Editorial

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Biographical notes: Holger Schlör studied Economics under Professor Faber in the University of Heidelberg and went on to complete his PhD in Economics under Professor Hoffmann in Berlin. His interest in economics and the idea of sustainable development has remained with him throughout his career. He has conducted research at several institutions and is currently working at Research Centre Jülich in the Institute of Energy Research – Systems Analysis and Technology Evaluation (IEF-STE). His research here focuses on the fields of sustainable development, economics and energy systems analysis. He is a member of the editorial board of the *International Journal of Green Economics.*

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The Brundtland Commission defines sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development (WCED), 1987). Since the publication of the Brundtland Report in 1987, the sustainability concept and its implementation have been discussed by the academic community and society in general.

In 2002, the World Summit on Sustainable Development (WSSD) in Johannesburg (United Nations, 2002) reaffirmed the resolutions of the 1992 Rio Conference (United Nations, 1992) by regarding sustainable development as a crucial concept for the future of the world and a keystone of the international agenda. The important outcomes of the WSSD include strong commitments and great efforts to promote and boost sustainable development. The Summit claimed that fundamental changes in the way societies produce and consume goods are indispensable for achieving global sustainable development. Therefore, all countries should promote sustainable consumption and production patterns. Thus, the Brundtland Commission and the WSSD have introduced a

critical new dimension into our conception of economic development by raising the issue of sustainability of development for resolving global environmental issues.

In Rio and Johannesburg, world leaders pledged that they would act to change the way societies produce and consume goods in order to achieve a sustainable pathway. However, world consumption and production patterns have not changed since then, so that the International Energy Agency (IEA) concluded in its World Energy Outlook 2007 that trends in energy demand and greenhouse gas emissions up to 2030 are now even worse than was projected earlier (International Energy Agency (IEA), 2007). The World Energy Council (WEC) confirmed the message of the IEA and defined the key challenge for the governments of the world (World Energy Council, 2007a, 2007b). The Council notes that one billion people do not have access to commercial energy today. As an example, the Council calculates that to allow everyone in the world to use just the amount of energy consumed per person in Poland today would double the demand for energy resources compared to the present world energy demand. To achieve the level of Russia, "more than three times as much energy" (World Energy Council, 2007a) would be required in comparison to that used today. Those impressions were also confirmed by the Global Environmental Outlook 2007 (GEO 2007) of the United Nations Environmental Programme (UNEP), which emphasises

> "the dangers of global warming, environmental degradation, loss of biodiversity and the potential for conflicts arising from competition over dwindling natural resources." (United Nations Environment Programme (UNEP), 2007)

These three reports outline the current global environmental issues which societies have to cope with worldwide and they reaffirm the conclusions drawn by the WSSD that the sustainability of development is a crucial concept for the future. The next step requires a worldwide discussion between science and society on ways of transition to a more secure, lower-carbon economic system. Ban Ki-moon, Secretary-General of the United Nations, stated in the GEW 2007 report: "Dealing with these issues is the great moral, economic and social imperative of our time (United Nations Environment Programme (UNEP), 2007)."

The papers presented in this special issue make a contribution to the ongoing discussion on resolving the problems addressed. They deal with qualitative and quantitative models which analyse how we work and live as a society. The models presented provide information on current and future conflicting goals in a systematic way. Hence, they enable us to develop measures to achieve fundamental changes in our production and consumption patterns which the WSSD and other international organisations consider to be necessary for global sustainable development.

Due to the exceptional interest in the subject of the special issue and the high quality of the submitted papers the special issue will be published in two separate parts. In the first issue, we have included papers dealing with sustainability indicator modelling. The second issue contains papers about general empirical modelling, environmental Kuznets curve modelling and sectoral empirical modelling.

In the first part, Renn et al., Spangenberg and Pinheiro et al. present different sustainability indicator concepts.

Renn et al. develop a normative-functional concept of sustainability and derive indicators for their concept. They identify three normative principles for their concept:

- the integrity of systems, which means the continuity and endurance of human social systems as well as of ecological systems that are relevant for humans
- justice as the strongest normative principle of social order
- quality of life.

The authors formulate adequate indicators and apply this concept to Germany as a model.

Spangenberg shows that the development of sustainability indicators is characterised by three main dilemmas – indicators vs. indicator systems, themes vs. systems, and governance insufficiencies – which lead to difficulties in data preparation. Against the background of these dilemmas, he suggests a systematic approach for sustainability indicators and presents an integrated system of indicators covering the economic, social, institutional and environmental dimensions and the interlinkage between the systems.

Pinheiro et al. present an adaptive methodology of sustainable indicators managed by ontology. Therefore, they analyse different Brazilian proposals for sustainability indicators and apply a high-level methodology to compare and analyse indicator composition.

On the basis of a case study research project in the Dutch residential house building sector, Bart A.G. Bossink built a model to analyse sustainable innovation processes. He thereby elucidated the significance of interorganisational innovation processes and national innovation systems.

The second part of the special issue starts with a section about general empirical modelling.

Sassi et al., Lutz et al., Wissema and Dellink, and Bertinelli et al. utilise different concepts of general empirical modelling. Their quantitative empirical models address two different levels: what are the patterns of production and consumption on the global scale or on the level of states in developed and developing countries.

Sassi et al. use IMACLIN-R as a modelling framework for investigating climate- and energy-related issues to assess the sustainability of future development pathways. Their model aims to address three methodological challenges: combining knowledge from economics, demography, natural sciences and engineering sciences, supporting dialogue with and between stakeholders, and producing scenarios for analysing development patterns, technology and growth.

Lutz et al. present a multisectoral and multicountry energy-economic-environment model named GINFORS. They define a high oil price scenario and derive a global forecast for energy demand, CO_2 emissions and economic development up to 2020. Using their model, they develop a differentiated picture of the economic development in 53 countries.

Wissema and Dellink develop a general equilibrium model to investigate the impact of climate policy on the Irish economy. Special attention is paid to the interactions within the existing tax structure and the double-dividend hypothesis. They calculate three simulation scenarios: reduced indirect tax rates, reduced labour tax rates and reduced output tax rates. In a sensitivity analysis, they test the robustness of the model parameters. Their paper addresses the possible effects of the implementation of climate change policy instruments.

Bertinelli et al. analyse the issue of pollution and its relation to sustainable economic development. They study how the export of technologies that are not state of the art to developing countries influences the economic performance and environmental quality of

these countries. The authors show that the use of older technologies helps developing countries to overcome capital shortages and enables them to reach their economic goals, but with the consequence of higher pollution rates and with the possibility of jeopardising the pathway to sustainable economic development.

Costantini and Martini, and Cantore develop models on the basis of the environmental Kuznets curve.

Costantini and Martini interpret sustainable development in the sense of the Brundtland Commission. Their paper therefore analyses the connection between development and sustainability by using the concept of the environmental Kuznets curve. They use a Modified Environmental Kuznets Curve (MEKC) to consider economic growth, well-being and also sustainability for analysing the development process. They combine two macroeconomic measures of sustainability, the World Bank's genuine saving index and the United Nations' human development index, to analyse the sustainability of human development. Their model analyses the link between the welfare of the people and their natural resource consumption.

Cantore uses the DICE model for an integrated assessment model approach with the purpose of analysing the relationship between income and pollution over time against the background of the environmental Kuznets curve.

Krey and Minullin, Tetzlaff et al. and Piranfar discuss specific sustainable issues in the energy and water sector.

Krey and Minullin use a game theory model for the analysis of China's natural gas demand. The authors investigate the economic potential and prospects of several pipeline projects from Russia and other CIS countries to China. They identify several pipeline projects that are economically competitive and could enter the gas market in China. The authors outline a possible pathway for China towards cleaner forms of energy.

Tetzlaff et al. analyse a sustainable management concept of the European water resources against the background of the European Union Water Framework Directive.

Piranfar discusses the volatility of the oil price and its implications for alternative sources of energy in order to achieve a sustainable development pathway.

The selected papers in this special issue document the wide range of research currently taking place in the field of sustainability. They provide information which will serve as a basis for decision makers to shape sustainable development.

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