



# Mapping expectations for system transformations Lessons from Sustainability Foresight in German utility sectors

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## ABSTRACT

Expectations held by different actor groups are of key importance for the shaping of socio-technical transformation processes. Foresight activities may be interpreted as a means to elicit, aggregate, modulate and contextualize expectations held by different actors. The paper proposes a conceptual framework that allows assessing and reflecting expectations in foresight initiatives that focus on sustainable sector transformations. For this purpose it draws on the recent literature on socio-technical system transformations and social expectation dynamics. The application of the framework is illustrated by experiences gained with the Sustainability Foresight method developed for the case of sustainable utility sector futures in Germany. The process was conceived as a series of participative scenario and strategy workshops involving about 120 stakeholders from the provision, use and governance of utility services.

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## 1. Introduction

The sustainable transformation of product fields or entire sectors may be framed as a problem of system innovation [1]. System innovation does not focus on single artifacts, products or practices, but on the creation of new socio-technical configurations in which artifacts, products and practices are aligned and embedded in broader institutions, infrastructure, use patterns, cultural values, scientific paradigms etc. The analysis of this kind of transformation processes has to anticipate complex interactions between the different technical and institutional components [2]. As an implication, precise forecasts about the actual course of these developments are often not possible. Furthermore the assessment of sustainability of these developments depends on divergent value positions and is therefore fraught with uncertainties and ambivalences. Future oriented methods that want to address sustainable sector transformation processes have therefore to adequately address uncertainty, ambivalence and complexity. The present paper elaborates a conceptual framework based on the recent literature on system transformations and social expectation dynamics. This framework allows interpreting foresight processes that aim at system transformations as structured contexts for eliciting, aggregating and translating expectations among heterogeneous sets of actors.

In the recent innovation research literature, system transformations have been analyzed for a wide range of different contexts [3–5]. One of the key insights is that the interplay between different kinds of actors (industry, technology developers, users, government departments, professional associations, NGO's, etc.) is crucial for understanding the resulting transformation dynamics. The strategies envisaged by each of these actor groups will, in general, depend on each other and therefore only those innovations can succeed, for which coherent, mutually aligned strategies are chosen. This alignment depends on different kinds of expectations that these actors hold: (i) expectations about future context conditions, under which the sector has to work, (ii) expectations about future performance characteristics of specific socio-technical configurations and (iii) also expectations about the likely role specific actor groups (or individuals) will hold in the future. In the absence of an already materialized reality these

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expectations represent “narrative infrastructures” [6], which enable and constrain actions of individual actors and therefore guide the corresponding innovation processes. However, the specific expectations relating to future context conditions, technologies and actor roles will differ considerably between actor groups or even between individuals. In order to identify the potential room for coordinated strategy formulation, these expectations have to be mutually accommodated.

Discursive and participatory foresight processes may in this sense be interpreted as occasions for reconstructing and exploring the multi-faceted set of expectations held by different actors in a certain sector. If analyzed appropriately, these expectations may systematically be articulated and related to each other. They can be analyzed with regard to their mutual fit or mismatch [7]. In this view, foresight may support the contextualization of specific expectations, enable the development of shared interpretive frames and may therefore constitute a basis for alignment of strategies in the course of shaping sustainable transformation process.

In this article we propose a conceptual framework, which allows mapping patterns and dynamics of expectations within foresight processes that address multi-actor system transformation. For this purpose, we draw on two bodies of recent literature, namely on socio-technical system transformations and on social expectation dynamics. The resulting framework is illustrated by an application of the Sustainability Foresight method, a specific approach to reconstruct and explore these structures of expectations. The Sustainability Foresight approach is inspired by scenario planning processes, which are well established at the level of individual firms [8,9]. While at the firm level scenarios and strategies can be focused to the more or less coherent perspectives of actors within the firm, sustainable transformations of product fields or entire sectors necessitate the integration of a broader range of roles, competences, rationalities and interests of different actor groups. In such a context, coordination failures and conflicts come to the fore and require the development of a high degree of reflexivity on the side of participating actors. In this sense, Sustainability Foresight can be understood as an important element of reflexive governance, which allows for anticipation of co-evolutionary dynamics within socio-technical systems and the mutual adaptation of specific actor strategies [7].

The paper is structured as follows. In the second section we refer to the theoretical strands of socio-technical transformations and social expectation dynamics and propose an integrated framework for carrying out foresight processes on socio-technical system transformations. Against this backdrop, we introduce the Sustainability Foresight method as applied in the context of utility sector futures in Germany, in Section 3. Section 4 interprets the first phase of the Sustainability Foresight process as a deconstruction of implicit visions and expectations and a conjoint reconstruction of various alternative, but more explicit and coherent views on the future. Section 5 focuses on the implications that were drawn from these shared visions by different actor groups. This analysis focused on three critical innovation fields (combined heat and power generation, smart building and network access regulation). They led to mutually reflected strategic implications and an overarching transformation agenda for the sector. Section 6 concludes by interpreting the Sustainability Foresight experience as a series of translation and aggregation processes of expectations of the participating actors and discusses the relevance of this framework for foresight processes, in general.

## 2. Mapping expectations about system transformations

### 2.1. Multi-level concepts of system transformations

A recent interest of innovation research in the social sciences has been the analysis of far reaching socio-technical transformations, or system transformations. A core tenet in this literature is that separations between “social” and “technological” aspects of such transformations could only be justified for analytical reasons and only for very specific situations. In most transformation contexts, the two sides are intimately intertwined [10]. A wide number of historical analyses about changes in technological systems have since illustrated how new technologies and products are socially shaped (for an overview see [4,11]). Recently these concepts have also been applied in future oriented contexts and especially for sustainable transformation analysis [3,12,13].

An important focus of these studies has been on historically identifiable combinations of technological, use, infrastructural, social and regulatory aspects that make up the totality of a “technology” that we refer to in everyday discourse. Concepts like technological paradigms, technological trajectories or socio-technical systems have been proposed in order to identify coherent socio-technical configurations. One of the well known approaches proposes a multi-level perspective on socio-technical transformation processes [4,5,14]. It distinguishes interdependent patterns at three levels. The core level of analysis is the socio-technical regime. A regime may be identified in a specific historical period as a mutually aligned, established set of technological artifacts, use patterns, institutional contexts, regulations, infrastructures etc. that prevail for delivering a specific service, e.g. personal mobility [5]. Adaptations within a regime will, as a rule, be rather incremental because the internal couplings of the regime represented by established paradigms, sunk costs and vested interests will limit the possible variations of its structural components. A socio-technical regime will thus in general develop along specific trajectories. In an economic sector or a societal subsystem, several socio-technical regimes may exist alongside each other (e.g. public and private transport, which represent quite distinctive regimes, (see also [15]). Within a given historical period however, often one regime emerges as the dominant mode for delivering the respective services.

Regimes are embedded in a broader socio-economic environment, the so-called socio-technical landscape. It provides a macro-context in which specific socio-technical configurations or regimes may prosper [16]. Regimes are not static structures even though this may appear so in short-term historical appraisals. Changes at the landscape level may put pressure on a regime, which will have to adapt accordingly. Regimes may also come under pressure from “below”, by the growth of new socio-technical configurations that pose alternatives to or require adaptations of the regime's structure. New technologies often do not fit entirely to the institutional structures defined by the dominant regime. They therefore have to adapt by exploiting appropriate niches.

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