MODELING TRANSMISSION INVESTMENT DECISIONS

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1 Overview

Over the past decade, the role of cross-border electricity transmission capacity in Europe has changed from a means to improve security of supply in case of exceptional contingencies, to facilitating competition in a common European electricity market by enabling power transports from lower price to higher price areas (Lynch et al., 2012). Increasingly important is the role of transmission in providing opportunities to better utilize intermittent, renewable resources.

In order to fully and efficiently utilize the potential of renewable energy sources, transmission grid expansions are necessary (Buijs et al., 2011; Schaber et al., 2012). Producing renewable energy at locations with abundant supply has the potential to lower the cost of electricity, with energy flowing from the place where it can best be produced (e.g., wind in the North Sea, hydro in Scandinavia, solar in the Mediterranean), even when including the cost of transporting power across large distances (Battaglini et al., 2009). However, transmission investments often problematic in practice, and Buijs et al. (2011) argue that investments are already lagging behind the capacity we actually desire to have.

In 2006, Meeus et al. warned that "more investment coordination is clearly necessary in Europe (...)" (p. 6) because regulatory frameworks were not adequate to ensure that the right investments with long-term benefits would be undertaken. Despite the fact that cooperation has increased over the past years (e.g. through organizations such as ENTSO-E and ACER, or the definition of Projects of Common Interest by the European Commission), national interests still prevail when it comes to investments in (cross-border) transmission infrastructure. It is our hypothesis that the current, nationally-focused regulation of transmission does not provide the right incentives for TSOs to do the necessary investments.

2 Methods

We present an agent-based model that allows for simulating investments in transmission capacity over time by TSOs and the evaluation thereof by regulators, both of which under national rules and regulations that differ throughout the continent. National regulation and government objectives set the rules of the game (e.g., in terms of tariffs) within which (national) TSOs must operate.

The investments are driven by decision criteria and constraints that can be varied in order to simulate e.g. a variety of regulatory frameworks applicable to the transmission sector. Using this model we can show what happens in terms of consumer and producer welfare as well as transmission costs (tariffs) when different investment criteria are applied to grid investments (i.e., under different regulatory frameworks), and what effects different (generation/load) scenarios have under these criteria. The model uses a simplified load flow model to represent the transmission grid. It divides the Central Western European region under consideration in 2 – 5 nodes per country, and calculates physical flows between these nodes on the basis of a Power Transfer Distribution Factor (PTDF) table, which prescribes how commercial flows between two nodes lead to physical line loads in the grid.

3 Results

First of all, we apply a purely national focus to the evaluation of transmission investment decisions for the Central Western European region (CWE). We compare the resulting development of the transmission network that would result from a cross-border welfare maximizing (ideal) investment criterion. We show the degree to which a national focus leads to suboptimization in terms of generation dispatch cost and transmission cost. Next, we adjust the national investment criterion to include the financial flows resulting from the existing European inter-TSO compensation mechanism. This mechanism is intended

to facilitate cross-border transmission investment that are not in the benefit of all participating countries, but do contribute to overall welfare. We show that this mechanism indeed produces an improvement, compared to investment from a purely national focus, but that there is significant room for further refinement of this mechanism.

4 Conclusions

A model of investment in the CWE network is presented. A unique feature of this model is that investment criteria in new transmission lines is endogenous, which makes it possible to study long-term effects of different regulatory policies. We studied a purely national focus, as would result from the current national regulatory frameworks and the effects of the inter-TSO compensation mechanism, which is intended to alleviate the shortcomings of the nationally focused framework. We compared both to an optimal (regional welfare optimizing) investment criterion and showed where there is further room for improvement in the regulatory framework.

References

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