



Seasonal Flexibility in the European Natural Gas Market

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Seasonality of gas demand is a central characteristic of the European gas market. European countries balance the seasonal demand swing (i.e. differences between winter and summer gas consumption) with a mix of flexibility options such as variations in domestic gas production, variations in pipeline or liquefied natural gas (LNG) imports as well as the operation of underground gas storage facilities.

In recent years, a relative abundance of seasonal flexibility was observed in the European gas market. It was reflected by low seasonal gas price spreads on gas hubs and low utilisation of regasification terminals. However, the current situation is a snapshot. In the future, several factors will put significant downward pressure on the oversupply of flexibility options. They include (i) closures of existing seasonal flexibility options and (ii) decreasing volumes (and associated flexibility) of European domestic gas production. On the other hand, there are factors that work in the opposite direction. They include continuous integration of European gas markets (completion of new transmission and storage infrastructure), as well as optimised utilisation of existing assets. Taken together, the future need for seasonal flexibility (and implied scarcity) remains unclear.

The central focus of the paper is the investigation of the role of different flexibility options in covering European seasonal gas demand swing. Previous studies either discussed seasonal flexibility using top-down or statistical approaches or they maintained a narrow focus, mostly on security of supply issues. Furthermore, a systematic understanding of how to measure the importance of a particular supply source contributing to a seasonal demand swing is still lacking.

Hence, we contribute to the ongoing discussion of this topic (i) focusing our analysis on seasonal flexibility and (ii) addressing the problem using a bottom-up market optimisation model to simulate the operation of the gas market over a long period. This allows us to explore structural trends in market development, which are driven by



changing supply and demand fundamentals. Furthermore, we contribute to the methodological question of how to measure the contributions of different flexibility options by proposing a new metric. We also publish the source code, associated data, and processing of the results.

Our results provide several insights about the development of gas supply sources' utilisation. In particular, we illustrate that (i) European domestic production is facing a significant decrease in production volumes; (ii) LNG has a growing share in the European import mix, but does not become a game changer; (iii) Europe most likely continues to rely heavily on pipeline imports from Russia; (iv) storage utilisation at peak demand levels is forecasted to remain high on both the national and European level.

We show that our methodologically improved coefficient of variation (a “scaled coefficient of variation”) improves the understanding of seasonal flexibility's market dynamics. The scaled coefficient of variation captures the effects caused by, e.g. the drop of Dutch domestic production volume and flexibility, the closure of Rough storage facility in the UK, and the completion of new transmission infrastructure projects (e.g. Nord Stream 2). Our findings suggest that even in the long term gas storage facilities are unlikely to be displaced from their position as key seasonality provider by either pipeline or LNG imports.

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