

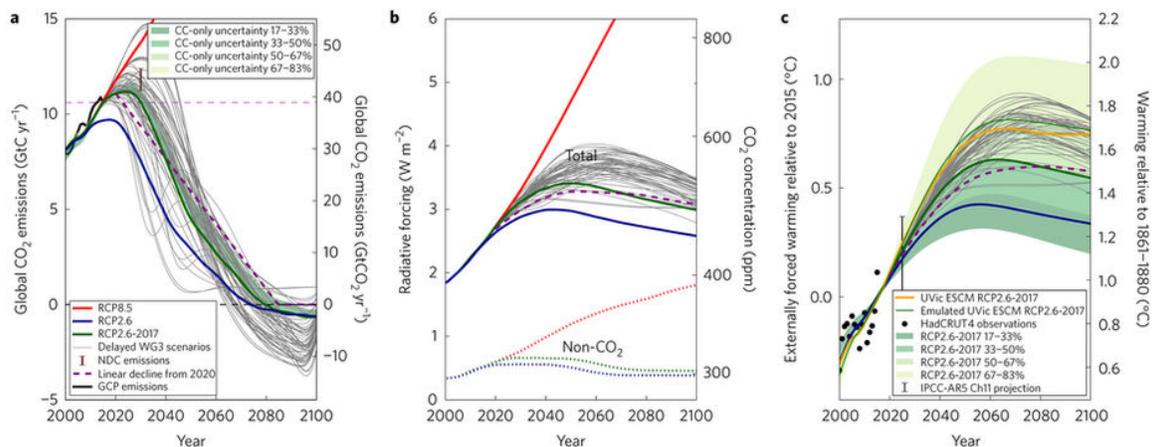


Aspen Global Change Institute Energy Project

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Threading the Needle: Pathways to Stay Below 2°C

Even though most climate science news tends to be dire, one set of researchers intimate with emission trajectories and their effect on climate what it would take to achieve the Paris Agreement’s aspirational goal of limiting warming to 1.5°C. Given the global average surface temperature increase of 0.9°C since pre-industrial time to the present, Millar and colleagues (2017) consider a range of carbon emission budgets that allow for an additional 0.6°C of warming. Their analysis shows that limiting additional CO₂ emissions to about 200 GtC (billion tons of carbon) achieves this goal. If this is combined with aggressive non-CO₂ mitigation, then the remaining allowable budget for CO₂ goes up to about 240 GtC. The authors contend the stringent goal of 1.5 deg C is “not yet a geophysical impossibility”.

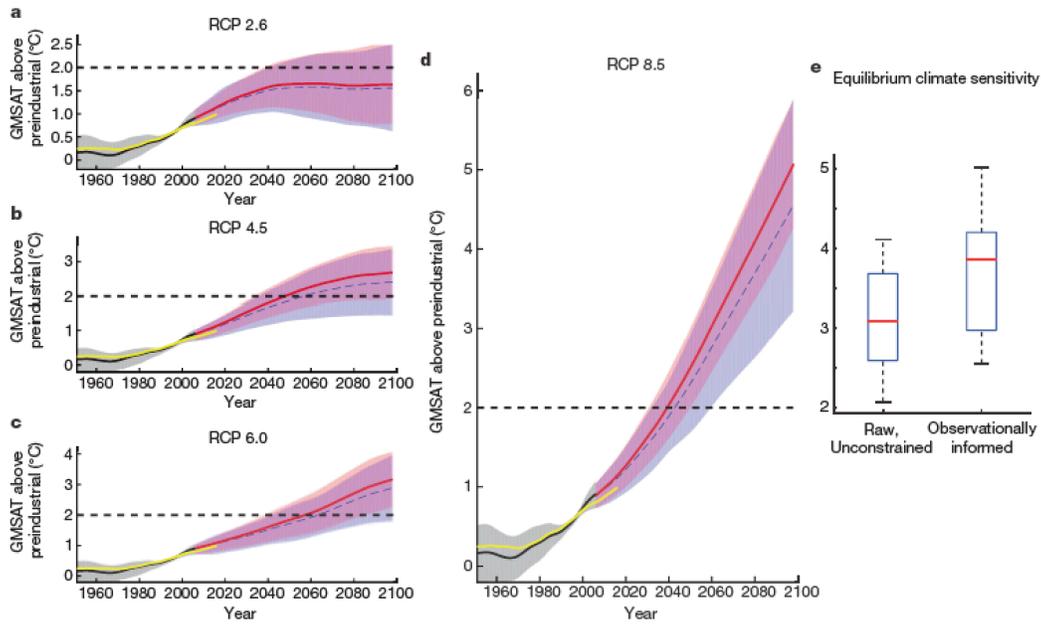


As shown in the Millar’s figure 2, the blue line is the standard IPCC RCP 2.6 scenario in all 3 panels which includes major emissions reductions beginning in 2010. Reality has exceeded the RCP2.6 path. This analysis updates the standard RCP2.6 with a start date in 2017 (green line) but otherwise utilizing similar emissions. The seven-year delay results in higher concentration and temperature by 2100 – the difference between the blue and

green lines. The result for the 2017 (modified RCP 2.6 referred to by the authors as RCP2.6-2017) is very similar to a straight line reduction in emissions beginning in 2020 and reaching zero in the 2080s, indicated as a dashed purple line. RCP2.6-2017 allows for a mid century peak in temperature with a slight decline by 2100. The brown bar in (a) shows the projected emissions by 2030 if the Nationally Determined Contributions (NDCs) are adhered to. The right panel (c) shows the simple model results for the modified RCP2.6-2017. The median result for the RCP2.6-2017 is peak warming of 1.6°C above pre-industrial and a resulting warming of 1.5°C by 2100.

Millar and colleagues also find promise from what is emerging in China. While China was central to much of the increase in global emissions between 2000 and 2013, the question becomes one of its economic growth rate in the coming years combined with greater energy efficiency measures and deployment of cleaner energy sources. Improvement from China's efforts coupled with the potential for aggressive mitigation efforts by other countries will set the still unknown timing for peak global emissions. In general, many studies make the point that the sooner peak emissions are reached, the rate of decline following peak becomes a more manageable task. The NDC goals from Paris, while an important step, fall short of the 2°C or better goal. The analysis in this study provides guidance that informs needed updates to the NDCs for global emissions to be consistent with the aspirational goals set at Paris – a remaining budget of 200 to 240 GtC.

A study also in 2017 focuses on new understanding of the Earth's energy balance with important implications for future warming projections. Brown and Caldeira utilize satellite data to better evaluate climate models identifying ones that produce atmospheric and their radiative properties closer to satellite observations. The result is shown in the figure below where the red line is showing results from Brown and Caldeira and the dashed blue line is showing the IPCC AR5 results for RCP 2.6, 4.5, 6.0, and 8.5.



The effect becomes more important for the higher emission scenarios where in RCP8.5 the effect is about 0.6°C above what was determined in the IPCC RCP8.5 by 2100 multi-model results. The Brown & Caldeira study also provided information on the equilibrium climate sensitivity (ECS) to a doubling of CO₂. The IPCC AR5 estimated ECS range is much as it has been for decades – about 1.5 to 4.5°C. This work indicates that the ECS is likely higher signaling the need for greater emission reductions than previously thought to limit any desired limit to the Earth’s global average temperature above pre-industrial. When taken together the two papers offer better understanding of the climate system and allowable emission paths to achieve the desired Paris goals. Uncertainties in climate sensitivity and in carbon cycle feedbacks as well as better sorting of model results consistent with new findings offer both optimism and caution.

Millar, R. J., et al. (2017). "Emission budgets and pathways consistent with limiting warming to 1.5°C." Nature Geoscience 10: 741.

Brown, P. T. and K. Caldeira (2017). "Greater future global warming inferred from Earth’s recent energy budget." Nature 552: 45.