

IEA

Training Manual

*A training manual on
integrated environmental
assessment and reporting*

Training Module 6

Scenario development and analysis

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Module 6

A training manual on integrated environmental assessment and reporting

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List of Acronyms

AIM	Asia-Pacific Integrated Model
CSER	Center for Environmental Systems Research (University of Kassel, Germany)
EU	European Union
EU ETS	European Union Emissions Trading System
GEO	Global Environment Outlook
GDP	Gross Domestic Product
IEA	Integrated Environmental Assessment
IMAGE	Integrated Model to Assess the Greenhouse Effect
IF	International Futures
IPCC	Intergovernmental Panel on Climate Change
NIES	National Institute for Environmental Studies (Japan)
RIVM	Rijksinstituut voor Volksgezondheid en Milieu (Dutch Institute for Public Health and Environment)
SoE	State of the Environment
UNEP	United Nations Environment Programme
WaterGAP	Water Global Assessment and Prognosis Model

Overview

This module will help you develop scenarios and analyse them, either in terms of the impact they would have on existing policies, or the kinds of policies that would be needed in order for a particular scenario to unfold. The module provides the basis for an entire process for developing and analysing scenarios.

A scenario is not a prediction of what the future will be. Rather it is a description of how the future might unfold. Scenarios explore the possible, not just the probable, and challenge users to think beyond conventional wisdom. They support informed action by providing insights into the scope of the possible. They also can illustrate the role of human activities in shaping the future, and the links among issues, such as consumption patterns, environmental change and human impacts. In this way, they make use of the general DPSIR framework.

Scenarios were first used formally after World War II as a method for war game analysis. Their value was quickly recognized, and the use of scenarios for a number of other strategic planning applications developed. Today, scenario development is used in a wide variety of different contexts, ranging from political decision making to business planning, and from global environmental assessments to local community management.

There are hundreds of examples of scenarios developed during the last 30 years or so. A small number of examples are selected here to illustrate the range of scenarios that have been developed, from specific country/regional exercises to global visions of the future, covering a range of time frames from 10 to 100 years. The illustrations are the Mont Fleur scenarios for South Africa, the Global Environment Outlook (GEO-3 and GEO-4) scenarios and the Intergovernmental Panel on Climate Change (IPCC) scenarios.

A range of processes has been used to produce scenarios. We can distinguish among these according to three overarching themes: project goal, process design and scenario content. Goals might include raising awareness, stimulating creative thinking and gaining insight into the way societal processes influence one another. An overriding goal is usually to directly or indirectly support decision making. Process design addresses aspects such as scope and depth of the analysis, the degree of quantitative and qualitative data used, and choices among stakeholder workshops, expert interviews or desk research. Scenario content focuses on composition of the scenarios (i.e., on the variables and dynamics in a scenario and how they interconnect).

While many different processes have been used to develop and analyse scenarios, most involve steps similar to ones used in this module, although emphasis on particular steps varies. The steps used in this module are grouped as follows:

Clarifying the Purpose and Structure of the Scenario Exercise

- a. Establishing the nature and scope of the scenarios.
- b. Identifying stakeholders and selecting participants.
- c. Identifying themes, targets, indicators and potential policies.

Laying the Foundation for the Scenarios

- d. Identifying drivers.
- e. Selecting critical uncertainties.
- f. Creating a scenario framework.

Developing and Testing the Actual Scenarios

- g. Elaborating the scenario narratives.
- h. Undertaking the quantitative analysis.
- i. Exploring policy.

Communication and Outreach

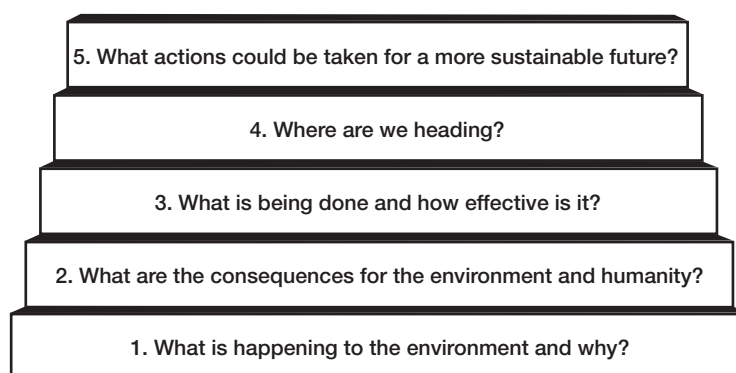
A full scenario process would ideally involve going through each of the above steps. In many cases, however, the scenario development will be nested within an overall integrated environmental assessment and reporting process. Thus, to the extent possible, the scenario development should be pursued in concert with the other components of this process, such as those described in Modules 4 and 5 of this training manual. Furthermore, many times, particularly in a national-scale GEO-type process, we avoid developing completely new scenarios. Instead, scenarios at the national level are developed based on existing scenarios at a higher level (e.g., global and regional scenarios developed for GEO). This adoption and adaptation facilitates scenario development by providing the core information needed in the process, but can present significant challenges in terms of methodology and credibility of the results.

Course Materials

1. Introduction and learning objectives

Module 5 of the workbook focuses on assessments of the state of the environment (SoE) and trends. In Module 6, we address the fourth and fifth steps shown below (Figure 1).

Figure 1: Key questions to be answered by SoE analysis and policy assessment in the IEA framework.



This module shows you how to develop scenarios and analyse them in terms of the impact they could have on existing policies or the kinds of policies that would be needed in order for a particular scenario to unfold. The module provides the basis for an entire process for developing and analysing scenarios.

The module begins with an introduction to what scenarios are (and are not), and provides details on particular aspects of scenarios and their development. Depending on the primary purpose of the scenario exercise, the form, content and process of your scenario(s) will differ. A brief summary of the scenario development literature and a few examples are presented. This is followed by a section that addresses more specifically how scenario development and assessment can be used to address policy issues. We then provide step-by-step guidance on one approach to scenario development, noting where this might need to be modified for other purposes. Recognizing that national and regional scenario development will often build on existing scenarios rather than start from scratch, we provide guidance on how this can be done. Finally, the module concludes with a section focused on the importance of communication and outreach as part of a scenario exercise.

After using the material presented in this training module you will:

- be familiar with the types of scenarios;
- have developed an understanding of the structure, complexity and dynamics of scenario processes;
- be familiar with the steps required for the development of scenarios; and
- understand how scenarios can be used for the discussion and development of policy options.

The success of a scenario process depends crucially on excellent facilitation. Scenario development and analysis is a demanding process, although we have tried to make it as easy as possible by presenting one step-by-step process.



EXERCISE

Think of a time when you have imagined different future possibilities to help you solve a problem in your everyday life.

Take five minutes to write a brief summary focusing on the following questions:

- What was the situation, and what were the future possibilities?
- Were there key uncertainties on which the future depended?
- What information did you have to help you make your decision or prepare for the future?
- How did you think through this problem?

Take two minutes to share your thoughts with your neighbour.

Discussion in plenary.

2. What is a scenario?

Scenarios are descriptions of journeys to possible futures. They reflect different assumptions about how current trends will unfold, how critical uncertainties will play out and what new factors will come into play. (UNEP 2002)

It is now generally accepted that scenarios do not predict. Rather, they paint pictures of possible futures, and explore the differing outcomes that might result if basic assumptions are changed. (UNEP 2002)

The future cannot be predicted because of ignorance, surprise and volition. Our information on the current state of the global system is incomplete, as is our knowledge about many of the drivers of change. Even if precise information were available, we know that complex systems exhibit turbulent behaviour, extreme sensitivity to initial conditions and branching behaviours at critical thresholds, all of which make prediction impossible. Furthermore, the future is unknowable because it is subject to human choices that have not yet been made. In the face of such indeterminacy, scenario analysis offers a means of exploring a variety of long-range alternatives, knowing that the uncertainty about the future increases with distance from the present (see, for example, Raskin and others 2002).

A scenario, as we use the term here, is not a prediction of what the future will be. Rather it is a description about how the future might unfold, subject to underlying assumptions about key social and environmental processes and key choices at the individual and societal scale. Scenarios explore the possible, not just the probable, and challenge their users to think beyond conventional wisdom.



Scenarios are carefully created stories about the future. They include an interpretation of the present, a vision of the future and an internally consistent account of the path from the present to various futures. They can be applied to any geographic or temporal scale, but tend to be more useful vis à vis other methods of considering the future as time horizons increase. They can include both qualitative and quantitative representations, and can be developed by very participatory or more “expert-driven” processes. Scenarios explore not only the implications if particular developments come to pass, but also what paths might lead us to particular outcomes, be they desirable or not. Perhaps most importantly, insights they provide are relevant to decisions being made today.

Scenarios support informed action by providing insights into the scope of the possible. They also can illustrate the role of human activities in shaping the future, and the links among issues. In the process of helping to clarify possible future developments and their effects, scenarios often are a source of inspiration for creative ideas.

Scenarios can be used for multiple purposes, including to:

- aid in recognition of “*weak signals*” of change;
- avoid being caught off guard – “*live the future in advance*;”
- challenge “*mental maps*;”
- understand the world better, and make better decisions;
- raise awareness;
- test strategies for robustness using “*what if*” questions;
- provide a common language; and
- stimulate discussion and creative thinking.

The ultimate aim, in most cases, is to:

- provide better policy or decision support; and
- stimulate engagement in the process of change.



EXERCISE

In groups of 3-4 persons, discuss the following questions for five minutes. Be prepared to discuss your key points in plenary.

1. Are you familiar with scenarios that have been developed in the past by other groups? If so, describe those scenarios. What do you find interesting about them?
2. What do you think are the most important reasons for developing scenarios?

3. A very short history of scenario development

Formal scenarios were first used after World War II as a method for war game analysis (van der Heijden 1996). Their value was quickly recognized by Herman Kahn and others who advanced use of scenarios for other strategic planning applications (Kahn and Weiner 1967). The scenario approach was refined at Royal Dutch/Shell by Pierre Wack in the 1970s and 1980s, during which time Shell became a leader in using scenarios for business planning. Their approach is described in detail in Shell International (2003).

Today, scenario development is used in a wide variety of contexts ranging from political decision making (e.g., Kahane 1992 and Kahane 1998) to business planning (e.g., Wack 1985 and Schwartz 1996) and from global environmental assessments (e.g., Gallopín and others 1997, Cosgrove and Rijsberman 2000, Nakicenovic and Swart 2000, and van Notten and others 2003) to local community management (Peterson and others 2003). In 2002, the Global Scenario Group published a path-breaking set of scenarios that spurred the debate on the challenges of sustainability (Raskin and others 2002).

Rothman (2008) provides a far-reaching review of scenario development from the areas of environment and sustainable development, including a synthesis of other reviews, and a catalogue of scenarios at the global and sub-global levels. Guidelines for production of scenarios also are available on the Internet (e.g., <http://scenariosforsustainability.org>; <http://www.beesuccessful.com>).

4. Examples of scenario exercises

Numerous scenarios have been developed that include an emphasis on issues of relevance for sustainable development. These cover a range of spatial and temporal scales, as well as the scope of issues addressed. We highlight three general categories, focusing on prototypical cases, while noting other similar exercises. While the categories are primarily defined by spatial and temporal scale, the chosen scenarios also differ in terms of their purpose, political context and the manner in which they have been developed, particularly the degree of stakeholder participation.

4.1 Short-term country scenarios – Mont Fleur

The Mont Fleur scenario exercise was carried out in South Africa in 1991-92. The purpose of the exercise was to stimulate debate about how to shape policy over the next 10 years in the country. It brought together a diverse group of 22 prominent South Africans from across the political spectrum (including politicians, activists, academics and business people) to develop and disseminate a set of stories about what might happen in their country during this period. Its innovativeness and importance stemmed from the fact that, in the midst of a deep conflict and profound uncertainty, it brought people together from diverse organizations to think creatively about the future. The scenarios were widely publicized, being first published in 1992 in the South African newspapers, *The Weekly Mail* and *The Guardian Weekly*. The scenarios were reprinted in *Deeper News*, published by the Global Business Network (<http://www.gbn.org>) with an introduction by Adam Kahane, who facilitated the scenario process.

The participants agreed on four scenarios that they believed to be plausible and relevant:

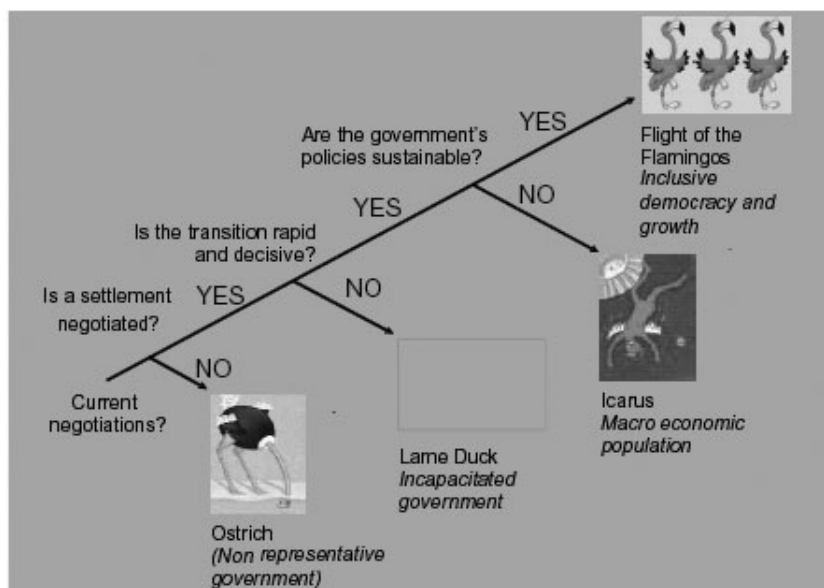
Ostrich – in which a negotiated settlement to the crisis in South Africa is not achieved, and the country's government continues to be non-representative;

Lame Duck – in which a settlement is achieved, but the transition to a new system is slow and indecisive;

Icarus – in which transition is rapid, but the new government unwisely pursues unsustainable, populist economic policies; and

Flight of the Flamingos – in which the government's policies are sustainable, and the country takes a path of inclusive growth and democracy.

Figure 2: The Mont Fleur scenarios



The group developed a narrative for each of these stories. A 14-page report was included as a supplement in a national newspaper, and a 30-minute video was produced. Furthermore, the scenarios were directly presented to more than 50 groups.

The Mont Fleur scenarios were not in themselves novel. The remarkable thing about the exercise was the involvement of such a heterogeneous group of important people developing and delivering the message. The scenarios were broadly understood and discussed in many circles. Through this process, it became clear that **Flamingo** was a feasible and broadly desirable outcome, although some of the decisions it implied were not in line with those that might have been proposed by some of the parties at the start of the exercise. Thus, the informal process of producing the Mont Fleur scenarios produced substantive messages, informal networks and changes in thinking about the challenges that the country faced.

A key lesson learned through the Mont Fleur process is that a successful scenario effort must be credible, informal, reflective and inclusive. The team needs to be respected, open-minded and representative of all of the important perspectives on the issues at hand.

Box 1: Other examples

The Democratic Dialogue Regional Project of the UNDP Regional Bureau for Latin America and the Caribbean (RBLAC) has compiled a number of case studies and learning histories building on the Mont Fleur experience and similar scenario exercises, particularly in Colombia and Guatemala (see <http://www.democraticdialoguenetwork.org/>). Under the auspices of the Society for International Development's Future Searches programme, scenario exercises have been carried out in Kenya, Uganda and Tanzania (see <http://www.sidint.org/programmes/future.htm>). A special issue of the journal *Development* (47.3, September 2004) was devoted these and other exercises. As part of the Millennium Ecosystem Assessment, several of the sub-global assessments also developed sub-national scenarios (see MA 2005a, particularly chapter 10).

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4.2 Medium-term regional and global scenarios – The UNEP GEO-3 and GEO-4 Scenarios

The development of the scenarios for UNEP's third Global Environment Outlook (GEO-3) has been described in detail by Bakkes and others (2004); these in turn formed the foundation for the scenarios of GEO-4. The scenarios were built on existing and ongoing exercises, in particular the work of the Global Scenario Group (Raskin and others 2002) and the Intergovernmental Panel on Climate Change (2000). A key aspect of both the GEO-3 and GEO-4 processes was that, although global in extent, each scenario was developed at regional and sub-regional levels (using UNEP's regions and sub-regions, see <http://www.unep.org/geo/region.htm>). The scenarios were to be developed using a holistic approach that included all aspects of sustainable development, but offered an environmental window by emphasizing environmental descriptions and policies. The narratives included the current state and trends, drivers, a story line into the future, and a vision of the future. The GEO-3 scenarios used a 30-year time period (i.e., 2002–32), which was then extended to 2050 for GEO-4. The categories of drivers were: institutions and socio-political frameworks; demographics; economic demand, markets and trade; scientific and technological innovation; and value systems.

The scenarios were developed through series of meetings that elaborated the scenario narratives complemented by an integrated multi-model exercise that produced quantitative data. The resulting four scenarios were named *Markets First*, *Policy First*, *Security First* and *Sustainability First*, emphasizing the key underlying societal focus in each case.

Markets First. The private sector, with active government support, pursues maximum economic growth as the best path to improve the environment and human well-being. Lip service is paid to the ideals of the Brundtland Commission, Agenda 21 and other major policy decisions on sustainable development. There is a narrow focus on the sustainability of markets rather than on the broader human-environment system. Technological fixes to environmental challenges are emphasized at the expense of other policy interventions and some tried-and-tested solutions.

Policy First. Government, with active private and civil sector support, initiates and implements strong policies to improve the environment and human well-being, while still emphasizing economic development. Policy First introduces some measures aimed at promoting sustainable development, but the tensions between environment and economic policies are biased towards social and economic considerations. Still, it brings the idealism of the Brundtland Commission to overhauling the environmental policy process at different levels, including efforts to implement the recommendations and agreements of the Rio Earth Summit, the World Summit on Sustainable Development (WSSD), and the Millennium Summit. The emphasis is on more top-down approaches, due in part to desires to make rapid progress on key targets

Security First. Government and private sector compete for control in efforts to improve, or at least maintain, human well-being for mainly the rich and powerful in society. Security First, which could also be described as Me First, has as its focus a minority: rich, national and regional. It emphasizes sustainable development only in the context of maximizing access to and use of the environment by the powerful. Contrary to the Brundtland doctrine of interconnected crises, responses under Security First reinforce the silos of management, and the UN role is viewed with suspicion, particularly by some rich and powerful segments of society

Sustainability First. Government, civil society and the private sector work collaboratively to improve the environment and human well-being, with a strong emphasis on equity. Equal weight is given to environmental and socio-economic policies, and accountability, transparency and legitimacy are stressed across all actors. As in Policy First, it brings the idealism of the Brundtland Commission to overhauling the environmental policy process at different levels, including strong efforts to implement the recommendations and agreements of the Rio Earth Summit, WSSD, and the Millennium Summit. Emphasis is placed on developing effective public-private sector partnerships not only in the context of projects but also that of governance, ensuring that stakeholders across the spectrum of the environmentdevelopment discourse provide strategic input to policy making and implementation. There is an acknowledgement that these processes take time, and that their impacts are likely to be more long-term than short-term.

There is much fuller collaboration among governments, citizens and other stakeholder groups in decision making on issues of close common concern. A consensus is reached on what needs to be done to satisfy basic needs and to realize personal goals without beggaring others or spoiling the outlook for posterity.

Box 2: GEO scenarios

Previous editions of GEO also included scenario work. In GEO-1 (UNEP 1997) and the accompanying technical report (UNEP/RIVM 1997) a single “business as usual” scenario was analysed, portraying the effect of a further convergence of the world’s regions towards Western-style production, consumption and resource management. Rudimentary estimates of the effect of applying best available technology to all investments gradually over all regions was also considered, though not in a fully integrated fashion. GEO-2000 (UNEP 1999) continued with the baseline and variant approach, but shifted focus towards more region-specific analyses of alternative policies. Each region considered a specific issue, for example freshwater in West Asia, urban air quality in Asia and the Pacific, and forests in Latin America and the Caribbean. A six-step methodology was followed in these studies and described in a technical report (UNEP/RIVM 1999).

At least two other studies have produced scenarios in recent years that are similar to those in GEO-3 in terms of their spatial and temporal scope. The scenarios of the Global Scenarios Group (Raskin and others 2002) represented the starting point for the GEO-3 and GEO-4 scenarios. As part of the World Water Vision exercise, three scenarios were developed focusing on issues surrounding freshwater availability (Cosgrove and Rijsberman 2000). Finally, a set of four scenarios was developed as part of the Millennium Ecosystem Assessment (MA 2005b).

4.3 Long-term global scenarios – Intergovernmental Panel on Climate Change (IPCC)

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In order to provide plausible pictures of future emissions of greenhouse gases, the IPCC developed four families of scenarios, based on an extensive assessment of the literature, six alternative modelling approaches and an “open process” that solicited wide participation and feedback from many groups and individuals. The scenarios provide a basis for analysing how drivers may influence future emissions, as well as to assess the associated uncertainties.

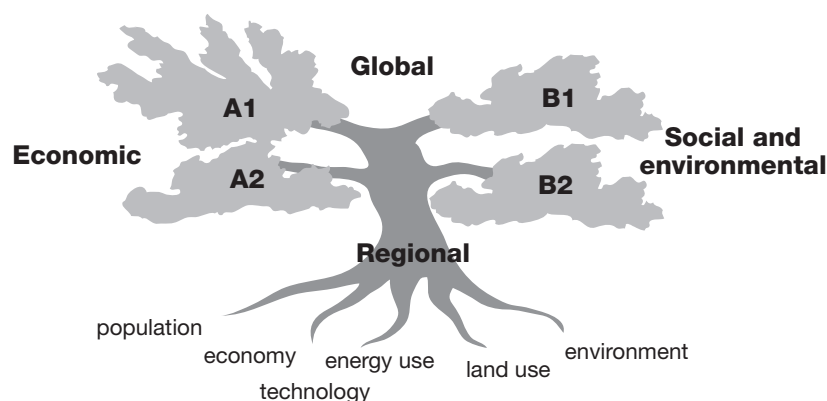
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The four basic storylines are:

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A1. A future world of very rapid economic growth, global population that peaks in the middle of the 2100s and declines thereafter, and rapid introduction of new and more efficient technologies. Major underlying themes are convergence among regions, capacity building and increased cultural and social interactions, with a substantial reduction in regional differences in per capita income.

Figure 3: IPCC Scenarios



A2. A very heterogeneous world emerges; the underlying theme is self-reliance and preservation of local identities. Fertility patterns among regions converge very slowly, which results in continuously increasing global population. Economic development is primarily regionally oriented, and per capita economic growth and technological changes are more fragmented and slower than in other story lines.

B1. A convergent world with the same global population trends as the A1 story line, but with rapid changes in economic structure toward a service and information economy, reductions in material intensity, and introduction of clean and resource-efficient technologies. The emphasis is on global solutions for economic, social and environmental sustainability, including improved equity, but without additional climate initiatives.

B2. A world in which the emphasis is on local solutions to economic, social and environmental sustainability. This is a world with continuously increasing global population, although at a rate lower than seen in A2, intermediate levels of economic development, and less rapid, more diverse technological change than in the B1 and A1 story lines.

Box 3: Other long-term scenarios

Few other studies have tried to look as far out into the future as IPCC, although the MA (2005b) provided some indication of certain trends to 2100 in its scenarios. Kahn and others (1976) presented a scenario looking 200 years into the future and a small set of 1 000-year scenarios were created as an exercise as part of the United Nations University's Millennium Project (Glenn and Gordon 2005). Other studies, such as the UN's *World Population to 2300* (UN 2004) represent more narrow projections of specific issues, rather than actual scenarios.



EXERCISE

Working in small groups, each person takes 4-5 minutes to consider the GEO scenarios and answer the following question:

What trends in the present day world are signals of one of the four GEO scenarios?

Discuss answers in the group.



Paste answers on flip charts (one for each GEO scenario). Are there more signals for one scenario than for others, or are the signals evenly spread? Discuss.

Note: It is possible that participants see elements of all four scenarios in the present world. On the other hand they might, for example, see many more signals for a “Markets first” world or a “Policy First” world. The important point of this exercise is to increase familiarity with the GEO-3 scenarios, and to start thinking about the way the present and the future are connected. The present always carries the seeds of multiple future trajectories, so it is to be expected that different people will see signs of different futures today.

5. The purpose, process and substance of scenarios and scenario exercises



A range of processes have been used in producing the large number of scenarios described in the literature. Van Notten and others present a typology that examines nine separate characteristics of scenarios and scenario exercises. At a higher level, these are aggregated into three overarching themes: project goal, process design and scenario content. In very simple terms, these can be stated as the why, how and what of scenarios and scenario development. As might be expected, there are generally strong connections among these themes. The project goal influences the process design, which, in turn, influences scenario content.

The first theme addresses the **objectives** of a scenario analysis as well as subsequent demands on design of the scenario development process. On one end of the spectrum is the goal of exploration. This might include awareness raising, stimulation of creative thinking and gaining insight into the way societal processes influence one another. In such an exercise, the process is often as important as the product (i.e., the scenario or set of scenarios), which may even be discarded at the end of the process. At the other end of the spectrum is the goal of direct decision support. In this case, scenarios might propose concrete strategic options. Decision-support scenario exercises often contain value-laden combinations of scenarios that are described as desirable, middle-of-the-road and undesirable. The two types of project goals often are combined: exploratory scenarios are developed first, after which new scenarios are developed by zooming in on aspects relevant to strategy development.

Box 4: Forward-looking compared to backcasting in scenario exercises



One major distinction among various scenarios and scenario exercises is between *forward-looking* and *backcasting*. In the former, the story is developed with the present day as a starting point, and is not constrained by a predetermined end vision. A backcasting approach on the other hand, identifies the end vision and then a story is developed to describe the path from the present to that end point. In *forward-looking* processes, the key questions in the scenario development begin with *What if...?*; in *backcasting* processes they begin with *How could ...?* Because the specified end state often has a value attached to it (i.e., it is either viewed as “good” or “bad”), back casts are frequently called “normative” scenarios. We have chosen not to use that terminology here because forward-looking scenarios also can have normative elements.

Many, if not most, scenario exercises combine both processes, but one approach generally takes precedence. There is, however, no reason why a single scenario exercise cannot include both approaches. Robinson presents an interesting exploration of the iterative nature of some scenario exercises and, in the process, introduces the concept of second-generation backcasting. This concept assumes that the initial end vision is less than perfectly formed, and emerges in a more coherent form in and from the process of scenario development.

Process design, the second overarching theme, focuses on how scenarios are produced. It addresses aspects such as the degree of quantitative and qualitative data used, or the choice among stakeholder workshops, expert interviews and desk research. On one end of the spectrum, there is the intuitive approach, which considers scenario development as an art form, and leans heavily on qualitative knowledge and insights. Creative techniques, such as development of stories or storylines or collages of pictures, are typical intuitive approaches to scenario analysis. Interactive group

sessions with a diversity of participants are often central to storyline development. At the other end of the spectrum is the technical approach. Contrary to the intuitive approach, the technical school regards scenario development primarily as a rational and analytical exercise. This technical school tends to work from quantified knowledge, and often relies on computer models in developing scenarios. Both approaches have their strengths and a number of recent studies have worked to combine the two approaches (see e.g., UNEP, IPCC and Rijsberman).

Box 5: The value of participatory processes

Most scenario development exercises are participatory in nature. Some reasons for wanting to make scenario exercises more participatory:

- *to make use of local and specialized knowledge*: many people, particularly those working in key sectors or living in key regions, will have specific expertise on the issues being addressed in development of the scenario;
 - *to create buy-in*: people are more willing to accept results and insights of any analysis in which they have had a hand in production;
 - *to create ambassadors*: those involved in the development will often be able and willing to reach audiences that are less available to the researchers; and
 - *to reach those whose minds you most want to change*, especially when the point of the exercise is to influence decision-makers, it is more effective to have them be part of the process rather than passive recipients of information.
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Box 6: The advantages and disadvantages of qualitative and quantitative scenarios

At a basic level, the advantages and disadvantages of qualitative and quantitative approaches are as follows.

Qualitative Scenarios

Advantages: Understandable, interesting, and represent views and complexity of many different interests.

Disadvantages: Arbitrary, tough to identify or test underlying assumptions. Do not provide numerical information.

Quantitative Scenarios

Advantages: Model-based, with numerical information; can identify underlying assumptions.

Disadvantages: Models have limited view of the world, and are often are not transparent; exactness gives illusion of certainty; difficult to reflect changes in fundamental scenario features such as values, lifestyles, institutions, and structural shifts in the social and environmental system under study.

The third theme, **scenario content**, focuses on the composition of the scenarios. It examines on the nature of variables and dynamics in a scenario, and how they interconnect. With regard to scenario content, we distinguish between complex and simple scenarios. A multitude of interpretations of the term complex exists. Here, a complex scenario is one that is composed of an intricate web of causally related, interwoven, and elaborately arranged variables and dynamics. Complex scenarios manifest alternative patterns of development consisting of a series of action-reaction mechanisms. They often draw on a broad range of actors, factors and sectors, and use multiple temporal or spatial scales. In contrast, simple scenarios are more limited in scope. A simple scenario might focus on a single topic, considering only the immediate or first-order effects of changes in the external environment. Simple scenarios may also limit themselves to extrapolation of trends. The term “simple” is not meant to indicate poor quality. An exercise with a narrow focus or a short-term perspective may not require the relatively lengthy and demanding investment of developing complex scenarios, which can be a benefit in many other circumstances. Furthermore, a simple scenario can be more effective in communicating its message than a complex scenario.

EXERCISE

In small groups, discuss the objectives, proposed process design and content of a planned or hypothetical regional, national or sub-national scenario exercise. Report back to plenary to discuss your results and resolve differences.



Note: for this exercise, it could be interesting to have one female and one male group, since there could be gender differences in the ideas about objectives, process and content.

6. Policy analysis

Experience suggests there are a variety of ways in which policies can and have been addressed in a scenario exercise.¹ Unfortunately, in most cases, this has been an afterthought, and little attention has been paid to how these approaches differ, their appropriate purposes and the implications for designing a scenario exercise. In this section, we will explore this issue in some detail.

In order to clarify the distinctions among the various approaches to link policy and scenario analysis, it is useful to consider the following questions:

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- *Are there existing policies you wish to explore as part of the scenario exercise?*

A standard use of scenario analysis is to compare the feasibility, effectiveness, and broader impacts of alternative policies (or combinations thereof), e.g., taxes vis-à-vis tradable permits on certain pollutants. This can be done by assessing scenarios that differ only with respect to the absence or inclusion of the policies of interest. Remembering the basic uncertainties that underlie the use of scenarios, the robustness of existing policies can be assessed by exploring their feasibility, effectiveness and broader impacts across a range of scenarios that differ with respect to other significant factors.

If there are no relevant, existing policies, then one purpose of the scenario exercise should be the identification of policy options. Even where they do exist, the exercise can, of course, be useful for expanding the set of policy options for consideration.

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- *Is there a preconceived end vision, or at least some aspects of a vision, i.e., specific targets?*

In many cases, a scenario exercise is used to explore the feasibility and broader implications, e.g., tradeoffs, of meeting a specific target, e.g., an 80 per cent reduction in CO₂ emissions by 2050. If the vision is used to define the scenarios, i.e., the range of scenarios to be explored is restricted to only those for which the target is achieved, the exercise takes on the character of a standard back cast. At a minimum, the presence of a preconceived end vision implies that there are at least some metrics against which a scenario and its policies can be evaluated as being “successful.”

In the absence of any preconceived vision, the question of how to evaluate a scenario and the impacts of policies, in particular any definition of “success,” is less clear. There will almost certainly be metrics that can be used for this purpose. Even where clear targets do exist, these other metrics are important for evaluating the broader implications of achieving the targets.

- *Are the effects of a policy of such magnitude that they would fundamentally alter the basic structure of the scenario?*

Depending on how the scenario is defined and the perspective of the person using them, policies can be seen as essentially determining the scenario or as merely affecting some aspects of it. For example, if a scenario is defined by the international trade in agricultural commodities, a group like the WTO or some larger countries could conceive of policies that will alter the overall level and terms of this trade. Small countries and individual producers, on the other hand, are more likely to take these as given. In the latter case, the policy question to be asked can be phrased as, “What can we do to cope best with the set of possible situations we might face?” In the former, a more relevant question would be, “What could we do to create a particular situation?”

¹ For the purposes here, the word *policy* is defined broadly. It denotes any organized intervention by an actor in the system of interest. Thus, it should be seen to include *inter alia* laws and legislation, economic instruments, property rights reform and market creation, reform of state bureaucracies, activities by the private sector, NON-GOVERNMENT ORGANIZATIONS, and civil society.

Combining the above, we can talk about eight cases:



Case	Existing policies?	Preconceived end visions?	Policies determine the scenario?	Potential uses
a	YES	YES	YES	Test particular policies to see if they can create the conditions under which end visions or specific targets can be achieved, while also considering the broader implications of the policies.
b	YES	YES	NO	Test particular policies to see whether and to what extent they can help to achieve end visions or specific targets under otherwise fixed conditions, while also considering the broader implications of the policies.
c	YES	NO	YES	Explore the role of particular policies in determining the broad nature of the future.
d	YES	NO	NO	Explore the effects of particular policies under otherwise fixed conditions.
e	NO	YES	YES	Identify policies that can create the conditions under which end visions or specific targets can be achieved, while also considering the broader implications of the policies.
f	NO	YES	NO	Identify policies that can help to meet specific targets under given conditions, while also considering the broader implications of the policies.
g	NO	NO	YES	Identify policies that may determine the broad nature of the future.
h	NO	NO	NO	Identify policies and their implications under certain given conditions.

Each of these cases is obviously a caricature; most scenario exercises will include some combination of these, and certain cases are of less interest than others. The lack of both existing relevant policies and a preconceived vision in cases g and h make it highly unlikely that either would be undertaken in isolation. However, they might be used as extensions to cases d and e, respectively, whereby new policies are identified in the process of testing existing ones. Given their inclusion of preconceived visions, cases a, b, e, and f lend themselves to backcasting exercises, but they can also be addressed in forward-looking exercises when the targets are not used to limit the set of scenarios to be considered. With the latter, they are not significantly different from the equivalent cases without preconceived visions (i.e., c, d, g, and h respectively). Finally, cases b, d, f, and h, by exploring policies that do not “determine” the scenario, can be pursued without a full scenario development process if scenarios already exist within which these policies can be adequately assessed.

Several concrete examples of where scenario exercises have been used, and how they can be seen to fit within this schema, are provided below.

■ **Testing policies to limit pollutant emissions from the power sector in the United States²**

The Energy Information Administration (EIA) in the United States analysed the potential costs and impacts of various existing policies that sought to limit emissions of four pollutants from electricity generators, sulphur dioxide (SO₂), nitrogen oxides (NO_x), carbon dioxide (CO₂) and mercury (Hg), in four different scenarios. Since there were existing policies and clear targets, but other basic conditions were held fixed (e.g., overall economic growth), this serves best as an example of case b above. The analysis showed emissions could be significantly limited for all pollutants, if a substantial effort was made by industry, and this helped to illustrate the nature and scale of the effort depending on the scenario. It also indicated that the increase in energy costs and other economic impacts of the policies under investigation would decline over time.

■ **Identifying policies to achieve a 60 per cent reduction in carbon emissions by 2050 in the United Kingdom**

The UK Department of Trade and Industry has used the Royal Commission on Environmental Pollution's target of a 60 per cent reduction in carbon emissions by 2050 as a desired vision of the future, and has used scenarios to help identify possible paths to meet this target. Since the policies were not clearly specified beforehand, but a target did exist and key scenario conditions were held fixed, this is best seen as an example of case f but also a and e, inasmuch as some particular policies were tested. This work yielded a number of new policy initiatives and measures to achieve this target. The scenario analysis was model-based and helped identify the technology portfolios in each sector that could achieve the target and their evolution over time, while providing an indication of the overall cost.

■ **Exploring the future of the environment in Latin America and the Caribbean**

GEO Latin America and the Caribbean: Environmental Outlook 2003 (UNEP 2003) considered three broad scenarios for the future. Each started from a set of assumptions about general policy developments, which was assumed to determine, in large part, the future shape of the region. This can be seen as an example of case c, but also g to the extent that the policies considered were somewhat vaguely defined. The authors pointed out that the path to a sustainable future, as presented in the "Great Transitions" scenario, would be supported by the Latin American and Caribbean Initiative for Sustainable Development, approved by the Regional Forum of Ministers of the Environment in August 2002. The initiative's numerous priority areas included "Strengthening of technical and vocational training institutions" and "Promotion of human resources development, particularly in information and communication technology." In contrast, the "Market Scenario" emphasized policies such as free-trade agreements, intellectual property rights, deregulation and privatization as well as other measures, resulting in quite different implications for the environment.

■ **Scenarios to explore adaptation to Climate Change**

Within the Global International Waters Assessment and, as reported in the assessments of the IPCC and elsewhere, numerous scenarios have explored not only the potential impacts of climate change, but also policies and actions to ameliorate or adapt to these changes. These may or may not have preconceived policies or end visions, but almost all take the change in climate as given. Thus, depending on their particular setup, they can provide examples of cases b, d, f or h.

² Note that a similar approach was used by the OECD in their second Environmental Outlook (OECD 2008)

EXERCISE

For your country, a set of national scenarios for a selected issue (water, energy, food security, tourism) is to be developed. In small groups, select an issue and discuss which existing policies would be relevant for consideration in the scenario, whether there is an end vision for this issue (and if so, what it is), and whether particular policies would essentially determine the scenarios, or merely influence parts of them? Decide on the basis of the discussion which of the cases listed in the table above best characterizes the scenario.

Present and discuss in plenary.



7. Developing scenarios – A complete process

While there are many different processes that have been used to develop and analyse scenarios, most involve a common set of steps. While recognizing that there are benefits and drawbacks to following the specific approach outlined here, in order to provide a coherent training module, we felt it was easiest to present one process. For those interested in exploring other alternatives, we suggest reviewing Alcamo (2001), Galt and others (1997), and other papers cited in Section 3, above.

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The following process is proposed as a useful framework for an IEA if a complete scenario development is to be carried out. It follows the GEO approach in three ways:

1. It is explicitly policy-relevant;
2. It is intended to be comprehensive enough to allow the scenario team to incorporate a broad range of issues that arise in sustainability analyses; and
3. It is presented as a participatory, stakeholder-driven process. Furthermore, it is a built upon the scenario processes used in earlier GEOs, and also adopted (with some modifications) in the first GEO Training Manual (Pinter and others 2000).

The steps of the scenario process can be grouped as follows (see also Figure 4). As they relate to similar stages in the process, the steps in each group will often be pursued in parallel. There is no single best way to undertake each of the steps; still, suggested approaches for each are presented in some detail below. Finally, although Communication & Outreach is identified as a separate group, such activities should take place throughout the process and not just at the end of the exercise, as discussed in detail in Module 3.

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Clarifying the Purpose and Structure of the Scenario Exercise

- a. Identifying stakeholders and selecting participants.
- b. Establishing the nature and scope of the scenarios.
- b. Identifying themes, targets, indicators, and potential policies.

Laying the Foundation for the Scenarios

- d. Identifying drivers.
- e. Selecting critical uncertainties.
- f. Creating a scenario framework.

Developing and Testing the Scenarios

- g. Elaborating the scenario narratives.
- h. Undertaking the quantitative analysis.
- i. Exploring policy.

Communication and Outreach

Not all of these steps are required in every scenario process. Some exercises forego the quantitative aspects, while others have little or no narrative element. Also, it has become common practice to use existing scenario studies as the starting point for developing new scenarios. This can be due to resource limitations, as some of the steps can be carried out very quickly building on the prior analysis. For example, if a national scenario process builds on the GEO-4 scenarios, the main drivers are identified in the global stories, although at the national level there could be additional driving forces that have to be considered. It may also be useful if the exercise is meant to link with scenarios being developed at other scales (see box), or if the primary purpose is to test the robustness of specific policies across a range of futures that is already well represented in an existing set. Ideally, though, since scenario development aims to be an exploratory exercise, it is preferable to not use existing scenarios as this might inhibit the recognition of other relevant signals of change,

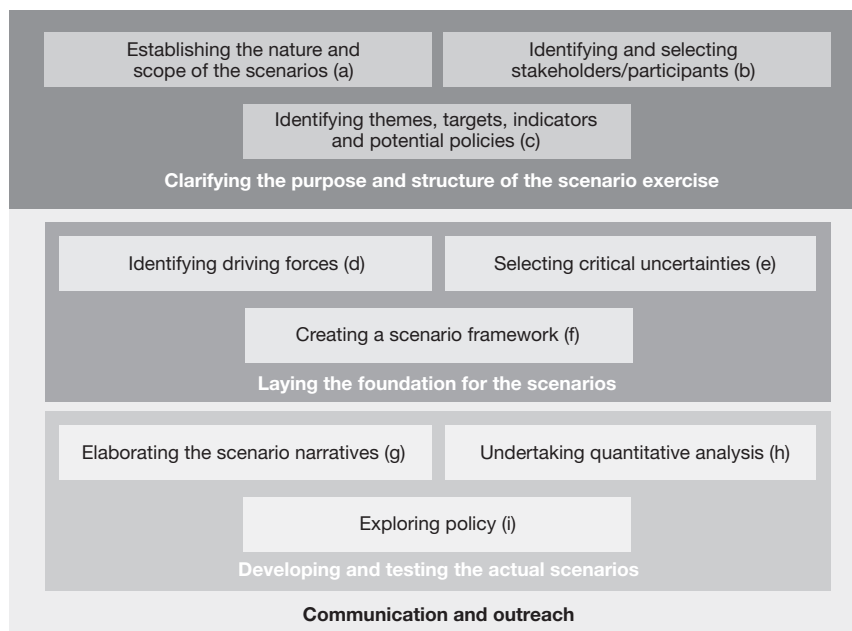
leaving the policy-maker vulnerable to developments that were not anticipated in the scenarios adopted.



Box 7: Recognizing the significance of developments at other scales for a national scenario process

Although the focus here is on national IEA processes, a study might be complemented by the development of scenarios on other levels: global, regional and local. The challenge then is to conceive scenarios that are consistent on all the levels. To illustrate: the pattern of rising sea levels described in global scenarios should be consistent with its impact as addressed in scenarios at lower scale levels, namely flooding in low-lying regions such as Bangladesh, the Netherlands and the Seychelles. The integration of multiple geographical scales is still subject to methodological development, as in such scenario studies as *VISIONS* and *GEO-4*. In both cases, the respective scenario teams worked to integrate global and regional information. Global developments served as input for regional scenarios, and regional developments were used to enrich and refine the scenarios at the higher scale level.

Figure 4: Steps in a generic scenario development process



Box 8: Seeing the scenario development as part of the whole IEA process

The IEA process as a whole is described in Module 2 of this training manual. The scenario development is nested within the overall IEA process, with planning of the scenario sub-process in stages 3 and 4. In step 2, there is reference to and discussion of stakeholders, which also is of relevance to the scenario process. Indeed, it is most likely that each stage of the IEA process would use the same set of stakeholders for identification of priority issues, development of indicators and scenario analysis. Also, the scenario process often will be based on or informed by the state of the environment analysis and *ex post* policy analysis (Module 5).

7.1 Clarifying the purpose and structure of the scenario exercise

Careful planning and thinking in the early stages will significantly improve the quality of any scenario exercise. Some of the most important questions to ask right away are why you are doing the exercise, who should be involved and what are the key elements required to structure the process. In some cases, the steps described in this phase have been done at the start of a scenario exercise, but in a fairly informal and ad hoc manner. In other cases, they are only really treated explicitly once the process is well underway and the scenarios are already (partially) developed. This can lead to problems later on in that it can be difficult to use the scenarios developed to address the issues of interest in the detail desired. At the same time, there should be enough flexibility for revisiting each of these steps, as much will be learned throughout the process. Thus, the outcome of what is presented in this phase should not be seen as set in stone for the whole length of the exercise.



a) Establishing the nature and scope of the scenarios

Purpose

To establish a clear view of the scenario process to be used.



Output(s)

The output or outputs from this step should be a clear overview of and plan for the scenario process. The specific details of the plan will depend on the type of scenarios chosen and other factors, e.g. available resources. This includes such factors as, time horizon, balance between narrative and quantitative elements, nature of policy analysis and available resources for exercise.



Steps

1. The core team running the exercise, perhaps in consultation with the funders and key stakeholders, should ask themselves the following questions (please note that the second and third of these are very slight modifications of the questions discussed in the previous section on policy analysis).
 - What are the issues we want addressed in the scenario project? If it is part of a larger assessment, how are these addressed in the other sections of the assessment?
 - Are there existing policies we wish to explore as part of the exercise? Are the effects of these of such magnitude that they would fundamentally alter the basic structure of the scenarios?
 - Do we have a preconceived end vision, or at least some aspects of a vision, such as specific targets, for the scenarios?

- Why is scenario development the appropriate approach for dealing with the problem?
 - Who is the audience?
 - What types of scenarios are needed to address the problem and to communicate to the audience? Would a backcasting or forward-looking approach be better?
 - What time frame should be considered? Should the scenarios be narrative and/or quantitative?
 - How are the scenarios to be developed connected with scenarios developed for higher levels (e.g., regional or global)?
 - What do we want to have achieved by the end of the scenario process (e.g., new policy options, better understanding of a particular issue, better understanding of a region's most pressing concerns for the future)?
 - What resources (e.g., time, money, people) are needed to achieve the goal and is it possible/desirable to make that investment?
 - What is the expected role of the scenario team, and what are the expected roles of other stakeholders and participants?
2. If not done so originally, the above questions should be revisited in consultation with the participants selected to take part in the scenario exercise.

Comments

This step provides clarity and focus for the scenario team, a strong reasoning to support the approach adopted and valuable context material for those subsequently engaged in the process.

EXERCISE

In a previous exercise, you have selected an issue and discussed which existing policies would be relevant for consideration in the scenario. These provide the answers to the first four questions presented above. **Discuss the remaining questions in plenary.**



b) Identifying stakeholders and selecting participants

Purpose

To ensure that the scenario process benefits from the input of a cross-section of society, thus increasing the likelihood that the scenarios have buy-in from the appropriate actors. This improves the usefulness of the scenarios to the end-user (note: identification of stakeholders is also covered in Modules 2 and 3).

Output(s)

A list of participants and alternates.

Steps

1. Identify who (i.e., which organization or institution) is convening this scenario exercise. This is one audience, and it might be important to consider participant(s) from this group.
2. Identify other audiences for the scenarios by deciding whom the scenarios are intended to reach. It might be important to consider participants from these audiences. The audience for scenarios could well be the same as for the national IEA as a whole, as discussed in Module 3.
3. Identify other key stakeholders. Consider who has an important stake in the country's future, who are the decision-makers (determining both public policies and private behaviours), and who are the people directly affected by such decisions.



Comments

Policy-makers and others who will make use of the scenarios should be included in the scenario team³. If they cannot participate, it is important that their views are canvassed to establish what issues are most pressing and how they view their interests unfolding over the scenario time frame. Once the participants are chosen, they need to be involved in the subsequent activities, preferably in face-to-face meetings, with sufficient time to have detailed discussions and to reach consensus where possible.



EXERCISE

Continuing the previous discussion in plenary produce a list of the stakeholders that would have to be included in the scenario exercises.



c) Identifying themes, targets, potential policies and indicators

One of the most daunting aspects of any scenario exercise, particularly one that is intended to consider a range of issues in an integrated fashion, is identifying the key issues or problems of concern. It is important to be clear about a number of factors, such as:

- what are the key themes upon which the scenarios should focus;
- what, if any, are the key targets and/or goals that should be considered in evaluating the scenarios;
- what are the most useful indicators for describing the system of interest; which can help us to see if targets are being met; and
- what, if any, are the key policies we wish to explore as part of the scenario exercise?

As these four aspects are intricately related, they are best treated at the same stage in a scenario exercise. Some exercises will start with identified themes, which in turn suggest targets and policies for consideration; in other cases, the targets or the policies may themselves be the starting point for the exercise. In all cases, the indicators need to be able to accurately represent these targets or policies in the scenarios. Thus, there is no correct answer as to which of the following should be done first, or if they should be done together or as separate steps. For the purposes of clarity, we describe them one at a time.

Identifying themes

Purpose

To determine the important themes on which the scenario exercise will focus.

Output(s)

An initial list of themes with brief explanations.

Steps

1. Telling the story of the present (how we got here, and topics that are of interest). This provides background to the scenarios, and illustrates the seeds of the future in the present.
2. Identifying issues that are important with respect to your country's future. If you were to write a comprehensive "history of the future," consider what topics you would need to discuss.

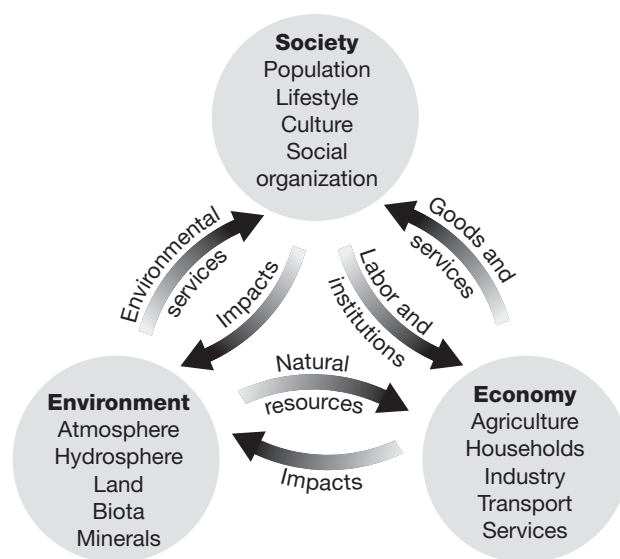
³ In reality, for a national GEO there may be no separate scenario team. The team that is in charge of the assessment as a whole would lead the work on all sections, including the scenarios.

- Thinking about the broad range of future possibilities, the participants should discuss their hopes and fears for the future of their country. Think broadly. Think near and long term. If you are concerned about sustainability, think, for example, about ecosystem services (not just resources and extraction) and equitable well-being (not just economic growth).
- Define the time horizon, choosing a length of time that is, on balance, long enough to be appropriate to the themes you have identified.

Comments

Figure 5 summarizes some general themes to consider (see Gallopin and Raskin, 2002). It may be necessary to identify a number of sub-themes to satisfy the needs of the scenario exercise.

Figure 5: General scenario themes



Source: Gallopin and Raskin 2002)

EXERCISE

In small groups identify a set of themes and sub-themes for a scenario exercise in your country. Build on the exercise in Section 6, where you selected an issue around which to develop scenarios.

Discuss these in plenary and agree on a list to be used by all groups in the following exercises.



Identifying targets

Purpose

To specify key targets and goals, including constraints or thresholds that are to be avoided.

Output(s)

An initial list of constraints, limits, goals and targets that will help define the scenarios.

Steps

In the context of the themes and policies to be considered, indicate specific targets. Some common examples are meeting the Millennium Development Goals and keeping the maximum increase in global average surface temperature below 2°C. Be clear whether these are intended to restrict the scenarios to be considered or if they will simply provide benchmarks against which the scenarios will be evaluated.

Identifying potential policies

Purpose

To specify the policies to be considered in the scenario exercise.

Within different scenarios, distinct opportunities and threats emerge. Society would respond to those opportunities and threats in many ways, including through policy responses. Incorporating such policy responses in the scenario exercise enables participants to anticipate and prepare for possible eventualities.

Output(s)

An initial set of potential policies to consider in the scenario exercise

Steps

The previous section of this module explored the issue of policy analysis in the context of scenarios in some detail. This is an issue that is also explored to some extent in the steps already described above. It is also a core aspect of Module 5 (Integrated Analysis of Environmental Trends and Policies). Thus, this step should build upon those efforts. At this point, it is important to be more explicit about the policies to be considered in the scenario analysis, recognizing that this should include not only previous and existing policies, but also other potential options.

Consider, therefore:

Are there existing or potential policies you wish to explore as part of the scenario exercise?

Is there a preconceived end vision, or at least some aspects of a vision, i.e., specific targets?

Selecting indicators

Purpose

To select specific (quantitative) indicators that characterize the system of interest, in order to enhance and elaborate the scenario narrative and provide measures by which to partially evaluate the scenarios against key criteria.

Output(s)

An initial set of (quantitative) indicators.

Steps

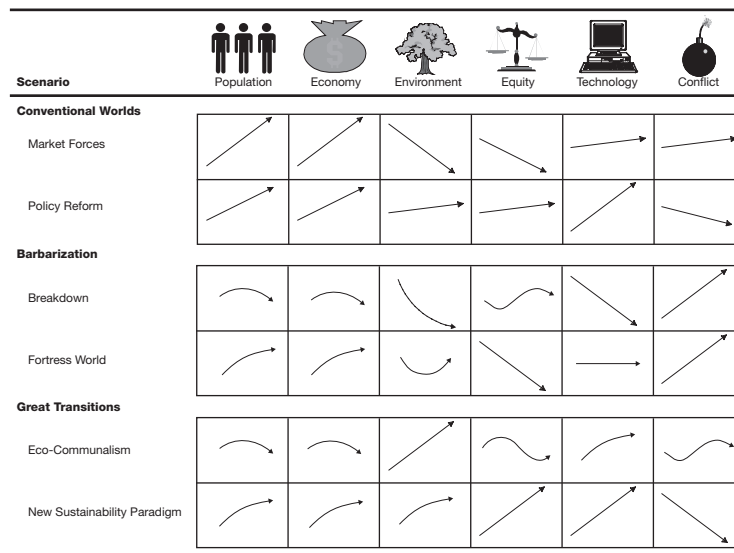
1. In the context of the themes, targets and drivers, select indicators that would provide useful elaboration and deepening of the scenario narratives. Be sure to include indicators that can serve as metrics to evaluate the scenarios in light of any identified targets. Indicators are also a key aspect of a complete assessment (see Modules 4 and 5), so it might be useful to link this step with steps in those modules.

- Indicate in a qualitative way how the trends in a few of these indicators could evolve in the future. Even though this may not be as scientifically rigorous an exercise as quantitative modelling, it will help make explicit the participants' understanding of the issues and scenarios. It will also provide a basis against which to compare the narrative and quantitative aspects of the scenarios.

Comments

Figure 6 summarizes an exercise in which a number of key issues are profiled for each of four GSG scenarios, upon which the GEO-3 and GEO-4 scenarios were based (Raskin and Kemp-Benedict 2004). This semi-quantitative analysis not only provided a valuable starting point for the modeling exercises, but also provided valuable insights and consistency checks for the comparison of the narratives with the quantitative outputs.

Figure 6: Trends in indicators in four GSG scenarios.



Source: http://www.unep.org/geo/pdfs/GEO_ScenarioFramework.pdf

EXERCISE

For the themes and sub-themes identified above attempt to fill in the following table. Build on the results of the exercise from Section 6:

Theme	Target(s)	Potential policies	Indicators
e.g., Air Quality	e.g., by 2015 no air pollutant to exceed safe limits	e.g., vehicle emission standards	Concentrations of major pollutants
e.g., Health	e.g., by 2020 reduce child mortality by 90%	e.g., sanitation provision, air quality standards, public health policies	Child mortality

7.2 Laying the foundation for the scenarios

The previous steps provide the broad outline for the scenario exercise as a whole. At this point, it is necessary to look more closely at the foundations for the scenarios themselves. How many scenarios are to be developed, and what should be the fundamental distinctions between them?



d) Identifying drivers

Purpose

To identify, in the context of the exercise, the key trends and dynamics that will determine the course of the future. (Note: this can build on the SoE analysis carried out in Module 5. For scenario development, the important question is whether these drivers are likely to change and whether new drivers are expected to emerge.)

Output(s)

List of drivers with brief explanations.

Steps

1. Identify the drivers. Be sure to do this in the context of the themes that you developed earlier. Think about key historical events and trends, and how these have affected the themes in the past. To identify drivers, think in terms of underlying causal relationships, not just descriptions.
2. For each driver, describe briefly the range of possible ways it could evolve in the future.

Comments

Figure 7 lists some of the drivers that were considered in the GEO-3 global scenarios. Drivers at the national level might be different, but the principle is the same.



Figure 7: Examples of scenario drivers from GEO-3, including current trends.

<p>Demographic</p> <ul style="list-style-type: none"> • Population is growing • Urban population is increasing • Population is aging <p>Economic</p> <ul style="list-style-type: none"> • Economy increasingly globalized <p>Social</p> <ul style="list-style-type: none"> • Increasing inequality • Worsening poverty <p>Cultural</p> <ul style="list-style-type: none"> • Spread of values of consumerism and individualism • Rising nationalist and fundamentalist reaction 	<p>Technological</p> <ul style="list-style-type: none"> • Advancement and penetration of <ul style="list-style-type: none"> - Computer and information technology - Biotechnology - Nanotechnology and miniaturization <p>Environmental</p> <ul style="list-style-type: none"> • Increasing global stress • Local degradation • Some remediation (in richer countries) <p>Governance</p> <ul style="list-style-type: none"> • Evolution of global institutions (e.g., MEAs) • Spreading of democratic governance • Expanding roles for civil society in decision-making <p><i>...but important exceptions</i></p>
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EXERCISE

Divide into small groups (one for each of the themes developed above) and produce a list of the main drivers and describe how they could develop in the future. Discuss the tables in plenary.



E.g.

Theme	Drivers	Assumptions about development
Air Quality	Population growth	Increase until 2030 then tapering off
	Mobility	Major increase in number of cars until 2030 Or Major increase in use of public transportation
	Energy consumption	Stabilization of energy consumption due to massive investments in energy efficiency Or Switch to renewable sources completed by 2030
	...further drivers...	...further developments

e) Selecting critical uncertainties**Purpose**

To select the critical uncertainties, which will define the scenario framework.

Output(s)

A set of critical uncertainties, selected from among the drivers developed in Step 5.

A critical uncertainty is a driver that is especially important in determining how the future evolves, but whose future development is highly unpredictable.

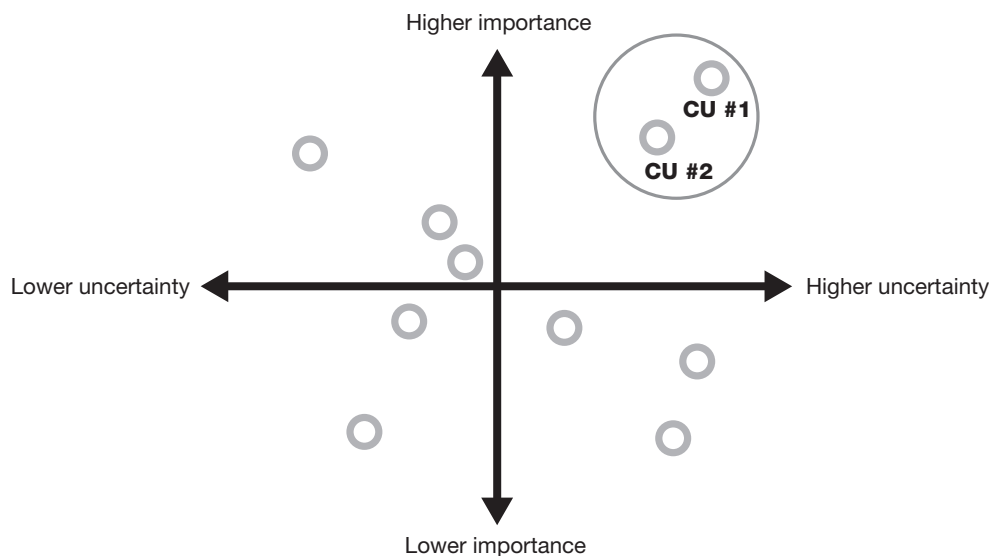
Steps

1. Consider each driver in turn, and recall the range of possible ways it could evolve.
2. Consider the degree of uncertainty in each driver. How much variation is there in the range of possible ways it could evolve? Is there a great deal of uncertainty, or relatively little?
3. Consider the relative impact/importance of each driver into the future. Does the way that it evolves make a major difference in the overall vision for the future, or does it make a relatively minor difference?
4. Plot each driver on the chart of impact/importance versus uncertainty. (In Figure 8, each circle represents a particular driver.) The farther to the right, the greater the uncertainty in how that driver could develop. The farther upward, the more significant is the impact of that driver.
5. Identify the drivers (usually two or three) that are highest impact and highest uncertainty. (In Figure 8, the two drivers that have the combination of the highest importance and highest uncertainty are labeled CU1 and CU2.)





Figure 8: Identifying critical uncertainties (CU)



Comments

For those drivers that are:

- in the “low importance, low uncertainty” quadrant: these will not figure prominently in the scenario analysis because outcomes are clear, or the issues are not thought to be particularly influential in the future;
- in the “low importance, high uncertainty” quadrant: these will not figure prominently in the scenario analysis because they are not of sufficient significance;
- in the “high importance, low uncertainty” quadrant: these should figure prominently in the scenario analysis, but their future evolution should not differ significantly across the scenarios, reflecting the low level of uncertainty; in this way they can be considered ‘inevitables’; and
- in the “high importance, high uncertainty” quadrant: a subset of these should figure prominently in the scenario analysis by defining the key underlying distinctions between the scenarios as described in next step. The others will also figure prominently, and their future evolution may very well differ across the scenarios.



EXERCISE

In small groups for each of the themes discussed above, take the list of drivers and categorize them using Figure 8. Present the diagrams in plenary and discuss the drivers that fall in the category “high importance and high uncertainty”



f) Creating a scenario framework

Purpose

To establish the scenario framework using the critical uncertainties.

Output(s)

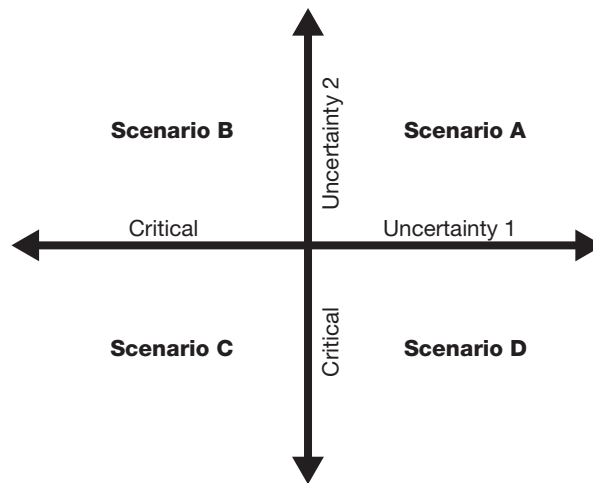
A set of clearly defined scenario bases.

The critical uncertainties identified in Step 6 capture in a very simplified, orderly way a set of fundamental ways the future can evolve. Step 7 provides a simple procedure for creating a scenario framework, and thereby defining four distinct scenarios.

Steps

Picture two clearly dominant critical uncertainties (say, CU#1 and CU#2, Figure 8), each of which could evolve in two distinct ways. Define a scenario grid as shown in Figure 9. This framework reflects the four possible combinations of how CU#1 and CU#2 can evolve, and thus four possible future worlds.

Figure 9: Four possible futures define the scenario framework from two critical uncertainties



For a simple example, consider a case where scenario participants have identified two critical uncertainties, CU#1, which refers to the sensitivity of ecosystems to human pressures, and CU#2, which refers to the future development of technology. Assume that participants have concluded that the sensitivity of ecosystems to human pressures (e.g., GHG emissions, coastal erosion, fishery exploitation) could be described as falling along the follow spectrum:

Sensitive global ecosystem

High level of sensitivity, with feedbacks that lead to large impacts, even from relatively minor human pressures.

Resilient global ecosystem

High level of resilience and ability to adapt and recover, leading to modest impacts from even relatively large human pressures.



Assume also that the participants have decided that future development of environmentally relevant technologies (e.g., renewable energy, environmentally sensitive agricultural technologies) could be described as falling along the following spectrum:

Technological stagnation

Slow and incremental, with minor potential for addressing environmental challenges with technological fixes.

Technological innovation

Rapid and fundamental, with considerable potential to address environmental challenges with technological fixes.



Combining these into their four possible combinations defines four scenarios.

Scenario A: The world proves to be an ecologically resilient world, with high potential for innovation in environmentally relevant technologies.

Scenario B: The world proves to be ecologically vulnerable, but with high potential for innovation in environmentally relevant technologies.

Scenario C: The world proves to be ecologically vulnerable, with low potential for innovation in environmentally relevant technologies.

Scenario D: The world proves to be ecologically resilient, but with low potential for innovation in environmentally relevant technologies.

This simple approach yields four distinct scenarios in the situation where there are two critical uncertainties and each has two fundamentally distinct future paths worth exploring. There would be more than four distinct scenarios, if there are more than two critical uncertainties, and/or if any of them has more than two possible paths worth exploring. In such a case, you could enumerate all combinations, and thus all possible scenarios.

Consider the example illustrated in the table below, in which there are three critical uncertainties. Critical Uncertainty #1 has two fundamentally distinct possible future evolutions (1a and 1b). Likewise, Critical Uncertainty #2 has two fundamentally distinct possible future evolutions (2a and 2b). Critical Uncertainty #3, has three fundamentally distinct possible future evolutions (3a, 3b and 3c). This leads to a total of twelve combinations ($2 \times 2 \times 3 = 12$), and thus twelve possible scenarios. This is a large number of scenarios, and it probably will not be possible to elaborate and clearly present them all. Thus, it generally makes sense to pare the possible scenarios down to a number that is manageable given the time, resources and intended audience. In many cases, some of them will likely be less coherent than others. For example, if in the case described above a third critical uncertainty were to be the general rate of economic development, defined as low, medium and high. Many people would argue that high rates of economic development are not plausible in a world of technological stagnation; thus any combinations of the two would not be worth pursuing.

	Critical Uncertainty 1 (1a, 1b)	Critical Uncertainty 2 (2a, 2b)	Critical Uncertainty 3 (3a, 3b, 3c)
Scenario 1	1a	2a	3a
Scenario 2	1a	2a	3b
Scenario 3	1a	2a	3c
Scenario 4	1a	2b	3a
Scenario 5	1a	2b	3b
Scenario 6	1a	2b	3c
Scenario 7	1b	2a	3a
Scenario 8	1b	2a	3b
Scenario 9	1b	2a	3c
Scenario 10	1b	2b	3a
Scenario 11	1b	2b	3b
Scenario 12	1b	2b	3c

Having completed the steps above, consider whether the result is a meaningful set of scenario bases to explore. Do they span a sufficiently wide range of possible futures? Do they allow you to take into account the most important concerns of the participants? If not, return to the discussion of drivers and see whether important issues have been left out, or if possible future evolutions of some drivers have been neglected.

EXERCISE

In plenary, do one of the following: a) select two of the critical uncertainties identified above and create a scenario framework, or b) group the critical uncertainties identified above into two clusters (e.g. technological developments and external policy decisions) and use these clusters to create a scenario framework:



7.3 Developing and testing scenarios

With the foundation established, it is now possible to more fully develop the actual scenarios, as well as undertake more detailed policy analyses. Depending upon the choices made, greater or lesser emphasis will be placed on the narrative and quantitative aspects in developing the scenarios. In addition, the nature of the policy analysis desired will affect both the development and use of the scenarios.

g) Elaborating scenario narratives

Purpose

To create a detailed, compelling description of the scenario.

Output(s)

A (several page long) scenario narrative.

Steps

For *each* scenario do the following steps.

1. Current state and trends. Lead a discussion among the stakeholders of aspects of today's world that seem to represent characteristics of the particular future scenario being developed. Explore each to identify as many "seeds of the future" as possible. These will help flesh out a plausible picture of how our current world could evolve into the future depicted in the scenario.
2. End picture. Lead a discussion among the stakeholders of the end vision of the scenario. Once the critical uncertainties have been resolved, what would the world look like? Add detail and texture that will help round out the end vision of the scenario, and create an integrated, self-consistent snapshot of the end state. Consider each theme and driver, and provide some detail. Consider what aspects of life have changed for better or worse. Consider what challenges have been resolved, and what challenges have emerged and still lie ahead.
3. Timeline. Lead a discussion to connect the current state to the end picture through a plausible historical route. Consider the interactions among the themes and how they would evolve together in a self-consistent manner. You might want to draw on a poster paper or whiteboard a timeline spanning the period from present to the time horizon of the scenario, and have the group brainstorm events occurring at specific times. Consider each theme and each driver. (You might want to draw several parallel timelines to keep track of different themes or drivers.) Consider the challenges that have been resolved or that have emerged, and reflect these in events on the timeline.
4. Using the current state, the end picture and the timeline, your group can now expand these to create a coherent narrative. Add detail and texture that will help round out each scenario and create an integrated, self-consistent and compelling storyline. Your group might want to consider describing crises and shocks, or branch points where two scenarios diverge because of different societal decisions or key events. Your group might also want to use novel and compelling ways of presenting information within the narratives, such as news stories, advertisements, memoirs and "day-in-the-life" vignettes.



5. While developing your scenario narratives, create a name for each scenario. Try to find a name that captures the essence of the scenario and differentiates it clearly from the others. It is also useful if there is some link across the set of names that helps to capture the key differences between the scenarios.



Exercise

In four groups, develop plausible short stories for each of the scenarios defined by the scenario framework specified in the previous exercise. The stories need to present the situation at the end of the time horizon as well as the path between the present day and that time. What happens with the critical uncertainties, inevitables, and main themes needs to be clear in the stories. In addition, the stories need to provide information on policies, goals, and targets identified in earlier exercises.

Present these short narratives in plenary and consider their main differences.



h) Undertaking the quantitative analysis

Purpose

To enhance and elaborate the scenario narrative with quantitative information.



Output(s)

Specific, scientifically defensible quantitative information.

Steps

The quantitative analysis supports and complements the scenario narrative, and can help highlight and remove internal inconsistencies within these. Steps in a quantitative analysis are:

1. Determine the approach to be used for quantification (e.g., which tools and models to use, how these will be linked to each other, and how these will be informed by/inform the narratives).
2. Assemble the necessary data and relationships.
3. Use the tools and models to produce the quantitative estimates.

Comments

For quantification, it is best to use models that are as simple as possible without being simplistic, are transparent, rely on widely available data, and can be applied and compared across widely differing circumstances. Quantification ideally will provide much more policy-relevant information than qualitative descriptions alone. It can provide a measure of the magnitude of the challenge and the scale of the needed policy response.

Models that can be used interactively are advantageous because they can be used in working sessions to provide quantification, leading to a revision of the narrative and a next round of quantification. In any case, iterations between storylines and models are an important part of a scenario process including quantification.

The selection of models to be used in the quantification depends on the issues emphasized in the scenarios. For GEO-3, for example, initial quantification for two of the scenarios was done using the PoleStar software tool (Raskin and others 2002). While PoleStar offers a flexible and easy-to-use accounting framework for organizing economic, resource and environmental information for alternative scenarios, the scenario authors agreed that the analysis needed to be complemented by further information on environmental impacts. This could only be provided by other, more spatially explicit and process-oriented modelling tools. Therefore other models (i.e., IMAGE from RIVM, WaterGAP from CSER, AIM from NIES) were introduced to make the data more consis-

tent across regions and with the narratives, and to harmonize input data (e.g., growth rates of GDP per capita). Bakkes and others (2004) show how the quantification of the GEO-3 scenarios was carried out and describe the tools that were used. This is also in line with what was done in the Millennium Ecosystem Assessment and has been done in GEO-4.

The Africa Environment Outlook (UNEP 2006) used two tools to provide quantification of their scenario narratives: the Polestar software tool developed by the Stockholm Environment Institute (www.sei.se); and T21, a tool for integrated, comprehensive development and policy planning developed by the Millennium Institute (see <http://www.threshold21.com/collaborative.html>). In the latter case, the existing T21-Malawi Model was customized to enhance its environmental modelling capability for the production of the case study.

Box 9: Linking narratives and numbers in scenario development

The results of the quantification process should provide additional, complementary information about the scenarios, specifically regarding the major themes and drivers for which indicators had been selected. If some of the results conflict with the narrative description of the scenario, these should be examined carefully. It might be the case that results of the quantification reflect complex interactions more correctly, particularly where large numbers of calculations are needed to go from assumptions to conclusions; alternatively the models used may not have captured key relationships described in the narrative, particularly where these are not amenable to traditional methods of modelling. Thus, those developing the quantification and the narrative need to explore important differences, and both should be prepared to revise their respective representations of the scenarios being developed.

EXERCISE

Explore scenario quantification using the International Futures model developed by Barry Hughes at the University of Denver. For this exercise computers and access to the internet will be required (the model can also be loaded onto the computers directly, but this description assumes that this is not the case as many participants will have their own computers).

IFs is a world model, representing the world in multiple regions as well as individual countries. It allows you to forecast developments in demographics, food and agriculture, energy, economics, politics, and the environment from 2000 to 2100. Using IFs you can make multiple forecasts based on changes in assumptions about the workings of the world and about government policy choices. After making such changes you can run the model and then display the results in tabular or graphical form. Through comparison of forecasts you can analyze the leverage we have to affect our world and the policies that may improve our futures. IFs has been used in the scenario development for GEO-4.

Go to <http://www.ifs.du.edu>

Select “Web-Based IFs”

Select Scenario Set “UNEPGEO” (These are the GEO Scenarios described earlier in this module)

Select time horizon

From here on you have several options, including displaying scenarios or actually carrying out scenario analysis. Please note that there is an extensive Help system that allows you to learn more



about the model and how to use it. For this activity, in order to illustrate the link between narratives and quantification, select “Display”.

Select your country and look at a few key indicators, e.g. carbon emissions and water usage, for the four GEO scenarios. Discuss those differences by reflecting on the overall narrative of each scenario.



i) Exploring policies

Purpose

To explore the feasibility, appropriateness, effectiveness and robustness of various policies.

Output(s)

Identification of further potential policies beyond those elaborated in step c (Identifying Themes, Targets, Potential Policies and Indicators), and information about the feasibility, appropriateness, effectiveness and robustness of particular policies (including combinations) in shaping and/or coping with the range of scenarios.

Steps

As discussed in the previous section, the nature of policy analysis can differ markedly across and sometimes within scenario exercises. In some cases, the introduction of policies into the scenarios will occur at a very early stage, e.g., they may represent one or more of the key uncertainties defining the scenarios. In other cases, the exercise may involve developing scenarios which, from the standpoint of the users, are ‘incomplete’ in that they do not include specific policy assumptions, and are only finalized with the introduction of potential policies. In either case, it is important to reflect upon and analyse the feasibility, appropriateness, effectiveness and robustness of particular policies. This should be done, in part, by comparing the scenarios as defined by key indicators, against key goals and targets, with and without the inclusion of specific policies.



EXERCISE

For the scenario narratives developed above discuss in groups the particular policy areas that would be most relevant for inclusion in the scenario. Which new policies would be critical to reach the defined endpoint? Which existing policies would need to be modified to reach the endpoint?

More advanced users can try to implement some basic aspects of their own scenario narratives in International Futures (IF).

Discuss the results in plenary.



7.4 Communication and outreach

Module 7 of this training manual deals with the communication of the assessment, and Module 3 deals with design of an impact strategy. The entire training manual is designed to provide capacity building in environmental and sustainable development assessment processes. That said, there are special issues related to communication, outreach and capacity building that are of particular importance to scenario development.



Because uncertainty is at the core of the development and use of scenarios, the communication of the results of any scenario exercise must recognize the limitations as well as the value of such a process. No scenario exercise should be expected to capture all the intricacies of the world. It is as important to describe clearly the purpose and scope of a scenario exercise, and the assumptions underlying any scenario or set of scenarios as the results of any analysis based upon a particular scenario or set of scenarios. Scenarios are intended to explore what could happen, not what will



happen. If this is not clearly communicated, there is great potential for scenarios to be misused and misinterpreted.

The extent and manner of communication of scenarios is particularly important if the scenarios are to succeed in inspiring new visions of the future. Note, for example, the success of the Mont Fleur scenarios, which were published first in a newspaper and thus, widely communicated (see section 4, above). This kind of communication obviously needs a language and style of presentation that is suitable for a broad audience.

Outreach is important in order to generate a discussion with all stakeholder groups about the content and implication of the scenarios. This provides “buy-in” to the results of the scenario exercise from a group much larger than that involved in development and analysis of the scenarios. It also can provide valuable feedback on the results. This can be achieved through a series of workshops in which the scenarios are presented and discussed.

Finally, as discussed above and depicted in Figure 4, communication and outreach should take place throughout the scenario process, and not merely occur at the end. The involvement of a range of stakeholders in the various stages of the process should be seen as part of the communication and outreach effort. In fact, experience would indicate that such engagement is potentially the most effective form of communication and outreach.

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Module 6

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