Agriculture/Forestry and Land use

and Flying …

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Disclaimers ….

Not enough space for the fine print…..

What I've got in this presentation ....

- Land use/agric as part of total emissions
- Sources of greenhouse gas in this sector
- The importance of methane
- Reducing emissions
- Carbon sinks
- Flying (if we have time)

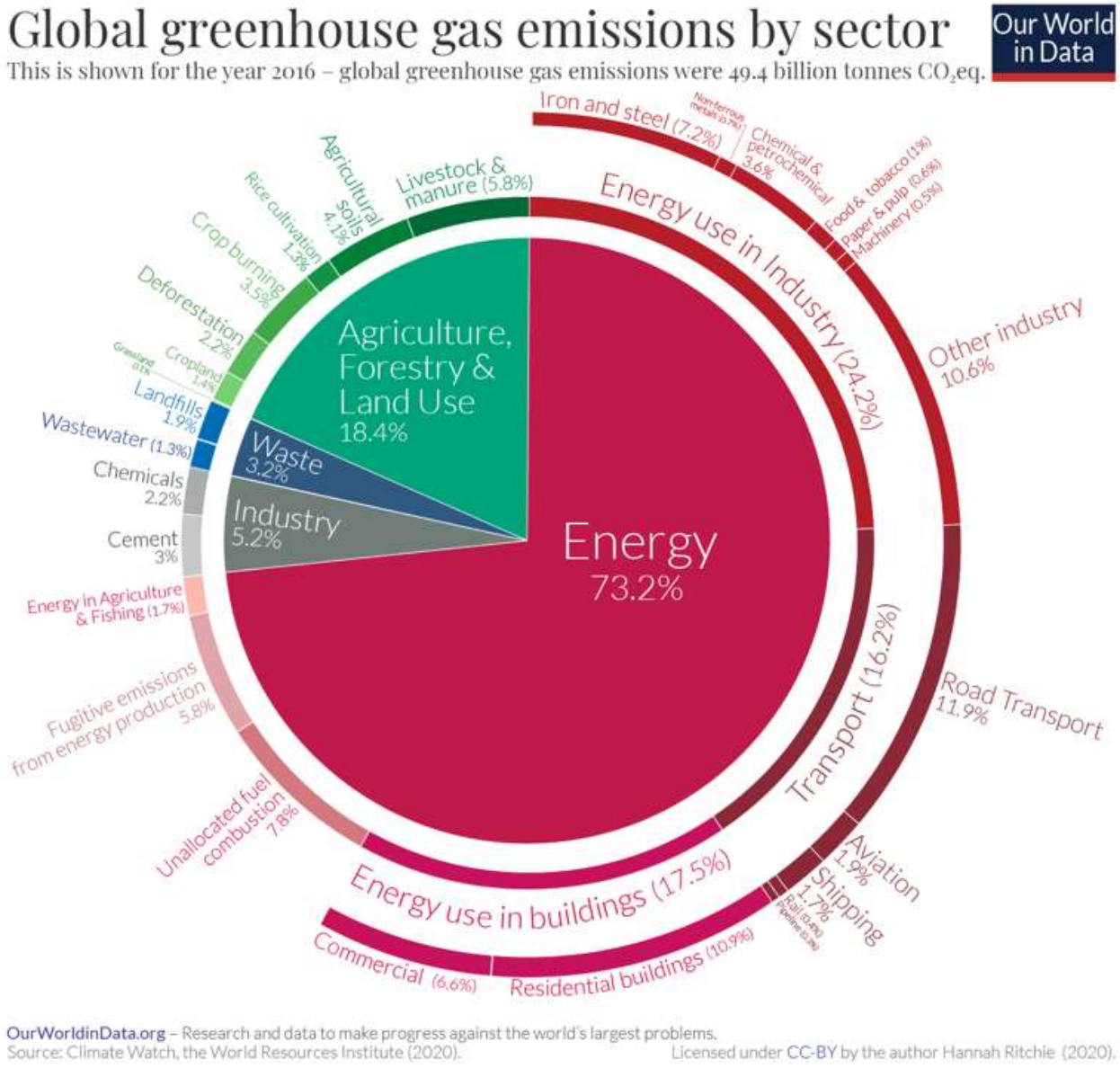
Sector by sector: where do global greenhouse gas emissions come from?

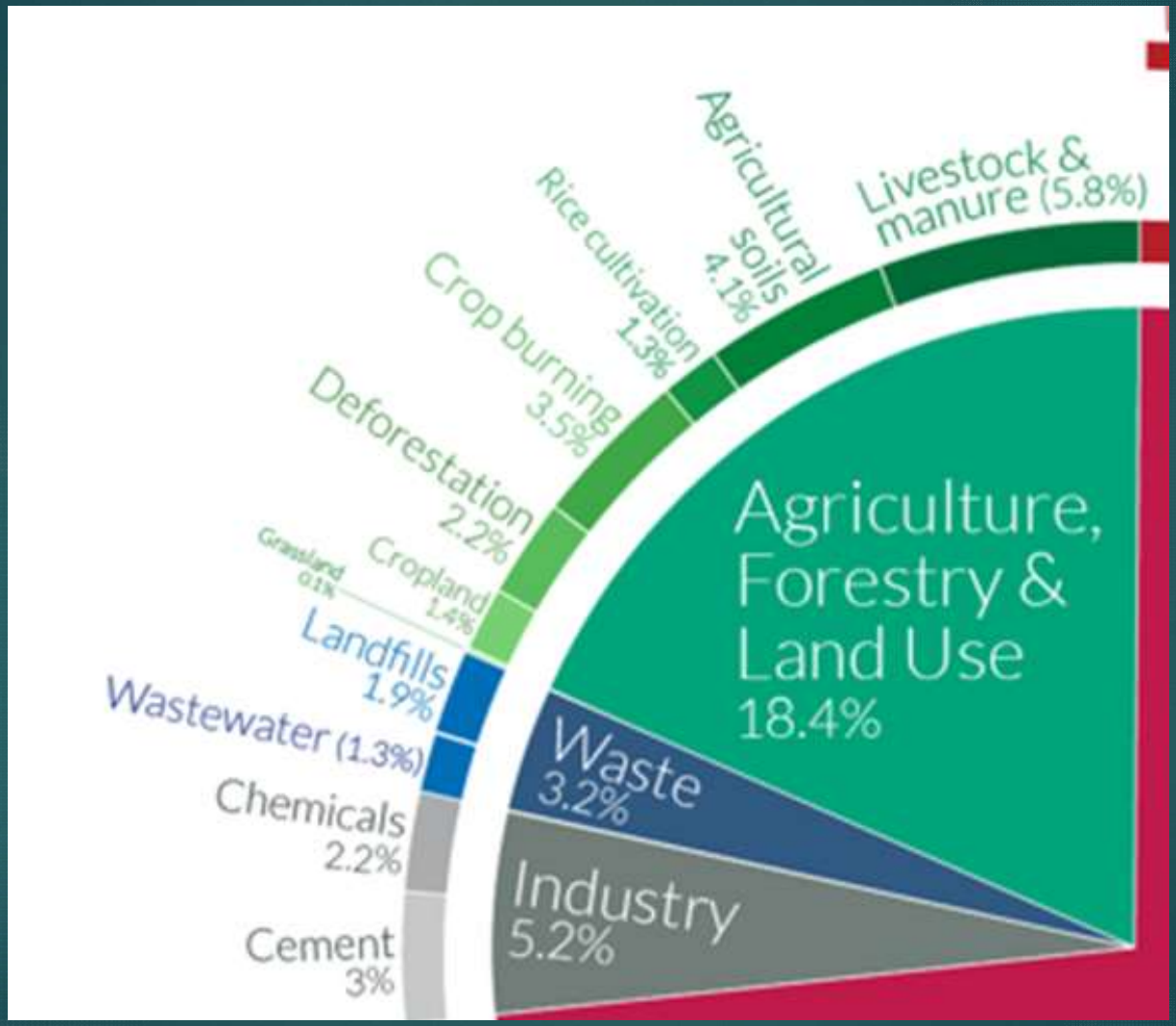
Globally, we emit around 50 billion tonnes of greenhouse gases yearly. Where do these emissions come from? We take a look, sector-by-sector.

By: Hannah Ritchie

September 18, 2020

https://ourworldindata.org/ghg-emissions-by-sector

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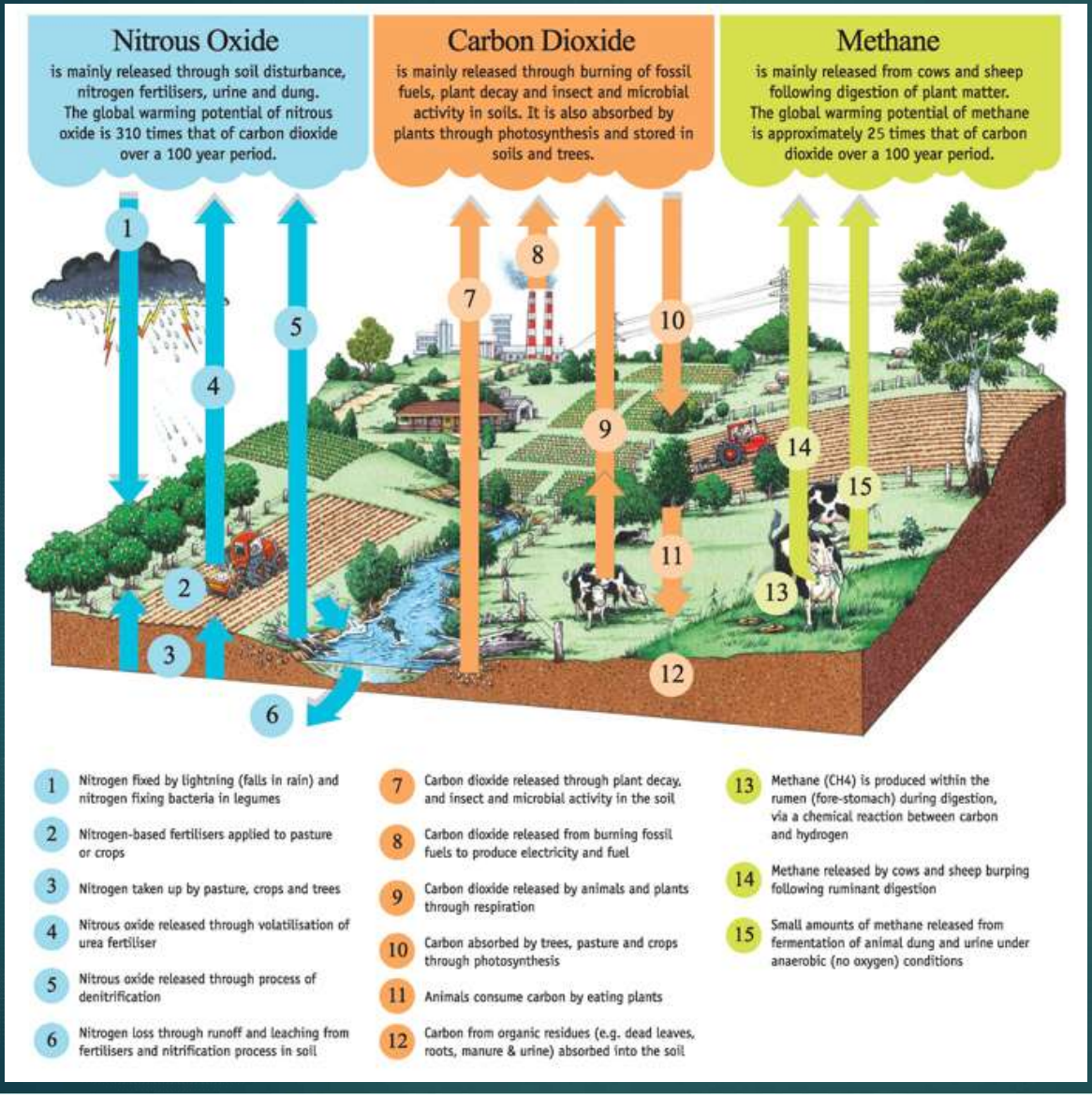
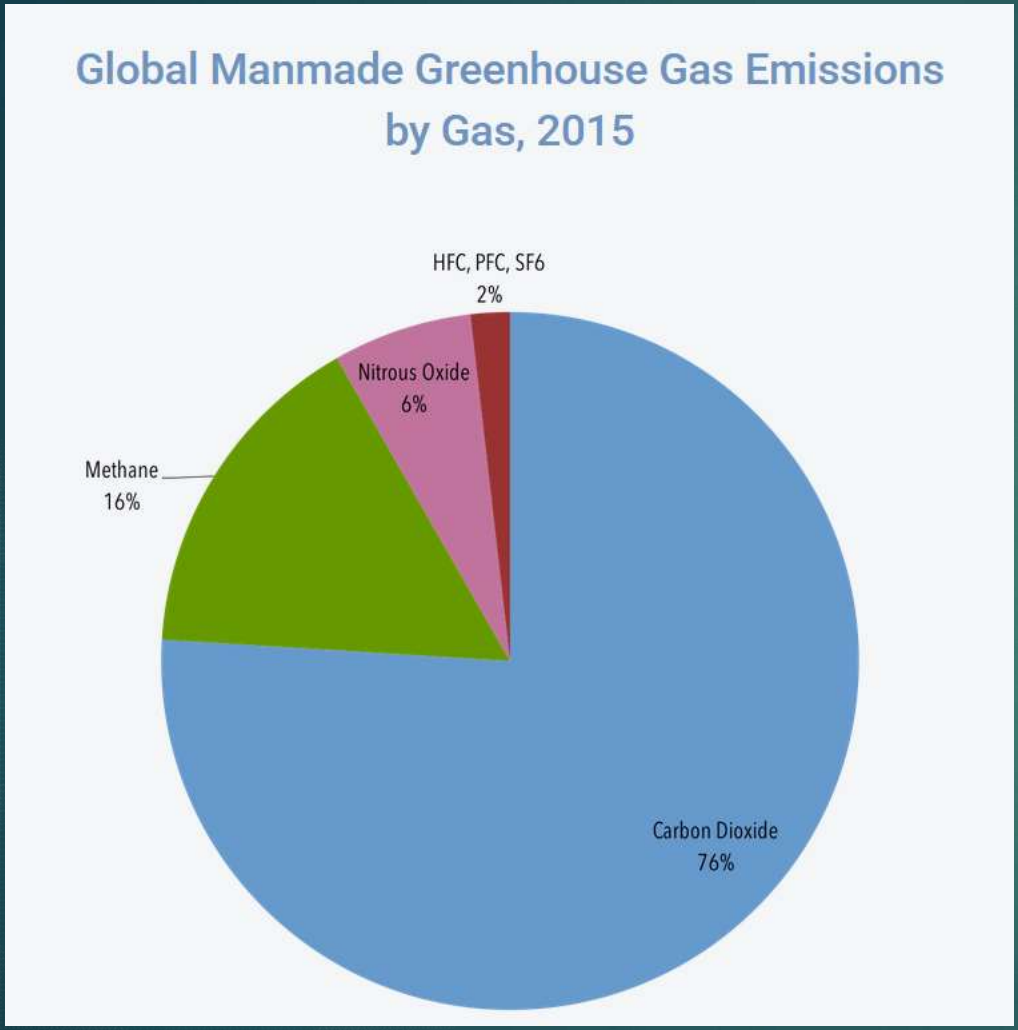


https://agriculture.vic.gov.au/climate-and-weather/understanding-carbon-and-emissions/greenhouse-gas-cycles-in-agriculture



Source

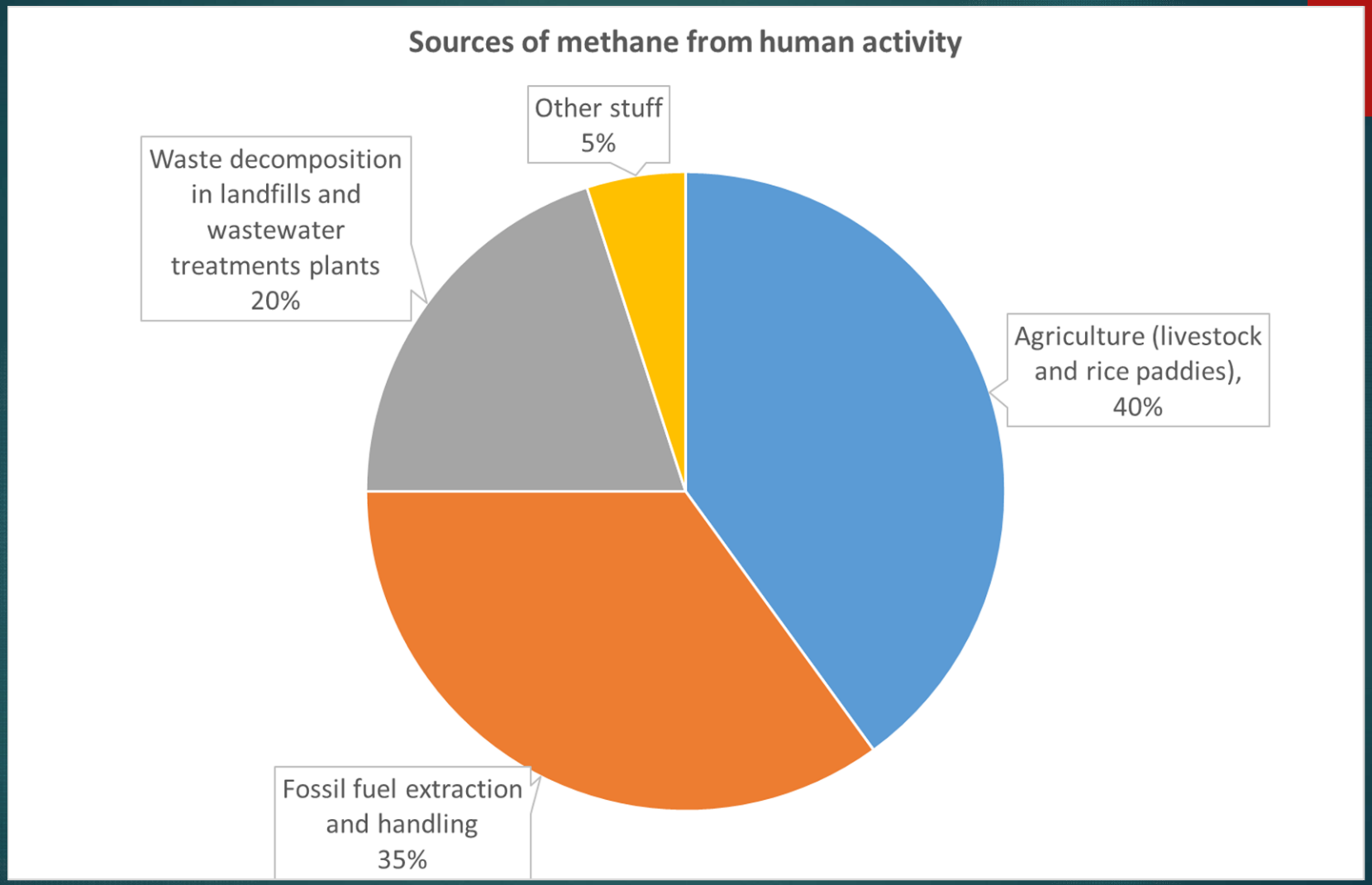
Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2015 (EPA, 2017)

Methane's greater potency as a greenhouse gas is represented in figures by its Global Warming Potential (GWP). A GWP is a measure of how much a given gas contributes to global warming compared to carbon dioxide (CO2), over a specified period, typically 100 years.

Methane's GWP100 is about 28, meaning that for every 100 years, methane's warming impact is 28 times greater than that of CO2.

While CO_2 persists in the atmosphere for hundreds of years, methane's lifespan is much shorter (around 12 years), but it absorbs significantly more energy during its lifetime.

This means that reducing methane emissions now will have a higher short-term impact.
(Methane is also a serious ground level pollutant and is explosive!)

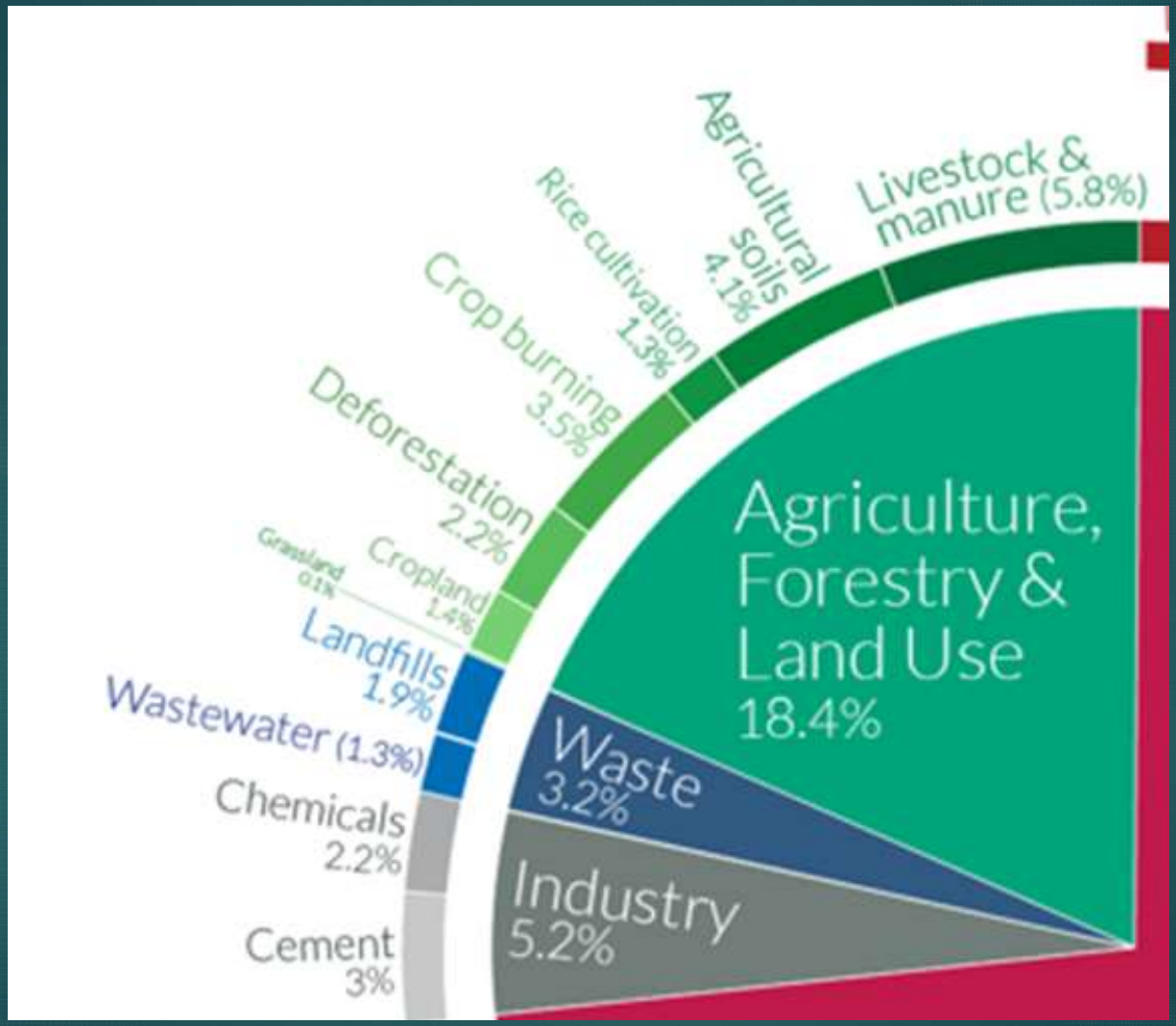

Sources of methane from human activity
Other stuff 5%
Waste decomposition in landfills and wastewater treatments plants 20%
Agriculture (livestock and rice paddies), 40%
Fossil fuel extraction and handling 35%

Video from the UN Environment Programme (with an Australian accent!)

2 minutes….

https://youtu.be/O3aHhhE0E54?si=qYbrxr0TSXnf1lau

Now … back to greenhouse gasses in the agricultural/land use sector …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In Australia, agriculture accounts for around 18% of our total climate pollution

Most of this pollution is a harmful greenhouse gas that is often overlooked: methane. Agriculture was responsible for over half of Australia's methane emissions in 2022-23, the largest share of any sector of our economy, with nearly 65% of the climate pollution coming from methane burped by cattle as they digest their food.

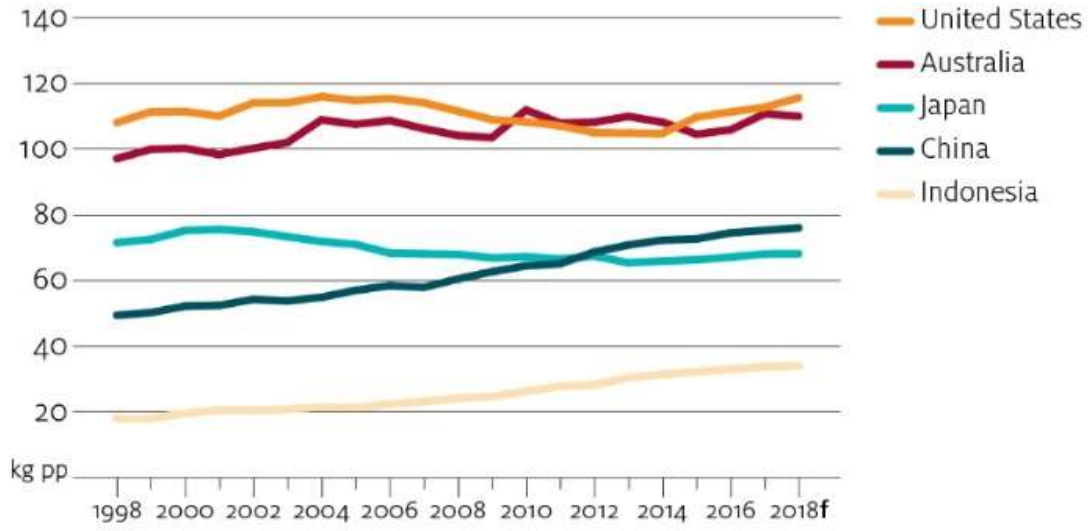
Climatecouncil.org.au

Video from
https://www.youtube.com/watch?v=oRUjKZOhV6E

The average amount of meat consumed per person globally has nearly doubled in the past 50 years, from around 23kg in 1961 to 43kg in 2014. The increase in average individual meat consumption means total meat production has been growing at a much faster rate than the rate of population growth, increasing four or fivefold since 1961.

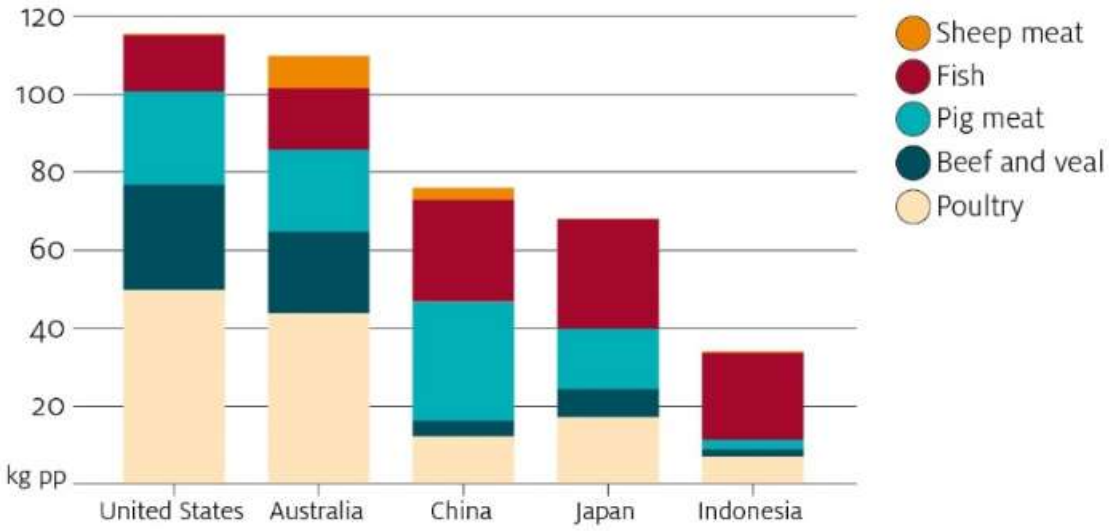
https://www.theguardian.com/environment/2018/jul/19/rising-global-meat-consumption-will-devastate-environmentreasing four or fivefold since 1961.

Figure 3 Per person consumption of meat, 1998 to 2018f



f OECD forecast.
Source: OECD

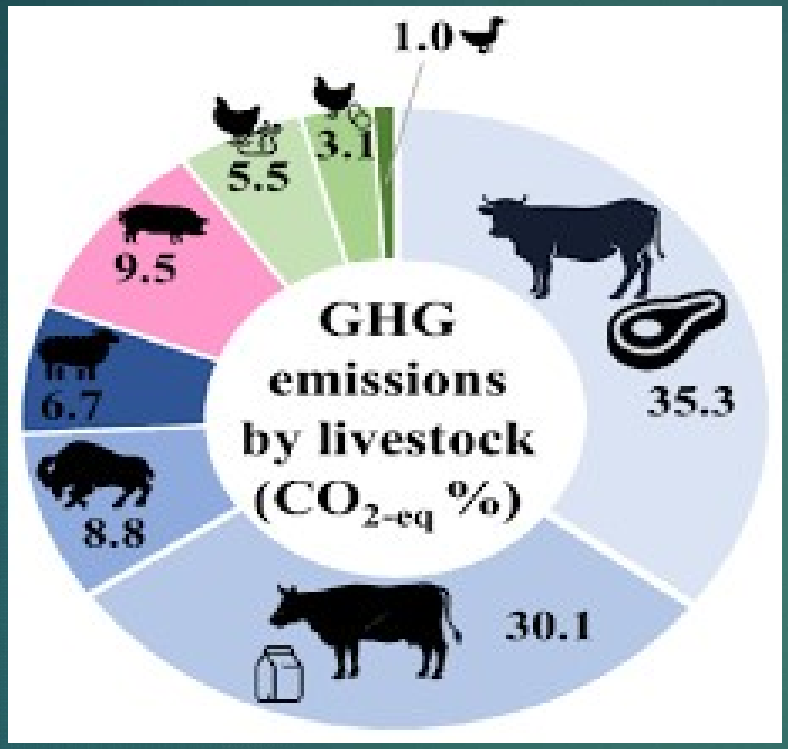
Figure 2 Per person consumption of meat, selected countries, 2018f



f OECD forecast.

Notes: Per person consumption data are expressed on an edible weight basis, estimated using OECD conversion factors of 0.7 for beef and veal; 0.78 for pig meat; 0.88 for poultry and sheep meat; and 0.6 for fish. Poultry includes chicken, duck, goose, guinea fowl, turkey and prepared liver.

Source: OECD



https://www.mdpi.com/

The other ugly gas in the climate change room - nitrogen

Agriculture is responsible for 14% of Australia's greenhouse gas emissions and is the dominant source of methane and nitrous oxide, accounting for 56% and 73%, respectively, of Australia's emissions.

Livestock urine and manure are significant sources of methane and nitrous oxide when broken down under anaerobic conditions.

https://www.agric.wa.gov.au

Methane has 25 times and nitrous oxide has nearly 300 times the global warming potential of carbon dioxide.

Measures to reduce livestock urinary nitrogen

- breeding animals for improved nitrogen efficiency
- using forages that have a higher energy-to-protein ratio
- balancing high protein forages with high-energy supplements.

https://www.agric.wa.gov.au

Reducing greenhouse gas emissions from livestock manure

Manure stockpile aeration and composting reduces methane emissions

Adding urease inhibitors to manure stockpiles can reduce nitrous oxide emissions (urease inhibitors are chemical additives that stop or reduce the rate that urea - found in animal urine and manure - is converted to nitrous oxide)

https://www.agric.wa.gov.au

Using manure to capture and use methane on-farm

Livestock industries have shown increased interest in biogas (methane) capture-and-use systems, such as covered ponds and the flaring or combustion of the captured biogas to provide heat or power. These systems are common in Europe but not in Australia, and may be profitable, regardless of offset income, because of the energy production and the trading of renewable energy certificates.

https://www.agric.wa.gov.au

Use of fertilisers…

One of the main nutrients that plants need to grow is nitrogen. But plants can't take in nitrogen from the air the way they can absorb carbon dioxide or oxygen. In the early 1900s, scientists invented a process to mass-produce a nitrogen-containing compound, ammonia, that plants can absorb from the soil.

Ammonia manufacturing today contributes between 1 and 2% of worldwide carbon dioxide emissions.

https://climate.mit.edu/explainers/fertilizer-and-climate-change

Fertilizers also produce greenhouse gases after farmers apply them to their fields. Crops only take up, on average, about half of the nitrogen they get from fertilizers.

Much of the applied fertilizer runs off into waterways, or gets broken down by microbes in the soil, releasing the potent greenhouse gas nitrous oxide into the atmosphere.

https://climate.mit.edu/explainers/fertilizer-and-climate-change

Making fertilizer more sustainable

Scientists and engineers are working to reduce the high temperature and pressure currently needed to manufacture ammonia. These changes would make it easier to run fertilizer plants entirely on renewable energy or other climate-friendly sources. They would also allow ammonia to be made in smaller factories, making fertilizer more accessible to farmers in developing nations.

To tackle the problem of nitrous oxide emissions, we also need to figure out how to use less fertilizer without sacrificing crop yields. There are a number of ways to do that, from using slow-release fertilizers, to changing when fertilizer is applied, to using sensors to better monitor nutrient absorption by plants.

https://climate.mit.edu/explainers/fertilizer-and-climate-change

Sources other than livestock - Rice

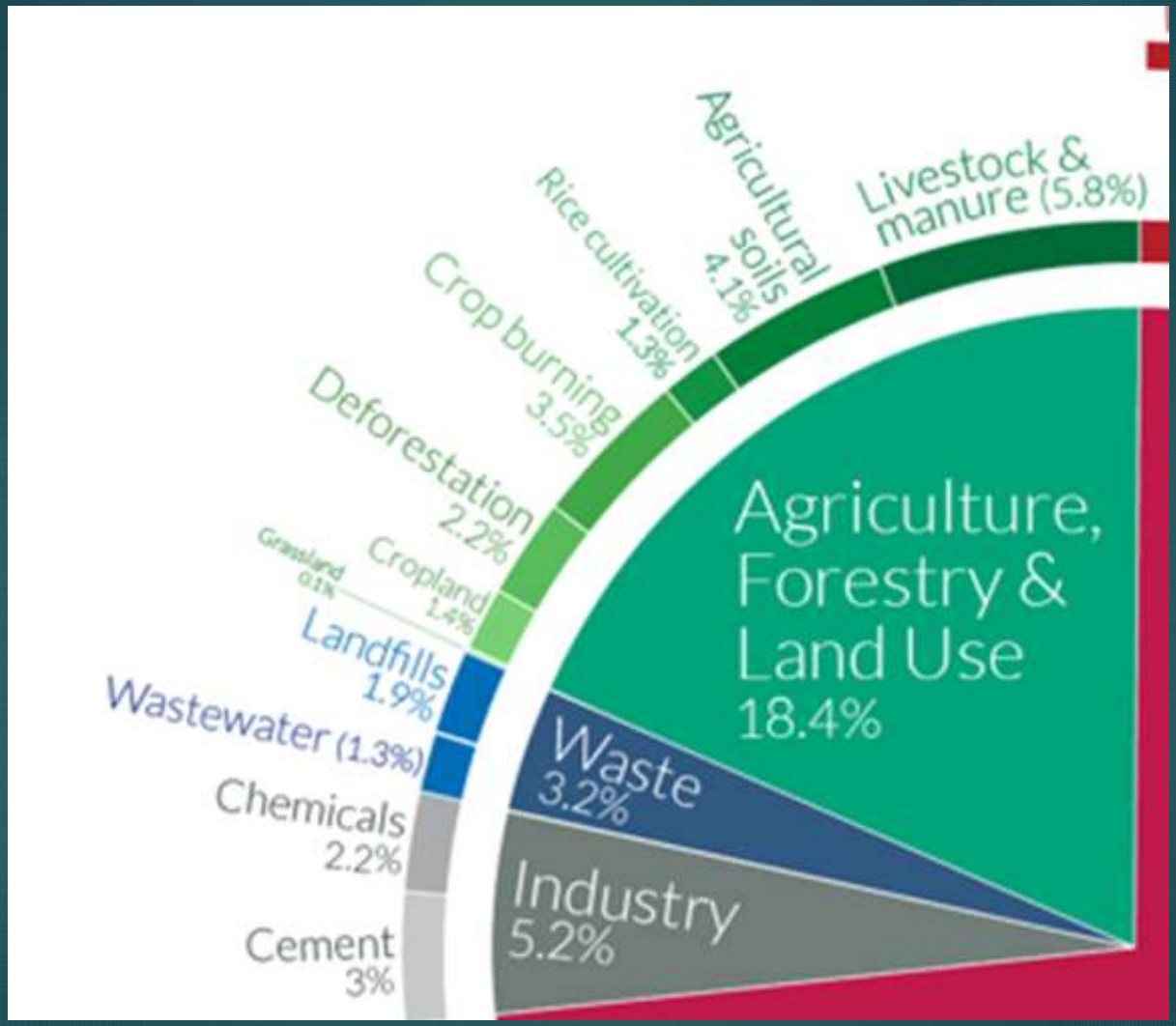
The production of rice creates around 8-11% of global methane pollution from human activities. Rice is traditionally grown in flooded paddy fields, where water stops oxygen from penetrating the soil. This creates the ideal conditions for methane-producing bacteria. In 2023, around 70,000 hectares of Australian land was used for growing rice, across approximately 1,500 agricultural businesses mostly based in New South Wales and Queensland.

Climatecouncil.org.au

In rice farming, around 60-70% of farmers in Australia are now using a different sowing method that delays flooding fields with water until late in the year and has been found to reduce emissions by more than 50 percent. Drill sowing also has the advantage of reducing water use without affecting yields, a win-win!

Climatecouncil.org.au

(Drill sowing can take many forms but generally involves drilling the seed into the soil before applying flush irrigations to establish the crop.)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REDUCE GREENHOUSE GAS EMISSIONS

and

INCREASE/PROTECT CARBON SINKS

A carbon sink is anything that absorbs more carbon from the atmosphere than it releases – for example, plants, the ocean and soil.

More than half of Australia's forest and woodlands have been degraded or destroyed **since Europeans arrived here.**

Agriculture is the **biggest driver of deforestation globally.**

In Australia, more than half the landmass is used for **sheep and cattle grazing.**

The bulldozing of forests by a **minority of beef producers** is the main reason Australia is a global deforestation hotspot.

Most of Australia's beef is exported.

https://www.acf.org.au/news/deforestation-in-australia-why-its-happening-and-how-to-stop-it

While deforestation is a problem nation-wide, the main reason Australia is a deforestation hotspot is thanks to Queensland.

The Statewide Landcover and Trees Study (SLATS) report released in 2024, showed that **323,676 hectares** of forest and bushland in Queensland was degraded or destroyed in 2021-2022. 88% of this was for pasture.

To give you a clearer picture of where this places Queensland on a global scale, that's **10 times more deforestation** than there was in all of Indonesia for palm oil over a one-year period.

Research published in 2024 by the University of Queensland found that of the over **1.5 million hectares of vegetation bulldozed** in Queensland and the Northern Territory alone in 2014-15 and 2019-2020, 65% was potentially not compliant with relevant laws, mainly **Australia's national nature laws**. And **91% of this was for pasture.**

Source: https://www.acf.org.au/news/deforestation-in-australia-why-its-happening-and-how-to-stop-it

Unlike trees, grasslands sequester most of their carbon underground. When they burn, the carbon stays fixed in the roots and soil instead of in leaves and woody biomass. Forests have the ability to store more carbon, but in unstable conditions due to climate change, grasslands stand more resilient.

https://clear.ucdavis.edu/explainers/what-carbon-sequestration#:~:text=Unlike%20trees%2C%20grasslands%20sequester%20most%20of%20their,to%20climate%20change%2C%20grasslands%20stand%20more%20resilient.

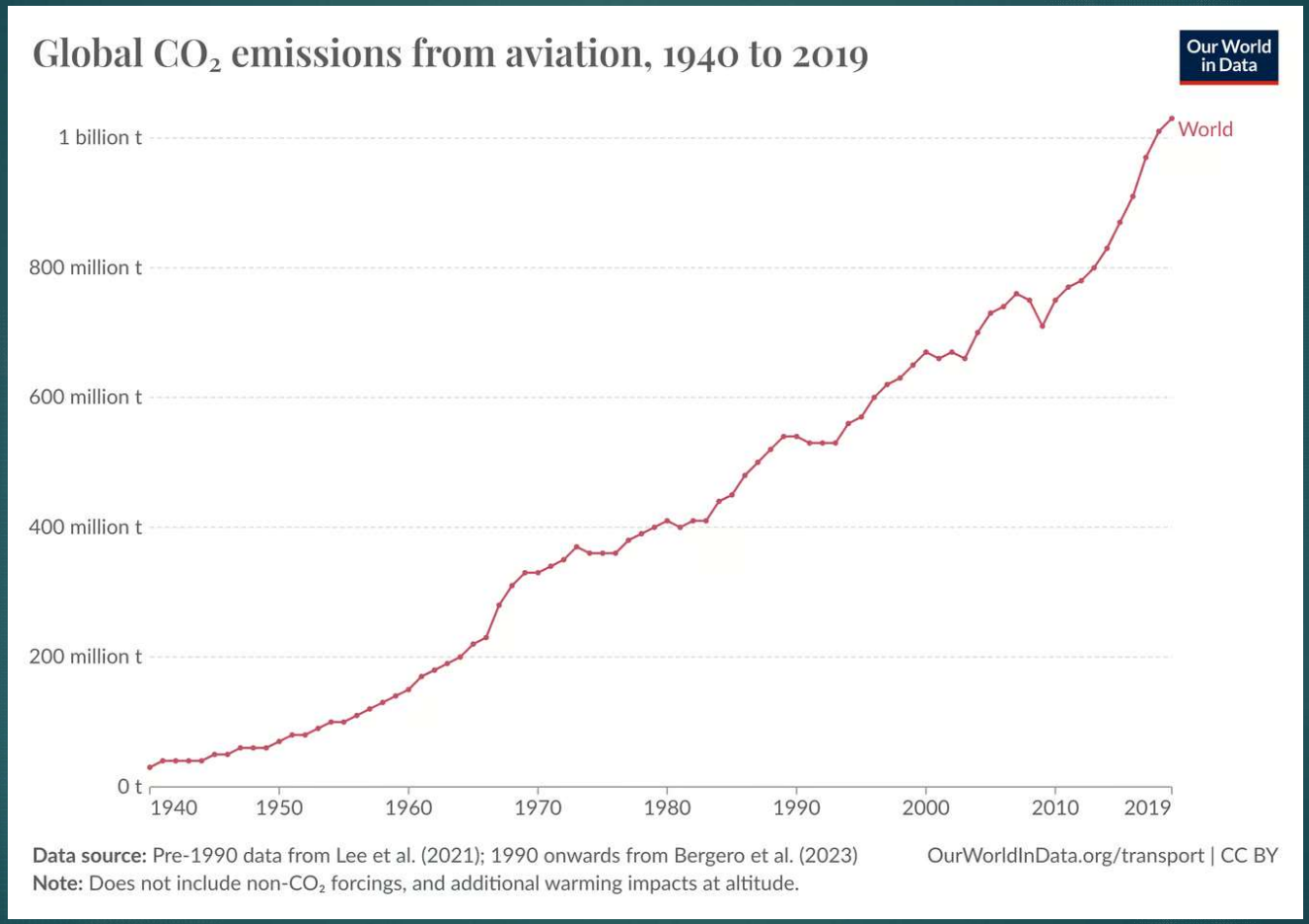
Improve soil management

Carbon is sequestered in soil by plants through photosynthesis and can be stored as soil organic carbon (SOC). Agroecosystems can degrade and deplete the SOC levels but this carbon deficit opens up the opportunity to store carbon through new land management practices. Soil can also store carbon as carbonates. Such carbonates are created over thousands of years when carbon dioxide dissolves in water and percolates the soil, combining with calcium and magnesium minerals, forming "caliche" in desert and arid soil.

Carbonates are inorganic and have the ability to store carbon for more than 70,000 years, while soil organic matter typically stores carbon for several decades. Scientists are working on ways to accelerate the carbonate forming process by adding finely crushed silicates to the soil in order to store carbon for longer periods of time.

https://clear.ucdavis.edu/explainers/what-carbon-sequestratiotext=Unlike%20trees%2C%20grasslands%20sequester%20most%20of%20their,to%20climate%20change%2C%20grasslands%20stand%20more%20resilient

Flying high …

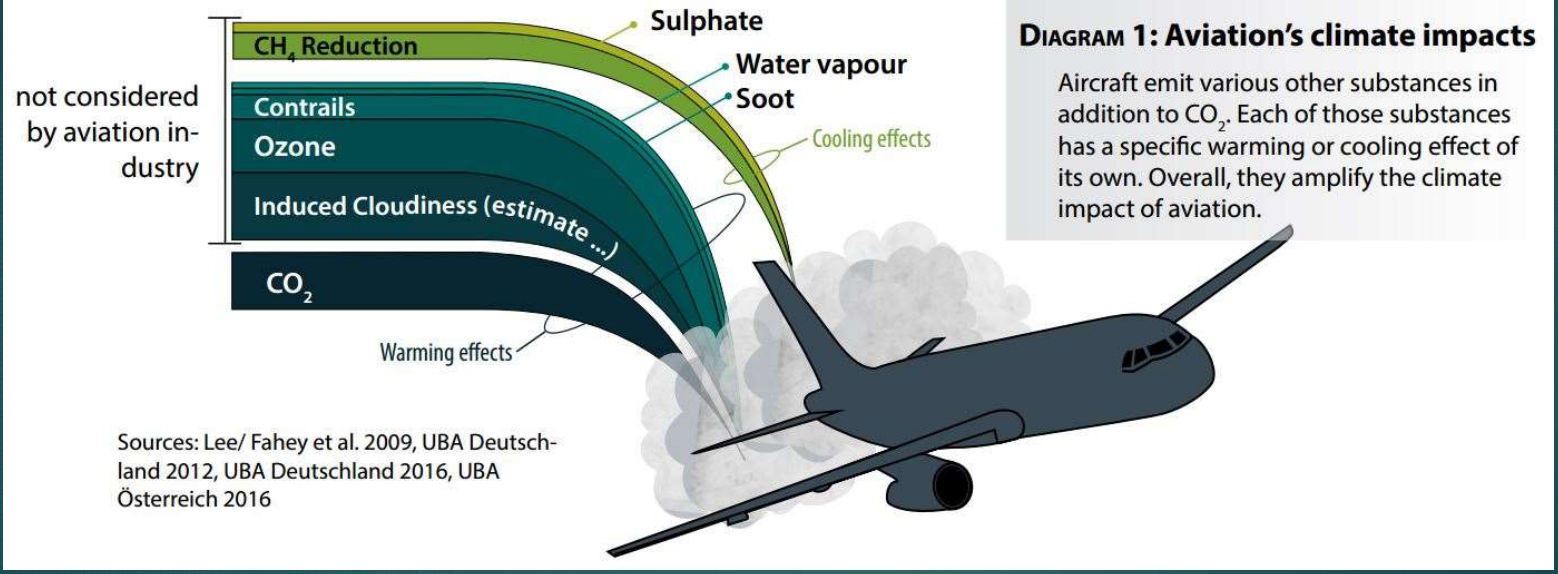

Global CO_2 emissions from aviation, 1940 to 2019
Our World in Data
World
1 billion t
800 million t
600 million t
400 million t
200 million t
0 t
1940
1950
1960
1970
1980
1990
2000
2010
2019
Data source: Pre-1990 data from Lee et al. (2021); 1990 onwards from Bergero et al. (2023)
Note: Does not include non-CO_2 forcings, and additional warming impacts at altitude.
OurWorldInData.org/transport | CC BY

Emissions from aviation constitute around 2.5% of annual global CO_2 emissions (Graver et al., 2018) and if no mitigation action is taken, are likely to reach 22% by 2050 (EEA, 2017).

https://www.sciencedirect.com/science/article/abs/pii/S2214367X21000405

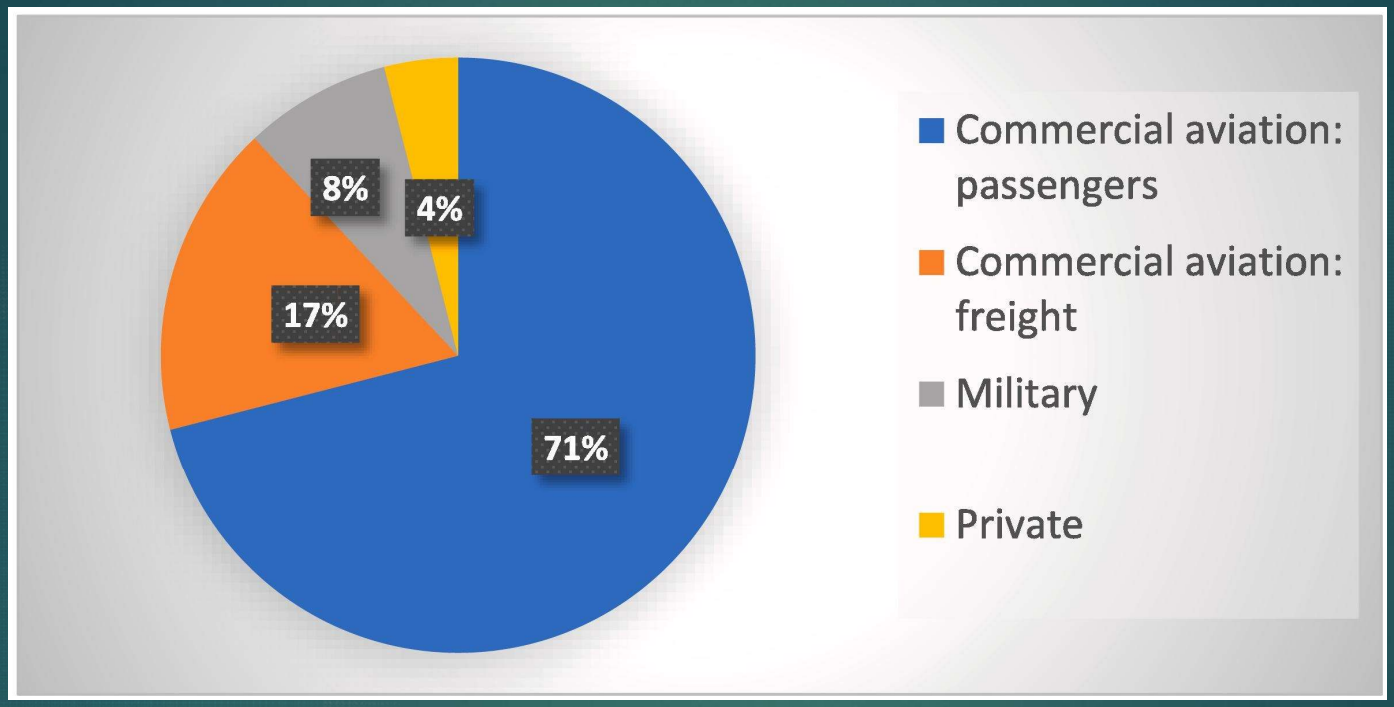
Flying high …

https://www.uecna.eu/key-issues/climate-change/illusion-green-flying/



Along with emitting CO_2 from burning fuel, planes also affect the concentration of other atmospheric gases and pollutants. They generate a short-term increase but a long-term decrease in ozone and methane and increased emissions of water vapor, soot, sulfur aerosols, and water contrails. While some of these impacts result in warming, others induce a cooling effect. But overall, the warming effect is stronger.

https://ourworldindata.org/global-aviation-emissions



- Fig. 1. **Global distribution of aviation fuel use.** Source: Calculation based on Eyers et al., 2004, IATA, 2019, ICCT, 2019, IEA, 2019a

Although there have been gains in the efficiency of the aeroplane fleet, they are not sufficient to counteract the growth of demand, and currently discussed technological advancements, such as hydrogen or fully electric planes, will not bring about significant emission reductions in the near future

Therefore, individual behavioural change is crucial for lowering aviation‘s climate impacts.

https://www.sciencedirect.com/science/article/abs/pii/S2214367X21000405

“You have fuel efficiency improvements on the order of 1% per year, and flights are increasing 6%,” says Rutherford, “It's not even close.”

https://www.bbc.com/future/article/20200218-climate-change-how-to-cut-your-carbon-emissions-when-flying

Globally, few people fly regularly. Less than 20 percent of people have ever flown, and only five to 10 percent of the world's population flies in any year. Further, the wealthiest 10 percent of people are responsible for 76 percent of the energy consumption involved with packaged holidays.

The research, published by the UK-based climate charity Possible

Meanwhile, the top 10 countries for aviation emissions account for 60 percent of the world's total, while the top 30 account for 86 percent. The top three countries for total emissions from flying were the U.S., China and the UK, while the top five for per capita emissions from residents came from Singapore, Finland, Iceland, Australia and the UK.

At the same time, a gap remains within those top-flying countries between the most frequent flyers and everyone else.

To address these inequalities and reduce aviation emissions, Possible is proposing a Frequent Flyer Levy in the UK, which would tax people who take more flights.

Other environmental groups agree with the frequent flyer levy, but also argue for an end to frequent flyer rewards programs.

The research, published by the UK-based climate charity Possible

Private planes …

The annual carbon dioxide emissions from private planes have increased by 46% between 2019 and 2023,

The results also show that some people who regularly use private aviation may produce almost 500 times more CO_2 in a year than the average person.

Australia has 317 private planes which account for 1.2% of the global total but we rank sixth highest for the number of planes per 100,000 residents.

Journal/conference: Communications Earth & Environment, **Organisation/s:** Linnaeus University, Sweden, **Funder:** Open access funding provided by Linnaeus University. Quoted at: ttps://www.scimex.org/newsfeed/carbon-emissions-from-private-jets-jump-46-percent-in-5-years