

COP26 Briefing paper: Updated warming projections for NDCs, long-term targets and the methane pledge. Making sense of 1.8°C, 1.9°C and 2.7°C.

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Key points:

- Implementing all conditional NDCs, and the long-term targets implies a best-estimate peak warming this century of 1.9°C, with end-of-century warming of 1.8°C. To make this a reality, the world needs domestic policies, implementation and adequate support, not just pledges.
- Considering only the unconditional NDCs up to 2030 is more in line with an emission trajectory towards 2.7°C (2.1 to 3.5°C) warming.
- The main difference between 2.7°C and 1.9°C projections is due to whether long-term and net-zero targets are considered.
- Further progress towards 1.5°C warming is likely impossible without substantially enhanced ambition this decade.
- While the Global Methane Pledge on its own might yield 0.2°C temperature reductions, we find that in the context of NDCs and long-term targets, the reduction is more limited, by a factor of ten (i.e. only 0.02°C of median peak warming is shaved off).

¹ This is an expanded and updated analysis on the 3rd November Briefing paper, available at climate-resource.com/tools/ndcs.

Summary:

The pledges put forward in the lead up to and during COP26 could, if supported and achieved, result in projected best-estimate peak warming of 1.9°C and end-of-century warming of approximately 1.8°C (5% to 95% range from 1.3 to 2.7°C). If long-term and conditional targets are not implemented, either due to a lack of support or lack of domestic policies, the 2030 NDCs could well be on a trajectory that leads to 2.7°C median warming by the end of the century with a range from 2.1 to 3.5°C, as suggested in the UNFCCC Synthesis Report. These projections come with a wide uncertainty range, both in terms of the conditionality, precise definitions of the NDCs as well as the climate system uncertainties. We analysed the previous and current NDCs for 196 countries². We also considered on a country-by-country basis the extent to which the NDCs and long-term targets of 130 countries that signed the Global Methane Pledge might already imply some reduction of methane. When avoiding double counting, we find that the temperature benefit of the Global Methane Pledge for peak warming might be an additional 0.02°C beyond what conditional NDCs and long-term targets might be able to achieve.

For the first time, commitments can be regarded as consistent with the goal of limiting warming to 2°C. An immediate increase in commitments and acceleration of the pace of reduction in emissions is required for the world to be on a path to 1.5°C. Strong policies, support for ambitious conditional NDCs and implementation actions are now needed to deliver the changes that are critical to achieving the pledges already made.

This briefing note steps through some key aspects of warming projections made in relation to the NDCs and long-term targets that are currently on the table, ranging from 1.8°C, 1.9°C to 2.7°C.

² available as NDC factsheets on climate-resource.com/tools/ndcs

Background:

- **An historic moment:** For the first time in history, the aggregate effect of the combined pledges by 194 countries could deliver projected 2100 warming of $<2^{\circ}\text{C}$ with more than a 50% chance. On 28th October, when China submitted its NDC, the most optimistic interpretation of NDCs could also have yielded 1.9°C median peak warming. We find that after India's announcement, peak warming could be limited even in a less optimistic interpretation (e.g. if countries are ambiguous in terms of what exact net-zero emissions concept they refer to, we assumed net-zero CO_2 rather than net-zero GHG in the less optimistic interpretation).
- **China and India and other countries:** The major changes that bring projected warming below the significant benchmark of 2°C are China's new NDC on 28th October and India's new announcement at COP26, both featuring net-zero emission targets by 2060 and 2070, respectively. We interpreted China's NDC as either referring to net-zero CO_2 or net-zero GHG, whereas we assumed India's 2070 net-zero emissions for now to cover CO_2 emissions only. Overall, 13 countries updated their NDCs since 18th October, our pre-COP26 comparison point with the latest being New Zealand and Comoros (all these updated NDCs are taken into account with country-by-country factsheets available on climate-resource.com/tools/ndcs).
- **The Global Methane Pledge** was joined by over 130 countries, including 27 EU countries, on 2nd Nov. The Global Methane Pledge commits to reduce methane emissions

by 30% between 2020 and 2030. It is likely to accelerate reductions, and help to reduce air pollution. A 30% reduction of global methane reductions would approximately equate to more than 100 Mt CH_4/yr . When considering country-emission profiles of the 130 participating countries and their conditional or unconditional NDCs, we find however that by 2030, there is only a total of 37 to 57 Mt CH_4/yr reductions needed, respectively, in order to meet at least a 30% reduction below 2019/2020 levels. The remainder of the reductions is likely to be part of the NDC and trajectory towards the long-term targets already. This is not to diminish the worthiness of the Global Methane Pledge as doubled pledges might support more action, although it is a word of caution against double counting. Analysing these additionally induced methane reductions in terms of their effect on peak warming suggest that the benefit might be less than 0.02°C - a factor of 10 less than has been assumed in some analysis.

- **Strong step forward from the 2.7°C projected warming in recent NDC assessments:** The reported warming of 2.7°C in line with the SSP2-4.5 scenario - is often associated with the NDC pledges from a few weeks ago (UNFCCC Synthesis Report, UNEP Gap report). The less ambitious and unconditional end of the NDC pledges to 2030 are still in line with the SSP2-4.5 scenario up to 2030. That SSP2-4.5 scenario is assessed by IPCC AR6 WG1 to yield 2100 temperatures around 2.7°C (with a range from 2.1°C to 3.5°C). Thus, if long-term targets are not assumed to be implemented, this is still a projection in line with pre-COP (unconditional) NDCs.
- **Including the long-term targets brightens the picture.** Our 3rd November aggregation pathway yields peak median

temperatures of 1.9°C and 2100 temperatures of 1.8°C (1.3°C - 2.7°C), very similar to the SSP1-2.6 scenario. The SSP1-2.6 scenario in IPCC AR6 WG1 is assessed to be 1.8°C (1.3°C to 2.4°C) by the end of the century.

- **Reasons for the difference:** The large difference between the 2.7°C warming estimates and an estimated peak warming of 1.9°C is twofold: For one, the 1.9°C estimate includes all the 70+ countries' long-term strategies (2050, 2060 or 2070 net-zero CO₂ or net-zero GHG and other targets etc). Secondly, it includes the new NDCs by China and a few other countries, including the announcement by India for lower 2030 emissions and net-zero by 2070. The UNEP Gapreport published in October 2021 quantified the effect of net-zero targets in the decades beyond 2030 as reducing mean projected 2100 warming by 0.5°C. Together with targets announced since 18th of October, we estimate this difference is now approximately 0.8°C. Since our previous briefing on 3rd November, the situation has not substantially changed with only the new 2030 target by New Zealand being officially received.
- **The fineprint - the limitations:** The temperature projections obviously hinge on the assumption that the pledges are going to be underpinned by respective climate, energy and land use policies and actions. In the near-term up to 2030, several pledged NDCs are far higher than business-as-usual

emission projections, whereas net-zero targets in the long-term require in all cases a substantial upscaling of efforts. All the conditional NDCs also require appropriately scaled-up climate finance and adequate support in order to be implemented. Take Australia's hollow net-zero pledge as an example: Without climate policies, sectoral targets and a change of course, the 2050 net-zero target won't come about. And 1.9°C won't be achieved without a proper implementation of the pledges.

- **Still a long way from 1.5°C:** The combined pledges of countries, both the conditional ones, and certainly the unconditional ones, are not yet sufficient to halt warming at around 1.5°C. Using probabilistic projections, the exceedance probability for 1.5°C is still around 90%, meaning wide scale increases of extreme climate events and the demise of the coral reefs, unless the pace of transition to net-zero emissions continues to accelerate rapidly.

Data and Figure availability:

The key data and Figures in this briefing are available at:

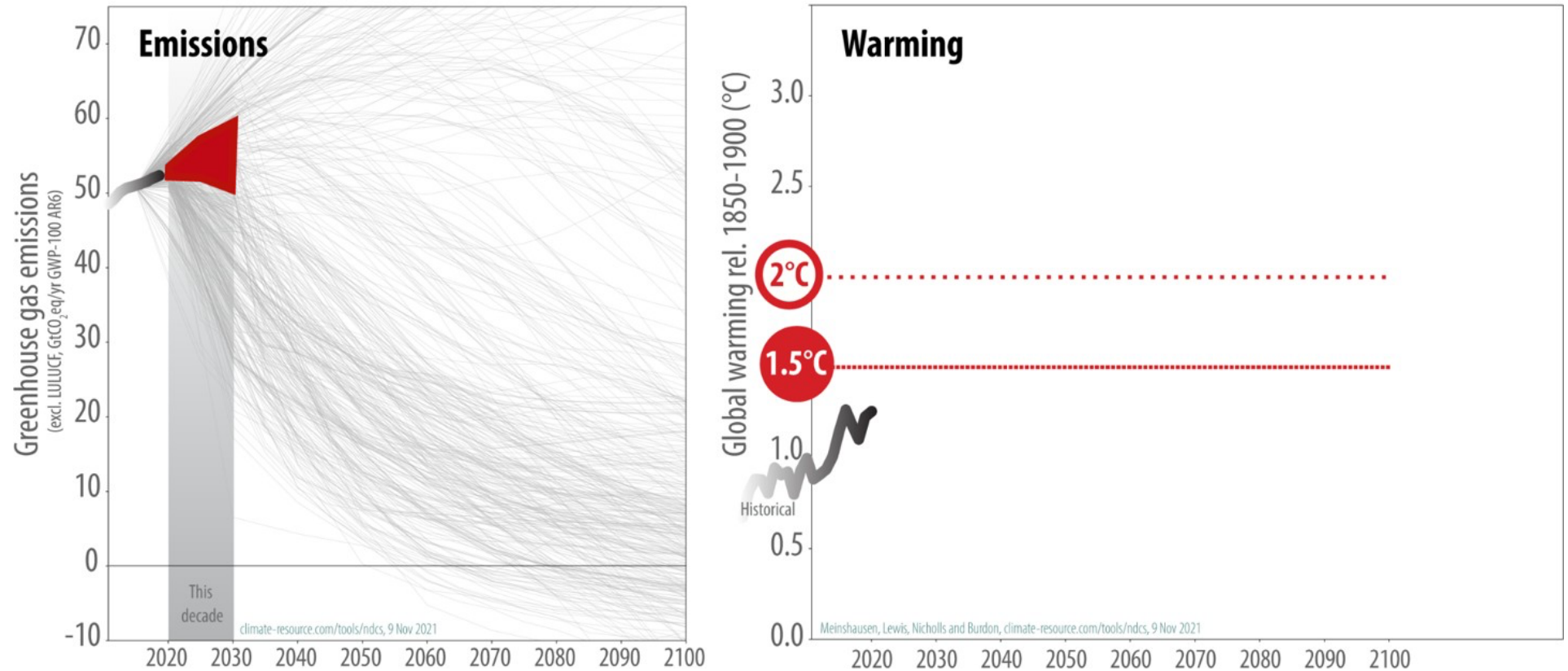
<https://data.climateresource.com.au/ndc/20211109-ClimateResource-ndc-figures.zip>

A slide deck, which is free to use and share, is available at:

<https://data.climateresource.com.au/ndc/20211109-ClimateResource-ndc-slides.pptx>

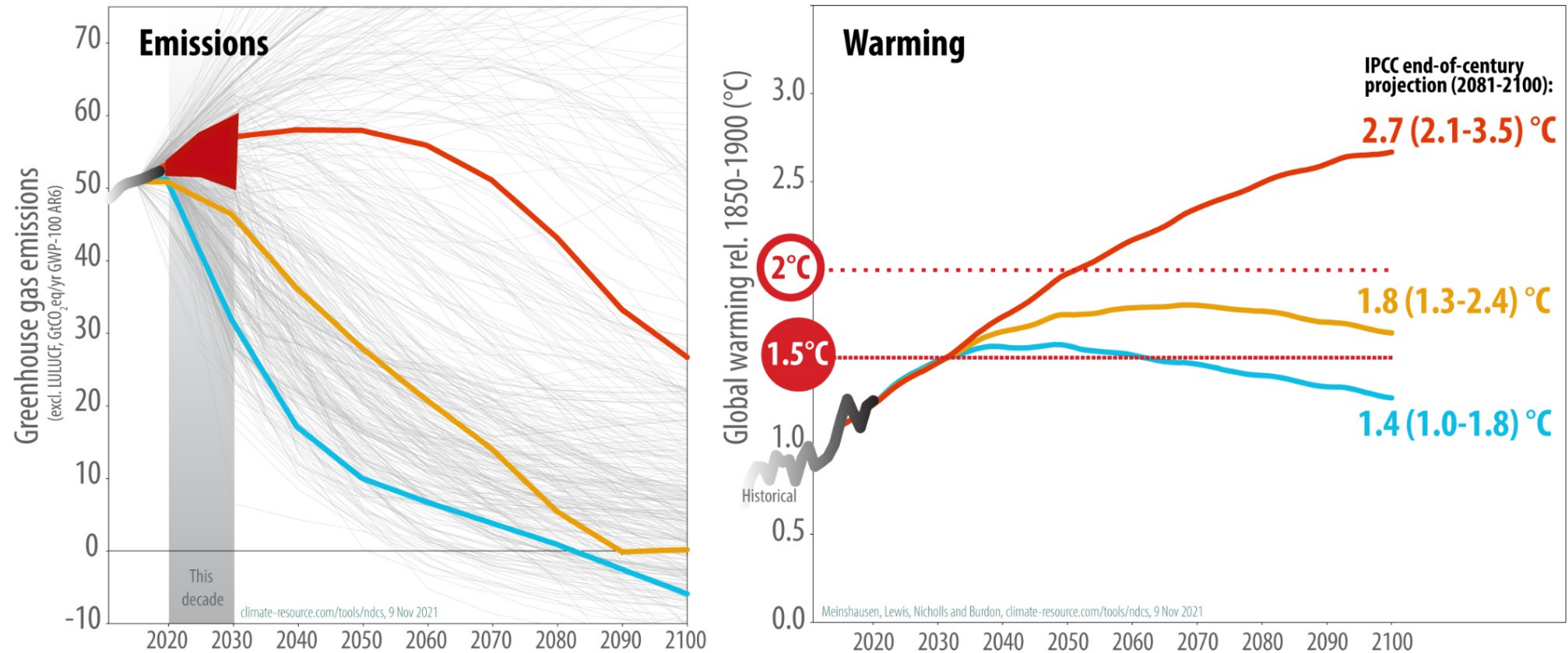
NDCs up to 2030:

NDCs up to 2030 come with some uncertainties and conditions. The full range of possible quantifications is relatively wide (red triangle spanning from Pre-COP high-end at 18th October to an optimistic interpretation of full implementation of NDCs as of 3 Nov). The key reason for the 2030 range is whether conditional/unconditional, and whether higher or lower quantifications of uncertain NDC are considered, and whether “hot air” is excluded or not.



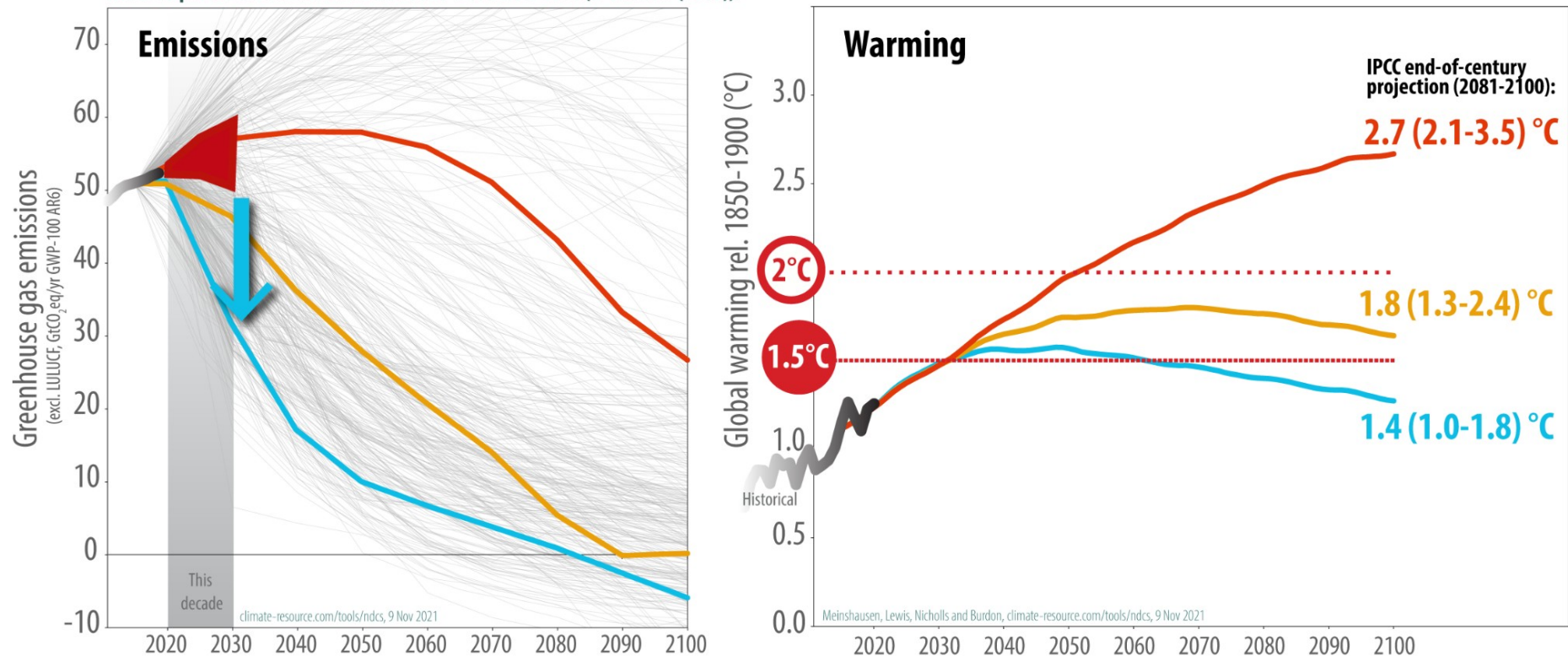
2.7°C: Consistent with extension via intermediate IPCC scenario

To assess the end-of-century warming implied by 2030 targets we need to extend the implied emissions trajectory to 2100, which is inherently difficult and uncertain. One approach is to use the IPCC-assessed temperature projections for the SSP scenarios that seems most consistent with the trajectory to 2030. The IPCC SSP2-4.5 is most consistent with the upper end of the 2030 emissions targets range - and results in end-of-century warming of 2.7°C (2.1-3.5)°C. No long-term targets are taken into account.



For 1.5°C: no way around strong reductions this decade

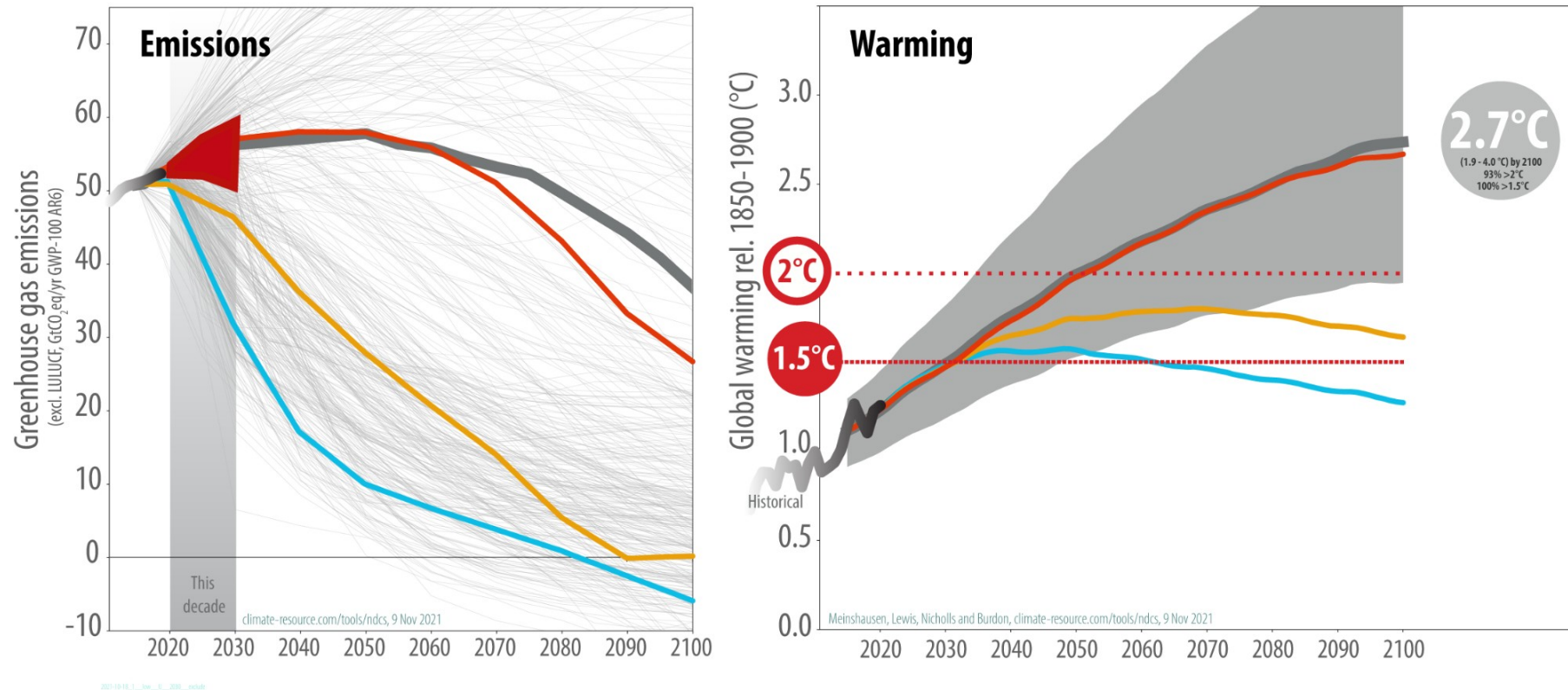
The IPCC WG1 AR6 includes two strong mitigation scenarios that yield mean warming of <2°C and 1.5°C respectively (orange: SSP1-2.6; and blue: SSP1-1.9). In both, GHG emissions drop decisively by 2030, and far more than if 2030 emissions targets in NDCs. UNFCCC on 4 Nov 2021 flagged* that 2030 emissions (excl. LULUCF) are heading to 13.7% above 2010 levels based on the unconditional NDCs: Very different to the path needed to be consistent with 1.5°C, which requires 2030 emissions to be about 45% below 2010 (IPCC SR1.5 (2018)).



* https://unfccc.int/sites/default/files/resource/message_to_parties_and_observers_on_ndc_numbers.pdf

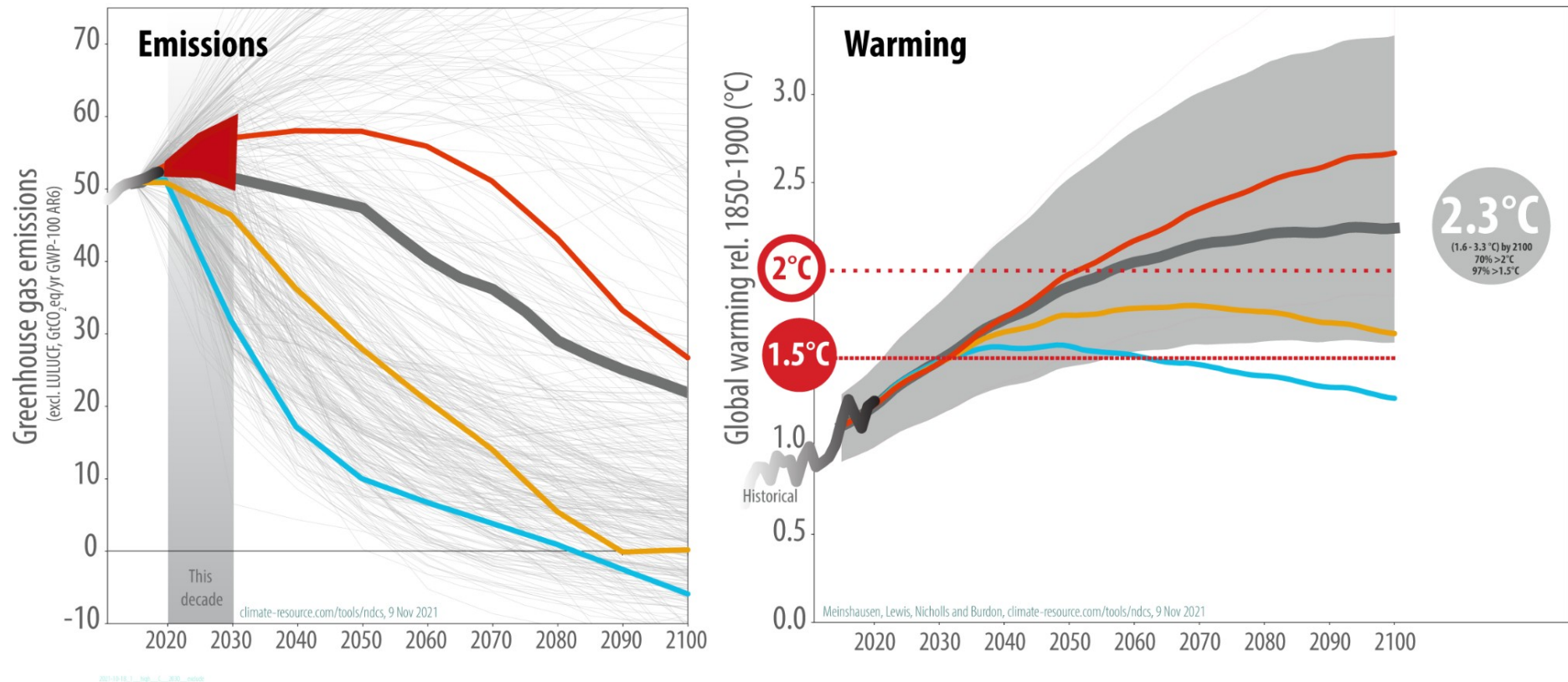
~2.7°C: Pre-COP unconditional NDCs up to 2030 & no hot air + extrapolation

Our assessment of NDCs as of 18 October also results in warming of 2.7°C by 2100, (with a 5% to 95% range from 1.9°C to 4.0°C) if we take a positive interpretation of unconditional NDCs up to 2030 (eg without hot air) and extrapolate to 2100 (bold grey line) in line with IPCC SR1.5 (2018) scenario characteristics. This does not take into account targets beyond 2030, or updates at COP like China's NDC or India's announcement.



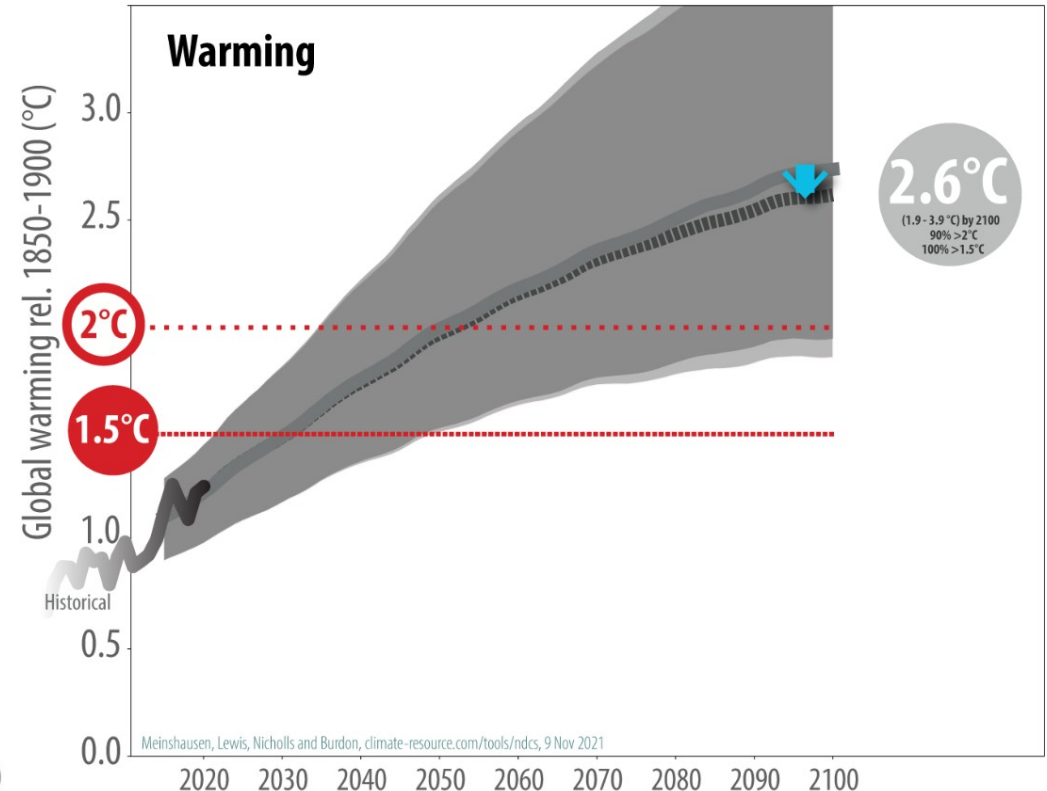
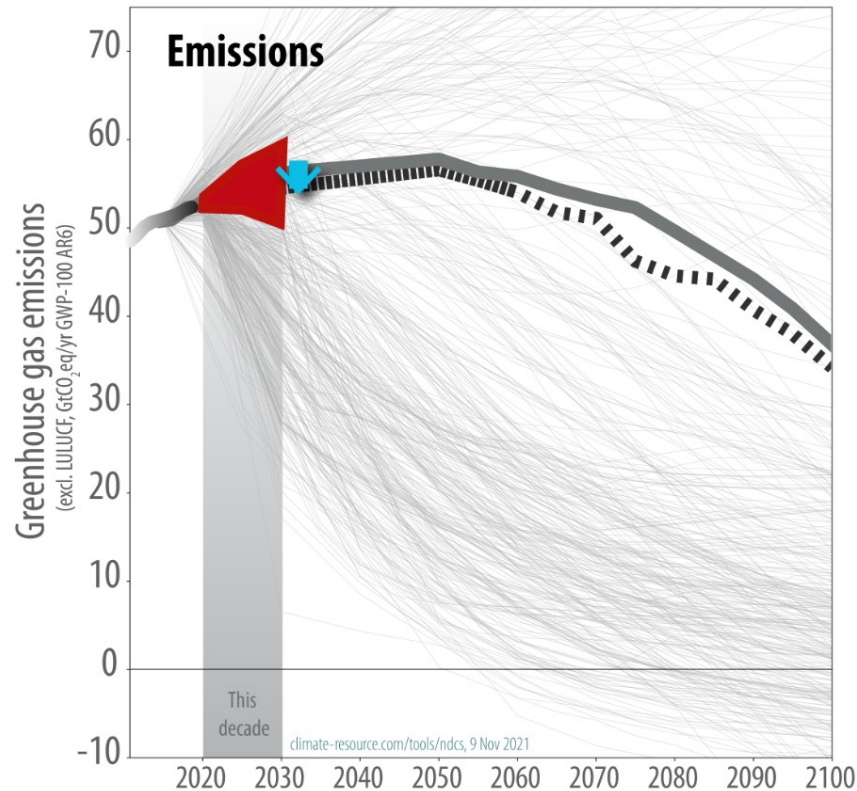
~2.3°C: Optimistic interpretation of pre-COP 2030 conditional NDCs

NDCs received by 18 October result in warming of 2.3°C by 2100, (with a 5% to 95% range from 1.6°C to 3.3°C) if we assume optimistically that adequate support will be provided to meet all conditional NDCs up to 2030, exclude hot air, and extrapolate to 2100. This still excludes any long-term targets, such as 2050 net-zero targets - but it does assume commensurate mitigation with throughout the century in line with SR1.5 scenarios at a similar 2030 emission level.



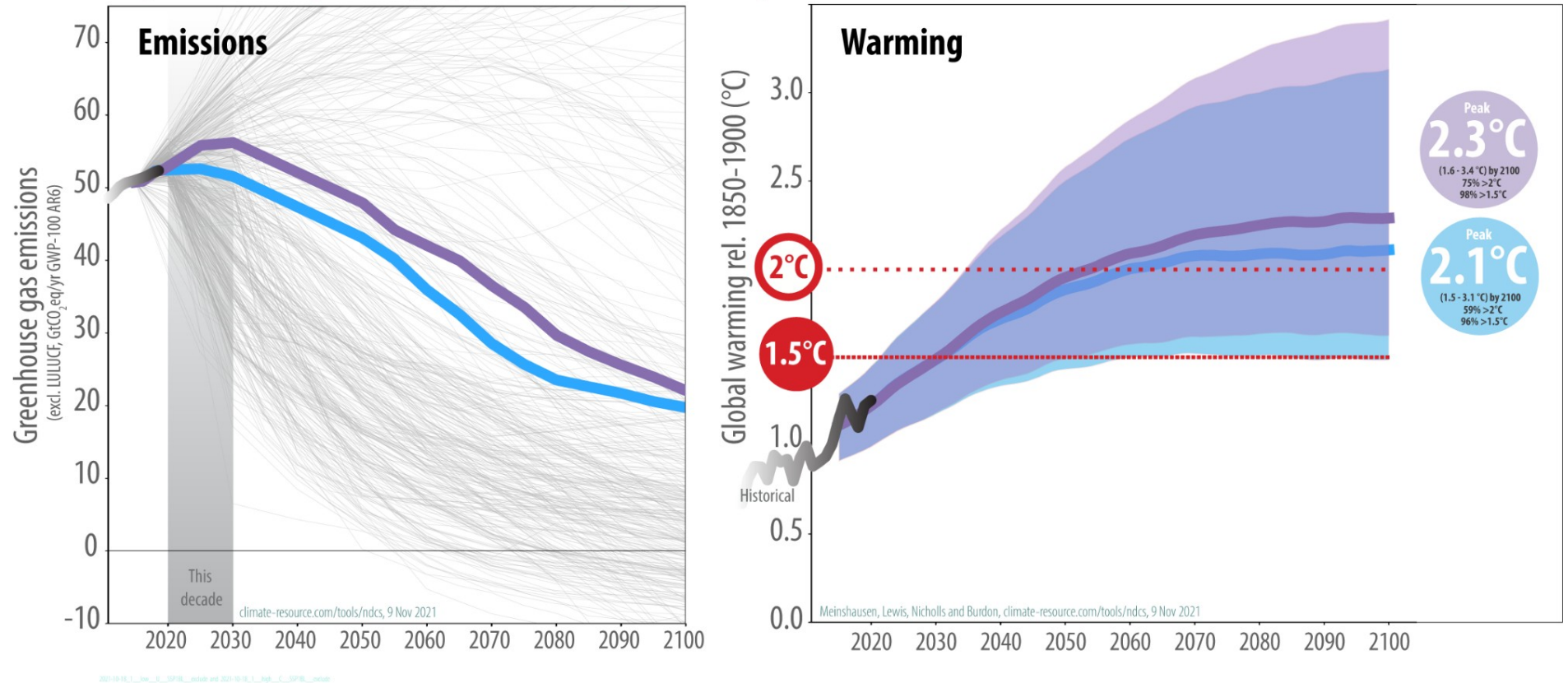
-0.1°C: Effect of recent 2030 targets (incl. China and India)

How would these 2.7°C or 2.3°C projections change, if we take China's 2030 NDCs and India's announcement of 2030 goals into account, but exclude the impact of their longer term 2060 and 2070 goals? Answer is: By just -0.1°C. China's updated NDC lowered its 2030 intensity target from a 60%-65% range to a 65% intensity improvement. India increased its 33% intensity target to 45%. At the high end of the extrapolated NDC 2030 emissions, that effect is a bit bigger (up to 0.3°C).



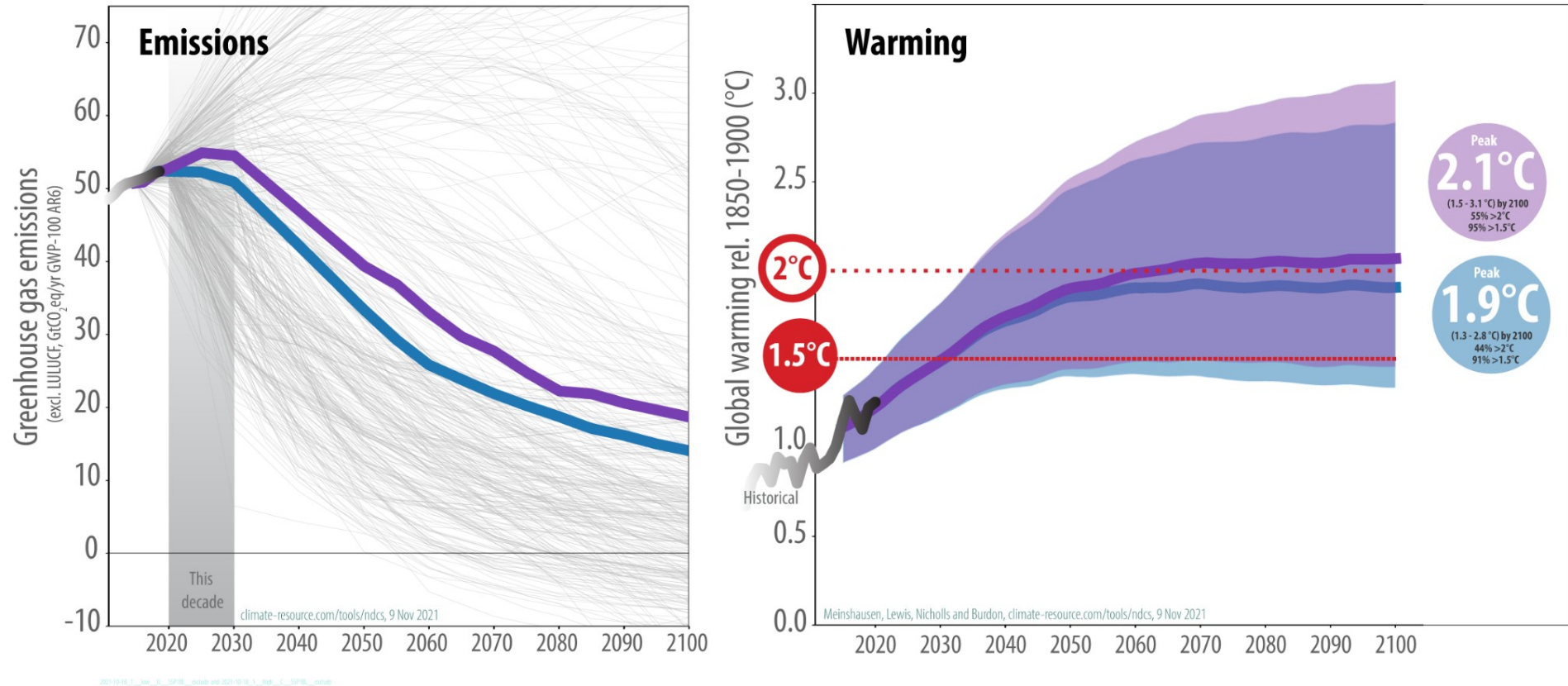
2.1-2.3°C: Pre-COP targets, including long-term / net-zero targets

The big difference for future temperature projections comes from the long-term pledges, most of them targeting either net-zero carbon or (even better) net-zero greenhouse gas emissions. The NDCs and long term low emissions development strategies (LT-LEDS) as of 18th October 2021 result in best-estimate end-of-century projections between 2.1 or 2.3°C (the range in the median arises from whether 2030 conditional or unconditional targets are considered, and whether a more ambitious or less ambitious interpretation is taken (e.g. if a country only states “net-zero target” one can interpret that as net-zero CO₂ or net-zero GHG)).



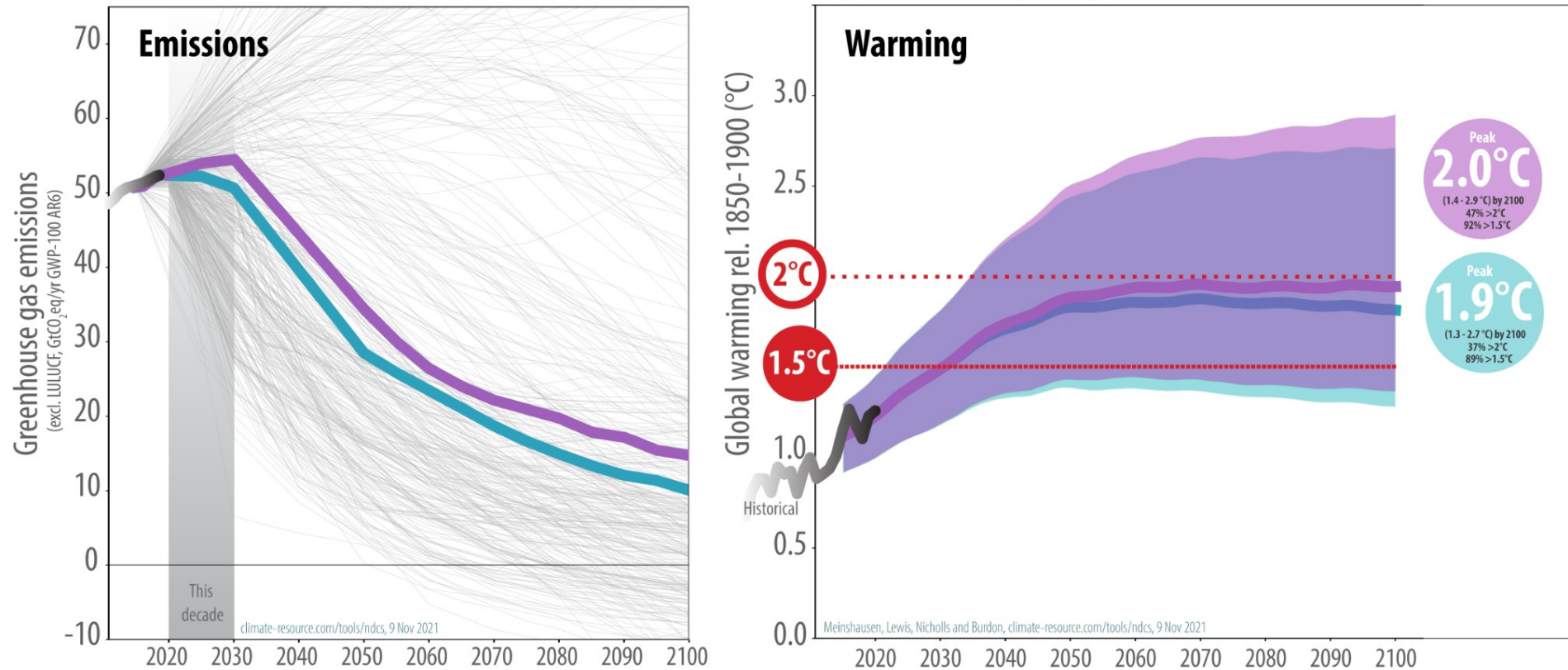
1.9-2.1°C: The effect of China's NDC and long-term targets, and other updates.

On 28th October, China submitted its NDC, including its carbon neutrality goal for 2060. Together with a few other country updates (e.g. Japan), that lowered best-estimate global-mean temperatures this century by 0.15°C to 0.2°C - compared to the Pre-COP26 status as of 18th October. Projected peak warming of 1.9-2.1°C could arise, if those pledges are adequately supported and implemented. The lower projection assumes conditional 2030 targets and a more ambitious interpretation of long-term targets, the higher one does not.



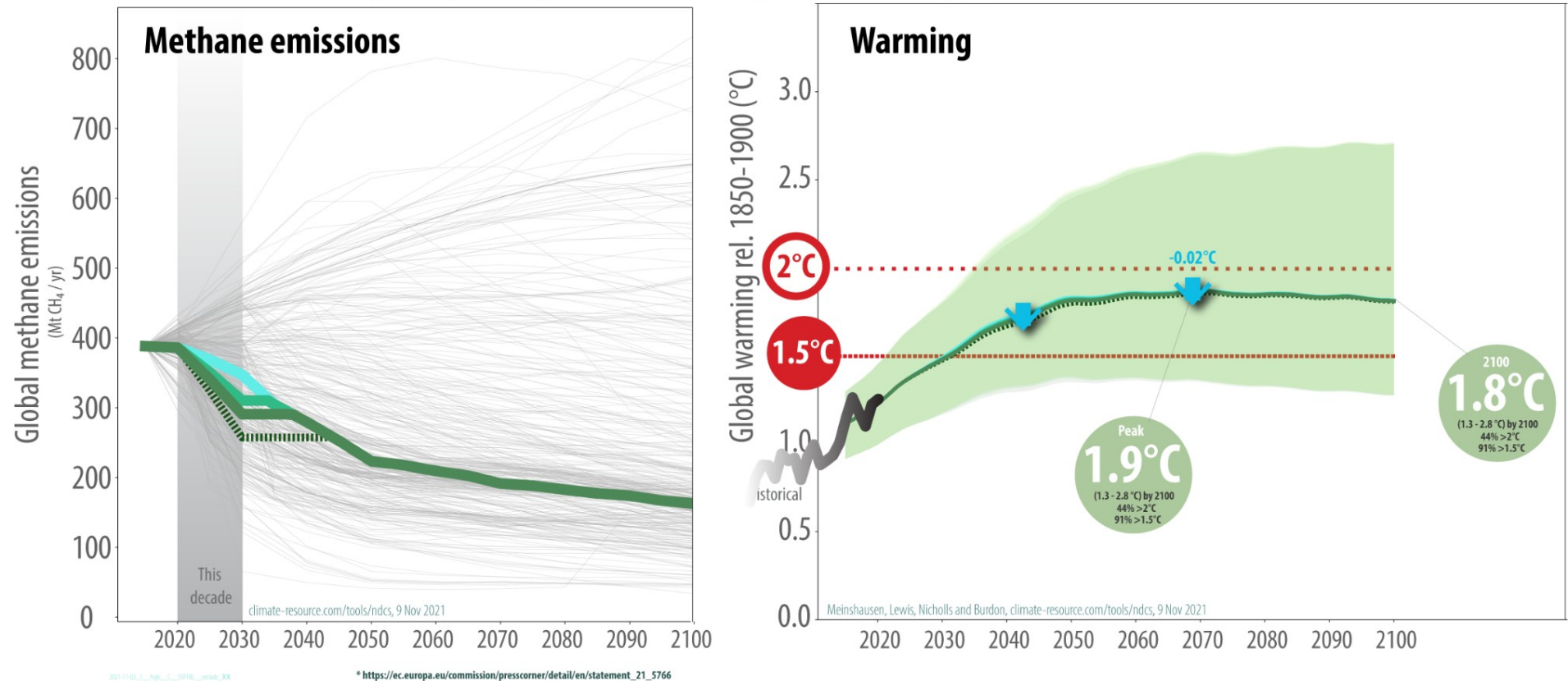
IF implemented, pledges might be just below 2°C, incl. India's announcement.

On 1 Nov 2021, India announced its target of net-zero by 2070. That could either be a net-zero greenhouse gas or net-zero CO₂ emission target. Interpreting it only as a net-zero CO₂ target, but assuming a linear trajectory towards 2070 (one could also assume a peak in the 2040s), we found that India's pledge now brings the world's projected mean 2100 warming to below 2°C for the first time in history, if the targets are supported and achieved. Projected peak warming is either just below 2°C, if we consider only unconditional 2030 targets and a less ambitious interpretation of long-term targets, or 1.9°C peak warming (with end-of-century warming of 1.8°C).



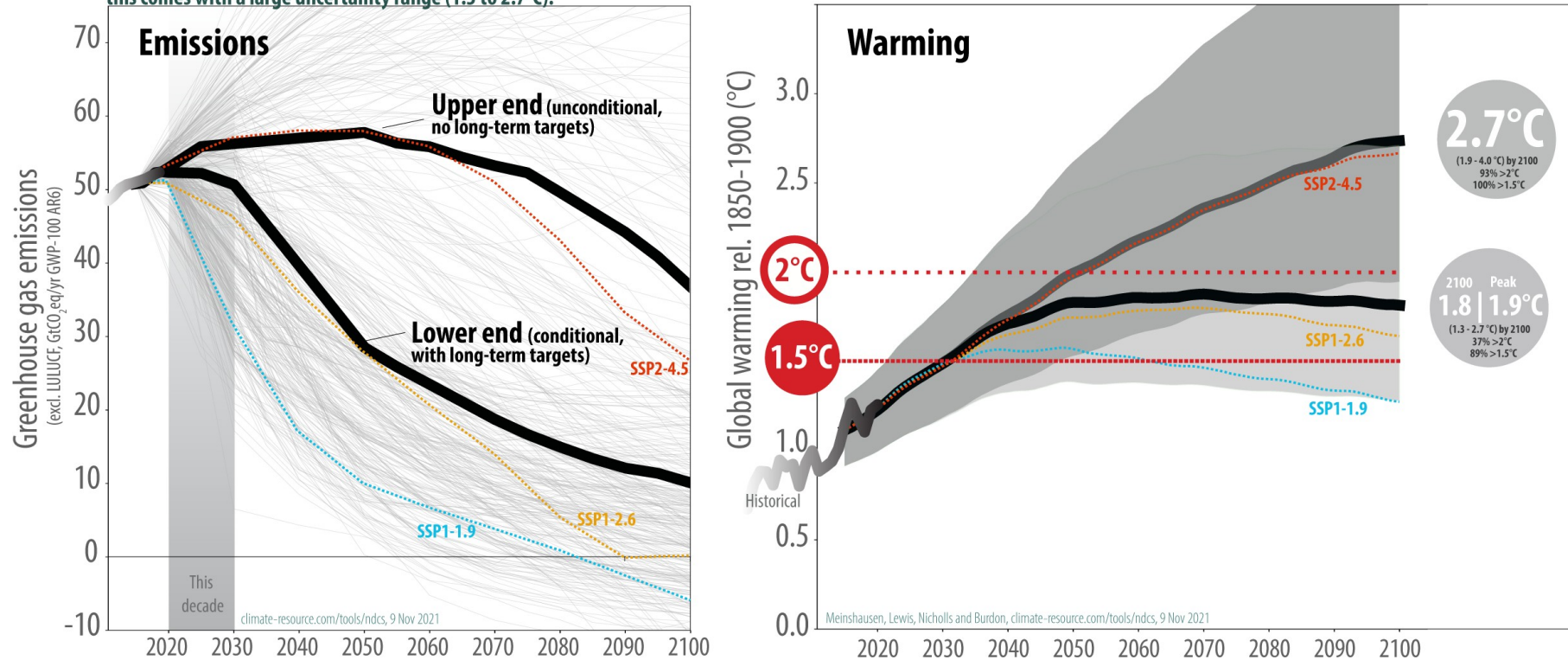
The global methane pledge. Additional effect might only be -0.02°C for peak warming

On 2 Nov 2021, the United States and the EU led an alliance of over 100 countries to commit to the Global Methane Pledge to reduce methane emissions by 30 percent from 2020 to 2030. This has been reported as shaving of 0.2°C off future warming. The impact on projected warming however depends on the baseline. The additional impact can be a factor of 10 smaller if the baseline takes into account existing pledges and net-zero targets, which we approximated for each individual of the 130 signing countries (solid green lines in left panel). While the Methane pledge turns out not to be additive to NDCs and long-term targets, reducing methane is nevertheless important (also for reducing air pollution).



Summary: Depending on policy action, the answer is 1.8°C, 1.9°C or 2.7°C.

If the question is what the warming might be following the upper end of the 2030 pledges, representing the unconditional NDCs, then the warming associated with the SSP2-4.5 scenario, i.e. 2.7°C with a range from 2.1 to 3.5°C is probably one of the best proxies. The extension beyond just 2030 pledges is difficult however, as the warming very much depends on what comes after 2030. When taking into account the long-term pledges, which come with the big question of whether they are going to be adequately implemented and supported, then the answer could be: Just below 2°C, i.e. peak 1.9°C warming or end of century 1.8°C warming. But again, this comes with a large uncertainty range (1.3 to 2.7°C).



Conclusion

For the first time, the aggregate effect of pledges to reduce emissions, if supported and achieved, is projected to limit warming to below 2°C. However, as several observers to COP26 famously put it, a pledge is not yet reducing emissions, “blah blah blah” is not replacement of the necessary implementation action on the ground. The main achievement of the years since Paris is the flurry of net-zero targets. While further in the future, these targets set the compass needle for where the journey needs to go. And they are now the test for whether 2030 targets this decade are in line. For many larger economies, 2030 targets are not yet in line – and inadequate 2030 targets are a major hurdle towards bending global mean temperatures even closer to 1.5°C. Taken together, the 2030 NDCs and, if supported and implemented, the longer-term targets could indeed limit warming to below 1.9°C this century and bring it slightly back down to ~1.8°C by the end of the century.

It remains essential that all countries deliver on those pledges, and put in place the policies and actions required to meet those targets. If the ambitious end of NDCs and long-term targets are not achieved, warming is projected to exceed 2°C. Far more is needed to accelerate the pace of transition to zero-emissions for the world to limit warming to 1.5°C: this requires an immediate increase in the pace and scale of action, notwithstanding the progress made in recent weeks and the preceding months. While reducing methane as a short-lived climate pollutant is also important, the main task is to avoid burning fossil fuels (which can also reduce fugitive methane

³ The data for the current NDC (as of 2 Nov 2021) conditional pathway is available here: Current conditional <https://live.magicc.org/public/scenarios/ba3f3134-ad29-466c-9111-c83c39a3e42c>

emissions). Without limiting CO₂ emissions to net-zero, global warming is going to continue.

Methods and Details:

- **Data availability:** The emission data for individual country pledges is provided here: climate-resource.com/tools/ndcs - free for re-use with a share alike & cite license. This includes the temperature plots³. The data for the two pathways, including the GHG emissions (not shown) and temperature quantifications from the graph, is also available⁴, free for any reproduction with attribution to Climate Resource.
- **Climate calculations:** This analysis uses probabilistic climate model emulator projections in line with the IPCC AR6 WG1 report released in August, 2021, specifically using the climate emulator MAGICC, available at live.magicc.org, which is maintained by scientists and programmers at Climate Resource and the University of Melbourne. The model configuration used to quantify the projected temperature implications of NDCs and longer-term net-zero targets was also used by our team to assist the IEA to deliver the World Energy Outlook, in the UNEP Gap Report and other scientific endeavours, including our recently co-authored study in Science (Ou et al., 2021, available at: <https://www.science.org/doi/10.1126/science.abc8976>). .
- **NDC quantifications:** The NDC are quantified in terms of their total GHG emissions. While several NDC pledges are

The data for the 18th October NDC aggregate pathway is available here: <https://live.magicc.org/public/scenarios/6f013083-34e0-4029-9544-f24377bccc7f>

⁴ https://data.climateresource.com.au/ndc/20211102-briefing/20211102_CR_complete.csv

difficult to quantify, we transparently provide 196 individual country factsheets for all current NDCs at climate-resource.com/tools/ndcs. This temperature projection is based on the NDCs as of 8 November 2021 - considering both conditional and unconditional elements. At Climate Resource, we were one of four global teams (PBL, Climate Action Tracker, and JRC) contributing to the quantitative assessment of NDC pledges that are part of the UNEP Emission Gap report 2021.

- **Hot Air:** In this analysis, - unless otherwise stated - we assume that NDC target levels that are higher than high reference scenarios (i.e. scenarios without additional climate or energy policies to reduce emissions) are not going to be reached, but “overachieved”. (Overachievement is the wrong word, as the NDC targets are simply set too high). Specifically, we assume the country-downscaled and high- emission growth SSP5 reference scenarios, normalised with recent historical emissions, to be the maximal amount of emissions for any country. This assumption does not make a difference for most countries, but it does for some (like Turkey or Pakistan).
- **Extension beyond 2030/2050:** The end of century temperatures obviously depend a great deal on the emission assumptions made beyond the horizon of a country’s pledge, whether that is 2030 or 2050. With more and more net-zero targets, that influence of the methodological choice is diminishing, though. Here, we assume SSP1 - reference growth rates for the period from 2030 – 2050 and our co- authored quantile rolling window approach by Lamboll et al. 2021 (<https://gmd.copernicus.org/articles/13/5259/2020/>).

⁵ Available here: <https://unfccc.int/process-and-meetings/the-paris-agreement/nationally-determined-contributions-ndcs/nationally-determined-contributions-ndcs/ndc-synthesis-report>

Context of other reports:

- There is a very useful collection of other reports and analysis on the question of what NDCs mean for future emissions of different countries and global temperatures. Many of these other analyses we contributed to in one form or another. Those analyses are:
 - The UNFCCC Synthesis Report⁵.
 - The UNEP Emission Gap report⁶ (Climate Resource was one of four global teams providing NDC quantifications):
 - The recent Science paper by Ou et al. (2021) (<https://www.science.org/doi/10.1126/science.abl8976>)
 - The Climate Action Tracker analysis (CAT also uses MAGICC, which we maintain and develop).
 - PBL NDC quantifications (we did not contribute to this one from our colleague Michel den Elzen – great resource, nevertheless :-))⁷

⁶ Available here: <https://www.unep.org/resources/emissions-gap-report-2021>

⁷ Available here: <https://themasites.pbl.nl/o/climate-ndc-policies-tool/>



About Climate Resource:

Climate Resource was established in mid 2020. We use climate science to create tools that support decision makers to assess and respond to climate risk, and the opportunities in the transition to a net-zero emissions global economy. We're doing all we can to ensure the best science accelerates an effective global response to climate change.
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