How to compare greenhouse gases for climate stabilisation

MC²

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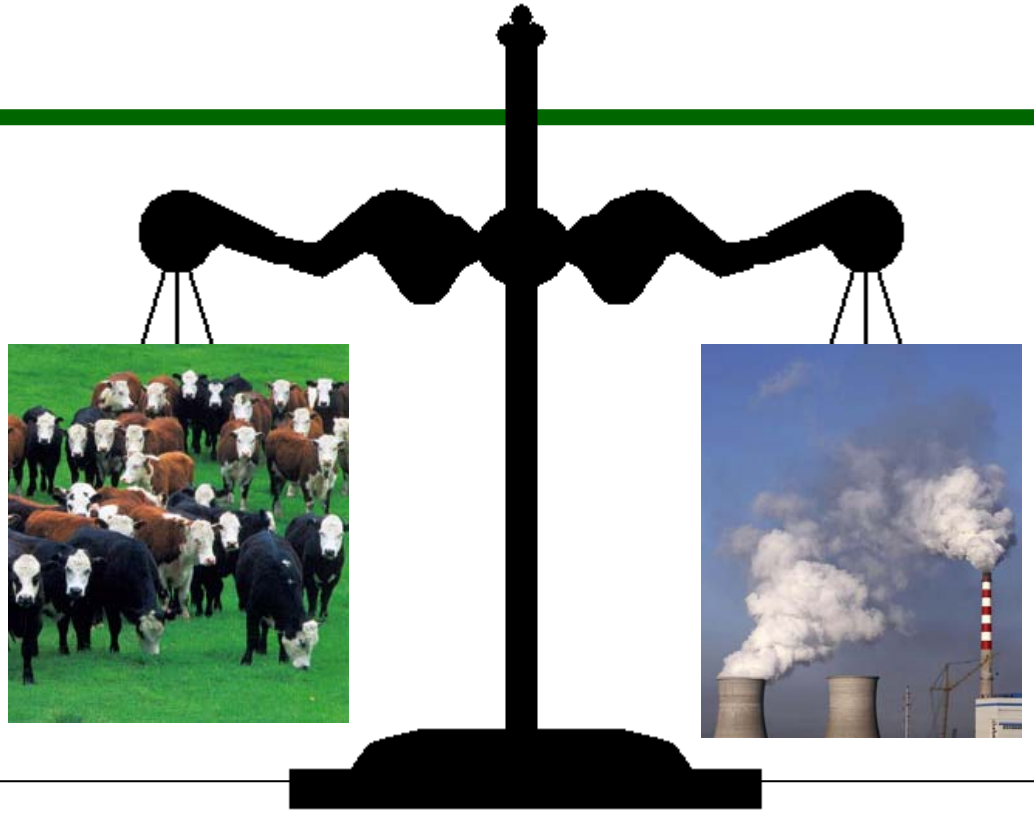

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Outline

- Dealing with many greenhouse gases
- Uncertainties and trends in GWPs
- Keeping to stabilisation scenarios
- Other contextual issues

Dealing with many GHGs

- Multigas mitigation strategies – need a basis for comparing changes in different gases
- Short lived –vs– Long lived gases
- Policy framework adopted GWPs back in 1990s
- Scientists still looking for better approaches

Dealing with many GHGs

- Early approaches were at a project level – fixed term investments etc (Harvey, 1993)
- Policy framework is now increasingly looking to longer term strategy
- "Carbon pricing" sets up a long term economic structure based on GWPs
- So do GWPs work for stabilisation scenarios?

Uncertainties and trends in GWPs

- New survey of uncertainties using range of models considered in the IPCC WG1-AR4
- Broader range of atmospheric chemistry can be considered – e.g. Drew Shindell, 2009
- All GWPs go up as CO_2 concentrations rise
  (methane GWP is 3% higher in 2007 than in 2001 due to the 12 ppm rise in CO_2)
- GWP for methane also increases if its concentration decreases
  (methane GWP increases by 24% in the RCP2.6 scenario)

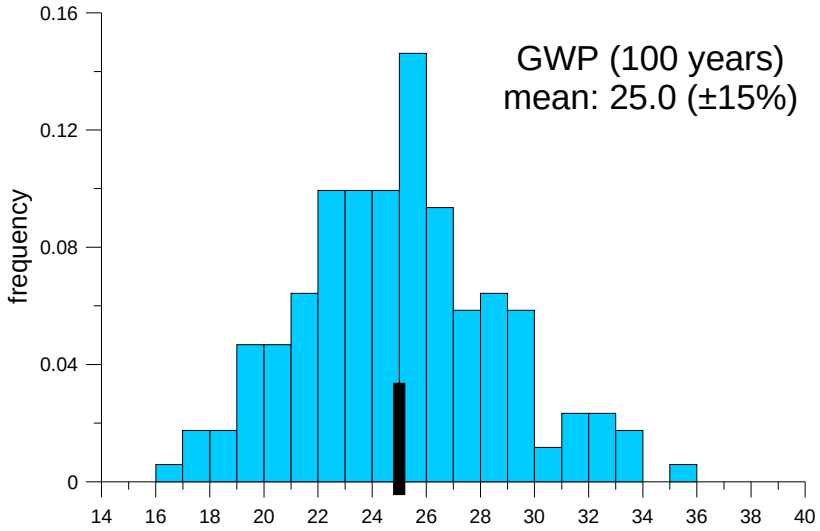
Uncertainties of GWPs and GTPs

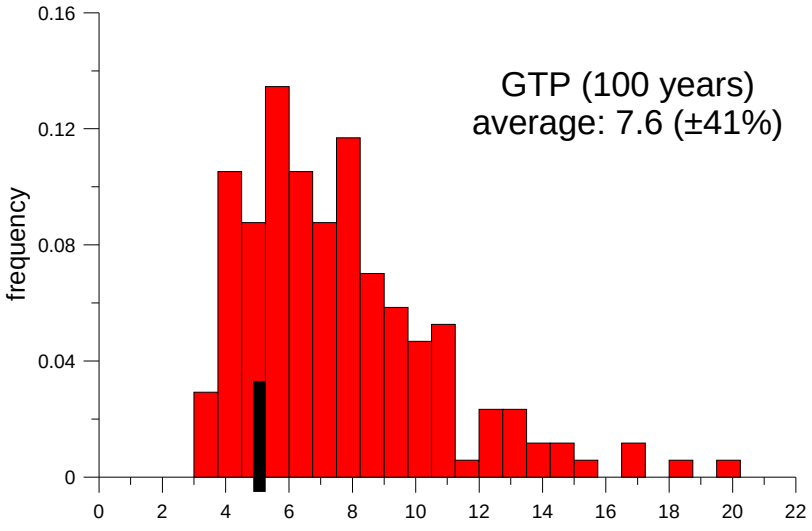
Reisinger et al, 2009, about to be submitted…

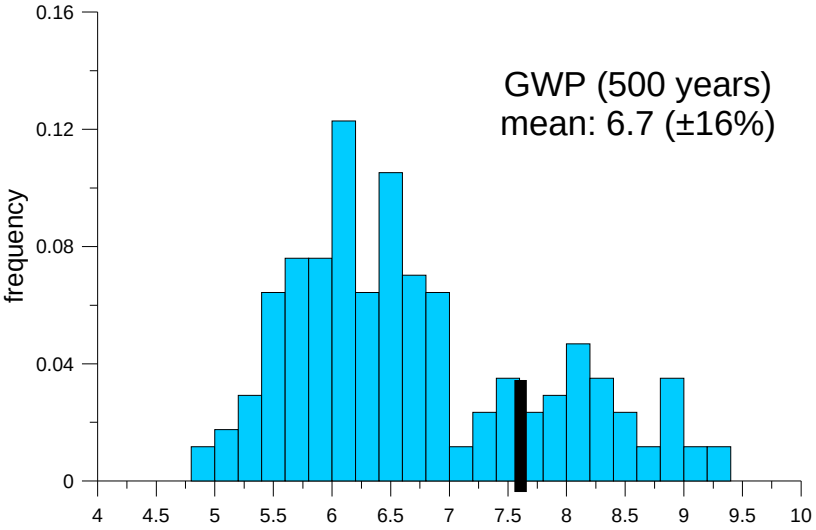
		GWP			GTP		
		20	100	500	20	100	500
CH_4	average	72.8	25.0	6.7	50.5	7.6	0.9
	median	72.3	25.0	6.5	49.7	6.9	0.7
	std. dev	11%	15%	16%	17%	41%	95%
other studies for comparison		*72*	*25*	*7.6*	*46*	*5*	*0.8*
		(Forster et al. 2007)			*(Shine et al. 2005)*		

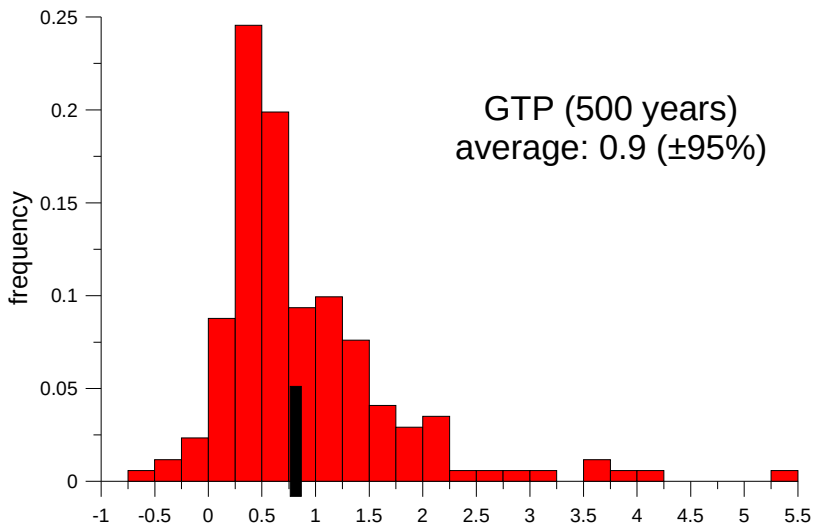
Uncertainties based on 19 AOGCMs and 9 carbon cycle models = 171 models

Uncertainties of GWPs and GTPs





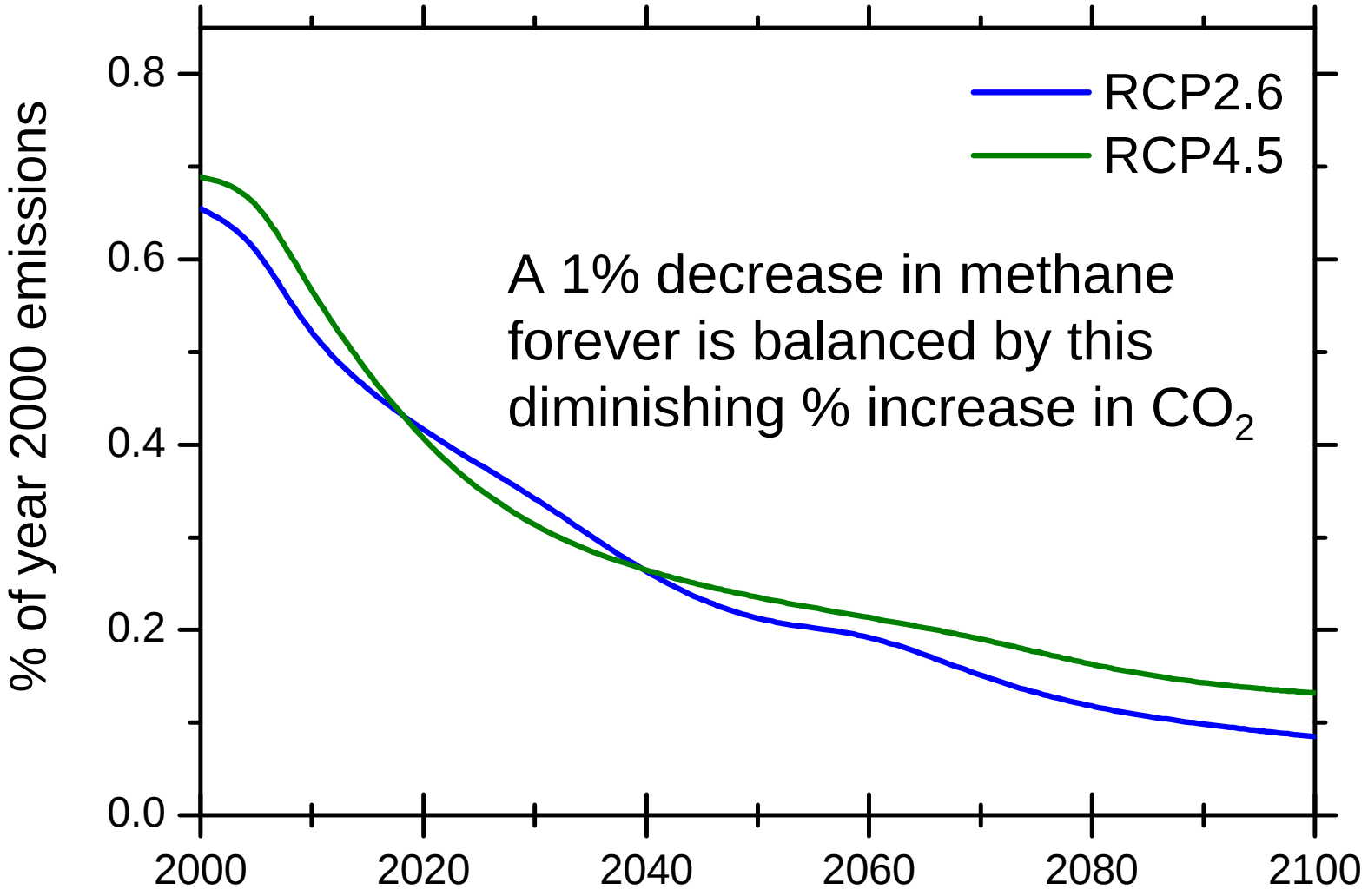




Comparing GHGs along stabilisation paths

- The fixed time horizon is out of line with stabilisation – so drop it
- Compare adjustments in emissions that keep to exactly the same pathway for total radiative forcing
- A constant reduction in methane allows an increase in CO_2 but it must diminish steadily over time
- How does this compare with GWPs

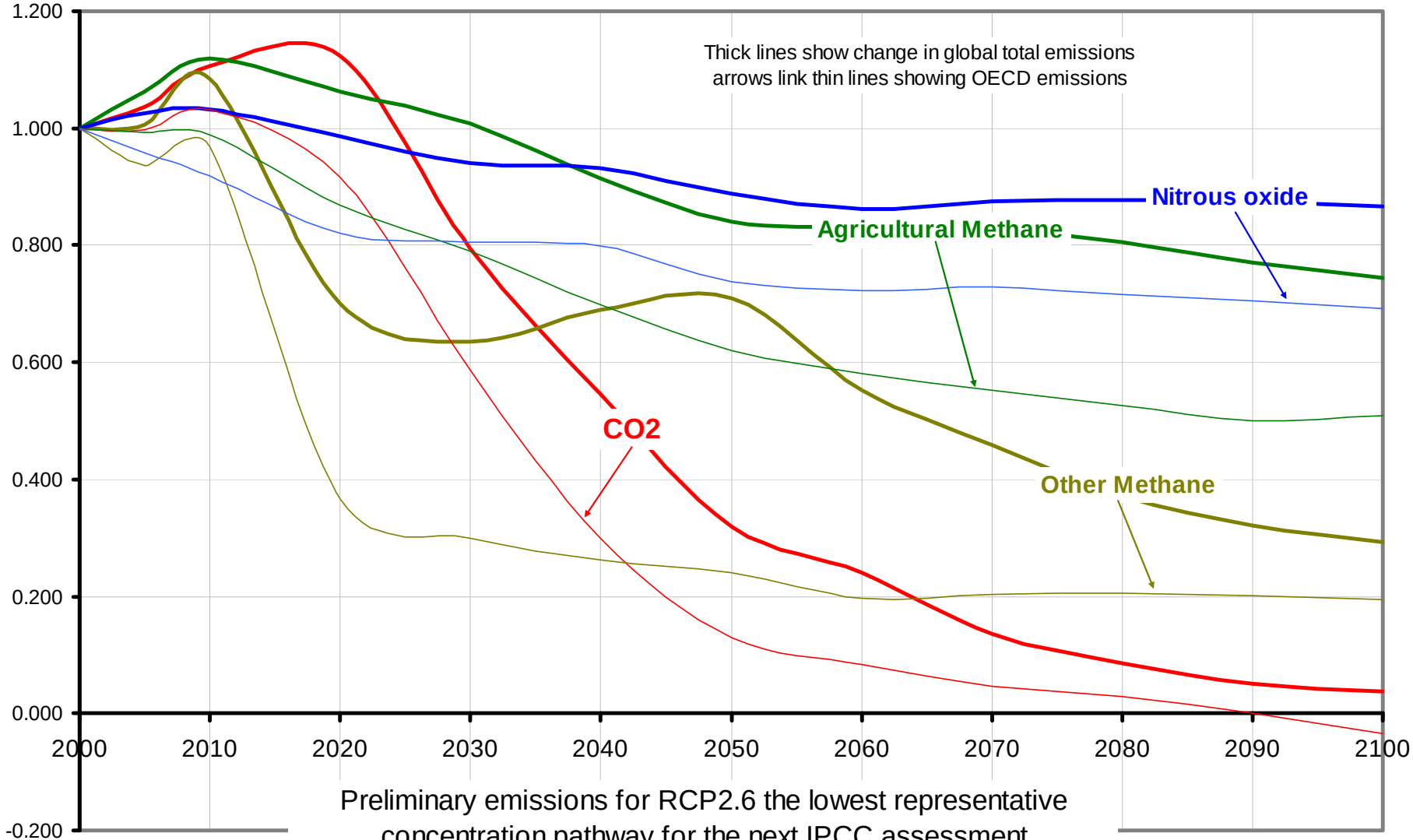
Comparing emissions for stabilisation



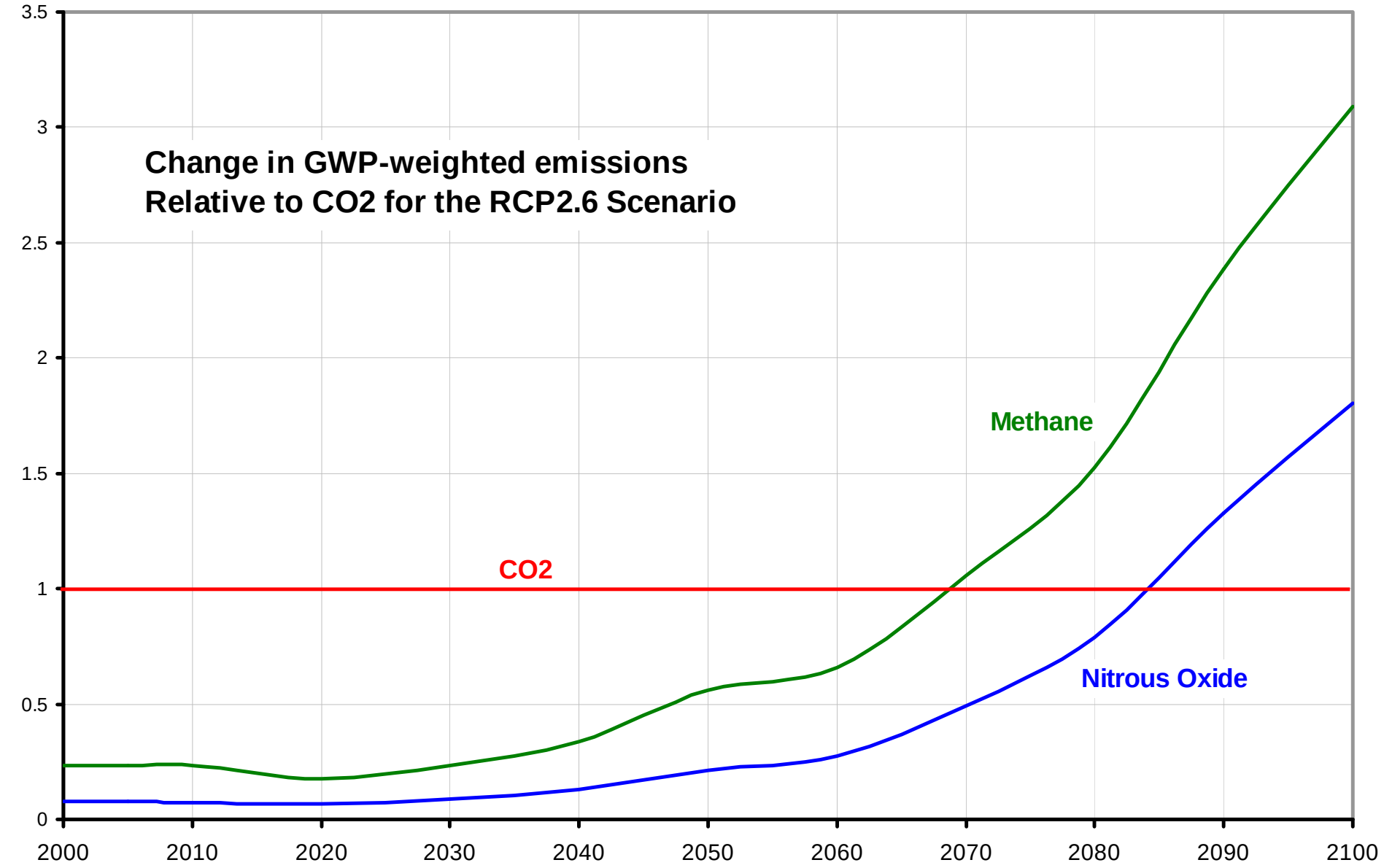
Other contextual issues

- GWPs are based on the idea of well balanced increases in costs – but global balance has to go beyond climate change
- The poorest 1 billion people depend on rice – a GWP based carbon price increase in rice would be relatively bigger than for lamb and butter
- Look at the RP2.6 scenario aimed at 2^{o}C warming in the next IPCC assessment

Relative Changes in Global Emissions (from year 2000) for Keeping Global Warming to 2 degrees C



Preliminary emissions for RCP2.6 the lowest representative concentration pathway for the next IPCC assessment


Change in GWP-weighted emissions
Relative to CO2 for the RCP2.6 Scenario
Methane
CO2
Nitrous Oxide
3.5
3
2.5
2
1.5
1
0.5
0
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100

Summary

- GWPs are a good start but lead to distortion if we head towards stabilisation
- Comparing marginal changes in emissions around a stabilisation path is better
- But it does not produce a constant exchange rate between gases
- We need more examinations of marginal perturbations around stabilisation pathways