

Cambridge University Press

978-0-521-11941-2 - Making Climate Change Work for Us: European Perspectives on Adaptation and Mitigation Strategies

Edited by Mike Hulme and Henry Neufeldt

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MAKING CLIMATE CHANGE WORK FOR US European Perspectives on Adaptation and Mitigation Strategies

Making Climate Change Work for Us is an introduction to the main challenges and opportunities of developing local, regional and global strategies for addressing climate change, and explains many of the dilemmas faced when converting strategies into policies.

The book provides a synthesis of the findings of the three-year ADAM (Adaptation and Mitigation Strategies: Supporting European Climate Policy) research project. Written from a European perspective by many of the continent's leading inter-disciplinary climate change research teams, European strategies for tackling climate change are placed within a global context. The volume addresses questions such as 'How is European climate policy made?', 'How feasible are very low emissions scenarios?', 'What is the role of policy in adaptation?', 'How can the goals of climate change and development policy be brought into alignment?' and 'What options are there for an international climate agreement after 2012?' The book explains and illustrates the differences between adaptation and mitigation, offers regional and global case studies of how adaptation and mitigation are inter-linked, and suggests five different metaphors for thinking about the strategic options we have for making climate change work for us, rather than against us.

The book is intended for readers interested in finding practical solutions to climate change – both adaptation and mitigation – within the policy contexts in which these solutions have to be implemented. It is valuable reading for researchers in environmental studies, environmental economics, political science, geography, international relations, integrated assessment, and risk analysis, as well policy-makers in government, industry and NGOs.

Three other books arise from the ADAM project, all published by Cambridge University Press and, together with this volume, derive from research funded by DG-RTD as part of the Sixth Framework Programme of the European Commission. *Global Climate Governance Beyond 2012: Architecture, Agency and Adaptation*

Edited by Frank Biermann, Philipp Pattberg and Fariborz Zelli

Climate Change Policy in the European Union: Confronting the Dilemmas of Adaptation and Mitigation?

Edited by Andrew Jordan, Dave Huitema, Harro van Asselt, Tim Rayner and Frans Berkhout

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Mainstreaming Climate Change in Development Cooperation: Theory, Practice and Implications for the European Union

Edited by Joyeeta Gupta and Nicolien van der Grijp

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THE ADAM BOOK SERIES FROM CAMBRIDGE UNIVERSITY PRESS

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and Mitigation Strategies

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Foreword

Climate change has become one of the essential political, social and economic challenges of our times. This was a challenge that the European Union was quick to recognise in the late 1980s and one that we have continued to place close to the heart of our strategic thinking and policy-making, at the same time as the EU has enlarged and strengthened as a political entity. During these 20 years or more, the European Commission has funded a significant number of research projects exploring the scientific, economic, social and political dimensions of the problem. Our contribution to the international body of knowledge about climate change has been impressive. Within the Sixth RTD Framework Programme of the European Community (2002–2006), new opportunities were created for large-scale Integrated Projects to be implemented, which brought together significant European research capacity to address strategic questions of high scientific and political significance. The ADAM project – Adaptation and Mitigation Strategies: Supporting European Climate Policy – was one such project. I am very pleased to see the results of this project now appear in this edited volume at such a timely moment in the evolution of our thinking and decision-making about climate change. It is published during COP 15 in Copenhagen, where the signatories to the UNFCCC will attempt to forge a forward-looking deal that will break the policy deadlock and provide the necessary instruments to tackle climate change more effectively.

I sincerely hope that this book – and the three others in the ADAM book series – fulfils its goal of bringing the insights of European integrated climate change researchers into the wide arena of international climate change deliberation, debate and decision making.

*José Manuel Silva Rodríguez
Director-General of the
Directorate-General for Research
European Commission
Brussels, September 2009*

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Preface

The ADAM Project

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Changes in climate induced by human emissions of greenhouse gases, and other climate changing agents, into the atmosphere have introduced a new political and cultural dynamic at the beginning of the twenty-first century. Debates about public policy, the development of business strategies and the deliberations of new social and environmental movements and organisations are now conducted with considerations about climate change very much in evidence. Anthropogenic climate change not only changes the nature – frequency and intensity – of climate risks to which societies have long been exposed, but introduces the possibility at some indeterminate point in the future of prospective changes to climate which lie well outside the experience of human history. These prospects and possibilities introduce new challenges for all levels of governance – for public authorities from local and regional/city scales, through to national to international scales; for small businesses and multinational corporations; and for elected and non-elected sovereign governments.

Making Climate Change Work for Us: European Perspectives on Adaptation and Mitigation Strategies offers a synthesis of recently completed research which addresses these challenges. The research upon which this book is based was completed in the project ‘Adaptation and Mitigation Strategies: Supporting European Climate Policy’ (ADAM), a project funded by the European Commission under the Sixth Framework Research Programme of the European Union (EU). The ADAM project involved 24 of the continent’s leading inter-disciplinary climate change research institutions, plus two partner institutions from China and India. The research described in this edited volume was completed during the period 2006 to 2009 and involved some 150 researchers from across Europe and beyond.

The significance of *Making Climate Change Work for Us* is twofold. Firstly, the book offers an inter-disciplinary perspective – drawing upon environmental

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economics, policy sciences, geography, technology analysis, integrated assessment and other social and natural science disciplines – on the ideas and dilemmas surrounding the development and deployment of adaptation and mitigation strategies for addressing climate change, and on the methods and tools used to investigate them. Secondly, it offers this unique perspective from a cohort of Europe's leading integrated climate change research experts who have developed their analytical and intellectual skills over many years as close observers and participants in vibrant EU and international science and policy debates about climate change.

The research described here is contextualised by current EU and international developments, dilemmas and debates about climate change and about the relationship between climate science and policy. Our point of departure is the EU's policy goal of restricting anthropogenic global warming to no more than 2 °C above pre-industrial temperature. Yet the analyses in this book examine a wider range of questions and concerns. They are set in the context of a contested and slowly evolving global climate regime, against a back-drop of growing interest in adapting societies around the world to be more resilient to climate risks, and are fully aware of the changing international climate diplomacy in search of a new global framework agreement for the post-2012 period. The chapters navigate through various combinations of these scientific, political, economic and ethical uncertainties, exploring them at different scales and reporting new ideas, new findings and new possibilities from an integrated research perspective and from within European culture.

The title of this volume – *Making Climate Change Work for Us* – is intended to reflect a positive stance in relation to climate change. The editors firmly believe that the risks and challenges of climate change must be viewed as opportunities to improve quality of life for all peoples, both now and in the future, i.e. as a means of moving towards greater sustainability, rather than portrayed as the first signs of an inevitable global catastrophe. It is important that the unique characteristics of anthropogenic climate change – the global drivers and consequences of change and the demand for a multi-decadal if not multi-generational perspective – are used powerfully to re-think and re-shape the ways in which local, national, regional and international strategic planning and policy making are conducted in the early twenty-first century. While not being directly addressed in this volume, the current financial and economic crisis provides just one such opportunity. By now investing heavily in transformations of energy systems worldwide, new possibilities arise for avoiding high-end climate change scenarios.

In the context of other books

The number and diversity of books about climate change has increased almost exponentially over the last few years. Each of the book publishing categories

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Edited by Mike Hulme and Henry Neufeldt

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of textbooks, popular science, polemical, journalistic, coffee-table and academic research are now well populated with climate change offerings. *Making Climate Change Work for Us* falls clearly into the category of academic research yet by focusing specifically on adaptation *and* mitigation strategies, and by being rooted in a large inter-disciplinary research project (ADAM), *Making Climate Change Work for Us* makes a unique contribution to the literature.

This volume should be viewed as a logical supplement to the earlier Cambridge University Press books edited by John Schellnhuber and colleagues (Schellnhuber *et al.*, 2006) arising from the February 2005 Exeter Conference on dangerous climate change, and by Neil Adger and colleagues (Adger *et al.*, 2009) arising from the February 2008 Tyndall Centre Conference on limits to adaptation. The former focused on the dangers of climate change, the latter on limits and barriers to adapting to these dangers, while *Making Climate Change Work for Us* examines the range of adaptation and mitigation strategies, at different scales, that can be pursued to avoid, defuse or otherwise manage such dangers. Collectively, these three research-based and edited volumes make a valuable triumvirate contribution to our understanding of climate change, global ecology and human society.

Making Climate Change Work for Us is itself supplemented by three further books emerging from the ADAM research project and also published by Cambridge University Press: *Climate Change Policy in the European Union* (edited by Andrew Jordan and colleagues), *Global Climate Governance Beyond 2012* (edited by Frank Biermann and colleagues) and *Mainstreaming Climate Change in Development Cooperation* (edited by Joyeeta Gupta and Nicolein van der Grijp). These three volumes provide more in-depth analyses of the policy dimensions of climate change as examined within Europe (Jordan *et al.*, 2010), from an international perspective (Biermann *et al.*, 2010) and from a development perspective (Gupta *et al.*, 2010). Taken together, these four books from the ADAM project constitute a substantial advance in our understanding of the policy implications of climate change as viewed from the end of the first decade of the twenty-first century. The research completed in the ADAM project, and which informs this book series, is also reported in two journal special issues: in *The Energy Journal* ('The economics of low stabilisation' edited by Ottmar Edenhofer and colleagues) and in *Mitigation and Adaptation Strategies for Global Change* ('Assessing adaptation to extreme weather events in Europe' edited by Zbigniew W. Kundzewicz and Reinhard Mechler).

Structure and contents

Making Climate Change Work for Us is built around 14 substantive and original chapters. The first five of these introduce some of the concepts and scenarios used in the ADAM project. Four chapters in Part II of the book then explore strategies for

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responding to climate change within Europe, followed by four chapters in Part III, which extend this exploration of strategic options beyond the boundaries of the European Union. The volume is completed by an integrating synthesis chapter.

In Part I of the book, five chapters introduce some of the concepts and scenarios used in the ADAM project: concepts used as the basis for identifying and analysing mitigation and adaptation strategies, and scenarios used as the basis for framing possible future states of Europe and the world so as to be amenable for strategic and policy investigations. Together, these chapters build the conceptual and methodological framework for later analyses of climate change strategies. These opening perspectives go beyond current state-of-the-art: they benefit from new insights emerging from recent climate policy analysis and integrated assessment research and they are oriented to illuminate climate change decision making and policy deliberations.

Chapter 1 (co-ordinated by Henry Neufeldt from the Tyndall Centre and School of Environmental Sciences at the University of Anglia in the UK) offers a conceptual basis for discussing adaptation and mitigation by looking at the different kinds of challenges that need to be addressed when dealing with both adaptation and mitigation climate policies: synergies, conflicts and trade-offs as played out in different sectors and over different scales. Chapter 2 (co-ordinated by Duncan Russel also from the School of Environmental Sciences at the University of East Anglia) provides an analysis of current trends and future challenges for climate change appraisal processes in the EU, drawing upon empirical evidence of recent climate policy appraisals conducted in Europe at different scales and contexts. Chapter 3 (co-ordinated by Detlef van Vuuren from the Netherlands Environmental Assessment Agency) introduces the global society–energy–climate–environment scenarios used in the ADAM project and which frame the analysis consistently throughout the project. This chapter outlines the recent development of recursive scenarios that take into account the impacts of climate change and a certain level of future adaptation. Such scenarios of adaptation are further investigated in Chapter 4 (co-ordinated by Asbjørn Aaheim from the Center for International Climate and Environmental Research in Norway) using different top-down and bottom-up modelling approaches to explore climate impacts and adaptation in Europe. It is suggested that the common perception of adaptation taking place at local levels will lead to significant underestimation of the actual costs of adaptation because of the existing market imperfection: for example locality and extreme weather events or limits to moving stranded assets. National and international adaptation strategies may instead be needed. In contrast, Chapter 5 (co-ordinated by Jochen Hinkel from the Potsdam Institute for Climate Impact Research in Germany) takes a bottom-up approach to examining adaptive capacity and the barriers to adaptation practice. Illustrated through four different decision-making contexts, the chapter focuses on the social

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and institutional processes of adaptation learning. These illustrations are drawn from the ADAM project's case studies, as well as from a meta-analysis of existing literature.

The four chapters in Part II of the book explore strategies to deal with a number of challenges related to European climate change policy at different scales and for varying contexts. Yet these are representative of similar challenges facing other regions of the world: climate governance, the energy system, weather risks and extremes and regional land use and water management. Chapter 6 (co-ordinated by Frans Berkhout from the Institute of Environmental Studies in the VU University Amsterdam) introduces the concept of governance dilemmas (i.e. making choices between equally favourable or equally disagreeable alternatives) as applied to EU climate mitigation policies. Chapter 7 (co-ordinated by Gunnar Eskeland from the Center for International Climate and Environmental Research in Norway) discusses how Europe can devise strategies that enable a transition towards a low-carbon energy system while still operating effectively within a global context. The chapter explores questions of energy efficiency, low-carbon technology, land use changes and the direct impacts on electricity supply and demand of the changing climate. Chapter 8 (co-ordinated by Reinhard Mechler from the International Institute for Applied Systems Analysis in Vienna, Austria) examines the changing nature of weather risk in Europe using the theory and practice of disaster risk analysis and management. It focuses on current and future risks emerging from floods, drought and heat waves and illustrates the economic impacts of such events and how structural funds may be used as a form of adaptation. The final chapter in this section of the book – Chapter 9 co-ordinated by Saskia Werners from Wageningen University in the Netherlands – investigates two central issues of regional and spatial planning in the face of climate change and variability: land use change and water distribution. For three regions studied in the ADAM project – the Tisza basin in Hungary, the Guadiana basin in the Iberian Peninsula and the Alxa region in Inner Mongolia, China – the chapter synthesises lessons for adaptation derived from understanding the differing environmental, social and political settings of each region.

Part III of the book comprises four chapters which extend analysis beyond the borders of the EU and provide insights into, respectively, governance, economic/technological, development and financial aspects of climate change at the global level. These chapters investigate a number of adaptation and mitigation strategies that will have to be considered carefully if climate change is to be retained at levels approximating to the EU's policy target of 2 °C. Chapter 10 (co-ordinated by Frank Biermann from the Institute of Environmental Studies at the VU University Amsterdam) establishes a number of avenues to explore regarding global climate governance after 2012. These perspectives include how to involve

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non-state actors in such a regime and how to strengthen the goals of adaptation in such an international system of governance. Their investigations rely on qualitative policy assessment, formal modelling and participatory methods. Chapter 11 (co-ordinated by Brigitte Knopf from the Potsdam Institute for Climate Impact Research) uses an ensemble of energy-economy models to reveal the technological challenges and political and economic consequences of reaching the 2°C goal with more than a 50% chance of success. This goal implies negative global emissions at some point this century. Special attention is therefore given to the emissions reduction potentials of bio-energy, non-carbon dioxide gases and carbon capture and storage, and the consequences of these technologies for different global regions and for Europe. Chapter 12 (co-ordinated by Joyeeta Gupta from the Institute of Environmental Studies at the VU University Amsterdam) explores the relationship between climate change and European development assistance. It examines the possibilities and barriers to mainstream considerations of climate change and variability into development policies and how best to improve EU development cooperation in the future. One specific option for mainstreaming – risk-sharing through insurance mechanisms – is investigated in Chapter 13 (co-ordinated by Joanne Linnerooth-Bayer from the International Institute for Applied Systems Analysis). Such mechanisms require global public–private partnerships to be effective at different scales and the chapter describes examples of such insurance-based adaptation at local, national and regional scales that manage climate-related risks for developing countries. The analysis also explores the limits of such insurance-based instruments for reaching the poorest of the poor.

The final chapter of the book – Chapter 14 co-ordinated by Anthony Patt from the International Institute for Applied Systems Analysis – draws on many of the arguments, analyses and insights from the ADAM project to offer five guideposts for thinking about successful climate strategies. These guideposts are elaborated using a different metaphor for each case: describing priorities between mitigation and adaptation policies rather than optimal trade-offs; describing mitigation as the need to invest in strategies that go far beyond picking low-hanging fruit; describing climate policies as trial-and-error approaches out of which may emerge robust solutions; describing the technological changes necessitated by climate change as an opportunity to secure future sustainable development while eliminating many convenient, but inadequate, ‘crutches’; and, finally, describing climate change policies as a game of winners and losers where the losers will have to be compensated to continue to play the game. These strategic guideposts offer a vision of how we can – deploying collective wisdom, political will and human ingenuity – ‘make climate change work for us’.

How the book was produced

Each chapter in *Making Climate Change Work for Us* was led by a co-ordinating lead author who had overall responsibility for the chapter. With the exceptions of the opening and closing chapters – which frame (Chapter 1) and synthesise (Chapter 14) the entire project – each chapter is rooted in one of the primary areas of work conducted within the ADAM project. The full writing teams for each chapter were drawn, however, from across the ADAM consortium and reflect the inter-disciplinary and institutionally collaborative character of the ADAM project. Each chapter was peer reviewed twice: an initial internal review in which researchers in the ADAM project were required formally to review the work of colleagues in different domains of the project, followed by a second, external, review in which two independent reviewers selected from institutions in Europe and North America not involved in the ADAM project were asked to conduct a full evaluation of the merits and deficiencies of the draft chapters. The editors of the book required authors to respond formally in writing to each cycle of review comments and they ensured that corrections and improvements to each chapter were subsequently implemented.

The 101 authors of this volume are drawn from some of Europe's leading inter-disciplinary climate change research institutions, many of whom have had prominent roles in either the Third, Fourth or Fifth Assessment Reports of the Intergovernmental Panel on Climate Change. Their affiliations are included above.

Mike Hulme
 Henry Neufeldt
 Norwich, April 2009

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Abbreviations

A2	IPCC SRES scenario
AAD	Annual average damages
ACEA	European Automobile Manufacturers Association
ADAM	Adaptation and mitigation strategies: supporting European climate policy (EU FP6 research project)
ADB	Asian Development Bank
AD-RICE	Adaptation in regional dynamic integrated model of climate change and the economy (version of DICE)
AD-DICE	Adaptation in dynamic integrated model of climate change and the economy (see model appendix)
ALTENER	an EU programme aimed at promoting the use of renewable energy sources
AOSIS	Alliance of small island states
AR4	IPCC Fourth Assessment Report
ART	Alternative risk transfer
ASTRA	A strategic integrated assessment model (see model appendix)
B2	IPCC SRES scenario
BSAEU	Burden sharing agreement
C&D	Climate and development
CATSIM	Catastrophe simulation model (see model appendix)
CBA	Cost–benefit analysis
CCA	Climate change agreement
CCPMs	Common and co-ordinated policies and measures
CCRIF	Caribbean catastrophe risk insurance facility
CCS	Carbon capture and storage
CDAC	Commission for the Convention Development and Application

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List of abbreviations

CDM	Clean development mechanism
CEC	Commission of the European Communities
CGE	Computable general equilibrium model
CI	Carbon intensity
CIDA	Canadian International Development Agency
CIP	Climate insurance pool
CO ₂	Carbon dioxide
CO ₂ e	Carbon dioxide equivalent
COP	UNFCCC Conference of the Parties
Cropsyst	A multi-year, multi-crop, daily time-step crop-growth simulation-model (see model appendix)
DAC	Development Assistance Committee
Defra	UK Department for Environment, Food and Rural Affairs
DG	Directorate General (of the EU)
DICE	Dynamic integrated model of climate change and the economy
DIVA	Dynamic and interactive vulnerability assessment model (see model appendix)
DPSIR	Driver–pressure–state–impact–response
E3ME	Energy–environment–economy model of Europe (see model appendix)
E3MG	Energy–environment–economy modelling at the global level (see model appendix)
EAC	Environmental Audit Committee
EC	European Commission
ECAs	Energy conservation agreement schemes
ECCP	European Climate Change Programme
EDI	Ethiopia Drought Index
EEA	European Environment Agency
EFISCEN	European forest information scenario model
EI	Energy intensity
EMELIE	model assessing the European electricity market (see model appendix)
EMF	Stanford Energy Modelling Forum
ETS	Emissions trading scheme
EU	European Union
EU-15	Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden, United Kingdom

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EU-27	EU-15 countries + Bulgaria, Czech Republic, Cyprus, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia, Slovenia
EU-27+2	EU-27 countries + Norway and Switzerland
EuroMM	European Multi-regional MARKAL energy-conversion model (see model appendix)
EUSF	European Union Solidarity Fund
EV	Equivalent variation
FAIR	Climate policy model (see model appendix)
FES	Future energy solutions
FIT	Feed in tariff
FoEE	Friends of the Earth Europe
FPPP	Full polluter pays principle
FUND	An integrated assessment model of the climate and the economy
G77	Seventy-seven developing country signatories of the ‘Joint Declaration of the Seventy-Seven Countries’ on 15 June 1964
GDP	Gross domestic product
GEF	Global environment facility
GHG	Greenhouse gas
GIRF	Global index reinsurance facility
GIS	Geographical information system
GNI	Gross national income
GP	EU Adaptation Green Paper
GRACE	Global responses to anthropogenic change in the environment (see model appendix)
GRACE-EL	model based on GRACE, developed for the ADAM project (see model appendix)
GTAP	Global trade analysis project
GTZ	German Technical Co-operation Agency
HadCM3	Hadley Centre coupled climate model, version 3 – coupled atmosphere-ocean general circulation model
HIRHAM	Regional atmospheric climate model, with a pan-Arctic domain
IAM	Integrated assessment models
ICFD	International conference for financing in development
IEA	International energy agency
IFI	International financial institutions

xxx	<i>List of abbreviations</i>
IMAGE	Integrated model to assess the global environment (see model appendix)
IPCC	Intergovernmental Panel on Climate Change
IRI	International Research Institute for Climate and Society (Columbia University, New York)
IS	Industry energy system model simulating distinct conservation options and industrial processes (see model appendix)
ITC	Induced technological change
JAMA	Japanese Automobile Manufacturers Association
JI	Joint implementation
KAMA	Korea Automobile Manufacturers Association
MARA/ARMA	Malaria suitability model (see model appendix)
MATEFF	A model simulating potentials of material efficiency of energy-intensive materials (see model appendix)
MCII	Munich climate insurance initiative
MERGE	Model for evaluating regional and global effects (see model appendix)
MERGE-ETL	A modified version of MERGE5 (see model appendix)
MESSAGE	A model that embeds the world energy system within a macroeconomic framework
MMARM	Ministerio de Medio Ambiente Rural y Marino, Madrid
NAPA	National adaptation plan of action
NDRC	National Development and Reform Commission
NGO	Non-governmental organisation
NHS	National Health Service
NUTS	Nomenclature of territorial units for statistics
ODA	Official development assistance
OECD	Organisation for Economic Co-operation and Development
ORASECOM	Orange-Senqu River Commission
PAGE	Policy analysis of the greenhouse effect model
PAMs	EU climate change policies and measures
PESETA	Project – Projection of economic impacts of climate change in sectors of the European Union based on bottom-up analysis
POLES	A global sectoral model of the world energy system (see model appendix)
PowerACE	ResInvest, an agent-based sector model (see model appendix)
ppm	parts per million