FNB Gas
DIE FERNLEITUNGSNETZBETREIBER

Gas Network Development Plan 2020–2030

Draft

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Gas Network Development Plan 2020–2030

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Legal disclaimer

This document is a translation from the German original; the binding version is exclusively the draft document of the Gas Network Development Plan 2020–2030 in its German version.

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bayernets GmbH
Munich

Customers: 47 downstream network operators (of which 12 are directly downstream) as well as national and international gas traders

Employees	134
Gas transmission network	1,501 km
Compressor stations	1
Compressor units	2
Total capacity of the compressor units	17 MW
Cross border interconnection points	4
Exit points in the high-pressure network	169
Concurrent annual peak load	25,822 MWh/h
Annual exit quantity to final consumers and distributors	114* TWh

* including cross-border interconnection point and storage facilities

Ferngas Netzgesellschaft mbH
Schwaig b. Nürnberg

Customers: Gas distribution system operators, municipal utilities as well as industrial customers, traders and shippers

Employees	33 (group)
Gas transmission network	approx. 214 km
Compressor stations	0
Compressor units	0
Total capacity of the compressor units	0 MW
Cross border interconnection points	0
Exit points in the high-pressure network	19*
Concurrent annual peak load	3,560* MWh/h
Annual exit quantity to final consumers and distributors	4.6* TWh

* Ferngas has been a combination network operator since October 2018. The figures therefore refer to the transmission system part and to the fourth quarter of 2018.

Fluxys Deutschland GmbH
Düsseldorf

Customers: Gas traders

Employees	5
Gas transmission network	approx. 440 km
Compressor stations	0
Compressor units	0
Total capacity of the compressor units	0 MW
Cross border interconnection points	1
Exit points in the high-pressure network	1, internal points in the market area
Concurrent annual peak load	1,394 MWh/h
Annual exit quantity to final consumers and distributors	3 TWh

Fluxys TENP GmbH
Düsseldorf

Customers: 39

Employees	11
Gas transmission network	1,010 km
Compressor stations	4
Compressor units	17
Total capacity of the compressor units	150 MW
Cross border interconnection points	3
Exit points in the high-pressure network	22
Concurrent annual peak load	14,405 MWh/h
Annual exit quantity to final consumers and distributors	71 TWh

Information on company name, headquarters, customers, and employees: reporting date 31.12.2019
Other information: reporting date 31.12.2018

GASCADE Gastransport GmbH
Kassel (Hessen)

Customers: Regional companies, municipal utilities, industrial customers and gas traders

Employees	approx. 460
Gas transmission network	2,429 km
Compressor stations	9
Compressor units	29
Total capacity of the compressor units	approx. 486 MW
Cross border interconnection points	8
Exit points in the high-pressure network	85
Concurrent annual peak load	87,293 MWh/h
Annual exit quantity to final consumers and distributors	135 TWh

Gastransport Nord GmbH
Oldenburg

Customers: Approximately 50 national and international shippers, regional companies and industrial customers

Employees	44
Gas transmission network	322 km
Compressor stations	0
Compressor units	0
Total capacity of the compressor units	0 MW
Cross border interconnection points	1
Exit points in the high-pressure network	72
Concurrent annual peak load	9,723 MWh/h
Annual exit quantity to final consumers and distributors	30 TWh

Gasunie Deutschland Transport Services GmbH
Hanover

Customers: 140 regional companies, municipal utilities, industrial customers and gas traders

Employees	242
Gas transmission network	3,795 km
Compressor stations	10
Compressor units	32
Total capacity of the compressor units	206 MW
Cross border interconnection points	6
Exit points in the high-pressure network	181
Concurrent annual peak load	38,534 MWh/h
Annual exit quantity to final consumers and distributors	146 TWh

GRTgaz Deutschland GmbH
Berlin

Customers: 26 shippers

Employees	39
Gas transmission network	1,161* km
Compressor stations	6*
Compressor units	23*
Total capacity of the compressor units	348* MW
Cross border interconnection points	3*
Exit points in the high-pressure network	15*
Concurrent annual peak load	60,425 MWh/h
Annual exit quantity to final consumers and distributors	220* TWh

* MEGAL value

Information on company name, headquarters, customers, and employees: reporting date 31.12.2019
Other information: reporting date 31.12.2018

Lubmin-Brandov Gastransport

Lubmin-Brandov Gastransport GmbH
Essen

Customers: Gas traders

Employees	3
Gas transmission network	472 km
Compressor stations	1
Compressor units	3
Total capacity of the compressor units	96 MW
Cross border interconnection points	2
Exit points in the high-pressure network	1
Concurrent annual peak load	no details MWh/h
Annual exit quantity to final consumers and distributors	0 TWh

NEL Gastransport GmbH
Kassel (Hessen)

Customers: Municipal utilities, industrial customers and gas traders

Employees	6
Gas transmission network	441 km
Compressor stations	0
Compressor units	0
Total capacity of the compressor units	0 MW
Cross border interconnection points	1
Exit points in the high-pressure network	2
Concurrent annual peak load	39,684 MWh/h
Annual exit quantity to final consumers and distributors	1 TWh

Wir transportieren Gas.

Nowega GmbH
Münster

Customers: Regional companies, municipal utilities, industrial customers and gas traders

Employees	62
Gas transmission network	1,545 km
Compressor stations	1
Compressor units	2
Total capacity of the compressor units	1 MW
Cross border interconnection points	0
Exit points in the high-pressure network	102
Concurrent annual peak load	6,686 MWh/h
Annual exit quantity to final consumers and distributors	27 TWh

ONTRAS Gastransport GmbH
Leipzig

Customers: 74 national and international shippers

Employees	349
Gas transmission network	6,935 km
Compressor stations	2
Compressor units	5
Total capacity of the compressor units	38 MW
Cross border interconnection points	4
Exit points in the high-pressure network	445
Concurrent annual peak load	42,295 MWh/h
Annual exit quantity to final consumers and distributors	163 TWh

Information on company name, headquarters, customers, and employees: reporting date 31.12.2019
Other information: reporting date 31.12.2018

OPAL Gastransport GmbH & Co. KG
Kassel (Hessen)

Customers: Gas traders

Employees	7
Gas transmission network	473 km
Compressor stations	1
Compressor units	3
Total capacity of the compressor units	99 MW
Cross border interconnection points	2
Exit points in the high-pressure network	1
Concurrent annual peak load	53,793 MWh/h
Annual exit quantity to final consumers and distributors	0 TWh

Open Grid Europe GmbH
Essen

Customers: more than 450 national and international wholesale transmission companies, municipal utilities, industrial customers and gas traders

Employees	approx. 1,450
Gas transmission network	approx. 12,000 km
Compressor stations	26
Compressor units	97
Total capacity of the compressor units	approx. 1,150 MW
Cross border interconnection points	17
Exit points in the high-pressure network	1,034
Concurrent annual peak load	136,687 MWh/h
Annual exit quantity to final consumers and distributors	approx. 342 TWh

terranets bw GmbH
Stuttgart

Customers: more than 150 national and international customers – gas network operators, municipal utilities, industrial customers and traders

Employees	235
Gas transmission network	2,000 km
Compressor stations	2
Compressor units	8
Total capacity of the compressor units	approx. 38 MW
Cross border interconnection points	3
Exit points in the high-pressure network	194
Concurrent annual peak load	24,637 MWh/h
Annual exit quantity to final consumers and distributors	78 TWh

Thyssengas GmbH
Dortmund

Customers: 48 network interconnection partners 152 network connection customers with 187 NCPs

Employees	357
Gas transmission network	4,161 km
Compressor stations	6
Compressor units	17
Total capacity of the compressor units	149 MW
Cross border interconnection points	5
Exit points in the high-pressure network	1,071
Concurrent annual peak load	22,485 MWh/h
Annual exit quantity to final consumers and distributors	65.3 TWh

Information on company name, headquarters, customers, and employees: reporting date 31.12.2019
Other information: reporting date 31.12.2018

Foreword | Executive summary

Foreword

Dear Reader

In the Gas Network Development Plan for 2020-2030, the German transmission system operators present their plan for network expansion that describes key positions on the way to achieving a secure, sustainable and cost-effective gas supply for the future.

On the basis of the scenario framework, which has been discussed intensively with the market partners and confirmed by the Bundesnetzagentur (BNetzA – Federal Network Agency), the transmission system operators have identified network expansion measures to provide efficient transportation infrastructure at optimal cost that will also constitute the basis for a secure supply with H-gas and L-gas in the future. As before, the L-to-H-gas conversion will exert a strong influence on the development of the transmission system in the next few years. To what extent substantial changes will be made to the L-to-H-gas conversion planning will essentially depend on the duration of the currently prevailing restrictions as a result of COVID-19. The transmission system operators are maintaining close contacts in this regard with the affected distribution system operators, the BNetzA and the BMWi. The forthcoming market area merger in 2021 and the increasing importance of green gases and hydrogen are further essential components of the present Network Development Plan.

The climate protection targets of an 80–95 % reduction in greenhouse gas emissions by 2050 in comparison to 1990 currently set by the government are already ambitious. These are expected to be replaced in the near future by the new targets of the EU Commission. The EU Commission President Ursula von der Leyen has announced that Europe plans to be the first climate-neutral continent by 2050. The transmission system operators believe that such ambitious targets can be achieved only by integrating, aligning and optimising all available infrastructure. New logistics chains and thus transportation infrastructure will also be created in this way. One of these challenges will be the construction and operation of a Germany-wide hydrogen network, as demand is already emerging in industry, transport and the heating market.

The German cabinet resolved the national hydrogen strategy on 10 June 2020 [BMWi 2020]. According to this, hydrogen is set to play a major role in Germany's decarbonisation strategy. The existing gas infrastructure is part of the national hydrogen strategy from the outset, because it can already be used to transport hydrogen. In the future, infrastructure for the exclusive transport of hydrogen could emerge. The transmission system operators will support the federal government in developing a national hydrogen economy. For this purpose, the transmission system operators drafted a visionary hydrogen network and published a map in February 2020. The pipelines shown in the map are based 90 % on the existing transmission system and will be connected to key demand points for hydrogen in the future.

The transmission system operators expressly welcome the consideration of green gases in the Network Development Plan. The first regions with potential for hydrogen-based gas supply systems by 2030 can thus be shown on the basis of the market partner survey conducted in the previous year. Furthermore, the network operators have dedicated a separate chapter to the topic of green gases and provide an outlook on the future development of the gas transportation infrastructure. The transmission system operators point out that it will be necessary to amend the legal and regulatory conditions in order to approve and implement the identified measures.

This version incorporates information and suggestions that arose from the public consultation conducted by the transmission system operators from 4 to 29 May 2020.

The transmission system operators' database has been updated and is available to the general public for the Gas Network Development Plan 2020–2030 at www.nep-gas-datenbank.de.

We thank Prognos AG for their co-operation.

Yours faithfully

Your transmission system operators

Executive summary

In the Gas Network Development Plan 2020-2030, the transmission system operators present the results of the network development planning, including the information received in conjunction with the public consultation, and thus fulfil the requirements of the Energy Industry Act (EnWG) and the Gas Network Access Regulation (GasNZV). This Gas Network Development Plan is based on the scenario framework developed by the transmission system operators and confirmed by the BNetzA on 5 December 2019.

Two scenarios for the development of gas demand in Germany up to 2030 are presented in the scenario framework. The "Technology mix scenario –95 % (dena-TM95)" of the pilot study of the Deutsche Energie-Agentur GmbH (dena – German Energy Agency) and the European Commission's "EUCO30" scenario were used for the energy demand for gas. These scenarios take the current European climate protection targets into consideration.

With the confirmation of the scenario framework the BNetzA tasked the transmission system operators to calculate two modelling variants (base variant and green gas variant) and to include a design variant for Baden-Württemberg. The results of the modelling are presented in Chapters 7 and 8.

The transmission system operators have specified in greater detail the plans for a hydrogen network up to 2030 on the basis of the market partner survey that has been conducted. These plans represent a first step towards a national and, in the future, European hydrogen network. The transmission system operators have made the implementation of these measures subject to any change in the existing legal and regulatory conditions.

The measures of the Gas Network Development Plan 2018–2028 are confirmed. The network extension proposal of the transmission system operators is based on the green gas variant. The following extension measures are necessary in consideration of the 10-year timeframe:

Table 1: Network expansion proposal of the transmission system operators up to the end of 2030

	2030		
Network expansion proposal	Natural gas	Green gases	Total
Compressor capacity in MW	405	0	405
Pipelines in km	1,594	1,294	2,888
– of which new build	1,594	151	1,746
– of which conversion	0	1,142	1,142
Investments* in EUR billion	7.8	0.7	8.5

* including GPCM stations, valve stations and other facilities

Source: Transmission system operators

The additional measures in comparison with the previous Gas Network Development Plan are largely related to the supply of Baden-Württemberg, the connection of the LNG facilities, the necessary extension measures for green gases and the security of supply of the Netherlands.

For the first time, the Gas Network Development Plan for 2020–2030 compares the potential costs for the market-based instruments in the context of the future market area merger to the costs of a potential network expansion.

More than 51,000 individual load cases per calculation year have been referenced for the bottleneck analysis in the Germany-wide market area Trading Hub Europe (THE). In the scenarios analysed with differing forecast market shifts, there are significant variations for the different sources, namely Russia, Norway and LNG.

The following table shows the development of the costs for the use of market based instruments.

Table 2: Costs for the use of market-based instruments per year

	2021/2022	2023/2024	2025/2026	2030/2031
	EUR million			
Maximimum scenario	2.9	23.9	27.6	68.3
Average scenario	0.6	6.2	5.8	23.2
Minimum scenario	0.1	1.1	1.1	7.6

Source: Transmission system operators

In the opinion of the transmission system operators, the relatively low overall costs for using market-based instruments in the gas year 2025/2026 do not provide sufficient justification for network expansion as an alternative.

In the interest of a demand-based network expansion, an assessment of potential construction measures after the gas year 2025/2026 as an alternative to the use of market-based instruments should take into account the findings from the use and the evaluation of the market-based instruments at a later date.

The L-to-H-gas conversion planning is at a very advanced stage up to 2026 and has already been finalised to a large extent. However, at the time of publication of the Gas Network Development Plan 2020–2030 it cannot be rule out that changes to the conversion plan may be necessary, due to the restrictions in Germany caused by COVID-19 and that delays will result. The transmission system operators are maintaining close contacts in this regard with the affected distribution system operators, the BNetzA and the BMWi. Assuming that the current COVID-19 situation does not deteriorate, the conversions planned throughout the whole of Germany for 2020 can be implemented almost entirely.

Introduction 1

1 Introduction

1.1 Legal basis, tasks and objectives

In accordance with section 15a of the Energiewirtschaftsgesetz (EnWG – Energy Industry Act), the German transmission system operators have to draw up a joint Network Development Plan in even years and submit it to the BNetzA as the competent regulatory authority. The German transmission system operators are additionally required in accordance with section 17 of the Gasnetzzugangsverordnung (GasNZV – Gas Network Access Regulation), to conduct a market area-wide assessment of the long-term capacity demand in the network development planning process pursuant to section 15a EnWG.

Gas Network Development Plan

The Germany-wide Gas Network Development Plan pursuant to section 15a EnWG has to include all effective measures for a demand-based optimisation, reinforcement and expansion of the network and for guaranteeing the security of supply that will be necessary in terms of network equipment in the next ten years to operate the network securely and reliably. Measures that have to be implemented in the next three years have to be specified in particular. The basis for drawing up the Gas Network Development Plan is a scenario framework that contains appropriate assumptions about the trends in the most important exogenous input parameters relating to the dimensioning of a transmission system. These include the production, supply and consumption of natural gas, the gas exchange with other countries, planned investments in the infrastructure and the impacts of any disruptions to supply. The Network Development Plan has to take into consideration the Community-wide Network Development Plan pursuant to article 8(3b) of Regulation (EC) No 715/2009.

Before submitting the plan to the BNetzA, the transmission system operators have to grant the general public and the downstream network operators the opportunity to express their views. The BNetzA has in turn to give a hearing to all actual and potential network users concerning the draft of the Network Development Plan submitted by the transmission system operators and to publish the results. It can subsequently request changes to the Network Development Plan.

Assessment of the long-term capacity demand

Following the amendment to the GasNZV of 11 August 2017, the transmission system operators are required to determine on a market area-wide basis the long-term capacity demand in accordance with section 17 GasNZV in the network development planning procedure pursuant to section 15a EnWG in a transparent and non-discriminatory process that encompasses all network operators. It is accordingly stipulated that the requirements pursuant to section 17(1) sentence 2 nos. 1 to 10 GasNZV are furthermore included in the scenario framework on the Gas Network Development Plan.

Network expansion measures in Germany with PCI status

The European Commission's list of Projects of Common Interest (PCI) of 31 October 2019 does not include any gas transportation projects originating in Germany [EC 2019].

1.2 Procedure and schedule

The Gas Network Development Plan 2020–2030 has been jointly developed by the German transmission system operators working in close collaboration with each other. The list below describes the most important steps and, at the same time, the structure of the document.

- **Chapter 2** summarises the assumptions and results of the **scenario framework** for the Gas Network Development Plan 2020–2030 that was drawn up by the transmission system operators, opened to public consultation and confirmed by the BNetzA on 5 December 2019. These specifically include the assumptions on the trends in gas demand and gas supply in Germany.
- **Chapter 3** presents the basic approach adopted for **modelling** the transmission systems, the input parameters required for this and the modelling variants. The influence of the market area merger on the modelling and on the related methodological approach is also described in this chapter.
- The **status of the L-gas and H-gas transmission system** is **Chapter 4**. In addition to the measures to expand the transmission system that are already under construction or that have been decided and planned, it describes the implementation status of the network expansion measures arising from the Gas Network Development Plan 2018–2028. Any delays that can be foreseen in the measures are also presented in this chapter.
- **Chapter 5** deals with the security of supply scenario and the market area conversion from L-gas to H-gas while looking at the **development of the L-gas supply**. It contains an L-gas quantity and capacity balance up to 2030 and descriptions of the areas of the relevant transmission system operators that are planned to be converted.
- The **development of the H-gas supply** is presented in **Chapter 6**. This includes an H-gas capacity balance up to 2030 as well as the allocation of the additional demand identified in the modelling variants to the cross-border interconnection points.
- The **results of the modelling** of the transmission systems for the base variant and the design variant for Baden-Württemberg are presented in **Chapter 7**. Calculations are performed and network expansion measures are identified in the modelling on the basis of the confirmed scenario framework. This chapter also contains the results of the modelling for the market area merger.
- **Chapter 8** presents the basis procedure adopted for the **green gas variant** as well as the modelling results that it produces.
- **Chapter 9** contains the **network expansion proposal** based on the modelling results of the transmission system operators. Furthermore, the **costs** of the proposed network expansion measures are reported in this chapter.
- **Chapter 10** provides an **overview of upcoming Network Development Plans** of the transmission system operators.

Timeline of the preparation of the Gas Network Development Plan

The consultation document on the Gas Network Development Plan 2020–2030 was published on the FNB Gas website www.fnb-gas.de on 4 May 2020. The general public and the market was given the opportunity to express their views during a public consultation running from 4 May 2020 to 29 May 2020. In addition, an online workshop was held on 13 May 2020, at which the Gas Network Development Plan 2020–2030 was explained and discussed. The results of this public consultation are presented in Chapter 1.4.

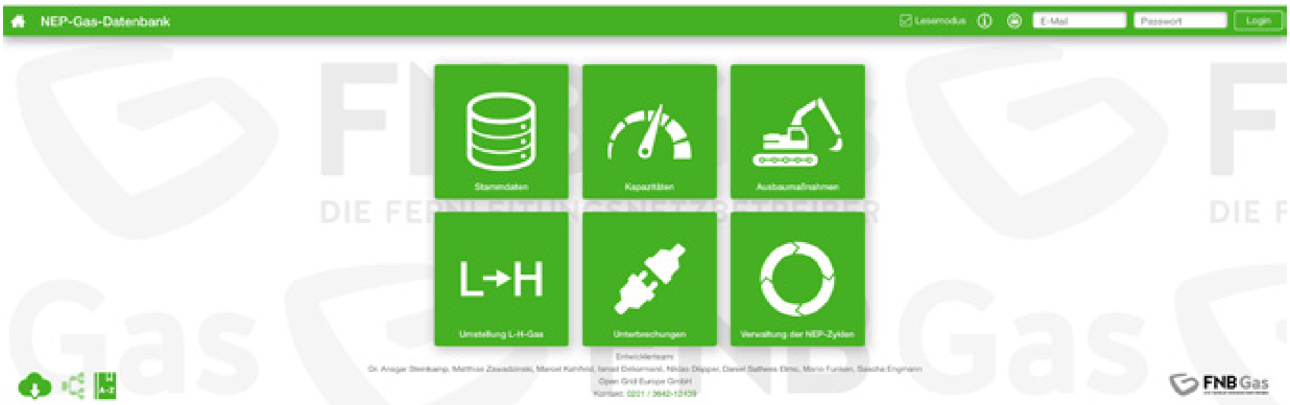
After the consultation period, the views that have been received were assessed and the results of the consultation incorporated in the draft Gas Network Development Plan 2020–2030 which was sent to the BNetzA on 1 July 2020.

The BNetzA has in turn to give a hearing to all actual and potential network users concerning the draft Gas Network Development Plan 2020–2030 submitted by the transmission system operators and to publish the results. It can subsequently request changes to the Gas Network Development Plan, which have to be incorporated by the transmission system operators within three months.

1.3 Database for the Gas Network Development Plan

The transmission system operators will provide the general public with a database at www.nep-gas-datenbank.de that contains the input parameters for the modelling, measures and other details about the Gas Network Development Plan.

Figure 1: NDP gas database homepage



Source: www.nep-gas-datenbank.de

The relevant categories of the “2020 – NEP Entwurf” database cycle will be referred to in the following chapters. It will also be possible to download all available data as an Excel file. To do this, the user can select the field “Download data” in the bottom left-hand corner of the screen on the homepage, please see Figure 1. The type of point “MÜP” (market area interconnection point) is dispensed with in the “Capacity” tile in the NDP gas database from the “2020 – NEP Konsultation” cycle as a result of the merger of the previous GASPOOL and NCG market areas.

For further questions about the NDP gas database please contact FNB Gas.

1.4 Consideration of the results of the public consultation from 4 May to 29 May 2020

In accordance with section 15a(2) EnWG, the transmission system operators provided the public with the opportunity to express their views on the consultation document of the Gas Network Development Plan 2020–2030 in the period from 4 May 2020 to 29 May 2020.

In total, 32 opinions were received in this period. An overview of the issues they touch on can be found in Appendix 2 ("Analysis of the opinions on the consultation by transmission system operators").

The transmission system operators find the overwhelmingly positive response to the green gas variant particularly noteworthy. Half of those who submitted an opinion, including authorities, association, energy companies and network operators, welcome the inclusion of green gases in the Gas Network Development Plan 2020–2030 and the transmission system operators network expansion proposal. These opinions attribute a crucial role in energy supply to green gases as regards the advancing energy transition and the decarbonisation of other consumption sectors.

Based on the many key comments on green gases in the opinions submitted, the transmission system operators have added and expanded on various aspects in Chapter 8 and Chapter 10. Furthermore, separate text components were added in this section on the assumptions concerning the distribution of hydrogen sources, hydrogen blending, the consideration of distribution system operators, the regulatory aspects and the criteria for the inclusion of green gas projects in future Network Development Plans.

The aspects brought up by the consultation participants and the Federal Network Agency have been addressed as follows:

General revision of the consultation document

Following the consultation, the transmission system operators made editorial and content revisions to the Gas Network Development Plan 2020–2030. Information from various opinions was added on the one hand, while the transmission system operators also made their own adjustments on the other. These revisions concern both the Gas Network Development Plan 2020–2030 and the NDP gas database. For example, the transmission system operators have made a number of additions to the explanation of the H-gas balance (Chapter 6), the LNG approach (Chapter 3 and Chapter 6) and the green gas variant (Chapter 8 and Chapter 10).

Chapter 2: Scenario framework

Various opinions refer to the scenario framework for the Gas Network Development Plan 2020–2030, in particular the gas demand scenarios presented.

The scenario framework forms the foundation for the Gas Network Development Plan 2020–2030. The current scenario framework was produced by the transmission system operators in spring 2019 and then opened up for consultation in June/July 2019. Following the revision of the scenario framework on the basis of the opinions received in the consultation, the scenario framework was forwarded to the Federal Network Agency. The Federal Network Agency confirmed the scenario framework on 5 December 2019 and finally set the requirements for modelling in the Gas Network Development Plan 2020–2030. The transmission system operators are bound to these requirements.

Please refer to the confirmed scenario framework for more information on the scenario framework and the gas demand scenarios; this section also provided details of where the gas demand scenarios influence network modelling.

The Gas Network Development Plan and thus the scenario framework must be published every two years. The transmission system operators will probably release the scenario framework for the Gas Network Development Plan 2022–2032 for consultation in the middle of 2021.

Chapter 3: Gas power plants

Several opinions brought up the modelling of gas power plants in the Gas Network Development Plan 2020–2030. Some of the opinions were critical of the capacity product for the firm dynamically allocable capacity of gas power plants and questioned the power plant allocation points used in the modelling.

In accordance with the confirmation of the scenario framework, the transmission system operators have modelled gas power plants with the firm dynamically allocable capacity product in the modelling for the Gas Network Development Plan 2020–2030 as well. The aim here is to devise a network expansion that makes sense macroeconomically. The transmission system operators still consider it appropriate to use firm dynamically allocable capacity for gas power plants. In revising the consultation document, information from the opinions for power plant allocation points was added and Tables 9 and 10 in the document and the NDP gas database were adjusted accordingly.

Chapter 3 and Chapter 7: Market area merger

As announced in the consultation document, the transmission system operators have added the results of the modelling for the market area merger (NewCap) in the Gas Network Development Plan 2020–2030. The results are presented in Chapter 7.1.6 in addition to further notes in Chapter 3.4.

Chapter 3 and Chapter 6: LNG and H-gas balance

Some opinions (those from German LNG Terminal/Hanseatic Energy Hub/Uniper) are clearly against a dynamically allocable capacity product as regards the security of supply and the liquidity of the German market. LNG imports already make an important contribution to the liquidity of the European gas market today, which – according to these opinions – could not be guaranteed with dynamically allocable capacity. They go on to state that every restriction of product quality greatly impedes economic operation, and would ultimately even endanger the success of the LNG project. According to these opinions, restricting the allocability of entry capacity would amount to discrimination between different LNG facilities on the European market, as freely allocable capacity is essential for LNG facilities that must compete at an international level. On the other hand, INES calls for dynamically allocable capacity allocation to storage facilities.

On the basis of opinions concerning the capacity product for LNG facilities, the transmission system operators have made additions in Chapter 3 and Chapter 6, and added further information on the H-gas balance in Chapter 6 on the basis of other opinions.

Chapter 5: Effects of COVID-19 on market area conversion

Some opinions concerned the current development of the market area conversion and asked how COVID-19 is expected to affect market area conversion.

The transmission system operators are continuously in communication with the distribution system operators concerned, the BNetzA, the BMWi, the BDEW and the DVGW in this regard. In this document, the transmission system operators have added information on the specific impact of the current situation on the TSO switching dates for the market area conversion in 2020 and explained the necessary adjustments in Chapter 5.8.5.

Assuming that the current COVID-19 situation does not deteriorate, the conversions planned throughout the whole of Germany for 2020 can be implemented almost entirely.

Chapter 7: Presentation of the results of the base variant

The results of the base variant are presented in Chapter 7. Measures were already allocated to power plants and LNG facilities in Chapters 7.1.3 and 7.1.4 of the consultation document. The transmission system operators have added an allocation of measures for the security of supply of the Netherlands in Chapter 7.1.5 of the draft of the Gas Network Development Plan 2020–2030.

Chapter 8: Green gas projects in the distribution system

Some opinions asked how green gas projects at distribution system level are being handled in the Gas Network Development Plan 2020–2030.

The transmission system operators launched the market partner survey on green gas projects and sector coupling on 21 March 2019. Corresponding project reports were requested so that the NDP process can play a more coordinating role in the integration of green gases into the German transmission system, thereby also serving the implementation of the energy transition. Project reports at distribution system level were also received in conjunction with the market partner survey. These projects were documented in the Gas Network Development Plan 2020–2030 for information and for reasons of transparency. A proposal for the future consideration of distribution system operators was added in Chapter 8 and Chapter 10.

Chapter 8: Hydrogen blending

Some opinions questioned the possibility of blending hydrogen into the natural gas transportation system and the need to transport hydrogen unmixed in a separate infrastructure. In this context, reference was made to the future potential of high hydrogen concentrations in distribution system structures and also to sensitive industrial processes for which the maximum volume concentration already used by transmission system operators of 2 % hydrogen in the natural gas stream causes problems. Transmission system operators feel that the feedback from the consultation has confirmed their basic approach of developing a separate infrastructure for hydrogen transmission in pipeline networks.

The approach chosen by transmission system operators considers blending hydrogen into the natural gas system only where connecting to a purely hydrogen infrastructure is not economically possible in the period covered by the Gas Network Development Plan 2020–2030. This comes closest to the requirements of consultation participants, and largely grants the necessary flexibility of allowing further hydrogen injections in downstream distribution systems as well. Separate hydrogen networks also offer a basis on which the respective distribution systems could, in future, blend a defined hydrogen concentration into the natural gas stream as demand requires, as far as the technology allows.

The transmission system operators are of the opinion that the planning presented in Chapter 8 is already consistent with the interests and demands of the consultation participants. A presentation of the projects revealed by the market partner survey and taken into account by blending into the natural gas network and methanisation was added in Chapter 8.4.

Chapter 8: Distribution of hydrogen sources

Some opinions refer to the distribution of hydrogen sources applied by the transmission system operators in hydrogen modelling. The results of the market partner survey revealed significantly higher hydrogen demand than can be covered by entry sources, which is why the transmission system operators have devised a distribution of hydrogen sources.

The opinions fundamentally support the transmission system operators' procedure for the distribution of hydrogen sources. In particular, the opinions see importing hydrogen as a key element in meeting demand in Germany, though the source of the hydrogen should be open to different technologies. Various opinions reference similar notions of building a European hydrogen infrastructure in neighbouring countries (Netherlands, Norway, Belgium, France). Storage facilities were also referenced as a logical option for providing hydrogen capacity, if the necessary framework conditions can be accomplished.

For market participants with industrial applications, the security of supply or availability is an essential element for the economic operation of their facilities, in some cases using hydrogen. Thus, connecting to corresponding infrastructures in neighbouring countries is seen as a good thing. Initial talks have already been held between German transmission system operators and neighbouring transmission system operators about potential import points.

The transmission system operators feel that the feedback from the consultation has confirmed their assumptions concerning the fulfilment of demand in the distribution of hydrogen sources. Nonetheless, the transmission system operators are also aware of the challenges of building a hydrogen infrastructure. In particular, domestic renewable electricity is seen as a "scarce commodity" for which several applications are competing. A fair framework open to different technologies for the development of infrastructures has to be created and the hydrogen available has to be used as efficiently as possible.

Chapter 8, Chapter 9 and Chapter 10:
Regulatory framework for green gas measures taking into account the network expansion proposal

When the consultation document was published on 4 May 2020, the transmission system operators proposed the resulting measures of the green gas variant as specific network expansion measures on the condition that the legal and regulatory framework for the construction, operation, access to and use of natural gas transmission pipelines will apply equally to the hydrogen infrastructure system in future. The Federal Network Agency already said at the Gas Network Development Plan 2020–2030 consultation workshop on 13 May 2020 that it welcomes the modelling of the green gas variant, though it does not feel that the resulting green gas measures can currently be confirmed as the measures for the hydrogen infrastructure are not covered by section 15a EnWG.

A number of market participants took the opportunity to comment on this as part of the consultation on the Gas Network Development Plan 2020–2030. The opinions received clearly show widespread support for a prompt adjustment and extension of the legal and regulatory framework to include hydrogen as an energy source. The main reasons for this are legal and planning security for green gas project investment decisions, hydrogen's potential to contribute to the security of supply and the logical ongoing use of natural gas pipelines after completion of the market area conversion. Furthermore, it would clear the way for commercial hydrogen injection beyond a laboratory experiment. In the opinion of various market participants, the existing legal framework for natural gas could be extended to include hydrogen by broadening "natural gas" to "gas" in the German Energy Industry Act and the German Gas Network Access Regulation. Some market participants believe that this is both pragmatic and achievable. The association proposal from the BDEW, BDI, DIHK, FNB Gas and VIK with specifically formulated requirements for the adjustment to the legal framework was repeatedly referred to in this context [FNB Gas/BDI/BDEW/VIK/DIHK 2020]. Furthermore, some market participants feel that the hydrogen infrastructure is a component of the gas network infrastructure, and therefore the adjustment of the legal framework is essential to promote hydrogen integration.

The Ministry for the Economy, Innovation, Digitisation and Energy of the State of North Rhine-Westphalia (MWIDE) also advocates considering broadening the term "gas" in accordance with section 3 no. 19a/section 3 no. 10c EnWG to include hydrogen in line with technological developments. The association proposal referred to above could serve as a basis for this. Furthermore, the MWIDE welcomes the network expansion essentially being achieved by repurposing existing infrastructure.

One market participant suggests first analysing the need for the regulation of potential hydrogen networks transparently and with broad participation, and considering the extent to which regulatory intervention helps or hinders the development of a sustainable hydrogen economy. Another participant then said that the network expansion proposal is premature as the political and regulatory foundations have yet to be resolved. It was also criticised that the Gas Network Development Plan 2020–2030 does not take into account the German government's hydrogen strategy.

The overwhelming advocacy for an adjustment of the legal and regulatory framework was countered by an opinion from the environmental organisation Deutsche Umwelthilfe (DUH). The DUH is against an adjustment of the legal and regulatory framework if the costs of the hydrogen infrastructure are to be passed on to all gas consumers. Rather, the DUH feels that the costs should be borne by industry, the main beneficiary. This applies to both the construction of new hydrogen pipelines and the conversion of existing natural gas pipelines.

Furthermore, the DUH feels that hydrogen transmission should be limited to “green hydrogen”, i.e. hydrogen produced from regenerative sources. Other market participants do not share this opinion, and exclusively emphasised the need for network expansion proposals to be open to all technologies. Accordingly, they feel that the transmission of hydrogen should not be exclusively limited to “green hydrogen”, and that instead, among other things, “blue hydrogen”, which is produced by the capture and storage of CO_2, should also be considered. Furthermore, some market participants criticised the concentration of network expansion proposals on the North-West Region. Other market participants expressed a desire for the earlier implementation of specific network expansion proposals for hydrogen.

The transmission system operators are grateful for the many opinions received on this issue that is so vital to the success of the energy transition. The transmission system operators will continue to analyse and shape the dynamic development in this field together with the market, and also take it into account in future Network Development Plans. Like the majority of those who submitted opinions, the transmission system operators appeal to politicians to adjust the legal and regulatory framework soon in order that the network expansion measures to build a comprehensive hydrogen transmission network can begin.

Chapter 10: Green gas project criteria for future Network Development Plans

Some opinions called for more openness to different technologies when selecting the green gas and similar projects to be considered in the scenario framework, and for more involvement on the part of distribution system operators.

In the interests of being open to different technologies, the transmission system operators have added the criteria for the future inclusion of green gas projects in Chapter 10. Blue hydrogen has already been taken into account in the modelling of the green gas variant.

The transmission system operators are complying with the demand of the Federal Network Agency, as expressed in its confirmation of the scenario framework, by focusing on the possible criteria for green gas projects connecting to the transmission system. The transmission system operators have broadened the criteria to allow greater inclusion of all network levels, and therefore distribution system operators in particular. Project plans that are intended to connect to the distribution system can be included in modelling through the long-term forecast. The inclusion of long-term forecasts is also expected to help further boost commitment to the project plan.

Opinions on the criteria for the inclusion of green gas projects are inconsistent. Some point out the chicken-and-egg nature of the implementation decision by project developers for the respective green gas projects. This highlights the necessity of creating and adjusting the legal framework quickly, as called for by the transmission system operators and the majority of those who submitted opinions.

Chapter 10: Visionary hydrogen network

Various opinions concerned the visionary hydrogen network published by the transmission system operators. A hydrogen infrastructure is seen as a key issue for the future, and the majority of opinions expressly welcome its inclusion in the Gas Network Development Plan 2020–2030. It was also pointed out that the implementation of a hydrogen network cannot be left to wait until 2050 if the goal of greenhouse gas neutrality is to be achieved.

The transmission system operators published the visionary hydrogen network for the first time in February 2020. The planning to build a hydrogen network by 2030 has been fleshed out in the Gas Network Development Plan 2020–2030. The development of a hydrogen network is a key step in preparing the gas infrastructure for the future and making it greenhouse gas-neutral, and it is fundamental for the creation of a competitive hydrogen market. The transmission system operators will continue to advance this planning as far as the legal framework allows.

Chapter 10: Integrated network development planning

Several opinions expressly welcome the approach of future integrated consideration of the sectors and their infrastructures. In addition, some opinions called for the involvement of distribution system operators in the network development planning process, in particular to connect the distribution systems to the hydrogen infrastructure.

Climate protection goals can only be achieved if renewable energy can be used in all sectors, and if the planning processes of infrastructures (electricity grids, gas grids, heating grids and storage facilities) are all coordinated. An integrated approach to planning processes is currently being analysed/devised by dena Network Study III with the involvement of all stakeholders.

The establishment of a hydrogen transmission infrastructure is to be fully integrated into gas network development planning. The Gas Network Development Plan 2020–2030 already (subject to the creation of a legal framework for hydrogen networks) takes into account a number of hydrogen projects for which existing pipeline sections are being converted and supplemented with newly built hydrogen pipelines. In light of the rising demand for hydrogen in the energy supply, the transmission system operators developed a possible future vision for a hydrogen network in Germany in early 2020. The scope of the visionary hydrogen network includes major metropolitan areas that can achieve reductions in CO_2 emissions in the heating sector by blending hydrogen in the regional distribution systems there. The modelling result of the green gas variant of this Gas Network Development Plan 2020–2030 is a first step towards making this future vision a reality.

NDP gas database

The commissioning dates of the measures resulting from hydrogen modelling, ID 720-01, ID 721-01, ID 722-01, ID 723-01 and ID 730-01, were adjusted in the NDP gas database from December 2026 to December 2030 in accordance with the modelling result. The reason for the adjustment is the joint approach among transmission system operators to identify green gas measures needed for the requirements of 2031 in the NDP gas database with a launch date of December 2030. Furthermore, some of the pipelines to be converted in the green gas variant are needed for the L-to-H-gas conversion beyond 2026.

Confirmed scenario framework 2

2 Confirmed scenario framework for the Gas Network Development Plan 2020–2030

The scenario framework with its results and findings forms a key basis for the modelling that is carried out.

The BNetzA confirmed the draft scenario framework [FNB Gas 2019a] submitted by the transmission system operators, with some changes, on 5 December 2019

Important assumptions and results of the scenario framework concerning the trends in gas demand are presented in brief to begin with [FNB Gas 2019a]. More detailed information on this can be downloaded from the Internet (download from: www.fnb-gas.de). The key results of the confirmation of the scenario framework are presented in Chapter 2.3.

2.1 Assumptions of the scenario framework for the Gas Network Development Plan 2020–2030 relating to the German trends in gas demand

Two scenarios for the development of gas demand in Germany up to 2030 are presented in the scenario framework. One scenario additionally provides a long-term outlook extending to 2050.

Prognos AG analysed renowned studies and publications on the future development of gas demand and gas supply in Germany on behalf of the transmission system operators for this scenario framework. Target scenarios that fulfil the targets of energy and climate policy are focused on here. In the following, gas demand is understood to be the demand for natural gas, biomethane and green gases.

For the scenario framework, the transmission system operators decided to take the dena-TM95 [dena 2018, Scenario I up to 2050] and EUCO30 [EUCO 2017, Scenario II up to 2030] scenarios into more detailed consideration. Dena-TM95 presents a scenario that contains a wide variation in technologies and energy sources. By using the EUCO30 scenario as a basis for consideration, the consistency with the previous Gas Network Development Plan 2018–2028 is retained. The final energy demand, the non-energy consumption and indirectly also the gas demand for the generation of district heating in Germany are taken from the scenarios.

For the gas demand in the transformation sector (power plants including own consumption), the trend has been mapped using the Prognos electricity market model. The coal phase-out path, as recommended by the “Commission on Growth, Structural Change and Employment” (“Coal Commission”) [BMWi 2019], has been mapped in both scenarios. Starting out from the BNetzA’s list of power plants, the current stock of power plants and also the trends in additional and decommissioned capacity in German are mapped. The capacity reservations and capacity expansion claims currently present at the transmission system operators pursuant to sections 38 and 39 GasNZV have also been taken into consideration. In sum, increasing capacity from the gas-based generation of electricity is expected. The table below shows the trend in the installed electrical capacity of the gas power plants up to 2030 that results in the scenarios.

Table 3: Electrical power plant capacity (net) installed in gas power plants in Germany

Installed net capacity Gas power plants (GW_e)	2017	2020	2025	2030	2040	2050	Change 2030 from 2020	Change 2050 from 2020
	GW_e						Percent	
Scenario I	27	28	36	37	63	57	31	102
Scenario II	27	28	36	37	–	–	31	–

Source: Prognos AG

The gas supply in Germany consists of the domestic production of natural gas and petroleum gas as well as the generation and injection of green gases and biomethane.

- **Domestic production of natural gas:** The development path has been taken from a current investigation by the Bundesverband Erdgas, Erdöl und Geoenergie e. V. (BVEG – German Federal Association of Natural Gas, Petroleum and Geoenergy) [BVEG 2019].
- **Green gases (hydrogen, synthetic methane):** A forecast has been produced on the basis of the FfE study [FfE 2019] and other assumptions of how the gas supply from green gases will develop in Germany.
- **Injection of biomethane:** The basis for the assessment is provided by the FfE study [FfE 2019]. The Germany-wide regionalisation of the use of biomethane for providing electricity and heating is based on the assessment of the Federal Network Agency's current 2018 monitoring report [BNetzA/BKartA Monitoringbericht 2019] and the project list for biomethane injection published by Deutsche Energie-Agentur GmbH (dena 2019 – German Energy Agency).

The table below shows the results of the BVEG forecast for conventional natural gas production in Germany up to 2030.

Table 4: Projection of natural gas production and capacity

Natural gas production in Germany and the main extraction regions – Scenario I and II								
Germany as a whole*, of which			… Elbe-Weser region (excluding Altmark)			… Weser-Ems region (excluding Ostfriesland)		
	Production	Capacity	Production	Capacity based on planning	Capacity with safety margin	Production	Capacity based on planning	Capacity with safety margin
Year	Billion m^3	Million m^3/h	Billion m^3	Million m^3/h	Million m^3/h	Billion m^3	Million m^3/h	Million m^3/h
2019	6.26	0.80	2.65	0.33	0.31	3.30	0.41	0.38
2020	5.82	0.74	2.47	0.31	0.29	2.98	0.37	0.35
2021	5.72	0.73	2.25	0.28	0.26	3.16	0.40	0.37
2022	5.38	0.68	2.20	0.28	0.25	2.85	0.36	0.33
2023	5.11	0.65	2.13	0.27	0.24	2.55	0.32	0.29
2024	5.76	0.72	1.91	0.24	0.22	2.43	0.30	0.28
2025	5.44	0.68	1.75	0.22	0.20	2.22	0.28	0.25
2026	5.02	0.63	1.60	0.20	0.18	1.97	0.25	0.22
2027	4.61	0.57	1.49	0.19	0.16	1.72	0.21	0.19
2028	4.23	0.52	1.34	0.17	0.14	1.50	0.19	0.16
2029	3.99	0.49	1.22	0.15	0.13	1.35	0.17	0.14
2030	3.73	0.46	1.08	0.14	0.11	1.23	0.15	0.13

* Germany as a whole contains the two main production areas Elbe-Weser (excluding Altmark) and Weser-Ems (excluding Ostfriesland) as well as the production and capacity of other small regions.

Source: BVEG 2019

2.2 Results of the scenario framework for the Gas Network Development Plan 2020–2030 for the trends in German gas demand

The demand for gas (natural gas, biomethane and green gases) in scenarios I and II is compiled from the individual results of the development paths related to the final energy consumption, non-energy consumption, gas usage in the transformation sector (generation of electricity and heating) and internal consumption in the transformation sector. In Scenario I, an increase in total German gas demand of around 7 % is expected between 2020 and 2030. In Scenario II, the demand for gas in the same period declines by around 9 %.

The two tables below show the total German gas usage in the examined scenarios presented in terms of high calorific value (Hs) in each case.

Table 5: Development of German gas demand in scenario I, temperature-adjusted, presentation as high calorific value (H_S)

Gas demand in Germany – Scenario I Presentation as calorific value (H_S)	2017	2020	2025	2030	2040	2050	Change 2030 from 2017	Change 2030 from 2020	Change 2050 from 2020
	TWh H_S						Percent		
Gas demand, total	968	980	1,013	1,054	1,095	1,159	9	7	18
Final energy demand for gas	656	650	639	652	687	722	-1	0	11
– Industry	261	274	297	319	337	355	22	16	29
– Households/commerce, trade and services	394	371	333	296	225	155	–25	–20	–58
– Transport	2	4	9	37	125	212	1,757	734	4,657
Non-energy consumption of gas	38	45	57	69	101	157	81	53	247
Gas usage in the transformation sector*	274	285	317	333	307	280	22	17	–2

* Gas consumption in the transformation sector comprises power plants, district heating plants and the internal gas consumption in the sector.

Source: BDEW/AG Energiebilanzen (final energy consumption of natural gas), calculation of the transmission system operators (temperature-adjusted values), dena 2018, Prognos AG

Table 6: Development of German gas demand in scenario II, temperature-adjusted, presentation as high calorific value (H_S)

Gas demand in Germany – Scenario II Presentation as calorific value (H_S)	2017	2020	2025	2030	2040	2050	Change 2030 from 2017	Change 2030 from 2020	Change 2050 from 2020
	TWh H_S						Percent		
Gas demand, total	968	980	932	894	–	–	–8	–9	–
Final energy demand for gas	656	656	580	525	–	–	–20	–20	–
– Industry	261	261	222	204	–	–	–22	–22	–
– Households/commerce, trade and services	394	393	354	313	–	–	–20	–20	–
– Transport	2	3	4	8	–	–	276	185	–
Non-energy consumption of gas	38	39	40	40	–	–	5	2	–
Gas usage in the transformation sector*	274	284	312	329	–	–	20	16	–

* Gas consumption in the transformation sector comprises power plants, district heating plants and the internal gas consumption in the sector.

Source: BDEW/AG Energiebilanzen (final energy consumption of natural gas), calculation of the transmission system operators (temperature-adjusted values), EUCO 2017, Prognos AG

Conventional natural gas production in Germany will decline sharply based on the BVEG forecast up to 2030. The results of the forecast are presented in the table below for individual years in terms of volume (billion m^3) and in units of energy (TWh, high calorific value).

Table 7: German natural gas production in various units

Natural gas production in Germany – Scenario I and II	Unit	2017	2020	2025	2030	Change 2030 from 2017	Change 2030 from 2020	Change 2030 from 2025
Conventional gas	billion m^3*	7.25	5.82	5.44	3.73	–49 %	–36 %	–32 %
Conventional gas	TWh H_S**	71	57	53	36			

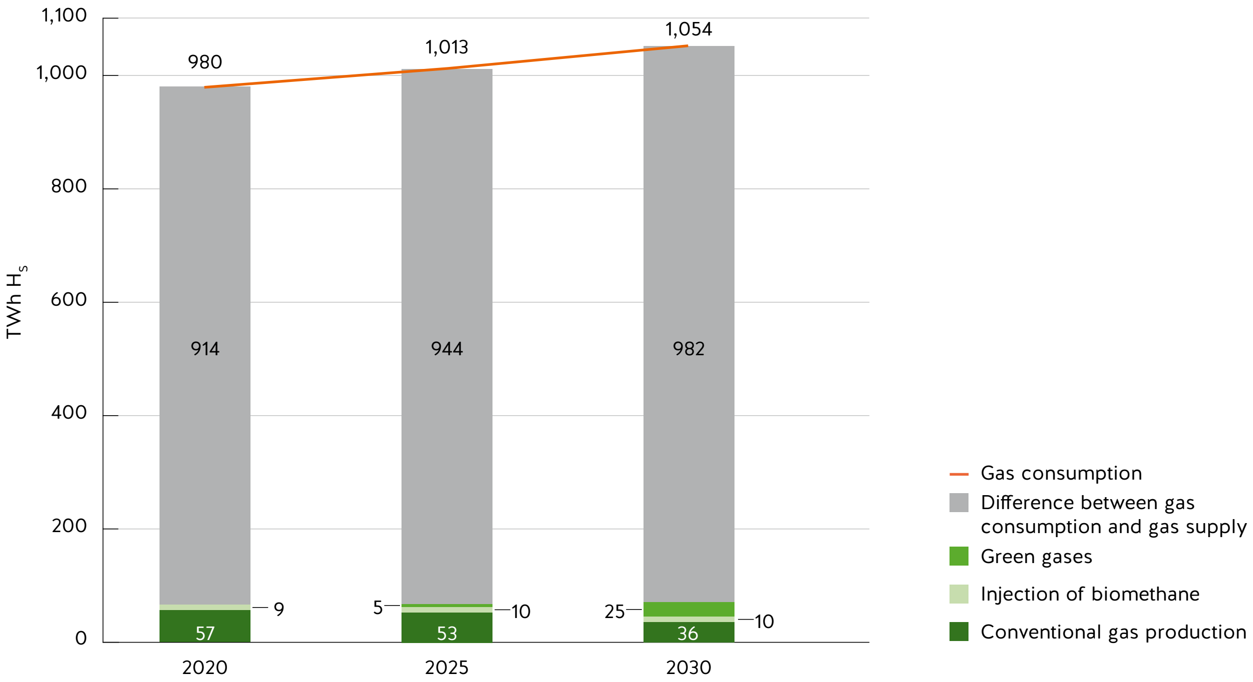
* Quantities relate to natural gas with a uniform high calorific value (H_S) of 9.7692 kWh/m^3.
** Quantities converted into TWh (9.7692 kWh/m^3), high calorific value (H_S)

Source: Prognos AG, BVEG 2019

Production of non-conventional gases has not been taken into consideration in the gas demand scenarios for the Gas Network Development Plan 2020–2030.

Based on the gas demand scenarios presented in the scenario framework, a difference arises (excluding transit quantities) between gas demand and gas supply (conventional natural gas production, biomethane injection and green gases). This difference is shown in Figure 2 below and in Table 8. This consideration involves a simple quantity balance based on gas demand scenarios I in the scenario framework. The balances relevant for the network modelling are presented in the Chapters 5 and 6.

Figure 2: Development of the difference between gas demand and gas supply in Germany according to scenario I, presentation as high calorific value (H_S)



Source: Scenario framework for the Gas Network Development Plan 2020–2030

Table 8: Development of the difference between gas demand and gas supply in Germany according to scenario I, presentation as high calorific value (H_S)

Results of scenario I, presentation as high calorific value (H_S)	2020	2025	2030
	TWh H_S		
Gas consumption	980	1,013	1,054
Gas supply	66	68	71
– Conventional gas production	57	53	36
– Injection of biomethane	9	10	10
– Green gases (hydrogen, synthetic methane)	0	5	25
Difference between gas consumption and gas supply	**914**	**944**	**982**

Source: Prognos AG, FfE 2019

2.3 Confirmation of the scenario framework for the Gas Network Development Plan 2020–2030

The BNetzA confirmed the draft scenario framework, which was revised by the transmission system operators following consultation, on 5 December 2019 subject to changes and conditions [BNetzA 2019a].

The requirements of the BNetzA that arise from the confirmation of the scenario framework will be taken into consideration if possible by the transmission system operators in various chapters of the Gas Network Development Plan 2020–2030.

- **Operative provision 1** of the scenario framework confirmation sets requirements for the consideration of green gas projects:
  - In accordance with operative provision 1a, the transmission system operators are required to take exclusively the capacity of existing green gas plants into consideration for the injection of hydrogen in the modelling of the base variant. This requirement has been implemented in the modelling (cf. Chapter 7) and in the “2020 – NEP Entwurf” cycle in the NDP gas database.
  - Operative provision 1b requires the transmission system operators also to take the planned green gas projects from the market partner survey into consideration in a separate modelling variant (green gas variant) for 2025 and 2030. The procedure described in Chapter 10.3 of the scenario framework has to be applied here for 2025. Capacity for electrolysis output totalling a maximum of 2.8 GW_e has to be recognised in the modelling for 2030. This requirement has been implemented in the modelling (cf. Chapter 8).
  - In accordance with operative provision 1c, the transmission system operators are required to identify in the green gas variant the need for capacity and expansion resulting from green gas projects as well as the upgrading or rededication of existing gas infrastructure that may be required and in this process to allocate the proposed infrastructure measures to the projects taken into consideration as accurately as possible. The transmission system operators have to present the procedure in the modelling in a comprehensible and transparent way. Furthermore, the transmission system operators have to present and corroborate which capacity products have been taken as the basis for the green gas projects. This requirement has been implemented by the transmission system operators (cf. Chapters 8 and 10, the “2020 – NEP Entwurf” cycle in the NDP gas database).
  - Operative provision 1d requires the transmission system operators to develop binding criteria for the consideration and inclusion of green gas and comparable projects in future network development planning processes and to consult the market on these. The criteria have to be developed in the course of preparing the Network Development Plan and to be presented and explained in the consultation document. If forecasts and sources for the generation or import of hydrogen that extend beyond specific green gas projects are to be taken into consideration, the transmission system operators also have to develop a methodological approach for this and present it in the consultation document. This requirement has been implemented by the transmission system operators (cf. Chapter 10).
- In **operative provision 2**, the BNetzA confirms the procedure proposed by the transmission system operators to use technical available capacity amounting to 16.2 GWh/h from 2026 in the modelling when drawing up the Gas Network Development Plan 2020–2030 with regard to the capacity approach at the Wallbach cross-border interconnection point (exit) and requires the transmission system operators to ascertain the network expansion resulting from this. This requirement has been implemented in the modelling (cf. Chapter 7, “2020 – NEP Konsultation” cycle in the NDP gas database).
- In **operative provision 3**, the BNetzA confirms the procedure proposed by the transmission system operators to take into consideration, in addition to the existing capacity at the Greifswald and Lubmin II (entry) cross-border interconnection points pro rata and the Bunde/Oude Statenzijl cross-border interconnection point (H, exit) that is included in the “2020 – SF” database cycle, dynamically allocable capacity at these points totalling 12 GWh/h for the preparation of the Gas Network Development Plan 2020–2030. The transmission system operators are required in this respect to fulfil the following requirements in the Gas Network Development Plan 2020–2030:
  - In accordance with operative provision 3a, the transmission system operators have to identify the resulting network expansion and conduct an accurate allocation of these measures to this capacity approach. This requirement has been implemented by the transmission system operators (cf. Chapters 3.2.7 and 7, “2020 – NEP Entwurf” cycle in the NDP gas database).

> In accordance with operative provision 3b, the transmission system operators have to justify transparently and in a way that is comprehensible to third parties without more information why the capacity increase at the specified cross-border interconnection points and the resulting expansion measures are preferable to other solution options for guaranteeing the security of supply in the relevant region (north-west Europe). This requirement has been implemented by the transmission system operators (cf. Chapter 3.2.7).

- **Operative provision 4** requires the transmission system operators to implement the following requirements in terms of the capacity approach at the connection points for new gas power plants in the Gas Network Development Plan 2020–2030:

  > In accordance with operative provision 4a, the transmission system operators must also take the Staudinger power plant into consideration in the cluster approach. The Staudinger power plant has to be assigned to Cluster 1 with the Biblis power plant that has already been taken into account. The estimated electrical power output has to be capped at 0.3 GW_e in Cluster 1. A total of 0.9 GW_e has to be taken into consideration for special network operating equipment in the total German H-gas balance. This requirement has been implemented in the modelling (cf. Chapter 3.2.2).

  > In accordance with operative provision 4b, the transmission system operators are required to identify the network expansion resulting from new gas power plant plans, show this separately and allocate the proposed network expansion measures as accurately as possible to the new gas power plant plans taken into consideration. This requirement has been implemented by the transmission system operators (cf. Chapter 7.1.3, "2020 – NEP Entwurf" cycle in the NDP gas database).

- **Operative provision 5** requires the transmission system operators to implement the following requirements in relation to the consideration of the requests for possible LNG facilities included in the scenario framework in the Gas Network Development Plan 2020–2030.

  > In operative provision 5a, the BNetzA confirms the procedure proposed by the transmission system operators to recognise the four requests for LNG facilities included in the scenario framework as being in competition for planning purposes in the modelling. They have here to utilise the transfer potential, to show the competition zones and the cross-border interconnection and storage connection points in competition with the relevant LNG entry points that are included and to present them transparently in the Gas Network Development Plan 2020–2030. The transmission system operators have to allocate the network expansion resulting from this consideration as specifically as possible to the relevant competition zones and the LNG projects. This requirement has been implemented by the transmission system operators (cf. Chapters 3.2.6 and 7.1.4, "2020 – NEP Entwurf" cycle in the NDP gas database).

  > Operative provision 5b requires the transmission system operators to estimate on an indicative basis the expansion costs that a consideration of the present four requests with dynamically allocable capacity as planning premises would signify. The transmission system operators have made a statement on this point in Chapter 3.2.6.

- In accordance with **operative provision 6**, the transmission system operators have to take the NewCap market area model that they have developed into consideration when drawing up the Gas Network Development Plan 2020–2030. The capacity in the "2020 – SF" database cycle is assumed as planning capacity. The transmission system operators additionally have to fulfil the following requirements:

  > In accordance with operative provision 6a, the transmission system operators have to explain in detail which assumptions form the basis of the load situations considered in the model. They furthermore have to determine and justify whether and why using market-based instruments (wheeling, third-party network use and exchange-based spread products) are preferable to expanding the network in order to remedy the bottlenecks that emerge in the load scenarios that are considered. The related assumptions and assessment criteria have to be presented transparently so that they are comprehensible to third parties without any further information. This requirement has been implemented by the transmission system operators (cf. Chapter 3.4 and 7.1.6).

> Operative provision 6b requires the transmission system operators to identify the expansion measures required to resolve the bottleneck, if the investigation shows that a network expansion is more efficient and cost-effective in terms of network equipment and is thus preferable to the use of market-based instruments in order to resolve the transport functions under consideration, and to present these measures with their technical characteristics, the possible commissioning dates, the expected investment costs as well as their impacts on other network areas. This requirement has been implemented by the transmission system operators (cf. Chapter 3.4 and 7.1.6).

- **Operative provision 7** requires the transmission system operators to calculate the design variant for Baden-Württemberg in addition to the base variant for the 2030 year under consideration. The transmission system operators have to recognise capacity demand of 35.6 GWh/h in the terranets bw network in this variant. The expansion measures in the terranets bw network that result from this consideration have to be identified and the related technical characteristics, the necessary investment costs and possible commissioning dates have to be reported. Furthermore, possible impacts, for example in terms of their technical dimensioning, on other planned projects in the network area of terranets bw are to be presented. In addition, the impacts on other network areas that are upstream in particular in terms of flow mechanics, the resulting expansion measures in these networks and related investment costs have to be estimated on an indicative basis and presented. This requirement has been implemented by the transmission system operators (cf. Chapter 7.2).

- **Operative provision 8** requires the transmission system operators to take an aggregated value of 186 MWh/h into consideration for the demand from industrial customers on the terranets bw network when drawing up the Gas Network Development Plan 2020–2030. This requirement has been implemented in the modelling (cf. Chapter 7) and in the "2020 – NEP Entwurf" cycle in the NDP gas database.

- In accordance with **operative provision 9**, the transmission system operators are required to send to the BNetzA no later than by the time the draft Gas Network Development Plan 2020–2030 is submitted detailed information on the peak load case considered in the plan in the context of the capacity balances of the base variant. To this end, information has to be provided on the assumed capacity for each individual cross-border interconnection point, market area exchange point, distribution system operator network interconnection point, underground gas storage connection point, power plant connection point, industry connection point, LNG connection point, production entry point, biogas entry point and hydrogen entry point. This requirement has been implemented by the transmission system operators in the form of a data-delivery to the Federal Network Agency.

- **Operative provision 10** requires the transmission system operators to adjust the value of the technically available capacity and of the freely allocable capacity at the Eynatten cross-border interconnection point, specifically ID 541, that is contained in the "2020 – SR" NDP gas database cycle and to take a value of 5,395 MWh/h into consideration when drawing up the Gas Network Development Plan 2020–2030. This requirement has been implemented in the modelling (cf. Chapter 7) and in the "2020 – NEP Entwurf" cycle of the NDP gas database.

Modelling of the transmission systems 3

3 Modelling of the transmission systems

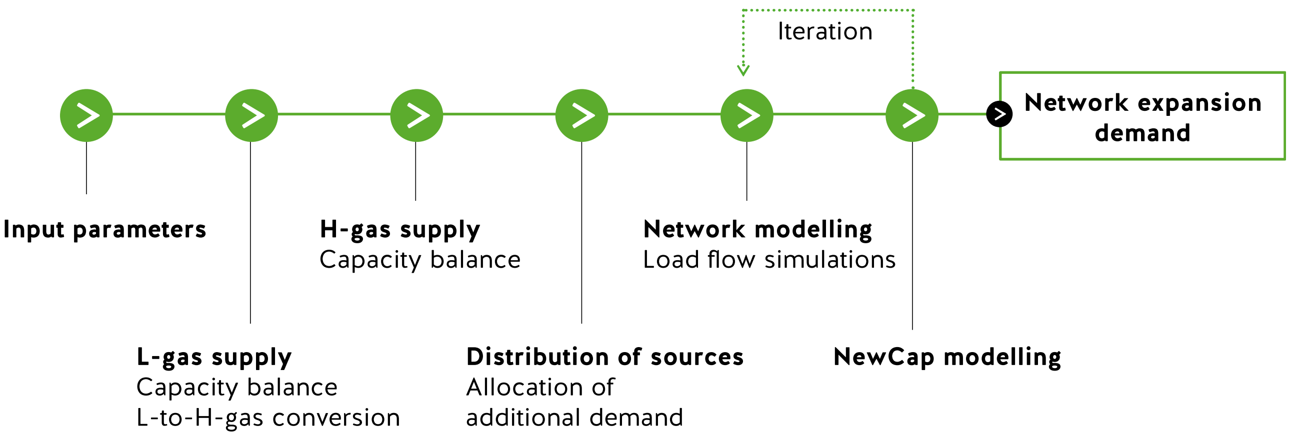
The transmission system operators have further developed the methodology that was jointly designed in the previous Network Development Plans for the Germany-wide modelling of the transmission systems in the Gas Network Development plan 2020–2030. The basis for the modelling is provided by the scenario frameworks confirmed by the BNetzA on 5 December 2019.

3.1 Basic procedure and input parameters for the network modelling

The basic procedure for the network modelling is presented in Figure 3. The starting point involves determining the relevant input parameters for the network modelling. The conversion areas are subsequently identified and the L-gas capacity and quantity balance is drawn up in the course of the analysis of the L-gas supply. The next step involves drawing up the H-gas capacity balance and, as a result, determining the additional H-gas capacity demand. Based on the results of the distribution of H-gas sources, the required additional H-gas demand is subsequently allocated with the appropriate potential to the regions and, using certain criteria, to the cross-border interconnection points. The network modelling of the transmission system operators is then carried out on the basis of these values. After several iteration steps, results are subsequently generated that then lead to the definition of the network expansion demand in the individual modelling variants.

Additional iteration steps are taken in the Gas Network Development Plan 2020–2030 for the first time with the NewCap model in order to identify and verify the impacts of the market area merger and the resulting need for expansion. The procedure planned for this is described in Chapter 3.4.

Figure 3: Basic network modelling procedure

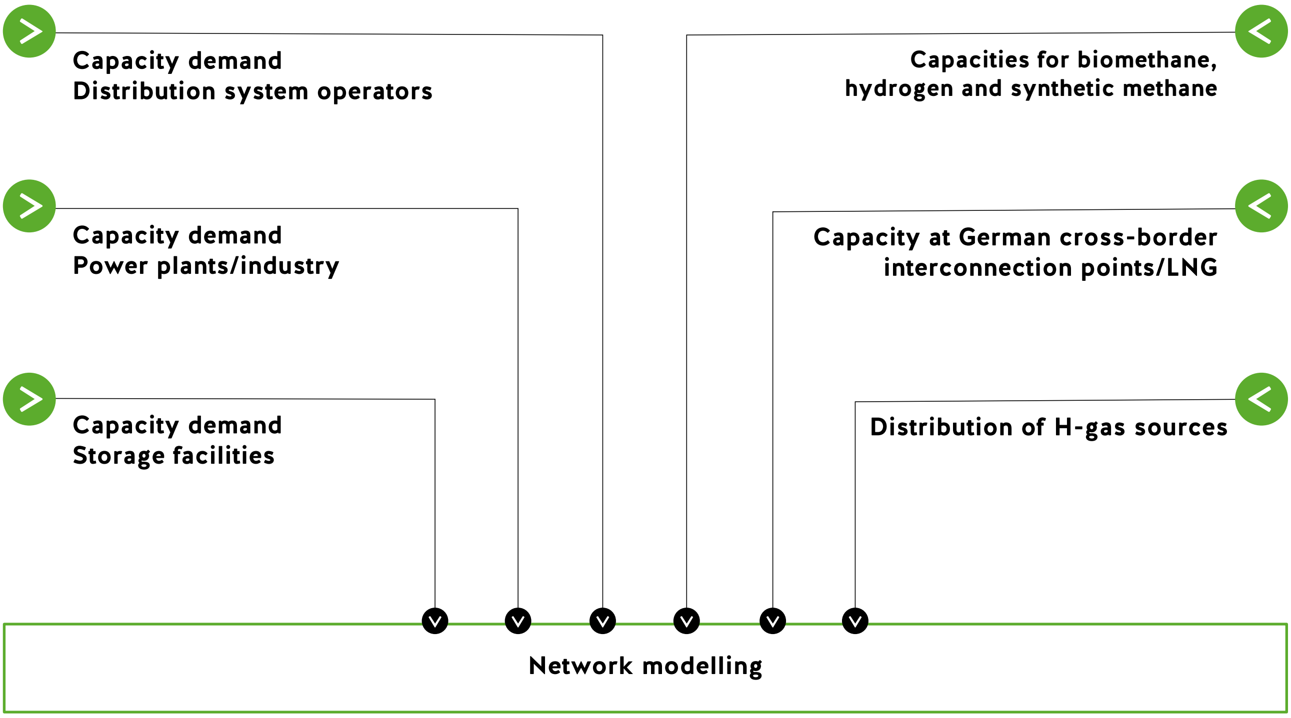


Source: Transmission system operators

The capacity demands of 31 December 2025 and of 31 December 2030 are used as the basis for determining the network expansion measures to cover the demand in 2025 and 2030 respectively. These are shown in this document as the 2025/2026 and 2030/2031 gas years.

The input parameters for the network modelling include basic data that is taken from a variety of sources, adjusted and updated if necessary and then used as input for the network modelling. Figure 4 shows all the important input parameters for the network modelling.

Figure 4: Input parameters for the network modelling



Source: Transmission system operators

The input parameters for the network modelling can be found in the NDP gas database in the "2020 – NEP Entwurf" cycle.

3.2 Important input parameters for the modelling

The key input parameters based on the confirmation of the scenario framework are described below.

3.2.1 Distribution system operators

The following modelling approach is used to model the capacity demand of the distribution system operators.

- Start value: Requested internal order of the distribution system operators for 2020.
- Period 2021–2025: Verified long-term forecast of the distribution system operators in accordance with section 16(1) of the cooperation agreement between the operators of gas supply networks located in Germany [BDEW/GEODE/VKU 2019].
- Period 2026–2030: Constant updating on the basis of the verified long-term forecast of the distribution system operators from 2026 onwards.

In deviation from this, the design variant for Baden-Württemberg also takes the verified long-term forecast of the distribution system operators in Baden-Württemberg as well as an offset for storage capacity that is being discontinued into consideration in the 2026–2030 period.

3.2.2 Gas power plants

In the modelling of the gas power plants, a distinction has to be drawn in principle between gas power plants that are connected directly to the network of the transmission system operators and gas power plants that are connected to downstream networks.

Gas power plants that are connected directly to the network of the transmission system operators can be broken down as follows:

- existing not systemically important gas power plants,
- existing systemically important gas power plants and
- new build gas power plants.

Power plant capacity that is connected not to the network of the transmission system operators, but to downstream networks have to be taken into consideration by the distribution system operators in the internal order.

Existing not systemically important gas power plants

Existing not systemically gas power plants connected to the transmission network are taken into consideration in the modelling with the existing capacity in accordance with the NDP gas database.

Existing systemically important power plants

The statements in this document on systemically important gas power plants refer to gas power plants that are connected directly to the transmission system.

The systemically important gas power plants have been defined by the electricity transmission system operators in consultation with the BNetzA. A requirement for the designation was that the availability of these gas power plants is regarded as potentially necessary for maintaining the security and stability of the transmission network and that they are thus necessary for ensuring that the electricity network can operate safely. The gas power plants classified as systemically important are present in Table 9 and in Figure 5.

In accordance with the confirmation of the scenario framework, the transmission system operators have modelled gas power plants classed as systemically important in all the modelling variants for 2025 and 2030. The capacity product recognised in each case can be found in the table below.

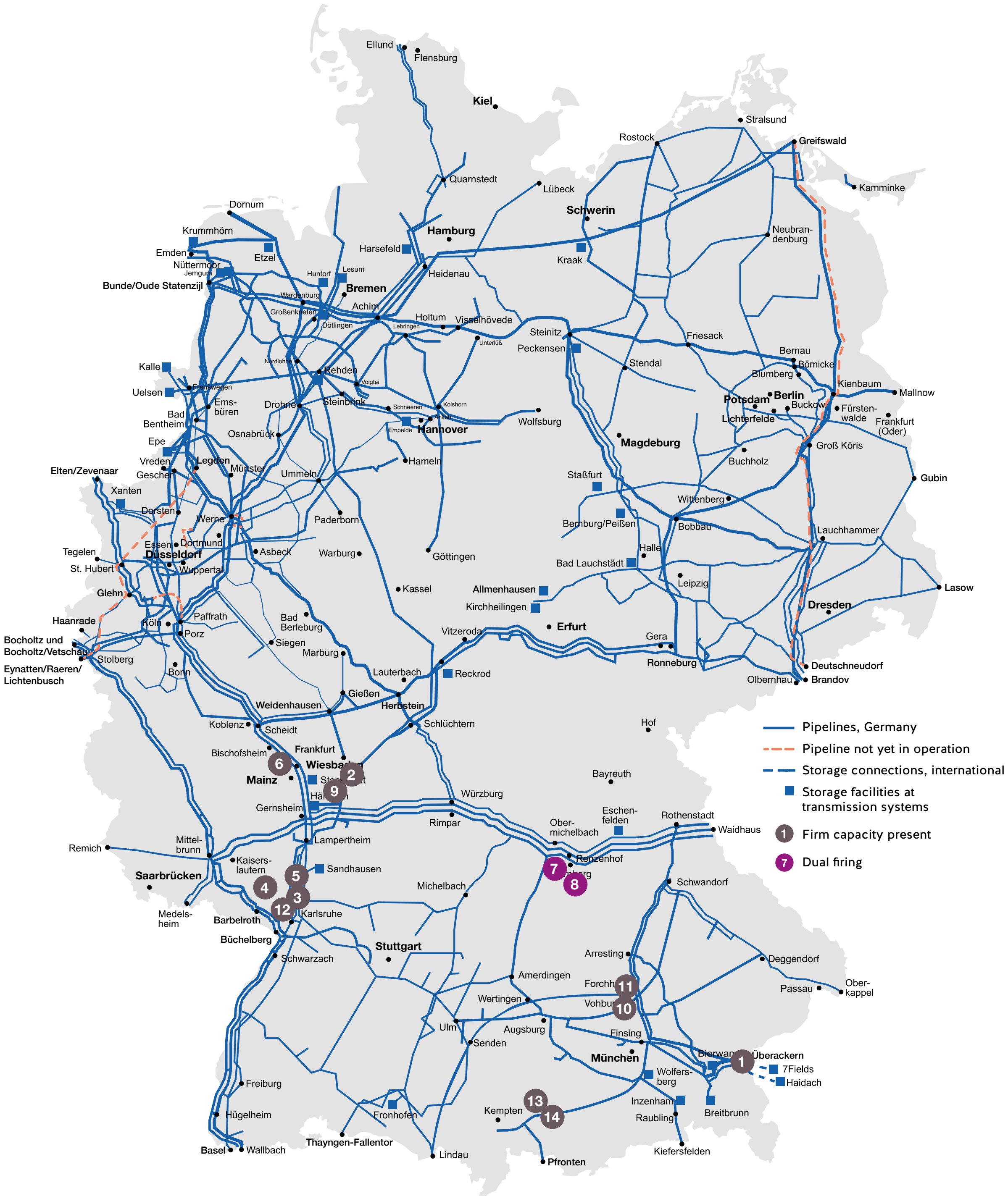
Table 9: Systemically important gas power plants connected to the transmission system

No.	Power plant number	Power plant name	Scheduled exit capacity (MWh/h)	Transmission system operators	Allocation point	2025	2030
1	BNA0172	Dampfkraftwerk BGH – O1	710	bayernets	–	Conditional allocable capacity	Conditional allocable capacity
2	BNA0374	Staudinger 4	1,914	OGE	–	Freely allocable capacity	Freely allocable capacity
3	BNA0514	Rheinhafen-Dampfkraftwerk, Karlsruhe	740	OGE	Wallbach	Firm dynamically allocable capacity	Firm dynamically allocable capacity
4	BNA0614b	Kraftwerk Mitte, Ludwigshafen	–*	GASCADE	–	Freely allocable capacity	Freely allocable capacity
5	BNA0615	Kraftwerk Süd, Ludwigshafen	–*	GASCADE	–	Freely allocable capacity	Freely allocable capacity
6	BNA0626	Kraftwerk Mainz	1,500	OGE	–	Freely allocable capacity	Freely allocable capacity
7	BNA0744	Franken 1 1, Nuremberg	0**	OGE	–	–	–
8	BNA0745	Franken 1 2, Nuremberg	0**	OGE	–	–	–
9	BNA0857	Rüsselsheim gas and steam plant	445	OGE	–	Freely allocable capacity	Freely allocable capacity
10	BNA0994	Gemeinschaftskraftwerk Irsching 5	1,700	OGE	–	Freely allocable capacity	Freely allocable capacity
11	BNA0995	Ulrich Hartmann (Irsching)	1,100	OGE	Haiming 2 7F, Bierwang storage facility, Breitbrunn storage facility	Firm dynamically allocable capacity	Firm dynamically allocable capacity
12	BNA1078	HKW Wörth	–*	GASCADE	–	Freely allocable capacity	Freely allocable capacity
13	BNA1248a	UPM Schongau	75	bayernets	–	Freely allocable capacity	Freely allocable capacity
			180	bayernets	Haiming 2-7F/bn, USP Haidach, Haiming 2-RAGES/bn, Inzenham-West USP, Wolfersberg/USP	Firm dynamically allocable capacity	Firm dynamically allocable capacity
14	BNA1248b	HKW 3 UPM Schongau	150	bayernets	–	Freely allocable capacity	Freely allocable capacity
			60	bayernets	Haiming 2-7F/bn, USP Haidach, Haiming 2-RAGES/bn, Inzenham-West USP, Wolfersberg/USP	Firm dynamically allocable capacity	Firm dynamically allocable capacity

* Not published for reasons of third-party trade secrets
** Dual firing

Source: Transmission system operators based on power plant lists and notices relating to systemically important gas power plants from the BNetzA, BNetzA 2019c, BNetzA 2019d

Figure 5: Systemically important gas power plants connected to the transmission system



Source: Transmission system operators, reporting date: 1 March 2020

New build gas power plants

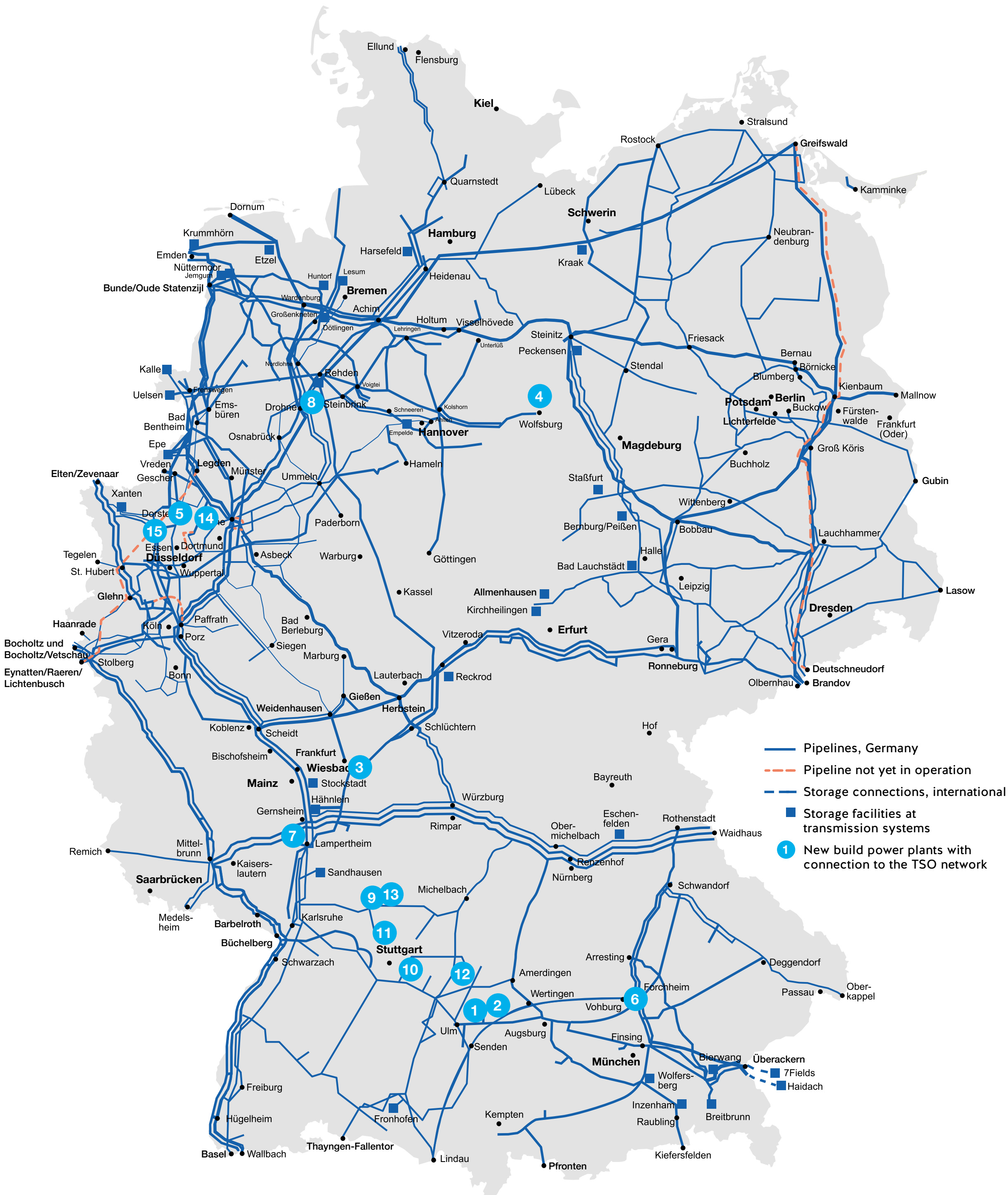
The transmission system operators have taken the new gas power plants presented in Table 10 and also in Figure 6 into consideration in accordance with the confirmation of the scenario framework in all modelling variants. The allocation points necessary for new gas power plants have been reviewed or identified in the course of the modelling and can also be found in the table below.

Table 10: New build gas power plants

No.	Transmission system operators	Project name	Gas type (H-gas/L-gas)	Gas connection capacity (MW)	Status	Allocation point	Modelling year	
							2025	2030
1	bayernets	GUD Leipheim I	H-gas	1,900	Section 39 GasNZV	Überackern 2, Überackern/ABG	x	x
2	bayernets	GUD Gundremmingen I	H-gas	1,500	Section 39 GasNZV	Haiming 2-7F/bn, USP Haidach, Haiming 2-RAGES/bn	x	x
3	GASCADE	Power plant Staudinger	H-gas	1,000	Section 38 GasNZV	Eynatten, Mallnow, Sp. Rehden, Jemgum I, Jemgum III, Nüttermoor, Bobbau	x	x
4	GUD	VW2 gas-powered cogeneration plant	H-gas	920	Section 39 GasNZV	Ellund, Greifswald, UGS Harsefeld, UGS Uelsen, UGS Etzel, UGS Jemgum EWE	x	x
5	OGE	Power plant Scholven	H-gas/L-gas	167	Section 38 GasNZV	Epe H storage facility	x	x
5	OGE	Power plant Scholven	H-gas/L-gas	168	Section 38 GasNZV	Epe H storage facility	x	x
5	OGE	Power plant Scholven	H-gas/L-gas	40	Section 38 GasNZV	Epe H storage facility	x	x
6	OGE	Irsching power plant	H-gas	1,000	Section 38 GasNZV	Bierwang storage facility, Breitbrunn storage facility, Haiming 2 7F	x	x
7	OGE	Power plant Biblis	H-gas	973	Section 38 GasNZV	Dornum	x	x
8	OGE	Power plant Heyden	L-gas	813	Section 38 GasNZV	Eynatten/Raeren	x	x
9	terranets	Gas turbine Heilbrunn	H-gas	1,200	Section 39 GasNZV	Eynatten, Mallnow, Sp. Rehden, Jemgum I, Jemgum III, Nüttermoor, Bobbau	x	x
10	terranets	Gas and steam plant Altbach	H-gas	1,200	Section 39 GasNZV	Eynatten, Mallnow, Sp. Rehden, Jemgum I, Jemgum III, Nüttermoor, Bobbau	x	x
11	terranets	Gas and steam plant Marbach	H-gas	800	Section 39 GasNZV	Eynatten, Mallnow, Sp. Rehden, Jemgum I, Jemgum III, Nüttermoor, Bobbau	x	x
12	terranets	Gas and steam plant Aalen	H-gas	316	Section 39 GasNZV	Haiming 2-7F/bn, USP Haidach, Haiming 2-RAGES/bn	x	x
13	terranets	CHP plant AUDI AG factory Neckarsulm	H-gas	120	Section 39 GasNZV	Eynatten, Mallnow, Sp. Rehden, Jemgum I, Jemgum III, Nüttermoor, Bobbau	x	x
14	Thyssengas	Gas and steam power plant Herne	H-gas	1,600	Section 39 GasNZV	Epe/Xanten I (UGS-E; Innogy)	x	x
15	Thyssengas	Gas and steam power plant Walsum	H-gas	1,250	Section 38 GasNZV	Epe/Xanten I (UGS-E; Innogy)	x	x

Source: Transmission system operators

Figure 6: New build gas power plants according to the confirmation of the scenario framework that are connected to the transmission system



Source: Transmission system operators, reporting date: 1 March 2020

Consideration of the capacity requested for special network operating equipment in southern Germany

Some of the new gas power plants taken into consideration in the scenario framework are located in southern Germany and are planned as special network operating equipment. As in the Gas Network Development Plan 2018–2028, the transmission system operators have examined whether power plant projects for special network operating equipment are in competition with each other. The transmission system operators have described in the scenario framework that they envisage a cluster approach for special network operating equipment in southern Germany when a scenario of this kind occurs. Full consideration of the requested capacity reservations and capacity expansion claims pursuant to sections 38 and 39 GasNZV would otherwise lead to an oversized and inefficient expansion of the network.

Demand for new construction on network stability facilities totalling 1.2 GW_e is shown in the report by the BNetzA to identify the demand at network stability facilities in accordance with section 13 k EnWG of 31 May 2017 [BNetzA 2017]. The transmission system operators TenneT, Amprion and TransnetBW subsequently issued a technology-neutral tender for special network operating equipment for a total of 1.2 GW_e from the end of June 2018 onwards. The tender extended across four regions in southern Germany. The following results were produced to date from the tenders that were conducted:

- “The transmission system operator TenneT has awarded the contract for the construction and operation of special network operating equipment to the energy company Uniper. Uniper will therefore build and operate a gas power plant with a capacity of 300 megawatts at the Irsching location.” [TenneT 2019]
- Furthermore, the transmission system operator TransnetBW awarded the contract in a tender for the construction of a power plant at the Marbach location to EnBW [TransnetBW 2019]. The power plant will be oil-fired however [energate 2019], meaning that no demand for capacity has to be taken into account.
- The two other tenders have not yet been concluded at the moment [TenneT 2018].

The following new gas power plants that are planned (cf. Table 10) are taken into consideration by the transmission system operators as special network operating equipment on the basis of the confirmed scenario framework:

- Biblis power plant (0.3 GW_e);
- Staudinger power plant (0.3 GW_e);
- Irsching power plant (0.3 GW_e); and
- Leipheim I gas and steam power plant (0.67 GW_e).

The following picture is thus produced for the clustering of network operating equipment in the Gas Network Development Plan 2020–2030 (cf. Figure 7):

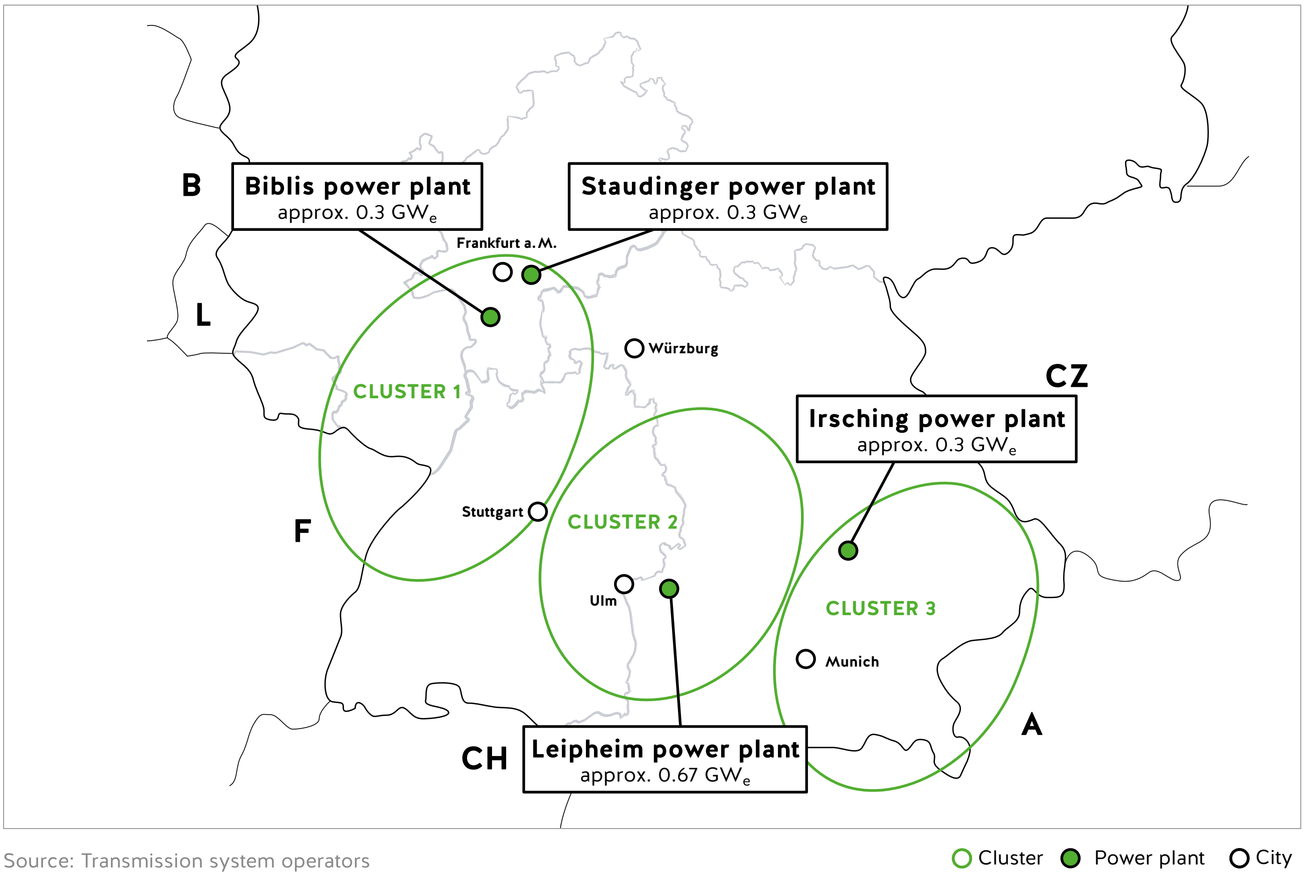
Clustering by the transmission system operators is carried out using the regional network location of the power plants in relation to the main transmission systems. Power plant projects that can be allocated to the same main transmission systems form a cluster here. Three clusters have been created in total.

The electricity transmission system operators have issued tenders totalling 1.2 GW_e as necessary network operating equipment. The award of the contracts for two lots – Irsching power plant (0.3 GW_e) and Marbach power plant (0.3 GW_e) – means that 0.6 GW_e still remain for the two other tenders. This capacity is divided into Cluster 1 and Cluster 2 (0.3 GW_e per cluster).

- **Cluster 1 – Biblis and Staudinger power plants**
  The Biblis and Staudinger power plants have to be assigned to Cluster 1 in accordance with the confirmation of the scenario framework (operative provision 4a). These are in competition with each other. Only one power plant is thus taken into consideration for energy balance purposes and the estimated electrical power output in Cluster 1 is capped at 0.3 GW_e.
- **Cluster 2 – Leipheim gas and steam power plant**
  There is no competition from nine gas power plants for the tender for special network operating equipment in Cluster 2. The Leipheim I gas and steam power plant (0.67 GW_e) is accordingly taken into account in the modelling.

- **Cluster 3 – Irsching power plant**
  There is no competition from nine gas power plants for the tender for special network operating equipment in Cluster 3. The Irsching power plant (0.3 GW_e), which has in fact also awarded a contract within the framework of the tenders, is accordingly taken into consideration in the modelling.

Figure 7: Cluster approach for special network operating equipment in southern Germany



Source: Transmission system operators

3.2.3 Industry

The transmission system operators also draw a distinction when it comes to industrial customers between customers connected directly to the transmission system and customers connected to the distribution system.

For the industrial customers connected directly to the transmission system, the existing contract values have generally been updated for the future on a constant basis. Furthermore, some changes that are already known as well as capacity increases requested in the course of case by case assessments have also been taken into account.

Industrial customers connected to downstream networks have to be taken into consideration by the distribution system operators in the internal orders and forecasts.

3.2.4 Underground gas storage

The capacity reservations and capacity expansion claims pursuant to sections 38 and 39 GasNZV that are included in the scenario framework are taken into account as further input parameters in the modelling.

The capacity reported in the NDP gas database have been recognised in the reporting of the transport capacity (cf. "2020 – NEP Entwurf" NDP gas database cycle). New builds and expansions of storage facilities (cf. Table 11) have been taken into consideration at 100 % of the firm temperature-dependent capacity.

Table 11: Additional storage projects

TSO	Project name	Gas type (H-gas/L-gas)	Gas connection capacity (MW)	Status
bayernets	Storage facility Nussdorf/Zagling (7F)	H-gas	648 entry / 432 exit	Section 39 GasNZV
bayernets	Storage facility Nussdorf/Zagling (7F)	H-gas	346 entry / 230 exit	Section 39 GasNZV

Source: Transmission system operators

3.2.5 Biomethane, hydrogen and synthetic methane

The consideration of biomethane, hydrogen and synthetic methane in the modelling is carried out in accordance with the statements in Chapters 6 and 8.

3.2.6 LNG facilities

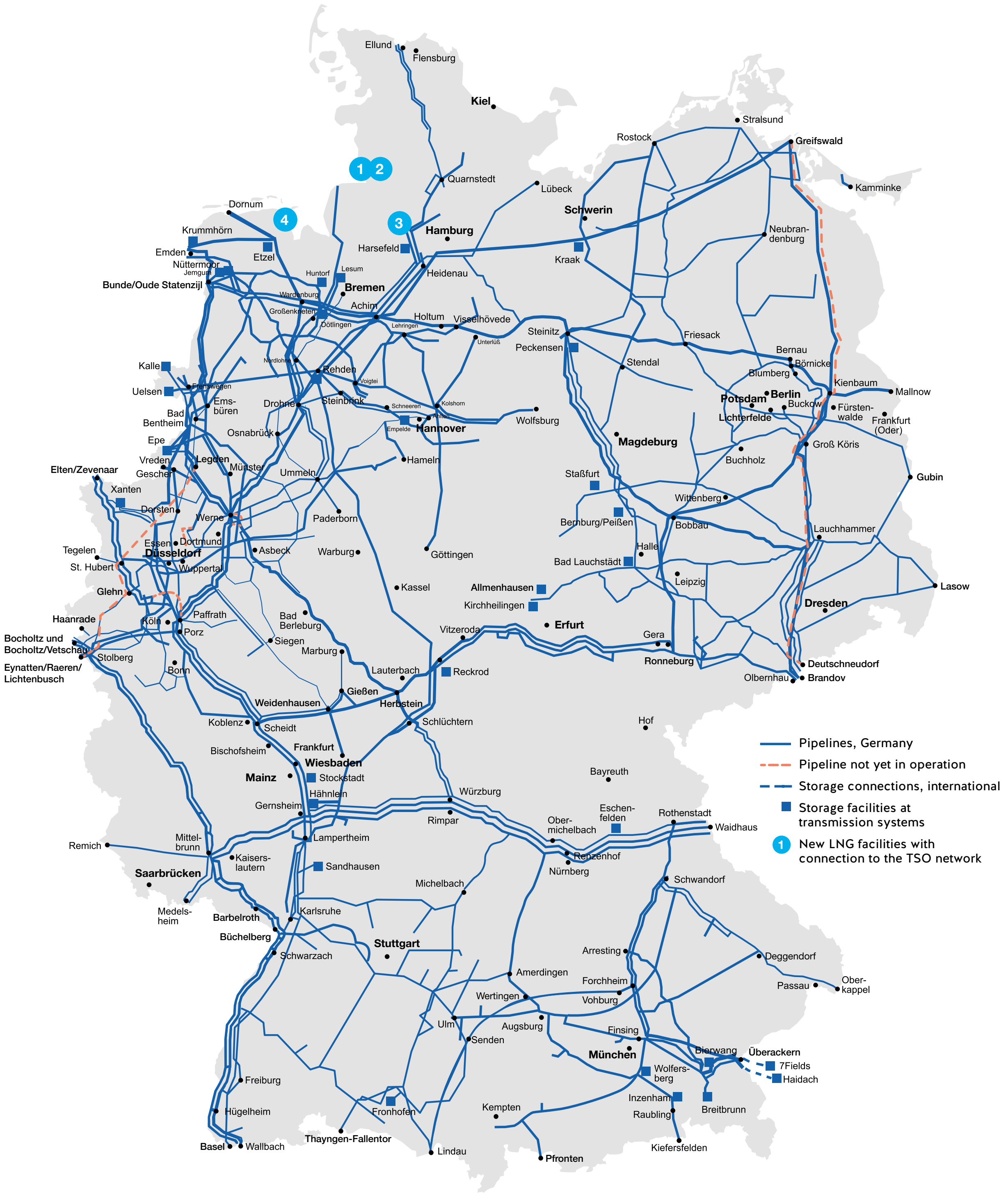
Capacity reservations and capacity expansion claims pursuant to sections 38 and 39 GasNZV for planned LNG facilities in Brunsbüttel, Wilhelmshaven and Stade are available to the transmission system operators for the Gas Network Development Plan 2020–2030. These are taken into consideration in the modelling in accordance with the confirmed scenario framework.

Table 12: LNG facilities taken into consideration in the modelling (reporting date: 1 August 2019)

No.	TSO	Project name	Gas type (H-gas/L-gas)	Gas connection capacity (MW)	Status
1	GUD	LNG facility Brunsbüttel	H-gas	8,700	Section 39 GasNZV
2	GUD	LNG facility Brunsbüttel	H-gas	1,975	Section 38 GasNZV
3	GUD	LNG facility Stade	H-gas	9,300	Section 38 GasNZV
4	OGE	LNG facility Wilhelmshaven	H-gas	12,500	Section 38 GasNZV

Source: Transmission system operators

Figure 8: Planned LNG facilities on the network of the transmission system operators



Source: Transmission system operators, reporting date: 1 March 2020

The capacity demand of the planned LNG facilities is recognised for planning purposes as being in competition with existing cross-border interconnection points and storage connection points in the modelling.

The capacity reservation request pursuant to section 38 GasNZV in Wilhelmshaven on the OGE network was taken into full consideration by the transfer of capacity from other entry points, as a result of which there is the possibility to offer rival marketing of output at cross-border interconnection points. It has thus been possible to confirm the capacity reservation request pursuant to section 38 GasNZV.

GUD has been unable to transfer entry capacity in the full amount of the request output of the Brunsbüttel and Stade LNG facilities. The reason for this is external circumstances, such as the option for transfer that also results from the ratio of the amount of the requested capacity in relation to the existing entry capacity. The capacity reservation request pursuant to section 38 GasNZV therefore had to be rejected and a capacity expansion claim pursuant to section 39 GasNZV was claimed. This capacity expansion claim results in measures to present the necessary capacity in the GUD network and additionally at the connection points with other transmission system operators.

The transfer is made in the OGE system from the points Dornum, Emden and Oude Statenzijl, and in the GUD system from the points Emden, Speicher Jemgum and Oude (H-gas).

As can be seen in Figure 8, the LNG facilities are not planned in the immediate vicinity of the existing gas infrastructure. Connecting pipelines will be required for connecting the facilities to the transmission system for this reason. These have to be laid by the transmission system operators in accordance with the amendment to sections 38 and 39 GasNZV within the framework of the "Regulation on the enhancement on the general conditions for the expansion of the LNG infrastructure in Germany". The integration points of the relevant connecting lines have thus been recognised as an input parameter for the modelling. The connection lines and the related GPCM stations are not results of the modelling and thus not an expansion proposal from the transmission system operators, but are presented as measures in the NDP gas database for the purpose of full mapping and monitoring. These are listed below:

- **Brunsbüttel – Hetlingen pipeline (ID 502-02a)**
  The construction of a pipeline from Brunsbüttel to Hetlingen, including all necessary technical installations, is necessary to connect to the planned LNG facility in Brunsbüttel. It has been necessary here to adjust the length of the pipeline on the basis of current findings made as the project has progressed.
- **Hetlingen GPCM station (ID 502-01b)**
  Construction of a new GPCM station for the connection of the new Brunsbüttel-Hetlingen pipeline to the existing GUD system. Parameters have been added in the project profile of the NDP gas database.
- **Stade-Elbe South pipeline (ID 640-01)**
  The construction of a pipeline from Stade to Elbe South, including all necessary technical installations, is necessary to connect to the planned LNG facility in Stade.
- **Elbe South GPCM station (ID 641-01)**
  Construction of a new GPCM station for transmitting oversupply from the new Stade-Elbe South pipeline to the existing GUD system.
- **WAL (ID 606-01)**
  The measure described here involves a new pipeline construction project, including all necessary technical installations. The new pipeline is planned to be built between Wilhelmshaven and Friedeburg Etzel in order to connect the LNG facility in Wilhelmshaven.
- **Wilhelmshaven GPCM station and connecting pipeline (ID 607-01)**
  The measure described here involves the construction of a new gas pressure measuring station to connect the WAL pipeline with the LNG facility in Wilhelmshaven.
- **Friedeburg-Etzel GPCM station and connecting pipeline (ID 608-01)**
  The measure described here involves the construction of a new gas pressure control station to connect the WAL pipeline with the Dornum-Wardenburg pipeline.

The requested capacity of the LNG facilities has been recognised in the modelling in line with the capacity reservations and capacity expansion claims pursuant to sections 38 and 39 GasNZV as freely allocable capacity (FZK). In the opinion of the transmission system operators, this is a contribution to the security of supply and serves to increase the liquidity of the markets by diversifying the sources of supply.

Dynamically allocable capacity allocation for LNG facilities

A suitable and sensible allocation would have to be conducted, if the requested capacity would have been taken into consideration as dynamically allocable capacity (DZK), in accordance with the confirmation of the scenario framework. The allocation could be carried out to a large number of exit points or groups of exit points. An allocation by the transmission system operators would be arbitrary and thus not demand-based and non-discriminatory.

Nonetheless, the transmission system operators are complying with the Federal Network Agency's requirement from the confirmation of the scenario framework and look at the issue of dynamically allocable capacity allocation for LNG facilities below.

Changes in general conditions compared to the Gas Network Development Plan 2018–2028

The modelling in the Gas Network Development Plan 2018–2028 was based on the available capacity models for the GASPOOL and NCG market areas. By contrast, the modelling in the Gas Network Development Plan 2020–2030 looks at the considerably larger new THE market area. In addition, the regulatory conditions of section 39 GasNZV have been amended in favour of LNG facility operators and their significance for the security of supply and liquidity of the whole German market has emerged.

In the Gas Network Development Plan 2018–2028, the entry capacity of the Brunsbüttel LNG facility of 8.7 GWh/h was allocated as dynamically allocable capacity with allocation conditions for all exit points in the GUD network, in accordance with the market situation for LNG at that time.

An injection volume of currently 19.975 GWh/h for the LNG facilities of the GUD network is to be taken into account in the Gas Network Development Plan 2020–2030. The injection volume of the LNG facilities of the GUD network has therefore more than doubled compared to the Gas Network Development Plan 2018–2028.

LNG facilities Wilhelmshaven

A dynamically allocable capacity analysis was not performed for the LNG facility in Wilhelmshaven as the capacity reservation in accordance with section 38 GasNZV was confirmed and this can therefore be presented in competition for planning purposes without network expansion. Accordingly, a consideration as dynamically allocable capacity cannot lead to a more cost-effective solution.

Brunsbüttel and Stade LNG facilities

If a total injection volume of 19.975 GWh/h for the LNG facilities in Brunsbüttel and Stade were considered as dynamically allocable capacity in the H-gas balance and in the network calculation, this would result in an additional injection volume of around 10 GWh/h at GUD compared to the base variant analysis. Entry capacity at GUD cross-border interconnection points and storage facilities would be fully taken into account.

This would lead to either around 10 GWh/h in additional exit capacity at cross-border interconnection points as dynamically allocable capacity or a correspondingly higher overfeed between GASPOOL and NCG would have to be considered, as GASPOOL is already overfed today and thus has no demand for additional injection volume. Similarly, dynamically allocable capacity allocation to storage facilities would theoretically be feasible.

Consideration of cross-border interconnection points for dynamically allocable capacity allocation

Dynamically allocable capacity allocation to cross-border interconnection points could be possible with the following neighbouring countries:

- cross-border interconnection points to the Netherlands, Belgium, Switzerland and France
- cross-border interconnection points to Poland
- cross-border interconnection point to Denmark
- cross-border interconnection points to Czechia and Austria

The Netherlands, Belgium, Switzerland, France and Poland are already supplied by existing LNG facilities. A further, additional direct connection from German LNG facilities to the cross-border interconnection points with these countries would therefore not be efficient, as their demand could already be met by existing LNG facilities. Dynamically allocable capacity allocation to these cross-border interconnection points would therefore not make any sense.

Denmark sources gas from Norway. Furthermore, the "Baltic Pipe" is to deliver additional gas in the direction of Denmark and Poland. In addition, sales in Denmark are too low to absorb around 10 GWh/h. Dynamically allocable capacity allocation would therefore not make any sense.

Czechia and, indirectly, Austria are connected to alternative, high-performance transmission routes through OPAL and EUGAL. Furthermore, these countries are networked by existing infrastructures from Eastern Europe. Given the long transmission distances, an expansion of North German LNG facilities to create dynamically allocable capacity for Czechia and Austria would amount to the same as an expansion of freely allocable capacity. Dynamically allocable capacity allocation would therefore not make any sense.

Regional consideration in dynamically allocable capacity allocation

In conjunction with the entry at cross-border interconnection points, a dynamically allocable capacity allocation to GUD or GASPOOL would lead to an even greater surplus in this network area. Given the long transmission distances, an overfeed in the direction of NCG would amount to the same as an expansion of freely allocable capacity. Dynamically allocable capacity allocation would therefore not make any sense.

Consideration of storage facilities for dynamically allocable capacity allocation

The transmission system operators assume that the gas in storage facilities would largely be withdrawn in winter, and therefore dynamically allocable capacity allocation to storage facilities would not be possible in these cases. In conjunction with the entry at cross-border interconnection points, a dynamically allocable capacity allocation to storage facilities would lead to an overfeed of the northern network area in the summer. Given the long transmission distances, a dynamically allocable capacity allocation to storage facilities in the south would amount to the same as an expansion of freely allocable capacity. Dynamically allocable capacity allocation would therefore not make any sense.

Summary of dynamically allocable capacity allocation for LNG facilities

For the reasons set out above, the transmission system operators feel that a dynamically allocable capacity approach for LNG facilities would not make sense, and would lead to higher investment than for the competing approach for planning purposes with freely allocable capacity.

3.2.7 Cross-border interconnection points and VIPs

The capacity at cross-border interconnection points and virtual interconnection points (VIPs) recognised in the modelling of the Gas Network Development Plan 2020–2030 is presented in the NDP gas database (see "2020 – NEP Entwurf" cycle).

In the confirmation of the scenario framework, the BNetzA has tasked the transmission system operators with justifying transparently and in a way that is comprehensible to third parties without additional information why the capacity increase at the cross-border interconnection points Greifswald and Lubmin II (Entry), in part, and Bunde/Oude Statenzijl (H, Exit), and the resulting expansion measures are preferable to other possible solutions for guaranteeing the security of supply in the relevant region (north-west Europe).

According to an evaluation of the scenarios of the investment plan of GTS released in May 2020 that is available to the transmission system operators, the provision of the capacity of 12 GW additionally required for the security of supply of the Netherlands within the meaning of Regulation (EU) 2017/1938 cannot be guaranteed to an adequate level and with the required reliability from the north, west or south. These findings are based on new calculations carried out by GTS with the help of ENTSOG on the basis of the TYNDP modelling, which incorporates current findings on the development of the Dutch gas infrastructure.

Based on the calculations performed with the help of ENTSOG, GTS sees that the BBL pipeline delivers gas from the EU to Great Britain at peak times. The British production and the capacity of the LNG terminals are not sufficient to cover the domestic demand in winter. It cannot be expected under these general conditions that gas from BBL will flow in the direction of the Netherlands in a peak load situation.

From the south, gas flows from Belgium in the direction of the Netherlands only in the summer months. These originate from LNG facilities or the British production and serve to fill the Dutch storage facilities. GTS expects hardly any imports from Belgium in the winter months, as the Belgian market is itself heavily dependent on imports. The scenarios of the Dutch 2020 investment plan show a higher demand for flexible entry for Belgium from the direction of the Netherlands up to 2030.

An increase in the Dutch LNG capacity would not be sufficient as part of technical expansions to the facilities already in operation to remedy the bottleneck of 12 GW that has been identified. In addition to the limited capacity of the Gate LNG facilities, the supply of LNG will depend largely on the global balance between demand and supply and on prices and is therefore not reliable for guaranteeing the security of supply.

Norwegian pipeline gas is used to supply the base load and does not offer any further potential for increases. Very high utilisation of the capacity in the direction of the Netherlands can be seen at the cross-border interconnection points between Germany and the Netherlands. This is particularly necessary in order to import sufficient gas volumes into the Netherlands and not in order to cover the Dutch peak supply.

According to information provided by GTS, only the import of gas using pipelines from Germany as well as local storage facilities to cover peaks in demand can provide a reliable gas supply of the Netherlands.

3.2.8 Distribution of H-gas sources

The decline in L-gas imports from the Netherlands and in Germany's own production as well as increased demand (e.g. for gas power plants and distribution system operators) is leading, as described in the scenario framework, to an increased need for H-gas imports for Germany.

This additional demand is determined in Chapter 6 and distributed to cross-border interconnection points in line with the criteria presented there.

3.3 Modelling variants

Taking the views expressed by the market participants in the consultation into consideration, the transmission system operators have proposed a variety of modelling variants in the scenario framework [FNB Gas 2019a].

Table 13 below shows the modelling variants that have to be taken into consideration in accordance with the confirmation of the scenario framework.

Table 13: Modelling variants

Modelling variant	Base variant 2025/2030	Green gas variant 2025/2030	Design variant for Baden-Württemberg 2030	L-gas balance 2030	H-gas balance 2030
Designation	B.2025/B.2030	G.2025/G.2030	A.2030	L.2030	H.2030
Calculation	2025/2030 in full	2025/2030 in full	2030	Balance analysis	
Reporting date/ period	31 December 2025/ 31 December 2030		31 December 2030	1 October 2030	
Distribution system operators	Initial value: Internal orders 2020, development: the 10-year verified forecast of the DSOs up to 2025, constant value afterwards		As base variant, deviation involves use of the 10-year forecast of the DSOs and loss of 1.2 GWh/h storage capacity for Baden-Württemberg for 2030	Analysis of the long-term L-gas balances up to 2030	Analysis of the long-term H-gas capacity balance up to 2030
L-to-H-gas conversion	Modelling of the conversion areas, including conversions up to 2031 in order to identify the necessary network expansions measures up to 31 December 2030				
Gas power plants	Inventory according to "2020 – NEP Entwurf" NDP gas database cycle, systemically important power plants directly connected today on interruptible basis in accordance with Chapter 3.2.2, new build in accordance with Chapter 3.2.2, 100 % firm dynamically allocable capacity (fDZK)				
Industry	Constant capacity demand, consideration of the binding additional demand, free allocable capacity approach				
Underground gas storage facilities	Inventory according to "2020 – NEP Entwurf" NDP gas database cycle, new build in accordance with Chapter 3.2.4: 100 % temperature-dependent capacity				
Biomethane	According to NDP gas database cycle "2020 – NEP Entwurf"				
Hydrogen and synthetic methane	Consideration of market surveys on hydrogen and synthetic methane and Grid Development Plan Power 2019–2030, see also Chapter 8				
LNG facilities	New build in accordance with "2020 – NEP Entwurf" NDP gas database cycle, see also Chapter 3.2.6				
IP/VIP	Inventory according to "2020 – NEP Entwurf" NDP gas database cycle, Need for expansion in accordance with Chapter 6, taking the TYNDP into account				
H-gas sources	Additional demand by distribution of H-gas sources in accordance with Chapter 6.2				
Use of MBIs	Use of commercial instruments for planning purposes, see also Chapter 3.4				
Market area inter-connection points	Discontinuation of market area interconnection points on account of the market area merger				

Source: Transmission system operators

3.4 Market area merger

3.4.1 Background

The two German market areas NCG and GASPOOL have to be merged into one market area in accordance with the Gas Network Access Regulation by no later than 1 April 2022. The transmission system operators are planning to carry out the merger on 1 October 2021.

The goal of section 21 GasNZV is "to increase the liquidity of the gas market" by merging the two existing market areas. In fulfilment of this statutory requirement, the TSOs should aim to transfer the capacity existing in the two separate market areas of GASPOOL and NCG (e.g. capacity in the Gas Network Development Plan 2018–2028) in terms of quantity and quality into capacity in a Germany-wide market area as far as possible.

As the most recently published opinions expressed in the course of the market dialogue on the draft of the capacity model of the transmission system operators show, a future offer of capacity that is comparable with the current capacity level is of central importance for the market. The capacity structure at the cross-border interconnection points and storage facilities published in the confirmed scenario framework therefore corresponds essentially to that of the Gas Network Development Plan 2018–2028. Deviations arise as a result of the new LNG capacity and the new dynamically allocable capacity between the Greifswald/Lubmin II cross-border interconnection points and the new planned German-Dutch Knock (Oude zone) cross-border interconnection point.

However, the goal of maintaining the previous capacity both in scope and in quality after the market area merger represents a major challenge. With the considerable enlargement of the market area, the number of possible combinations of entry and exit capacity grows many times over, with the result in particular that the freely allocable capacity is given a significant upgrade.

The existing exchange capacity between the NCG and GASPOOL market areas currently in place is not sufficient on its own to guarantee that the previous capacity offer can be freely allocated. In addition to investment measures, the use of market-based instruments is also an option for maintaining the previous capacity structure.

Significant structural measures cannot be realised until the market area merger is implemented. In order to ensure the goal of having an energy supply that is both secure and cost-efficient, the costs of a possible network expansion (taking into consideration the depreciation periods) can be compared with the costs for using market-based instruments.

The proposed use of market-based instruments met with great support in the course of the market dialogue. The option of using market-based instruments for the purposes of maintaining capacity also forms part of the BK7-19-037 KAP+ procedure [BNetzA 2019c].

For more background information on the market area merger, please refer to the scenario framework [FNB Gas 2019a].

3.4.2 New capacity model – NewCap

Based on the existing technical conditions in the networks, the transmission system operators in the two market areas currently use different approaches to identify available capacity. These different approaches have to be harmonised upon the merger of the two German market areas.

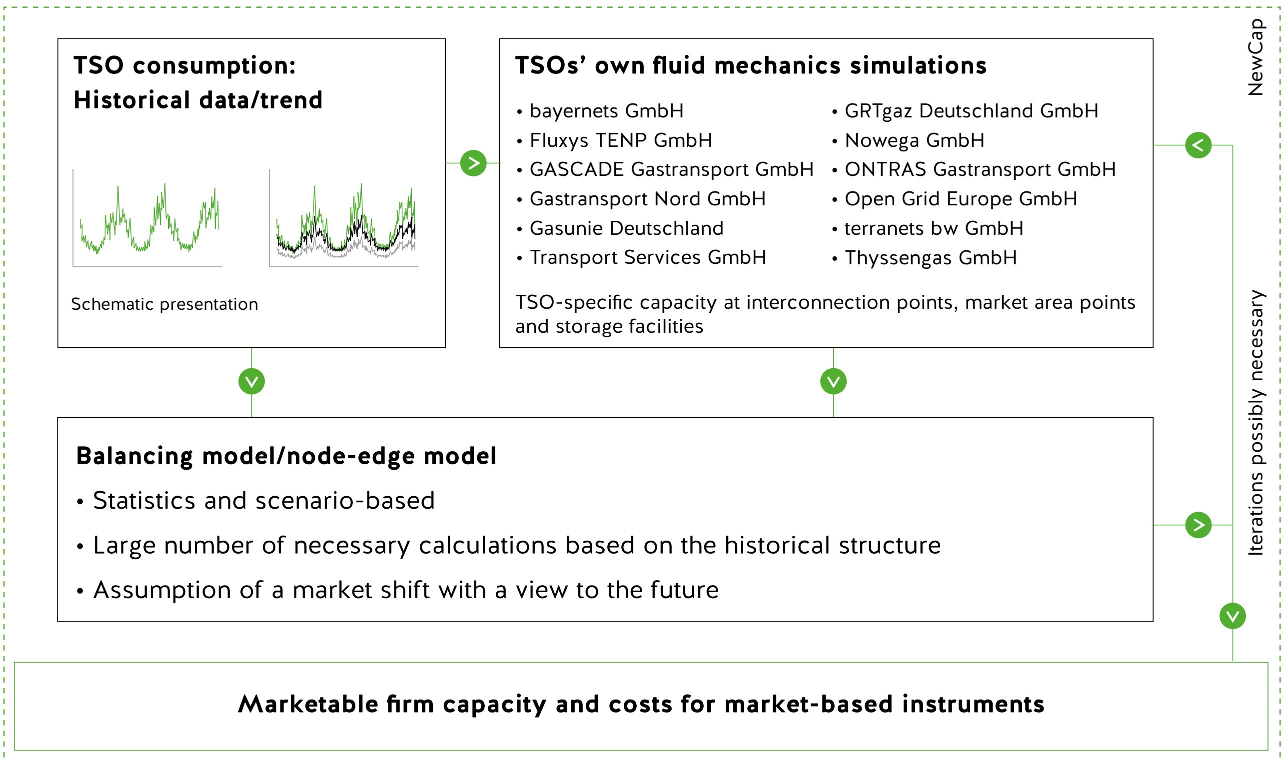
The experience gained from ten years of market area mergers using different models has been incorporated in the development of the new capacity model. In this process, the combination of a statistical model with the use of Germany-wide load scenarios has emerged as the preferred approach for processing future transport functions. The model is based on historical flow data and (future) capacity both at the borders of the future market area and at the exchange points (market area points, MAP) between the transmission system operators and the consumers within the networks of the various transmission system operators.

Using the network simulations, the transmission system operators assume network areas without bottlenecks. It is therefore sufficient for the exchange between the network areas to apply a balance model using an abstracted network topology.

- Nodes in the model represent among other things an aggregation of the networks into large entry and exit areas (e. g. networks of the transmission system operators) or cross-border interconnection points with neighbouring countries.
- Edges in the model represent the connections between the above-mentioned nodes. The transmission options and restrictions between the individual aggregated entry/exit areas and with neighbouring countries are described in terms of edges.

The figure below provides a schematic presentation of the process involved in a calculation in the new NewCap capacity model.

Figure 9: NewCap capacity model



Source: Transmission system operators

Planned expansion measures change the capacities between the individual network areas. The impact of the expansion measures on the demand for capacity instruments can thus be estimated by using a calculation in the balancing model. Conversely, an (excessively) high forecast demand for capacity instruments can also be a sign of an additional need for expansion between the network areas. An expansion of this kind then has to be planned and checked by the transmission system operators in the course of new flow-dynamic network calculations.

A statistical approach allows the consideration of how frequently certain load situations have arisen in the past, which can be used as the basis for estimating their occurrence in the future. In a capacity model based on statistical evaluations and assumptions, assumptions and decisions can thus also be made for future load situations.

In the rare network use cases in which the physical network would be unable to provide transport, marketing of the capacities can be carried out by using additional market-based instruments. The statistical approach thus specifically allows an estimate to be made concerning the required scope for the use of these instruments.

Statistical approach in NewCap

The statistical approach (for each scenario, see below) serves on the one hand to generate numerous network use cases for the domestic German consumption.

The determination of the demand for market-based instruments is based on accurate daily values in the period from 1 April 2016 to 31 March 2019. The consumption is scaled to the forecast capacity development according to the Gas Network Development Plan 2020–2030. In particular, the market area conversion is taken into account in the development of consumption until the 2030/2031 gas year. The market area merger therefore does not have any influence on the market area conversion.

For each scenario, 1,095 load cases are thus generated for the future consumption, which also map in particular the demand that fluctuates depending on the temperature, while taking the statistical frequency of occurrence into consideration.

On the other hand, the historical load profiles are used to begin with for the employment of the cross-border interconnection points and storage facilities, and these then vary within the framework of the scenarios. Extending beyond domestic German consumption, the assumed employment of the other entries and exits thus also includes a statistical component.

Statistical approaches produce meaningful information only if a sufficiently large amount of data is available. By using over 60 scenarios each containing 1,095 load cases, over 65,000 load cases are analysed for each year of the calculation within the framework of the NewCap.

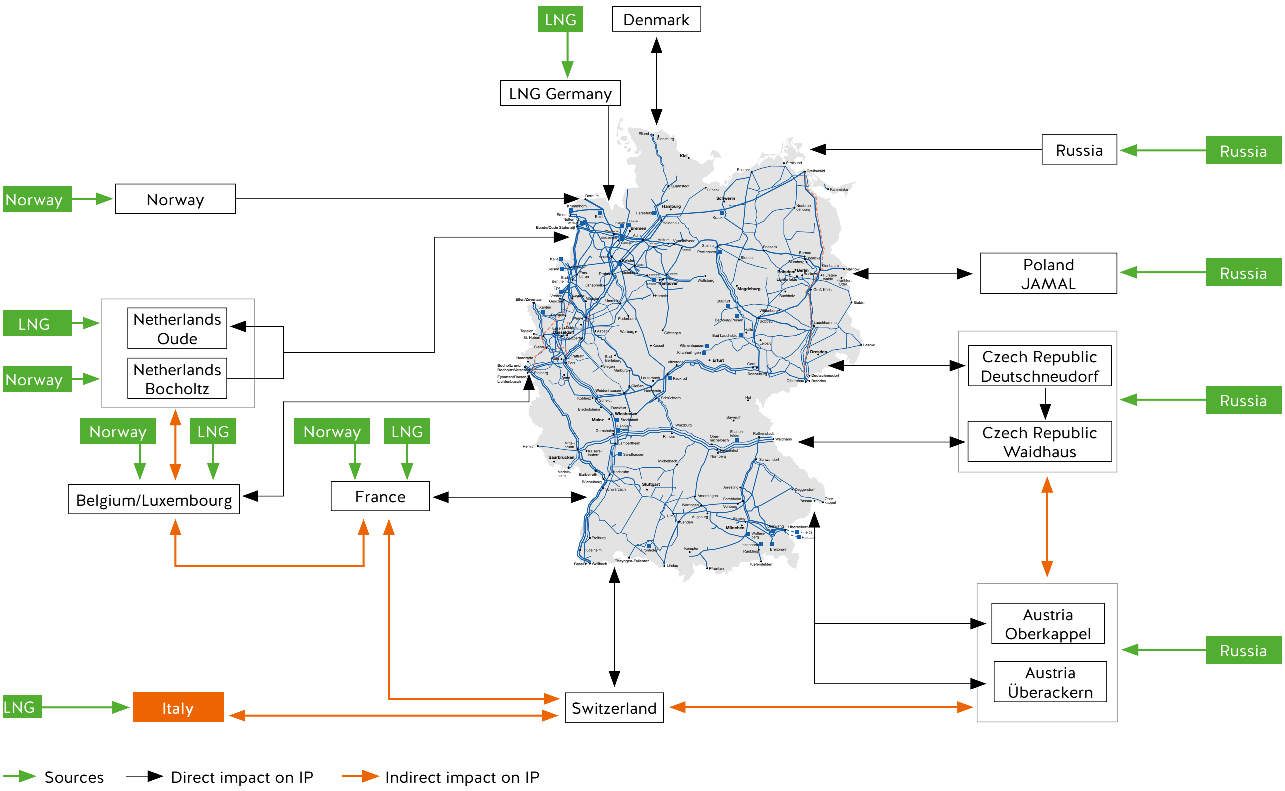
Scenarios in NewCap

In the same way as for consumption, the historical employment in the period from 1 April 2016 to 31 March 2019 is also used for cross-border interconnection points, storage facilities and production. In contrast to consumption, however, the history on its own does not provide a sufficient indicator for future employment for these points.

The scenario-based approach therefore supplements the statistical approach with various assumed (extreme) scenarios. The usage profiles of the cross-border interconnection points are adjusted to the scaled consumption to be begin with (base scenario) and subsequently increased or reduced on a daily basis in the course of the scenarios investigated. The technically available capacities based on the Gas Network Development Plan 2020–2030 form the limit here.

The scenarios map a variation of the Russia, Norway and LNG sources and take into particular consideration planned expansion measures based on the previous Network Development Plans and expected changes in entry and exit volumes (e.g. market area conversion) for the future. The cross-border interconnection points in Germany (entry and exit) will be consolidated into what are known as import zones for the three sources mentioned above.

Figure 10: Variation in the supply of the German market area – Grouping of the cross-border entry and exit interconnection points



Source: Transmission system operators

The scenarios can be divided into two categories:

- **Redistribution variants (diversified supply Germany)**
  A percentage increase in the netted volume in an import zone (i.e. increase in the historical imports while historical exports decrease at the same time) and a corresponding reduction in the netted volume in another zone.

- **Transit variants (transit Germany – supply Europe)**
  A simultaneous increase in the entry volume in an import zone and an increase in the exit volume in another zone. An increase in the transit volume is intended to be simulated in this way.

The transfer of the volumes between these three groups is primarily considered in pairs: e. g. Russia and Norway, Russia and LNG, etc.

Market shift

Depending on the capacity and the historical use of the individual import zones, the same percentage variation leads to very different absolute changes. In order to make sure the various scenarios can be compared, the market shift of a scenario is considered relative to domestic consumption, i.e. the quotient from the absolute (annual) change of the import zone in question and the annual consumption that is assumed.

The percentage increase that is described of the imports accompanied by a simultaneous decrease in the exports of an import zone quickly leads to changes in the netted entry volume of more than 30 % and up to 50 %. Although a change of this kind in the historical relationships is conceivable in the co-operation on individual days, it is regarded as unrealistic on an annual average by the transmission system operators.

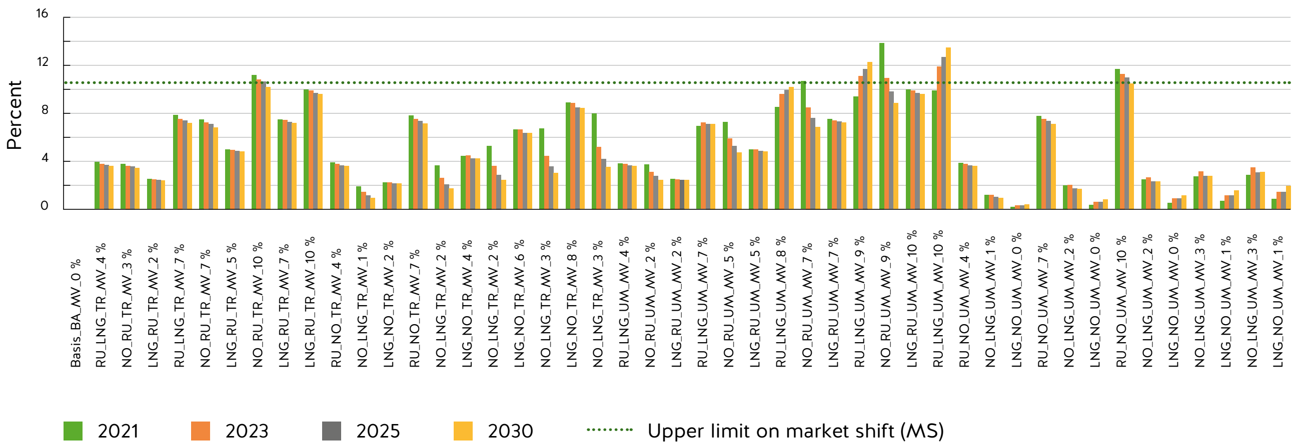
In the GASPOOL market area, a market shift of 5 % is assumed in the capacity model currently in use. The 5 % limit was temporarily exceeded on individual days before 2014, while no overruns have been registered since 2015. The transmission system operators furthermore assume that larger market shifts, as experience has shown in the last few years, are roughly balanced again by the market and for this reason a market shift that is permanently higher than 10 % is assessed to be unsustainable.

To cover the range of realistic variations in the NewCap, a consideration of the scenarios with an annual market shift of up to 10 % is therefore regarded as sufficient by the transmission system operators. A shift of this kind already takes into account in individual regions a change in the annual netted import volume of up to 20 % to 30 %.

To guarantee comparability between the years considered in the NewCap calculation in the Gas Network Development Plan 2020–2030 (2021/2022, 2023/2024, 2025/2026 and 2030/2031 gas years), an identical number of scenarios has to be looked at in each calculation year. Therefore, such scenarios with a market shift of up to 10 % (rounded) in at least one of the four years looked at are taken into account.

In total, 47 scenarios with a market shift of up to 10 % were analysed (cf. Fig. 11).

Figure 11: Relative market shift of scenarios analysed



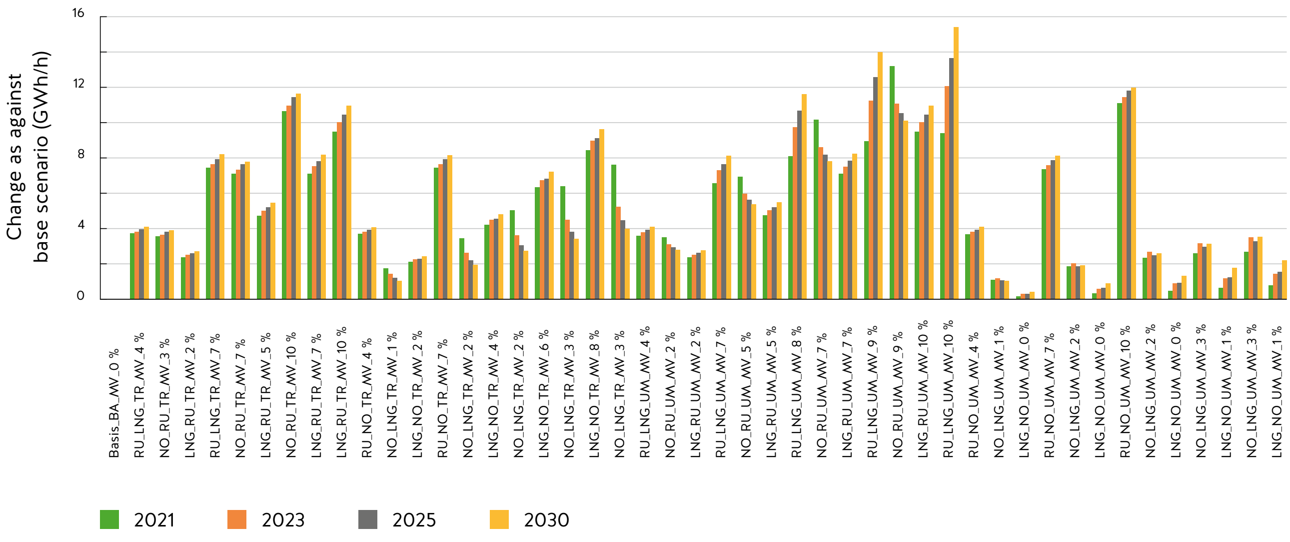
Source: Transmission system operators

Note: The scenario designation "RU_LNG_TR_MV_4 %", for example, means that transit (TR) from Russia (RU) increases and LNG (in accordance with allocation in Figure 10) is reduced. A 4 % market shift (MV) is taken into account. There are also redistribution scenarios (UM).

As each of these scenarios consists of 1,095 individual load cases, more than 51,000 individual load cases per year of calculation are referenced to analyse potential bottlenecks in a market area covering the whole of Germany.

In the scenarios analysed, there are significant variations for the different sources of Russia, Norway and LNG.

Figure 12: Average variation of sources per scenario



Source: Transmission system operators

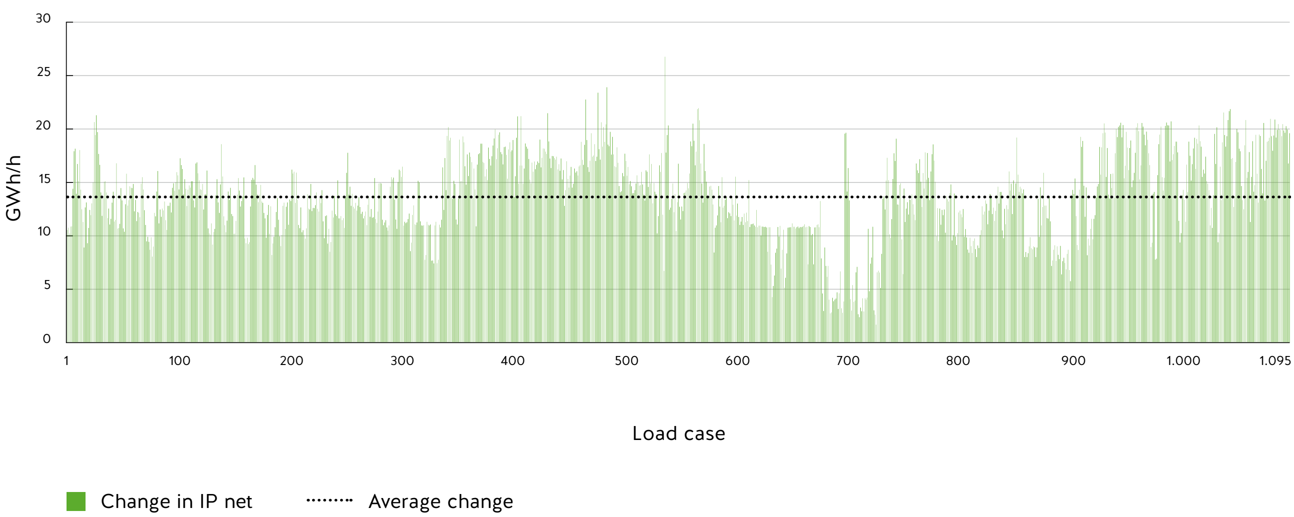
Figure 12 above shows the average variation of the various sources compared to the base scenario.

This looks at the change in net imports and exports over the same period across the various cross-border interconnection points of the respective source. The amount of variation is partly dependent on the potential of the source to be maximised (Russia, Norway or LNG) and the historic usage/exploitation of the firm capacity at the import/export points.

The average is formed across all 1,095 load cases in a scenario. The range of the source variation of the individual load cases is significantly greater than the average.

For example, the progression of the 1,095 load cases in a scenario is shown below as an example. The average variation for the Russia source in 2025/2026 is 13.6 GWh/h, while the individual load cases see an increase in net Russian imports and exports of between 1.6 GWh/h and 26.7 GWh/h.

Figure 13: Example variation for Russia source as against base scenario 2025



Source: Transmission system operators

Using the numerous scenarios that are considered for the two categories, both transit requirements that may have increased and shifts between the different import sources are taken into account.

Moreover, regular monitoring of the market shifts that occur is planned, the results of which will then influence the future creation of scenarios in the capacity model and the necessary expansion. In this sense, an increasing market shift or an increasing demand for market-based instruments could also be interpreted as a market signal.

LNG capacity and competing approach for planning purposes

It is ensured in the TSOs' own flow-dynamic calculations that the use of the competing capacity level can be used free of bottlenecks both at LNG facilities and alternatively at the rival entries (cf. Chapter 3.2.6). The lack of bottlenecks relates at least to the network of the transmission system operators that are connected. The freedom from bottlenecks beyond the TSO borders also has to be ensured – where appropriate by using network expansion or market-based instruments in the entire market area.

For the NewCap calculations in the Gas Network Development Plan 2020–2030 that go beyond the above examination, the LNG capacity to be marketed in competition is mapped using a simplified approach. A distinction is drawn here in terms of the quality of the relevant capacity reservations and capacity expansion claims in accordance with sections 38 and 39 GasNZV.

A capacity expansion claim pursuant to section 39 GasNZV results in an obligation on the part of the connectee to issue a long-term booking (≥ 4 gas years) from the time it is realised. For the NewCap calculations, the capacity is taken into account at the LNG facility in this case, even if – within the framework of the approach where competition is assumed for planning purposes – it cannot be ruled that the capacity may be employed or transferred during the year to the rival points.

This procedure is conducted in a similar way to the consideration of cross-border interconnection points. It also cannot be ruled out for these at the time the Gas Network Development Plan 2020–2030 is drawn up that transfers of capacity will take place between these points in the future.

A request pursuant to section 38 GasNZV, in contrast, results only in an offer to reserve capacity, not, however, to a binding submission of a long-term booking. When a long-term booking is not submitted, there is therefore a high likelihood that the rival capacity will be booked primarily at cross-border interconnection points and only partially at LNG facilities.

Therefore, for model theory reasons, capacity at the rival cross-border interconnection points (and not at the LNG facility) is taken into consideration in the NewCap calculations in this case, in order to map the employment of competing entry points during the year as well. This approach does not contradict the assumption in the H-gas balance in terms of network planning.

A capacity-based balance for the peak load case is produced in the H-gas balance. On the basis of the approach where competition is assumed for planning purposes, an alternative employment of LNG terminals or cross-border interconnection points is possible in terms of flow mechanics. The alternative employment in a peak load situation has no influence on the annual demand for market-based instruments calculated in the NewCap model.

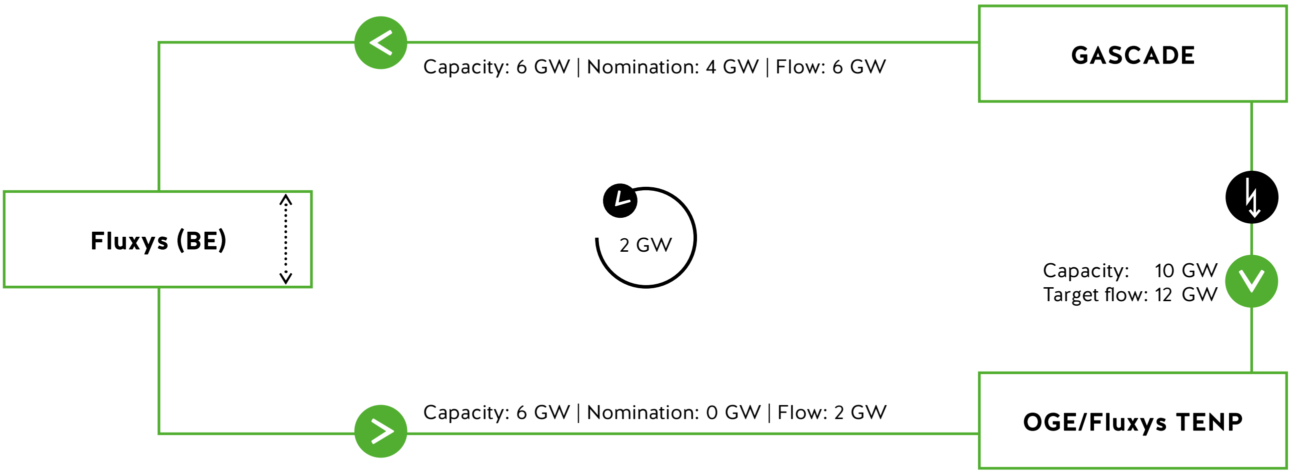
For the Brunsbüttel and Stade LNG facilities, the capacity of the rival cross-border interconnection points is transferred to the LNG facilities from the 2022/2023 gas year onwards. As the approach for the use of these two LNG facilities, a synthetic load profile is taken as the basis for the structure during the year, which is based on the historical employment of LNG facilities in north-west Europe and scaled to the level of the existing capacity reservations and capacity expansion claims pursuant to sections 38 and 39 GasNZV.

Market-based instruments (MBI)

The market-based instruments described in more detail below (wheeling, third-party network use and exchange-based spread products) are currently under discussion in terms of their design and required level. In order to take the requirement of cost-efficiency into account, these market-based instruments are always intended to be used only as needed, i.e. only when the given infrastructure is not sufficient for resolving the network use case. Furthermore, their use must have an optimal cost and benefit impact on the network.

Figure 14: Example of wheeling

Wheeling: gas transmission from one transmission system operator to another transmission system operator via an interconnection point or nearby network interconnection points

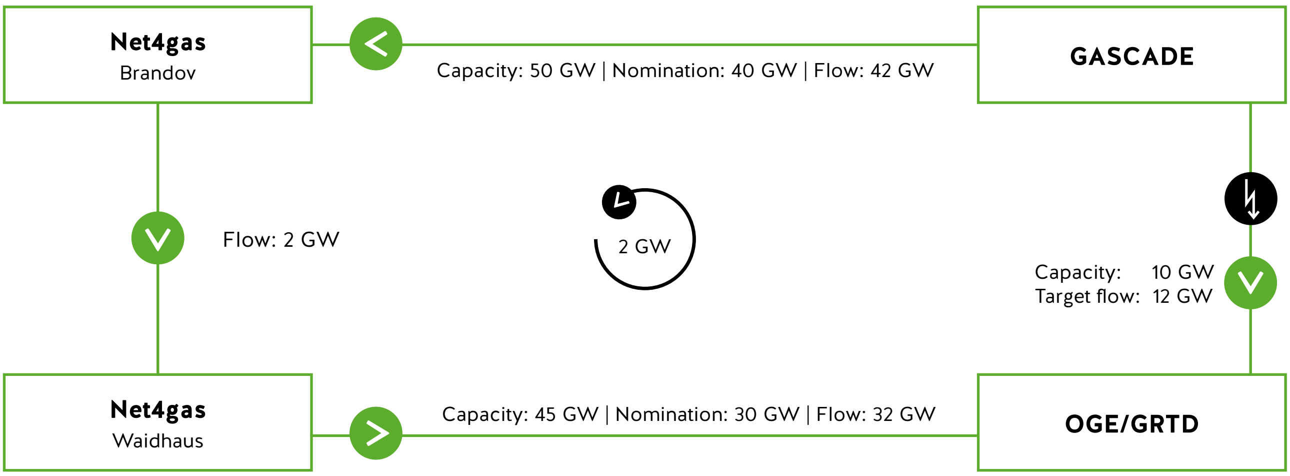


Example of wheeling: bypassing of a bottleneck between GASCADE and OGE/Fluxys TENP through a flow via an interconnection point in Belgium

Source: Transmission system operators

Figure 15: Example of third-party network use

Third-party network use: gas transmission from one transmission system operator to another transmission system operator via two interconnection points

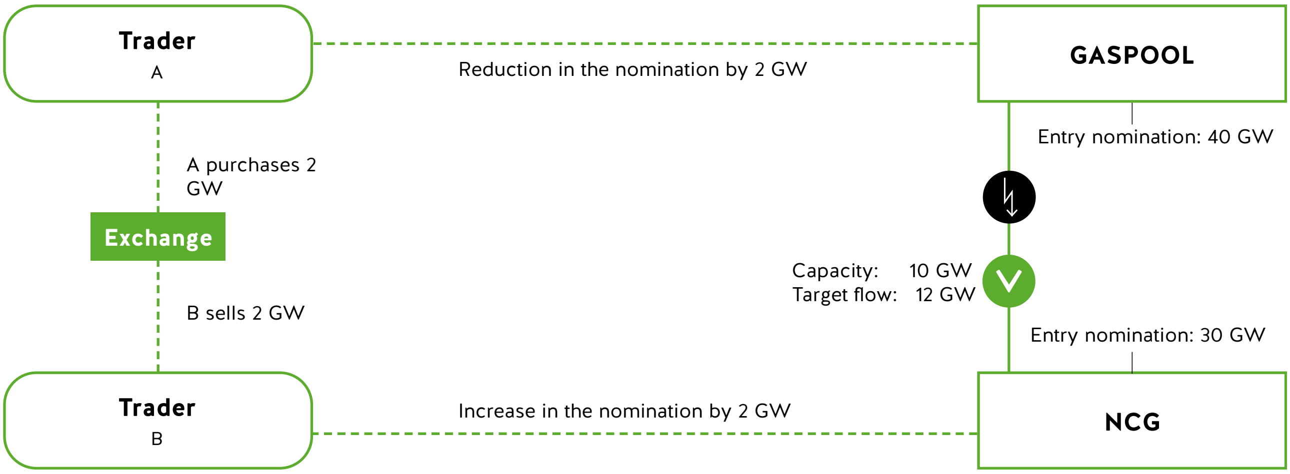


Example of third-party network use: bypassing a bottleneck between GASCADE and OGE/GRTD by a flow through two interconnection points in the Czech Republic

Source: Transmission system operators

Figure 16: Example of an exchange-based spread product

Exchange-based spread product: fictitious gas transmission from one transmission system operator to another transmission system operator by a local purchase and sale of gas volumes. In this solution, the excess volumes in a network area are sold and the additional volumes accordingly required in another network area are purchased. The networks are thus balanced with the help of the market participants.



Example of an exchange-based spread product: bypassing a bottleneck between GASPOOL and NCG by the sale of the excess volumes in the GASPOOL market area and the purchase of the missing volumes in the NCG market area (source: www.marktgebietszusammenlegung.de)

Source: Transmission system operators

While wheeling and third-party network use make use of concrete possibilities in neighbouring foreign networks, the exchange-based spread product is not intended to be offered on a specific point or specific network operator basis.

The use of two large bottleneck zones – encompassing multiple network operators – for the exchange-based spread product is planned in order to offer flexibility to the market, and to ensure adequate liquidity. Based on the current planning, the delineation of the bottleneck zones corresponds to the former GASPOOL and NCG market areas.

Use of the wheeling and third-party network use instruments is assumed only in the amount of the bundled free firm capacity. In the scenarios, there are multiple variations of historic employment at cross-border interconnection points that simulate the employment of imports and exports by shippers.

The commercial instruments referred to above are applied in conjunction within the framework of an overbooking system. A formal consultation process is performed by the Federal Network Agency for this purpose [BNetzA 2019b].

Based on the model, market-based instruments are used at the most efficient place, which does not necessarily have to be the same as the place where the bottleneck was caused. Neither the bottlenecks nor the resulting costs can thus be assigned clearly and by cause to the individual transmission system operators. These also have to be taken into consideration in the efficiency comparison of BNetzA. The costs for market-based instruments therefore have to have a neutral impact on the profit of the transmission system operators and may not exert an influence on the efficiency comparison.

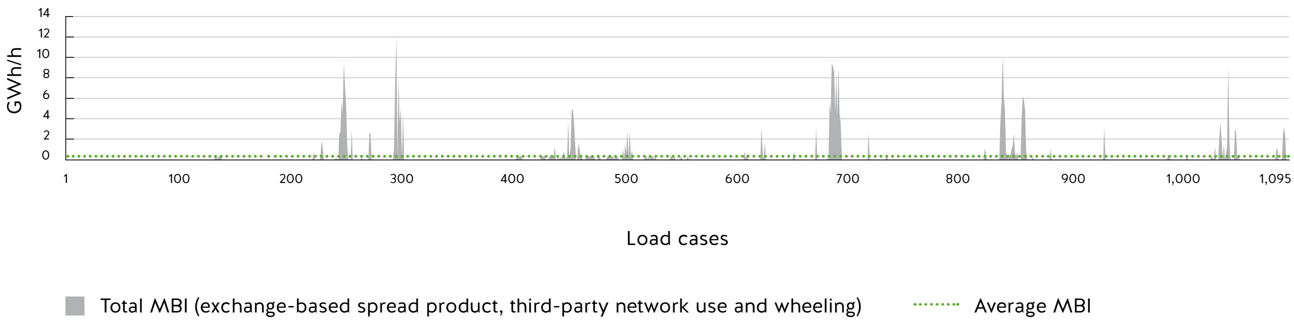
As the respective availability of the individual market-based instruments is taken into account in NewCap, maximum demand is not relevant in the statistical approach used. Rather, the aim of a NewCap calculation is to estimate the annual demand in terms of quantity for market-based instruments and the resulting costs of the market area merger.

An individual scenario comprises 1,095 load cases in total. These are used to generate statements on annual demand for a representative year.

The level of the demand for instruments per load case is dependent on the consumption assumed and on the employment of cross-border interconnection points and storage facilities. In order to estimate the annual demand for instruments of a scenario, the average use of instruments across all load cases is extrapolated to determine total annual demand.

The figure below shows an example of the demand for instruments for the 1,095 load cases in a scenario. The use of various instruments is assumed per load case according to availability and the principle of cost minimisation.

Figure 17: MBI requirement of all 1,095 load cases, base scenario 2025 (exemplarily)



Source: Transmission system operators

If there is a change in the structure of use in future, this can affect the demand for instruments.

The level of the demand for instruments is also dependent on the assumed employment of imports and exports, and therefore varies significantly between the different scenarios. Among other things, the future employment of different sources is dependent on their respective availability and the development of gas prices.

A reliable forecast of these developments is not possible at the current time. An analysis of just the average value for all scenarios is not practical for a conservative estimate of future annual demand for market-based instruments. In addition to the average demand for instruments, the development in the scenario with the maximum costs is therefore also shown in the NewCap calculation results (cf. Chapter 7). Thus, a possible range of costs for the market area merger is shown.

From the transmission system operators point of view the long-term occurrence of the maximum scenario is extremely unlikely. The costs of the market-based instruments will thus vary in the respective year under review within the range, but will not lie at the outer limits of this range for long.

A more exact statement on the amount of market-based instruments necessary will not be possible until experience of the new market area is available. Findings from the planned monitoring will be taken into account in future NewCap calculations.

3.4.3 Alternatives: network expansion and market-based instruments

An alternative to the market-based instruments proposed by the transmission system operators is the expansion of the network in order to maintain the capacity in the entire German market area. Based on the underlying project periods currently in place, a majority of the measures required can be realised only in five to seven years. They can thus definitely not be implemented by the time the merged market area comes into being. On the basis of earlier investigations, expansion costs are estimated to be in the range of several billion euro over a depreciation period of 55 years.

Another theoretical alternative to the use of market-based instruments would be to reduce entry capacity. Conditionally firm freely allocable capacity and free allocable capacity in particular could not be fully maintained in a combined market area. A reduction by approximately 200 GWh/h – which would correspond to around 78 % compared with the Gas Network Development Plan 2018–2028 – would result. Capacity that has already been booked and the booking quotas are not affected by the reduction.

This theoretical alternative is not currently being pursued. The use of market-based instruments preserves the firm capacity in full without capacity restrictions.

In order to ensure efficient network access, it is to be reviewed on a regular basis in the Gas Network Development Plan whether the costs of the market-based instruments permanently exceed the costs of an alternative network expansion. Should this be the case, the market-based instruments should be replaced by an appropriate network expansion.

The method used to weigh up the costs of market-based instruments against expansion is described in more detail in the following section, where the flow-dynamic network simulations are linked with the modelling of the new NewCap capacity model.

Description of the load situations/definition of the general conditions

The calculations in the new NewCap capacity model are performed on the basis of the base variant in accordance with the scenario framework. The calculations are made for the 2021/2022, 2023/2024, 2025/2026 and 2030/2031 gas years. The additional (in contrast to the flow-dynamic simulation) consideration of the 2021/2022 and 2023/2024 gas years is used to compare the development of the costs of the market-based instruments, even if a network expansion is not available as an alternative in these first two years because of the implementation periods that are required.

The amount of the capacity to be taken into account in the calculation depends on the assumed expansion status of the network, known as the infrastructure level. The infrastructure level is changed by the consideration of additional network expansions. By varying the level of the network expansion, it is possible – where the capacity structure is identical – to assess the two alternatives network expansion versus the use of market-based instruments. As a start for the NewCap calculations, an exchange capacity based on the existing network, including all expansion measures in accordance with the confirmed Gas Network Development Plan 2018–2028 and plus the needs for expansion already established that cannot be replaced by market-based instruments is used as the basis between the transmission system operators.

The aim is to present the capacity structure in accordance with the scenario framework (including all capacity increases from the H-gas balance of the Gas Network Development Plan 2020–2030). A reduction of the capacity structure is not intended to take place.

A change in the infrastructure level can be the result of an expansion plan in accordance with internal TSO network simulations, the impact of which on the demand for market-based instruments is then examined in a further NewCap calculation. Conversely, the results of a NewCap calculation can, however, also produce indications for the expansion planning to connect several TSO networks.

Please see Chapter 3.4.2 for a description of the load situations and scenarios that have been used.

The (regulated) (daily) fees of the neighbouring foreign network operators are used as specific costs for the use of market-based instruments in a first step for wheeling and third-party network usage. In order to map the variation that is dependent on supply and demand realistically for the use of the exchange-based spread products, the historical time series for the spread between purchase and sale of gas for balancing actions between the GASPOOL and NCG bottleneck zones are used – in the same way as in statistical approach described in 3.4.2.

NDP – Linking of flow-dynamic simulation and NewCap calculation

To begin with, each network operator establishes what expansion measures are necessary to provide the capacity in their network area separately using their own flow-dynamic simulations as in previous Network Development Plans. The network expansion measures identified in this way thus result discretely not from the market area merger. The basis for the model calculations are formed by the capacity demands identified for the base variant that emerge from the confirmed scenario framework.

The capacity between the transmission system operators that results from the identified network expansion measures are subsequently included in the NewCap calculations.

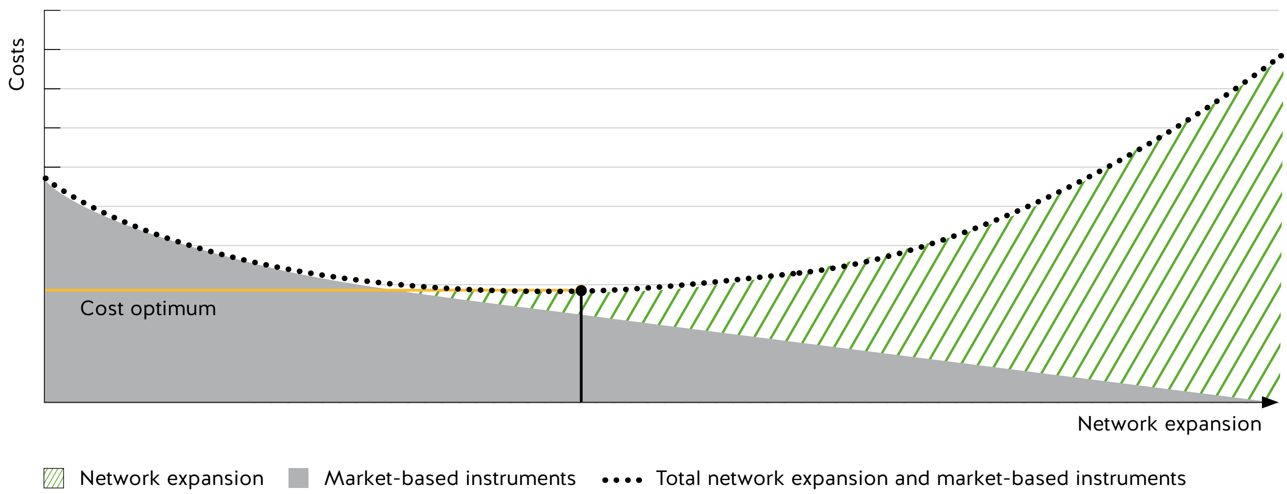
The capacity structure according to the Gas Network Development Plan 2020–2030 forms the basis for identifying the bottleneck zones and the demand for market-based instruments with NewCap for each of the four gas years to be considered. The capacity at cross-border interconnection points and storage facilities correspond here essentially to that of the Gas Network Development Plan 2018–2028, while the domestic German consumption in particular has been adjusted to the current demands of the scenario framework.

The combination described in Chapter 3.4.2 of a statistical model approach with a Germany-wide consideration of extreme load scenarios for processing future transport functions identifies possible bottlenecks in the combined market area.

The sum produced by the costs of the market-based instruments emerging here and the costs of the network expansion already taken into account are used as the base costs for the comparisons with the alternative calculations below.

It is analysed in these alternative calculations whether the bottlenecks that are identified can be resolved more efficiently by investments in the network infrastructure or by the use of market-based instruments.

Figure 18: Costs of market-based instruments and network expansion



Source: Transmission system operators

Alternatively, the minimum required scope of the network expansion can also be determined if the costs for the market-based instruments are to be limited to a defined extent.

The amount and the location of the capacity adjustment between transmission system operators resulting from the network expansion either can be the result of the flow-dynamic expansion planning or the NewCap results can alternatively provide indications for necessary network expansions.

Several parallel NewCap calculations with variation of the location and the amount of the adjustments to the market area interconnection points can also be carried out in order to identify the most cost-effective network expansion.

The sum of the costs of the market-based instruments and the costs for the network expansion is determined for each variation calculation in NewCap so that a comparison of the costs can be carried out between different variation calculations and with the base costs.

The aim of the successive variation calculations is to minimise the sum of the costs of the market-based instruments and network expansion.

3.4.4 Cost assessment

In the case where bottlenecks occur, it is assessed whether the use of market-based instruments offers advantages over the expansion of the network to remedy these bottlenecks.

The assumptions that favour the use of market-based instruments are presented transparently. This presentation includes the description of the scenarios for determining the base costs, other criteria that exert an influence on the assessment as well as the assessment of whether the costs of market-based instruments and network expansion costs can be compared. The costs of the market-based instruments and the costs of the network expansion are made comparable using suitable methods, such as the determination of a present value for the network expansion costs.

The amount of the costs of the market-based instruments of an individual scenario is produced here as average annual costs across all 1,095 load cases that are considered. Both the maximum value across all scenarios and the mean value across all scenarios can be used for each year to compare the variation calculations.

Where a network expansion is preferable to the use of market-based instruments, the resulting measures are identified and presented with their technical characteristics, the possible dates when they can come on stream and the expected investment costs.

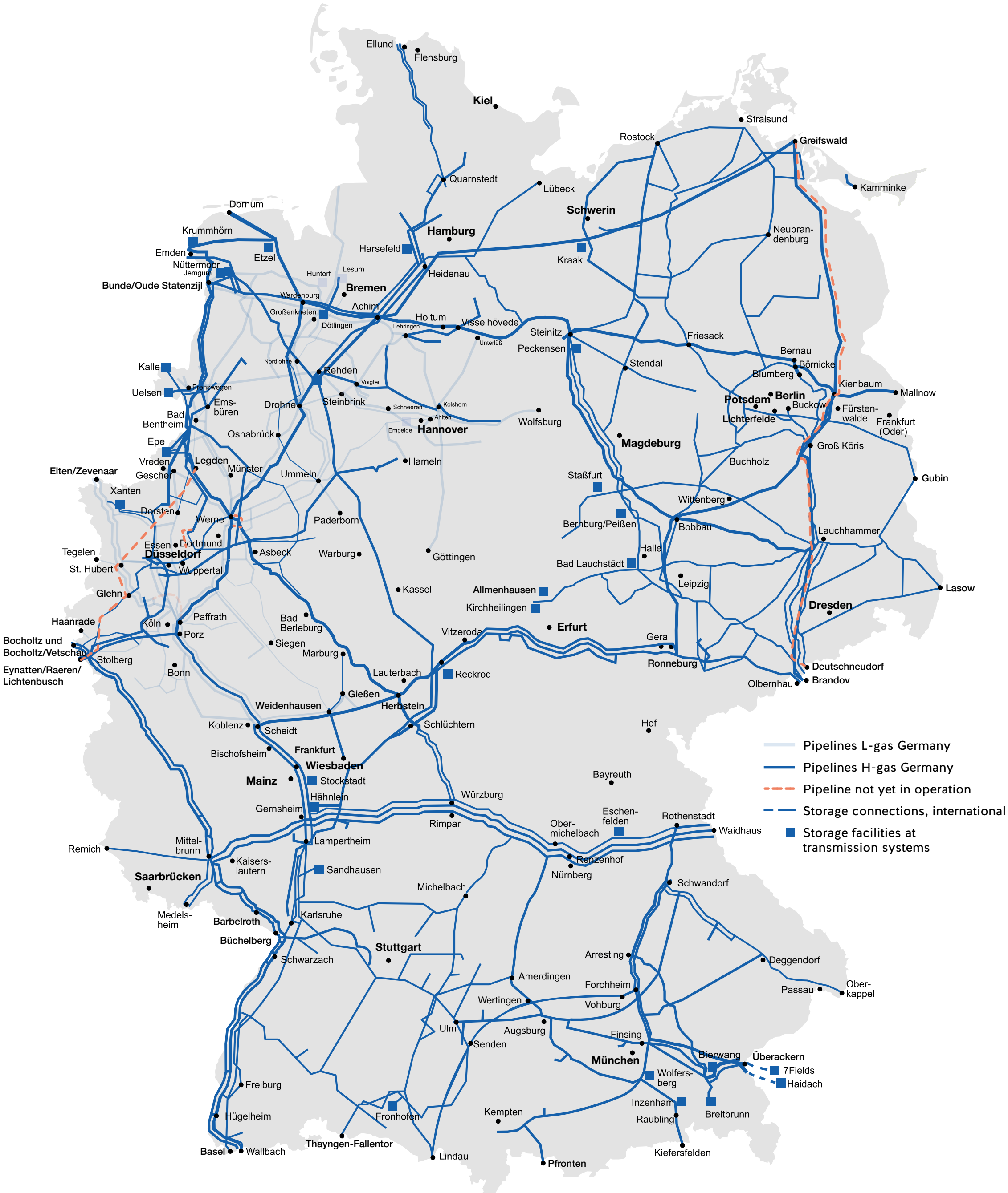
The impacts of the measures that are identified, such as the resulting increase in the individual capacity at the market area interconnection points or capacity increases in individual network areas, are described in a comprehensible way.

The transmission system today 4

4 The transmission system today

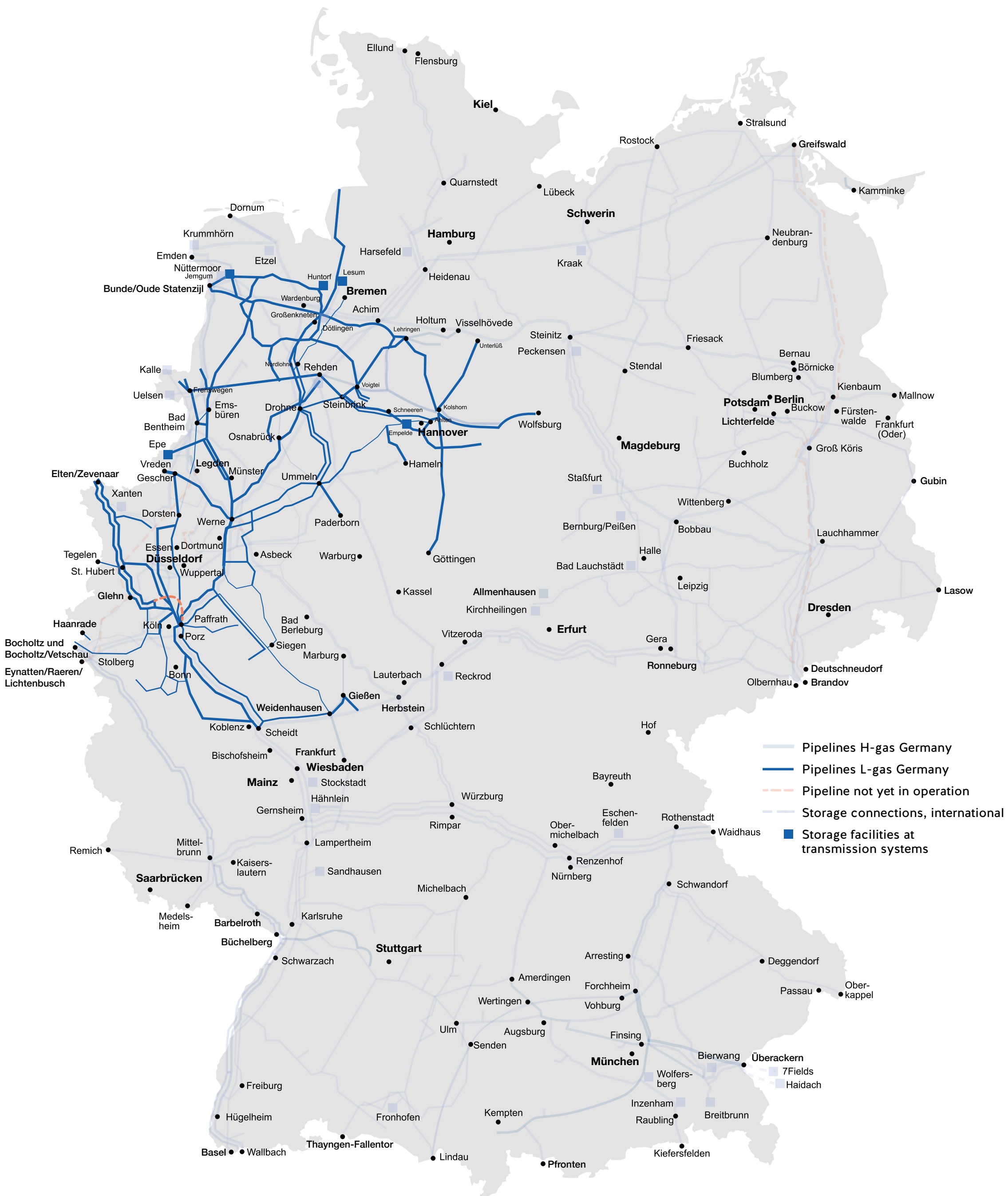
The German gas transmission system can be divided into an H-gas area and an L-gas area. These two areas are shown in Figure 19 and Figure 20. Chapter 4.1 describes the initial network underlying the modelling (reporting date: 1 March 2020) and the implementation status of the Gas Network Development Plan 2018–2028.

Figure 19: H-gas transmission network



Source: Transmission system operators, reporting date: 1 March 2020

Figure 20: L-gas transmission network



Source: Transmission system operators, reporting date: 1 March 2020

4.1 Initial network for the modelling of the Gas Network Development Plan 2020–2030

In accordance with the confirmed scenario framework, the initial network recognised in the network modelling comprises the current inventory of the transmission system, measures that have come on stream since the 2019 implementation report, measures under construction and other measures from the Gas Network Development Plan 2018–2028 selected using the criteria below as at the reporting date of 1 March 2020:

- The final investment decision (FID) by the transmission system operators has been taken.
- The approvals under public law and private law that are required for the measure are available.

The measures included in the initial network are treated in the network simulation in the same way as pipelines and plants that already form part of the existing network. Measures included in the initial network can thus no longer be the result of the modelling. They are thus in fact given the status of the existing network for modelling. The funding requirements necessary to implement these measures are taken into account in the total costs for the network expansion proposal.

Measures no longer considered in the Gas Network Development Plan 2020–2030

Measures that were shown as in operation in the 2019 implementation report are no longer listed in the Gas Network Development Plan 2020–2030 or in the NDP Gas database. This applies to the measures in Table 14.

Table 14: Measures no longer considered in the Gas Network Development Plan 2020–2030, as they have already been shown as in operation in the 2019 implementation report

No.	ID number in the 2019 implementation report	Network expansion measure	Transmission system operator
1	026-06	Rothenstadt compressor station	GRTD/OGE
2	030-02a	MONACO 1	bayernets
3	040-05	Werne compressor station	OGE
4	045-04	Epe-Legden pipeline	OGE
5	049-07	Herbstein compressor station	OGE
6	224-03	Nordlohne GPCM station and connecting pipeline	OGE
7	225-04	Legden GPCM station and connecting pipeline	OGE
8	226-03	Weidenhausen GPCM station and connecting pipeline	OGE
9	227-05	Marburg GPCM station and connecting pipeline	OGE
10	228-03	Hilter GPCM station and connecting pipeline	OGE
11	304-01	Waidhaus compressor station reverse flow west-east MEGAL	GRTD/OGE
12	306-02	Legden GPCM station and connecting pipeline	OGE
13	322-02	Weidenhausen-Gießen pipeline	OGE
14	401-01	Wertingen GPCM station	bayernets
15	414-01	Krummhörn compressor station	OGE
16	430-01	Posthausen GPCM station	GTG Nord

Source: Transmission system operators

Measures that have come on stream since the 2019 implementation report

The following measures that were still in the planning or construction phase in the 2019 implementation report have come on stream in the meantime:

Table 15: Measures that come on stream since the 2019 implementation report (reporting date: 1 March 2020)

No.	ID number	Network expansion measure	Transmission system operator
1	028-04a	Forchheim-Finsing pipeline	OGE
2	028-04b	Finsing 3 GPCM station and connecting pipeline	OGE
3	036-04	Wertingen compressor station	bayernets/OGE
4	207-03	Obermichelbach GPCM station reverse flow	OGE/GRTD
5	209-02a	Gernsheim GPCM station (MEGAL)	OGE/GRTD
6	209-02b	Gernsheim GPCM station (OGE)	OGE

No.	ID number	Network expansion measure	Transmission system operator
7	221-01	Conversion to H-gas (area: Luttum to Wolfsburg)	GUD
8	222-02	Conversion to H-gas (area: Bremen/Achim/Delmenhorst)	GUD
9	324-01	Niederpleis valve station and connecting pipeline	OGE
10	406-01	Amerdingen GPCM station	bayernets/OGE
11	407-01	Schnaitsee GPCM station	bayernets/OGE
12	412-04	Lubmin II natural gas receiving station	Fluxys D/GASCADE/GUD/ONTRAS
13	419-02	Hamborn GPCM station expansion	Thyssengas
14	432-02b	Bunde-Landschaftspolder GPCM station and H-L-gas blending facility	GTG Nord
15	503-02a	Hetlingen compressor station expansion	GUD
16	507-01b	North European Natural Gas Pipeline (NEL) link pipeline	Fluxys D/GASCADE/GUD/ONTRAS
17	507-01c	Lubmin-NEL GPCM station	Fluxys D/GASCADE/GUD/ONTRAS
18	507-01f	Deutschneudorf-EUGAL GPCM station	Fluxys D/GASCADE/GUD/ONTRAS
19	507-01g	Kienbaum II GPCM station including connecting line to the European Gas Pipeline Link (EUGAL)	ONTRAS
20	507-01h	Börnicke GPCM station (DÜG)	ONTRAS
21	507-02i	Steinitz GPCM station	GUD/ONTRAS
22	507-01j	Groß Köris GPCM station	ONTRAS
23	507-02k	Sülstorf GPCM station	Fluxys D/GUD/NEL Gastransport

Source: Transmission system operators

Measures under construction

The following measures are currently under construction:

Table 16: Measures currently under construction (reporting date: 1 March 2020)

No.	ID number	Network expansion measure	Transmission system operator
1	203-02	Würselen compressor station	OGE/Thyssengas
2	204-02a	ZEELINK 1 (pipeline)	OGE/Thyssengas
3	204-02b	ZEELINK 1 Glehn GPCM station and connecting pipeline	OGE/Thyssengas
4	205-02a	ZEELINK 2 (pipeline)	OGE/Thyssengas
5	205-02b	ZEELINK 2 Legden GPCM station and connecting pipeline	OGE/Thyssengas
6	206-02	Mittelbrunn GPCM station	OGE/GRTD
7	208-02	Rimpar GPCM station	OGE/GRTD
8	302-01	Datteln-Herne pipeline	Thyssengas
9	305-02	TENP reverse flow	Fluxys TENP/OGE
10	307-01	Mittelbrunn GPCM station	GRTD/OGE
11	308-02b	Gernsheim GPCM station (OGE)	OGE
12	309-01	Rimpar MEGAL GPCM station	GRTD/OGE
13	310-02	Reichertsheim GPCM station and connecting pipeline	OGE
14	311-02	Schlüchtern-Rimpar pipeline	OGE
15	312-02	Rimpar MEGAL GPCM station	OGE/GRTD
16	323-02	Aggertal network area conversion	Thyssengas
17	327-03	Niederscheiden GPCM station and connecting pipeline	OGE
18	328-03	Langenscheid GPCM station and connecting pipeline	OGE
19	329-03	Siegwiesen GPCM station and connecting pipeline	OGE

No.	ID number	Network expansion measure	Transmission system operator
20	330-02	Elsdorf GPCM station and connecting pipeline	OGE
21	331-01	Scheidt GPCM station	OGE
22	415-01	Krummhörn compressor station	OGE
23	420-01	Emsbüren compressor station	OGE
24	505-01	Rehden conversion expansion	Nowega
25	507-01a	EUGAL long-distance gas pipeline	Fluxys D/GASCADE/GUD/ONTRAS
26	507-01e	Radeland II GPCM station	Fluxys D/GASCADE/GUD/ONTRAS
27	507-02d	Radeland II compressor station	Fluxys D/GASCADE/GUD/ONTRAS
28	523-01	Bergedorf GPCM station system modification	GTG Nord
29	526-01	Hamm-Bergkamen pipeline	OGE
30	527-01	Stockum-Bockum Hövel pipeline	OGE
31	528-01	Merschhoven-Daberg pipeline	OGE

Source: Transmission system operators

Other measures in the Gas Network Development Plan 2020–2030

The following measures meet the criteria specified above for other measures to be included in the initial network:

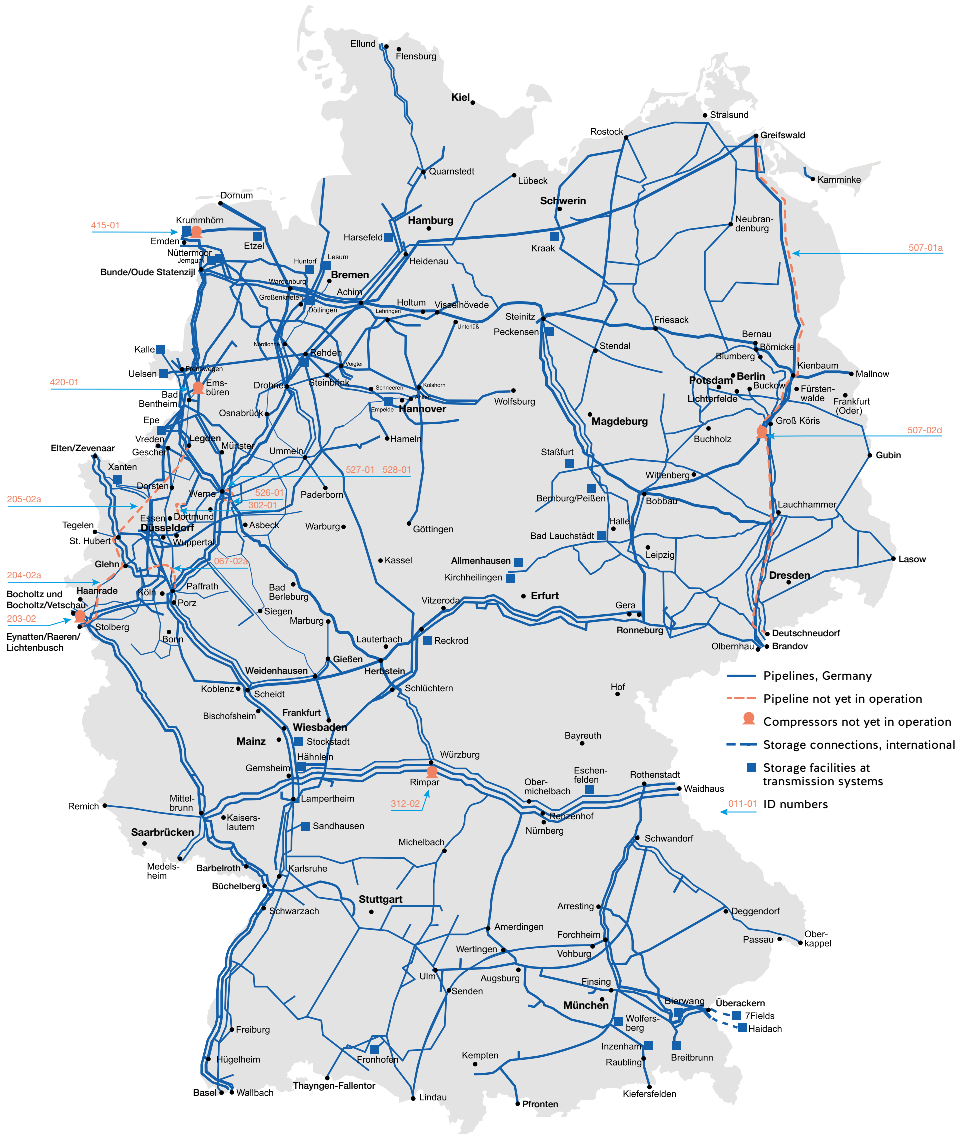
Table 17: Other initial network measures in the Gas Network Development Plan 2020–2030 (reporting date: 1 March 2020)

No.	ID number	Network expansion measure	Transmission system operator
1	067-02a	Voigtslach-Paffrath pipeline	OGE/Thyssengas
2	204-02c	ZEELINK 1 St. Hubert GPCM station and connecting pipeline	OGE/Thyssengas
3	204-02d	ZEELINK 1 Stolberg GPCM station and connecting pipeline	OGE/Thyssengas
4	320-01	Conversion of the Bergheim 1 network area to H-gas	Thyssengas
5	325-01	Neukirchen valve station and connecting pipeline	OGE/Thyssengas
6	410-01a	Rehden GPCM station	GASCADE
7	410-01b	Drohne GPCM station	GASCADE

Source: Transmission system operators

Figure 21 below shows the current transmission system with the measures taken into consideration in the modelling as well as the storage facilities as at 1 March 2020. For greater clarity, the large number of compressor stations in the existing network and the compressor stations that have come into operation as well as smaller-scale measures (e.g. GPCM stations, valve stations) are generally not presented in the maps in the Gas Network Development Plan 2020–2030. Pipelines that have come on stream as initial network measures, are treated in the same way as the existing network and therefore presented in the same way.

Figure 21: The initial network for the modelling on the Gas Network Development Plan 2020–2030 as at 1 March 2020



Source: Transmission system operators, reporting date: 1 March 2020

4.2 Implementation status of the Gas Network Development Plan 2018–2028

In accordance with section 15a(2) EnWG, the current Gas Network Development Plan must include the implementation status of the previous Gas Network Development Plan. The implementation status of the measures in the Gas Network Development Plan 2018–2028 was presented as at the 1 March 2019 reporting date in the 2019 implementation report [FNB Gas 2019b]. The transmission system operators have updated the implementation status of the measures as at the 1 March 2020 reporting date in the Gas Network Development Plan 2018–2028 in Table 18. Measures that were shown as in operation in the 2019 implementation report are no longer listed (cf. Table 15).

Table 18: Gas NDP 2020–2030: Implementation status of the NDP measures in comparison with the 2019 implementation report as at 1 March 2020

No.	ID no. in the 2019 imple-mentation report	ID no. in the Gas NDP 2020–2030	Network expansion measure	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	km planned	km realised	Commissioning: Imple-men-tation report 2019	Commissioning: GAS NDP 2020–2030
1	028-04a	028-04a	Forchheim-Finsing pipeline																				79.0	79.0	12/2018	12/2018
2	028-04b	028-04b	Finsing 3 GPCM station and connecting pipeline																				0.1	0.1	12/2018	12/2018
3	036-04	036-04	Wertingen compressor station																				0.0	0.0	12/2019	12/2019
4	067-02a	067-02a	Voigtslach-Paffrath pipeline																				23.2	0.0	12/2022	12/2022
5	067-02b	067-03b	Paffrath GPCM station and connecting pipeline																				0.2	0.0	12/2022	12/2022
6	112-02	112-03	Heilbronn connection																				28.0	0.0	12/2021	12/2021
7	116-02	116-02	Wiernsheim GPCM station (Heilbronn area)																				0.1	0.0	12/2021	12/2021
8	119-02	119-03	Achim GPCM station																				0.1	0.0	10/2021	10/2021
9	203-02	203-02	Würselen compressor station																				0.0	0.0	03/2021	03/2021
10	204-02a	204-02a	ZEELINK 1 (pipeline)																				112.0	0.0	03/2021	03/2021
11	204-02b	204-02b	ZEELINK 1 Glehn GPCM station and connecting pipeline																				0.1	0.0	03/2021	03/2021
12	204-02c	204-02c	ZEELINK 1 St. Hubert GPCM station and connecting pipeline																				0.1	0.0	03/2021	12/2021
13	204-02d	204-02d	ZEELINK 1 Stolberg GPCM station and connecting pipeline																				0.1	0.0	03/2021	12/2021
14	205-02a	205-02a	ZEELINK 2 (pipeline)																				115.0	0.0	03/2021	03/2021
15	205-02b	205-02b	ZEELINK 2 Legden GPCM station and connecting pipeline																				0.1	0.0	03/2021	03/2021
16	206-02	206-02	Mittelbrunn GPCM station									•											0.1	0.0	12/2019	12/2019
17	207-03	207-03	Obermichelbach GPCM station reverse flow																				0.1	0.1	12/2019	12/2019
18	208-02	208-02	Rimpar GPCM station																				0.1	0.0	12/2020	12/2020
19	209-02a	209-02a	Gernsheim GPCM station (MEGAL)																				0.1	0.1	12/2019	12/2019
20	209-02b	209-02b	Gernsheim GPCM station (OGE)																				0.1	0.1	12/2019	12/2019
21	221-01	221-01	Conversion to H-gas (area: Luttum to Wolfsburg)																				0.0	0.0	10/2021	10/2021
22	222-02	222-02	Conversion to H-gas (area: Bremen/Achim/Delmenhorst)																				0.0	0.0	12/2020	12/2020
23	223-01	223-01	Conversion to H-gas (area: Bremen Nord, Bremerhaven to Cuxhaven and eastern part of the network of EWE Netz)																				0.0	0.0	06/2021	06/2021

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6 Commissioning project conclusion/completion

Future project stages
• (Foreseeable) delay if progress is not optimal
Planned change

Source: Transmission system operators

No.	ID no. in the 2019 implementation report	ID no. in the Gas NDP 2020–2030	Network expansion measure	2012–2030	km planned	km realised	Commissioning: Implementation report 2019	Commissioning: GAS NDP 2020–2030
24	300-02	300-02	Integration of the Folmhusen compressor station in the H-gas		0.0	0.0	01/2020	07/2026
25	301-01	301-01	Embsen overfeed		0.0	0.0	12/2020	10/2021
26	302-01	302-01	Datteln-Herne pipeline		23.0	0.0	12/2021	12/2021
27	305-02	305-02	TENP reverse flow		0.0	0.0	12/2020	12/2020
28	307-01	307-01	Mittelbrunn GPCM station		0.1	0.0	12/2020	12/2020
29	308-02b	308-02b	Gernsheim GPCM station (OGE)		0.1	0.0	12/2020	12/2020
30	309-01	309-01	Rimpar MEGAL GPCM station		0.1	0.0	12/2020	12/2020
31	310-01	310-02	Reichertsheim GPCM station and connecting pipeline		0.1	0.0	12/2020	12/2020
32	311-02	311-02	Schlüchtern-Rimpar pipeline		0.3	0.0	12/2020	12/2020
33	312-02	312-02	Rimpar MEGAL GPCM station		0.0	0.0	12/2023	12/2023
34	314-01	–	Leeheim GPCM station and connecting pipeline	This measure will not be realised. The reasons are given in Chapter 7.	–	–	12/2025	–
35	320-01	320-01	Conversion of the Bergheim 1 network area to H-gas		1.0	0.0	12/2020	12/2020
36	323-02	323-02	Aggertal network area conversion		0.2	0.0	12/2019	10/2020
37	324-01	324-01	Niederpleis valve station and connecting pipeline		0.1	0.1	12/2019	12/2019
38	325-01	325-01	Neukirchen valve station and connecting pipeline		0.1	0.0	12/2020	12/2020
39	326-02	326-02	Horrem valve station and connecting pipeline		0.1	0.0	12/2020	12/2020
40	327-02	327-03	Niederschelden GPCM station and connecting pipeline		0.3	0.3	12/2020	12/2020
41	328-03	328-03	Langenscheid GPCM station and connecting pipeline		0.1	0.0	12/2020	12/2020
42	329-03	329-03	Siegwiesen GPCM station and connecting pipeline		0.2	0.0	12/2020	12/2020
43	330-02	330-02	Elsdorf GPCM station and connecting pipeline		0.2	0.2	12/2020	12/2020
44	331-01	331-01	Scheidt GPCM station		0.2	0.0	12/2020	12/2020
45	333-01	333-02	Asbeck GPCM station and connecting pipeline		0.2	0.0	12/2021	12/2021
46	334-02	334-02	Rauschendorf valve station and connecting pipeline		0.1	0.0	12/2020	12/2020
47	335-02a	335-02a	Kempershöhe GPCM station and connecting pipeline		0.2	0.0	12/2021	12/2021
48	335-02b	335-02b	Wipperfürth-Niederschelden pipelines		7.0	0.0	12/2021	12/2021
49	336-02	336-02	Oberaden valve station and connecting pipeline		0.1	0.0	12/2020	12/2020

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No.	ID no. in the 2019 implementation report	ID no. in the Gas NDP 2020–2030	Network expansion measure	km planned	km realised	Commissioning: Implementation report 2019	Commissioning: GAS NDP 2020–2030
50	337-01	337-02	Porz GPCM station	0.1	0.0	12/2023	12/2024
51	338-01	338-02	Paffrath GPCM station	0.2	0.0	12/2022	12/2022
52	402-01a	402-02a	Wertingen-Kötz pipeline	41.0	0.0	12/2022	12/2024
53	402-01b	402-02b	Wertingen 2 GPCM station	0.3	0.0	12/2022	12/2024
54	402-01c	402-02c	Kötz GPCM station	0.4	0.0	12/2022	12/2024
55	406-01	406-01	Amerdingen GPCM station	0.2	0.2	12/2019	12/2019
56	407-01	407-01	Schnaitsee GPCM station	0.1	0.1	12/2019	12/2019
57	410-01a	410-02a	Rehden GPCM station	0.1	0.0	12/2020	12/2020
58	410-01b	410-02b	Drohne GPCM station	0.1	0.0	12/2020	12/2020
59	412-03	412-04	Lubmin II natural gas receiving station	0.1	0.1	01/2020	01/2020
60	415-01	415-01	Krummhörn compressor station	0.0	0.0	12/2022	12/2022
61	416-02	416-02	Legden compressor station	0.0	0.0	12/2023	12/2023
62	417-02	417-02	Northern Black Forest pipeline compressor station	0.0	0.0	09/2022	12/2023
63	418-02	418-02	Scharenstetten compressor station expansion	0.0	0.0	12/2022	12/2022
64	419-01	419-02	Hamborn GPCM station expansion	0.1	0.1	10/2018	01/2020
65	420-01	420-01	Emsbüren compressor station	0.0	0.0	12/2020	12/2020
66	422-01	422-01	Elten compressor station	0.0	0.0	09/2022	09/2022
67	431-01	431-02	Emstek GPCM station	0.3	0.0	12/2021	12/2021
68	432-02b	432-02b	Bunde-Landschaftspolder GPCM station and H-L-gas blending facility	1.3	1.3	06/2019	06/2020
69	435-02	435-03	Altena GPCM station and connecting pipeline	0.1	0.0	12/2021	12/2021
70	436-02	436-02a	Heiden Marbeck-Heiden Borken pipeline	1.5	0.0	06/2021	12/2026
71	436-02	436-02b	Heiden Borken-Dorsten pipeline	17.0	0.0	06/2021	12/2026
72	437-01	437-01	Heiden-Borken GPCM station and connecting pipeline	0.1	0.0	06/2021	12/2026
73	438-01	438-01	Epe storage facility pipeline link remodelling	0.1	0.0	12/2022	12/2025
74	439-01	439-01	Pattscheid GPCM station and connecting pipeline	0.5	0.0	12/2022	12/2022
75	440-02	440-02	Erftstadt-Euskirchen pipeline	18.4	0.0	12/2021	12/2021

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Future project stages
(Foreseeable) delay if progress is not optimal
Planned change

Source: Transmission system operators

No.	ID no. in the 2019 imple-mentation report	ID no. in the Gas NDP 2020–2030	Network expansion measure	2012–2030	km planned	km realised	Commissioning: Imple-men-tation report 2019	Commissioning: GAS NDP 2020–2030
76	441-01	441-02	Vinnhorst valve station and connecting pipeline		0.1	0.0	12/2023	12/2023
77	442-02	442-02	Ahlten GPCM station and connecting pipeline		0.1	0.0	12/2023	12/2023
78	443-01	443-02	Drohne GPCM station and connecting pipeline		0.3	0.0	12/2024	12/2024
79	444-01	444-01	Werne GPCM station and connecting pipeline		0.0	0.0	12/2025	12/2025
80	445-01a	445-01a	St. Hubert-Voigtslach valve stations and connecting pipeline (NETG)		0.1	0.0	12/2021	12/2021
81	445-01b	445-01b	St. Hubert-Voigtslach valve stations and connecting pipeline (OGE)		0.1	0.0	12/2021	12/2021
82	446-01	446-01	Wipperfürth-Niederschelden conversion		0.1	0.0	12/2021	05/2022
83	448-01	448-01	Euskirchen GPCM station and connecting pipeline		0.1	0.0	12/2021	12/2021
84	449-01	449-02	Heilbronn connection extension (SEL 1)		25.0	0.0	10/2024	10/2024
85	450-01	450-01	Steinhäule GPCM station expansion		0.1	0.0	12/2022	12/2022
86	451-02	451-02	Au am Rhein GPCM station expansion		0.1	0.0	12/2022	12/2022
87	501-01a	501-02a	Walle - Wolfsburg pipeline		33.0	0.0	10/2021	10/2021
88	501-01d	501-02d	Kolshorn GPCM station expansion		0.1	0.0	10/2021	10/2021
89	501-01e	501-02e	Unterlüß GPCM station expansion		0.1	0.0	10/2021	10/2021
90	503-01a	503-02a	Hetlingen compressor station expansion		0.1	0.0	10/2019	10/2019
91	503-01b	503-02b	Embsen compressor station expansion		0.0	0.0	10/2022	10/2022
92	504-01a	504-01a	EPT-Rysum – Rysum-Folmhusen pipeline connection		0.4	0.0	10/2023	10/2023
93	504-01b	504-02b	Folmhusen GPCM station expansion		0.1	0.0	10/2023	10/2022
94	504-01c	504-02c	Emden GPCM station		0.1	0.0	10/2023	10/2022
95	505-01	505-01	Rehden conversion expansion		0.0	0.0	01/2021	01/2021
96	506-02a	–	Massenheim-Hattersheim pipeline	This measure will not be realised. The reasons are given in Chapter 7.	–	–	12/2023	–
97	506-02b	–	Massenheim II GPCM station and connecting pipeline	This measure will not be realised. The reasons are given in Chapter 7.	–	–	12/2023	–
98	507-01a	507-01a	EUGAL long-distance gas pipeline		480.0	480.0	12/2019	12/2019
99	507-01b	507-01b	North European Natural Gas Pipeline (NEL) link		0.2	0.2	12/2019	12/2019
100	507-01c	507-01c	Lubmin-NEL GPCM station		0.1	0.1	12/2019	12/2019

1 Project idea
2 Planning brief/feasibility study
3 Design planning/regional planning procedure
4 Detailed/approval planning/planning approval procedure/planning permission procedure/approval process pursuant to the Federal Immissions Control Act (BImSchG)/acquisition of rights of way
5 Procurement of materials and services/construction preparation and start of construction/installation/construction
6 Commissioning project conclusion/completion

Future project stages
(Foreseeable) delay if progress is not optimal
Planned change

Source: Transmission system operators

No.	ID no. in the 2019 implementation report	ID no. in the Gas NDP 2020–2030	Network expansion measure	km planned	km realised	Commissioning: Implementation report 2019	Commissioning: GAS NDP 2020–2030
101	507-01d	507-02d	Radeland II compressor station	0.0	0.0	12/2020	12/2020
102	507-01e	507-01e	Radeland II GPCM station	0.1	0.0	12/2019	06/2020
103	507-01f	507-01f	Deutschneudorf-EUGAL GPCM station	0.1	0.1	12/2019	12/2019
104	507-01g	507-01g	Kienbaum II GPCM station including connecting line to the European Gas Pipeline Link (EUGAL)	0.1	0.1	12/2019	12/2019
105	507-01h	507-01h	Börnicke GPCM station (pressure security system)	0.1	0.1	12/2019	12/2019
106	507-02i	507-02i	Steinitz GPCM station	0.1	0.1	12/2019	12/2019
107	507-01j	507-01j	Groß Köris GPCM station	0.1	0.1	12/2019	12/2019
108	507-01k	507-02k	Sülstorf GPCM station	0.1	0.1	12/2019	12/2019
109	507-01l	507-01l	Holtum compressor station reverse flow	0.0	0.0	10/2020	10/2022
110	507-01m	507-01m	Sayda compressor station	0.0	0.0	12/2023	12/2023
111	508-01	508-01	Leonberg-West GPCM station expansion	0.1	0.0	12/2022	12/2022
112	520-01	520-01	Visbek Astrup valve station	0.1	0.0	10/2019	12/2020
113	521-01	521-01	Twistringen Ehrenburg valve station	0.1	0.0	12/2020	12/2020
114	523-01	523-01	Gergedorf GPCM station system modification	0.1	0.0	06/2020	06/2020
115	524-01	524-01	Steinfeld-Düpe GPCM station system modification	0.1	0.0	12/2021	12/2021
116	525-01	525-01	Willich-Meerbusch pipeline	4.6	0.0	12/2024	12/2024
117	526-01	526-01	Hamm-Bergkamen pipeline	5.5	0.0	12/2020	12/2020
118	527-01	527-01	Stockum-Bockum Hövel pipeline	4.0	0.0	12/2022	12/2022
119	528-01	528-01	Merschhoven-Daberg pipeline	2.0	0.0	12/2020	12/2020
120	529-01	529-01	Elten – St. Hubert valve stations	0.1	0.0	12/2025	12/2025
121	530-01	530-01	Cologne – Dormagen conversion	0.3	0.0	12/2024	12/2024
122	531-01a	531-01a	Appeldorn GPCM station	0.1	0.0	12/2025	12/2025
123	531-01b	531-01b	Xanten valve stations	0.1	0.0	12/2025	12/2025
124	–	532-01	Leer GPCM station and connecting pipeline	0.1	0.0	–	12/2023
125	552-01	552-01	Mittelbrunn-Schwanheim pipeline	38.0	0.0	12/2024	12/2024
126	554-01	554-01	Hügelheim-Tannenkirch pipeline	16.0	0.0	12/2024	12/2024
127	555-02	555-03	TENP I to TENP II interconnections	0.1	0.0	12/2021	12/2021

1 Project idea
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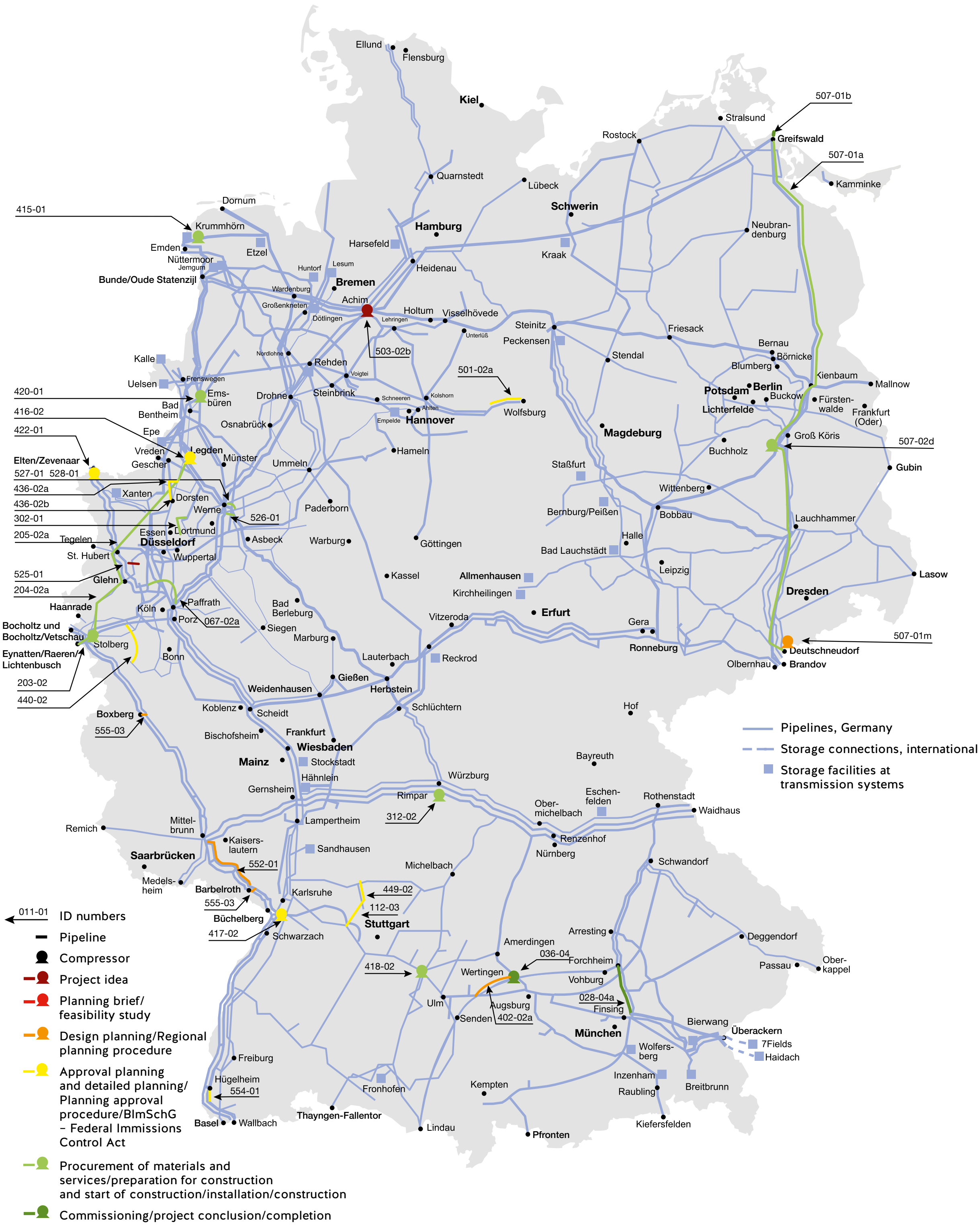
Future project stages
(Foreseeable) delay if progress is not optimal
Planned change

Figure 22: Implementation status of the measures as at 1 March 2020



Source: Transmission system operators, reporting date: 1 March 2020

4.3 Measures where a change to the commissioning dates is planned

The measures specified below where a change to the commissioning date is planned (e.g. because of a change to the L-to-H-gas conversion area plan) refer to changes from the scheduled commissioning deadlines shown in the 2019 implementation report.

ZEELINK 1 St. Hubert GPCM station and connecting pipeline (ID 204-02c)

The St. Hubert GPCM station is required for the conversion from L-gas to H-gas. The first conversion stage is planned for the start of 2022. The GPCM station will therefore be commissioned at the end of 2021.

The adjustment of the time when this expansion measure is implemented does not affect the planned time when the capacity will be provided.

ZEELINK 1 Stolberg GPCM station and connecting pipeline (ID 204-02d)

The Stolberg GPCM station is required for the conversion from L-gas to H-gas. The first conversion stage is planned for the start of 2022. The GPCM station will therefore come on stream at the end of 2021.

The adjustment of the time when this expansion measure is implemented does not affect the planned time when the capacity will be provided.

Integration of the Folmhusen compressor station in the H-gas (ID 300-02)

Current plans for the market area conversion show that unit 3 of the Folmhusen compressor station will be required in L-gas until the Bielefeld-Paderborn area is converted.

The adjustment of the time when this expansion measure is implemented does not affect the planned time when the capacity will be provided.

Embsen overfeed (ID 301-01)

Changes to general conditions from the internal order, the implementation of the LNG facilities and the market area conversion mean that the oversupply transmission needs to be realised only after the end of 2021.

The adjustment of the time when this expansion measure is implemented does not affect the planned time when the capacity will be provided.

Porz GPCM station (ID 337-02)

The Porz GPCM station is required for the conversion of the Middle Rhine area from L-gas to H-gas. This area is expected to be converted in 2023. The GPCM station will therefore come on stream in 2024.

The adjustment of the time when this expansion measure is implemented does not affect the planned time when the capacity will be provided.

Heiden Marbeck-Heiden Borken pipeline (ID 436-02a)

The Heiden-Dorsten pipeline (ID 463-02) has been divided into two measures. The first part runs from Heiden Marbeck to Heiden Borken (ID 436-02a), the second part from Heiden Borken to Dorsten (ID 436-02b). The pipeline is required for the conversion of the Sonsbeck-Dorsten conversion area from L-gas to H-gas. The pipeline will therefore come on stream only in 2026.

The adjustment of the time when this expansion measure is implemented does not affect the planned time when the capacity will be provided.

Heiden-Borken GPCM station and connecting pipeline (ID 437-01)

The Heiden-Borken GPCM station is required for the conversion of the Sonsbeck-Dorsten conversion area from L-gas to H-gas. The pipeline will therefore come on stream only in 2026.

The adjustment of the time when this expansion measure is implemented does not affect the planned time when the capacity will be provided.

Epe storage facility pipeline link remodelling (ID 438-01)

The St. Hubert GPCM station is required for the conversion from L-gas to H-gas. Initial findings of a possible conversion concept show that the measure will be needed in 2026 at the earliest. The remodelling will therefore come on stream in 2025.

The adjustment of the time when this expansion measure is implemented does not affect the planned time when the capacity will be provided.

Wipperfürth-Niederschelden conversion (ID 446-01)

The commissioning of the Wipperfürth-Niederschelden conversion measure has been rescheduled from December 2020 to May 2022. The postponement is caused by the progress of the planning and by the conclusion of the conversion timetable.

The adjustment of the time when this expansion measure is implemented does not affect the planned time when the capacity will be provided.

Holtum compressor station reverse flow (ID 507-01l)

The reverse flow at the Holtum compressor station was originally required for shipping the EUGAL volumes. The reverse flow at the Holtum compressor station has to be implemented in the Gas Network Development Plan 2020–2030 to derive the volumes for the security of supply in the Netherlands. The measure will therefore be required only in 2022 instead of 2020.

The adjustment of the time when this expansion measure is implemented does not affect the planned time when the capacity will be provided.

Visbek Astrup valve station (ID 520-01)

The Visbek Astrup valve station is necessary for the separation of the EWE Zone part II and part III conversion areas in 2021. The value station will therefore first come on stream in 2020.

The adjustment of the time when this expansion measure is implemented does not affect the planned time when the capacity will be provided.

4.4 Measures subject to a delay

4.4.1 Measures where a delay has occurred

Delays in comparison with the 2019 implementation report have occurred in the following measures:

Mittelbrunn GPCM station (ID 206-02)

The measures under ID numbers 206-02 and 307-01 have to be implemented in Mittelbrunn in order to increase the overfeed capacity between the MEGAL and the TENP pipeline systems.

The plans for the measures were started on the basis of the full transport capacity of the TENP transmission system. Because of the temporary shutdown of sub-sections of TENP I, the plans have had to be amended or rewritten in order to avoid further capacity restrictions while the structural engineering of the measures is being implemented. These new plans and the related renewed and additional processes to product material and services result in an extension of the project period.

On the basis of the new planning, the commissioning is expected to take place in December 2020. Impacts on the planned time when the capacity will be provided will be avoided by carrying additional temporary engineering measures.

Aggertal conversion (ID 323-02)

The commissioning date of the Aggertal network area conversion measure is delayed slightly from December 2019 to April 2020. The postponement is caused by the progress of the planning and by the conclusion of the conversion timetable. The adjustment of the time when this expansion measure is implemented does not affect the planned time when the capacity will be provided.

Bunde-Landschaftspolder GPCM station and H-L-gas blending facility (ID 432-02b)

The commissioning of the Bunde-Landschaftspolder GPCM station and H-L-gas blending facility measure will be postponed because of the delays in concluding approval procedures and an increased need for co-ordination in the detailed planning.

Based on the new planning, commissioning is expected to take place in June 2020. The delay has impacts only on the mix potential of H-gas to L-gas and accordingly does not exert any influence on the provision of capacity.

Radeland II GPCM station (ID 507-01e)

Expected commissioning in the second quarter of 2020 is assumed for the Radeland II GPCM station measure.

The adjustment of the time when this expansion measure is implemented does not affect the planned time when the capacity will be provided.

4.4.2 Measures with a foreseeable delay

The measures with a foreseeable delay compared with the 2019 implementation report that are specified below refer exclusively to delays from the scheduled commissioning dates shown in the NDP gas database.

Wertingen-Kötz pipeline (ID 402-02a), Wertingen 2 GPCM station (ID 402-02b), Kötz GPCM station (ID 402-02c)

There will be a delay in the commissioning of the Wertingen-Kötz pipeline measures and also of the related GPCM stations. This delay arises essentially from the constant changes to the general conditions surrounding the power plants for which a tender has been issued for southern Germany by the electricity TSOs as "special network operating equipment (bnBm power plant)".

Various capacity expansion claims pursuant to section 39 GasNZV with capacity demands of between 3.4 GW_{th} and 5.7 GW_{th} have been available to bayernets since 2016. Neither a notification of a contract award by the electricity transmission system operators for "special network operating equipment (bnBm power plant)" in the administrative district of Schwaben nor an investment decision of the power plant planners has been provided to bayernets to date.

The problem has not been helped, but instead complicated by the long-lasting uncertainty in Baden-Württemberg on the same circumstances. The dimensions of the pipeline have had to be revised on account of the increase in capacity demand in Baden-Württemberg.

Major uncertainty and constantly new requirements have therefore emerged in the search for an efficient and demand-based expansion in the southern German natural gas network. The constant change in the general conditions results in a delay in the design and planning of the Wertingen-Kötz NDP measure.

It is therefore not possible to complete the Wertingen-Kötz measure at the time set out in the Gas Network Development Plan 2016. Instead, the commissioning is expected at the end of 2024 based on the current planning status.

The delay has impacts on the provision of capacity for the Gundremmingen power plant and also on the provision of capacity for Baden-Württemberg. Various measures to mitigate the capacity restriction are in preparation.

Northern Black Forest compressor station (ID 417-02)

The commissioning of the Northern Black Forest compressor station measure will be delayed because of extensive negotiations on locating the site. It has since been possible to agree the location for the Northern Black Forest pipeline.

The delays that have resulted thus mean that commissioning is expected in December 2023. Impacts on the planned time when capacity will be provided cannot be ruled out at the moment.

4.5 Other measures where a final investment decision has not been made

No final investment decisions on the part of the transmission system operators have been made for the following measures. The measures therefore do not form part of today's transmission system and have not been taken into consideration in the initial network for the modelling of the Gas Network Development Plan 2020–2030.

With the Süddeutsche Erdgasleitung (SEL – South German natural gas pipeline), a plan is being followed that already has its origins in the time before the gas transmission systems were regulated. The route runs through Hesse and Bavaria in places, but primarily through Baden-Württemberg. The section of the route that runs mainly through Baden-Württemberg is around 260 km in length in total and runs from Lampertheim to Amerdingen.

The SEL is broken down into five subsections. Based on the capacity demand in Baden-Württemberg reported in the scenario framework, three of these SEL sections have been identified as part of the modelling as currently necessary for supply (cf. Chapter 7, ID 449-02, ID 612-01, ID 614-01).

The analyses performed by terranets on the development of the capacity demand show it is necessary to consider powerful pipeline systems that can play a part in creating additional transmission capacity. Taking into consideration the developments regarding capacity demand that are due in the next few years, the SEL constitutes overall a core infrastructure system with diversified sources for supplying Baden-Württemberg based on demand. Some of these developments will be triggered by the Kohleausstiegsgesetz (Coal Phase-out Act). The limited number of potential locations for power plants in Baden-Württemberg, which will continue to be centred regionally in the greater Stuttgart and Heilbronn area can be connected to the high-pressure gas network through the SEL. The emerging developments for Baden-Württemberg in the context of the energy transition and the fuel switch show that full realisation of the SEL can now be foreseen. The use of powerful and diversifiable supply points enables a demand-based supply of the Baden-Württemberg system from the upstream pipeline networks that can be efficient and sustainable.

The original motivation behind the SEL, to provide a sustainable and flexible supply of Baden-Württemberg and southern Germany, thus continues to be fully valid.

4.6 Summary

The following results can be recorded on the status of the implementation of the Network Development Plan measures:

- A total of 127 measures were considered in the course of the review of the implementation status (reporting date: 1 March 2020).
- 61 measures meet the requirement for inclusion in the initial network in the Gas network Development Plan 2020–2030.
- Compared with the 2019 implementation report, 23 measures have come on stream and 31 measures are currently under construction.
- As a result of findings from the planning that have since been made, a planned change to the date of commissioning has been made in 11 measures.
- Delays have occurred or are foreseeable in eight measures.

Development of the L-gas supply 5

5 Development of the L-gas supply – Security of supply scenario

In accordance with section 15a(1) EnWG, the transmission system operators are required to take into consideration in the Network Development Plan the impact of conceivable disruptions to the supply of natural gas in connection with the security of supply. A joint approach by the transmission system operators that deals with these aspects in the context of the market area conversion is outlined in the scenario framework. On account of the reduced availability of L-gas on the German market, the detailed conversion plans up to 2030 have to be further elaborated in particular in this process. Furthermore, an important contribution to guaranteeing the security of supply is made by examining the L-gas balances up to 2030. In addition to the German production, the focus here is placed on the available injection volumes from storage facilities and at interconnection points.

5.1 Description of the situation

Part of the German gas market is supplied with low calorific value natural gas (L-gas). L-gas originates entirely from production in Germany and the Netherlands. High calorific value natural gas (H-gas) comes primarily from Norway and Russia or arrives in Germany at LNG facilities. The two different groups of natural gas must be shipped in separate systems within defined limits for technical and calibration reasons. Action has to be taken for areas of the network that are to be supplied with gas of a different quality, which includes modifying the consumer appliances that use the gas. The market areas with overlapping qualities ensure that, in terms of the energy balance, every customer can be supplied with energy irrespective of the gas quality – in physical terms, however, the gas composition limits have to be complied with.

L-gas production in Germany is in continual decline. Where possible, the remaining German L-gas reserves will continue to be extracted and injected into the natural gas transmission network.

The decline in L-gas production has significant impacts in terms of both the annual volumes available in Germany and the capacity that is available. Starting in October 2020, the L-gas capacity available from the Netherlands will additionally experience a steady decline. For this reason, the German transmission system operators take part in regular exchanges with the Dutch transmission system operator Gasunie Transport Services B.V. (GTS) in order to harmonise and update the planning assumptions for future L-gas imports.

The following section provides an update to the L-to-H-gas conversion plans up to 2030 that have been outlined in the previous Network Development Plans and implementation reports. In addition, experiences from previous conversions and a current view of the situation involving gas imports from the Netherlands are included in the Gas Network Development Plan 2020–2030.

All assessments and figures are based on the status of the conversion plans as at the reporting date of 1 October 2019; this is shown in the NDP gas database. Chapter 5.7.3 describes the changes to the L-to-H-gas conversion plans in comparison with the 2019 implementation report. Chapter 5.7.4 explains possible changes. The transmission system operators will show the effects of these changes on the energy balances and on the network expansion measures in the 2021 implementation report.

5.2 Impacts of COVID-19

As a result of the rapid spread of COVID-19 in Germany, there have been changes to the conversion planning with reporting date 1 October 2019. These changes are described in Chapter 5.8.5 with reporting date 1 June 2020.

5.3 Converted areas and experiences from the previous conversion

Converted areas

22 areas featuring a total of around 600,000 appliances have been converted since the L-to-H-gas conversion was launched in 2015 (cf. Table 19).

In GUD's network, work was started as early as 2015, with Schneverdingen the first area to be converted. The conversion of the major areas of Walsrode and Fallingbostel followed in 2016, as did the first conversion of an industrial customer with a direct connection. Another five conversion areas from Nienburg to Hanover (including the conversion of power plant and industrial locations) and the Bremen/Achim region were successfully converted from L-gas to H-gas in 2017. The conversion of further areas in the Bremen region and the conversion in the region of Hanover/Peine followed in 2018 and 2019.

In OGE's network, work was started in 2017, with Teutoburger Wald 1 the first area to be converted. In addition to the regularly scheduled conversions, 2017 and 2018 also saw early conversions of industrial locations in the transmission and distribution system to relieve the strain on the Germany-wide L-gas capacity and quantity balances (conversion areas of Leverkusen, Dormagen, Essen and Cologne). Larger areas supplied by OGE were converted from L-gas to H-gas for the first time in 2019, including the cities of Osnabrück (Osnabrück conversion area) and Marburg (Middle Hesse conversion area). A total of around 170,000 appliances were successfully converted from L-gas to H-gas in OGE's network area in 2019.

The conversion areas of Emsland I (Nowega), Hüthum (Thyssengas) as well as Posthausen I and Posthausen II (GTG Nord) were successfully converted between 2017 and 2019.

In total, the conversion volume that has been realised in Germany since 2015 corresponds to an annual consumption volume of around 40 TWh and a capacity of 8.6 GWh/h.

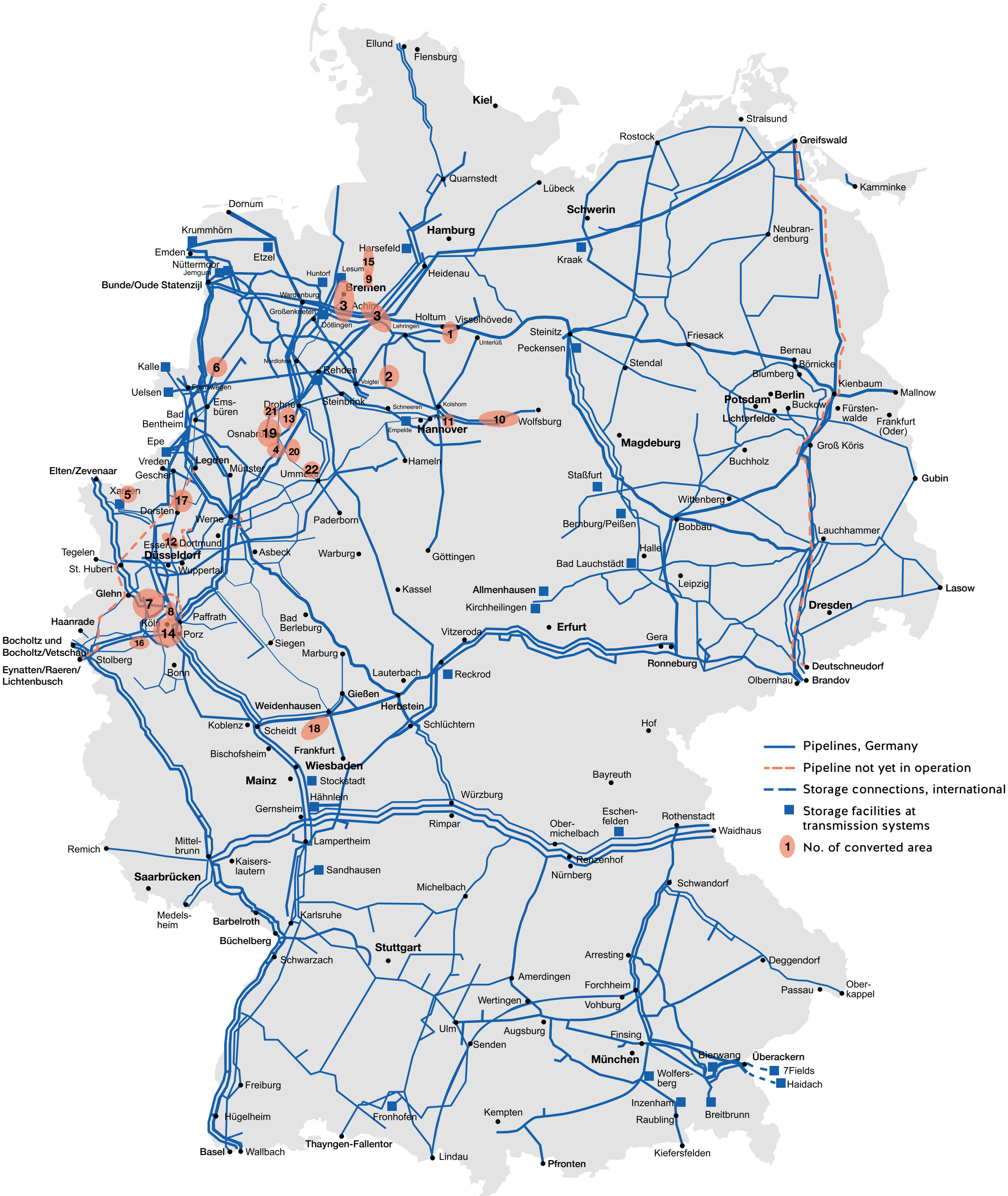
Table 19: Converted areas 2015–2019

No. in the Gas NDP 2020–2030	Conversion area	Transmission system operator	Time of conversion	Estimated number of appliances
1	Schneverdingen	GUD	2015	8,000
1	Walsrode/Fallingbostel	GUD	2016	12,000
3	Achim	GUD	2017	23,000
2	Nienburg/Neustadt/North Hanover	GUD	2017	44,000
3	Bremen/Delmenhorst	GUD	2017	15,000
4	Teutoburger Wald 1	OGE	2017	2,000
5	Hüthum	Thyssengas	2017	10,000
6	Emsland 1*	Nowega	2017	–
7	Dormagen*	OGE	2017	–
8	Leverkusen*	OGE	2017	–
9	Posthausen I	GTG	2018	4,000
3	Bremen/Delmenhorst	GUD	2018	77,000
10	East Hanover/Wolfsburg	GUD	2018	61,000
11	Peine	GUD	2018	15,000
12	Essen*	OGE	2018	–
13	Teutoburger Wald 2	OGE	2018	5,000
14	Cologne*	OGE	2018	–
15	Posthausen II	GTG	2019	48,000
3	Bremen/Delmenhorst	GUD	2019	42,000
10	East Hanover/Wolfsburg	GUD	2019	60,000
16	Bonn	OGE	2019	11,000
17	Marl*	OGE	2019	–
18	Middle Hesse	OGE	2019	63,000
19	Osnabrück	OGE	2019	64,000
20	Teutoburger Wald 3	OGE	2019	15,000
21	Teutoburger Wald 4	OGE	2019	3,000
22	Teutoburger Wald 6	OGE	2019	13,000

* no distribution networks

Source: Transmission system operators

Figure 23: Converted areas 2015–2019



Source: Transmission system operators, reporting date: 1 March 2020

Experiences from the previous conversion

The technical network expansion measures necessary for the L-to-H-gas conversion were completed on schedule by the transmission system operators. The areas were converted on the switching dates defined in the conversion timetables in agreement between the participants. Distribution system operators, power plants and industrial customers were affected. Around 600,000 appliances were modified in the course of the conversion to date.

The conversion has to be notified to the customer by the transmission system operator at least 38 months in advance. Where possible, a longer period should be chosen in order to ensure the optimal co-ordination between all the parties involved and to implement any technical expansions that may be necessary.

In the conversion of very large networks, network sections can be identified as pilot conversion areas. These pilot conversion areas that are converted in a preliminary stage can provide the participants with greater peace of mind about the process of the market area conversion.

Regular co-ordination between the transmission system operators and the distribution system operators is necessary in order to adhere to the switching dates and to provide capacity. After the conversion concept has been finalised, the detailed plan is generally drawn up by the distribution system operators and their conversion service providers. Changes resulting from these plans have to be co-ordinated with the transmission system operators. Any changes should be taken into consideration by the relevant distribution system operators when the internal orders are issued.

Fluctuating gas qualities have led to problems in the conversion at some distribution system operators, as gas-fired appliances have to be set to a reference Wobbe Index after the gas quality has been converted. The provision of data, possibly automated, on the quality parameters calorific value and Wobbe Index allows the process to be optimised on both sides.

It has furthermore been shown that the processing of “residuals” can be especially critical for the smooth execution of the conversion. “Residuals” is the term used to describe consumers who the distribution system operators were unable to contact in good time. This can result in a situation where it was not possible to convert the relevant appliances until shortly before the switchover or where it was not yet possible even to survey some of them. The punctual initiation of suitable measures, even including suspension processes, is necessary to be able to keep to the agreed switching date.

It was found that there is a preference for the H-gas to arrive in the morning hours. The reason for this is the modification work that arises directly especially in industrial enterprises as well as the utilisation of the morning peak to transmit the H-gas as widely as possible in the distribution systems. The arrival of the H-gas is dependent especially in longer pipeline sections on various parameters (e. g. pipeline pressure, acceptance by the connected network points with or without temperature dependence). It was possible in the past to make a good estimate of the time period for the arrival of the H-gas on the basis of the purchases forecast by the consumers. Longer intervals can also arise in individual cases, or configurations can emerge where the forecast time periods do not meet the preferences of all the consumers connected to the pipeline system.

5.4 Situation involving gas imports from the Netherlands

The last few years have seen an increase in the number of earthquakes in the area around the Groningen field, which are regarded as being linked to the extraction of natural gas. Earthquakes measuring 3.4 on the Richter scale shook the Groningen region on both 8 January 2018 and 22 May 2019. The earthquake in 2019 in particular triggered significant political pressure in the Netherlands to end production in the Groningen field as quickly as possible.

In order to take the risks arising from natural gas production into consideration, the Dutch Ministry of Economic Affairs and Climate Policy announced that the production of natural gas in the Groningen area would be suspended from 2022 onwards when annual temperatures were average. Production volumes from Groningen will still be available probably up to 2026 only for cold winters [Tweede Kamer der Staten-Generaal 2020].

The permitted production volume amounted to 19.4 billion m^3 in the 2018/2019 gas year. The production volumes were initially limited to 11.8 billion m^3 for the 2019/2020 gas year [Ministerie van Economische Zaken en Klimaat 2019] and were reduced again in March 2020 to 10.7 billion m^3 [Ministerie van Economische Zaken en Klimaat 2020]. To be able to compensate for the decline in natural gas production, the following measures were proposed by the Dutch transmission system operator GTS [GTS 2019]:

1. Increase the utilisation of the conversion facilities in Ommen and Wieringermeer to 100 %
2. Supply the “Oude Statenzijl” cross-border interconnection point with converted or enriched Groningen-gas
3. Supply the Norg natural gas storage facility with converted or enriched Groningen-gas
4. Store smaller deposits in the Norg natural gas storage facility for winter 2019.

GTS has stated that the security of supply is not put at risk by the four measures even on the assumption of a cold winter.

GTS expects a decline in production volume to 9.3 billion m^3 [Tweede Kamer der Staten-Generaal 2020] for the 2020/2021 gas year, while the prospect of a figure of around 3 billion m^3 is held out for the following 2021/2022 gas year.

The further reduction in the L-gas production volumes up to 2022 will be compensated for by an expansion of the Dutch conversion facilities, the conversion of the nine largest industrial customers on the GTS network to H-gas and the decline in the demand for L-gas in Germany, Belgium and France.

The transmission system operators maintain close contacts with GTS in this connection and also in order to co-ordinate the respective plans in the Netherlands and Germany. The demands for L-gas capacity and volumes in Germany presented in the following chapters are thus an integral part of the Dutch network development planning and are thus also included the production planning of the Dutch ministry. Since 2019, there has also been an exchange at international level through “Task Force Monitoring L-Gas Market Conversion”, which was established on the initiative of the Dutch Ministry of Economic Affairs. This task force, under the leadership of the respective ministries for the economy of the Netherlands, Belgium, France and Germany, produces a report semi-annually to report to the Dutch parliament on matters including measures to reduce L-gas sales/production. The task force’s first report was published in February 2020. In addition to communication at network operator level, the task force is also an ideal platform for guaranteeing harmonised planning assumptions with high transparency.

5.5 L-gas capacity balance 2030

The L-gas capacity balance sets the L-gas capacity demand that is expected according to the current conversion planning against the entry capacity available from production, imports, storage and conversion.

The individual items of the L-gas balance 2030 are explained in more detail below.

5.5.1 Domestic production

The development of the production capacity presented in Table 20 is based on information from the Bundesverband Erdgas, Erdöl und Geoenergie e. V. (BVEG – German Federal Association of Natural Gas, Petroleum and Geoenergy) of 15 May 2019. The production capacity is furnished with a safety margin (7 % to 17 % depending on the year) by the BVEG for the consideration in the L-gas balance (cf. Figure 25).

In comparison with the forecast from 2018, which formed the basis for the 2019 implementation report, the capacity forecast for the sum of the Elbe-Weser and Weser-Ems areas declines up to 2023 (by 2 % to 5 % depending on the year), while a higher production capacity (2 % to 4 % depending on the year) is expected for the period from 2024 onwards when set against the forecast from 2018.

Table 20: Capacity forecast in accordance with BVEG

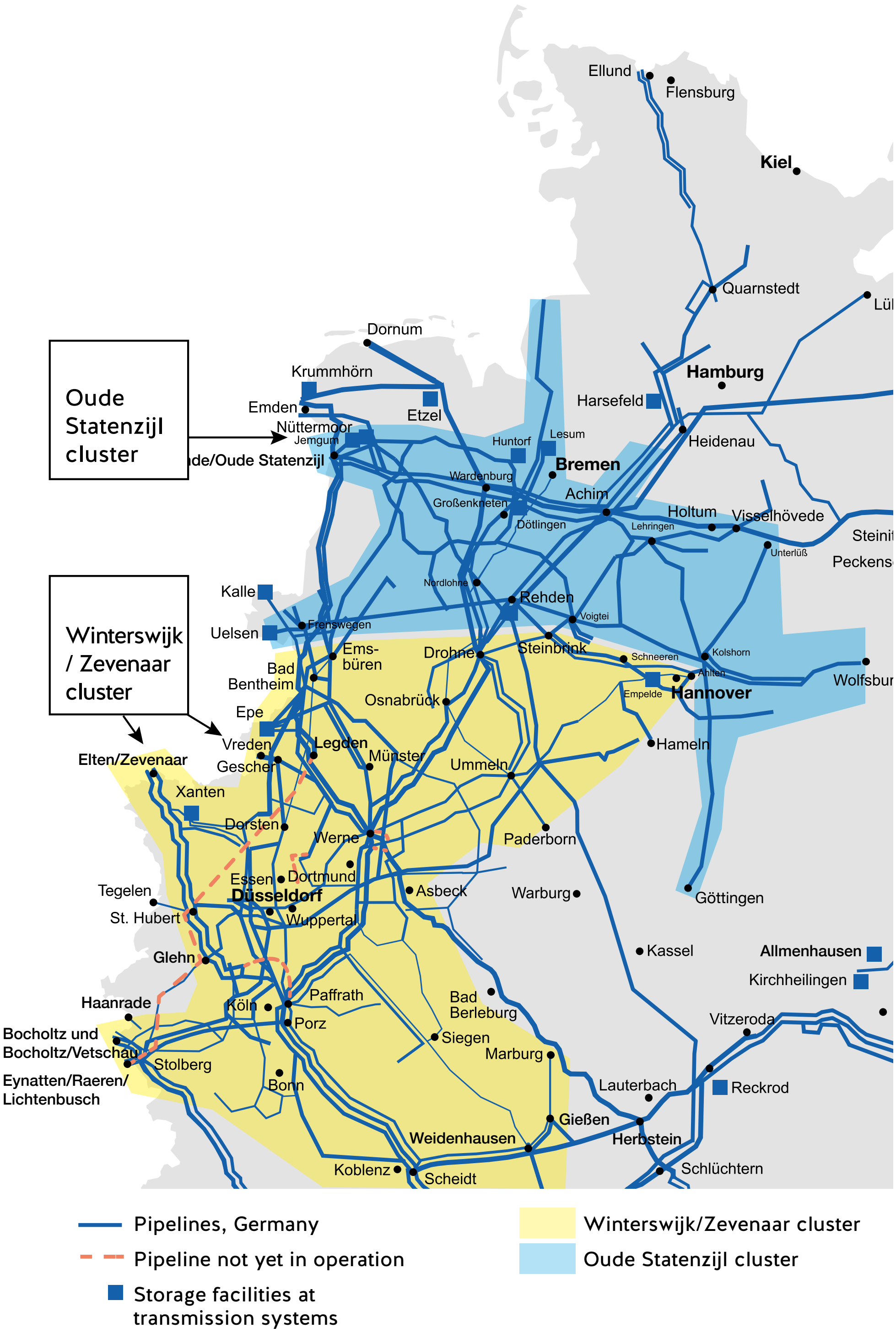
Year	Germany	Elbe-Weser region	Elbe-Weser region with safety margin in accordance with BVEG	Weser-Ems region	Weser-Ems region with safety margin in accordance with BVEG
	Million m³/h				
2020	0.74	0.31	0.29	0.37	0.35
2021	0.73	0.28	0.26	0.40	0.37
2022	0.68	0.28	0.25	0.36	0.33
2023	0.65	0.27	0.24	0.32	0.29
2024	0.72	0.24	0.22	0.30	0.28
2025	0.68	0.22	0.20	0.28	0.25
2026	0.63	0.20	0.18	0.25	0.22
2027	0.57	0.19	0.16	0.21	0.19
2028	0.52	0.17	0.14	0.19	0.16
2029	0.49	0.15	0.13	0.17	0.14
2030	0.46	0.14	0.11	0.15	0.13

Source: Transmission system operators on the basis of BVEG 2019

5.5.2 Imports from the Netherlands

The largest contribution on the entry side is provided by the imports from the Netherlands, which account for more than 60 % of the L-gas supply capacity. A distinction has to be drawn here between the Oude Statenzijl and Winterswijk/Zevenaar import clusters (cf. Figure 24). The greater dependency on the Oude Statenzijl cluster for the Dutch production means that it is necessary to consider the clusters separately.

Figure 24: Import points from the Netherlands



Source: Transmission system operators

Part of this capacity is provided on the German side through interruptible capacity, as the import capacity required in winter cannot be safely shipped to cover the peak demand in weak load situations in the summer.

The decline in production in the Netherlands leads to a gradual reduction in the L-gas export capacity for Germany. For this reason, the capacity is recognised in the L-gas capacity balance as decreasing on a linear basis (by 10 % of the initial value per year). The planning assumptions concerning capacity have not changed since 2012.

The import capacity totalling 47.7 GWh/h shown in Table 21 for the 2019/2020 gas year is the concurrent maximum flow in the years from 2010–2013 at the three import points of Oude Statenzijl, Winterswijk/Vreden and Elten/Zevenaar.

Table 21: Distribution of the L-gas import capacity to the cross-border interconnection points

Gas year	Oude Statenzijl (GASPOOL)	Zevenaar, Winterswijk (NCG)	Total
	GWh/h		
2019/2020	9.0	38.7	47.7
2020/2021	7.3	35.7	43.0
2021/2022	7.0	31.2	38.2
2022/2023	7.0	26.4	33.4
2023/2024	7.0	21.6	28.6
2024/2025	7.0	16.9	23.9
2025/2026	7.0	12.1	19.1
2026/2027	3.0	11.3	14.3
2027/2028	2.2	7.3	9.5
2028/2029	2.2	2.6	4.8
2029/2030	0.0	0.1	0.1
2030/2031	0.0	0.1	0.1

Source: Transmission system operators

The addition of H-gas has not been taken into consideration in the L-gas capacity balances or in the L-gas quantity balances shown in Chapter 5.5.3. It is possible to blend Groningen gas with H-gas in order to maintain an L-gas in accordance with the DVGW G260 specification with a high calorific value and Wobbe Index number. Operationally, the blending is used where and when possible.

Blending facilities are present in the Netherlands and on the GUD network. An additional facility is under construction in the GTG Nord network.

5.5.3 L-gas storage facilities

The exit capacity of the L-gas storage facilities listed in Table 22 is 20.6 GWh/h in the 2019/2020 gas year. The capacity in the L-gas balance that can be realised technically with today's L-gas network is taken into account here. This is composed as follows:

Table 22: Storage capacity of the L-gas storage facilities on the TSO network

Gas year 2019/2020	Empelde	Epe	Lesum	Nüttermoor/ Huntorf	Total
	GWh/h				
Capacity taken into consideration in the L-gas balance	1.6	9.0	2.1	7.9	20.6

Source: Transmission system operators

Every additional capacity requirement would lead to a network expansion in the L-gas network and to a re-allocation of capacity at cross-border interconnection points or German production points. The expansion in the L-gas network necessary for this is not regarded as sustainable by the transmission system operators against the background of the L-to-H-gas conversion.

On the other hand, a stronger consideration of the storage facilities at the expense of other feed-ins such as imports from the Netherlands or German production would not be practical, as storage facilities – seen over a period of one year – do not supply additional volumes. Other sources also supply a corresponding volume for a capacity. Moreover, the L-gas storage facilities tend to be capacity storage facilities. If the capacity in the capacity balance were increased, elevated withdrawal rates could lead to the storage facilities being emptied more quickly and thus reduce the storage filling levels more sharply during the winter. Adverse effects on the security of supply cannot be ruled out in this respect.

A presentation of the redundant storage capacity will therefore be dispensed with in the future Network Development Plans.

Table 23 shows the development over time of the withdrawal capacity recognised by the transmission system operators for the Empelde, Epe, Lesum and Nüttermoor/Huntorf storage facilities.

Table 23: Development of the recognised withdrawal capacity of the L-gas storage facilities

Gas year	Empelde	Epe	Lesum	Nüttermoor/Huntorf	Total
	GWh/h				
2019/2020	1.6	9.0	2.1	7.9	20.6
2020/2021	1.6	9.0	2.1	6.9	19.6
2021/2022	1.6	9.0	0.0	6.4	17.0
2022/2023	1.6	9.0	0.0	5.0	15.6
2023/2024	1.6	7.0	0.0	3.7	12.3
2024/2025	1.6	5.5	0.0	1.9	9.0
2025/2026	1.6	5.0	0.0	0.2	6.8
2026/2027	1.6	3.5	0.0	0.0	5.1
2027/2028	1.6	2.5	0.0	0.0	4.1
2028/2029	1.6	2.0	0.0	0.0	3.6
2029/2030	1.6	0.0	0.0	0.0	1.6
2030/2031	1.6	0.0	0.0	0.0	1.6

Source: Transmission system operators

The transmission system operators maintain a continual dialogue with the storage system operators and the BNetzA concerning the conversion of the L-gas storage facilities. Further discussions have taken place on this subject since the Gas Network Development Plan 2018–2028 and the 2019 implementation report were published. The transmission system operators will also continue these co-ordination meetings in the future with the aim of harmonising jointly developed conversion concepts for the L-gas storage facilities.

5.5.4 Conversion

Another option for compensating for the decline in the L-gas supply and imports is the use of technical conversion facilities. Conditioning to L-gas can be carried out here by adding nitrogen to the H-gas in accordance the DVGW Worksheet G 260.

The transmission system operators have compared an L-to-H-gas conversion and a conversion for special network situations and have planned a technical conversion to present exit capacity in the following two cases:

- **Nowega conversion facility in Rehden**
  The conversion facility in Nowega's network area has a total capacity of a maximum of 1.4 GWh/h in the 2019/2020 gas year. From 2021 onwards the maximum total capacity amounts to 2.4 GWh/h at peak load following the addition of a nitrogen generator to expand the facility.

- **Thyssengas conversion facility in Broichweiden**
  The existing conversion facility now has firm capacity. This means it is possible to safely feed in 250 MWh/h to a regional L-gas system during demand peaks until this system is also converted to H-gas in 2027.

5.5.5 Demand for exit capacity

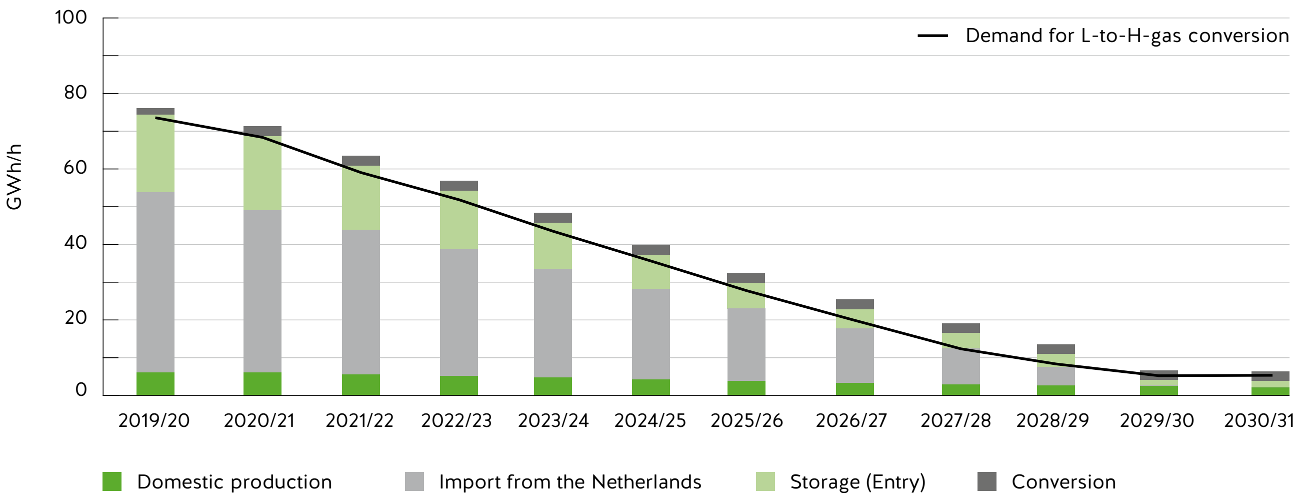
The distribution system operator's capacity demand corresponds to the verified long-term forecasts underlying the Gas Network Development Plan 2020–2030. The capacity demands of industrial customers and power plants have also been updated since the 2019 implementation report.

In comparison with the 2019 implementation report, further changes to the remaining L-gas demand are produced by the advanced conversion plans and postponements in certain conversion areas.

5.5.6 L-gas capacity balance, Germany

Figure 25 and Table 24 show the updated Germany-wide L-gas capacity balance.

Figure 25: Germany-wide L-gas capacity balance



Source: Transmission system operators

Table 24: Germany-wide L-gas capacity balance

Gas year	Domestic production	Imports from the Netherlands	Storage facility Entry	Conversion	Total presentation	L-gas demand	L-gas demand excluding L-to-H-gas conversion
	GWh/h						
2019/2020	6.0	47.7	20.6	1.7	75.9	73.3	77.2
2020/2021	6.0	43.0	19.6	2.7	71.1	68.1	78.4
2021/2022	5.5	38.2	17.0	2.7	63.3	58.8	79.7
2022/2023	5.1	33.4	15.6	2.7	56.8	51.6	80.8
2023/2024	4.7	28.6	12.3	2.7	48.3	43.3	81.0
2024/2025	4.2	23.9	9.0	2.7	39.8	35.4	81.0
2025/2026	3.8	19.1	6.8	2.7	32.3	27.6	81.5
2026/2027	3.3	14.3	5.1	2.7	25.4	19.9	81.3
2027/2028	2.9	9.5	4.1	2.4	18.9	12.2	81.4
2028/2029	2.6	4.8	3.6	2.4	13.3	8.2	81.5
2029/2030	2.4	0.1	1.6	2.4	6.4	5.1	81.6
2030/2031	2.1	0.1	1.6	2.4	6.2	5.2	81.6

Source: Transmission system operators

Overall, the updates to the planning premises in this Gas Network Development Plan 2020–2030 set against the results of the 2019 implementation report produce only minor changes to the L-gas capacity balance.

5.6 L-gas quantity balance

An updated L-gas quantity balance is drawn up in this Gas Network Development Plan 2020–2030 in order to take into consideration the developments since the 2019 implementation report was published, especially the results of the analysis of the 2018/2019 gas year, in the same way as in the preparation of the L-gas capacity balance.

The transmission system operators would like to ensure by doing so that, in addition to the capacity peaks (capacity balance) that can be expected, the availability of sufficient L-gas volumes (quantity balance) is also presented transparently during the entire period of the market area conversion.

5.6.1 Basic procedure

As before in the Gas Network Development Plan 2018–2028, the trends in demand in accordance with the EUCO30 scenario in the scenario framework are used as the basis. The 30 % efficiency target (decline in primary energy consumption by 30 % in comparison with the 2007 baseline development) is realised in this scenario. Furthermore, the EU target for the reduction of greenhouse gases (at least –40 % in comparison with 1990) is achieved. With the help of a temperature adjustment (cf. Chapter 5.5.3), a distinction is drawn here between a cold year and an average year in order to take into consideration the greatest possible range of trends in the demand for volume. Furthermore, the approach of the Dutch Ministry of Economic Affairs, where the permissible annual production volume in Groningen depends on the temperatures in the year in question, is also taken into account here.

5.6.2 Analysis of the 2018/2019 gas year and impacts on the L-gas quantity balance

Analysis of the 2018/2019 gas year

The 2018/2019 gas year was considerably warmer than an average year. L-gas consumption in Germany was therefore considerably lower than had been assumed.

The L-gas demand from final consumers totalled 209.6 TWh and was thus 16.2 TWh lower than the planning assumptions of 225.8 TWh used in the 2019 implementation report. Converted to the temperatures of the 2018/2019 gas year, the planned volume in the 2019 implementation report totals 214.1 TWh for the 2018/2019 gas year, i.e. the deviation between planned volume and actual demand is only around 2 % and can be attributed to fluctuations in consumption among final customers and at power plants.

At 48.7 TWh, the share of L-gas in the German production was only around 1.5 TWh higher in the 2018/2019 gas year than the planning assumption of the transmission system operators, despite a safety margin of 22 %.

At the 1 October 2019 reporting date, the filling level of the natural gas storage facilities recorded a value that was 3.8 TWh higher compared to the planning assumption, while the technical conversion of H-gas to L-gas showed a value that was 1.7 TWh higher than the assumption.

In summary, the effects described above meant that the imports from the Netherlands in the 2018/2019 gas year were 15.8 TWh lower than the temperature-adjusted planning assumptions, where 11.7 TWh of this figure can be attributed to the influence of the temperature.

Converted to a year with average temperatures, the analysis of the 2018/2019 gas year shows good consistency between the planned demand and the assumed import volumes.

Impacts on the L-gas quantity balance

The deviations between the planned volumes and the actual volumes that were observed in the 2018/2019 gas year can essentially be attributed to the influence of the temperature and, adjusted by this temperature influence, confirm the plans of the German transmission system operators.

Based on the production figures of past years, the transmission system operators believe it appropriate to adjust the safety margin for the German production volume using a time-dependent, variable factor. It is assumed here that the quality of the forecast declines in relation to the length of the forecast. For example, the production forecasts were repeatedly revised downwards in the past, as a result of which a higher effect emerged in the later years. The security margin of 22 % in the 2019/2020 gas year therefore rises to 28 % up to the 2022/2023 gas year and then remains constant at 30 % from the 2023/2024 gas year onwards.

5.6.3 L-gas quantity balances for Germany

The individual items of the L-gas quantity balances up to 2030 take the analysis results of the 2018/2019 gas year into consideration and are explained in more detail below.

L-gas demand

Parts of the L-gas volumes are replaced each year by H-gas as a result of the market area conversion that has been launched, and the demand for L-gas is thus continually falling overall. The decline in volumes in the final energy demand that has to be taken into consideration in parallel is assumed in two different variants:

- **Cold year:** In this variant, the L-gas volume demand for the period from April 2012 to March 2013 is recognised as the initial value for the 2019/2020 gas year. A temperature adjustment to a cold year is subsequently made. Finally, a decline in volume in accordance with scenario II of the scenario framework is assumed.

- **Average year:** In this variant, the L-gas volume demand for the period from April 2012 to March 2013 is recognised as the initial value for the 2019/2020 gas year. A temperature adjustment to the average temperature for the years from 1991 to 2013 is subsequently made. Finally, a decline in volume in accordance with scenario II of the scenario framework is assumed.

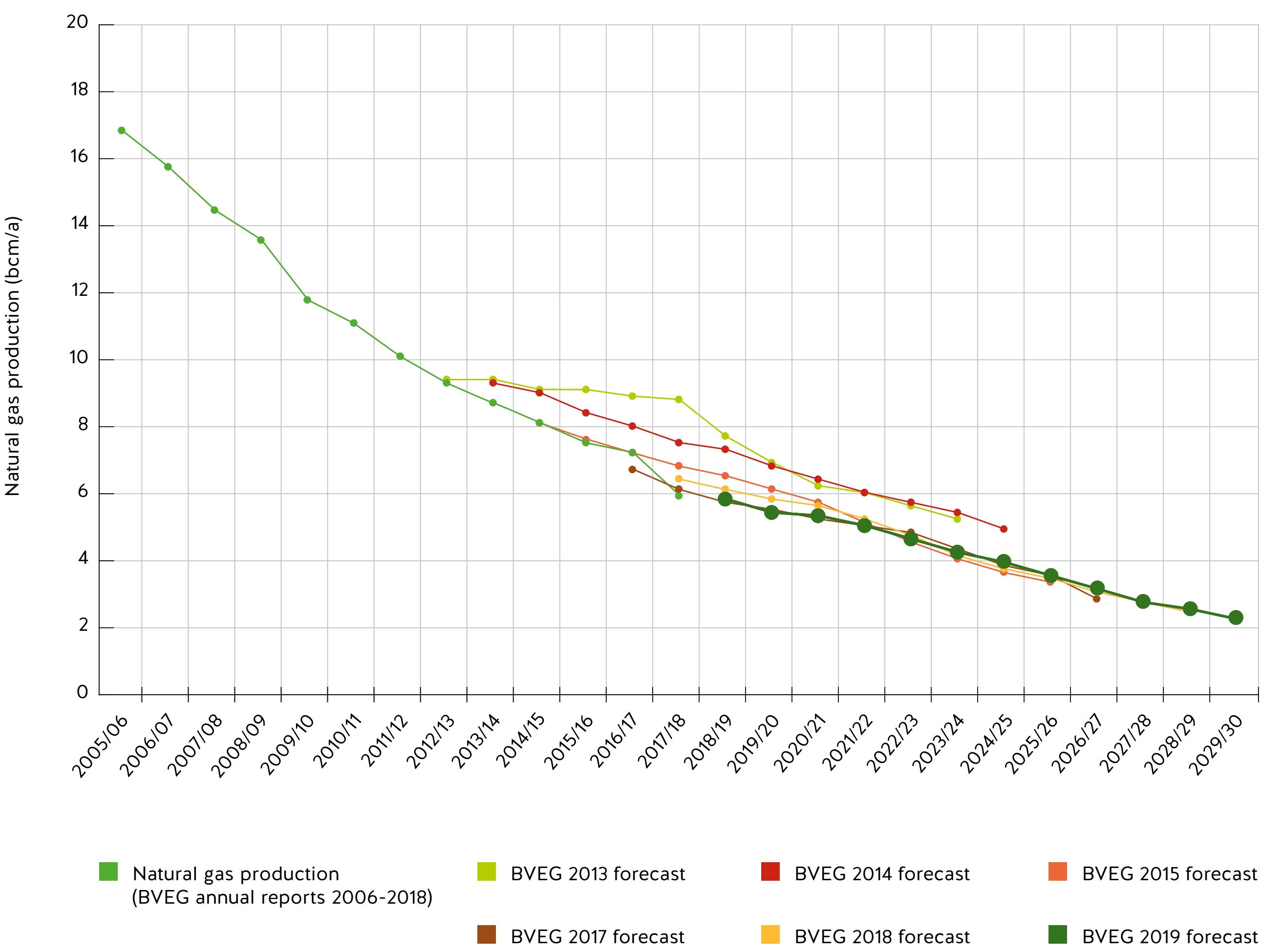
The temperature adjustment is carried out with the help of the degree day figures of the relevant years as well as the degree day figure of the long-term average. Information on the degree day figures in accordance with VDI Guideline 3807 is used for this. The daily degree day figures indicate here the difference between the daily mean temperatures and a defined average room temperature of 20.0 °C. The degree daily figure of the coldest year since 1991 is used to estimate the L-gas consumption in a cold year.

Going beyond the changes resulting from the analysis of the 2018/2019 gas year (cf. 5.5.2), the transmission system operators do not see any further need for adjustment concerning the assumed trends in demand.

Domestic production

Figure 26 shows the historical and forecast development of German natural gas production in the period from 2005/2006 to 2029/2030.

Figure 26: Natural gas production in the Elbe-Weser and Weser-Ems supply regions



Source: Transmission system operators

The production data for the years from 2006 (corresponds to the 2005/2006 gas year) to 2018 (2017/2018 gas year) is based on the figures published by the BVEG for the two most important German production regions Elbe-Weser and Weser-Ems [BVEG 2018]. For the period from 2019 onwards, the values are based on the BVEG's projections of regional natural gas production up to 2030 of 15 May 2019. A share of 78 % in the 2019/2020 gas year is used for the L-gas quantity balance and is reduced to 70 % up to the 2023/2024 gas year (cf. also Chapter 5.6.2).

In comparison with the forecast in 2018, which forms the basis for the 2019 implementation report, the BVEG has slightly reduced its forecast of the annual natural gas production up to 2023.

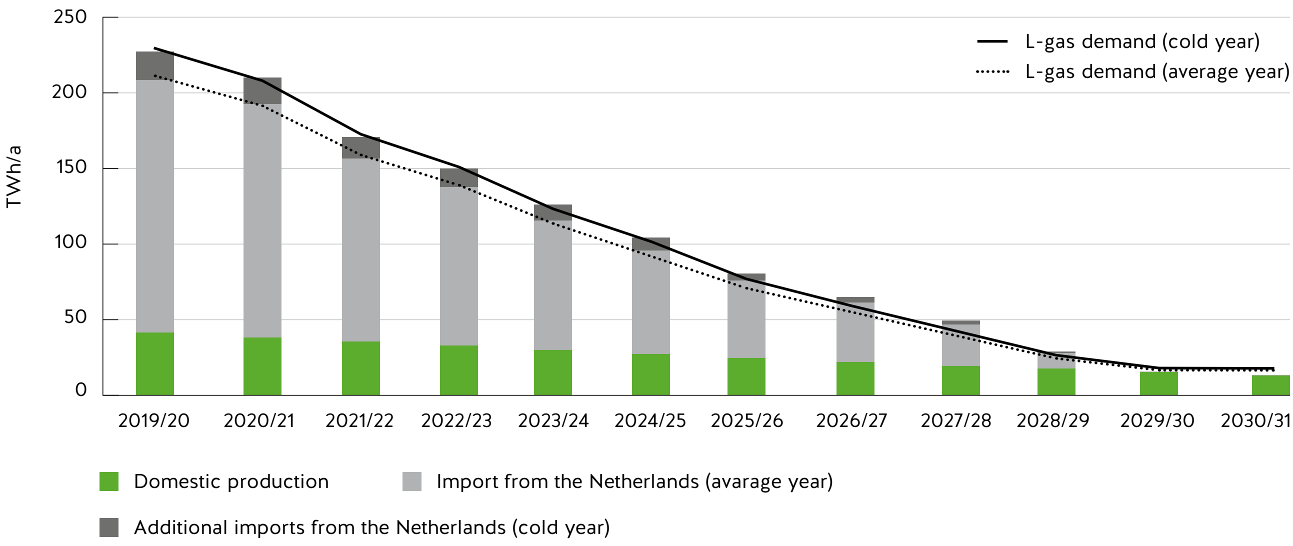
Imports from the Netherlands

It was established in the course of the analysis of the 2018/2019 gas year that the realised imports were close to the assumptions in the 2019 implementation report adjusted by the temperature effect. The transmission system operators have therefore decided in consultation with GTS not to change the import assumptions of the 2019 implementation report for the German quantity balance.

Germany-wide L-gas quantity balance

The results of the Germany-wide L-gas quantity balance are presented in Figure 27 and Table 25. The updated demand assumptions of the current forecast for domestic production and the assumptions for imports from the Netherlands have been compared here. The objective is to present transparently the changes in the quantity balance that result from the updated production and demand trends.

Figure 27: Germany-wide L-gas quantity balance



Source: Transmission system operators

Table 25: Germany-wide L-gas quantity balance, cold year and average year

Gas year	L-gas demand Cold year	L-gas demand Average year	Domestic production	NL imports Cold year (total)	NL imports Cold year (of which Oude Statenzijl)	NL imports Average year (total)	NL imports Average year (of which Oude Statenzijl)
	TWh/a						
2019/2020	229.1	210.9	41.6	185.4	49.5	166.7	43.7
2020/2021	207.7	191.1	38.1	171.7	45.2	154.4	40.0
2021/2022	172.3	158.6	35.5	135.1	38.6	121.1	34.3
2022/2023	150.6	138.6	32.9	116.9	37.5	104.7	33.7
2023/2024	123.0	113.3	29.7	96.1	35.3	85.8	31.9
2024/2025	101.2	93.2	27.1	76.9	30.8	68.5	27.8
2025/2026	76.6	70.5	24.4	55.9	15.8	51.4	15.3
2026/2027	58.7	54.0	21.9	42.8	8.6	39.4	8.2
2027/2028	41.4	38.1	19.4	29.7	7.7	27.3	7.4
2028/2029	26.2	24.1	17.6	11.1	7.7	10.2	7.4
2029/2030	17.7	16.3	15.3	0.3	0.0	0.3	0.0
2030/2031	17.5	16.2	12.9	0.3	0.0	0.3	0.0

Source: Transmission system operators

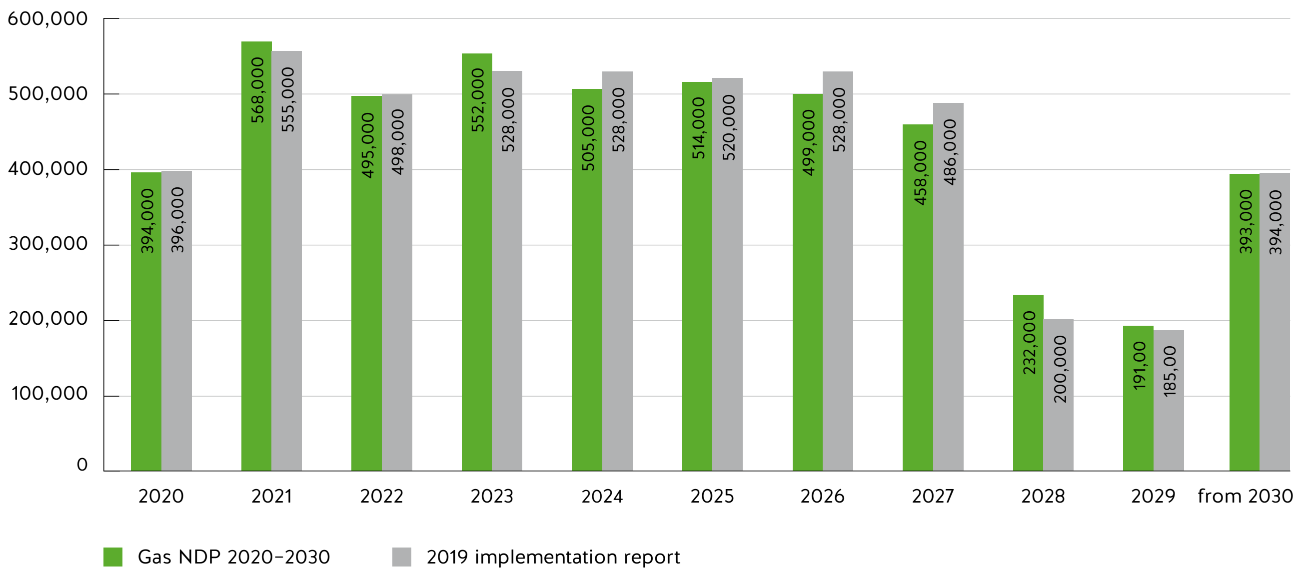
5.7 Number of annual appliance modifications

2020 is already the sixth year in which appliances have been modified in the course of the market area conversion. A steady increase in the annual appliance figures has been recorded since the L-to-H-gas conversion project was launched. This results in a continual expansion of resources and in the training of personnel to carry out the appliance modifications. In the course of the detailed planning by the distribution system operators, there were changes in the conversion plan in comparison with the 2019 implementation report and an increase in the number of appliances in 2021. The concepts for implementing the market area conversion in the areas in question are extensively co-ordinated with the distribution system operators and network customers up to 2024.

For the conversion years up to and including 2026, the development of the required conversion concepts are well advanced and have been elaborated in further detail compared with the 2019 implementation report. As long as the general external conditions do not fundamentally change, only a few adjustments to the conversion concepts are expected for the years up to 2026.

The level of detail in the conversion plans for the conversion period from 2027 onwards is not yet of any great depth essentially because of the time horizon. Further changes and detailed specifications, in which the experience gained from the conversions in progress can be integrated, will be made here in the 2021 implementation report. Figure 28 presents a comparison of the number of appliances to be modified with the 2019 implementation report.

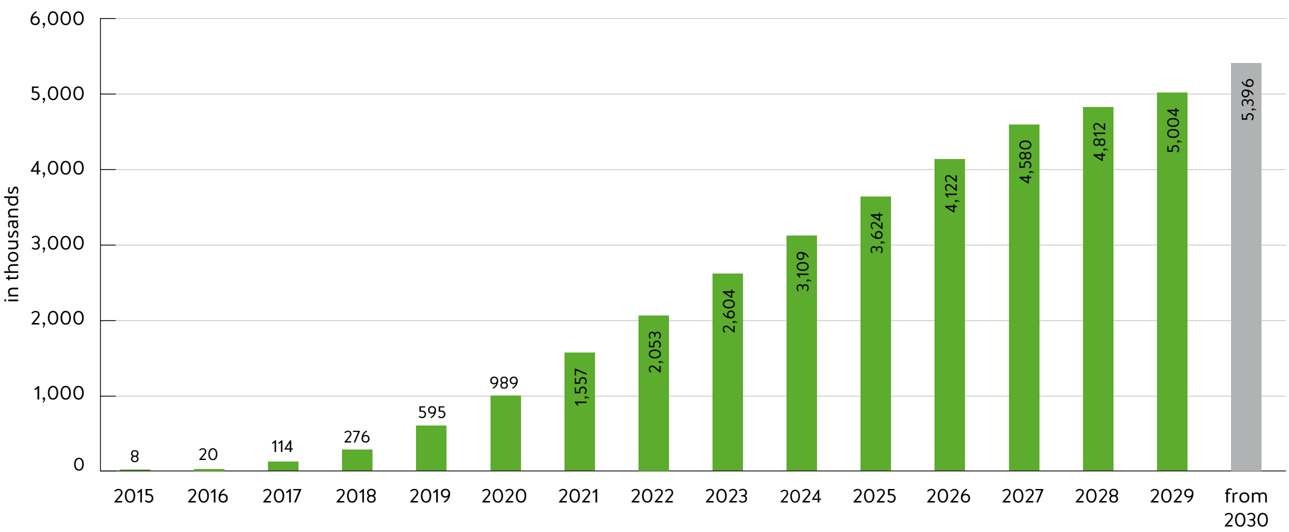
Figure 28: Number of consumer appliances to be modified per year in the conversion areas specified up to 2030



Source: Transmission system operators

Figure 29 additionally presents the cumulative number of appliances to be modified for the period of the market area conversion.

Figure 29: Cumulative number of consumer appliances to be modified from 2015 to 2030



Source: Transmission system operators

5.8 Conversion areas

5.8.1 Definition of the conversion areas

The conversion of network areas to a supply with H-gas is highly complex in organisational terms and associated with significant costs both in relation to the necessary modification of the consumer appliances to the altered gas quality and in relation to ensuring the transmission of the H-gas. The areas have been selected very carefully and also with a great deal of attention paid to the security of supply across all network levels. It has been and continues to be possible to achieve this only thanks to the very close co-operation with the distribution system operators. The concepts of the conversion areas described in the previous Network Development Plans and in the 2019 implementation report have been elaborated together with the distribution system operators affected and agreed as binding in conversion schedules.

A list of the directly and indirectly connected distribution system operators and their allocation to the conversion areas can be found in the NDP gas database. Furthermore, dependencies of various conversion areas concerning the conversion sequence if detailed plans are already available are described in the NDP gas database.

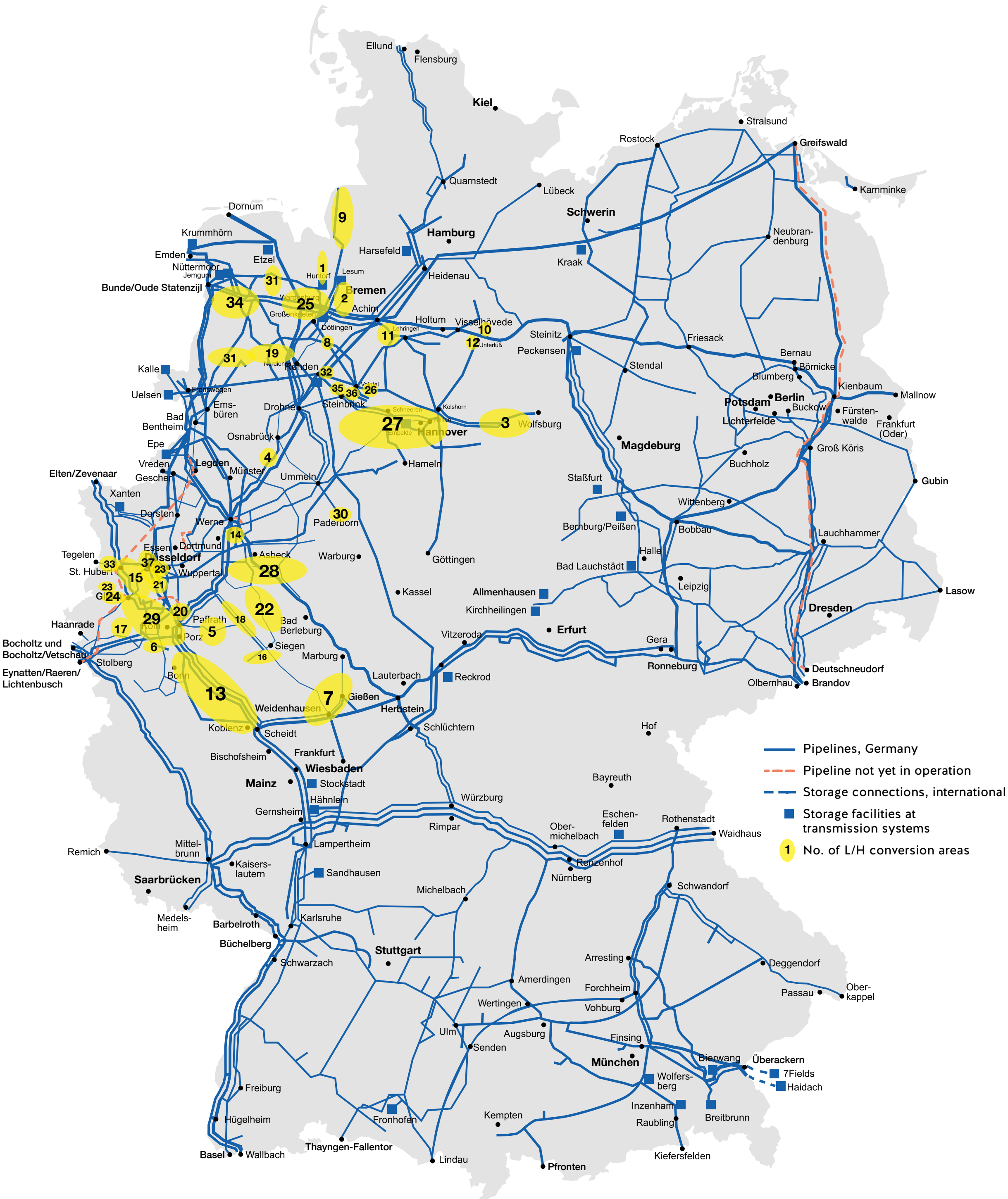
In the course of the positive co-operation with the distribution system operators, the conversion concepts for the planned areas have already been largely agreed up to 2026.

The L-to-H-gas conversion plans are drawn up in a continual process that is subject to constant revisions until they are finalised in a contract. The reporting date of 1 October has been selected for this Gas Network Development Plan 2020–2030, as described in the scenario framework. Changes that may have emerged in the meantime do not form part of the balances and evaluations shown above. These are described in Chapter 5.8.4.

5.8.2 Overview of the conversion areas

Figure 30 below shows the conversion areas for the years up to 2025. The size of the forms presented in yellow symbolises the capacity demand for the area to be converted.

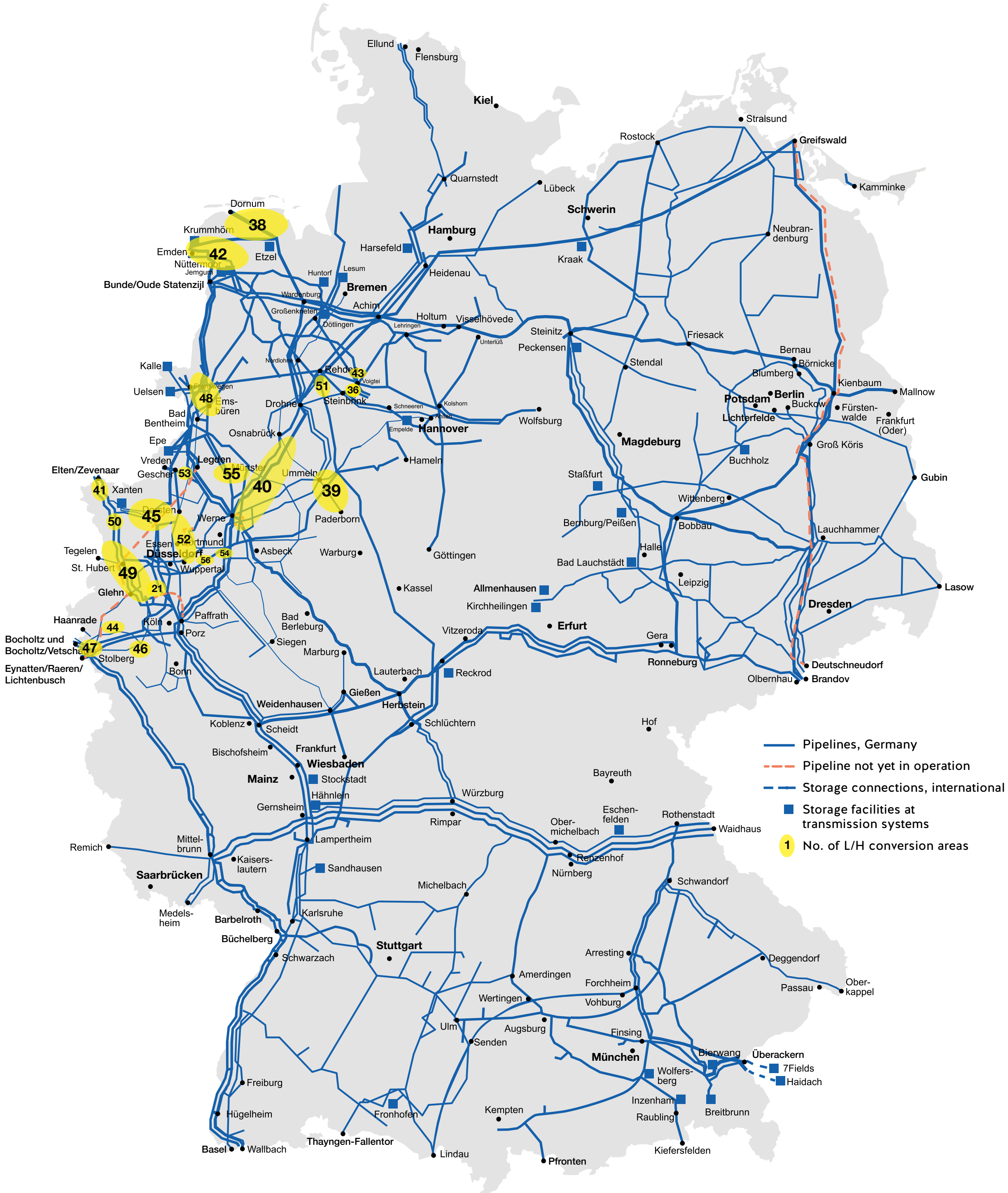
Figure 30: L-to-H-gas conversion areas up to 2025



Source: Transmission system operators, reporting date: 1 March 2020

Figure 31 below shows the conversion areas for the years from 2026 to 2030.

Figure 31: L-to-H-gas conversion areas 2026 to 2030



Source: Transmission system operators, reporting date: 1 March 2020

Table 26 below provides an overview of all conversion areas up to 2030. An accurate list of the conversion areas with around 1,100 network interconnection points and network connection points that have to be converted can additionally be found in the NDP gas database. The indicative conversion dates each refer to the calendar year that is specified.

Table 26: Overview of the L-to-H-gas conversion areas

No.	L-to-H-gas conversion area	Transmission system operator	Conversion date Gas NDP 2020–2030
1	EWE Zone part I	GTG	2020
2	Bremen/Delmenhorst	GUD	
3	East Hanover/Wolfsburg	GUD	
4	Teutoburger Wald 5	Nowega	
4	Teutoburger Wald 5	OGE	
5	Aggertal pipeline	OGE	
5	Aggertal pipeline	Thyssengas	
6	Bonn	OGE	
7	Middle Hesse	OGE	
3	East Hanover/Wolfsburg	GUD	2021
5	Aggertal pipeline	Thyssengas	
7	Middle Hesse	OGE	
8	EWE Zone part II	GTG	
9	North Bremen/Osterholz Scharmbeck/Bremerhaven/Cuxhaven	GUD	
10	Unterlüß-Gockenholz	GUD	
11	Verden	GUD	
12	Munster Gockenholz area	Nowega	
13	Middle Rhine	OGE	
14	Oberaden	OGE	
15	Rhineland	OGE	
15	Rhineland	Thyssengas	
16	Westerwald/Sieg	OGE	
17	Bergheim 1	Thyssengas	
18	Oberbergisches Land	Thyssengas	
13	Middle Rhine	OGE	2022
16	Westerwald/Sieg	OGE	
18	Oberbergisches Land	OGE	
18	Oberbergisches Land	Thyssengas	
19	EWE Zone part III	GTG	
20	Bergisches Land	OGE	
20	Bergisches Land	Thyssengas	
21	Düsseldorf	OGE	
21	Düsseldorf	Thyssengas	
22	South Westphalia	OGE	
23	Viersen-Meerbusch	OGE	
23	Viersen-Meerbusch	Thyssengas	
24	Mönchengladbach	Thyssengas	

No.	L-to-H-gas conversion area	Transmission system operators	Conversion date Gas NDP 2020–2030
13	Middle Rhine	OGE	2023
23	Viersen – Meerbusch	OGE	
23	Viersen – Meerbusch	Thyssengas	
25	EWE Zone part IV	GTG	
26	Voigtei area	Nowega	
27	Drohne – Ahlten	OGE	
28	Hagen – Iserlohn – Ergste	OGE	
29	Cologne – Bergisch Gladbach	OGE	
29	Cologne – Bergisch Gladbach	Thyssengas	
30	Paderborn	OGE	
20	Bergisches Land	OGE	2024
27	Drohne – Ahlten	OGE	
29	Cologne – Dormagen	OGE	
29	Cologne – Dormagen	Thyssengas	
30	Paderborn	OGE	
31	EWE Zone part V	GTG	
32	Rehden – Bassum	Nowega	
33	Kaldenkirchen	OGE	
27	Drohne – Ahlten	OGE	2025
29	Cologne – Dormagen	OGE	
29	Cologne – Dormagen	Thyssengas	
34	EWE Zone part VI	GTG	
35	Lemförde area	Nowega	
36	Petershagen	Nowega	
37	Düsseldorf – Neuss	OGE	
37	Düsseldorf – Neuss	Thyssengas	
21	Düsseldorf	OGE	2026
21	Düsseldorf	Thyssengas	
38	EWE Zone part VII	GTG	
39	Bielefeld/Paderborn	GUD	
40	Werne – Ummeln – Drohne	OGE	
41	Emmerich	Thyssengas	
40	Werne – Ummeln – Drohne	OGE	2027
42	EWE Zone part VIII	GTG	
43	Westnetz Zone	GTG	
44	Rommerskirchen/Blatzheim	Thyssengas	
44	Rommerskirchen/Kerpen	OGE	
45	Sonsbeck – Oberhausen	Thyssengas	
45	Sonsbeck – Dorsten	OGE	
46	Hürth/Brühl/Bergheim 2	Thyssengas	
47	Weisweiler/Düren	Thyssengas	
40	Werne – Ummeln – Drohne	OGE	2028
41	Kalkar	Thyssengas	
48	Emsland II	Nowega	
49	Krefeld – Langenfeld	OGE	
49	Krefeld – Langenfeld	Thyssengas	
50	Hamb/Kapellen/Aldekerk	Thyssengas	

No.	L-to-H-gas conversion area	Transmission system operators	Conversion date Gas NDP 2020–2030
36	Petershagen Messlinger Straße	Nowega	2029
40	Werne – Ummeln – Drohne	OGE	
45	Sonsbeck – Dorsten	OGE	
51	Rehden – Lengerich area	Nowega	
52	Dorsten – Leichlingen	OGE	
53	Gescher	OGE	
54	Hagen	OGE	
55	Münsterland	OGE	
56	Wuppertal	Thyssengas	

Source: Transmission system operators

5.8.3 Changed conversion areas in comparison with the 2019 implementation report

Changes from the 2019 implementation report have resulted in the following conversion areas:

Table 27: Changed conversion areas in comparison with the 2019 implementation report (reporting date: 1 October 2019)

No.	Changed L-to-H-gas conversion area	Transmission system operators	Conversion date Gas NDP 2020–2030
20	Bergisches Land	Thyssengas	2022
40	Werne – Ummeln – Drohne	OGE	2026/2027/2029
27	Drohne – Ahlten	OGE	2023/2024/2025
30	Paderborn	Thyssengas	2023/2024
45	Sonsbeck – Dorsten	OGE	2027/2029
48	Emsland II	Nowega	2028

Source: Transmission system operators

The conversion of the Lindlar-Scheel network interconnection point has been assigned to the **Bergisches Land** conversion area in accordance with the agreement with Rheinische NETZGesellschaft. This does not result in any change to the time of the conversion.

In the **Werne-Ummeln-Drohne** conversion area, a smaller network area in the Beckum region has been postponed from 2026 to 2027 at the request of a distribution system operator. In addition, an industrial customer in the Stemwede region has been postponed from 2026 to 2029.

Based on the joint detailed planning by the transmission system operator OGE with the competent distribution system operator enercity Netz GmbH on the conversion in the Hanover region, part of the **Drohne-Ahlten** conversion area has been brought forward one year from 2024 and will now be implemented in 2023.

In a change from the 2019 implementation report, smaller network areas south of Paderborn will be brought forward from the Werne-Ummeln-Drohne conversion area in 2026 into the newly created **Paderborn** conversion area in 2023 and 2024.

In the **Sonsbeck-Dorsten** conversion area, the change of the conversion year from 2027 to 2029 is the result of a more accurate and more detailed conversion plan to avoid major network expansion measures. The time of the expected conversion dates will be adjusted in the Bottrop, Gladbeck, Marl and Dorsten region.

The **Emsland II** conversion area has been brought forward from 2029 to 2028.

5.8.4 Possible changes in the L-to-H-gas conversion plans

The development of concepts in the course of the L-to-H-gas conversion plans is very advanced up to 2026, with a large part already finalised.

At the time that the Gas Network Development Plan 2020–2030 goes to press, it cannot be ruled out that changes will still be made to the conversion plans up to 2026, however, on account of the restrictions in Germany triggered by COVID-19 and the delays resulting from that.

No detailed conversion plans have been developed by the transmission system operators so far for the years from 2027 to 2029. The two transmission system operators OGE and Thyssengas have held initial discussions on the development and co-ordination of conversion concepts with the distribution system operators concerned. Changes to these conversion years may still be produced as a result.

A large part of the remaining residual market in L-gas is located in Nowega's network area. There is currently no final conversion concept yet for the Salzgitter area, which has over 380,000 appliances to be converted. The conversion is planned for after 2030. Discussions on bringing this conversion area forward to 2028–2030 are currently taking place based on current developments.

5.8.5 Current area situation in the 2020 conversion year (impact of COVID-19)

The rapid spread of COVID-19 in Germany has resulted in minor changes to the original conversion plans presented in the Gas Network Development Plan 2020–2030 for 2020.

The COVID-19 pandemic means that all involved are facing challenges that were previously unknown in some cases. In particular, these include the reduction or temporary suspension of survey and adjustment work (causes including those refusing entry), guaranteeing the full availability of conversion service providers, the implementation of special hygiene concepts and providing the customers concerned with comprehensive information.

This has ultimately also resulted in impacts on individual switching measures agreed between the transmission system operators and the distribution system operators, which could not be carried out as planned.

The current status of the market area conversion in the context of COVID-19 is as follows as at 1 June 2020:

The market has calmed significantly since the highly emotional discussions at times in March and April. Each working day, the industry associations BDEW and the DVGW are recording figures for refused entry and illness directly from market conversions service providers in order to monitor ongoing developments.

Transmission and distribution system operators have jointly established a system of "playing it by ear" in terms of the handling of the COVID-19 situation in the market area conversion. There have also been good experiences of market area conversion communication specific to COVID-19.

Hardly any problems due to COVID-19 have been reported for the switchovers currently being implemented. Across the whole of Germany, in coordination with the respective distribution system operators, operations have been postponed in various conversion areas (around one to three months).

Relative to the status of the consultation document of the Gas Network Development Plan 2020–2030 (reporting date: 1 October 2019), the following current status of conversion planning for the conversion areas for 2020 has arisen due to the restrictions in Germany caused by COVID-19:

Table 28: Current situation of the conversion areas intended in 2020 (reporting date: 1 June 2020)

No.	Area in the Gas NDP 2020–2030	TSO	Number of appliances (estimated) NDP 2020, as at 1 October 2019	Number of appliances (estimated) currently, as at 1 June 2020	Planned technical conversion month NDP 2020, as at 1 October 2019	Planned technical conversion currently, as at 1 June 2020
1	EWE Zone part I	GTG	50,000	38,000	February–June	February–June
1	EWE Zone part I	GTG	17,000	23,000	September–October	September–November
2	Bremen/ Delmenhorst	GUD	30,000	30,000	July	July
2	Bremen/ Delmenhorst	GUD	22,000	22,000	September	September
3	East Hanover/ Wolfsburg	GUD	5,000	5,000	March	March
3	East Hanover/ Wolfsburg	GUD	34,000	34,000	April	May
3	East Hanover/ Wolfsburg	GUD	27,000	27,000	June	June
3	East Hanover/ Wolfsburg	GUD	8,000	8,000	September	September
3	East Hanover/ Wolfsburg*	GUD	0	0	October	October
4	Teutoburger Wald 5	OGE (Nowega)	39,000	39,000	October	October
5	Aggertal pipeline	OGE	4,000	4,000	April	August
5	Aggertal pipeline	OGE	3,000	0	August	–
5	Aggertal pipeline	OGE	–	3,000	–	September
5	Aggertal pipeline	Thyssengas	0	0	April	April
5	Aggertal pipeline	Thyssengas	5,000	5,000	April	August
5	Aggertal pipeline	Thyssengas	10,000	15,000	June	September
5	Aggertal pipeline	Thyssengas	9,000	20,000	August	November
5	Aggertal pipeline	Thyssengas	16,000	0	October	–
6	Bonn	OGE	21,000	21,000	March	March
6	Bonn	OGE	4,000	4,000	June	July
7	Middle Hesse	OGE	22,000	22,000	March	March
7	Middle Hesse	OGE	20,000	20,000	April	April
7	Middle Hesse	OGE	17,000	17,000	June	June
7	Middle Hesse	OGE	16,000	16,000	July	July
7	Middle Hesse	OGE	16,000	16,000	September	September
	Total		**395,000**	**389,000**		

* no distribution networks

Note: The entries in the NDP gas database reflect the status with reporting date 1 October 2019.

Source: Transmission system operators

The switchovers in the **EWE Zone part I** conversion area went ahead as planned from February to March. Owing to COVID-19, the distribution system operator in question suspended the conversion process from March onwards. This resulted in delays in both the recording of gas appliances for the upcoming conversion districts and the conversion of three planned conversion districts in April and May. In coordination with the transmission system operator GTG, the distribution system operator then produced a new plan for 2020. The original conversion of the second step of EWE Zone part I (September to October) has therefore been delayed to the period June to November. One conversion district with around 6,000 appliances has therefore been delayed to later years due to COVID-19.

The conversion stages in the **Bremen/Delmenhorst** conversion area so far went ahead as planned. The preparations for the last two conversion stages on 30 June 2020 and 22 September 2020 are currently on schedule. Conversion with the Delmenhorst municipal utilities is expected to go ahead as planned for the two switching dates.

As a result of the restrictions due to COVID-19, in April, in the **East Hanover/Wolfsburg** conversion area, a conversion stage was postponed from the end of April to early May by arrangement between all involved. The main reasons for the delays in the preliminary appliance adjustments were the accessibility of the respective households due to public perception of the coronavirus and, later, the two-week ban on adjustment work for the Braunschweig region. The time lost due to the delay has since been made up for, with the result that the preparations for the subsequent conversion stages in 2020 are back on schedule. It is currently expected that the other switching dates will be implemented on time.

The preparations for the conversion of the **Teutoburger Wald 5** area were temporarily suspended in spring 2020 due to COVID-19. Activities have since been resumed and are currently on schedule. This does not currently result in any change to the time of the conversion.

Owing to the restrictions in Germany caused by COVID-19 in spring 2020, at the end of March, the distribution system operator responsible for the **Aggertal pipeline** conversion requested an adjustment of the schedule for the conversion of the network area in question by mutual consent. Thus, just one industrial customer was converted as planned in April. The transmission system operators OGE and Thyssengas, together with the distribution system operator, then immediately began work on a new plan for the market area conversion for the Aggertal pipeline conversion area for 2020. A schedule was developed that should allow the performance of all conversion stages planned for 2020. The original conversion (April to September) has therefore been delayed to the period August to November.

The first conversion (conversion stage 1) in the **Bonn** conversion area was implemented as planned in March. At the request of the distribution system operator concerned, a delay of four weeks was agreed for the second conversion stage (June 2020).

Five conversion stages are planned for the **Middle Hesse** conversion area in 2020. The first switching date went ahead on schedule in March 2020. The second conversion stage in 2020 was carried out as planned in April despite the at times substantial impact of the peak phase of the COVID-19 pandemic. The performance of the third stage of conversion was finally confirmed in early June. The preparations for the last two conversion stages in 2020 are currently on schedule, and both are expected to proceed on time.

Assuming that the current COVID-19 situation does not deteriorate, the conversions planned throughout the whole of Germany for 2020 can be implemented almost entirely.

5.9 Remaining L-gas market 2030

The remaining L-gas market results from the definitions of the conversion areas up to 2030. The supply from the remaining German product is predominantly shipped through the Nowega network.

Based on the current plans, the L-gas market in Germany will develop into a supply island around the remaining German reserves. A development of the remaining market of this kind requires in turn that sufficient flexibility can be provided by integrating storage and conversion capacity in order to ensure two premises:

- The security of supply of the customers supplied with L-gas must continue to be guaranteed.
- For technical and economic reasons, continuous delivery of the L-gas supply should be possible.

The maintenance of the L-gas market and thus the ability to market the remaining domestic production volumes is both in the economic interests of the producers and in the general economic interest. It must be ensured, however, that no inappropriate, additional or unjustifiable costs are charged to all shippers for maintaining the L-gas market. This would lead to incorrect economic incentives on the one hand and, on the other, eliminate the macroeconomic benefits of the remaining production.

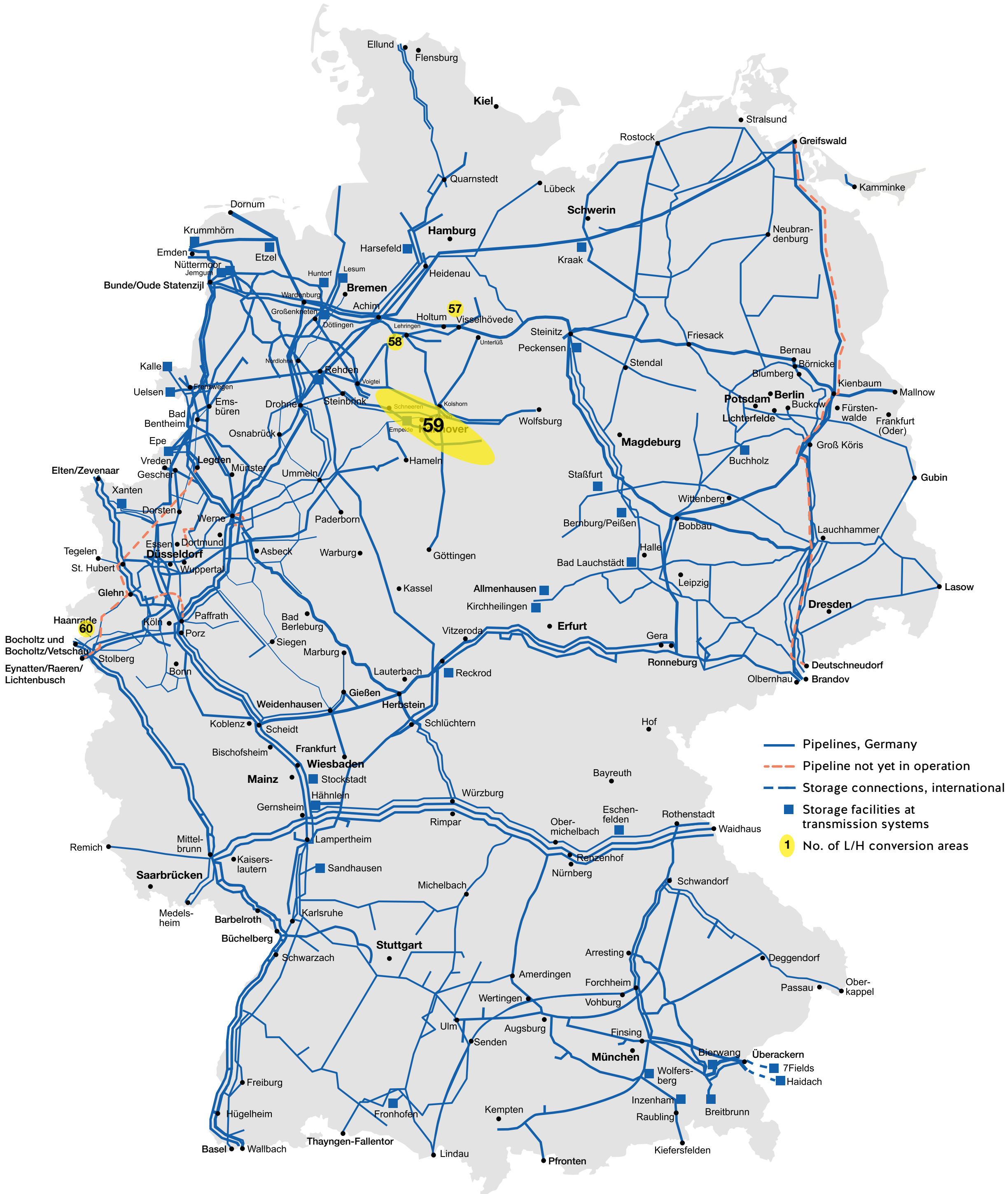
Table 29: Remaining L-gas market after 2030

No.	L-to-H-gas conversion area	Transmission system operator	Conversion date Gas NDP 2020–2030
57	In the production area/upstream	GUD	After 2030
58	Voigtei (GUD)	GUD	
59	Salzgitter area	Nowega	
60	Haanrade	Thyssengas	

Source: Transmission system operators

The remaining L-gas market after 2030 is presented in Figure 32.

Figure 32: Remaining L-gas market after 2030



Source: Transmission system operators, reporting date: 1 March 2020

After all conversion areas have been converted and taking into consideration the updated BVEG forecast based on current findings, the remaining L-gas production will continue to be injected at appropriate entry points throughout the whole year and added to the H-gas.

5.10 Summary

The transmission system operators have looked intensively at the following points in this chapter:

- Determination and presentation of the L-gas capacity and volume balance in due consideration of the local factors up to 2030;
- Consideration of the number of gas appliances to be modified from the use of L-gas to H-gas per year;
- Examination of the technical measures required to maintain the security of supply that can promptly compensate for the decline in L-gas;
- Creation of a complete overview of the L-gas conversion areas that is specific to each year;
- Changes to the L-to-H-gas conversion plans due to delays caused by COVID-19 for the 2020 conversion year were taken into account as at 1 June 2020;
- Elaboration of the remaining L-gas market in detail;
- Consideration of the available detailed plans of the distribution system operators.

A list of all network operators affected by the conversion as well as an allocation of the relevant conversion year are published in the NDP gas database.

6 Development of the H-gas supply

6 Development of the H-gas supply – Security of supply scenario

The transmission system operators continue to see the need, especially against the background of the decline in the availability of L-gas, to investigate the demand for H-gas and to present this in a capacity balance up to 2030.

6.1 H-gas capacity balance 2030

It is investigated in the H-gas capacity balance 2030 whether sufficient H-gas capacity is available to cover the expected trends in gas demand. The injection volumes available in the peak load case, firm capacity plus any interruptible capacity are compared here with the expected assumptions.

The key assumptions for the H-gas balance are listed below:

- The H-gas balance considers a peak load situation. The necessary injection volume is defined by the exit demand (peak load demand).
- The recognised capacity at the cross-border interconnection points is based on the relevant technical available capacity.
- Seasonal employment is assumed for storage facilities. Retrieval is assumed in the peak load case.
- Distribution system operators are recognised with the verified capacity in accordance with the NDP gas database ("2020 – NEP Entwurf" cycle).
- Industrial customers are recognised at the capacity in accordance with the NDP gas database ("2020 – NEP Entwurf" cycle).
- Conversions of areas that are still supplied with L-gas today to a supply with H-gas are included in the consideration accordingly.
- New gas power plants and the cluster approach are taken into consideration in accordance with Chapter 3.2.2
- The LNG facilities are recognised at the capacity in accordance with the NDP gas database ("2020 – NEP Entwurf" cycle) as freely allocable capacity (FZK). Furthermore, around 50 % of the LNG facility capacity is reduced at rival cross-border interconnection points and storage facilities.

6.1.1 Germany-wide H-gas capacity balance

The demand for H-gas increases in the period under review from 2020 to 2031 from 382 GW to 522 GW (cf. Table 30). The reasons for this are essentially the L-to-H-gas conversion, new power plants, the bookings from the 2017 annual auction in the context of "more capacity" and the increased demand in the Netherlands that is assumed based on security of supply reasons of GTS.

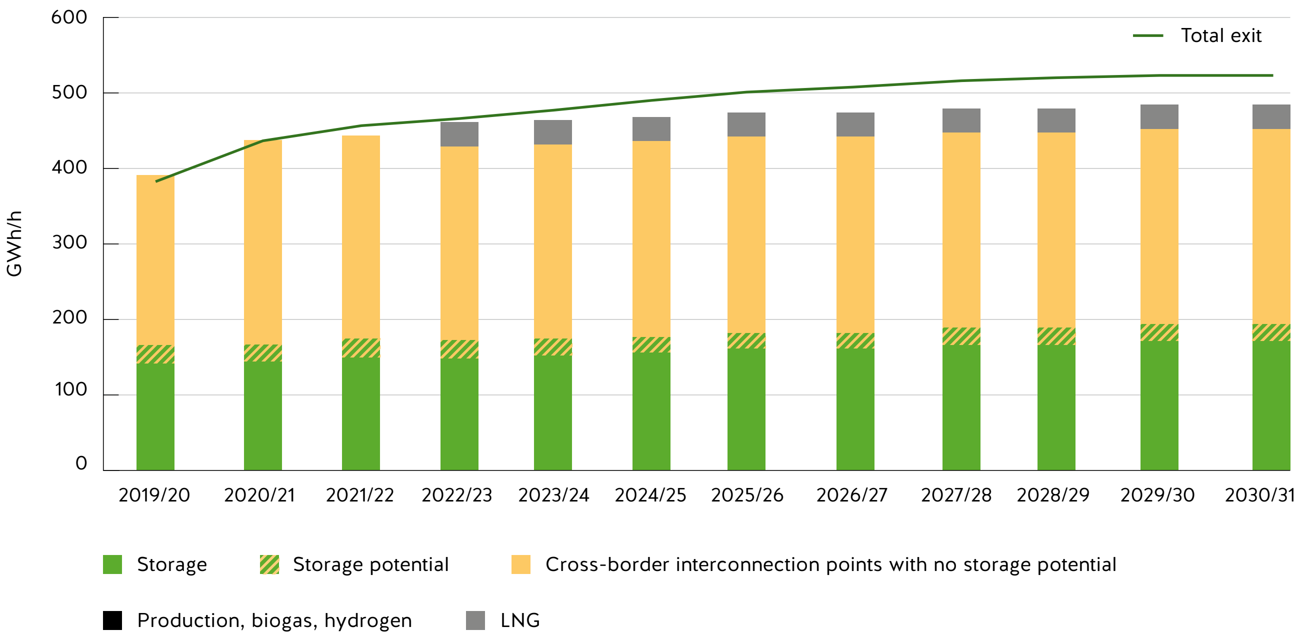
The supply of H-gas increases in the period under review from 2020 to 2031 from 390 GW to 483 GW (cf. Table 30). The causes of this are primarily the bookings in the 2017 annual auction in the context of "more capacity", increased provision of capacity at the storage facilities (e.g. new and converted storage facilities), increased injections at the Greifswald and Lubmin 2 cross-border interconnection points to supply the Netherlands and new LNG facilities.

Overall, additional H-gas demand totalling 27 GWh/h and 39 GWh/h results for energy balance purposes for the 2025/2026 and 2030/2031 modelling years respectively, which is allocated to cross-border interconnection points in line with the distribution of H-gas sources in accordance with the procedure explained in Chapter 6.2.

Part of the injection volume necessary to cover the demand can alternatively be provided from cross-border interconnection points or from storage facilities ("storage potential"). The transmission system operators have calculated this additional storage capacity upon a reduction in the capacity of cross-border interconnection points along the lines of the procedure in the Gas Network Development Plan 2018–2028.

Production, including biogas and hydrogen, with injection into the H-gas network makes a contribution over the whole of the period under review of less than one GWh/h to the fulfilment of demand.

Figure 33: Germany-wide H-gas capacity balance



Source: Transmission system operators

Table 30: Data on the Germany-wide H-gas capacity balance

Gas year	Storage facilities	Storage potential	Cross border interconnection points	LNG	Production, biogas, hydrogen	Total entry	Total exit	Additional demand
	GWh/h							
2019/2020	141	24	225	0	0	390	382	0
2020/2021	143	23	270	0	0	436	436	0
2021/2022	149	25	268	0	0	442	456	14
2022/2023	148	24	256	32	0	460	465	5
2023/2024	152	22	257	32	0	464	476	12
2024/2025	156	20	259	32	0	468	489	21
2025/2026	161	20	260	32	0	473	500	27
2026/2027	161	20	260	32	0	473	507	34
2027/2028	166	22	258	32	0	478	515	37
2028/2029	166	22	258	32	0	478	519	41
2029/2030	171	22	258	32	0	483	522	39
2030/2031	171	22	258	32	0	483	522	39

Source: Transmission system operators

6.1.2 Consideration of the cross-border interconnection points and LNG facilities (entry)

To cover the exit demand, the transmission system operators initially recognise the provision of available capacity at the LNG facilities and at the cross-border interconnection points in the H-gas balance, as it is assumed that their injection volumes are not adversely affected by possible restrictions on storage capacity. After taking local technical transport circumstances into consideration, the storage facilities are subsequently used to cover the capacity. Overall, the provision of capacity at the cross-border interconnection points increases in the period under review from 249 GWh/h to 312 GWh/h. This capacity also includes the LNG facilities and the storage potential.

The transmission system operators take into consideration in the H-gas balance three planned LNG facilities at the locations in Wilhelmshaven, Brunsbüttel and Stade with a total capacity of 32.5 GWh/h.

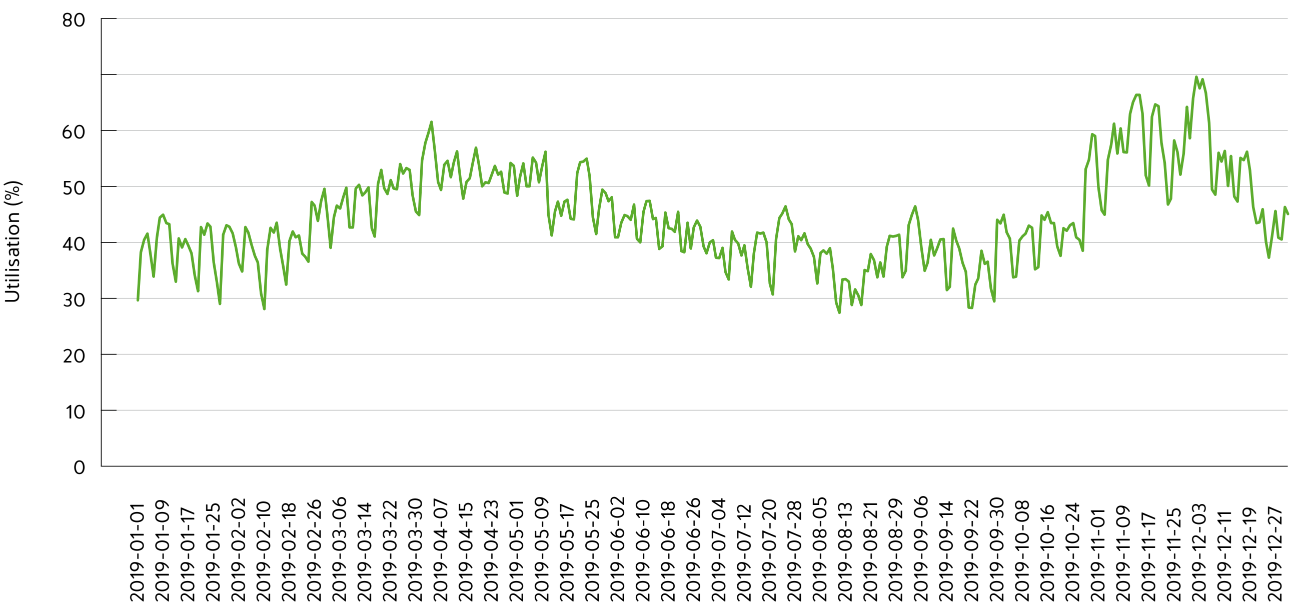
The present capacity reservations and capacity expansion claims pursuant to sections 38 and 39 GasNZV are considered here for planning purposes in accordance with the confirmed scenario framework as being in competition with relevant cross-border interconnection points and storage facilities in the network areas of Gasunie Deutschland and Open Grid Europe and – as described in Chapter 3.2.6 – shown as freely allocable capacity (FZK).

The transmission system operators assume that a simultaneous employment of all LNG three plants and the competing entry points at cross-border interconnection points and storage facilities will not occur in a peak load situation in winter. Therefore, at the competing entry points, the capacity shifted to the LNG entry points is reduced by just 50 % of the LNG injection volume for energy balance purposes. Thus, the estimated capacity in the peak load situation rises by 16.25 GWh/h.

The analysis of the utilisation rates of the European LNG facilities has led to the conclusion that the average utilisation – defined as the ratio of the daily "send out" to the maximum "send out capacity" – amounted in the 2019 year under review to around 45 % per day. This is based on an evaluation of the utilisation rates of the north-west European LNG facilities that are published by GLE (GAS LNG EUROPE) on the ALSI (AGGREGATED LNG STORAGE INVENTORY) platform.

Based on the GLE data, the maximum utilisation rate in 2019 amounted to around 70 %.

Figure 34: Utilisation rate of European LNG facilities in 2019



Source: Transmission system operators

Based on this data, the transmission system operators consider it appropriate to assume a utilisation of the German LNG facilities of 50 % in a peak load situation as a planning premise.

This approach also corresponds to the analysis presented in the scenario framework by the transmission system operators to determine the necessary exit capacity at the Wallbach cross-border interconnection point. A planning utilisation of the Italian LNG facilities of around 50 % is also assumed here by the joint transnational working group in the preferred scenario II.

16.25 GWh/h is additionally recognised in the H-gas balance in a peak load situation for this reason. The LNG facilities thus make a significant contribution to covering the total additional demand.

6.1.3 Consideration of the storage facilities (entry)

Storage facilities are recognised in the H-gas balance in the same way as in the Gas Network Development Plan 2018–2028. In sum, increasing provision of capacity at the storage facilities is produced. This increase results from the conversion of L-gas storage facilities to H-gas as well as an additional capacity contribution from the existing storage facilities, which can be given greater consideration because of the increasing demand for H-gas.

In a similar way to the procedure in the Gas Network Development Plan 2018–2028, the transmission system operators have identified the additional potential of the storage facilities in comparison with the cross-border interconnection points. To derive this potential, the transmission system operators have used storage data depending on filling level for the storage facilities currently connected to the transmission system.

The transmission system operators have examined here for the storage facilities that have been recognised in the H-gas balance with a lower capacity than the exit capacity possible when the storage filling level is 35 % what capacity contribution can be provided from the relevant storage facilities. The provision capacity from cross-border interconnection points that compete on capacity is reduced accordingly in this case.

Around 24 GWh/h for the 2019/2020 gas year and around 22 GWh/h for the 2030/2031 gas year is produced in sum as additional potential at the storage facilities that have not been recognised with at least the exit capacity available when the filling level is 35 % (cf. Table 30).

37 % of the demand for H-gas in the 2030/2031 gas year would thus be covered by German storage facilities (193 GWh/h of 522 GWh/h).

6.1.4 Consideration of the German production (entry)

Supplies that are injected only into the H-gas network are also present at the Imbrock, Groothusen and Leer fields in the German production regions of Elbe-Weser and Weser-Ems. The BVEG forecast does not feature an allocation to the individual supplies.

The production output of these fields has amounted to around 200 MWh/h on average in the last few years. This output has been updated using the averaged annual percentage decline in the BVEG forecast and taken into appropriate consideration in the H-gas balance.

6.1.5 Consideration of the demand (exit)

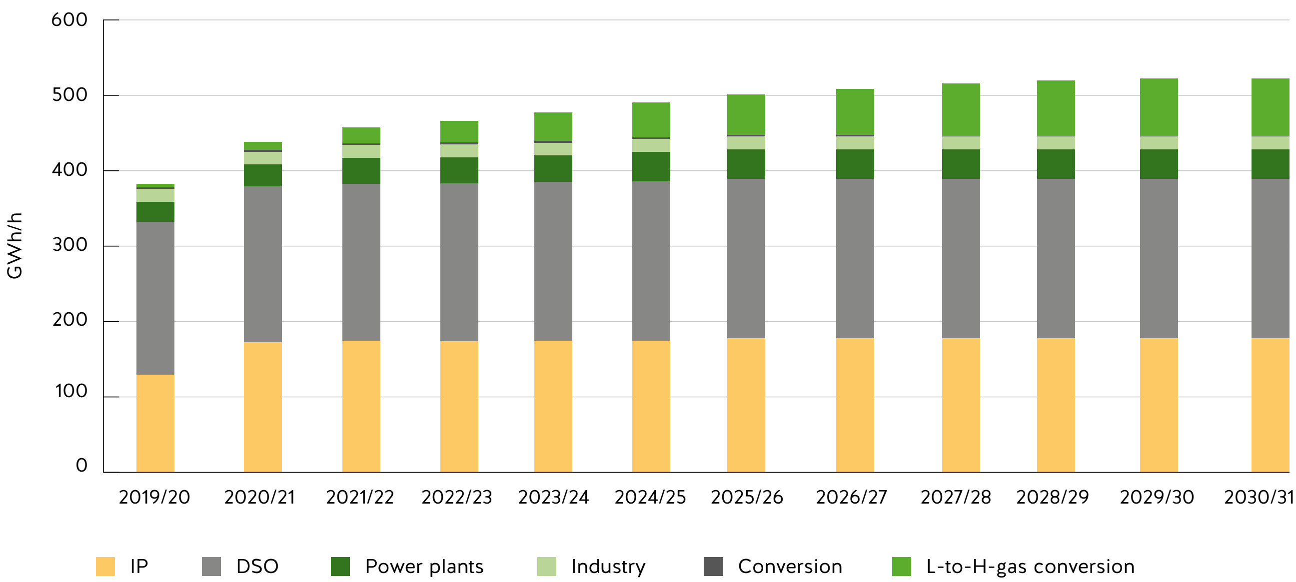
The demand for H-gas is produced as the sum of the capacity demand

- of the H-gas exit points (cross-border interconnection points, distribution system operators, industrial customers, gas power plants),
- of the additional demand for H-gas that results from the L-to-H-gas conversion and
- of the demand for H-gas for converting H-gas to L-gas.

In the period under review, the demand for H-gas rises by 140 GWh/h from 382 GWh/h in the 2019/2020 gas year to 522 GWh/h in the 2030/2031 gas year. Of this, around 72 GWh/h is attributed in the 2030/2031 gas year to the additional H-gas demand resulting from the conversion (cf. Table 31). The additional exit demand at the cross-border interconnection point totalling around 48 GWh/h up to the 2030/2031 gas year can be attributed essentially to the higher exports to the Czech Republic resulting from Nord Stream 2 as well as a higher exit demand to the Netherlands in a peak-load situation.

The assumed exit demand in the direction of the Netherlands also increases significantly as a result of the new exit capacity totalling 12 GWh/h in the event of a peak load situation. The remaining growth can essentially be attributed to rising demand among distribution system operators and power plants.

Figure 35: Development of the H-gas capacity demand



Source: Transmission system operators

Table 31: Data on the H-gas capacity demand

Gas year	Cross-border interconnection point	Distribution system operators	Power plants	Industry	Conversion	L-to-H-gas conversion	Total exit
	GWh/h						
2019/2020	129	202	27	17	2	4	382
2020/2021	172	206	29	17	2	11	436
2021/2022	174	208	34	17	2	21	456
2022/2023	173	209	35	17	2	29	465
2023/2024	174	210	35	17	2	38	476
2024/2025	174	211	39	17	2	46	489
2025/2026	177	211	39	17	2	54	500
2026/2027	177	211	39	17	2	61	507
2027/2028	177	211	39	17	1	69	515
2028/2029	177	211	39	17	1	73	519
2029/2030	177	211	39	17	1	76	522
2030/2031	177	211	39	17	1	76	522

Source: Transmission system operators

6.1.6 Conclusion

Based on the results of the H-gas capacity balance, the next few years will see constantly increasing demand for H-gas in Germany, the majority of which will have to be covered by imports. The procedure has been described in detail in the scenario framework. A brief summary is provided in Chapter 6.5.

6.2 Distribution of H-gas sources

The decline in Europe's own production mean that the import demand for H-gas will increase in Europe in the coming years. Traditionally, the German transmission infrastructure is heavily characterised by cross-border natural gas streams that are used to supply its neighbouring western and southern European states, It can be expected that the requirements in terms of the cross-border exchange of natural gas will continue to grow in the future.

To be able to assess the impacts of future expansions of the infrastructure for importing H-gas into Europe on the German transmission networks, the transmission system operators updated the tried and trusted, accepted model and presented the results in the scenario framework.

The following changes resulted in comparison with the Gas NDP 2018–2028 when the distribution of H-gas sources was drawn up:

- TYNDP: TYNDP 2018 is used instead of TYNDP 2017.
- LNG: new build plants are taken into consideration only if an FID is available.
- Pipelines: new pipeline projects are taken into consideration only if an FID is available.

The middle value of the lower and upper limits of the gas provision that are filed in the scenarios of the TYNDP 2018 has been used in the scenario framework for supply regions to present the distribution of gas sources for Europe in graphic form (cf. Figure 25 in the Scenario Framework 2020). The remaining demand has been allocated to LNG facilities. It is thus assumed for planning purposes that the demand is initially covered by pipeline gas and the remaining demand by LNG.

The LNG value recognised for 2020 and updated constantly up to 2030 is significantly lower – as a result of this planning assumption – than the average LNG value for 2020 that is indicated in the TYNDP 2018, as a shortfall in the capacity balance would be produced if this higher value was taken into account. Higher consideration of LNG supply volumes assumed for planning purposes would require a planning reduction in the pipeline supply volumes in order to avoid a surplus balance.

Pipeline projects with the volumes indicated in the TYNDP 2018 have been used to cover the additional demand for cover in Europe. It has subsequently been assumed that the remaining additional H-gas demand is covered by LNG facilities. It is assumed that pipelines will also be utilised as a preference in the future.[1]

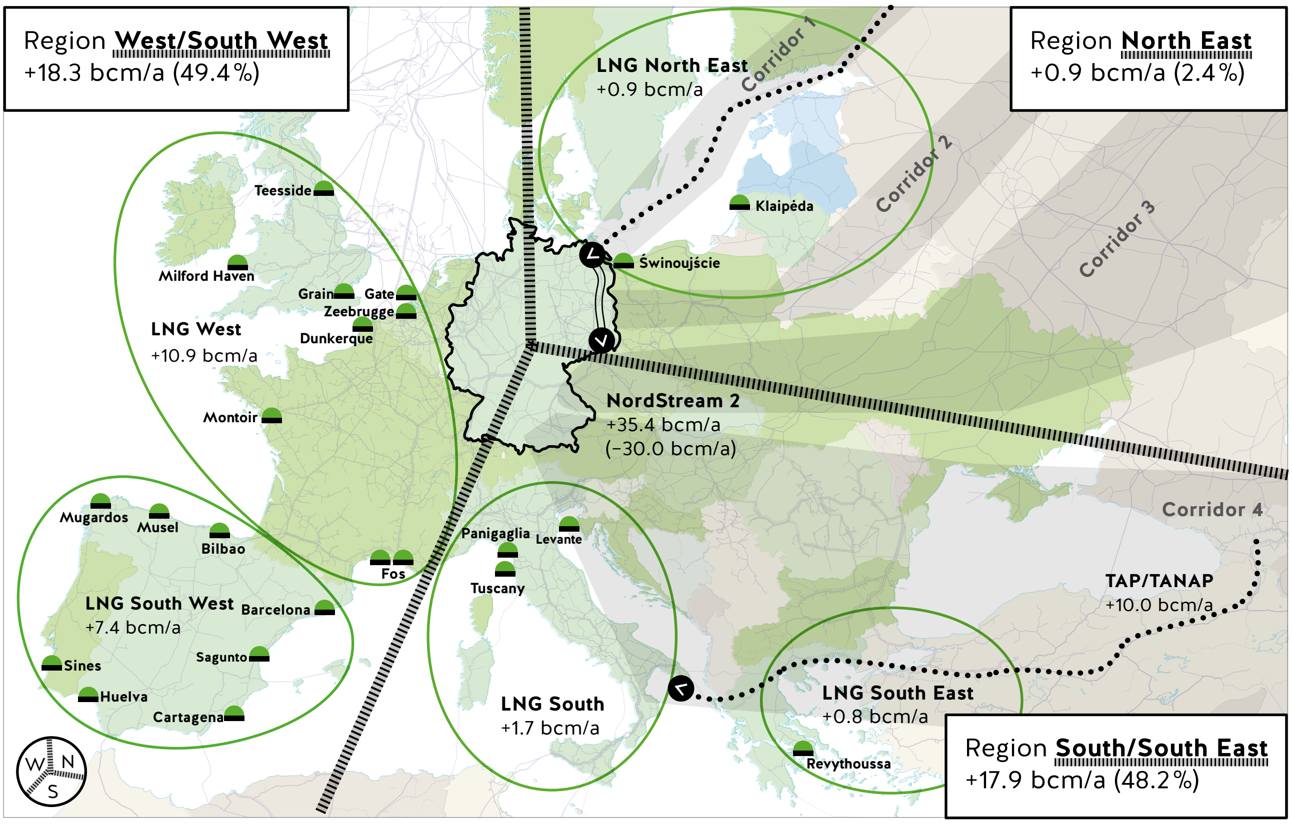
The result for the additional pipeline and LNG volumes to cover the additional demand as well as the distribution of the volumes to regions and sub-regions are presented in Figure 36.

The following regional distribution results overall:

- North-east region share: 2.4 %
- West/south-west region share: 49.4 %
- South/south-east region share: 48.2 %

1 Alternative assumptions on the utilisation rates of pipelines are not available to the transmission system operators and were not proposed by the participants in the course of the consultation on the scenario framework 2020–2030.

Figure 36: Coverage of the additional European demand up to 2030



Source: Transmission system operators

6.3 Consideration of the additional demand based on the distribution of H-gas sources

The transmission system operators analysed the developments at the cross-border interconnection points in the chapter "Gas exchange between Germany and its neighbouring countries" in the scenario framework. An estimate for the inclusion of the additional demand for gas produced for the distribution of H-gas sources has been carried out for all cross-border interconnection points at which the German transmission system is connected to the networks of the neighbouring countries. The cross-border interconnection points have been assigned to individual regions here in accordance with the distribution of H-gas sources.

The estimate of the potential of the respective cross-border interconnection point has been carried out by the transmission system operators in particular using the following criteria:

a. Information from network development plans of neighbouring countries/network operators as well as plans of neighbouring transmission system operators to increase the entry capacity at the cross-border interconnection points

b. Information in the TYNDP 2018 on planned investment measures in the natural gas transmission infrastructure of the neighbouring countries and the development of capacity at the cross-border interconnection points

c. Capacity demand in the network area adjacent to the cross-border interconnection points (e.g. on account of the market area conversion or the additional demand from gas power plants)

d. Presentation of the additional demand through optimised network expansion measures

e. Consideration of the high LNG import potential in the TYNDP 2018 through reduction of the exit capacity at cross-border interconnection points (no physical import).

The following aspects are additionally considered during the selection:

- Declines in production in the Netherlands and Denmark
- Special characteristics of individual network areas (e.g. upstream and downstream pipeline systems are not able to fulfil the increased capacity demand)
- Special characteristics of individual cross-border interconnection points (e. g. pure exit point).

The transmission system operators have identified the cross-border interconnection points listed in Table 32 on this basis for consideration in the distribution of H-gas sources in the Gas Network Development Plan 2020–2030.

Table 32: Cross-border interconnection points considered in the distribution of H-gas sources

Cross-border interconnection point	Country	Region	Criterion	Explanation
Bunde/Oude Statenzijl	Netherlands	Western/ South-western Europe	c	After the conversion to H-gas of regions that are supplied with L-gas today, the connected system is to continue to be operated efficiently for H-gas transmission.
Bocholtz-Vetschau	Netherlands	Western/ South-western Europe	c	After the conversion to H-gas of regions that are supplied with L-gas today, the connected system is to continue to be operated efficiently for H-gas transmission.
Elten/Zevenaar	Netherlands	Western/ South-western Europe	c	After the conversion to H-gas of regions that are supplied with L-gas today, the connected system is to continue to be operated efficiently for H-gas transmission.
Vreden	Netherlands	Western/ South-western Europe	c	After the conversion to H-gas of regions that are supplied with L-gas today, the connected system is to continue to be operated efficiently for H-gas transmission.
Eynatten/Raeren/ Lichtenbusch	Belgium	Western/ South-western Europe	a, c, d	The Belgian transmission system operator Fluxys Belgium SA has repeatedly confirmed that Belgium can provide gas volumes of up to 13 bcm/a, with additional potential of up to 20 bcm/a, through the Eynatten cross-border interconnection point for the German market from the LNG facilities in Zeebrugge and Dunkirk (France).
Medelsheim	France	Western/ South-western Europe	d, e	Based on the high LNG import potential for France, the transmission system operators see the possibility of continuing to recognise the Medelsheim cross border interconnection point in the source distribution.
Wallbach	Switzerland	Southern/ South-eastern Europe	a, b, c, d	The cross-border project of Snam Rete Gas and FluxSwiss to enable transmission flows from Italy via Switzerland in the direction of Germany and France was completed on the Italian and Swiss sides in 2018. The TENP reverse flow project (part of measure ID 305-02) serves the transport of additional capacity of 10 GWh/h from the region south/southeast, which arises at the Wallbach interconnection point according to the H-gas source analysis.
Überackern	Austria	Southern/ South-eastern Europe	a, b, c	In the KNEP 2019–2028 [KNEP 2018], Gas Connect Austria shows a technical exit capacity (exit Austria/entry Germany) at the Überackern interconnection point of around 7.3 GWh/h.
Überackern 2	Austria	Southern/ South-eastern Europe	a, b, c	In the Co-ordinated Network Development Plan 2017–2026 [KNEP 2016], Gas Connect Austria GmbH (GCA) reports additional demand for free allocable capacity (exit Germany/entry Austria) of 250,000 Nm^3/h (around 2,800 MWh/h) at the Überackern 2 (Überackern-SÜDAL) cross-border interconnection point.
Oberkappel	Austria	Southern/ South-eastern Europe	a, d	Additional volumes are available in the south/south-east region from the TAP (TRA-F-051, TRA-N-1193) pipeline projects and the transit volumes of Nord Stream 2 (TRA-F-937).
Waidhaus	Czech Republic	Southern/ South-eastern Europe	a	Additional volumes are available in the south/south-east region from the TAP (TRA-F-051, TRA-N-1193) pipeline projects and the transit volumes of Nord Stream 2 (TRA-F-937).

Source: Transmission system operators

Because of the significant increase in the total demand for H-gas – despite consideration of the three LNG facilities in Brunsbüttel, Stade and Wilhelmshaven – all cross-border interconnection points that meet at least two of the criteria specified above are taken into consideration in the source distribution of the Gas Network Development Plan 2020–2030. This concerns the Eynatten/Raeren/Lichtenbusch, Medelsheim, Wallbach, Oberkappel and Überackern cross-border interconnection points.

The amount of the capacity additionally to be taken over in the modelling variants can be found in the next Chapter 6.4.

6.4 Additional demand in accordance with the distribution of H-gas sources

The H-gas capacity balance is presented in Table 30. A shortfall of 26.8 GWh/h is produced in the 2025/2026 modelling year and of 39.3 GWh/h in the 2030/2031 modelling year for Germany. The additional demand produced from the H-gas balance is assigned to allocation points in accordance with the scenario framework. This is presented in Table 33.

The transmission system operators have assumed no additional capacity from the north-east region in accordance with the scenario framework. For this reason, the share of the north-east region of 2.4 % in the additional demand is distributed equally to the other regions. A share of around 51 % for the West/South-West region and a share of around 49 % for the South/South-East region is thus produced.

Furthermore, the transmission system operators point out that the values stated in Table 33 are not necessarily additional – i.e. extending beyond the technically available capacity already in place – firm capacity. Existing capacity is primarily used to cover the capacity balance. The term “additional capacity” has to be understood to mean for these cross-border interconnection points that this is capacity that is necessary in the capacity balance to cover the peak load and is thus not required all year round. Essentially, cross-border interconnection points are used that can be employed both in the entry and exit direction, with the result that a reduction in the exit capacity can in fact be recognised for these cross-border interconnection points and thus an additional network expansion is avoided.

Table 33: H-gas capacity balance for 2025/2026 and 2030/2031

	2025/2026	2030/2031
	GWh/h	
Total exit (demand)	–499.6	–522.3
Total entry	472.7	482.8
– Cross-border interconnection point entry and production	312.2	312.2
– Entry, storage	160.5	170.7
Net total	–26.8	–39.3
Distribution of the additional H-gas demand across the distribution of H-gas sources		
Total	26.8	39.3
– North-east region share: 0 %	0.0	0.0
– West/south-west region share: 50.6 %	13.6	19.9
– South/south-east region share: 49.4 %	13.3	19.4
Distribution of the additional demand in the regions		
Total, north-east region	0.0	0.0
Total west/south-west region	13.6	19.9
– of which Heyden power plant (NEW), allocation point: Eynatten (OGE)	0.8	0.8
– of which Medelsheim	3.0	7.0
– of which Eynatten/Raeren/Lichtenbusch	9.8	12.1
Total south/south-east	13.3	19.4
– of which Leipheim power plant, allocation point: Überackern 2, Überackern/ABG	1.9	1.9
– of which RDK 4 power plant, allocation point: Wallbach (OGE)	0.7	0.7
– of which Oberkappel	1.0	7.1
– of which Wallbach	9.7	9.7

Source: Transmission system operators

The capacity at cross-border interconnection points that is specified in Table 34 represents additional capacity compared with the capacity contained in the NDP gas database.

Table 34: Additional capacity at cross-border interconnection points on the basis of the distribution of H-gas sources

Cross-border interconnection point	Transmission system operator	Entry/Exit	IP	Type of capacity	Additional output 2025/2026 (GWh/h)	Additional output 2030/2031 (GWh/h)
Eynatten – OGE	OGE	Entry	IP	Firm dynamically allocable capacity	0.8	0.8
Eynatten/Raeren/Lichtenbusch	OGE, Fluxys TENP, Thyssengas	Entry	IP	interruptible	9.8	12.1
Medelsheim	OGE, GRTD	Entry	IP	interruptible	3.0	7.0
Wallbach	OGE	Entry	IP	Firm dynamically allocable capacity	0.7	0.7
Oberkappel	OGE, bayernets	Entry	IP	interruptible	1.0	7.1
Wallbach	OGE, Fluxys TENP	Entry	IP	interruptible	9.7	9.7
Überackern	bayernets	Entry	IP	Firm dynamically allocable capacity	1.9	1.9

Source: Transmission system operators

6.5 Summary

The transmission system operators have considered the various aspects of the H-gas supply in this chapter. The focus here has been the consideration in the energy balance of the cross-border interconnection points, LNG facilities and storage facilities as well as the allocation of the required additional demand to the cross-border interconnection points.

The transmission system operators would like to summarise the most important points once again at this juncture as follows:

- To cover the exit demand, the transmission system operators initially recognise the provision of available capacity at the LNG facilities and at the cross-border interconnection points in the H-gas balance, as it is assumed that their injection volumes are not adversely affected by possible restrictions on storage capacity.
- After taking local technical transport circumstances into consideration, the storage facilities are subsequently used to cover the capacity.
- Part of the injection volume necessary to cover the demand can alternatively be provided from the cross-border interconnection points or from storage facilities (“storage potential”).
- The additional demand identified in the energy balance in accordance with the distribution of H-gas sources to the identified cross-border interconnection points is allocated on the basis of the criteria presented in this chapter and the considerations of the transmission system operators.

Modelling results 7

7 Modelling results

7.1 Base variant modelling results

7.1.1 Base variant measures

The modelling results for 2025 and 2030 are described in the following section. The differences from the 2019 implementation report[2] are highlighted here. The results are divided into the following four categories:

A) Measures that are unchanged from the 2019 implementation report

Unchanged measures and measures with changes that are not the outcome of the results of the modelling are listed under A). These include for example changes concerning costs, the location of a measure and the related modification of name, commissioning date (e. g. on account of current findings in the framework of the L-to-H-gas conversion), the allocation of a measure to a pipeline and a gas pressure control and measuring (GPCM) station or the distribution of a measure in order to clearly allocate it to assets that are owned by different transmission system operators.

B) Measures that have changed from the 2019 implementation report

Measures with substantial changes of the technical design parameters (pipeline length and diameter, pressure rating, plant capacity) are listed under B).

C) Additional measures in comparison with the 2019 implementation report

D) Measures that have been cancelled since the 2019 implementation report

A distinction is then drawn within a category between 2025 and 2030 in respective sub-chapters. A description of the measures of the transmission system operators' network expansion proposal can be found in the NDP gas database under the tile "Ausbaumaßnahmen" (expansion measures).

A) Measures that are unchanged from the 2019 implementation report

The measures from the 2019 implementation report that are listed below have not changed and remain the modelling result for 2025 as before:

- Wiernsheim GPCM station (Heilbronn area) (ID 116-02)
- Conversion to H-gas (area: North Bremen, Bremerhaven to Cuxhaven and eastern part of the network of EWE Netz) (ID 223-01)
- Integration of the Folmhusen compressor station in the H-gas (ID 300-02)
- Embsen overfeed (ID 301-01)
- Horrem valve station and connecting pipeline (ID 326-02)
- Rauschendorf valve station and connecting pipeline (ID 334-02)
- Kempershöhe GPCM station and connecting pipeline (ID 335-02a)
- Wipperfürth-Niederschelden pipelines (ID 335-02b)
- Oberaden valve station and connecting pipeline (ID 336-02)
- Legden compressor station (ID 416-02)
- Northern Black Forest compressor station (ID 417-02)

2 The "2019 implementation report" refers here to the data listed in the NDP gas database under the tile "Ausbaumaßnahmen" (expansion measures) in the "2018 – USB zum NEP" NDP cycle [FNB Gas 2019b].

- Scharenstetten compressor station expansion (ID 418-02)
- Elten compressor station (ID 422-01)
- Remodelling of Epe Storage facility's connecting pipeline (ID 438-01)
- Pattscheid GPCM station and connecting pipeline (ID 439-01)
- Erfstadt–Euskirchen pipeline (ID 440-02)
- Ahlten GPCM station and connecting pipeline (ID 442-02)
- Werne GPCM station and connecting pipeline (ID 444-01)
- St. Hubert-Voigtslach valve stations and connecting pipeline (NETG) (ID 445-01a)
- St. Hubert-Voigtslach valve stations and connecting pipeline (OGE) (ID 445-01b)
- Wipperfürth-Niederschelden conversion (ID 446-01)
- Euskirchen GPCM station and connecting pipeline (ID 448-01)
- Steinhäule GPCM station expansion (ID 450-01)
- Au am Rhein GPCM station expansion (ID 451-02)
- EPT-Rysum – Rysum-Folmhusen pipeline connection (ID 504-01a)
- Holtum compressor station reverse flow (ID 507-01l)
- Sayda compressor station (ID 507-01m)
- Leonberg-West GPCM station expansion (ID 508-01)
- Visbek Astrup valve station (ID 520-01)
- Twistringen Ehrenburg valve station (ID 521-01)
- Steinfeld-Düpe GPCM station system modification (ID 524-01)
- Willich-Meerbusch pipeline (ID 525-01)
- Elten-St. Hubert valve station (ID 529-01)
- Cologne – Dormagen conversion (ID 530-01)
- Appeldorn GPCM station (ID 531-01a)
- Xanten compressor station (ID 531-01b)
- Mittelbrunn-Schwanheim pipeline (ID 552-01)
- Hügelheim-Tannenkirch pipeline (ID 554-01)

Furthermore, the following measures from the 2019 implementation report have not changed and remain the modelling result for 2030 as before:

- Heiden Marbeck-Heiden Borken pipeline (ID 436-02a, division of the Heiden-Dorsten pipeline into two pipeline sections)
- Heiden-Borken GPCM station and connecting pipeline (ID 437-01)

B) Measures that have changed from the 2019 implementation report

The following measures from the 2019 implementation report are the result of the modelling for 2025 with amended technical parameters. The reasons for the modification of the network expansion measures are described below:

- **Paffrath GPCM station and connecting pipeline (ID 067-03b)**
  Modification of technical parameters on the basis of current findings from the L-to-H-gas conversion planning.
- **Heilbronn connection (ID 112-03)**
  Modification of the length of the pipeline on the basis of current findings from the concluded regional planning procedure.
- **Achim GPCM station (ID 119-03)**
  Modification of technical parameters on the basis of current findings from the detailed planning.
- **Asbeck GPCM station and connecting pipeline (ID 333-02)**
  Modification of technical parameters on the basis of current findings from the L-to-H-gas conversion planning.
- **Porz GPCM station (ID 337-02)**
  Modification of technical parameters on the basis of current findings from the L-to-H-gas conversion planning.
- **Paffrath GPCM station (ID 338-02)**
  Modification of technical parameters on the basis of current findings from the L-to-H-gas conversion planning.
- **Wertingen-Kötz pipeline (ID 402-02a)**
  Modification of the pipeline dimensions on the basis of the increased demand for capacity in Baden-Württemberg.
- **Wertingen 2 GPCM station (ID 402-02b)**
  Minor modification to the plant capacity on the basis of the increased demand for capacity in Baden-Württemberg.
- **Kötz GPCM station (ID 402-02c)**
  Minor modification to the plant capacity on the basis of the increased demand for capacity in Baden-Württemberg.
- **Emstek GPCM station (ID 431-02)**
  Modification of technical parameters on the basis of current findings from the L-to-H-gas conversion planning.
- **Altena GPCM station and connecting pipeline (ID 435-03)**
  Modification of technical parameters on the basis of current findings from the L-to-H-gas conversion planning.
- **Vinnhorst valve station and connecting pipeline (Vinnhorst GPCM station and connecting pipeline) (ID 441-02)**
  Modification of technical parameters on the basis of current findings from the detailed planning.
- **Drohne GPCM station and connecting pipeline (ID 443-02)**
  Modification of the plant capacity on the basis of the increased demand for capacity of a distribution system operator as well to take the capacity demand of the planned new Heyden power plant into consideration.
- **Heilbronn connection extension (SEL 1) (ID 449-02)**
  Modification of technical parameters on the basis of current findings. The measure will be constructed in conjunction with the Lochgau-Altbach pipeline (SEL 2) (ID 612-01) as well as the Heidelberg-Heilbronn pipeline (SEL 3) (ID 614-01).

- **Walle-Wolfsburg pipeline (ID 501-02a)**
  Modification of the pipeline length on the basis of current findings in the course of the project progress.

- **Kolshorn GPCM station expansion (ID 501-02d)**
  Addition of technical parameters.

- **Unterlüß GPCM station expansion (ID 501-02e)**
  Addition of technical parameters.

- **Embsen GPCM station expansion (ID 503-02b)**
  Addition of technical parameters.

- **Folmhusen GPCM station expansion (ID 504-02b)**
  Modification to the plant capacity and the commissioning date on account of the demand for security of supply of the Netherlands.

- **Emden GPCM station (ID 504-02c)**
  Modification to the plant capacity and the commissioning date on account of the demand for security of supply of the Netherlands.

- **TENP I to TENP II interconnections (ID 555-03)**
  Modification of technical parameters and discontinuation of the interconnection in Büchelberg on the basis of current findings from the detailed planning.

C) Additional measures in comparison with the 2019 implementation report

Additional network expansion measures in the modelling for 2025 compared with the 2019 implementation report are described below:

- **Leer GPCM station and connecting pipeline (ID 532-01)**
  The measure described here involves the construction of a new GPCM station and of the related connecting line to receive H-gas volumes from the GASCADE network. It ensures the transport of H-gas volumes for the L-to-H-gas conversion process.

- **Lauchhammer GPCM station pipeline (ID 601-01)**
  The measure described here involves the construction of a new pipeline, including all necessary technical installations. The new pipeline is planned to be constructed on the site of the Lauchhammer GPCM station and serve the increase in the entry capacity for the downstream DP 25 bar system.

- **Schwanheim-Elchesheim pipeline (ID 602-01)**
  The measure described here is a new pipeline construction project, including all necessary technical installations. The new pipeline is planned to be built between Schwanheim and Elchesheim in parallel to the existing TENP II natural gas transport pipeline.

- **Schwarzach-Eckartsweier pipeline (ID 603-01)**
  The measure described here is a new pipeline construction project, including all necessary technical installations. The new pipeline is planned to be built between Schwarzach and Eckartsweier in parallel to the existing TENP II natural gas transport pipeline.

- **Tannenkirch-Hüsingen pipeline (ID 604-01)**
  The measure described here is a new pipeline construction project, including all necessary technical installations. The new pipeline is planned to be built between Tannenkirch and Hüsingen in parallel to the existing TENP II natural gas transport pipeline.

- **Wesseling-Knapsack pipeline (ID 605-01)**
  The measure described here is a new pipeline construction project, including all necessary technical installations. The new pipeline is planned to be constructed between Wesseling and Knapsack.

- **Wirtheim-Lampertheim pipeline (ID 609-01)**
  The measure described here is a new pipeline construction project, including all necessary technical installations. This pipeline connects to the MIDAL system at Wirtheim and serves to supply new power plants in Neckarsulm, Heilbronn, Marbach and Altbach as well as to increase the overfeed capacity at distribution system operators in Baden-Württemberg.

- **Wirtheim GPCM station (ID 610-01)**
  The measure described here involves the construction of a new GPCM station. The plant serves to transmit overfeed from the MIDAL to the new Wirtheim-Lampertheim pipeline (ID 609-01) of terranets.

- **Lampertheim GPCM station (ID 611-01)**
  The measure described here involves the construction of a new GPCM station. The plant serves to transmit overfeed from the new Wirtheim-Lampertheim pipeline (ID 609-01) to the existing terranets pipeline system.

- **Löchgau-Altbach pipeline (SEL 2) (ID 612-01)**
  The measure described here is a new pipeline construction project, including all necessary technical installations. The pipeline constitutes one of the new sections of the approved SEL in Baden-Württemberg that are to be built. The measure will be constructed in conjunction with the Heilbronn pipeline connection extension (SEL 1) (ID 449-02) as well as the Heidelberg-Heilbronn pipeline (SEL 3) (ID 614-01). These sections of the SEL will be used for the general supply as well as to supply the new power plants in Neckarsulm, Heilbronn, Marbach and Altbach.

- **Bietigheim GPCM station (ID 613-01)**
  The measure described here involves the construction of a new GPCM station. The plant serves to transmit overfeed between the new pipelines of the Heilbronn connection extension (SEL 1) (ID 449-02), the Löchgau-Atlbach pipeline (SEL 2) (ID 612-01) and the Heilbronn connection (ID 112-03) of terranets.

- **Heidelberg-Heilbronn pipeline (SEL 3) (ID 614-01)**
  The measure described here is a new pipeline construction project, including all necessary technical installations. The pipeline constitutes one of the new sections of the approved SEL in Baden-Württemberg that are to be built. The measure will be constructed in conjunction with the Heilbronn connection extension (SEL 1) (ID 449-02) and also the Lochgau-Altbach pipeline (SEL 2) (ID 612-01). These sections of the SEL will be used for the general supply as well as to supply the new power plants in Neckarsulm, Heilbronn, Marbach and Altbach.

- **Heidelberg GPCM station (ID 615-01)**
  The measure described here involves the construction of a new GPCM station. The facility ensures the overfeed from the new Heidelberg-Heilbronn pipeline (SEL 3) (ID 614-01) to the existing pipeline system of terranets.

- **Heilbronn GPCM station (ID 617-01)**
  The measure described here involves the construction of a new GPCM station. The facility ensures the overfeed from the new Heidelberg-Heilbronn pipeline (SEL 3) (ID 614-01) to the existing pipeline system of terranets.

- **Kirchheim unter Teck GPCM station (ID 619-01)**
  The measure described here involves the construction of a new GPCM station. The facility will be used to regulate and control additional gas volumes in the North-South transmission in the Lake Constance area.

- **Hittistetten GPCM station (ID 621-01)**
  The measure described here involves the construction of a new GPCM station. The facility will be used to regulate and control additional gas volumes from the east.

- **Eichstegen GPCM station (ID 622-01)**
  The measure described here involves the construction of a new GPCM station. The facility will be used to regulate and control additional gas volumes in the Lake Constance area.

- **Weißensberg 2 GPCM station (ID 623-01)**
  The measure described here involves the construction of a new GPCM station. The facility will be used to regulate and control additional gas volumes in the Lake Constance area.

- **Scharenstetten GPCM station (ID 625-01)**
  The measure described here involves the construction of a new measurement and control line to ensure permanent and uninterruptible gas transmission.

- **Aalen-Essigen pipeline (ID 626-01)**
  The measure described here is a new pipeline construction project, including all necessary technical installations. This pipeline will be used to connect and to supply municipalities in the Ostalb region as well as to supply the power plant in Aalen.

- **MIDAL Middle North pipeline (ID 627-01)**
  The measure described here involves a loop pipeline for the existing MIDAL long-distance gas pipeline in the northern area of the Lippe compressor station. The measure is intended to increase the transmission capacity on the Middle-North section of the MIDAL long-distance gas pipeline. The measure is necessary only if the two LNG facilities in Brunsbüttel and Stade are implemented.

- **MIDAL Middle South pipeline (ID 628-01)**
  The measure described here involves a loop pipeline for the existing MIDAL long-distance pipeline in the northern area of the Reckrod compressor station. The measure is intended to increase the transmission capacity on the Middle-South section of the MIDAL long-distance gas pipeline. The measure is necessary only if the two LNG facilities in Brunsbüttel and Stade are implemented.

- **Reckrod compressor station (ID 629-01)**
  The measure described here involves a new construction to expand the existing Reckrod compressor station. The measure serves to increase the transmission capacity of the MIDAL-South long-distance gas pipeline. The location is near Eiterfeld in Hesse.

- **Lampertheim 5 GPCM station (ID 630-01)**
  The measure described here involves a new Lampertheim 5 GPCM station. The measure serves to transmit gas volume overfeed from the new terranets Wirtheim-Lampertheim pipeline (ID 609-01) to the MIDAL-South long-distance gas pipeline of GASCADE. The measure is located near Lampertheim in Hesse.

- **Lubmin 2 GPCM station (ID 631-01)**
  The measure described here involves an expansion of the existing Lubmin 2 GPCM station. The measure is intended to transfer gas volumes from the Nordstream pipeline. The measure is located near Greifswald in Mecklenburg-West Pomerania.

- **Greifswald GPCM station (ID 632-01)**
  The measure described here involves an expansion of the existing Greifswald GPCM station. The measure is intended to transfer gas volumes from the Nordstream pipeline. The measure is located near Greifswald in Mecklenburg-West Pomerania.

- **NEL (Middle) compressor station (ID 633-01)**
  The measure described here involves the construction of a new compressor station. The station is intended to increase the transmission capacity of the NEL long-distance gas pipeline to the west and to transmit overfeed in the long-distance gas pipelines located there. The location is near Schwerin in Mecklenburg-West Pomerania.

- **NEL West pipeline (ID 634-01)**
  The measure described here involves a loop pipeline for the existing NEL long-distance pipeline in the area around the western end of the NEL. The measure serves to increase the transmission capacity of the NEL long-distance gas pipeline in the Achim to Rehden route section. The measure is necessary only if the two LNG facilities in Brunsbüttel and Stade are implemented.

- **Embsen GPCM station (ID 635-01)**
  The measure described here involves the expansion of the Embsen GPCM station described on account of the capacity demand increasing in the Netherlands in the context of the gas transmission for the security of supply.

- **South Elbe-Achim pipeline (ID 636-01)**
  The measure described here involves the construction of a new loop pipeline including all necessary technical installations between South Elbe and Achim. This will be required to derive the gas volumes of the LNG facilities planned in the GUD system. The measure is necessary only if the two LNG facilities in Brunsbüttel and Stade are implemented.

- **Achim compressor station modification (ID 637-01)**
  The measure described here involves modifications to the compressor station in Achim. This will be required to derive the gas volumes of the LNG facilities planned in the GUD system. The measure is necessary only if the two LNG facilities in Brunsbüttel and Stade are implemented.

- **Embsen preheating (ID 638-01)**
  The measure described here involves the expansion of the preheating at the Embsen station in order to derive the volumes from the Stade LNG facilities, for the market area conversion and increased long-term forecasts.

- **Achim GPCM station (ID 639-01)**
  The measure described here involves the expansion of the Achim GPCM station described on account of the capacity demand increasing in the Netherlands in the context of the gas transmission for the security of supply.

- **Ludwigshafen GPCM station (ID 642-01)**
  The measure described here involves an expansion of the existing Ludwigshafen GPCM station. The measure is planned for the additional preheating of gas volumes and serves to increase the transmission capacity of the MIDAL-South long-distance gas pipeline. The measure is located near Ludwigshafen in Rhineland-Palatinate.

- **Herringhausen GPCM station (ID 650-01)**
  The measure described here involves the expansion of the existing Herringhausen GPCM station on account of the higher operating pressure being set in the course of the L-to-H-gas conversion.

- **Neuss Rheinpark GPCM station and connecting pipeline (ID 651-01)**
  The measure described here involves the construction of a new GPCM station, as well as a new connecting pipeline to connect the current L-gas pipeline to the Lausward power plant with the pipeline Neuss Floßhafenstrasse and the connected northern pipeline system for the L-to-H-gas conversion.

- **Engelbostel GPCM station and connecting pipeline (ID 652-01)**
  The measure described here involves the construction of a new GPCM station, as well as a new connecting pipeline, required to connect the H-gas pipeline system of GUD at Resse with the pipelines currently operated with L-gas running to the south towards Vinnhorst for the L-to-H-gas conversion.

- **Iserlohn Hennen valve station (ID 654-01)**
  The measure described here involves the expansion of the Iserlohn Hennen valve station for separating the Werne-Paffrath pipeline and the Hennen Eisborn pipeline for the L-to-H-gas conversion.

- **Conversion to H-gas (area: Rehden-Bassum) (ID 657-01)**
  This measure includes the necessary modifications for converting the area between Rehden and Messingen and Bassum respectively to H-gas.

- **Conversion to H-gas (Kolshorn-Ahlten-Empelde storage facility) (ID 659-01)**
  The area between Kolshorn, Ahlten and the Empelde storage facility is to be converted to H-gas. This measures serves both to convert Enercity and to gradually integrate the Empelde storage facility in the H-gas.

Furthermore, the following additional network expansion measures in comparison with the 2019 implementation report are the result of the modelling result for 2030:

- **System connections and modifications for the L-to-H-gas conversion 2026-2029 (ID 229-01)**
  Modifications to the OGE transmission system in order to convert the OGE network areas in the period from 2026 to 2029. The relevant measures will be specified in more detail in the following Network Development Plans.
- **System connections and modifications for L-to-H-gas conversions (ID 447-01)**
  Modifications to the Thyssengas transmission system in order to convert the Thyssengas network areas in the period from 2026 to 2029. The relevant measures will be specified in more detail in the following Network Development Plans.
- **Kleinenhammer GPCM station and connecting pipeline (ID 653-01)**
  The measure described here involves the construction of a new GPCM station, as well as the new connecting pipeline, which are required to connect the Bergische pipeline and pipeline II at Remscheid in the framework of the L-to-H-gas conversion. These pipelines are currently operated separately from each other and at different operating pressures.
- **Essen Dellwig valve station and connecting pipeline (ID 655-01)**
  The measures described here involve the expansion of the Essen Dellwig valve station to connect the sections operated with L-gas of the Dorsten-Oberhausen-Mintard (North) pipeline and the Essen Dellwig-Duisburg Hamborn pipeline to the section of the Dorsten-Oberhausen-Mintard (South) pipeline currently operated with H-gas.
- **Duisburg Mündelheim valve station and connecting pipeline (ID 656-01)**
  The measure described here involves the expansion of the Duisburg Mündelheim valve station to connect the Werne-Duisburg pipeline currently operated with L-gas to the Hüls Wuppertal pipeline operated with H-gas, in the framework of the L-to-H-gas conversion.
- **Conversion to H-gas (Emsland II area (ID 658-01)**
  This measure includes the necessary technical modifications for converting the loop system in the Emsland II conversion area from L-to H-gas.

D) Measures that have been cancelled since the 2019 implementation report

- **Leeheim GPCM station and connecting pipeline (ID 314-01)**
  The measure is no longer required on account of changes in demand reports and current findings in the detailed plan.
- **Heiden Borken-Dorsten pipeline (ID 436-02b)**
  The Heiden-Dorsten pipeline (ID 463-02) has been divided into two measures. The first part runs from Heiden Marbeck to Heiden Borken (ID 436-02a), the second part from Heiden Borken to Dorsten (ID 436-02b). The Heiden Borken-Dorsten pipeline measure is no longer required, since the additional demand of a network's customer was no longer reported by 15 July 2019 and the Sonsbeck-Dorsten conversion concept has been amended.
- **Massenheim-Hattersheim pipeline (ID 506-02a)**
  The capacity demand for the Griesheim power plant was not taken into consideration in the scenario framework for the Gas Network Development Plan 2020–2030. The Massenheim-Hattersheim pipeline is therefore no longer a result of the modelling of the base variant in the Gas Network Development Plan 2020–2030.
- **Massenheim II GPCM station and connecting pipeline (ID 506-02b)**
  The capacity demand for the Griesheim power plant was not taken into consideration in the scenario framework for the Gas Network Development Plan 2020–2030. The Massenheim II GPCM station and connecting pipeline are therefore no longer a result of the modelling of the base variant in the Gas Network Development Plan 2020–2030.

7.1.2 Base variant results

The base variant produces the following results:

Table 35: Base variant results

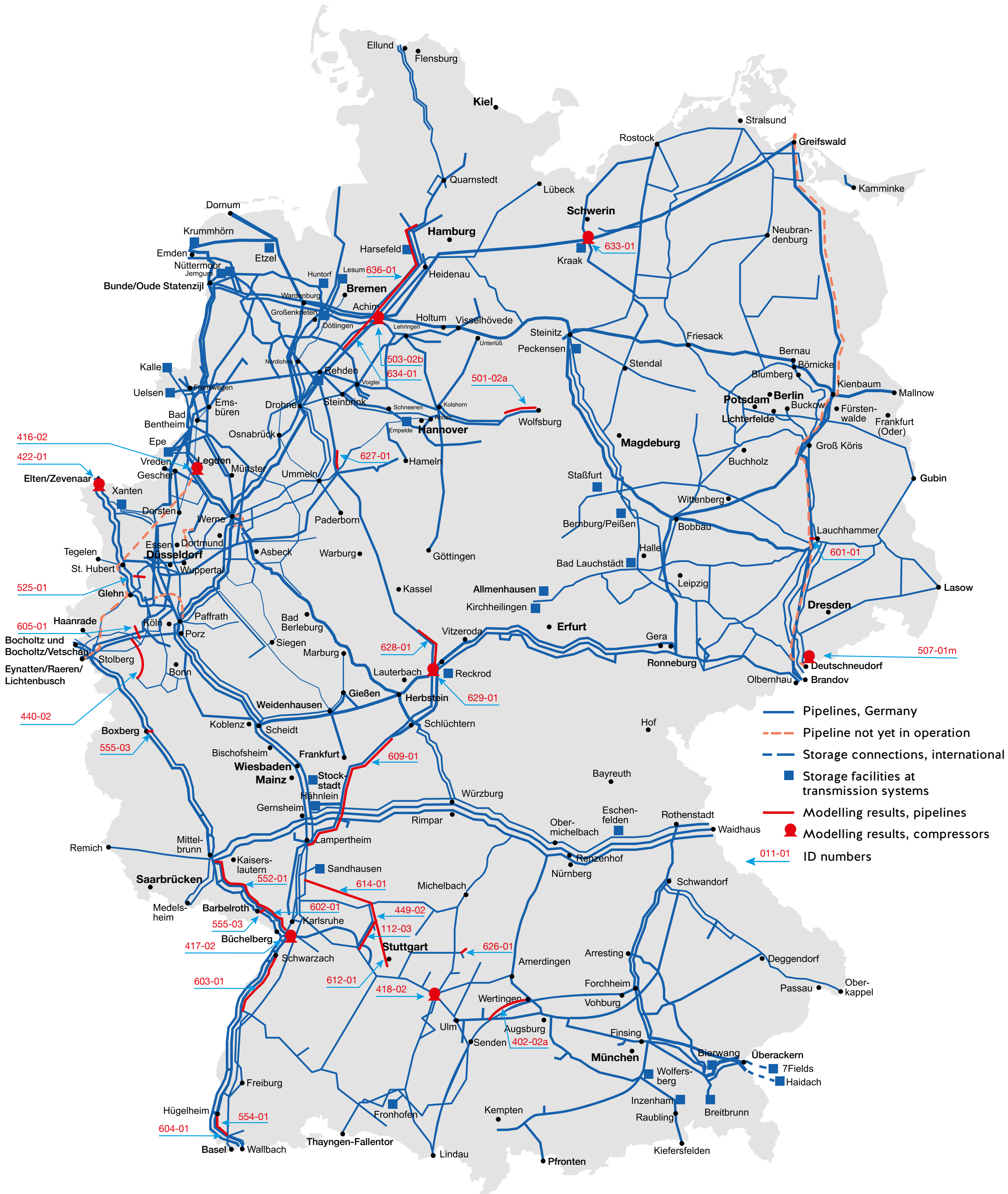
	Up to the end of 2025	Up to the end of 2030
Modelling result		
Compressor stations (additional capacity and necessary flow reversals)	205 MW	205 MW
Pipeline construction	741 km	743 km
Costs	EUR 3.3 billion	EUR 3.3 billion
Initial network measures		
Compressor stations (additional capacity and necessary reverse flow)	200 MW	
Pipeline construction	851 km	
Costs	EUR 4.5 billion	
Total result		
Compressor stations (additional capacity and necessary reverse flow)	405 MW	405 MW
Pipeline construction	1,592 km	1,594 km
Costs*	EUR 7.7 billion	EUR 7.8 billion

* including GPCM stations, valve stations and other facilities

Source: Transmission system operators

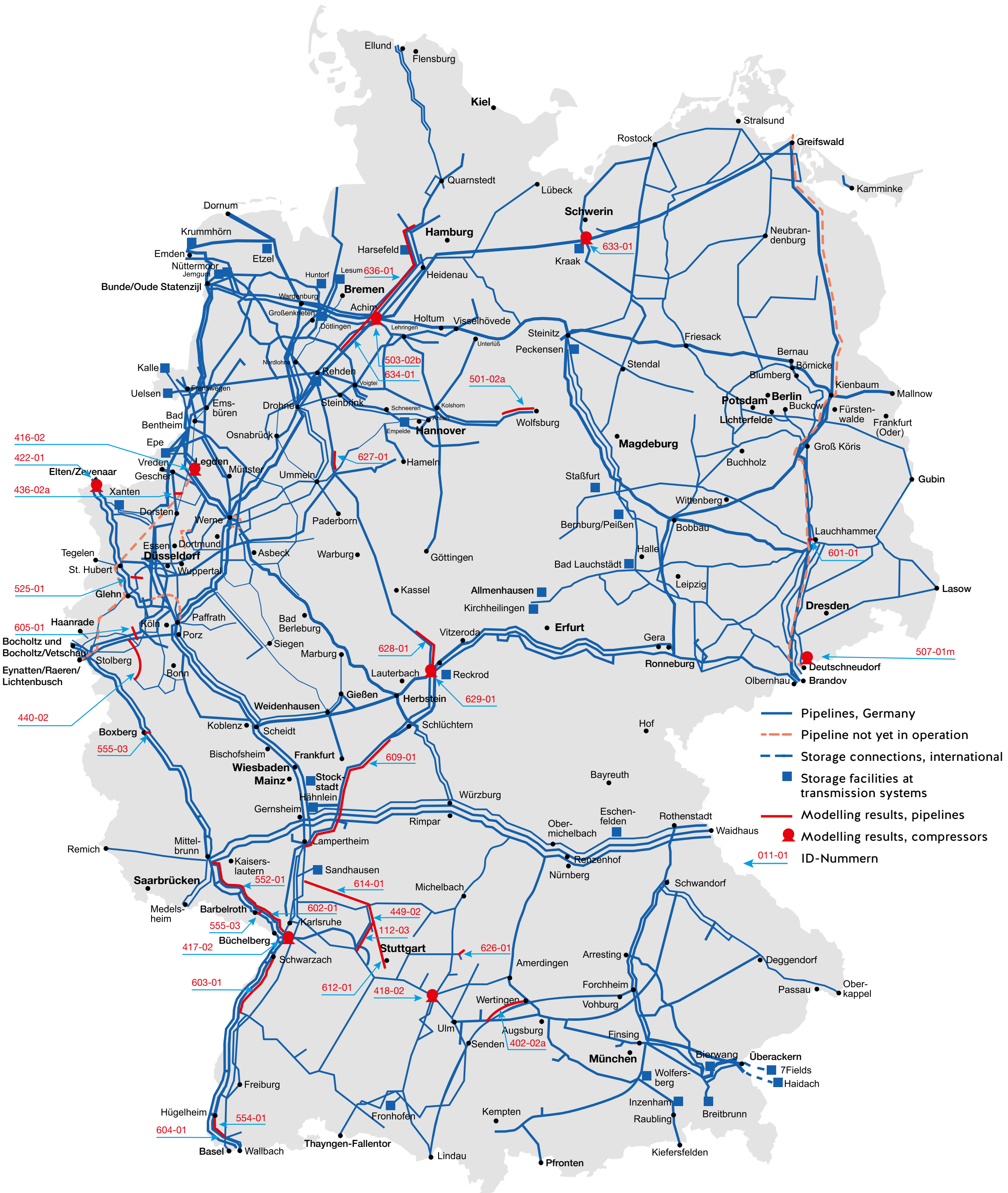
The resulting network expansion measures are listed in detail in the NDP gas database and are presented in the illustrations below.

Figure 37: Expansion measures in the base variant up to the end of 2025



Source: Transmission system operators, reporting date: 1 March 2020

Figure 38: Expansion measures in the base variant up to the end of 2030



Source: Transmission system operators, reporting date: 1 March 2020

7.1.3 Allocation of the network expansion measures for new gas power plants

The transmission system operators have taken new gas power plants into account in the modelling on the basis of the confirmation of the scenario framework. The BNetzA additionally instructed the transmission system operators in the confirmation of the scenario framework to specify all network expansion measures that will contribute to covering the capacity demand for planned gas power plants. The transmission system operators have implemented this requirement in Table 36 below.

Table 36: Allocation of the network expansion measures that cover the capacity demand for new power plants among other things

ID no.	Network expansion measure	Necessary only for power plant	Planned new gas power plants														
			Leipheim I gas and steam	Grundremmingen gas and steam	Staudinger power plant*	VW2 gas-powered cogeneration plant	Scholven power plant*	Irsching power plant*	Biblis power plant*	Heyden power plant	Heilbronn gas turbine	Altbach gas and steam plant	Marbach gas and steam plant	GuD power plant Aalen	AUDI AG factory CHP plant Neckarsulm	Herne gas and steam power plant	Walsum gas and steam power plant*
036-04	Wertingen compressor station		x	x										x			
302-01	Datteln-Herne pipeline	x														x	
402-02a	Wertingen-Kötz pipeline		x	x										x			
402-02b	Wertingen 2 GPCM station		x	x										x			
402-02c	Kötz GPCM station		x	x										x			
417-02	Northern Black Forest pipeline compressor station										x						
443-02	Drohne GPCM station and connecting pipeline									x							
449-02	Heilbronn connection extension (SEL 1)										x	x	x				
501-02a	Walle – Wolfsburg pipeline	x				x											
501-02d	Kolshorn GPCM station expansion					x											
501-02e	Unterlüß GPCM station expansion					x											
609-01	Wirtheim-Lampertheim pipeline										x	x	x		x		
610-01	Wirtheim GPCM station										x	x	x		x		
611-01	Lampertheim GPCM station										x	x	x		x		
612-01	Löchgau-Altbach pipeline (SEL 2)											x	x				
614-01	Heidelberg-Heilbronn pipeline (SEL 3)										x	x	x		x		
615-01	Heidelberg GPCM station										x	x	x		x		
616-01	Heidelberg GPCM station										x	x	x		x		
617-01	Heilbronn GPCM station										x	x	x		x		
618-01	Heilbronn GPCM station										x	x	x		x		
626-01	Aalen-Essingen pipeline													x			
629-01	Reckrod compressor station										x	x	x		x		
630-01	Lampertheim 5 GPCM station										x	x	x		x		
642-01	Ludwigshafen GPCM station										x	x	x		x		

* No need for expansion is required or appropriate measures are already in operation for these power plants.

Source: Transmission system operators

7.1.4 Allocation of the network expansion measures for LNG facilities

The transmission system operators have taken new LNG facilities into account in the modelling on the basis of the confirmation of the scenario framework. The BNetzA additionally instructed the transmission system operators in the confirmation of the scenario framework to specify all network expansion measures that will contribute to covering the capacity demand for these LNG facilities. The transmission system operators have implemented this requirement in Table 37 below.

Table 37: Allocation of the network expansion measures that cover the capacity demand for new LNG facilities among other things

ID no.	Network expansion measure	Planned new LNG facilities			
		Brunsbüttel	Stade	Stade and Brunsbüttel	Wilhelmshaven
301-01	Embsen overfeed	x		x	
627-01	MIDAL Middle North pipeline			x	
628-01	MIDAL Middle South pipeline			x	
634-01	NEL West pipeline			x	
636-01	South Elbe-Achim pipeline			x	
637-01	Achim compressor station modification			x	
638-01	Embsen preheating		x	x	

Note: Other measures for connecting the LNG facilities are presented in Chapter 3.2.6.

Source: Transmission system operators

7.1.5 Allocation of the network expansion measures for the security of supply of the Netherlands

The transmission system operators have taken the security of supply of the Netherlands into account in the modelling on the basis of the confirmation of the scenario framework. The BNetzA additionally instructed the transmission system operators in the confirmation of the scenario framework to specify all network expansion measures that will contribute to the security of supply of the Netherlands. The transmission system operators have implemented this requirement in Table 38 below.

Table 38: Allocation of network expansion measures that, among other things, serve the security of supply of the Netherlands

ID no.	Network expansion measure
504-01a	EPT-Rysum – Rysum-Folmhusen pipeline connection
504-02b	Folmhusen GPCM station expansion
504-02c	Emden GPCM station
507-01l	Holtum compressor station reverse flow
631-01	Lubmin 2 GPCM station
632-01	Greifswald landing terminal GPCM station – facility extension 3
633-01	NEL compressor station (middle)
635-01	Embsen GPCM station
639-01	Achim GPCM station

Source: Transmission system operators

7.1.6 Results of the NewCap modelling

In conjunction the merger of the two German market areas, this Gas Network Development Plan 2020–2030 also includes NewCap modelling for the first time (cf. Chapter 3.4). The measures of the base variant in accordance with 7.1.1 were fully taken into account.

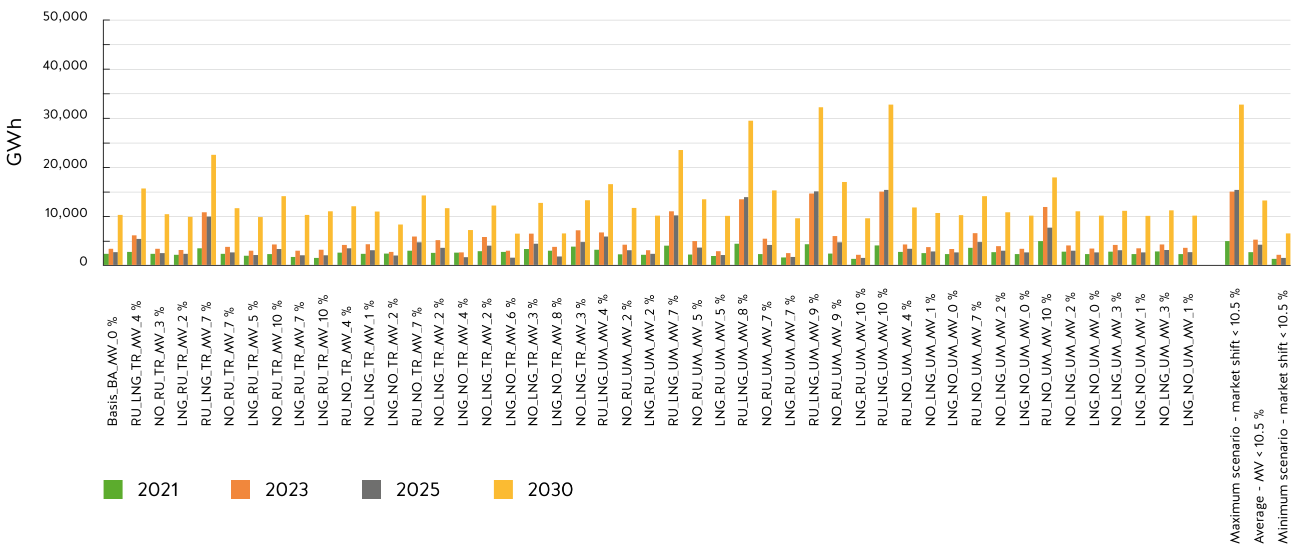
Local bottlenecks

The NewCap modelling did not identify any statistically significant local bottlenecks. The sole exception is the terranets network area in the 2021/2022 gas year. Depending on the scenario in question, shortfalls are possible up to a maximum of five days per year. The size of the shortfall ranges between 0.0 GWh/h and a maximum of 3.0 GWh/h. From the 2023/2024 gas year onwards, the NewCap calculations show, that there are no longer any shortfalls, including the terranets network. This is the result of the higher exchange capacity between transmission system operators.

Demand for market-based instruments

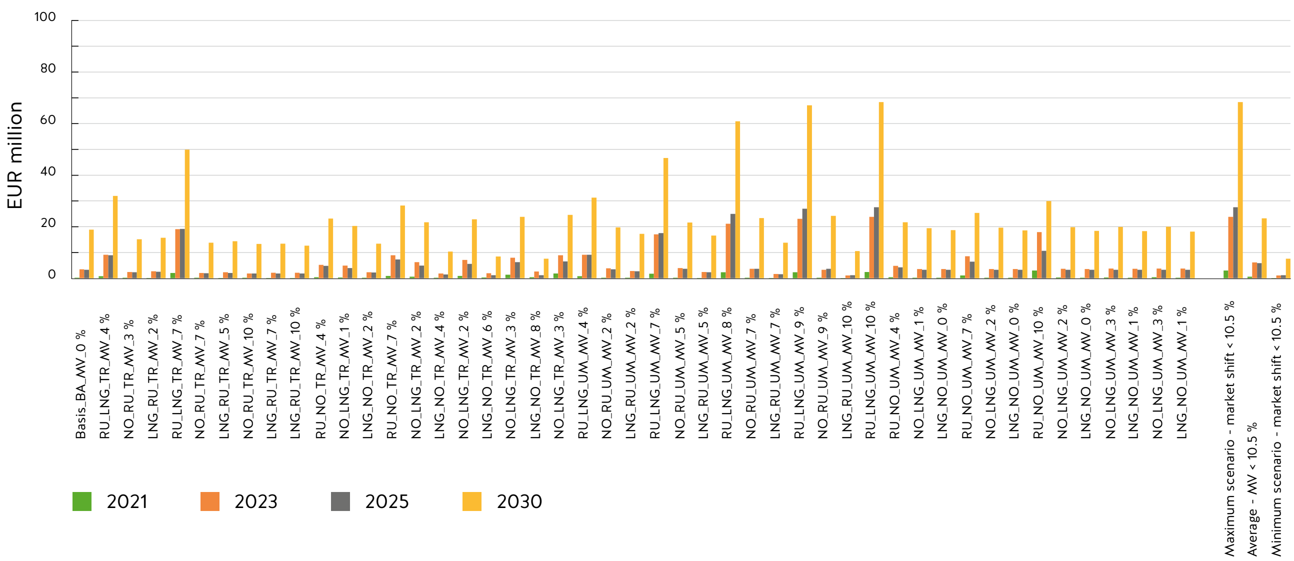
Demand for market-based instruments rises in the period between the 2021/2022 and 2030/2031 gas years.

Figure 39: Average annual output of market-based instruments



Source: Transmission system operators

Figure 40: Average costs of market-based instruments



Source: Transmission system operators

The overall rise in demand for market-based instruments is due to growing consumption within Germany, mainly as a result of the L-gas-to-H-gas conversion.

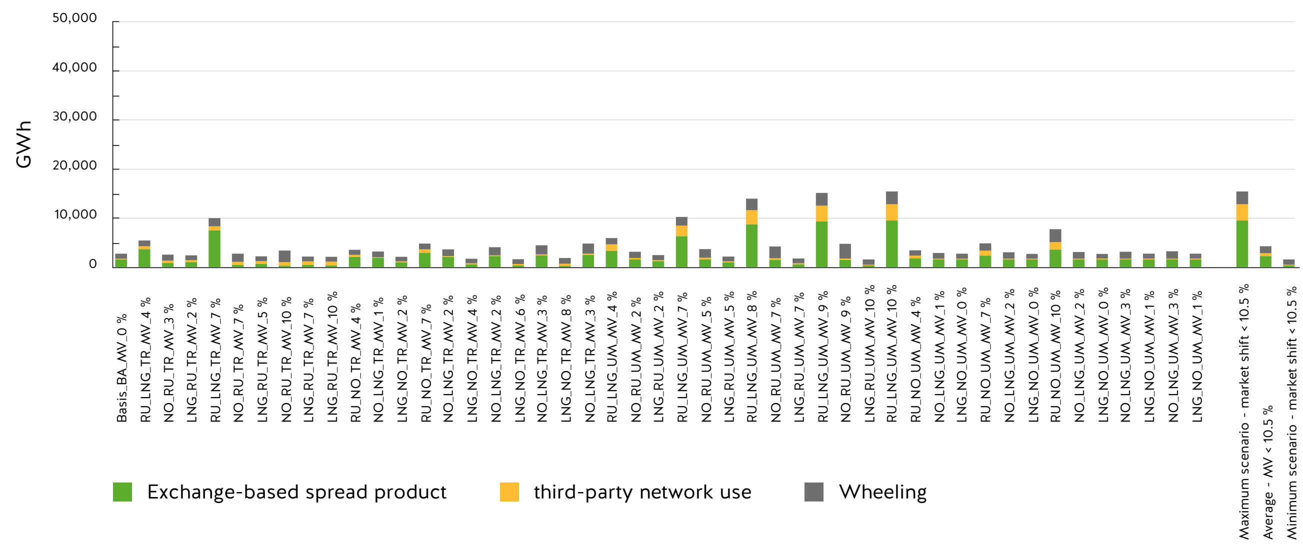
While the previous conversion planning guaranteed the free allocability in conjunction with the previous GASPOOL and NCG market areas, the additional entry and exit capacity combinations possible in the new market area can lead to growing demand for market-based instruments.

The low growth in the scenario with the maximum costs between the 2023/2024 and 2025/2026 gas years is due to the fact that an adjustment of exchange capacity between transmission system operators increases flexibility in the market area. The costs even decline slightly on average across all scenarios.

The shares of exchange-based spread product, third-party network use and wheeling instruments shift between each other over the years, with the result that the development in quantities differs from that of costs. In particular, the use of the exchange-based spread product rises in the 2030/2031 gas year, as the capacity available from wheeling and a third-party network use does not allow increases in the use of these products.

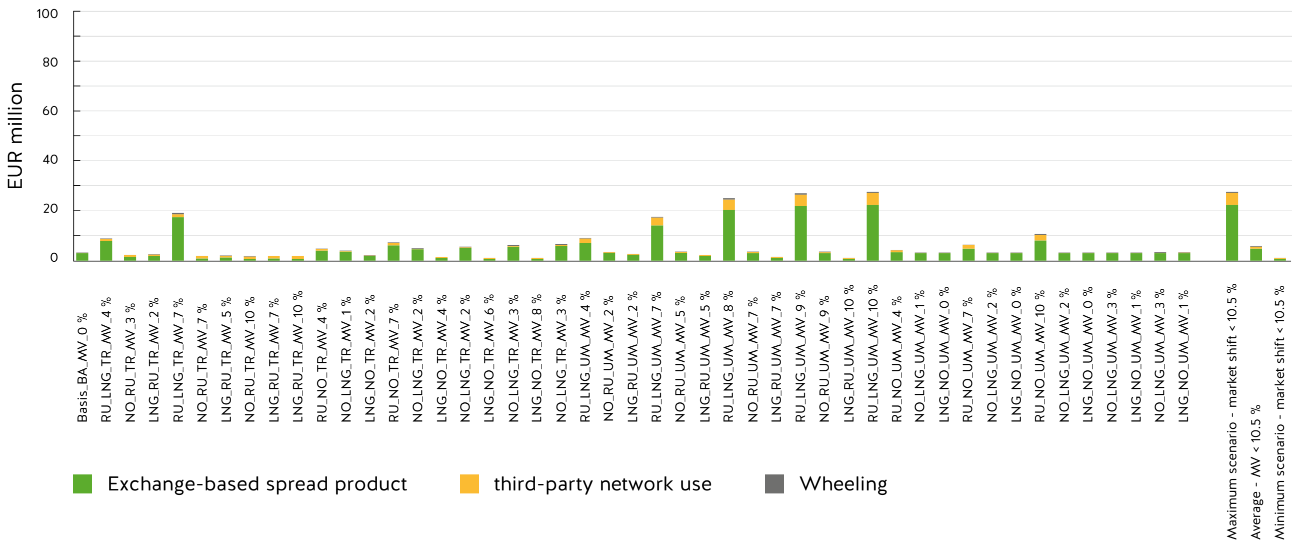
The following figures 41 and 42 show examples for a breakdown of demand by exchange-based spread product, third-party network use and wheeling instruments for the 2025/2026 gas year.

Figure 41: Average annual output of market-based instruments in 2025



Source: Transmission system operators

Figure 42: Average costs of market-based instruments in 2025



Source: Transmission system operators

Owing to the differing assumptions regarding specific prices, the share of the exchange-based spread product in annual costs is higher than its share of the annual volume. Conversely, wheeling covers more than half of the annual volume of instruments required in some scenarios, while its share of costs in these scenarios is marginal.

Operationally, the use of the different products at optimal costs will be determined by their day-to-day availability.

Assessment of alternative market-based instruments and network expansion

The following Table 39 shows the development of costs for the use of market-based instruments for the maximum and minimum scenario and the average for the scenarios analysed.

Table 39: Costs for the use of market-based instruments per year

	2021/2022	2023/2024	2025/2026	2030/2031
	EUR million			
Maximum scenario	2.9	23.9	27.6	68.3
Average scenario	0.6	6.2	5.8	23.2
Minimum scenario	0.1	1.1	1.1	7.6

Source: Transmission system operators

As described in Chapter 3.4.2, in addition to the structure of use within Germany, demand for market-based instruments is also dependent on the future employment of imports and exports. Demand therefore varies greatly between the scenarios analysed.

The results of NewCap modelling can thus show only a possible range of the costs of the market area merger, with – at minimum – no costs being incurred.

The cost development in the maximum scenario alone cannot be used to assess whether a network expansion is the more cost-effective means of increasing the exchange capacity between the current GASPOOL and NCG market areas.

While market-based instruments can be procured at short notice and therefore used as required, investment leads to a long-term increase in network costs, even if future scenarios assume lower exchange demand than in the maximum scenario.

The assessment of an alternative network expansion to reduce the costs of market-based instruments for the 2021/2022 and 2023/2024 gas years is irrelevant, since expansion measures cannot be available this soon because of the implementation time needed. As also already mentioned above, the analysis of the 2021/2022 and 2023/2024 gas years is intended merely to show a comparison of the cost development of market-based instruments.

At around EUR 27.6 million, the costs calculated for market-based instruments for the 2025/2026 gas year are acceptable even for the maximum scenario. The maximum costs to be expected for the 2025/2026 gas year are therefore less than the costs that were published in conjunction with the market dialogue on the market area cooperation/capacity model for 2023 on 6 February 2019. The figures calculated in advance as part of a proof of concept were already up to EUR 30 million in the 2023/2024 gas year.

As for an alternative network expansion, further statistical data in addition to the costs for the maximum scenario have to be considered for an objective assessment. These include the effect referred to above that the actual costs incurred can absolutely be less than those of the maximum scenario – all the way down to zero additional costs.

In addition to the maximum scenario, the average costs for market-based instruments (around EUR 5.8 million per year) are also analysed for all relevant scenarios. An investment with comparable additional annual costs would not have a significant effect on capacity. Market-based instruments should only give way to a corresponding network expansion when the costs of market-based instruments permanently exceed the costs of an alternative network expansion.

To illustrate this, a new 20 MW compressor unit with an annual operation of approximately 2,000 full load hours is taken as an example. Solely the energy costs incurred for this new compressor unit – not including the additional annual costs of capital – come to a similar amount as for the average costs for market-based instruments of around EUR 5.8 million.

Thus, the relatively low overall costs for the use of market-based instruments in the 2025/2026 gas year do not provide sufficient justification for an alternative network expansion.

In the opinion of the transmission system operators, an assessment for the period after the 2025/2026 gas year will not be possible until experience of the new market area is available. In forming this opinion, the transmission system operators relied not least on the approach of the Federal Network Agency which, in conjunction with the resolution to approve an oversubscription and buyback system for the transmission system operators to offer additional capacity on a nationwide market area BK7-19-037 KAP+ [BNetzA 2019 b], operative provision 3(b)), opted for a monitoring process. In this, “the transmission system operators are required to submit to the Federal Network Agency by 1 December of each calendar year (for the first time as at 1 December 2022) a joint report analysing the use of market-based instruments and capacity buyback in the past gas year.”

In the interests of a demand-based network expansion, an evaluation of possible construction measures for the period after the 2025/2026 gas year should take into account the findings of the actual use and their evaluation as an alternative to the use of market-based instruments. As already stated under 3.4.2, findings from ongoing monitoring will be taken into account in future NewCap calculations.

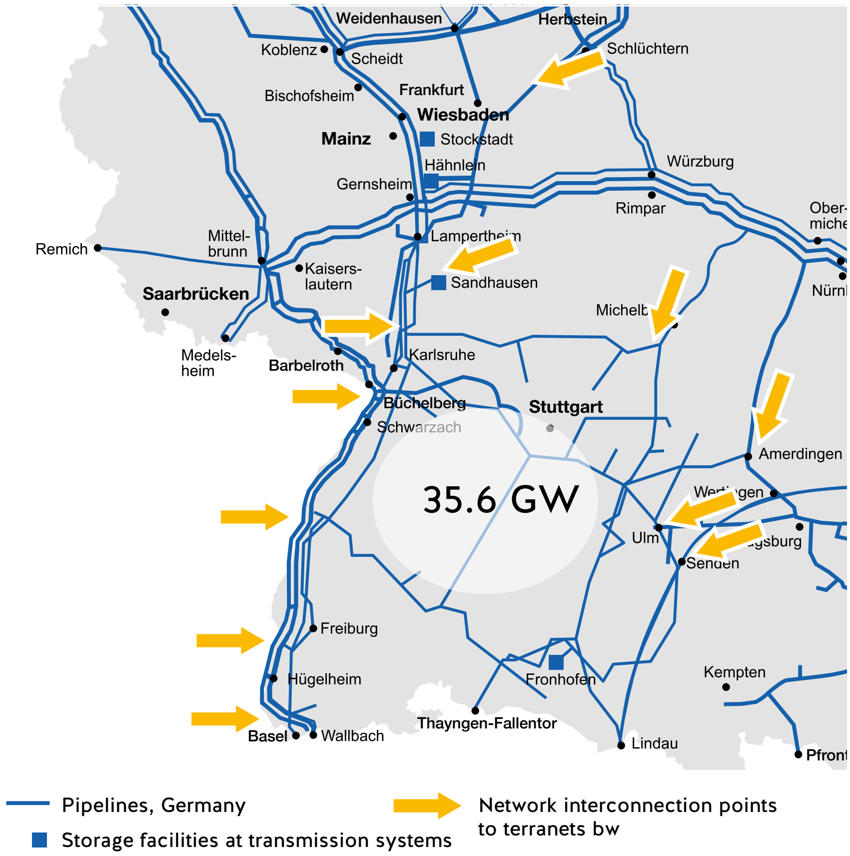
7.2 Modelling results for the design variant for Baden-Württemberg

7.2.1 Background

Building on the base variant, the design variant for Baden-Württemberg examines an increased trend in demand in Baden-Württemberg for the 2030/2031 modelling year.

For the Baden-Württemberg design variant, the BNetzA confirmed a demand for terranets of approximately 35.6 GWh/h in 2030, as reported in the NDP gas database ("2020 – NEP Entwurf" cycle). This means a capacity increase of around 2.2 GWh/h compared to the base variant. This increase can be attributed to the complete consideration of the long-term forecast of the distribution system operators up to 2030 and to a consideration of the storage capacity that ceases to apply.

Figure 43: Network interconnection points for the terranets supply in the 2030/2031 modelling year in the design variant for Baden-Württemberg



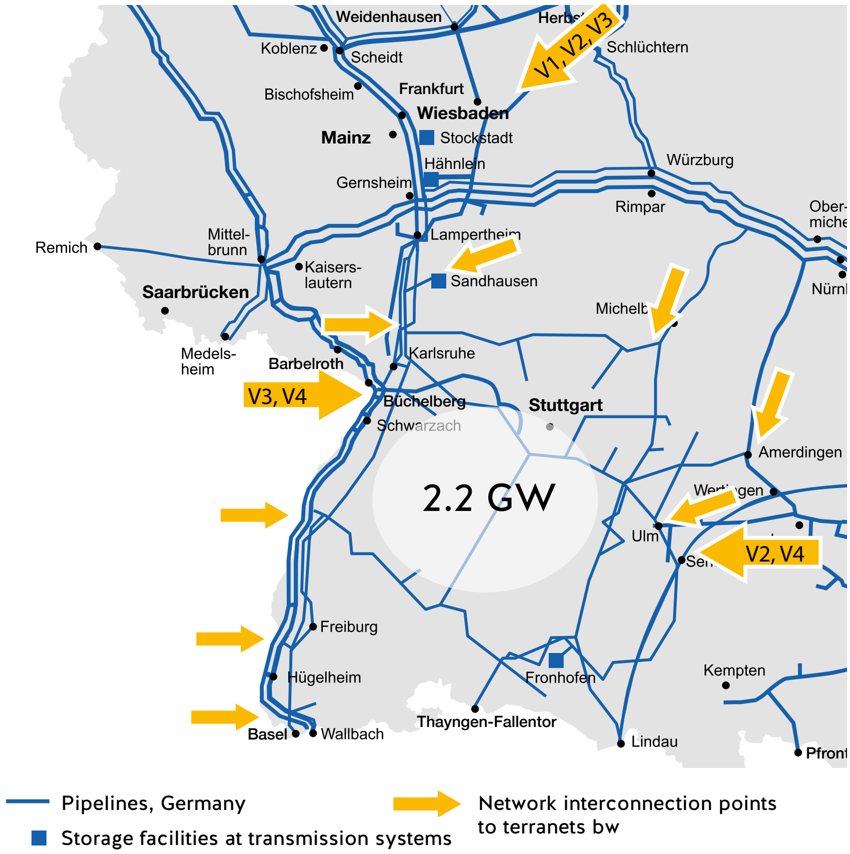
Source: Transmission system operators

7.2.2 Supply variants

Building on the base variant, an examination of the potential entry and supply within terranets was carried out in order to cover the confirmed capacity demand of the design variant for Baden-Württemberg of around 35.6 GWh/h.

The transmission system operators have considered various supply variants in order to determine the required network expansion for the additional capacity demand of 2.2 GWh/h in comparison with the base variant.

Figure 44: Presentation of the supply variants for terranets in the design variant for Baden-Württemberg



Source: Transmission system operators

- **Supply variant 1: North (V1)**
  The additional capacity is provided completely through the new Wirtheim network interconnection point.
- **Supply variant 2: North+East (V2)**
  The additional capacity is provided through the new Wirtheim network interconnection point as well as the Hittistetten or Steinhäule eastern network interconnection point.
- **Supply variant 3: North+West (V3)**
  The additional capacity is provided through the new Wirtheim network interconnection point as well as the Au am Rhein western network interconnection point.
- **Supply variant 4: West+East (V4)**
  The additional capacity is provided through the Au am Rhein western network interconnection point as well as the Hittistetten or Steinhäule eastern network interconnection point.

The different design variants, which are based on the network expansion measures of the base variant for the 2025 modelling year, are presented below. As agreed with the BNetzA, the variants have been modelled by terranets and checked on an indicative basis by the fluid-mechanical upstream transmission system operators. On this basis, the required network expansion measures have been identified and the associate investment costs have been compared.

Supply variant 1: North

In variant 1, the additional capacity demand of approximately 2.2 GWh/h is provided entirely through the Wirtheim network interconnection point in Hesse.

The capacity reports received as part of the scenario framework reveal consumption centres in the terranets network located in the greater Stuttgart/Heilbronn area as well as in the south of the network, including the greater Lake Constance area. Measures extending beyond the expansion proposals of the base variant were identified by terranets in the course of the modelling.

The network expansion measures required in addition to those in the base variant are described below:

- **Heidelberg GPCM station (ID 616-01)**
  This measure is an expansion of the measure under ID 615-01 identified in the base variant and is necessary for the capacity transportation in the Stuttgart and Heilbronn area.
- **Heilbronn GPCM station (ID 618-01)**
  This measure is an expansion of the measure under ID 617-01 identified in the base variant and is necessary for the capacity transportation in the Stuttgart and Heilbronn area.
- **Kirchheim unter Teck GPCM station (ID 620-01)**
  This measure is an expansion of the measure under ID 619-01 identified in the base variant and is necessary for the capacity transportation in the Southern Black Forest and also the Lake Constance region.
- **Weißensberg 2 GPCM station (ID 624-01)**
  This measure is an expansion of the measure under ID 623-01 identified in the base variant and is necessary for the capacity transportation in the Lake Constance region.
- **Nenzingen-Stahringen pipeline (ID 643-01)**
  The measure described here involves the construction of a new pipeline between Nenzingen and Stahringen, which supplies the Konstanz region in the context of a potential discontinuation of storage facilities. This measure is not necessary in the base variant and depends primarily on the consumption trends in the Konstanz region.
- **Schwäbische Alb compressor station (ID 644-01)**
  The measure described here involves the construction of a new compression station on the pipeline going in the direction of the Southern Black Forest. This measure enables capacity to be transmitted from the north of the network to the Southern Black Forest and also the Lake Constance region. This measure is not necessary in the base variant.

The additional investments in the network area of terranets in comparison to the base variant are to be around EUR 64 million.

The upstream transmission system operators have no network expansion that is additionally necessary in comparison with the base variant.

Supply variant 2: North+East

In variant 2, the additional capacity demand totalling 1.65 GWh/h is provided through the Wirtheim network interconnection point in Hesse, while the additional capacity demand totalling 0.55 GWh/h is provided through the Hittistetten network interconnection point in the east.

The additional measures required for the transport of the allocated capacities in the terranets network area have been identified. These include modifications to dimensions compared to the reported variant 1 as well as an additional compression in the southern direction for the Upper Swabia/Lake Constance region. The construction of a new local pipeline has been identified to compensate for the potential discontinuation of storage facilities in the distribution system in the Lake Constance region.

The additional investments in the network area of terranets in comparison to the base variant are to be around EUR 64 million.

The investment costs associated to the additionally necessary network expansion of the upstream transmission system operators are estimated to be around EUR 50 million when compared to the base variant.

Supply variant 3: North+West

In variant 3, the additional capacity demand totalling 0.40 GWh/h is provided through the Wirtheim network interconnection point in Hesse, while the additional capacity demand totalling 1.80 GWh/h is provided through the Au am Rhein network interconnection point in the west.

The additional measures required for the transport of the allocated capacities in the terranets network area have been identified. These include modifications to dimensions as in variant 1, a modification of the compressor station of the Northern Black Forest pipeline (ID 417-02) in the greater Karlsruhe area and an additional southern compression in the Southern Black Forest as well as the Lake Constance region. The construction of a new local pipeline has been identified to compensate for the potential discontinuation of storage facilities in the distribution system in the Lake Constance region.

The additional investments in the network area of terranets in comparison to the base variant are to be around EUR 90 million.

The investment costs associated to the additionally necessary network expansion of the upstream transmission system operators are estimated to be around EUR 100 million when compared to the base variant.

Supply variant 4: West+East

In variant 4, the additional capacity demand totalling 1.80 GWh/h is provided through the Au am Rhein network interconnection point in west Baden-Württemberg, while the additional capacity demand totalling 0.40 GWh/h is provided through the Hittistetten network interconnection point in the east.

The additional measures required for the transport of the allocated capacities in the terranets network area have been identified. These include modifications to dimensions in the compressor station of the Northern Black Forest pipeline (ID 417-02) in the greater Karlsruhe area and an additional southern compression in the direction of Upper Swabia/the Lake Constance region. The construction of a new local pipeline has been identified to compensate for the potential discontinuation of storage facilities in the distribution system in the Lake Constance region.

The additional investments in the network area of terranets in comparison to the base variant are to be around EUR 84 million.

The investment costs associated to the additionally necessary network expansion of the upstream transmission system operators are estimated to be around EUR 140 million when compared to the base variant.

7.2.3 Results of the design variant for Baden-Württemberg and proposal of the transmission system operators on the next course of action

The design variant for Baden-Württemberg considers local changes in the capacity demand of the distribution system operators in Baden-Württemberg. It is used to present the future potential of the measures identified in the base variant. This concerns both modifications to dimensions in measures in the base variant and construction of new measures that are additionally required.

Table 40 below shows the additional investments in the supply variants under consideration that are necessary in comparison with the base variant.

Table 40: Results of the supply variants for 2030

	2030			
	V1	**V2**	**V3**	**V4**
Measures in the terranets network area				
– Additional compressor capacity in comparison with base variant in MW	7	7	11	11
– Additional pipeline construction in comparison with base variant in km	7	7	7	7
Cost estimate by terranets in addition to the base variant in EUR million	64	64	90	84
Cost estimate in the network of upstream TSOs in addition to the base variant in EUR million	–	50	100	140
Estimated total additional costs in comparison with the base variant in EUR million	**64**	**114**	**190**	**224**

Source: Transmission system operators

A comparison between the different estimated investments shows, that the supply variant 1 is the most cost-effective alternative for the design variant for Baden-Württemberg. The results of supply variant 1 are presented in the NDP gas database.

The network expansion measures identified within the framework of the design variant for Baden-Württemberg can be divided into new and modified measures compared to the base variant.

The new network expansion measures identified in comparison with the base variant result from the development and distribution of the capacity demand under the confirmed premises of the design variant for Baden-Württemberg in the period up to 2030. The transmission system operators do not yet plan any consideration in the network expansion proposal for this purpose. A new examination and assessment of the new construction measures that have been identified is to be carried out on the basis of the further developments, especially in terms of the phase-out of coal, in the Gas Network Development Plan 2022–2032.

Measures that mean a change to technical parameters in the base variant have to be assessed differently. Later modification to the dimensions of GPCM stations can be presented under a reassessment in the Gas Network Development Plan 2022–2032, but are associated with losses of time. terranets therefore proposes implementing the dimensioning of the GPCM stations in accordance with the design variant.

Green gas variant 8

8 Green gas variant

8.1 Green gas projects from the survey of market partners

In the course of the market partner survey for green gases, a total of 31 green gas projects were reported to the transmission system operators by 12 July 2019. Of these 31 projects, 27 project developers agreed to have their submissions published. Table 41 below shows these projects and classifies them based on the parameters of gas quality, source/sink, planned commissioning, competent transmission system operator and connection to the TSO and/or DSO network.

Table 41: Green gas projects from the survey of market partners

No.	Designation	Companies involved	Gas type	Source/ sink	Planned com- missioning	Competent TSO	Connection to	
							TSO net- work	DSO net- work
1	Green Hydrogen Integration	BASF	Hydrogen	Sink	2022	GASCADE	x	
2	HySynGas/ARGE Brunsbüttel	ARGE Netz GmbH & Co. KG, MAN, Vattenfall	Hydrogen, synthetic methane	Source	By 2025	GUD	x	x
3	SALCOS	Salzgitter Flachstahl GmbH	Hydrogen	Sink	From 2025	Nowega	x	
4	GET H2	enertrag, Forschungszentrum Jülich, hydrogenious, IKEM, nowega, RWE, SIEMENS, Stadtwerke Lingen	Hydrogen	Source/ sink	2023	Nowega	x	
5	Audi Industriegas	Audi Industriegas	Hydrogen, synthetic methane	Source	In operation	Nowega	x	x
6	BP	BP Europa SE, Ruhr Oel GmbH	Hydrogen	Source/ sink	2022	Nowega/ OGE	x	
7	Innogy Gas Storage	Innogy Gas Storage	Hydrogen	Source/ sink	2025	Nowega/ OGE	x	
8	Evonik	Evonik	Hydrogen	Source/ sink	2023	Nowega/ OGE	x	x
9	Biogas plant InfraServ Wiesbaden	InfraServ GmbH & Co. Wiesbaden KG	Biogas	Source	2020/2021	OGE		x
10	Wasserstoff thyssenkrupp	thyssenkrupp Steel Europe AG	Hydrogen	Sink	From 2021	OGE	x	
11	BW Bürgerwindpark Fehndorf/Lindloh	BW Bürgerwindpark Fehndorf/ Lindloh GmbH & Co. KG	Hydrogen	Source	2021	OGE	x	
12	hybridge	Amprion, OGE	Hydrogen, synthetic methane	Source/ sink	2023	OGE	x	
13	Biogas plant Stadtwerke Trier	Stadtwerke Trier Versorgungs-GmbH	Biogas	Source	2019	OGE		x
14	PtG STEAG	STEAG GmbH	Hydrogen	Source	2024	OGE		x
15	Kreis Steinfurt/ Münster	Kreis Steinfurt/Stadtwerke Münster GmbH/münsterNETZ	Hydrogen	Source/ sink	2024/2020	OGE	x	
16	Wasserstoffein- speisung Mainz	Mainzer Netze GmbH	Hydrogen	Source	2018/2021	OGE		x
17	ZinQ	Voigt & Schweitzer/ZINQ	Hydrogen	Sink	From 2021	OGE		x
18	Grapzow	WIND-WASSERSTOFF-projekt GmbH & Co. KG	Hydrogen	Source	2022	ONTRAS	x	

No.	Designation	Companies involved	Gas type	Source/ sink	Planned com-missioning	Competent TSO	Connection to TSO network	Connection to DSO network
19	Energiepark Bad Lauchstädt	DBI GTI, Terrawatt Planungs-gesellschaft mbH, Uniper Energy Storage GmbH, VNG Gasspeicher GmbH, ONTRAS	Hydrogen	Source/ sink	2023	ONTRAS	x	
20	Wasserstoffregion Lausitz	Energiequelle GmbH, Enertrag AG, IKEM, ONTRAS	Hydrogen	Source	2021	ONTRAS	x	
21	GASAG/E.dis AG	GASAG/E.dis AG	Hydrogen	Source	2020/2021	ONTRAS		x
22	BGEA Schwarze Pumpe	Zweckverband Industriepark Schwarze Pumpe	Biogas	Source	2022	ONTRAS	x	
23	ELEMENT EINS	Thyssengas GmbH (TG) TenneT TSO GmbH Gasunie Deutschland Transport Services GmbH (GUD)	Hydrogen, synthetic methane	Source	By 2030	GUD, Thyssengas	x	x
24	BGEA Krefeld	EGK Entsorgungsanlagengesell-schaft Krefeld GmbH & Co. KG	Biogas	Source	In operation	Thyssengas	x	
25	BGEA Coesfeld	GFC mbH – Gesellschaft des Kreises Coesfeld zur Förderung regenerativer Energien mbH	Hydrogen	Source	By 2025	Thyssengas	x	
26	Salzbergen	No details	Hydrogen	Sink	2023	OGE	x	
27	Statkraft Emden	Statkraft Markets GmbH	Hydrogen	Source	2022	OGE	x	

Source: Transmission system operators

Green gas inquiries with a follow-up inquiry to the TSO and DSO network were taken into account in the transmission system operators' modelling.

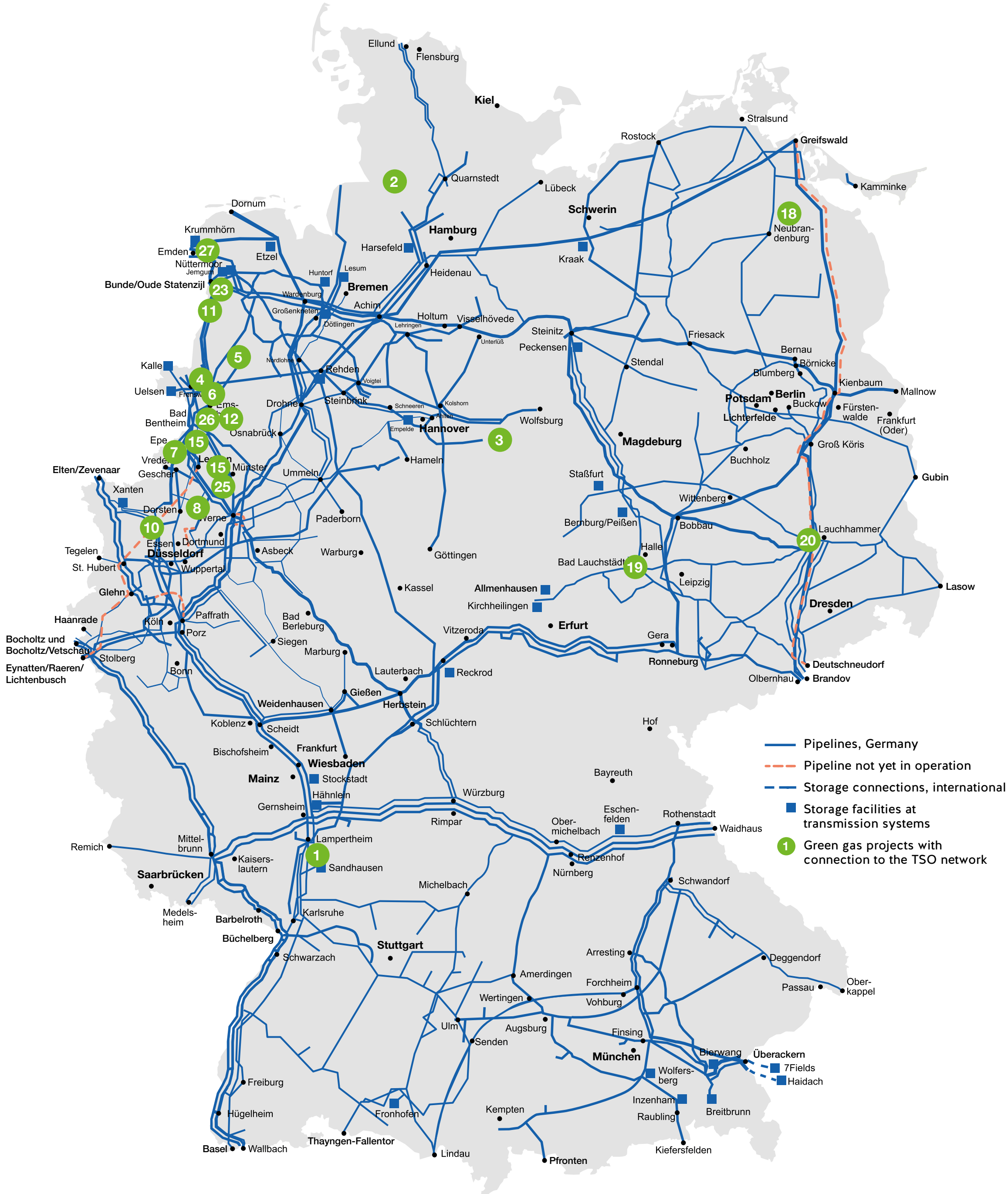
Green gas inquiries with an exclusive follow-up inquiry to the DSO network were not taken into account in the transmission system operators' modelling. The transmission system operators assume that the corresponding inquiries have been or will be placed with the distribution system operators and processed there. This should then be taken into account in the transmission system operators' planning by way of feedback from the distribution system operators to the transmission system operators, including in the context of an adjusted long-term forecast.

Green gas projects in which the hydrogen produced is consumed directly at the industrial location and that therefore do not require a network connection to the transmission system have not been reported to the transmission system operators in conjunction with the market partner survey.

The green gas variant is modelled for 2025 and 2030. Earlier commissioning outside the Network Development Plan process can be examined in consultation with the relevant project partners.

The green gas projects that are connected to the TSO network are presented in Figure 45.

Figure 45: Green gas projects from the market partner survey* with a connection to the TSO network



*Note: Some green gas projects from the market partner survey in the federal states of North-Rhine Westphalia and Bavaria are not presented as they involve trade secrets.

Source: Transmission system operators, reporting date: 1 March 2020

Other green gas projects were reported to the transmission system operators after the 12 July 2019 reporting date. These projects are discussed and examined with the relevant market participants. A reassessment of the projects to be taken into account will be carried out in the Gas Network Development Plan 2022–2032.

8.2 Basic procedure

The transmission system operators included in the modelling only the green gas projects that are intended to be connected to the TSO network.

The green gas variant consists of two forms of modelling:

- **Natural gas modelling:** Review of which pipelines of the existing transmission system can be converted from natural gas to hydrogen. Furthermore, the addition of hydrogen or synthetic methane to the existing natural gas network is modelled.
- **Hydrogen modelling:** Transportation of hydrogen in a separate hydrogen network (converted[3] or new network expansion measures).

The selection of the modelling depends for the specific project on whether hydrogen pipelines converted for transport are available or whether it makes more sense to build new hydrogen pipelines. If this is not possible, pure hydrogen or synthetic methane is added to the natural gas network.

The procedure can be presented here as follows:

1. Identify a potential hydrogen network (basis: green gas projects and visionary hydrogen network)
2. Identify pipelines that can be converted from natural gas to hydrogen (natural gas modelling)
3. Model the hydrogen transport in a separate hydrogen network from the converted natural gas pipelines that have been identified and necessary new-build pipelines (hydrogen modelling)

8.3 Identifying the potential hydrogen network

The starting point for identifying the potential hydrogen network is provided by the observations that were received by the transmission system operators in the visionary hydrogen network published on 28 January 2020 (cf. Chapter 10) as well as by the results of the market partner survey.

In a first stage of the analysis, pipelines of the visionary hydrogen network through which the projects in the market partner survey for 2025 and 2030 could be achieved were selected. This produced a “potential hydrogen network” for the next step of the study.

As part of the natural gas modelling, it was determined in the next step which pipelines of the potential hydrogen network in conjunction with which measures (in the natural gas or the hydrogen network) it may be possible to use in the 2025 and 2030 modelling years for the transportation of hydrogen.

8.4 Natural gas modelling

The natural gas modelling is based on the base variant of this Gas Network Development Plan 2020–2030 with the existing and new pipelines presented in this document. Natural gas modelling examines which pipelines of the potential hydrogen network can be separated/removed from natural gas modelling so that future natural gas demands can still be covered by the remaining pipelines, thereby achieving an optimal overall natural gas and hydrogen supply from the perspective of the transmission system operators. If this is the case, the identified section of pipeline would be available for hydrogen transportation.

The analysis also includes an examination of whether it would be possible to use longer sections of a pipeline in the potential hydrogen network, e.g. by building a new, shorter natural gas pipeline for hydrogen transportation.

3 Converted pipelines are gas pipelines that are used in the transmission system today and that will transport hydrogen instead of methane in the future.

The transmission system operators would like to point out at this juncture that the identified potential hydrogen pipelines are natural gas pipelines needed for natural gas transportation. However, in conjunction with the expansion of the natural gas network (cf. network expansion measures in Chapter 8.10.1), demand for natural gas can be met without these pipelines.

The transmission system operators have taken a maximum blending concentration of 2 % as the basis for modelling the green gas variant. The definition was carried out on the basis of the transmission system operators' assessment that the most extensive tolerability of the methane-hydrogen blend is produced among consumers up to this limit concentration without triggering a signification need for investment both in the network infrastructure and on the consumer side. The transmission system operators do not rule out the possibility that higher blending concentrations will also become feasible in the future.

Hydrogen injection requests for addition are subject in principle to the check of whether the blended gas is compatible with the gas property requirement in accordance with the currently applicable rules and regulation and is interoperable with gas infrastructure directly and indirectly affected in the system.

Nine projects were identified in the course of the market partner survey that was conducted, for which the addition of hydrogen and also of synthetic methane to the existing natural gas network was examined in the modelling. The reason for this is that no natural gas pipeline to be converted to hydrogen was identified for these projects in the period under review up to 2030 and a connection to new hydrogen infrastructure to be constructed does not appear to make sense on account of the distance from the potential hydrogen network (cf. Chapter 8.3). Furthermore, the transmission system operators have also taken technical restrictions into consideration, such as the flow-dynamic relationships prevalent in the pipeline systems in question, which would have resulted in a maximum blending concentration being exceeded (e.g. danger of hydrogen clotting forming where transportation is bidirectional).

Based on the boundary conditions previously described as well as the results of the natural gas modelling, the five projects described below are suitable for direct addition of hydrogen to the existing natural gas infrastructure:

1. BW Bürgerwindpark Fehndorf/Lindloh,
2. Grapzow,
3. Wasserstoffregion Lausitz,
4. BEGA Coesfeld,
5. Statkraft Emden.

The natural gas modelling showed for three projects that direct injection of hydrogen into the existing natural gas network is not possible on account of the technical restrictions referred to above. In this case, prior methanisation has to be carried out, while complying with the requirements for the gas quality. Two of the three projects are subject to secrecy, the third project is HySynGas/ARGE Brunsbüttel.

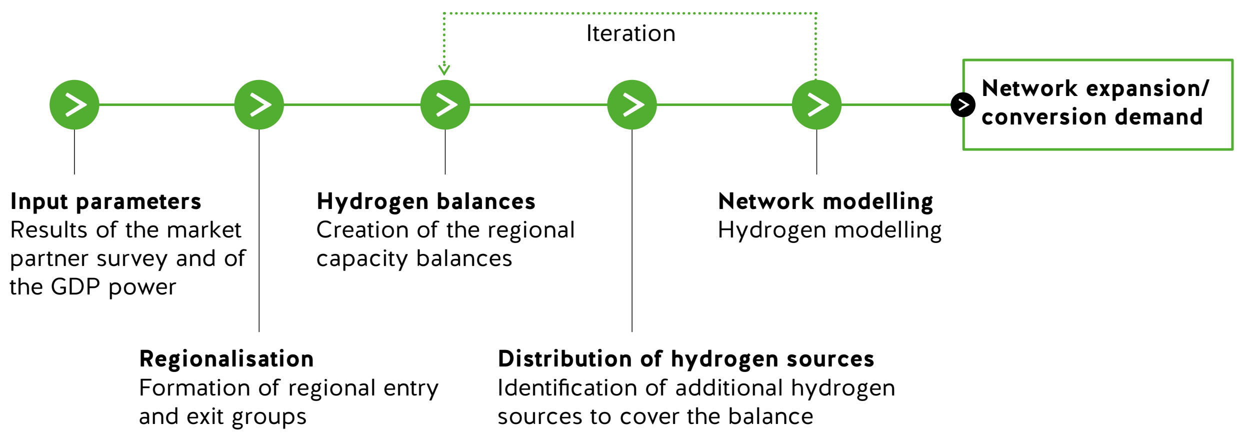
The results of the natural gas modelling additionally show that not all hydrogen exit requests from the market partner survey can be connected to a potential hydrogen network, as the existing gas infrastructure is not available for conversion to hydrogen until 2030. This means that no connection to a hydrogen network of a transmission system operator will be possible for the project Green Hydrogen Integration until 2030.

Which pipelines can be made available for the hydrogen modelling is examined in the course of the natural gas modelling (cf. Chapter 8.9). Which measures may be necessary in order to make available the pipelines of the potential hydrogen network in the 2025 and 2030 modelling years to be used for hydrogen transmission is also examined. The natural gas pipelines identified can be found together with the results of the modelling in Chapter 8.10.

8.5 Hydrogen modelling

The basic approach for the hydrogen modelling of the green gas variant is presented in Figure 46. The starting point is provided by the input parameters of the network modelling for the green gas variant, i.e. the project reports in the market partner survey of 12 July 2019 and the results of the Grid Development Plan Power 2019–2030 (GDP Power) with the locations of PtG plants. Taking these input parameters into account, regional entry/exit groups are created in the next step. After the relevant groups are formed, hydrogen capacity balances are drawn up for the regions that have been identified and the hydrogen capacity demand additionally necessary to cover the balance based on the results of the market partner survey and the Grid Development Plan Power is determined. The additional hydrogen demand required is subsequently allocated on the basis of these results to the entry points identified in the course of the distribution of hydrogen sources. The network modelling of the transmission system operators is then performed, where the necessary network expansion or conversion requirement is identified. An iteration is carried out in the course of the modelling if necessary in order to determine the expansion of the hydrogen network.

Figure 46: Basic procedure for the hydrogen modelling of the green gas variant



Source: Transmission system operators

8.6 Input parameters for the hydrogen modelling

In accordance with the criteria described in the scenario framework, 21 green gas projects (hydrogen, synthetic methane) have been taken into consideration in the hydrogen modelling for the Gas Network Development Plan 2020–2030. Some project developers requested that the reported data be anonymised.

8.6.1 Results of the market partner survey

The Germany-wide hydrogen capacity balance presented in Table 42 and Figure 47 was produced for the entire period up to 2030 from the market partner survey.

Overall, a shortfall is produced in the energy balance, i.e. there is a higher demand for hydrogen than can be covered by existing hydrogen sources. The shortfall in cover amounts to 1,166 MW_{th} and 1,906 MW_{th} for the 2025 and 2030 modelling years respectively. This additional demand that has been identified has to be covered from other hydrogen sources (cf. Chapter 8.8).

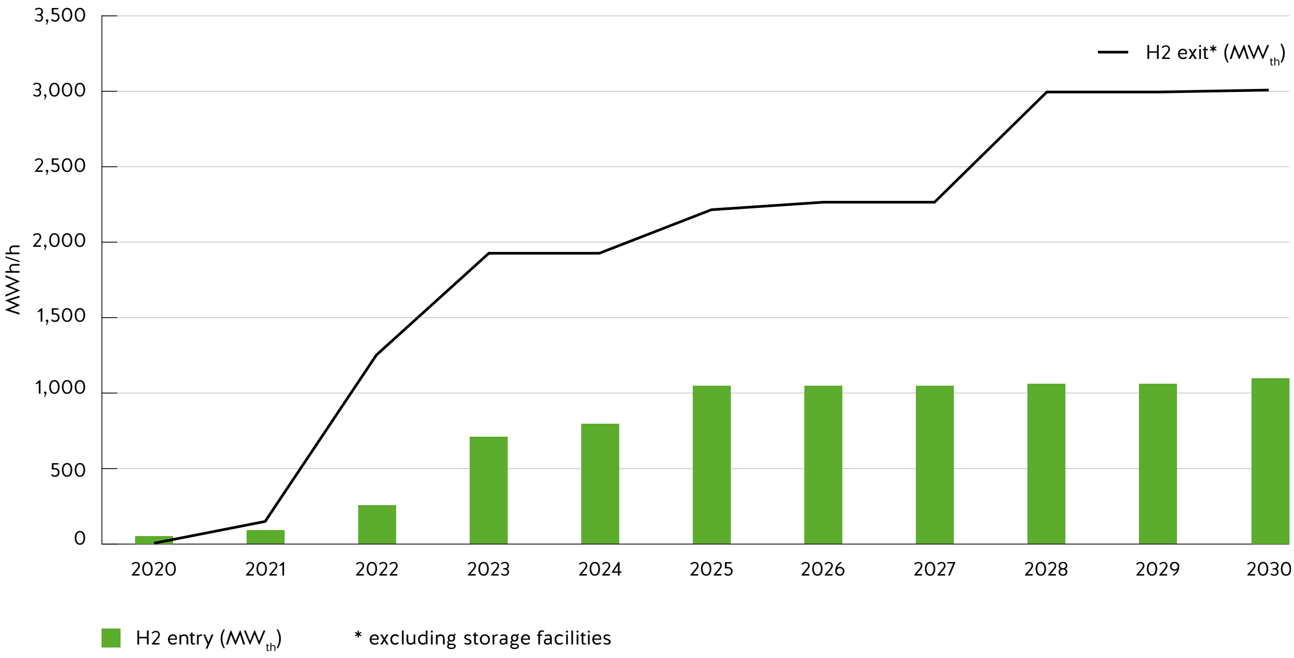
Table 42: Presentation of totals of the green gas projects taken into consideration by the transmission system operators in the hydrogen modelling

Year	Electrolysis capacity	H2 entry	H2 exit*	Additional demand
	MW_e	MW_{th}		
2020	67	50	1	0
2021	119	89	147	58
2022	338	253	1,248	995
2023	943	707	1,922	1,215
2024	1,042	793	1,922	1,130
2025	1,397	1,044	2,210	1,166
2026	1,397	1,044	2,260	1,216
2027	1,397	1,044	2,260	1,216
2028	1,417	1,058	2,989	1,931
2029	1,417	1,058	2,989	1,931
2030	1,467	1,095	3,002	1,906

* excluding storage facilities

Source: Transmission system operators

Figure 47: Germany-wide hydrogen capacity balance in the survey of market partners



Source: Transmission system operators

8.6.2 Consideration of the Grid Development Plan Power

In order to cover the hydrogen demand resulting from the market partner survey, power-to-gas plant capacity that goes beyond the electrolysis capacity of the green gas projects that been reported in concrete has to be taken into consideration.

To this end, the BNetzA has determined in the confirmation of the scenario framework that the district-specific electrolysis capacity assumed by the transmission system operators (electricity) in the 2019–2030 scenario framework (scenario B 2030) for hydrogen can be taken into consideration in addition to the results of the market partner survey. A condition for this is that the electrolysis capacity identified in the market partner survey does not exceed the capacity indicated in the Grid Development Plan Power. Table 43 below presents the electrolysis capacity from the Grid Development Plan Power of 400 MW_e and 1,600 MW_e at the level of the federal states for the 2025 and 2030 modelling years respectively. This is equivalent to a thermal output of 300 MW_{th} in 2025 and of 1,200 MW_{th} in 2030.

Table 43: Electrolysis volumes from the Grid Development Plan Power that are taken into consideration

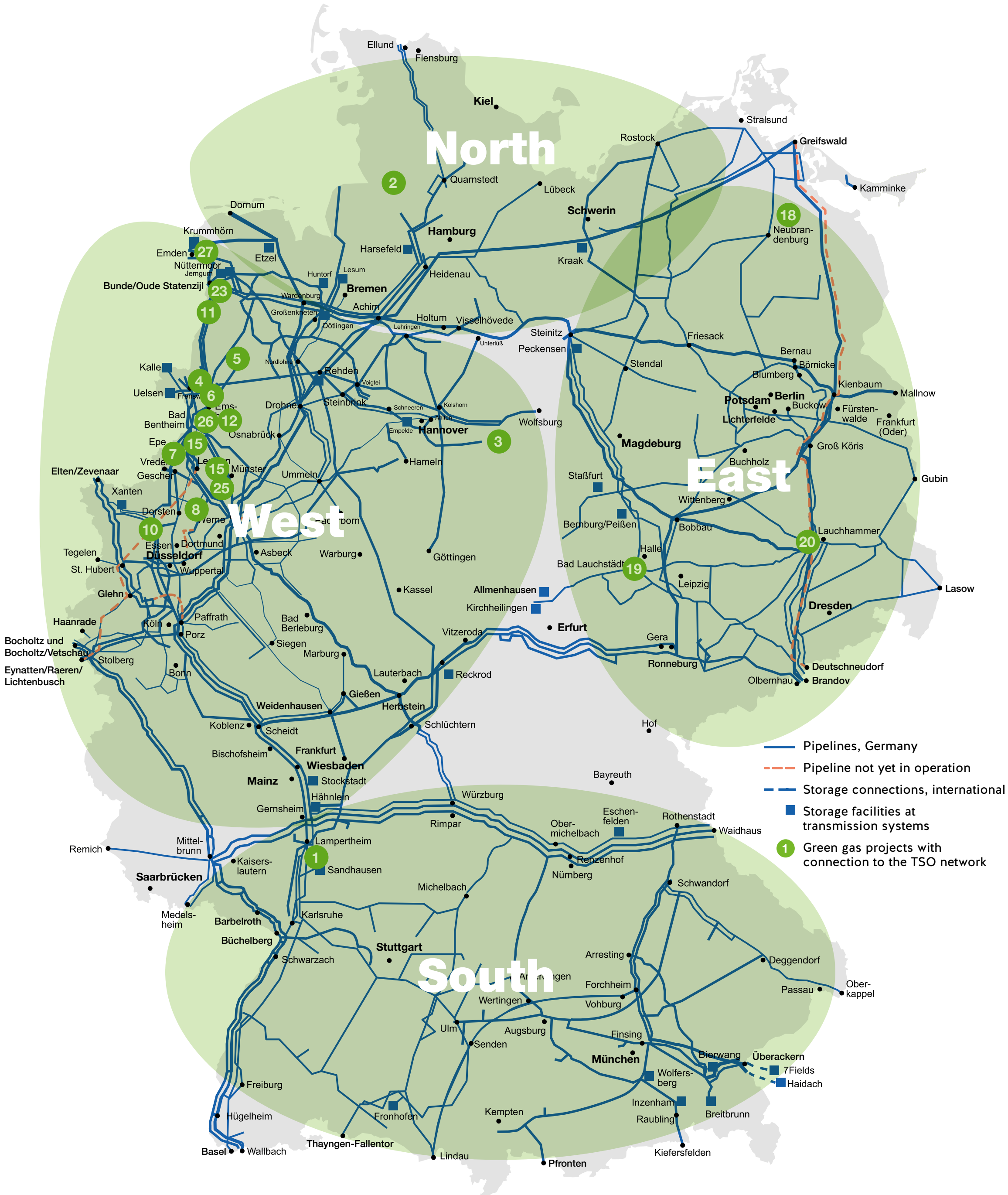
	Electrical power output (MW_e)	
Federal state	**2025**	**2030**
Baden-Württemberg	0.7	3.0
Bavaria	25.5	99.0
Berlin	0.2	1.0
Brandenburg	37.7	147.0
Bremen	2.1	8.0
Hamburg	2.1	8.0
Hesse	2.1	8.0
Mecklenburg-West Pomerania	0.2	1.0
Lower Saxony	49.9	195.0
North Rhine-Westphalia	151.4	611.0
Rhineland-Palatinate	27.6	107.0
Saxony	31.8	125.0
Saxony-Anhalt	39.9	175.0
Schleswig-Holstein	21.2	83.0
Thuringia	5.3	21.0
Total	**400**	**1,600**

Source: Transmission system operators

8.7 Regional consideration in the hydrogen modelling

The transmission system operators have carried out a regional consideration and summarised project reports in the vicinity for the green gas projects. Four regions have been produced here, which are described below (cf. Figure 48).

Figure 48: Overview of the regions for the green gas variant



Note: Other green gas projects from the market partner survey in the federal states of North Rhine-Westphalia and Bavaria are not presented because they involve trade secrets.

Source: Transmission system operators, reporting date: 1 March 2020

8.7.1 North Region

Only one project, the HySynGas/ARGE Brunsbüttel, that envisages an injection of green gas is located in the north region. There has been no demand for the procurement of hydrogen in the region. It is thus not necessary to consider the region for energy balance purposes. The planning of the transmission system operators currently does not envisage any conversion of a neighbouring pipeline to hydrogen before 2030. For this reason, the addition of the hydrogen to the natural gas network or methanisation should be pursued.

8.7.2 East Region

An integral element of the Energiepark Bad Lauchstädt project is the connection of at least one cavern of the Bad Lauchstädt underground gas storage facility to an existing hydrogen network by means of a transmission line routing (FGL 46.04/FGL 201.07) that is approximately 20 km long and that has up to now been integrated in the H-gas network of ONTRAS. This transmission line routing will be completely separated from the ONTRAS network and used exclusively for shipping hydrogen to this end. Separate modelling of this pipeline run and a consideration of the region for energy balance purposes is not necessary.

8.7.3 South Region

BASF reported a hydrogen demand for the Ludwigshafen chemical industry location in the course of the green gas projects survey. The long-term goal is to reduce the CO_2 emissions at the Ludwigshafen location among things by using climate-neutral hydrogen. The demand may increase significantly up to 2050 in the course of the Carbon Management Programme in process.

The reported demand cannot be covered by an injection of hydrogen from the south region, as no suitable potential sources of hydrogen are available here to date. Consideration of this demand in the west region is also not possible for the planning horizon up to 2030 as things stand at present, because no hydrogen infrastructure will yet be available up to that time. This project therefore has to be taken into consideration as part of the visionary hydrogen network of the transmission system operators.

One project for the production of hydrogen and for subsequent injection into the gas network was reported in the federal state of Bavaria. The market partner requested that this project be treated anonymously, and a detailed description and a disclosure of expansion measures therefore has to be forgone.

8.7.4 West Region

The majority of the green gas projects reported in the course of the market partner survey are located in Lower Saxony, Schleswig-Holstein and North Rhine-Westphalia. The transmission system operators have therefore conducted a joint consideration of these projects in a “West” balancing area and network area.

Hydrogen balance of green gas projects in the West Region

The hydrogen balance presented in Table 44 is compared on the basis of the West Region’s hydrogen demand resulting from green gas projects taken into consideration with the expected hydrogen supply.

Table 44: West Region: Hydrogen balance on the basis of the green gas projects taken into consideration

Year	Entry in total	Entry in total	Exit* in total	Additional demand
	MW_e	MW_{th}		
2025	1,071	803	1,730	927
2030	1,193	890	2,751	1,861

* excluding storage facilities

Source: Transmission system operators

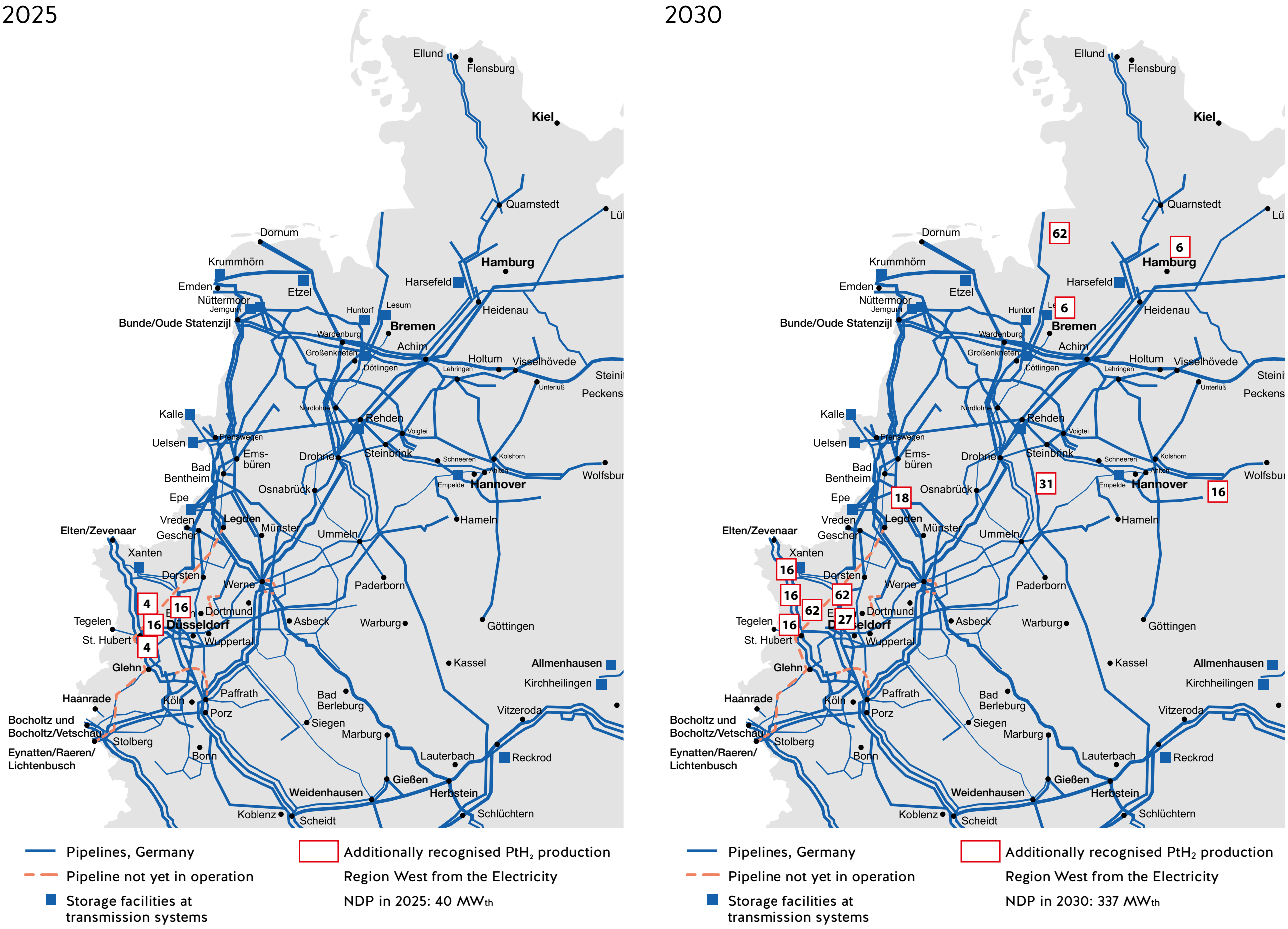
A shortfall is produced in the energy balance of 927 MW_{th} for the 2025 modelling year and of 1,861 MW_{th} for the 2030 modelling year, which has to be covered by additional hydrogen sources.

Consideration of the Grid Development Plan Power for the West Region

The consideration of the Grid Development Plan Power produces the thermal electrolysis capacity additionally recognised in Figure 49 for the West Region. Some capacity has not been taken into consideration for energy balance purposes because of the large distance from the TSO hydrogen network.

In total, capacity of 40 MW_{th} that additionally has to be recognised is produced for the 2025 modelling year and capacity of 337 MW_{th} that additionally has to be recognised is produced for the 2030 modelling year.

Figure 49: Additionally recognised electrolysis capacity in 2025 and 2030 in the West Region in MW_{th}



Source: Transmission system operators

Taking into consideration the intersection of the market partner survey with the Grid Development Plan Power, the hydrogen balance presented in Table 45 is produced for the West Region.

Table 45: West Region: Hydrogen balance including intersection with the Grid Development Plan Power

Year	Entry in total	Additional capacity, GDP Power	Exit* in total	Additional demand
	MW_{th}			
2025	803	40	1,730	887
2030	890	337	2,751	1,523

* excluding storage facilities

Source: Transmission system operators

A shortfall is produced in the energy balance of 887 MW_{th} for the 2025 modelling year and of 1,523 MW_{th} for the 2030 modelling year, which has to be covered by additional hydrogen sources within the framework of the distribution of hydrogen sources. The coverage of the additional hydrogen demand is presented in Chapter 8.8.

8.8 Additional hydrogen demand for the West region in 2025 and 2030

It is examined below for the 2025 and 2030 modelling years for the West Region what additional hydrogen sources – extending beyond the results of the market partner survey and the consideration of the Grid Development Plan Power – could be available to cover the hydrogen demand.

The transmission system operators have already shown in the scenario framework, by reference to various studies and the market partner survey conducted in 2019, that the demand for hydrogen cannot be covered solely by a forecast electrolysis capacity of 2.8 GW_e in 2030. In this respect, there is a need to tap other supply sources for a well-adjusted hydrogen balance.

8.8.1 Basic procedure

As the electrolysis capacity from the market partner survey and the Grid Development Plan Power is not sufficient to cover the hydrogen demand, the transmission system operators have considered other potential sources of hydrogen:

- Domestic production of “green” hydrogen from onshore wind farms where the renewable energy sources subsidy has expired
- Imports of decarbonised hydrogen (“green” or “blue”)
- Storage facilities

Domestic production of “green” hydrogen from onshore wind farms where the renewable energy sources subsidy has expired

The next few years will see an increasing number of onshore wind turbines which have been in operation for more than 20 years. These wind turbines will then drop out of the support scheme of the Erneuerbare-Energien-Gesetz (EEG – Renewable Energy Sources Act), as this support is limited to a maximum of 20 years. It can be assumed that a certain number of the wind turbines will be repowered, i.e. they will be replaced by more powerful turbines in the same location. Another part of the turbines are expected to continue to be operated unchanged or following an overhaul. Electricity from these turbines will then be sold directly to the electricity exchanges or through power purchase agreements (PPA) [BWE 2019]. There is additionally the option of converting the electricity into heat or green gases using power-to-x technologies.

It is therefore assumed for the modelling of the green gas variant that wind turbines will also become available as a further source for providing renewable electricity for electrolysis plants. The EEG plant master data register of the electricity transmission system operators has been evaluated in order to determine the potential for this additional electrolysis capacity [ÜNB 2019]. Using this register, the wind energy output where the renewable energy sources subsidy will expire in the next five to ten years can be determined for each specific location. This is around 15.6 GW_e in 2025 and around 24.4 GW_e in 2030. Using the postcodes of the individual wind turbine locations, this capacity can be allocated to the individual districts in Germany.

With regard to the distribution of the hydrogen sources, there is a concentration on the West Region, as there is here a demand for hydrogen in the selected system of the market partner survey that has to be covered. The region, consisting of the federal states of Lower Saxony, Schleswig-Holstein and North Rhine-Westphalia, is home to wind turbine potential where the renewable energy sources subsidy will expire by 2030 of around 10.8 GW_e (7.4 GW_e in 2025).

As it is assumed that the wind turbines for which renewable energy subsidies have expired are still largely used to meet demand for electricity, only a small share of domestically produced capacity from "green" hydrogen from these onshore wind farms is used to cover the capacity balance (share in 2030: 4 %).

Imports of decarbonised hydrogen ("green" or "blue")

Potential for compensating the hydrogen balance is seen by the transmission system operators in neighbouring European countries, especially the Netherlands. The Netherlands adopted the National Climate Agreement in June 2019. One of the integral elements of the agreement is both to establish hydrogen as climate-neutral energy source and to provide it on a cross-border basis.

There are already numerous major projects in the Netherlands in which it is planned to produce climate-neutral hydrogen. Furthermore, the EU Commission last year commended the Hydrogen for Important Projects of Common European Interest (H2-IPCEI) research framework as an important instrument in the "Green Deal". Twelve project proposals have been put forward to the H2-IPCEI to date. In the Netherlands and Belgium, the Green Octopus project is set to be realised to generate green hydrogen with an electrolysis output of 6 GW_e. A map published by the Green Octopus project shows the conversion of around 2,000 km of existing natural gas transport pipelines to hydrogen, where cross-border interconnection points with Germany are also planned.

Other major projects are intended to contribute to an increase in the hydrogen supply in the Netherlands, for example the Green Flamingo project, which plans for hydrogen imports from Portugal in the GW order of magnitude.

In addition to green hydrogen, the option of generating hydrogen from natural gas in a climate-neutral way is being vigorously pursued. There are already major projects in the Netherlands for this "blue" hydrogen, which will be launched in the next few years with the production of climate-neutral hydrogen. The Magnum project in Eemshaven with a capacity of around 1 GW_{th} to generate hydrogen and the H2-vision project in Rotterdam with a capacity of around 1 GW_{th} to 3 GW_{th} are just two examples of this.

Overall, it can be assumed that a capacity of around 10 GW_{th} for generating climate-neutral hydrogen will be available in the Netherlands in 2030. Given this background, the transmission system operators assume an increasing proportion of hydrogen exports to Germany up to 2030, with the result that the availability of a generating capacity of around one GW_{th} for export to Germany is estimated as realistic.

Storage facilities

Requests for injections of hydrogen from storage facilities to the transmission system totalling around 300 MW_{th} were received in the course of the market partner survey. The transmission system operators assume that greater withdrawal capacity will become available when the first caverns have been converted for hydrogen. The transmission system operators therefore decided for the Gas Network Development Plan 2020–2030 to take additional capacity from storage facilities into consideration in the distribution of hydrogen sources.

Distribution of the additional hydrogen demand

Overall, therefore, the transmission system operators assume the following percentage distribution of the other hydrogen sources to cover the demand for hydrogen:

- Imports of decarbonised hydrogen from the Netherlands: 70 %
- Domestic production of “green” hydrogen from onshore wind farms where the renewable energy sources subsidy has expired: 20 %
- Additional capacity from storage facilities: 10 %

8.8.2 Additional hydrogen demand for the West region in 2025 and 2030

The percentage distribution previously calculated refers essentially to the 2030 year under review. As less than 70 % of the required capacity will be available from the Netherlands in 2025, the distribution for 2025 will be slightly revised. Based on the initial consultations with GTS conducted beforehand, the transmission system operators recognise the additional entry capacity presented in Table 46.

Table 46: West Region: Covering of the additional demand to 2025 and 2030

	Additional demand (MW_{th})	
	2025	**2030**
Importing of decarbonised hydrogen from the Netherlands	500	1,066
Domestic production of “green” hydrogen from onshore wind farms where the renewable energy sources subsidy has expired	235	305
Storage facilities	152	152
Total additional demand	**887**	**1,523**

Source: Transmission system operators

The capacity from the Netherlands is recognised in the modelling in the Vlieghuis area in 2025 and in Elten in 2030.

Other potential entry points from the Netherlands include Vreden and Oude/Statenzijl from 2030 onwards. As the Netherlands and Germany are connected to Norway by various high-performance transport routes, it would also be conceivable to consider imports from Norway.

In the modelling for the West Region, domestic production of “green” hydrogen was broken down on a regional basis based on the postal codes for the individual turbine locations, and taken into account collectively in the Emsbüren and Ochtrup clusters in 2025, and in the three Löningen, Rehden and Ochtrup clusters in 2030.

The storage capacity included in hydrogen modelling has no effect on the base variant modelling as only a lower working gas volume is needed. The transmission system operators assume that one cavern will be converted to hydrogen at the Epe storage location, and that this is not relevant for the provision of natural gas given the size of the storage facility.

The total balance shown in Table 47 is thus produced in total for the West Region.

Table 47: West Region: Hydrogen balance including additional entry sources

Year	Entry in total	Additional capacity, GDP Power	Additional capacity, NL imports	Additional capacity, wind farms	Additional capacity, storage facilities	Exit* in total
	MW_{th}					
2025	803	40	500	235	152	1,730
2030	890	337	1,066	305	152	2,751

* excluding storage facilities

Source: Transmission system operators

8.9 Results of the hydrogen modelling

The results of the hydrogen modelling for 2025 and 2030 are described below. They are broken down in principle here into the following two categories:

- Measures to convert natural gas pipelines to hydrogen
- New measures on the basis of the hydrogen modelling

A description of the measures can be found in the NDP gas database under the tile "Ausbaumaßnahmen" (expansion measures) in the “2020 – NEP Entwurf” cycle.

8.9.1 Measures to convert natural gas pipelines to hydrogen

Additional network expansion measures in the modelling for 2025 compared with the base variant in the Gas Network Development Plan 2020–2030 are described below:

- **Bad Lauchstädt energy park pipeline system conversion (ID 701-01)**
  The FGL 46.04/FGL 201.07 pipeline system is currently used to transport natural gas and can be converted for potential future hydrogen transportation between Bad Lauchstädt and Schkopau/Leuna.
- **Lingen-Bad Bentheim pipeline system conversion (ID 702-01)**
  The pipeline connection from Lingen to Bad Bentheim is currently used to transport natural gas and can be converted for potential future hydrogen transportation.
- **Emsbüren-Bad Bentheim pipeline system conversion (ID 706-01)**
  The Emsbüren-Bad Bentheim pipeline system is currently used to transport natural gas and can be converted for potential future hydrogen transportation.
- **Bad Bentheim-Legden pipeline system conversion (ID 707-01)**
  The Bad Bentheim-Legden pipeline connection jointly owned by OGE and Nowega is currently used to transport natural gas and can be converted for potential future hydrogen transportation.
- **Legden-Dorsten pipeline system conversion (ID 708-01)**
  The Legden-Dorsten pipeline system jointly owned by OGE and Nowega is currently used to transport natural gas and can be converted for potential future hydrogen transportation.
- **Kalle-Ochtrup pipeline system conversion (ID 713-01)**
  The Kalle-Ochtrup pipeline system is currently used to transport natural gas and can be converted for potential future hydrogen transportation.
- **South Elbe-Heidenau conversion (ID 714-01)**
  The South Elbe-Heidenau pipeline system is currently used to transport natural gas and can be converted for potential future hydrogen transportation.

- **Eckel-Achim pipeline system conversion (ID 715-01)**
  The Eckel-Achim pipeline system is currently used to transport natural gas and can be converted for potential future hydrogen transportation.

- **Ganderkesee-Achim pipeline system conversion (ID 717-01)**
  The Ganderkesee-Achim pipeline system is currently used to transport natural gas and can be converted for potential future hydrogen transportation.

- **Ganderkesee-Bremen pipeline system conversion (ID 718-01)**
  The Ganderkesee-Bremen pipeline system is currently used to transport natural gas and can be converted for potential future hydrogen transportation.

- **South Bavaria pipeline system conversion (anonymous) (ID 724-01)**
  The pipeline connection owned by bayernets is currently used to transport natural gas and can be converted for potential future hydrogen transportation.

Additional network expansion measures in the modelling for 2030 compared with the base variant in the Gas Network Development Plan 2020–2030 are described below:

- **Messingen-Egenstedt pipeline system conversion (ID 703-01)**
  The pipeline connection from Messingen to Egenstedt is currently used to transport natural gas and can be converted for potential future hydrogen transportation. The pipeline sections that are included are: Messingen-Rehden; Rehden-Voigtei; Voigtei-Middle Weser; Kolshorn-Egenstedt.

- **Middle Weser-Kolshorn pipeline system conversion (ID 704-01)**
  The Middle Weser-Kolshorn pipeline system is currently used to transport natural gas and can be converted for potential future hydrogen transportation.

- **Löningen-Emsbüren pipeline system conversion (ID 705-01)**
  The Löningen-Emsbüren pipeline system is currently used to transport natural gas and can be converted for potential future hydrogen transportation.

- **Rheine-Wettringen pipeline system conversion (ID 709-01)**
  The Rheine-Wettringen pipeline system is currently used to transport natural gas and can be converted for potential future hydrogen transportation.

- **Wettringen-Albachten pipeline system conversion (ID 710-01)**
  The Wettringen-Albachten pipeline system is currently used to transport natural gas and can be converted for potential future hydrogen transportation.

- **Elten-Sonsbeck pipeline system conversion (NETG) (ID 711-01)**
  The Elten-Sonsbeck (NETG) pipeline system is currently used to transport natural gas and can be converted for potential future hydrogen transportation.

- **Sonsbeck-Hamborn pipeline system conversion (ID 712-01)**
  The Sonsbeck-Hamborn pipeline system under the joint ownership of OGE and Thyssengas is currently used to transport natural gas and can be converted for potential future hydrogen transportation.

- **Oude Statenzijl-Ganderkesee pipeline system conversion (ID 716-01)**
  The Oude Statenzijl-Ganderkesee pipeline system is currently used to transport natural gas and can be converted for potential future hydrogen transportation.

- **Folmhusen-Nüttermoor pipeline system conversion (ID 719-01)**
  The Folmhusen-Nüttermoor pipeline system is currently used to transport natural gas and can be converted for potential future hydrogen transportation.

- **Barßel-Rheine pipeline system conversion (ID 720-01)**
  The Barßel-Rheine pipeline system is currently used to transport natural gas and can be converted for potential future hydrogen transportation.

- **Ganderkesee-Drohne pipeline system conversion (ID 721-01)**
  The Ganderkesee-Drohne pipeline system is currently used to transport natural gas and can be converted for potential future hydrogen transportation.

- **Ganderkesee GPCM station (ID 722-01)**
  The measure described here involves the retrofitting of a GPCM station to connect the Ganderkesee-Drohne pipeline section that is to be converted with the Oude Statenzijl-Ganderkesee, Ganderkesee–Bremen and Ganderkesee-Achim pipeline systems that are to be converted.

- **Barßel GPCM station (ID 723-01)**
  The measure described here involves the retrofitting of a GPCM station to connect the Barßel-Emsbüren pipeline section that is to be converted with the Oude Statenzijl-Ganderkesee pipeline system that is to be converted.

8.9.2 New measures in the hydrogen modelling

Additional network expansion measures in the modelling for 2025 compared with the base variant in the Gas Network Development Plan 2020–2030 are described below:

- **New Frensdorfer Bruchgraben-Frenswegen pipeline construction (ID 731-01)**
  The measure described here is a new pipeline construction project, including all necessary technical installations, that serves the network interconnection point between Thyssengas and Nowega. This will be necessary in the course of supplying the network with hydrogen from the Netherlands. The measure is located north-west of Nordhorn.

- **New Dorsten-Hamborn pipeline construction (ID 733-01)**
  The measure described here is a new pipeline construction project, including all necessary technical installations. The new hydrogen pipeline is planned to be constructed between Dorsten and Hamborn to connect the Bad Bentheim-Legden and Sonsbeck-Hamborn pipelines that are to be converted.

- **New Epe-Ochtrup pipeline construction (ID 734-01)**
  The measure described here is a new pipeline construction project, including all necessary technical installations. The new hydrogen pipeline is planned to be constructed between Epe and Ochtrup to connect the Bad Bentheim-Legden pipeline that is to be converted with the Epe gas storage facility.

- **New Dorsten-Marl pipeline construction (ID 735-01)**
  The measure described here is a new pipeline construction project, including all necessary technical installations. The new hydrogen pipeline is planned to be constructed between Dorsten and Marl to connect the Legden-Dorsten pipeline that is to be converted with the industrial park in Marl.

- **Dorsten GPCM station and connecting pipeline (ID 739-01)**
  The measure described here involves the construction of a new GPCM station to connect the Legden-Dorsten pipeline that is to be converted with the new Dorsten-Hamborn and Dorsten-Marl pipelines that are to be constructed.

- **Bad Bentheim GPCM station and connecting pipeline (ID 740-01)**
  The measure described here involves the construction of a new GPCM station to connect the Emsbüren-Bad Bentheim, Bad Bentheim-Legden and Lingen-Bad Bentheim pipelines that are to be converted.

- **New Vlieghuis-Kalle pipeline construction (ID 743-01)**
  The measure described here is a new pipeline construction project, including all necessary technical installations. The new hydrogen pipeline is planned to be constructed between the Dutch border at Vlieghuis and Kalle to connect potential Dutch hydrogen sources with the Kalle-Ochtrup system that is to be converted.

Additional network expansion measures in the modelling for 2030 compared with the base variant in the Gas Network Development Plan 2020–2030 are described below:

- **Schlootdamm/Steinfeld GPCM station (ID 730-01)**
  The measure described here involves the construction of a new GPCM station for the overfeed transmission of gas volumes from the Ganderkesee-Drohne pipeline system to the Nowega system as well as of the new connecting pipeline required for this.
- **New Egenstedt-Hallendorf pipeline construction (ID 732-01)**
  The measure described here is a new pipeline construction project, including all necessary technical modifications. The new hydrogen pipeline is planned to be constructed between Egenstedt and Hallendorf and will be used to supply hydrogen.
- **Elten GPCM station and connecting pipeline (ID 736-01)**
  The measure described here involves the construction of a new GPCM station to connect the Elten-Sonsbeck pipeline section of NETG that is to be converted with the potential hydrogen sources from the Netherlands.
- **Sonsbeck GPCM station and connecting pipeline (ID 737-01)**
  The measure described here involves the construction of a new GPCM station to connect the Elten-Sonsbeck pipeline section of NETG that is to be converted with the Sonsbeck-Hamborn pipeline that is to be converted.
- **Hamborn GPCM station and connecting pipeline (ID 738-01)**
  The measure described here involves the construction of a new GPCM station to connect the Sonsbeck-Hamborn pipeline that is to be converted with the new Dorsten-Hamborn pipeline that is to be constructed.
- **Emsbüren GPCM station and connecting pipeline (ID 741-01)**
  The measure described here involves the construction of a new GPCM station to connect the Löningen-Emsbüren, Emsbüren-Bad Bentheim and Barßel-Emsbüren pipelines that are to be converted.
- **Wettringen valve station and connecting pipeline (ID 742-01)**
  The measure described here involves the construction of a new valve station to connect the Rheine-Wettringen and Wettringen-Albachten pipelines that are to be converted.

8.9.3 Other measures in the hydrogen modelling

To cover the hydrogen demand in the energy balance, the transmission system operators have also recognised electrolysis capacity from the Grid Development Plan Power and from wind turbines where the renewable energy source subsidy will expire in addition to the green gas projects that have been taken into consideration.

The measures that result from the connection of these projects and plants to the transmission system are not shown. On the one hand, these are expected to involve connection pipelines that do not fulfil the factual requirements of section 15a EnWG based on the statements of the BNetzA in the request to change the Gas Network Development Plan 2018–2028 and accordingly do not belong to the measures that can form part of the Network Development Plan. On the other, the measures cannot be specified in adequate detail for a network expansion proposal yet.

Connection infrastructure is also required for each of the projects that were reported in the course of the market partner survey conducted by the transmission system operators. For the exit, these generally consist of a connection pipeline and GPCM station, while for the injection into the transmission network they may additionally include a compressor in order to increase the hydrogen injection to the required pressure level. This also applies to a potential compression at cross-border interconnection points for the import of hydrogen. The transmission system operators have also not shown this connection infrastructure for the reasons mentioned above.

New compressor stations for the hydrogen network are not needed until 2030 under the Gas Network Development Plan for 2020–2030. The pipelines that have been identified for conversion to hydrogen are largely part of what is currently the L-gas network, and are scaled to current L-gas requirements. As hydrogen requirements are still relatively low in the Gas Network Development Plan for 2020–2030, hydrogen transportation is achievable with very low pressure losses.

8.10 Results of the natural gas modelling

The results of the natural gas modelling for 2025 and 2030 are described below.

A description of the measures can be found in the NDP gas database under the tile "Ausbaumaßnahmen" (Expansion measures) in the “2020 – NEP Entwurf” cycle.

8.10.1 New measures in the natural gas modelling

Additional network expansion measures in the modelling for 2025 compared with the base variant in the Gas Network Development Plan 2020–2030 are described below:

- **Heiden Borken-Dorsten pipeline (ID 436-02b, division of the pipeline into two sections)**
  The measure described here is a new pipeline construction project, including all necessary technical installations. The new pipeline is to be constructed between Heiden Borken and Dorsten. The pipeline route begins with the connection to the Heiden Marbeck-Heiden Borken pipeline and the Heiden Borken GPCM station and ends with the connection at the existing Gescher-Dorsten natural gas transmission pipeline near Dorsten.

- **Rehden-Diepholz pipeline (ID 760-01)**
  The measure described here is a new pipeline construction project, including all necessary technical installations. The new pipeline is planned to be built between Rehden and Diepholz to supply a downstream network operator with H-gas.

- **Egenstedt-Clauen pipeline (ID 761-01)**
  The measure described here is a new pipeline construction project, including all necessary technical installations. The new pipeline is planned to be built between Egenstedt and Clauen to supply a downstream network operator with H-gas.

- **South Elbe-Achim pipeline (ID 767-01)**
  The measure described here is a new pipeline construction project running in parallel to the existing pipeline system between South Elbe and Achim, including all necessary technical installations. A pipeline has to be constructed between South Elbe and Achim to ship LNG from the planned LNG facilities in Brunsbüttel and Stade. If this is designed with a larger diameter than is required for shipping LNG, all gas flows can be presented through the newly constructed pipeline. The existing pipeline system between South Elbe and Achim is then ready to be converted to potential future transportation of hydrogen.

Additional network expansion measures in the modelling for 2030 compared with the base variant in the Gas Network Development Plan 2020–2030 are described below:

- **Wallach-Alpen pipeline (ID 762-01)**
  The measure described here is a new pipeline construction project, including all necessary technical installations, to supply Alpen with H-gas. The new pipeline is planned to be constructed between Wallach and Alpen.

- **Budberg-Eversael pipeline (ID 763-01)**
  The measure described here is a new pipeline construction project, including all necessary technical installations, to supply Eversael with H-gas. It is planned to construct the new pipeline between Budberg and Eversael.

- **Sonsbeck-Oberhausen pipeline link remodelling (ID 764-01)**
  The measure described here involves several projects along the Sonsbeck-Hamborn pipeline to supply the connection customers and network interconnection points with H-gas via a parallel pipeline system. The measures are located in the western Ruhr region and the Wesel region.

- **Glehn II GPCM station (ID 765-01)**
  The measure described here involves the construction of a new GPCM station for the overfeed transmission of gas volumes from the NETG to the Thyssengas pipeline system as well as of the new connecting pipelines required for this. The measure is located approximately 10 km east of Mönchengladbach.

- **Hamborn I GPCM station (ID 766-01)**
  The measure described here involves the extension of a GPCM station for the overfeed transmission of gas volumes from the Hünxe-Hamborn pipeline system to the Hamborn-Barmen pipeline system. The measure is located in Duisburg.

- **Hassel-Westen pipeline (ID 768-01)**
  The measure described here is a new pipeline construction project between Hassel and Westen, including all necessary technical installations, with a connection to the intersecting H-gas system. The Westen and Hassel exit points can thus continue to be supplied with natural gas, while the Middle Weser-Kolshorn pipeline system is ready for conversion to potential future hydrogen transmission.

Network expansion measures that have been discontinued in the modelling for 2025 compared with the base variant in the Gas Network Development Plan 2020–2030 are described below

- **South Elbe-Achim pipeline (ID 636-01)**
  The South Elbe-Achim pipeline measure (ID 636-01) is planned with larger dimensions than the South Elbe-Achim pipeline measure (ID 767-01) in the green gas variant. Measure ID 767-01 therefore replaces measure ID 636-01 in the green gas variant.

8.11 Results of the green gas variant

The green gas variant produces the following results overall:

Table 48: Results of the green gas variant

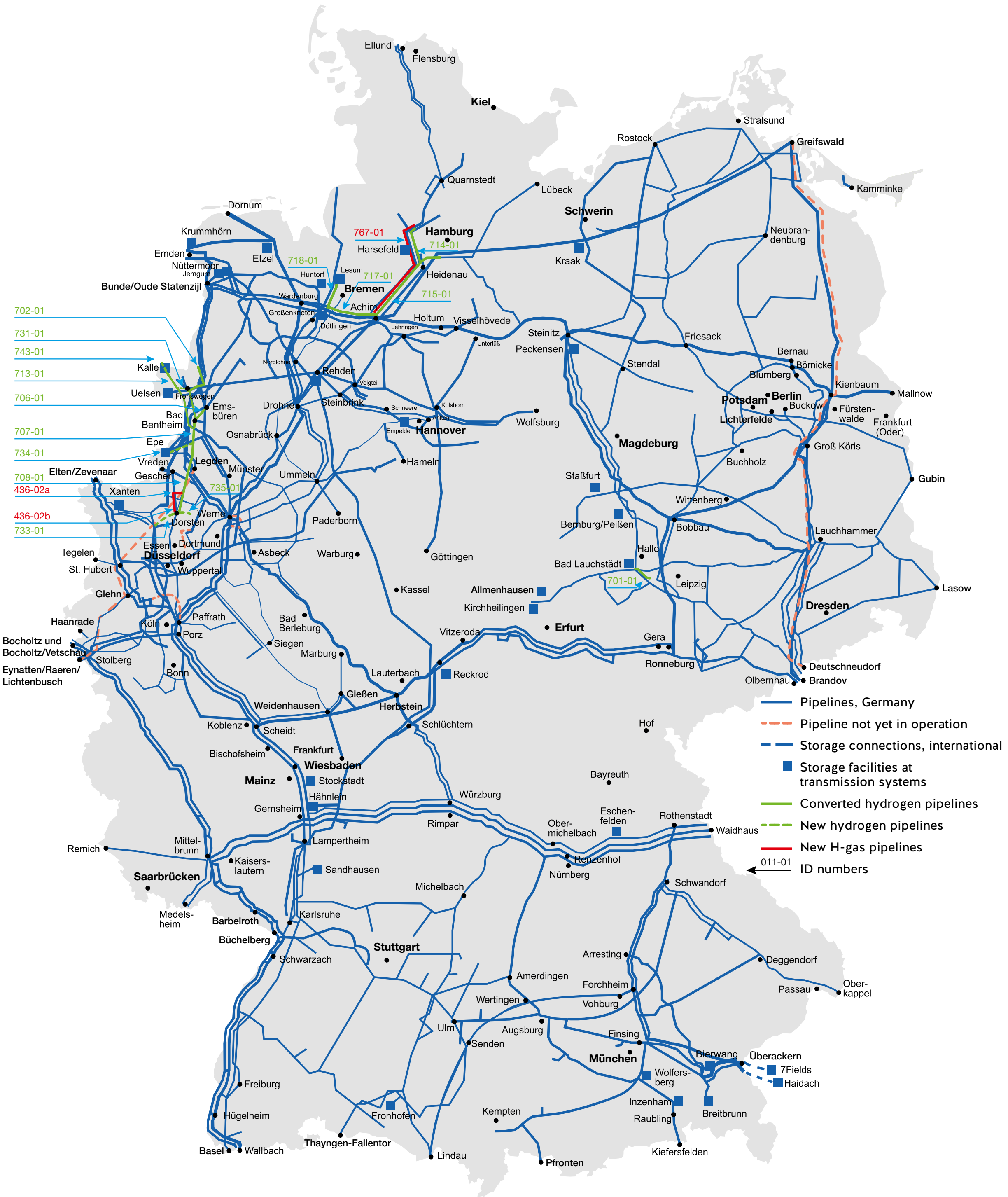
	Up to the end of 2025	Up to the end of 2030
Modelling result in addition to the base variant		
Compressor stations	0 MW	0 MW
Pipelines	471 km	1,294 km
– of which converted pipelines	389 km	1,142 km
– of which new hydrogen pipelines	63 km	94 km
– of which new H-gas pipelines	19 km	57 km
Additional costs in comparison with the base variant		
Conversion of natural gas pipelines	EUR 82 million	EUR 310 million
New construction measures, hydrogen modelling	EUR 128 million	EUR 220 million
New construction measures, natural gas modelling	EUR 84 million	EUR 132 million
Additional total costs	EUR 294 million	EUR 662 million

Source: Transmission system operators

Based on the results of the base variant that have already been presented in Chapter 7, total costs for the green gas variant of around EUR 8.0 billion for 2025 and of around EUR 8.5 billion for 2030 are produced.

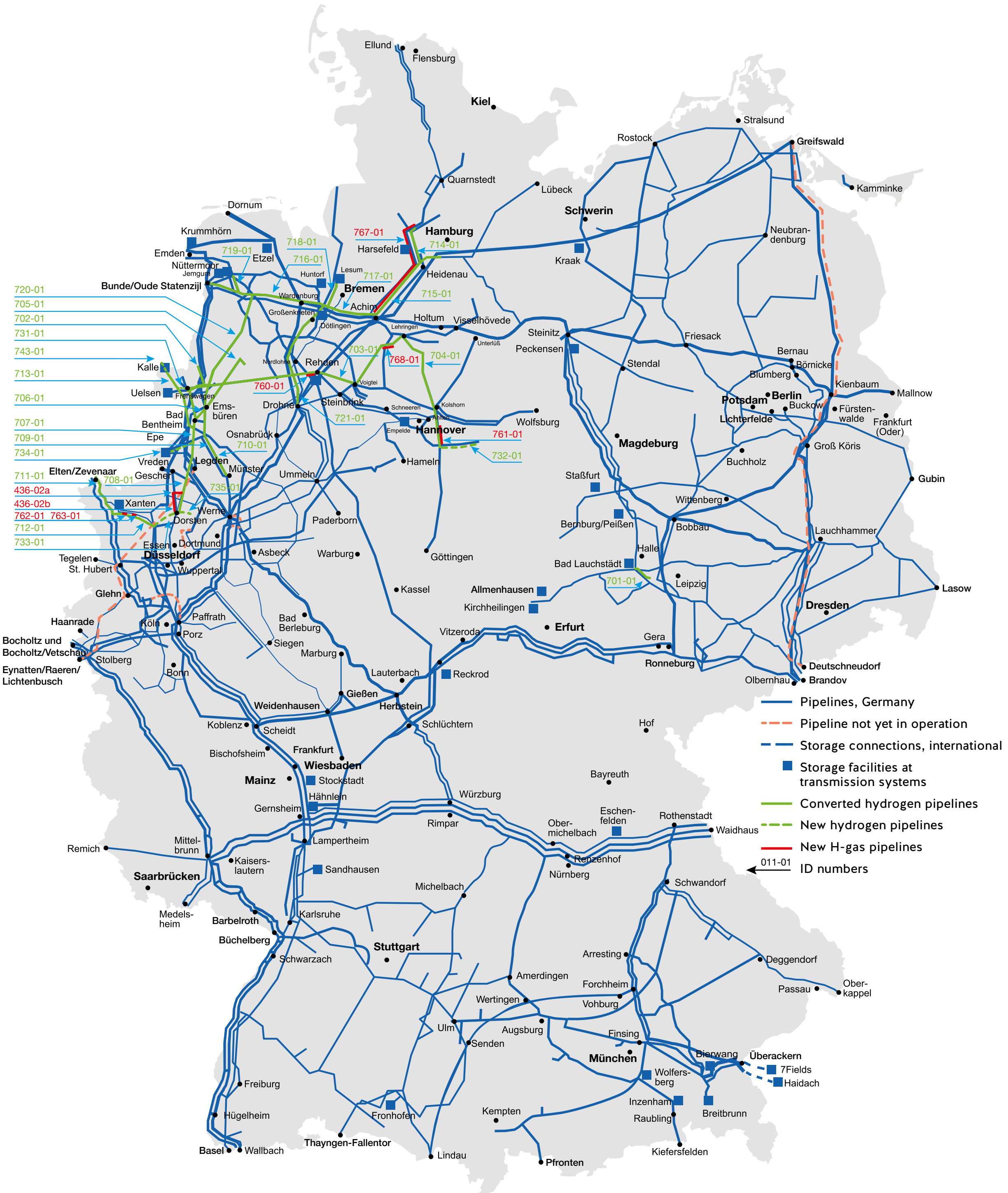
The resulting network expansion measures are listed in detail in the NDP gas database in the “2020 – NEP Entwurf” cycle.

Figure 50: Result of the green gas variant – Hydrogen network 2025



Source: Transmission system operators, reporting date: 1 March 2020

Figure 51: Result of the green gas variant – Hydrogen network 2030



Source: Transmission system operators, reporting date: 1 March 2020

9 Network expansion measures

9 Network expansion measures

The measures to expand the transmission system require significant financial resources, which have to be provided by the transmission system operators. The costs that will be incurred by the network expansion will be allocated through the network charges. Special attention will therefore have to be paid by all the parties involved in the preparation of the Gas Network Development Plan to ensuring that the network expansion continues to make macroeconomic sense from long-term perspectives and remain economically viable for the companies making investments in light of the shippers' ever shorter commitment periods. This primarily requires a stable and sustainable regulatory framework and an interest rate that is commensurate with the risk.

9.1 Criteria for determining the network expansion costs

The additional capacity demand resulting from the results of the modelling is implemented in network expansion measures. The transmission system operators are required to indicate the investments associated with the network expansion measures accurately for each measure. Uniform plan cost approaches are used to allow the measures to be compared. Standard terms and conditions are used here and a flat-rate risk premium is recognised. The specific costs will generally deviate from these standard values because of the specific features of the respective measures.

It is important to the transmission system operators to point out that no conclusions about the investments actually accumulating in specific measures can be drawn from the investment figures that are calculated in this way and the figures are indicated for comparison purposes only.

On initial consideration of pure hydrogen transportation in conjunction with the green gas variant of this Gas Network Development Plan 2020–2030, the costs of converting transmission pipelines today used in natural gas for the transport of hydrogen and costs for constructing new hydrogen pipelines must be taken into account.

The transmission system operators use individual project-specific cost calculations for both the conversion of transmission pipelines today used in natural gas for the transport of hydrogen and costs for constructing new hydrogen pipelines. This is necessary above all for the conversion of transmission pipelines today used in natural gas owing to the different construction periods, technical dimensioning and designs, e.g. regarding the pipe steels, pipe connections and valves used. The transmission system operators also decided to produce individual project-specific cost calculations for the construction of new hydrogen pipelines. These take into account key elements of the specific cost rates also used for the construction of natural gas transmissio pipelines, e.g. for planning services, the project periods and pipework and civil engineering. The costs also include estimates specific to the measures.

The transmission system operators use the specific cost rates listed in the table below as the basis for determining the costs of measures to expand the natural gas transmission network, unless measure-specific estimates are already available to the transmission system operator in question; these are flagged in the NDP gas database.

The specific cost rates form the basis for determining the costs at the present moment. To determine the costs at the time the measures are planned to be commissioned, the transmission system operators have recognised annual cost increases of 1.0 %. This value corresponds to the amount of the average "Index of Producer Prices of Industrial Products" [Destatis 2020] for the years from 2009 to 2019. In comparison with the Gas Network Development Plan 2018–2028, the index value for the escalation of the costs at the time the measures are planned to be commissioned increases by 0.2 percentage points.

The transmission system operators have checked the specific cost rates against the information in the Gas Network Development Plan 2018–2028 and have come to the conclusion that it is not necessary to make a general adjustment to the cost rates. The plan cost rates have been adjusted in comparison with the Gas Network Development Plan 2018–2028 only by the cost increment factor (1.0 % per year).

The specific cost assumptions for the plant types long-distance gas pipelines, compressor stations, major GPCM stations and valve stations are displayed below.

Cost calculation for long-distance gas pipelines in the natural gas transmission network

Table 49: Plan cost estimates for standard natural gas transmission pipelines in EUR/m

DN*	DP** 70	DP 80	DP 100
mm	Euro/m		
400	1,350	1,360	1,370
500	1,500	1,510	1,530
600	1,640	1,650	1,720
700	1,800	1,830	1,920
800	1,970	2,020	2,120
900	2,150	2,200	2,340
1,000	2,390	2,450	2,620
1,100	2,490	2,630	2,840
1,200	2,770	2,860	3,100
1,400	3,470	3,620	3,950

* DN – Standard diameter in millimetres
** DP – Pressure rating in bar

Source: Transmission system operators

Cost calculation for compressor stations in the natural gas transmission network

Table 50: Plan cost estimates for natural gas compressor stations

Cost details in EUR 1,000/MW of installed drive power per stations		Complexity of the compressor station		
		Simple	Medium	High
Power ratings per machine unit	< 10 MW	4,590	5,100	5,610
	10–20 MW	3,570	4,080	4,590
	> 20 MW	2,550	3,060	3,570
Station transmission volume	Euro/(Nm³/h)	10	15	20

Source: Transmission system operators

Cost calculation for GPCM stations in the natural gas transmission network

Table 51: Plan cost estimates for natural gas GPCM stations

Station capacity (m³/h)	Costs DP 100 (EUR million)	Costs for preheating DP 100 (EUR million)	Total costs DP 100 (EUR million)
500,000	7.4	1.0	8.5
1,000,000	10.6	1.5	12.1
2,000,000	13.8	2.0	15.8
5,000,000	24.3	4.1	28.4

Source: Transmission system operators

Cost calculation for valve stations in the natural gas transmission network

The cost calculation for the construction of natural gas valve stations is made using an individual cost estimate.

9.2 Proposal of the transmission system operators for the specific network expansion measures for the Gas Network Development Plan 2020–2030

This chapter lists the network expansion measures proposed by the transmission system operators in the Gas Network Development Plan 2020–2030 to implement the requirements of section 15a(1) EnWG.

The transmission system operators propose the network expansion measures of the green gas variant. In deviation from this, four measures are intended to be taken into consideration in the dimensioning of the design variant for Baden-Württemberg in the network expansion proposal. A list of the measures can be found in Appendix 1. All the details of the network expansion measures and the initial network measures are contained in the NDP gas database in the "2020 – NEP Entwurf" cycle.

The transmission system operators have taken note of the legal opinion of the BNetzA, according to which the development of infrastructure purely for hydrogen is currently not covered by the legal framework of section 15a(1) sentence 2 EnWG and thus cannot be the subject of the binding part of the Gas Network Development Plan.

The BNetzA expects, however, as do the transmission system operators, that the ongoing discussion on the future role and integration of green gases will result in an appropriate development and more detailed specification of the legal framework.

For this reason, the transmission system operators propose the measures presented in the green gas variant to convert the natural gas pipelines to hydrogen transmission and to construct new infrastructure purely for hydrogen for inclusion in the binding part of the Gas Network Development Plan 2020–2030 subject to the proviso below. The implementation of these measures is subject to a change in the existing statutory and administrative regulations to the effect that the legal framework currently applicable to the construction, operation and use of and access to (natural) gas supply networks is extended to the construction, operation and use of and access to networks purely for hydrogen.

In addition to being subject to the necessary expansion of the applicable legal framework for the construction, operation and use of and access to networks purely for hydrogen, the implementation of the network expansion measures resulting from the project plans is also subject to the conclusion of a realisation timetable between the project plan developer and the respective transmission system operator based on section 39 GasNZV.

The "South Elbe-Achim pipeline" measure is dimensioned with a smaller pipeline diameter in the base variant (ID 636-01) than in the green gas variant (ID 767-01). If the measures to construct hydrogen infrastructure cannot yet be confirmed at the time the BNetzA makes the decision on the Gas Network Development Plan 2020–2030, the measure under ID 636-01 would be necessary to cover the demand of the base variant.

For all new measures to construct a hydrogen infrastructure (ID 730-01 to ID 743-01) transmission system operators are available for implementation. In view of the necessary change in the existing legal and regulatory regulations, the decision which company implements which measure can take place at a later point in time.

The iteration with the NewCap model showed that market-based instruments have advantages over an alternative network expansion. The transmission system operators therefore propose no further network expansion measures compared to the consultation document.

The transmission system operators' network expansion proposal contains an investment volume of around EUR 8.0 billion for the requirements of 2025 and of around EUR 8.5 billion in total for the requirements of 2030.

The costs for the expansion of the transmission infrastructure are composed in detail as follows:

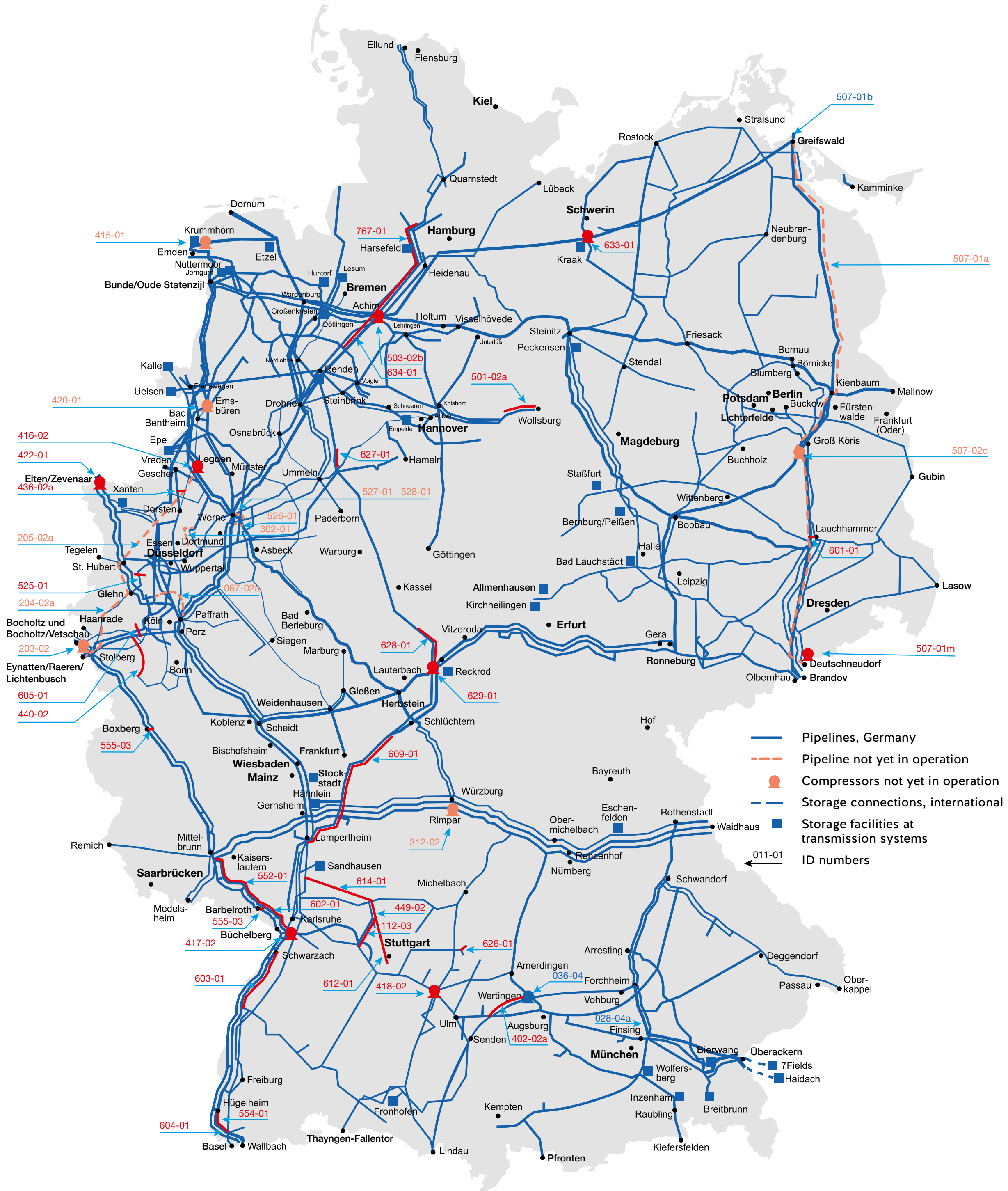
Table 52: Network expansion proposal of the transmission system operators

Network expansion proposal	**2025**			**2030**		
	Natural gas	Green gases	Total	Natural gas	Green gases	Total
Compressor capacity in MW	405	0	405	405	0	405
Pipelines in km	1,592	471	2,064	1,594	1,294	2,888
– of which new build	1,592	82	1,674	1,594	151	1,746
– of which conversion	0	389	389	0	1,142	1,142
Investments* in EUR billion	7.7	0.3	8.0	7.8	0.7	8.5

* including GPCM stations, valve stations and other facilities

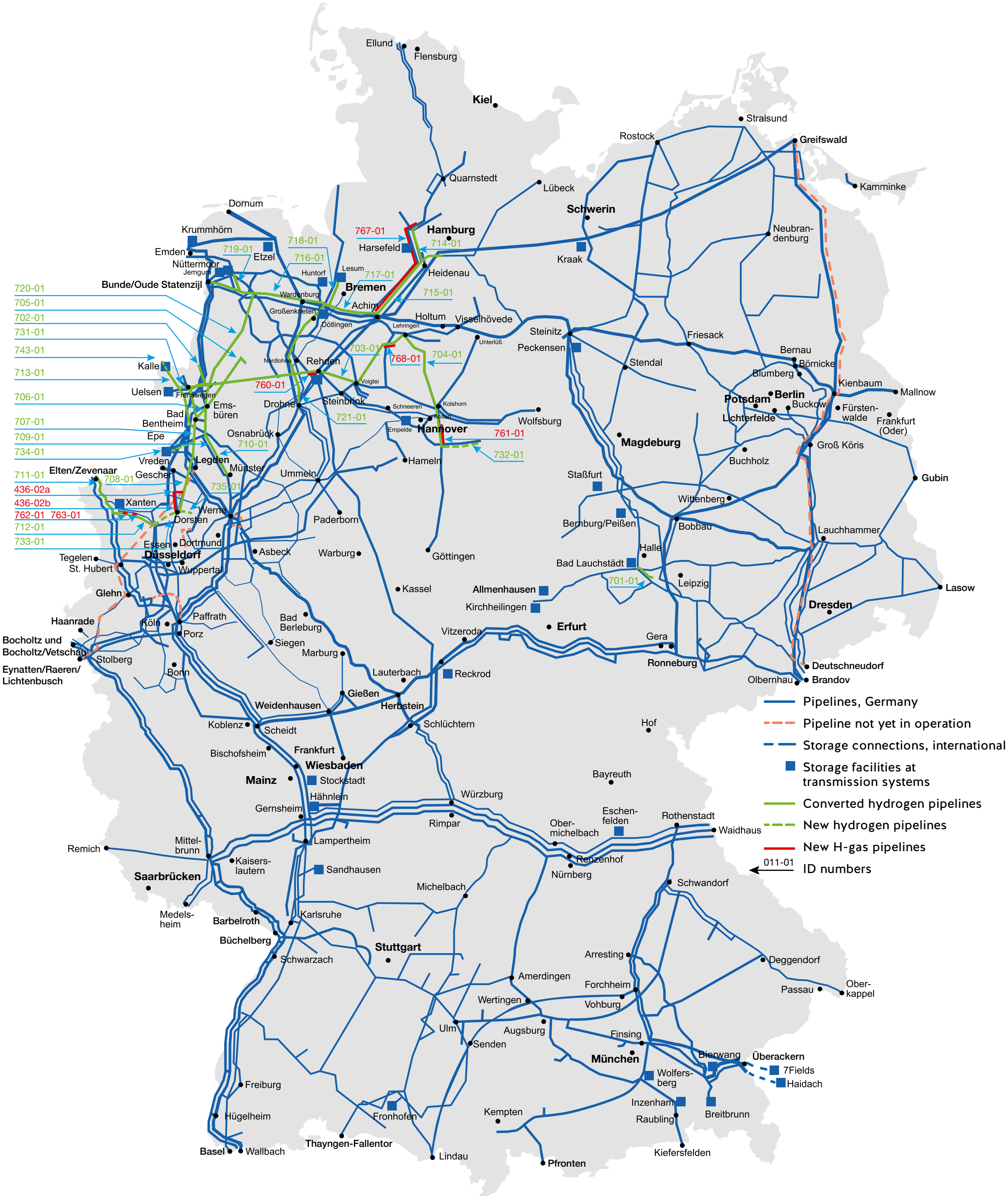
Source: Transmission system operators

Figure 52: Network expansion proposal of the transmission system operators (1/2)



Source: Transmission system operators, reporting date: 1 March 2020

Figure 53: Network expansion proposal of the transmission system operators (2/2)



Source: Transmission system operators, reporting date: 1 March 2020

Outlook on upcoming Network Development Plans

10

10 Outlook on upcoming Network Development Plans

10.1 Green gases

10.1.1 Green gas project criteria for future Network Development Plans

The transmission system operators were requested by the BNetzA in the confirmation of the scenario framework to develop binding criteria for the consideration and inclusion of green gas and comparable projects in future Network Development Plan processes and to consult the market on these criteria. The criteria are to be developed in the course of preparing the Gas Network Development Plan 2020–2030 and to be presented and explained in the consultation document. If forecasts and sources for generation or import of hydrogen that extend beyond concrete green gas projects are intended to be taken into consideration, the transmission system operators are also obliged to develop a methodological approach for this and present it in the consultation document.

The transmission system operators fulfil the obligation to develop possible criteria for the consideration and inclusion of green gas and comparable projects in future Network Development Plan processes at an early stage:

- A project is taken into consideration in the scenario framework if a connection to the transmission system is planned and is reported within the specified period of a future market partner survey.
- However, if a connection to the distribution system is planned, the project plan can be taken into account by having the distribution system operator to whose network the project is to be connected take this into consideration in the report of its long-term forecast. Given the duty to provide a reason for a declining natural gas demand, this can be explained here by a rising hydrogen supply and thus allowing to include the effect of a green gas project indirectly in the Network Development Plan.
- A project plan is taken into consideration in the scenario framework if complete information on the following parameters is presented:

  1. Name of the project plan
  2. Description of the project plan and project status
  3. Information on the gas type (hydrogen, synthetic methane, biogas)
  4. Location of the planned network interconnection point or network connection point on the transmission system
  5. Planned commissioning (month/year)
  6. Entry and exit pressure at the network interconnection or network connection point (minimum pressure)
  7. Details of the gas quality with specification of the concentration of hydrogen and of the purity grade of the hydrogen
  8. Electrical capacity of the facility (MW_e) given hydrogen production from electrical energy
  9. Entry and/or exit capacity at the network interconnection or network connection point on the transmission system (MW_{th}), including imports
  10. Entry and/or exit volume at the network interconnection or network connection point on the transmission system (MW_{th}) per year, including imports
  11. Capacity forecast (time series in MW_{th}) for the request period of the relevant Network Development Plan, including explanation of the time series

- A project plan is taken into consideration in the scenario framework if these details can be completely publicly presented. The transmission system operators assume that the project planning is of a sufficient binding nature in these cases.

The transmission system operators review the reported projects to ensure they comply with the above-mentioned parameters and verify the plausibility of the information.

Irrespective of the transmission system operator to which a project owner submits their request, the transmission system operators determine in the course of the modelling which of their networks the plant should be connected to.

The implementation of the network expansion measures necessary to connect the project to the transmission system and to provide the required capacities from the project plans are subject to the conclusion of an implementation schedule in conjunction with a long-term booking between the project owner and the respective transmission system operator following section 39 GasNZV.

According to the current plan, a large period of time still remains until the next market partner survey on green gas and comparable projects for consideration in the scenario framework for the Gas Network Development Plan 2022–2032. The transmission system operators therefore reserve the right to adapt the aforementioned criteria sensibly to the market and regulatory developments in the period to the next Network Development Plan process and to discuss and define these again in the process that is then binding.

10.1.2 Visionary hydrogen network

Against the background of the increasing interest in hydrogen in a variety of sectors, especially in industry, the transmission system operators developed a possible future vision for a trans-regional hydrogen network and published this in January this year. The pipelines of the visionary network connect regions where hydrogen is produced and regions where hydrogen is consumed by using natural gas infrastructure that is largely (over 90 %) already in place. It comprises a total length of around 5,900 km. The transmission system operators will continue to develop this visionary hydrogen network on the basis of new findings.

The basis for the visionary hydrogen network was provided by a study on the regionalisation of hydrogen production and consumption by the Forschungsstelle für Energiewirtschaft mbH (FfE – Research Institute for the Energy Economy) that the transmission system operators commissioned [FfE 2019]. According to this study, the potential domestic focal points for the production of hydrogen from renewable energy sources can be expected to be found predominantly in the regions of Mecklenburg West Pomerania, Brandenburg, Schleswig-Holstein, Lower Saxony and North Rhine-Westphalia in the future. The transmission system operators additionally conducted a market partner survey on green gas projects currently in development. In the final analysis, 31 projects, predominantly hydrogen projects in industrial centres of consumption, were reported.

The scope of the hydrogen network includes:

- Cavern storage locations for potential use as hydrogen storage facilities to balance hydrogen consumption and hydrogen production and imports
- Industrial consumers such as steel producers, the chemicals industry, refineries and regions affected by the phase-out of coal as well as the local hydrogen networks that are already in place
- Major metropolitan areas, which can realise reductions in CO_2 emissions in the heating sector by blending hydrogen in the regional distribution systems there
- Approximately 80 % of the German vehicle fleet and part of the non-electrified rail network in order to enable a contribution to the transport transition in this way
- Regions with large supplies of renewable energy sources for producing hydrogen as possible hydrogen import locations

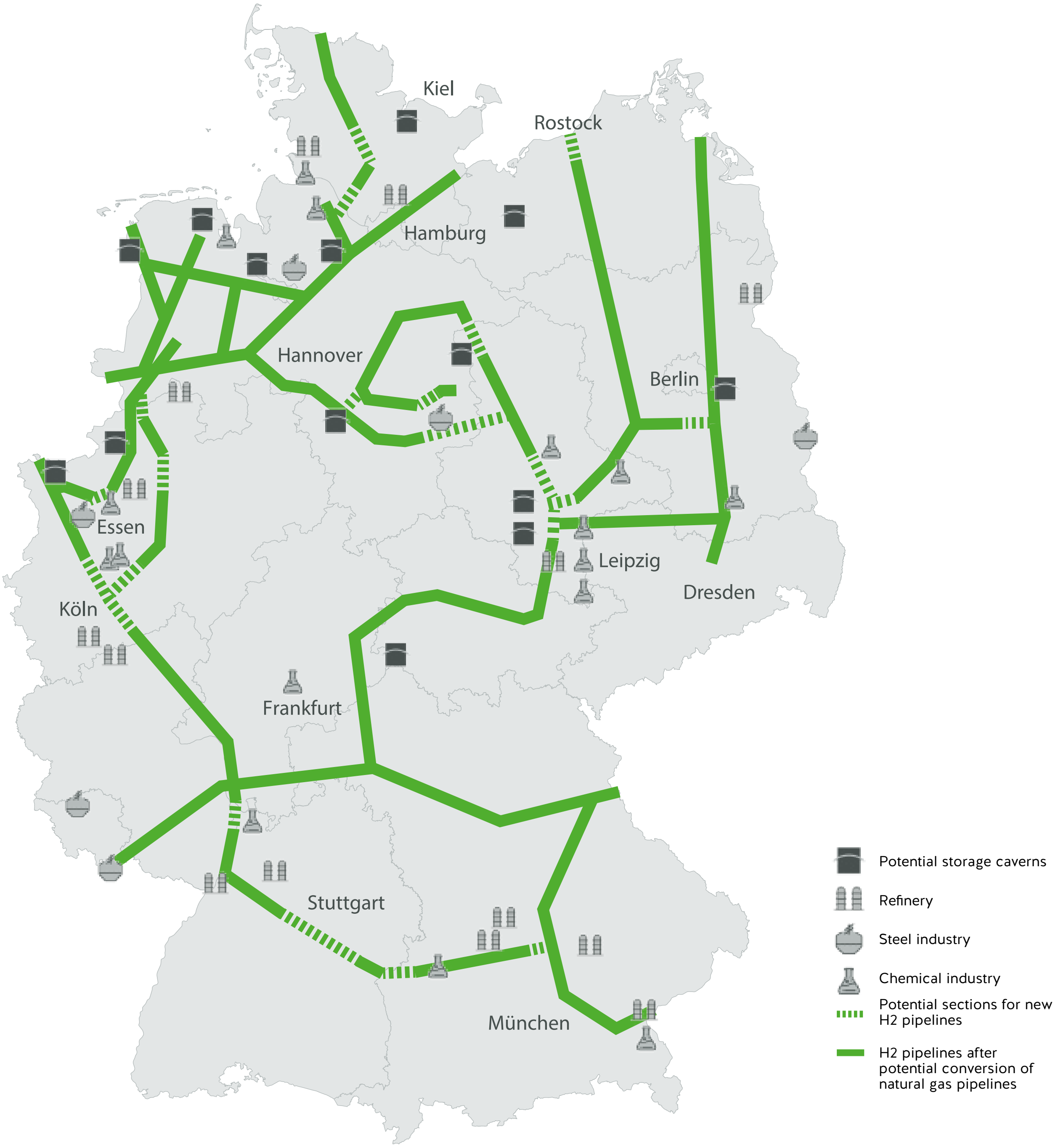
The implementation of the first hydrogen projects (e.g. field labs as hotbeds of a hydrogen economy) is already planned by 2025. These projects can be linked with the first implementation steps for the hydrogen network.

The hydrogen network is open to different technologies. It can receive hydrogen irrespective of the source. For example, regions with a level of electricity generated from renewable energy sources in northern and eastern Germany or imports that arrive in Germany through pipelines or tankers offer great potential.

The hydrogen network will probably be developed in geographical terms from north to south, as the potential sources and storage locations for hydrogen are predominantly found north of the River Main. The expansion in the direction of the south will develop into the major consumption centres.

By connecting the hydrogen network up to the hydrogen infrastructure in our neighbouring European countries, the Europe-wide exchange of hydrogen will already be possible at an early date.

Figure 54: Vision for a hydrogen network



Disclaimer: This map is a schematic representation and thus has no claim to completeness regarding storage facilities and consumers.

Source: Transmission system operators

10.1.3 Capacity product, green gas projects

Following the confirmation of the scenario framework of 5 December 2019, the transmission system operators are also obliged, in addition to developing binding criteria for including green gas projects in the Gas Network Development Plan 2020–2030 and presenting concrete information on the allocation of green gas projects to the gas network infrastructure, to state what capacity product can be recognised for the transmission of hydrogen.

As described below and also confirmed by the BNetzA, extensive regulatory aspects need to be clarified before hydrogen can be transported in pipeline infrastructure that is new or has to be converted. These also include in particular the design of the future market model for hydrogen transportation. This is accompanied by the fact that few guaranteed starting points for a future hydrogen infrastructure system are known at the present time. The goal is, however, to transfer the tried and trusted capacity products for natural gas to the hydrogen market with increasing liquidity, growing demand and also an expanding hydrogen offer – after all regulatory issues have been clarified.

10.2 Integrated network planning

Against the background of the targets in energy and climate policy, sector coupling or the integrated consideration of sectors and their infrastructure is of central importance. To implement this in an economically efficient way, the transmission system operators believe a joint energy infrastructure plan is required in order to guarantee a safe and reliable energy supply through electricity and gas networks and to secure the demand for transmission and transport capacity on a permanent basis.

The transmission system operators were involved in the dena Network Study III for the first time at the beginning of Phase 2. Work is being conducted together with the electricity transmission system operators and other stakeholders on common input parameters and anchor points for the individual gas or electricity network planning. This furthermore involves enhancing the interfaces between the network planning processes. The transmission system operators will continue actively to accompany this process.

In the view of the transmission system operators, a requirement for an integrated network plan in the future is additionally the harmonisation of the planning horizons and the synchronization of the development processes for the electricity and Gas Network Development Plans. Furthermore, potential for optimisation across all infrastructure should be identified by the network operators upstream of the individual network planning and binding parameters for sector coupling should be defined.

By making use of the existing optimisation potential, locations for PtG plants could for example be defined in the course of the future integrated network planning no longer only in close vicinity to consumption/industry, but transportation of hydrogen over the existing transmission system or a future hydrogen network in a way that relieves the strain on the electricity network could also be realized.

10.3 Long-term capacity demand in a Germany-wide market area

In its confirmation of the scenario framework, the BNetzA calls on the transmission system operators to develop a proposal that contains possible criteria and indicators for determining the amount of the long-term capacity demand in the new Germany-wide market area. This proposal is to be put forward for discussion in the consultation document to the Gas Network Development Plan 2020–2030.

The transmission system operators intend to fulfil the obligation in accordance with section 21(1) sentence 2 GasNZV to create by no later than 1 April 2022 a Germany-wide market area from the existing two Net Connect Germany and GASPOOL market areas as early as 1 October 2021. From today's perspective, it is planned to implement from 1 October 2021 an oversubscription and buyback system based on the "KAP+" procedure for additional capacity in the Germany-wide market area (file ref. BK7-19-037).

Ruling Chamber 7 of the BNetzA has selected the route for an oversubscription and buyback system and additionally furnished this with a three-year test phase. The determination of the capacity demand in accordance with section 9(3) GasNZV in relation to the new Germany-wide market area is currently rated in the view of the BNetzA as not possible with reasonable assurance. To begin with, experiences would also have to be gathered concerning the subscription behaviour in the new integrated market area.

Based on section 17(8) Gas NZV, “existing findings on capacity demand that results from mergers of market areas pursuant to section 21” are to be taken into consideration. Against this background, it would be only logical to defer the question of the determination of the long-term capacity demand to a time when sufficient information on the subscription behaviour of the shippers is already available.

Ruling Chamber 7 of the BNetzA writes on this in its “KAP+” procedure for additional capacity in the Germany-wide market area: “The consideration of the capacity demand in a Germany-wide market area resulting from demand during the year is possible, on the other hand, only with effect for the scenario framework for the Gas Network Development Plan 2024–2034, as bookings during the year can be made in a Germany-wide network area only from the 2021/2022 gas year onwards. […] The scenario framework for the Gas Network Development Plan 2022–2032, which is expected to be published in the second quarter of 2021 (and thus still before the market area merger), can already include findings on the demand for firm freely allocable capacity in a Germany-wide market area.”

The transmission system operators agree with the BNetzA that annual bookings and bookings during the year could possibly be criteria for determining the demand for firm freely allocable capacity. The transmission system operators do not consider it practical, however, to develop criteria and objective indicators for determining the amount of the long-term capacity demand in this document already. Rather, the transmission system operators propose collecting experiences first with the 2020 and 2021 annual auctions and the bookings of the 2021/2022 gas year made during the year in order to create a valid basis for developing criteria. Furthermore, the test phase of the oversubscription and buyback system (or at least a meaningful part of that) should be used in order to enable, on the basis of the findings, a well-founded, appropriate balance between the oversubscription and buyback system on the one hand and section 9(3) GasNZV on the other.

Appendices

Appendix 1: Overview of the network expansion measures proposed by the transmission system operators

No.	ID number	Network expansion measure
1	028-04a	Forchheim-Finsing pipeline
2	028-04b	Finsing 3 GPCM station and connecting pipeline
3	036-04	Wertingen compressor station
4	067-02a	Voigtslach-Paffrath pipeline
5	067-03b	Paffrath GPCM station and connecting pipeline
6	112-03	Heilbronn connection
7	116-02	Wiernsheim GPCM station (Heilbronn area)
8	119-03	Achim GPCM station
9	203-02	Würselen compressor station
10	204-02a	ZEELINK 1 (pipeline)
11	204-02b	ZEELINK 1 Glehn GPCM station and connecting pipeline
12	204-02c	ZEELINK 1 St. Hubert GPCM station and connecting pipeline
13	204-02d	ZEELINK 1 Stolberg GPCM station and connecting pipeline
14	205-02a	ZEELINK 2 (pipeline)
15	205-02b	ZEELINK 2 Legden GPCM station and connecting pipeline
16	206-02	Mittelbrunn GPCM station
17	207-03	Obermichelbach GPCM station reverse flow
18	208-02	Rimpar GPCM station
19	209-02a	Gernsheim GPCM station (MEGAL)
20	209-02b	Gernsheim GPCM station (OGE)
21	221-01	Conversion to H-gas (area: Luttum to Wolfsburg)
22	222-02	Conversion to H-gas (area: Bremen/Achim/Delmenhorst)
23	223-01	Conversion to H-gas (area: Bremen Nord, Bremerhaven to Cuxhaven and eastern part of the network of EWE Netz)
24	229-01	System connections and modifications for L-H-gas conversion 2026–2029
25	300-02	Integration of the Folmhusen compressor station in the H-gas
26	301-01	Embsen overfeed
27	302-01	Datteln-Herne pipeline
28	305-02	TENP reverse flow
29	307-01	Mittelbrunn GPCM station
30	308-02b	Gernsheim GPCM station (OGE)
31	309-01	Rimpar MEGAL GPCM station
32	310-02	Reichertsheim GPCM station and connecting pipeline
33	311-02	Schlüchtern-Rimpar pipeline
34	312-02	Rimpar MEGAL GPCM station
35	320-01	Conversion of the Bergheim 1 network area to H-gas
36	323-02	Aggertal network area conversion
37	324-01	Niederpleis valve station and connecting pipeline
38	325-01	Neukirchen valve station and connecting pipeline
39	326-02	Horrem valve station and connecting pipeline
40	327-03	Niederscheiden GPCM station and connecting pipeline
41	328-03	Langenscheid GPCM station and connecting pipeline

No.	ID number	Network expansion measure
42	329-03	Siegwiesen GPCM station and connecting pipeline
43	330-02	Elsdorf GPCM station and connecting pipeline
44	331-01	Scheidt GPCM station
45	333-02	Asbeck GPCM station and connecting pipeline
46	334-02	Rauschendorf valve station and connecting pipeline
47	335-02a	Kempershöhe GPCM station and connecting pipeline
48	335-02b	Wipperfürth-Niederschelden pipelines
49	336-02	Oberaden valve station and connecting pipeline
50	337-02	Porz GPCM station
51	338-02	Paffrath GPCM station
52	402-02a	Wertingen-Kötz pipeline
53	402-02b	Wertingen 2 GPCM station
54	402-02c	Kötz GPCM station
55	406-01	Amerdingen GPCM station
56	407-01	Schnaitsee GPCM station
57	410-02a	Rehden GPCM station
58	410-02b	Drohne GPCM station
59	412-04	Lubmin II natural gas receiving station
60	415-01	Krummhörn compressor station
61	416-02	Legden compressor station
62	417-02	Northern Black Forest pipeline compressor station
63	418-02	Scharenstetten compressor station expansion
64	419-02	Hamborn GPCM station expansion
65	420-01	Emsbüren compressor station
66	422-01	Elten compressor station
67	431-02	Emstek GPCM station
68	432-02b	Bunde-Landschaftspolder GPCM station and H-L-gas blending facility
69	435-03	Altena GPCM station and connecting pipeline
70	436-02a	Heiden Marbeck-Heiden Borken pipeline
71	436-02b	Heiden Borken-Dorsten pipeline
72	437-01	Heiden-Borken GPCM station and connecting pipeline
73	438-01	Epe storage facility pipeline link remodelling
74	439-01	Pattscheid GPCM station and connecting pipeline
75	440-02	Erftstadt-Euskirchen pipeline
76	441-02	Vinnhorst valve station and connecting pipeline
77	442-02	Ahlten GPCM station and connecting pipeline
78	443-02	Drohne GPCM station and connecting pipeline
79	444-01	Werne GPCM station and connecting pipeline
80	445-01a	St. Hubert-Voigtslach valve stations and connecting pipeline (NETG)
81	445-01b	St. Hubert-Voigtslach valve stations and connecting pipeline (OGE)
82	446-01	Wipperfürth-Niederschelden conversion
83	447-01	System connections and modifications for L-H-gas conversions (previously not specified more precisely)
84	448-01	Euskirchen GPCM station and connecting pipeline
85	449-02	Heilbronn connection extension (SEL 1)
86	450-01	Steinhäule GPCM station expansion

No.	ID number	Network expansion measure
87	451-02	Au am Rhein GPCM station expansion
88	501-02a	Walle - Wolfsburg pipeline
89	501-02d	Kolshorn GPCM station expansion
90	501-02e	Unterlüß GPCM station expansion
91	503-02a	Hetlingen compressor station expansion
92	503-02b	Embsen compressor station expansion
93	504-01a	EPT-Rysum – Rysum-Folmhusen pipeline connection
94	504-02b	Folmhusen GPCM station expansion
95	504-02c	Emden GPCM station
96	505-01	Rehden conversion expansion
97	507-01a	EUGAL long-distance gas pipeline
98	507-01b	North European Natural Gas Pipeline (NEL) link
99	507-01c	Lubmin-NEL GPCM station
100	507-01e	Radeland II GPCM station
101	507-01f	Deutschneudorf-EUGAL GPCM station
102	507-01g	Kienbaum II GPCM station including connecting pipeline to the European Gas Pipeline Link (EUGAL)
103	507-01h	Börnicke GPCM station (pressure security system)
104	507-01j	Groß Köris GPCM station
105	507-01l	Holtum compressor station reverse flow
106	507-01m	Sayda compressor station
107	507-02d	Radeland II compressor station
108	507-02i	Steinitz GPCM station
109	507-02k	Sülstorf GPCM station
110	508-01	Leonberg-West GPCM station expansion
111	520-01	Visbek Astrup valve station
112	521-01	Twistringen Ehrenburg valve station
113	523-01	Gergedorf GPCM station system modification
114	524-01	Steinfeld-Düpe GPCM station system modification
115	525-01	Willich-Meerbusch pipeline
116	526-01	Hamm-Bergkamen pipeline
117	527-01	Stockum-Bockum Hövel pipeline
118	528-01	Merschhoven-Daberg pipeline
119	529-01	Elten - St. Hubert valve stations
120	530-01	Cologne – Dormagen conversion
121	531-01a	Appeldorn GPCM station
122	531-01b	Xanten valve stations
123	532-01	Leer GPCM station and connecting pipeline
124	552-01	Mittelbrunn-Schwanheim pipeline
125	554-01	Hügelheim-Tannenkirch pipeline
126	555-03	TENP I to TENP II interconnections
127	601-01	Lauchhammer GPCM station pipeline
128	602-01	Schwanheim-Elchesheim pipeline
129	603-01	Schwarzach-Eckartsweier pipeline
130	604-01	Tannenkirch-Hüsingen pipeline
131	605-01	Wesseling-Knapsack pipeline

No.	ID number	Network expansion measure
132	609-01	Wirtheim-Lampertheim pipeline
133	610-01	Wirtheim GPCM station
134	611-01	Lampertheim GPCM station
135	612-01	Löchgau-Altbach pipeline (SEL 2)
136	613-01	Bietigheim GPCM station
137	614-01	Heidelberg-Heilbronn pipeline (SEL 3)
138	616-01	Heidelberg GPCM station
139	618-01	Heilbronn GPCM station
140	620-01	Kirchheim unter Teck GPCM station
141	621-01	Hittistetten GPCM station
142	622-01	Eichstegen GPCM station
143	624-01	Weißensberg 2 GPCM station
144	625-01	Scharrenstetten GPCM station
145	626-01	Aalen-Essingen pipeline
146	627-01	MIDAL Middle North pipeline
147	628-01	MIDAL Middle South pipeline
148	629-01	Reckrod compressor station
149	630-01	Lampertheim 5 GPCM station
150	631-01	Lubmin 2 GPCM station
151	632-01	Greifswald landing terminal GPCM station – facility extension 3
152	633-01	NEL compressor station (middle)
153	634-01	NEL pipeline west
154	635-01	Embsen GPCM station
155	637-01	Achim compressor station modification
156	638-01	Embsen preheating
157	639-01	Achim GPCM station
158	642-01	Ludwigshafen GPCM station
159	650-01	Herringhausen GPCM station
160	651-01	Neuss Rheinpark GPCM station and connecting pipeline
161	652-01	Engelbostel GPCM station and connecting pipeline
162	653-01	Kleinenhammer GPCM station and connecting pipeline
163	654-01	Iserlohn Hennen valve station
164	655-01	Essen Dellwig valve station and connecting pipeline
165	656-01	Duisburg Mündelheim valve station and connecting pipeline
166	657-01	Conversion to H-gas (area: Rehden-Bassum)
167	658-01	Conversion to H-gas (area: Emsland II)
168	659-01	Conversion to H-gas (Kolshorn-Ahlten-Empelde storage facility)
169	701-01	Bad Lauchstädt energy park pipeline system conversion
170	702-01	Lingen-Bad Bentheim pipeline system conversion
171	703-01	Messingen-Egenstedt pipeline system conversion
172	704-01	Middle Weser-Kohlshorn pipeline system conversion
173	705-01	Löningen-Emsbüren pipeline system conversion
174	706-01	Emsbüren-Bad Bentheim pipeline system conversion
175	707-01	Bad Bentheim-Legden pipeline system conversion
176	708-01	Legden-Dorsten pipeline system conversion

No.	ID number	Network expansion measure
177	709-01	Rheine-Wettringen pipeline system conversion
178	710-01	Wettringen-Albachten pipeline system conversion
179	711-01	Elten-Sonsbeck pipeline system conversion (NETG)
180	712-01	Sonsbeck-Hamborn pipeline system conversion
181	713-01	Kalle-Ochtrup pipeline system conversion
182	714-01	South Elbe-Heidenau pipeline system conversion
183	715-01	Eckel-Achim pipeline system conversion
184	716-01	Oude Statenzijl-Ganderkesee pipeline system conversion
185	717-01	Ganderkesee-Achim pipeline system conversion
186	718-01	Ganderkesee-Bremen pipeline system conversion
187	719-01	Folmhusen-Nüttermoor pipeline system conversion
188	720-01	Barßel-Emsbüren pipeline system conversion
189	721-01	Ganderkesee-Drohne pipeline system conversion
190	722-01	Ganderkesee GPCM station
191	723-01	Barßel GPCM station
192	724-01	South Bavaria pipeline system conversion (anonymous)
193	730-01	Schlootdamm/Steinfeld GPCM station
194	731-01	New Frensdorfer Bruchgraben-Frenswegen pipeline construction
195	732-01	New Egenstedt-Hallendorf pipeline construction
196	733-01	New Dorsten-Hamborn pipeline construction
197	734-01	New Epe-Ochtrup pipeline construction
198	735-01	New Dorsten-Marl pipeline construction
199	736-01	Elten GPCM station and connecting pipeline
200	737-01	Sonsbeck GPCM station and connecting pipeline
201	738-01	Hamborn GPCM station and connecting pipeline
202	739-01	Dorsten GPCM station and connecting pipeline
203	740-01	Bad Bentheim GPCM station and connecting pipeline
204	741-01	Emsbüren GPCM station and connecting pipeline
205	742-01	Wettringen valve station and connecting pipeline
206	743-01	New Vlieghuis-Kalle pipeline construction
207	760-01	Rehden-Diepholz pipeline
208	761-01	Egenstedt-Clauen pipeline
209	762-01	Wallach-Alpen pipeline
210	763-01	Budberg-Eversael pipeline
211	764-01	Sonsbeck-Oberhausen pipeline link remodelling
212	765-01	Glehn II GPCM station
213	766-01	Hamborn 1 GPCM station
214	767-01	South Elbe-Achim pipeline
215	768-01	New Hassel-Westen pipeline construction

Source: Transmission system operators

Appendix 2: Evaluation of the submissions

Chapter	Contents: Consultation document, consultation by transmission system operators from 4 May 2020 to 29 May 2020	Frequency of opinions		
		infrequent (up to 5)	frequent (6–10)	very frequent (>10)
	Major issues			
	• NDP documents/consultation/schedule	x		
	• Information on gas infrastructure	x		
1	**Introduction**			
2	**Confirmed scenario framework for the Gas Network Development Plan 2020–2030**			
	• Gas demand scenarios in scenario framework		x	
	• Gas power plants	x		
3	**Modelling of the transmission systems**			
	• Market area merger		x	
	• Capacity product for and connection of LNG facilities			x
	• Modelling of gas power plants			x
	• Capacity demand for Netherlands	x		
	• Further input parameters for modelling		x	
4	**The transmission system today**			
5	**Development of the L-gas supply – Security of supply scenario**			
	• Market area conversion and coronavirus	x		
	• Planning of appliance figures	x		
	• Situation involving gas imports from the Netherlands	x		
6	**Development of the H-gas supply – Security of supply scenario**			
	• H-gas balance IP/LNG		x	
	• H-gas balance storage facilities	x		
	• H-gas balance exit/quantity balance	x		
	• H-gas balance other	x		
7	**Modelling results**			
	• Network expansion measures, general	x		
	• Network expansion measures for southern Germany	x		
	• Design variant for Baden-Württemberg		x	
	• LNG facilities and expansion due to LNG		x	
	• Presentation of maps	x		
8	**Green gas variant**			
	• Green gas variant			x
	• Market partner survey		x	
	• Regulatory framework			x
	• Distribution of hydrogen sources			x
	• Hydrogen infrastructure and blending			x
	• Green gas measures and specific individual green gas projects		x	
	• Others	x		
9	**Network expansion measures**			
	• Comments on individual measures	x		
	• Network expansion proposal		x	
10	**Outlook on upcoming Network Development Plans**			
	• Visionary hydrogen network		x	
	• Integrated network development planning		x	
	• Criteria for green gas projects			x
	• Proposals for further developments	x		
	Appendix			
	• NEP gas database	x		

Source: Transmission system operators

Glossary

Transmission system operators

bayernets	bayernets GmbH
Ferngas	Ferngas Netzgesellschaft mbH
Fluxys	Fluxys TENP GmbH
Fluxys D	Fluxys Deutschland GmbH
GASCADE	GASCADE Gastransport GmbH
GRTD	GRTgaz Deutschland GmbH
GTG Nord	Gastransport Nord GmbH
GUD	Gasunie Deutschland Transport Services GmbH
LBTG	Lubmin-Brandov Gastransport GmbH
NGT	NEL Gastransport GmbH
Nowega	Nowega GmbH
OGE	Open Grid Europe GmbH
OGT	OPAL Gastransport GmbH & Co. KG
ONTRAS	ONTRAS Gastransport GmbH
terranets	terranets bw GmbH
Thyssengas	Thyssengas GmbH

Other abbreviations

bar	Pressure in relation to sea level
BDEW	Bundesverband der Energie- und Wasserwirtschaft e. V. – German Federal Association of Energy and Water Industries
BDI	Bundesverband der Deutschen Industrie e. V. – The Federation of German Industries
bFZK	Bedingt feste frei zuordenbare Kapazität – conditionally firm freely allocable capacity: capacity is fixed if usage/gas flow-dependent conditions are met.
BKartA	Bundeskartellamt – German competition authority
BMWi	Bundesministerium für Wirtschaft und Energie – German Federal Ministry for Economic Affairs and Energy
bnBM	Besondere netztechnische Betriebsmittel – special network operating equipment
BNetzA	Bundesnetzagentur für Elektrizität, Gas, Telekommunikation, Post und Eisenbahnen – German Federal Network Agency for Electricity, Gas, Telecommunication, Post and Railways
BVEG	Bundesverband Erdgas, Erdöl und Geoenergie e. V. – German Federal Association of Natural gas, Petroleum and Geoenergy

BZK	Beschränkt zuordenbare Kapazität – conditionally allocable capacity: capacity can be used only subject to an allocation condition. No virtual trading point access.
CS	Compression station
dena	Deutsche Energie-Agentur – German Energy Agency
DIHK	Deutsche Industrie- und Handelskammertag e. V. – Association of German Chambers of Industry and Commerce
DN	Standard diameter
DP	Design pressure
DSO	Distribution system operator
DVGW	Deutscher Verein des Gas- und Wasserfaches e. V. – German Technical and Scientific Association for Gas and Water
DZK	Dynamisch zuordenbare Kapazität – dynamically allocable capacity. Capacity is fixed if it can be used without a VHP for balanced transmission between entry and exit capacities with a nomination obligation.
EE	Erneuerbare Energien – renewable energies
EEG	Gesetz für den Ausbau erneuerbarer Energien – Renewable Energy Sources Act
Entry	Feed-in
ENTSOG	European Network of Transmission System Operators Gas
EnWG	Energiewirtschaftsgesetz – Energy Industry Act
EUGAL	Europäische Gas-Anbindungsleitung – European gas pipeline link
Exit	Outtake
fDZK	Feste dynamisch zuordenbare Kapazität – firm dynamically allocable capacity Capacity is fixed if it can be used without a VHP for balanced transmission between entry and exit capacities with a nomination obligation.
FfE	Forschungsstelle für Energiewirtschaft – Research Institute for the Energy Economy
FID	Final investment decision
FZK	Frei zuordenbare Kapazitäten – freely allocable capacity, enables booked entry and exit capacities to be used without stipulating a transmission path
GasNZV	Verordnung über den Zugang zu Gasversorgungsnetzen/Gasnetzzugangsverordnung German Gas Network Access Regulation
GASPOOL	GASPOOL Balancing Services GmbH
GCA	Gas Connect Austria GmbH
GEODE	Groupement Européen des entreprises et Organismes de Distribution d'Énergie (European energy distribution companies)
GPCM	Gas pressure control and measuring station
Green gases	Hydrogen and synthetic methane
GTS	Gasunie Transport Services B. V.
GuD	Gas-und-Dampf – Gas and steam

GWh	Gigawatt hour
GWJ	Gaswirtschaftsjahr – gas year
H-gas	Natural gas with a high calorific value
H_i	Net calorific value, conversion factor to the gross calorific value of around 1.109
H_s	Gross calorific value, conversion factor to the net calorific value of around 0.902
Hydrogen, blue	Hydrogen that is decarbonised by means of carbon capture and storage (CCS) and carbon capture and utilisation (CCU)
Hydrogen, green	Hydrogen that is produced by electrolysis from renewable energy sources
ID	Identification number
INES	Initiative Erdgasspeicher e. V. (association of operators of German gas storage)
IP	Interconnection point
IPCEI	Important Projects of Common European Interest
IR	Implementation report
KNEP	Koordinierter Netzentwicklungsplan – Co-ordinated Network Development Plan (of Gas Connect Austria)
KoV	Kooperationsvereinbarung – co-operation agreement between the operators of gas supply networks located in Germany
kWh	Kilowatt hour
LaFZK	Lastabhängig fest, frei zuordenbare Kapazität – load-dependent firm and freely allocable capacity: capacity is firm if a specific network load is present.
LDGP	Long-distance gas pipeline
L-gas	Natural gas with a low calorific value
Load flow commitment	Contracutal agreements with third parties that ensure specific load flows and that are suitable and necessary for enhancing the ability to report freely allocable entry and exit capacity
LNG	Liquefied natural gas
Loop	Pipeline laid parallel to an existing pipeline
m^3	Cubic metre. Unless otherwise specified, a volume at normal conditions is to be understood by this.
MBI	Market-based instruments
MEGAL	Mittel-Europäische Gasleitung(sgesellschaft) – Central European gas pipeline (company)
MIDAL	Mitteldeutsche Anbindungsleitung – Central German connecting pipeline
MÜP	Marktgebietsübergangspunkt – market area interconnection point
MWh	Megawatt hour
NCG	NetConnect Germany GmbH & Co. KG
NDP	Network Development Plan

NEL	Nordeuropäische Erdgas-Leitung – Northern Europe Natural Gas Pipeline
NETG	Nordrheinische Erdgastransportgesellschaft (gas shipper)
NM	Normkubikmeter – standard cubic metre
OPAL	Ostsee-Pipeline-Anbindungsleitung (Baltic Sea pipeline link)
PCI	Project of Common Interest
PPA	Power Purchase Agreements (PPA)
PtG	Power-to-Gas
SEL	Süddeutsche Erdgasleitung – Southern German Gas Pipeline
SR	Scenario Framework
TaK	Temperaturabhängige Kapazität – temperature-dependent capacity: capacity is fixed within and interruptible outside a defined temperature range.
TAP	Trans-Adriatic Pipeline
TC	Technical capacity
TENP	Trans Europa Naturgas Pipeline
THE	Trading Hub Europe
TSO	(Gas) transmission system operator
TWh	Terawatt hour
TYNDP	Ten-Year Network Development Plan (from ENTSOG)
UGS	Underground gas storage
ÜNB	Übertragungsnetzbetreiber (Transmission system operator)
VIP	Virtual interconnection point
VIK	VIK Verband der Industrielle Energie- und Kraftwirtschaft e. V. – German Association of the Energy and Power Industry
VTP	Virtual trading point
VKU	Verband kommunaler Unternehmen e. V. – German Association of Local Utilities

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