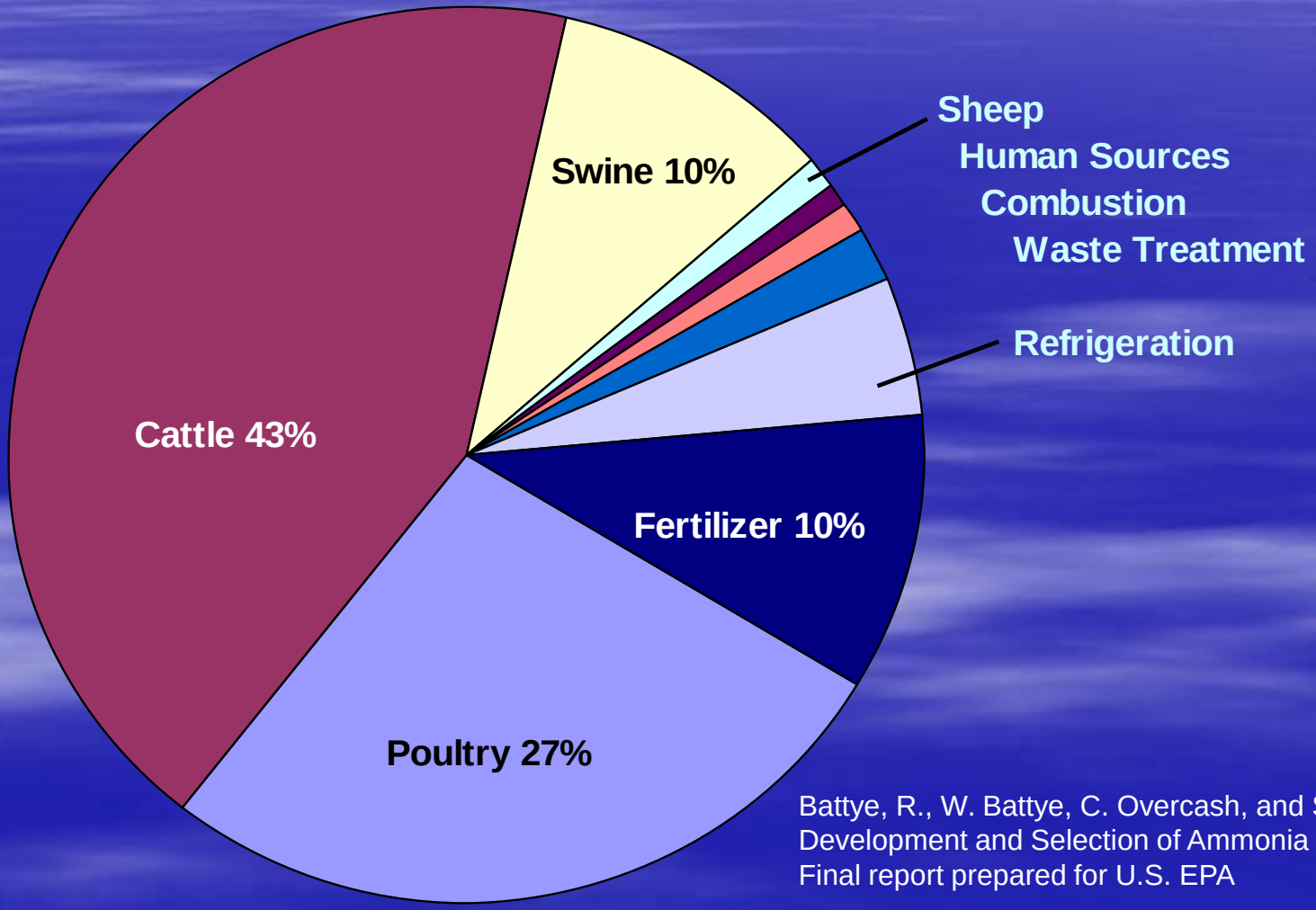
Emissions from Animal Agriculture

- Regulated gases
- Greenhouse gases
- Odor

Regulated Gases from Animal Agriculture

- Ammonia
- Hydrogen sulfide
- Greenhouse gases
  - Carbon dioxide
  - Methane
  - Nitrous oxide

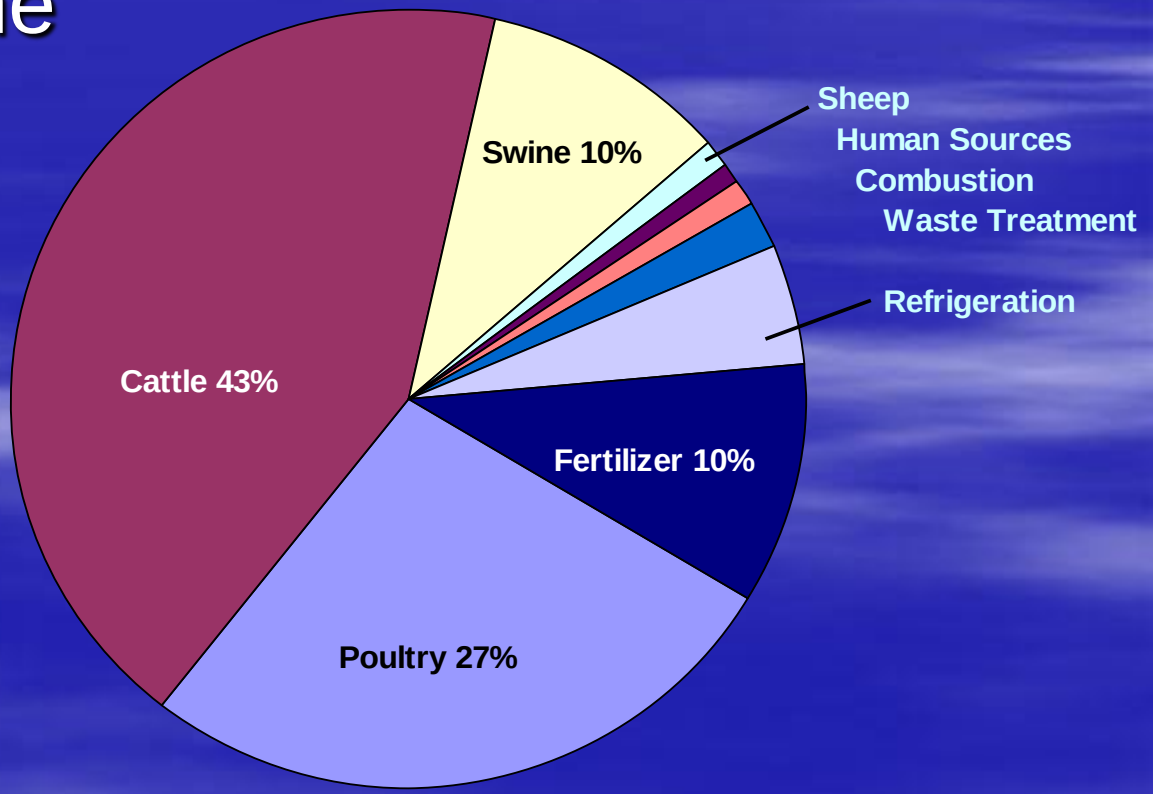
Most Ammonia Sources in USA are from Animal Agriculture



Battye, R., W. Battye, C. Overcash, and S. Fudge. 1994. Development and Selection of Ammonia Emission Factors. Final report prepared for U.S. EPA

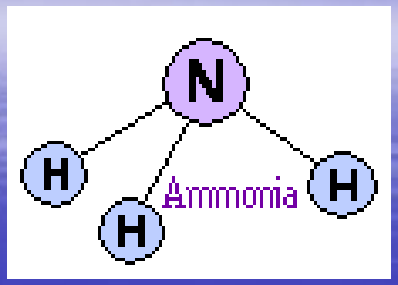
Ammonia NH_3 Source

- Manure in housing and storage
- Poultry and cattle are major sources followed by swine

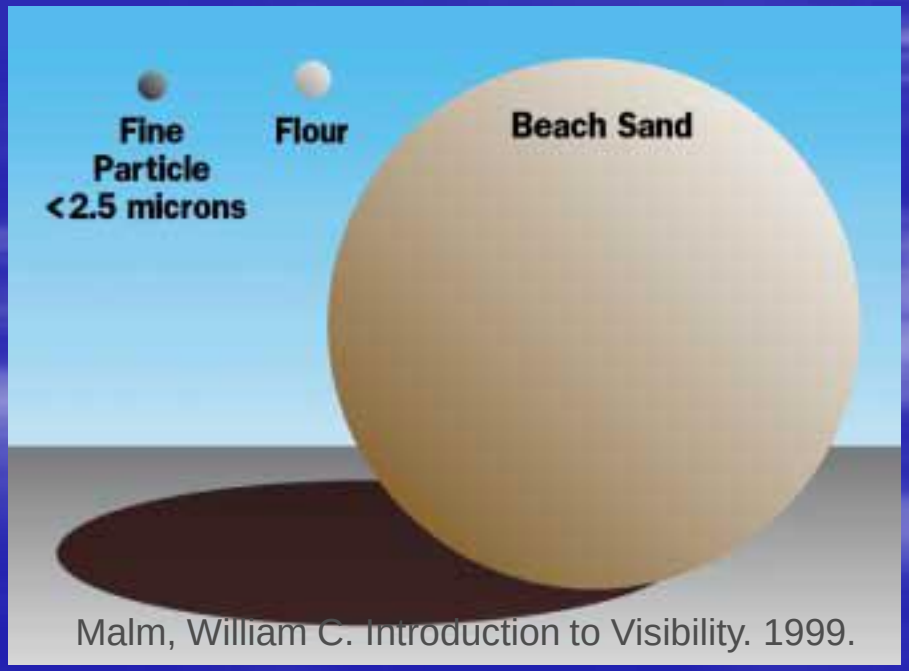


Source: Battye, R., W. Battye, C. Overcash, and S. Fudge. 1994. Development and Selection of Ammonia Emission Factors. Final report prepared for U.S. EPA

Ammonia NH_3



- "Local" deposition in sensitive areas
- "Global" combination with atmospheric trace gases to form aerosols
  - These compounds are the precursor of fine particle aerosols ($PM_{2.5}$)
  - Reduced visibility-haze
  - Respiratory problems



Malm, William C. Introduction to Visibility. 1999.

Regulated Gases from Animal Agriculture

- Ammonia
- Hydrogen sulfide
- Greenhouse gases
  - Carbon dioxide
  - Methane
  - Nitrous oxide

Hydrogen Sulfide H_2S Source

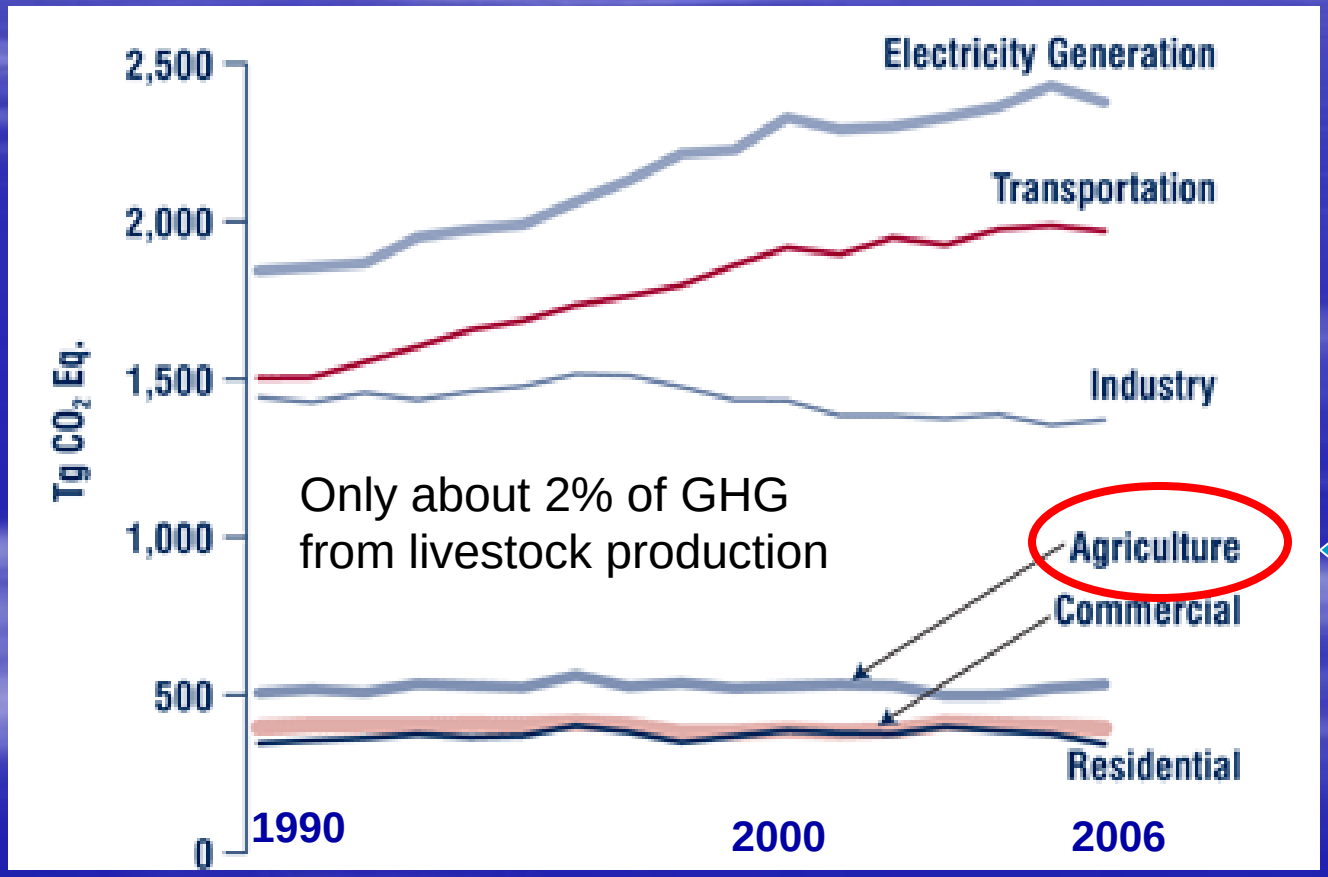
- Manure in storage - anaerobic conditions
- Swine manure
- Very low H_2S from cattle and poultry manures

Emission from housing typically is small

Regulated Gases from Animal Agriculture

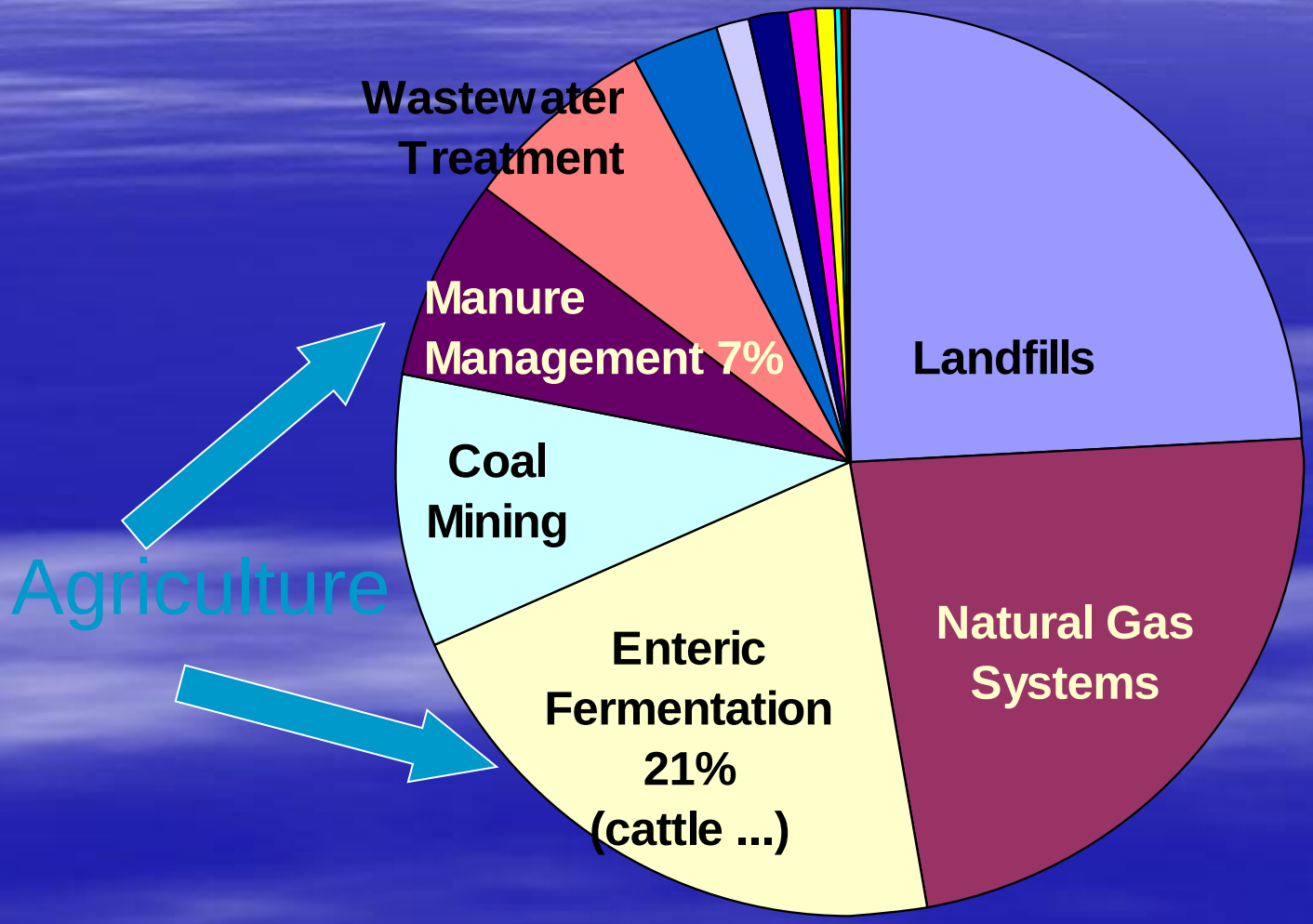
- Ammonia
- Hydrogen sulfide
- Greenhouse gases
  - Carbon dioxide
  - Methane (20x)
  - Nitrous oxide (310x)

USA Greenhouse Gas [GHG] Sources Allocated to Economic Sectors



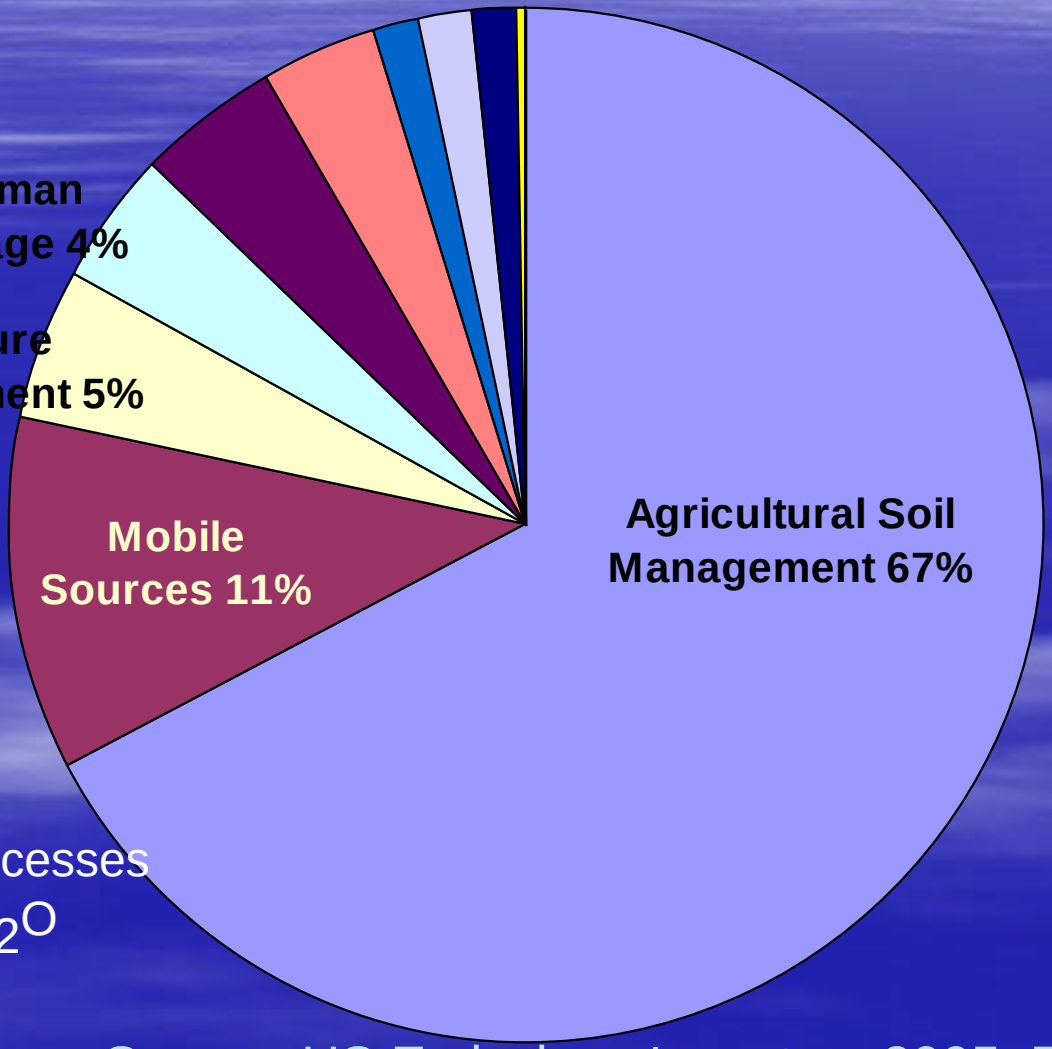
Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2006, USEPA #430-R-08-005

Anthropogenic Methane Sources



Source: US Emissions Inventory 2005. EPA 430-R-05-00

Nitrous Oxide Inventory USA



Nitrification and denitrification processes in soil produce N_2O

Source: US Emissions Inventory 2005. EPA 430-R-05-00

Gases from Animal Agriculture Review the Importance

- Ammonia- a major source & regulated gas
- Hydrogen sulfide – minor but regulated gas
- Greenhouse gases – Anthropogenic sources
  - Carbon dioxide – not a major source

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- Ammonia- a major source & regulated gas
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  - Methane > 40% all Ag: cattle a major source
  - Nitrous oxide > 50% all Ag: land application primarily

Estimates from: Climate Change 2001: The Scientific Background Cambridge University Press

Emissions from Animal Agriculture

- Regulated gases
- Greenhouse gases
- Odor

Odor Problems in Animal Agriculture
Odor Difficult to Regulate

- EPA has virtually no odor regulations or criteria so citizen complaints against local animal agriculture air quality are not easily evaluated
  - Scentometer used in some EPA regions
  - Odor compounds of interest?
    - Hydrogen sulfide
    - Ammonia
    - 180 compounds in swine odor

Nasal Ranger™ field olfactometer

EPA Air Regulations Ammonia & Hydrogen Sulfide

- CAA - Clean Air Act
- CERCLA –Comprehensive Environmental Response, Compensation and Liability Act
- EPCRA –Emergency Planning and Community Right-to-Know Act

EPA Air Regulations and Animal Agriculture

- CAA - Clean Air Act
- CERCLA – "S… …sive Environm… …isation and L…
- … Planning and Co… …t-to-Know Act

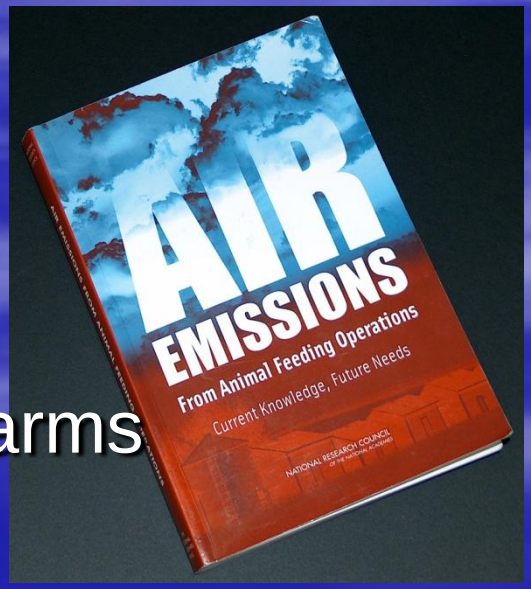
EPA has never initiated a response based upon notification of a hazardous substance release to the air from animal waste at farms.

Reporting requirements recently relaxed for most animal farms.

2000 → 2010

- Citizen concern and lawsuits over odor, air emissions, and mega-livestock farms
- Individual EPA actions
- 2003 National Academy of Sciences report
  - Insufficient scientific data to regulate

- Consent Agreement between EPA and livestock organizations to support National Air Emissions Monitoring Study completed at 22 farms



Air Emissions from Animal Feeding Operations. 2003. National Research Council

SUMMARY: Emissions from Animal Agriculture

- Regulated gases
- Greenhouse gases
- Odor

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Gas Emissions Animal Agriculture **Global** Impact

Emission Compound	Global Effect	Local Effect	Concern
Ammonia	Major	Minor	Deposition Haze
Nitrous oxide	Significant	Insignificant	Climate change
Methane	Significant	Insignificant	Climate change
Carbon dioxide	Significant	Insignificant	Climate change

Adapted from: Air Emissions from Animal Feeding Operations. 2003. NRC

Gas Emissions Animal Agriculture **Local** Impact

Emission Compound	Global Effect	Local Effect	Concern
Odor	Insignificant	Major	Quality of human life
Hydrogen sulfide	Insignificant	Significant	Quality of human life

Adapted from: Air Emissions from Animal Feeding Operations. 2003. NRC

More Air Quality Resources

Livestock and Poultry Environmental Stewardship (LPES) Curriculum

A National Educational Program

www.extension.org

Select → animal manure management

Select → air quality

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Agriculture and Air Quality

- What emissions are of regulatory concern and being monitored?
  - Ammonia, NH_3
  - Hydrogen sulfide, H_2S
  - Particulate matter, PM (dust)
  - Volatile organic compounds, VOCs
  - Greenhouse Gases
    - Carbon Dioxide, CO_2
    - Methane, CH_4
    - Nitrous oxide, N_2O

Fugitive Dust

- The generation of particulate matter where some portion of the material escapes beyond the property where source is located.

- EPA estimates that 50% of $PM_{2.5}$ emissions arise from fugitive dust sources

Emissions Animal Agriculture Local Impact

Emission Compound	Global Effect	Local Effect	Concern
Odor	Insignificant	Major	Quality of human life
Hydrogen sulfide	Insignificant	Significant	Quality of human life
Coarse “dust” PM_{10}	Insignificant	Significant	Haze
Fine “dust” $PM_{2.5}$	Insignificant	Major	Health Haze

Adapted from: Air Emissions from Animal Feeding Operations. 2003. NRC