National preventive action plan for Sweden's natural gas supply

– in accordance with Regulation (EU) 2017/1938 of the European Parliament and of the Council

Ref.: 2019-006087

Version 1.1 (2019-10-17)

Foreword

As the competent authority, the Swedish Energy Agency (Energimyndigheten) is obliged, pursuant to Regulation (EU) No 2017/1938 of the European Parliament and of the Council, to draw up a preventive action plan at national level.

This preventive action plan covers the western Swedish natural gas system and is based on the risk assessment that was carried out in 2018 in accordance with the regulation.

This plan applies from 15 April 2019. The European Commission issued an opinion on the plan on 17 July 2019. The plan was therefore reissued with minor updates on 17 October 2019.

Eskilstuna, March 2019

Robert Andrén Head of Department	Patricia Enhörning Project Manager

Contents

General information

The Security of Supply Regulation was adopted in November 2017 for the purpose of safeguarding the security of gas supply by ensuring the proper and continuous functioning of the internal market for natural gas. In accordance with the Regulation, security of gas supply is a shared responsibility of natural gas undertakings, Member States (notably through their competent authorities), and the Commission, within their respective areas of activities and competence. In addition, the Security of Supply Regulation states that gas supplies to protected customers must be ensured. In accordance with the option provided for in the Security of Supply Regulation, Sweden has chosen to include within the definition of ‘protected customers’ only household customers who are connected to a gas distribution network.[1] The term ‘household customers’ is also used in Directive 2009/73/EC[2]. However, in the Natural Gas Act (2005:403) the term ‘household customer’ has been replaced with the term ‘consumer’.

In accordance with the Security of Supply Regulation, after consulting competent authorities at the appropriate regional level and the Commission, the competent authority must update the preventive action plan, which is to contain the measures to be taken to remove or mitigate the risks identified in the risk assessment[3] in relation to Sweden’s natural gas supplies. The Swedish Energy Agency has consulted Denmark’s competent authority. This document constitutes the updated preventive action plan as referred to above.

The entry into force of the first Security of Supply Regulation (994/2010) has resulted in the Security of Natural Gas Supply Act (2012:273) and the Security of Natural Gas Supply Ordinance (2012:275), both of which came into force on 1 July 2012 and are now being updated in accordance with the new regulation. The Act and Ordinance authorise the Swedish Energy Agency (the competent authority) to issue regulations on the obligation of natural gas undertakings and companies using large quantities of natural gas to draw up and adhere to a preventive action plan and emergency response plan for the undertaking’s activities, referred to as ‘company plans’. One of the aims of the company plans is to specify which measures the respective companies are to take at different crisis levels, as well as to make it easier for the competent authority to gather the information on which the national plans are based.

---

[1] Government Bill 2011/12:68 Secure natural gas supply, Section 6.

[2] Directive 2009/73/EC of the European Parliament and of the Council of 13 July 2009 concerning common rules for the internal market in natural gas and repealing Directive 2003/55/EC.

[3] An account of the risk assessment is given in the document ‘Risk assessment for the western Swedish natural gas system – in accordance with Regulation (EU) No 2017/1938 of the European Parliament and of the Council

The terms used in this national preventive action plan are based on the terms in the Security of Supply Regulation, which in turn refers to the definitions in Directive 2009/73/EC and Regulation (EC) No 715/2009[4]. Where terms relevant to this preventive action plan are not contained in the aforementioned legal acts, the terms of the Swedish Natural Gas Act have been used as far as possible.

The national preventive action plan is to be updated every four years, unless circumstances warrant more frequent updates, and is to reflect the updated risk assessment.

Note

This risk assessment concerns the western Swedish natural gas system, which spans four counties: Skåne, Halland, Västra Götaland and Jönköping.

[4] Regulation (EU) No 715/2009 of the European Parliament and of the Council of 13 July 2009 on conditions for access to the natural gas transmission networks and repealing Regulation (EC) No 1775/2005.

1 Description of the system

1.1 Description of the regional risk group gas systems

Sweden is a member of three regional risk groups: risk group Denmark, risk group Baltic Sea and risk group Norway.

1.1.1 Risk group Denmark

For an overview of the regional risk group gas system, please see the Denmark regional chapter.

1.1.2 Risk group Baltic Sea

For an overview of the regional risk group gas system, please see the Baltic Sea regional chapter.

1.1.3 Risk group Norway

For an overview of the regional risk group gas system, please see the Norway regional chapter.

1.2 Description of the Swedish gas system

1.2.1 General overview - Supply

Production

There is no extraction of fossil natural gas in Sweden. Although approximately 2 TWh of biogas was produced nation-wide in Sweden during 2017, only a limited amount was injected into the western Swedish natural gas system: 399 GWh during the gas year 2016/2017.

Infrastructure

The Swedish transmission system for natural gas begins in Dragør in Denmark, crosses the Öresund strait via the Öresund pipeline to Klagshamn south of Malmö, from where the trunk pipeline heads northward to Stenungsund. The technical capacity of the Öresund trunk line and the technical capacity of the entry point of

Dragør (in Denmark) is 8.6 mcm/d. The natural gas network consists of approximately 620 km of transmission lines and 2 700 km of distribution lines. The network has one aeration station and about 40 M/R stations, which are connected to the distribution networks. Figure 1.1 illustrates the main outlines of the network.

Figure 1.1: The main outline of the Swedish natural gas network.

Key infrastructure for the Swedish natural gas system is the Öresund pipeline and the Stenlille storage facility in Denmark. Moreover, during the closure of the Tyra fields, the compressor station in Ellund at the Danish-German border is another key infrastructure for the Swedish natural gas system.

Imports

The fossil natural gas consumed in the western Swedish natural gas system is imported from Denmark via the Öresund pipeline. The gas comes mainly from the Tyra gas fields, but imports from continental Europe have in the past supplemented supplies on the Danish and Swedish markets. As shown in figure 1.2, annual imports have varied and are today around 0.8 BCM or 8.5 TWh per year.

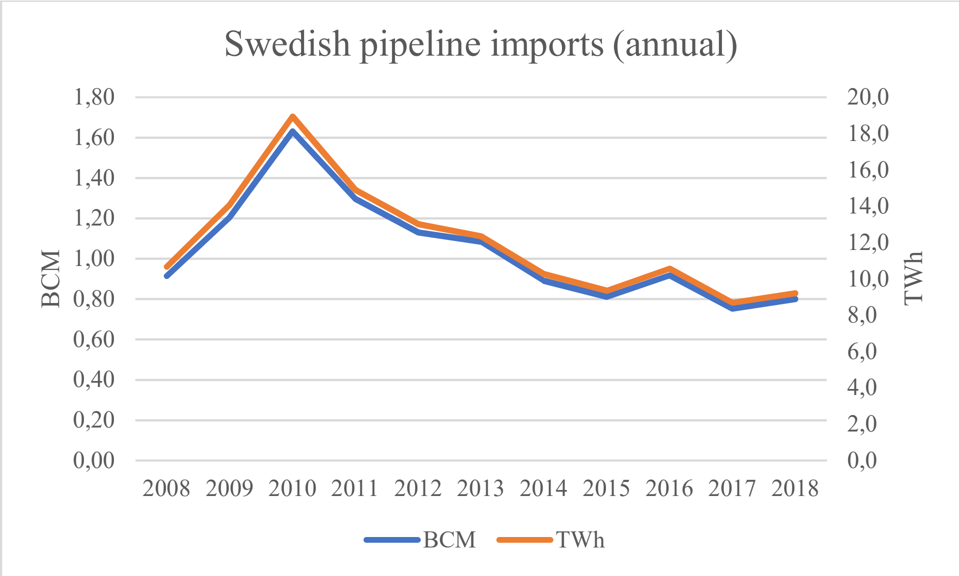

Figure 1.2: (IEA Natural Gas Information)

As shown in figure 1.3, the volume of monthly imports varies seasonally, with peak amounts imported during the late winter/early spring and smaller amounts imported during the summer months.

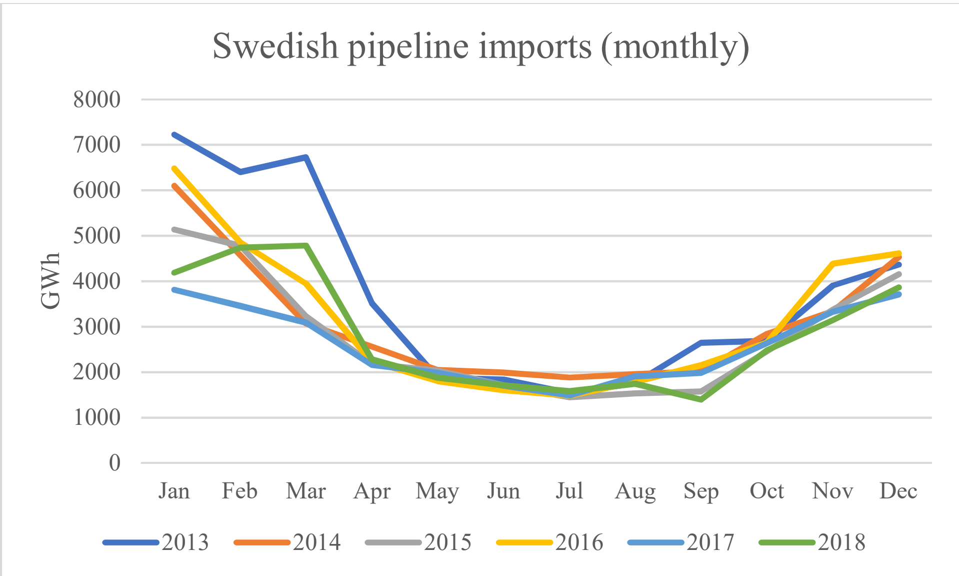

Figure 1.3: (IEA Natural Gas Information)

The calorific value of the gas imported from Denmark varies, but is currently around 12,15 kWh/Nm3.

Storage

The western Swedish natural gas system has one small gas storage facility called Skallen. Skallen has a working storage capacity of 10 million Nm3 with an available working volume of 7.3 million Nm3 and a technical withdrawal capacity of 40 000 Nm3/h. At a filling level of 0-25% the withdrawal capacity varies from 8 200-30 000 Nm3/h. However, the withdrawal capacity is also affected by the pressure difference between the trunk line and the storage; at a low-pressure difference of around 2 bar the withdrawal capacity drops to around 5 000 Nm3/h.

Previously mothballed, Skallen was reopened during the spring of 2019 and can today provide limited extra support for the western Swedish natural gas system during a strained supply situation . However, the most significant storage facilities for supply security in the western Swedish natural gas system are in Denmark, most notably the Stenlille storage facility near Copenhagen. During the winter months, supplies to consumers in eastern Denmark and Sweden are supported by injections from Stenlille, as production alone is insufficient to supply the entire combined market.

Joint balancing zone

Since 1 April 2019, the Swedish and Danish gas markets are integrated in a joint balancing zone. This has a positive effect on the security of supply in Sweden, both through improved robustness of the system as well as through improved competition on the joint market.

Shutdown of Tyra during the maintenance period

From September 2019 the Tyra gas fields will be closed for maintenance until 2022. This has a number of implications for the security of supply for Sweden and Denmark.

During the reconstruction of Tyra, the Danish and Swedish markets will for the first time be completely dependent on natural gas imports from Germany via Ellund. Germany is, in turn, dependent on supplies from other sources, notably imports from Russia. This has significantly extended the route through which gas is supplied to Denmark and Sweden and has therefore increased the risk of supply complications, both through the dependence on new key infrastructure – notably the Ellund entry point – as well as an increased exposure to political developments between the European Union and third countries.

Moreover, the natural gas that will be imported from Germany has a lower calorific value than the natural gas previously produced in Denmark: 11,23 kWh/Nm3 or roughly 8% less than the current value. This means that the energy content of both key storage sites at Stenlille and Skallen, as well as the energy content of the line-pack in the western Swedish natural gas system will be lower during the Tyra maintenance period[5]. This, in turn, means that the room for manoeuvre during potential supply shortage situations will be reduced, adding additional security of supply risks.

Future developments

The plans for the construction of the Baltic pipe from Norway to Poland via Denmark will have additional security of supply benefits for Sweden.

Work is underway to investigate the market incentives for biogas production in Sweden. This will likely result in additional biogas production in Sweden in the longer term.

1.2.2 General overview - Demand

Final consumption

During the gas year 2017/2018, the final consumption of natural gas in the western Swedish natural gas system was 8 633 GWh, and corresponds to roughly 2 per cent of total energy demand in Sweden. The maximum demand for gas in Sweden is estimated to be 7,2 MNm3/day on a cold winter day (-15 degree Celsius).

At the county level in western Sweden, the dependency on gas is higher than 2 per cent, as shown in table 1.1. It should be noted that, while detailed local level data does exist, some figures are subject to commercial classification and can in some cases only be shown as aggregates.

[5] While the energy content of the line-pack in Sweden will be reduced starting from September 2019, the Stenlille and Skallen storage facilities currently contain gas from Tyra and will only have a lower energy content starting from the new stock-build period in the summer of 2020.

Geographic area	**Natural gas as part of final energy consumption (%)**	**Natural gas as fuel for electricity production (%)**	**Natural gas as fuel for district heating (%)**
Sweden	6	1	6**
Skåne	6	12	12***
Halland	2	2*	..
Västra Götaland	25	5	6
Jönköping	2	0,01	..

Table 1.1: Overview of natural gas consumption in Sweden, 2017.[6] *(Statistics Sweden)*

In the above counties, there are 33 municipalities that have access to natural gas through the western Swedish natural gas system. In the municipalities where the natural gas network is located, natural gas can account for more than 20 percent of final energy use, which is in line with the European average.

The use of natural gas in western Sweden is characterized by the fact that a few plants account for a significant part of natural gas use. Table 1.2 provides a breakdown of consumer categories and their natural gas consumption during the gas year 2017/2018. The table shows that 80 consumers accounted for almost 80 per cent of natural gas consumption. Protected customers – roughly 30 000 households – constitute a very limited part of the market by approximately 2 per cent of total use.

[6] In this dataset, natural gas is defined as the aggregate of natural gas as well as a range of other non-renewable gases. The figures presented therefore represent an upper limit of the role of natural gas in the different categories.
* Represents the electricity generated from plants that can run on natural gas as well as on other fuels.
** Aggregate of natural gas and liquid renewables.
*** Aggregate of natural gas, liquid renewables and biogas.
.. = Classified

Consumer category		**Total energy consumed (GWh)**		**Power requirement at 0 deg. C (MW)**	
	Quantity		Share (%)		Share (%)
CHP and heating plants	40	1 754,4	20,3	588,7	35,9
Major consumers (x>20 GWh/y)	40	5 007,1	58,0	721,8	44,0
Consumers (3<x<20 GWh/y)	105	789,0	9,1	123,4	7,5
Consumers (x<3 GWh/y)	4 364	890,0	10,3	165,1	10,1
Protected customers	29 582	193,1	2,2	42,3	2,6
Total	**34 131**	**8 633,6**	**100**	**1 641,2**	**100**

Table 1.2: Breakdown of customer categories' consumption, 2017/2018, including gas for non-energy use.

The role of gas in electricity production

As shown in table 1.1, natural gas corresponds to up to 1 per cent of electricity produced at the national level and has the highest share in Skåne of up to 12 per cent. While the historical share of natural gas in the electricity sector in western Sweden has been higher, a significant tax increase on fossil fuels for power production effective as of 1 August 2019 means that natural gas will now only be used to meet peak demand under normal circumstances[7] at the local level in the future. The role of natural gas in the electricity sectors in Skåne, Halland, Västra Götaland and Jönköping is therefore now considered to be marginal.

For information on installed capacities for electricity production, see the discussion below on installed capacity for district heating production.

The role of natural gas in district heating

At the national level, natural gas corresponds to up to 6% of district heating production. As shown in Table 1.1, this data is subject to extensive commercial classification and this figure therefore constitutes an upper limit to the direct contribution of natural gas to district heating. Moreover, excess heat sold from industry to the district heating networks is not part of this figure. A survey conducted during 2018 indicated that around 1 760 GWh of excess heat was sold annually to local district heating systems in western Sweden, but this is the heat that originated from all fuels, not just natural gas. The role of gas in the sales of excess heat to local district heating systems is therefore considered to be marginal.

---

[7] For information on booked capacity to address high electricity demand situations as well as to handle disturbances in the electricity system, see section 3.2 of the Swedish national emergency plan.

There is no installed capacity capable of consuming natural gas in western Sweden that produces electricity only. The installed natural gas capacity is CHP or heat only. The production split between electricity and heat in the CHP installations can be adjusted, from 1:1 to 1:2 in most cases.

The current amount of installed heat and power capacity in western Sweden that is either completely dependent on natural gas or that can use natural gas as one of several fuels is 1,235 GW. Out of this capacity, only 124 MW of combined capacity ever consumed natural gas is 2017.

The preliminary conclusion is therefore that the dependence of district heating in western Sweden on natural gas is currently limited, but this is an area that requires further study.

Potential for fuel switching

In the power sector, around 1,5 GW of installed heat and power capacity can switch between natural gas and alternative fuels – mainly fuel oil, but also biofuels and waste. At present it is estimated that the gas consuming district heating sector in western Sweden can maintain normal output levels during a complete gas disconnection for about one week, then the output will have to be reduced. The economic viability of sustaining a switch for a longer period may however further reduce this figure. Moreover, in some cases natural gas is needed as a start-up fuel before it can be fully replaced by an alternative fuel.

Around half of the companies that responded to the 2018 survey confirmed having a capacity to switch from natural gas to alternative fuels. The choice of alternative fuels depends on the specific installations and include biogas, fuel oil, LNG, LPG, waste and electricity. However, replacing natural gas often forces the companies to make large and sometimes irreversible investment decisions. Moreover, the time taken to switch from natural gas to an alternative fuel ranges from a few hours to several months.

The preliminary conclusion is therefore that fuel switching in the power sector and in industry can handle a strained natural gas supply situation for at least a short period of time, but this is an area that requires further study.

2 Summary of the risk assessment

2.1 Regional risk assessments

2.1.1 Risk group Denmark

Risk group Denmark focused on the coming period when the Tyra facilities will be under reconstruction between November 2019-2022. During this period the Danish and Swedish market will be dependent on gas imports from Germany and an optimal use of the capacities in the system: full utilisation of the import capacity at the German-Danish border and Danish storage volumes.

The scenario which was chosen for analysis was therefore the Ellund entry point with a technical disruption in the form of an incident involving the Quarnstedt compressor station. At a minimum pressure of 60 barg the available capacity would still be around 52% of the maximum capacity of 5.186 MW. If the pressure is reduced to 55 bar, the available capacity would increase to 65% by utilising the compressor in Ellund. Therefore, there is a little risk that the capacity at Ellund will be zero.

The following scenarios were analysed: a total disruption of gas from Germany, and 65% imported gas from Germany. In both cases the Danish storage levels were assumed to be fully filled and were simulated on three different assumptions:

- A historical high demand winter
- A period of 2 weeks of exceptionally high demand
- One day (Peak Day) of exceptionally high demand.

The result of the simulations showed that if the storages were sufficiently filled, the Danish and Swedish markets will be able to manage the situation even with a 100% interruption in Ellund.

2.1.2 Risk group Baltic Sea

Two scenarios were chosen with different interruption durations and conditions. The first scenario was a 50% disruption of the Greifswald entry point with the following interruption durations and conditions:

- 2 months under average winter conditions
- extreme temperatures during a 14-day peak period occurring with a statistical probability of once in 20 years
- a peak day with a statistical probability of once in 20 years

The second scenario was a 100% disruption of the Greifswald entry point with the following interruption durations and conditions: extreme temperatures during a 14-day peak period occurring with a statistical probability of once in 20 years; and a peak day with a statistical probability of once in 20 years.

First, the competent authority in Germany analysed the effect of a 50% and a 100% disruption of the Greifswald entry point on all the cross-border points. This was made by looking at the different capacity products that the different cross-border points supplied based on statistical historical assumptions as well as the historical maximum network usage.

Next step of the analysis was for each member to take the capacity reduction found in the cross-border points relevant to their markets and apply these on their market to identify the impact. The risk group found that there is no particularly high-risk exposure and that each member state is in a position to handle the effects of the disruption scenarios with their own infrastructure and alternative sources.

None of the cases of the scenarios had any impact on the supply to the Swedish market.

2.1.3 Risk group Norway

The risk group used three different scenarios: disruption of the largest offshore infrastructure to the United Kingdom (Langeled pipeline); disruption of the largest offshore infrastructure to continental Europe (EUROPIPE II); and disruption of the largest onshore infrastructure from Norway (Emden station). For every scenario three cases were simulated to assess the effect of three high demand events: peak day, long high-demand period (historically high demand and two weeks in 20 years). The supply potential in each scenario were based on the average of a five-year period: gas imports from Norway do not exceed 669 TWh and the average import flows do not exceed 3.854 GWh/d however the daily limit of 4.100 GWh/d has been reached on some days.

None of the cases of the scenarios had any impact on the supply to the Swedish market.

2.2 National Risk assessment

The risk assessment was carried out in September 2018. This risk assessment is based on the relevant infrastructure as of 1 January 2018, namely the transmission system in Sweden, including the Öresund pipeline, and the transmission system in Denmark.

The conclusions from the risk assessment are as follows:

1. The incidents that would have the greatest impact on gas supply in the western Swedish natural gas system are an interruption in gas supplies in the Swedish transmission system, particularly in the Öresund pipeline, or an interruption in gas supplies to the Danish-Swedish natural gas market from the Danish North Sea, Germany via Ellund or the Stenlille gas storage facility.
2. In the event of a disruption of the single largest gas infrastructure on a day of exceptionally high gas demand (Article 5(1)), only a limited proportion of the market could be supplied with gas.
3. In the event of extreme temperatures during a 7-day period (Article 6(1)(a)), the gas market would be able to supply gas to all protected customers.
4. In the event of a period of at least 30 days of exceptionally high gas demand (Article 6(1)(b)), the gas market would be able to supply gas to all protected customers.
5. In the event of a disruption of the single largest gas infrastructure under average winter conditions (Article 6(1)(b)), gas could be supplied to protected customers for a period of at least 30 days.

Relevant risks that could lead to disruptions in accordance with point 1 above have been reported in the 2018 risk assessment for the western Swedish natural gas system. The material is deemed sensitive and is therefore not appended to this plan.

In addition to the risks referred to above, a disruption in gas supply to the western Swedish natural gas system could affect local electricity production.

3 Infrastructure standard

3.1 Calculation of the N-1 at the level of the risk group

3.1.1 Risk group Denmark

This common risk assessment for risk group Denmark covers a period, where the main source of gas in Denmark and Sweden, the Tyra facilities, will be rebuild and the gas supply to Denmark will therefore be significantly reduced.
The main gas source during the reconstruction period is imported gas from Germany. The single largest infrastructure of the area relevant for risk group Denmark is therefore the Ellund entry/exit point.

The Danish TSO Energinet is currently looking at different initiatives that can be implemented in order to strengthen the system and increase flexibility during the reconstruction of Tyra. Some of these initiatives include an increase of the storage withdrawal capacity at Lille Torup storage facility and an increase of the import capacity at Ellund by reinforcement in the northern German gas transmission system. The calculation of the regional N – 1 in the risk group was therefore calculated based on the current capacities and with the expected increased capacities.

As for the national risk assessment the calculation of N – 1 should be based on two different storage volume levels: 100 % and 30 %. However, the Danish gas storage facilities are able to yield the same withdrawal capacity irrespective of these storage volume levels. Energinet reserves strategic volumes for Emergency (less than 30% of the maximum storage volume) both for short and long-term incidents, in order to ensure that maximum withdrawal capacity is available at this level.

The parameter values based on the current capacities are shown in table 3.1 below.

Parameter	Mcm/d	Description
D_{max}	25.5	Total daily gas demand on an exceptional cold day (20 year-incidence with an average temperature of -13 degrees Celsius). The Danish gas demand is expected to be 19.5 mcm/d (including BNG) and the Swedish gas demand is expected to be 6 mcm/d.
EP_m	10.3	Total technical capacity for all entry points that can supply the calculated area, excluding production, storage and LNG facilities. The value of this parameter is equal to the entry capacity at the Danish side of the Ellund point based on the maximum existing capacity at the German side (the capacity at the Danish side is much higher).
P_m	1.0	Maximum technical production capacity. The forecast for the gas production in the Danish part of the North Sea is used instead of the maximum technical production capacity. In the period 2020-2022 the value of this parameter is expected to decrease significantly from 10.1 mcm/d to 0.5 mcm/d. Furthermore, this parameter includes the Danish biogas production, which is expected to be 0.5 mcm/d in 2020.
S_m	16.2	Maximum existing technical withdrawal capacity from all storage facilities. The value of this parameter is the sum of the withdrawal capacity at the two Danish storage facilities: Stenlille 8.2 mcm/d and Lille Torup 8.0 mcm/d. The withdrawal capacities for the two storages are the same irrespective of a storage level of either 30 % or 100 % of the maximum working volume. The capacity of the Swedish Skallen storage facility is not included as it mothballed and will only be commissioned again if it is commercially viable.
LNG_m	-	Maximum technical capacity at all LNG facilities. There are no LNG facilities connected to the gas grid in Denmark or Sweden. A LNG facility will be available in Gothenburg. However, it is not assumed connected to the Swedish transmission system
I_m	10.3	Technical capacity of the single largest infrastructure. Danish Ellund Entry point.
D_{eff}	0.5	The amount of gas demand that can be covered with market-based demand-side measures. The Danish concept of “commercial interruptibility” entails Energinet to pay gas customers in Denmark and Sweden to voluntarily reduce their gas consumption within 3 hours if the crisis level Alert has been declared in the Danish gas system. Today’s level has been chosen as a conservative level.

Table 3.1: Demand and capacities before realization of initiatives

Calculation of N – 1

$$N-1[\%]=\frac{\frac{10.3\,mcm}{d}+1\frac{mcm}{d}+\frac{16.2\,mcm}{d}+0\;-\frac{10.3\,mcm}{d}}{\frac{25.5\,mcm}{d}}\cdot 100=67\%$$

Calculation of N – 1 with market-based demand-side measures

$$N-1[\%]=\frac{\frac{10.3\,mcm}{d}+1\frac{mcm}{d}+\frac{16.2\,mcm}{d}+0\;-\frac{10.3\,mcm}{d}}{\frac{25.5\,mcm}{d}-0.5\frac{mcm}{d}}\cdot 100=69\%$$

The parameter values including increased entry capacity (EP_m) and increased storage withdrawal capacity (S_m) are shown in the table below.

Parameter	Mcm/d	Description
D_{max}	25.5	Total daily gas demand on an exceptional cold day (20 year-incidence with an average temperature of -13 degrees Celsius). The Danish gas demand is expected to be 19.5 mcm/d and the Swedish gas demand is expected to be 6 mcm/d.
EP_m	12.3	Total technical capacity for all entry points that can supply the calculated area, excluding production, storage and LNG facilities. The value of this parameter is equal to the entry capacity at the Danish side of the Ellund point.
Pm	1.0	Maximum technical production capacity. The forecast for the gas production in the Danish part of the North Sea is used instead of the maximum technical production capacity. In the period 2020-2022 the value of this parameter is expected to decrease significantly from 10.1 mcm/d to 0.5 mcm/d. Furthermore, this parameter includes the Danish biogas production, which is expected to be 0.5 mcm/d in 2020.
S_m	18.5	Maximum existing technical withdrawal capacity from all storage facilities. The value of this parameter is the sum of the withdrawal capacity at the two Danish storage facilities: Stenlille 8.2 mcm/d and Lille Torup 10.3mcm/d. The withdrawal capacities for the two storages are the same irrespective of a storage level of either 30 % or 100 % of the maximum working volume. The capacity of the Swedish Skallen storage facility is not included as it mothballed and will only be commissioned again if it is commercially viable.
LNG_m	-	Maximum technical capacity at all LNG facilities. There are no LNG facilities connected to the gas grid in Denmark or Sweden. A LNG facility will be available in Gothenburg. However, it is not assumed connected to the Swedish transmission system.

Parameter	Mcm/d	Description
I_m	12.3	Technical capacity of the single largest infrastructure. Danish Ellund Entry point.
D_{eff}	0.5	The amount of gas demand that can be covered with market-based demand-side measures. The Danish concept of "commercial interruptibility" entails Energinet to pay gas customers in Denmark and Sweden to voluntarily reduce their gas consumption within 3 hours if the crisis level Alert has been declared in the Danish gas system. Today's level has been chosen as a conservative level.

Table 3.2: Demand and capacities after realization of initiatives

Calculation of N – 1 with expansions:

$$N-1[\%] = \frac{\frac{12.3\,mcm}{d} + 1\frac{mcm}{d} + \frac{18.5\,mcm}{d} + 0 - \frac{12.3\,mcm}{d}}{\frac{25.5\,mcm}{d}} \cdot 100 = 76\%$$

Calculation of N – 1 with expansions and market-based demand-side measures

$$N-1[\%] = \frac{\frac{12.3\,mcm}{d} + 1\frac{mcm}{d} + \frac{18.5\,mcm}{d} + 0 - \frac{12.5\,mcm}{d}}{\frac{25.5\,mcm}{d} - 0.5\frac{mcm}{d}} \cdot 100 = 78\%$$

A summary of the results from all the calculations are shown in the table below.

Largest infrastructure	Im (mcm/d)	N – 1 (%)
N – 1 based on current capacities	10	67
N – 1 based on current capacities with demand-side measures	10	69
N – 1 based on new capacities	12	76
N – 1 based on new capacities with demand-side measures	12	78

Table 3.3: Results

The calculation of the regional N – 1 for the calculated area in risk group Denmark shows that N – 1 < 100 % for all scenarios. Therefore, the calculated regional area does not comply with article 5 (Infrastructure standard) of the Regulation during the period of reduced Danish national production due to the reconstruction of the Tyra-complex.

However, it must be noticed that Sweden has an exemption from the infrastructure criteria and can only supply the protected market in case of a major incident.

From north to south the firm capacity is 8.2 MCM/day. From south to North the firm capacity is 10.3 MCM/day

3.1.2 Risk group Baltic Sea[8]

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 considered. Capacities at cross-border points inside the region are not included.

The N-1 standard is calculated with the following formula

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

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.

[8] This information originates from the German preventive action plan, as submitted in June 2019.

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	1247.5	0.0	169.5	461.6		1356.8	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	3915.3	272.5	7453.0	0.0	1 776.0	5202.0	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	2266.0	2156.0	3421.0	399.0		3678.0	0.0
Slovakia	2204.8	2.1	560.2	0.0	2 028.0	470.9	0.0
Sweden	0.0	1.9	0.0	0.0		78.0	0.0
∑ Sum	**10 428.6**	**2 489.3**	**15 425.2**	**2190.6**	**3 804.0**	**16 398.3**	**0.6**

Table 3.4: Entries for the N-1 formula by each Member State

N – 1: Single largest infrastructure

N-1 for region with failure of:	EP_{VK} [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

$$N-1\ [\%] = \frac{11\,372.9 + 2\,478.2 + 15\,245.4 + 2\,190.6 - 2\,028.0}{16\,187.8 - 0.5} * 100 = 203\%$$

N – 1: Second single largest infrastructure

N-1 for region with failure of:	EP_G [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

$$N-1\ [\%] = \frac{11\,372.9 + 2\,478.2 + 15\,245.4 + 2\,190.6 - 1\,776.0}{16\,187.8 - 0.5} * 100 = 206\%$$

N – 2: the two single largest infrastructures

N-1 for region with failure of:	EP_{VK+G} [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 ex-tensive infrastructure offers more possibilities to transport and distribute gas.

3.1.3 Risk group Norway

The calculation uses the following formula:

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

Where

- *EPm: technical capacity of entry points, other than production*
- *Pm: maximal technical production capacity*
- *Sm: maximal technical storage deliverability*
- *LNGm: maximal technical LNG facility capacity*
- *Im: technical capacity of the single largest gas infrastructure*
- *Dmax: total daily gas demand*
- *Deff: demand-side measures*

For EPm, interconnection between member states within the risk group and interconnection with Switzerland have not been considered. Those calculations do not take into consideration the possible limitation of flow within the risk group due to limited capacity trough Switzerland. Additional calculations have also been conducted considering only members states directly connected.
For the calculation it has been considered the disruption of largest infrastructures which supplies Norwegian:

- Disruption of Emden station (from Norway to the continent)
- Disruption of Langeled pipeline (from Norway to United Kingdom)

	2015	2016	2017	2018	2019	2020
				Projected Data		
	GWh/d	GWh/d	GWh/d	GWh/d	GWh/d	GWh/d
Technical capacity of entry points (EPm)*	**11 696**	**11 637**	**11 372**	**11 269**	**11 269**	**11 269**
Maximal technical production capacity (Pm)	**4 878**	**4 193**	**4 208**	**4 562**	**4 397**	**4 172**
Maximal technical storage deliverability (Sm)	**16 218**	**16 200**	**15 992**	**16 132**	**16 183**	**16 300**
Maximal technical LNG facility capacity (LNGm)	**5 945**	**6 464**	**6 464**	**6 464**	**6 464**	**6 464**
1 in 20 gas demand (Dmax)	**26 714**	**26 637**	**27 020**	**27 706**	**27 706**	**27 731**
Market-based demand side response (Deff)	**5**	**5**	**5**	**35**	**35**	**35**

* only entry point from outside the risk group

Technical capacity largest gas infrastructures (Im)			2015	2016	2017	2018	2019	2020
DE/NL	Norway	Emden EPT	989	989	989	989	989	989
UK	Norway	Langeled	770	770	770	770	770	770

N-1 for region		Historical Data		Projected Data		
	2015	2016	2017	2018	2019	2020
	GWh/d	GWh/d	GWh/d	GWh/d	GWh/d	GWh/d
Emden EPT	141%	141%	137%	135%	135%	134%
Langeled	142%	142%	138%	136%	136%	135%

Table 3.5: Regional overview

N-1 results are well above 100% meaning in case of disruption of a major infrastructure supplying Norwegian gas the other entry capacities shall be sufficient to cover peak demand as it may occur 1 in 20 years.
Regarding the issue of transit trough Switzerland, both N-1 calculations for Italy on one side and the others member states in the risk group on the other side are above 100%.

3.2 National Level

In accordance with this article, the necessary measures are to be taken so that, in the event of a disruption of the single largest gas infrastructure (i.e. the Öresund pipeline), the capacity of the remaining infrastructure is able to supply the gas required during a day of exceptionally high demand occurring with a statistical probability of once in 20 years (-15°C).

The maximum gas demand in Sweden on a cold winter's day (20 year winter) is estimated to be 87 GWh_h/day (7.2 MNm^3/day). The gas storage facility at Skallen has a working storage capacity of 10 million Nm^3 with an available working volume of 7.3 million Nm^3. However, as the technical withdrawal capacity is 40 000 Nm3/h, the maximum daily withdrawal is 0.96 MNm^3.

In accordance with Article 5(1), the infrastructure standard must be met. Sweden has been granted an exception from the infrastructure requirement as per article 5.9, but the Swedish Energy Agency still preforms the calculation to give an indication of the supply situation in case of an N-1 event.

The West Swedish natural gas system is exclusively connected to the Danish natural gas system. The interconnection consists of one connection, the Öresund pipeline, which is thus the largest single infrastructure.

The calculated area is the geographic area supplied with gas through the West Swedish natural gas system.

The requirement in Article 5.1 of the Regulation is assumed to constitute a winter day with extreme temperatures when the heating requirement in premises and housing increases the consumption.

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

Parameter	Value [MNm³/day]	Comment
D_{max}	7,2	'D_{max}' means the total daily gas demand (in mcm/d) of the calculated area during a day of exceptionally high gas demand occurring with a statistical probability of once in 20 years.
D_{eff}	0	'D_{eff}' means the part (in mcm/d) of D_{max} that in the case of a disruption of gas supply can be sufficiently and timely covered with market-based demand-side measures in accordance with point (c) of Article 6(1) and Article 5(2).
EP_m	8,6	'EP_m': technical capacity of entry points (in mcm/d), other than production, LNG and storage facilities covered by P_m, LNG_m and S_m, means the sum of the technical capacity of all border entry points capable of supplying gas to the calculated area.
P_m	0,18	'P_m': maximal technical production capability (in mcm/d) means the sum of the maximal technical daily production capability of all gas production facilities which can be delivered to the entry points in the calculated area.
S_m	0,96	'S_m': maximal technical storage deliverability (in mcm/d) means the sum of the maximal technical daily withdrawal capacity of all storage facilities which can be delivered to the entry points of the calculated area, taking into account their respective physical characteristics.
LNG_m	0	'LNG_m': maximal technical LNG facility capacity (in mcm/d) means the sum of the maximal technical daily send-out capacities at all LNG facilities in the calculated area, taking into account critical elements like offloading, ancillary services, temporary storage and re-gasification of LNG as well as technical send-out capacity to the system.
I_m	8,6	'I_m' means the technical capacity of the single largest gas infrastructure (in mcm/d) with the highest capacity to supply the calculated area. When several gas infrastructures are connected to a common upstream or downstream gas infrastructure and cannot be separately operated, they shall be considered as one single gas infrastructure.

Table 3.6: Definitions and values of the parameters of the N – 1 formula

$$N-1[\%] = \frac{8.6+0.18+0.96+0-8.6}{7.2} * 100 = 15.83\%$$

For Sweden, the result is 15.8% due to limited domestic biogas production, one small storage facility and a single route of supply. The main conclusion of the result of the N-1 calculation is that the western Swedish natural gas system does not live up to the requirement. However, Sweden has been granted an exception from the infrastructure requirement on the condition that the following criteria apply:

(a) no gas transit to other Member States on its territory;

(b) an annual gross inland gas consumption of less than 2 Mtoe; and

(c) less than 5 % of total primary energy use from gas.

3.2.1 Bi-directional capacity

The link between Sweden and Denmark is characterized by the fact that all gas flows in one direction, into Sweden via the Danish border station in Dragør and through the Öresund trunk line. Sweden has no production of natural gas or any significant gas storage, nor is biogas production significant. This means that Sweden cannot contribute to the security of supply in the Danish or European gas system, and there is therefore no need for reverse flow over the connection to Denmark. This exception was reconfirmed on 1 September 2019

4 Compliance with the supply standard

4.1 Supply standard, Article 6(1)

In accordance with Article 6(1), the competent authority shall require the natural gas undertakings that it identifies to take measures to ensure the supply of gas to the *protected customers*[9] of the Member State in the following cases:

a) extreme temperatures during a 7-day period occurring with a statistical probability of once in 20 years – corresponding in energy terms to 13 GWh_h of gas;

b) for a period of 30 days of exceptionally high gas demand, occurring with a statistical probability of once in 20 years – corresponding in energy terms to 47 GWh_h of gas;

c) for a period of up to 30 days in case of the disruption of the single largest gas infrastructure (the Öresund pipeline) under average winter conditions – corresponding in energy terms to 34 GWh_h of gas.

4.2 Measures to comply with the supply standard

The measures available to Sweden as of 1 January 2018 for meeting the supply standard are described below.

4.2.1 Supply of protected customers for 7 days during extreme temperatures, Article 6(1)(a)

When demand is high, the pressure in the transmission system may fall if the input pressure in Dragør is insufficient. In the event of pressure levels lower than around 45 bar, the connections of customers with high pressure requirements are ‘automatically’ shut off. The categories of customers whose connections are shut off first are cogeneration power plants and large-scale industrial customers. Customers with low pressure requirements can continue to be supplied with gas when the pressure levels in the transmission system fall. Protected customers are among the group with the lowest pressure requirements.

The conclusion is, therefore, that no preventive action is required in order to meet this part of the supply standard.

[9] Where Sweden is concerned, protected customers are customers who are connected to the gas distribution system, i.e. household customers and those only using gas for cooking purposes, a total of around 30 000 customers.

4.2.2 Supply of protected customers for at least 30 days of exceptionally high demand, Article 6(1)(b)

In the Swedish gas system, exceptionally high gas demand is expected to occur when extreme temperatures are experienced during the winter. When demand is high, the pressure in the transmission system may fall if the capacity in Dragør is insufficient, but the protected customers can continue to be supplied with gas.

The conclusion is, therefore, that no preventive action is required in order to meet this part of the supply standard.

4.2.3 Supply of protected customers for at least 30 days in the event of the disruption of the single largest gas infrastructure under average winter conditions, Article (6)(1)(c)

The requirements of supplying the protected customers for 30 days under average winter conditions amount to 34 GWh_h, However, the repair time in the event of complete failure in the single largest infrastructure, the undersea pipeline between Denmark and Sweden, could be 40-50 days. The supply standard requirement is *at least 30 days*, however, several of the incidents that could cause leakage in/failure of the undersea pipeline have a significantly shorter repair time than 40-50 days. This means that it is reasonable for the protected customers' requirements to correspond to 30 days' gas consumption.

No decisions have been made concerning investments in the infrastructure in order to reduce the likelihood or consequences of an N-1 incident occurring.

The measures and conditions that can contribute to the compliance with the supply standard comprise:

- Using the gas in the transmission system (line pack);
- Using the biogas that is supplied to the western Swedish natural gas system;
- Using the gas in storage;
- Promptly reducing consumption by the non-protected customers manually or by ordering them to reduce consumption within the specified time period;
- Supply of solidarity gas from Denmark

The above measures are described in more detail below, and are summarized in table 4.1.

Use line pack

The measure involves the system balancing operator ensuring that the operating pressure level in the transmission system does not fall below 45 bar during normal operation. This level is in line with previous practice.

The normal pressure level (zero point) in the transmission system is 60 bar, whereas the lowest operating level is 45 bar. In the latter case, around 38 GWh_h of gas (3.4 MNm^3) can be used before the pressure reaches 7 bar, which, with some spare capacity, is sufficient pressure to provide the protected customers with gas[10].

Use biogas

During an emergency, biogas producers are expected to continue to supply gas to the western Swedish natural gas system in accordance with the business agreements they have entered with gas suppliers. This corresponds to approximately 24 GWh.

Use storage

During an emergency, the stored gas at the Skallen storage facility can be used as a complement to the market-based measures available and orderly consumption reduction. In this case, the competent authority instructs the system balancing operator to increase or decrease the injection or withdrawal of gas from the storage. At the requested withdrawal, the TSO informs the actor who has booked storage-capacity. The purpose is to increase the amount of available gas for, if necessary and possible, delivery to protected customers at crisis level emergency.

The system balancing operator ensures that, in accordance with a decision of the competent authority, there is sufficient gas available in the gas storage. This is achieved by the system balancing operator purchasing storage services and storing gas so that, together with other measures, there is a sufficient amount of gas to ensure that protected customers can be supplied with gas under 30 days at normal winter conditions in case no gas is supplied to the Swedish gas system via the Öresund line. At present, 4 GWh of gas has been allocated as emergency gas.

Order a reduction in consumption by non-protected customers

The system balancing operator may order a reduction in gas consumption by non-protected customers via the operator of the distribution pipeline. This can either be done by ordering a complete consumption stop for all non-protected customers in severe supply disruption scenarios or be implemented gradually by disconnecting non-protected customers according to a pre-established priority list (see the section on “Styrgas” in the national emergency plan).

The operator of the distribution pipeline must be able to implement the decision to reduce consumption within the time limits indicated in the national emergency plan. Non-protected customers will therefore approximately consume 32 GWh of gas when a complete consumption stop is ordered.

---

[10] The distribution networks following directly after an M/R station have a maximum pressure of 4 bar and a minimum pressure of 1 bar, but protected customers may be connected at an even lower pressure (0.1 bar) after pressure reduction in control stations. From 56 bar to 7 bar there is approximately 53 GWh_h available in the system.

Fuel switching

While fuel switching may take place on a voluntary basis, there is at present no legislative mandate for the Swedish Energy Agency to order a mandatory fuel switch among non-protected customers.

Supply of solidarity gas from Denmark

When an agreement between Denmark and Sweden is in place, Sweden will be able to request solidarity gas from Denmark. Once an agreement is in place, this measure will be described in more detail in the preventive action plan. This is expected to happen in the near future.

Summary of the capacity of the current measures to meet the supply standard

The results of the measures and prerequisites described above are summarised in table 4.1. This table does not include information on the provision of solidarity gas to Sweden.

Phase/measure	**Supply/consumption (GWh)**	**Remarks**
Use line pack (a)	38	Based on the 'worst case scenario', i.e. from lowest operating limit (45 bar) down to 7 bar.
Use biogas (b)	24,1	Based on 30 days' production.
Storage (c)	4	Use of strategic gas storage
Consumption by non-protected customers (d)	32.3	Taking into account the time required to carry out disconnection in as described in the national emergency plan.
Consumption by protected customers (e)	33,5	
Net effect	0,3	(a) + (b) + (c) - (d) - (e)

Table 4.1: Summary of the capacity of the current measures to comply with Article 6(1)(c).

5 Measures and volumes for compliance with the standards and for dealing with risks identified (preventive measures)

The strategy, measures and volumes for dealing with the risks and scenarios described in the previous sections are outlined below. The measures are prioritised first and foremost in order to endeavour to meet the infrastructure standard and to comply with the supply standard and, secondly, in order to improve the general situation.

5.1 Basis for selecting measures to comply with the infrastructure and supply standards

5.1.1 Concerning interconnections, cross-border flows, etc.

The western Swedish natural gas system is only connected to the Danish natural gas system. The interconnection consists of one connection, the Öresund pipeline, which, as a result, is the single largest infrastructure. There have been no decisions to establish alternative supply routes.

The flow of gas in the Öresund pipeline is unidirectional from Denmark to Sweden. It is currently not technically possible to reverse the direction of flow so that the gas flows from Sweden to Denmark. Sweden does not have any natural gas production or any significant gas storage, nor does it have any significant biogas production, even though decisions have been taken and plans made for a gradual increase in biogas production. This means that Sweden cannot contribute to safeguarding the security of supply in the Danish or European gas system, and there is therefore no need for a reversal of the direction of flow through the connection to Denmark.

There are currently no agreements concerning access to storage facilities in Denmark in order to be able to supply Swedish customers in an emergency. However, there is no formal obstacle to entering into such agreements. Nevertheless, any agreements concerning access to storage capacity in Denmark are without prejudice to the fulfilment of the infrastructure standard or the part of the supply standard based on a failure of the Öresund pipeline (Article 6(1)(c)).

5.1.2 Concerning public service obligations that relate to the security of gas supply

No operator on the Swedish gas market is responsible for providing any public services linked to the security of gas supply.

Certain cogeneration power plants and some large industrial customers have the technical capacity to use an alternative fuel. However, there are no requirements for customers to store an alternative fuel in proportion to their gas use.

5.1.3 Capacity and plans in respect of border points, gas storage and LNG supply

The transmission capacity from Denmark to Sweden is 95 GWh_l/day (8.6 MNm^3/day).

At present, there have been no decisions to increase the number of border points to the natural gas systems of other countries.

There has been no decision to connect LNG facilities to the western Swedish natural gas system.

5.2 Measures to comply with the infrastructure standard

Sweden has been granted an exception from the infrastructure requirement (Article 5.9).

5.2.1 Use biogas in the distribution network

As a result of the decisions taken and plans made concerning facilities for supplying biogas to both the distribution network and the transmission network, the supply capacity will gradually improve. In 2017 total production capacity for biogas for injection into the distribution and transmission networks was 66 MW_l. This corresponds to 2.0 per cent of the maximum requirements of the gas system.

5.2.2 Market-based measure

There has been a market-based demand-side measure[11] in place since 2014, under which large Swedish gas customers can participate in the Danish system for commercially interruptible customers. Agreements are entered into with large gas customers to the effect that, in return for financial compensation, they are prepared to rapidly reduce their gas consumption if ordered to by the Danish TSO. This type of agreement is also referred to as a hyper-interruptible contract. The measure will help, to a large extent, to maintain gas supplies to more than just the protected customers in the event of a disruption in gas supplies from Denmark.

[11] A market-based measure is a measure taken by the market operators themselves to increase robustness and flexibility during normal operation and at all crisis levels. Market-based measures can be regulated via agreements concerning financial compensation and/or require the 'alert' crisis level to have been declared. Measures that are not market-based may only be used when the market-based measures can no longer ensure the security of supply, in particular to protected customers. A non-market-based measure is mandatory for the operators. Use of non-market-based measures requires an 'emergency' crisis level to have been declared.

5.2.3 Calculation of the N-1 formula following measures

The degree of compliance with the standard is demonstrated by means of a technical calculation of the capacity of the facilities responsible for the country's natural gas supplies in relation to the needs of the natural gas customers. As far as Sweden is concerned, the relevant facilities are the Öresund pipeline, and biogas production.

Calculation according to the formula in Annex 1 to the Security of Supply Regulation indicates that, for Sweden, N-1 is 15,8%, based on the input data in **Fel! Hittar inte referenskälla.**. The standard requires 100 %.

Parameter	**Value (MNm^3/day)**	**Remarks**
D_{max}	7.2	The total daily gas demand of the calculated area during a day of exceptionally high gas demand occurring with a statistical probability of once in 20 years.
D_{eff}	0	The part of D_{max} that, in the event of a supply disruption, can be sufficiently and timely covered with market-based demand-side measures.
EP_m	8.6	Technical capacity of entry points, other than production, LNG and storage facilities covered by P_m, S_m and LNG_m: the sum of the technical capacity of all border entry points capable of supplying gas to the calculated area.
P_m	0.18	Maximal technical production capability: the sum of the maximal technical daily production capability of all gas production facilities which can be delivered to the entry points in the calculated area.
S_m	0,96	Maximal technical daily capacity of storage facilities.
LNG_m	0	Maximal technical LNG facility capacity.
I_m	8.6	Technical capacity of the single largest gas infrastructure.

Table 5.1: Definitions and values of the parameters of the N – 1 formula

5.3 Measures for maintaining gas supply to all customers

In accordance with Article 9, the preventive action plan is to set out the other preventive measures that are required to maintain gas supply to all customers to the greatest extent possible.

No appropriate measures are available for reducing the likelihood of disruptions in gas supplies from Denmark.

5.4 General impact assessment of the measures to fulfil the supply standard

Order a reduction in consumption (disconnection)[12]

The basic measure in the event of serious emergencies ('emergency' crisis level) is a reduction in consumption through the disconnection of non-protected customers. This is a drastic measure, but at present it is an essential measure to safeguard supplies to protected customers. Disconnection is a measure that has been in place for some time for serious emergencies, but the disconnection time requirements have been formalised in this plan.

The largest customers will be disconnected first. The disconnection times selected have been counterbalanced by the use of line pack, biogas and strategic gas storage, so that it has been possible to prolong the deadline for disconnection to give the operators a chance for a certain amount of forward planning before carrying out the disconnection.

Impact on the electricity sector in western Sweden

This is expected to have a small or negligible effect on the electricity sector in western Sweden.

Impact on district heating and on industry in western Sweden

A disconnection could have an impact on district heating in western Sweden. It is currently estimated that the district heating sector can sustain normal output levels for one week under winter conditions by switching to alternative fuels, after which the output will have to be reduced. The impact on the district heating sector by disconnecting industries that sell excess heat to local district heating networks is considered to be marginal.

It is also estimated that around half of industry can switch to alternative fuels such as biogas, fuel oil, LNG, LPG, waste and electricity. Replacing natural gas often forces the companies to make large and sometimes irreversible investment decisions, and the time taken to implement the switch can range from a few hours to several months. The industries that use natural gas as feedstock will be obliged to stop production. Moreover, in the worst case, disconnection will result damage to production equipment in certain industries.

Impact on transport

Gas-powered heavy vehicles (primarily buses) will, in the worst case scenario, be unable to fill their tanks with gas in certain places/areas connected to the western Swedish natural gas system, which will, at least initially, cause disruption in the public transport system and give rise to increased costs and increased emissions of carbon dioxide. Smaller gas-powered vehicles can refuel with oil-based fuel or

---

[12] For further information on the role of gas in the electricity and heating sectors, as well as information on fuel switching, see section 1.2.2.

potentially refuel with gas at a filling station that is not connected to the western Swedish natural gas system.

Environmental impact

A switch from natural gas to fuel oil will increase environmental pollution as a result of increased emissions of carbon dioxide, sulphur dioxide and particulate matter. A switch from natural gas to petrol and diesel in the transport sector is also associated with higher emissions.

Use line pack

The measure involves the formalisation of an established practice and thus will not restrict the functioning of the market or procedures in general.

Use storage

The measure is an established practice and thus will not restrict the functioning of the market or procedures in general.

Supply of solidarity gas from Denmark

This measure has not yet been established. Once an agreement on the provision of solidarity gas is in place between Sweden and Denmark and an analysis has been carried out, the impact of this measure will be described in more detail in the preventive action plan.

Impact of the measures on the European market

The currently established Swedish measures will have no negative impact on the European natural gas market.

Measures' link with crisis management principles

Disconnection of non-protected customers will, where possible, be carried out according to an order of priority, taking account of both Sweden's recognised crisis management principles and the unique requirements of the natural gas market.

The supply situation will improve over the next few years, when biogas production is expected to make up an increasing proportion of the gas supplied, and in a few years' time this alone may cover at least the requirements of the protected customers. In such a situation, certain other customers would also be able to obtain gas in the event of significant disruptions in natural gas supplies from Denmark.

6 Obligations of the system balancing operator, natural gas undertakings and customers

The requirements to be met by the system balancing operator, natural gas undertakings and customers as a consequence of the measures described in Section 4 are described below.

6.1 System balancing operator

The system balancing operator, Swedegas AB, is to act to ensure that the operating pressure level in the transmission system does not fall below 45 bar during:

- normal operation;
- an ‘early warning’ crisis level;
- an ‘alert’ crisis level.

Where necessary during an ‘emergency’ crisis level, the system balancing operator must, via the network operators, implement a reduction in consumption or disconnection of non-protected customers.

The system balancing operator must ensure that there is a sufficient quantity of gas in the Skallen storage facility to enable a controlled reduction in consumption/disconnection of non-protected customers to be carried out and to enable protected customers to obtain gas for 30 days in accordance with Article 6(1)(c) of the Security of Supply Regulation. Prior to each winter, the competent authority is to determine the quantity of gas that needs to be stored for that purpose.

6.2 Gas suppliers and balancing service providers

Gas suppliers are responsible, in cooperation with balancing service providers, for ensuring, both during normal operation and in a crisis situation, that protected customers in particular receive gas.

6.3 Operator of storage facilities

An operator of storage facilities must make available to the system authority the storage capacity which, according to the system balancing operator, is needed for strategic gas storage, as decided by the competent authority.

6.4 Operator of a natural gas pipeline

The operator of a natural gas pipeline must make sure that there is sufficient capacity to ensure that, following an order from the system balancing operator, non-protected customers reduce or stop their gas consumption by the deadlines stated in the national emergency plan.

6.5 Large-scale customers

Large-scale customers are to cooperate with the operator of the natural gas pipeline in order to reduce their consumption as soon as possible where necessary, in accordance with the circumstances and the instructions issued by the owner of the pipeline.

7 Infrastructure projects

No major infrastructure projects that will have a direct impact on the security of supply of natural gas in the western Swedish gas network are currently ongoing.

8 Public service obligations related to the security of supply

Sweden has no public service obligations related to the security of supply.

9 Stakeholder consultations

The Swedish energy agency arranged consultations with relevant stakeholders where the stakeholders had the opportunity to read the draft of the preventive action plan in its current state and were given the opportunity to provide feedback.

Consultations have taken place with Energigas Sverige (Swedish gas association), natural gas undertakings, Svenska kraftnät (Swedish electricity transmission system operator) as well as with the regional risk groups: Denmark, Norway and Baltic Sea.

10 Regional dimension

10.1 Operational cooperation between TSOs

The Swedish and Danish TSOs have created a common balancing area for Danish shippers and Swedish Balancing Administrators. This came into effect 1 April 2019. The main purpose of the Joint Balancing Zone is to enhance efficiency of cross-border trade between the Swedish and Danish markets and harmonize balancing procedures. Establishing a borderless Danish-Swedish balancing zone is expected to improve competition in the region.

The Balancing area includes the Swedish market area's entry/exit points and the Danish market areas entry/exit points. This means that Swedish balancing administrators have adapted to a balancing model that is in accordance with the European network code on Balancing (NC BAL). Swedegas, the Swedish TSO, had an exception from implementing NC BAL which expired 1 April 2019, and through the establishment of the joint balancing zone this regulation is now fully implemented in Sweden.

10.2 Mechanisms used for cooperation

In its role as the competent authority for natural gas supply security under Regulation (EU) 2017/1938, the Swedish Energy Agency has the coordinating role for bilateral and regional cooperation on supply security.

Bilateral cooperation

The Swedish Energy Agency has a close dialogue and cooperation with its Danish counterpart Energistyrelsen. This cooperation includes regular meetings and information exchanges on issues that affect the Danish-Swedish natural gas market, notably the effect of the implementation of the joint balancing zone as well as the practical procedures for handling and minimizing the effects of natural gas supply shortages. Exchange of information has also taken place in the build-up to the closure of the Tyra production facilities during the fall of 2019.

During the time of the closure of the Tyra production facilities, Denmark and Sweden will depend on natural gas imports from Germany. It is therefore important for Sweden to improve on its mechanisms for cooperation with its German counterparts during this period.

Cooperation in the EU and in the regional risk groups

As the competent authority on natural gas supply security, representatives from the Swedish Energy Agency regularly attend the meetings of the EU Gas Coordination Group in order to keep stock of the implementation of Regulation (EU) 2017/1938 as well as to monitor other issues and development concerning the security of supply of natural gas on the European market.

The Swedish Energy Agency is part of three regional risk groups: Baltic Sea, Denmark, and Norway. The cooperation between these groups has largely consisted of phone conferences. Some physical meetings have been had between the Swedish Energy Agency and the Danish competent authority regarding the scope of the regional risk group Denmark as this scenario would have a direct impact on the security of supply in Sweden.

10.3 Preventive measures

There are currently no joint preventive measures agreed under the risk groups.