PBL Netherlands Environmental
Assessment Agency

BUILDING SCENARIOS FOR ENVIRONMENTAL, NATURE AND SPATIAL PLANNING POLICY

Guidance Document

Building scenarios for environmental, nature and spatial planning policy
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Building scenarios for environmental, nature and spatial planning policy: a guidance document

The Hague, 2019
PBL publication number: 3434

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Acknowledgements
We would like to thank the following PBL colleagues for sharing their insights during interviews and scenario platform meetings: Aldert Hanemaaijer, Alexandra Tisma, Andries de Jong, Barry Zondag, Daniëlle Snellen, Detlef van Vuuren, Dorien Manting, Gert Jan van den Born, Jan Bakkes, Jan Ritsema van Eck, Jan Schuur, Marcel Kok, Martijn Eskinasi, Nico Hoogervorst, Nico Pieterse, Peter Janssen, Petra van Egmond, Ton Dassen and Ton Manders.

Graphics
PBL Beeldredactie

Layout
Xerox/OBT, The Hague

Production coordination
PBL Publishers

PBL Netherlands Environmental Assessment Agency is the national institute for strategic policy analysis in the fields of the environment, nature and spatial planning. We contribute to improving the quality of political and administrative decision-making by conducting outlook studies, analyses and evaluations in which an integrated approach is considered paramount. Policy relevance is the prime concern in all of our studies. We conduct solicited and unsolicited research that is both independent and scientifically sound.

Contents

1 Introduction

1.1 Wide range of scenario practices in PBL

PBL Netherlands Environmental Assessment Agency, the national institute for strategic policy analysis in the fields of the environment, nature and spatial planning (PBL, 2016) is regarded as a leading scenario developer in the Netherlands (Van 't Klooster, 2007). It works to improve the quality of political and administrative decision-making by conducting outlook studies, analyses and evaluations, in all of which an integrated approach is considered paramount. PBL conducts policy-related research, not just to contribute to the decision-making process of the Dutch Government and Parliament, but also for other government authorities and international and non-governmental organisations. PBL conducts solicited and unsolicited research that is both independent and scientifically sound.

PBL and its predecessors have a long and rich history in the development of outlook studies.[1] Publications include various scenario studies relating to the environment, nature and spatial planning, such as *Zorgen voor morgen* (Concern for tomorrow (RIVM, 1988)), *European nature in the plural* (PBL, 2017[a]) and the *Ruimtelijke verkenning 2019* (Spatial outlook 2019 (PBL, 2019)). PBL also develops scenarios in cooperation with other national and international organisations, on subjects such as global climate change, spatial developments in the EU and spatial and economic developments in the Netherlands. Past studies include *Climate Change 2014* (IPCC, 2015)[2], *Spatial scenarios and orientations in relation to the ESDP and cohesion policy* (IGEAT et al., 2006) and *Welfare, Prosperity and the Human Environment* (CPB and PBL, 2015[a]).

The first question, therefore, is what are scenarios? Various descriptions may be applied, and this can cause some confusion. However, as this guidance document describes the many different types of scenarios that are developed and the different methods used to do this, we here apply a broad definition: *Scenarios explore possible futures and the developments that may lead to these and/or desirable futures and the developments required to achieve these* (Dammers et al., 2011).

PBL scenario studies are usually carried out to support national and international environmental, nature and spatial planning policy. However, studies may also zoom in on a particular region, or they may consider developments in demography, the economy, energy, the food supply, water management, or some other area. Scenarios may be developed to serve a variety of purposes. For example, some scenario studies explore future developments relevant to government policy and the policy challenges that such

Scenario studies carried out by PBL and its predecessors

Source: PBL

developments present. Others help structure policy dialogue, for example by exploring different future visions relating to a certain policy issue. Yet other scenario studies explore the effectiveness of government policy under different future situations.

Because of the different fields in which the scenario studies are carried out, and because of their different purposes, PBL develops different types of scenarios. Some scenarios are largely quantitative, while others are much more qualitative. Some scenarios focus on the current dominant trends in society and policy, while others explore alternative developments, and yet others explore possible or desirable futures.

These many different types of scenarios mean that different methods are used to build them. Most of the PBL scenarios named above are based on model calculations. However, other scenario studies use essays, stakeholder participation and/or particular designs, examples of these being *Adapting EU governance for a more sustainable future* (Clingendael and PBL, 2009), *Duurzame stad* (The Sustainable City (PBL, 2010)) and the *Ruimtelijke verkenning 2019* (Spatial Outlook 2019 (PBL, 2019)).

The different approaches taken and the different methods used reflect the eclectic nature of scenario development, as it is not possible to identify a single, clearly defined method to apply (Dammers et al., 2011). Even so, shifts in research conceptions that have taken place over the years mean that there is now a greater focus on integrating knowledge, which affects the approach taken and the methods used (Petersen et al., 2011). The wide variety in scenario practices has some important benefits. For example, it means that PBL has not only gained considerable experience in developing scenarios, but also in the different ways in which this can be done. This abundance and diversity of experience makes it possible to improve and innovate, for example by combining different methods. The situation of many different scenario practices also has its disadvantages. For example, it can cause confusion among some researchers regarding how to go about building a set of scenarios, with the result that they tend to reinvent the wheel and develop their own approach, rather than build on experiences gained in earlier projects (WRR, 2010). As this can involve long, complex decision-making processes, it can result in a lack of focus and project delay.

Another disadvantage is that some researchers may be used to a certain method, and less acquainted with others. They may therefore use the same method time and time again, which is not conducive to innovation in scenario development. For example, PBL scenario studies have until now made little use of particular designs, despite PBL's expertise in this area, and despite several attempts having been made to do so. Examples of such an approach are *Waar de landbouw verdwijnt* (Disappearing agricultural landscapes (RPB, 2005)) and *Duurzame stad* (The Sustainable City (PBL, 2010)).

Yet another disadvantage of the variety in scenario practices is that it can complicate decision-making; for example, regarding the steps to take in a scenario project, such as the number of scenarios to include. Some scenario developers prefer to use just one scenario, for the sake of simplicity and transparency and to limit the time required.

The client (party commissioning the scenario study) may also find one scenario sufficient. Others, however, believe that long-term developments and their impacts on the physical environment are so uncertain that more than one scenario should always be developed (Van Vuuren et al., 2014), and that it is their responsibility to convince the client of this.

1.2 Purpose of this guidance document

The aim of this guidance document is to help users maximise the advantages named above and minimise the disadvantages. To achieve this, we carried out a comprehensive literature study and interviewed project leaders of scenario studies at PBL. The main goals of the guidance document are to:

- help researchers make optimum use of the knowledge and experience available within PBL when developing scenarios;
- facilitate scenario studies by providing an overview of the steps to be taken and the decisions to be made;
- help improve the quality of scenario studies in terms of policy relevance, scientific excellence and objectivity;
- facilitate partnerships with institutes in national and international consortia that also carry out scenario projects.

This guidance document describes the steps to be taken in a scenario study, the decisions to be made, and the enabling and constraining factors created by these decisions. It therefore differs from guidelines, which dictate how to build scenarios. We believe that the method chosen depends on several factors, such as the purpose of the scenarios, the types of scenarios being built and the available resources. There is therefore no single best way to build scenarios.[3] The aim of this guidance document is therefore to help scenario developers make well-balanced decisions, not to make use of every conceivable possibility, which would create unnecessarily large and complex scenario studies. Although plenty of literature is available on scenario building, both in the Netherlands and other countries, this guidance document does fill a gap in the literature and meet a certain need, both of PBL and other scenario developers. One reason for this is that much of the available literature is relatively old, and therefore does not consider recent insights into scenario building (Becker, 1994; Becker et al., 1982; Von Reibnitz, 1988; Wright and Goodwin, 1998).

Furthermore, scenario studies vary slightly in their focus. For example, some publications focus on building scenarios for individual organisations (often private organisations), not for policies in the public domain, such as environmental policy (e.g. Lindgren and Bandhold, 2003; Nekkers, 2006; Shell, 2008; Van der Duin, 2012). One important difference between these two categories is the many different organisations involved in policy-making in the public domain. The relationships between these organisations may vary, and therefore the objectives and target audiences of the scenarios, as well as the ways in which they are used, are less clear-cut than in the private sphere. There is also more blurring between policy and autonomous developments in the public sphere, which

means that insights gained into scenario building for the private domain cannot be simply transferred to the public domain.

Some publications do address scenario building for the public domain (Van Asselt et al., 2010; Van 't Klooster, 2007; Van Notten, 2005), or the use of scenarios in this domain (Dammers, 2000; De Man, 1987). However, although such studies provide useful insights into the practices associated with building and using scenarios, they do not provide concrete suggestions for the steps to be taken in a scenario study and the corresponding decisions that need to be made.

Other publications reflect on the theory and practice of outlook studies for the public domain, including scenario building (In 't Veld, 2001; WRR, 2010). These publications have produced some interesting insights, based on an analysis of the literature, empirical research, expert essays and the authors' own knowledge and experience. However, these publications provide very few suggestions on how to actually carry out a scenario study. Although the guidance document produced by the Ministry of the Interior and Kingdom Relations (BZK, 2011) does to some extent do this, it focuses more on policymakers than on scenario developers. It therefore considers the decisions to be made from a global point of view, rather than describing which methods to apply in which situations.

In this guidance document, PBL makes use of the insights provided in the literature wherever possible, particularly if they are relevant to current practice and scenario development for the public domain. These insights may be based on practice or on theory, and they are translated into concrete scenario projects for the physical environment – the focus of PBL research. Where necessary, we have adapted, specified and commented on these insights, based on interviews with project leaders and the knowledge and experience available within PBL.

1.3 How to use this guidance document

This guidance document is primarily intended for PBL management and researchers who are involved in scenario building, such as project leaders, the managers who have ordered such studies, and project team members working on scenarios. PBL staff with some experience in scenario building could use the guidance document to find out whether a scenario study, or a part of it, could be carried out differently. Others may use it to learn more about the options during subsequent steps in the scenario-building process.
The guidance document may also contain interesting insights for other assessment agencies, research institutes and university departments involved in scenario building, irrespective of whether they are working with PBL. The same applies to ministries and other government authorities who commission scenario studies. Some sections of the guidance document may also be relevant to scenario users, in particular Chapter 2, which addresses the various applications of scenario studies. *Using scenarios for environmental, nature and spatial planning policy – a guidance document* (Dammers, Van 't Klooster and De Wit, 2019)

addresses the many different areas of application and ways in which scenarios can be used in more detail.

This guidance document can be used in the different phases of a scenario project. At the start of a project, it helps ensure that the project is set up properly. It helps the proper decisions to be made regarding the target groups of a scenario study, the objectives, the types of scenarios to be developed and the scenario components required, the methods to be used and the project organisation.

As a project progresses, the guidance document can be used to monitor progress and consider where adjustments need to be made. This may be required if the scenario project objectives change based on new information or policy developments. For example, a project may initially focus on assessing the feasibility of current environmental policy, while a change of cabinet makes it more relevant to explore various alternatives.

At the end of a scenario project, the guidance document can be used to evaluate the project, the steps taken, the decisions made, the outcomes, and the lessons to be learned for future scenario projects. The guidance document therefore contributes to quality assurance and the learning process at PBL.

A checklist and presentation have also been produced to accompany this guidance document (to download from www.pbl.nl/en). The checklist and the presentation summarise the steps and the decisions described in the guidance document, and the three documents should be used in conjunction. The checklist and the presentation are based on the guidance document, and the guidance document provides background information when working with the checklist and the presentation. For ease of use, each of the three documents is structured in the same way. The presentation could be used at a meeting attended by the project leader, the team members and, possibly, the client, so that everyone has the opportunity to discuss the main steps and decisions, express their views and make well-informed decisions. The checklist can be used to make sure that none of the main steps or decision points are missed. This is a useful work of reference, for example, when writing the project plan, applying a method such as stakeholder participation, or evaluating the project. The guidance document authors will be more than happy to provide any assistance required to a PBL or partner scenario team.

The guidance document is structured as follows. Chapter 2 describes the preparation phase of a scenario project. Note that, if the guidance document is used at the start of a project, this is the only chapter required. Chapter 3 addresses the components of a scenario study, and Chapter 4 describes the methods that may be used. Chapter 5 covers project completion. If the guidance document is used during a project, in other words in the implementation or completion phases, it is recommended to consult Chapters 2 to 5. The same applies if the guidance document is used to evaluate a completed project.

Notes

1. PBL was formed by the merger of the Netherlands Environmental Assessment Agency (MNP) and the Netherlands Institute for Spatial Research (RPB).
2. *Climate Change 2007* is the fourth assessment report by the Intergovernmental Panel on Climate Change (IPCC). This report is based on IPCC scenarios published in 2000 and developed in cooperation with PBL.
3. This guidance document aims to describe the steps and decisions as clearly as possible, without over-simplifying. Most PBL scenario studies are large, complex and eclectic, and many decisions tend to be 'both/and' rather than 'either/or', such as the decision to develop scenarios with both a qualitative and a quantitative nature (future narratives supported by numbers). It is for this reason that we do not use presentation forms such as decision trees.

2 Preparation phase

2.1 Introduction

Scenario development is, in most cases, a complex process, and we therefore recommend taking a project approach. This means that certain activities are carried out in a certain timeframe, using certain resources, for a particular purpose, together with other individuals or organisations (Nekkers, 2006). The preparation phase is an important phase of the scenario project, as it is in this phase that we decide whether the project is useful, effective and feasible. In fact, the preparation phase largely determines the ultimate success of a project. Although the preparation phase can be time-consuming, this investment will be easily recouped during the rest of the project (Bos and Harting, 2006). In this chapter, we discuss the preparation phase of the scenario project. We address the most important elements of this phase, including outlining the scenario project, defining the deliverables, selecting the methods, and deciding on the project organisation. We also address the most important decisions that need to be made in the preparation phase and the opportunities and limitations that these decisions imply. Table 2.1 summarises the main elements and decisions, and the sections in which they are discussed.

2.2 Outline scenario project

The first step in outlining the scenario project is usually to decide on the target audience (Section 2.2.1). Whether a scenario project is being carried out at an organisation's own initiative or for a client, it is important to identify the main target groups as early as possible in the project. Interviews with these target groups can help in defining the project objectives (Section 2.2.2) and deciding on the project scope (Section 2.2.3); in other words, the main themes, the geographical scales and the time horizon. We also need to decide whether the best solution really is to develop scenarios, or whether forecasts or speculations may be more suitable (Section 2.2.4).

2.2.1 Identify target groups

When preparing to carry out a scenario study, the first question to ask is who the study is for. We therefore want to identify the target audience, or the intended users of the scenario project. An overview of these users is given in Figure 2.1.

Target groups may include policy advisers for government authorities such as ministries, provinces, water boards or municipalities, or policy advisers in non-governmental organisations such as agricultural, commercial or environmental organisations.

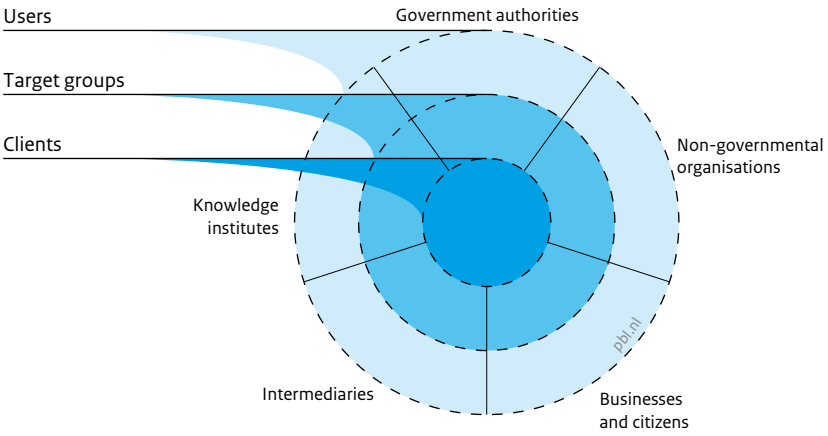
Table 2.1
Phase elements and decisions

Elements	Decisions
Outline scenario project	• *Identify target groups:* e.g. government authorities, non-governmental organisations, businesses, research institutes, at national, European, global or regional level (Section 2.2.1) • *Determine objectives:* achieve new insights, support communication and/or encourage engagement (Section 2.2.2) • *Define project scope:* main theme, geographical scales, time horizon (Section 2.2.3) • *Decide whether or not to build scenarios:* scenarios, forecasts or speculations (Section 2.2.4)
Define deliverables	• *Choose scenario types:* qualitative or quantitative, level of exploration, descriptive or normative (Section 2.3.1) • *Determine scenario components:* baseline scenario, contextual scenarios, policy scenarios, policy messages
Select methods	• *Models:* e.g. decide on components to model, select model, choose databases (Section 2.4) • *Essays:* e.g. existing scenarios, analyses, visions (Section 2.4) • *Stakeholder participation:* e.g. scenario workshops, Open Space conferences, interviews (Section 2.4) • *Particular designs:* e.g. type of images, media (Section 2.4)
Organise scenario project	• *Determine project size:* large, small and/or mini-project (Section 2.5.1) • *Assemble team:* e.g. range of disciplinary backgrounds, qualities (Section 2.5.2) • *Draw up project plan:* risk assessment, quality assurance, communication (Section 2.5.3)

Other potential target groups include company employees (e.g. of power companies, construction companies or banks) and citizen groups. Knowledge institutes, such as universities and private research institutes, or intermediaries such as consultancies, may also be scenario users. Clearly, target audiences for scenario projects that focus on European and global levels will usually be much broader than those with a national or regional focus. Such target audiences may include international organisations (EU, OECD, UN) and their member countries, as well as internationally active non-governmental and commercial organisations (WWF, ILO, oil producers, food producers).

Clients form a specific target group, as they are not only the intended users, but they are also the party authorising the particular scenario study, providing the funding and setting various conditions, such as the main theme, the methods to be used and the date of publication. Although PBL conducts many scenario studies at its own initiative or as part of its statutory responsibilities, it also builds scenarios for clients. This is particularly true in the case of international scenario studies, with clients such as the UN, the OECD and the EU. Other scenario users may not directly belong to a particular target group but may use the scenarios to develop or implement policy.

Figure 2.1
Potential scenario study users



Source: PBL

As mentioned above, it is important to identify the main target groups at the start of the project. This ensures that the scenarios are relevant to the users, that the main users are able to contribute to the scenario-building process, and that the scenarios are actually used. It also gives the scenario developers an idea of the extent to which the users are acquainted with scenarios, how they think they will use them and what for, and what their ambitions are with relation to the scenarios. It may therefore be useful to conduct a target audience analysis, which involves interviewing a wide range of potential user groups (Bos and Harting, 2006).

Such interviews should take the form of an open dialogue, as potential users do not always have a clear idea of what scenarios are, what they can be used for or how they are built. They may confuse scenarios with forecasts (Hoogervorst, 2011) or they may automatically request four scenarios based on the four quadrants, whereas two or three scenarios may be more suitable (WRR, 2010). It is therefore important to ask the right questions, while also managing expectations. This helps the client understand what he or she can and cannot expect from the scenarios. A useful resource for conducting an open dialogue is a 'scoping document' (Text Box 2.1).

Text Box 2.1 Scoping document

A scoping document outlines the preliminary ideas relating to a particular scenario project and can be used as a starting point for open dialogue with the client and other target groups. The scoping document may include suggestions for scenario study objectives and themes, for the types of scenarios to be built, for the main scenario components and for the methods to be used, and may briefly describe the enabling and constraining factors. It may also provide more information on the scenario components, for example in the form of a mini-project (Section 2.5.1). PBL has until now mainly produced scoping documents for international scenario projects such as the IPCC *Fifth assessment report* synthesis report (2014). However, scoping documents can also be used for national projects.

2.2.2 Determine objectives

The objectives of a PBL scenario study can vary. To determine the objectives, it is important to consider the context in which the scenarios will be used; in the case of PBL, strategic policy at the global, European, national or regional level, with a focus on the physical environment and relevant scientific research. Strategic policy is policy that focuses on general objectives and policy measures, other than tactical policy, which focuses on more specific goals and measures, or operational policy, which focuses on implementation (Dammers, 2000). Strategic policy is therefore very broad in terms of actions, time and place. It is developed to influence the actions of large groups of actors (members of the public, companies, non-governmental organisations or other government authorities) in a large physical domain (region, country, continent or world) and in the long term (over several decades).

The nature of strategic policy means that, while it has a significant impact, it also entails high levels of uncertainty. Strategic policy can involve significant investment (e.g. in water defences) and have far-reaching consequences (e.g. on flood safety), but at the same time we often do not know exactly what its effect will be. Furthermore, these effects depend not just on the policy itself, but on various societal and physical developments that are also uncertain in the long term (e.g. sea-level rise, and demographic and economic developments behind the flood defences). Such developments may slow economic growth due to the high costs involved, or they could stimulate economic growth if investments are made in new technologies that can then be exported (which depends, in turn, on factors such as a focus on innovation in business).

This combination of significant impacts and high uncertainty means that strategic policy always runs the risk of failing to achieve the intended result, or even of complete policy failure (Bovens and 't Hart, 1996; Van der Steen, 2016). In the first case, policy is inefficient and ineffective (e.g. if far-reaching measures fail to contain climate change); in the last, spending may be way over budget, or unintended effects may overshadow the intended effects (e.g. in the case of accidents involving subsurface CO_2 storage).

Table 2.2
Potential scenario project objectives

Objectives	Aspects
Achieve new insights	• Relevant future developments, their interactions and impacts • Possible discontinuities, the conditions under which they could take place and their impacts • Policy alternatives and their intended and unintended impacts • Main knowledge gaps
Support communication	• Input to strategic policy and research dialogue • Open dialogue on expectations and ambitions for the future • Structure dialogue about the future
Encourage engagement	• Support for existing strategic policy or research • Inspiration and support for alternative policy or research • Better management of conflicts relating to strategic policy and research

We develop scenarios to better manage the complexity and uncertainty inherent to strategic policy, and to reduce the chance of poor policy outcomes, or even policy failure. Three types of complexity and uncertainty can be defined: cognitive, communicative and normative. Scenarios can help us better manage these, for example by providing new insights into the future situation, by supporting communication about the future or by encouraging engagement in future policy (Dammers, 2010[a]). These are therefore directly related to the scenario project objectives. A summary of the scenario project objectives and relevant aspects is given in Table 2.2.

Achieve new insights

As noted above, strategic policy needs to take a wide range of societal and physical developments into account, even though these are often uncertain, particularly in the long term. We cannot simply rely on information about past events, because this concerns ongoing developments and their effects, while the future may involve new developments with unforeseen effects (Dror, 1988). We are therefore faced with cognitive complexity and uncertainty.

Scenarios can help us manage this cognitive complexity and uncertainty (see also the Guidance for uncertainty assessment and communication (*Handreiking voor omgaan met onzekerheden*). They help us understand the main developments that impact on a certain issue, the most important interactions between these developments, the course that these developments may take, the combined impacts of these developments on the issue, and any relevant gaps in our knowledge (Wack, 1985; EEA, 2001).

Some scenario studies, such as the IPCC scenarios, have as their objective to integrate fragmented scientific knowledge, to assess the level of scientific consensus and to disseminate knowledge for policymakers (Kok et al., 2008). Scenario studies may also help identify discontinuities, such as a new economic crisis or a technology breakthrough, and

the expected impacts of these. Scenarios may also provide information on policy alternatives, their suitability and effectiveness under different circumstances, and any unintended effects. Such insights can help users take a broader view of the policy issue and any contributing factors, identify new issues or new aspects to the policy issue, steer strategic policy in a new direction and therefore contribute to vision building, or develop a new research agenda (Kroeze, 2010; Westhoek et al., 2006).

Text Box 2.2 Set of scenarios used as a wind tunnel

The insights that scenarios produce can also be used to assess and optimise the robustness of policy strategies, in the same way that an aeroplane is tested under various conditions in a wind tunnel (De Ruijter et al., 2011). This is true for context scenarios but not for policy scenarios (Sections 3.3 and 3.4). If a certain strategy is successful under scenario A but not under scenarios B or C, the strategy can be tweaked until it is successful under all scenarios. This may have the effect of making the strategy less suitable and effective under the first scenario, but it enables a strategy to be developed that is successful under all types of future situations.

Support communication

Strategic policy development and analysis usually involves many different actors (see the target groups named above). These actors rely on each other during the preparation and implementation phases of the policy, for the knowledge they own, the decisions they take and the actions they carry out. However, this is complicated by their different frames of reference and, by extension, their different expectations and ambitions concerning the future situation and the research required. The different actors may think that they understand each other, but very often they are talking at cross purposes. They lack the common language that would enable them to discuss their different expectations and ambitions (Weick, 1995), and this stands in the way of a clear dialogue about future developments. We are therefore faced with communicative complexity and uncertainty.[1]

Scenarios can help manage communicative complexity and uncertainty, for example by facilitating a strategic dialogue with the different target groups so that they can discuss their varying expectations and ambitions (Petersen et al., 2006; Shell, 2008). Such dialogue can take the form of public debate or policy dialogue. Scenarios can also help researchers to discuss current and potential knowledge gaps. By presenting a variety of future visions in which relevant developments each follow a different pathway, each user can recognise something of his or her expectations and ambitions in the scenarios. This makes it easier for users to express their own expectations and ambitions, and to understand those of other users. Similarities between the future visions (i.e. addressing the same issue, undergoing the same development or impacting the same issue) can also serve as a common point of reference for users during the dialogue process. Scenarios therefore help structure the dialogue with relation to users' expectations and ambitions for the future.

Encourage engagement

Preparing for and implementing strategic policy also requires a certain level of *engagement*. As described above, a wide range of many different actors are involved in strategic policy-making. These actors may support or oppose the policy in various ways and to varying degrees, depending on their expectations and ambitions. Engagement implies more than simply providing passive support by not opposing policy (e.g. by exercising the power to delay legislation). Engagement means providing active support, for example by making expertise, manpower or resources available. Such engagement is particularly important when trying to achieve a transition, such as that to a low-carbon energy supply.

However, this support cannot be taken for granted, as strategic policy involves making 'tragic' choices. This means that we have to choose between things that it is impossible to choose between, and we have to assign some degree of importance to values that most people regard as absolute (Dror, 1988). An example of this is the conflict between the Dutch oil and gas company NAM and the Dutch association for the preservation of the Wadden Sea (the Waddenvereniging) concerning drilling for natural gas in the Wadden Sea. Another reason why active support cannot be taken for granted is that the values and opinions of actors can change, over time. These changes are difficult to predict, which means that the level of future engagement is uncertain. Research into strategic policy issues, such as controversial research into geo-engineering or subsurface CO_2 storage, suffers from similar problems. We are therefore also faced with normative complexity and uncertainty.

Scenarios can encourage engagement in strategic policy and research and therefore may help to deal with normative complexity and uncertainty. This is because scenarios can be used to legitimise an existing strategy or research agenda, and to endorse the coalition that supports it. This can happen, for example, if a scenario study is used to convince people of the benefits of an existing strategy or research agenda. A scenario study can also inspire users to take a new approach (In 't Veld, 2010). For example, one scenario may show that existing strategy negatively impacts on a particular policy issue, while other scenarios may identify other, more beneficial, strategies and the research needed to develop them. Scenarios can also make it easier to manage the conflicts surrounding strategic policy and research as they clarify the expectations and ambitions of different organisations and groups for the future. After all, it is often these expectations and ambitions that are the reason for the conflict. Scenarios open up conflicts to dialogue, by addressing the different expectations and ambitions, by exploring the consequences and by identifying the similarities and differences.

The objectives of scenarios built for strategic policy or research often overlap. A scenario study may only be able to help convince policymakers and stakeholders (objective: encourage engagement) if these groups support certain study conclusions, for example relating to possible future developments and their expected effects (objective: achieve new insights), and if the scenarios contribute to open dialogue about these conclusions (objective: support communication).

Once the main objectives of the scenario study have been decided on, the research questions will normally follow quite logically. A scenario study usually answers several, often exploratory and open questions, such as 'What is the expected average increase in the global temperature by the end of the 21st century?', and 'What will the main impacts of this be on the Netherlands?'. Such questions help focus the scenario study as they give an idea of what we want to know and what we already know. The questions also guide the exploratory phase as they identify which insights the scenario team still needs to acquire (Verschuren and Doorewaard, 2015).

2.2.3 Define project scope

The scope of a scenario study refers to the main theme and geographical scales on which the study focuses and the time horizon of the developed scenarios (Bakkes, 2012[b]). We determine the main theme by identifying the subject or subjects that the scenario project will concentrate on. Doing this makes it more likely that the study will focus on the relevant issues and less likely that it will lose focus during the study. This is important, because some scenario studies are so broad that they run the risk of including everything but concentrating on nothing. We can also improve the project focus by identifying what the scenario study will *not* cover, possibly contrary to some of the target audience's expectations. However, this has the benefit of tempering too high expectations about the scenario study amongst the target groups.

Although the main theme of a scenario project can be very broad, this is not always the case. For example, *European nature in the plural* (PBL, 2017[a]) focuses only on the future of nature in Europe, whereas *Welfare, Prosperity and Quality of the Human Environment* (CPB and PBL, 2015[a]) addresses multiple themes related to the physical environment (i.e. the economy, regional development and urbanisation, mobility, the climate and energy, and agriculture). Separate reports have been published on each of these themes, but here they are explored together. The Sustainability Outlook (*Kwaliteit en toekomst: verkenning van duurzaamheid*, MNP, 2004) even addresses over 50 societal issues–including water quality, education, hunger and human rights–each of which are considered aspects of sustainability.

The advantage of a narrow theme is a clear focus, but there is a risk that too little attention will be paid to other, closely related, issues, such as agriculture, the environment and water in relation to nature. A broad theme makes it possible to analyse the relationships between the sub-themes. However, the scenarios may become too complicated and breadth may be achieved at the cost of depth, which again limits the usefulness of the scenarios. It is therefore important to define the theme properly, especially if it is broad.

The main theme can play out over different geographical scales. Most of the studies that PBL works on focus on the national, European or global scale, as do the policy issues for which the scenario studies are developed. Examples of such studies are *Welfare, Prosperity and the Human Environment* CPB and PBL, 2015[a]), which focuses on spatial and economic developments in the Netherlands, *Eururalis 2.0* (Wageningen UR and MNP, 2008), which deals with European agricultural and rural areas, and *Climate change 2014* (IPCC, 2015),

which concerns global climate change. Although these studies usually focus on a particular geographical scale, they often address other scales too. For example, *Ruimtelijke verkenning* 2019 (Spatial Outlook 2019 (PBL, 2019)) not only focuses on the future of urban development, infrastructure and mobility in the Netherlands as a whole, but also zooms in on urban regions. After all, the regional level is becoming increasingly important with the decentralisation of spatial, environmental and nature policy. The *Deltascenario's voor 2050 en 2100* (Delta scenarios for 2050 and 2100 (Deltares et al., 2013)) focus on national flood protection and the freshwater supply, but they also consider other factors such as global climate change and European water policy.

The time horizon is the period that the scenarios focus on. Most scenarios are developed for the long term, which is roughly 10 to 50 years into the future. This is because developments in society, the physical environment and policy are often so uncertain over this kind of timeframe that various pathways need to be explored. There is usually less uncertainty in the shorter term, so that a forecast will often suffice, although unexpected developments can still take place during this timeframe (WRR, 2010). In the very long term, the level of complexity and uncertainty is often so high that it is not possible to predict with any certainty which direction a development or policy will take; taking us into the realm of speculation. The differences between forecasts, scenarios and speculations are explained in more detail below.

Ultimately, the choice of time horizon depends on the scenario project objectives and the types of scenarios to be built. If, for example, the objective is to inspire policymakers, interested parties and researchers to take a new approach, then a longer time horizon is recommended. However, if the main objective is to explore how existing policy objectives can best be achieved, a short time horizon is more suitable. The choice of time horizon also depends on the policy issue. For example, investments in sustainable energy infrastructure can take years to develop and implement, and the infrastructure itself has a lifetime of several decades. It is for this reason that the *OECD environmental outlook to 2050* (OECD, 2012) looks several decades ahead. However, the slow dynamics of climate change imply a time horizon of a hundred years, as seen in the IPCC scenarios in *Climate change 2014* (IPCC, 2015). Some scenario studies make use of several time horizons. For example, the OECD environmental outlook focuses on international environmental policy up to 2030 and on the impacts of this policy up to 2050, which enhances assessment of the policy effects.

2.2.4 Decide whether or not to build scenarios

Once the target groups have been identified, the objectives determined and the project scope defined, the next step is to decide whether a scenario project is the most suitable form of outlook study. After all, other forms, such as forecasts and speculations, are also possible. It is important to decide whether scenarios really are the most appropriate method during the preparation phase, as time, energy and manpower will be wasted if a different method needs to be chosen later on in the project. To decide whether scenarios are the most suitable method, we need to consider the dilemma inherent to outlook studies.

An outlook study follows a number of phases (research, dialogue, design and reporting), and these phases structure the scenario development process. The research phase involves applying various methods to project future developments, for example based on data. The dialogue phase can take the form of workshops in which participants discuss their ideas for the future. The design phase involves the creation of images (e.g. maps) that portray possible or desirable future situations. Finally, the reporting phase focuses on describing possible or desirable futures and the developments needed to achieve these futures.

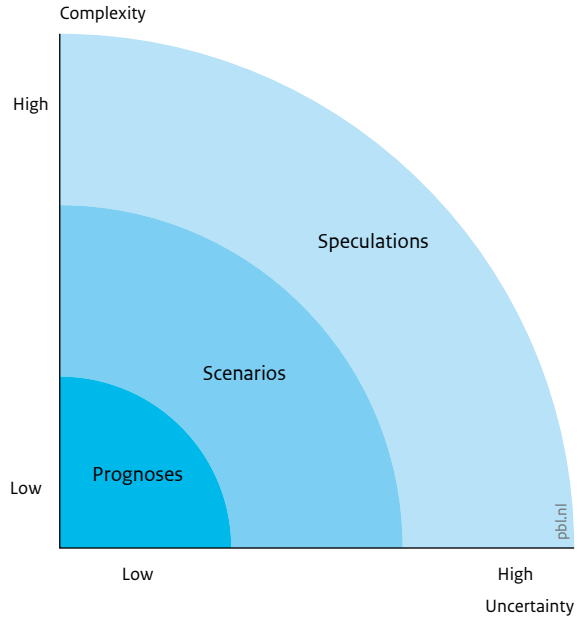
However, outlook studies are faced with the following dilemma. On the one hand, researchers make certain claims about the future, which helps policymakers to design policy that anticipates this future. These claims may enable them to overcome any limitations and make the most of possible opportunities. On the other hand, the future is uncertain; there is no empirical evidence for the claims, which means it is impossible to actually analyse the future. Such claims about the future, therefore, take a leap from *actual* developments (real-life) to *possible* or *desirable* developments in the future. Claims about the future, thus, are constructions rather than representations of the future (Van Latesteijn and Schoonenboom, 1997), and present insights into rather than knowledge about the future (Van 't Klooster, 2007).

However, not every construction is equally valid: constructions must balance imaginativeness and realism, be internally consistent and be mutually comparable (see Section 2.5.3 on quality criteria). Various methods have been developed in recent decades to deal with this dilemma. These methods can be roughly divided into three groups, each of which applies to a different situation: forecasts, scenarios and speculations (Figure 2.2) (compare Henrichs et al., 2006; Van Vuuren, 2007).[2]

Prognoses describe future developments as accurately as possible, based on knowledge and historical data. They are usually accompanied by a confidence interval, with an upper and lower limit, and a certain probability (De Beer, 2011). A *population forecast* is an example of a prognosis. Prognoses are often made when the complexity and uncertainty involved in future developments is low; for example, beca use there are only a limited number of factors in play, because developments will take place at a steady pace, or because the time horizon is short to medium term (5–10 years).[3]

Scenarios describe possible future developmental pathways, based on knowledge of and data from the past. These could be future developments that are considered possible, desirable, or a combination of both. Scenarios may describe more or less autonomous societal and physical developments, or policy developments over which policymakers have a certain amount of control. Scenarios are built for situations that involve some complexity and uncertainty, but not too much. For example, the number of factors that affect developments may be large, but not too large, developments may take place at a dynamic, but not chaotic, rate, and the time horizon may be long, but not too long. An example of such a development is the level of urbanisation over the next 10 to 15 years,

Figure 2.2
Distinction between prognoses, scenarios and speculations



Source: PBL

in the Netherlands. In the case of more steady developments, such as climate change, the time horizon can be up to 100 years.

Speculations are claims about the future based on expectations, ambitions and creative solutions. Knowledge and data usually play a less important role, or are less useful in terms of validating the claims made. Again, these claims can apply to possible or desirable futures, and autonomous or policy developments. Often, developments are taken to their extreme conclusion, new developments are discovered, or radically new pathways are explored. This approach can show where the limits lie and encourage out-of-the-box thinking. Speculations are often used in situations with a high level of complexity and uncertainty, for example because such developments have not been seen before, because developments are affected by a large number of existing or new factors, because developments follow a chaotic course, or because the time horizon is very long.
An example is the possible switch in the Gulf Stream in the northern part of the Atlantic Ocean in the second half of the 21st century. This development may imply a drop in temperature in north-western Europe, rather than the predicted temperature rise due to global warming.

2.3 Define deliverables

The target groups and objectives have been determined, the project scope defined and the decision has been taken to actually build scenarios. The next question is: what deliverables must the scenario project produce to achieve the objectives and meet the needs of the target audience? In other words, what types of scenarios need to be developed (Section 2.3.1) and which scenario components should these include (Section 2.3.2)?

The deliverables can only be described in general in the preparation phase of the scenario project, and it is likely that they will be reformulated during the implementation phase as new information becomes available. Even so, it is important to describe the deliverables in as much detail as possible during the preparation phase. This gives the project direction, makes sure that there is a goal to work towards and helps make sure that we do not drift off course. Broad scenario studies benefit in particular from defining the deliverables in an early stage and therefore ensuring focus in terms of activities, resources and planning.

2.3.1 Choose scenario types

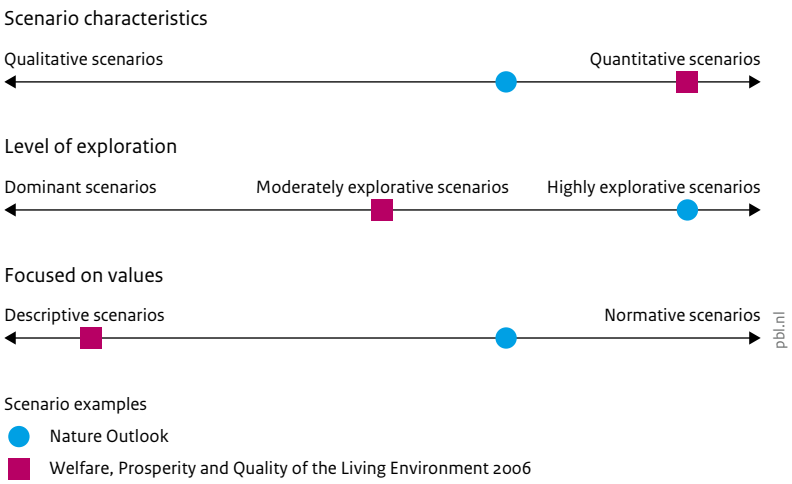
Different types of scenarios can be differentiated, based on whether they are qualitative or quantitative, the extent to which they explore uncertainty, and whether they are descriptive or normative. A single study may include different types of scenarios. Note that the scenario types represent a continuum rather than a strict division. An overview of scenario types is given in Figure 2.3.

Qualitative or quantitative

It is possible to distinguish between qualitative and quantitative scenarios (EEA, 2001). Qualitative scenarios describe or portray the future using words and visual symbols. These scenarios consist primarily of storylines or images of the future (maps, artist impressions, photomontages), or a combination of these. Qualitative scenarios can be further divided into two categories: narrative scenarios and visual scenarios. An example of a narrative scenario is *Adapting EU governance for a more sustainable future* (Clingendael and PBL, 2009), which describes various sustainability strategies available to the EU. An example of a visual qualitative scenario is *Nieuw Nederland 2050* (The new Netherlands 2050; Stichting Nederland Nu als Ontwerp, 1987), which uses maps and artist impressions to depict various desirable future spatial developments in the Netherlands. The two sorts can also be combined, for example in the SCENE study (RPB, 2003). Scenarios that are narrated or visualised well can help raise awareness of developments, including their interactions and impacts, and of a wide range of policy alternatives, in a way that people can understand. They therefore contribute to an open dialogue about the future, and can inspire policymakers or researchers to follow a new pathway (Salewski, 2012).

Quantitative scenarios provide numerical information in the form of tables and graphs. They are more precise than qualitative scenarios, because assumptions about the future are expressed numerically, for example using model equations, model inputs and coefficients (De Beer, 2011). Furthermore, such models have often been published in the

Figure 2.3
Scenario types divided according to characteristics, level of exploration and value focus



Source: PBL

scientific literature, so that we can assume that some quality assurance has already taken place in the form of a model evaluation. Quantitative scenarios can therefore provide detailed information on future developments and their interactions, and on policy alternatives and the impacts that these have on the issue. They can also give an idea of the order of magnitude. Furthermore, the scientific nature of these scenarios means that they can help legitimise existing policy (in so far as they support such policy), or highlight the necessity of new policy (if they show that alternative policy is more effective) and new research (to support the alternative policy). However, the line of reasoning that these scenarios take can be so complex that they are difficult to understand for people with no modelling experience. This can weaken the scenario study's communication objectives.

Level of exploration
If we consider scenarios in terms of the extent to which they explore uncertainty in future developments, we can distinguish between dominant scenarios, limited exploratory scenarios and highly exploratory scenarios.

Dominant scenarios show where societal and physical developments that are currently dominant can lead if they are projected into the future. They also show where undesirable situations could arise and where policy measures may be required. Dominant scenarios also identify the possible bottlenecks and challenges if current policy continues. This is seen, for example, in the baseline scenario of the *OECD environmental outlook to 2050* (OECD, 2012), in which current socio-economic and environmental trends and current

environmental, nature and water policy are projected into the future. Not only do dominant scenarios help us understand the possible bottlenecks and challenges related to certain developments, but they also help us structure communication about these, and they encourage policy engagement. Note that not every policymaker, researcher or other interested party will be equally receptive to these scenarios, as they cannot meet everyone's expectations and ambitions. Dominant scenarios are sometimes called baseline, reference or business as usual scenarios (De Beer, 2011).

Limited exploratory scenarios present future visions that differ slightly from current developments and policy, but not too much. The policy simulations in the OECD environmental outlook are examples of limited exploratory scenarios. These explore policy alternatives such as an accelerated response to climate change, the expansion of nature reserves and the more efficient use of water. These scenarios are situated between the dominant scenarios and the highly exploratory scenarios in terms of attempting to manage the complexity and uncertainty associated with future developments. They are more likely to identify new policy issues and alternatives than dominant scenarios, as they deviate more from the dominant trends. However, highly exploratory scenarios are even better at this as they deviate even more from current trends and policy.

Highly exploratory scenarios take developments or policy to their ultimate conclusion, to explore the limits of what is possible. Such scenarios deviate strongly from the current situation. Take, for example, the different perspectives on nature presented in *European nature in the plural* (PBL, 2017[a]), which are 'Allowing nature to find its way', 'Strengthening cultural identity', 'Going with the economic flow' and 'Working with nature'. These are examples of highly exploratory scenarios. Highly exploratory scenarios can help researchers understand the uncertainty surrounding developments and policy alternatives. They can also identify new developments and policy issues, and therefore contribute to vision building. These scenarios can also encourage open dialogue about the future, as they address the expectations and ambitions of almost all policymakers, researchers and other interested parties. Furthermore, the fact that they present a wide range of policy alternatives means that they can inspire new policy development and research pathways.

Descriptive or normative

In recent years, a large amount of attention has been paid to the nature of scenarios (whether they are normative or not), encouraged by the Netherlands Scientific Council for Government Policy's plea for more normative scenarios (WRR, 2010). At the other end of the spectrum are the descriptive scenarios (Becker et al., 1982).

Descriptive scenarios focus primarily on exploring *cognitive uncertainty*, for example in relation to possible future developments and their impacts on the policy issue in question. They may use *forecasting or foresight*, which look ahead to the future based on the past and the present. The difference between *forecasting and foresight* depends on whether one or more scenarios are to be developed (WRR, 2010). This in turn depends on whether developments

are expected to be continuous and stable, or discontinuous and unstable. The *baseline scenario* in the *OECD environmental outlook to 2050* (OECD, 2012) is an example of *forecasting*, while the scenarios from the SCENE study (RPB, 2003) ('The Netherlands as consumer space', 'The Netherlands as production space', 'The Netherlands as experience space' and 'The Netherlands as a natural environment') on the spatial impacts of future societal and physical developments are an example of *foresight*.

Descriptive scenarios make it possible to take a broad view, because they provide insight into possible future developments and the impacts of these developments on future policy. They also provide insight into whether any new policy issues will arise. Descriptive scenarios also help policymakers and other stakeholders discuss their ambitions for the future. Clearly, this applies more readily to *foresight*, which uses more scenarios, than to *forecasting*.

Normative scenarios focus primarily on exploring *normative uncertainty,* for example related to new policy objectives or changing societal values. This can be explored using *backcasting* or *critical futures*. In both cases, the future situation is assessed before the possible pathways leading to a particular future are identified.

The decision to use *backcasting* or *critical futures* depends on whether one or more scenarios will be developed (WRR, 2010).[4] One scenario is used if there is consensus on societal values and objectives, as in *Getting into the right lane for 2050* (PBL and SRC, 2009). This study takes a global perspective to explore EU policy challenges relating to three themes: food production and biodiversity, energy and climate change, and mobility and a low-carbon energy supply. The study therefore discusses opportunities for linking long-term ambitions to the policy development process for the coming years.

More scenarios are used if there is no such consensus and we want to explore the various positions that different stakeholders might take. This is the case in *European nature in the plural* (PBL, 2017[a]), for example. In this study, each policy scenario describes both the desired situation for nature and a strategy to achieve that situation.

Backcasting can provide insight into the measures that need to be taken to achieve defined policy objectives, to communicate these measures and to ensure that people engage with these measures. *Critical futures* help us identify possible future policy objectives and the measures needed to achieve these objectives. Most of all, they contribute to the development of a policy vision, to a dialogue on the policy criteria and to willingness to identify new policy and research pathways.

Table 2.3 summarises the types of scenarios and the ways in which they contribute to project objectives.

Table 2.3
Scenario types and their contributions to scenario project objectives

Scenario type	Contributions to scenario project objectives
Qualitative or quantitative scenarios Qualitative	*Easily understood* insights into developments, interactions, policy alternatives and impacts; open dialogue about the future; inspiration for new strategic policy and research
Quantitative	*Numerical* insights into developments, interactions, policy alternatives and impacts; legitimise existing policy and highlight necessity of new strategic policy and research
Level of exploration Dominant scenarios	Show where dominant trends become unacceptable, present alternatives, make policy effects clearer (reference)
Limited exploratory scenarios	Positioned between dominant scenarios and highly exploratory scenarios
Highly exploratory scenarios	Insight into new issues and policy alternatives, more open dialogue about the future, vision building
Descriptive or normative scenarios Descriptive scenarios	Encourage broader view of societal and physical developments, more open dialogue about ambitions and expectations for the future, increase perceived need for new policy or research strategy
Normative scenarios	Increase understanding of feasibility of current policy and policy alternatives, more open dialogue about ambitions and expectations, more inspiration and support for alternative policy or research strategies

2.3.2 Determine scenario components

Once the scenario types have been chosen, the next decision is which scenario components to include. A scenario study can include the following four components: a baseline scenario, contextual scenarios, policy scenarios and key messages (Dammers, 2010[a]). However, not every component is required for a particular study, and those that are may not need to be developed to the same extent. These choices need to be made in the preparation phase of the scenario study, as they provide the project with focus, help structure the project plan, and facilitate communication with the client and the target audience (Section 2.5.3). Choices are only made at a global level in the preparation phase, as new information obtained during the implementation phase may require new decisions to be made and the global choices to be refined. The scenario components are described briefly below and addressed in more detail in Sections 3.2 to 3.6.

The *baseline scenario* describes the current situation with regard to a particular issue, the developments that affect the issue and the policy in place to address the issue, as well as the events that have resulted in the current situation. It forms a point of reference for the other scenario study components. After all, first identifying the policy issue and the developments that affect it make it easier to explore future developments and any possible changes. Furthermore, it is easier to develop relevant policy messages if we first have a clear idea of the policy currently in place. The baseline scenario can be relevant for all types of scenarios, regardless of whether they are qualitative or quantitative, descriptive or normative, or have a high or low level of exploration.

Contextual scenarios explore possible future developments that affect the policy issue, and the possible impacts of these developments on the issue. For example, the impact of sea-level rise on flood protection in the Netherlands will depend on the extent of sea-level rise due to climate change. Depending on the level of exploration, contextual scenarios may take the form of a dominant scenario, a limited exploratory scenario or a highly exploratory scenario. Some contextual scenarios also explore discontinuities, such as a breakthrough in the low-carbon energy supply, and the possible impacts of such discontinuities on an issue. This is usually seen in highly exploratory scenarios. Contextual scenarios are largely descriptive; they apply *forecasting* or *foresight*, depending on whether one or more scenarios are to be built (Section 2.3.1).

Policy scenarios explore a range of desirable future situations and the policy required to achieve these, considering the enabling and constraining factors arising from the developments in the contextual scenarios. For example, the future of several large nature reserves (the 'Vital Nature' scenario in the *Natuurverkenning 2010-2040* (Nature Outlook 2010–2040; PBL, 2012[a])) depends on the level of private and public investment, which in turn depends on economic growth. Policy scenarios are largely normative, as people have differing views of what constitutes a desirable future situation, depending on their values. Policy scenarios apply *backcasting or critical futures*, depending on the number of scenarios to be built (Section 2.3.1). Depending on the level of exploration, policy scenarios may be dominant scenarios, limited exploratory scenarios or highly exploratory scenarios.

Key messages are points for consideration and recommendations for strategic policy and research. They comment on and provide suggestions for policy that is to be implemented in the short term, based on an exploration of long-term developments (using the contextual scenarios) and possible policy alternatives (using the policy scenarios). Key messages increase the usefulness of scenario studies as they provide clear pointers for policy (Henrichs et al., 2010). They can be developed for every scenario type, regardless of whether they are qualitative or quantitative, descriptive or normative, or have a high or low level of exploration. In practice, however, this component receives very little attention (Section 3.6). An overview of the relationships between the scenario components and scenario types is given in Table 2.4.

An interim report may be produced for each scenario component, to describe the main findings. This report may include calculations, descriptions and/or images (see next section). Each time we produce an interim report, we are a step further in producing the final deliverables, which include a scenario report. The interim reports also make it possible for the main target groups to assess the preliminary results as the project progresses.

Table 2.4
Relationships between scenario components and scenario types

Scenario components	Scenario types
Baseline scenario	• May be relevant to all scenario types
Contextual scenarios	• Primarily descriptive scenarios: *forecasting* in the case of one scenario, *foresight* in the case of several scenarios • Explore trends in dominant, limited exploratory and highly exploratory scenarios • Explore discontinuities in highly exploratory scenarios
Policy scenarios	• Primarily normative scenarios: *backcasting* in the case of one scenario, *critical futures* in the case of several scenarios • Explore business as usual policy in dominant scenarios and policy alternatives in limited and highly exploratory scenarios
Key messages	• May be relevant to all scenario types

2.4 Select methods

Once we have a general idea of which types of scenarios we are going to produce and which scenario components these require, we need to determine which methods we will use: stakeholder participation, essays, particular designs and/or models. Making some global choices in the preparation phase of the scenario project will give us a clearer idea of the most suitable project approach. It will also ensure that the methods, and the people who are to implement them, are mobilised in time and therefore used efficiently. Note that we only make general choices in the preparation phase. More specific choices are made in the implementation phase, which is when earlier choices can be adjusted as required.

Stakeholder participation means actively involving target groups in the scenario development process. This helps create new insights, develop more creative solutions, and test or better disseminate the results. The project team may, for example, ask stakeholders to come up with ideas for the scenarios during a workshop, based on which the team develops the general outline of the scenarios. Various forms of stakeholder participation are possible, such as workshops, Open Space conferences, group model-building meetings and interviews. In most cases, an expert panel is put together and contacted at various times during the scenario project. This panel may include members of the target groups, as well as other people able to provide creative input. When developing qualitative scenarios, stakeholder participation may be used to generate ideas; in the case of quantitative scenarios, it is mainly used to evaluate the results. Stakeholder participation helps make sure that a wide range of views are taken into account, and is therefore most useful in highly exploratory scenarios.

Essays are used to develop storylines for scenarios. A storyline describes the main developments in a scenario as a clear, logical narrative, plus their causes and their impacts on the policy issue in question (Henrichs et al., 2010). Essays often play an important role in qualitative scenarios (Section 2.3.1). They are usually developed based on the available literature, combined with the author's own expertise and logical reasoning. The literature may include a wide range of sources, such as previous scenario studies, recent research, policy recommendations and newspaper articles. Using existing scenario studies can save much time, although such studies will usually need to be updated in some way.
Although essays can also be written for dominant scenarios and limited exploratory scenarios, they are most often used in highly exploratory scenarios that develop a wide range of future visions.

Particular designs are used to visualise scenarios in some way. The analyses carried out (design-driven research) can provide some important insights, for example into the future geographical distribution of a particular issue (e.g. pollution) or future spatial patterns (e.g. urbanisation). In fact, images can sometimes communicate the essence of a scenario better than words or numbers, and can therefore form an important addition. This is almost always the case for issues relating to the physical environment. Particular designs may take the form of maps, drawings, photomontages, and so on. They may be produced by hand, using digital imagery and photography programmes, or using geographical information systems. Particular designs can play an important role in qualitative scenarios, and are sometimes used in quantitative scenarios to present the results of model calculations in a more accessible manner.

Models are often used for those aspects of policy issues and strategic policy that lend themselves to calculation and for which sufficient data are available or can be obtained during the scenario project (Dammers, 2010[a]), for example relating to developments in society and the physical environment. It is also possible to produce models that only present the main variables and interconnections. The first type of model is important in quantitative scenarios, while the second may be used in qualitative scenarios.
Some aspects of a particular issue, policy or development may be more suited to incorporation in a model than others. For example, future population changes are easier to model than changing attitudes to nature. Note that data collection and model building are time-consuming activities and therefore need to be planned carefully. Note too that, although quantitative models are very useful for exploring existing interconnections and known uncertainties, they are less useful for exploring and analysing new developments, as the insights and data that are produced are too limited to be used in a model. Qualitative models do not have this limitation and are therefore particularly useful in highly exploratory scenarios. An overview of the methods and their uses in the different scenario types is given in Table 2.5.

Table 2.5
Relationships between methods and scenario types

Method	Scenario types
Models	• In quantitative scenarios in particular, sometimes in qualitative scenarios • In dominant and limited exploratory scenarios in particular, sometimes in highly exploratory scenarios
Essays	• In qualitative scenarios • In limited and highly exploratory scenarios in particular
Stakeholder participation	• In both qualitative and quantitative scenarios • In limited and highly exploratory scenarios in particular
Particular designs	• In qualitative scenarios in particular, sometimes in quantitative scenarios • In highly exploratory scenarios in particular

The methods may be applied on their own, or they may be combined, in which case they can be used to test and supplement one another. If the methods are combined, it is important to set aside sufficient time to integrate the results produced by each method, as this is no simple task. Different methods are based on different assumptions and apply different processes and criteria for assessing the results. Combining the methods therefore involves a process of mutual learning. This implies that the scenario team will need to meet often to discuss the different methods, the opportunities and limitations that they present, the results that they produce, and so on. This is addressed in further detail in Section 4.6.

2.5 Organise scenario project

The last, but certainly not least, part of the preparation phase is to organise the scenario study, preferably as a scenario project. The decision points in a scenario project are similar to those in a research project. The document *Projectmanagement in het Planbureau voor de Leefomgeving* (Project management at PBL; Van den Berg et al., 2013) and project guidelines such as *Projectmatig creëren* (Creative projects; Bos and Harting, 2006) are useful sources of information. The size, complexity and eclectic nature of many scenario projects means that particular attention needs to be paid to decisions such as the project size (Section 2.5.1), the project team (Section 2.5.2) and the project plan (Section 2.5.3).

2.5.1Determine project size

The size of a scenario project, expressed as the number of man-hours required to complete it, can vary enormously, from a few days of work to a few years. Depending on the time required, projects can be categorised as large, small or mini projects. Note that this represents a continuum rather than a strict division.

A *large project* can take anything from 1 to 15 or more person-years to complete, with a total project time of 1 to 3 years. Most PBL scenario projects are large projects, often carried out in partnership with other institutes, and developed to support national, European or global policy relating to nature, the environment or spatial development. *Welfare, Prosperity and the Human Environment* (CPB and PBL, 2015[a]), *Spatial scenarios and orientations in relation to the ESDP and cohesion policy* (IGEAT et al., 2006) and *Climate change 2014* (IPCC, 2015) are examples of such projects. The strategic policy implemented at these scales and in these policy areas has a significant impact, while it is also highly complex and uncertain (Section 2.2). Well-validated scenarios therefore need to be built, and these are often based on a variety of methods. This is particularly important if the scenarios are developed for European and global policy arenas, where much value is attached to negotiations based on accepted scientific insights. It does however make such scenario projects highly labour-intensive, particularly if model calculations are required.

Small projects take one person-week to one person-year to complete, with a total project time of a few weeks to a few months. Small projects may be carried out if the main purpose of the scenarios is to structure communication regarding the future situation and if the cognitive or normative complexity and uncertainty are not too high. After all, a high level of detail and validation is not always required in such cases. Small projects are also suitable if other scenario studies are available and only need to be updated or integrated with other scenarios. An example of such a project is *Deltascenario's voor 2050 en 2100* (Delta scenarios for 2050 and 2100; Deltares et al., 2013), which is based on two earlier studies: *Klimaat in de 21e eeuw* (Climate in the 21st century; KNMI, 2006) and *Welfare, Prosperity and Quality of the Living Environment* (CPB and PBL, 2006). It may also be sufficient to quantify one scenario and provide a qualitative description of the others. This has the benefit of reducing the amount of time required. However, it does mean that the qualitative scenarios may be taken less seriously than the quantitative scenarios. A small project may also be carried out as a preliminary study, in preparation for a large project, for example by carrying out a horizon scan (Text Box 2.3).

Text Box 2.3 Horizon scan

A horizon scan analyses possible future issues and developments and the associated threats and opportunities. It looks further than the usual time horizons and beyond the limits of individual disciplines and policy areas. A horizon scan may be carried out as a stand-alone outlook study, or as preparation for a large scenario study. For example, in 2013, PBL published the horizon scan *Welvaart en leefomgeving* (Welfare, prosperity and quality of the environment (PBL, 2013)), as a preliminary study for the scenario study titled *Welfare, Prosperity and the Human Environment* (CPB and PBL, 2015[a])). A horizon scan may be carried out on the basis of an analysis of the literature, expert consultation and/or responses collected online. Results are then clustered, processed and prioritised before being published as a collection of essays (Verlaan et al., 2007).

Mini projects are carried out in less than a person-week, and possibly in just one or a few days. These scenarios can help a team that has little experience in scenario development become more acquainted with the process and the methodological issues that arise. Mini projects may also be carried out to produce a scoping document for a small or large project. This document can then be used to discuss the project outline and content with the main target groups (Section 2.2.1 and Text Box 2.1).

2.5.2 Assemble scenario team

The composition of the team that is to build the scenarios – the scenario team – makes an important contribution to the ultimate success of a project. After all, the large, complex and eclectic nature of scenario projects conducted by PBL makes them no easy task (Nekkers, 2006). The team size varies, depending on the size of the scenario project, from a few to hundreds of researchers. Particularly large teams often work on international scenario studies (Kok et al., 2008). For example, hundreds of researchers all over the world are working on the IPCC scenarios. Large teams are often divided into a core team that coordinates the project, smaller teams that work on sub-projects and researchers who work on their own deliverables (Shell, 2008).

A diverse scenario team is able to address the many aspects of a policy issue and the developed policy, the wide range of developments that may affect these and the different methods applied during the project. The scenario team therefore needs to be diverse in terms of disciplinary background, age, work experience, personal qualities (initiator, supporter, thinker, doer), and so on (Bos and Harting, 2006). It is also important that the team members are able to look beyond the borders of their own disciplines and that they question these and the methods that they use.

2.5.3 Draw up project plan

The last step in the preparation phase of a scenario project is usually to draw up a project plan. A well-prepared, well-designed project plan is crucial to the ultimate success of the project (Shell, 2008). It provides a clear direction and makes sure that the team maintains focus; it makes the project more manageable in terms of activities, resources and lead time; and it helps the team anticipate unexpected developments or setbacks. A project plan is also required to obtain a project mandate, while it can also be used to inform other internal and external parties about the scenario study.

You can find a checklist of the items to include in the project plan in the *PBL Handboek Onderzoek/Projecten* (PBL research/projects handbook). As well as those items that have already been discussed in this chapter, such as the theme, the research question, the methods and the team, the handbook also addresses other issues such as planning, staffing and financial resources, and communication. Risk assessment, quality assurance and communication are particularly important aspects of scenario projects, as discussed below.

Risk assessment

Exploring future developments involves, by definition, high levels of uncertainty (Section 2.2.2). Furthermore, scenario projects often entail a high level of risk due to their size, complexity and eclectic nature. A risk assessment can help manage these uncertainties. This involves identifying the main risks and possible impacts on the project, and taking measures to stimulate the enabling factors while limiting the constraining factors, for example by organising extra discussion sessions and planning go/no-go moments in the project. Bos and Harting (2006) describe how to carry out a risk assessment.

Quality assurance

Particular attention should be paid to the *qualities* of the scenario study. Policymakers and other stakeholders are often inundated with research reports, vision documents, policy recommendations and policy documents, all describing future developments. They are therefore only going to use a scenario study if they think it contains valuable information, or if it can be used as reference material or to mobilise support. The following qualities can help (Dammers, 2010[a]):

- *Consistency.* This relates to the logic within a scenario. A scenario that is illogical will not be considered credible. However, a scenario can explore developments that have conflicting impacts on the issue, or social discrepancies. In fact, this improves the scenario's credibility.
- *Contrast.* This concerns the extent to which the scenarios explore different directions in future societal, physical and policy developments. Contrast is important when exploring uncertainty, although it is more important in highly exploratory scenarios than in limited exploratory or dominant scenarios.
- *Comparability.* This concerns the extent to which the scenarios address the same issue, the same policy and the same driving forces, even though they may explore different directions. Comparability is important to be able to extract the key messages from the scenarios.
- *Intended outcome.* This quality concerns the applicability of the conclusions about the future. The scenarios will be considered more useful if the outcomes match the needs of the target groups. Note that scenarios are less specifically applicable than forecasts or plans.
- *Appeal.* This concerns the extent to which the scenarios reflect the thought processes and activities of the target groups. It is important here to find a balance between imaginativeness and realism. Creativity inspires users, while realism ensures that users find the scenarios plausible, and therefore worth consideration.

In addition to the qualities named above, the quality of the arguments used to support the conclusions and the way in which uncertainty is dealt with are, of course, also very important. The *voor omgaan met onzekerheden* (Guidance for uncertainty assessment and communication) can help identify and communicate the uncertainties in scenario projects. This includes identifying and assessing relevant uncertainties, considering the extent to which available knowledge and methods are useful, deciding which indicators to use and reporting uncertainty.

Communication

Not only is the quality of the project deliverables important, but also the quality of the project process. Communication plays a large role in this. There are many different ways in which *communication* can be relevant in a scenario project, and it can be a critical factor in the project's success. Project guidelines therefore pay a large amount of attention to communication (e.g. Bos and Harting, 2006). Four forms of communication require particular attention in the case of scenario projects. These are: communication within the project team, communication with the client, communication within the wider organisation and communication with the target groups.

Most internal communication is carried out during team meetings, and the approach taken during these meetings largely determines the progress made. The project start-up (PSU) is an important part of the scenario project (Bos and Harting, 2006). This is a workshop held during the preparation phase of the scenario project in which the scenario team decides on the overall project structure. The results of this workshop are recorded in the project plan. The main purpose of the PSU is to discuss and decide on the main components of the project (as discussed above). As it involves the whole of the project team, the PSU increases engagement amongst the team members and contributes to the development of the team as a whole. This is particularly important in international scenario projects, as the researchers usually have very little face-to-face contact. In the case of large scenario projects, separate PSUs may be organised for the core team and the sub-project teams. It is also important that the client takes part in the PSU, to ensure that the project outcomes reflect the client's needs. This guidance document and the accompanying presentation may be used during the PSU.

At PBL, the client is either the Director-General of PBL or a head of department. If the project is funded externally, the Director-General of PBL or head of department act as the internal client. This is also the case if PBL is part of a consortium developing a scenario study for an organisation such as the UN, the OECD or the EU. Communication can take place between the project leader and the client through a formal consultation process, during face-to-face meetings, and during team meetings or the PSU. It is important that the client approves the project plan, and therefore the formal start of the project, and that approval is also obtained from the management team. Approval must also be obtained for the use of resources (manpower, funding, time). Only when these conditions have been met can the project be considered to have a sufficient mandate from the organisation. It is also useful if the client is aware of the enabling and constraining factors inherent to scenarios (Nekkers, 2006), and this guidance document can provide some help where this is concerned.

Communication with the wider organisation helps ensure that the scenario project becomes institutionalised within PBL. This is achieved by informing PBL employees about the project, which increases the project's legitimacy and the willingness of employees to lend their knowledge and expertise. It can also ensure that the project is aligned with other projects being carried out in the organisation. After all, other projects may be able

to provide input to the scenario project, or make use of its results. Useful forms of communication include the intranet, newsletters, lunch presentations, presentations in other project teams and contact with the project leaders or team members of other projects.

Various forms of communication can take place with the target groups. For example, key figures in the target groups could be invited to take part in advisory or user groups. Advisory group meetings are often organised for scenario projects, while user groups have been applied in projects such as the Delta scenarios, in this case to obtain feedback from the Delta programme on the usefulness of the scenarios as they are being developed. It is also possible to inform other stakeholders of ongoing developments in a newsletter, or by asking them to provide feedback on draft versions of the scenario report. Another option is to interview target group members, or to invite them to take part in scenario workshops or internet discussion groups, for example. These forms of communication are addressed in more detail in the *PBL Leidraad stakeholderparticipatie* (Stakeholder participation guidance for PBL Netherlands Environmental Assessment Agency; Hage and Leroy, 2009[a]).

Be aware that, just because the target groups are involved in the project, this does not mean that all their ideas and ambitions will be taken into account. Some target group members may find it difficult to consider alternative future visions, and therefore may hope for scenarios that more resemble the prognoses (Hoogervorst, 2011). They may also not want to include developments that they consider to be negative (e.g. the disintegration of the EU in a scenario project for a Directorate-General in Brussels) in the study. However, we stress that PBL conducts its research independently and therefore has sole responsibility for the scenario project approach and outcomes. This must be clearly communicated to the target groups at an early stage in the project, to prevent any misunderstanding and disappointment.

Notes

1. We add communicative uncertainty to the cognitive and normative uncertainties defined by WRR (2010). Given the diversity in frames of reference and the corresponding expectations and ambitions for the future, there can also be a high level of uncertainty in the communication between actors.
2. This differs from the approach taken by WRR (2010), in which it is not clear which forms of outlook studies should be regarded as scenarios.
3. Statistics Netherlands has however produced a population forecast for the period 2011–2060.
4. The term *backcasting* is also used to deduce the past based on the present if past developments are unknown. An example is immigration levels in the Netherlands prior to the 1970s.

3 Implementation phase: develop the scenario components

3.1 Introduction

In Chapter 2, we focused on how to prepare for a scenario study. In this chapter, we consider the first part of the implementation phase: the components to be included in a scenario study, or the 'what'. Chapter 4 then deals with the second part of the implementation phase: the methods that we apply to develop the scenario components, or the 'how'.

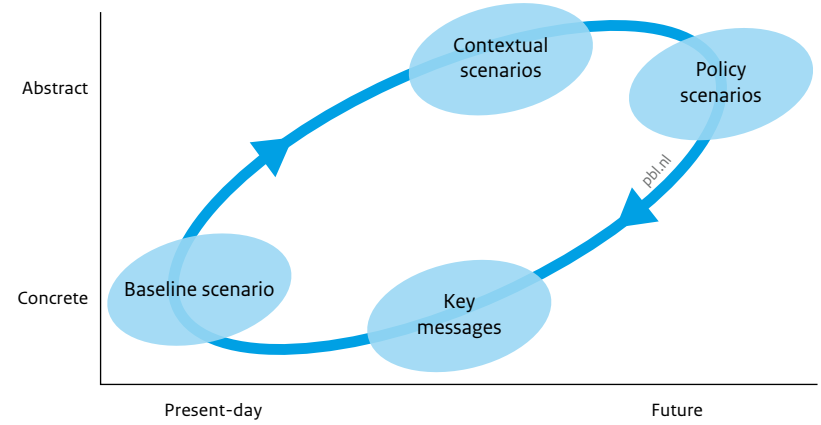
A scenario study consists of four components: the baseline scenario, the contextual scenarios, the policy scenarios and the key messages for policy or research. However, it may not be necessary to develop every component for a particular study, or to develop them all to the same level of detail. The four scenario components are connected with each other in the form of a cycle, which acts in two directions (Figure 3.1). There is a cycle in time, from the past and the present (baseline scenario), via the long-term (contextual scenarios and policy scenarios), to the short term (key messages). There is also a cycle in the level of detail, from concrete (baseline scenario), to abstract (contextual scenarios and policy scenarios), and back to concrete (key messages).

The scenario study components were described briefly in the previous chapter. In this chapter, we provide more detail (Table 3.1): first we describe the baseline scenario (Section 3.2), the contextual scenarios (Section 3.3) and the policy scenarios (Section 3.4), then some additional decisions (Section 3.5), and finally the key messages for policy and research (Section 3.6).

3.2 Construct a baseline scenario

The baseline scenario forms a background (reference) for the other scenario study components. It is important to analyse the current situation before the future can be explored in a meaningful way. Such an analysis helps us understand the nature of the policy or research issue, the influence that current policy and driving forces have on these, and the dynamics that are taking place. The baseline scenario also helps clarify the

Figure 3.1
Scenario cycle



Source: PBL

developments seen in the scenarios as it enables comparison with the past and the present. A particular focus on the past and the present also reduces the risk of the scenarios moving into the realm of speculation. It is also easier to derive concrete key messages from the scenarios if a link can be made with current policy or research.

The baseline scenario provides an overview of: (1) the aspects of the policy or scientific issue on which the scenario study focuses, (2) the policy that affects the issue, and (3) societal and physical developments that have an important impact on the issue but cannot be influenced by policymakers. Such developments are also called 'driving forces' (see below). The baseline scenario can be described in the first interim report and discussed with the client and the main target groups.

Most scenarios are produced to support strategic policy or the required research (Section 2.2.2). The *issue* on which strategic policy focuses normally takes the form of a so-called wicked problem. Wicked problems are characterised by a lack of consensus concerning both the values that are at stake and the relevant knowledge (Bakkes, 2012[b]; Hisschemöller, 1993; In 't Veld, 2010). Because of the complexity involved, different policymakers and stakeholders define the issue in different ways. Furthermore, the interests at stake mean that the importance that people attach to the issue (priority) also varies. An additional problem is that people tend to talk at cross purposes. We are therefore faced with cognitive, normative and communicative uncertainty.

Policy aims to influence a particular issue in a certain way. Scenario studies often focuses on the actors who aim to achieve certain goals with relation to the issue, who take certain measures to achieve those goals and who, in doing so, intentionally and unintentionally

Table 3.1
Scenario components and decisions

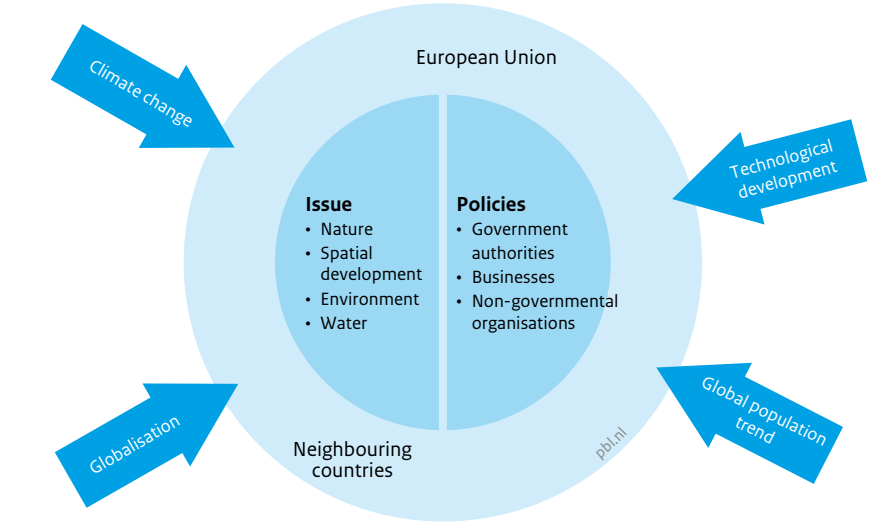
Scenario component	Decisions
Baseline scenario	• Include baseline scenario? • Include policy issue, policy and/or driving forces? • Determine time horizon in the past
Contextual scenarios	• Include contextual scenarios? • Explore trends, discontinuities and/or separation points? • Include policy (no, established, trend-based, proposed or new policy)?
Policy scenarios	• Include policy scenarios? • Determine desired futures and strategies • Compare with contextual scenarios? (challenges, wind tunnel)
Additional decisions	• Number of time periods (one or more) • Number of scenarios (one to five) • Use world views?
Key messages	• Include key messages? • Formulate points for consideration and/or recommendations • Relevance to public debate, policy dialogue and target groups

affect the issue in all kinds of ways. These actors include not just government bodies with the authority to implement policy (policymakers), but also businesses, non-governmental organisations and citizen groups that also take measures or attempt to influence policy (stakeholders). A scenario study also describes the extent to which goals or measures display synergy or conflict with one another.

Driving forces are developments that have a major impact on the issue and/or policy in question, but on which the policymakers tasked with dealing with the issue have little or no influence. These driving forces are often linked to various domains: the socio-cultural, technological, economic, environmental and political (STEEP) domains (Schwartz, 1991). In addition to their impact on the issue and policy, the influence of the driving forces on each other is also described, to make it clear which of them are the most powerful.

The policy issue and policy can be regarded as a *system* and the driving forces as the system's *context* (system environment). Following this logic, policy can then be considered as the driving sub-system and the policy issue as the driven sub-system. We also make a distinction between the driving forces on which policy can exert some influence (immediate context) and the driving forces on which it has almost no influence (wider context) (Van der Torre, 2010; BZK, 2011). This distinction is illustrated in Figure 3.2. Higher-level policy is also included in the context, such as global climate agreements (wider context) and European climate policy (direct context) in a scenario study for national water policy. To manage the complexity, we normally only include the strongest five to seven driving forces in the scenario study. This is because each extra driving force increases the complexity of the analysis, while the additional benefit (in terms of explanatory power) decreases.

Figure 3.2
The system and its immediate and broader context



Source: PBL

The baseline scenario describes not just the current situation, but also how this situation has developed. If we are to properly describe how a system functions, its context and the dynamics involved, the baseline scenario needs to look as far back as the contextual and policy scenarios look ahead (Henrichs et al., 2010). This also helps us to let go of our current frame of reference and to take a long-term view. It also has the benefit of revealing relatively slow developments, such as sedimentary processes in an estuary, or changes in the relationships between various layers of government in a country (Meyer et al., 2015).

There are various decisions to be made when developing the baseline scenario. For example, the scenario team may choose not to include the baseline scenario in the study at all. If it does decide to do so, this has the advantages described above. However, developing a baseline scenario is time-consuming and therefore increases the project duration. Including the baseline scenario in the scenario report also means that the users need to read through a lot of text before they get to the main components of the scenario study (the contextual and policy scenarios and the key messages). This can be dealt with by providing a summary of the baseline scenario in the report.

If we do include the baseline scenario in the scenario study, we need to decide which aspects take into account. This depends largely on the types of scenarios to be built (Section 2.3.1). For example, the policy issue and policy will be sufficient for normative scenarios. It makes the baseline scenario less complex, but increases the risk that the influence of policy on the issue will be overestimated, as we ignore the impact of the driving forces. In the case of descriptive scenarios, we can choose to leave policy out of the baseline scenario. Again, this simplifies the baseline scenario, but it makes it more difficult to derive clear policy messages from the scenario study as a comparison with current policy is harder to make.

3.3 Develop contextual scenarios

We develop contextual scenarios to explore future changes in the driving forces and the impact of these changes on the policy issue and the policy developed to address the issue. For example, the impact of sea-level rise on flood protection in the Netherlands will depend on whether climate change leads to a high or a low increase in the sea level. Flood protection policy and the resources available to put it in place also depend on a slow or higher rate of economic growth. Contextual scenarios can help us take a broader view of relevant societal and physical developments (achieve new insights), they can encourage open dialogue about future expectations (support communication) or they can increase the sense of urgency for new policy or research (encourage engagement). They can also be used to assess the robustness of and optimise policy strategies, in which case the scenarios are used as a 'wind tunnel' (Section 2.2.2).

Contextual scenarios provide a coherent description of several possible pathways that the driving forces could follow. They are therefore primarily descriptive. They involve *forecasting* or *foresight*: using one or more scenarios to look into the future, based on the past and the present. They explore the possible directions that developments may take and their interactions with one another, as well as the combined effects on the policy issue. These effects can be defined in terms of policy challenges (bottlenecks, problems). Contextual scenarios also explore the policy opportunities and threats resulting from the driving forces, such as resources that may become available to implement policy or the possibilities provided by policy developed at a higher level. The contextual scenarios can be developed as an interim product and discussed with the client and the main target groups.

When exploring the possible course that the driving forces may take, the focus could lie on trends or on discontinuities, where separation points represent a particular form of discontinuity. The first approach plays a role in dominant scenarios; the second and third in highly exploratory scenarios. If we combine trends and discontinuities, we develop limited exploratory scenarios. An overview of the advantages and disadvantages of each of the three approaches is given in Table 3.2.

Table 3.2
Advantages and disadvantages of exploring trends, discontinuities and separation points

Approach	Advantages	Disadvantages
Trends	• Simple analysis • Easy to present • Easy to understand	• Limited focus on uncertainty
Discontinuities	• Greater focus on contextual changes • Easier to assess robustness of strategies	• Scenarios are more complex • Scenarios are more difficult to communicate
Separation points	• Shows causal relationships • more clearly	• Difficult to place in time • Restrict scenarios to response to events

3.3.1 Explore trends

Exploring trends means identifying a number of trends in the developments that take place within the context of the system, examining how they interact and exploring their possible future course. Trends have the following characteristics (Van der Duin and Stavleu, 2006; Nekkers, 2006):

- a trend has begun and can therefore be identified;
- a trend has a certain direction and causes a change;
- a trend takes place over a longer period: 10, 30 or even 100 years;
- a trend takes place at a more or less steady rate.

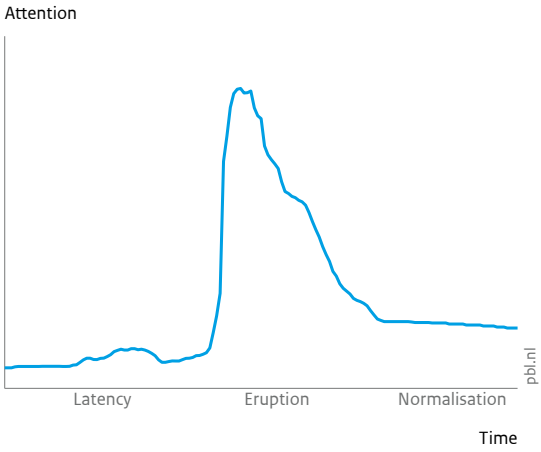
Although a trend has a certain direction, its future course is never certain. Trends often turn out to have taken a different course than expected, and may even go in the opposite direction. Even if the explored direction is correct, the rate at which the change takes place is often uncertain. For example, it is uncertain whether globalisation will continue and, if it does, what the pace of change will be. As well as exploring the possible directions and rates of change of the trends, we also explore the most important impacts that they have on each other, on the policy issue and on policy.

The advantage of exploring trends is that it is a relatively easy analysis, that the results can be presented clearly and that the trends are fairly easy to understand. However, the disadvantage is that we assume a steady rate of change (a surprise-free future), and therefore pay little attention to the uncertainties that the future entails.

3.3.2 Explore discontinuities

Discontinuities are events that may not be highly probable, but that can have a large impact. Such events are also called 'wild cards' or 'black swans' (Steinmüller and Steinmüller, 2004; Taleb, 2010). When exploring discontinuities, we explore not just the impacts of the events on the driving forces, but also the conditions under which they may take place and their impacts on the issue and on policy. Events are explored in various domains. For example, the *Spatial scenarios and orientations in relation to the ESDP and cohesion*

Figure 3.3
The life cycle of discontinuity



Source: PBL

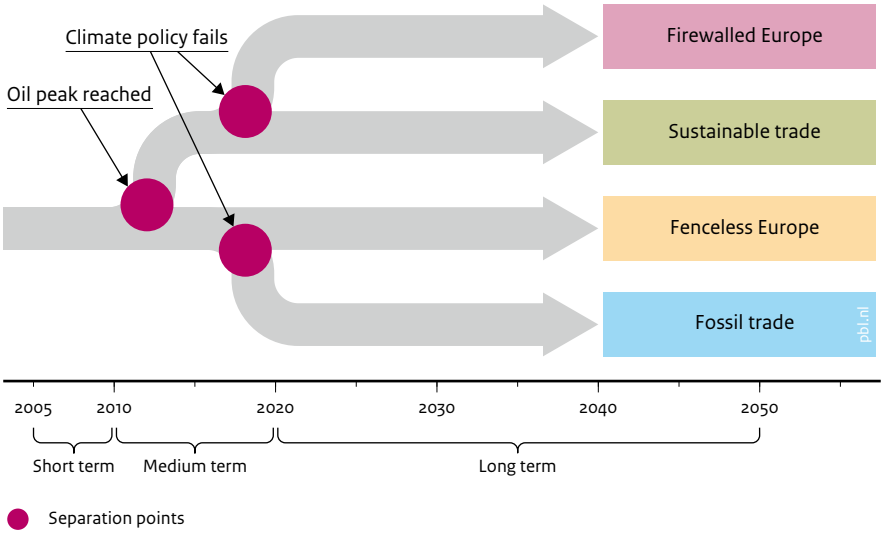
policy (IGEAT et al. 2006) take into account events such as an energy shortage, a drop in the dollar and a reversal in the Gulf Stream along Europe's Atlantic coast.

Discontinuities have a certain life cycle (Figure 3.3) and are usually preceded by a period of latency. An example is the experimental and testing phase that precedes the introduction of an innovation, such as energy from algae. This is followed by an eruption, as the event unfolds and significant changes are seen in people's behaviour. For example, a breakthrough in energy from algae can increase interest in the technology, and therefore its more widespread use. This is followed by a normalisation phase during which people get used to the event. Energy from algae has then become part of the regular, renewable energy supply.

Not all discontinuities are characterised by a sudden breakthrough; gradual discontinuities may also take place (Van Notten, 2005). One example is a regional population that follows year-on-year growth, stabilises then starts to decrease. This is a trend that changes direction over a period of several years (or even decades).

Discontinuities can be identified by detecting weak signals during the latency phase. Such a weak signal consists of poorly defined, unstructured information about one or more events that may point to a discontinuity. This is information that is usually ignored or wrongly interpreted, such as the earliest stage of a new development. It can be detected by following reports in the media, reading articles, consulting websites, brainstorming and interviewing creative professionals (Nekkers, 2006).

Figure 3.4
Exploring separation points



Source: ECN 2005

If we include discontinuities, we acknowledge the high level of uncertainty in the future (Jakil, 2011). After all, this allows us to take into account not just a few uniform trends that take one of several directions, but also breaks in the trend. This is important, because the past shows us that unexpected events with far-reaching consequences regularly take place. Examples are the credit crisis and the Arab Spring. Exploring discontinuities makes users more aware of the changeability of the context (Smith and Dubois, 2010) and can help test the robustness of policy strategies. On the other hand, including discontinuities makes scenarios more complex and therefore more difficult to communicate. We therefore recommend limiting the number of discontinuities to three or four.

An interesting method for including discontinuities is to explore separation points. This involves introducing a number of successive discontinuities, comparing the courses of the alternative futures and exploring the impacts on the issue and policy. We therefore produce a 'history book of the future', with a timeline. This is the approach taken in *Four European energy futures* (ECN, 2005), which explores peak oil production and a new global climate agreement, along with the possibility that this will cause the energy supply, which is currently based on existing technology, to undergo a transition to a low-carbon energy supply (Figure 3.4).

Exploring separation points has the advantage that it clearly shows the causal relationships. However, it is often difficult to decide on the order in which the events will take place. If we consider the example above, which event will take place first: the oil production peak or the new global climate agreement? There is also a risk that the scenarios will simply be reduced to a response to one or more possible future events, while the reality is much more complex.

3.3.3 The role of government policy in contextual scenarios

An important issue when it comes to the development of contextual scenarios for the public domain is the role of government policy in the scenarios. After all, policy implemented at a higher level, such as European environmental policy in a national environmental outlook study, is also part of the context (Section 3.2). We also need to ask whether, and if so how, to include national policy in the scenarios. The following options are available.[1] The options 'no policy', 'established policy' and 'trend-based policy' can be implemented in contextual scenarios. The options 'proposed policy' and 'new policy' are more suited to policy scenarios (see next section).

- *No policy.* A strict division is often made in the private sector between developments in the context of a company (the core of the scenarios) and developments in company policy (the core of the strategy). However, it is not usually possible to divide policy and context in this way in the public sector. For example, we cannot explore developments in a country's economy without taking into account national economic policy. The no policy option is sometimes used as a baseline reference for some policy scenarios. However, ignoring policy makes the scenarios less plausible and should therefore be explained carefully to the users.
- *Established policy.* This is national policy that has been approved by the government and for which resources have been allocated. This option, also called the low-policy option, shows clearly where bottlenecks may occur. However, the scenarios may become implausible beyond the period for which policy has been established, as the bottlenecks increase and there is no government policy in place to address them.
- *Trend-based policy.* The main features of government policy implemented in recent decades and recently established policy continues to be implemented in the scenarios, also beyond the period of established policy. To ensure the plausibility and consistency of the scenarios, a slightly different accent is placed on future policy in each scenario: a slight differentiation is made (CPB and PBL, 2015[b]). This option shows clearly where bottlenecks may occur in the future. It also makes it possible to test policy alternatives (expressed as deviations from the policy trend; in other words, to consider scenarios as a 'wind tunnel'). It is important to explain this clearly, as users may find it difficult to understand this approach.
- *Proposed policy.* This is policy that the government intends to implement, but which has not yet been formally introduced. This could be trend-based policy, or it could be new policy. For example, the Balkenende IV cabinet proposed the introduction of a road user charge as part of its national mobility policy. This option therefore better reflects actual

policy developments than trend-based policy. However, if the proposed policy is not implemented, the scenarios will be considered dated.

- *New policy.* This option concerns government policy that deviates from the policy trend. Applying the same new policy in every scenario helps us understand what the impact of the policy will be in different situations. If the policy is different in each scenario, it is unclear which effects are due to policy and which are due to driving forces. In this case, it is better to build separate policy scenarios and compare these with the contextual scenarios.

3.4 Develop policy scenarios

Policy scenarios explore a number of desirable future states of the policy issue (desired futures) and the policy required to achieve these (strategies). This involves *backcasting* or *critical futures*: working backwards from one or more future states to explore how the desirable situation can be achieved. Policy scenarios provide insight into different policy alternatives to help us address the issue and the intended and unintended impacts of the alternatives (obtain new insights). They also encourage a more open discussion about policy objectives and values (support communication) and inspire us to follow new policy or research pathways (encourage engagement) (Section 2.2.2).

Policy scenarios are largely normative (WRR, 2010). After all, they explore desirable futures, and people's idea of what is desirable can vary, depending on their values. We often assume in a policy scenario that a certain value will dominate policy for the next 25 years or so, so that we can explore the limits to implementation of this value (Dammers et al., 2017). To obtain insight into the policy alternatives, it is important that the scenarios represent as many different viewpoints that people may take in the discussions as possible. This is also important for organising social and policy debate. Like the baseline scenario and the contextual scenarios, the policy scenarios can be developed as an interim product and discussed with the client and the main target groups.

3.4.1 Desired futures

A desired future portrays a desirable version of the policy issue that could be achieved at some point in the future. This is based on a particular set of values, which directs the desired future and forms a response to one of the challenges explored in the contextual scenarios. For example, in 'Allowing nature to find its way' – one of the scenarios from *European nature in the plural* (PBL, 2017[a]) – priority is given to the intrinsic value of nature and natural processes and man's responsibility towards biodiversity, in response to the challenge of reversing biodiversity loss in Europe.

A desired future explores a situation that could be achieved and therefore goes further than a policy objective or a group of objectives. This is important, because portraying a future situation is more inspiring and informative than describing the objectives (Senge, 1990). 'Allowing nature to find its way' explores a situation that not only increases

biodiversity – a possible policy objective – but that also describes the types of nature, the locations, the environmental conditions, human activities and interactions with other functions.

3.4.2 Strategies

Each desired future can be achieved by applying different strategies. However, in order not to unduly complicate the scenarios, we usually take a single strategy as an example. When exploring a strategy, we consider the coalition of actors responsible for the strategy, their way of working, the measures they implement, the resources they use, the coordination with relevant policies in adjacent domains (the direct context) and any possible synergies or conflicts (PBL, 2017[b]).

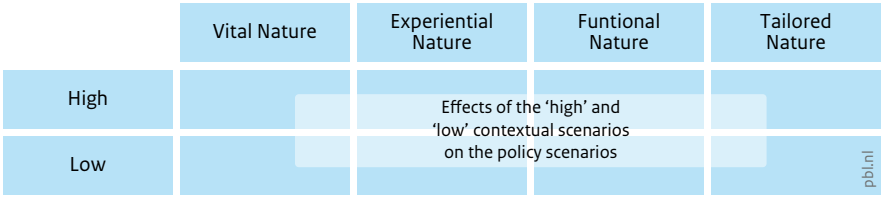
In the case of 'Allowing nature to find its way', this strategy is largely the responsibility of government authorities. As well as the EU, national government also has an active role, and both organisations actively look for opportunities to work together with other parties. Natural areas with low biodiversity are sold, and land with more potential is bought, developed and managed. Funding comes from national investment programmes, co-financed by the EU. Coordination takes place with flood protection policy, for example through nature development in riparian zones. This serves various objectives, and therefore results in synergy. However, conflicts may arise if people object to the loss of existing nature areas.

3.4.3 Combining policy and contextual scenarios

Policy scenarios can also be developed in combination with contextual scenarios. This can be done in various ways. One way is to develop a single contextual scenario and compare this with several policy scenarios (Kok et al., 2008). In this case, the contextual scenario is a dominant scenario (business as usual), in which current societal and physical developments and current policy continue (see Section 3.3.3 for the role of policy in contextual scenarios). One or more policy scenarios are then compared with this contextual scenario. These policy scenarios explore alternative measures to achieve current policy objectives (limited exploratory scenario) or alternative policy objectives (highly exploratory scenario). Examples are the *Roads from Rio+20* study (PBL, 2012[b]), which explores the feasibility of achieving global sustainability goals and bases its analysis on current goals, and the *OECD Environmental Outlook to 2050* (OECD, 2012), which examines the challenges relating to climate change, biodiversity, water and the impact of pollution on health and explores alternative goals.

Because of the uncertainty involved in societal and physical developments, the contextual scenario should be subjected to a sensitivity analysis. This gives us a clear idea of the required policy effort and the expected impacts of the policy alternatives, while also inspiring policymakers and other interested parties to follow a new pathway. However, this approach pays little attention to the uncertainty surrounding future developments, or the fact that policy success depends in part on such developments.

Figure 3.5
Contextual scenarios set against policy scenarios, example from *Nature Outlook*



Source: PBL

It is also possible to combine several contextual scenarios with several policy scenarios. For example, the two contextual scenarios in *Welfare, Prosperity and the Human Environment* CPB and PBL, 2015[a]) have been incorporated into *De toekomst van de Noordzee* (The Future of the North Sea; PBL, 2018). One scenario explores a future with high development rates and the other does so for low rates of development, with respect to population, the economy, technology, climate and other developments for which the government policy as established in 2015 is being continued. For the North Sea scenario study, two more sustainability scenarios were developed that, in addition to the high and low rates of development, also assume policy that contributes to the Paris climate goals and to the United Nations Sustainable Development Goals with regard to the North Sea. This results in the following four scenarios: 'Slow Change', 'Pragmatic Sustainability', 'Rapid Development' and 'Together Sustainable' (Figure 3.5).

Combining contextual and policy scenarios in a single scenario study makes it possible to explore which driving forces have the highest impact. For example, if we want to develop a cohesive nature network in the North Sea, the most important factors are the development of offshore wind farms and the opportunity to combine wind farms with nature. Combining contextual and policy scenarios also makes it clear what opportunities and limitations possible future developments in driving forces present for policy. For example, in the case of high economic growth, more public and private funding will be available for measures that combine wind farms with nature development than in the case of low economic growth. Combining the scenarios also provides insight into the policy effort required. High rates of economic and technological development will make it easier to achieve the Paris climate agreement objectives than low rates of development. Finally, it also gives us insight into what this means in terms of achieving the desired futures. For example, we achieve a larger nature network in the 'Together Sustainable' scenario, which assumes high levels of development, than in the 'Pragmatic Sustainability' scenario, in which dynamics are lower.

Combining several contextual scenarios with several policy scenarios has the advantage that it addresses both the cognitive and normative uncertainty associated with the issue (Section 3.2). The analysis also clearly differentiates between the impacts of the driving forces and the impacts of policy, which increases our understanding of the effectiveness of policy under different circumstances.

3.5 Additional choices

Three more choices need to be made when developing contextual and/or policy scenarios. These are: the number of time periods to use, the number of scenarios to include in the study, and whether or not to use world views.

3.5.1 Number of time periods

Scenarios focus on the long term, and in some cases the very long term. The time horizon to use depends mainly on the scenario study objectives, the types of scenarios to be built and the relevant dynamics (Section 2.2.3).

However, we also need to decide how many time periods to apply. If we use just one time period, covering the whole of the time horizon, this simplifies the scenarios and their communication. On the other hand, splitting the time horizon into several shorter periods does greater justice to the complexity of and uncertainty associated with societal, physical and policy developments. It also makes it possible to take into account changes in the rate of development, in the direction, and so on. In the case of policy scenarios, using several time periods provides more opportunities for developing policy messages. Therefore, the scenarios not only provide insight into possible strategies and their impacts, but also into the speed with which the strategies could or should be implemented.

In the absence of a general formula for the maximum number of periods, we need to find a balance between the rate with which developments take place and ensuring that we do not introduce undue complexity. The number of periods depends primarily on the types of scenarios to be built. For example, it makes more sense to define several time periods for limited and, in particular, highly exploratory scenarios than for dominant scenarios. After all, these assume a higher level of dynamism. Past developments can also provide an indication: the higher the dynamism in the past, the more periods are required.

3.5.2 Number of scenarios

As far as future developments in the driving forces are concerned, all kinds of combinations are possible. For example, if 7 driving forces are to be explored and each one can increase or decrease, there are, in theory, $2^7 = 128$ possibilities. Many different possibilities can also be explored for the strategies. After all, there are many different desired futures, and various strategies can be developed to achieve each of these. However, the point is not to produce as many scenarios as possible to explore every conceivable development, but to develop a limited number of scenarios that explore logically consistent but clearly distinct pathways.

Table 3.3
Number of scenarios and corresponding advantages and disadvantages

Number of scenarios	Advantages	Disadvantages
One scenario	• Simple analysis • Requires little time • High degree of transparency	• Does not take cognitive uncertainty into account • Limited insight into effectiveness of policy • Does not take normative uncertainty into account • Threatens study independence
Two scenarios	• Easy to carry out • Easy to understand • Easy to use	• Scenarios may only differ quantitatively • Risk of leaving out relevant pathways
Three scenarios	• Larger number of different pathways • More qualitative difference| in pathways	• More difficult to use • Risk of one of the scenarios being seen as the most probable
Four scenarios	• Even larger number of different pathways • Scenarios portrayed clearly	• Use of four quadrants can cause considerable debate • Use of four quadrants can be considered restrictive
Five scenarios	• Possible to focus on different users	• Difficult to remember so many scenarios • Risk of one of the scenarios being seen as the most probable

Here too, in the absence of a general formula, we need to address the uncertainty associated with developments in the driving forces, policy and the issue, while ensuring that the scenario study does not become overly complex and therefore difficult to communicate. Table 3.3 summarises the possible number of scenarios and the corresponding advantages and disadvantages.

Some studies are made up of just one scenario. This is usually a contextual scenario that takes the form of a reference scenario (business as usual) and extrapolates past and present driving forces into the future. This scenario serves as a reference against which to compare a number of policy scenarios, which gives us an idea of the effectiveness of the different policy alternatives. It is implicitly assumed that driving forces are more likely to follow a business as usual pathway than to deviate from this. An example of such a scenario is the *OECD environmental outlook to 2050* (OECD, 2012).

A single scenario may also consist of a policy scenario that takes the form of a vision. An example of this is *Getting into the right lane for 2050* (PBL and SRC, 2009). This study explores EU policy challenges relating to the following three themes from a global perspective: food production and biodiversity, energy and climate change, and mobility

and a low-carbon energy supply. The study therefore explores the opportunities for linking long-term ambitions to the policy development process for the coming years.

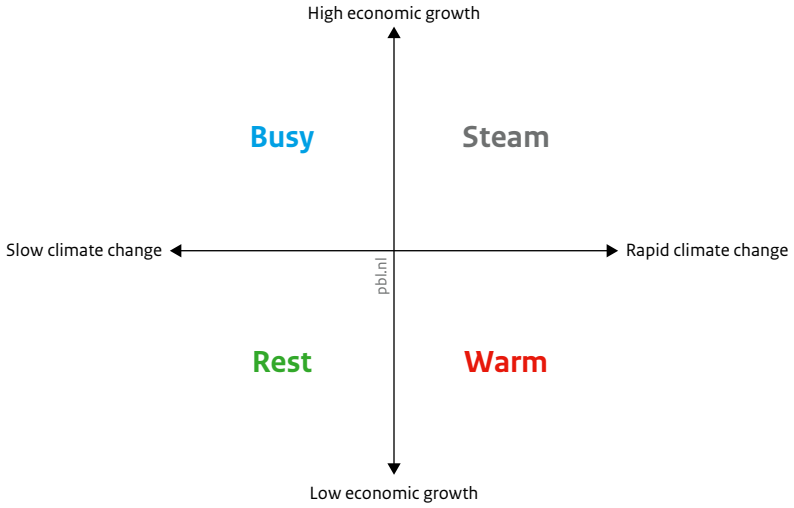
The advantages of a single scenario study are that it increases the transparency of the study, it simplifies the analysis and it limits the amount of time required. However, it also fails to take into account cognitive uncertainty (about developments in the driving forces). It also says very little about the effectiveness of policy alternatives. After all, policy that is effective in handling predicted developments in the driving forces (global emissions trade) may be less effective if developments take a different course (increased competition between global regions). We therefore recommend that, at the very minimum, the reference scenario is analysed to explore the main uncertainties (Van Vuuren et al., 2014). A single vision fails to capture the normative uncertainty, as policy objectives can change over time. The question also arises whether presenting just one vision reflects PBL's mission to produce independent research. After all, using just one vision introduces a normative aspect, even if it attempts to reflect official policy objectives.

The number of scenarios can be limited to two by assuming in one scenario, for example, that all the driving forces show strong growth ('high dynamics') and in the other that they all show low growth or decline ('low dynamics'). This makes it possible to explore the extent of the policy challenge if developments take a different course. *Nederland in 2030 en 2050* (The Netherlands in 2030 and 2050) is an example of a study that uses two scenarios. The assumption is that, if policymakers prepare for two different developmental pathways, they will also be able to respond to developments that lie somewhere in between. If public and policy debate is dominated by two different positions, these can also be analysed in two scenarios. An example could be the debate concerning the future of the EU, which has for many years been dominated by the 'liberal model' and the 'solidarity model' (IGEAT et al., 2006). This makes it possible to explore the outcomes of each position and the measures required to achieve them. It is also possible to explore the similarities and differences between the two positions.

The advantages of using two scenarios is that it simplifies the analysis and that two scenarios are easy to understand and to use as users do not need to work with more scenarios than is strictly necessary. The disadvantages are that the scenarios tend to differ quantitatively (high or low economic growth) rather than qualitatively (industrial or knowledge economy) and that other relevant pathways that the driving forces or policy may take are ignored.

We can build three scenarios by developing three pathways that describe possible future developments in the driving forces or policy. An example could be three scenarios in which autonomous developments are dominated by the market, by society or by the government (contextual scenarios). Another example is policy developments that are dominated by economic, social or ecological aspects of sustainability (policy scenarios). What is important is that the scenarios explore three clearly distinct pathways. In the past, contextual scenarios were sometimes divided into a 'high', a 'middle' and a 'low' scenario.

Figure 3.6
Coordinate system of Delta scenarios for 2050 and 2100



Source: Deltares et al. 2013

However, users tended to consider the middle scenario to be a prognosis and ignore the other two scenarios, with the result that they were surprised when developments took a different course (Dammers, 2000).

The advantages of building three scenarios are that more pathways can be explored compared with a two-scenario study and that these can differ more qualitatively. They therefore better address the cognitive and/or normative uncertainty associated with future developments. The disadvantages are that users find it more difficult to work with three scenarios than two, and that they may regard one of the scenarios as the most probable 'middle' scenario. However, this can be dealt with by providing user instructions to accompany the scenario study and supervising use of the study.

If four scenarios are developed, these are often plotted in four quadrants. In the case of contextual scenarios, this can be done by scoring the driving forces being explored according to the impact that they have on the issue and the uncertainty in their future course. These scores are based on expert judgment. Two driving forces are then selected that score high both in terms of impact and uncertainty. The possible upper and lower limits of the developments in these driving forces are then described, such as high growth or low growth (or decline). This therefore forms two axes, and four quadrants.
Each quadrant defines one scenario in which all the driving forces act in a direction that is consistent with the developments in the two driving forces that were used to determine the quadrant. Therefore, in the *Deltascenario's voor 2050 en 2100* (Delta scenarios for 2050 and

2100; Deltares et al., 2013), the axes economic growth (high, low) and climate change (rapid, slow) are used to position the four scenarios (Figure 3.6). Then, to develop the scenarios, possible future developments (e.g. in demography, energy or EU policy on climate) were also taken into account.

In the case of policy scenarios, the axes may be chosen based on the main policy objectives. For example, the scenarios from the study titled *Spatial scenarios and orientations in relation to the ESDP and cohesion policy* (IGEAT et al. 2006) were defined based on two objectives that have dominated EU policy for several decades, namely that of increasing the competitive power of Europe as a whole (liberal model), and that of strengthening cohesion between European regions (solidarity model). The axes are determined by deciding whether or not to focus on each of the objectives, resulting in four possibilities.

The advantage of using quadrants is that the scenarios are presented in an organised manner and that the scenarios clearly differ from each other. The disadvantages are that the choice of axes and their interpretation often results in much discussion and disagreement, and that the axes are regarded as being highly restrictive. It is therefore important to see the axes as a sort of scaffolding – they help us build the scenarios but they can be removed once the scenarios are complete (Van 't Klooster and Van Asselt, 2005; Van 't Klooster, 2007).

Another method for defining scenarios is to use divergence and convergence. This involves first coming up with many ideas about how to guide societal and physical developments and/or policy developments in the coming decades. These ideas are then clustered into a few scenarios. For example, ideas generated during a scenario workshop for the *European nature in the plural* study included 'Sustainable use of nature as conservation', 'Wilderness at the heart of society', 'Nature, business and innovation', 'Connectivity between all citizens and nature' and 'Boxed nature'. These were then clustered by the team and developed into the following scenarios: 'Working with nature', 'Allowing nature to find its way', 'Strengthening cultural identity' and 'Going with the economic flow'. For the clustering process, the following criteria were applied: maximise consistency within the scenarios, maximise contrast between the scenarios and maximise relevance to public and policy debate (Dammers et al., 2017).

Only rarely does a study include more than four scenarios. However, a few examples are available, such as the European Commission's *White paper on the future of Europe* (2017), which has five scenarios: 'Carrying on', 'Nothing but the single market', 'Those who want more do more', 'Doing less more efficiently' and 'Doing much more together'. One benefit of having so many scenarios is that it allows us to meet the needs of many different target groups, as each group can find a scenario that represents its expectations or ambitions. This can be important if complex negotiations are to take place, such as those concerning the future of the EU. However, there are also two disadvantages, which are that users find it difficult to remember all the scenarios (Dammers, 2000) and some scenarios may be so similar that it is difficult to tell them apart.

Figure 3.7
The four world views of the sustainability outlook

Source: RIVM 2004

Although *European nature in the plural* also contains five scenarios, none of these disadvantages are seen in this study. This is because the study consists of one contextual scenario – the reference scenario – which explores the possible future course of the main issues that impact European nature, such as climate change and agricultural developments and the challenges that these present for nature policy, plus the four policy scenarios named above that each address the challenges described in the reference scenario. This means that the users only need to compare four scenarios. Note that this study does have the disadvantages named above for one scenario.

3.5.3 Whether or not to use world views

Contextual scenarios and policy scenarios are sometimes based on existing world views. These world views represent the various frames of reference applied by different groups of people. Each frame of reference consists of a system of values and opinions about how society functions, what the important policy issues are, and how these issues should be addressed. A world view is not necessarily associated with a particular group, but may be held by different groups. World views may relate to the future course of societal and physical developments, but also to a desirable future and the measures required to achieve it.

World views can be used to build both normative and descriptive scenarios. In the former, the values in the world views guide the scenario categorisation, such as a belief in 'Allowing nature to find its way', 'Strengthening cultural identity', 'Working with nature'

or 'Going with the economic flow'. In the latter, the scenarios are categorised according to different ideas about how society will function in the future; for example, according to the primacy of the market, civil society or the government. A categorisation that is often applied comes from the cultural theory of Thompson et al. (1990), which distinguishes between four world views: hierarchy, egalitarianism, individualism and fatalism. According to the authors, all four world views are found in society and these largely cover the spectrum of perspectives that people have. The IPCC global future development scenarios are inspired on these four world views, and these, in turn, served as a source of inspiration for the *Duurzaamheidsverkenning* (First Sustainability Outlook; RIVM, 2004). Figure 3.7 shows the world views presented in the sustainability outlook and the two axes along which they are positioned.

World views may also be based on empirical observation, for example by conducting a discourse analysis. A discourse refers to a 'more or less cohesive whole of ideas, concepts and categorisations that can be found in certain discussions' (Hajer, 2000). A discourse can be analysed by looking for the main ideas and positions taken in social and policy debate. These positions can be used to define the world views. It is also possible to use a literature analysis, document analysis, interviews or surveys.

World views help us consider an issue, policy and the societal and physical developments that can influence these from different points of view (achieve new insights). They also contribute to a discussion of the similarities and differences between people's desires and expectations (support communication). Furthermore, they can help increase support amongst various groups for a policy alternative (encourage engagement). We should however note that future developments according to the world view of a particular group or even dominant section of society may say very little about the actual developments that take place. Finally, an excessive focus on world views can lead us to overestimate their effect. For example, a world view in which the market dominates assumes this market to function without any interference, whereas this is not always the case, in practice.

3.6 Derive key messages

Policy and research messages consist of points for consideration and recommendations that aim to increase the robustness of the policy and research. These key messages may be derived by reflecting on policy that can or will be implemented in the short term and on the research required to achieve this, based on an analysis of future developments in driving forces and future situations that may be achieved in the long term (Kok et al., 2008). They key messages increase the usefulness of a scenario study. This is because, without them, the target groups will find it difficult to identify points that are relevant to policy and research, which will negatively impact on their opinion of the usefulness of the study (Henrichs et al., 2010).

Despite this, the key messages are often neglected in many scenario studies (Bakkes, 2012[a]; WRR, 2010). This is because the method used to derive the key messages from the other scenario components is complex and because it receives too little attention during the project planning phase. In some cases, the key messages are deliberately left out for the main part, and the scenario study ends with instructions for its use and a few illustrative key messages. The users are given instructions on how to derive more key messages from the scenarios, for example by making the comparisons described below. As with the other scenario components, the key messages can form an interim product to be discussed with the client and the main target groups.

The *points for consideration* for policy and research are derived by comparing the contextual scenarios with one another and with the current situation. First of all, we consider the developments that are similar across the scenarios and that have roughly the same impacts on the issue (Shell, 2008). At the very minimum, policy must take these developments into account. We then consider the developments, and therefore their impacts, that are more uncertain. It is important to monitor these developments (BZK, 2011), for example using the Environmental Data Compendium (www.compendiumvoordeleefomgeving.nl), developed by PBL, CBS and Wageningen University. This allows us to assess whether developments are taking place in accordance with a particular scenario, so that policy can respond. We also need to consider any discontinuities and their impacts. This helps alert policymakers to any surprises, so that they can anticipate or respond to them. The above process brings the main policy challenges to light, as well as the possible situations in which they may occur. The same applies to our gaps in scientific knowledge concerning societal and physical developments, the relationships between them and the impacts that they may have.

The *recommendations* for policy and research can be derived by comparing the policy scenarios with each other and with current policy. This helps us identify which components of the future situations or strategies we can combine, which are in conflict with one another and which aspects of current policy need to be changed to increase the policy robustness. To do this, we need to find components in the policy scenarios that produce synergy. Examples could be the development of nature reserves that not only improve biodiversity but also benefit outdoor recreation and services such as water storage. We also look for components in the policy scenarios that conflict with one another, such as the creation of nature reserves that benefit biodiversity while high levels of property development are also taking place in the area. In this case, choices need to be made. This also provides insights into gaps in our knowledge and the research still required to fill those gaps.

When developing the key messages, it is important to clearly distinguish between the points for consideration, which are based on the contextual scenarios, and the recommendations, which are based on the policy scenarios. After all, in the case of contextual scenarios, it is not possible to choose between scenarios or combine elements of the scenarios. This is because these scenarios explore future developments over which policymakers have very little or no influence, which means that they need to take into account every possible pathway. It is possible to choose between scenarios or combine

certain elements in the case of policy scenarios. After all, these scenarios describe futures that policymakers can aim to bring about through policy.

It is also possible to produce recommendations by comparing the policy and contextual scenarios, for example making use of a matrix. The four policy scenarios in the *Natuurverkenning 2010–2040* (Nature Outlook 2010–2040) were compared with two contextual scenarios from the *Welfare, Prosperity and Quality of the Living Environment* study (CPB and PBL, 2006) in this way. These were the two contextual scenarios with the lowest and highest levels of societal dynamics: 'Regional communities' and 'Global economy' (Figure 3.8). There are several ways in which completing a matrix can help. A horizontal comparison (within the rows) shows what impacts the societal and physical developments that take place in each of the contextual scenarios have on the issue and the policy alternatives, and therefore what effect the context has on the issue and policy. A vertical comparison (within the columns) provides insight into the feasibility of the policy alternatives under different circumstances (required efforts) and into the robustness of the alternatives (necessary changes). Comparing all the cells (diagonally) shows which components of the policy alternatives:

- can be implemented at a minimum, e.g. concentrate nature in several large areas to benefit biodiversity and restrict its impact on other functions;
- can be implemented under one contextual scenario and not the other, e.g. lobbying the EU is useful under more ambitious European nature policy, but not if this policy is to be scaled back;
- cannot be implemented in any of the contextual scenarios, e.g. nature development can only be carried out by private parties (there is no demand for nature as a public good, and this will be met to a limited extent by private parties);
- are to be implemented immediately, e.g. improve the environmental and water quality of a nature area as to do otherwise will lead to irreversible damage;
- are to be implemented at a later date, e.g. sell nature areas with low levels of biodiversity only after areas with more potential have been bought, to reduce opposition from the general public.

By developing points for consideration and recommendations, this part of the scenario study results in 'building blocks for policy'. Of course, policymakers and other stakeholders may choose not to use these building blocks. The key messages do more than simply provide sug*gestions for the implementation of existing policy, as was the case in Natuurverkenning 2* (Nature Outlook 2; RIVM and DLO, 2002). However, they do not go so far as to present a blueprint for new policy, as in *Nederland Later* (The Netherlands Later; MNP, 2007[a]).

As far as the usefulness of the scenario study is concerned, it is important that the key messages reflect ongoing public and policy debate. This ensures that they are relevant and in tune with current opinion. This, in turn, makes it possible to interest policymakers and other stakeholders in the key messages, and to use them to change their views. It is also important that the messages reflect the views of the different target groups. The targets groups were identified in the project preparation phase (Section 2.2.1); now we need to tailor the key messages to these target groups and ensure that they reflect their world views.

Note

1 With thanks to Jan Schuur, who provided the ideas for this categorisation.

4 Implementation phase: applying the methods

4.1 Introduction

Following on from the 'what' in the previous chapter, this chapter focuses on the 'how': the methods that we can apply when developing the different components of a scenario study and the choices we can make. We describe the following methods and their role in the development of scenario components: stakeholder participation (Section 4.2), essays (Section 4.3), particular designs (Section 4.4) and model calculations (Section 4.5). Finally, in Section 4.6, we discuss how to coordinate and combine these methods. An overview of the methods and the advantages and disadvantages of each is given in Table 4.1.

4.2 Organise stakeholder participation

Stakeholder participation refers to the active involvement of external experts in the development of scenario components. In most cases, the scenario team forms a panel that includes, for example, policymakers, stakeholders, scientists, designers and creative professionals (Van der Heijden, 1996). More diversity in participants ensures that a variety of viewpoints are represented and reduces the risk of groupthink. The number of experts invited to take part in stakeholder participation can vary from about 30 to over 100, as in *European nature in the plural* and the *Duurzame stad* (The Sustainable City) respectively. More participants are invited if the goal of stakeholder participation is to give policymakers the opportunity to discuss the future or disseminate the scenarios with a diverse group. Experience with stakeholder participation shows that the main criteria for taking part are that participants (Dammers et al., 2011):

- have expertise in relevant aspects of the subject area in which scenarios are to be built;
- are capable of thinking in the long term and beyond the boundaries of the own sector or discipline;
- together with other participants, represent a wide range of viewpoints in the subject area.

Table 4.1
The advantages and disadvantages of each method

Method	Advantages	Disadvantages
Organise stakeholder participation	• Provides the scenario team with new insights • Increases the creativity of the scenarios • Makes it possible to obtain feedback on the outcomes • Increases legitimisation of the scenarios • Makes it more likely the scenarios will be used	• Risk of bias due to selective participation • Insights are very general, both old and new • Risk of undesirable group influence
Write essays	• Helps us clearly communicate relevant insights about the future	• Produces fairly general insights • Does not always explain why certain developments and effects take place • Risk of essays being affected by personal opinion
Produce particular designs	• Visualises spatial developments and their impacts • Clearly portrays the essence of the scenarios • Increases the imaginative power of the scenarios	• Not always transparent • Does not always explain why certain spatial developments or patterns occur • Risk of utopian thinking that limits plausibility
Carry out model calculations	• More detailed scenarios • Better validation of scenarios • More consistent scenarios • More plausible and convincing scenarios	• Only includes quantifiable developments • Risk that time restrictions will mean that uncertainty is not analysed • Risk that calculations will not be repeated based on new information • Risk of reduced consistency if more than one model is used

The external experts are first asked to generate ideas for each scenario component, for example concerning possible developments in the driving forces for the contextual scenarios or possible measures for the policy scenarios (Carlsson-Kanyama et al., 2008). At this point, the participants are also asked to form small groups then present their results to the other participants for feedback. All kinds of creative techniques can be used, to discover new aspects of the issue or new driving forces, for example. Once plenty of ideas have been generated, these are clustered to form a general outline of the scenario components.

The outcome of stakeholder participation depends on the way in which it is reported. The workshop may go well, but if the reports are not well written it will all have been for

nothing (Nekkers, 2006). Reporting can take the form of flip charts, notes, recordings and/or photographs. Another benefit of a well-written report is that people will read it who were unable to take part in the workshop. After the workshop, the scenario team selects and refines the ideas and develops them further. This therefore represents the first step towards developing the scenarios and their storylines (Section 4.3).

There are various reasons why stakeholders may be invited to take part in the scenario project. In practice, these reasons overlap somewhat and are not always easy to define clearly:

- Stakeholders can provide *insights* that the scenario team may not have come up with. Examples could be scientific insights or insights from policy practice, for example concerning future developments in driving forces and their impacts on the issue.
- Stakeholders can improve the *creativity* of the scenarios. Involving policymakers, interested parties and visionary experts can help generate creative ideas about the future (Chermack, 2004). This is particularly important in the case of highly exploratory scenarios.
- Stakeholders can be asked to *review* the outcomes and thus improve the scenarios. These could be preliminary versions of descriptions, particular designs or model calculations, or interim products or draft reports.
- Stakeholder participation can contribute to the *legitimisation* of the scenarios; in other words, it can make them more acceptable (Henrichs et al., 2010). Inviting influential users to take part in meetings can raise the status of the scenario study, and therefore increase its acceptance (Hage and Leroy, 2009a).
- Stakeholder participation can encourage more people to *use* the scenarios. People then become more familiar with the scenarios, possibly understand them better and discuss them with other people. This is likely to increase ownership of the scenarios, which makes it more likely that people will accept the outcomes (Dammers and Hajer, 2011).

Various social techniques are available for organising stakeholder participation in scenario studies. Commonly used techniques are:

- *Scenario workshops*. Policymakers, stakeholders, scientists and other creative professionals are invited to come up with ideas for the scenario components or to provide feedback on the outcomes of other methods applied by the scenario team. An example is given in Text Box 4.1.
- *Open Space conference*. This is a type of workshop in which participants can put forward their own ideas and lead discussions about them (Hage and Leroy, 2009[b]). The open nature of such conferences makes them more suited to generating ideas for scenario components than structuring or developing ideas.
- *Group decision support*. This is a workshop that makes use of computer-assisted debate (Hage and Leroy, 2009b), which combines information input into the computer with group discussions. Using the computer in this way ensures that each participant can contribute equally, while guaranteeing anonymity where required.
- In *group model building*, participants spend several sessions developing a conceptual model of the issue, the policy and the driving forces (Vennix, 1996). This is done by translating participant's ideas into many different variables and interactions.

- *The Delphi technique* is an iterative process in which the participants are sent a series of online questionnaires (Hage and Leroy, 2009b), for example containing questions on possible discontinuities. The participants are also able to respond to the results of the previous round. One advantage of this method is that unwanted group influence (which happens if certain participants dominate the discussion) is avoided. Another advantage, certainly in the case of international projects, is that it is easy to contact the participants.
- *Interviews* with creative experts can produce new, validated ideas for the scenario components. For example, De Ruijter Strategie conducted interviews to build water management scenarios for the Rijnmond-Drechtsteden region (Deltaprogramma Rijnmond-Drechtsteden, 2011). Both direct and open questions were used in these interviews, and the respondents were given the freedom to describe their visions of the future.

Text Box 4.1 Workshops on the future of nature in the Netherlands

As part of the *Natuurverkenning 2010-2040* (Nature Outlook 2010-2040) study, a series of workshops were organised addressing all four of the scenario components. The first four workshops were used to develop the policy scenarios. The policy and research experts who took part in the workshops were employed by ministries, provinces, municipalities, nature organisations, civil organisations, knowledge institutes and commercial organisations. The participation criteria applied meant that the workshops produced a wealth of ideas. Extra workshops were organised for the 'land nature' component that were attended by the Dienst Landelijk Gebied (DLG; the Countryside Department) and the recreation and construction sectors. The first two workshops were spent developing the general outlines of the policy scenarios for nature on land and at sea. This was done by first letting the participants come up with several main, general themes about the future of nature in the Netherlands, such as 'nature at home', 'recycling nature' and 'interwoven nature' (nature combined with, for example, recreation, agriculture and housing). These were then clustered and the participants were asked to develop the ideas further, as key words and outlines. The scenarios were then refined by the scenario team and presented to the workshop participants for feedback in the next two workshops. The result was a preliminary version of the scenarios.

The two extra workshops with DLG helped develop and define the scenarios further at the regional level. More than in the other workshops, the emphasis was primarily on the policy strategies. For each policy scenario, an analysis was made of the regions in which it could be achieved and the measures required to do so. Separate workshops were organised for the recreation and the construction sectors as these sectors were underrepresented in the other workshops. These workshops provided additional information, for example concerning opportunities for recreation in large nature areas and for more green spaces in housing developments.

The techniques described above may be applied separately or in combination. For example, the Delphi technique may be applied to prepare for a workshop, by asking workshop participants to complete a questionnaire. The results can then be presented at the start of the workshop, to help it get off to a good start.

The guidance for stakeholder participation, *Leidraad stakeholderparticipatie* (Hage and Leroy, 2009[a]; 2009[b]; 2009[c]), commissioned by PBL, can be used to support the decision-making process. The publication was organised around a number of questions: 'Why do I want participation?', 'What about?', 'Who do I want to involve?', 'How much participation do I want?' and 'What form of participation do I want?' It consists of three documents: the main document to support those responsible for making choices; a checklist that summarises the guidance; and the practice guide that provides more detailed information on stakeholder participation methods.

Two main points should be made concerning stakeholder participation. First of all, the scenario team needs to take into account possible conflicts between stakeholders. After all, strategic policy is about developing broad outlines for policy, in which major and conflicting interests are often at stake. As these interests can also play a role in scenario building, it is important that the participants are able to think beyond their own sectors. The scenario team also needs to make it clear that each participant may present his or her own expectations and desires for the future and that the team will do its best to take these into account in the scenarios. It is also important to apply some general rules, such as 'don't criticise but come up with a better idea'.

Secondly, the scenario team needs to be sure to maintain impartiality. This is particularly important for an assessment agency that prides itself on its independence. Such impartiality can be ensured by inviting as many different stakeholders as possible, to reduce bias. It is also important to make it clear to the participants that, while they are free to make suggestions, the scenario team is also free to decide whether or not to include their suggestions in the scenario study and to adapt them if necessary. This reduces the risk of certain participants influencing the scenarios too much (Dammers, 2000; Kok et al., 2008).

Stakeholder participation offers opportunities, but it also has its limitations. First of all, there is a risk of selective participation, which can skew the ideas provided by the participants. This can be dealt with by applying a combination of participation methods. For example, stakeholders who are underrepresented in a workshop can be interviewed at a later date (this also saves the respondent time). Secondly, stakeholder participation produces global ideas, which could be relatively mature or very new. This is why the scenario team needs to select, adapt and develop the ideas, as well as always apply one or more other participation techniques. Thirdly, participation methods that involve people working together in groups can mean that the influence of the group prevents people from coming up with innovative ideas. This risk can be minimised if the workshop is organised properly. Using the Delphi technique ensures that the participants have no contact with one another and therefore that no unwanted group influence can take place.

4.3 Write essays

We write essays to develop storylines about the scenario components. A storyline is a logical, consistent description; for instance, of possible future developments in driving forces, the reason for these developments and their impacts on the issue and the policy in question (Henrichs et al., 2010). In the case of contextual scenarios, storylines may consist of incremental developments in the driving forces (a gradual increase in sea level due to climate change), a transition whereby a development represents a fundamental system change (an energy transition to a low-carbon energy supply), or stagnation (the economy fails to recover in the coming decades). Examples of essays are given in Text Box 4.2.

Text Box 4.2 Essays about the future of the energy supply in Europe

The scenario study *The next 50 years: four European energy futures* (Bruggink, 2005) consists of four essays on the future of the energy supply in Europe: 'Firewalled Europe', 'Sustainable trade', 'Fenceless Europe' and 'Fossil trade'. The author, who works for the Energy Research Centre of the Netherlands, considers the future of the global energy markets and global climate change, based on an analysis of the literature combined with his own expertise and logical reasoning. He argues that major discontinuities could take place (peak in oil production, global climate agreements) that may have far-reaching consequences for the European energy supply. He describes what the discontinuities could consist of, why they could occur and what the consequences could be for the energy supply. In the essays, the plots of the storylines are just as important as the futures that the scenarios describe. These plots describe how the discontinuities, which are each caused by a particular confluence of developments, result in a certain energy transition. The author goes on to discuss the implications for European and Dutch innovation strategies and provides concrete examples of possible changes in the Netherlands: small-scale nuclear power, smart and clean coal-fired stations, biofuels from modified plants and a regional hydrogen economy.

Storylines help us communicate relevant insights about the future in an understandable and compelling manner (EEA, 2001). They are important because they have a psychological impact that graphs, comparisons and other forms of presentation lack. Storylines help explain why certain developments are relevant to the future of an issue and why these developments may follow a certain pathway. They therefore give meaning to these developments, which is crucial for understanding the opportunities and limitations that they present. When developing storylines, it is important to pay attention to the following points (Van der Heijden, 1996):

- connect hypothetical future developments to actual past and present developments;
- clearly describe the possible impacts of the future developments on the issue and policy in terms of challenges or opportunities and threats;

- ensure that the storyline has a coherent structure that can be understood as a whole;
- ensure that the storyline consists of one or more plots that are able to clearly show why developments may follow a certain direction;
- ensure that the storyline is powerful enough to inspire policymakers and to challenge their frames of reference;
- ensure that the storyline is plausible enough for policymakers to accept it;
- include certain key elements in each storyline to enable comparison.

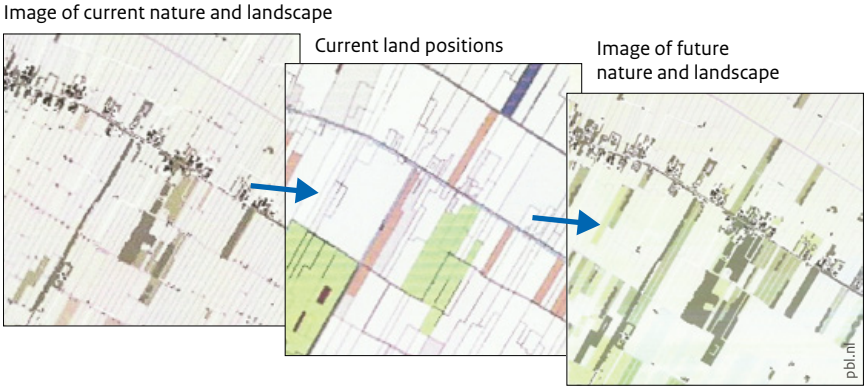
It is also important to give the scenarios names and to clearly express what they represent, for example as a motto. This makes it easier for policymakers, interested parties and researchers to immediately understand what the scenario is about and remember it, which increases the chance that it will be used (Van der Heijden, 1996). The name should capture the essence of the scenario in two or three words. The same applies to a motto, which expresses the scenario as a concise sentence. Two examples from the *SCENE* study (RPB, 2003) are 'the Netherlands as production space', with the motto 'there's money to be earned in the global space', and 'the Netherlands as experience space', with the motto 'always something to do in aesthetic space'.

There may also be reasons for using more neutral names. For example, the 2007 IPCC climate change scenarios are called 'A1', 'B1', 'A2' and 'B2', to emphasise their neutral, scientific character. This is important for ensuring that they are accepted in the climate negotiations, which aim to achieve consensus through value-free, scientific insight. In this case, the policymakers and interested parties are involved in the scenario development process, and the climate negotiations take place over a long period, so that there is plenty of time to get used to the names.

In most cases, the project team bases its essay writing on an analysis of the literature, combined with the authors' own expertise and logical reasoning. The outcome of the stakeholder participation techniques may also form an important input. Various sources may be consulted in the literature analysis, including previous scenario studies on the subject or related subjects, scenario studies conducted in other countries, recent research, policy documents and recommendations, newspaper and journal articles, and so on. Much time can also be saved by using recent scenario studies. For example, *Deltascenario's voor 2050 en 2100* (Delta scenarios for 2050 and 2100; Deltares et al., 2013) were largely based on *Klimaat in de 21e eeuw* (Climate in the 21st century; KNMI, 2006) and *Welfare, Prosperity and Quality of the Living Environment* (CPB and PBL, 2006). Often, these existing scenario studies need to be updated. For example, we may need to identify the relevant driving forces, explore driving forces that were not included in the scenario study, or update the scenarios based on previously unavailable information (Henrichs et al., 2010; Westhoek et al., 2006).

Essays do of course also have their limitations. One limitation, for example, is that the claims made about the future are often fairly general. This makes it difficult to draw well-substantiated conclusions concerning the magnitude of future developments in the driving forces, or the impacts that these developments may have. It is also difficult to draw

Figure 4.1
Representation of a future situation, using a land ownership map



Source: RPB 2005

quantified conclusions. Another limitation is that essays may outline the driving forces and the impacts that these have, but they do not always show why the driving forces follow a certain pathway or why they have the impacts that they do. Essays describing possible policy alternatives have similar limitations. A third limitation is that essays may be biased due to the personal opinions of the author or authors. However, this can be dealt with by sending draft versions of the essays to various experts in the scenario team and the policy and scientific fields for feedback (Shell, 2008).

4.4 Produce particular designs

Designs are used to portray particular aspects of scenarios as maps or images. In most cases, we visualise spatial developments and their analysis or the spatial effects of other developments. In the case of contextual scenarios, we analyse and visualise the spatial impacts of the driving forces; in the case of policy scenarios, the desired futures; and in the case of world views, the spatial impacts of certain dominant values in society. The *SCENE* study (RPB, 2003) is an example of the first case; *Nederland 2030* (The Netherlands in 2030 (RPD, 1997)) of the second, and *Nieuw Nederland 2050* (The Netherlands 2050 (Van der Cammen, 1987)) of the third.

Not only do designs visualise spatial developments or the spatial impacts of other developments, but they can also make scenarios concrete in a way that benefits their communication. The right image conveys the essence of the scenarios at a glance. A compelling visualisation of the scenarios also increases their communicative power (Salewski, 2012; PBL, 2012[c]). An example is given in Text Box 4.3.

Text Box 4.3 Designs for the future of agriculture

The aim of the *Waar de landbouw verdwijnt* (Disappearing agricultural landscapes; RPB, 2005) scenario study was to explore possible future developments in Dutch agriculture and the main policy options. First of all, the authors reflected on the possible impacts of the societal and physical developments described in the *Welfare, Prosperity and Quality of the Living Environment* study on Dutch agricultural landscapes. The relevant developments in this scenario study were translated into scenarios. Qualitative descriptions were then applied to categorise the scenarios according to the different types of agricultural landscapes seen in the Netherlands. *Waar de landbouw verdwijnt* (Disappearing agricultural landscapes) goes further than the *Welfare, Prosperity and Quality of the Living Environment* scenarios as it also explores the effect of the land market.

In this study, this land market was considered as a context within which landscape developments take place. Developments in the land market were explored for each scenario, by conducting an analysis of landownership and available locations in several pilot areas (one pilot area was selected per landscape type). The demand for land in each sector was then compared with the land-use map of the Netherlands (Figure 4.1). The scenarios show the available bandwidth for future developments in a particular landscape. Based on this, conclusions were drawn regarding the robustness or vulnerability of each landscape type and policy recommendations made for each different type.

The methods available for producing designs are less developed than the other methods. Nevertheless, designs can play a very useful role in a scenario study, for example by analysing spatial patterns (that are either the result of future developments or that we aim to achieve), and by translating these into spatial concepts. A spatial concept summarises a spatial pattern both in words and pictures. It does this by combining various spatial developments and searching for connections between them by focusing on one or more themes. Examples of this are the spatial developments in the Netherlands that aim to achieve a 'Park landscape' or 'Compact city landscape', as explored in *Nederland 2030*.

A design that is presented as a map always includes different types of spatial functions (the legend) at different locations (the spatial distribution) (De Jong, 1992). In the design, at least two situations are compared with one another, whereby situation A (e.g. the current situation) and a certain intervention (e.g. an autonomous development or a policy intervention) results in situation B (e.g. the future situation). Various changes can take place to move from situation A to situation B:

- a *change of function* changes the legend; for example, agricultural land becomes nature conservation area;
- a *change in form* changes the spatial distribution of a legend unit; for example, to more low-density development;

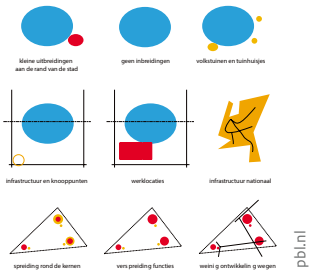
Figure 4.2

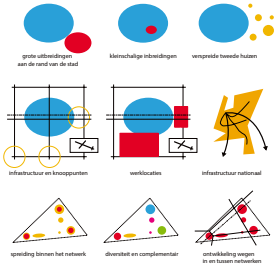
Images of various future situations

Maps

Artist impressions

Symbols





Manipulated photographs

Source: CPB et al. 2006; RPB 2003

- a *structural change* changes the relationship between the legend units; for example, a division between or an overlap in agriculture and water storage;
- a *functional change* concerns a change in the use or preconditions of use; for example, from extensive to intensive agriculture.

Producing large numbers of designs helps us explore possible or desirable spatial developments. This is even more the case if we develop extreme designs together with the intermediate steps.

Designs can take many different forms, such as a map, or symbol, artist impression or manipulated photograph (Figure 4.2). The designs can be drawn by hand or produced using digital drawing and photography programmes. For some analyses, it may be important to use detailed maps that show exactly which spatial functions are seen at which locations. However, to communicate scenarios it is important to use stylised maps that show the essence of the scenario and do not pretend to be more accurate than they are. This can be done by indicating the most important functions using coloured marks or symbols. It is also possible to produce images of anonymised case study areas. This prevents the scenarios from being seen as 'blueprints for the future', and prevents people from focusing on the details rather than the general ideas.

Using designs in a scenario study has many benefits, but also some limitations. For example, the method used to produce particular designs is often intuitive and therefore not always transparent. This is because producing designs is more of an art than a science (Salewski, 2012). Furthermore, it is not always very clear how developments in driving forces or policy result in the spatial pattern described in the scenario. This can mean that people see the designs as a utopian ideal, and therefore less plausible.

4.5 Carry out model calculations

Models are often used to quantify aspects of the scenario components that lend themselves to such calculations. This increases the level of detail in these scenario components and improves their validity and consistency (Shell, 2008; Westhoek et al., 2006). For example, a contextual scenario that projects an average of 5% growth for the coming decades, describes a more detailed future than one that simply projects high levels of growth. The scenario's validity increases even more if we describe the quantitative contribution of each economic sector to this growth, rather than just saying that the services sector makes the largest contribution, for example.

Models improve the consistency of a scenario, if sufficient data are available, or are made available during the study (Dammers, 2010[a]). Note that the collection and processing of data and the development and application of models requires considerable capacity and time. However, it is also possible to build qualitative models, which outline the main variables and interactions without quantifying them. Model calculations do not simply

extrapolate developments in driving forces into the future based on the past and the present. Rather, the emphasis is on the factors that could change the future course of the driving forces.

Quantification of the scenario components depends on several factors (Henrichs et al., 2010). First of all, we need to work out which aspects available data and models address. As we mentioned above, future demographic developments are easier to calculate than future attitudes of people to nature, as attitudes can change more quickly. Another factor is whether the models are already available or whether they need to be developed, which often requires additional expertise. Yet another factor is the amount of manpower or money (if manpower is to be hired) that is available for the scenario project.

Model calculations usually require substantial capacity and time, especially if new models need to be developed. Another factor is the time within which results need to be produced. Clearly, the amount of work required means that model calculations may not always be feasible if the deadline is tight.

International scenario studies may face conflicts concerning the use of data files (Bakkes, 2012[b]). For example, the scenario team may prefer to use internationally harmonised data, while individual countries may prefer to use national data files. This kind of dilemma could be solved by using several different data files, so that international models are based on the harmonised data and the national models on the individual national datasets. As it is very rare for a single model to contain all the relevant variables and interactions, a scenario study often uses a variety of models. Some studies even use a wide range of different models, and the output of one model is input to one or more other models, and vice versa. This is sometimes called a 'model train'. Examples of studies that use such a model train are *Deltascenario's voor 2050 en 2100* (Delta scenarios for 2050 and 2100) and *Nederland in 2030 en 2050* (The Netherlands in 2030 and 2050).

Models play a particularly important role in the international scenario studies that PBL takes part in or carries out. Well-known examples are the *OECD Environmental Outlook to 2050* (OECD, 2012), the *Fifth global environmental outlook* (UNEP, 2012), *Roads from Rio+20* (PBL, 2012) and *Climate change 2014* (IPCC, 2015). The quantitative data for these scenarios were provided by global PBL models such as IMAGE, GLOBIO and GISMO. The IMAGE model is briefly described in Text Box 4.4, while Figure 4.3 provides an overview of the relationships between the global models. The fact that the output of one model is used as the input to the other models ensures consistency in the quantitative data produced by the scenarios. PBL models are often used in conjunction with the economic models of other institutes, such as those of the OECD or CPB. Again, this makes consistency crucial.

Text Box 4.4 IMAGE 3.0

IMAGE 3.0 is a comprehensive integrated modelling framework of interacting human and natural systems (PBL, 2014). The model framework is suited to large-scale (mostly global) and long-term (up to the year 2100) assessments of interactions between human development and the natural environment, and integrates a range of sectors, ecosystems and indicators. The impacts of human activities on the natural systems and natural resources are assessed and how such impacts hamper the provision of ecosystem services to sustain human development. The model identifies socio-economic pathways, and projects the implications for energy, land, water and other natural resources, subject to resource availability and quality. Unintended side effects, such as emissions to air, water and soil, climatic change, and depletion and degradation of remaining stocks (fossil fuels, forests), are calculated and taken into account in future projections.

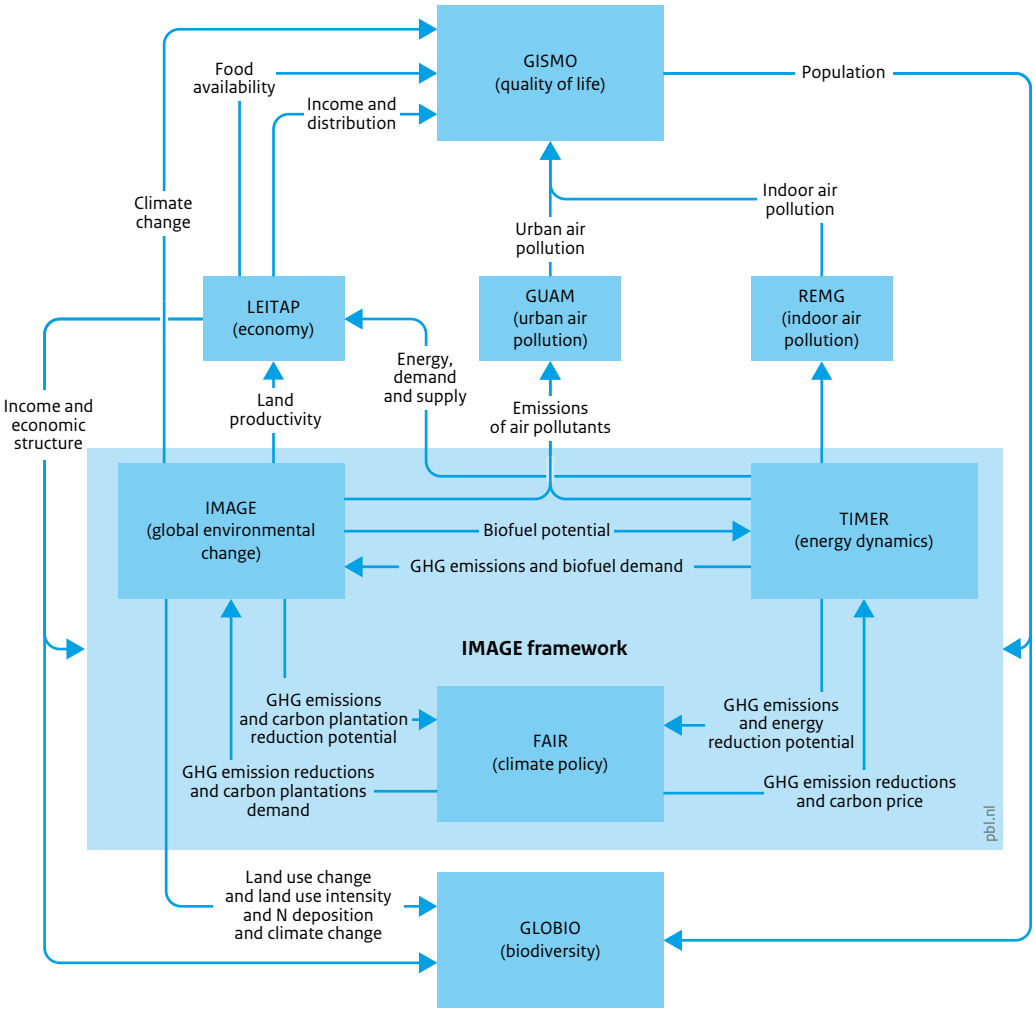
IMAGE has been designed to be comprehensive in terms of human activities, sectors and environmental impacts, and where and how these are connected through common drivers, mutual impacts, and synergies and trade-offs. The components of the IMAGE framework are presented in Figure 4.3, which also shows the information flow from the key driving factors to the impact indicators. Future pathways or scenarios depend on the assumed projections of key driving forces. Thus, all results can only be understood and interpreted in the context of the assumed future environment in which they unfold. As a result of the exogenous drivers, IMAGE projects how human activities would develop in the human system, namely in the energy and agricultural systems. Human activities and associated demand for ecosystem services are squared to the Earth system through the 'interconnectors' Land Cover and Land Use, and Emissions. Assumed policy interventions lead to model responses, taking into account all internal interactions and feedback.

A baseline scenario is developed to assess the magnitude and relevance of global environmental issues, such as climate change, and how they relate to human activities. This is important at the beginning of a policy cycle when an environmental issue arises. The scenario can be used to explore how the future might unfold under business as usual, and to assess the costs and foregone opportunities of policy inaction, and to study the impacts on the natural environment of a human development pathway with essentially unaltered practices. Often, alternative scenarios explore possible replies to the global environmental issue by assuming societal and policy responses to the impacts projected under baseline conditions. To this end, alternative cases are developed and implemented in model-compatible terms to test how the outcomes change. They also reveal synergies and trade-offs between policy issues.

Figure 4.3

Interaction between various models used in global scenario studies

Overview of the IMAGE model suite



Source: OECD 2012

Models have been used in international scenario studies for many years. The first was the World II model, which was used to carry out calculations for the *Limits to growth* study (Meadows et al., 1972). Models are now used in many different applications in a wide range of scenario approaches. For example, the calculations for the IPCC climate scenarios focus on the uncertainties associated with global climate change. If we are to succeed in

describing the complexity of the global climate system, it is essential to use complex models such as general circulation models. In the OECD environmental outlooks, the models are mainly used to analyse the economic and environmental impacts of certain policy options, and less to explore the uncertainty in the future course of driving forces. These models compare the impacts of the policy alternatives with a reference scenario in which current policy continues (OECD, 2008; see too Section 3.3.1). This makes it essential to ensure a clear distinction in these models between the driving forces and policy.

In the *Roads from Rio+20* study, PBL carried out model calculations to achieve backcasting. A selection of global policy goals, mainly environmental and development goals, were taken as a starting point. The models were then used to examine which measures are required to achieve these goals. Here too, the system is so complex that it is very important to use integrated models. However, this integrated approach is not always necessary. If the issue is less complex, or if it is described more specifically, individual models or sub-models may be used. Examples are the CBS population model used for long-term population scenarios (De Jong et al., 2004), the GISMO model for *Beyond 2015* (Hilderink et al., 2009) and the HOUDINI model used to calculate the future of regional housing markets in the Netherlands (Text Box 4.5).

Text Box 4.5 HOUDINI

HOUDINI is a system dynamics model of Dutch regional housing markets (Eskinasi et al., 2011). System dynamics is a discipline that focuses on using computer simulations to model complex, non-linear policy problems. HOUDINI consists of five sectors: 1) the demand side, 2) the housing market, 3) the supply side, 4) policy interventions and 5) effect indicators. The model is able to simulate all kinds of changes in housing policy, such as a reduction or even abolition of mortgage interest tax reduction, while also taking into account the flanking policy required to avoid any negative effects. This makes the model particularly suitable for use in policy scenario development in this field. However, the model can also be used to develop urbanisation scenarios to simulate housing development. Compared with other models, the development of this model is relatively simple. The model is also more able to cope with a lack of statistical data. This is because it is based mainly on information about structural interactions between the variables – information that can be obtained from the literature and experts in the field. The parameters may be determined based on historical data, but also using rules of thumb, prefixes or estimates.

Model calculations also have some limitations. First of all, it is only possible to include developments in the scenarios that can be quantified (e.g. population changes), which means that other developments that may also impact the policy issue (e.g. changes in governing relationships) are ignored. Model calculations are also usually highly labour-

intensive, far more so than organising stakeholder participation, writing essays or producing particular designs. This can also form an obstacle when it comes to exploring uncertainty, as policy scenarios may be compared with just one contextual scenario, for example, rather than two or more. This is an example of *certainification*, or reasoning away the uncertainty associated with the future during the course of a scenario project (Van Asselt et al., 2007). The amount of work required may also be a reason not to repeat model calculations, even if new information suggests that this is needed. Furthermore, using more models increases the risk of obtaining different results and introducing inconsistencies. This, however, can be reduced by limiting the number of interactions between the models (Henrichs et al., 2010).

4.6 Combining and integrating methods

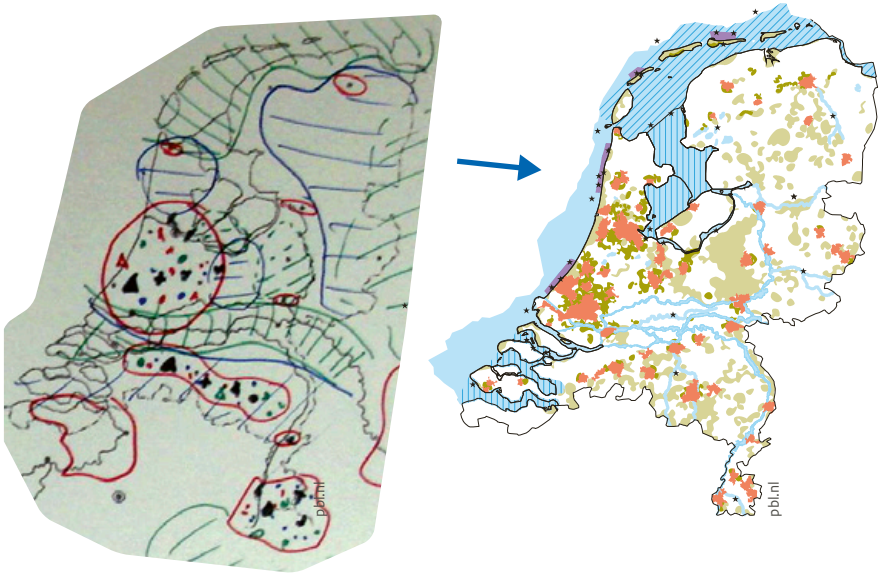
4.6.1 Method combinations

A scenario study may use one of the previously discussed methods, or two or more methods may be combined. Combining methods means that a larger, more diverse range of perspectives is mobilised and integrated in the study: visual and data-based as well as narrative, and practice-based as well as scientific. Because the future is uncertain and cannot be analysed empirically, it is important to consider different perspectives, to compare them and to combine them. This allows us to draw qualitative conclusions about developments that cannot be calculated using models, and to compare scientific perspectives with practice.

If the decision is made to combine two or more methods in a scenario study, the study will take longer to complete than if just one method was chosen. This is particularly true if a relatively labour-intensive method is chosen such as model calculations. Combining methods also presents organisational challenges, and it can be difficult to integrate the results, particularly if more than two methods are used. We therefore need to ask ourselves what the added value is of an extra method and whether this weighs positively against the extra effort and cost involved. Different combinations of two methods are presented below, to give an idea of the possibilities. Based on this, you may wish to consider the advantages and disadvantages of combining three or four methods.

Stakeholder participation and essays. In this combination, the scenario team invites stakeholders to come up with ideas for the scenario components, for example in a scenario workshop, through group decision support (described below) or using another participation technique. The ideas that are generated may relate to future developments in driving forces (contextual scenarios) or different desired futures (policy scenarios) (Carlsson-Kanyama et al., 2008). Once a number of ideas have been generated, these are clustered and the scenario components start to take shape.

Figure 4.4
Translation of a sketch into a map



Source: Dammers 2010; PBL 2013

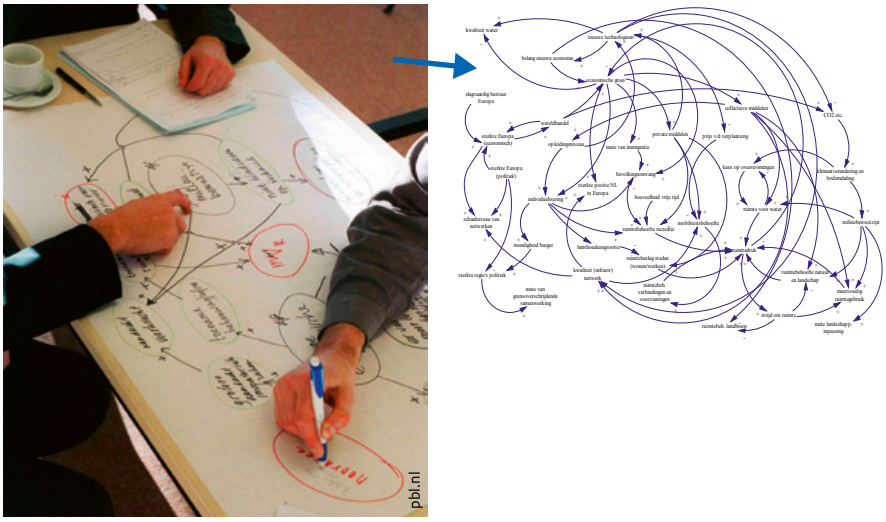
The scenario team selects the most interesting ideas and develops them further. This provides the broad outlines for the storylines, which the team then develops using essays. The team does this based on the available literature, their own knowledge and logical reasoning. Summaries of the essays are presented to the stakeholders for feedback at the next meeting.

Stakeholder participation and particular designs. It is also possible to focus on particular designs during a scenario workshop or other participation meeting. In this case, designers are asked to visualise and integrate the generated ideas. Expressing the ideas not just in words but also images results in cross-pollination that increases creativity. Words inspire images, and vice versa. Visualisation also makes the ideas more tangible.

After the meeting, the designers work on the sketches produced during the meeting to produce fully fledged designs. As mentioned in Section 4.5, these could be maps, artist impressions, photographs, photomontages, and so on. Figure 4.4 shows how a sketch can be developed to produce a map. As with the essays, the maps, artist impressions and other designs can be presented to the stakeholders in the next meeting for their feedback.

Figure 4.5
An application of group model building

From the first model ... ... to a more elaborate one



Source: RPB 2003; Foto: Jan Zandé

Stakeholder participation and model calculations. Some stakeholder participation techniques structure the idea generation process in such a way that the ideas can be incorporated into a computer model. Group model building is an example of this (Vennix, 1996). Using this technique, which is based on system dynamics, the stakeholders systematically generate ideas to model the policy issue central to the scenario study and the influencing factors. This is done during one or more meetings with the stakeholders, supervised by a facilitator. Based on the generated ideas, the participants then develop a conceptual model that links these ideas. This is done by first translating the ideas into variables and interactions, then indicating the direction of these interactions. An example is given in Figure 4.5.[1]

The scenario team goes on to quantify the variables and interactions and translate them into mathematical formulas. The system structure (policy issue, policy) and exogenous factors (driving forces) are visualised using a causal loop diagram. It is important that the structure is properly validated, for example with a literature analysis (theories, existing formulas) or consultation with external experts (expert judgment). The team may use data, indicators or estimates to determine the parameters, but the main focus is on determining the relative importance of a particular variable in the model. Here too, we recommend that the scenario team presents its results to the stakeholders for feedback.

Essays and particular designs. Combining essays and designs can produce some interesting results. On the one hand, the storylines in the essays can produce ideas for the designs and the design brief. On the other, the analyses carried out for the designs can be used to strengthen the spatial dimension of the essays. Maps, artist impressions and other designs may also help visualise and refine the storylines. For such cross-pollination to take place, it is important to properly coordinate the writing and design processes.

It is also possible to combine stakeholder participation, essays and designs, for example by outlining the scenario components in a workshop using key words and sketches, then developing and validating these outlines using essays and designs.

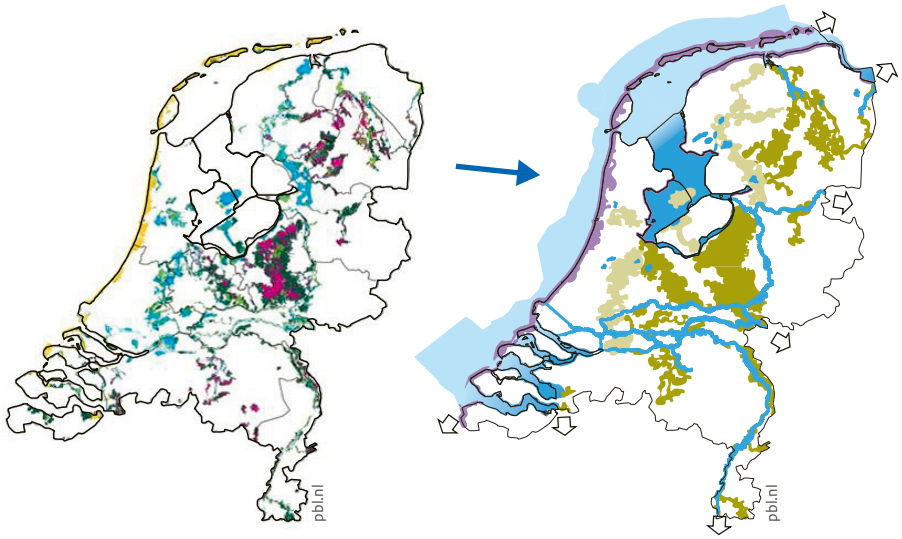
Essays and model calculations. Very often, scenarios are based on both model calculations and essays. Examples are *Climate change 2014*, the *Deltascenario's voor 2050 en 2100* (Delta scenarios for 2050 and 2100) and *Nederland in 2030 en 2050* (The Netherlands in 2030 and 2050). The model calculations can help quantify and specify the storylines, while making them more consistent and improving their validity (EEA, 2001; Westhoek et al., 2006). Conversely, the essays provide a framework to structure the model calculations, as well as insights into the variables and interactions on which the scenarios focus, and a frame of reference that can be used to interpret and assess the results of the model calculations.

Good communication is important between those writing the essays and those carrying out the model calculations, to ensure consistency between the qualitative storylines and the quantitative model calculations (Henrichs et al., 2010). This can be achieved if the team carrying out the model calculations provides feedback on the different versions of the storylines, and if the team writing the storylines provides regular feedback on the model calculation results. In the international scenario studies carried out by PBL, the same team members often carry out the model calculations and write the essays.

Particular designs and model calculations. This combination is not often seen in scenario studies, with the exception of a few examples such as *SCENE* and *Natuurverkenning 2010-2040* (Nature Outlook 2010–2040). Nevertheless, they are certainly highly complementary methods (Groen et al., 2004), particularly if the models are used to produce GIS maps, as is the case with the Spacescanner. The level of detail that GIS maps can provide regarding the spatial aspects of scenarios makes them highly suitable for use in spatial analyses, but less useful for communicating the results. This is because the high level of detail detracts from the main story, while people who are less experienced in map-reading will find it difficult to recognise the differences between the scenarios. The opposite applies to maps produced as particular designs, which usually visualise the essence of the spatial aspects.

The difference between particular designs and model calculations is not as clear as would first appear. After all, designers use analytical tools, while model users interpret the geographical results of the calculations in a creative manner. GIS maps can support particular designs by formalising and increasing the transparency of the design process, by providing quantified design specifications, by showing which geographical information

Figure 4.6
Translation of a GIS map into a sketched map



Source: PBL 2013

is available, by generating alternatives, by enabling a methodical assessment of the alternatives and by visualising and assessing the impacts of the designs (Groen et al., 2004). Based on the GIS maps, designers can produce sketch maps that visualise the essence of the scenarios (Figure 4.6).

One way of doing this is to take a GIS map showing future land use, then exaggerate the changes (e.g. by enlarging the changes by 20%), cluster the major changes and leave out the minor changes, and finally present the most essential changes only in the final sketch map.

4.6.2 Organising the combinations

When combining different methods, it is important to consider how the scenario team will organise this. In practice, we still see that the focus comes to lie on one method and the other methods receive less attention. For example, the team may focus on the details of the calculations, or on organising the scenario workshops, and less on the design, with the result that these are no more than pictures that accompany the text. Two different approaches can be taken when combining methods, each of which have their advantages and disadvantages. These are shown in Table 4.2.

Table 4.2
Approaches to combining methods and their advantages and disadvantages

Approaches	Advantages	Disadvantages
Linear	• Straightforward to use for scenario team • Easy to organise • Transparent for users	• Scenario components may not be updated based on new insights • May have insufficient time to develop key messages • Risk of severe project delay
Cyclical	• Gradual development, refinement and validation of scenario components • Little risk of carrying out unnecessary calculations	• Project may take too long • May not be possible to integrate methods properly

Linear approach. The scenario team applies the chosen methods to develop the scenario components: first the baseline scenario, followed by the contextual scenarios, then the policy scenarios, and finally the key messages. The role of each method can vary, depending on the component. For example, model calculations are not required for the past and the present, while they may make an important contribution to the contextual and policy scenarios. Feedback between the scenario components means that previous components may need to be updated based on new insights gained while developing later components. This approach is easy to follow and organise for the scenario team and is transparent for the scenario study users.

However, there is a risk that previous components are not updated, even though they should be based on insights gathered during the development of later components. Another risk is that the first scenario component receives the most attention, because there is more time available at this phase, and that later components receive less attention as time starts to run out. The project may also take much longer to complete than planned, as each delay directly affects the project lead time.

Cyclical approach. The scenario team develops the scenario components in several successive cycles, applying a different method in each cycle. This can be done, for example, by outlining the baseline scenario, the contextual scenarios, the policy scenarios and the key messages in a series of workshops, by refining and validating the components in essays, then quantifying the components using model calculations. In this way, the scenario components are gradually developed, refined and validated, so that the contours of the scenario components are sketched out before more detailed, labour-intensive work is carried out. This focuses the calculations and reduces the risk of carrying out unnecessary work.

However, if we wait to carry out model calculations until the workshops have been completed and the essays have been written, we increase the project lead time. We can deal with this by carrying out the model calculations that we know we will need at the beginning of the project (no-regret activities). For example, it was clear at the start of *Nederland in 2030 en 2050* (The Netherlands in 2030 and 2050) that the scenario study would focus on the impacts of agglomeration. The team can then refine the calculations at a later stage, based on workshops, essays and/or designs. There is also a risk of poor integration, as the methods are applied in succession which makes it difficult to coordinate them.

4.6.3 Integrating the outcomes

Combining methods allows the scenario team to utilise and integrate a larger, wider range of perspectives than if just one method was used. This is important, because exploring future developments using a scenario study is complex and uncertain, and the opportunities for empirical analysis are limited. Only the baseline scenario can be fully based on empirical research. The contextual and policy scenarios and the key messages make use of empirical analysis, but the outcomes are applied to the future – a future that is by definition uncertain as it has yet to take place. Although it is important to integrate the outcomes of the different methods, we often see that, in practice, not enough time is reserved for this and that the process tends to be regarded as 'revision work' (Bakkes, 2012[a]). The integration process therefore causes stress for the scenario team and does not always receive the attention it deserves. Integration must also be well-planned and organised and with the right conditions put in place.

This integration of the outcomes of the different methods represents transdisciplinary insight development, which involves the integration of different disciplinary and practical perspectives (In 't Veld, 2010). This is not easy to achieve. After all, different disciplines assess outcomes based on varying and often conflicting views, assumptions, concepts, methods and criteria. Because they often quite literally speak different languages, the experts tend to speak at cross purposes. This is further complicated by the fact that we are attempting to integrate various scientific as well as practical insights.

This integration of the different types of insights obtained from the different methods means that the scenario team needs to ensure that the different disciplines learn from one another. This, therefore, means that team members need to conduct an intense and open dialogue to discuss their methods and the advantages and disadvantages of using those methods, their results, any lack of insight and how to address such a lack. The following techniques can encourage integration (Pohl and Hirsch Hadorn, 2007):

- a *boundary object*: an object that all stakeholders refer to, based on their own disciplinary perspective and that does not require any further explanation, such as a particular city or area;
- a *conceptual model*: developing a model together (e.g. a causal loop diagram) makes it possible to describe and discuss the main variables and interactions;

- *transfer of concepts*: adopting concepts from one discipline in other disciplines can help consider future developments from a different point of view, such as the application of the term 'energy' to society;
- *unifying concepts*: new concepts can establish links between disciplines, such as a network (e.g. ecological, urban, social, virtual);
- a *concept glossary*: this summarises the main common concepts that are used and their meanings, and refers to their definitions in the text.

These techniques can only be successfully implemented if the team can create the right conditions for their use. Such conditions include: reserving enough time to discuss the methods, being open to views from other disciplines, trusting one another, making sure that each team member has sufficient input, and repeating the activities required to develop the scenario components several times so that they can be further refined with each cycle (Weismann et al., 2008). The cyclical approach is more suited to this than the linear approach.

Note

1 A positive relationship means: more of A results in more B; a negative relationship means: more of A results in less B. We are therefore not concerned here with assigning a particular value.

5 Completion phase

5.1 Introduction

Once the scenario study has been carried out, it must also be properly completed. Although this is an important part of the scenario project, the completion phase often receives too little attention, and too late (Bakkes, 2012[a]). In this chapter, therefore, we consider three activities that play an important role in completion of a scenario study: recording the outcomes of the scenario study (Section 5.2), accounting for the methodology applied (Section 5.3), and disseminating the outcomes amongst the target groups (Section 5.4; see too Section 2.2.1).

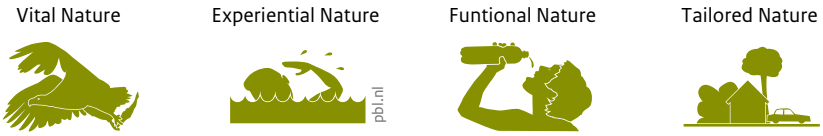
5.2 Recording the outcomes

The outcomes of a scenario study can be recorded in a variety of ways, for example in reports, flyers, presentations or films. In this chapter, we consider how to translate the outcomes into narratives about the future. The challenge is to record the scenario study outcomes in such a way that they can be readily communicated to the target groups. Strategic policy issues and the related scientific issues are, after all, wicked problems (Section 3.2). These problems are usually multifaceted and variable – think for example of a more sustainable energy supply. Furthermore, there are usually considerable interests at stake. These strategic issues are therefore complex, their future development is uncertain, and it is difficult to reach consensus.

One way in which the outcomes can be recorded and communicated in an understandable way is to translate them into narratives about the future. This means that the scenarios describe, in a logical, compelling manner, which events and developments may take place in the future, why they may follow a certain pathway, what the relationships are between the events and developments, and how they may impact the issue and policy (Wack, 1985). They therefore give structure and meaning to possible future events and developments. The narratives may consist of various elements: words (e.g. essays), images (e.g. maps), figures (e.g. model results), or a combination of all three.

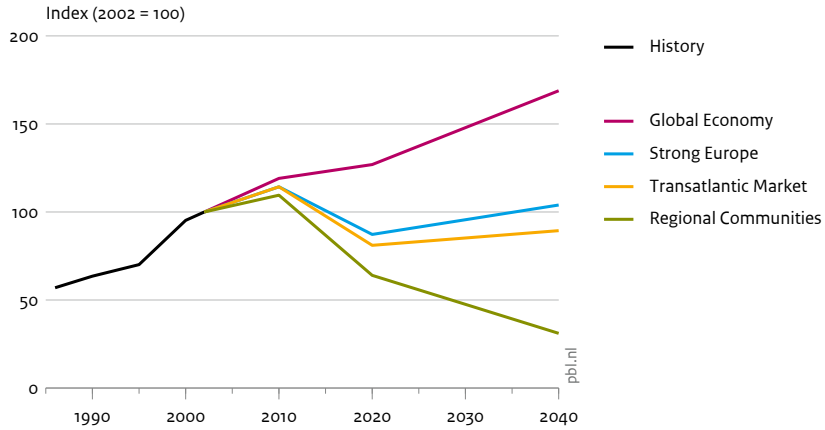
A narrative scenario invites the reader or listener to place him or herself in the future. If essays have been written earlier on in the scenario project, these form important building blocks for the future narratives. In Section 4.3, we addressed some points to consider when writing narratives, as well as the importance of scenario names and mottos. Using icons and colours can also help clearly differentiate between the scenarios

Figure 5.1
Scenarios from the *Nature Outlook* visualised as icons



Source: PBL

Figure 5.2
Various future pathways for traffic congestion development



Source: CPB et al. 2006

(Figure 5.1). The scenario narratives can be interspersed, validated and supplemented with fictitious newspaper articles, personal stories, maps, artist impressions, graphs, tables, and so on. A map, for example, can help readers to understand a complex phenomenon at a glance, such as a certain pattern of urbanisation. Similarly, a graph can portray a particular future development in a scenario in a very compelling way (Shell, 2008; see Figure 5.2), while infographic visualisation techniques can also play an interesting role (PBL, 2012[b]).
These all enable the scenarios to be visualised in various forms that appeal to different target groups. After all, some people prefer to communicate using words, others using images and yet others using numbers. This therefore stimulates the imagination and makes it easier to identify with the scenarios (BZK, 2011).

It is also worth paying attention to the presentation style used for the scenarios and the effect that this has on people's perception of the scenario producer. An assessment agency that aims to conduct scientifically sound research, for example, prides itself on its scientific excellence, and is therefore less likely to illustrate scenarios using cartoons or drawings, while a consultancy firm may choose to do so, in an attempt to highlight its creativity or accessibility. Whichever style is chosen, it is important to make sure that the scenarios are not 'embellished' to such an extent that it overshadows the content (Nekkers, 2006).

There is more to writing narrative scenarios than the analytical skills required to distil the main outcomes from the scenario study and relate these to one another in a meaningful way. It also requires writing skills that make it possible to present the results in a comprehensible and compelling manner (Nekkers, 2006; De Ruijter et al., 2011). This therefore calls for an experienced scenario writer or the services of a journalist or other professional text writer who can work with the analytical texts produced by the scenario team.

Once the results have been presented in some form, instructions need to be provided on how and how not to use the scenarios (BZK, 2011). An example is the instructions developed by CPB and PBL (2015[b]) to accompany the scenario study *Welfare, Prosperity and the Human Environment* (CPB and PBL (2015[a]). The instructions must, for instance, make clear that components of the policy scenarios may be combined, while contextual scenario components may not. It is possible to combine policy scenario components, because this concerns measures and collaborations over which policymakers have some control. In the case of contextual scenarios, however, policymakers have little or no influence on the events and developments that take place, and in fact need to take into account a variety of situations when developing strategic policy to ensure the robustness of such policy (Section 3.4).

Users need to understand that the future will never unfold exactly as described in a scenario, but that the scenarios give us an idea of possible events and developments, the conditions under which they may take place, the impacts that they may have on the issue and policy, and the policy options available for dealing with the threats and utilising the opportunities. It is therefore important to explain the differences between prognoses, scenarios and speculations (Section 2.2.4), the types of scenarios produced in the study (Section 2.3.1), the ways in which these can contribute to the scenario study objectives (Section 2.2.2), and the main target groups on which the study focuses (Section 2.2.1). The scenario study objectives can also be regarded as the intended use or purpose of the scenarios.

5.3 Accounting for the methodology

PBL finds it very important to provide scientific accountability for a scenario study. As set out in its mission statement, the assessment agency is policy-oriented and conducts independent and scientifically sound research. A policy-oriented study will only be used by policymakers and stakeholders if they consider the results to be interesting, legitimate and plausible. To prove the study's independence, we have to show how this has been guaranteed, particularly if the scenarios embody normative principles. As far as the scientific basis of the study is concerned, we need to show which methods were applied and why, the choices that were made and the results that they produced. This ensures the repeatability of the study.

Such considerations are essential for PBL studies in general, but for scenario studies in particular. After all, many of the scenario studies carried out by the assessment agency are large, complex and diverse (too Section 2.1). Very often, dozens of people work on the studies for several years. As previously mentioned, the issues on which the scenarios focus usually represent wicked problems with many facets and uncertainties. Different methods are applied to develop the scenarios, depending on the study objectives and the types of scenarios, and often in different combinations. This means that almost every scenario study is different, and scenario building is never routine.

The methodology can be explained in a chapter of or appendix to the scenario report, or you may decide to refer a background report (web publication) or another scientific article. This guidance document and the accompanying checklist and presentation can be helpful in accounting for the methodology used in a scenario study, as it systematically describes all the possible steps in a scenario project, as well as the choices to be made in each step and the corresponding advantages and disadvantages. We also discuss the required qualities of the scenarios: consistency, contrast, compatibility, detail and appeal (Section 2.5.3).

Particular attention should be paid to accounting for the way in which complexity and uncertainty are dealt with when building the scenarios. After all, the purpose of scenario studies is to help policymakers and other interested parties deal with the cognitive, communicative and normative complexity and uncertainty that surround the future (Section 2.2.2). This complexity and uncertainty, in turn, requires that the scenario team accounts for the way it deals with uncertainty in the study. The *PBL Leidraad voor omgaan met onzekerheden* (Guidance for uncertainty assessment and communication) may help with this. This guide addresses, amongst other things, how to conduct a quick scan of the uncertainties, the methods and techniques to apply to explore the uncertainties, and how to prioritise, analyse and communicate the uncertainties.

Draft reports describing the methods and preliminary outcomes should be circulated periodically, to ensure that they meet expectations (Shell, 2008). We recommend working from the inside out: discussions within teams, internal assessment by colleagues, then external reviews by scientific and policy practice experts. It is particularly important to circulate the draft version widely (nationally and preferably internationally) during the completion phase of a project, and to obtain feedback that can be included in the final version report (EEA, 2001). We also recommend that the project team periodically discusses the methods and preliminary results with a review panel or user group, to prevent any unwelcome surprises during the completion phase. Note that, because of PBL's independent status, such a panel or group has no right of approval regarding the methods applied or the study outcomes.

5.4 Disseminating the results

Particular attention needs to be paid to dissemination of the results, as not all policymakers and interested parties may necessarily be acquainted with the scenario study. The study therefore first needs to be brought to their attention. Participants in the scenario project will already be acquainted with the results (or the preliminary results), but the target groups are usually much larger than the group of people who have participated in the project. Furthermore, it is usually impractical to involve all the potential users in a project. Policymakers and stakeholders who are acquainted with the scenario study will invest time in studying the scenarios in more detail if they believe them to be relevant to their own practice, and more relevant than other sources of information, such as their own insights or other published scenarios. However, even if they explore the scenarios in more detail, this does not mean that they will accept the scenarios. After all, insights into the future are by definition less well-validated than knowledge about the past and the present, and are therefore more open to criticism. Furthermore, even if they accept the scenarios, this does not mean that they will use them in the intended manner. After all, some policymakers and interested parties aim to reduce uncertainty rather than deal with it (WRR, 2010).

When disseminating the results, the form of the communication plays an important role (Dammers, 2000). This is because different target groups have different communication requirements (Section 2.2.1). An overview of the possible forms of communication and their main advantages and disadvantages is given in Table 5.1. Note that, in this guidance document, we only consider conventional forms of communication. Other forms are addressed in *Using scenarios for environmental, nature and spatial planning policy – a guidance document* (Dammers et al., 2019), such as a user atelier, serious gaming, films and exhibitions.

Table 5.1
Forms of communication and their advantages and disadvantages

Form of communication	Advantages	Disadvantages
Series of reports	• Possible to tailor to different target groups • Possible to discuss complexity and uncertainty in detail • Possible to account for methodology	• May be expensive • Does not always meet communication needs
Data files	• Makes calculations using scenarios possible • Detailed analysis of complexity and uncertainty possible	• Only suitable for researchers • Less attention often paid to exploring uncertainty than in other forms of communication
Website	• Meets information needs of target groups • Possible to account for methodology • Can be widely disseminated • Cheap	• Users need to print out information themselves • Quality poorer than printed copy
Presentation	• Easily accessible for users • Possible to tailor communication of complexity and uncertainty to different target groups	• Giving many presentations can be time-consuming
Conference	• Raises awareness of scenario study • Reaches wide audience	• Complexity and uncertainty can only be addressed globally • May be expensive
Workshop	• Possible to bring target groups together • Direct discussion possible with target groups regarding how to deal with complexity and uncertainty • Possible to supervise use of scenarios by target groups	• Can be time-consuming

Most scenario study results are presented as a *series of reports*, which includes:
- a main report containing the scenario highlights and the main key messages, for policy advisers and middle management;
- one or more background reports containing more detailed versions of the scenarios and an account of the methodology, for experts;
- a flyer containing a summary, for politicians, higher management and the general public (also see Becker et al., 1982; Shell, 2008).

For example, a main report with summary was published for the *Natuurverkenning 2010-2040* (Nature Outlook 2010–2040; PBL, 2012[a]), plus a background report and a great number of reports produced in sub-studies.

The advantage of producing a series of reports is that it is then possible to tailor communication about the complexity and uncertainty associated with a particular issue to the various user groups. The background reports in particular make it possible to address the complexity and uncertainty in greater depth, as well as the resulting key messages for policymakers and interested parties. They also make it possible to provide a clear account of the methodology. The main report and the flyer make more use of graphical presentation forms. A series of reports also makes the wide dissemination of the results possible, although printing costs can be high. There is also a risk that this form of communication – a large report – does not always meet the current communication needs of the target groups.

The scenario study outcomes do not always need to be communicated in a report; they may also be communicated using *data files*. This is more common in scenario studies that focus primarily on researchers employed by the government or other organisations. These researchers then use the data files to carry out their own model calculations. One example of this is *Climate change 2007* (IPCC, 2007), for which both a series of reports and several data files on global climate change were produced. The data provided in the data files was explained in the reports. The data files were used by researchers in the EU and individual Member States to explore climate change in Europe or the particular Member State. In the Netherlands, these data files were used by the Royal Netherlands Meteorological Institute in the *Klimaat in de 21e eeuw* (Climate in the 21st century; KNMI, 2006) scenario study. Data files have the advantage that they allow users to explore complexity and uncertainty in greater depth, and to carry out their own calculations. A disadvantage, however, is that data files are often less good at portraying uncertainty than other methods. Data files are also only suitable for use by researchers, due to the models and expertise required.

If a scenario study is published on a *website*, the results can be accessed by a large audience. This means that the results are available to members of the public as well as the usual target groups, who can also download the results. However, people need to be made aware of the study and where to find it. All of the scenario studies that PBL publishes can also be found on its website. This makes it possible to meet the informational needs of different target groups. The information can be provided in different layers and forms (images, text, figures), so that the users can decide for themselves at which level of detail they wish to explore the complexity and uncertainty. Other advantages are that it is easy to account for the methodology on the website, and the costs are relatively low. One disadvantage, however, is that users who would rather see the results on paper or who are less comfortable with digital media will need to print out the results themselves, and therefore accept a lower quality than if they had access to a printed copy.

Both during the scenario study and after completion, the project leaders or other team members may present their results to the main target groups. These could be ministries, provinces, Directorate-Generals of the European Union, non-governmental organisations or businesses. *Presentations* represent a highly accessible form of communication, because

the team members go to the users. They also make it possible to tailor communication on complexity and uncertainty to the specific users and their needs (Shell, 2008). Furthermore, they enable direct discussion with the target groups concerning how to deal with complexity and uncertainty. However, presentations can be time-consuming for the scenario team, especially if there are many different, large user groups.

Organising a *conference* just before or just after completion of the scenario study gives the target groups the opportunity to learn about and discuss the results directly with the scenario team. If organised just before project completion, they can also provide feedback on the draft version, which can be included in the final version. Inviting experts to reflect and comment on the scenarios and the policy messages can considerably increase awareness of and interest in the scenario study. To give an example, former CPB director and Nobel Prize winner Jan Tinbergen was invited to share his ideas at a national conference organised for the *Scanning the future* study (CPB, 1992). The disadvantage of conferences is that it is only possible to present and discuss the complexity and uncertainty in very global terms. A large conference with renowned guest speakers can also be expensive.

We discussed the organisation of *workshops* in the section on stakeholder participation (Section 4.4). A scenario team may organise workshops to generate new ideas or obtain feedback on preliminary results, or to disseminate the results. Workshops present the perfect opportunity for bringing different target groups together and, under the guidance of the scenario team, acquainting them with the scenarios and their use. It is also possible to focus during a workshop on methods for dealing with complexity and uncertainty. To give an example, PBL and the Dutch Ministry of Economic Affairs organised several 'ateliers' in which various parties involved in national nature policy generated all kinds of ideas, or building blocks, for a robust nature vision, based on scenarios from the *Natuurverkenning 2010-2040* (Nature Outlook 2010–2040). Note that the organisation of a series of workshops can be very time-consuming.

Of course, the forms of communication described above can also be implemented in various combinations. For example, the main report of a scenario study can be published in print, and the background report on the website. It is also possible to provide access to data files on a website, accompanied by a report that describes the storylines and therefore provides the data with context and meaning. This was the case, for example, in the *Deltascenario's voor 2050 en 2100* (Delta scenarios for 2050 and 2100; Deltares et al., 2013) study. A film can also be used to acquaint participants with the scenarios at the start of a conference, workshop or serious game, or to reach a wider audience through the website.

5.4.1 Points to note

Finally, there are two important points to note regarding dissemination of the results. The first concerns the policy momentum, or the policy window (Kingdon, 2003; In 't Veld, 2010). Policymakers often aim to create momentum, or support, for a policy decision. This represents a process, during which policymakers aim to enable decisive actions and irreversibility in the policy process. Such momentum can come from a new cabinet

wanting to develop new policy, the development of a new policy document, or preparations for strategic decisions such as large investment decisions. It is at such moments that insights about the future, structured communication and greater engagement is required (Section 2.2). If scenarios are published too early or too late, they risk attracting little interest and being largely ignored. The scenario team therefore needs to consider this in the preparation phase of the project (Section 2.5.3).

The second point concerns reiteration of the key messages. Many different publications (e.g. studies, policy recommendations, policy documents) are produced, all of which contain visions and insights about the future, which means that the impact of a single scenario study, however large, should not be overestimated. It is therefore important to treat a scenario study not as a one-off exercise, but to publish scenario studies at regular intervals. This returns the focus to the main policy messages, assuming that they are still relevant (they may need to be redefined based on new insights). Such studies do not necessarily need to be carried out by PBL: other research institutes and advisory bodies may also publish scenario studies that communicate similar messages. 'This "beat" produces a steady stream of outlook studies … that find their way into policy' (WRR, 2010: 95). Note that PBL has a statutory responsibility to publish scenario studies at regular intervals.

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September 2019