UNDERSTANDING INDUSTRIAL TRANSFORMATION
Views from Different Disciplines

ENVIRONMENT & POLICY

VOLUME 44

The titles published in this series are listed at the end of this volume.

Understanding Industrial Transformation

Views from Different Disciplines

Edited by

Xander Olsthoorn

Institute for Environmental Studies (IVM),
Vrije Universiteit, Amsterdam, The Netherlands

and

Anna J. Wieczorek

Industrial Transformation Project (IT),
International Human Dimensions Programme
on Global Environmental Change (IHDP),
c/o Institute for Environmental Studies (IVM),
Vrije Universiteit, Amsterdam, The Netherlands

Springer

A C.I.P. Catalogue record for this book is available from the Library of Congress.

ISBN-10 1-4020-3755-4 (HB)
ISBN-13 978-1-4020-3755-9 (HB)
ISBN-10 1-4020-4418-6 (e-book)
ISBN-13 978-1-4020-4418-2 (e-book)

Published by Springer,
P.O. Box 17, 3300 AA Dordrecht, The Netherlands.

www.springeronline.com

Cover design and logo by Carel Boss

Printed on acid-free paper

Printed in the Netherlands.

‘A system is just like truth’s tail, but the truth is like a lizard. It will leave the tail in your hand and escape; it knows that it will soon grow another tail’

(Ivan Sergeevich Turgenev (1818–1883), Letter, January 3, 1857, to Count Lev Nikolaevich Tolstoy. Turgenev: Letters, ed. David Lowe (1983)).

Table of Contents

List of figures

List of tables

ABOUT THE AUTHORS

Jeroen van den Bergh is professor of environmental economics at the Faculty of Economics and Business Administration, and professor of 'Nature, water and space' at the Institute for Environmental Studies (IVM), Vrije Universiteit, Amsterdam. His research covers elements of environmental, spatial and evolutionary economics. In 2002 he was awarded the Royal/Shell prize for research on energy and sustainable development.

Frank Biermann is professor of political sciences and environmental policy sciences and head of the department of Environmental Policy Analysis at the Institute for Environmental Studies (IVM), Vrije Universiteit, Amsterdam. He also directs the Global Governance Project, a multidisciplinary international research programme jointly administered by Vrije Universiteit Amsterdam, the Freie Universität Berlin, Potsdam Institute for Climate Impact Research, and Oldenburg University. Most of his research has addressed questions of global environmental governance.

Joop de Boer is research coordinator at the Institute for Environmental Studies (IVM), Vrije Universiteit, Amsterdam. He has a doctor's degree in psychology from the University of Amsterdam. His current research includes indicators of environmental quality and sustainability, risk perception and risk communication, determinants of sustainability and health in food choice, focussing on consumers' responses to information about culturally sensitive issues associated with food options.

Frank A. G. den Butter is professor of economics at the Vrije Universiteit, Amsterdam. He started his professional career at de Nederlandsche Bank and obtained his PhD from Erasmus University Rotterdam. He was member of the Scientific Council for Government Policy (at the Prime Minister's Office) and chairman of the Royal Netherlands Economic Association. His main other present functions are chairman of the Supervisory Committee of the Economic Institute for the Building Industry and member of the Central Statistical Committee.

Frank Geels is post-doctoral researcher at the Department of Technology Management, Technical University Eindhoven. Transitions and system innovations are the main topic of his work. He carries both theoretical works on this topic as well as historical case studies to test and refine theory. He also works on translating these insights to policy makers interested in bringing about transitions to sustainability.

Joyeeta Gupta is professor of policy and law on water resources and the environment at the UNESCO-IHE Institute for Water Education and head of the Programme on International Environmental Governance at the Institute for Environmental Studies (IVM), Vrije Universiteit, Amsterdam.

Marjan W. Hofkes is acting director of the Institute for Environmental Studies (IVM), Vrije Universiteit, Amsterdam, the Netherlands and acting head of the department of Economics and Technology of the same institute. In 1991 she received her PhD in mathematical economics from the Vrije Universiteit, Amsterdam. At the moment her main fields of interest are economic modelling, sustainable development and endogenous technology.

Klaus Jacob is research director at the Environmental Policy Research Centre, Freie Universität Berlin. He holds a doctoral degree in political science. His main foci of research are strategies and instruments to integrate environmental concerns in sectoral policies, innovation oriented environmental policy and environmental effects of industrial structural change. He is chair of the Environmental Policy / Global Change Section of the German Association of Political Scientists (DVPW).

Marleen van de Kerkhof is a post-doctoral researcher at the Institute for Environmental Studies (IVM), Vrije Universiteit Amsterdam, the Netherlands. She was educated as a policy scientist and is specialised in issues of stakeholder analysis, participatory methods, and dialogue approaches in the field of energy and climate, water management, and transition processes. Her most recent work concerns the development of a stakeholder dialogue on governance strategies for the transition towards a hydrogen economy in the Netherlands.

Onno Kuik is senior researcher the Institute for Environmental Studies (IVM), Vrije Universiteit, Amsterdam. He is an economist. His main interests are international trade and the environment, the monetary valuation of environmental change, market-based instruments of (international) environmental policy and economic aspects of interactions between agriculture and the environment.

Derk Loorbach is a political scientist developing the theory of transition management as a form of modern governance that deals with complex and structural societal and environmental issues. Main focus of his research is the development of an integrated governance-model based on complex-systems thinking. In addition he applies and develops a number of methods and tools for transition management in interaction with practitioners. Derk has worked for International Center for Integrated Studies (ICIS) the last 3 years and will continue his research with Jan Rotmans in Rotterdam.

Arthur P.J. Mol is head of the Environmental Policy Group at Wageningen University. He is the president of the Research Committee 'Environment and Society' of the International Sociological Association. He published widely on the topics of globalisation and environmental reform, on ecological modernisation in transitional economies and on the environmental state. He is coordinator of some major research programmes on environmental reform in Asia.

Xander Olsthoorn is senior researcher at the Institute for Environmental Studies (IVM), Vrije Universiteit, Amsterdam. He was educated as chemical engineer. Most of his environmental science work was in a multidisciplinary setting, with economists and social scientists. Main research topics are (cost-benefit) analysis of air pollution policies and impacts of climate change.

Frans Oosterhuis is senior researcher at the Institute for Environmental Studies, Vrije Universiteit, Amsterdam. Being an economist by education, his experience is mainly in policy oriented, multidisciplinary research. Recently, he has (among others) been involved in projects on the implementation of EU environmental policy in the Netherlands, environmental taxes, environmentally sound public procurement, and environmentally harmful subsidies. Energy is one of the main sectors on which his research work focuses.

Jan Rotmans is one of the founding fathers of Integrated Assessment and an expert in the field of integrated modelling, scenario-analysis, indicator-development and uncertainty-analysis and -management. He has founded and directed International Center for Integrated Studies (ICIS) for the last 6 years. The last few years, he has focused his research on the development of the concepts of transitions and transition management. He is currently involved in founding a comprehensive knowledge infrastructure focused on system innovations and transitions in the Netherlands. He will also head a new transitions institute at the Erasmus University in Rotterdam.

Gert Spaargaren is senior researcher and part-time professor of Environmental Policy for Sustainable Lifestyles and Consumption at the Environmental Policy Group of Wageningen University. His main research interests and publications are in the field of environmental sociology, sustainable consumption and behaviour, and the globalisation of environmental reform.

Adrian Smith is a research fellow at SPRU - Science and Technology Policy Research Unit at University of Sussex. The majority of the research carried out by Dr Adrian Smith falls into one of two, related areas: critical analysis of environmental policy processes; and research into relationships between technology and sustainable development. He has research experience in a variety of policy areas, including climate, energy, water and industrial pollution; a number of industrial sectors, such as the renewable energy, chemicals, and paper industry sectors. He has also researched different social arenas, such as the alternative technology movement. His research projects have covered regional, national, European, and global levels; his analysis tends to be interdisciplinary, drawing upon theoretical frameworks from a variety of disciplines, including political science and social studies of technology.

Anna J. Wieczorek is executive officer of the Industrial Transformation project of the International Human Dimensions Programme on Global Environmental Change (IHDP IT) hosted by the Institute for Environmental Studies (IVM), Vrije Universiteit Amsterdam. Her interests are in global environmental change and alternative development pathways that cause considerably less environmental burden. At the IT office she works on integrating and stimulating co-operation among international and interdisciplinary scientists whose work draws upon the dynamic interactions and mutual dependencies between the socio-economic, the producer (technological) and the consumer (market) domain, which have, so far, been studied almost exclusively as rather isolated factors.

PREFACE

'It is increasingly recognised that important changes in production and consumption systems will be required to meet the needs and aspirations of a growing world population while using environmental resources in a sustainable manner. Scientific research that informs how to bring about system changes must overcome disciplinary boundaries and be international in scope. In recent years this challenge has been discussed internationally under the label *Industrial Transformation* (IT).'(IT Science Plan, Vellinga and Herb 1999).

This volume attempts to bridge disciplinary barriers by discussing a variety of social science perspectives on society-environment interactions, the driving forces of change and development trajectories that have a significantly smaller burden on the environment. The book shows how the unique perspectives of each of the disciplines may contribute to understanding and the design of possible solutions. This book is a reaction to the well-known observation that scientists often talk past each other and find it hard to establish common ground. This book illustrates the foundations of the different perspectives, aiming at a richer interaction between them. Disciplinary foundations are essential in the development of knowledge, but they need not be fixed and unbending. This book will have succeeded if it prompts readers to reframe some of their starting assumptions so that interesting new research questions can emerge.

The role of the Industrial Transformation programme of IHDP has been to bring together multiple approaches and to encourage discussion in the international and multidisciplinary fora. The IT and other IHDP programmes have been successful in helping to set agendas that stretch across disciplinary boundaries. Given the scale, depth and complexity of interactions between societies and natural environments, researchers face the continuing challenge of taking the broad view and of moving beyond the constraints of conventional disciplinary boundaries.

Prof. Dr. Frans Berkhout
Chair, Industrial Transformation of IHDP

Prof. Dr. Pier Vellinga
Former chair, Industrial Transformation of IHDP

Chapter 1

INTRODUCTION

Xander Olsthoorn and Anna Wieczorek
Institute for Environmental Studies, Vrije Universiteit Amsterdam, De Boelelaan 1087, 1081 HV Amsterdam, The Netherlands[*]

Abstract: This Chapter introduces industrial transformation as a specific field of science. The key assumption of research on industrial transformation is that deep societal change is required to achieve sustainability. Its study requires concerted efforts from many scientific disciplines.

Key words: industrial transformation, International Human Dimensions Programme, global environmental change

1. WHAT IS INDUSTRIAL TRANSFORMATION?

A brief history

Up to the 1960s, post-war economic growth was considered a great achievement of industrial societies, as it secured social stability and welfare. After 1960, however, gloomier views of economic growth emerged as well, in particular with respect to its adverse environmental implications: increasing pollution, over-exploitation of renewable resources and depletion of non-renewable resources. Publications that mark the start of broad scientific interest in these issues include Ayres (1978), Boulding (1966), Hardin (1968), Daly (1977), Ehrlich *et al*. (1977) and Georcescu-Roegen (1971). In the beginning of the 1970s, the publication of the *Report to the Club of Rome* (Meadows 1972), which coincided with the oil crisis, led to a

[*] e-mail: xander.olsthoorn@ivm.falw.vu.nl, anna.wieczorek@ivm.falw.vu.nl

Xander Olshoorn and Anna J. Wieczorek, Understanding Industrial Transformation: Views from Different Disciplines 1–11.

wide public discussion about the apparently catastrophic effects of continuous exponential economic growth.

Concerns about the adverse environmental impacts of economic growth were at odds with claims that economic growth would benefit the environment, the assumption being that environmental quality is a luxury good and people are willing to spend more on this good the richer they become (de Bruijn, 1999). The public debate on environmental policy-making, economic growth and the environment motivated research in these fields. In the beginning of the 1990s, the first results (*e.g.* Grossman *et al.,* 1991) of empirical research on the relation between wealth and environmental quality pointed to an inverted U-shaped relationship between income and emissions of certain pollutants. Panayotou (1993) suggested naming this relationship the Environmental Kuznets Curve (EKC), after the similarly-shaped relation between income inequality and per capita income, established by the economist Simon Kuznets (Kuznets, 1955).

Of course, the EKC is just a simple statistical relationship. But the EKC implicitly suggests that existing governance structures and technologies will suffice in addressing environmental problems. That is, existing economic signals and political institutions can handle the problem without *deep* societal change, as long as there is sufficient economic growth.

This notion may have facilitated mainstream policy institutions, such as the World Bank (1992), to take policy initiatives that specifically aim at de-linking economic growth from its environmental burdens. In May 2001, the decoupling of environmental pressures from economic growth became one of the main objectives of the OECD Environmental Strategy for the First Decade of the 21^{st} century (OECD, 2002). The EKC may also have been instrumental in the OECD countries' committing themselves — at the Rio Earth Summit in 1992 — to sustainable development (Brundlandt, 1987), which says *inter alia* that environmental improvement goes hand in hand with economic (and social) development.

However, in spite of some undoubtedly successful environmental policy and '…despite all the elegant rhetoric that surrounds discussions about sustainable development, we are far from having made significant progress toward that goal.' (Johnson 2002, 26) Research on past trends and on the prospects for future decoupling indicates that there has been only *certain* decoupling of *some* emissions in *selected* developed countries (Azar *et al.*, 2002). Relative decoupling (emissions of pollution per Euro of GDP) is commonly observed, but there is much less evidence of absolute decoupling (total emissions to the environment). Some environmental problems appear to defy the downward trajectory of the EKC. Emissions of greenhouse gases, for instance, have continued to grow in many countries, despite the development of climate mitigation policies. Likewise, in the fast-growing developing countries and in cities, emissions and problems linked to key resources, such as water, are on the rise. Even with relative decoupling, by adopting solutions applied in developed countries, growing populations are a decisive factor for the growth of these problems. Some sectors, notably transport and food production, appear to be especially insensitive to efforts to improve their environmental performance.

The irreversibility and persistency of problems associated with resource use and environmental services call for another category of actions beyond those suggested by the EKC. In particular, longer-term and more fundamental changes appear to be needed. What kinds of system change we need to consider, and how to evaluate their effectiveness has been the overarching policy question posed by the International Human Dimensions Programme (IHDP) on Global Environmental Change (GEC).

The IHDP programme

IHDP was brought into existence in 1990 by International Council for Social Unions (ICSU) and International Social Science Council (ISSC) to complement the ongoing natural scientific research on Global Environmental Change coordinated largely by two older GEC programmes: International Geosphere Biosphere Programme (IGBP) and World Climate Research Programme (WCRP). Although its name may suggest otherwise, IHDP's role was not to conduct purely social scientific research. Its aim was to build bridges over the many disciplines that contribute to a better understanding of the complex human-environment relationships and the predicaments of global change.[2] The IHDP has been created as an international, interdisciplinary and non-governmental research programme, aiming at '…the development and integration of research on the human dimensions of global environmental change'.

IHDP stems from *(i)* the observation that the global environment is changing, (*ii)* the analysis that human activities account for the larger part of this change, and (*iii)* the belief that, without intervention, the current pattern of human activities is having and will eventually have severe adverse effects on global environmental systems. The research mission is to analyse the 'pattern of human activities' in order to identify leverages for reducing the environmental risks.

[2] Since 2001, the three programmes (IHDP, IGBP, WCRP), as well as a fourth, Diversitas (looking into the biodiversity aspects of GEC), have formed the Earth System Science Partnership (ESSP). The goal of the ESSP is to develop that type of integrative science that is necessary for understanding the Earth System and its stewardship.

Industrial Transformation (IT)[3] is one of the core science projects of IHDP. Within IT research (Vellinga and Herb, 1999) two major observations were made. The first relates to the phenomenon of 'lock-in' of technologies. Lock-in refers to the situation that the use of a certain technology — for example, the petrol-fuelled car — is embedded in a wider pattern of human activities, each involving other technologies and institutions, such as the system of petrol supply. The successful introduction of mass hydrogen-fuelled cars depends on the emergence of an alternative system to supply hydrogen for these vehicles. The thrust of the concept of lock-in is that the introduction of a certain environmentally-desirable technology requires 'side' policies.

The second observation is about the economics of technological change (Verbruggen and Kuik, 1999). Economists have long been concerned with the concept of the incentive structure: such a structure (and its history) would explain the current techno-economic system. For instance, since the cost of environmental damage caused by car pollution is not borne by the car owner — the polluter does not pay — there is no economic incentive for producers, in the form of market demand from consumers, to produce low-emission cars. In such cases, a way out is for government to set regulations, such as emission standards that with which car makers and drivers must comply.

The analysis of the IT programme starts with the notion that changes in technologies — put differently, changes in the ways in which humans use environmental resources and services — are embedded in changes in the social realm. While many agree about the desirability of having cleaner technologies, their introduction and use is influenced by social and economic factors. According to industrial transformation research, to combine growing income levels with significant reductions of human impacts on global life support systems, deep changes in the structure of current economies and societies are likely to be necessary. In other words, system changes are required that go beyond the domain of individual sectors, but include chains of production and consumption, including distribution and disposal activities. System changes encompass the incentives that shape this system (*i.e.* property, liability and fiscal laws and regulations). System changes affect and involve social actors (government, producers, and consumers), the flow of goods and/or services (including industrial 'metabolisms'), and the overall physical and institutional settings in which they operate. Given system complexity, and given the need for a purposive approach, such

[3] As a clarification, in this book we have used the term *industrial transformation* in its non-abbreviated form to describe the *process* of industrial transformation. The abbreviation, IT, is reserved for reference to the IT programme of the IHDP.

system changes call for the involvement of society as a whole and an inspiring vision to mobilise and coordinate social action.

About the concept of industrial transformation

We have observed some confusion about the industrial transformation concept, mostly with respect to the adjective *industrial*. We relate this misunderstanding to the fact that in some languages (*e.g.* in Dutch and in German) the term ‘industrie’ refers solely to manufacturing industries, while in English the meaning of ‘industrial’ is not restricted to materials-processing activities. In English, *industrial* refers to any human activity that, through systematic labour, produces goods or services. In *industrial transformation,* ‘industrial’ has the latter connotation. So, for instance, agriculture and tourism are sectors that are within the scope of the IT programme.

A second confusion might arise from the non-discriminatory use of the terms *transformation* and *transition*. We consulted main reference dictionaries in an attempt to sort out whether these terms are divergent. The explanations in the dictionaries suggest that *transition* comes from the Latin verb for ‘to pass through,’ and refers rather to the process of change, while *transformation* refers to both the process, as well as to the beginning and the end states (forms) of a process or development like, *e.g.* the pupation of a caterpillar to butterfly, or the change of a pre-modern society into a modern society. We also found that native English speakers tend to take *transition* as less important and having a lower pace than *transformation*. Changing form seems therefore more fundamental than simply passing through. It is indeed changing form in which industrial transformation is interested.

Another confusion arises from *industrial transformation* is assumed to refer to the industrialisation process — a change of pre-modern society into modern society, with the advent of fossil fuel-based manufacturing industry and the creation of the class of industrial labourers that occurred in Europe in the nineteenth century. In sociology, however, one refers to this process as *industrialisation*.

This leads us to a clarification or justification of the term industrial transformation. If we consider all human activities, then why not use *societal transformation*? This is since, conceptually, we focus only those activities that raise concerns because of their environmental implications. Thus, *industrial transformation* is a subset of societal transformation. By using this name for one of the IHDP projects, the originators wanted to emphasise that a sustainable future implies more than change in a technological sense only.

The relevance of research on industrial transformation

The main question that confronts researchers of industrial transformation is: 'what policies can be pursued to avoid futures that are unsustainable?' This question will be raised by decision makers from different governance domains: not only by national and international governments, but also by firms and NGOs.

The policy domain — the set of levers for policy making — is composed of activities that connect with sustainability, in particular those aspects that promote processes of change towards sustainability. Environmental policy is one of the main areas to which industrial transformation research is relevant; other areas might include economic policy, energy policy, agricultural policy, consumer policies and urban policies. There is no geographical boundary to the policies that IT wants to support and advocate. Since, however, many of the environmental problems dealt with in IT research have their origin in developed countries, the most relevant policies address issues in these societies.

What do policy- and decision-makers need from science? Usefulness may refer to the clarification of policy problems and claims. Sound science helps. Scientific value refers to an agreement among trusted/peer scientists about the relevance of the outcomes of research for the design of an action to meet a policy objective. An objective may range from producing a drug for curing some disease, producing a safer car, or reducing unemployment, to improving air quality or reducing dependence on fossil energy resources. Scientific relevance refers to qualities such as internal consistency and clarity about the scope of conclusions. High scientific value does not necessarily lead to high usefulness for policy-making, for various reasons. For instance: it might be irrelevant if the scope of its conclusions do not relate to the framework of policy issues that decision-makers are concerned with. A study that concludes that the widespread use of hydrogen as a fuel is environmentally-beneficial, without indicating the economic consequences, may be accepted as scientifically-sound, but have little operational relevance to policy-makers, except for raising the policy question about the economics of hydrogen fuel use.

From the viewpoint of the policy-maker there is a question of the relative usefulness of the products of industrial transformation research. Policy-makers want adequate descriptions of policy goals and recommendations on the right instruments. Scientists could give answers, but it is seldom the case that they accurately understand how stakeholders perceive the issue. This problem is especially acute in relation to sustainability issues, where deep disputes may exist about the relative importance of different issues. The role of scientists is therefore limited to helping, by providing sound science, while the role of decision-makers and stakeholders may be to sort out policy issues and agree on actions.

2. ABOUT THIS BOOK

Since the publication of the IT Science Plan in 2000, several research projects have been initiated and/or endorsed by the IT programme around the world. In addition, the IT office has created a database of research considered to be relevant to the industrial transformation domain. Conferences and workshops have been organised to discuss research on broad environmentally-driven innovations towards sustainability.

Characteristic of industrial transformation research is that: *(i)* industrial transformation research requires the integration of knowledges (scientific and practical) that are typically shared between person and teams, *(ii)* industrial transformation research often requires non-sectoral approaches to problems, if for no other reason than that the industrial sectors are linked in complex ways, and *(iii)* industrial transformation research is inherently international, primarily because the flow of raw materials and processed goods is global.

This book aims to contribute to the development of industrial transformation research in particular with respect to the first criterion. We think this is important since our impression from the work so far is that there is room for a wider, cross-disciplinary integration in industrial transformation research. Our assumption is that there is scope for better coordination between disciplines.

The choice to use 'science discipline' as the headline principle to structure this volume follows from this proposition. This also allows an analysis of the extent to which disciplinary research is mutually-consistent and complementary. In the end, we hope to inform public policy-making with useful insights.

We admit that the selection of disciplines has not been an easy task. The first simple barrier we came across at the start was the issue of what *is* a scientific discipline and what *is not*, and which of the fields should be selected for analysis and which passed-over. In our search we discovered that there is no official, commonly-recognised categorisation of disciplines, since new disciplines are continually emerging through processes of specialisation and fusion. The disciplinary approaches presented in this book were narrowed using three criteria: applicability of a specific discipline to analysing industrial transformation; the availability of authors; and the available space in the book. We also wanted to avoid an overlap with an IT-endorsed edited volume '*System Innovation and the Transition to*

Sustainability' (Elzen, *et al.*, 2004) for a view on industrial transformation from the area of innovation studies.

We did not, however, fully comply with our 'disciplinary' principle. The Chapter by Frank Geels is a typical example of a multidisciplinary view on industrial transformation. We thought this view to be important since, besides its intrinsic merits, it is a prelude to the description of the framework for 'transition management' as adopted by the Dutch Government in its 4th National Environmental Programme (VROM, 2001). This policy might be seen as one of the first efforts to apply the ideas of industrial transformation in policy frameworks.

The book is built around nine chapters. The first seven can be classified as contributions from traditional disciplines: psychology; sociology; economics; political science; and law. Due to significant developments in the Netherlands we made some space — two chapters — for a description of the multi-level perspective on system innovation (the chapter by Geels) and transition management (the chapter by Loorbach and Rotmans). The concluding chapter is our attempt to summarise the various approaches and to seek the synergies between disciplines in the field of industrial transformation.

ACKNOWLEDGEMENTS

During our work on this book we received intellectual support from the Scientific Steering Committee[4] (SSC) of the IHDP-IT. The Netherlands Ministries of Housing, Spatial Planning and Environment (VROM), of Economic Affairs (EZ), of Agriculture, Nature and Food Quality (LNV) and the Ministry of Transport, Public Works and Water Management (V&W), provided financial support.

The specific contributions were discussed at an international workshop entitled *Disciplinary review of transformation research*, which was organised in September 2003 in Amsterdam and financially supported by the Royal Dutch Academy of Sciences (KNAW). We are very grateful to the

[4] Prof. Dr. Ken Green, Manchester School Management, UK; Prof. Dr. Marina Fischer-Kowalski, Institute for Interdisciplinary Studies of Austrian Universities, Austria; Dr. Leena Srivastava, TERI, India; Dr. Nina Poussenkova, Russian Academy of Sciences, Russia; Prof. Dr. David Angel, Clark University, USA; Prof. Dr. Christian Azar, Chalmers University of Technology, Sweden; Prof. Dr. Frans Berkhout, SPRU, Sussex University, UK; Prof. Dr. Jose Moreira, CENBIO, National Reference Center on Biomass, Brazil; Prof. Dr. Pier Vellinga, Vrije Universiteit Amsterdam, the Netherlands.