WWW.EFMN.INFO The European Foresight Monitoring Network

Sustainable Transformation of German Utilities 2025

Foresight Brief No. 034

Authors:	Kornelia Konrad	Kornelia.Konrad@eawag.ch
	Jan-Peter Voß	J.Voss@oeko.de
	Bernhard Truffer	Bernhard.Truffer@eawag.ch
Sponsors:	The BMBF - German Federal Ministry of Education and Research	
Type:	Sectoral foresight on utilities - electricity, gas, water & telecom - with a national focus on Germany	
Organizer:	Öko-Institut e.V., Christof Timpe – Coordinator	C.Timpe@oeko.de
	The EAWAG - Eidgenössische Anstalt für Wasserversorgung, Abwasserreinigung und Gewässerschutz, Bernhard Truffer	Bernhard.Truffer@eawag.ch
	Forschungszentrum Jülich, Cornelia Karger	C.Karger@fz-juelich.de
Duration:	2002-2006 **Budget:** €1,800,000	**Time Horizon:** 2025

Motivation

This project was established to explore the consequences of structural change in German utility sectors and to raise awareness of the need for coordinated action by stakeholders as well as for the development of strategies for sustainable development. A three step procedure was applied comprising socio-technical scenarios, sustainability assessment and strategies for critical innovation processes. Interactions between four utility sectors - electricity, natural gas, water and sanitation, telecommunications - were considered. Stakeholders involved in production, consumption and governance have been involved at all stages. A multi-level approach was applied to link developments at the sector level with general societal developments and the dynamics of specific fields of innovation. The project also aimed at developing a general methodology for 'sustainability foresight'.

Decentralisation, Customer Orientation and Integration of Utility Sectors

The project was set up under a research programme that supports trans-disciplinary sustainability research financed by the BMBF - German Ministry of Education and Research. It took ongoing transformation processes in the utility sectors as a starting point. Network bound infrastructures for electricity, gas, water and telecommunications undergo changes triggered by policies for market liberalisation and privatisation. Additionally, recent developments in the sectors indicate great potential for radically new technologies and for the existence of demand conditions which could fundamentally transform the way utility services are produced and consumed in modern societies. Obviously such transformations would have considerable impact on the sustainability of these utility sectors as well as on most other economic activities and patterns of consumption.

These changes are characterised by three dimensions of important for the public debate:

- Decentralisation of production,
- Stronger interaction between sectors and
- A more central role for customers.

More generally this project addresses the challenge of governance under conditions of uncertainty due to:

- Complex interaction between social, technical and ecological processes,
- Ambivalence about sustainability goals,

The EFMN is financed by the European Commission DG Research. It is part of a series of initiatives intended to provide a 'Knowledge Sharing Platform' for policy makers in the European Union. More information on the EFMN and on the Knowledge Sharing Platform is provided at WWW.EFMN.INFO

- Dispersion of the authority required to command change among many independent actors.

The objective of the project was to develop strategic orientation on transformation across action domains. For this it was necessary to:

- Analyse, empirically and theoretically, transformation processes in the provision, consumption and governance of the four sectors
- Develop socio-technical scenarios spanning a possibility space for the development of the sectors until 2025
- Assess the scenarios according to sustainability criteria defined by stakeholders
- Develop measures and strategies addressing specific innovation fields for modulating transformation processes
- Bring together stakeholders from the different sectors and different action domains - provision, consumption and governance of utility services.

Sustainability Foresight

The analysis of ongoing transformation processes was based on desktop research, expert interviews and a series of stakeholder workshops. The ‘scenarios’, mainly qualitative in nature, were developed in the course of a series of stakeholder workshops. The ‘sustainability assessment’ combined participative approaches and expert judgements. The development of ‘measures and strategies’, was based on desktop research and a stakeholder workshop.

The following table provides an overview of the ‘sustainability foresight’ process:

Phase	Process Steps	Actors
Adaptation to problem area	Scanning of future discourse and visions discussed in problem area and development of heuristic conceptual framework of the transformation process	Project Team
Phase I: Exploratory Scenarios	Collection of influence factors and elaboration of alternative projections, cross-impact analysis, construction of scenarios as combinations of factor projections, narrative storylines for selected scenarios	Stakeholders and Project Team
Phase II: Discursive Sustainability Assessment	Elicitation of sustainability criteria 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 fields Analysis of actor networks and context conditions of critical innovations; Sketching of paths leading to the different states of the innovation fields as they were described in the scenarios	Project Team
	Development of measures supporting a sustainable development of innovation fields; identification of potential interactions between measures which should be taken into account by an integrated strategy	Stakeholders and Project Team

Four Scenarios for the Future of German Utilities

On the basis of about 40 influence factors, four alternative future scenarios were developed. Influence factors covered processes in the provision of the utility such as the size and type of power plant, consumption factors such as geographical changes of consumption structure and regulatory factors such as environmental and energy policy.

The scenarios considered developments at the sector level as well as general societal developments such as demographic change and economic growth. They also factored in the innovation dynamics of relevant technology domains.

Scenario A: Decentralisation by Consensus

- Decentralisation of technology
- Energy mix with high percentage of gas and renewables
- Low market concentration
- High degree of service orientation
- Utility sectors tightly coupled
- State as moderator

Scenario B: Conservative-Ecological Development Path

- Mainly centralized technologies accompanied by decentralized technologies for environmental reasons
- Energy mix which has a high percentage of gas and renewables
- Active innovation policy focusing on efficiency gains for central technologies
- Low market concentration

Scenario C: Diffusion of Technology Mix by Energy Corporations

- Mainly centralized technology but decentralized technologies are used to diversify the technology portfolio
- The energy mix as a high percentage of coal and nuclear
- High market concentration (international oligopoly)
- Strong market regulation

Scenario D: No Replacement of Established Structures

- Centralized technology for energy and decentralized technology for water
- Energy mix with a high percentage coal and nuclear
- High market concentration
- Two tier class society
- Utility sectors separated
- No active innovation policy
- Weak market regulation

These scenarios delineate a space for possible future developments. This 'probability space' may be characterised as follows: The scenarios cover:

- A broad range of possible technological and organisational strutures for the provision of utility services,
- Both a technical decentralisation for example in the form of combined heat and power plants at the district or household level or decentral sanitation and water recycling systems, and centralisation expressed in the use of large central power plants.

A fully decentralised electricity or sanitation system however is not to be expected to arise within the timeframe considered. Market concentration of utility companies may decrease or increase in the future. Technical and organisational (de)centralisation are not necessarily correlated. This may seem counter intuitive to some, but it is dealt with explicitly in the scenarios. The role of 'the customer' increases to a greater or lesser degree in all scenarios. This translates into the form of the various services offered by utilities, and may involve the contracting of appliances, package offerings, remote maintenance or demand side management. Furthermore all scenarios assume stronger interaction between the different utility sectors. Limited interaction scenarios take the form of multi-utilities, integrated customer services and network maintenance. More extensive interaction may be required however as a follow-on from technical decentralisation.

The sustainability assessment showed that no scenario excelled clearly as the most sustainable scenario. Each scenario presented its own spectrum of strengths and weaknesses from a sustainable development point of view.

Critical Fields of Innovation

In the scenario process various technical and non-technical innovation fields were identified as having a potentially important impact on the future of utility services. From these three innovation fields were chosen: **c**ombined **h**eat and **p**ower plants at the household level (micro CHP), smart building and network regulation. These fields address the provision, consumption and regulation of utilities. They vary substantially from one scenario to another in terms of their role and importance. However it is expected that they may make a substantial contribution to the 'sustainability performance' of utilities.

Combined Heat, Smart Buildings and Network Regulation

'Micro-Cogeneration' units are small power plants which produce energy for heating what are usually large buildings and electricity, which may then be fed into the grid. It is believed that combined heat and power production provides a key to sustainable energy use. However there is a risk that indiscriminate promotion of micro CHP applications could displace competing innovations for sustainable energy generation which may in some cases be more appropriate. This may apply to cogeneration on larger scales (district heating), high building insulation standards (passive housing), or solar energy use.

'Smart Building' technologies allow for the management of utility use and consumption on the basis of communication between building technology and household appliances, from within the house and from outside. These technologies may influence energy and water consumption in buildings. They provide opportunities for efficient energy use and better resource management. On the other hand smart building may result in additional energy consumption. Networking technologies applied inside buildings and with the outside world link the provision and consumption of energy. On this basis demand side management tasks such as load management and consumption analysis are possible. Furthermore they can help to optimise the operation of micro CHP either on a local level or on the level of electricity networks.

'Network Regulation' refers to a set of institutional provisions for access to and usage of utility network infrastructure. It balances a variety of different objectives such as the stimulation of competition through non-discriminatory rules for different categories of service providers, with the need to ensure security of supply by enabling the recuperation of investment costs and appropriate load management by network operators, while at the same time preventing actors from earning monopoly rents.

The sustainable development of utility systems may require additional concerns to be taken into account. For example the construction of network structures is closely linked to anticipated patterns of generation and consumption. These must adapt if new generation technology is to be introduced in the system, based for example on renewable sources, if new technologies such as the internet change patterns of demand, or if energy saving technologies allow us to modify the impact of our consumption on the environment. Active network operators can play a central role as change agents matching new patterns of supply and demand.

Finding the Nexus between these Three Fields of Innovation

In a two-day workshop that brought together about 50 stakeholder experts from these three fields of innovation, a set of measures was developed for each of these innovation fields.

They took in a wide range of variables relating to areas such as regulation, experimentation and technical development. They tried to capture the positioning of a heterogeneous group of actors representing interests as wide ranging as those of policy makers, business or consumer associations and manufacturers. Furthermore, the interactions, possible synergies and coordination requirements were identified.

Local load management as well as network oriented load management in systems that involve micro CHPs constitute a nexus between these three innovation fields.

Establishing an Institutional Framework for Different Fields of Innovation

The transformation of utility sectors opens up a broad range of possible development paths. They each show different sustainability impacts. However no single scenario scores high on all accounts. Decentralisation appears favourable in many respects but it is not a panacea. In appraising alternative utility structures various perspectives have to be taken into account to find the optimal scale and combinations between centralized and decentralized structures for technology, organisation, and policy-making.

With respect to social and ecological issues, two different pathways can lead towards desired futures. In one of these, public policy supported by public opinion, assumes a strong lead role in guiding structural transformation. This pathway requires strong innovation policy, to address innovation in large scale environmental technologies, combined with strong regulation. The other path is characterised by a high degree of social self-organisation. This includes public discourse on technology and required service levels as well as stakeholder participation in corporate decision-making. In this case the state assumes the role of a moderator. This path is based on the appraisal of a broad range of impacts of alternative futures and on recognition of mutually interdependent groups of actors. This path would be linked to more decentralized organisational and technological structures for utility provision.

Transformation Fora

Specific measures to be undertaken by various groups of actors have been identified in the foresight process. A report summarizing these proposals will be available quite soon at www.mikrosysteme.org. The need to establish an institutional framework to accompany these measures in a continuous and systematic manner was emphasised. In particular this required to support and co-ordinate the measures and processes taking place in different fields of innovation. Until now, there are no institutional structures which support processes that lie in the nexus of different fields of innovation. This gap could be bridged by 'transformation for a' set up by the research ministry or a similar institution, to some extent modelled on the Dutch example of 'transition arenas'. These institutions would involve different stakeholder groups affecting or affected by the transformation process in a continuous process of strategic and long-term co-ordination of actions. These do not necessarily imply a common vision shared by all participants. Transformation fora may be complemented by strategic programmes of innovation support and they should carry out the following tasks:

- Coordinate measures in relevant innovation fields
- Monitor and evaluate experience gained from experiments
- Explore evolving relevant contexts and developments
- Adjust strategies in the innovation fields on the basis of these experiences, interactions and developments.

Once one or multiple transformation fora are established for a certain set of innovation fields, additional fora may follow interlinked with innovation fields covered so far.

Transformation fora represent new instruments or 'nexus arrangements' for accompanying and modulating innovation field specific foresight processes as well as technology research and development aimed at ensuring the sustainable transformation of the utility sector.

Sources and References

www.mikrosysteme.org
www.sozial-oekologische-forschung.org