Antonis Papaemmanouil[1], Evdokia Kaffe[1], Göran Andersson[1]

GENERATION PROFITS IN MULTI-AREA POWER MARKETS CONSIDERING GREEN CERTIFICATES

[1] Power Systems Laboratory, ETH Zurich, Switzerland, +41 44 632 69 04
ekaffe@student.ethz.ch
{papaemmanouil,andersson}@eeh.ee.ethz.ch

OVERVIEW

The effort to integrate the national and regional power markets of Europe, i.e. NordPool, APX, EEX, EXAA, OMEL etc., into one unified European power market has intensified lately. However, regulation and congestion treatment differences inside Europe combined with constantly increasing electricity demand make it more difficult to achieve such an integrated power market. Besides, the different applied market structures Europe-wide create more complicated operating conditions and thus the profitability of generation investments and their impact on transmission network and vice-versa, becomes a quite tricky task. Towards the next generation of the European power system additional transmission and production capacity is needed in order to cover the increasing demand and the environmental requirements of a sustainable development. This reinforcement can either be profitable for the generation companies, for the consumers, for the transmission grid increasing its operational efficiency or to some extend after strong coordination for all market participants [1]. This paper deals with the generation profits of companies that own production capacity in different areas, when constraints for green certificates and for the transmission network are applied. A multi-area decomposition methodology has been used for the power exchange representation and has been compared with a more centralized market structure like the nodal pricing scheme.

METHODS

Power flow is strongly affected by the market structure and the transmission network availability as different price signals derive. In this paper, two different market structures are studied and the results of each one in generator profits and carbon emissions are examined while the transmission network capacity is taken into account. The first, nodal pricing, is a price determining method where an equilibrium point and clearing price is calculated for each node of the system [2]. A node represents a specific location in the transmission grid where power is provided by the generators and withdrawn by loads. The objective is the maximization of social welfare.

The second market structure studied is the power exchange. In this case, one common price for electricity is calculated, not for each node, but for each area [3], [4], [5]. Power trading between areas A, B, C is allowed and production companies may own a production capacity in any area, e.g. coal, wind, hydro, gas and nuclear.

The studied model where the two different market structures are applied is presented in fig. 1. The aggregated generation profit of one company derives from the summary of the profits in each area, which means that small areal changes in generation mix or in transmission capacity could affect the profits stochastically.

Environmental issues should also be addressed as increasing greenhouse gas emissions worsen global warming with widely known catastrophic results. Therefore, a green certificate trading scheme is also implemented in this study in an attempt to model a more realistic power market.

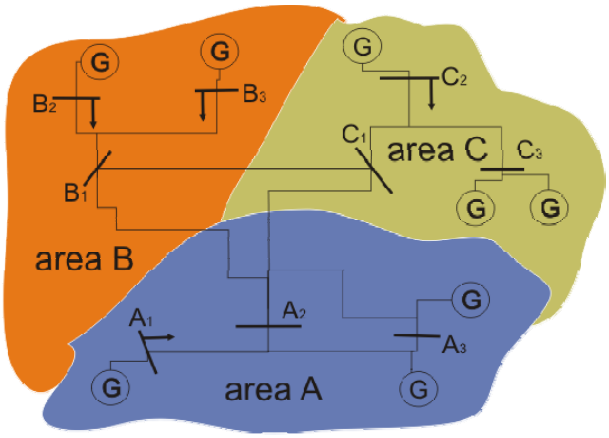

Fig. 1. Three areas interconnected system with loads, generators and transmission lines. Production companies are allowed to own power plants in any area in order to maximize their profits.

RESULTS

The results are going to describe the generation profit differences of the two market structures (nodal pricing, power exchange) for three generation companies that act in the aforementioned multi-area market environment. Different scenarios of additional generation or transmission capacity will be studied and the two market structures will be compared. The price differences as well as the green certificates prices will be examined. The paper will contain a detailed description of the above mentioned methods and their implementation, as well as an analytical documentation and evaluation of simulation results of the tested power system.

CONCLUSIONS

As environmental constraints become more and more part of the energy systems and the market structures are changing, the latter analysis can support decision makers in the planning of the future electricity system. What's next? Is nodal pricing more profitable for the generation companies? Does the power exchange lead to lower electricity prices?

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