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NATURAL GAS CORRIDORS AMONG THE EU AND ITS MAIN SUPPLIERS: SIMULATION RESULTS WITH THE DYNAMIC GASTALE MODEL

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Overview

European demand for natural gas has grown and is expected to expand considerably in the next decades. This growth is partly induced by the environmental policy targets, e.g., the Kyoto pro-tocol, and the European energy market liberalisation. However this development also poses a challenge for the energy consumers in the EU and other gas importing countries with respect to the increasing dependency on gas imports and consequently also the security of gas supplies. Moreover, the importance of gas transit routes into the EU is becoming a more important part of this threat. This paper studies investment decisions by Transmission and Storage System Operators concerning the gas corridors connecting EU markets with its main suppliers in a liberalised gas market with imperfect competition.

Methods

The study was conducted with support of the GASTALE model version 4.4, employing a computational game theoretic modeling approach. Our model is a logical extension of the GASTALE model developed at ECN (Boots et al, 2004, Egging and Gabriel, 2006). The approach of this paper brings together the strengths of both of these models and recursive dynamic investment decisions in storage and transport infrastructure (pipelines and LNG) are added. GASTALE version 4.4 addresses interactions between demand, supply, transport and investments in the natural gas market over the period 2005-2030. Moreover, the model distinguishes between upstream producers and downstream arbitragers. Both can exercise market power, although this paper focuses on producer strategic behavior. Upstream producers make four types of decisions, namely how much to 1) produce, 2) transport through pipelines, 3) transport over sea as LNG, and 4) sell to power generators, industries or households. Transport services are provided by the transmission system operator (TSO) who is assumed to operate the system efficiently. Downstream arbitragers decide how much to arbitrage among power generators, industries, households and storage. Storage takes place during the low demand summer season and is extracted for consumption during the high demand winter season. The storage system operator is assumed to be a price taker. Finally, prices clear the markets.

Results

This paper develops a business-as-usual (BAU) scenario with a focus on the required gas infrastructure, following the standard EU scenario as closely as possible. The results focus on interactions among demand, supply and gas transport infrastructure, pipeline and LNG transport, storage, and necessary investments in the natural gas market over the period 2005-2030. For dealing with the great uncertainties that are part of our long term future, a number of policy scenarios are formulated to study the impact of demand uncertainty and delaying investment behavior on the gas transport infrastructure (pipeline transport, LNG facilities and storage capacity) required in the long run in Europe, namely the high and low demand scenario, the (investment) deferral scenario and a number of disruption cases to test the resilience of the gas network after investments are realized. In addition, some of the key tradeoffs among investments in pipelines, LNG liquifaction and regasification

facilities, and storage capacity are investigated. An overview of the results in terms of prices is given in Fig. 1. Prices in the low demand scenario are lower than the BAU prices, while prices in the high demand scenario are higher, and the prices are the highest in the deferral scenario. Hence, the prices under the four scenarios can be clearly distinguished.

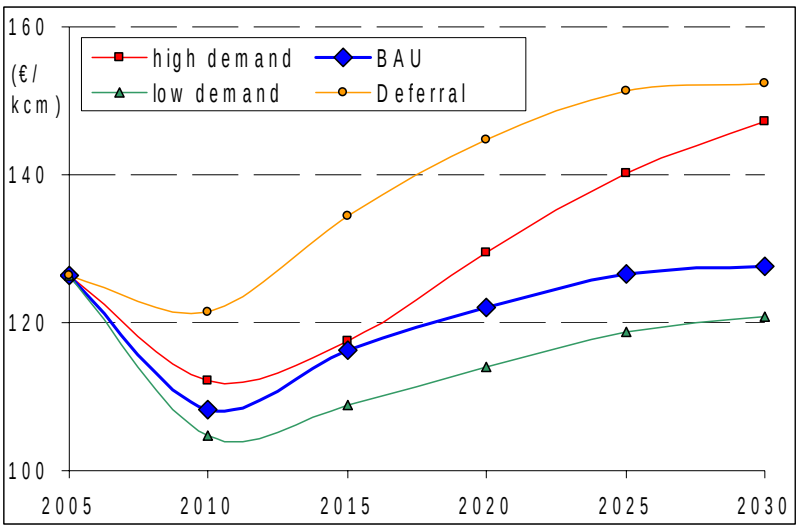

Fig. 1: Total average gas prices in the EU in four scenarios.

Conclusions

To derive a realistic BAU scenario, the expansion of some pipeline connections has been limited from above and some pipeline connections have been fixed in the model. From this we can conclude that pipeline connections of Russia to Germany and of Norway to France are mainly constructed for political reasons, because they are substantially more expensive than existing alternative routes. Pipeline connections of Norway to the UK and of Northern Africa to Spain and Italy are very attractive and the model would make them if decisions concerning these pipelines were to be based on economical reasons alone.

In addition, the ability of Russia to transport gas as LNG to EU is limited from above in the model. This indicates that LNG is an attractive option from a purely economic point of view and would substitute a portion of the existing pipeline network in the period 2005–2030, in case the LNG option rises on the Russian political gas agenda. The pipeline connection between Egypt and Turkey is also an economically attractive project, however it is politically unsure whether this connection will be realized.

Disruption of gas supplies indicates that the prices in neighboring countries rise. The price effect is higher for Algeria and Turkey in 2020 as compared to 2010 due to higher gas flows, while the price effect is lower for central European countries in 2020 as compared to 2010, due to availability of alternative gas supplies.

The main policy conclusion is that substantial investments in gas transport corridors are needed to provide for security of supply. Especially the pipeline connections running from East to West need to be prioritized. The future gas price largely depends upon the sufficient availability of gas from Russia, Iran, and Central Asian countries.

References

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