

Taking another look at methane

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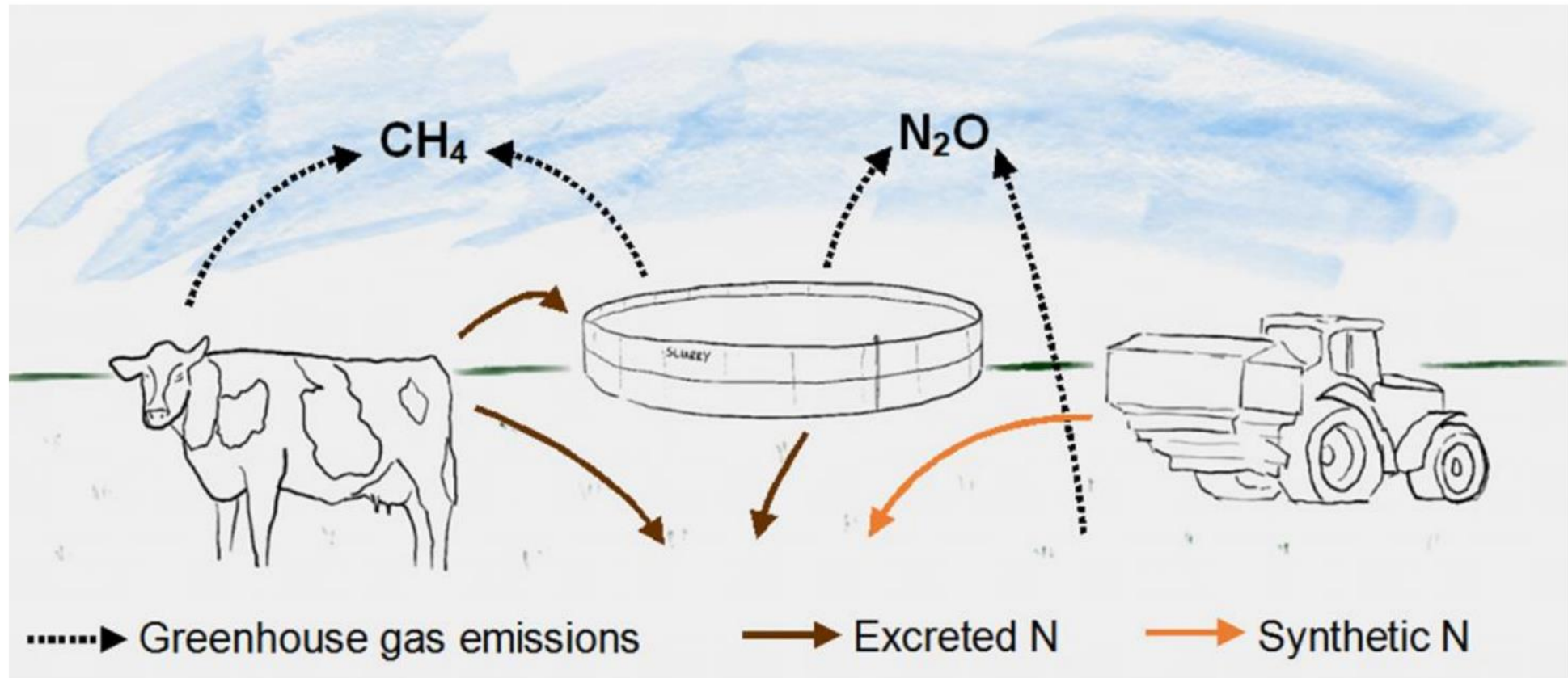


Overview

- Greenhouse gas emissions associated with ruminant production
- CO₂-equivalents and the 100-year Global Warming Potential
- Warming impacts of CO₂ and CH₄
- Contribution of ruminant livestock to global warming
- The bigger picture

Greenhouse gas emissions associated with ruminant production

- On farm



Greenhouse gas emissions associated with ruminant production

- Pre-farm
 - Embedded energy use
 - E.g. to make fertilisers
 - Imported feed production
 - Fertiliser application
 - Agricultural operations
 - Land-use change
- Transport of inputs



An example - lowland sheep carbon footprint

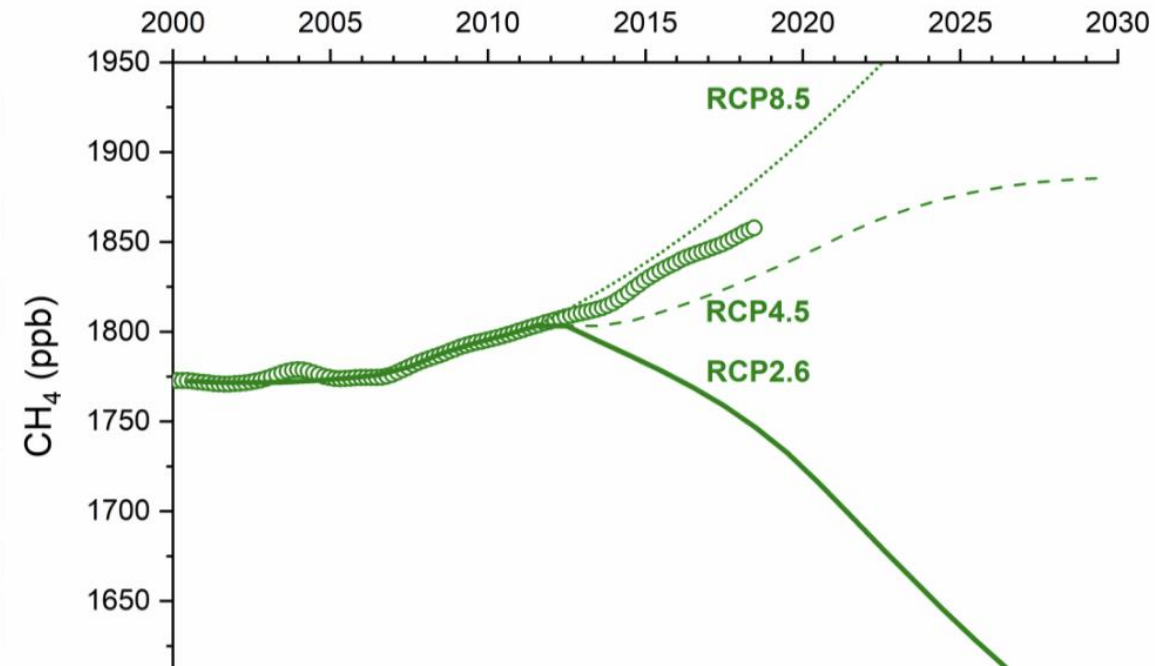
- 10.85 kg CO₂e per kg of finished lamb liveweight
 - 4.73 kg CO₂e methane (4.62 from *enteric fermentation*)
 - 3.94 kg CO₂e nitrous oxide (fertilisers and manures)
 - 2.18 kg CO₂ (fuel + energy use, liming)
 - (average of 27 lowland sheep farms in Jones et al, 2014)
- So direct methane emissions dominate ruminant footprints
 - In turn dominates discussions around sustainability

'CO₂ equivalents'

- 'CO₂e' emissions used in current reporting and policy
 - Uses the 100-year global warming potential (GWP100) of gases to scale different emissions to a CO₂e quantity
 - CO₂ = 1
 - Nitrous Oxide (N₂O) = 265
 - Methane (CH₄) = 28
 - IPCC 5th Assessment Report (2013); earlier values also often used
- Essentially assumes emissions of each gas act in the same way (the same way as CO₂), with different strengths
 - Overlooks important differences between gases

Note: methane (CH₄) is important

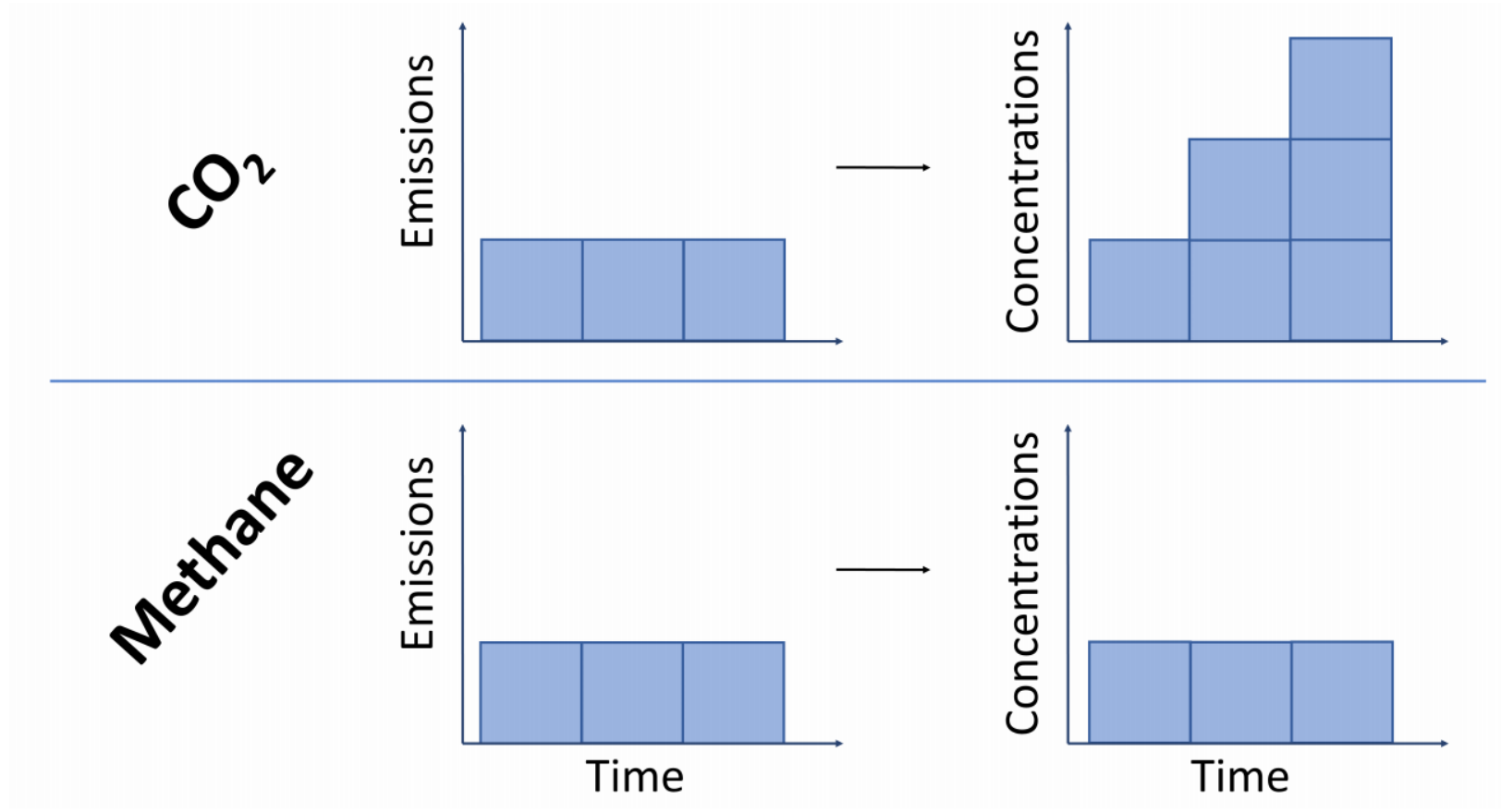
- Strong warming per molecule compared to CO₂
 - Important climate impact: second largest contributor to anthropogenic global warming
- Currently, atmospheric methane is rising almost as fast as RCP8.5
 - ‘worst-case’ emissions scenario
- Accurately valuing the impacts of methane emissions essential



Nisbet et al 2019

Very Strong Atmospheric Methane Growth in the 4 Years 2014–2017: Implications for the Paris Agreement

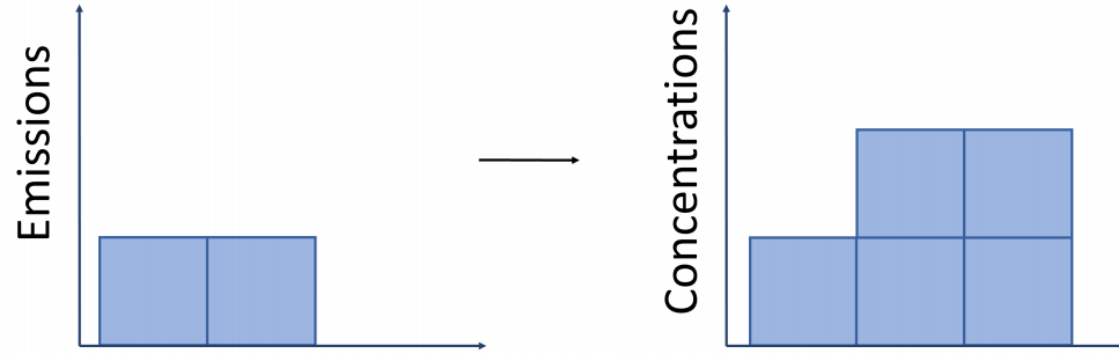
Stock and flow pollutants



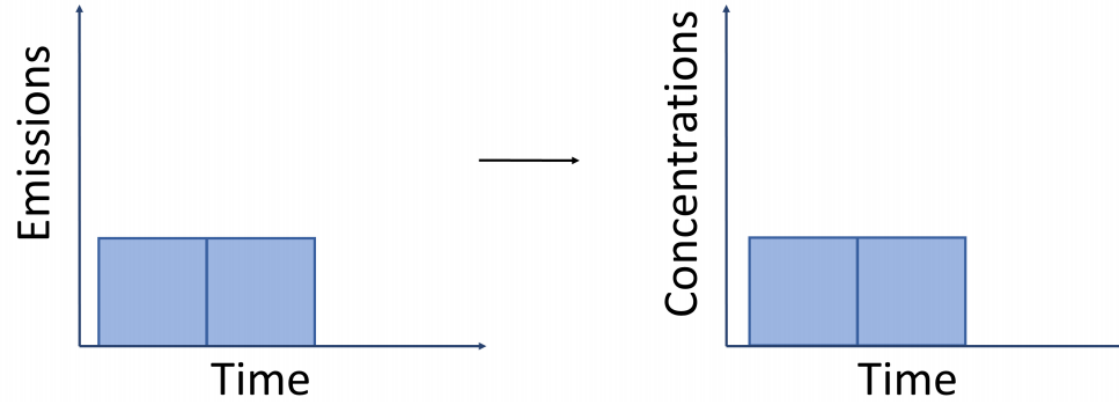
Lynch, 2019, Agricultural methane and its role as a greenhouse gas

Stock and flow pollutants

CO₂



Methane

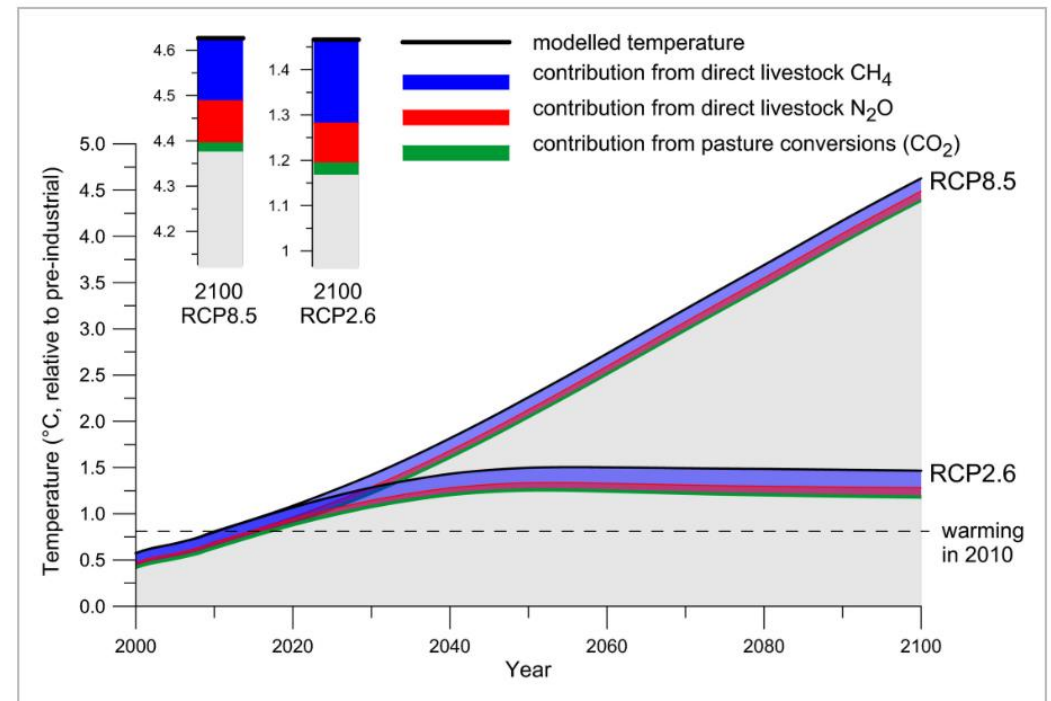
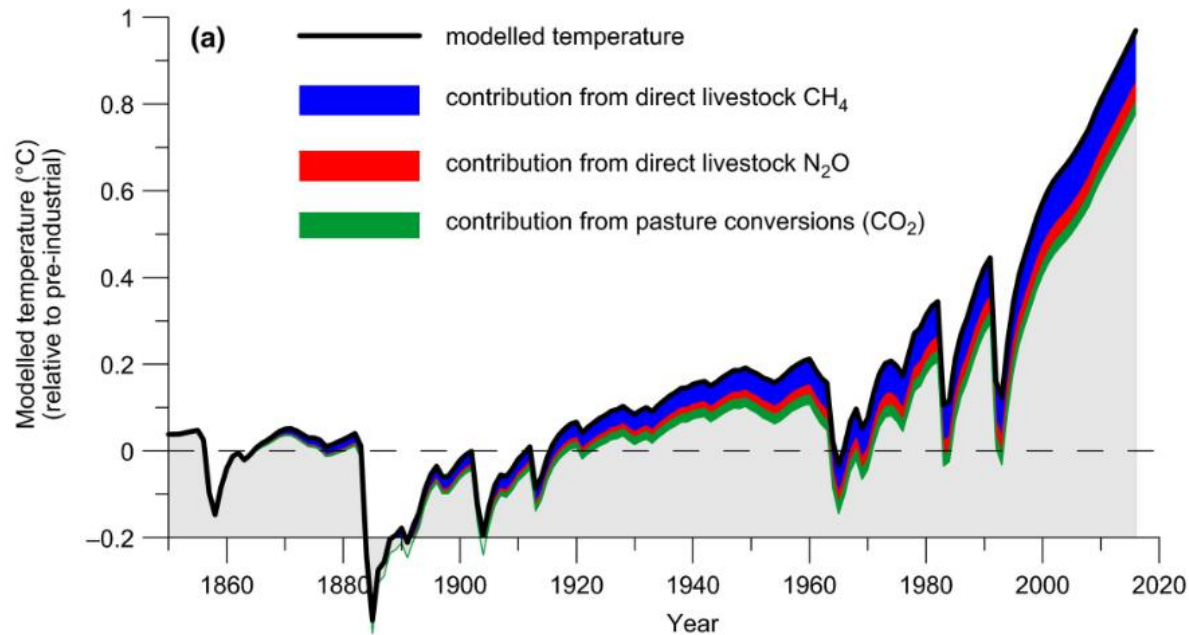


Lynch, 2019, Agricultural methane and its role as a greenhouse gas

Stock and flow pollutants - implications

- Bringing CO₂ emissions to net-zero is a ***physical requirement***
- Temperature will not stop increasing until we do this
- For methane, it is possible to have some ongoing emissions
- Decreasing emissions still good! And probably required
- Requirement depends on when we finally stop emitting CO₂
- Trade-offs in mitigation effort are politics, not physics
- Policy makers should recognise that impacts of zero emissions depend on gas, so sectors differ

Impact of global livestock emissions on temperature



Reisinger and Clark, 2017, 'How much do direct livestock emissions actually contribute to global warming?'

The bigger picture

- Methane not the only gas associated with production
- CO₂ and N₂O still need to be reduced + offset
- Given the unique importance of CO₂, land-use probably bigger issue
- ‘Opportunity cost’ of using land for livestock
 - Bioenergy, sequestration, climate change adaptation
- Wider issues
 - Nitrates, ammonia, pesticides, antibiotics
- Outputs
 - Landscapes, culture, rural economy... meat and dairy!
 - ‘Carbon leakage’
- Sustainable vs environmentally optimal?
- Worth getting methane right, but also only part of the story