

# LONG-TERM DEVELOPMENT OF EUROPEAN NATURAL GAS MARKETS – SCENARIO ANALYSIS USING THE GLOBAL GAS MODEL (GGM)

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Natural gas, Europe, energy crisis, prices, LNG

## Overview

The massive reduction of Russian natural gas exports to Europe following the invasion of Ukraine in February 2022 has led to a significant reshuffling of gas flows in Europe and – via international trade of liquefied natural gas (LNG) – beyond. In the short-term, supply security in Europe was maintained through a significant increase of other pipeline deliveries, and additional LNG imports, mainly through Belgium and the Netherlands (McWilliams et al. 2023). Planned outages could be avoided and overall, and the risk of serious short term supply gaps for the next winters appears manageable (Holz et al. 2023, 2022; Höhne, Marquardt, and Fekete 2022). However, longer-term natural gas markets in Europe are subject to substantial uncertainty, not only on the supply side but also on the demand side, where the future role of natural gas is challenged by climate considerations and electrification. The paper provides a model-based analysis of potential developments of European gas markets in the context of global natural gas trends, including both geopolitical developments and climate policy considerations.

## Methods

The model applies a numerical partial equilibrium model of the global natural gas market, the “Global Gas Model” (GGM), to a set of scenarios defined by the authors. The Global Gas Model is a multi-period partial equilibrium model for analyzing the world natural gas market along the value chain from production wells to final consumers; market agents include suppliers, transmission system (TSO) and storage operators (SSO) (Figure 1) (<https://www.ntnu.edu/iot/energy/energy-models-hub/ggm>). The GGM has a detailed representation of the European natural gas pipelines and LNG-terminals and has been applied to similar model-based analyses, such as in (Egging et al. 2009; Egging and Holz 2016; Holz et al. 2017; Egging, Holz, and Czempinski 2021).

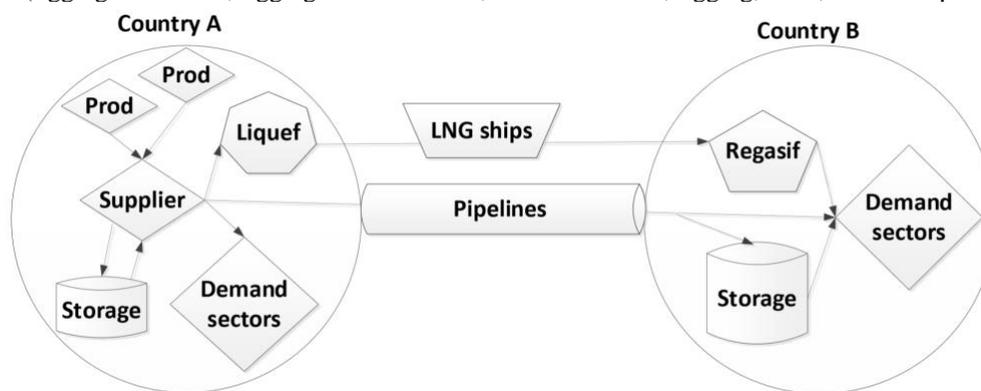


Figure 1: Representation of the Global Gas Model (GGM)

Source: <https://www.ntnu.edu/iot/energy/energy-models-hub/ggm> [last access 2023-03-16]

The paper first presents a calibration of the status quo of European and international gas markets before the run-up of the war, i.e., the “status quo ante bellum”, based on previous model exercises and some updating of the data. The paper then proceeds with a 2x2-matrix of scenarios, covering both the supply side and the demand side (Table 1). On the demand side, we take scenarios inspired by two projections from the IEA’s World Energy Outlook (IEA 2021, 2022): The Stated Policies Scenario (STEPS) of

2021, and the Announced Pledges Scenario (APS) of 2022 (if possible, we will extend the model by a “Net Zero Emissions by 2050” scenario (NZE)). On the supply side, scenarios vary with respect to trade between Russia and Europe, one without natural gas trade altogether (“New normal”), and another one with a gradual re-establishment of trade flows, albeit at a lower level than before (“gradual recovery”).

Table 1: Scenarios for European natural gas markets to 2050 Source: Authors own.

	<b>“New normal”: No direct pipeline-based natural gas trade between Russia and Europe</b>	<b>“Gradual recovery”: Re-establishment of natural gas trade between Russia and Europe</b>
<b>Higher global demand (IEA Stated Policies Scenarios (STEPS))</b>	(1) New normal – higher demand	(3) Gradual recovery – higher demand
<b>Lower global demand (IEA Announced pledges (APS))</b>	(2) New normal – lower demand	(4) Gradual recovery – lower demand

## Expected Results

At present, an update of the model data for existing infrastructure in 2020 is under way, as is calibration of supply and demand projections to the STEPS and APS scenarios. First exploratory scenario runs are carried out. While the model covers global trends, the focus of the results will be the impact on European natural gas markets in the four scenarios, until 2050, in terms of quantities, net import balances, and the role of international LNG trade. Europe has plenty regasification capacity, but LNG supply will be rather tight for several years, and an uptake of Chinese demand post-covid could put upward pressure on LNG prices. The paper will also put these results in perspective with other ongoing papers on the topic, and compare them to previous scenarios in the literature before the supply interruptions from Russia (e.g. Hauser 2021).

## Conclusions

The paper provides insights into an important recent issue, i.e. the development of European natural gas markets following the Russian invasion of Ukraine and the plans laid out in REpowerEU to become independent from Russian fossil fuel supply well before 2030, and reduce fossil fuel consumption in the EU significantly. Expected results should provide valuable insights into future developments for both academics, as well as practitioners and policy makers.

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