European Natural Gas Supply Secure Despite Political Crises

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

Natural gas is a significant contributor to European energy supply. Hence, the political crisis between Russia and Ukraine increases fears of the consequences of Russia suspending natural gas supplies to Ukraine and the European Union. The last time this had occurred was in the winter of 2009 when Russia and Ukraine disputed about the price of natural gas and transit costs. However, the European Union has subsequently increased the security of its gas supply. Progress has been made in implementing the measures proposed by the European Commission, particularly the diversification of supply sources and the expansion of natural gas infrastructure to secure supply from various countries. The opportunities to ease temporary supply bottlenecks have improved significantly within the Union in recent years. Nevertheless, Russia remains a major supplier of natural gas to the EU. The Russian gas company Gazprom plays a key role in Eastern Europe and is also gaining importance in Germany. However, this dependency is not a one-way street: Russia generates high export revenues from its natural gas trade and currently has few alternatives to exporting to the EU.

Model calculations by DIW Berlin show that Europe can largely cope with a supply disruption by Russia via Ukraine. Some Eastern European countries, however, would struggle to fully offset a complete suspension of Russian supply. To further increase supply security in Europe in the medium term, it will be necessary to continue diversifying gas supplies, particularly by making more efficient use of existing infrastructure, and expanding pipelines and capacity to import liquefied natural gas. Additionally, Europe should consider setting up strategic gas reserves. Another important step would be to continue to improve energy efficiency in all sectors and consistently expand renewable energy sources as part of the European energy and climate strategy.

As of end July 2014, it is unclear how the open conflict between Russia and Ukraine will develop and to which extent the Russian natural gas supply to Europe will be affected. In light of this, there is a particular focus on identifying alternatives to natural gas supply from Russia and on ways to reduce demand and increase energy efficiency. Nowadays, the Central and Western European countries can be more relaxed about temporary supply disruptions compared to the situation some years ago. Nevertheless, such a disruption would have a significant short-term impact on the Eastern European countries in the EU, such as Estonia, Latvia, Lithuania, and Bulgaria, and, of course, also Ukraine.

The prevailing geopolitical tensions threaten to damage the good, long-standing, and mutually beneficial relations between the EU and Russia. Almost one quarter of the EU's natural gas consumption is imported from Russia; in turn, the Russian economy depends heavily on exports of and other raw materials. Russia currently has no alternative to exporting its natural gas to the EU, due to lack of infrastructure, for example to China.

In connection with the EU-wide debate on adaptation strategies, the recent proposal by the Polish government for a European Energy Union is based, among other things, on the idea of jointly purchasing natural gas, promoting domestic fossil resources, and completing the internal market (see Box 1).[1] The reasoning behind the proposal is that the majority state-owned Gazprom company can exert market power on the design of contracts and charge very different prices for natural gas.[2] The Polish vision of an Energy Union has been well received by some EU member states but has also been target for criticism from the European Commission and others. This criticism refers largely to the incomplete

1 The Polish proposal is available online at www.energypost.eu/roadmap-towards-energy-union-europe/.

2 This is especially problematic if the supply contracts contain what are known as destination clauses.

Box 1

The European Energy Union: A (Not Entirely New) Idea Causes Controversy

In mid-April 2014, the Polish Prime Minister Donald Tusk presented a proposal for an EU Energy Union[1] which the member states of the European Union become the subject of controversial debate, particularly in terms of security of supply. The initiative aims to deepen cooperation on energy policy between a number of EU countries, especially with regard to jointly purchasing fossil fuels from non-member countries, promoting domestic fossil fuels (mainly coal and natural gas, including shale gas), and accelerating completion of the internal market for natural gas. Other important components of the proposal include solidarity mechanisms between neighboring EU countries and diversifying sources of supply.

Bearing in mind that Russia and natural gas giant Gazprom frequently offer very different contracts to the individual EU countries, sometimes with anti-competitive clauses for gas sales and pricing, it makes sense for the EU to coordinate more closely in order to achieve greater supply security. The proposal for a European Energy Union has therefore received a positive response from some European capitals; among others, German Chancellor Angela Merkel supports the initiative "in principle."[2] However, a more detailed analysis reveals that the initiative is primarily an attempt to allocate additional financial resources to countries with a high proportion of fossil energy resources for the development of these resources—this includes coal in Poland. This clearly contradicts climate targets pursued at the European level. A further criticism is the lack of any reference to other objectives from the European energy and climate change package, including the further deployment of renewable energies and improving energy efficiency.

The current thrust toward an Energy Union is not the first in the recent history of European energy policy: the former President of the EU Commission Jacques Delors proposed a "European Energy Community" in 2010 which also envisaged greater coordination of joint natural gas purchases.[3] In addition, this proposal was focused more on creating an internal market for a sustainable, low-carbon energy economy. Other attempts to form an "Energy Community," for example, a "European Community for Renewable Energy (ERENE)," had similar objectives.[4]

It remains to be seen whether the Polish proposal for a European Energy Union is destined to last longer than its predecessors. Certainly, the current EU Energy Commissioner Günther Oettinger flatly rejected the idea in his final days of office and pointed out that the proposed regulations had already been widely adopted at the EU level.[5]

1 The Polish proposal is available to download online at www.energypost.eu/roadmap-towards-energy-union-europe/.

2 See "Merkel unterstützt Tusks Energieunion," Wirtschaftswoche-online, April 25, 2014, www.wiwo.de/politik/europa/energiepolitik-merkel-unterstuetzt-tusks-energieunion/9808990.html.

3 www.notre-europe.eu/media/europeanenergycommunity-andoura-hancher-vanderwoude-ne-march10.pdf?pdf=ok.

4 www.erene.org/web/149.html.

5 "Oettinger erteilt Energieunion Absage," Frankfurter Allgemeine Zeitung (FAZ), May 15, 2014, www.faz.net/aktuell/wirtschaft/wirtschaftspolitik/eu-energiekommissar-oettinger-erteilt-energieunion-absage-12939975.html.

implementation of regulations already in place, such as the third Internal Gas Market Directive[3] and the Regulation on the security of gas supply.[4] Furthermore, the Polish proposal appears not compatible with the objectives of the European energy and climate change package proposed in January 2014, in particular, with regard to CO_2 reduction targets, the expansion of renewable energy, and energy efficiency improvements.[5]

3 Directive 2009/73/EC of the European Parliament and of the Council of July 13, 2009 concerning common rules for the internal market in natural gas and repealing Directive 2003/55/EC, eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:211:0094:0136:en:PDF.

4 Regulation (EU) No. 994/2010 of the European Parliament and of the Council of October 20, 2010 concerning measures to safeguard security of gas supply and repealing Council Directive 2004/67/EC, eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:295:0001:0022:EN:PDF.

5 C. Kemfert, C. Lorenz, and C. von Hirschhausen, "Europäische Energie- und Klimapolitik braucht ambitionierte Ziele für 2030," Wochenbericht des DIW Berlin, no. 10 (2014): 175–185.

Box 2

Strategic Investments by Gazprom in the European Natural Gas Industry

To date the Russian gas giant OAO Gazprom has an export monopoly on natural gas. Over the past 25 years, through its various subsidiaries, Gazprom has bought shares in a variety of pipelines and gas storage facilities in the natural gas industry in Eastern and Western Europe. This forward integration follows the economic rationale of getting closer to markets and customers. But the Russian state is also pursuing political strategic objectives through Gazprom. This is particularly evident in its pricing policy which is determined by political factors: for example, after the overthrow of President Yanukovych and the annexation of Crimea by Russia, the price of natural gas for Ukraine was pushed up from a "friendship price" of 280 US dollars per thousand cubic meters to a monopoly price of 485 US dollars per thousand cubic meters.

Gazprom has invested widely in natural gas supply in a number of countries, including Slovakia, Romania, Bulgaria, and Hungary.[1] It controls export pipelines to Central and Western Europe and also has holdings in the national pipelines of almost all Eastern European countries as well as in Austria, Germany, and Italy. Moreover, Gazprom has stakes in the natural gas storage infrastructure: it has already invested heavily in Latvia, Austria, and Serbia and plans to purchase additional storage facilities in the Czech Republic, the Netherlands, and the UK.

Gazprom has been particularly active in Germany since reunification: it owns a comprehensive transport and storage infrastructure, until recently jointly with Wintershall but now as sole owner.

1 F. Holz et al., "European Gas Infrastructure: The Role of Gazprom in European Gas Supplies," DIW Berlin, Politikberatung Kompakt, no. 81 (2014), study commissioned by the Greens political group in the European Parliament.

In a recent study, DIW Berlin examined the importance of Russian natural gas exports to Europe and the role of the Russian natural gas company Gazprom (see Box 2).[6] The present report is based on the findings of this analysis as well as on many years of research conducted by DIW Berlin on the issue of supply security.[7]

Previous Experience: How Can Security of Supply Be Increased?

Countries particularly affected by the temporary interruption of Russian gas supplies to Europe via Ukraine in 2009 were those that were unable to bridge short-term supply shortages due to poor connections with the European gas network and low storage capacity, such as Bulgaria. To tackle such supply disruptions, in October 2010, the European Union adopted the Regulation on the security of gas supply. The aim was to complement the isolated precautionary measures taken up until then by individual member states with a more Community-based strategy.

At the time the Regulation was adopted, the European Commission acknowledged the increasing importance of natural gas for European energy supply and the growing dependence on imports due to a decline in domestic production. As a result, the EU tends to be vulnerable to supply disruptions. This applies all the more because some member countries, such as Estonia, Latvia, and Lithuania, are effectively gas islands due to lack of infrastructure links: they completely rely on natural gas supplies from Russia. Against this background, the Commission proposed a series of supply-side measures, including:

- Diversifying supply routes and sources inside and outside the Union and, thus, investing in capacity for liquefied natural gas (LNG),
- Expanding cross-border connecting pipelines with the added option of reverse flows,
- Increasing storage capacity for natural gas.

In addition, as part of an emergency plan, strategic gas stocks or strategic minimum stocks of mineral oil as an alternative fuel could be used. It should also be possible to order a change to different fuels, the interruption of contracts where possible, and the exclusion of customers from supply. For "protected customers"—mainly private households—natural gas companies must safeguard supply for 30 days even under extreme conditions.

6 F. Holz et al., "European Gas Infrastructure: The Role of Gazprom in European Gas Supplies," DIW Berlin, Politikberatung Kompakt, no. 81 (2014), study commissioned by the Greens / European Free Alliance in the European Parliament.

7 H. Engerer, M. Horn, and A. Neumann, "Bei erneutem Gasstreit zwischen Ukraine und Russland: Wäre Europa jetzt gewappnet?," Wochenbericht des DIW Berlin, no. 2 (2010); C. von Hirschhausen et al., "Supply Security and Natural Gas," in F. Lévêque et al. (eds.): Security of Energy Supply in Europe: Natural Gas, Hydrogen, and Nuclear (Cheltenham: 2009).

In recent years, the European Union has made progress in developing its natural gas infrastructure. Further expansion plans, as specified in the Third Energy Package, are presented each year by the European gas network operators at both national and European level in their Ten-Year Network Development Plans.[8] Although these plans do not constitute binding timetables for expanding the pipeline and liquefied natural gas infrastructure, they give the industry, regulators, and policy-makers an indication of further investment needs.

The infrastructure developments implemented in recent years were an important step toward making gas flows within the Union more flexible and improving intra-European deliveries in the event of a crisis. Disruptions in supply can still not be ruled out for individual regions of Eastern Europe but the EU is now less vulnerable to crises.

Almost a Quarter of Europe's Natural Gas Consumption Supplied by Russia

According to the International Energy Agency (IEA), in 2012, the European Union imported 112 billion cubic meters of natural gas via pipelines from Russia—this is equivalent to almost a quarter of the EU's total natural gas consumption of approximately 472 billion cubic meters (see Table 1).[9] Russia therefore is the largest supplier of natural gas to the EU although the amount imported varies from country to country:[10] Germany covers about 38 percent of its consumption with natural gas from Russia which corresponds to 35 percent of all German natural gas imports (see Figure 1). The Eastern European countries of the EU are heavily dependent on imports from Russia, in particular the Baltic States, the Czech Republic, and Bulgaria. The diversity of supply in these countries has not increased markedly even in recent years. In contrast, Romania, which has its own reserves, and Poland, whose energy supply is mainly based on coal, are less dependent on imports from Russia.

In Western Europe, the UK, Belgium, the Netherlands, and the Iberian Peninsula are hardly or not at all reliant on Russian imports. In France, imports of Russian natural gas only account for 16 percent of total natural gas consumption. Italy, on the other hand, obtains one quarter of its total consumption from Russia, a significantly higher share.

Norway is the second largest supplier to the EU and its natural gas supplies account for one fifth of Europe's consumption, playing a particularly important role in the UK, Belgium, the Netherlands, France, and Germany. The supply through gas pipelines from the North African countries of Algeria and Libya also play a key role, especially in Southern Europe.

Most Russian natural gas exports reach EU countries via three major pipelines: the pipeline through Ukraine, the Yamal pipeline via Belarus, and the Nord Stream pipeline through the Baltic Sea (see Table 2). There are other smaller pipelines, particularly in countries neighboring Russia, such as Finland and the Baltics (Latvia). The importance of Ukraine as a transit country for natural gas supplies from Russia to the European Union has declined in recent years due to the Nord Stream pipeline which provides a direct link between Russia and Ger-

Table 1

Production, Net Imports, and Consumption of Natural Gas in the EU in 2012
In billion m^3

	Production	Net imports	Domestic consumption
Austria	1.9	7.8	9.0
Belgium	0.0	16.7	16.8
Bulgaria	0.4	2.5	2.7
Denmark	6.4	−2.7	3.9
Czech Republic	0.2	7.5	8.3
Estonia	0.0	0.7	0.7
Finland	0.0	3.7	3.7
France	0.5	42.7	44.1
Germany	12.3	69.6	82.1
Greece	0.0	4.5	4.5
Hungary	2.2	7.3	10.2
Ireland	0.4	4.4	4.7
Italy	8.6	67.6	74.9
Latvia	0.0	1.7	1.5
Lithuania	0.0	3.3	3.4
Luxembourg	0.0	1.2	1.2
Netherlands	80.1	−34.3	46.0
Poland	6.2	12.2	18.1
Portugal	0.0	4.6	4.6
Romania	10.6	2.9	13.6
Sweden	0.0	1.1	1.1
Slovakia	0.2	4.8	5.3
Slovenia	0.0	0.9	0.9
Spain	0.1	32.3	32.5
UK	41.1	37.1	78.3

Sources: IEA, Natural Gas Information 2013, OECD/IEA, Paris; IEA, Natural Gas Information Statistics, Online Database, OECD/IEA, Paris.

Most EU member countries are net importers of natural gas.

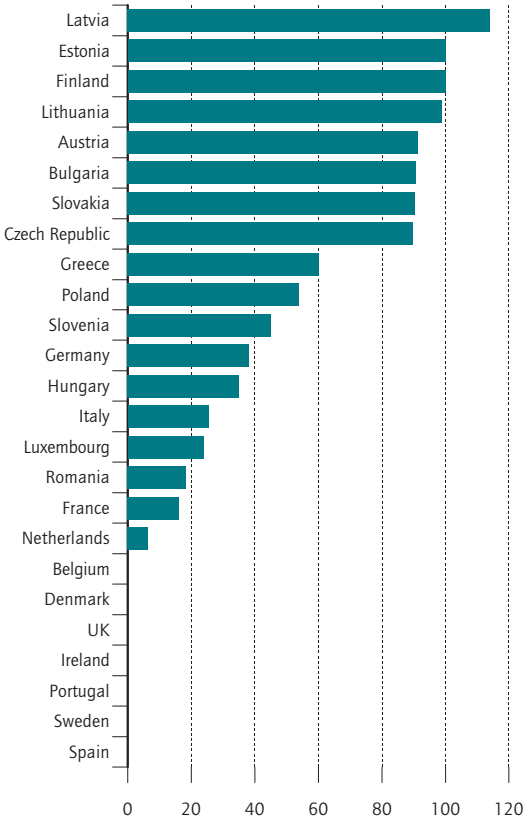
8 See for example FNB Gas, Netzentwicklungsplan Gas 2013 der deutschen Fernleitungsnetzbetreiber (2013); and ENTSO-G, Ten-Year Network Development Plan (TYNDP) 2013–2022 (Brussels: 2013).

9 International Energy Agency, Natural Gas Information 2013 (2013).

10 Malta and Cyprus are not considered in the following, Croatia is only included from 2013, following its accession to the EU.

Figure 1

Share of Imports from Russia in Natural Gas Consumption in 2012
In percentage



Source: IEA, Natural Gas Information 2013, OECD/IEA, Paris.

Russian gas imports most important in Eastern Europe.

Table 2

Export Pipelines from Russia to Europe

Name	From	To	Capacity in billion m³
Ukrainian corridor	Russia	Ukraine	112
	Belarus	Ukraine	25
	Ukraine	Romania, and on to *Bulgaria* *Greece* *Turkey*	36.5
	Ukraine	Hungary, and on to *Serbia* *Bosnia-Herzegovina*	19.5
	Ukraine	Slovakia	83
	Slovakia	Czech Republic	25.5
	Slovakia	Austria	57
	Austria	Italy	37
Yamal-Europe	Russia	Belarus	33
	Belarus	Poland	40
	Poland	Germany	33
Nord Stream	Russia	Germany	55

Sources: Gazprom website; ENTSO-G, The European Natural Gas Network (Capacities at Cross-Border Points on the Primary Market), Brüssel, Juli 2013; Datenbank des Global Gas Model.

There are alternatives to the transit via Ukraine.

many and which has a capacity of 55 billion cubic meters (see map).

If the conflict between Russia and Ukraine were to lead to a temporary disruption in supply, some deliveries could be redirected to the Nord Stream pipeline and the Yamal pipeline via Belarus and Poland (with a capacity of 33 billion cubic meters). Consequently, Germany, as a buyer of gas from all three major Russian pipelines, could reroute some of its Russian imports.

Opportunities for Importing LNG Expanded Significantly

Besides importing natural gas by pipeline, European countries also import LNG by ship from non-European countries, in particular Qatar, Nigeria, and Algeria (see Figure 2). In 2012, 58 billion cubic meters of LNG were imported, which is equivalent to 12 percent of Europe's natural gas consumption. In particular, the UK, Spain, France, and Italy have increased their capacity to import LNG in recent years. By 2013, the EU's total capacity to import LNG had already reached 184 billion cubic meters or almost 40 percent of all gas consumed in the EU (see Figure 3).[11] Further facilities, including in the Baltic States and Poland, with a capacity of over 30 billion cubic meters are currently under construction and should be completed by the end of 2015. This will lead to a substantial increase in European capacity to import LNG.

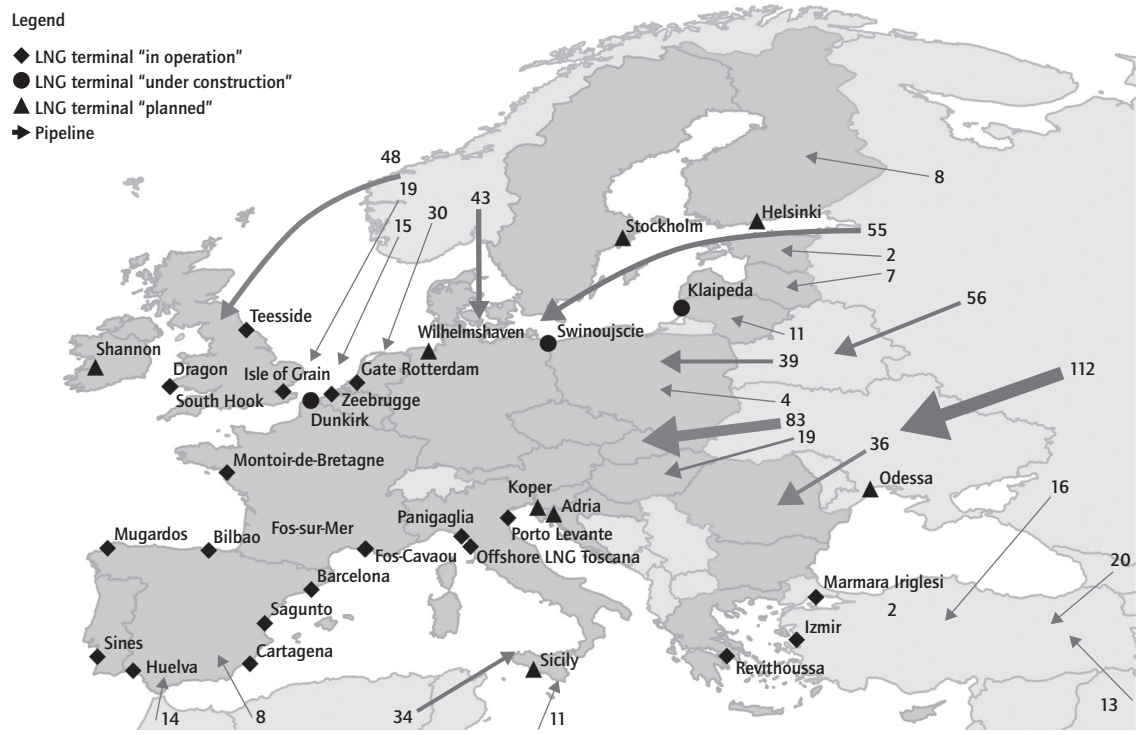
Natural Gas Storage Extensive but Regionalized

By the end of 2012, the European Union had a storage capacity for natural gas of 92 billion cubic meters; this is approximately 12 billion cubic meters more than in 2009. Two-thirds of the storage facilities are exhausted

11 Gas Infrastructure Europe, GLE LNG Investment Database (2013), www.gie.eu/index.php/maps-data/lng-investment-database.

Map

Most Important Pipeline Import Routes to, and LNG Terminals in, Europe
In billion m³

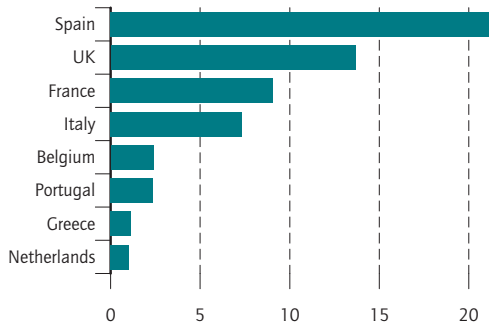


Source: map template by Eurostat; graphic by DIW Berlin, based on GIIGNL (2013); ENTSO-G (2013).

Europe has a variety of options for purchasing its natural gas.

Figure 2

EU LNG Imports in 2012
In billion m³



Sources: IEA, Natural Gas Information 2013, OECD/IEA, Paris.

Spain, UK, France, and Italy all record high LNG imports.

oil and natural gas deposits, almost a fifth are aquifers. More than half of European storage capacity is located in Germany, France, and Italy (see Figure 4 and Table 3).

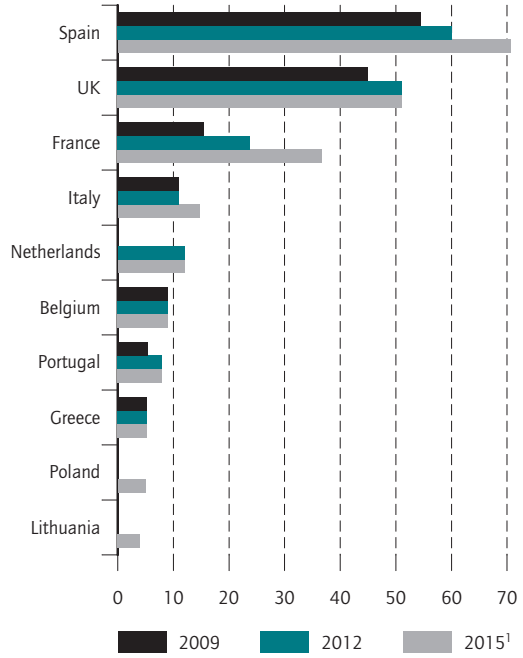
There are also countries with no storage capacity, including Estonia, Lithuania, and Finland, which lack the necessary geological conditions for underground storage; Greece only has small storage capacity at its LNG terminal. Most Eastern European countries failed to expand their storage capacity for natural gas in response to the conflict over natural gas supplies between Russia and Ukraine and the accompanying supply disruptions in winter 2009.[12] Thus, in Eastern Europe, natural gas storage continues to make only a marginal contribution to the region securing its own supply in the short term. The Baltic States are a special case since they

12 For natural gas storage facilities and geological conditions in individual countries see Energy Charter Secretariat, The Role of Underground Gas Storage for Security of Supply and Gas Markets (Brussels: 2010). Bulgaria has poor geological conditions for expanding its storage capacity.

Figure 3

EU Import Capacity for LNG

In billion m³



1 Forecast.

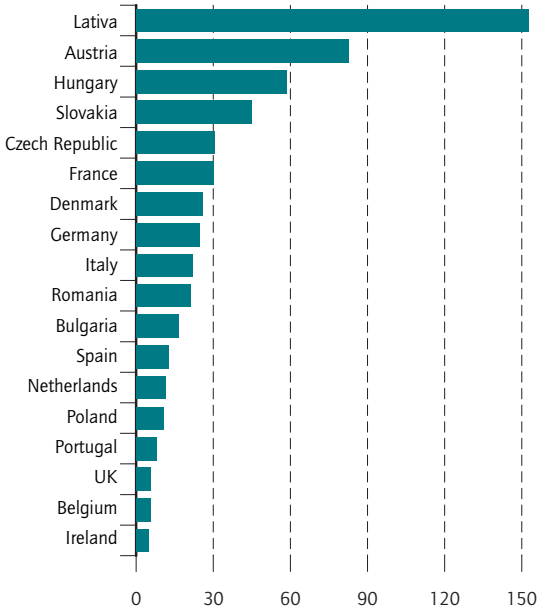
Sources: GIE 2013; GLE LNG Investment Database.

Capacity for LNG imports continues to rise.

Figure 4

EU Natural Gas Storage Capacity as Share of Natural Gas Consumption in 2012

In percent



Source: IEA, Natural Gas Information 2013, OECD/IEA, Paris.

The importance of storage facilities varies among the member states.

Table 3

Storage Capacity at the End of 2012

In billion m³

	Total	Depleted oil and gas fields	LNG storage	Aquifers	Caverns	Other
Austria	7.5	6.5				1.0
Belgium	0.9		0.2			0.7
Bulgaria	0.5	0.5				
Czech Republic	2.5	2.4		0.2	0.1	
Denmark	1.0			0.6	0.4	
France	12.8	0.1	1.0	11.7		
Germany	20.3	9.6		0.9	9.9	
Hungary	6.1	6.1				
Ireland	0.2	0.2				
Italy	16.3	16.3				
Latvia	2.3			2.3		
Netherlands	5.3	5.0	0.8		0.2	
Poland	1.9	1.5			0.4	
Portugal	0.4				0.4	
Romania	2.9	2.9				
Slovakia	2.9	2.9				
Spain	4.1	3.1		1.1		
UK	4.3	3.7	0.1		0.6	
Total	**92.3**	**60.8**	**2.1**	**16.7**	**11.9**	**1.7**

Source: IEA, Natural Gas Information 2013, OECD/IEA, Paris.

Storage capacity for natural gas is regionally concentrated.

are a gas island and, as such, completely dependent on Russian natural gas imports. Latvian storage capacity is also used to supply the other Baltic countries.[13] Germany's share of storage capacity in natural gas consumption is 25 percent, placing it in the mid-range of the EU Member States.

At the beginning of March 2014, storage facilities in the European Union were about half full which was higher than in previous years due to the mild winter. This level corresponds to about one-sixth of annual EU import demand or approximately 40 percent of imports from Russia. After the mild winter, it was possible to bridge supply disruptions of Russian imports for several months during the warm season.[14]

Unlike oil, for which, according to guidelines set by the International Energy Agency, member countries must keep minimum reserves of 90 days' consumption, there are no EU-wide mandatory storage levels for natural gas although some member countries already have strategic reserves in place.[15] It would be worth considering setting up an EU-wide strategic gas reserve. The EU Regulation on security of natural gas supply allows for the possibility of cross-border access to storage capacity and also advocates the expansion of connecting pipelines between the member states. A more efficient use of the existing infrastructure is also essential.

Reverse Flows in Pipelines: Further Expansion Prudent and Feasible

In recent years, additional cross-border pipelines have been built in the EU. At the same time, this has created increased opportunities for reverse flows. Measures adopted by the EU in 2010 stipulated that member states are to create capacity for reverse flows in all cross-border connecting pipelines by the end of 2013 (see Table 4).[16] To a large extent, this measure has now been implemented enabling the Community to respond more flexibly to supply bottlenecks.[17] There is still a need for expansion especially between certain member states in Eastern and South-Eastern Europe; Bulgaria in particular is still poorly integrated into the European network, i.a. due to delays in constructing a connection between Romania and Bulgaria.

Table 4

Direction of Flows in Pipelines between EU Member States in Central and Eastern Europe

From	To	Reverse flows possible?
Austria	Slovenia	yes
Austria	Slovakia	yes
Austria	Hungary	yes
Poland	Germany	yes
Czech Republic	Germany	yes
Slovakia	Czech Republic	yes
Hungary	Croatia	yes
Latvia	Estonia	yes
Latvia	Lithuania	yes
Bulgaria	Greece	**no**
Romania	Bulgaria	**no**
Hungary	Romania	**no**
Slovenia	Croatia	**no**
Czech Republic	Poland	**no**
Poland	Slovakia	No pipeline
Lithuania	Poland	No pipeline

Sources: ENTSO-G, The European Natural Gas Network (Capacities at Cross-Border Points on the Primary Market), Brussels, July 2013; updates by DIW Berlin.

Reverse flows can and should be developed further.

Natural Gas Has Long-Term Key Role in Europe's Energy Mix

The European Commission believes that natural gas will continue to play an important role in Europe's energy mix in the long term. The so-called Reference Scenario until 2050, presented in 2013, assumes a constant proportion of natural gas primary energy consumption of 24 percent.[18] The importance of natural gas in the power sector would decrease in line with a general reduction of energy consumption. In the transport sector too, natural gas consumption is not likely to increase. According to the reference scenario, however, it would retain its importance in the industrial and household sectors.

13 The natural gas supply to the Russian enclave of Kaliningrad is also transported via Lithuania. Consequently, a disruption of Russian supplies to Lithuania is unlikely.

14 Gas Infrastructure Europe, GSE Aggregated Inventory (AGSI+) (2014), transparency.gie.eu.

15 This is the case in Hungary, Romania, Italy, Portugal, and Spain. See United Nations for Europe Commission For Europe, Study on Underground Gas Storage in Europe and Central Asia (Geneva: 2013), 46 ff.

16 Reverse flows involve transporting natural gas against the original direction of the flow. This is made possible by technical additions or upgrading.

17 However, it is uncertain whether reverse flows can be achieved via Slovakia to Ukraine. In addition to low capacity in smaller pipelines, reverse flows could also be established in the main pipeline with up to 30.1 billion cubic meters per annum. However, there are various political problems, see www.nytimes.com/2014/05/05/world/europe/gazprom-seen-stanching-flow-of-gas-to-ukraine.html?_r=0.

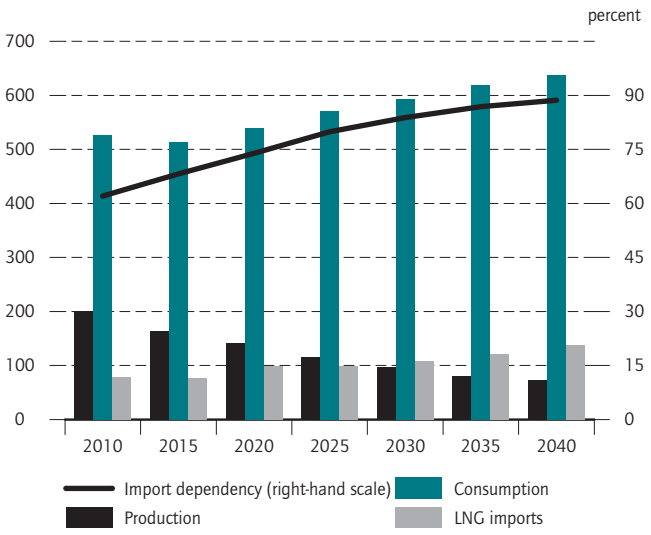
18 European Commission, EU Energy, Transport and GHG Emissions Trends to 2050 – Reference Scenario 2013 (Brussels: Directorates-General for Climate, Energy and Transport, 2013).

In 2011, the European Commission had introduced even more ambitious climate and energy scenarios in its Climate and Energy Roadmaps, with a reduction in CO_2 emissions of 40 or even 80 percent by 2050, compared to 35 percent in the Reference Scenario 2013.[19] A 40-percent reduction in CO_2 emissions would only slightly reduce natural gas consumption. In a scenario with greater decarbonization and an 80-percent reduction of greenhouse gases, the use of all fossil energy sources —including natural gas—in the electricity sector would fall to practically zero. Natural gas would only be used by end consumers, i.e., by industry and households. In this case, consumption could be halved between 2010 and 2050.

Natural gas consumption in the individual EU countries develops very differently due to the availability of domestic fossil resources and the potential of renewables. All scenarios for the UK, the Netherlands and France, for example, include a drop in natural gas consumption, while for countries such as Spain—currently with a rather low share of natural gas—it is assumed there will be an increase in consumption.

Figure 5

EU Natural Gas Sector in Global Gas Model Reference Scenario
In billion m^3



Source: calculations by DIW Berlin.

The import dependency of natural gas will continue to increase with falling domestic production.

European Gas Supply by 2040: More Dependent on Imports, but Fewer from Russia

DIW Berlin's *Global Gas Model* calculates various scenarios for the long-term development of European natural gas consumption and natural gas imports.[20] DIW Berlin's reference scenario takes into account the requirements of the Commission's Energy Roadmap 2050 with its 40-percent reduction in greenhouse gas emissions in Europe, and the 2012 New Policies Scenario developed by the International Energy Agency.

Natural gas production in EU countries has been declining for more than a decade; production from conventional fields is falling and only a small number of new fields are being tapped. 15 years ago, the UK was still one of the largest gas-producing countries in Europe with an annual production of more than 100 billion cubic meters; since 2004, it has been a net importer, now producing less than 50 billion cubic meters annually. Germany's already low production levels have also fallen significantly in recent years and even production in the Netherlands, the largest natural gas producer in the EU, is expected to decline significantly in the coming years.[21]

This long-term trend is likely to continue (see Figure 5). Only the Netherlands and Romania within the EU and Norway outside the EU are expected to produce natural gas after 2040. Even the exploitation of shale gas deposits, such as in Poland, could, at best, delay this development. Due to uncertain resource estimates, the high production costs of extracting shale gas, and the strict environmental regulations, significant unconventional production in Europe is rather unlikely at the moment.[22]

Stagnating and even declining natural gas consumption in the European Union after 2030 will mean that it will have to rely on importing more than 80 percent of its natural gas consumption. Many EU countries will further diversify their natural gas imports by importing LNG and through new pipelines connections. This

19 European Commission, Energy Roadmap 2050, COM(2011)0885 final, (Brussels: 2011); and Roadmap for Moving to a Low-Carbon Economy in 2050, COM/2011/0112 final (2011).

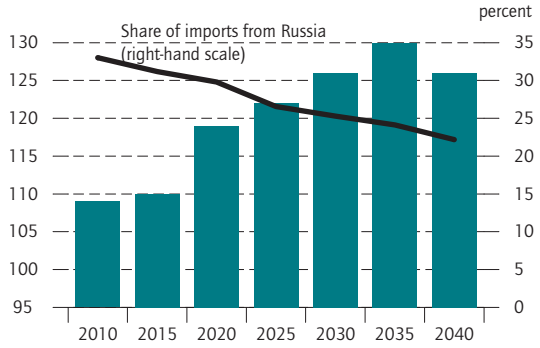
20 See also F. Holz, P. M. Richter, and C. von Hirschhausen, "Structural Shift in Global Natural Gas Markets–Demand Boom in Asia, Supply Shock in the US," DIW Economic Bulletin, no. 11.12 (2013); F. Holz et al., "The Role of Natural Gas in a Low-Carbon Europe: Infrastructure and Regional Supply Security in the Global Gas Model," DIW Discussion Paper, no. 1273 (Berlin: 2013); and P. M. Richter, "From Boom to Bust? A Critical Look at US Shale Gas Projections," DIW Discussion Paper, no. 1338 (Berlin: 2013).

21 IEA, Energy Policies of IEA Countries - The Netherlands (2014).

22 F. Holz et al., "The Role of Natural Gas in a Low-Carbon Europe: Infrastructure and Regional Supply Security in the Global Gas Model," DIW Discussion Paper, no. 1273 (Berlin: 2013)

Figure 6

European Natural Gas Imports from Russia
In billion m³

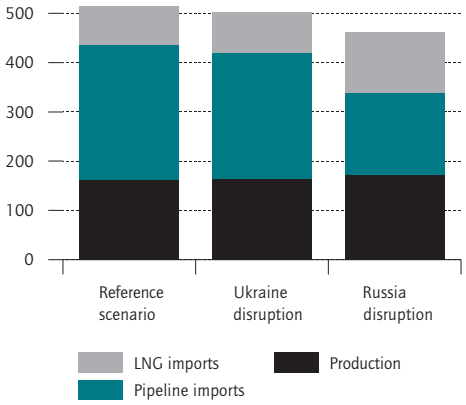


Source: calculations by DIW Berlin.

The percentage of imports from Russia will fall.

Figure 7

Structure of European Gas Supply in 2015 by Scenario
In billion m³



Source: calculations by DIW Berlin.

To a great extent, any disruptions to Russian imports can be overcome...

applies particularly to those countries in Eastern Europe that are currently heavily dependent on Russian imports. Accordingly, Russia's share of European natural gas imports should decline in the coming decades (see Figure 6).

A further expansion of reverse flow capabilities in Eastern European countries will improve their integration into the European network and provide access to natural gas from Western and Northern Europe (Norway). Previous import countries in Western Europe will then become transit countries for gas supplies, in particular toward Eastern Europe. Consequently, Germany could pass on a portion of its direct imports from Norway and Russia (Nord Stream pipeline) toward Eastern Europe to Poland, the Czech Republic, and Austria.

Construction of Non-European Pipelines Progressing

Moreover, the Eastern European EU countries will open up sources of supply outside the EU itself, both of LNG and of natural gas via pipelines. For example, the construction of a LNG terminal in Świnoujście (Poland) is almost complete; in Lithuania a floating LNG terminal will be commissioned in fall 2014 (in Klaipėda). In South-Eastern Europe, the southern gas corridor has replaced original plans to construct the Nabucco pipeline. Even before 2020, natural gas from the Caspian Sea (Azerbaijan) will be delivered via Turkey to Greece, and potentially the Balkan Peninsula as well. The findings from DIW Berlin's model suggest that this corridor should be further expanded in the coming years to satisfy stable to increasing demand from South-Eastern Europe.

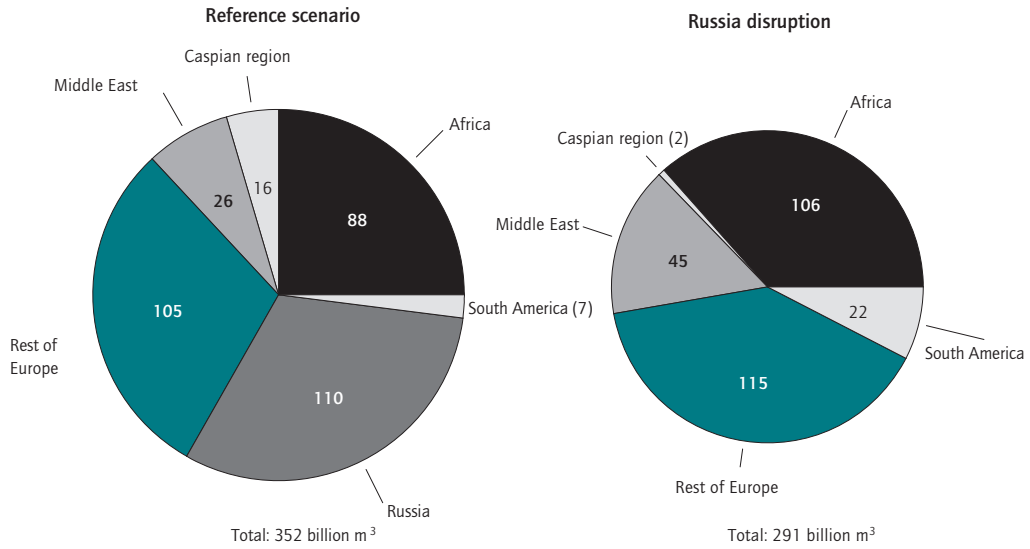
Overall, the model calculations for Europe show stable, slightly increased natural gas consumption in the coming decades, which will mainly be covered by imports through pipelines. Even if there is a rising dependence on imports, natural gas supply will be secured through a greater diversification of sources and supply routes.

In the long term, the importance of Europe's demand for natural gas in the global natural gas market will fall and the importance of emerging Asian economies, such as India and China, will rise. LNG exports to Asian countries will increase in the coming decades. In addition, new pipelines will improve connections between the Asian market and traditional suppliers, such as between China and Russia. However, more than half of Russia's natural gas exports will still go to Europe until 2050, depending on the scenario. As a result, Europe will remain an important market for Russia.

Europe's LNG imports will initially rise and then remain constant from 2020 onwards. Nevertheless, the LNG import terminals will play an important role with regard to security of supply: they enable short-term imports of natural gas if there are delivery problems through pipelines.

Figure 8

Composition of European Imports by Supplier in 2015
In billion m³



Source: calculations by DIW Berlin.

...by supplies from North Africa and Norway.

Opportunities for Short-Term Diversification

Using its *Global Gas Model*, DIW Berlin has examined two potential scenarios for 2015 in which imports of natural gas from Russia are disrupted.[23] Both scenarios are deemed possible given the current crisis. The model calculations are therefore based on projected values for the coming year and on infrastructure projects currently under construction. This includes, for example, the South Stream connection between Russia and Bulgaria with a small initial capacity of 15 billion cubic meters.

The scenario calculations provide an insight into the importance of imports from Russia for gas supply to individual European countries, as well as current diversification options, given the existing supply infrastructure:

- In the *Ukraine Disruption scenario*, Russia interrupts supplies to and through Ukraine;
- In the *Russia Disruption scenario*, Russia interrupts its entire natural gas exports to Europe (including Turkey, but excluding Belarus which is in a customs union with Russia).

Particularly in the *Russia Disruption scenario*, the European Union's entire natural gas consumption will decrease significantly, primarily in Eastern European member states which do not yet have sufficient alternative sources of supply and the infrastructure in place. In the *Ukraine Disruption scenario*, as expected, the easternmost member states (mainly Hungary, Romania, and Croatia) and Ukraine will be most affected by a lack of access to LNG and reverse flow capabilities. A substantial portion of Russian supply disruptions would be compensated by imports of LNG which would increase by 60 percent in the Russia Disruption scenario (see Figure 7). The additional supplies of LNG could come from South America (mainly Trinidad and Tobago), and from the Middle East or from Africa (Nigeria and Algeria). Natural gas production in Europe could only be increased to a limited degree in the short term (see Figure 8).

Due to limited production and transportation capabilities additional natural gas would be supplied from Norway and North Africa by pipeline. Natural gas producers in the Caspian region (currently including Turkmenistan among others) can only supply natural gas to Europe through the Russian pipeline network—via

23 F. Holz et al., "European Gas Infrastructure: The Role of Gazprom in European Gas Supplies," DIW Berlin, Politikberatung Kompakt, no. 81 (2014), study commissioned by the Greens political group in the European Parliament.; P. M. Richter and F. Holz, "All Quiet on the Eastern Front? Disruption Scenarios of Russian Natural Gas Supply to Europe," DIW Discussion Paper, no. 1383 (Berlin: 2014).

Ukraine—due to existing infrastructure limitations and cannot therefore be considered alternatives to Russia.

Supply Disruptions Have Strongest Impact on Eastern Europe

The Eastern European EU member states of Romania, Hungary, and Croatia, in particular, would be affected by both scenarios in which Russian imports are disrupted as, even with significantly increasing prices, they do not have sufficient access to alternative sources of supply for natural gas due to technical constraints (see Figure 9). These countries would be the only European importers to suffer a decline in consumption of approximately 25 percent if supply via the Ukraine transit pipeline were to be disrupted. For them, the establishment and expansion of reverse flow capabilities and connectivity to other suppliers is of the utmost urgency.

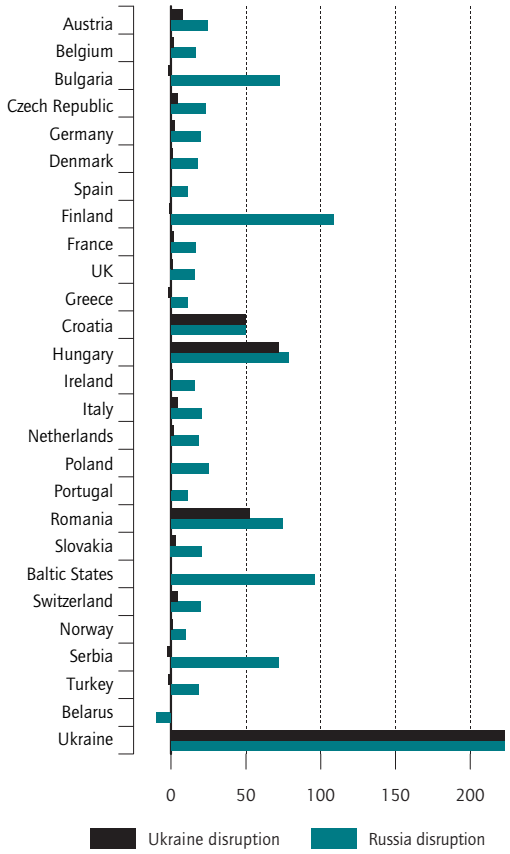
In the *Russia Disruption scenario*, consumption in several countries would decline partly due to strongly increasing prices. As expected, Russia's direct neighbors in the Baltic States and Finland would be subject to the most significant constraints; natural gas consumption would fall markedly in these countries (by approximately 70 percent). Hungary, Croatia, Bulgaria, and Romania would follow with a decline of about 30 percent. But natural gas consumption in Central and Western Europe (Poland, Germany, Austria, the Czech Republic, Slovakia, and Italy) would also fall slightly by approximately 10 percent due to rising prices. Despite currently relying on a large proportion of Russian imports for its supply, this region is able to fall back on alternative sources. Even the traditional transit countries, the Czech Republic, Slovakia, and Poland, now have access to alternative suppliers—partly due to reverse flows.

The extensive import capacity for LNG in Western Europe can only partly compensate for disruptions to supplies from Russia. A large number of regasification plants have been constructed in recent years, particularly in Spain and the UK. However, only limited volumes of natural gas leaving those countries can be transported to Central and Eastern Europe. The capacity of the connection between the Iberian Peninsula and France in particular is still low. Only limited exports are possible also from France eastwards—further evidence of the need to set up more reverse flows for the traditional delivery directions (see Figure 10).[24]

Figure 9

Price Impact of Disruption Scenarios on European Countries

In percentage



Source: calculations by DIW Berlin.

Eastern European countries must expect high price increases.

Conclusions

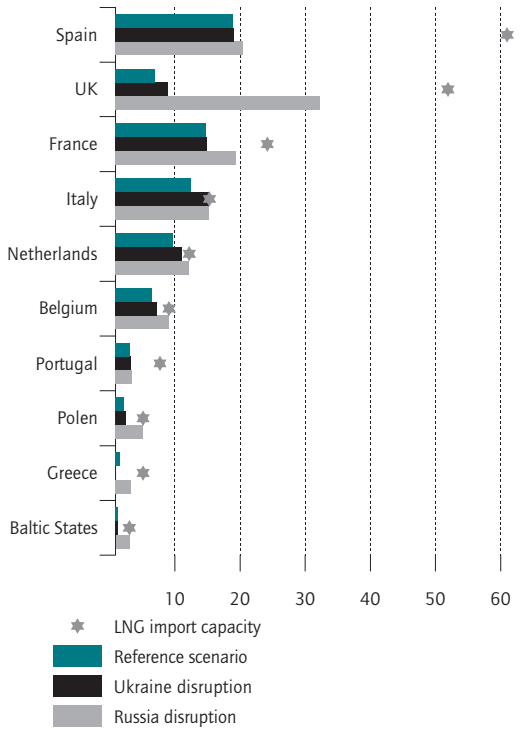
Natural gas is of particular importance to energy supply. Europe covers a large share of its natural gas consumption needs from Russian imports. As a result of political crises, in particular between Russia and Ukraine, the question is to what extent can natural gas supplies to Europe continue to be secured.

In recent years, European countries have made progress in their efforts to diversify sources and supply routes for natural gas and in expanding the internal natural gas infrastructure. However, more needs to be done in some Eastern European countries to secure supply. This could be achieved in the medium term by increasing the

24 See also the decision of the Council of Ministers from March 2014 which states that, "Such interconnections should also include the Iberian peninsula and the Mediterranean area," http://www.consilium.europa.eu/uedocs/cms_Data/docs/pressdata/en/ec/141749.pdf, 10.

Figure 10

EU LNG Imports in 2015: Scenario Comparison
In billion m^3



Source: calculations by DIW Berlin.

LNG could partially compensate for a cutoff in supply.

interconnectedness of the European natural gas infrastructure, by expanding cross-border pipeline connections and reverse flows, and by significantly stepping up construction of the southern gas corridor.

In the short term, the European Union can overcome disruptions to the supply of natural gas; storage capacity has been increased and more opportunities for reverse flows have been created. The EU should continue its efforts to diversify sources and supply routes in the medium to long term. At the same time, it should be noted that natural gas consumption in Europe will stagnate in the long term.

The controversial proposal for a European Energy Union is currently being discussed in the context of supply security. Particularly against the backdrop of Russia and its natural gas giant Gazprom often charging very different prices for natural gas and offering contracts that hinder competition, it would certainly not harm Europe to improve its coordination in respect to supply security.

The Polish proposal for an Energy Union also suggests making greater use of domestic energy sources, especially coal technologies. However, this is not compatible with the Union's medium-term climate objectives.

Europe must focus far more on securing supply by continuing to diversify its energy sources. LNG will play a greater role in the medium term. It is, therefore, important that Europe persists with its expansion of pipeline infrastructure. In addition, a strategic natural gas reserve should be considered in all EU countries.

European natural gas supply is secure in the short term despite the current political crisis between Russia and Ukraine—but for this to remain the case in the long term, energy efficiency should continue to be improved in all sectors and renewable energy sources consistently expanded in the course of the energy transition.

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