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European Natural Gas Infrastructure: The Role of Gazprom in European Natural Gas Supplies

Franziska Holz, Hella Engerer, Claudia Kemfert, Philipp M. Richter, Christian von Hirschhausen

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DIW Berlin
Deutsches Institut für Wirtschaftsforschung
Mohrenstraße 58
10117 Berlin
Tel. +49 (30) 897 89-0
Fax +49 (30) 897 89-200
www.diw.de

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Franziska Holz[1]
Hella Engerer
Claudia Kemfert
Philipp M. Richter
Christian von Hirschhausen

European Natural Gas Infrastructure: The Role of Gazprom in European Natural Gas Supplies

Study commissioned by
The Greens / European Free Alliance in the European Parliament

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[1]DIW Berlin, Department Energy, Transportation, Environment. fholz@diw.de
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Abbreviations

AG	Aktiengesellschaft (German joint-stock company)
AFR	Africa
bcm	Billion cubic meters
CIS	Commonwealth of Independent States
CS	Compressor station
DG Ener	Directorate Generate Energy
EIA	Energy Information Administration (U.S. Department of Energy)
ENTSO-G	European National Transmission System Operators - Gas
EU	European Union
EUR	Euro
FID	Final Investment Decision
FSU	Former Soviet Union
GGM	Global Gas Model
GIIGNL	Groupe International des Importateurs the Gaz Natural Liquéfié (International Group of International Liquefied Gas Importers)
GmbH	Gesellschaft mit beschränkter Haftung (limited liability company)
GM&T	Gazprom Marketing and Trading
IEA	International Energy Agency
LNG	Liquefied Natural Gas
m^3	Cubic meter
mcm	Million cubic meters
MET	Mineral extraction tax (in Russia)
Mtoe	Million tons of oil equivalent
OAO	(Russian) Open joint-stock company
OOO	(Russian) Limited liability company
RUB	Russian Ruble
USD	US-Dollar
TPA	Third Party Access
TYNDP	Ten Year Network Development Plan
UGSF	Underground Gas Storage Facility
USA	United States of America

Executive Summary

1. The disturbance of the European-Russian relations and the political destabilization of Ukraine have revitalized considerations by the EU, the Member States, and Ukraine about the security of energy supply, in particular the potential threats of natural gas supply interruptions by Gazprom, the Russian natural gas export monopolist. This study analyzes different aspects of European natural gas supply and the role of Russia and Gazprom therein, with a focus on European policy to increase resilience against physical supply shocks; it also addresses the issue of Ukrainian energy supply dependence, which can be considered the most critical aspect in the coming years.
2. Overall, the share of natural gas imports from Russia in total primary energy supply in Europe is very modest, below 10% on average. Also, the resilience of the European natural gas infrastructure and supply diversification have significantly improved since the natural gas crises of 2006 and 2009. However, some East European countries, mainly Ukraine and Bulgaria, are still vulnerable to supply disruptions.
3. Gazprom still controls the largest part of natural gas production in Russia, and produced ca. 75 % of total Russian production of 600 bcm; total exports have been rather constant over the past decade, somewhat below 200 bcm/a, 60 % of which went to non-CIS countries in 2013. Over the last two decades, Gazprom has invested significantly in trading, distribution, pipeline, and storage activities all across Europe. It controls large shares, or even majority shares, in many East European countries. Gazprom owns distribution activities in the Baltic countries and Finland, pipeline transportation shares all over Eastern Europe, Turkey, Germany, in the UK interconnector, Poland, and Serbia, and under-ground storage facilities in Austria, Germany, Latvia, and Serbia, with projects under way in the Czech Republic, the Netherlands, and the UK.
4. A model-based analysis of two supply disruption scenarios confirms that the real threat potential of Gazprom lies in Ukraine (and Belarus) and Eastern Europe, and much less in Central and Western Europe. The Global Gas Model (GGM) is used to simulate two scenarios against a base case: i) In a Ukraine-disruption scenario, all pipeline connects to Ukraine are interrupted, whereas ii) in a Gazprom-infrastructure scenario all infrastructure that is majority-owned by Gazprom is interrupted. Mainly Eastern neighbors of

Russia are severely affected in the Ukraine-disruption scenario: Romania, Croatia, Hungary and – primarily – Ukraine. By contrast, West European countries have multiple options of diversification and are less affected. Cuts of imports from Russia can be compensated by own production, LNG imports, and a reduction of natural gas consumption. Our model results further underline currently limited opportunities for Russia to diversify its exports in the short-term because construction of long-planned pipelines to China has not started yet.

5. The EU and the Member States should continue to take an active approach to improve the resilience against politically motivated supply interruptions. In the short-term, additional infrastructure to diversify supplies in the critical East European region is necessary, such as reverse flow options and the completion of LNG-terminals, etc. Member States can introduce national or (cross-border) "strategic gas reserves" for several weeks, in addition to the measures already prescribed in the Natural Gas Supply Security Directive. Complementary measures may need to be taken for particularly vulnerable consumer groups, e.g. large housing districts or industrial complexes that currently rely solely on imported natural gas. Domestic natural gas production from fracking is unlikely to play a major role in most EU countries due to political objections or insufficient geological conditions. The importance of Gazprom on the European market is alleviated by the availability of manifold other supplies, both via pipeline and via LNG; however, some East European countries, and in particular Ukraine, are still highly dependent upon Russian natural gas and need rapid diversification and higher efficiency.
6. In the medium-term, the EU and the Member States should work towards a reduced exposure to natural gas imports, in the context of a coherent low-carbon energy and climate strategy, involving increased efficiency, the further decarbonization of the energy system, and a more systematic use of renewable energy sources. East European countries need support to convert their inefficient and fossil-dependent energy systems to more flexible and more efficient systems. The major challenge appears to be the restructuring of the Ukrainian energy system, both with respect to domestic energy consumption and a diversification of energy imports.

Zusammenfassung

1. Die zunehmenden Spannungen im Verhältnis der Europäischen Union und Russland sowie die politische Destabilisierung der Ukraine haben die Diskussion bzgl. der Energie-, insb. der Erdgasversorgungssicherheit wieder belebt. Angesichts dieser Situation müssen Szenarien der Versorgungsunterbrechung durch Russland bzw. Gazprom geprüft werden. Die vorliegende Studie analysiert insbesondere die Bedeutung von Gazprom in der europäischen Erdgasinfrastruktur und mögliche Diversifizierungsstrategien im Fall der Unterbrechung von Erdgaslieferungen durch Gazprom. Die Studie basiert auf aktuellen Recherchen, einer Modellierung, Hintergrundgesprächen mit europäischen Stakeholdern sowie früheren Ausarbeitungen der Forschungsgruppe „Ressourcenmärkte und –politik“ am DIW Berlin.
2. Der Anteil russischer Erdgaslieferungen am Primärenergieverbrauch ist eher gering, er liegt im EU-Durchschnitt unterhalb von 10%. Seit den russisch-ukrainischen Erdgaskrisen 2006 und 2009 hat sich die Flexibilität der europäischen Erdgasinfrastruktur erheblich vermehrt, u.a. durch Flüssiggasterminals, Umkehrflüsse sowie engere grenzüberschreitende Verbindungen. Allerdings verbleibt in einigen osteuropäischen Ländern, insb. der Ukraine und Bulgarien, eine hohe Abhängigkeit von russischen Erdgaslieferungen.
3. Gazprom ist nach wie vor der dominante Erdgaskonzern in Russland und verfügt über das Exportmonopol. Ca. 200 Mrd. m^3 der jährlichen Erdgasproduktion von 600 Mrd. m^3 werden exportiert; die Exporterläse tragen zu ca. 10% des russischen Haushalts bei und stützen – neben den noch höheren Erdölexporterlösen – die gesamte russische Wirtschaft. Angesichts derzeit fehlender alternativer Exportmöglichkeiten hängt somit die russische Wirtschaft stark von Exporten in die EU ab. Seit zwei Jahrzehnten baut Gazprom systematisch seine Beteiligung an der europäischen Erdgaswirtschaft aus, sowohl durch Zukauf von Infrastruktur (Pipelines, Speicher, etc.) als auch durch die Beteiligung an Handelsunternehmen und dem Erdgasvertrieb. Gazprom kontrolliert inzwischen Erdgasanteile in den meisten osteuropäischen Ländern, insb. Bulgarien, Serbien, Polen, als auch in Mittel- und Westeuropa, besonders stark auch in Deutschland. Da Gazprom neben ökonomischen Zielen auch ein Vektor der russi-

schen Außen- und Sicherheitspolitik ist, entstehen durch die weitverzweigten Anteile in Europa politische Risiken.

4. Eine modellbasierte Szenarienanalyse von Versorgungsstörungen bestätigt die Vermutung, dass die kritischen Bereiche vor allem in der Ukraine und Osteuropa liegen, Deutschland und Westeuropa jedoch über erhebliche Diversifizierungsmöglichkeiten verfügen. Im Fall eines russischen Erdgasembargos gegen die Ukraine sowie dem Ausbleiben von Erdgastransit bestünde in der Ukraine eine kritische Situation für die Versorgung von Haushalten und Industrie; aufgrund der inzwischen vielfältigen Umgehungsmöglichkeiten von Erdgastransport rund um die Ukraine wäre die ost- und westeuropäische Erdgasversorgung allerdings weiterhin aufrechtzuerhalten. Im Fall sämtlicher Versorgungsunterbrechung durch Gazprom, inkl. seiner europäischen Infrastrukturbeteiligungen, wären neben der Ukraine vor allem Bulgarien sowie die baltischen Staaten getroffen. In Deutschland bzw. anderen größeren westeuropäischen Ländern (Frankreich, Italien, UK) gäbe es zwar kurzfristig Anpassungsbedarf, jedoch keine strukturellen Versorgungsengpässe.
5. Mittelfristig sollte die EU sowie seine Mitgliedsstaaten weiterhin aktiv an der Diversifizierung seiner Energieversorgung arbeiten, ihre Energieabhängigkeit aber im Rahmen ihrer langfristigen Energie- und Klimapolitik reduzieren. Hierzu gehören drastische Maßnahmen zur Steigerung der Energieeffizienz und der Senkung des Endenergieverbrauchs, der Ausbau erneuerbarer Energien und der Verzicht auf Atom- und fossile Kraftwerke, als auch die bessere Nutzung bestehender Infrastruktur durch Vertiefung des Energiebinnenmarktes.
6. Der langfristige Erdgashandel zwischen europäischen Ländern und der Sowjetunion bzw. nunmehr Russland hat über viele Jahrzehnte gegenseitige Wirtschaftsbeziehungen und eine Vertrauensbasis gefördert, welche für ein friedliches Nebeneinander wertvoll war und bliebt. Für die EU ist Russland bzw. Gazprom ein wichtiger Energiehandelspartner, umgekehrt ist die notleidende russische Wirtschaft auf Exporterlöse aus Europa angewiesen. Dieses Kooperationspotenzial sollte weiter im Sinne einer friedlichen Koexistenz genutzt werden und der Gesprächsfaden nicht unterbrochen werden.

1 Introduction

The disturbance of the European-Russian relations and the political destabilization of Ukraine have revitalized considerations by the EU, the Member States, and Ukraine about the security of energy supply, in particular the potential threats of natural gas supply interruptions by Gazprom, the Russian natural gas export monopolist. Natural gas plays an important role in the energy mix of most EU member states, its share in Total Primary Energy Supply being 24% for the EU-28. Under the current political tension, a potential disruption of Russian natural gas supplies to Eastern, Central, and Western Europe must be taken seriously.

This study analyzes different aspects of European natural gas supply and the role of Russia and Gazprom therein, with a focus on European policy to increase resilience against physical supply shocks. The study has been commissioned to DIW Berlin by The Greens / European Free Alliance in the European Parliament in March 2014. It is based on desk research, some expert interviews, and background discussions with European stakeholders; the study is also informed by ongoing research projects of the group on “Resource Markets and Policies” at DIW Berlin.

The study is structured in the following way: we first set out the issue of European natural gas supply dependency, which we characterize through several indicators. The subsequent section highlights the importance of natural gas in the European energy sector and shows a prominent role for Russian natural gas in European consumption. We then explain the Russian natural gas sector in order to set the picture of where Gazprom comes from. Subsequently, we analyze the engagement of Gazprom in Europe in detail, both via its subsidiaries and with a special focus on its participations in the gas infrastructure sector (pipelines, storage, and liquefied natural gas import harbors). We then use the Global Gas Model to investigate the potential impact on European gas supplies of two disruption scenarios in the short term: one scenario where the transit via Ukraine is disrupted; and one scenario where all Gazprom infrastructure to and within Europe is disrupted, including the relevant storage capacities.

2 The Issue: European Natural Gas Dependency

2.1 The Role of Natural Gas

Natural gas plays an important role in the energy mix of most EU member states with a share in Total Primary Energy Supply (TPES) of 24% for the EU-28 varying across EU countries between 2% in Sweden and 42% in the Netherlands (see Figure 1). Natural gas is used for heating, electricity generation and industry usage. The country-specific role of natural gas is defined by the domestic resource potential, infrastructure availability for imports, the willingness to pay and the competitive position vis-à-vis other energy carriers in a specific country.

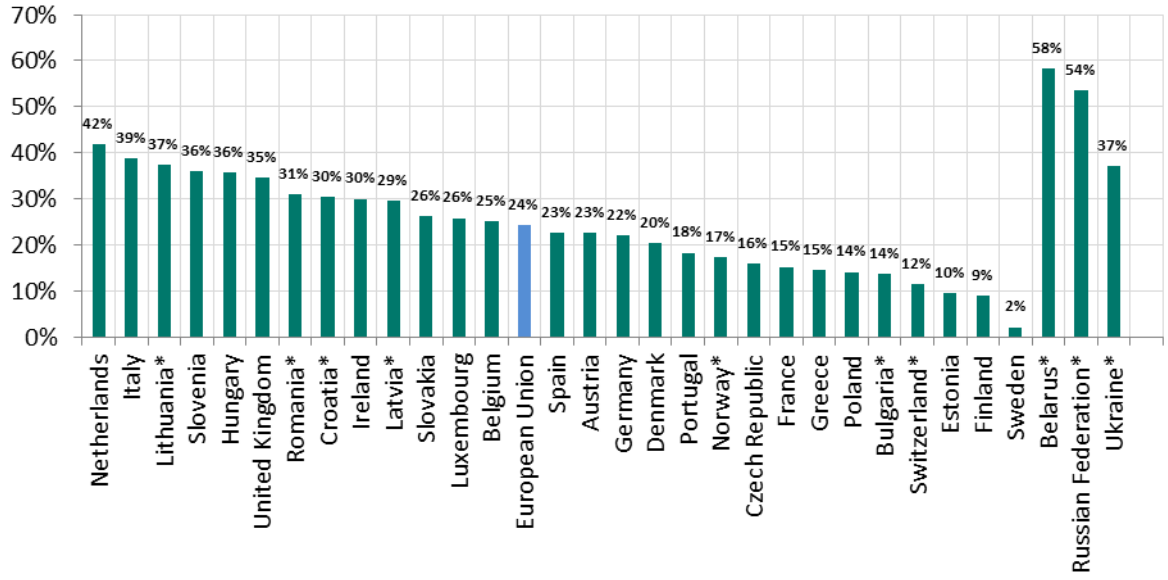

Figure 1: Share of natural gas in Total Primary Energy Supply in European countries in 2012

*Source: Own illustration based on IEA (2013b). Data for countries labeled with * is for 2011.*

Some European countries completely depend on Russian gas imports, like Estonia, Finland, Latvia and Lithuania, or import almost all of their consumed natural gas from Russia, like the Czech Republic (97%), Slovakia (97%) and Bulgaria (85%).[2] Countries with a significant domestic gas production like the Netherlands and Norway or countries located far away from

[2] The country dependence is calculated by the share of imports from Russia in total natural gas supply, i.e. relative to total imports plus domestic production.

Russia like the UK and Spain are independent from Russian gas. On the other hand a few countries like Germany and Romania with a relatively high domestic gas production still have considerable import rates from Russia.

Figure 2 illustrates that as a legacy of the past it is especially Eastern Europe that is dependent on Russian gas supplies while Western Europe has a more diverse access to natural gas. The average dependency on Russian natural gas exports for the European Union lies around 24 % (see also Table 13 in the Appendix). Germany is the largest importer of Russian with more than 30 bcm per year, followed by Italy that imports almost 20 bcm each year from Russia (Figure 3). The East European countries Czech Republic and Slovakia import less than 10 bcm each year from Russia, and the Baltic countries and Finland each less than 5 bcm per year, which is, however, almost 100 % of their natural gas supplies.

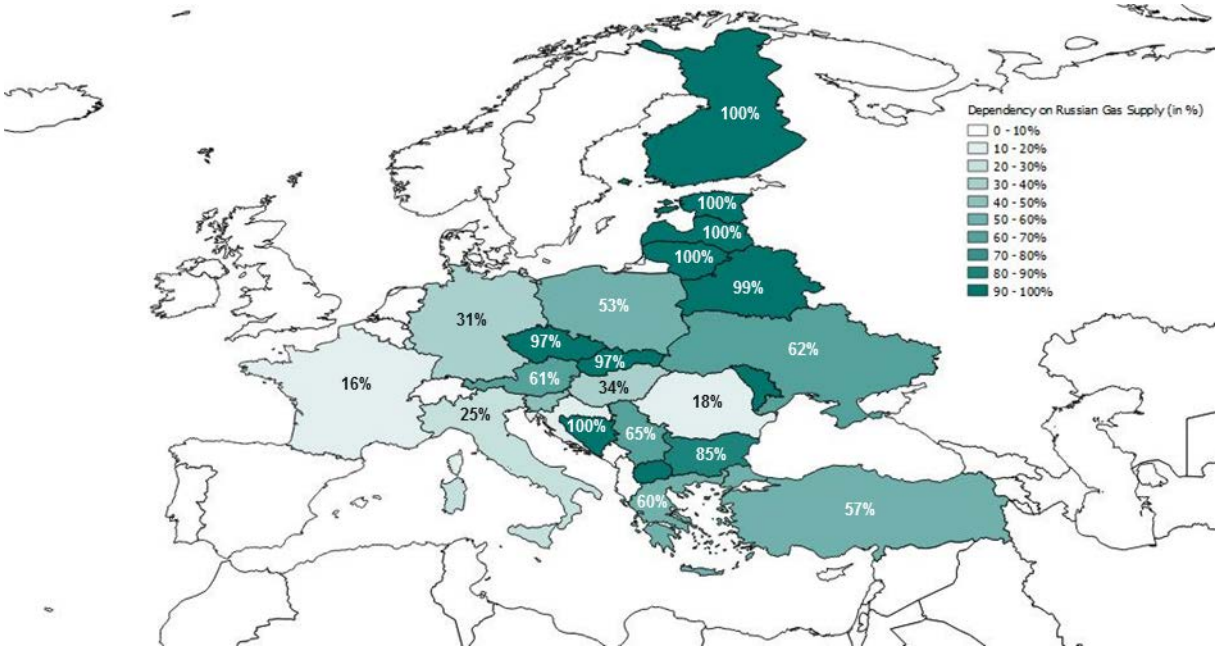

Figure 2: Dependency on Russian natural gas in 2012, calculated by the share of imports from Russia in total supply (domestic production and total imports), in percentage.

Source: Own illustration based on IEA (2013c). Also see Table 13 in the Appendix. The blank map (shape file) has been provided by Eurostat:
http://epp.eurostat.ec.europa.eu/portal/page/portal/gisco_Geographical_information_maps/geodata/reference, accessed on May 20, 2014.

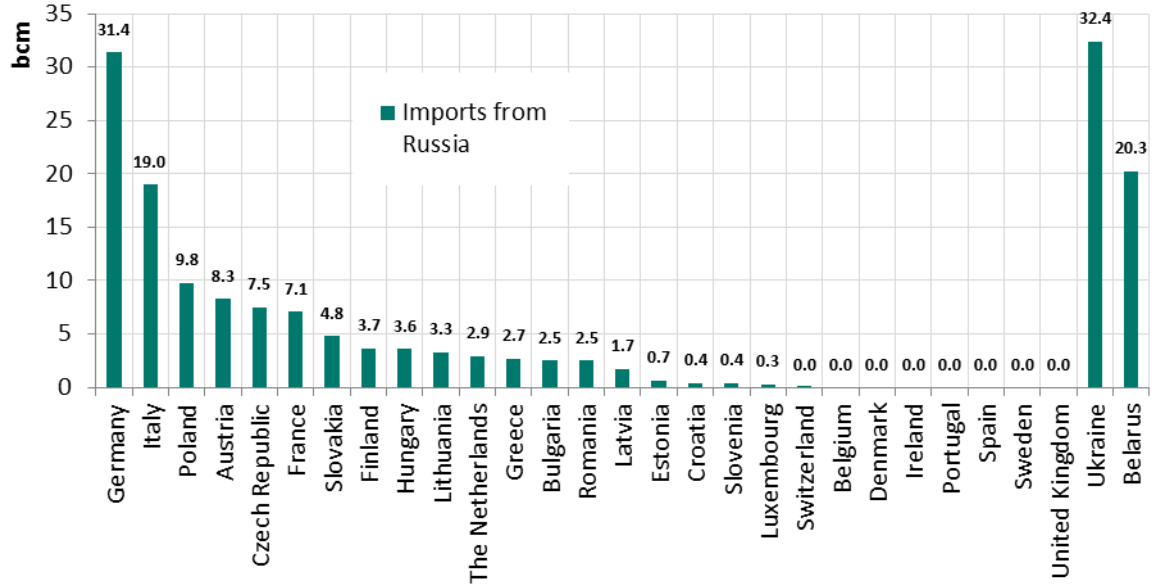

Figure 3: Imports of natural gas from Russia in 2012, in bcm.

Source: Own illustration based on IEA (2013b).

2.2 A Broader Supply Security Indicator

To measure the security of natural gas supply, it is not sufficient to solely report the dependency on Russian natural gas. Other important factors are the size of domestic production, concentration of imports and the evaluation of country risks. Frondel and Schmidt (2009) propose a risk measure, taking these factors into account. For a respective importing country the indicator is calculated using the shares of all supplying countries in total supply of the importing country, multiplied by the probability of delivery failure of any supplying country.[3]

The probability of delivery failure is approximated by the normalized country risk classification of the OECD (2013), a measure to quantify country credit risk. Russia has a relatively low value, which does not take the specific risk for Ukrainian natural gas supply into account. Domestic production is assumed to be certain. Hence, a country with a high share of domestic production in total supply has a lower value of this risk measure, all other factors being

[3] More precisely, the risk indicator for natural gas g is measured for importing country i as $risk_{i,g} = \sum_j x_{j,g}^2 * r_j$, where $x_{j,g}$ is the share of country j in the natural gas supply of country i and r_j denotes the country-specific probability of delivery failure of country j. Low shares are penalized by being squared. Frondel and Schmidt (2009) further propose to consider the importance of natural gas and other fuels in the TPES of the respective importing country. The extended risk indicator is obtained by the sum of all fuel-specific risk indicators, weighted by the fuel shares in TPES.

equal. By construction, the indicator is normalized between zero and one, where a higher value corresponds to a higher risk in the supply of natural gas.

Figure 4 depicts this risk measure for selected European countries for the last 20 years. For most of these countries the indicator is relatively stable over time and indicates consistent differences between Central, Western European countries (like Italy, Germany, France and the UK) and East European countries (namely the Slovak Republic, Bulgaria and Ukraine). In particular, these East European countries rely to a larger extent on natural gas from Russia and the Caspian region, which increases their risk indicator. Romania is characterized by a low risk indicator since most of its supply is provided by domestic production and only 18% originate from Russia (also see Table 13 in the Appendix).

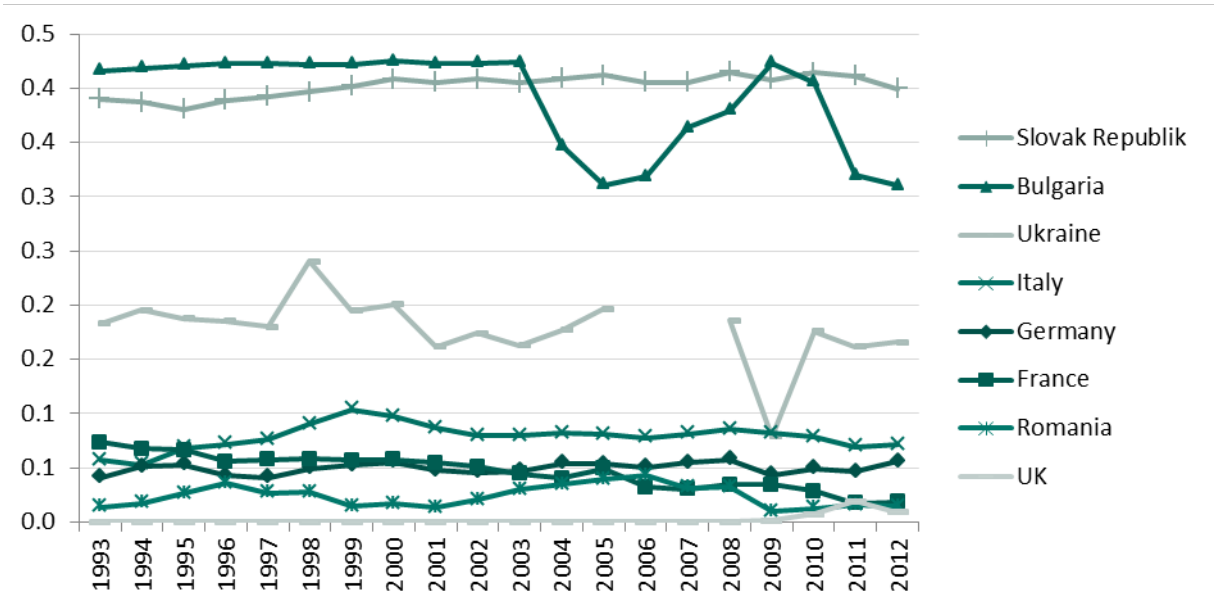

Figure 4: Risk indicator of natural gas supply for selected European countries.

Source: Own illustration based on Frondel and Schmidt (2009) with data from IEA (2013c) and OECD (2013). Values for Ukraine in 2005 and 2006 are omitted due to unspecified reporting in the IEA (2013c) trade flows data base.

3 The Russian Natural Gas Sector

Russia has the largest proven reserves of natural gas worldwide and is the second-largest producer of dry natural gas (Holz et al., 2013). It is also the largest natural gas exporter to the global gas market. Within Russia the gas sector plays an important role for the economy. It contributes to export revenues and government tax income. This holds particularly true for Gazprom, the key player in the Russian natural gas sector. The company is important in the Russian economy because it provides cheap energy at regulated prices to households and

industrial consumers. The company still has the dominant position in Russian natural gas production. In addition, it has the *de facto* monopoly on foreign natural gas trade. In the following the main characteristics of the Russian gas sector and its major player Gazprom are presented.

3.1 Russian Natural Gas Production and Exports

The financial crisis in 2008/2009 also affected the Russian economy and, in particular, the Russian gas sector. Whereas during the period 2000-2008 Russian natural gas production steadily increased and amounted to 613 bcm in 2008, it dipped during the financial crisis. Since 2010 gas production has recovered, and in 2013 it almost has achieved the pre-crisis level (Figure 5).[4]

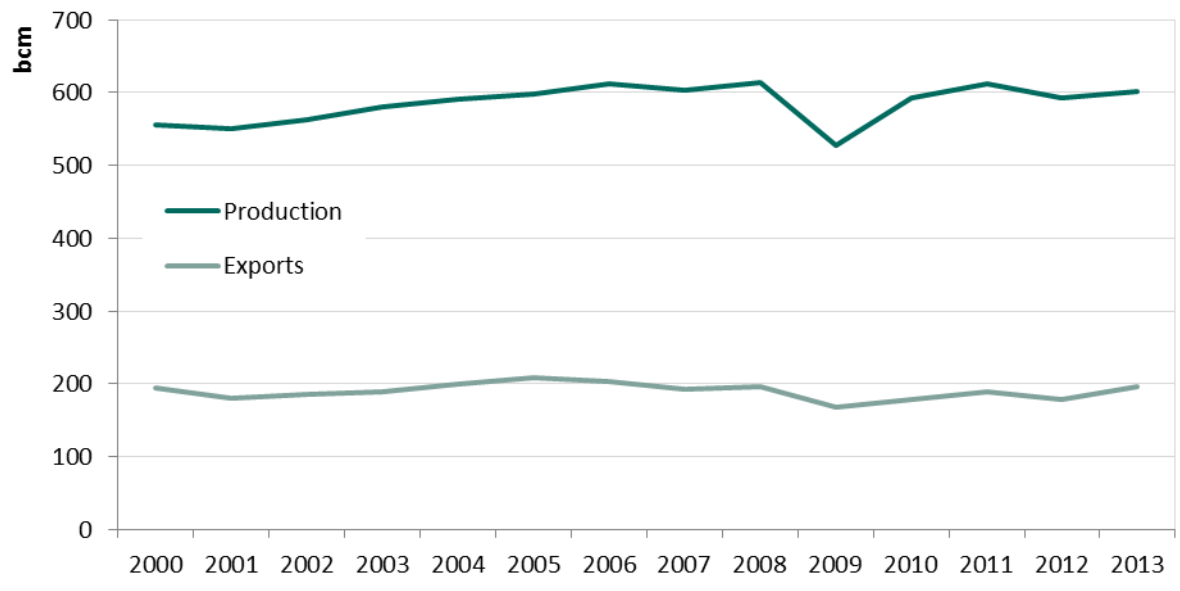

Figure 5: Russian natural gas production and exports in bcm.

Source: Goskomstat Rossii, Statistical yearbook, various issues, and Russian Central Bank.

Note: Small volumes of LNG exports to the Asian market are not included.

Russia exports about 200 bcm natural gas per year. In 2013 Russian natural gas exports amounted to 196 bcm which is about the pre-crisis level. After 2008 the volume of gas ex-

[4] Different production levels are reported by the various domestic and foreign sources. In particular, the International Energy Agency reports higher annual production levels of 650 bcm in 2010 (IEA, 2013c).

ports had declined, in particular to non-CIS countries (e.g. the European Union) where natural gas demand had temporarily decreased.

About 70 % of the gas exports are delivered to customers outside the CIS. The value of natural gas exports also significantly reduced during the financial crisis. However, as average gas export prices increased, the revenues of natural gas exports recovered soon (Table 1). Average gas export prices as reported in Figure 6 have increased considerably since 2000 due to two main factors: i) the increase and high level of oil prices to which Russian gas contract prices are generally linked; and ii) the gradual increase of export prices to former Soviet Union countries such as Ukraine. While these countries still paid relatively low prices close to Russian price levels at the end of the 1990s, their price levels have approached, and in some cases even exceeded, European import price levels since. For example, Balmaceda (2012) reports that Georgia and Moldova in 2009 paid higher prices than the German importers; Ukraine has been asked a higher price than West European importers since April 2014.

Table 1: Russian natural gas exports

Year	Value, bn. USD	Volume, bcm		
	total	total	to non-CIS countries	to CIS countries
2000	16.6	193.9	134.0	59.9
2001	17.9	180.9	131.9	48.9
2002	15.9	185.5	134.2	51.3
2003	20.0	189.4	142.0	47.3
2004	21.8	200.4	145.3	55.1
2005*	31.7	209.2	161.7	47.5
2006	43.9	202.8	161.8	41.0
2007	44.8	191.9	154.4	37.5
2008	69.1	195.4	158.4	37.0
2009	42.0	168.4	120.5	47.9
2010**	47.9	177.8	107.4	70.4
2011**	64.3	189.7	117.2	72.5
2012**	62.2	178.7	112.7	66.0
2013**	67.2	196.4	138.0	58.4

* Including natural gas exported from Ukrainian underground gas storage.

** Including natural gas exported to the countries which are members of the Eurasian Customs Union (Russian Federation, Belarus, Kazakhstan).

Source: Russian Central Bank.

Note: Small volumes of LNG exports to Asian non-CIS countries are not included.

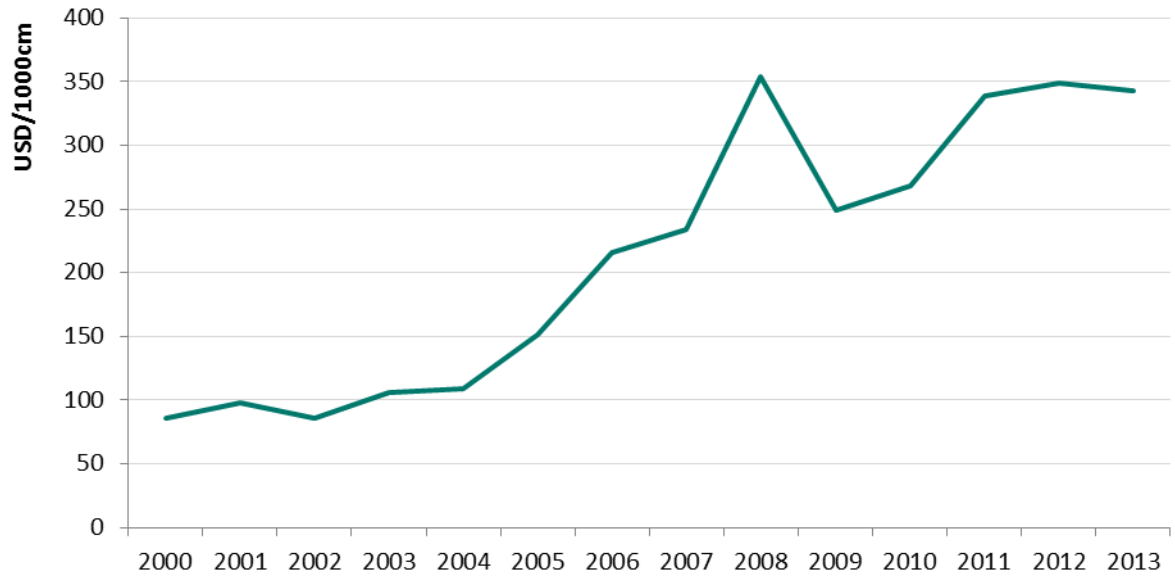

Figure 6: Average Russian export price of natural gas, in USD/1000 m³.

Source: Russian Central Bank.
Note: Excluding LNG sales.

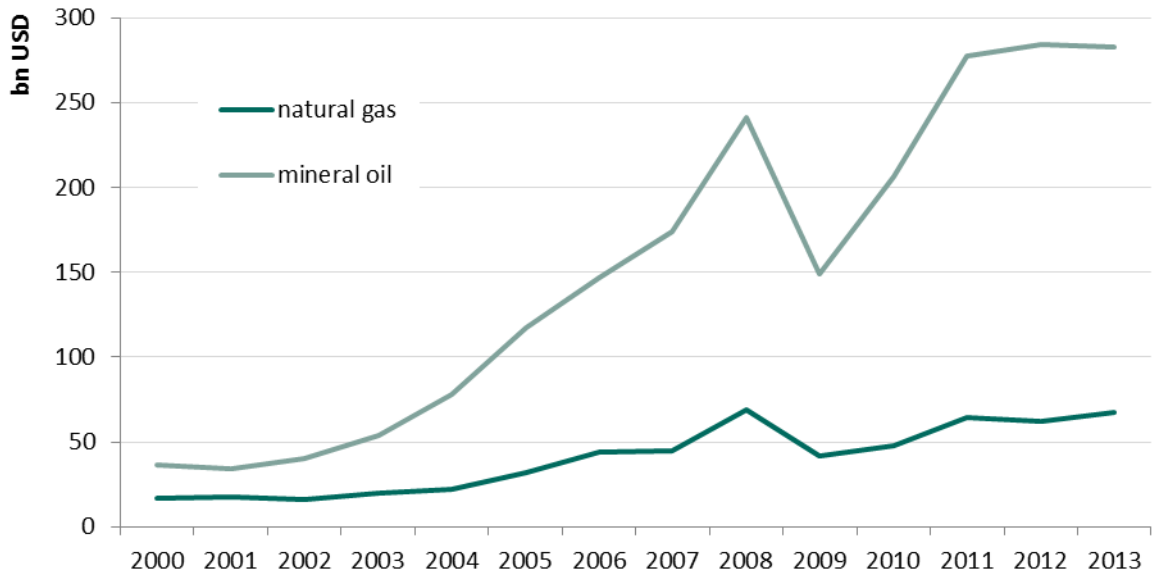

Figure 7: Value of Russian exports of natural gas and mineral oil, billion USD

Source: Russian Central Bank.
Note: Excluding LNG sales.

The hydrocarbon sector plays an extraordinary role for the Russian economy. The bulk of Russian foreign trade revenues stems from exports of mineral oil (Figure 7). Whereas the share of natural gas exports in Russian foreign trade declined in the period 2008-2013 from about 15 % to 13 %, the share of crude oil and oil products exports increased from 50 % to

54 %. This is because exports of mineral oil have significantly increased after the financial crisis. Together, the exports of mineral oil and natural gas sum up to about two thirds of Russian foreign trade revenues.

3.2 Contribution to Federal and Regional Budgets

The Russian natural gas sector is also an important contributor to the federal and regional budgets, albeit to a considerably lesser extent than the oil sector. The mineral extraction tax (MET) which the users of subsoil have to pay is the most important single tax of the Russian consolidated budget contributing about 23 % to revenues.[5] It is followed by the profit tax with 18 %. The maximum profit tax for companies is 20 % (2 % payable to the federal budget and 18 % payable to regional budget). For natural gas the MET has been adjusted for inflation in recent years; in 2014 it amounts to 278 RUB/1000 m³. A special MET rate applies to Gazprom and its 50 % and more affiliates (622 RUB/1000 m³) (Deloitte, 2012). However, it is intransparent how much Gazprom indeed contributes to the federal and regional budgets and some sources stress that Gazprom may actually benefit from tax rebates.[6]

The gas sector activities are regulated and monitored by a number of Russian ministries and agencies (EIA, 2014a). Besides the Ministry of Energy, responsible for energy policy, and the Finance Ministry which sets tax regulations, the Ministry of Natural Resources monitors the compliance with production license agreements. In addition, the Federal Energy Commission and the regional Energy Commissions regulate domestic natural gas prices.

3.3 Natural Gas and the Current Energy Supply

Natural gas plays an outstanding role in Russian energy supply to what remains a highly inefficient energy system: in 2011, Russia used almost seven times as much energy for a unit

[5] Cf. Tax Statistics of the Federal Tax Service of Russia, http://analytic.nalog.ru/portal/index.en-GB.htm (accessed April 14, 2014). Note that total personal income tax contributions to the budget revenue are higher than the mineral extraction taxes or profit taxes.

[6] Cf. http://www.eegas.com/tax-2012-04e.htm Buras and Grätz (2009) quote Russian President Putin that Gazprom would contribute about 5-6 % to the Russian state budget. Buras and Grätz (2009, p. 5) calculate that the Gazprom contribution to the federal budget in 2007 was about 8 % of the state revenues, compared to about 33 % from the oil sector.

of GDP than the EU average. Although Russia's energy intensity is gradually declining over time, this ration is almost unchanged, as the EU countries are making progress as well.[7]

Natural gas accounted for about 54 % of Russian primary energy supply in 2011 (Figure 8). It is used, in particular, for electricity generation where it has a larger share than coal, a resource also abundantly available in Russia.[8] In final energy consumption natural gas is mainly used in the residential sector, followed by transport and industry (Figure 9).

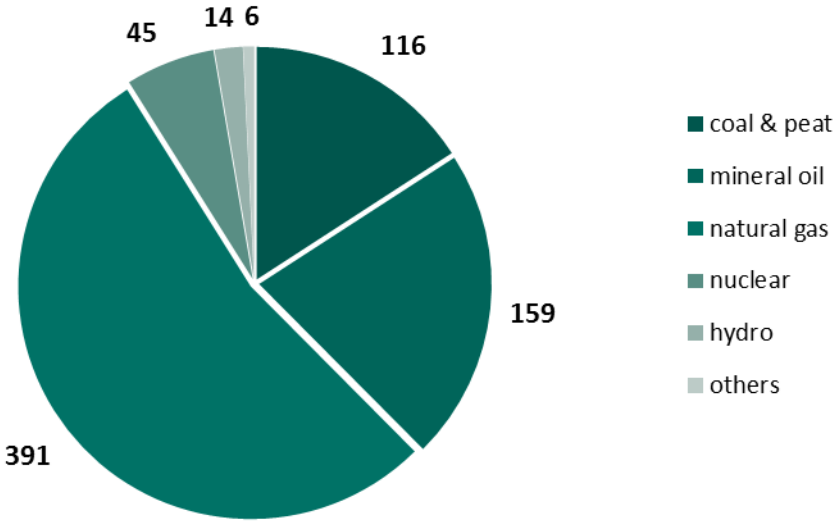

Figure 8: Total primary energy supply of Russia in 2011, in mtoe.

Source: IEA (2013b)

[7] Using a GDP calculation with constant 2005 USD, Russia even has a 6.8 times higher energy intensity than the EU-28 average. The energy intensity of the EU and Russia sank from 2004 to 2011 in almost the same relation, irrespective of comparing the GDP with or without Purchasing Power Parity (PPP). Source: calculated from World Development Indicator (World Bank Database).

[8] In the international energy community there have regularly been discussions whether Russia may have an incentive to intensify the use of coal in order to increase the volumes of natural gas available for exports; however, locally one can hardly observe a conversion of the electricity sector away from natural gas.

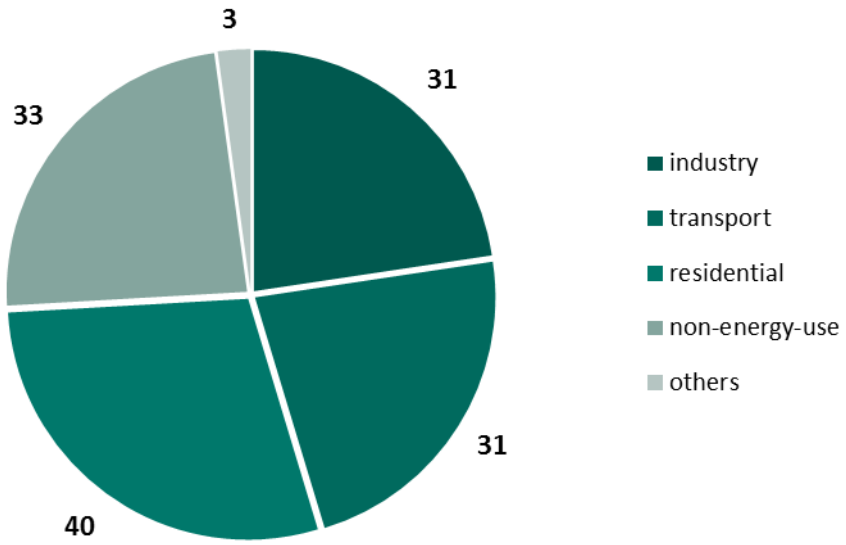

Figure 9: Final consumption of natural gas in Russia by end-use sectors in 2011 in mtoe.

Source: IEA (2013b).

For a long time gas prices for domestic consumers had been kept artificially low, below production and transportation costs. In December 2010 the government once more adopted a directive according to which wholesale gas prices remain regulated until 2014. However, in the period 2011-2014 wholesale prices were adjusted by a special formula which finally should equalize the profitability of natural gas exports and domestic gas sales. There are various price zones in Russia depending on the consumer remoteness from gas production areas and on consumer categories.[9] Household gas prices are based on wholesale prices and are further differentiated; in 2013 wholesale gas prices ranged from 2224 RUB/1000 m³ in the Yamal Nenets autonomnous okrug to 3100 RUB/1000 m³, for example, in the Northern Caucasus.[10]

Domestic use of natural gas is concentrated in the Western part of Russia in line with existing areas of natural gas exploration and production, in particular Western Siberia and the Urals region. The future development of remote gas fields in Eastern Siberia (e.g. Kovykta giant gas field in the Irkutsk region) and the Far East (e.g. on Sakhalin island) is expected to allow the gasification of the regions in the Eastern part.

[9] Gazprom, Regulated Russian gas market, http://www.gazprom.com/about/marketing/russia/.

[10] See Prikas Federal'noj služby po tarifam (FST Rossii) ot 27 nojabrja 2012 r. No. 273-e/1 "OB utverždenii optovnych cen na gaz, dobyvaemyj OAO <<Gazprom>> I ego affilirovannymi licami, prednaznačennyj dlja posledyjuščej pealizacii naseleniju", http://www.fstrf.ru/tariffs/info_tarif/gas/citizens/415. Higher prices are charged in so-called new pipeline areas (Altai, Archangelsk).

3.4 Gas Sector Development in the Russian Energy Strategy

According to the Russian Energy Strategy (2009) for the period up to 2030, published in 2009, natural gas will play an increasing role in domestic supply as well as in energy exports. Domestic natural gas consumption is supposed to increase from 457 bcm in 2008 to 605-641 bcm in the so-called third stage (2023-2030) of the energy strategy. For this, the internal gas infrastructure will be further developed. Export of natural gas which amount to approximately 200 bcm today is envisaged to rise to 360 bcm. The Asian market will gain importance. In addition to the existing one on Sakhalin island, new export terminals for LNG will be constructed, both in the Far East but also in Western Siberia (e.g. on Yamal peninsula).

The corridors of the forecast for future domestic energy demand and energy exports have not been essentially changed in the draft of the new Energy Strategy for the period up to 2035 published in January 2014. The draft – so far - is rather a routinely update done every five years. Nevertheless, the draft takes account of the slowing economic growth of the Russian economy. It also mentions the shift of worldwide energy demand to Asian markets and the increasing role of LNG, in line with international forecasts (e.g. IEA, 2012).

The draft ascribes the energy sector's high importance for the Russian economy. It stresses the role of the Russian energy sector as a "stimulator of innovation and modernization" of the economy; in the Energy Strategy the energy sector is seen as the "locomotive for the development". Both interpretations obviously fail to recognize that the Russian economy is increasingly dependent on its resource base. Russia's economy has immense structural problems with a virtually non-existent high technology sector and low competitiveness of its non-energy products on international markets.

3.5 OAO Gazprom and Other Natural Gas Companies in Russia

The Russian gas sector is dominated by Gazprom which inherited its predominant position from the Soviet past because the company was formed out of the former Soviet Ministry of Natural Gas.[11] In the early 1990s, Gazprom was transformed into a joint-stock company of

[11] Also see Engerer (2003) and Victor and Victor (2006) for an overview of Gazprom's history and organizational structure.

which the State retained less than 40%. Today, however, OAO (Open Joint-Stock Company) Gazprom is *de facto* majority-owned by the Russian State and State-controlled Russian state companies (Rosneftegaz and Rosgazifikatsiya) with a joint share of slightly more than 50% (Figure 10). Hence, the influence of the Russian State on Gazprom is ensured.

The remaining shares are owned by diverse shareholders: according to Gazprom information there are more than 500,000 shareholders. Regular Gazprom shares are publicly traded at the Moscow stock exchange.[12] Moreover, ADR (American Depositary Receipts) are traded at the New York stock exchange; they are no direct Gazprom shares but financial instruments incorporating the promise of exchange for normal Gazprom shares (Victor and Victor, 2006).

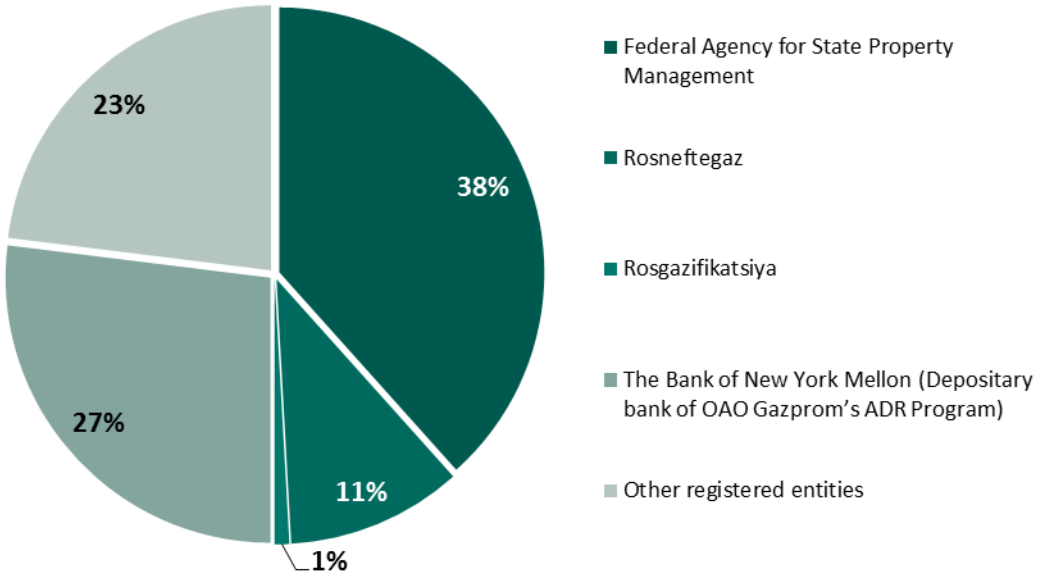

Figure 10: Shareholders of OAO Gazprom as of end 2012, in percentage.

Sources: Own illustration based on http://www.gazprom.com/investors/stock/*, accessed April 16, 2014.*

[12] See http://www.gazprom.com/investors/stock/

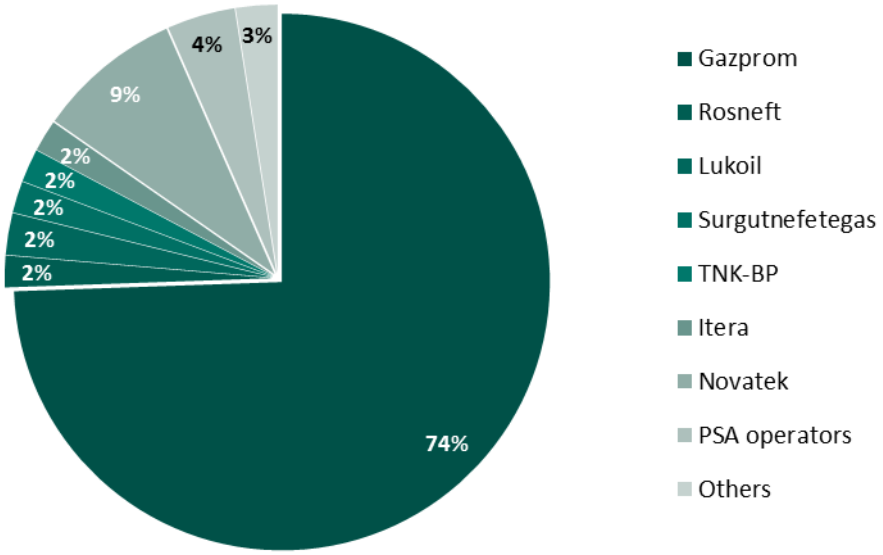

Figure 11: Natural gas production in Russia by company in 2012, in percentage.

Source: EIA (2014a)

Gazprom controls about 75 % of Russian natural gas production (Figure 11); the remaining production is carried by oil companies (e.g. Lukoil, Rosneft), and independent natural gas producers (e.g. Novatek, Itera). Gazprom directly controls more than 65 % of the proven natural gas reserves; additional reserves are controlled by joint ventures with other companies (EIA 2014a). It also controls natural gas exports to European and Asian customers. Thus, Gazprom still plays a dominant role in the gas sector. However, independent Russian gas companies have gained importance in gas exploration, gas production and, in particular, in domestic supply in recent years.

For a long time independent gas companies operated in niches markets. First they were engaged in reselling gas to Asian markets and they produced only small amounts of natural gas. In contrast, Gazprom held most of the exploration and production licenses. In 2001 it still produced 88 % of Russian natural gas production and was licensed to develop about 70 % of proven reserves. As an inheritance of the past Gazprom owns the Unified Gas Supply System ("UGSS") which is the centralized system for natural gas production, transportation, storage and supply in Russia.

Gazprom must provide access to the UGSS for independent gas companies under the conditions, among others, that spare capacity is available and independent suppliers meet certain

quality specifications (King & Spalding, 2012). In practice, however, independent companies often had difficulties to access the Russian pipeline network.[13] Gazprom also has the monopoly on natural gas exports via its subsidiary "OOO Gazprom Export" that is fully owned by Gazprom.

The law "on gas export" in 2006 even strengthened the position of Gazprom Export in external trade of natural gas and LNG.[14] To access the long distance pipeline network, independent companies had to pay a distance based transit tariff. The tariff for exports to customers beyond the Customs Union increased from about 40 RUB/1000 m³ for 100 km in January 2008 to 68.7 RUB/1000 m³ for 100 km in August 2013.[15] In addition, they have to pay an export duty of approximately 30 % of the customs value; export duties do not apply to LNG exports (Deloitte, 2013). In practice, independent suppliers of natural gas were bound to natural gas sales to the domestic market where domestic gas prices and tariffs are regulated.

Gazprom's position slightly weakened when (international) gas demand declined after the financial crisis 2008/2009. In the aftermath of the crisis Gazprom's production volumes were far below the pre-crisis levels of about 550 bcm are reported by the company; Gazprom's natural gas deliveries to the domestic and foreign market decreased. At the same time, independent companies strengthened their position on the domestic markets by, among others, merger & acquisition activities. They have received licenses to develop new natural gas fields, in particular in previously undeveloped regions with respect to natural gas production (e.g. Eastern Siberia). In recent years their natural gas production and domestic sales have increased.[16]

[13] A special problem of Russian energy production is gas flaring. Some natural gas (often associated with oil production) is not processed and sold but flared instead. Russia is the worldwide largest contributor to gas flaring, even though it has substantially reduced gas flaring from 52.3 bcm in 2007 to 37.4 bcm in 2011 (World Bank, 2012). This problem is partly due to the fact that that oil producers can hardly gain access to the natural gas pipeline network and are thus not able to commercialize the associated natural gas.

[14] Rossijskaja Federacija Federal'nyj zakon ot 18 ijulja 2006 goda No. 117-F3 "Ob eksporte gaza".

[15] Federalnaja služba po tarifam, srednii uroven' tarifov na uslugi "Gazprom" dlja nezavizimych oganizacij po transportirovke gaza po magistral'nym gazoprovodam, http://www.fstrf.ru/tariffs/analit_info/gas/17.

[16] The contract database of DIW Berlin (Neumann et al., 2013) even indicates that Novatek, in 2012, concluded a 10-year contract with EnBW on deliveries of about 2 bcm/year. However, the delivery terms of this contract are unclear given the *de facto* export monopoly of Gazprom in the Russian export infrastructure. Also see http://www.themoscowtimes.com/business/article/novatek-signs-deal-to-supply-gas-to-germanys-enbw/462124.html, where it is discussed that the sales of Novatek to EnBW are likely not exports from Russia but rather purchased by Novatek in Europe that are re-sold to EnBW.

In November 2013 the law "on gas exports" has been amended, liberalizing to some extent the export monopoly for certain LNG exports from particular sources. In the first place, the independent producer Novatek, of which Gazprom holds a 10 % share,[17] will benefit from this change with its Yamal LNG project for which the final investment decision (FID) was taken end 2013, with deliveries expected to start in 2016. Novatek also benefits from tax breaks for this LNG project on the Yamal peninsula. In practice, Gazprom will retain the export monopoly on gas pipelines and only a small number of companies will benefit from the new regulations on LNG exports. In addition, potential LNG exporters still have to obtain an export license from the Ministry of Energy (Kardas, 2013). In sum, additional LNG export volumes can only be realized in the medium term when the needed infrastructure is completed. Therefore, the relevance of the legal changes for future (LNG) exports of independent gas companies still remains unclear.

4 The Scope of Gazprom Abroad

In this section, we investigate the participation and influence of Gazprom in natural gas companies abroad, with a particular focus on infrastructure activities in the European Union. While Gazprom still is the dominant player in the Russian natural gas sector, it has less and less importance in the importers' gas systems as one goes further West: Gazprom has an large role in the transit countries Ukraine and particularly Belarus where it controls the transport system and the storage; in European neighboring countries in the Baltics and Finland, Gazprom has large shares in the local distribution companies which are often monopolies on their markets; further West, Gazprom participates in trading companies in Germany which also have storage and transmission capacities. For several years, Gazprom has attempted to increase its role on other West European markets, in particular in the downstream segment of the value chain. In this vein, it has founded trading companies and bought participations in storage activities, but it has also increased its presence in the European media by sponsoring several football teams and the UEFA Champions League.

[17] According to the Wall Street Journal:
http://online.wsj.com/news/articles/SB10001424127887323836504578553323525867116

4.1 Gazprom Activities in the European CIS Countries

Gazprom plays an important role in the natural gas sector of its Western CIS neighbors Ukraine and Belarus where it is the sole (Belarus) or a major natural gas supplier. In particular, Gazprom plays a considerable role in Belarus where it fully controls the transit pipeline system of the Yamal Pipeline via Gazprom Transgaz Belarus (Table 2). This is a subsidiary of the same style as the "Gazprom Transgaz" subsidiaries in the Russian provinces (e.g. "Gazprom Transgaz Moscow"). It operates three underground gas storage facilities in the transmission system in Belarus and 233 distribution stations to local consumers.

Table 2: Direct and indirect shares of OAO Gazprom in European CIS countries

Country	Transportation & Storage	Share	Trade	Share
Belarus	Gazprom Transgaz Belarus	100%	--	--
Ukraine	UkrGazEnergo	50% (via RusUkrEnergo, 50 % Gazprom-owned)	Gazprom Sbyt Ukraine	100%

Source: Own compilation based on Gazprom website

Gazprom's role is less pronounced in Ukraine where the transit pipeline system in state-owned (via Naftogaz Ukrainy). Gazprom has a unique influence as exporter, though, despite occasional "re-labeling" of Russian natural gas exports as Uzbek or Turkmen gas exports in the last years (causing the ups and downs in Figure 4). In addition, Gazprom is engaged in the downstream sector in Ukraine as a supplier and distributor of natural gas via its fully-owned subsidiary Gazprom Sbyt Ukraine which mostly serves industrial consumers.

4.2 Gazprom Activities in Europe

Gazprom is present as supplier and as shareholder in local subsidiaries in many European countries. Its supplies are primarily delivered within long-term contracts which have recently been subject of re-negotiations and also investigations by the European Commission. Recently, Gazprom has also started to participate in wholesale markets in Europe via newly

founded subsidiaries such Gazprom Marketing and Trading (GM&T). The next section first investigates the subsidiary schemes of Gazprom in European importing countries.

4.2.1 Gazprom Subsidiaries in Europe

Gazprom has shares in several transportation and distribution companies in Central and East Europe, often in the local monopolies. Many of its subsidiaries in the Western European countries were founded in the last decade or so, in an attempt to increase Gazprom's role in Western European markets. For a better understanding, some of the participations and subsidiaries of Gazprom in Europe are highlighted in the following (see Table 3). Germany is a special market in which Gazprom holds shares in various companies along the entire value-added chain and which we therefore discuss separately in Section 4.2.2.

The holding OAO Gazprom has subsidiaries in many European countries and for different activities along the value chain (production, distribution, transportation and storage). OAO Gazprom's main (though not only) subsidiary with strong activities in Europe is its export and trading company OOO Gazprom Export of which it is the exclusive shareholder.

In the Baltic countries and Finland, which depend solely on Russia for their natural gas supplies, Gazprom holds shares of varying extent in the national distribution companies as well as in the pipeline operator in Lithuania. Gazprom is also active in trading and distribution in other Eastern and Central European countries, e.g. in Bulgaria, Romania, Slovakia and the Czech Republic.

Table 3: Direct and indirect shares of OAO Gazprom in Europe

Country	Transportation	Share	Trade	Share	Other activities (e.g. production, storage)	Share
Multi-country	Nord Stream AG South Stream Transport B.V.	51% 50%	GM&T Ltd. (Gazprom Energy)	100%	--	--
Austria	South Stream Austria GmbH	50%	--	--	--	--
Belgium	Interconnector (UK) Ltd.	10%	--	--	--	--
Bulgaria	Overgas Inc. South Stream Bulgaria AD	50,5% 50%	WIEE	100%	--	--
Czech Republic	--	--	Vemex s.r.o.	50,1%	--	--
Estonia	--	--	Eesti Gaas	6,4%	--	--
Finland	--	--	Gasum Oy	25%	--	--
France	--	--	GM&T France SAS	100%	--	--
Germany	Gascade NEL Gastransport GmbH OPAL VNG	50% 50% 50% 10,5%	Gazprom Germania GmbH W&G Wingas GmbH WIEH GM&T Retail Germania GmbH	100% 50% 100% 100% 100%	Astora	100%
Greece	South Stream Greece S.A. Prometheus Gas S.A.	50% 50%	--	--	--	--
Hungary	South Stream Hungary Ltd.	50%	Panrusgas	50%	--	--
Italy	JSC Promgaz	50%	--	--	--	--
Latvia	--	--	Latvijas Gaze	34%	--	--

Lithuania	Amber Grid	37%	Lietuvos Dujos	34%	--	--
Luxembourg	--	--	--	--	--	--
Netherlands	--	--	--	--	Wintershall Noordzee (WINZ)	50%
Norway	--	--	--	--	--	--
Poland	EuRoPol Gaz	48%	--	--	--	--
Portugal	--	--	--	--	--	--
Romania	--	--	WIEE	100%	--	--
Slovakia	--	--	Vemex s.r.o.	50,1%	--	--
Slovenia	South Stream Slovenia LLC	50%	--	--	--	--
Switzerland	--	--	Gazprom Schweiz AG GM&T Switzerland AG	100% 100%	--	--
Turkey	Blue Stream Special-Purpose Company (BSPC B.V.)	50%	--	--	--	--
United Kingdom	Interconnector (UK) Ltd.	10%	Gazprom UK Ltd. GM&T Retail Ltd.	100% 100%	--	--

Sources: Own compilation based on Gazprom and subsidiaries' websites

Gazprom also holds shares in some companies that are active in pipeline operations, e.g. in Bulgaria and Greece. These latter companies are involved in natural gas distribution in parallel. Other pipeline operators, such as EuroPolGaz (Poland) and the Interconnector between Belgium and the UK are specific transportation companies, some of them for the transit of Russian natural gas sales. Furthermore Gazprom holds 50 % of each of the national companies founded to develop the onshore section of South Stream in South East Europe (Austria, Bulgaria, Greece, Hungary, Slovenia, and Serbia (51%)).

In its commercial strategy to complement its traditional long-term contract sales by more flexible sales and purchases at the (EU) trading hubs, Gazprom has founded various international trading companies around Gazprom Marketing & Trading Ltd. (GM&T). It has various

subsidiaries in Europe, such as GM&T Switzerland AG, GM&T France SAS, GM&T Retail Germania GmbH, GM&T Retail Ltd. in the UK and also Gazprom Global LNG. Moreover, via the GM&T subsidiary Gazprom Energy, the company entered the power distribution market. This engagement in GM&T also shows the increasing willingness of Gazprom over the last decade to get closer to the customers downstream in local distribution company engagements.[18]

4.2.2 Case study: Gazprom Participations in Germany

Over the last 25 years, Gazprom has systematically expanded its activities in the German natural gas sector. In this section, we describe the comprehensive investment strategy of Gazprom in Germany which is pursued somewhat similarly in other European countries, too.

In 1990 already, just weeks after the fall of the Berlin wall, BASF, a large industrial natural gas consumer, sought the cooperation with the Russian natural gas industry, because it had been cornered by what was then the German monopolistic natural gas importer, Ruhrgas. In fact, Ruhrgas had tried to sell natural gas at a price considerably above its costs, and had prevented BASF from purchasing natural gas elsewhere and transport it through Ruhrgas' pipelines to its Ludwigshafen chemical plant. BASF therefore not only tried to secure third party natural gas supplies, but also to develop – from scratch – its own pipeline system (Victor and Victor, 2006).

In this vein the chain of subsidiary connections via W&G was created in the early 1990s (see Figure 12). The W&G Beteiligungs-GmbH & Co. KG is a joint venture between OAO Gazprom and Wintershall Holding GmbH, a BASF subsidiary. W&G has subsidiaries in different segments of the value chain, mostly in Central Western Europe.

Most recently, in June 2014, with retroaction to April 2013, Gazprom becomes exclusive shareholder of Wingas GmbH Europe; until today it has a 50 % share. Wintershall will cede its 50 % shares of W&G to Gazprom. W&G remains the sole owner of three transportation subsidiaries, namely Gascade, NEL Gastransport and Opal. Wingas, in turn, owns the storage company astora, so that the merger makes Gazprom the sole owner of the Wingas storage activities in Germany and abroad.

[18] Similarly, the European Commission's Directorate Generate Energy concludes "that Gazprom is interested in asset backed trading and will use hubs for marketing and portfolio optimization purposes" (DG Ener, 2013b).

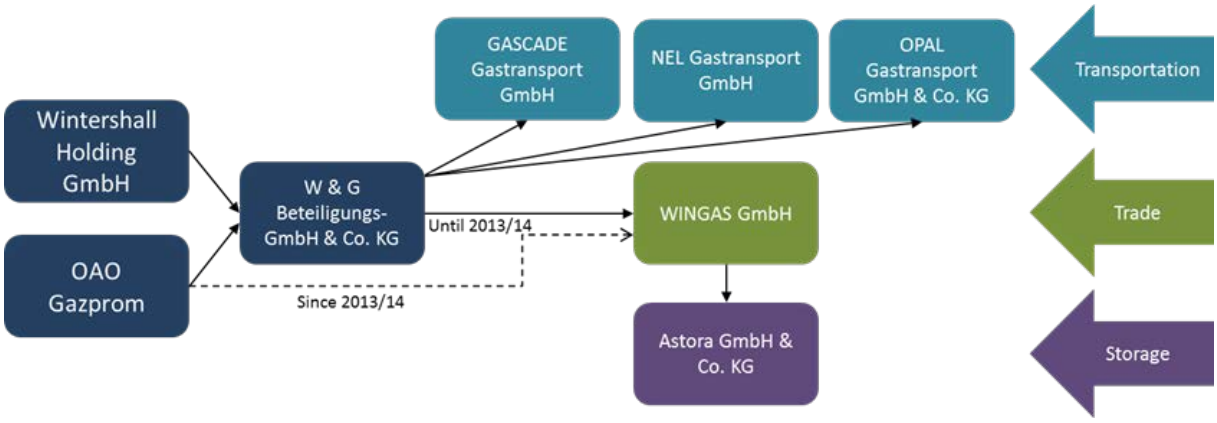

Figure 12: Chain of subsidiaries in Germany of OAO Gazprom and Wintershall GmbH

The merger is carried out as an asset swap in which Wintershall receives additional participation in natural gas production assets in Russia (in the Achimov formation in Western Siberia, to be developed jointly with Gazprom) for ceding all its shares in Wingas and WIEH and some of its shares in WINZ and Wintershall Services. The merger has been controversial because with this deal Gazprom would own 20 % of all German storage capacity and control a fifth of the German gas trade. However, the merger was approved by the EU Commission after investigation of the German, Austrian and Czech natural gas markets. These three markets have been found sufficiently strong and with diverse supplies, in contrast to the Eastern European markets, so that Gazprom would not have a dominant position.

In addition, Gazprom has a 10.52 % share in VNG (Verbundnetz Gas AG), a German natural gas transmission company. Gazprom obtained the shares in this company, which was the traditional East German pipeline network operator, after the German reunification and the restructuring of the German gas sector.

4.3 Long-term Contract Sales

Natural gas markets in Europe have traditionally relied on long-term contracts with a duration of two to three decades to bring the gas to the consumers and ensure the profitability of pipeline construction (IEA, 2004, Neumann and Hirschhausen, 2008). The second and third-energy package have significantly changed the European gas market by imposing the principles of third-party access (TPA) and unbundling. In parallel, the sales outside of long-term contracts have increased in the European Union, not only in the United Kingdom but

also on the Continent. The import volumes of LNG have increased and also the volumes of (low-price) spot gas trade. Although the long-term upstream contracts are still the backbone of the European natural gas trade, their role tends to diminish.

In the last years, several parties have pushed for the de-linking of natural gas prices to oil prices not only for the gas traded at the European hubs, but also in long-term contracts. The new pricing scheme would be based on gas-to-gas competition at wholesale market hubs, not only for the internal European market. However, the complete abandon of oil price indexation in long-term contracts is unlikely to be observed any time soon in Europe since importers have a high willingness to pay for secured, contracted supplies, as witnessed by the round of new 30 year decades struck in the 2000s. Nevertheless, several exporters to Europe have agreed to introduce more flexibility in the price formulas (e.g. partial hub-price indexation) and other contract components in the last years. In this trend, Gazprom, too, accepted to re-negotiate the pricing rules of the contracts of its European importers: it accepted a reduction of the base price of its oil-price indexed contracts with several European importers in the late 2000s.[19] Despite Gazprom's strong wish to keep the oil price indexation, it had to accept partial hub-price linking in at least one case.[20]

Apart of the oil indexation also other contract clauses with certain import companies in Europe are beginning to loosen: destination clauses are prohibited by European authorities (Talus, 2011). The "destination clause" that prohibits re-sales of imported gas to another company or country was a standard term in European import contracts in the last decades which had a clear-cut market-dividing effect. Its abrogation in Gazprom contracts was under negotiation since 2001 in the framework of the EU-Russia Energy Dialogue. Other exporters such as Algeria's Sonatrach and Nigeria LNG as well as large European companies such as GDF (Gaz de France) had also been subject of investigations of the European Commission on the destination clause (Sartori, 2013).

After first investigations in September 2011 the European Commission started formal proceedings against Gazprom on September 04, 2012 (Case number 39816). The Commission

[19] http://www.argusmedia.com/pages/NewsBody.aspx?id=886677&menu=yes

[20] In a decision in summer 2013, the International Court of Arbitration of the International Chamber of Commerce adjusted Gazprom's long-term price contract formula with RWE's Czech subsidiary (formerly RWE Transgas) and ordered Gazprom to include gas market indexation. Analysts commented that this was the first court ruling to impose spot pricing on Gazprom (DG Ener, 2013a).

investigates if Gazprom uses its dominant market positions in Central and Eastern Europe to hinder the free gas flow across Member States. It is suspected that, against the Article 102 Treaty on the Functioning of the EU, the diversification of gas supply may have been prevented by Gazprom and that it has imposed unfair pricing by linking oil and gas prices.

The EU Commissioner for Energy G. Oettinger said that a price difference up to 30 % for Russian gas imports in different EU member states "can't be".[21] DG Energy states that the Commission is finalizing the investigation, but there is neither an official final date (though it is expected for the summer 2014) nor official probable consequences. A severe consequence for Gazprom would be to lose the right of charging different prices for EU member states and be charged a fine about USD 14 billion.[22]

4.4 Gazprom Access to Infrastructure

In this section, we take a closer look at natural gas infrastructure into and within Europe, namely pipelines, storage and import harbors of liquefied natural gas. We investigate the grasp of Gazprom on specific infrastructure facilities and try to contrast it to other large suppliers in Europe wherever possible. For this section, it must be kept in mind that the European gas sector has been subject to considerable liberalization efforts in the last 20 years or so, mainly pushed by the European Union. The current regulations in place from the Third Energy Package stipulate, among others, non-discriminatory access to infrastructure for all interested parties as well as ownership unbundling of production and transportation activities (EC, 2009a, b). These regulations apply to all infrastructure facilities located in Europe.

4.4.1 Export Pipelines

Europe is mostly supplied by pipeline due to its advantage of being closely located to major suppliers via land or short sea routes. The importance of pipeline supplies is a major characteristic of the European market and distinguishes it strongly from other natural gas markets such as North America and Asia which are more isolated and have to use the liquefaction

[21] Sytas, A. and H. Gloysein, "EU says Russia must accept its gas market rules." *Reuters*, 14.09.2012 http://www.reuters.com/article/2012/09/14/eu-gas-gazprom-idUSL5E8KE9YZ20120914.

[22] The Economist: http://www.economist.com/news/business/21573975-worlds-biggest-gas-producer-ailing-it-should-be-broken-up-russias-wounded-giant

technology to access international supplies. Nevertheless, LNG also complements European imports (see Section 4.4.4).

Figure 13 shows that Europe is served by large and small export pipelines from essentially a trinity of suppliers: Russia (and potentially the Caspian region) in the East, Norway in the North and North Africa (mostly Algeria, but also Libya) in the South.

Table 4 details the different export routes that Russian gas can take to Europe at the moment and in the medium-term future. The table also provides information on the ownership of the pipelines along the transit routes: all pipelines are majority-controlled by Gazprom when exiting Russia and Gazprom has gradually less and less influence on the pipelines as they go westwards. In the new large pipelines to importing countries – Blue Stream (to Turkey, start-up in 2003) and Nord Stream (to Germany, start-up in 2011) – Gazprom accepted the participation of Western companies in pipelines starting at the Russian border.

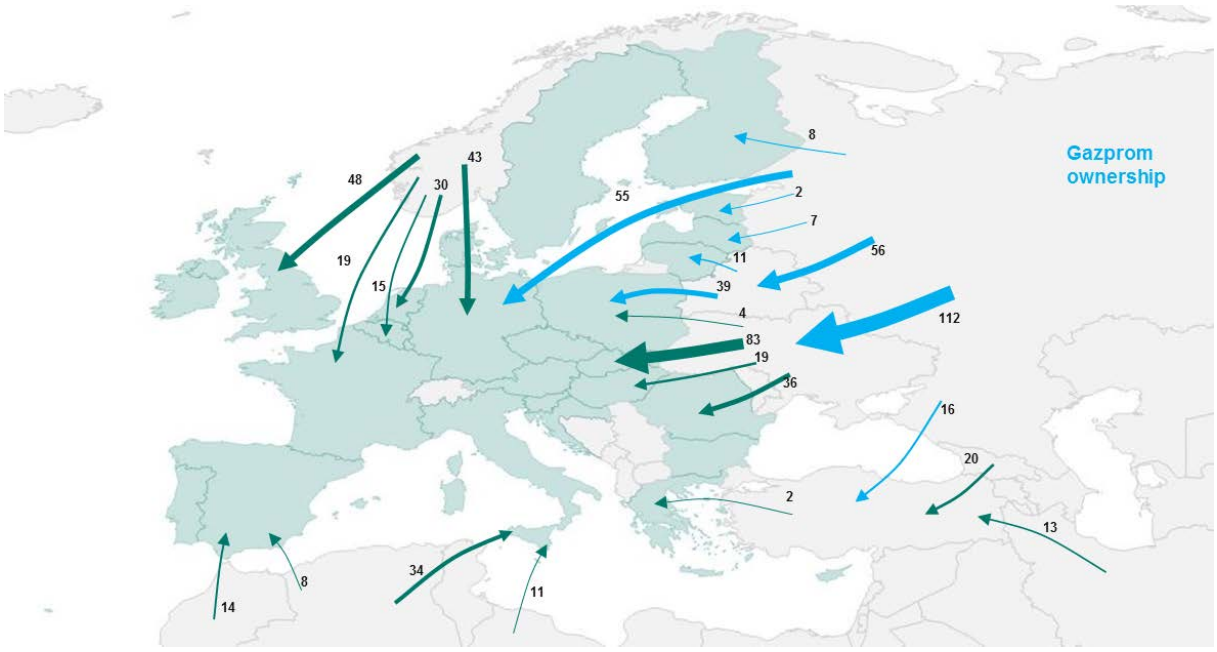

Figure 13: Current pipeline infrastructure to supply the European market, in bcm/a.

Note: Relative arrow sizes correspond to current capacities.

Source: Own illustration based on GGM database including information from ENTSO-G (2013) and various sources. The blank map (shape file) has been provided by Eurostat: http://epp.eurostat.ec.europa.eu/portal/page/portal/gisco_Geographical_information_maps/geodata/reference, accessed on May 20, 2014.

Table 4: Export pipelines from Russia to Europe

Name	From	To	Ownership	Capacity
Ukrainian Corridor (Transgas)	Russia	Ukraine	100 % Gazprom	112 bcm
	Belarus	Ukraine		25 bcm
	Ukraine	Romania, *and on to* *Bulgaria* *Greece* *Turkey*	100 % Naftogaz Ukrainy	36.5 bcm
	Ukraine	Hungary, *and on to:* *Serbia* *Bosnia-Hercegovina*	100 % Naftogaz Ukrainy	19.5 bcm
	Ukraine	Slovakia	100 % Naftogaz Ukrainy	83 bcm
	Slovakia	Czech Republic	Eustream (51% National Property Fund SR, 49% Slovak Gas Holding B.V.)	25.5 bcm
	Slovakia	Austria	Eustream	57 bcm
	Austria	Italy	TAG (89% Cassa Depositi e Prestiti, 11% OMV AG)	37 bcm
Yamal Europe	Russia	Belarus	100% Gazprom	33 bcm
	Belarus	Poland	EuRoPol GAZ (48% Gazprom, 48% Polskie Górnictwo Naftowe i Gazownictwo S.A, 4% Gas-Trading S.A)	40 bcm
	Poland	Germany	Gascade (50% Gazprom, 50% Wintershall Holding GmbH)	33 bcm
Nord Stream	Russia	Germany	51% Gazprom 15.5 % Wintershall 15,5 % E.ON 9 % Gasunie 9 % GDF Suez	55 bcm
Blue Stream	Russia	Turkey	Blue Stream SPC B.V. (50 % Gazprom, 50 % ENI)	16 bcm
South Stream	Russia	Bulgaria	100 % Gazprom	63 bcm
	Bulgaria	Greece	50 % Gazprom, 50 % DESFA	Not specified
	Bulgaria	Serbia	50 % Gazprom 50 % Bulgarian Energy Holding	Not specified
	Serbia	Hungary	51 % Gazprom, 49 % Srbijagas	Not specified
	Hungary	Austria	50 % Gazprom, 50 % OMV	32 bcm
	Hungary	Slovenia	50 % Gazprom, 50 % Hungarian Development Bank MFB	Not specified
	Slovenia	Italy	50 % Gazprom, 50 % Plinovodi	Not specified

Source: Gazprom website, ENTSO-G (2013b), GGM database

The table also includes the South Stream pipeline project on which Gazprom started construction in December 2012. With this fast move on starting construction, Gazprom effectively pre-empted the Nabucco consortium from entering the South East European market because there would not have been enough demand in South East Europe for both pipelines in parallel.

The so-called **Ukrainian gas corridor** has long been the backbone of Russian gas exports to Europe, of which the "Brotherhood" pipeline (in the Russian and Ukrainian section) and the Transgas pipeline (in Slovakia and the Czech Republic) are the main components. Today the importance of the Ukrainian gas corridor for Western European consumers has decreased even though it is the shortest route for Russian (and Central Asian) natural gas to reach the European market. The Ukrainian gas corridor transports Russian natural gas to up to 18 European countries and has a capacity of about 140 bcm at the Ukrainian Western borders.[23] The first Soviet export pipelines from the 1960s were running through Ukraine because they were linked to the original Soviet pipeline system between the Ukrainian gas fields and the demand centers in European Russian territory, in particular Moscow. When developing the West Siberian gas fields and starting exports to Europe, the new pipelines were linked to the existing intra-Soviet Union pipeline system which was no problem when Ukraine was part of the Soviet Union and not an independent transit country (Victor and Victor, 2006).

While Gazprom controls the intra-Russian lines in this pipeline system, it does not exert any direct control beyond the Russian border. Ukraine has integrated the transit pipelines in the state-owned Naftogaz Ukrainy company. Further on in the European section, the transit pipelines are owned and operated by national private and unbundled transmission system operators (Slovak Republic: eustream, Czech Republic: Net4Gas).

The **Yamal–Europe** was laid much later than the Ukrainian gas corridor, namely in the 1990s. Even though the name suggests that gas from the Yamal peninsula in Western Siberia is shipped through the pipeline, it carries gas from the Western Siberian fields in the Urengoy region.[24] The Yamal-Europe runs through Belarus and Poland to Germany. Thus, the pipeline

[23] Naftogaz Ukrainy reports that this capacity can be extended up to 200 bcm p.a. after some investments (http://www.naftogaz.com/www/3/nakweben.nsf/0/3375A8575C8884D0C22571010035B9D2?OpenDocument&Expand=2&).

[24] The Yamal gas fields only start to be developed today and non-Gazprom producers play an important role there, too.

takes a different route than the previous export lines. It also served to circumvent the Ukrainian transit (Hubert and Ikonnikova, 2011). Moreover, it allowed to access the Polish market (previously hardly a consumer of natural gas) and enters the German WINGAS network, thereby circumventing the traditional importer E.ON Ruhrgas (Victor and Victor, 2006). Gazprom Transgaz Belarus operates the Belarus section of the Yamal-Europe pipeline and is a 100 % subsidiary of OAO Gazprom. The Polish part of the pipeline is operated by EuRoPol GAZ s.a. of which Gazprom owns 48 %. GASCADE, formerly WINGAS Transport (see Section 4.2.2) owns the German section of the gas pipeline. In 2006, the pipeline reached its design capacity of 33 bcm p.a.

The offshore **Nord Stream** pipeline links Russia's Baltic Sea coast near Vyborg (Leningrad Oblast) to Germany's Baltic Sea coast in the vicinity of Greifswald. The pipeline is 1224 kilometers long and consists of two strings with an annual designed capacity of 55 bcm. The Nord Stream project is implemented by Nord Stream AG, a joint venture of Gazprom (51 %) with E.ON Ruhrgas, the BASF subsidiary Wintershall (each holding 15.5%), and the N.V. Nederlandse Gasunie and GDF SUEZ (each holding 9 %). The Nord Stream pipeline's first string was opened in late 2011; full capacity was reached with the second string in late 2012.

The offshore **Blue Stream** gas pipeline was the first pipeline project directly to an importing country, without crossing any transit country. It transports Russian gas to the fast-growing Turkish market via the Black Sea. The pipeline is about 1213 kilometers long and has a transmission capacity of 16 bcm p.a. It was constructed in the early 2000s and started operations in 2002. It is owned and operated by a Russian-Italian joint venture, Blue Stream Pipeline Company B.V., between Gazprom and Eni (each holding 50 %).

The **South Stream** gas pipeline is also an offshore project through the Black Sea. It shall transport Russian gas to Bulgaria and then on to several South East European countries (Serbia, Hungary, Slovenia, Austria, Greece). The construction began in December 2012 on the Russian Black Sea shore, and in 2013 on the other end of the pipeline in Serbia. With a designed capacity of 63 bcm the South Stream project is a very large export project. In order to make the project happen Gazprom, between 2008 and 2011, co-founded national development companies in the importing countries of which Gazprom holds at least 50 % (Table 4). In order to feed the required amount of gas into the South Stream gas pipeline, Gazprom

announced that upstream Russia's gas transmission system will have to be expanded. This internal Russian project has been named Southern Corridor and shall be implemented in two phases before 2018.[25]

The onshore section in the European Union of the South Stream project is causing legal concerns in the EU. The pipeline is already under construction although the EU Commission did not give the final approval for the pipeline and its desired operation. High level political talks are currently frozen because of the Ukraine crisis, although technical talks about the pipeline have continued. Without solving the legal problems, the involved member states like Bulgaria and Italy will face either EU penalties or prosecutions from Gazprom for the infringements of their contracts with Gazprom. The EU Commission stresses that for the South Stream pipeline's approval the ownership unbundling according to the Third Energy Package needs to be respected and non-discriminatory third-party access needs to be assured. Until now Gazprom would own the production capacity and the transmission capacity. However, there has not been a TPA exemption application by the South Stream consortium until now but the project plans include Gazprom as the only shipper. The third big concern of the Commission is the intended tariff structure. DG Competition stated that it is difficult to preview what consequences these juristic conflicts and the stop in political talks will have on the whole pipeline project.

Gazprom and the Russian state have a general concern about the European Third Energy Package. Gazprom fears that if pipelines can no longer be fully dedicated to a specific supply contract, a mismatch between supply and transportation capacity could arise. Moreover, it is afraid of difficulties to contract sufficient transportation capacity to deliver gas also for new supply contracts (Yafimava, 2013). In this vein, on April 30, 2014 Russia filed a dispute against the European Union with the World Trade Union because of the Third Energy Package, and in particular the unbundling and the TPA provisions.[26]

[25] Source: http://www.gazprom.com/about/production/projects/pipelines/southern-corridor/ This is not to confuse with the import route from the Caspian Sea region to Europe via Turkey that is also often called Southern Corridor and in which the Nabucco project was supposed to be integrated; the BP-sponsored SEEP (South East European Pipeline) connected to the TANAP (Trans-Anatolia Pipeline) will be realized in the next years.

[26] http://www.wto.org/english/news_e/news14_e/ds476rfc_30apr14_e.htm

4.4.2 Intra-European Transmission

Since the Russo-Ukraine gas dispute in 2009, the pipeline interconnections between European Member States have been considerably improved, following the EU regulation 994/2010 on gas supply security (EU, 2010). This regulation stipulated that, from December 2013 on, all cross-border connections shall also accommodate reverse flows in addition to the traditional flow direction. The regulation has been implemented to a large extent, but there is still need for construction of pipeline capacity between the most vulnerable Eastern European countries, in particular to Bulgaria (Table 5).

Table 5: Directed flow capacities between EU Member States in Central and Eastern Europe

From	To	Reverse Flows Possible?
Austria	Slowenia	Yes
Austria	Slovakia	Yes
Poland	Germany	Yes
Czech Republic	Germany	Yes
Slovakia	Czech Republic	Yes
Latvia	Estonia	Yes
Latvia	Lithuania	Yes
Austria	Hungary	Yes
Bulgaria	Greece	No
Romania	Bulgaria	No
Hungary	Romanio	No
Hungary	Croatia	No
Slowenia	Croatia	No
Czech Republic	Poland	No
Poland	Slovakia	No pipeline
Lithuania	Poland	No pipeline

Sources: ENTSO-G (2013b) and own updates

Gazprom is holder of shares in several East and Central European natural gas companies which also operate the national pipeline grids on either the transmission level (potentially also to foreign consumers) or the distribution level (to the local consumers) or both. These companies have been privatized in the 1990s, giving Gazprom the possibility to become shareholder.

In the neighboring countries of Russia, Finland, Lithuania, Latvia, and Estonia – which are completely dependent on Russia for their natural gas supplies – Gazprom participates in all

national gas companies which all operate pipeline infrastructure (Table 6). Gazprom does not hold controlling stakes in these companies, but often obtains a majority with its long-time partner E.ON Ruhrgas (holding 47.2 % in Latvijas Gaze, 38.9 % in Amber Grid, 33.6 % in Eesti Gaas, and 20 % in Gasum Oy). The state is no shareholder in Latvia and Estonia and a small shareholder in Lithuania and Finland.

Table 6: Pipelines with Gazprom participation in countries with dominance of Gazprom imports (Finland and Baltic countries)

Location	TSO/DSO	Gazprom-Parent Company	Share, in %	length transmission network of TSO, in km	length distribution network of DSO, in km
Finland	Gasum Oy	OAO Gazprom	25	1 286	556
Latvia	Latvijas Gaze	OAO Gazprom	34	1239	4871
Lithuania	AB Amber Grid	OAO Gazprom	37.1	2007	--
Estonia	AS EG Võrguteenus, part of the Eesti Gaas Holding	OAO Gazprom (shareholder of Eesti Gaas)	37.03	885	--

Source: Own compilation based on company websites

Gazprom also holds shares in pipeline operating companies further West in Europe, in particular in Serbia and Germany (Table 7). The W & G Beteiligungs-GmbH & Co. KG (W & G), a joint venture between Wintershall Holding GmbH and OAO Gazprom, provides Gazprom access to almost three thousand kilometers of German gas transmission network, in particular the former WINGAS network (now GASCADE) and the connecting onshore pipelines of the Nord Stream pipeline (OPAL and NEL).

In Poland, EuRoPol Gaz is the operator of the Polish section of the international Yamal-Europe transmission pipeline; the operator of the national network Gas Transmission Operator Gaz-System S.A. is fully owned by the Polish state. Gazprom also holds a 10 % share of the Interconnector between Belgium and the UK. This is equivalent to 2 bcm annual transportation capacity from the UK to the Continent and 6 bcm to the UK from the Continent. This capacity is used, according to Gazprom information, by the subsidiary GM&T to transport natural gas from the Northern Germany UGS or purchased on the Continent to the UK market as well as to flexibly take advantage of price changes on the liberalized British market.

A gas pipeline that currently causes differences between the EU and Russia is OPAL ("Ostsee-Pipeline-Anschlussleitung"), one of the onshore extensions of the Nord Stream pipeline in Germany. OPAL crosses Eastern Germany southwards to the Czech border where it connects with the GAZELLE pipeline. Gazprom applied for an increased access to the OPAL pipeline which may be in breach with the third-party access of the third energy package. The EU Commission postponed its decision about the pipeline access, which was planned for March 10, 2014, without announcing an expected new date for the ruling. If Gazprom were allowed to fully use OPAL, it could even more effectively bypass Ukraine and rely on the Nord Stream pipeline to supply not only Germany but also the previous East European transit countries Czech Republic and Slovakia.

Table 7: Pipelines with Gazprom participation in Western and Central European countries without dominance of Gazprom imports

Location	TSO/DSO	Gazprom-Parent Company	Share, in %	length transmission network of TSO, in km
UK	Interconnector (UK) Limited	OAO Gazprom	10	235
Germany	GASCADE Gastransport GmbH	W & G	100	2400
	NEL Gastransport GmbH	W & G	100	441
	VNG	Gazprom Germania GmbH	10.52	7200
Poland	EuRoPol Gaz	OAO Gazprom	48	685
Serbia	YugoRosGaz	OAO Gazprom	50	124

Source: Own compilation based on Gazprom and company websites

4.4.3 Storage

In Europe, storage is used to balance inter-seasonal demand variations: natural gas is stored in the summer months, from where it is retrieved during the winter. Storage plays a different role in each European Member State, to a large extent depending on the endowment with appropriate geological sites (Figure 14). However, in some East European countries, e.g. Romania and Poland, there is unused potential for more storage sites as there has been a preference on relying on storage services provided by the Russian supplier.

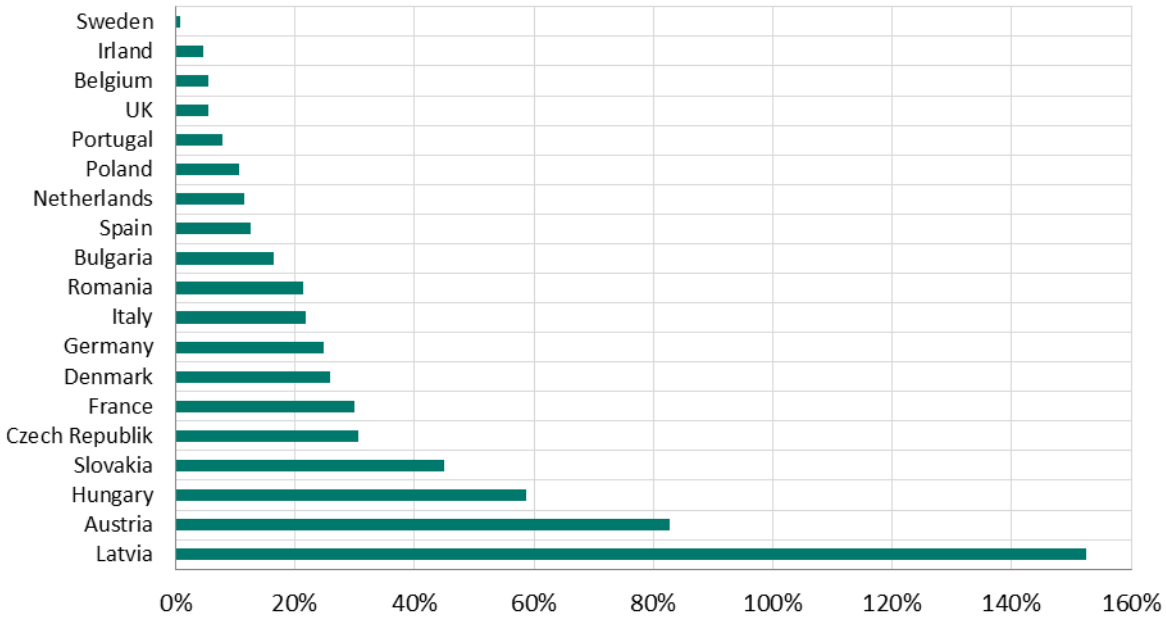

Figure 14: Capacity of natural gas storage in the EU Member States as share of national natural gas consumption as of end 2012, in percentage.

Source: Own illustration based on IEA (2013a)

In contrast to crude oil, for which the International Energy Agency organizes a strategic reserve in the order of 90 days of average consumption of its member countries, there is no such EU-wide regulation for natural gas. However, some Member States have national regulations of mandatory security reserves for varying consumption levels: Hungary, Romania, Italy, Portugal and Spain (UNCE, 2013). The political option to mandate strategic gas reserves must be carefully evaluated given that storage capacity is geologically scarce and in many countries is available for considerably less than the 90 days for crude oil mandated by the IEA. It may be worth the while to consider shorter-time period strategic gas storage – in particular the time it takes to install or reinforce additional (reverse flow) pipeline capacity to supply a disrupted gas market. The natural gas industry is intransparent about the time it takes to (temporarily) install additional pipeline capacities, but it is sometimes reported to be relatively short, in the order to two weeks to one month.[27]

[27] This relatively short time frame needed to install (or revive) pipeline and compressor capacity is also indicated by the very fast news in April 2014 that Ukraine will be served with natural gas supplies from the West, for example by RWE (https://www.rwe.com/web/cms/en/113648/rwe/press-news/press-release/?pmid=4010924, retrieved May 12, 2014).

The 2010 EU regulation on supply security in natural gas (EU, 2010) also explicitly mentions the possibility to access storage across borders – this is done, for example, in the Baltic "gas island" where Lithuania supplies the storage services for all Baltic countries, and in the Austro-German border region where the storage facilities Haidach and 7Fields in Austria are connected to the German pipeline grid.

So far, Gazprom is involved in only a few storage facilities in the European Union (Table 8). However, it has development plans of several other gas storage facilities as part of its strategy towards the downstream markets (Table 9) in Europe. More importantly, Gazprom controls the underground gas storage (UGS) facilities along the transmission network through the FSU country Belarus. These UGS are used to balance the gas supply to Europe between low-demand and high-demand seasons.

Table 8: Underground gas storage facilities in Europe with Gazprom participation

Location	Facility	Company	Share of Gazprom	Type	Working gas capacity, mcm	Maximum potential daily output, mcm
Austria	Haidach	RAG/Astora/Gazprom Export	Astora and Gazprom Export sole marketers (100%)	Depleted Gas Field	2640	26.4
Germany	Katharina	Erdgasspeicher Peissen GmbH	50%	Salt Cavity	106	1.9
	Rehden	Astora	100%	Depleted Field	4400	57.6
Latvia	Incukalns	Latvijas Gaze	34%	Aquifer	2320	n.a.
Serbia	Banatski Dvor	Srbijagas/Gazprom Germania	51%	Depleted Field	450	5

Sources: GIE (2013), RAG Website

The annual report 2012 of OAO Gazprom states that it has access to 4.51 bcm of working gas capacity of underground storage facilities in Europe; it is involved in most storage projects through its subsidiaries. OAO Gazprom is also involved in four German storage sites. It has partial ownership rights as co-investor (33.3 %) for the Etzel storage. Gazprom Export and VNG have a 50 % each share for the Katharina storage while Astora owns two more storage facilities. Gazprom Export, Astora and RAG split the ownership rights for the Haidach storage in Austria and the Gazprom Group has another 51 % share in a Serbian storage site.

Table 9: Planned gas storage projects in Europe with Gazprom participation

Location	Facility	Company	Share of Gazprom	Type	Working gas capacity, mcm	Maximum potential daily output, mcm
Czech Republik	Dambořice	Gazprom Germania/MND Gas Storage	50%	Depleted Oil Field	456	7.6
Germany	Etzel	Gazprom Germania/ BP/DONG	33.3%	Salt Cavity	356	n.a.
	Katharina	Erdgasspeicher Peissen GmbH	50%	Salt Cavity	629	n.a.
	Jemgum	Astora	100%	Salt Cavity	833	n.a.
The Netherlands	Bergermeer	TAQA Energy BV	access to 1.9 bcm	Depleted Field	4100	57
Belarus	Osipovskoye/ Pribugskoye/ Mozyrskoye	Gazprom Transgaz Belarus	100%	Depleted Field/ Salt Cavity	993	18
UK	Saltfleetby	Wingas/Gazprom Germania	100%	Depleted Field	770	8.5

Source: GIE (2013)

Of the UGS projects with Gazprom participation, the Dutch Bergermeer project (Gazprom access to 26.4 mcm daily output) is close to completion (ramp-up started in April 2014). For the possible participation in more storage projects in Austria, UK, France, Romania, Slovakia, Turkey, Czech Republic, Belgium and other countries Gazprom is conducting a feasibility assessment. Currently, Gazprom controls 6 % of the storage capacity in the European Union. If all projects reported by GIE (2013) are realized in the next years, Gazprom's share could increase to 7.4 %. This shows that the storage sector is rather fragmented where regional infrastructure companies play a major role.

4.4.4 LNG Import Terminals

LNG has been imported to Western Europe for many decades; it is a completely new source of gas supplies for Eastern European countries (Figure 15). Poland has constructed a terminal on the Baltic Sea coast (Swinoujscie) which will be operational in the winter 2014/15. Similarly, Lithuania has commanded a floating LNG terminal that will start operations in Klaipeda in the winter 2014/15, too.

Gazprom does not participate in any existing LNG import harbor in Europe, even though it controls export capacity in Russia's Far East.[28] However, one of its subsidiaries has plans to develop a terminal (ENTSO-G, 2013a): in Finland, which is 100% dependent on imports from Russia for its natural gas supplies, the Finnish distributor Gasum Oy plans the terminal named "Finngulf LNG". It is currently in the prospecting stage on the site of the terminal in Southern Finland, but final investment decision is planned to be taken in 2014. As detailed in Section 4.2.1, Gazprom holds a 25 % share in Gasum Oy. A second terminal in the Eastern Baltic Sea is discussed between Finland and Estonia.[29]

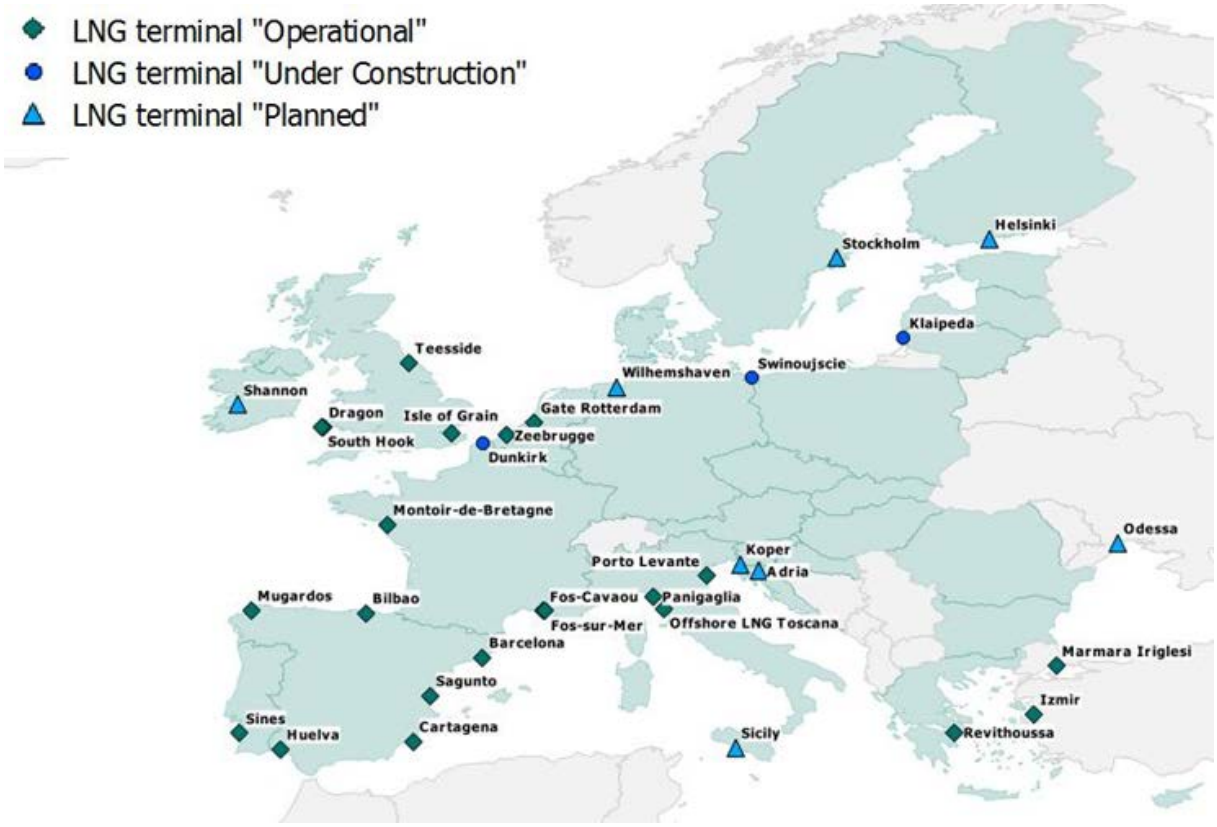

Figure 15: LNG imports terminals in Europe, which are "operational", "under construction" and "planned".
Source: Own illustration based on GIIGNL (2013) and ENTSO-G (2013a). The blank map (shape file) has been provided by Eurostat: http://epp.eurostat.ec.europa.eu/portal/page/portal/gisco_Geographical_information_maps/geodata/reference, accessed on May 20, 2014.

[28] Transportation costs of LNG are strongly correlated to transportation distance. Hence, LNG supplies from the Russian Far East Sakhalin island are unlikely to be shipped to Europe.

[29] http://yle.fi/uutiset/estonia_and_finland_agree_on_separate_liquefied_natural_gas_terminals/7115156

5 The Effect of Disruption Scenarios – Simulation Results with the Global Gas Model

5.1 A New Modelling Tool: the Global Gas Model (GGM)

The Global Gas Model (GGM) is used to simulate future patterns of natural gas production, consumption and trade. A specific focus lies on infrastructure expansion needs that are indicated by the model results. Cross-border pipelines and global infrastructure to trade Liquefied Natural Gas (LNG) are included in the model. In particular, the GGM can be used to analyze counterfactual scenarios, e.g. the disruption of pipeline capacity between Russia and Europe.

The basis for the GGM is a stylized representation of market entities along the entire natural gas value chain, i.e. producers, traders, transmission and storage system operators and final consumers. They are characterized by optimizing behavior under operational and technical constraints, such as capacity constraints. The model features seasonality and endogenous investments in infrastructure.

The GGM is set up as partial equilibrium model, i.e. a gas-only sector model. It is solved numerically in 5 years steps starting in 2010 by means of the software GAMS. The data set includes 98 countries[30] that are represented by current and projected consumption and production levels, prices, production capacities and costs as well as capacities of the transmission and storage system. The data originate from various and mainly public sources. Cross-border capacities of pipelines toward and within Europe are provided by ENTSO-G (2013b) with status of January 2013. Capacities of pipelines, LNG and storage facilities for the model period 2015 are determined by exogenously included capacities (infrastructure that is available today and that is currently under construction), and by endogenously determined expansions in the model period 2010. For a more detailed description and model applications see Egging (2013) and Holz et al. (2013b).

[30] The GGM database includes 23 EU member states in 21 nodes (Lithuania, Latvia and Estonia is aggregated in the node “BALT”). Not included EU member states are Cyprus, Luxembourg, Malta, Sweden and Slovenia.

5.2 Two Disruption Scenarios

The GGM *Base Case* is set up in line with projections of the New Policies Scenario (NPS) of the World Energy Outlook 2012 (IEA, 2012), a moderate climate policy scenario. In addition, two scenarios have been constructed around the disruption of Gazprom majority-owned infrastructure. In both disruption scenarios the model period 2015 is shocked, i.e. affected by exogenous assumptions. In order to avoid any inconsistencies, all decisions made in the first model period (2010) in the *Base Case* are held fixed across both disruption scenarios:[31]

- In the first scenario, "*UKR Disruption*", it is assumed that all pipeline connections to Ukraine, which serve to deliver Russian natural gas, are interrupted. Hence, no transit via Ukraine can take place.
- In the second scenario, "*Gazprom*", the total infrastructure, which is majority-owned by OAO Gazprom or any subsidiary, is interrupted. See Table 10 for detailed scenario descriptions, while Table 11 shows the capacity differences for all affected pipelines across scenarios.

[31] For a detailed description of the scenarios and results see Richter and Holz (2014). The short-term shocks (only one model period) are applied to a world slightly different than today regarding production and consumption levels as well as existing infrastructure. While all current European pipeline, storage and LNG capacities are included (e.g. from ENTSO-G 2013b, GIE, 2013 and GIIGNL, 2013), some projects currently under construction are assumed to exist in 2015, e.g the ALTAI pipeline from Russia to China with 30 bcm as of 2015, or the South Stream pipeline from Russia to Bulgaria with its initial capacity of 15 bcm in 2015. Moreover, some (small) endogenously determined infrastructure expansion between 2010 and 2015 take place in the model results. The model results can be interpreted as long-term cost-efficient equilibria in the presence of market power of selected traders. It is abstracted from institutional friction, such as long-term contracts or oil-price linking. Hence, adjustments in international trade of natural gas are facilitated in the model relative to the real world. Moreover, it is assumed that the slack capacity of 2015 production levels in Norway and the Netherlands is about 10% in the *Base Case*. At increasing cost, both countries may balance a shortfall of Russian imports to a certain extent. The tightened limitation of production at the Groningen field in the Netherlands due to concerns of seismic events is not taken into account.

Table 10: Scenario descriptions of GGM simulation runs

Scenario Name	Description	Specific Assumption
Base	Base Case: Projections of future natural gas production, consumption and trade based on the New Policies Scenario of the IEA in its World Energy Outlook 2012	
UKR Disruption	Ukrainian Disruption: Interruption of Russian pipeline connection to Ukraine (neither direct pipeline connection from Russia nor indirect connection via Belarus included) in 2015	• Zero capacity on pipeline RUS-UKR • Zero capacity on pipeline BLR-UKR
Gazprom	Disruption of Gazprom infrastructure to Europe (incl. Turkey): Reduction of total cross-country pipeline and storage capacity in 2015 that is currently majority-owned by Gazprom (incl. subsidiaries). Belarus is not affected, i.e. the pipeline from Russia and the Belarussian storage capacity has full capacity. However, the transit via Belarus is disrupted. Affected pipelines: • Nord Stream • Brotherhood • Yamal Europe • Blue Stream • South Stream • OPAL Affected storage facilities • Rehden in Germany • Haidach in Austria • Incukalns in Latvia • Banatski Dvor in Serbia	• Zero capacity on pipeline RUS-DEU • Zero capacity on pipeline RUS-FIN • Zero capacity on pipeline RUS-BALT • Zero capacity on pipeline RUS-BGR • Zero capacity on pipeline RUS-TUR • Zero capacity on pipeline RUS-UKR • Zero capacity on pipeline BLR-UKR • Zero capacity on pipeline BLR-POL • Zero capacity on pipeline BLR-BALT • Reduced capacity on pipeline DEU-CZE by 74% • Reduced storage capacity in DEU by 20% • Reduced storage capacity in AUT by 35% • Reduced storage capacity in BALT by 100% • Reduced storage capacity in SRB by 100%

Table 11: Selected pipeline capacities at the time of disruption in 2015, in bcm/a (gross capacity, before losses)

From	To	*Base Case*	*UKR Disruption*	*Gazprom*
Russia	Bulgaria	15.56	15.56	0
Russia	Finland	8.36	8.36	0
Russia	Germany	57.17	57.17	0
Russia	Turkey	16.49	16.49	0
Russia	Ukraine	114.29	0	0
Belarus	Baltic	10.69	10.69	0
Belarus	Poland	39.92	39.92	0
Belarus	Ukraine	25.25	0	0
Germany	Czech Republic	42.58	42.58	11.07

Source: GGM database

5.3 Base Case Projections until 2035: the Setting

The *Base Case* is characterized by an increasing world production and consumption over time. The Asia-Pacific region plays a dominant role with respect to consumption and imports, while the EU's import needs increase in line with declining domestic production. In 2015, global production and consumption is 10% higher compared to 2010. Projections for the EU see lower levels of natural gas consumption by 3%, and substantially lower production levels by 18% relative to 2010. Consumption and production paths are depicted in regionally disaggregated form in Figure 16.

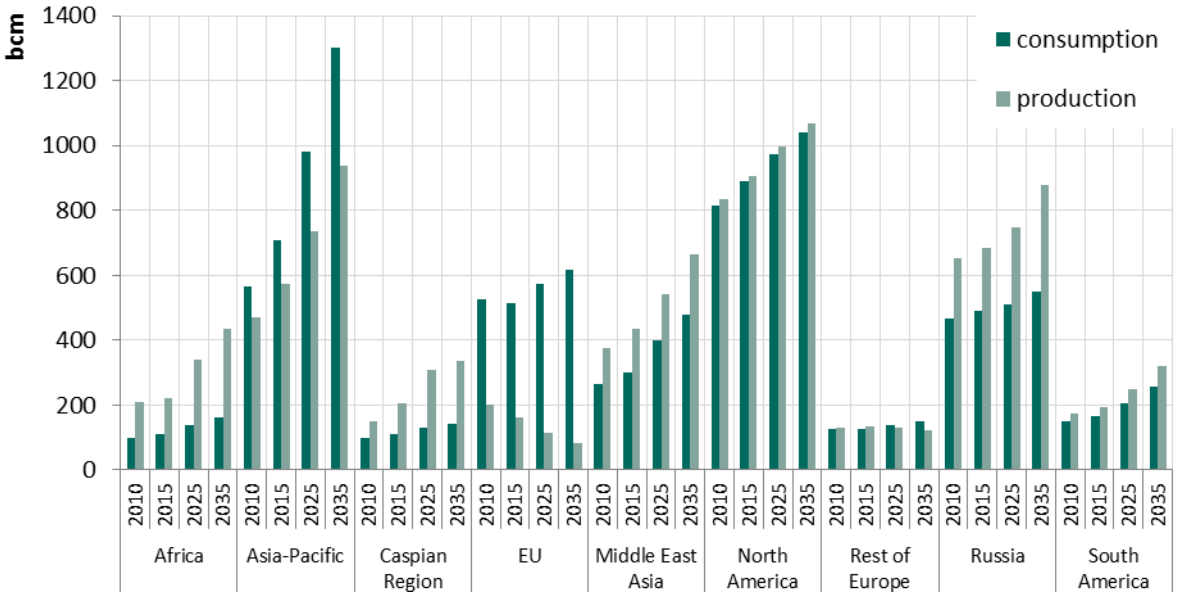

Figure 16: Consumption and production pathways in the GGM Base Case, in bcm.

EU import dependency is hence projected to increase to about 90% of consumption in 2040. Imports originating from Russia increase until 2035 in levels, but decrease in share relative to total EU imports (see Figure 17). Model results hint at a long-term diversification of European supplies with a higher reliance on natural gas from Africa, the Caspian region and LNG exporting countries in the next decades.

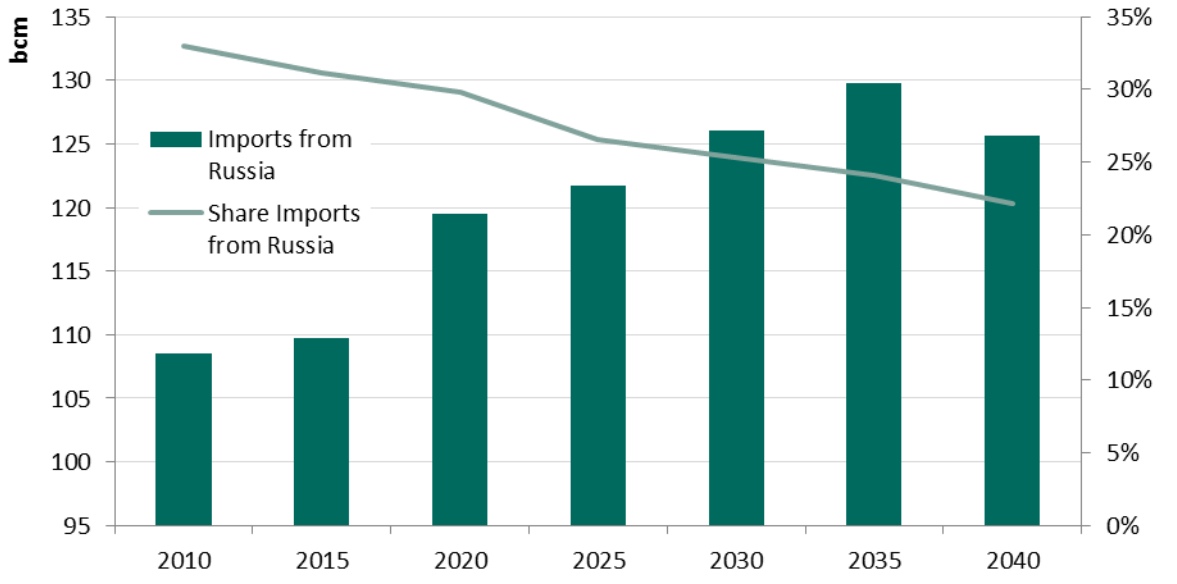

Figure 17: EU natural gas imports from Russia, absolute and as share of total imports, in bcm and percentage.

5.4 Results of the Disruption Scenarios

5.4.1 Consumption and Prices

As expected, in the *UKR Disruption* scenario Ukraine is substantially affected and natural gas consumption is reduced by almost 70 % in 2015 relative to the Base Case. By assumption, there is no short-term possibility to export natural gas to Ukraine via physical capacity, and domestic production can only marginally be increased.

On the other hand the EU is only slightly affected with small average reductions of consumption levels (by 2 %, or 11 bcm), but the deviation across countries is large. In particular, in Croatia, Hungary and Romania consumption is reduced substantially by more than 20 % but also in Austria the transit disruption can be noticed (-4% consumption in *UKR Disruption* relative to the *Base Case*). See Figure 18 for consumption levels in 2015 across scenarios, while Figure 19 depicts levels deviations from the *Base Case*.

The *Gazprom* scenario is characterized by similar effects on Ukraine but a stronger impact on EU countries. At the aggregate level, EU consumption in 2015 is reduced by 10 %, or 53 bcm. Notably, East European countries are affected the most, but also Germany's consumption level is reduced by 8 % or 7 bcm.

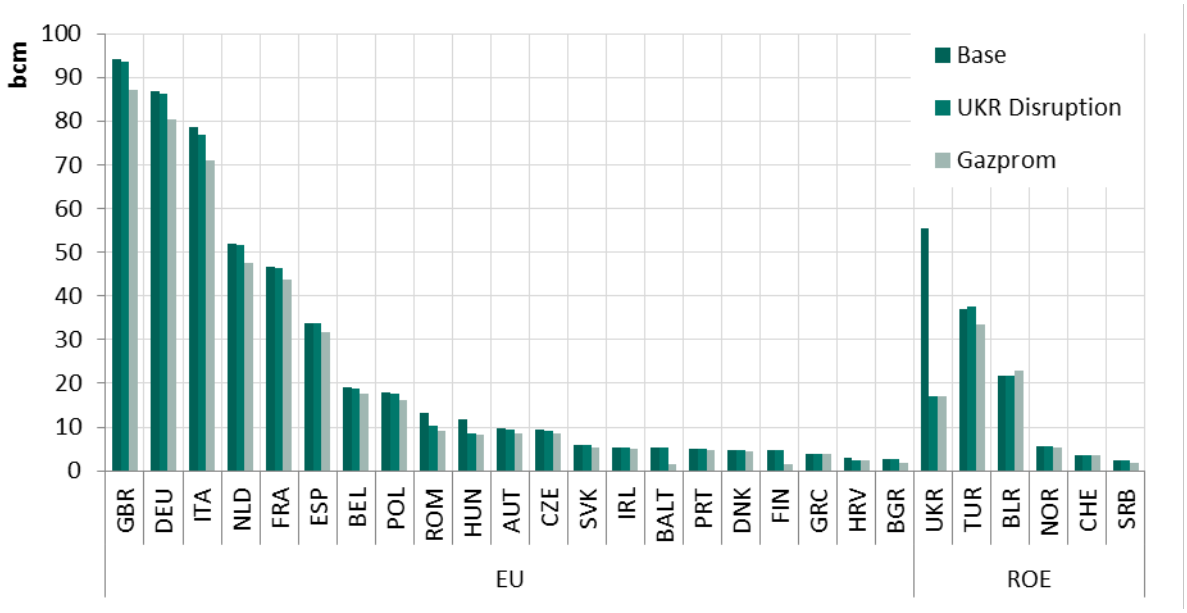

Figure 18: Consumption of natural gas in Europe (EU and Rest of Europe) in 2015 across scenarios and ranked by consumption levels in the *Base Case* in each region, in bcm.

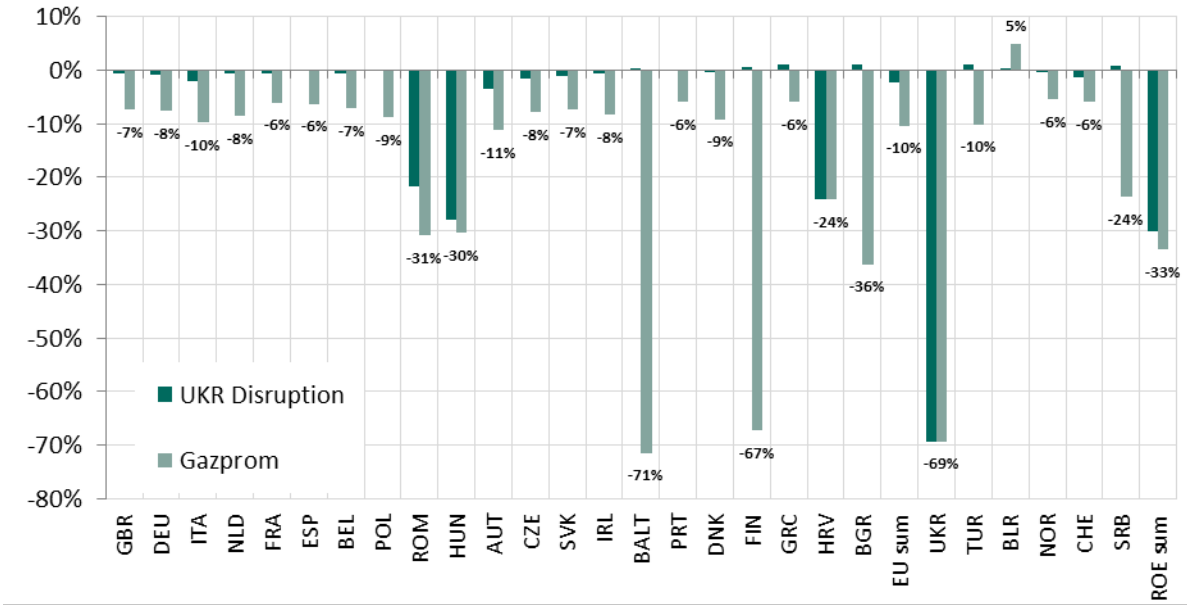

Figure 19: Changes in 2015 consumption levels relative to the Base Case, in percentages.

Note: Values for the Gazprom scenario are provided next to the respective bars. Countries are ranked by consumption levels in the Base Case in each region (see Figure 18).

A reduction in consumption levels is the result of both economic considerations, i.e. the trade-off between the (assumed) willingness-to-pay and the price for natural gas, and physical limitations of the available infrastructure.

Accordingly, consumption prices are changed relative to the Base Case (see Figure 20). Note, that for each country and model period, an equilibrium price-quantity pair along the constructed demand curve is reached. Similar to consumption level, prices in *UKR Disruption* are only significantly higher in Ukraine, Hungary, Romania and Croatia, while in *Gazprom* each EU country bears a price increase of at least 10% relative to the *Base Case*. On average, prices are increased by 4.5 % in the *UKR Disruption* scenario and by 21 % in *Gazprom*. For the Baltic countries the price increase is particularly pronounced in the high demand season (by 143 % higher consumption price relative to the *Base Case*) due to the complete interruption of storage facilities.

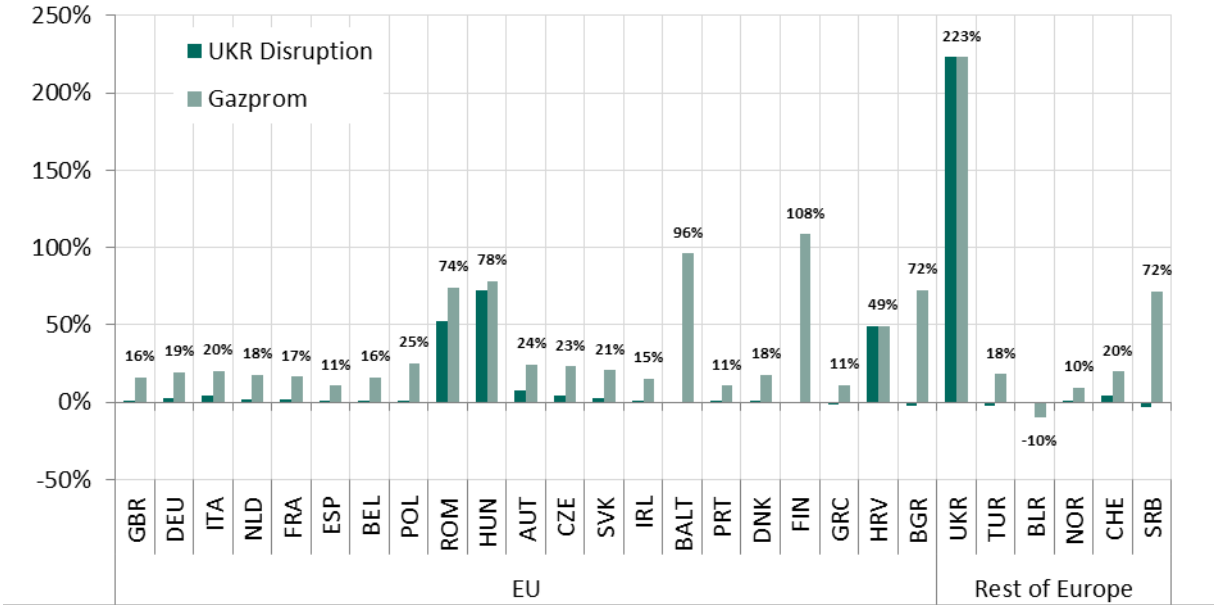

Figure 20: Prices in 2015 relative to the Base Case, in percentages.

Note: Values for the Gazprom scenario are provided next to the respective bars. Countries are ranked by consumption levels in the Base Case in each region (see Figure 18).

5.4.2 Shift in the European Supply Structure – Substitution of Russian Natural Gas

To some extent, the shortfall of Russian supply to some countries (*UKR Disruption*), or all European countries (*Gazprom*), in 2015 is compensated by an increase in domestic production as well as by imports from other producing regions.

While domestic EU production is only marginally increased in *UKR Disruption*, production is larger in the *Gazprom* scenario, namely by 5%, or 8 bcm relative to the *Base Case*. This increase is almost entirely driven by an increase in the production of the Netherlands.

In the *Gazprom* scenario the shortfall of 110 bcm (14 bcm) imports from Russia (the Caspian region) relative to the *Base Case* is countervailed by the increase of 8 bcm in domestic production and by 62 bcm of imports from other suppliers (imports from Africa +18 bcm; Middle East +19 bcm; South America +15 bcm, and from Rest of Europe +10 bcm). The remaining 53 bcm reflect the reduction in EU consumption.

Figure 21 shows that the disruption impact is most visible in a pronounced change in the EU import structure by type of imports. In particular, the share of LNG imports is substantially increased (+45 bcm, or almost 60% higher in *Gazprom* than in the *Base Case*), while pipeline imports drop significantly, despite small increases from North Africa and Norway.

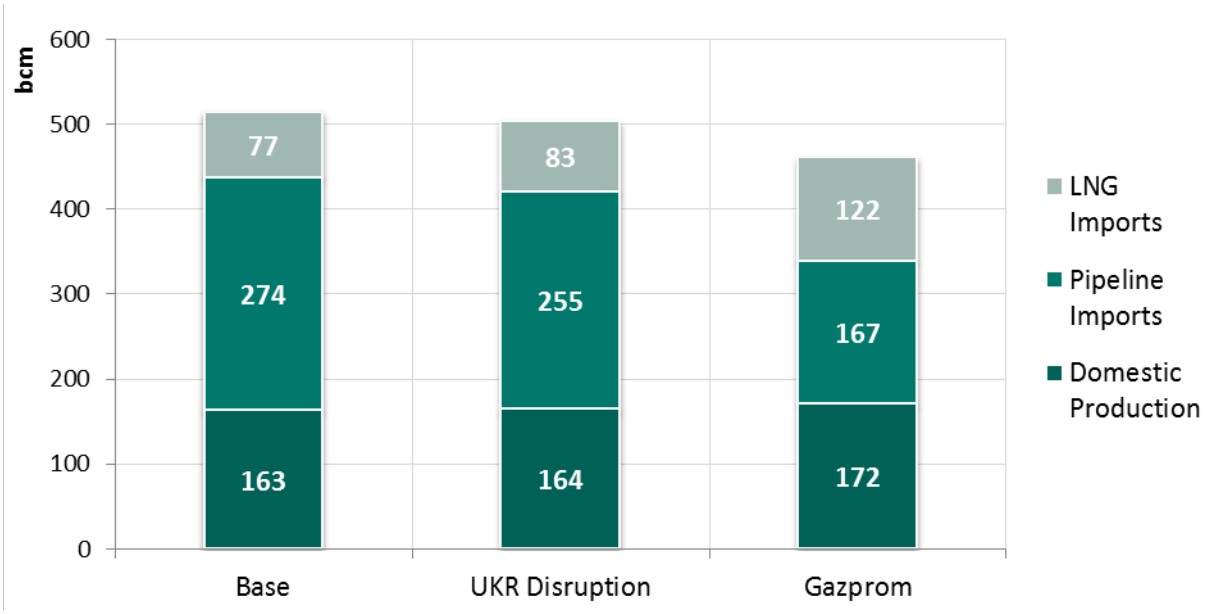

Figure 21: EU supply structure in 2015 across scenarios, in bcm.

Moreover, the market shares of regional suppliers are changed as can be seen in Figure 22. Natural gas is imported to a larger extent from Africa, Middle East, South America, and the Rest of Europe (Norway).

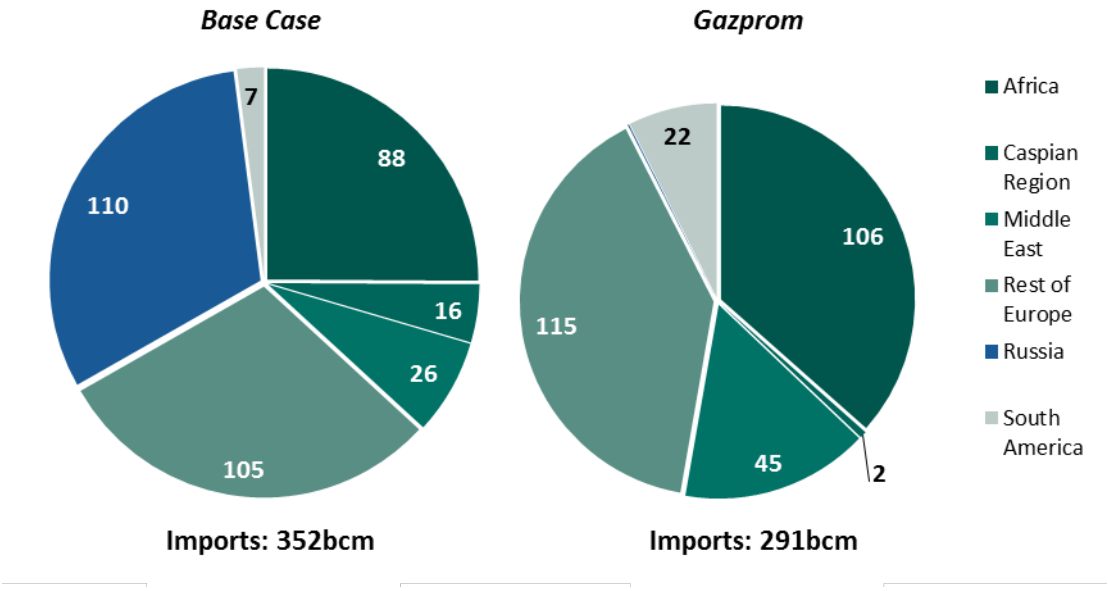

Figure 22: EU import structure in 2015 by supplier, in bcm.

5.4.3 Focus on European LNG Imports

LNG imports are most important in balancing the Russian trade interruption. In the *Gazprom* scenario the increase of LNG imports to the EU is mainly supported by Qatar, African countries like Nigeria, Algeria and Egypt, and by Trinidad & Tobago. Figure 23 depicts the regional distribution of LNG imports into the EU and contrasts trade flows with total import capacities. The largest additional LNG imports in the *Gazprom* scenario relative to the *Base Case* can be observed in the UK (increase by a factor of 4.7).

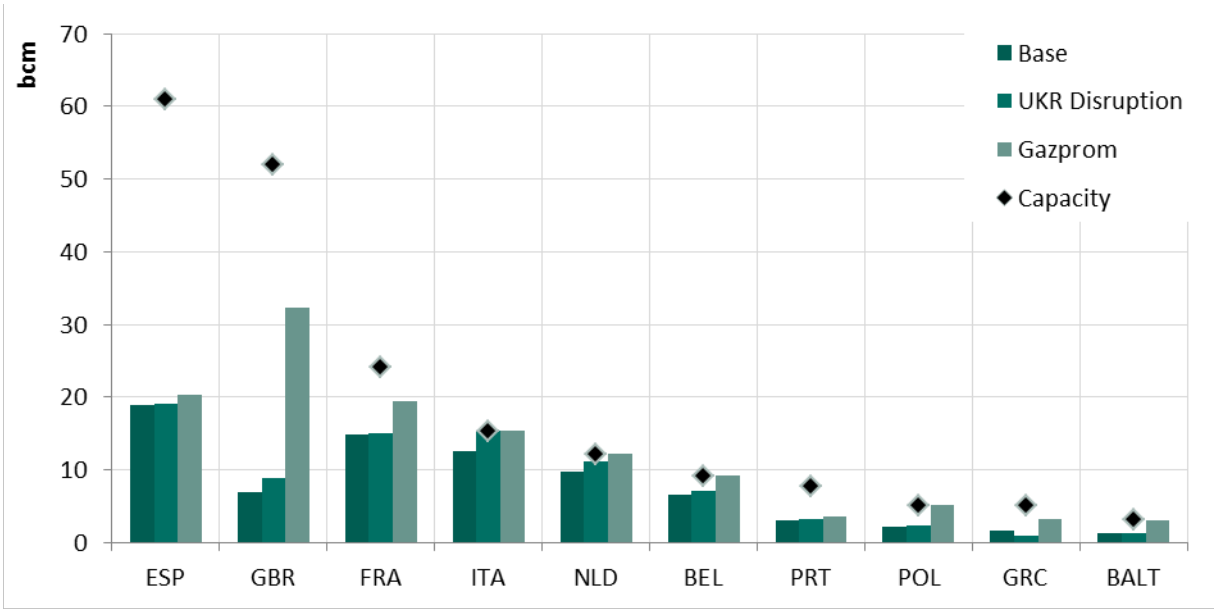

Figure 23: EU LNG imports in 2015 by countries compared to potential regasification capacity (bcm).

Table 12 provides further information on the capacity of operating LNG regasification terminals in the EU as of today, and as included in the GGM simulation runs for the period 2015.

While regasification terminals in Italy, the Netherlands, Poland and the Baltic are completely used in the *Gazprom* scenario, it is deducible from Figure 23 and Table 12 that the utilization rate of regasification capacity in some EU countries is rather low in the two disruption scenarios.

Most remarkably, the utilization rate of Spanish terminals only reaches 33% in the *Gazprom* scenario. Particularly, cross-border pipeline capacity restrictions prevent higher Spanish LNG imports used for an efficient distribution across Europe: The pipeline capacity from Spain to France is completely utilized and cannot be extended on short notice (see Figure 24). This

has also been noted by the European Council which concluded in March 2014 that "interconnections should also include the Iberian peninsula".[32]

Similarly, a possible increase in French LNG imports beyond the *Gazprom* scenario level is prevented by a lack of pipeline capacity toward Germany or Italy. Italy in turn is poorly connected to central Europe and cannot serve as transit country for African pipeline gas and LNG imports. Hence, the large total EU regasification capacity of 195 bcm cannot be completely used to balance import needs in all member states.

Table 12: LNG regasification capacity in the EU as of today, and in 2015 (GGM), in bcm.

Country	Terminal	2013	2015 additions in GGM
Belgium	Zeebrugge LNG Fluxys LNG	9.00	
France	Fos Tonkin and Fos Cavaou Elengy	8.25	
France	Fos-sur-Mer	5.50	
France	Montoir de Bretagne Elengy	10.00	
Greece	Revithousa	5.00	
Italy	Panigaglia	3.30	
Italy	Rovigo (Atlantic) Cavarzere Porto Levante	8.00	
Italy	Offshore LNG Toscana	3.75	
Lithuania	Klaipeda	-	3.00
Netherlands	GATE	12.00	
Poland	Swinoujscie	-	5.00
Portugal	Sines REN Atlantico	7.60	
Spain	Barcelona Enagas	17.10	
Spain	Bilbao BBG	7.00	
Spain	Cartagena	11.80	
Spain	Huelva	11.80	
Spain	Mugardos Reganosa FERROL	3.60	
Spain	Sagunto Saggas	8.80	
Spain	Gijon (El Musel); mothballed (7.5 bcm)	-	
UK	Dragon	6.00	
UK	Isle of Grain	20.50	
UK	South Hook	21.20	
UK	Teesside Dockside	4.20	
EU	Total capacity	184	192

Source: GIIGNL 2011, 2012 and 2013 and project homepages.

[32] http://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/ec/141749.pdf, p. 10

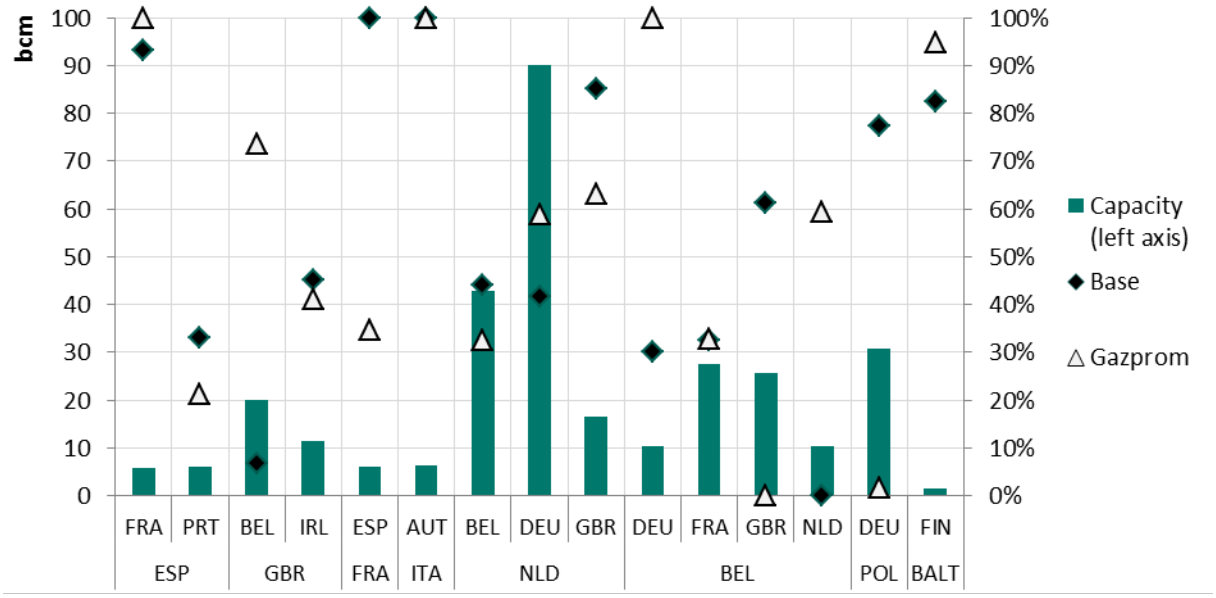

Figure 24: Pipeline capacities (left axis) and export utilization rates from LNG importing countries, in bcm and percentages.

It should be noted that EU countries compete with other world regions for limited international LNG supply. This can be seen when relating the current worldwide LNG import capacity of around 900 bcm to the global LNG export capacity of only 360 bcm (cf. GIIGNL, 2013). As the USA are expected to become a net exporter of LNG as of 2016 (cf. EIA, 2014b), the Asia-Pacific region is and will remain the main competitor to the EU for international LNG supply.

In the *Gazprom* scenario one can observe an increase in global LNG supply by 3.5% and a pronounced shift of LNG trade flows from Asia toward the EU. These reduced LNG flows toward Asian consumers (-37 bcm) are partly backed by an increase in Asian pipeline imports from Russia (+6 bcm relative to the *Base Case*) and the Caspian region (+23 bcm).

5.4.4 Changes in the Russian Supply of Natural Gas

In both disruption scenarios, one can observe the following pattern for Russia: exports are lower than in the Base Case (by 16% in UKR Disruption, and 30% in Gazprom), domestic consumption increases to a lower extent (by 3%, and 14% respectively) such that overall production is reduced (by 2%, and 10% respectively). Figure 25 illustrates these patterns.

This also shows the limited export possibilities of Russia with available capacities in 2015. For instance, the (East) Russian LNG export terminal in Sakhalin is completely utilized in the *Base*

Case already, and an increase of LNG exports is no alternative to the shortfall in exports toward Europe. Pipeline exports toward Asia, on the other hand, are limited by capacity and compete with exports from the Caspian region.

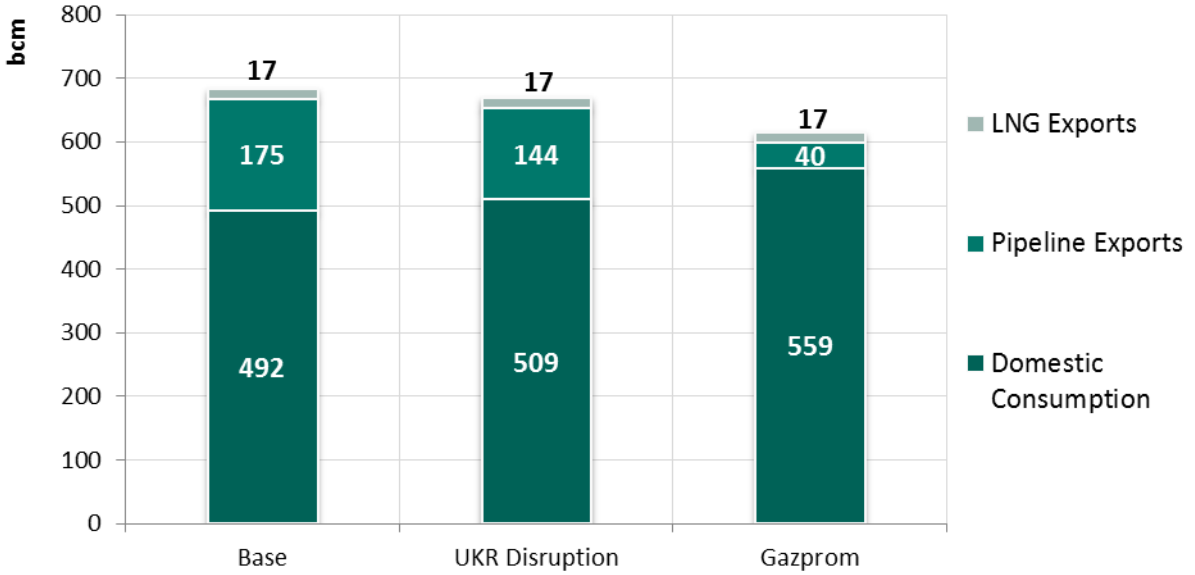

Figure 25: Supply structure of Russian production in 2015 across scenarios, in bcm.

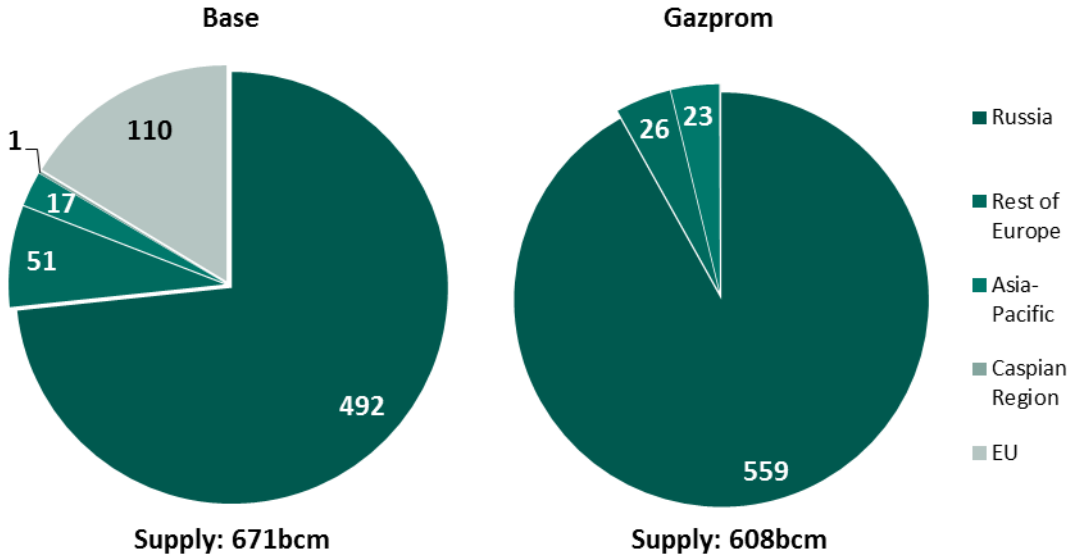

Figure 26: Consumption of Russian natural gas by region in 2015, in bcm.

Hence, one can observe a shift in the destination of Russian natural gas toward domestic consumption due to a lack of attractive export alternatives. See Figure 26. This, of course,

means a substantial reduction of revenue, both for Gazprom and for Russia (in form of profit tax, mineral extraction tax and export tax).

A similar pattern arises for the Caspian region, which is limited in its export possibilities (via Russia) toward Europe. Production is lower in the disruption scenarios in 2015 relative to the *Base Case*, while consumption increases. All other world regions are affected in order to cope with the shift in natural gas flows and the reduced supply of Russian natural gas on the world market. Exports are increased at the expense of domestic consumption (e.g. in Africa, where consumption is reduced by 9% in the *Gazprom* scenario). Global production patterns, depicted in Figure 27, show a significant (relative) increase in Africa, the EU and Rest of Europe to partly balance the reduction in Russia and the Caspian region.

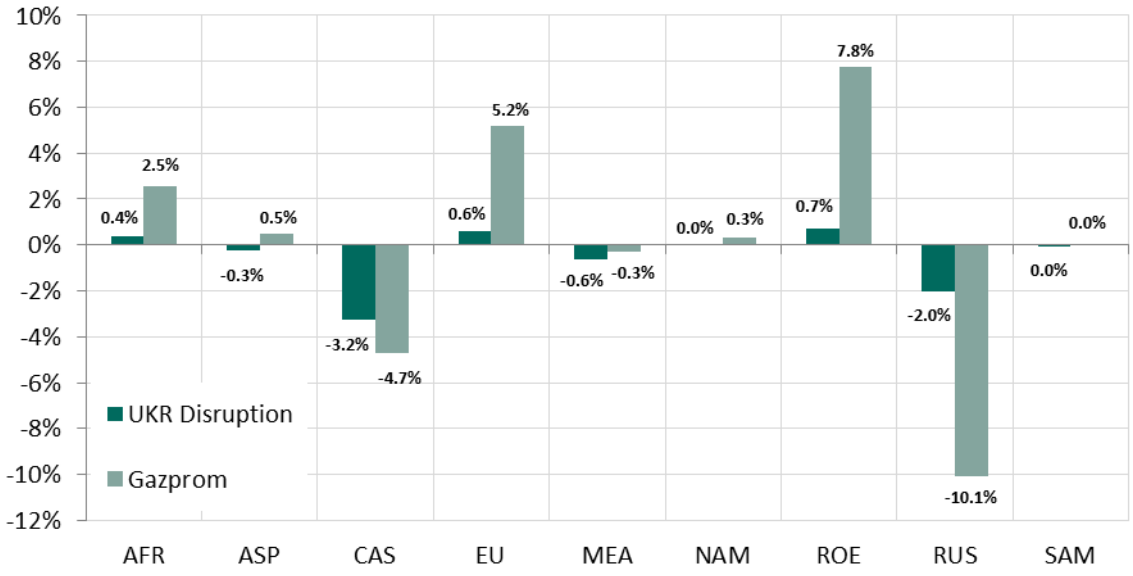

Figure 27: Change in production relative to the Base Case (in 2015), in percentages.

6 Summary and Conclusions

The disturbance of the European-Russian relations and the political destabilization of Ukraine have revitalized considerations by the EU, the Member States, and Ukraine about the security of energy supply, in particular the potential threats of natural gas supply interruptions by Gazprom, the Russian natural gas export monopolist. This study analyzes different aspects of European natural gas supply and the role of Russia and Gazprom therein, with

a focus on European policy to increase resilience against physical supply shocks; it also addresses the issue of Ukrainian energy supply dependence, which can be considered the most critical aspect in the coming years.

Energy supply security is a relative concept that encompasses the resilience of a country against short-term supply disruptions (short-term) and the longer-term adaptation process of both supply and demand patterns (e.g. higher energy efficiency). This study focusses on potential short-term supply disruptions but also suggest longer-term adaptations of the concerned countries' energy systems.

Gazprom still controls the largest part of natural gas production in Russia, and produced ca. 75 % of total Russian production of 600 bcm. Total exports have been rather constant over the past decade, somewhat below 200 bcm/a, 60 % of which went to non-CIS countries in 2013. The "Russian Energy Strategy 2030" foresees a further increase in natural gas in production (towards 1000 bcm), domestic consumption (towards 650 bcm) and exports (towards 350 bcm).

All natural gas security indicators show a steep reduction from East to West with respect to dependence upon natural gas supplies from Russia. Ukraine currently depends to two thirds upon natural gas from Russia, while this ratio is 100 % or close for Belarus and the East European countries Finland, Estonia, Latvia, Lithuania, Slovakia, Czech Republic, and Bulgaria. Other countries in the region are also heavily dependent, like Poland (53 %), Serbia (65 %), Greece (60 %), and Austria (61 %). On the contrary, "Western" European countries are much less dependent on Russian gas, such as Germany (31 %), Italy (25 %), and France (16 %), and they have much easier conditions to diversify their supplies.

Over the last two decades, Gazprom has invested significantly in trading, distribution, pipeline, and storage activities all across Europe. It controls large shares, or even ma-jority shares, in many East European countries. Gazprom owns distribution activities in the Baltic countries and Finland, pipeline transportation shares all over Eastern Europe, Turkey, Germany, in the UK interconnector, Poland, and Serbia, and under-ground storage facilities in Austria, Germany, Latvia, and Serbia, with projects under way in the Czech Republic, the Netherlands, and the UK.

Several legal cases between the EU and Gazprom render the natural gas supply even more complicated. The European Commission has opened formal proceedings against Gazprom about the potential abuse of its dominant position in upstream gas supply markets in Central and Eastern European Member States. In this context, the EU threatens to boycott the plans of the South Stream natural gas pipeline through the Black Sea, in which six EU Member States have a stake. Should the political tensions rise, the entire EU-Russia energy dialogue and cooperation projects are at stake.

A model-based analysis of two supply disruption scenarios confirms that the real threat potential of Gazprom lies in Ukraine (and Belarus) and Eastern Europe, and much less in Central and Western Europe. The Global Gas Model (GGM) is used to simulate two scenarios against a base case: i) In a Ukraine-disruption scenario, all pipeline connects to Ukraine are interrupted, whereas ii) in a Gazprom-infrastructure scenario all infrastructure that is majority-owned by Gazprom is interrupted. Mainly Eastern neighbors of Russia are severely affected in the Ukraine-disruption scenario: Romania, Croatia, Hungary and – primarily – Ukraine.

By contrast, West European countries have multiple options of diversification and much lower impact. Cuts of imports from Russia can be compensated by own production, LNG imports, and a reduction of natural gas consumption. However, a disruption causes slightly higher gas prices and might also cause further economic impacts (on GDP etc.), which we do not measure in this study. In the medium term, the imports could be further reduced by a more efficient use of natural gas pipeline network and the extension of some pipeline capacity, e.g. from Spain to France and on to Northwest Europe. Our model results further underline currently limited opportunities for Russia to diversify its exports in the short term because construction of long-planned pipelines to China has not started yet.

The EU and the Member States should continue to take an active approach to improve the resilience against politically motivated supply interruptions. In the short-term, additional infrastructure to diversify supplies in the critical East European region is necessary, such as reverse flow options and the completion of LNG-terminals, etc. Member States can introduce national or (cross-border) “strategic gas reserves” for several days, in addition to the measures already prescribed in the Natural Gas Supply Security Directive. Complementary measures may need to be taken for particularly vulnerable consumer groups, e.g. large hous-

ing districts or industrial complexes, that currently rely solely on imported natural gas. Domestic natural gas production from fracking is unlikely to play a major role in most EU countries due to political objections or insufficient geological conditions.

In the medium-term, the EU and the Member States should work towards a reduced exposure to natural gas imports, in the context of a coherent low-carbon energy and climate strategy, involving increased efficiency, the further decarbonization of the energy system, and a more systematic use of renewable energy sources. East European countries need support to convert their inefficient and fossil-dependent energy systems to more flexible and more efficient systems. The major challenge appears to be the restructuring of Ukrainian energy system, both with respect to domestic energy consumption and a diversification of energy imports.

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8 Appendix

Table 13: Natural gas statistics for Europe, in bcm

Country	Imports from Russia	Total Imports	Domestic Production	Consumption*	Imports from Russia/ (production + total imports)	Share Natural Gas of TPES
Austria	8	12	2	9	61%	23%
Belgium	0	21	0	17	0%	25%
Bulgaria	2	2	0.4	3	85%	14%**
Croatia	0.4	1	2	3	12%	30%**
Czech Republic	7	7	0.2	8	97%	16%
Denmark	0	0.3	6	4	0%	20%
Estonia	0.6	0.7	0	0.7	100%	10%
Finland	4	3	0	4	100%	9%
France	7	45	0.5	44	16%	15%
Germany	31	88	12	82	31%	22%
Greece	3	5	0	4	60%	15%
Hungary	4	8	2	10	34%	36%
Ireland	0	4	0.4	5	0%	30%
Italy	19	68	9	75	25%	39%
Latvia	2	2	0	2	100%	29%**
Lithuania	3	3	0	3	100%	37%**
Luxembourg	0.3	1	0	1	24%	26%
Netherlands	3	26	80	46	3%	42%
Norway	0	0	115	6	0%	17%
Poland	10	12	6	18	53%	14%
Portugal	0	5	0	5	0%	18%
Romania	2	3	11	14	18%	31%**
Slovakia	5	5	0.2	5	97%	26%
Slovenia	0.4	0.9	0	1	45%	36%
Spain	0	35	0	32	0%	23%
Sweden	0	1	0	1	0%	2%
Switzerland	0	4	0	4	0%	12%
United Kingdom	0	50	41	78	0%	35%
EU	**112**	**302**[#]	**173**	**475**	**24%**	**23%**
Ukraine	32	32	20	54	62%	37%**
Belarus	20	20	0.2	20	99%	58%

Sources: IEA (2013b) and IEA (2013c).: for OECD-countries consumption is calculated based on mass accounting, for NON-OECD countries values reflect observed consumption. Data for countries labeled with ** is for 2011 .[#] EU imports are calculated as the difference between consumption and domestic production.*
EU: all member states without Malta and Cyprus