GENERATION ADEQUACY OUTLOOK IN A BIPOLAR ELECTRICITY SYSTEM

ELECTRICITY SUPPLY SECURITY ASSESSMENT FOR BELGIUM UP TO 2050

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Overview

In a power landscape that grows ever more complex due to a.o. increased electricity production by variable energy sources and (heavily) distorted investment signals, guaranteeing security of electricity supply becomes increasingly challenging. The absence of investments in sufficient reserve capacity and – worst case scenario – inadequacy of generation capacity can have huge consequences and may lead to soaring societal costs. This paper looks into the topic of generation adequacy in Belgium by drafting a Belgian Reference scenario compliant with the EU Climate/Energy package and examining whether this scenario will meet ENTSO-E's definition of generation adequacy at all times.

Methods

The (European) technico-economic energy model PRIMES is used to sketch the Belgian Reference scenario in accordance with the European Commission's macroeconomic and energy price framework (European Commission, 2013). The PRIMES model is developed and managed by NTUA. It generates long term energy and emissions' projections on the supranational (European) and national (e.g. Belgian) level.

The methodology used to ensure generation adequacy is inspired by the deterministic approach set by ENTSO-E, the European network of transmission system operators. In this approach, the equilibrium between electricity supply and demand in terms of capacity takes into account a security margin (called 'system reserve margin') which in fact acts as a buffer between peak demand and reliable available capacity (the fraction of total capacity that can be assured to be available at all times). The methodology differs however from ENTSO-E's in the precise calculation of the reliable available capacity and in the reserve margins used which are adapted to the Belgian context based on information from the national TSO.

Results

The paper investigates if the future electricity generation park as depicted in the Belgian Reference scenario allows guaranteeing generation adequacy both under normal and exceptional circumstances up to a horizon of 2050.

Even under reference settings (meaning no additional policies and measures (or targets) are assumed after the year 2020), the penetration of renewable energy sources in the future Belgian power system becomes significant. This has to do with the fact that Belgian law stipulates that no new nuclear power plants can be constructed and even specifies an upper limit on the operational lifetime of existing nuclear power plants. On top of that, there is an implicit ban on investments in new coal power plants, leading to a de facto bipolar future power generation system fuelled by renewable energy sources on the one hand and natural gas on the other.

All in all, the future investments in the Belgian electricity system become considerable and will demand specific policy attention. With a future mix of 54.5% of renewables (of which 82% variable renewable sources) in 2050, specific attention has to be devoted to the topic of both generation adequacy and system security. In such a system, the ratio of unavailable capacity to total capacity rises from 23% in 2010 to 44% in 2030 and even reaches 50% in 2050, causing an inflated amount of additional capacity necessitating to be built. Total installed capacity increases by 132% between 2010 and 2050 whereas final electricity consumption only grows by 27% during that period.

Conclusions

Past (and future) market conditions point to the fact that attracting new investments in power capacity is arduous. Hence one cannot exclude the system not being able at some point to withstand a potential breakdown. Under such circumstances, terms like security of supply and system reliability gain importance and lead utilities, grid operators and governments alike to devote time and resources to a reflection on the optimal level of supply and system reliability. This paper is intended to contribute to the debate by pinpointing the evolution of generation adequacy for Belgium under a Reference scenario which simulates the EU Climate/Energy package.

Under normal conditions, the analysis shows that the electricity production park resulting from the Reference scenario allows guaranteeing the equilibrium between electricity demand and supply in terms of capacity. The reliable available capacity is always superior to peak demand or, put in other words, the residual capacity is positive at all times.

One can then conclude that the generation capacity as calculated in the Reference scenario suffices following the ENTSO-E criterion to respect the demand and supply balance under normal (and exceptional) circumstances but that huge investments in the future electricity system are necessary given the large penetration of variable renewable energy sources. This result also makes the case for the pursuit and even intensification of research and development on electricity storage as this option may considerably reduce the amount of investments needed in new generation capacity.

References

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