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ANALYSIS

The allure of energy visions: Are some visions better than others?

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ABSTRACT

Energy visions, which define the desirable state of the future energy system, are used by leaders and other societal actors in developing energy strategies. Low-carbon energy, 100% renewable energy system and 2000 W society are examples of such visions. While all visions sound appealing and promising, they also tend to be 'black box'-like and gloss over the potential negative consequences. A good vision needs to be both socially viable and analytically sound. This paper describes an approach for comparing several visions from quantitative analytical and qualitative social perspectives. This approach, based on the EXPANSE methodology, also allows for eliciting the commonalities (overlaps) and fundamental differences of various visions. The method is illustrated by comparing three visions of heat and electricity supply in a Swiss municipality. All three visions have their strengths and weaknesses and there is hardly a single best vision. Even if several visions differ substantially in their qualitative narrative, they can still overlap in their implementation options (energy scenarios) and consequences. Thus, there is no pressing need to try to develop only a single best vision as multiple visions may overlap and can co-exist.

1. Introduction

Energy Strategy Reviews journal [1,2] and other scholars [3–9] already acknowledged the role of energy visions as a part of an energy strategy. Energy visions define the ideal, desirable future state of the energy system and are used by various societal actors in purposively shaping the energy system transition [10–13]. There are multiple visions used in national, continental and global as well as local energy strategies. Table 1 lists several examples of such visions, clustered by the author. When the detailed descriptions of these visions are studied, it becomes evident that all of them promise a more environmentally friendly, more secure, and, generally, more sustainable energy system. All visions sound appealing and promising and this is the 'allure of energy visions'.

With the exceptions of [3,6–9,14], there have been limited efforts in transparently comparing various visions. This is essential because visions tend to be 'black box'-like and even the actors, who support these visions, may not be completely aware of the implementation requirements and the potential consequences [7,8]. Visions tend to gloss over the potential conflicts and negative consequences [7,8,10]. A number of practical examples illustrate this argument. Scholz [15] showed that the Swedish vision to become an oil-free society did not account for the local potential of bioethanol production. Major bioethanol imports from the Southern hemisphere would be thus required. This would lead to negative environmental and societal impacts, such as deforestation or relocation of indigenous communities, in the Southern hemisphere. Späth and Rohraher [4] documented how a renewable energy vision emerged in an Austrian region. Once the vision started dominating the local discourses, the critical voices about the sustainable use of biomass or protection of the remaining unregulated rivers against hydropower were perceived to "demonize" the discourse rather than to raise credible concerns about the likely negative consequences. McDowall and Eames [14] showed that even among experts the expected benefits and drawbacks of the hydrogen economy vision vary greatly. The negative consequences of visions may not only be related to environmental impacts, but also cause societal conflicts. Frei [3] showed how four energy visions—clean coal society, nuclear society, smart grid electricity society and bio society—differ in their acceptance by the key societal actors, such as consumers, big industries, etc. In sum, there are two sides of visions: positive and negative.

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Table 1
Examples of energy visions.

Clusters of visions	Visions for countries, continents and the world	Visions for districts, towns, cities and regions
Resources-based visions	• 100% renewable energy in European Union [18] • Desertec—solar energy from deserts for Europe [19] • Fossil fuel independence in Denmark [20] • Oil-free society in Sweden [21] • Wind, water and solar energy systems for the world [22]	• 100% renewable energy cities in the world [23] • Bioenergy regions in Germany [24] • Solar communities in the United States [25]
Technology-based visions	• Hydrogen economy in the world [26] • Solar hydrogen system in the world [27] • Nuclear phase-out in Switzerland [28] • Smartgrids and the supergrid in European Union [29,30]	• Advanced integrated energy system for Geneva [31] • Energy hubs for rural or urban districts [32]
Environment-focused visions	• 1 ton CO_2 society in Switzerland [33] • Clean coal in Canada [34] • Clean energy in United States [35] • Low-carbon energy or economy for the world [36]	• Clean energy cities in China [37] • Low-carbon city of Melbourne [38]
Demand reduction–based visions	• 2000 W society in Switzerland [39] • Green consumption in Sweden [40] • Dematerialization in the world [41]	• 2000 W society in Zurich [42]
Values-based visions	• Energy independence in the United States [43]	• Energy-independent Wisconsin [44] • Energy self-sufficient Alps or the town of Güssing in Austria [45,46] • Transition towns in the UK [47]

This paper thus argues that a good vision needs to be both analytically sound and socially and politically viable. An approach is described for systematically comparing several visions from the quantitative analytical and qualitative social perspectives. The quantitative perspective [7,8], based on the EXPANSE methodology for energy scenario construction [7,8,16,17], also allows for eliciting the commonalities (overlaps) and fundamental differences of various visions. In this way, a more detailed and transparent comparison of visions becomes possible.

2. Quantitative analytical comparison of visions

The majority of visions are expressed as qualitative narratives or short titles [8,48]. Their analytical comparison is thus challenging, especially given the inherent need for numbers in developing energy strategies [49]. For this purpose, an existing approach [7,8,16] is especially useful as it 'translates' a qualitative vision into a number of maximally different energy scenarios. There are multiple different energy scenarios that can implement the same qualitative vision and this approach allows for systematically capturing them. At the core of this approach is the EXPANSE methodology [7,8,16,17], which is summarized in Fig. 1:

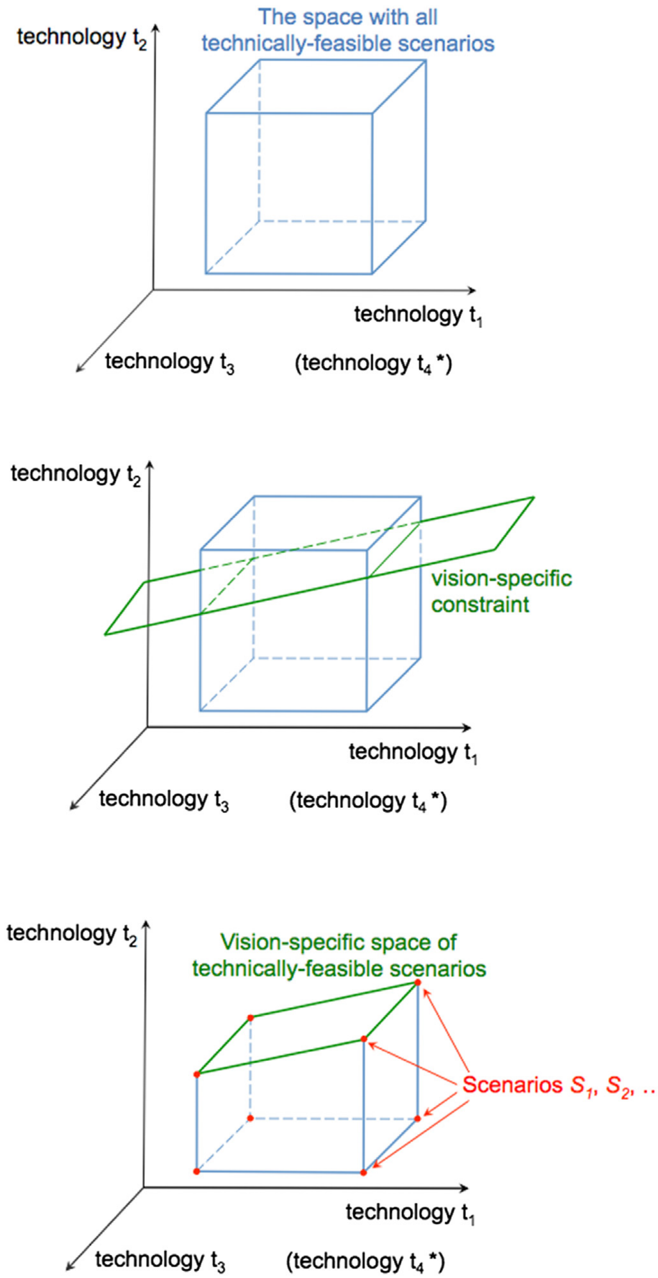

Fig. 1. EXPANSE methodology for translating qualitative visions into energy scenarios (technology mixes). *Note: This is a simplified example. For the space of technically feasible energy scenarios to be a cube, there is a need for four technologies. The axes of only three technologies are depicted in this figure.

1. An energy vision is conceptualized as a multidimensional space of technically feasible energy scenarios. An energy scenario is defined as a technology mix that is needed to supply the required energy demand, including the potential end-use efficiency improvements. Like in any bottom-up energy model [50], the mathematical constraints on demand-supply balance, technical feasibility, environmental impacts and others are used to define this space of technically feasible energy scenarios.
2. A vision-specific space of technically feasible scenarios is defined next (Fig. 1). The rationale for this is that every qualitative vision adds one or several additional constraints to the space of the technically feasible scenarios. For example, the low carbon energy vision limits the level of carbon emissions.