Food & Climate
Clearing the Air

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AFFILIATION/FINANCIAL INTERESTS ***(prior 12 months)***	***ENTITIES***
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Other	Omnivore

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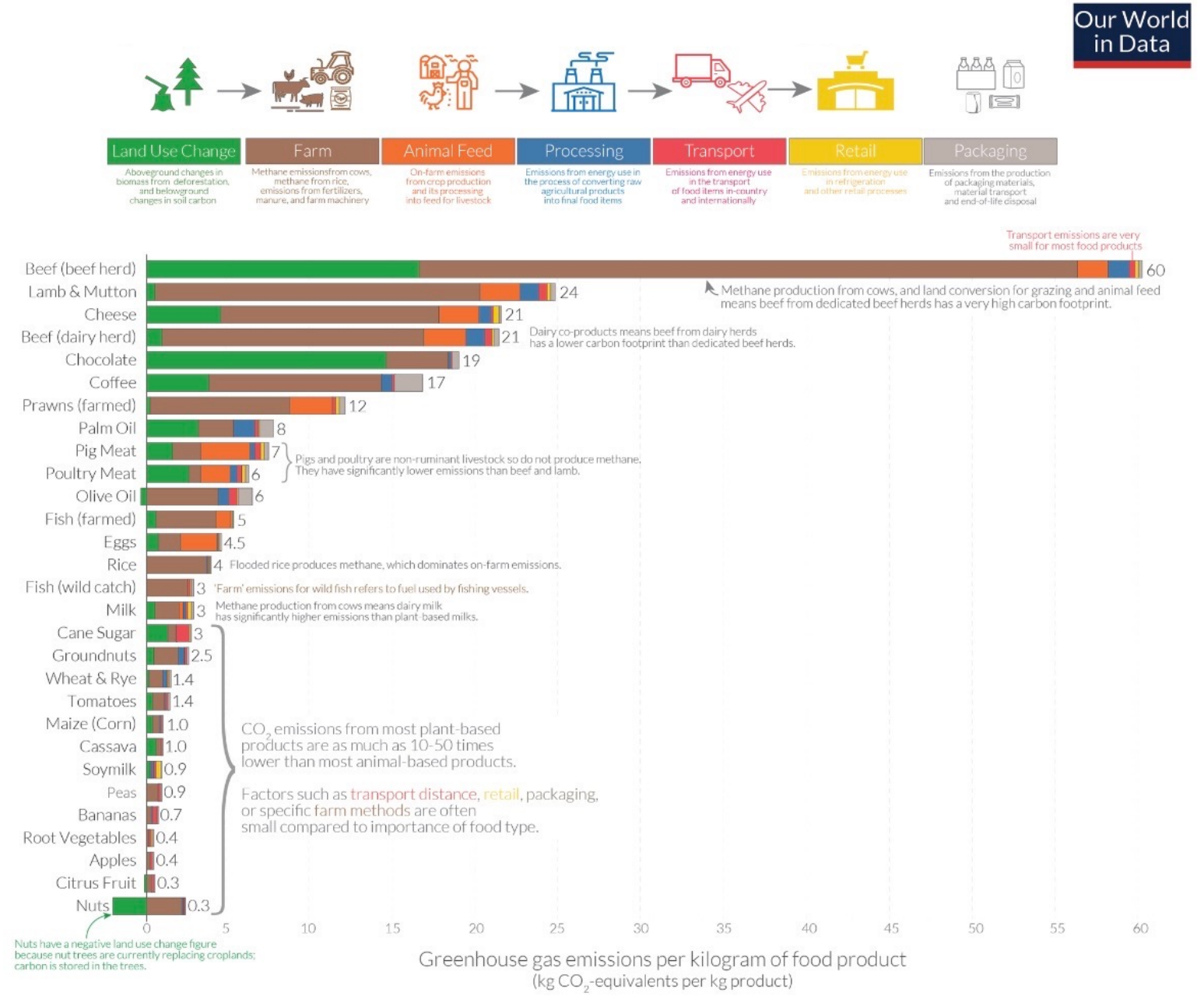

Greenhouse gas emissions across the food supply chain

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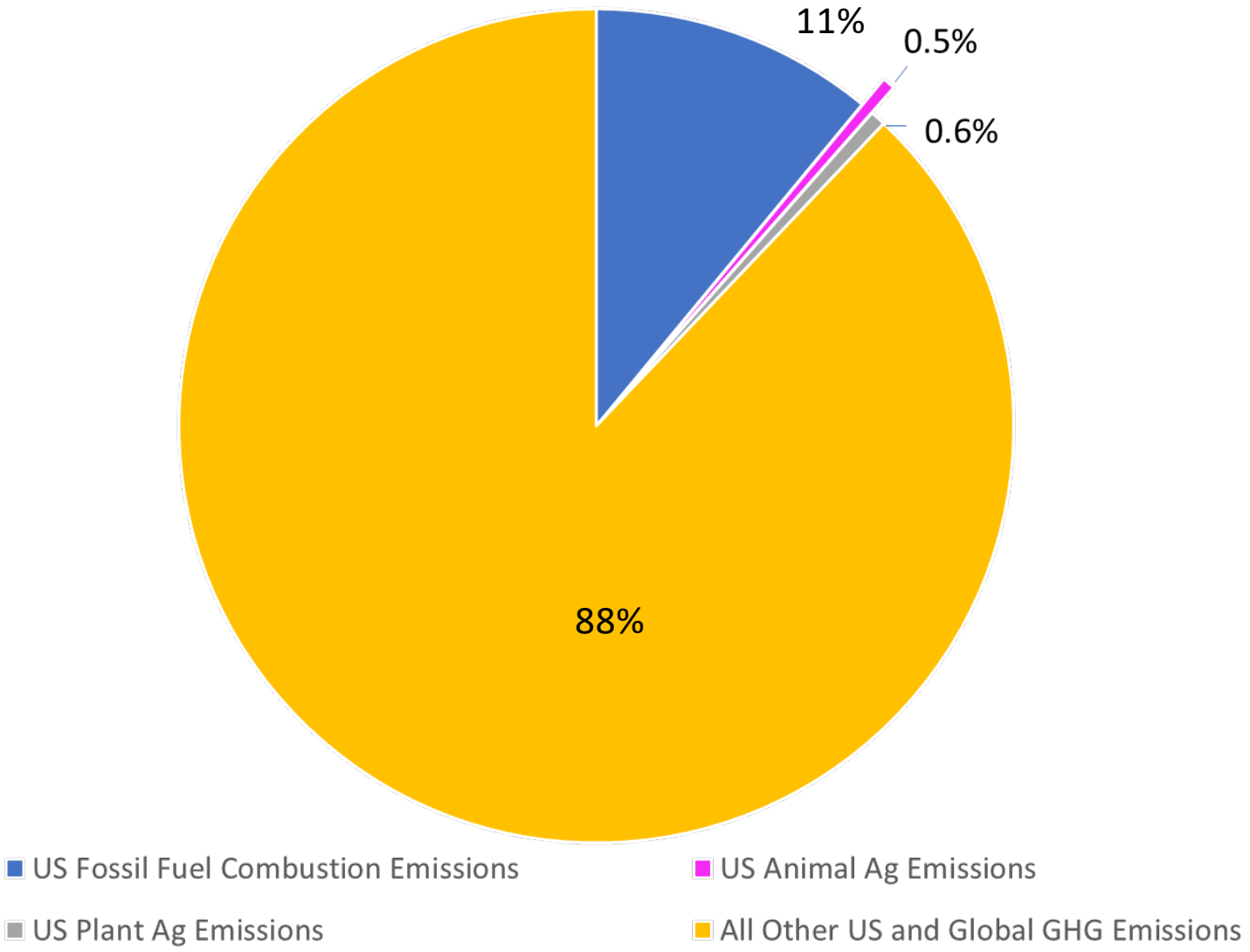
Global Greenhouse Gas Emissions in 2017
(Total Emissions were 49 Gt of CO2 Equivalents)



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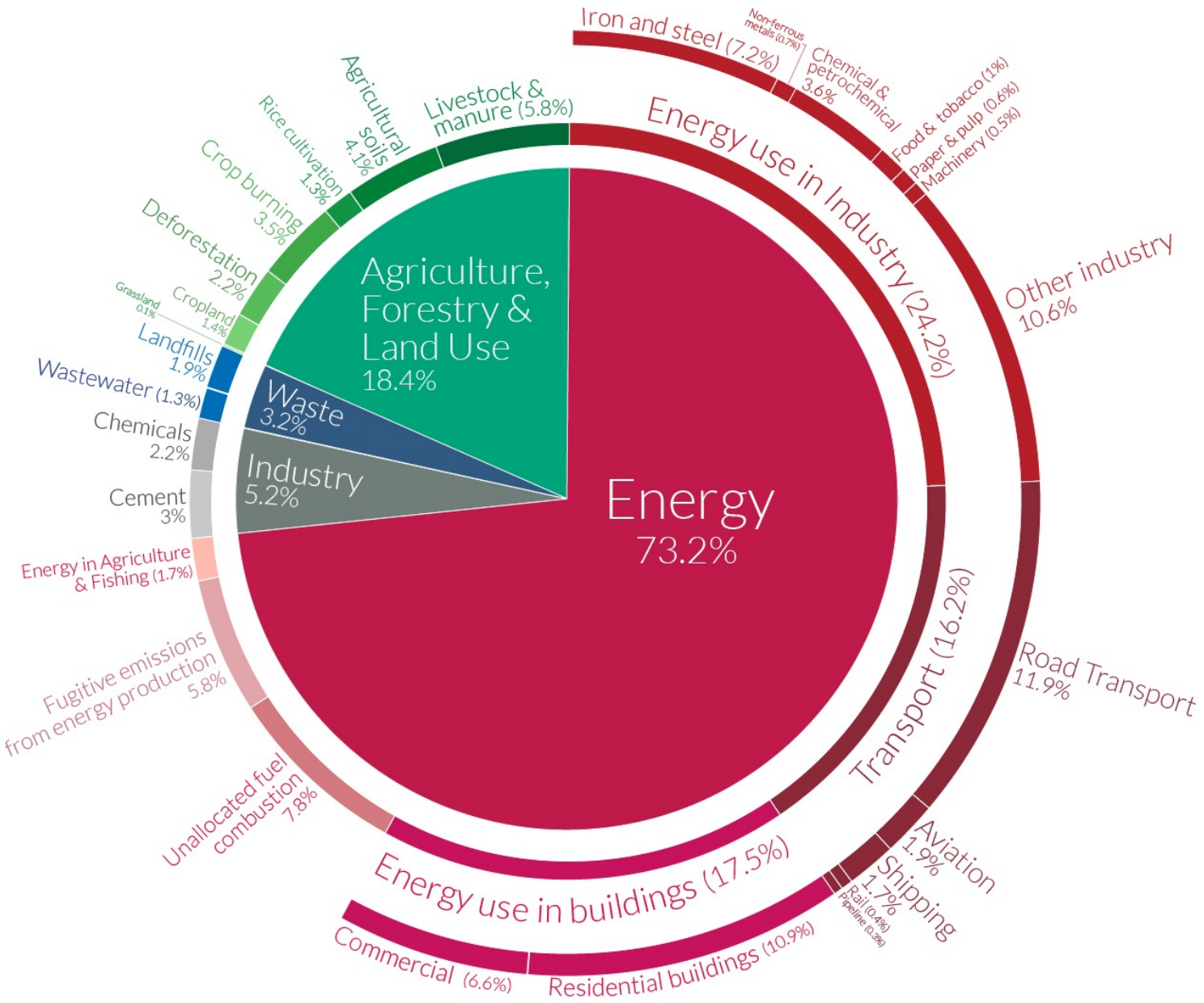
Source: US EPA Greenhouse Gas Emissions Inventory

Global Greenhouse Gas Emissions by Sector



Emissions from 2016, when global greenhouse gas emissions totaled 49.4 GT (billion tons) CO_2eq.

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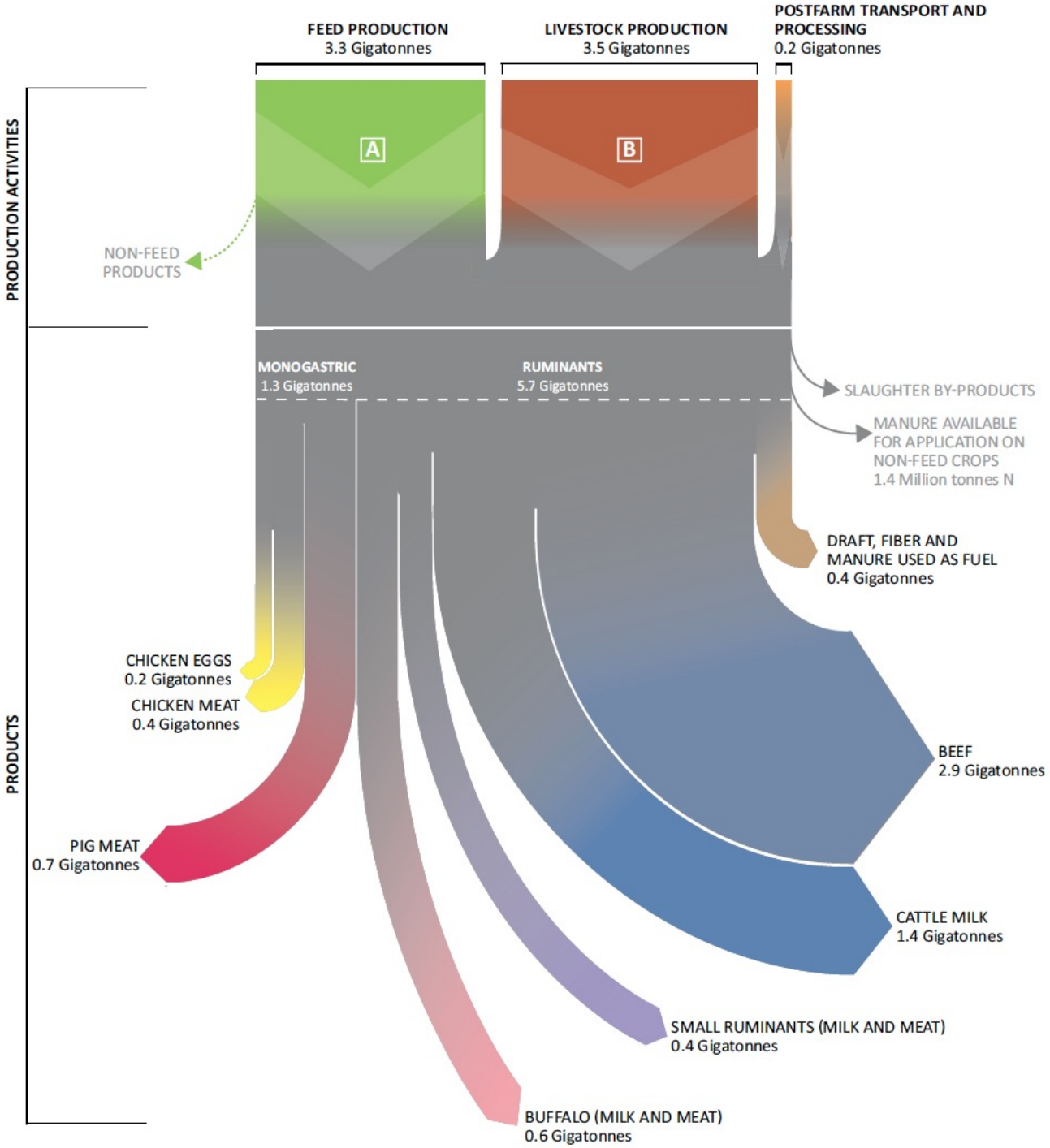
OurWorldinData.org – Research and data to make progress against the world's largest problems.
Source: Climate Watch, the World Resources Institute (2020).

GHG emissions from global livestock supply chains, by production activities and products



Source: UN FAO - Tackling climate change through livestock – A global assessment of emissions and mitigation opportunities; page 18.

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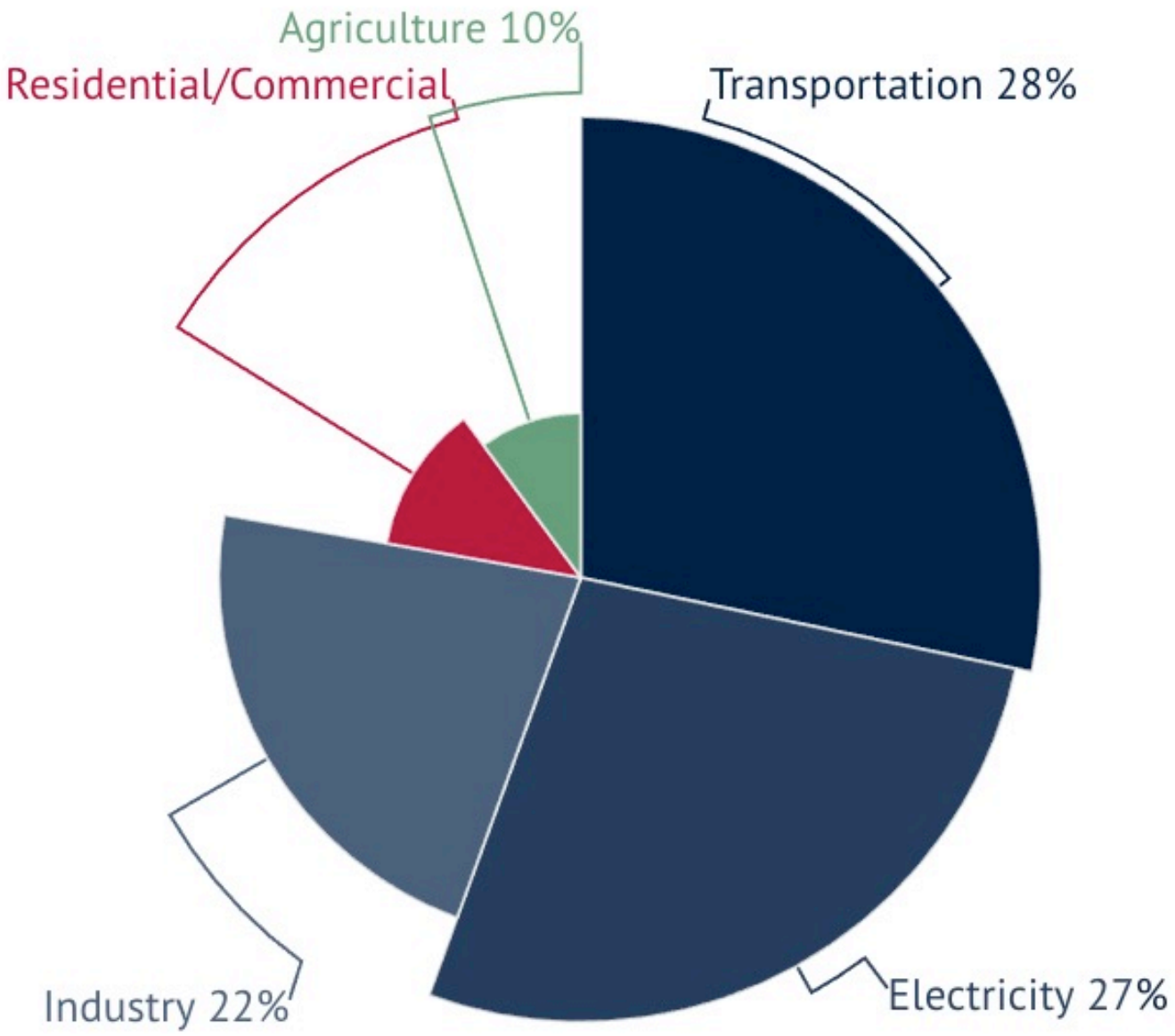
United States Greenhouse Gas Emissions by Sector



Total U,S, Emissions in 2018 = 6,677 Million Metric Tons of CO_2 equivalent. Source: https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions

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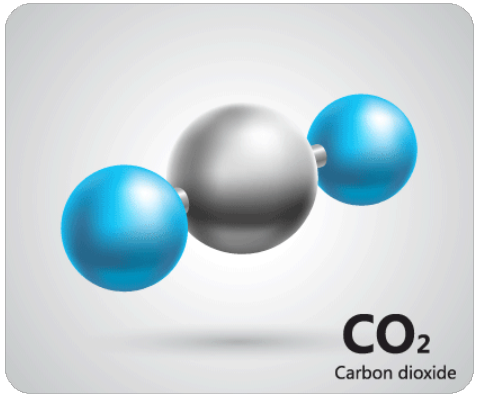

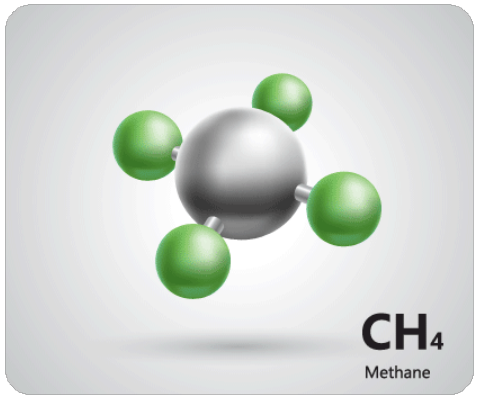

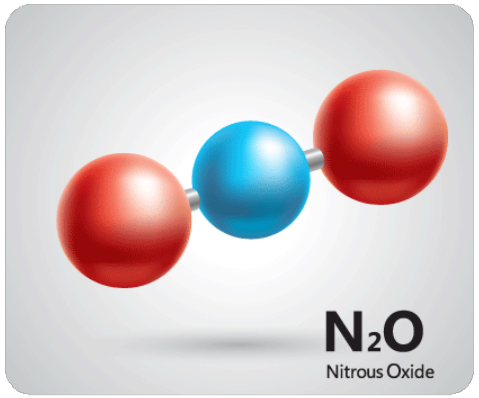

Global Warming Potential (GWP_{100}) of Main Greenhouse Gases

Carbon Dioxide (CO_2)	1
Methane (CH_4)	28
Nitrous Oxide (N_2O)	265

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GLOBAL METHANE BUDGET

Global Carbon Project

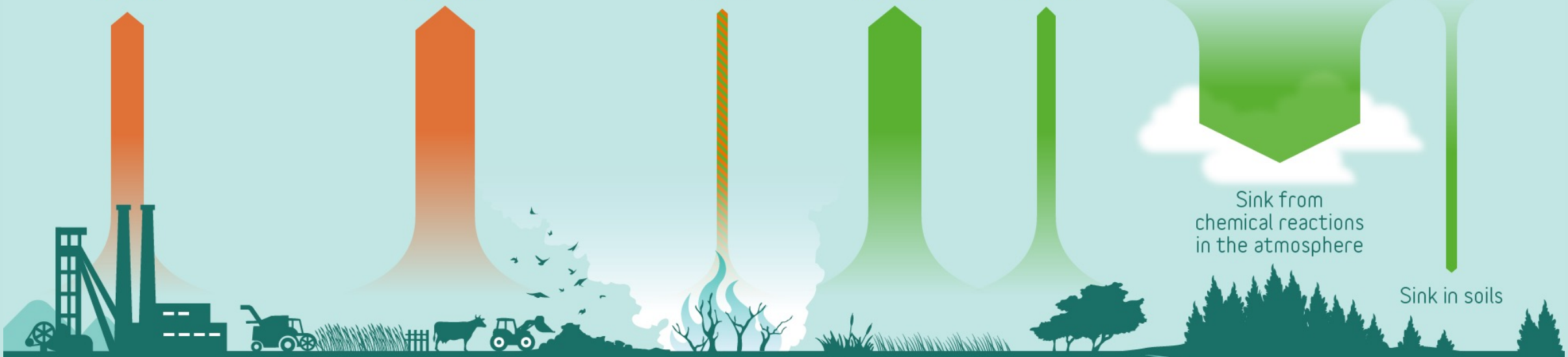
TOTAL EMISSIONS

558
(540-568)

CH_4 ATMOSPHERIC GROWTH RATE
10
(9.4-10.6)

TOTAL SINKS

548
(529-555)



Fossil fuel production and use

Agriculture and waste

Biomass burning

Wetlands

Other natural emissions

Geological, lakes, termites, oceans, permafrost

EMISSIONS BY SOURCE

In million-tons of CH_4 per year (Tg CH_4 / yr), average 2003-2012

Anthropogenic fluxes

Natural fluxes

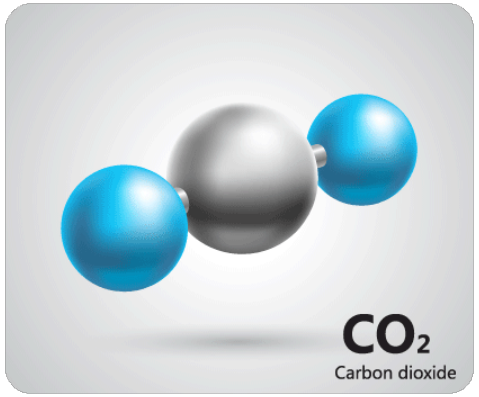
Natural and anthropogenic

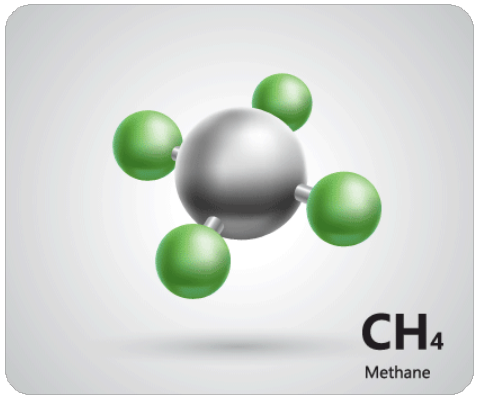
GLOBAL CARBON PROJECT

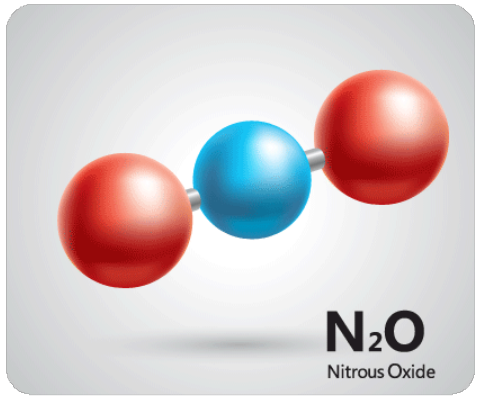
FONDATION BNP PARIBAS

Half-Life of Main Greenhouse Gases in Years

Carbon Dioxide (CO_2)	1,000
Methane (CH_4)	12
Nitrous Oxide (N_2O)	110







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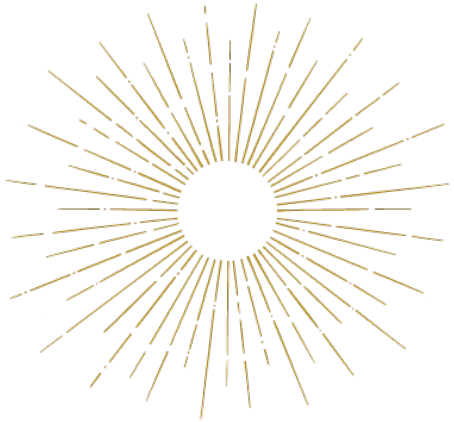
Biogenic Carbon Cycle

Methane - CH_4

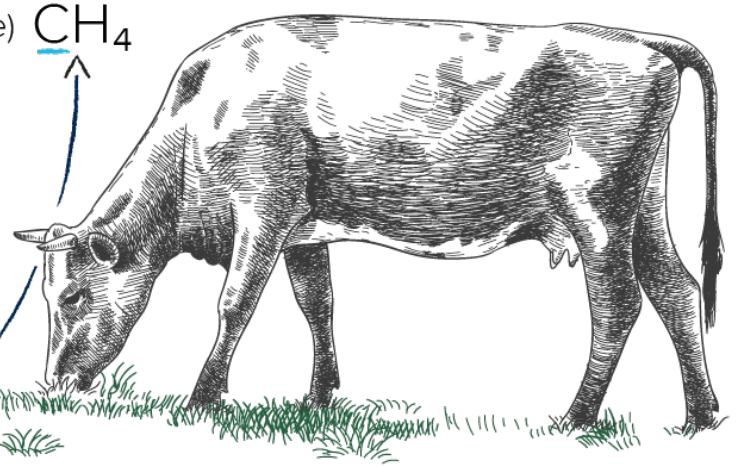


CO_2

10 Years
Hydroxyl Oxidation

CO_2

(Methane) CH_4



Photosynthesis
Sunlight + H_2O + CO_2

C (Carbon)
Carbohydrates

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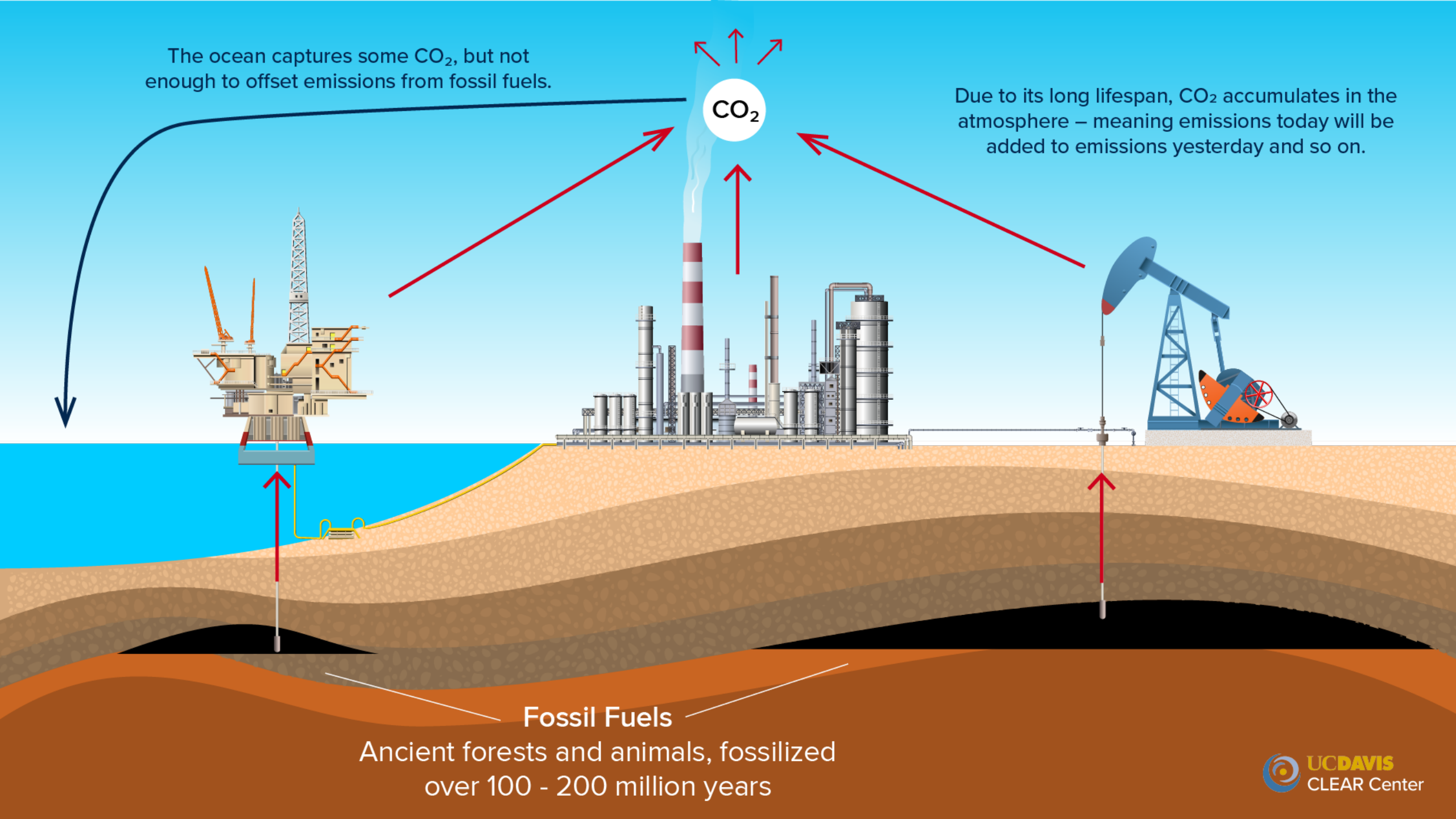
The ocean captures some CO_2, but not enough to offset emissions from fossil fuels.
CO_2
Due to its long lifespan, CO_2 accumulates in the atmosphere – meaning emissions today will be added to emissions yesterday and so on.
Fossil Fuels
Ancient forests and animals, fossilized over 100 - 200 million years
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GWP* - A new way to characterize short-lived greenhouse gases

- GWP* is a new metric out of the University of Oxford that assesses how an emission of a short-lived greenhouse gas affects temperature.

- GWP100 overestimates methane's warming impact of constant herds by a factor of 4, and overlooks it's ability to induce cooling when CH_4 emissions are reduced.

- GWP* not only accounts for methane's short lifespan, but also its atmospheric removal.

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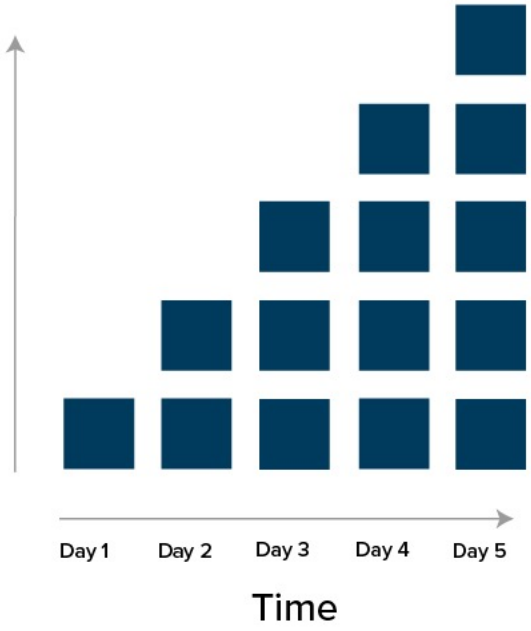
= Pulse of CO_2

Stock Gas

Carbon dioxide (CO_2)

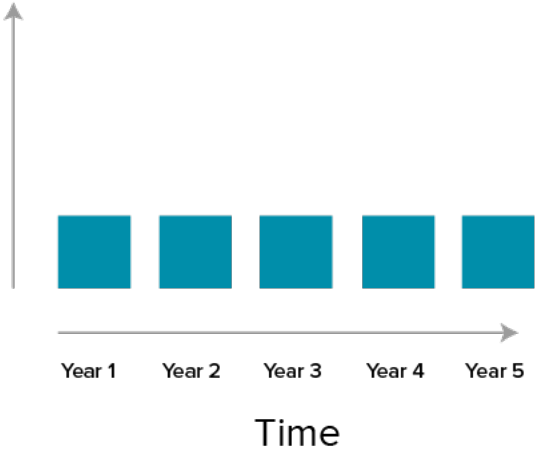


Stock gases will accumulate over time, because they stay in the environment.

= Pulse of CH_4

Flow Gas

Methane (CH_4)



Flow gases will stay stagnant, as they are destroyed at the same rate of emission.

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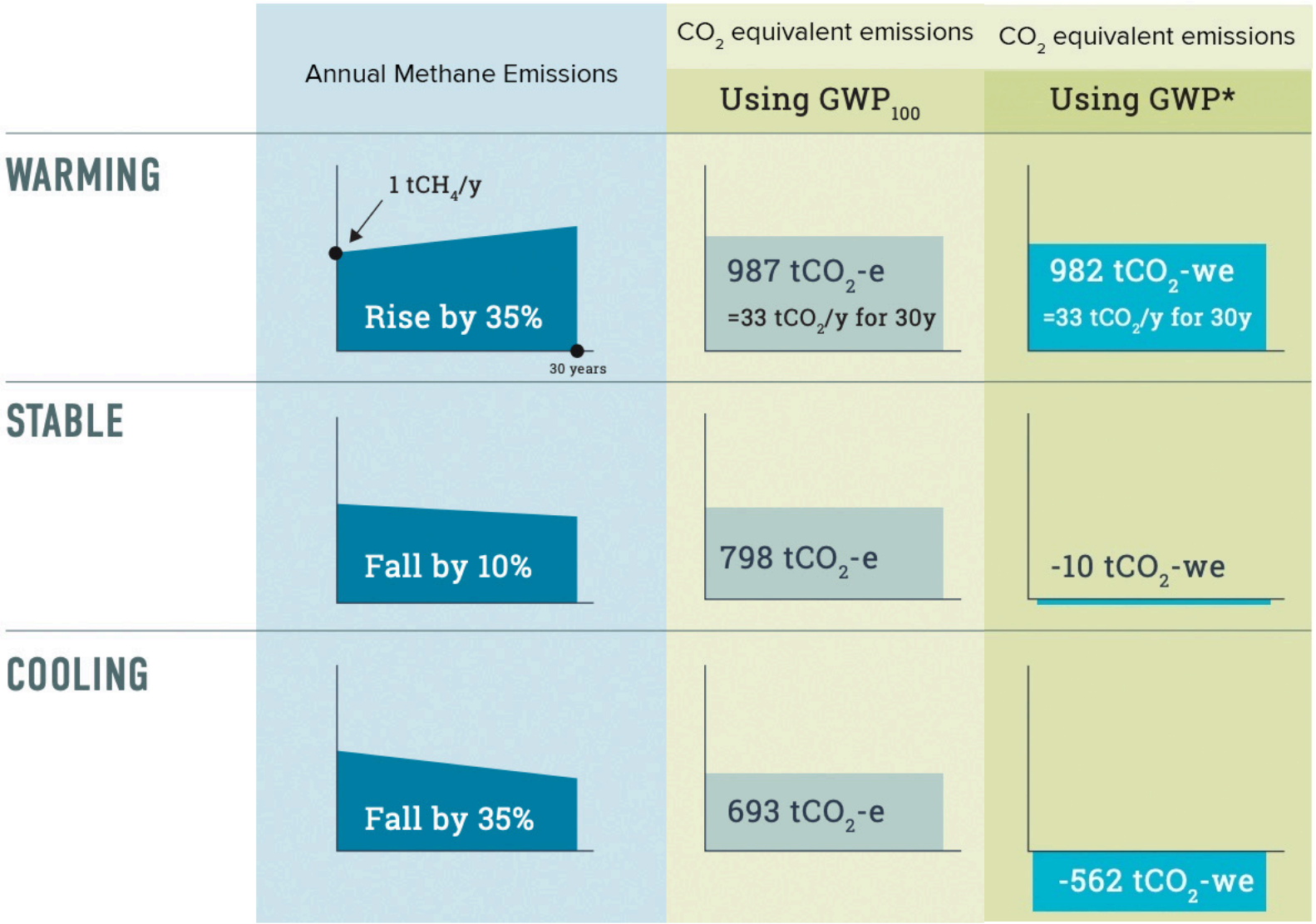
Based on research by Myles R. Allen, Keith P. Shine, Jan S. Fuglestvedt, Richard J. Millar, Michelle Cain, David J. Frame & Adrian H. Macey.
Read more here: https://rdcu.be/b1t7S



Cain, M., Allen, M. & Lynch, J. *Oxford Martin Programme on Climate Pollutants* (2019). Read more at: https://www.oxfordmartin.ox.ac.uk/downloads/academic/201908_ClimatePollutants.pdf.

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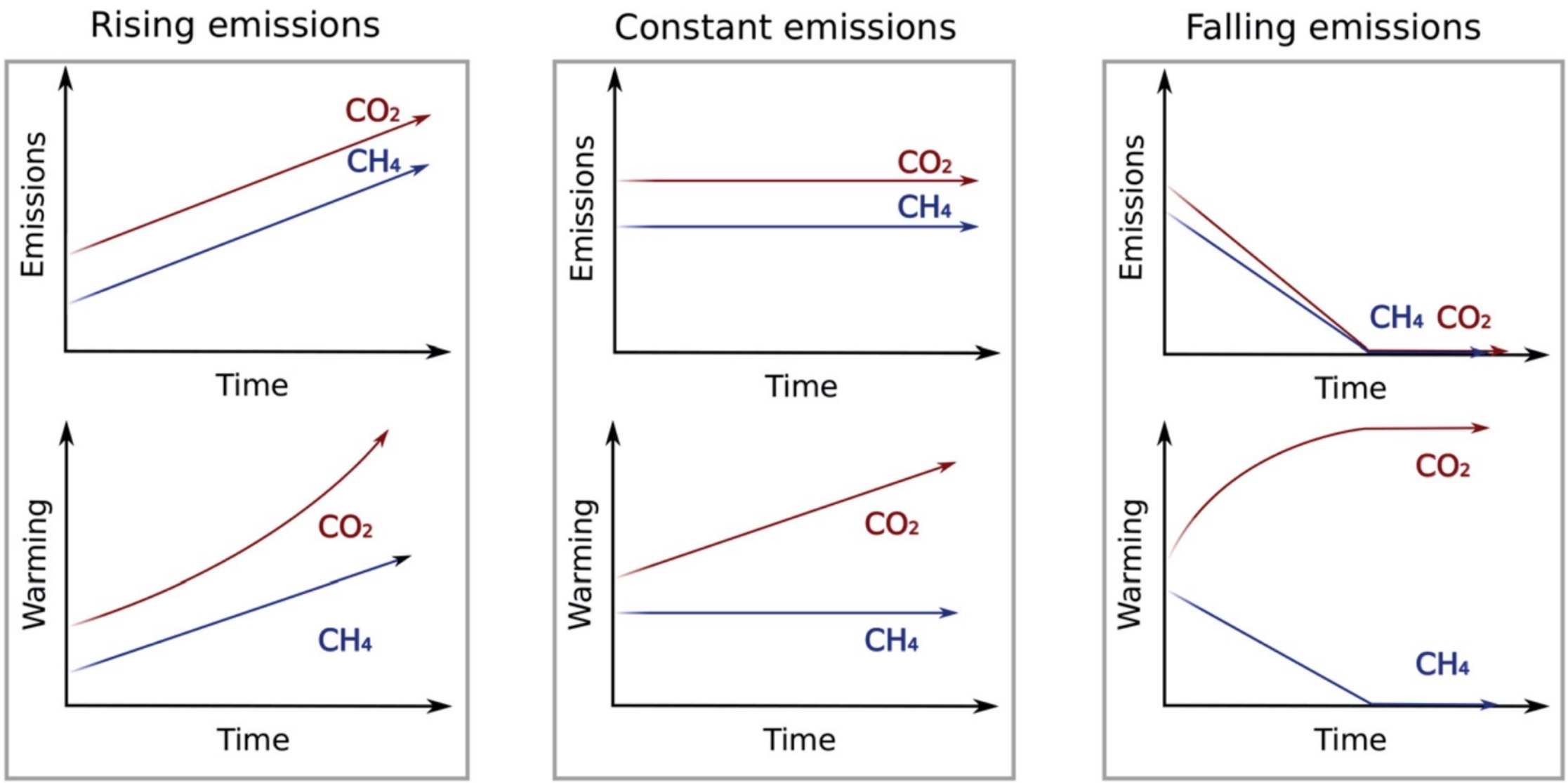

Oxford Martin, Climate Metrics for Ruminant Livestock, July 2018,
https://www.oxfordmartin.ox.ac.uk/downloads/reports/Climate-metrics-for-ruminant-livestock.pdf%C2%A0

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California GHG trends

Since 2015 California dairies has reduced methane by

2.2 million metric tons CO2e annually.

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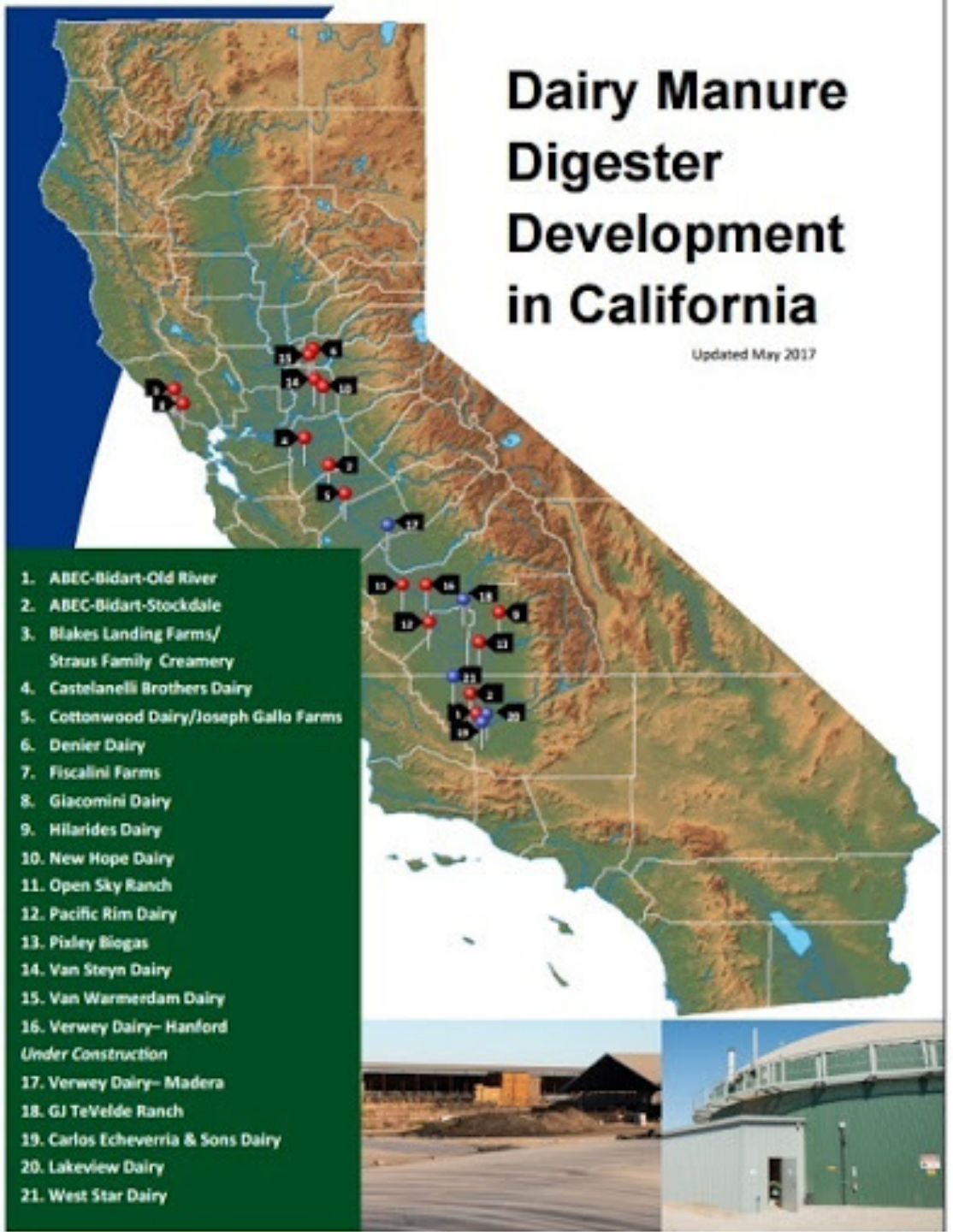

That's a ***25 percent*** reduction in the dairy industry's methane emissions.

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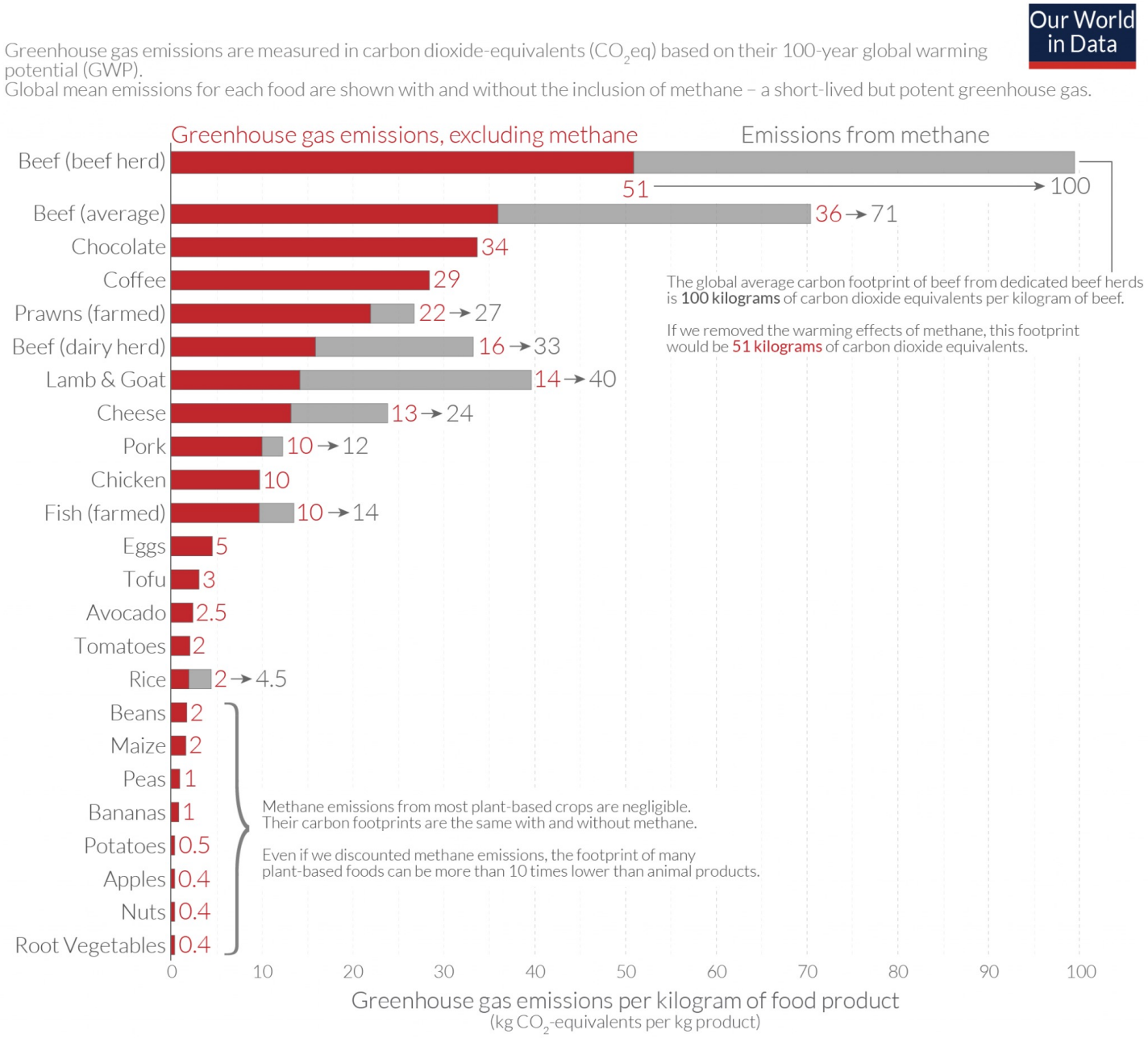
Greenhouse gas emissions from food, short vs. long-lived gases



Note: Greenhouse gas emissions are given as global average values based on data across 38,700 commercially viable farms in 119 countries.
Data source: Poore & Nemecek (2018). Reducing food's environmental impacts through producers and consumers. *Science*.
OurWorldinData.org – Research and data to make progress against the world's largest problems.

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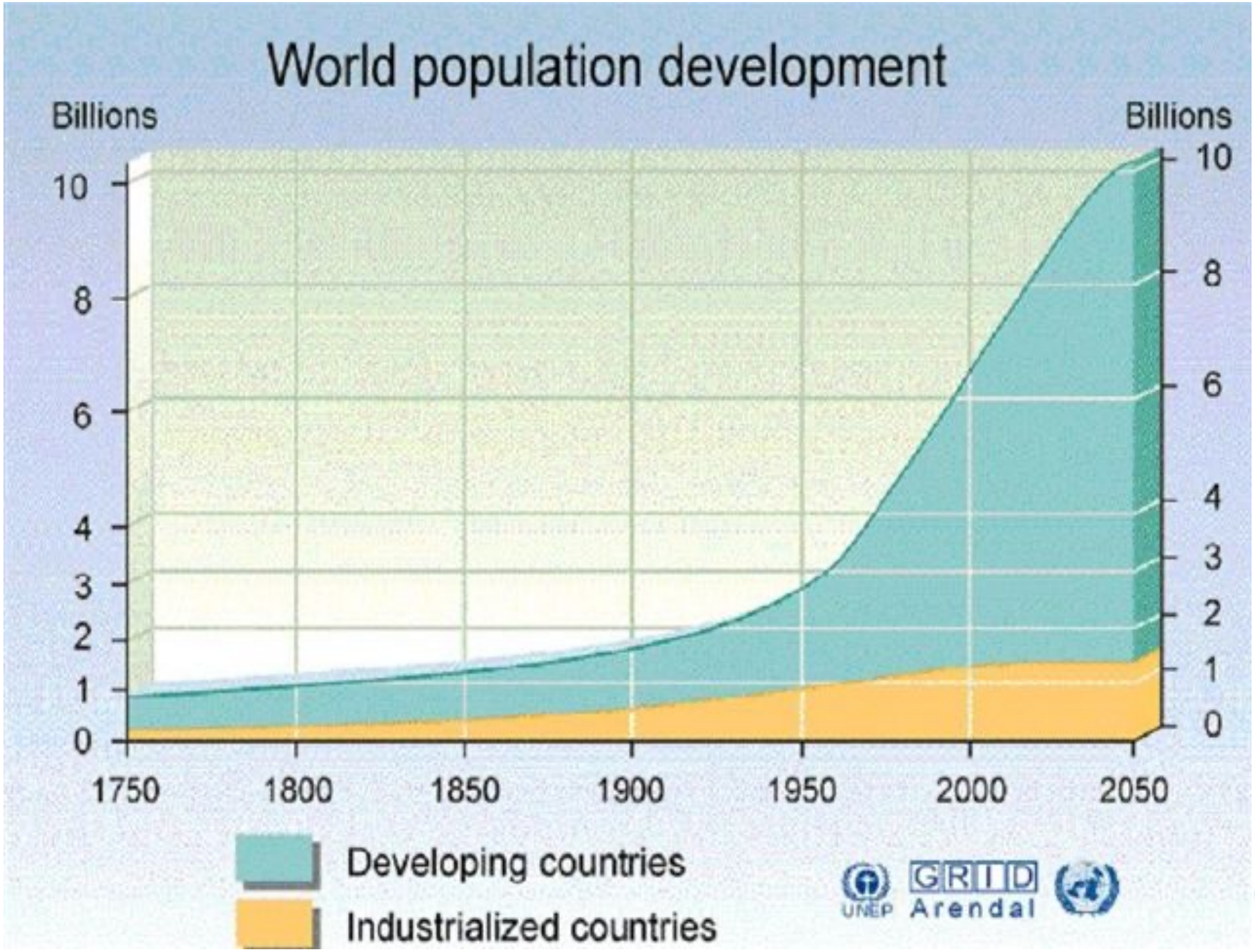

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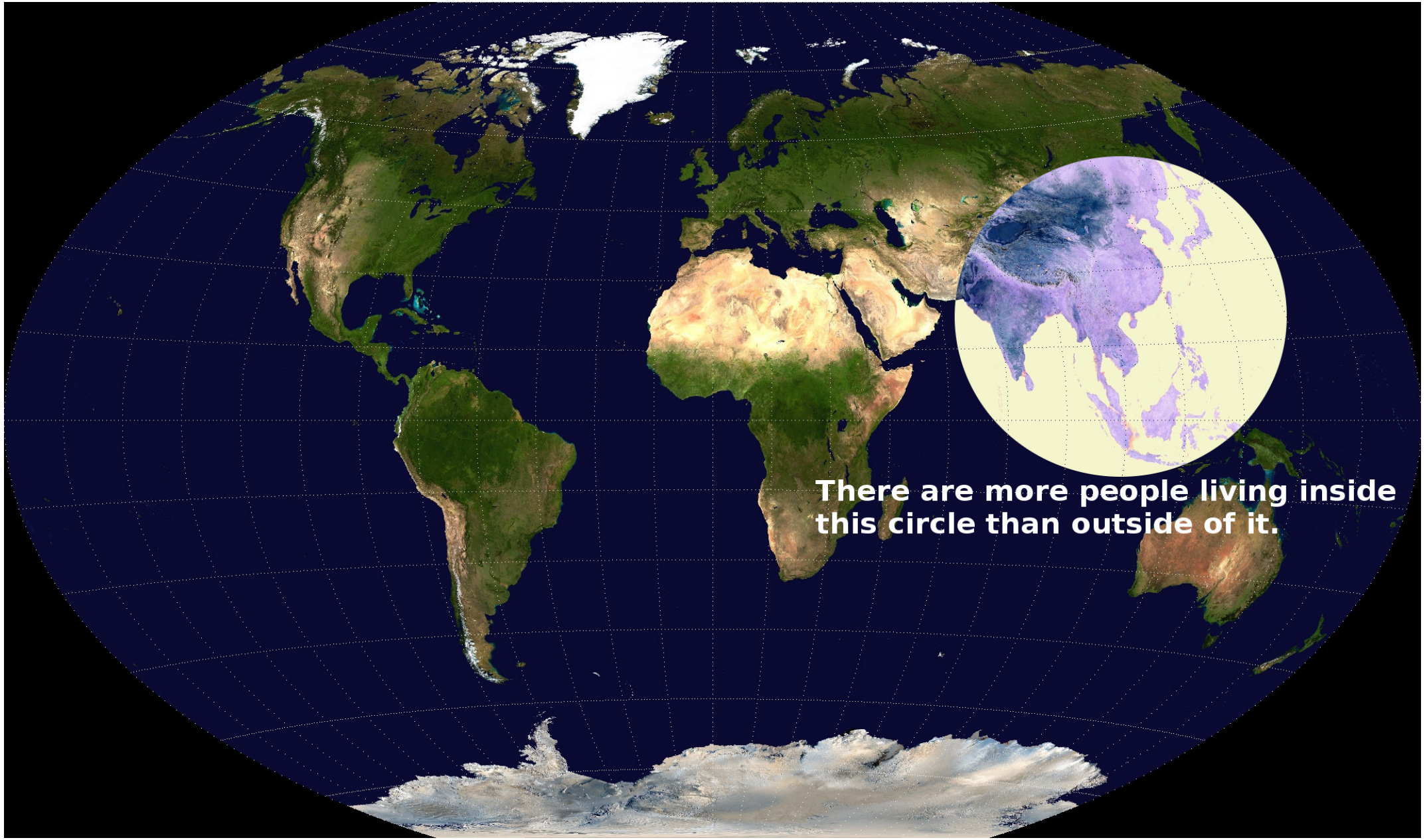

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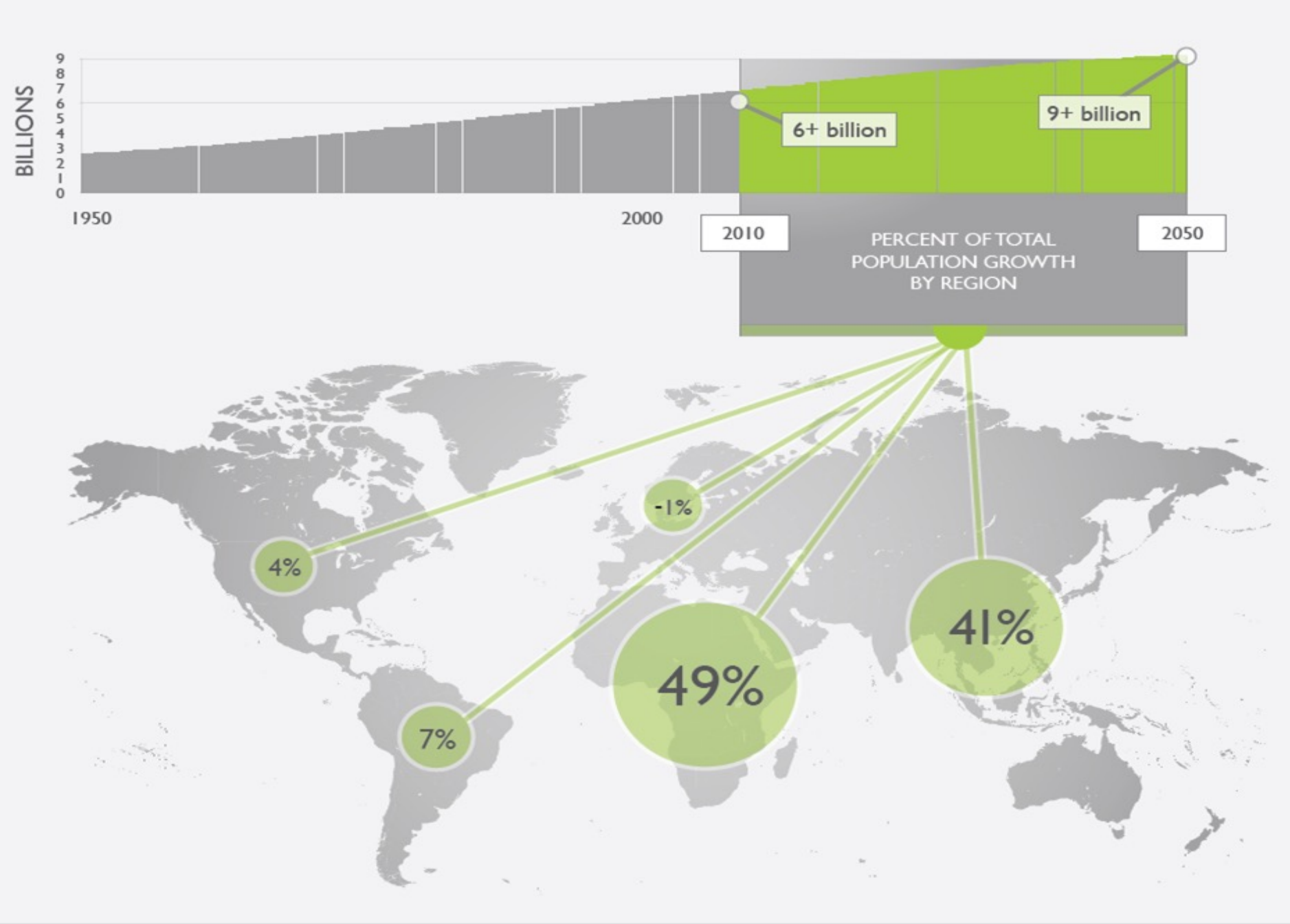

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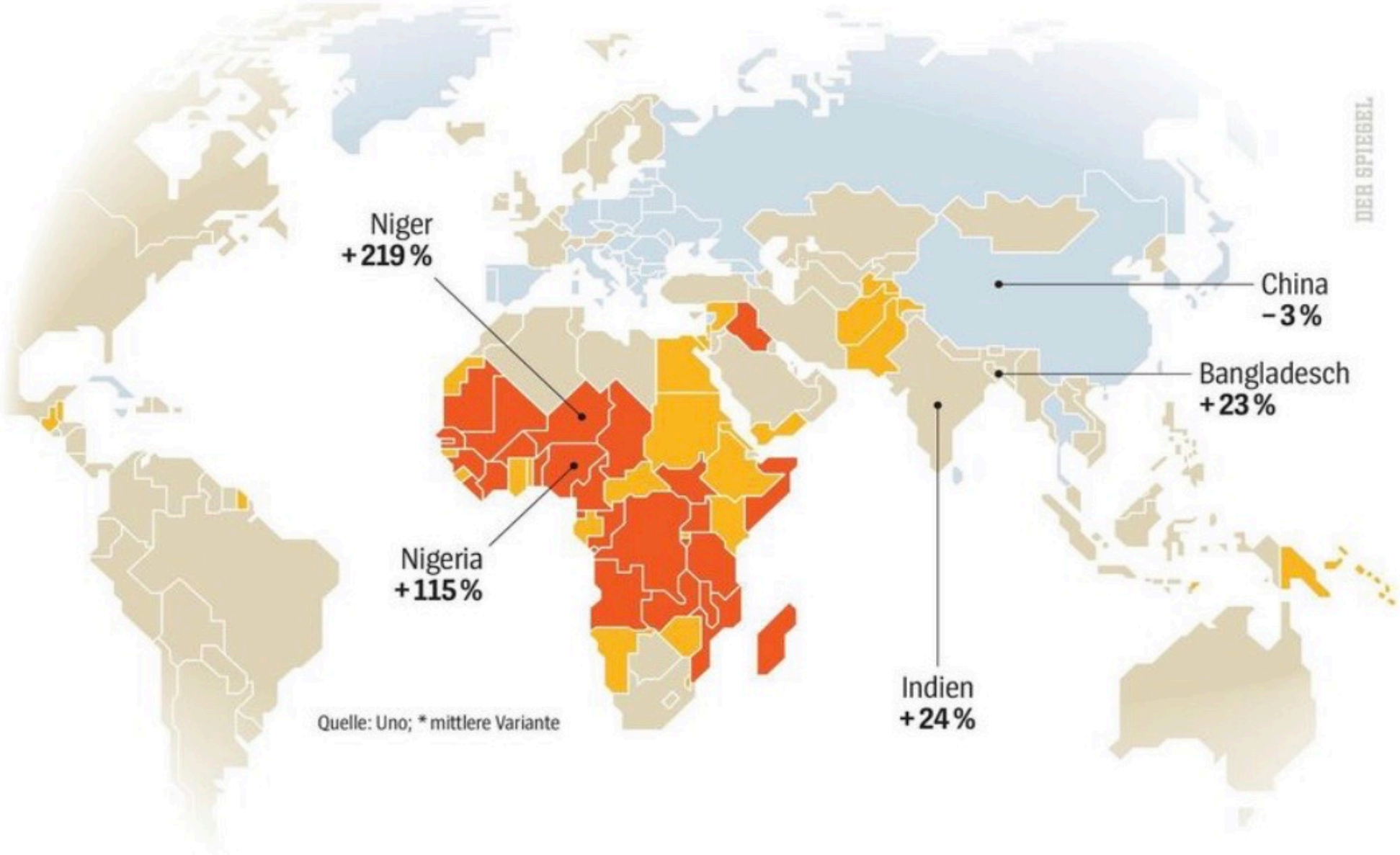

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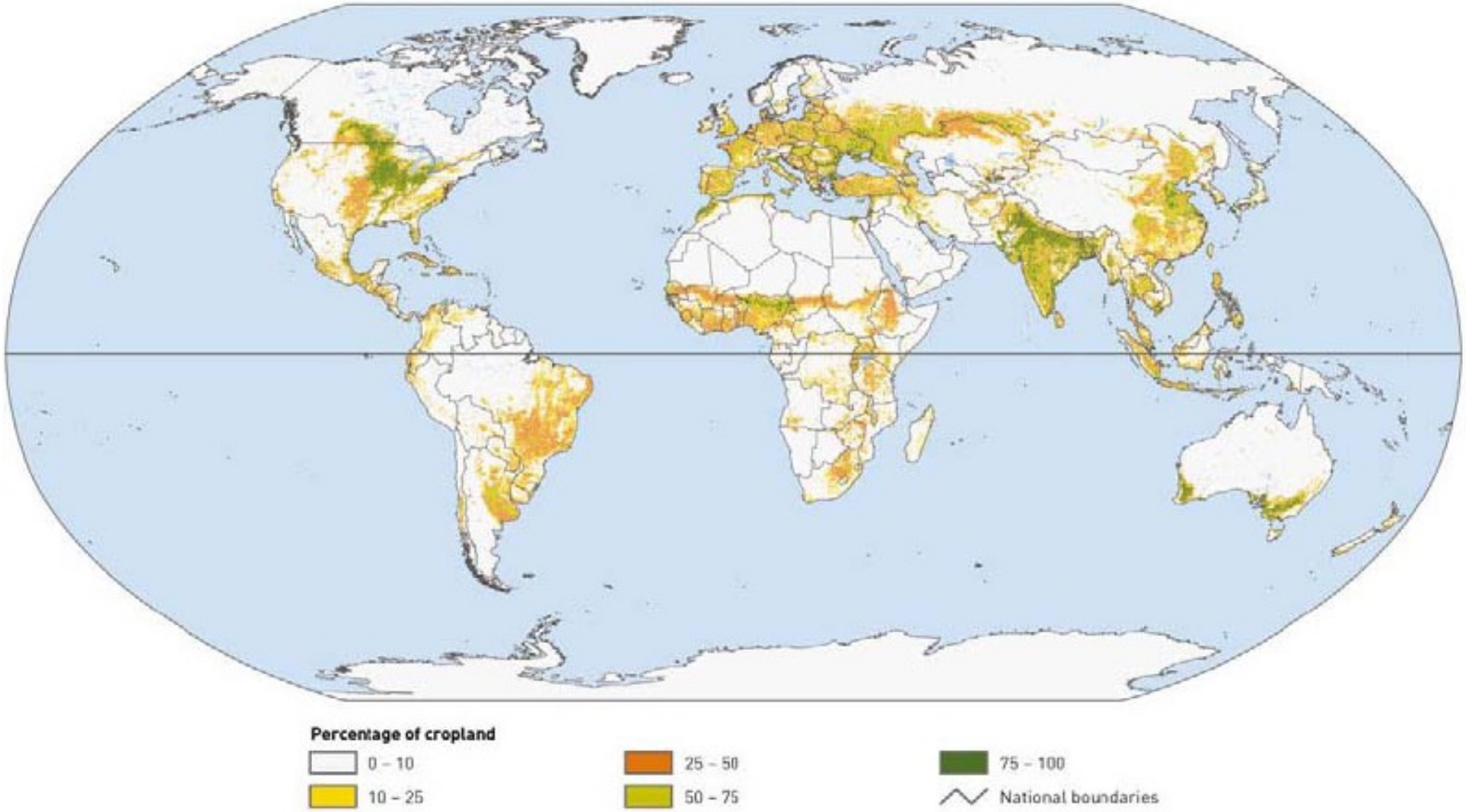
Distribution of cropland



FAO (2006)

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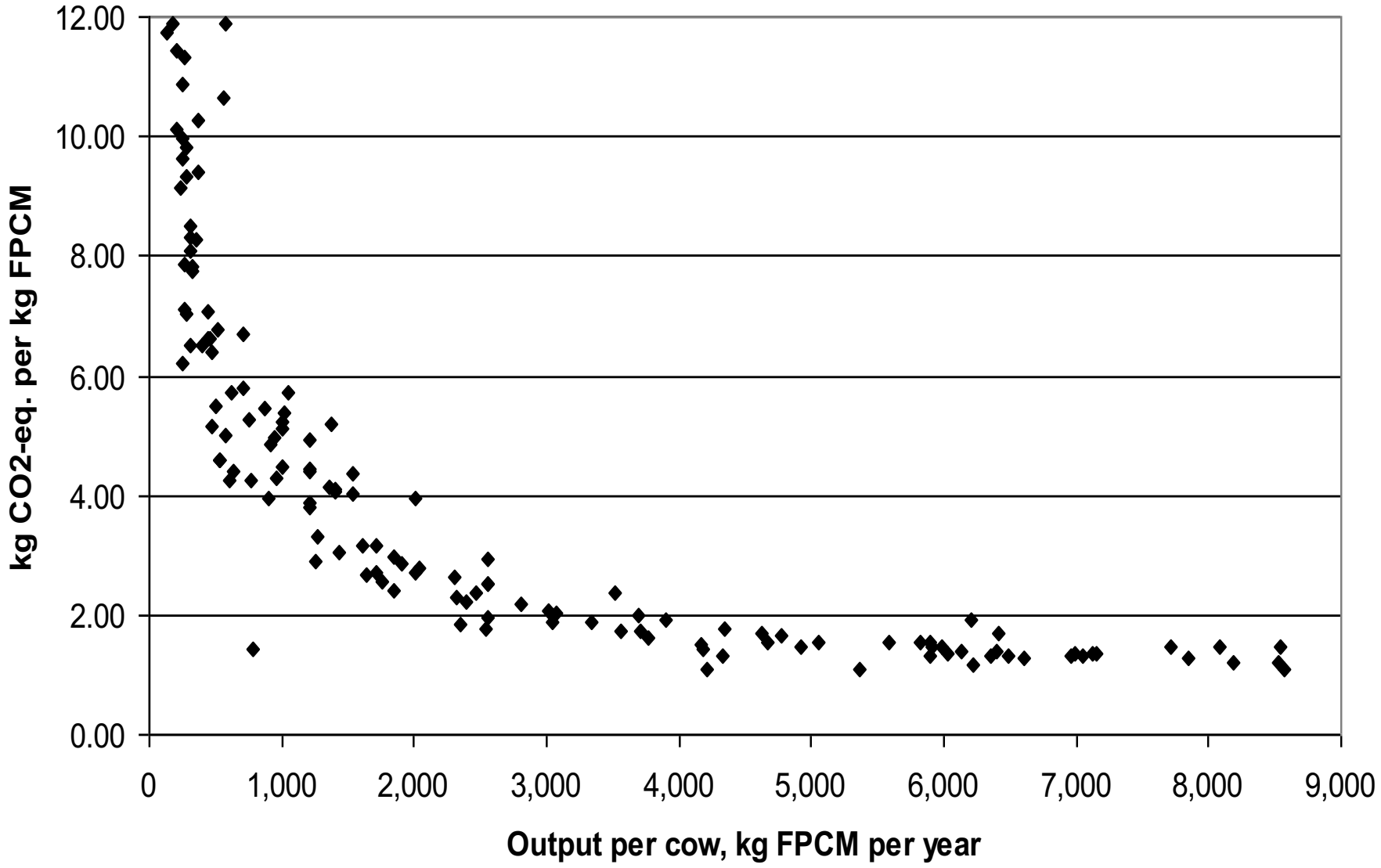

Relationship between total greenhouse gas emissions and milk output per cow

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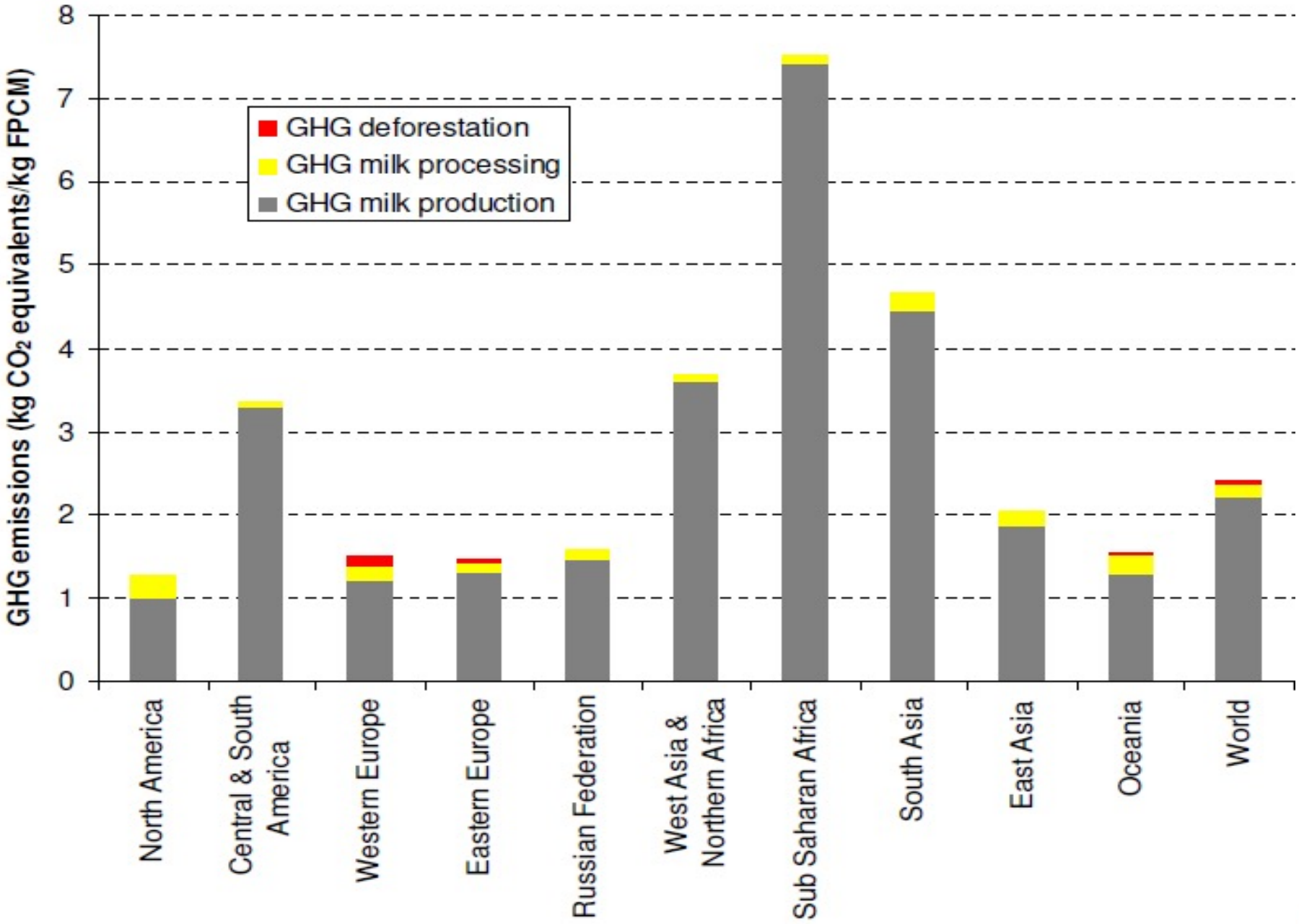
H. Steinfeld, 2015



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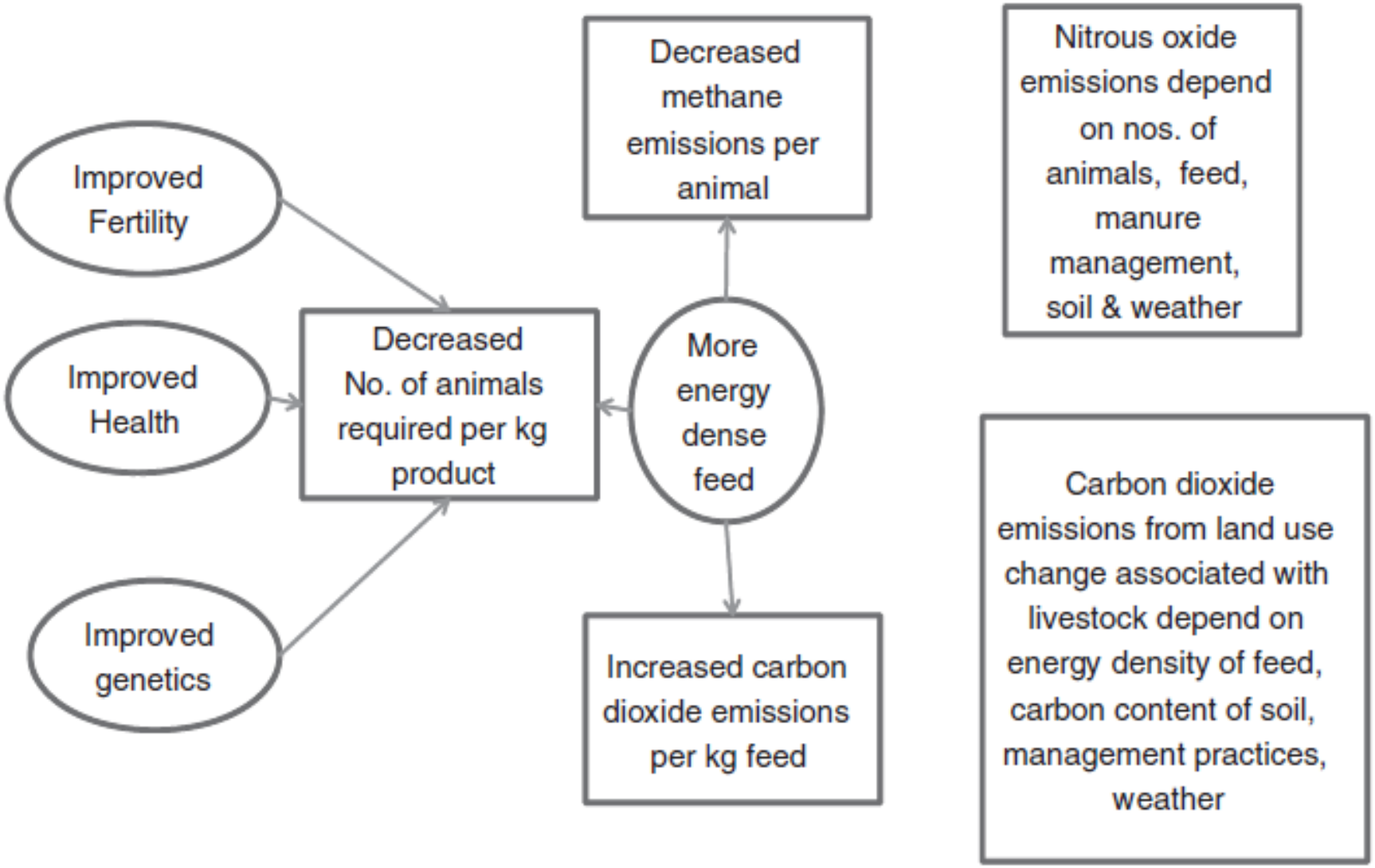
FAO (2010)



Mitigation: interventions to improve productivity

Gill et al. (2010)

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US Beef Trends

- In 1970, the U.S. 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.

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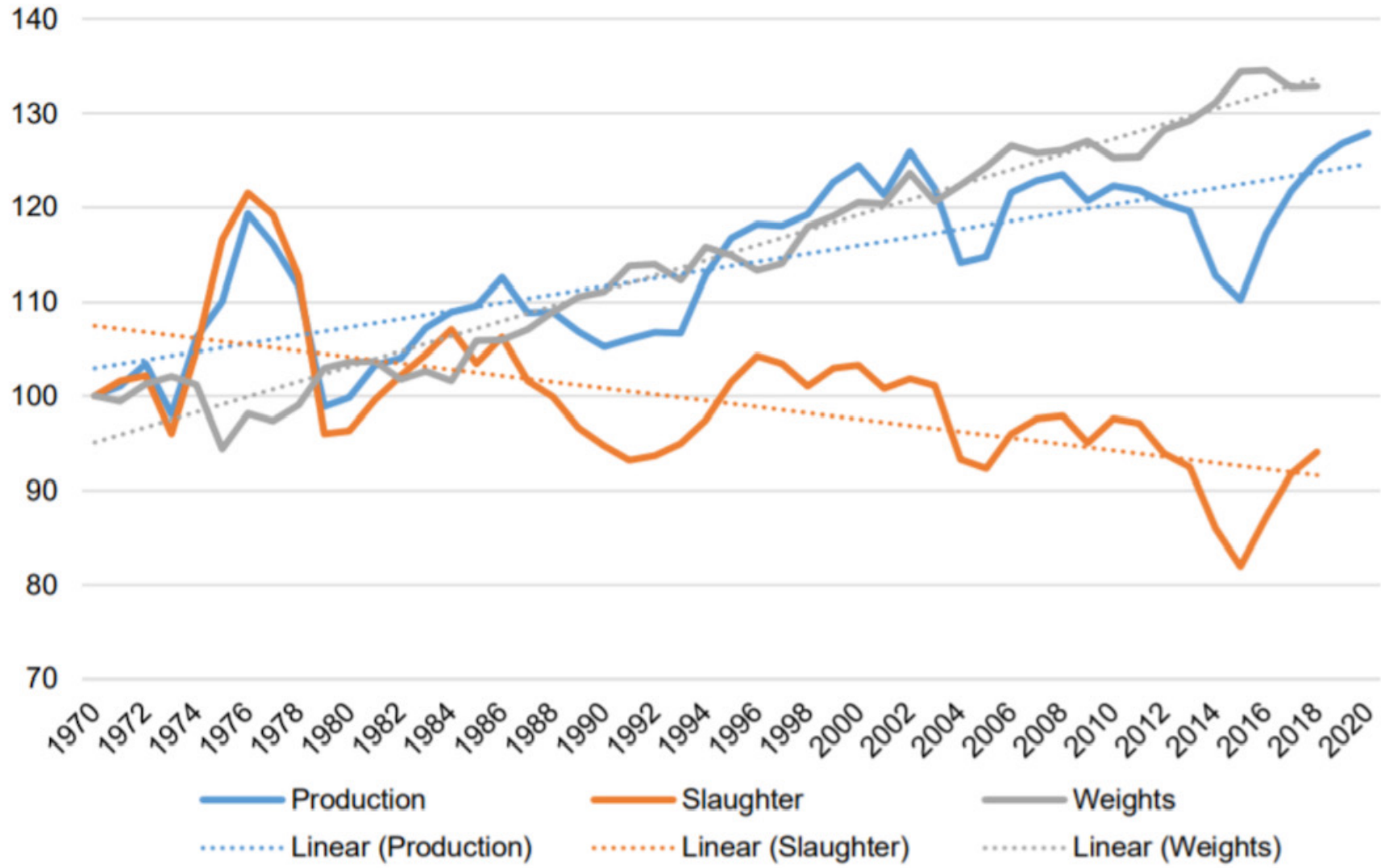
For over 50 years, cattle weights have propelled beef production as cattle slaughter decreased

Index 1970=100



Source: Calculations by USDA, Economic Research Service based on data from USDA, National Agricultural Statistics Service.

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US Dairy Trends

- In 1950, there were 25 million dairy cows in the U.S. Today there are 9 million.
- 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.

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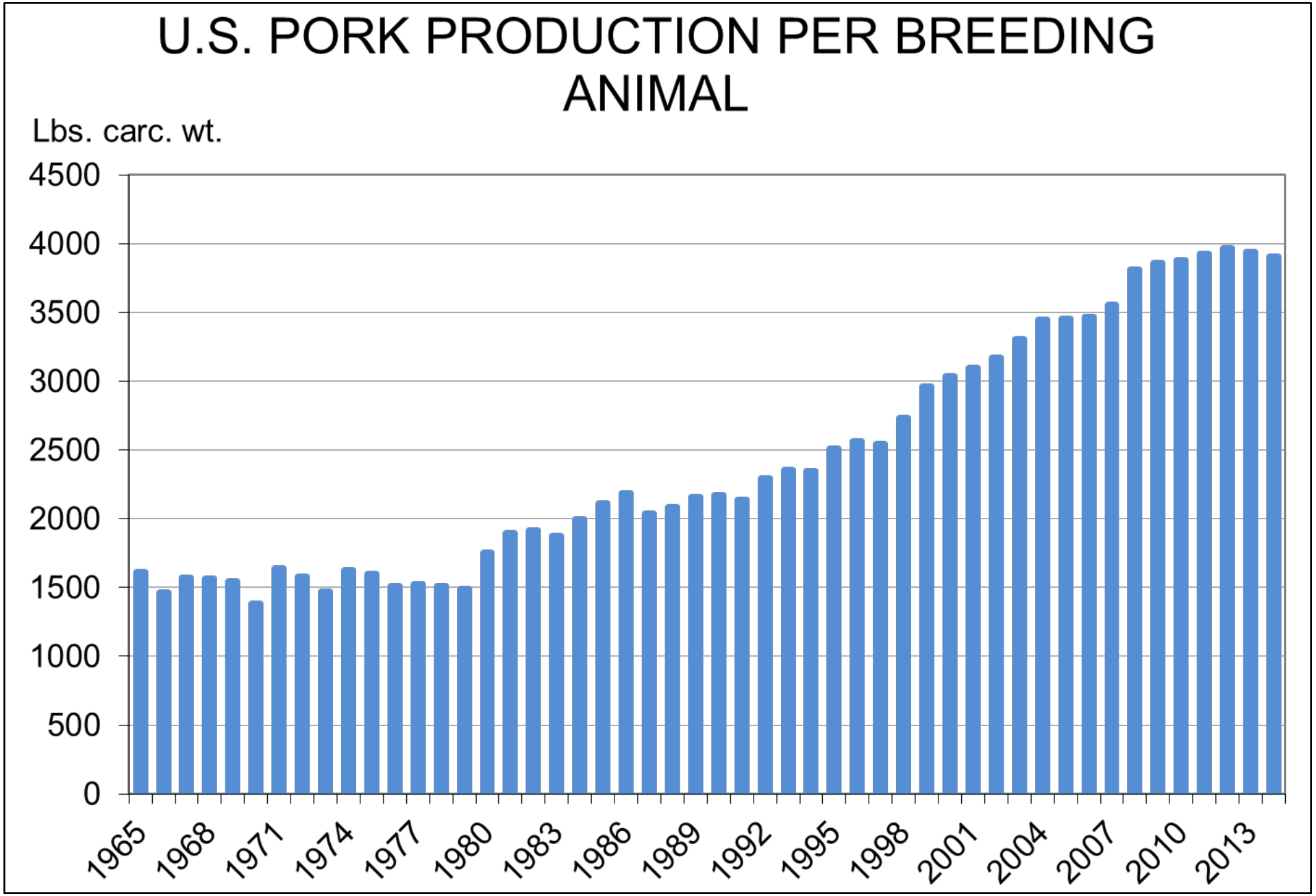

U.S. Pork Trends

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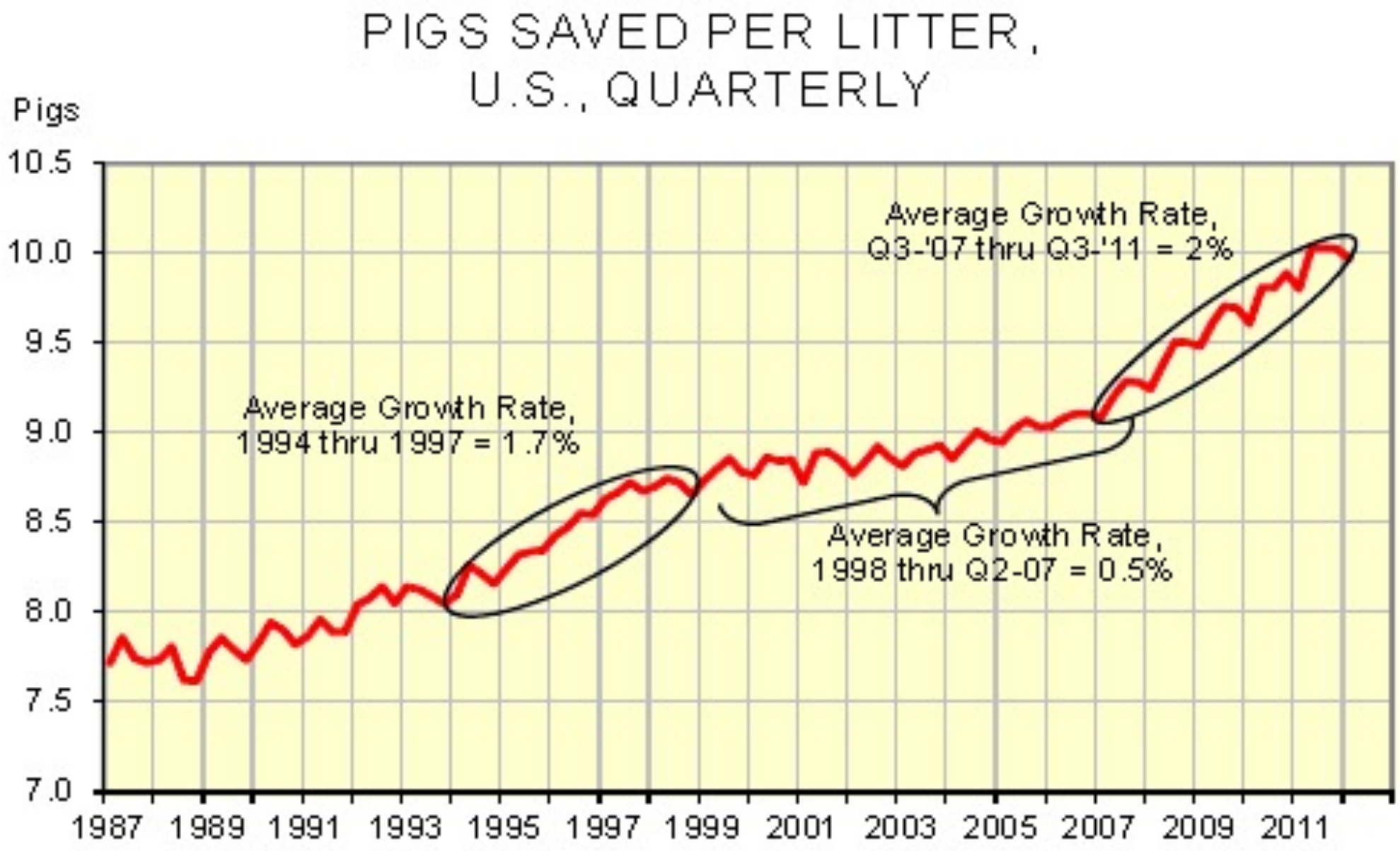

U.S. Pork Trends

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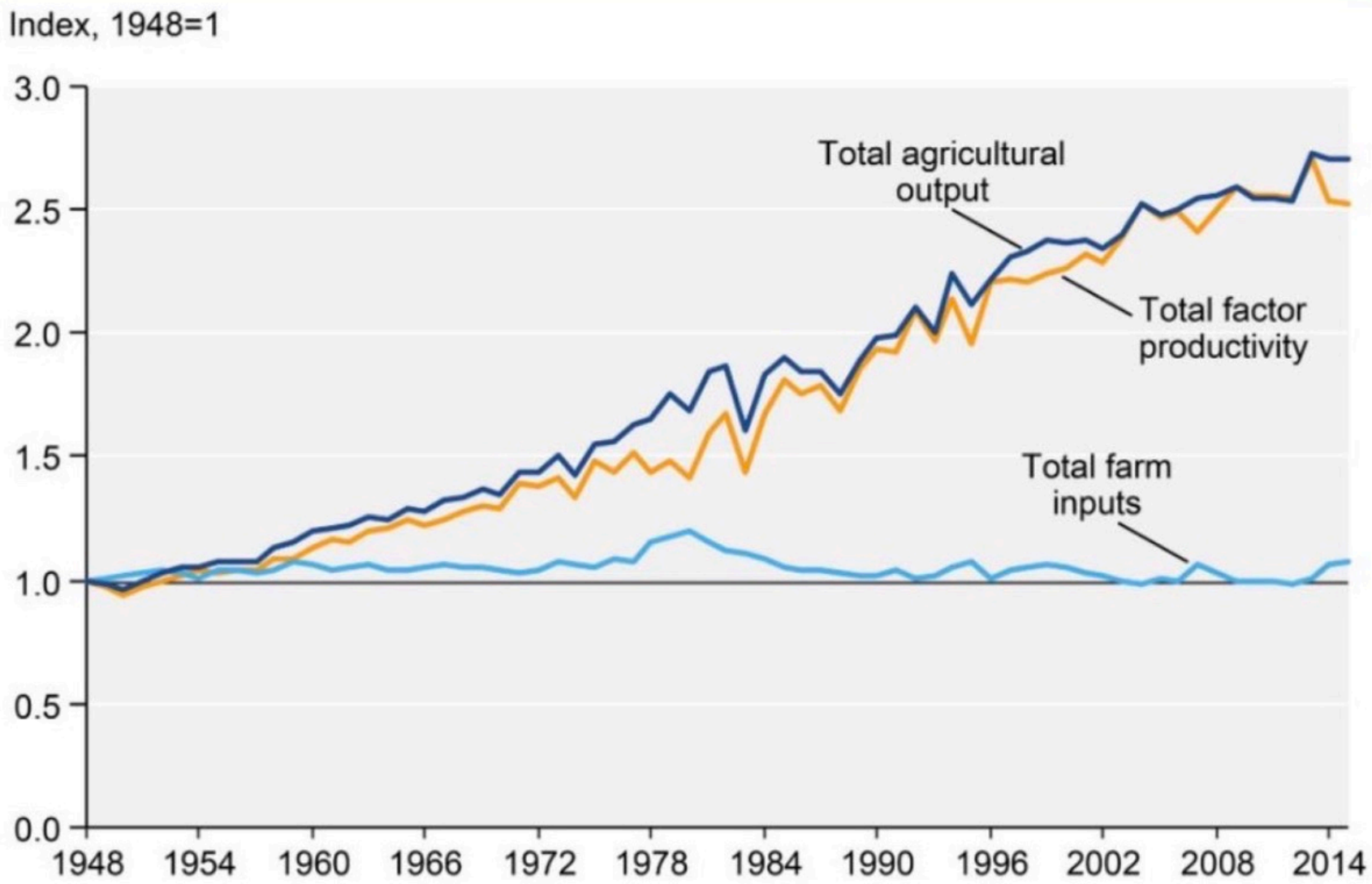

Source: USDA, Economic Research Service, *Agricultural Productivity in the U.S.* series; data as of October 2017.

U.S. Agricultural output, inputs, and total factor productivity, 1984-2015

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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

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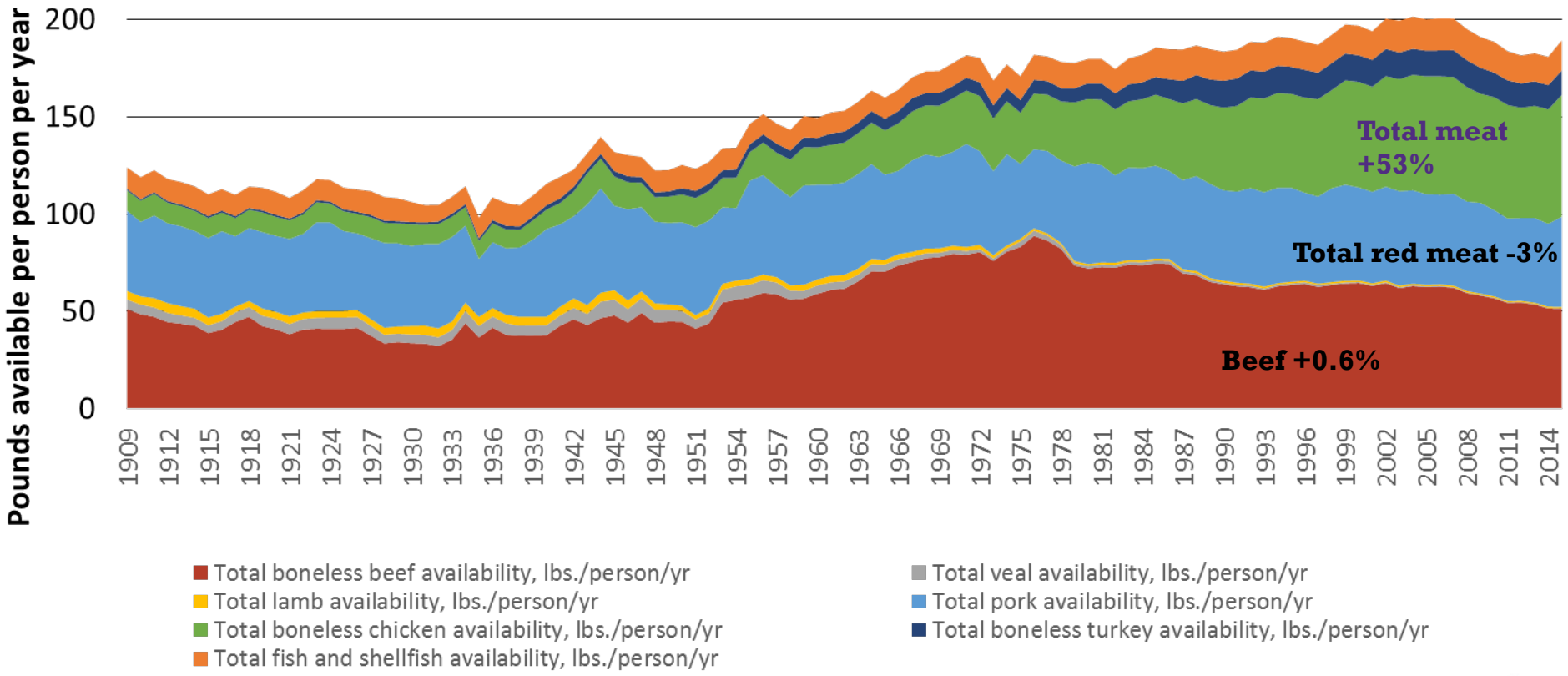
Americans eat the same amount of beef as 1909, but 500% more chicken



Source: USDA-ERS Food Availability Data System

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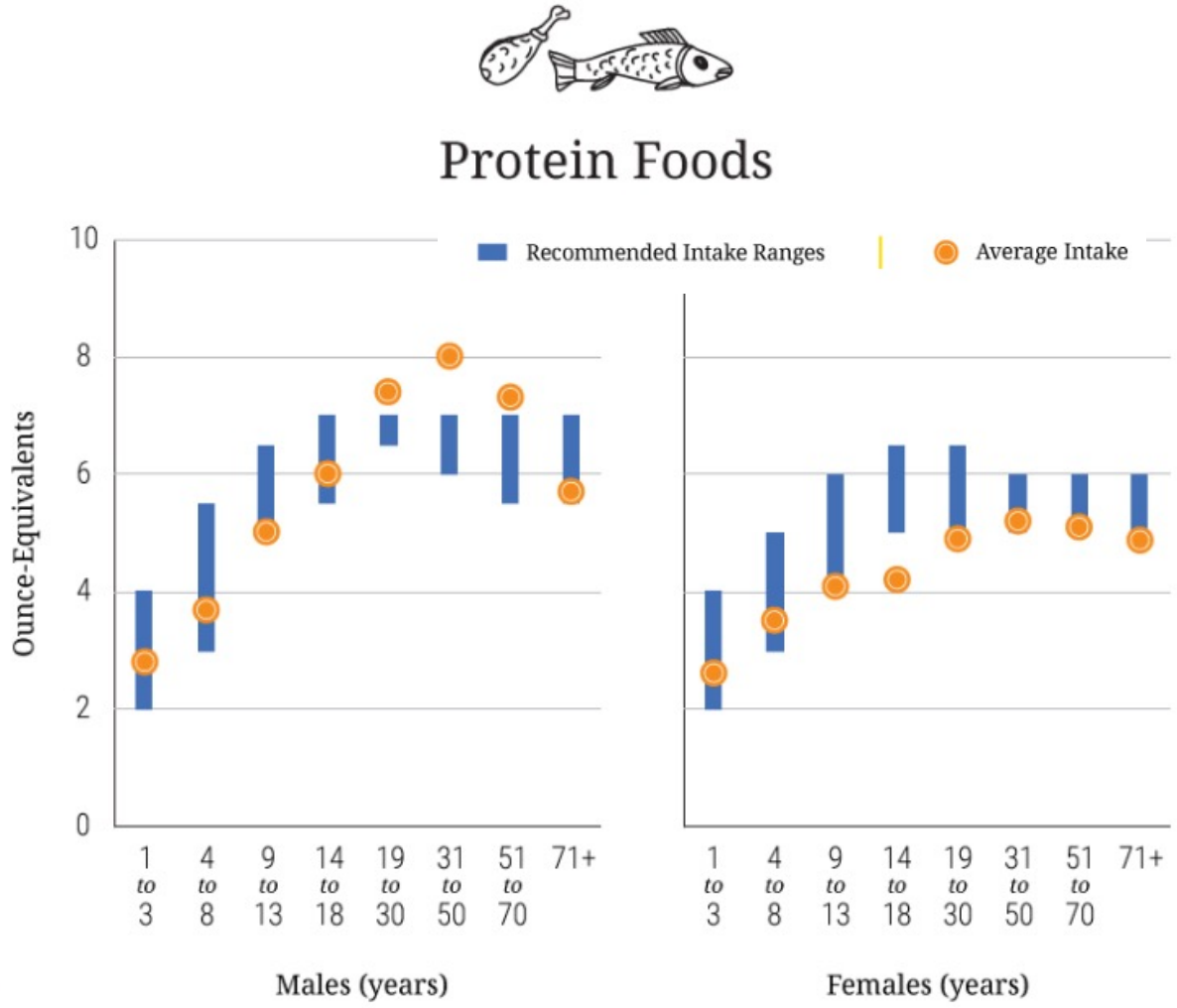
Publicly available data does not suggest we are overconsuming protein in the U.S.

- 2016:
  - USDA-ERS data estimate is we eat 5.8 ounces of meat & poultry per day
  - 1.8 ounces of beef
- DG 2015-2020:
  - 5.5 ounce equivalents of “protein foods”/day on 2000 calorie diet
    - 4 ounces from meat, poultry, eggs



Source: What We Eat in America, NHANES 2007-2010 for average intakes by age-sex group. Healthy U.S.-Style Food Patterns, which vary based on age, sex, and activity level, for recommended intake ranges

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Can we eat our way out of climate change?

- Omnivore to vegan (per yr) = 0.8 tons CO2e (Wynes & Nicholas, 2017)
- One trans-Atlantic flight (per passenger) = 1.6 tons CO2e (Wynes & Nicholas, 2017)
- Meatless Monday (US) = 0.3% GHG reduction (Hall & White, 2017)
- Vegan US = 2.6% (Hall & White, 2017)

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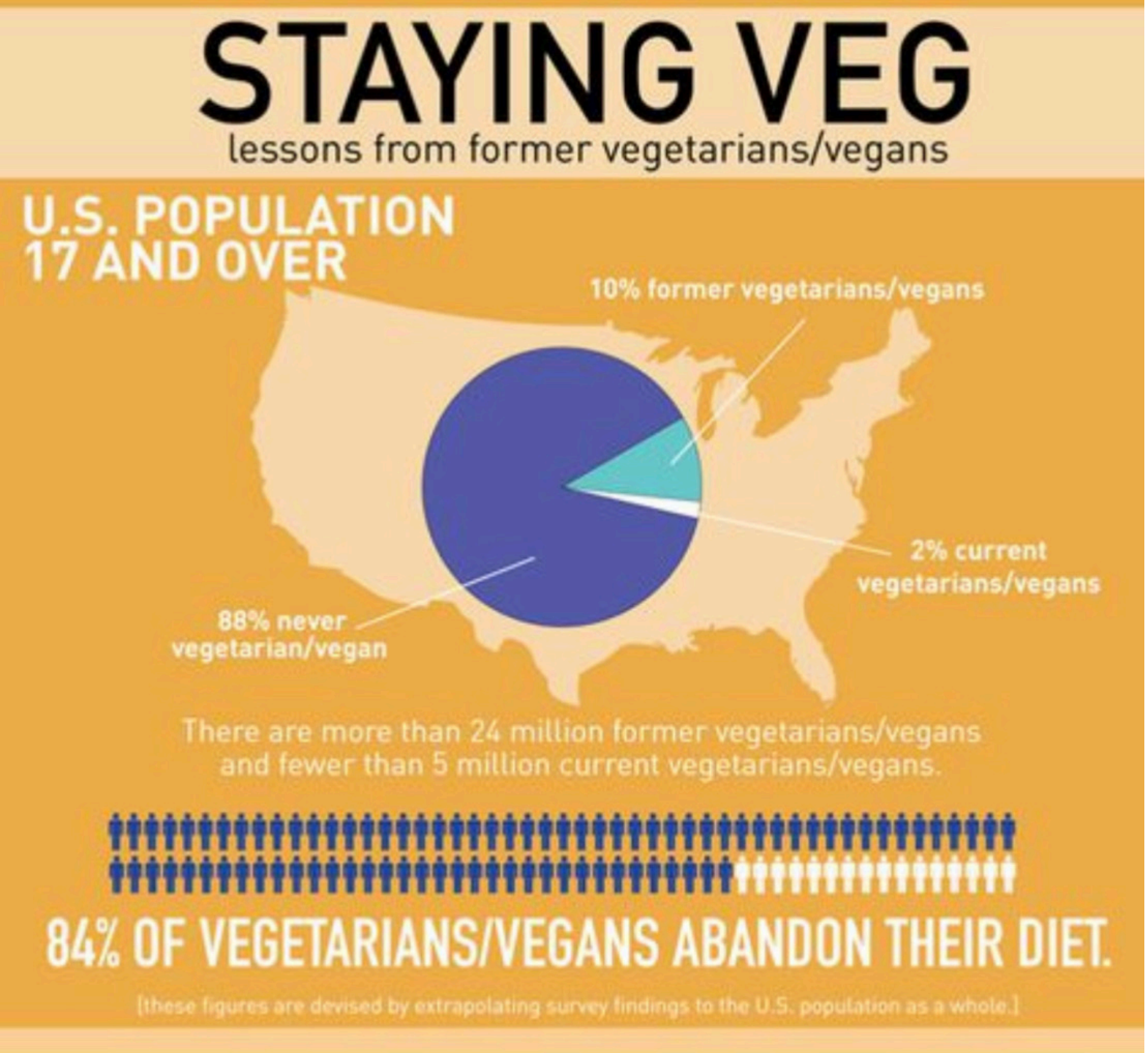

For every person who eats a vegan diet, there are five who have given that diet up.

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PHOTOGRAPH BY ROBERT CLARK, NATIONAL GEOGRAPHIC

Global Waste:

1 out of 3 calories

40% of food in the U.S. is wasted

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Read my blog

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Thank you

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