

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 in gas consumption across seasons) with a mix of flexibility options such as varying domestic gas production, varying pipeline or liquefied natural gas (LNG) imports, and operating of underground gas storage facilities.

The years leading up to 2018 saw a relative abundance of flexible capacity in the gas market. It was reflected by low seasonal gas price spreads on gas hubs and low utilization of regasification terminals. However, this abundance of seasonal flexibility is not permanent. 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 optimized utilization of existing assets. Taken together, the future need for seasonal flexibility (and implied scarcity) remains unclear.

The paper analyzes flexibility options covering European seasonal gas demand swing. Previous studies either discussed seasonal flexibility using other methodological 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 optimization 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 and associated data for the entire research project.

Our results provide several insights about the development of gas supply sources' utilization. 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; (iii) Europe most likely continues to rely heavily on pipeline imports from Russia; (iv) storage utilization at peak demand levels is forecasted to remain high on both the national and European level.

We show that our methodologically enhanced metric—the scaled coefficient of variation—allows for a better understanding of how market dynamics affect seasonal flexibility. 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). We find no evidence that gas storage facilities will be displaced by pipeline or LNG imports from its role as the key seasonal flexibility provider in the long term.

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