Interactive backcasting (IB)
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1 Introduction

Already in 1976, Lovins introduced the ‘backwards-looking-analysis’ in his exploration of long-term energy policy in the United States (Lovins, 1976). In 1982, Robinson elaborated on this approach and developed the method of backcasting as an alternative approach to traditional forecasting and planning methods (Robinson, 1982). It has been especially designed as a tool for exploring sustainable policies.

A major distinguishing characteristic of backcasting analysis is a concern, not with what futures are likely to happen, but with how desirable futures can be attained. It is thus explicitly normative, working backwards from a particular desirable future end-point to the present in order to determine the physical feasibility of that future and what policy measures would be required to reach that point.” (Robinson, 1982). According to Robinson and other authors, backcasting should be based on explicit moral and normative considerations, i.e. by defining and exploring desirable futures and scenarios rather than BAU scenarios. The idea of designing desirable scenarios as a foundation for strategic action is not of recent date. Dreborg (1996) points to the tradition La Prospective in France, that can traced back to the work by Bertrand de Jouvenel (1967).

Backcasting is based on an epistemological and pragmatic critique on predictive forecasting. This critique is based on the notion that science is a social process, which may involve power and the exclusion of minority views. This inter alia means that one should avoid that the covered experts’ assumptions determine research outcomes. Dreborg (1996) claims that based on dominant trends one might overlook solutions that would presuppose the breaking of trends. So, backcasting should deliberately seek for possibilities to breaking with dominant trends. In a similar vein, Höjer (1998) defines backcasting as “a scenario technique, which focuses on presenting solutions to problems that do not seem to be solved, according to conventional scenarios, trends and forecasts” (1998: 446; also Holmberg, 2000). A related point is that predictive forecasting requires a closed system, whereas social developments over the long term cannot be captured in these terms. Such future predictions are based on assumptions about choices and behavior in the here and now, disregarding the possibility that new urgent problems may accommodate behavioral choice in the future. These observations lead to the conclusion that future predictions based on a forecasting approach share a conservative bias, as they seek the future within the boundaries of existing institutions. This point can be illustrated by the observation that the energy forecasts from the 1970s and beyond have predicted a raise in energy consumption levels that was significantly higher than the actual trends showed (e.g. De Man, 1987).

It is for these epistemological reasons that Dreborg (1996) argues in favor of backcasting as an approach or even a paradigm rather than a method. Backcasting relates to the context of discovery rather than to the context of justification. This idea fits in with the notion that participatory methods such as backcasting should enable problem structuring rather than problem solving. If backcasting is looked at from this perspective, it might be considered a recipe rather than a tool, an overarching approach that may involve a variety of specific methods. In this report, we focus on participatory approaches of backcasting as a way to build scenarios and explore pathways in an interactive mode.

2 Methodology

Originally, backcasting was not meant to be applied in an interactive mode. Especially the Swedish backcasting tradition looks into the building of desirable futures and the exploration of feasible trajectories as a method of scientific inquiry, which may assist in scenario development and model building. However, climate change projects in Canada and, more recently, in the Netherlands have developed interactive approaches to backcasting. Whereas traditional backcasting tends to take the desired end-state for granted and analyses how it maybe achieved, second-generation backcasting puts more emphasis on an iterative process to define the desired future result itself. In this process the stakeholder may learn about what is desirable
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through confrontation with the consequences of specific initial preferences. (Robinson, 2003: 849). From the perspective of research and modeling, backcasting provides an opportunity to involve the anticipated users of knowledge in the design and actual research itself. (idem).

The various approaches to operationalizing backcasting show similarities and differences. In this section, we point to the shared characteristics of the method. The following characteristics favor backcasting (Dreborg, 1996: 816):

- Complex problem, affecting many sectors and levels of society.
- Incremental approach insufficient, need for major (systemic) changes.
- Dominant trends are part of the problem.
- The problem relates to externalities that cannot be addressed by the market alone.
- The time horizon is long enough (30 – 50 years) to allow for deliberate choice.

An important feature of the tool is that it enables to analyze alternative images of the future, thoroughly analyzed as to their feasibility and consequences. Each alternative must appear as coherent and the analysis of consequences for social life must be credible. Backcasting should identify strategic choices for society for decision makers of all kinds.

### 3 Process

For interactive backcasting, as for other participatory tools, the starting point is to carefully define the settings of the assessment (Van de Kerkhof, 2004). The settings include:

1. The formulation of a problem and scope for the assessment, which may be rather broad, e.g. the identification of sustainable development strategies for a particular region, or rather specific, e.g. the assessment of the possibilities for reducing GHG emissions in a particular sector by 80% in the year 2050. A generally accepted starting point is that backcasting takes mostly a time frame of 25 – 50 years. It has been pointed out that a scenario time frame of 40 years is of interest to most participants (Robinson, 2003: 852). Many participants in interactive backcasting care about a time frame that is roughly the working life of their children or, in case they are young, their own working life. It has also been found important to adjust the spatial scale of the analysis to the interests of the participants, whereas most models reflect formal issue definitions or legal administrative boundaries.

2. The identification and recruitment of participants, which may be interested companies, governments, NGOs and citizens. A choice should be made as to whether the participants will constitute a more homogeneous group, e.g. local and regional policy makers, or a more heterogeneous group, e.g. persons from companies, from national and local NGOs, consumers, farmers etc. In order to enhance interactive learning it might be recommendable if most participants do not know one another from the outset.

3. The identification of the science to be involved and how. Scientists can contribute to the backcasting in different roles. The Canadian experience shows probably the best-documented record in involving modeling tools as to assist participants in the construction of future images (see below). But scientific assistance may also be provided by written input or oral presentations in order to provide participants with state of the art knowledge.

Especially the Canadian and Dutch experiences have shown the importance of a careful preparation of the backcasting process as to increase the commitment of all parties involved. The goals and mutual expectations must be well communicated, the process must be transparent to all and concerns and risks must be taken seriously. This is particularly so if the project is of major seize, involves a lot of actors and costs a lot of money and time investment on the side of both facilitating institutes and participants.

The procedure of the actual assessment will basically take two major steps. The first step is the definition of future images or desirable end-states, the second step is analyzing backwards from the future into the present, thereby identifying a time path for major decisions and change. Most of the literature on analytical as well as
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Interactive backcasting has focused on the production of future images. An example is provided by the scheme proposed by Holmberg (1998), which has been applied to strategy formulation in companies. Holmberg distinguishes four steps:

1. Identification of long-term sustainability criteria.
2. Analysis of the present state of the company as compared to these criteria.
3. Developing a vision of what a successful company might look like in a sustainable society.
4. The construction and creative design of the pathway to the successful company of the desired future.

The steps 1 to 3 are needed to produce a future image for the specific company. Interestingly, Roth and Käberger (2002), who cite this procedure, refer to step 3 as "the most exciting step". The exercise needed to translate the future image into a perspective for intervention is addressed in step 4. As to our knowledge, only the Dutch COOL project has given most weight to address the backward feasibility analysis of options (which is in most schemes the last step). These researchers have also suggested a procedure for a third step, i.e. a comparative evaluation of the outcomes in case of separate backcastings. Below, we address the interactive production of future images in more detail, using reports from the approach taken in the Canadian Georgia Basin project. Then, we address the backward feasibility analysis using the Dutch COOL project.

Building Future Images

In what we refer to as the Canadian approach, e.g. the Georgia Basin Futures project, desirable future images are defined with the help of the GB−Quest model. Critical in this approach is that each model user can construct his / her own desirable future and that not one future is by definition more sustainable than others. The model is used to offer choices to the user in order to shape and sharpen the reflection on what future outcomes or goals are most desirable: “...the choices offered to the user maybe thought of as desired outcomes, rather than the policies that would accomplish those outcomes”(Carmichael et al., 2004: 177). The goals can however be rather specific, such as ‘alternative means of traveling in a region’. The model may not only set goals of a general nature, such as preservation of landscapes or x% reduction of emissions, but may also be helpful to explore specific choices / goals / interventions to reach the general goals (Carmichael et al., 2004).

So, models may come to play a role in the actual ‘backcasting’ as well, but this is not very well documented. The model helps the user to evaluate the resultant scenario outputs in terms of their desirability or their consistency with his or her internal image of a desirable future, and to iterate through the system by changing inputs and viewing results until they get a future scenario that reflects their preferences.” (Robinson, 2003: 848). Interface driven modeling requires that the modeling system be attractive and interesting for the users, but they should also meet standards of academic quality and credibility. In other words, they should overcome the tension between the need to be ‘fun to use’ and the need to be ‘true to life’. As a result, the QUEST models are based on a interface template that is intended to be very much like that of a computer game (Robinson, 2003: 852).

Carmichael et al. (2004) distinguish three steps in the model use process, (1) Set Context, (2) Options for the Future, and (3) Results. Each step is organized into a hierarchy. Users can choose either a simplified package. In order to illustrate how the model assists the user, we go in some more detail into the first step, Set Context. Set Context has three sections, Rank Priorities, External Conditions and How the World Works. Rank Priorities asks for user’s priorities regarding the social, economic and environmental health of the region. For that purpose, it offers predefined value clusters, labeled as Planet first, People first, Rural Economy First or Urban Economy First. (Carmichael et al., 2004: 178): “By toggling back and forth among the four clusters the user can see that exactly the same scenario can give rise to very different conclusions about desirability, depending on the values of the user.” External Conditions provides the user with a choice of four scenarios, which provide regional interpretations of the impact of different global conditions. A key characteristic of External Conditions is that these are not in the power of the model users to control. How the World Works articulates basic user’s assumptions relating to uncertainty. These examples give some clarification on how QUEST has been designed to assist participants to design and reflect upon desirable futures.

The Quest model has been used in different settings such as:
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- Stakeholder forums, including a variety of actors from the region.
- Laboratory style studies, aimed at exploring and evaluating different procedures and ways of presenting data, user choices and model outputs.
- Individual uses, where users ‘play’ with the model in order to sharpen their own insights.
- Educational applications.

We might conclude that the Canadian approach is probably by far the best–documented approach of model use in backcasting. Of course, there are also other ways of constructing future images (see also under Combinations). In the Dutch COOL project, National Dialogue (Van de Kerkhof et al., 2002; Van de Kerkhof, 2004), the future images were initially constructed by the scientific support team and then translated into sectoral futures by the four stakeholder dialogue groups. Basically, one image sketched a liberalized high growth scenario, while the other provided a scenario with a more moderate (though still substantial) growth and more government services and regulation. A similar procedure was also followed in choosing climate reduction options for interactive analysis and reflection. The scientific support team offered a list of viable options, the stakeholder groups chose a set of (mostly technical) options which were then analyzed in the context of (either one of) the two guiding future images.

**Backward analysis**

For this part, we draw upon the method designed for the Dutch COOL project. The COOL project aimed to generate strategic recommendations for long–term climate policy in the Netherlands (Van de Kerkhof et al., 2002). This project addressed the following question: “How can greenhouse gas emission reductions up to 80% compared to 1990 levels for the Netherlands and Western Europe be realized by 2050?” The project thus did not address the question as to whether such reductions might be necessary or desirable. Nationally, the dialogue took place in four groups of 12 – 15 participants each. The groups dealt with the following sectors: (1) industry / energy, (2) traffic and transport, (3) housing and construction, and (4) agriculture respectively.

The actual interactive backward analysis was then carried out in subgroups of 4 –6 people. Each exercise addressed a specific option in the context of either one future image for the sector. It happened that one option was analyzed by two subgroups for the same sector, both approaching the option from a different image. In most cases, however, the option under scrutiny was linked to one of the images and the subgroup was asked to have a quick scan for the other image as well. The backcasting process was organized into six steps, total duration about 1.5 hour per exercise (Van de Kerkhof et al., 2002):

**Step 1**: Participants form a joint view of how the option under scrutiny looks like in the context of a specific future image, for example the option solar photovoltaic for the stakeholder group Housing and Construction. In this case, the subgroup analyzed the options for existing buildings. It formulated hypotheses about the improvement rate of solar photovoltaic cells by 2050 and assessed how many square roof meters it would take to meet future households electricity needs.

**Step 2**: Participants brainstorm on barriers and opportunities that have occurred in implementing the option. The question to be addressed is: "Suppose that option X has been implemented in 2050 to the extent that was assumed, what opportunities and barriers have occurred?" In the above example of solar photovoltaic for the existing buildings in the housing sector, one of the possible barriers discussed was as to whether there would be sufficient square roof meters to meet the need for solar. It was concluded that square roof would not be a serious barrier.

**Step 3**: Participants select what according to them is the 'most challenging problem'. The idea behind this is that decision–makers have the bad habit to address easy problems first and move the more difficult ones ahead. In the case of solar pv for the Housing sector, the costs of solar as compared to other options was considered the most challenging problem. This problem has different aspects. Important is the externalization of environmental costs in the past (year 2000), but other aspects relate to the behavior of companies who contribute to developing solar (in The Netherlands Shell and Akzo) and the conservative attitude that energy companies take vis a vis their costumers.
Step 4: Participants find out how this most challenging problem has been solved over time. They identify the actors relevant in this respect.

Step 5: Participants map out the implementation trajectory on a time path, which highlights the major interventions related to barriers and opportunities over time. They may examine more closely if the option has really been implemented. In the case of solar photovoltaic for Housing, the question that remained was as to whether solar photovoltaic could have been implemented before 2050, given the expected costs. This question was laid down with the scientific support team and answered at a next meeting.

Step 6: If necessary, the participants carry out a quick scan for the other image. They address the question: Suppose that this option was implemented under the other future image, to what extent were barriers, opportunities, the most challenging problem and the interventions, different from what you just analyzed?

So far, we found the COOL report as the most detailed on backward analysis both in terms of procedure and in terms of the evaluation of the procedure. This project then initiated a third step, in which the dialogue groups, separately and jointly, evaluated the major findings from the separate backcastings. For this purpose, the project used an interactive mode of repertory grid analysis (see section 4 of this report).

4 Review

4.1 Evaluation Results

Policy processes

In principle, backcasting is a very simple analytical tool that, in case of complex or unstructured problems is most fit to be carried out in an interactive way. Interactive backcasting is here defined as an exercise in which stakeholders take an imaginable future state as a starting point for their analysis and subsequently work backwards to the present situation in order to explore the feasibility of that future state, as well as the interventions needed to realize it. In this exploration, the stakeholders identify milestones as well as opportunities and obstacles to be overcome 'along the way' (Van de Kerkhof et al., 2002). This tool is designed and most suitable for developing strategies towards sustainability in all meanings of this concept. There is also quite some experience with the tool in various countries and settings and it can be combined with a lot of other tools (see below). Given these main features, backcasting is without doubt a recommendable tool for sustainability assessments. The tool can be used in all processes that are meant to structure policy problems; to set policy goals; and develop strategic policy plans. The tool is only in an indirect way useful to monitor and evaluate existing policies. See Section 4.4 for difficulties that may be taken as issues for further work in the near future.

Operational aspects

The tool itself is quite cheap. A simple backcasting exercise within an organization might be prepared in a few days, provided that state of the art knowledge with respect to the issue at hand is available. The formation of future vision and the backward analysis can be carried out in several hours, provided a careful preparation. Normally, the costs will be determined by the complexity of the issue, the heterogeneity of the stakeholder group to be involved, the willingness of stakeholders to participate, careful preparation of the scientific input and the combination of backcasting with other tools in a participatory assessment.

4.2 Experiences

It is interesting to note that, although the idea of what has come to be known as backcasting was first published in the international relations journal Foreign Affairs (Lovins, 1976), the first major experiences with the method addressed the technical feasibility of options, especially sustainable energy and transport options in the 1970s and 1980s (cf. Dreborg, 1996). One of the latest examples of a dominant focus on the feasibility
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of technology was the Dutch Sustainable Technological Development (STD) project (Weaver, 2000). Socio-economic, political, institutional and behavioral aspects have been taken into account more recently. We might refer to the experiences with the regional sustainability assessments in British Columbia and the Dutch COOL project, which focused on the social conditions that would make drastic greenhouse gas reductions acceptable.

Experiences mainly relate to sustainability assessments, which provided the context for developing backcasting in the first place. But it has also been applied in other issue areas, such as in the Australian long-term defense modernization planning (Dortmans, 2004, in press). The examples below refer to interactive backcastings only.

Canada: The Georgia Basin Futures Project, GBFP (Tansey et al., 2002; VanWynsberghe et al., 2003). Community goals e.g. learning, consensus building and visioning.

EU wide: SusHouse project (Green and Vergragt, 2002; Vergragt, 2000). Comparative backcastings in the Netherlands, Hungary, England, Italy and Germany.

This project can in part be considered a successor of the Dutch STD (DTO) project. It focused on the formation of vision and strategy with respect to sustainable household.

The Netherlands: Sustainable Technological Development (STD) Weaver et al (2000), Vergragt and Van der Wel (1998). This project interactively developed sustainable technological futures in the Netherlands. Many stakeholders from companies participated in this project. Another project that needs to be mentioned is the Climate OptiOns for the Long term (COOL) project (Berk et al., 2002). This project consisted of three dialogue projects, a Global, a European and a National Dialogue (see resp. Berk et al., 2001; Anderson et al., 2002; Hisschemöller and Van de Kerkhof, 2001). The assessments explored the possibilities for 80% reduction of GHG emissions by 2050. The National and European Dialogue used interactive backcasting as their main method. A third project worth mentioning is the project Governing the transition to a sustainable Hydrogen economy that started in 2004 and is carried out by the Institute for Environmental Studies, Free University, Amsterdam. Three stakeholder groups from business, environmental NGOs, government agencies and others will develop different (technical) hydrogen futures and explore (institutional) pathways to reach these. Finally, a number of climate change related projects involving backcasting will be carried out in the context of the Dutch research program Climate for Space, Space for Climate.

Belgium: The Sustainability and Nuclear Development Project (Keune and Goorden, 2002). Focusing on issues related to nuclear, Belgian stakeholders developed a vision for a sustainable energy supply system in Belgium, and explored a pathway for realizing this vision.

4.3 Combinations

Backcasting can probably be combined with a huge amount of tools for assessing or promoting sustainability. The Canadian approach is a combination of computer-aided models, scenarios and participatory processes (e.g. Tansey et al., 2002). Robert et al. (2002) have brought together a number of tools into a ‘systems model for sustainable development, e.g. backcasting, upstream thinking, ecological footprinting, and LCA. Höjer and Mattson (2000), drawing upon a number of transport studies, suggest to combine backcasting with forecasting, since the forecasting may indicate the need to step out of BAU scenarios in order to shift a trend that maybe part of the problem. Höjer (1998) reports of a survey which combined backcasting and conventional Delphi, a method aimed at reaching convergence among experts on ‘likely’ scenarios for the future through articulating the assumptions underlying different initial pathways. Such a combination might be worthwhile in an interactive setting as well, provided that conventional Delphi be replaced by interactive policy Delphi. In a policy Delphi, scientific experts, policy makers and other stakeholders do not aim for convergence, but seek to generate the strongest possible opposing views on the potential solutions to a major policy problem (Van de Kerkhof, 2004). Drawing upon experiences with Australian defense planning, Dortmans (2004, in press), propagates a combination of backcasting, forecasting with techniques like

### 4.4 Strengths and weaknesses

#### Strengths

- Developing future visions and implementation pathways fosters creativity and learning among those involved. It may enhance an integrated picture of the possibilities and bottlenecks to reduce emissions; and it may provide insights in the working of and opportunities for institutions and organizations. The interactive learning about how scenarios are developed is as important as the scenario tool itself. This is because, firstly, it is important to expend significant thought and resources on designing and managing the processes through which users become engaged in the project. Secondly, most interesting forms of social engagement and learning come with the actual backcasting processes (after the models have been shut down). So, backcasting can serve as a stimulus for social interaction and learning that go well beyond the scenarios themselves (Robinson, 2003: 853).

- Dreborg (1996: 819) considers backcasting primarily as a means to enhance creative thinking about long–term developments and policy.

- In order to induce sustainability, a systemic change may in certain cases be preferable to an incremental improvement. Backcasting may support the policy process by exploring the critical decisions and investments to be made. This, in its turn, may lead to a more efficient spending of scarce resources (Roth and Käberger, 2002).

- Backcasting can result in the interactive development of a long–term strategy. Implementing such a strategy can provide a company or a country with a competitive advantage (Roth and Käberger 2002).

- The capacity of the backcasting approach to combine analytical methods and participatory methods, i.e. the role of computer models as mediating between scientific and civic cultures, (Robinson, 2003).

- Backcasting is easy to handle and fun for the participants. It manages to establish a learning effect, especially at the technical and cognitive level of analysis (Van de Kerkhof, 2004).

#### Weaknesses

- The function of the future image is not always clear. If not immediately linked to backward looking analysis, the tool may become somewhat utopian in character (Van de kerkhof, 2004; Hisschemöller and Mol, 2001).

In most definitions of the method, the creation of one or more desirable future images is considered a prerequisite of backcasting. Without denying this, the specific value and function of the future images for backcasting is not entirely unproblematic. Whereas most literature focuses on highlighting the construction of desirable future images, this step needs to be intrinsically linked to the next one, the backward analysis and feasibility evaluation of possible trajectories towards reaching the desired future. If not, the tool might appear as utopian. As the illustration provided by QUEST already shows, the desirability of a future image can, in practice, only be decided upon in close connection with the feasibility analysis, that is by pointing to the future's practical implications. Therefore, the Canadian approach to defining desirable futures already involves some sort of backward reflection, given the input from the model. The Dutch approach as described above was quite different. The COOL project in fact separated the construction of future images from the question of desirability. Participants were committed to take part in an investigation of opportunities for drastic climate change emissions without asking them to commit themselves to this goal in advance. Only in the final stage of the project, participants were asked to discuss the desirability in the context of their analyses. This example makes clear that backcasting may take a normative perspective, which is not necessarily a perspective considered desirable. In fact, this is also a practical implication of the Canadian approach, which allows model users to shift among different future images in order to form a view on what they consider desirable.

- The role of scientific models and scientific support in general.

Undoubtedly, the QUEST model is one of the most innovative examples of models that are fit to
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contribute to participatory assessments. From the example above it appears, though, that this model, like other models, to a certain extent shapes the opportunities for choice. It might be asked as to whether categories such as environmental, economic and social may facilitate creative reflection on the future, as these concepts are normally associated with current ideological or interest–based social conflicts. A sustainable future, to the contrary, might only be feasible or even imaginable if current social and political contradictions can be overcome in that environmental options are also viable for economy.

Potential for discussing conflicting views is limited (Van de Kerkhof, 2004). Especially from the COOL project comes the experience that backcasting, especially the backward looking analysis, was positively evaluated by participants. One critical remark made in the project evaluation might be worth further exploring. Whereas COOL was explicitly designed to foster an open dialogue on conflicting views with respect to the potential of mitigation options, the backcasting exercises themselves did not turn out most adequate to discuss these conflicting views. A combination with other methods, such as repertory grid analysis or policy Delphi, may help to avoid artificial consensus and increase the quality of the debate.

4.5 Further work

In line with the weaknesses that were mentioned in Section 4.4, further work on the backcasting approach should focus on: (1) improve the linkage between the development of future images and the feasibility analysis of these future images in backcasting; (2) further clarify and improve the role of scientific models and scientific information in general, in order to encourage the participants in the backcasting exercise to explore environmental, economic and social aspects of the future; and (3) explore the opportunities to improve the quality of the argumentative process in backcasting, for instance, by using backcasting in combination with other methods.

4.6 References


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