# SECURITY OF NATURAL GAS SUPPLY FOR EUROPE IN THE SPECIAL CASE OF AUSTRIA UNDER CONSIDERATION OF GRID AND STORAGE EXPANSION

Andreas Fleischhacker, Vienna University of Technology, +43 1 58801 370361, fleischhacker@eeg.tuwien.ac.at
Georg A. Lettner, Vienna University of Technology, +43 1 58801 370376, lettner@eeg.tuwien.ac.at
Hans Auer, Vienna University of Technology, +43 1 58801 370357, auer@eeg.tuwien.ac.at

## Overview

To guarantee economic and technical competitiveness of the European Union, an undisturbed supply of natural gas is essential. The EU imports over 60% of its annual gas demand in the year 2013 (Eurogas 2013). Gas disruptions like the Ukraine-Russian gas conflict in 2009 have shown the vulnerability of the European natural gas supply. The disruption in natural gas supply during an extended cold period particularly affected Eastern and South-Eastern Europe. In concern of the current Ukraine–Russian tensions resulting in the Crimean Crisis 2014, Europe's Energy Policy is in urgent discussion.

Motivated by supply uncertainties of natural gas, this work describes a Central Europe transmission gas grid model. It consists of the current natural gas storages and transmission lines. Thus it is possible to investigate the impacts of bottlenecks and supply disruptions, in the case of Austria. A second task of the model is to show the sensitivity of supplier countries and transmission routes. A weakness of the transmission grid view is the lack of information at local level, concerning natural gas shortage.

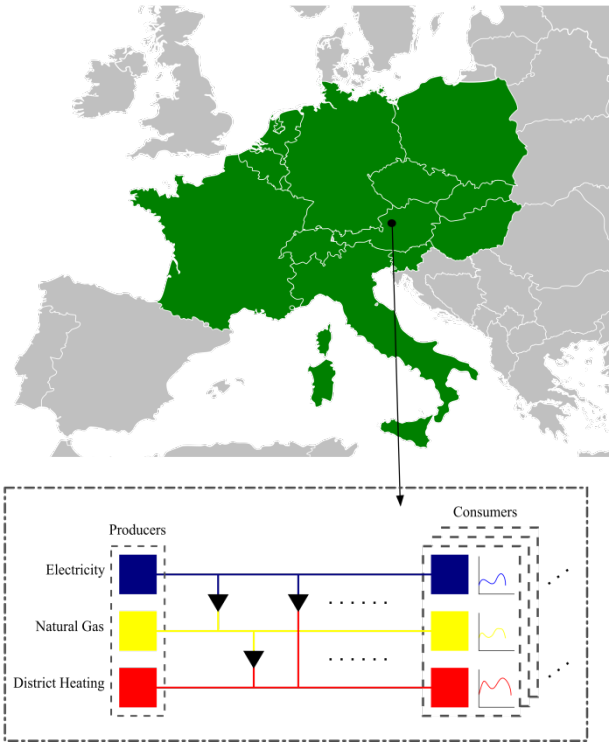


Figure 1 Modelled region by the Central Europe model (top) and simplified Local Model of Salzburg (bottom)

For this reason the next step is a detailed investigation of the urban region Salzburg, to determine impacts of natural gas breakdown to residential and industrial consumers on a local level. For natural gas shortage concerns both heat and electricity production, the Local Model consists of multiple energy carriers (natural gas, electricity, fuel oil, biomass and renewable energy sources). The energy sector's components are predefined and consist of producers, consumers and transmission lines. If natural gas supply breaks down, the Local Model quantifies the effect on energy consumers. This effect depends on redundancy of the consumers energy supply.

## Method

Figure 1 shows the modelled region by the Central Europe model (top) and the simplified local model (bottom). The model consists of predefined load nodes connected by transmission lines. Natural gas imports to Central Europe (e.g. Russian and Norwegian imports) are modelled by exogenous sources, connected by transmission lines. It is modelled by the multigrid optimisation tool eTransport, developed by SINTEF (Bakken et al. 2007; SINTEF 2012). By this method it is possible to simulate transmission as well as any kind of supply disruptions.

In addition to the Central European Model the Local Model identifies shortage effects on certain energy carriers at local level. In this work the city Salzburg in Western Austria is modelled.If natural gas input is changing the effects on consumer of different energy carriers is shown. In comparision to the Central Europe Model, the Local Model is modelled as a linear optimization problem in the optimization software GAMS.

For this work, two scenarios, concerning the security of supply are defined:
*Scenario 1* describes a natural gas supply disruption at all supplying nodes to Austria beginning at 1 January. In this case Austria is a natural gas isolated island, with full storages. Furthermore this scenario is divided into three cases.

a) Simulation without the natural gas storages 7Fields and Haidach. The geographical position of these two storages is Austria, but technically they are connected to Germany's natural gas grid.
b) Same parameter as scenario1a in addition to a load reduction of 5, 10 and 30%.
c) With a connection of the natural gas storages 7Fields and Haidach to Austria's natural gas grid.

*Scenario 2*, sensitivity analysis in regard of supply regions. Three supply regions (cases) are investigated:

a) Russian,
b) North Sea,
c) LNG and North African imports to Italy.

## Results

The first scenario considers Austria as an island concerning natural gas supply under the consideration of 60% filled natural gas storages. Without a demand reduction natural gas supply Austria's natural gas demand can be ensures about 100days by a disruption beginning at 1 January. By reducing the load by 30% this period extends till the summer months. The third case anticipates the two natural gas storages Haidach and 7Fields are connected to Austria's natural gas grid and this enables to shift the situation of undersupply into the summer. Down to the present day 7Fields is connected in spring 2014 and Haidach will be connected during this year. This enhanced storage capabilities increases Austria's security of supply sustainable.

The Local Model's results are only significant in scenario 1a, because this case results in a situation of undersupply. Effects appear especially in Salzburg district heating and natural gas distribution grid. Salzburg has installed a high capacity of natural gas fired combined heating power plants (CHPP) By using alternative fired power plants (oil und biomass) the situation of natural gas shortage can be disarmed. Not supplied heating energy is 1.65GWh/week by a total district heating demand of 21.1GWh/week. This situation occurs during the annual peak loads in winter and transition period months. A solution is the installation of additional oil or biomass fired CHPP or heating plant with a nominal power of 49.5MW. The situation for natural gas consumers is much heavier, because the entire supply is broken down. To ensure a supply of heating additional electric heating devices can be installed. This shifts the problem to the electrical grid. The electrical grid's peak load power raises of 120% and weekly energy demand raises of 80%.

The second scenario analyses the impact of supply disruptions of Europe's main importers as shown in Figure 2. Cutting off from Russians natural gas mainly concerns the East European countries Poland, Slovakia and Hungary. Switzerland is affected too, because of missing natural gas storage capabilities. North Sea gas imports affect the states Belgium and Luxembourg, France, Netherland, Germany and Switzerland. North African and LNG imports do not affect Europe's at all, only Italy has 27% degree of undersupply. In case of natural gas undersupply in Austria, scenario 2a and 2b the results of Local Model results are the same as in Scenario 1. Due to that reason a separate representation is not shown.

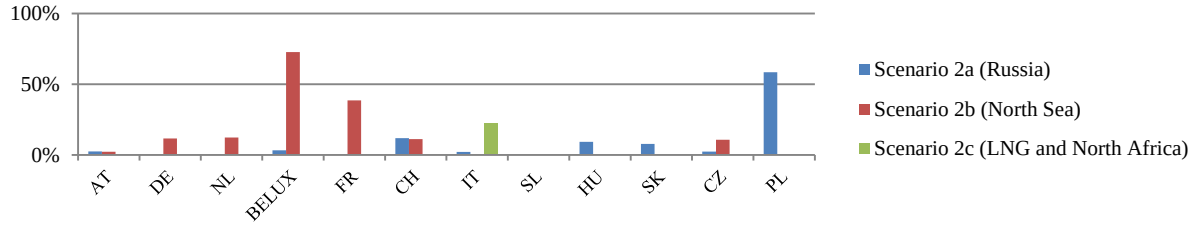


Figure 2 Degree of undersupply in scenario 2 (Central European Model)

## Conclusions

To ensure future security of supply in Central European States it is necessary to diversify the supply countries as well as the energy mix's composition. A reduction of natural gas consumption in residential heating has high potential, too. Another important transnational challenge is the implementation of the Ten Year Network Development Plan (TYNDP) according to (ENTSOG 2013). This plan includes future pipeline and storages projects in order to satisfy Europe's raising energy demand and diversify the origin of natural gas.

## References

Bakken, B.H., Skjelbred, H.I., Wolfgang, O., 2007. eTransport: Investment planning in energy supply systems with multiple energy carriers. Energy, 32, 1676–1689.

Eurogas, 2013. Statistical Report 2013.

SINTEF, 2012. eTransport. - new tool for local planning of sustainable energy systems. http://www.sintef.no/home/SINTEF-Energy-Research/Project-work/eTransport-/ (29 September, 2012).