LONG-TERM DEVELOPMENT OF REGIONAL DISTRIBUTION AND OWNERSHIP OF RENEWABLE ENERGY PROJECTS IN GERMAN ELECTRICITY SECTOR

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(1) Overview

The objectives of the energy concept of the German government in 2010 and the energy revolution (German: "Energiewende") of 2011 are clearly defined. The share of renewable energy sources in electricity production shall be 80% in 2050. Germany is faced with an enormous need for investments in renewable energy. Against this background, the question arises how the investments in different RES-E technologies (RES-E: Renewable Energy Sources for Electricity generation) will develop in Germany. To deal with this question, a quantitative modeling tool was developed that predicts the development of RES-E technologies in Germany in high spatial and techno-economic resolution up to 2050, taking into account the potential of the individual technologies, the current political framework (feed-in tariffs) and different groups of investors with their specific investment decision behavior.

(2) Methods

Since the future market development of RES-E technologies is particularly dependent on individual investors' decisions, a dynamic investor-based model approach has been adopted, which takes into account the complex ownership structure of RES-E technologies in Germany. The unique feature of this model is reflected in the fact that costs are compared not only from the perspective of utilities, but also from the perspective of many other investor groups, e.g. from the private or financial sector. Simultaneously, highly spatially resolved surface potential of the considered RES-E technologies are allocated to the different investor groups in German administrative districts (so-called "Landkreis-Ebene" or "NUTS3"), that a development path for the RES-E technologies is derived involving dynamic techno-economic implications. To take into account the techno-economic characteristics of the RES-E technologies and the unequal spatially distributed and limited RES-E resources, its own cost resource curves were derived and integrated in the model. The market development of RES-E technologies corresponds to a technology diffusion process. The temporal dynamics of technology diffusion typically follows a so-called logistic growth. The growth is first exponentially, slows down and comes to a standstill when the saturation point is reached. Characteristic is a resource that is used up with the growth. In this model, for example, the growth of PV systems is limited by the available roofs. Therefore, the growth of the RES-E technologies is described by the logistic equation with a characteristic sigmoidal, in other words s-curve, shape.

(3) Results

If the German Renewable Energy Sources Act (EEG) is preserved in the present form, a strong market growth of RES-E technologies can be realized depending on the techno-economic parameters of the model. In 2050, 80% of electricity generation can be provided by RES-E technologies in Germany taking into account area restrictions. This corresponds to approximately 700 TWh, with which theoretically all of today's German electricity demand can be met. Two developments are expected: a rapid construction of PV systems, mostly by private individuals and associations, will be supported after reaching the EEG- target of 52 GW in 2016 by self-consumption and avoided electricity costs and a high share of further, large-scale RES-E capacities, especially wind offshore, will be implemented by utilities. Therefore, in the future the utilities will have a market-dominant position besides private individuals. Figure 1 shows as a result of the model the shares of investors in the installed capacity of RES-E plants.

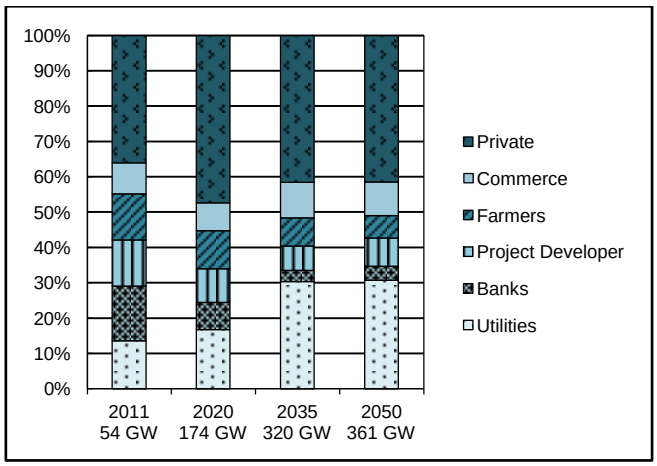

Fig. 1: Shares of investors in the installed capacity of RES-E plants

(4) Conclusions

The developed model can be used for specific quantitative assessment on changes to the Renewable Energy Sources Act (EEG) or for creating energy scenarios. With the help of sensitivity analysis, the model can assess - concerning the development of RES-E technologies - changes in the EEG, in the techno-economic framework, in the investors' structure or in the area restrictions.

Quantitative results for the ownership of future renewable energy projects could be projected, as well as the regional distribution of wind and PV projects which are represented by small-scale projects of private investors and large-scale power plants by institutional investors, cooperative association or utilities.