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SIMULTANEOUS OPTIMIZATION OF THE GENERATION AND TRANSMISSION EXPANSION USING THE EXAMPLE OF GERMANY

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OVERVIEW

The restructuring of the European electricity sector due to the development of the European electricity market and the promotion of renewable energy sources, especially wind power, induces changes in the generation portfolio. Volumes of electricity trade are growing and the sites for renewable energy sources are geographically concentrated, so that the necessity of adapting transmission capacity furthermore increases.

The situation concerning this issue is eminently distinct in Germany. For example, the majority of installed wind power capacity is located in Northern Germany, where, with the development of offshore wind farms, the future expansion mainly will take place. However, the centers of load are the Ruhr area and Southern Germany. Due to these reasons, the distance between generation and load will increase and thus the required transmission capacity grows. In addition local characteristics of costal areas like low transportation costs for fuels also favor the concentrated construction of thermal power plants in Northern Germany, which further increases the required transmission capacity.

In order to assure an economic and efficient electricity supply in the future, the question arises how to adjust network and power plant investments to secure an optimal adaption to the above mentioned challenges. In optimization models which focus only on power plant investments, the impacts on the transmission grid and its utilization are neglected. On the other side, an isolated optimization of the transmission grid has to assume an exogenously defined power plant park. In this case impacts of the transmission expansion on the optimal power plant park remain unconsidered. As a consequence, with existing instruments, the optimal expansion of the electricity system cannot be completely achieved. The proposed contribution is devoted to the problem of the economically optimal expansion strategy for the electricity supply system with simultaneous consideration of generation and transmission. The developed system optimization model, whose application focuses on Germany, includes power plant and network expansion options

METHOD

As objective the inelastic electricity demand is covered with minimal cost. Investment costs are considered via annuities. On operational level numerous technical characteristics of the unit commitment (capacity limits, part load efficiencies, start-up processes) and adjacent costs are taken into account. In order to model the transport of electricity, an adequate geographical resolution and restrictions of load flow (DC-power flow and transmission limits) are considered.

RESULTS AND CONCLUSION

Obtained results indicate that network expansion is driven by the wind power development and is mainly directed from North to South and from the wind centers in Eastern Germany to Middle

Germany. In order to relieve high network loads, construction of new conventional generation capacity should be close to demand centers.

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