The science of net zero

The single largest driver of the currently-changing climate is CO_2. As long as human activities continue to add CO_2 to the atmosphere, the global temperature will keep rising. This means that stabilising global warming at any level requires us to end all CO_2 emissions, or balance out any residual emissions with removals: net zero.

In ratifying the Paris Agreement, countries agreed to 'pursue efforts' to limit the temperature rise to 1.5˚C. They also agreed to achieve a balance between sources and sinks of greenhouse gases from human activities in the second half of this century.

Tasked by countries with assessing what it will take to meet the 1.5˚C limit, the IPCC concluded in 2018 that global emissions of CO_2 must approximately halve by 2030, reach net zero by mid-century, and continue to fall beyond. Emissions of other greenhouse gases must also fall sharply. In these pathways, total emissions of all greenhouse gases (when measured in standard CO_2-equivalent terms) reach net zero around 2060-2070.

Although the IPCC stipulates that it is CO_2 emissions alone that reach net zero by mid-century, many targets include all major greenhouse gases in combination. A 2050 net zero target for all greenhouse gases, such as the UK's, is in practice more ambitious than a target of net zero CO_2 by 2050.

Use of carbon offset credits muddies the picture somewhat, not least because offsets encompass a range of different approaches spanning emission reduction (e.g. energy efficiency or renewables projects), emission avoidance (e.g. forest preservation) and removal from the air (e.g. tree planting or, at small scales, engineered CO_2 capture and storage). Crucially, the only form of net zero which stabilises global temperature is one in which any continued emissions of fossil CO_2 are balanced out by permanent removals of CO_2.[1]

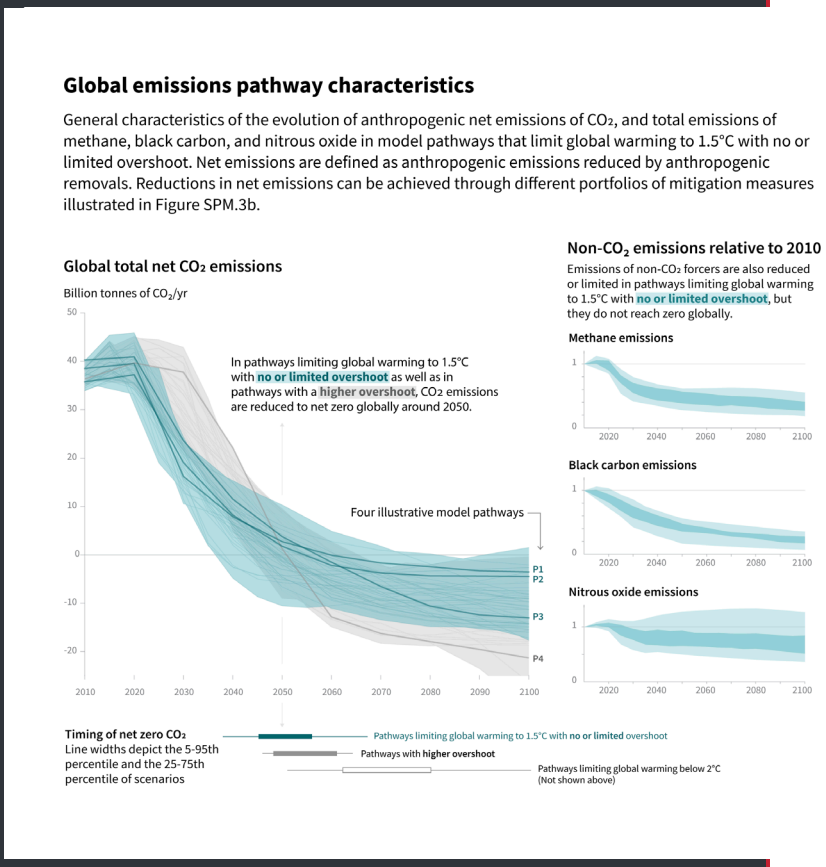

Fig. 2: From IPCC Special Report on 1.5˚C of Global Warming (https://www.ipcc.ch/sr15/chapter/spm/spm-c/spm3a/)

1 Allen et al. (2020) The Oxford Principles for Net Zero Aligned Carbon Offsetting https://www.smithschool.ox.ac.uk/publications/reports/Oxford-Offsetting-Principles-2020.pdf

with potentially important co-benefits for biodiversity. But there are multiple concerns: last month, for example, a Friends of the Earth report called offsetting 'chasing carbon unicorns,' saying that 'powerful actors are using net zero pledges to hide their climate inaction.'[25] In order to be truly consistent with stabilising the climate, any offsetting will eventually need to involve permanent CO_2 removal, for which very few projects currently exist.[26]

25 https://www.foei.org/resources/publications/chasing-carbon-unicorns-carbon-markets-net-zero-report
26 Allen et al. (2020) The Oxford Principles for Net Zero Aligned Carbon Offsetting https://www.smithschool.ox.ac.uk/publications/reports/Oxford-Offsetting-Principles-2020.pdf

Fig. 3: The Race to Zero 'starting line' criteria (https://unfccc.int/sites/default/files/resource/Minimum-criteria-for-participation-in-RTZ.pdf)

Other issues are that some net zero pledges do not specify which greenhouse gases are covered, contain no requirement to report progress, and may draw attention away from the need for immediate action to begin cutting emissions.

In parallel with this civil society criticism, academics and other experts have developed checklists of criteria that a credible net zero target needs to have. The NewClimate Institute and Data Driven EnviroLab proposed 'Ten basic criteria for net zero target transparency', including charting a decarbonisation pathway with interim targets, providing details on use of offsets and documenting a stakeholder consultation.[27] The World Resources Institute suggested that, to be credible, net zero

27 https://newclimate.org/2020/10/22/navigating-the-nuances-of-net-zero-targets/