

Scenario Plausibility

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Scenarios are common in environmental research, and particularly so in climate research and policy. The climate research community uses scenarios to “provide plausible descriptions of how the future might unfold in several key areas – socioeconomic, technological and environmental conditions, emissions of greenhouse gases and aerosols, and climate” (Moss et al. 2010). Such scenarios “play a fundamental role in improving understanding of the climate system as well as characterizing societal risks and response options” (O’Neill et al. 2016). Climate scenarios thus make important contributions to the development and evaluation of climate policy options.

In this short paper I summarize recent work I and colleagues have conducted on the plausibility of the scenarios of the Intergovernmental Panel on Climate Change (drawing from Burgess et al. 2020, Pielke and Ritchie 2021, Burgess et al. 2022, Pielke et al. 2022). The IPCC and much of the climate research community uses carbon dioxide (CO₂) emissions scenarios to imagine and evaluate “a range of plausible futures, because human development is determined by a myriad of factors including human decision making” (IPCC WGIII 2014).

Scenarios used in the IPCC 5th Assessment Reports (AR5) and 6th Assessment Reports (AR6) include the ‘Representative Concentration Pathways’ (RCPs) and the ‘Shared Socioeconomic Pathways’ (SSPs) (see Pielke et al. 2022). The high-emissions end of the RCP/SSP range is consistent with 8.5 W/m² radiative forcing and 4°C–5°C of warming relative to pre-industrial levels by 2100 (e.g. SSP5-8.5, RCP8.5). At the low end, scenarios project emissions consistent with 1.9 W/m² radiative forcing and 1.5°C of warming or slightly less by 2100 (e.g. SSP1-1.9).

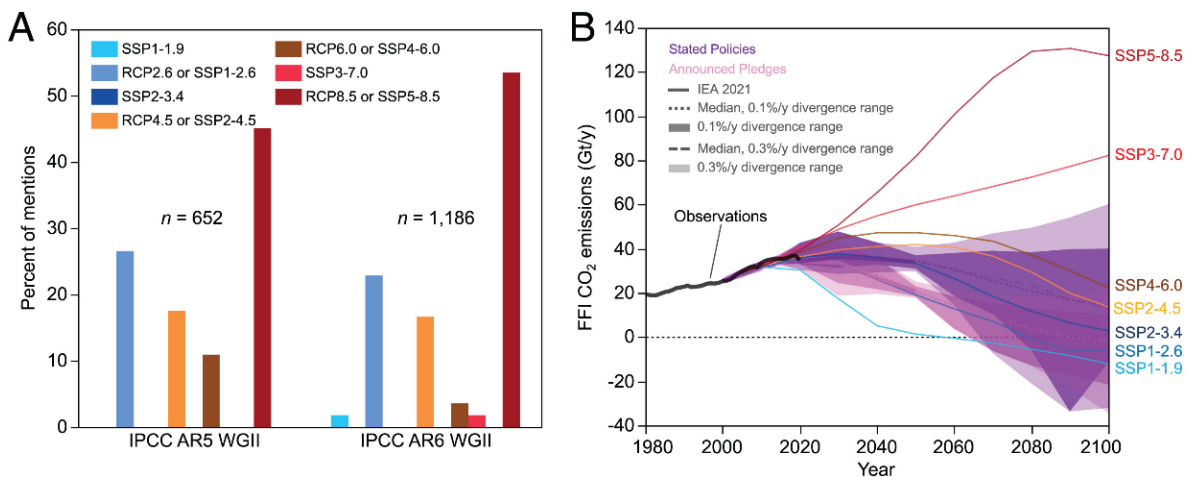
The report of Working Group 1 of the IPCC AR6 observes that “No likelihood is attached to the scenarios assessed in this Report.” Yet, at the same time the IPCC AR6 recognizes that “the likelihood of high emissions scenarios such as RCP8.5 or SSP5-8.5 is considered low” and recent ‘stated policy’ scenarios of groups such as the International Energy Agency (IEA) are “approximately in line with the medium RCP4.5, RCP6.0 and SSP2-4.5 scenarios.” The IPCC’s recent recognition of scenario likelihood is part of a broader and fast-moving discussion of scenario plausibility and implications for research and policy (sources can be found in Pielke et al. 2022).

Scenario ‘plausibility’ has been discussed for many years, but the IPCC has not evaluated the plausibility of scenarios central to much of climate research and assessment (Pielke and Ritchie 2021). Our recent analysis defines a ‘plausible’ scenario as one in which future fossil-fuel-and-industry (FFI) CO₂ emission growth rates of the scenario show a consistency with historical observations and IEA Stated Policies Scenario (STEPS) near-term projections (see Pielke et al. 2022 for details on our methodology). A scenario that has already diverged from reality is, by

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definition, not plausible. It is theoretically possible for a scenario that has already diverged significantly from observations to later return to the same projected future emissions level, though for this to occur would imply opposite divergences in the future, which would require a major departure from the trajectory of the original scenario, thus also making that scenario implausible, even if it were to arrive at the same final level of emissions (see Burgess et al 2021).

The figures below show (A, left) the prevalence of scenario mentions in the IPCC AR6 (Working Group 2 report) and (B, right) our results for all scenarios of the IPCC AR6 in terms of plausibility (the figures were originally published in Burgess et al. 2022). The detailed methodology for the quantitative evaluation of plausibility is described in Pielke et al. (2022).



The figure shows that plausible scenarios span a 2100 range below and above the SSP1-1.9 and SSP4-6.0 scenarios, centered on a median of a SSP2-3.4 scenario. The SSP3-7.0 and SSP5-8.5 scenarios reside far from the zone of plausibility. However, as the left panel shows the SSP5-8.5 (and RCP8.5) scenarios dominate the mentions in the IPCC report (which follows the same practice of the IPCC AR5, see Pielke and Ritchie 2021). Unfortunately, the climate research and assessment communities emphasize implausible scenarios.

In our work, we have made several recommendations on how the climate research community can correct course away from implausible scenarios and toward those with greater plausibility.

First, and obviously, the climate community could recognize the over-reliance on implausible scenarios, and take steps to immediately address it to avoid a growing credibility crisis. As common sense as this may seem, there are countless academic papers, research grants, the scenario architecture developed over 17+ years, and the ongoing Sixth Assessment of the IPCC – all of which has created an enormous momentum that may prove difficult to change.

Second, serious consideration should be given to either (a) terminating the role of the IPCC in orchestrating the content of climate science, or (b) transferring the mandate of the IPCC to assess climate science research to an organization independent of scenario development that plays no role in shaping how climate research is produced. With respect to scenarios of the future, the hegemony of the IPCC has become a source of myopia, rather than enlightenment.

Third, despite the presence of thousands of scenarios in the community, more regular attention needs to be given to a much simplified set of near-term, policy relevant scenarios, similar to how the International Energy Agency issues scenarios on an annual basis.

Fourth, more work is needed to reconcile long-term narrative pathways based on an idealized year 2100 end-point with what policy makers need to know about the next years and decades. While there are an increasing number of scenarios focused on the role of Paris Agreement NDCs through 2030, there is a significant gap in the IPCC assessments for scenarios that address developments before 2050 in the context of today's policy environment. This gap is created by an excessive focus on long-run, full century scenarios, driven in large part by the needs of the physical science modeling community.

Finally, climate research and assessment would benefit from a more ecumenical and expansive view on relevant knowledge. The IPCC scenario process has been led by a small group of academics for more than a decade, and decisions made by this small community have profoundly shaped the scientific literature and correspondingly, how the media and policy communities interpret the issue of climate change. The dominant role of this small community might be challenged in order to legitimize a broader perspective of views, approaches and methods.

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Writer's Profile

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Professor Pielke founded and served as Director of the Center for Science and Technology Policy Research at the University of Colorado Boulder from 2001 to 2007 and from 2013 to 2016. He was a visiting scholar at Oxford University's Saïd Business School in the 2007-2008 academic year. His interests include understanding the use and misuse of science in areas such as the Covid-19 response, climate change, disaster mitigation, energy policy; and sports governance. In 2022, he was on sabbatical in residence at the University of Oslo.