

Foreword

This book is needed. Man-made climate change is a serious issue and needs our attention.

After almost 50 years of climate research with positions at the Max-Planck-Institute of Meteorology, the University of Hamburg and the Helmholtz Zentrum Geesthacht, I have followed the public debate about climate change closely. Questions have risen in the past regarding whether or not climate change is real. People have asked if its consequences are serious, if it is really man-made, and why it is getting so much publicity now. These questions have taken the headlines of public debate. Luckily, this debate now has ended, and for good reason — more and more people join the chorus that's roaring loudly: *something needs to be done.*

Indeed, when asking students and young scholars these days about the main task of climate sciences, then it is first about increasing the public motivation to act. And second to find solutions to the problem. But which action should the public be asked to engage in? Mostly, the answer is to avoid emissions at all cost and in all quantities. The effects of such efforts are hardly considered — usually, it is sufficient to claim: “a lot.” The efficiency of the measures is not considered — essentially it is the good intention that is appreciated. Thus, in the end, the results are symbolic acts. At the same time, the main driver of man-made climate change — the emission of greenhouse gases — is hardly affected.

The heydays of climate science, the science which establishes quantitative and theoretical understanding about the mechanism linking emissions and climate change, are over. This mechanism is well researched, the statistical proof of “detection and attribution” of man-made climate change has been presented. The budget approach, which linearly links the sum of previous emissions to the intensity of change, allows a robust estimate of the change to come.

The question is — what do we do with climate change? The Intergovernmental Panel on Climate Change (IPCC) has determined, based on the budget approach, that a limitation of the increase of the global mean air temperature to below 2 degrees until 2100 compared to preindustrial times, is possible. But only if the global annual net emissions of about 40 billion tons of Carbon Dioxide (CO₂) are stopped until 2050 and are replaced by significant negative emissions (i.e., extraction of CO₂ from the atmosphere). And the international political community has declared in the Paris accord that it wants to achieve this goal of a maximum of 2 degrees.

This is the challenge of dealing with man-made climate change — how to phase out the use of fossil fuels everywhere on the globe until 2050. And at the same time install massive extraction of carbon dioxide from the atmosphere and store or use it somehow.

Besides this mitigation approach to limit climate change, there is a second challenge, which is outside of the scope of the present book, but which at least should be mentioned. This second challenge — climate change adaptation — is the fact that not all climate change can be avoided. Climate change can only be limited. Thus, there will be climate change impacts, to which societies need to install adaptive measures. Efficient measures will need advances and global accessibility of technology.

Regarding “mitigation,” humanity is currently facing several serious challenges. As described by the Millennial goals of the United Nations, the out-phasing of global CO₂ emissions should be achieved without compromising. Even if one welcomed a different lifestyle in Western countries for various reasons, the overall effect would not be enough to achieve the climate goal. And at the same time, the Global South demands improved living conditions, usually associated with enhanced emissions. Thus, one may rightly argue, the solution must be with improved technology, which

combines the goal of better living conditions (which includes access to mobility) and of phasing-out greenhouse gases.

The analyses and ideas presented in this book become essential for the debate of how to proceed. How do the world's societies manage to reach the Paris goals of a warming of less than 2 degrees? This book addresses the major issue of traffic on the land surface, on the sea and in the air. There is no "silver bullet" solution for all aspects of transport. And investing in different technologies will prepare for a variety of options, satisfying both, the economic and the climatic requirements – while allowing the democratic process to sort out preferences and values. This book discusses the currently identified needs, options, and complexities of the challenge.

This is not a book for those youngsters, who believe that panicking and activity irrespective of efficiency would be the "cure." It is a book for people who take climate change seriously. A book for adults who understand that detail matters, and that a variety of cultural differences and goals need to be balanced. This book opens doors to such a world of arguments and analysis. That's why this book is needed.

Hamburg, January 27, 2021, Hans von Storch