



Federal Ministry
for Economic Affairs
and Energy

Preventive Action Plan for Gas for the Federal Republic of Germany

pursuant to Art. 8 of

REGULATION (EU) no. 2017/1938 of the European Parliament and of the Council of 25 October 2017 concerning measures to safeguard the security of gas supply and repealing Regulation (EU) No 994/2010

June 2019

Table of Contents

Background	4
Timetable for the production of the Preventive Action Plan	5
Content of the Preventive Action Plan	5
1. Description of Germany's national gas system	7
1.1 Gas in the energy mix	7
1.2. Description of the functioning of the gas system	8
1.2.1 Description of the functioning of the H gas area	9
1.2.2 Description of the functioning of the L gas area	9
1.3 Storage	10
1.4 German gas production	13
1.5 Description of the role of gas in electricity generation	14
1.6 Description of the role of energy efficiency measures and their impact on annual final consumption of gas	15
2. Summary of the national risk assessment pursuant to Art. 7 SoS Regulation	17
3. Infrastructure standard	19
3.1 N-1 formula	19
3.2 Bidirectional capacities	21
4. Compliance with the supply standard	23
4.1 Protected customers	23
4.2 Gas volumes and capacities	23
4.2.1 Requirements pursuant to Art. 6(1) a) of the SoS Regulation	23
4.2.2 Calculation for Germany	23
4.3 Measures to comply with the supply standard	25

5. Preventive measures	27
5.1. Risk prevention measures	27
5.1.1 Market area conversion from L to H gas.....	27
5.1.2 Reversal of the TENP.....	28
5.2 Other preventive measures	28
5.2.1 National Network Development Plan for Gas (NDP).....	28
5.2.2 Cross-border interconnectors and gas flowse.....	30
5.2.3 Cross-border crisis management exercise (LÜKEX).....	32
5.2.4 Improving the data basis and transparency.....	33
5.2.5 Integrated rules on the supply of electricity and gas.....	33
6. Other measures and obligations	35
6.1 Responsibilities of the gas undertakings	35
6.2 Cooperation between the system operators	35
6.3 Responsibilities of the authorities.....	36
6.4 Overview of responsibilities pursuant to the SoS Regulation.....	36
7. Infrastructure projects	37
8. Community obligations relating to security of supply	39
9. Stakeholder consultation	40
10. Regionale Dimension	41
10.1 Summary of the Risk assessment of Baltic sea Risk group.....	41
10.2 Calculation of the infrastructure standard for the risk group Baltic sea.....	42
10.3 Cooperation between Member States.....	43
10.4 Preventive measures.....	44
11. Directory of figures, tables and maps	45

Background

In the European Union, security of gas supply is a shared responsibility of natural gas undertakings, Member States, notably through their competent authorities, and the European Commission within their respective areas of activities and competence. This shared responsibility requires a concerted exchange of information and cooperation between stakeholders.

Against this background, Regulation (EU) 2017/1938 of the European Parliament and of the Council of 25 October 2017 concerning measures to safeguard the security of gas supply and repealing Regulation (EU) No 994/2010 (Security of Supply (SoS) Regulation) provides for a comprehensive range of instruments to strengthen the internal market for gas and to take precautions for the case of a supply crisis. The national policies and the rights for undertakings and authorities to act are already in place within the legal framework currently in force in Germany.

Germany's natural gas supply is very secure and reliable. This is especially true of the supply to household customers, who are of particular significance in the SoS Regulation. This means that Germany is fully compliant with the infrastructure and supply standards stipulated in the SoS Regulation. Nevertheless, it is important not only to take appropriate action to maintain resilience against supply crises, but where necessary to strengthen it and thus to reduce the likelihood that supply crises will occur. This frequently necessitates close cooperation between all sides and a timely implementation of corresponding measures. This is particularly true of the expansion of the grid, of cooperation between the electricity and gas sectors, and of improvements in data collection. Also, cross-border coordination is necessary between German and neighbouring foreign grid operators and competent authorities regarding the handling of bottleneck situations.

The SoS Regulation defines responsibilities and obligations for undertakings, national authorities and the European Commission, and calls on the Member States to stipulate in advance the envisaged crisis management and preventive measures in the form of Preventive Action and Emergency Plans. According to Art. 8 of the Security of Supply Regulation:

The competent authority of each Member State shall, after consulting the natural gas undertakings, the relevant organisations representing the interests of household and industrial gas customers, including electricity producers, electricity transmission system operators, and, where it is not the competent authority, the national regulatory authority, establish:

- a) a preventive action plan containing the measures needed to remove or mitigate the risks identified, including the effects of energy efficiency and demand-side measures in the common and national risk assessments and in accordance with Article 9;*
- b) an emergency plan containing the measures to be taken to remove or mitigate the impact of a disruption of gas supply in accordance with Article 10.*

The competent authority for ensuring the above-mentioned measures is the Federal Ministry for Economic Affairs and Energy (BMWi). The Bundesnetzagentur (Federal Network Agency - BNetzA) has been assigned the competence for the regular drafting and updating of the risk assessment. The Emergency Plan produced by the Federal Ministry for Economic Affairs and Energy has been published in a separate document.

The Preventive Action Plan for Gas presented here meets the requirements of the SoS Regulation.

Timetable for the production of the Preventive Action Plan

The Preventive Action Plan for Gas was drafted by the Federal Ministry for Economic Affairs and Energy in cooperation with the gas industry and the Bundesnetzagentur. The gas industry has ensured its involvement in the work to implement the SoS Regulation by setting up a project group under the German Association of Energy and Water Industries (BDEW); the Federal Ministry for Economic Affairs and Energy attended its meetings on a regular basis. In the course of the current revision, the BDEW, EFET Germany (European Federation of Energy Traders – Germany), FNB Gas (association of gas transmission system operators), INES (association of natural gas storage operators), and the VKU (Association of Local Utilities) were consulted.

The interests of the household and commercial consumers were taken into account via consultation with the Association of German Chambers of Industry and Commerce (DIHK) and the Federation of German Consumer Organisations (VzBV).

The Länder and the competent authorities of all Member States of the risk groups pursuant to Section 7(2) SoS Regulation were also consulted.

Content of the Preventive Action Plan

Requirements pursuant to Art. 9 of the SoS Regulation:

The required content of the Preventive Action Plan is defined in Art. 9 of the SoS Regulation. According to this provision, the Preventive Action Plans must meet the following criteria:

They shall contain:

- a) the results of the risk assessment and a summary of the scenarios considered, as referred to in point (c) of Article 7(4);*
- b) the definition of protected customers (...);*
- c) the measures, volumes and capacities needed to fulfil the infrastructure and gas supply standards laid down in Articles 5 and 6, including, where applicable, the extent to which demand-side measures can sufficiently compensate, in a timely manner, for a disruption of gas supply as referred to in Article 5(2) (...);*
- d) obligations imposed on natural gas undertakings, electricity undertakings where appropriate, and other relevant bodies likely to have an impact on the security of gas supply, such as obligations for the safe operation of the gas system;*
- e) other preventive measures designed to address the risks identified in the risk assessment, such as those relating to the need to enhance interconnections between neighbouring Member States, to further improve energy efficiency, to reduce gas demand and the possibility to diversify gas routes and sources of gas supply and the regional utilisation of existing storage and LNG capacities, if appropriate, in order to maintain gas supply to all customers as far as possible;*
- f) information on the economic impact, effectiveness and efficiency of the measures contained in the plan, including the obligations referred to in point (k);*

- g) a description of the effects of the measures contained in the plan on the functioning of the internal energy market as well as national markets, including the obligations referred to in point (k);*
- h) a description of the impact of the measures on the environment and on customers;*
- i) the mechanisms to be used for cooperation with other Member States, including the mechanisms for preparing and implementing preventive action plans and emergency plans;*
- j) information on existing and future interconnections and infrastructure, including those providing access to the internal market, cross-border flows, cross-border access to storage and LNG facilities and the bi-directional capacity, in particular in the event of an emergency;*
- k) information on all public service obligations that relate to the security of gas supply.*

The Preventive Action Plan takes account, in particular regarding the actions to meet the infrastructure standard as laid down in Article 5, the Union-wide 10-year network development plan to be elaborated by the ENTSO for Gas [ENTSOG].

Measures in the Preventive Action Plan shall primarily be market-based; they must not impose a disproportionate burden on the gas companies, and must not impact negatively on the functioning of the internal market for gas.

Concept

In line with the above-mentioned requirements, this Preventive Action Plan describes measures to maintain – and where necessary to improve – the security of supply in Germany. It gives consideration to the findings gained in the 2018 risk assessment previously compiled in accordance with Art. 7 SoS Regulation and thus the potential risk of a possible impairment to supply as identified in those findings.

1. Description of Germany's national gas system

1.1 Gas in the energy mix

The need for energy is met in Germany by an energy mix of fossil and non-fossil energy sources; Germany's energy policy aims to boost the share of renewable forms of energy. Natural gas is regarded as the most environmentally friendly of the fossil fuels. In comparison with oil, hard coal and lignite, the combustion of natural gas results in the lowest carbon emissions. Also, the gas infrastructure offers the possibility to add renewable gases like hydrogen, synthetic methane or biomethane and thus to further reduce carbon emissions. Furthermore, gas-fired power plants can be deployed flexibly.

Table 1: Development of primary energy consumption from 2008 to 2018 in petajoules

Year	Oils	Natural gas	Hard coal	Lignite	Nuclear energy	Renewable energy	Others ²	Total
2008	4,904	3,222	1,800	1,554	1,623	1,147	130	14,380
2009	4,635	3,039	1,496	1,507	1,472	1,201	180	13,531
2010	4,684	3,171	1,714	1,512	1,533	1,413	189	14,217
2011	4,525	2,911	1,715	1,564	1,178	1,463	244	13,599
2012	4,527	2,920	1,725	1,645	1,085	1,385	161	13,447
2013	4,628	3,059	1,840	1,629	1,061	1,499	107	13,822
2014	4,493	2,660	1,759	1,574	1,060	1,519	116	13,180
2015	4,491	2,770	1,729	1,565	1,001	1,644	60	13,262
2016	4,566	3,056	1,693	1,511	923	1,676	65	13,491
2017	4,675	3,121	1,465	1,508	833	1,790	48	13,439
2018*	4,395	3,075	1,301	1,465	832	1,809	45	12,917

1) Calculations based on efficiency rate approach.

2) Other forms of energy: mine gas, non-renewable waste and waste heat as well as balance of electricity exchange.

* preliminary figures

PJ = petajoule; 1 PJ = 0.0341204 mtce (coal equivalent)

References: Working Group on Energy Balances, gas: BDEW

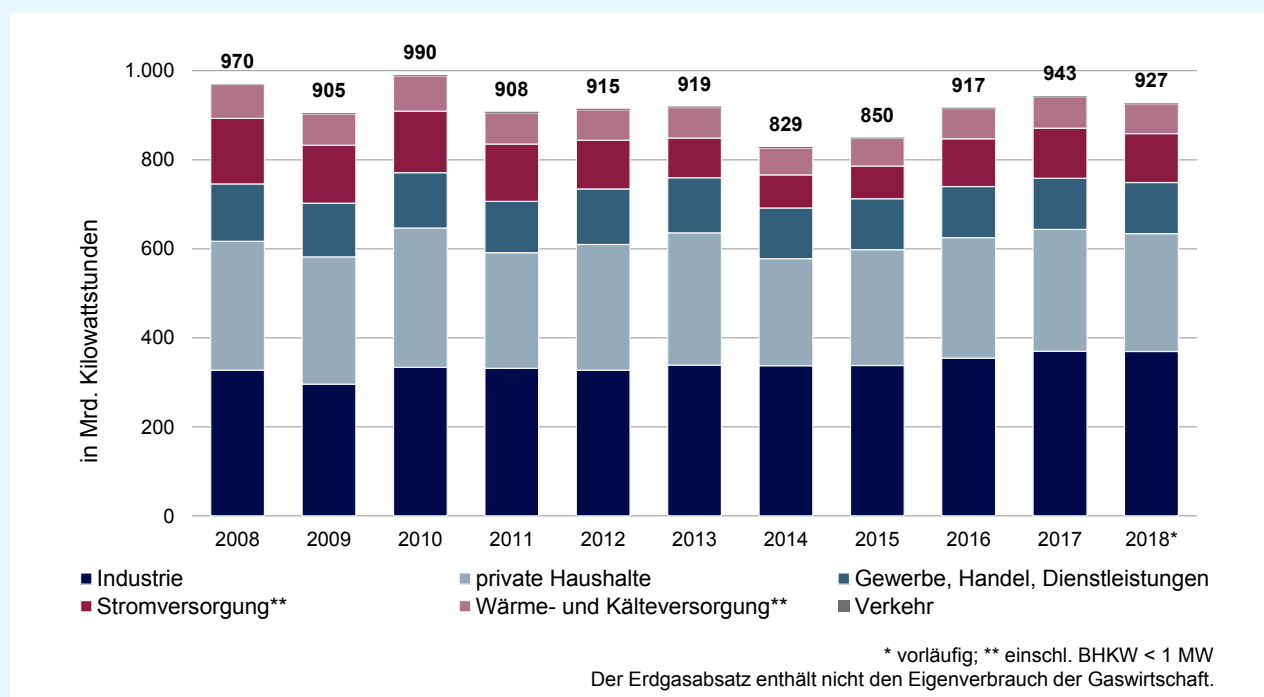
Status: 02/2019

In the last 20 years, the share of primary energy consumption covered by gas has ranged between 20 and 24%. In the context of the discussions on attaining the climate targets and the related energy transition in Germany, the expansion of renewable energy, the phase-out of the use of nuclear energy and the findings of the Commission for Growth, Structural Change and Employment (dubbed the Coal Commission), the future significance of gas is of particular interest in terms of the production of electricity and heat.

The consumption of natural gas (sales to final consumers and gas consumed in the technical maintenance of operations – consumption in the course of extracting, storing and transporting gas) stood at between 915 and 1020 TWh between 1998 and 2008. In the last ten years, annual consumption has dropped below the 900 TWh mark on several occasions. Consumption has been rising again since 2016. Consumption in 2018 amounted to 945 TWh, 15 TWh below the previous year's level. It should be noted that the development is affected by various market-driven changes and temperature-related fluctuations in demand.

Out of total German demand, roughly one-third is accounted for by household customers and district heating. Consuming around 40% of the total, industrial customers are the largest group of gas consumers. This figure has been steady over the last few years. In the course of the year, the industrial customers' consumption is very stable, since industrial consumption is little affected by temperature. The consumers in commerce/trade/services account for 15% of total consumption each year. Consumption for power generation is at a similar level, but it should be noted that this consumption fluctuates widely. In view of the small sales quantities, the transport sector can be disregarded in terms of total annual German consumption.

Figure 1: Gas sales by consumer group (2008–2018)



Quelle: BDEW, Stand 02/2019

The gas market is very much driven by temperature and price. In summer, gas storage facilities are filled up in response to price movements; peak loads can occur when prices are low. In winter, peaks in demand arise when temperatures are very low. In order to ensure a reliable supply of gas, the crucial points are not only the absolute volumes of gas sold, but also the potential maximum capacity, in order to ensure a secure supply of gas, particularly when there are seasonal peaks in demand. The gas infrastructure can cope with peak demand at a level which statistically occurs once every 20 years. This maximum amount was reached in December 2009, and stood at 5,202.5 GWh/day. This corresponds to consumption of approximately 521.5 million m³/day.

1.2. Description of the functioning of the gas system

The German gas grid consists of nearly 500,000 km of pipelines, subdivided into the transmission and distribution systems. The transmission system is subdivided into an H gas and an L gas area. These two areas are described in the following two sections.

1.2.1 Description of the functioning of the H gas area

Germany has a densely meshed transmission system for gas and a well-developed storage infrastructure (cf. also Chapter 1.3). This grid is roughly 38,000 km in length, and is connected via a large number of interconnection points with the grids of neighbouring countries. This transport infrastructure is the reason why the German gas market, which is located at the “centre of Europe”, has developed into a leading trading place in Europe.

In the past, the gas consumed in the northern part of the supply area, Schleswig-Holstein and Hamburg, largely came from Danish deposits. In view of the decline in domestic output, Denmark has for some years been increasingly relying on a supply from imports via the Ellund station from Germany. The upgrading of the German system necessary for this has been completed.

The neighbouring area stretches from the import points (IPs) on the North Sea to the systems that bring gas from Schleswig-Holstein, Saxony-Anhalt, Thuringia, to the import and, in some cases, export points in the south from the Czech Republic and Austria and in the west from the Netherlands and Belgium, and to the export points to France and Switzerland.

An important role is played by the import of large quantities in the north-west of Germany. Large quantities also enter the area via the pipeline systems from the east and the north-east. The prevailing direction of flow is thus from the north-east to the south-west. In the western part, the Aachen region, there are further import points to the western transport system. This means that further quantities of gas can enter Germany from the Netherlands and Belgium via Eynatten/ Raeren and Bocholtz. Eynatten/ Raeren can also be used as an export point.

In the southern part, there are important import points on the borders to the Czech Republic and Austria. The main export points are located on the borders with France, Switzerland and Austria. The transport system serves both transit and supply.

The eastern part of the supply area covers Mecklenburg-Western Pomerania, Brandenburg, Saxony-Anhalt, Saxony, Thuringia and Berlin. The gas for the eastern part of the supply area comes from import points in the east via Poland, in the north-east via the Baltic, and in the south from the Czech Republic. Part of the required gas is fed in from the west of Germany. This means that the transport system serves both transit and supply.

The Nord Stream and OPAL (Ostsee-Pipeline-Anbindungsleitung) pipelines came on stream at the end of 2011. Up to 35 billion m³ of gas can be taken off the Nord Stream pipeline via OPAL each year. This means that Nord Stream and OPAL, together with transport pipelines in the Czech Republic (Gazelle), cover the quantities to be received at the Waidhaus IP and strengthen the security of supply, particularly for Germany, France and the Czech Republic. The NEL (Nordeuropäische Erdgasleitung) pipeline, which came into full commercial operation as of 1 November 2013, runs from the landing point of Nord Stream in Lubmin near Greifswald to the west through Mecklenburg-Western Pomerania to Lower Saxony. Since then, more than 20 billion m³ of gas has been able to flow through the NEL each year.

1.2.2 Description of the functioning of the L gas area

The L gas grids in the north (GASPOOL market area, TSOs: Gastransport Nord GmbH (gtg Nord), Gasunie Deutschland Transport Services GmbH (GUD), Nowega GmbH (nowega)) have grown up over time around the existing deposits. These are the deposits in Germany with the large areas of Elbe/ Weser and Weser/ Ems, and in the Netherlands with the Groningen field, the gas from which is imported via the Oude Statenzijl station. These remain the only sources today. Storage systems to structure the output and to cover peak loads are located in Nüttermoor/ Huntorf, Lesum and Empelde. The grid is designed for a supply from these deposits, and only offers limited flexibility.

Like the northern grids, the L gas grid in the west (NCG market area, TSOs: Open Grid Europe GmbH (OGE), Thyssengas GmbH (TG)) primarily serves to supply final consumers via the various levels of the grid. Due to a high proportion of household customers, the sales of gas are highly dependent on temperatures. This means that difficult grid situations arise not only when it is working at full capacity, but also in intermediate and low demand situations. The system is

supplied firstly by imports from the Netherlands. Secondly, it is topped up with gas from the GASPOOL market area with gas produced in Germany. Storage systems to structure the output and to cover peak loads are located at Epe.

Due to the infrastructure situation, the two German L gas market areas differ. For example, the German L gas production is located exclusively in the GASPOOL market area.

The two market areas are affected to differing degrees by the decline in L gas production in the Dutch Groningen field:

The GASPOOL market area is only linked to the Dutch grid for L gas imports via the IPs at Oude Statenzijl. The directly affected TSOs are gtg Nord and GUD; Nowega does not have its own L gas IP. Oude Statenzijl solely transports gas from the Groningen field, which is affected by the earthquake problem.

The L gas system operators of the NCG market area (OGE, TG) can also be supplied with gas converted from H to L gas in the Netherlands via the IPs at Winterswijk/ Vreden, Elten/ Zevenaar, Tegelen and Haanrade. This means that the NCG market area is less immediately affected by earthquake-related falls in output. However, it should be noted that 75% of the planned capacity of the Dutch conversion capacities is already being used. If there are restrictions on the output of L gas, therefore, it is likely that there will be relatively little additional capacity from conversion. The NCG market area obtains further quantities of L gas via connectors to the GASPOOL market area.

The Rehden conversion plant in the Nowega grid area has a total capacity of 2.8 GWh/h, but for redundancy reasons and only limited available nitrogen the TSO plans its deployment with a maximum capacity of 1.4 GWh/h. In the NCG market area, the existing Broichweiden (TG) conversion plant will be optimised from 2019, but it is much smaller than the Rehden plant and, due to the way it is connected to the grid, only has a limited area of impact. This plant has a planned maximum capacity of 0.3 GWh/h.

In view of the declines in German L gas production and L gas imports from the Netherlands, Germany decided to convert the L gas market areas to H gas, stipulating this in Section 19a of the Energy Industry Act. The relevant TSOs are working together with their downstream DSOs on the conversion timetable, which states the dates on which the relevant supply areas are converted from L to H gas.

The conversion timetable has been included as an input variable in the national Network Development Plan. The investment measures deriving from the Network Development Plan for Gas at transmission system level which are required for the conversion from L to H gas have been submitted to the regulatory authority for scrutiny. As an element of the national Network Development Plan, these investment measures are basically legally binding. If there is any need to adapt the conversion plan, changes can be made when the Network Development Plan is drafted.

It is no longer possible to publish a breakdown of the gas import sources by country of origin for data protection reasons.

1.3 Storage

Adequate availability of storage capacity with a high take-off capacity is a key factor in ensuring the supply of natural gas, particularly in the case of supply bottlenecks and the coverage of seasonal fluctuations in consumption.¹ At present, underground storage facilities are commercially operated in Germany at 49 sites; these can hold approx. 24.3 bn m³ of working gas. In detail, these are 17 aquifer reservoirs and 32 cavern systems with 270 individual caverns.² They are scattered across almost the whole of Germany, with geological factors meaning that many are located in the north-west, central Germany and the south-east (cf. Figure 2). In line with the structure of the German gas market, the vast majority of storage facilities are used to store H gas.

1 Storage levels can be found at <https://agsi.gie.eu/#/>.

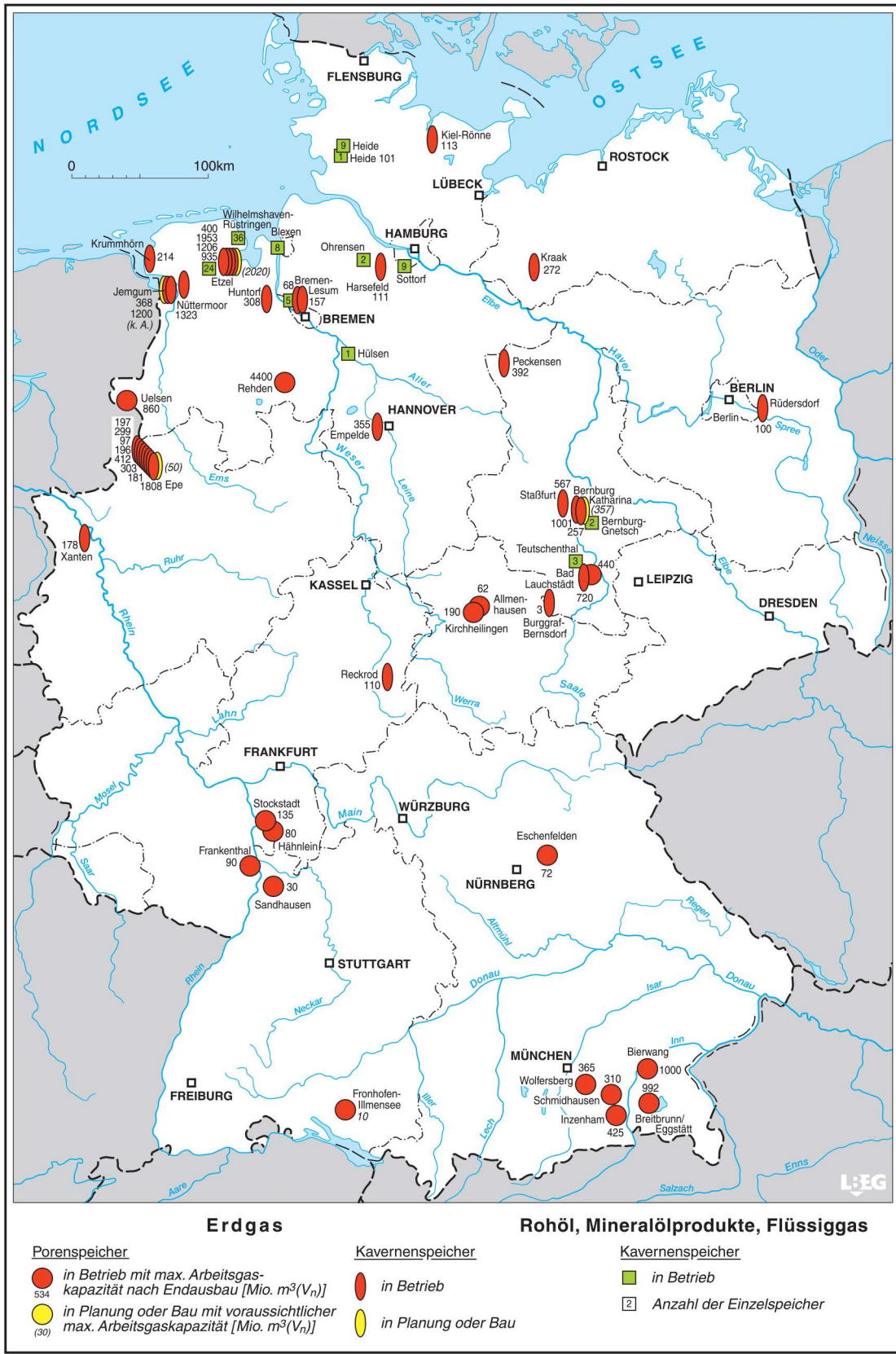
2 LBEG – State Authority for Mining, Energy and Geology: “Erdöl und Erdgas in der Bundesrepublik Deutschland 2017”, Table 22

The current maximum useful working gas volume of approx. 23.5 bn m³ equates to around a quarter of the gas consumed in Germany in 2018. The German gas sector has the largest volume of storage in the European Union, and the fourth-largest underground storage capacities in the world. Increased take-off rates in the case of disruption to supply are naturally limited by the fact that the take-off performance declines as the amount of gas in the storage facility falls. Should all planned storage projects actually be realised, a maximum working gas volume of approx. 27.7 bn m³ will be available in the long term. This means that Germany will theoretically be able to cover approx. one-third of its annual gas consumption from storage facilities in future. Also, quantities of stored gas are available in Austria in the Haidach and 7Fields underground facilities close to the border; these are connected directly by pipeline to the German system.

There is no restriction on access to storage facilities in Germany. It is agreed by contract between the market partners and must be granted on a non-discriminatory basis. All of the storage facility operators are private-sector companies. There are no strategic storage or reserve facilities. This means that German storage facilities are also available for foreign customers.

The traders use the storage facilities. For example, they can retain sufficient quantities to meet the needs of their customers in the underground storage facilities, particularly during periods of cold weather and in the event of unexpected supply disruptions. It should be noted that users of storage facilities do not tend to book storage capacity for the long term.

Figure 2: Map of German gas storage facilities



L:EG Hannover - L.2.2 - Anl_14 Untertagespeicher_2017.fh11

Stand: 31.12.2017

Übersichtskarte der Untertagespeicher für Erdgas, Rohöl, Mineralölprodukte und Flüssiggas.

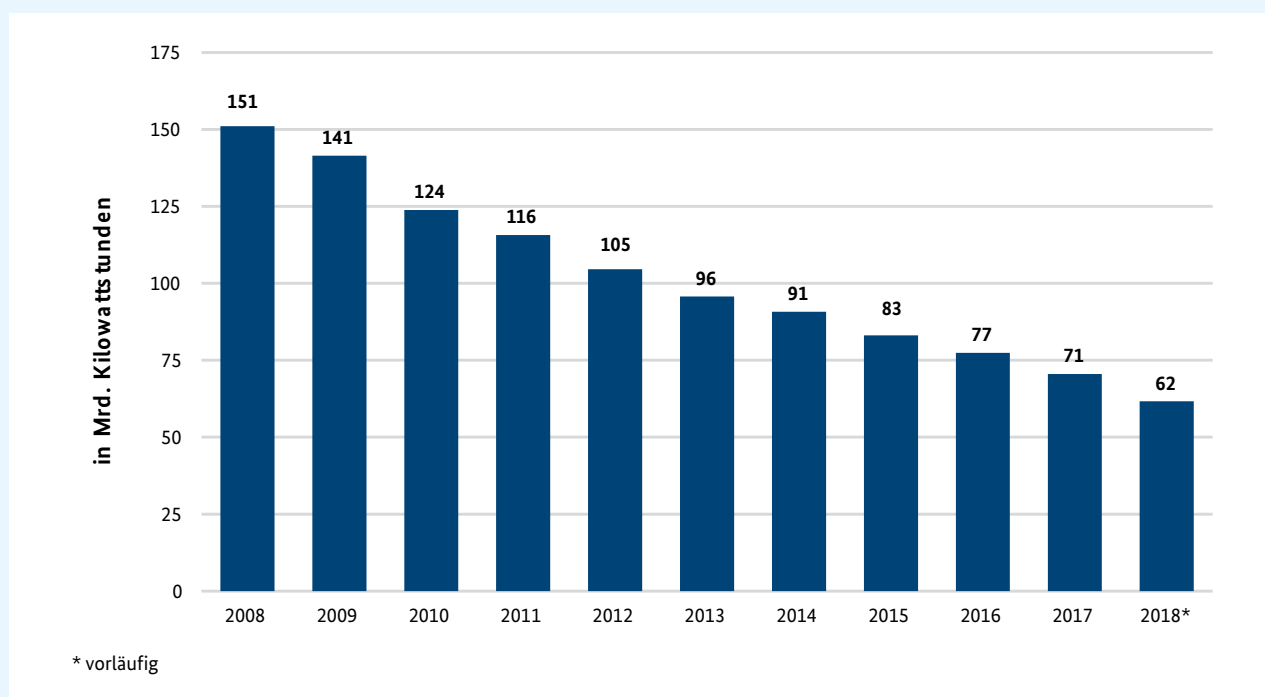
Source: LBEG 2017, annual report "Erdöl und Erdgas in der Bundesrepublik Deutschland" (Oil and Gas in the Federal Republic of Germany)

1.4 German gas production

On the supply side, domestic production makes a contribution towards meeting demand for gas. For example, German gas production covered around 6.5% of annual gas consumption in 2018. Total domestic output amounted to approximately 61.6 TWh in 2018 (2016: 70.5 TWh)³. Technically, with a safety margin, the maximum possible daily output is 25.16 million m³ (245.8 GWh). Around 96% of the gas produced in Germany comes from the two largest German production areas. In terms of quality, it is mainly relatively heterogeneous L gas with a varying calorific value. The domestic production is not sufficient to meet Germany's demand for L gas, resulting in a large need for additional imports from the Netherlands. The gradual fall in L gas imports from the Netherlands and the relating market area conversion means that the L gas supply area is becoming smaller and smaller in Germany, until it will ultimately only cover the direct vicinity of the domestic fields.

In the scenario framework, the 2018-2028 NDP for Gas forecasts that German gas production will decline steadily over the coming years. In 2007, the amount of gas extracted in Germany was still as high as 17.03 billion m³ (166 TWh). Ten years later, this figure was down to 7,25 billion m³ (71 TWh). See also Figure 3. According to forecasts by the BVEG (Federal Association for Gas, Petroleum and Geothermal Energy), the quantity extracted will drop to 5.59 billion m³ (55 TWh) in 2023 and even to 3.47 billion m³ (34 TWh) in 2028, or only just under half of the volume extracted in 2017.

Figure 3: Development of domestic gas production



Quelle: Statistisches Bundesamt, BVEG, BDEW; Stand : 02/2019

Based on these assumptions, the scenario framework for the 2018-2028 NDP for Gas defines the future import requirements for Germany up to 2028. To this end, the gas production in Germany, i.e. domestic extraction and the feed-in of biogas, is contrasted with the total demand for gas in Germany. With regard to the Preventive Action Plan, it should be noted that despite the more or less declining demand for (H and L) gas in future in Germany, the dependency on imports of gas to cover domestic gas demand will continue to be a factor influencing the security of supply. This does not factor in the quantities of renewable gas deriving from power-to-gas technologies, which are described in the 2018 NDP as being a future option for the substitution of fossil gas.

1.5 Description of the role of gas in electricity generation

Gas accounted for 81.8 TWh, or around 13% of total German net power generation in 2018. This share contrasts with a declining trend between 2011 and 2015, when gas-based net electricity generation dropped by 6%, or 28.5 TWh.

Table 2: Net electricity generation in Germany by energy source

year	nuclear energy	Lignite	hard coal	natural gas	mineral oil products	renewable energy
2000	160.708	136.100	131.200	47.000	5.400	37.079
2001	162.316	142.302	127.204	52.902	5.709	37.948
2002	156.287	145.666	123.533	53.818	8.073	45.123
2003	156.456	145.669	134.711	60.292	9.485	44.200
2004	158.378	145.536	129.383	60.581	9.881	54.988
2005	154.612	141.630	123.059	70.071	10.997	60.417
2006	158.711	138.467	126.837	72.608	9.955	69.022
2007	133.229	142.328	130.799	75.447	9.011	85.425
2008	140.710	138.090	114.423	86.244	8.722	90.209
2009	127.690	133.653	98.773	78.236	9.058	91.789
2010	132.971	134.169	107.357	86.560	7.860	101.127
2011	102.241	137.888	103.177	83.505	6.364	119.726
2012	94.180	148.147	106.755	74.000	6.785	139.007
2013	92.127	149.163	116.754	65.264	6.446	147.681
2014	91.800	144.328	108.670	58.911	5.031	157.767
2015	86.765	143.045	107.003	59.803	5.545	183.469
2016	80.038	138.397	102.732	78.758	5.217	184.455
2017	72.155	137.365	85.377	83.837	4.933	210.942
2018*	72.081	134.512	75.710	81.080	4.642	220.476

*vorläufig

Quellen: Statistisches Bundesamt, ZSW, Öko-Institut, BDEW

Stand: 02/2019

Table 2: Net electricity generation in Germany by energy source (continued)

year	thereof:							total	natural gas share (in percent)	
	hydro power	wind power onshore	wind power offshore	photo-voltaics	biomass	urban waste	geothermal energy			others
2000	24.550	9.498	0	40	1.608	1.383	0	21.002	538.489	8,7 %
2001	22.852	10.508	0	76	3.124	1.388	0	19.785	548.166	9,7 %
2002	23.382	15.783	0	162	4.333	1.463	0	16.788	549.288	9,8 %
2003	17.469	18.713	0	313	6.057	1.648	0	18.677	569.490	10,6 %
2004	19.828	25.509	0	557	7.447	1.647	0	19.565	578.312	10,5 %
2005	19.312	27.230	0	1.282	10.169	2.424	0	22.038	582.824	12,0 %
2006	19.663	30.710	0	2.220	13.468	2.961	0	23.322	598.922	12,1 %
2007	20.751	39.713	0	3.075	18.359	3.527	0	24.396	600.635	12,6 %
2008	20.098	40.547	0	4.420	21.463	3.669	12	22.668	601.066	14,3 %
2009	18.697	38.648	0	6.583	24.492	3.355	14	19.470	558.669	14,0 %
2010	20.650	37.793	0	11.729	27.180	3.755	20	24.464	594.508	14,6 %
2011	17.304	48.883	0	19.599	30.126	3.795	19	23.280	576.181	14,5 %
2012	21.697	50.670	0	26.380	36.264	3.971	25	23.054	591.928	12,5 %
2013	22.654	50.803	905	31.010	37.933	4.305	71	23.589	601.024	10,9 %
2014	19.322	55.908	1.449	36.056	40.128	4.837	67	24.396	590.903	10,0 %
2015	18.667	70.922	8.162	38.726	42.335	4.565	92	24.775	610.405	9,8 %
2016	20.220	66.324	12.092	38.098	42.811	4.746	164	24.738	614.335	12,8 %
2017	19.979	86.293	17.414	39.401	42.897	4.802	156	24.452	619.061	13,5 %
2018*	16.259	90.760	19.060	46.163	43.073	4.979	182	24.954	613.455	13,2 %

*vorläufig

Quellen: Statistisches Bundesamt, ZSW, Öko-Institut, BDEW

Stand: 02/2019

In 2011, renewable energy accounted for around 21% of total German electricity generation, a figure which rose by 13.2 percentage points to a total of 36% in 2018. Even though renewable energy accounted for more than a third of total German electricity generation in 2018, the energy produced in this way is subject to some strong fluctuations in the course of the year.

1.6 Description of the role of energy efficiency measures and their impact on annual final consumption of gas

At European level, the Member States agreed in June 2018 (formal entry into force at the end of 2018) with the European Parliament and the European Commission on a reduction in the proportion of primary energy consumption consumed for energy purposes by 32.5% in 2030 compared with the consumption figure forecast for 2030, and anchored this in the new version of Energy Efficiency Directive. In order to achieve this target, Member States must notify national indicative contributions. The basis for the measurement of the national contribution towards attaining the Union target is the national target confirmed in the 2010 Energy Concept, which was confirmed in this legislative term. According to this, primary energy consumption is to be cut by 20% by 2020 and by 50% by 2050, compared to the baseline year 2008. The necessary measures and a German contribution towards the EU's 2030 energy efficiency target will be drafted and adopted in 2019 in the context of a federal energy efficiency strategy. The data currently available do not permit any reliable statement as to whether any, and, if necessary, what energy efficiency measures will impact the gas market.

Gas is an energy source which is already making a rapid and effective contribution via available and innovative technologies towards leveraging potential for efficiency.

In the context of the energy transition, a key role is played by the heat market, since it accounts for nearly 40% of final energy consumption in Germany. In the medium term, the demand for gas in the building sector will not fall due to efficiency measures, since increases in efficiency due to improvements in heating systems will be overridden by the replacement of oil-based heating with gas-based heating.

In the field of grid-based heating supplies, the consumption of gas will increase where coal-fired CHP installations are replaced by gas-based, flexible CHP installations. Alternatives, and particularly the use of renewable energy in heat networks, can mitigate this rise. In densely populated urban areas, the grid-based heat supply can contribute to an economically cost-efficient heat transition. In the long term, the consumption of gas will fall significantly due to the diminishing heat requirement in the building sector and the use of renewable heat.

2. Summary of the national risk assessment pursuant to Art. 7 SoS Regulation

Germany's natural gas supply is assessed as very secure and reliable. The TSOs have a wide range of market-based instruments at their disposal in the case of disruption to supply, and these are suited to maintaining the supply of protected customers and are generally sufficient.

With a view to a secure and reliable supply of gas, it is very important that the gas transport infrastructure which exists in Germany links the German gas market with a relatively high number of supply sources. In addition to the "traditional" pipeline gas, which is mainly imported from Norway, Russia and the Netherlands, the German market has additional volumes of gas available to it in the medium term which are already being landed in the single European market in the form of LNG.

It is equally important that the transport infrastructure in Germany is designed to ensure that several routes are normally available via which gas can be transported from a supply source onto the German market. In this context, mention should be made for example of the Nord Stream 1 gas pipeline in the Baltic Sea; it offers a direct connection between Russia and Germany.

In particular against the background of the declining domestic production of gas in the medium to long term, the need to import gas will remain a fundamental structural feature of the German gas market.

In order to boost security of supply in Germany, however, a particular role is played by the system expansion measures undertaken by the TSOs; not least, these are increasing the transport capacities at IPs. The ongoing expansion of the gas system is minimising the supply risk. The Network Development Plan for Gas (NDP Gas), which has to be compiled by the TSOs – annually from 2012 and every two years from 2016 – ensures a coordinated grid expansion (Section 15a of the Energy Industry Act).

Security of supply in Germany is also decisively boosted by the high availability and use of gas storage facilities (with a total of 49 underground storage sites). Germany has by far the large storage capacity in the EU.

Although the trend is pointing downwards, the ongoing high proportion of long-term reservation of storage capacity in the coming years suggests that sustainable use will continue to be made of the storage facilities. At present, more than 95% of the storage capacity is booked up.

The liquid market for gas trading in Germany has a positive impact on the efficiency of supply and thus on the security of supply. It is generally possible to buy and sell volumes of gas at prices formed on a competitive basis at short notice.

Gas currently accounts for about 13% of the German power supply. In comparison, the share of renewable energy totals around 36%. The feed-in of renewable energy is subject to sharp fluctuations across the year. Gas-fired power stations can be used to offset these, as they can be deployed very flexibly.

In periods of low feed-in from renewable energy, or in the case of grid congestion, Germany's gas-fired power stations, particularly in southern Germany, play an important role in the electricity supply in terms of delivering system stability. In response to this, the legislature has regulated the systemic relevance of gas-fired power stations in Section 13f of the Energy Industry Act. This ensures the maintenance of the gas/fuel supply for gas-fired power stations which have been designated systemically relevant.

Germany fulfils the infrastructure standard ($N-1 \geq 100\%$) of the SoS Regulation.

If there is a failure at IP Mallnow, which in view of the special situation at the Greifswald IP is the largest German gas infrastructure in operation, the result is at least 199%.

As the infrastructure standard of the SoS Regulation uses a purely arithmetical contrast of “remaining” feed-in capacity for the whole of Germany against the maximum daily load, also determined for the whole of Germany, it is difficult to draw conclusions about security of supply at regional level from the calculated indicator. This is particularly true of the assessment of the physical situation of the grid in the case of disruption to supply which mainly impacts at regional level.

In general, the German gas grid can be regarded as very secure. Based on past experience, the likelihood of a serious disruption to supply is less than once in 50 years.

3. Infrastructure standard

3.1 N-1 formula

Note:

Not all of the technical capacity at IP Greifswald is included in the calculations. In nominal terms, Greifswald has a technical capacity of 1,570 GWh/d, but only 618.8 GWh/d are considered. It is necessary to make this distinction, because if the IP Greifswald is used at full capacity, for technical reasons relating to the grid some of the gas must flow from there to Waidhaus via the Czech Republic, because it cannot be fully absorbed by the German gas grid, so that part of the gas has to be transported away via OPAL to IP Brandov. The capacity of IP Greifswald is therefore adjusted by the capacities of OPAL which have been designated for transit. This reflects the technical situation on the grid.

Definition of the calculation parameters of the N-1 formula

The N-1 formula is now described (cf. Annex II.1. of the SoS Regulation):

$$N - 1 [\%] = \frac{EP_m + P_m + S_{m100\%} [S_{m30\%}] + LNG_m - I_m}{D_{max}} \times 100, N - 1 \geq 100 \%$$

For the calculation of the infrastructure standard, the variables were defined as follows:

$$EP_m \text{ (million m}^3\text{/d)} = 565.74$$

Total of the technical capacity of all German IPs (taking into account the special situation at IP Greifswald described above).

The conversion of the technical capacities from GWh/d to m³/d was made using the factor 10.83 kWh/m³.

In view of its central location in Europe and in the European gas infrastructure, Germany is a transit country for gas flows. In the SoS Regulation's formula, the capacities of the exit points at the borders are completely disregarded.

$$P_m \text{ (million m}^3\text{/d)} = 25.16$$

Total of the maximum technical daily production capacity of all gas production installations in Germany (incl. biogas production).

$$S_{m100\%} \text{ (million m}^3\text{/d)} = 672.16; S_{m30\%} \text{ (million m}^3\text{/d)} = 526.56$$

For this risk assessment, these figures were obtained from the storage operators for individual storage facilities and represent the total of the individual figures. Competing grid connection situations are disregarded; for this reason, the figure is much higher than in the last few risk assessments. In those assessments, the totality of German storage facilities was considered.

For the Haidach and 7 Fields storage facilities, it was assumed in the calculation that 50% of the offtake capacity are available to Germany. Whilst these two storage facilities are located in Austria, they are connected to both the Austrian and the German gas systems.

Pursuant to the SoS Regulation, and in line with the import capacities, no consideration is to be given to whether the stored volumes of gas are destined for export.

I_m (million m³/d) = 86.01

The infrastructure element with the largest supply capacity is IP Greifswald, with a technical capacity of 1570.3 GWh/d (145 million m³/d). Technically, however, as indicated above, it is not possible to fully use this capacity for the supply of Germany. A failure of the Greifswald IP would therefore only result in the following reduction in import capacities to the German supply area:

1,530.7 GWh/d – 951.5 GWh/d = 618.8 GWh/d (57.14 million m³/d)

At the same time, the import capacity of Mallnow IP exceeds this amount:

Import capacity of Mallnow IP = 931.5 GWh/d (86.01 million m³/d).

In view of the greater impact on Germany's supply, calculations of the loss of the largest import capacity should be based on the capacity of Mallnow IP.

The entry point capacities of the production, LNG and storage facilities in Germany are smaller than that of the largest IP.

LNG_m (million m³/d) = 0

The total of the largest possible daily offtake capacities of all LNG installations in the calculated area, taking account of discharging, auxiliary services, temporary storage, regasification and the technical capacity to feed the gas into the grid.

Germany does not currently have any LNG installations, so this figure is put at zero.

D_{max} (million m³/d) = 517.44

Describes the total daily demand for gas in Germany on a day of extraordinarily high demand, the statistical probability of which is once in 20 years, as provided in the Regulation; directly included here are the systemically relevant gas-fired power stations.

These are the parameters defined in the Regulation for which the infrastructure standard is calculated below.

Data used

To a very large extent, generally available data were used to calculate the infrastructure standard. Specifically, these are publications of the TSOs on the technical capacity at the IPs, data from the association of German gas producers, data of the BDEW on biogas feed-in, and data from the storage operators regarding the maximum technical withdrawal capacity.

Calculation

Compliance with the infrastructure standard is based on whether, assuming a failure in the gas supply at the point of import with the largest entry capacity to Germany, enough gas can enter via the "remaining" transport capacities to satisfy the calculated maximum daily demand in Germany.

N-1 calculation

The N-1 formula is as follows for the above-mentioned parameters:

$$N-1 [\%] = \frac{565,74 + 25,16 + 672,16 [526,56] + 0 - 86,01}{517,44} \times 100,$$

$$N-1 \geq 100 \%$$

Outcome:

N-1 [%] = 227 % [199 %]

3.2 Bidirectional capacities

Tabelle 3: Bidirectional capacities

Name of point	Entry/Exit	TSO	Type of gas	Type of capacity	MWh/h
Deutschnedorf	Entry	ONTRAS	H-Gas	TAC*	8,264
Deutschnedorf	Exit	ONTRAS	H-Gas	TAC	4,400
Eynatten	Entry	GASCADE	H-Gas	TAC	5,687
Eynatten	Exit	GASCADE	H-Gas	TAC	5,525
Eynatten/Raeren	Exit	Fluxys TENP	H-Gas	TAC	3.396
Eynatten/Raeren	Entry	OGE	H-Gas	TAC	6,022
Eynatten/Raeren	Exit	OGE	H-Gas	TAC	4,033
GCP GAZ-SYSTEM/ONTRAS	Entry	ONTRAS	H-Gas	TAC	4
GCP GAZ-SYSTEM/ONTRAS	Exit	ONTRAS	H-Gas	TAC	2,029
H095 – OUDE STATENZIJJL H	Exit	GUD	H-Gas	TAC	1,926
H104 – OUDE STATENZIJJL H	Entry	GUD	H-Gas	TAC	2.678
H106 – ELLUND	Entry	GUD	H-Gas	TAC	3,622
H207G – GREIFSWALD	Entry	GUD	H-Gas	TAC	7,182
Mallnow	Entry	GASCADE	H-Gas	TAC	38,812
Mallnow	Exit	GASCADE	H-Gas	TAC	7,700
Oberkappel	Entry	GRTgazD	H-Gas	TAC	5,607
Oberkappel	Exit	GRTgazD	H-Gas	TAC	538
Oberkappel	Entry	OGE	H-Gas	TAC	1,055
Oberkappel	Exit	OGE	H-Gas	TAC	7,769
Oude Statenzijl	Entry	OGE	H-Gas	TAC	2.978
Oude Statenzijl	Exit	OGE	H-Gas	TAC	6,759
Überackern 2	Entry	bayernets	H-Gas	TAC	9,589
Überackern 2	Exit	bayernets	H-Gas	TAC	9,016

* TAC = technically available capacity

Source: The current dates are available on <https://www.nep-gas-datenbank.de>

The first version of Regulation (EU) No 994/2010 concerning measures to safeguard the security of gas supply of 20 October 2010 already provides for the general technical upgrading of all cross-border interconnectors to accept reverse flow. The Bundesnetzagentur was designated by Section 54a subsection 2 number 2 of the Energy Industry Act as the competent authority for implementing this process. The first examination was carried out in 2012. At the time, 14 German TSOs submitted applications for a total of 52 cross-border interconnectors. Each of the applications was for an exemption from the upgrading requirement. Only the TSO Gascade withdrew its application for an exemption from the Bundesnetzagentur following discussions with the Polish side, and applied for an upgrading of Mallnow for exit from Germany to Poland. Apart from Poland, no other Member State participated in the consultations on the various applications for exemptions. In the other direction, the Bundesnetzagentur was asked by Belgium, the Netherlands and Poland for the possibility to make comments.

In the following rounds of examinations, no new facts have emerged which would require an alteration of the authorisations previously issued in 2012. This means that all the approvals issued by the Bundesnetzagentur in accordance with Annex 3 no 13 of the SoS Regulation remain in force. All the approvals were issued without a time limit.

4. Compliance with the supply standard

4.1 Protected customers

In line with the revised definition, the term “protected customers” of gas undertakings means directly supplied

- a) end-users in the gas distribution network receiving gas directly from gas undertakings and that are subject to standardised load profiles, or end users in the gas distribution network receiving gas directly from gas undertakings and delivering gas for heating purposes to households, to the extent that the gas is needed for this purpose.
- b) essential social services within the meaning of Article 2(4) of Regulation (EU) No. 2017/1938 and within the gas distribution network and the gas transmission network, and
- c) district heating systems – to the extent that they are used to deliver heat to customers within the meaning of lit. (a) and (b) and that they are connected to a gas distribution network or a gas transmission network and are unable to switch to a different fuel, and to the extent that this gas is needed for heating purposes.

The new definition of the “protected customer” was reported to the European Commission in February 2018. This definition is currently being implemented in national law.

4.2 Gas volumes and capacities

4.2.1 Requirements pursuant to Art. 6(1) a) of the SoS Regulation

Pursuant to Art. 6(1) a) of the SoS Regulation, the supply standard requires that the gas undertakings maintain the supply of the “protected customers” even in the case of particularly high gas consumption, and take appropriate preventive action. Three scenarios are prescribed for this:

Case a) **Extreme temperatures** during a 7-day peak period occurring with a statistical probability of once in 20 years

Case b) Any **period of at least 30 days of exceptionally high gas demand**, occurring with a statistical probability of once in 20 years

Case c) For a period of 30 days in case of the **disruption of the single largest gas infrastructure** under average winter conditions

4.2.2 Calculation for Germany

This provision is currently being implemented in national law. The new definition of “protected customers” reported to the European Commission is taken as a basis for the following calculation of the supply standard (cf. Chapter 4.1). Pursuant to this, gas undertakings have a particular responsibility for supplying gas to household customers, as well as to district heating installations to the extent that such installations deliver heating to household customers and, since the new definition of “protected customers” within the meaning of the SoS Regulation, also for standard load profile customers which are not household customers, and basic social services.

This means that the gas undertakings must also be able to ensure gas supply to protected customers in these three cases, and are obliged to take appropriate measures to this end.

Supply scenario a) Extreme temperatures during a 7-day peak period, once in 20 years

Pursuant to Article 6(1) a) of the SoS Regulation, the gas utilities must ensure supply for protected customers at extreme temperatures during a 7-day peak period occurring with a statistical probability of once in 20 years. In terms of the last 20 years, the relevant period for this (defined at the time when the risk analysis was produced) is from 27 December 1996 until 2 January 1997. In this period, the weighted temperatures were between -7.9C and -3.6C.

On the basis of the calculation parameters set out above, the total gas consumption of protected customers in Germany for the period cited in Art. 6(1) a) of the SoS Regulation is 2,000 million m³. The maximum possible quantity of imports at the IPs for this period is 3,960 million m³ of natural gas, meaning that the supply standard can be deemed to be met.

Side note:

The consumption in the Austrian network areas (Tirol and Vorarlberg), which can only be supplied via the German gas grid, totalled 27 million m³ for supply scenario a), and took place in the period of 3-10 February 2012. The consumption of the systemically relevant gas-fired power stations amounted to 260 million m³ over 7 days. This means that the gas requirement to be covered in this special case, during a 7-day peak period of extreme temperatures, is 2,287 million m³, adding the quantities for the aforementioned network areas in Austria and the systemically relevant gas-fired power stations. The maximum possible quantity of imports at the IPs for this period is 3,960 million m³ of natural gas, which is larger than the calculated demand. **This calculation is for information only and is of no relevance to the application of the SoS Regulation.**

Supply scenario b) A period of at least 30 days of exceptionally high gas demand, occurring with a statistical probability of once in 20 years

Pursuant to Article 6(1) b) of the SoS Regulation, the gas utilities must ensure supply for protected customers for a period of at least 30 days of exceptionally high gas demand, occurring with a statistical probability of once in 20 years. On the basis of the calculation parameters set out above, the total gas consumption of protected customers in Germany for the period cited in Art. 6(1) b) of the SoS Regulation is 7,478 million m³, and occurred in the period from 8 January 2006 - 6 February 2006. The maximum possible quantity of imports at the IPs for this period is 16,972 million m³ of natural gas, meaning that the supply standard can be deemed to be met.

Side note:

The consumption in the Austrian network areas (Tirol and Vorarlberg), which can only be supplied via the German gas grid, totalled 99 million m³ for supply scenario b), and took place in the period of 24 January - 23 February 2012. The consumption of the systemically relevant gas-fired power stations amounted to 1,113 million m³ over 30 days. This means that the gas requirement to be covered in this special case, during a 30-day peak period of exceptionally high gas demand, again adding the quantities for the aforementioned network areas in Austria and the systemically relevant gas-fired power stations, is 8,690 million m³. The maximum possible quantity of imports at the IPs for this period is 16,972 million m³ of natural gas, which is larger than the calculated demand. **This calculation is for information only and is of no relevance to the application of the SoS Regulation.**

Supply scenario c) Disruption of the single largest gas infrastructure under average winter conditions for a period of 30 days

Pursuant to Article 6(1) c) of the SoS Regulation, the gas utilities must ensure supply for protected customers for a period of at least 30 days in case of the disruption of the single largest gas infrastructure under average winter conditions.

On the basis of the calculation parameters set out above, the total gas consumption of protected customers in Germany for the period cited in Art. 6(1) c) of the SoS Regulation is 5,768 million m³, based on the period of 1 - 30 January 2011 as an average winter month. The maximum possible quantity of imports at the IPs for this period, assuming a failure of the Mallnow IP, is 14,392 million m³ of natural gas, meaning that the supply standard can be deemed to be met.

Side note:

The consumption in the Austrian network areas (Tirol and Vorarlberg), which can only be supplied via the German gas grid, totalled 77 million m³ for supply scenario c), and took place in the period of 23 November - 23 December 2012. The consumption of the systemically relevant gas-fired power stations amounted to 1,113 million m³ over 30 days. This means that the gas requirement to be covered in this special case, the disruption of the single largest gas infrastructure under average winter conditions for a 30-day period, adding the quantities for the aforementioned network areas in Austria and the systemically relevant gas-fired power stations, is 6,958 million m³. The maximum possible quantity of imports at the IPs for this period, assuming a failure of the Mallnow IP, is 14,392 million m³ of natural gas, meaning that the supply standard can be deemed to be met. **This calculation is for information only and is of no relevance to the application of the SoS Regulation.**

Table 4: Supply standard for Germany

Scenario	Needs of protected customers met?
a) extreme cold, 7 days	✓
b) exceptional gas demand	✓
c) failure of largest single infrastructure, 30 days	✓

4.3 Measures to comply with the supply standard

- a) The risk assessment shows that all the requirements of the SoS Regulation are met in Germany. This means that the German gas undertakings have not only been required to meet the supply standard, but are also very probably in a position to fulfil this; **no further measures are necessary in order to comply with the two prescribed infrastructure and supply standards.**
- b) In Germany, a distinction is made between the following players, in particular in terms of ensuring the supply of gas, with their corresponding responsibilities:

Transmission system operators (TSOs): operate grids with border-crossing points or market-area crossing points which in particular ensure the inclusion of large European import pipelines in the German transmission system, (...) and which are responsible for the orderly operation, maintenance and if necessary the expansion of a grid (...) [cf. Section 3 no. 5 of the Energy Industry Act].

Distribution system operators (DSOs): are responsible for distributing gas and for operating, maintaining and if necessary expanding the distribution system in a particular area and possibly also the connectors with other systems [cf. Section 3 no. 7 of the Energy Industry Act].

Underground storage operators (USOs): are responsible for storing natural gas and operating a storage facility [cf. Section 3 no. 9 of the Energy Industry Act].

Transport client (TC): Wholesalers, gas suppliers, end consumers [cf. Section 3 no. 31b of the Energy Industry Act].

Market Area Manager (MAM): natural or legal person nominated by the TSO and providing services in a market area needed to ensure an efficient handling of access to the gas system in a market area [cf. Section 2 no. 11 of the Gas Network Access Ordinance]. Procures balancing energy to offset physical differences between input and offtake. Has information about the balancing supply situation in the market area.

Balancing group manager (BGM): natural or legal person answering to the market area manager and in charge of the handling of the balancing group [cf. Section 2 no. 5 of the Gas Network Access Ordinance]. Nominates to TSOs and MAMs on behalf of its TCs, responsible for the management of the balancing groups, obliged to ensure the availability of quantities and the equilibrium of the balancing groups within the market area.

Input and offtake systems operators (ISOs, OSOs): system operators with which the transport client concludes an input or offtake contract [cooperation agreement].

The unbundling of the market roles within the meaning of the EU single market packages liberalising the electricity and gas markets requires that the market players undertake the tasks directly relating to their respective roles. In line with this, the operators of gas supply systems (all TSOs, DSOs) and storage facilities (USOs) pursuant to Sections 6 ff. of the Energy Industry Act currently operate independently from the other fields of activity of energy supply and ensure the non-discriminatory handling of access to the grid and storage. The complexity of the market activities on the German gas market has thus increased significantly in recent years.

The rules governing the various activities on the market, including the safe and secure operation of the gas grid, derive chiefly from the Energy Industry Act, the relevant ordinances and the corresponding regulations of the Bundesnetzagentur, and the generally accepted rules of the DVGW (German Association for Gas and Water).

5. Preventive measures

Key Issues paper on gas

On the basis of the Key Issues paper entitled “Measures to further improve security of the gas supply” (https://www.bmwi.de/Redaktion/DE/Downloads/E/eckpunkte-gasversorgungssicherheit.pdf?__blob=publication-File&v=5), which was published by the Federal Ministry for Economic Affairs and Energy at the end of 2015, the MAMs developed two cost-efficient measures to strengthen Germany’s gas balancing energy markets. These measures were firstly an expansion of the contracting of the existing “Long term options” (LTO) balancing energy product, and secondly the introduction of a long-term “Demand-Side Management” (DSM) balancing energy product. The expansion of the contracted volume serves to cover the highly unlikely case that the balancing energy requirement cannot be adequately covered via exchange-based or bilateral trades. The system operators now have a larger amount of balancing energy reserve products available with which to alleviate bottlenecks in their gas networks. The independent DSM product was merged with the LTO product with effect from 1 January 2018 and is thus no longer a separate balancing energy product. This means that, with the new overall LTO product, bids can be submitted for maintenance of capacity within a balancing energy (sub)zone which, if they are called on, can be fulfilled at all entry and exit points which can be nominated and at RLM exit points in the respective balancing energy (sub)zone. In order to increase the readiness and operative possibility for industrial end-users to participate in the balancing energy market, the number of possible days on which the capacity can be called up within a commissioning period has been restricted, and the possibility opened up for the pooling of different flexibility sources. This means that the market is also opened up for these reserve products to those industrial end-users which are connected not only to the transmission system, but also to the downstream gas system (offtake system). Further to this, “short-term balancing services” (STBs) have been introduced as a further non-standardised balancing energy product to cover short-term local supply shortages. The MAMs can use the STB product at short notice in case of need to achieve balancing energy potential which suppliers cannot offer via the standardised trading products (e.g. industrial customers can offer reductions in consumption in return for payment of a price for their service).

An annual evaluation of the measures is envisaged in the context of the balancing energy report to be compiled by the MAMs and can be used for further improvements in the two measures.

5.1. Risk prevention measures

5.1.1 Market area conversion from L to H gas

The conversion of the German L gas area to H gas is the greatest challenge to the long-term security of the gas supply in Germany. Even if possible measures – such as the use of flexibility instruments (e.g. conversion plants or storage), the acceleration of the conversion process from L to H gas, the increase in the trade in L gas in general – are implemented fully and quickly, these will be insufficient to fully offset the existing risk. For this reason, the German government is calling on the Dutch government to ensure that decisions relating to Dutch gas production do not impact negatively on German L gas security.

Against the background of the ongoing L gas market area conversion, the legislature has amended the Energy Industry Act in terms of the requirement to connect new connection users in the L gas area and created the possibility for operators of L gas supply networks to refuse new connections to the L gas network in certain circumstances. The new statutory rules are particularly targeted at new connections with a high capacity requirement – difficulties relating to the connection of household customers to a gas grid are extremely unlikely – and must be seen against the background of the planned production cuts in the Netherlands. The German gas industry commenced the process of incremental market conversion at an early stage and prepared itself for the changes. The Federal Government aims at no significant increase in the demand for L gas during the market conversion. This should also be regarded as an expression of prudent and responsible action.

In order to ensure an incremental and smooth transition of the L gas areas to H gas, the German government has established a comprehensive legal basis in the form of Section 19a of the Energy Industry Act. These include new rules on passing on costs, on reimbursement entitlements for the owners of end-use equipment, access rights for the system operators to adjust the end-use equipment, etc. Apart from this, the cooperation agreement between the gas grid operators (KoV X) contains detailed stipulations for the conversion process.

5.1.2 Reversal of the TENP

500 km of the TENP pass through Germany and provide a direct connection between the Dutch and Belgian gas markets with the Swiss market. This has traditionally been the route from the Dutch and Belgian trading points to the south. The TENP is also connected to the MEGAL system, which carries Russian gas to Germany.

The liberalisation of the gas markets, the rising demand in southern Germany, and the development of southern transport routes is increasing the demand for transport capacities in a south-north direction. For this reason, the TSOs Open Grid Europe and Fluxys TENP are planning to make the pipeline bidirectional. In future, the upgrading of the southern gas corridor will make it possible to transport gas from Italy via Switzerland towards Germany and beyond when required. This will diversify the transport routes and boost security of supply in western Europe. Cf. also Chapter 7.

5.2 Other preventive measures

The risk assessment shows that Germany is already in full compliance with the infrastructure and supply standards stipulated in the SoS Regulation and already has a comparatively large number of entry routes which also offer the possibility of reverse flow to supply the German market (“diversification of the supply sources”). The neighbouring markets can also obtain gas from Germany via various routes. This means that, both for the German and the neighbouring markets, the risk of serious impairment of security of supply due to the failure of individual import supply infrastructures is limited.

Ongoing close cooperation between all sides and the timely implementation of corresponding measures is necessary in order not only to maintain, but where necessary and useful in macroeconomic terms also to further increase the resilience to supply crises and thereby to further reduce the likelihood of supply crises as defined in the SoS Regulation. This is particularly true of the use of market-based congestion avoidance instruments, the strengthening of the possibilities for cooperation on the operation of the grid, expansion of the grid, the establishment of additional cross-border interconnectors with reverse flow capability, the expansion of storage facilities, cooperation between the electricity and gas sectors, and improvements in the data basis. The measures cited on these issues have already been decided and are now being implemented. The necessary cross-border coordination between German and neighbouring foreign system operators on the handling of bottleneck situations is discussed in Chapter 8.

5.2.1 National Network Development Plan for Gas (NDP)

In view of the significance of natural gas for Germany’s energy supply, an important role is played by expanding the gas grid infrastructure in a manner that meets demand and makes sense in overall economic terms. Gas is the second most important primary energy source behind oil. In 2017, its share of primary energy consumption (i.e. the total quantity of energy used by a country in a year) was 23.8%. Gas will continue to make a major contribution to Germany’s energy supply in the coming decades.

Various network expansion measures both in Germany and in neighbouring countries have significantly improved the security of supply in the transport of gas, particularly following the bottleneck situation in February 2012. With a view to diversification, the transport infrastructure in Germany is designed to ensure that several different routes are normally available via which gas can be transported from a supply source onto the German market. In addition to the Key Issues paper of the Federal Ministry for Economic Affairs and Energy entitled “Measures to further improve

security of the gas supply”, a particular role is also played by the system expansion measures undertaken by the system operators in the German transmission system; these increase the transport capacities at IPs.

The Network Development Plan for Gas (NDP Gas), which has to be compiled by the TSOs – annually from 2012 and every two years from 2016 – ensures a coordinated grid expansion which serves the needs of the economy (Section 15a of the Energy Industry Act).

The NDP is mainly based on the requirements of a framework scenario confirmed by the Bundesnetzagentur, covering gas consumption, extraction, storage, import and new infrastructure projects. The core finding of the scenarios is that, nationwide, a slight to medium-sized decline in gas consumption can be expected over the next ten years. However, the development in gas demand can vary widely between regions. Whilst a massive drop is expected in eastern Germany, there will actually be clear increases in southern Germany. When it comes to the subsequent calculation of the grid expansion (grid modelling), however, the transport capacities are the main driver. Here, it can be seen that a decline in gas consumption does not always go hand in hand with a decline in the necessary capacities, e.g. due to changed flow direction in the grid or an increase in the capacity needs of downstream system operators or industrial clients.

The Network Development Plans and Scenario Frameworks of recent years each contain various modelling variants with different assumptions of the capacity products and levels to be used in the system calculation for gas-fired power stations, storage facilities, IPs and downstream systems, and create the basis for the planning of the expansion of the system and thus for the future expansion of the system.

At present, the 2018-2028 NDP for Gas is binding, with security of supply being delivered on the basis of the current, temporary restriction in the transport capacity of the TENP pipeline system. The coordination of the new, planned infrastructure projects for gas takes place at European level in the context of the Ten Year Network Development Plan (TYNDP) of the European Network of Transmission System Operators Gas (ENTSO-G).

2018-2028 Network Development Plan for Gas (NDP)

The currently valid NDP for 2018-2028 cites grid expansion measures entailing investment of €6.9 billion up to the end of 2028. This involves expansion of 1,364 km of pipelines and the newbuild of 499 MW of compressor capacity. Basically, the measures of the 2016-2026 NDP are confirmed by the findings of the 2018-2028 NDP. Furthermore, 47 additional expansion measures are necessary in the outlook up to 2028; these mostly result from the need to convert the market area due to the falling L gas imports from the Netherlands in the coming years, the consideration of increased H gas demand and of increased capacity need for planned reserve gas-fired power stations. Furthermore, individual measures are due to the increased capacity requirement in the distribution system, particularly in the area of southern Germany.

In addition to modelling the basic and storage variants, the 2018-2028 NDP also contains other security of supply scenarios. One security of supply scenario covers the supply of L gas in the context of the market area conversion from L to H gas. It takes an accounting-based approach to analysing the market areas for low and high calorific gas, taking security of supply aspects into consideration. Another modelling variant in the 2018-2028 NDP covers the temporary restriction of the transport capacity on the TENP pipeline system. The reason for this is corrosion damage on a line in the TENP pipeline system, which results at IP Wallbach in a reduction of transport capacity of roughly 50%. In order to ensure that the line can be safely recommissioned, further studies and repairs to the pipeline system must be carried out up to the end of September 2020. Against this background, a security of supply scenario has been drawn up which considers the theoretically feasible case that the current transport situation on the TENP could continue after 30 September 2020.

The Network Development Plans always model a “security of supply scenario” in which assumptions are made about the effects of feasible disruption to supply (Section 15 subsection 1 of the Energy Industry Act). Since the NDP Gas 2013, the ongoing L-H gas conversion has been the subject of detailed discussions. The TSOs have fleshed out the conversion planning further each year, and have now provided an outlook for the conversion roadmap up to 2030.

The NDP is drawn up by the TSOs in a public consultation process involving all the affected market participants. The specific measures can be found in the TSOs' NDP Gas 2018-2028 (www.netzentwicklungsplan-gas.de).

5.2.2 Cross-border interconnectors and gas flowse

Germany has a widespread long-distance grid totalling about 38,000 km, which is interconnected with the long-distance gas grids of neighbouring countries via 29 IPs (as calculated by ENTSOG, cf. Figure 4).

A relatively large number of import routes are available to supply the German market ("Diversification of supply routes") and the neighbouring markets are also able to obtain gas from Germany via various routes. This means that the risk of disruption to supply is reduced both for the German and the neighbouring markets. The Nord Stream and OPAL pipelines came fully on stream at the end of 2012. Up to 36.5 billion m³ of gas can be taken off the Nord Stream pipeline via OPAL each year (32 billion m³ in transit and 4.5 billion m³ taken off at Groß Körös near Berlin). This means that Nord Stream and OPAL, together with the Gazelle pipeline in the Czech Republic, cover the quantities to be received at the Waidhaus IP and strengthen the security of supply, particularly for Germany, France and the Czech Republic, and also for Slovakia and Austria and beyond.

Cross-border movements of gas exist with all of Germany's neighbours, and there are also supplies of gas from Russia and Norway via pipelines which do not pass through other countries.

Figure 4: The German long-distance gas grid and its integration in the European transport infrastructure



Quelle: ENTSOG Mai 2017, Das Europäische Erdgasnetz (kapazitäten an Grenzübergangspunkten auf dem Primärmarkt, Ausschnitt, BMWi)

5.2.3 Cross-border crisis management exercise (LÜKEX)

On the basis of Section 14 Federal Civil Protection and Disaster Relief Act, the 8th cross-border crisis management exercise LÜKEX 18 took place on 28 and 29 November 2018. The exercise was prepared with the participants at more than 80 events during more than 2 1/2 years. The exercise covered the issue of a national gas shortage. Unlike a power outage, a large-scale gas shortage with direct effects on private households is not an event which occurs abruptly, but one which gradually builds up. Gas pipelines and gas storage facilities initially serve as buffers when supplies to the system fail.

The exercise took place on the basis of the Emergency Plan for Gas for Germany (in the version of December 2016). In line with the severity of a gas shortage, the Emergency Plan for Gas differentiates between three crisis levels (early warning, alarm and emergency). As each of these three levels was to be mapped in LÜKEX 18 and the related processes and responsibilities practised, the gas shortage had to incrementally worsen in the course of the LÜKEX scenario. In order to enable this scenario to be mapped on two exercise days, several leaps forward in time were required in the exercise design. For this reason, LÜKEX 18 consisted of four exercise sections, including the discussions of the plans, which were separated in the imaginary exercise period by three leaps forward of several days each. The core exercise times were 8 a.m. to 6 p.m. on 28 November and 8 a.m. to 4 p.m. on 29 November 2018.

The scenario was based on a particularly cold and long winter period. Due to this extreme weather and the related high level of gas demand, the volumes held by the storage facilities fell rapidly in the scenario. In addition, there were many technical, economic and weather-related factors, e.g. disruption to gas imports at IPs, which taken together resulted in a shortage of gas and placed the Bundesnetzagentur in the position of federal load distributor. As the exercise continued, not only the industrial customers were cut off – this happened at the very start – but also increasing numbers of “protected customers”. This meant that homeland security became increasingly prominent.

At the outset of the scenario (the imaginary date was 30 January 2019), the southern German gas storage facilities were relatively empty, at an average of 40% full. Further to this, the TSOs announced forthcoming restrictions on supply from abroad.

In the course of the scenario, the storage levels dropped and the withdrawal rates increased in the gas storage facilities. Furthermore, there were repeated increased restrictions on supply at IPs in the H gas area. In the course of the exercise, all three stages of the emergency action plan were identified or announced.

When the emergency level was declared, on the afternoon of the first day of the exercise, the Bundesnetzagentur became the federal load distributor and was tasked with ensuring vital gas deliveries by distributing the load as a sovereign actor.

This means that the LÜKEX 18 scenario was based on the real situation in February 2012, when parts of Baden-Württemberg and Bavaria experienced supply bottlenecks due to the unusually high utilisation rate of the gas supply systems in their region and the simultaneous reduction in gas imports to Germany.

The participants in the exercise were, at federal level, the Federal Ministry of the Interior, Building and Community and the Federal Ministry for Economic Affairs and Energy, along with its agency, the Bundesnetzagentur. Further to this, the exercise included the Länder of Baden-Württemberg, Bavaria, Berlin, Brandenburg, Hesse, Rhineland-Palatinate, Saarland, Saxony, Saxony-Anhalt and Thuringia, as well as companies with “critical infrastructure” (TSOs) and business associations. The European Commission observed the exercise.

Basically, the exercise showed that the envisaged emergency measures and information processes work well in the field of crisis management in the gas sector. However, during the substantial preparatory phase for LÜKEX 18 and the exercise itself, a corresponding need for changes to or for greater detail in the legislation was identified, primarily in the Energy Security of Supply Act, the Ordinance to Ensure the Supply of Gas in a Supply Crisis, and the Energy Industry Act.

5.2.4 Improving the data basis and transparency

A well-grounded assessment of the gas supply situation requires a good, aggregated data basis which can be broken down by region. This is not merely the case for crisis situations in which the measures described in the Emergency Plan take effect. Rather, it is particularly important to keep mapping the situation, to recognise incipient bottlenecks in terms of quantities and capacities at an early stage and to provide the market players with these without delay so that rapid and effective action can be taken in response. This is primarily a task for the gas industry, which takes preventive measures to tackle bottlenecks and disruption on its own responsibility, deploying market-based instruments anchored in the Energy Industry Act and the Annex to the SoS Regulation.

In order to improve the data basis available to the authorities, the TSOs and the Bundesnetzagentur, with support from the German Association for Gas and Water (DVGW), have drawn up a concept for the automated transmission and storage of system data (“load flow data protocol project”). The TSOs transmit hourly figures for each relevant point in the system, particularly on the maximum technical capacities, nominations and load flows, as well as interruptions, to a data platform run by the German Association for Gas and Water (“IT-based collector”). The reports are submitted once a day for the previous gas day. Before further analysis, the raw data are subject to continuous and rigorous plausibility checks by the Bundesnetzagentur.

This coordinated and established process can help the Bundesnetzagentur to meet its obligation to exchange information with the European Commission during an emergency pursuant to Art. 14(1) b) of the SoS Regulation, as long as for their part the TSOs have transmitted data to the German Association for Gas and Water and the Bundesnetzagentur can access their server. It is true that this approach to data transmission has generally functioned smoothly in technical terms, but it is necessary to make the point that neither the Bundesnetzagentur nor the German Association for Gas and Water, can guarantee data provision during an emergency.

Furthermore, the nomination figures from the transport clients to the TSOs can provide daily forecasts for capacity demand, which can be used by the European Commission when it considers the supply of and the demand for gas pursuant to Art. 14(1) a) of the SoS Regulation.

When requested by the Federal Ministry for Economic Affairs and Energy, the evaluated data will be rapidly passed on from the Bundesnetzagentur to the Federal Ministry for Economic Affairs and Energy.

5.2.5 Integrated rules on the supply of electricity and gas

As already stated in Chapter 4, the Bundesnetzagentur’s risk report on the gas supply situation in Germany concluded in June 2014 showed that it is necessary to take an integrated view of the security of supply in the gas and electricity sectors. For example, in a bottleneck situation in the gas system, interruptions to the supply of gas-fired power stations can endanger the security and stability of the electricity grids. Such an unprecedented situation became particularly apparent during the tense supply situation in February 2012. The unusually high demand for gas coincided with impending instability on the power grid. Gas-fired power stations which had interruptible rather than fixed capacity had to be temporarily taken off the gas grid as a precaution in order to manage congestion in the gas grid, and this exacerbated the congestion in the electricity grid.

The “**Third Act revising Energy Industry Rules**” contains rules on improving security of supply and ensures that an integrated view is taken of the gas and electricity systems.

The new Section 16 subsection 2a of the Energy Industry Act in conjunction with Section 13f of the Act is of especial significance for security of supply. Basically, in the case of a bottleneck in the field of electricity and gas, the operator of the electricity transmission system must weigh up the potential damage and other repercussions in the case of any necessary emergency measures in both fields, and on this basis can require that “systemically relevant” gas-fired power stations are supplied with gas. The designation of a gas-fired power plant with nominal capacity above 50 megawatts as “systemically relevant” (for a maximum period of 24 months in each case) is undertaken by the electricity transmission system operator and must be approved by the Bundesnetzagentur (cf. Section 13f subsection 1 of the Energy

Industry Act). This rule does not mean that the systemically relevant gas-fired power stations are given equal status to the “protected customers” within the meaning of Art. 2 of Regulation (EU) No 2017/1938.

Furthermore, pursuant to Section 13 subsection 1 of the Energy Industry Act, the operators of systemically relevant gas-fired power plants are required to ensure that the feed-in of effective capacity and reactive power or the take-off of effective capacity is adjusted when so required by the TSOs. This means that the power plant must be operationally ready. To this end, the operator of the gas-fired power plant can use existing fuel-switching possibilities to secure the necessary capacity if this is possible in technical and legal terms and reasonable in economic terms (this is stipulated explicitly in Section 13f subsection 2 sentence 1 of the Energy Industry Act). Alternatively, the TSO can require the operator of the gas-fired power station to book the necessary quantity of fixed capacities in the gas supply system in order to establish operational readiness within the meaning of Section 13a subsection 1 of the Energy Industry Act. Should the relevant operators of the gas supply networks not currently be able to offer any fixed capacities, they must take all technically possible and economically reasonable measures to enable them to offer these fixed capacities as quickly as possible.

So that system operators can ensure security of supply in their networks whilst keeping network user fees as low as possible in the interest of a low-cost energy supply (Section 1 of the Energy Industry Act), Section 14b of the Act permits the offering of interruptible gas network connection contracts in distribution networks. These enable the distribution system operators to temporarily interrupt or reduce the take-off of gas from the system in order to compensate for bottlenecks in the upstream transmission system. The intention is to extend the scope to adjust the entry and exit of gas on a market basis in the instance of supply bottlenecks. In order to create economic incentives for final consumers to conclude such contracts, under Section 14b of the Energy Industry Act operators of gas distribution networks calculate a reduced network fee in return if the interruptibility of the use of gas connections is contractually agreed between network operator and final consumer in order to reduce the burden on the system. These interruptible contracts can thus be advantageous for both contracting parties and permit the network operators to take preventive action to improve the security of supply in the form of such flexible contracts.

In addition to the above-mentioned measures, which are anchored in the Energy Industry Act, various working groups in the gas sector are aiming in particular to stipulate clear rules on communications between the system operators within the sector and also between the electricity and gas sectors. At federal level, all the German gas and electricity TSOs have developed and put in place a joint concept for communication and decision-making processes, enabling them to respond at an early stage to possible transport bottlenecks in the electricity and gas sector. On a weekly basis, the electricity TSOs produce a forecast of the likely need for systemically relevant gas-fired power stations in the forthcoming week. This forecast is transmitted to the gas TSOs, which check whether they can supply gas to the necessary systemically relevant gas-fired power stations which do not have fixed capacities. These measures are the sector’s response in particular to the experience gained in the tense transport situation in the gas networks in February 2012.

In Germany as a whole, there are in principle sufficient power generation capacities, but the existing bottlenecks in the system mean that these generation capacities cannot be fully used at present, particularly for the supply in southern Germany, since the expansion of the electricity grid will only result in structural improvements in this situation in a few years’ time.

6. Other measures and obligations

The following stipulations in this legislation should be highlighted:

- a) **All gas undertakings** are responsible for supplying the public with gas. The gas undertakings carry out these tasks on their own responsibility.
- b) The **system operators** are responsible for the secure operation and the necessary expansion of the grid.

The national rules of relevance to the Preventive Action Plan are mainly found in the provisions of Sections 53a and 54a of the Energy Industry Act; they have been inserted in order to implement the SoS Regulation.

6.1 Responsibilities of the gas undertakings

Clearly defined **general economic obligations** have been imposed on all gas undertakings operating in Germany with regard to the supply of the population and the protected customers in particular:

- According to Sections 1 and 2 of the Energy Industry Act, they are tasked with ensuring a **supply of gas to the general public** which is as secure, low-cost, consumer-friendly, efficient and environmentally compatible as possible.
- According to Section 15 of the Act, the TSOs must ensure the **stability of the grid**. To this end, they can use the instruments cited in Section 16 of the Act.
- Pursuant to Section 53a of the Act, the gas undertakings are responsible for **meeting the supply standard** in line with the SoS Regulation. In particular, they must supply the category of “protected customers” with gas, even in the case of a partial interruption to the gas supply or in the case of unusually high demand for gas, “as long as it is reasonable in economic terms to supply the gas”.

Since a gas supply is only possible via secure and reliable systems, a central role is played by the TSOs and the DSOs. In the case of measures pursuant to Section 16 of the Energy Industry Act, they must take account of the need to ensure the supply to protected customers. In particular in the case of a danger of bottlenecks in the gas supply, the operation of the system and the granting and planning of capacities including transit capacities must be undertaken in a manner which maintains the security of supply to the protected customers for as long as possible.

In order to meet the supply obligations, the gas undertakings may have recourse to the market-based instruments cited in Annex II of the SoS Regulation. Depending on the market role, this includes measures like diversification of gas supplies and gas supply routes, infrastructure investment and the maintaining and use of quantities of gas in storage.

6.2 Cooperation between the system operators

The system operators must engage in close coordination with one another as they meet their supply obligations:

- **Provision of information:** In order to secure the supply of gas, the TSOs / DSOs shall be obliged pursuant to Section 15 subsection 2 of the Energy Industry Act to provide the necessary information to every other operator of gas supply systems which is linked with its own system. The obligation also applies to operators of storage facilities.
- **Network Development Plan (NDP)** According to Section 15a of the Energy Industry Act, the TSOs are required to draw up the NDP every two years. In the Plan, they jointly ascertain the need for infrastructure in the next ten years. The TSOs make available the necessary information for this. Following approval by the Bundesnetzagentur, this plan is binding for the TSOs.
- **Capacities for reverse flows:** The TSOs are responsible for creating permanent bi-directional capacity on all cross-border interconnectors pursuant to Art. 6(5) of the SoS Regulation. To this end, they shall cooperate with the neighbouring TSO.

The operators of the gas supply systems located in Germany have arranged their cooperation in the form of a Cooperation Agreement (KOV). The updated version of Cooperation Agreement X (KOV X) entered into force on 1 October 2018. As before, it contains guidelines entitled “Contingency Planning for Gas”. These guidelines mainly describe procedures, related information obligations and communication channels between system operators for a coordinated implementation of the measures pursuant to Section 16 and Section 16 a of the Energy Industry Act.

Further to this, it should be noted that all operators of gas infrastructure and traders have a high level of self-interest in maintaining the security of the gas supply. To this end, they have implemented a large variety of preventive measures in their respective grid areas. Maintenance work is undertaken regularly.

6.3 Responsibilities of the authorities

The responsibilities of the authorities pursuant to the SoS Regulation are stipulated in Section 54a of the Energy Industry Act. The competent authority for ensuring the implementation of the measures stipulated in the SoS Regulation is the Federal Ministry for Economic Affairs and Energy. The Federal Ministry for Economic Affairs and Energy is thus responsible for the concept of the preventive action and emergency plan and, in the context of this responsibility and the legal framework set out above, stipulates the tasks and responsibilities of the agencies and persons involved. The Federal Ministry for Economic Affairs and Energy is also responsible for meeting the infrastructure standard pursuant to Art. 6 of the SoS Regulation.

Article 54a of the Energy Industry Act gives the Bundesnetzagentur the responsibility for the production of the risk assessment and for the procedure to put reverse flow capacity in place between Member States. Further to this, the Bundesnetzagentur shall supervise the fulfilment of the obligations imposed on undertakings or associations of undertakings in line with the Energy Industry Act and ordinances enacted on the basis of the Energy Industry Act. If necessary, it can impose measures to comply with obligations in line with Section 65 of the Energy Industry Act. Within the framework of their competencies, the Länder supervise the technical safety of facilities within the meaning of Section 49 of the Energy Industry Act.

6.4 Overview of responsibilities pursuant to the SoS Regulation

The gas undertakings and the authorities are jointly responsible for implementing the SoS Regulation; Table 3 contains an overview.

Table 5: Overview of responsibilities pursuant to the SoS Regulation

Obligation	Pursuant to the SoS Regulation	Competent authority	Relevant clause in Energy Industry Act
Infrastructure standard	Article 5(1)	BMWi	Section 54a Energy Industry Act
Supply standard	Article 6(1)	BNetzA	Section 53a Energy Industry Act
Risk analysis	Article 7(2)	BNetzA	Section 54a Energy Industry Act
Preventive Action Plan/Emergency Plan	Article 8(2)	BMWi	Section 54a Energy Industry Act
Solidarity	Article 13(1)	BMWi	Section 54a Energy Industry Act
Duty to disclose	Article 14(1), (6), (10)	BMWi	Section 53b Energy Industry Act,
Ensuring implementation	Article 3(2)	BMWi	Section 95 (1c) Energy Industry Act

7. Infrastructure projects

The following section provides an overview of the main gas grid expansion measures which have been realised since the last risk assessment in 2016 or form part of the currently valid Gas Network Development Plan for 2018–2028 and contribute towards security of supply.

Nordschwarzwaldleitung (2016)

The 71-km Nordschwarzwaldleitung (North Black Forest Pipeline) is located in the southern German area of the grid operators Fluxys TENP, Open Grid Europe and terranets bw. The pipeline increases the transport capacities in southern Germany and was built by terranets bw in the period up to 2016. In Baden-Württemberg, Nordschwarzwaldleitung connects to the existing Trans Europa Natur Gas Pipeline (TENP), which transports gas from the Netherlands to Switzerland and Italy – in future also in the opposite direction. The Nordschwarzwaldleitung represents a major increase in capacities for the gas-fired power stations and distribution systems located in southern Germany.

MONACO I (2017)

Monaco I has helped to reduce congestion in the southern German area since winter 2017/2018. The 86.7 km pipeline runs from Burghausen on the Austrian border to Finsing. Its effects include the increase in transfer capacity between the TSOs Open Grid Europe and bayernets, the increase in transport capacities to the 7Fields and Haidach storage facilities, and an increase in the exit capacities for downstream system operators. It must also be mentioned that Monaco I also serves to cover gas demand in Germany by connecting to international transport pipelines.

Schwandorf-Forchheim (2017) and Forchheim-Finsing (2018) pipelines

In parallel to the existing pipeline system in Bavaria, the TSO Open Grid Europe has expanded the existing transport system to include loop pipelines from Schwandorf to Forchheim and from Forchheim to Finsing; the 62 and 78 km pipelines were commissioned in 2017 and 2018 respectively. The pipelines help to improve the capacity situation in Bavaria and the connections to the 7Fields and Haidach storage facilities.

Rothenstadt compressor station (2018)

As of winter 2018/19, GRTgaz Deutschland and Open Grid Europe commissioned the new Rothenstadt compressor station on the MEGAL pipeline system. The new station has three compressor units with a total capacity of 45 MW. The station is intended to compress volumes of gas coming from the east in MEGAL I and MEGAL II to the west, and to increase the pressure for the transfer of certain volumes to the south towards Schwandorf and Munich. The new Rothenstadt compressor station will ensure the necessary increase in the transfer capacities of Open Grid Europe with bayernets, and the provision of the necessary transport capacities for the Haidach, 7fields and Inzenham storage facilities.

Werne compressor station (2017)

Werne compressor station is a central hub in the German long-distance gas grid at which pipelines converge from various directions. The TSO Open Grid Europe is currently working on a reversal of the compression station so that in future gas will also be able to flow from south to north. The measure was commissioned at the end of 2017. This has not least improved the transfer capacities towards Denmark and between the TSOs Open Grid Europe and Thysengas, thus increasing security of supply. At the same time, the measure plays an important role in the conversion of grid areas from L to H gas.

Rehden conversion plant (2016/2021)

The TSO Nowega commissioned a conversion plant in Rehden in early 2016 to convert H gas into L gas. The Nowega grid area hosts important German L gas deposits. The planning for the L-H gas conversion of the German TSOs envisages making full use of these German gas deposits. To this end, the plan is to continue to supply grid areas covered by Nowega with L gas beyond 2030. However, local production is insufficient to cover all the consumption peaks during the entire year. The conversion plant will make it possible to feed H gas into these grid areas and, converted into L gas, to use it to cover peak loads.

The existing conversion plant is currently being upgraded by Nowega to include an on-site nitrogen generation plant; once it comes on stream in 2021, it will be possible to convert an additional 1 GWh/h of output. The on-site generation of the nitrogen will mean that the plant can also operate in medium-load periods. As a result, the maximum conversion capacity will rise from 1.4 GWh/h to 2.4 GWh/h, with the existing 1.4 GWh/h continuing to be used exclusively to cover peak loads.

Wertingen compressor station (2019)

The TSO bayernets is constructing a new compressor station with three compressor units at Wertingen. It is to help improve the supply situation in the southern German area from the end of 2019. The measure increases the transfer capacities between the TSOs Open Grid Europe, bayernets and terranets bw. This will mean that the existing storage facilities of 7Fields and Haidach can be better connected, and the capacity situation will also be improved for distribution system operators.

Reverse flow in the TENP (2020)

The liberalisation of the gas markets and the development of southern transport routes is increasing the demand for transport capacities in a south-north direction. For this reason, the TSOs Open Grid Europe and Fluxys TENP are planning to make the pipeline bidirectional. In future, the upgrading of the southern gas corridor will make it possible to transport gas from Italy via Switzerland towards Germany and beyond when required. This will diversify the transport routes and boost security of supply in western Europe.

For reverse flow in the pipeline, it is necessary to reverse the Hugelheim compressor station and to build a deodorisation facility at the Swiss-German border. Commissioning is planned for the end of 2020.

NOWAL (2017)

The TSO GASCADE has built the 26 km Nord-West-Anbindungsleitung (NOWAL - North-west connection pipeline) from Rehden to Drohne. The pipeline serves to transport volumes of gas coming from the north – e.g. from the Netherlands or Nord Stream – to the German centres of consumption. This makes it possible to increase the transfer capacities from the GASPOOL market area to the NCG market area. The pipeline came on stream at the end of 2017.

Reverse flow at Waidhaus compressor station (2017)

The Waidhaus compressor station is located on the German-Czech border. So far, gas arriving from the Czech Republic has been fed into the MEGAL pipeline and transported westwards to the NCG market area. The TSOs Open Grid Europe and GRTgaz Deutschland are planning to upgrade and alter the compressor station to permit reverse flow from Germany to the Czech Republic. This will make it possible in future to use the IP Waidhaus in both directions and to transport gas, e.g. from the Netherlands or from storage facilities on the German-Austrian border to central and eastern Europe. This will improve security of supply in central and eastern Europe. The new facility came on stream at the end of 2017. BIS, the parallel pipeline to the MEGAL pipeline, strengthens an important north-south connection in the German gas grid and, as well as supplying local users (industry, gas-fired power stations), creates additional transport capacity to Austria.

8. Community obligations relating to security of supply

The Federal Ministry for Economic Affairs and Energy is the central point of contact for European partner states and the European Commission, and ensures the flow of information to these points in the context of the consultations. Crisis prevention is in principle a national responsibility; consultations take account of cross-border issues.

In order to be able to take measures to maintain security of supply in neighbouring Member States on a cross-border basis in the case of a crisis, it is urgently necessary to engage in advance **cross-border coordination between the relevant German and neighbouring TSOs at the respective international IPs**, if necessary with the backing of the competent authorities. The TSOs also involve neighbouring cross-border system operators in their considerations about the expansion of infrastructure in the context of the consultations on the Network Development Plan.

Further to this, reference is made to cooperation within the various risk groups and Chapter 10 (Regional dimension).

9. Stakeholder consultation

The Preventive Action Plan for Gas was drafted by the Federal Ministry for Economic Affairs and Energy in cooperation with the gas industry and the Bundesnetzagentur. The gas industry has ensured its involvement in the work to implement the SoS Regulation by setting up a project group under the German Association of Energy and Water Industries (BDEW); the Federal Ministry for Economic Affairs and Energy attended its meetings on a regular basis. In the course of the current revision, the BDEW, EFET Germany (European Federation of Energy Traders - Germany), FNB Gas (association of gas transmission system operators), INES (association of natural gas storage operators), and the VKU (Association of Local Utilities) were consulted.

The interests of the household and commercial consumers were taken into account via consultation with the Association of German Chambers of Industry and Commerce (DIHK) and the Federation of German Consumer Organisations (VzBV).

The Länder and the competent authorities of all neighbouring EU states, Italy, Slovakia, Sweden and Switzerland were also consulted.

10. Regionale Dimension

10.1 Summary of the Risk assessment of Baltic sea Risk group

According to the regulation, each Member State shall ensure that in the event of a disruption of the single largest infrastructure the necessary measures are taken in order to continue to supply the market. This is the infrastructure criterion. With its geographical location in the middle of Europe, Germany plays a central role as a consumer and transmission country, hence Germany is a member of seven risk groups and chairs the Baltic Sea Risk Group.

Baltic Sea Risk Group

The Baltic Sea risk group is chaired by Germany and made up of the following countries: Austria, Belgium, Czech Republic, Denmark, France, Germany, Luxembourg, the Netherlands, Slovakia, Sweden.

The description of the gas infrastructures in the various Member States reveals a tightly meshed gas infrastructure in this region. This risk group has a variety of supply sources and routes at its disposal.

The risk group possesses considerable storage capacity. Germany alone has more than 40 gas storage facilities and the second highest storage capacities in Europe (if Ukraine is included). In combination with the storage capacities in the other countries in this area, this region is capable of ensuring a very high level of security of supply.

Further to this, a considerable amount of investment is currently planned in the region (Chapter 7). The majority of the investment in Germany will have a direct and positive impact on the interconnection capacities with neighbouring Member States. Additional transport capacities have a positive effect on the trading markets, since different transport routes and supply sources can be used.

The trading markets in this region are also characterised by a high level of liquidity, which also has a positive impact on security of supply. The Title Transfer Facility (TTF) in the Netherlands and the two German market areas, Gaspool and Net Connect Germany (NCG), are trading places with some of the highest liquidity in Europe.

The region meets the N-1 standard. The calculation of the N-1 standard has been undertaken for the two leading entry points into the region, Greifswald and Velke Kapusany. Both calculations show that the N-1 standard is well above 100%. This will improve further in the future as a host of infrastructure measures will be realised which will further increase the import capacities.

The risk group has not identified a risk to which it feels particularly exposed. Risks do of course exist, particularly technical ones which cannot be entirely excluded, as was shown in 2017 by the Baumgarten incident. But at the same time one has to say that the gas infrastructure in this region displays a high level of resilience due to significant redundancies. The scenarios defined in this risk group cover the widest possible range of disruption, irrespective of the risk event triggering the disruption.

The analysis has shown that all the Member States in this risk group are capable of coping with the defined disruption to supply and interruption scenarios without external support, i.e. using the infrastructure available to them and by using alternative sources of gas, such as liquefied natural gas (LNG), without any impact on supply being expected. Furthermore, the Member States in this risk group are not reliant on support from neighbouring countries, and no cross-border effects or repercussions have been identified.

The resilience of this risk group to exogenous supply shocks is bolstered by domestic production, alternative gas imports, existing storage capacities and liquid and developed gas markets. Supply can be maintained even in the case of extreme scenarios.

10.2 Calculation of the infrastructure standard for the risk group Baltic sea

For the calculation of the N-1 standard it is assumed that the entire region is seen as one “calculated area”. This means that only the entry points connecting the region with countries outside the region are taken into account. Capacities at cross-border points inside the region are not included.

N – 1 - Standard

$$N - 1 [\%] = \frac{EP_m + P_m + S_m + LNG_m - I_m}{D_{max} - D_{eff}} \times 100, N - 1 \geq 100 \%$$

Where:

EP_m : technical capacity of entry points, other than production, LNG and storage facilities, means the sum of the technical capacity of all border entry points capable of supplying gas to the calculated area

P_m : maximal technical production capacity

S_m : maximal technical storage deliverability LNG $_m$:: maximal technical LNG facility capacity

I_m : technical capacity largest gas infrastructure

D_{max} : 1 in 20 gas demand

D_{eff} : market-based demand-side response

The single largest infrastructure in this region is the Slovakian entry point Velke Kapusany. The analysis we will conduct further focuses on the Greifswald entry point, which is slightly smaller than Velke Kapusany. The calculation of N-1 will be performed for both entry points.

Table 6: Entries for the N – 1 formula by each Member State

Member State [GWh/d]	EP_m	P_m	S_m	LNG_m	I_m	D_{max}	D_{eff}
Austria	0.0	40.4	470.6	0.0		595.2	0.0
Belgium	1 247.5	0.0	169.5	461.6		1 356.8	0.0
Czech R.	0.0	4.3	754.9	0.0		709.4	
Denmark	0.0	12.1	196.0	0.0		236.0	0.6
Germany	3 915.3	272.5	7 453.0	0.0	776.0	5 202.0	0.0
France	795.0	0.0	2 400.0	1		4 020.0	0.0
Luxembourg	0.0	0.0	0.0	0.0		52.0	0.0
Netherlands	2 266.0	2 156.0	3 421.0	399.0		3 678.0	0.0
Slovakia	2 204.8	2.1	560.2	0.0	028.0	470.9	0.0
Sweden	0.0	1.9	0.0	0.0		78.0	0.0
Σ Sum	10 428.6	2 489.3	15 425.2	2190.6	804.0	16 398.3	0.6

Table 7: N – 1: Single largest infrastructure

N-1 for region with failure of:	EPVK [GWh/d]	P _m [GWh/d]	S _m [GWh/d]	LNG _m [GWh/d]	I _m [GWh/d]	D _{max} [GWh/d]	D _{eff} [GWh/d]
Velke Kapusany (SLO)	9 168.1	2 478.2	15 245.4	2 190.6	3 804.0	16 187.8	0.5

$$N - 1 [\%] = \frac{11.372,9 + 2.478,2 + 15.245,4 + 2.190,6 - 2.028,0}{16.187,8 - 0,5} * 100 = 203 \%$$

Table 8: N – 1: Second single largest infrastructure

N-1 for region with failure of:	EPVK [GWh/d]	P _m [GWh/d]	S _m [GWh/d]	LNG _m [GWh/d]	I _m [GWh/d]	D _{max} [GWh/d]	D _{eff} [GWh/d]
Greifswald (D)	9 596.9	2 478.2	15 245.4	2 190.6	3 804.0	16 187.8	0.5

$$N - 1 [\%] = \frac{11.372,9 + 2.478,2 + 15.245,4 + 2.190,6 - 1.776,0}{16.187,8 - 0,5} * 100 = 206 \%$$

Table 9: N – 2: the two single largest infrastructures

N-1 for region with failure of:	EPVK [GWh/d]	P _m [GWh/d]	S _m [GWh/d]	LNG _m [GWh/d]	I _m [GWh/d]	D _{max} [GWh/d]	D _{eff} [GWh/d]
Velke Kapusany (SLO) + Greifswald (D)	7 568.9	2 478.2	15 245.4	2 190.6	3 804.0	16 187.8	0.5

$$N - 2 [\%] = \frac{11.372,9 + 2.478,2 + 15.245,4 + 2.190,6 - (2.028,0 + 1.776,0)}{16.187,8 - 0,5} * 100 = 193 \%$$

The common risk group infrastructure consists of several operational facilities. Even with the failure of the two largest infrastructures, the resulting figure from the N-1 formula remains distinctly above 100%. This proves that the security of gas supply does not depend on a few large facilities because the extensive infrastructure offers more possibilities to transport and distribute gas.

10.3 Cooperation between Member States

A cooperation mechanism has been drawn up pursuant to Art. 8 (4) SoS Regulation. It basically provides for all forms of communication to be used for the cooperation within the risk group. Conference calls have proved to be an efficient method. Prior to a conference, the chair presents a proposal for discussion during the conference. Objections and requests for changes which affect all Member States equally are resolved if possible in consensus. In terms of crisis prevention, it is important to have expert contacts in order to avert harm by engaging in an early and transparent exchange of information. It has proved worthwhile also to use these forms of cooperation for the drafting of the preventive action and emergency plans in order to facilitate contacts in a crisis.

Crisis prevention is in principle a national responsibility; consultations take account of cross-border issues. In order to be able to take measures to maintain security of supply in neighbouring member states on a cross-border basis in the case of a crisis, it is urgently necessary to engage in advance in cross-border coordination between the relevant German and neighbouring TSOs at the respective international IPs, if necessary with the backing of the competent authorities. In particular, a common understanding of the handling of crisis levels and resulting measures should be reached, so that crisis management can be undertaken in line with the SoS Regulation in the case of a bottleneck, particularly where there is a shortage on both sides, and the burden of the measures can be distributed equally (i.e. on a nondiscriminatory basis).

The TSOs also involve neighbouring cross-border system operators in their considerations about the expansion of infrastructure in the context of the consultations on the Network Development Plan.

10.4 Preventive measures

The risk analysis has shown that the risk of a disruption to supply in the Baltic Sea risk group – caused by technical failure – is predictable. Nevertheless, it is important to continue to ensure that the system is reliably maintained and secure.

The German Network Development Plan Gas (NDP) plays an important role in ensuring of an orderly gas supply – including in the international context. It must contain all the effective measures which are technically required in the coming ten years for a secure and reliable operation of the system. These include:

- the needs-based optimisation and strengthening of the grid
- the needs-based expansion of the grid
- the maintaining of security of supply

It thus makes a major contribution towards ensuring security of supply throughout the Baltic Sea region.

In particular, the NDP contains all the grid expansion measures which must be undertaken in the coming three years, including the timetables necessary for the implementation. The NDP is a key element for Germany, as a central transit country for gas flows. All the members of the Baltic Sea risk group – like other neighbours of Germany – depend on Germany's security of supply and benefit from a high standard of planning. The ever-broader updating of the NDP is an indispensable element of this.

In order to enable the German TSOs to continue to fulfil their responsibility for a secure and reliable operation of the grid in future, they are required to produce a joint Network Development Plan in every even calendar year and to present it to the Bundesnetzagentur, the competent regulatory authority, by 1 April (Section 15a Energy Industry Act). This Network Development Plan is based on the scenario framework, and the TSOs must use this framework as they draw up the Plan (Section 15a subsection 1 sentence 4 Energy Industry Act).

The scenario framework must include appropriate assumptions about the development of gas production, supply, consumption and exchange with other countries. Also, the TSOs must take account of planned investment projects in the regional and EU grid infrastructure, in storage facilities and in LNG regasification facilities. Finally, they must include the effects of possible disruption to supply.

In order to identify these measures, the Energy Industry Act requires that the German TSOs model the German long-distance gas grids when they draw up the Network Development Plan. This procedure guarantees not only the security of gas supply in Germany but also for their neighbouring countries.

11. Directory of figures, tables and maps

Figure 1: Gas sales by consumer group (2008–2018).....	8
Figure 2: Map of German gas storage facilities.....	12
Figure 3: Development of domestic gas production.....	13
Figure 4: The German long-distance gas grid and its integration in the European transport infrastructure.....	31
Table 1: Development of primary energy consumption from 2008 to 2018 in petajoules.....	7
Table 2: Net electricity generation in Germany by energy source.....	14
Table 3: Bidirectional capacities.....	21
Table 4: Supply standard for Germany.....	25
Table 5: Overview of responsibilities pursuant to the SoS Regulation.....	36
Table 6: Entries for the N – 1 formula by each Member State.....	42
Table 7: N – 1: Single largest infrastructure.....	43
Table 8: N – 1: Second single largest infrastructure.....	43
Table 9: N – 2: the two single largest infrastructures.....	43