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Modelling the Swiss Gas Market in a European Context

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Project goals

The objective of this project is to evaluate the upcoming challenges on the Swiss natural gas market by first, developing a European natural gas market model to simulate potential future market developments and its feedback on the Swiss supply security; and second, developing a detailed Swiss natural gas market model to simulate different market designs and conditions.

Summary

The Swiss Energy Strategy 2050 and the European Energy Roadmap to 2050 both aim for higher energy efficiency and for a shift towards renewable electricity generation. These goals have direct and indirect impacts on the natural gas markets. Moreover, the Swiss natural gas market is currently facing questions concerning its future design with regard to a liberalized market framework. In parallel, on a European level, the recent Russian-Ukrainian confict spurs doubts about the supply security. It fruther highlights the role of liquidifed natural gas (LNG) for import diversificaition and of the extension of the European pipeline system for a better management in case of supply interruptions. Finally, on a global level, the rise of unconventional natural gas production in the US triggers market dynamics that lead to a significant price divergence between US, European, and Asian markets.

In the first phase of the project, a European natural gas market model has been developed to assess different supply security scenarios. The evaluation shows that a combination of enhanced infrastructure (new LNG terminals, alternative import corridors), the implementation of reverse flow options on existing pipeline corridors, and strategic storage management can help to significantly reduce the negative effects of supply disruptions. The costs associated with the storage provision can furthermore be reduced if a joint European approach is chosen instead of singular national regulations.

In the second phase a detailed Swiss market model will be developed to address the specific Swiss market situation focusing on the distribution level. First results are expected for 2017.

Work undertaken and findings obtained

European model

The project started mid October 2015. In the first part of 2016, the focus was put on the devlopment of the European market model following the approaches presented in Egging et al. (2008), Neumann et al. (2009), Abrell and Weigt (2012, 2014), and Abrell et al. (2013). The model is designed as an optimization model.

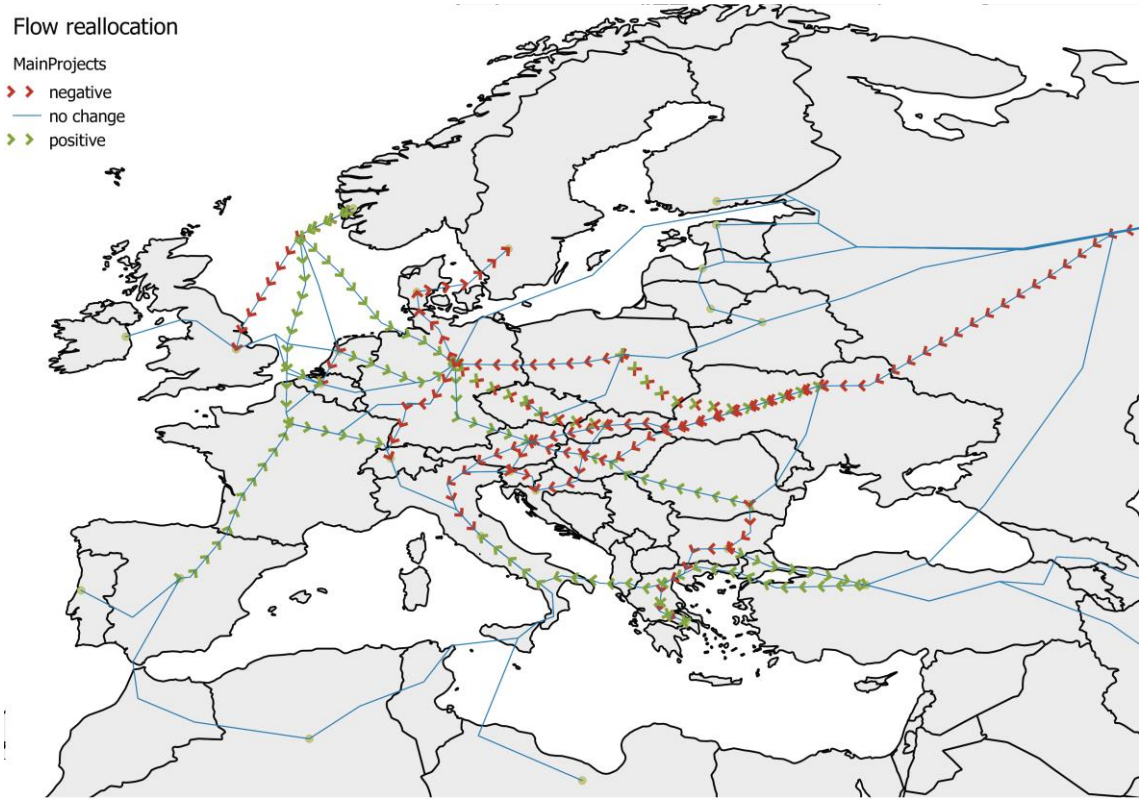
The framework includes technical details on the gas producers and traders as well as on storage and pipeline infrastructure. It further ensures linkage to the world market through LNG exports and imports infrastructures. The spatial coverage includes all European countries with aggregated cross-border pipeline capacities, the main exporters and aggregated international trading hubs (i.e. US, Middle East, and Asia). The model is designed with monthly resolution to capture the seasonal dynamics of the gas market. Subsequently, we designed scenario analyses as exogenous shocks on the market.

Specifically, we developed four analyses closely related to the security of gas supply on the European market.

First, we simulated projections of the European natural gas market in 2030 and studied the impact of major infrastructure projects (additional pipelines, new LNG terminals, etc.). Several insights can be drawn from these demand evolution scenarios. First, the forecasted levels of natural gas production in 2030 force Europe to diversify its supply sources, even without new infrastructure. Thereby, the importance of LNG is significantly reinforced. Second, the projected infrastructures help Europe on its ways towards diversification of supply sources, with the notable exception of the Nord Stream 2, which leads to an increased Russian market share. From a cost perspective, all projects result in greater availability of gas on the market, and thus in lower prices.

To assess the short-term resilience of the European market we simulate an unexpected supply shock with a fictive disruption of Russian exports. Throughout the disruption, one can observe several general trends. First, the larger availability of production capacity forecasted by the IEA, notably in the Middle East, as well as the implementation of back-flow capabilities in the European pipeline network results in enhanced security of gas supply (SoS) in Europe in 2030 compared to today. The shortage of supply from Russia can partly be compensated be rerouting flows from North and West Europa towards East Europe as well as increasing imports from non-Russian suppliers (**Figure 1**). Second, the planned infrastructure projects have a strong positive impact on the European short-term SoS. Last, the extension of the Nord Stream creates a trade-off for the current East European transit countries (e.g. Poland), between the loss of transport fees and an enhanced SoS.

Figure 1: Reallocation of pipeline flows in case of a Russian supply disruption, 2030



In a third step, we simulated the introduction of a strategic gas reserve policy on the European level, seeking to evaluate its influence on the supply security. One the one hand, strategic storage reserves provide a substantial benefit in terms of energy security and managing short term disruptions. The strategic storage is used as a buffer, helping to cope with unforeseen circumstances or crises and to maintain a continuous gas supply. On the other hand, however, the policy induces certain costs. (financial burden of holding storage, crowding out of commercial usage of storage and growing demand on the market) therefore negatively impacting consumers. The simulation results indicate that already modest storage requirements reduce the impact of supply disruptions; i.e. a 20% storage obligation reduces demand outages by 50% while only increasing consumer expanses by 3%. Depending on the valuation of supply security, this might be considered an acceptable compromise.

Finally, for the last scenario, we aimed to quantify the benefits of cooperation among EU member countries in case of supply disruption. Several countries possess limited storage capacity in relation to their demand, while a few do not hold any storage facilities at all. For these countries, shared access to strategic storage is essential, to prevent severe welfare cuts during supply disruptions. The difference in overall welfare between non-cooperation and cooperation can be as high as 30%.

Swiss model

During the second phase of the project (fall 2016 until fall 2017), the Swiss market will be the focus with the objective to develop a detailed Swiss natural gas market model. In preparation of the model development, a detailed study of the Swiss market organization was conducted to identify the required design characteristics of the Swiss model. In parallel, first test runs with a simplified dataset have been conducted to test the model formulation. The Swiss model will cover the gas distribution sector of Switzerland, the main import nodes and the connecting pipeline network. By the end of 2016 a dispatch model formulation was finalized providing average yearly demand and flow levels.

National and International cooperation

The project team is embedded within existing energy economic research groups at the University Basel (Research Center for Sustainable Energy and Water Management, FoNEW) and at the ETH Zurich (Center for Energy Policy and Economics, CEPE).

In parallel, the project is embedded in the Swiss Competence Center for Research in Energy, Society and Transition (SCCER CREST). This competence center brings together research groups from different disciplines and almost all major Swiss research institutions. Furthermore, the project team has established connections to the research teams at DIW Berlin and TU Berlin addressing European and global gas market topics (i.e. Abrell et al. (2013)).

A first version of the European model and its application was presented in May 2016 at the European Energy Market Conference in Porto.

Outlook for 2017

The main task of 2017 will be the further development of the Swiss market model, the extension of the underlying dataset, and the subsequent calibration to the historic Swiss natural gas demand and flow patterns. Consequently, data on network capacity as well as detailed information on consumption patterns are crucial to obtain meaningful and convincing insights. The current dispatch model formulation will furthermore be extended to account for the existing market structure (local monopolies) and potential future formulations of market access (entry-exit systems) and competition forms.

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