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European ability to cope with a gas crisis. Comparison between 2009 and 2014

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HIGHLIGHTS

- We analyse the improvements in the EU gas infrastructure between 2009 and 2014.
- A model of the EU gas grid is used to study the disruption of the major importers.
- We find that Europe has greatly improved its ability to cope with a gas disruption.
- We find that Eastern Europe, though enhanced, remains the most vulnerable area.

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ABSTRACT

Regulation (EU) No 994/2010 concerning measures to safeguard security of gas supply was adopted following the 2009 commercial dispute between Ukraine and Russia which yield to a gas disruption. Since then, new infrastructure and cooperation measures have being implemented in order to reinforce the European gas system to better cope with gas shortages. Joint Research Centre has developed GEMFLOW, a country-based model of the European gas network, to simulate gas disruptions of different duration and to estimate the survival time and gas non-served per country. In this paper an analysis and comparison of the improvements carried out in the European gas system between 2009 and 2014 is presented and GEMFLOW model is used to evaluate the progress being made to strengthen the security of gas supply at European level.

1. Introduction

Regulation (EU) No 994/2010 (European Union, 2009d) concerning measures to safeguard security of gas supply was adopted following the 2009 natural gas crisis, which showed important weaknesses of the European high pressure transmission system. It repealed and replaced Directive 2004/67/EC (European Union, 2004) on measures to safeguard security of natural gas supply by providing a consistent framework to carry out a full risk assessment of national grids, identifying tools and criteria to improve performances and resilience, and providing means to increase preparedness and skills to cope with crisis. The lesson learnt from the implementation of Directive 2004/67/EC had shown that it was necessary to harmonise national measures in order to ensure that all Member States (MS) are prepared at least on a common minimum level. It was felt that, if all Member States were to comply with minimum standards, this would enhance solidarity between them in case of crisis, since no one could be seen "to take a free ride" on the efforts made by others. At the same time, the legislator considered that excessive protection of own gas consumers in some Member States could leave consumers in other Member States more exposed or could disproportionally restrict trade.

During the 2009 gas supply crisis the necessary amounts of gas were available on the EU internal market but it was physically impossible to ship them to the affected Member States in Eastern Europe. Against this background, Regulation (EU) No 994/2010 aims to improve cross-border capacities by pursuing the development of new infrastructure which may not necessarily be commercially feasible but is essential in terms of security of supply. The two tools chosen are the implementation of the so-called N-1 rule and the implementation of permanent bi-directional capacity (physical "reverse flows") (European Commission, 2014a).

On 28 May22.9 2014 the Commission adopted its European Energy Security Strategy providing a comprehensive plan to strengthen the security of energy supply in Europe (European Commission, 2014c). A common European strategy, along with a

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Nomenclature

Bcm	Billion cubic metre
CONS	Gas consumption of a country
JRC	Directorate General Joint Research Centre of the European Commission
H-gas	High calorific gas
EU	European Union
EXP	Gas flow exported in a country
IMP	Gas flow imported in a country
L-gas	Low calorific gas
LNG	Aggregated send-out flow of all the regasification terminals of a country
Mcm	Million cubic metre
MS	Member State
PROD	Aggregated production flow of a country
STO	Aggregated withdrawal flow of the underground storages of a country
TSO	Gas Transmission System Operator
UGS	Underground Storage facility

common European Energy Market – as it has been reinforced by the adoption by the European Commission on 21 September 2009 of the third package of legislative proposals for electricity and gas markets (European Union, 2009a, 2009b, 2009c) – is more and more a fundamental need for the European Union in light of the role played by natural gas in the European energy mix, as the share of natural gas in the European final energy consumption is still slowly increasing, moving from 21.8% in 2009 to 22,9% in 2013.[1]

Furthermore, to meet the ambitious targets of the 2020 Climate and Energy Package[2] and live up to the objectives of the 2030 Framework for Climate and Energy Policies (i.e., the European Council endorsed a binding EU target of an at least 40% domestic reduction in greenhouse gas emissions by 2030 compared to 1990) (European Council, 2014), greater investments in the energy infrastructure will be required in the near future in all the sectors that make up Europe's energy market. New investments in energy infrastructure across the Union are also instrumental in ensuring integrated and efficient internal energy market and security of energy supply.

For all the above reasons, we aim with this paper at providing a first analysis of the effects and improvements put in place by Member States and Transmission System Operators (TSOs) after the enforcement of Regulation (EU) No 994/2010. We provide first a description of the changes in the national infrastructure, and then we start with a comparison of the behaviour of the European grid under four crisis scenarios for 2009 and 2014 by using the "Gas EMergency FLOW" simulator model (GEMFLOW) (Szikszai and Monforti, 2011; Zaccarelli et al., 2014).

2. Improvements in the EU gas infrastructure between 2009 and 2014

This section aims at describing the general improvements developed in the European gas physical infrastructure on the grounds of Regulation (EU) No 994/2010. Within this context, the analysis is focused on assessing and comparing the status of the European natural gas system in 2009 and 2014 in five strategic areas such as length and compression power of the national gas systems, liquefied natural gas (LNG), underground storage (UGS), cross-border capacity and physical reverse flow.

It has been intentionally avoided presenting any discussion concerning economic aspects like changes in gas market liquidity or how the gas value chain has been transformed along with the general business model, though it is recognised the relevance of such topics for a mature and well-shaped Energy Union.[3] Furthermore, it is not addressed here the positive implications of the Regulation (EU) No 715/2009 (European Union, 2009c) to enhance market transparency and to facilitate access to information for network users and market participants. Although it should be noted that 86% European Transmission System Operators fully comply with the requirements of the Regulation (ACER, 2013), which it has enormously facilitated the study carried out in this paper thanks to the ad-hoc web-based platform for transparency and data dissemination created by ENTSO-G[4] under the umbrella of Regulation (EU) No 715/2009.

2.1. Pipelines and compression power

Besides the comparison of the gas facilities a simple comparison of two key indicators of the structure of the high pressure grid of a Member State (MS) is carried out to offer a more complete picture of the complex interaction and feedbacks among the components of the integrated European gas grid. The first indicator, the total length of the grid, would provide an idea of how investments were translated into a better connection from sources to customers to increase volumes, distribution and generally the resilience of the network. The second, the total installed compression power, could give a further indication of the increase capacity and commitment to implement bidirectional flows. The general picture depicted in Table 1 shows how, with some remarkable differences between MS, the EU high pressure grid has grown 8% in length of pipelines and 14% in total compression installed power, to better address issues related to increase interconnectivity (within and between MS) and volumes (i.e higher capacity to move gas). The role as pivotal actors of some MS, like Germany and the Netherlands, is marked by relevant changes in the two indicators, while other MS, in particular from Eastern Europe and the Baltics, show less relevant improvements.

2.2. LNG facilities

The European LNG market has been characterised by a substantial reduction since 2011 (see Fig. 1) due to a combination of factors such as a general decrease in demand (linked to relatively mild weather conditions and the economic crisis), competition with other markets (mainly the far East markets), cheaper prices for natural gas from pipelines (with Russian origin in first place) and competition with other fuels in the power generation sector. Demand in Europe fell to 34.3 Bcm in 2014 (GIILNG, 2009–2013), accounting for 8.5% reduction compared to 2013. This is the third year of a decline in LNG demand and overall demand is 42.5% lower than in 2009.

[1] EUROSTAT, 2015.

[2] The 2020 Climate and Energy Package sets three key objectives: (i) 20% reduction in EU greenhouse gas emissions from 1990 levels; (ii) raising the share of EU energy consumption produced from renewable resources to 20%; (iii) a 20% improvement in the EU's energy efficiency.

[3] The EU's Energy Union strategy is made up of 5 closely related and mutually reinforcing dimensions: supply security, a fully-integrated internal energy market, energy efficiency, climate action and research and innovation.

[4] https://transparency.entsog.eu/