Kristin Dietrich, Florian Leuthold, Christian von Hirschhausen and Hannes Weigt

ELMOD - ELECTRICITY MODEL USING NODAL PRICES AN APPLICATION TO EFFICIENT INVESTMENT IN GENERATION CAPACITY

Dresden University of Technology, Faculty of Business and Economics, Chair of Energy Economics and Public Sector Management, D – 01069 Dresden, Germany
Phone: +49-(0)351-463-39766, e-mail: kristin.dietrich@mailbox.tu-dresden.de

Overview

The driving force of changes in electricity markets is the effort of the European Union to create a single integrated electricity market. Hence, marked incumbents as well as new entrants face the problem of an ongoing change in market structure which has a substantial impact on their investment decisions. Particularly in the German electricity market there is a significant need for replacement investments whereas on the other side large scale wind capacities are constructed with political support. This may lead to congestion which is not properly taken into account under current network management methods. We use a combined approach to identify efficient investment, using a newly-developed model of the European electricity market (ELMOD) and compare the results to planned investment decisions.

Methods

The analysis is carried out by using ELMOD, an electricity transmission network model developed at the Chair of Energy Economics at Dresden University of Technology. ELMOD is a DC-Load Flow model of the European integrated transmission grid. Generation and demand are localized at the nodal level to allow for a detailed representation of different grid situations. Load at each node is modelled using the gross value added of services and industries as well as the number of inhabitants and typical load profiles. In different scenarios characteristic winter and summer workdays are implemented on an hourly basis. Generation plants are represented with marginal costs based on plant individual efficiency values and fuel and CO_2-certificate-prices. The model is implemented in GAMS.

ELMOD is capable of different congestion management schemes. In this paper, we apply a welfare maximizing nodal pricing approach as presented in Schweppe (1988) and Todem and Stigler (2005).

Expected Results

Fossil plants investments will be either coal fired or combined cycle gas turbines. Especially large scale coal plants have a significant impact on the grid situation. The geographically most cost efficient region for new coal plants is close to possible import locations, namely near ports along the Northern Sea. One drawback of this location is the high amount of fluctuating wind capacities especially if the planned offshore capacities will be connected. Within the analysis an optimal investment scenario for fossil plants is developed based on a full nodal pricing mechanism and compared to the published investment plans (Knight, 2006). The results show that the currently planned investments are not in line with an efficient investment plant optimizing the overall economic situation.

Tentative Conclusions

We use nodal prices to define locations for efficient investment. Furthermore various influencing factors as the industry-density or density of wind offshore capacity could be identified. Since Germany is going to install 5 to 15 GW wind offshore capacity (DENA, 2005), congestion is going to play an important role even within the German grid. Hence it will be an important question where to construct new power plants. Our model suggests that efficient investment scenarios under nodal pricing may differ from the current investment projects.

References

DENA (2005): *Summary of the Essential Results, Planning of the Grid Integration of Wind Energy in Germany Onshore and Offshore up to the Year 2020* (dena Grid study). Deutsche Energie-Agentur.

Schweppe, Fred C., Caramanis, Michael C., Tabors, Richard D., and Roger E. Bohn (1988): *Spot Pricing Of Electricity*. Boston, Kluwer.

Stigler, Heinz, and Christian Todem (2005): Optimization of the Austrian Electricity Sector (Control Zone of VERBUND APG) under the Constraints of Network Capacities by Nodal Pricing. In: *Central European Journal of Operations Research*, 13, 105-125.

VDEW (2006): Investitionen für Versorgungssicherheit, VDEW, Internet: http://www.strom.de/vdew.nsf/id/DE_Investitionen