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REGULATING FUTURE OFFSHORE GRIDS: ECONOMIC IMPACT ANALYSIS ON WIND PARKS AND TRANSMISSION SYSTEM OPERATORS

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Overview

The increasing development of offshore wind parks in the European offshore territory may lead to their envisaged interconnection in meshed offshore grids. This is more cost-efficient from a socioeconomic point of view (deDecker and Kreutzkamp, 2011) and supported by EU policy. It implies that single wind parks can be connected to several coastal countries. The offshore grids could be subject to various regulatory regimes, depending on the degree of cooperation between the respective countries. In this regard, significant elements are the regulation of market access and pricing rules as well as the choice of support scheme for the offshore area. While research has recently started to be done on offshore grids and their benefits from a macroscopic perspective, there is a certain lack of understanding as of how the market actors, especially the investors in wind parks and transmission systems, are affected by the choice of regulatory regime in an offshore grid. This gap was first addressed by Schröder and Kitzing (2012). With the further development and extension of our quantitative model, we are now investigating the economic impact of different regulatory regimes on the investors and operators of wind parks as well as transmission systems. Based on our results, we argue that the specific effects should be considered when choosing the regulatory regime and designing the support scheme in the offshore grid, in order to maintain the effective and efficient development of offshore wind in Europe.

Methods

We consider two different support schemes: Feed-in tariffs and price premium mechanisms. In case of feed-in tariffs, wind farm operators are not exposed to significant market risk and market pricing rules do not play a decisive role in the investment decision. In the case of feed-in premium mechanisms, operators are exposed to market price signals and market pricing rules for the offshore grid become decisive. In extension to our previous analysis, we distinguish three fundamentally different options on market access and pricing rules: 1) The wind park in the offshore area is assigned to one 'home' country and has only secondary access to the other connected markets; 2) the offshore area is flexibly integrated into any of the neighbouring markets, so that the wind park operator has access to the respective maximum price, or 3) the offshore area forms its own market price area and thus the wind park operator is subject to separate nodal pricing. We investigate these options for offshore grids containing connections to one to four countries. In order to capture the uncertainties related to the exposure to market prices in the case of price premiums as well as risks related to line failures, we develop a stochastic model for our quantitative analysis.

We model the market prices of the different markets as stochastic mean reverting Wiener processes, following well-established methods (for example Dixit and Pindyck, 1994). We model stochastic line failures with our own approach, inspired by previous modelling of jump processes in commodity prices (see e.g. Hambly et al., 2009). We then compare the mean expected value of a wind park and its standard deviation in the different cases of regulatory regimes and country-connections to the reference case, which is the connection to only one country. We do the same for the congestion rents obtained by the involved transmission system operators.

Results

We find that the choice of regulatory regime has decisive impact on the value of a wind park investment. The impact can be both positive and negative. In the case where the wind park operator has primary access to the connected markets, there is a significant option value connected to the operational flexibility of choosing to sell into the highest-price market at any time. The more countries are connected, the higher the option value. In our (fictive) case with connections to four similar archetypical power markets, the internal rate of return for an investment in a wind park increases with up to 33%. If this were not reflected in the remuneration level, for example in the level of price premium, then the wind park operator would be able to benefit from significant windfall profits.

On the other hand, if an offshore price hub is formed and the wind park operator is subject to nodal pricing, the value of a wind park investment is significantly decreased by connections to other countries. The option of future additional connections therefore depicts a risk for the investor of a wind park, which can lead to up to 15% lower internal rate of return of the investment. This additional risk is reducing the incentive for investment and would have to be accounted for in the remuneration level in order to trigger a sufficient amount of investment. An interesting result revealed by the stochastic analysis is that the wind park value is most affected by the risk of establishing the connection to a second country, meaning that it would always be subject to the lower of the two prices of the neighbouring markets. The connection to a third country mitigates this effect quite significantly, as now mostly the middle of the three prices would form in the offshore hub.

The effects on congestion rents obtained by the transmission system operators have a somewhat opposite trend than the effects on the wind park operators. Obviously, the congestion rents increase with the number of countries connected to the offshore grid, as there simply is more generation being transmitted. The less correlated the countries' markets are, the higher is this effect. However, the congestion rents are significantly higher in the case of nodal pricing, because in this case the transmission system operator rather than the wind park operator accesses the high and low price markets.

In addition to the above discussed results we also undertake sensitivity analyses regarding different market characteristics and interconnection capacities – especially the case of asymmetric export options for the wind park gives new insights especially into the economics of investments in transmission capacities.

Conclusions

The economic impact analysis of different regulatory regimes in offshore grids on the investors and operators of wind parks and transmission systems reveals two major insights. Firstly, the choice of regulatory regime can have both positive and negative impact on the value of a wind park investment. If this is not considered in the design of the regulatory regime and the level of support for the wind park, an effective and efficient development of offshore wind in Europe may be hampered. Secondly, the incentives for the different market actors in relation to additional connections are very different and in some cases even contrary. Thus, the market actors such as transmission system operators and wind farm operators may take very different positions towards establishing new connections at different stages in the development of meshed offshore grids. The successful development of an offshore grid may come to rely on the avoidance of such additional barriers, even if meshed offshore grids are beneficial from a macroscopic perspective.

References

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