CO_2 Footprinting 101
for the Poultry Industry

Jason Perry
UGA Engineering Outreach Service
jperry@engr.uga.edu

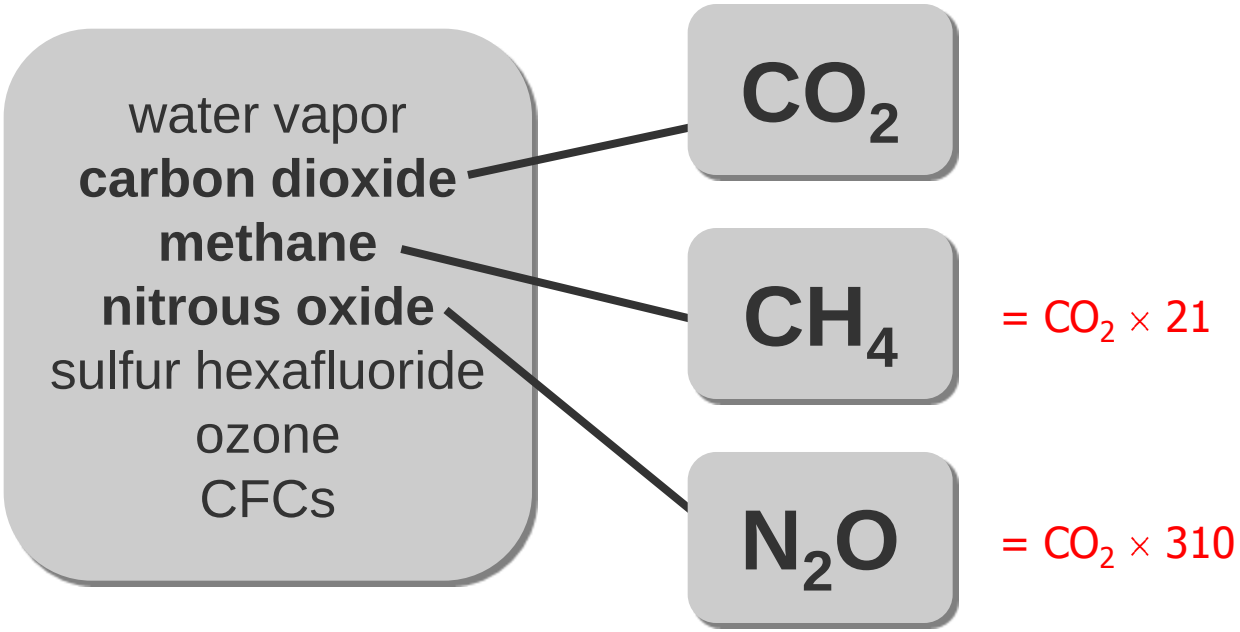
Outline

- What?
- Why?
- How?
- Steps Forward

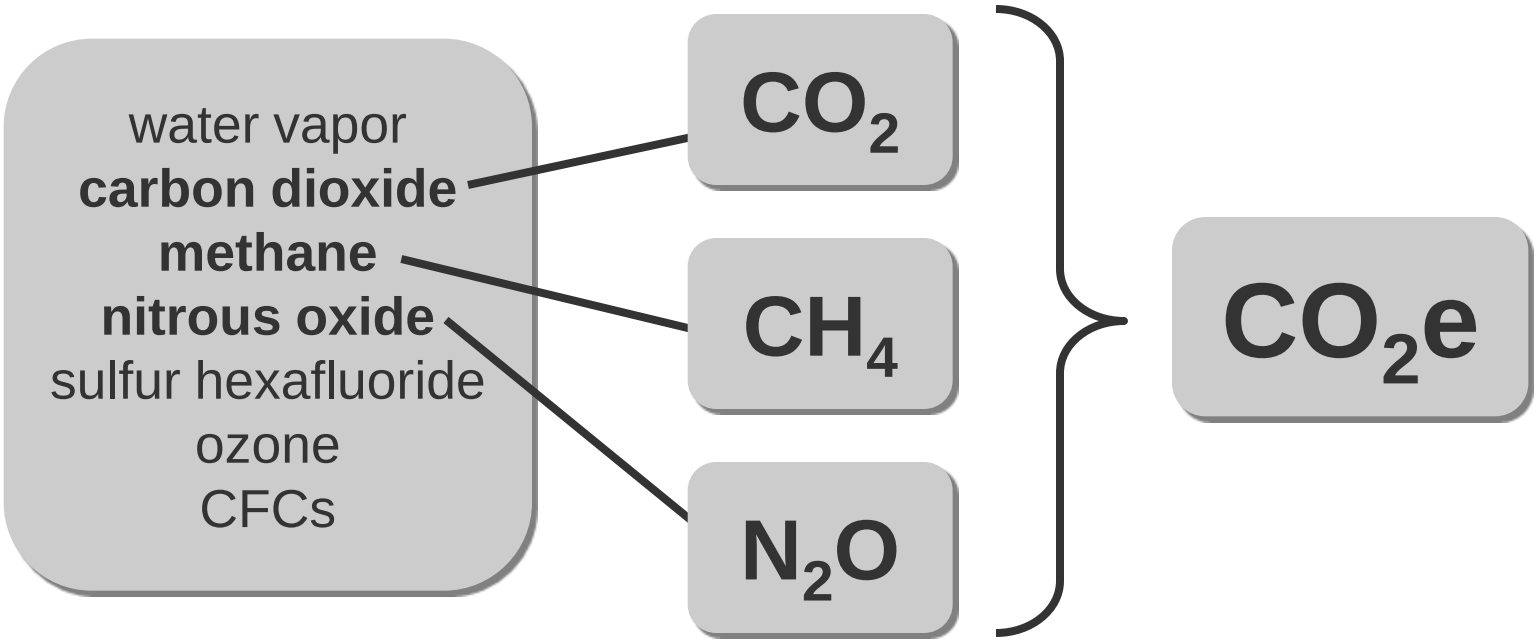
=

Annual greenhouse gas emissions resulting from the operation of a facility, business, etc.

What are greenhouse gases?



What are greenhouse gases?



Types of emissions

energy-related

biological

Natural emissions

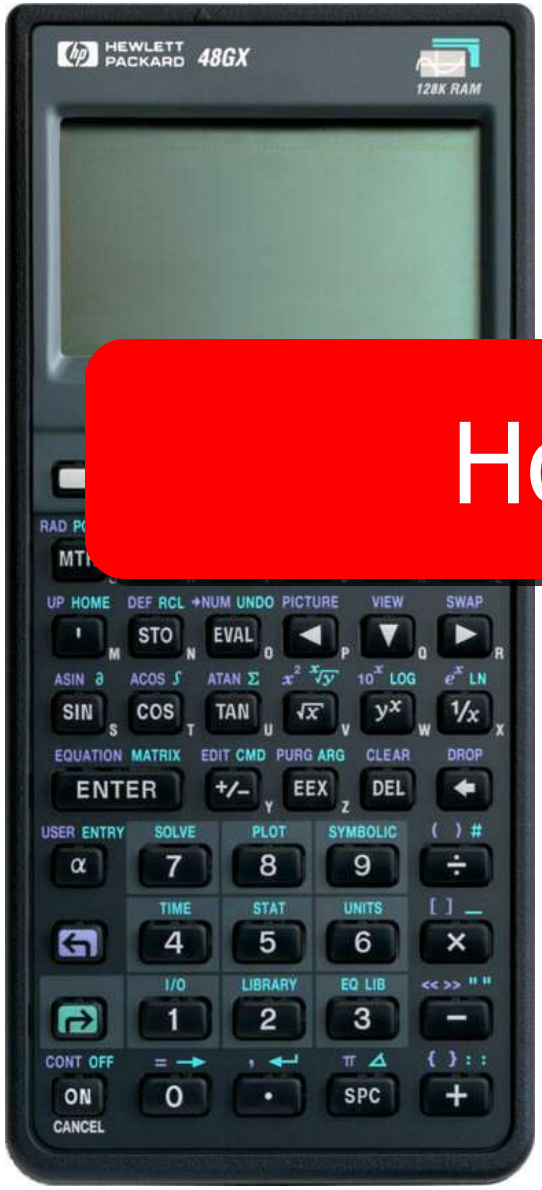
would happen without “us”

(usually excluded from footprint)

Anthropogenic emissions

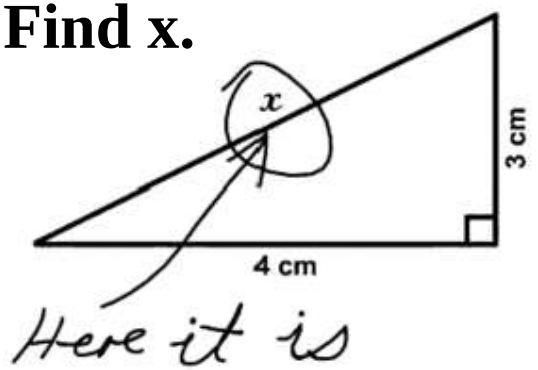
happen because of human activities

Why do you care?



How do you do it?

3. Find x.



#13. Continued

$$u_1'(-8)e^{-8t} + (-u_1'e^{-t})(-7)e^{-7t} = 54e^{-5t}$$

$$-8u_1'e^{-8t} + 7u_1'e^{-t}e^{-7t} = 54e^{-5t}$$

$$-8u_1'e^{-8t} + 7u_1'e^{-8t} = 54e^{-5t}$$

$$-u_1'e^{-8t} = 54e^{-5t}$$

$$u_1' = -\frac{54e^{-5t}}{e^{-8t}} = \boxed{-54e^{3t}} = u_1'$$

$$u_2' = -u_1'e^{-t}$$

$$u_2' = -(-54e^{3t})e^{-t}$$

$$\boxed{u_2' = 54e^{2t}}$$

← What do I do with this now?

$$y = u_1e^{-8t} + u_2e^{-7t}$$

$$\int u_2' = \int 54e^{2t} \qquad \int u_1' = -\int 54e^{3t}$$

$$u_2 = 27e^{2t} \qquad u_1 = -18e^{3t}$$

$$y = (-18e^{3t})e^{-8t} + 27e^{2t}e^{-7t}$$

$$\boxed{y = 9e^{-5t}}$$






Where do you draw the **line**?

Source Energy vs. Site Energy

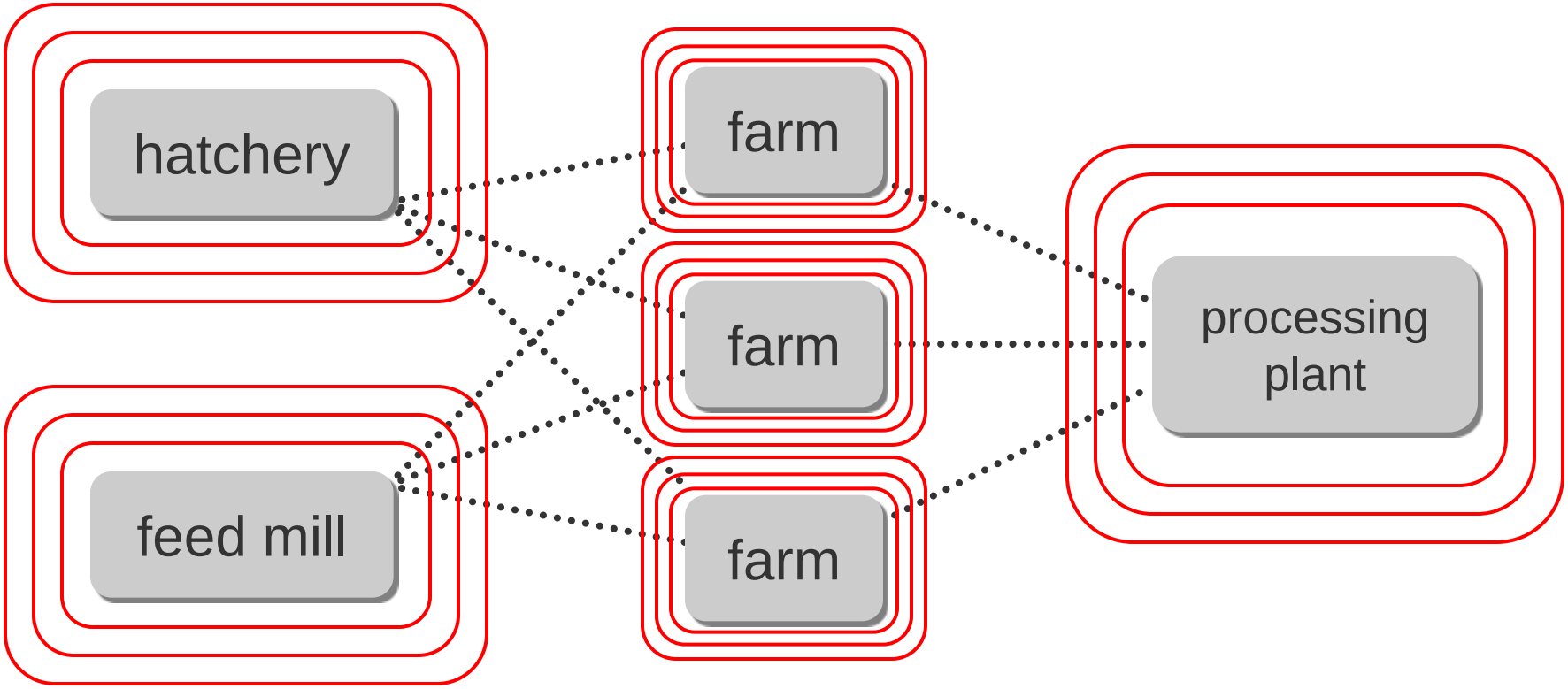
Source *Emissions* vs. Site *Emissions*



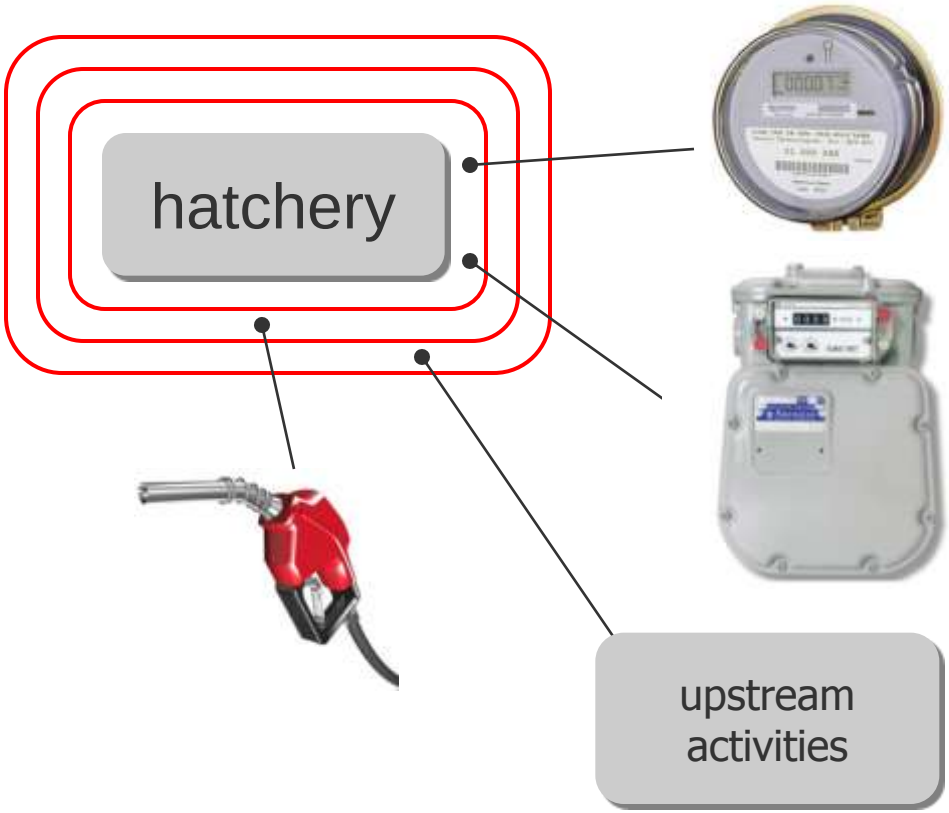





Where do you draw the **line**?



Where do you draw the **line**?



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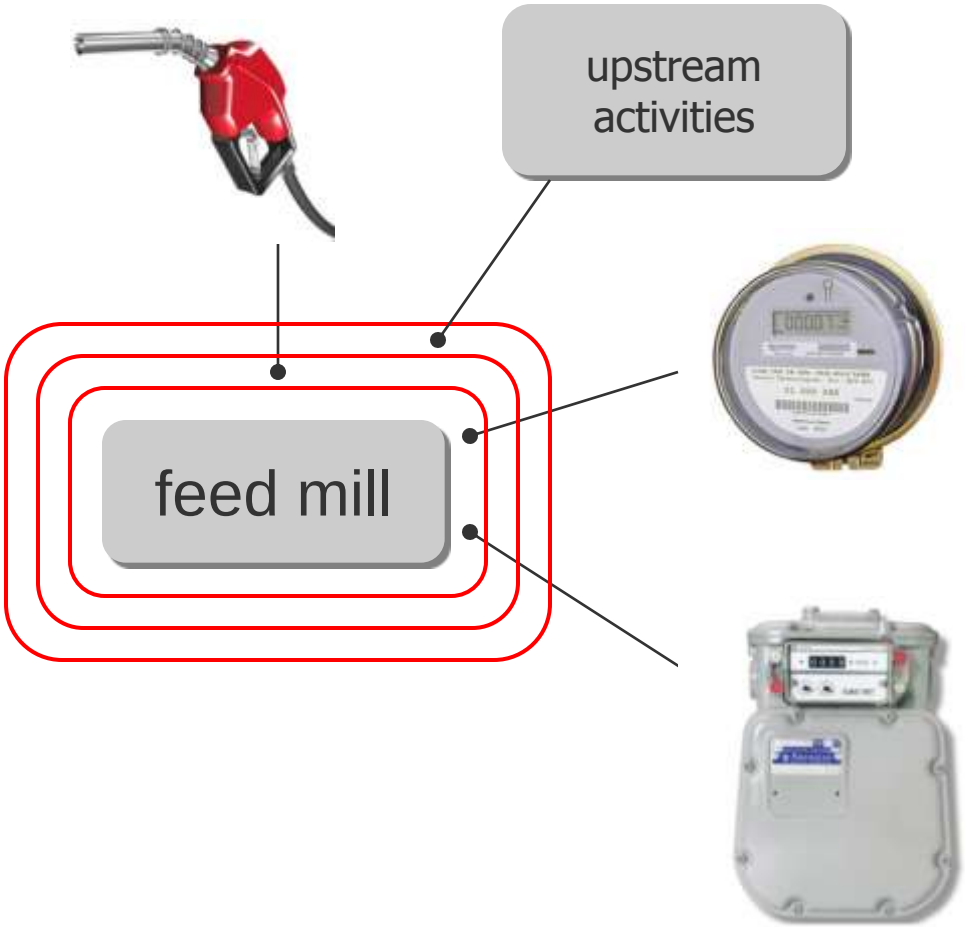


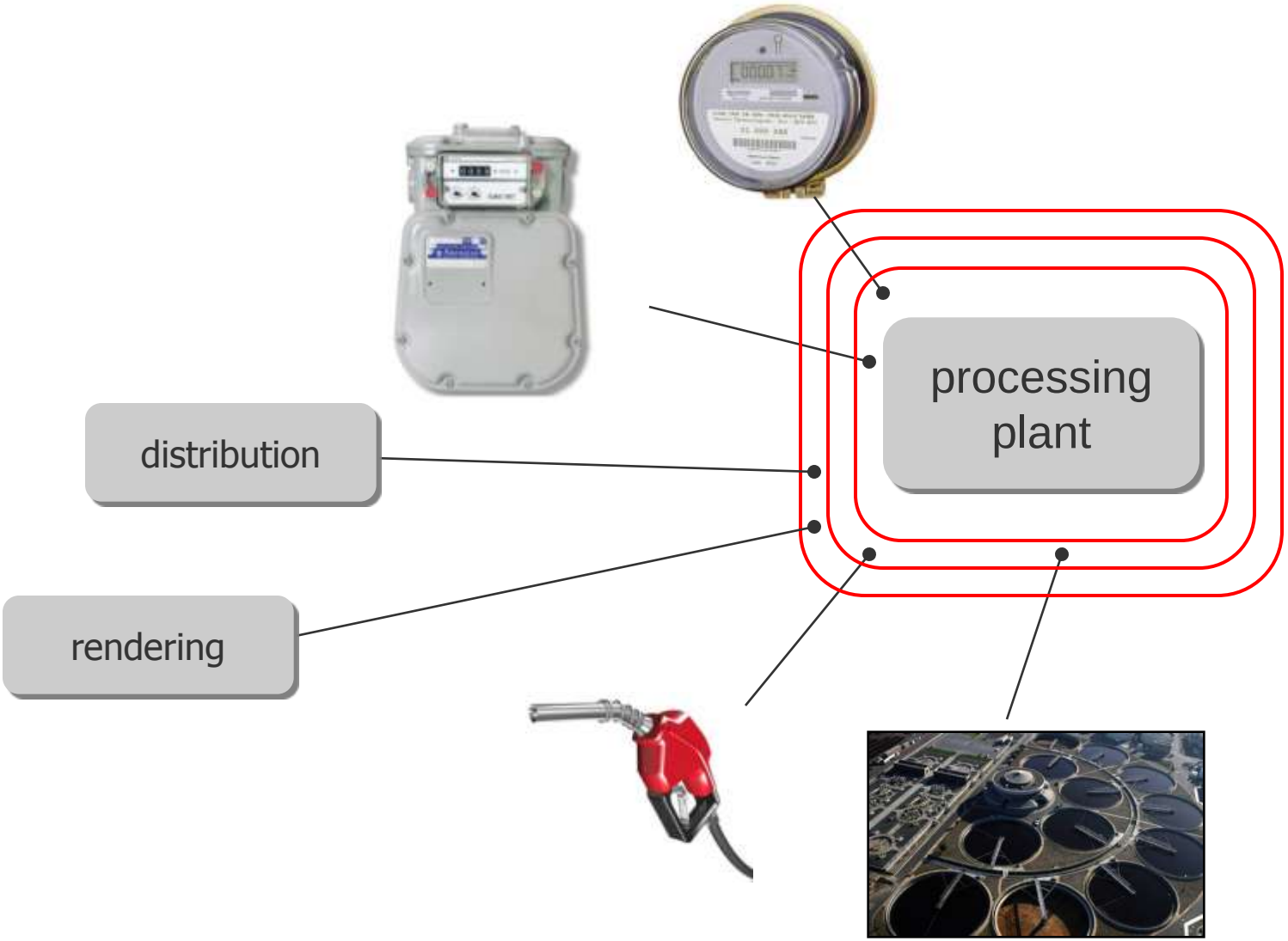
Where do you draw the **line**?

farm

farm

farm

Where do you draw the **line**?



Calculating emissions

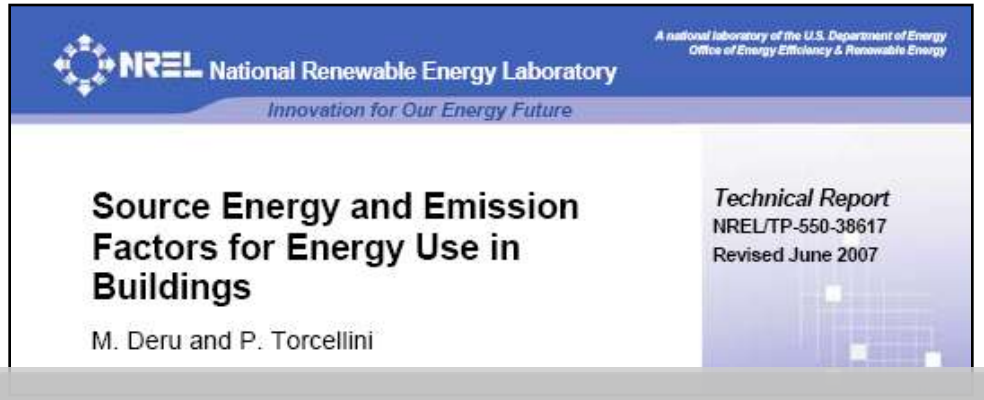
easy — difficult





Easy: Electricity and heating fuels

usage × emission factor = emissions



NREL Technical Report: **NREL/TP-550-38617**

Easy: Electricity and heating fuels

5,000 kWh × 1.67 lb CO_2e/kWh* = **8,350 lb CO_2e**

usage | emission factor | emissions

9,000 ft^3 × 123 lb CO_2e/1000 ft^3 = **1,107 lb CO_2e**

* national average

Not as easy: Transport fuels

usage × emission factor = CO_2 emissions

and, depending on type and age of vehicle:

usage × emission factor = CH_4 emissions

usage × emission factor = N_2O emissions

Not as easy: Transport fuels

U.S. Energy Information Administration
Independent Statistics and Analysis

Home > Environment > Voluntary Reporting Program > Emission Factors

Voluntary Reporting of Greenhouse Gases Program

Emission Factors and Global Warming Potentials

The greenhouse gas emission factors and global warming potentials (GWPs) presented on this page should be used for preparing emission inventories and calculating emission reductions submitted to EIA on Form EIA-1605(b).

- Fuel and Energy Emission Factors: Instructions | Tables
- Electricity Emission Factors: Instructions | Tables
- EPA's AP-42 Emission Factors: Instructions | Tables
- Global Warming Potentials (GWPs): Instructions | Tables

www.eia.doe.gov/oiaf/1605/emission_factors.html

Difficult: Wastewater treatment

Wastewater → *Anaerobic!*  → CH_4

CH_4 emissions = f { COD & BOD; primary treatment; secondary treatment; % anaerobic }

Difficult: Wastewater treatment

U.S. ENVIRONMENTA

Climate Change - Greenhouse Gas Emissions

Contact Us **Search:** All EPA This Area Go

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U.S. Greenhouse Gas Inventory | U.S. Greenhouse Gas Inventory Report | U.S. Greenhouse Gas Inventory /

Climate Change Home

Greenhouse Gas Emissions Home

Greenhouse Gas Overview
- Carbon Dioxide
- Methane
- Nitrous Oxide
- Fluorinated Gases

2009 U.S. Greenhouse Gas Inventory Report

INVENTORY OF U.S. GREENHOUSE GAS EMISSIONS AND SINKS: 1990-2007 (April 2009)

Read or download the entire Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2007 (PDF, 410 pp., 24.2 MB, About PDF). For faster access, individual report sections are posted below, for example the Executive Summary (PDF, 21 pp., 906 KB, About PDF).

Individual sections of the report are also available for download:

epa.gov/climatechange/emissions/usinventoryreport.html
Section 8.10

More difficult: Manure management

CH_4

N_2O

More difficult: Manure management

CH_4 emissions = f { bird type, bird population, climate, excretion rate, management }

More difficult: Manure management

N_2O emissions = f { bird type, bird population, climate, excretion rate, management, runoff }

More difficult: Manure management

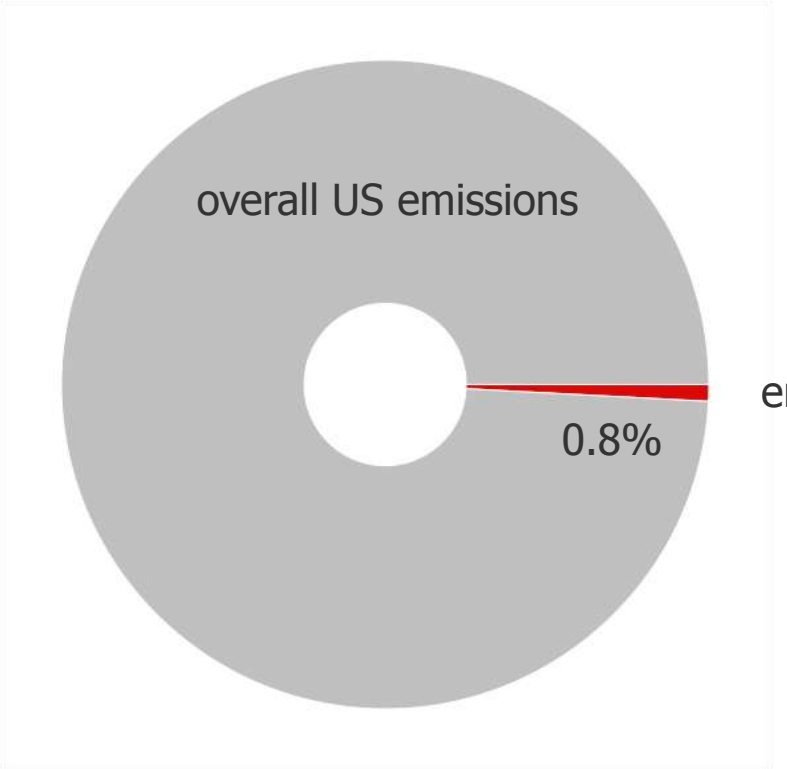
epa.gov/climatechange/emissions/usinventoryreport.html

Section 6.2

and

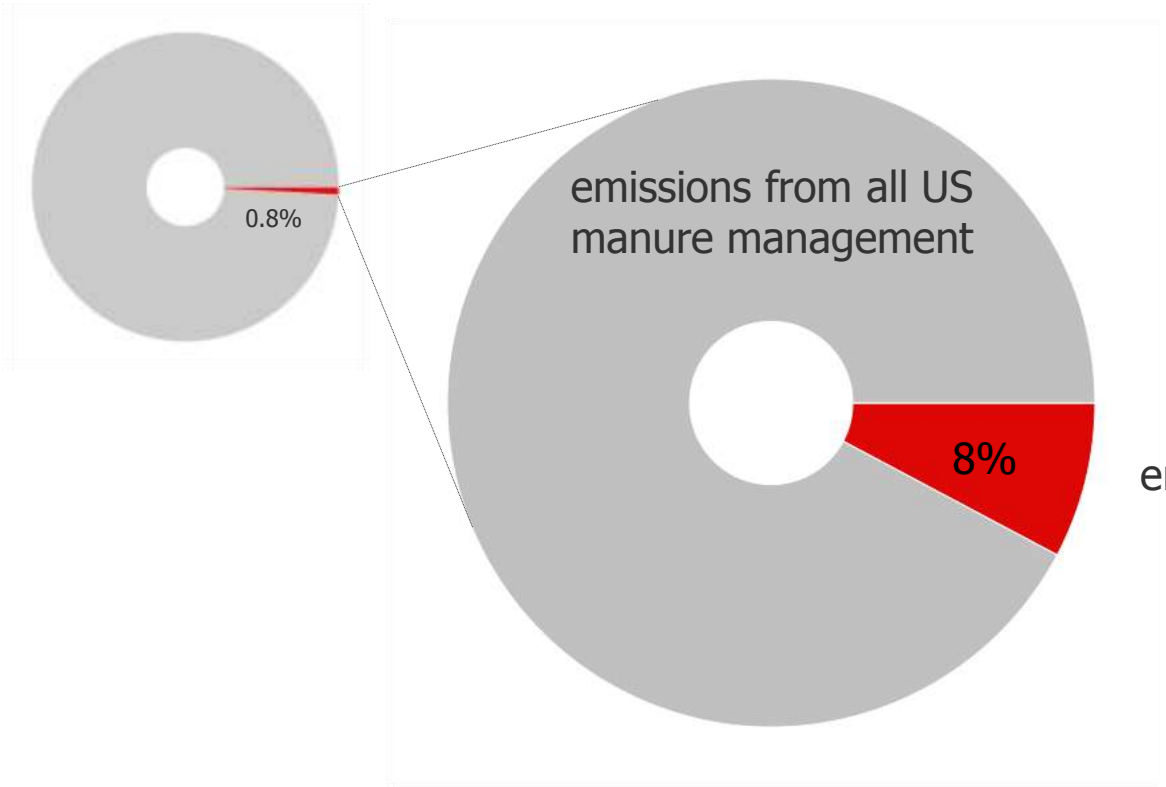
Annex 3, Section 10

Manure: Some perspective



emissions from all US manure management

Manure: Some perspective



emissions from US poultry manure management

Next steps

1. Decide on a baseline year
2. Decide where to draw the lines
3. Compile energy usage data
4. Compile WWTP and manure data
5. Apply methods and emission factors
6. Compare subsequent years to baseline

Thank you. Questions?

Jason Perry
UGA Engineering Outreach Service
jperry@engr.uga.edu
706-542-4768