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Cloudy crystal balls

An assessment of recent European
and global scenario studies and models

Experts' corner report
Prospects and scenarios No 4

This report has been prepared by:

International Centre for Integrative Studies (ICIS)

Sandra C.H. Greeuw
Marjolein B.A. van Asselt
Jasper Grosskurth
Chantal A.M.H. Storms
Nicole Rijkens-Klomp
Dale S. Rothman
Jan Rotmans

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Project Manager of EEA:
Teresa Ribeiro

European Environment Agency

Cover design & layout: Folkmann Design A/S

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In order to provide possible inputs to the developing work programme of the EEA, and to stimulate debate on issues that may contribute to the identification, framing and evaluation of environmental policy measures, the EEA, from time to time, asks independent experts to summarise their views on topical or upcoming issues, so that the EEA can consider publishing them as Experts' corner reports.

Experts' corner reports do not necessarily reflect the views of the EEA, or of any other EU institution: they are the opinions of the author only. However, they are intended to facilitate the broader dissemination of more recent environmental information that may provide useful inputs into the developing environmental agenda. The EEA hopes, therefore, that they will be of interest to the Community, Member States and other environmental stakeholders, whose comments on the contents it would welcome.

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European Environment Agency
Kongens Nytorv 6
DK-1050 Copenhagen K
Denmark
Tel: +45 33 36 71 00
Fax: +45 33 36 71 99
E-mail: eea@eea.eu.int
http://www.eea.eu.int

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Foreword

Expert corner reports provide a forum for disseminating views on new developments on issues relevant to EEA activities. They also contribute to the translations of these views into practical activities for the Agency and others involved in producing information for framing and implementing environmental policies.

The need for this report was identified during at special session of the European Forum for Integrated Environmental Assessment held at the EEA in December last year. This workshop was organized to review the EEA's state of the art on Integrated Environmental Assessment with particular emphasis on the report *Environment in the European Union at the turn of the century* published in 1999. This is one of the three state-of-art studies requested following this evaluation, to act as a basis for further development of scenarios and outlooks at the Agency.

While this is the first Experts' corner to be published on the topic of *'scenarios'* other reports have already been published under the EEA series '*Prospects and Scenarios';* they mirror the growing interest in this area and its emerging contribution to policy decision making by identifying and anticipating potential developments (desirable or undesirable) and information gaps and inconsistencies. Generating '*images of the future'* and '*focusing attention on causal processes and decision points*' are certainly important ways by which we can devise better strategies to address today's and tomorrow's environmental problems.

This report presents an inventory of existing scenarios studies relevant for Europe in the context of sustainable development, including European and global models. It also provides a useful review of a selected number of scenarios and pinpoints their strengths and weaknesses.

I would like to thank the authors for their useful contribution and insight into the complex and cloudy area of scenario and prospective analysis.

Domingo Jiménez-Beltrán

Copenhagen, October 2000

1. Introduction

Europe is entering a period of great uncertainty. Scenario methodology is an essential tool which allows policy makers and other stakeholders to look into the crystal ball with confidence and the lessons provide a useful starting point for that process (Anastasi, 1997).

Scenarios are becoming increasingly important as tools for policy makers. Also models and the links between models and scenarios are seen as useful means to support policy decisions. However, it seems as if the existing scenario studies and models are not capable of dealing with the complex issues dealt with by, for example, the European Environment Agency.

1.1. Objectives

In 1998 an overview and assessment of the last decade of European scenario studies was conducted by ICIS in the scope of the VISIONS project (see page 111) (Van Asselt et al., 1998). About 40 studies were assessed, of which nine were selected for further investigation. These studies were then used as means to evaluate the current state of the art in European scenario-building and to create a basis for the development of new integrated scenarios for Europe.

The European Environment Agency in Copenhagen (EEA) showed an interest in an update of this scenario review together with a review of global scenarios that are relevant for European environmental assessments and a quick scan of models relevant for scenario development. The current study takes the following issues as its starting points:

- Which European and global scenario studies on aspects of sustainable development have been developed since 1997 or are under development?
- What are important models useful for scenario development in the context of the aims of the EEA?

The study has the following aims in terms of output:

- An inventory of scenario studies relevant in the context of sustainable development for Europe.
- A thorough review of scenario studies of particular relevance to the EEA (including quality assessments of the scenario studies).
- A quick scan of European and global models useful for scenario development.

1.2. Structure of the report

Chapter 2 describes the current state of the art in scenario building to provide a context for the rest of the report. Chapter 3 describes the method used in the assessment of the scenario studies. Chapter 4 gives a quick scan of existing models for scenario analysis. Chapter 5 – the core of the report – contains a review of scenario studies relevant to the EEA. Finally chapter 6 presents an assessment of the selected scenario studies in terms of their strengths and weaknesses and some recommendations for the EEA are briefly explored.

2. State of the art in scenario studies

Scenarios are perhaps most effective when seen as a powerful tool to broaden perspectives, raise questions and challenge conventional thinking (EC-DGXI, 1996).

2.1. Introduction

Looking back to developments over the past 25 years, one clear lesson can be learned from projections made in the 1970s: dogmatic predictions regarding the Earth's future, are unreliable and can be politically counterproductive (UN-DPCSD, 1997). During the last decade the crucial role of uncertainty has been increasingly recognised. This has lead to the understanding that scenario-building should not be a deterministic scientific activity. Scenarios cannot predict, but they paint pictures of possible futures and explore the different outcomes associated with 'what-if' questions.

In this chapter, the state of the art in scenario studies is described, without pretending to provide a comprehensive overview. A number of influential ideas on scenarios are discussed, which will serve as a context for the scenario evaluation exercise underlying this report. To this end, this chapter explores the scholarly literature for:

- definitions of scenarios;
- types of scenarios;
- main characteristics of scenarios;
- methods to develop scenarios;
- use of scenarios.

The chapter closes with discussing scenario building in the broader context of Integrated Assessment, and the resulting conditions that integrated scenarios ideally should satisfy.

2.2. What are scenarios?

A multitude of scenario definitions exists in the scientific literature. The first and widely cited definition is:

Scenarios are hypothetical sequences of events constructed for the purpose of focussing attention on causal processes and decision points (Kahn and Wiener, 1967).

Notwithstanding the variety of definitions, scenarios have several common features. In the first place scenarios describe processes, representing sequences of events over a certain period of time. Scenarios are also hypothetical, describing possible future pathways (Rotmans, 1998 van Asselt, 2000). Further, scenarios contain elements that are judged with respect to importance, desirability, and/or probability (Jungermann, 1985).

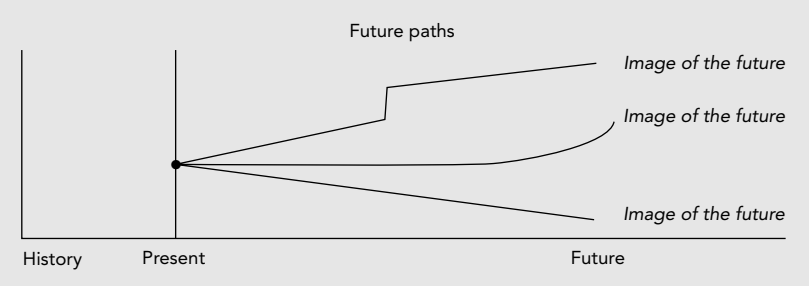
The definition adopted in this report is the one provided by Rotmans and van Asselt (1998):

Scenarios are archetypal descriptions of alternative images of the future, created from mental maps or models that reflect different perspectives on past, present and future developments.

As follows from both definitions, evaluation of possible decisions and/or policy strategies is inherent to scenario building. This is, for instance, explicitly done in the Dutch scenario study 'Ground for choices' (WRR, 1992), which evaluates policy goals regarding land use. Scenarios consist of states, events, actions and consequences that are causally linked (van Asselt, 2000), but that does not imply that they are just extrapolations of current trends. Scenarios include the depiction of an initial state, usually lying in the present, and/or a final state at a fixed time horizon (Jungermann, 1985). Scenarios are not equivalent to images of the future, but they include images of the future. Images of the future are static snapshots of future states, whereas scenarios are dynamic movies that consist of a logical sequence of images of the future. However, scenarios not only contain sequences of such images, but they also include driving forces, events and actions that lead to the future conditions as visualised in the images of the future (Rotmans et al., 2000). Ideally, scenarios should be internally consistent, plausible and recognisable stories exploring paths into the future (Anastasi, 1997). Figure 2.1 is an attempt to visualise the scenario concept, starting from a historical or the current situation, extending till the chosen time horizon.

Different subdivisions of scenarios exist. First, a subdivision can be made between

Figure 2.1 **Elements in scenarios and the time horizon**



forecasting and *backcasting* scenarios. Forecasting scenarios explore alternative developments, starting from the current situation with or without expected/desired policy efforts. The majority of recent scenario studies can be characterised as forecasting exercises. An example of such a forecasting study is the study 'Scenarios Europe 2010' (EC Forward Studies Unit, 1999) that presents five possible futures for Europe. Backcasting scenarios reason from a desired future situation and offer a number of different strategies to reach this situation. An example of a backcasting study is the POSSUM project (POSSUM team, 1998) in which sustainable transport goals for the year 2020 are formulated from which different scenarios that explore strategies to reach these goals have been designed.

Second, we can distinguish between *descriptive* and *normative* scenarios. Descriptive scenarios sketch an ordered set of possible events irrespective of their desirability or undesirability, while normative scenarios take values and interests into account. Most current scenario studies have a descriptive character or are only implicitly normative. For example, the Intergovernmental Panel on Climate Change (IPCC) study (1995) presents six descriptive emission scenarios, IS92a to IS92f. An example of a normative scenario study is 'The Netherlands in threefold' (CPB, 1992), as the explicit aim of one of the scenarios, i.e. 'Balanced Growth scenario' was to show that economic growth can be combined with environmental protection (1999).

Third, we distinguish *quantitative* from *qualitative* scenarios. While quantitative scenarios are often model-based, qualitative scenarios are based on narratives. Until now, quantitative, model-based scenarios have been primarily used by the energy sector and technology-oriented communities. Modelling methods involve the use of computer models, either as a central means of exploring the future consequences of sets of assumptions, or as a tool to check the consistency of the developed scenario. Narrative scenarios are usually deployed in cases where data is weak or missing. Pathways into the future are then qualitatively described.

Another distinction often made is the one between *trend* and *peripheral* scenarios. Ducot and Lubben (1980) describe a trend scenario as a scenario that represents the extrapolation of the current trends, while a peripheral scenario includes unlikely and extreme events. In this context, Schwartz (1995) states that scenarios should include surprises in order to break with old stereotypes. From this point of view trend scenarios are no real scenarios and will therefore be called trend *stories* in this study. However, in many long-term scenario studies, surprises and bifurcations are not taken into account, although the inclusion of surprises is important since history shows us that historical trends are characterised by strong fluctuations rather than smooth curves, often triggered by unexpected changes (Rotmans, 1997). Surprises can be categorised in the following way (van Asselt et al, 1998):

- Unimaginable surprises (like a journey to the Earth's centre in the time of Jules Verne)
- Imaginable surprises that are improbable (like a global nuclear war)
- Imaginable surprises that are probable (like a oil price shock and ecological refugees)
- Certain surprises (like earthquakes, economic recession)

Many scenarios have a 'business as usual' character, assuming that current conditions will continue to exist for decades, which is highly implausible (Rotmans and van Asselt, 1997). Most recent scenario studies go beyond trend scenarios, but cannot be adequately characterised as peripheral scenarios, because quite often the anticipated changes are merely incremental. An example of a scenario study attempting to include peripheral scenarios is the Shell study (Ringland, 1998) in which two scenarios, named Just do it and Da Wo are explored.

2.3. Use of scenarios

Scenarios can also have different ***functions***. Scenarios have the ambition to inform and/

or advise decision–making. They can be useful tools to (EC-DGXI, 1996); (Rotmans and Van Asselt, 2000), (van Asselt, 2000):

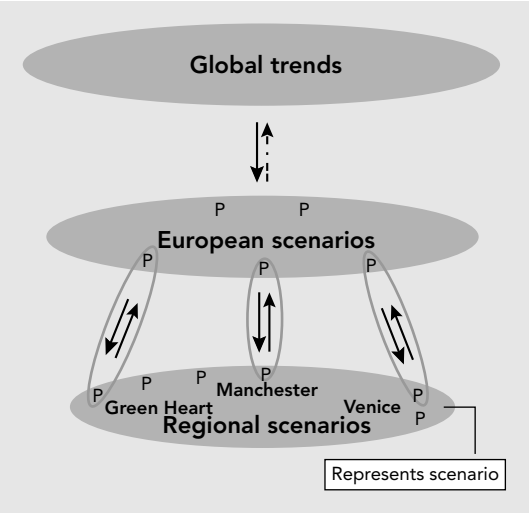
- help us articulate or to think through our key considerations and assumptions: scenarios can help us to imagine a range of possible futures if we follow a key set of assumptions and considerations;
- identify gaps, inconsistencies, dilemmas, uncertainties and indeterminacies and to understand complexity;
- help us expand and improve our think ing, take on and explore possibilities that are new, or challenge conventional thinking;
- blend quantitative and qualitative knowledge; scenarios are in principal power ful frameworks for using both data and model-produced output in combination with qualitative knowledge elements.

2.4. Characteristics of scenarios

Scenario studies can be worked out on different geographical *scales*, i.e. global, international regions (such as OECD or EU), national and sub-national regions. Examples of global scenarios are the OECD scenarios 'the world in 2020' and their associated scenarios on global economy (OECD, 1997; 1999). Also the IPCC study on emission and climate change scenarios (IPCC, 1995) and the TARGETS scenarios (Rotmans and de Vries, 1997) are global scenarios. The present report involves scenarios on the scale of global as well as on the scale of international regions, in particular the European Union. National scenario studies are abundant, especially in the USA, the Netherlands[1], Germany, Denmark and Sweden. On the regional level, scenario studies are in their infancy. An example of a regional scenario study is the Dutch study 'Good morning 2015' (LIOF, 1995) that explores demographic, economic and urban planning developments in the Dutch province of Limburg.

It is also possible that a scenario-study comprises various geographical scales. For example, scenarios can be worked out on a European scale, taking notice of global developments. Though only one-way integration takes place here, integrating scales in itself is still a rarity. A positive exception is the Visions project (Visions team, 2001; see p 111). In this project scenarios will be developed that include a two-way integration across scales (Figure 2.2). Scenarios are being made for Europe, including global trends, and for three European regions. The explicit aim of the project is to develop visions for Europe, an integration of the European and the regional scenarios. So in this project the integration goes both ways, bottom-up and top-down.

Integration of different scale levels in the Visions projects (Visions team, 2001) — Figure 2.2



Scenarios differ according to the *time-horizon* addressed. They can be worked out on a short (less than 20 years, one generation) and long term scale (two generations and beyond). An example of a short term scenario study, is 'Technology and the future of Europe' (Pardoe, 1992), in which technological developments over a ten year period are covered. An example of a long-term scenario study is the study of the WBCSD (1998), in which possible futures for businesses are explored up to the year 2050.

Scenarios always, either implicitly or explicitly, embody perceptions and judgments. Instead of hiding the crucial assumptions, uncertainties and choices underlying the scenarios, it is better to make them *transparent*. Related to transparency is the issue whether fundamentally different *perspectives* are taken into account. Perspectives are consistent descriptions of how the world functions and how decision-makers should act on it (Rotmans and van Asselt, 1996). Rotmans (1998) and van Asselt (2000) argue that the majority of current scenarios are developed from narrow, discipline based perspectives, resulting in a lack of diversity. Incorporation of multiple perspectives enables us to make subjective and normative choices explicit and to explore the frontiers of our knowledge. In contrast to scenario studies in which the set of scenarios is merely

[1] Examples of Dutch scenario studies are: 'The sustainable economic development scenarios' (VROM, 1996), 'The Netherlands in 2030' (VROM, 1997) and 'Possibilities for CO2 reduction in 2020' (ECN, 1998).

a variation on one scenario (as the IPCC (1995) IS92a till IS92f scenarios), scenario studies that comprise multiple perspectives have much more potential for informing and facilitating societal debate. 'Perspectives on global change, the TARGETS approach' (Rotmans and de Vries, 1997) is an example of a study explicitly adopting a multiple perspective approach.

Scenarios can furthermore be characterised by the *level of integration*. To what extent is the mutual interplay between social, economic, environmental and institutional developments explored? The WRR study 'Sustained risk: a lasting phenomenon' (WRR, 1994) is an example of a non-integrated study. Different sectors like the water, food and energy sectors have been addressed. The interrelations between those sectors were neglected in the scenario exercise, however. An integrated scenario study should address both different cause-and-effect chains within one issue (vertical integration) as well as the interplay between different sectors and issues (horizontal integration) (Rotmans, van Asselt et al., 1994). A minimum condition to arrive at an integrated evaluation of the future is that the underlying scenario development process be interdisciplinary. Interdisciplinarity implies an original combination derived from the integration of multidisciplinary ideas or methods that permits explanation or assessment not achievable of non-integrated application of multidisciplinary ideas or tools (Schneider, 1997).

2.5. Scenario methods

Scenario methods can be classified according to the character of the tools used, and the focus of the scenario exercise. With regard to the first, we can distinguish between modelling, narrative and participatory methods. These result in respectively quantitative, qualitative and hybrid scenarios. According to van Asselt (2000) a distinction can also be made between the following scenario development approaches according to the focus of the scenario exercise: the global scenario approach, a focused scenario approach and a theme-specific approach. Table 2.1 provides some examples of the studies associated with the various approaches.

Table 2.1 **Examples studies associated with the various approaches**

	Analytical		Participatory
	Quantitative (model-based)	*Qualitative (expert-based)*	*hybrid*
Global	Rotmans et al. (1997) IIASA/WEC (1995)	WBCSD (1998)	IPCC
Regional	BCI (1996) CPB	McRae EC DGXI Smith	CPB
Theme-specific	WRR EFILWC ECN EC DGXVII	Button	EC DGXVII (1996)

Modelling methods involve the use of computer models, either as central means to explore the future consequences of sets of assumptions or as a tool to check the consistency of the developed scenarios. Narrative methods are usually deployed in cases where data is weak or missing. Pathways into the future are then qualitatively described. These two classes of methods are usually adopted in scenario projects involving a small 'core' group of experts.

Participatory methods refer to approaches in which non-scientists, such as policy makers, stakeholders and/or lay people play an active role. The use of participatory approaches in scenario development is advocated with the argument that complementary heterogeneity in perspectives, expertise and knowledge is needed to guarantee sufficient 'richness' (Anastasi, 1997). Rotmans and van Asselt (Rotmans and Van Asselt, 2000) distinguish three classes of participatory methods: dialogue methods, policy exercises and mutual learning methods. The dialogue method is applied in cases where the intended users are considered as a source of information necessary for the experts to develop scenarios. In a policy exercise, a game is set up that represents a negotiation process in which the different teams are responsible for a certain country or region. The strategies used and the negotiations from them provide the basis for the set of scenarios to be developed. In the mutual learning method, participation of stakeholders and citizens enriches the assessment by a multiplicity of perspectives, skills and competence. The participants are then co-designers of the scenarios.

Global methods result in scenarios that depict the future of the world as a whole. In contrast, focused and theme-specific approaches concentrate on a particular geographical area or emphasise a single theme, like energy or transport. Anastasi (1997) explored the differences among the various

approaches in scenario building. He concluded that until now model-based scenarios, as well as global narratives and energy-based and technology-based scenarios have enjoyed the most exposure in science and decision making communities.

The use of *indicators* and indices is central to all scenario development, irrespective of the method used. Indicators are pieces of information designed to communicate complex messages in a simplified, (quasi) quantitative manner (Rotmans, 1997; van Asselt et al, 1998). Indices are aggregates, comprising and relating different indicators. Current scenario studies are often based on a very limited set of standard economic indicators and, to a lesser extent, environmental indicators. In particular social and institutional indicators are neglected (Rotmans, 1997). Furthermore, there is a discrepancy between the indicators policy makers are interested in and the indicators captured in current scenarios.

2.6. Integrated assessment

Integrated Assessment is a relatively new field of decision support in which scenarios are used as tool to explore complexity. Complexity means that major social problems can no longer be addressed from one perspective, one country, one state, one culture, one ministry or one scientific discipline. The increasing complexity of our society can be attributed to different causes. First the element of *scale-enlargement*: processes at the global and international level more and more interfere with processes at the national and local level. A second important factor is *technological development*. Other important factors are that of *time acceleration*, which causes a shorter rotation time of all sorts of processes, and *knowledge increase*, in particular about the interactions between social, economic and ecological processes (Rotmans, 1999). The complex dynamics of strongly interacting short-term and long-term processes on various scale levels force us to think and act in a more integrative manner (Rotmans, 1999).

There are many definitions of Integrated Assessment [2]. These all have three elements in common: multi- or interdisciplinarity, structuring of knowledge and decision-support. Rotmans (1999) defines IA as:

An interdisciplinary process of structuring knowledge elements from various scientific disciplines in such a manner that all relevant aspects of a complex societal problem are considered in their mutual coherence for the benefit of decision-making.

Metaphorically Integrated Assessment can be viewed as making a puzzle. Everybody sees the separate pieces of the puzzle, but the real art is fitting them together in such a manner that an integrated picture arises, which is more than the sum of its parts. The essence of Integrated Assessment is, however, that there is no optimal solution of fitting the disciplinary pieces of the puzzle together. Depending on the underlying perspective, there is a multitude of possible ways of integration.

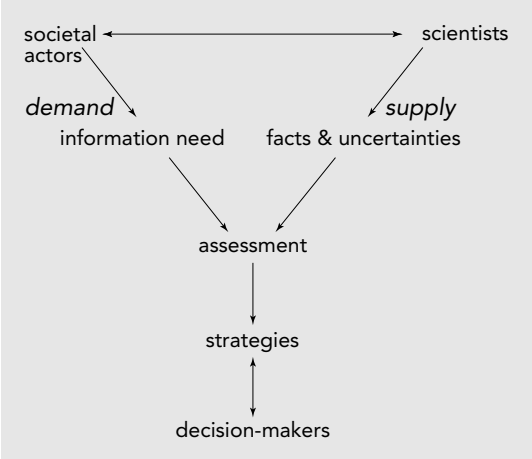
The key objective of Integrated Assessment is to support public decision making by developing a coherent framework for assessing trade-offs between social, economic, institutional and ecological determinants and impacts (Rotmans and de Vries, 1997).

The complex, intuitive, and value-laden process of Integrated Assessment cannot be addressed by one unique approach. In general, two types of Integrated Assessment methods can be distinguished: analytical methods and participatory methods. While analytical methods are often rooted in natural sciences, participatory methods, also called interactive or communicative methods, stem from social sciences. The group of analytical methods is reasonably well-defined and basically includes model analysis, scenario analysis and risk analysis. Their commonality is that they provide analytical frameworks for representing and structuring scientific knowledge in an integrated manner. The group of participatory methods involves a plethora of methods, varying from expert panels and delphi methods, to gaming, policy exercises and focus groups. They have in common the aim to involve non-scientists as stakeholders in the process, where the assessment effort is driven by stakeholder-scientist interactions.

The process of Integrated Assessment can be represented in a simplified manner through a sort of demand/supply mechanism, as depicted in Figure 2.3. There is a societal demand for information about complex social issues. Science delivers facts, uncertainties and hypotheses with regard to these complex issues and thereby serves as the supply side. Demand and supply come together in an active dialogue, which ultimately leads to integrated insights. These insights are to be, together with decision-

[2] See for literature on Integrated Assessment for example: Dowlatabadi and Morgan (1993); Haigh (1998); Jäger (1998); Morgan and Dowlatabadi (1996); Parson (1995); Parson and Fisher-Vanden (1997); Risbey, Kandlikar et al. (1996); Rotmans and van Asselt (1996); Rotmans (1998); Rotmans and Dowlatabadi (1998); Schneider (1997); Toth and Hizsnyik (1998); Weyant, Davidson et al. (1996).

Figure 2.3 **Sketch of IA process**



makers, translated into strategies. We should realise that social actors also bring in knowledge in the form of non-scientific expertise and judgment, while scientists can use the insights for prioritising research themes and thereby also consider clients next to suppliers.

Performing Integrated Assessment has a number of advantages. In general terms, IA can help to:

- put a complex problem in the broader context of other problems, by exploring the interrelations of the specific problem with other issues;
- assess potential response options to complex problems. This may, but does not have to be be done, in the form of cost-benefit and cost-effectiveness analysis;
- identify, illuminate and clarify the different types and sources of uncertainties in the cause-and-effect chain(s) of a complex problem;
- translate the concept of uncertainty into the concept of risk analysis, to assist in decision-making under uncertainty;
- set priorities for research topics, by identifying and prioritising decision-relevant gaps in knowledge.

For the future of Integrated Assessment, it is of crucial importance that bridges be built. The gap between natural scientists and social scientists [3], and the gap between the decision-making community and the scientific community must both be overcome. This stands or falls with the continuous effort of both researchers and decision-makers who have the courage to step across the barriers of their discipline or background.

Integrated Assessment aims at developing scenarios that, apart from being well structured and documented:

- describe dynamic patterns of changes,
- include a variety of perspectives,
- include both social, economic, environmental and institutional indicators,
- are consistent among different sectors, problems and scales,
- are coherent in the sense that all relevant dimensions are addressed and that all relevant interactions between the various processes are considered,
- are transparent with regard to assumptions and choices,
- are challenging, with a strong narrative as well as quantitative component,
- are developed in an iterative way involving a balanced and heterogeneous group of people.

[3] Many social scientists consider the IA-models as technocratic artifacts that merely reflect the worldview of its developers; many natural scientists regard the participatory approaches as virtually useless, adding nothing relevant to existing scientific knowledge.

3. Research approach

The research discussed in this report can be considered as a four stage search and evaluation process (Figure 3.1).

In the first step, the terms of reference for the literature search are set. The scenarios and models should be for Europe or for the world as a whole, developed in the last decade and focussed on environment or sustainable development. The scenarios and model studies should be important for the goals of the EEA.

The core of the second phase consists of the literature review. Literature was searched with help of the Internet, library catalogues and references. Also, experts were consulted. In Appendix II the complete list of scenario studies that satisfy one or more elements of the terms of reference are listed in chronological order.

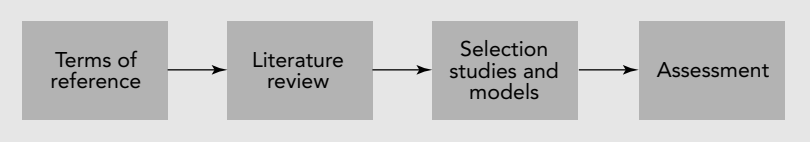
The third step includes a further selection of the most relevant studies in view of our purposes. The study should have an impact on either policy, science or on other social actors, it should have a potential use value, and it should be innovative. In Table 3.1 the selected model studies are summarised and in Table 3.2 the selected scenario studies are listed. In this second table a division is made between pure European scenario studies, pure global studies and studies that have a global and European component. Building upon our earlier review of European scenarios we considered the last decade of European scenarios (i.e. since 1990) and we restricted ourselves to the most recent global ones (i.e. developed since 1997).

In the fourth phase the selected scenario studies are assessed by means of an evaluation scheme. Following Robinson (1992), Rotmans and van Asselt (2000), we distinguish three classes of quality criteria for scenario studies, namely:

- methodological quality,
- analytical quality,
- usability.

Methodological quality addresses the quality of the scenario development process and the methods and approaches adopted.

Schematic overview of research approach Figure 3.1



Analytical criteria involve the quality of the product, i.e. the scenario themselves. In order to be useful for decision-making purposes, scenario studies should provide recommendations for decision-making, which can range from agenda setting priorities to policy measures. Usability criteria therefore involve whether the recommendations are concrete, challenging, realistic and practical.

These quality criteria enable us to evaluate the quality of scenario studies. The analytical and methodological criteria enable us to evaluate whether the assessment is qualified. The quality criteria in terms of usability provide the possibility to evaluate the societal impacts and benefits of a study. Being aware of these two dimensions, Rotmans and van Asselt propose the following hierarchical quality assessment procedure (Figure 3.2).

The selected model studies Table 3.1

Model	Model
World 3	GTAP
Int. Futures	GEM-E3
TARGETS	E3ME
Threshold 21	WorldScan
Polestar	JOBS
IPCC multi-model approach:	Quest RAINS
• AIM • ASF • IMAGE • MESSAGE-MACRO • MARIA • MiniCAM	

Table 3.2 **The selected scenario studies. The table is divided into European studies, global studies and global studies with a European subdivision**

Year	Author(s)/Institution(s)	Title
European scenarios		
1990	European Commission DGXVII [1]	Energy for a new century – Energy in Europe: the European perspective
1992	WRR	Ground for choices, four perspectives for the rural areas in the European Community (in Dutch: Grond voor keuzen, vier perspectieven voor de landelijke gebieden in de Europese Gemeenschap)
1993	Thord, R. (ed)	The future of transportation and communication, visions and perspectives from Europe, Japan and the USA
1994	European Foundation for the Improvement of Living and Working Conditions (EFILWC)	The potential for employment opportunities from pursuing sustainable development
1995	McRae, H.	The world in 2020: power, culture and prosperity. A vision of the future
1996	European Commission DGXVII	European energy to 2020: a scenario approach
1996	European Commission DGXI	Vision 2020, Scenarios for a sustainable Europe
1996	CPB	Surrounding scenarios: Long term exploration 1995-2020 (In Dutch: Omgevingsscenario's: Lange termijn verkenning 1995-2020)
1997	CPB	Economy and physical environment (In Dutch: Economie en fysieke omgeving)
1997	European Commission	Vision 2020, Scenarios for a sustainable Europe. Summary and recommendations agreed on by the General Consultative Forum.
1997	Smith, D.	Eurofutures
1998	Nijkamp, P., Rienstra, S.A., Vleugel, J.M.	Transportation, planning and the future
1998	EC DG DGVII	POSSUM (policy scenarios for sustainable mobility)
1999	EC, Forward Studies Unit	Scenarios Europe 2010
2001 in pre-paration	EC, DGXII	VISIONS
Global scenarios with a European component		
1998	Hammond, A.	Which world? Global destinies, regional choices
1999	Xerox corporation	Looking Inward. Visions of the 21st century family by students from around the world
2000	Jackson Environment Institute	ACACIA project
Global scenarios		
1997	OECD	The World in 2020: Towards a New Global Age
1997	SEI	Branch Points: Global Scenarios and Human Choice
1998	SEI / GSG	Bending the Curve: Toward Global Sustainability
1998	WBCSD	Exploring Sustainable Development: WBCSD Global Scenarios 2000-2050
2000	in preparation	IPCC -WG III Third Assessment Report

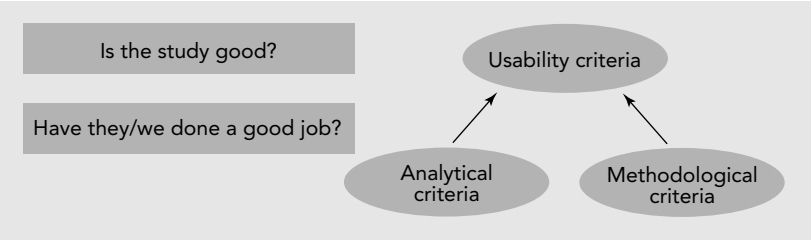
[1] The directorates-general of the European Commission are at this moment in a transitional stage. The names are changed, but in this report we will refer to the old names. The new names of the mentioned DGs are:
DG VII: Transport
DG XI: Environment, Nuclear Safety and Civil Protection
DG XII: Science, Research and Development
DG XVII: Energy

Quality criteria preparatory study — Table 3.3

Methodological quality	Analytical quality	Usability
Interdisciplinarity	Scenario dimensions	Recommendations for policy
Methods of scenario development	- Scales	
Character scenario study	- Issues	
- Qualitative, quantitative, hybrid	- Sectors	
	- Indicators	
Level of integration	- Time-horizon/time steps	
Multiple perspectives	Consistency	
Backcasting/forecasting	Coherency	
Surprises and bifurcations	Transparency	
	Character scenarios	
	- Degree of variation	
	- Reference scenario	
	- Plausibility	

Building upon the evaluation of the individual studies, an assessment of the state of the art in European and global scenario building is made. In this assessment all selected scenario studies are taken together and compared with each other. In the last part of the report, it is discussed how the European Environment Agency could make use of the scenarios described.

Quality assessment procedure (Rotmans and Van Asselt, 2000) — Figure 3.2



4. Selected models

4.1. Introduction

This chapter provides a survey of past and present integrated models that have been used for the generation and analysis of global and European scenarios. The models are clustered in three groups. The first group contains those models that have been built with the explicit objective of providing an integrated insight into a broad range of environmental, economic and socio-cultural aspects of sustainability. This group of models includes the World 3 model and the more recent related models International Futures, TARGETS and Threshold 21 as well as the accounting based models Polestar and Quest. The second group contains models that put an emphasis on the link between the energy sector and the environment. These models usually concentrate on the issues of emissions, climate change or acid rain and depletion of resources. This study includes as examples RAINS and the set of six models used in the recent IPCC *Emission Scenarios* study, namely AIM, ASF, MESSAGE-MACRO, MARIA and MiniCAM. The third group of models focuses on the link between the economy and the environment. It includes JOBS, GTAP, GEM-E3, E3ME and WorldScan. Most models in this group exhibit sophisticated and detailed scenarios of economic developments and translate these into rough sketches of possible environmental impacts.

The descriptions of the models focus on the breadth and depth of models as well as the modelling techniques used. Appendix I provides an overview of the main characteristics as well as key references for the models described. At the end of this chapter, some preliminary conclusions are drawn concerning the general usefulness of existing models for a thorough and well balanced analysis and projection of developments related to sustainability in Europe. The main criteria for such an assessment from a methodological point of view are the levels of horizontal and vertical integration. Horizontal integration refers to the integration between different aspects of a models' domain. Issues of integration between the environmental, the economic and the socio-cultural domain as well as integration within each of these domains are important in that respect.

Vertical integration refers to integration between different stages of cause-effect chains in the sense of the pressure-state-response cycle. Following these definitions, a causal chain that combines several domains would be an example of both horizontal and vertical integration. Further criteria in the assessment of the models are the time horizon, the geographical coverage and the ease of use of the model for people other than the developers themselves. The latter criterion provides insight into the transparency of a model.

4.2. Integrated models for the assessment of sustainability

4.2.1. Meadows, Meadows and Randers (1972 and 1991), World 3

World 3 was the first comprehensive integrated global simulation model. It became known to a wide audience through the publication of *Limits to Growth* (Meadows, Meadows et al., 1972) and in its revised form through the publication of *Beyond the Limits* (Meadows, Meadows et al., 1991). The forecasts of the model are not up to date, but the methodological lessons learned from World 3 justify its inclusion in this survey.

World 3 is a system dynamics model that covers a wide range of population, food, energy, environmental and economic issues. System dynamics models are based on sets of difference equations. These equations are used to express levels of stock variables and rates as a measure of change in the stock variables. Auxiliary variables, mostly parameters, quantitatively describe the relationships between the different stocks and flows. This modelling technique enables modellers to model complex interactions without having to tackle massive sets of time-series data. Scenarios can be forecasted and backcasted from a base year, which is the only year for which data is needed for a scenario run (for validation and calibration other data sets might be needed). In the case of the revised World 3 model, the base year is 1990. The forms of the equations, the interactions and the values for the auxiliaries and the constants are based on statistical analysis and scientific judgement without participative input. Scenario simulations run

from 1900 until 2100. The so-called back-casting is used in order to validate and calibrate the model to actual history. A comprehensive technical description of the original World 3 model can be found in *Dynamics of Growth in a Finite World* (Meadows, Meadows et al., 1972).

World 3 is the first comprehensive example of horizontal integration. There is a plethora of feedbacks between the different domains of the models. However, the socio-cultural domain and the institutional domain are not represented in the model at all. The level of vertical integration is limited. It is not possible to trace clear cause-effect chains as the descriptions of the different processes are too crude to allow for a detailed analysis. A major drawback of the model is the fact that it can only provide scenarios on a global level without a regional disaggregation. The scenarios generated are of limited use for policy makers as they allow only very general conclusions about the possible effects of different policy strategies. As each new scenario run requires adjustments in the code of the program, the ease of use for people other than the developers is very limited.

4.2.2. Barry B. Hughes (1999), International Futures

International Futures (IF) (Hughes, 1999) is a global system dynamics model based on a similar methodology as World 3.[1] The model simulates population, food, energy, environmental and economic developments for the period from 1992 until 2050 at a global as well as at a regional level. One of the 14 regions in the model is the EU. IF adds the domains of domestic and global social and political systems to the coverage of World 3. However, these aspects are covered more implicitly than explicitly in the model. An important feature of IF is the interactive way of developing scenarios, which allows users to efficiently adjust virtually all values of variables, parameters and constants in order to explore variations of a given base-line. However, the user can not adjust the form of the underlying equations. The IF base scenario draws on the extrapolation of current trends. The greater breadth of the model increases horizontal integration. However, the environmental domain is limited. With respect to vertical integration the model suffers from similar problems as World 3. The possibility to quickly create a set of partially custom-made scenarios is very valuable for policy analysis. The user is more likely to identify with the results as they are based on his/her own assumptions. The possibility to derive concrete underpinnings for policy analysis has not substantially improved.

4.2.3. Rotmans and de Vries (1997), TARGETS

TARGETS (Tool to Assess Regional and Global Environmental and Health Targets for Sustainability) is another example of a global system dynamics model (Rotmans and de Vries, 1997).[2] As the title suggests, TARGETS puts its emphasis on the assessment of long-run environmental developments, taking into account biophysical, social and economic processes. Estimates of impacts on ecosystems and humans are the central results of the models. Like World 3, the model is restricted to the global level as datasets are fully aggregated at this level. Scenarios run from the year 1900 to 2100. The explicit introduction of cause-effect chains differentiates the model from previous system dynamics models described in this overview. For this purpose the pressure-state-response approach developed by the OECD (1993) has been refined. The state part is split into state and impact to allow for a more detailed distinction between changes in the various functions of (sub)systems and the changes in the state of the system. TARGETS consists of five sub-models and an economic scenario generator, which are integrated and interlinked with each other. The five highly aggregated sub-models are meta-models of expert models in the respective fields. The structures of the expert models have been simplified in order to make integration between the models possible. The result is a set of meta-models, that capture the behaviour of their "expert-parents" quite well, without describing the field concerned in infeasible detail. The sub-models cover the aspects of population and health, land and food, energy, water, and global bio-geo-chemical cycles. The economic scenario generator is a relatively primitive tool to feed exogenous GWP (Gross World Product) trajectories into the model. TARGETS has a unique way of dealing with uncertainty. The model uses a generic description of the users world view and management style in order to adjust the underlying assumptions to that persons probable convictions. The options offered for both choices are egalitarian, hierarchist and individualist. The choices made influence the way in which adjustment in behaviour, learning and other aspects takes its effect during the run of the model. The three categories are derived from cultural theory (Thompson, Ellis et al., 1990).

[1] International Futures is available for downloading at http://w3.arizona.edu/~polisci/ifs/.

[2] TARGETS is available on CD-Rom from the authors.

TARGETS focuses on the assessment of the environmental and health effects of sustainability. Within these fields there is interaction between the different sub-models. There is no further horizontal integration with other sectors. Within the coverage of the model, horizontal integration through the consequent application of the pressure-state-impact-response approach (PSIR), vertical integration within the domain of environmental assessment is rather advanced. On a European level, the model has little use for concrete policy analysis or advice other than to quantify the urge for a reduction in resource use and emissions.

4.2.4. Millennium Institute, Threshold 21

Threshold 21 (T21) is a system dynamics model that covers the domains of the three previous models.[3] It combines the social, economic and environmental domains in an extremely transparent model. Within the structure of the model market and government behaviour plays a key role, which allows users to easily adjust political strategies and view its impacts. These adjustments can be introduced in the form of changes in the otherwise static parameters that quantify the relationship between the different stock and flow variables. The model is generally adjusted for use on the national level and has already been used in a number of developing countries as well as in Italy and the US. Global influences in issues such as GHG emissions are also included in T21. The level of detail in the output variables is impressive. However, this level of detail is not applied in the description of the cause-effect chains.

Horizontal integration in T21 is very high. All the sectors directly influence each other through a plethora of feedback cycles and other linkages. Vertical integration is also implemented, but less detailed. The high accessibility of the model and the ease with which every link can be adjusted allows the fast analysis of a large number of different policy options under changing assumptions. One should, however take care that the model is calibrated only for a given reference data set. Playing with the model in itself does not provide substantive input for policy analysis, but communicates a feeling for the complexity and integratedness of sustainable development.

4.2.5. Raskin, Heaps and Sieber (1995, 1999), POLESTAR

Polestar uses a very different technique from the models above.[4] Polestar is an integrated accounting framework developed by the SEI Boston Center and applied by the Global Scenario Group in the scenario studies described on pages 78-82 of this report (Gallopin, Hammond et al., 1997). The backbone of the model is an extensive data set containing a wide range of social, economic and environmental variables. Some political and cultural variables are also included. Base year data is available for the year 1995. In a stepwise procedure the user can introduce assumptions from other studies and/or models and check these against the values of indicators of sustainable development for future years. The first step of the scenario building process contains the external development of scenarios for population change and economic development. Based on these scenarios, the model calculates the consequences for the environment and for world resource availability based on standard parameters. Societal responses to certain developments can be introduced externally to explore a set of different pathways. The geographical focus of the model is rather flexible. For the year 2050, two reference scenarios are available. The settings used in these two scenarios can be used as default option for all interrelations that the user does not wish to define herself. There is also the option to introduce new variables or to ignore existing ones. These options make Polestar a very flexible accounting tool (SEI Boston Center, 1999).

Polestar exhibits a very low level of horizontal and vertical integration. Horizontal integration is restricted to a minimum of strictly necessary interactions, vertical integration is lacking on the whole. This limits the possibility to derive integrated and balanced answers for issues related to political decision making from the model. For the analysis of very specific rather short-term questions the model provides a useful first insight.

4.2.6. SDRI University of British Columbia (1999), Quest

Quest is a framework that combines the properties of an accounting framework with elements of input-output, GIS, and other modelling techniques for a computer simulation of local developments.[5] It has been developed at the Sustainable Development Research Institute (SDRI) at the University of British Columbia. Quest simulates the development of a region in an integrated way. The purpose of Quest lies more in the education about the complexity of a sustainable future than in the development of

[3] Further information about Threshold 21 is available at http://www.threshold21.com.

[4] A demo-version of Polestar is available for download at www.tellus.org.

[5] Further details and a demo-version of Quest are available for download at http://www.envisiontools.com/.

scenarios in their own rights. Through a very user friendly interface, the user, who is usually a local stake-holder, explores different strategies for local development. The user also defines his view of what sustainability is in choosing a few benchmark variables that are important in his/her opinion. These benchmarks mainly affect the visualisation ,but not the calculation of the scenarios. The computer program runs in steps of ten years after which the development progress is being reviewed and the strategy can be adjusted up to 2030. In this way, Quest is quite similar to the popular computer game SimCity. Playing with different scenarios teaches the user a feeling for the complexities involved in the sustainable development of a region. These features make the model a suitable tool at the interface of scientific advice, political decision-making and communication with the general public (SDRI, 1999).

Quest explores issues related to sustainability on a sub-national level with good horizontal integration. However, this integration is too rigid in its interactions to allow for reasonable long-term evaluations as most parameters for interaction are constants or develop in a purely linear way. Vertical integration in Quest lacks the final feedback loop in the cause effect chain. Quest is very useful for policy advice on the local level as it allows for a great amount of detail combined with large flexibility. But so far, its only been fully implemented for the Lower Fraser Basin in BC, Canada. The strength of the model turns into a weakness if one wants to apply such a model at the European level as it is currently not possible to cover the many co-existing contradicting trends in different regions within Quest. However, such a spatial differentiation could be developed.

4.3. Environment-energy models

4.3.1. Alcamo et al. (1990), RAINS and RAINS- Asia

RAINS (Regional Acidification INformation and Simulation) is a first generation integrated assessment model developed by IIASA.[6] The model focuses on the analysis of SO_2, NOx and NH3 emissions and their effects on sensitive ecosystems through acidification and eutrophication (Alcamo, Shaw et al., 1990). The projections are based on the technique of linear programming, although non-linear components have been included in recent versions. RAINS consists of a large number of sub-models that are clustered in three modules: the emission-cost module (EMCO), the acid deposition and ecosystem impact module (DEP) and the optimisation module (OPT). Estimates of emission costs are based on information about economic activity, energy consumption, fuel characteristics and agricultural activities derived from national statistics and projections. The DEP module allows the manipulation of geographical data and functions as an interface between the other two modules. The optimisation module finds the cost-minimal allocation of measures to reduce emissions for a set of given target emissions. Currently, energy-data is supplied up to the year 2000, forecasts are possible up to the year 2040. The recent RAINS 7.2 version has been applied to Europe. For this purpose, Europe was has been divided into 41 countries and sea regions.

Horizontal integration of RAINS is limited by its specific focus from the perspective of comprehensive environmental assessment. Within the domain of the model, vertical interactions are modelled with a great level of detail. The geographical focus of the model on Europe might make RAINS a suitable input for a larger integrated model with a wider domain. RAINS provides useful output within its focus and has been influential in policy analysis on an international and national level (Sluijs, 1997).

4.3.2. IPCC (2000), multi-model approach for developing emissions scenarios

In a recent study, the IPCC uses a multi-model approach for developing GHG emission scenarios. The IPCC considers the selected models as representative for current modelling techniques. Six models are included: The *Asian Pacific Integrated Model* (AIM), the *Atmospheric Stabilization Framework Model* (ASF), the *Integrated Model to Assess the Greenhouse Effect* (IMAGE) used in connection with the *WorldScan* model described in the next section, the *Multiregional Approach for Resource and Industry Allocation* (MARIA), the *Model for Energy Supply Strategy Alternatives and their General Environmental Impact* (MESSAGE) and the *Mini-Climate Assessment Model* (MiniCAM).[7]

AIM is a general equilibrium model developed by the National Institute of Environmental Studies in Japan.[8] The model focuses on the assessment of greenhouse gas emissions. It calculates the level and type of energy use on the basis of external socio-economic scenarios. The model consists of six sub-models: The *Socio-Economic Scenarios* sub-model is an input module for the exter-

[6] A demo version of the current version of RAINS as well as an excellent description and history of the model can be found at http://www.iiasa.ac.at/~rains/.

[7] The following descriptions are based on IPCC (2000) , App. IV and additional information available at the indicated websites unless otherwise noted.

[8] More information about AIM is available at http://www-cger.nies.go.jp/ipcc/aim/

nal scenarios. It requires the exogenous input of GDP, population, resource base and lifestyle developments. The *Bottom-up Model* provides information about sectoral energy and resource efficiency. The *Energy-Economic Model* calculates a market equilibrium for energy markets. It does so for 17 world regions. Among them is the OECD-West. The *Land Equilibrium Model* calculates the land use based on biomass energy demand, food consumption patterns and technological change. From the latter two sub-models GHG emissions are calculated which are in turn fed into the AIM *Climate Model* and subsequently the AIM *Impact Model*. Outputs from the latter model can be used to provide feedback concerning the socio-economic scenarios.

Horizontal integration in AIM is limited by the extremely narrow focus of the model. The only interaction between the socio-economic module and the environmental module concerns the climate related land-use patterns. AIM lacks horizontal integration with other aspects of environmental sustainability. Vertically, there is only a limited feedback mechanism between the environmental impact calculation and the socio-economic scenarios, which brakes the pressure-state-response cycle. The exogenous treatment of socio-economic developments limits the level of vertical integration. The geographical focus of the model is primarily meant to cover global issues rather than issues relevant on a regional scale. A very detailed version of the model exists for the Asian Pacific region where the model distinguishes 3200 regions.

ASF is an accounting framework covering the fields of energy, agriculture, deforestation, GHG emissions and an atmospheric model. Emission estimates are provided for nine world regions, among them the OECD-West. ASF consists of a cluster of five sub-models The energy model contains four sectors: residential, commercial, industrial and transportation. An equilibrium for the energy market is based on prices, which differ by region, type of energy and conversion costs. An agricultural model is linked to a deforestation model. Interactively, these two models calculate the agricultural production and the area of deforestation based on population and GNP developments. The emissions model uses the output of the three previous models to estimate GHG emissions. The atmospheric model uses this as an input to calculate the effects with respect to temperature and CO2 concentration.

Integration in the ASF model is limited horizontally by the narrow focus of the model. Within this focus the level of integration between the different modules is actually quite high. The model does not represent any socio-economic factors. The horizontal integration of economic and environmental issues is very limited. Vertically, there are some gaps in the PSIR causal chain, especially concerning responses. The possibility to derive substantial input for policy analysis from the model is limited by these factors.

IMAGE was developed at RIVM in order to assess the impact of anthropocentric climate change (Rotmans, 1990). The current IMAGE 2.1 is an integrated model consisting of three sub-models. The Energy-Industry System (EIS) calculates greenhouse gas emissions in thirteen world regions, among them OECD-Europe. Emissions from the energy sector are modeled with the TIMER simulation model, a system dynamics model for the prediction of energy related information in 5 sectors of the economy. The Terrestial Environment System (TES) simulates land-use and land-cover change and their consequences for climate related biophysical processes. The Atmosphere-Ocean System (AOS) calculates the behaviour of greenhouse gases in the atmosphere and its effects on temperature and precipitation patterns. Sub-models of the AOS cover the atmospheric composition, zonal atmospheric climate, oceanic climate, oceanic biosphere and oceanic chemistry. Economic data, technological change, demographic developments and control policies are exogenous input into the model.

Simulations run up to the year 2100. The geographical focus of the model ranges from a 0.5 degree x 0.5 degree latitude-longitude grid to world regional level (CIESIN, 1995). An overview of applications of IMAGE 2.1 can be found in Alcamo (1994). IMAGE 2.2 is currently under development and and will shortly be available.

IMAGE 2 exhibits a lack of horizontal integration from the perspective of general sustainability analysis. Within its narrow focus horizontal integration is exemplatory. Horizontal integration is introduced at all computing levels of the model and not restricted to higher domains. There are a multitude of important feedbacks between models in the sub-systems, and between sub-systems. Vertical integration is more limited as there is a lack of feedback from the

outcome of the model and the input. Only the output of land-use and climate data is used as input for the next round of calculations without affecting other exogenous inputs. In perspective of a more general model of sustainability in Europe, it is questionable whether the level of detail and integration could be achieved in a model that covers a wider domain.

MESSAGE-MACRO: MESSAGE is a dynamic linear programming model. It is a sub-model of the IIASA integrated modeling framework and is generally used in a tandem with the MACRO macro-economic model.[9] The two models are a combination of top-down and bottom-up modeling techniques. MACRO (top-down) calculates the maximal utility of a representative consumer for each region and its relations with macro-economic development and energy use. MESSAGE (bottom-up) calculates energy demand, supply and emission patterns on the basis of economic input. The model requires the exogenous input of population and GNP scenarios on a regional level. From this, the *Scenario Generator* (SG) derives scenarios for future energy demand that are consistent with empirical results derived from historical data stored within the SG. The model divides the world into eleven regions, among which Western Europe. In the IIASA integrated modeling framework MESSAGE is also used in combination with RAINS, MAGICC and other specific models.

The MESSAGE-MACRO tandem in its own right lacks vertical as well as horizontal integration. Horizontal integration can be improved through the interaction with other models, but is then limited to the highest scale level and does not directly affect subsections of the model. Vertical integration is also a problem because effect chains have to be limited to rather general descriptions. As such the model is more a tool for the analysis of the consistency of given scenarios rather than a relevant basis for political decision making.

MARIA is an inter-temporal non-linear optimisation model focusing on the assessment of technology and policy options available to address global warming. The model is based on the DICE model (Nordhaus 1994) and covers aspects of economics (consumption and trade), land use, natural resources, and energy. MARIA divides the world into eleven regions. The region covering Europe includes the whole OECD other than the US and Japan, i.e. includes Canada, Australia and New Zealand. The model requires the exogenous input of population and potential per capita GDP growth rates. The simulation of economic activities are then modelled under the assumption of constant substitution elasticities. The analysis of emissions is limited to global carbon emissions.

The level of horizontal integration of the model is limited by its narrow focus. Vertical integration is limited by the exogeneity of key economic indicators. With respect to policy relevance there is a lack of detail concerning the policy options available. The effects of specific policy choices are hard to evaluate. The strength of the model lies in the general macro-level evaluation of various consistent options. The regional division of the model makes it unsuitable for the application to EU specific problems.

MiniCAM is an integrated model developed at Battelle Pacific Northwest Laboratories.[10] The model consists of a combination of the Edmonds-Reilly-Barnes (ERB) energy model and the Model for the Assessment of Greenhouse-Gas Induced Climate Change (MAGICC) atmospheric global climate model. The ERB model describes long-term trends in economic output, energy use, and greenhouse gas emissions for nine world regions through detailed sub-modules representing energy resources, primary energy supply and demand, energy markets including world trade and electricity conversion, and fuel-specific emissions factors. An exogenous economic scenario is fed into the ERB model which calculates the energy supply, demand, balance and resulting GHG emissions. This output is used as input into MAGICC where the gas-cycle module feeds into the climate module and the sea-level module. The atmospheric composition, radiative forcing, mean global temperature rise and sea level rise are then fed back into the ERB model. Some applications use the MERGE model to translate the output from MAGICC into input for the adjustment of the economic scenarios in the form of market and non-market damages using simple damage functions. A simple graphical spreadsheet-based interface allows the fast exploration of different scenario runs. The geographical focus of the model distinguishes 14 regions, among which Western Europe.

MiniCAM exhibits low levels of horizontal and vertical integration. Horizontally, the economic and environmental issues addressed are very limited. There is a complete

[9] Further information about the IIASAs integrated modelling framework and MESSAGE is available at http://www.iiasa.ac.at/Research/ECS/.

[10] Further information about MiniCAM is available at http://sedac.ciesin.org/mva/.

lack of socio-cultural aspects. Vertically, there are no feedback mechanisms other than the final link of output to input, which is one of the weakest links of the model. A full-feedback version including the link between climate change and the economy is under development. The purpose of MiniCAM lies more with the quick exploration of a set of possibilities rather than a detailed description of the domains involved.

4.4. Economic-environmental models

The third group of models focuses on the assessment of the link between economic developments and its environmental consequences.

4.4.1. OECD, JOBS

JOBS is a rather simple simulation model that solves a sequence of static equilibria. It does so under the assumptions of national income accounting where aggregate investment equals aggregate savings for each time step. Substitution elasticities are held constant throughout a model run. The time horizon of the model is limited to 2020. JOBS is a global model that divides the world into ten regions, among which is Western Europe. The model uses the GTAP data base (see below) as a source. The model has been developed at the OECD (RIVM, forthcoming).

The level of horizontal integration of the model is limited to a selected few ecological and economic indicators. The level of vertical integration is limited by the non-dynamic modelling technique. The breadth and width of the model are more limited than with the other economic-environmental models. The lack of accessibility to the model is a major drawback. It limits the possibilities of analysis to the simulation of isolated shocks and their effects in a very limited domain.

4.4.2. Hertel and Tsigas (1997) GTAP

GTAP (Global Trade Analysis Project) is a general equilibrium model. The model represents the developments and interactions between 50 sectors in 45 regions on the basis of the assumptions of perfect competition and constant returns to scale. The model is restricted to the economic analysis of consumption and trade. Environmental and socio-cultural aspects are not addressed by the model. So there is a lack of horizontal integration. Vertical integration is much more advanced. Similar to WorldScan (see below), the model uses an Armington trade specification in its representation of inter-regional trade.

GTAP is a sophisticated tool for the simulation of global economic and trade patterns. Within that domain, the model exhibits a good degree of vertical integration. Horizontal integration is limited to the trade sector. Other economic perspectives of sustainability as well as environmental or socio-cultural aspects are lacking. However, GTAP might become relevant in the context of a European model on sustainability as a provider of economic scenarios, an aspect that has been rather neglected in many of the other models described here. In its own right the domain of the model is insufficient to address questions of sustainability. The global focus of the model is a necessity in a globalised economy. The regional subdivision of the model could be deepened to accommodate more specific European issues, such as intra-EU trade patterns in more detail. An interesting part of the model is the GTAP data-base. It covers a wide range variables and is constantly extended according to the needs expressed by its users. Not all of the variables in the data base are used in GTAP as the data base is open to all users and has been used in other models as well.

4.4.3. Valette, Capros and Smeers (1995) GEM-E3

GEM-E3 (General Equilibrium Model for Energy – Economics – Environment) is another general equilibrium model (Capros, Georgapopoulos et al., 1996). GEM-E3 focuses on the macro-economy and its interaction with the environment and the energy system. The model covers the EU with an explicit national subdivision. Each member state economy is divided into 11 sectors. Trade in goods and services as well as dynamics of capital accumulation and technological progress are endogenous. Public consumption is exogenous. GEM-E3 calculates the equilibrium for all represented markets annually. A fully operative sub-model represents the monetary side of the economy. A speciality of the model is the close attention it pays to distributional effects between countries and industrial sectors. In order to be able to cover the environmental and energy effects of consumption, the representation of the consumption choice allows for substitution at a highly disaggregated level. Also, the model discriminates between durables, which are treated as stocks and non-durables which are treated as flows. Utility functions dominate the choice between work and leisure as well

as present and future consumption. A consequence of this is that the strength of the model lies in the assessment of those environmental impacts that are related to energy and resource use.

GEM-E3 lacks feedback mechanisms between the environmental sector and the economy. There is no further horizontal integration with other sectors. The level of detail within the environmental sector is not sufficient to horizontally integrate several different aspects of sustainability. Institutional and socio-cultural aspects are missing from the model. There is a good degree of vertical integration. The results of the model are relevant for policy decisions, but the analysis of possible political strategies in themselves is difficult. The geographical focus on the EU with a national subdivision is optimal for European policy analysis and assessment. The model is best suited for a qualitative analysis of trade-offs between conflicting policy objectives. Of course, this analysis is restricted to the domain of the model. The modelling technique restricts the inclusion of dynamic effects and surprises. These can only be introduced exogenously.

4.4.4. CEC (1995), E3ME

E3ME (Energy-Economy-Environment Model for Europe) was developed under the co-ordination of Cambridge Econometrics. It is an econometric input-output model in a general equilibrium framework representing sectoral and regional developments. The 11 EU member states (EU-12 without Greece) are treated as separate interacting entities. The model divides each economy into 30 industries, 27 consumer categories, 17 fuel users and 11 fuels. CO2 and SO2 emissions are represented with a great level of detail. The economic part of the model is based on neo-Keynesian assumptions, i.e. there is no market clearing assumption for labour and goods markets. The major advantage of the model over existing national models is the common base of definitions and classifications so that results can easily be aggregated to the European level (Barker and Koehler, 1998). Output, prices, employment, fuel demand and supply are solved for on an annual basis up to the year 2010. The data for the model are derived from EUROSTAT statistics.

Horizontal integration of the model is achieved within a restricted domain. The model limits its attention on environmental sustainability to emissions. Socio-cultural sustainability is not addressed, although an extension of the model represents 14 socio-economic groups for classifying households. The level of vertical integration is difficult to judge on the basis of the information available. The rather short time horizon limits the policy relevance of the model for long-term sustainability planning as it misses the representation of developments in capital stocks. The regional focus on Europe with the opportunity for national disaggregation is a great advantage of the model.

4.4.5. CPB Netherlands Bureau for Economic Policy Analysis (1999), WorldScan

WorldScan (WORLD model for SCenario ANalysis) is a global applied general equilibrium (AGE) model with a strong emphasis on economic aspects. The underlying assumptions of the model are based on neo-classical economic theory. The model is suitable for a wide range of applications in the fields of economics, energy, transport, trade and environmental policy. Model scenarios generally run from 1995 until 2020, but some aspects such as technological innovation and emissions are explored up to the year 2050 (CPB, 1999).

WorldScan divides the world into twelve regions, one of these being Western Europe. The economy is divided into 11 sectors with differing factor requirements. These are rather crudely defined to allow major shifts in production within sectors. Primary inputs in all sectors are low-skilled labour, high-skilled labour, capital and a fixed factor. Economic growth is predicted in line with neo-classical growth models on the basis of physical capital, labour and technology. Technology is allowed to differ between regions and can easily be adopted by developing countries. Labour is divided into low-skilled labour and high-skilled labour and in developing countries a fraction of the labour force works in low-productivity sectors, i.e. the subsistence sectors. Trade is modelled in such a way as to avoid abrupt specialisation patterns. Consumption is allocated over time, categories and regions. Consumption patterns generally tend to converge with OECD preferences and are assumed to change with changes in GDP per capita. Richer societies spend relatively less on agricultural products and relatively more on services than poorer societies. These allocation decisions influence the amount of transport required and thus the level of emissions.

A recent application of WorldScan has been to analyse policy strategies for the implementation of the Kyoto protocol on climate

change. For this purpose, the trade module of the model has been adjusted to incorporate the trade of different kinds of permits and the Clean Development Mechanism (CDM).[11] With respect to the environmental effects of globalisation and the related increase of transport, four scenarios for the transition towards the year 2020 and in some respects towards 2050 have been developed using WorldScan. The assumptions underlying these four quantitative scenarios are derived from the qualitative scenarios developed by Van Veen-Groot and Nijkamp for the GITAGE project. Future work with WorldScan is planned to be more explicit with respect to the effects of trade, consumption and production on international transport and the related environmental costs.

WorldScan is useful with respect to the analysis of global economic trends. The European module is sufficiently detailed for an analysis of regional trends. However, it is not focused on Europe as a region. A focus on Europe as a region would allow the modelling of very specific issues that are relevant for European policy makers. This in itself need not result in a more complex model, as mechanisms that play an important role on the world as a whole or in other regions but have little impact on Europe could be dismissed from the model. Horizontal integration with environmental, institutional and socio-cultural factors is lacking. Vertical integration is insufficient due to a lack of feedback mechanisms. The lack of integration makes it difficult to derive balanced policy advice from WorldScan. For the economic domain, specific policy advice would be improved through a better access to different scenario runs, which would allow the analysis of the effects of different policy strategies concerning a specific question.

4.5. Conclusion

From the overview it should be clear that the available models do not fulfil the objectives of full horizontal and vertical integration, policy relevance and European focus. However, some patterns in the descriptions of the models are striking and provide valuable insights into problems and possibilities with respect to the development of an integrated European model for the analysis of issues related to sustainability. These insights concern the trade-offs between the depth and the breadt of models as well as between the transparency of a model and its policy relevance.

Those models that have been developed in order to assess sustainability in an integrative way, i.e. World 3, IF and TARGETS are the least relevant for concrete political decision making as they do not offer a regional analysis of variables that policy makers could directly influence. Threshold 21 is more advanced in some respects, but still lacks the ability to provide detailed support to policy makers. It is interesting that all four models are based on system dynamics. The strength of this methodology seems to lie in a more general description of interactions between a wide variety of fields. So there is a clear trade-off in favour of breadth at the cost of depth. The combination of both, breadth and depth provides difficulties.

Another interesting fact is the use of general equilibrium modelling techniques by all economy-environment models described in section four of this chapter excluding JOBS. JOBS uses the closely related concept of static equilibria. One should note that most other models require the exogenous input of economic and demographic data. None of the seven environment-energy models included features endogenous treatment of economic factors. The six models of the first group also lack a reasonably detailed representation of the economy. So there is a definite need for the integration of more sophisticated economic modules in existing models with an environmental focus. These models provide the user with considerable depth at the cost of crucial breadth. However, the integration of existing models with an environmental focus with model that put an emphasis on economics encounters the difficulty of conflicting modelling techniques.

It could be argued that the more user-friendly models such as Polestar and Quest have externalised the process of political feedback to scenario developments by letting the user provide input at given intervals during the scenario run. This highlights the normativity of the choices made and at the same time enables the researcher to provide insight into links that have previously been neglected due to lack of quantification.

The socio-cultural domain has not been explored in satisfying depth in any of the above models. The indicators chosen to represent this domain are still largely demographic or economic and only marginally correlated to the underlying issues.

Building an integrated model that fulfils the objectives of breadth and depth combined

[11] A comprehensive overview of WorldScan applications can be found in WorldScan (1999) on page 128.

with policy relevance would require a concerted effort of several innovative research institutes. Based on the existing models combined with some new elements, such a project could result in a model that can provide a base for horizontally balanced and vertically integrated European policy analysis with respect to concrete policy targets. According to van der Sluijs, *'[a] perfect IAM [integrated assessment model] would model the complete so-called causal chain, including all the feedbacks within this chain. The causal chain starts with socio-economic drivers leading to economic activity and other practices, leading to emissions and other pressure on the environment leading to environmental changes, leading to physical impacts on societies and ecosystems, leading to socio-economic impacts, eventually returning to cause changes in the socio-economic drivers.'* (Sluijs 1997, p. 128). Such a model would nest a detailed analysis for the region of Europe in a less detailed world model. Furthermore it would allow for an analysis of sustainability at the national and even sub-national level. This would require a detailed representation of the different issues related to sustainable development including economic, environmental and socio-cultural aspects.

5. Selected studies

5.1. Introduction

This chapter discusses the selected European and global scenario studies. The studies are described chronologically. At the end of the chapter a competition by Xerox Corporation (1999) is presented. Because of the innovative character of this study and the insights in young peoples perspectives on the future, this study is implemented in the report.

Some of the studies described are still under development, which makes it sometimes difficult to assess the whole process. It is nevertheless tried to describe the scenarios and the methodologies as clear as possible with the available information. Most unfinished studies however, are in their final stage, so it might be expected that they will not fundamentally change anymore.

The descriptions are not just summaries of the reports. The aim of this report is to produce a well-structured overview in which the scenario studies considered are described in a comparable way. The descriptions of the selected scenario studies are structured as follows:

- background information, such as the goal of the study, the scenario development team and the target group
- method of scenario development
- summary of the scenarios
- policy recommendations resulting out of the scenario study

5.2. Description of the scenario studies

The selected scenario studies are described below.

5.2.1. WRR, (1992) Ground for choices

Four scenarios for the agriculture and forestry sectors in the EU up to 2015 are presented in the report 'Ground for choices' (WRR, 1992); i.e. Free market and free trade, Regional development, Nature and landscape, and Environmental protection. This scenario study uses quantitative methods to gain policy-relevant insights into the interrelations between:

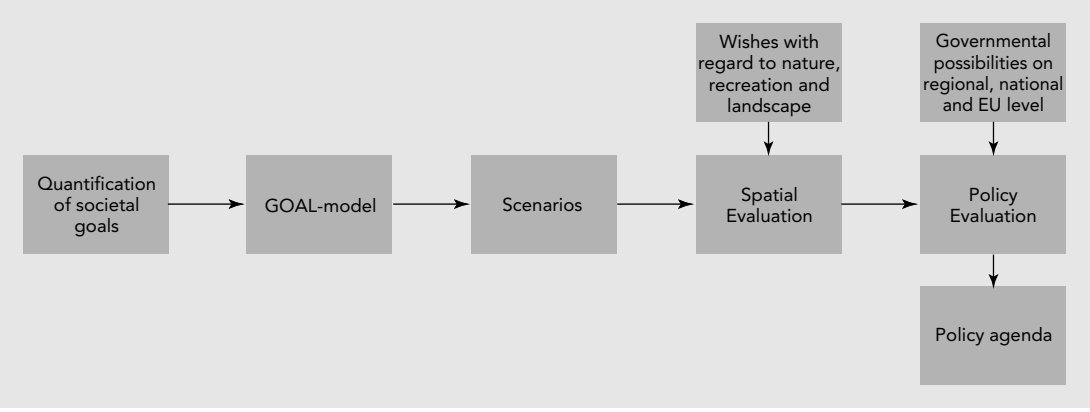
- various agricultural and technological developments;
- societal goals with regard to socio-economic developments, environmental protection and landscape;
- the consequences of these interactions for the rural areas in Europe.
  This study was performed for the Dutch council of ministers.

From thorough analysis of the study, we conclude that the adopted research approach has been as follows:

The WRR scenarios

Four scenarios on land use have been developed by means of a linear programming model, named General Optimal Allocation of Land use (GOAL), which has been developed by the WRR. The selected

Figure 5.1 **The development process of the WRR scenarios (based on WRR (1992)**



policy goals incorporated in the GOAL-model involve economic, social and environmental issues. Not all policy goals considered relevant by the WRR are included in the GOAL-model for the following reasons: (i) the relation between land use and the intended policy is not clear enough, (ii) the nature of the relation is clear, but cannot be specified properly and (iii) the relation between the land use and policy goals varies over Europe. This holds especially for policy goals with regard to landscape, recreation and nature conservation. These four scenarios are used to assess the consequences of alternative policy goals for the rural areas.

The scenarios are derived from main streams in the social discussion on the future of agriculture (WRR, 1992):

Free market and free trade
Agriculture is treated as a pure economic activity. It is assumed that the introduction of the free market mechanism will lead to efficient production for the lowest possible prices. The competitive advantages of the agricultural areas in the EU will determine where the production will take place. In this scenarios, import and export of agricultural products is not restricted.

Regional development
The driving force in this scenario is employment. Within the EU, agriculture should remain a large employer. Dependent on the company's size, there will be support even if the producers do not work optimally. In order to promote self-provision on the level of the EU, import and export of agriculture products will be regulated.

Nature and landscape
The focus of this scenario is the pressure of agriculture on nature. Higher production takes per definition place at the costs of animal and plant species. It is therefore desired that agriculture will shrink down in order to protect nature and landscape. In this scenario, free trade of agricultural products is allowed.

Environmental protection.
Environmental protection is the central focus in this scenario. Agricultural production, regardless of where it takes place, has to be restricted by environmental criteria. Production, preferably, takes place in the EU, so import and export of agricultural products will be regulated.

These scenarios are translated into policy goals (see Table 5.1). The GOAL model generates a variety of land use scenarios, in which apart from the policy goals the level of future food consumption is varied. The WRR assesses two levels (see Table 5.2), i.e. one similar to the current diet and a luxury diet (that includes more protein) [1].

The excersice resulted in two quantitative forecasts per scenario. Comparison of the scenarios reveals large differences. If the future food level involves the current diet, the estimates for agricultural area differ a 3 (i.e. 26.4 mln ha in Nature and landscape versus 76.8 mln ha for Regional development). With regard to the costs of land use (71 mld euro in Free market versus 101 mld euro in Environmental protection), employment (1.5 mln labour year equivalent in Free market versus 2.2 in both Regional development and Environmental protection) and nitrogen use (2.1 mln ton N in both Nature and landscape

[1] The current diet is inferred from statistics, while the luxury diet is estimated based on assumptions with regard to:
* future population size (total population size EU12 will increase with less than 0.1 percent per year for the coming 20 years)
* increase in income (growth percentage of 2.5 percent for the coming 20 years)
* future price (a decrease of 30 percent in consumer prices for some products for the coming 20 years)
the human metabolism (changes in diet may occur in order to satisfy more health norms)

Translation of scenarios into policy goals (WRR, 1992) Table 5.1

	Free market and free trade	Regional development	Nature and landscape	Environmental protection
Economic				
• Employment	+	++	+	
• self-provision/protection	0	++	0	
• regional economic development	0	++	++	
• productivity development	++	0	++	
Social				
• income	+	++	+	+
• regional employment	0	++	0	0
Environment				
• emissions	+	+	+	++
Nature & landscape				
• nature values	+	+	++	+

Table 5.2 **Two levels of food consumption (kg per head per year) (WRR, 1992)**

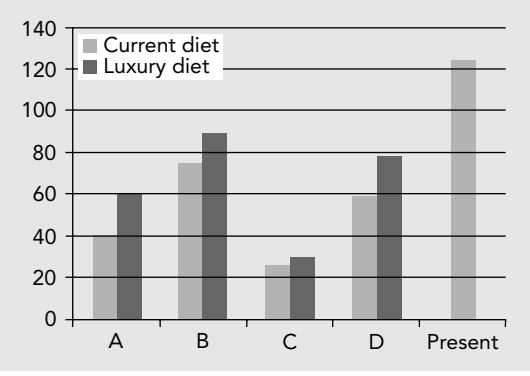
	Current diet	Luxury diet
Grain	108.2	86.6
Sugar	31.6	43.1
Potatoes and –products	96.4	116.6
Oil	17.3	16.2
Fruit	62.3	80.3
Beef	23.3	35.1
Pork	38.5	28.5
Poultry meat	16.7	24.3
Eggs	13.2	22.5
Mutton	3.8	6.5
Fresh milk products	95.9	138.2
Butter	5.3	7.1
Cheese	13.5	20.3
Whole powdered milk	0.6	0.9
Skinny powdered milk	0.9	1.2

and Environmental protection versus 2.8 mln ton N in Regional development) the estimates differ about a factor 1.5. Vegetation protection per hectare shows a factor 3.5 (0.5 in Environmental protection versus 1.7 in Free market) and vegetation protection total a factor 4.5 (21 for Nature and landscape versus 89 for Regional development). Reasoning from these differences, the WRR concludes that there is room for policy.

In the following, the scenarios will be discussed with regard to the EU12[2] level and the regional level.

[2] EU12: Belgium, Germany, France, Italy, Luxembourg, The Netherlands, Denmark, Ireland, United Kingdom, Greece, Spain and Portugal

Figure 5.2 **The *land use* in the different scenarios in comparison with the present ground use (in mln ha) (adapted from WRR, 1992)**



A: Free market and free trade, B: Regional development, C: Nature and landscape, D: Environmental protection

The EU level

The prospects with regard to *land use* are strongly influenced by the composition of the diet. In case of a future shift to more use of meat and animal products (such as milk), more grain will be needed in the form of feed. Figure 5.2 presents the land use estimates associated with the different scenarios. If the future diet is comparable to the current, as much as possible land is reserved for nature and landscape and agricultural production involves both irrigation and environmental friendly techniques complemented (scenario Nature and landscape and current diet), the mean land productivity will be very high and only 26.6 mln ha is needed for agriculture, which is less then a third of the current agricultural area in the EU. Under the conditions described in Regional development, food demand involving a luxury diet requires that 90 million-hectare of EUs area is devoted to agriculture, while land-productivity in this case is the lowest.

In all the scenarios the *employment* in the agricultural sector decreases, however, the level of employment decreases less in the scenarios with a luxury diet. So employment would benefit from a shift in diets. The Environmental protection features the highest employment levels, which implies that environmental restrictions may be beneficial with regard to employment. Nevertheless, also in this scenario employment will decrease with more than 50 percent (from approximately 6 mln labour year equivalent to 2.9 mln labour year equivalent). The differences between the Environmental protection and Regional development scenarios are marginal. The Regional development scenario indicates that a strong emphasis on a fair regional distribution of labour may be profitable in terms of employment policy. The Free market and free trade scenario shows the lowest estimates for employment. Strong rationalisation of production will lead to an inevitable loss in employment, estimated up to 1.5 million labour year equivalent in 2050.

In all the scenarios the pressure on the *environment* by agriculture is considerably lower than in the present situation if we take the use of nitrogen as indicator. There are no big differences in the total amount of nitrogen use between the scenarios. This can partly be explained by the assumption underlying all scenarios that the 'best technical means' are adopted. As expected, the nitrogen use increases if the food range

is changed. Remarkable is that, as well with regard to the current diet as the luxury diet, the nitrogen use is the highest for Regional development (see Figure 5.4). This can be explained by the lack of priority for environmental policy in the Regional development input scenario. The set of scenario estimates that it will be technically possible that the use of nitrogen can be limited in the future without negative consequences for the production. In Nature and landscape the lowest amount of pesticides is used to protect the vegetation (see Figure 5.5); in this scenario only environmental friendly techniques are used to protect vegetation. In Regional development the highest amount of pesticides is used because of the large amount of area used in this scenario.

The total *costs* estimates differ over the scenarios with a factor 2 (see Figure 5.6). The difference in the total costs in Free market and free trade compared to Nature and landscape can be considered as an estimate for the economic price for environmental friendly agriculture. A remarkable aspect is the difference in costs with regard to the current and luxury diet. A comparison between these diets shows that with an alteration to a more luxury diet, the costs will increase with about 30 to 40 percent. The set of scenarios also enables to assess the consequences of trade-barriers by comparing the free-trade scenarios (i.e. Free market and free trade and Nature and landscape) with the trade-barrier scenarios (i.e. Regional development and Environmental protection). Such a comparison suggests that the costs for the domestic production will be lower in case of free agricultural trade. The difference of about 20 billion euro between the trade-barriers and free-trade scenarios can thus be considered as the economic price for safeguarding self-provision.

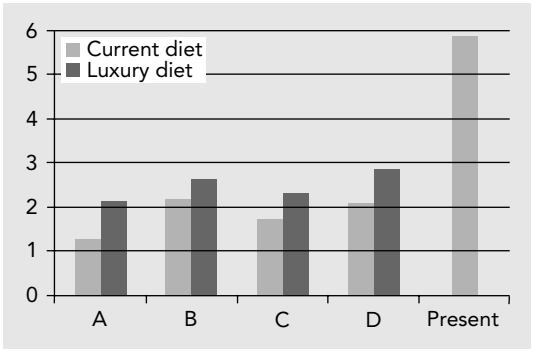
The regional level

In Free market and free trade, future agriculture will be mainly situated in the Northwest of the EU. In Regional development there will be an almost fair distribution of agricultural activities. In Nature and landscape, a lot of the agricultural activities will move to the southern regions. Environmental protection indicates a seemingly fair division of the agriculture activities among the EU member states, with exception of Ireland and the Benelux.

A comparison of these scenarios in terms of the current differences between strong and weak regions[3] yields the following insights:

Employment **in the different scenarios in comparison with the present employment (in mln labour year equivalent) (adapted from (WRR, 1992)**

Figure 5.3



A: Free market and free trade, B: Regional development, C: Nature and landscape, D: Environmental protection

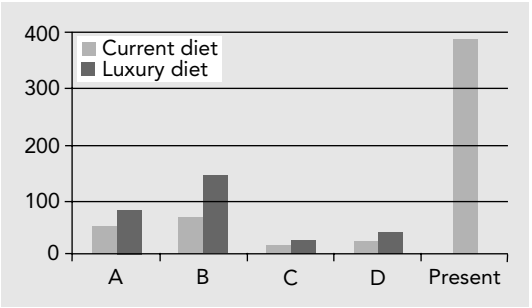
Nitrogen use **in the different scenarios in comparison with the present nitrogen use (in mln ton) (adapted from WRR (1992)**

Figure 5.4

A: Free market and free trade, B: Regional development, C: Nature and landscape, D: Environmental protection

Use of pesticides **in the different scenarios in comparison with the present vegetation protection (in mln kg) (adapted from WRR (1992)**

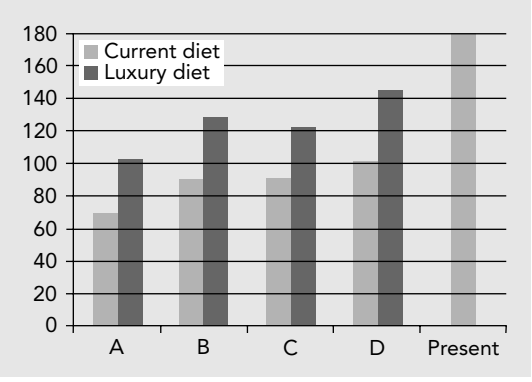
Figure 5.5



A: Free market and free trade, B: Regional development, C: Nature and landscape, D: Environmental protection

Total cost **in mld euro adapted from WRR (1992)**

Figure 5.6



A: Free market and free trade, B: Regional development, C: Nature and landscape, D: Environmental protection

[3] Weak regions are regions that have low productivity, production and employment participation but high unemployment. Currently, the regions in the South and East are considered weak regions within the EU12.

- Different regions can give under diverse preconditions, the same performance. For example: The Regional development scenario indicates that it may be possible to maintain 29 % of the current employment levels in all regions, while the Environmental protection and Nature and landscape scenarios suggest that employment in a southern region as Spain may be maintained up to the level of 50 % in case of redistribution of agricultural activities.
- In a Free market situation it is likely that the current weak regions will become even weaker. For example, the 'weak regions' shares in farming will decreases to marginal levels (with the exception of Ireland).
- The present division in strong and weak regions has to be put into perspective, because also the strong regions are likely to have to pay a high price in terms of employment.
- The set of scenarios reveals that a future map of EU12 in terms of weak and strong regions is very uncertain. For example, weak regions in Free market and free trade are strong regions in the Nature and landscape estimates for the future.

Spatial evaluation

Not all policy goals considered relevant by the WRR are incorporated in the GOAL-model. To this end their model-based scenario development is complement by a qualitative spatial evaluation. To this analogous to the Dutch concept of Ecological main structure (in which natural areas are connected in order to preserve and develop nature), a tentative ecological main structure (TEMS) for the EU-12 is sketched. The scenarios have been compared with this map. This so-called spatial checks reveal that realisation of such a European ecological main structure may be technically possible. All scenarios suggest that there will be enough area available for the realisation of this hypothetical ambitious nature protection plan. But, problems will arise with regard to financing. Because of conflicts between macro (EU level) and micro (level of individual farmer) interests, the ground price will stay high. As a result of this a future realisation of TEMS is likely to be expensive. The main conclusion of this spatial evaluation is that nature preservation and agriculture do not have to compete with regard to area.

Recommendations for policy

The aim of present EU agricultural policy is to create a situation in which less land, cattle and labour is needed in order to safeguard the future food provision. The first policy goal is therefore to contribute to an increase of agricultural productivity, by means of higher profits per hectare ground or per head of cattle. This leads to a paradoxical situation: the EU strives for a higher productivity of ground, cattle and labour. But, the realisation of this goal leads to so many problems that the production needs to be lowered (WRR, 1992). The use of vegetation protection means and fertilisers affects the quality of the environment. Assumed is that the farmers have income loss and need to be compensated. The scenarios show however, that the nitrogen use and the use of vegetation protection means can be decreased without production loss, which implies that compensation is counterproductive. Reasoning from the set of scenarios, the WRR listed the following insights that are considered to be relevant for policy:

- Technological development is an important driving force for change in land use and land productivity. The WRR suggested that policy can stimulate this development by improvement of production circumstances, price guarantees and RD&D[4] programs.
- It is likely that in the near future rural areas in the EU12 will undergo severe changes.
- Policy aimed at keeping the use of land sustainable will cause resistance, since there is a surplus of agriculture area in all the scenarios for land use. The costs of sustainable land use can be very high and the eventual result may be counter productive with regard to other policy goals.
- It is impossible to keep employment in the agricultural sector at present levels. Policy should be prepared for alleviation of the social and economic consequences of this change.
- Policy should promote the use of avail able environmental friendly technologies that are currently unused or underused in the agricultural sector.
- While spatial conflicts are not to be expected, possibilities for an active European nature protection policy are available. Precondition for this is that a financing structure will be set up.

According to the WRR, national governments can use the scenarios as framework for developing national agricultural policies. An example for the Netherlands provided in the WRR-report is:

[4] Research, Development and Demonstration programs.

- The set of scenarios indicates a substantial weakening of the agricultural sector compared to the present situation. A reorganisation policy seems inescapable.

5.2.2. R. Thord (1993), A study on the future of transportation

In the year 1993, two seminars on the future of transport were organised by the Swedish National Road Administration in co-operation with the International Road Federation, the Royal Swedish Academy of Engineering Sciences and the Royal Institute of Technology in Stockholm. The participants represented industry, road users, universities and research institutes and governments. The seminars culminated in a book with the title 'The future of transportation and communication' edited by Thord (Thord, 1993). For our purposes, Button's chapter (Button, 1993), that focuses on the future of the European transport is the most relevant one.

The following scenario development method was adopted:

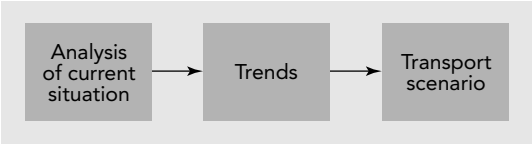
The transport scenario

Reasoning from the continuation of current trends and continuation of existing policy the prospects for the European transport sector for the next decade are assessed. The scenario developed by Thord can therefore be characterised as a market-oriented business-as-usual scenario.

The transport scenario involves the following forecasts structured around the following key issues: Single European market, the liberalisation of eastern Europe, pressures on the natural environment (and resulting taxation measures for the transport sector), industrial changes, modal integration and privatisation.

The creation of the *single European market,* the likely expansion of membership and the almost inevitable links with the post-communist states will have implications for the transport sector. Autonomous changes, such as the likely increase of overall efficiency of infrastructure use, continuation of current policies and further EU supported investments will not be sufficient to meet the forecasted growth in traffic. With the continuation of existing policies, road traffic growth will continue. For example, forecasts for Great Britain suggest an increase in growth of traffic of 142 % in 2025 compared to 1988 (Department. of Transport, 1989). Similar forecasts for the Netherlands suggest a 72 % growth between 1986 and 2010. The

The development process of the transport scenario (based on Thord, 1993) Figure 5.7



underlying problem is that under current policies the efficiency of the transport system will inevitably deteriorate in Europe as congestion develops. So, there is a need to develop entirely new transport networks in Europe (Round table of European Industrialists, 1990).

The *liberalisation of eastern Europe* represents both problems and opportunities. Many more major transport links will become part of Europe's infrastructure. In the long term, this may be advantageous for the transport sector. However, in the short term disadvantages will arise because i) the transport systems of the former Eastern Europe are dominated by low-productive rail, ii) these transport systems tend to be of poorer quality than in Western Europe, and iii) these transport systems have been designed to cope with the particular form of internal trade between the Members of the Council for Mutual Economic Assistance (Button 1991). The scenario holds that by the beginning the next century this trade pattern will be transformed accompanied by different transport needs.

Transport induced *pressures* on the *natural environment* almost inevitably intensify over the next decade without significant policy changes for at least two reasons: i) there will be a continued increase in traffic volumes in the industrialised world and previous experience suggest that, while individual vehicles can be made more environmental-friendly, the increased number of cars will outbalance this improvement (Barde and Button, 1990); ii) in eastern and central Europe private transport use will increase, leading to more environmental pressure.

In the European *industrial sector*, there will be pressures towards supplying appropriate road and air services rather than rail or inland shipping, because these latter are inflexible and slower means of transport. These pressures will be the result of a switch within western Europe to the manufacturing of final goods rather than the production of intermediate goods or the extraction of raw

materials. This will result in a significant increased use of road freight transport. Secondly, car use, either for work and leisure purposes, will increase due to higher levels of female participation and a continuing increase in part time work. The use of just-in-time management approaches that will continue to expand throughout the industrialised world, require fast and reliable transport.

The issue of *modal integration* (i.e. integrated use of various means of transport[5]) will become important. Modal integration is, and will increasingly come via the market rather than through government interventions. While much of the current impetus for intermodalism is coming from new developments on the operations side, it is also stimulated by trends in infrastructure investment. The Channel Tunnel, for example, has necessitated the development of new lorry/rail loading techniques. Modal integration is also likely to gain ground in a wider sense. Telecommunications offer an important substitute. Because the costs of person transport will rise, the costs of interaction, for example by means of teleconferencing, may fall by with 90 % by the turn of the century.

The overall ***costs*** of European transport will increase in the short and medium term. This scenario advocates a more rational pricing of transport in Europe as the way forward. Appropriate economic pricing has the advantage not only of making more efficient use of existing infrastructure but also indicates which expansions in the system will generate the greatest benefits. It will more closely link transport use to investment priorities. An indirect effect will be a decrease in environmental costs associated with congestion.

Over the past decade transport in Europe is increasingly ***privatised***, because of rapid need for expansions and efficiency concerns (European Conference of Ministers of Transport, 1990 and (Button, 1991). The general trend in Europe is towards greater involvement of the private sector in supplying goods and services. Furthermore, as Europe will become more economically integrated, national transport policies are likely to be subsumed into wider international policies. A danger is that national governments will attempt to manipulate national ownership and transport operations to its own economic ends. To prevent such political involvement, (Button, 1993) suggests that transport supply elements should be handed over to the private sector.

5.2.3. EFILWC (1994) The potential for employment opportunities

The European Foundation for the Improvement of Living and Working Conditions (EFILWC) study 'The potential for employment opportunities from pursuing sustainable development' (1994) focuses on the employment potential associated with sustainable activities. This study has been performed in co-operation with the European Commission (DG XI). This study consists of nine case studies, illustrating the employment implications of changes in consumption and production patterns. The majority of the studies merely address the short term (i.e. till 2000). The energy and transport case studies extend to resp. 2020 and 2010 and are therefore selected for thorough analysis. The case-studies are performed by ECOTEC Research and Consulting Ltd (United Kingdom).

The energy case-study

The energy study focuses on the employment effects as the result of a shift to a more sustainable energy supply. The study has been carried out in the following way:

Building upon the Business as Usual scenario prepared by the European Commission (EC, 1992), quantitative estimates for future energy consumption in case the available energy resources are used more efficiently and conventional technologies are substituted by the best available technologies (BATs) (see Table 5.3).

The BATs in Table 5.4 have the potential for producing savings of energy of 20 % of total

[5] Current examples of modal integration are the integration of the French TGV system with the Paris (Charles de Gaulle) airport and mainline railway stations under airports like in Switzerland.

Figure 5.8 **The development process of the energy case study (based on EFIL WC, 1994)**

final energy consumption in the EU in 2020. These BATs are comprised in the ECOTEC study.

For each of these technologies, assumptions are made with respect to the costs and employment intensities of the technologies. With use of a model, employment effects of the selected BATs are then calculated for the following European countries – Belgium, Germany, France, Italy, Luxembourg and The Netherlands (EU6) – individually and for this group in total.

The direct employment impact of the transition to sustainable energy supply has been estimated at additional 880 000 jobs in 2020. The indirect employment impact is the reduction in employment elsewhere in the economy of 190 000 jobs. The net employment effect is approximately 690 000 jobs. The new jobs in the renewables industry will require reasonably skilled personnel. For work on the installation and maintenance the labour is likely to involve only semi-skilled activities, which are not gender biased. Alternatively, employment opportunities in energy efficiency technologies are likely to be low skilled and not necessarily biased. A part of the employment opportunities created by the renewables relates to the provision of employment in rural areas. The move towards renewable energy technologies and energy efficiency can also aid regional development and improve local economies in the less favoured regions of the EU.

Key issues for the policy debate is to encourage mechanisms that underlie the technological transition. The EFILWC study suggests different options for providing the financial basis of a mechanism to fund the necessary investment programme, including:

- industry funded, out of own capital investment programme
- third-party finance schemes, paid for through the energy savings
- investment from central, local or European funds
- the recycling of revenues from a pollution tax

The transport case study

The approach adopted in the transport case study is rather analogous to the energy case study:

The ECOTEC transport scenario is based upon the Integrated (INT) Scenario used for a 5EAP (Fifth Environmental Action Pro-

Total final energy consumption for the DGXVII and ECOTEC scenarios — Table 5.3

	Total Final energy consumption (mtoe[6])		
	1990	*2020*	*2050*
Business as usual: (DG XVII)	722	1076	1658
ECOTEC scenario 20 % reduction	722	861	861

Source: EFILWC, 1994)

[6] mtoe: mega tons oil equivalent

Best available technologies energy study (EFILWC, 1994) — Table 5.4

Best available technologies	Net costs (Meuro)(1)	Maximum total energy savings (mtoe)(2)
Heating control	-416	1.05
Improvements to trucks	-2299	7.01
Improvements to buses	-348	1.10
Improvements to cars	-8173	28.43
Condensing gas boilers	-1524	5.38
Electrical appliances	-5051	19.58
Lighting	-7148	28.38
BATs in iron/steel industry	-1528	7.97
BATs in paper/pulp industry	-568	3.00
BATs in inorganic chemicals industry	-1049	5.96
BATS in organic chemicals industry	-187	1.10
BATs in non-metallic minerals industry	-1060	6.25
Refineries/coking plant	-655	4.32
District heating	-299	2.04
Variable speed drives	-871	8.87
Hydro power	-413	7.06
Industrial heat recovery	-760	16.67
Combined heat and power	-1060	29.37
BATs in non-ferrous metals industry	-45	1.93
Wind power	2704	33.62
Heat pumps	268	1.72
Passive solar	1392	7.73
Building insulation (double glazing technologies)	12766	60.93
Combined cycle gas turbines	3395	7.88
Active solar	9427	20.27
Photovoltaic	22587	14.17
TOTALS	19155	332.08

(1) Net costs are calculated as the annualised investment and operating costs, minus the value of energy savings

(2) Energy savings are calculated on the basis of the maximum potential usage of the technology

Figure 5.9 **The development process of the transport case study (EFILWC, 1994)**

gramme) study (ECOTEC, 1994). In this scenario, the objectives were to secure:

- A move away from the car as a means of passenger transport towards more collective systems such as buses and rail.
- A shift in (new) infrastructure invest ment from roads to rail and bus trans portation systems.
- Inclusion of more radical options (such as the lease economy for cars, car recycling, and zero or low-emission vehicles).

The policy measures included in the ECOTEC transport scenario are:

- An internalisation of the external costs of transport through a doubling of fuel duties for transport fuels.
- A shift of 50 % of all new investment in infrastructure from road to rail and bus systems.

The next step includes the development of a simple transport and employment model. The employment impacts have been based upon an estimate of employment in the transport sector, distinguishing about 15 different transport activities (for example: manufacture of motor vehicles, fuel supply and bus operators). Table 5.5 shows the impacts in terms of travel demand and energy consumption relative to a baseline case, which is estimated from past trends and predicted changes in output and productivity for the year 2010. This table shows that the above policy measures will result in a decrease in the use of road transport as well as a decline in passenger air transport, on the one hand, and an increase of the use of bus and rail systems, on the other hand.

The first order employment effects are calculated for each country (of the EU6) and summed to indicate the total net direct employment impact. Employment will increase in the public transport sector (esp. with regard to provision of services, manufacture of vehicles and rolling stock, and construction of the necessary infrastructure), but this will be insufficient to offset a loss of employment in motor vehicle and component manufacturing. Employment associated with car use will fall by around 16 %. The majority of these job losses relates to vehicle maintenance and repair, road construction and maintenance, parts and accessories and fuel supply. There will be a considerable increase in employment in rail passenger services of 50 %. This is to a large extent due to the switch in new infrastructure investment from road to rail incorporated, and the relatively high labour intensity of travel by rail (over 3 times that of travel by car on a per passenger km basis). Employment in rail freight services is anticipated to increase by 19 % as the dependence of freight transport on road slowly diminishes in the scenario. The comparatively small increase in employment in bus services takes account of increasing occupancy rates on buses from current low levels to accommodate some of the increase in passengers and the relatively minor infrastructure investments required providing a more comprehensive service. Indirect employment effects, especially those related to new technologies such as biofuels, are likely to be small. The employment effects, furthermore, will not be evenly distributed within the EU.

The approximate total effects on the future employment are relatively small compared to the current total number of employees in transport-related activities in the EU. A net decrease of 286 000 jobs represents some 2.5 % of the total transport-related work force.

Table 5.5 **The impact of the INT scenario on travel demand and energy consumption relative to the baseline case**

Mode of transport

	% change travel demand (1990-2010), Passenger/Tonne kilometres	*% change in energy consumption (1990-2010)*
Passengers		
Car	-21.4 %	-35.1 %
Bus	34.7 %	40.0 %
Rail	35.6 %	33.6 %
Air	-25.3 %	-27.3 %
Freight		
Road	-9.7 %	-15.5 %
Rail	8.9 %	8.1 %
Inland waterway	4.2 %	-5.2 %
Shipping	5.3 %	-2.2 %

Source: ECOTEC, 1994.

Direct employment effects relative to the baseline case (adapted from EFILWC, 1994) Table 5.6

	Passenger				Freight			Total
	Car	*Bus*	*Rail*	*Air*	*Road*	*Rail*	*Inland Waterway*	
Effect of change in transport patterns in terms of employment (% of baseline case)	-498 000*	81 000	474 000	-162 000	-268 000	86 000	1 000	-286 000
	(-16.7)	(13.1)	(49.4)	(-12.7)	(-6.5)	(15.9)	(0.3)	(-2.7)

*Assumes a proportion of the change in car demands met by fuel-efficient vehicles.

5.2.4. ECN (1995), Energy scenarios for a changing Europe

The ECN study 'Energy scenarios for a changing Europe' focuses on effects of European developments on the European energy markets. Two socio-economic scenarios, namely the Integration and the Fragmentation scenario, have been developed for Western Europe, more specifically, Germany, France, United Kingdom, Italy, Denmark, Sweden, Finland, Norway, Spain, the Netherlands, Belgium, Austria and Switzerland.

The following scenario development approach was adopted:

Major assumptions ECN scenarios (ECN, 1995) Table 5.7

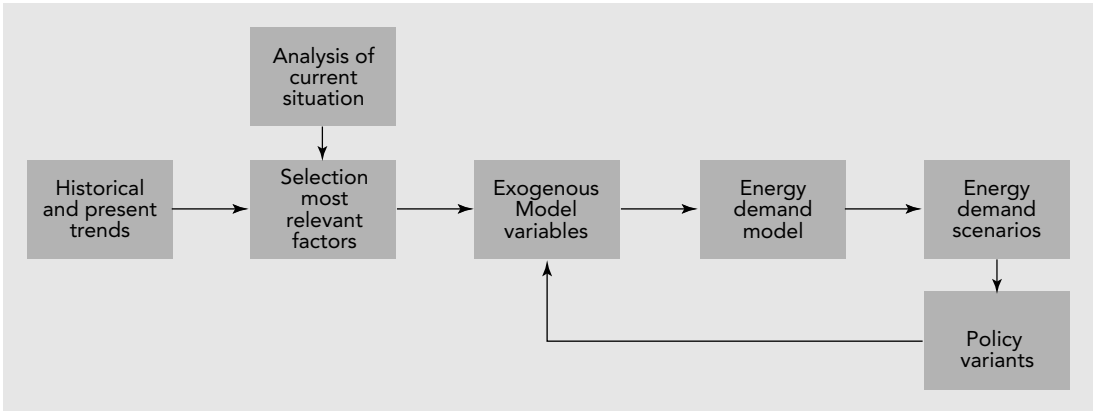
Integration scenario	Fragmentation scenario
Implementation Maastricht Treaty	National states dominate policy decisions
Monetary Union completed	Unstable exchange rates
Tax harmonisation 2000-2010	Tax regimes unchanged
Higher economic growth	Lower economic growth
Maximum gains after 2010	Peripheral countries suffer most
No energy/environmental policy	No energy/environmental policy
More market and EU-level co-ordination	More national regulation
Higher increase efficiency	Lower increase efficiency

The ECN scenarios

The Integration scenario assumes ongoing European integration as proposed in the Maastricht Treaty. The Fragmentation scenario considers continuation of the current state in which the national states are independent. Both scenarios do not involve energy and environmental policies, so they can both be considered as business-as-usual scenarios (ECN, 1995). Table 5.7 summarises the major assumptions underlying the scenarios. To assess policy options, reasoning from the two scenarios various policy variants have been examined, such as a tax harmonisation scenario, which is based on the Integration scenario. Furthermore, three other scenarios are introduced to detect the effects of price changes, a CO_2-tax and a non-nuclear policy on energy demand.

The model inputs are: world energy prices, economic prices, economic growth and energy efficiency improvements. For the energy price trends, the Statoil world energy scenarios (ECN, 1995) have been used as reference. The Statoil 'Market Forces' sce-

The scenario development process (based on ECN, 1995) Figure 5.10



nario matches rather well with the Integration scenario, while the Statoil 'Muddling Through' scenario is based on about similar assumptions as the Fragmentation scenario (ECN, 1995). Furthermore, because of unification and market integration in the Integration scenario, the economic growth is assumed to be higher in the Integration scenario then in the Fragmentation scenario. On a country level, peripheral countries are expected to suffer more from imperfect integration in the Fragmentation scenario in the EU, than countries with relative large domestic markets and located in the heart of Europe.

Quantitative estimates
With regard to *energy consumption,* the future total energy demand will increase most in the Integration scenario, e.g. future primary energy demand will increase with 1.7 % annually in the Integration scenario versus 1.2 % in the Fragmentation scenario. The increase in energy demand in the Integration scenario results of higher economic growth and lower prices, and is partly dampens by higher efficiency improvement.

On a *sectoral* level, differences for oil *demand* between the two scenarios will be largest in the electricity sector (in the Integration scenario 70 % larger compared the Fragmentation scenario). This is mainly explained by relative low taxes, and thus stronger effects of decreasing prices in the Integration scenario. But, also in the industry sector, the difference between the Integration and Fragmentation scenario is rather large (45 %). In the household sector, tax rates are also high, but income elasticities in that sector are larger than in the service sector, and therefore reactions on energy demand by households are much stronger than in the services sector. The transport sector is a large and increasing oil consumer, with very limited fuel substitution possibilities. As a result of this, the share of oil demand is large in both scenarios. For the results, see Figure 5.11.

Different ***demand effects*** are distinguished to identify the main causes for differences in energy demand between the Integration and the Fragmentation scenario. The difference between energy demand in 2020 and the base year can be assigned to four effects:

- Volume effect: energy consumption as a result of an unchanged socio-economic structure, which means production in all sectors will grow at the same (GDP) rate;
- Structure effect: energy consumption can decrease (or increase) due to mutations in the socio-economic structure (inter-sectoral changes), in general it is assumed that the services sector will increase its production faster than industry in developed countries;
- Saving effect: based on price developments and technological improvement energy savings can be achieved;
- Supply effect: fuel switches due to different price developments and efficiency improvements have also an impact on fuel demand in electricity generation.

Figure 5.12 and 5.13 show the volume, structure, saving and supply effects for both scenarios.[8]

In the Integration scenario the electricity generation sector positively effects total energy demand. Due to relatively decreasing oil and gas prices, share of these fuels will increase. Since these fuels have relatively higher efficiencies, the overall efficiency will improve resulting in declining input requirements. This effect is fortified by the inclusion of best available technologies in the Integration scenario. In the Fragmentation scenario however, total efficiency in the electricity generation sector decreases, because due to forecasted higher gas and oil prices a shift towards coal and nuclear power (with a lower efficiency) will take place.

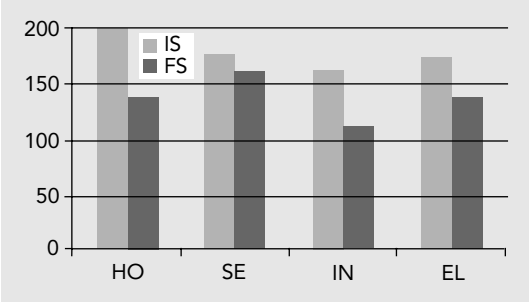
Tax harmonisation can be carried out in different ways. In the ECN study, it is chosen to harmonise energy taxes for each fuel and each sector to the current average European level. To assess the effects of harmonisation on energy demand and supply, tax harmonisation is imposed on the Integration scenario.

[7] The units are not mentioned in the ECN report.
[8] ECN does not discuss the differences between the scenarios with regard to these effects

Figure 5.11 **Gas and oil consumption in 2020 by sector (indexed by 1991=100)**

(adapted from ECN, 1995)[7]

HO= household sector, SE= services sector, IN=industry sector, EL=electricity sector



Comparison of this scenario with the original Integration scenario shows that the highest share of taxation will arise with regard to gasoline and diesel, with taxes counting for about 50 % of the end-user price. Oil for the household sector will be another fuel with a high tax level (about 25 % of the end-user price). For the other fuels, tax harmonisation will not have a very large impact on the average European energy market.

To illustrate the regional diversity and implications of tax harmonisation, ECN discusses the example for gasoline. Comparison of the current price components of the gasoline price for all European countries teaches us that Italy has highest taxation, followed by Norway. Germany and UK are below the European average. Tax harmonisation in Italy will reduce taxes severely, thus (considering other assumptions equal) will result in lower end-user. For France prices in case of tax harmonisation will be slightly lower, while for Germany and the UK tax harmonisation leads to slightly higher gasoline prices. The overall effect of such a gasoline tax on the demand for gasoline seems to be marginal.

Policy variants

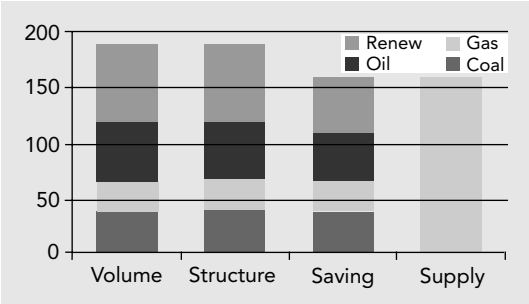
In the scenarios described above, energy demand will increase substantially. This results in a steep increase of CO_2 emissions to 2020 (about 60 % compared to the present) in the Integration scenario. To detect the effects of price changes on energy demand and CO_2 emissions, various policy variants have been assessed (see Table 5.8):

- the CO_2 reduction variant involving a carbon tax of 100$/ton carbon
- the PRI[10] variant featuring increasing oil and gas prices
- the non-nuclear variant that implies a phasing out of nuclear energy in 2020 in all countries except France (NNUC[6]).

Figure 5.14 presents the future primary energy associated with these scenarios.

Comparison of these policy variants teaches us that a CO_2 tax will have the largest impact on total energy demand, i.e. a 7 % decrease of total energy demand compared with the reference results. The CO_2 tax will result in a decrease of CO_2 emissions of about 14 % relative to the Integration scenario. This reduction is still far from sufficient to meet CO_2 reduction targets as stabilisation of emissions in the near future. Clearly coal becomes less attractive, while nuclear energy

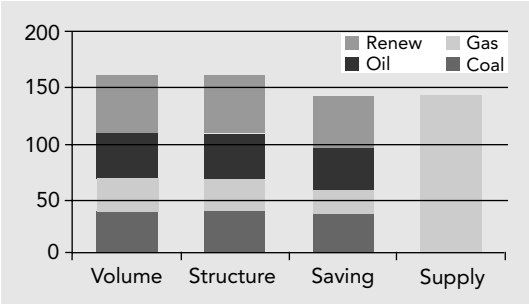
The Integration scenario Figure 5.12



Source: ECN, 1995.[9]

[9] The units are not mentioned in the ECN report

The Fragmentation scenario Figure 5.13



Source: ECN, 1995.[9]

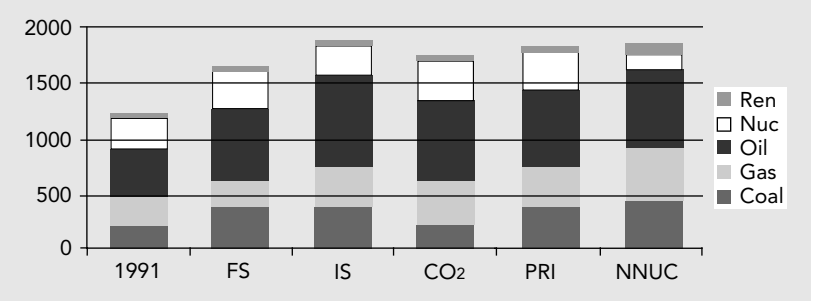
Policy variants (based on ECN, 1995) Table 5.8

	CO_2	PRI	NNUC
Prices oil	0	+	+
Prices gas	0	+	+
Policy	CO_2-tax	no	0

[10] Unknown abbreviation, not explained in ECN documentation

[11] The units are not mentioned in the ECN report

Resulting primary energy demand (ECN, 1995)[11] Figure 5.14



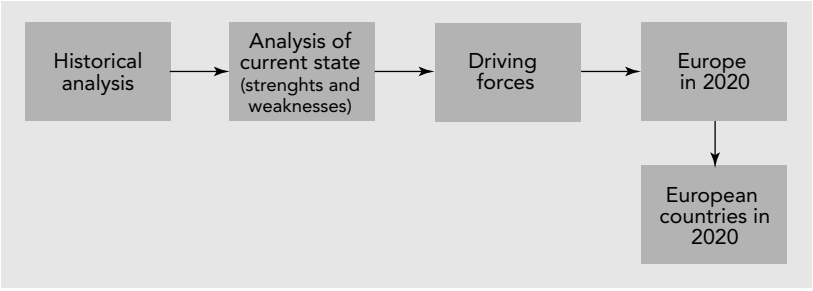
will profit from CO_2 tax. With respect to the higher world market prices for oil and gas it is important to mention that import prices are only part of end-user prices, and thus price changes will affect energy demand only marginally. The non-nuclear variant will, of course, result in a very small share of nuclear power, so that coal, oil, gas and renewables in accordance with price differences will produce future electricity. On the other hand, the phasing out of nuclear power will increase the CO_2 problem.

5.2.5. H. McRae (1995), The world in 2020

The work of Hamish McRae (McRae, 1995) focuses on global future economic and political developments. The goal of this study has been to explore the long-term future in international political and financial terms in a way accessible to the general public. This study describes one scenario in the form of an individual essay. On the world scale three main economic regions were distinguished, namely North America, the European Union and East Asia. For the purpose of our study, we mainly focus on what is forecasted with regard to Europe.

The adopted scenario development method can be described in the following way:

Figure 5.15 **Scenario development method**



The European countries taken into consideration are: United Kingdom, Ireland, Italy, The Netherlands, Germany, France, Spain, Portugal, Austria, Scandinavian and eastern European countries.

The European scenario

The analysis of both the historical and current state and driving forces resulted in the following picture of Europe. Europe has become an economic giant because it has allowed the different countries to sort out the areas at which each seems to excel. Almost every industry has a significant presence. The region has developed the most comprehensive network of state support in education, health care and social security. There is a solid range of private sector services in which European countries are very large exporters. These include financial services, insurance, television and popular music, legal services and tourism. The European Union is a key player on the world food market; both in terms of export and import. However, Europe's industries have failed to achieve the productivity levels of their counterparts in the US: its service sector is uneven, with parts that are world class in performance and productivity but other parts that are far below standard US practice and best East Asian practice. There is a number of reasons for suspecting that Germany's industrial success is drawing to a close, i.e. high labour costs, the heavy dependence on electro-mechanical manufacturing, a relative weak electronics sector, an inflexible manufacturing sector, and the burden of German unification. What happens in Germany will heavily influence Europe's industrial future. Western Europe has very little influence on the political development of the countries in the east. Its most important decision is at what pace economic integration between east and west will take place.

In theory the process of European integration should help to improve service industry performance. Most services, however, are very difficult to sell across cultural and linguistic boundaries. Perhaps more serious, the social security network created by European Governments has become extremely expensive to operate. Furthermore, it will become more expensive, as the European population gets older and the ratio workers to dependants deteriorates. The picture that emerges of European education is a mixed one. Some aspects clearly work well. But with the exception of the UK, it lacks the peaks of excellence of the best of the US system and it fails to deliver the consistently high average quality of the Japanese or Korean education systems. Much of the same conclusions emerge in health care. The fact that education and health in Europe are principally financed by the state, and will continue to be so for the foreseeable future places a great and growing burden on European tax levels. As a result, all European countries will find their government budgets under increasing pressure.

The scenario

The European Union will widen and deepen; it will accept more members and the existing members will move towards a political union. It will reach a point where it becomes impossible

to proceed further. The countries of the European Free Trade Area will become members of the EU by the early years of the next century. The central and eastern European countries will subsequently join. As their economies will become heavily tied to the western European market economy, economic pressures from both sides will force inclusion. By 2020 this process of enlargement will be more or less complete.

The EU will have different classes of membership. Germany and France will continue their close association, though this will have stopped short of having a durable common currency. The Benelux group will join them. As particular issues arise, deals will have to be made on an ad hoc basis. Apart from this core, a group of countries exists that is economically integrated but will opt out of some of the core decisions. These will include Italy (if it remains a single country), Spain, Portugal, Ireland, the Scandinavic countries, Austria and probably Britain and Greece. There will be a further ring of states which will be part of a European trading zone, but which will prefer a looser association. For Britain and Greece to leave the EU might seem almost inconceivable. If Europe ceases to be a successful economic entity, Britain might see its self-interest in focusing on non-EU markets. As for Greece, as Eastern Europe develops it might build up its relationships with that area rather than remain a junior member of the EU.

Pressures, more political than economic, for a single European currency will continue. However, the internal economic tensions are such that it is unlikely that a European currency, if it exists at all, will involve more than the core members. But there may well be a quite sophisticated system of linkages between the various European currencies that will work much better than the 1980s Exchange Rate Mechanism.

Economic specialisation may carry on a little further but long before 2020 it will have reached its political limits. Economic nationalism will be too strong. Specialising inevitably involves ceding control of large areas of economic activity. Trade within the EU in services will increase, but will reach cultural limits. For example, British people will not want to place their money in German banks or vice versa.

The first decade of the next century will be spent adjusting to the collapse of the Soviet Empire. That process will continue to be extremely dangerous, for it is quite unrealistic to expect tensions, which have been suppressed for at least two generations to disappear overnight. It is overwhelmingly in Western Europe's self-interest that the rest of the Continent will be prosperous and stable.

European countries in 2020

The next twenty-five years will be a period of modest success for *Britain*. It has three advantages over the rest of Europe: i) it will age slower than other large European countries ii) structural adjustments to the manufacturing sector will be made quicker than the rest of Europe iii) and it has close relationships with both North America and East Asia. The less successful the continental European economy, the more likely it is that the UK will opt out and carry on with its trading relationships with North America, Japan and China. If, however, Europe as a region is able to make similar structural changes as the UK, then the UK's relative position will not improve so much. The UK's educational system still pays too little attention to the less academic section of the community, which will lead to greater social tensions. Scotland may well have become independent from the Westminster parliament by 2020. One possible catalyst for an independent Scotland would be Northern *Ireland* uniting with the South. On present trends, by 2020 Roman Catholics will be a clear majority in the north. This trend will speed up as the Protestant community feels it is losing critical mass and its younger members migrate to Britain.

Italy is the most fragile of the middle-sized European states, due to the high level of organised crime and corruption, the lowest birth rate in Europe which may indicate a deeper social malaise and the contrasts between the rich north and the poor south. These tensions will increase, due to the ageing of the population and immigrant pressure. Some form of central Italian state may persist, but it would be one in which the provisions of a normal unified state – such as common taxes and common social security benefits – would no longer apply. If the country splits, the big transfer of wealth from north to south will cease for there will no longer be sufficient political support in the north to sustain it. Shorn from the south, northern Italy could again become the most successful economic region of Europe. Its advantages will become even more evident in the future, for its portfolio of products is unique: it is the best place in the world for producing high quality craft products with a

very large proportion of the added value coming from design. Splitting the country might work to the advantage of the south, too. It would, in the short term, suffer from a decline in the scale of transfer payments, but in the medium term it might gain from the dynamic effects of having control over its own destiny.

The Netherlands' particular characteristic is that it exports an enormous proportion of its output – around 55 %. This international orientation shows in a large financial services sector, and, for a relatively small country, it is unusual in having three very large multinational corporations – Philips, and the Dutch sides of Unilever and Shell. Much of its future turns on two things: the ability to find new markets if Germany falters and the success of those three giant companies.

The German people will find the last years of this century and the early years of the next century very difficult. *Germany*'s economy has to go through three difficult transitions: i) it has to reduce the size of its manufacturing sector and to expand the service sector; ii) it has to lift the performance of the former East Germany; iii) and it has to encourage its workforce to accept longer working hours and cuts in state benefits. In addition to these economic pressures there will be a social pressure. The German people have to cope with a flood of immigrants something, which Germany in history, has never been good at accepting.

In many ways *France* is well placed to become the dominant economy of Europe. It has great strength both in strategic high-technology niches and in popular crafted products. On the debit side, however, it has a record of bouts of political instabilities, and it is not hard to see what might trigger another: the pressures from immigration from North Africa. French unemployment will persist at high levels through the end of the century and beyond, because of the inflexibility of the labour market.

Spain and Portugal will experience a further period of 'catching up' with the rest of Europe. The economies of Spain and to an even greater extent Portugal, are still in the early stages of reaching northern European income levels. There are several reasons to believe that they will continue in this direction for another generation at least: i) they still have relatively low labour costs; ii) the fall in the birth rate is relatively recent, so the adverse effect of demography on the size of the workforce will not be apparent until deep into the next century; iii) both economies have a strong service sector; and iv) both are improving public education.

The Scandinavic countries as well as *Austria* will join the EU before 2000. The common difficulty these countries face is that they have created a system of social welfare that they do not seem to be able to afford. There is a curious irony that countries, which have one of the highest per capita GDP in the world, will also suffer an exodus of skilled people seeking to escape their tax rates.

By 2020 *eastern European* countries like Hungary, the Czech republic, Poland, and Slovakia and the Baltic will, to a greater or lesser extent, share in the wealth of Europe. They will be functioning democracies, living in peace with each other, having by then learnt the skills of developed market economies.

5.2.6. European Commission DGXI (1996), Vision 2020

In 1996 the General Consultative Forum on the Environment started a study named 'Vision 2020' (EC-DGXI, 1996). This study has resulted in three scenarios for a sustainable Europe (EU15)[12], i.e. Opening Opportunities, Guiding Change and Transforming Communities.

The developers have set the following objectives for the scenario project:

- Communicating to a wider audience the complexity and interdependencies involved in achieving a Sustainable Europe.
- Helping the European Commission to develop its own 2020 vision for a sustainable Europe.
- Challenging policy makers and stake holders to develop a more future-oriented approach to environmental policy.

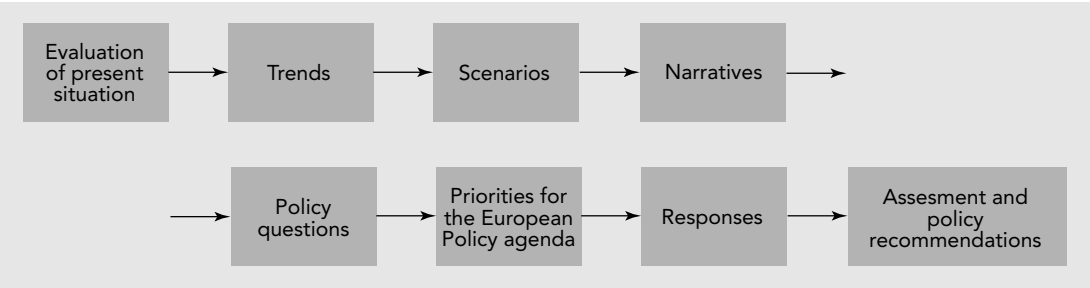
Unfortunately, the developers did not make explicit, which scenario development method they used in the development process. From our analysis we conclude that the scenarios are mainly informed by several discussions among the development team. The scenario development process, as inferred from the documentation, has been as follows:

The Vision 2020 scenarios

In the next section, the scenarios are described. First in terms of the major underlying trends, then from an economic, social, envi-

[12] EU15: Belgium, Germany, France, Italy, Luxembourg, The Netherlands, Denmark, Ireland, United Kingdom, Greece, Spain, Portugal, Finland, Austria and Sweden.

The development process of the Vision 2020 scenarios (based on EC-DGXI, 1996) Figure 5.16



ronmental, political and international point of view. Secondly, attention is paid to the following sectors: energy, agriculture, transport, telecommunication, manufacturing, cities and science and technology.

Opening Opportunities has it that EU policy of the 1990s fail to deliver economic growth and jobs. The only way to solve these problems and to improve environmental quality is to innovate and grow through more liberal policies. Globalisation, liberalisation and technological innovation will continue fast. There is a strong focus on competitiveness and economic progress.

In this scenario, economic development is based on new patterns of more eco-efficient growth emphasising services, knowledge and new materials. Privatisation will continue and subsidies to industry will be stopped. Governments will enable markets to work efficiently and will better use the creative forces of entrepreneurship. The social partners will embrace the need for continuous change, for a shift towards a high skill economy, despite the social dislocations and changes in employment patterns that this will entail. Market mechanisms will drive environmental improvement through a combination of strong tradable property rights and liability law. Environmental campaigners will focus their attention on building tightly knit alliances with the business sector and consumers to accelerate the diffusion of cleaner technologies and products. Mistrust of government and business information on the sustainability of production and products will give way to independent certification by coalitions of environment organisations, trade unions and human rights organisations. The economy will be truly global. Markets will have been fully opened. Global trade and investment liberalisation will diminish the importance of EU policy. The move to global free trade will prove to be of far greater benefit to developing countries than aid used to be.

In the Opening opportunities scenario, all subsidies will be removed from the *energy* sector. Due to liberalisation of energy markets, economic players compete freely. Energy intensity will continue to decrease. In the *agricultural* sector, the Common Agriculture Policy will be completely phased out. Biotechnology will increase productivity and reduce environmental impacts. Land, unsuited to agriculture, will be taken out of production. In the *transport* sector, vehicles will be clean and efficient both in production and use. IT will reduce the demand for mobility. Sophisticated traffic management systems will further reduce congestion. In the *telecommunications* branch, innovation will drive dematerialisation and efficiency improvements, and thereby reduce pressures on the environment. In the *manufacturing* sector, strict environmental liability will be the major driver for industrial clean up. *Cities* will be refurbished and will become attractive again. *Science* and *technology* will permit growth while using energy and other resources more efficiently. Most R&D[13] will be conducted in the private sector, although governments will continue to fund basic research.

Guiding Change has it that the market is unable to solve problems without regulation: social and economic disparities are increasing, while environmental issues are not being resolved. Citizens will welcome a stronger government role in maintaining standards of living and securing stability and certainty in a changing world. There is insecurity and persistent unemployment and growing numbers of old people are faced with declining social security systems. Nationalism and populism are growing.

In the Guiding Change scenario, the EU will co-fund large-scale investments in environmental infrastructure including transport systems, waste treatment and renewable energy supplies. There will be a controlled phase-out of unsustainable industries,

[13] R&D: Research and Development

supported by outplacement and subsidy schemes. Green groups will lobby for EU efforts to improve the environmental performance in eastern and central Europe. Society will have high levels of security, social services and a strong economy. There will be common welfare systems that will provide for a dignified livelihood rather than just a minimal safety net. Rights to social and environmental quality will be strengthened. Stakeholders and citizens will participate at local and national levels to set priorities and to guide policy. Producers will be legally responsible for environmental impacts. There will be subsidies to promote eco-efficient companies, and to fund environmental R&D. To promote the transition to sustainability, governments will seek to change consumption and production behaviour. To this end, they will aim to universalise best practice, through a radical overhaul of regulations and incentives. The economy will be predominantly intra-regional rather than global. EU policy will focus on the internal market. The EU will have strong borders and will continue the policy of controlled trade.

In this scenario, EU-wide *energy* policy involves taxes and incentives to promote energy efficiency and R&D on non-fossil fuel energy. Nuclear power will still be used. In the *agricultural* sector, the Common Agriculture Policy will be an integrated agriculture, land use and environmental protection policy. Conventional agriculture will be replaced by organic and low input agriculture. Only a few carefully controlled biotech applications will be allowed. In the *transport* sector, private vehicles will be heavily taxed. Investments will be directed to infrastructure and education. Ultra clean-burn engines for 'hypercars' will be developed. In the *telecommunication* sector, eco-efficiency will increase due to an integrated IT and clean manufacturing strategy in the EU. In the *manufacturing* sector, there will be large EU support and subsidies for R&D and 'clean' technologies. Furthermore, an EU-wide strategy for sustainable *cities* will be effective: initiatives in planning and higher building standards will reduce travel demand, energy and water use. In the *science* and *technology* branch, regulations and incentives will be used to encourage environmental-friendly goods and services that are acceptable in life-style terms. R&D will be substantially increased and will become more coherent at the EU level.

Transforming Communities has it that EU policy of the 1990s fail to tackle the root causes of growing social insecurity, declining quality of life and environmental degradation. There is a spreading conviction that radical changes are required, which will put the goals of social justice and environmental sustainability first. Attitudes to environment, work and lifestyles will continue to develop along the lines of 'not more, but better' and people will seek greater satisfaction in social and cultural relations rather than increased material wealth.

In the Transforming Communities scenario, government efforts will be especially geared towards an economic framework in which social and environmental enterprises can prosper. A new wave of community based organisations will promote local development techniques such as micro-credit and local currencies. Targets for economic growth will be set within the broader context of Europe's fair share of the global ecological carrying capacity. Quality of life will increasingly be experienced through low impact activities such as art, music and appreciation of the natural world. Radical reductions in resource use and pollution will manifest themselves through changes in infrastructure, lifestyles and the scale of the economy. Governments will internalise environmental costs through ecological tax reform. Emphasis is being placed on decentralisation. Unnecessary resource flows and transport will be minimised through widespread use of IT and networking. The EU will become less dependent on imported material and energy resources from unstable regions. The EU will take the lead in establishing international environmental policy.

This scenario features an *energy* sector with high taxes on fossil fuels. Furthermore, there will be programs to promote non-fossil energy. Nuclear power will be phased out. In the *agricultural* sector, the Common Agricultural Policy will become a system of incentives for Community Supported Agriculture, stressing local production. In the *transport* sector, changes in land use and lifestyles will reduce mobility and this will especially reduce air and road transport. Passenger transport will be mainly by public transport means. IT and the *telecommunication* will become very important. The *manufacturing* sector will concentrate on the production of long-lasting, recyclable products. The majority of the enterprises will see themselves as providers of services rather than products. *Cities* are eco-villages. The economic role of cities will change drastically in line with changing social and economic

priorities. The *science* and *technology* sector will develop new technologies that enable radical ecological modernisation and maximum recycling efficiency.

Narratives

For each scenario a short narrative is written. The narrative focuses on a European citizen living in the year 2020. Box 5.1 presents one of the narratives as an example.

Policy questions

The previous steps lead to policy questions for each scenario (see Table 5.9), subdivided in environmental, economic and societal questions.

Box 5.1: Example narrative, Transforming Communities (EC-DGXI, 1996)

Angharad is up before dawn and as the sun rises, she picks plums, pears and apples in the community square that, together with the solar heated swimming pool is surrounded on three sides by the forty 'lov-impact' homes of their urban 'village' – a redeveloped inner city block. Nick – Angharad's old father – calls to her from the kitchen, where (despite his advanced age) he has prepared a delicious breakfast of garden produce and fish from the nearby stream. Angharad loves her home life: but is greatly frustrated by the lack of opportunities in her working environment. Although she doesn't mind taking elderly people to and fro in a rickshaw, she feels frustrated that there have been so few opportunities for her to develop her business acumen and to travel afield. And, like many people in 2020, she is anxious at the apparent incapacity of the EU to face up to Chinese expansion.

Policy questions for the scenarios (based on EC-DGXI, 1996) Table 5.9

		Questions
Environment	OO	• Will an approach based on property rights and liability create an US-style litigious society? • How will commons resources be managed in a system based on individual environmental property rights? • Can the market deliver environmental quality standards and is it vulnerable to surprise? • Will there be adequate sanctions against environmental laggards? • Does the EU have the capacity to deregulate on environmental policy? · • Can the eco-efficiency 'treadmill' be sustained?
	GC	• Will tough environmental targets constrain innovation and competitiveness? • How quickly will the possibilities for cheap environmental win-win solutions be exhausted?
	TC	• What if some environmental concerns prove to be overstated? • What if measures taken are still not adequate to cope with environmental change?
Economy	OO	• What can globally or nationally be done about free riders? • Can the EU sustain the innovation needed to drive economic development? • What is the future of service sector jobs in the face of global competition?
	GC	• How can the necessary trade-offs between economic, social and environmental goals be made? • Who decides what the trade-offs should be? • Will the cost of environmental targets and requirements be prohibitive, especially for small companies? • How quickly will the possibilities for cheap environmental win-win solutions be exhausted?
	TC	• Is a steady-state really possible? Can we step off the economic 'treadmill'? Where will jobs come from? • Will there be mass capital flight from EU? Are there adequate returns in a steady state economy? • Will industry leave the EU? What would the impacts on jobs and society? • Will government be able to get a mandate for significant cost internalisation? • How can policies be co-ordinated in a decentralised EU? • How will free riders or objectors be dealt with?
Society	OO	• How will society cope with increasing job insecurity and stress? • How can increasing disparities in wealth and their social effects be dealt with?
	GC	• How strong can social and environmental limits to trade be without endangering the global trading system? • Will there be enough political will to change framework conditions and impose solutions that will be unpopular with certain interest groups? • What will be the impact in developing countries of EU trade restrictions? • Will fiscal instruments for environmental quality add to growing divisions between rich and poor?
	TC	´ Will European accept declining importance of steady state EU in a growing world? • Will threats to individual liberties and lifestyles be acceptable? • What role is there for individual aspiration and ambition? • Who do citizens feel solidarity with? Global eco-rationing or local community values? Can 'thinking globally and acting locally' work? • How can policies be co-ordinated in a decentralised EU?

OO: Opening Opportunities, GC: Guiding Change, Transforming Communities

Priorities for the European policy agenda and responses

DGXI has evaluated the set of policy questions in order to arrive at priorities for the EU policy agenda:

- Unemployment
- Environmental degradation
- Social security systems
- Culture
- Democracy

Each scenario implies different responses to these priorities (see Table 5.10):

Assessment and policy recommendations

The last step in the Visions 2020-study involved the assessment of the scenarios and policy priorities in order to arrive at policy recommendations:

- An EU *sustainability task force* to explore new and innovative solutions for environment, economic and social cohesion.
- Regular EU *reporting* on Sustainable development
- *Think tank* on 'House of the future', to ensure that the long-term is integrated in EU thinking.
- *Programs* to raise *awareness* and to promote *communication* with citizens and businesses on sustainable production and consumption.
- An *R&D strategy* for an eco-efficient Europe by 2020.
- EU *strategy* for promoting sustainable development *globally*.
- Strengthening the role of *local communities* (e.g. setting up local hearings similar to those used by the Brundtland Commission).

5.2.7. European Commission DGXVII (1996), Energy in Europe

The Directorate General for Energy (DGXVII) has a tradition in scenario development. Six years ago, DGXVII wrote the report 'Energy for a new century: the European perspective' (EC-DGXVII, 1990), describing four scenarios. More recently, the study 'European energy to 2020' (EC-DGXVII, 1996) has been performed. A comparison between these studies offer insights of the lessons learned with regard to European scenarios and scenario building:

- The 1990 scenarios were merely variations on each other[14], the 1996 scenarios inhibit more variety: they are based on different perspectives.
- Where in the 1990 scenarios demand-side forecasts dominated the analysis, the 1996 scenarios also comprise supply-side forecasts.
- The 1996 scenarios comprise more options for renewable energy supply.
- In the 1996 scenarios more attention is paid to the employment issue.
- The 1996 scenarios consider more emissions, i.e. CO_2-, SO_2-, NO_x- CH_4- and

[14] Scenario 2 is a variation on scenario 1, and scenario 4 is a variation on scenario 1 and 3.

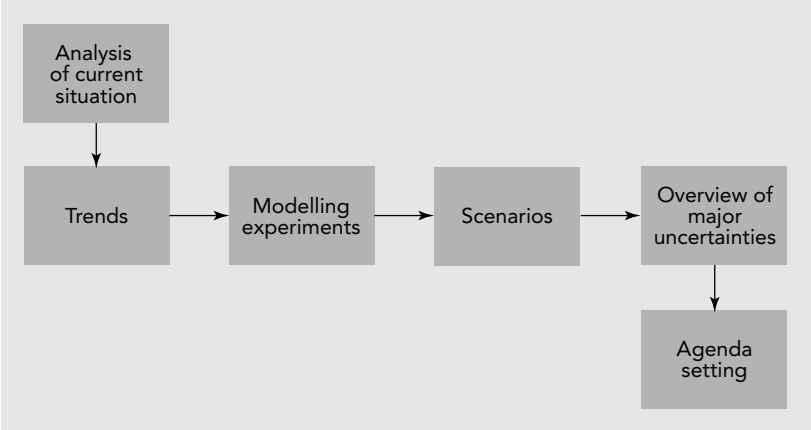
Table 5.10 **Responses on the key policy issues (based on EC-DGXI, 1996)**

	Opening Opportunities	Guiding Change	Transforming Communities
Unemployment	New opportunities through the information/service economy.	Public backed employment rights and retraining assistance.	Labour intensive local development, plus work sharing.
Environmental degradation	High value placed on personal health and private environment.	Strategies and targets achieved by regulatory reform and incentives. Ecological values balanced with social and economic.	Respect intrinsic value of nature.Overriding priority given to avoidance of health risks.
Social security systems	Privatised: minimal safety net.	Maintain services and extend rights, using the market as a possible provider.	More community provision/presentative health.
Culture	Whole new global cultural dimensions open up.	Subsidies for European arts and culture and restraints on foreign imports.	Rediscovery of local distinctiveness.
Democracy	Consumer first: minimal role for public choice.	Emphasis on representative democracy and formal rights.	Stress on participatory democracy and local control.

N_2O- emissions, while the 1990 scenarios neglected the latter two.
- The 1996 scenarios extend to 2020 (versus 2010 in the 1990 study).

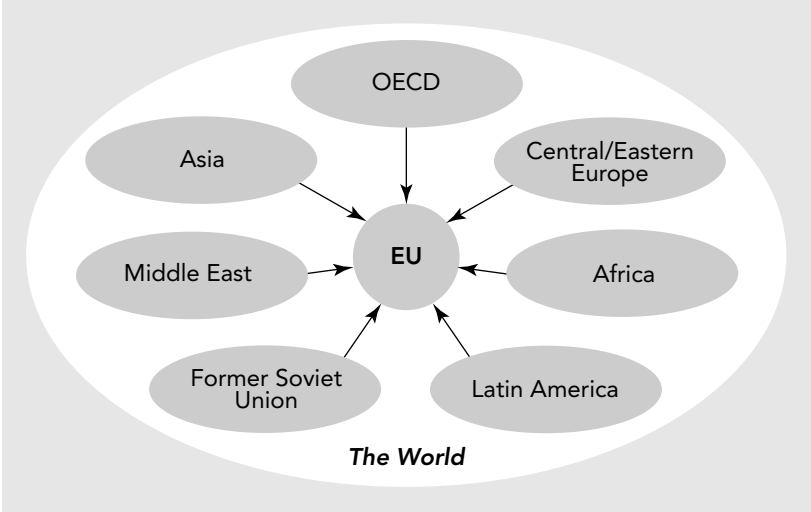
In this section, the 1996 energy study (EC-DGXVII, 1996) is discussed in more detail. For this study the European Commission used data from the International Energy Agency, the World Energy Council and other private and public institutions. During the scenario development process, special attention was paid to dialogues with experts, stakeholders of the energy industry, consumers and others with special interest. The resulting four scenarios are named: Conventional Wisdom, Battlefield, Forum and Hypermarket. The scenarios were developed in the following way (see Figure 5.17):

The development process of the Energy scenarios (EC-DGXVII, 1996) — Figure 5.17



The following models were used in this process: MIDAS, MEDEE and the World Energy Model. To put the scenarios in a global context, a more simple analysis of the energy future in other parts of the world, esp. in terms of near neighbours to Europe (EU15) (see Figure 5.18), was performed.

The European Union and its relations with other regions (based on EC-DGXVII, 1996) — Figure 5.18



The crucial uncertainties were made explicit by means of a series of some workshops (in 1994) involving, experts from the energy sector and industry, scientists and a variety of governmental institutions.

The Energy scenarios

DGXVII considers the following trends of crucial importance: i) the continued increase in *energy demand* (increased energy efficiency is offset by an increase in energy consuming activities), ii) evolving *market structures* due to greater competition in industrial markets, the expansion of economic activities of the developing world and growing energy trade, iii) concerns on global *competitiveness* of energy and technology, and iv) the growing recognition of the *environmental impacts* of the energy sector.

In the *Conventional Wisdom* scenario, *energy* policies will remain fragmented, as the result of unresolved conflicts with regard to European objectives and national aims. Significant gains in energy intensity will be achieved. The overall import dependency will increase from 50 % in 1992 to 65 % in 2020, mainly due to gas imports. Energy costs will decrease for the economic players. Energy investment requirements will stay at an affordable level. The quality of energy services will improve, since the bulk of energy consumption will involve electricity and gas. Concerning the diffusion of technology, the energy system will strongly favour combined-cycle technology for power generation and will use clean coal technologies, biomass, wind and biofuels. European *economic growth* will decelerate in the long run: the 2.2 % growth forecasted for the next decade will slow down to 1.8 %. European industrial production will increase by 2.5 % per year to 2000, before it progressively slows down to 1.4 % after 2010. The present core group will complete monetary union around 2000. The European Union will emit 3.6 GigaTon CO_2 in 2020 (versus 3.2 GigaTon in 1990), representing an increase of 13.6 % in total and 0.4 % annually. This rise is due to transport and power generation. Till 2010, the labour force will grow by an annual average of 0.2 % average. Hereafter, the rate will continue to increase, mainly because of

higher pension age. It is unlikely that there will be a rapid decline in *unemployment* in the near future: it is expected that the unemployment rate will be in the range of 7.0-7.5 %.

In *Battlefield scenario* the future *energy* system will be characterised by a slowdown of economic growth. Furthermore its is characterised by the protectionism policy in favour of indigenous energy resources and the low prices of imported energy products in the long run. The Battlefield scenario does not involve development of new technologies and fuels. Increasing dependency on fewer major suppliers will lead to an oil shock. As a result, no efficiency gains are anticipated, and energy demand will fall back. There will be conflicts in terms of competitiveness, environmental and geopolitical considerations. The EU *economy* will grow relatively slowly, on average by 1.7 % per year. After the turn of the century, all European economies will suffer decreased growth in the export market. The slowdown will capped by a deep recession in 2005-2006, and will be followed by a peak in oil prices to around $40 per barrel (in 1993 $). In the first decade of the next century, there will be a 10 % decline of industrial production. The EMU will not occur, due to national interests in own currencies for maintaining the export market share. European governments will face problems to provide pensions for the ageing population. There will be some diffusion of new, energy-efficient demand and supply *technologies*, driven by public standards and the market. With regard to *environmental impacts*, three counteracting factors will come into force: i) less energy will be used because of a lower economic growth, ii) less energy-efficient technologies and fuels will be used, and iii) more nuclear energy will be used. The net effect is that CO_2 emissions will increase (0.09 GigaTon more emissions in 2020 than in 1990). Labour force participation will be weak, due to the continuing high level of *unemployment* (11 % in 2020) and the consequently poor prospects for finding a job.

In the *Forum* scenario, markets will operate freely within a framework of an agreed global policy, supporting particular *energy* forms. This scenario scores badly on competitiveness, since taxes will affect the energy costs for the end-users. This energy future will be characterised by considerable intensity and efficiency gains. New supply structures will emerge in power generation due to decentralised generation (heat, renewables, biomass, fuel cells), biofuel production, hydrogen production and market-introduction of fuel cell and electric vehicles. The required investments will be higher than in the other two scenarios. Energy prices will be stable. Policies and technologies will limit energy demand, economic growth and emissions. In the immediate future, *economic* growth will be moderate primarily because several countries will adopt tough budget policies in order to prepare for the EMU. In the course of the first decade of the next century, EU economic growth will increase to 2.5 % per year and will maintain this level throughout the second decade. Industries will have to adapt to stricter environmental rules and changes in fiscal policies designed to promote sustainable development. Monetary union will be established in the year 2000. A global policy in support of non-fossil fuels and an extensive programme of renewables will be established. New, more efficient demand and supply *technologies* will diffuse fast, driven by worldwide public standards. This scenario is very successful in meeting *environment* objectives. The European Union will stabilise and reduce total CO_2 emissions (2.8 GigaTon of CO_2 in 2020 versus 3.2 GigaTon in 1990). Labour force participation will be rather stronger: the EU un*employment* rate will decrease to 5.6 % in 2020.

The *Hypermarket* scenario features free markets. Strategic decisions in the *energy* sector will concentrate on short-run economic returns. Public support on technology diffusion and new energy supply structures will be limited to a minimum. The absence of public intervention will be reflected in lower taxation compared to the other two scenarios. Economic competitiveness will be best in this scenario, which is illustrated by lower cost of energy per unit of production, lower cost of energy per unit of total expenditures in the domestic sector and a lower ratio of total energy investment requirements per unit of GDP. There is high *economic* growth: on average 2.5 % per year. The core of the EU will establish a formal monetary union in 2000 with a currency tightly linked to the D-mark. The upward drift in public deficits due to pension and health care commitments will be curbed by serve cuts in government spending and privatisation. The diffusion of new, more efficient *technologies* will primarily depend on market forces and international competition. The implications in terms of *CO_2 emissions* will be considerable. In 2020, the EU will emit 0.5 GigaTon more CO_2 than in 1990, representing an increase of 16.4 % or 0.5 % per year.

The bad performance is due to the decrease in nuclear energy and the low diffusion of carbon-free fuels and technologies. Labour market liberalisation will be important in this scenario. Wages will only increase slightly, which will pull some new workers into the labour force in order to supplement family incomes. EU *employment* rises by 0.3 % per year.

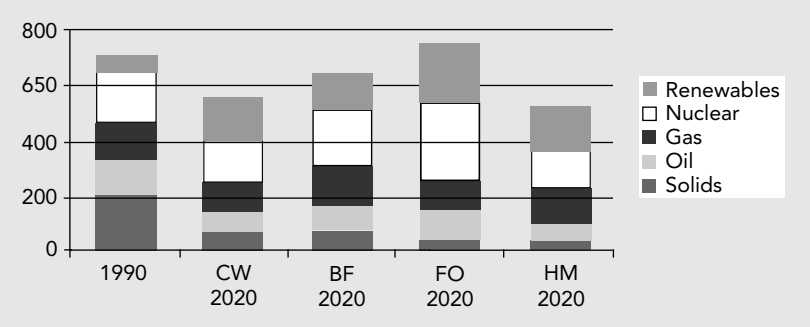
Uncertainties and agenda setting
With the above scenarios on the table, in a series of workshop the following crucial uncertainties were brought to the fore:

- Energy intensity and price levels
- Transport energy demand
- Energy supply
- The role of technology

With regard to these uncertainties, the following key messages were considered important for policymakers:

- Increasing European *dependence on imports* is inevitable. It is expected that oil prices, will remain affordable even if occasionally volatile. Coal can be expected to maintain its share of global energy supply due to its inherent price advantage. Supply of renewables will grow quickly as problems of economics and market acceptability are overcome. Gas is expected to be the fastest growing fuel in the medium term.
- *Energy intensity* gains will continue. Electricity will take a greater share in final energy demand, distributed heat will become a more important source of energy and the share of gas will grow with regard to primary energy. However, the rate of improvement is subject of debate.
- Major *technological changes* occur towards the end of the period analysed (1996-2020). While these innovations will take considerable time to materialise, in the long term substantial results, relevant to climate change, are to be expected.
- The *transport* sector will be critical to the energy future of the EU.
- Under the condition that energy and agricultural policy is integrated and co-ordinated, high economic growth seems to be compatible with CO_2 *reduction* without comprising security of supply.
- With regard to the *internalisation of external costs,* voluntary agreements and regulations are preferred as medium term instruments. A reform of the fiscal system that incorporates fiscal measures to promote energy-efficient and carbon free energy supply is particularly suited for the longer term.

Energy mix in the scenarios Figure 5.19



(**Source**: EC-DGXVII, 1996)

5.2.8. CPB (1997), Economy and physical environment

In 1997 the Central Planning Office, (in Dutch: Centraal Plan Bureau, CPB) launched the report 'Economy and physical environment' (CPB, 1997). The goal of this study is to get insight in economic, energy, planning and environmental issues Dutch policy makers will face in the long term. The co-operation of the CPB with other Dutch institutes (Dutch Advise Council for Traffic and Transport, ECN and RIVM), resulted in three economic scenarios for Europe[25] reaching until the year 2020, i.e. Divided Europe, European Co-ordination and Global Competition.

The CPB used the following scenario development method (see Figure 5.20):

For the global analysis, information from the study 'Scanning the future' (CPB, 1992) was used. Some assumptions were actualised and more attention was paid to European integration.

The CPB surroundings scenarios
For the purpose of our overview, the scenarios developed on the European scale are most relevant. The Dutch scenarios will not be further discussed.

In the *Divided Europe* scenario the European co-ordination and market mechanisms will not function well, while social-economic problems remain unresolved. European integration will be heavily debated. Nationalism and antagonism will play a decisive role. So the development towards a single European market, the EMU and a political union will slow down. North America and Asia will

[25] Because of the Dutch focus of their effort, CPB refers to these scenarios for Europe as surroundings scenarios.

be successful with regard to their free market perspective, technological growth and very dynamic economic developments. This will worsen European competitiveness and negatively impact upon Europe's economic growth. European technological developments will lag behind. There are fewer possibilities to develop one's talents. Environmental problems will remain.

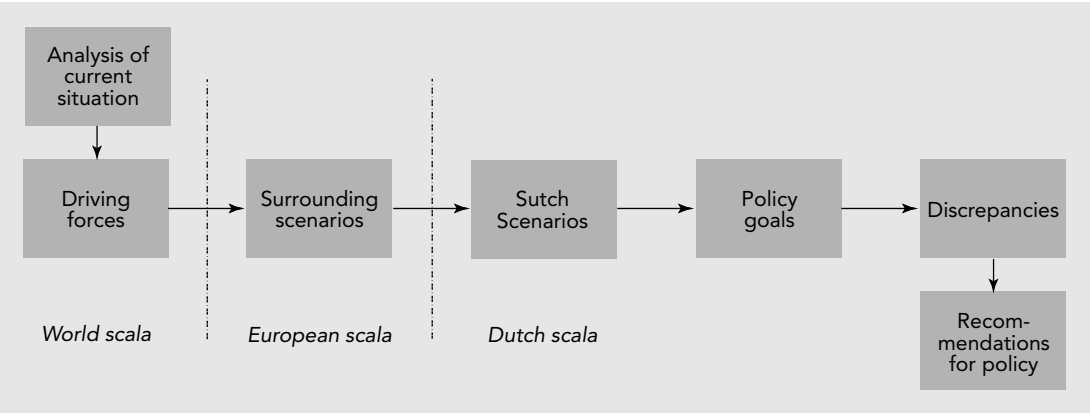
The *European Co-ordination* scenario stresses the need for policy co-ordination with regard to the environment, transport and energy. European integration will progress: governments will agree on targets. On the global level, isolationism will reign: world trade between the great blocs will decrease. As a result, European GDP growth will be rather high but dampened. The single European market will come into being. Liberalisation and deregulation will take place on the national scale, and will in the long term be replaced by EU co-ordination. These developments will be reinforced by the realisation of EMU. The EU will stimulate technological developments (e.g. R&D activities, energy technology and agricultural research), thereby reinforcing European competitiveness and increasing employment. Integrated European environmental transport- and energy policies involve, for example, a European CO_2-tax and gas import from the former Soviet Union. Equity, solidarity and cohesion will be important. People consider themselves either to be a European or regional citizen. Immaterial, spiritual and/or idealistic lifestyles, culture and the environmental-friendly consumption will receive increasing interest. Public policy will involve environmental protection measures and stimulation of societal-relevant technological developments. The knowledge potential will grow.

The *Global Competition* scenario features a competitive Europe with strong technological developments, strong internationalisation, deregulation and the market liberalisation. The telecommunication, energy, transport, labour, bank and insurance markets will be liberalised. The market approach will be also applied to social sectors like education and health services. This scenario presents the highest forecasts on economic growth. IT will grow rapidly. International trade will develop dynamically. The knowledge potential will grow and knowledge will diffuse fast. There will be no further political European integration, because of lack of agreement on targets. However, nationalism will be less important: people will consider themselves as a world citizen with English as common language. Lifestyles will be material and hedonistic. Incomes will not be distributed in a balanced manner. Job prospects will be uncertain and insecure.

5.2.9. Smith (1997), Eurofutures

Smith (Smith, 1997) attempted to peer ahead into the 21st century. This study involved the following questions: What will happen with Europe as a whole, and its constituting parts? How will that affect business, government and individuals? Is Europe coming together or on the brink of a painful schism? Will Europe be a good place to live, work and do business in? Various sets of answers to these key questions culminated into five scenarios, i.e.: The Renaissance, Plus ça change, Les Etrangers, The dark ages and The apocalypse. These scenarios can be located on an axis derived from two extremes: a highly integrated Europe and a fragmented Europe. The underlying implicit

Figure 5.20 **The scenario development process (based on CPB, 1997)**

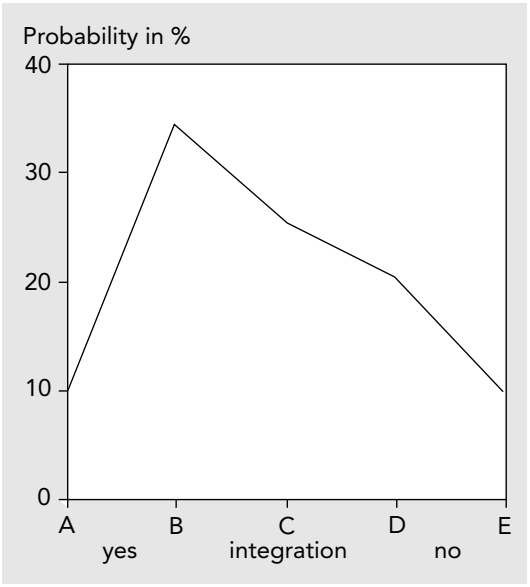


The main features of the CPB scenarios (adapted from CPB, 1997) — Table 5.11

	Divided Europe	European coordination	Global competition
International economic-political developments	Market- and co-ordination mechanism ineffective Disagreement about integration	Global isolationism European co-ordination perspective	Free market Europe a la carte Policy competitiveness between countries
Social-cultural factors	Discords and conflicts Intolerance	Cohesion and solidarity Immaterial lifestyle	Strong individualisation More material lifestyle
Technological developments	Slow growth knowledge potential Slow diffusion	Moderate diffusion speed Technology of public importance Growth knowledge potential	Rapid diffusion knowledge potential Rapid diffusion Technology market oriented
Economy	Strong growth in North America and Asia Europe lags behind	North America lags behind More international environmental policies European energy tax	World wide strong growth Very dynamic

normative assumption is that integration of Europe is desirable. According to Smith, fragmentation will imply a disaster for Europe. An interesting feature of this study is that the author assigned probabilities to the scenarios. Probabilities are often used in quantitative methods, but rarely in qualitative exercises. The set of probabilities does not result in a normal distribution, as can be concluded from Figure 5.21.

Probabilities of the scenarios — Figure 5.21



A: The Renaissance, B: Plus ça change, C: Les Entrangers, D: The Dark ages, D: The Apocalypse

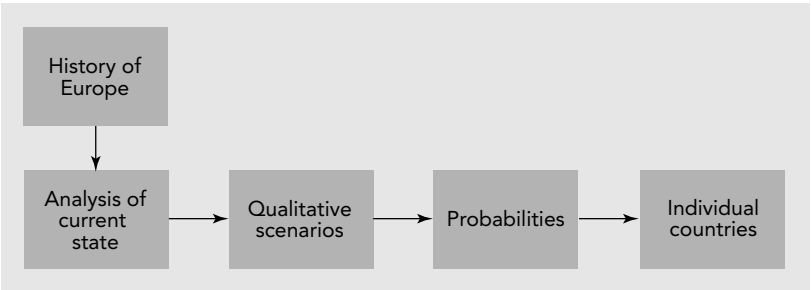
The scenarios are developed in the following way:

The Eurofutures scenarios

This section discusses the five scenarios, including the author's probability judgement.

In *The renaissance* scenario, European economic growth will accelerate to a rate between 3.5 % and 4 % per year, as a series of favourable factors will come into play, i.e. the opening-up of Eastern Europe, the completion of the Single market and the single currency. EMU will lower average European interest rates significantly. This economic growth will provide an environment in which Europe will be able to deal with its competitiveness problems, including inflexible labour markets. The common currency, Euro, will become the world's major currency. Europe will be a stable, high-growth region, while Asia will become turbulent and unstable. Economically, culturally and politically, the 21st century will

The scenario development process (based on Smith, 1997) — Figure 5.22



be a time of sustained European revival.

Standing back a little from the hopes this scenario gives, it is, according to Smith, necessary to be realistic. EMU and the Single Market are neither likely to presage a benign revolution for Europe's economies. Mature economic groups may be able to grow a little faster under the right circumstances. But, they are unlikely to be able to double their trend growth rate to 3.5-4 %. If Europe's mature industrial countries will maintain a steady growth rate, they are doing quite well. Even with everything conspiring in its favour, the chances of a European economic miracle are slim. So, the probability Smith attached to this scenario is correspondingly low (i.e. 10 %).

In *Plus ça change*, Europe will gain from the growth of world trade, which will compensate the gradual loss of market share to the emerging economies of Asia. The Single Market will gradually be completed and the single currency, Euro, will extend its reach beyond the initial 'core' countries. Closer integration and the absence of internal and external shocks will lift European growth to 2.5 % per year initially, rising to 2.7 % by the end of the 21st century. European integration will be economically driven. Member States will heavily attempt to arrive at a political union.

As we move into the next century, there will be no brave new world of a fully integrated Europe. The present scenario is based on a much more realistic assessment of Europe's economic prospects: there are good reasons to believe that some of the factors that have held down European growth in recent times will prove to have been a temporary effect. For these reasons, Smith assigned a probability of 35 % to this scenario.

In the scenario *Les Etrangers*, the EMU will be a milestone in European integration. A small number of core countries (i.e. France, Germany and the Benelux countries) will move successfully ahead. However, this will not pave the way for an extended EMU to other EU states, and new entrants. Instead, EMU will become an exclusive club for economic and politically stable countries. After failing to enter the first wave, the other European countries will suffer significant economic divergence, and will thereby be unable to negotiate the hurdles for subsequent entry. For example, in Italy pressure for a split between the north and south of the country will intensify. Britain will probably leave the EU. EMU, rather than uniting Europe, will lead to irrevocable splits.

The multi-speed approach is well established and will rather likely be a reality when EMU will enter its final stages. The question is whether the core countries will dominate the setting of European monetary policy. The possibility of a split in Italy has to be taken seriously. Whether or not a Europe of insiders and outsiders is sustainable, is another matter. The difficulty for the outsiders may be that there will be nowhere else for them to go. In sum, Smith assigned a probability of 25 % to the Les Etrangers scenario.

In *The dark ages*, slow economic growth will be the new reality. EMU will reinforce Europe's sclerotic tendencies, before other forces, mainly the burden of ageing populations will condemn the continent to a grim future. In these circumstances EMU will not last. Average unemployment in Europe will climb to 30 %. EU countries will adopt protectionist measures to try and protect their remaining industries, only exacerbating the problem in doing so. Far from becoming a cohesive united force, the EU will not even survive as a free trade area.

This scenario is the malign version of the Plus ça change scenario. The scenarios differ in the following respect. The Dark ages scenario carries forward the trends already evident in the 1990s, and adds in a few other emerging difficulties, notably those arising from ageing populations and more intense competition. On the one hand Smith sees the Dark ages scenario as deadly logic, but on the other hand the Europe's loss of economic influence, and the pauperisation of her citizens will be more likely to be a gradual, almost imperceptible process than something more sudden. Therefore, Smith characterised the likelihood of this scenario with a probability of 20 %.

In *The apocalypse* Europe, beset with tribal and nationalist tensions, will become a dangerous place to live. There will be conflicts, small wars and the danger of a big war. The rest of the world will achieve economic dominance over Europe, and the rise of Islam and an aggressive China will force European countries to increase defence spending when they can ill afford to do so. EMU will fail catastrophically. This may happen as a result of a chronically high unemployment in member states, or as a result of a forced splitting of the Franco-

German axis. This Europe will be dirty: widespread, choking pollution and Europe will be vulnerable to nuclear disaster. The apocalypse scenario is, in many respects, the mirror image of the renaissance, in that it assumes that many things can go wrong, and keep on going wrong.

Although this scenario is deeply gloomy, it should not, according to Smith, be dismissed out of hand. For Europe to be prey to so many adverse developments, even over a prolonged period, may seem as unlikely as for everything to keep coming up sunny, as in renaissance. There is, however, an important difference between the two scenarios – it takes many events to produce a lasting economic, social and cultural rebirth for Europe but it could take only one to give it an apocalypse. The probability assigned to this scenario is 10 %.

Country specific
The five scenarios described have very different implications for the individual countries in and outside Europe. These implications for EU15 countries will be addressed in this section.

Europe's future will highly depend on the *Germany*'s future. The prospects for Germany are optimistic compared to the other European countries in Europe, except for the apocalyptic scenario. For Germany, the strategic vision of the late 20th century will be full commitment to European integration. For medium term (i.e. the next 5-10 years), propagation of this strategy will present the biggest challenge. Tension will arise over the economic and monetary union. The German strategy will imply a wide EMU, because the exclusion of a significant number of member states would raise the chances of a divisive future for Europe. On the other hand, a wide EMU would risk the permanent loss of one source of Germany's competitive advantage: i.e. a strong currency.

France will succeed in gaining a greater influence over Europe's institutions and in steering Europe in the direction that is most advantageous to its national interests. The sacrifices required maintaining the 'franc fort' policy will be widely questioned by the French electorate. Nationalism will have a powerful political voice, much of it will be directed against further European integration. However, even with a new exchange rate mechanism, the French economy would be highly vulnerable to the competitive gains that EMU-outsiders could achieve as a result of currency shifts. The question remains whether France will be competitive enough not to lose out in a permanent single currency arrangement with the more competitive European countries (i.e. Germany, Austria and the Netherlands). France's optimal strategy will differ from that of Germany, because no guarantee for a degree of dominance over Europe exists for France. Its national political interest will lie in maintaining some kind of two-tier structure for Europe in which an inner core, heavily influenced by France, will make the key decisions. But its economic interest will require the widest possible EMU. The next decade will be crucial. A continuation of the current recession will imply that France will enter the 21st century in poor shape.

The 1990s have been a decade of fevered *United Kingdom* Euroscepticism. Even with a more pro-European government now in power, there seems little doubt that a substantial majority of the votes will reject UK participation in EMU. A debate over whether Britain should be part of the EU at all, will rumble in the background and could in certain circumstances come to the forefront of the political debate. Britain will have much to gain from economic integration in Europe, and in particular from the opening up of markets. For example, Toyota and Unilever have already warned that exclusion from EMU could affect their future investments in Britain. It is possible that Britain needs to choose between the European model – on the ground that if you cannot change them you might as well join them – or pursuing its own course. This latter choice would imply that Britain will be a 'semi-detached' member of the EU or that, in the extreme, withdrawal will become a serious option.

Italy presents in many respects the most fascinating 21st century possibilities in Europe. As one of the founders of the EC, Italy can claim being at the centre of further integration. However, even if on most economic measures, the country cannot be said to be ready for it. If Italy fails to enter EMU, the consequences could be far-reaching. The support for separation between north and south may gain ground. Under such circumstances, a break-up during the 21st century would be a real possibility. The worrying thing about the Italian strategy is the absence of a 'Plan B' or fallback position. In the end, Italy's hope will be that a wide EMU is considered to be in the interest

of both France and Germany. If not, turbulence will loom.

Spain and Portugal will rely on being part of Europe's core within the relatively near future. Both countries have based their political and economic strategies upon it. In particular, with chronic high unemployment in Spain, inward investment will be vital. Competition for that inward investment will come from the lower-cost producers in Eastern Europe. So, for Spain and Portugal a long period is required in which they are part of EMU, but Eastern European countries are not. Both countries will have a long way to go before they will be able to catch up with GDP levels in the more mature European economies. In Spain in particular, extensive labour market reforms will be needed.

Despite the fact that EU membership is recent, it is rather sure that *Austria* will be a first wave EMU member. However, on the other hand, nationalism is a rising political force in Austria. Austria's fortunes are tied closely to those of Germany and the outlook is thus relatively optimistic. The spur for Austrian EU membership was economic. The question is whether the enthusiasm of the Austrian people for integration will evaporate in the light of economic adversity. Being neutral for such a long time, the relative fortunes of Austria and Switzerland, which rejected membership of the European Economic Area, will be one of the interesting side issues of Europe's 21st century development. A successful EMU may prove to be highly attractive for the Swiss. Switzerland has proved immune to the general argument that smaller countries have a bigger influence if part of larger groupings. The losses of, for example, national identity are larger concerns.

Belgium is the classic example of a country that has gained in status and influence from European integration. Being in Europe's centre, Belgium is guaranteed a pivotal role. European integration will be almost instinctive for Belgium. The degree to which regionalisation and federalism characterise the political system is surprising for such a small country. As in other countries, however, the demands of the regions will be seen as more likely to be catered for in an integrated Europe. Interesting questions would arise in the event of any rupturing of the Franco-German axis. While Flemish Belgium would stay with the smaller German core, francophone Belgium would probably split away.

The Netherlands have been a considerable economic success in recent years. Participation in EMU will be virtually a foregone conclusion for the Netherlands, which formalised the tight link between the guilder and the Deutschmark. The Netherlands will be part of Europe's hard core and will argue against any softening of the anti-inflationary emphasis of monetary policy. For the Netherlands, Europe has to work. There will be no alternative nor can there be one, given its geographical position and intertwined economic links with the other EU countries.

Denmark, as the longest serving Scandinavian member of the EU, is also the most Eurosceptical – Finland and Sweden apparently embrace integration more willingly. Among the smaller countries, Denmark will be the most likely European country to leave the EU. The challenge for Denmark outside the EMU and on the fringes of the EU will be not to get squeezed by the potential monetary leviathan on its doorstep.

Finland applied for membership of the EU after emerging from the long shadow of the former Soviet Union. Linguistically and geographically distant from Europe's core, Finland will be economically distinct, being highly dependent on forestry industry. The Finish people will be enthusiastic about EU membership, but will be less convinced on the necessity of EMU. Much will depend on the decisions of Sweden, Finland's main trading partner, but it is implausible that Finland will become a core EU country in the near future.

Sweden came late to the EU. For Sweden, Denmark and Finland, one key question in the 21st century is whether there will be pressure for harmonisation of welfare provision. At present the Scandinavian countries tax and spend to the equivalent of around 60 % of GDP, compared with about 50 % for Europe's core economies. In a true single market, activity will gravitate toward the lowest tax economies. The Swedish model may require further surgery, in a way that will prove unpopular to the Swedish people, accustomed as they are to their particular approach.

Greece is in a class of its own when it comes to the integration process. It is hard to be optimistic about the prospects for Greece. Greek governments have been, at times, unenthusiastic about EU membership, despite the direct benefits it has brought. Not corrected are the fundamental economic

weaknesses, which will be exposed, in a wider EU.

Ireland, like Greece, Spain and Portugal, has been a substantial net beneficiary from the EU budget. Ireland is caught between enthusiasm for European integration and a desire not to be on the wrong side of the currency moves. The great fear is that Ireland will enter EMU, only for this to be followed by a significant sterling devaluation. Competitive devaluation by Britain would pose very serious problems for Irish-based industry. In the end, political will is what matters, and there is a strong political will in Ireland to break free from over-reliance on Britain. EMU will be one route to achieving it. The 21st century will continue to see Ireland attempting to align itself with Europe's core.

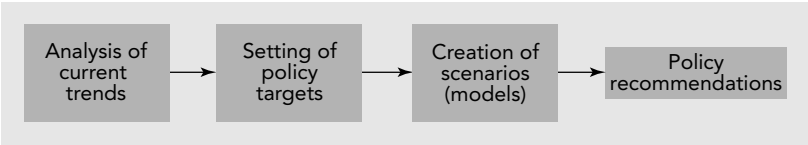
Luxembourg will ally itself to any hard-core, hard currency bloc, with or without Belgium. Luxembourg's enthusiasm for the EU and EMU is not doubted. The former provides Luxembourg with more than its share of European institutions, while the latter will arguably give the country a greater influence over monetary policy than now.

5.2.10. OECD (1997) The world in 2020. Towards a new global age.

The report sets out some of the key economic, social and environmental policy challenges for realising a new 'global age'. This new global age is, according to the OECD, a world where all societies have the potential to participate actively in the world economy. Also some implications for the role of international organisations, including the OECD itself, are presented. To explore how to achieve this 'global age', they have set out two alternative visions of the global economy in 2020. The report starts with a policy overview followed by an analytical part in which key issues concerning the world economy are analysed. The study aims to see which actions are required, by governments within and outside the OECD area, to achieve a borderless world through free flows of goods and services, capital and technology. In this world high and equitable growth supported by stable and sustainable macroeconomic conditions and wide-ranging structural reforms should be ensured.

In Figure 5.23 the scenario development process used in the study is visualised:

Scenario development process — Figure 5.23



In the analytical part of the study trends and possibilities of globalisation are explored. This is partly done by means of modelling. Two models have been used, the LINKAGE equilibrium model of the OECD (OECD, 1997) and the WORLDSCAN model of the Netherlands Bureau for Economic Policy Analysis (CPB, 1992). The scenarios are developed and analysed by means of these models.

Two visions of the world economy in 2020 are presented. One is a slow-track reform and adjustment scenarios ('business-as-usual' or 'low-growth' scenario), and the other is a high performance scenario of the world economy, where governments and societies seize the challenge of realising a new age of global prosperity ('New Global Age' or 'high-growth' scenario). This latter scenario seeks to paint a plausible scenario for the world economy, if governments undertake a wide range of necessary policy reforms.

In the study much attention has been paid to how to achieve the goals of the high-growth scenario. The low-growth scenario is almost seen as a given if no fundamental changes are undertaken. Therefore this scenario is not elaborated upon as much as on the other scenario. In Table 5.12 the basic assumptions of the two scenarios are listed.

'Business-as-usual' scenario

Trends in population and technology will clearly mark the future. In this scenario it is assumed that governments make only slow progress in liberalisation of international trade and finance, fiscal consolidation, policies enhancing innovative capacity and technology diffusion, or further reforms to product and labour markets. OECD countries might see a similar productivity performance to that of the past 25 years. In these circumstances annual economic growth could fall to around 2 per cent, compared to almost 3 per cent over the last 25 years. In such a future, poverty and marginalisation remain major problems for a large number of non-OECD economies. Looking at GDP levels the following trends can be distinguished:

- Real GDP per capita in the OECD area would be 50 % higher in 2020 than in 1995

Table 5.12 **The basic assumptions of the two scenarios (OECD, 1997)**

	'New Global Age' scenario	'Business as Usual' scenario
Policy assumption		
Trade barriers	Tariff-equivalents fall to zero by 2020	Tariff-equivalents reduced to 50 % of their 1992 level
Export taxes/subsidies	Decline to zero by 2020	Decline to 50 % of 1992 level
Fiscal consolidation	Achievement of targets	No achievement of targets
Labour-market related reforms	Implementation of the OECD Jobs Strategy	No major improvements with respect to labour-market flexibility
'Technical' assumptions		
Energy efficiency	Increase of 1 % per annum in OECD countries and 2 % per annum elsewhere	Increase of 0.8 % per annum in OECD countries and 1.5 % per annum elsewhere
World oil prices	Increase of 2 % per annum in real terms between 1995 and 2010 and 1 % per annum between 2010 and 2020	Increase of 1.5 % per annum in real terms between 1995 and 2010 and 0.8 % per annum between 2010 and 2020
Crude oil and natural gas extraction rates	No differences between the two scenarios	
Decline in trade and transport margins	Decrease of 1 % per annum	Decrease of 0.8 % per annum

- Real GDP per capita for non-OECD countries would be around double the 1995 levels by 2020.

'New Global Age' scenario
This scenario assumes that OECD and non-OECD governments move towards free trade and capital movement. Some of the key features of the world economy in 2020 are then expected to be:

- Real GDP per capita in the OECD area would be 80 per cent higher in 2020 than in 1995
- Progress would be far more dramatic in the non-OECD world, given its current generally lower level of development. Real GDP per capita would be around triple the 1995 levels by 2020.
- Higher growth in the non-OECD area would also mean a big shift in global economic weight, as the non-OECD share of world GDP would rise to about 67 % in 2020 from 44 % in 1995.
- The non-OECD area could become a driving force in the global economy, and the OECD economic performance will depend more and more on their policies and performance.

The strong boost in prosperity would improve capacities to deal with many problems, such as:

- the unsustainable use of water, fisheries and forests and other natural resources as well as a growing range of environ mental problems at local, national, regional and global levels,
- the likely substantial urbanisation in many non-OECD countries, as their economic structure moves toward industry and services,
- the challenges for social policy, especially for OECD countries with ageing populations.

Realisation of this scenario poses challenges for governance and it will require macro-economic stability. A fundamental requirement will be maintaining, and strengthening wherever possible a free and open, rules-based multilateral system for the benefit of all participants. Also the labour markets and the social policies in OECD countries need to change: The 'global age' requires greater flexibility and the social policy must enhance the capacity to change. Furthermore there needs to be consolidating integration of non-OECD countries into the global economy. Policies for sustainable development are necessary, especially since the non-OECD economies will account for a growing share of environmental problems. International agreements will be needed to reduce emissions.

Globalisation will require greater international co-operation, so strong political leadership will also be necessary. The OECD can contribute to global change especially for new emerging issues. The OECD will also be shapened by globalisation and should expand its dialogue with non-governmental actors.

5.2.11. Stockholm Environment Institute and Global Scenario Group (1997) Branch Points: Global Scenarios and Human Choice

The report is written by the Global Scenario Group, a group that was established to engage a diverse group of development professionals in a long-term commitment to examining the requirements for sustainability. It is an independent international and inter-disciplinary body. This report presents the perspective of the GSG on the sustainability challenge and on global futures. The aim of the study is to illuminate the character of the current global system, the dynamics driving it forward, and the spectrum of possible futures states and pathways.

The report begins with a description of the sustainability problem and outlines criteria for a transition to sustainability. After that some key methodological concepts for scenario analysis are described. In Figure 5.24 the, according to them, general scenario process is described. Most studies begin with the current state and driving forces. In addition, the scenario description should include the identification of critical uncertainties the resolution of which will fundamentally alter the course of events. The current state, driving forces, and critical uncertainties form the backbone of the scenarios. Surprises can influence the future strongly and should be taken into account. As a complement to the driving forces, they found it useful to introduce the concept of attractive and repulsive forces. If the attractors and repellors are assumed to be weak, or if they are consistent with current driving forces, the future evolves in what is typically called a business-as-usual scenario.

They state that to shed light on the problem of global sustainability, it is desirable to consider scenarios that incorporate alternative social visions, and highlight significant causal processes and critical decision points. At such points, the choices of many actors and interests (e.g. individuals, corporations, labor, policy makers, political institutions, cultural and spiritual leaders, and environmental activists) can influence which global pathway emerges from the range of possible futures.

Whether or not they use the above described methodology in their study is not clear from their description. They use a socio-ecological sytem for identifying design criteria for policy-oriented scenario analyses (Figure 5.25). Ideally scenarios would be:

- global with regional and, ultimately, subregional disaggregation
- comprehensive with integrated treatment of major environmental, social and economic issues and interactions
- analytically sound with regard to use of data and scientific theory
- diverse with representation of a range of future visions, values and world-views

The socio-ecological system can be defined at multiple spatial levels e.g. global, regional, national and local. Different issues come into focus as one zooms in or out. The focus in this study is global, but the other scale levels are also taken into account.

In the study they classify scenarios within a two-tier hierarchy: those based on fundamentally different social visions and variants reflecting a range of possible outcomes within each class. This procedure highlights the plausible qualitative transitions in funda-

The general scenario development process (according to SEI and GSG, 1997) Figure 5.24

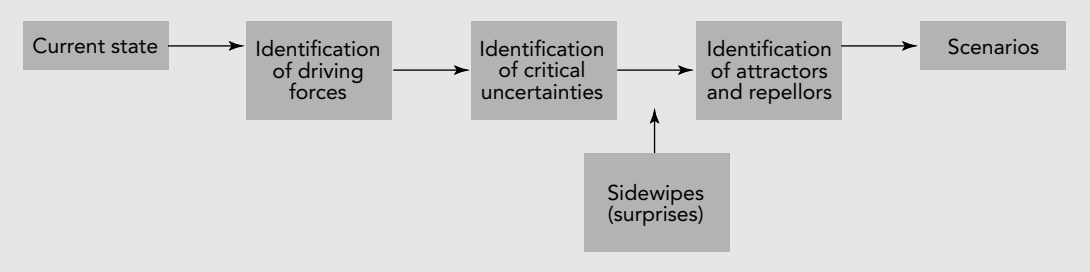
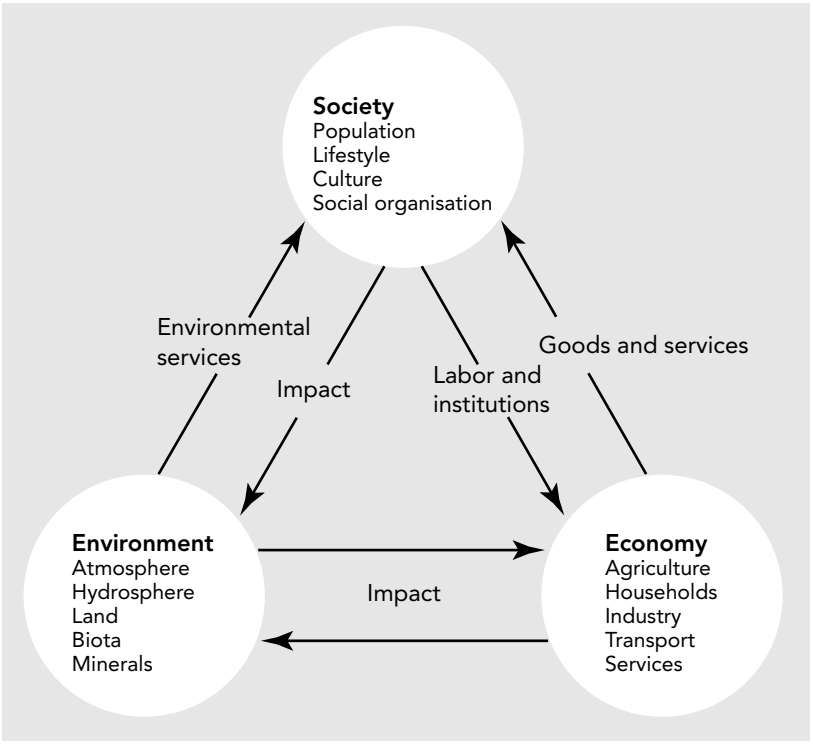


Figure 5.25 **The socio-ecological system (Raskin et al, 1996)**



mental directions for society in light of today's driving forces, future uncertainties and the many critical individual and collective decisions yet to be taken. They begin with three broad classes which they call Conventional Worlds, Barbarization, and Great Transitions distinguished by, respectively, essential continuity with current pattern, fundamental but undesirable social change, and fundamental and favorable social transformation. For each class, they define two variants, for a total of six scenarios.

Conventional Worlds
Within Conventional Worlds, the Reference variant incorporates mid-range population and development projections, and typical technological change assumptions. The Policy Reform scenario adds strong, comprehensive and coordinated government action, as called for in many policy-oriented discussions of sustainability, to achieve greater social equity and environmental protection. In this variant, the political will evolves for strengthening management systems and rapidly diffusing environmentally friendly technology. Whatever their differences, Conventional Worlds variants share the premises of the continuity of institutions and values, the rapid growth of the world economy and the convergence of global regions toward the norms set by highly industrial countries. In the business-as-usual Reference variant, the problem of resolving the social and environmental stress arising from global population and economic growth is left to the self-correcting logic of competitive markets. In the Policy Reform variant, sustainability is pursued as a proactive strategic priority.

Barbarization
Barbarization scenarios envision the grim possibility that the social, economic and moral underpinnings of civilization deteriorate, as emerging problems overwhelm the coping capacity of both markets and policy reforms. The Breakdown variant leads to unbridled conflict, institutional disintegration, and economic collapse. The Fortress World variant features an authoritarian response to the threat of breakdown. Ensconced in protected enclaves, elites safeguard their privilege by controlling an impoverished majority and managing critical natural resources, while outside the fortress there is repression, environmental destruction, and misery.

Great Transitions
Great Transitions explore visionary solutions to the sustainability challenge, including new socio-economic arrangements and fundamental changes in values. These scenarios depict a transition to a society that preserves natural systems, provides high levels of welfare through material sufficiency and equitable distribution, and enjoys a strong sense of social solidarity. Population levels are stabilized at moderate levels and material flows through the economy are radically reduced through lower consumerism and massive use of green technologies.

TheEco-communalism variant incorporates the green vision of bio regionalism, localism, face-to-face democracy, small technology, and economic autarky. The New Sustainability Paradigm variant shares some of these goals, but would seek to change the character of urban, industrial civilization rather than replace it, to build a more humane and equitable global civilization rather than retreat into localism.

Many alternative scenarios can be constructed as variations of these cases. Scenarios more nuanced than the ideal types presented in this study would reflect regional variations and the possibilities of discontinuous jumps at critical points in the development trajectory. But the idealized taxonomy provides a useful framework and point of departure for more detailed explorations.

5.2.12. Stockholm Environment Institute and Global Scenario Group (1998) Bending the Curve: Toward global sustainability

This report is a follow-up of the report summarised above: 'Branch points: global scenarios and human choice'.

In this report the focus is on the Conventional Worlds-Policy Reform scenario. The Policy Reform scenario is distinguished from the business-as-usual Reference scenario by the assumption that comprehensive and coordinated government action is taken for sustainability. The scenario is used to explore the requirements for achieving sustainability and the challenges for policy within a Conventional Worlds framework. They acknowledge that the fundamental premises of these scenarios are not inevitable. Nevertheless they have chosen this scenario because, according to them, the center of the policy discussion today lives in the Conventional Worlds niche.

First a broad set of environmental and social criteria to serve as goals for long-term sustainability are given. They suggest sustainability indicators and targets for five broad environmental challenges:

- stabilizing the climate within safe eco logical limits,
- reducing the flow of materials through economies,
- decreasing toxic waste loads on the environment,
- easing the pressure on freshwater resources,
- maintaining the integrity of ecosystems.

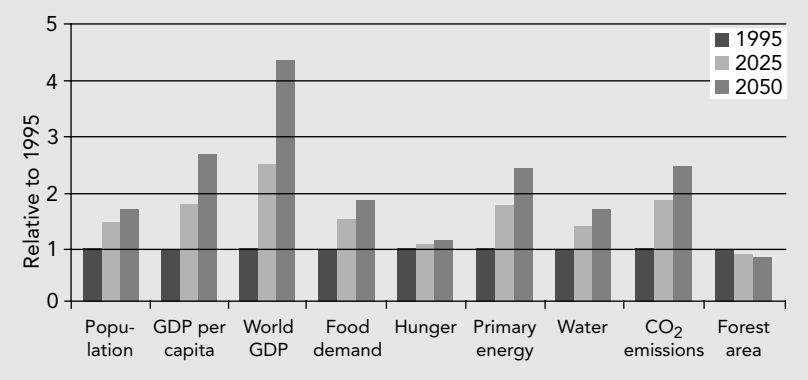
The targets call for substantial decreases in environmental pressures from OECD economies.

According to them there can be no easy consensus on broad social goals, which will vary across worldviews and societies. They consider only a minimal set of objectives that have wide international consensus:

- the provision of basic human needs such as adequate food,
- clean drinking water,
- access to health care and education.

After setting these targets they use the Reference (business-as-usual) scenario to see whether these targets are achievable when current trends continue. They use this baseline to assess the types of policy changes needed.

Overview of the Reference scenario (SEI and GSG, 1998) — Figure 5.26



Measured against their sustainability criteria they conclude that the world in the Reference scenario would be a risky one for people living in 2050. The increasing pressure on environmental systems is environmentally unsustainable. This degradation of the environment undermines perpetual economic growth on a global scale, one of the premises of the scenario. The developments in this scenario also fail to address the social goals for sustainability.

To see what strategies are necessary to reach the sustainability goals, the scenario is constructed as a backcast from a desired future in 2050 and beyond. The aim is to identify plausible development pathways for getting there, including the choices and actions for shaping a sustainable future. In the Policy Reform scenario, poverty reduction goals are realised through initiatives to increase the incomes of the poor. International equity is aided by strategies that accelerate the convergence of developing and transitional regions toward OECD levels of development. National equity is improved through income distribution policies. Meeting the environmental goals in the Policy Reform scenario requires dramatic adjustments in the use of resources, abatement of pollution, and protection of ecosystems. Energy, water and resource use efficiency must increase substantially. Renewable energy, ecologically based agricultural practices, and integrated eco-efficient industrial systems must become the norm. To live within water and land constraints, a number of developing countries must rely more heavily on food imports, countering recent trends in industrialized regions of withdrawing lands from agricultural production.

The conclusion of the study is that environmental degradation is not a necessary out-

come of development. Also poverty and extreme inequity are not inevitable. They are all the outcome of specific sets of policy choices. They also conclude that reversing the negative trends, and creating a transition to global sustainability will not be easy. It will require a widespread conviction that action is necessary and it will depend on finding sufficient political will.

5.2.13. Hammond (1998) Which world? Global destinations, regional choices

This study builds on the work of the Global Scenario Group (Hammond is a member of this group). They developed the scenarios a described in the report 'Branch points: Global Scenarios and Human Choice (see page 78); Also the work of the 2050 Project, an earlier joint effort of the World Resources Institute, the Brookings Institute, and the Santa Fe Institute is used. The report further relies on data from the World Bank, United Nations agencies, and other sources.

Hammond himself identifies that the set of scenarios he presents lacks the full complexity and richness of the original work. The names he has given to the scenarios are:

- Market World
- Fortress World
- Transformed World

In the following the scenarios are briefly described. The scenarios are written from the perspective of 2050, so it is a story about what happened in the last half century.

Market World

This scenario describes a future based on the belief that market forces and new technology will lead to rising prosperity and will offer humanity a bright future, a future in which markets rule and global corporations dominate. Economic reform and technological innovation fuel rapid economic growth. Developing regions are integrated into the global economy, creating a powerful global market, and bringing modern techniques and products to virtually all countries. The result is widespread prosperity, peace, and stability. In this scenario current trends continue.

Fortress World

Fortress World is a fundamentally pessimistic vision based not only on the failure of market-led growth to redress social wrongs and prevent environmental disasters but also on the belief that unconstrained markets will exacerbate these problems and that large portions of humanity will be left out of the prosperity that markets bring. These failures eventually destroy the resources and the social framework on which markets and economic growth depend. Economic stagnation spreads as more resources are diverted to maintain security and stability, as does economic fragmentation where conflict dominates or the social order breaks down. The scenario describes the dark side of global capitalism, a future in which enclaves of wealth and prosperity coexist with widening misery and growing desperation, a future of violence, conflict, and instability.

Transformed World

In this scenario fundamental social and political change, and perhaps even changed values and cultural norms, give rise to enlightened policies and voluntary actions that direct or supplement market forces. Transformed World envisions a society in which power is more widely shared and in which new social coalitions work from the grass roots up to shape what institutions and governments do. Although markets become effective tools for economic progress, they do not substitute for deliberate social choices; economic competition exists but does not outweigh the larger needs for cooperation and solidarity among the world's peoples and for the fulfillment of basic human needs. In effect, this optimistic vision asserts the possibility of fundamental change for the better.

The three scenarios are constructed to frame sharply contrasting images of the future. In reality, the world in 2050 is likely to contain elements of all three scenarios. The scenarios are also intended to be clearly within the realm of the plausible; therefore they are based on existing trends. There are no real surprises included in the scenarios.

After the description of the scenarios the critical trends that will shape our future are discussed. Demographic, economic and technological as well as environmental, security, social and political trends are discussed.

The world is already so strongly interdependent that no region's future can be fully separate from that of others. The book divides the world in seven regions for which the future is unraveled in more detail. The three scenarios described above are adapted for each region. The regions described include:

- Latin America
- China and Southeast Asia
- India

- Sub-Saharan Africa
- North Africa and the Middle East
- Russia and eastern Europe
- North America, Europe and Japan

The latter region is described in more detail in the next section. The focus of these summaries is on North America and Europe. Japan is only touched upon.

North America, Europe and Japan

Market World: The Long Boom
Powered by an unprecedented burst of innovation and relatively unhampered market forces, the U.S. economy continued its steady growth well into the new century. A scarcity of labor, especially skilled labor, kept unemployment rates low and gave new impetus to training programs and basic education. Slowly but surely, Europe and Japan adopted similar approaches: deregulating, opening markets to competition, reducing government interference, reducing taxes and stimulating social benefits. Wealth became even more concentrated in the industrial world. And with that wealth came all that money could buy-cities sparkled, the air and the rivers were relatively clean, and environmental trusts bought up and preserved huge tracts of forests, wetlands, and wild rivers.

As average incomes doubled, even those inhabitants of the industrial countries with modest wages found they could afford the good life. Indeed, so vast was the gap between incomes in industrial and developing countries that travel to exotic places and even the purchase of vacation homes complete with servants in far-off resort locations became common practice. Of course, high-consumptive lifestyles had some environmental costs: the climate was undeniably warmer, for example, and fish were more expensive since the collapse of most marine fisheries. But air-conditioning took care of the first problem and most people in industrial countries could easily afford higher prices for delicacies. Only in developing countries did the real costs become apparent, but few tourists from the rich countries ventured far from the luxurious resorts and carefully chaperoned tours organized for their benefit.

Fortress World: Turning Inward
The U.S. economic boom continued for a few years into the new century, but did not lead to social progress. Innovation slowed and recessions reappeared. Welfare reform did remove the poor from government roles, but left a lot of them still on the street. The result was even sharper economic divisions between rich and poor. Demand for private security services grew rapidly, and there was a massive increase in gated communities. Many desperate people from developing regions continued to try every means possible to reach the United States. The political debate over immigration intensified.

Europe suffered similar problems. Despite a common currency, the European Union's complex regulations and employment laws discouraged business innovation; unemployment remained high. Subsidies to newer and poorer member countries kept taxes high, as did the burden of supporting an ever-larger group of retirees with a shrinking workforce. With low-priced imported goods from Asia swamping European markets, the pressure to protect companies and jobs became overwhelming: Europe adopted stiff tariffs on many imported products. But the move triggered a trade war with the United States, and Russia threatened to shut down the pipelines supplying most of Europe's natural gas.

What worsened matters was the fundamentalist Islamic revolution that swept across North Africa and the Middle East, triggering a mass exodus of people fleeing the violence and strict codes of dress and behavior. Many sought refuge, mostly illegally, in Europe, where they were blamed for the economic decline and for rising crime rates. As the crisis deepened, ultra-right parties increasingly attracted mainstream voters fed up with political and economic paralysis and drawn to the xenophobic and anti-government message. As new elections showed the strength of voter reaction, these parties demanded, and most parliaments were only too ready to approve, the re-imposition of internal border controls and other security measures, including new identity cards. Fortress Europe increasingly abandoned its liberal ideas and retreated into itself.

Without U.S. and European leadership, international efforts to protect the climate went nowhere. By 2020, the effects of an altered climate were inescapable – heat waves, more intense floods and droughts, and shifts in biological patterns, including tropical diseases moving north.

Transformed World: An Open Society
Some of the changes were driven by economic policies. In the United States, forging political support for trade deals required

more social efforts to help those who lost jobs as a result. In contrast, as economic integration accelerated in Europe, this region gradually scaled back its generous social welfare benefits.

Environmental concerns also forced change. Initial agreements to make modest cuts in emissions of greenhouse gases were strengthened. Although coalmines were shut down, many new jobs were created in the booming fuel cell, solar cell, and wind energy industries. At the same time, as governments in the industrial countries used their revenue windfalls from energy-related taxes or sales of emission permits to lower social security or other employment taxes, labor costs came down and employment surged, especially in Europe. Lower taxes proved so popular that many countries also raised their levies on natural resources, in addition to energy. That extended the revolution in industrial efficiency. Low-impact lifestyles, vegetarian diets, and anti-materialist ethics gained a wide following. With less need for raw materials and energy, pollution and waste-disposal problems in the industrial countries declined sharply.

Social activism also helped bring fundamental social change. Slowly, U.S. society began to share its new wealth and expanding opportunities with its entire people. Similar efforts in Europe helped to reclaim the 'lost generation' of young people who had endured years, sometimes a decade or more, of unemployment. With urban revitalization, cities again became attractive, exciting places to live, greatly slowing suburban sprawl. In Europe, the integrated economy began to hum. Before long, unemployment ceased to be a concern to governments in the region. Social benefits were more modest, but higher prosperity was for most an acceptable alternative. The turn toward more flexible and more open economies, painful and politically controversial at first, also made it easier to push European integration eastward, eventually all the way to the borders of Russia. In all of the industrial regions and in the more prosperous developing countries as well, there emerged the widespread conviction that it was now within the grasp of a global civilization to finally eliminate poverty.

Internet

On the Internet a site is set up where people can explore the scenarios interactively (http://mars3.gps.caltech.edu/whichworld). The three world scenarios and all scenarios for the regions are presented and people can react on them and give their suggestions. Also there is the possibility to build your own scenario based on population growth and GDP per capita.

5.2.14. Nijkamp, Rienstra and Vleugel (1998), Transportation planning and the future

The aim of this study was to fill the current gap in strategic thinking by offering a methodology for scenarios in which expert knowledge is integrated with policy ideas (Spider methodology). The study focusses on the future of transportation with the aim to explore more environmentally friendly mobility patterns.

It is recognised that it is impossible to isolate the transport sector from other human and industrial activities. However the need for a broad approach runs the risk of lack of focus and hence of spurious conclusions. Therefore several limitations are build into the Spider methodology:

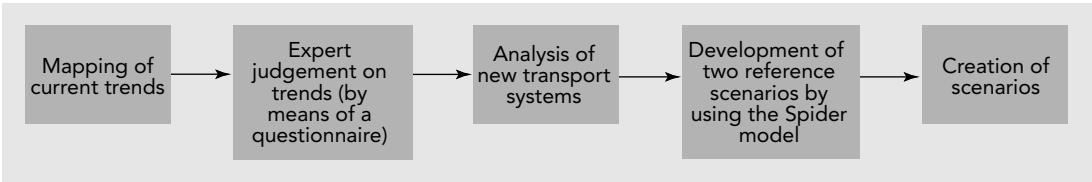
- Scale: Western Europe
- Time: 2030 (short enough to connect current trend to new futures and long enough to allow for rather drastic changes)
- Focus: passenger transport, not on freight transport

The Spider methodology is visualised in Figure 5.27 and elaborated upon on the following.

The study begins with a profound mapping of the current trends in transport and its environmental impacts. The trends studied include the current European environmental and transport policies, trends in European passenger transport, the modal split and spatial, institutional, economic and socio-psychological trends. In general, one of the conclusions of this investigation may be that the current major trends in transport tend to move the transport system away from sustainability, despite the efforts in the technical field to reduce the negative environmental impacts of transport. A more drastic change may be necessary.

After the mapping of the trends experts were asked to give their opinion on the value of these trends. This was done by means of a mail questionnaire responded to by 271 transport specialists. The questionnaire contained questions on perception, expectations and desirabilities of sustainable transport policies at present and in the future. One of the conclusions based on the ques-

The scenario development process Figure 5.27



tionnaire was that the expectation of experts in the effectiveness of policies is not very high.

Next a survey has been conducted to analyse technical innovations. Two major directions in technology were distinguished: improvements of current modes and the introduction of new ones. Among the subjects covered in this survey are alternative fuels, electric cars, hybrid cars, fuel cell cars, guided cars and telematics and hydrogen planes. For the collective transport modes the high-speed train, MAGLEV and subterranean transport systems are examined. From the survey it was concluded that there are many technological options that may reduce the externalities caused by existing transport.

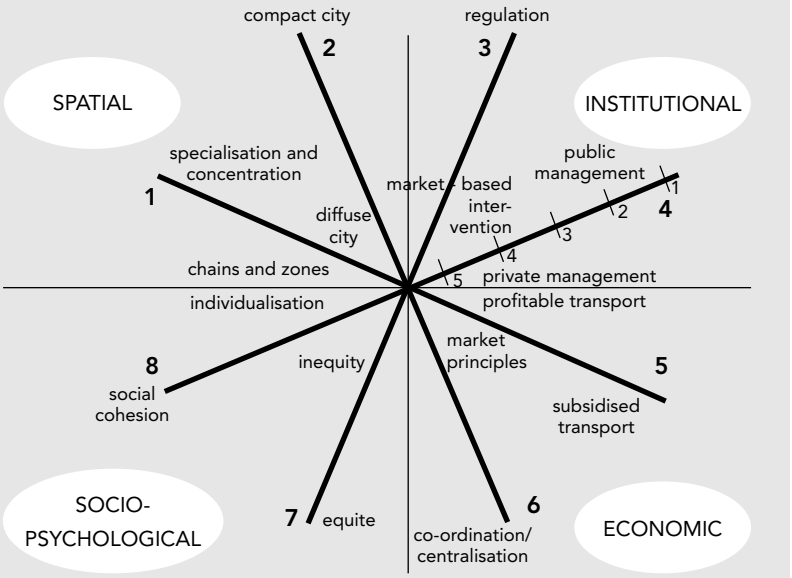
After the clarification of the trends and technological innovations, various scenarios are constructed for the future of transport. Nijkamp et al. consider scenarios as a tool that may play an important role in scanning the uncertainties, in designing new opportunities and in identifying possible bottlenecks. The factors taken into account are spatial (e.g. trends in regional-economic development), institutional (e.g. co-ordinating policy, reducing government deficits), economic (e.g. world and European economy and economics of the transport sector) and socio-psychological (e.g. ageing, individualisation), as well as the technological potential needed for various sustainability options in transport systems. The scenarios aim to be policy-oriented, seeking transport-related strategies to reduce the negative externalities of transport. Another feature of the scenarios is that they are explicitly bottom-up oriented: the scope, contents and orientation of a scenario are based on a participatory procedure in which multiple individual opinions and views are used to compose scenarios. The scenario approach adopted in the study is explicitly expert-based. The scenario experiment is also menu-driven, which means that experts, in the questionnaire, are confronted with individual features and driving forces that altogether make up a transportation system (see Figure 5.28). By asking their views on individual constituents of scenarios in terms of relative importance, significance etc., they composed scenarios based on different compositions of the menu created by the experts.

Nijkamp et al. used the so-called Spider model to provide a web from which they developed the scenarios. The Spider model is a conceptual model that involves a qualitative type of multi-criteria approach. Advantages of a quantitative approach are that the individual assessment criteria do not have to be measured in a single quantitative unit. The Spider model comprises four dimensions, i.e. spatial, institutional, economic and socio-psychological. The rank order of scores for the items on each of the eight axes (1-5, in Figure 5.28 displayed only for one axis) is such that the inner points close to the origin are more associated with non-intervention (market-oriented) strategies, whereas the outer points reflect the motives associated with policy (regulatory) interventions. The two extreme points on each axis have only a qualitative meaning.

On axis one, possible developments in the future for European spatial organisation are mapped. Axis two in the spatial organisation quadrant is mainly concerned with urban patterns. On axis three the degree of government intervention in the transport market is depicted. The management of transport modes and infrastructure is found on axis four. Axis five concerns the economic feasibility of transport as, according to Nijkamp et al., the required profitability of transport modes is an important factor for their chance to survive in the future. Axis six introduces the market principles in the economy versus coordination by the government. The socio-psychological factors consist of axes seven and eight, respectively equity versus inequity and social cohesion versus individualisation.

A transport system can be represented and assessed by a combination of eight points (or

Figure 5.28 **The spider-model for depicting the driving forces of future transport systems (Nijkamp, Rienstra et al., 1998)**



qualitative rank order scores) on the successive axes of the Spider model. So for each driving force the importance can be given by means of a number (1-5) on each of the eight axes. In the scenario experiments, two reference scenarios were used to provide a reference pattern. These two scenarios (market-oriented and regulatory) are constructed in such a way that they form the inner and outer circle of the Spider model (Figure 5.29). They mainly serve as a frame of reference for assessing and evaluating intermediate scenarios.

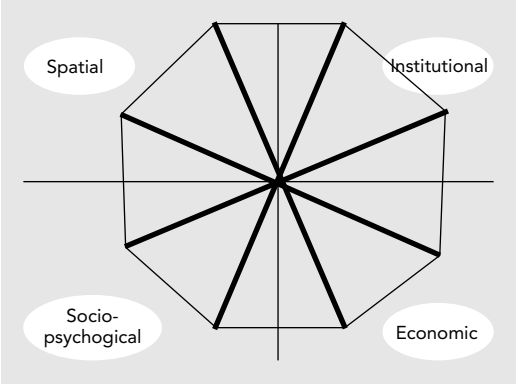
The two contrasting reference scenarios each describe a different development of the future. Both scenarios result in a different transport system, one dominated by individual modes and the other by collective transportation. In both scenarios the CO_2 emissions may be reduced substantially. In the market-oriented scenario most population and activities are found outside the cities, while in the regulatory scenario these are more concentrated in the compact cities, and therefore also the mobility patterns differ largely. In the market-oriented scenarios a sustainable transport system develops without large-scale intervention of the government. The spatial organisation and the transport system develop rather naturally because of market forces. This has positive consequences for economic growth, and the economic development of regions is quite equal. There is freedom of choice for individuals. Transport is operated in an efficient way. There is quite a large number of people who have relatively more negative living conditions, while they also have fewer possibilities for satisfying their transport needs. In this way transport may become a luxury good.

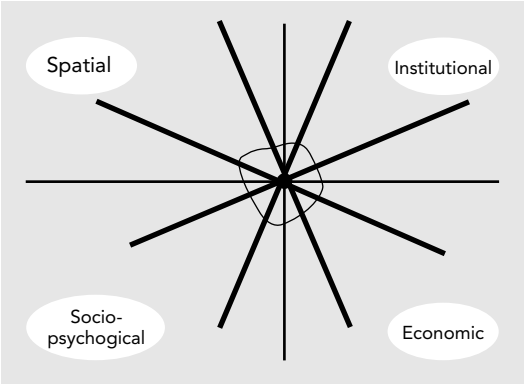
Between these two reference scenarios other scenarios are possible. Experts developed an expected scenario as well as a desired scenario. In Figures 5.30 and 5.31 the expected desired behavioural options and the expected and desired policy measures are displayed. The expected scenario is more or less an extrapolation of current trends. In the desired scenario there is a clear choice for a collective transport system. Therefore large-scale changes are necessary.

The expected behavioural options are always valued lower than the desired ones. The same holds for the policy measures.

It appeared that in general the experts expected a transport system for the year 2030 in which the private car, and to a lesser extent, its improved versions, will remain the dominant modes. For the long-distance

Figure 5.29 **The two reference scenarios, the regulatory and the market-oriented scenario (adopted from Nijkamp, Rienstra et al., 1998)**





transport system the train and high speed train may have a rather high share. Measures to reduce the use of cars are not expected to be introduced to a great extent. In the desired system the use of the conventional car is much smaller. When a car is used it should be run with clean fuels or electricity. Collective modes are considered to deserve a much larger market share.

Nijkamp et al. argue that scenarios should not only view a common sense future, but that they should also focus on interesting minority viewpoints including contrast-images of the future. Therefore they tried to find homogeneous subgroups within their experts group, with rather similar viewpoints. Based on these minority groups more scenarios were made. Examples of such minority groups are economists, planners, traffic engineers working at university and traffic engineers working at a ministry.

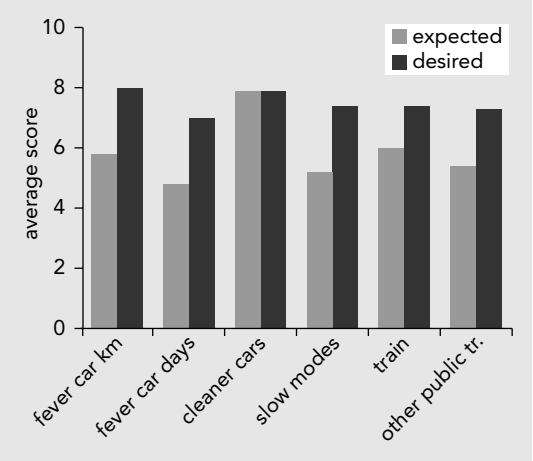
The initial four scenarios (two reference scenarios and two expert scenarios) are partially quantified. For each scenario it is sketched how the passenger transport system might look in terms of the use of various existing and future transport technologies and the corresponding modal split. Expected energy consumption characteristics of the various transport modes, figures from the present fuel supply and electricity generation system, as well as estimations of the future energy system are used. Also the energy consumption and CO_2 emissions by the future passenger transport systems is estimated and compared with those of the current systems.

The general conclusion of Nijkamp et al. is that in the long term a sustainable transport system can be realised by means of rather different sets of spatial, institutional, economic, socio-psychological and technological changes in our society and its transport system. However to reach this, drastic improvements of current transport technologies are necessary. Another conclusion drawn from this study is that 'business as usual' is an unviable strategy to attain a sustainable future for the transport sector.

Finally it is analysed which policy options are possible and which choices have to be made to achieve a more sustainable transport system. The following policy choices are distinguished:

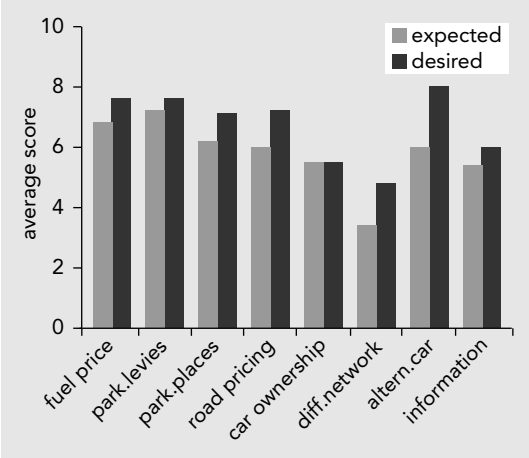
- the choice between collective modes of transport or individual modes. It is not possible to develop both modes simultaneously.

The expected and desired behavioural options (adopted from Nijkamp, Rienstra et al., 1998) Figure 5.30



Scores 1-10; 1 is lowest, 10 is highest
n = 246-259 (not all 271 respondents answered all questions)

The expected and desired policy measures (adopted from Nijkamp, Rienstra et al., 1998) Figure 5.31



Scores 1-10; 1 is lowest, 10 is highest
n= 254-261

- Essential for this first policy choice is the future spatial organisation. Depending on which spatial organisation has been developed (e.g. compact-city concept) it can be decided which mode of transport has most potential. In practice, however, this means a trade-off has to be made beteen the environmental, societal and other external impacts.
- to make the conventional car and plane deliberately unattractive despite resistance in society,
- the government may stimulate the introduction of new options by means of offering convincing examples of both good intentions and actions.

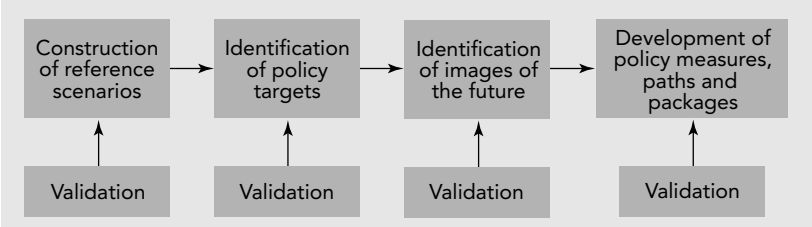
5.2.15. POSSUM team (1998), POSSUM project

The main task of the POSSUM project has been to construct scenarios for achieving the objectives of sustainable development and to

assist the European Commission in future decisions about the Common Transport Policy and the development of the Trans-European Networks (POSSUM team, 1998). More specifically the project aims at identifying future key issues for policy makers at the European level, such as packaging (how can policies be packaged to increase their effectiveness?), timing, implementation (public acceptability) and responsibilities (of decision-makers and other stakeholders. The reference year 2020 is chosen because it allows radical changes, and it allows assessing the long-term impact of policy packages. A shorter time horizon may reduce the possibilities of analysing large shifts, while a longer period may reduce the policy relevance of the scenarios. The project focuses on urban transport problems. For more rural areas and the peripheral regions of Europe, different problems exist.

The POSSUM methodology involves two main steps. The first step is the construction of reference scenarios. This was done to highlight possible goal conflicts and to identify policies that would optimise each goal. The method involved a bottom-up approach, the use of questionnaires and expert groups in order to provide an overview of key policy issues and important external factors. In the second step a backcasting technique comprising of three main stages is used: the identification of policy targets, the definition of 'images of the future' and the development of policy packages and paths. It is attempted to validate the methodology, the images of the future, the policy paths and the overall conclusions and recommendations. Validation has been done by means of workshops and meetings with transport experts and the scientific community. The issues addressed were, among others, whether the images and the policy paths were consistent and whether the proposed policy packages were considered effective enough.

Figure 5.32 **Scenario development process**



Policy targets

For the identification of the policy four approaches are used: literature review, internal workshops, questionnaire and review of sustainability targets. The policy targets focused on environmental protection, economic efficiency and regional development. The identified policy targets for the year 2020 for the POSSUM project are shown in Table 5.13.

Images of the future

Three images of the future were developed for this study, reflecting different assumptions about external factors (e.g. dominant level of policy making) and strategic elements (changes in technology and decoupling). They specify the future conditions under which policy-making will take place. As part of the identification of images of the future, key issues and key states were identified. The key issues specify important policy areas between the present and the target date (2020) for each of the three images of the future. The key issues include potential problems for policy-making, sectors where policy must be focused and important changes in transport demand. The key states specify the strategic policy steps between the present and 2020 for each of the three images of the future. The key issues and key states act as an intermediate between the images of the future and the identification of policy packages and paths.

They have identified two main categories of change that are evaluated in view of the POSSUM targets by the year 2020:

1. A reduction of energy use and emissions by means of technological improvements.
2. A decrease in transport intensity of GDP, that will allow the volume of transport to increase at a rate which is less that the economy at large.

The contextual elements deal with the level of co-operation in society. Here three alternatives are distinguished:

1. Local, regional and EU cooperation
2. Global and EU cooperation
3. Local – global cooperation

Based on the two dimensions nine possible images of the future can be constructed (Table 5.14).

Three of these images were selected in view of policy relevance:

Image I: EU coordination of active citizens. This image has a focus on decoupling and has a bottom-up approach.

Image II: Global cooperation for sustainable transport. The focus is on technology and a top-down approach.

Image III: Accord on sustainability. This is a combination of both top-down/bottom-up and decoupling/technology.

In the following the Images are described in more detail (POSSUM team, 1998):

Image I: EU co-ordination of active citizens
There has been a trend towards more 'local life-styles' and green values among the general public. People increasingly take responsibility for the common good and attitudes towards collective actions are positive, especially at the local and regional levels. People are pushing the politicians to adopt stricter environmental regulations and standards, especially at the local level (urban areas). At the global level no agreement on harmonising standards is achieved. Also, demand is affected. People are willing to pay for greener products as well as for locally produced goods. Settlement patterns and location of workplace and service functions are also affected. Many urban sub-centres have developed to a higher degree of self-sufficiency and city centres are being re-urbanised. There is an increased acceptability for urban public transport, bicycles, and electric urban cars.

Production is more local and mainly serves local markets, but is based on licenses and the know-how of the big international firms and networks (global production). There is also an increasing share for the service sector, with traditional manufacturing industry showing a declining share of total production. GDP grows at a moderate pace, green GDP develops faster. Freight transport volumes have actually levelled off. A tax base reform (in line with a dematerialisation strategy) has taken place in the EU countries, shifting taxation from labour to the use of natural resources and energy, with the aim to stimulate conservation of resources. This and green demand have made producing firms reduce their use of energy, materials and hazardous substances etc.

General approach to transport policy
The shift in values and life styles has led to a higher acceptability for changes in residential and travel patterns, providing an opportunity to bring the growth of transport volumes under control. Therefore the prime political strategy vis á vis the environmental goal, is to promote a decoupling of transport growth from GDP growth. As mentioned above, the shift in demand has in itself led to a considerable degree of decoupling regarding freight. This is complemented by policy measures intended to reduce structurally enforced travel, such as commuting to work and service trips. Here, urban land use planning and measures to facilitate telecommuting are important. A policy for cleaner transport (both personal travels and freight) is also important. This consists of three parts:

POSSUM policy targets for 2020 (POSSUM team, 1998) Table 5.13

Environmental targets
- 25 % reduction of CO_2 emissions from 1995-2020
- 80 % reduction of NO_x emissions from 1995-2020
- No degradation of protected areas.
- Marginal increase of net infrastructure surface in Europe.

Regional development targets
- Improve relative accessibility of peripheral regions (both internal and external). This target includes cost and time, and allows for substitution of physical accessibility by telecommunications.

Economic efficiency targets
- Full cost coverage (including external costs) of transport under market or equivalent conditions.
- Reduce public subsidies to all forms of transport to zero, except where there are particular social equity objectives.

The nine images of the future obtained from combining the two dimensions (POSSUM team, 1998) Table 5.14

Contextual elements	Strategic elements		
	Technology+/ Decoupling+++	Technology+++/ Decoupling+	Technology++/ Decoupling++
Local, Regional + EU cooperation	**D1**	T1	TD1
Global + EU cooperation	D2	**T2**	TD2
Local-Global cooperation	D3	T3	**TD3**

1. measures to promote a shift in modal split towards a higher share for cleaner modes (e.g. more public transport, a higher share for freight by rail etc.);
2. measures intended to make each mode cleaner, by spread of cleaner technologies;
3. measures to increase load factors.

Measures affecting modal choice form an important part of the general policy. Cleaner technologies are supported by research and development funding, and niche markets for introduction of new vehicles, and systems such as car pooling with specialised vehicles are all created. There is no great need for new inter-regional infrastructure, the exception being the improved quality of links to the former CEEC countries. Railways and other public transport are kept in public hands but they operate independent from the governments. EU has an important role in coordinating regional and national policies and in harmonising targets and standards in Europe.

Image II: Global co-operation for sustainable transport

There is a certain degree of green consciousness and an acceptance of policy measures intended to mitigate the environmental problems, i.e. those related to transport. However, these issues are not pushed by a broad opinion among the public. Rather, it is the politicians that are at the forefront, trying to find solutions at the EU and global levels. Politicians are relatively successful in forming opinions and there is an understanding that transport must in principle pay its full costs. But most people are not inclined to accept a major change of travel behaviour. Also, there is some green demand, but of a relatively small size.

The international life-style has gained strength. Many people prioritise the broader international output to the narrow local assortment. Also, there is a trend towards segmentation of society into different lifestyles that go across the world. Many enterprises have specialised on a specific segment of customers and provide their specific brand across the world. An early sign of this trend was in the 1990s when Swatch and Mercedes exploited Swatch's knowledge of a certain market segment, to launch the Smart car. Production is increasingly characterised by 'flexible specialisation', and economic development is generally dynamic with a relatively high average GDP growth. Some regions of Europe tend to lag behind, though. Despite a trend towards dematerialisation, transport volumes continue to grow due to increasing distances. A high degree of accord has developed in the relations between EU, the US and Japan as regards international regulations and standards in order to cope with global environmental problems.

General approach to transport policy

The widespread environmental consciousness among leading politicians at the world stage, makes it possible to reach agreements on international standards and norms for cleaner vehicles, reductions of CO_2 emissions and similar levels of taxation of externalities, at least in the OECD area. The accord among world leading politicians impress the general public and makes it possible to gain popular support for such measures. However, as mentioned above, people will not accept measures that interfere with their habitual ways of living, such as using private cars and living in sparse residential areas.

Consequently, the prime policy regarding the environmental goal in Europe is to make transport cleaner. Although some measures are directed towards raising the share of cleaner modes (per person-km), the emphasis is on promoting the development and introduction of cleaner technologies and fuels. As people adhere to the private car, much of research and development is directed towards improving the technology of the conventional all-purpose car. However, more far-sighted policies also exist and are promoted by the EU, such as creation of niche markets for fuel cell vehicles. This is achieved by experiments with environmental zones.

Image III: Accord on sustainability

A spirit of co-operation permeates all levels of interaction – among individuals, locally, regionally, at the national and EU levels, as well as globally. Of course, some problems are still difficult to handle, but there is a respect for other parties' true interests and a willingness to find win-win solutions. The high level of interest and initiatives in societal matters by the general public, has led to a strong support for the principle of subsidiarity. At the same time the overarching political structures of Europe are powerful because of the consensus among leading economic powers of the world regarding many global issues, such as the environment. A kind of balance of power has evolved, based on a strong popular involvement in local and regional affairs and a more passive support for EU coordination and politics in high level issues.

General approach to transport policy
The regions and municipalities of Europe largely choose their own ways in coping with local emissions, congestion etc., while the targets are agreed at higher levels.

Policy measures and packages
The second step is the review of different types of policy measures and their potential contribution to the achievement of the POSSUM targets (Table 5.15).

After that a list of potential policy measures is constructed. These are, for example, policy measures dealing with land-use planning, pricing/taxation, infrastructure, technical improvements, behavioral patterns and information and public awareness. This list of policy measures are combined in sets, likely to work well together. These sets of policy measures are called policy packages Each of the policy packages is designed to relate to a specific image of the future. Policy packages can be imagined as a package of measures to be introduced and discussed in a parliament. They are the result of a creative, iterative process. A triggering issue (central measure) has been taken as starting point and to this complementary measures are added.

Policy paths are combinations of policy packages that lead from the present to one of the images. Paths are made up of both policy packages and policy measures that are needed to attain the targets set in the images. The basic argument is that combinations of policies are more effective in achieving sustainable mobility objectives (Figure 5.33).

In the study some policy packages are described. In the following the main policy measures of two of these packages are shortly described.

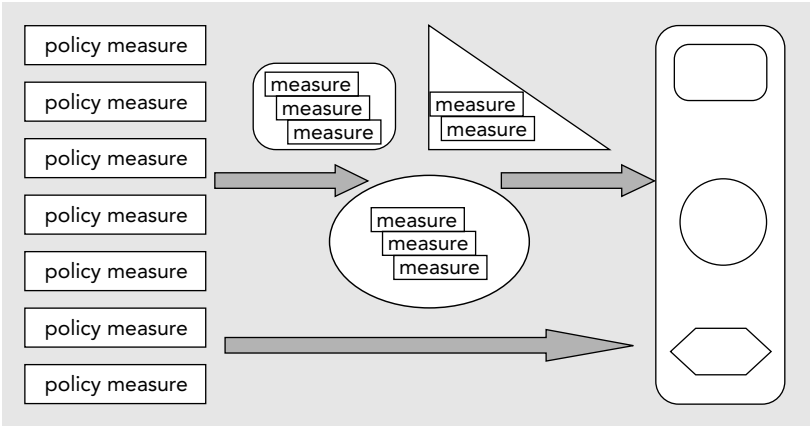
1. Policy package: Electric city vehicles
This policy package aims at a better matching of transport demand with type of vehicle used. This could significantly increase resource efficiency. The main policy measures are:

- A new category of Small Low Speed Vehicles (SLSV) is introduced.
- Support for car pooling and car rental
- Concerted action to promote very efficient and clean vehicles for taxi-fleets, rental-fleets and public car fleets.
- Dedicated parking space for SLSV with shorter lots and much less parking space for conventional cars.
- Low speed zones in residential areas (30-40 km/h).
- Environmental zones only allowing very clean vehicles in central areas.
- Cycling conditions improved, for example by dedicated cycling lanes and supervised parking.

Summary of the achievements of the targets (POSSUM team, 1998) Table 5.15

Targets	Image I	Image II	Image III
CO_2-emissions -25 % EU 15+3	-36 %	-36 %	-44 %
CO_2-emissions -25 % CEEC/CIS	+26 %	+36 %	+24 %
CO_2-emissions -25 % EU 15+3+CEEC/CIS	-29 %	-28 %	-37 %
NO_X-emissions -80 % EU 15+3	-78 %	-80 %	-82 %
No degradation of special protected areas	Target fulfilled low infrastructure investments.	Target fulfilled moderate infrastructure investments.	Target fulfilled Low infrastructure investments.
No or minor increase of net infrastructure surface in Europe	Target fulfilled	Target may be fulfilled if some outdated infrastructure is removed	Target fulfilled
Improve relative accessibility of peripheral regions (both internal and externally)	Target fulfilled, main means is improved telecommunications	In general target is fulfilled, but social distribution of accessibility is rather uneven	Target fulfilled, main means is improved telecommunications
Full cost coverage of transport under market or equivalent conditions	Yes but operated by public sector	Yes but subsidies to infrastructure investments in peripheral regions	Yes but subsidies to research and development on advanced vehicles

Figure 5.33 **Methodology for the construction of policy paths (POSSUM team, 1998)**



2. Policy package: Liveable cities
This package aims at making cities more attractive by diminishing the dependence on car travel. The main policy measures are:

- Possibilities for telecommuting, tele-services and tele-shopping/doorstep delivery are much improved by, for example, adapting legislation and setting up tele-offices.
- Appropriate land-use planning supporting IT-accessibility and public transport by, for example, promoting decentralised concentration.
- Conditions for walking, cycling and public transport improved by, for example, dedicated lanes.
- Space for cars is progressively reduced.
- Low speed zones (30-40 km/h) are introduced in residential areas.
- Environmental zones to stimulate very clean niche vehicles.
- Coordinated distribution with very clean vehicles is promoted.

Four policy paths are identified of which two are directed towards Image I and two towards Image II. Image III is a combination of policies for achieving Image I and II. In two paths the dominant policy orientations are market and lifestyle, the other two are dominated by regulations and public services.

Policy recommendations
Some conclusions are drawn concerning policy:

- If transport is to become more sustainable, then positive policy action is required along the two main POSSUM dimensions (technology and decoupling). In the short term, firm action and direction is required at the EU level to promote best practice and to help push particular technological paths. In the longer term, there should be an open market with pricing and regulations determining which technologies are consistent with sustainable mobility.
- The analysis of different aspects of decoupling transport volume growth from economic growth indicates that a Common Transport Policy must be supplemented by measures outside the transport sector.
- The Trans European Networks form an important component in the achievement of cohesion within Europe, but in terms of sustainable mobility, their role may be more limited.

5.2.16. World Business Council for Sustainable Development (1998), Exploring Sustainable Development. Global Scenarios 2000-2050

A team of people from different businesses (e.g. Shell and GBN Europe) developed the three scenarios of this study, under the auspices of the World Business Council of Sustainable Development. The scenarios are designed to stimulate broad discussion on the challenges of sustainable development for business and to provide a platform for more focused industry and corporate scenarios [15].

The main areas of required research were identified, and information was gathered. The developers took a wide range of views so as to construct a basis for creative thinking. The next step was to analyse driving forces that will shape the environment. The scenarios decribed in this study begin with three pre-determined elements: the new, the many and the connected. According to the WBCSD these are the driving forces that shape the global business environment. They form the common starting point from which the three stories emerge and then diverge, due to the varying ways in which actors respond. The new has to do with social and technological innovations and with the economy in which more and more new countries, new businesses etc. are involved. The many deals with population growth and the connected is the increasing connection between humans and between humans and the environment.

After this identification of the driving forces, a set of plausible storylines is constructed. These storylines are then structured, the relevant interconnections are identified and the scenario logics, including discontinuities are defined. In Figure 5.34 this process is visualised.

[15] e.g. 'Scenarios and biotechnology' and 'Current' thinking in the electricity sector' (both still in preparation). These more focused scenarios will, in turn, provide a useful stimulant for the review of existing strategies and the creation of new ones. The focused scenarios are not further elaborated upon in this review.

The scenarios

In the next section the summaries of the scenarios are given (WBCSD, 1998):

- FROG!, in which the social and environmental problems are ignored and there is total trust in the dynamic of economic growth and the innovations of technology.
- GEOpolity, where people turn away from ineffective institutions of government and business to seek new models of governance that will take into account religious and democratic values
- Jazz, where people try to embody the growing environmental and social values within the economy.

FROG!

The world of FROG! is a familiar world, at least at first. Many nations experience a fair degree of economic success, and, for almost all, economic growth is the major concern, with sustainable development acknowledged to be important, but not pressing. As environmental NGOs continue to demand enforcement of standards that have been set in global summits, those nations striving to develop argue that if the developed nations insist on raising environmental standards, they should '**F**irst **R**aise **O**ur **G**rowth**!'** In this scenario, some nations leapfrog from underdeveloped status to benchmarker in particular areas of technology. People in western nations respond in uneven ways; sometimes by offering help in improving the environment, and sometimes in raising various cries of 'FROG!' themselves, especially in response to perceived threats from underdeveloped nations in the areas of employment, and copyright and patent infringement. People value sustainable development in the FROG! scenario, but it is not top priority. In addition, in the early years, environmental health in many areas improves significantly. The improvement in local air quality, solid waste management, and environmental education leads to a perception that the environment is in much better shape than it was in the late 1990s. But at the global level, the picture is less clear. With economic growth and the increase in population, greenhouse gases are rising, unnoticed by most. The signals are difficult to read, and people disagree about what they mean. Both the difficulty and the disagreement are good reasons, it is felt, to continue to '**F**irst **R**aise **O**ur **G**rowth**!'** But, by 2050 there is evidence that the darkest predictions about global warming are actually nearer to the truth than the more optimistic ones. In FROG!, the habitual reliance on technology has not been sufficient to solve longer-term problems of either environmental or social health. Globalisation and liberalisation of markets along with the pressures of rapid urbanisation have raised the degree of social inequity and unrest to a level that threatens basic survival of both human and environmental ecosystems. In this scenario, people react like the proverbial frog: when placed in boiling water, the frog leaped out of danger; but placed in cold water that was gradually heated to the boiling point, the complacent frog was boiled to death.

GEOpolity

GEOpolity begins with a succession of signals in the first two decades, some real, some imagined, that an environmental and social crisis looms. The prevailing "economic myth" is increasingly viewed as dangerously narrow. This is particularly true in Asia, where rapid economic growth has meant that corners have been cut and traditions lost. Because many institutions, especially governments, have lost credibility as problem-solvers, people expect something from the new centres of power, the multinationals. But the business sector seems unable or unwilling to respond adequately. Business is distrusted, and in some cases, because of its prevailing focus on narrow self-interest, is even perceived to be hindering solutions to problems. Its actions are not coordinated on a global level, and it seems to lack the will even to address the problems. Because neither governments nor businesses are effective in providing leadership, people begin to look for new leaders and to demand new social institutions. Some of these involve the strengthening of government, for example, 'sustainable cities', 'sustainable national accounting', and comprehensive implementa-

Scenario development process (based on WBCSD, 1998) Figure 5.34

tion of industrial ecology. Others are politically innovative. The perceived need for strong and certain responses leads to a new global consensus that welcomes technocratic solutions, sanctions, and more direct control of the market to ensure that environmental values and social cohesion are preserved. The impetus behind all these movements is the growing consensus that the market has no inherent incentives to protect the commons, social welfare, or any other non-economic values. In the absence of leadership from business and government to solve problems, people form new global institutions, such as the Global Ecosystem Organisation (GEO), which has broad powers to design and enforce global standards and measures to protect the environment and preserve society, even if doing so requires economic sacrifice. In GEOpolity, governments are rejuvenated as focal points of civil society. Governments seek to work with markets rather than to displace them. But they take the lead in shifting the structure of the economy towards sustainable development in conjunction with institutions such as GEO.

Jazz

In the world of Jazz, diverse players join in ad hoc alliances to solve social and environmental problems in the most pragmatic possible way. The keynote of this scenario is dynamic reciprocity. This is a world of social and technological innovations, experimentation, rapid adaptation, much voluntary interconnectedness, and a powerful and ever-changing global market. What enables the quick learning and subsequent innovation in Jazz is high transparency, the widespread availability of information about ingredients of products, sources of inputs, company financial, environmental, and social data, government decision-making processes, and almost anything else concerned consumers want to know. Many players are involved, in part because the way information technology lowers barriers to entry allows new actors to step onto the economic stage. And that stage itself is characterised by a global free market, sound legal systems, and a respect for property rights. To the extent that government is involved, it is most active at the local level, with ad hoc global institutions arising to solve particular problems. Agreements are reached through mediation in a world in which transparency is required, but particular 'green' behaviours are not, even though such behaviours are rewarded. Achievement of the new environmental and social standards occurs largely out of self-interest. The public is made aware of transgressions and quickly acts against companies or countries that violate standards. Companies have an interest in seeing that disputes do not escalate and indirectly harm them. They monitor relationships with customers and suppliers closely and drop risky partners quickly. In this highly competitive and interconnected world, businesses see strategic economic advantages in being perceived as environmentally and socially responsible, and many become proactive leaders in responding to social and environmental challenges. Jazz is a world in which NGOs, governments, concerned consumers, and businesses act as partners, or fail. Together, along with other players, they learn effective ways of incorporating environmental and social values into market mechanisms.

For each scenario some challenges to businesses are identified and some lessons that can be learned from the scenarios are described. For FROG! the main lesson is to take social precautions. This scenario indicates the consequences of lack of leadership and coordination between business and government. For GEOpolity the lesson is to contribute, and, where possible, shape the emerging debate on new institutions and rules for conduct in relation to environmental and social matters. Jazz has a lesson in becoming involved early on in working with various stakeholders to take on environmental and social matters as competitive issues, in an open and more transparent world. This scenario indicates that it is not possible to operate against the public good for long.

5.2.17. European Commission Forward Studies Unit (1999). Scenarios Europe 2010. Five possible futures for Europe

The objective of this study was to produce a set of coherent and thought-provoking images of the future of Europe. The results, presented in the report, are five scenarios. The principal aim of the study was twofold: to stimulate debate inside and outside the Commission on the future of European integration; and to develop a tool to put the Union's policies and strategies into perspective and contribute to their improvement.

The scenarios are entirely qualitative in nature. Five themes were selected on which working groups with 12 to 15 commission officials build partial scenarios. Every working group worked on one theme. The themes were:

- institutions and governance

- social cohesion
- economic adaptability
- enlargement of the EU
- external environment

In the second phase of the project a core theme integrated the partial scenarios into full scenarios. In Figure 5.35 this process is visualised.

The scenarios (implicitly) take into account a number of trends that are almost definitely affecting Europe within the time horizon of 2010. The project team made an analysis of these trends. The trends of the following issues are described:

- demography (Europe and world),
- globalisation and inequalities,
- technology and productivity,
- societal trends and values,
- new security threats
- environment.

The scenarios

The following scenarios were developed: Triumphant Markets, The Hundred Flowers, Shared Responsibilities, Creative Societies and Turbulent Neighbourhoods. In the following the scenarios are summarised:

Triumphant Markets

In this scenario there is an increasing mismatch between welfare states and the demands of the economy. Inequality has increased, but it remains at a tolerable level. American society was organised in such a way that it enabled it to take full advantage of the potential of the new information technologies. Europe stays behind. In Europe there is a shift of the political debate to liberalism and individualism and there is a replacement of the political class. There is a reduction in unemployment, which stimulates the whole economy. Governments have made reductions in public expenditure by privatisation of social services and downsizing of the state. There is rapid growth in small businesses and there is an increasing openness to the international environment. Almost unanimous world consensus exists in favour of free trade. Russia and China follow the movement against a background of good economic results. There are prospects of a monetary co-ordination in the zone of the yen, the euro and the dollar. This would mean a world free trade area.

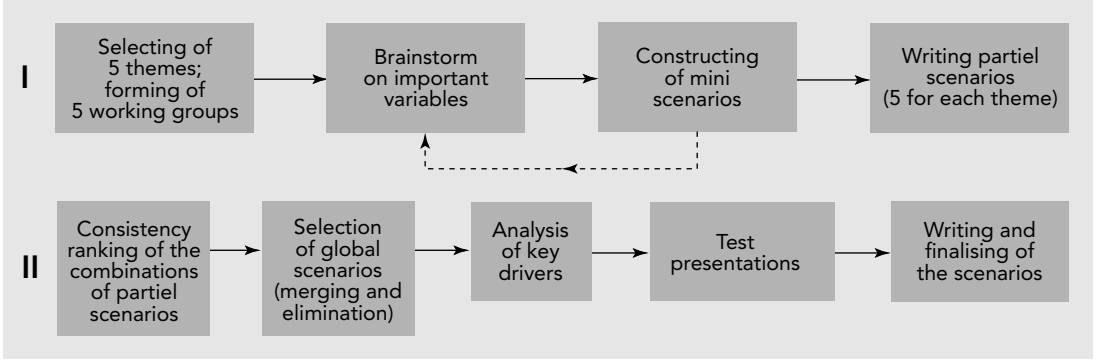
There is an increase in the number of Western-style consumers, but world-wide inequalities are growing. The EU's agricultural and regional policies are revising downward. Most aspects of the European project are abandoned. There is slow progress in justice and home affairs and foreign and security policy are not considered to be a priority. There is no political will to develop the environmental or social dimensions.

The European Union enlarges. Even Israel, Lebanon and Morocco join the Union. Now there is a huge market from the Sahara to Siberia. Behind this dream of a frontier-free economy, however, there is a proliferation of non-military risks and rapid development of international organised crime networks. It appears that there is an inadequacy of international police co-operation. Because of the spread of Western lifestyles the environment is increasingly damaged. Social and regional inequalities are still increasing, both globally and domestically. Societies are individualistic and fragmented, mainly concerned with the short-term.

The Hundred Flowers

The world is settling into an unstable equilibrium over which neither government nor multinationals have any influence, given their dearth of room and lack of legitimacy. Economic performance is disappointing on the whole, even relative to the diminished

Scenario development process (based on EC Forward Studies Unit, 1999) Figure 5.35



expectations at the end of the 20th century. The increasing uneven distribution of wealth, the proliferation of international crime and the multiplication of small regional conflicts are destabilising the global system, but it still continues to muddle along.

Europe is evolving just as patchily as its partners. Some regions have sunk into a lethargy from which it seems they will never rouse, while others are forging ahead with remarkable vitality and enthusiasm. Under the leadership of a new generation of business people, and taking full advantage of the access to knowledge offered by the new technologies, cities and whole regions are enjoying an unprecedented economic, cultural and social revival. The European Union is losing more and more of its powers of persuasion and seriously undermined its credibility by abandoning half-way its planned expansion eastwards (after the accession of four Central and Eastern European countries).

Shared Responsibilities
In this scenario there are increasing signs of discontent in the general public. Wide-ranging audits reveal that major inconsistencies exist in the implementation of public policies throughout Europe. In 2001 a committee of Wise Men has to find ways to improve the situation. They proclaim four fundamental principles: decentralisation, openness, subsidiarity and duty to co-operate. Following their report far-reaching reforms of the public sector are implemented. The accountability principle is applied to all public policies. Unemployment is reduced, partly by systematisation of local employment pacts.

Concerning social dialogue, important breakthroughs have taken place thanks to the strong commitments of governments. There is a rebalancing of labour law and there are welfare schemes in favour of outsiders. Pension and sickness schemes are reformed towards greater accountability of the citizens and there is a better balance between generations. Slight improvements can be noticed in regional and social cohesion despite persisting development and income gaps. Striking is the rise in civil society. The subsidies for social and political innovation introduced in most European regions have enabled many people to set up local community associations, networks for political debate, etc.

Europeans converge around shared values: confidence, solidarity and responsibility. The EU is still in the process of digesting its eastward enlargement. Between 2004 and 2009, thirteen new states have joined the Union. The success of enlargement owes much to world economic prosperity and the relatively peaceful relations between the EU neighbours, but it is also due to the constant commitment of the member states and the gradual emergence of a common political vision. In 2007 there is a major reform of EU institutions and there is a strong commitment towards 'more Europe' to face the main political challenges. Major progress is made in the field of foreign policy, EU's neighbourhood policy is reinforced by a series of all-encompassing partnerships.

Creative Societies
Cuts in public spending and new austerity programmes lead to massive public protest all over Europe. A European Forum is set up where people can submit their proposals to save the situation. The Forums offer the opportunity to recognise the importance of the human dimension. There is a rising public pressure on governments to focus on social questions. Governments decide to support green accounts, new taxes on pollution and international financial movements. The other great innovation of the first decade was the recognition and funding of types of activity that offer an alternative to traditional work. All Europeans were given the right to devote several years of their working life to collectively useful tasks.

The reforms have achieved their main purpose, namely to improve the social situation. The economic impact is more debatable. There is relocation of some industrial and financial activities outside Europe. However the situation shows signs of improving and some forecasters are predicting that by 2015 Europe will have regained the level of wealth it enjoyed at the turn of the century. Some innovative firms take advantage of the new socio-economic framework.

The enlargement process of the EU is delayed by a Western European 'post-modern' revolution. European integration in general is looking somewhat shaky. The EU is not able to develop a coherent foreign policy. For sustainable development as well as for international crime and world poverty a stronger system of international governance is urgently needed. There is pressure for more multilat-

eral co-operation, but there is lack of political will.

Turbulent neighbourhoods
Twenty years after the Cold War political instability is a growing problem the world over, particularly in the countries neughbouring Europe. There is no indication that the situation will improve in the near future. There is a proliferation of small-scale conflicts and globalisation fails to deliver. There are increasing tensions on the doorstep of the EU and there is a growing public anxiety over the insecurity in Europe. The EU lacks a coherent foreign and security policy while in the EU's backyard major armd conflicts erupt (the Thirst War, about water). Terrorists export the conflict to the EU which leads to a military response from Europe, led by the big member states. The US declines to take part in the conflicts. Six months and twenty-five thousand deaths later, the Thirst War is over.

The deterioration in neighbourly relations and the events in the winter of 2003-2004 brought about profound changes in the European Union, particularly its institutions. A European Security Council and security agencies were established. There is more intergovernmentalism in the EU's approach to foreign policy and internal security. Chaos emerges in the former Soviet Union and Eastern Europe. There are intractable problems with illegal immigration. Furtermore the Turkish liberal elites weakened, which causes deterioration in the relations with the EU. Also the Southern Mediterranean countries suffer from political instability.

Religious parties are more and more present in politics and the world is increasingly split into regional blocs and spheres of influence. The difficult situation on the outside is having serious repercussions on the life inside the EU. People are willing to shut their eyes to infringements of certain fundamental rights and freedom to preserve the fragile peace that they are living in. Europe is coming to resemble a police state a little more every day. The European public is unsettled, passive and becomes increasingly intolerant. There is a passive acceptance of degradation of public services.

Internet
On the European Commission's website (http://europa.eu.int/comm/cdp/index_en.htm) a dialoque mailbox is available to which people can send their reactions and ideas about the scenarios. In this way a discussion platform can be established.

5.2.18. IPCC, Working Group III (in preparation), Special Report on Emissions Scenarios

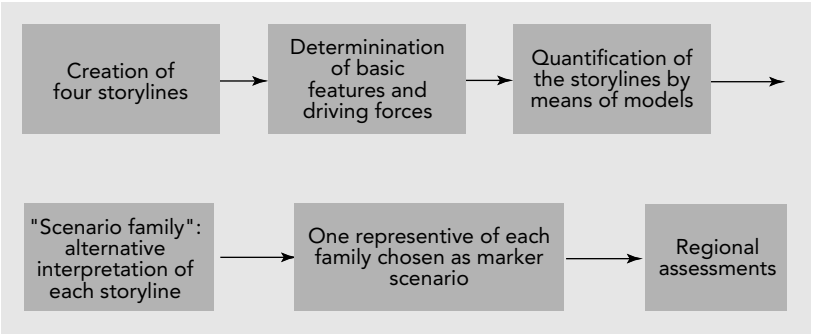
In 1992 the IPCC published six scenarios, the IS92 scenarios (Legett et al, 1992). They provided alternative emissions trajectories spanning the years 1990 through 2100 for greenhouse-related gases, CO_2, CO, CH_4, N_2O, NO_x and SO_2. They consisted mainly of a series of runs with one model, at a high degree of sectoral aggregation. The scenarios were useful to serve as input for climate model simulations, but they were not capable of dealing with climate impact and mitigation analyses. However, there have been a lot of developments since 1992, such as the economic depression in the former economies of Europe. It was recently decided that the scenarios needed an update, therefore the Special Report on Emissions Scenarios (SRES) is being developed.

The SRES is included in the Third Assessment Report, which is currently under review. A provisional set of four marker emissions scenarios and their associated socio-economic driving forces has already been released, especially to get feedback (http://sres.ciesin.org). They are reference scenarios that seek specifically to include the effects of climate change and climate policies on society and the economy ('non-intervention'). They are based on a set of narrative storylines which are subsequently quantified using different modelling approaches. In Figure 5.36 the development process of the scenarios is visualised.

Storylines and scenario families
In the SRES, the writing team decided to describe their scenarios coherently by narrative storylines, based on the futures and scenario literature. They developed the storylines for several reasons:

- To make the scenarios more useful; the social, political and technological con text described in the scenario storylines is important in analyzing the effects of policies either to adapt to climate change or to reduce GHG emissions.
- To help the team think more coherently about the complex interplay between driving forces.
- To make it easier to explain the scenarios to the various user communities by providing a narrative description of alternative futures that goes beyond

Figure 5.36 **The scenario development process**



quantitative scenario features.
- To provide a guide for additional as sumptions to be made in detailed climate impact and mitigation analyses.

Historical, demographic, economic and technological developments were reviewed. After that the team met to begin their development of scenario storylines. Each storyline is basically a short history of possible future developments of (a combination of) key scenario characteristics. The storylines identify particular dynamics, visible in the world today, that might have important influences on future Green House Gas emissions. They deliberately explore what might happen if political, economic, technical and social developments take a particular alternative direction at the global level. Attention is also paid to regional differences and interactions, especially between developing and industrialized countries.

It was decided not to have a 'best guess' storyline. The future is inherently unpredictable. This is new for the IPCC.

In the following the storylines are briefly summarised (Carter et al, 1999):

• A1: A future world of very rapid economic growth, low population growth and rapid introduction of new and more efficient technology. Major underlying themes are economic and cultural convergence and capacity building, with a substantial reduction in regional differences in per capita income. In this world, people pursue personal wealth rather than environmental quality.

• A2: A differentiated world. The underlying theme is that of strengthening regional cultural identities, with an emphasis on family values and local traditions, high population growth, and less concern for rapid economic development.

• B1: A convergent world with rapid change in economic structures, 'dematerialization' and introduction of clean technologies. The emphasis is on global solutions to environmental and social sustainability, including concerted efforts for rapid technology development, dematerialization of the economy, and improving equity.

• B2: A world in which the emphasis is on local solutions to economic, social, and environmental sustainability. It is a heterogeneous world with less rapid, and more diverse technological change, but a strong emphasis on community initiative and social innovation to find local, rather than global solutions.

After determining the basic features and driving forces for each of the four storylines, six different models [16] are used to quantify the storylines. These six models are representative of emissions scenario modelling approaches in the literature and include top-down and bottom-up models. Each model quantification of a storyline constitutes a scenario and all scenario variants of one storyline constitute a 'scenario family'.

The writing team has chosen one model run that best represents each scenario family. This has been done for purposes of presentation. This model run is designated as a 'marker scenario'.

In simple terms, the four marker scenarios combine two sets of divergent tendencies: one set varying between strong economic values and strong environmental values, the other set between increasing globalization and increasing regionalisation (Robinson *et al.*, 2001).

5.2.19. Jackson Environment Institute (in preparation), Assessment of the potential effects of climate change in Europe: ACACIA project

The ACACIA project (A Concerted Action Towards A Comprehensive Climate Impacts and Adaptations Assessment for the European Union) is an attempt to assess the impacts of, and adaptations to, climate change in Europe in the period through to the 2080s (Parry, 2000). The scenarios described are consistent with the IPCC scenarios as described in their Special Report on Emissions Scenarios (see section 5.2.18) and the UK DTI (Department of Trade and Industry) Technology Foresight

[16] The models used were AIM (National Institute of Environmental Studies, Japan), ASF (ICF Kaiser, USA), IMAGE (RIVM, The Netherlands), MESSAGE (IIASA, Austria), MARIA (Science University of Tokyo, Japan), en MINCAM (PNNL, USA) (see Chapter 4, section 4.3.2, page 28) .

(Berkhout et al, 1999). The approaches of the IPCC and the UK DTI studies are different. The IPCC scenarios are mainly concerned with the sectors and societal choices that primarily affect climate change issues. The Foresight scenarios have a somewhat wider view, encompassing more non-climate sectors as well as aspects of environmental change which extent beyond climate change.

The scenarios are primarily qualitative in nature and they are structured around a series of storylines describing important social, economic, political and regional trends. However, for certain scenario indicators (e.g. population and energy) quantitative predictions have been made. In the following the scenarios are shortly described:

A1 / World Markets
Enlargement proceeds rapidly in this scenario, driven by the perceived need to open up new markets and resources in the former Eastern Bloc. Trade between member states accelarates with the completion of the Single European Market (SEM) in Europe. National environmental protection requirements which exceed international norms are regarder as a barrier to free tradeand are penalised.The most paradoxical feature of this scenario is that although rapidly growing volumes of trade and travel increase the level of economic interdependence in Europe, social cohesion remains relatively weak, with a strong emphasis upon satisfying individual, consumerist preferences.

EU social and economic policy becomes increasingly harmonised in order to create a level playing field for multinational businesses to compete. There is growing exodus of richer people from urban areas seeking refuge from environmental stress. Growing wealth creates a a more mobile society, pushing up the demand for new housing in rural areas. An open and liberalised energy market in Europe produces lower energy prices. Consumption rises steeply and weak efforts are made by the states to promote energy efficiency. The main thrust of the EU's energy policy is to leave the market to tailor suppy and demand. Car transport dominates, given the freedom it gives to individuals. Air traffic also grows strongly, increasing green house gas emissions. The level of subsidy received by farmers declines rapidly as the market becomes more competitive. The money is diverted to new entrants. Only the most efficient farmers survive by intensifying production and taking up genetically modified crops.

B1 / Global Sustainability
The EU adopts a much more federal structure with a directly elected executive and a powerful Parliament. More and more state sovereignty is shifted to theEU and sub-national bodies to produce a democratic multi-level system of governance overseen by a powerful European Court. Enlargement proceed much slower that in *World Markets*. External and internal state retreat continues but at a greatly reduced rate as society demands that important functions remain in the public sector. A liberalised and globalised system of trade boosts economic growth in Europe. However a strong, green WTO ensures that disputes are settled in favour of higher environmental quality.

The EU adopts strong process and product standards across Europe. Sustainable development is enshrined in the founding Treaties of the EU as the primary purpose of European integration. The spread of urban areas is countered by strengthening green belts. Environmentally sensitive planning helps to re-invigorate inner city areas and reduce urban degradation. Tourist destinations begin to lose their appeal as tourists make more local trips. Eco-tourism grows in more local areas and in European cities. European governments make an effort to engineer a modal shift from private to public transport.

A2 / Provincial Enterprise
Enlargement of the EU proceeds extremely slowly because the existing Member States are too worried about the costs of enlargement and steady federalisation of the EU to cede further sovereignty. Fearful of the possible adverse effect on competition, the existing states block efforts to assist the new entrants implement the environmental acquis. EU competencies remain largely as they are today. Areas of high policy such as defence, foreign and taxation policy, remain at the state level. The rapid expansion of the Single Market process delivers high levels of trade, but the Euro collapses due to fears about the loss of economic and political sovereignty. The liberalisation of global trade begins to slow as disputes between the main regional trading blocs sharpen. The effect of declining volumes of trade eventually feeds into the political system in Europe, reducing the desire for greater political and social integration.

Political commitment to environmental management weakens and states and sub-state entities begin to adopt approaches depending

upon what is viewed to be important locally. Global environmental problems such as climate change are neglected politically as pressure grows in Europe to tackle sub-regional problems. Urban sprawl grows as the wealthy seek refuge from environmental stress, leaving the poor to live in increasingly degraded urban environments. Fearful of the long-term insecurities arising from greater import dependency, European states begin to rely more heavily on indigenous supplies of fossil fuel. There is little or no extra state sponsored development of renewable resources. Transport in this scenario is mainly car-based, although new roads are built when they attract private sector funding.

B2/Local Stewardship
Plans to enlarge the EU are abandoned as European states decide to devolve more power to localities. Tensions develop and continue to grow between Member States which, in time, may result in the break-up of the EU, with greater conflict between the largest and most powerful Member States. The EU and the UN are increasingly left to perform subsidiary functions that cannot properly be undertaken at the sub-national level, such as addressing global environmental problems. There is little role for the private sector in this scenario. Many service delivery functions are returned to local authorities who are seen to be closer in political terms to citizens and hence more accountable. Local businesses thrive by addressing local niche markets, supported by Local Economic Trading Schemes (LETS). The Euro collapses. The global market n goods and services shrinks as firms tailor their activities to much smaller spatial scales.

There is a public high demand for natural, pristine environments in this scenario. Urban dwellers express their equally strong preference for a more Communitarian lifestyle by relocating to small local communities, such as rural villages. Voluntary work becomes an increasingly popular leisure activity. Overseas tourism is shunned and the sector witnesses a serious decline as individuals turn instead to local destinations. In Europe there is a pronounced trend towards local and greener sources of energy. Local energy efficiency schemes to reduce fuel poverty and to promote social inclusion are particular popular. The overall demand for transport in Europe declines as the volume of international trade and tourism falls. More sociable and environmentally sustainable modes of transport and public transport are preferred to the car. Food production becomes increasingly localised with a significant shift to towards self sufficient, eco-friendly farming.

The three main sources of uncertainty addressed in the ACACIA scenarios are: future greenhouse gas emissions, the climate sensitivity and the regional climate response to planetary warming (Jackson Environmental Institute, 2000).

The scenarios serve as a basis for a large assessment of some specific sectors in Europe, including water, soils, ecosystems, forestry, agriculture, fisheries, insurance, transport, energy and other industry, recreation and tourism and human health. Furthermore the scenarios are elaborated upon for coastal zones and mountains.

The ACACIA project is mainly concerned with issues relating to vulnerability and adaptation in Europe. It does not explicitly consider mitigation policies or their environmental and economic consequences. Four future climate change scenarios are presented for Europe, namely, *World Markets, Global Sustainability, Provincial Enterprise* and *Local Sustainability* (Table 5.16). The scenarios have Western Europe as their primary focus, but draw attention to the connections with global and sub-regional processes and actors where relevant.

The Foresight scenarios are expressed qualitatively in terms of the changes which could conceivably occur to the level at which decisions are taken (global or local) and the nature of societal preferences relative to today (more conservationist or more consumerist). In Figure 5.37 the Foresight scenarios are compared with the IPCC scenarios according to these qualifications.
Figure 5.37: The four scenarios (Jackson Environment Institute, in preparation)

The scenarios indicate that the basic human topography of the Europe in which climate impacts are likely to be experienced in the period through the 2080s could be very different to the Europe of today. The scenarios vary substantially in some features, for example the political boundaries and the precise allocation of decision-making tasks across the levels of governance within it. The scenarios also involve different assumptions about the stringency of future climate mitigation strategies. Some sectors of the economy and certain levels of governance will thrive under some of the scenarios, but will be inherently more

Summary of the four scenarios (adapted from Berkhout et al, 1999; Hertin at al, 1999) Table 5.16

	World Markets	Provincial Enterprise	Global Sustainability	Local tewardship
Values	Consumerist	Individualist	Conservationist	Conservative
Governance	Globalised, weak	National, weak	Globalised, strong	Regional / national, strong
Fast growing sectors	Health care, leisure, distribution, financial services	Private health care and education, maintenance services, defence	Renewable energy, household services, information-intensive business services, nuclear power	Small-scale intensive manufacturing, locally based financial and other services, small scale agriculture
Declining sectors	Manufacturing, agriculture	High-tech specialised services, financial services	Fossil-fuel based power systems, resource-intensive agriculture and manufacturing	Retailing, leisure and tourism
Equity	Decline	Decline	Improvement	Improvement
Air quality	General deterioration	Deterioration	Improvement	Mixed
Water quality	Mixed	Deterioration	Improvement	General Improvement
Biodiversity	Under pressure	Deterioration	Stable	Improvement
Climate Convention	Emissions trading	Regime fails	Strong climate regime	Weak regime

vulnerable under others. Furthermore the adapted strategies are likely to differ across the scenarios. Also the way in which society values different parts of the human and physical environment is different under the different scenarios.

In the conclusions, implications for policy and recommendations for further research are given.

5.2.20. VISIONS team (in preparation), VISIONS project

The project Integrated Visions for a Sustainable Europe (VISIONS) aims to be a groundbreaking endeavour towards the development of scenarios and Integrated Visions for Europe over the next two generations. It is a collaborative effort between nine research institutes. It is a three year project and is now running in its third year. The project will be finished in January 2001.

The ambition of VISIONS is to raise awareness of sustainable development by increasing the understanding of the many links between socio-economic and environmental processes and by improving the assessment of the consequences for Europe from an integrated viewpoint.

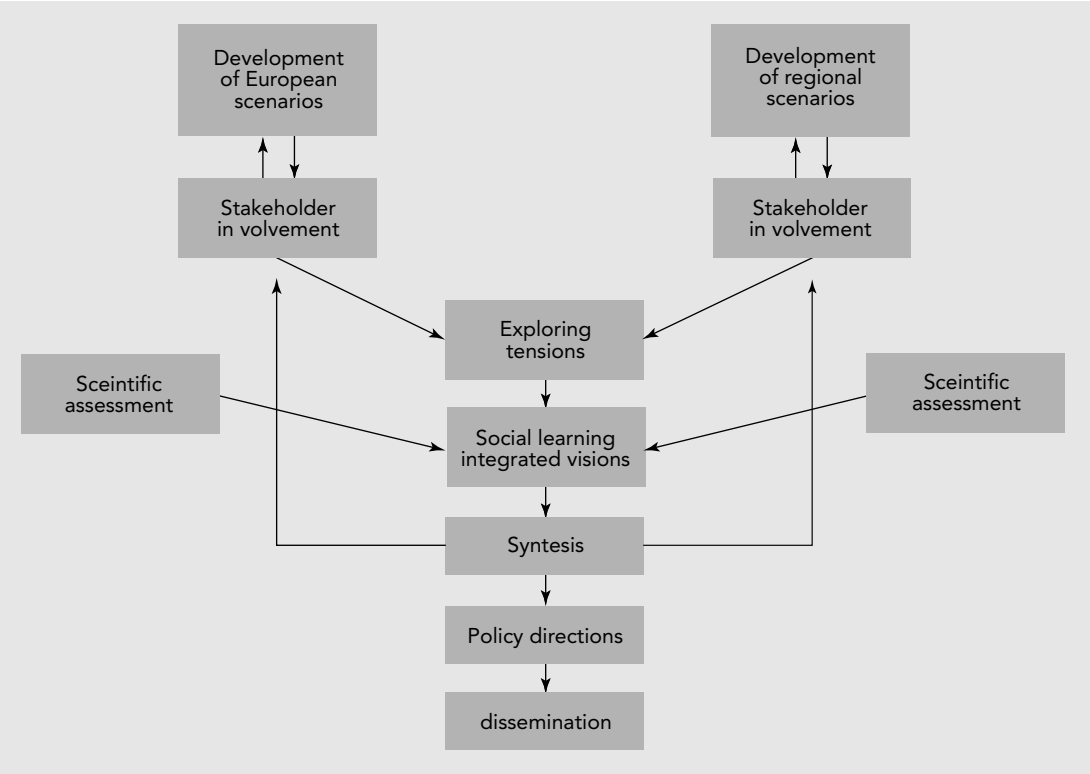
The overall research theme of VISIONS is to bring together both physical and social science tools and techniques, to assist, broaden and deepen the process of policy-making for sustainable development in Europe. This theme includes a set of linked key objectives:

- the development of *scenarios* for Europe and for three selected regions, namely The Green Heart (Netherlands), Greater Manchester (UK) and Venice (Italy);
- the integration of the European scenarios and the regional scenarios into a range of *alternative integrated visions* for a sustainable Europe;
- the testing of new and existing *scientific tools* and *participatory methods* for scenario-building;
- the development of a *framework for integration* of tools and methods for sustainable development;
- the identification and evaluation of *consensus* and *conflicts* and between *multiple perspectives* in alternative scenarios.

In Figure 5.38 the research methodology is visualised.

The main intent is to develop a set (three or four) of *forecasting, descriptive, qualitative and quantitative and participatory* scenarios. For each of the regions and for Europe as a whole a set of scenarios is developed, covering the time span of 20 and 50 years in the future. Based on this long-term future outlook a range of concrete policy directions, which are not recommendations in the prescriptive sense,

Figure 5.38 **Reserch methodology adapted in the VISIONS project**



will be formulated for the next 5-10 years.

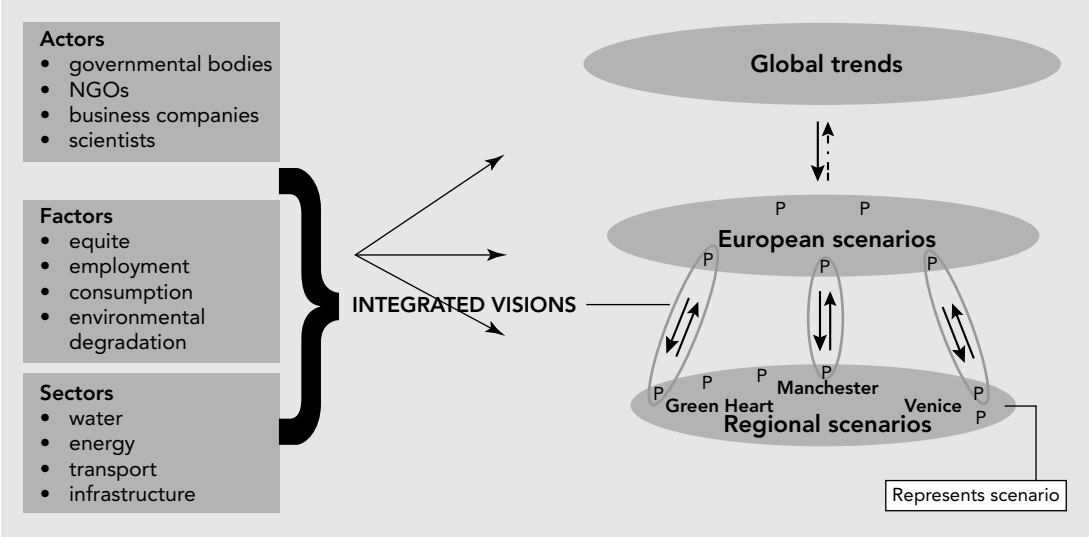
The VISIONS scenario methodology is based on two pillars of integration. First an integrated framework is developed that consists of a selected number of themes, sectors and institutions to be addressed in the scenarios: the so-called *factors, sectors and actors*. The *factors* considered are the following themes: equity, employment, consumption behaviour, and degradation of the natural resource basis. The *sectors* involved are: water, energy, transport and infrastructure, whereas the selected *actors* are: governmental bodies, business companies, NGOs and scientists. In practical terms this means that each scenario is centered around the above factors, actors and sectors, as indicated in Figure 5.39. The second pillar of integration is that of the geographical scale level. Although the emphasis may differ by region, the factors, actors and sectors are taken as cross-cutting elements for integrating the scenarios into visions.

In each region and for Europe as a whole different methods are used to develop the scenarios. Figure 5.40 exposes these different analytical and participatory methods.

For Europe as a whole, a participatory process of mutual learning was used which was based on the so-called 'story-line' approach. This approach involved a combination of knowledge and expertise provided by various experts in the form of lectures, and 'free-format' creative thinking by selected stakeholders. This led to a multitude of ideas, which were then structured by clustering and prioritising them, ultimately leading to so-called storylines. Storylines are sequences of events, linked in a logical and consistent manner. The development of the European scenarios kicked off at a two-day workshop with the participation of a range of stakeholders that comprised a variety of expertise, perspectives, nationalities and cultures.

The storylines produced by the stakeholders were first aggregated into a limited set of common storylines, and then fleshed out and enriched using background research material. The storylines were clustered and aggregated into three storyline clusters, representing the main themes that resulted from the storylines. These storyline clusters were then enriched. Missing scenario elements were examined, as well as the extent to which the existing European scenarios could cover those missing elements. Finally, some 'wild' or highly controversial assumptions underlying the storylines were either left out, or were made more plausible.

The factors -actors-sectors framework — Table 5.39



This resulted in so-called *sketch scenarios*, which can be described as narratives written around the elements of the aggregated storylines. A process of enrichment was initiated, ultimately resulting in *draft scenarios*. The *draft scenarios* were then exposed to a critical evaluation, involving several VISIONS partners and some participants from the European stakeholder group, focusing on both the methodological aspects and the contents of the draft scenarios.

The European draft scenarios were compared and confronted with the regional draft scenarios, in order to identify tensions and linkages between the European and regional outlooks. In the next phase of the project The scenarios wil be integrated into visions for Europe.

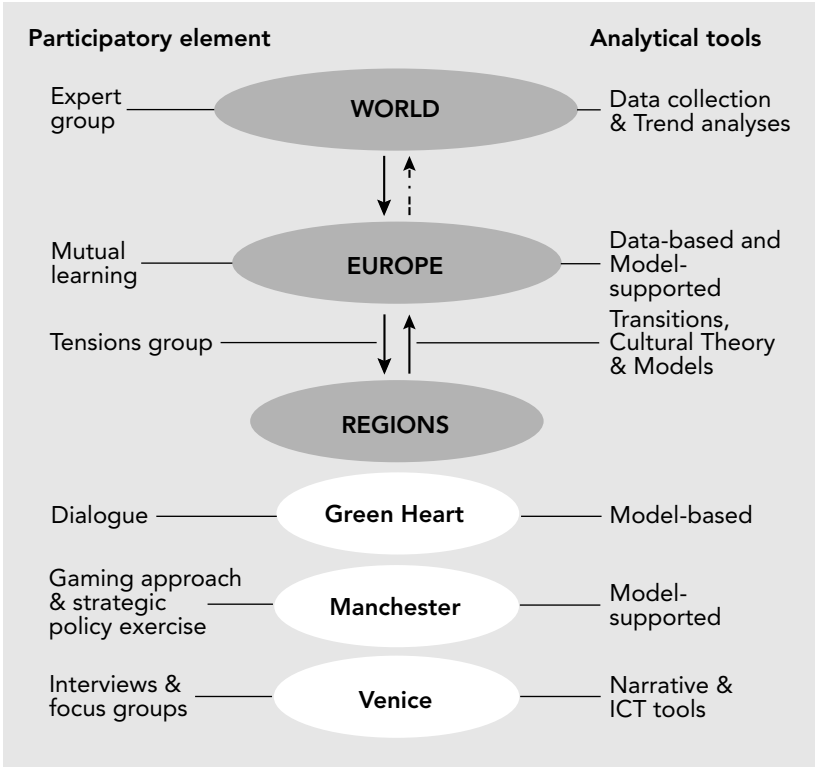
The draft scenarios

The draft scenarios for Europe as they have been developed so far in the VISIONS project are integrated in the sense that the various dimensions are covered, although not yet in balanced manner. In this section concise summaries of the European draft scenarios produced so far are presented. They are still in development, so they can still slightly change in the course of the project.

Knowledge is King

This scenario describes a world in which ICT (Information and Communication Technology) revolutionises Europe. This revolution touches all aspects of Europe in terms of economy, society, institutions, and environment. Traditional industries decline and the knowledge sector expands. The economic transition creates a pool of unemployed workers with obsolete skills. The double burden of high unemployment and an ageing population leave the government powerless to re-stimulate employment. Instead, community-based action, assisted by NGOs, creates employment through local economic initiatives. The environment too benefits in the *Knowledge is King* world through the decline in heavy industries and the shift in consumer patterns from physical to non-physical goods.

Integrated framework for participatory methods and analytical tools — Figure 5.40



The full ramifications of the new ICT-age are not overly apparent in the first decade of the new century, overshadowed as they are by traditional solutions in an increasingly competitive world. Yet the new technologies are being applied creatively, lowering barriers to new innovative practices. ICT systems improve the productivity of traditional industries, and ICT becomes a key component of innovation. The transition away from 'bits' to 'bytes' in the world of *Knowledge is King* creates a pool of people with no work. On the one hand declining costs make ICT accessible to virtually all people, and the ICT-revolution has become part of their lives, since they use internet for entertainment and e-commerce. But on the other hand they are not sufficiently skilled to engage in the highly competitive 'knowledge' sector. Income inequality grows and society begins to polarise into those with access to 'knowledge' (the 'dominant') and those without (the 'excluded').

There are significant changes in the nature of work as careers are built around individual projects rather than with companies. Team working is still important but it is now conducted in a virtual office; networking and co-dependency replace the traditional hierarchical management styles. A significant number is able to work from homes, homes that provide services using 'smart' technology, easing traffic congestion. There are benefits to the environment as energy per capita values fall dramatically and energy and wealth creation are at last decoupled, and the decarbonisation process is moving space through new hydrogen technology. Armed with the power of knowledge, and encouraged by governments, new genetically modified crops are developed that are proven to be neutral to ecosystems. The overall transition from physical to non-physical goods induces an overall improvement of the air, water and soil quality. Unfortunately, water availability remains a problem as per capita consumption continues to rise, in part due to a vibrant leisure industry.

In time, two major new forces emerge. The application of ICT in medical R&D yields breakthroughs that signal a fundamental shift in demographics – life extension drugs are licensed for the first time, and become accessible to an increasing number of people. Not only will many of these people remain healthy for many more years than before, but they also have the possibility of working for as long as they want in the world of *Knowledge is King*. A second force in society also emerges as Government attempts at stimulating re-employment of the 'excluded' fail. Frustrated by their situation, alliances emerge between strong local leaders and NGOs. Community based Local Exchange Trading Schemes (LETS) emerge which use the skills and knowledge of the 'excluded' to provide products and services, which are traded.

Gradually, equilibrium is reached as the 'excluded' play a full role in society, but not integrated into it. The over-65s who have benefited most from medical breakthroughs are less of a burden to society in two important ways. Many continue to work and thus contribute to wealth creation; and they are much better able to pay for their needs once their health does begin to deteriorate, albeit much later than previous generations, as nature reasserts its influence.

Big is Beautiful

This scenario describes a world in which the forces of liberalisation, globalisation and technology create an environment in Europe in which rationalisation of industries is allowed to proceed at an unprecedented scale. At the mature end of the industry spectrum this process brings together long established players to form relatively few companies who have the ability to compete on a regional and global level. There are few new entrants into these sectors. In the newer, service based industries merger mania creates large international companies, but new entities are continually being created that grow and compete in niche markets, regenerating the sector, ensuring the merger process continues for long periods of time. The rationalisation process results in the formation of Big Business.

The privatisation process unleashed by Governments in Europe has two profound effects in *Big is Beautiful*. They bring into being many new companies promoting a frenzy of activity in the market. These are powerful companies with considerable assets. Governments try to ensure that state monopolies do not become private ones by creating a number of companies servicing the same sector. Secondly, governments have, in essence, devolved power and influence to the market in areas that have, traditionally, been in the public domain: energy, water, transport, and telecommunication in the first tranche, health and education follow. With its responsibilities significantly curtailed, Governments need to re-invent their role in this new reality.

The European Union is extended to 27 countries, changing the character of the EU irrevocably. Big Business plays a crucial role in the harmonisation process through investment and new technology. The new enlarged EU has profound effects on local communities in the more established western European democracies. Loss of national sovereignty means local needs are inadequately addressed and a significant sector of the population is disaffected. The capacity for decision making at the local level is considerably diluted, not least because economic power increasingly resides at the EU level.

The nature of work in *Big is Beautiful* has changed. The gradual move away from manufacturing towards an emerging, high value knowledge sector, requires workforces that are educated and flexible. The education system, neglected by government and under the influence of Big Business is now a three tier system: high quality private institutions underpinned by Big Business, public institutions inadequately funded by government, and institutions relying on local government, that concentrate on providing a minimum curriculum.

Big is Beautiful is a world in which inequalities are transparent, where society exhibits clearly identifiable fault lines. There are those in work who are very well off, particularly those able to exploit the potential of the knowledge sector. But unemployment is also a key component of *Big is Beautiful*. Those out of work see their quality of life decline. Small local enterprises are created to service local needs ignored by Big Business although their growth is hampered, because those involved lack the necessary skills and are unable to find the necessary investment.

If life is hard for the unemployed, the quality of life for a significant group of employed people also declines across Europe. Those with jobs are working longer hours. Commuting times between home and the office by car and rail increase significantly as local infrastructure declines. The benefits of an enlarged Europe pass as convergence is achieved. Economic growth of the EU stagnates and Big Business seeks to maintain sales and profits by focussing on markets outside the region. With this gradual shift in emphasis, Big Business gradually gives up the power and influence it holds. It is a difficult world and it is not surprising that there is distrust of the EU institutions and Big Business. There is recognition that the devolution of responsibility in many areas to Big Business in the first decades of the 21st century, although unavoidable in the transition period, has proved limiting in many ways.

Convulsive Change

This scenario describes a world in which climate change has profound and multiple effects on Europe. The indicators become all too apparent: a steady rise in temperature, a significant increase in variability in weather, an increased frequency of freak storms, and greater incidence of drought. All this, and more, not only changes the shape of the environment in many areas, but also disrupts society. Despite drastic measures to reduce greenhouse gas emissions, European governmental institutions fail in averting anthropogenic climate change. But there have been some benefits. The unified European effort to address lower emissions targets did succeed in creating a stronger, respected European governance. In the world of C*onvulsive Change,* national importance declines, and despite severe problems in the early years, integration is enhanced through the process of international migration, and the strengthening of European level governance.

Climate change entails huge economic costs, which push the European economy to the brink of collapse. However, climate change also stimulates activity in new technology within an emerging environmental sector in the economy, technology that ultimately opens up new markets overseas. At first the environmental perturbations, thought to be a consequence of anthropogenic climate change, are seen as freak weather events. The storms that cause floods displace people from their homes, causing death and destruction in Northern Europe. A gradual rise in temperature goes largely unnoticed at first, but prolonged periods of hot, dry spells in Southern Europe eventually promote action in the form of adaptation measures. These measures include the development of infrastructure to transport water to regions prone to drought; water conservation strategies and water-use restrictions are encouraged, and major new projects involving desalination plants are initiated. These alleviate some of the worst problems but it becomes apparent that they are not long standing solutions. Eventually people leave the areas prone to such relatively harsh conditions, migrating to *safe places*.The first *safe places* are primarily urban areas less susceptible to the worst impacts of climate change. Migration to these areas causes pressures in terms of housing, competition for jobs, and tensions arising

from cultural differences. Some cities become very uncomfortable places to live in due to these pressures; social friction occasionally spills over into violence.

Despite some significant problems, the European Union reaches the emissions targets set out in the Kyoto agreement. This is achieved by a whole package of climate-related policy measures. Nobody expected this success to avert the onset of climate change, but the fact that the target set was reached due to co-operation between EU nations created confidence in European level governance. This was an important development in light of the Kyoto II agreement in which Europe had agreed a further 20 % reduction on 1990 emissions by 2020, and a 30 % reduction by 2030. For a time the reductions efforts appear to be in vain. Heavy investment is made in reducing emissions and no benefits are seen. Worse still, adaptation to, and reparation of the damage caused by climate change also proves costly and pushes the economy to its limits. However, it becomes apparent that the investment in emissions reductions and adaptation stimulates a major new sector of the economy – the *environment sector*. This sector grows to become a significant employer and contributes to growth in the European economy, helping to pull the economy back from the brink of collapse.

Migration to safe areas passes its peak as adaptive measures become so extensive that environmental events are relatively less disruptive. The physical loss of national borders due to flooding in some cases, and the large-scale international migration cause national identity to become much less important. This social decline of national importance is mirrored by the political decline in national importance, which began as a result of collective action to reduce greenhouse gas emissions. In the world of *Convulsive Change* governance shifts fully to the European level leading to the completion of an integration process only dreamed about in the late 20th century.

5.2.21. Millennium Assessment Steering Committee (to begin in mid 2000), Millennium Ecosystem Assessment

The Millennium Ecosystem Assessment (MEA) Steering Committee was established in 1998 to explore the merits of launching an international ecosystem assessment and to recommend the focus, design, governance and institutional arrangements for such an assessment. The steering committee consists of 31 persons from all over the world. They are scientists, people from NGOs, people from ministries. The first Assessment will begin in late 2000 and will be completed by late 2003. As currently envisioned, the global component of the MEA will be repeated at 10-year intervals and become a regular part of the activities of the international community.

The methodology of the assessment is not yet specified. Within the first six moths of the initiation of the assessment a design workshop will be held. For this workshop a report detailing the methodology for conducting an integrated ecosystem assessment at global, regional, national and local levels will be produced.

An integrated ecosystem assessment is an analysis of the capacity of an ecosystem to provide goods and services important for human development. Such an assessment includes both ecological and economic analysis and it considers both the current state of the ecosystem and its future potential. Ecosystem goods include products such as food, timber, genetic resources and medicines. Services encompass water purification, flood control, coastline stabilisation, carbon sequestration, waste treatment, biodiversity conservation, soil generation, disease regulation, pollination, maintenance of air quality, and the provision of aesthetic and cultural benefits. An approach to evaluate the condition of an ecosystem is to assess the capacity of the system to provide each of the various goods and services and then to evaluate the trade-offs among those goods and services.

The Millennium Ecosystem Assessment is such an integrated ecosystem assessment. It is designed to improve the management of ecosystems and their contribution to human development by helping to bring together the best available information and knowledge on ecosystem goods and services. With this information it can support policy and management decisions. The MEA consists of a global scientific assessment as well as catalytic regional, national, and local assessments and has the aim of building capacity at all levels to undertake integrated ecosystem assessments and to act on their findings. The primary users of the MEA will be the international ecosystem-related conventions, national governments, civil society, and the private sector. The MEA will provide information and strengthen capacity but it will not set goals or advocate specific policies or practices. It will

be policy relevant but not policy prescriptive.

The MEA will focus on the capacity of ecosystems to provide goods and services that are important to human development, including consideration of the underlying ecosystem processes on which those goods and services depend. The MEA will address both the biological attributes of goods and services and the social and economic attributes such as employment and economic value.

More specifically, the assessment will address:

- *Current ecosystem extent, trends, pressures, condition, and value.*
  The MEA will provide 'baseline' information for the year 2000 on the geographic extent of different ecosystems and the land- or resource-use patterns associated with them. It will present information on trends in ecosystem goods and services, their condition and value, their contribution to human development, and pressures affecting them.
- *Ecosystem scenarios and trade-offs*
  The MEA will present a range of plausible scenarios for how the quantity and quality of ecosystem goods and services may change in coming decades in different regions of the world. It will assess the trade-offs among various goods and services and identify opportunities to increase the aggregate benefits that ecosystems provide. The approach will use existing scenarios and modelling work as drivers for exploring potential impacts on ecosystems and their goods and services. Integral to the development of the regional scenarios will be the assessment of the state of knowledge on forecasting ecological change.
- *Response options*
  The MEA will identify policy, institutional, or technological changes that could improve the management of ecosystems, thereby increasing their contributions to development and maintaining their long-term sustainability.

The MEA will consist of a global assessment and approximately ten catalytic assessments undertaken at regional, national, and local scales. By including local, national, and regional, components as integral components of the global assessment, the MEA will better reflect regional differences, serve a direct capacity-building role, and facilitate the involvement of regional and local expertise. Integration of the various components will be assured structurally through a Committee comprised of the chairs of each component activity The MEA will seek a balanced involvement of experts from different regions of the world.

5.2.22. Xerox Corporation (1999), Looking Inward. Visions of the 21st century family by students from around the word

This study is completely different from the other studies considered in this review. It is not a scientific study and the stories describes in the book are not scenarios, but just images of the future. However, the book gives an insight in the perspectives of students around the world of how they see the future. The book is based on 'The second DocuWorld Authors Competition', a result of the collaborative efforts of Cascade Press and Xerox Corporation. Tens of thousands of young people (14-18 years of age) entered the competition, which was held in four cities on three continents in the world, namely Amsterdam, Chicago, Los Angeles and São Paulo. The competitors were allowed to choose any literary form the wanted. Also students from the Otis College of Art and Design were asked to create illustrations. The jury included professional writers, a former Dutch minister of state, U.S. State governors, other politicians, academic leaders and sports celebrities. In this book the winning stories are presented. They are all shortly summarised below.

The future stories focus on family life in the 21st century. They are images of the future, days in the life of people that live in the late 21st century.

Youngsters in the 21st century (Brasil)
Her story is about the influence technology has on society. She states that in Brazil the influence is very serious and it is not developing in the right direction. Children get in touch with technologies from their early days on and they get a wrong picture of reality. According to her the solution to this problem lies in a greater investment from the government in education. In this way the youngsters are able to absorb the good part of technology.

Three Dutch stories are incorporated in the book:

The Netherlands
and the effect of the social revolution
In the first a press conference with a psychologist specialised in the social revolution after 2020 is presented. Family life has changed drastically. Matrimony is not com-

mon anymore (people have to share their lives for at least 150 years now) and people rather prefer to buy a kid than to have one themselves. The female president would like to return to former lifestyles. To stimulate this thought she is one of the first women pregnant again.

Neanderthal Ted
The second story is a dream in which a boy, Ted, thinks he is frozen into hibernation in 1998 and defrosted in 2099. His new parents select him from a Cyber-space-shop. Due to a lot of frightening diseases, people are not allowed to produce children anymore. The people live in a dome city, because the ozone layer has completely been shattered. At the time Ted awakes only ninety thousand people live on earth in this dome. All roads have disappeared and are replaced by belts. The sky has a purple pinkish glow and people take day-trips to the moon. All shopping's are done by means of video screens in the living room. The eating of meat is forbidden.

Iron Alex
This story takes place in the year 2022 and is about an eighteen year old boy, Alex, who is involved in an accident in which he loses an arm. The arm is replaced by an iron arm of which everybody is frightened. He lives with his mother in a very small old house. Time is very precious these days and nobody seems to know how to cook anymore; every meal is made in the microwave. Public traffic is so crowded that every day people are crushed to death in the crowds. Also the values have changed. Alex once hits a man with his iron arm and he doesn't even bother to see whether the man is dead or not, although he hears 'a cracking noise coming from his head when he hits the wall'.
Nine stories are from students of the USA:

The eyes of tomorrow
In this story that is written as a poem the future is seen in two ways. For some people the future might be looked upon in a negative way, for others the future might be shiny. Technology plays in both futures the leading role, but for some technology might be the solution for every problem that we see nowadays, while for others technology only strengthens the problems.

Once upon a time
A thirteen-year-old girl by accident burns down the house she and her mother live in. Her mother dies, but it is 2010 and at this time it is possible to turn a part of the DNA of her mother into a new life. The girl raises this baby. The story tells a day in the life of the now eighteen-year-old girl and her 5-year-old daughter that has nightmares about the fire. The girl doesn't dare to tell her that it is not just a dream, but that these are real memories.

Generation G.E
The story is told from the perspective of a young girl that is ordered by her mother from a catalogue. She has two sisters, that both look exactly like her and one brother. Her mother has to work all week and even sleeps at the office. During the week there is a kind of uncle in the house that is a tutor for them. They all already know what they are going to do in the rest of their lifes. For some this destiny is to work for the catalogue company, because only a few girls can have children.

Home
Greg is a sixteen-year-old boy living in 2084. In this time, people live in cities that are sheltered by a plastic-covered geodesic dome, which stretches across the width of the megapolis and rises two kilometers above ground level. Greg's father works in a Space Station, where he has to stay for more than a year. They have contact with him by a communication satellite, where they can actually see each other. The most common transport system is the hovercraft. Greg has one himself. His world falls apart the day he discovers that his parents are not his real parents, but that they have adopted him from the cloning agency.

Down this road again
A seventy-two year old lady goes for a walk. She hasn't been outside for a long time and she thinks back at the time that emotions still existed and the time that not everybody was addicted to his computer. The time that people still knew family values, the time that children were not just looked upon as simple DNA. In the present days, human race has forgotten about life. They have forgotten that even with computers and new technology, what humans need more than anything is human companionship.

Setting the stage for the coming century
This essay is a little different from the others. It is a historic review in which a lot of subjects, e.g. communism, religion, medicine and wars are analysed. From this historical perspective it is possible to carefully predict the future. Among others the writer thinks religion will decline and level off and that medicine will continue its rapid evolution.

The message of this essay is that the future will not change as drastically as is often suggested in science fiction movies or books.

Virtual family well-being
In this story, technology has conquered the world. Computers do everything. It is possible to spent time in virtual reality, in which you can go on a holiday for years in just one minute. The generation gap is growing larger, because there's no common ground or common time anymore. Children practically grow up without their parents, because they go on virtual trips alone on a very young age.

A not so perfect existence
Everybody lives in outer space and the girl (Natalia) that the story is about, lives in a place where no other houses are around. Her mother is an intergalactic ambassador and her husband (her fifth) lives in the same house as Natalia. She barely sees her mother, she hates her stepfather and she almost never leaves the house. It is too dangerous to travel on the surface bare-skinned because of the sun. Natalia lives in another (virtual) world through her Holodeck, where she has a twentieth century family that just do 'normal' stuff.

The Pullman poet
Darius is an eighteen-year-old boy that is fond of poetry. The story is located in the year 2015, but there are a lot of flashbacks to earlier years. His thoughts about the world are described. He lives in a house with his father and grandfather. In 2006 the Lazarus Pill was invented, which keeps the heart of people beating. Since that time no person has died. At the end of the story there is a bulletin on the news that announces that the first man in 9 years has died. The new time is not to bad, but he thinks back to the old time with melancholy.

With one exception, the overall impression of the above-described stories is that they are all negative. It doesn't matter whether the story is from a writer in The Netherlands, in the USA or in Brazil.

6. Assessment

6.1. Introduction

In this chapter we will discuss what the studies presented in Chapter 5 teach us about the state of the art in European and global scenario studies. To that end we discuss the studies in terms of the various quality dimensions, which can be considered as an assessment of the set of the state of the art of scenario studies (see Chapter 3).

6.2. Assessment of scenario studies

The aim of the assessment of the scenario studies in terms of strengths and weaknesses is to provide a basis for a systematic evaluation of the state of the art in European and global scenario building. It is **not** our intention to judge the quality of the individual studies, but to use this set of representative studies to indicate challenges and opportunities for future projects.

Methodological quality
The *scenario design methods* can be classified into two classes, i.e. desk studies and participatory methods. The desk study (analytical) part can be further subdivided into quantitative and qualitative and the participatory class is called hybrid. We can furthermore distinguish between global, focused and theme-specific exercises (see Chapter 2). Table 6.1 indicates how the selected studies can be clustered according to the method used. Models are used in the EC-DGXVII (1996), WRR (1992), EFILWC (1994), ECN (1995) and OECD (1997) studies, resulting in predominantly quantitative studies. The EC-DGXI (1996), Button (1993) McRae (1995), Smith (1997), Stockholm Environment Institute and Global Scenario Group (1997, 1998), EC Forward Studies Unit (1999) and WBCSD (1998) studies have used ongoing discussions, historical facts and passive references as work material. As a result, the scenarios developed in these studies have a qualitative character. The use of participatory methods is explicitly reported in the following studies: the EC-DGXVII (1996), CPB (1996), Nijkamp, Rienstra et al. (1998), POSSUM team (1998), IPCC (forthcoming) Jackson Environment Institute (in preparation) and VISIONS team (in preparation) studies. In the case of the EC-DGXI (1996), ECN (1995), and EFILWC (1994) study, the information presented in the reports is too concise to determine whether participatory methods are used. The available documentation, however, does not indicate any signs of participation. EC-DGXVII (1996), POSSUM team (1998)and VISIONS team (in preparation) used the participatory method most extensively. For example, the scenarios and uncertainties were discussed in participatory workshops. External experts, NGOs and other stakeholders were involved in this process. As a consequence, the scenarios show a wider variety and the quality of the scenarios has improved compared to the scenarios as developed in a non-participatory

Table 6.1 **The studies associated with the various approaches**

	Analytical		**Participatory**
	Quantitative (model-based)	*Qualitative (expert-based)*	*Hybrid*
Global	OECD (1997)	WBCSD (1998) SEI/GSG (1997/1998)	IPCC WGIII/SRES (forthcoming)
Regional		McRae (1995) EC DGXI (1996) Smith (1997) EC Forward Studies Unit (1999) Hammond (1998)	CPB (1997) Jackson Environment Institute (forthcoming) VISIONS team (forthcoming)
Theme-specific	WRR (1992) EFILWC (1994) ECN (1995) EC DGXVII (1996)	Button (1993)	EC DGXVII (1996) Nijkamp et al. (1998)

manner in an earlier phase (EC-DGXVII, 1990). The CPB study (CPB, 1996) involved a less heterogeneous group. Their participants were experts from other Dutch research and governmental institutes, such as the Dutch Advise council for Traffic and Transport (AVV), Energy Centre Netherlands (ECN) and the Dutch National Institute for Public Health and the Environment (RIVM). Also the study of Nijkamp et al only involved (mostly Dutch) transport experts.

Regarding the ***character of the scenarios*** only minor differences exist among the studies discussed:

- The set of scenarios shows a limited variety, although the various scenarios are *no variations* on one single scenario. The study of the EC Forward Studies Unit, the VISIONS team (in preparation) and the study of the SEI/GSG (1997) are the exceptions. The scenarios in these studies do show variations.
- Because most scenarios do not include major shifts, they cannot be adequately characterised as peripheral scenarios (See Chapter 2). On the other hand, they are neither trend scenarios. Only the Button (1993) study, the SEI/GSG (1997) and the OECD (1997) comprise pure trend scenarios.
- McRae (1995), Smith (1997) and EC-DGXVII (1996) addressed surprises (also referred to as 'events'). Both McRae (1995) and Smith (1997) indicate the event that Northern Italy splits from the South. Smith furthermore incorporated the following surprises in his assessment of Europe's future: a split with regard to the United Kingdom leaving the European Union (in the scenario Les Etrangers) and a forced splitting of the Franco-German axis (in the Apocalypse scenario). The Battlefield scenario as developed by EC DGXVII (1996) com prises an oil price shock. These events can all be characterised as imaginable surprises that are probable or even certain. Surprises are also included in the studies of the EC Forward Studies Unit (1999) and in the VISIONS team (in preparation). None of the studies involves improbable imaginable surprises (see Chapter 2), except for the Xerox Corporation (1999) study. This study includes major surprises, but these surprises are not plausible.
- Most studies have a *forecasting* character. EC DGXI study (1996) also used backcasting techniques, but just to a minor extent. The study of Nijkamp et al (1998), the POSSUM team (1998) study and the study of the OECD (1997) use backcasting to construct their scenarios.

Analytical quality
As follows from the terms of reference set in Chapter 3, the selected studies either consider the European or the global *scale*. Next to these scale levels, also the national and regional scales receive attention in some studies (see Table 6.2). Smith (1997), for example, discussed developments on the global scale, such as the influence of Asia on Europe and the possibility of America holding back, and consequences of the European scenarios on the national scale.

Where McRae (1995) did consider different regions, he did not, like Smith (1997), incorporate these forces outside Europe in

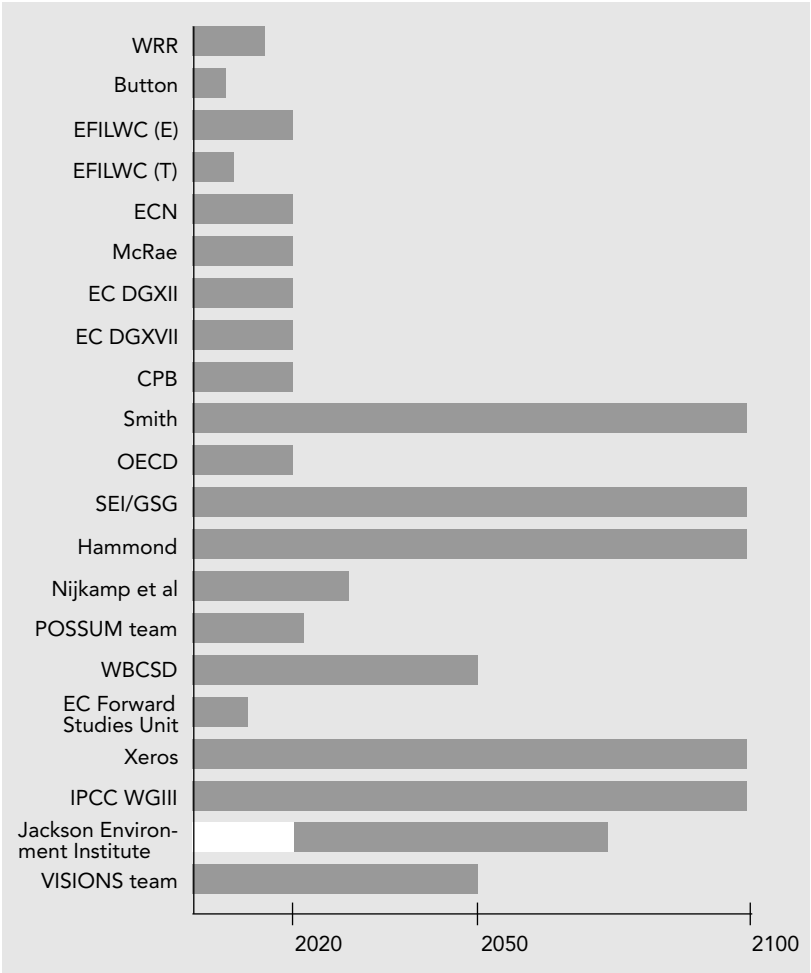
The various scales addressed in the studies Table 6.2

	Scales			
	Global	European	National	Regional
WRR (1992)		*	*	*
Button (1993)		*		
EFILWC (1994)		*	*	
ECN (1995)		*	*	
McRae (1995)	*	*	*	
EC DGXI (1996)		*		
EC DGXVII (1996)	*	*	*	
CPB (1997)	*	*	*	
Smith (1997)	*	*	*	
OECD (1997)	*			
SEI/GSG (1997, 1998))	*			
Hammond (1998)	*	*		
Nijkamp et al (1998)		*	*	
POSSUM team (1998)		*		
WBCSD (1998)	*			
EC Forward Studies) Unit (1999	*	*		
Xerox (1999)	*		*	
IPCC WGIII (forthcoming)	*			
Jackson Environment Institute (forthcoming)	*	*	*	
VISIONS team (forthcoming)	*	*		*

the scenarios. On the contrary, studies like the WRR (1992), EFILWC (1994) and POSSUM team (1998) seem to have treated Europe as an isolated continent. A remarkable approach with regard to multi-scale assessment is adopted by CPB (CPB 1997). In this study, the global driving forces are assessed, which are then used to design scenarios for the European level, which in turn determine the context of the national scenarios (i.e. the Netherlands). However, if it is attempted to address multiple scales, it is just a 'one-way-integration' of scales. In the VISIONS project (VISIONS team, in preparation) a two-way integration between the global, European and regional level has been performed. The ACACIA project (Jackson Environment Institute, in preparation) builds on the global scenario work of the IPCC. They try to translate these scenarios to the European situation and they also address some national issues.

The time horizon for the various studies is presented in Figure 6.1. This figure indicates

Figure 6.1 **Time horizon of the various studies**



EFILWC (E) = the Energy scenario of EFILWC
EFILWC (T) = the Transport scenario of EFILWC

that from the reviewed studies the more recent ones consider longer time horizons than the studies developed at the beginning of the nineties. These older studies all concentrate on the mid-long term whereas the studies developed after 1997 generally concentrate on the long term (50 till 100 year from now).

In Figure 6.2 the scale dimension and the time dimension are related to each other. The studies in the upper right corner display most scale levels and describe the longest period of time. The Smith study describes a period of 100 years for three different levels of scale. On the other hand the Button study only describes a period till 2010 for one scale level.

With regard to *issues, sectors* and *indicators/ indices*, it is usual that the indicators/indices used reflect the sectors and issues addressed. Economic indicators (like GDP and employment figures) dominate in the majority of the studies (see Table 6.3). The WRR (1992), EC DGXI (1996) and EC DGXVII (1996) studies addressed economic, social and environmental indicators. Examples of the indicators used in the latter studies are unemployment, emissions, land use, energy consumption/production, and GDP-growth. The EFILWC (1994) study only used social indicators, while McRae (1995), and Smith (1997) included both economic and institutional indicators. More recent studies include more indicators. For example SEI/ GSG (1997), Hammond (1998), Nijkamp et al (Nijkamp *et al.* 1998) and VISIONS team (in preparation) address all indicators in their scenarios. However, the indicators indicated in Table 6.3 are indicators per scenario study and **not** per scenario. This means that studies using more indicators do not naturally include more integrated scenarios. It does however imply that the studies are more interdisciplinary.

Inspection of Table 6.3 reveals that only six studies are conceivably interdisciplinary in terms of synthesising socio-economic and environmental and institutional dimensions, i.e. the SEI/GSG (1997), the Hammond (1998), the Nijkamp et al (1998), WBCSD (1998), the EC Forward Studies Unit (1999) and the VISIONS team (in preparation) studies.

A majority of the studies offers *policy recommendations*. The studies that provide policy recommendations differ with regard to the level of detail and how concrete the sugges-

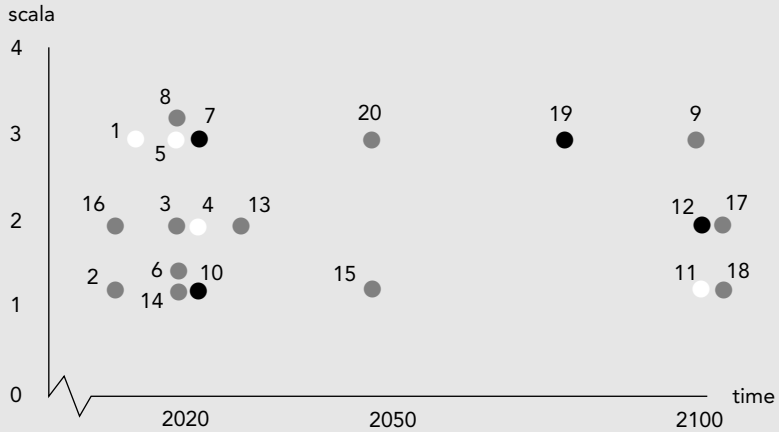
tions are. EC DGXVII (1996) delivered clear and challenging key messages for energy policy makers. The policy recommendations as provided by EC DGXI (1996) are also challenging. However, some are short term-oriented (e.g. policy paper on EU foreign policy and sustainability issues), while others focus on the long term (e.g. institutionalising sustainability in international institutions). Some recommendations are rather vague (e.g. developing a vision for sustainable development in Europe), while others are more concrete (e.g. setting-up local hearings). Although the WRR (1992) explicitly stated that they would not provide policy recommendations, the final report discussed some general suggestions for policy-making that followed quite logically out of the scenario exercise, such as promotion of available environmental technologies in agriculture. The OECD (1997) provided clear policy recommendations on how to come to a sustainable future. The POSSUM team (1998) gave some rather straightforward policy conclusions that are drawn from the scenarios. They discussed these policy recommendations for 15 specific issues. The WBCSD (1998) is an organisation that focusses on businesses. Therefore they have provided challenges to businesses and they discussed some lessons learnd from the scenarios. EC DGXVII (1996), EC DGXI (1996), and WRR (1992). ECN (1995) and Nijkamp et al (1998) did not discuss policy recommendations, but provide some rather straight policy-variants of the scenarios (i.e. carbon tax, energy prices, or changes in the use of nuclear energy).

A related question is if and how these policy recommendations can be translated into suggestions for the daily practise of decision-makers. Do the studies suggest how their recommendations can be implemented into specific policy measures? One of the tools to assess the feasibility of the proposed measures is cost-benefit analysis. This type of analysis enables to evaluate long-term goals in terms of the effectiveness of short-term actions. The selected studies did not perform cost-benefit analyses, nor an alternative evaluation of the feasibility of the recommendations, which implies that the potential usefulness of the studies for day to day policy is rather limited.

6.3. Scenario clusters

In order to come to a more comprehensive overview of the scenarios described in this

Amount of scale levels and time horizon of the scenario studies — Figure 6.2



1. WRR
2. Button
3. EFILWC
4. ECN
5. McRae
6. EC DGXII
7. EC DGXVII
8. CPB
9. Smith
10. OECD
11. SEI/GSG
12. Hammond
13. Nijkamp et al.
14. POSSUM team
15. WBCSD
16. EC Forward Sudies Unit
17. Xerox
18. IPCC WGIII
19. Jackson Environment Institute
20. VISIONS team

The classes of indicators used in the various studies — Table 6.3

	Indicators			
	Social	*Economic*	*Environmental*	*Institutional*
WRR (1992)	*	*	*	
Button (1993)		*		
EFILWC (1994)	*			
ECN (1995)		*		
McRae (1995)		*		*
EC DGXII (1996)	*	*	*	
EC DGXVII (1996)	*	*	*	
CPB (1997)		*		
Smith (1997)		*		*
OECD (1997)	*	*	*	
SEI/GSG (1997, 1998)	*	*	*	*
Hammond (1998)	*	*	*	*
Nijkamp et al (1998)	*	*	*	*
POSSUM team (1998)		*	*	
WBCSD (1998)	*	*	*	*
EC Forward Studies Unit (1999)	*	*	*	*
IPCC WGIII (forthcoming)		*	*	
Jackson Environment Institute (forthcoming)		*	*	
VISIONS team (forthcoming)	*	*	*	*

report, we identify three main clusters which are further subdivided into four subclusters. The main driving forces (social, environmental or economical) are used for the initial clustering. This subdivision does not mean that a scenario divided into, for example, the social driving forces cluster only deals with social factors. It does, however, imply that these social factors are the most important driving forces upon which the whole scenario is build.

The subclusters are characterised as follows:

- *Wait and See*, with limited policy action as the binding element (van Asselt et al, 1998)
- *Just do it*, with considerable policy intervention as the binding element (Shell)
- *Doom Monger*, with the pessimistic character of the future outlook as the binding element (van Asselt et al, 1998)
- *Carpe diem*, with a positive character of the future outlook as the binding element

Four scenarios could not be divided into these clusters. Two of them are scenarios from the VISIONS project and the other two are the scenarios from the study of Nijkamp et al. The VISIONS scenarios both have a driving force (one economic and on social), but a further subdivision is not possible. The two transport scenarios from Nijkamp et al. don't have one clear driving force. Because of the Spider model that they use, more elements (spatial, institutional, socio-psychological and economic) can be seen as driving force. Only environmental driving forces are not evident from this model.

From the clustering it becomes clear that most scenarios could be grouped in the cluster with economical driving forces.

Use of clusters

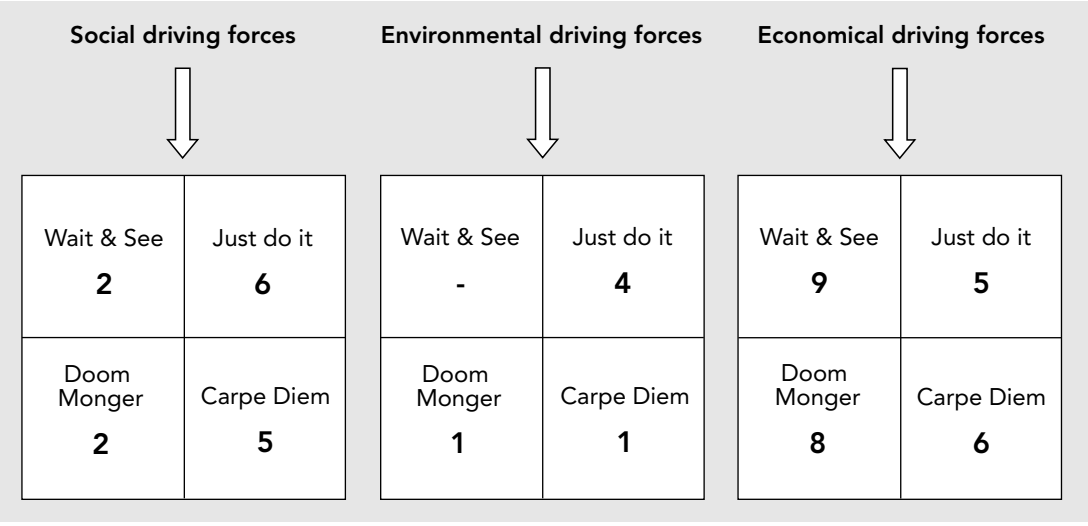
How can EEA use these scenario clusters? On the short term the clusters can be used as a framework for evaluation of existing scenarios. It can make people conscious of what kind of scenarios currently exists. It can also be a guide for the development of scenarios for specific goals of the EEA, in other words it can be food for thought. For the longer term the clusters can be used to try to develop scenarios that don't have one main driving force. The ultimate goal will be to develop scenarios in which it is not clear if the social, the environmental or economic drivers are dominant. In this way the scenarios will be real integrated scenarios. However, this is a difficult challenge. The goal of the VISIONS project was to develop such scenarios, but now it becomes clear that also these scenarios all have one main driving force. The EEA should probably discuss this with experts.

6.4. Lessons learned

Our assessment of the strengths and weaknesses of current scenario-exercises indicates that the following aspects are crucial:

- Participatory development of scenarios
- Two-way integration of scales (cross-scaling concepts)
- Integration of surprises resulting in more peripheral scenarios

Figure 6.4 **The clustering of the scenarios. The numbers represent the amount of scenarios divided in that cluster. (Appendix V gives the complete list of scenarios per cluster)**



- Balanced integration of environmental, social, economic and institutional processes
- Integration of various scenario methods
- Explicit inclusion of a wide variety of perspectives
- Translation of long-term policy recommendations to short-term policy agenda.

Furthermore, the assessment of current scenario-studies enables some potential pitfalls to be identified, namely:

- Detailed is not the same as comprehensive.
- Integration is not merely addressing a variety of scales, sectors and issues. Crucial to integration is analysis of the mutual interplay and trade-offs.
- Using perspectives is no guarantee that all relevant uncertainties are addressed and that all assumptions are transparent. Stringent documentation remains needed.
- The composition of participatory scenario groups should be both heterogeneous as well as balanced.
- Most scenario studies are too technical, they miss the institutional dimension. If they are not desk studies, they miss the variety that they need.
- Methodological underpinning is crucial. More research should be dedicated towards this methodology for scenarios.

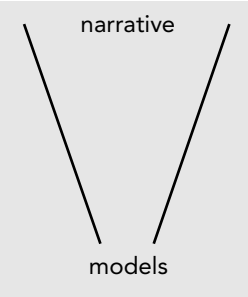
6.5. A way forward?

Both models and scenarios are tools to assess the future. Ideally, models and scenarios are used in a complementary manner. EEA explicitly aims to develop an integrated perspective on the future. To that end, models need horizontal and vertical integration, a feature that existing models lack. Furthermore, future model strategies should be more scenario oriented. If a scenario study starts with a model, the narrative resulting from this modelling exercise almost always becomes too narrow. However, when a study starts with the narrative the model cannot include all the richness of the narrative anymore (e.g. institutional or social dimensions). The most promising way to use current models is to check the consistency of narratives, so to use the models as underpinning of the narratives.

The overview and structuring of existing scenario studies in this report indicates that there is enough useful scenario material the EEA can make use of. On the other hand, it is clear that the existing scenarios are not directly suitable to serve the purposes and needs of the EEA and its stakeholders. A possible way forward is to establish collaboration with and among a selected number of institutions in order to further develop and/or adapting existing scenario work. An example of such an exercise might be the downscaling of the IPCC scenarios to the European level. While the ACACIA project is trying to down scale IPCC scenarios, their focus is on specific themes and regions (e.g. mountains) and therefore it does not cover the whole of Europe. European scenarios developed in the VISIONS project could also provide useful material for the EEA. These kind of endeavours can facilitate the EEA in using scenarios for their own purposes.

Scenarios and models are not objectives in themselves. However, it is because they provide a consistent and robust approach to the construction of sequential events, focusing on causal processes and decision points, that they can be useful tools for policy making. More experience should therefore be gained on how to use scenarios and models to support policy. Most available studies present the scenarios, but they do not disclose relevant insights for decision making, leaving it up to the readers to discover these for themselves. The challenge for the future is to try to derive concrete policy implications from existing scenario and model studies. The European Environment Agency, probably together with partner organisations or institutions, could explore this possibility.

The model – narrative flume Figure 7.1



Scenario studies starting with narratives result in scenarios too rich to be represented by a model and scenario studies initiated by a model almost always result in scenarios that are too narrow.

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In the table (Appendix I), horizontal integration is classified as very limited, limited, present or advanced. *Very limited* indicates a lack of integration between different domains as well as within a domain. *Limited* refers to a lack in one of the two. Horizontal integration is *present* when several domains are covered in an integrated manner. The term *advanced* is used for models that include environmental, economic and socio-cultural aspects.

Vertical integration is classified as limited, present or advanced. *Limited* refers to models where several parts of the cause-effect chains modelled are missing or not explicit. *Present* refers to models where the causal chain is modelled, but there is a lack of feedback from the output of the model to the input. The term *advanced* is reserved for models where this final loop is also closed.

The Ease of Use by Non-Developers is classified as very limited, limited, high or very high. Very limited refers to models that are not accessible to non-developers. Limited refers to models where the model can be used by outsiders after considerable training. The term high classifies models that are easy to grasp and use for non-developers. The term very high is reserved for models that exhibit an interface and a level transparency that makes it very easy for non-developers to apply the model and to adjust it to their own needs.

Appendix I Description of the models

Model	Analytical Technique	Time Horizon used in scenarios	Geographical Coverage	European Representation	Horizontal Integration	Vertical Integration	Key References	Existing Scenarios	Ease of Use by Non-Developers
World 3	System Dynamics	2100	Global	none	Present	Limited	(Meadows, Meadows et al. 1972; Meadows, Meadows et al. 1991)	13 explorative scenarios	Very limited
Int. Futures	System Dynamics	2050	Global	EU	Advanced	Limited	(Hughes 1999)	base scenario	Very high
TARGETS	System Dynamics	2100	Global	none	Present	Present	(Rotmans and de Vries 1997)	reference case with varieties	High
Threshold 21	System Dynamics	2100	National nested in global system	none so far, national application for Italy	Advanced	Present		several explorative scenarios	Very high
Polestar	Accounting	2050	Global with several regional applications		Present	Limited	(Raskin, Heaps et al. 1995)	two reference scenarios	Very high
Quest	Combination of Input-Output and Accounting	2030	Selected small regions	none so far	Present	Present	(SDRI 1999)	reference case	Very high
RAINS	Linear Programming	2040	Global	EU-15 on national level and aggregate	Very limited	Advanced	(Alcamo, Shaw et al. 1990)	Two reference scenarios	High
IPCC multi-model approach	Several	Several	Global	Several	many fields covered, but lacking interaction	Advanced	(IPCC 2000)	4 integrated scenarios resulting from 40 specific scenarios	Very limited
AIM	General Equilibrium	2100	Global	OECD-West	Limited	Limited	(Morita, Matsuoka et al.1994)	Seven scenarios	Limited
ASF	Accounting	2100	Global	OECD-West	Limited	Advanced	(Lashof and Tirpak 1989) and (Sankovski, Barbour et al. 2000) (in press)	Four scenarios	Limited
IMAGE	System Dynamics	2100	Global	0.5 degree longitude/ latitude grid (economic data: OECD Europe)	Limited	Advanced	(Rotmans 1990) (Alcamo 1994)	Four scenarios	Limited
MESSAGE-MACRO	Dynamic linear programming	2100	Global	Western Europe	Limited	Limited	(Messner and Strubegger 1995; Riahi and Roehrl 2000) (in press)	Nine scenarios	Limited
MARIA	Non-linear optimisation	2100	Global	OECD minus USA and Japan	Limited	Limited	(Mori and Takahashi 1999)	Five scenarios	Limited
MiniCAM	Partial Equilibrium	2100	Global	OECD-Europe	Limited	Limited	(Edmonds, Wise et al. 1996)	11 scenarios	High
GTAP	General Equilibrium	Used for comparative statics	Global	EU	Limited	Advanced	(Hertel and Tsigas 1997)	Several explorative scenarios	High
GEM-E3	General Equilibrium		EU	National level and aggregate	Limited	Advanced	(Conrad, Capros et al. 1997)		Limited
E3ME	Combined Input-Output and General Equilibrium	2010	EU-12 without Greece	National level and aggregate	Limited	Limited	(CEC 1995)	Baseline and five variations	Limited
WorldScan	Applied General Equilibrium	2020 (2050)	Global	Western Europe	Limited	Limited	(CPB 1999)	Four reference scenarios	Very limited
JOBS	Static equilibrium	2020	Global	Western Europe	Limited	Limited	(RIVM forthcoming)	Baseline and several explorative scenarios	Very limited

Appendix II Literature overview of the scenario studies

Year	Author(s)/Institution(s)	Title
1990	*European Commission DGXVII*	*Energy for a new century – Energy in Europe: the European perspective*
1991	VROM	Perspectives in Europe
1992	CPB	Traffic and transport in three scenarios to 2015 (in Dutch: Verkeer en vervoer in drie scenario's tot 2015)
1992	CPB	Scanning the future: a long term scenario study of the world economy 1990-2015
1992	European Commission	The future development of the common transport policy: a global framework for pursuing sustainable development
1992	European Commission	Towards sustainability. A European Community programme of policy and action in relation to DGXI the environment and sustainable development
1992	European Commission	Urbanisation and the functions of cities in the European Community
1992	IPCC	Climate change 1992. The supplementary report to the IPCC scientific assessment
1992	VROM	The transport of goods by road and its environment in the Europe of tomorrow
1992	Pardoe, G.K.C. (et al)	Technology and the future of Europe: the impact of emerging technologies on the activity and economy of the member states beyond 1992
1992	ECN	Evaluation DG XVII and DG XII: CO_2 scenarios by country (In Dutch: Evaluatie DGVII en DGXII: CO_2 scenario's per land)
1992	RIVM	The environment in Europe: a global perspective
1992	*WRR*	*Ground for choices, four perspectives for the rural areas in the European Community (in Dutch: Grond voor keuzen, vier perspectieven voor de landelijke gebieden in de Europese Gemeenschap)*
1993	den Draak, J.	From blueprint to screenplay: scenarios in spatial planning and housing (In Dutch:Van blauwdruk naar draaiboek: scenario's in de ruimtelijke planning en volkshuisvesting)
1993	Greenpeace	Towards a fossil free energy future
1993	Rorsch, A., C. de Hart	Threshold 2000: constraints and scenarios for sustainable development in the Netherlands and Europe
1993	*Thord, R. (ed)*	*The future of transportation and communication, visions and perspectives from Europe, Japan and the USA*
1993	Whitelegg, J.	Transport for a sustainable future: the case for Europe
1994	Economic and Social Committee of the European Communities	Europe 2000+: co-operation for European territorial development
1994	*European Foundation for the Improvement of Living and Working Conditions (EFILWC)*	*The potential for employment opportunities from pursuing sustainable development*
1994	WRR	Sustained risks: A lasting phenomenon
1995	*ECN*	*Energy scenarios for a changing Europe: integration versus fragmentation*
1995	IPCC	Climate change 1994. Radiative forcing of climate change and an evaluation of the IPCC IS92-emission scenarios
1995	*McRae, H.*	*The world in 2020: power, culture and prosperity. A vision of the future*
1995	Schoute, J. Th. (ed)	Scenario studies for the rural environment: selected and edited proceedings of the symposium Scenario studies for the rural environment
1995	Spaargaren, G., T. Mol, D. Liefferink (ed.)	Sustainable Europe: Changed borders and dependencies (In Dutch: Duurzaam Europa: veranderde grenzen en afhankelijkheden)
1995	WEC and IIASA	Global energy perspectives to 2050 and beyond
1995	Wuppertal Institute	Towards a sustainable Europe
1996	*European Commission DGXVII*	*European energy to 2020: a scenario approach*
1996	*European Commission DGXI*	*Vision 2020, Scenarios for a sustainable Europe*

1996	*CPB*	*Surrounding scenarios: Long term exploration 1995-2020 (In Dutch: Omgevingsscenario's: Lange termijn verkenning 1995-2020)*
1996	CPB	The economy and the environment in search of sustainable development
1996	European Commission	European sustainable cities: Report by the expert group on urban environment
1996	European Commission	Progress report from the Commission on the Implementation of the European Community programme of policy and action in relation to the environment and sustainable development
1996	Husslage, W.J.G.	The urban green structures of Europe. The functions of green and blue lungs and veins through European cities (In Dutch: Stedelijke groenstructuren in Europa)
1996	Independent Commission on Population and Quality of Life (ICPQL)	Caring for the future: making next decades provide a life worth living report
1996	OECD	Shaping the 21st century: the contribution of development co-operation
1996	*Robinson, J. B.*	*Life in 2030: Exploring a sustainable future for Canada.*
1996	Wieners, B., D. Pescovits	Reality check
1997	*CPB*	*Economy and physical environment (In Dutch: Economie en fysieke omgeving)*
1997	*European Commission*	*Vision 2020, Scenarios for a sustainable Europe. Summary and recommendations agreed on by the General Consultative Forum.*
1997	Knoke, W.	Bold new world. The essential road-map to the twenty-first century (in Dutch: Plaatsloze nieuwe wereld)
1997	Nijkamp, P., H. Ouwersloot, S.A. Rienstra	Sustainable urban transport systems: An expert-based strategic scenarios approach
1997	Rotmans, J., H. de Vries	Perspectives on global change: The TARGETS approach
1997	*Smith, D*	*Eurofutures*
1997	ECN	Scenarios for Western Europe on long term abatement of CO2 emissions
1997	Hey, Nijkamp, Rienstra & Rothenberger	Assessing Scenario on European Transport Policies by means of Multicriteria Analysis
1998	N.V. Samenwerkende electriciteits-produktiebedrijven (Sep)	Guides to 2050.Transport in the 21st century (In Dutch: Wegwijzers naar 2050. Verkeer envervoerin de 21e eeuw)
1998	University of Sussex (Foresight programme)	Environmental Futures Scoping Study (UK)
1998	*Nijkamp, Rienstra & Vleugel*	*Transportation, planning and the future*
1998	European Commission	Deuxieme communication de la communaute Europeenne dans le contexte de la convention-cadre des nations unies sur les changements climatiques
1998	*European Commission DGVII*	*POSSUM (policy scenarios for sustainable mobility)*
1999	Office of Science and Technology Foresight	Actions for Sustainable Transport – Optimisation across modes (UK)
1999	*European Commission, Forward Studies Unit*	*Scenarios Europe 2010*
1999	IMF	The Economic Consequences of the Kosovo Crisis: An Updated Assessment
1999	European Commission (ECFIN)	The Economic Consequences of Ageing Population (A Comparison of the EU, US and Japan)
1999	ECN & RIVM	Voorraden en prijzen van fossiele brandstoffen. Schattingen en projecties voor de 21ste eeuw met het oog op klimaatbeleid
1999	Van Latesteijn (WRR)	Land use in Europe: A methodology for policy-oriented future studies. WRR-voorstudie nr.106
In pre-paration	European Commission, Forward Studies Unit	XVIIth European Carrefour on Science and Culture: Which role for the regions in the enlarged EU
In pre-paration	*European Commission DG R&D*	*VISIONS*
?	European Commission	SCENES: Scenarios for European Transport

1997	RIVM/UNEP	The Future of the Global Environment: A model-based Analysis Supporting UNEP's First Global Environment Outlook
1997	IFPRI	Feeding the World, Preventing Poverty, and Protecting the Earth. A 2020 Vision (Washington)
1997	*OECD*	*The World in 2020: Towards a New Global Age*
1997	*SEI / GSG*	*Branch Points: Global Scenarios and Human Choice*
1997	UNEP	Global Scenario Group: First Meeting Report TR. 97-2
1998	OECD	The Future of Food: Long-term Prospects for the Agro-food Sector
1998	OECD	21st Century Technologies: Promises and Perils of a Dynamic Future
1998	OECD	Societal Cohesion and the Globalising Economy: What Does the Future Hold?
1998	*SEI / GSG*	*Bending the Curve: Toward Global Sustainability*
1998	*Allen Hammond*	*Which world? Global destinies, regional choices*
1998	Van Veen-Groot, Nijkamp	Globalization, International transport and the Global Environment (GITAGE): a scenario approach
1998	Feenstra, Burton, Smith & Tol	Handbook on Methods of Climate Change Impact Assessment and Adaptation Strategies.
1998	*WBCSD*	*Exploring Sustainable Development: WBCSD Global Scenarios 2000-2050*
1999	IFPRI	World Food Prospects: Critical Issues for the Early Twenty-first Century
1999	OECD	The Future of the Global Economy: Towards a Long Boom?
1999	*Xerox corporation*	*Looking Inward. Visions of the 21st century family by students from around the world*
1999	CPB	Globalization, International Transport and the Global Environment: four quantitative scenarios
1999	ECN & RIVM	Voorraden en prijzen van fossiele brandstoffen. Schattingen en projecties voor de 21ste eeuw met het oog op klimaatbeleid
1999	IFPRI	Livestock to 2020. The Next Food Revolution
1999	UNEP / World Bank / NASA	Protecting our Planet, Securing our Future
1999	UNEP	Pachamama: Our Earth – Our Future (GEO-2000 for youth)
2000	Van Veen-Groot, Nijkamp, van den Bergh	A scenario study for investigating the implications of globalization on international transport and the global environment: a case study for the Dutch paper industry
2000 (in progress)	UN	Replacement Migration: Is it a solution to declining and ageing populations?
2000 (in progress)	*IPCC-WG III*	*Third Assessment Report*
2000 (in progress)	WBCSD	Scenarios and biotechnology
2000 (in progress)	WBCSD	'Current' thinking in the electricity sector
2001 (in progress)	*European Commission DG Research & Development*	*Integrated Visions for a Sustainable Europe*

Titles in *italics* are described and assessed in this report.

Appendix III Vertical assessment of the scenario studies

Evaluation of the WRR-, Thord/Button and EFILWC-study Table I

	WRR (1992) Ground for choices	Thord/Button (1993) A study on the future of transportation	EFILWC (1994) The potential for employment opportunities
Goal	• Gaining insight into the consequences of interactions for the rural areas in Europe	• Advising on transport developments	• Information for the wide ranging research programmes and policy debates of the Commission and the Member States
Target group	• Dutch policy makers	• European policy makers and scientists	• European policy makers and scientists
Developers	• WRR	• Button	• ECOTEC
Size team	• Big	• Small	• ?
Interdisciplinary	• Yes	• No	• ?
Methods	• Modelling	• Narrative	• Modelling
Participatory	• No	• No	• ?
Structure study	• -	• -	• 0
Documentation	• -	• -	• -
Dimensions			
Scale	• EU 12 and regions	• EU 6	• EU 6 (country specific)
Issues	• Land-use	• ?	• Employment
Sectors	• Agriculture	• Transport	• Energy and transport
Indicators	• Economic, environmental, and social	• Economic	• Social
Time horizon	• 2015	• About 2005	• 2020 (energy), 2015 (transport)
Consistency	• -	• ?	• ?
Coherency	• -	• ?	• ?
Transparency	• 0	• -	• -
Character study	• Hybrid	• Hybrid	• Predominantly quantitative
Integration	• -	• —	• —
Character scenarios			
Variations	• No	• No	• No
Perspectives	• Yes	• No	• No
Reference scenario	• No	• No	• No
Back/forecasting	• Forecasting	• Forecasting	• Forecasting
Normative	• No	• No	• No
Plausibility	• 0	• 0	• -
Surprises	• No	• No	• No
Recommendations	• Yes	• No	• Yes
Cost benefit	• No	• No	• No

With ? = not enough information to address this criteria, — = rather bad, - = not so good, 0 = sufficient, + = good, ++ = very good.

Appendix III Vertical assessment of the scenario studies

Table II **Evaluation of the ECN-, McRae- and EC DGXII-study**

	ECN (1995) Energy scenarios for a changing Europe	Mc Rae (1995) The world in 2020	EC DGXII (1996) Vision 2020
Goal	• ?	• Informing about global financial and political developments	• Challenging to develop future approach to environmental policy
Target group	• Various target groups	• No special target group	• Broad public, especially EC members
Developers	• ECN	• McRae	• General Consultative Forum on the Environment
Size team	• ?	• Small	• Small
Interdisciplinary	• ?	• No	• ?
Methods	• Modelling	• Narrative	• Narrative
Participatory	• No	• No	• ?
Structure study	• 0	• 0	• -
Documentation	• —	• 0	• -
Dimensions			
Scale	• Western Europe	• World, EU 12 (country specific)	• EU15
Issues	• Energy	• Politics	Employment, consumption and lifestyles, social security, social cohesion, equity, cultural diversity, health, environmental degradation,
Sectors	• Economy	• Economy and industry	• Energy, agriculture and transport
Indicators	• Economic	• Economic	• Economic, environmental and social
Time horizon	• 2020	• 2020	• 2020
Consistency	• 0	• 0	• 0
Coherency	• -	• -	• +
Transparency	• 0	• 0	• 0
Character study	• Quantitative	• Quantitative	• Quantitative
Integration	• -	• -	• +
Character scenarios			
Variations	• No	• No	• No
Perspectives	• Yes	• No	• Yes
Reference scenario	• No	• No	• No
Back/forecasting	• Forecasting	• Forecasting	• Fore- and backcasting
Normative	• No	• No	• No
Plausibility	• -	• 0	• 0
Surprises	• No	• No	• No
Recommendations	• No	• No	• Yes
Cost benefit	• No	• No	• No

With ? = not enough information to address this criteria, — = rather bad, - = not so good, 0 = sufficient, + = good, ++ = very good.

Appendix III Vertical assessment of the scenario studies

Evaluation of the EC DGXVII-, CPB and Smith-study Table III

	EC DGXVII (1996) Energy in Europe	CPB (1997) Economy and physical environment	Smith (1997) Eurofutures
Goal	• Tool for energy policie	• Gaining insight into economic, energy, planning and environmental issues	• ?
Target group	• European policy makers	• Dutch policy makers	• Broad target group
Developers	• Members DGXVII	• CPB	• Smith
Size team	• Big Co-operation	• Co-operation	• Small
Interdisciplinary	• Yes	• Yes	• No
Methods	• Modelling	• Modelling	• Narrative
Participatory	• Yes	• Yes	• No
Structure study	• +	• +	• 0
Documentation	• +	• 0	• +
Dimensions			
Scale	• Global, EU 15 (country specific)	• EU 15	• EU 15 (country specific)
Issues	• Employment, environmental degradation, monetary and fiscal policy	• Environmental degradation	• Politics
Sectors	• Energy, economy and technology	• Planning	• Economy
Indicators	• Economic, social and environmental	• Economic	• Economic and institutional
Time horizon	• 2020	• 2020	• 2100
Consistency	• +	• ?	• 0
Coherency	• 0	• ?	• -
Transparency	• +	• 0	• 0
Character study	• Hybrid	• Hybrid ·	• Qualitative
Integration	• 0	• 0	• -
Character scenarios			
Variations	• No	• No	• No
Perspectives	• Yes	• Yes	• Yes
Reference scenario	• Yes	• No	• No
Back/forecasting	• Forecasting	• Forecasting	• Forecasting
Normative	• No	• No	• No
Plausibility	• +	• 0	• —
Surprises	• Yes	• No	• Yes
Recommendations	• Yes, key messages	• No	• Yes, for Dutch policy makers
Cost benefit	• No	• No	• No

With ? = not enough information to address this criteria, — = rather bad, - = not so good, 0 = sufficient, + = good, ++ = very good.

Appendix III Vertical assessment of the scenario studies

Table IV **Evaluation of the OECD, SEI/GSG and Nijkamp et al.**

	OECD (1997) The world in 2020: Towards a new global age	SEI / GSG (1997,1998) Branch point / Bending the curve	Nijkamp et al (1998) Transportation planning and the future
Goal	• Making a contribution to realising the opportunities of the New Global Age	• To illuminate the character of the current global system, the dynamics driving it forward and the spectrum of possible futures states and pathways	• Fill the current gap in strategic thinking
Target group	• policy makers ?	• ?	• Policy makers, transport experts and scientists
Developers	• All parts of OECD secretariat	• Global Scenario Group	• Nijkamp, P., Rienstra, S.A., Vleugel, J.M.
Size team	• Big	• Big	• Small
Interdisciplinary	• Yes	• Yes	• No
Methods	• Narrative and modelling	• Narrative	• Narrative and modelling
Participatory	• No	• No	• Yes
Structure study	• —	• 0	• +
Documentation	• -	• -	• +
Dimensions			
Scale	• OECD and non-OECD countries (world)	• World	• Western Europe
Issues	• Globalisation, trade, environmental degradation	• Lifestyles, equity, environmental degradation, policy reforms	• Spatial, institutional, Economic and socio-psychological trends
Sectors	• Economy	• Economy, society, technology	• Transport
Indicators	• Economic, social, environmental	• Social, economic, institutional, environmental	• Environmental, social, economic, institutional
Time horizon	• 2020	• 2100	• 2030
Consistency	• 0	• +	• 0
Coherency	• -	• +	• 0
Transparency	• -	• -	• +
Character study	• Mainly quantitative	• Qualitative	• Predominantly qualitative
Integration	• -	• +	• 0
Character scenarios			
Variations	• Yes	• No	• Yes
Perspectives	• No	• Yes	• Yes
Reference scenario	• Yes	• No	• Yes
Back/forecasting	• Backcasting	• Forecasting	• Backcasting
Normative	• Yes	• No	• Partly
Plausibility	• +	• +	• +
Surprises	• No	• No	• No
Recommendations	• Yes	• No	• No
Cost benefit	• No	• No	• No

With ? = not enough information to address this criteria, — = rather bad, - = not so good, 0 = sufficient, + = good, ++ = very good.

Appendix III Vertical assessment of the scenario studies

Evaluation of the POSSUM team, WBCSD and the EC Forward Studies Unit-study Table V

	POSSUM team (1998) POSSUM	WBCSD (1998) Exploring sustainable development: WBCSD global scenarios 2000-2050	EC Forward Studies Unit (1999) Scenarios Europe 2010
Goal	• Achieving the objectives of sustainable mobility and to assist the EC in future decisions	• to stimulate broad discussion on the challenges of sustainable development for business and to provide a platform for more focused industry and corporate scenarios	• Stimulate debate inside and outside the EC on the future of European integration; develop a tool to put EC policies and strategies into perspective
Target group	• European Commission	• Businesses	• European policy makers and scientists
Developers	• University College London, Free university Amsterdam, National Technical University of Athens, EURES, FOA/ESRG, VTT, Warsaw University of Technology, Scientific Centre for Complex Transport Problems	• WBCSD	• Different DGs of the European Commission
Size team	• Big	• Small	• Big
Interdisciplinary	• No	• No	• Yes
Methods	• Narrative	• Narrative	• Narrative
Participatory	• Yes	• No	• ?
Structure study	• 0	• 0	• ++
Documentation	• +	• 0	• ++
Dimensions			
Scale	• EU, EFTA-countries, CEEC-countries and CIS-countries	• World	• Europe
Issues	• Regional development, economic efficiency and environmental protection	• Governance, equity, ecology, demography	• Institutions and governance, social cohesion, economic adaptability, enlar
Sectors	• Transport	• Economy, technology	gement of the EU,
Indicators	• Economic, environmental	• Economic, social, institutional and environmental	Europe's external environment
Time horizon	• 2020	• 2050	• 2010
Consistency	• 0	• 0	• +
Coherency	• -	• 0	• +
Transparency	• 0	• -	• +
Character study	• Qualitative	• Qualitative	• Qualitative
Integration	• -	• 0	• 0
Character scenarios			
Variations	• No	• Yes	
Perspectives	• Yes	• Yes	• Yes
Reference scenario	• Yes	• No	• No
Back/forecasting	• Backcasting	• Forecasting	
Normative	• Yes	• No	
Plausibility	• +	• 0	
Surprises	• No	• No	
Recommendations	• Yes	• Yes	• No
Cost benefit	• No	• No	• No

With ? = not enough information to address this criteria, — = rather bad, - = not so good, 0 = sufficient, + = good, ++ = very good.

Appendix III Vertical assessment of the scenario studies

Table VI **Evaluation of the Xerox, IPCC WGIII and Jackson Environment Institute study**

	Xerox corporation (1999) Looking inward. Visions of the 21st century family by students from around the world	IPCC -WG III (forthcoming) SRES	Jackson Environment Institute (forthcoming) ACACIA project
Goal	• Promotion of literacy and encouragement of self-expression With this our world can be a better place		• ?
Target group	• Young people	• Broad research community	• ?
Developers	• Students from around the world + XEROX and Cascade Press	• IPCC Working Group III	• Co-operation
Size team	• Big	• Big	• Big
Interdisciplinary	• ?	• Yes	• Yes
Methods	• Narratives	• Modelling and narrative	• Modelling + narrative
Participatory	• Yes	• Yes	• ?
Structure study	• -	• 0	• -
Documentation	• 0	• ?	• ?
Dimensions			
Scale	• World, with regions (USA, Brazil, The Netherlands	• World	• EU 15 + Hungary, Poland, the Czech Republic, Slovania, Estonia, Cyprus, Bulgaria, Lithuania, Slovakia and Romania
Issues	• ?	• Climate change, demography, economy	• Climate change
Sectors	• Family life		• Water, soil, ecosystems, forestry, agriculture, fisheries, insurance, transport, energy, recreation and tourism, human health
Indicators	• Environmental, Economic, Social and Institutional	• Environmental, economic	• Economic, environmental
Time horizon	• 21st century (the time horizon differs for each story)	• 2100	• 2020 – 2080
Consistency	• -	•	• 0
Coherency	• -	•	• 0
Transparency	• —	• +	• -
Character study	• Qualitative	• Hybrid	• Predominantly qualitative with some quantification
Integration	• Yes	• Yes	• 0
Character scenarios			
Variations	• No	• No	• No
Perspectives	• Yes	• Yes	• No
Back/forecasting	• ?	• Forecasting	• Forecasting
Normative	• No		
Plausibility	• —	• +	• +
Surprises	• Yes		
Recommendations	• No		• Yes
Cost benefit	• No		• No

With ? = not enough information to address this criteria, — = rather bad, - = not so good, 0 = sufficient, + = good, ++ = very good.

Appendix III Vertical assessment of the scenario studies

Evaluation of the Visions team-study Table VII

	VISIONS team (forthcoming) VISIONS project
Goal	• Raise awareness of sustainable development by increasing the understanding of the many links between socio-economic and environmental processes.
Target group	• People involved in the sustainable development question
Developers	• Cooperation between nine European institutes
Size team	• Big
Interdisciplinary	• Yes
Methods	• Modelling + narratives
Participatory	• Yes
Structure study	• ?
Documentation	• +
Dimensions	
Scale	• Global, European and regional
Issues	• Equity, Employment, Consumption behaviour, Environmental degradation
Sectors	• Energy, Water, Transport, Infrastructure
Indicators	• Social, Economic, Environmental, Institutional
Time horizon	
Consistency	• 0
Coherency	• 0
Transparency	• +
Character study	• Hybrid
Integration	• +
Character scenarios	
Variations	• No
Perspectives	• Yes
Reference scenario	• No
Back/forecasting	• Forecasting
Normative	• Yes
Plausibility	• 0
Surprises	• Yes
Recommendations	• ?
Cost benefit	• ?

With ? = not enough information to address this criteria, — = rather bad, - = not so good, 0 = sufficient, + = good, ++ = very good.

Appendix IV Characteristics of the scenarios

	Social dimension	Environmental dimension	Economic dimension	Institutional dimension
Free market and free trade (WRR)	• Competitive labour market	• No additional environmental policy	• Competitive market mechanism • Free trade	-
Regional development (WRR)	• Equity in terms of employment • Employment on regional scale	• No additional environmental policy	• Import and export regulation	-
Nature and landscape (WRR)	-	• Environmental protection policy	• Regional economy • Free trade	-
Environmental protection (WRR)	• Equity in terms of employment	• Environmental protection policy	• Internalisation of environmental costs • Import and export regulation	-
Transport scenario (Button)	-	• Environmental degradation	• Privatisation of transport market • Single European Market	• Liberalisation of East Europe
Energy scenario ECOTEC (EFILWC)	• Increased employment	• Environmental protection policy	• Business as Usual	-
Transport scenario ECOTEC (EFILWC)	• Increased unemployment	• Environmental protection policy	• Continued economic growth	-
Integration scenario (ECN)	-	• No additional environmental policy	• High economic growth • Tax harmonisation	• Successful EMU
Fragmentation scenario (ECN)	-	• No additional environmental policy	• Low economic growth • National tax regimes • National economy	• Failed EMU • Nationalism
McRae scenario	• Cultural limits to European integration	-	• National economies • Government budgets under increased pressures	• Expansion EMU
Opening Opportunities (EC DGXI)	• Inequitable distribution in wealth • Job insecurity	• Environmental-friendly technologies	• Competitive global market • Privatisation	• Globalisation
Guiding Change (EC DGXI)	• High social security	• Environmental protection policy	• Strong intra-regional economy • Single European Market	• European Fortress
Transforming Communities (EC DGXI)	-	• Environmental protection policy • Use of environment in terms of European ecological footprint[26]	• Local economy • Ecological tax reform	• Decentralisation • EU key player in globalenvironmental policy
Conventional Wisdom (EC DGXVII)	• High unemployment	• High CO_2 emissions	• Decelerated economic growth	• National energy policies • EMU for core
Battlefield (EC DGXVII)	• Ageing • High unemployment	• High CO_2 emissions	• Slowdown of economic growth	• Protectionism • EMU fails
Forum (EC DGXVII)	• Increased employment	• Low CO_2 emissions • Environmental protection policy • Environmental-friendly technologies	• Stabilisation of economic growth thereafter increased economic growth after 2010	• Successful EMU
Hypermarket (EC DGXVII)	• High social security • High employment	• High CO_2 emissions	• Competitive market mechanism • High economic growth	• Successful EMU for core
Divided Europe (CPB)	• Social and cultural conflicts	• Environmental degradation	• Low economic growth	• Slow development towards EMU

	Social dimension	Environmental dimension	Economic dimension	Institutional dimension
European Co-ordination (CPB)	• Equity • Solidarity • Cohesion	• Integrated European environmental policy • Immaterial lifestyles	• High economic growth	• Global isolationism • Realisation EMU • European Fortress
Global Competition (CPB)	• Strong individualisation • Inequity	• Material lifestyles	• Competitive free market • High economic growth	• Deregulation • No European integration
The renaissance (Smith)	• Cultural Renaissance • Social happiness	-	• High economic growth	• Successful EMU • Single currency • Political Renaissance
Plus ça change (Smith)	• Cultural and social stability	-	• High economic growth	• Gradually realisation EMU and currency • Political stability
Les etrangers (Smith)	• Social and cultural tensions	-	• Moderate economic growth	• Successful EMU for core • Political tensions
The dark ages (Smith)	• Social and cultural disorder • High unemployment	-	• Slow economic growth	• EU countries protectionistic sovereign countries • EMU will not last • Political conflicts
The apocalypse (Smith)	• Social and cultural chaos • High unemployment	• Environmental degradation	• Low economic growth	• EMU fails catastrophically • Political instability
New Global Age (OECD)	• Social policy changes	• International agreements to reduce emissions	• High economic growth • Shift in global economic weight	• Movement towards free trade
Business as Usual (OECD)	• Poverty and marginalisation remain major problems	-	• B.a.u. economic growth	• Slow progress in liberalisation of international trade
Conventional worlds (SEI / GSG)	• Greater social equity	• Environmental protection • Environmentally friendly technology	• Rapid growth of world economy	• Continuity of institutions and values
Barbarization (SEI / GSG)	• Unbridled conflict	• Environmental destruction	• Economic collapse	• Institutional disintegration
Great Transitions (SEI / GSG)	• High levels of welfare • Strong sense of social solidarity	• Preservation of natural systems • Green technologies	• Economic autarky	• Localism
Market World (Hammond)	• Widespread prosperity, peace and stability	-	• High economic growth • Global corparations dominate	-
Fortress World (Hammond)	• Violence, conflict and instability	• Environmental disasters	• Economic stagnation	-
Transformed World (Hammond)	• Fundamental social change	-	• Continued economic growth	• Fundamental political change
Regulatory (Nijkamp et al.)	• Social cohesion • equity	• CO_2 emissions reduced	• Subsidised transport	• Regulation
Market-oriented (Nijkamp et al.)	• Freedom of choice for individuals	• Sustainable transport system	• Economic growth	• No large scale intervention of government
EU co-ordination of active citizens (POSSUM team)	• Local life-styles • Green values	• Stricter environmental regulations and standards (locally)	• Moderate economic growth • Decoupling transport from GDP	• Localisation
Global co-operation for sustainable transport (POSSUM team)	• International life-style • Segmentation of society	• Environmental consiousness among leading politicians • Agreements on international standards	• High economic growth	• Politicians at the forefront of green consiousness

	Social dimension	Environmental dimension	Economic dimension	Institutional dimension
Accord on sustainability (POSSUM team)	• Co-operation	• Agreements on international standards and norms	-	• Overarching political structures in Europe
FROG! (WBCSD)	• Social inequity	• Sustainable development not priority	• Fair degeree of economic success	• Globalisation • Liberalisationof markets
GEOpolity (WBCSD)	-	-	· Economic sacrifice	• New global institutions
Jazz (WBCSD)	• Social innovations	• Environmental awareness	• Global free market	• Globalisation
Triumphant Markets (EC Forward Studies Unit)	• Increasing inequality • Reduction in unemployment	• Environment increasingly damaged	• Rapid growth in small businesses • World free trade area	• Liberalism • Individualism
The Hundred Flowers (EC Forward Studies Unit)	• Growing inequalities • Rising crime • Small regional conflicts	-	• Economic performance disappointing at first, then flourishing	• EU looses powers
Shared Responsibilities (EC Forward Studies Unit)	• Unemmployment reduced • Rise in civil society	-	• Econommic prosperity	• Common political vision among EU member states
Creative Societies (EC Forward Studies Unit)	• Improvement of social situation	• Support of green accounts • New taxes on pollution	• Economic situation muddles through	• Setting up of European Forum
Turbulent Neighbourhoods (EC Forward Studies Unit)	• Small-scale conflicts • Passive acceptance of degradation of public services	• Water shortage	-	• Establishment of a European Security Council • Political instability • More and more religious parties
A1 (IPCC)	• Cultural convergence • Low population growth	• Less concern for environmental quality	• Very rapid economic growth	• Globalisation
A2 (IPCC)	• Strengthening regional cultural identities • High population growth	-	• less concern for rapid economic development	• Localisation
B1 (IPCC)	• Improving equity	• Global solutions to environmental sustainability	• Rapid change in economic structures • Dematerialisation	• Globalisation
B2 (IPCC)	• Community initiatives • Social innovation	• Local solutions to environmental sustainability	v Local solutions to economic sustainability	• Localisation
Knowledge is King (VISIONS team)	• Two-pace society • Life extension drugs • Local Exchange Trading Schemes	• Environment improves slightly • Water scarcity	• Two-pace society	• Less influence from government
Big is Beautiful (VISIONS team)	• Inequality • Quality of life deteriorates	-	• Mergers • Economic growth • stagnates	• Privatisation
Creeping Change '(VISIONS team)	• Social tensions • National identity less important	• Environmental disasters	• Economy on the brink of collapse	• National importance declines • Stronger European governance

Appendix V Scenarios subdivided in clusters

Social driving forces				**Environmental driving forces**				**Economical driving forces**			
W&S	*JDI*	*DM*	*CD*	*W&S*	*JDI*	*DM*	*CD*	*W&S*	*JDI*	*DM*	*CD*
Guiding change	GEO-polity	Barbari-zation	Energy (ECOTEC)		Nature & land-scape	Convul-sive Change	Great transi-tions	Button scenario	Free market and free trade	Frag-menta-tion	Integra-tion
The hundred flowers	Shared respon-sibilities	Turbulent Neigh-bour-hoods	Transport (ECOTEC)		Envi-ronmen-tal protec-tion			McRae scenario	Regional deve-lopment	Battlefield	Opening oppor-tunities
	Creative societies		Trans-forming com-munities		EU co-ordination of active citizens			Conven-tional wisdom	Hyper-market	Divided Europe	Forum
	A2		Transfor-med world		Global co-operation for sustai-nable transport			European coordina-tion	Global compe-tition	The dark ages	The renais-sance
	B2		Accord on sustaina-bility					Plus ca change	A1	The apocal-ypse	New global age
	Jazz							Les etranger		Fortress world	
								Business as usual		FROG!	
								Conven-tional worlds		B1	
								Trium-phant markets			

W&S : Wait and See
JDI : Just do it
DM : Doom Monger
CD : Carpe Diem

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