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Flexibility, Capacity and Carbon Pricing to Keep the Lights On

Within the next three years, Belgium could see its conventional generation capacity cut off by 6 GW compared to its level in 2012. To avoid black-outs on the short run, efforts could be made on two fronts. First, the flexibility of both the production and the consumption could be further incentivised to better cope with the variability of renewables, and second, stable support schemes could be developed to attract investors in cleaner base-load generation.

The ever increasing share in variable renewable energies (VRE) put the power system in higher stress as ever before. VRE having marginal costs of nearly zero constantly reduce the wholesale price which fell down from an average of 80€/MWh in 2008 to 40€/MWh today, far below the cost of combined-cycle gas turbines (CCGT) [1] [2]. Hence, Belgium has seen its conventional capacity reduced by roughly 1GW over the past years, mostly due to the mothballing of unprofitable CCGT plants, and 2 GW more could follow by 2017 [3].

In the meantime, 2014 has seen the closure of nearly 3 GW of nuclear capacity and, even if a license extension is approved this year, one more gigawatt should be durably lost due to the lack of nuclear fuel by 2016.

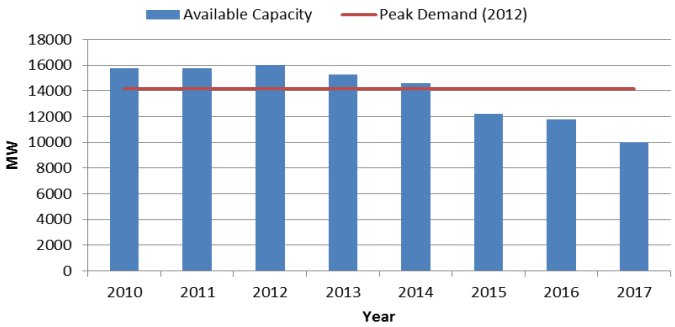

Figure 1: Evolution of the available production capacity, compared to the peak power demand during the winter 2012

Altogether, up to 6 GW of generation capacity could be lost in the following years, which is huge compared to the modest 14 GW peak load of Belgium and represents a real threat for the security of supply [4] [5].

To alleviate for this substantial lack and ensure the security of supply for the years to come, two complementary approaches are proposed in this article, namely increasing the flexibility of both the generation and the demand, and developing stable support schemes towards cleaner base-load generation.

More flexibility at every level will relieve imbalances on the grid and allow for a higher share of renewable

As long as no technological breakthrough occurs in energy storage, which is likely to be the case for the decade to come [6], flexibility of both the demand and the production will remain the only profitable way to increase the penetration of VRE, while securing the supply. In this context, the Belgian transmission system operator (TSO) Elia created contracts to incentivize the participation of industrial customers in the balancing of the grid: ICH (industrial consumers) and R3-DP (distributed producers) contracts represent today more than 360 MW of flexibility [7] [8]: when an imbalance occurs between the production and consumption, the signatories can be asked to reduce temporarily their demand or generation.

Recent surveys [9] [10] showed that the industrial sector could account for more than 600 MW of flexible consumption. This number being very likely underestimated due to the very low response rate of roughly 25%, Elia should further assess the potential of this flexibility resource and harness it completely.

On the other hand, a large potential for the residential sector of more than 500 MW was also revealed in [10]. The amplitude of the daily peak in power demand being only due to the residential sector [11] [12], it could be wise to also allow individuals to take part in the flexibility.

Open access to the energy markets will allow aggregators to fully grasp the potential for demand response

In this endeavour, aggregators could be of precious help to identify and harvest as yet unexplored sources of flexibility: aggregators aspire to close the gap between TSOs and demand response, by gathering the contributions of many small players connected on the low-voltage grid and making them relevant to the TSO.

This principle is already applied in ICH and R3-DP contracts, but for its potential to be fully exploited, aggregators should broaden their scope to small consumers and be given open access to the energy markets. By reflecting the wholesale electricity price on the electricity bill of small companies and households, aggregators could create a powerful incentive for customers to adapt their consumption in periods of high stress, corresponding to price spikes. This would also enable them to fully compete with the generation, hence optimizing the energy mix, while reducing the costs for the customers and operators of the whole power system.

However, demand-side response can only alleviate for short imbalances and other solutions will have to be implemented to cope with the current structural lack in base-load generation.

A strong carbon market and a capacity market will put our gas assets back in the market

The CCGT assets, while cleaner than any other fossil fuel-based generation, are also the fittest to follow the variations in VRE production. A stable support scheme should therefore be implemented to value the advantages of CCGT compared to coal power plants (CPP).

First, the competitiveness of Belgian gas assets against foreign CPP should be brought back by restoring a very strong carbon market. By allowing the price of carbon to rise as high as 40€/tCO_2, the cost of CPP would increase to such a point that CCGT would become cheaper [13]. Today, this price has dropped to a ridiculous 5€/tCO_2 due to an excess of permits that followed the economic crisis of 2008 [14], and the emission trading system (ETS) has failed fostering investments in low-carbon technologies.

A reform of the ETS, the market stability reserve, was proposed by the European Commission to increase the carbon price by limiting the number of emission permits on the market by 2019 [15]. However, for this reform to have the most impact on the investors' confidence and on the carbon price, it should be implemented as soon and as strong as possible. Delaying this reform will only weaken the market [16], cause investor uncertainty, and keep the status quo for 4 more years. Belgium should therefore join forces with Germany and UK to try and make it happen in 2017 at last [17].

Finally, since the share of VRE in the energy mix is set to continuously increase for the decades to come, peak load power plants will continue withdrawing from the market due to their higher marginal cost and decreasing load factor. A fair and viable capacity mechanism should therefore be introduced in Belgium to support assets having a very low load factor, but indispensable to meet the peak demand. The strategic reserve mechanism introduced in Belgium in 2014 is especially inefficient and expensive for the community since it is not based on a market principle [18]. A better alternative is implemented in UK since 2013 and proven successful: the capacity market. An amount of 19.40£/year is paid for each kW made available, thanks to which more than 25 GW of gas assets have been preserved and the security of supply ensured [19] [20]. Lessons should be learnt from this experience to implement to most efficient market.

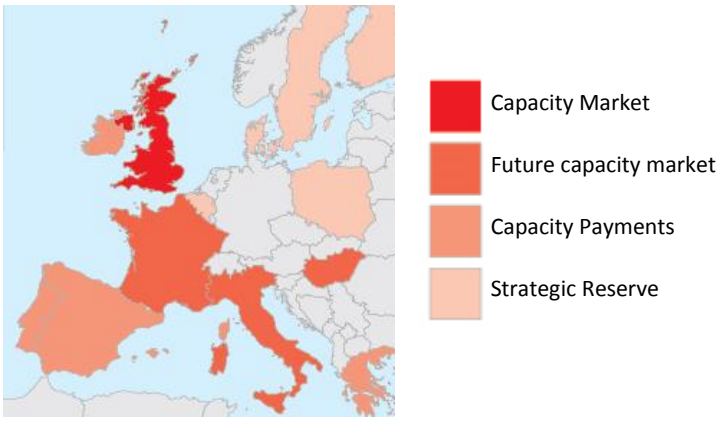

Figure 2: Capacity Remuneration Mechanisms in Europe [21]

In summary, to tackle the current energy paradigm in Belgium and ensure the security of supply on the short run, two methods were presented. First, instead of fitting the power generation to the demand as it is done today, the energy consumption should be modulated according to the real-time renewable generation by incentivizing the flexibility of industries, but also households and small companies through the contribution of aggregators.

Then, support schemes should be implemented to restore the lacking base-load generation: while a well-designed capacity market could bring back mothballed assets to life and resolve the structural lack, a strong carbon market would incentivize the use of versatile and cleaner combined-cycle gas turbines.

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