Abstract for 1 - 2 presentations (concept-application)

Constructing "hybrid" scenarios to enhance socio-technical system understanding and to improve coupling the "story" with quantitative modelling. An approach applied on two regional energy system case studies."

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The awareness within the energy research community has increased that narrowly focusing on technical aspects in energy systems analysis is inadequate. It finds wide acceptance to consider a socio-technical system for long-term energy analysis, but by now the level of integration of societal contexts (political, economic, social and cultural aspects) in energy system modelling is still rather insufficient. Additionally we are challenged by a lack of methodological approaches for the practical implementation of the inclusion of societal contexts in energy scenario construction.

The problem in energy modelling, which is used for long-term scenario analysis, is that societal issues are neither considered in-depth, nor are they considered systematically. In particular, the uncertainty and complexity of the future development of the embedding society is not clearly reflected in traditional energy scenario analysis. The embedding society is coupled with the energy scenarios via "framework conditions" (e.g. the future population, economic and technical development or political instruments) and also via implicit assumptions (e.g. technology preferences, consumer behaviour, international conditions). Analysing the uncertainties behind these assumptions in a more systematic and comprehensive manner would open up the chance not only to acquire better systems knowledge, but also to identify socio-technical risks impacting on energy systems development.

For that reason we attempt to fill the methodological gaps using an innovative approach to develop qualitative scenarios and to combine them with quantitative scenario exercises. This approach has the ability to address on the one hand society's complexity by making the above mentioned assumptions more explicit. On the other hand it addresses the uncertainty of future development by including an assumed range of future developments of societal and other external factors in scenario construction which are systematically related to each other. Methodological background of this approach is the "Story-And-Simulation"-approach (SAS) [1], known from environmental modelling. Recent research in climate change analysis [2, 3] has shown that the "story" in the SAS-approach can be improved and strengthened by replacing the usual rather intuitive approaches with a more systematic scenario approach, the Cross-Impact-Balance Analysis (CIB) [4]. We expect that the application of this combined approach ("CIB-and-Simulation") ameliorates the validity of framework assumptions also in long-term energy scenario analysis. The resulting internally consistent CIB scenarios provide a basis to develop comprehensive qualitative scenarios. The results are translated into numerical sets of input parameters for energy simulations. The product of combining societal scenarios with model based energy scenarios are "hybrid" scenarios with which we expect to get better system understanding. We stay abreast of complex societal changes first by increasing the level of integration of social contexts in energy system modelling and second by systematically considering interdependencies between different variants of social and technical future developments.

In the Helmholtz research alliance ENERGY-TRANS (see www.energy-trans.de), the "CIB-and-Simulation"-approach is applied in three projects to reflect energy system transformation as socio-technical transformation and to test the approach for its applicability to facilitate the process of linking storylines with quantitative scenarios in the field of energy systems analysis.

Against the background of the German energy transition various energy models analyse the transformation on a national level, but in one of the alliance's context scenario exercises we consider it highly important to focus also on the regional level because local technical and economic conditions as well as basic needs of urban and rural people vary significantly [5]. More precisely, the energy transformation pathways depend on different regional societal developments like demography, economic structure, the established structure of the energy supply systems, as well as on mobility patterns and others. The challenge is to develop regional scenarios consistent with the upper spatial scales like the national and international level, but nonetheless take into account individual framework conditions of different regional areas.

We selected one urban region (Berlin) and one rural region (Southern Thuringia) within Germany for an in-depth study on the regional transformation process. In this study multiple sub-models are combined to determine the induced changes in energy supply, mobility structures, economic structures and environmental qualities. To cope with interdependencies between several regional mega trends a set of so called descriptors (system elements describing the development of a system or the influences that determine the systems behaviour) has been established for each region. The descriptors were compiled considering developments that could lead in contrary directions on the national and regional scale (e.g. population growth) and developments that are decisive mainly on the regional level (e.g. social infrastructure). For each descriptor we have established a set of trends covering the possible "area of uncertainty" in the future reflecting literature and expert interviews. In the next step, the quality of interrelations has been systematically assessed by attributing the strength of the impact of one trend on another one by one. Balancing these impact judgments lead to an internally consistent set of trend combinations. These raw scenarios are the basis for creating the storylines for our regional model to get a better image of the examined region, how it may evolve until 2050 and to understand the regional system behaviour.

Besides a better system understanding we also assume that these scenarios can subsequently be better translated in numerical framework conditions and constraints for quantitative models. We want to outline that descriptors can adopt different functions in the coupling process. On the one hand they can affect a model directly by influencing the model concept itself or by appearing as model parameter. Both impacts are derived from CIB scenarios. On the other hand descriptors can be used to guide the selection process of exogenous parameters. This process of coupling the regional context scenarios with the regional energy models is on-going, but first efforts in a demonstrator version of the "CIB and Simulation"-approach as well as research conducted by other ENERGY-TRANS partners [6] has proved that hybrid scenarios are practicable to tackle the methodological gaps in energy system modelling we presented.

Based on these two case studies, we want to present the CIB-and-Simulation approach highlighting socio-technical scenario development of different regions. Moreover, we want to demonstrate results of the regional context scenarios and share first experiences of the improvements we see in the coupling process if using "CIB-and-Simulation" presenting some examples of translation steps from CIB-Scenarios to numerical modelling.

Sources

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