Greenhouse Gas Emissions and the Carbon Footprint of Dairy Production Systems

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What do our Farms Emit?

Little good information exists on the net GHG emissions from our farms

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Our Goal

Create a software tool for estimating individual emissions, the net total emission, and the carbon footprint of dairy production systems

- **Cradle-to-farm gate Life Cycle Assessment (LCA)**
- **Includes all sources and sinks of carbon dioxide**
- **Enforces a carbon balance for the production system**

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Greenhouse Gases

- Carbon dioxide
- Methane
- Nitrous oxide

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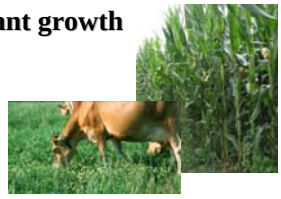
Carbon Dioxide Emissions

- Carbon fixation in plant growth
- Soil respiration
- Plant respiration
- Engine exhaust
- Animal respiration
- Manure respiration on barn floor
- Manure respiration in storage



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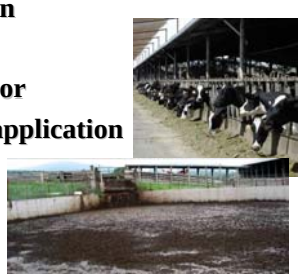
Methane Emissions

- Enteric fermentation
- Manure storage
- Manure on barn floor
- Following manure application
- Feces from grazing animals



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Nitrous Oxide Emissions

- Nitrification/denitrification processes in cropland
- Manure storage surface
- Manure in bedded pack or dry lot

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Secondary Emissions

Emissions occurring during the manufacture or production of farm inputs

- Fuel
- Electricity
- Machinery
- Fertilizer
- Pesticides
- Seed
- Plastic
- Purchased replacement animals

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Global Warming Potential

- Gases have different Global Warming Potentials relative to carbon dioxide
  - Methane (25 times CO_2)
  - Nitrous oxide (298 times CO_2)
- EPA reporting rules use 21 for methane and 310 for nitrous oxide

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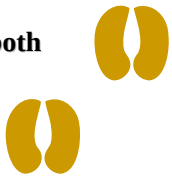
Carbon Footprint

- The net sum of all greenhouse gas emissions (CO_2e) per unit of energy corrected milk production
- For a complete assessment, both primary and secondary emissions are included



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DairyGHG

- Easy to use Windows program
- Available for Internet download

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A Comparison of Production Systems

- Base: 100 cows plus replacements, free stall barns, slurry storage tank, fed alfalfa and corn silage, milk production of 19,800 lb/cow
- Increased production to 22,900 lb/cow through improved genetics and feed management
- Feed more corn silage and less alfalfa
- Use enclosed manure storage with flare

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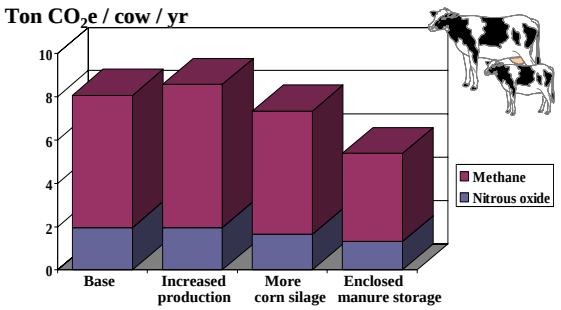
Net GHG Emission



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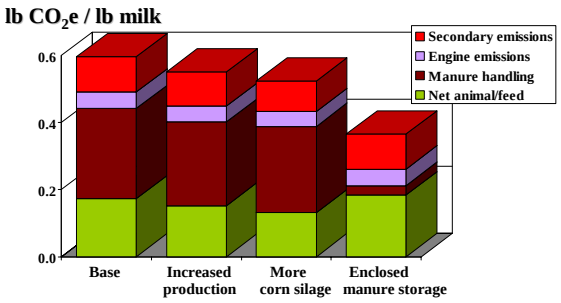
Carbon Footprint



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EPA Rules for GHG Reporting

Includes only methane and nitrous oxide emissions from the manure management system

- **Housing facility (bedded pack and dry lot)**
- **Manure storage (solid, slurry or liquid)**
- **Treatment (solid separation, composting, anaerobic digestion)**

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Example: California Dairy

- Holstein herd
- 4000 cows plus 1500 replacement heifers and 1700 calves (less than one year old)
- Milk production of 24,000 lb/cow
- Housed in free stalls and dry lot
- Six month manure storage

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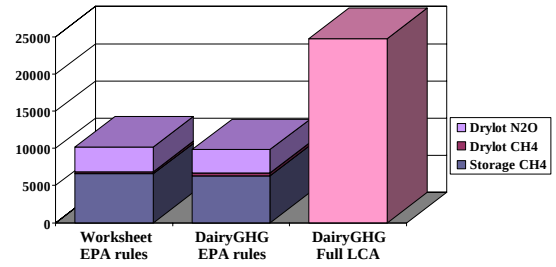
California Dairy

Ton CO_2e / yr



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What makes the difference?

LCA also includes:

- Methane from enteric fermentation
- All sources and sinks of carbon dioxide
- Carbon dioxide from fuel combustion
- Nitrous oxide emissions from crop production
- All secondary emissions

DairyGHG uses newer global warming indexes

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Summary

- **DairyGHG provides a simple tool for estimating greenhouse gas emissions and the carbon footprint of dairy production systems**
- **DairyGHG uses process-level simulation to determine a cradle-to-farm gate LCA**
- **DairyGHG predicts manure management emissions similar to that required for EPA reporting, but primarily provides a more complete LCA of the production system**

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Model Availability

http://ars.usda.gov/naa/pswmru

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