Key Factors for scenario generation for energy systems

Energiepolitik
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Motivation and Research Question

For scenario generation the first step is to identify the model parameters and to quantify them in a second step. Therefore, a metastudy is realized to investigate what the main key factors are and to present them graphically. Furthermore, similarities and differences for the selected scenarios are analysed with respect to the identified key factor. The aim is to demonstrate which factors influence the future energy system the most, to identify game changers (key factors with which the target scenarios can reach their aim) and to set them realistic limitations (range in which the particular key factor can be chosen).

Methods

To analyse the key factors, a shell model is constructed. Starting from the centre, the energy system gets break down with every following shell. Depending on the assumed perspective, the scenarios are built either by going from outer to inner shell or vice versa. The modeller starts from the centre, the scenario analysist from outside to create the story behind the scenario. For better understanding, the number of shells is restricted to four. In this work, the key factors were collected, hierarchically sorted and then embedded in the shell model.

In total seven representative studies with in total 17 scenarios (6 trend scenarios, 6 target scenarios with 80% emission reduction in respect to 1990 and 5 target scenarios with 95% emission reduction) were selected. The selection was based on the following criteria: actuality, that different models were used, a homogenous selection of trend and the different target scenarios and an extensive documentation. The selected studies are shown in Table 1. To analyse which key factors influence the future energy system the most, the final energy consumption of the sectors as well as the green gas emissions are examined.

Table 1: Selected studies

Title	Abbreviation	Contracting Authority	Authors	Year
Entwicklung der Energiemärkte – Energiereferenzprognose	ERP	BMWi	Prognos, EWI, GWS	2014
Klimaschutzszenario 2050	KSZ	BMUB	Fraunhofer-ISI, Öko-Institut e.V.	2015
EU Reference Scenario 2016 – Trends to 2050	EU	EU	European Commission	2016
Langfristszenarien für die Transformation des Energie-systems in Deutschland	LFS	BMUB	Consentec, Fraunhofer ISI, IFEU	2017
Den Weg zu einem treibhaus-gasneutralen Deutschland ressourcenschonend gestalten	THG	UBA	IFEU, Fraunhofer IWES, CONSIDEO, Dr. Karl Schoer SSG	2017
Klimapfade für Deutschland	KP	BDI	Boston Consulting Group, Prognos	2018
Integrierte Energiewende	IEW	dena	dena, EWI	2018

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Results and Conclusions

To give guidance to both modeller and scenario analysist for the scenario generation, a shell model is constructed splitting up the energy system down to the context factors (see Figure 1). Comparing the shell model to a CIB matrix, the shell model shows the context, the hierarchical structure. On the other hand, the CIB matrix reveals a measure for the relation between key factors. Depending on the objectives, either the CIB or the shell model should be chosen.

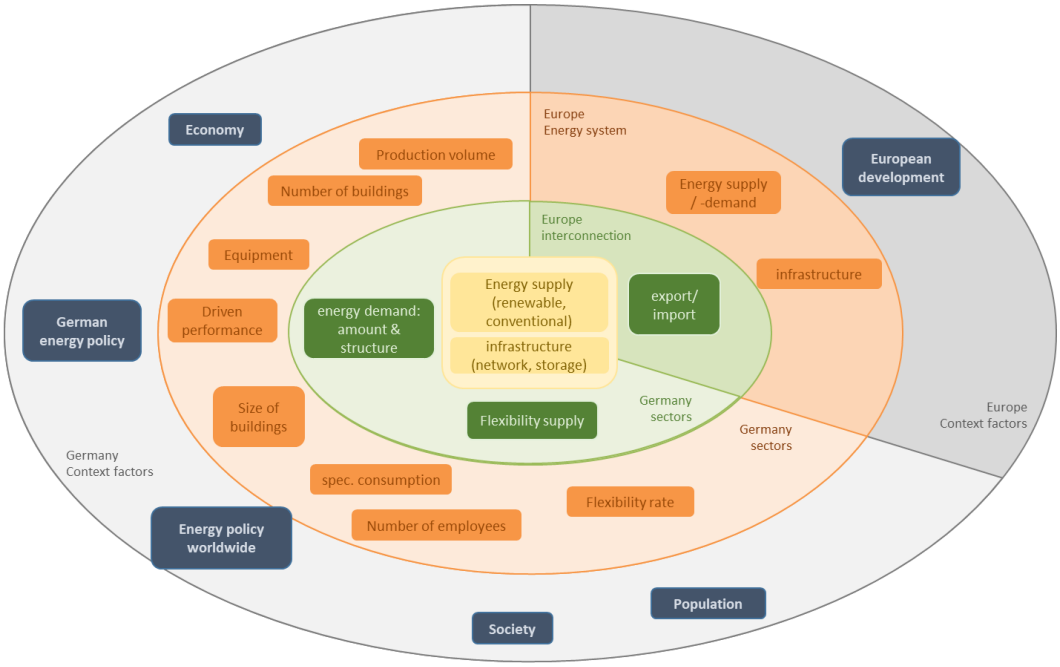
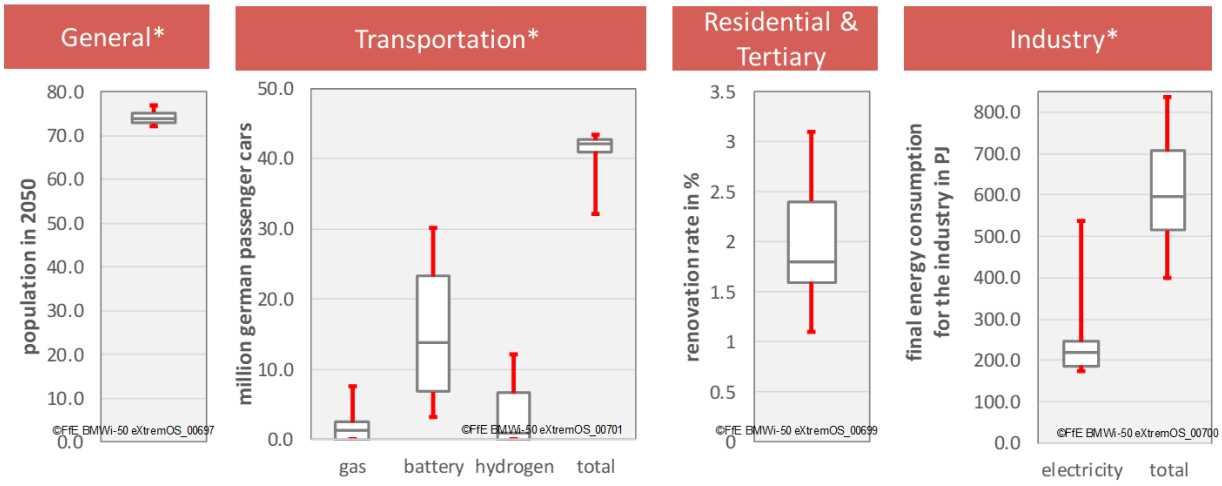


Figure 1: Shell model of the key factors

The second research question was how the key factors vary between the different scenarios. To answer this question, we present the key factors in boxplots (exemplary in Figure 2). Key factors as the renovation rate or the amount of electricity in the industry differ significantly, while in contrast the population development is very homogenous (since a stable Germany is assumed). The great range for e.g. the renovating rate reflects the uncertainty for the transformation path to 2050. For scenario generation the attention has to focus on these uncertain factors since they influence the future energy system the most. From the boxplots, also limitations/ranges for the key factors can be extracted.



*no endogenous but exogenous parameter (relevant endogenous parameter is not mentioned)

Figure 2: Boxplots of some exemplary key factors

Literatur

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