THE CHALLENGE OF A NUCLEAR PHASE OUT IN BELGIUM

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Overview

With a capacity of 6 000 MW, nuclear plants produce around 55% of electricity in Belgium. In 2003, the Belgian government decided to phase-out nuclear plants after 40 years of production. In 2015, the oldest nuclear plants will be closed and the phase-out will be complete by 2025. Given the share of nuclear energy in the Belgian energy mix, the planned phase-out poses a challenge. Several factors furthermore complicate this challenge. Investments in renewable energy technologies – mainly intermittent technologies – did increase strongly and are expected to increase further between now and 2020. The load factors and firm availability of intermittent generation technologies cannot be compared to the typical properties of nuclear capacity. Secondly, many old thermal assets (coal and gas plants) reach their end of lifetime in the phase-out period between 2015 and 2025. As a result, 6 000 MW nuclear assets and 4 000 MW thermal assets need to be replaced. Thirdly, the investment climate on the Belgian electricity market depends on the dynamics on the interconnected European electricity markets. Because of economic crisis there is overcapacity on the NW European electricity market leading to low electricity prices and an unfavorable investment climate for all generation technologies without subsidies. As the energy landscape will change drastically in the next two decades, we want to shed some light on how the will affect the electricity market in general with a focus on security of supply.

In this paper, we present a realistic electricity generation model to assess these challenges and their interactions. The probabilities of shortages and excess production are investigated under several scenarios up to 2030. Our scenarios do not assume exogenous investment decision but price-driven investment behavior.

Methods

The first step of the analysis is to find a way to model the electricity supply and demand in the coming decades. We explicitly consider the inflexibility of nuclear capacity combined with "must run" power plants (biomass and CHP) and the variability of intermittent generation technologies. In order to estimate the future electricity supply, a model was created to simulate production patterns for wind and PV-electricity, based on real data. These production figures were randomized in order to create a random PV and wind electricity production pattern for a given year. The production pattern can be multiplied with a given capacity to simulate PV and wind production patterns in the future. The output of the electricity production model can be combined with various demand patterns to estimate the possibility of having a shortage or a surplus in a given year. In this study we start from existing demand data for the period 2005-2011. The model includes the export/import capacity of the Belgian electricity grid from a dynamic perspective.

Results

We find that because of a decreasing nuclear capacity, the chances of having a blackout from 2017 onwards are strongly increasing. Our model indicates a shortage during 10% of the time (30 days in one year). Such a black-out risk can definitely not be tolerated. Also, due to increasing intermittent renewables, by 2017 there will be significant surpluses during 4% of the time (on average). The higher share of PV and wind slightly decrease the risk of a blackout but also increase the risk of excess production.
The model can also be used to estimate the need for flexible capacity. The results from this analysis indicate that much more flexible capacity will be needed in the future; however, this capacity will only run a small amount of time. This makes the economical viability of flexible gas or peak plants very difficult. A combination of nuclear and intermittent renewables results in a very inflexible market, which is likely to result in highly fluctuating spot prices on the electricity market.

Conclusions

Phasing out the nuclear capacity might be needed in order to increase the market flexibility. However, one must not ignore the risk of a blackout due to a combination of high demand and low wind/sun weather occasions. We suggest making the electricity market more flexible, for example by removing the "must run" status of renewable energy and by promoting more flexible generation. In addition, demand side management and storage can be very valuable and might be more efficient or effective.

References

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