2

AN EXPLORATION OF BACKCASTING AND RELATED APPROACHES

This[1] chapter introduces various types of future studies (2.1), before reporting on a literature survey of backcasting and related approaches (2.2). Next, this chapter compares four selected backcasting approaches (2.3), before developing a methodological framework for participatory backcasting (2.4) and presenting conclusions (2.5).

2.1 Introduction

Before taking a look at backcasting and related approaches, I briefly discuss various types of futures that are distinguished in future studies. Building on Dunn[2] (1994: 195) I distinguish between likely futures, possible futures and desirable futures. Each type of futures can be related to a group of approaches in future studies[3].

The vast majority of forecasting approaches focuses on likely futures and are projective in nature, using, for instance, trend extrapolation and quantitative historical data. The drawback here is that traditional forecasting is only reliable in the case of well-defined and relatively stable systems like existing markets and in the short term (e.g. De Laat 1998).

Most foresighting and scenario[4] approaches focus on possible futures. Well-known examples are the context scenario approach (e.g. Van der Heijden 1997, Thissen 1999, Enserink 2000) and global system scenario approaches, such as the one by the IPCC (ww.ipcc.org) and the one by Meadows and colleagues (Meadows 1972, Meadows *et al.* 1992). It is also possible to combine elements from possible futures and normative futures. For instance, the Netherlands Council for Government Policy, which has been a major foresighting organisation in the Netherlands for several decades, has used normative views like varying political visions and different action perspectives for defining different policy goals, as well different scenarios (e.g. WRR 1980, WRR 1983, WRR 1992, WRR 1994). I will return to this approach in 9.3.

Approaches focusing on normative or (un)desirable futures are the least widely applied. These approaches focus on desirable, yet attainable futures. Backcasting is a well-known example of such an approach. Before the emergence of backcasting reference was made to normative forecasting (e.g. Jantsch 1967), while in France desired futures are referred to in what has been called 'la prospective' (Godet 2000)[5].

As approaches using desirable or normative futures are highly important from the viewpoint of sustainable development, this has resulted in an increasing interest in this type of future studies approaches in general and in backcasting in particular. Backcasting and related approaches are explored in the next section.

2.2 Backcasting: a brief history

2.2.1 Backcasting in energy studies: soft energy paths

The origin of backcasting dates back to the 1970s, when Lovins (1976, 1977) proposed backcasting as an alternative planning methodology for electricity supply and demand (Robinson 1982, Anderson 2001). He called this method 'backwards-looking analysis', while Robinson (1982) proposed the term 'energy backcasting'. Assuming that future energy demand is mainly a function of current policy decisions, Lovins argued that it would be beneficial to describe a desirable future or a range of desirable futures and to assess how such futures could be achieved, instead of focusing only on likely futures and projective forecasts. The assumption was that, after identifying the strategic objective(s) in a particular future, it would be possible to work back to determine what policy measures should be implemented to guide the energy industry in its transformation towards that future. In the 1960s, Jantsch (1967) had already dealt with normative forecasting[6], which can be seen as a predecessor of backcasting.

At that time energy studies using backcasting were especially concerned with so-called soft energy (policy) paths, which took a low energy demand society and the development of renewable energy technologies as a starting point. These studies were a response to regular energy forecasting practice. This was based on trend extrapolation and projected rapidly increasing energy consumption and focused strongly on large-scale fossil fuel and nuclear technologies to deal with the estimated growth. The response led to numerous studies on soft energy paths (e.g. Lovins 1977, Robinson 1982), comparing them to regular ones (e.g. Lönnroth *et al.* 1980, Johansson and Steen 1980, Goldemberg *et al.* 1985). Interestingly, backcasting has been applied regularly in energy studies since then (e.g. Mulder 1995, Mulder and Biesiot 1998, Anderson 2001, MacFarlane 2001, Hennicke 2004), sometimes under the header energy end-use analysis.

Whereas the focus of energy backcasting was on analysis and on developing policy goals, the backcasts of different alternative energy futures were also meant to reveal the relative implications of different policy goals (Robinson 1982: 337-338), and to determine the possibilities and opportunities for policy-making. Robinson has always emphasised that the purpose of backcasting was not to produce blueprints, but to indicate the relative feasibility and different social, environmental and political implications of different energy futures (Robinson 1990: 823). Robinson (1982) also worked out the principles defined by Lovins into a sequential six-step methodology for energy and electricity futures. The central step was developing an outline of the future economy by constructing a model of the economy in a final future state, followed by an energy demand scenario that corresponded to the results of the model. Recently, Anderson (2001) adapted the energy backcasting approach, with the aim of reconciling the electricity industry with sustainable development. He takes into account wider environmental and social responsibilities, as well as non-expert knowledge, and includes the development of supporting policies within his methodology.

In summary, the early focus in backcasting was on exploring and assessing energy futures and on their potential for policy analysis in the traditional sense of supporting policy and policy-makers, usually adopting a government-oriented perspective.

2.2.2. Backcasting for sustainability

It was realised that the backcasting approach could potentially be applied to a much wider range of subjects, due to its characteristics and normative nature. For instance, Robinson (1988) discussed the wider conceptual and methodological issues of backcasting; this includes the role of learning and unlearning with respect to existing dominant views about the future, the issue of broadening the process to a larger group of potential users and how to alter the hegemony of existing dominant perspectives. Elsewhere, Robinson (1990: 822) mentioned that backcasting is not only about how desirable futures can be attained, but also about how undesirable futures can be avoided or anticipated.

Robinson's (1990) paper also marked the move towards the application of backcasting to sustainability and illustrates the interest in Sweden, as the paper reported on a study supported by the Swedish Energy Research Council. In Sweden, a strategic interest in alternative energy futures had developed (Johansson and Steen 1980, Lönnroth *et al.* 1980), which was followed by substantial efforts in conceptual development (e.g. Dreborg 1996, Holmberg 1998, Höjer and Mattsson 2000). Dreborg (1996) has argued that traditional forecasting is based on dominant trends and is therefore unlikely to generate solutions based on breaking trends. Due to their normative and problem-solving character, backcasting approaches are much better suited to address long-term problems and sustainability solutions. Dreborg also emphasises that our perception of what is possible or reasonable may be a major obstacle to real change – which is in line with earlier remarks by Robinson (1988) about (un)learning and the dominance of existing perspectives. Scenarios or future visions of a backcasting project should, therefore, broaden the scope of solutions to be considered by describing new options and different futures. According to Dreborg, backcasting is particularly useful when applied to complex and persistent problems, when dominant trends are part of the problem, when externalities are at play, when there is a need for major change and when time horizon and scope allow development of radical alternative options. Sustainability problems obviously combine all these characteristics (Dreborg 1996).

Dreborg (1996) also focuses on the conceptual level beyond Robinson's stepwise method and relates backcasting to Constructive Technology Assessment (CTA). The purpose of CTA is to broaden the technology development processes and the debate about technology with environmental and social aspects, as well as to enhance the participation of social actors like public interest groups, in addition to the traditional participants in such processes (see 2.2.4 for a further explanation on CTA). A distinction can be drawn between the analytical side and the constructive and process oriented side of backcasting (Dreborg 1996). With respect to the analytical side, the main result of backcasting studies are alternative images of the future, thoroughly analysed in terms of their feasibility and consequences. With respect to the constructive-oriented side, backcasting studies should provide an input to a policy developing process in which relevant actors should be involved. Results of backcasting studies should therefore be addressed to many actors, including political parties, government authorities, municipalities, organisations, enterprises and a general public that needs to be well informed.

Höjer and Mattsson (2000) have suggested that backcasting and regular forecasting are complementary rather than conflicting opposites. They favour backcasting in cases where existing trends are leading towards an unfavourable state. Although this is in line with Dreborg's (1996) argument, they add a forecasting step to their backcasting approach in which forecasts and the desired vision are compared. If the vision is unlikely to be reached based on the most reliable forecasts, model calculations and other estimates, backcasting studies should be used to generate images of the future that fulfil the targets. Höjer and Mattsson (2000: 630) also emphasise the importance of scrutinising how to attain the desirable future by working back from the desirable future to check the physical and social feasibility of the route or pathway towards that future. This requires not only identifying the necessary measures and actions for bringing about that future, but also using models and regular forecasting tools to quantify the consequences of different measures.

Backcasting for sustainability has been applied in Sweden on a range of topics, for instance sustainable transportation systems (Höjer 1998, Höjer and Mattsson 2000, Roth and Kaberger 2002, Åkerman and Höjer 2006), for air transport (Åkerman 2005) and to explore futures for a region like the Baltic Sea (Dreborg *et al.*1999). Despite the plea (Dreborg 1996) in Sweden to broaden backcasting with a range of social actors and participants, the backcasting studies referred to above are not participatory and have a strong analyti-

cal focus. Expert involvement in backcasting studies has occasionally been reported (Höjer 1998, Banister *et al.* 2000a). Although the Natural Step backcasting methodology, which aims at sustainable companies, can be seen as participatory, it focuses on internal stakeholders and employees (Holmberg 1998, Holmberg and Robèrt 2000).

The interest in backcasting for sustainability is still growing. Studies have been conducted in many countries, albeit especially in Europe. In addition to the Swedish examples mentioned above, there have been various backcasting studies on water, mobility and mobility technologies (Falkenmark 1998. Geurs and Van Wee 2000, Banister *et al.* 2000a, Banister *et al.* 2000b, Marchau and Van der Heijden 2003, Geurs and Van Wee 2004). Attempts have also been made to combine backcasting with other approaches (Höjer 1998, List 2003, Robèrt 2005, Dortmans 2005, Marchau and Van der Heijden 2003, MacDonald 2005), while recently different backcasts and visions for the future of hydrogen were discussed (McDowell and Eames 2006).

2.2.3 The shift to participatory backcasting

The shift towards participatory backcasting using broad stakeholder involvement started in the Netherlands in the early 1990s. Participatory backcasting has been applied in the Netherlands since that time, first at the government programme for Sustainable Technology Development (STD) that ran from 1993-2001 (Vergragt and Jansen 1993, Weaver *et al.* 2000) and later in its EU funded spin-off, the research project 'Strategies towards the Sustainable Household (SusHouse)', which ran from 1998 to 2000 (Green and Vergragt 2002, Quist *et al.* 2001a). Both initiatives focused on achieving sustainable need fulfilment in the distant future, using a backcasting approach that included broad stakeholder participation, future visions or normative scenarios, and the use of creativity to reach beyond existing mind sets and paradigms.

Inspired by the Swedish practice, Vergragt and Jansen (1993) mentioned backcasting as part of the philosophy of the STD programme. They described the basic idea (1993: 136) as *"to create a robust picture of the future situation as a starting point, and start to think about which (technical and other) means are necessary to reach this state of affairs. Such a view of reality is not a scenario or a product of forecasting, but should be seen as a solid picture that can be accepted by the technological spokesmen right now."* Like Dreborg (1996), Vergragt and Jansen (1993) emphasised the link with Constructive Technology Assessment, including a broadening of technology development processes with sustainability aspects and the participation of social actors like public interest groups in such processes, in addition to the traditional participants. Elsewhere, Vergragt and Van der Wel also emphasise the importance of implementation and follow-up (Vergragt and Van der Wel 1998: 173). *"Future visions alone are not enough: Backcasting implies an operational plan for the present that is designed to move toward anticipated future states. Backcasting, then, is not based on the extrapolation of the present into the future – rather, it involves the extrapolation of desired or inevitable futures back into the present. Such a plan should be built around processes characterised as interactive and iterative."* This implies that many stakeholders need to be involved and that there is continuous feedback between future visions and present actions.

Weaver *et al.* (2000: 74), reporting on the approach and results of the STD programme, describe backcasting as a possible tool for establishing shared visions of desirable future system states and for securing a 'systems' perspective. They also emphasise that backcasting can be used to define feasible short-term actions that can lead to trend-breaking change, in other words putting vision into action (Jansen 2005). Weaver *et al.* (2000: 72-78) refer to backcasting not only as an overall methodology, but also as a concept and as a specific step in the full methodology. This may cause some confusion, as these authors relate the term backcasting to different aspects. Furthermore, different tools and methods can be applied as part of the overall backcasting methodology (Aarts 2000, Weaver *et al.* 2000).

While the focus of the STD programme was on sustainable technologies, the SusHouse project, which was an international project initiated from the Netherlands, aimed at developing and testing strategies for sustainable households in the future. The backcasting methodology used stakeholder workshops, creativity methods, normative scenarios, scenario assessments and backcasting analysis (Vergragt 2000, Quist *et al.* 2001a, Young *et al.* 2001, Green and Vergragt 2002). In the SusHouse project it was originally assumed that all backcasting activities could be concentrated in a single workshop. However, it turned out that backcasting activities took place during a large part of the project; not only during the stakeholder workshops, but also during the scenario elaboration and scenario analysis activities of the research teams (Quist *et al.* 2000). Quist *et al.* (2000: 8-16) also mention the link with CTA, the connections with the field of Creative Problem Solving (e.g. Isaksen 2000) and the importance of (conceptual) learning by the stakeholders and researchers involved. Tassoult (1998) has reported on the integration of a particular creativity method entitled 'Future Perfect' as part of a backcasting project on sustainable washing; the final results of the complete project have been reported by Vergragt and Van der Wel (1998). Green and Vergragt (2002), reporting on the results of the SusHouse project, conclude that stakeholders should not only be involved in constructing normative scenarios, but also in the economic and environmental assessment of the normative scenarios. Elsewhere, Vergragt (2005) emphasises that, although it is important that stakeholders share a future vision, in itself that is not enough to achieve implementation and follow-up; he argues that it is also important to understand the culture and interests of stakeholders and their reasons for participating both in the backcasting study and in follow-up activities.

Since it was applied in the STD programme, participatory backcasting has become a well-known and widely applied approach in the Netherlands (see also Quist 2006). For instance, backcasting and normative future visions have been applied in strategic research programmes at DLO, the main Dutch research organisation for agriculture and rural areas (e.g. Grin *et al.* 2004, Poot 2004). A participatory backcasting approach has been applied to the subject of climate change, involving stakeholders in a debate on different futures meeting Kyoto targets (Van de Kerkhof *et al.* 2003, Van de Kerkhof 2004). Partidario has elaborated and applied a backcasting approach similar to the SusHouse methodology to study sustainable futures for industrial paint chains in the Netherlands and Portugal (Partidario and Vergragt 2002, Partidario 2002). Rotmans *et al.* (2001: 23-24), working on transition management, also refer to backcasting from the future as part of their transition management approach. Jansen (2003) has paid attention to backcasting in national foresighting programmes and has compared these to backcasting in the STD programme. The STD approach has also been elaborated in a backcasting methodology for vision development and the integration of spatial functions (e.g. agriculture, leisure, nature, landscape, etc) in rural areas (De Kuijer and De Graaf 2001). This methodology has been applied in various regions in the Netherlands (De Graaf *et al.* 2003, De Graaf and De Kuijer 2004a, De Graaf and De Kuijer 2004b). There is also an interest in developing more quantified ways of backcasting, which has been applied to the design of transition strategies for sustainable transportation chains (Suurs *et al.* 2004).

The shift towards participatory backcasting has also taken place in other countries. For instance, in Sweden, 'The Natural Step' (TNS) methodology, as reported by Holmberg (1998), Holmberg and Robèrt (2000), is a backcasting methodology focusing on strategic planning for sustainability in companies (see also www.thenaturalstep.org). It has been applied successfully within corporations like Ikea, carpet producer Interface and Scandic hotels (Holmberg 1998; for a detailed account, see Nattrass and Altomare 1999). After assuring commitment from top level management, as many employees as possible are involved and consultation takes place at all levels of the organisation to generate ideas about how to become a sustainable corporation; in several cases external stakeholders were involved as well. This example shows that it is possible to apply

backcasting at the level of particular organisations.

In Canada, Robinson, elaborating upon his extensive experience in backcasting (e.g. Robinson 1982, 1988, 1990), has also developed backcasting further and has included participation. Robinson (2003) emphasises the importance of social learning, interactive social research, and the engagement of non-expert users in backcasting studies, and he has called this 'second generation backcasting'. This form of backcasting has been applied to the Georgia river basin in West Canada and has been related to participatory integrated assessment (Tansey *et al.* 2002), using a modelling tool based on the QUEST approach, which enables residents to engage in interactive construction of future images for the river basin; users are also asked to evaluate the scenario outputs in terms of their desirability and to match them with personal preferences. As it is possible to iterate by adjusting inputs, it enables users to continue towards future visions that provide a better match with their preferences. This contributes to learning among users (Robinson 2003).

Other examples of participatory backcasting have taken place in Sweden (Carlsson-Kanyama *et al.* 2003a) and Belgium (Keune and Goorden 2002, 2003). The former was part of an international project on sustainable cities in five European countries (Carlsson-Kanyama *et al.* 2003b) including the Netherlands (Falkena *et al.* 2003). Finally, local scenarios and participatory backcasting have been combined with continental scenarios (Kok *et al.* 2006a, Kok *et al.* 2006b).

2.2.4 Related approaches

This section briefly deals with two groups of approaches and methodologies that may be relevant to participatory backcasting[7]:

(1) Participatory approaches that develop and use normative or desirable futures, but have not been labelled as backcasting.
(2) Participatory approaches in Constructive Technology Assessment (CTA) and Participatory Technology Assessment (PTA).

Participatory approaches using normative futures

Transition Management (TM) is a strongly emerging approach in the Netherlands aiming at transitions towards sustainability (Rotmans *et al.* 2000, Rotmans *et al.* 2001, Kemp and Rotmans 2004, Rotmans 2003). TM uses normative future visions as a core element, in addition to long-term thinking as a framework for short-term policy, a focus on learning and thinking in multiple aspects, multiple domains and multiple levels. The relationship with backcasting is sometimes referred too (Rotmans *et al.* 2001), although differences with backcasting have also been emphasised (Rotmans 2003). TM has a strong policy orientation and emphasises the need to keep various options open by working towards different visions at the same time. It has been adopted by the Dutch government and is currently being applied to future energy supply systems in the Netherlands (www.energietransitie.nl). It has also been advocated that TM can be applied to any complex societal problem and offers a management strategy for the government for dealing with such societal problems through transitions (Rotmans *et al.* 2001). I will return to the Transition Management approach in 9.3.

Elsewhere, Rotmans *et al.* (2000) and Van Asselt *et al.* (2005) have reported on normative scenarios for sustainable areas in Europe in which stakeholders were involved. Street (1997) has described the use of scenario workshops as a participatory approach to sustainable urban living, involving citizens and other local stakeholders. Mayer (1997) has reported on the so-called Awareness Workshop Methodology, which also involves local stakeholders in scenario development on local environmental improvement. Grin *et al.* (1997) have proposed Interactive Technology Assessment (ITA) in which both broad stakeholder involvement and the construction of normative future visions by stakeholders are core elements. Developing desirable futures has also been combined with context scenarios for the Scheldt river basin, though in an educational setting (Ruijgh-van der Ploeg and Verhallen 2002). Raskin *et al.* (2002) have reported on efforts by the Global Scenario Group of the Tellus Institute, which has resulted in a set of global futures as well as strategies for achieving a sustainable future.

In 't Veld (2001) has proposed a participatory foresight approach entitled TO3[8] after an evaluation of future studies for spatial planning policymaking in the Netherlands (Stuurgroep T&O 2001). This approach (In 't Veld 2001: 27-37) combines participation, orientation, design and analysis in the generation of normative future images. It assumes trans-disciplinary research, connecting heterogeneous knowledge, combining creativity and reflexivity, taking into account ambiguity and uncertainties, and using experts and other stakeholders to connect and relate heterogeneous knowledge. The approach also assumes process demands (e.g. type and range of participation, or the transparency of the process) and knowledge demands (e.g. quality of the future images).

Constructive and Participatory Technology Assessment

Other approaches that are relevant to backcasting are the participatory approaches like the ones practiced in what has been referred to as Constructive Technology Assessment (CTA, see Schot and Rip 1996), Participatory Technology Assessment (PTA, see Schot 2001). In general, the focus of these types of approaches is not on generating normative or desirable futures, but on broadening the process of technology development and related decision making with societal aspects and societal actors. The purpose is that technology driven futures of technology developers are adjusted to societal aspects and concerns, as well as to broaden the public debate on technology. This group of approaches is interesting, as they focus on broadening innovation and technology processes, though in general not on a system level. These approaches do not use sustainability as the only target, but treat sustainability aspects as part of a set of relevant aspects. CTA/PTA approaches may use normative visions, as shown by Grin *et al.* (1997), but not necessarily. Mayer (1997) has given an overview of participatory methods that can be used in CTA and PTA.

Another CTA methodology is Strategic Niche Management (SNM, e.g. Hoogma *et al.* 2002), while others have referred to a similar methodology as Bounded Socio-Technical Experiment (BSTE, see Brown *et al.* 2003). Strategic Niche Management refers to experimenting with new technological options in a space protected from regular market pressures, to enable stakeholders (both producers, users, regulators) to learn about a new technology, articulation of user demands and the embedding in its context. While market niches can survive under market conditions, so-called technological niches cannot, and as a result they need protection, which can be provided by governments through subsidies, taxes or levying, but it also requires support from other actors. Rather than looking at the longer term, this approach focuses on concrete technologies and artefacts that are already available and can be tested in a pilot. SNM may be part of a long-term strategy, which includes implementation of new technologies. However, it is still unclear how the removal of the protection mechanisms (as suggested in SNM) could take place in a balanced way, without 'killing' the technology in an early phase and without offering protection for too long.

Fonk (1994) has developed a CTA methodology called Future Images for Consumers[9]. This methodology focuses on dialogue and discussion between major actor groups, like technologists and scientists, producers, as well as consumer groups and public interest groups. It starts with developing actor group specific future images assuming that these are rather homogeneous, while emphasising the role of consumers or end-users. These images are not necessarily images of a desirable future, but rather images based on the expectations and assumptions of relatively homogeneous groups of actors. Next, the images serve as a

starting point for discussion between these groups, with the aim of identifying issues of consensus and disagreement.

Another emerging methodology refers to socio-technical scenarios (Elzen *et al.* 2002, Elzen *et al.* 2004, Hofman *et al.* 2004, Hofman 2005), building on the same insights as CTA. These authors argue that this type of scenarios makes it possible to take into account the complexity and multi-level nature of transitions or system innovations. The approach focuses strongly on niches that can become stepping stones for transitions and technological regime change, as well as on the possible pathways to realise them. This methodology is expert and analysis driven, rather than stakeholder driven. Its explicit aim is to take into account the social aspects of technology development and system innovations, as well as the mutual influence between society and technology.

2.3 Comparing four backcasting approaches

In the literature survey presented in the previous section a number of backcasting studies and experiments were discussed, in which a range of methods were applied. It has been argued that reports on backcasting methods are hard to find and that therefore conventional methods have to be combined in backcasting approaches (Marchau and Van der Heijden 2003: 266). This calls for a more detailed exploration of various backcasting approaches, which is the topic of this section. In the literature both the term backcasting approach and the term backcasting methodology are used. In my view the term backcasting approach should be used to describe (backcasting) approaches in general and more abstract terms, whereas I use the term (backcasting) methodology for more elaborated varieties, for instance when applied in concrete cases.

In this section four different backcasting approaches are more extensively discussed, using selected papers from the literature review with a comprehensive description of a particular backcasting approach or methodology. The four backcasting approaches are:

- The backcasting approach as proposed by Robinson (1990);
- The Natural Step backcasting approach (Holmberg 1998, Nattrass and Altomare 1999, Holmberg and Robèrt 2000);
- The STD backcasting approach as described by Weaver *et al.* (2000) and Aarts (2000);
- The backcasting approach as applied in the SusHouse project, based on Vergragt (2000, 2005), Quist *et al.* (2001a), and Green and Vergragt (2002).

The four approaches are summarised in Table 2.1, which shows key assumptions, proposed steps and examples of methods. Descriptions of methods can be found in the references.

Robinson's (1990) backcasting approach

Robinson (1990: 823) characterises his approach as explicitly normative and design-oriented, aimed at exploring the implications of alternative development paths as well as the underlying values. It starts by defining future goals, objectives and constraints for both the defined system and its external context, followed by the construction of future scenarios, which can be based on criteria set externally to the analysis. Next, the scenarios must be evaluated in terms of socio-economic, technological and physical feasibility and of policy implications. Iteration of scenario construction is needed to avoid physical inconsistencies

Table 2.1 *Four backcasting approaches*

	Robinson's backcasting approach	**TNS backcasting approach**	**STD backcasting approach**	**SusHouse backcasting approach**
Key assumptions	*> Criteria for social and environmental desirability are set externally to the analysis* *> Goal-oriented* *> Policy-oriented* *> Design-oriented* *> System oriented*	*> Decreasing resource usage* *> Diminishing emissions* *> Safeguarding biodiversity and ecosystems* *> Fair and efficient usage of resources in line with the equity principle*	*> Sustainable future need fulfilment* *> Factor 20* *> Time horizon of 40-50 years* *> Co-evolution of technology & society* *> Stakeholder participation* *> Focus on realising follow-up*	*> Stakeholder participation* *> Factor 20* *> Sustainable households in 2040* *> Social and technological changes are needed* *> Achieving follow-up is relevant*
Methodology (steps)	*(1) Determine objectives* *(2) Specify goals, constraints and targets & describe present system and specify exogenous variables* *(3) Describe present system and its material flows* *(4) Specify exogenous variables and inputs* *(5) Undertake scenario construction;* *(6) Undertake (scenario) impact analysis*	*(1) Define a framework and criteria for sustainability* *(2) Describe the current situation in relation to that framework* *(3) Envisage a future sustainable situation* *(4) Find strategies for sustainability*	*(1) Strategic problem orientation* *(2) Develop sustainable future vision* *(3) Backcasting – set out alternative solutions* *(4) Explore options and identify bottlenecks* *(5) Select among options & set up an action plan* *(6) Set up cooperation agreements* *(7) Implement research agenda*	*(1) Problem orientation and function definition* *(2) Stakeholder analysis and involvement* *(3) Stakeholder creativity workshop* *(4) Scenario construction* *(5) Scenario assessments* *(6) Stakeholder backcasting and strategy workshop* *(7) Realisation follow-up and implementation*
Examples of methods	*> Social impact analysis* *> Economic impact analysis* *> Environmental analysis* *> Scenario construction methodologies* *> System analysis & modelling* *> Material flow analysis and modelling*	*> Creativity techniques* *> Strategy development* *> Employee involvement* *> Employee training*	*> Stakeholder analysis* *> Stakeholder workshops* *> Problem analysis* *> External communication* *> Technology analysis* *> Construction of future visions* *> System design & analysis*	*> Stakeholder analysis* *> Function & system analysis* *> Backcasting analysis* *> Stakeholder workshops* *> Scenario constructio* *> Scenario evaluation (consumer acceptance, environmental, economic)*

and to mitigate or avoid adverse impacts.

This resulted in the six step approach summarised in Table 2.1. The approach does not specify who will set the criteria and the future goals and how this will be done. Stakeholder participation is also not included. The focus is on analysis and policy recommendations. It is acknowledged that the analysis must be connected to the policy process, which can be done by involving relevant government agencies as well as the wider public.

No reference is made to particular methods, but various groups of methods are mentioned, such as different types of scenario impact analyses, modelling and scenario approaches. The approach combines analysis and design, supported by modelling.

The Natural Step (TNS) backcasting approach

Holmberg (1998) describes a backcasting approach for strategic sustainability planning in companies and other organisations that consists of four steps. The first step is to define relevant sustainability criteria for the organisation under study, based on four principles that are listed as key assumptions in Table 2.1. The second step consists of an analysis of the present situation, the present activities and competences of the organisation and the supply and consumption chain of which the organisation is a part. This makes it possible to identify sustainability bottlenecks. In the third step future options and future visions are envisaged with the help of employee involvement, for which creativity techniques can be applied. The future options and visions for the organisation need to be widely discussed within the organisation and can imply new activities. Finally, in the fourth step strategies are developed to move from the present towards the desired situation.

Although Holmberg (1998) does not elaborate on particular methods, he refers to employee involvement, discussing the results widely within organisations, creativity techniques, developing relevant sustainability criteria, strategy development, training and consulting employees, and translating the outcomes into the organisation's activities and policies.

STD backcasting approach

Weaver *et al.* (2000) have described the backcasting approach of seven steps as depicted in Table 2.1. According to Weaver *et al.* (2000: 76), Steps 1-3 are designed to develop a long-term vision based on a strategic review of how a need might be met in the future in a sustainable way and backwards analysis is used to set out alternative solutions for sustainable need fulfilment. Step 4 and step 5 are meant to clarify the short-term actions that are needed to realise that future, and can be seen as a joint action, R&D and policy agenda. Steps 6 and 7 deal with implementation, facilitating stakeholder cooperation and realising the action agenda. The idea is that stakeholders who are involved in the backcasting projects set up cooperation enabling the implementation of research and follow-up agendas. The approach allows iteration and moving forwards and backwards between two steps.

Basic assumptions include the factor 20 environmental improvement by 2040, high-level stakeholder involvement, a focus on the sustainable fulfilment of societal needs, a focus on follow-up and agenda-setting and a focus on technological options, while acknowledging that technology development is bounded by cultural and structural conditions.

Aarts (2000) has made an overview of the methods that have been applied as part of the STD backcasting approach. She mentions several methods for the development of future visions, like essays by experts, the TvC methodology, stakeholder interviews and creativity workshops, the Delphi method, while she also refers to the relevance of visualisation and communication. In addition, she refers to problem analysis, stakeholder analysis and stakeholder involvement, as well as to methods for organising and managing projects on options that originate from the backcasting analysis and the future vision. Finally, she emphasises the relevance of methods for the transfer and dissemination of outcomes and follow-up agendas.

SusHouse backcasting approach

The SusHouse project used a backcasting approach to develop strategies for sustainable households (Vergragt 2000). Basic assumptions include (i) a factor 20 environmental improvement (ii) broad stakeholder involvement, (ii) development of normative future scenarios, and (iv) taking into account follow-up and implementation.

The approach was divided into seven steps, as shown in Table 2.1 (see also Quist *et al.* 2001a, Green and Vergragt 2002). For each household function a stakeholder analysis was performed, covering stakeholders on the demand side, the supply side, research bodies, government and public interest groups. Selected stakeholders participated in stakeholder creativity workshops with the aim of identifying sustainable ways of future function fulfilment. The results were used for construction of normative, so-called design-oriented scenarios. These scenarios were assessed in terms of environmental gain, consumer acceptance and economic credibility. Scenarios and assessment results were discussed in a second set of stakeholder workshops, which also focused on follow-up proposals, research agendas and policy recommendations in line with the scenarios. In both series of workshops backcasting techniques were applied, for which a set of guiding questions has been developed (Quist *et al.* 2000a). Backcasting analysis was also carried out during scenario construction by the research teams involved. Thus backcasting techniques, participatory methods, analytical methods, design methods and management and communication methods were all applied as part of this backcasting approach. Finally, the approach allows for iterative cycles. After each round of assessments, scenarios can be adjusted after which the scenario assessments can be conducted again.

Comparison

There are various differences and similarities between the different backcasting approaches. With regard to the differences, both Robinson's backcasting approach and the TNS approach do not contain a separate backcasting step. They reserve the term backcasting for the overall approach. By contrast, the SusHouse approach and the STD approach contain a separate backcasting step. In all four examples the overall backcasting approach provides a framework consisting of steps in which various types of methods can be applied. While the SusHouse methodology and the STD approach both contain an explicit backcasting step, no reference is made to methods or tools for this step. This would suggest that the backcasting step is underdeveloped in methodological terms. Sometimes, but not always reference is made of iteration or iterative cycles within the approach. Sometimes the use of modelling is emphasised (e.g. Robinson 1990, Robinson 2003), whereas in the STD approach and the SusHouse approach modelling is not explicitly referred to, or is considered part of further elaboration after the vision has been developed.

All four approaches contain analytical methods and design methods. Participatory methods can be found in three approaches; the exception is Robinson's backcasting approach, which was not intended to be participatory in nature. All four approaches contain steps in which future visions or (normative) scenarios are constructed, as well as steps in which the current situation or present system is analysed. In addition, all four approaches deal with basic assumptions and starting points that can be part of the first step or set external to the backcasting study. All four approaches include activities like elaboration and (scenario) analysis. Also, the TNS approach, the STD approach and the SusHouse approach contain steps dealing with operational aspects of implementation and follow-up, strategies and agenda setting. In the STD approach

the importance of operational management and coordination has been emphasised. Finally, learning is important in all four approaches.

2.4 A methodological framework for participatory backcasting

2.4.1 Developing a methodological framework

The purpose of this section is to develop a generic methodological framework for participatory backcasting that has the potential to cover the full range of participatory backcasting approaches found in the literature. For this I build on the following findings of the previous sections.

- Backcasting approaches function as methodological frameworks in which different types of methods can be applied. Backcasting approaches do not prescribe specific methods, but allow combining various methods.
- In the four approaches that were analysed, reference has been made to design methods and analytical methods. More recent approaches include participatory or interactive methods. These approaches also emphasise agenda setting, strategy development and follow-up and implementation and have separate steps corresponding to these elements.
- All four approaches include the development of desirable future visions or normative scenarios. They also include an analysis of the present situation or the problem under study, as well as analysis of generated future visions or normative scenarios.
- Two recent approaches include a separate backcasting step in which looking back from the desirable future is explicated, although methods in this step are not clearly articulated.
- In one case (Aarts 2000), explicit reference has been made to practical organisation, communication and project management, which refers to another group of relevant methods.
- The four approaches show different sets of basic starting points and assumptions, which are partially normative. These assumptions can either be set before the backcasting study or in the first step of a backcasting study.
- From another foresighting approach described by In 't Veld (2001) I take the starting point that in participatory backcasting both process and knowledge demands can be set. Because of the normative nature of backcasting I add a third type of demands, which I call normative demands.
- Goals should not only relate to the content of the future vision, as emphasised in earlier backcasting approaches, but need to cover all aspects of the backcasting experiment and may be process related or refer to realising follow-up and implementation.

2.4.2 Participatory backcasting in five steps

Despite the fact that different backcasting approaches show differences in methods applied, ways of stakeholder involvement and number of steps (Robinson 1990, Holmberg 1998, Weaver *et al.* 2000, Quist *et al.* 2001a), it is possible to develop a methodological framework for participatory backcasting consisting of five steps:

STEP 1: Strategic problem orientation
STEP 2: Develop future vision
STEP 3: Backcasting analysis
STEP 4: Elaborate future alternative & define follow-up agenda
STEP 5: Embed results and agenda & stimulate follow-up

It is assumed that setting the normative assumptions and goals is part of the first step, as is achieving agreement on the normative assumptions among stakeholders involved. However, sometimes the normative assumptions are set before the problem orientation starts, for instance as part of an overall structure or programme. This was the case in the Netherlands with the STD programme, where the time horizon of 40 years, the factor 20 and the focus on sustainable need fulfilment were set as general assumptions, and were approved by key persons at the participating ministries and some leading industries in the Netherlands before specific backcasting studies were started.

In addition, if more than five steps are identified in a particular backcasting approach, generally speaking it is possible to place specific steps parting one of the suggested five steps. Occasionally, (e.g. Holmberg 1998) the fourth and the fifth step have been combined into one. In the SusHouse project embedding outcomes and realising follow-up were considered very difficult, and these were therefore left out of the methodology (Quist *et al.* 2001a). However, because embedding and initiating follow-up and implementation are of crucial importance, I argue that is justified to distinguish them as a separate step in the approach.

It must be emphasised that, although the approach is depicted in a linear way, it definitely is not. Iteration cycles are possible, while there is also a mutual influence between consecutive steps. Although it may be interesting to conceptualise the approach as a set of activities that all need to be carried out, rather than in a linear sense, in practical applications it remains necessary to use a transparent time frame that can be communicated to the stakeholders involved and to other external parties.

In a backcasting experiment the process has a dynamic nature, which means that stakeholders may leave the process, while new stakeholders may join it. Stakeholders are important, not only because of their context-specific knowledge, but also because they help endorse results and realise the proposed action agenda and specific follow-up. Four major societal groups can be distinguished: companies, research bodies, government and public interest groups and the general public.

2.4.3 A toolkit of four categories of methods

A wide range of methods and tools is necessary in a participatory backcasting framework. Four groups of methods and tools can be distinguished that together form the outline of a toolkit. Three groups of tools and methods relate to (1) stakeholder participation, (2) design and development, and (3) analysis. The fourth group involves tools and methods for process and stakeholder management. It must be noted that each step of the backcasting approach generally requires tools and methods from all four categories. It is possible for different steps to involve different tools and methods from the same group.

Participatory tools and methods make up the first group, which includes all the tools and methods that are useful for involving stakeholders and generating and guiding interactivity among them. It includes specific workshop tools, tools to generate stakeholder creativity, tools that help stakeholders in specific backcasting activities and tools for participatory vision and scenario construction. Mayer (1997) has provided an interesting overview of participatory tools and methods, while Slocun (2003) has provided a toolkit.

Secondly, there are design tools and methods. These are not only meant for scenario construction, but also for elaboration and detailing systems as well as process design.

Thirdly, backcasting involves analytical tools and methods. These relate not only to the assessment of scenarios and designs, like consumer acceptance studies, environmental assessments, economic analyses, but also include methods for process analysis and evaluation, stakeholder identification and stakeholder analysis.

Fourthly, backcasting also requires management, coordination and communication tools and methods. This includes methods for communication, to shape and maintain stakeholder networks that originate from the backcasting study and for process management (e.g. De Bruijn *et al.* 2002).

2.4.3 Possible goals in backcasting

In the literature regarding energy backcasting, the goal orientation reflects the desirable future states. Here, backcasting is considered as an approach applied in a backcasting experiment involving stakeholders. As a consequence, goals should not only reflect the desirable futures, but also the process side. Then, possible goals for backcasting experiments may include:

- Generation of future visions and analysing these;
- Putting visions and options on the agenda of relevant arenas;
- Developing a follow-up agenda with activities for various groups of stakeholders in line with the envisioned desirable future;
- Participation of a wide range stakeholders;
- Awareness and learning among the stakeholders involved with respect to the future vision, the consequences, the agenda and the views and perspectives of others;
- Realising follow-up and stakeholder cooperation.

It must be noted that specific goals can also be more or less relevant in a specific backcasting experiment or can be achieved in a particular step. It is also important to realise that for a backcasting experiment different demands can be made. As mentioned in 2.4.1, a distinction can be drawn between normative demands, process demands and knowledge demands.

Finally, backcasting as proposed here is both inter-disciplinary and trans-disciplinary. It is inter-disciplinary in the sense that it brings together and integrates methods and knowledge from various disciplines. It is trans-disciplinary because it involves stakeholders, stakeholder knowledge and stakeholder values.

2.5 Conclusion

A distinction has been drawn between likely futures, possible futures and normative or desirable futures and the associated types of future studies. Backcasting belongs to the third type of future studies. This type of future studies has been less widely applied, but it is becoming more popular because of applicability in sustainable development. Backcasting is not the only approach that uses normative or desirable future visions; it belongs to a family of participatory approaches that all use normative futures or normative scenarios.

Backcasting originated in the 1970s and was originally developed as an alternative to traditional energy forecasting and planning. It has evolved into a participatory approach involving a wide range of stakeholders, with the aim of not only identifying and analysing radical sustainable alternatives, but in many case also of setting agendas, spreading information, realising follow-up activities and achieving other effects. Backcasting has been applied to a range of topics and levels, like regions, companies and various socio-technical systems, like the mobility system. Stakeholder participation also varies. This ranges from expert and employee involvement, to broad involvement covering a wide range of stakeholders.

The term backcasting can refer to a concept, a study, an approach, a methodology or an interaction process among participating stakeholders. Backcasting can also refer to backwards-looking analysis or backcasting analysis, which is the specific step of looking back from the desired future. In other words, different people use different definitions, which is why one should always specify what is exactly meant when using the term backcasting.

In this chapter I have proposed a methodological framework for participatory backcasting, based on the analysis of four backcasting approaches. This framework consists of five steps and the outline of a toolkit containing four groups of methods and tools: design tools, participatory tools, analytical tools and management, coordination and communication tools. The backcasting approach is not only inter-disciplinary (combining and integrating tools, methods and results from different disciplines), but also trans-disciplinary (through the involvement of stakeholders). The framework distinguishes three types of demands: normative demands, process demands and knowledge demands. In addition, different goals are distinguished that relate to process aspects, content aspects or both.

Finally, three key concepts can be identified in participatory backcasting: (1) desirable futures, also called future visions, (2) stakeholder participation, and (3) learning by stakeholders. These are the starting point for the theoretical exploration presented in the next chapter.

Notes

1 *Parts of this chapter are based on Quist and Vergragt (2006), but updated here; these parts are 2.2 (but not 2.2.4) and 2.4.*

2 *In fact Dunn (1994:195) uses the terms plausible futures, potential futures and normative futures, but these are similar to the terms likely futures, possible futures and desirable futures, respectively. Recently, Börjeson et al. (2006) use the terms predictive scenarios (what will happen), explorative scenarios (what can happen) and normative scenarios (how can a predefined target be achieved), thus making similar distinctions.*

3 *In addition to the basic distinction used here, numerous other typologies for scenario and future studies are possible and proposed in the literature (e.g. Van Notten et al. 2003).*

4 *Though most scenario approaches focus on possible futures, in the literature reference is also made to business as usual scenarios that depict likely futures and to normative scenarios that resemble desirable futures,*

5 *There is a French scenario tradition, which is referred to as 'futuribles' or the 'strategic prospective (la prospective' (Godet 2000). Within this tradition has both been dealt with possible futures and desirable futures and combining these in strategic scenario planning (e.g. Godet 2000). This French tradition has not further been covered in this study.*

6 *Jantsch distinguished between explorative forecasting, which is forward-looking, and normative forecasting that should be used for setting goals in technology development. He used the Manhattan project and various other defence related programmes as examples.*

7 *As a consequence, I do not focus on other groups of methodologies and approaches like participatory policy analysis, participatory integrated assessment or so-called soft systems methodologies.*

8 *In Dutch TO3 stands for 'Toekomst-Orientatie, Ontwerp en Onderzoek'.*

9 *In Dutch abbreviated as TvC (Toekomstbeelden voor Consumenten). It has been applied as part of several backcasting projects within the STD programme (Weaver et al. 2000, Aarts 2000: 24-25). It may be used to develop desirable future images; it was not designed for that, but to incorporate consumer aspects early in the R&D process.*