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7. Sustainability foresight: reflexive governance in the transformation of utility systems

Jan-Peter Voß, Bernhard Truffer and Kornelia Konrad

INTRODUCTION

Utility systems play a key role in a broader project of transforming industrial society for sustainable development. At the same time, these sectors are particularly resistant to change. This is due to strong interlinkages between technological systems, natural resources, institutions and value orientations which stabilise consumption, production and governance patterns and constitute a so-called socio-technical regime (Kemp 1994; Rip and Kemp 1998). The interconnectedness of the elements mentioned and the dependency of modern societies on the provision of utility services make it hard to introduce radically new production and consumption patterns – such as energy provision based on renewable sources, recycling of drinking water or provision contracts based on demand-side management. The high complexity implies that it is difficult to predict the consequences from exchanging parts of the prevailing socio-technical regime.

The large scale introduction of intermittent renewable energy sources such as offshore wind energy in electricity systems is a case in point. As a consequence, incumbent interests may profit from such uncertainties by emphasising risks to the security of supply in order to prevent changes which could endanger their established position. Political power based on the existence of asymmetrical information therefore plays a crucial role in stabilising regimes of utility provision. Some research work and political effort has been put into strategies to transform prevailing socio-technical regimes (Kemp et al. 1998; Summerton 1992; Mayntz and Schneider 1995).

Utility systems have often been chosen as a field of application (Voß 2000; Kubicek 1994; Schneider 2001; Mez 1997; Arentsen and Künnecke 2003). Utility regimes are currently undergoing accelerated and fundamental changes linked to liberalisation and privatisation policies which started

in the 1990s. These comprise corporate organisations, political institutions, technology, cultural values and theoretical concepts of utility provision.

The current phase of transformation succeeds a long period of structural stability which has persisted starting from the Second World War until the beginning of the 1990s. During this phase utility systems were characterised by a socio-technical regime that consisted of public or semi-public monopolies and was organised around the principle of central control of large-scale generation and integrated distribution networks. During the 1970s and 1980s, pressures on the regime had built up. They included, for example, the reduced effectiveness of rate-of-return regulation of monopolies to a point where great investments for the extension of network infrastructures were not needed anymore because domestic markets were saturated; a growing perception of environmental problems connected with the established regime structure; and the advance of new technologies which would create opportunities for more decentralised and competitive modes of service provision.

In combination with neo-liberal ideas these changes culminated in the adoption of liberalisation and privatisation policies in the 1990s (Midttun 1997; Arentsen and Künnecke 2003; Schneider 2001). In parallel and supported by some of these changes, a shift towards decentralised technology could be observed in most industrialised countries (Patterson 1999). Furthermore, a new understanding and evaluation of utility system performance began to take shape over the past couple of years. The society-wide shared goal of 'public service' is fading, giving way to values like efficiency, entrepreneurial spirit and consumer sovereignty. These changes trigger further adaptive changes that build up momentum, thus opening spaces for a spectrum of new socio-technical configurations ranging from highly decentralised generation of electricity, heat and water in the context of 'intelligent' buildings, to centralised renewable electricity generation in areas of concentrated energy flows such as off-shore wind fields or solar plants in deserts. The future structure of utility provision is being shaped by a myriad of individual actions and decisions: companies sketching market or investment strategies, consumers purchasing appliances or signing up for supply contracts, policy makers negotiating subsidies or drafting rules for network access.

Shaping these ongoing changes with the aim of a sustainable transformation of utility systems is linked to some fundamental problems. As illustrated above, 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 and 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 it presupposes 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 scientifically or politically, once and for all.
- ($C_{complex}$) The power to shape transformation is distributed among many autonomous, yet interdependent actors without anyone having the power to control all others.

But how can such co-evolutionary developments across the boundary of society, technology and nature be shaped in order to assure sustainability, that is, the long-term viability of society? In the following pages 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 called 'sustainability foresight' and comprises the following three steps:

1. Exploring transformation dynamics: constructing alternative paths of transformation in participatory scenario workshops, and identifying highly dynamic fields of innovation.
2. Sustainability assessment: eliciting evaluation criteria held by different stakeholders and discursive assessment of transformation paths with respect to sustainability impacts.

3. Developing strategies: analysing options and constraints for actors to shape transformation, developing measures to modulate innovation processes with respect to sustainability.

The sustainability foresight method was developed and is currently being tested in German utility systems (provision of electricity, natural gas, water and telecommunications).[1] Building on and extending established foresight methodology, this approach 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 assessing their practical potential for implementing reflexive governance for sustainability. We expect sustainability foresight to work complementarily to conventional problem-solving by increasing the reflexivity in 'wicked' problem areas which do not lend themselves to straightforward problem-solving (Hisschemöller and 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 prior mutual adaptation of strategies.

We first explain the conceptual background behind the method. We then 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 results which are hitherto available and putting the approach in relation to the concept of reflexive governance as formulated in the Introduction. In a concluding section we reflect on the practical potential of reflexive governance in general and sustainability foresight in particular to shape processes of socio-ecological transformation in a sustainable way.

Shaping Transformation Through Foresight

Since the 1960s both the business and public policy sectors have systematically employed foresight methods to explore the embedding of strategies in dynamic contexts (Godet 1987; Ringland 1998). The approach has become popular through the Shell oil company which used it to deal with the uncertainties of their business environment that cropped up with the oil crises in the 1970s.

Foresight is about anticipating possible future developments in a focal area. It differs from forecasting, however, because it recognises the

impossibility of predicting the future due to the complex dynamics that are involved in bringing it about. Foresight conceptualises the future as open, not determined by natural necessities, but contingent and influenced by human action. The future is therefore seen as malleable and apt to strategic shaping, not to fatalistic adaptation. 'Foresight is not a process of forecasting the future but rather an attempt to explore the space for human actions and interventions to shape the future. Foresight is aimed at producing orientations rather than predictions; it provides guidance to all actors and reduces uncertainty' (Renn 2002, cited in Borup 2003, p. 3).

Foresight is not about finding out about one most probable path of development, but rather it entails the construction of a range of different, equally plausible paths of future development. Such paths are derived from the partly contingent interaction of various factors of influence. Foresight is also referred to as a 'scenario approach' to system analysis (Gallopín 2002; Berkhout and Hertin 2002). It is qualitative and explorative and does not aim at numerical predictions. As such it does not focus on exactitude but on a comprehensive account of the diversity of factors from society, technology and nature that work together in shaping transformations in the real world. For this purpose foresight exercises seek to make use of the distributed knowledge, expectations and understanding which are contained in the diverse perspectives of present-day actors on developments of common concern.

By putting these expectations in the form of scenarios, they have an effect on present-day actions and thus feed back on the development itself. The actual results of foresight activities are therefore not the more or less probable stories about alternative futures on their own, but the repercussions they have in social interaction processes in the present (Truffer et al. 2003). This may be that expected opportunities enhance actions, which in turn support developments that spur their actual realisation (self-fulfilling prophecy) or, vice versa, that expected risks call for preventive action, which makes them less likely to occur (self-defeating prophecy). Foresight processes thus potentially shape the developments they set out to explore. As such they become a strategic device in shaping socio-technical transformation.

How foresight, which yields alternative futures, affects present actions, however, differs remarkably from the effect of forecasting, which yields one most probable future. Beyond self-fulfilling or self-defeating effects, the 'pluralistic vision' which is constituted by the alternative scenarios that are the outcome of foresight exercises has a self-reflecting effect. The variety of future developments across the scenarios calls the inevitability of each single scenario into question and points out the indeterminacy of long-term transformation. As such foresight can prepare decision makers for alternative courses of development and prevent premature lock-in to specific

trajectories. In this respect foresight relates to reflexive governance as outlined in the Introduction to this volume. It is a method for systematically embedding decision making into contingent contextual developments. A closer examination of the similarities is provided towards the end of this chapter.

Variants of foresight methods exist for different purposes. The sustainability foresight approach has been developed for the task of shaping processes of socio-technical transformation. It is designed to integrate a broad range of interacting factors from heterogeneous domains. Moreover, it includes two steps beyond explorative scenario building. This is a participatory procedure for assessing threats and opportunities that are connected to the scenarios and the development of measures to shape innovation processes, which appear critical for sustainable development. A more detailed description of these phases and how they are linked is given in the next section.

If we try to specify the role of sustainability foresight for the transformation of utility systems, it seems clear that it cannot easily be assigned to knowledge production, innovation, or governance. Instead, it appears to be a hybrid process which combines elements from each of these domains of social practice. It generates knowledge about utility transformation and factors that drive it, coordinates interaction processes between interdependent stakeholders who shape the transformation process, and plays a role in technological and social innovation processes by providing a specific form of strategic guidance.

In doing this, sustainability foresight reflects a number of lessons from recent literature on knowledge production, governance and innovation. In the science studies literature, knowledge production is claimed to transcend disciplinary scientific boundaries increasingly and to take place in networks of scientists from different disciplines and societal stakeholders (Nowotny et al. 2001). Governance studies diagnose that policy networks of public and private actors, which span several institutionalised policy fields and different levels of societal organisations, overcome the limitations of conventional institutions of national democratic government (Mayntz 1998). Innovation studies ultimately claim that innovation processes increasingly take place in networks of heterogeneous actors and become linked with broader social and environmental developments through intensified and interaction-based technology assessment and strategic R&D policy (Rammert 1997).

Against this background the sustainability foresight method can be seen to provide a platform for these developments, which is open to heterogeneous actors, institutions and purposes. As a consequence, it can be expected to fulfil an important integrative function in an otherwise highly differentiated modern society. The need for arrangements to transcend the

established institutional separation between functional domains is repeatedly stressed in analyses of modern society and sustainable development (Beck 1993; Mayntz 1999; Minsch et al. 1998; Brand 2002).

Another approach to conceptualising the working of the sustainability foresight method is from a co-evolutionary understanding of societal change (Norgaard 1994; Rip 2002). In this perspective, transformation in the utility system is conceptualised as the outcome of interacting developments in technology, the economy, politics, culture, science and so on. For any one of these developments to unfold it is crucial that it fits the context which is constituted by all the other developments. Their interaction may work as selection when, say 'performance contracting' as a new business model is being tested and does not survive in the market. However, it may also work as mutual adaptation when market conditions are anticipated in the development of business models (and vice versa, the emergence of new business models is anticipated in the development of market regulations and user practices).

In the co-evolutionary study of technological development, specific social arrangements have been identified that serve to facilitate mutual adaptation by linking developments at an early stage when they are still adaptable (that is, when form and function of an artefact are not irreversibly fixed and when users have not yet developed stable attitudes towards that technology). These arrangements have been termed 'nexus' (van den Belt and Rip 1987). As far as nexus arrangements give actors the opportunity to probe strategies before they make large investments at the risk of failure, the actors involved have a substantial benefit. By promoting the alignment of ongoing developments in technology, policy, culture and so on, the working of nexus arrangements also provides social benefits in avoiding unexpected side effects, irreconcilable developments and social conflict.[2] Sustainability foresight can thus be conceptualised as a 'macro-nexus' for the interaction of actors which bring about sectoral transformation. By collectively going through a process of exploring and assessing the aggregate outcome of their actions and drawing conclusions for their own particular strategies, actors fulfil a necessary precondition for alignment. The articulation of mutual dependencies and potential interference in the collective anticipation of system dynamics makes distributed innovation processes more reflexive, that is, they become strategically embedded in their respective context.

In the following pages we give an overview on the concrete procedural set-up of sustainability foresight as it is currently applied in German utility systems.

THE SUSTAINABILITY FORESIGHT PROCESS

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.[3] The specific methods which have been devised for each step take account of the inherent complexity and ambivalence:

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, and
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 Tables 7.1 and 7.2).

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 able to adapt their strategies accordingly. Moreover, new cooperative relationships between stakeholders may become established and this in turn increases their capacity for collective action.

In an important initial step of sustainability foresight, the general method is thoroughly adapted to a specific field of application. This includes an empirical study of the structure and dynamics and future expectations that are put forward by actors. As a starting point we chose to take expectations on future developments of the utility system which are discussed in the practice of electricity, gas, water and telecommunications provision. These expectations are not articulated in the form of full-fledged scenarios but rather appear more often as expectations about prices, technologies, market structure and so on. If carefully analysed, however, they do link up to form

Table 7.1 Overview of the sustainability foresight process

Phase	Process steps	Actors
Adaptation to problem area	Scanning of future discourse and visions discussed in problem area	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 30 factors	Stakeholders
	Cross-impact analysis, construction of scenarios as combinations of 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

a more encompassing picture. In our case we identified three central features of the future utility system which frequently came up in expert discussions:

1. System structures are going to be more decentralised than today (for example, renewable energy, fuel cells, biogas, membrane technology for drinking water processing and mobile telecommunications).
2. Utility provision will be oriented towards services, not commodities, with the boundary between supply and demand dissolving (for

Table 7.2 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

example, customer generation in small combined heat and power units, contracting, facility management).

3. Organisational and technical linkages between electricity, gas, water and telecommunications will become more intensive (for example, integrated service contracts, intelligent networking of infrastructure and appliances in smart buildings).

These three 'dimensions of change', as they are referred to in the project, provide an exploration space in which 'integrated microsystems of supply' is a hypothetical extreme scenario in which decentralisation, service orientation and the interlinkage between sectors is fully developed. This vision serves as a background foil for contrasting 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. Through the sustainability foresight process, however, they are critically scrutinised and discussed from diverse viewpoints like those of large utility companies, equipment manufacturers, consumer groups, environmental associations, trade unions and public administration (see Grin and Grunwald 2000). The long-term perspective adopted for the process helps to strengthen a communicative orientation of involved actors

to prevail over strategic orientations.[4] In terms of actually influencing transformation processes, sustainability foresight focuses on innovation processes as the breeding grounds of future structures. Integrating radical alternatives into established utility structures is less conflict intensive at an early stage in the lifecycle of socio-technical configurations. Fostering innovation is more likely 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 a new system architecture. They do not have to be asserted against the rationality and inner dynamics of the utility system then, but rather they have to work for themselves (Rip and Schot 1999). In light of uncertainty and ambivalence associated with sustainability assessments of emerging utility structures, however, a crucial task is to find ways to shape new structures constructively and at the same time keep up structural adaptability for adequate responses to new knowledge, evaluations and experiences of unexpected effects.

A second step for problem structuring, besides the empirical study of future 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. The concept will provide 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 approach is useful in order to ask the right 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 also be relevant for other areas of transformation. In principle, however, important categories should be derived from an empirical study of the specific transformation which is in focus of sustainability foresight:

- 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 as well as their 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.

We use co-evolution as a general concept to understand the interaction of patterns within and across these different overlapping categories (Konrad et al. 2003; Voß 2004).

The conceptual framework is useful for systematically structuring issues and selecting stakeholders. Especially the latter is important since the participants have a very strong role in defining the substantial contents and results of sustainability foresight, whereas the organisers (in our case an interdisciplinary research team) act to a large extent as facilitators, moderators and service providers 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 between '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 alternative visions of future utility systems out of the 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 from production, consumption and political regulation in the four sectors (see Table 7.2).

In a first step various factors which influence the transformation of utility systems were collected. This took place in the form of a moderated process, initiated by the following question: 'What does the future of utility provision (electricity, gas, water, and telecommunications) look like (. . .) and on which factors does it depend?'. The first rather 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 formulated 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 that represent alternative future structures of utility provision as well as a set of detailed descriptions of highly relevant factors influencing the transformation process. Both developed from the interaction of heterogeneous perspectives on utility provision. By means of this procedure it is possible to overcome some limitations often set by particular institutional perspectives like, for example, the one of technology development, business or consumer protection. This yields a trans-disciplinary and trans-professional view of the system in which processes become central that are – under everyday conditions – often externalised (such as 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' (Canzler and Dierkes 2001; Brand 2002). In this case it is not the coordinating force of visions which become embraced as commonly held expectations and translated into agendas (van Lente 1993; Konrad 2004), but the ambiguity of multiple expectations that may influence general action orientations towards experimenting, adaptivity and cooperation.

Phase II: Discursive Sustainability Assessment

The second phase moves from exploration to assessment. The focus is on the production of knowledge about goals, that is, the 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 to develop problem-specific practical judgements (Loeber 2003: 20). This can only be achieved in societal discourse among those who 'own' these values (see Stirling and Zwanenberg 2002). Such discourses may change the views of actors and allow for consensus or help to identify areas of irresolvable 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 transformations.[5]

The result of the assessment phase is the explication of threats and opportunities of transformation from the perspective of the various actors who are potentially affected by them. In this way critical aspects can be identified, which form starting points for the development of adequate strategies. Such an open-ended approach to sustainability assessment allows for a concretisation of the abstract notion of sustainability without passing over inherent ambiguities. 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 (see Saretzki 1996).

Phase III: Shaping Innovation Processes

The third phase focuses on the development of strategies. It addresses 'critical innovation processes' to shape broader transformation patterns. Critical innovations are identified on the basis of the foregoing scenario analysis and sustainability assessment: factors which have a central role in the transformation of utility systems as a whole and are linked to outstanding threats, opportunities or areas of conflict with respect to sustainability are candidates for a closer investigation into the innovation processes that determine future characteristics of this factor. If, for example, 'service orientation', 'demand-side management' and 'market development for smart building technology' are identified as important factors, and discursive assessment shows consensus on the desirability of user involvement in the utility systems, but at the same time divergent evaluations with respect to smart building technology, the latter would qualify as a critical innovation process and should be given special attention in strategies for sustainably shaping utility transformation.

Critical innovation processes thus refer to the emergence of new technological, institutional or cultural patterns in utility provision. Institutional innovations related to economic, political or cultural contexts are treated symmetrically with technological innovations in this context. In addition to smart building technology or small combined heat and power generation, network regulation, performance contracting schemes or cultural practices to switch providers or engage in self-supply of utility services could also receive special attention as critical innovations processes.

Since it is impossible actually to steer co-evolutionary processes, shaping strategies need to rely on 'modulation', that is, influencing innovation processes, while knowing that it is impossible to understand and control their outcome completely (Rip 1998, and Chapter 4, this volume). Influence can be exercised by various means of 'context steering' such as extending innovation networks to comprise users, affected or critical actors, empowering weak actors, providing information, moderating cooperative problem solving and so on. Such approaches can be effective in opening up opportunities or making undesired developments less likely, but they cannot determine final outcomes (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 uncertainty and ambiguity in assessing the sustainability of innovations. These conditions make it necessary to create possibilities for social learning rather than implementing 'best solutions' in a straightforward way.

The core of this approach is to create connections between actors and processes which are otherwise institutionally separated. Even though they are separated with respect to strategy and internal dynamics, there can be strong interference in implementation and outcomes. Such is the case for example with departmental policies on energy and the environment, with science dynamics and societal problems, with technology development and user practices and with political regulation and business strategies. This can show 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 of fit with their environment (for example in their 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 (such as the side effects of industrial agriculture, climate change, poverty induced migration, nuclear risk).

The strategic approach of the third phase of sustainability foresight thus is to foster the contextualisation of critical innovation processes. This happens on two levels. On the level of the interactions that are relevant for critical innovations, new arrangements are created which bring together the rationalities of developers, investors, 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 R&D consortia, focused impact assessments, collective experiments and so on. On the level of expectations of changing sector structures, new visions are constructed which can serve to orient the search for sustainable transformation paths. Such visions are based on the scenarios and evaluation of sustainability impacts.

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

New visions of sectoral transformation need to be based on discussion among stakeholders which take into account both (1) the breadth of possible developments and contingency of factor interactions and (2) the ambiguities in assessing these developments with respect to sustainable development. It is against this background that reflexive visions can be constructed, which are based on the diverse expectations of stakeholders. These visions reflect the interaction of multiple factors and pluralistic viewpoints in utility transformation. Moreover, they can orientate experimentation and shaping strategies to search for sustainable transformation paths.

SUSTAINABILITY FORESIGHT AS REFLEXIVE GOVERNANCE

So far we have 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. A project in which sustainability foresight is applied in the German utility system and which provides the empirical experience for this chapter has, by this time, been implemented half way. It is therefore too early for a concluding evaluation. Nevertheless, it is possible to discuss initial results and articulate some linkages between our case and the more encompassing concept of reflexive governance as outlined in the Introduction to this book.

The scenario workshops 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 7.3). One interesting

Table 7.3 Overview of scenarios of utility transformation

Scenario A 'Technological competition in a cooperative society'	Scenario B 'Development along the lines of "conservative ecology"'	Scenario C 'Broadening technology mix by competition of transnational corporations'	Scenario D 'The old Rome'
Decentral technology Low market concentration Utility sectors tightly coupled Visions generated in societal discourse become decentrally implemented State as moderator Competition stimulates technology development	Central 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	Central technology High market concentration Utility sectors separated Economic stagnation No active innovation policy Weak market regulation

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.

The scenarios tell stories which make one think in new ways and draw attention to factors and their ways of interacting that go beyond the expected paths of future discourse in the utility system. Apart from these substantial results, the process by which the scenarios were created also proved effective in itself. Participants affirmed that they learned 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 work.

When one examines sustainability foresight from a governance perspective, that is, concerned with patterns of social regulation, it is important not to misinterpret its intention. Sustainability foresight is not a steering approach or a policy instrument in the classical sense. We have already mentioned its hybrid character between knowledge production, innovation and governance. It does not shape utility production, technological innovation, consumption behaviour or the regulatory process in any direct manner. Accordingly, it is also not oriented towards the achievement of any specific output goals such as a determined amount of money spent on R&D, technologies to be applied in households, or greenhouse gas emissions linked to utility services. The goal of sustainability foresight is to shape the processes by which any of these outputs are generated. It could rather be called 'second-order governance' which is complementary to other modes of policy making. The central orientation in this respect is to bridge the gaps between distributed activities which exert influence on the transformation process in an uncoordinated way. The black box of large-scale and long-term transformation will be opened a little to allow for anticipatory adaptation of strategies according to their embedding in larger processes of change.

As such, the concept of reflexive governance described in the Introduction to this book works well in understanding sustainability foresight. It is not a process to steer transformation, but to modulate it by establishing linkages between its various sub-processes. As such, it 'reflects, orients and supervises diverse specialised problem-solving processes' (Voß and Kemp in the Introduction to this volume). The following paragraphs give an overview on how elements of the sustainability foresight method can be related to the strategy elements of reflexive governance.

Integrated knowledge production: in order to combine distributed knowledge for the understanding of transformation in utility systems, their assessment and a development of action strategies, a great variety of stakeholders is involved in the different stages of the sustainability foresight process. They bring knowledge from production, consumption and political regulation in four different utility sectors into the process (see Table 7.2). Scientific expertise in the project team is interdisciplinary, comprising physics, engineering, geography, economics, political science, sociology and psychology. These different types of knowledge are integrated by various methods which make particular use of the diversity of perspectives such as scenario workshops, value analysis, discursive assessment, and interactive strategy workshops.

Adaptivity of strategies and institutions: the exploration of four quite different futures for the utility system and the contingencies which have been encountered in the process of scenario construction emphasise the

need to be prepared for adaptation when things turn out to be different than expected. This is what sustainability foresight 'teaches' its participants as well as the users of its products such as the scenarios, 'value landscape' and the integrated strategy for shaping innovation processes. Especially the latter takes due account of uncertainty about system dynamics as well as ambiguity of sustainability assessments and therefore follows a procedural and experimental approach by facilitating interactive learning instead of pushing particular best solutions, be it technologies, policy instruments or behavioural patterns. Strategies aim to open innovation processes to integrate diverse perspectives and to remain open for the revision of guiding visions and design principles.[6]

Anticipation of long-term systemic effects: anticipation is the general idea behind any kind of foresight process. The approach of sustainability foresight in particular is to draw the system boundaries in a very broad manner in order to become aware of distant side effects and long feedback loops which are linked to certain strategies (for example, the four utility sectors, action domains production, consumption and regulation, interactions across the dimensions of society, technology and nature). Anticipation is not done with impact assessment by experts but in the context of moderated interaction of stakeholders from various parts of the system under investigation. It is important to note that this approach to anticipation does not aim to make correct projections, but to collectively explore plausible futures by actors who themselves shape this future by their daily interactions. The process may as such help to create an alignment of strategic orientations and is therefore more about bringing about and shaping developments than predicting them.

Iterative participatory goal formulation: the discursive sustainability assessment which serves to identify risks and opportunities of transformation acknowledges that sustainability goals must become established and weighed against each other in broader social processes, not by scientific experts or politicians alone. It builds on the participation of the spectrum of different social actors who are affected by utility transformation in order to lay bare the ambivalence involved in sustainability assessment and prepare the ground for the deliberation of pragmatic judgements. Iteration is not part of the process itself, if it is only conducted once. By proposing the method, however, we envision that successive sustainability foresight processes are performed in order to keep track of the changes in knowledge and values that are part of the transformation process and adapt goals and assessments accordingly.

Interactive strategy development: the strategy recommendations which are elaborated in the course of the sustainability foresight process are interaction oriented in two ways. First, they are developed in interaction with the

stakeholders who are the ones to implement them or are affected by them. This happens in the course of group interviews linked to the in-depth analysis of critical innovation processes and in the form of a strategy workshop for drawing conclusions from these analyses. A second aspect of iterative strategy development is linked to the kind of strategies which are developed in the sustainability foresight process. Their procedural orientation actually puts interactions between actors who are involved in and affected by critical innovation processes at the core of the shaping approach. Thus, strategies and measures which result from sustainability foresight are indeed aimed at moderating the self-organisation of actors who play a part in the transformation process. Distributed capacities to influence the course of transformation are utilised by this means without the need to exert central control.

CONCLUSIONS AND REFLECTIONS ON REFLEXIVE GOVERNANCE

In the preceding section we have shown how sustainability foresight relates to the concept of reflexive governance. We have established that it actually represents an illustrative case of interactive anticipation and analysis which fits very well into the five criteria for reflexive governance for sustainable development. In this concluding section, we emphasise the lessons learned from this approach for refinement of the reflexive governance concept.

Sustainability foresight can be seen as an example of the existence of reflexive governance in practice. As stated in the Introduction it represents a new form of governance, or societal problem treatment more generally, which developed out of learning experiences in a concrete area of practice. In the case of sustainability foresight it is the elaboration of technology assessment methods which moved from single technologies towards socio-technical systems as the object of study and from expert assessments to citizen participation and stakeholder interaction as the ways of producing knowledge and evaluative judgements. The concept of sustainable development played an important role for this process in demanding to take into account long-term effects of technologies in larger socio-ecological system contexts (that is, including social impacts and global effects) and to face for assessment diverse criteria that are not easily reconcilable (such as social, ecological and economic) (Grunwald 2002).

In this respect the concept of sustainable development has effectively induced changes in social practice. Up to now, one cannot speak of a full regime change which has taken place in technology assessment, but it is clearly visible that new and more reflexive forms of governing technological

change are developing and becoming institutionalised (Simonis 2001). A separate question which cannot be answered here is about the conditions of these governance innovations to develop further and diffuse to actually become established as part of a new governance regime. In order to assess the potential for reflexive governance adequately in technology assessment and possibly elsewhere, however, we can offer some reflections on our experiences with the operation of sustainability foresight in 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 more 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. This may also be extended to reflexive governance in general. Rather than providing a specified toolkit, it may serve as a 'regulative idea' which orients the problem-specific design of process arrangements.

This means that the project team, that is, researchers, public officials, or whoever else is initiating and conducting sustainability foresight, has 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 therefore has important discretionary powers which go beyond the role of a facilitator of stakeholder interaction. Also the specific set-up and moderation do, of course, shape 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 reflexive governance to bring about sustainable development is the basic dilemma of (critical) discursive communication about problem-solving on the one hand and (affirmative) realism towards interests and power in actual institutional contexts on the other hand. Although 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 which were 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; it can only help to find a good way to deal with it. 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. It is also not 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, and perhaps reflexive governance more generally, 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.

In this context it is important to note that sustainability foresight, as other reflexive governance approaches, cannot, in our understanding, be a complete substitute for more conventional problem-solving methods in policy making and management which are based on a positivistic conception of rationality (such as model-based forecasting, cost–benefit analysis and mobilisation of powers for political control). One reason is that taking uncertainty and ambivalence seriously makes one careful to make final decisions though this is necessary for taking (collective) action. Another reason is that the emergence of strategies from stakeholder deliberations – which sustainability foresight seeks to facilitate – does not allow for assignment of responsibility. Legitimising by democratic control through those who are not themselves part of the deliberation is therefore not applicable.

Here is another dilemma which cannot be overcome. Where positivist problem-solving works productively it does so by constructing an 'illusion of agency' 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 bound to induce uncontrollable side effects and 'second-order problems' precisely 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 solve them. Reflexive governance arrangements, on the other hand, face limits in reaching decisions which are necessary for action – as long as they keep up reflexivity and do not evade to pragmatic simplifications. Sustainability foresight and other reflexive governance arrangements therefore have to be conceived as being complementary to conventional problem-solving. Their particular value is to buffer the side effects of routine problem-solving by opening up narrow problem conceptions and recontextualising 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. How the balance of reflexive and positivistic approaches to sustainable development can be evaluated and how they can be productively combined are questions which lead us beyond the scope of this chapter. A first step that we have attempted to take is to contribute to a better understanding of the specific quality of reflexive governance by discussing sustainability foresight as a specific case.

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NOTES

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2. With the concept of 'Constructive technology assessment', the social phenomenon of nexus arrangements has been turned into a programmatic approach to overcome the 'control dilemma' in technology assessment which refers to the discrepancy between a lack of knowledge about the effects of technological developments at an early stage and a lack of opportunity to influence its course at a later stage (Collingridge 1980). For a more encompassing elaboration of the concept which has also played a role in the development of the sustainability foresight method see Rip et al. 1995; Rip 2002; Simonis 2001.
3. The three steps are related to the distinction of system knowledge, knowledge about goals and transformation knowledge as elements of sustainability research (see Mogalle 2001).
4. Looking at long-term developments, the uncertainty about one's own position increases. As a result, a 'veil of indifference' (Rawls 1999) 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.

5. The procedure resembles the method of participatory policy analysis developed by Ortwin Renn et al. (1993).
6. Here we touch on a fundamental problem which has to do with the dilemma of exploration and exploitation as elaborated nicely by March (1991). While it is necessary, especially in the face of uncertainty and ambivalence, to have many options ready and keep up flexibility to adapt, it is also necessary to choose certain paths for concentrated investment of resources and accumulation of learning effects in order to allow for the development of momentum for new structures. By focusing on exploration and opening up, which we think is important in the current state of utility development, though, we leave the task of developing appropriate approaches to select paths for exploitation to processes beyond the method of sustainability foresight as it is presented here.

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