Energy Policy 80 (2015) 177–189

Contents lists available at ScienceDirect

Energy Policy

journal homepage: www.elsevier.com/locate/enpol

All quiet on the eastern front? Disruption scenarios of Russian natural gas supply to Europe

Philipp M. Richter *, Franziska Holz

German Institute for Economic Research (DIW Berlin), Mohrenstr. 58, 10117 Berlin, Germany

HIGHLIGHTS

- We analyze disruption scenarios of Russian natural gas exports to Europe.
- Most EU countries are only weakly affected by a complete Russian supply disruption.
- We find that Eastern Europe is vulnerable to Russian supply disruptions.
- We identify infrastructure bottlenecks in the European natural gas network.
- We find that the large EU LNG import capacity is not sufficiently connected.

ARTICLE INFO

Article history:
Received 10 August 2014
Received in revised form
20 January 2015
Accepted 22 January 2015

Keywords:
Natural gas trade
Russia
Europe
Security of supply
Infrastructure investment
Equilibrium modeling

ABSTRACT

The 2014 Russian–Ukrainian crisis reignited European concerns about natural gas supply security recalling the experiences of 2006 and 2009. However, the European supply situation, regulation and infrastructure have changed, with better diversified import sources, EU member states being better connected and a common regulation on the security of supply has been introduced. Nevertheless, European dependency on natural gas remained high. This paper investigates different Russian natural gas export disruptions scenarios and analyses short- and long-term reactions in Europe. We use the Global Gas Model (GGM), a large-scale mixed complementarity representation of the natural gas sector with a high level of technical granularity with respect to storage and transportation infrastructure. While we find that most of the EU member states are not severely affected by Russian disruptions, some East European countries are very vulnerable. Prioritizing the removal of infrastructure bottlenecks is critical for securing a sufficient natural gas supply to all EU member states.

1. Introduction

The 2014 tensions between the Russian Federation and Ukraine reignited European concerns about the security of its natural gas supply. Civil war in Ukraine and the sanction policies of the West and Russia have led to fears that Russian natural gas supplies will be interrupted not just to Ukraine but also the EU. At first glance, the dispute over natural gas prices and potential interruptions to supply was comparable to 2006 and 2009, although the situation is more severe with an actual looming war between Russia and Ukraine. However, since 2009 both the global and the European natural gas sectors have significantly changed

- Since the inauguration of the Nord Stream pipeline in late 2011, Russian exports of natural gas via the Ukraine have diminished from 65% of total Russian natural gas exports to Europe in 2010 to about 50% in 2013 (IEA, 2014a). The direct link to a West European importer has stopped the long-term reduction trend of the Russian share in total EU natural gas imports: Russia's share in the natural gas imports of the EU28 was above 50% in 2001 and fell to 37% in 2012, before increasing to 44% in 2013 (IEA, 2013b, 2014b).
- EU security-of-supply regulation 994/2010 (EU, 2010) was introduced in order to harmonize national emergency plans. Many EU interconnectors have been expanded in the aftermath and now allow for reverse flows (cf., ENTSO-G, 2010, 2014).
- The import capacity of Liquefied Natural Gas (LNG) in the EU has been expanded by 16% between 2009 and 2013; an increase to more than 185 bcm of physical import potential (cf. GIIGNL, 2010, 2014). EU LNG imports can potentially be increased since utilization rates are low; only averaging about 25% in 2013 (IEA, 2014b).
- In 2013, natural gas consumption in the EU was 6% lower than

* Corresponding author.
E-mail addresses: prichter@diw.de (P.M. Richter), fholz@diw.de (F. Holz).

http://dx.doi.org/10.1016/j.enpol.2015.01.024
0301-4215/

in 2009 (IEA, 2013a, 2014b). This is due to the economic crisis and low CO_2 prices which favor the use of coal in power generation. The mild 2013/14 winter left storage facilities filled above-average in the spring 2014.

- In the world markets, US natural gas imports were lower in 2013 than in 2009 by more than 50%, since US production increased by almost 20% due to a boom in the extraction of shale gas (EIA, 2014b). In particular, US LNG imports are much lower than previously expected and current projections suggest that the USA will become a net exporter of natural gas as of 2020 (EIA, 2014a; Richter, 2015).
- Japan, on the other hand, attracts more LNG imports to compensate for the (at least temporary) phase-out of nuclear power following the Fukushima Daiichi nuclear accident (cf. Hayashi and Hughes, 2013). Compared to the ten year linear trend prior to 2010, Japanese LNG imports (IEA, 2013b, 2014b) were about 15–20 bcm higher in 2013. Moreover, total LNG imports to Asia have increased by 50% between 2009 and 2014 (IEA, 2013b, 2014b).

Behrens and Wieczorkiewicz (2014) see the EU as better prepared for any disruption of Russian supply and highlight the dependence of Russia on the EU as its main customer. Although the Asian market is an attractive alternative for Russia, with good prospects (Paltsev, 2014), in the short-run actual trade flows are limited due to a lack of production and transportation infrastructure in East Russia. LNG export capacities and pipeline infrastructure toward Asian consumption regions have yet to be constructed on a large scale.

Despite the progress in the EU, the disruption of Russian natural gas exports to Europe may nevertheless have severe consequences, particularly for several East European countries. Consequently, the aim of this paper is an impact assessment with a focus on short- and long-term adjustment possibilities. We investigate the European natural gas market position, alternative natural gas suppliers, and the expansion of existing infrastructure in order to ensure the secure supply of natural gas. Complementary to Hecking et al. (2014) and EC (2014), we can highlight global trade flows of natural gas and infrastructure expansions that would attenuate the impact of Russian natural gas disruptions.

For this purpose, we use the Global Gas Model (GGM; Egging, 2013; Holz et al. 2013), a partial equilibrium model of the natural gas sector with a pronounced focus on natural gas trade and infrastructure. Notably, the current EU natural gas infrastructure is taken into account with its connection to external suppliers as well as the transportation network within the EU. Cross-border pipelines and global infrastructure to trade LNG are included in the model. We account for recent infrastructure developments, in particular reverse flows to Ukraine, that took place in response to the current Russia-Ukraine crisis. Hence, our results differ from earlier modeling exercises with less interconnection of Ukraine (e.g. Richter and Holz, 2014).

We compare three Russian natural gas supply disruption scenarios to a Base Case projection: two short-term disruption scenarios affecting, respectively, the Ukrainian supply and transit, and all Russian export pipelines to Europe, as well as one long lasting disruption of Russian natural gas supply to the European customers. Although unlikely, these scenarios serve to identify bottlenecks within the European natural gas infrastructure and highlight possibilities and necessary expansions in order to diversify the European natural gas supply.

The role of Russian natural gas supplies to Europe and in particular the importance of the individual transit routes has been discussed since the 1990s when Russia started to diversify from its traditional export route via Ukraine by constructing the so-called Yamal-Europe pipeline via Belarus (Fig. 1). Hirschhausen et al.

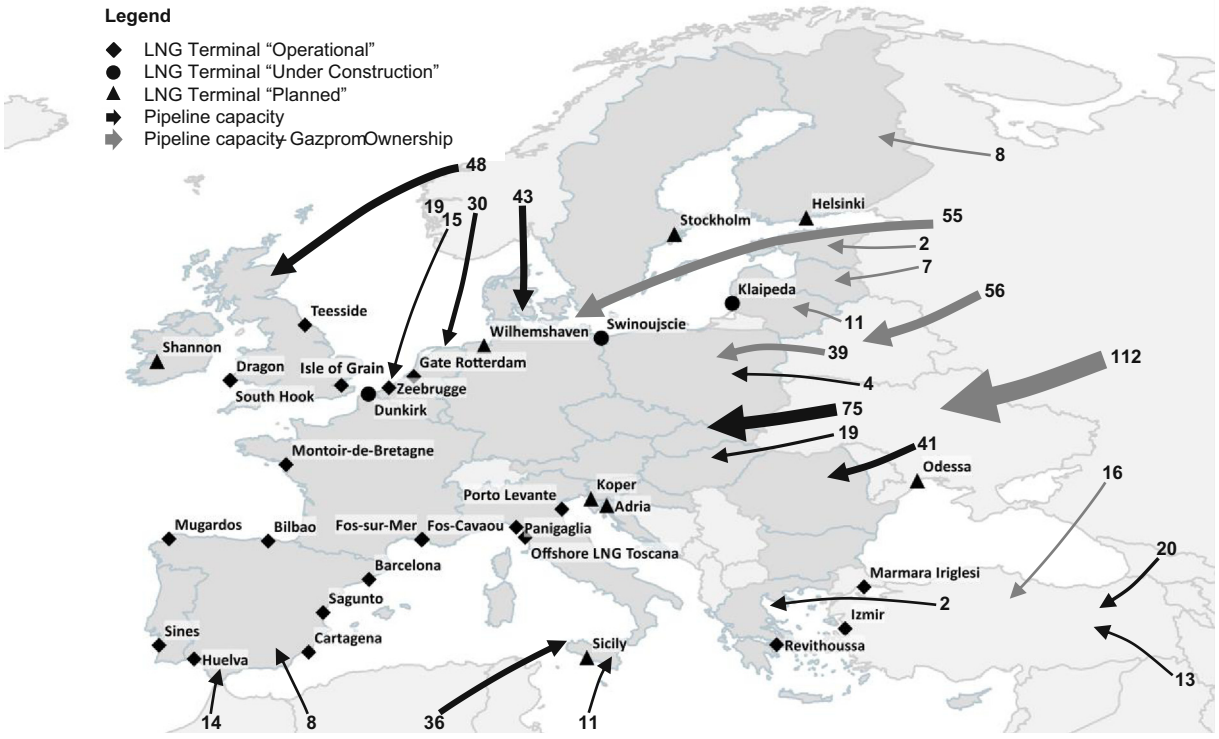

Fig. 1. European LNG and pipeline import infrastructure from external suppliers in 2014.
Note: Relative arrow sizes correspond to current capacities; figures represent current capacities in bcm/a. Source: Own illustration based on GGM database including information from GIIGNL (2014), ENTSO-G (2013a, 2014) and various sources. The blank map (shape file) is available from Eurostat: http://epp.eurostat.ec.europa.eu/portal/page/portal/gisco_Geographical_information_maps/geodata/reference.