

Ruminant methane discussion

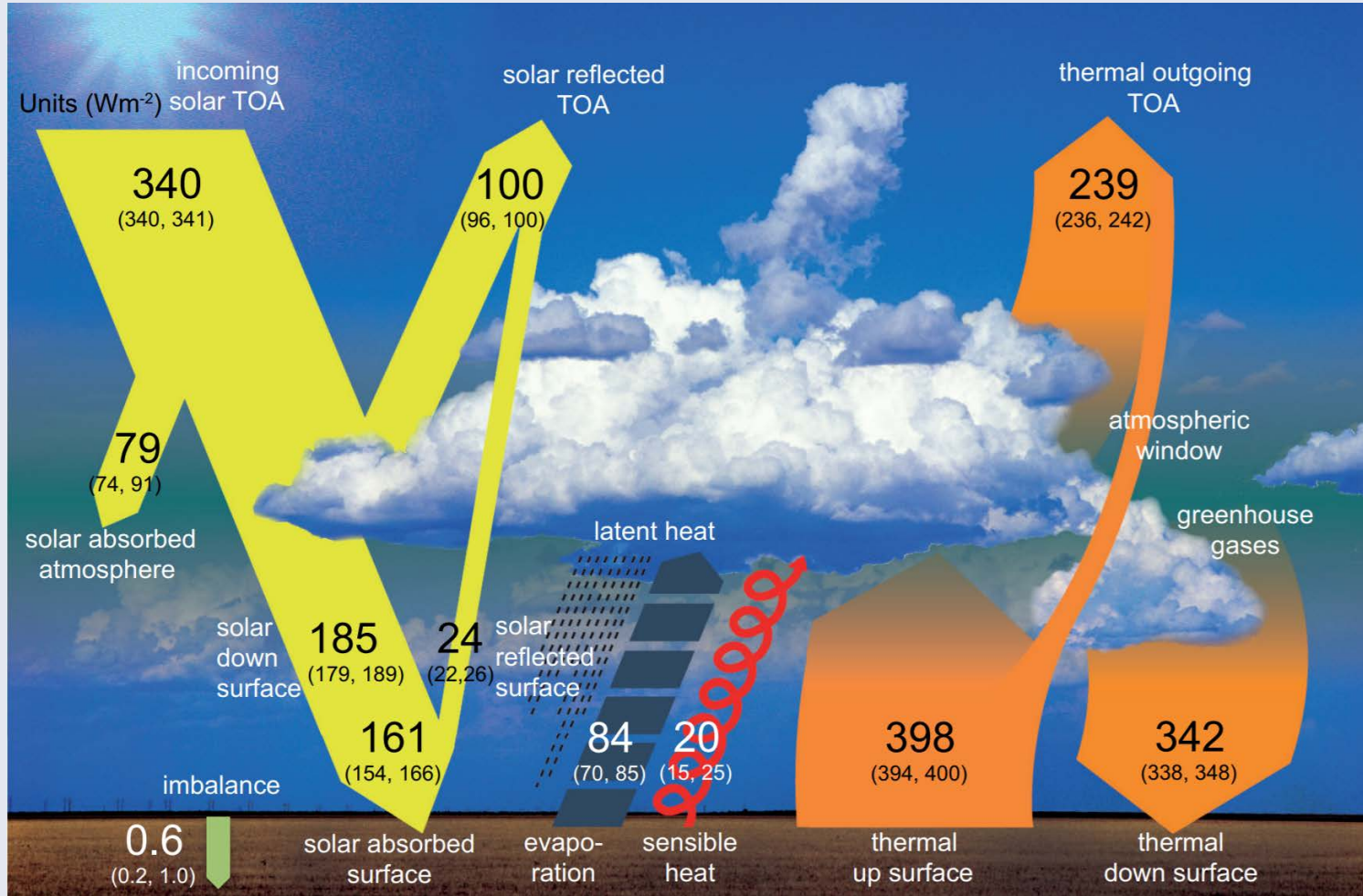


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Outline

- Global context: methane and climate change
- Ruminant methane and global warming
- Reporting methane emissions ('CO₂eq')
- Methane emissions in Europe and Sweden
- Reducing ruminant methane emissions
- Food systems and land use
- Life-cycle assessment (LCA) & indicators

Global Warming

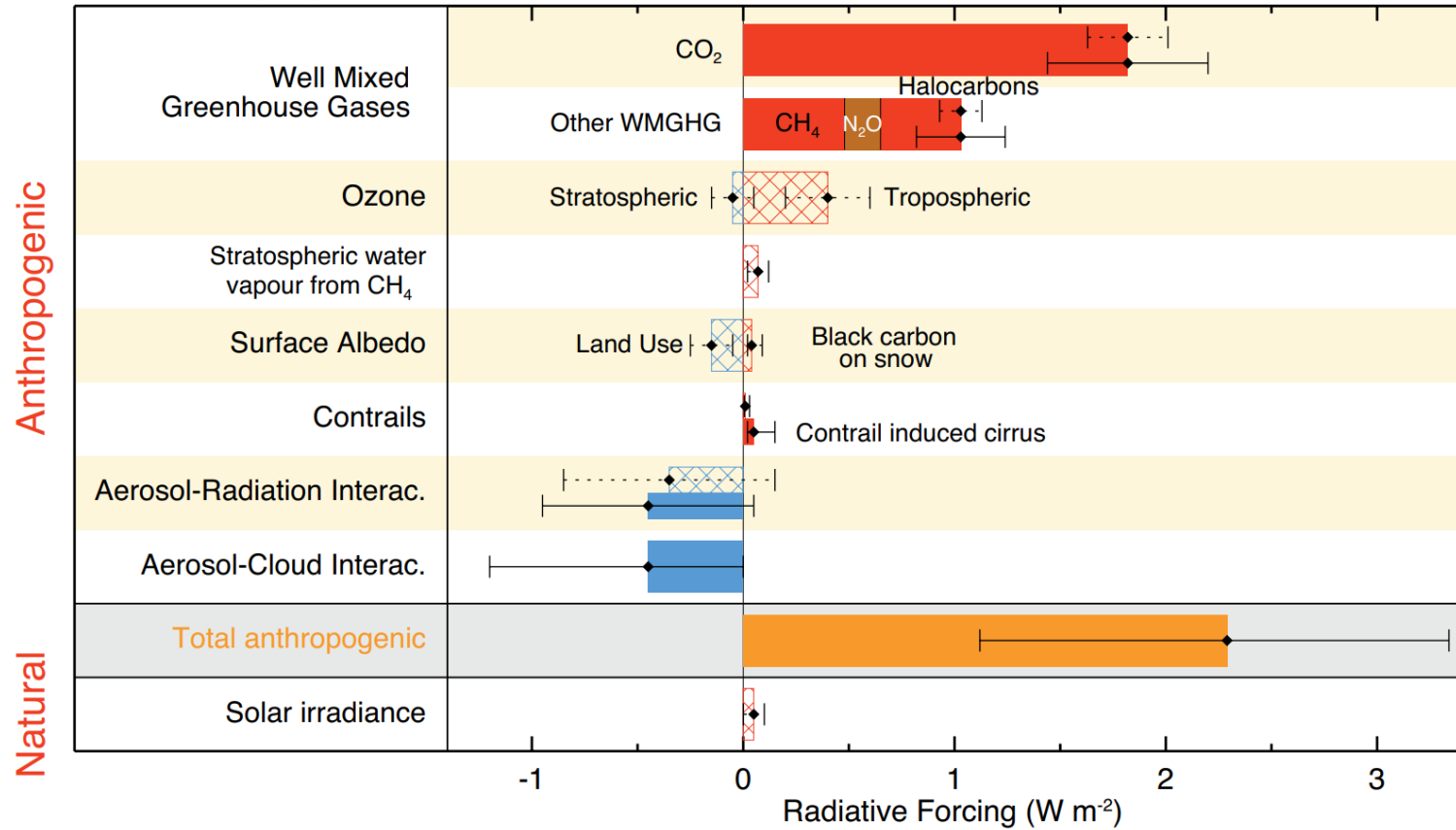


Hartmann et al. (2013)

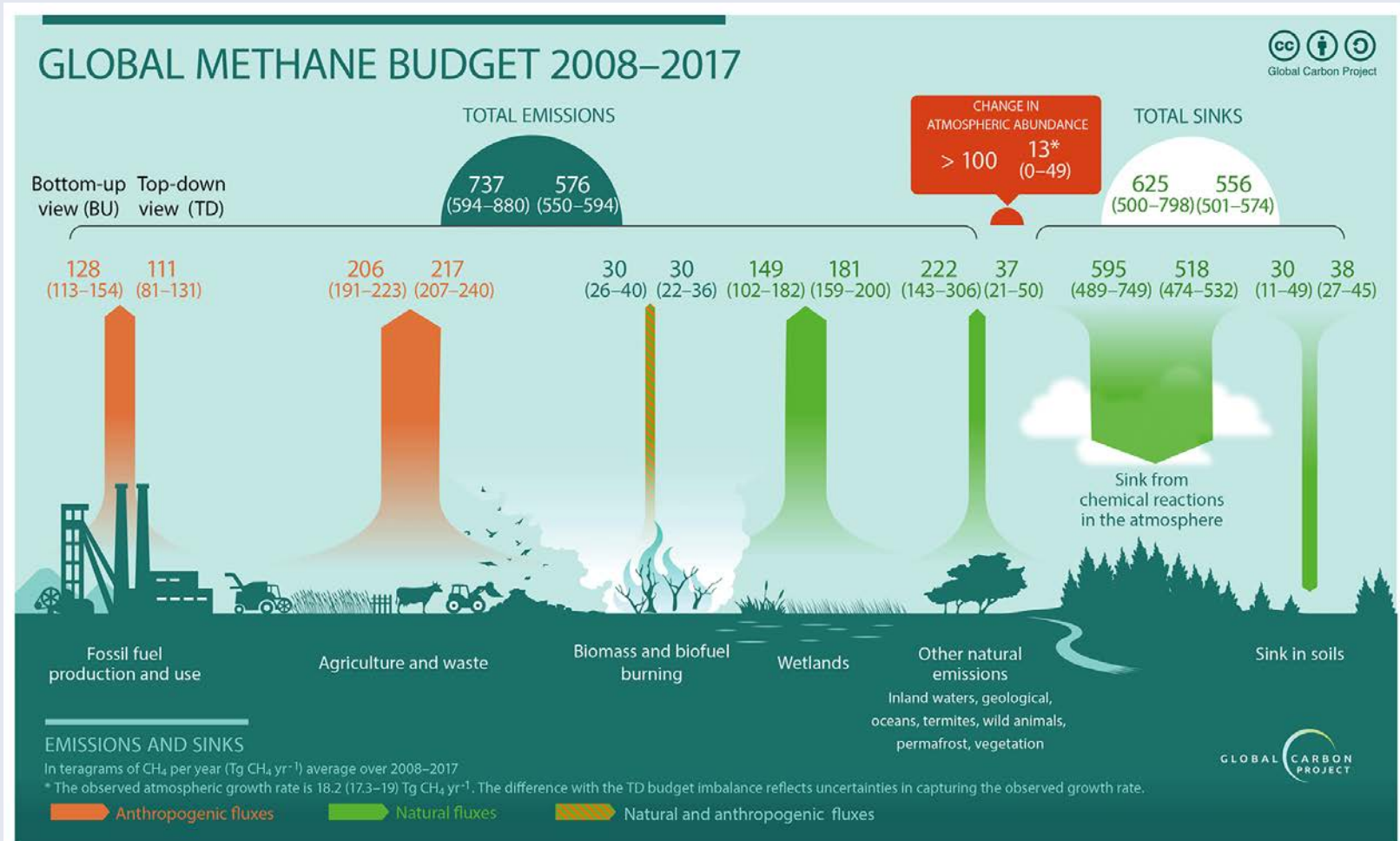


Contributors to global warming

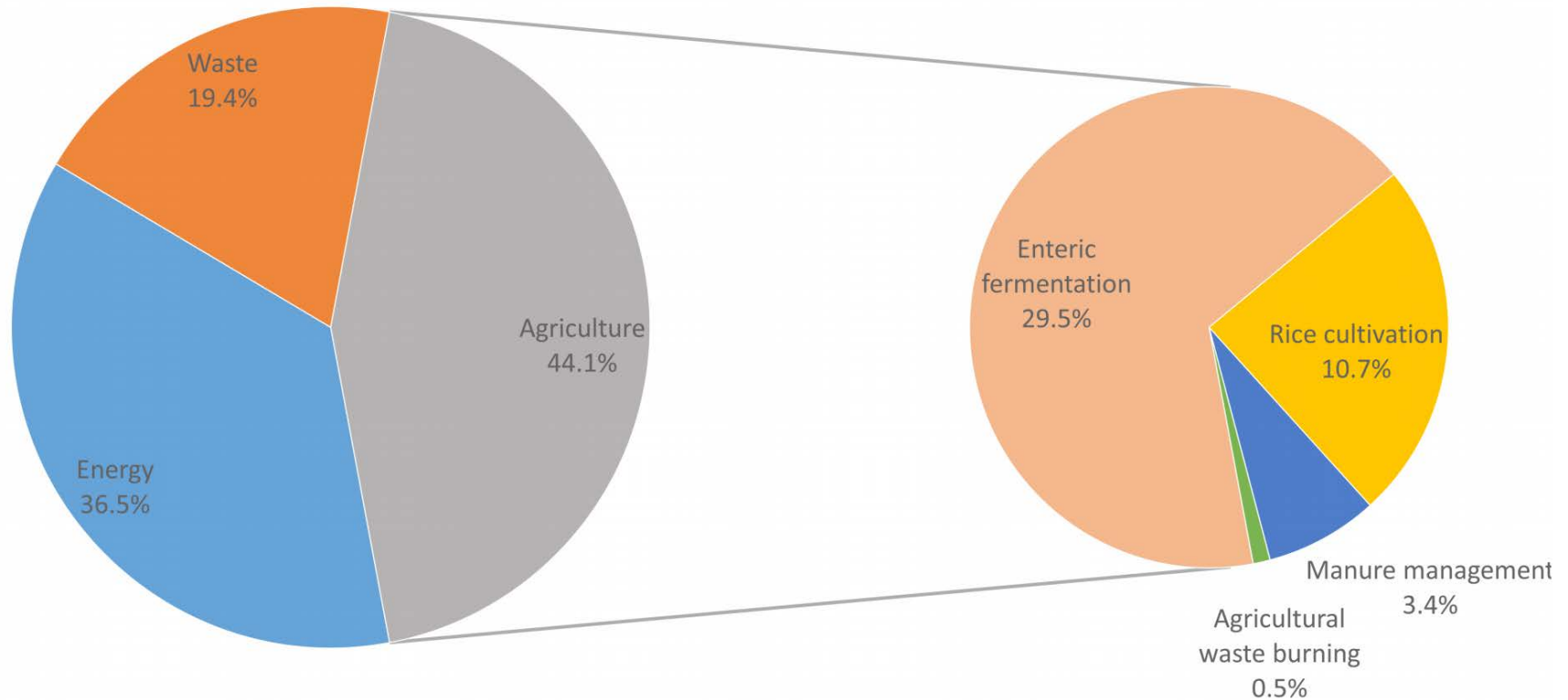
Radiative forcing of climate between 1750 and 2011
Forcing agent



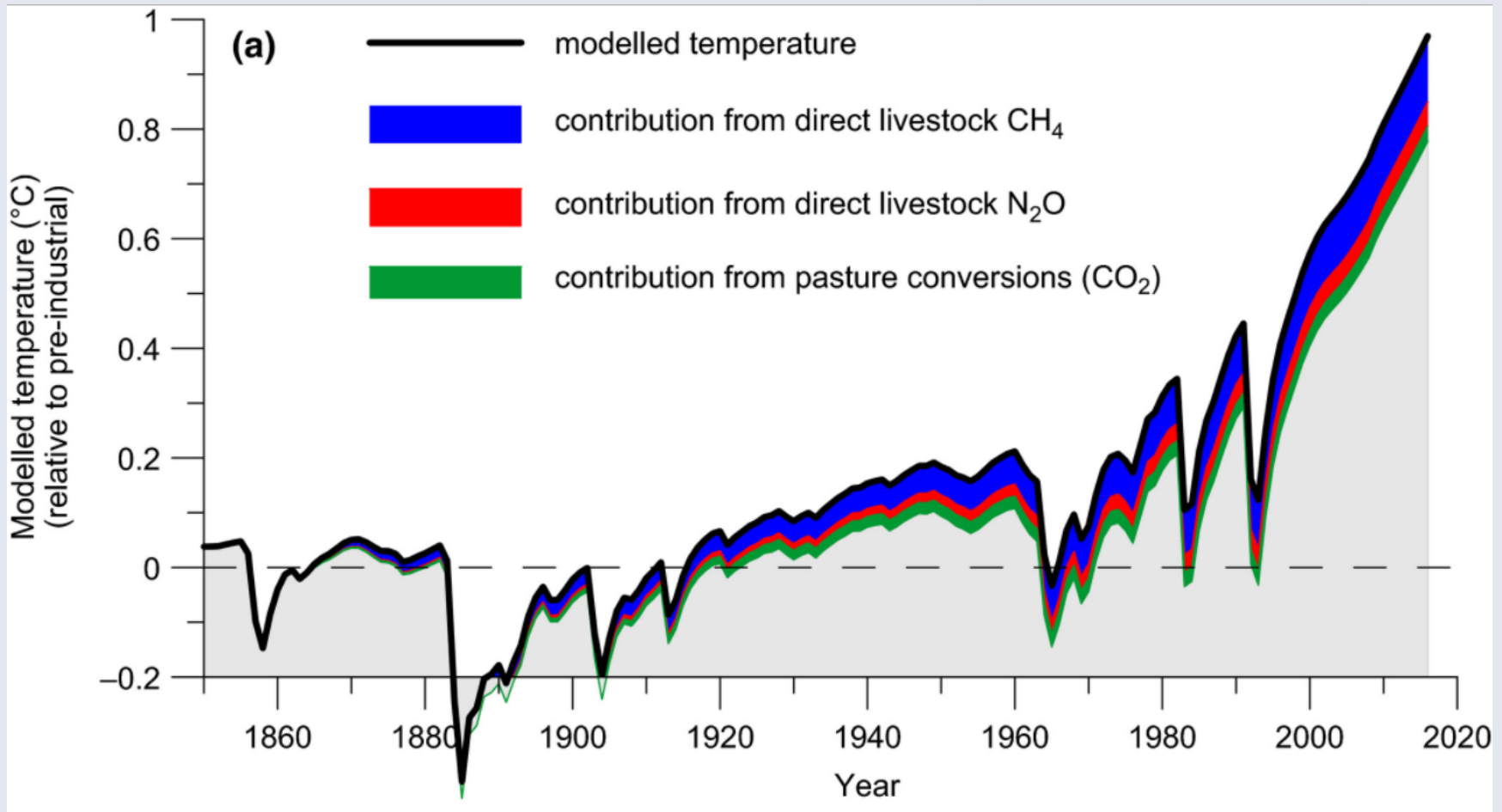
Annual methane budget



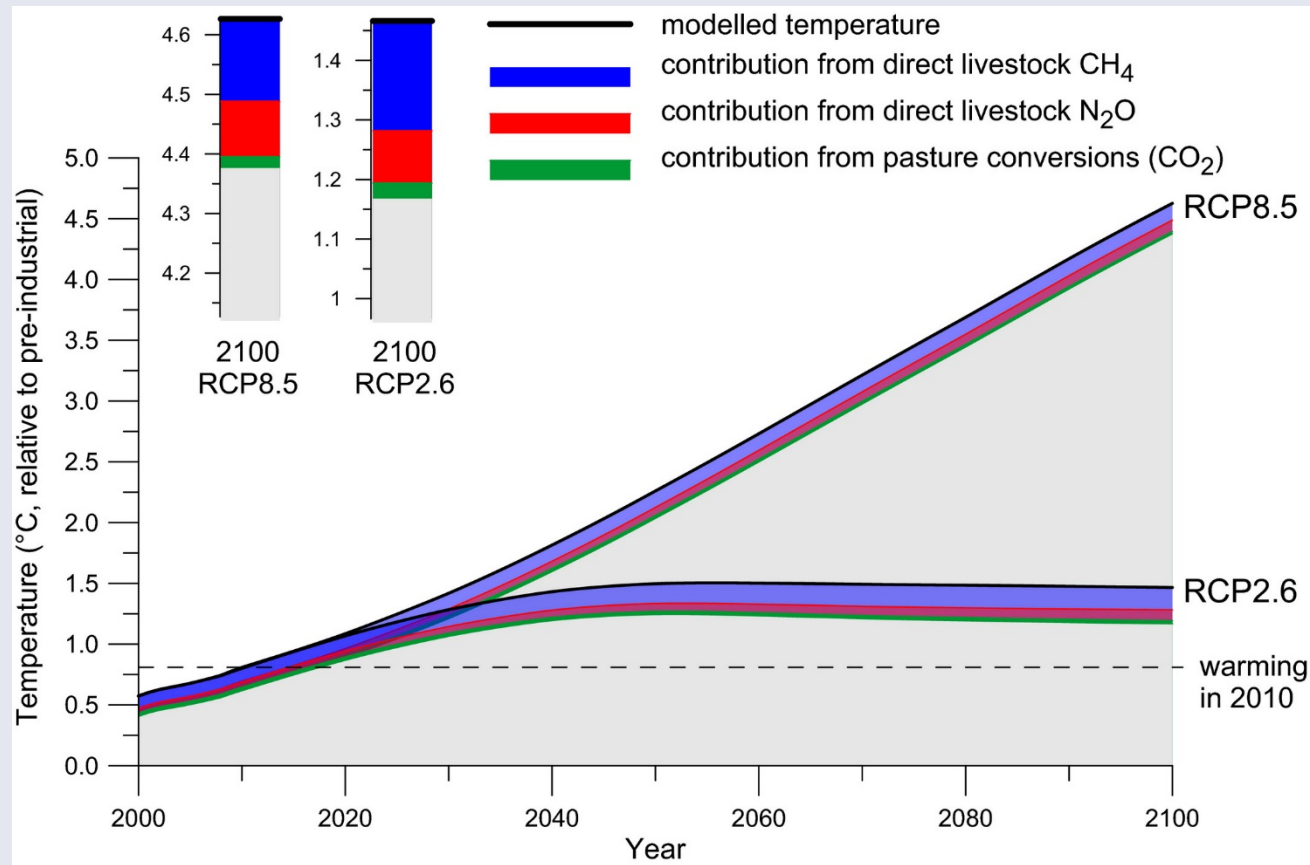
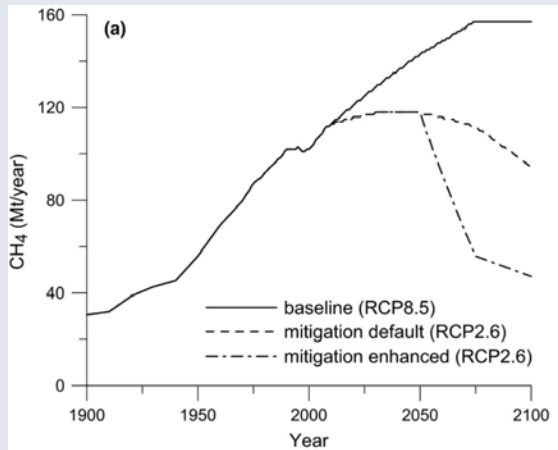
Anthropogenic methane sources (global)



Livestock and global warming

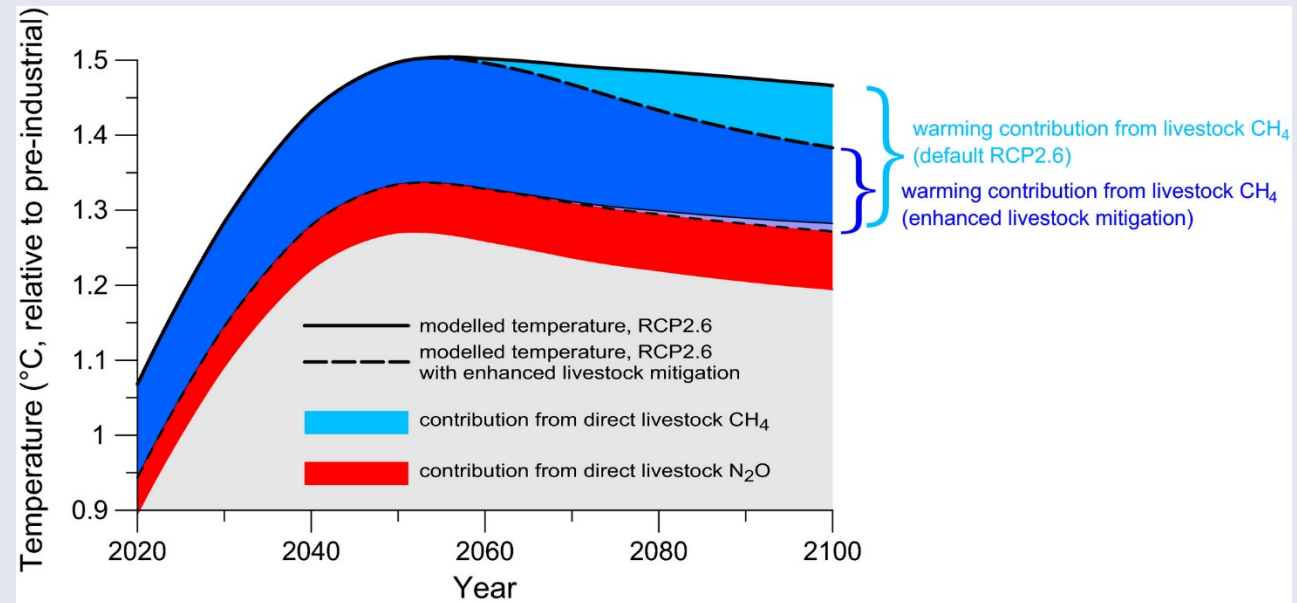
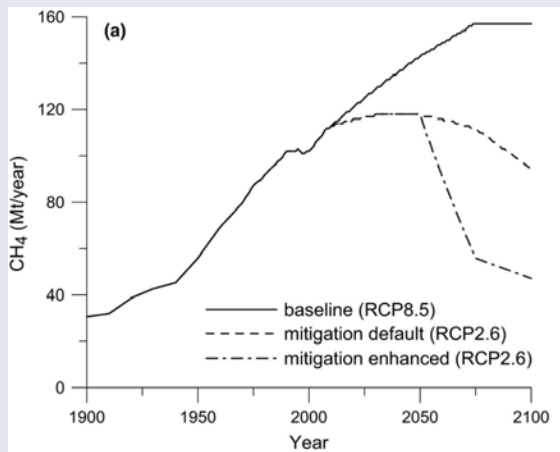


Livestock and mitigating global warming



Reisinger and Clarke (2018)

Livestock and mitigating global warming



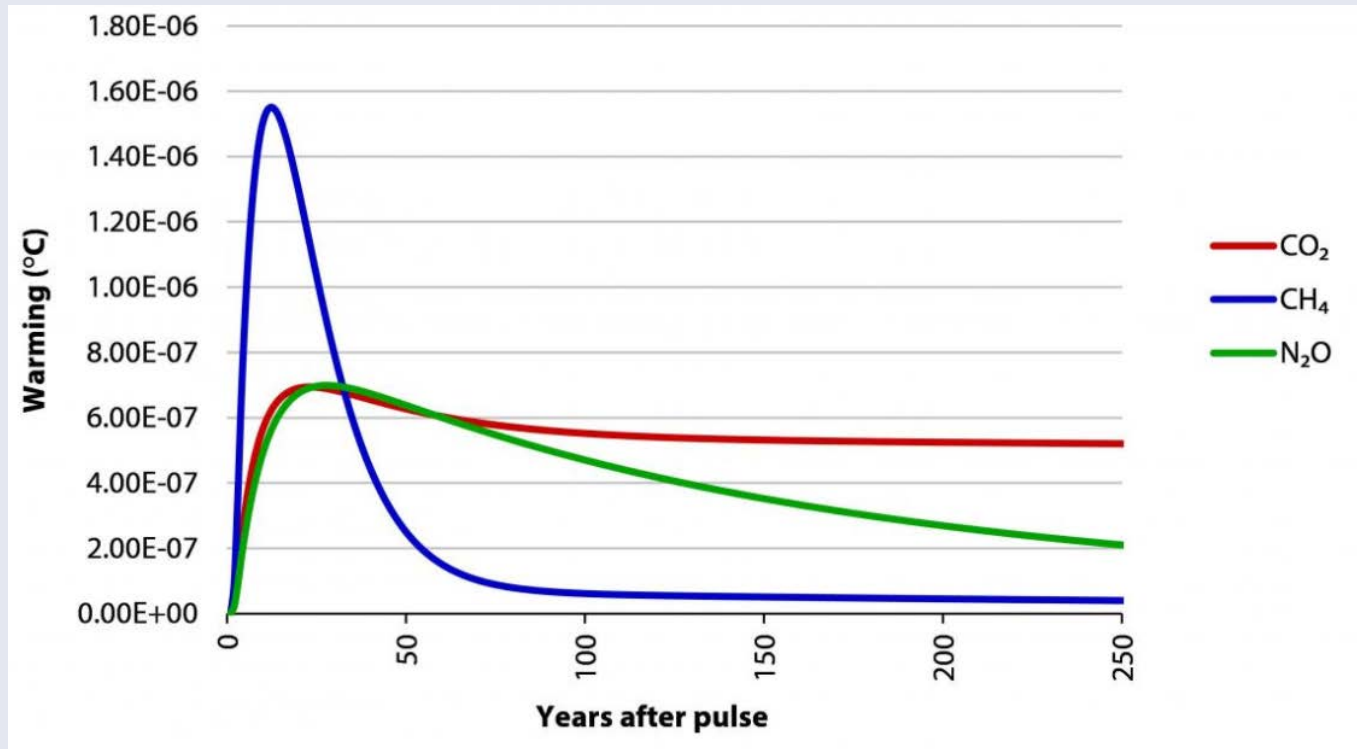
Reporting emissions

- A Swedish beef footprint (organic, Cederberg et al 2009)
 - Kg gases (or GWP₁₀₀ CO₂e) per kg bone-free beef

CO ₂	(CO ₂ e)	CH ₄	(CO ₂ e)	N ₂ O	(CO ₂ e)	Total CO ₂ e
0.9	0.9	0.8	22.4	0.02	5.3	28.6

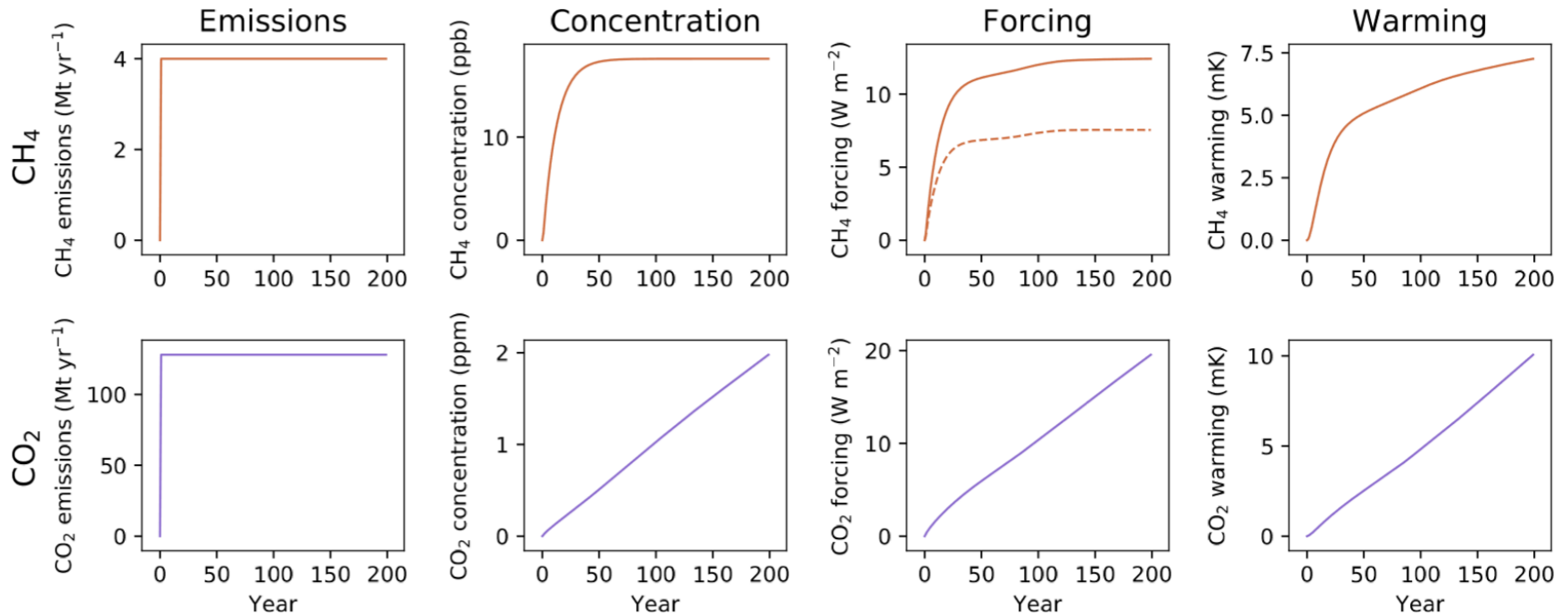
- What is a CO₂-equivalent?
 - Weights amounts of different gases relative to CO₂
 - Typically uses the '100-year Global Warming Potential' (GWP100)
 - Methane = 28, Nitrous oxide = 265 (IPCC 5th Assessment Report)
- Simplifies time – dependent differences

Global Warming Potential



- Warming over time for 1Mt CO₂ or 'equivalent' (GWP100) methane or nitrous oxide.
- Figure from UK CCC Report on Land Use: Policies for a net-zero UK

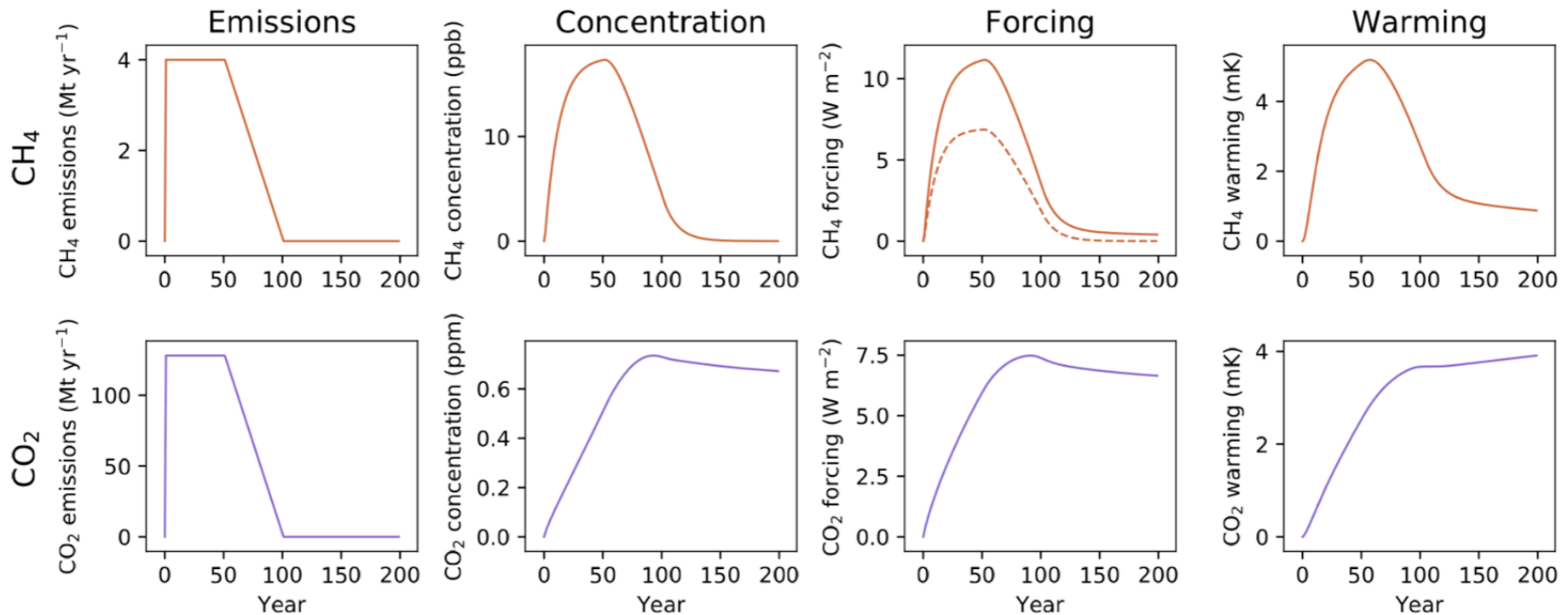
CH₄ and CO₂ warming dynamics



Lynch et al (2020) Demonstrating GWP*

doi.org/10.1088/1748-9326/ab6d7e

CH₄ and CO₂ warming dynamics



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GWP₁₀₀ and GWP*

Conventional metrics (GWP₁₀₀, GWP₂₀, GTP₁₀₀)

$$\text{CO}_2\text{-e} = E_{\text{CH}_4(t)} \times \text{GWP}_{100}$$

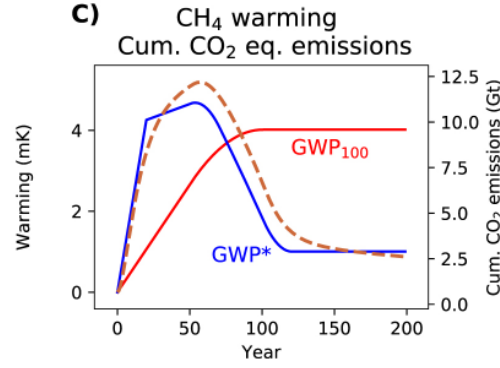
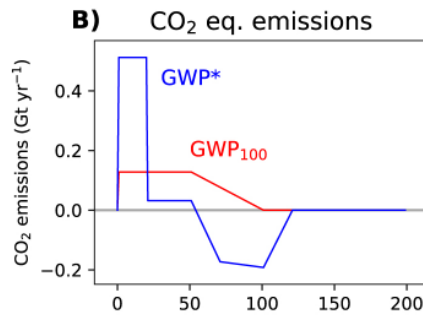
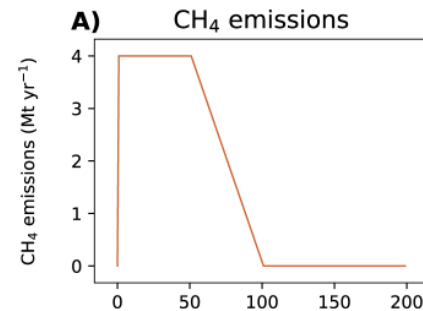
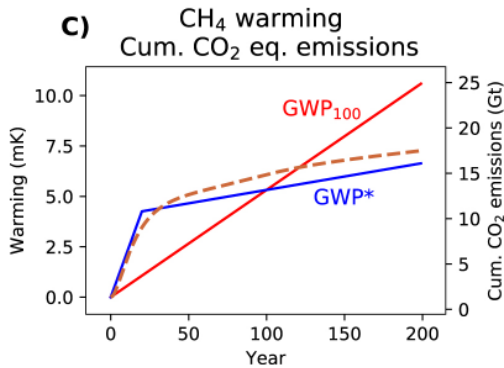
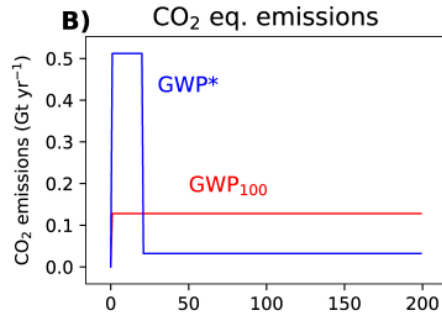
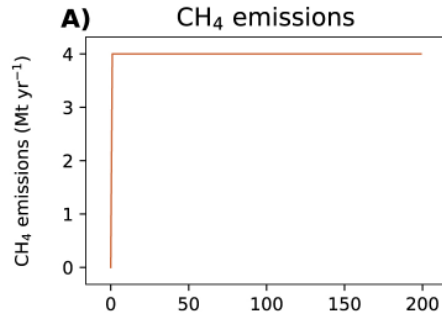
Direct equivalence

'CH₄ like CO₂ but 28x worse'

GWP*

$$\text{CO}_2\text{-w.e.} = \text{GWP}_{100} \times \left[75 \times \frac{\Delta E_{\text{CH}_4}}{20} + 0.25 \times E_{\text{CH}_4} \right]$$

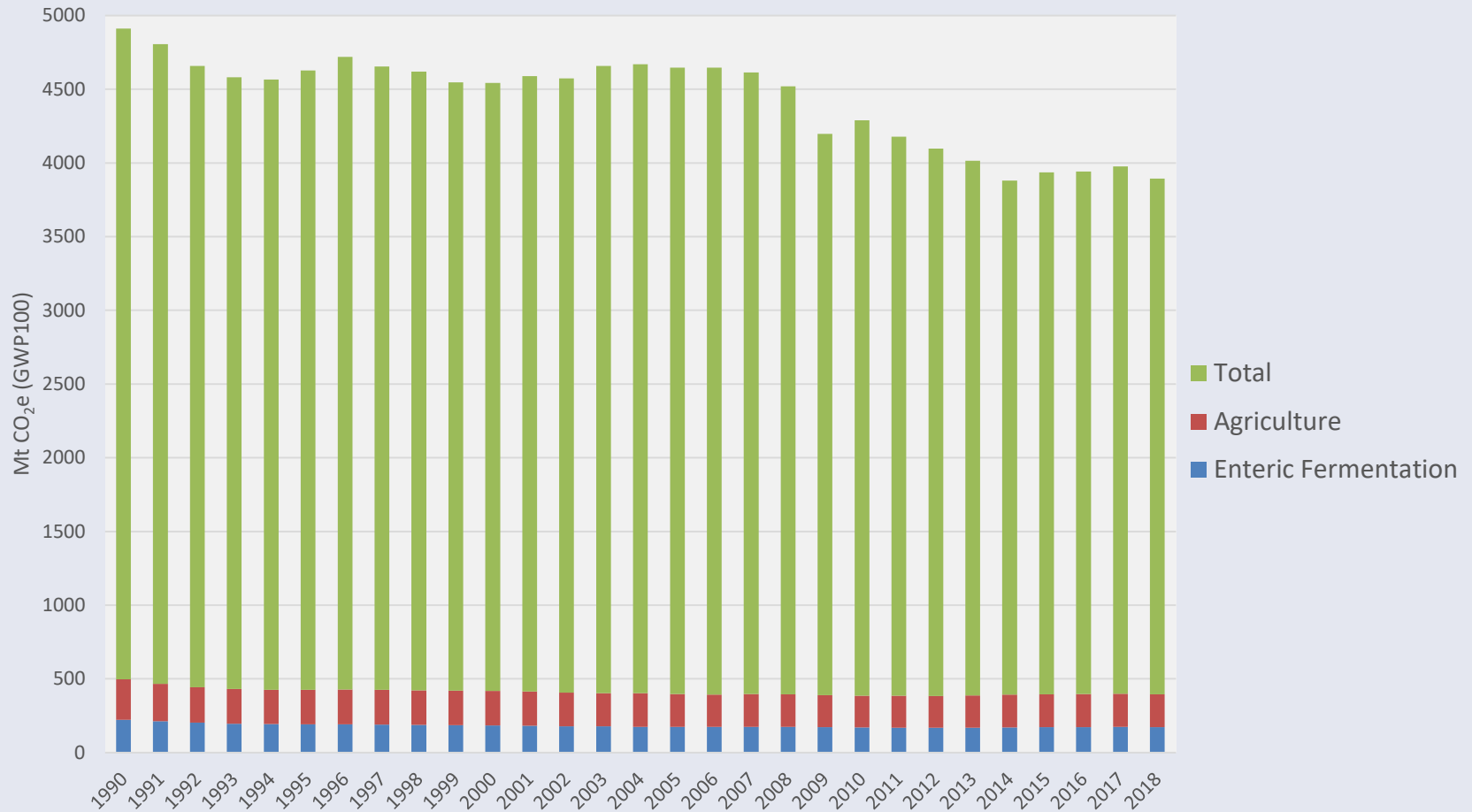
Dynamic equivalence, *change* in methane \approx one-off CO₂



Reporting methane: summary

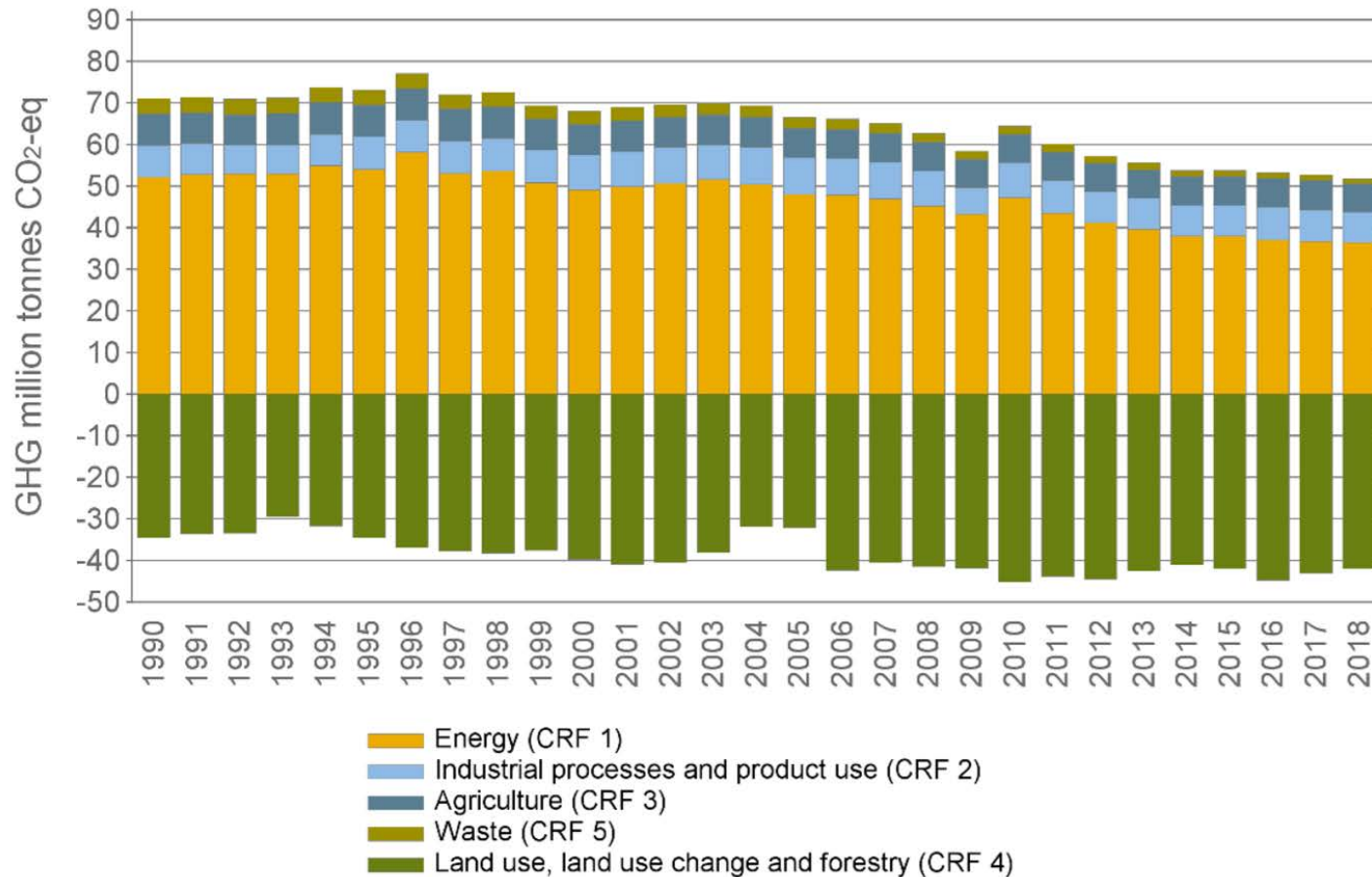
- Individual gases play different roles
- Convention/expectation report using GWP₁₀₀
- Policy implications contested
 - ‘net-zero’
- Takeaways for agri-env researchers
 - Lower emissions = better for climate
 - Keep trade-offs in mind
 - **Report individual emissions!**

European Union GHG emissions



Data from European Environment Agency

Swedish GHG emissions



Swedish GHG emissions

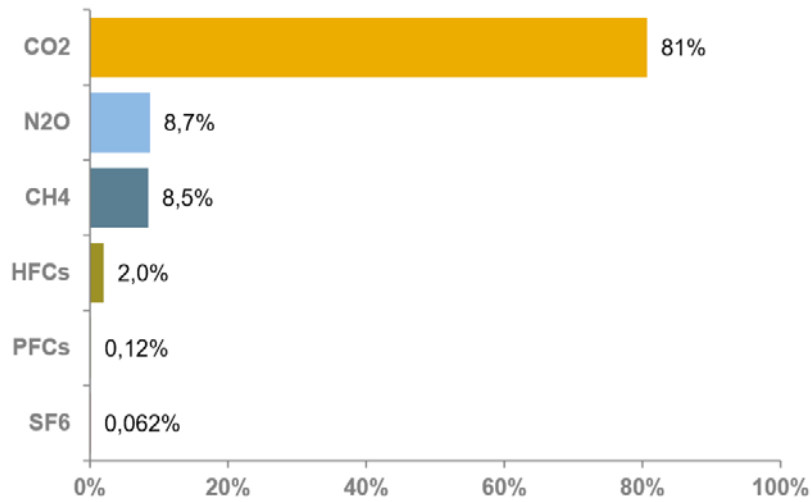
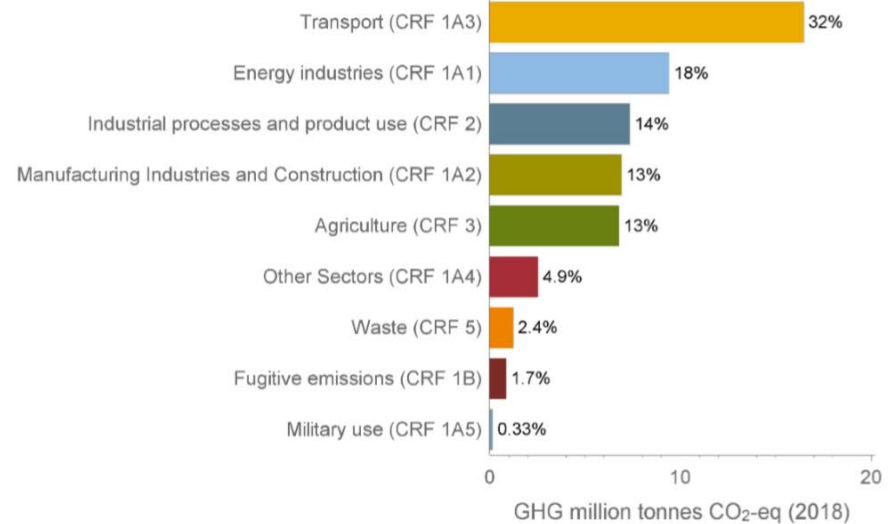
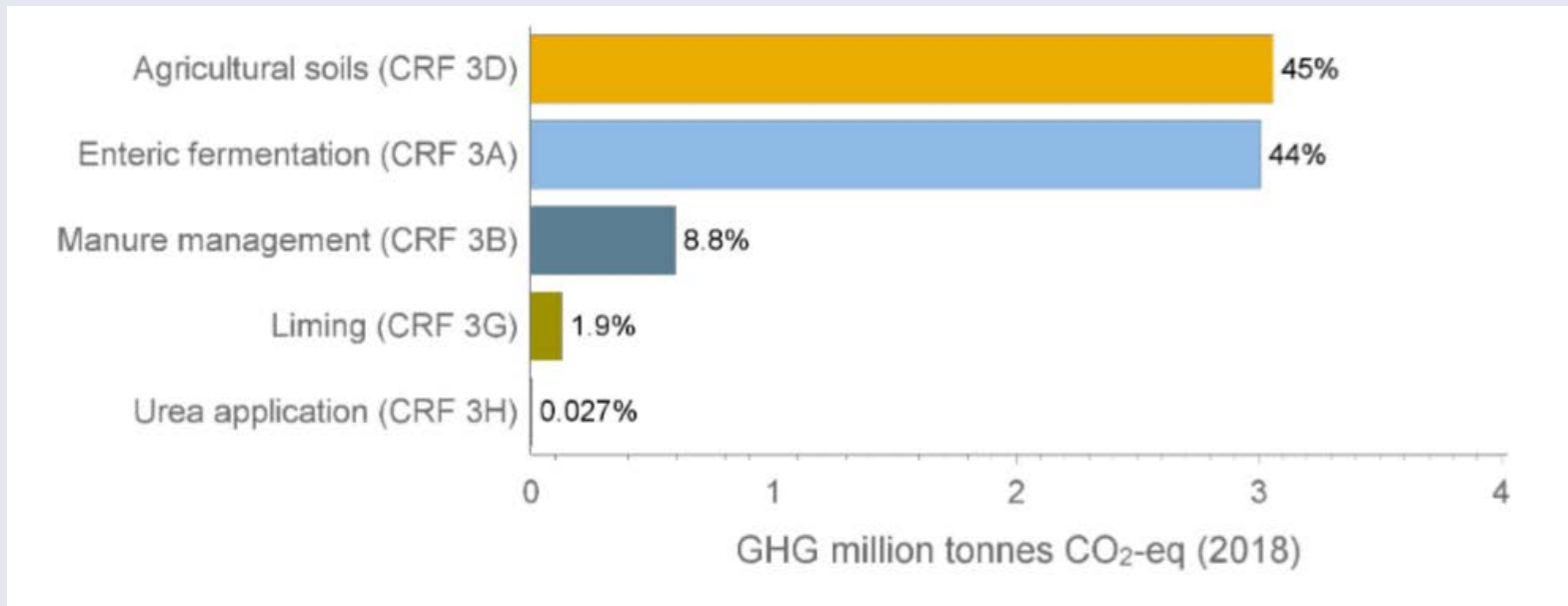


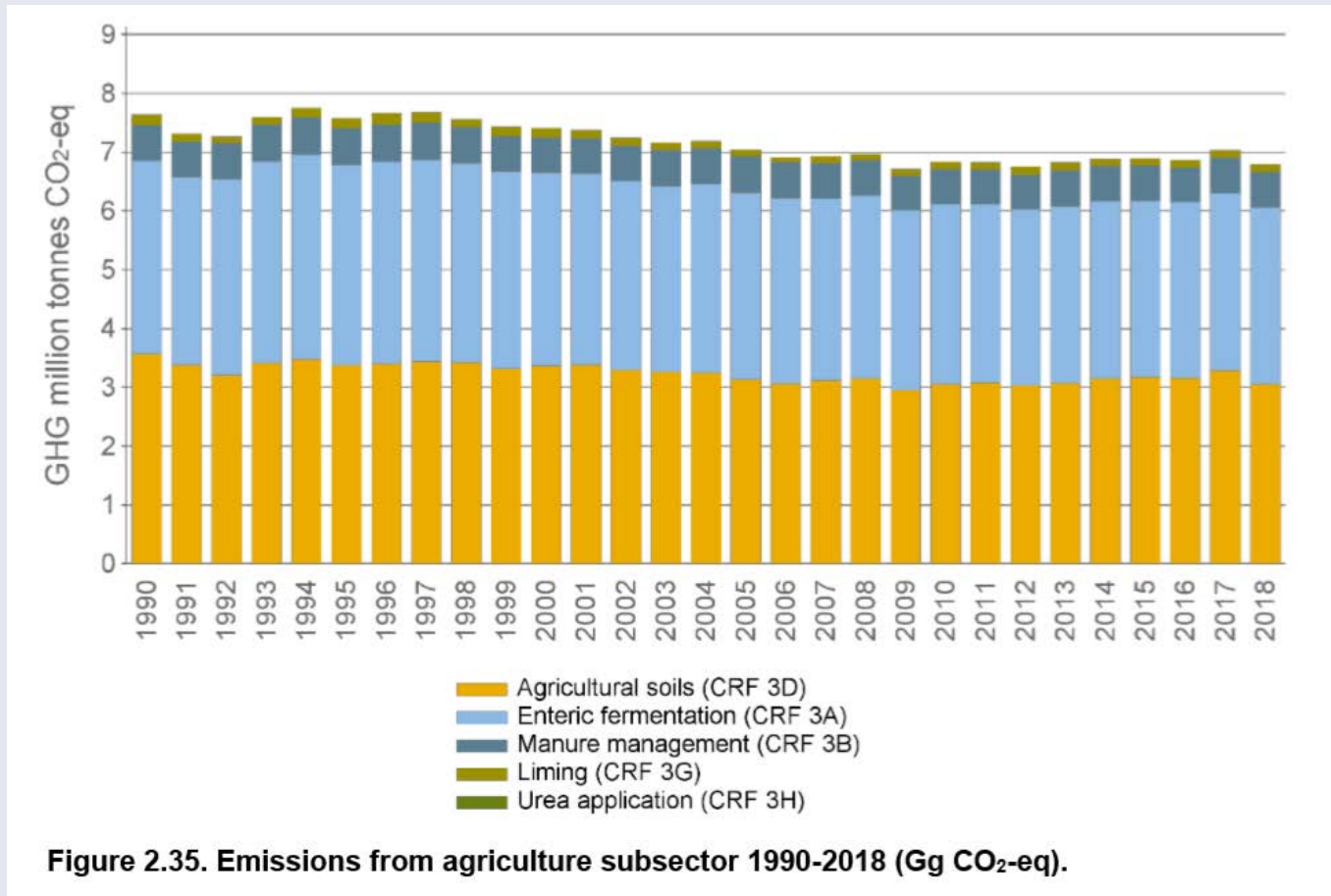
Figure 2.4. Share of greenhouse gases of total emissions in CO₂-eq, in 2018.



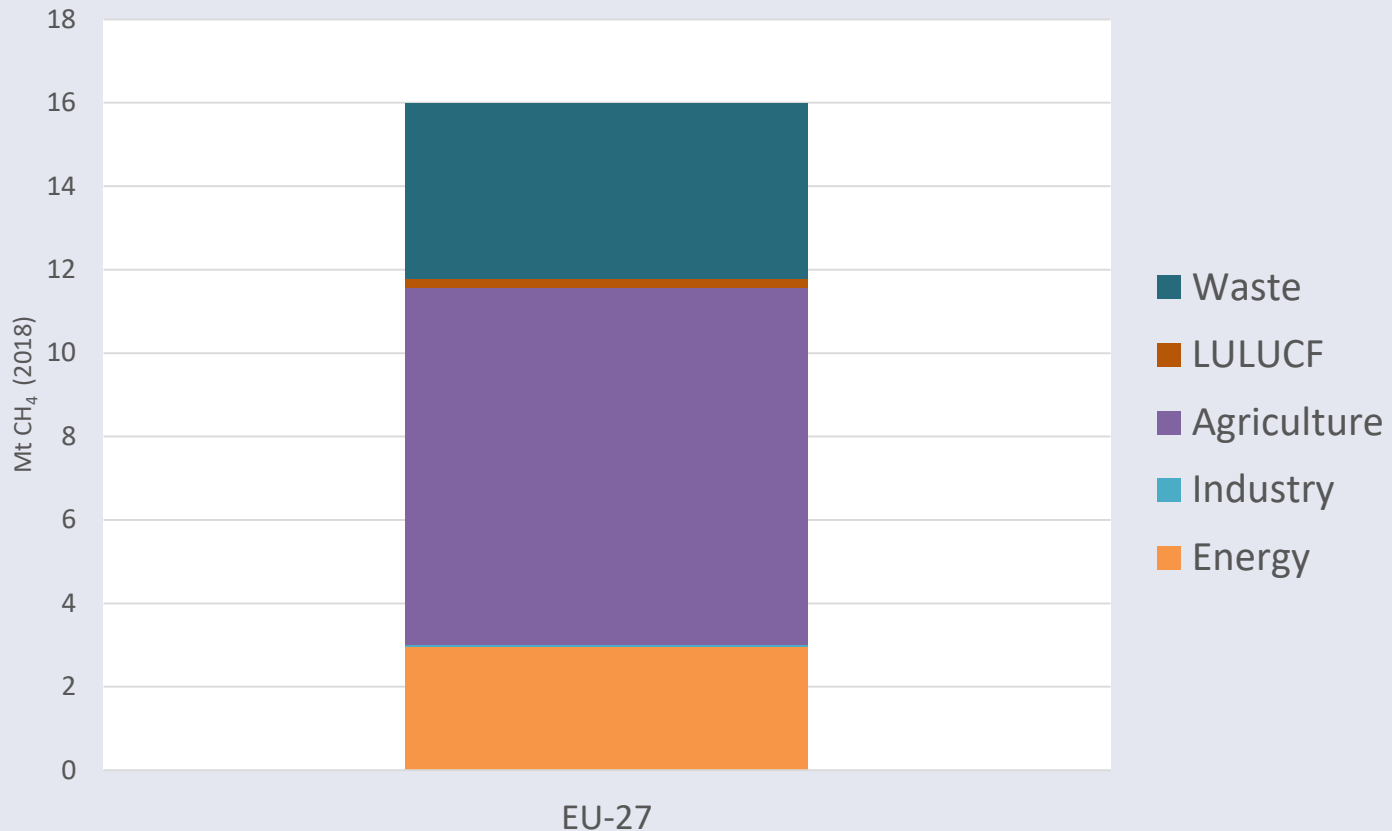
Swedish GHG emissions



Swedish GHG emissions

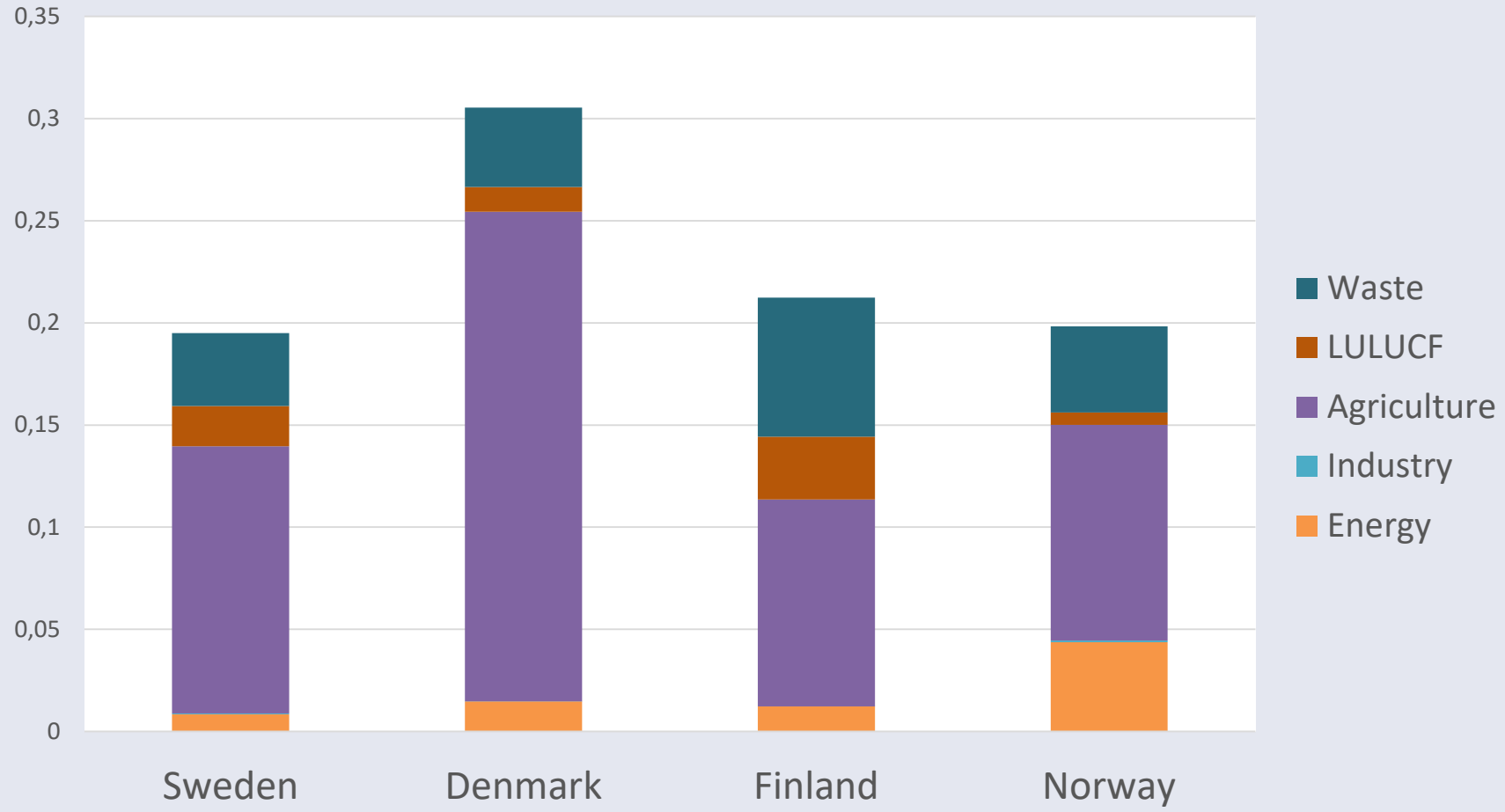


European Union methane emissions

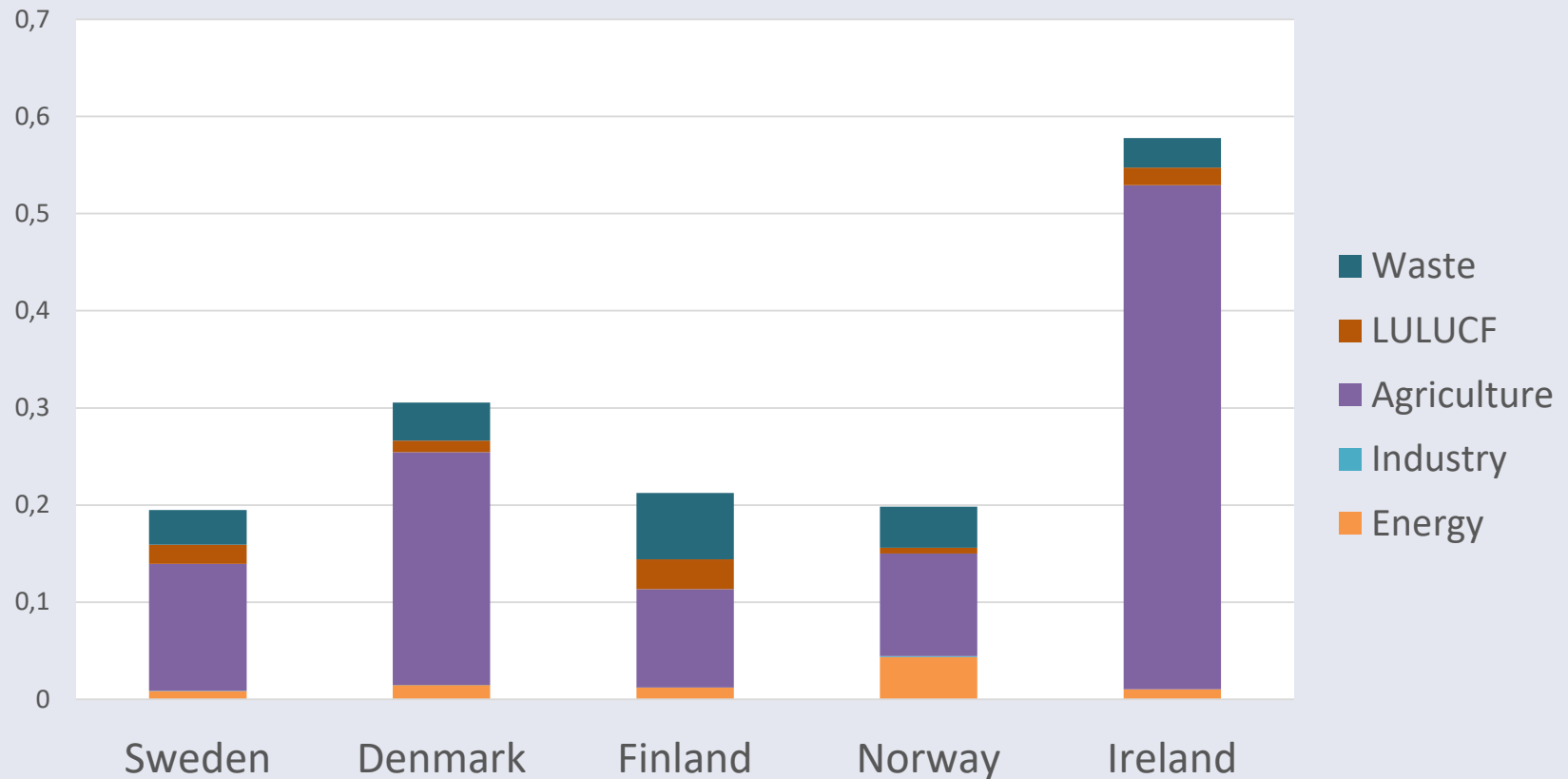


Data from European Environment Agency

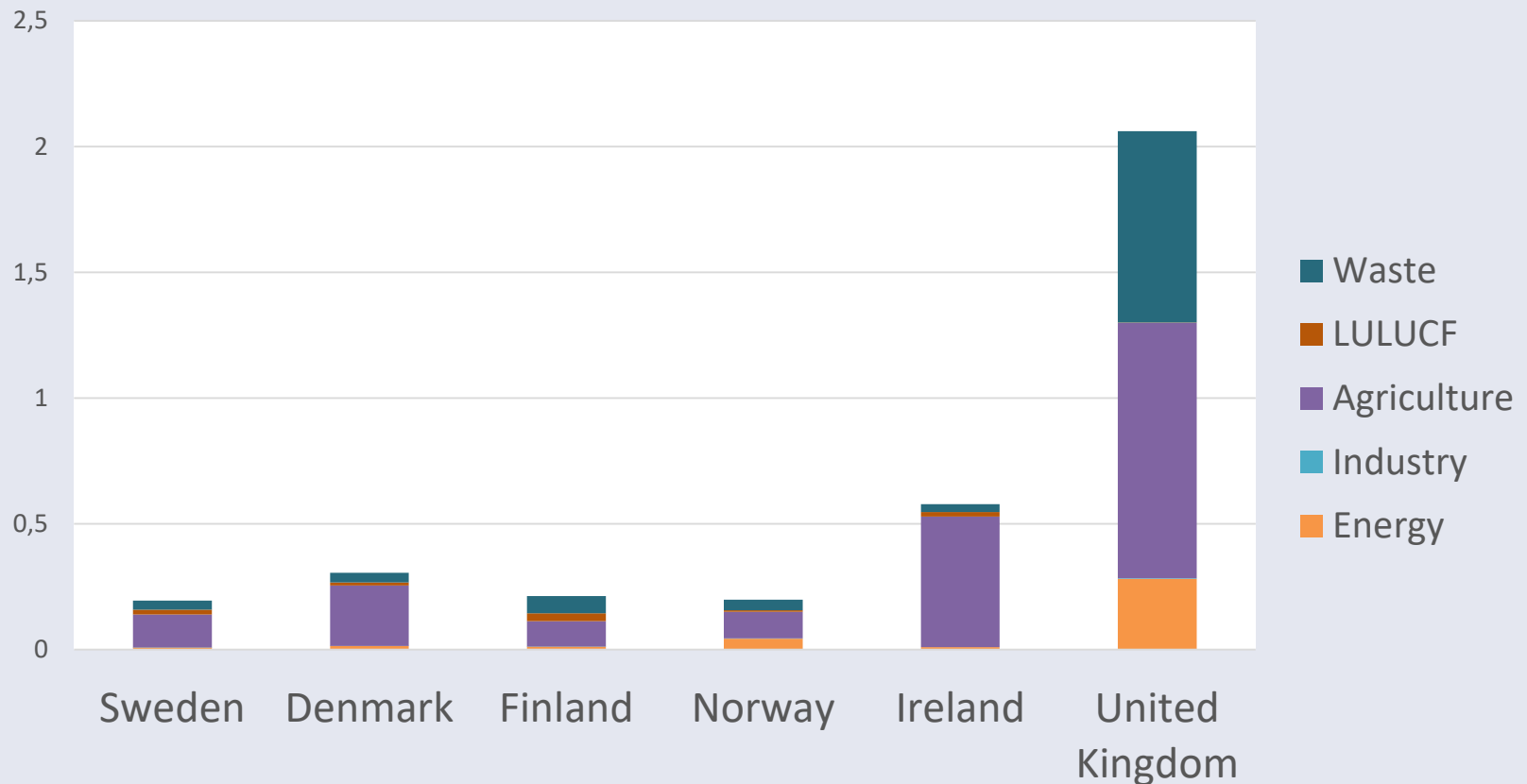
Methane from Sweden and neighbours



Sweden and neighbours... + Ireland



Sweden and neighbours... + Ireland & UK



Reducing ruminant methane

- Increased performance and efficiency
 - Better health and welfare – win-wins?
 - Intensification – risk of trade-offs?
- New technologies
 - Dietary supplements
 - Methanogenesis vaccination
- Reduced consumption and production
 - Less and better

Food systems and land-use

- Multifunctional agriculture
 - Grassland non-food outputs
 - Silvopasture
 - Landscape preferences
- Opportunity costs
 - Land repurposed for carbon or biodiversity
 - Intensification or less and better?

Life-Cycle Assessment & Indicators

- LCA useful tool for tracking all impacts
- But do reporting indicators capture detail?
- Two key challenges
 - Environmental integrity of impact indicators
 - Functional unit of outputs

LCA: environmental integrity of indicators

- Do indicator metrics correspond with impact?
- Greenhouse gases and climate change
 - Time-dependence: subjective?
 - Impact indicator vs ‘sustainability’ end-goal?
- Related issues for others (e.g. nitrate, land)
- Concern and solution depends on application
 - Who informing, what telling them?

LCA: functional unit

- Absolute emissions for national, global
- For impact assessment, relative impact
- But scaled relative to what?
 - Kg food
 - Nutritional content (e.g. kg protein, g omega-3)
 - Rural economies and family farms
 - Aesthetic landscape preference
- Co-production and allocation
 - ‘dairy beef’
- Again, depends on purpose

Thank you!

- Any further questions?
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