Kühe sind keine Klimakiller

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RETHINKING METHANE

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Facts & Fiction on Livestock/Poultry and Climate Change?

- Livestock & poultry produces 18% of all anthropogenic GHG globally
- Livestock & poultry produce more GHG than transportation
- 70% of all agricultural land is used for livestock & poultry

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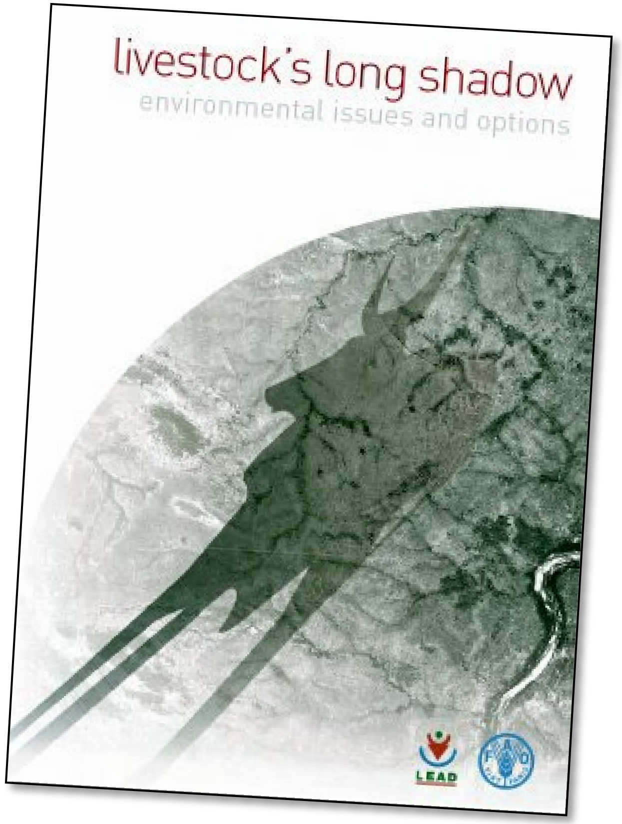
“Livestock’s Long Shadow” (FAO, 2006)

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



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“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

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.

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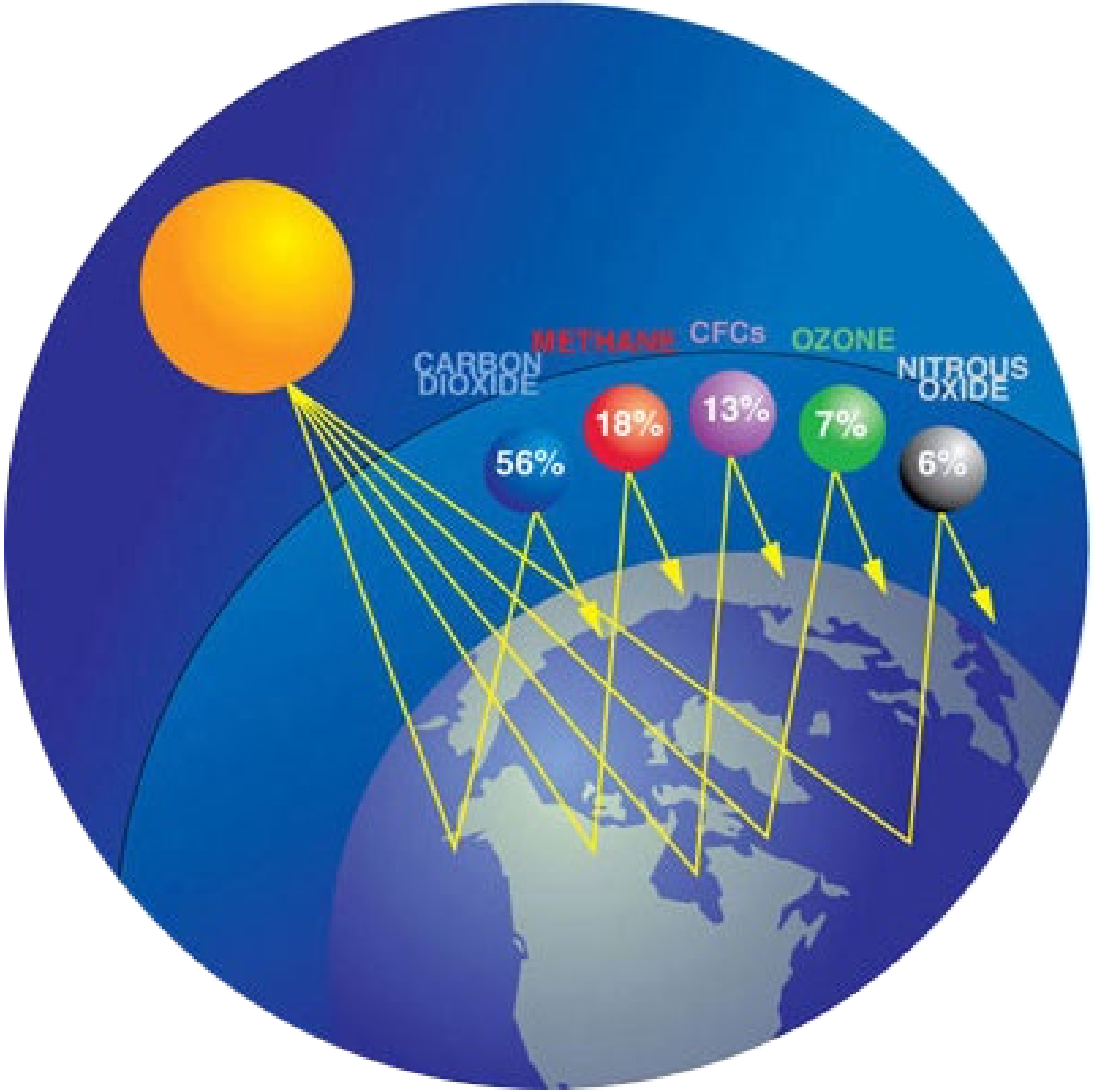

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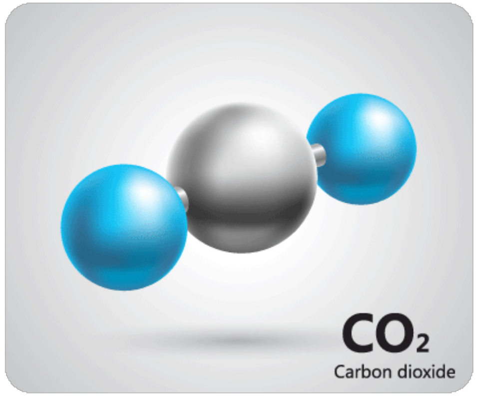
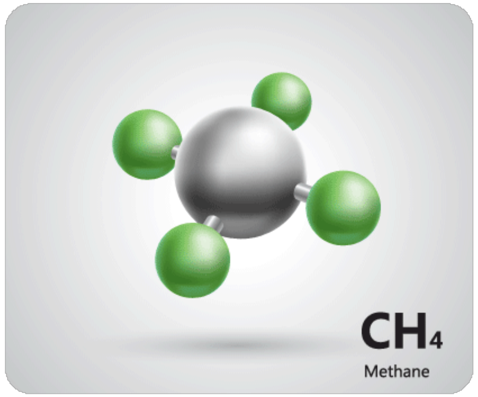
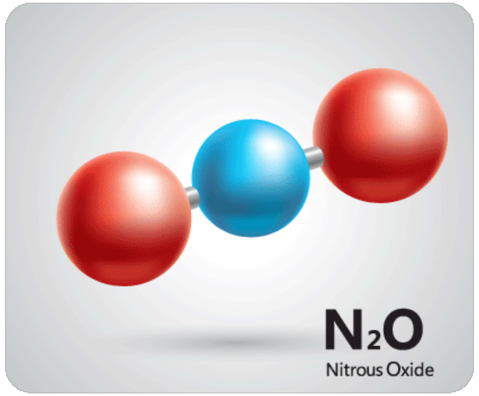
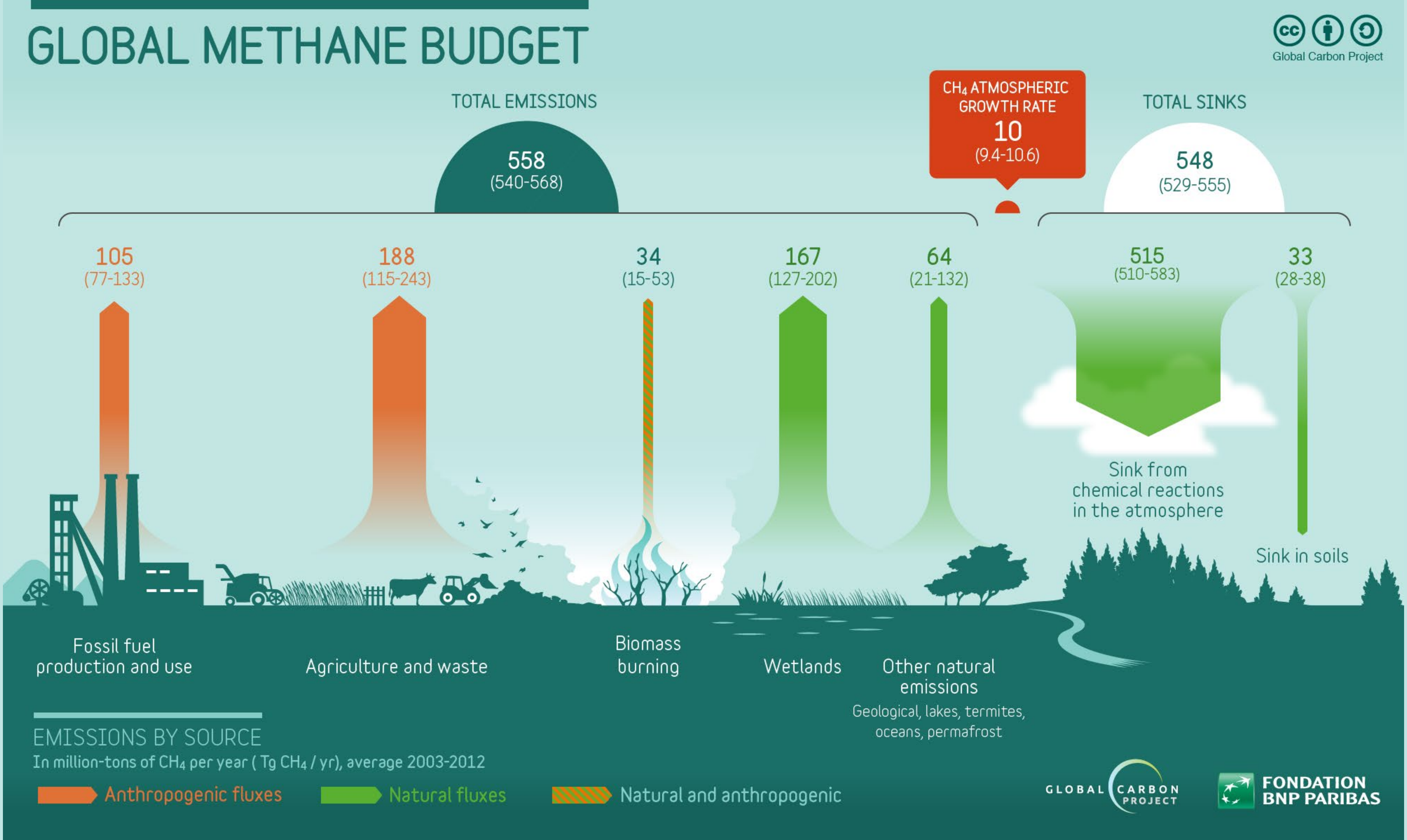
Global Warming Potential (GWP_{100}) of Main Greenhouse Gases

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



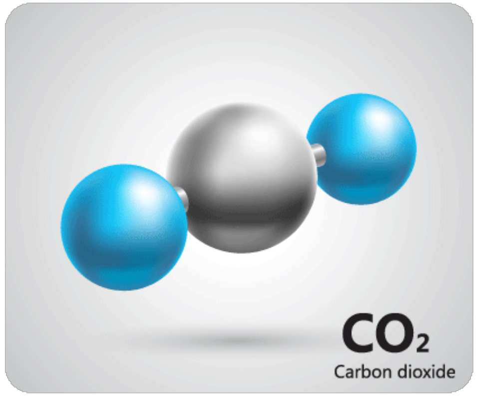


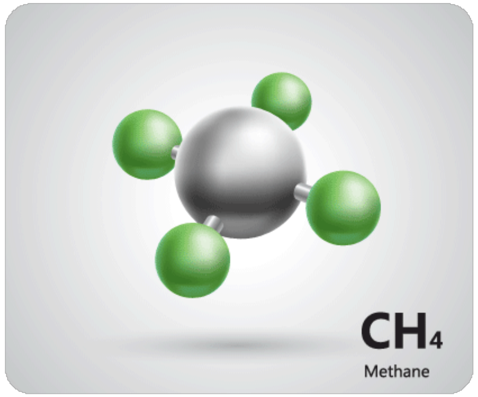


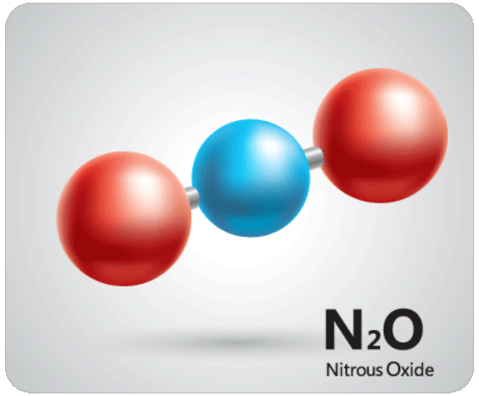

GLOBAL METHANE BUDGET
Global Carbon Project
TOTAL EMISSIONS
558
(540-568)
CH4 ATMOSPHERIC GROWTH RATE
10
(9.4-10.6)
TOTAL SINKS
548
(529-555)
105
(77-133)
188
(115-243)
34
(15-53)
167
(127-202)
64
(21-132)
515
(510-583)
33
(28-38)
Sink from chemical reactions in the atmosphere
Sink in soils
Fossil fuel production and use
Agriculture and waste
Biomass burning
Wetlands
Other natural emissions
Geological, lakes, termites, oceans, permafrost
EMISSIONS BY SOURCE
In million-tons of CH4 per year (Tg CH4 / 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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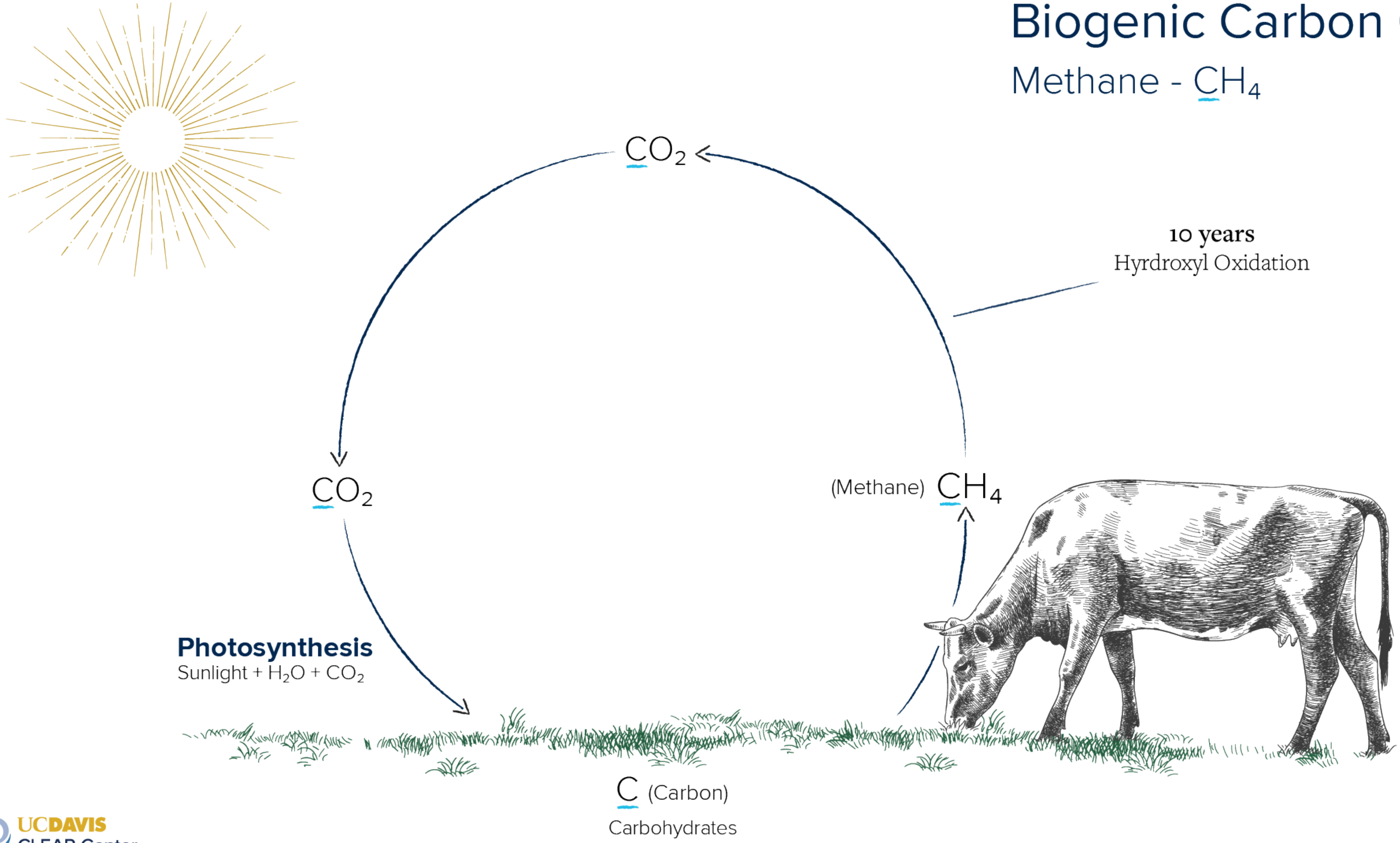
Biogenic Carbon Cycle

Methane - CH_4



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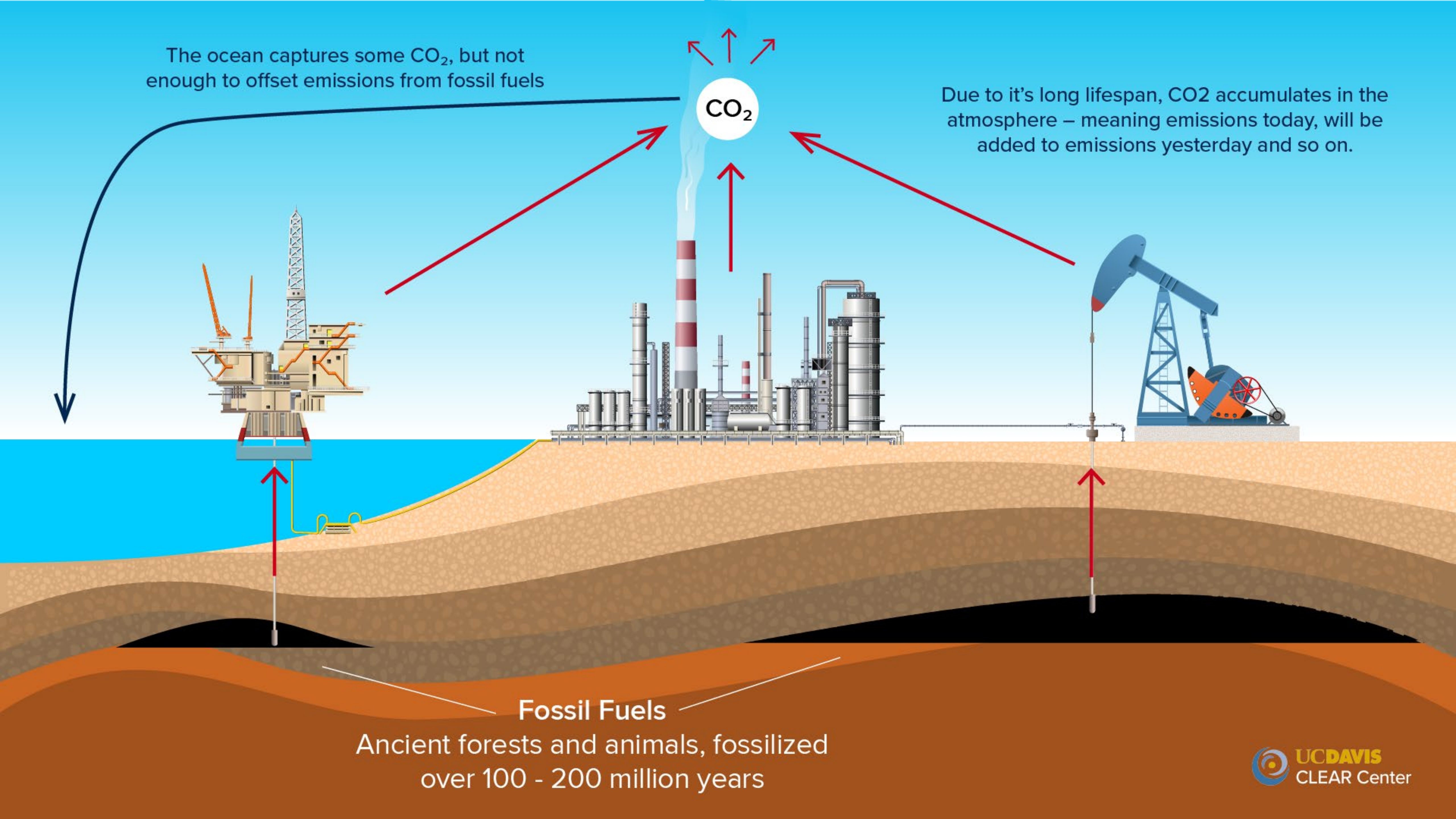

The ocean captures some CO_2, but not enough to offset emissions from fossil fuels
CO_2
Due to it's long lifespan, CO2 accumulates in the atmosphere – meaning emissions today, will be added to emissions yesterday and so on.
Fossil Fuels
Ancient forests and animals, fossilized over 100 - 200 million years
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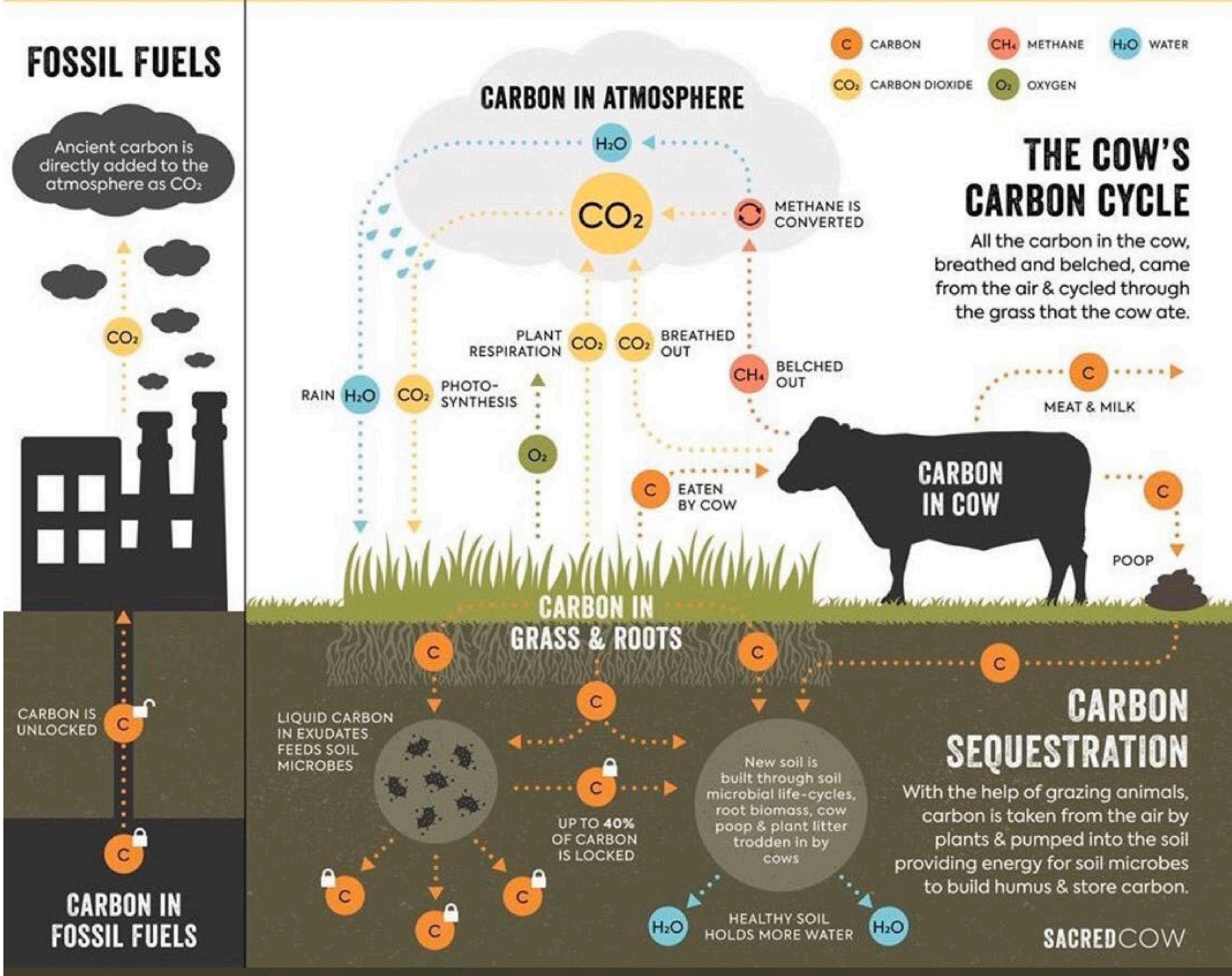
Fossil vs. Biogenic Carbon

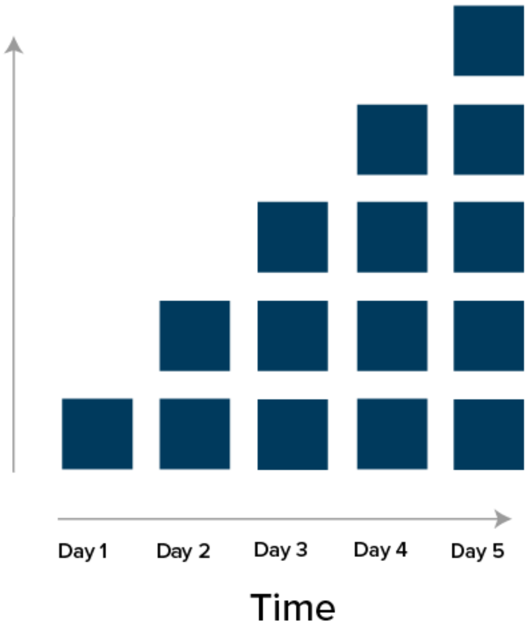


Via:
@sustainabledish
sacredcow.info

= Pulse of CO_2

Stock
Gas
Carbon dioxide (CO_2)

Atmospheric Concentration

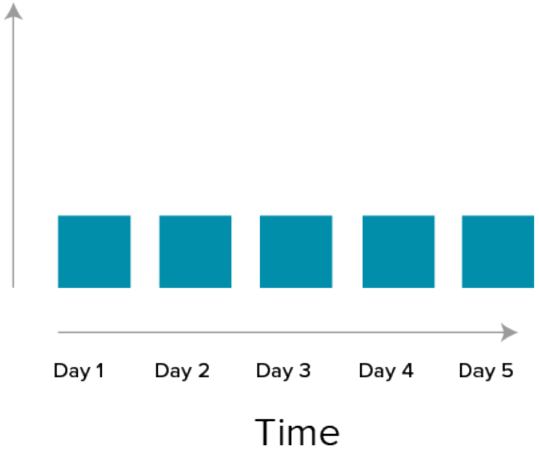


Stock gases will accumulate over time, because they stay in the environment.

= Pulse of CH_4

Flow
Gas
Methane (CH_4)

Atmospheric Concentration



Flow gases will stay stagnent, 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

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 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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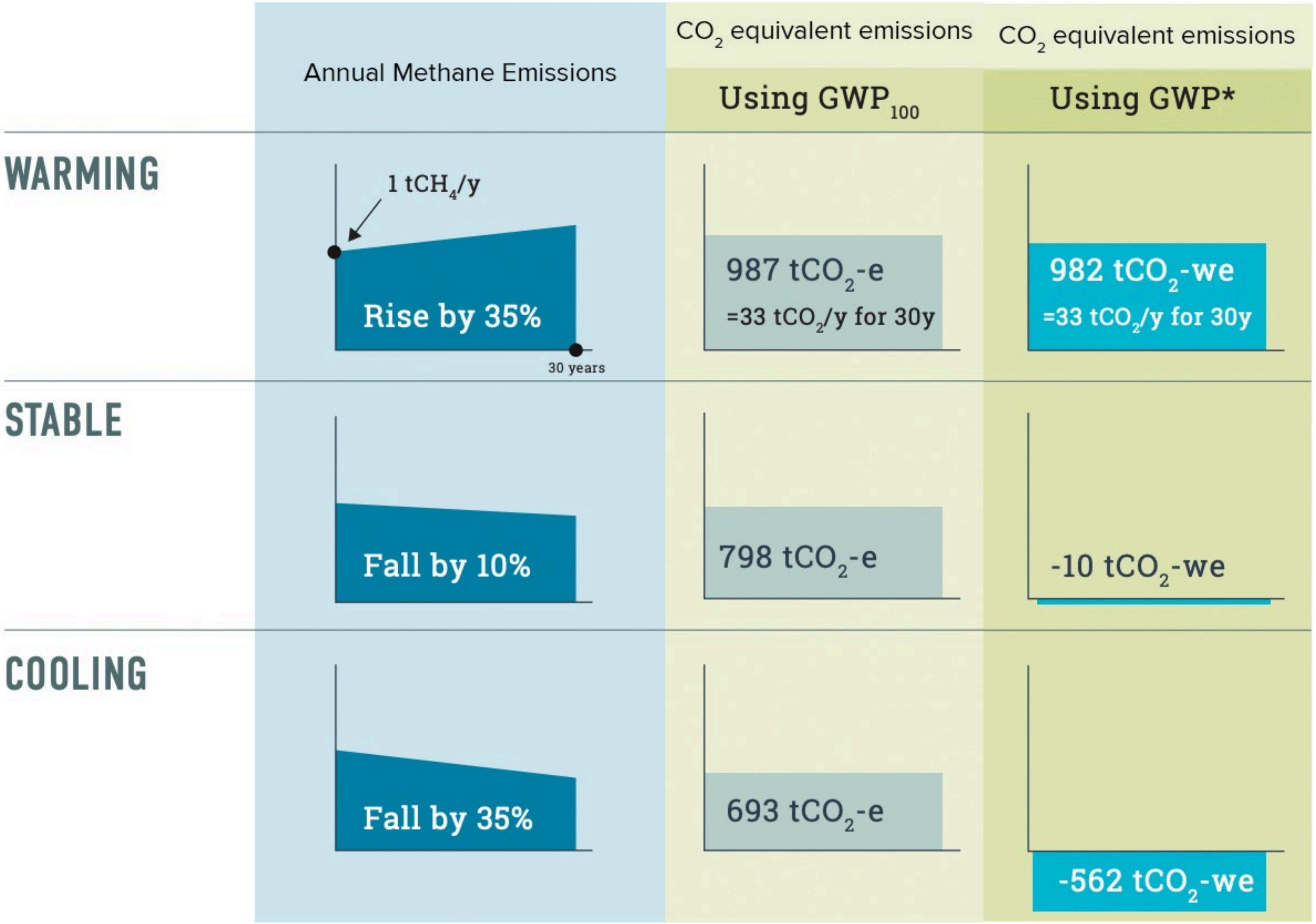

Cain, M., Allen, M. & Lynch, J. *Oxford Martin Programme on Climate Pollutants* (2019). Read more at: https://www.oxfordmartin.ox.ac.uk/downloads/academic/201908_ClimatePollutants.pdf.

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calculated for any species, but it is least dependent on the chosen time horizon for species with lifetimes less than half the time horizon of the metric (Collins et al., 2020). Pulse-step metrics can therefore be useful where time dependence of pulse metrics, like GWP or GTP, complicates their use (see Box 7.3).

For a stable global warming from non-CO_2 climate agents (gas or aerosol) their effective radiative forcing needs to gradually decrease (Tanaka and O'Neill, 2018). Cain et al. (2019) find this decrease to be around 0.3% yr^{-1} for the climate response function in AR5 (Myhre et al., 2013b). To account for this, a quantity referred to as GWP* has been defined that combines emissions (pulse) and changes in emission levels (step) approaches (Cain et al., 2019; Smith et al., 2021)[2]. The emission component accounts for the need for emissions to decrease to deliver a stable warming. The step (sometimes referred to as flow or rate) term in GWP* accounts for the change in global surface temperature that arises in from a change in short-lived greenhouse gas emission rate, as in CGTP, but here approximated by the change in emissions over the previous 20 years.

Cumulative CO_2 emissions and GWP*-based cumulative CO_2 equivalent greenhouse gas (GHG) emissions multiplied by TCRE closely approximate the global warming associated with emissions timeseries (of CO_2 and GHG, respectively) from the start of the time-series (Lynch et al., 2020). Both the CGTP and GWP* convert short-lived greenhouse gas emission rate changes into cumulative CO_2 equivalent emissions, hence scaling these by TCRE gives a direct conversion from short-lived greenhouse gas emission to global surface temperature change. By comparison expressing methane emissions as CO_2 equivalent emissions using GWP-100 overstates the effect of constant methane emissions on global surface temperature by a factor of 3-4 over a 20-year time horizon (Lynch et al., 2020, their Figure 5), while understating the effect of any new methane emission source by a factor of 4-5 over the 20 years following the introduction of the new source (Lynch et al., 2020, their Figure 4).

[START FIGURE 7.21 HERE]

Figure 7.21: Emission metrics for two short-lived greenhouse gases: HFC-32 and CH_4, (lifetimes of 5.4 and 11.8 years). The temperature response function comes from Supplementary Material 7.SM.5.2. Values for non-CO_2 species include the carbon cycle response (Section 7.6.1.3). Results for HFC-32 have been divided by 100 to show on the same scale. (a) temperature response to a step change in short-lived greenhouse gas emission. (b) temperature response to a pulse CO_2 emission. (c) conventional GTP metrics (pulse vs pulse). (d) combined-GTP metric (step versus pulse). Further details on data sources and processing are available in the chapter data table (Table 7.SM.14).

[END FIGURE 7.21 HERE]

Figure 7.22 explores how cumulative CO_2 equivalent emissions estimated for methane vary under different emission metric choices and how estimates of the global surface air temperature (GSAT) change deduced from these cumulative emissions compare to the actual temperature response computed with the two-layer emulator. Note that GWP and GTP metrics were not designed for use under a cumulative carbon dioxide equivalent emission framework (Shine et al., 1990, 2005), even if they sometimes are (e.g. Cui et al., 2017; Howard et al., 2018) and analysing them in this way can give useful insights into their physical properties. Using these standard metrics under such frameworks, the cumulative CO_2 equivalent emission associated with methane emissions would continue to rise if methane emissions were substantially reduced but remained above zero. In reality, a decline in methane emissions to a smaller but still positive value could cause a declining warming. GSAT changes estimated with cumulative CO_2 equivalent emissions computed

Since 2015
California dairies
have reduced
2.2 million
metric tons
of greenhouse
gases

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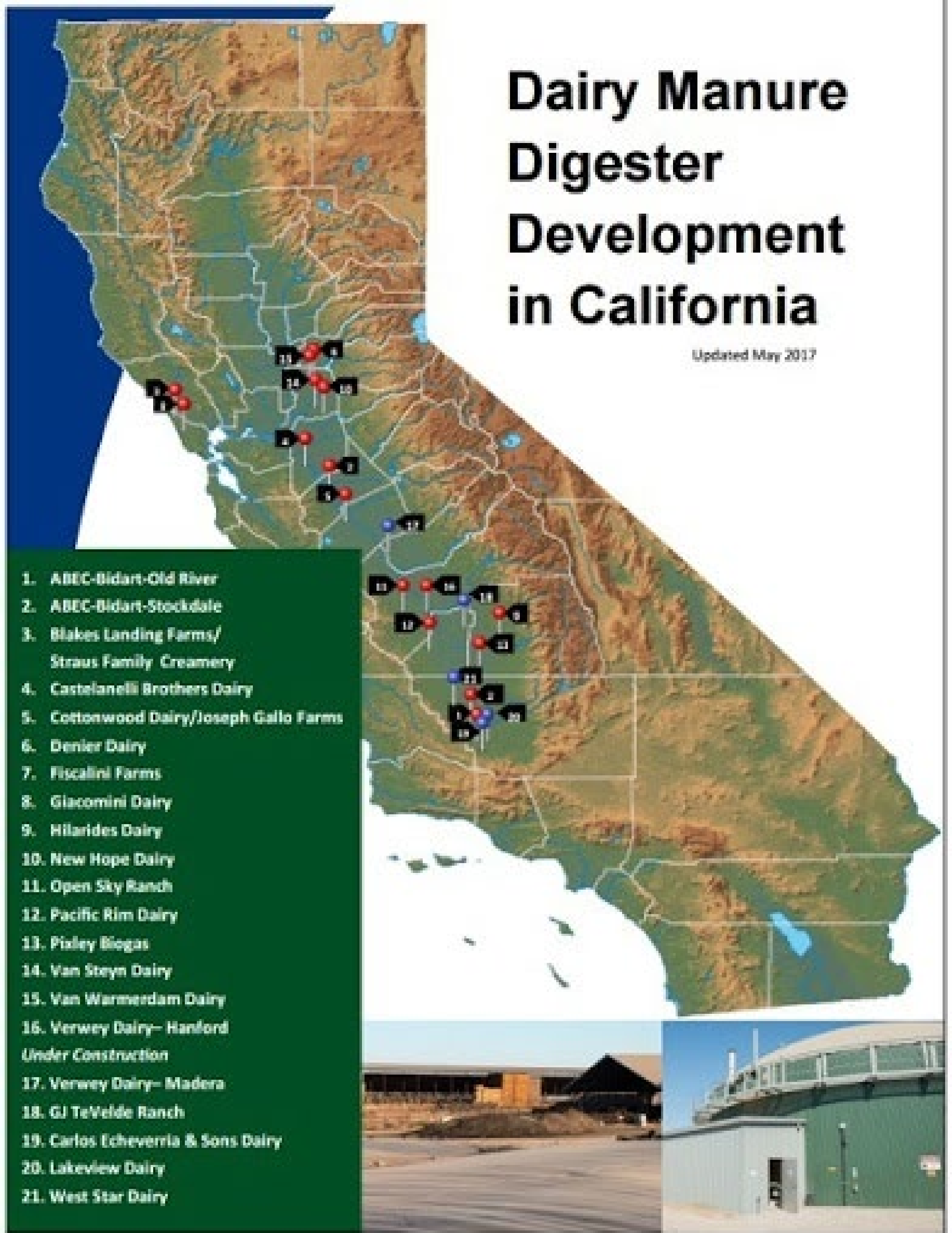

That's a **25 percent** reduction in GHG emissions.

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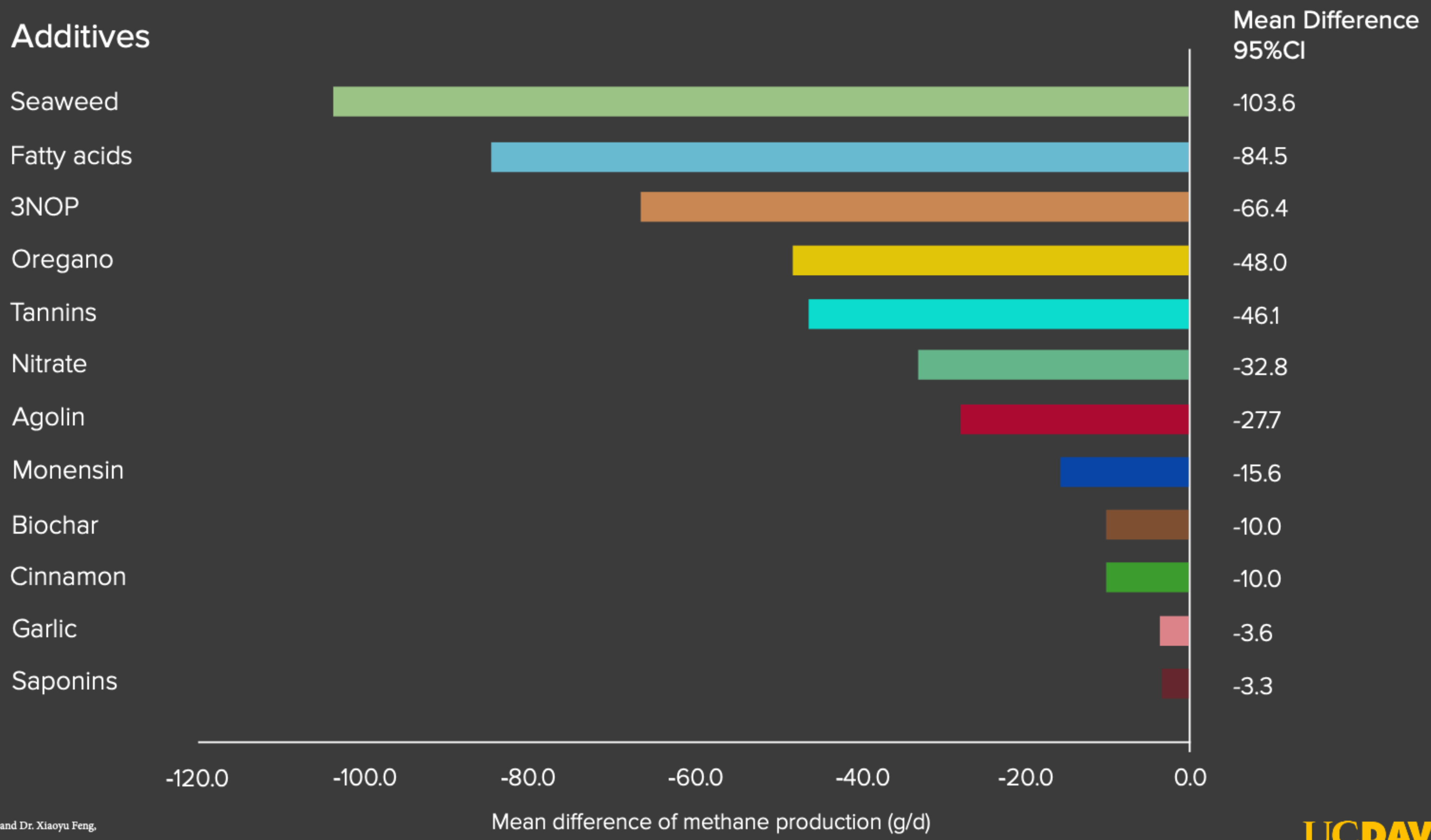
Methane Reductions from Feed Additives



Created based on the work of Dr. Ermias Kebreab and Dr. Xiaoyu Feng, University of California, Davis.
https://ww2.arb.ca.gov/sites/default/files/2020-12/17RD018.pdf

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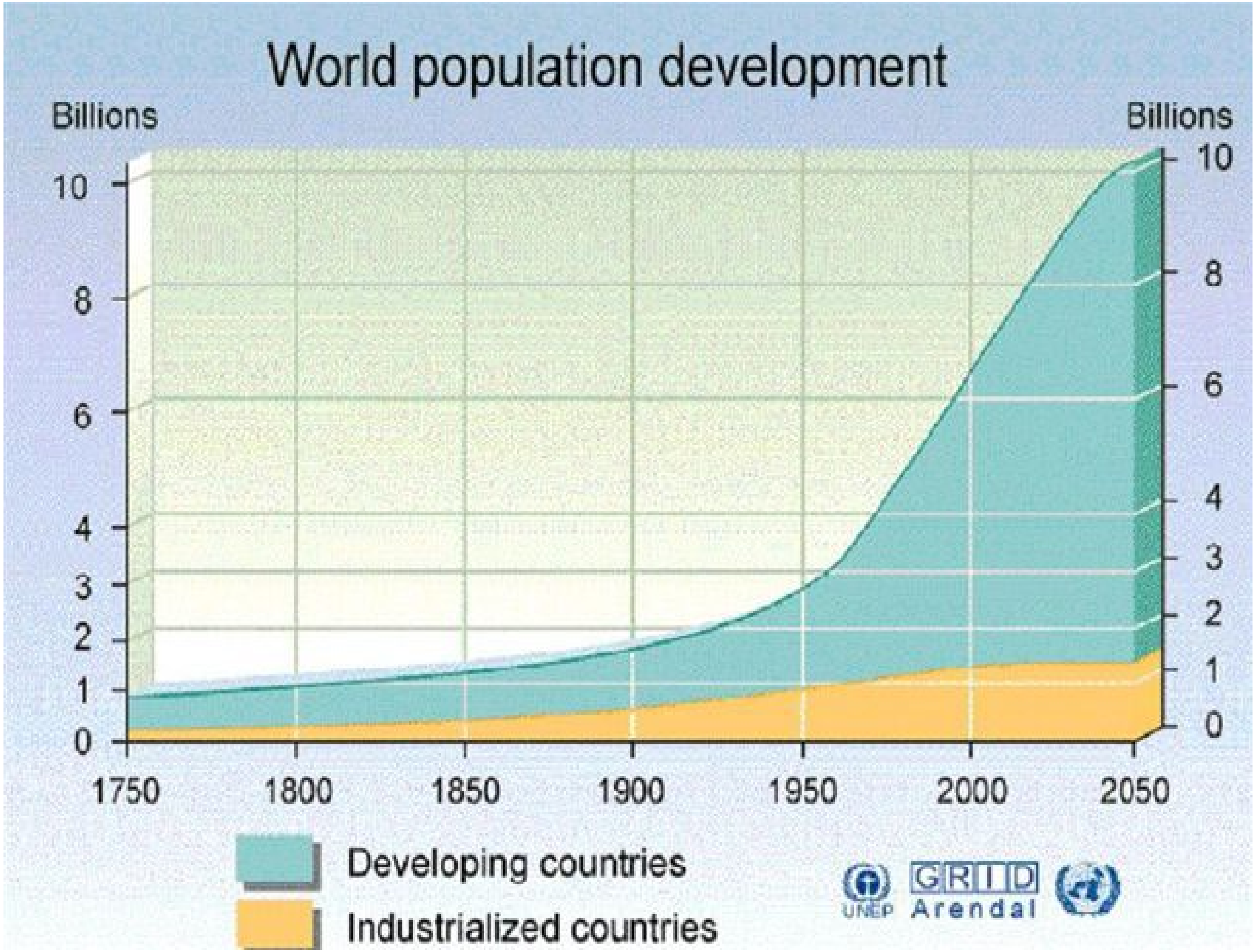

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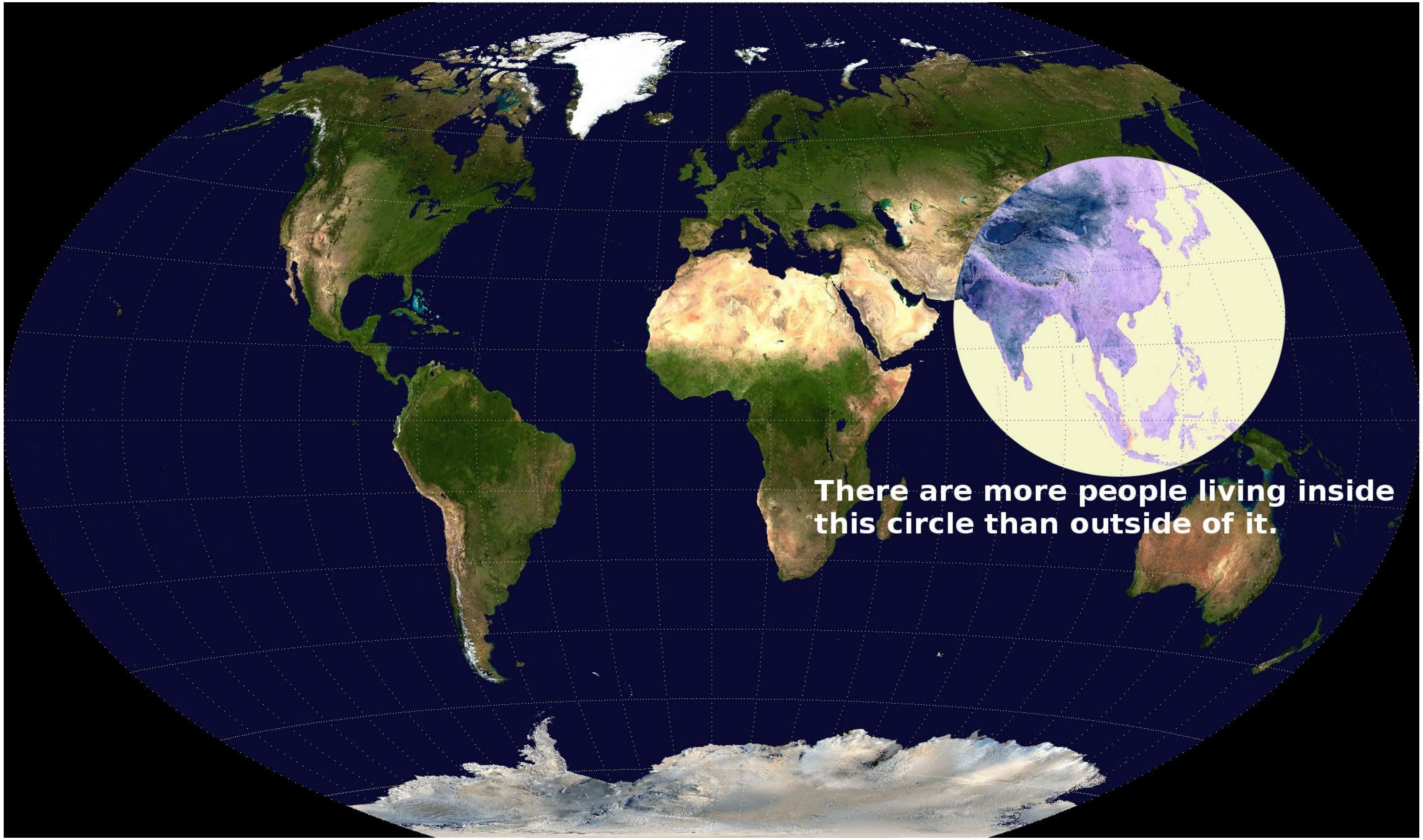

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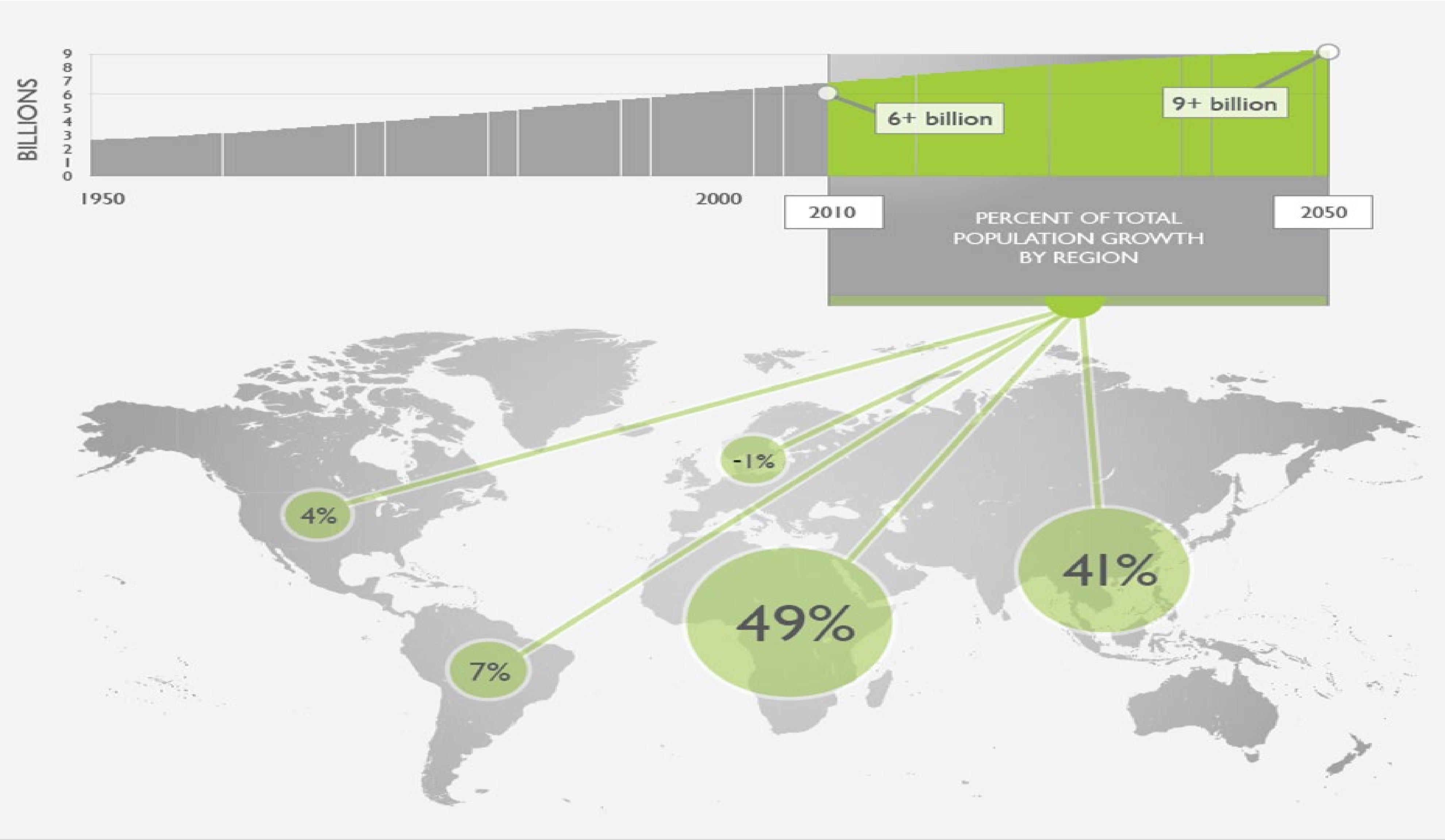

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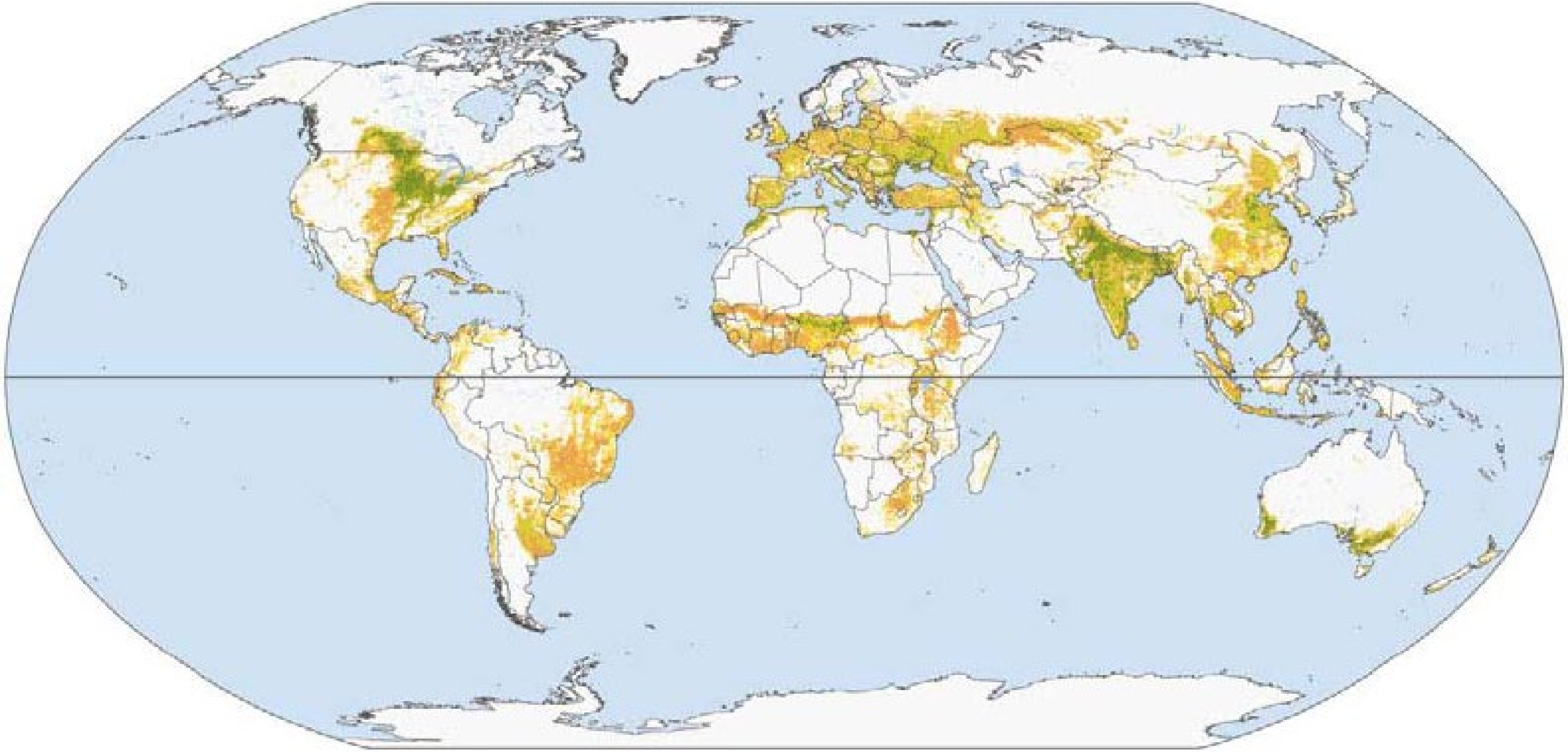
Distribution of cropland



Percentage of cropland

- 0 – 10
- 10 – 25
- 25 – 50
- 50 – 75
- 75 – 100
- National boundaries

Source: FAO, 2006f.

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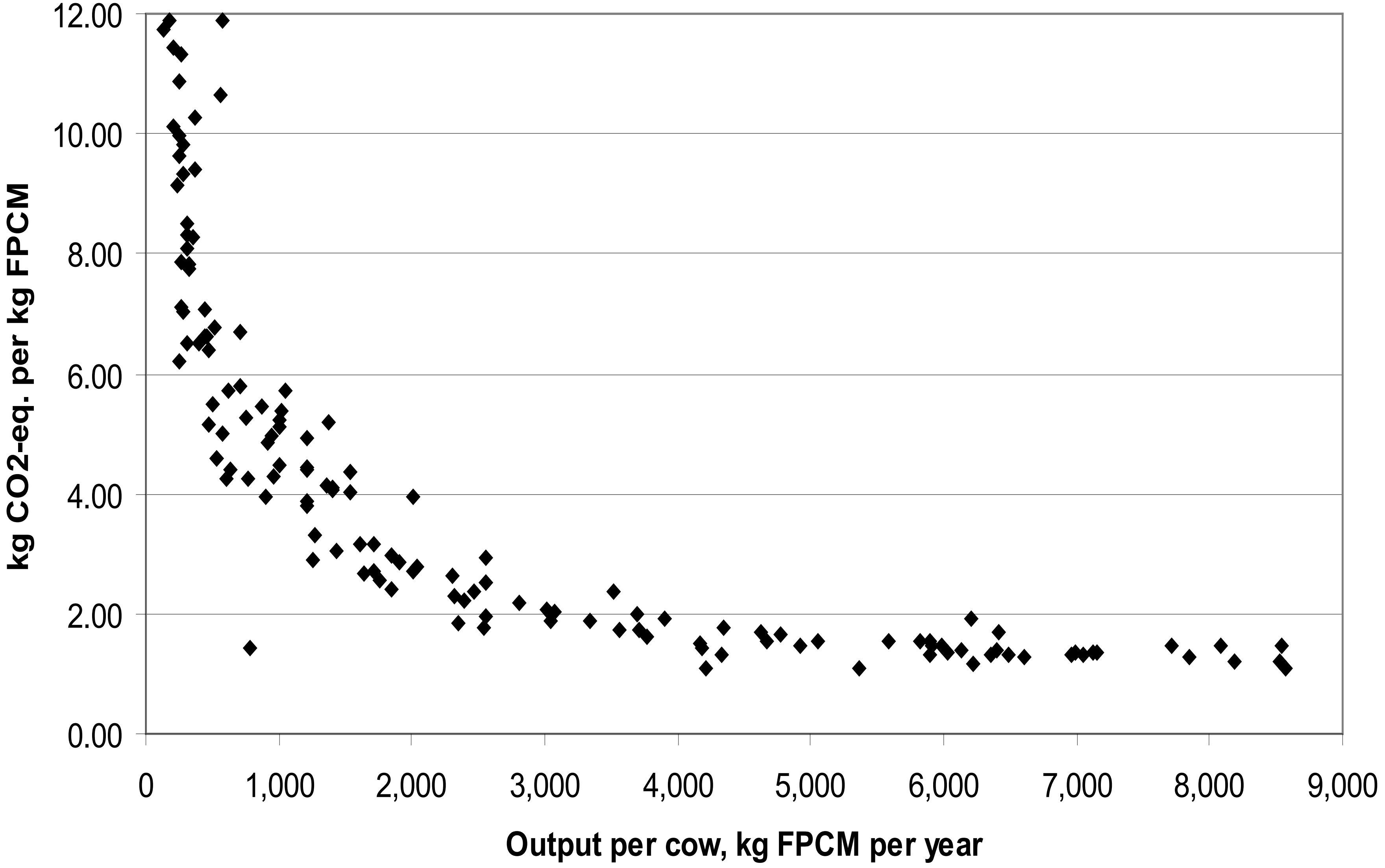
FAO (2006)

Relationship between total greenhouse gas emissions and milk output per cow



H. Steinfeld, 2015

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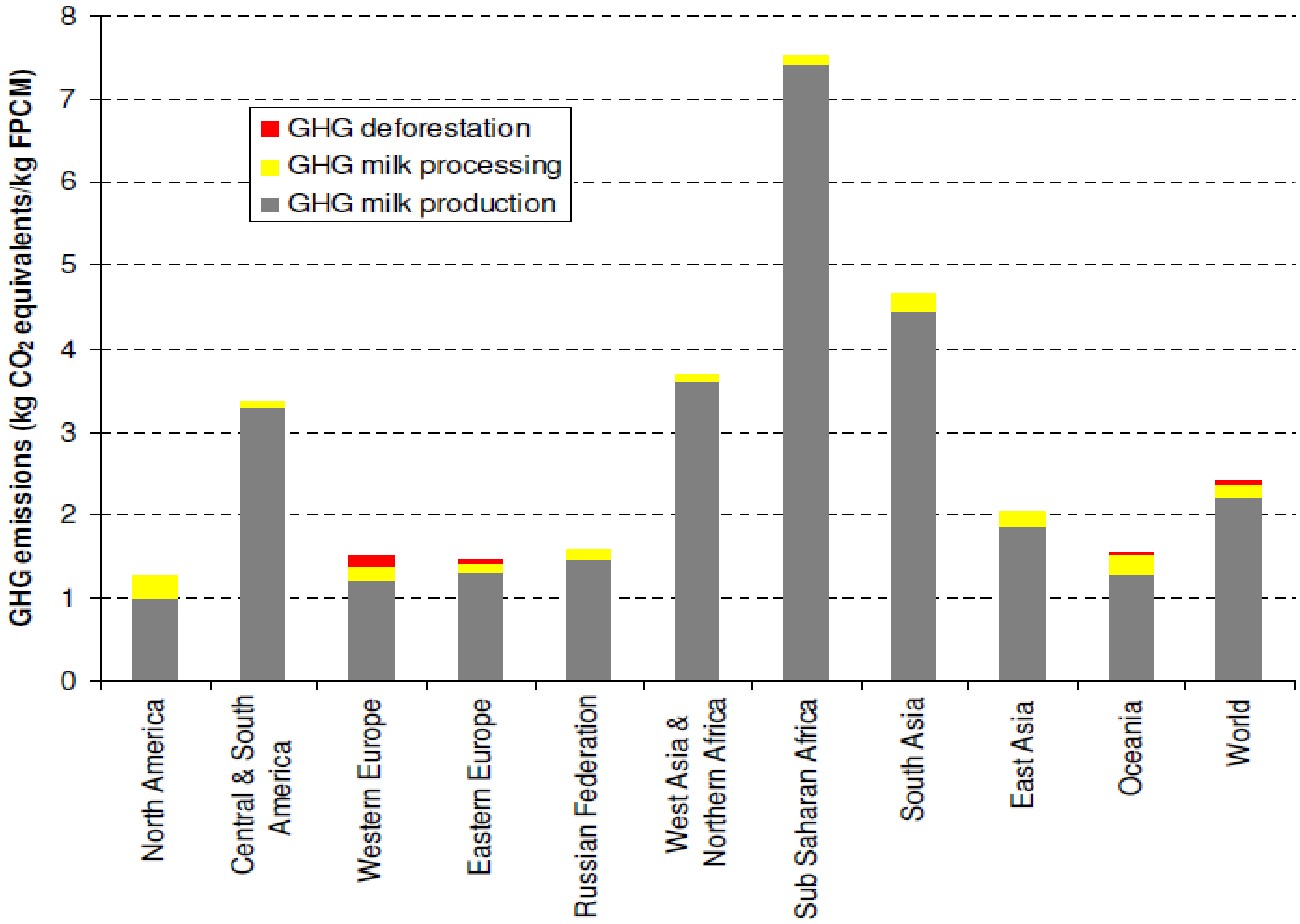
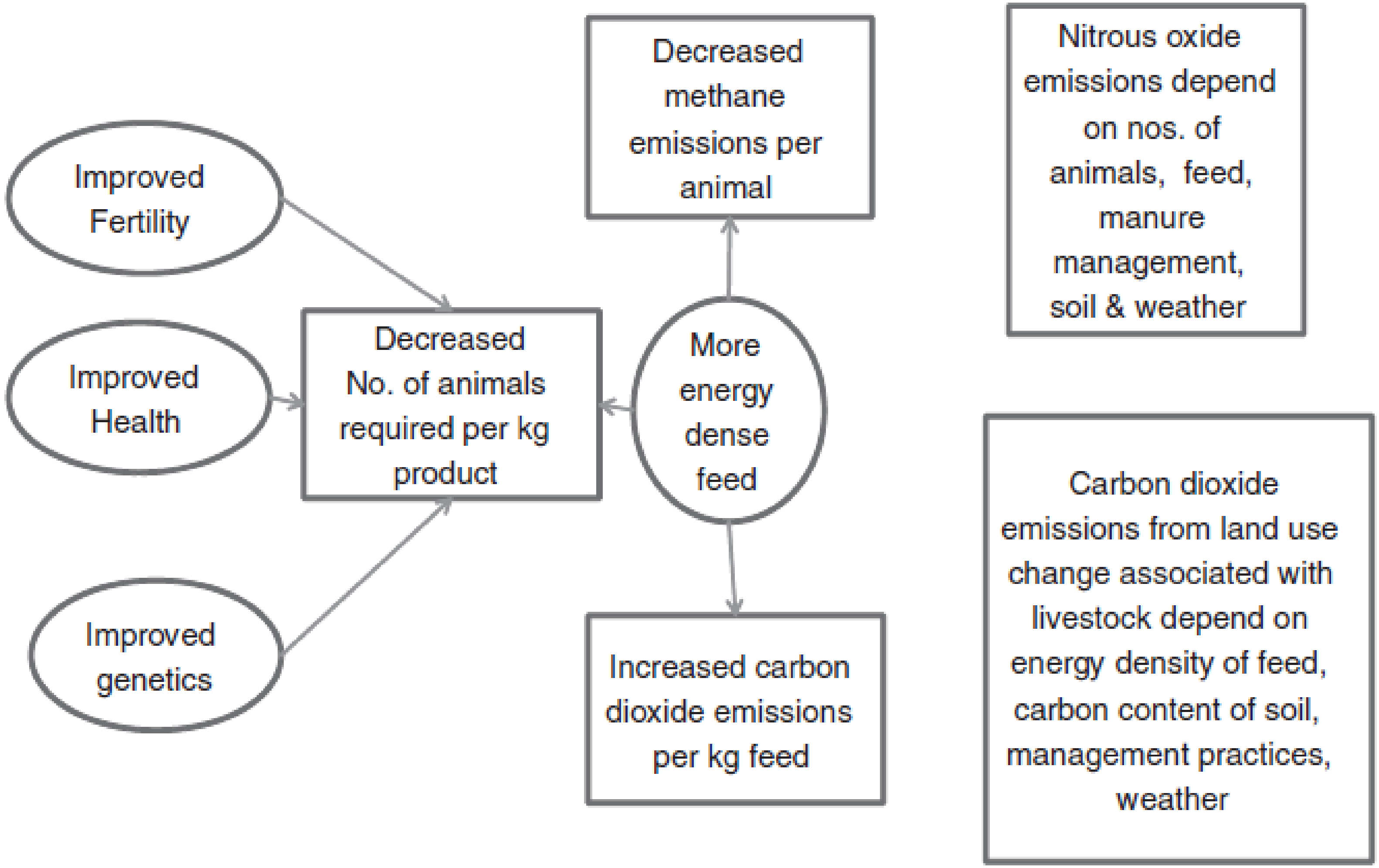


GHG emissions (kg CO2 equivalents/kg FPCM)
8
7
6
5
4
3
2
1
0
GHG deforestation
GHG milk processing
GHG milk production
North America
Central & South America
Western Europe
Eastern Europe
Russian Federation
West Asia & Northern Africa
Sub Saharan Africa
South Asia
East Asia
Oceania
World

FAO (2010)

Mitigation: interventions to improve productivity



Gill et al. (2010)

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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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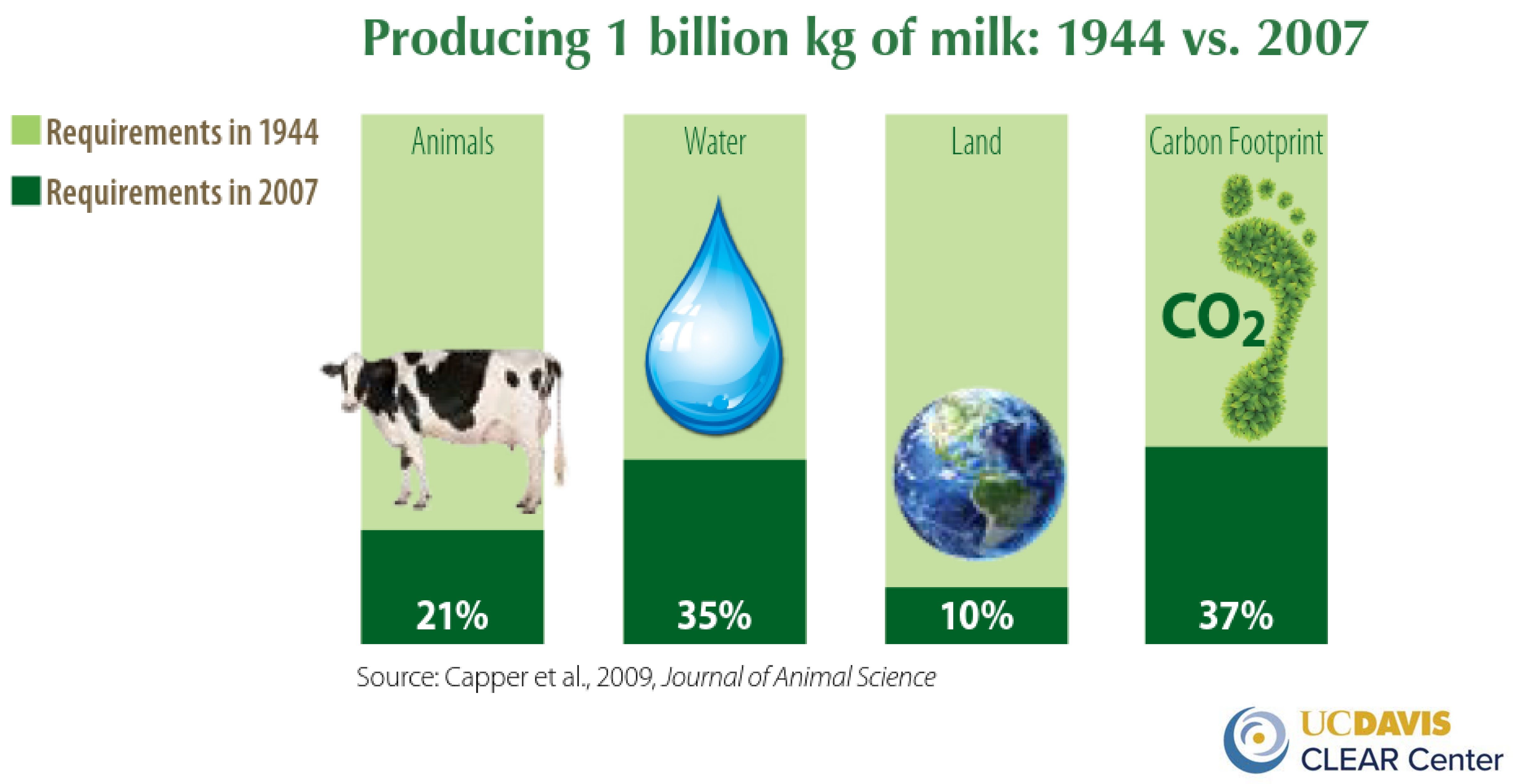
Producing 1 billion kg of milk: 1944 vs. 2007
Requirements in 1944
Requirements in 2007
Animals
Water
Land
Carbon Footprint
CO_2
21%
35%
10%
37%
Source: Capper et al., 2009, *Journal of Animal Science*
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Can we eat our way out of climate change?

- 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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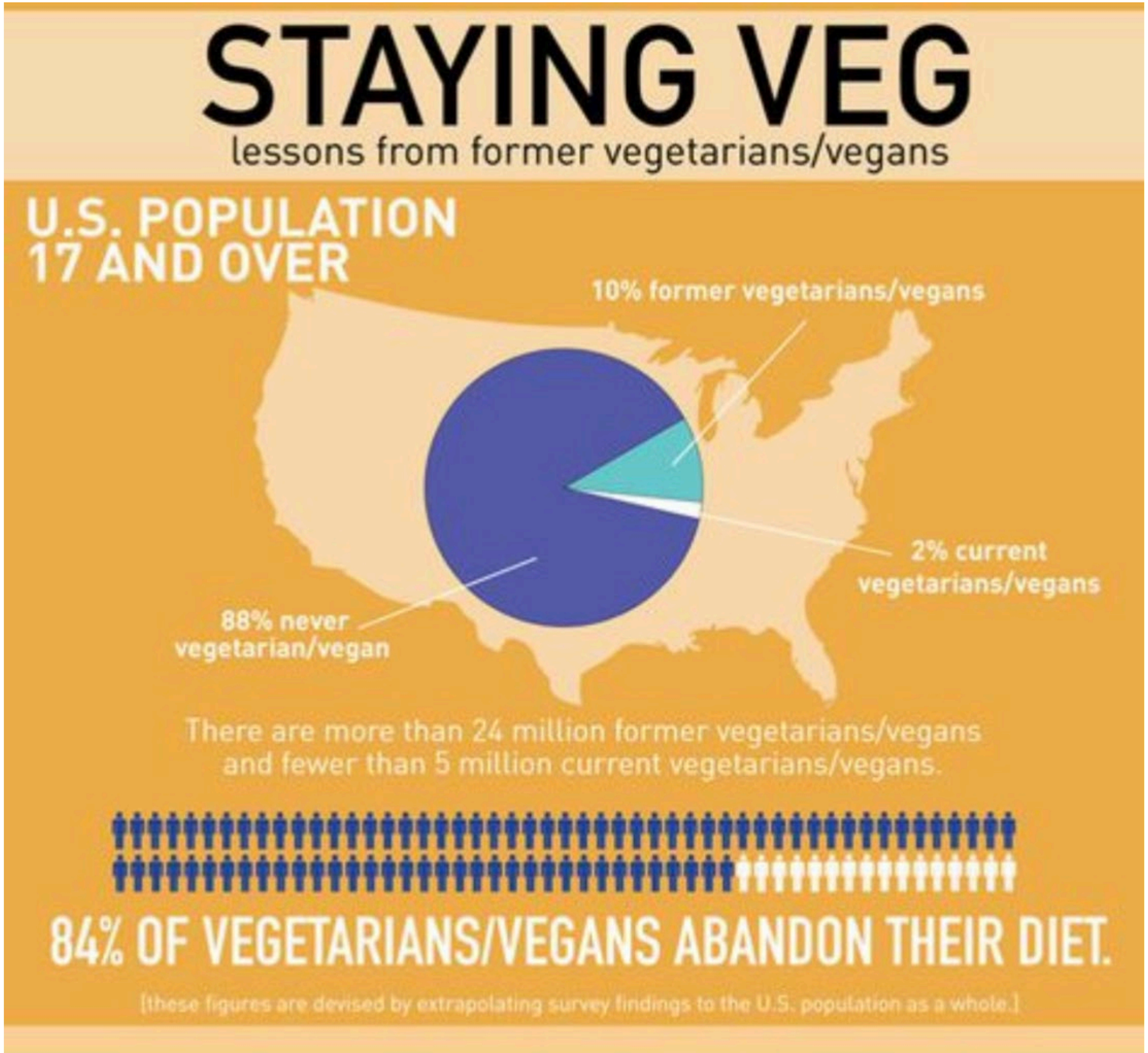

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National Geograpic

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