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Tool use in integrated assessments

Integration and synthesis report for the *SustainabilityA-Test* project

W. de Ridder (editor)

Contact:
W. de Ridder
Air Quality and European Sustainability (LED)
Wouter.de.Ridder@mnp.nl

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Netherlands Environmental Assessment Agency (MNP), P.O. Box 303, 3720 AH Bilthoven, the Netherlands;

Tel: +31-30-274 274 5; Fax: +31-30-274 4479; www.mnp.nl/en

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Netherlands Environmental Assessment Agency (MNP)
PO Box 303
NL-3720 BA Bilthoven
The Netherlands
Correspondance: Wouter de Ridder (Wouter.de.Ridder@mnp.nl)

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Abstract

Tool use in integrated assessments – Integration and synthesis report for the *SustainabilityA-Test* project

The way policy assessments have been carried out by making use of assessment tools such as cost–benefit analysis, multi-criteria analysis and tools for organising participation does leave room for improvement. A precondition for making good use of tools is to know what tools there are and what they can deliver. This became the central issue in setting up the *SustainabilityA-Test* project, which is described in this report.

The *SustainabilityA-Test* project produced a framework describing the tasks that are generally to be done in policy assessments and identifying tools that can support these tasks. A website, www.SustainabilityA-Test.net, was also designed in the course of this project. This website not only provides easily accessible, peer reviewed information about assessment tools but can also be used to find suitable tools for specific evaluation tasks.

Key words: assessment tools, sustainability assessment, integrated assessment, policy assessment, policy evaluation, impact assessment, EU

Rapport in het kort

Tool gebruik in integrale analyses – integratie en synthese rapport van het SustainabilityA-Test project

De wijze waarop beleidsbeoordelingen uitgevoerd worden met behulp van tools, zoals kosten–baten analyse, multi-criteria analyse en tools om participatie te organiseren, kan verbeterd worden. Een voorwaarde voor het goed gebruik maken van tools is weten welke tools beschikbaar zijn en weten wat tools kunnen doen. Dit was het thema van het *SustainabilityA-Test* project, dat in dit rapport staat beschreven.

Het *SustainabilityA-Test* project heeft een raamwerk opgeleverd dat de taken beschrijft die in het algemeen in een integrale beleidsbeoordeling uitgevoerd moeten worden en daarbij de tools laat zien die deze taken kunnen ondersteunen. Daarnaast is in het project een website ontwikkeld: www.SustainabilityA-Test.net. Deze website biedt naast wetenschappelijk gereviewde informatie over de tools ook hulp bij het vinden van geschikte tools voor specifieke taken in een beleidsbeoordeling.

Trefwoorden: evaluatie tools, duurzaamheidanalyse, integrale beoordeling, beleidsbeoordeling, beleidsevaluatie, effect rapportage, EU

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Co-authors of this report are listed below in alphabetical order:

Hermann Lotze-Campen
Potsdam Institut für Klimafolgenforschung (PIK), Germany

Marc Dijk
International Centre for Integrated assessment Sustainable development (ICIS), Netherlands

Dirk Günther
Institute for Environmental Systems Research (USF), Germany

Marjan van Herwijnen
Institute for Environmental Studies (IVM), Netherlands

Nadja Kasperczyk
Institute for Rural Development Research (IfLS), Germany

René Kemp
International Centre for Integrated assessment Sustainable development (ICIS), Netherlands

Karlheinz Knickel
Institute for Rural Development Research (IfLS), Germany

Onno Kuik
Institute for Environmental Studies (IVM), Netherlands

Pim Martens
International Centre for Integrated assessment Sustainable development (ICIS), Netherlands

Alexa Matovelle
Centre for Environmental Systems Research (CESR), Germany

Måns Nilsson
Stockholm Environment Institute (SEI), Sweden

Mita Patel
International Centre for Integrated assessment Sustainable development (ICIS), Netherlands

Tiago de Sousa Pedrosa
Joint Research Centre (JRC), Italy

Ângela Guimarães Pereira
Joint Research Centre (JRC), Italy

Anneke von Raggamby
Ecologic, Germany

Philipp Schepelmann
Wuppertal Institute, Germany

Karlheinz Simon
Centre for Environmental Systems Research (CESR), Germany

John Turnpenny
Tyndall Centre for Climate Change Research, United Kingdom

Bart Wesselink
Netherlands Environmental Assessment Agency (MNP), Netherlands

Furthermore, the following persons have provided valuable input to the report: J. David Tàbara of the Institute of Environmental Science and Technology (IEST) in Spain, John Robinson of the Sustainable Development Research Initiative (SDRI) in Canada, David Stanners of the European Environment Agency (EEA) in Denmark and Jan Bakkes, Peter Janssen, Tom Kram and Arthur Petersen of the Netherlands Environmental Assessment Agency (MNP) in the Netherlands.

Contents

The reader and main points of interest

This report is geared to those who want to know more about the role of tools in assessment and about how these tools' roles have been derived. The report provides the scientific background for the website www.SustainabilityA-Test.net.

The following items are also included in this report:

– **Executive summary**: **page 9**

– **Results of interviews** held with European Commission staff on their experiences with Impact Assessment: **page 33**

– **Tool overview**: **page 44**

– **Summary of the role of each tool type** in an integrated assessment: **page 49**

– Overall **conclusions and recommendations** relevant for **Impact Assessment**: **page 91** and **93.**

Summary

This report documents the project *SustainabilityA-Test*, integrating and synthesising the work done throughout the entire project. It is developed in conjunction with a website specifically designed for the project (the so-called webbook), accessible via www.SustainabilityA-Test.net. The report and website are the result of a joint effort between researchers with various scientific backgrounds, but all active in the field of integrated assessment.

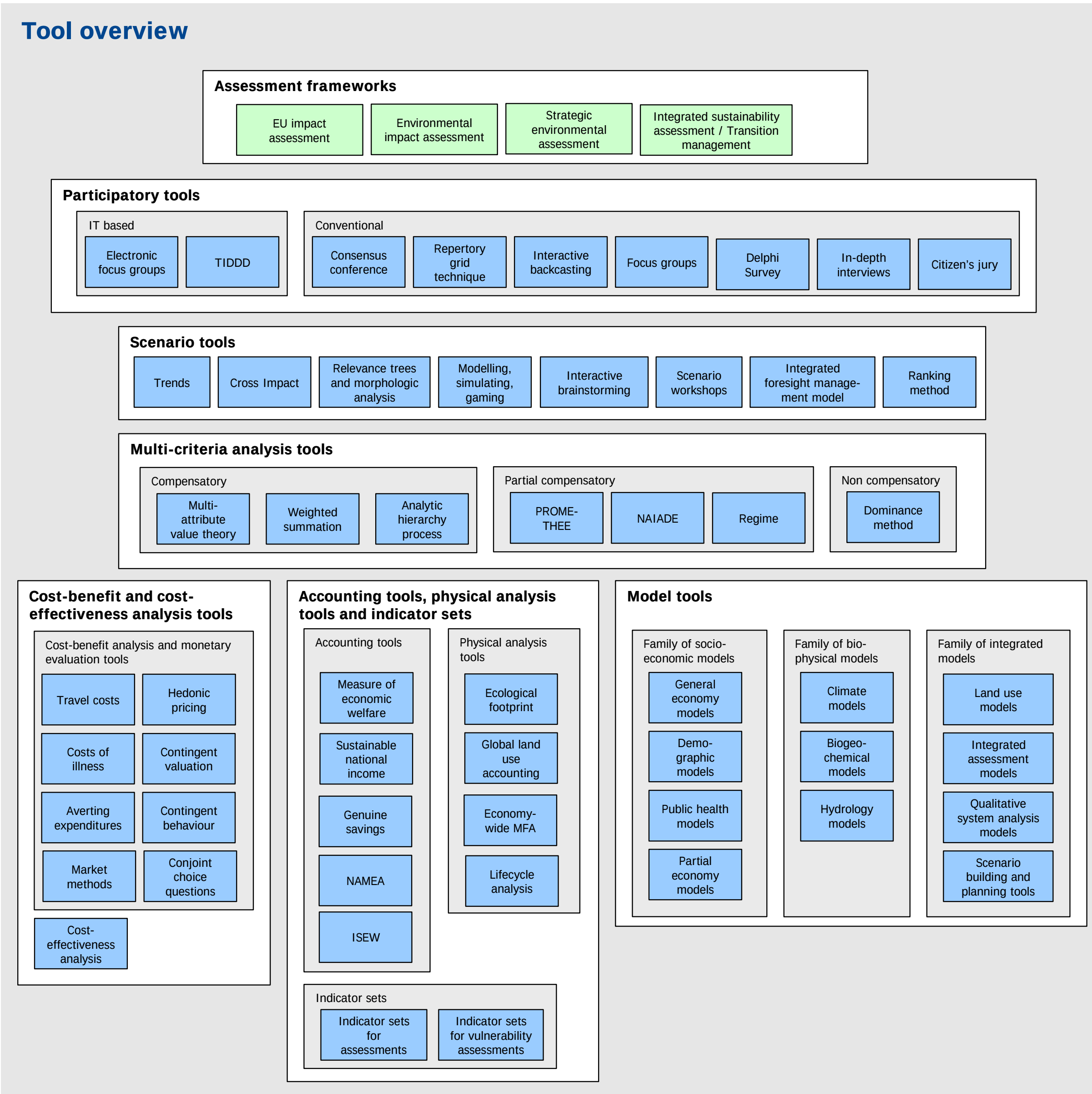

Figure A: Tools covered by the *SustainabilityA-Test* project.

Purpose of the SustainabilityA-Test project

The purpose of the *SustainabilityA-Test* project was to strengthen integrated assessments for sustainable development by scientifically underpinning the use of assessment tools in integrated assessments for sustainable development. Assessment tools comprise all kinds of tools used to carry out assessments. Examples are found not only among model tools, and cost–benefit analysis and participatory tools, but also among tools that frame integrated assessments for sustainable development, such as the European Commission's Impact Assessment procedure. Figure A, previous page, provides an overview of all the tools used in the project.

Table A: The role of tools in assessments

<table>
<tr><th></th><th>Phase I
Problem analysis</th><th>Phase II
Finding options</th><th>Phase III
Analysis</th><th>Phase IV
Follow-up</th></tr>
<tr><td>Participatory tools</td><td>Problem framing (mobilising and integrating knowledge and values)</td><td>Supporting scenario building</td><td>Providing the context for and improve robustness of MCA, CBA and CEA</td><td>Evaluating the assessment process</td></tr>
<tr><td>Scenario tools</td><td>Providing the future perspectives to problem framing</td><td>Visioning futures, finding options and setting objectives</td><td>Providing references for the application of analytical tools</td><td>–</td></tr>
<tr><td>Multi-criteria analysis tools (MCA)</td><td>–</td><td>Definition of criteria</td><td>Comparing different alternatives</td><td>–</td></tr>
<tr><td>Cost-benefit analysis (CBA) and cost-effectiveness analysis (CEA) tools</td><td rowspan="3">Providing the analytical basis for problem-framing</td><td rowspan="3">Supporting objective setting</td><td rowspan="3">Full analytical characterisation of options to enable comparison</td><td rowspan="3">Ex-post assessment</td></tr>
<tr><td>Accounting tools, physical analysis tools and indicator sets</td></tr>
<tr><td>Model tools</td></tr>
</table>

Note: The table shows six tool groups in the left-hand column, followed by a column for each of the four generic phases of an assessment. A cell describes a task that is to be done in a particular phase. This task can be supported by the tool group of the same row as the cell. The shaded cells in the table represent task/tool combinations that are 'in the lead' in a particular phase. The labels of the top row (problem analysis, finding options, etc) can be replaced by corresponding terminology found in different types of assessments, like Impact Assessment or Strategic Environmental Assessment.

Tools and tool groups

About 50 tools have been identified and evaluated within the project and grouped into seven tool groups. Although many more tools exist, these are not covered here. The tool groups developed during the project do, however, allow extra tools to be easily added in the future if needed.

The strengths and weaknesses are described for each tool covered in the project, along with the capacity of the tools to address the various issues relevant to sustainable development. Some of the operational characteristics of these tools, such as time and resource needs, are also outlined.

Tool groups and their roles in integrated assessment

A literature study into the use of tools in integrated assessment has resulted in an overall framework for the tools, focusing on the role of each of the seven tool groups in integrated assessments. This framework is summarised in Table A (previous page), which shows a simplified representation of four generic phases of integrated assessments for sustainable development and the tasks to be done. The tasks and the tool groups to support them are presented in the table. The tasks are described in the cells of the table; the left column shows the tool groups that can support the tasks.

Choosing a tool within a tool group

Selection criteria have been developed to aid in deciding which tools to choose from in a specific tool group (see Table B). Each tool group has its own set of selection criteria to aid in the search for the most suitable tool for a certain assessment task.

Table B: Selection criteria for each tool group

Tool group	Criteria
Participatory tools	Number of participants to involve, whether or not ICT-based tools can be used, goal of participation, problem content, type of outcome desired and type of mediator needed/available
Scenario tools	Type of scenario desired, problem content, type of outcome desired (referring to process) and necessity to involve (scenario) experts
Multi-criteria analysis tools	Decision rule and type of data
Cost-benefit and cost-effectiveness analysis tools (valuation methods)	Approach (stated-preference or revealed preference) and aspect (of sustainable development) to be monetised
Accounting tools, physical analysis tools and indicator sets	Aspects (of sustainable development) to be covered
Model tools	Aspects (of sustainable development) to be covered

Interviews with European Commission desk officers

A number of interviews were held with desk officers from the European Commission during the project as a source of hands-on experience in putting the concept of integrated assessment within the European Commission into practice. The Commission’s desk officers are potential users of the project’s results. The interviews suggested that because desk officers are often not that familiar with the tools, information on the range of tools available for integrated assessment will be important. This information will be provided for through the

SustainabilityA-Test's webbook. Even if such information may not help desk officers to actually apply the tools – the actual application is often delegated to (policy) researchers and analysts – it is important that they know about them and about the pros and cons of each.

Case study

The *SustainabilityA-Test* case study has deepened the tool evaluation, and further allowed investigation of the role that tools play in integrated assessments. This was done by investigating how tools had been applied in a real policy situation – the development of the biofuels directive and the energy crop premium regulation – and examining how tools and tool combinations could have been applied. This case study facilitated a more direct comparison of the usefulness of tools. It has also led to several observations on the use of tools in integrated assessments for sustainable development. The case study observations formed the cornerstone for the overall conclusions drawn from the project.

Integration and synthesis

The results of the project were integrated and synthesised on the basis of three recurring themes listed below. In this way the overall framework, the case study and the interviews with desk officers could be integrated. The three recurring themes are:

1. The value of making tool combinations;
2. The scope of an assessment and coverage of impacts;
3. The communication about tools within the scientific community and between scientists and policy makers.

On the value of making tool combinations:

Conclusion 1: An integrated assessment for sustainable development is best supported by a *combination* of tools.

Conclusion 2: Not too many tools should be used in an assessment, and tools do not necessarily have to be linked.

Conclusion 3: The potential of combining tools is largely unexplored and could be significant.

On the scope of the assessment and coverage of impacts:

Conclusion 4: Defining the scope is crucial for the outcome of an assessment and could be supported by participatory tools.

Conclusion 5: An integrated assessment for sustainable development combines quantitative and qualitative information. Tools are available for making this combination.

On the communication about tools within the scientific community and between scientists and policy makers:

Conclusion 6: Tool use is hampered by jargon.

Conclusion 7: Scientists need to better explain the added value of their own tools and learn about other tools.

Additionally, there are two conclusions that are specifically relevant for Impact Assessments as carried out by the European Commission:

Conclusion 8: Impact Assessments could benefit from the results of assessments done earlier in the policy making process.

Conclusion 9: Impact Assessment can contribute to a comprehensive integrated assessment for sustainable development.

Overall conclusion

There seems to be room for significant improvements in the way integrated assessments are carried out by making use of efficient combinations of existing tools. A precondition for devising tool combinations is to know both what tools exist and what each can deliver.

The webbook, developed in the course of this project, can be helpful in making integrated assessments for sustainable development for two reasons. Firstly, it outlines what an integrated assessment for sustainable development might look like, and secondly, it clarifies the role of tools in an integrated assessment, providing scientifically underpinned, easily accessible information about these tools to increase tool use and support use of tool combinations. And so, in this way, the webbook can forge a link between the scientific and policy-making communities.

As the *SustainabilityA-Test* project did not cover all tools that exist, the results of this project should be considered a first step towards a better dissemination to tool information by means of a generic framework for explaining what tools can contribute to policy assessments.

1 Introduction

Wouter de Ridder

This report documents the project *SustainabilityA-Test*, and integrates and synthesises the work done throughout the entire project. The *SustainabilityA-Test* project is a so-called 'specific targeted research or innovation project' (STREP) under the 6th framework research programme of the European Commission (priority 1.1.6.3 – Global change and ecosystems).

The project is about *assessment tools* used to assess a policy's contribution to *sustainable development*. The word 'tools' refers to all kinds of methods, analytical approaches, procedures and frameworks that can be used for the assessment of policy. Examples of tools are cost–benefit analysis tools, participatory tools, scenario tools, multi-criteria tools and models. The *SustainabilityA-Test* project is not an innovative research project in the sense that new tools have been developed. Instead, the project focussed on *existing* tools and created an inventory of tools, showing what can and cannot be done with them within an assessment.

Together with this report, an internet-based handbook is published in which all information and other project deliverables can be found. This website is accessible via www.SustainabilityA-Test.net. This report is written as a scientific background report, explaining the methodology used to build the functions offered by the website.

This introductory chapter of the report explains the project's background and objectives, and methodology. It ends with an overview of the structure of the entire report.

1.1 Study background and objectives

Many different tools are available for carrying out policy assessments for sustainable development. In the *SustainabilityA-Test* project these tools were examined on the basis literature review and a review of tool applications, and a case study.

As the *SustainabilityA-Test* project is an EU research project, the EU level formed the background against which the project investigated the existence of tools and their usage in assessments, as well as the practice of policy assessment for sustainable development. In recent years, the EU – in particular the European Commission, but recently also the Council and Parliament – uses the so-called Impact Assessment methodology (CEC, 2003a; CEC, 2005) to accompany policy proposals with an assessment of the possible impacts of such proposals[1]. This impact assessment system therefore forms an important basis of the project.

[1] See http://ec.europa.eu/governance/impact/index_en.htm for further information about the European Commission's Impact Assessment system [last accessed: December 2006].

But, the *SustainabilityA-Test* project is not only about the European Commission's Impact Assessment system, and also discusses other types of integrated assessment, such as Strategic Environmental Assessment and Environmental Impact Assessment, collectively referred to as integrated assessment.

Sustainable development in the EU is made explicit by means of the EU Sustainable Development Strategy (EU SDS). Therefore, assessing for sustainable development is interpreted in this project as assessing a policy proposal in light of the priorities, targets and objectives set in the EU SDS.

The overall goal of the project *SustainabilityA-Test* is to:

1. Support the definition and implementation of the EU Sustainable Development Strategy by describing, assessing and comparing tools that can be used to measure or assess sustainable development; and thus
2. Improve the scientific underpinning of sustainable development impact assessment.

The main deliverable of the project is the internet-based handbook (webbook), which aims to support policy makers (and researchers) with finding the most suitable tools for carrying out an integrated assessment for sustainable development.

1.2 Study methodology

The project has been executed in 30 months time, starting in March 2004 and ending in August 2006. A consortium of 18 partners from the EU, USA and Canada were involved in the project, spending in total approximately 170 man months of working time. The project members have different scientific backgrounds, but are for the most part working in the field of integrated (environmental) assessment.

The research done in the *SustainabilityA-Test* project basically comprises five strands of work, which are briefly described in the next sections:

1. Building an inventory of assessment tools and carrying out an evaluation of them;
2. Developing a theoretical framework for the scientific underpinning of the selection of assessment tools;
3. Applying the assessment tools on a concrete policy case within a case study for investigating the practicalities related to the selection and application of assessment tools;
4. Interviewing staff of the European Commission in order to analyse the policy making context and in particular the usage of assessment tools;
5. Building of an internet based handbook (referred to as webbook) for all assessment tools.

1.2.1 Tool inventory and evaluation

More than 50 common assessment tools were identified at the start of the project. These tools have been described in a standard way, by means of the evaluation methodology as described in the project's inception report (De Ridder, 2005). The evaluation criteria included the suitability of assessment tools to support the various steps of a policy processes (e.g. problem recognition, analysis of policy proposals), their ability to cover the various key aspects of sustainable development (e.g. environmental, social and economic impacts, and crosscutting issues like intergeneration effects) and the costs, time needs et cetera to actually apply the tool. A database accessible via Internet was set up to store the collected information. The evaluations were done by the tool experts of the project team and peer-reviewed by experts from outside the project consortium.

1.2.2 Theoretical framework

The evaluation results made it clear that it was necessary to deepen the tool evaluation to arrive at a better scientific underpinning of why (not) to use certain tools in assessments. During the evaluation, all tools were initially considered exchangeable. They were all evaluated with the same evaluation criteria, with the aim to build a tool database in which a user (e.g. Commission staff) could search for tools covering specific aspects of sustainable development, supporting a specific policy process and with certain maximum costs and time needs to apply the tools. However, it appeared that most tools can be deployed in many different ways and with many different scopes, thus addressing some or many sustainable development aspects, costing little or a lot and so forth. The main difference between all tools covered by the project lies in the *role* (i.e. the task or purpose) these tools have in an assessment. Thus, this scientific underpinning should concentrate on different tasks or steps in an assessment and in particular on the role that assessment tools can have to support these tasks. Such underpinning would do justice to the fact that e.g. model tools and participation tools are used for different purposes – and thus have a different role – but could in principle support the same policy making phase, cover the same economic, social and environmental impacts and crosscutting aspects and have more or less the same costs and time needs to be applied.

The theoretical framework for assessment tools has been derived from available literature on integrated assessment and assessment tools and methods, and from the evaluation results of the assessment tools covered by the *SustainabilityA-Test* project. It has been extensively discussed within the project team. The result is a table with four generic phases of an assessment and six tool groups, with in each cell of the table a description of the specific role of the tool group in each phase of an assessment.

1.2.3 Case study

The purpose of the *SustainabilityA-Test* project's case study is to better understand the theoretical and conceptual basis of the various tools, to analyse the role played by tools in decision making processes, and to compare the different tools in their ability to address key aspects of sustainable development. In other words, the case study deepens the tool evaluation with experiences from practically applying them. The focus in this strand of work is the experts' points of view on tool selection and opportunities for tool combinations. The users' perspectives on tool usage and tool combinations is addressed by means of the interviews, which were part of the case study work package, but discussed separately in the next paragraph.

The project team decided to use an existing policy case for the case study. The case chosen was the development of the biofuels directive and the energy crop premium regulation. These two policy proposals can in principle affected a wide variety of sustainable development aspects, and therefore provide the case study with a solid basis for investigating (potential) tool use. During the case study, the tool experts of the project consortium investigated which tools had been applied to the policy case and which tools could have been applied to strengthen the assessments that were made. In addition, three assessment plans were developed (but not applied) to illustrate which tools could be used, and how, to comprehensively assess the selected policy case.

1.2.4 Interviews

The purpose of the interviews is to investigate the user's perspective on assessments in support of decision-making. As the *SustainabilityA-Test* project is an EU research project in support of EU policy making, the people interviewed were European Commission staff responsible for, or otherwise involved in, Impact Assessments that had been carried out in recent years. The interviews thereby complemented the project with the user perspective, next to the theory and practice of tool selection, and form the 'reality check' of this project.

1.2.5 Building the webbook (i.e. internet based handbook)

One of *SustainabilityA-Test* products to be delivered is a handbook on assessment tools. The project team discussed the necessity for such handbook to be updateable, flexible and easily accessible. With a paper handbook these criteria are hard to meet. An internet based handbook, referred to as webbook, was decided upon.

The webbook has been designed, programmed and tested in the course of the project. The basis for the webbook is formed by the evaluation criteria and evaluation results stemming form the tool evaluation. These are transferred into an internet-accessible tool-database. The tool-database can be approached in different ways. These different approaches are derived from the tool evaluation, the theoretical framework, the case study and the interviews. The webbook brings together the different pieces of work done in the project and all reports and documents made.

1.3 Outline of the report

The report is structured according to Figure 1.1. The first two chapters of the report provide the introduction of the report (chapter 1) and the definitions of used concepts (chapter 2). The next four chapters present the three research strands that are discussed in this report.

Chapter 3 presents the results of the interviews with European Commission staff. Chapter 4 and 5 describe the theoretical framework and the role of tools in integrated assessments. In chapter 6 the main outcomes of the case study are presented.

The tool evaluation itself (outcome and used methodology) is not discussed in this report. The outcome of the evaluation is a data base filled with tool information, accessible via the webbook on www.SustainabilityA-Test.net. The used methodology can be found in the project's inception report (De Ridder, 2005). Chapter 7 integrates and synthesises the work done in the *SustainabilityA-Test* project and draws nine overall conclusions.

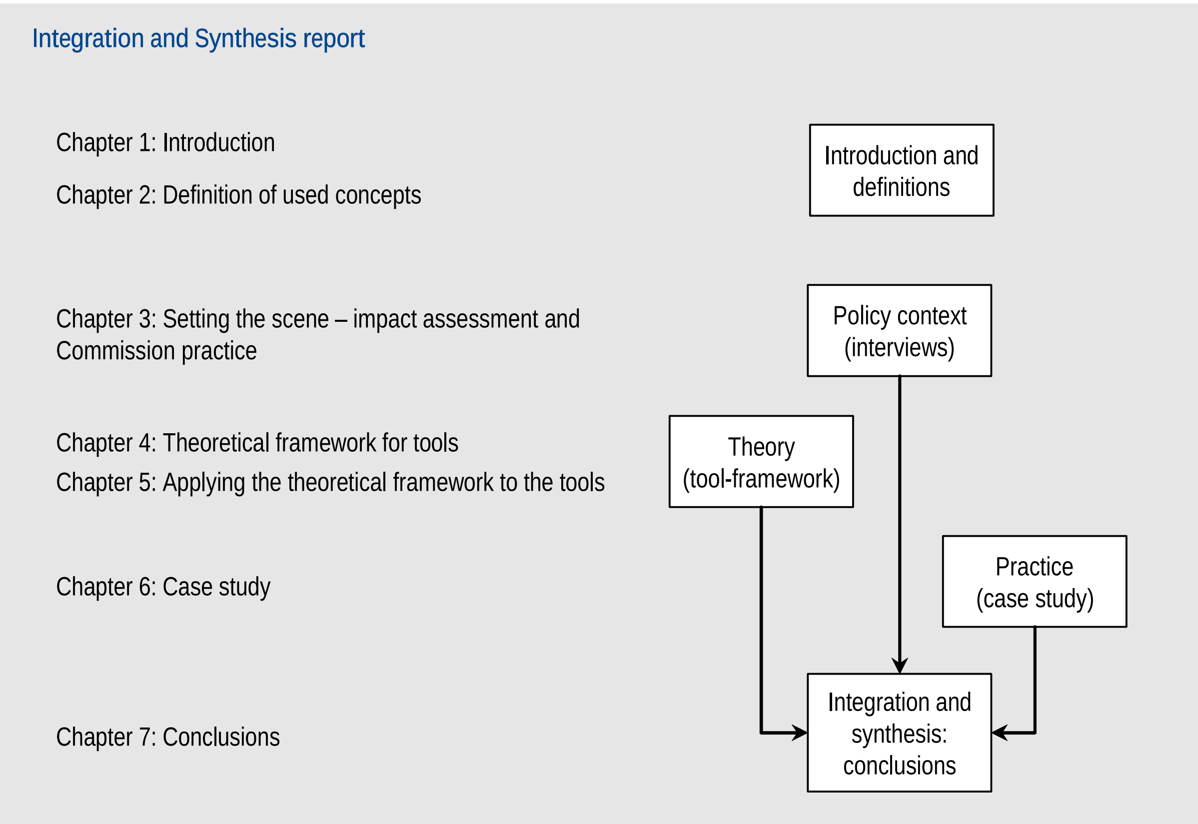

Figure 1.1: Content and structure of this report.

2 Definitions of used concepts

Wouter de Ridder, Pim Martens, Ângela Guimarães Pereira, Tiago Pedrosa

In a project like *SustainabilityA-Test*, where terminology like integrated assessment, tools, methods, sustainable development and so forth are frequently used, it is a must to be clear about what is actually meant with these terms. This chapter describes (rather than defines) how the terminology used in this project is interpreted.

2.1 Integrated assessment

Many definitions or description exist for integrated assessment. The European Environment Agency uses the following definition (see http://epaedia.eea.europa.eu):

> The interdisciplinary and social process, linking knowledge and action in public policy/decision contexts, and aimed at identification, analysis and appraisal of all relevant natural and human processes and their interactions which determine both the current and future state of environmental quality, and resources, on appropriate spatial and temporal scales, thus facilitating the framing and implementation of policies and strategies.

The Integrated Assessment Society (TIAS) has the following definition (see http://www.tias-web.info/):

> Integrated assessment […] can be defined as the scientific 'meta-discipline' that integrates knowledge about a problem domain and makes it available for societal learning and decision making processes. Public policy issues involving long-range and long-term environmental management are where the roots of integrated assessment can be found. However, today, [integrated assessment] is used to frame, study and solve issues at other scales. [Integrated assessment] has been developed for acid rain, climate change, land degradation, water and air quality management, forest and fisheries management and public health. The field of Integrated Assessment engages stakeholders and scientists, often drawing these from many disciplines.

Integrated assessment in the *SustainabilityA-Test* project refers to all kinds of assessments in which some form of integration takes place. Many forms of integration exist, such as the integration of various scientific disciplines, of science into decision making processes or the integration of separate impact assessments (Scrase and Sheate, 2002; Lee, 2005; Weaver and Rotmans, 2005). An integrated assessment also has to be an assessment, which is interpreted in this project as a valuation or evaluation, a test or judgement of some plan, programme, policy or project, with the aim to inform the decision makers on the suitability, desirability, effectiveness or efficiency of it. Important in this respect is the link to decision makers. As a result, the term integrated assessment could be used to refer to complex assessments, with multi-disciplinary teams and a high level of stakeholder involvement, as well as simple straight-forward, quick assessments, without stakeholder involvement.

2.2 Sustainable development

Sustainable development actually is a straightforward concept: a development that can be sustained. Yet, when making the concept of sustainable development more concrete, e.g. when using it as a guiding principle in policy development, complexity surfaces. This paragraph first explains the complexity of the notion of sustainable development, followed by an explanation of how sustainable development has been made more concrete in the *SustainabilityA-Test* project.

2.2.1 The complexity of sustainable development

The essence of sustainable development is simply this: to provide for the fundamental needs of mankind without doing violence to the natural system of life on earth. This idea arose in the early eighties of the last century and came out of a scientific look at the relationship between nature and society. The concept of sustainable development reflected the struggle of the world population for peace, freedom, better living conditions and a healthy environment (NRC, 1999). During the latter half of the 20^{th} century, these four goals recurred regularly as world-wide, basic ideals.

The last twenty five years have been characterized by an attempt to link together the four ideals cited above – peace, freedom, improved living conditions and a healthy environment (NRC, 1999), an ambition which stems from the realization that striving for one of these ideals often means that the others must necessarily also be striven for. This struggle for ‘sustainable development’ is one of the great challenges for today’s society.

Sustainable development is a complex idea that can neither be unequivocally described nor simply applied. There are scores of different definitions, but in the *SustainabilityA-Test* project the most frequently quoted will be used. This is the definition of the Brundtland Committee (1987) (WCED, 1987):

> ‘Sustainable development is development which meets the needs of the present without compromising the ability of future generations to meet their own needs.’

Four common characteristics can be noted when looking at the lowest common denominator of the different definitions and interpretations of sustainable development (Grosskurth and Rotmans, 2005). The first indicates that sustainable development is an intergenerational phenomenon: it is a process of transference from one to another generation. So, if anything meaningful is to be said about sustainable development, a time-span of at least two generations has to be taken into account. The time period appropriate to sustainable development is thus around 25 to 50 or more years.

The second common characteristic is the level of scale. Sustainable development is a process played out on several levels, ranging from the global to the regional and the local. What may be seen as sustainable at the national level, however, is not necessarily sustainable at an international level. This is due to shunting mechanisms, as a result of which negative consequences for a particular country or region are moved on to other countries or regions.

The third common characteristic is that of multiple domains. Sustainable development consists of at least three: the economic, the ecological and the socio-cultural domains. Although sustainable development can be defined in terms of each of these domains alone, the significance of the concept lies precisely in the interrelation between them.

The aim of sustainable social development is to influence the development of people and societies in such a way that justice, living conditions and health play an important role. In sustainable ecological development the growth of natural systems is the main focus of concern and the maintenance of our natural resources is of primary importance. In sustainable economic development, the focus is on the development of the economic infrastructure and on an efficient management of natural and social resources.

What is at issue here are three different aspects of sustainable development which in theory need not conflict but which in practice often conflict. The underlying principles are also essentially different: with sustainable economic development the concept of efficiency has a primary role, whereas with sustainable social development the same may be said of the concept of justice and with sustainable ecological development it is the concepts of resilience or capacity for recovery that are basic.

The fourth common characteristic concerns the multiple perspectives on sustainable development. Each definition demands a projection of current and future social needs and how these can be provided for. But no such estimation can be really objective and, furthermore, any such estimation is inevitably surrounded by uncertainties. Besides, the valuing and weighing of the various aspects from the different sustainable development domains will be highly perspective dependent. As a consequence, the idea of sustainable development can be interpreted and applied from a variety of perspectives.

As will be apparent from the above, a concept like sustainable development is difficult to pin down. Because it is by its nature complex, normative, subjective and ambiguous, it has been criticized both from a socio-political and from a scientific point of view.

2.2.2 Sustainable development in the *SustainabilityA-Test* project

Notwithstanding the complexity related to pinpointing sustainable development, the concept has been made more concrete in this project in order to evaluate a tool's capacity to address key aspects of sustainable development. This is done by using the EU Sustainable Development Strategy (EU SDS), and in particular the objectives set in that strategy (see next section).

Assessing for sustainable development is not only about evaluating a proposal's impact on key aspects of sustainable development. For instance, the question whether a proposal is desired at all, if it is consistent with views of a sustainable future, should also be part of an integrated assessment for sustainable development (see also textbox: *Paradigm shift for sustainable development assessments* on page 27).

2.2.3 Key aspects of sustainable development used in the *SustainabilityA-Test* project

The key aspects used in the *SustainabilityA-Test* project have been derived from the EU SDS adopted by the European Council in 2001. At that meeting, the Council added a list of environmental concerns to the socio-economic priorities agreed a year earlier at the Lisbon Council. The socio-economic and environmental priorities were elaborated even further by the so-called external dimension of sustainable development, adopted at the European Council of Barcelona in 2002. A total of 12 priorities have been identified, that together form the priorities for sustainable development of the EU (Council of the European Union, 2000, 2001 and 2002):

1. Limit climate change and increase the use of clean energy
2. Address threats to public health
3. Manage natural resources more responsibly
4. Improve the transport system and land-use management
5. Combating poverty and social exclusion
6. Dealing with the economic and social implications of an ageing society
7. Harnessing globalisation: trade for sustainable development
8. Fighting poverty and promoting social development
9. Sustainable management of natural and environmental resources
10. Improving the coherence of European Union policies
11. Better governance at all levels
12. Financing sustainable development

These priorities have been used throughout the case study of this project, but not for the tool evaluation. Instead, a list of environmental, economic and social aspects has been used. These have been taken from, amongst others, impact categories identified in the European

Commission’s handbook on how to do an Impact Assessment (CEC, 2003a), complemented with a list of crosscutting aspects (e.g. intergenerational equity) of sustainable development, largely based on a list developed by the European Environment Agency. How this is done is explained in detail in the project’s inception report (De Ridder, 2005: 31ff). The reason for not using the 12 priorities set by the European Council is to make the evaluation results less dependant of changes in policy priorities.

For each tool in considered in the *SustainabilityA-Test* project the project’s tool experts have described which environmental, economic, social or crosscutting aspects of sustainable development can be assessed by it. This appeared to be useful only for certain tools (see section 5.8 for further explanation).

2.3 Integrated assessment for sustainable development

In the *SustainabilityA-Test* project, integrated assessment for sustainable development, as combining section 2.1 with section 2.2 shows, is interpreted as any decision-making related assessment in which some form of integration occurs and that is done for the purpose of determining whether the decision contributes to sustainable development. Integrated assessment for sustainable development is therefore a broad notion that in principle can cover any type of integrated assessment, as long as some integration occurs, some link to decision-making exists and some key aspects of sustainable development are being addressed.

An integrated assessment for sustainable development entails finding the appropriate scope for the assessment, in other words, finding the right balance between assessing too much and assessing too little. An integrated assessment for sustainable development involves multiple generations (i.e. longer time scales), multiple geographical scales (i.e. from local to global), multiple domains (i.e. economic, environmental and social) and multiple perspectives (i.e. different ideas about what sustainable development entails). A comprehensive integrated assessment for sustainable development is capable of addressing all possible domains and perspectives, although in practice time and budget constraints often limit the possibilities. As a result, integrated assessments for sustainable development often focus on a selection of aspects of sustainable development, addressing thereby the expected most relevant economic, environmental and social issues at stake at limited geographical and time scales, and involving a limited number of perspectives. By doing so, one risks missing crucial – but difficult to assess – sustainable development issues, such as long-term effects or impacts caused way beyond the area under study, or ignoring minority perspectives. One risks arriving at mainstream options for incremental changes, setting aside systemic, transitional changes.

There are different types of integrated assessments for sustainable development that can roughly be placed on a gradual scale from integrated assessments with a relatively small scope and with a relatively broad scope. This scope refers to time scale, geographical scale, options considered and impacts assessed (see Figure 2.1).

All forms of integrated assessment, from those with a smaller to a wider scope, have an added value to policy making for sustainable development. Therefore, any kind of integrated assessment is referred to as an integrated assessment for sustainable development in the *SustainabilityA-Test* project. However, it is not said that all these forms of integrated assessment are comprehensive integrated assessments for sustainable development that – by themselves – sufficiently support policy making for sustainable development, acknowledging that there is (scientific) discourse with respect to the need of new paradigms that better reflect the complexity and multidimensional character of sustainable development
(see textbox: *Paradigm shift for sustainable development assessments*).

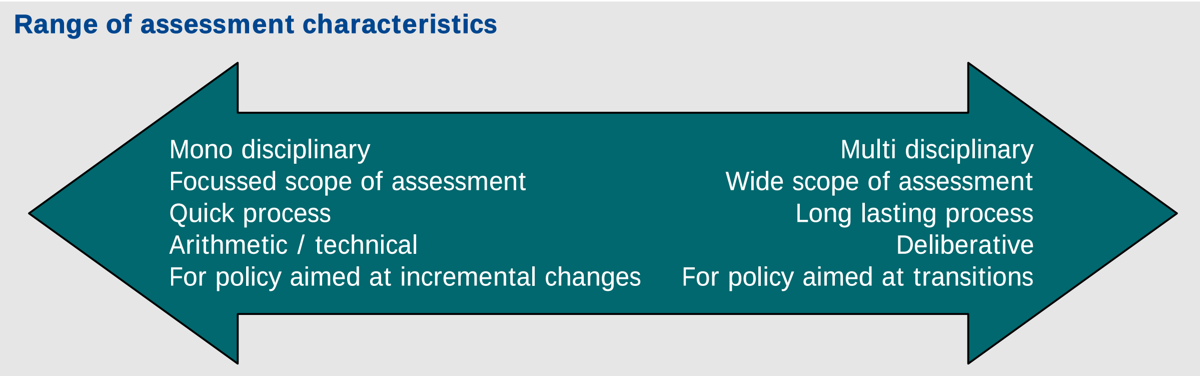

Figure 2.1: Integrated assessment types considered in the *SustainabilityA-Test* project.

2.4 Tools

In the project *SustainabilityA-Test* the word tool is used as a collective term for all tools and methods covered in the project. There are different types of tools that can roughly be described as analytical tools and methods, participative tools and methods and the more managerial 'assessment frameworks':

- **Analytical tools** mainly look at the nature of sustainable development, employing often some form of computation. An example of an analytic tool is the integrated assessment model. Another analytic tool is Ecological Footprint (Wackernagel et al., 1999), which calculates how much biologically productive land would be required on a continuous basis to provide for the necessary energy and material resources consumed by a population and to absorb the wastes discharged by that population.
- **Participatory tools** support involving researchers, non-scientists such as policy makers, representatives from the business world, social organizations and citizens in assessments.
- The **assessment frameworks** are used to investigate the policy aspects and the controllability of sustainable transitions on the one hand and provide guidance for executing integrated assessments on the other. An example of the former type of assessment framework is provided by transition management (Rotmans et al., 2000,

2001). An example of the latter is provided by the European Commission's Impact Assessment procedure.

An overview of all tools covered in the *SustainabilityA-Test* project can be found at www.SustainabilityA-Test.net, under 'Overview' ( ).

Paradigm shift for sustainable development assessments

There is scientific discourse ongoing with respect to the role of science in decision-making processes for sustainable development, and thus with respect to integrated assessment for sustainable development.

New research paradigms are evolving that might be better able to reflect the complexity and the multidimensional character of sustainable development by focussing on different magnitudes of scales (of time, space and function), multiple balances (dynamics), multiple actors (interests and perspectives), multiple failures (systemic faults) and multiple sources of knowledge (extended knowledge).

One new paradigm emerges from a scientific sub-current that characterizes the evolution of science in general – a shift from mode-1 to mode-2 science production (see Gibbons et al., 1994; Gibbons and Nowotny, 2001). Mode-1 science production is completely academic in nature, mono-disciplinary and the scientists themselves are mainly responsible for their own scientific performance. Mode-2 science production is in essence both inter- and intra-disciplinary. It renders a different framework of intellectual activity in which the context of application, stakeholder involvement, accountability, and quality control (in the sense of societal 'value integrated' to define what quality science is) are important and in which the scientists form a part of a heterogeneous network. Their scientific tasks are part of an extensive process of knowledge production and they are also responsible for more than merely scientific production. Trans-disciplinary (see Nicolescu, 1999; Flinterman et al., 2001; Klein et al., 2001; Gibbons and Nowotny, 2001) approaches emerge as an inevitable explicit or implicit alternative to the disciplinary structure. This is due to the nature of the issues addressed and also to the increasing variety of places where recognisably competent research is carried out, and where most likely, disciplinary research is inappropriate (Guimarães Pereira and Funtowicz, 2006).

Another paradigm that is gaining increasing influence is what is known as post-normal science (Funtowicz and Ravetz, 1990, 1992). The presence of irreducible uncertainty and complexity in science-relevant policy issues necessitates the development of alternative problem-solving approaches, in which uncertainty is acknowledged and science is consciously democratised. The uncertainty and complexity in decision-making processes must therefore be adequately managed through organised participatory processes in which the co-production of knowledge takes place (where different kinds of knowledge – not only scientific knowledge – come into play). As a result, those making policy are as well informed as possible about complex social problems of major importance.

These new paradigms have consequences for the kind of tools that are used in integrated assessments for sustainable development. The tools that are useful in the 'old paradigm' have to be complemented – not replaced – by tools that have different characteristics. In order to make them better capable for assessments, tools should be more demand-driven than supply-driven, and have for example the following features:

- Being more participative than technocratic in nature;
- Being capable of addressing subjectivity;
- Being more exploratory rather than predictive in nature; and
- Being capable to acknowledge and deal with uncertainty.

3 Setting the scene – Impact Assessment and Commission practice

Anneke von Raggamby and John Turnpenny

The European Commission's Impact Assessment (IA) system (CEC, 2002a, 2003) played a special role in this project. Although it was understood as a framework tool (see section 2.4 for a definition) and the term 'integrated assessment' was interpreted in a general way and not only to encompass the EU IA system (see section 2.1), the Commission's IA system has always been present during the project, serving different purposes. It served as a prototype, helping to make the term 'integrated assessment' more tangible for the project team, as a source of hands-on experience with the concept of integrated assessment and as a point of reference for the work done in the project. Last but not least, the Commission IA system provides a potential case for using the project's results.

In the following sections the EU Impact Assessment system is introduced and various concepts of Impact Assessment from the Commission's system are delineated. Finally, insights from interviews on the Commission's IA practice are presented.

3.1 Commission Impact Assessment: an introduction

The European Commission's Impact Assessment (IA) system is a specific form of integrated assessment. All European Commission policy proposals listed in the Commission's Annual Work Programme which are either regulatory or expected to have a significant impact, must be supplemented with an Impact Assessment report. The main idea of the Commission's IA procedure is to identify the likely positive and negative impacts of proposed policy actions notably those relevant under the EU Sustainable Development Strategy and thus enable informed political judgements about the proposal.

This Impact Assessment is a fairly new instrument, having been introduced in 2003. The European Commission aims at a learning-by-doing process, where Impact Assessments gradually improve in quality and influence in the decision making process. The recently revised guidelines (CEC, 2005) stimulate Impact Assessment to become more of a process rather than a one-off event.

Although the Communication on IA (CEC, 2002a) states that the 'new' IA system aims to integrate the various forms of assessment which have developed separately over time, covering environmental, economic as well as social aspects, other forms of impact assessment exist alongside the overall system and confusion exists as to the exact denotation of the different IA procedures. The most important distinction within the EU concerns Environmental Impact Assessment (EIA), Strategic Environmental Assessments (SEA) and

Sustainability Impact Assessments (SIA) from IA. Both EIAs and SEAs, as set out by the respective directives (EIA Directive 2003/35/EC[2] and SEA Directive 2001/42/EC[3]), are to be carried out by the Member States in order to assess environmental impacts of actions at the project level, or at the level of political decision-making for plans and programmes in areas such as land use, transport, waste, energy and water management at the national level. SIAs are only applied to trade policy. DG Trade regularly issues SIAs for trade negotiations alongside the IA system required by the Commission.

3.2 Commission practice

Any discussion of the characteristics and range of the tools, methods and procedures available must be understood within the context of how those tools are used in practice. By exploring this, one can gain a valuable additional perspective of the tools' characteristics which may challenge conventional views of the suitability of tools to different situations. To investigate how tools are used in EU Impact Assessments and how the Impact Assessment process works in practice, several interviews were carried out with Commission officials. Since another 6th Framework Program research project (MATISSE, http://www.matisse-project.net/projectcomm/) – closely related to the *SustainabilityA-Test* project – undertook similar interviews, ways have been explored to share experiences and approach strategy between this and the MATISSE project, to avoid multiple stakeholder approaches, and to enhance both projects. One way has been to coordinate and share data from the interviews with the Commission that the MATISSE and *SustainabilityA-Test* projects have carried out. Below the issues are summarised emerging from both projects' interviews.

3.2.1 Case selection and interviewee selection

The focus has been on the EU Impact Assessment system launched in 2003. A sample of these IAs were chosen based on representing a range of DGs, sectors and types of policy strategies, regulations, communications, directives et cetera. Throughout, it was tried to cover appraisals that have previously not been studied in depth (e.g. in the 6th Framework Research Program IQ Tools: Indicators and Qualitative Tools for improving impact assessment process for sustainability). The focus was deliberately on a wider range of IAs than those found in the environment sector (i.e. produced within DG ENV), for several reasons. Sustainability is a concept with implications beyond the environment. Furthermore, the interviews were not about studying the quality of individually selected IAs, but aimed at better understanding the way IA is implemented overall. Hence it is important to examine IAs from a wide range of sectors and DGs. Interviews with Desk Officers and Policy Officers responsible for sixteen IAs were carried out: Agriculture and Rural Development (DG AGRI, 2); Environment (DG ENV, 4); Justice, Freedom and Security (DG JLS, 4); External Relations

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[2] Official Journal L 156, 25/06/2003 p. 17 – 25.

[3] Official Journal L 197, 21/07/2001 p. 30 – 37.

(DG RELEX, 1); Research (DG RTD, 1); Taxation and Customs Union (DG TAXUD, 1); Development (DG DEV, 1); Employment, Social Affairs and Equal Opportunities (DG EMPL, 1); Internal Market and Services (DG MARKT, 1).

3.2.2 Summary of findings

IA practice varies widely across the Commission; the following sections present what the project team perceived to be the main lines of Impact Assessment practice as presented in the interviews.

IAs are carried out early on in the decision-making process, i.e. before the proposal is presented. Every policy proposal is accompanied by an IA report. Although IAs usually take place before the proposal is presented, their role in the policy process varies significantly. Most Desk Officers said that IAs are an aid to decision-making, for example by providing information on the effectiveness of, or on problems, objectives and options with regard to the proposal. The best way, however, to achieve this was perceived differently. Views varied from the expectation that IAs should contain a quantitative assessment, to the view that IA should not be a technical exercise but rather reflect the broad lines of expected impacts and avoid presenting specific numbers. Some Desk Officers also saw IA as an opportunity to engage with stakeholders and to kick-start discussions internally as well as externally.

Overall, the interviews suggest that individual Policy Officers have little control over the wider agenda, even if IA begins early in policy development. They are bound by the policy remit and higher level policy priorities (e.g. Lisbon, Rights agenda, Security et cetera), and decisions made by Commissioners. IA thus becomes a way of screening for impacts – and is increasingly focussed on regulatory burden rather than sustainable development – rather than thinking about the nature of ‘the problem’ and different ways of tackling it. This is despite the fact that the IA guidelines require the equal consideration of economic, social and environmental issues to reflect the fact that sustainable development is a Treaty objective in the EU. However, in practice, sustainable development appears to be low down the political agenda in comparison to the narrower, economic-competitiveness concerns of the Lisbon process. Many policies seek to promote the cause of ‘Jobs and Growth’, or trade liberalisation and security concerns. They are subsequently appraised in a way which reflects these priorities.

IAs are developed by the operational Units, with help from the Commission’s Directorate General (DG) ‘Secretariat-General’ and ‘overseeing’ units within each other DGs, whose size and role vary. Policy proposals are then sent for Inter-Service Consultation and passed through to Parliament and Council. All IAs are published on the Internet, including the lists of stakeholders consulted and in some cases a collation of their submissions. The level of resources (people, data, time) in nearly all the cases was rather low and were, alongside restricted budgets, perceived as a main restraint when carrying out IAs. This adds weight to the argument by some interviewees that the IA process as it is currently applied is not seriously intended to alter the EU policy process.

Due to time and budget constraints IAs are often built on work that has already been carried out. This can be in-house experience, consultation with other DGs and existing IAs or studies.

The final proposal is usually clearly stated, along with justification for the choice. Whether the final proposed policy option was chosen as a result of the IA or pre-dated the appraisal process appears to vary from DG to DG. IA has a significant influence on proposals in DG ENV, but for many other areas (eg. Security) the direction of policy is already fairly clear before the IA is started. The IA then becomes a method for enhancing the transparency of the policy process, not for selecting the 'best' policy option. This shows how the rationale of IA, as set out in the official documents, often diverges from IA in practice where IA reports tend to justify Commission proposals rather than neutrally highlight possible impacts of the proposal. The IA can therefore play a variable role in the final shaping of policy.

Demand for formal tools and methods is generally quite low. The most popular tools are quite simple and economic-focussed, such as Cost-Benefit Analysis, Cost-Effectiveness Analysis or modelling. Often tools are of sectoral character (this applies mainly to models) and have been developed specifically for energy, or transport policy. Tools are generally used in order to clarify trends, challenges and problems, or to compare different scenarios. Desk Officers were aware about the flaws and limitations of using such tools.

Tool choice is mainly determined by time, data, and budgetary constraints, the qualifications of Desk Officers and also by the range of tools available and easily accessible to Desk Officers. There is a tendency to identify the impacts of a policy proposal and then to scan through the tools, finally selecting the tool considered to best address the impacts identified. This implies, of course, that tool choice strongly depends on the tools known to the Desk Officers and their ability to apply the tools. Specific characteristics of a policy area often make tool choice difficult and require sector specific models. Studies are only commissioned in case the application of certain models or tools is required. Again, the number and extent of studies commissioned depends on the time and budget available for assessment. Therefore, Desk Officers often draw on already-existing knowledge instead. Tool characteristics determining choice include transparency and accuracy of tools, the flexibility to adjust tools to a given situation, the scientific and political acceptance of a tool and previous experience of it. Pre-existing personal contact with certain tool developers is another factor determining method selection. Only a few Desk Officers considered combining one tool with another in order to cover blind spots associated with one of the tools.

In current tool use practice gaps exist in quantifying environmental and social impacts. While economic impacts can easily be quantified (for example in the form of monetary values), environmental and, especially, social impacts are often of qualitative character or cannot be quantified due to a lack of data or methodological gaps. Nevertheless, environmental and social impacts may be as, or more severe than economic impacts. However, this is often not shown due to aforementioned limitations if the IA mainly relies on quantitative results. Moreover, the way in which the IA procedure is set out does not leave room for grey zones because of the tendency to only accept quantified information. This weakness of IA to address implicit, qualitative and indirect effects also becomes apparent looking at the scope of regulatory items the IA system is applied to. The IA format – currently applying to all items in the Commission's Work Programmes (regulations, directives, decisions and communications) - does not appear to be appropriate for all items, especially action plans and strategies.

A clear divide emerges in relation to the use of IA between environment-based issues (processed by DG ENV and DG AGRI) and others. IAs involving environmental issues employ much more quantification than IAs which are not primarily concerned with environmental measures. There are two principal reasons for this. Firstly, the simple fact that chemical levels, air pollutants and transport volumes can actually be quantified. In these cases, there is a rather confusing plethora of different tools available; the process by which tools are chosen is described above. Secondly, at present, the environment is perceived to be in a politically weak position vis a vis the competitiveness agenda. Consequently, pro-environment DGs often find themselves under pressure to use quantification as much as possible to press their case. One Desk Officer even put it like this: if there is no tool with which to address an impact then the impact does not exist. Other areas (e.g. Free Trade) are perceived to be politically stronger – and options are often presented in these areas without recourse to models or other tools. More analysis and tools at the environment IA level, although potentially useful, will not necessarily make the environment politically more salient or lead to a more sustainable policy making process. Importantly, IA is an aid to political decision-making, not a substitute for it. The role of politics in the balancing of priorities, rather than being led to a policy by 'analysis', is very clear.

3.3 Conclusions

The interviews suggest that information on the range of tools available for Impact Assessments, such as in the *SustainabilityA-Test* webbook, is important given that Desk Officers are often not familiar with them. Even if such information may not help them to actually apply the tools, it is important that they know about the pros and cons of each. More data to validate models would be welcomed by Desk Officers, as would some consolidation of the available models. In addition to providing more information on the tools it would be necessary to offer IA training.

More specifically, tool information should provide:

- a typology of tools covering a broad range, from modelling to stakeholder participation
- strengths, weaknesses, caveats and limitations of the methods
- Requirements for use of tools (e.g. data, software, time and resource needs)
- concrete examples in which the various methods were used in practice (e.g. in the form of sector specific examples for each of the environmental media)

- information on who used the tool and experience with applying the tool (e.g. user comments)
- information on whether the method is widely accepted and in use or whether it is more controversial
- general information on ways tools may be combined.

These observations and recommendations have been taken into account in the design of the webbook.

4 Theoretical framework for tools

Wouter de Ridder with John Turnpenny, Bart Wesselink, Tiago Pedrosa, Ângela Guimarães Pereira, Dirk Günther, Philipp Schepelmann, Karl-Heinz Simon, Hermann Lotze Campen, Onno Kuik, Mita Patel, Marc Dijk and René Kemp

This chapter and the next present a theoretical framework to scientifically underpin tool use. The framework helps in finding useful tools for assessment tasks and facilitates making efficient tool combinations. Whereas this chapter focuses on the role of tool *groups* in assessments, the next will focus on the specific tools within a group.

It is important to realise that the theoretical descriptions used in this chapter (e.g. policy cycles, integrated assessments) are simplified representations of real-life complex processes. In reality, such processes seldom go in the way described here (Norse and Tschirley, 2000). As a framework is sought for understanding about why certain tools are helpful in integrated assessments and in policy making, this simplified view on how such processes progress is deemed helpful.

The starting point for the overall framework is a review of different types of integrated assessment. Each integrated assessment consists of different phases. Within each phase certain tasks have to be done, and can be supported by tools. The phases and tasks within an integrated assessment process therefore form the core of the theoretical framework.

Section 4.1 introduces four generic phases of an integrated assessment that form the basis of the theoretical framework. Section 4.2 adds an extra dimension to these phases by introducing the notion of problem types. Section 4.3 presents the tool groups made in the *SustainabilityA-Test* project and connects the phases of an integrated assessment to these groups. The section describes in detail how the different tool groups can contribute to each phase of an integrated assessment. Section 4.5 summarises the theoretical framework in a table and draws a few conclusions.

4.1 A generic framework for integrated assessment

The usefulness of tools in integrated assessments is related to the phases of an integrated assessment. There are different phases in an integrated assessment, including problem-framing early on in the assessment and evaluation and monitoring later on. The phases are explained in more detail below. To illustrate the relation between the usefulness of tools and the phases of an assessment, consider participatory tools. Stakeholder participation early in an integrated assessment is likely to aim for generating different views and ideas about the problem and options to solve the problem. The participatory tools needed in such a process are tools that stimulate out-of-the-box thinking and creativity. In a later stage of an integrated assessment: e.g. when evaluating the assessment process, participatory tools are used to ensure that those involved can have their say in the evaluation. The former form of participation differs from the latter. Certain participatory tools are better in supporting the former form of participation than the latter. It is therefore valuable to distinguish phases of an integrated assessment and to use these phases when describing the suitability of tools to support a certain task.

There is no single and commonly accepted approach to integrated assessment that provides a useful basis to distinguish different phases of an integrated assessment. Instead, many different descriptions of integrated assessment, or of the role of science decision-making processes, can be found in the literature (e.g. Finnveden et al., 2003; Norse and Tschirley, 2000; Sheate et al., 2003; Dalkmann et al., 2004; Devuyst, 1999; Lee and Kirkpatrick, 2001; Weaver and Rotmans, 2005). These descriptions reflect the existence of the many different assessment approaches, like transition management, impact assessment, strategic environmental assessment and regulatory impact assessment. It is difficult – if not impossible – to choose one preferred ‘form’ of integrated assessment for the purpose of the *SustainabilityA-Test* project, which is to provide a framework that could in principle encompass all tools covered by the project.

A generic set of phases can be derived from the integrated assessment types that can be found in literature (see Annex 2), as there appears to be similarities between them. Most integrated assessment types follow, to a more or lesser extent, the following sequence of four phases:

– **Phase I – Problem analysis**: this phase is about understanding the problem for which a policy intervention might be needed, and understanding the stakeholder field and their opinions. The phase is also referred to as the phase of problem analysis, system analysis, stakeholder analysis, problem perception analysis et cetera. Problem analysis could also include objective-setting, if one argues that a problem exists only as a policy-relevant problem when a situation can be envisaged where the problem no longer exists (or has been diminished). Then, getting to that state can be called the objective.

– **Phase II – Finding options**: this phase refers to the process of finding options to solve or diminish the problem. This includes clarifying what the objectives are and which pathways towards these objectives can be envisaged. In Phase I, understanding the system under study is the main task (i.e. finding out its dynamics), whereas in Phase II the main task is to use this knowledge to find ways to tackle the problem. Objectives are not always clear or commonly agreed upon. In such cases, objectives can be deducted from overarching sustainability goals, in collaboration with stakeholders, by building visions of a future in accordance with the sustainability goals in which the problem has been diminished.

– **Phase III – Analysis**: this phase is about developing more concrete proposals in line with the options and specific objectives as set out in the previous phase, and about assessing possible impacts of the proposals. Note that in some assessment frameworks (e.g. Impact Assessment and Strategic Environmental Assessment), the development of concrete proposals is considered part of Phase II (finding options) not of Phase III (see Annex 2). Assigning the development of concrete proposals to either Phase II or Phase III is ambiguous, as there is no sharp line between the two phases. In the generic phases used in the *SustainabilityA-Test* project, the development of concrete proposals has been assigned to Phase III rather than to II. This is to emphasise that Phase II is the ‘divergent’ and creative phase, where all options are to be considered, whereas Phase III is the ‘convergent’ phase, where the number of options is being reduced.

– **Phase IV – Follow up**: to conclude, all assessment types have a phase that can be called follow-up. This final phase of an integrated assessment is about (preparing for) monitoring of the policies that are (to be) implemented. Furthermore, it includes carrying out an evaluation of the entire integrated assessment and decision-making process.

The four phases described here are generic phases, using terminology for and boundaries between phases that are debatable. The labels used for each phase are generic enough to encompass the variety of labels found in literature, but still specific enough to understand what each phase is about. With respect to the boundaries between the different phases it is acknowledged that these are not that sharp and that integrated assessments need not necessarily follow these phases sequentially. Iterations take place and certain phases can be done in parallel. As stated in the introduction to this chapter, these four phases are a simplification of complex processes, meaningful for better understanding the role of tools in integrated assessment, but not for understanding how decision-making processes unfold in reality.

Quick assessments and rather simple policy processes as well as long-lasting and complex transition processes and all there is in between, can be linked to the four generic phases described above. Thus, the generic phases are in accordance with the flexible and broad interpretation of integrated assessment used in the *SustainabilityA-Test* project (see section 2.1).

The next two subsections discuss two particular processes in relation to four generic phases: the policy cycle and the European Commission’s Impact Assessment procedure. This is done for the policy cycle because it has been used as a basis for the tool evaluations made during the project. Linking the policy cycle with the four phases of an integrated assessment ensures that no valuable evaluation information will be lost. The link with Impact Assessment is made because it has become a requirement to follow the process for new proposals of the European Commission (CEC, 2002a, 2005). An important target group of the *SustainabilityA-Test* project is the European Commission, and it is therefore meaningful to explicitly link the four phases to Impact Assessment.

Iintegrated assessment, the policy cycle and impact assessment

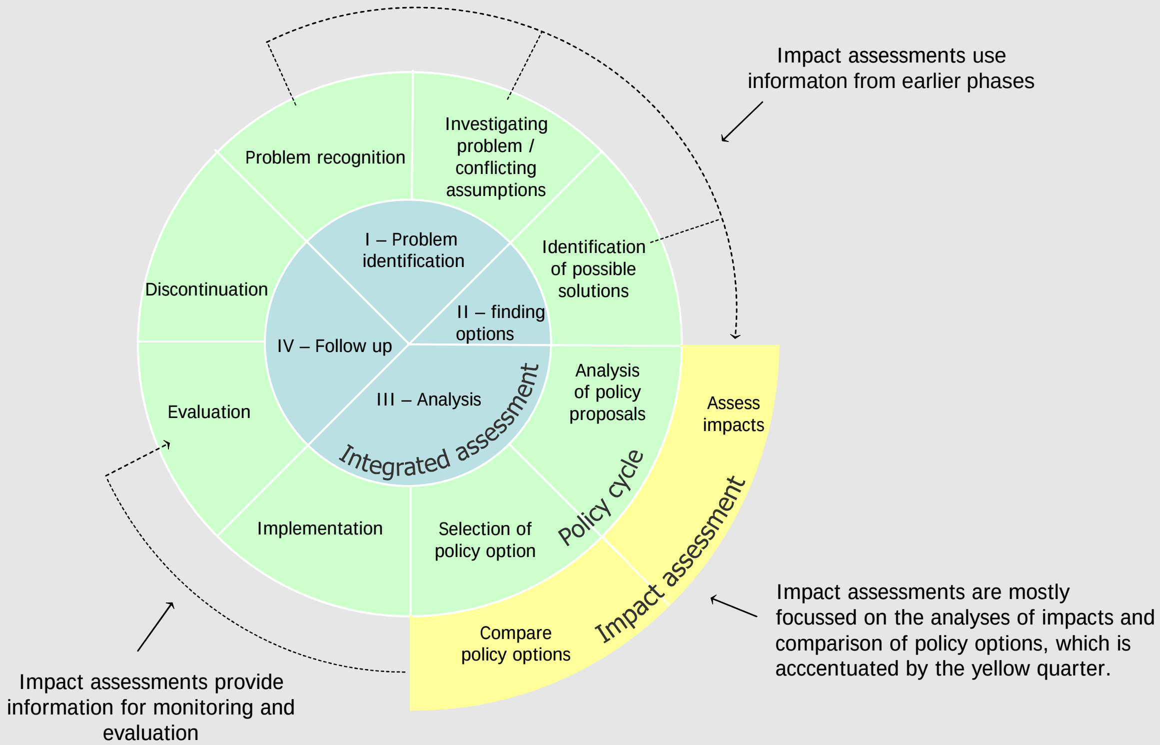


Figure 4.1: The link between the four generic phases of an integrated assessment, the policy cycle and the EC's Impact Assessment procedure.

4.1.1 Linking integrated assessment with the policy cycle

The link between the integrated assessment phases and phases of a policy cycle (Brewer and DeLeon, 1983) is relatively straightforward, as integrated assessment is (or at least should be) aimed at integrating knowledge and stakeholders' views into decision-making processes. The links between the implementation, evaluation and discontinuation phases of a policy cycle, and the analysis and follow-up phases of an integrated assessment are perhaps less straightforward. They are linked because in transition management, for example, the process of learning from implementation, evaluation and discontinuation is considered part of the assessment itself. For the more short-term integrated assessments, like Impact Assessment, the link is less evident, as the integrated assessment is often considered to be finalised by the time that an Impact Assessment report has been published.

Figure 4.1 does not show any timeline, as a policy cycle leading to any kind of decision being adopted can be passed through in different time frames. A complete policy cycle could take place within a few months, but could in also stretch out over decades. It is clear that in the latter case meanwhile numerous other policy processes take place, possibly linked to the long-term policy process. In addition, it is important to realise that what is considered to be part of a certain policy process depends on what is considered to be part of the problem addressed by the policy process, as illustrated for the development of the biofuels directive in Section 4.1.3 below.

4.1.2 Linking integrated assessment with the EC's Impact Assessment

The link between the Impact Assessment procedure used by the European Commission (CEC, 2005) and the four generic phases of an integrated assessment is visualised in Figure 4.1.

The fact that Impact Assessment has to date been known to be focused on analyses of impacts and comparison of policy options, as emphasised by the yellow quarter in Figure 4.1. In principle, the terms used in the inner circle in Figure 4.1 could be replaced by Impact Assessment terminology, i.e. problem identification, objectives definition, development of main policy options, analyse of impacts, comparison of options, outlining of monitoring and evaluation. However, in practice most Impact Assessments carried out or commissioned by the European Commission are one-off events rather than processes following the policy cycle (Wilkinson et al., 2004: 9).

4.1.3 Illustrating the generic framework for integrated assessment: the process of developing the biofuels directive

The generic framework for integrated assessment is illustrated by means of applying it to a concrete policy case: the process of developing the biofuels directive.

One can look at this process in many different ways. Two views are discussed:

1. The first is a policy process that is aimed at reducing the high dependency on energy imports. The aim of the biofuels directive is then to reduce energy import dependence. In this case, the oil crisis of the 1970s could be considered as the starting point.
2. The second is a policy process that is aimed at increasing the share of renewable energy sources. In this case, the aim of the biofuels directive is to contribute to increasing that share. The staring point of this process can be considered to be around 1998, when the European Council endorsed a target of a 12% share of renewable energy by 2010.

The difference between these two views is related to the difference in what is considered to be the problem. In the first view, the problem is the high degree of energy import dependency, which means uncertainty with respect to energy supply. In the second view the

Table 4.1: The biofuels directive from two points of view

<table>
<tr><th>Year</th><th>Event</th><th></th><th>View I</th><th></th><th>View II</th></tr>
<tr><td>1973</td><td>Oil crisis</td><td>Phase I – Problem framing</td><td>The 1973 oil crisis made it very clear how vulnerable the EU's economy had become to sudden changes in world wide supply and prices of energy. One could say that the oil crisis clarified the problem (too high dependency on oil imports) and contributed to building consensus with respect to the idea that something had to be done. No actual integrated assessment was ongoing at this point; the policy making process was started by events from outside the policy making or research domain</td><td></td><td></td></tr>
<tr><td>1986</td><td>Council resolution[1] on new energy policy objectives, including less oil imports and more renewables</td><td>Phase II – Finding options</td><td>The second phase could be considered to start in the wake of the 1973 oil crisis and to end with the 1986 Council Resolution[1] on new energy policy objectives for 1995. With this Resolution the Council envisioned several options addressing the identified problem, including more renewable energy sources.</td><td></td><td></td></tr>
<tr><td>1997</td><td>The Commission proposes a 7% target for biofuels[2]</td><td rowspan="5">Phase III - Analysis</td><td rowspan="5">During Phase III more concrete policy options to increase the share of renewables were identified and evaluated. Scenario studies[4] and Green Paper[5] discussions contributed to converging concrete and reasonable proposals. The phase resulted in a proposal for a biofuels directive and proposal for amending directive 92/81/EEC with regard to the possibility of applying a reduced rate of excise duty on certain mineral oils containing biofuels and on biofuels[6].</td><td rowspan="2">Phase I – Problem framing</td><td rowspan="2">In 1998, the European Council endorsed a target of 12% share of renewable by 2010. The 'problem' in this case refers to not yet having a 12% share of renewable.</td></tr>
<tr><td>1998</td><td>The Council endorsed a 12% objective for renewable energy sources[3]</td></tr>
<tr><td>1999</td><td>Publication of the energy outlook 'EU Energy Outlook 2020 – Energy in Europe'[4]</td><td rowspan="2">Phase II – Finding options</td><td rowspan="2">Phase II is about finding options to bring the share of renewables to 12% by 2010. A 7% share of biofuels was already mentioned by the Commission (in 1997) and considered an ambitious, but realistic option. Studies were done and discussions were held to investigate other options.</td></tr>
<tr><td>2000</td><td>Publication of Green Paper 'Towards a European strategy for the security of energy supply'[5]</td></tr>
<tr><td>2001</td><td>Publication of the proposal for a biofuels directive, including statements on expected impacts and a proposal for amending directive 92/81/EEC with regard to the possibility of applying a reduced rate of excise duty on certain mineral oils containing biofuels and on biofuels</td><td>Phase III - Analysis</td><td>Phase III was about developing a proposal to increase the share of biofuels. The proposed Biofuels directive proposal for amending directive 92/81/EEC with regard to the possibility of applying a reduced rate of excise duty on certain mineral oils containing biofuels and on biofuels[6] were the result of that. The possible effects of the biofuels directive on amongst others employment and environment were assessed, mostly by referring to the studies done earlier. A 5.75% share of biofuels in road transport was eventually included in the proposal.</td></tr>
<tr><td>2003</td><td colspan="5">Adoption of biofuels directive[7] and energy taxation directive[8]</td></tr>
</table>

Table 4.1 (cont.) – sources

[1] Council resolution of 16 September 1986 concerning new Community energy policy objectives for 1995 and convergence of the policies of the Member States (OJ C 241 1986).

[2] Energy for the Future: Renewable Sources of Energy. White Paper for a Community Strategy and Action Plan. Communication from the Commission, COM(97)599 final (26/11/1997). http://ec.europa.eu/energy/library/599fi_en.pdf [last accessed: 18 July 2006].

[3] Council Resolution of 8 June 1998 on renewable sources of energy. (OJ C 198/1) http://europa.eu.int/eur-lex/pri/en/oj/dat/1998/c_198/c_19819980624en00010003.pdf [last accessed: 18 July 2006].

[4] EU Energy Outlook 2020, Energy in Europe – Special Issue (November) – the 'Shared Analysis Project'. http://www.shared-analysis.fhg.de/Pub-fr.htm [last accessed: 18 July 2006].

[5] European Commission Green Paper - Towards a European strategy for the security of energy supply. COM (2000) 769 final. http://europa.eu.int/eur-lex/en/com/gpr/2000/com2000_0769en.html [last accessed: 18 July 2006].

[6] Communication from the Commission to the European Parliament, the Council, the Economic and Social Committee and the Committee of the Regions on alternative fuels for road transportation and on a set of measures to promote the use of biofuels, COM (2001) 547. http://europa.eu.int/eur-lex/en/com/pdf/2001/en_501PC0547_01.pdf [last accessed: 18 July 2006].

[7] Directive 2003/30/EC of the European Parliament and of the Council of 8 May 2003 on the promotion of the use of biofuels or other renewable fuels for transport. (OJ L 123/42). http://europa.eu.int/eur-lex/pri/en/oj/dat/2003/l_123/l_12320030517en00420046.pdf [last accessed: 18 July 2006].

[8] Council Directive 2003/96/EC of 27 October 2003 restructuring the Community framework for the taxation of energy products and electricity. (OJ L 283/51). http://europa.eu.int/eur-lex/pri/en/oj/dat/2003/l_283/l_28320031031en00510070.pdf [last accessed: 18 July 2006].

problem is a share of renewable energy in the EU that is too low, which might be bad for the security of supply, but also for the climate and perhaps the competitiveness of the EU. More views would have been possible will suffice. Note that both views are two different theoretical views on one single sequence of events that occurred in reality.

Table 4.1 shows a number of events that have contributed to the development of the biofuels directive. Obviously not all events relevant for the biofuels directive are shown, only those relevant for the two views. View I and View II respectively show the first and second view on the biofuels case.

One can see from the table that what can be considered an integrated assessment process from problem analysis (Phase I) to analysis of impacts (Phase III) in View II, can be considered just one phase (Phase III – Analysis) in View I. The main reason for this is the difference in what is considered to be the problem.

Furthermore, in both cases the integrated assessment process involves much more than assessing the impacts of the eventual proposal. Different decision-making tiers have responsibilities in the different phases of an integrated assessment. Seldom is one person or department responsible for the entire process. The Impact Assessment report that was eventually produced for the biofuels directive was therefore not only the result of impact assessments that were carried out around the time that the proposal was drafted, but the result of work done throughout the entire integrated assessment process, including Green Papers (discussion papers) that were developed, and scenario studies and modelling exercises that were done. Thus, although tool usage might have been limited during the drafting of the proposal (as the case study of this project has shown), tools were used in the years preceding the proposal. The results from this tool were employed during the drafting of proposal.

4.2 Problem types

Distinguishing between different problem types is helpful as an extra dimension for understanding why certain tools are (or are not) useful in the four phases of an integrated assessment. The problem types are discussed in this section. The application of these problem types to the four phases is the subject of the next chapter.

Hisschemoller (1993) distinguishes four types of problems on the basis of two dimensions (see Figure 4.2); one dimension refers to the degree of certainty concerning the kind of knowledge required for a problem, the other dimension refers to the degree of consensus on relevant norms and values. The four types of problems that emerge are structured problems (consensus on relevant norms and values and certainty on knowledge), moderately structured problems (consensus on values, uncertainty on knowledge), badly structured problems (no consensus on values, certainty on knowledge) and unstructured problems (no consensus on values and uncertainty on knowledge) (Hisschemöller and Gupta, 1999; Hisschemöller et al., 2001: 447ff). Note that structured problems could also refer to problems for which it is known what uncertainty and what dissent exists. With sustainable development issues, often dealing with complex systems and multiple perceptions, problem structuring is perhaps mostly about understanding uncertainty and dissent, rather than creating certainty and building consensus.

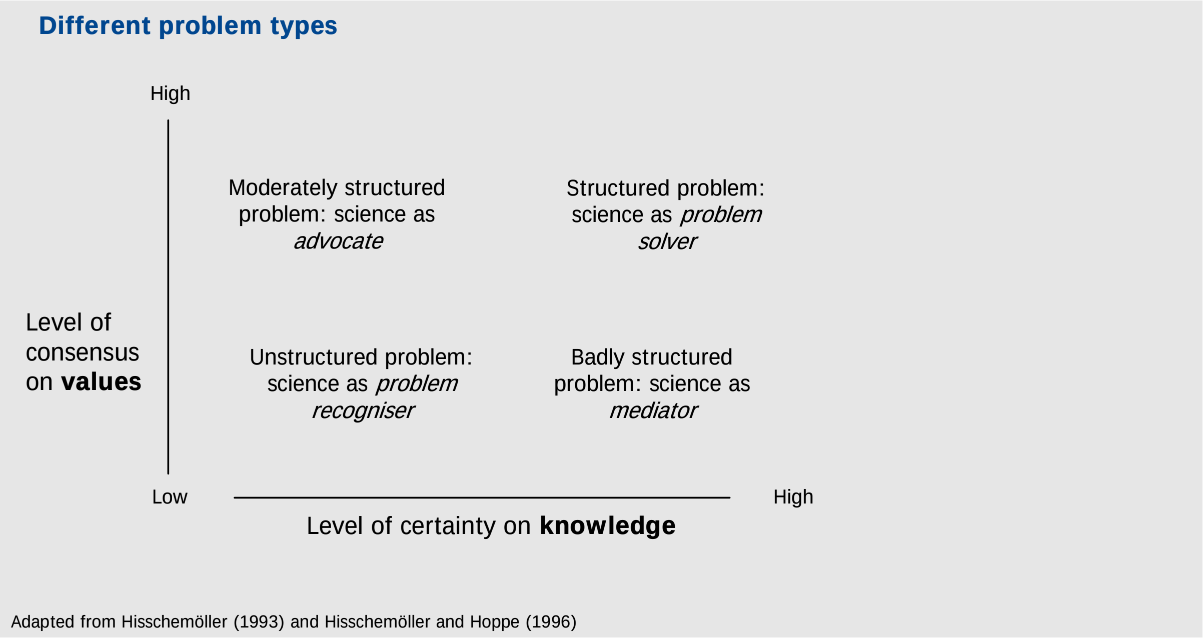


Figure 4.2: Problem types.

Assessment tools that can be used for structured problems might not be usable for problems for which no consensus exists on values and/or no certainty on knowledge (Hisschemöller, 1993: 17). A cost–benefit analysis, for example, can be used to calculate the expected costs and benefits of a certain policy intervention. This makes most sense when all relevant impacts expected from a policy intervention are known, and can be calculated and monetised (certainty on knowledge), and when the monetisation is commonly accepted by stakeholders (consensus on values). If there is uncertainty with respect to knowledge, there could be uncertainty with respect to which impacts matter and/or how to calculate the magnitude of these impacts. The benefits of air quality improvement, for example the number of human lives saved, can be seen as an example of such situation. If there is no shared perception on values, there could be disagreement in the stakeholder group with respect to the monetisation of impacts. Attaching a value to human life is an example of that. When there is either dissent on values or uncertainty on knowledge, or both, a cost–benefit analysis becomes less useful.

4.3 Tools

Although an integrated assessment can be done without tools, assessments can be strengthened when tools are applied. This section introduces the 50 tools that are covered by the *SustainabilityA-Test* project (Figure 4.3).

4.3.1 Seven tool groups

Seven tool groups have been made, combining tools that offer more or less the same support to an integrated assessment. It is fully acknowledged that alterative groupings of tools could have been made. The grouping used in *SustainabilityA-Test* has been shaped iteratively by combining tools that have similar scientific origins, analysing whether the tools within a group support similar tasks in an integrated assessment, and making adjustments to the tool grouping if necessary, et cetera. Should the *SustainabilityA-Test* project have started with an alternative set of tools, it is quite possible that another tool grouping would have emerged. The overview serves the purpose of helping people in finding appropriate tools. Future feedback of the users of the tool overview will eventually determine if further changes have to be made.

The seven tool groups are (see white blocks in Figure 4.3):

- Assessment frameworks
- Participatory tools
- Scenario analysis tools
- Multi-criteria analysis tools
- Cost–benefit analysis tools and cost-effectiveness analysis tools
- Accounting tools, physical analysis tools and indicator sets
- Model tools.

Delphi Survey, In-depth interviews and Citizens' jury in the group 'participatory tools' are not yet included in the *SustainabilityA-Test* webbook. Therefore, a brief explanation of these tools is given in Annex 4. The tools shown in the group 'scenario analysis tools' are also not yet included in the *SustainabilityA-Test* webbook. A brief explanation of these tools can be found in Annex 5.

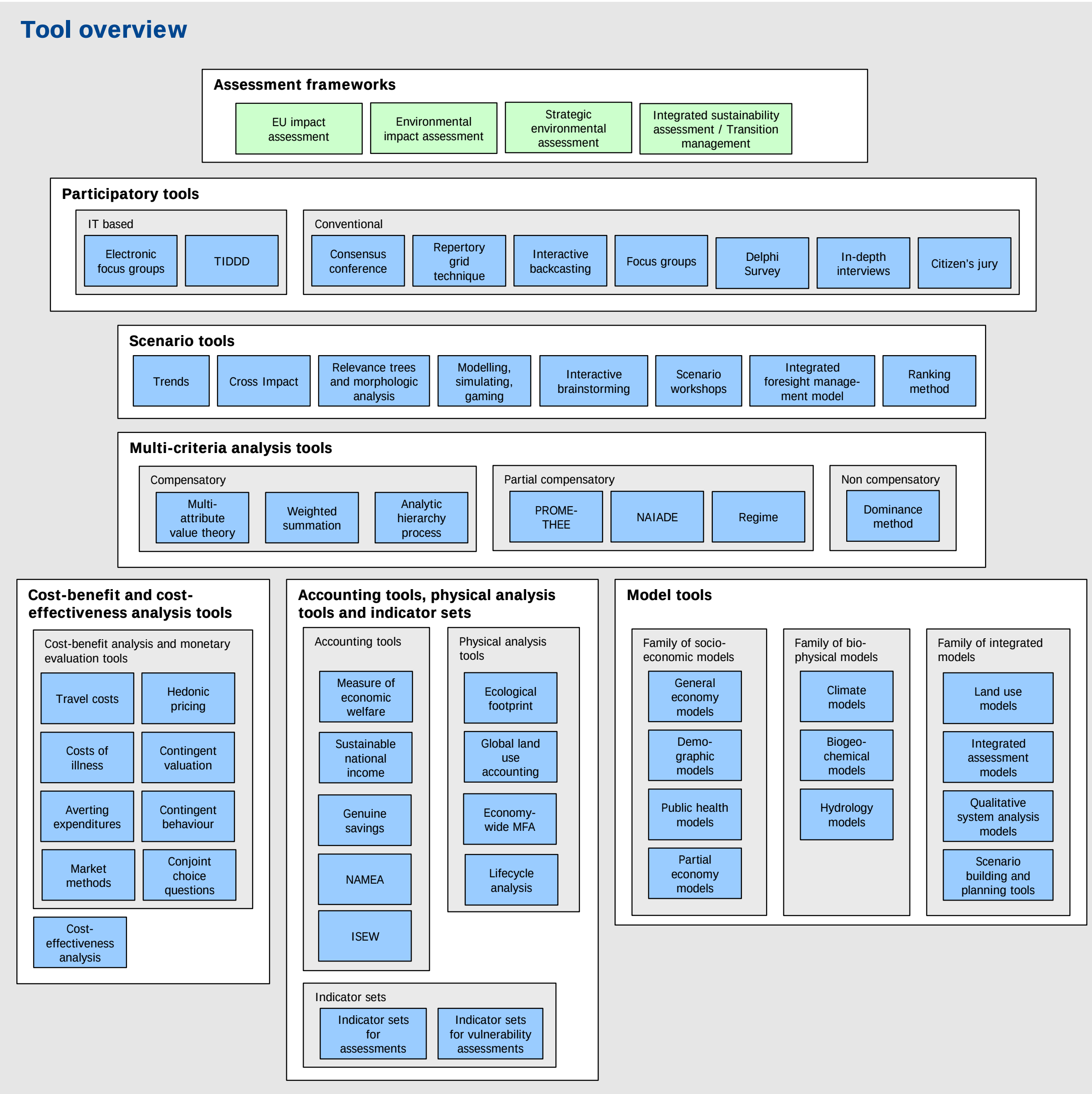


Figure 4.3: Tools covered by the *SustainabilityA-Test* project.

4.3.2 The logic behind the tool overview

The tool overview unavoidably includes some form of judgement with respect to what tools can and cannot be used for in an integrated assessment for sustainable development. The tool overview as presented in Figure 4.3 was under heavy discussion during the project. Although its initial purpose was to simply provide an overview of all tools covered by the project, the result is an overview in which the hierarchy of the tool grouping has significance.

As a start, a distinction was made between tools that need other tools and tools that can be used without other tools. Multi-criteria analysis tools, scenario tools, participatory tools and assessment frameworks belong to the former group (referred to as 'downstream tools'). Cost–benefit and cost-effectiveness analysis tools, accounting tools, physical analysis tools and indicator sets, and model tools belong to the latter group ('upstream tools'). Without upstream tools, applying downstream tools either often gets stuck or remains qualitative.

Next, within the upstream tools the distinction was made between tools that can address the economic side of a problem, tools that can address the physical side of a problem and tools that can do both.

For the downstream tools (scenario analysis tools, participatory tools and assessment frameworks) the hierarchy is given by the link of the tools to the user-side of assessments (rather than the scientific side); going from multi-criteria analysis to assessment frameworks, the connection to the user-side becomes stronger.

A controversial issue is the position of cost–benefit analysis tools. These tools are often considered an alternative to multi-criteria analysis tools (e.g. Mandelkern Group, 2001; CEC, 2005; Pearce et al., 2006), or even preferable above multi-criteria analysis tools (CEC, 2002b). The logic behind this is that with a cost–benefit analysis the costs of implementing certain policy can be compared with the benefits of that policy. However, the key task in a cost–benefit analysis is attaching a monetary value to every aspect one wishes to take into consideration rather than comparing costs/benefit ratio of various options. The key task in a multi-criteria analysis is applying a methodology to compare different options with one another on the basis of agreed criteria. Thus, cost–benefit analysis is not about comparing options, but about investigating the justification of one option on the basis of its costs and benefits, whereas multi-criteria analysis is about comparing different policy options. The equivalent of cost–benefit analysis would be the physical analysis tools that aim to attach physical units to every aspect considered relevant (e.g. the ecological footprint attaches surface units to resource needs and waste streams). Cost–benefit analysis tools and physical analysis tools shine a light on the economic and physical sides of a policy options respectively. Both types of information can feed into a multi-criteria analysis, where the actual comparison can be made between different options.

4.4 The role of tools in integrated assessments

The role of the tool groups in each generic phase of an integrated assessment can now be described in more detail. The phases are used as the basis, whereas the problem typology adds an additional dimension when useful.

The tasks that are to be done in each phase of an integrated assessment described below are derived from the various types of assessment that have been studied (details about these assessment types can be found in Annex 2). The tools that can support these tasks are derived from the tool evaluation done in the *SustainabilityA-Test* project, which is supplemented by expert knowledge and experiences present in the project team.

4.4.1 Phase I – Problem analysis

The aim of this phase is to understand the problem and to frame it, whilst accounting for different views on it. Useful tools in the problem analysis phase are tools that can steer the process of mobilising knowledge and articulating values, by means of stakeholder participation (experts, policy makers, laymen). In this phase, knowledge is being developed, made available and discussed, to reduce uncertainty and to build consensus on the problem. Uncertainty cannot always be reduced and consensus cannot always be reached; the problem analysis process should at least result in acknowledging and understanding the uncertainty and the dissent. Through participation, stakeholders become the (co-)definers of the problems to be addressed. This will assure the relevance of the assessment and could avoid so-called Type-III errors, which is assessing the wrong problem by incorrectly assuming that there is no difference between the problem as defined by the analyst, and the actual problem as defined by the stakeholders (Dunn, 1997).

Although tools for organising participation form the core of tool usage during this phase, other tools could be used as well. Scenarios, for instance, could provide the future perspective in the problem analysis to better understand the problem and why it is (or remains) a problem in the future. Models could also contribute to this phase for example by showing to stakeholders how systems behave and how such behaviour could result in problems. Models can also be used to show what is known and what is not known. Model building could be done as part of this phase, but always with feedback from and to the participatory process, otherwise one risks developing the wrong model for the problem. Cost-benefit analysis tools, physical analysis tools, accounting tools and indicator sets are also used to inform the debate by bringing to attention the different aspects of the problem (i.e. costs, physical aspects, et cetera).

4.4.2 Phase II – Finding options

The aim of this phase is to identify all possible options so as to act on the problem as defined in Phase I. In this phase the scenario analysis tools form the centre of the assessment. Scenarios are used to elucidate visions on sustainable futures and pathways, including policy interventions, towards such futures. Whereas the previous phase focussed on mobilisation and development of knowledge and problem perceptions, in order to reduce/understand uncertainty and to understand to what extent consensus exists about the problem, this phase could actually make explicit which uncertainties remain (scenarios are a way to illuminate uncertainties) and make concrete what dissent exists with respect to values (the different scenarios could represent different values and objectives).

In addition to scenario tools, other tools could be used. Participatory tools could be used to ensure that available knowledge is made accessible to the scenario-building exercise and to build support by integrating different views from stakeholder groups with respect to the visions and pathways. Models (mostly existing ones) could be applied to aid scenario development by, for example, characterising (parts of) plausible scenarios. Models are not supposed to be in the foreground, as they might hamper the creative thinking required in this phase.

Note that this phase could also be done *without* any tools being used. Objectives could, for example, be set politically. Only in the more strategically integrated assessment approaches are visioning and participatory scenario development used for setting objectives.

During this participatory, scenario-building exercise, it is preferable to make explicit the evaluation criteria and information needs that are needed in the next phase of the assessment to analyse the proposed policy interventions and to compare these with one another. Agreement, or ‘agreeing to disagree’, on the parameters that are relevant in the remainder of the integrated assessment is helpful as it facilitates the discussion about the best option to implement. New models might need to be developed or existing ones to be defined, to calculate the parameters that have been agreed. The choice of models (and indicators) must be done involving the relevant stakeholders. This is necessary, as described before, to avoid Type III errors, but also to reduce the risk of non-acceptance of the results.

4.4.3 Phase III – Analysis

The third phase is about characterising to the extent possible the details of the plausible scenarios and policy interventions developed in Phase II, with the final aim to select options for implementation. Here, the emphasis lies on the analytical tools, such as models, indicator sets, cost–benefit analysis tools and physical analysis tools. Models might help to further specify the scenarios, resulting in data series. Such series in turn could feed into other analytical tools. Detailed quantitative assessments are carried out for sub-systems within which, possibly by accepting boundary conditions, a relatively high degree of consensus and certainty exists. All analytical assessment results can eventually be fed into a multi-criteria analysis.

Stakeholder involvement during this phase could be relevant when, for example, comparing outcomes of various assessment tools in a multi-criteria analysis, in particular when dissent exists with respect to the problem and the relevant parameters to assess, and when there are large uncertainties. When a high level of consensus exists and when there is a high level of certainty with respect to the problem, this phase further rationalises the eventual policy choice. In that case, participatory tools have a limited specific role: the analysis becomes mostly a technical exercise.

4.4.4 Phase IV – Follow up

The last phase of an integrated assessment has two purposes: 1) to reflect on the entire integrated assessment *process* with the aim to learn from it and to improve future assessment processes, and 2) to monitor and evaluate the *result* of the integrated assessment (e.g. implemented policy measures) with the aim of learning about why the intended changes to the system did (or did not) occur. For learning from the process there is a role for the participatory tools in bringing together the stakeholders involved in the integrated assessment, thereby extending the quality assurance process. For monitoring and evaluating the result of the policy intervention there is a role for cost–benefit and cost-effectiveness analysis, accounting tools, physical analysis tools, indicator sets and model tools, as part of ex-post assessments.

4.5 Summary of the theoretical framework

The table on the next page summarises the theoretical framework described in this chapter.

The role of tools is essentially the same in different types of assessment and therefore the generic headings of the top row in Table 4.2 can be replaced by the headings belonging to a particular framework. Whether the table is used for Impact Assessment or Integrated Sustainability Assessment, the tasks that are to be done, at least in the generic way described in the table, will largely remain the same (see Annex 2). Clearly, the context, time frame and scope of the tasks can be quite different.

The table shows the tool group that is *best* to support a certain task or tasks that are best supported by a certain tool group. This does not exclude tools to be used for other tasks than mentioned here as well.

Note that by going from Phase I to Phase III, the character of an assessment gradually changes from deliberative to technical, visualised by the grey-shaded cells. The base of the table is rooted in scientific knowledge, raw data and statistics (the knowledge base), whereas the top of the table connects to the user-side of assessments (e.g. policy makers and other stakeholders). Although the knowledge base is needed throughout the entire assessment, one can see that the emphasis early on in the assessment process lies more on the deliberative and user-side of the assessment, i.e. involving stakeholders in identifying the problem and options. Gradually, the assessment becomes more of a technical exercise, with cost–benefit analysis and cost-effectiveness analysis tools, accounting tools, physical analysis tools and indicator sets, and models becoming more important.

Table 4.2: The role of tools in assessments

<table>
<tr><th></th><th>Phase I
Problem analysis</th><th>Phase II
Finding options</th><th>Phase III
Analysis</th><th>Phase IV
Follow-up</th></tr>
<tr><td>Participatory tools</td><td>Problem framing (mobilising and integrating knowledge and values)</td><td>Supporting scenario building</td><td>Providing the context for and improve robustness of MCA, CBA and CEA</td><td>Evaluating the assessment process</td></tr>
<tr><td>Scenario tools</td><td>Providing the future perspectives to problem framing</td><td>Visioning futures, finding options and setting objectives</td><td>Providing references for the application of analytical tools</td><td>–</td></tr>
<tr><td>Multi-criteria analysis tools (MCA)</td><td>–</td><td>Definition of criteria</td><td>Comparing different alternatives</td><td>–</td></tr>
<tr><td>Cost–benefit analysis (CBA) and cost-effectiveness analysis (CEA) tools</td><td rowspan="3">Providing the analytical basis for problem-framing</td><td rowspan="3">Supporting objective setting</td><td rowspan="3">Full analytical characterisation of options to enable comparison</td><td rowspan="3">Ex-post assessment</td></tr>
<tr><td>Accounting tools, physical analysis tools and indicator sets</td></tr>
<tr><td>Model tools</td></tr>
</table>

Note: The table shows six tool groups in the left-hand column, followed by a column for each of the four generic phases of an assessment. A cell describes a task that is to be done in a particular phase. This task can be supported by the tool group of the same row as the cell. The shaded cells in the table represent task/tool combinations that are 'in the lead' in a particular phase. The labels of the top row (problem analysis, finding options, etc) can be replaced by corresponding terminology found in different types of assessments, like Impact Assessment or Strategic Environmental Assessment.

4.6 Conclusions

One conclusion that logically follows from the Table 4.2 is that combinations of tools are needed when tool support is needed for the various tasks of an integrated assessment. Not any one tool can support all tasks that are to be done.

The core of an Impact Assessment, as carried out by the European Commission (CEC, 2005), lies in the third phase, i.e. analysis of an integrated assessment (see Figure 4.1 on page 38). It is therefore logical that of the few tools that are used within an impact assessment, it is mostly the more technical ones that are used (see chapter 3). However, chapter 3 also shows that Impact Assessments tend to focus on those sustainable development concerns that are high on the political agenda, i.e. competitiveness, economic growth, employment, etc., despite the requirement in the Impact Assessment guidelines to consider the environmental, social and economic equally. This observation is confirmed by other evaluations of the Impact Assessment system (see e.g. Wilkinson et al., 2004; Lee and Kirkpatrick, 2004 and

EEAC, 2006). The tools that are used in Impact Assessment are therefore often analytical tools that can address economic impacts, although some argue that tools like cost–benefit analysis should be used more (CEC, 2002b).

An Impact Assessment is a *part* of an integrated assessment for sustainable development, focusing on the generic phase called ‘analysis’. Other tasks ought to be done in the two preceding phases (i.e. ‘problem analysis’ and ‘finding options’), and the successive phase (i.e. ‘follow-up’). This does not mean that an Impact Assessment should be elaborated to include these other tasks. Instead, they are done *before* the actual Impact Assessment starts, and *after* it has been finalised. Tools are available to support those tasks. The DG responsible for the Impact Assessment could also be made responsible for the rest of the integrated assessment for sustainable development.

If integrated assessment for sustainable development requires a shift in paradigm with respect to science production, away from mode-1 towards mode-2 science (see page 27), this will require a shift in tool understanding. Rather then seeing tools as aids to delivering data, they are to be seen as methodological instruments that help to gain better insight into complex sustainability problems and different views on them. In terms of Table 4.2, this means building combinations of tools from both the bottom and the top of the table.

5 Applying the theoretical framework to the tools

Måns Nilsson (5.1), Tiago Pedrosa and Ângela Guimarães Pereira (5.2), Tiago Pedrosa, Ângela Guimarães Pereira, Alexa Matovelle and Karl-Heinz Simon (5.3), Marjan van Herwijnen (5.4), Onno Kuik (5.5), Dirk Günther (5.6), Hermann Lotze-Campen (5.7) and Wouter de Ridder (5.8)

This chapter elaborates in more detail how the tools in each tool group can support the various tasks within an integrated assessment. Selection criteria are presented to choose a tool within a group.

Many tools are mentioned in this chapter. A detailed description of each tool, including references to literature, can be found at www.SustainabilityA-Test.net, under the icon 'tool overview' ( ).

5.1 Assessment frameworks

The assessment frameworks can be considered 'procedural tools' in the sense that they do not carry out a particular kind of analysis, like analytical tools do, but instead are set up as procedures that are designed to connect to a decision-making process and within which a range of different analytical tools can be applied (Finnveden et al., 2003). In fact, without a content of analytical tools they are merely frameworks, or shells, without much substance.

The four assessment frameworks considered are: Environmental Impact Assessment (EIA); Strategic Environmental Assessment (SEA), Impact Assessment (IA), and Integrated Sustainability Assessment (ISA). More assessment frameworks exist. The ones covered here are obligatory assessment frameworks for project (EIA), plans and programs (SEA) and policy proposal from the European Commission (Impact Assessment). The latter (ISA) is an example of an integrated assessment framework that is rooted into transition management. But note that assessment frameworks are not exclusively used for the level of intervention (i.e. project, plan, et cetera) for which the different frameworks are designed

Literature and guidance on these frameworks display a considerable variety. At the same time, there are no clear-cut lines between the frameworks, and there are variations within the same labelling that implies that sometimes what is called an SEA may in effect be closer to an EIA.

5.1.1 Key qualities of assessment frameworks covered by the SustainabilityA-Test project

Environmental Impact Assessment (EIA) – EIA is the most standardized, institutionalized and professionalized of all the frameworks, having been in place for almost forty years, and since many years well integrated in legislation and regulation. There are many consultants available for EIA, and it is has its own journals and professional societies such as IAIA (International Association of Impact Assessment). Guidelines and experience is plentiful and well-published (Petts, 2000). However, EIA has been thoroughly criticized for being a marginal and disconnected procedure with no real influence on decision-making. As a regulatory requirement for the project proponent, the procedure is usually seen as a bureaucratic hurdle to be overcome as soon as possible. As decision support it has had limited effect (Cashmore et al., 2004). The application of tools in EIA is normally very limited, and analytical work is based primarily on data gather and measurements on site, and filling in checklists and matrices. In principle, however, EIA can deploy tools to the same extent as the frameworks described below.

Strategic Environmental Assessment (SEA) – SEA has developed from EIA practice, following the realization that EIA is rather ineffective and that the application of EIA to strategic-level decisions (plans, programmes and policies) require modified processes. Although at the beginning it was notably concerned with preparing a report (like EIA) (Therivel et al., 1992) in an effort to make the tool more decision-relevant, SEA literature later has emphasised the need to develop a procedure that runs in parallel and supports the entire decision-making process, rather than just report on possible impacts. This has meant moving the emphasis up-stream in the decision-making process and really provide input not only regarding impact analysis, but also in the formulation of objectives, success criteria and decision alternatives (Partidario, 2000; Dalkmann et al., 2004). This has opened the field of a range of tool applications, including scenarios, multi-criteria analysis, and cost–benefit analysis, which is now becoming evident in recent examples (Nilsson et al., 2005). The current trend in SEA is to broaden it to encompass also social and economic considerations to become a more holistic strategic assessment. This last development lends it a considerable overlap with IA, described further below, in particular since SEA relates to policies as well as programmes and plans, although the European directive on SEA limited its scope to plans and programmes.

Impact Assessment (IA) – IA is sometimes a broad term, but here refers to the policy level or ‘regulatory’ Impact Assessment of the European Commission, and national incarnations of the same. IA has typically been developed as a more integrated tool, supposed to facilitate and support policy-level decision making by combining all cross-cutting environmental, social, and economic concerns into one procedure (CEC, 2002a). Although in principle this correlated with a ‘sustainability approach’, recent evidence suggests that sustainability concerns have in effect had difficulties competing with business, economic and competitiveness concerns, not least in the applications made in the European Commission (CEC, 2003b; Wilkinson et al., 2004; Lee and Kirkpatrick, 2004; EEAC, 2006; Adelle et al., 2006). As a relatively immature procedure, the institutional checks and balances are not in place yet, such as evaluation quality control of the assessment.

Integrated Sustainability Assessment (ISA) – ISA is a continuation of the field of integrated assessment. Its development is coordinated through the on-going MATISSE project (2005-2008). It is therefore more a research orientation than an established tool. However, real policy processes in the Netherlands relating to transitions management have deployed ISA-like approaches, which suggest it is viable as an institutionalized assessment framework in a relatively near future. In comparison with the other tools, it puts a stronger emphasis on stakeholder engagement and the upstream processes of scoping the issues and formulating visions, objectives, and strategies, as well as inducing a reframing and learning process among participants in the process (Weaver and Rotmans, 2006). It is also more direct towards formal modelling. On-going empirical work suggests is likely to be most useful for strategic and complex policy processes rather than more routine regulatory processes (Turnpenny et al., 2006).

5.1.2 Choosing between assessment frameworks

The project *SustainabilityA-Test* has developed stylized conceptions of the assessment frameworks. Each of them correspond to sustainability assessment at different levels of governance: EIA operates primarily at the concrete project or plan level; SEA operates primarily at a more strategic planning and programme level; IA is supporting the policy level; and ISA is being developed to support a ‘meta-policy’ level, i.e. a strategic visionary level. The choice of framework is therefore primarily based on what level of intervention the decision-making process is concerned with.

The Table 5.1 (page 54) summarised some key principles and aspects of the different frameworks that could be taken into consideration when selecting the appropriate assessment framework.

Table 5.1: Selection criteria for assessment frameworks

Method	Primary level of intervention	Typical emphasis in the decision process*	Focus of role and attention	Institutional
EIA	Project decision	Downstream (i.e. later in the decision-making process)	Analysing impacts and report to the decision stage	Strongly regulated and mainstream practice
SEA	Plan, programme, policy	Upstream (i.e. early in the decision-making process) and downstream	Identify objectives, alternatives, and analysing impacts and report to these different stages	Partly regulated and not yet mainstream practice
IA	Policy, regulation	Downstream	Analysing impacts and reporting to the decision stage	Partly regulated and not yet well practiced
ISA	Strategic policy	Upstream	Understanding the problem, formulating visions and options for decision making	Primarily at the research level

Notes: Because there is considerable variety in the application of the different frameworks the table is a strong simplification based on an overall impression and judgment.

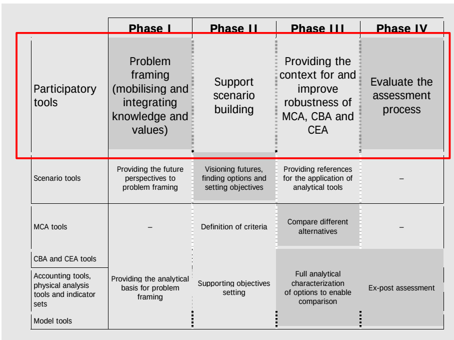
*) 'Upstream' refers to early on in the development of a policy intervention; 'downstream' refers to later in the development of a policy intervention.

5.2 Participatory tools

Participation is of key importance in integrated assessments and is about mobilising stakeholders and their values, views, knowledge and ideas. The project *SustainabilityA-Test* covered six participation methods, two of which use information technology (IT-based participatory processes).

5.2.1 Role of participatory tools in an integrated assessment

Participatory tools play a leading role in Phase I of an integrated assessment (i.e. problem framing). Participatory tools support the engagement of stakeholders (experts and laypeople) and the knowledge, ideas and views they hold. This in turn supports an extended reflection upon the problem under study and its boundaries, resulting in shared framing of the problem and/or understanding that different stakeholders frame the problem differently. In short, stakeholders become the (co-)definers of the problem to be addressed.



	Phase I	Phase II	Phase III	Phase IV
Participatory tools	Problem framing (mobilising and integrating knowledge and values)	Support scenario building	Providing the context for and improve robustness of MCA, CBA and CEA	Evaluate the assessment process
Scenario tools	Providing the future perspectives to problem framing	Visioning futures, finding options and setting objectives	Providing references for the application of analytical tools	–
MCA tools	–	Definition of criteria	Compare different alternatives	–
CBA and CEA tools Accounting tools, physical analysis tools and indicator sets Model tools	Providing the analytical basis for problem framing	Supporting objectives setting	Full analytical characterization of options to enable comparison	Ex-post assessment

In addition, participatory tools may also be used for more specific tasks that could be derived from problem framing, such as: exploring the knowledge base (identifying knowledge gaps);

assure the relevance of the assessment, increasing its social robustness and assuring the assessment's quality from a societal point of view (fitness for purpose, relevance and legitimacy).

In Phase II participation is generally used to get stakeholders involved in the development of scenarios. By doing so, stakeholders get involved in identifying cause-effect relations needed to build scenarios as well as aid the task of identifying which parts of knowledge are contested (scientific and societal controversies) and the adequacy of the available knowledge base. Participation can also be used to ensure that the stakeholders agree on the selection of relevant models and indicators and on the definition of multi-criteria analysis (MCA), cost–benefit analysis (CBA) and cost–effectiveness analysis (CEA) criteria used to evaluate different options. Participation in this second phase of an integrated assessment is thus organised to support the deployment of other tools, setting the context where stakeholders can participate, supplying the process with knowledge and information in order to enhance understanding of the problem and, if necessary with deliberative purpose helping to decide which criteria and/or indicators to use.

In Phase III of an integrated assessment, participatory tools could be used to involve stakeholders in MCA, CBA and CEA. This improves the robustness and legitimacy of such evaluation. Legitimacy of policy options is even further improved through an extended assessment process, whereby participatory tools help with attaining shared ground for concerted action, including deliberation (e.g. attaining consensus).

In the last phase of an integrated assessment (Phase IV) participation could be used to evaluate the integrated assessment process by internal and/or external (peer) review. Participation tools could be used to allow those involved in the decision-making process, and other stakeholders (not participating) in the process, to reflect on the integrated assessment with the aim to further improve tools, methods and framework used. Participatory processes may also be used to extend the peer review process. By extended peer review (Funtowicz, 2001; Funtowicz and Ravetz, 1990), is meant a reflexive process through which quality of processes and/or products are enhanced by integration of different sources of knowledge. Hence: Inclusion of those affected and/or affecting the issue of concern.

5.2.2 Choosing between different participatory tools

Due to the variety of methods, it is difficult to choose which method, or combination of methods, to use in which situation. The choice of tools depends a great deal on the objectives, context, participants, goals and issues been address.

Participation (and therefore the method chosen to organise or set up participation) should be seen in two main perspectives: those that have an exploratory, investigative nature (with hardly any connection with established institutional arrangements of decision and policy making) and those that are deliberative (having a bidding effect with regards to policy making even if used for explorative or analytical purposes). In fact, if in sustainability assessment there is a deliberative phase, which might be the case (for instance the scoping phase can be considered deliberative in the sense that decisions are taken regarding to what has to be assessed), deliberative participatory methods should be used (e.g. citizen juries) could be appropriate.

Participatory IA processes may serve different purposes and functions (see for instance Tàbara, 2006). Specifically they may help to:

1. Frame and define in more relevant ways the problems at stake, their possible causes, effects, and feasible courses of action or futures on the basis of the stakeholders' views.
2. Improve the available information, communication and participation channels both for the production of knowledge and for feeding the policy-making process with preferences and views which would rarely be taken into account otherwise.
3. Enhance the integration of diverse forms of knowledge and value domains, both from experts and non-experts, as well as from different scientific disciplines.
4. Optimise the existing processes of social and institutional learning, by rising awareness of complexities and uncertainties of the situation, as well as the limits or the gaps in the available knowledge and of the capacities to deal with them.

When selecting the type of tool(s) to use to carry out a participatory process, six main criteria may be considered (other selection criteria exist, see for example Rauschmayer and Risse, 2005):

1. Participants number and method of identification/selection;
2. The goal of carrying out a participation process (Arnstein, 1969);
3. The problem content of the issue to be addressed (Steyaert and Lisoir, 2005);
4. The type of desired outcome (Involve, 2005);
5. The style of moderation required (Guimarães Pereira, 2005);
6. Whether and how ICT is used.

These criteria are first explained in more detail and then presented with respect to the participation methods in an overview table (Table 5.2).

Participants

There are several methods to identify and select the participants in a participatory process. Many of the participatory tools methodologies already consider specific formats of identification and selection of participants. The identification and selection method is of crucial importance for the sake of transparency and, if deemed necessary, the 'representativeness' of the process.

There are four selection processes considered here (Involve, 2005):

1. *Self-selected participants* – anyone who wants to join can. This selection process is appropriate when is wanted the community engagement as widely as possible;
2. *Stakeholder representatives* – participants representing views, values and knowledge of specific interest groups or with specific skills;
3. *Demographically* – samples are selected to provide a sample of a larger population;
4. *Number of participants* – number of participants the tool/method foresees.

Participatory process goal

Participatory processes may entail different type(s) of involvement emerging from the application of a tool/method. The applied tool may foster (or not) a more active participation in the final result of the process by the participants. These types of participation can be divided into three broad categories adopted from the original ladder of Arnstein (1969):

1. *Consultation* (gauging opinions, obtaining reactions or options) – co-thinking
2. *Partnership* – Citizen engagement (in-depth thinking by citizens about key public policy issues, informing policy and the decision-making process with citizen perspectives and values) – co-operating, co-defining or co-production;
3. *Deliberation* – place final decision-making in the hands of the public – co-decision;

Problem Content

The nature and scope of the issue to be addressed can be regarded based on four aspects (Steyaert and Lisoir, 2005):

1. *Knowledge* – to what extent does the society already possess a general knowledge of the subject? To what extent relevant common knowledge is possessed by participants?
2. *Maturity* – to what extent has the society already developed opinions or even legislation on the subject? Do strong views exist or is the issue so emergent that norms have not become established?
3. *Complexity* – is the subject highly complex, such that a great deal of (technical) information is required?

4. *Controversy* – is the issue highly controversial and has the debate become polarised, such that consensus is difficult to reach?

Participatory Process Outcome

Different tools produce different types of outcomes (Involve, 2005). Here we take to account also the knowledge already in possession or acquired during the process by the participants. Seven types of outcomes that tools are good at producing are considered:

1. *Map existing options* – some methods are good for discovering existing opinions or impacts about an issue;
2. *Map of informed options* – methods that involve deliberation usually lead to the creation of better informed opinions;
3. *Improved relationships* – some methods are better than others at revealing common interests and thereby improving relationships;
4. *Shared vision* – some methods are good for creating a shared vision;
5. *New ideas* – some methods are also excellent at producing new ideas and visions for change;
6. *Recommendations* – some methods are good at producing recommendations;
7. *Participants empowerment* – finally, some methods empower participants by giving them skills and/or confidence to take a more active part in decision-making.

Style of moderation

Each participatory tool requires a specific style of moderation (Guimarães Pereira, 2005) that will affect the way that process are conducted, and results and outcomes are achieved. Practitioners originally trained in certain approaches tend to value those outputs above others. For example, a facilitator trained in Stakeholder Dialogue will run a Focus Group very differently from the way a facilitator with a marketing background would run it. In other words, the shape, use and results of methods are determined by who is using them, as well as by the nature of the methods themselves and the context, purpose et cetera (Involve, 2005). Also is to consider that some styles of moderation require more skills than others.

Five styles are considered:

1. *Arbitrator* – style of mediation used when the direct discussion between two or more parties need to be arbitrated. The arbitrator facilitates the direct dialogue between participants;
2. *Facilitator* – Leads the participants through an agenda, keeps the flow of the dialogue or provides the technical assistance to software deployment;
3. *Mediator* – Mediators need the skills of facilitators plus need to assist with the communication between the participants, translating if necessary different

languages (jargon). They need a good knowledge of the issues in discussion and if necessary they should assist parties in reaching agreements;

4. *Negotiator* – Have an active role on the final result of the participation process. He can have a direct interest on a specific result and his main objective is to achieve an agreement /solution regarding the issue(s) at stake;
5. *Assistance* – Give the necessary assistance to the moderator.

Apart from the moderation styles considered above, it is desirable that either the moderator or a dedicated person has the role of 'integrator', that is the person that integrates different forms of *knowledge* feeding into and arising from the participatory process, and mediation of that *knowledge* in the assessment and policy making process. This task may be assigned to a moderator of the participatory process (as suggested in Tabara, 2006) but it can also be assigned to a specific professional (as suggested in Guimarães Pereira et al., 2003a; 2003b).

Information and Communication Technologies (ICT)

ICT can be used in two main ways in participatory process: they can be used as *support* to the process, i.e. the tool/method deploys ICTs that can help with the participatory process (introducing issues, facilitating visualization, etc); or they can *guide the process* itself, allowing stakeholders to participate virtually in the processes (e.g. internet, video conference, email, forums, et cetera). The deployment of ICT becomes the participatory process itself.

Table 5.2: Selection criteria for participatory methods*

Method	Participants				ICT		Goal			Contents***				Outcomes							Mediator				
	Self-selected participants	Stakeholder representatives	Demographically	Number o participants**	Support	Process	Consultation	Partnership	Deliberation	Knowledge	Maturity	Complexity	Controversy	Map existing options	Map of informed options	Improved relationships	Shared visions	New ideas	Recommendations	Empowerment	Arbitrator	Facilitator	Mediator	Negotiator	Assistance
IT based																									
Electronic focus groups		✓		6-15		✓	✓	✓		±	-	m	±	✓	✓			✓					1-2		1
TIDDD		✓		1-xx	✓		✓	✓	✓	m	m	±	+	✓	✓		✓			✓		1			
Conventional																									
Focus groups		✓		10-12			✓	✓	✓	±	-	m	±	✓				✓					1		1
Delphi Survey							✓	✓		-	-	+	±	✓								1-2			
In-depth interviews		✓	✓	1-xx			✓			+	+	-	±	✓	✓							1			
Citizens' jury			✓	12-24			✓	✓	✓	±	±	±	+		✓				✓	✓			2		
Participatory workshops		✓	✓				✓	✓	✓					✓	✓	✓	✓		✓	✓			2		2-4

*) This table provides a limited number of participatory methods (those covered by the *SustainabilityA-Test* project), providing an indication for the specific circumstances in which the method can be used (marked by '✓', if not the cell is empty). Other methods exist (see for instance: Rowe, 2000; Abeison et al., 2001; Involve, 2005; IAP2; Steyaert and Lisoir, 2005). Delphi Survey, In-depth interviews and Citizens' jury are not included in the webbook; information about these methods can be found in Annex 4. Repertory Grid Analysis and Consensus Conference, included in the webbook, are not included in this table.

**) 1-xx means that the number of participants ranges from individuals to groups (with in principle an unlimited number of participants.

***) With respect to contents, the "+"-sign denotes high suitability, the "–"-sign low suitability and the "m" medium suitability of a tool for situations where there is a high level of common knowledge, a high level of maturity (most participants have formed their opinion), high complexity and a highly controversial issue. "±" denotes that the tool can be used for all cases.

5.3 Scenario analysis tools

The term 'scenario analysis' is used in the *SustainabilityA-Test* project in a very general way, including the phases of defining scenarios, developing scenarios and interpreting the results.

A manifold of definitions exists in practice and in the literature on what 'scenario analysis' is. However, most scenario developers would agree that scenarios are constructed especially to assist in the understanding of possible future developments of complex systems. In the *SustainabilityA-Test* project, scenarios are also assumed to provide some form of future perspective to an integrated assessment. Scenarios are made up of a set of explicit 'if-then' propositions that explore the consequences of a range of driving force assumptions (i.e. each scenario should include a set of driving forces as well as a representation of resulting pressures, states, impact and/or responses). A scenario can take many forms including an image, a graphic, a table, or text.

The scenario analysis tool group in the *SustainabilityA-Test* project comprises tools that can be used to develop scenarios. Using existing (i.e. already developed) projections, data series or qualitative story-lines is not considered as using scenario analysis in the *SustainabilityA-Test* project. Scenario analysis tools in this project thus refer to the *development* of scenarios.

5.3.1 Role of scenario analysis tools in an integrated assessment

Scenario analysis tools are powerful tools in integrated assessments especially in Phase II of an integrated assessment, called 'finding options' in the *SustainabilityA-Test* project.

	Phase I	Phase II	Phase III	Phase IV
Participatory tools	Problem framing (mobilising and integrating knowledge and values)	Support scenario building	Providing the context for and improve robustness of MCA, CBA and CEA	Evaluate the assessment process
Scenario tools	Providing the future perspectives to problem framing	Visioning futures, finding options and setting objectives	Providing references for the application of analytical tools	–
MCA tools	–	Definition of criteria	Compare different alternatives	–
CBA and CEA tools Accounting tools, physical analysis tools and indicator sets Model tools	Providing the analytical basis for problem framing	Supporting objectives setting	Full analytical characterization of options to enable comparison	Ex-post assessment

Scenario analysis tools are mainly used in Phase I (problem framing), Phase II (finding options), and Phase III (Analysis) of an integrated assessment. In any situation where scenario analysis tools are used, the tools are used in conjunction with other tools, especially participatory tools and modelling tools.

In Phase 1 – providing future perspectives to problem framing – scenario analysis contributes to the building of knowledge about the problem and its cause and effect relationships. Suitable scenario tools are capable of helping to get over narrow views on the problem area, like brainstorming, workshops (like 'future conferences') and other participatory scenario-building exercises.

In Phase II – finding options – scenario analysis plays an important role in visioning futures and setting the objectives. Scenarios are used to elucidate visions on sustainable futures and pathways, including policy interventions and variation of framework conditions. At this stage of the integrated assessment, the main drivers are identified and a broad spectrum of possible future developments, or possible pathways to certain objectives, is described. An important role for scenario application in this phase is a first clustering of promising policy options that can be further investigated in Phase III (analysis).

In Phase III – analysis – further steps of analysis are based upon the results of the scenario definition processes. Scenario calculation often provide the data series needed by the more analytical tools to calculate expected impacts, costs and benefits of various policy options.

In Phase IV – follow-up – there is no particular role for scenario analysis tools. Existing projections and scenarios might be used for ex-post evaluation of implemented policies, but this is not considered application of scenario analysis tools in the *SustainabilityA-Test* project.

5.3.2 Choosing between different scenario analysis tools

There are various ways to develop scenarios, and various reasons for doing so. Probably the most important factor determining what method to use is the *reason* for which the scenario Three typical reasons for developing scenarios can be distinguished, which more or less link to the different phases of integrated assessment. These are (Westhoek et al., 2006):

1. Strategic orientation, to answer questions such as what alternative ‘worlds’ can be expected, what preparations are needed, what if current assumptions are wrong, and what would be robust strategies?
2. Advocacy/vision building, to answer questions such as what are the positive changes that are needed (e.g. structural changes, value changes, ect.)?
3. Policy optimisation, to answer questions such as what policy variant is most effective, cost-efficient, fast, acceptable, etc?

There are many additional considerations for choosing one scenario development method over the other. Four of these are discussed in further detail below:

1. Type of desired scenario – participatory vs. non-participatory and qualitative vs. quantitative (or hybrid);
2. Problem content – the nature and scope of the issue to be addressed (Steyaert and Lisoir, 2005);
3. Scenario outcome – types of outcomes that the approach is good producing (Involve, 2005);
4. Whether or not the tool requires specific (scenario) expertise to be applied.

Each criterion is explained in more detail below, followed by an overview table mapping a few methods for scenario development to the criteria (Table 5.3).

Type of scenarios

There are several types of scenarios that can be produce by a tool or combination of tools. Several scenario characteristics were already mentioned in this chapter from which two are strongly affected by the type of tools used:

1. *participatory vs. non-participatory* scenarios with respect to inclusion of stakeholders
2. *qualitative vs. quantitative* (or hybrid) scenarios with respect to knowledge used.

If the scenario aims to explore more the values of the issues at stake, it is important to use tools that allow participation of stakeholders. On the other hand, if the scenario has as main objective to support the assessment with data series, it is probably more appropriate to use quantitative tools.

Problem Content

The nature and scope of the issue to be addressed can be regarded based on four aspects (Steyaert and Lisoir, 2005):

1. *Knowledge* – to what extent does the society already possess a general knowledge of the subject?
2. *Maturity* – to what extent has the society already developed opinions or even legislation on the subject? Do strong views exist or is the issue so emergent that norms have not become established?
3. *Complexity* – is the subject highly complex, such that a great deal of (technical) information is required?
4. *Controversy* – is the issue highly controversial and has the debate become polarised, such that consensus is difficult to reach?

Scenario Outcome

Different tools produce different types of outcomes that can go from simple gather of information to the production of a scenario. Four types of outcomes that can be produced by tools are considered (Involve, 2005):

1. *Gather information* – some methods are good for gathering the information necessary to characterise a scenario;
2. *Organise information* – some methods are good to organise the data to be used in the scenario's building;
3. *Produce a scenario* – methods that involve the development of a complete scenario;
4. *Hybrid* – some methods are good to gather information and produce a new scenario.

Table 5.3: Selection criteria for scenario analysis tools

	Reason			Type			Contents***				Outcomes				
Method*	Strategic orientation	Advocacy / vision building	Policy optimisation	Participatory	Qualitative	Quantitative	Knowledge	Maturity	Complexity	Controversial	Gather	Organise	Produce	Hybrid	**Scenario Experts**
Trends	✓					✓	±	±	+	+	✓	✓			
Cross Impact	✓			✓	✓		±	±	+	±		✓			
Relevance trees and morphologic analysis			✓	✓	✓		+	±	+	+		✓			✓
Modelling, simulation, gaming	✓		✓	✓		✓	±	±	±	±			✓		✓
Participatory methods**		✓	✓	✓	✓		±	±	±	±	✓	✓			
Interactive Brainstorming		✓		✓	✓		±	-	+	±	✓				
Scenario workshops	✓	✓	✓	✓			+	±	±	±				✓	✓
Integrated Foresight Management Model		✓	✓		✓		-	-	±	±				✓	✓
Ranking method			✓		✓		±	-	±	±		✓			

*) These methods are not yet included in the *SustainabilityA-Test* webbook. A brief description of each method is given in Annex 5. Note that when a method is said to be useful in terms of the criteria mentioned here, denoted by '✓', this is based on the typical application of the method. An empty cells means that a method is not particularly good for that specific situation.

**) Participatory methods are those tools that can help with building a scenario such as Focus Group, Delphi survey and in-depth interviews. These tools are described in the Participatory tools chapter.

***) With respect to contents, the "+"-sign denotes high suitability, the "–"-sign low suitability and the "m" medium suitability of a tool for situations where there is a high level of common knowledge, a high level of maturity (most participants have formed their opinion), high complexity and a highly controversial issue. "±" denotes that the tool can be used for all cases.

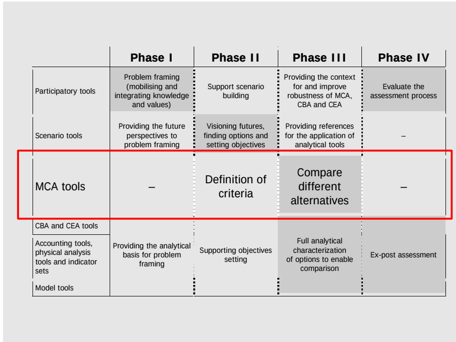
5.4 Multi-criteria analysis tools

Multi-criteria analysis (MCA) tools are tools that support comparison of for example different policy options on the basis of a set of criteria. They are very effectively in supporting the assessment of and decision making on complex sustainability issues because they can integrate a diversity of criteria in a multidimensional guise and they can be adapted to a large variety of contexts. The procedures and results obtained from MCA can be improved with the interaction of stakeholders.

The robustness of an MCA result depends on the (un)certainty of the information feeding into the selected criteria, on the priorities given to the criteria (the weights or importance) and the extent to which these weights are commonly agreed upon by stakeholders. Sensitivity analysis can be used to check the robustness of the result for changes in scores and/or weights. Most computer programs that provide the use of one or more MCA methods also provide the use of sensitivity analysis.

5.4.1 Role of multi-criteria analysis tools in an integrated assessment

MCA plays its main role in Phase III of an integrated assessment, i.e. analysis. Here MCA can be used to compare the policy options, to identify the effects of these options and to identify the trade-offs to be made. MCA could be considered to play a role in Phase II (finding options) as well, when it is used to evaluate a series of options to eliminate the most undesired or unrealistic ones. However, such application is considered to be done to converge (considered part of Phase III) rather then to diverge (considered part of Phase II).



There is no particular role for MCA in Phase I (problem analysis) and IV (follow-up) of an integrated assessment. However, in order to apply a MCA effectively in an integrated assessment, first the objectives have to be made clear and the problem has to be structured in a specific way. So, Phase I of an integrated assessment has to be done (properly) in order to successfully apply an MCA in Phase III.

5.4.2 Choosing between multi-criteria analysis tools

A large number of MCA methods exist to rank, compare and/or select the most suitable policy options according to the chosen criteria. These methods distinguish themselves through the decision rule used (compensatory, partial-compensatory and non-compensatory) and through the type of data they can handle (quantitative, qualitative or mixed). So the method to choose to apply MCA depends of the decision rule preferred and the type of data available (see Table 5.4).

Table 5.4: Selection criteria for methods for multi-criteria analysis

	Decision rule			Type of data		
	Compensatory	**Partial-compen-satory**	**Non-compen-satory**	**Quantitative data**	**Qualitative data**	**Mixed data**
MAVT	✓					✓
Weighted summation	✓			✓		
AHP	✓					✓
PROMETHEE		✓				✓
NAIADE		✓				✓
Regime		✓			✓	✓
Dominance method			✓		✓	

Note: A tick mark (✓) indicates that a specific method can be used for a specific decision rule (left) or type of data (right) – see main text for further details.

Decision rules

A decision rule is a procedure that allows for ordering alternative policies (Starr and Zeleny, 1977; Greco et al., 2005). It integrates the data and information on alternatives and decision maker's preferences into an overall assessment of the alternatives. The concept of compensability is an important factor in these decision rules. Compensability refers to the possibility of compensating what is considered to be a 'bad' performance of a criterion (for example a high environmental impact) with a 'good' performance of another criterion (for example a high income). According to the extent different criteria can be compensated by other criteria, three main types of methods can be distinguished in MCA: compensatory, partial-compensatory and non-compensatory methods. Within a compensatory method a weak performance of one criterion can be totally compensated by a good performance of another criterion. Within a partial-compensatory method a limit is set to the allowance to compensate weak performances by good ones. A non-compensatory method finally does not allow compensation at all.

Type of data

In principle each criterion to order policy alternatives can be measured qualitatively or quantitatively. Some MCA methods are designed to process only quantitative information on criteria (Weighted Summation). In practice, this disadvantage is not very significant because the pluses and minuses used for qualitative assessments are often derived from underlying classes of quantitative data. With a well-chosen method of standardisation such as goal standardisation this underlying quantitative scale can be used in the weighted summation of these scores. Other methods are designed to process qualitative data (Dominance method, Regime). Finally there is a group of MCA methods that can handle data according to the way it is measured (those with a tick mark under the heading 'mixed data' in Table 5.4).

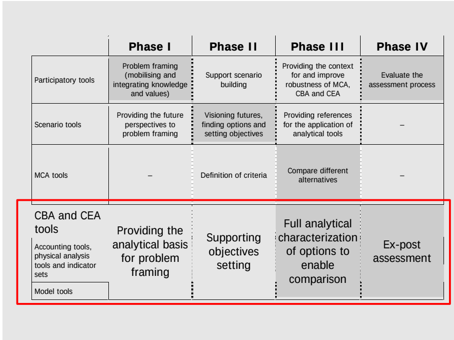
5.5 Cost–benefit analysis and cost effectiveness analysis tools

Cost-benefit analysis (CBA) is an economic technique applied to public decision-making that attempts to quantify and compare the economic advantages (benefits) and disadvantages (costs) associated with a particular project or policy for society as a whole. The appeal of CBA is that by monetising the benefits of the policy, it is possible to compare and/or aggregate many different categories of benefits with one another, and with the costs of the policy. Out of a number of alternative programs being examined, CBA would recommend choosing the one with the largest net benefits, where net benefits are defined as the benefits minus the costs. Cost-benefit analysis – or more specifically, the estimation of costs and benefits that is required to perform a CBA – also allows one to determine the socially optimal size of the program or project, i.e., the one that maximises net benefits. At the socially optimum program, the marginal benefits of the program will be equal to its marginal costs. There are some concerns with respect to the application of CBA, as described in the textbox *Main concerns related to the application of CBA.*

Cost-effectiveness analysis (CEA) seeks to find the best alternative activity, process, or intervention that minimises the costs of achieving a desired result. Analysts and agencies perform CEAs when the objectives of the public policy have been identified and the only remaining question is to find the least cost-option of arriving at these objectives. CEA, therefore, does not ask, nor attempts to answer, the question whether the policy is justified, in the sense that its social benefits exceed its costs.

5.5.1 Role of CBA/CEA in an integrated assessment

The main role of CBA in an integrated assessment is in Phase III (analysis) by supporting the comparison of alternative options. In a relatively well-structured problem, CBA could also be used to support target setting (Phase II) if it is possible to quantify costs and benefits to a sufficient degree. CBA can also be used in Phase IV as an ex post assessment of a certain policy (see also the discussion on ex post use of CEA below).



	Phase I	Phase II	Phase III	Phase IV
Participatory tools	Problem framing (mobilising and integrating knowledge and values)	Support scenario building	Providing the context for and improve robustness of MCA, CBA and CEA	Evaluate the assessment process
Scenario tools	Providing the future perspectives to problem framing	Visioning futures, finding options and setting objectives	Providing references for the application of analytical tools	–
MCA tools	–	Definition of criteria	Compare different alternatives	–
CBA and CEA tools Accounting tools, physical analysis tools and indicator sets Model tools	Providing the analytical basis for problem framing	Supporting objectives setting	Full analytical characterization of options to enable comparison	Ex-post assessment

CEA can be used in Phase III (analysis) of an integrated assessment to assess the expected impacts of alternative policy measures before they are implemented (ex-ante), and in Phase IV (follow-up) of an integrated assessment to assess the effectiveness of a policy measure that is already in place (ex-post). While the approach and the methods used are the same for ex-ante and ex-post CEAs, the purpose of the instrument is different. Ex-ante CEA is used up front, at an early stage in the policymaking process, to identify the path of action that promises to be most cost-effective. By contrast, the ex-post CEA aims to assess whether a problem has been tackled effectively through the policy measure or project investigated. In other words, it provides a measure for the efficiency of policy implementation. To achieve this, a (counterfactual) comparison with alternative paths of actions is one possibility: with the benefit of hindsight, would there have been cheaper/more efficient ways of reaching the same target?

Main concerns related to the application of CBA

The application of CBA in an integrated assessment poses a number of questions. First, CBA measures costs and benefits on the basis of (subjective) individual preferences given objective resource constraints and technological possibilities. Whether or not a project or policy that maximises (subjective) individual preferences is 'sustainable' is an open question – and should probably be answered on a case-by-case basis.

Second, CBA is often criticised for its apparent insensitivity to issues of intra- and intergenerational equity. With respect to the issue of intra-generational equity, CBA is insensitive as to the *distribution* of cost and benefits over different individuals, as long the 'winners' could, in principle, compensate the 'losers' (but CBA does not require that this compensation actually takes place). With respect to intergenerational equity, the correct practice of CBA to discount future costs and benefits to their present values has been criticised on the grounds that it would thus neglect the welfare of future generations. While the critique on discounting in CBA has sometimes been less than rational, it is true that the choice of a particular discount rate (or discount function) will strongly influence the net present value of long-term sustainability policies such as climate change policies. In academics as well as in policy, some consensus seems to be emerging to discount potentially irreversible environmental damages in the very long term (> 100 years) at the lowest possible rates.

Third, in CBA uncertainty and risk are treated in a classical fashion. If certain future effects are uncertain, the correct procedure is to assess the (discounted) expected utility of the effects. In this approach, the probability and the size of the effects play a role, but also the rate of risk aversion of the relevant population. In CBA, future low probability – high impact events are more important for current policy making, the higher the probability of occurrence, the higher their potential damage, the lower the discount rate, and the higher the rate of risk aversion.

Fourth, certain costs and benefits that are in the social and environmental domains of sustainable development may be difficult to quantify and to value in monetary terms. There are observers who object in principle (or on moral grounds) to the notion that every 'value' can be traded for a price. But putting these moral objections aside, in the practice of CBA advanced 'valuation' tools have been developed that are capable of inferring individuals' preferences over both market and non-market (e.g. environmental) goods (a number of non-market valuation methods are listed in Table 5.5).

5.5.2 Choosing between CBA and CEA and valuation methods in a CBA

CEA is sometimes used as a second-best option when a full-blown CBA would be desirable, but many benefits cannot easily be monetised. CEA and CBA can be seen as parts of a continuum of monetary assessment tools, with CBA as the most extensive and elaborated option, and CEA as a somewhat less extensive procedure.

When deciding to use CBA as tool to compare different policy options, a variety of valuation techniques is available to monetise benefits. Table 5.5 shows how certain valuation tools may be used to measure which non-market impacts under what conditions. A distinction is made between so-called 'revealed preference' and 'stated preference' methods:

– In 'revealed preference' methods such as Hedonic Pricing and the Travel Cost Method, economic preferences for environmental goods are inferred from observable market behaviour of consumers and/or producers. For example, the Travel Cost Method makes use of information on time and money that people spend to visit nature sites, to infer their (minimum) willingness-to-pay for recreation at that site. The Hedonic Price method infers environmental preferences from market prices of goods and services whose values are (partially) related to environmental characteristics (such as a higher price of a house in a nicer natural environment).

– ‘stated preference’ methods, such as Contingent Valuation and various Choice Models, make use of survey techniques to illicit environmental preferences of the population.

While ‘revealed preference’ methods have the advantage that they measure what people do instead of what people *say* they will do, ‘stated preference’ methods have the advantage that their area of application is much wider than that of ‘revealed preference’ methods. For certain classes of preferences, such as preferences for the mere existence of environmental goods, ‘stated preference’ methods are virtually the only alternative.

Table 5.5: Selection criteria for non-market valuation methods for a cost–benefit analysis

Method	**Suitable for…**	**Type of values**	**Conditions**
Stated-preference approaches			
Contingent valuation	Virtually any public policy or program; extremely flexible	Use values, Non-use values	Design and administration of the questionnaire are difficult, a number of biases are possible that can limited through careful construction and pretesting of the survey instrument.
Revealed-preference approaches			
Travel cost methods	Only for amenities, natural resources (e.g., beaches, bodies of water, national parks or wildlife reserves) or cultural sites (monuments) that people actively visit.	Use values	Travel cost can be subject to measurement error, especially if the researcher wishes to include the opportunity cost of time. It may be difficult to identify substitute sites. Questions about trips taken under hypothetical conditions may be necessary to trace out the demand function at post-policy conditions.
Hedonic pricing methods	Only for changes in environmental or urban quality that can be captured into housing markets; only for job risks that are captured into compensating wage differentials.	In theory, both use and non-use	Individuals are assumed to be perfectly aware of the environmental, urban quality, job risks. Market must be clear. Sufficient transactions must be observed to estimate the hedonic regression, and sufficient variability in environmental or urban quality or job risks must exist to identify their effect. Difficult to separate the effect of these variables from other factors that can influence housing prices or wages.
Averting expenditures	Human health effects or other effects (e.g., materials damage) from which people can protect themselves	n/a	Possible when individuals can document actions and expenditures incurred to reduce risks. In some cases, it is possible to engage in actions that reduce risks (e.g., staying indoors in days with high air pollution) but it is not easy to place a monetary value on these actions. Fails to capture the value of the discomfort of being sick.
Cost of illness	Human health effects	n/a	Relatively easy to perform, but fails to capture the value of the discomfort of being sick.

5.6 Accounting tools, physical analysis tools and indicator sets

This tool group – somewhat a residual category – comprises a variety of tools. What these tools have in common is that they are used for elucidating the physical side in an assessment, rather than the economical, or monetised, side as with cost–benefit analysis.

The group comprises three subgroups:

1. Accounting tools – tools that add the physical dimension to common economic accounts, such as input/output tables;
2. Physical analysis tools – tools that can be used to calculate certain physical quantities, like the ecological footprint;
3. Indicator sets – a selection of data and assessment tools that are used in an assessment.

All assessments basically rely on raw statistical data. However, this data is often processed by tools before it enters the assessment. An example is the calculation of the ecological footprint (Wackernagel et al., 1999) from a broad variety of statistical data.

The tools in this group have in common that they all use raw data to calculate a certain meaningful output. In a sense, they form the link between data and assessment. Models and scenario studies can also be considered intermediaries between raw statistical data and meaningful assessment data, but these two groups are dealt with separately.

5.6.1 The role of accounting tools, physical analysis tools and indicator sets in an integrated assessment

	Phase I	Phase II	Phase III	Phase IV
Participatory tools	Problem framing (mobilising and integrating knowledge and values)	Support scenario building	Providing the context for and improve robustness of MCA, CBA and CEA	Evaluate the assessment process
Scenario tools	Providing the future perspectives to problem framing	Visioning futures, finding options and setting objectives	Providing references for the application of analytical tools	–
MCA tools	–	Definition of criteria	Compare different alternatives	–
CBA and CEA tools				
Accounting tools, physical analysis tools and indicator sets	Providing the analytical basis for problem framing	Supporting objectives setting	Full analytical characterization of options to enable comparison	Ex-post assessment
Model tools				

In general the accounting tools, physical analysis tools and indicator sets support each phase of an integrated assessment, mostly through other tool groups. The tools are deployed because of their specific quality to quantify certain dimensions of sustainable. They form the information basis in each phase of an integrated assessment.

Accounting tools, physical analysis tools and indicator sets have different origins and have been developed for different purposes. The accounting tools originate from the desire to complement national statistical accounts that tend to neglect the physical dimensions of an economy. The physical assessment tools can be said to originate from the desire to enrich economic impact calculations by adding the physical dimension. The indicator sets, to conclude, stem from the desire to use a system-analysis based approach, whereby indicators are used to show how different elements of a system behave.

5.6.2 Choosing between accounting tools, physical analysis tools or indicator sets

The most relevant selection criterion for choosing between the three sub-groups is the purpose for which information is needed. Accounting is often done in monetary units, providing a monetary view on the economy. The methods for greening national accounts can be used for the purpose of adding to that overview the physical side of the economy. The physical analysis tools can be used for the purpose of illuminating the physical impacts of a problem or proposed policy. As such, physical analysis tools complement cost–benefit analysis tools by considering physical impacts next to the economic ones. Indicators sets can be used for the purpose of ensuring that a particular fixed set of impacts (economic, physical and social) are used throughout an assessment, in the decision-making process and for monitoring. Developing such sets can also be done purely for the purpose of agreeing on the problem and its drivers (in which case the developed set is less important then the process of developing the set).

Choosing between accounting tools

By its focus on the economy as a whole, green accounting is particularly suitable to examine questions of de-coupling between economic growth and environmental pressures, in any stage of an integrated assessment. Different methods of accounting focus on different aspects of sustainable development. Obviously, all methods include a measure of economic development, but there are differences in the ways that methods include environmental damage, resource depletion, and income inequality. It can also be said that some methods focus explicitly on sustainable development, while others limit themselves to the adjustment of national accounts to environmental damage only. Among the methods that explicitly focus on sustainability, there is a difference between the so-called ‘genuine savings’ approach that is based on the concept of ‘weak’ sustainability (i.e. based on the assumption that natural capital can be replaced by human or economic capital), and the ‘sustainable national income’ approach that is based on the concept of ‘strong’ sustainability (i.e. based on the assumption that natural capital cannot be replaced by human or economic capital).

The type of accounting method to choose thus depends on the desire to focus on sustainable development or on the adjustment of national accounts to environmental damage. Table 5.6 below shows how various accounting methods can be clustered and how each deals with the economic, environmental and social dimensions of sustainable development.

Table 5.6: Selection criteria for accounting tools

Accounting tool	Dimensions of sustainability		
	Economic	Environmental	Social
Tools that focus on adjusting national accounts for environmental damage			
National accounting matrix including environmental account	Economic accounts	Environmental problems and environmental substances	None
Measures of economic welfare	Economic welfare, instrumental and defensive expenditures	None	Urbanization, Leisure and Non-market activities
Index of sustainable economic welfare	Economic welfare, defensive expenditures	Environmental stocks and flows and natural resource stocks	Distributional inequality
Tools that focus on sustainable development			
Genuine savings	Savings	Environmental and natural resource stocks	Education (human capital)
Sustainable national income	Sustainable income	All environmental aspects that are considered important for sustainable development	None

Choosing between physical analysis tools

Physical assessment tools quantify the physical components in an assessment. Ecological impacts always have a physical component that can be quantified or qualified. There are various tools that calculate certain physical impacts of policy, each relying upon physical data concerning the consumption of natural resources or land resources by social units (society, economy, sector, etc.). The *SustainabilityA-Test* project covered the following four: ecological footprint (EF), economy-wide material flow analysis (MFA), life cycle assessment (LCA) and global land use accounting. Which one to chose depends on the dimension of impacts to be covered.

Table 5.7: Selection criteria for physical analysis tools

Physical analysis tool	Dimensions of impact		
	Land use	Production pattern	Consumption pattern
Ecological footprint	Land occupation for different life styles none	None	Land occupation due a specific consumption pattern
Material flow analysis	None	Material used (direct and indirect) for a production chain	Material used (direct and indirect) of a specific consumption pattern
Life cycle analysis	None	Physical impact of the production of a specific product over the entire production chain	Physical impact of using / consuming a specific product, incl. recycling or disposal
Global land use accounting	Total land-use associated with material resource flows	None (delivered by material flow analysis)	None (delivered by material flow analysis)

Choosing between indicator sets

An integrated assessment requires information. The information requirements can be made explicit in the form of indicator sets, specifying exactly what kind of information is needed to describe the system under study adequately enough to be able to assess its behaviour. Indicator sets differ widely in scope, and can be found in many different forms. A global directory to indicator initiatives for sustainable development can be found at http://www.iisd.org/measure/compendium/searchinitiatives.aspx [last accessed December 2006].

What indicator set to use, or which indicators to use to create a set, is context specific. The main criterion for using a certain set, or for adding an indicator to a set, is its relevance for the system under study. Such relevance could be determined by scientists, policy makers and laymen. Building sets in a participatory setting is common.

A particular indicator set is a set of indicators designed to measure vulnerability. Vulnerability assessment attempts to capture what makes people or systems vulnerable to a range of stresses and how their vulnerability can be characterized. Vulnerability can be defined as the degree to which an exposure unit is susceptible to harm due to exposure to a perturbation or stress, and the ability (or lack thereof) of the exposure unit to cope, recover, or fundamentally adapt (Kasperson and Kasperson, 2001). Therefore assessing vulnerability depends on likelihood of exposure to a hazard or stress as well as on the underlying capacity to deal with the stress (i.e. to be resilient). It is this endogenous capacity to absorb and manage the stress that makes people or systems less vulnerable or more resilient. The indicator based approach to vulnerability assessment, covered by the *SustainabilityA-Test* project, is basically a selection of indicators with the aim to measure pressures and risks within an area under study. Vulnerability indicators are thereby a specific indicator set. When combined with geographical information data to identify vulnerable hot spots, it is called *vulnerability mapping*.

5.7 Models

‘Models’, defined as a distinct tool group for integrated assessment in this project, are simplified representations of complex real-world phenomena. The focus in this group model tools lies on ‘applied’ models, i.e. models which try to simulate real-world processes based on or calibrated to empirical information and with some relevance to actual policy-making processes. The models considered here are models from exact sciences and do not include e.g. psychological models.

	Phase I	Phase II	Phase III	Phase IV
Participatory tools	Problem framing (mobilising and integrating knowledge and values)	Support scenario building	Providing the context for and improve robustness of MCA, CBA and CEA	Evaluate the assessment process
Scenario tools	Providing the future perspectives to problem framing	Visioning futures, finding options and setting objectives	Providing references for the application of analytical tools	–
MCA tools	–	Definition of criteria	Compare different alternatives	–
CBA and CEA tools Accounting tools, physical analysis tools and indicator sets Model tools	Providing the analytical basis for problem framing	Supporting objectives setting	Full analytical characterization of options to enable comparison	Ex-post assessment

Models are based on scientific theory and have a formal, mathematical structure. The formal structure implies that models have well-defined input requirements as well as specific sets of outputs. With the exception of a rather small number of qualitative modelling tools, most models work on the basis of quantitative information, which means that they require quantitative data as inputs and they provide quantitative data as outputs. Models can be applied to analyse complex chains of argumentation. The model developer is forced to structure the problem to be analysed, in order to facilitate an appropriate formulation in computer code. An important decision of the modeller is about endogenous and exogenous variables and processes in the model. Endogenous processes are described and simulated within the model, while exogenous information has to be taken as an input from external sources, e.g. other models, statistics or expert judgements.

Whether or not computer models are useful for the analysis of complex real-world phenomena, especially in an interdisciplinary setting, is subject to debate. Modellers would argue that the application of rigorous mathematical methods provides essential structure and transparency to the analysis of complex problems. It also makes it in some cases easier to communicate problem formulation, as compared to pure verbal descriptions of a research approach. Critics would argue that models have to make use of simplifications and exogenous assumptions to such an extent that in many cases it renders them useless for saying anything substantial about the problems to be analysed. The choice of the model structure may in many cases to a certain degree predetermine the outcomes. Moreover, while being simplifications of reality, many scientific models remain so complex that for non-scientists they may appear as black boxes instead of transparent research machines. Lastly, models tend to focus on the quantifiable elements of problems, as qualitative information is poorly dealt with by most models. Hence, some of the great strengths of modelling tools are felt as serious weaknesses by non-modellers.

5.7.1 The role of modelling tools in integrated assessment

Modelling exercises have to rely on inputs from raw data and statistics on the one hand, and on a well-framed problem or well-defined scenarios to be analysed on the other. Hence, in the first phase of an integrated assessment (problem framing), models will only play a limited role. Already existing model results from previous policy cycles or assessments can be useful for problem identification and problem framing. They can be used to construct sustainability indicators which are related to and justified by the problem under study and used throughout the integrated assessment.

As a part of the general pool of existing knowledge, model results will be used in the second integrated assessment phase (finding options) for defining scenarios, and in particular in defining realistic ranges for key aspects of scenarios. In this phase, models will contribute to knowledge generation and provide a necessary ‘reality check’.

Once a problem-related, well specified scenario setting has been developed, in Phase III of an integrated assessment models can be fully applied to explore the overall outcome, (e.g. impacts of policy options), specific outcomes of certain parts as well as their interactions, and sensitivities to a wide range of exogenous assumptions and uncertainties. Uncertainties can be systematically investigated by altering important parameters or providing ranges of these parameters instead of one single number. With increasing computer power, models can be run a large number of times in order to assess the ranges of possible outcomes. Models can provide counterfactual baselines, along the line of ‘what would have happened without any intervention’. Moreover, isolated effects and causal relationships ‘ceteris paribus’ can be analysed. The results of modelling exercises can become part of wider cost–benefit analysis or multi-criteria analysis.

Finally, models can be used to conduct ex-post assessments, in order to analyse detailed aspects of a broader policy measure in the past. This would in turn contribute to the generation of knowledge for the next policy and assessment cycle, as described earlier.

5.7.2 Choosing between models

When deciding to use model tools one needs to determine the required scientific domain(s), the desired geographical scale, level of detail et cetera. There are two important ‘trade-offs’ that are to be taken into account with respect to models:

1. Complexity versus transparency: the more complex a model becomes, the less transparent it becomes. Oversimplifying real and complex problems could make the model better understandable and transparent, but at the same time less reliable and realistic. Transparency of models is important, as the acceptance of model results for non-modellers very often depends on the acceptance and understanding of basic assumptions.
2. Specialisation versus integration: the more focussed a model is on a specific real-world process, the more appropriate will be the model representation with regard to this process. On the other hand, more external processes have to be ignored or treated as exogenous. Integrated models try to include many linkages between different domains in an explicit way, but in order to keep the overall complexity under control they will often have to rely on simplified representations of the single elements involved. Increasing computer power partly helps to make integrated models also more sophisticated, but the basic trade-off remains and has to be acknowledged by model developers and model users. There cannot – and should not – be a ‘one-size model that fits all purposes’.

Table 5.8: Examples of modelling tools for integrated assessment

Model category	Model examples
Biophysical models	
Climate models	General Circulation Models (HadCM, ECHAM); Earth-system Models of Intermediate Complexity (CLIMBER, MAGICC/SCENGEN)
Hydrology models	WaterGAP, SWIM, IRM-ABM
Biogeochemistry models	LPJ, VECODE, 4C, WOFOST, ACCESS
Socio-economic models	
General economy models	General equilibrium models (GEM-CCGT, GEM-E3, GTAP, WorldScan, SNI-AGE); Macroeconometric models (NEMESIS, QUEST-II, GINFORS)
Partial economic sectors models	Energy sector models (POLES, PRIMES, MARKAL); Agricultural sector models (WATSIM, IMPACT, CAPRI, RAUMIS); Transport sector models (TREMOVE)
Demography models	PHOENIX, IIASA Population Project
Public Health models	MIASMA, PHSF, TARGET
Integrated models	
Land use change models	FARM, AgLU, CLUE, SFARMOD, CORMAS
Qualitative systems analysis models	SYNDROMES, QSA-SCENE
Integrated assessment models	IMAGE, ICLIPS, ICAM, FUND, MIND, DEMETER, RICE-FEEM, GENIE, IMPACT-WATER, QUEST, RAINS
Scenario Building and Planning tools	POLESTAR, THRESHOLD-21

The evaluation of model tools in the *SustainabilityA-Test* project has not been carried out on the level of individual models or specific model types, as the available resources did not allow for that. Instead, the models have been categorised on the basis of the scientific domain for which they have been designed, as this is most likely the first argument for selecting a particular model. While many other forms of categorisation would also be plausible, the current approach was chosen, because:

– it reflects the development and application of models in their traditional disciplinary setting and, hence, will be most familiar to model developers and potential users, like policy makers and the wider public,

– it shows the relative position of available models, along the lines of increasing thematic integration, and

– it illustrates the challenges for more integrated modelling, which reflects the more general challenge of truly integrated research on sustainability impacts.

Those wanting to use a model can therefore first select a scientific domain and then see which models within that domain best correspond with the desired balance between complexity and transparency and between specialisation and integration. Table 5.8 presents the model categories and models within each category.

5.8 Conclusions

The previous chapter pointed out that when selecting tools for an integrated assessment, first the tasks need to be identified for which tool support is needed. These tasks determine which tool group to look at. This chapter dealt with the selection of the best tool *within* a tool group. This is done on the basis of selection criteria that are specific for each tool group. Table 5.9 gives an overview of the selection criteria for the tool groups. Note that for the tool groups at the bottom of the table, the coverage of sustainable development aspects is an important selection criterion. For the multi-criteria analysis tools, the scenario tools and the participatory tools other criteria are used.

Table 5.9: Summary of the selection criteria for tool within each tool group

Tool group	**Criteria**
Participatory tools	Number of participants to involve, whether or not ICT-based tools can be used, goal of participation, problem content, type of outcome desired and type of mediator needed/available
Scenario tools	Type of desired scenario, problem content, type of outcome desired of the process and necessity to involve (scenario) experts
Multi-criteria analysis tools	Decision rule and type of data
Cost-benefit and cost-effectiveness analysis tools (valuation methods)	Approach (stated-preference or revealed preference) and aspect (of sustainable development) to be monetised
Accounting tools, physical analysis tools and indicator sets	Aspects (of sustainable development) to be covered
Model tools	Aspects (of sustainable development) to be covered

6 Case study

Nadja Kasperczyk, Karlheinz Knickel and Wouter de Ridder

This chapter summarises the case study work. More information can be found in the detailed case study report (Kasperczyk and Knickel, 2006) and case study workshop report (Hisschemöller et al., 2006). All documents prepared during the case study can be found at www.SustainabilityA-Test.net, under the icon 'case study' ().

6.1 Objectives and function of the case study

The case study carried out in the *SustainabilityA-Test* project aimed at deepening the preliminary tool evaluation, which was primarily based on literature review and expert knowledge. The basic idea of the case study has been that the application of the tools to the same policy case facilitates a direct hands-on experience and enables a more direct comparison of the ability of tools to address different aspects of sustainable development, to learn about their operational characteristics, and to identify suitable and efficient tool combinations.

6.2 Contents of the case study: biofuels policy case

The increasing governmental support given to biofuels and the expansion of energy crop production has a broad range of possible effects, both within and outside Europe. Effects one can think of are, for example, effects on greenhouse gas emissions, land-use, energy security and employment. The biofuels case is thus an interesting subject for the case study as it allows in principle a broad variety of tools to assess the various effects that can be expected from more biofuels usage.

As the starting point for the case study two policy decisions were taken:

- Biofuels directive: Directive 2003/30/EC[4] of the European Parliament and of the Council of 8 May 2003 on the promotion of the use of biofuels or other renewable fuels for transport;
- Energy Crop Premium regulation[5]: Regulation on the introduction of an energy crop premium in the Common Agricultural Policy (CAP) (Reg. (EC) No 2237/2003 of 23 December 2003.

[4] Official Journal L 123, 17/05/2003, p. 42 – 46.

[5] Official Journal L 339, 24/12/2003 p. 52 – 69.

Whereas the first policy decision is rooted in energy and environmental policy (preservation of finite energy resources; environmental protection and climate change goals), the second is part of the 2003 CAP reform (integration of environmental goals into agricultural support systems; creation of new markets, sector income and employment). Both the directive and regulation were already adopted at the start of the case study. This in principle allowed an application of the tools to the directive or regulation and to compare the outcome with the assessments that had actually been done. Both pieces of legislation provided sufficient room for sketching out a wide variety of assessment approaches supported by a broad spectrum of tools.

6.3 Design and practical implementation

The practical implementation of the case study was divided in the following 4 steps, which are explained in more detail below:

- Step 1: Review of assessments made at EU level during the development of the directive and regulation
- Step 2: Review of assessments made at Member State level during the development of the directive and regulation
- Step 3: Description of an 'illustrative application' of how each tool covered in the *SustainabilityA-Test* project could have been applied in an assessment of the directive or regulation
- Step 4: Development of an illustrative assessment plan describing how tools could have been used in combination in an assessment of the directive or regulation.

Step 1: The review of existing EU level assessments in the course of the preparation and adoption of the biofuels directive was done in Step 1. For the Energy Crop Premium regulation no assessments were found. On the basis of the analysed assessments made in the context of the biofuels directive, tool experts of the project team were asked to elaborate on how 'their' tools could have contributed to the assessments that were made in terms of addressing additional aspects relevant for sustainable development and strengthening the decision-making process.

Step 2: In Step 2 the review of EU level assessments was extended to national level assessments that had been made in the context of the biofuels directive and the Energy Crop Premium regulation. The objective of this exercise was twofold. Firstly, to complement the overview of assessment practice at EU level with experiences at Member State level and, secondly, to see to it that the *SustainabilityA-Test* project had not missed out on tools that are used at Member State level. 'National teams' were formed that reviewed the assessments made in the Netherlands, United Kingdom, Czech Republic, Spain, Sweden, Italy, Latvia and Germany.

Step 3: The practical exercise of the case study started with Step 3. During this step, tool experts elaborated an 'illustrative application' of their tools. This illustrative application is a description of how a tool can be used within an assessment and what kind of results can be expected from it. The assessment question that was used for the illustrative applications was the question whether the biofuels directive or Energy Crop Premium regulation contributed to move towards a more sustainable Europe. In the EU, this means moving towards the objectives set by the EU Sustainable Development Strategy. Each illustrative application thus described how a tool could be applied to this concrete assessment question. Although the question was the same for each illustrative application, the interpretation of it by tool experts diverged. Thus, the illustrative applications had to make clear how the question was interpreted, what the underlying assumptions of the assessment were, and what the scope of analysis would be. Strengths and weaknesses and possible linkages with other tools were also identified.

Step 4: Whereas the previous steps were focussed on single tools, Step 4 focussed on tool *combinations*. During this step, a complete assessment plan had to be developed, satisfying the needs of a more comprehensive sustainability assessment and building on different (types of) tools. Trans-disciplinary teams were formed in which tool experts, each having knowledge about a particular tool type, had to work together. The emphasis in this step was on developing an effective assessment plan that could address relevant sustainable development aspects by using and combining different tools. The assessment question used was the same as for Step 3. The assessment plans were presented to and discussed with a review panel comprising three representatives of the European Commission and three integrated assessment experts. For the assessment plans of the three trans-disciplinary teams (called *Consortiums* 1, 2 and 3), see www.SustainabilityA-Test.net, under the case study button () and then under ‘New assessment plans’.

6.4 Lessons learned from the case study

The case study did not only deepen the tool-by-tool evaluation, but did also provide broader experiences and lessons. The following sections summarise these experiences according to the following themes:

- The value and challenge of combining tools;
- The scope of an assessment and the coverage of aspects relevant for sustainable development;
- Issues related to the communication within the scientific community and between scientists and policy makers.

6.4.1 The value and challenge of combining tools

Few tools are used

The review of assessments that were done in the context of the biofuels directive and energy crop premium regulation shows that not that many tools are being used, let alone tool combinations. Thus, from a big variety of available tools, only a small number of them were actually applied while the directive and regulation were developed.

Combining tools gives an added value to integrated assessments

Combining tools can help to better address a complex problem by enriching the assessment and elucidating different dimensions of sustainable development. Tool combinations can also be used to ensure that both qualitative and quantitative information – this mix being often unavoidable in assessments for sustainable development – can enter the assessment.

The ‘illustrative applications’ (see previous page) that were developed in Step 3 of the case study identified the strengths and weaknesses of tools and the added value of making tool combinations. Modelling tools, for instance, have the weakness that they can be seen as ‘black boxes’ to non-modellers and for that reason could be mistrusted. However, when applied in a participatory setting, where non-modellers and modellers work together, trust in models and therefore their effectiveness may be increased. Another example is multi-criteria analysis (MCA) tools that support comparison of different policy options on the basis of a set of criteria. The result of an MCA is a ranking of policy options on the basis of how well these options score in terms of the criteria. When done in isolation, the result may be contested. When the MCA procedure is done in a participatory setting, the results have a higher likelihood of being accepted.

But, combining tools, which are often applied in isolated ways, is a challenging task for tool experts, as emerged from Step 4 of the case study.

The challenge is to find the right balance in tool usage

Each assessment plan developed through Step 4 of the case study included a large set of tools, using tools from each tool group in the *SustainabilityA-Test* project. Though this variety was innovative, the review panel that evaluated each plan stressed the need to explain why particular tools are needed and how these are combined. The transparency of the assessment plans suffered from too many tools being proposed. From this it emerges that it might be better to use a limited number of tools in an assessment, whilst clearly explaining what each tool contributes to the assessment and how tools are combined. An assessment framework, such as the generic framework described in Chapter 4, or a specific framework described in Annex 2) could help here to articulate the boundaries and connections between tools.

Participation is considered valuable, but concerns remain

Participation took place when the biofuels directive was originally developed (De Ridder, 2006). Participation also formed a prominent part of the assessment plans developed in the case study. The participation organised throughout the development of the biofuels directive was mostly in the form of stakeholder consultation. In contrast, the assessment plans proposed a more prominent role for stakeholders by making them part of the assessment itself. It was, for example, proposed to involve stakeholders in problem framing and identification of suitable options to tackle the problem. The potential of using participation in such way was acknowledged by the review panel. However, opening up the assessment process by participation also raised concerns with respect to loosing focus on the concrete policy proposal when the scope of the assessment is too much widened. Concerns were also raised with respect to the representativeness of stakeholders. Lastly, concerns were raised with respect to the risk that an assessment becomes too much influenced by certain particular interests.

6.4.2 Scope of assessment and coverage of sustainable development aspects

Assessing the multiple dimensions of sustainable development is a major challenge

Dealing with the multi-dimensionality of sustainable development problems, and even more so with the interrelations between natural, economic and social systems and between long-term and short-term concerns, still is a major challenge in policy assessments. This can be concluded from the review of assessments that were carried out at EU level and Member State level (Steps 1 and 2) and from the assessment plans developed in Step 4 of the case study. The reviews furthermore revealed that economic aspects and environmental aspects were covered fairly well. In contrast, social aspects were hardly, or not at all, addressed. A lack of tools that can assess social aspects underlies the limited attention for social aspects.

Regional case studies can be helpful in assessments

One team in Step 4 proposed using regional case studies at widely differing locations to depict European diversity and to go into more context-specific sustainable development impacts. The team proposed to select case study objects (e.g. regions) where many of the expected impacts of the biofuels directive would manifest themselves. These case studies can be used to better address the more detailed interrelationships on the one hand and spatial diversity on the other. Additionally, case study approaches can help to overcome data limitations that otherwise could exist for carrying out assessment on a more aggregated level. A critical question is, however, if and, how regional level results of context-specific sustainable development impacts can later be translated into conclusions relevant for the analysis at an aggregated level (e.g. EU-level).

There appeared to be a tension between scope and focus of an assessment

The discussions with the review panel evaluating the assessment plans developed in Step 4 highlighted a tension between the *scope* of the proposed assessments on the one hand, and the *focus* on the other. Scope refers to, for example, the time frame used, dimensions and impacts of sustainable development addressed and the extent in which stakeholders are involved in the assessment process. An integrated assessment for sustainable development requires keeping the 'big picture' in mind while at the same time a sufficient degree of precision is important. This tension surfaced because two plans were using the transition context for the assessments, through the integrated sustainability assessment framework (see page 53).

Although the review panel in principle welcomed the idea of using a more transition-management type of assessment framework, concerns were raised with respect loosing the focus on the concrete policy proposal that had to be assessed. In other words, widening the scope of the assessment could result in getting too little concrete results for the policy process. The panel was furthermore concerned that using an integrated sustainability assessment framework would require a lot of time and resources, more than what would normally be available for, for instance, Impact Assessments.

Which sustainable development aspects are assessed is primarily determined by the approach chosen for the assessment

All three assessment plans developed in the case study framed the assessment of the biofuels directive differently, even though the initial question to each team was the same. This is the results of choosing different approaches to deal with the complexity of the biofuels directive in relation to sustainable development.

All three plans included two steps that are referred to as *differentiation* and *unification* in Hisschemöller et al. (2006). *Differentiation* is the process of identifying all relevant components and aspects that are to be assessed, whereas *unification* is the process of reducing complexity by selecting elements for further (in-depth) analysis. *Differentiation* and *unification* 'do not simply reflect different steps or stages in the assessment. Each phase in the process relates to both, although it is likely that processes of differentiation will be more visible in the beginning whereas processes of unification will become dominant towards the end' (Hisschemöller et al., 2006: 15). Differentiation and unification are somewhat comparable with *divergence* and *convergence* as described in the theoretical framework for integrated assessments (see section 4.1), although divergence/convergence refer to considered options and differentiation/unification to the scope of the assessment.

In each assessment plan a particular approach was chosen for differentiation and unification (see Hisschemöller, 2006). The decision on the approaches to deal with differentiation and unification strongly influences the scope of the assessment (i.e. time frame used, what to take into account in the assessment, how to involve stakeholders, et cetera.). Within the approach chosen in Plan 1, a system analysis determined the boundaries of the system under study and thus the scope of the assessment. The plan envisaged e.g. not only biofuels but also other forms of alternative energy sources to play a role in the assessment, as the team considered these relevant for the system under study. Plan 2 proposed a more prominent role for stakeholders to define the system's boundaries. Plan 3 used yet another approach by focussing on a few research questions that were considered 'policy-relevant'. Clearly, each approach has an effect on the openness of the entire assessment process (i.e. whether or not the scope is set in advance), the scope of the assessment (i.e. the system's boundaries), the role of stakeholders during the assessment, and – as a result – the impacts that will be assessed and the tools that will be used.

Thus, selecting which impacts to assess is not a matter of identifying impacts from a list of possible impacts, but foremost a result of choosing an assessment approach and deciding on the scope of the assessment.

6.4.3 Communication

Jargon can hamper effective tool use

The case study revealed that the integrated assessment jargon is not always clearly understood by policy makers. As a result, assessment plans and the reason for using certain tools could be misunderstood. The language and terminology used in research differs from that used in the policy-making sphere. Therefore, assessment plans and tool use has to be explained in clear understandable ways.

Not only needs communication be improved between the scientific community and the policy-making community, also within the scientific community there is ample room for improvements. Even the members of the three trans-disciplinary teams, all working in the field of integrated assessment, but having different scientific backgrounds, experienced difficulties in understanding one another. This shows that working on integrated assessment puts a burden on the involved scientists from different disciplines and with different 'frames of mind' with respect to communication.

7 Conclusions

Wouter de Ridder with Dirk Günther, Nadja Kasperczyk, Måns Nilsson, Anneke von Raggamby, John Turnpenny

This chapter brings together the main conclusions drawn from the interviews with European Commission staff on Impact Assessment, the theoretical framework and tool review, and the case study (section 7.1). Recommendations arising from the conclusions are integrated in the text. This section is followed by a discussion of future challenges for integrated assessment for sustainable development (section 7.2).

7.1 Integrating the interview results, theoretical framework and case study

The case study, in particular, revealed three recurring themes related to tool use:

- The value and challenge of combining tools;
- The scope of an assessment and the coverage of aspects relevant for sustainable development;
- Issues related to the communication within the scientific community and between scientists and policy makers.

The overall conclusions of the *SustainabilityA-Test* project are discussed through these three themes, followed by two observations relating to the European Commission's Impact Assessment procedure and to the European Sustainable Development Strategy.

7.1.1 Combining tools

Conclusion 1:	An integrated assessment for sustainable development is best supported by a *combination* of tools.

Specific tasks need to be carried out within each phase of an integrated assessment. The theoretical framework developed in the project shows these tasks to be supported by different tools. No single tool can support all tasks that have to be done. Consequently, tool combinations are needed. Tools which can be combined are illustrated in the figure below (a simplified version of Table 4.2 on page 49). This figure also shows which tool types are central in each phase of an integrated assessment (grey shaded cells). The assessment framework tools frame the integrated assessment, thereby providing the time frame and scope of the assessment.

Tool use in integrated assessments (simplified)

<table>
<tr><th rowspan="2">Tools</th><th colspan="4">Phases of an integrated assessment</th></tr>
<tr><th>Phase I
Problem analysis</th><th>Phase II
Finding options</th><th>Phase III
Analysis</th><th>Phase IV
Follow-up</th></tr>
<tr><td>Participatory tools</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>Scenario tools</td><td>✓</td><td>✓</td><td>✓</td><td></td></tr>
<tr><td>Multi-criteria analysis tools</td><td></td><td>✓</td><td>✓</td><td></td></tr>
<tr><td>Cost-benefit analysis and cost-effectiveness analysis tools</td><td rowspan="3">✓</td><td rowspan="3">✓</td><td rowspan="3">✓</td><td rowspan="3">✓</td></tr>
<tr><td>Accounting tools, physical analysis tools and indicator sets</td></tr>
<tr><td>Model tools</td></tr>
</table>

Figure 7.1: The role of tools in the generic phases of an integrated assessment.

In addition to the above-mentioned reason for making tool combinations to support different *tasks*, tool combinations can also be made to enrich (broaden) the *coverage* of an assessment. Each of the available tools covers a limited part of sustainable development (e.g. economic impacts or environmental impacts). Integrated assessments for sustainable development should bring together impacts found in different systems (e.g. human/societal systems and biophysical systems). Tool combinations can be used to do just that by adding mono-disciplinary pieces of knowledge to the assessment. But rather than 'just' adding mono-disciplinary pieces of knowledge (departing from different epistemological assumptions) integrated assessments and tool combinations should actually aim at providing an integrated vision of the relationships and dynamics *between* various systems, such as social and biophysical systems. Various integrated models can achieve this integrated.

Lastly, tools are also used because they can start or guide a process. The process of carrying out an integrated assessment for sustainable development can be more important than the outcome of the assessment. Tools can therefore also be combined to support the various processes (or phases) in an integrated assessment for sustainable development.

Conclusion 2: Not too many tools should be used in an assessment, and tools do not necessarily have to be linked.

When making tool combinations it is not specifically necessary, and sometimes even undesirable or impossible, to actually *link* the tools that are used in combination, for example, by linking data flows or by building complex integrated assessment models. Neither is it needed or desirable to use very many tools in an assessment. An important reason for this – as identified by means of the interviews and case study – is that policy makers do not want complex integrated assessments because these often are too incomprehensible. Rather, policy makers prefer using a few tools separately, highlighting different aspects of a proposal in a transparent way.

Conclusion 3:	The potential of combining tools is largely unexplored and could be significant.

The potential and possible constraints of using tool combinations in policy-making processes have not been thoroughly researched in the *SustainabilityA-Test* project. The theoretical framework provides a scientific underpinning of the *theoretical* potential and possibilities for tool combinations, but on the basis of the case study and the interviews with European Commission staff, *practical* constraints with respect to making these tool combinations were revealed.

These practical constraints are caused, for example, by the amount of resources available (time and money) and the limited awareness of the existence and potential of tools, for both those carrying out and those commissioning an assessment. Obviously, little tool knowledge limits the possibility of making tool combinations.

More research into the combinations of *existing* tools, next to the development of *new* tools and *new* complex integrated assessment frameworks – which is often the aim of research projects – would be worthwhile to explore the potential of making tool combinations in practice.

7.1.2 Covering impacts

Conclusion 4:	Defining the scope is crucial for the outcome of an assessment and could be supported by participatory tools.

As the theory underlines and the case study has shown, making decisions with respect to the scope of an integrated assessment for sustainable development is, or should be, part of the integrated assessment process itself. Deciding on the scope of the assessment is crucial for the outcome of the assessment. Scoping includes setting the problem's boundaries and making a selection of impacts that are to be addressed by the integrated assessment as well as making decisions as regard the geographical and time scales that will be worked with. With respect to spatial diversity particular attention could be required to put into context specific or local impacts and how to use that type of information in national or EU-wide assessments.

Deciding on the scope of an assessment in a participatory setting contributes to making the integrated assessment process more transparent, but also makes it more open (and thus less predictable). Participation in defining the scope is likely to make the outcome of the integrated assessment less contested, as it allows stakeholder to express alternative views and perspectives. Such an open process is not only worthwhile for the bigger and more complex integrated assessments, but also for the seemingly straightforward and more technical assessments. The challenge is to open up the integrated assessment without losing too much of its focus on the policy process that it is supposed to support.

Conclusion 5:	An integrated assessment for sustainable development combines quantitative and qualitative information. Tools are available for making this combination.

There seems to be a tendency, revealed by the interviews, to quantify certain aspects of sustainable development more than others, with the aim of making a better case for those aspects in the decision-making process (so-called ‘strategic ammunition’). The interviews furthermore revealed that sustainable development has a relatively low priority at the moment. Combining these two observations with the observation that sustainable development is often about *long-term* effects, which are difficult to quantify, suggests that the tendency to quantify aspects as much as possible: building a stronger case will not necessarily help the case of sustainable development.

Qualitative and quantitative information can be reasonably combined, for example, by using multi-criteria analysis. Such tools can stimulate non-quantified aspects relevant for sustainable development to be taken into account. How to more effectively have the outcome of tools like multi-criteria analysis to play as strong a role as quantified information in decision-making processes remains a subject for further research.

7.1.3 Communication

Conclusion 6:	Tool use is hampered by jargon.

Assessment frameworks and tools are sometimes described in such complex terms that they are not well understood by policy makers. This observation was made during the case study. An easier accessible language should therefore be used by the scientific community to describe the purpose and method of different tools and frameworks in order to ensure that these tools are actually being used by policy makers. The webbook provides an important step in that direction.

Conclusion 7:	Scientists need to better explain the added value of their own tools and learn about other tools.

Communication within the scientific community on tools and tool use can be improved. For making efficient and useful tool combinations, tool developers (i.e. scientists) will need to understand and think about tools in the bigger picture of policy making and integrated assessment. Many tool owners have a tendency to see their own tool or framework as the overarching one, and the others as subcomponents that will ‘feed’ their own tool. Scientists need to keep an open mind, get acquainted with and respect alternative mind sets and thinking frameworks. It cannot be up to the policy maker alone to have the overview of tools and to combine different disciplines with one another. The webbook could provide a valuable function with respect to knowing and understanding which tools exists and what these do.

7.1.4 Impact Assessment and the EU SDS

Lastly, there are two conclusions that are specifically relevant for Impact Assessments as carried out by the European Commission.

Conclusion 8:	Impact Assessments could benefit from the results of assessments done earlier in the policy-making process.

An integrated assessment as described in this report suggests starting with framing the problem, thereby allowing different perspectives on the problem, the goals, and possible options, to enter the assessment. However, the case study and interviews showed that starting with such an open process does not necessarily match the reality of policy making. Impact Assessment usually starts when a policy proposal is being developed and little room exists to doubt the necessity of the proposal, or even the existence of the problem being solved with the proposal. Therefore, the Impact Assessment to support the proposal will not start with framing the problem and investigating possible options. Instead, it starts with screening and evaluating impacts (called Phase III in the *SustainabilityA-Test* project, see Annex 2). By doing so, those involved in the assessment (implicitly) assume that consensus on values and knowledge exists, while this is not always the case. This could lead to unexpected resistance against the proposal, and thus delays in the decision-making process.

In many cases, however, framing the problem and finding suitable options have actually been done in the time preceding the moment that a proposal is drafted. This can be months or even years before the publication of the proposal (as illustrated for the biofuels directive in section 4.1.3). It is worthwhile to use the information generated throughout such a process. In other words, the ones responsible for carrying out an Impact Assessment on a proposal should use, for example, the outcome of Green Paper discussions and other processes done prior to drafting the proposal. Using such information will make the assessment more transparent, furthers the discussion on the proposal and, in doing so, speeds up the process rather than delaying it.

Conclusion 9:	Impact Assessment can contribute to a comprehensive integrated assessment for sustainable development.

Impact Assessment is a type of integrated assessment with a particular emphasis on Phase III of an integrated assessment (i.e. ‘analysis of impacts’). For Impact Assessment to become a more complete integrated assessment for sustainable development two particular shortcomings identified in this project need to be addressed:

1. Arbitrary selection of sustainable development aspects: The (long-term) objectives used to evaluate policy proposals during an Impact Assessment are selected quite arbitrarily. In the EU, they should be taken from the European Sustainable Development Strategy (EU SDS); however, during the case study much ambiguity seemed to remain with respect to what these EU SDS objectives actually mean in

an integrated assessment. The interviews with Commission staff suggest that often the (long-term) sustainable development objectives are made more concrete in an assessment in a fairly subjective way. In addition, the interviews and other evaluations of the impact assessment system have shown that the various aspects of sustainable development are not being considered equally in an Impact Assessment (e.g. Wilkinson et al., 2004; Lee and Kirkpatrick, 2004 and EEAC, 2006). In particular the environmental and social, and long-term aspects of sustainable development tend to get less consideration than aspects like short-term competitiveness, economic growth and employment.

2. Limited scope: Impact Assessment is not such an open and deliberative process which could lead to rejection of (or even serious changes to) policy proposals. Still, assessing sustainable development is a complex exercise, where trans-disciplinary, uncertain and value-laden problems prevail. Such problems require a rather ‘deliberative’ process, with a strong role for stakeholders. Deliberative processes are not well accepted by the policy-making community; reasons being, for example, that these processes are considered to be too open, lengthy, costly, and do not match with the reality of policy making where pre-selected problems are to be dealt with, and options evaluated, within a strict time frame.

Arbitrariness with respect to (long-term) objectives for sustainable development and the lack of openness of the assessment and decision making process can be solved by using elements of assessment frameworks that are specifically designed for that, such as Integrated Sustainability Assessment (see page 53). Such frameworks already have a lot in common with the Impact Assessment framework (see Annex 2), and they will not necessarily require more resources. In fact, Integrated Sustainability Assessment and the like could contribute to faster, more transparent, and – most importantly – better policies, in the end saving time and money. However, how to make the most of supplementing Impact Assessment with the more open integrated assessment frameworks remains a topic for further research.

7.2 Future challenges

Research

More research into making and using combinations of existing tools can be justified. Although the *SustainabilityA-Test* project theoretically underpinned why tool combinations are necessary, not that many tool combinations were actually tested in practice within the project. Further research into tool combinations should, in particular, address tool combinations and tool usage in connection with actual policy-supporting integrated assessment processes, such as the Impact Assessment procedure used by the European Commission. Such research should particularly identify, and possibly solve, barriers and constraints with respect to using existing tools and tool combinations.

There seems to be a mismatch between integrated assessment theory and policy reality that is worthwhile exploring in further detail. Trans-disciplinary, deliberative integrated assessment frameworks, promoted by the scientific community, are able to support entire decision-making processes. These frameworks are, however, hardly used. The reality of policy making constrains the possibilities of integrated assessments, in particular, as there is often no room for open processes that might undermine the goals set and options proposed by politicians. Further research should therefore particularly focus on how to make a link between the more open and science-driven processes promoted by integrated assessment theory and the more closed and policy-driven processes seen in practice. Convincing cases in which such a link is successfully made can also be used as Impact Assessment training tools.

More research is also needed aimed at strengthening qualitative information in decision-making processes. Long-term sustainable development concerns can often only be qualitatively assessed, and ensuring that such information is well communicated to the decision-makers is therefore crucial.

Knowledge management

Making available the vast amount of research on and experiences with integrated assessment in the EU is crucial for furthering integrated assessment for sustainable development. Trans-disciplinary approaches are built on links between expert groups from different scientific domains and links between science and policy communities. Knowledge management is crucial to actively bring together research results and practical experiences. Thus, future challenges also include knowledge management. One may consider developing programmes, training sessions and websites through which 6^{th} and 7^{th} framework research projects can be made easily accessible to researchers, policy makers and universities.

The website developed in this project represents a first step towards better dissemination of all available knowledge with respect to tools and integrated assessment for sustainable development. The success of the website depends on the one hand on the ability to maintain the site, to keep it up-to-date and to further improve it, and, on the other hand, on disseminating the site to potential users (policy makers and researchers). To give the website a serious chance to succeed as a ‘tool information broker’, a budget for maintenance and dissemination is necessary.

Impact Assessment

Impact Assessment is a ‘learning by doing’ process. The conclusions drawn from this project show that although Impact Assessment is certainly valuable for assessing expected impacts of policy proposals, there is ample room for improvements. One important area of improvement is to get away from *impact* assessment and move towards *integrated* assessment, which requires more emphasis on the first two phases of an integrated assessment: ‘problem framing’ and ‘finding solutions’. This will require joint efforts from both the scientific and policy-making communities, in particular, connecting science-based forms of assessment with policy requirements for assessments.

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Glossary

CAP	Common Agricultural Policy
CBA	Cost-benefit analysis
CEA	Cost-effectiveness analysis
DG AGRI	Directorate General for Agriculture and Rural Development
DG ENV	Directorate General for the Environment
EC	European Commission
EIA	Environmental Impact Assessment
EU	European Union
EU SDS	European Union’s Strategy for Sustainable Development
IA	Impact Assessment (*integrated assessment* is not abbreviated in this report)
ICT	Information and Communication Technology
ISA	Integrated Sustainability Assessment
MCA	Multi-criteria analysis
RIA	Regulatory Impact Assessment
SEA	Strategic Environmental Assessment
SIA	Sustainability Impact Assessment
TM	Transition management

Annex 1: List of all project partners

Participant name	Country
Institute for Environmental Studies/Vrije Universiteit	Netherlands
The Tyndall Centre for Climate Change Research	United Kingdom
Institute of Environmental Systems Research, University of Osnabrück	Germany
Institute for Rural Development Research, Goethe University in Frankfurt	Germany
Netherlands Environmental Assessment Agency	Netherlands
Czech Environmental Institute	Czech Republic
Potsdam Institute for Climate Impact Research	Germany
Joint Research Centre	Italy
Stockholm Environment Institute	Sweden
International Centre for Integrative Studies	Netherlands
Center for Environmental Systems Research	Germany
Institute of Environmental Sciences and Technology	Spain
Ecologic, Institute for International and European Environmental Policy	Germany
Fondazione Eni Enrico Mattei	Italy
Wuppertal Institute	Germany
Institute for Environmental Science and Management	Latvia
University of Twente	Netherlands
Sustainable Development Research Initiative/British Columbia	Canada

Annex 2: Assessment frameworks

Måns Nilsson, Marc Dijk and Wouter de Ridder

This annex describes different assessment frameworks. From these, four generic phases of an integrated assessment have been deduced, which form the basis of the theoretical framework used to describe the role of tools (see chapter 4). Table I below summarises the four phases and how they can be mapped to different assessment frameworks, which is further explained in the text that follows.

Table I: Generic integrated assessment phases mapped with various forms of assessments

Four phases	Policy cycle	Frameworks for integrated assessment: IA	TM / ISA	EIA	SEA	Policy analysis, science policy interface
I – Problem analysis	Problem recognition, investigating problem and conflicting assumptions	Problem identification	Scoping	Screening, scoping	Scoping and baseline assessment	Problem structuring, problem identification
II – Finding options	Identification of possible options (divergence)	Objectives definition	Envisioning	Examination of alternatives (divergence)	Alternatives generation (divergence)	Forecasting, strategy formulation
III – Analysis	Identification of possible options (convergence)	Development of main policy options	Experimenting	Examination of alternatives (convergence)	Alternatives generation (convergence)	Selection of policy options
	Analysis of policy proposals	Analysis of impacts		Impact analysis and management, and reporting	Impact analysis, valuation, SEA reporting	
	Selection of policy option	Comparison of options		Decision making		
	Implementation					Implementation, setting of regulatory standards
IV – Follow-up	Outlining policy monitoring and evaluation	Outlining evaluation and monitoring	Learning	Follow up	Monitoring and evaluating	Monitoring and evaluation

Notes: Abbreviations and sources explained in main text.

Policy cycle

See section 4.1.1 on page 38 of the main report.

IA: European Commission's Impact Assessment procedure

Impact Assessment (IA) is here taken to represent the policy level assessment processes, be it at the European or at national levels. At national levels it is sometimes referred to as Regulatory Impact Assessment (RIA), although in many cases, RIA has special connotations regarding impacts on small business and administrative demands. The Impact Assessment procedure as described by the European Commission comprises six 'key analytical steps' (CEC, 2005:4).

- *Problem identification* is 'providing the policy makers with a clear idea of the issues being addressed' (CEC, 2005: 16), by describing in detail the key components of the problem, the size of it (e.g. how many persons are affected and how badly), and the drives that influence the problem.
- *Objectives definition* is the process of deriving (iteratively) specific objectives for the policy intervention and 'operational' objectives for the policy intervention itself, consistent with overall objectives (i.e. European objectives).
- *Development of main policy options* is the process of identifying policy options that could meet the objectives and quick-scanning ('screening') these on feasibility, effectiveness and consistence to develop a short-list of promising policy options.
- *Analysis of impacts* is the process of actually carrying out impact assessments to determine all possible effects of the policy options.
- *Comparison of options* is the process of weighing the positive and negative impacts of each option and identifying a preferred option.
- *Outlining evaluation and monitoring* is the process of identifying indicators, and monitoring and evaluation arrangements.

TM/ISA: Transition management and Integrated Sustainability Assessment

Transition management (TM) is a special case under the assessment frameworks, since in fact it is more than that (Rotmans et al., 2000; Loorbach and Rotmans, 2006). Beside the assessment of the complex problem, TM also sets (or prescribes) the frame of actually solving that (societal) problem. Therefore, the four phases of an IA will comprise a much longer timescale than the other assessment frameworks. TM will usually take 15-25 years, depending on the problem addressed.

The philosophy behind TM is that societal problems are too complex to be solved in a short time period, even when a thorough assessment is done. Instead, the transition arena is put in place to make sure that, in attacking the problem, alternative social trajectories are explored in adaptive and anticipatory manner (Kemp et al., 2006).

The following phases can be distinguished in TM:

- *Forming of a transition arena and structuring of the problem:* In the first phase a transition arena, i.e. a multi-actor innovation-network, should be formed around the issue or problem. At first this should be a limited but diverse number of actors (e.g. 10). Members should be part of the arena on a personal basis, hence without institutional or organizational responsibilities. The starting point for transition management by the arena is the need for the problem to be structured and well defined. Especially the fact that this issue does not have a single 'owner' and thus requires collective action, makes that a common definition of the problem at hand is necessary, which enables developing shared goals.
- *Development of a transition agenda, end-visions and transition paths:* The transition agenda, given the defined and structured problem, helps to define the desired transition and timing. End-visions are a means to translate the transition goal(s) into transition visions, which are system images with a technological, economical and behavioural component that are appealing and imaginative. There may be different visions that contradict or complement each other.
- *Development and execution of transition experiments, and mobilising networks:* Next, practical experiments (programs) that are targeted at exploring the transition paths are derived from the analysis and developed strategically and then executed. These may run for a number of years. Experiments should be socio-technical experiments, involving technicians, businessmen and users. These form small networks. They should report on their experiences, and what they learnt.
- *Monitoring, evaluation, learning and adaptation:* Transition management involves monitoring and evaluation as a regular activity and uses 'development rounds', where what has been achieved in terms of content, process dynamics and knowledge is evaluated. The actors who take part in the transition process evaluate the transition paths in each interim round and then set interim transition objectives, possibly define new transition experiments.

Integrated Sustainability Assessment (ISA) is a relatively recent concept, developed through the on-going MATISSE project. It is based on the principles of Transitions Management, but is an analytical exercise rather than a societal experimentation. Weaver and Rotmans (2005) describe an ISA as 'a cyclical, participatory process of scoping, envisioning, experimenting and learning through which a shared interpretation of sustainability for a specific context is developed and applied in an integrated manner in order explore options persistent problems of unsustainable development'.

- *Scoping* focuses on the problem definition and analysis, from different perspectives. During this phase, the boundaries, characteristics and alternative views on a specific threat to sustainable development will be made clear. Sustainability is made concrete in the context of the problem.
- *Envisioning* is about development of transition pathways which could transform the 'unsustainability' problem into a sustainable future. This requires a shared

conceptualisation of sustainability for the problem and an ‘evolutionary vision with evolving long-term targets and multiple pathways’.

- *Experimenting* is the phase where policy proposals are being tested and researched in terms of consistency with the sustainability vision, their effectiveness.
- *Learning* makes explicit the evaluating and other lessons learnt throughout the process. These lessons form a basis for another iteration of the ISA process, with possibly adjusted problem perceptions, visions, pathways and reformulated experiments.

EIA: Environmental Impact Assessment

EIA is one of the older and most institutionalised procedures, and refers primarily to the assessment of project level interventions. It is the one framework that is most firmly embedded in national legislation. In the EU, EIA is obliged through directive 85/337/EEC[6] of 1985, which was amended in 2003 (Directive 2003/35/EC).

EIAs are carried out for projects. Whether or not the project itself is needed, is not addressed by an EIA. In terms of the generic phases of an integrated assessment: the project is the selected option. Therefore, EIA is represented in Table I (page 107) as a process that starts in the third phase of an integrated assessment (i.e. analysis).

IAIA/EIA (1999) describes the following steps as being part of an EIA process: screening, scoping, examination of alternatives, impact analysis, mitigation and impact management, evaluation of significance, preparation of environmental impact statement (EIS) report, review of the EIS, decision making and follow up. Note that not all these steps are specifically mentioned in (or obligatory on the basis of) the EU EIA directive (Sheate et al., 2005).

- *Screening* is the process of determining whether an EIA is required for a specific project.
- *Scoping* is identifying the impacts that are likely to be important (establishing a ToR for the EIA).
- *Examination of alternatives* is the process of determining the environmentally most desired policy option.
- *Impact analysis* is the process of identifying and predicting the effects of the proposal.
- *Mitigation and impact management* is the process to establish measures (or mechanisms) to minimise negative effects.
- *Evaluation of significance* is the process of evaluation if the impacts that cannot be mitigated are acceptable as compared to the benefits stemming from the proposal.

[6] Official Journal L 175, 05/07/1985 p. 40 – 48.

- *Environmental impact statement* (EIS) report needs no further explanation.
- *Review of the EIS* is the process of assessing the quality of the report.
- *Decision making* is approving or rejecting the proposal (although arguably not occurring within the EIA process).
- *Follow up* is the process of monitoring impacts and effectiveness of mitigation measures as well as reflecting on the EIA to strengthen future applications.

SEA: Strategic Environmental Assessment

SEA grew out of EIA work, and in particular its earlier incarnations were completely mirroring EIA. Today, some differences have unfolded. Although there are variations in the stages of SEA, mainstream literature agrees on the following stages: scoping and identifying objectives, indicators and targets; baseline assessment, alternatives generation, impact analysis and valuation, SEA reporting, and monitoring and evaluation (e.g. Therivel, 2004; Nilsson et al., 2005). The European 'Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment' does not detail any stages. Like with EIA various EU manuals and guidelines on SEA (CEC, 1998, 1999) formulate slightly different phases. However, the overall logic remains basically the same.

- *Scoping* is the process of determining what impacts or issues are relevant with respect to the decision that is envisaged.
- *Baseline assessment* determines the current concerns and challenges and opportunities in the areas that are affected by the proposed intervention.
- *Alternatives generation* generate two or more decision options and describes how they will unfold.
- *Impact analysis* is the process of analysing the impacts, including forecasting, scenario analysis and evaluation of the alternative options.
- *Valuation* is the process of weighting and synthesising the impact data and if requested provide a decision recommendation from the SEA perspective.
- *SEA reporting* is the process of integrating the results of the SEA into the decision-making process. This could also be an integration of SEA results into integrated assessment for concrete projects falling within the scope of the plan or program for which the SEA was done.
- *Monitoring and evaluation* is the process of the implementing the entire plan, including specifying which specific projects and plan need additional EIAs and/or SEAs, and mobilising the network involved to keep rack on progress.

Policy analysis / science-policy interface

Policy analysis is an older and more advanced field of study than environmental assessment and basically constitutes its conceptual origin. Thus it is a useful benchmark and reference point. The mainstream thinking here is that analytical support should contribute to all stages of policymaking. Dunn (2004) outlines the five uses of policy analysis as problem structuring, forecasting, recommendation, monitoring and evaluation, hence largely corresponding to mainstream policy-making process descriptions. Norse and Tschirley (2000) describe the role of science in policy as a sequence of contributions that include policy stages such as problem identification, strategy formulation, selection of policy options, policy implementation, setting of regulatory standards, monitoring and evaluation. The contribution to problem identification is a process of conducting scientific research to minimise uncertainty with respect to the problem. Strategy formulation is where policymakers set out priorities for action, supported by science by determining the scientific pros and cons of strategies. Selection of policy options needs no further explanation and is supported by research through, amongst others, identification of parameter for assessing potential impacts, through scenario development and economic analysis. To policy implementation science contributes through, for example, setting of regulatory standards, feasibility studies and formulation of codes of conduct. Setting of regulatory standards is supported by research establishing the quantitative framework to set meaningful standards. Monitoring and evaluation is a process that science contributes to by determining which variables to measure and how, and by using those measurements (in models) to estimate the effectiveness of measures.

Annex 3: Set up of the webbook

Marjan van Herwijnen and Wouter de Ridder

The webbook developed in the *SustainabilityA-Test* project unlocks the vast amount of information about the tools covered within the project. The next sections explain in more detail how this information can be accessed via the webbook.

Information is available via five entry points that will be explained below:

1. Overview
2. Tool search
3. Book of references
4. Case study
5. About

In addition, a standard Google™ search can be used within the webbook.

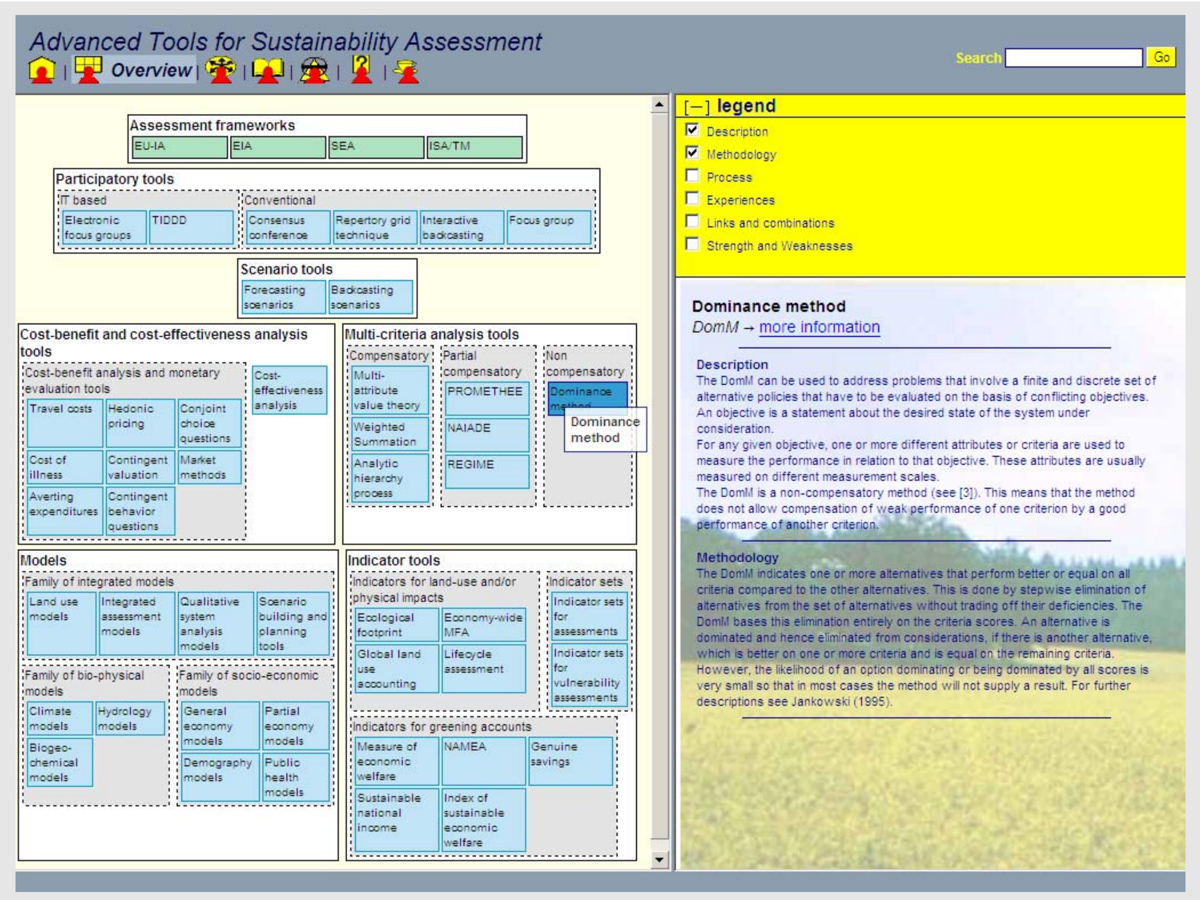


Figure I: Screenshot of the tool overview on the webbook.

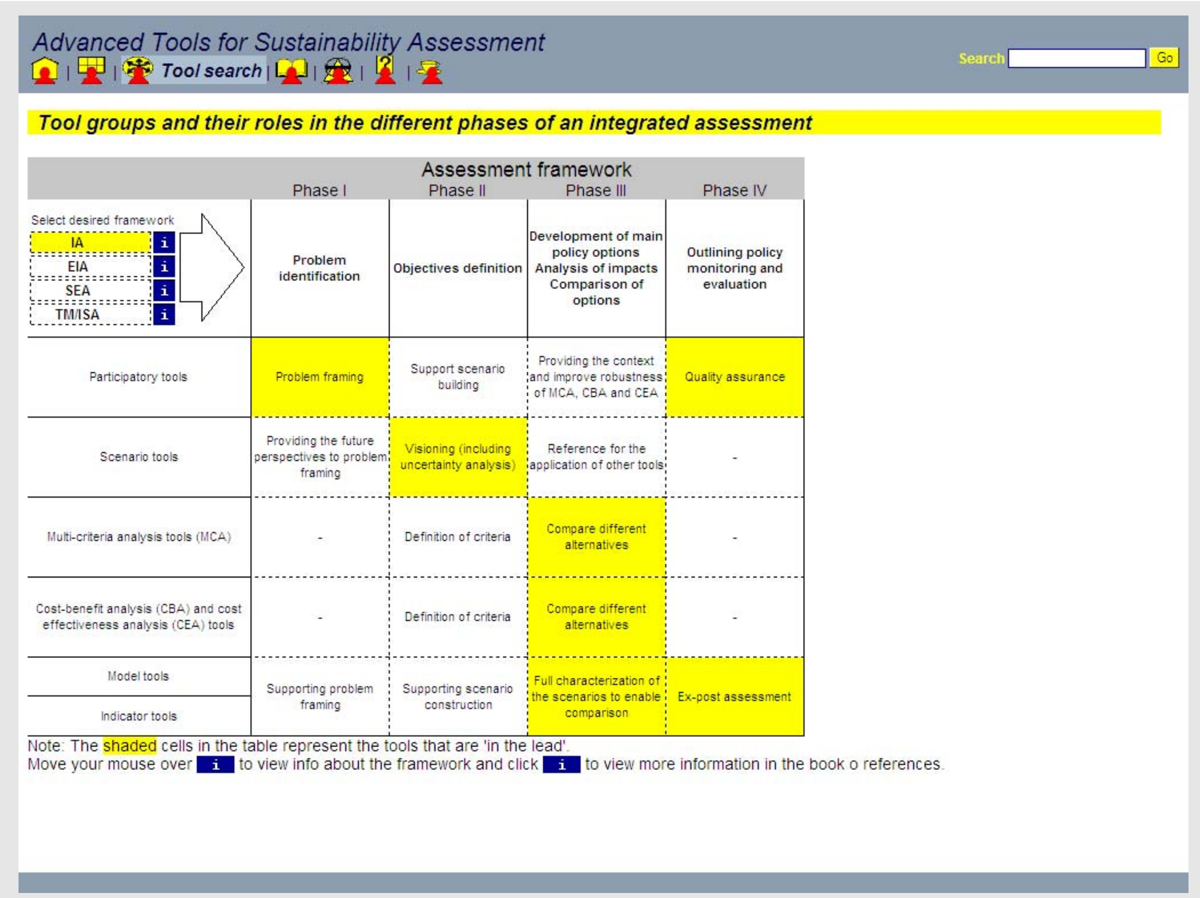
1. Tool overview

The overview is an interactive representation of all tools covered by the project (see Figure I). It is based on Figure 4.3 on page 44. Clicking on a tool will show information about it on the screen. The information is concise and easy to understand for non-experts.

In this way, the overview can provide easily accessible information on tools and thus contribute to communicating that tools exist and what these tools can do for policy-making and scientific communities.

2. Table with tool roles

The theoretical framework, in the form of Table 4.2 on page 49, is completely embedded in the webbook (see Figure II). This table visualises the 'ideal-type' integrated assessment and shows the user what tasks are to be done and what tool groups can be used to support these tasks. In that sense, the table fulfils two functions: giving information about what integrated assessment could actually entail and giving information about the role of the different tool groups.



	Assessment framework			
	Phase I	Phase II	Phase III	Phase IV
Select desired framework: IA, EIA, SEA, TM/ISA	Problem identification	Objectives definition	Development of main policy options Analysis of impacts Comparison of options	Outlining policy monitoring and evaluation
Participatory tools	Problem framing	Support scenario building	Providing the context and improve robustness of MCA, CBA and CEA	Quality assurance
Scenario tools	Providing the future perspectives to problem framing	Visioning (including uncertainty analysis)	Reference for the application of other tools	-
Multi-criteria analysis tools (MCA)	-	Definition of criteria	Compare different alternatives	-
Cost-benefit analysis (CBA) and cost effectiveness analysis (CEA) tools	-	Definition of criteria	Compare different alternatives	-
Model tools / Indicator tools	Supporting problem framing	Supporting scenario construction	Full characterization of the scenarios to enable comparison	Ex-post assessment

Note: The shaded cells in the table represent the tools that are 'in the lead'.
Move your mouse over i to view info about the framework and click i to view more information in the book o references.

Figure II: Screenshot of the table with tool roles on the webbook.

The table in the webbook is interactive, so the user can select the desired assessment framework from a list of available assessment frameworks; the table will be adjusted automatically. Clicking on a particular tool group in the table will open a page explaining what tools belong to that particular group, and what criteria are relevant in choosing a tool from that group. In that way, the webbook clearly shows that the selection of a particular tool should be done *after* selecting the task one wishes to support by tools.

3. Book of reference

The book of references is for users who want to know more about a tool than given in the short outlines in the tool overview. This book is structured according to the tool groups. Clicking on a particular tool will access more detailed and extensive information on that tool.

A link to the TIS, the tool information sheet, can be found here too. A TIS shows how tools cope with a large number of evaluation criteria. Information can be read on-screen but may also be printed out or converted and saved into a PDF file.

4. Case study

All the information generated during the case study of the project is accessible via the ‘case study’ entry point. Here, the user can discover how a particular tool has been used in practice by the EU and in a number of EU countries. Illustrated applications show how a tool can be used, while three assessment plans have been developed to illustrate how tools can be combined.

Although information is not available for all tools, it may be added in the future. Providing users with real examples of how tools have been applied helps both to build trust in the tools and to create a better understanding of these tools by illustrating their applications.

5. About

This section will lead the user to all the relevant project information as listed below:

1. Introduction to the project
2. Definitions used in the webbook
3. Reports delivered by the project
4. Project partners and their homepages
5. Calendar of past and coming events
6. Links to other relevant projects
7. Contact information

Annex 4: Brief description of a selection of participatory tools

Ângela Guimarães Pereira and Tiago Pedrosa

Method	Brief description
Delphi Survey	Delphi involves an iterative survey of experts. Delphis may focus on forecasting technological or social developments, helping to identify and prioritise policy goals or determining expert opinion about some aspect of affairs that cannot be measured directly by conventional statistical means. A dialectical process, Delphi was designed to provide the benefits of a pooling and exchange of opinions so that respondents can learn from each others' views, without the sort of undue influence likely in conventional face-to-face settings (which are typically dominated by the people who talk the loudest or have most prestige). Each participant completes a questionnaire and then is given feedback on the whole set of responses. With this information in hand, (s)he then fills in the questionnaire again, this time providing explanations for any views they hold that were significantly divergent from the viewpoints of the other participants. The explanations serve as useful intelligence for others. The idea is that the entire group can thus weigh dissenting views that are based on privileged or rare information. While traditionally conducted via mail, other variations of Delphi can be online or face-to-face. Sources: Glenn, no year; Dick, 2000; Van Asselt et al., 2001; Steyaert and Lisoir, 2005.
Citizens' jury	The citizens' jury method is a means for obtaining informed citizen input into policy decisions. The jury is composed of 12-24 persons who are either randomly selected or otherwise representative of a given public or set of stakeholders. The jurors then go through a process of deliberation and subgroups are often formed to focus on different aspects of the issue. Finally, the jurors produce a decision or provide recommendations to direct decision making in the form of a citizens' report. Juries are not designed to create a consensus amongst the jurors, but there does tend to be a momentum towards consensus. The sponsoring body (e.g. government department, local authority) is required to respond to the report either by acting on it or by explaining why it disagrees with it. Usually a 4-5 day process, the citizens' jury is intended to provide decision-making processes that better reflects the public's views and a high profile example of public engagement. The conclusions or recommendations the jury reaches are considered to represent what any member of the public would put forward if she or he had the time to investigate the issue in some depth. . In a four-day process, day one is largely about bringing jurors up to speed on the issue. Days two and three tend to focus on witness presentations about different ways of dealing with the issue. Most of the fourth day is spent by the Jury developing its recommendations. Citizens' Jury can take between two to four months to set up costing between 60 000-120 000 Euro, depending on how long the process is designed to last and the exact nature of the methodology. Sources: Steyaert and Lisoir, 2005; CPRN, 2000; Van Asselt et al., 2001; Crosby, 1995; Armour, 1995.
In-depth interviews	An in-depth interview is an open-ended, discovery-oriented method that is well suited for describing both program processes and outcomes from the perspective of the target audience or key stakeholder. The goal of the interview is to deeply explore the respondent's point of

view, feelings and perspectives.

In essence, in-depth interviews involve not only asking questions, but the systematic recording and documenting of responses coupled with intense probing for deeper meaning and understanding of the responses. Thus, in-depth interviewing often requires repeated interview sessions with the target audience under study. Unlike focus group interviews, in-depth interviews occur with one individual at a time, or sometimes pairs of respondents, to provide a more involving experience.

There are key characteristics that differentiate an in-depth, qualitative research interview from a regular interview. Some key characteristics of in-depth interviews include:

Open-ended Questions. Questions should be worded so that respondents cannot simply answer yes or no, but must expound on the topic.

Semi-structured Format. Although you should have some pre-planned questions to ask during the interview, you must also allow questions to flow naturally, based on information provided by the respondent. You should not insist upon asking specific questions in a specific order. In fact, the flow of the conversation dictates the questions asked and those omitted, as well as the order of the questions.

Seek understanding and interpretation. You should try to interpret what you are hearing, as well as seek clarity and a deeper understanding from the respondent throughout the interview.

Conversational. You should be conversational, but your role is primarily that of a listener. There should be smooth transitions from one topic to the next.

Recording responses. The responses are recorded, typically with audiotape and written notes (i.e., field notes)

Record observations. You observe and record non-verbal behaviours on the field notes as they occur.

Record reflections. You record your views and feelings immediately after the interview as well.

Source: Guion (2006).

Annex 5: Brief description of a selection of scenario analysis tools

Karl-Heinz Simon and Alexa Matovella

Method	**Brief description**
Trend Analysis	A process of analysing data to identify underlying longer-term trends.
Cross-Impact-Analysis (CIA)	A further means of measuring the correlation between variables. The procedure involves working horizontally across a matrix in order to establish direct causality between variables.
Relevance Trees & Morphological Analysis	Are normative forecasting methods, which start with future needs and seek to identify the requirements to achieve them. A Relevance Tree subdivides a broad topic into increasingly smaller subtopics thereby showing ‘all’ possible paths to the objective. Morphological Analysis involves mapping options to obtain an overall perspective of possible solutions.
Models or simulations	Mathematical relationships to explain a system, and then when it is understood, explorations into the future can be made.
Focus Groups (Participatory methods)	With a small group of people you FOCUS on one general question for about two hours.
Delphi Survey (Participatory methods)	A structured group interaction process directed in ‘rounds’ of opinion collection and feedback. Opinion collection is achieved by conducting a series of questionnaires sent to a pre-selected group of experts.
In-depth Interviews (Participatory methods)	Is a conversation with an individual conducted by trained staff that usually collects specific information about one person.
Interactive Brainstorming (Participatory method)	A process where all ideas generated throughout a meeting are gathering. The best ideas are streamlined and discussed in detail, to harness the synergy of the participants.
Scenario Workshops	A typical outcome of a scenario planning exercise is a complexity reduction of systems, based on secure information. A workshop therefore cannot substitute a longer process of information gathering.
Integrated Foresight Management Model (IFMM)	Is an attempt to provide an integrated and holistic view about the impact of foresight on the management on the future.
Ranking Method	A non-quantitative method of comparing different alternatives. A ranking list is developed, showing the better variants for an specific problem.