

Climate Change 2007 Mitigation

Edited by

Bert Metz

Co-chair Working Group III
Netherlands Environmental
Assessment Agency

Ogunlade Davidson

Co-chair Working Group III
University of Sierra Leone

Peter Bosch

Rutu Dave

Leo Meyer

Technical Support Unit IPCC Working Group III
Netherlands Environmental Assessment Agency

Contribution of Working Group III
to the Fourth Assessment Report of the
Intergovernmental Panel on Climate Change

Published for the Intergovernmental Panel on Climate Change

 **CAMBRIDGE**
UNIVERSITY PRESS

CAMBRIDGE UNIVERSITY PRESS

Cambridge, New York, Melbourne, Madrid, Cape Town, Singapore, São Paulo, Delhi

Cambridge University Press

32 Avenue of the Americas, New York, NY 10013-2473, USA

www.cambridge.org

Information on this title: www.cambridge.org/9780521880091

© Intergovernmental Panel on Climate Change 2007

This publication is in copyright. Subject to statutory exception and to the provisions of relevant collective licensing agreements, no reproduction of any part may take place without the written permission of Cambridge University Press.

First published 2007

Printed in Canada by Friesens

A catalog record for this publication is available from the British Library.

ISBN 978-0-521-88011-4 hardback

ISBN 978-0-521-70598-1 paperback

Cambridge University Press has no responsibility for the persistence or accuracy of URLs for external or third-party Internet Web sites referred to in this publication and does not guarantee that any content on such Web sites is, or will remain, accurate or appropriate.

Please use the following reference to the whole report:

IPCC, 2007: *Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* [B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA., XXX pp.

Cover photo:

Contents

Foreword	v
Preface	vii
Summary for Policymakers	1
Technical Summary	25
1 Introduction	95
2 Framing issues	117
3 Issues related to mitigation in the long term context	169
4 Energy supply	251
5 Transport and its infrastructure	323
6 Residential and commercial buildings	387
7 Industry	447
8 Agriculture	497
9 Forestry	541
10 Waste management	585
11 Mitigation from a cross sectoral perspective	619
12 Sustainable Development and mitigation	691
13 Policies, instruments and co-operative agreements	745
Annex I: Glossary	809
Annex II: Acronyms, abbreviations and chemical compounds	823
Annex III: List of contributors	827
Annex IV: List of reviewers	833
Index	841

Foreword

“Climate Change 2007 – Mitigation”, the third volume of the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), provides an in-depth analysis of the costs and benefits of different approaches to mitigating and avoiding climate change.

In the first two volumes of the “Climate Change 2007” Assessment Report, the IPCC analyses the physical science basis of climate change and the expected consequences for natural and human systems. The third volume of the report presents an analysis of costs, policies and technologies that could be used to limit and/or prevent emissions of greenhouse gases, along with a range of activities to remove these gases from the atmosphere. It recognizes that a portfolio of adaptation and mitigation actions is required to reduce the risks of climate change. It also has broadened the assessment to include the relationship between sustainable development and climate change mitigation.

At regular intervals of five or six years, the IPCC presents comprehensive scientific reports on climate change that assess the existing scientific, technical and socioeconomic literature. The rigorous multi-stage review process of the reports, the broad and geographically-balanced participation of experts from all relevant fields of knowledge and the thousands of comments taken into account guarantee a transparent and unbiased result.

As an intergovernmental body established by the World Meteorological Organization and the United Nations Environment Programme, the IPCC has the responsibility of providing policymakers with objective scientific and technical findings that are policy relevant but not policy prescriptive. This is especially evident in the Mitigation report, which presents tools that governments can consider and implement in their domestic policies and measures in the framework of international agreements.

Hundreds of authors contributed to the preparation of this report. They come from different backgrounds and possess a wide range of expertise, from emissions modelling to economics, from policies to technologies. They all dedicated a large part of their valuable time to the preparation of the report. We would like to thank them all, in particular the 168 Coordinating Lead Authors and Lead Authors most closely engaged in the process.

The preparation of an IPCC Assessment Report is a complex and absorbing process. We would like to express our gratitude to the Technical Support Unit for its massive organizational efforts. We would also like to thank the IPCC Secretariat for its dedication to the efficient completion of the report.

We express our appreciation to the Government of the Netherlands, which hosted the Technical Support Unit; the Government of Thailand, which hosted the plenary session for the approval of the report; the Governments of China, Germany, New Zealand and Peru, which hosted the Lead Authors’ meetings; and to all the countries that contributed to IPCC work through financial and logistic support.

We wish to sincerely thank Dr Rajendra K. Pachauri, Chairman of the IPCC, for his steady and discreet guidance and to express our deep gratitude to Drs Ogunlade Davidson and Bert Metz, Co-Chairs of Working Group III, who successfully led their team with positive, efficient and constructive direction.



M. Jarraud
Secretary General
World Meteorological Organization



A. Steiner
Executive Director
United Nations Environment Programme

Preface

The Fourth Assessment Report of IPCC Working Group III, “Mitigation of Climate Change”, aims to answer essentially five questions relevant to policymakers worldwide:

- What can we do to reduce or avoid climate change?
- What are the costs of these actions and how do they relate to the costs of inaction?
- How much time is available to realise the drastic reductions needed to stabilise greenhouse gas concentrations in the atmosphere?
- What are the policy actions that can overcome the barriers to implementation?
- How can climate mitigation policy be aligned with sustainable development policies?

A description of mitigation options for the various societal sectors that contribute to emissions forms the core of this report. Seven chapters cover mitigation options in energy supply, transport, buildings, industry, agriculture, forestry and waste management, with one additional chapter dealing with the cross-sectoral issues. The authors have provided the reader with an up-to-date overview of the characteristics of the various sectors, the mitigation measures that could be employed, the costs and specific barriers, and the policy implementation issues. In addition, estimates are given of the overall mitigation potential and costs per sector, and for the world as a whole. The report combines information from bottom-up technological studies with results of top-down modelling exercises. Mitigation measures for the short term are placed in the long-term perspective of realising stabilisation of global average temperatures. This provides policy-relevant information on the relation between the stringency of stabilisation targets and the timing and amount of mitigation necessary. Policies and measures to achieve mitigation action, both at national and international levels, are covered in chapter 13; this is additional to what is included in the sector chapters. The link between climate change mitigation, adaptation and sustainable development has been further elaborated in the relevant chapters of the report, with one chapter presenting an overview of the connections between sustainable development and climate change mitigation.

The process

After two scoping meetings to establish possible content, the formal assessment production process got underway in 2003 with the approval of the report outline by the IPCC at the Panel’s 21st session. Soon after this, an author team of 168 lead authors (55 from developing countries, 5 from EIT countries and 108 from OECD countries) and 85 contributing authors was formed by the Working Group III Bureau, based on nominations from governments and international organisations. Thirty-six per cent of the lead authors came from developing countries and countries with economies in transition. The IPCC review procedure was followed, in which drafts produced by the authors were subject to two reviews. Thousands of comments from a total of 485 expert reviewers, and governments and international organisations were processed. The processing into new drafts was overseen by two review editors per chapter, who ensured that all substantive comments received appropriate consideration.

The Summary for Policymakers was approved line by line, and the main report and Technical Summary were accepted at the 9th session of the IPCC Working Group III held in Bangkok, Thailand from 30 April to 4 May 2007.

Acknowledgements

Production of this report was a major enterprise, in which many people all around the world delivered a wide variety of contributions. This input could not have been made without the generous support from the governments and institutions involved, which enabled the authors, review editors and reviewers to participate in this process. To them, our thanks.

We are particularly grateful to the governments of Germany, Peru, China and New Zealand, who, in collaboration with local institutions, hosted the crucial lead author meetings in Leipzig (October 2004), Lima (June 2005), Beijing (February 2006) and Christchurch (October 2006).

Various countries and institutions supported expert meetings and stakeholder consultations that have contributed to the depth and scope of the report, namely:

- Adaptation, mitigation and sustainable development in La Réunion (supported by the government of France)
- Emissions scenarios in Washington DC (supported by the US Government)
- Input by industry representatives in Tokyo (supported by the Japanese government) and Cape Town, South Africa (co-sponsored by Eskom), and
- Input from environmental NGOs, intergovernmental organisations, research organisations and members of the International Energy Agency and its technology network in Paris (in cooperation with the IEA).

Throughout the process, the Working Group III Bureau – consisting of Ramón Pichs Madruga (Cuba), R.T.M. Sutamiardja (Indonesia), Hans Larsen (Denmark), (up to May 2005), Olav Hohmeyer (Germany, from June 2005), Eduardo Calvo (Peru), Ziad H. Abu-Ghararah (Saudi Arabia, up to September 2005), and Taha M. Zatari (Saudi Arabia, after September 2005), Ismail A.R. Elgizouli (Sudan) – delivered constructive support and continuous encouragement.

The success of this report is, however, fully based on the expertise and enthusiasm of the author team for which we are grateful. We would also like to express our appreciation of the expert reviewer inputs. Without their comments, the report would not have achieved its current quality level. Our review editors had a similar critical role in supporting the author team in dealing with the comments.

The assessment process was supported by the Technical Support Unit, financed by the government of the Netherlands. The following persons provided support, advice and coordination: Leo Meyer, Peter Bosch, Rutu Dave, Monique Hoogwijk, Thelma van den Brink, Anita Meier, Sander Brinkman, Heleen de Coninck, Bertjan Heij, David de

Jager, John Kessels, Eveline Trines, Manuela Loos (editing support), Martin Middelburg (layout), Rob Puijk (webmaster), Ruth de Wijs (coordination of copyediting), Marilyn Anderson (index) and many more from the secretariats of MNP and ECN in the Netherlands.

Finally, we would like to thank the IPCC secretariat in Geneva in the persons of Renate Christ (Secretary of the IPCC), Jian Liu, Carola Saibante, Rudie Bourgeois, Annie Courtin and Joelle Fernandez for their continuous support throughout the process.

Bert Metz
Ogunlade Davidson

Co-chairs, IPCC Working Group III

This report is dedicated to

Gerhard Petschel-Held, Germany

Lead Author in Chapter 12

Gerhard Petschel-Held died unexpectedly on September 9, 2005, at the age of 41 years. He worked at the Potsdam Institute for Climate Impact Research as head of the department Integrated Systems Analysis. He was an excellent scientist and a wonderful person to work with.

Based on his scientific credentials and his capacity to integrate, Gerhard Petschel-Held played a key role in several international research networks. He believed strongly in the communication of scientific knowledge to a wider public, and to improve the world with the help of science.