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Does political and social feasibility matter in energy scenarios?

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ABSTRACT

Scenarios have become an influential tool in the process of energy system transitions, as they form a basis for, e.g., investment decisions or legislative frameworks. In this respect, researchers have recently focused on the technological viability of normative targets (e.g., emissions reduction). Beyond that sufficient condition, experience has shown that missing social acceptance may serve as a severe hurdle to the actual implication. Furthermore, the functional principles of the surrounding political system may prove inconsistent with the scenario's assumptions or implications. As a contribution to scenario methodology, this paper presents an analytic framework with a focus on the German energy transition. Accounting for transparency, social acceptance and political feasibility, future energy scenarios might be inclined to be more mindful of societal limitations. These hurdles may range from subjectively ascribed characteristics of the energy system to political veto-players. While the analytic framework is applied, it is not limited to the four recent energy scenarios published by German public actors. This study's results highlight the need for an advanced scenario construction process, which becomes eminent given that the emphasis is currently moving from *if* an energy transition is possible to *how* this goal can be achieved.

1. Introduction

The current transition in energy systems is driven by various motivations. The reasons for gradually replacing fossil fuels are not only to reduce emissions but also to abridge structural import dependencies and to address the foreseeable exhaustion of such fuels. Moreover, support for nuclear energy has precipitously declined since the Fukushima incident in 2011. Many countries have therefore decided to enforce the adoption of renewable energies, albeit with varying degrees of ambition. In this context, energy scenarios form a basis for economic investments and political decision-making. In recent years, energy scenarios have focused primarily on assessing the general *technological viability* of this intended change in systems or on advocating a certain technology path [1,2]. However, it can be concluded that attention is currently shifting from *if* to *how* energy transition can be managed.

On the one hand, possible technology paths diverge in substance. For example, the aim to foster a predominantly national or even regional energy supply yields different technological implications than, for example, the large-scale import of solar heat electricity from the MENA-region [3]. This competition even between green technologies appears understandable as new path dependencies are about to be created. From these, various political, societal and economic stakeholders may benefit differently [4,5]. On the other hand, the population's acceptance of the implications of an energy scenario, e.g., technological infrastructure [6] or higher electricity bills [7–10], cannot be taken for granted. While, e.g., the implementation of carbon capture and storage technology (CCS) takes a prominent role among the technological options [11], an energy scenario that strongly rests on this pillar is likely to encounter greater hurdles given the population's reluctance in this regard [12,13]. Moreover, acceptance hurdles tend not to reveal themselves until planning is translated into concrete action, as evidenced in the case of the railway station project *Stuttgart 21* in Germany [14].

Consequently, to prevent extra costs, delays or even failures of energy system transitions by public disapproval, future energy scenarios that *aim to be feasible* – i.e., they form a basis for action plans – should be able to proactively integrate such possible constraints to a much greater extent. Accordingly, it is the research goal of this paper to develop a framework for analysing how energy scenarios consider *social acceptance* and *political feasibility*. It can be used to

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show which improvements can be made in existing scenarios but also as a checklist for designing future scenario studies. Using this integrative approach may aid in reducing transition costs [15]. As a minimum, our approach should make the social and political *contextual factors* with respect to the choice and implementation of a technology path more explicit. We test the framework in the German context given that it combines an aspiring renewable energy target with the gradual phase-out of nuclear energy by 2022.[1] Furthermore, disputes regarding both preferable technology pathways [5] and acceptance problems of energy infrastructure can be referenced for this case [17].

We first explain the importance of scenarios within the energy sector, provide a brief survey of their characteristics and explain how existing approaches challenge societal hurdles. Introducing our suggestion for a more holistic methodology, an analytic framework that includes the dimensions of transparency, social acceptance and political feasibility will be presented in a second step. Finally, an analytic framework will be applied within a quantitative content analysis to four recent German scenarios as we explore the degree to which social and political aspects are currently accounted for in Germany.

2. Scenario construction

2.1. Scenario types and challenges

This section provides a common understanding of scenarios, emphasises their importance – especially for the energy sector – and offers a brief overview of common approaches to integrating social and political aspects into energy scenarios. Scenario methodology has been identified as an important tool for science, politics and business. However, as scenarios serve a variety of functions, a wide range of definitions exists [18]. Based on the definition of the IPCC, a scenario is a coherent, internally consistent and plausible description of a possible state of a system, and it is to be distinguished from a mere projection that represents only the most likely state of a system [19]. Scenarios are therefore not suitable for accurately predicting the future; rather, they can only determine the conditions and requirements that may lead to a particular result [20].

In the scenario construction process, fundamentally different perspectives can be taken, which necessitates a distinction among scenario types.[2] To do so, the classification of Börjeson et al. [22] is utilised, which differentiates predictive, explorative and normative scenarios. A predictive scenario is intended to answer the question *What will happen?*, while an explorative scenario is designed to answer the question *What can happen*?[3] In contrast, a normative scenario has predefined target points (e.g., a carbon dioxide reduction target) and asks *How can a specific target be reached*? However, in energy scenarios this distinction is not always clear, as scenario studies are supposed to serve as a basis for political decision-making and include both normative and explorative elements. Yet, in the context of energy transitions emphasis is placed on the normative element, which is why we will refer to such scenario studies in the following section.

Regardless of their theoretical classification, scenarios attract remarkable interest in the energy industry and energy politics. From a business perspective, there is a need to assess the profitability of opportunities in changing circumstances due to high investments as well as the long lifespan of energy infrastructure [23]. From a more general perspective, the limitation of fossil fuels and the necessity to cope with radical emissions cuts increase the demand for scenarios in the energy sector [24]. Within the context of the energy transition in Germany, which is a multi-generation project with renewable energy extension goals codified in law until the year 2050, political actors have an increasing need for expertise on how to manage this transition [25]. On the one hand, decisions such as the choice of a specific research or funding policy should be made today to lay the foundation for a future development path. On the other hand, an early decision for a technology option or support scheme can also create path dependencies. These might constrain opportunities for technology options, which, in hindsight, would have proved beneficial [26]. Finding a suitable trade-off further complicates the construction of scenarios.

Against the backdrop of these general challenges, normative energy scenarios that form a basis for action plans would be more realistic if they integrated societal limitations. A commonly proposed approach to address these issues is to make the need for changes in the society or in the political environment explicit. This could be performed within a backcasting process [27,28]. Such approaches can address various questions [29,30], e.g., *What has to change? How can change happen?* and *Who is responsible for making change happen?* [31]. Furthermore, to integrate stakeholder views, participative backcasting approaches have been developed and applied [25,32,33]. Though these approaches are generally promising, they tend to take a slightly constructivist perspective on rather persistent societal structures, which are characterised by social and political inertia [34].

2.2. Integrating societal hurdles in scenarios

A more holistic scenario approach that considers social and political hurdles in the construction process would allow for feasible scenarios to be conducted. These would have a greater probability of being implemented as a real-life solution due to the reduced risk of facing public and political opposition. At the very least, this approach can be considered a useful tool for policymakers to identify critical issues before implementing specific pathways. Therefore, a scenario approach that combines energy system modelling and social and political hurdles is introduced in this section, while further detail is provided in the following chapter.

Both an ex-ante (❶) and an ex-post approach (❷) are capable of considering these barriers (cf. Fig. 1). The ex-ante approach considers acceptance factors, which can, for example, be determined by

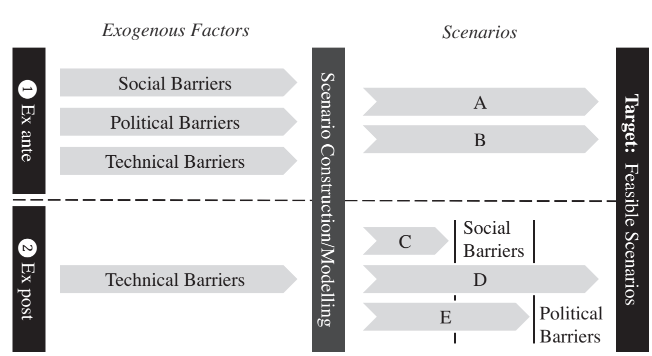

Fig. 1. Scenario construction approaches for feasible scenarios.

[1] The German government has announced that by 2050, renewables shall make up at least 80% of electricity consumption and at least 60% of gross final energy consumption [16].

[2] For a comprehensive description of the scenario construction process see e.g., Droste-Franke et al. [21].

[3] This question could be asked from various perspectives. For example, it could be based on external factors or on a strategic basis to assess possible policy options [22].