GENERATION ADEQUACY CRITERIA FOR INTERCONNECTED COUNTRIES

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Overview

This paper revisits the rationale behind national generation adequacy criteria for electricity systems in a context where such systems are becoming more and more interconnected. Because they prove instrumental to decisions worth billions of dollars, these criteria have a significant influence on the energy policy of European countries. For example, a national generation adequacy criterium is typically used to define the target of a capacity mechanism, or to calibrate generation fleets when performing cost-benefit analyses of major infrastructure investments. Given the high stakes involved, such criteria are typically taken as exogenous and infrequently updated. Accordingly, most generation adequacy criteria currently in use derive from a several-decade-old rule-of-thumb that relies on outdated assumptions.

Among obsolete assumptions, autarky – the fact that only home generation is used to meet peak demand – severely contrasts with the reality of the European Internal Energy Market (IEM). Indeed, one of the main rationales for the construction of the IEM is the obvious benefits from cooperation. Such benefits have been documented in numerous studies, such as Cepeda et al. (2009) and Hagspiel et al. (2018) for the role of interconnectors in capacity adequacy, and Baldursson et al. (2018) for reserve requirements. The first two studies however consider national generation adequacy criteria to be exogenous, while the latter only studies the case of two interconnected countries.

By contrast, this paper highlights that optimal generation adequacy criteria are endogenous to the structure of the electricity system, and investigates how these criteria change as electricity systems interconnect to a large extent. We start by providing a theoretically-grounded definition of generation adequacy criteria for a set of interconnected electricity systems. We then describe how such criteria can be computed in practice and apply our approach to a set of European countries. Finally, we compare our results with traditional generation adequacy criteria and discuss policy implications.

Methods

The theory used is standard electricity market microeconomics. The empirical application relies on publicly available hourly load data and net transfer capacities published by ENTSO-E and/or individual European TSOs.

Results

Deriving rigorous micro-economic foundations for generation adequacy criteria allows us to clearly highlight their strengths and weaknesses. First, such criteria are only properly defined when demand is perfectly inelastic beyond a certain level, and depend directly on the assumed value of lost load. Second, they hinge on the characteristics (both short and long-run marginal costs) of the peaking technology. A change in the characteristics of the peaking technology (e.g. from gas turbine to demand response) should thus translate into a change in the criteria enforced. Third, when a set of countries are interconnected, national generation adequacy criteria must specify a normative assumption regarding the assumed use of interconnectors during hours of coincident shortages in order to be well-defined.

While the first two caveats can be straightforwardly accounted for, the latter one is more challenging, notably due to combinatorial difficulties. We thus propose an algorithm to compute generation adequacy criteria in the context of interconnected electricity systems. We then apply our approach to a set of European countries and compare the obtained results to the national generation criteria currently enforced in these countries.

Conclusions

Although most European countries rely on generation adequacy criteria when making very important decisions regarding their electricity system, it is unclear whether such criteria still rely on well-understood micro-economic

foundations. This paper clarifies the extent to which optimal adequacy criteria are endogenous to the structure of the electricity system, and shows how such criteria change when a set of countries interconnect their electricity system.

References

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