

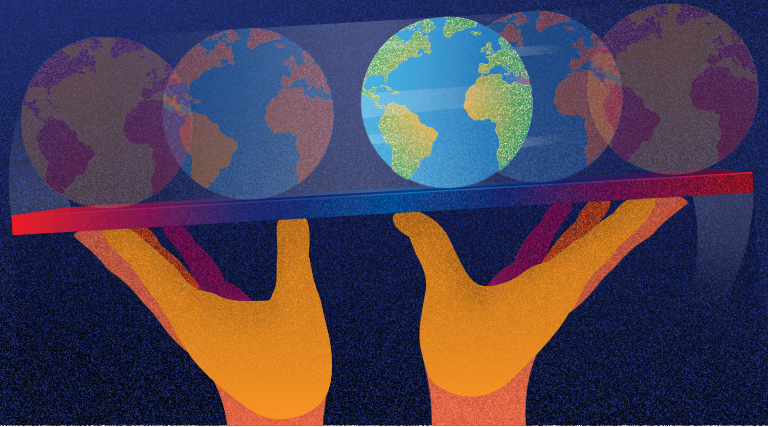


2023

## HAMBURG CLIMATE FUTURES OUTLOOK

The plausibility of a 1.5°C limit  
to global warming

Social drivers and physical processes



### Key Findings (1/2)

Among the many possible climatic futures, not all are plausible. The purpose of the second Hamburg Climate Futures Outlook is to systematically assess the plausibility of a climate future in which the Paris Agreement temperature goals are attained, namely holding global warming to well below 2°C and, if possible, to 1.5°C, relative to pre-industrial levels. Assessing plausible climate futures involves addressing a complex combination of social and physical dynamics. We establish the CLICCS Plausibility Assessment Framework to guide and integrate social and physical plausibility assessments. We analyze the dynamics of ten dominant social drivers of decarbonization and of six select physical processes of public interest. Our key findings are:

- ▶ None of the ten social drivers support deep decarbonization by 2050, as in the 2021 Outlook. Seven social drivers (i.e., United Nations climate governance, transnational initiatives, climate-related regulation, climate protests and social movements, climate litigation, fossil-fuel divestment, and knowledge production) support decarbonization, but not deep decarbonization by 2050. Two social drivers (i.e., corporate responses and consumption patterns) continue to undermine the pathways to decarbonization, let alone deep decarbonization. One driver (i.e., media) remains ambivalent insofar as its dynamics are volatile, both supporting and undermining decarbonization.
- ▶ The dynamics of virtually all social drivers of decarbonization are significantly affected by the short-, medium-, and

long-term consequences of the COVID-19 pandemic and Russia's invasion of Ukraine. Recovery programs and measures to relieve the socioeconomic impacts of the COVID-19 outbreak have locked in fossil-fuel dependence, making transformations to deep decarbonization less plausible than previously expected. There is still insufficient empirical evidence to conclude whether Russia's invasion of Ukraine in the long term will lead to or undermine worldwide efforts for reducing dependence on fossil fuels and toward faster energy transitions.

- ▶ Three physical processes (i.e., polar ice-sheet melt, Arctic sea-ice decline, and regional climate change and variability) barely influence global mean temperature and thus do not affect the plausibility of attaining the Paris Agreement temperature goals. Three physical processes (i.e., permafrost thaw, AMOC instability, and Amazon Forest dieback) can moderately affect the global mean temperature, thus moderately inhibit the plausibility of attaining the Paris Agreement temperature goals. Global-warming-induced changes in the dynamics of all six physical processes have extensive effects on regional hydrological cycles, ecosystems' resilience, or communities' well-being.
- ▶ Failing to attain the Paris Agreement temperature goals has three main implications for physical processes. First, drastic or abrupt changes in the 21<sup>st</sup> century in the polar ice sheet and regional climate are plausible, but are not plausible for the Arctic sea ice or the AMOC. Second, future development of deforestation activities is a fundamental condition that can either enable

## Key Findings (2/2)

or constrain the plausibility of large-scale dieback of the Amazon Forest. Third, uncertainties about the behavior of permafrost carbon preclude us from assessing the plausibility of drastic changes in permafrost thaw within the 21<sup>st</sup> century. However, we can exclude that permafrost thaw will lead to runaway warming.

► The joint social and physical plausibility assessments reveal that the prospects of attaining the Paris Agreement temperature goals through deep decarbonization are fundamentally shaped by the interaction of social and physical dynamics. The social driver assessments demonstrate that human agency has a large potential to shape the way climate futures will evolve, highlighting a series of conditions and resources for societal transformation required for the climate future scenario to become plausible. However, the assessments also show that human agency is strongly shaped by injustices and social inequalities, which inhibit social dynamics toward deep decarbonization by 2050.

► We address the interconnections between climate mitigation and climate adaptation and introduce key concepts and guiding principles toward a Sustainable Adaptation Plausibility Framework. This framework will be further developed in upcoming editions of the Hamburg Climate Futures Outlook.

In light of these findings, we conclude that reaching worldwide deep decarbonization by 2050 is currently not plausible, given the observable trajectories of social drivers. The select physical processes of public interest only moderately, if at all, inhibit the plausibility of attaining the Paris Agreement temperature goals, although they can substantially modify the physical boundary conditions for society. Meeting the 1.5°C Paris Agreement temperature goal is not plausible, but limiting the global temperature rise to well below 2°C can become plausible if ambition, implementation, and knowledge gaps are closed.