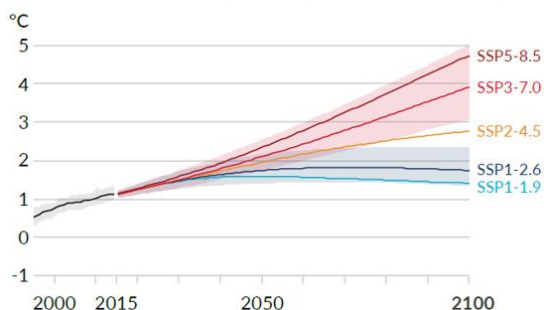


Climate Risk and Resilience

Global surface temperature change relative to 1850-1900



KEY INSIGHTS

Near-term planning relevance.

Before midcentury, climate model choice drives potential climate outcomes more than emissions pathways. If using 2050 as the planning horizon, prioritize building an ensemble of projections that capture different climate outcomes across models.

Status and continued use of the 8.5 pathways. RCP8.5 and SSP5-8.5 are global emissions pathways developed to help test climate models across a wide range of future warming levels, not to represent business as usual. Research finds these emissions trajectories to be implausible; however, there may still be reasons to use the associated climate projections, including stress testing, provided users are informed and communicate their reasoning.

Inputs versus outputs. Global emissions pathway plausibility and climate model outcome plausibility are different judgments, though the latter relates to the former. Potential future climate change is uncertain and depends on both future emissions and complex climate system responses.

A User Guide to the 8.5-Based Pathways and Projections

Understanding and Using Information Based on Very High Emissions Scenarios in Utility Planning and Risk Management

by Laura Fischer, Delavane Diaz, Claudia Octaviano, Steven Rose, Erik Smith, and Andrea Staid

Recent media articles reported that the highest global emissions pathways, Representative Concentration Pathway 8.5 (RCP8.5) and Shared-Socioeconomic Pathway 5-8.5 (SSP5-8.5), are no longer relevant. RCP8.5 and SSP5-8.5 represent the highest of a range of global emissions pathway inputs that were used to produce two generations of global climate model projections through the Coupled Model Intercomparison Project (CMIP) phase 5 and 6 exercises, respectively. The “8.5” refers to the radiative forcing level of 8.5 watts per meter squared (W/m^2) reached in 2100. The media headlines have garnered wide attention and could lead practitioners to set aside information that may be useful for company planning and risk assessment.

This Back Pocket Insight (BPI) summarizes research on the plausibility of the 8.5 emissions pathways, distinguishes emission pathway plausibility from the possibility of climate model outcomes, and outlines considerations for the potential use of 8.5-based climate projections in company risk management activities.

Origins of the 8.5 emissions pathways. The integrated assessment modeling community has periodically provided the climate modeling community with consistent sets of emissions inputs that are fed into global climate models to produce climate projections. RCP8.5, and subsequently SSP5-8.5, were developed in response to requests from the climate modeling community for as wide a range of forcing outcomes as possible to facilitate testing of climate system dynamics in Global Climate Models (GCMs) and Earth System Models (ESMs, hereafter simplified to GCMs for both GCMs and ESMs). 8.5 was created by artificially pushing fossil fuel use above reference levels without consideration for

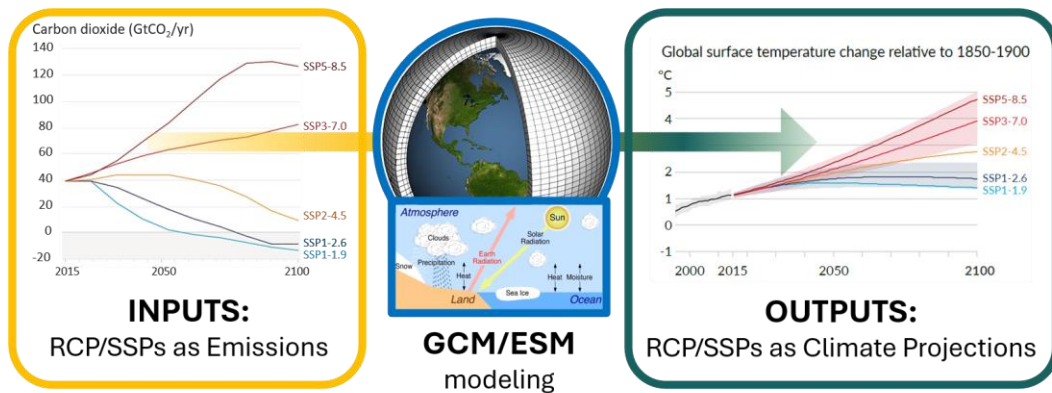


Figure 1: The same RCP/SSP scenario label describes both the emissions and forcing inputs (left) to global climate models and the resulting climate projections (right) produced by those models, shown in the center. Emissions trajectories may be implausible as inputs to climate models, but the associated climate model outputs could still be possible due to uncertainty in climate system responses.

emissions pathway plausibility. The 8.5 pathways were not created to be used as “business-as-usual” or counterfactual projections and guidance was provided accordingly. However, some users have incorrectly described the 8.5-based climate projections as business-as-usual, reference cases, or no-policy counter-factuals.

Why are the 8.5 emissions pathways considered implausible? [EPRI](#) and [others](#) have found the 8.5 emissions pathways to be implausible because the emissions results are inconsistent with historical emissions and trends, current climate policy futures, and fossil resource constraints and adoption of air quality policies over time¹. Because of these findings, in 2025, [the modeling community](#) announced that they would not include an 8.5-level emissions pathway in the set of global emissions inputs for the next generation of climate model runs, CMIP7, and expected to be released in the late 2020s.

An implausible emissions trajectory does not necessarily imply an implausible climate outcome. Complicating matters from a communication perspective, the same RCP/SSP label is frequently used when referring to the emissions **inputs** to GCMs and the climate projection **outputs** those models produce (Figure 1). But an emission pathway does not translate one-to-one into a global or local climate outcome. Due to climate response uncertainty, there are many possible climate outcomes for a given emissions pathway (as shown by the range of outcomes on the right side of Figure 1). Uncertainty in Earth system processes, system structure as captured

by alternative models, and internal variability all contribute to variation in the climate response, with the possibility of more or less climate change for a given emissions pathway and overlap between possible climate outcomes for different emissions pathways (both shown in Figure 1).

The overlap in local climate projections for different emissions pathways can be significant. The shaded ranges of Figure 2 show the variation in the number of extreme heat and extreme cold days from the different climate model projections for four of the SSP emission pathways—SSP1-2.6, SSP2-4.5, SSP3-7.0, and SSP5-8.5. Note the considerable overlap for the two highest emission pathways—SSP5-8.5 (purple) and SSP3-7.0 (red). Thus, the 7.0 pathway produces many of the climate outcomes produced by the 8.5, but not all of them.

Before mid-century, climate model choice and natural climate variability drive climate outcome variation more than emissions pathways. Midcentury is a commonly selected future period for assessing climate change relative to current or historic climate conditions. Climate projection ranges from different emissions pathways diverge notably by the end of the 21st century but show significant overlap pre-midcentury. Thus, variation due to differences in model responses and natural variability are the dominant drivers pre-midcentury. Figure 2 illustrates this phenomenon for Phoenix, AZ. The four SSP climate outcome ranges overlap more in the near term.

¹Other [EPRI work](#) has also found the very low emissions pathways (i.e., SSP1-1.9) to be implausible.

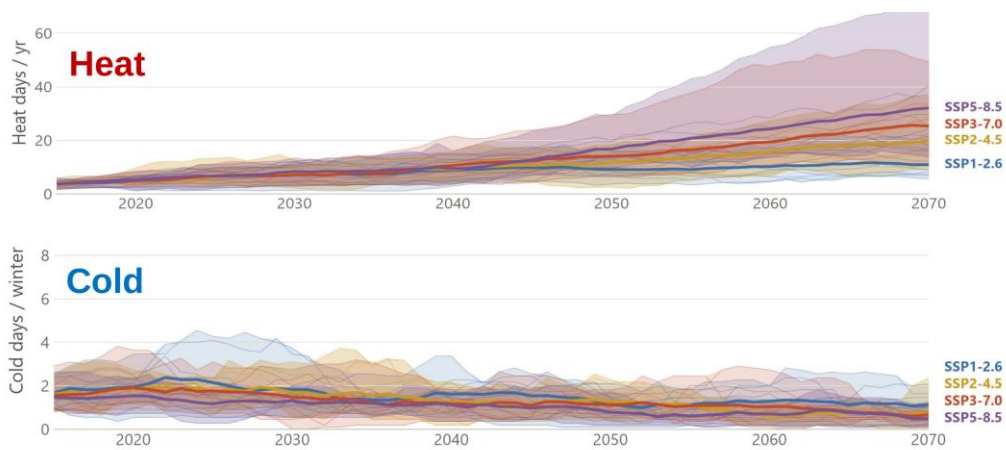


Figure 2: Extreme heat days (a) and extreme cold days (b) per year at Phoenix, Arizona, 2015–2070, under four emissions pathways. Extremes are relative to each model's 1995–2014 baseline (heat, above the 98th percentile of June-July-August maxima; cold, below the 2nd percentile of December-January-February minima). Bold line shows the eight-model ensemble mean; shading, full inter-model range; thin lines, individual models; all smoothed with an 11-year running mean. Note, the y-axis of the heat days plot (a) has a larger scale than the cold days plot (b).

As a result, for near-term analyses, companies will want to prioritize building an ensemble of climate projections from multiple models to capture potential outcomes for a given location.

Could companies still consider using an 8.5 climate projection for hazard assessment or physical risk management? Yes, for now, before CMIP7 projections become available, but be informed. The 8.5 emissions pathways have been shown to be implausible; however, there are scientific and practical reasons why a company might still consider using a CMIP6 (or 5) 8.5-based climate projection:

- **Climate outcomes.** Uncertainty in the climate response means that some 8.5 climate outcomes can still be possible off lower emissions futures.
- **Data availability.** For important current secondary data products, such as downscaled or specialized hazard data like hurricane or hydrological simulations, results based on 8.5 global climate projections may be all that are available on the “high” end. Results for other high emissions climate projections (7.0 or 6.0) may not be available.
- **Continuity and comparison.** If companies have assessed the physical risks of 8.5 in legacy studies, they may want to compare to their previous analysis.

- **Global warming levels (GWLs).** 8.5 climate projections provide additional data for defining relationships between GWLs and local climate change that can be valuable for assessing potential local outcomes associated with different levels of warming. Combining GCM simulations across multiple RCP/SSPs increases the sample size and robustness of the local climate change insights.
- **Stress-testing vulnerable systems.** Companies could use 8.5 simulations to inform robust, precautionary decisions where vulnerability consequences are potentially more severe and infrastructure is long-lived. While the 8.5 emissions inputs are implausible, 8.5 climates could be used to evaluate resilience designs against additional extreme conditions.
- **Help evaluate marginal impacts.** Additional analysis using 8.5 climate outcomes shown to still be plausible, even if low probability, can help evaluate the incremental risk of potential higher warming outcomes.

The new CMIP7 global climate results will not be available for a few years, and secondary data products years after that. Ultimately, these new resources will provide an updated basis for assessment over time.

Related EPRI Research

- EPRI Climate Data User Guide (2024). [3002028078](#).
- Grounding Climate Risk Decisions: Physical Climate Risk Assessment Scientific Foundation and Guidance for Companies - Initial Key Company-level Insights, Technical Principles, and Technical Issues (2022). [3002024246](#).
- Assessment of Newer Global Emissions Scenarios for Corporate Climate Transition Risk and Target Setting Applications (2026). [3002034775](#).
- Technical Considerations for Global Warming Level Frameworks (2026). [3002036364](#).

External References in Back Pocket Insight

- van Vuuren, D.P., O'Neill, B.C., Tebaldi, C., ..., Rose, S.K., et al., The Scenario Model Intercomparison Project for CMIP7 (ScenarioMIP-CMIP7), Geosci. Model Dev., 19, 2627–2656,(2026).
<https://doi.org/10.5194/gmd-19-2627-2026>
- Hausfather, Z., Peters, G.P. ., "Emissions – the ‘business as usual’ story is misleading," Nature, Nature, vol. 577(7792), pages 618-620, (2020).
<https://doi.org/10.1038/d41586-020-00177-3>

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