Capacity value of gas storage facilities for the electricity system

ACER GRI SSE Meeting in Prague, 27 November 2019

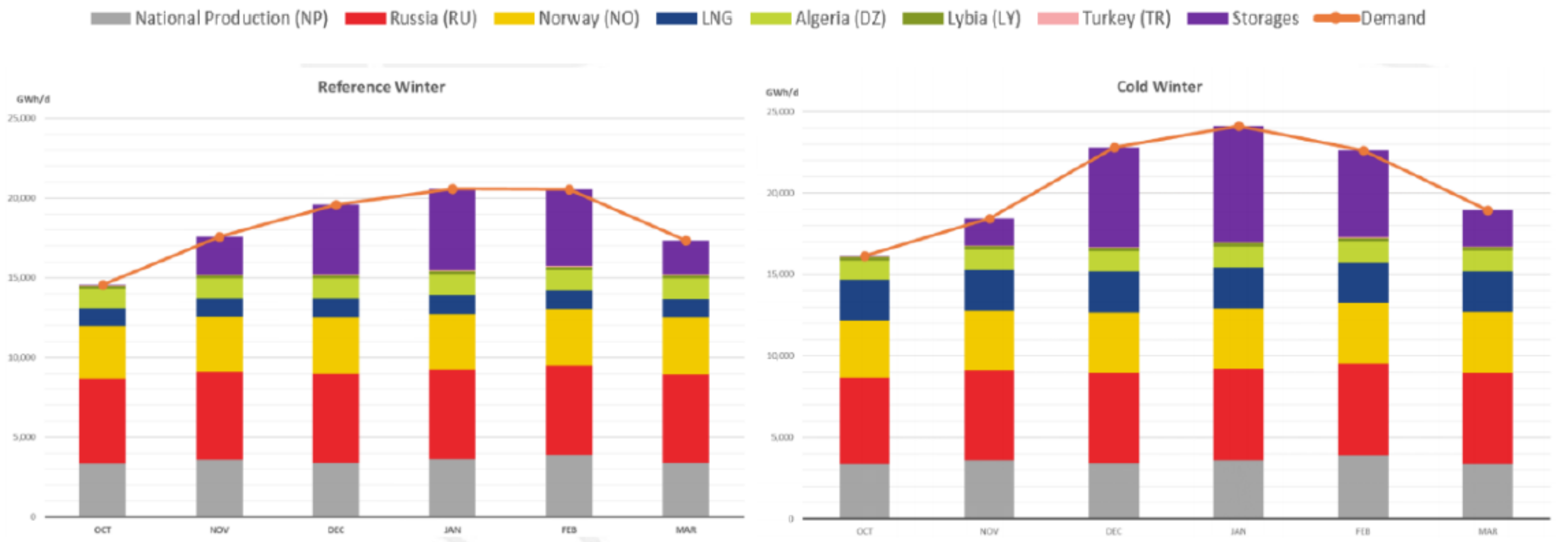
Will we need gas storage for the electricity generation?

2030

The key roles of gas storage assets

Importing, moving, storing and delivering gas to European consumers and businesses relies on the presence of gas infrastructure. Gas storage facilities have been shown to be key components of this complex system, as they allow to cover a large share of the seasonal flexibility needs, and enable the system to cope with cold winter conditions. In addition, gas storage is also providing flexibility on shorter timescales, e.g. to cope with disruptions of other infrastructures. It is therefore essential to ensure the value of these assets are properly identified and remunerated.

Storage is the key provider of seasonal flexibility during all winters



Storage is the key provider of additional flexibility during cold winters

Source: ENTSOG Winter Supply Outlook 2018/2019

Remark: The supply assumptions shown above by ENTSOG are based on the supply observed in the last five winters and should not be considered as a forecast, the actual supply mix will depend on market behaviour and other external factors

Data Input into the Model

Network Assumptions for 2030*

- ENTSOE: electricity generation capacities + transmission capacity
- ENTSOG: gas transmission capacity

Model

- Artelys Crystal Grid: METIS platform used by the European Commission
- Hourly resolution
- Geographical resolution: EU Member State level
- Optimalisation on EU level

Sustainable Transition 2030 **
Key characteristics

- Commodity prices such that using gas is cheaper than using coal for power generation ("gas before coal" merit-order)

*Input data: https://tyndp.entsoe.eu/maps-data/

** Full ENTSOE+ENTSOG report incl. detailed scenarios: https://tyndp.entsoe.eu/tyndp2018/

Key principles of the methodology

The key objective of the study is to quantify the **cross-sectoral benefits** of gas storage assets, and in particular to assess the capacity value of gas storage from the point of view of the electricity sector. To do so, we compare the following situations:

Counterfactual scenario

ENTSOs' TYNDP 2018[(1)]
Sustainable Transition scenario for 2030[(2)]

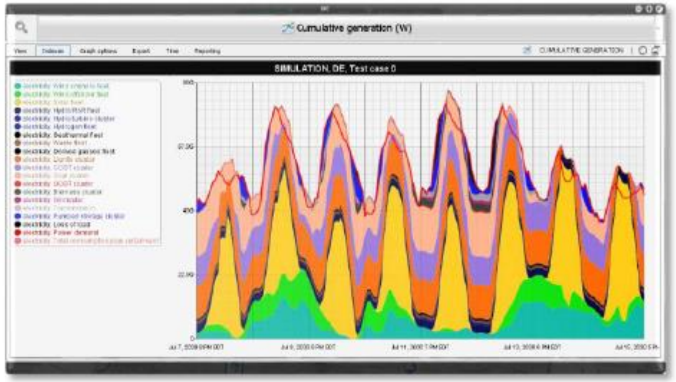
Sensitivity analysis

Decrease of the gas storage capacity by 10%, 20%, etc.

When reducing the gas storage capacity, we assume an homogenous decrease of storage volume, withdrawal and injection rates, in all countries.

The **key impacts** are measured in terms of:

- Electricity **dispatch**, its costs and market prices
- Avoided **operational** costs for electricity generation (OPEX)
- Avoided **investment** costs in the electricity system (CAPEX)



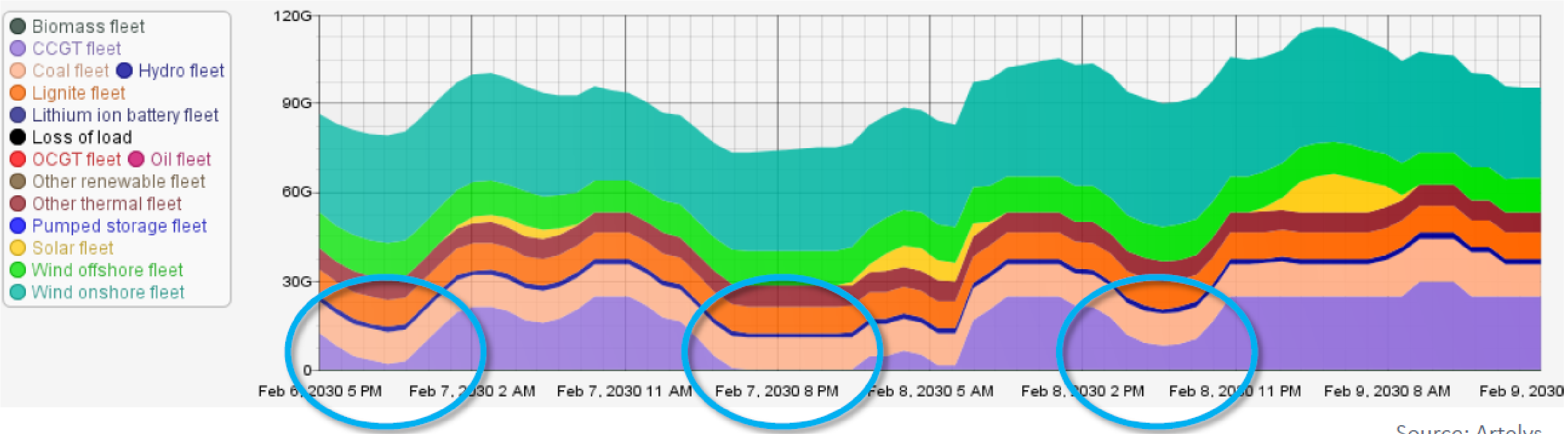
Source: Artelys (Artelys Crystal Super Grid)

(1) Latest edition of the Ten-Year Network Development Plan, prepared jointly by the European Network of Transmission System Operators for Electricity and Gas (2) The scenario is presented on Slide 12.

Avoided operational costs

In the situation where gas storage assets are reduced by 10%, there are some periods of the year where gas-fired power plants cannot gain access to gas. Therefore more expensive generation technologies have to remain online or to be started in order for the electricity demand to be met at all times.

Situation #2 – Additional operational costs due to the use of more expensive power plants



Source: Artelys

With our assumptions, a **10% reduction** of gas storage capacity results in more coal being used (and more greenhouse gas emissions of around 6 $MtCO_2e$/year), for an overall **extra cost of 1 B€ per year**. The impact on costs could be higher if coal use were to be limited.

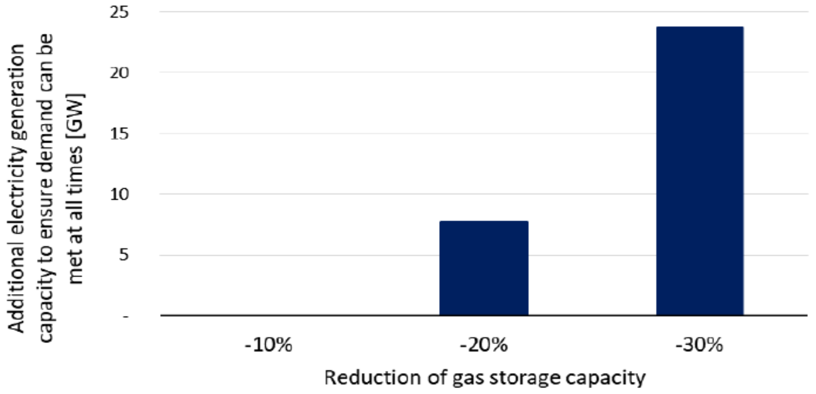
Key Study Outcomes

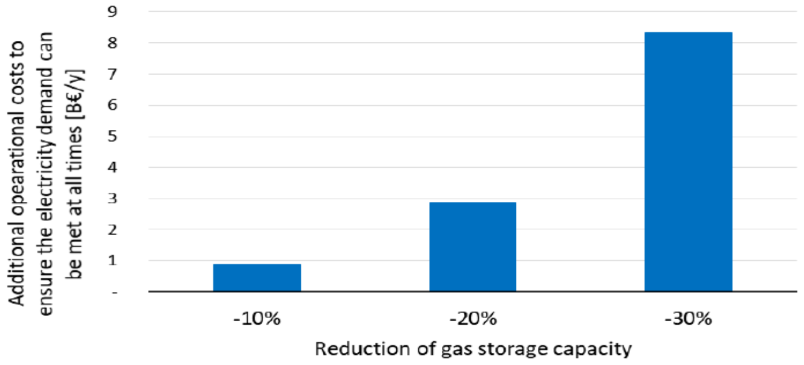
This graph shows that the absence of 30% of gas storage capacity induces additional investments in a generic electricity generation technology (assumed to be dispatchable and flexible) reaching around **23 GW** at the European level. This investment is required in order to avoid electricity demand curtailment.

The absence of 30% of gas storage assets would induce investment costs that have been estimated to reach **55 B€**.

This graph shows that the absence of 30% of gas storage capacity would lead to additional operational costs of around **8 B€/year**.

This amount corresponds to the sum of the costs that would be induced by using more expensive existing assets and of the operational costs of operating the 23 GW of additional generation capacity.

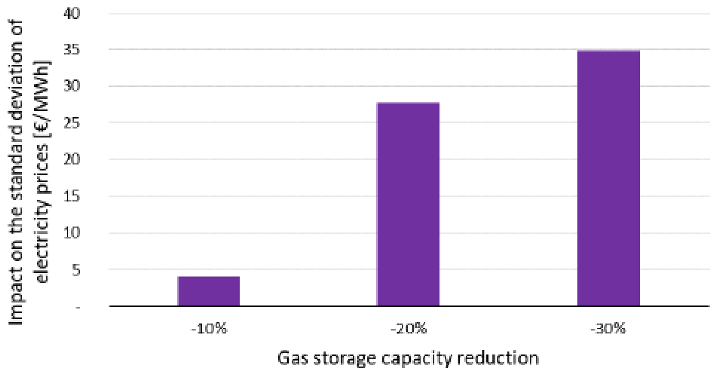




Gas storage reduces the variability of electricity prices

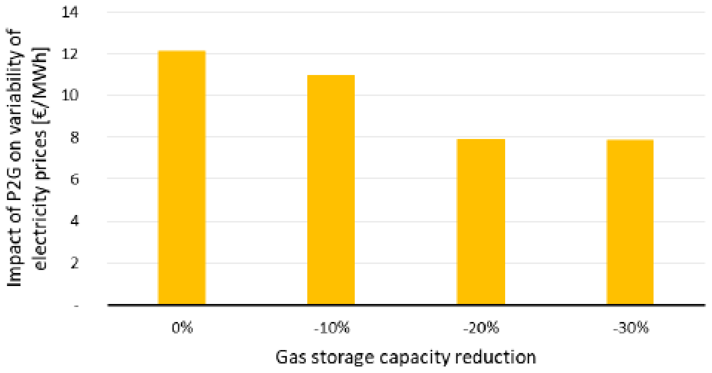
The variability of electricity prices, as measured by the standard deviation of the distribution of hourly electricity prices, is shown to increase rapidly as gas storage assets are taken out of the system. Furthermore, removing gas storage assets reduced the damping effect that P2G may have on the variability of electricity prices.

The **variability of electricity prices increases as the gas storage capacity is reduced**. This figure presents the impacts in terms of the standard deviation of the electricity prices for a given country.



Source: Artelys

Finally, we have found that the ability of P2G to reduce the variability of electricity prices is **most effective** with high levels of gas storage capacity.



Source: Artelys

Key conclusions and outlook

Key conclusions

- Through arbitrage, gas storage assets allow for the **best use of available resources** in well-functioning markets
- **Electricity demand curtailment** situations could appear when the gas storage capacity is reduced by 20%*
- The presence of gas storage assets **prevents unnecessary investments in electricity generation from materialising**. For illustration, we have estimated that the around 23 GW of electricity generation capacity would be required in the absence of 30% of gas storage capacity
- The presence of gas storage assets allow to **decrease the variability of electricity prices**

*In some countries, problems may arise for lower reductions of gas storage capacity due to local circumstances that have not been modelled in this study

Thank you for your attention