

**IMPROVING KNOWLEDGE MANAGEMENT SYSTEMS:  
ISSUES AND REVIEWS OF RECENT EXPERIENCES**

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**Introduction**

Chapter 40 of Agenda 21 stresses the importance of adequate knowledge for decision making in the area of sustainable development. In fact, adequate knowledge should be seen as a precondition for effective governance structures focusing on sustainable development. Reaching this goal requires the creation of a long-term view for decision making, challenging equally the organisational and administrative nature of decision-making systems and the current form of expert advice used in the process.

The nature of the issues at large renders the traditional linkages between national knowledge systems and the decision-making level, defined as knowledge management systems, incompatible. Regulatory systems are faced with problems that transcend their traditional scope of competence. The pursuit of sustainable development has to take into account issues of a transnational, trans-generational and trans-disciplinary nature, leading to increased uncertainty in decision making. However, prevailing knowledge management systems are of a highly specialised, mono-disciplinary and hierarchical nature. This incompatibility can impede the development of a sufficiently precautionary regulatory approach, which is of vital importance to achieving sustainable development.

The introduction of governance structures that adapt and strengthen the linkages between knowledge systems and the decision-making level in governments could be an answer to this dilemma. These new structures would imply the increased participation of the public and representatives of different scientific disciplines, a focus on the management of increased risk and uncertainty, and increased international co-operation to ensure parity of knowledge.

This paper will explore the possibilities of adapting current knowledge management systems through the introduction of governance patterns. It will begin by analysing the fundamental barriers to a long-term perspective and then discuss the opportunities for improving the supply of information and the form of knowledge for decision making, drawing on examples of existing practices.

**REASONS FOR THE DILEMMA**

Prevailing knowledge management systems have structural deficits that prevent them from producing the knowledge necessary to forming a long-term perspective. This failure is largely due to problems with defining sustainable development itself and identifying its implications for policy making.

## THE NATURE OF THE ISSUES

Sustainable development is defined by the so-called «triple-bottom-line»: social, economic and environmental sustainability. This definition implies that policies should be directed at equal attainment of all three goals in the long-term. Yet it is clear that in the short-term these three goals can be contradictory. Decision-making systems then face the challenge of balancing the different objectives of each goal through the creation and stimulation of *synergies* (OECD 2001a: 35).

When dealing with issues related to sustainable development, knowledge management systems are faced with the following three fundamental problems<sup>1</sup> :

**The trans-generational time frame:** As stated in the Rio Declaration of 1992, policies have to be sustainable over the long-term. Therefore, these policies should take into account the present requirements and the anticipated needs of future generations. In practice this refers to a minimum time frame of 25 years, which for some democratic systems implies over five electoral cycles and therefore demands a long-term political commitment. This timeframe is problematic in terms of upholding the political commitment and in terms of the feasibility of desired policies over such a long time span. In the area of sustainable development, the results of implemented policies may be visible only decades later. There can be no assurance that decisions based on prevailing scientific evidence and technologies are sufficient to provide the required solutions (Ravetz 1997: 7). The Dutch Government encountered this problem during the implementation of its first environmental policy plan (NEPP I), which was designed to solve all known environmental problems at that time within one generation (20-25 years). The feasibility of this plan was soon found to be unrealistic and led to the following policy plan (NEPP II) which pledged to make the known problems «manageable» within one generation (Muijen 2000: 147).

**The transnational aspect:** Sustainable development is not restricted by national borders. A clear example is pollution control. Similarly, the question of social standards has become internationalised, due to the increased interlinking of national economies (through, for example, the transnational activities of multinational corporations). Sustainable development also addresses the issues of knowledge transfer between the developed and the developing world. National policies often have international repercussions and unilateral measures can be ineffective. This calls for increased international co-operation between states and the delegation of activities to international and multinational organisations.

**The trans-disciplinary nature of the answers:** Sustainable development is complex. Finding answers to the questions raised by the triple-bottom-line definition requires more than the expertise of a single scientific discipline. Due to the social and political relevance of the required knowledge, solutions can only be sought by a close collaboration among different scientific disciplines and other relevant stakeholders, scientific specialists and experts coming from business, political and social arenas (Kerkhof/Leroy 2000: *ibid*; Gibbons et al. 1995: 27-30).

## STRUCTURAL DEFICITS

These constraints render traditional knowledge management systems unable to produce the required knowledge for decision making in the area of sustainable development. This is especially true for two main organisational requirements that originate from the specific knowledge needs created by sustainable development issues: The management of uncertainties and the management of policy relevance (Rotmans et al. 2000: 810). Faced with these two obligations, traditional knowledge management systems are experiencing difficulties due to the following structural deficits:

**Mono-disciplinary ex-post approach:** Traditional knowledge management systems are characterised by a predominance of natural sciences and a mono-disciplinary paradigmatic approach. Uncertainties are considered reducible through technological progress. Therefore, knowledge management systems focus on risk reduction obtainable through technological innovations, intervening primarily via ex-post regulation. This takes on the form of regulation or intervention only after the occurrence of an incidence. The rise of technical assessment procedures since the 1970s is an example of this development. This approach has caused a high degree of specialisation in knowledge management systems because of the increasing complexity of the uncertainties within a subject area, like those linked with sustainable development (Liberatore 2001: 118-119; Kerkhof/Leroy 2000: 905). For example, research on matters of sustainable development in the Dutch Ministry of Agriculture, Nature Management and Fisheries is conducted by 12 highly specialised research institutes with over 3000 specialised employees (OECD 2001b). The high degree of specialisation can result in inadequate knowledge for decision making and can also produce too much information, which further complicates the final decision making process. Further, the mono-disciplinary approach sometimes fails to meet the holistic objectives of the aforementioned definition of sustainable development. Finally, the ex-post nature of this method can impair the development of a precautionary regulatory approach, which is of central importance in the creation of sustainable development policies.

**Strict hierarchies:** Another structural deficit arises from the strict hierarchies of a top-down approach. These hierarchies are especially visible in planning processes and evaluation systems based on expert peer review, another manifestation of the mono-disciplinary approach. Research projects are often carried out by universities, leading to a dominance of primary research and neglect of applicability. Similarly, this focus on primary research can lead to the disregard of established innovations, as many research organisations prefer to «re-invent the wheel» rather than work with previously developed theories. Thus the «NIH Syndrome» (Not Invented Here) can lead to duplication and resource inefficiencies. Private sector attempts to counteract this development have met with similar difficulties. Increased private sector involvement raises fundamental conflicts over scientific neutrality, profit maximisation and the role of science as a public good. The resulting decision-making process has often been classified as being autistic and non-transparent. Due to the lack of participation by different scientific disciplines and relevant social stakeholders, the legitimacy of some decisions has been questioned (Kasemir 2001: 131; United Nations 2001: 13).

**Knowledge demand and supply gap:** A result of the aforementioned structural deficits is the incompatibility between knowledge supply and demand. The fundamental problem of knowledge management systems is in the supply of policy-relevant information for the decision-making process, because not all forms of knowledge are relevant. Scientific findings may lead to general knowledge advancements, but their policy relevance or utility in social debates may be remote. Mono-disciplinary approaches can disregard expertise from different disciplines, thus rendering the knowledge supply ineffective and incomplete. Similarly, the demand for knowledge may include the need for methodologies and data which are either unavailable or unconfirmed and controversial. This is very much the case for policies linked to sustainable development. Topics such as de-coupling economic growth from environmental pressures, consumption pattern changes and dematerialisation<sup>2</sup>, social development or the reform of subsidies are all highly complex and controversial subjects, hence related policy implementation requires adequate knowledge (OECD 2001a: 130; Liberatore 2001: *ibid*).

## ADAPTING KNOWLEDGE MANAGEMENT SYSTEMS

These structural deficits can be overcome through a refocusing of knowledge production towards an increased management of uncertainty and through increased attention to quality as it relates to policy

relevance. Such re-focusing would necessitate the introduction of instruments similar to those required for the creation of effective governance structures. The following is by no means an exclusive recommendation, but presents some solutions for developing effective knowledge production for sustainable development decision making.

**Increased participation:** What is needed is a trans-disciplinary approach that includes a more diverse representation of scientific disciplines involved in the production process and widening participation with the inclusion of relevant stakeholders such as business and NGOs. The aim is to create a constant dialogue throughout all three phases of knowledge gathering during a research project (planning, implementation, and evaluation). This dialogue, including all participants, would give a greater degree of policy relevance to the information required for decision making (Kerkhof/Leroy 2000: 906-907).

**Increased transparency:** Increased participation goes hand in hand with the need for increased transparency in the decision making process. Intermediary results could generate public debate between the responsible project panel and the general public to allow for project redefinition based on the public's views and opinions. This might also lead to an increased public awareness of issues related to sustainable development, as decision making would be a top-down and bottom-up process requiring citizen participation. Increased transparency would also contribute to legitimising decisions and strengthen the political commitment to achieving sustainable development (Kasemir 2001: 129-130).

**Management of uncertainties:** As already elaborated in the previous passages, policy making for sustainable development is wrapped in a shroud of uncertainty -- uncertainty that stems from the timeframe involved and the capacity to predict policy results. The variables involved are too complex and uncertain to provide adequate solutions to the broader problems. The scientific approach must be redesigned to accept the fallibility of science to reduce uncertainties. The project outline should therefore integrate rising technical, methodological and epistemological uncertainties by differentiating between these uncertainties and then devising strategies for dealing with them. Again, such an approach calls for a continuous dialogue among the different scientific disciplines, stakeholders and citizens, whereby the identification of possible risks and uncertainties is of paramount importance. Ongoing communication between different actors could lead to increased confidence and acceptance of the general public towards the envisaged decisions (Kerkhof/Leroy 2000: *ibid.*; Ravetz 1997: 34).

**Increased international co-operation:** As already stated, increased international co-operation is important to the production of knowledge for sustainable development decision making. The aim is to pool resources and to create knowledge production capacity on a global scale. This could be achieved through the initiation of international dialogues between epistemic communities, political institutions and stakeholders to strengthen national decision making on sustainable development issues. Enhanced transfer of knowledge and a stronger role for international and multinational organisations that could act as forums and initiators for this international communication process are essential. (OECD 2001c: 19).

## **CURRENT DEVELOPMENTS**

The following section contains examples of projects that have adapted knowledge management systems to counter the constraints faced by sustainable development. The first two examples are based on the integrative assessment methodology. These process-oriented projects are directed to the understanding and the facilitation of methods and procedures to enhance decision making and public debate (Liberatore 2001: 123). Finally, there is an overview on the state of international co-operation, in the form of programmes designed to strengthen decision making initiated by various international organisations.

## INTEGRATIVE ASSESSMENT APPROACH

The following two research projects have in common one methodological approach: integrative assessment. Defined as the interdisciplinary process of combining, interpreting and communicating knowledge from diverse scientific disciplines, the main aim of this approach is to provide more adequate information to decision-makers through the supply of value added knowledge compared to traditional mono-disciplinary assessment forms. Further, computer projections are used as metaphors for future living situations. However, the aim is not to predict the future, but to learn more about current living situations through a trans-disciplinary communication process evaluating the cause-effect chain of a problem from a synoptic perspective (Kasemir 2001: 130; Kasemir et al. 1999: 2).

The underlying notion of integrative assessment is based on the assumption that the issues of sustainable development are an expression of «reflexive modernity», originating from the German social theorist Ulrich Beck (1986). The apparent incapability of modern sciences to produce the required knowledge and of political institutions to take the necessary decisions is the result of a change in the rules of political and scientific discourse. This change renders the traditional relations between the political, social and scientific actors obsolete due to new constraints and modes of living created by the modern industrial society. In this context, the role of the State changes from the traditional direct active State to a more indirect passive role in which the State acts from «behind the scenes» as an incentive giver and director, negotiating compromises between the different interests present in society (Kasemir et al. 1999: 3-6).

### *ULYSSES: Urban Life Styles, Sustainability and Integrative Environmental Assessment Project (1996-1999)*<sup>3</sup>

The aim of the ULYSSES Project was the development of a methodology for Integrative Environmental Assessment, a methodological subset of integrative assessment. It was financed by the European Commission as part of the 4<sup>th</sup> Framework Research and Technology Development (RTD) Programme, Environment and Climate, Human Dimensions of Climate Change and completed in 1999.

ULYSSES was designed to address the relations between urban lifestyles and climate change in a European context and aimed to foster a pluralistic debate on local policies. The project intended to cope with climate change through the integration of specifically programmed computer models of different climate change scenarios for the designated geographical areas. The models played the role of metaphors for depicting future alternative living situations. These scenarios were monitored and commented on by integration assessment groups comprised of laypersons representing the different strata of the general public. The trans-disciplinary and transnational aspect as well as the situation of scientific uncertainty of climate change were an integral part of the research project. Scientific input came from a wide range of natural and social sciences. The empirical research was conducted in a total of 7 European cities (Stockholm, Frankfurt/Main, Manchester, Barcelona, Venice, Athens and Zurich), thus encompassing European regions with differing living standards and cultural backgrounds. Approximately 600 people participated as jurors in integrated assessment groups.

The empirical research was conducted in three phases. In the first phase, the participants were asked to give their views on the effects of climate change and energy use. The test persons were asked to relay their knowledge and opinions on the effects of climate change on their living situations under a business-as-usual assumption and then under the assumption of a 50% reduction of energy use. In the second phase, participants were exposed to expert views on the effects of climate change. The jurors had to explore various conflicting computer models that underlined the uncertainty of the effects of climate change. The final phase consisted of the summary of the participants' views in the form of written reports based on a scientifically prepared list of questions.

Besides significantly advancing the development and testing of the methodology of integrative assessment, ULYSSES also relayed very coherently the assessment of ordinary citizens on the extremely complex issue of climate change effects and responses. In summary, the participants were very aware of the effects of climate change on their regions and refused timid wait-and-see policies. Still, climate policy in a European context will only be acceptable to the majority of Europeans, if it leads to the development of low-cost options for substantially reducing energy use. Further, the experience of computer modelling under the premise of uncertainty, together with the empirical data gathered by the integration assessment groups, was used to develop further modelling programmes, such as the Novel Approach to Imprecise Assessment and Decision Environments software (NAIADE) for multi-criteria decision making. This tool can aide the decision making process in long-term issues by generating scenarios under the premise of uncertainty and allowing policy-makers to seek "defendable" decisions that reduce the degree of interest conflict and lead to greater equity in their impacts.

### ***VISIONS: Integrated Visions for a Sustainable Europe<sup>4</sup> (1998-2001)***

Financed by the European Commission through the 4<sup>th</sup> Framework Research (RTD) Programme, Environment and Climate, Human Dimensions of Climate Change and completed in the beginning of 2001 the VISIONS project is based on a similar methodology to ULYSSES, but had a different research outlay. Integrative assessment methodology, extensive computer modelling and participation were also integral elements of the VISIONS project research design. However, the project's primary concern was the creation of a future perspective of European sustainable development in a time frame of 25 to 50 years through the evaluation of possible developments in a European context and in three European regions, the Green Heart in the Netherlands, the Northwest of England and the region of Venice.

All three regions were chosen because of their distinct ecological, economical and social features. The Green Heart is a nature recreation area surrounded by the largest Dutch cities and industrial farming. This area is facing mounting pressure regarding water quality and quantity and increasing population density with corresponding spatial development. The Northwest of England is characterised by the ecological and social problems of economic decline. The region of Venice is faced with rising tensions stemming from economic expansion and corresponding ecological degradation.

VISIONS scenario methodology was based on two integrative pillars around which all scenario types were centred. The first pillar was the integrative framework, which consisted of a selected number of factors or issues of concern related to sustainability (equity, employment, consumption, environment). Their development was tracked in each scenario. Main actors were identified and became the base for the participant selection (government bodies, NGOs, business community, scientists). Finally, sectors deemed most effected by sustainable development were chosen (water, energy, transport, infrastructure). The second pillar consisted of the geographical scale. Three general types of scenario were developed. At the micro level, scenarios were designed for the three chosen regions, serving as examples of the challenges facing a sustainable Europe. The intermediary level contained three scenarios developed for the whole of Europe. The macro level consisted of a selection of global trends, thus representing the global context of the issues at large in the previous geographically subordinate levels. The European and regional levels stood in a reciprocal relationship and were defined by «tensions» based on culture and transition theory and quantified by computer models.

The first step was the identification of global trends, classified in social, environmental and economic flows, and the development of the European scenarios, which were influenced by the global context. The European scenarios were developed using the «Story-line-approach» created by the Strategic Planning Unit of Shell London. The approach was based on the process of mutual learning, free communication and constant clustering and prioritising ideas among the participants. Participants came from across

Europe and were selected in line with the methodological preconditions (political representatives, various stakeholders and scientific experts from different disciplines). The 10 story-lines were summarised with the help of quantifying computer simulations to create three scenarios of Europe in the year 2050. In each scenario one of the included factors had a dominant effect on the outcome of the scenario. The first scenario, «Knowledge is King», was defined by the IT revolution enhancing both local development and globalisation. The second scenario, «Big is Beautiful», depicted a Europe dominated by big business, a mass concentration of industry, ongoing industrial mergers steered by globalisation, and Government privatisation measures. The third European scenario, «Creeping Change», presented a Europe affected by climate change.

The next step consisted of developing scenarios for the three selected regions. The participatory process was different for each region, as new participatory tools and scenario techniques were experimented with and the specific problems in each region demanded individualised scenarios.

The methodology for the region of Venice followed the principles already encountered in ULYSSES. A group of stakeholders was selected following the actor requirements stated in the integrative framework. In-depth interviews with these stakeholders were conducted and, in a later phase, integrative assessment focus groups were formed. During the in-depth interviews, the participants were confronted with various pre-drafted scenarios for the Venice region projected for the year 2050 following the general outline of the European scenarios. The Venetian scenarios were adjusted according to the responses of the test persons. The scenarios were remodelled, enriched and quantified using computer simulation programmes.

The participants for the Green Heart area in the Netherlands were largely members of an already existing stakeholder discussion platform. The participatory process was a dialogue between the different members. The participants actively discussed the different possible futures of the region with simulation experts and selected an in-depth list of indicators, around which the computer simulation model for spatial planning was centred. The resulting spatial trends were then analysed and enriched to form the final scenarios.

In the Northwest of England the participatory process was centred around possible policy choices and set up in the form of gaming exercises or strategic policy exercises. Pre-defined scenarios were discussed with the test persons. The gaming exercises were supported by an accounting framework that set policy priorities and by dynamic computer models, which simulated regional trends, to quantify projections for the region.

The integrative approach of the VISIONS project does aid decision making processes with a longer-term multi-disciplinary perspective under the constraints of increased uncertainties. The project has tried to integrate social, economic, environmental and institutional dimensions, as well as different geographical scales, without following an overly outlined approach. Hence, it has tried to implement the holistic approach intrinsic to the definition of sustainable development. However, the participatory approach is more restrictive than the approach undertaken in ULYSSES, as only stakeholders and no laypersons were selected to participate in the project. This difference may call into question the overall legitimacy of the recommended decisions and models. Further, all scenarios have similar implications for the role of national governance structures. The role of national centralised institutions is rendered obsolete, whereas the role of private, local and supranational actors is emphasised in line with the philosophical background described by Beck (1986).

### ***International Co-operation***

The issues of sustainable development are not nationally restricted. Problems concerning resource efficiency, poverty or pollution are predominantly of an international context. Tackling the issues raised

by sustainable development from a long-term perspective demands a sufficient national knowledge base and increased international co-operation to ensure sufficient knowledge transfer and promote capacity building. The above mentioned examples of knowledge gathering for long-term decision making are also examples of regional research co-operation in this field. However, international co-operation can be bilateral, such as the international activities of the Dutch Government, which actively supports sustainable development initiatives in developing countries and in Central and East European countries via official development assistance (OECD 2001b).

International organisations can play an important role in this context by acting as knowledge pools and discussion forums, as well as developing new methods of knowledge production. A prominent example is the United Nations Division on Sustainable Development initiatives to develop indicators on sustainable development. A total of 134 indicators and methodology sheets have been developed and are currently being tested by 22 Member States. Other major initiatives include the work of the World Bank on savings and wealth indicators and the human development index of the United Nations Development Programme (UNDP). Besides the development of indicators, the issue of statistical harmonisation and rationalisation is also an important topic and the subject of various projects by UN agencies and other international organisations. Currently, the United Nations Statistics Division is exploring initiatives to pool statistical resources in order to avoid work duplication and to increase efficiency in the gathering of data and provision of statistical information on sustainable development (United Nations 2000: 7-8; OECD 2001a: 59).

International and regional organisations also support the international exchange of knowledge in order to enhance capacity building and to provide policy assessments via the establishment of networks. The World Bank Institute, as well as the Organisation for Economic Co-operation and Development (OECD), is implementing programmes to create a dialogue on sustainable development. The World Bank Institute is initiating the Global Dialogue on Sustainable Development. The aim is to facilitate a global dialogue between policy makers, stakeholders and scientists to provide support to developing countries in shaping their priorities for the World Summit on Sustainable Development in Johannesburg 2002. Based on panel discussions and corresponding background e-learning seminars, the programme will try to highlight issues whose complexity is determined by interrelated economic, social and ecological considerations and whose focus is centred on satisfying basic human needs and improving governance for sustainable development<sup>5</sup>.

The European Commission has been financing a similar project, which, although not directly linked to sustainable development, has valuable insights for further projects. The European Technology Assessment Network (ETAN) was financed through the 4<sup>th</sup> Framework RTD programme and designed to improve policy-making and the quality of scientific advice by improving the linkages between socio-economic research and science and technology policy. The aim was the establishment of an institutionalised communication platform enabling a high-level dialogue between researchers from various disciplines and policy-makers through seminars concerning the implications and the enhancement of technological progress in the European Union. Although this project provided valuable insights on such subjects as the problem of technological context of ageing societies and the further development of science and intellectual property rights, the larger part of its activities failed to attract the necessary attention. This was due to the inclusion of empirical observations on pre-defined topics and the management difficulties associated with a large number of members, over 400 European research organisations were affiliated with ETAN. ETAN was seen to be most effective in providing intellectual input to policy-making forums in an ad hoc and less institutionalised manner. The follow-up programme, Strategic Analysis of Specific Political Issues (STRATA), is the result of the lessons learned from the implementation of ETAN. STRATA is designed to render multi-disciplinary advice to policy-makers in the European Union during the decision making process with an emphasis on the establishment of a non-institutionalised process of collective multi-disciplinary scientific thinking (Kastrinos 2001)<sup>6</sup>.

## Conclusion

The examples studied here can be classified as tentative attempts to bridge the knowledge gap surrounding long-term policy-making for sustainable development. Even if these attempts are in an early stage and in need of further modifications, the overall direction is promising. They can provide possibilities to meet the challenge of implementing the «triple-bottom-line» definition of sustainable development.

Regarding the integrative assessment approaches, the inclusion of a trans-disciplinary perspective can overcome prevailing deficits caused by mono-disciplinary approaches. However, this method can not be used exclusively for project designs; it should be incorporated in a fundamental reform of national research systems starting foremost with university education. Further, the participation requirements can be seen as too restrictive, as in the case of the VISIONS project. The question of whether the selection of stakeholders is sufficient enough to legitimise the decision making process still remains. It should be contemplated to increase the use of laypersons representing the general public, even if this would cause subsequent research to become more costly, time intensive and complex.

The activities at an international level, though very promising, are still only the «tip of the iceberg». Many of the projects carried out by international organisations are notoriously under funded. As many international institutions are undertaking similar activities, there is a degree of duplication of activities, a lack of overall co-ordination and ineffective division of tasks (United Nations 2001: 6). This poses the question of whether there is sufficient political commitment on international level to support the efforts and to streamline the activities.

Finally, a long-term perspective is an issue of sufficient political commitment. As already stated, the issues of sustainable development go beyond the traditional short-term electoral cycle of modern democracies. It is therefore of paramount importance to ensure sufficient awareness in the general public of the issues related to sustainable development, thus creating more acceptance of the controversial policies entailed in its pursuit .

## BIBLIOGRAPHY

- BECK, Ulrich (1986): *Die Risikogesellschaft: Auf dem Weg in eine andere Moderne*, Frankfurt/Main.
- GIBBONS, Michael; LIMOGES, Camille; NOWOTNY, Helga; SCHWARTZMANN, Simon; SCOTT, Peter; TROW, Martin (1995): *The New Production of Knowledge: The Dynamics of Science and Research in Contemporary Societies*, London; Thousand Oaks; New Delhi.
- KASEMIR, Bernd (2001): «Improving Procedures for Citizen Participation and Stakeholder Involvement» in: OECD (ed.): *Social Sciences for Knowledge and Decision Making. OECD Proceedings*, Paris; 129-133.
- KASEMIR, Bernd; DAHINDEN, Urs; GERGER, Åsa; SCHÜLE, Ralf; TÀBARA, David; JAEGER, Carlo C. (1999): *Fear, Hope and Ambiguity: Citizens' Perspectives on Climate Change and Energy Use. ULYSSES Working Paper WP-99-1*, Darmstadt.

- KASTRINOS, Nikos (2001): «Promoting a Dialogue between Research and Policy Making: The ETAN Experience», in: OECD (ed.): *Social Sciences for Knowledge and Decision Making. OECD Proceedings*, Paris; 177-187.
- KERKHOF, Marleen van de; LEROY, Pieter (2000): «Recent Environmental Research in the Netherlands: Towards Post-normal Science?», in: *Futures* 32; 899-911.
- LIBERATORE, Angela (2001): «From Science/Policy Interface to Science/Policy/Dialogue», in: OECD (ed.): *Social Sciences for Knowledge and Decision Making. OECD Proceedings*, Paris; 117-128.
- MUIJEN, Marie-Louise van (2000): «The Netherlands: Ambitious on Goals – Ambivalent on Action», in: Lafferty, William M.; Meadowcroft, James (eds.): *Implementing Sustainable Development: Strategies and Initiatives in High Consumption Societies*, Oxford; 142-173.
- OECD (2001a): *Sustainable Development: Critical Issues*, Paris.
- OECD (2001b): *Governance for Sustainable Development: Case Studies from 5 OECD Countries*, Paris (forthcoming).
- OECD (2001c): *OECD Environmental Strategy for the First Decade of the 21<sup>st</sup> Century*, Paris.
- QUEROL, Cristina; GERGER, Åsa; KASEMIR, Bernd; TÀBARA, David (1999): *Citizens' Recommendations for Addressing Climate Change. A Participatory Integrated Assessment Exercise in Europe. ULYSSES Working Paper WP-99-4*, Darmstadt.
- RAVETZ, Jerry R. (1999): *Models as Metaphors. ULYSSES Working Paper WP-99-3*, Darmstadt.
- RAVETZ, Jerry R. (1997): *Integrated Environmental Assessment Forum: Developing Guidelines for «Good Practice». ULYSSES Working Paper WP-97-1*, Darmstadt.
- ROTMANS, Jan; ASSELT, Marjolein van; ANSTASI, Chris; GREEUW, Sandra; MELLORS, Joanne; PETERS, Simone; ROTHMAN, Dan; RIJEKENS, Nicole (2000): «Visions for a Sustainable Europe», in: *Futures* 32; 809-831.
- ROTMANS, Jan; ANASTASI, Chris; ASSELT, Marjolein van; PETERS, Simone; MELLORS, Joanne; GREEUW, Sandra; ROTHMAN, Dale (1999): *Visions for Europe: Interim Report September 1999*, Maastricht.
- UNITED NATIONS COMMISSION ON SUSTAINABLE DEVELOPMENT (2001): *Report of the Secretary-General: Information and Institutions for Decision making. E/CN.17/2001/PC/3*, New York, <<http://www.un.org/esa/sustdev/csd10/ecn172001-pc3.pdf>> (Download: 29.10.2001).
- UNITED NATIONS COMMISSION ON SUSTAINABLE DEVELOPMENT (2000): *Report of the Secretary-General: Information for Decision making and Participation. E/CN.17/2001/4*, New York, <[http://www.un.org/esa/sustdev/csd9/ecn17\\_2001\\_4.pdf](http://www.un.org/esa/sustdev/csd9/ecn17_2001_4.pdf)> (Download: 29.10.2001).

## NOTES

<sup>1</sup> As defined by Kerkhof/Leroy (2000: 906) and Gibbons et al. (1995: 27).

<sup>2</sup> Dematerialisation is a policy requirement, which includes the change of consumption patterns and the adaptation of national innovation systems towards increased resource efficiency (OECD 2001b).

<sup>3</sup> For more details see Kasemir (1999, 2001), Querol et al. (1999), Ravetz (1997, 1999) and the ULYSSES website <http://www.zit.tu-darmstadt.de/ulysses>.

<sup>4</sup> For more details see Rotmans et al. (1999, 2000) and the VISIONS website <http://www.icis.unimaas.nl/visions>.

<sup>5</sup> See websites of the OECD <http://www.oecd.org> and World Bank Institute <http://www.worldbank.org/wbi/sustainabledevelopment/globaldialogues/index.html>.

<sup>6</sup> For more information see ETAN website <http://www.cordis.lu/etan/home.html>.