Pergamon

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FUTURES

Futures 35 (2003) 839–856

www.elsevier.com/locate/futures

Future subjunctive: backcasting as social learning

J. Robinson

Sustainable Development Research Initiative, Institute of Resources, Environment and Sustainability, University of British Columbia, 1924 West Mall, Vancouver V6T 1Z2 Canada

Abstract

Backcasting represents a form of explicitly normative scenario analysis. This paper reviews some of the key theoretical and methodological issues that are raised by a backcasting approach and discusses how these are addressed in the Georgia Basin Futures Project, a five year participatory integrated assessment project focusing on modeling, scenario analysis and community engagement. The paper argues for a "second generation" form of backcasting, where the desired future is not determined in advance of the analysis but is an emergent property of the process of engaging with users and project partners. In this sense backcasting contributes to a process of social learning about possible and desirable futures.

Subjunctive: A: Adj. 1b. Designating a mood, the forms of which are employed to denote an action or a state as conceived (and not as a fact) and therefore used to express a wish, command, exhortation, or a contingent, hypothetical or prospective event. (Oxford English Dictionary, p. 3122)

1. Introduction: the intellectual pedigree of predictive social science

The desire to know the future is as old as recorded history. From the Chaldean astrologers of the 7th century BC to the latest climate models, a wide variety of methods have been used to say something meaningful about likely, possible or desired futures.

Over the past several centuries, however, the focus of much futures analysis has

E-mail address: johnr@sdri.ubc.ca (J. Robinson).

doi:10.1016/S0016-3287(03)00039-9

shifted from a deterministic to a probabilistic mode. Prior to the Scientific Revolution of the 17th century, it was commonly believed, at least in the western world, that the future was in some sense pre-ordained, and that it was possible, through various arcane arts, to discover the patterns and regularities that governed human destiny. Though Christian teaching placed great emphasis upon human free will, this existed in uneasy juxtaposition with a pre-Christian fatalistic view, which argued that, in some important ways, our destiny was written in the stars, and could be uncovered with the appropriate knowledge.

With the emergence of modern science, the focus shifted from a belief in immutable destiny that unfolds according to divine plan to a view that future outcomes are a product of past and present circumstances. This represented a shift from teleological to causal explanation, a shift that worked its way from its original formulation in astronomical explanations, through the physical sciences to the social sciences, over several hundred years. On this view, future outcomes are not pre-ordained but depend on historical circumstances, which may be affected by chance or choice. In this sense the future is essentially probabilistic, not deterministic.

Ironically perhaps, this shift was not accompanied by any lessening of interest in predicting the future. Indeed, the key regulative ideal, and test of legitimacy, of the new sciences was held to be their predictive power. This view perhaps reached it apogee in the arguments of the logical positivists of the Vienna Circle, for whom explanation was logically equivalent to prediction, making predictive power the true test of scientific validity. Whatever the fate of positivism as a philosophical position, this view still has strong currency today.[1]

While the importance of prediction as the primary measure of scientific validity is most pronounced in the natural and physical sciences, it has also been a strong current in the development of the social sciences. This has been especially true of two types of social science: those that existed on the quantitative side of a debate between more qualitative and more quantitative forms of explanation,[2] and those that were closely tied to the natural sciences. In both cases, predictive forms of analysis have been seen as a hallmark of what it takes to be scientific.

An example of the first type of social science is research in economics, which has generally taken a heavily quantitative route, especially over the past 50 years, focusing on mathematical explanation and the development of generalisability.[3] An illustration of the second type is the close ties between social science analysis in the environmental field and ecological and biological analysis, which has often led that social science to take a strong quantitative and predictive orientation.

One result of these factors has been the development of a strong tradition of predictive modeling in the environmental and economic fields. During the 1970s and early 1980s this was reinforced by the emergence of long-term forecasting approaches in fields such as energy and transportation, which supported regulatory

[1] For a discussion of the prevalence of positivist beliefs in the policy sciences, see [1].

[2] For discussion of this divide, expressed in a slightly different form, see [2].

[3] In a famous example, Wassily Leontief raised concerns about the methematization of economics [3]. For a more recent discussion see [4].

processes of assessing the need for new infrastructure and resource development. Such needs assessment required the production of long-term demand forecasts for the resource in question.[4]

An interesting aspect of this predictive tradition is that it flies in the face of typical human experience related to thinking about the future, which is strongly goal-oriented. When we set out to get to work, or buy a present for our partner, we ordinarily operate on the basis of planning and goal-setting. We do not so much predict the most likely future as articulate an intention, or set a goal, and then act to realize it.[5] This approach to the future underlies a quite different tradition in the humanities and more qualitatively-oriented social sciences that has to do with planning and more overtly reflexive and normative social analysis [2,5]. Much analysis of human behaviour in the humanities, for example, is focused on questions of motive and intentionality, while many of the planning or design-oriented social sciences also tend to look at the future in the context of the achievement of goals. As we will see below, some recent developments in futures studies focus on the attempt to integrate such goal-oriented approaches with the more predictive approaches typical of natural sciences.

2. Backcasting: theoretical and methodological issues

The term "backcasting" was coined by Robinson [6] to describe an approach to futures studies which involved the development of normative scenarios aimed at exploring the feasibility and implications of achieving certain desired end-points, in contrast to forecasting studies aimed at providing the most likely projection of future conditions. The essential rationale for a backcasting approach is twofold. First, our ability to predict the future is strongly constrained. There is fundamental uncertainty about future events, which stems from (i) lack of knowledge about system conditions and underlying dynamics, (ii) the prospects for innovation and surprise, and, most importantly, (iii) the intentional nature of human decision-making.[6] These factors do not make it impossible to say anything meaningful about future possibilities but they do seriously compromise our ability to predict the likelihood of alternative outcomes for complex human systems over the periods extending decades into the future [7]. With such systems, it simply makes more sense to develop alternative scenarios of

[4] However, over the past decade or so, deregulation in these sectors has had the effect of greatly reducing the demand for long-term predictive forecasting that had been required to establish "need" in a more regulated environment. The result has been the virtual elimination of long-term forecasting capability in many large resource and infrastructure industries, and the government departments that formerly regulated them.

[5] Of course there are predictive elements to such an approach. But the overall purpose is not prediction but achievement of an intention. See the discussion below about new approaches to incorporating goals in backcasting analyses.

[6] The question of intentionality is related to a long intellectual history in the social sciences between forms of explanation that are causal and those that are teleological. For discussions of these issues in the context of futures studies and sustainability, see [7].

possible self-consistent but often incommensurable outcomes. This has been a major rationale for the explosive growth in exploratory scenario analysis approaches over the last several decades [8,9] and the growing call for such approaches to be applied to complex societal problems such as sustainability [10–12].

Second, even if the future were predictable, in the cases of long-term societal problems like sustainability, the most likely future may well not be the most desirable. In such a situation, it is important to explore the desirability and feasibility of alternative futures, not simply focus on likelihood [13].[7] This leads to an approach that is explicitly normative in its approach to the future. Such an approach has the added advantage that it introduces the question of policy choice into the analysis, and is thus less able to be used to provide an apparently neutral cloak of scientific objectivity to justify decisions taken for other reasons [16].

Backcasting is an approach to analyzing alternative futures that is responsive to these concerns.[8] In response to the problem of prediction, backcasting adopts a scenario analysis approach. In response to the problem of desirability, it consists of an explicitly normative form of scenario analysis. As a result, the major distinguishing characteristic of backcasting is a concern with how desirable futures can be attained [17]. It involves working backwards from a particular desired future end-point or set of goals to the present, in order to determine the physical feasibility of that future and the policy measures that would be required to reach that point. In order to permit time for futures significantly different from the present to come about, end-points are usually chosen for a time 25–50 years into the future.

Unlike predictive forecasts, backcasts are not intended to reveal what the future will likely be, but to indicate the relative feasibility and implications of different policy goals. While the value and quality of a predictive forecast depend upon the degree to which it accurately suggests what is likely to happen under specified conditions, backcasting is intended to suggest the implications of different futures, chosen not on the basis of their likelihood but on the basis of other criteria defined externally to the analysis (e.g. criteria of social or environmental desirability). No estimate of likelihood is possible since such likelihood would depend upon whether the policy proposals resulting from the backcast were implemented. Thus, while the emphasis in forecasts is upon discovering the underlying structural features of the world that would cause the future to come about, the emphasis in backcasts is upon determining the freedom of action, in a policy sense, with respect to possible futures.

The approach to futures studies implied in this definition of backcasting raises a number of critical methodological issues.

[7] This represents a more critical view of forecasting and perhaps a more radical view of backcasting, than that articulated in [14], which argues for a complementary relationship between forecasting and backcasting. The approach suggested in this paper is consistent with the view of backcasting outlined by Karl-Henrik Robert and colleagues [15]. Robert's approach, which is enshrined in The Natural Step Program, involves "backcasting from principles" rather than "backcasting frolm scenarios" (Robert, K-H. Personal colmmunication, 2002).

[8] As Dreborg [7] has argued, it is more useful to think of backcasting as an approach than a method.

3. Backcasting and prediction

The first issue has to do with the relationship between predictive and non-predictive forms of analysis. While the purpose of backcasting analyses is to assess feasibility and desirability, rather than likelihood, there is an inescapable conditionality in any discussion of possible future conditions. For example, in order to assess the desirability of, say, high levels of energy efficiency, it is necessary to calculate the effects of significant penetration of energy-efficient technologies in a given end-use sector, such as residential appliances. This gives rise to two forms of conditionality. The first has to do with the projections of activity that underline the analysis. In our example, this would be the projection of demand for the services provided by appliances. The second has to do with the ability to project the effects of the use of the new technology or behaviour. In the appliance example, this would be the projection of the effect of the penetration of new appliances on appliance energy demand.

Both of these questions seem to suggest that the claim to be undertaking non-predictive analysis is problematic. The analysis seems necessarily shot through with conditional predictions of the future values of underlying activity variables or the effects of changes in technology or behaviour.

The claim that backcasting is a non-predictive approach to the future does not imply the lack of inclusion of conditional predictions in the analysis. It does however require that the *general purpose* of the analysis is not to predict the most likely future state of the system but to assess the feasibility and desirability of different outcomes. Though the analysis is based on individual predictive calculations (e.g. the likely effect of a change in population growth rates or in technological change), the overall goal is to indicate something about the range of possible outcomes and their consequences. In this sense, backcasting rejects what Dreborg calls the "total causal model" [7].

Another way to put this is that backcasting falls on the problem-driven side of the spectrum that Newby has articulated between problem-driven and science-driven forms of social science [18]. That is, backcasting lends itself to addressing specific societal problems, such as sustainability or future energy systems.[9] In so doing, backcasting must include consideration both of preferences and of descriptive analysis of how complex social and natural systems work.

4. User engagement

The normative nature of backcasting means that the analysis cannot simply consist of descriptive science. Normative considerations must enter in, both in the choice of what futures to study and in how the resulting scenarios are evaluated. But if

[9] For a discussion of how the distinction between science-driven and problem-driven approaches plays out in the case of climate change and sustainable development, see [19].

backcasting addresses desired futures, whose desires are to be expressed in the backcasting scenarios?

A key goal of most backcasting analyses is to articulate scenarios of the future that are different from conventional views of what is likely to happen (often misleadingly called ‘business as usual’ futures). This suggests that it is important that some thought be given as to how alternative values and preferences get incorporated into the analysis. Two methods of doing so are possible. In the first case, the research team itself articulates the criteria for choosing, and for evaluating, alternative desired futures states. This has been the method chosen in most “soft energy path” or “sustainable society” backcasting analyses. In such a case, the source of the normative content of the backcasting exercise is external to the analysis itself. It may come from a formal study of what stakeholders consider desirable or simply from the values of the analysts themselves. In either case, the purpose of the analysis is to show the implications of achieving one or more normatively defined end-points, with the goal of making that information available, via publication of the results, to others who can make up their own mind what they think about the findings. These others might be decision makers in government or firms, who may make different decisions based on the results of the analysis, or the general public, who may change their own behaviour or become part of a political constituency for certain kinds of choices.

An alternative approach would be for backcasting studies to involve various stakeholder groups or the public at large directly in the process of defining and evaluating the desirability of the scenarios that are developed. Such an “interactive social science” [20] approach to backcasting would be consistent with a growing interest in incorporating lay or stakeholder knowledge in sustainability analysis and with a long tradition in exploring the social construction of science. This approach has been adopted in our work in the Georgia Basin Futures Project and will be discussed at more length below.

5. Modeling issues

Traditionally, scenario analysis has relied heavily on qualitative approaches,[10] while forecasting approaches have tended to use quantitative models. However, backcasting analysis has its roots in the quantitative analysis of energy and other futures, and has therefore usually also involved some form of modeling. But the types of models needed for analysis of desirable futures differ radically from those used in forecasting analysis.

In order to be able to explore desirable futures, the modeling system used has to be capable of simulating alternative scenarios such that the user can iterate through the scenario generation process until they reach a future scenario with which they are happy. This imposes certain requirements on the design and implementation of the modeling framework. In particular, it is important that the models do not them-

[10] This is now changing. See the discussion of new developments in scenario analysis below.

selves optimize or solve for least cost or equilibrium solutions. They need to be able to show the implications of different user choices but not choose the most likely or optimal (e.g. least cost) solution. This has led to the development of what has been called the "design approach" to modeling [21], which involves building bottom—up models which, to a large degree, exogenise key behavioural relationships so that they are not hard-wired into the model and alternative forms of those relationships can be specified by the user. The resultant models act in part as accounting frameworks, which show the consequences of different behavioural choices, rather than predicting most likely outcomes.

Another crucial modeling issue emerges directly from the two previous sections: the problem-driven nature of backcasting and the need to incorporate the values and preferences of different stakeholders. Both of these characteristics imply that backcasting models should be able to address concrete social problems and speak to non-expert users to an unusual degree. This leads to the need to spend considerable time in designing the interface of backcasting models. As discussed below, it also has implications for the scale of the analysis.

6. Some recent developments in global scenario analysis

During the 1990s, the original sharp distinction between descriptive and normative scenario analysis approaches, and between top-down and bottom-up modeling methods, began to blur. In the energy and global change fields, there developed an increasing tendency towards hybrid models that incorporated both top-down and bottom-up characteristics, while deregulation in the resource sectors reduced the perceived need and incidence of long-term forecasting.

The result has been a growing interest in the use of scenario analysis to explore alternative future pathways, sometimes defined in explicitly normative terms. At the global scale, three examples are the World Business Council on Sustainable Development's global scenarios [22], the scenarios of the Global Scenarios Group [10,23], and the new set of reference emissions scenarios prepared for the Intergovernmental Panel on Climate Change in 1999 [24]. While significant differences exist among the approaches taken in each of these sets of scenarios,[11] they have in common the view that it is not very useful to think about the future in terms of perturbations of a single business as usual future. Instead, they argue for the existence of qualitatively different packages of future conditions, which define relatively coherent pathways into different futures. The difference between the different pathways may swamp the differences between any one pathway and its variants. For example, in the greenhouse gas emission scenarios prepared for the IPCC, it turns out that the differences among the four underlying socio-economic and technological development pathways

[11] In particular, the GSG and WBCSD scenarios go much further than the IPCC work in incorporating a number of explicitly normative elements in the analysis.

are as great as the difference between different scenarios of energy supply or demand within any of these pathways.

Another innovation in this work has to do with the combination of qualitative or narrative-based scenarios with quantitative modeling analysis. Traditionally, analyses that focused on widely divergent futures have used a form of qualitative scenario analysis [25] while those analyses using quantitative models have tended to focus on studying variants of base case forecasts.[12] However, in the work of the WBCSD, the GSG, and in the recent IPCC work, an explicit attempt has been made to combine narrative analysis with quantitative modeling. In the GSG work, the original scenarios were defined in qualitative terms and the group is undertaking a process of progressive quantification of them. In the case of the IPCC work, the original scenarios were defined in narrative terms and then multiple modeling groups around the world were asked to try to quantify them.

7. Backcasting and the Georgia Basin Futures Project (GBFP)

In Canada a tradition of energy backcasting [26] and scenario analysis [27] led to a series of backcasting studies that attempted to broaden the focus of analysis beyond the energy sector [28], to shift the focus to the regional scale [29], and to involve users directly in the scenario analysis process itself. The result of this trajectory was the development of Lower Fraser Basin QUEST, the first in a series of QUEST models intended to combine the characteristics of a computer game (fun to use) and of an academic modeling system (true to life) [30]. Subsequently the QUEST approach has been adopted in a successor project in British Columbia, the Georgia Basin Futures Project (GBFP) [31].

The GBFP is intended to build on the tradition of Canadian backcasting analyses, to address some of the methodological questions outlined above, and to profit from recent developments in studying alternative futures elsewhere in the world. The central goals of the project are to engage residents of the Georgia Basin region in western Canada in thinking through the implications of trying to achieve a desirable future. This required the development of a modeling tool—GB-QUEST—that allowed people to create and evaluate alternative scenarios of the future, and a series of processes for using that model that allowed such exploration to occur.

The specific objectives of the GBFP are:

[12] A good example of the latter are the many studies in the climate mitigation field that produce “non-intervention” scenarios (that assumed no additional climate policy) as base cases that are then used as a base for the production of “intervention” scenarios by adding additional climate policies to the base case scenarios. Note that such analyses privilege the base case scenarios, as most likely and least costly, since the intervention scenarios, by definition, involve adding additional policy, at an additional cost.

7.1. Objective 1

To develop and analyze varying scenarios of possible economic, social and ecological transitions in the Georgia Basin over the next 40 years, which reduce ecological impacts while enhancing human well-being. This will include consideration of:

1. the technical and economic potential of changes in technology and behaviour;
2. the social and institutional barriers to, and implications of, those changes; and
3. the policies required to achieve such scenarios.

7.2. Objective 2

To develop a dialogue with the interested publics, and with local and regional government decision-makers, firstly to incorporate in the scenarios their preferences for sustainable futures, and secondly to assess the usefulness and consequences of using computer game-like models for community engagement.

7.3. Objective 3

To develop for the Georgia Basin a set of interactive software tools that will support the first two objectives, based in part on existing tools developed for the Lower Fraser Basin. (Note: the Lower Fraser Basin lies geographically within the Georgia Basin.)

7.4. Objective 4

To collaborate with researchers in other jurisdictions towards the development of comparable international case studies of regional sustainability.

To accomplish these objectives, research in the Georgia Basin Futures Project is organised into six major research components, represented in Fig. 1, undertaken by a core team of ~20 Co-investigators and Research Collaborators, three research associates, about 20 graduate students, and a number of administrative staff, assisted

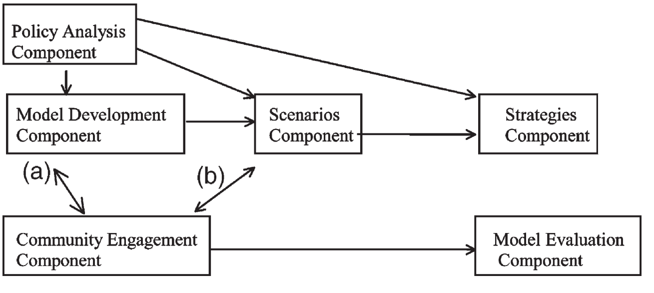

Fig. 1. GBFP project components.

by 17 NGO, government and private sector partners in the community. As of this writing (October, 2002) the first three components on the left-hand side of the diagram are finishing, and work is beginning on the three components to the right.

Major purposes of the GBFP are to facilitate debate about regional sustainability, and to allow users to explore the feasibility and desirability of alternative scenarios. In order to be appealing to non-expert users but at the same time to avoid misleading them, this means that the project, and GB-QUEST itself, must strike a balance between being "fun to use" and "true to life", and must be customized to address questions of interest to citizens in the region. In order that the questions being explored address the full range of sustainable futures issues, the modeling system should be both vertically and horizontally integrated and the processes of exploration should involve both quantitative and qualitative information.[13]

To achieve the goals of the project a number of features have been incorporated into the backcasting method at the core of the GBFP. These features represent our latest thinking about how large-scale backcasting projects like the GBFP can be made operational. They fall into four categories:

- General approach to backcasting
- A strong form of interactive social research
- Interface-driven modeling
- Backcasting as social learning

7.5. General approach to backcasting

The key feature of the GBFP that distinguishes it from earlier backcasting analyses is its adoption of the QUEST modeling approach for the construction of scenarios. From the standpoint of the user this means that the scenario analysis starts from the present and moves forward into the future. What distinguishes this from conditional scenario analysis is the explicitly normative frame of the exercise, and the use of successive iteration to approach more and more closely to a desired outcome. In other words, the user proceeds by making input decisions and then running GB-QUEST forward through time to see what the outcome of those decisions would be in the future. However, the user is asked to evaluate the resultant scenario outputs in terms of their desirability or their consistency with his or her internal image of a sustainable future, and to iterate through the system by changing inputs and viewing results until they get a future scenario that reflects their preferences.[14]

In more traditional backcasting analyses, much more emphasis is placed on articulating the nature of the desired end-point conditions at the outset and then analysing

[13] For the origins of these criteria, see the arguments in [32].

[14] In keeping with the general approach to sustainability underlying the development of the project, we do not try to define which futures are sustainable and which are not, but allow the users to reach their own judgement on this. In that sense, sustainable futures and desirable futures amount to essentially the same thing and are emergent properties of the scenario analysis process.

how those may be achieved.[15] The form of backcasting we have adopted in the GBFP emphasizes more the choice of pathways to achieve desired results. The backcasting element consists in repeated iteration to achieve desired goals.

This approach to backcasting has some important implications. It does not require that the elements of a desired future be known in advance. Instead the user goes through a process of learning and discovery, in which the desired future is a product of the process of trying to reach it. While any user may indeed have specific goals in mind, the desirability of a given set of future conditions is not fully determined in advance but emerges as a result of a form of negotiation with the consequences of different choices. The user may come to change his or her mind about what is desirable, based on seeing the outcomes of those choices.

In order for this learning process to be supported it is important that the scenario analysis process itself be strongly integrative and reveal some of the higher order consequences and trade-offs associated with different choices. It is the unanticipated consequences of choices, sometimes in sectors quite distant from the immediate first order effects, which may provide a basis for views to change. For example, the environmental or social consequences of a particular economic policy may turn out to be more significant than the immediate economic effects.

7.6. Interactive social research

A key component of the approach to backcasting adopted for the GBFP was the decision to involve citizens and stakeholders in the Georgia Basin in the research process itself.[16] The thinking behind this goal was that a major barrier to achieving a more sustainable society was a lack of social acceptability of the kinds of changes that would likely be required. In other words, social change in the direction of sustainable development would not be possible unless a political constituency developed that would support such changes. Politicians cannot act without such a constituency. Moreover, the private sector requires a market for sustainable products and services in order to be able to provide them. In both cases, the key lies in the beliefs, attitudes and preferences of the public. As a result, a major goal of the GBFP is to engage a segment of the "interested" public of the region in playing QUEST and expressing their preferences about the future. In so doing, they would be learning about the consequences and trade-offs associated with different choices, and in that way learning what futures they would prefer, based on that knowledge. Preferred futures then become an emergent property of the process of playing QUEST.

To accomplish this, the project adopts an "interactive social research" model of how to do research in this area. Interactive social research (ISR) refers to the process

[15] For an example see [33].

[16] The origins of this idea go back to a meeting of the research team of the Sustainable Society Project ([28]), in which one of the research team, Sally Lerner, pointed out that the real learning in the project had occurred within the research team in developing the project scenarios. She went on to propose the development of computer games that would allow anyone to experience this learning process for himself or herself.

of trying to engage the "users" of the research actively in the research process itself, not just as subjects of analysis or consumers of the final products of the research process [20].[17] As described in more detail elsewhere [34], the GBFP adopts a strong form of ISR, whereby the users and community-based partners are actively involved in the research design process and in the process of undertaking the research itself.[18] Such work is in the tradition of what has been variously called civic, vernacular or postnormal science, "through which both data and projections are subject to open negotiation among a wide range of stakeholders" [35], p. 395.

On the research design front, we have actively engaged various partners and stakeholders in processes of consultation to determine what they feel should be the key issues addressed in the research and built into the GB-QUEST modeling system (see next section).

It is in the process of research itself that the most profound form of ISR has been adopted. With the help of our community partners, we plan to engage hundreds of adult and student residents of the Georgia Basin in playing GB-QUEST. When they do, they develop scenarios that represent very rich representations of their views and preferences concerning desirable futures and policy choices. These representations are based on the interactive and iterative learning process described above. As a result we expect that they will represent much more informed and sophisticated views about these issues than can be obtained in any other way. We plan to study in detail the process by which such scenarios are chosen, and by whom, and to this end we have designed a whole series of processes of interaction with users, ranging from classroom use to highly facilitated and monitored workshop settings. In so doing, we hope to learn more about what choices different types of stakeholders make, the basis of such choices, what factors influence or change the choices, the connections between beliefs and preferences, whether tools like this affect such choices, whether the choices cluster in particular ways, whether such tools and processes affect the users' sense of agency, etc.

An innovative aspect of the form of ISR adopted in the GBFP is the interplay between expert knowledge of how complex ecological, social, and economic systems interact in the Georgia Basin, as represented by the algorithms in GB-QUEST, and public attitudes, values, beliefs and preferences, as manifest both in the user inputs to the design of GB-QUEST and in the choices made by users when they play GB-QUEST. This interplay means that both the design of GB-QUEST itself and, even more, the scenarios that result from its use represent a kind of fusion of expert and lay knowledge. This relationship is represented in Fig. 2, which suggests that this interaction creates a new, third form of understanding, which might be thought of as an emergent property of the interaction of the two original types of knowledge.

[17] The term "interactive social science" was used in the special issue of *Science and Public Policy* on this topic referenced here. In a subsequent meeting of that group the suggestion was made that the term interactive social research may be preferable. The latter term has been used here.

[18] The approach adopted is an attempt to apply the concept of "mutual learning systems" and "backcasting workshops" outlined in an earlier paper ([16]).

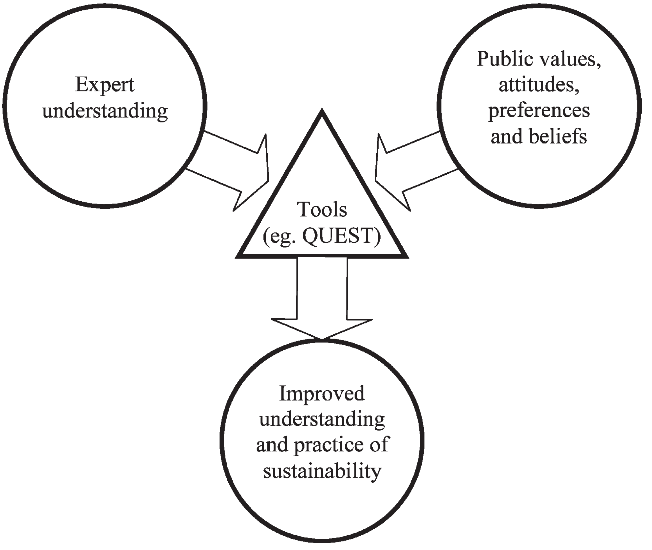

Fig. 2. Combining expert and lay knowledge in a new form of knowledge.

7.7. Interface-driven modeling

In order for engagement with non-expert users to be successful, it is critical that the modeling system be attractive and interesting to such users. At the same time, the models must meet academic standards of quality and credibility in order to minimize the risk of misleading the user about the consequences of particular choices. This tension between the need to be "fun to use" and the need to be "true to life" is fundamental to developing backcasting processes of the type being used in the GBFP.[19]

While the criterion of being "true to life" raises a number of issues that are beyond the scope of this paper,[20] the "fun to use" criterion is essential to the ability to involve non-expert users in backcasting exercises of the kind used in the GBFP. With regard to model design, it has led to an approach we have called "interface-driven modeling". Essentially this amounts to starting with the problems that matter to people, designing an interface that would address those problems, and then designing and building models that will support such an interface. This means a much stronger focus on interface design and development than is typical in most modeling

[19] The original graduate students who oversaw the building of Lower Fraser Basin QUEST, Mike Walsh and Dave Biggs, named themselves "Mr. Fun to Use" and "Mr. True to Life" to symbolize the essential tension between the two goals.

[20] These have mostly to do with the questions of credibility (in both the academic/professional domain and in terms of lay users of the model) and of the treatment of uncertainty, discontinuity and surprise. We are currently in the process of documenting the "executive summary" approach to modeling we used in building the submodels of GB-QUEST.

projects. As a result, all of the QUEST models are based on a interface template that is intended to be very much like that of a computer game.

A related consideration is that of scale, both temporal and spatial. Backcasting analyses have typically adopted time horizons of 25–50 years, in order to allow time for capital stock to turn over. By starting with the user and working back to the modeling, we have discovered another reason for scenario time frames of this magnitude. This is the fact that many users care about a time frame that is roughly the working life of their children, or their own working life if they are too young to have children. In the GBFP we have found that a scenario time frame of 40 years is of interest to most users.

In a similar way, it is important for the spatial scale of the analysis to reflect the interests of the users. While many modeling analyses adopt spatial boundaries that correspond to expert problem or issue definitions, or the administrative boundaries of key decision-making jurisdictions, we have found it useful to try and define spatial boundaries that represent identifiable communities or neighbourhoods of interest to the users.[21]

7.8. Backcasting as social learning

In a recent study of the management of global environmental risk in the UK, Wynne et al. [36] argue that social learning should be seen as a process of moral and cultural development as well as cognitive change, which focuses attention on institutional cultures and relationships. In the same report, Clark et al. [37] argue that the assessment of solutions to the problems of global environmental risk could benefit from “institutional settings and procedures that allow assessment users and producers to feel each other out—to negotiate and adjust over time a balance between the scientifically defensible and the policy relevant.” (p. 73). In a similar way, Jaeger et al. [38] suggest that “(w)here scientific knowledge needs to be combined with moral and aesthetic judgement, a social setting that fosters nonspecialized dialogue is much more appropriate than the setting of applied science or professional consultancy. In this view the inclusion of the ordinary citizen in schemes of public participation is vital to enhance the level of rationality in the debate in question,” (p. 198).

A major goal of the GBFP is to study whether and how backcasting exercises like those described here contribute to such social learning processes. We have designed a series of research processes to study how people interact with QUEST and other tools for thinking through the future. These include pre- and post- survey instruments, electronic monitoring of users’ choices, video-taping QUEST sessions, holding sessions with and without formal modeling tools, and interviewing of participants. In

[21] In fact, the expansion of our QUEST work from the boundaries of the Lower Fraser Basin (a quite identifiable region in BC) to the Georgia Basin (a much less well-known area) represents a bit of a gamble on our part. We do not yet know if this region works as an area that people care deeply about.

addition, we are developing elementary, secondary and post-secondary school curricula material for use in classrooms.

We are also developing a series of other tools that go beyond the backcasting scenario analysis capabilities of GB-QUEST. These include the development of "action tools" focused on supporting behaviour changes (from learning to action).[22] We are also involved in an extensive project to design and implement a Georgia Basin Digital Library to allow users to learn more about the past and current circumstances and conditions in the region [39].

A crucial insight that has developed out of the GBFP is the recognition that the processes through which the scenarios are developed is as important as the scenario analysis tools themselves. This is true in two ways. First, it is important to expend significant thought and resources on designing and managing the processes through which users come to engage with the project. Different purposes, stakeholder interests, group sizes and modes of interaction will give rise to different forms of outcomes. The interests of community planners, for example, can be quite different from those of high school students, or the local business community. Second, we have discovered that much of the most interesting form of social engagement and learning seem to occur after GB-QUEST is shut down and the discussion turns to questions of implementation and proposed action. In this sense the formal backcasting exercise can serve as the stimulus for processes of social interaction and learning that go well beyond the scenarios themselves.

A critical element of these processes is the involvement of partner organizations in the community. Not only can such partners provide invaluable help in the development of the modeling tools and the data they require, but they are crucial mediators of the project in the community, and they provide a form of institutional delivery simply unavailable to us as researchers. It may be useful to see the social learning process as a series of concentric circles of decreasing "learning density" centred around the project team, with the community partners located in the innermost circle, as co-designers of the community engagement components of the project. In that sense, the learning between the project team and the community partners may be extremely powerful.

8. Conclusions

Backcasting approaches have evolved significantly since their beginnings in the 1970s. Originally focused on evaluating the technical and economic potential for energy efficiency and alternative energy systems, backcasting methods have grown to encompass a much wider set of considerations. In so doing they have given rise to a set of important methodological questions about modeling, user engagement and the role and status of futures analysis.

The approach to backcasting adopted in the Georgia Basin Futures Project rep-

[22] See the preliminary description of action tools on the GBFP website at www.basinfutures.net

resents one attempt to come to grips with some of these questions in what might be called a “second generation” form of backcasting. That is, we have adopted an approach to modeling, scenario analysis and user engagement that represents a strong commitment to the concept of backcasting as a form of social learning about desired futures. This has involved an unusual degree of interaction with community partners and a strong form of interactive social research whereby those partners, and indeed citizens in general, have been involved in the design of the research, and in the research process itself. This is consistent with a view of backcasting that sees desired futures, and concepts of sustainability, as the emergent properties of structured conversations about future options, consequences and tradeoffs, that combine expert understanding with the knowledge, values, and preferences of citizens and stakeholders.

Such emergent knowledge is not reducible to, nor can it be obtained from, either side of the combination alone. It requires a form of backcasting that does not impose the normative conditions in advance (first generation backcasting) but allows the emergence of desired futures as a product of the process of analysis and engagement. Desired futures, like conceptions of sustainability are thus the product of a social learning process that is inherently open and unpredictable. Such processes offer the potential of exhibiting the characteristics called for by Jasanoff and Wynne [5]: “the patient construction of communities of belief that provide legitimacy through inclusion rather than exclusion, through participation rather than mystification, and through transparency rather than black boxing,” (p. 77).

Acknowledgements

The Georgia Basin Futures Project has been funded by the Social Sciences and Humanities Research Council of Canada, and received additional funding from the Shell Foundation and Environment Canada. An earlier version of this paper was presented at a seminar in memory of Peter Steen in Stockholm, on April 18, 2002. I would like to thank Karl-Henrik Drebrog and Mattias Hojer of fms for their invitation to this event and their hospitality. The paper has benefitted considerably from discussion at the workshop and subsequently at fms and The Natural Step offices in Stockholm, and from commentary by Karl-Henrik Robert, Justin Longo, Dale Rothman, David Brooks, Rob Swart and Bill Rees. Many thanks for their comments and suggestions.

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