

# *The Economics of Natural Gas Storage in North West Europe*

Chi Kong Chyong, EPRG, University of Cambridge,  
+44 1233 748197, k.chyong@jbs.cam.ac.uk  
David Reiner, EPRG, University of Cambridge,  
+44 1233 339616, dmr40@cam.ac.uk

## **Overview**

Gas storage is an essential element in national energy security strategies, while helping to meet downstream demand in a cost-effective way. The evolution and development of storage capacity in Europe was underwritten by quasi-vertical integration, whereby upstream producers sign long-term contracts with large integrated utilities who in turn had long-term supply agreements with regional distributors and large industrial users. Along that chain of long-term contracts, importers and regional suppliers and large consumers invested in and operated gas storage to manage demand swings, which cannot be fulfilled by pipeline contract flexibility alone. Thus, the proliferation of national storage capacity grew hand in hand with penetration of gas into the European energy mix.

However, with the structural changes in European gas markets over the past two decades brought on by deregulation and liberalization of the downstream gas markets in Europe, it was expected (see e.g., EC, 2015) that going forward the economic incentives (differences between summer/low and winter/high prices, or summer-winter spreads) would not be strong enough to encourage gas suppliers to use storage at sufficient level that would ensure normal profitability for storage operators across Europe. This negative trend has implication on gas security of supply since storages are seen as an important tool to mitigate potential impact of physical gas shortages and/or associated price spikes. For example, if storage operators are unable to recover their investment costs for a long period of time this could then lead to possible divestment of those unprofitable assets or increased in support from the government would be required to maintain the current storage capacity level. In turn, this divestment decisions are sunk in the sense that once storages (especially seasonal storages) are shut down they cannot be brought back to operations thereby putting security of supplies at increasing risks.

Therefore, motivated by these considerations, our research objectives are to understand (i) possible evolution of seasonal storages in key gas markets of North-Western Europe, (ii) competing sources of seasonal flexibility, and (iii) the economics of different storage types (seasonal and short-range storages).

## **Methodology and preliminary results**

Our analytical framework is grounded in competition analysis and, in particular, we seek to understand the geographic scope of competition between gas storages across Europe and alternative sources of flexibility (e.g., LNG and pipeline gas supplies as well as demand-side response), differentiating by main products – seasonal, monthly and daily flexibility – that storages can provide. For these purposes, we will use a global gas market simulation model (formulated as a social welfare maximization problem) supplemented by real options analysis to value the optionality associated with fast-cycle storage facilities. Large-scale, numerical gas market simulation models allow for the study of market structure and fundamentals on the dynamics of prices, consumption and the economics of different gas infrastructure assets (amongst others, see, e.g., Zwart and Mulder, 2006, Holz et al., 2008, Lise and Hobbs, 2008, Gabriel et al., 2012, Abada et al., 2013, Chyong and Hobbs, 2014, Growitsch et al., 2014).

Using our gas market simulation model we can conduct ‘what-if’ analyses, for example, assuming a hypothetical storage divestment scenario we can explore the responses from other sources of flexibility. This is quite similar to the withholding analysis<sup>1</sup> conducted as part of competition and merger investigations (Joskow and Kahn, 2002; Patton et al., 2002; CMA, 2015) with the only difference that we do not consider (at this stage) whether such a withholding (or divestment) of storage capacity is profitable for storage operators.<sup>2</sup> Our preliminary results for the German storage market suggest that seasonal storage facilities are facing increasing competition from alternative sources, especially in the next ten years when markets are expected to be oversupplied with LNG and pipeline gas. Figures 1-4 show responses coming from different sources of flexibility in response to a hypothetical divestment of 50% of storage capacity in Germany.<sup>3</sup> For example, Figure 1 shows that seasonal storage capacity in the UK, the Netherlands, Czech Republic, Austria and France are close substitutes for the seasonal storage in Germany because when storage capacity in Germany is decreased more gas is being filled in the Dutch, Austrian, Czech, French and UK storage facilities.

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<sup>1</sup> The withholding analysis is a flipside of the SSNIP (Small but Significant and Non-transitory Increase in the Price) test which seeks to define the smallest relevant market for which a firm hypothetical monopolist could profitably impose a hypothetical small (typically in the range of 5-10%), permanent price increase (see European Commission’s notice on the definition of the relevant market for the purposes of Community competition law. Published in the Official Journal: OJ C 372 on 9/12/1997.)

<sup>2</sup> Such ‘withholding’ could certainly increase congestion rents, allowing operators to recover capacity costs. Divestment of capacity is therefore a natural response in an oversupplied market. But, as noted, this could jeopardise security of supply when supply-demand balance in Europe is restored and markets are tight again, which, based on our model, will happen post-2025.

<sup>3</sup> This hypothetical divestment of storage capacity in Germany was based on the model results, which show that German storage market is oversupplied by roughly 50%, hence the rationale for considering divestment of half of the entire storage capacity.

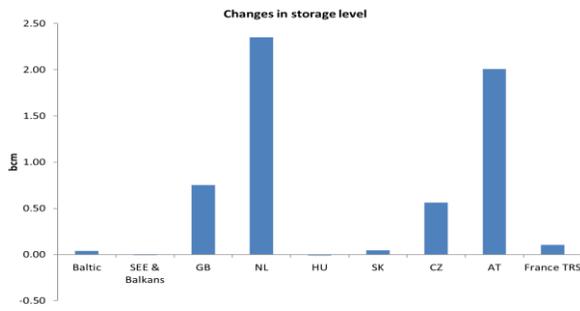


Figure 1: Sources of flexibility for the German gas market – Storage in other markets

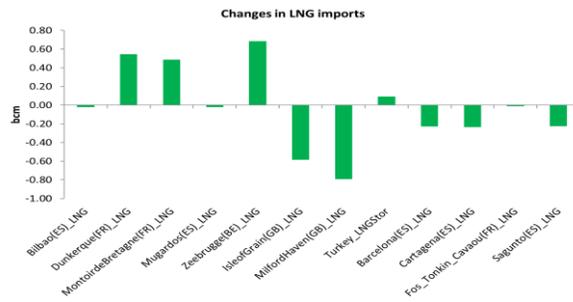


Figure 2: Sources of flexibility for the German gas market – LNG supplies

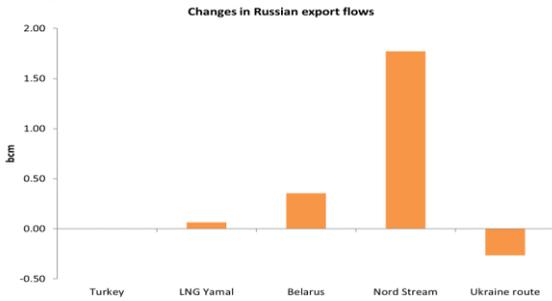


Figure 3: Sources of flexibility for the German gas market – Russian gas supplies

Note: the y-axis measures responses from different sources of seasonal flexibility in billion cubic meters per year (“+” means increase while “-” means decrease in supplies from a particular source compared to the base case when storage capacity in Germany is unchanged).

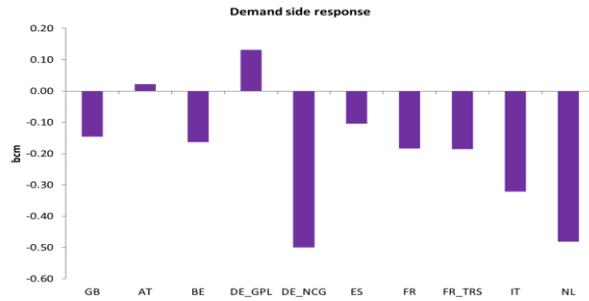


Figure 4: Sources of flexibility for the German gas market – Demand side response

In addition to storage capacity in neighbouring countries, direct supplies from LNG terminals in France and Belgium are also close substitutes for seasonal storage in Germany – if seasonal storage capacity in Germany is reduced, more LNG is being supplied to Germany through terminals in France and Belgium, which effectively become transit countries for LNG into Germany (Figure 2). The increased supply of LNG supplies arises from spare import capacity in France and Belgium, but this increase comes at the expense of LNG supplies to the UK and to Spain – under the scenario of storage capacity divestment, the French and Belgian routes are more profitable (on a netback basis) compared to supplies into the UK and Spanish markets.

It is obvious that, in general, the flexibility offered by Russian gas supplies to Germany directly competes with German seasonal storage, but the real question is which routes provide additional flexibility into Germany should it be called on to do so – the lower left chart shows changes in flows through Russian pipelines to Europe. Under the divestment case, Russia provides more gas (and hence flexibility) to Germany through Nord Stream and Belarus pipelines and less through the Ukrainian route compared to the base case (Figure 3). Primarily this is due to the fact that, on a route-cost basis, both the Nord Stream and Belarus pipelines are more cost competitive to deliver gas into Germany’s Gaspool market area, where competition between Russian gas and other supplies (such as Norwegian and Dutch supplies plus LNG) is less intense than its supplies through Ukraine into the NCG market area. In fact, most of the additional LNG that is coming into Germany through France and Belgium enters Germany’s NCG market area.

Finally, seasonal storage facilities in Germany compete directly with demand side response (Figure 4). As seen in the lower right chart when Germany’s storage capacity is reduced this will trigger demand responses from majority of the North-western European markets. For example, because LNG flows into Europe will be re-optimised (e.g., less flows into the UK and Spain and more to France and Belgium) in response to lower seasonal storage capacity in Germany, the realised wholesale prices in the UK, Spain and other countries which suffer from such a reduction of LNG flows will be higher, triggering demand-side response in these markets. Thus, coal and possibly other generating fuels in North-western European electricity sector will compete with seasonal storage in Germany.

## Conclusions

What are the implications for the economics of seasonal storage in Europe and Germany in particular? The above mentioned sources of flexibility act as competitive restraints on seasonal storages in Germany. In other words, the economics of seasonal storage in Germany will be improved by: (i) full utilization of storage capacities in the UK, the Netherlands, Czech Republic and Austria, (ii) full utilization of LNG import capacities in France and Belgium, (iii) more Russian gas flows through Ukraine and/or Nord Stream and Belarus pipeline capacities are substantially limited; and (iv) high demand for gas in majority of North-western European markets (constraining demand-side response or that coal prices are substantially higher than anticipated). We plan to do the similar analyses for other markets in Europe such as the UK, France and Italy in future research.

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