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Benefits and challenges of participatory methods in qualitative energy scenario development

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ABSTRACT

Energy scenarios are a tool for exploring possible future developments or states of energy systems. However, traditional energy scenarios mainly concentrate on technological feasibility and economic impacts and lack consideration of social feasibility. Participatory methods, meaning the involvement of external scientists and stakeholders in the scenario development process, can integrate different types of knowledge, perspectives, and values to improve energy scenario development. This paper reports on an approach which is deduced from the strengths and weaknesses of current research applying participatory methods to generate qualitative scenarios. Three different participatory methods - envisioning storylines, futures wheel, and evaluation of narratives - are combined in order to balance the strengths and weaknesses of each of them to create transparent, plausible qualitative scenarios without predisposition. At these three workshops, a total of 25 external and eleven internal participants discussed future developments of the German energy transformation (Energiewende). The paper examines whether this approach overcomes the limitations of current approaches and is ultimately suitable for improving energy scenarios. The findings suggest that a combination of different participatory methods and also a variety of participants help to overcome bias, explore different future pathways in depth, and distinguish between certain and uncertain developments.

1. Introduction

1.1. Motivation and background

The aim of developing energy scenarios is to describe possible future developments or future states of energy systems (Metz et al., 2007). Scenarios are neither predictions nor forecasts (Brewer, 2007; Metz et al., 2007) and thus do not claim to accurately predict the future. However, they can be used as a tool for exploring energy strategies and policies, which foster or hinder development towards a sustainable energy system. Scenario development helps to better understand diverse paths that describe different possible states of the energy system and thus provide more comprehensive knowledge for practical applications (Meissner and Wulf, 2013). The generation of energy scenarios can identify systemic interactions and dynamics within complex systems and assess a range of possibilities and uncertainties of future developments (Thompson et al., 2012). Therefore, the results of energy scenario development can contribute to policy implications and recommendations (Schubert et al., 2015). As energy systems are not only techno-economic configurations but also include social aspects such as norms, values, and behaviour (Rohracher, 2008), energy scenario development is a highly interdisciplinary task. In order to truly understand the dynamics and identify uncertainties all the drivers of transformation processes (Gaudreau and Gibson, 2015) need to be considered in energy scenario development (Verbong and Geels, 2012).

Quantitative models, comprising economic models and integrated assessment models (IAM) are commonly applied in order to analyse future transformations (Geels et al., 2016; Heinrichs et al., 2017). The traditional energy scenario process often contained a mathematical model that describes essential system properties such as technology efficiency, installation and operating costs or resulting CO_2 emissions. Furthermore, traditional energy models are often based upon normative neoclassical assumptions such as rational choice, utility and profit maximisation, perfect information (Li et al., 2015), but do not explain the underlying behaviour of individuals or societal actors. This results in 'endemic' forms of uncertainty (Smithson, 1989), which leads to invisibility of possibilities, inaccurate measurements, and exclusion of information during the acquisition of knowledge (Butler et al., 2015; Wynne, 1992). Nonetheless, there are also initial approaches towards including societal aspects in quantitative energy scenarios (Heinrichs et al., 2017).

In order to better understand and reflect the social environment in

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which the energy system is embedded, a suitable approach is the improvement of context scenarios or qualitative scenarios (Thompson et al., 2012; Weimer-Jehle et al., 2016). Qualitative scenarios are understood as descriptions which provide contextual information on 'anticipated future developments' (cf. Schmid and Knopf, 2012). Therefore, the terms 'context scenario' and 'qualitative scenario' are used synonymously in this paper. In contrast to quantitative scenarios, qualitative scenarios describe possible futures by storylines or narratives rather than numerical estimates (Alcamo, 2008). The qualitative data required for the development of qualitative scenarios can be generated, for example, by involving experts or stakeholders. Such participatory methods can enrich the process in general by making explicit the various and often conflicting values and underlying problem perceptions of the participants involved (van den Hove, 2007). However, this also creates limitations because the findings rely on the knowledge and perspectives of the participating actors and not on scientific analysis (Geels et al., 2016). Therefore, participatory approaches are often criticised as being insufficiently reproducible, transparent, and balanced, as well as lacking a proper estimation of the plausibility of future developments (Alcamo, 2008; Trutnevyte et al., 2014).

This paper reports on a participatory approach that generates qualitative scenarios. The approach is derived from the strengths and weaknesses of current research on scenario generation. Balancing the strengths and weaknesses of each of three different participatory methods is assumed to create transparent, plausible qualitative scenarios without predisposition. Therefore this paper contributes to ongoing research by providing insights into how to overcome the limitations of current approaches and, ultimately, how to improve energy scenarios.

1.2. Strengths and weaknesses of participatory methods generating qualitative scenarios

1.2.1. Strengths

Transformation processes are not only driven by technological innovation and policy changes, but also require changes in values, norms, and perceptions (Kollmorgen et al., 2015; van de Kerkhof and Wieczorek, 2005). That is why sustainable transformations can also be defined as 'a new quest for new value systems' (Grin et al., 2010, p. 2). The development of scenarios should represent such a quest to improve energy scenarios. This implies that energy scenarios need to make transparent the underlying perceptions regarding predominant values, behaviours, and goals in society that determine the relevant drivers of system changes (Schubert et al., 2015). This furthermore necessitates that the development of qualitative scenarios should be open to capture various perspectives on possible future pathways (Trutnevyte et al., 2016a) and analyse reasons supporting and opposing possible developments.

However, so far most energy scenarios lack a consideration of such social, political, and cultural reconfigurations. Furthermore, mathematical equations cannot incorporate the diversity of information and uncertainties (Geels et al., 2016). Therefore, researchers have investigated methods to improve energy scenario development and several studies have shown that a combination of quantitative models and qualitative scenarios, composed of storylines and narratives (Alcamo, 2008; Fortes et al., 2015; Trutnevyte et al., 2014), can be suitable to bring together the strengths and to overcome the weaknesses of the respective methods. We understand storylines as integral parts of qualitative scenarios, which entail broad descriptions of important future conditions that determine the development of societal systems, e.g. of future energy systems (O'Neill et al., 2015). In contrast, we define narratives as more detailed descriptions of specific drivers significantly influencing the energy system. Drivers are important features influencing energy systems. For example, climate change can be seen as a driver of energy systems. Descriptions of future developments of drivers can be used to structure the development of storylines, narratives, and qualitative scenarios. In contrast to a driver, a trend not only names the feature but also the direction of driver development such as 'increasing climate change'. Visions are understood as pictures of a future, which are normative in the sense that they are recognised as ideal and desirable by the respective participants (Andreescu et al., 2013; Trutnevyte, 2014).

In this spirit, qualitative scenarios were investigated in order to reduce the uncertainty concerning the robustness of quantitative energy scenarios (Weimer-Jehle et al., 2016). Qualitative scenarios are suitable for depicting the possible developments of societal features that cannot be adequately described by numbers (such as governance, institutional changes or energy-related behaviour). In addition, qualitative scenarios can explain the boundaries used for modelling and make their interdependences explicit, which at the same time provides possible starting points for further elaboration of these scenarios (O'Neill et al., 2015).

The construction of storylines is considered to be an integral part of developing qualitative scenarios (Weimer-Jehle et al., 2016). Storylines can be generated by involving external or internal experts and stakeholders thus integrating different types of knowledge, which results in the analysis of future developments that can go beyond modelling insights (Trutnevyte et al., 2014). While combining qualitative and quantitative energy scenarios is a relatively new field of research, in contrast applying participatory methods in scenario generation or scenario planning is quite common (cf. Amer et al., 2013; Bradfield et al., 2005; Godet and Roubelat, 1996; O'Neill et al., 2015; Schmid and Knopf, 2012). However, the participant structure and purpose of participatory methods in scenario development differ. While some scenario techniques include mainly internal experts facilitated by some experienced scenario practitioners (e.g. intuitive logics school) others largely consist of external experts (e.g. La Prospective school or probabilistic modified trends school) (Bradfield et al., 2005).

Furthermore, qualitative scenario development is not only discussed in order to provide more transparent and comprehensible scientific findings but also to improve decision-making processes by cognitive benefits for the participants. Specifically fostering strategic thinking, enhancing mental models of decision makers and reducing cognitive biases are mentioned as appearing (Meissner and Wulf, 2013). This might stimulate adaptive learning (Carlsson et al., 2015; Meissner and Wulf, 2013; van der Heijden et al., 2002). The participatory character of scenario development may improve the understanding of final scenarios because written narratives are considered a 'more interesting method for communicating the substance of the scenarios than numerical data' (Alcamo, 2008, p.137).

1.2.2. Weaknesses and research gap

Even though the involvement of experts and stakeholders is a commonly applied method to develop, test, and adapt storylines and narratives for energy scenario generation, this method also poses challenges. In general, participatory qualitative scenarios are criticised as lacking reproducibility, transferability of assumptions to quantitative models, and integration of the model results in the storylines (Alcamo, 2008). Furthermore, qualitative scenarios may be unrealistic because the experts and stakeholders involved present only a limited understanding of the feasibility of future developments and require greater transparency and balance (Trutnevyte et al., 2014). So far mainly cross-impact-balance (CIB) methods have been applied to ensure consistency of storylines (Schweizer and Kriegler, 2012).

In addition to workshops also interviews and other methods are applied to integrate the knowledge and values of stakeholders and experts into the generation of qualitative scenarios. However, especially surveys pose specific communication challenges because in the case of scenarios they do not call for factual knowledge but primarily estimations about future developments. The findings of Varho and Tapio (Varho and Tapio, 2013) suggest that if participants feel unable to estimate a trend, they will not provide an answer. This is in line with findings from public participation research, which suggest that low