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HAMBURG CLIMATE FUTURES OUTLOOK



Assessing the plausibility of
deep decarbonization by 2050



Universität Hamburg

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CLUSTER OF EXCELLENCE
CLIMATE, CLIMATIC CHANGE,
AND SOCIETY (CLICCS)

About CLICCS

Researchers from a wide range of disciplines have joined forces at the Cluster of Excellence CLICCS (Climate, Climatic Change, and Society) to investigate how climate and society will co-evolve. The CLICCS program is coordinated through Universität Hamburg's Center for Earth System Research and Sustainability (CEN) in close collaboration with multiple partner institutions and is funded by the Deutsche Forschungsgemeinschaft (DFG).

About the Outlook

In the annual *Hamburg Climate Futures Outlook*, CLICCS researchers make the first systematic attempt to assess which climate futures are plausible, by combining multidisciplinary assessments of plausibility.

The inaugural 2021 *Hamburg Climate Futures Outlook* addresses the question: Is it plausible that the world will reach deep decarbonization by 2050?

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Table of Contents

PART I: PLAUSIBILITY ASSESSMENT OF CLIMATE FUTURES

1	Introduction	11
2	Epistemological challenges for assessing plausibility	15
2.1	Identifying physical plausibility	16
2.2	Identifying social plausibility	17
2.3	Combining physical and social plausibility assessments	18
	Box 1: The <i>Hamburg Climate Futures Outlook</i> and other assessments of climate futures	19
3	Plausibility of model-based emissions scenarios	21
3.1	Climate scenarios used in the IPCC	22
3.2	The scenario framework of this Outlook	23
3.3	Plausibility of existing scenarios	24
3.4	Deep decarbonization by 2050	25
	Box 2: Synergies and trade-offs in the assessment of plausible climate futures	27
4	The Social Plausibility Assessment Framework	29
4.1	Societal climate futures as a research object	30
4.2	An assessment framework centered on social processes	33
5	Assessing the plausibility of deep decarbonization by 2050	39
5.1	Identifying the social drivers of decarbonization	40
5.2	Summary of the social driver assessments	41
5.3	Plausibility assessment of the scenario and its implications	49
	Box 3: Diverse ways of knowing in a changing climate	51
6	Which temperature trends can we expect for the 21st century?	53
6.1	Climate sensitivity and global mean surface temperature	54
6.2	When would we see the effect of emissions reductions in global temperature?	56
6.3	Regional temperature trends and their uncertainty	58
	Box 4: COVID-19 and the changing climate	60
7	Implications for climate futures	63

PART II: SOCIAL DRIVER ASSESSMENTS

8	Social driver assessments	69
8.1	UN climate governance	70
8.2	Transnational initiatives	75
8.3	Climate-related regulation	81
8.4	Climate protests and social movements	87
8.5	Climate litigation	90
8.6	Corporate responses	94
8.7	Fossil fuel divestment	98
8.8	Consumption patterns	101
8.9	Journalism	105
8.10	Knowledge production	109
	References	114
	Glossary	152
	Frequently asked questions	154
	Author list	6

1

Introduction

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Introduction

The purpose of the annual *Hamburg Climate Futures Outlook* (hereafter *Outlook*) is to assess which climate futures—future joint developments of climate and society—are possible and which are plausible. This and future *Outlooks* are dedicated to help answer questions such as: Toward which future is the Earth’s climate moving? What might the climate look like in 2050, or in 2100? And what type of society might evolve together with the changing climate? We cannot accurately predict this future, but we can use our joint understanding of the physical and the social worlds to identify which climate futures are plausible.

Physical climate is a global system with regional manifestations; it is driven by influences such as greenhouse gases emitted by human activity, and it is additionally altered by internal variability—fluctuations, such as the inevitable differences between two consecutive summers. Society is a complex system driven by divergent dynamics and strong moments of inertia. Joint development of these two systems occurs because climatic change, in all its regional and local manifestations, influences but does not determine the maneuvering space of social actors. Social dynamics eventually lead to greenhouse gas emissions, which in turn influence the climate system.

We understand *possible* climate futures as those future states that are consistent with our joint understanding of climate and social dynamics. *Plausible* climate futures denote the subset of those possible future states that we expect to unfold with appreciable probability, given the existing evidence from the physical and social worlds (see Figure 1). Physical plausibility is derived here from a quantified estimation of the responses of the physical climate system to specified human-induced perturbations, taking into consideration internal variability. The social plausibility of a particular climate future is derived from theories of social change and a theoretical understanding of the political, economic, and cultural conditions under which such transformations can unfold. This theoretical model leads us to identify relevant social drivers of change. The core of our social plausibility assessment is to weigh existing empirical evidence against the theoretical model of transformation.

The *Outlook* fills a crucial gap in the existing assessments of future climates (see Box 1). Whereas previous approaches frequently ask which futures are desirable, or what pathways might lead to desirable futures, we deliberately shift our focus toward the question “are specific climate futures plausible?,” regardless of whether they are desirable or not. Our assessment of plausibility is based on our

understanding of social transformations and their drivers, combined with empirical evidence on the direction that these drivers are currently taking (see Chapters 2 and 4). For this assessment, we draw on expertise from within the research cluster Climate, Climatic Change, and Society (CLICCS) at Universität Hamburg, which lends the *Hamburg Climate Futures Outlook*.

Among existing recurring climate assessments, the CLICCS approach is unique in that it jointly assesses both the social plausibility of global emissions futures and the physical plausibility of resulting temperature trajectories and extremes. Not only is the combined assessment of physical and social plausibility unique, our approach to social plausibility in the CLICCS assessment framework (Chapter 4) is entirely new. We go deeper than techno-economic or demographic drivers like population growth, and examine underlying social drivers which bring about the social dynamics that can change global emissions futures. However, this new Social Plausibility Assessment Framework is not yet able to assess varying degrees of plausibility for a range of specific emission scenarios. Instead, we use the framework to assess one politically relevant scenario that represents an outer limit of the range of possible future scenarios—*deep decarbonization by 2050*. Numerous existing studies suggest that *deep decarbonization by 2050* is still technologically possible. Here we inquire whether such a future is not only possible but also plausible.

This first *Outlook* 2021 thus explores the question: **Is it plausible that the world will reach deep decarbonization by 2050?**

We draw on a synthesis of systematic literature reviews, secondary data, and our own research. Our question translates the temperature goals of the 2015 Paris Agreement—holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels (UNFCCC, 2015)—into a scenario that encapsulates the required social and technical transformations consistent with these goals.

Chapter 2 discusses the epistemological challenges of assessing the plausibility of climate futures; it also justifies the chapter sequence we have chosen. Chapter 3 explores the plausibility of existing model-based emissions scenarios, testing their assumptions and identifying where critical social dynamics have been omitted. Chapter 4 introduces the Social Plausibility Assessment Framework for assessing the plausibility of future social dynamics.

This methodology is then applied in Chapter 5, which summarizes the social drivers and dynamics that influence the pathways toward or away from the scenario deep decarbonization by 2050. The in-depth assessment that serves as the foundation of Chapter 5 is found in Part II (Chapter 8) of this Outlook. Chapter 6 turns to physical plausibility, focusing on recent advances in assessing expected temperature trends throughout the twenty-first century.

Four boxes are interspersed between the chapters, providing brief summaries on overarching topics, including the distinction between the *Outlook* and other climate assessments (Box 1), the synergies and trade-offs between climate mitigation and other sustainability goals (Box 2), how *diverse ways of knowing* support the plausibility assessment of climate futures (Box 3), and how the current COVID-19 pandemic influences climate futures (Box 4). Answers to frequently asked questions are compiled at the end of this document, in order to explain and briefly summarize key aspects of the *Outlook*.

Scenarios of future developments are not merely descriptions, detached from the future they describe. They can change the way in which the future is imagined by actors, by introducing new conceivable courses of action or by reinforcing established ones. In doing so, they can influence the way and direction in which the future unfolds. Communicating the expectation of severe climate change can incite urgent action, but also fatalistic behavior. Alternatively, communicating the expectation that climate change can plausibly be mitigated could lead to a stronger motivation for mitigation efforts, but could also lead to complacency and a decreased sense of urgency. Once published, all assessments become part of the social world and can affect social dynamics in unforeseen ways. Chapter 7 therefore addresses the implications of our assessment: Achieving deep decarbonization by 2050 is currently not plausible, but nor is it impossible, and the *Outlook* identifies enabling conditions that would allow the plausibility of this outcome to increase.

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