Different greenhouse gases, their impact on climate, metrics, and the relevance to national approaches to mitigation

22 June 2021

Andy Reisinger

(**personal views only**, but disclosure: in my day job I work for the New Zealand Ministry for the Environment as Principal Scientist, Climate Change)

Some key Paris Agreement provisions

- *"Holding the increase in the global average temperature to well below 2 °C and pursuing efforts to limit the temperature increase to 1.5 °C above pre-industrial levels*"
- Net-zero global GHG emissions in second half of 21st century
- *"Each Party's successive nationally determined contribution will represent a progression beyond the Party's then current nationally determined contribution and reflect its highest possible ambition, reflecting its common but differentiated responsibilities and respective capabilities, in the light of different national circumstances*"

IPCC Special Report on 1.5°C

- For well below 2°C, global temperature peaks around 2070
- For 1.5°C, global temperature peaks around 2050
- Global warming at any point in time depends on:
  - ✓ CO_2: cumulative emissions up to that point
  - ✓ CH_4: rate of emissions during ~4 decades prior to that point
- ***Every tonne of CO_2 or CH_4 emitted from now on will make Earth warmer in 2050 and 2070 than it would be without those emissions***

"Every bit of warming matters, every year matters, every choice matters"

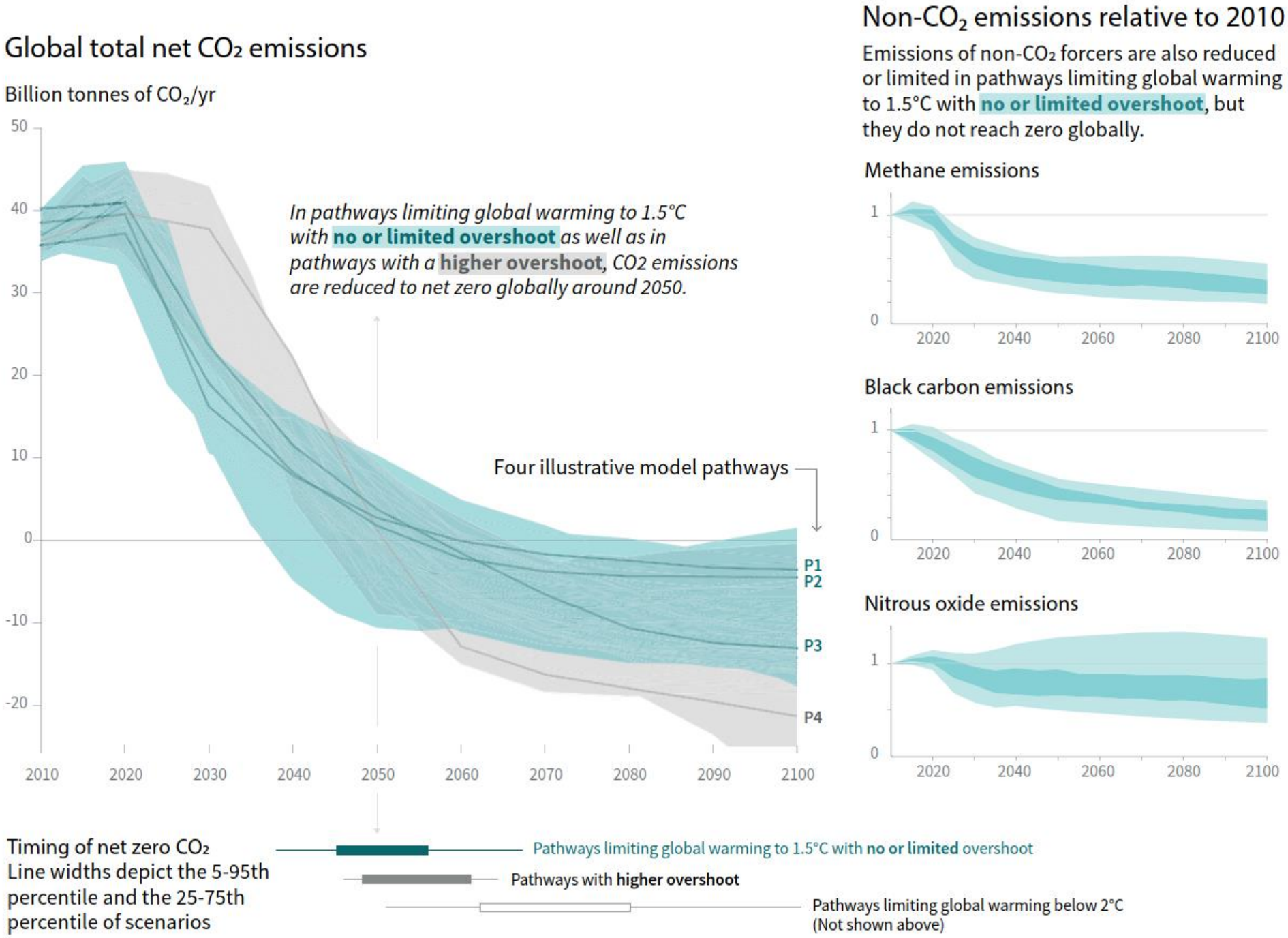
IPCC Special Report on 1.5°C

*"Pathways limiting global warming to 1.5°C with no or limited overshoot would require rapid and far-reaching transitions in energy, land, urban and infrastructure (including transport and buildings), and industrial systems (*high confidence*).*

*These systems transitions are unprecedented in terms of scale, but not necessarily in terms of speed, and imply deep emissions reductions in all sectors, a wide portfolio of mitigation options and a significant upscaling of investments in those options (*medium confidence*)."*

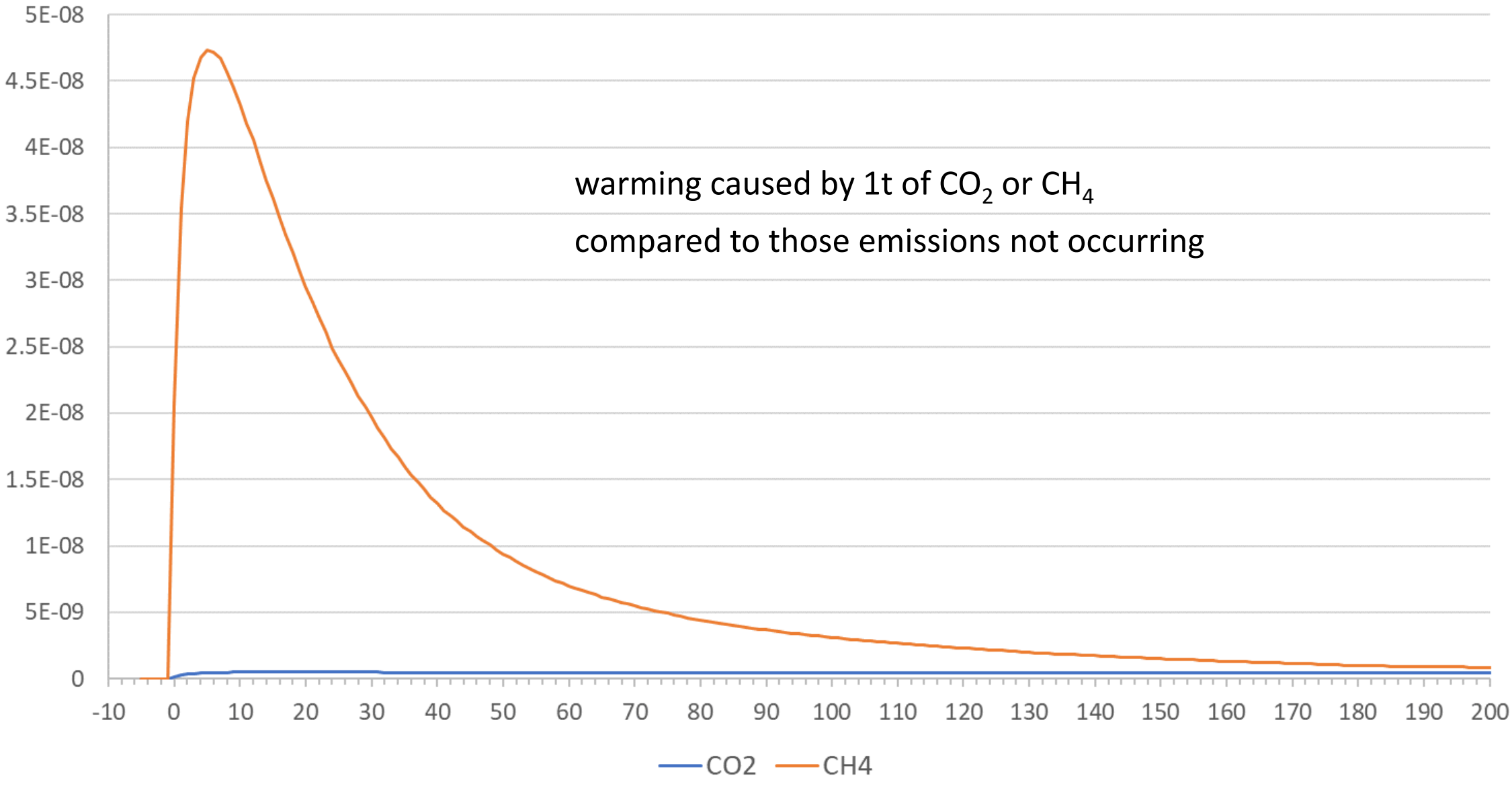
The more stringent the temperature target, the less possible it becomes to leave any sector out of rapid and far-reaching transitions

IPCC global least-cost emissions pathways for 1.5°C



CO_2 and CH_4: same, same, but different?

- Every future emission of CO_2 and CH_4 contributes to warming now and at peak if we have any intention of meeting Paris goals
- Every future emission causes damages that would not have occurred if that emission had not occurred
- We should try to avoid every emission of every gas, with the effort roughly proportional to the damage each emission causes …
- … or if we have a prescribed target, with the effort roughly proportional to the effect of that emission on the target.
- The fact that warming from past CH_4 emissions decays naturally does not change this. It means that damages from successive emissions don't accumulate – we're lucky that way. But it doesn't negate the damage caused by each and every emission.


warming caused by 1t of CO_2 or CH_4
compared to those emissions not occurring
5E-08
4.5E-08
4E-08
3.5E-08
3E-08
2.5E-08
2E-08
1.5E-08
1E-08
5E-09
0
-10 0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200
CO2
CH4

From a global goal to national / sectoral actions

- What science can tell us:
  - It's a zero-sum problem: less mitigation of one source requires more mitigation in another source to reach the same temperature limit with the same probability
  - The higher the rate of CH_4 emissions, the earlier we must reach net-zero CO_2; the later we reach net-zero CO_2, the lower the rate of CH_4 emissions must be
- What science can't tell us: how to distribute effort amongst emitters
- Distributing effort across emitters depends *entirely* on value judgements about what is considered feasible (economically, socially, environmentally) and fair – highest possible ambition?
  - Feasible or fair ≠ least cost
  - Feasible or fair ≠ most efficient producer
  - Feasible or fair ≠ causing no additional warming

New Zealand context

- Split-gas target 2050 – reduce biogenic CH_4 by 24-47%, net-zero all others
- Additional target for biogenic CH_4: -10% by 2030 (political compromise)
- Large part of near-term agricultural reductions from freshwater policy (about 7%)
- CO_2 removals from forestry core element of domestic climate policy but also seen by parts of agriculture sector as a threat to sheep/beef farming
- Split-gas target increases transparency but removes flexibility
- Advice from Climate Change Commission:
  - ✓ first set of domestic budgets to 2035 – now for consideration by Government
  - ✓ emphasis on feasibility but would track to (over)achieve current 2050 targets
  - ✓ biogenic CH_4 -12.5% by 2030: -29% waste, -11% agriculture – ***if*** no new technologies
  - ✓ farm-level price measure key to deliver ag reductions beyond non-climate policies
  - ✓ separate advice: current NDC is not compatible with a goal of limiting warming to 1.5°C
  - ✓ will consider adequacy of domestic targets in light of any new evidence in 2024

Challenges and choices

Science cannot tell us how much any sector in Ireland ‘should’ reduce its emissions – this is *always, entirely* a normative judgement

Science can tell us about the consequences of our choices

Economic, social, environmental science can offer insights about how much any sector ‘could’ reduce their emissions → proportionate *effort*

1. what’s any given sector’s *highest possible ambition*?
2. does it add up to the national target(s)?

… if not, rinse and repeat

3. do the country targets add up to the global target(s)?

… if not, rinse and repeat

Thank you