UN environment programme

CLIMATE & CLEAN AIR COALITION
TO REDUCE SHORT-LIVED CLIMATE POLLUTANTS

UNEP convened initiative

Science behind non-CO2 gases interactions with ozone & climate

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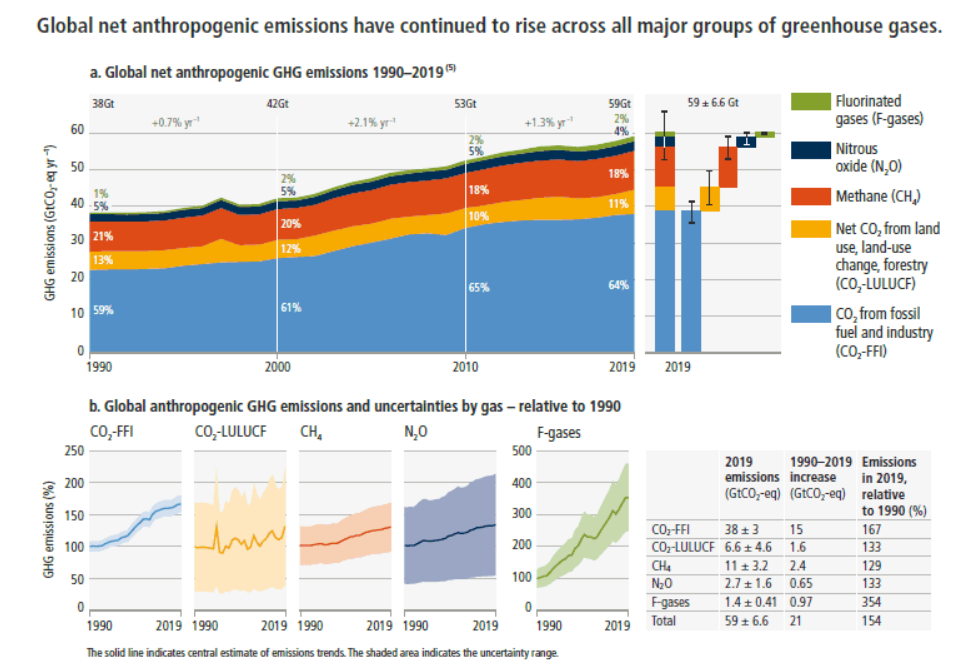
www.ccacoalition.org

Warming impacts of non-CO2 gases such as HFCs, methane and N2O



	2019 emissions ($GtCO_2$-eq)	1990–2019 increase ($GtCO_2$-eq)	Emissions in 2019, relative to 1990 (%)
CO_2-FFI	38 ± 3	15	167
CO_2-LULUCF	6.6 ± 4.6	1.6	133
CH_4	11 ± 3.2	2.4	129
N_2O	2.7 ± 1.6	0.65	133
F-gases	1.4 ± 0.41	0.97	354
Total	59 ± 6.6	21	154

SUPER POLLUTANTS

Climate pollutants	Major human sources	Atmospheric lifetime	Air pollutant	Air pollutant precursor	Contribution to 1750-2019 global warming due to emissions
Carbon Dioxide (CO_2)		Centuries			0.951
Methane (CH_4)*		Decades		X	0.595
Tropospheric Ozone (O_3)*	CH_4 CO VOCs	Weeks to months	X		N/A
Carbon Monoxide (CO)*		Weeks to months	X	X	0.247
Volatile Organic Compounds (VOCs)*		Minutes to years	X	X	
Fluorinated-gases (F-gases; e.g. hydrofluorocarbons (HFCs))*		Years to decades			0.102
Nitrous Oxide (N_2O)		Centuries			0.108
Black Carbon (BC)*		Days	X		0.063

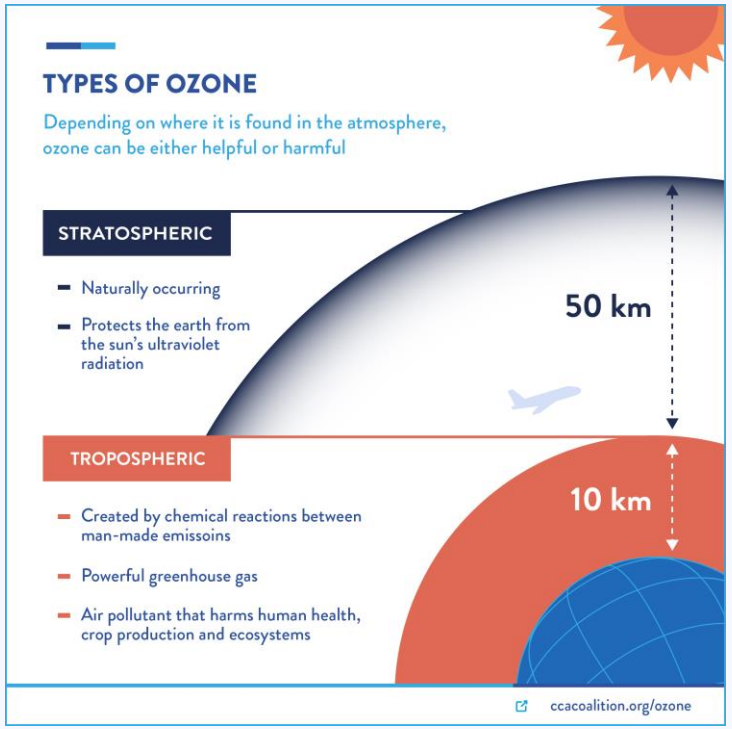
Sources: IPCC, IPCC Sixth Assessment Report; CCAC, Super Pollutant Factsheet

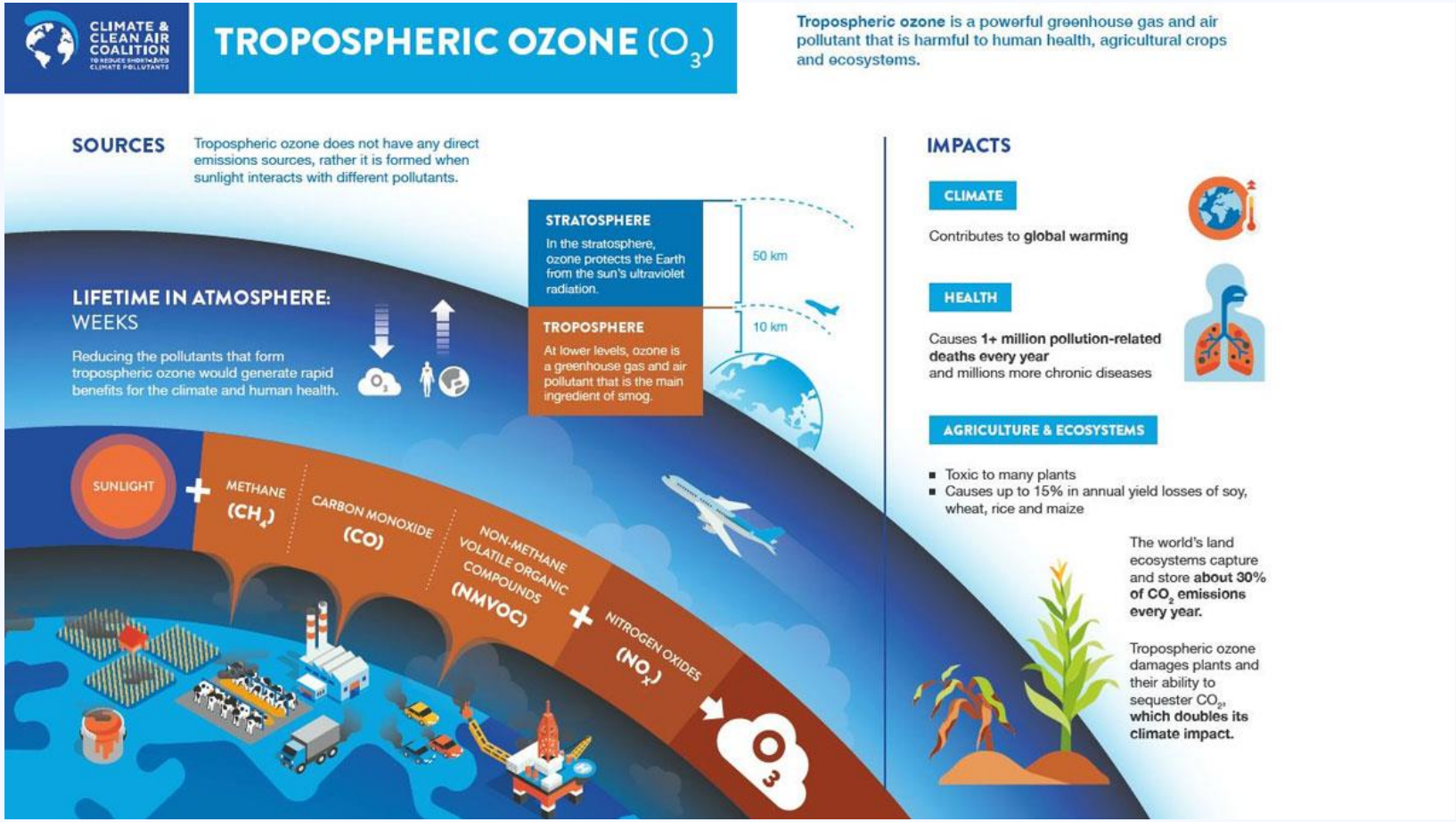
Warming impacts of non-CO2 gases such as HFCs, methane and N2O

Species	Lifetime (Years)	Radiative Efficiency (W m^{-2} ppb^{-1})	GWP-20	GWP-100	GWP-500	GTP-50	GTP-100
CO_2	Multiple	$1.33 \pm 0.16 \times 10^{-5}$	1.	1.000	1.000	1.000	1.000
CH_4-fossil	11.8 ± 1.8	$5.7 \pm 1.4 \times 10^{-4}$	82.5 ± 25.8	29.8 ± 11	10.0 ± 3.8	13.2 ± 6.1	7.5 ± 2.9
CH_4-non fossil	11.8 ± 1.8	$5.7 \pm 1.4 \times 10^{-4}$	79.7 ± 25.8	27.0 ± 11	7.2 ± 3.8	10.4 ± 6.1	4.7 ± 2.9
N_2O	109 ± 10	$2.8 \pm 1.1 \times 10^{-3}$	273 ± 118	273 ± 130	130 ± 64	290 ± 140	233 ± 110
HFC-32	5.4 ± 1.1	$1.1 \pm 0.2 \times 10^{-1}$	2693 ± 842	771 ± 292	220 ± 87	181 ± 83	142 ± 51
HFC-134a	14.0 ± 2.8	$1.67 \pm 0.32 \times 10^{-1}$	4144 ± 1160	1526 ± 577	436 ± 173	733 ± 410	306 ± 119
CFC-11	52.0 ± 10.4	$2.91 \pm 0.65 \times 10^{-1}$	8321 ± 2419	6226 ± 2297	2093 ± 865	6351 ± 2342	3536 ± 1511
PFC-14	50,000	$9.89 \pm 0.19 \times 10^{-2}$	5301 ± 1395	7380 ± 2430	10,587 ± 3692	7660 ± 2464	9055 ± 3128

Sources: IPCC, IPCC Sixth Assessment Report

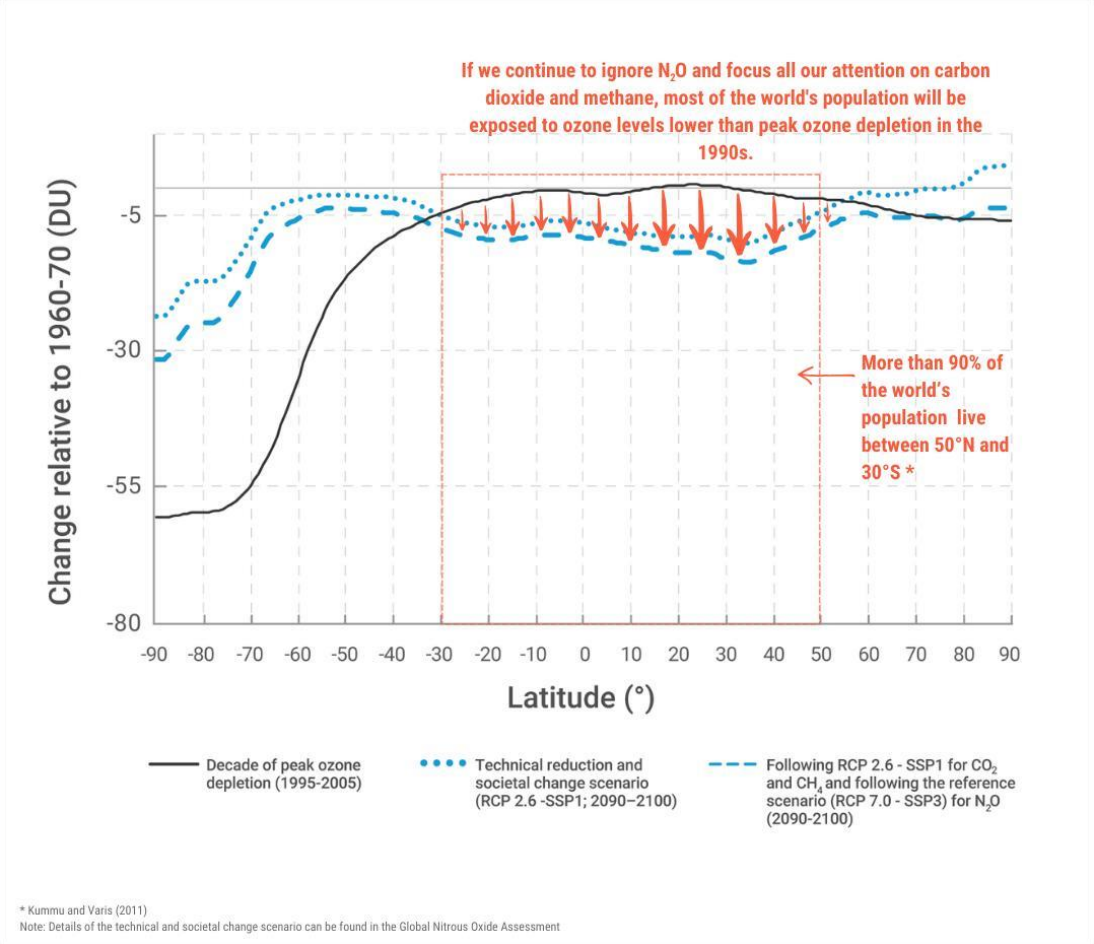
How methane influences both ozone destruction and formation





Sources: CCAC, Global Methane Assessment

Inaction on N_2O



Inaction on N_2O could lead to ozone depletion and harmful UV exposure for much of the world's population at levels worse than peak depletion in the 1990s.

Ambitious abatement of N_2O emissions could avoid a 2-10 per cent increase in skin cancers by 2080-2090.

Sources: UNEP and FAO, Global Nitrous Oxide Assessment

Ozone layer impacts

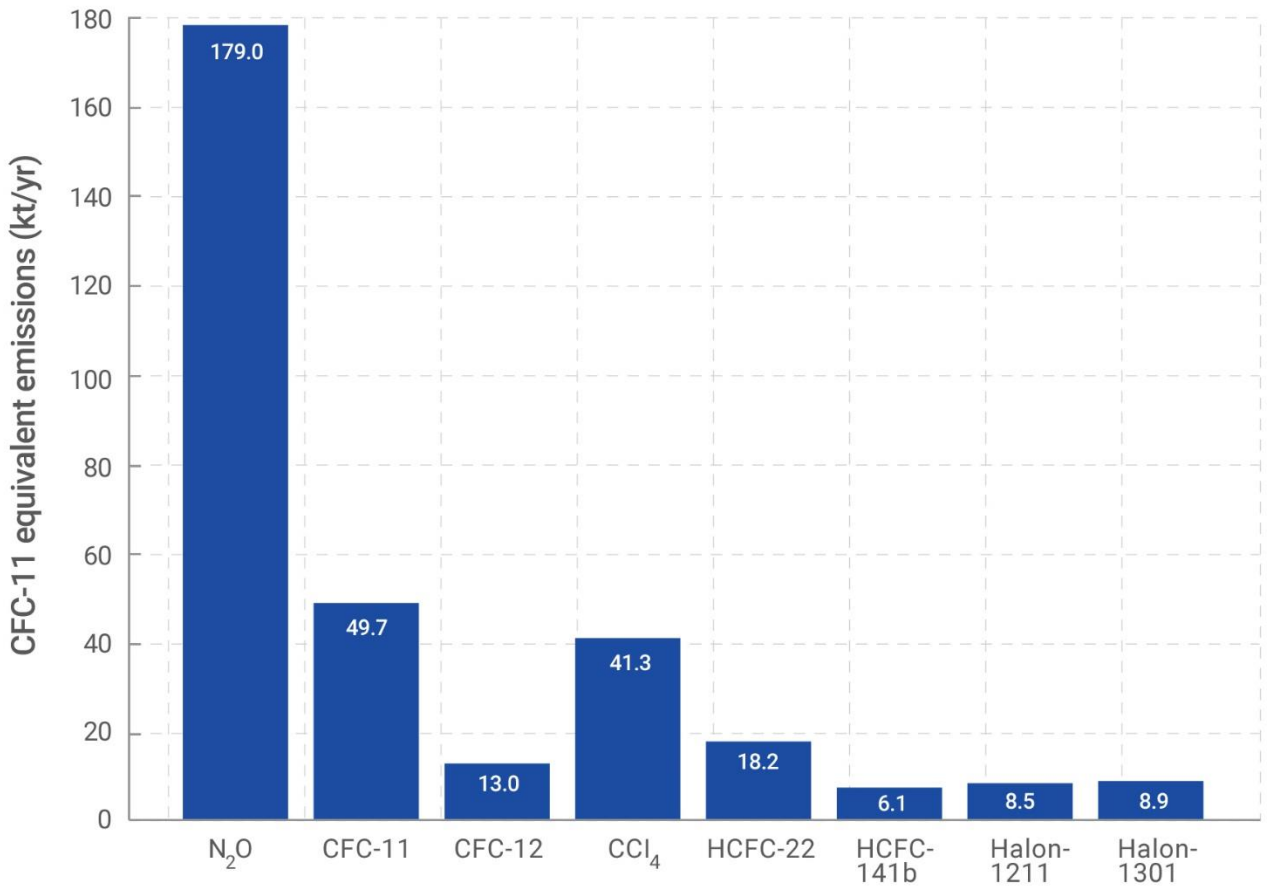
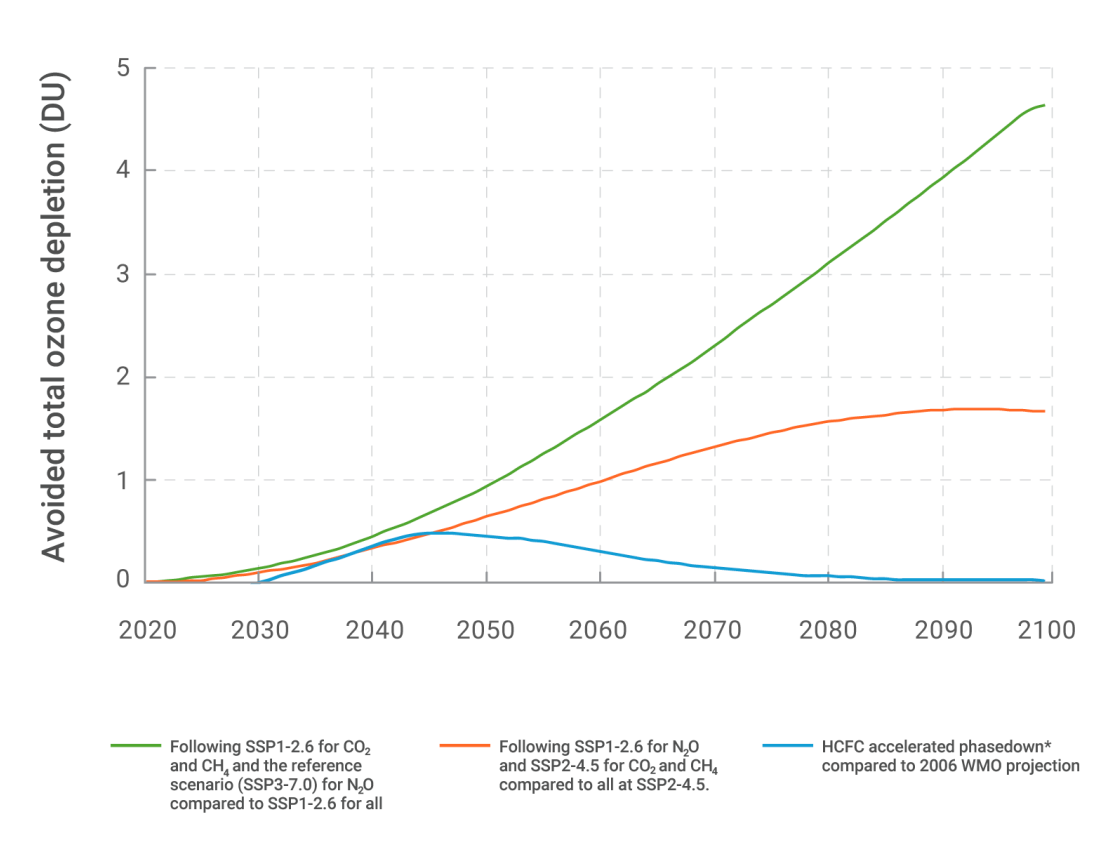


Figure 4.8 Comparison of the ozone-depleting potential-weighted global anthropogenic emissions of nitrous oxide with those of gases controlled under the Montreal Protocol, 2016, in megatonnes of CFC-11 equivalent per year.

- N_2O's ozone layer impacts have been known since the 1960s; but N2O was NOT thought of as an ODS.
- Success of the Montreal Protocol and accelerating emissions of anthropogenic N_2O means that N_2O is now most significant ozone depleting substance emitted to the atmosphere
- Its ODP-weighted emissions are equal to all other current emissions of ozone depleting substances combined

Sources: UNEP and FAO, Global Nitrous Oxide Assessment

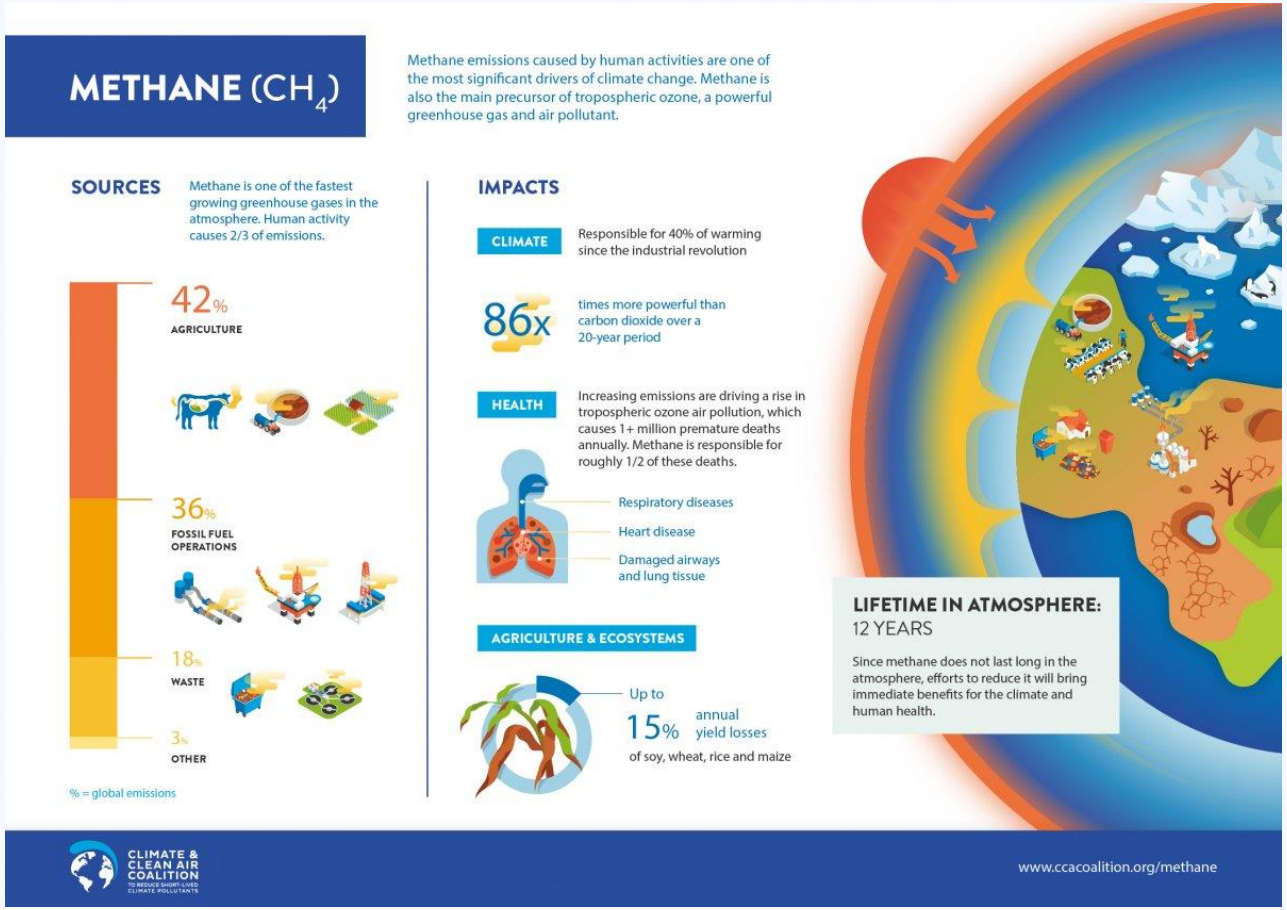
Benefits to ozone layer of ambitious action



- Ambitious N_2O abatement relative to 2020 levels could deliver more than five times the ozone benefits of the accelerated HCFC phase-out
- Ambitious abatement relative to a high emissions scenario could deliver more than 12 times the ozone benefits of the accelerated HCFC phase-out

Sources: UNEP and FAO, Global Nitrous Oxide Assessment

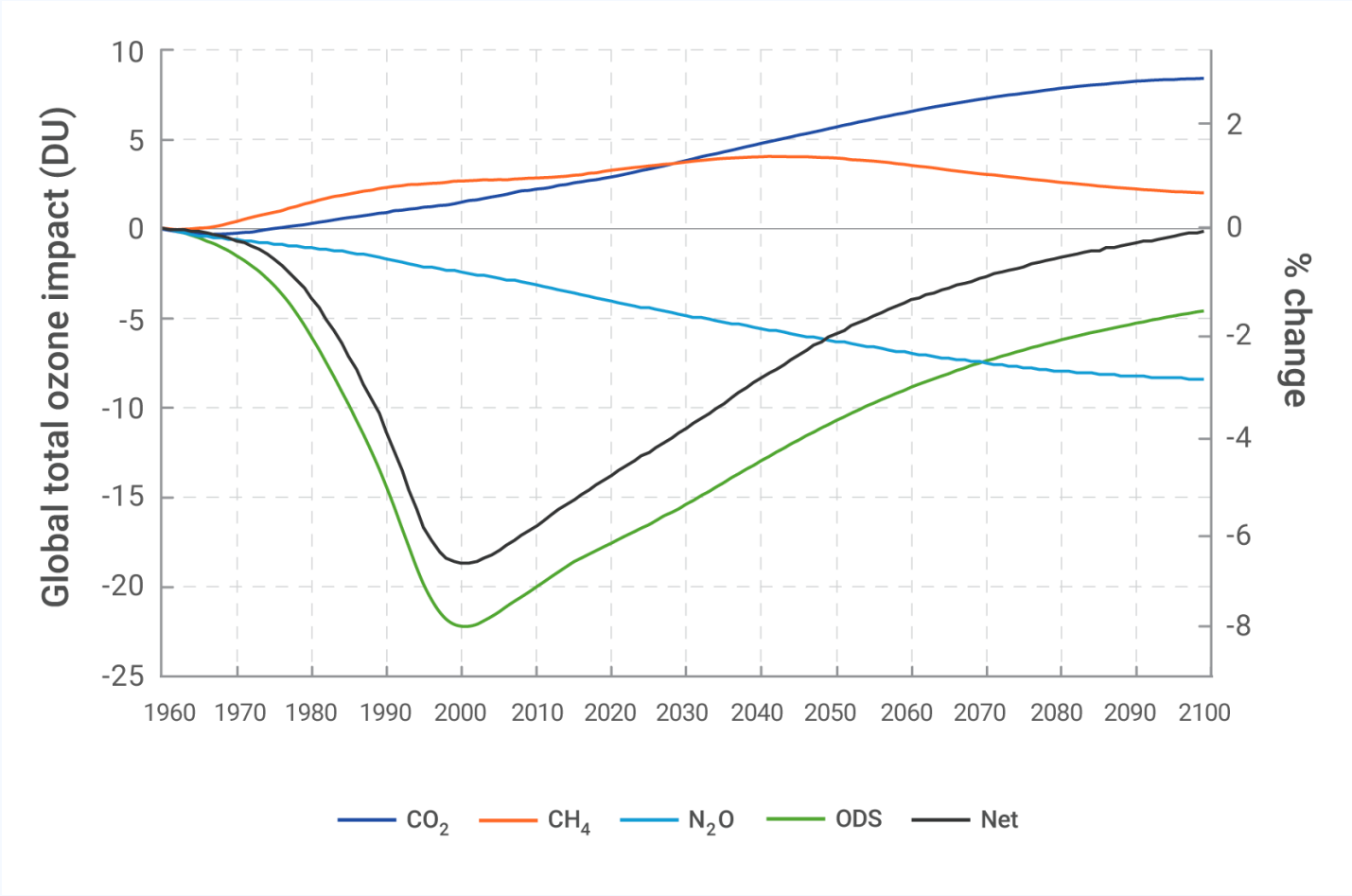
Why mitigation of methane remains important in spite of its contribution to increased stratospheric levels



- Methane is one of the fastest growing greenhouse gas in the atmosphere
- It has greater warming potential than CO2 in the near-term
- Fast reduction of methane can provide significant health, agriculture and socio-economic return

Sources: CCAC, Global Methane Assessment

Why mitigation of methane remains important in spite of its contribution to increased stratospheric levels

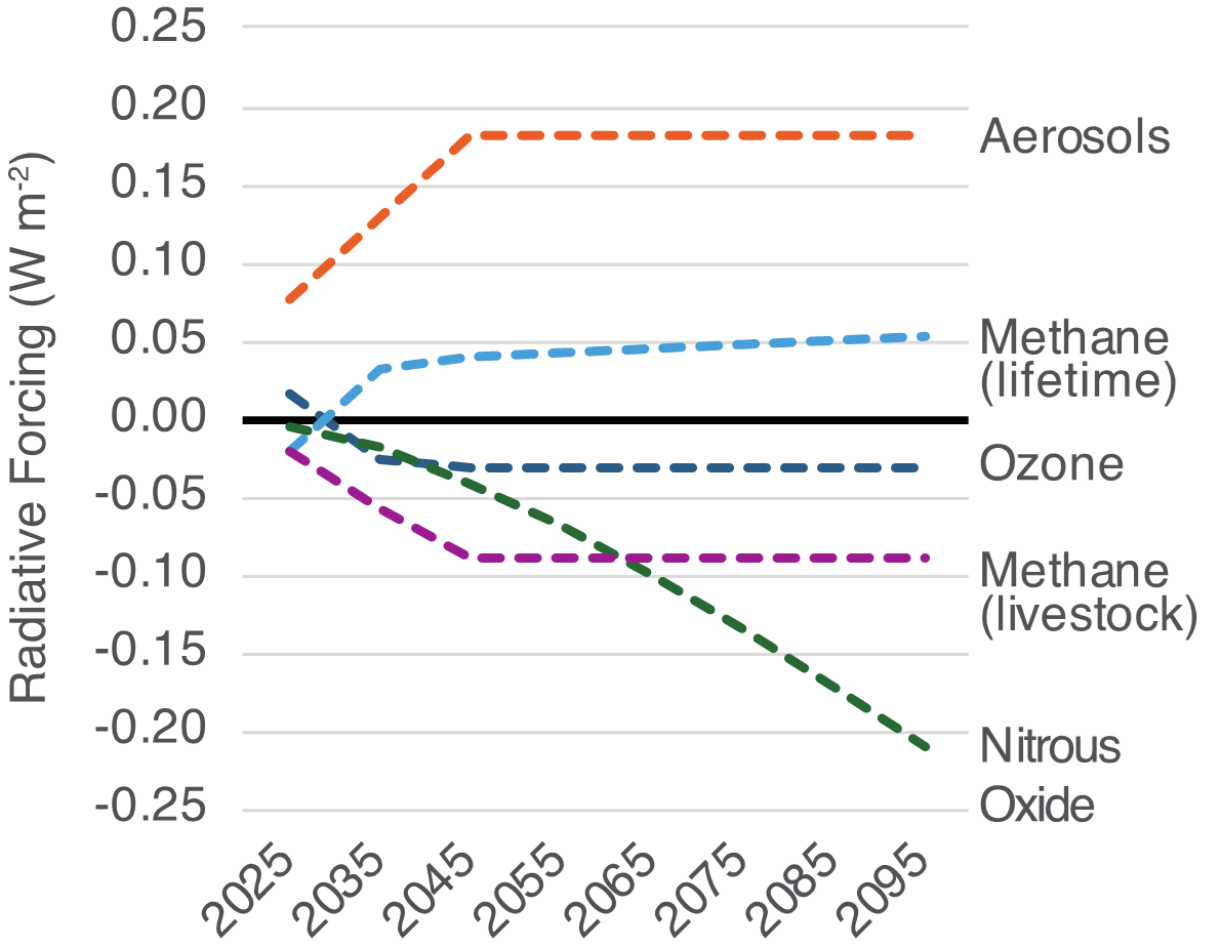


- The net evolution of the ozone layer reflects the combined effects of ozone-depleting substances and multiple greenhouse gases, rather than any single pollutant.
- If we mitigate (hopefully!) CO2 and methane, the role of N2O would be amplified.

Sources: UNEP and FAO, Global Nitrous Oxide Assessment

The need for addressing all non-CO2 and CO2 pollutants in an integrated manner from the scientific point of view

- In near-term, aerosol reductions have the largest impact
- In the long term, nitrous oxide reductions have the largest impact
- Methane abatement from livestock has a large impact

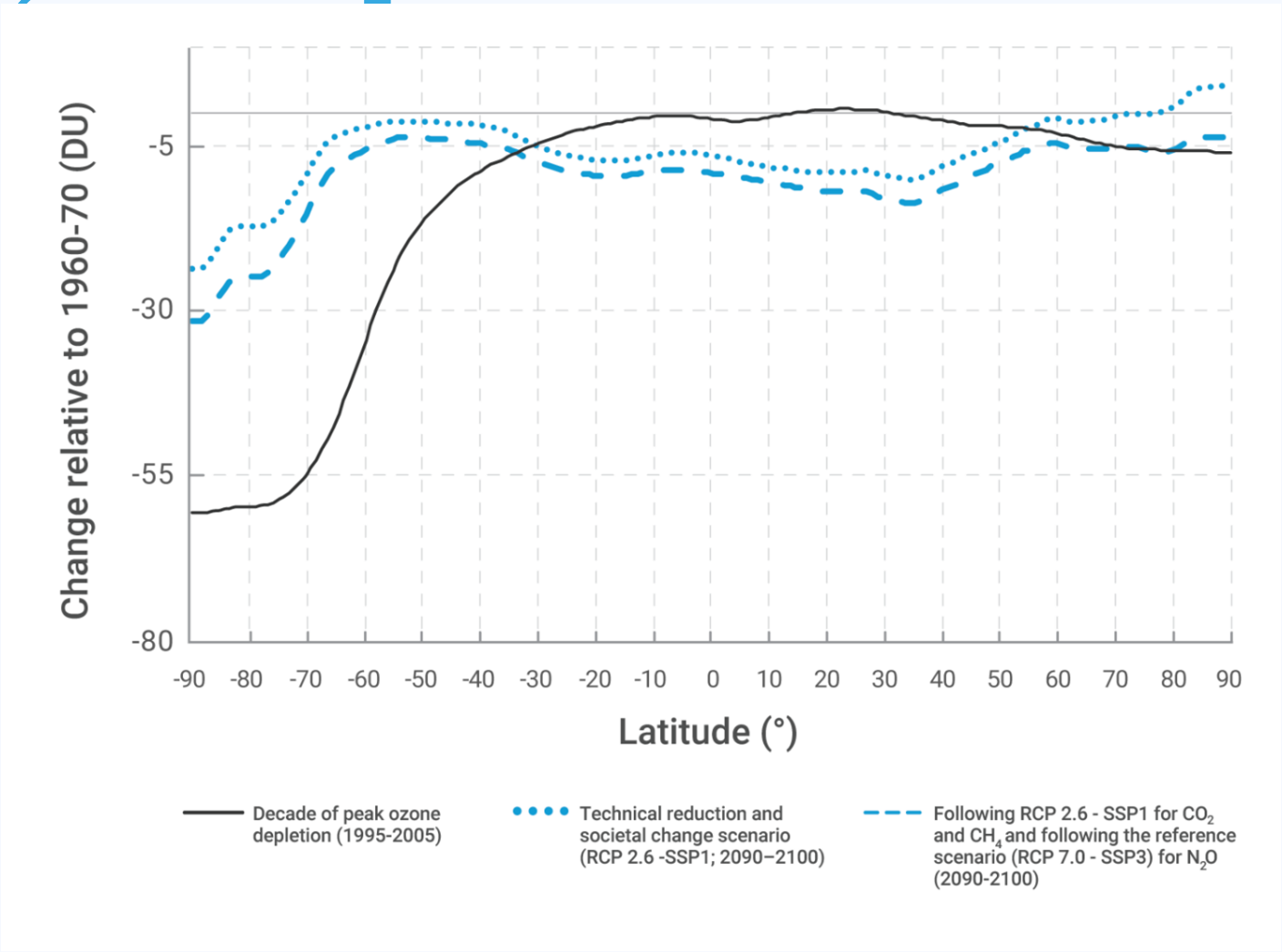


Sources: UNEP and FAO, Global Nitrous Oxide Assessment

N_2O's impact when CO_2 and CH_4 are reduced

If we act on CO_2 and CH_4, but not on N_2O…

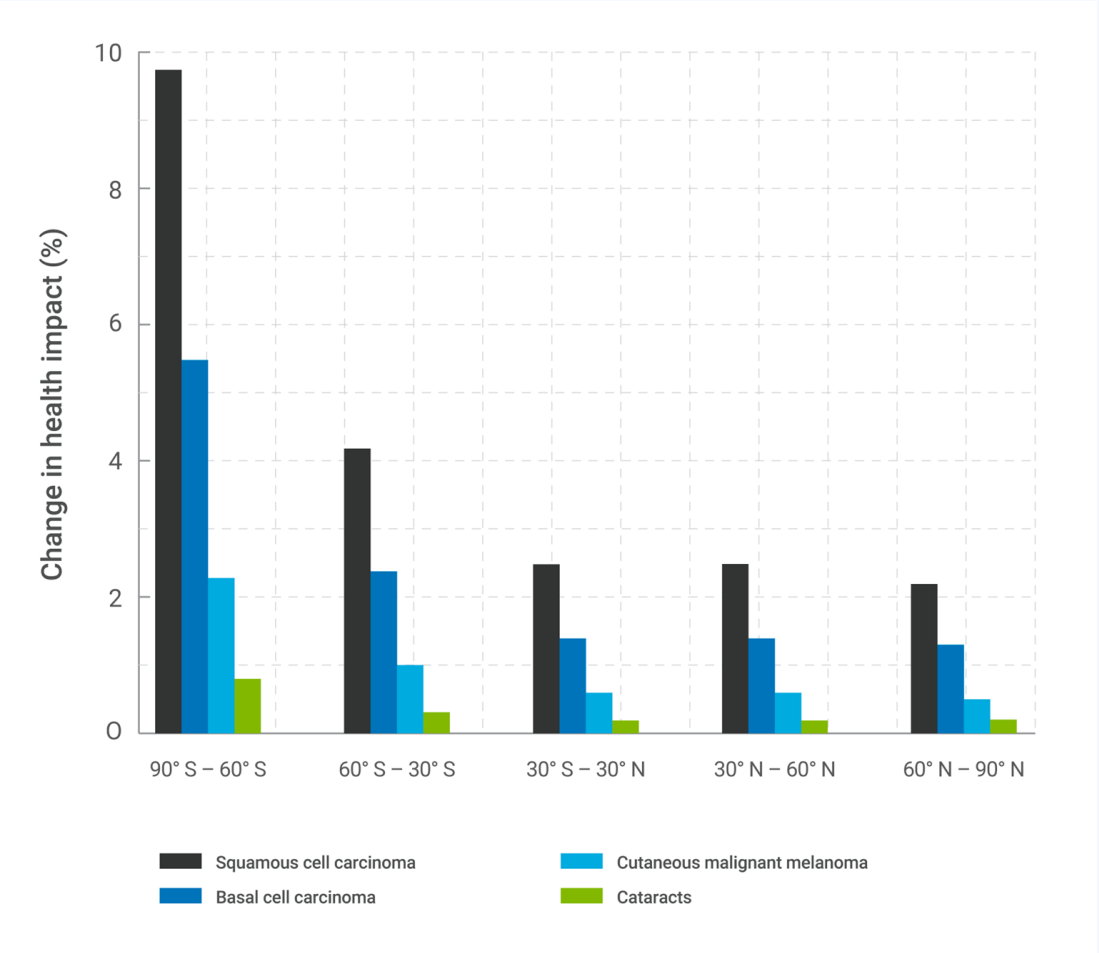
Impacts are in the tropics, the most populated region



Sources: UNEP and FAO, Global Nitrous Oxide Assessment

If we act on CO_2 and CH_4, but not on N_2O…

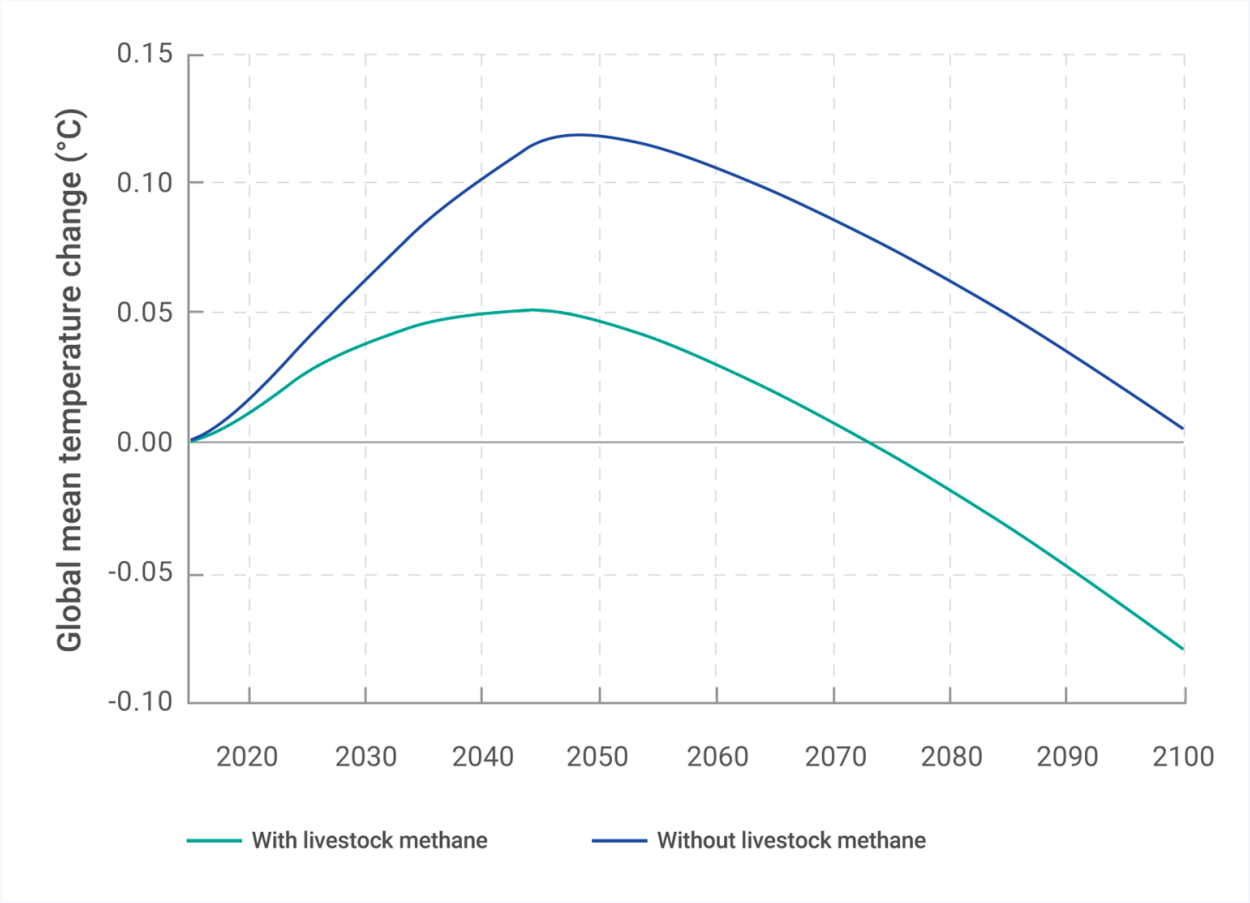
- The human health impacts of unabated N_2O emissions could be significant due to increased levels of harmful UV exposure
- Unabated N_2O emissions could increase cataract cases by up to 1% and certain skin cancers by up to 10% by end of the century, depending on latitude



Sources: UNEP and FAO, Global Nitrous Oxide Assessment

Climate: Temperature response

- Modest warming through 2050
  - Similar to effects of phasing out fossil fuels containing sulfur
- Including livestock methane, near-term warming is very small
- Long-term:
  - Net cooling towards end of century when including livestock methane



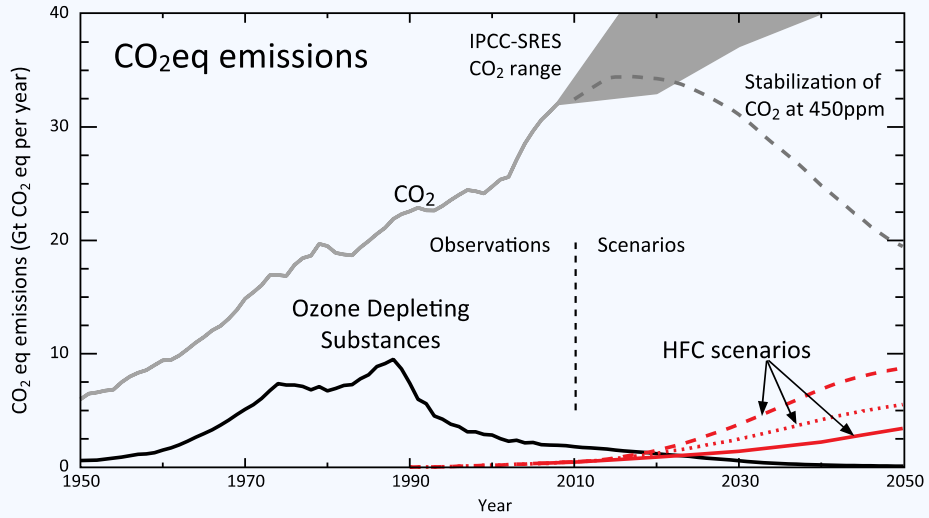
Sources: UNEP and FAO, Global Nitrous Oxide Assessment

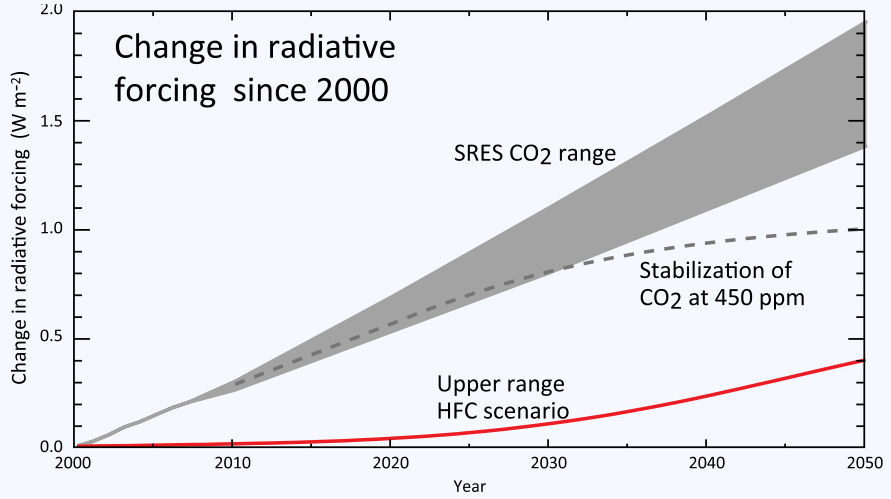
Montreal Protocol is also a “climate treaty*”

Some HFC (in the atmosphere mostly because of the MP’s strategy) could have been a major contributor to climate change.

- MP enacted the Kigali amendment to avoid this future issue, thus helping climate change mitigation.
- Faster phase down would further help mitigate climate change.
- Continued examination of the HFC-substitutes is warranted to ensure the intended outcome for the ozone layer and climate.

*Thanks to Tina Birmpili





Sources: UNEP, HFCs: A Critical Link in Protecting Climate and the Ozone Layer

To summarize…

There are connections in science between CH_4, N_2O, HFCs, and CO_2- connections as driving agents for multiple issues

There are connections in consequences of taking action for one policy on related policies

Concerted action would be helpful

Necessary for policy to take connections into account

Thank you for your attention!