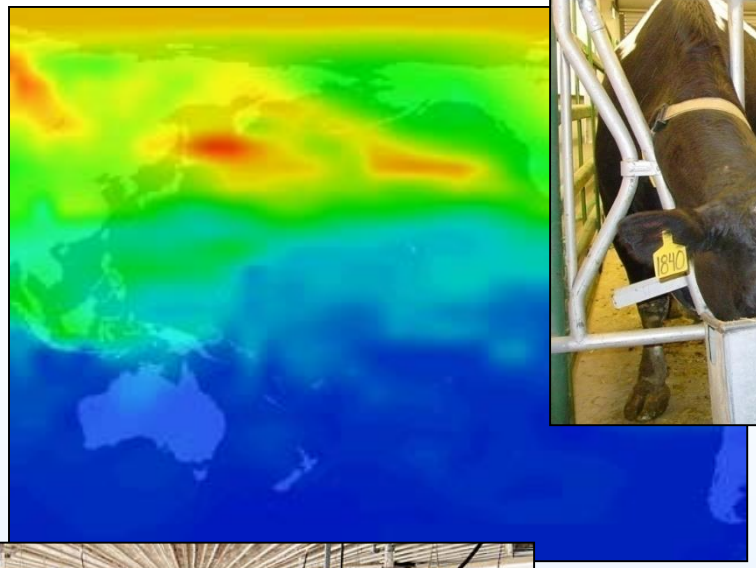
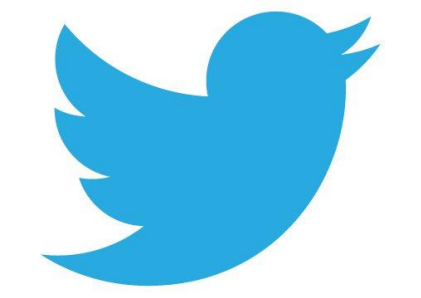
Animal Agriculture and Climate Change: a World View

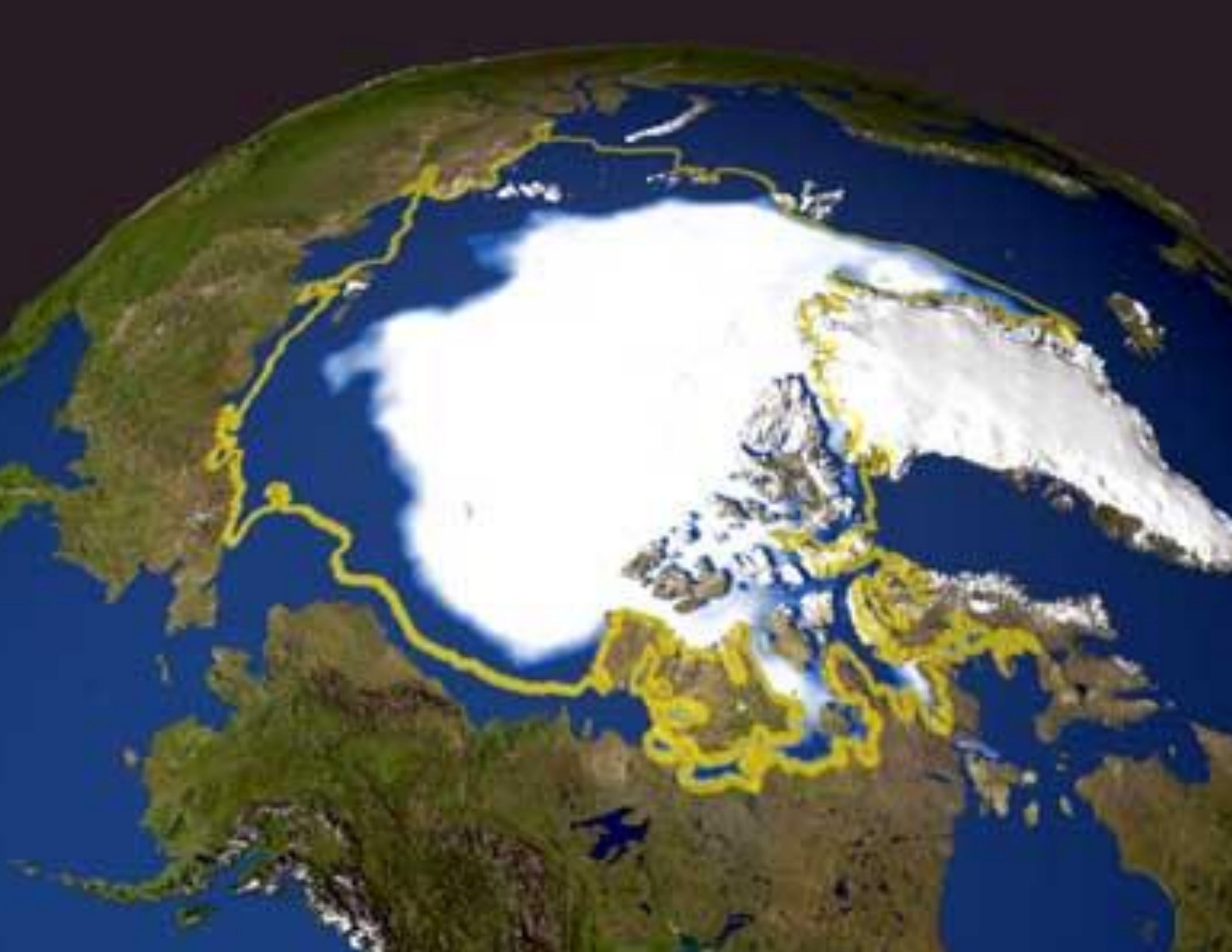


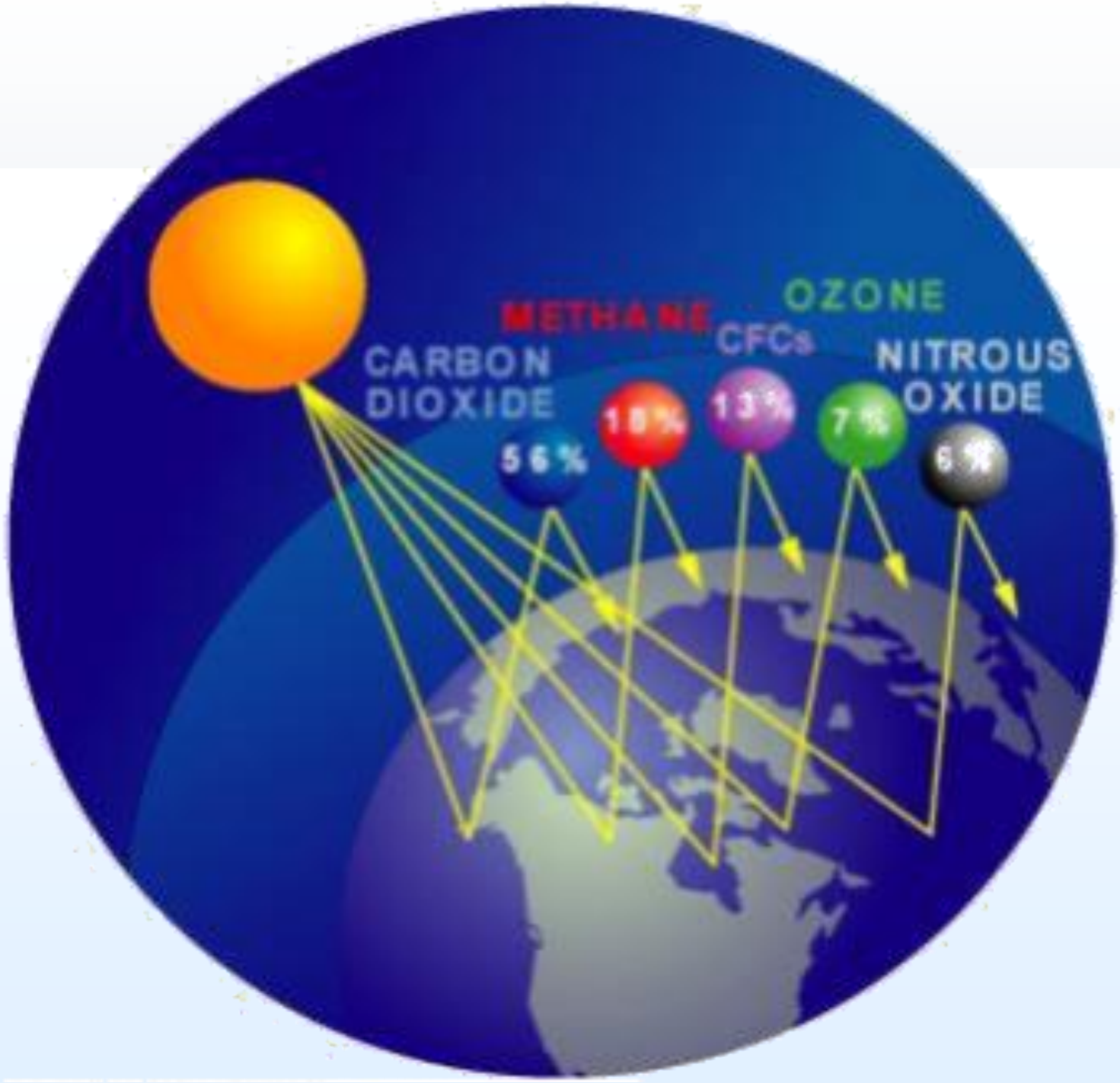
Frank Mitloehner, PhD
Professor & Air Quality CE Specialist
Dept Animal Science
University of California, Davis

Follow me on Twitter



#GHGGuru

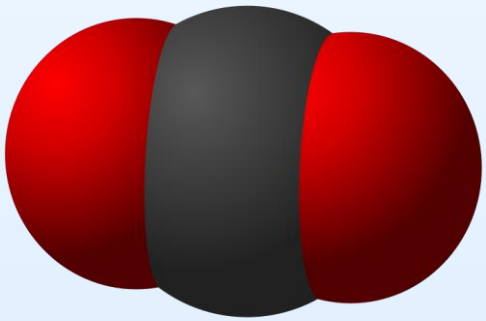



METHANE
OZONE
CFCs
CARBON DIOXIDE
NITROUS OXIDE
56%
18%
13%
7%
6%

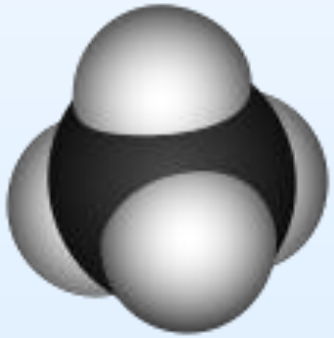
GHG & GWP

Global Warming Potential (GWP) of Main GHG

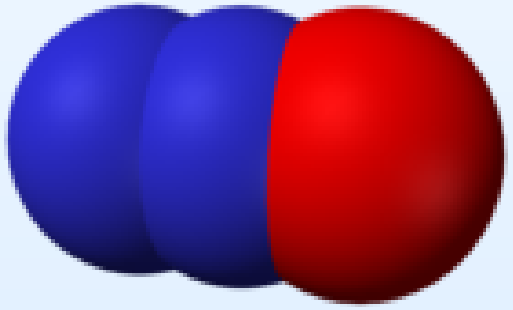
- Carbon Dioxide, CO_2 1
- Methane, CH_4 28
- Nitrous Oxide, N_2O 298



CO2 – Carbon Dioxide

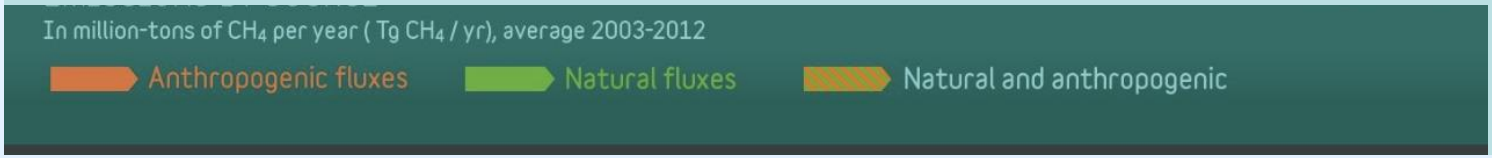


CH4 – Methane



N2O – Nitrous Oxide

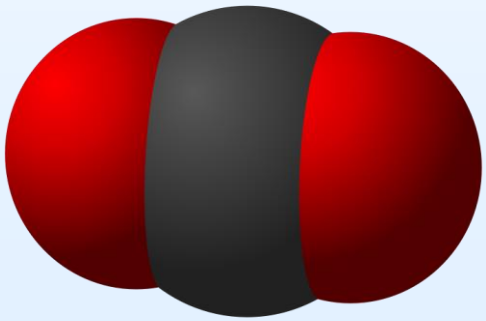
GLOBAL METHANE BUDGET



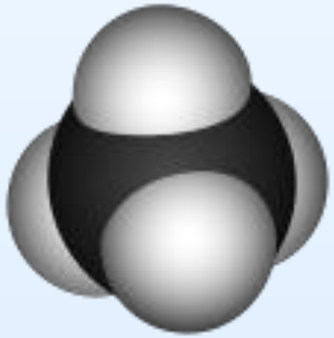
GHG & GWP

Global Warming Potential (GWP) of Main GHG

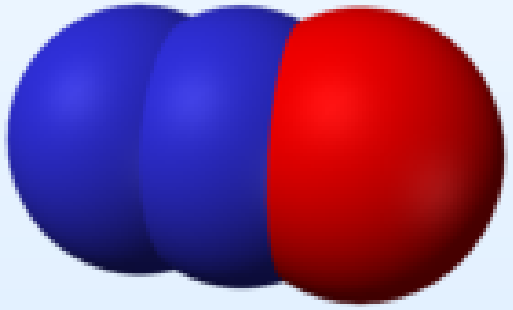
- Carbon Dioxide, CO_2 1
- Methane, CH_4 28
- Nitrous Oxide, N_2O 298



CO2 – Carbon Dioxide

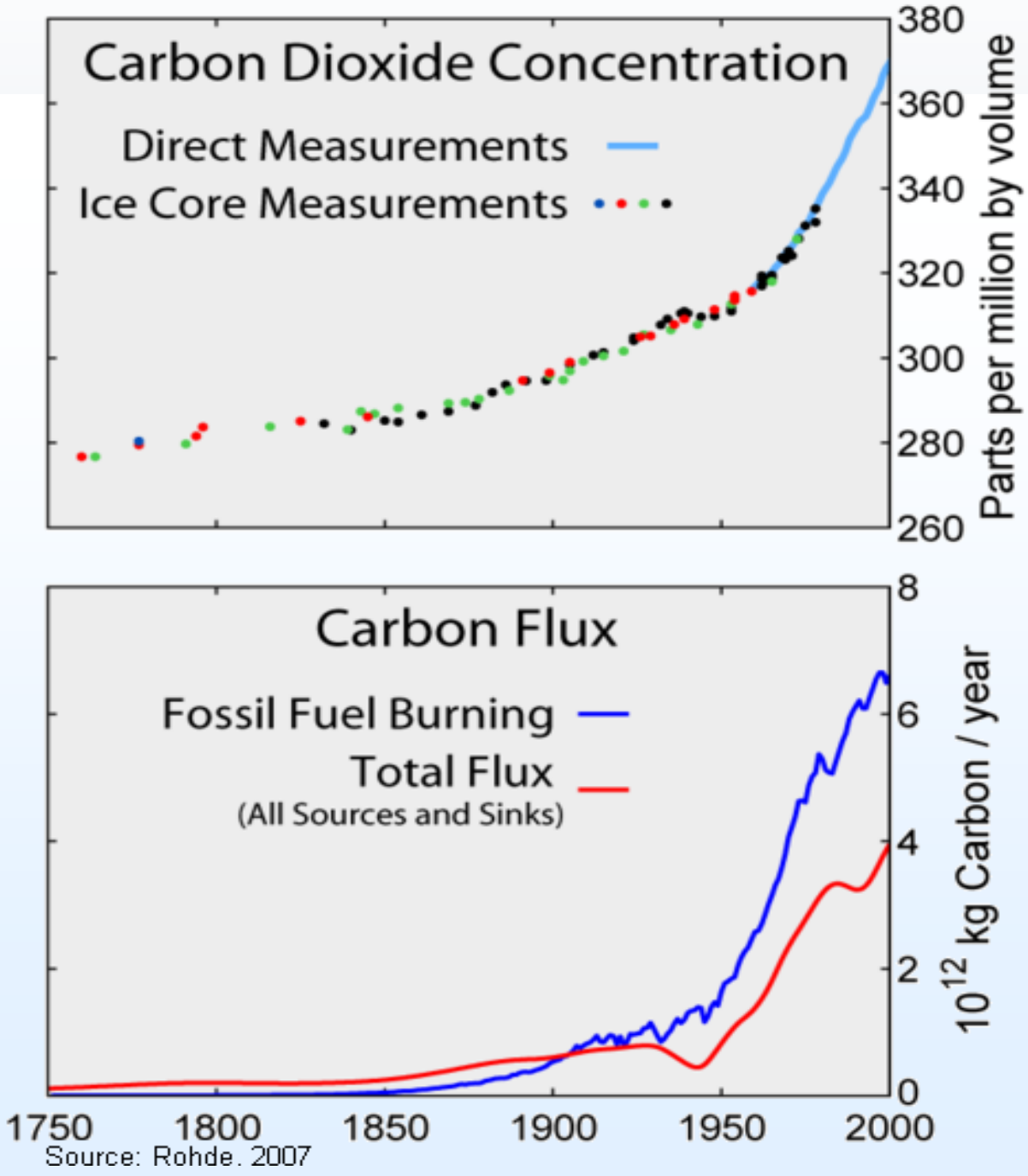


CH4 – Methane



N2O – Nitrous Oxide

Carbon Dioxide and Carbon Flux

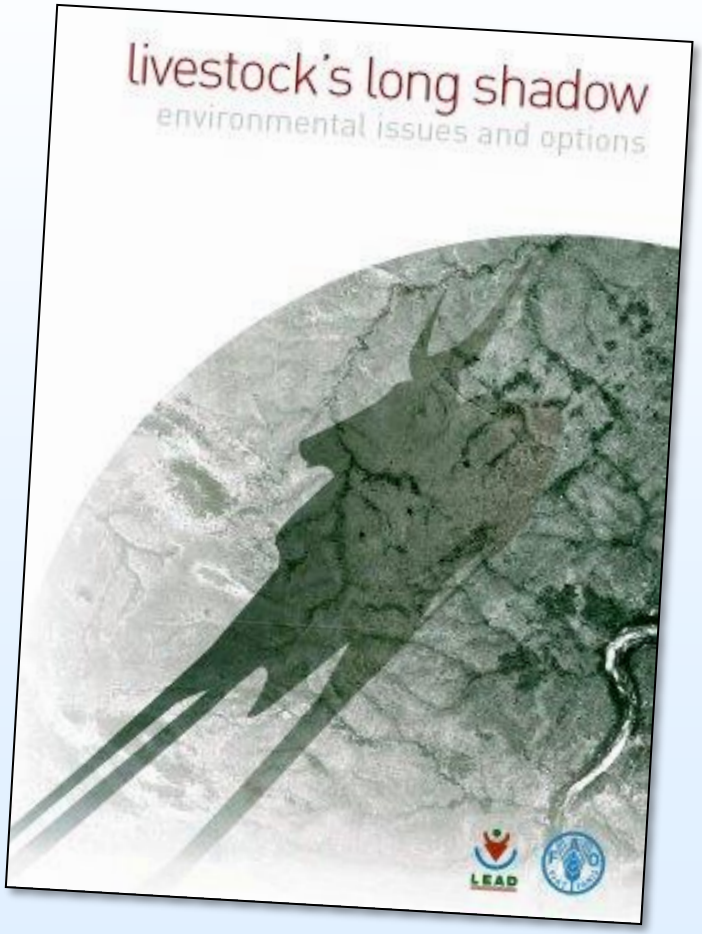


Facts or Fiction on Livestock and Climate Change

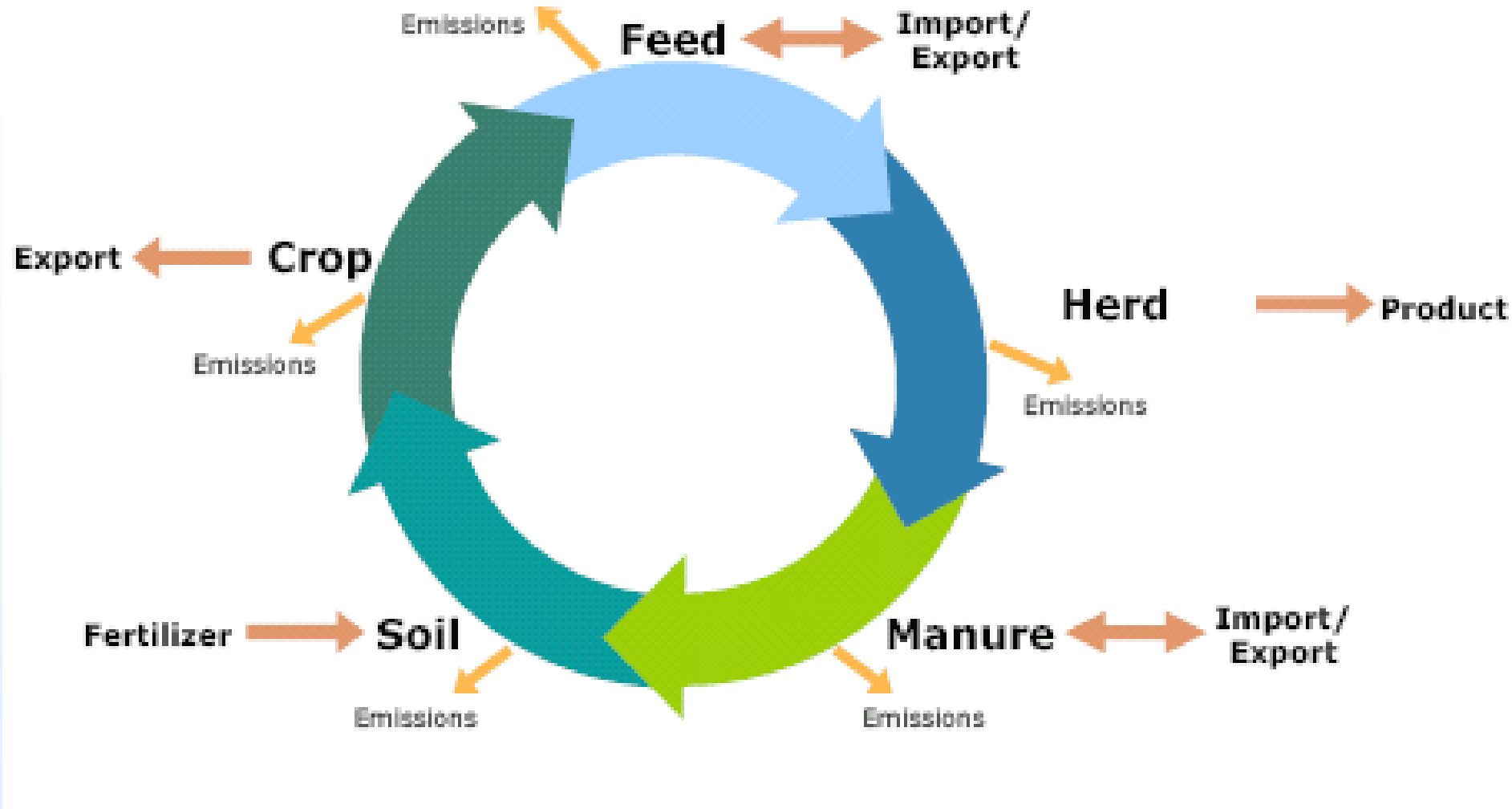
- Livestock produces 18% of all anthropogenic GHG globally
- Livestock produces more GHG than transportation
- Livestock occupies 70% of all agricultural land globally
- Grazing systems produce less GHG than conventional animal production in confinement systems

"Livestock's Long Shadow" (FAO, 2006)

- "The Livestock sector is a major player, responsible for 18% of GHG emissions measured in CO_2e. This is a higher share than transport"



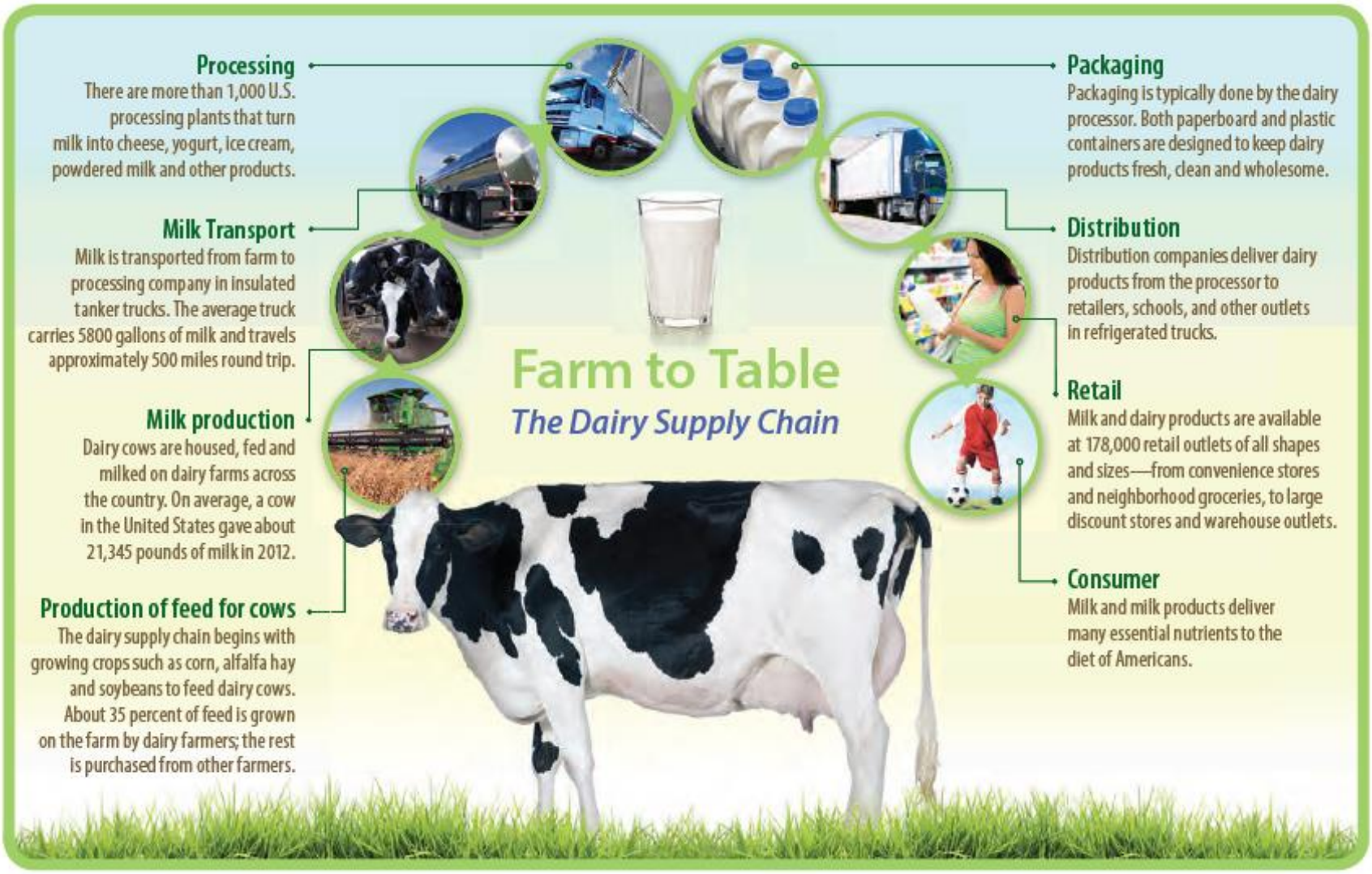
Life Cycle Assessment



(NRC, 2003)

Farm to Table

The Dairy Supply Chain



Processing
There are more than 1,000 U.S. processing plants that turn milk into cheese, yogurt, ice cream, powdered milk and other products.

Milk Transport
Milk is transported from farm to processing company in insulated tanker trucks. The average truck carries 5800 gallons of milk and travels approximately 500 miles round trip.

Milk production
Dairy cows are housed, fed and milked on dairy farms across the country. On average, a cow in the United States gave about 21,345 pounds of milk in 2012.

Production of feed for cows
The dairy supply chain begins with growing crops such as corn, alfalfa hay and soybeans to feed dairy cows. About 35 percent of feed is grown on the farm by dairy farmers; the rest is purchased from other farmers.

Packaging
Packaging is typically done by the dairy processor. Both paperboard and plastic containers are designed to keep dairy products fresh, clean and wholesome.

Distribution
Distribution companies deliver dairy products from the processor to retailers, schools, and other outlets in refrigerated trucks.

Retail
Milk and dairy products are available at 178,000 retail outlets of all shapes and sizes—from convenience stores and neighborhood groceries, to large discount stores and warehouse outlets.

Consumer
Milk and milk products deliver many essential nutrients to the diet of Americans.

BBC Home | News | Sport | Weather | TV | Radio

Page last updated at 00:15 GMT, Wednesday, 24 March 2010

UN body to look at meat and climate link

By Richard Black
Environment correspondent, BBC News

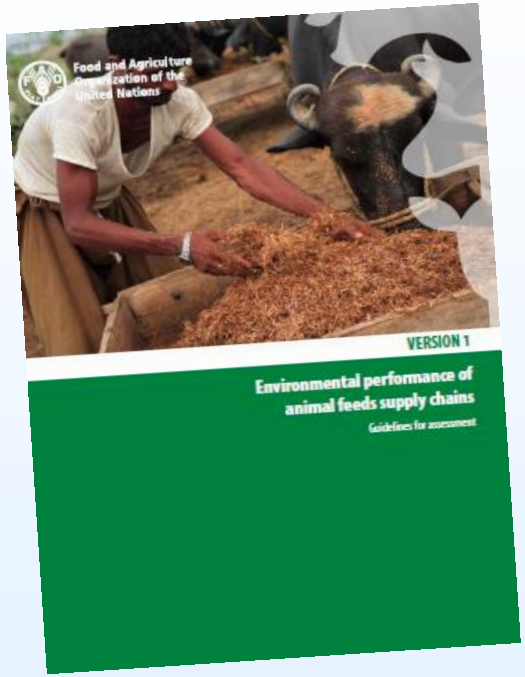
Livestock's Long Shadow calculated meat-related emissions from field to abattoir

UN specialists are to look again at the contribution of meat production to climate change, after claims that an earlier report exaggerated the link.

"I must say honestly that he has a point - we factored in everything for meat emissions, and we didn't do the same thing with transport, we just used the figure from the IPCC."

BBC **Dr. Pierre Gerber, LLS contributing author**

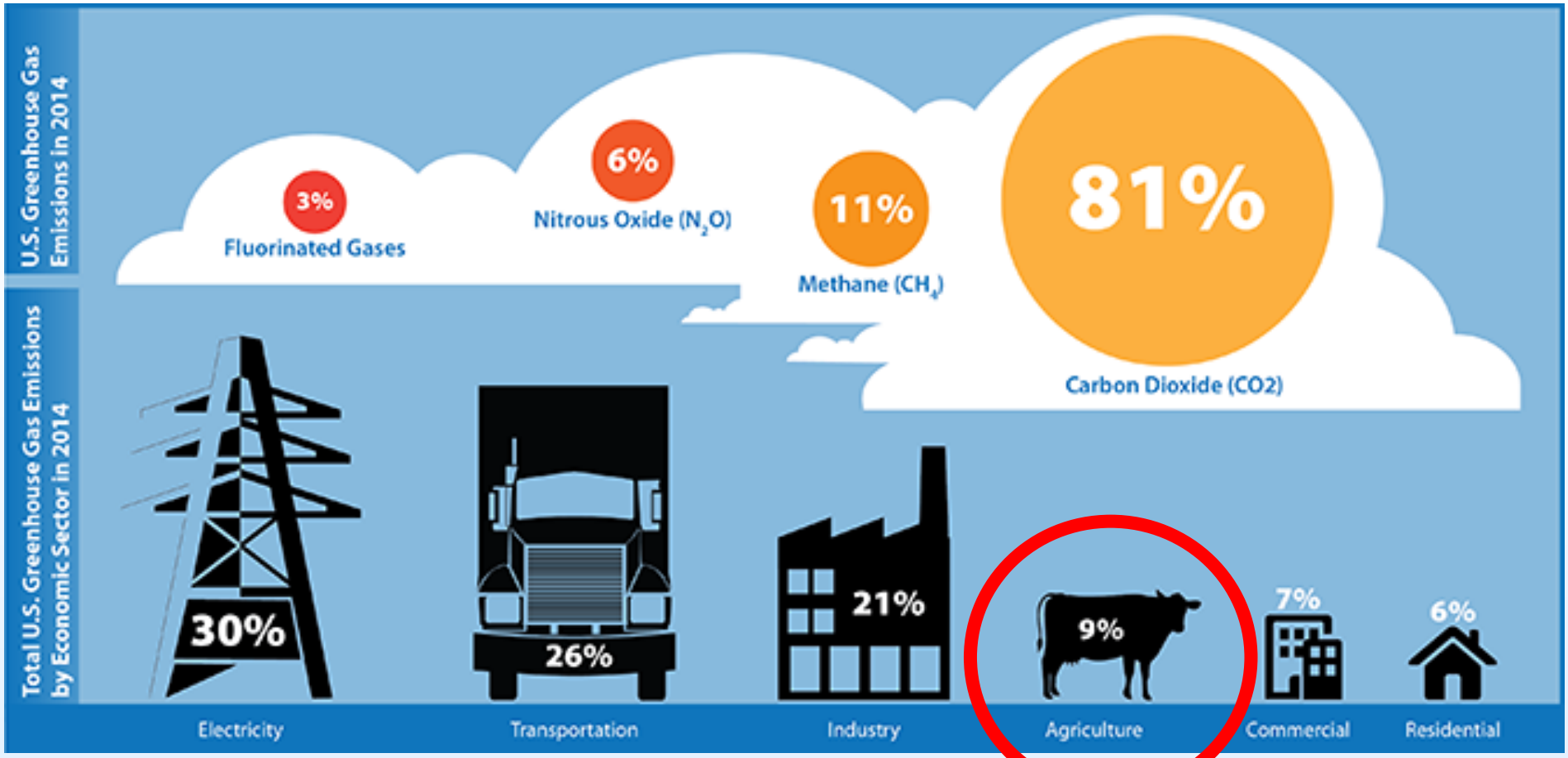
Livestock Environmental Assessment and Performance Partnership (LEAP)



- Internationally agreed sector-level methodologies and guidance to allow
  - transparent,
  - robust,
  - and fair measurement of the environmental performance of livestock supply chains

- FAO / LEAP LCA Guidelines officially released

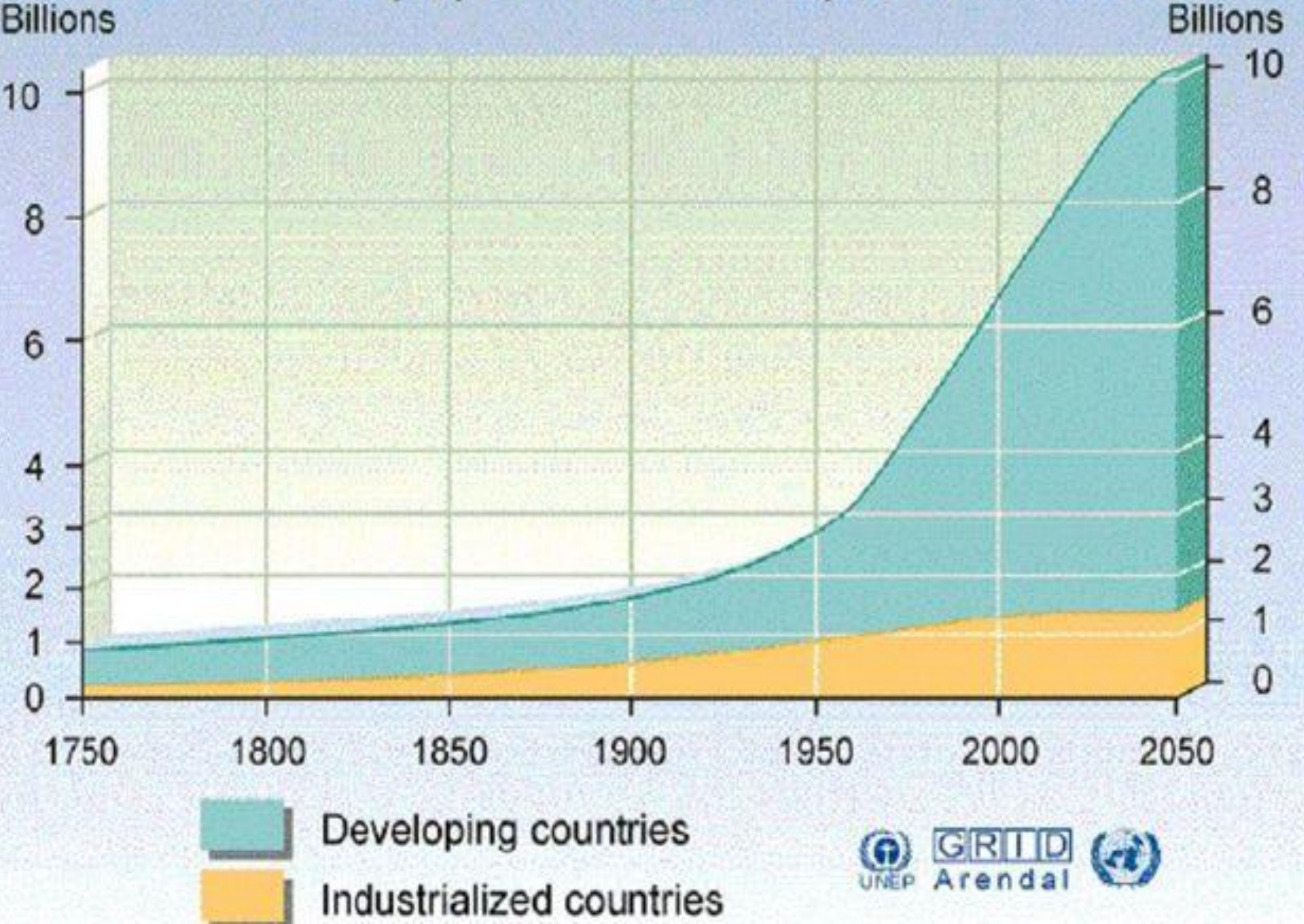
National-Level U.S. GHG Inventory



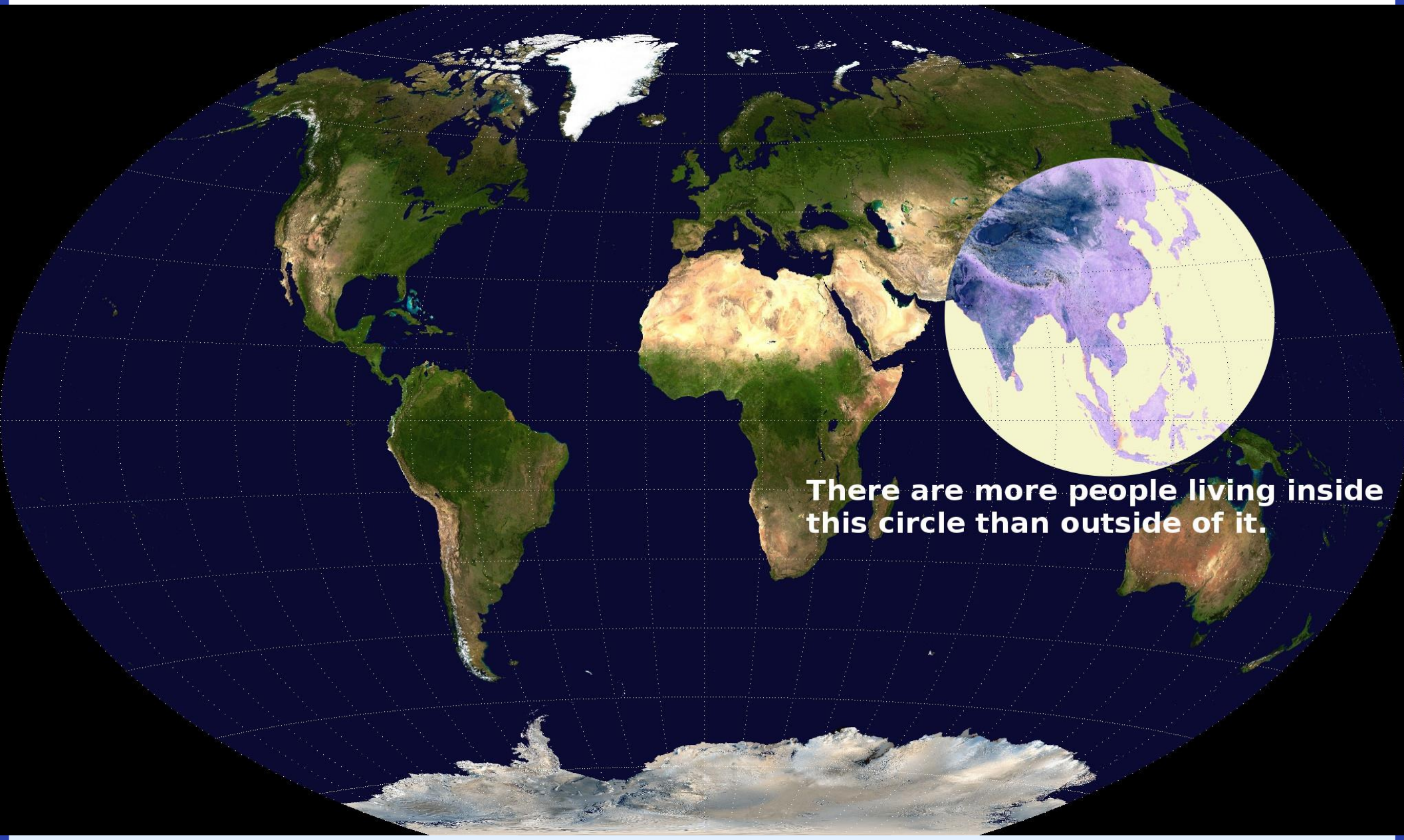
Source: EPA (2016)

National Geograpic

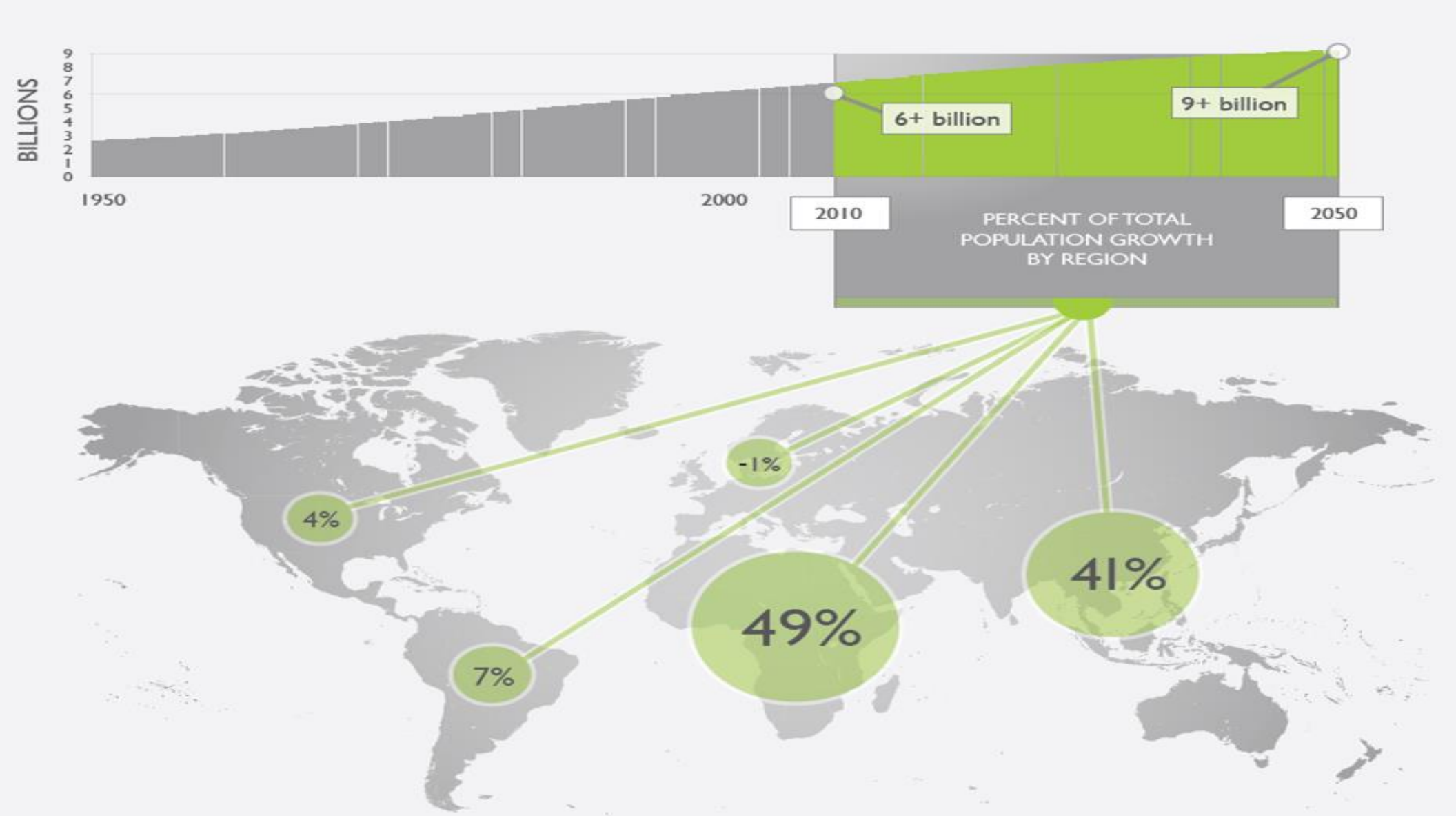
World population development



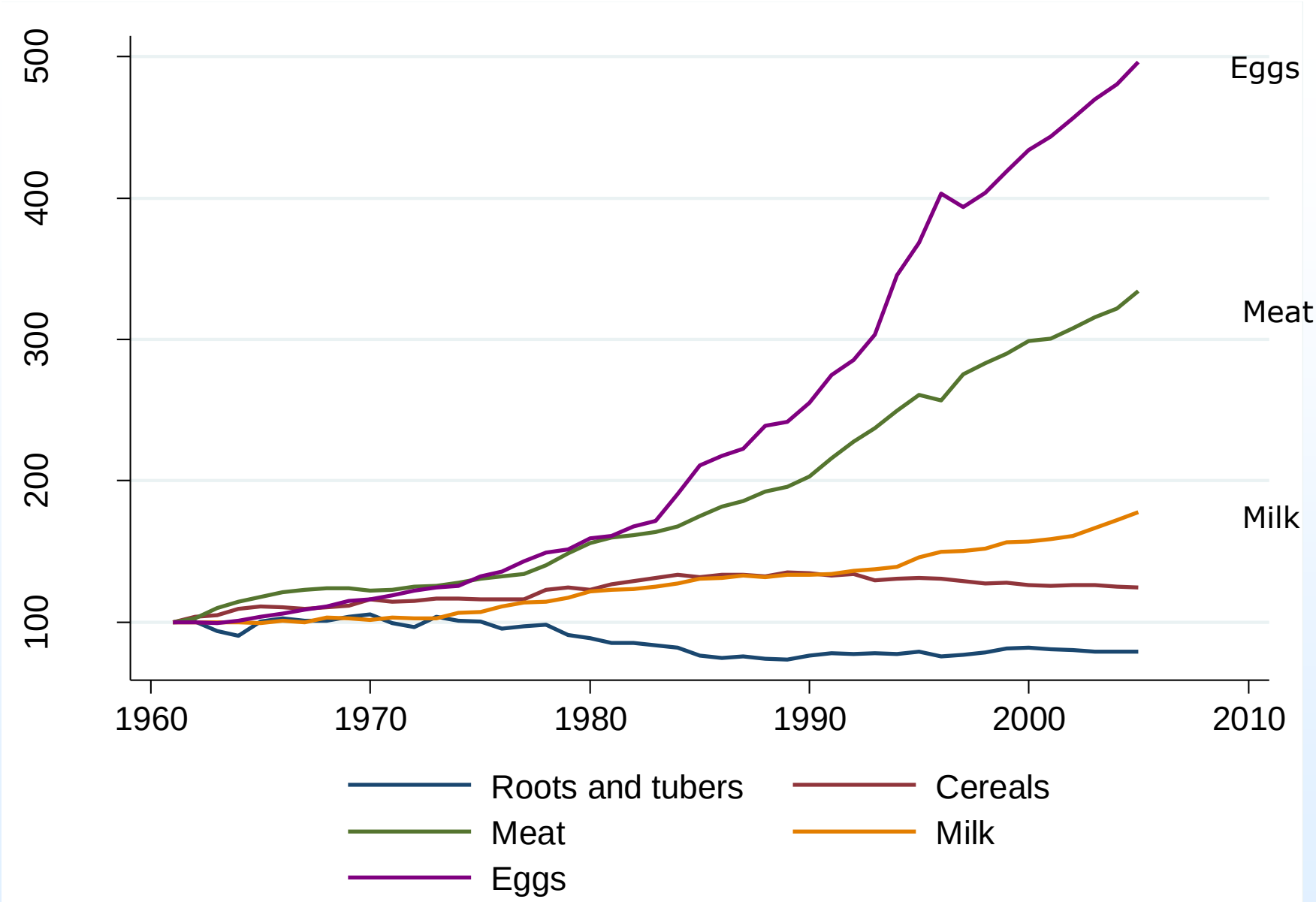
4.5 Billion + population of USA in 10 years



Today and Tomorrow's Markets

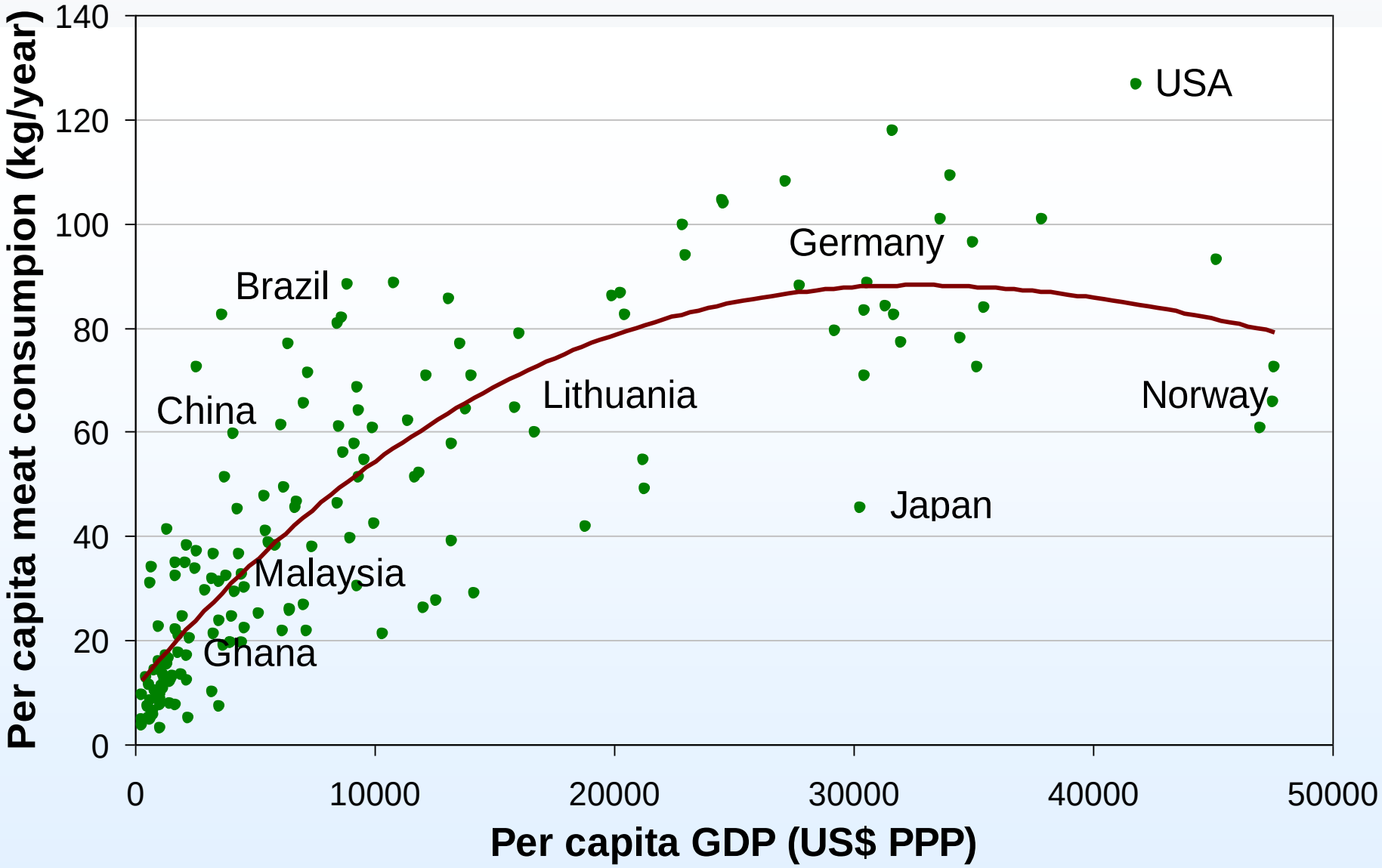


Consumption is growing rapidly in developing countries



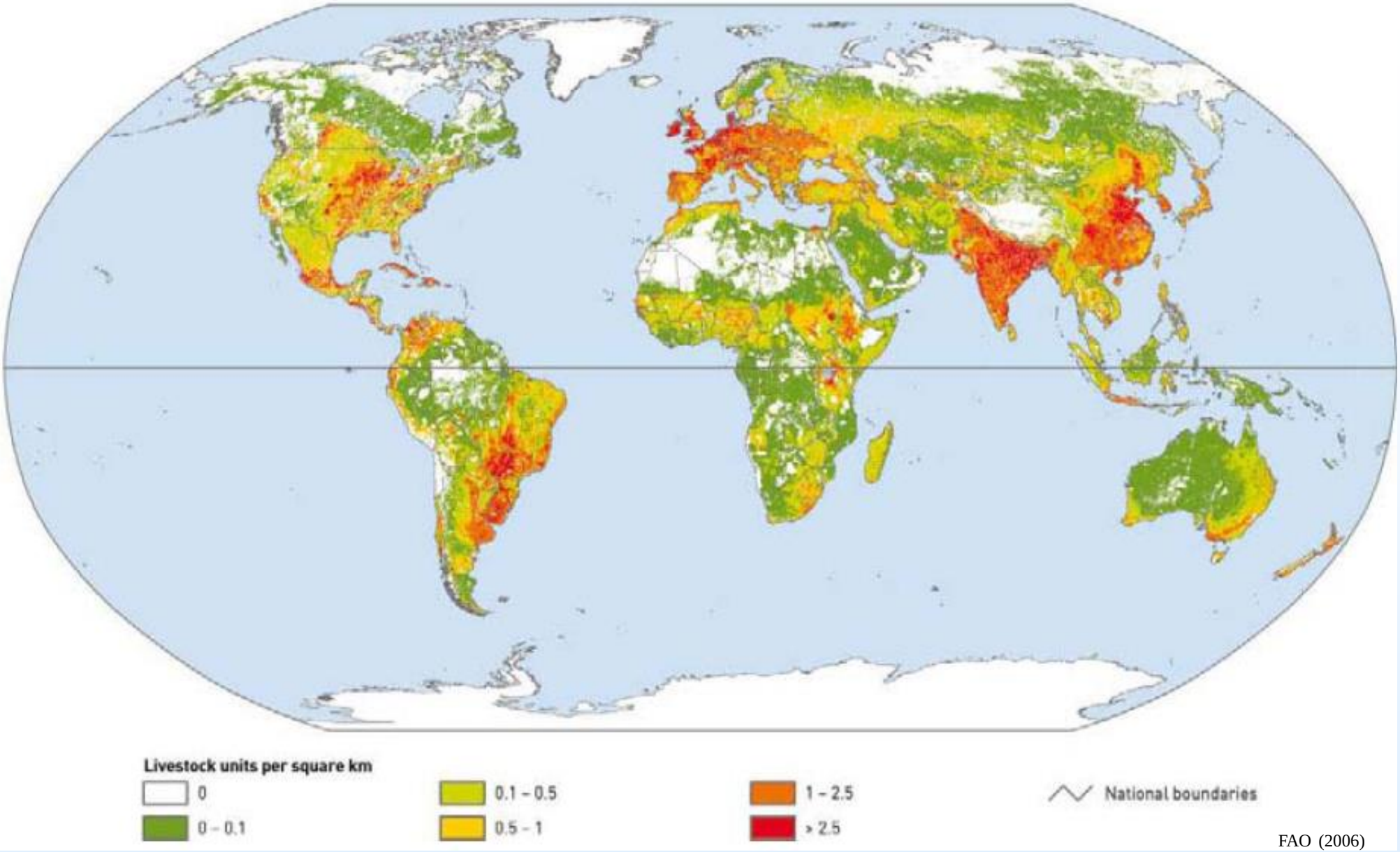
Per caput consumption of major food items in developing countries – kg per caput per year (index numbers 1961=100)

... driven by incomes ...



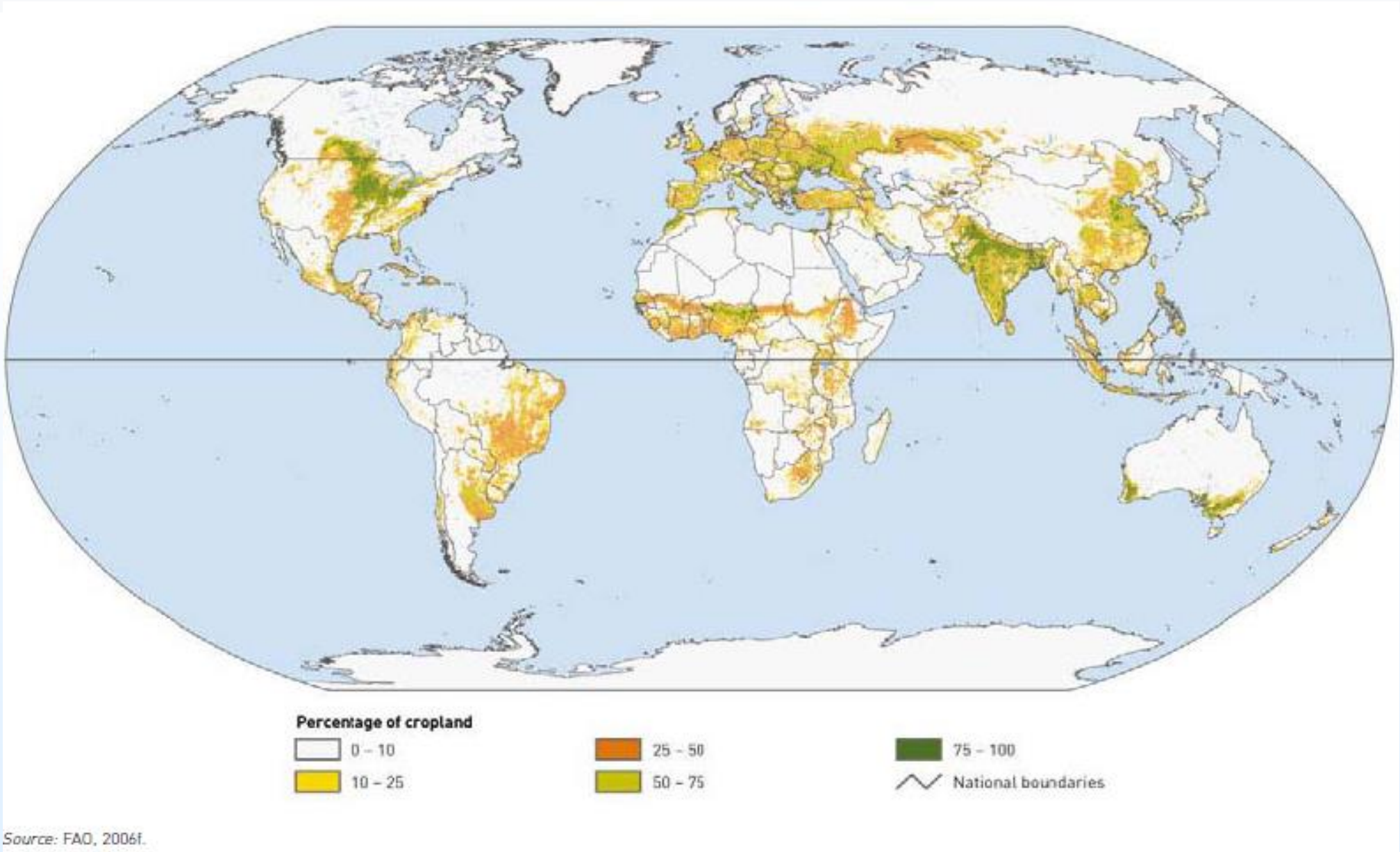
Per capita GDP and meat consumption by country, FAO, 2005.

Global livestock distribution



FAO (2006)

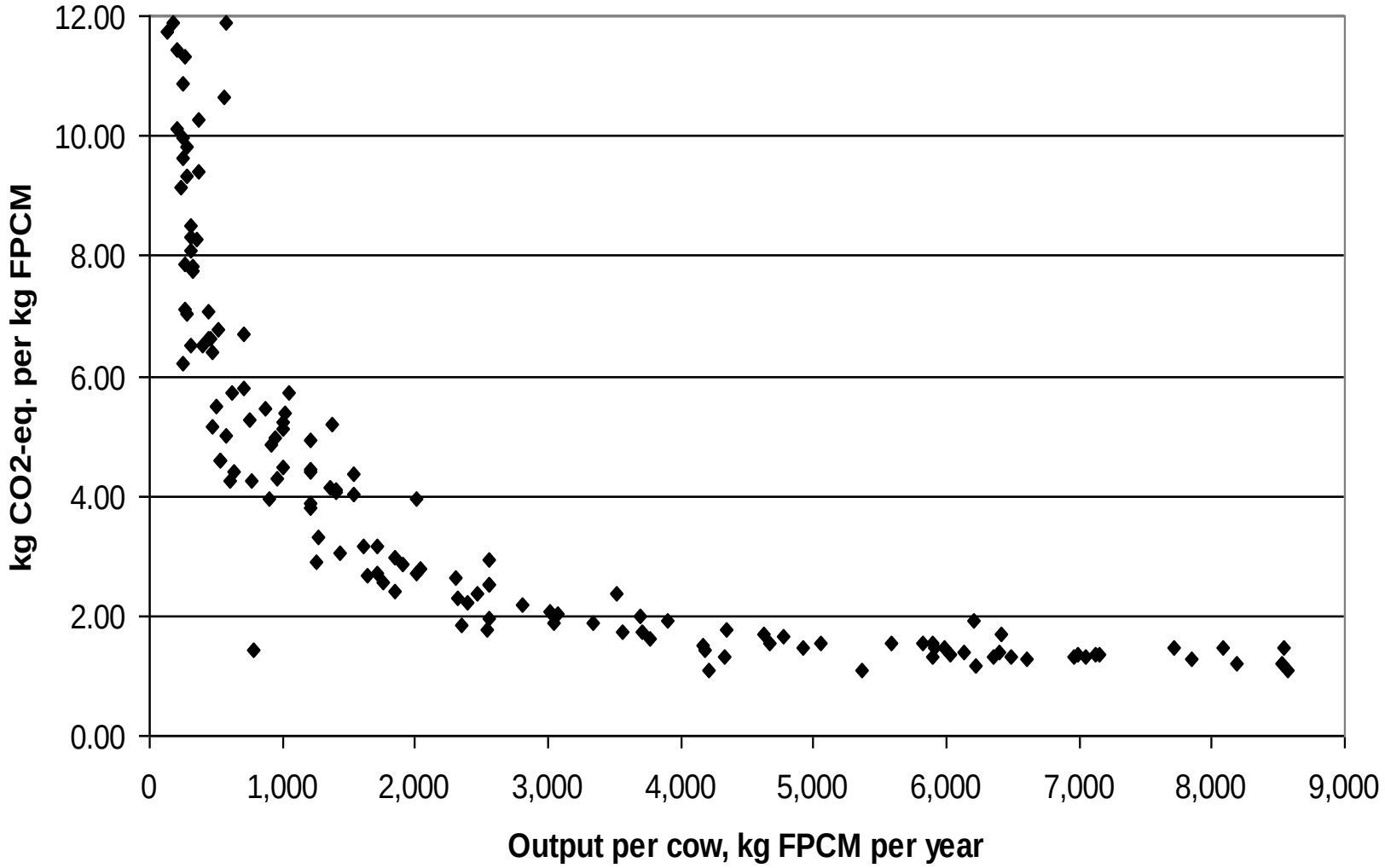
Distribution of cropland



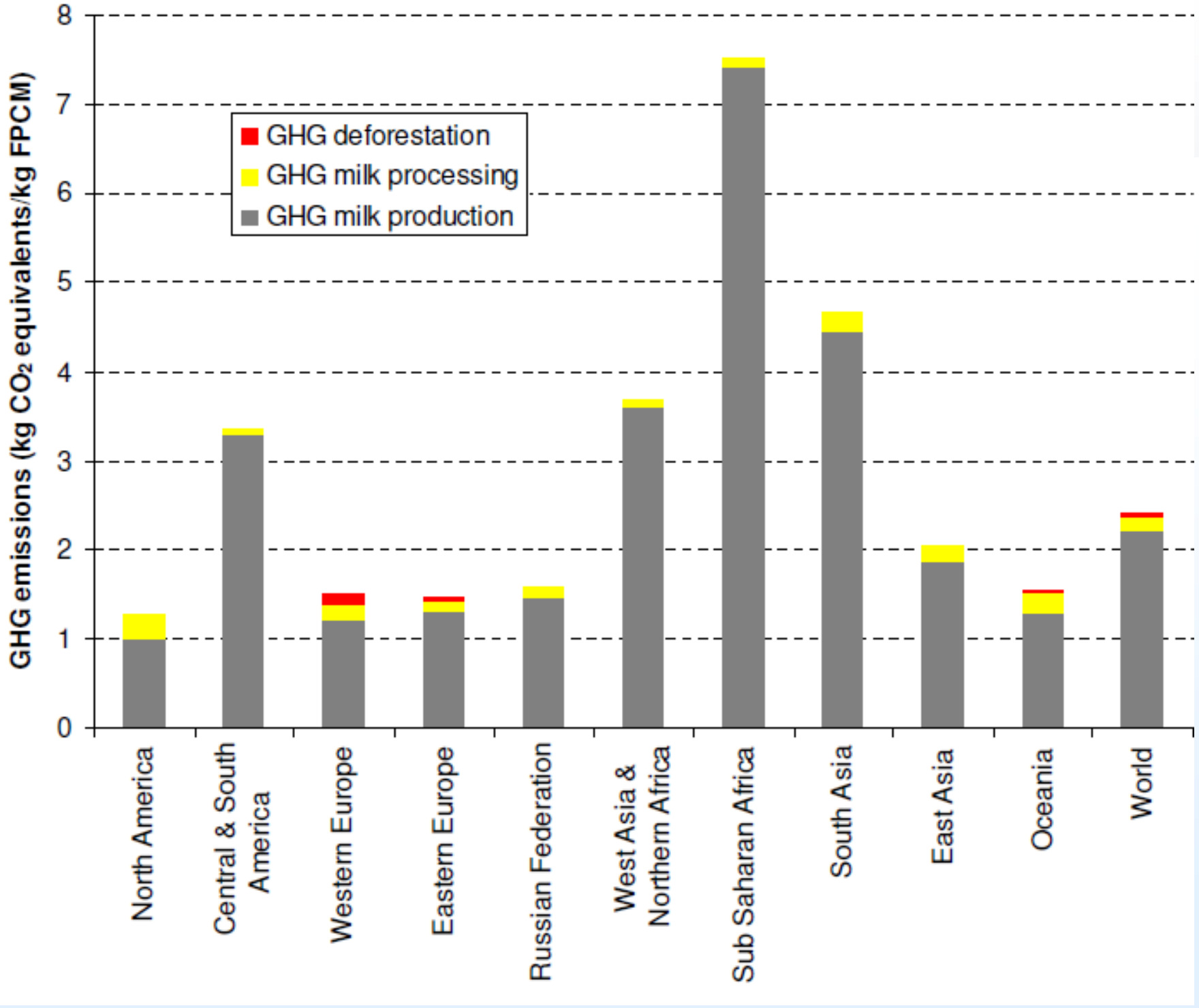
Source: FAO, 2006f.

FAO (2006)

Relationship between total greenhouse gas emissions and milk output per cow

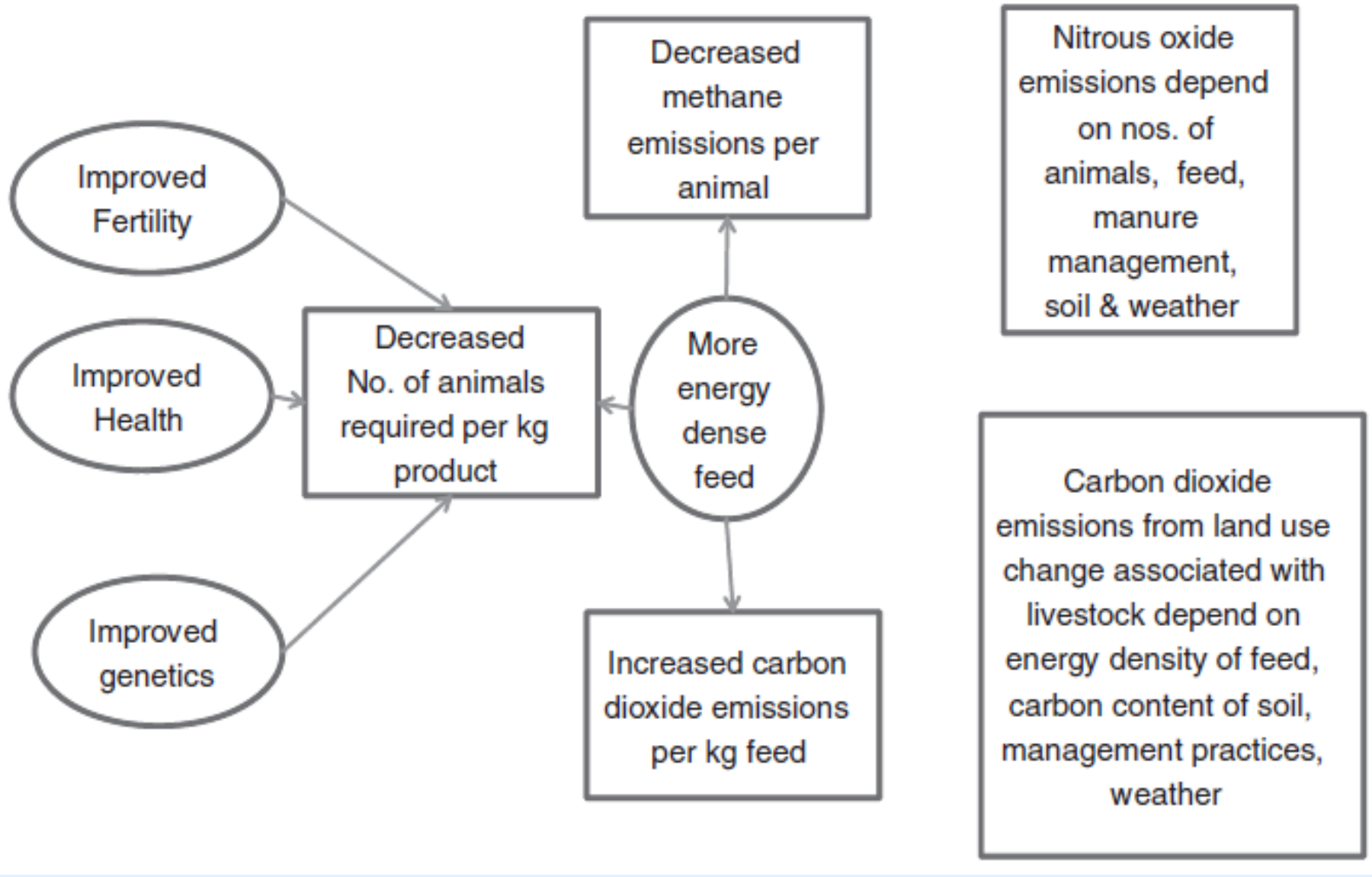


H. Steinfeld, 2015


GHG emissions (kg CO_2 equivalents/kg FPCM)
8
7
6
5
4
3
2
1
0
GHG deforestation
GHG milk processing
GHG milk production
North America
Central & South America
Western Europe
Eastern Europe
Russian Federation
West Asia & Northern Africa
Sub Saharan Africa
South Asia
East Asia
Oceania
World

FAO (2010)

Mitigation: interventions to improve productivity



Gill et al. (2010)

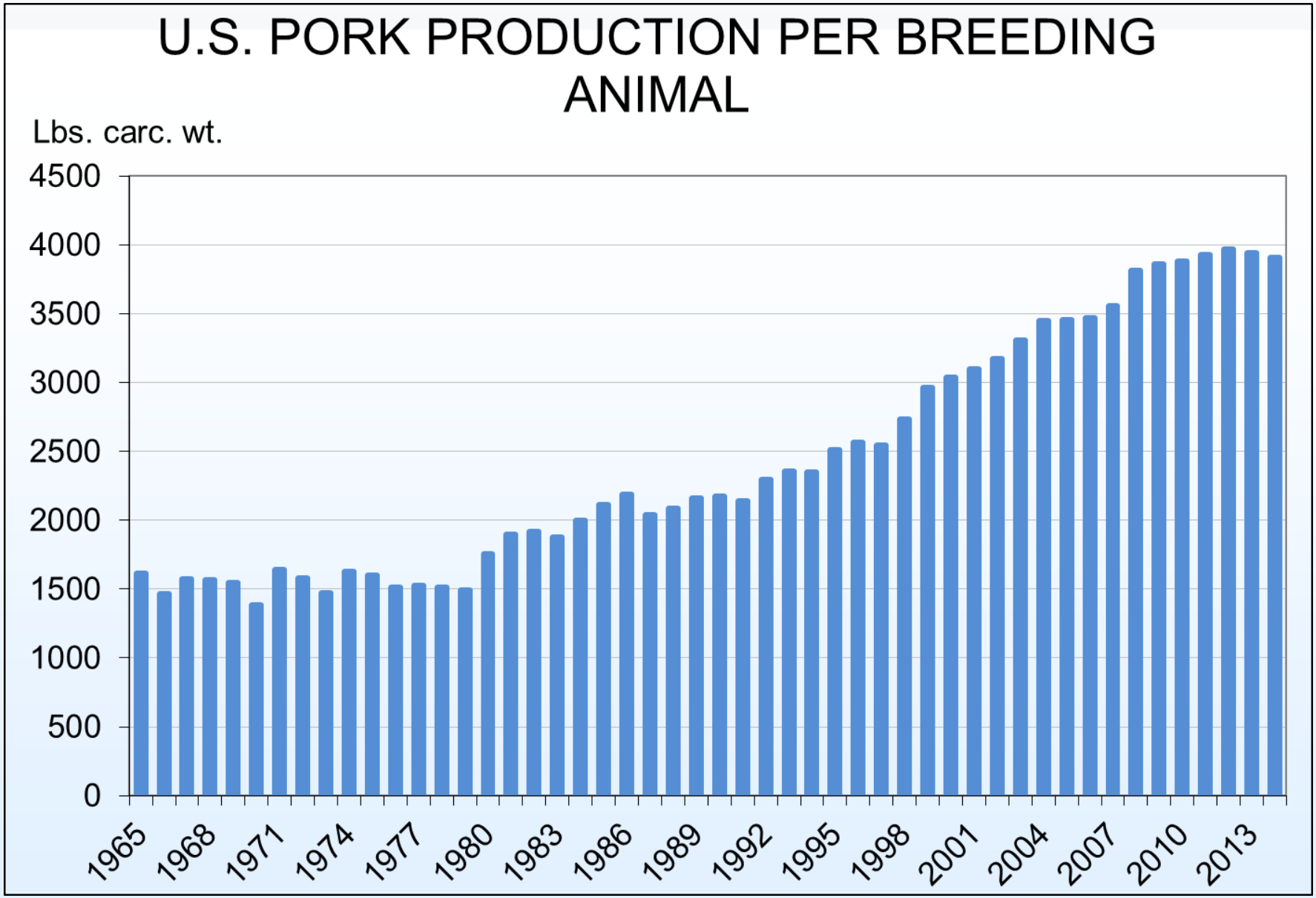
US Dairy trends

- In 1950, there were 25 million dairy cows in the US, vs 9 million today
- With 16 million fewer cows (1950 vs 2018), milk production nationally has increased 60 percent
- The carbon footprint of a glass of milk is 2/3 smaller today than it was 70 years ago

US Beef trends

- In 1970, the US had 140 Million head of beef
- By comparison, today there are 90 Million head
- In both 1970 and 2010, 24 Million tons of beef were produced

US Pork Trends



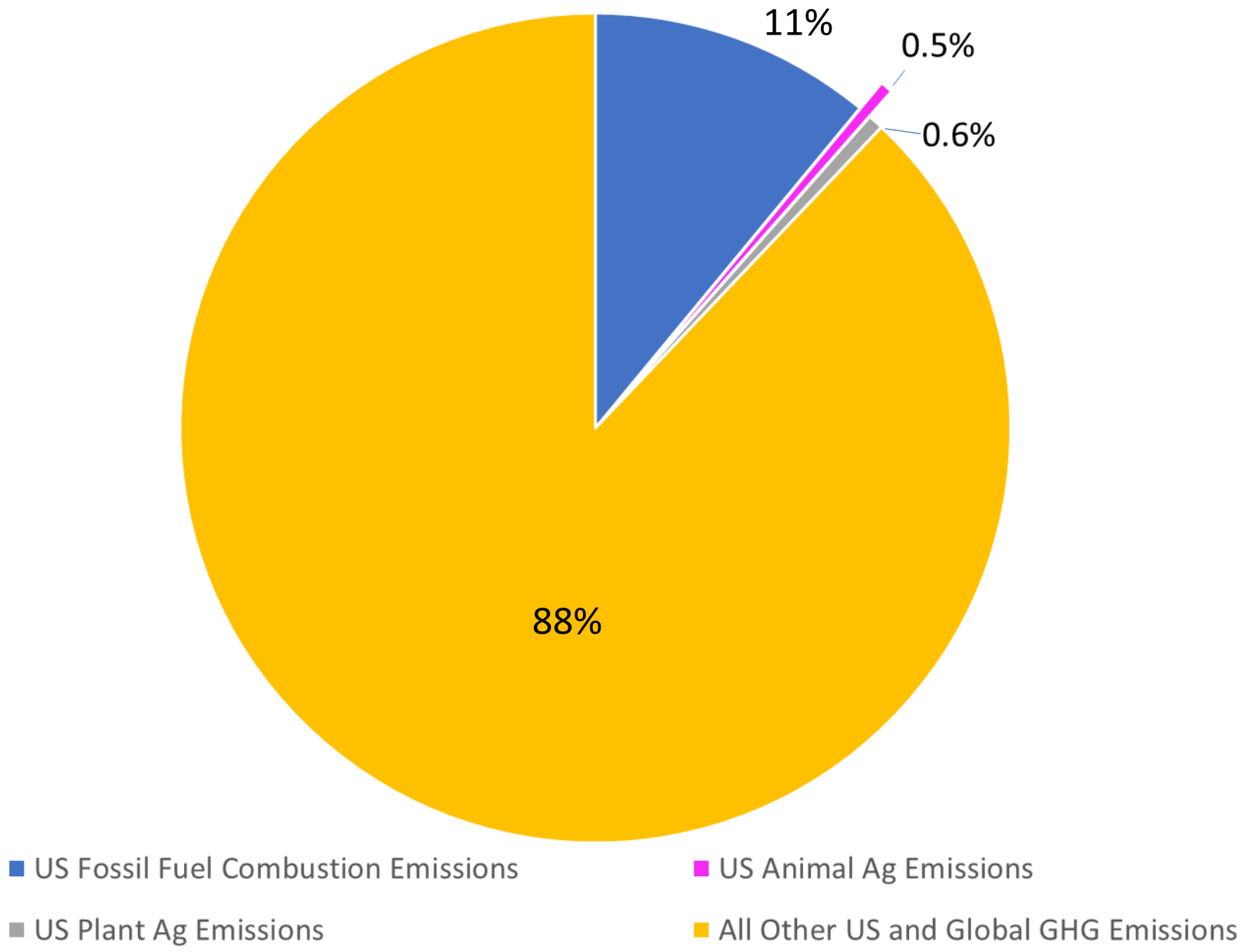
China Swine Example

- China's five year plan focuses on making farms larger and more efficient
- Half of the world's pigs live in China
- 50 million sows w/ 20 piglets born alive
- Equals annual production of 1 Billion pigs
- Pre-weaning mortality causes 400 Million pigs to never make it to the market
- One more pig per sow would mean 1 Million tons of feed saved

Summary

- Livestock in developing countries contribute to 70-80% of global enteric- and waste emissions (IPCC)
- Reductions of enteric- and manure emissions possible
- Production intensity and emission intensity are inversely related

Global Greenhouse Gas Emissions in 2017 (Total Emissions were 49 Gt of CO_2 Equivalents)



Source: US EPA Greenhouse Gas Emissions Inventory


THE · UNIVERSITY · OF · CALIFORNIA ·
A
LET THERE BE
LIGHT
1868