Assessing the Impact of Renewable Support Policies – Modelling Investors and Investment Decisions

By Francesco Hipp and Christoph Weber

INTRODUCTION

One key issue for renewable energy policy design is the estimation of possible impacts of specific support mechanisms such as feed-in-tariffs or quota systems. To assess the impact of different promotion schemes one has to be able to forecast future investment in renewable energies. Most models aiming at modelling investments in the energy sector focus on the assessment of the profitability of possible investments. This means capital demand is modelled but since every profitable investment is realized there is no consideration of capital availability and capital supply among the different investor groups. Every investment decision in reality is linked with a matching of capital supply and demand. Thus to model investment decisions in renewable energies it is necessary to model both aspects. In the proposed Renewable Energy Investment model (REInv model), the profitability of different renewable energy investments and the associated risk are assessed and on this basis the capital demand curve is derived. The corresponding capital supply is dependent on the financial resources of the investors and their requested return on investments. The model is used to assess the future development of renewable energies in Germany under different support schemes and allows to compute key figures like renewable energy production, installed capacity, investment volume and height of the renewable surcharge.

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THE REINV-MODEL

As in other markets, capital supply is expected to be an increasing function of the price of capital, i. e., the interest rate or expected return on investment. A parsimonius yet realistic model is needed to describe the investment behavior of different investor groups dependent on the profitability of the investment alternatives. Therefore a piecewise linear capital supply function is designed (see Figure 1). It is characterized by three key parameters: the minimum profitability above the relevant rate (which can be the risk free interest rate or the weighted average cost of capital depending on the specific investor group) required for any investment (the so-called hurdle rate), the maximum available capital for renewable energies and the level of profitability necessary to make full use of the available capital (maximum excess return). Because investors are heterogeneous the capital supply represented by the investment function has to be modelled separately for the different investor groups considered (e.g., private households, farmers, insurance companies).

$$Investment = maxInvestRE * max\left\{\min\left(\frac{IRR - (RR + HR)}{MER - HR}, 1\right), 0\right\}$$

maxInvestRE	*Maximum investments in renewable energies*
IRR	*Internal rate of return*
HR	*Hurdle rate*
RR	*relevant rate*
MER	*Maximum Excess Return*

. Therefore functions similar to cost potential curves are implemented for most of the 18 included investment alternatives. For each investment alternative, the IRR is calculated taking into account detailed information on the revenues depending on the policy support mechanism and market environment as well as technical and application characteristics like full-load hours and possible self consumption. The corresponding cost are derived using CAPEX, OPEX, depreciation time, physical lifetime etc.

The introduced modelling of capital supply and demand leads to an equilibrium solution, which may
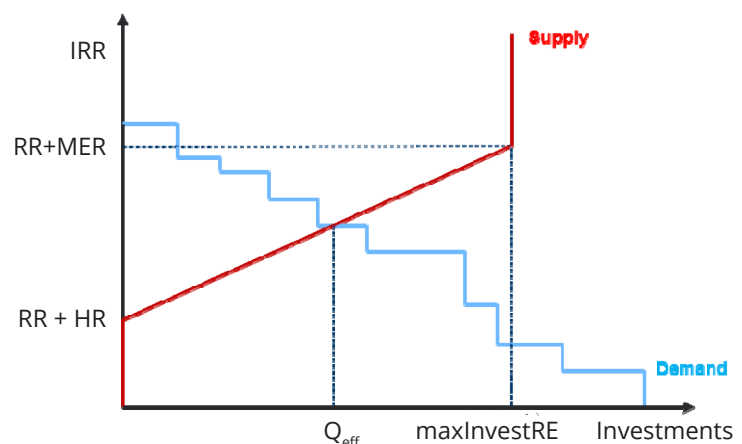
be computed in a dynamic recursive manner for a sequence of future years.

RESULTS

The impact of support schemes in energy markets can be measured in various dimensions. When it comes to the promotion of renewable energies key impacts are the annual electricity generation, necessary investments and the costs to society (measured notably through the height of the renewable surcharge for electricity consumers). The developed model is used to forecast the development of renewable energies in Germany until 2030 with a focus on these key impacts. By modelling different support schemes it is possible to compare the influence of these promotion schemes on the electricity market. Preliminary results cover the German feed-in tariff EEG 2012, a renewable energy premium and a renewable energy quota scheme. For the EEG 2012, also sensitivity analyses on the influence of several input parameter like central bank interest rates on the results have been made.

The highest investment in renewable energies is observed with the conventional feed-in tariff. Because of a missing adjustment of regulation we see an overachievement of the German goals. Under the considered premium scheme the support level adjusts as a f unction of the growth of renewable energies. Therefore only a temporary overachievement of policy goals is observed in this scheme and the amount of investment is lower. The quota is the mechanism with the lowest investment volume due to the fact that there is no overshooting of pre-established targets (as with the planned reform of the EEG 2016/2017) and no technology-specific support. This is accompanied by a similar ranking in social costs of policies. In our calculations the capital resources in all three mechanisms are sufficient to realise all profitable investments.

CONCLUSIONS

The developed model is a useful tool to forecast the investments in renewable energies by different investor groups depending on the policy support mechanism and the development of the market environment. Capital demand and supply are modelled which enables the assessment of a possible shortcoming of capital in the market. Among other things this allows a consideration of risk which is crucial when comparing the impact of different support policies. So far, risk adjustment is done based on risk scorings transformed into interest rate adjustments – as is current practice in companies. One possible model improvement would be an endogeneous calculation of risk-adjustment factors to better describe the influence of different support policies on the cost of capital. Furthermore the model may be extended to cover further support policies, investor groups or technologies.

While no final conclusions should be drawn based on the preliminary calculations, the results indicate that cost-efficiency of the promotion of renewable energies is strongly supported by technology-unspecific promotion which is adjusted as a result of the observed growth of renewable energies. Sensitivity analyses demonstrate a high robustness of the model results against variations of single input parameters like central bank interest rates.

Bergen Overview (continued)

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Social Events

Apropos Edvard Grieg: A private tour and concert for accompanying persons was arranged on Wednesday to the composer's home, Troldhaugen, (the Hill of Trolls) outside Bergen. The Director of the Troldhaugen museum, Sigurd Sandmo, received the busload of visitors, introducing them to the place and its history, and the renowned pianist, Håvard Gimse, played some of Grieg's music. It was a most memorable musical and historic event in beautiful surroundings.

Conference delegates had many opportunities to both network and enjoy the history and culture of Bergen