



ESSENCE OF BACKCASTING

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Sustainable development is a highly complex problem area, which will probably call for major changes of industrialized societies in the long run. How could futures studies contribute to a policy forming process directed to these problems? And what kind of knowledge about the future is most needed? It is argued that a backcasting approach, due to its problem-solving character, is well suited to these kinds of long-term problems. Fundamental theoretical assumptions behind backcasting are traced. One conclusion is that the merits of backcasting should be judged in the context of discovery rather than in the context of justification. Also, if one is inclined to see teleology as a specific form of understanding, beside causality, then backcasting becomes interesting. Backcasting studies typically aim at providing policy makers and an interested general public with images of the future as a background for opinion forming and decisions. Copyright © 1996 Elsevier Science Ltd

The transformation of industrialized societies into societies in harmony with the natural environment is a highly topical issue and a real challenge to man. There is much debate but little knowledge about what a sustainable society would look like, and what consequences it would have on social life.¹ How could futures studies contribute to policy making and the societal discussions about sustainability, and what kind of knowledge about the future is most needed in this context?

If sustainability is to be attained, then probably integrated efforts in several fields will be needed. Examples pertaining to the transport sector are research on cleaner cars, pricing of external effects of transports, regulations of emissions, infrastructure programmes that favour cleaner transports, land-use planning, influencing of public opinion etc. This calls for a comprehensive view, based on studies that apply a systems perspec-

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tive. But this is not enough. The way research approaches these issues is of crucial importance.

In the field of futures oriented studies, the traditional *forecasting* approach is still dominant. However, the fruitfulness of this approach in the study of highly complex long-term sustainability problems may be doubted. Based as it is on dominant trends, it is unlikely to generate solutions that would presuppose the breaking of trends. In the long run, though, discontinuities are likely to occur and should even be deliberately sought in some cases. Under these circumstances a *backcasting* approach is an interesting alternative.

Backcasting is a term introduced by Robinson, denoting a method to analyse future options. The method seems to have been first employed in energy futures studies by Lovins.² According to Robinson:

The 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, involving 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.³

In Sweden Steen *et al* have applied a similar approach in a series of energy future studies starting in the 1970s.^{4,5,6} Recently Steen *et al* have launched futures studies with the same approach in the fields of sustainable transports, sustainable infra-systems and recycling and waste management.^{7,8} In this article the term backcasting will be used also for the Swedish approach, although it deviates a bit from Robinson's concept.

Backcasting is essentially launched as a *method* by Robinson, but is this a pertinent description? The question about the character of backcasting is important to answer in order to set the expectations right. The answer will influence the choice of standards by which backcasting studies should be judged.

There are descriptions of cases and methodology in the literature but practically nothing about the *theoretical foundations* for backcasting. The choice between backcasting and forecasting is not just a matter of convenience. The two approaches stem from different views on scientific explanation in the social sciences, backdating to the antiques. They are also designed for different problems, as should be clear from the cited passage above.

The aim of the article is to give a more profound account of the character of backcasting, and to trace fundamental theoretical assumptions behind backcasting and forecasting. As to applications the focus of interest is on long-term sustainability problems, and illustrative examples will be taken from the field of traffic planning.

When is backcasting applicable?

Typically backcasting is applied on long-term complex issues, involving many aspects of society as well as technological innovations and change. The focus of interest is on a perceived societal problem of great importance such as the vast and growing impacts of transports on the environment. I think—and hope to make plausible—that this is a niche for backcasting.

A recent Swedish study may illustrate the point. A survey of studies concerning transitions of the energy and transport systems in Sweden has been carried out by Steen and Åkerman,⁹ on account of the Swedish Committee on Climate Change. One conclusion

is that very few studies take sustainability seriously into account. The studies are characterized according to *Figure 1*. The vertical axis represents whether a state can be considered to be in line with sustainable development or not. Today's society is generally not sustainable. The shaded area reflects differences of opinion about sustainability criteria.

Most studies concentrate on the short- or medium-term horizon. One category (A—Directional studies, see *Figure 1*) investigates different economic and other measures that promote behaviour more in accordance with the natural environment. The proposed measures will probably work in the right direction. How close to sustainability they will bring society is, however, a question not addressed in these studies.

Other studies (category B—Short-term studies, in *Figure 1*) take short-term official goals as a starting point and try to find a means of achieving them. These goals are usually just one step on the way to a real solution—ie sustainability.

There are also some studies applying a long-term perspective, the majority of which apply some kind of forecasting methodology (category C—Forecasting studies, in *Figure 1*). However, the predicted developments invariably fall short of the sustainability goal, mainly because the adopted presuppositions are so restrictive. Also, the methodology chosen seems to preclude major change.

A few long-term studies use a Backcasting approach (category D in *Figure 1*), starting with images of future states (scenarios) where eg the energy supply/demand satisfies the requirements of sustainability. The realism of the scenarios is discussed in the studies, but usually the analysis is confined to technical feasibility, while social and economic feasibility is left aside. One exception is a study by Kaiser, Mogren and Steen where a sociotechnical perspective is adopted.¹⁰ Here the acceptability of new technologies to dominant actors in society is analysed.

To sum up, we think that sustainability would require more than marginal changes at many levels of society. An approach that focus on the problem to be solved rather than on present conditions and current trends, is better suited to achieving real solutions than a traditional forecasting approach. Hence there is a need for studies of the backcast-

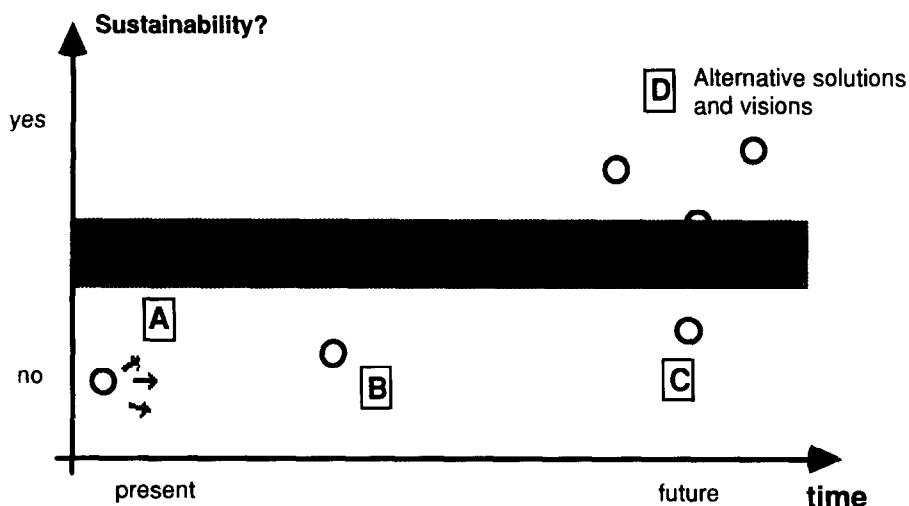


Figure 1. A—Directional studies; B—Short term studies; C—Forecasting studies; D—Backcasting studies. Source: Steen and Åckerman, 1994 (see note 9).

ing type (category D in the figure) as a basis for a public discussion about a sustainability policy. Images of the future may widen the perspective of many actors—private enterprises, households, public authorities, municipalities etc—and help them envisage the concept of sustainability. The other kinds of studies (categories A, B and C), being rather limited in scope, cannot alone provide a foundation for major change towards a sustainable society.

In the long term, the potential for man to influence development in a desired direction is relatively large. However, our perceptions of what is possible or reasonable may be a major obstacle to real change. The scenarios of a backcasting project may broaden the scope of solutions being considered by describing new options.¹¹

A conclusion from the study of Steen and Åkerman¹² is that backcasting should be seriously taken into consideration, when the subject to be studied is *a major societal problem* that needs to be solved. Given this point of departure, the following characteristics favour backcasting:

- when the problem to be studied is *complex*, affecting many sectors and levels of society;
- when there is a need for *major change*, ie when marginal changes within the prevailing order will not be sufficient;
- when *dominant trends are part of the problem*—these trends are often the cornerstones of forecasts;
- when the problem to a great extent is a matter of *externalities*, which the market cannot treat satisfactorily;
- when the time horizon is long enough to allow considerable scope *for deliberate choice*.

The problem of how society could attain sustainability, fits into this pattern.

Scenarios, backcasting and similar approaches

In the field of futures-oriented studies, the traditional forecasting approach is still dominant. However, scenarios have come widely into use during past decades, because they permit a broader analysis than a formalized prognosis methodology.^{13,14} Also, the use of a set of different scenarios is a way of coping with *uncertainty*.¹⁵

What, then, is the relationship between scenario studies, forecasting and backcasting? Well, at least some scenario studies could be classified as forecasting studies—albeit in a broad sense—as the scenarios are developed step by step by logical reasoning from the present situation into the future.

Clearly backcasting is a kind of scenario study, although not all scenario studies qualify as a backcasting study.

Even when a scenario methodology is chosen partly because it may give radically different images of the future development, these alternatives does not necessarily reflect (in some sense) desirable developments. Usually the scenarios are chosen just to give a feel for the scope of possibilities, whether these are desirable or not. In this case we cannot talk about backcasting. To qualify as a backcasting study the scenarios chosen in the project must reflect solutions to a specified societal problem.

Scenarios are being used by big companies as a basis for strategic planning. Often a set of radically different scenarios is worked out, the purpose being to increase the

mental preparedness for major changes that might be facing the company in the future. Shell International started early and has a well established tradition of scenario analysis.¹⁶ This tradition has spread and is now applied and elaborated also by the Global Business Network (GBN).¹⁷ Du Pont in Canada¹⁸ and Statoil in Norway¹⁹ are other examples of business firms which make use of scenarios when preparing for the future. Some firms also have developed scenarios describing a vision of where the firm wants to be at some time in the future.²⁰ This is like backcasting, applied to the problems of a single firm.

In Canada there is a futures study tradition based on the backcasting methodology. Robinson gives a detailed account of the approach.²¹ He and his colleagues develop scenarios which are chosen, not because they are probable but because they show how an important societal problem can be solved. Starting with desirable futures, they try to show a way to reach these goals, mainly by policy measures. Robinson has applied backcasting to issues such as the environmental problems of modern society.

In France there is a strong futuristic research tradition with Bertrand de Jouvenel as a prominent theoretical thinker.²² The approach called *la prospective* entails the development of scenarios of desirable future states, as a foundation for strategic action.²³ This approach seems to be applied in public planning, as well as strategic business planning.

In the USA there seems to be a widespread scepticism towards normative futures studies of broad societal problems. Their applications in private business planning are more accepted. Studies utilizing normative scenarios in a societal setting, are often regarded as 'backdoor socialism'.²⁴ Still, there are some sources advocating a perspective not unlike the one behind backcasting. Olson, for example, maintains that the idea of 'a sustainable society' can serve as an inspiring vision for many agents in society.²⁵ This emphasis on a wider targeted audience for images of the future is an interesting similarity to the Swedish backcasting tradition. Olson also refers to the historian Fred Polak, who emphasized the importance of images of the future for the development of the Western civilization, one salient example being the idea of the Enlightenment.²⁶

When discussing the concept of backcasting, German research on the significance of *Leitbilder*²⁷ is of great interest.^{28,29} In English *Leitbild* would be something like *inspiring vision* or *guiding image*. German synonyms are *Ideal*, *Wunschbild* and *Vorbild*. The German school of thought seems to be more focused on the role of visions in private enterprises and organizations than in society as a whole. The main interest of Dierkes *et al* is technological development and technology assessment. Their research is more descriptive/analytical than normative. They study how *Leitbilder* evolve in organizations and influence the way people look at the future. *Leitbilder* may, for example, help coordinate different actors into concerted actions.

Leitbilder are rooted in a social context, eg a corporation or an institution. They evolve in a process, where many persons take part. Therefore, they may become widely shared and accepted. This is probably a necessary condition for a *Leitbild* to have a guiding and coordinating role for actions.

The images of the future of a backcasting study is not, in my view, *Leitbilder*. But they may be an input to the process where *Leitbilder* continually evolve and change. By providing new knowledge, a backcasting study may question some suppositions inherent in prevailing perceptions, and open some new options.

Is backcasting a method?

According to Robinson backcasting is a *method* describing how a study should proceed in a number of well-defined consecutive steps, each of which in turn divided into sub-steps.³⁰ Apparently this is an attempt to establish backcasting as a sufficiently cogent method of study.

I would, however, like to widen the perspective and put the emphasis of the discussion on a more fundamental level. In my view, backcasting should rather be seen as a general *approach* than as a method.

The researchers' perspective on for example societal change, determinism and the scope for human choice in forming the future will be of great importance for the researchers' choice of approach. This takes us to the deeper layers of philosophical assumptions. In *Figure 2* five levels of description are proposed for the purpose of discussing differences and similarities between two scientific traditions, in this case forecasting and backcasting. A coherent view, comprising all five levels will constitute a *school of thought*. This concept has an affinity to Kuhn's famous concept of a paradigm, but is neutral in relation to Kuhn's theory of scientific revolutions and the incommensurability of different paradigms.³¹

When a school of thought has become well-established and has developed into a scientific tradition—as forecasting undoubtedly has—the fundamental questions of philosophy cease to be an issue. Also, the general perspective is usually taken for granted and may even become *tacit knowledge*,³² which the scientists cannot articulate clearly—at least not without difficulty. The actual projects and the methods and techniques for data gathering and analysis will dominate the scientific discussions. This is similar to those periods of scientific work which Kuhn labels *normal science*.³³ In such a situation a new approach, based on a different perspective, will not easily be understood—especially not if it is launched as a method.

We think that what is genuinely new with backcasting studies is the approach and the underlying perspective. This and some epistemological views is what really separates it from forecasting. Still a discussion of these questions is largely lacking in the literature.

For the remainder of this paper I will, therefore, concentrate on philosophical views, perspectives and approach (emphasised in *Figure 2*). Also, my main interest is to outline a backcasting view. I will compare backcasting to forecasting but only in order to make the backcasting perspective more clear.

For the comparison of backcasting and forecasting the following philosophical issues are of particular interest:

- the distinction between the *context of discovery* and the *context of justification*;
- whether *teleology* is a specific mode of understanding or if it can be reduced to *causality*;
- determinism and predictability of the development of society. Uncertainty and indeterminacy are related to these questions.

These questions are dealt with in the three following sections.

Context of discovery and context of justification

The distinction made in the philosophy of science between the *context of discovery* and the *context of justification* may help clarify a point. Within the context of discovery getting

	Forecasting	Backcasting
1. <i>Philosophical views</i>	causality; determinism; context of justification;	causality & teleology; partial indeterminacy; = + context of discovery;
2. <i>Perspective</i>	dominant trends; likely futures; possible marginal adjustments; how to adapt to trends;	societal problem in need of solution; desirable futures; scope for human choice; strategic decisions; retain freedom of action;
3. <i>Approach</i>	extrapolate trends into the future; sensitivity analysis;	define interesting futures; analyse consequences, and conditions for these futures to materialise;
4. <i>Methods</i>	various econometric models;	partial & conditional extrapolations highlighting interesting polarities and technological limits;
5. <i>Techniques</i>	various mathematical algorithms	-----

Figure 2. Forecasting and backcasting—five levels.

ideas is the one thing that matters. How you do it is not important. Although there exists a variety of ‘methods’ such as brainstorming and expert panels, there is no point in stipulating rules or prescribing specific methods for a creative process. It would probably be counterproductive. In the context of justification, however, the task is to employ the ideas and to demonstrate the validity of scientific results. Rules and formalized methods will increase the reliability of the findings. There is also a need for transparency. Other researchers must be able to follow and evaluate the analysis. Here well established or clearly stated methods are important.

The point I would like to make here is that the merits of backcasting should, to a large extent, be judged in the context of discovery rather than in the context of justification. It is an approach which may promote creativity, by shifting the focus from present conditions to a situation sufficiently far off in the future to permit radical change.³⁴ It is not in itself a method in any strict sense, nor does it require any *specific* backcasting methods. Clearly, a backcasting study depends on scientific methods for its credibility—and this is the context of justification—but these methods should be chosen in accordance with praxis within the scientific disciplines involved. The problem at stake will, in turn, determine the relevance of different disciplines.

Causality and teleology: two traditions in the philosophy of science

The principles of *causality* and *teleology* are two forms of explanation, identified already in Greek philosophy. The two principles have had their respective adherents throughout

the history of philosophy and science.³⁵ The principle of causality and the related idea of a functional relationship has totally dominated within physics at least since Newton (Galileo was an important forerunner). The remarkable success of science during the past 200 years have impressed on students of society, and have given the methodological principles of physics a strong appeal. Mill argued for the application of causality and the abandoning of the principle of teleology in the social sciences, and so did Comte.³⁶ The latter, however, thought the term 'cause' was unscientific and preferred to refer to 'general laws'. In our days the principle of causality has the upper hand, but since the 1950s some philosophers of science has argued for teleology as a special form of understanding, indispensable in the social sciences.^{37–40} Usually causality is recognized as important too.

At the same time the prominent causalists Hempel and Popper have followed Comte and Mill in arguing for causality/general laws to be the only scientific principle of explanation.^{41,42} This is the idea of *unity of scientific method*. According to this idea, any scientific explanation, be it in the natural sciences or in the social sciences, is a statement about causality or could be reduced to such a statement. A development of this position is the 'covering-law' theory,⁴³ which states that explanations should refer to a general law (like the laws of nature) as one premise in a syllogism—the other premise will specify the initial conditions. This view seems to have some adherents within the social sciences but there is no consensus.

Advocates of causality and the general law principle maintain that the principle admits explanations of what has happened, as well as forecasts of what *will* happen, given certain initial conditions. The principle works in both directions.⁴⁴

The opposing view holds that explanations within the social sciences is another form of understanding. Purposeful human behaviour cannot be fully explained by reference to some general law, and some philosophers hold that human behaviour is not totally deterministic. According to the principle of teleology (purposefulness) a behaviour is explained by intentions based on the *desires and beliefs* of the actors involved. Behaviour of this kind, ie conscious and purposeful behaviour, we shall call *actions*. The behaviour is intelligible in retrospect, but cannot generally be predicted.

A third category of explanation, of later date, is functional explanations, which are of special importance in the science of biology. A functional explanation explains a behaviour, which is typical for a species, by its leading to beneficial effects for the species.⁴⁵ Example: tigers are striped because this will make it easier for them to hide in the high grass and get closer to their prey. Note that no consciousness, planning or intentions are involved at the individual level. The explanation seems to presuppose the presence of a divine designer or that the system as such has an intention. This, however, is not so. Functional explanations can be translated into cause–effect mechanisms in a system with feedback.^{46,47} Functional explanations will not be treated further here.

A similar restating of truly teleological explanations in causal terms is, according to some philosophers, impossible in principle.^{48,49} However, this is an intricate question, and I shall refrain from arguing that teleology is *in principle* irreducible to causality, but I agree with Elster when he states: '...for practical purposes we may treat intentional and causal explanations as wholly distinct', and '...in the present state of knowledge, we cannot even see in outline how intentional explanations are related to causal analysis of the same phenomena'.⁵⁰

Most advocates of intentional explanations in the social sciences, accept that causality is important too. How, then, are these principles combined in the study of social

systems? The actions of different interrelated agents will be explained by the intentions of these agents. However, the actions will, in many cases, add up to combination effects at the systems level, which are not foreseen or intended by the actors. These second-order or systems effects will have to be analysed in causal terms. Elster proposes a paradigm for analysis in the social sciences: '...intentional explanation of individual actions together with causal explanation of the interaction between individuals'.⁵¹ He also puts forward the idea of a general sociological theory which would include: '(i) the explanation of individual action in terms of individual desires and beliefs, (ii) the explanation of macro-states in terms of individual actions, and (iii) the explanation of desires and beliefs in terms of macro-states'.⁵² The first point is a teleological explanation, whereas the other two are causal explanations. Elster admits that his conception of a general sociological theory appears to be 'light-years' away.

We now turn to the question how forecasting and backcasting relates to the different principles of explanation.

A forecasting approach, it seems, relies almost entirely on causality. Mathematical models are built with the intention to predict the future development of a system, given a set of initial conditions. Intentions (or teleology) enter the analysis essentially in the form of a few exogenous policy variables, assumed to be manipulated on a few occasions by one or a few monolithic decision makers—normally those who are supposed to use the forecasts as a basis for decisions. The behaviour of all other actors—individuals as well as institutions—is usually treated as causally determined according to the mathematical model.

If, instead, one sees teleology as an important complement to causality for understanding the development of society, backcasting would appear to be a fruitful approach in long-term futures studies. We think that the following points of view would make backcasting interesting:

- intentions do play an important role for human behaviour in many cases;
- the development of society is influenced by many actors (not just a few decision makers);
- intentions are affected by knowledge and perceptions of available options;
- intentions cannot be completely predicted by a causal model.

The principle of teleology makes intentions a focal point, and intentions are affected by the actor's perception of options open to him and his knowledge about means to ends relationships. From this perspective it appears to be a meaningful task for futures research to provide interesting images of the future and to highlight strategic choices. This, however, is the leading idea in backcasting studies.

New knowledge and new ideas may lead to the identification of some entirely new options for society as a whole or for some actors. The primary task of science is to produce new knowledge, including new ways of perceiving. Consequently science may—at least in the long run—greatly influence human decisions and the course of social development.

To sum up, if one believes in causality as *the* universal principle in scientific activities, then forecasting approaches and prognosis techniques probably become the natural choice in the study of the future. If, on the other hand, one is inclined to see teleology as a specific form of understanding—of special importance in the study of man and society—then a backcasting approach becomes interesting.

Uncertainty and indeterminacy

A crucial point for the choice between forecasting and backcasting is the attitude taken to *uncertainty*. This is an alternative way of approaching the question dealt with in the preceding paragraph, ie the predictability of societal development. Also the analysis of uncertainty will bring us deeply into philosophical questions.

Most people would admit, on reflection, that the present knowledge of a societal phenomenon—eg the rate of increase in road traffic—often does not permit conclusions to be drawn with certainty about the long-term development in that particular area. However, opinions will differ considerably as to the degree of uncertainty and the methodological implications for scientific studies.

In econometric forecasting the problem of uncertainty is usually treated by way of testing the sensitivity of the model results to variations in external variables. However, when investigating the distant future—say, more than 20 years ahead—this approach of sensitivity analysis will often be inadequate.⁵³ In this case the problem is not just that some external variables may be difficult to predict. In addition, the functional relationships assumed in the forecasting model may change in the long run. This is not a marginal problem, but threatens the whole idea of trying to extrapolate existing trends into the distant future.⁵⁴

An example from the field of traffic planning may serve as an illustration. In energy and traffic research and planning, it is customary to presuppose a stable relationship between household incomes and car ownership. This can be estimated by applying statistical analysis to historical data. Thus an expected increase in household incomes, will automatically bring about a predictable increase in car ownership and traffic. Traffic forecasts of this kind are in turn used to predict the energy demand of the transport sector or to motivate road investment programmes. This approach to the development of traffic is sometimes labelled 'predict and provide', and is evidently an example of forecasting.^{55,56,57}

However, the travellers preferences for cars may change a lot *in the long run* and not only because of changes in income. Unforeseen changes in lifestyle may for example occur. Even more important, it may well be possible to decouple economic growth and growth of private motorism by policy measures.⁵⁸

The availability of good alternatives to the car is of great importance for people's choice of transport mode. As long as easy access to markets, child care etc is dependent on car ownership, it is probably true that increasing incomes will lead to increasing road traffic. A policy of predict and provide may be part of the problem, by tipping the balance in favour of the car. Present trends or behaviour are mistaken for laws of nature. The alternative approach (backcasting) would rather describe the strengthening or weakening of a trend as *a choice* for the policy-forming authorities. If a sustainable transport sector and a good urban environment were important goals, then society should enhance alternatives to private motoring, especially in big cities.

The lesson to be drawn from this example is that a change of public policy may not only affect some exogenous policy variable (eg tax rates on fuel), but *may change the rules of the entire game*. The assumed regularity between increases in income and increases in car ownership may not hold any longer.

There are also other kinds of uncertainty that constitute a serious problem for long-term forecasting of social phenomena. One such kind has to do with the impossibility

to predict our own future decisions to the extent that they are influenced by future knowledge.

An actors intentions and decision in a situation are largely determined by *the ideas and the knowledge*⁵⁹ available to him or her. New knowledge may tip the balance in favour of one of the alternatives. More interesting, though, is the fact that new knowledge and new ideas may lead to the identification of some *entirely new options*.

Popper emphasizes the great importance of new knowledge for the development of society.⁶⁰ Consider as an example the discovery and utilization of electricity. Could anyone living before this discovery have foreseen modern society? Most likely, the answer is no.

The position taken here may seem to be a form of extreme idealism,⁶¹ but it is not. Admittedly, the innovation of, for example, the electric engine and the dynamo may have been interest driven and might not have taken place given another class structure or economic system. The point, however, is that no man made causal model will suffice to predict a genuinely new idea. In Popper's wording: '...if there is such a thing as growing human knowledge, then we cannot anticipate today what we shall know only tomorrow'. Furthermore: '...no scientific predictor—whether a human scientist or a calculating machine—can possibly predict, by scientific methods, its own future results'.⁶² This kind of uncertainty cannot be dissolved by more research, however zealous. It is part of the predicament of humankind that we are unable to foresee future knowledge and ideas.

Furthermore, when the innovation is made, some trends in society will be affected—in some cases very much. Hence the long-term development of society as a whole cannot be foreseen either.

To sum up, if we believe that people will get new ideas and acquire new knowledge also in the future, then we cannot hope to be able to foresee the development of a social system (society) in the long run.

It may still be possible to predict the development for a shorter period of time, where the influence of emerging new knowledge is limited.⁶³ In this case behaviour is more likely to conform to observed patterns, within reasonably small margins. The usual continuity suppositions and marginalistic analysis of neo-classical economics may be adequate.

The kind of uncertainty dealt with here has to do with our future decisions being partly underdetermined by the present conditions and trends of society, as we know them. I therefore propose the term *indeterminacy* for this variety of uncertainty.

What has been said about the existence of indeterminacy may seem to destroy the meaning of any real long term investigation, since the future will always bring surprises. This is actually the position taken by Popper.⁶⁴ But the conclusion depends on one's conception of what futures studies are for. If the idea is to figure out what will really happen in order to permit society or a customer to adapt to the more or less inevitable trends, then, clearly, indeterminacy may threaten the project. Sensitivity analysis will not suffice to avert this danger, since in the long run new knowledge will lead us to redirect our focus of interest, and to act in order to change trends.

When, on the other hand, the aim of a futures study is mainly to define a broader conceptual framework for discussing the future, the study is less vulnerable to unforeseen change. The results may still be of great value even if some new options are added. Indeed, studies of this kind may actually give an impulse to the search for new knowledge,

eg concerning technological solutions, and, hence, contribute to the emergence of unforeseen new options.

One conclusion is that in face of genuine uncertainty a process perspective on futures studies and long-term social change must be employed. Backcasting studies may make an important contribution to the process of forming the future society by broadening the scope of solutions to strategic societal problems that are being discussed.

Outline of a backcasting perspective

The concept of a (scientific) perspective employed here contains the following main aspects:

- focus of interest (relevant issues to be studied);
- kind of solutions/answers that are considered relevant (eg predictions of the development in an area or possible solutions to a societal problem);
- to whom the studies should be address (eg the scientific society, public sector decision makers or an informed general public).

Often a perspective centres around some fundamental concepts such as for example *Leitbild* or *Image of the future*.

Backcasting definitely belongs to the field of applied research and it is also multidisciplinary. The perspective is characterised by an orientation towards long-term problems, such as the detrimental effects from traffic on the environment. The problem-solving character makes natural the interest in what is called the context of discovery (see above), and the approach to take a future different state as a starting point for discussing the development of society.

The view was then expressed that the intentions of many actors—not only a few decision makers—are essential for the long-term development of society, and that these intentions can be influenced by new knowledge and novel concepts. This makes it an important task to supply well worked out images of the future which are analysed as to their consequences for social life as well as to necessary conditions and choices for attaining the one or the other (or some mix) of these future states. An important aim of backcasting studies, in the Swedish tradition is, accordingly, to provide different actors in society with a better foundation for discussing goals and taking decisions—to act or to seek further knowledge. Given this aim, the decisions of the actors cannot generally be treated as endogenous variables in a causal model.

It is true that backcasting studies often apply forecasting techniques on sub-problems within the broader field of study. Usually they are of a 'what if' kind, with the aim to investigate how significant some factor may be for the solution of the main problem. Eg how close would cleaner vehicle technologies bring us to sustainable transports? Here conditional forecasts may indicate whether the technological development is an important factor or not. However, although the principle of causality definitely has a role to play within a backcasting study, the *total causal model*, applied in many forecasting projects, is rejected.

The problems of indeterminacy were then discussed. Indeterminacy and other forms of uncertainty make any real long-term forecast of society's development very dubious, while futures studies with the aim to broaden the scope of options discussed still are meaningful. Also, in face of indeterminacy one has to adopt a process perspective. The

aim of backcasting studies in the Swedish tradition is actually to provide input to the policy-forming process. It is not meant as a blueprint of *the* desirable future or a cut and dried action plan.

Inherent in the process view permeating the studies of Steen *et al* is the idea of a continual revision of targets as new knowledge is acquired. This view is similar to that of the Constructive Technology Assessment (CTA) school of thought.⁶⁵

Typical for CTA is the attempt to strike a balance between foresight and successive adaptation to new knowledge. According to this view, it is highly unlikely that it should be possible to predict all social effects of a new technique at one point of decision. Thus, the possibility of successively influencing a new technology becomes important. The continually growing knowledge should be utilized in the development of a technology, its diffusion and the building of institutions.

I also suggest that a view on the role of values in futures studies should be included in the backcasting perspective. One objection that is sometimes raised against backcasting is that these studies are political and not scientific. One reason may be that the backcasting approach usually is applied on a question that is widely recognized as an important societal problem, ie the topic is of high political relevance. Such issues are frequently controversial.

Backcasting studies also often come up with new and unconventional ideas pertaining to the problem at stake. Such ideas may be interpreted as a political standpoint or initiative, while solutions conforming to business as usual are seldom regarded as political. Because the latter are in line with the habitual way of thinking, their value dependence is less apparent.

However, every scientific study presupposes values—a fact that is often overlooked. Admittedly the primary task of science is to produce new knowledge, including new concepts and perspectives—and this belongs to the cognitive dimension. However, the search for new knowledge and the creation of new concepts is typically interest-driven, ie dependent on values.⁶⁶ The choice of problem to be studied is made because it is interesting from some point of view. Also, the researcher must decide on the scope of solutions to be investigated etc. In some cases the underlying values for these choices may be fairly uncontroversial, but this is seldom the case when the topic addressed is of high political relevance, which is often the case in backcasting studies.

The problem of value-dependence must be treated openly. The leading principle should be to strive for sincerity and clarity.

A backcasting study that suggests new concepts and images of the future, should describe the kind of value-related considerations that lie behind the choice. Also, the relationship between a proposed solution or image of the future and different normative attitudes in society should be discussed. Furthermore, by providing a set of *different* images of the future, based on different concepts or values, a backcasting project will facilitate for groups with different views to utilize the results and to gain a deeper understanding of the issue at stake. The researcher need not commit himself to one definite solution, but should rather try to highlight the consequences, pros and cons of different solutions and strategies.

Summary: core features of backcasting

The main characteristics of the Swedish version of a backcasting approach can be summarized in the following way.

The product. The result of a backcasting study is alternative *images of the future*, thoroughly analysed as to their feasibility and consequences. Often they are made to high-light polarities (eg solar Sweden or nuclear Sweden), and limits to what is technologically and socially possible to attain (is economic growth compatible with a 40% reduction of transports over the next 30 years?).

Also, strategic choices for society are identified. Of specific interest are decisions that may close or open the door to some of the identified future solutions.

For whom. The studies are addressed to many actors such as political parties, Governmental authorities, municipalities, organizations, private enterprises and an informed general public—ie there is not one single, well-defined decision maker. The studies are meant to provide input to a policy-forming *process*, with many actors.

For what. The images of the future are meant to serve as well worked out examples of what, eg, sustainability may be like, with the aim of widening perceptions of possible solutions among various actors. Another purpose is to highlight consequences of strategic choices in society (the opening or closing of future options). The result of a backcasting study is not meant to form a basis for a single, big decision, nor is it a plan or a blueprint.

It is essential that the studies provide *alternative* images of the future. Also, each alternative must appear as coherent and the analysis of consequences for social life etc must be credible. Then the results may work as a scientific material in a process, facilitating for actors with different values and goals to form an opinion and a view on the future.

How. This question has only been touched on in this article, and is better treated in the context of a case-study. Nevertheless, a few general comments can be made. A backcasting study needs novel ideas about solutions to the problem at stake. Getting ideas is a non-logical process (see the discussion about the context of discovery above). There is no point in prescribing any formal methods. Methods such as expert panels etc may work, but you may also get a brilliant idea without using any specific method. It is the result that counts. However, a sound knowledge of the relevant aspects of society and technology is a necessary foundation. Since the studies cover such broad fields of knowledge, a multidisciplinary team is required.

When it comes to the analysis of the images of the future (the context of justification), one should try to find limiting conditions, and investigate the scope for social choice. Here, institutional conditions for change is of great relevance. Both causal connections and means to ends relations are important. The latter is the most essential kind of results, as the studies are addressed to actors, but the former are crucial for the credibility of the results.

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Notes and references

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26. F Polak, *The Image of the future* (Amsterdam, Elsevier, 1973).
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29. L Marz, *Leitbild und Diskurs* (Berlin, Wissenschaftszentrum Berlin für Sozialforschung, 1993).
30. See note 3.
31. T S Kuhn, *The Structure of Scientific Revolutions*, (The University of Chicago Press, Chicago, Second edn, Fifth Imp., 1974).
32. This concept was introduced by Michael Polanyi, see M. Polanyi, *Personal Knowledge; Towards a Post-Critical Philosophy*, 1957.
33. See note 31, *op. cit.* pages 10–42.
34. See E. de Bono, *Lateral Thinking*, (Pelican Books, Middlesex, 1983) for a comparison of vertical and lateral thinking.
35. The history of the two principles is being reviewed by von Wright, *Explanation and Understanding*, (Routledge & Kegan Paul, London, 1971).
36. See note 35, *op. cit.*, pages 3–4.
37. See Anscombe, *Intention*, (Basil Blackwell, Oxford; 1957).
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43. This concept is associated with Hempel, but the term "covering law model" was actually proposed by Dray, who was a critic of the theory, see note 39, op. cit. page 1.
44. See note 41, op. cit. § 4, page 38.
45. J Elster, *Explaining Technical Change*, (Cambridge, 1983), pages 17–19 and 49–67.
46. See note 35, op. cit. pages 16–17 and 22.
47. See note 45, op. cit. page 21.
48. See note 35, op. cit. chapter 3.
49. See note 38, op. cit. chapter 4.
50. See note 45, op. cit. page 23.
51. See note 45, op. cit. page 84.
52. See note 45, op. cit. page 86.
53. See for example Pearman, 1986, Scenario construction for transport planning, *Transportation Planning and Technology*, 12, 1988, pp. 73–85.
54. This is admitted by some adherents of the general law theory. Popper (see note 42) draws the conclusion that real long term predictions of social phenomena as well as predictions of the future state of society as a whole are not meaningful. The social sciences should confine themselves to short or medium term analyses of well defined aspects of social life.
55. S. Owens, 'From 'predict and provide' to 'predict and prevent'?: pricing and planning in transport policy', *Transport Policy*, 2(1), 1995, pages 43–49.
56. S Peake, *Transport in Transition*, (1994), pages 6 and 96.
57. S Peake and C Hope, Sustainable mobility in context; three transport scenarios for the UK, *Transport policy*, 1(3), 1994, pages 195–207.
58. See note 57. Peake and Hope argue for such a policy, the aim of which would be to increase society's transport efficiency.
59. These could be labelled the *cognitive factors* influencing choice. In addition there are other factors such as *emotions, attitudes, values* etc., which are non-cognitive.
60. See note 42, op. cit., the Preface.
61. By (historical) *idealism* is meant the view that history is governed by human ideas, which evolve and spread essentially unaffected by prevailing social and economic conditions. The opposite view, *materialism*, holds that material conditions, class structure etc. determine what ideas will emerge and reach acceptance. The most prominent exponent of this view is, of course, Marx with his concept of *historical materialism*. (Marx, Engels, *Werke*, Band 8, Dietz Verlag, Berlin 1960, page 139). Cf. also the sociology of knowledge school of thought (K Mannheim, *Ideology and Utopia*, Routledge & Kegan Paul, London, 1936). There are also more or less sophisticated theories about mutual conditioning between material and social conditions on the one hand and ideas and knowledge on the other (Asplund, J, *Teorier om framtiden*, Liber Förlag, Falköping 1979—in Swedish).
62. See note 42, op. cit. page vi of the Preface.
63. Normally, a totally new idea or new knowledge will not be implemented immediately. There is a time span between the emergence of a new idea and its being widely applied in production, communication, consumption etc. Therefore, only already existing knowledge and ideas may have a profound influence in the short run.
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