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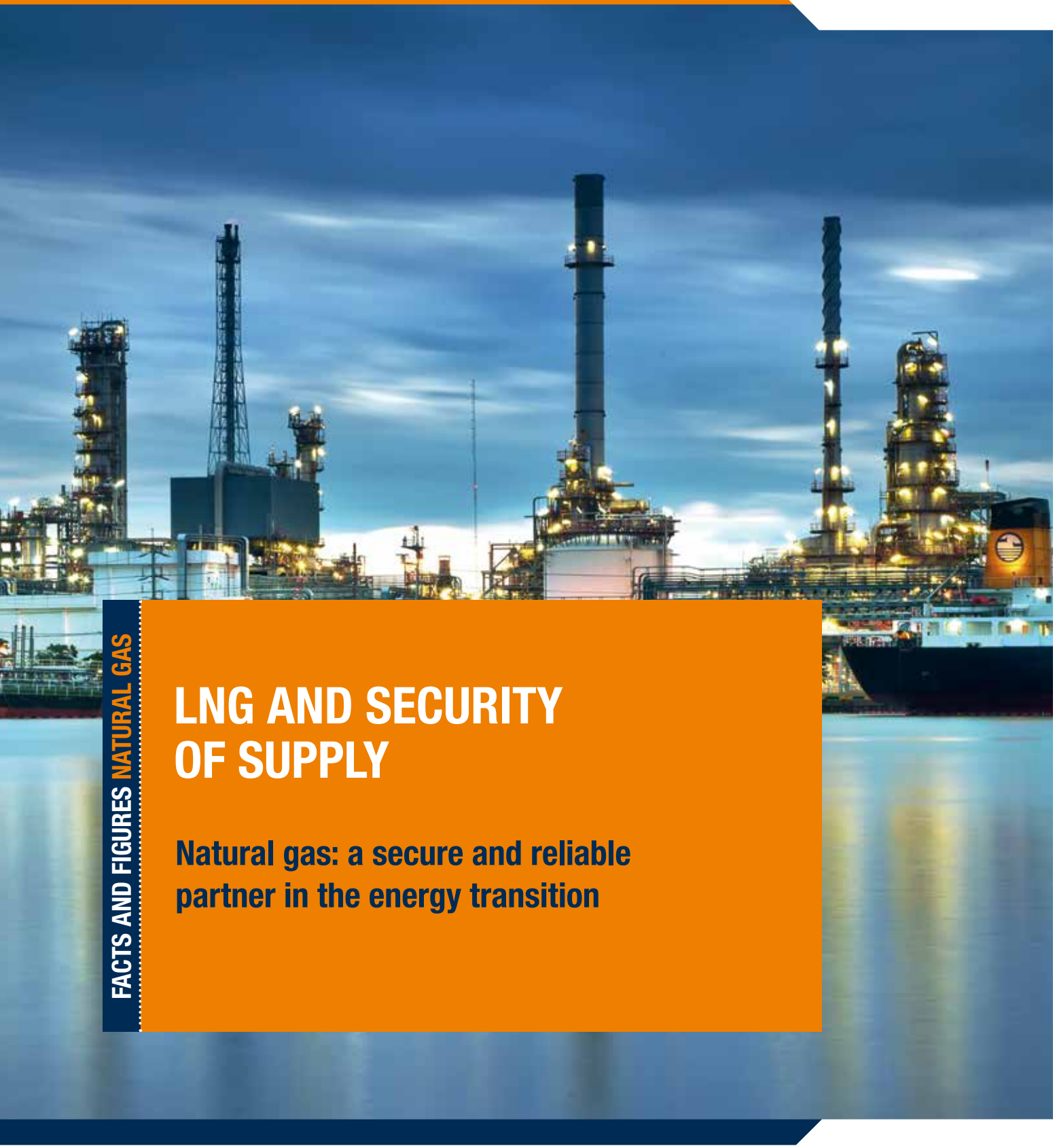

FACTS AND FIGURES NATURAL GAS

LNG AND SECURITY OF SUPPLY

Natural gas: a secure and reliable partner in the energy transition

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NATURAL GAS: A SECURE AND RELIABLE PARTNER IN THE ENERGY TRANSITION

Summary

Natural gas causes the lowest emissions of any fossil fuel and is therefore the ideal fuel to supplement and support the long-term transition to energy supplies without fossil fuels and greenhouse gas emissions. Natural gas is reliable and will be available in the long term. In Europe and especially in Germany, natural gas has reached a high degree of security of supply.

- **Reserves:** There are adequate conventional reserves of natural gas throughout the world. Even if natural gas consumption rises, reserves will be adequate to meet demand over the next decades. Non-conventional reserves also offer considerable potential[1].

- **Availability:** Europe is very well connected to global natural gas markets via the existing pipeline and LNG import infrastructure. Sufficient capacity for the import of natural gas quantities required to compensate for a decline in European production is already available. Projects to boost import capacities and eliminate regional bottlenecks will further improve the security of supplies. Natural gas importers are linked to natural gas producers by long-term import contracts and access to the natural gas quantities required is ensured. Liquid trading markets also increase availability.

- **Energy law context**: In February 2016, the European Commission presented a comprehensive package[2] to eliminate existing regional bottlenecks and avoid delivery problems in the event of a crisis such as the long-term non-availability of a supplier. In Germany, the Energy Industry Act also defines responsibilities and measures for ensuring a high degree of security of supply.

- **Short and medium-term security:** In Germany, the large storage capacities available would be sufficient to compensate for the non-availability of a key supplier for a period of several weeks to months. The decisive factor is the quantity of gas in storage at the beginning of the supply bottleneck. Additional security could be provided by holding a strategic reserve. The storage capacities available are also more than adequate to accommodate seasonal and short-term demand fluctuations.

- **Network stability:** German natural gas infrastructure is very well developed and extremely reliable. Over the past few years, the duration of supply interruptions on the German natural gas system totalled less than two minutes. In 2013, interruptions only totalled slightly less than 40 seconds.

1 shale gas & tight gas
2 Energy Security Package

1 THE ROLE OF NATURAL GAS AND THE NEED FOR NATURAL GAS IN THE ENERGY TRANSITION

Over the next few decades, natural gas can be and should be a mainstay of the energy transition. Natural gas can make a better contribution to the success of the energy transition than any other fossil fuel by supplementing renewable wind and solar energy in the transition to energy supplies largely without fossil fuels and free from greenhouse gas emissions.

In power generation, gas-fired power stations are ideally suited to compensate for fluctuations in power output from wind and solar facilities. Modern gas-fired power stations can be started up fast, have black start capabilities and can also be controlled flexibly. In the heating sector, the replacement of gas-fired heating systems using units with significantly higher efficiency offers considerable potential for the reduction of greenhouse gas emissions. In the traffic sector, natural gas (CNG and LNG) can help to reduce dependence on oil and make a key contribution to reducing emissions.

However, natural gas can only perform these functions if a high degree of security of supply is ensured. Disturbances to natural gas supplies would have considerable impact on consumers, depending on their extent, and cause severe economic damage. Politicians see this as a disadvantage of natural gas; as a result, they have given natural gas much too low a priority for future energy supplies considering the fact that it may be a fossil fuel but has significantly lower greenhouse gas emissions than other fossil fuels.

2 NATIONAL AND INTERNATIONAL GAS MARKETS (STATUS QUO)

Natural gas markets are linked to each other throughout Europe and beyond the borders of Europe. Especially the flexible supply of LNG allows natural gas to be traded globally. Throughout the world, 3,954 billion m^3 of natural gas were used in 2014. With a share of 24% in primary energy consumption, natural gas is in third place behind oil and coal. Over the past few years, global natural gas consumption has risen continuously. The average growth rate over the past 10 years is 2.6% per year. However, the pace of growth has slackened. In 2014, worldwide natural gas consumption only increased by 1.4%.

The main consumption regions are North America, with about 935 billion m^3, followed by the Asia-Pacific region (685 billion m^3) and Russia or the CIS with 627 billion m^3. In Asia, China (184 billion m^3) is the largest natural gas consumer, followed by Japan and South Korea. In 2014, Japan imported 118 billion m^3 of natural gas in the form of LNG and is therefore the world's largest LNG importer.

In Europe, natural gas consumption has fallen since 2010 and has now reached 472 billion m^3[3], with the EU-28 accounting for 409 billion m3. The reasons for this fall are the expansion of renewable energies, an inefficient emission trading system and low coal prices. Major natural gas consumers in the EU are Germany (85 billion m^3), the UK (70 billion m^3) and Italy (57 billion m^3). These three countries account for more than 50% of the total natural gas consumption of Europe (EU 28). In Germany, natural gas consumption has been falling since 2006. Natural gas now has a share of about 20% in primary energy consumption, making it the second most important primary energy source, after oil (35%) and ahead of coal.

Natural gas consumption in the Middle East is at about the same level as in Europe but, in contrast to Europe, has grown significantly over the past few

3 BGR energy study 2015

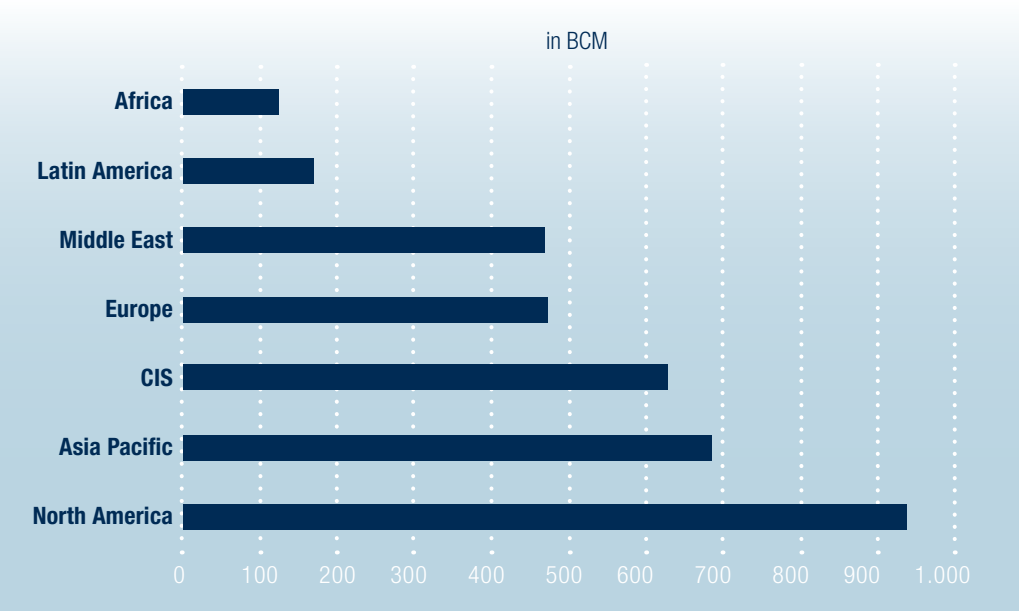

Fig. 1: Global natural gas consumption 2014 in billion m^3 (source of data: BGR energy study 2015)

years. Regions which still have a relatively low natural gas demand include South America and Africa.

Globally, natural gas consumption will continue to rise, but there will be considerable regional differences. In its main scenario (new policies), the IEA[4] predicts growth of 2 %/year to 5,378 billion m^3 in 2040. This scenario takes political commitments, published plans and announcements to reduce global greenhouse gas emissions into account and indicates moderate growth in natural gas consumption. The greatest growth potential for natural gas is seen in Asia. While consumption in the traditional Asian markets such as Japan and Korea is likely to stagnate, considerable growth is expected in markets such as Vietnam, Malaysia, Singapore and other countries, which are relatively small in absolute terms. The same applies to the Middle East. In the other major consumption regions of North America and the CIS, it is expected that growth in natural gas consumption will only be moderate.

For the EU-28, current scenarios indicate that natural gas consumption will stagnate or only increase slightly to 500 – 550 billion m^3 in 2035. In Germany, it is expected that the trend of steadily falling natural gas consumption will continue.

Both the Asia-Pacific region and Europe are strongly dependent on natural gas imports. In 2014, slightly more than half (53%) of the natural gas required in the EU was imported, with imports by pipeline from the Russian Federation accounting for by far the largest share, almost 150 billion m^3. Algeria and Libya supplied 25 billion m^3 as pipeline gas. Norway contributed 101 billion m^3 to natural gas supplies. As LNG prices were considerably higher than the prices of European pipeline gas, only about 20% of the capacity of European LNG import facilities was utilized in 2014. LNG imports totalled 45 billion m^3 LNG (measured in gaseous form).

The Asia/Pacific region is much more strongly dependent on LNG imports. In contrast to Europe, there is no continuous pipeline system and there are only a few supra-regional connections. 243 billion m^3 were imported in the form of LNG, corresponding to about 80% of total supplies. Key LNG suppliers for Asian markets are Qatar, with about 74 billion m^3, Australia with 32 billion m^3, Malaysia with 34 billion m^3 and Indonesia with 21 billion m^3.

Since 2011, wholesale natural gas prices in the three major trading regions have diverged. As a result of the high level of natural gas supplies in North

4 International Energy Agency, World Energy Outlook 2015

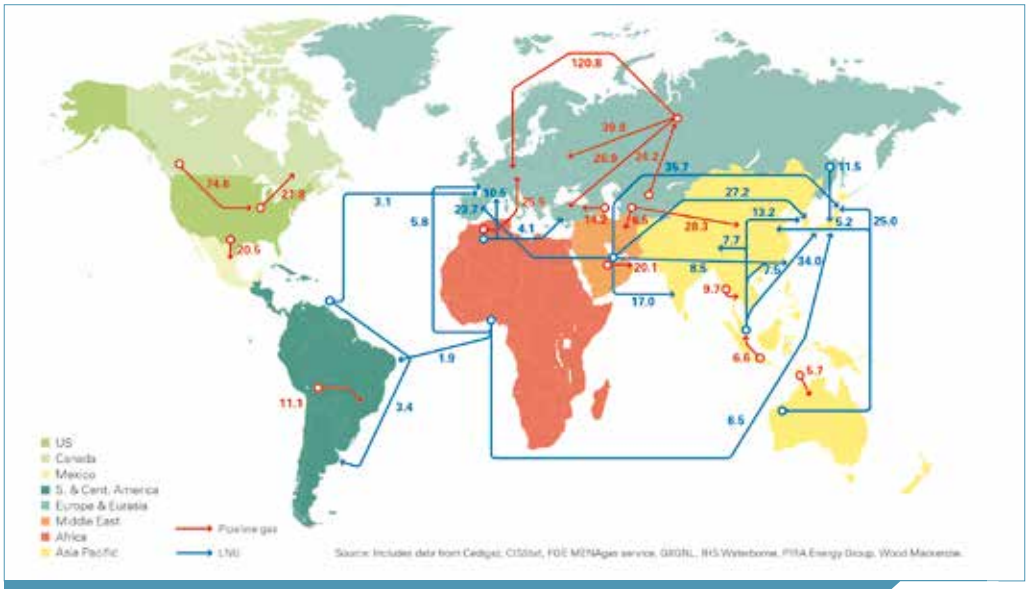

Fig. 2 : Natural gas trade movements in 2014 (source: BP Statistical Review of World Energy, June 2015)

America, wholesale prices in the USA at the Henry Hub (HH) have fluctuated between 2.5 and 5 USD / MMBTU[5] over the past few years. In Europe, wholesale prices reached about double this level, fluctuating within the range of 7 – 11 USD / MMBTU (NBP)[6]. Importers in the Asia / Pacific region had to pay the highest prices. As a result of high demand, especially from Japan following the shutdown of nuclear power stations, and from China, combined with low availability of LNG, prices reached high levels, within a range of 15 – 20 USD / MMBTU. In 2014 and 2015 markets were characterized by a supply surplus. In a buyer's market, international trading prices fell significantly and came closer to each other throughout the world. Currently, the US HH price is about 2 USD / MMBTU while European and Asian prices have converged at the level of 5.5 USD / MMBTU or 8.5 USD / MMBTU (Japan).

As a result of this development, the European market is becoming increasingly attractive for LNG volumes especially from North America but also from the Middle East (Qatar). Sea freight costs between the USA[7] and Europe are about one half to one third lower than for shipment from the USA to Asia.

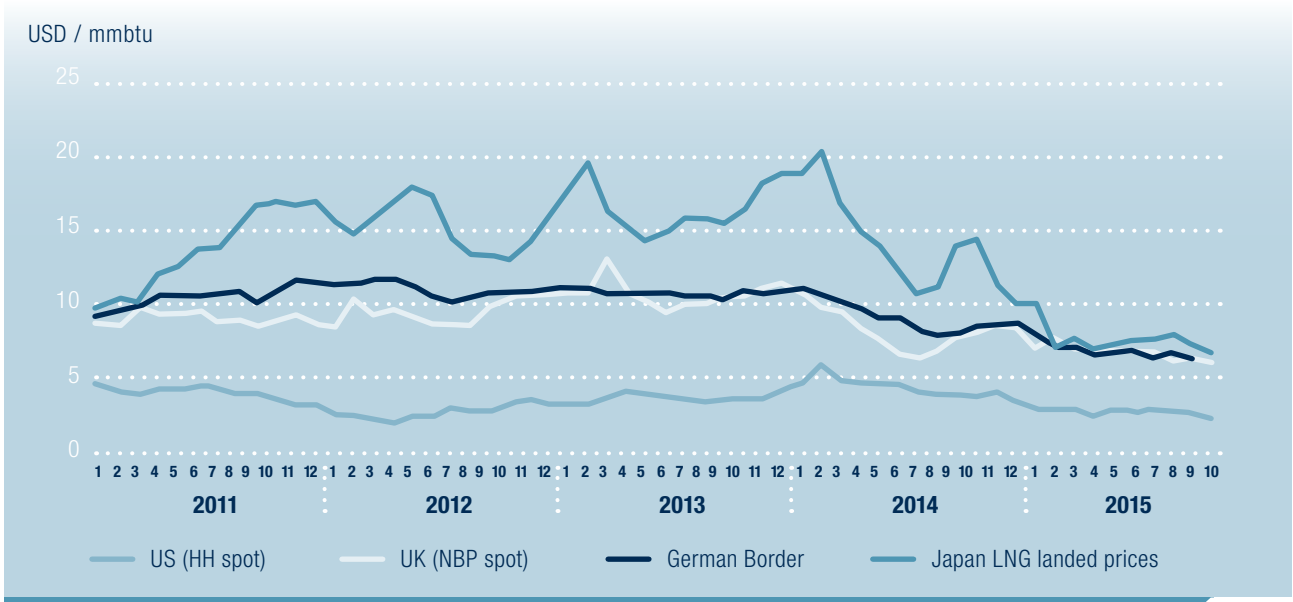

Fig. 3: Development of wholesale natural gas prices (source: EU Quarterly Report on European Gas Markets, DG ENER / Platts / Thomson Reuters / BAFA)

5 Million British Thermal Units (1 MMBTU = 293.071 kWh)
6 National Balancing Point
7 East coast

3 CORNERSTONES OF SECURE SUPPLIES

The key task of the natural gas industry is to ensure secure supplies and to serve the markets reliably and competitively in the long term. The secure supply of natural gas is based on the following cornerstones:

- The long-term availability of natural gas at competitive conditions
- Well-developed, diversified import and distribution infrastructure and access to this infrastructure
- Diversification of natural gas procurement and stable, long-term links with international natural gas suppliers
- A regulatory framework ensuring security of supplies
- A high degree of technical availability of gas infrastructure (pipeline system, compressor stations and storage facilities)

3.1 Availability

3.1.1 Natural gas reserves and resources

Global natural gas reserves are adequate to ensure natural gas supplies in the long term. BGR[9] estimates recoverable reserves[8] at 198,000 billion m^3. With annual production at about 3,400 billion [8], the static lifetime of natural gas reserves is 58 years. In addition, there are resources, i.e. proven reserves which are not economically recoverable with the current state of the art, of 638,000 billion [8]. In view of continued growth in demand and realistic expectations of further natural gas finds (conventional and non-conventional, combined with improved technologies, sufficient natural gas is available in the long term for all growth scenarios.

Global natural gas reserves are concentrated in a few major regions. 80% of the world's natural gas reserves are located in the countries of OPEC and the CIS. In the Middle East, Iran and Qatar have by far the largest reserves. The world's largest gas

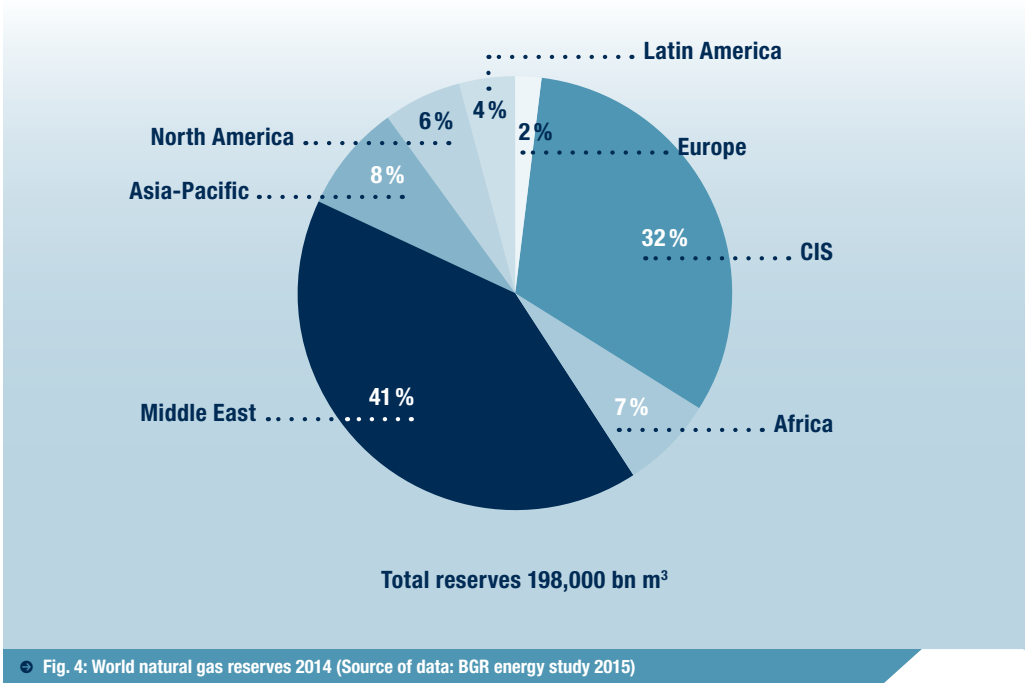

Fig. 4: World natural gas reserves 2014 (Source of data: BGR energy study 2015)

8 Bundesanstalt für Geowissenschaften und Rohstoffe (Federal Institute for Geosciences and Natural Resources), Hanover
9 Reserves: Gas quantities that are economically recoverable with the current state of the art

field is the North Field in Qatar, which is continued in the Iranian South Pars field. Reserves in Qatar and Iran alone are estimated at 49,000 billion m^3.

Russia's reserves are stated at 48,000 billion m^3. Among the CIS countries, especially Turkmenistan and Azerbaijan have large reserves. The total natural gas reserves of the CIS are 63,000 billion m^3. As they are relatively near to Europe, especially Turkmenistan and Azerbaijan have considerable potential for supplying European markets.

The Asia-Pacific region has reserves of 16,600 billion m^3, mainly in Australia, Indonesia and Malaysia. The natural gas reserves of Africa are stated at 14,000 billion m^3, with Nigeria (5,100 billion m^3) and Algeria (4,500 billion m^3) having the largest reserves. Tanzania and Mozambique are considered to have significant potential. The conventional natural gas reserves of North America amount to 12,100 billion m^3, with considerable additional potential for shale gas and tight gas. Europe only has relatively small reserves of about 3,600 billion m^3, mainly in Norway and the Netherlands.

Non-conventional natural gas resources such as shale gas or tight gas are not considered in the following paragraphs as reliable data is not available and the questions of environmental compatibility, approval for production and access to these resources have not been clarified in many regions. As a general principle, however, these resources offer considerable potential, as the massive development of shale gas production in the USA has already shown.

3.1.2 Natural gas production and imports

In 2014, 3,421 billion m^3 of natural gas were produced throughout the world. In 2014, the USA was the world's largest natural gas producer, with 729 billion m^3, ahead of Russia. In the USA, production was significantly expanded on the basis of shale gas resources; production rose by 6% in 2014. From 2016, the first natural gas quantities are to be exported as LNG via the Sabine Pass terminal in Texas.

In 2014, Russia produced 610 billion m^3 of natural gas, representing a slight fall compared with the previous year. The reasons were the political conditions, which are currently difficult, and the significant fall in oil and gas prices.

The Middle East produced 588 billion m^3 of natural gas. Iran is the largest natural gas producer in the Middle East, has significantly expanded its produc-

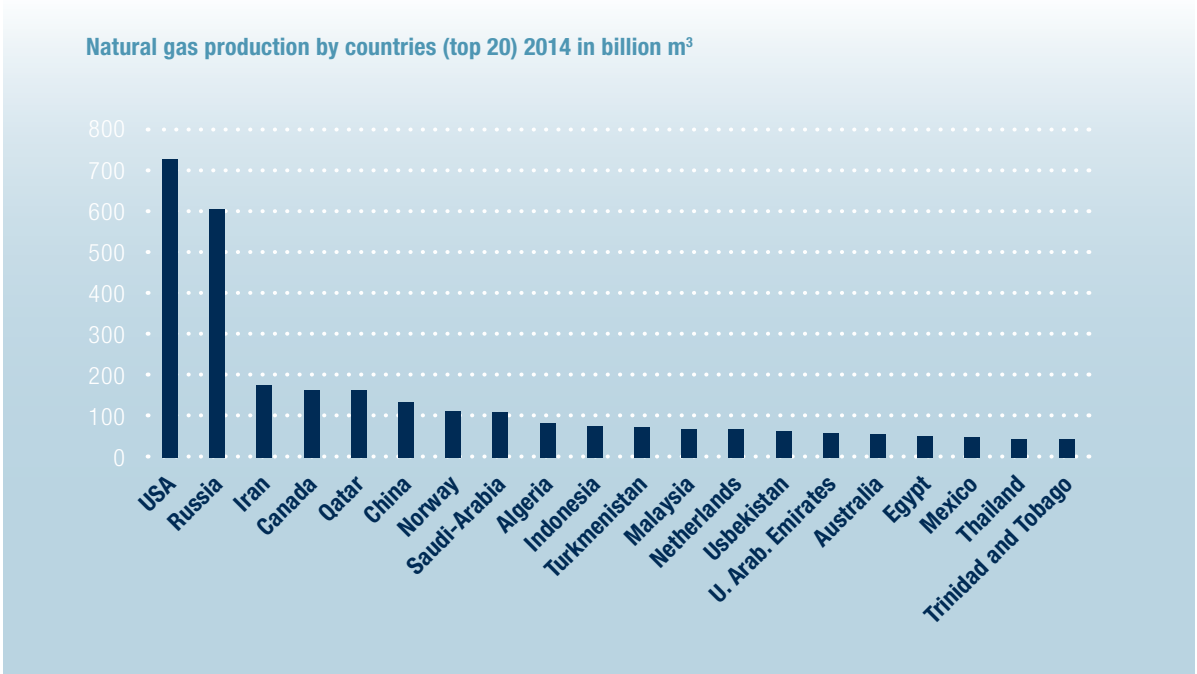

Fig. 5: world natural gas production 2014 (source: BGR energy study 2015)

tion capacities and produced 173 billion m^3. Qatar is producing at a constant level of about 160 billion m^3/year. Almost two-thirds of this gas is exported, mainly to the Asia-Pacific region, but also to Europe.

In the Asia-Pacific region, China and Australia have stepped up their natural gas production over the past few years, reaching 132 billion m^3 (China) and 56 billion m^3 (Australia) in 2014. As the second-largest producer in the region, Malaysian produced 66 billion m^3 in 2014.

The largest producer in Europe is Norway, with 108 billion m^3 in 2014, followed by the Netherlands (66 billion m^3). Whereas it will be possible to maintain Norwegian natural gas production at a constant level in the medium-term future, production in the Netherlands and other natural gas producing regions in Europe will continue to decline significantly over the next few years. In the Netherlands, reserves have been depleted considerably by extensive production from the Groningen field. In addition, future production will be made more difficult by seismic problems (subsidence). The Dutch Ministry of Economic Affairs has already announced that production from the Groningen field is to be reduced successively and that no further gas will be available for export from 2029 onwards.

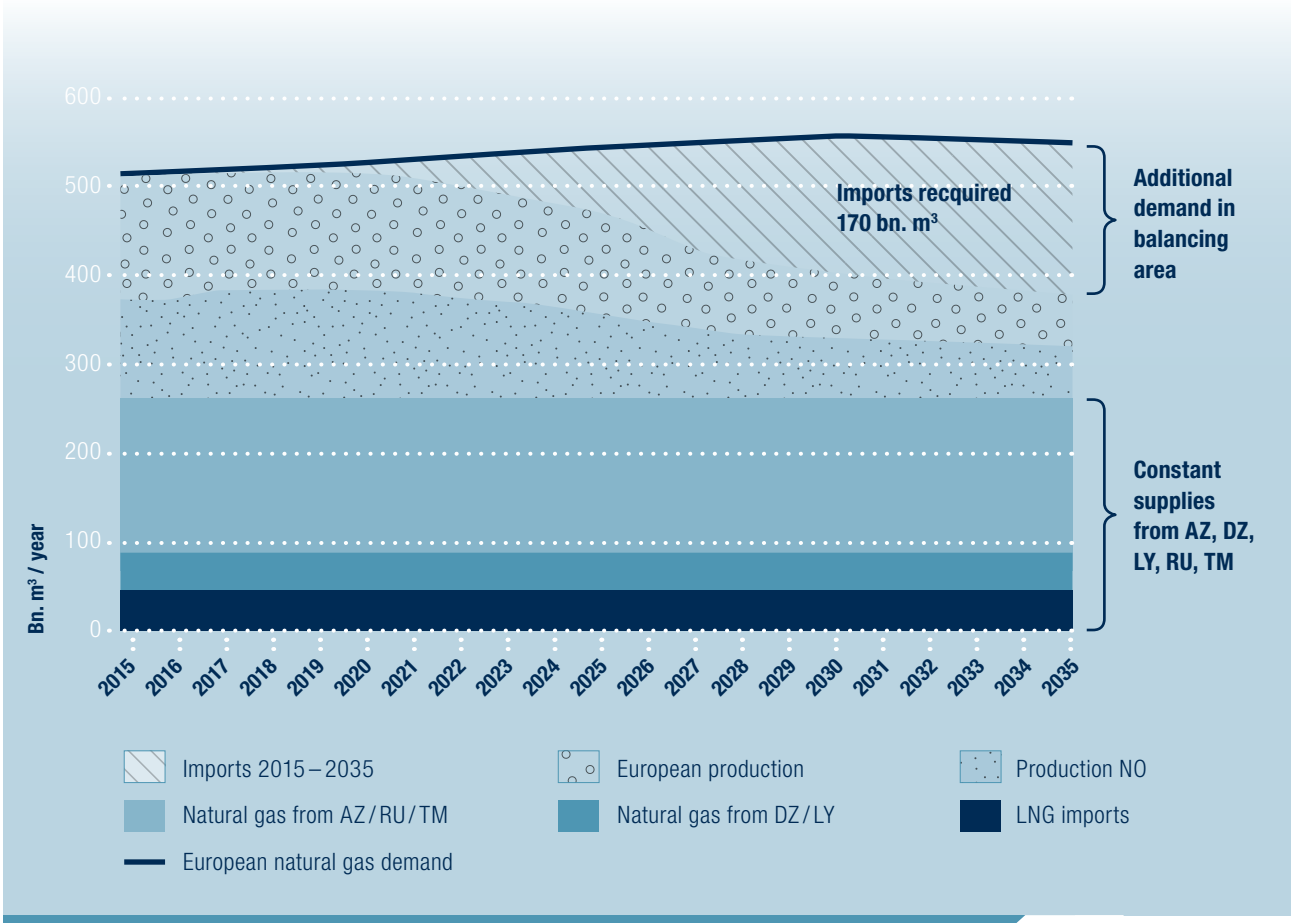

Fig. 6: Development of natural gas supply and demand in Europe (source: consultation document for Network Development Plan Gas, 2016)

In 2014, Germany produced about 10 billion m^3 of natural gas. German natural gas production continues to decline sharply; as a result of the depletion of gas fields, production will fall to below 4 billion m^3 in 2025.

In overall terms, natural gas production in Europe will continue to decline from the present figure of 258 m^3. CEDIGAZ[10] predicts a fall to 235 billion m^3 by 2020 and 170 billion m^3 by 2035. This will lead to an increase in demand for imports from countries outside the EU. German transmission system operators estimate that demand for natural gas

10 Medium and Long Term Natural Gas Outlook February 2015

imports which is currently not covered will reach 170 billion m^3 in 2035. In Europe, the conditions for the procurement of the additional gas required are favourable. Producer countries which could supply future demand include the present suppliers Norway (NO), Russia (RU), Algeria (DZ) and Libya (LY) as well as new suppliers from the CIS region, Turkmenistan (TM) and Azerbaijan (AZ).

Throughout the world, LNG liquefaction capacities are being expanded. In addition to the current capacities of roughly 300 mtpa[11] (390 billion m^3/year of natural gas) projects which will bring a further capacity of 112 mtpa onto the market over the next few years are currently under construction. Optimistic forecasts even assume that capacity will be doubled by 2025; however, these expectations are not realistic in view of current oil and gas price developments.

In Australia, seven liquefaction projects with an additional capacity of 62 mtpa are currently under construction or are being commissioned. Australia will overtake Qatar as the world's largest LNG producer and exporter. In the USA, four projects have a final investment decision. This will increase global liquefaction capacity by a further 44 mtpa. The Sabine Pass project on the border between Texas and Louisiana, the first of these projects, started production in February 2016. Further capacities of a lower order of magnitude are being added in Malaysia and Indonesia.

In contrast to pipeline gas, LNG is flexible and follows global price signals. LNG tends to flow first to high-price markets without access to pipeline gas or to niche markets (e.g. South America). Surplus quantities go to Europe, where they compete with pipeline gas and gas from domestic sources. This has been confirmed by the past decade, during which most LNG has gone to the Asia-Pacific region and only very little LNG has been delivered to Europe. In contrast to many Asian markets (Korea and Japan, for example), Europe can be supplied both by pipeline and via LNG, which also means that Europe will remain the residual market for LNG, taking up quantities which cannot be sold in Asia.

The significant increase in LNG availability combined with reduced growth in demand means that there is likely to be a surplus in the future, too. The global price level will then adjust. This means that adequate quantities of LNG will also remain available for European markets at competitive conditions in the long term.

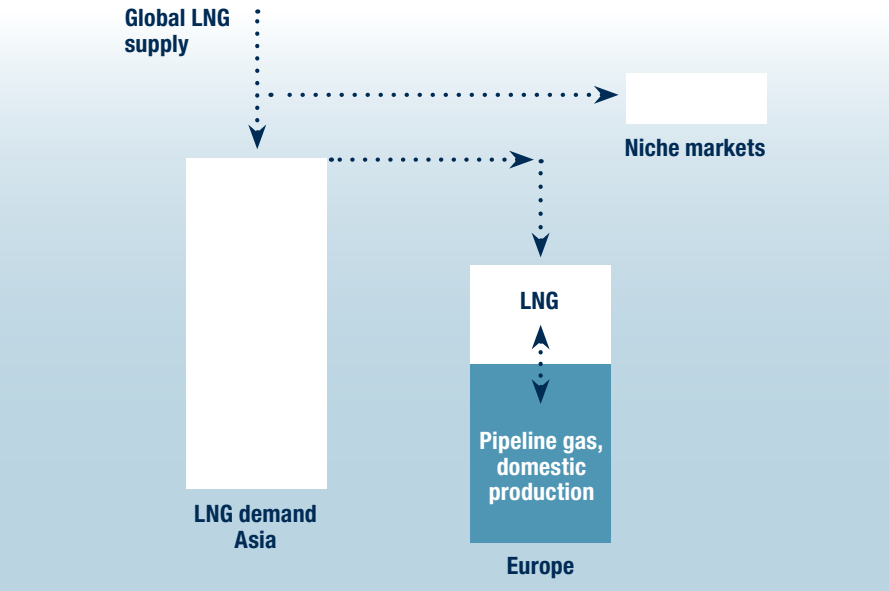

Fig. 7: Quantity flows in the global LNG market

11 million tons per annum

3.2 Import and distribution infrastructure

3.2.1 Pipeline infrastructure

In 2014, the import capacity for pipeline gas in Europe (EU-28) was 490 billion m^3/year. From the South, the European transmission system is supplied with gas from Algeria via the Maghreb-Europe Gas (MEG) line and Medgaz, which link North Africa with Spain, and via the Transmed pipeline, which links Algeria with Italy (Sicily). The Green Stream line connects Libya with Sicily.

Natural gas from the North Sea is fed to the European pipeline system by five pipelines with landfalls in Zeebrugge, Emden/Dornum and Dunkirk. The UK is linked to continental Europe via the Interconnector and BBL lines and has further links to gas fields in the North Sea. The main connection is the Langeled pipeline, linking Norway to the UK.

From the East, natural gas is supplied from Russia via the Nordstream and EuroPol pipelines as well as three transport corridors through Ukraine. Romania and Bulgaria are connected via the southern route.

Further pipeline infrastructure is under construction or design. The German transmission system operators indicate that additional import capacity of 127.5 billion m^3 is planned for Europe and is due to be commissioned successively over the next few years.

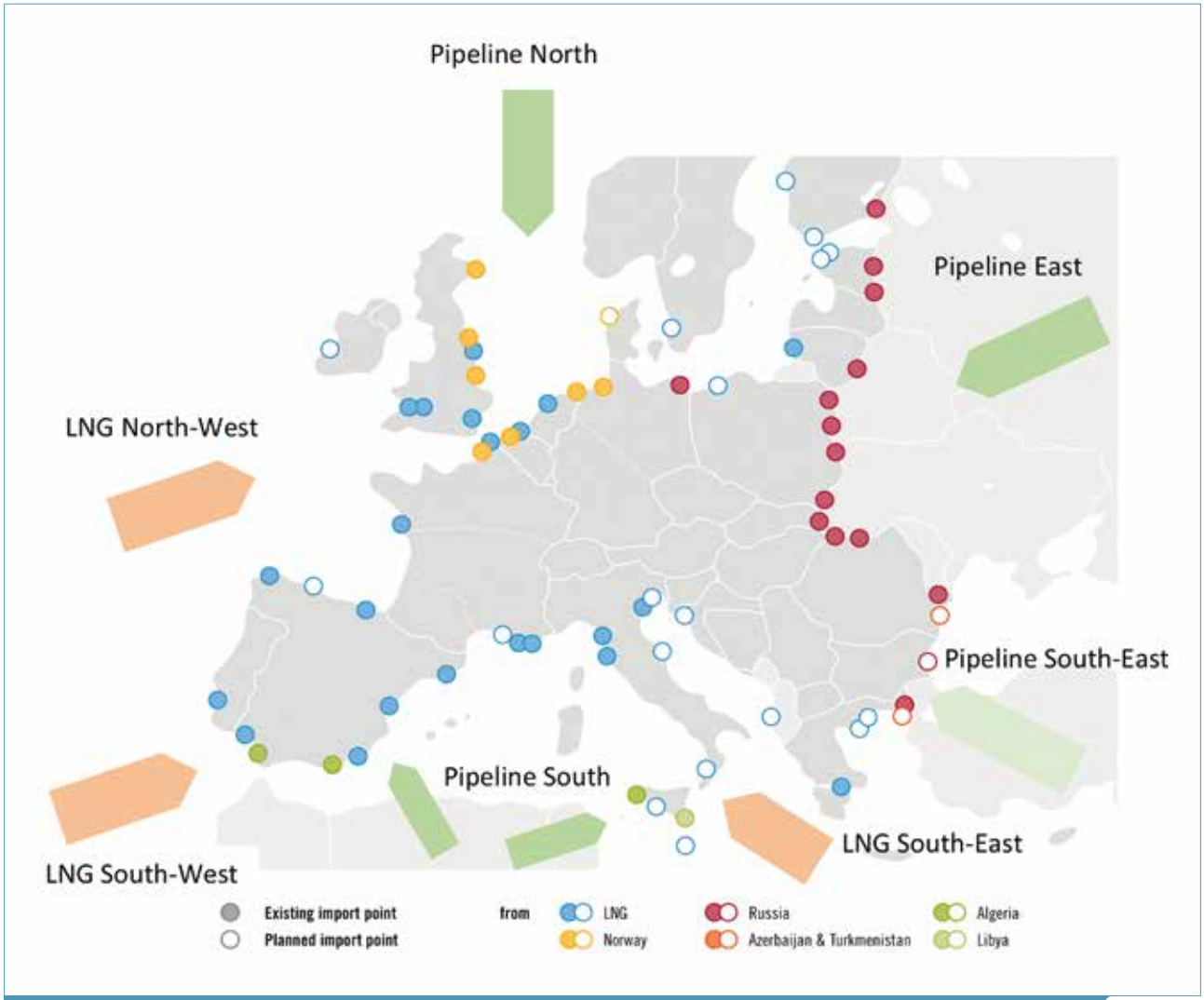

Fig. 8 : Possibilities of supply to the European gas pipeline system (source: ENTSOG, own information)

Project	Commissioning	Design capacity (bn. m³/year)
Nordstream (additional quantities)	2019	5.00
GALSI (Algeria-Sardinia-Italy gas pipeline)	2018	8.00
TAP (Trans Adriatic Pipeline)	2020	11.00
TESLA (Turkey-Austria)	2019	41.00
AGRI (Azerbaijan-Georgia-Romania Interconnector)	2022	8.00
EASTRING (pipeline connecting Slovakia and Romania/Bulgaria stage II)	2019	19.25
EASTRING (pipeline connecting Slovakia and Romania/Bulgaria stage I)	2022	19.25
White Stream (Azerbaijan/Georgia-Romania)	2022	16.00
Total capacity		**127.5**

Fig. 9: Import infrastructure – pipeline projects and annual capacity

These projects will significantly reinforce import capacities in South-Eastern Europe. The EASTRING, White Stream, TESLA and TAP pipeline projects will add an additional corridor to the existing transmission corridors for Russian natural gas through the Baltic and via Belarus/Poland and Ukraine, linking to natural gas reserves in the Caspian region, avoiding use of the Russian transmission system and improving connections to Romania and Bulgaria. The GALSI project (Algeria, Sardinia, mainland Italy) will improve pipeline capacities in the South of Europe and make additional quantities available from North Africa/Algeria.

3.2.2 LNG infrastructure

Europe has LNG import capacities of 203 billion m^3/a (EU-28 191 billion m^3). These would be sufficient to import 43% of the current natural gas demand of the EU-28 countries. The largest LNG import capacities are installed in Southern Europe, in Spain, Portugal, Southern France and Northern Italy. In North-Western Europe, LNG can be imported via the terminals in Zeebrugge and Gate (Rotterdam). The UK has developed import capacities at the terminals of Isle of Grain, Milford Haven and Dragon. In Poland, the terminal at Świnoujście is due to be commissioned soon. Greece can import LNG via the Revithoussa terminal to the South-West of Athens.

23 billion m^3/year of LNG import capacities are currently under construction or approaching commissioning in Europe[12]. Over the past few years, capacity deployment at the existing facilities has only reached 25%. Europe therefore has more than sufficient capacities to import growing quantities of LNG in the future and feed them to the pipeline system.

LNG terminals providing 150 billion m^3/year of additional LNG import capacity have been proposed in the EU-28 countries. However, additional capacities are only required on a regional basis to improve access to LNG imports in the South-East European countries and the Baltic states including Finland.

In overall terms, Europe has gas import infrastructure ensuring good connections with global natural gas markets and reserves. Even with optimistic scenarios for future development in demand, the existing LNG infrastructure and the additional pipeline capacities being constructed in South and South-Eastern Europe will be sufficient to cover growing demand for imports. This is even more the

12 Dunkirk (France) 13 billion m^3/year;
Świnoujście/Poland 5 billion m^3/year; small-scale terminals

Annual regasification capacity of large-scale LNG import terminals (billion m^3 / year)

	EU-28	Europe
operational	191	203
under construction	23	23
planned	146	170

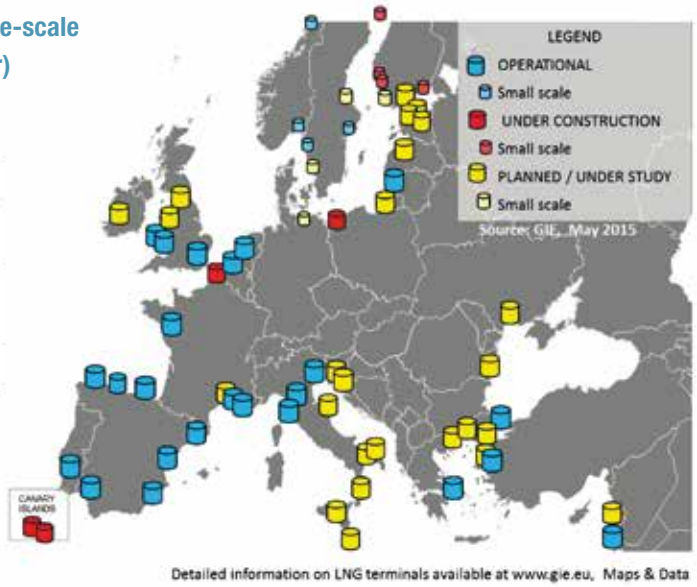

Fig. 10: LNG import capacities in Europe (source: GIE)

case considering the fact that natural gas demand is expected to remain constant or even to decline.

Import pipelines are mainly operated at constant flow rates and only used for adjustment to load fluctuations in natural gas distribution systems to a limited extent. In this context, LNG import terminals can perform an additional function, allowing regasification and injection of LNG into the transmission system in line with demand. LNG can therefore provide an additional element in security of supplies, supplementing conventional natural gas storage facilities.

3.2.3 Distribution within the EU

The EU has a well-developed pipeline system for the distribution of imported gas within the EU. With only a few exceptions, the gas transmission system is international and continuous. There are bottlenecks between Spain and France, in South-East Europe and in the connection of the Baltic states to Poland.

In 2015, the EU Commission (DG ENER) conducted a consultation process on the development of the European LNG and storage strategy. The objective is to further improve the security of natural gas supplies by making optimum use of LNG for the further diversification of natural gas supplies and through the use of natural gas storage facilities.

For the EU member states, access to global LNG markets is to be improved via existing and new LNG import infrastructure. The transport bottlenecks that have been identified are to be eliminated, the continuity of the transmission system is to be optimized and direct or indirect access to LNG import capacities is to be ensured. For this purpose, the following specific infrastructure projects have been proposed:

- Tallinn LNG terminal (Estonia)
- Krk LNG terminal (Croatia) and connection to Hungary
- Baltic Interconnector (Finland-Latvia)

- Estonia-Latvia link
- Poland-Latvia pipeline (GIPL)
- Expansion of Romanian and Bulgarian pipeline systems
- Pipeline from France to Spain (MidCat)
- Spain – Portugal (3rd Interconnector)

The EU commission has included these projects in the list of projects of common interest (PCI). PCI projects are subject to simplified and shortened approval procedures and can also benefit from financial support from the CFE[13] programme. An amount of €5.35 billion is available for this purpose for the period from 2014 to 2020. Through this action, the EU Commission has sent out clear signals for the improvement of infrastructure and security of supplies.

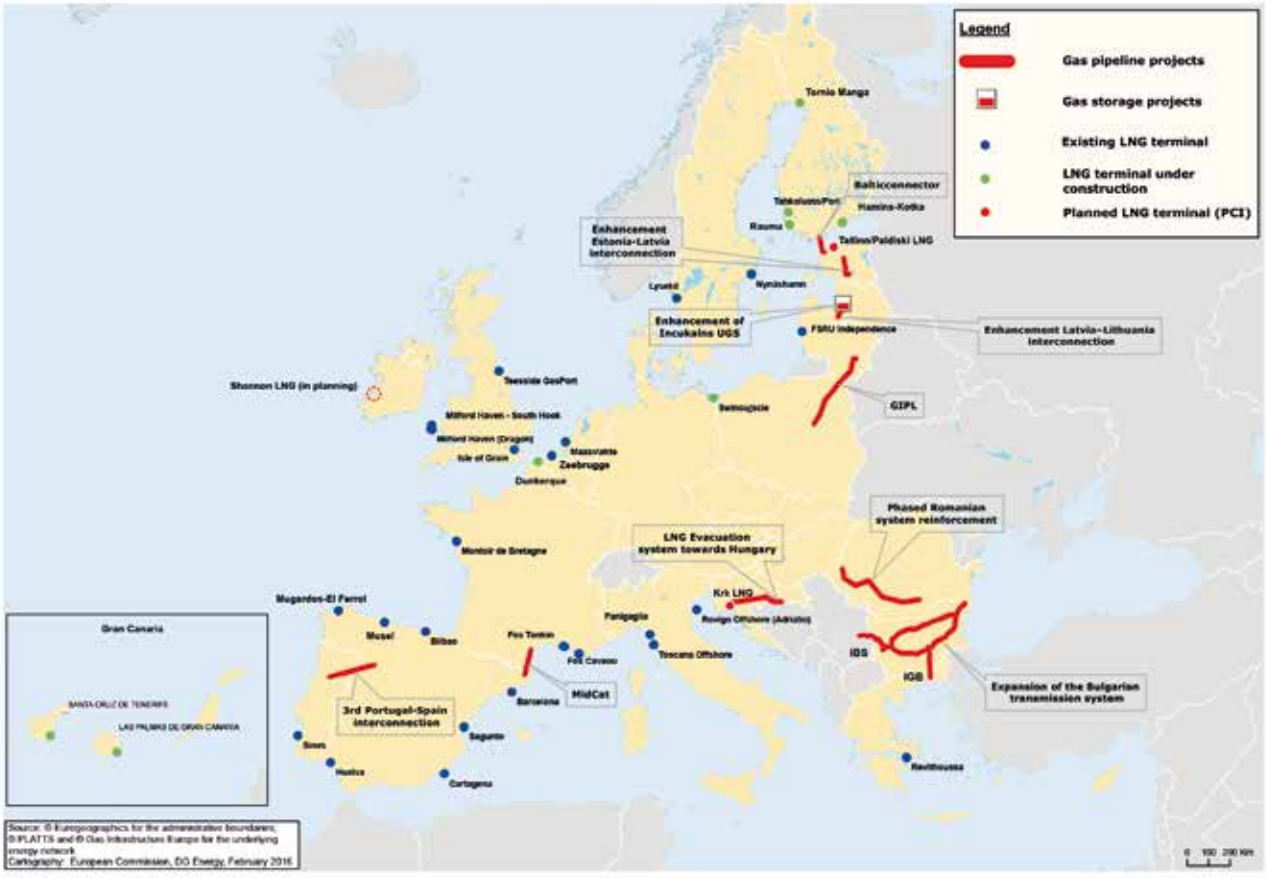

Fig. 11: EU infrastructure projects within the framework of the EU LNG and storage strategy (Source: EU Commission press release of Feb. 2016)

13 Connecting Europe

3.3 Diversification of natural gas supplies

In 2013, European production covered 34% of European natural gas demand (EU-28). The most important natural gas producers in the EU are the Netherlands (47%) and the UK (25%), followed by Germany (6.7%) and Romania (6.5%). Over the past few years, the dependence of the EU on natural gas imports has steadily grown. Russia provides 39 % of natural gas supplies, followed by Norway (30%) and Algeria (13%). The EU-28 countries therefore have very good supply base. However, there are considerable differences between the various European states as regards the degree of dependence on imports and the diversification of natural gas supplies.

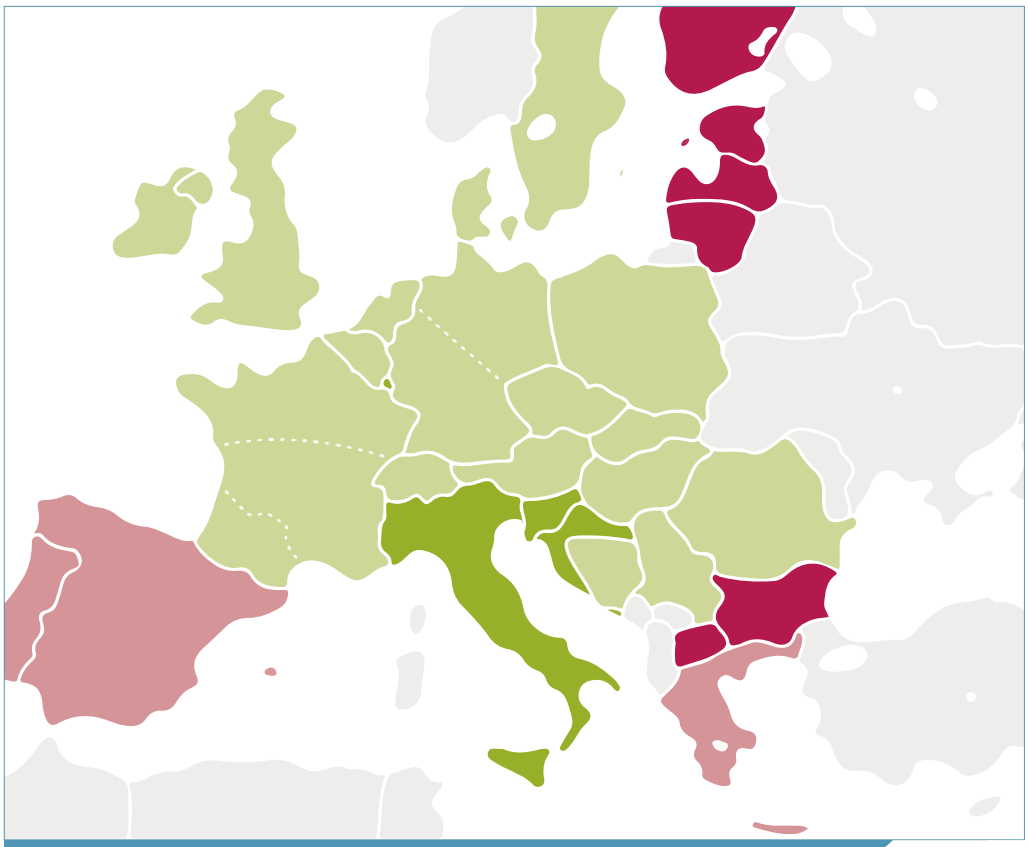

Fig. 12 : Degrees of diversification of natural gas supplies in the European countries (source: ENTSOG – Ten Year Network Development Plan 2015)

For historic and geographic reasons, the Baltic states (including Finland) and the countries of South-East Europe are largely dependent on natural gas deliveries from Russia. Here, the objective must be to avoid excessively one-sided dependence on deliveries from Russia and to develop alternatives in natural gas supplies. The commissioning of the LNG import terminal in Lithuania significantly reduced dependence on natural gas deliveries from Russia. Up to 4 billion m^3/year of LNG (in gaseous form) can be imported via the Klaipeda terminal.
In North-Western Europe, sources of natural gas supply are highly diversified. In 2014, Germany purchased natural gas from domestic production as well as importing gas from the Netherlands, Norway and Russia, with smaller quantities coming from the UK and Denmark.

Germany has no direct access to LNG import infrastructure. However, natural gas importers such as UNIPER have made long-term reservations for capacities at the Gate LNG import terminal in Rotterdam and have also reserved the necessary

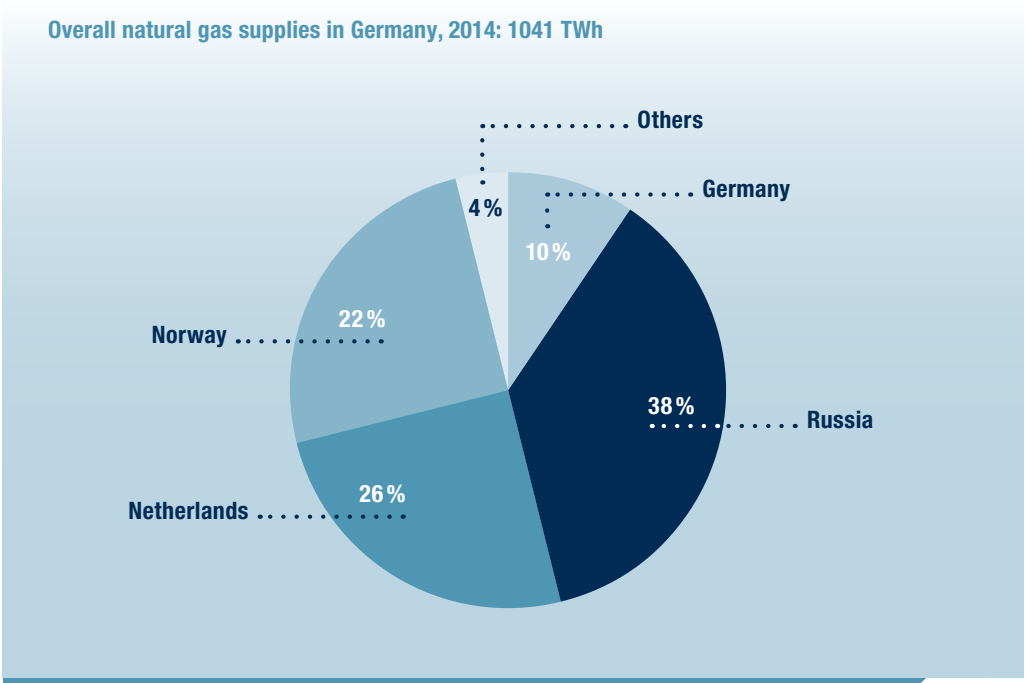

Fig. 13: Natural gas supplies in Germany, 2014

entry capacity for the use of the pipeline system to transport gas from the Gate terminal to the German market.

The UK, France and Italy import both pipeline gas and LNG and have achieved a high degree of diversification. As domestic production declined over the past few years, especially the UK has expanded LNG import capacities. However, LNG only supplies a small part of natural gas demand as a result of a lack of competitiveness. The main sources of supply are domestic production and Norway. In 2014, the main natural gas suppliers for France were Norway, Russia, the Netherlands and Algeria. As in the UK, only a very small part of LNG capacity was actually deployed. Italy purchases natural gas mainly from Algeria, Libya, the Netherlands, Qatar and Russia and has achieved the highest degree of diversification in Europe.

In Southern Europe, Spain and Portugal are largely dependent on LNG imports but have a very good supply base as a result of long-term LNG import contracts. In 2014, Spain imported LNG from seven countries[14]. However, some of the quantities imported were re-exported as a result of reduced demand and in order to exploit price differences.

For countries with large import requirements, long-term gas purchase contracts between natural gas importers on one hand and producers and suppliers on the other hand are a key element in ensuring secure supplies. These contracts are concluded for terms of up to 20 years and more. On the supplier's side, these contracts are required for financing investments in gas production and transmission facilities. For the importer, these contracts provide access to large quantities of natural gas. Over the past decades, the system of long-term contracts for natural gas imports remained stable. Sellers and purchasers can rely on each other for a long period and it is in the interest of both parties not to jeopardize these supply relationships. Re-negotiation clauses allow the adjustment of pricing formula and, if necessary, changes in the gas quantities. Over the past few years, almost all European import contracts have been adjusted by negotiation; in some cases these negotiations were very protracted. In general, long-term gas supply contracts provide a high level of security of supplies.

14 Algeria, Nigeria Norway, Oman, Peru, Qatar and Trinidad

3.4 Regulatory framework

In the first instance, security of supplies is a task for companies active in the marketplace. European and national laws set out a framework that ensures a high level of security of supplies. In Germany, the Energy Industry Act imposes on energy supply companies an obligation to ensure secure supplies of energy via pipelines and cables. The companies are also under an obligation to eliminate any disturbances and risks to energy supply. In a crisis, the competent authorities also have intervention rights.

In the summer of 2014, the EU carried out a stress test for natural gas supplies in order to simulate the impact of delivery bottlenecks and the failure of natural gas supplies from Russia. The results showed that the Eastern member states of the EU (Baltic and South-East European countries) were affected by supply restrictions while there were no restrictions on supply in any of the other regions. In general, the stress test showed that a high level of security of supplies has been reached. The impact of delivery failures can be limited by improved cooperation across national borders. Measures for the further reduction of supply risks have been identified and will be planned and implemented. In addition, a gas shortage situation would result in price signals which would mobilize alternative import sources, especially LNG, and lead to a fall in demand and to the increased use of storage facilities.

On 16 February 2016, the Commission presented its "Energy Security Package". With this initiative, the EU Commission has underlined the importance of natural gas in future energy supplies and its role as an enabler on the way to the use of fewer and fewer fossil fuels in energy supplies. The key points of the Energy Security Package were outlined by the Vice President of the European Commission responsible for Energy Union, Maroš Šefčovič, as follows:

"secure supplies in case of disruption, strengthen cooperation at regional level and improve crisis management at European level. An important element in this proposal will be to bring more transparency in gas contracts with third parties and facilitate access of more LNG into Europe."

In this package, the Commission addresses the need for secure natural gas supplies as a prerequisite for the role to be played by natural gas in future energy supplies and also defines natural gas as a complementary fuel to renewable energies and as a basis for the use of efficient, environmentally compatible technologies in the heating market.

The most important element in the package is the new version of the Security of Supply Regulation. This aim is to reinforce regional cooperation and coordination in the event of supply crises. The draft regulation introduces a solidarity principle obligating member states to provide mutual assistance in the event of a crisis. Security plans are no longer to be developed at the national level but for regions including several member states in order to ensure improved coordination and prevention and management of supply bottlenecks. In addition, cooperation with countries who export natural gas to the EU is to be reinforced. A further element in improved security of supplies is increased transparency with respect to natural gas import contracts relevant for security of supplies. This new regulation will be supplemented by the LNG and storage strategy and the definition of infrastructure projects eligible for support for the further improvement of security of supplies, especially in Eastern European countries (see also Section 3.2.3).

3.5 Reliability of infrastructure in Germany

In addition to the question of gas availability, access and imports and the regulatory framework, the natural gas transmission and storage infrastructure is a further cornerstone of security of supplies. While gas availability is associated with medium and long-term developments, a reliable infrastructure is essential for the distribution and delivery of natural gas quantities required in line with demand. However, storage capacities may also be used strategically to supply natural gas quantities required in the event of supply bottlenecks.

Germany has well-developed, reliable natural gas storage infrastructure. In order to compensate for the demand fluctuations and for peak shaving purposes, Germany has working gas capacities of 24 billion m^3. Cavern storage facilities used for short term structuring (peak shaving) account for a working capacity of 10 billion m^3. 14 billion m^3 of working gas can be stored in porous rock storage facilities, which are mainly used for seasonal load management and for security purposes. Germany is the European country with the largest gas storage capacities.

A study commissioned by the Federal Ministry of Economic Affairs and Energy in 2015[15] concerning security of supplies and the role of natural gas storage facilities identified a high level of security of supplies. On this basis, supply failures can be compensated for by purchasing natural gas from alternative sources in combination with the use of storage facilities for several months. This system is highly stress-resistant. Supply bottlenecks can only occur in extreme scenarios, i.e. if several factors occur in the same time such as the long term failure of an important source combined with extreme cold spells or the beginning of a crisis at the end of the winter or with low natural gas volumes in storage. Even under such conditions, supply problems are not likely to occur immediately but only after several weeks.

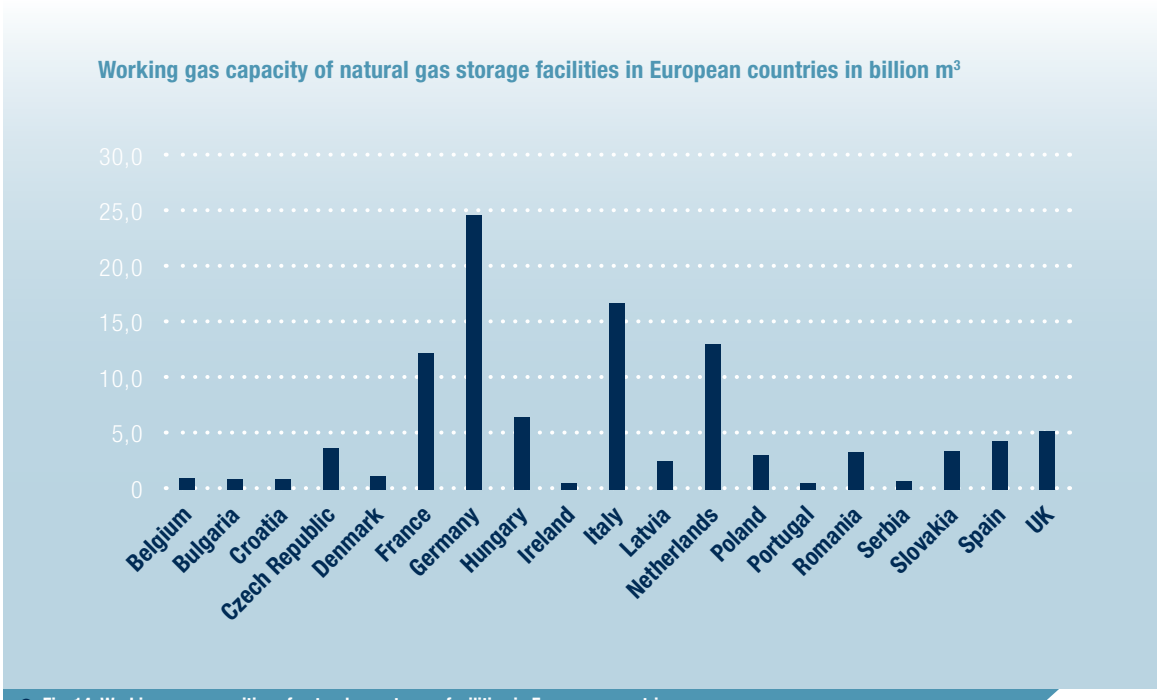

Fig. 14: Working gas capacities of natural gas storage facilities in European countries

15 Möglichkeiten zur Verbesserung der Gasversorgungsicherheit und der Krisenvorsorge durch Regelungen der Speicher (strategische Reserve, Speicherverpflichtungen), einschließlich der Kosten sowie der wirtschaftlichen Auswirkungen auf den Markt (Possibilities for improving gas supply security and crisis provision through the regulation of storage facilities (strategic reserve, storage obligations) including costs and economic impact on the market)

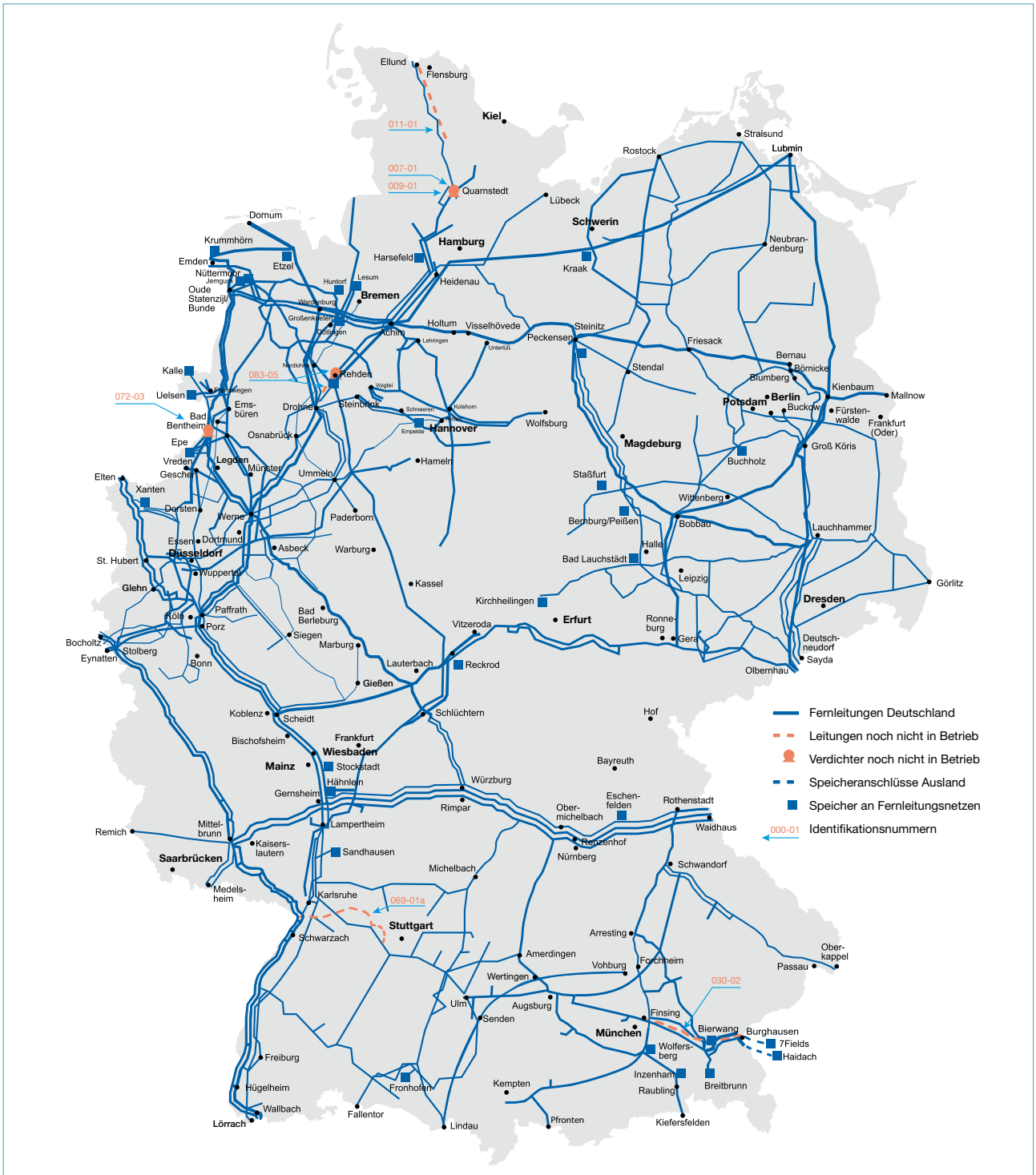

Fig. 15: Natural gas infrastructure in Germany (sources: Federal Ministry of Economic Affairs and Energy, transmission system

The gas transmission and distribution systems are well-developed throughout Germany and have a high technical standard. The total length of the gas distribution system, which is closely meshed and has reached a very high degree of reliability, is about 505,000 km.

In an analysis of network disturbances, DVGW has shown that the number of incidents and accidents has been reduced to a very low level over the past decades. The Federal Network Agency is tasked with monitoring supply interruptions. The results are expressed as the “SAIDI” index (System Average Interruption Duration Index). Since 2006, values between four minutes per year (maximum) and 0.6 minutes per year (minimum) have been determined. This corresponds to a very high degree of reliability.

4 CONCLUSION

A high level of security of supplies has been reached in Germany. Adequate quantities of natural gas are available for long-term supplies. Global natural gas reserves can be accessed via well-developed import infrastructure (via pipeline and LNG). In order to eliminate regional bottlenecks and further improve access to alternative import sources (LNG), the EU Commission has drawn up plans of action and supports the development of appropriate infrastructure projects.

This is especially true of Germany. In Germany and other European countries, the stability of the gas supply system has been proved, especially during the Russian-Ukrainian gas dispute in 2009 and during the interruption of Russian natural gas supplies in the second half of 2014 and in 2015 as a result of the Ukraine crisis. Despite restrictions in natural gas supplies from Russia, it was possible to avoid supply bottlenecks.

Germany has a diversified, reliable natural gas purchase portfolio, as well as reliable, well-developed infrastructure for the distribution, storage and supply of natural gas in line with demand. The risk of supply bottlenecks is extremely low. This would even apply in the event of a significant increase in natural gas demand, which currently appears to be unlikely.

Sources:

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