

# The Effect of Near-Term Climate Policies on the Achievability of Ambitious Long-Term Climate Targets

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## Abstract

To keep the risks of climate change in check, the international community has agreed on the long-term target of limiting the increase of global mean temperature to no more than 2 °C above pre-industrial levels. This target is, however, so far not underpinned by commensurate near-term policy measures. Given the commons nature of the climate problem, the solution will eventually require concerted actions on the international level. To this end, negotiations have been conducted under the United Nations Framework Convention on Climate Change, but so far only made little progress towards tangible emission reductions consistent with the 2 °C limit. Instead, policy initiatives enacted so far have been regionally fragmented, incomprehensive and generally not ambitious enough to reach the stated 2 °C targets in a cost-effective manner.

Starting from this observation, this dissertation aims to answer the following three main questions: 1. What are the implications of a further delay of comprehensive climate policies? 2. What are the crucial determinants of adverse lock-ins and path-dependencies in the energy system induced by delayed action? 3. Which policy portfolio can keep the door to achieving ambitious targets at moderate costs open?

The answer to the first question is an important prerequisite to informing policy makers about the appropriate policy stringency today, weighing current and future risks and opportunities against each other. To provide a comprehensive evaluation, our analysis not only considers the traditionally used aggregated cost metric, but complements it with three other metrics that better represent the distributional and dynamic dimension of the problem. The answer to the second question helps to identify the most adverse impacts of delayed climate policies on the energy system's climate change mitigation potentials. It thus also informs the choice about priorities for policies to bridge into a low-carbon future, as addressed in the third question. The idea here is to go beyond a one-dimensional option space of more or less near-term policy ambition, but to explore to which extent different policy instruments have a beneficial effect beyond their near-term effect on emissions, thus helping to keep long-term targets within reach. As recent experience has shown, governments have much less difficulty to implement technology policies than to implement carbon pricing. Therefore we analyze different policies regulating high-carbon and supporting low carbon technologies as well as a reform of subsidies and taxes for fossil fuels. Beyond the evaluation of the individual effects of these

policies, an important contribution is to quantify the interactions among these instruments, as well as the interactions of these with two carbon pricing mechanisms, a carbon tax and a cap-and-trade scheme.

The research presented here is mainly based on the analysis of quantitative scenarios of large scale detailed numerical models of the global energy-economy system. This dissertation makes use of both the detailed analysis of larger number of scenarios produced from one model as well as the comparative analysis of harmonized scenario sets across different models. Five different research articles published in peer-reviewed scientific journals form the core five chapters of this thesis, preceded by an introduction chapter laying out the wider background and methods. A discussion with the overall conclusions from the aggregate research plus an outlook to future research concludes.

**Keywords:** Climate change mitigation; Policy analysis; Delayed action; Carbon pricing; Technology policies