Jan-Peter Voß, Bernhard Truffer, Kornelia Konrad

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Sustainability Foresight as a Method to Shape Socio-Technical Transformation in Utility Systems

Jan-Peter Voß, Bernhard Truffer & Kornelia Konrad

Abstract

Utility systems for the provision of electricity, gas, water or telecommunication are at the interface of society and nature. They are of central importance for sustainable development but particularly difficult to shape. Large technical systems are intertwined with patterns of market organisation, administrative institutions, user routines and policy networks. Transformation is not matter of planning and control but of co-evolution across such heterogeneous domains. The transformation of utility systems thus exemplifies the limits of conventional steering approaches to achieve sustainable development. Shaping strategies are needed which take up uncertainty, ambivalence and distributed influence as basic features of shaping sustainable development. Sustainability Foresight represents a method that is currently being probed in German utility systems.

Introduction

Utility systems play a key role in a broader project of sustainably transforming industrial society. At the same time, these sectors are particularly resistant to change. This is due to strong interlinkages between technological systems, natural resources, as well as to value orientations and consumption patterns, which make up a functioning configuration, a so-called socio-technical regime (Kemp 1994; Rip & Kemp 1998).

Some research work and political effort has been put into strategies to transform prevailing socio-technical regimes (Kemp et al. 1998; Mayntz & Schneider 1995; Summerton 1992). Utility systems have often been chosen as a field of application (Arentsen & Künnecke 2003; Kubicek 1994; Mez 1997; Schneider 2001; Voß 2000).

The shaping of sustainable transformation of utility systems is linked to some fundamental problems. The transformation process comprises complex non-linear interactions between many very heterogeneous factors. We find that co-evolutionary concepts of development make good sense of the contingent and open-ended character of socio-technical transformation (Rip & Kemp 1998; Norgaard 1994). In such a context straightforward steering is not an option. Co-evolutionary dynamics have no single control centre where information and power are concentrated. Moreover, the ambiguity of the sustainability concept impedes the application of standard modes of 'rational problem solving' as they presuppose a clear definition of goals, which are independent of the process of problem solving. The dilemma can be demonstrated by confronting the presumptions of conventional problem-solving approaches with the conditions given for the shaping of sustainable transformation in utility systems. Whereas conventional problem solving requires the following:

- (A_{conv}) system analysis for the prediction of consequences of alternative actions,
- (B_{conv}) a clear definition of goals in order to rank alternatives, and
- (C_{conv}) a powerful steering centre able to implement specific instruments,

we face different conditions in all three points in the case of complex problems such as the long-term transformation of utility systems:

- ($A_{complex}$) Potential transformation paths and effects of intervention are highly uncertain, because they are a result of complex interactions between social, technical and ecological processes, which cannot be fully analysed and predicted.
- ($B_{complex}$) Sustainability goals remain ambivalent, because they are endogenous to transformation itself. Conflicts between objectives cannot be resolved once and for all, either scientifically or politically.
- ($C_{complex}$) The power to shape transformation is distributed among many autonomous, yet interdependent actors without any single one of these having the power to control all of the others.

But how can such co-evolutionary developments across the boundary of society, technology and nature be shaped in order to assure sustainability, i.e. the long-term viability of society?

In the following we present and discuss an approach to deal with the specific challenges that are linked to the shaping of ongoing socio-technical transformation. The approach is entitled Sustainability Foresight and comprises the following three steps:

(A) Exploration of transformation dynamics: Construction of alternative paths of transformation in participatory scenario workshops, identification of highly dynamic fields of innovation.

(B) Sustainability assessment: Elicitation of evaluation criteria held by different stakeholders and discursive assessment of transformation paths with respect to sustainability impacts.

(C) Development of strategies: Analysis of options and constraints for actors to shape transformation, development of measures to modulate innovation processes with respect to sustainability.

The Sustainability Foresight method was developed and is currently being probed in the German utility system (provision of electricity, natural gas, water and telecommunications).[1] Building on and extending established foresight methodology, it aims at providing a platform for collective, future oriented learning across the four utility sectors and the action domains of production, consumption and regulation.

Using the Sustainability Foresight method, we want to explore alternatives to conventional problem solving with a view to assess their practical potential for implementing reflexive governance for sustainability. We expect Sustainability Foresight to work complementary to conventional problem solving by increasing the reflexivity in 'wicked' problem areas which do not lend themselves to straightforward problem solving (Hisschemöller & Hoppe 2001). As such it can play a mediating role in shaping sustainable transformation. Sustainability Foresight provides for emerging structural patterns to be shaped not only by the interference of 'external effects' of specialised rationalities and narrowly defined strategies but also by the anticipation of long-term consequences on a system level and mutual adaptation of strategies beforehand.

We first give a more detailed description of the Sustainability Foresight approach with examples from the application in the German utility system. This will be the basis for discussing the hitherto available results and some reflections on the practical potential of Sustainability Foresight to shape processes of socio-ecological transformation.

The Sustainability Foresight process

The Sustainability Foresight comprises a three-step process in which a selection of diverse actors from the utility systems addresses the problem of sustainable transformation. The challenges of system analysis, goal formulation and strategy development are dealt with in sequence.[2] The specific methods devised for each step take account of the inherent complexity and ambivalence of sustainable transformation processes:

(1) uncertainties of system dynamics are taken up in explorative scenario analysis,
(2) ambiguity of sustainability goals is taken up in a discursive sustainability assessment procedure,
(3) distributed control capacities are reflected in strategies to shape critical innovation processes.

The process is described in detail in the remainder of this chapter. For an overview of the phases, process steps and actors involved see Table 1.

The intended effect of the process can be found in two directions. First, integrated knowledge about system dynamics, sustainability goals and strategy options is produced in interaction of various stakeholders who contribute practical insight and expertise. This knowledge can provide a robust basis for political action. Direct involvement of stakeholders is likely to raise issues and achieve encompassing strategies, which would not be obtainable from classical expert policy analysis (Fischer 1993). Second, the process itself has an effect on the actors involved. They are actively participating in shaping the transformation of utility systems through their daily activities. If they learn about the interdependency of their particular strategies and how they are embedded in broader system contexts they are likely to adapt their strategies accordingly. Moreover, new cooperative relationships between stakeholders may become established increasing their capability for collective action.

Table 1. Overview of the Sustainability Foresight process

Phase	Process steps	Actors
Adaption to problem area	Scanning of future discourse: specific expectations and broader visions of actors.	Project team
	Development of heuristic conceptual framework of the transformation process.	Project team
Phase I: Explorative scenarios	Collection of factors which influence transformation.	Stakeholders
	Selection by uncertainty and impact, elaboration of alternative projections for selected factors.	Stakeholders
	Construction of scenarios as resulting from the mutual influence between factor projections, composition of narrative storylines for selected scenarios.	Stakeholders
Phase II: Discursive sustainability assessment	Elicitation of criteria for sustainability assessment held by stakeholders.	Stakeholders
	Development of impact profile of scenarios with respect to identified criteria.	Experts
	Discursive assessment of risks and opportunities connected to scenarios.	Stakeholders and experts
Phase III: Shaping innovation processes	Identification of critical innovation processes (contingent across scenarios and high sustainability impact).	Project team
	In-depth analyses of actor networks and context conditions of critical innovations, identification of 'loci of influence'.	Project team and stakeholders
	Development of integrated strategy for shaping interdependent institutional, cultural and technological innovation.	Project team and stakeholders

An important first element of Sustainability Foresight is an analysis of prevailing discourses about sustainable transformation in the corresponding field of analysis (utility sectors of electricity, gas, water and telecommunications in our case). This is based on an empirical study of the structure and dynamics and expectations about potential future states of the system that are put forward by actors. These expectations are not articulated in the form of full-fledged scenarios but are more often appearing as expectations about development tendencies of particular driving factors like prices, technologies, market structure and so on. If carefully analysed, however, they do link up to form a more encompassing picture, which may coincide to a stronger or lesser extent with explicitly held visions about the future. In our case we identified three central features summarising the expectations of future utility systems in the context of a discourse analysis:

(a) System structures are going to be more decentralised than they are today (e.g. renewable energy, fuel cells, biogas, membrane technology for water processing, mobile telecommunication).
(b) Utility provision will be increasingly oriented towards services, rather than commodities, with conventional boundaries between supply and demand dissolving (e.g. customer generation in small combined heat and power units, contracting, facility management).
(c) Organisational and technical linkages between electricity, gas, water and telecommunications will become more intensive (e.g. integrated service contracts, intelligent networking of infrastructure and appliances in smart buildings), so delimitations between sectors might be blurred or redefined.

These three 'dimensions of change', as they are referred to in the project, provide an exploration space for potential developments in the field of utilities. We re-constructed the vision of 'Integrated Microsystems of Supply' as a hypothetical extreme scenario in which decentralisation, service orientation and interlinkage between sectors is fully fledged. This vision serves as a reference for exploring alternative possible developments.

If not systematically reflected, implicit visions may translate into agendas for action, and eventually socio-technical structures, without being consciously assessed with regard to their actual conditions of realisation including wider impacts. In the Sustainability Foresight process, we aim at critically scrutinising and discussing implicit expectations about the future from diverse viewpoints, as those of large utility companies, equipment manufacturers, consumer groups, environmental associations, trade unions and public administration (cf. Grin & Grunwald 2000). The long-term perspective adopted for the process helps to strengthen a communicative orientation of involved actors to prevail over strategic orientations.[3] In terms of actually influencing transformation processes Sustainability Foresight focuses on innovation processes as the hot beds of future structures. At an early stage in the lifecycle of socio-technical configurations it is less conflict intensive to get involved with radical alternatives to established utility structures. Fostering innovation is better able to gain broad societal support than attacking the given set-up right away. At the same time it can have strong and long lasting effects, if sustainability considerations already become incorporated into the design and performance specifications of new system architectures (Rip & Schot 1999). In the light of uncertainty and ambivalence connected to sustainability assessments of emerging utility structure, however, a crucial task is to find ways to consciously shape new structures and at the same time keep up structural adaptability for responding to new knowledge, evaluations and experience of unexpected effects.

A second step for problem structuring, besides the empirical study of expectations of actors, is the development of a heuristic concept for the particular transformation process under study. This is necessary to guide the detailed set-up of the Sustainability Foresight process for the specific problem area. The conceptual approach attempts a comprehensive account of the action arenas and types of factors of influence, which are important for the course of transformation and its impacts. Such a heuristic is useful in order to ask relevant questions, include the right actors and not 'overlook' any influential processes.

For the utility systems we have differentiated the following categories, which we considered important to give a comprehensive image of transformation. Most of them may be relevant also for other areas of transformation:

- Multiple *Sectors* for provision of electricity, natural gas, water and telecommunications, which undergo transformation in parallel.

- *Action fields* of production, consumption and political regulation whose inherent dynamics and mutual interaction drive transformation.
- *Structural dimensions* of values, knowledge, institutions, technology and ecology, which in combination enable and constrain patterns of utility provision.
- *Levels* of socio-technical organisation, like sectoral regimes, niche developments within the regime and changes in the socio-technical landscape in which regimes are embedded.

As a general concept to understand the interaction of patterns within and across these different overlapping categories we use the concept of *co-evolution* (Konrad, Voß & Truffer 2003; Voß 2004).

This framework is, in our experience, useful for a systematic structuring of issues, design of work packages and selection of stakeholders. The latter is especially important since the participants have a very strong role in defining the substantial contents and results of the Sustainability Foresight whereas the organisers (in our case an interdisciplinary research team) act as facilitator, moderator and service provider in gathering and structuring information. Problem structuring thus includes the development of a participation concept, which should clearly define the functions of stakeholders within specific steps in the procedure and derive respective criteria with respect to recruitment. We distinguished 'diversity of perspectives', 'affectedness', and 'influence on transformation' as specific recruitment criteria for the process steps of scenario analysis, sustainability assessment, and strategy development, respectively. These criteria have been translated into respective quota for groups of stakeholders to be part of the process.

Phase I: Explorative scenarios

The objective of the first phase of the process is to re-construct core visions of future utility systems out of specific expectations held by different stakeholder groups. This has been carried out in a series of scenario workshops with 20 participants. The participants represented the variety of perspectives within production, consumption and political regulation in the four sectors (see Table 2). In the following we will briefly sketch out the method applied in the project.

Table 2. Participants in scenario workshops

MVV Energie AG	Small integrated utility company
RWE AG	Large integrated utility company
Vaillant GmbH	Heating appliance manufacturer
VIK e.V.	Association of industrial energy users
Gelsenwasser AG	Water company
Enervision	Energy management appliances manufacturer
Deutsche Telekom AG	Telecommunications company
Alcatel SEL AG	Control appliance manufacturer
BUND LV Berlin	Environmental NGO
Ver.di LV NRW	Trade union
Verbraucherzentrale NRW	Consumer protection agency
Uni Essen	Power plant engineering
DIW	Energy economics
Fraunhofer ISI	Innovation studies in water and sewage
RegPT	Regulator for telecommunications
BMWA	Federal Ministry for Economic Affairs, Energy Department
Umweltministerium Bayern	Regional State Ministry for the Environment, Telecommunications Department

As a first step, various factors which influence the transformation of utility systems were collected. This took place in form of a moderated process, initiated by the following question: 'What does the future of utility provision (electricity, gas, water, telecommunication) look like (...) and on which factors does it depend?' The first relatively large sample of factors was clustered and selected according to the uncertainty of their future value and their potential impact in shaping future structures of utility provision. For a selection of the 30 most relevant factors, detailed descriptions were worked out which provided alternative projections of their value at the end of the exploration period (2025 in our case). Different combinations of factor values formed different scenario frameworks. These were based on a cross-impact analysis supported by a software tool. Consistent and particularly interesting scenario frameworks with respect to the three features of decentralisation, service orientation and sector integration were selected and fleshed out with narrative storylines.

This first phase resulted in four elaborated scenarios representing alternative future structures of utility provision as well as a set of detailed descriptions of highly relevant factors influencing the transformation process. Both resulted from the interaction of heterogeneous perspectives on utility provision. This procedure makes it possible to overcome some limitations often set by particular institutional perspectives like, for example, that of technology development, business or consumer protection. The vast complexity of factors and their interaction was successively reduced in problem-oriented deliberation. This yields a trans-disciplinary and trans-professional view on the system in which processes become central which—under everyday conditions—are often externalised in a specialised perspective (e.g. societal acceptance for new technologies). Another effect of the collective scenario construction is the 'creative destruction' of expectations and visions of future development, which were taken for granted by participants. Routine thinking about how things unfold and what will come next could be replaced with a fan of contingent alternatives which would each require specific strategic responses. This pluralisation of the future can work as a particular kind of 'steering through visions' (Brand 2002; Canzler & Dierkes 2001). In this case, however, it is not a commonly adopted vision which shapes expectations and thus coordinates actor strategies for the realisation of this particular vision. The effect of alternative scenarios is rather to explicitly reflect uncertainty and ambiguity which is involved in transformation. As such it may influence general action orientations in such a way that experimenting, adaptivity and co-operation is given a larger role.

Phase II: Discursive sustainability assessment

The second phase moves from exploration to assessment. The focus is on the production of knowledge about goals, i.e. criteria for sustainable utility development and respective opportunities and threats in ongoing developments.

It is not possible to determine sustainability criteria objectively. We do not know the exact conditions for the long-term viability of coupled societal and ecological systems. Trade-offs between goals rest on differences in normative values and cannot be resolved scientifically. Moreover, values are endogenous to transformation and may change over its course. Sustainability goals will therefore always remain ambivalent. What counts is to keep the balance between equally legitimate but potentially conflicting values and develop problem specific practical judgements (Loeber 2003, 20). This can only be achieved in societal discourse among those who 'own' these values (cf. Stirling & Zwanenberg 2002). Such discourses may change views of actors and allow for consensus or help to identify areas of unresolvable conflict which need careful political attention.

The Sustainability Foresight method envisages a systematically structured process in which stakeholders articulate their values, experts assess possible future developments with respect to their effect on these values and a broad range of affected actors engages in a discursive assessment of opportunities and threats which have to be taken special care of in future transformation.[4]

The result of the assessment phase is the explication of risks and opportunities of transformation from the perspective of the various actors who are potentially affected by them. By this means critical aspects can be identified, which form starting points for the development of adequate strategies. It yields a map of the societal value landscape with respect to the transformation of electricity, gas, water, and telecommunications provision. Societal goal formulation can be supported by differentiating between facts and values and making them accessible for differentiated modes of conflict resolution such as discourse about problem framing and bargaining over distributional aspects (cf. Saretzki 1996).

Phase III: Shaping innovation processes

The focus of the third phase is on the development of strategies to shape transformation. It addresses 'critical innovation processes'. These are identified on the basis of the foregoing scenario analysis and sustainability assessment. Factors which have a central role for the transformation of the utility system as a whole and are linked to particular opportunities or areas of conflict with respect to sustainability are possible candidates for closer investigation of the innovation processes that will determine the particular characteristics of the factor in the future. If, for example, 'service orientation', 'demand side management' and 'market development for smart building technology' result as important factors influencing the future structure of utility systems and the discursive assessment shows a consensus among stakeholders about the desirability of increased user involvement in system management, but at the same time a divergence of evaluations with respect to the role that smart building technology can play, the latter would be a critical innovation process that should be given particular attention.

Critical innovation processes refer to the emergence of new technological, institutional or cultural forms, which potentially have a strong impact on the sustainability of utility systems and where uncertainty is high with respect to the scope and shape of actual changes. For the Sustainability Foresight process, institutional innovations related to economic, political or cultural contexts are treated symmetrically with technological innovations (which are traditionally the focus of foresight and utility studies). In a similar manner to smart building technology or small combined heat and power generation it could be the institutions of network regulation, performance contracting schemes or cultural aptness to switch providers or engage in self-supply of utility services which appear as critical innovation processes meriting special attention in strategy development.

Since it is impossible to actually steer co-evolutionary processes, shaping strategies need to rely on 'modulation', i.e. influence the interaction processes from which new structures emerge, knowing that it is impossible to control them (Rip 1998). Influence can be exercised by various means of 'context steering' such as bringing new actors in, empowering weak actors, providing information, moderating cooperative problem solving, proposing procedures of conflict resolution etc. Such approaches may become effective in opening up opportunities or making undesirable developments less likely, but they cannot and do not intend to determine the final substantive outcome of interaction (such as what smart building technologies will actually look like, what they will be used for etc.). Such a modest approach with respect to the steering of transformation is not only due to the distribution of power and resulting limitations for central control. It is also due to remaining uncertainty about the effects of innovations in changing system contexts and ambiguity of sustainability goals. These conditions make it necessary to create possibilities for social learning rather than implementing 'best solutions' in a straightforward way.

Despite these reservations, however, strategy development in Sustainability Foresight follows a certain approach of procedural shaping, which we presume to increase the chances of sustainable transformations of utility sectors to emerge. The core of this approach is to create connections between actors and processes, which are usually institutionally separated and follow particular rationalities. Whereas there is a lack of direct interaction in the phase of strategy development, there may be strong interference in their implementation so that outcomes are highly interdependent. Such can be the case with departmentalised policy-making on issues of energy and the environment, with scientific agendas and societal problem perception, with technology development and user practices or with political regulation and business strategies. In modern industrial society these processes often go on in a de-contextualised manner, following internal dynamics and their own systems of meaning. Contrary to the institutional and communicative differentiation between these processes, however, their outcomes remain closely interconnected. This shows up in two ways:

- Strategies which are developed in isolation from their contexts fail when they are confronted with their selection environments, because they did not adequately anticipate conditions into which they must fit (e.g. technologies, policies, business strategies).

– If successful, the interaction of strategies with unanticipated context developments has unintended consequences (external effects) for society as a whole and—in the form of indirect and delayed feedback—also for the strategy itself. Problems which are related to sustainable development are indeed mostly linked to such repercussions (e.g. side effects of industrial agriculture, climate change, poverty induced migration, nuclear risk).

The shaping approach which constitutes the third phase of Sustainability Foresight is thus to create social arrangements by which critical innovation processes become socially and ecologically contextualised, i.e. more closely coupled with the rationalities of users, interest groups, regulators and other stakeholders who represent the socio-ecological context in which innovations are to take effect. Such arrangements can take the form of public discourses, participatory impact assessment, transdisciplinary research projects, policy networks, cross-sectional working groups etc. If this can be achieved at an early stage of the innovation process a broader range of success factors and societal impacts become incorporated in the design of new technologies, policies, business models, research programmes etc.

Concrete options for such arrangements need to be based on in-depth empirical analyses of critical innovation processes. This analysis is oriented towards specific actor constellations and relevant context conditions which have historically contributed to shaping the path of a particular technological or institutional innovation and those which are likely to play a role in the future development of the innovation. On this basis, possible future courses of the 'innovation journey' in relation to contingent actor strategies and context developments are mapped. Turning points can be anticipated which represent windows of opportunity for influence.

A particular focus is on the interaction of technological and institutional innovation processes. Concrete policies and measures for the shaping of innovation processes are elaborated together with stakeholders in a strategy workshop. The targeted result of the third phase is an integrated innovation strategy, which takes account of the multi-level dynamics of transformation and interactions between technological and institutional innovation processes.

Preliminary results and reflection about potential

We have so far given a brief account of the Sustainability Foresight method. The method was developed based on general considerations about the role of foresight for the shaping of socio-technical transformation. An exemplary project in which Sustainability Foresight is developed and applied in the German utility system is currently half completed. At the time of writing the sustainability assessment of scenarios is under way. It is therefore too early for a concluding evaluation. Nevertheless, we can discuss some preliminary results.

The scenario workshops have brought up four different scenarios, which represent alternative future structures of utility systems and which chart a spectrum of possible developments until 2025 (see Table 3). One interesting aspect, to mention only one example, is the scope of alternative developments in terms of decentralisation of technologies and concentration of markets. Here, the four scenarios represent all possible combinations, including technological decentralisation combined with high market concentration.

Scenarios tell stories which make participants and users think in new ways and draw attention to factors and their ways of interacting which go beyond the beaten paths of future discourse in the utility system. Participants affirmed that they learned a lot about the utility system as a whole, about long-term dynamics, interdependencies and about the different perspectives and capacities of other actors. Many of them particularly emphasised the special opportunity to stand aside, take some time to reflect and look at the larger picture of sectoral transformation—a quality of thinking and communicating which they miss in their daily practice.

We had to learn that interactive research involving a diverse set of heterogeneous actors is a precarious endeavour. It opens the research process towards ongoing dynamics in the field of study, and makes it vulnerable to the influence of interests and conflicts. This requires a high level of attention to current political processes, relations between actors, and possible tensions which will have repercussions within the process. A great deal of flexibility in the management of the process is necessary in order to navigate through the currents of the real world stream of action.

The Sustainability Foresight method as described here should thus not be understood as a toolkit for straightforward application, but rather as an ideal-type process arrangement which may inspire similar processes elsewhere.

Table 3. Overview of utility transformation scenarios

Scenario A	Scenario B	Scenario C	Scenario D
'Technological competition in a cooperative society'	'Development along the lines of 'conservative ecology''	'Broadening technology mix by competition of transnational corporations'	'The old Rome'
Decentralised technology Low market concentration Utility sectors tightly coupled Visions generated in societal discourse become decentrally implemented State as moderator Competition stimulates technology development	Centralised technology Low market concentration Utility sectors separated Active innovation policy (R&D) State regulates utility markets and technology development	Centralised and decentralised technology High market concentration (international oligopoly) Utility sectors separated Innovation policy concentrated on national champions Strong market regulation	Centralised technology High market concentration Utility sectors separated Economic stagnation No active innovation policy Weak market regulation

This means that the project team, i.e. researchers, public officials, or whoever else is initiating and conducting Sustainability Foresight, has a strong influence on the process and indirectly on its results. A clear example is the selection of stakeholders, which is an important factor in shaping the processes of problem analysis, goal formulation and strategy development. Yet, there is no standard method available by which relevant stakeholders for a particular problem can be identified. The project team thus has important discretionary powers which go beyond the role of a facilitator of stakeholder interaction. Furthermore the specific set-up and moderation also contribute, of course, to shaping the results of Sustainability Foresight. This central role of the project team should be reflected by providing good documentation of the specific process set-up and the reasoning behind it. It also underlines the importance of having interdisciplinary competences and process management skills represented in the project team.

Another proviso with respect to the capabilities of the method is the basic dilemma of (critical) discursive communication about collective problem solving on the one hand and (affirmative) realism towards interests and power in actual institutional contexts on the other hand. Whereas it is necessary to promote an argumentative orientation of the participating stakeholders in order to produce integrated problem definitions and cooperative strategies, it is questionable if knowledge and strategies produced under these conditions will actually prove to be robust in real world policy processes where institutional inertia, competitive struggle and opportunistic behaviour are prevalent. It is necessary to strike a balance between detached observation and strategic role playing. Sustainability Foresight cannot overcome this dilemma. This means that the social processes that take place when working with the method are not free from particular interests, asymmetrical power relations and strategic interaction. Neither is it guaranteed that the results which are produced in the 'laboratory' of Sustainability Foresight can and will be implemented in the real world contexts to which they refer, because the specific institutional embedding constrains what actors think, value and what they can do. In this respect, Sustainability Foresight cannot be regarded as a *solution* to the problems which are linked to established institutional patterns in modern societies. In providing space for collective, problem-oriented learning it can be regarded as a means to *create opportunities* for making use of institutional slack to establish more adequate practices for dealing with uncertainty and ambivalence in the shaping of sustainable transformation.

Where conventional problem solving works productively it does so by constructing an 'illusion of agency' (Rip 2005) on the grounds of a simplified conception of system dynamics, goal definition and steering capacity. The illusion of agency is effective and indeed necessary for mobilising (collective) action. At the same time, however, it is determined to induce uncontrollable side effects and 'second order problems' exactly with respect to those aspects which are neglected for the sake of constructing decisiveness. While productive in stimulating action, conventional governance forms based on a rationalistic problem-solving orientation are therefore prone to shift problems rather than solving them. Sustainability Foresight must therefore be conceived of as being complementary to conventional problem solving. Its particular value is to buffer the side effects from routine problem solving by opening up narrow problem conceptions and re-contextualising specialised operations with the perspectives of interdependent and affected stakeholders. It is in this respect that the effect of Sustainability Foresight should be valued and evaluated.

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Notes

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2 The three steps are related to the distinction of system knowledge, goal knowledge and transformation knowledge as elements of sustainability research (cf. Mogalle 2001).

3 Looking at long-term developments, the uncertainty about one's own position within the discussed field increases. As a result, a 'veil of indifference' (Rawls) with respect to the distribution of benefits and burdens to particular actor groups may increase the probability of future knowledge which is less biased with respect to individual interests.

4 The procedure resembles the method of participatory policy analysis developed by Ortwin Renn et al. (1993).

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