gasunie transport services

Netwerk Ontwikkelingsplan 2015

Network Development Plan 2015

Final version, rev.1

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Preface

I am proud to present to you the Network Development Plan 2015 (abbreviated as NOP 2015, from the Dutch Netwerk Ontwikkelingsplan). The plan describes the need for gastransport in the Netherlands for the next ten years.

At Gasunie Transport Services (GTS) we maintain and provide an infrastructure that supplies a vital energy source to millions of homes and offices, schools and hospitals, factories and power plants, both in the Netherlands and among our European neighbours. Here in the Netherlands, we guarantee the ability of our network to supply gas to keep people warm in the very coldest of winters, and to keep the wheels of economic life turning.

The energy world is changing quite fast: the use of green energy such as wind power, solar power and biogas, is steadily rising; new technologies are increasing the efficiency with which energy is used. At the same time the production of gas in north-west Europe is declining rapidly. On a commercial level, shippers of gas increasingly book short-term instead of long-term capacity in our pipelines, facilitated by the PRISMA platform. This dynamic world, which will probably see far-reaching changes in the mid to long term, needs a new process to guarantee the availability of transport capacity.

It takes many years to realise a major investment in the gas transport system. For cross border investments, which we know we will need, it can take five years or more. Investments will only be realised if it is clear that they will be viable for a reasonable number of years. For these reasons it is necessary to look 15 to 20 years ahead when considering if an investment is necessary. And we have to take care to avoid the equal faults of investing too little, or of investing too much. This NOP 2015 is the result of that new process.

The document in your hands or on your screens will help us to take our decisions wisely. It explores different possible energy futures; it looks at the sources of new gas supply; and it examines the impact of these on the flows in and out of our transport system. As a Network Development Plan for the Netherlands it is the first document of its kind, helping us to take a new approach to network investment. We are not yet obliged by law to prepare this first NOP, but we think that our customers will benefit from an 'early start' to the new investment approach that it offers.

A draft version of this plan was opened for consultation in May and June 2015. We are happy with the many, constructive and critical, responses received. We have adjusted the draft to take account of these comments. A striking result from the consultation is the widespread opinion that cross border cooperation is of utmost importance to support a well-functioning EU energy market. We strongly agree with this and in this final version devote an additional chapter to the subject.

I commend this document to you, with the assurance that we at GTS will work tirelessly to fulfill our ambition for a robust, efficient and economical gas transport system in the years to come.

Annie Krist
Managing Director Gasunie Transport Services B.V.

Executive Summary and Conclusions

This first Network Development Plan (in Dutch: Netwerk Ontwikkelingsplan, abbreviated as NOP) is prepared by Gasunie Transport Services (GTS) to propose investment measures that will ensure the required capacity for the gas transport system in the Netherlands. The NOP has a horizon of twenty years: it puts forward measures that are needed within the next ten years, while taking account of the period of time during which those measures will receive an economic return.

A well-functioning gas transport system in the Netherlands plays a vital role in the north-west European gas market. In turn, taking account of developments in north-west Europe is essential for good planning and efficient use of the GTS network. In investing in its network, GTS aims to provide economic opportunities for customers of the system, to assure security of supply of transport services, to support the internal European gas market, and to promote the further development of liquid trading markets, notably the market at the Dutch Title Transfer Facility (TTF).

GTS has developed three demand scenarios for the NOP, which describe a range of credible futures regarding gas transport for the GTS network. The main influences on demand in these scenarios are the rate at which sustainable energy will develop and the potential growth rate of the economy.

On the supply side, the main driving force for future planning is that gas produced in the Netherlands is in decline. Both in the short term and in the long run there is uncertainty about the production of the Groningen field. In the decisions on the amount of allowed Groningen production, security of supply on a yearly as well as on a peak supply basis is taken into account. This NOP incorporates the most recent known figures formally decided upon by the Minister of Economic Affairs. Gas produced in other, nearby parts of north-west Europe, notably the UK and Germany, is also declining. Norway's production is not expected to increase.

Comparing the three demand situations with the trend in local production, and with the existing entry capacity, there is a clear need for additional gas from outside north-west Europe. The amount of additional gas needed will differ according to scenario, and the direction from which it may come will differ over time. The sources of additional supply will be predominantly liquefied natural gas (LNG), delivered to terminals in north-west Europe, and Russian gas, delivered by pipe. Longer term options may include larger volumes of both pipeline gas and LNG from new infrastructure in Europe.

Analyses of the three scenarios show that the main gas transport system in the Netherlands (the Dutch gas roundabout) and the transport system connected to the market are robust enough to absorb expected changes in the level of market demand for gas over the next ten years. But the additional supply exceeds the possibilities of the entry part of the system, which needs to be expanded. An increased need to convert high calorific gas into a quality suitable for the low calorific market, due to the decline of the Groningen field, leads to a need for investment in additional quality conversion facilities.

The following adjustments are foreseen:

- **Responding to declining Groningen capacity.** The capacity of the Groningen field is declining, with the result that the low-calorific gas market needs to be delivered with higher quality gas from additional supply. Household customers, and others, in the whole of the Netherlands and in the parts of the neighbouring countries Germany, Belgium and France, depend on this gas. A consequence is the need for additional quality conversion. GTS is planning to build new large-scale facilities, including a nitrogen plant and a blending station, to facilitate this.

- E**nhancing entry capacity.** Due to the shift of supply capacity away from the declining Dutch gas fields to border stations and storages, the transport system between these entry points and the main system needs to be expanded. The location where additional gas will enter determines where investments are needed. Several parties are developing plans that lead to an increase in entry capacities and thus to proposed investments in the GTS system: the GATE LNG terminal is expecting to increase its send out capacity due to an investment in a additional LNG tank, and adjustments to the capacities of storages in the west of the Netherlands are being investigated.

Other developments relate to cross border gas flows and require a strong cooperation between neighbouring network operators (NNOs) in the interest of best serving customers, in line with European law:

- **Storage facilities linked to more than one network.** NNOs need to develop a shared view about the role of storages which are connected to both the Dutch and German networks and on the existing L-gas and H-gas cross border capacities.

- **L-gas to H-gas conversion Germany.** The conversion of the low–calorific gas market to high-calorific gas in Germany due to the decrease of the L-gas export from the Netherlands, is starting in 2020. The use of the existing Dutch system, which has enough capacity to transport high-calorific gas to the German market, is an attractive alternative for investing in a new system in Germany. But to enable the market conversion, adjustments have to be made to the exit system. On the German side of the border further investments would also be needed.

- **L-gas to H-gas conversion Belgium and France.** The conversion of the low–calorific gas market to high-calorific gas will start a few years later than in Germany. Strong cooperation between the TSOs is necessary to optimize this conversion process and gas flows after this process.

- **Reinforced two-way flow at Oude Statenzijl.** Additional, bidirectional, border crossing capacity is expected at Oude Statenzijl on the Dutch-German border.

Cross border cooperation is of utmost importance to support a well-functioning EU energy market. In their response to the consultation version of the NOP 2015, stakeholders supported the approach taken by GTS to consider not just the Netherlands but also to focus on the north-west European gas market.

A reliable alignment of the Dutch NOP 2015 and the German NEP 2015 (and network development plans of other NNOs) is a major goal of further cooperation. This will help to achieve a solid common understanding on both sides of the border for the expectations about and the possibilities of import and export flows as well as of storage use.

The measures proposed in the NOP are not exclusive. Stakeholders in the gas business in the Netherlands—existing shippers on the GTS system, gas customers, and new entrants to the business—always have the right to approach GTS at any time to request entry or exit access to the Dutch gas grid. GTS has a connection obligation in response to such requests, providing they are economically feasible. The NOP process does not limit such rights.

The study, planning, and implementation of engineering works on the high pressure system, such as those proposed in the NOP, typically has a lead time of about four or five years from the date on which an investment decision is taken. Such projects must take account of the safety and environmental standards as well as local sensitivities.

GTS stands ready to implement the measures that are described in this NOP, including those that have a connection with external parties' initiatives. This statement is without prejudice to any eventual need for further study by GTS, in the event that variations or deviations in the scope of external parties' proposed initiatives should make it unreasonable for GTS to proceed.

This NOP will enable GTS to undertake the necessary capacity measures to satisfy future customer needs in a timely manner.

Contents

1. Introduction

This report, the Network Development Plan (in Dutch: Netwerk Ontwikkelingsplan, abbreviated as NOP), has been compiled by Gasunie Transport Services (GTS), which is the transmission system operator for the gas transport network in the Netherlands.

GTS has a statutory mandate to provide sufficient transport capacity[1].

The report is a new departure for GTS. New Dutch law, which is under development, will require GTS to prepare and present, before 1 January 2018, a Network Development Plan that outlines, for a ten-year period, the investments that are expected to be needed to fulfil this task. The NOP must then be renewed, on a rolling ten-year basis, every two years. GTS considers that its customers, and other stakeholders, including its European partners, will best be served by an early start to the process of preparing a forward-looking plan for the development of the network. In this spirit, GTS has prepared this report as the first NOP, to be ready in July 2015 more than two years ahead of the legal requirement.

GTS considers that an early start is needed because the gas market is already signalling that a new approach is needed to underpin gas transport investment in the Netherlands. The report describes the reasons for this new approach and its results. It concludes by putting forward proposals as to how the network should be developed in order to continue providing sufficient transport capacity in the future.

The report is structured as follows. After this introduction (chapter 1), scenarios are developed for the period 2015 to 2035 according to choices made based on the main identified uncertainty factors (chapter 2). The scenarios are cross-referenced against well-respected outside sources, which will be familiar to most market players and regulatory authorities. They are then used to estimate the likely annual and peak demand for gas in each scenario (chapter 3). The scenarios were designed to give a range of reasonable expectations of demand for gas, and of demand for capacity to supply peak hourly demand. Chapter 4 presents the prospects for gas supply in north-west Europe[2], and chapter 5 examines the possible sources of additional supply that will be needed. Based on developments in gas demand and supply, the potential gas flows were identified and the demand for gas transport analysed in a way that will satisfy the GTS objectives that are described below. These transport analyses were then used to consider whether the existing infrastructure could meet this demand, consistent with the objectives. Where it could not, the capacity measures that will need to be undertaken in the next ten years were formulated. These are described in chapter 6. Chapter 7 describes interregional, cross border cooperation, which is needed to support a well-functioning EU energy market.

1 Where this document refers to transport, this includes any quality conversion. GTS' statutory responsibilities are defined in the Dutch Gas Law, http://wetten.overheid.nl/BWBR0011440/Hoofdstuk1/Paragraaf14/geldigheidsdatum_07-05-2015

2 North-west Europe in this report includes eight countries: the Netherlands, Belgium, Luxembourg, Germany, Denmark, the UK, Ireland and France.

1.1. The Network Development Plan: purpose and rationale

The NOP is guided by three key objectives that GTS intends to deliver for its customers in the Netherlands and in neighbouring European markets:

- **Providing sufficient entry to and exit from the 'gas roundabout'**. This is required to assure the supply of both domestic and foreign gas, to assure the transit of gas for cross border trade in line with European law, and to enable gas storage facilities to perform their seasonal and daily load balancing functions.
- **Providing sufficient exit from the 'gas roundabout' for domestic customers.** This is needed to ensure that transport capacity is securely available to supply customers in the Netherlands (although the responsibility for gas supply security does not lie with GTS, except for protected users in extreme peak circumstances).
- **Providing sufficient 'quality conversion'.** This is required to ensure that low-calorific gas customers continue to be served, and to permit the good functioning of gas trading at the TTF (Title Transfer Facility) without the need for shippers and traders to purchase quality conversion services.

Together these objectives will assure the users of the gas network in the Netherlands that they will have the best possible opportunities to buy gas from a wide range of competitive sources that are available. As domestic and local sources of gas decline, GTS must ensure that the gas grid in the Netherlands can provide enhanced access for customers to new and additional sources of gas, whether from west or east, by pipeline or LNG, and including green gas. Furthermore, good planning and delivery of these objectives is needed to maintain a good, internationally connected network, which in turn is necessary to support a well-functioning liquid market in gas. In summary, GTS' objectives aim to provide **economic opportunities for customers** of the network, **security of supply of transport services**, support for the **internal European gas market**, and the further development of **a liquid TTF**.

In the past, GTS had been able to establish the capacity requirement at border points using the Open Season method, under which long-term contracts (10 years or more) to transport gas were concluded by market players ('shippers'). For GTS, this made it clear what the long-term transport requirements would be. The response to Open Seasons enabled GTS to develop the network in such a way as to meet these requirements.

Shippers are now signalling that they do not wish to contract for long-term capacity. They prefer to rely on the newly developed short-term capacity auction platforms, such as PRISMA, which GTS has promoted and in which it holds an active share. GTS is therefore developing the NOP as an alternative method which takes a wider approach to long-term capacity planning, which is based on essential markets needs, and which looks at the potential patterns of future gas flows.

The Dutch legislator has also acknowledged this development and decided to incorporate it into new regulations, which are expected to be operational by 1st of January 2016[3]. As a result of this development, the NOP will also be designed in such a way that in future it can incorporate a number of other reports that GTS has previously been required by law to

3 GTS is a fully unbundled network company. As such, there is no formal obligation on the Netherlands under EU law for the preparation of an annual network development plan. The EU obligation applies only to network operators that are not fully unbundled.

prepare. Already in this first report, the NOP incorporates that part of the bi-annual Capacity and Quality Report (KCD), which relates to plans for new transport capacity. Replacement investments will, however, continue to be identified in the 2015 KCD, to be published in December 2015. The reports on the Small Fields, and on Security of Supply (VZG report), were stand-alone documents, but are included in this NOP.

1.2. The Network Development Plan: design approach

A gas network must develop to be responsive to a changing pattern of future gas flows. A key factor in charting gas flows is the evolution of gas demand and supply, and how it changes over time and from location to location. The location and volume of demand and supply indicate the transport routes that will be taken by the gas flows to get the supply to the market.

Demand will change in response to customer needs in north-west Europe and the Netherlands; supply will change in response to world market developments and in response to suppliers' alternative opportunities. Inevitably, these developments are surrounded by uncertainty, especially in the longer term, due to a number of important variables.

For the purposes of the Dutch and European gas market, the most important of these variables are: the level of **economic activity**, the development of **renewable energy and sustainable energy technologies** and the source of the **gas supply**. It was therefore decided to test the impact of these variables by adopting a scenario-based approach. The scope of the scenario analysis includes both the Netherlands and its neighbouring countries in north-west Europe. A European scope is necessary to provide insight into the evolution of cross border gas flows (for import, for export, and for transit) which provides economic opportunities and benefits for Dutch as well as for other European gas customers and gas suppliers. A European perspective is also essential both for supply security and for the efficient development of infrastructure inside the Netherlands and in the neighbouring countries.

1.3. The Network Development Plan: stakeholder engagement

GTS has prepared this first NOP on the basis of the company's expectations as to what the Dutch and north-west European market players may need in terms of transport capacity over the period 2015 to 2025. These expectations have been guided by:

- The new focus of customers on only their short-term capacity needs, as was evidenced in the response to the Open Season 2017 and the Open Season 2019, which were held in 2012 and 2014 respectively.
- Widely reported market expectations of future possible trajectories of European gas demand, visible for example in energy and gas demand forecasts made by public bodies such as the IEA (International Energy Agency) and the EC (European Commission) and by reputable private market analysts.
- Public planning documents prepared by Neighbouring Network Operators (NNOs) or appropriate authorities in Belgium, France, Germany, Great Britain and Norway, as well as the Europe-wide Ten Year Network Development Plan (TYNDP) prepared by ENTSOG and the associated regional work for north-west Europe (the GRIP), supported by insights provided at bilateral meetings held between GTS and the Dutch regulator, shippers, NNOs and the Ministry of Economic Affairs.

A formal process of consultation was open from May 13th until June 10th 2015. The received responses have led to the following adjustments to the consultation document:

- A new chapter "Cross border cooperation" (chapter 7.) has been added, in which the alignment of cross border capacities and cross border investments is described.
- A new "Appendix II" has been added, in which the responses related to the NOP have been addressed.
- The paragraph about the production of the Groningen field (4.1.) has been adjusted according to the latest decision of the Ministry of Economic Affairs on 23th Of June 2015.
- Paragraph 4.3. and 5.5.1. have been expanded and show, next to the volume and capacity balances taking into account only Dutch production and Dutch demand, also the volume and capacity possibilities which the Dutch transport system offers for transit gas through the Netherlands.
- Figures 4.1 and 5.8 have been adjusted .
- Appendix VII, which shows the capacity at the border stations, has been adjusted for some border stations.
- The "Preface" and the "Executive Summary and Conclusions" have been updated.

It is to be noted that stakeholders—including existing shippers, gas customers, and new entrants to the business—always have the right to approach GTS at any time to request entry or exit access to the Dutch gas grid, and that GTS has a connection obligation in response to such requests, providing they are economically feasible.

This NOP is therefore in no sense a limiting or exclusive process.

2. Scenario-based approach and description

2.1. Principles

A scenario approach to investment planning formalizes and acknowledges that firm decisions must be made in conditions of uncertainty about the future. In this NOP, the scenarios developed help to give structure to the main uncertainties relating to future gas demand in the Netherlands and in north-west Europe. The key uncertainties are identified, assumptions are made about a range of plausible outcomes for each of them, then the assumptions are combined into descriptive 'states of the world'. Within each state of the world, or scenario, a particular pattern of gas demand can be identified. The assumptions made must be mutually coherent, so that each scenario is internally consistent.

The demand scenarios are matched against future indigenous supply, which has a higher degree of certainty. Excess of demand over supply needs to be acquired from sources of gas outside north-west Europe. As this gas can also be sold and transported to other markets, outside north-west Europe, its availability for European customers cannot be assured. For security of supply reasons different combinations of these sources need to be studied.

Scenarios do not pretend to forecast future developments. Rather they describe that very different outcomes are each perfectly possible. Investment decisions can then be made for gas transport planning which are robust against a number of possible outcomes. By developing scenarios, unreasonable and inconsistent pictures of the future are excluded—minimising the risk of over-investment. But the combination of scenarios gives a view that acknowledges the possibility of different futures, in order to guide investment that offers both protection and flexibility for customers of the grid.

This NOP identifies two key areas of uncertainty which will have an impact on the demand for gas. This chapter explains these key areas and describes the choices that have been made for each scenario. The choices are designed to provide a robust picture of the future demand for gas transport in the Netherlands.

The third key area of uncertainty, future gas sourcing, will be described in chapter 5. Future gas sourcing will have an impact on the supply of gas and together with the two key uncertainties for gas demand, will indicate the future gas transport needs.

2.2. Gas demand scenarios

Two drivers in particular will influence the level of demand for gas in Europe and the Netherlands:

- Economic development.
- The rate of development of renewable energy and sustainable energy technologies.

The development of the economy is and will remain an uncertain factor in determining the size of the north-west European natural gas market. Economic prosperity drives production and consumption; it also creates investment conditions for relatively rapid turnover of the energy-using capital stock. This can be conducive to efforts to invest in a more sustainable energy supply, including energy-saving measures and new technologies.

The rate of penetration of renewable energies will depend on variables such as the maintenance or extension of policy-led support measures, technological progress, cost reductions, and certain elements of electricity market design.

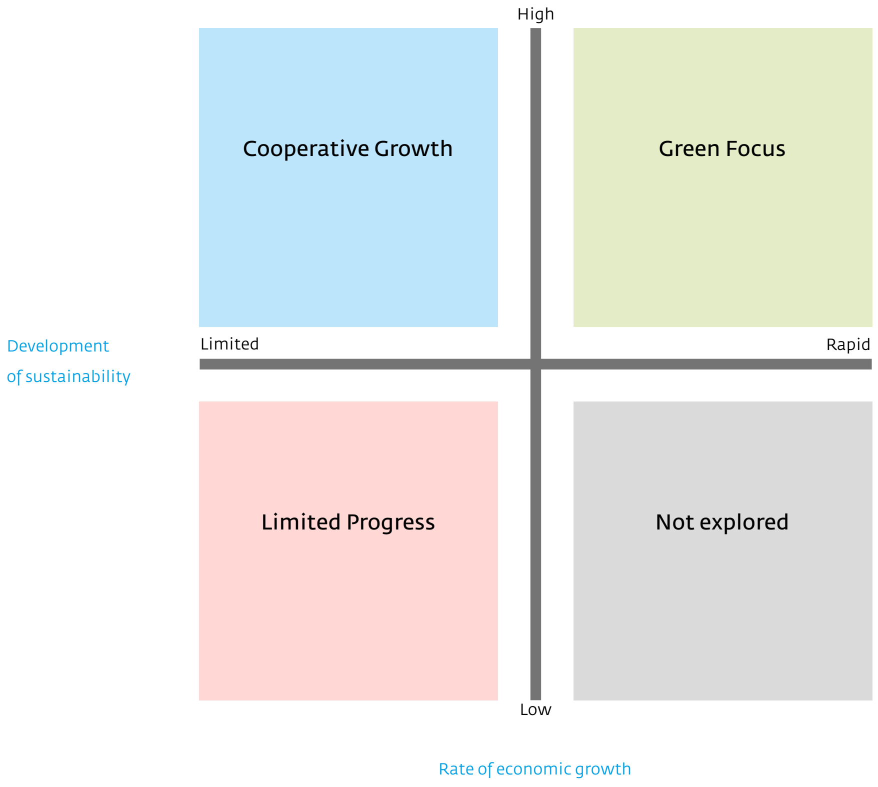
Based on these two key drivers, GTS has defined three energy demand scenarios for north-west Europe:

- A high rate of economic growth combined with rapid development of sustainable and renewable energies.
- A high rate of economic growth combined with limited development of sustainable and renewable energies.
- A low rate of economic growth combined with limited development of sustainable and renewable energies.

A fourth potential combination of factors—low economic growth and rapid development of sustainable energies—has not been explored, since it can be assumed that the peak load on the transport system with such a combination will fall within the envelope defined by any of the other scenarios.

The three demand-based scenarios, with the names they have been given in this document, are shown in Figure 2.1.

Figure 2.1 The 'Green Focus', 'Cooperative Growth', and 'Limited Progress' Scenarios



2.2.1. The Green Focus scenario

In the Green Focus scenario, the growth of the European and global economies will pick up again in the coming years. A period of economic recovery and growth will go hand-in-hand with a relatively high level of investment, especially in sustainable technologies. Emissions will be significantly reduced, coherent with the EU's politically agreed targets for 2020 and 2030.

In this scenario, demand for gas in north-west Europe is likely to decline due to rapid adoption of energy efficient technologies, including highly efficient gas technologies themselves, and a relatively strong focus on making European society more sustainable. Investments in high-efficiency, low carbon technologies in both the market for electricity production (power) and the rest of the market (non-power: domestic households and industries) will rise rapidly. Large-scale insulation of homes and more widespread adoption of condensing boilers, micro-CHP and hybrid heat pumps will result in a decline in demand for gas for heating (in households).

2.2.2. The Cooperative Growth scenario

The global and European economies will begin to expand once more in this scenario as the economic crisis passes. However, changes in societal objectives and changing political focus will reduce the pace of investment in sustainable technologies. As a result, internationally agreed targets for greenhouse gas (GHG) reduction will either not be met or will be revised downwards.

The volume of demand for natural gas in north-west Europe will rise, and new gas will be available in sufficient quantities for rising market demand. Substitution of oil and coal with gas in Europe will contribute to GHG reductions, but this scenario also anticipates that coal will still retain an important role in the European energy mix – although it is less in demand in the longer term due to increased costs associated with CO_2 emissions.

2.2.3. The Limited Progress Scenario

This scenario describes a situation involving long-term economic problems. Under these conditions, attention will still be given to sustainability, but the rate of investment will not be sufficient to drive an aggressive introduction of renewable energy or of innovative uses of natural gas. The scenario will be characterized by limited economic growth that slows demand for energy in north-west Europe. Coal will continue as an important fuel in the energy mix, and the relationship of coal and gas in the electricity generation merit order up to around 2030 will remain to the advantage of coal. Gas will lose market share to renewable energy sources, while the closure of nuclear power stations results in compensating additional demand for gas.

Figure 2.2 summarizes the macro-characteristics of the three scenarios.

FIGURE 2.2 DEMAND SCENARIOS

	Green focus	Cooperative growth	Limited progress
Rate of economic growth	- High	- High	- Low
Development of sustainability	- Rapid	- Limited	- Limited
Summary	- European gas volume demand decreases - Targets regarding sustainability realized - Coal is pushed back starting in the early twenties	- European gas volume demand increases - Development of sustainability does not accelerate - Coal is pushed back starting in the mid twenties	- European gas volume demand stable - Sustainability lacks resources and focus - Coal continues to be important

2.3. External sources consulted

A careful comparison of external analyses was made for each scenario, based mainly on similarities to the principles for defining each scenario that were applied by GTS. The following references were particularly helpful in developing the demand scenarios:

- The EU Roadmap 2050 High RES ('High Renewable Energy Sources') scenario was used as a reference for the Green Focus scenario. The initial subdivision of demand for gas and energy in the EU-28 to individual country level was carried out with the help of the EU Roadmap reference scenario.
- The Cooperative Growth scenario relates closely to the IEA World Energy Outlook (WEO) Current Policies scenario.
- The Limited Progress scenario is close to the IHS Cera Vortex scenario.

These reference scenarios were filled out in more detail for the larger north-west European countries using information from national scenarios for each country.

3. Demand for gas

For each of the scenarios, demand for gas in the Netherlands and in north-west Europe is determined on the basis of the levels of demand recorded in 2013/2014, the principles appropriate to that scenario as described in section 2.2. above, and available external analyses concerning possible developments in the demand for gas.

The NOP scenarios provide a range of outcomes for gas demand in the 2015 to 2035 period that directly takes account of uncertainty, providing a sound basis for system planning against this range of possible outcomes. GTS has validated the outlook for demand across the range of scenarios against other expert judgements.

This chapter presents the expected development in the volume demand for gas, and the capacity demand, in quantitative terms in each scenario. They are shown in Figures 3.1 to 3.8 below and the detailed results of the quantitative analysis are available on the GTS website[4].

The analysis focussed especially on the eight countries of north-west Europe, with more detail on the larger markets and the Netherlands. A broader assessment of European demand and supply helped provide the context for European transport analyses, which, together with the north-west European work, provided insight into potential gas flows on the Dutch border.

3.1. Understanding the relation between volume demand and capacity demand

Many public and private organizations involved in the energy business make forecasts of the volume of gas demand. This can be helpful for energy policy planning, and for developing commercial strategy. A gas transmission operator, such as GTS, must likewise be aware of trends in future demand volumes, but must also pay careful attention to the future demand for capacity—the ability to deliver what customers need at times of peak demand.

The relation between the demand for volume and the demand for capacity is defined in the load factor—which is the average hourly demand for gas divided by the peak hourly demand. Baseload demand therefore has a load factor close to 1 (one) and, since the average is smaller than the peak, peaky demand has a load factor of less than one.

The energy unit used to express gas volume demand in this report is the Terawatt hour (TWh); the unit used to express gas capacity demand is Gigawatt hour per hour (GWh/h). For reference, and to give an idea of scale, the annual volume of gas demand in the Netherlands in 2015 will be about 420 TWh, while the peak demand will be about 170 GWh/h. The load factor for the Dutch market as a whole will therefore be:

Average hourly demand in the year = 420 TWh ÷ 8760 hours = 48 GWh/h
Peak hourly demand in the year = 170 GWh/h
Load factor (average demand ÷ peak demand) = 48 ÷ 170 = 0.28

4 The figures in this report are available on the GTS website, at http://www.gasunietransportservices.nl/en/transportinformation/nop-2015-2035. External sources used for the figures are mentioned in this document, if no external sources are mentioned, figures are based on GTS information or on analyses performed by GTS.

The load factor is different in each market sector, as it depends on how customers choose to use their gas—at what time of day or at what season of the year, how steadily or how variably. In order to understand the future demand for capacity, it is necessary to understand how the load factor of each market sector will develop over time.

Two main market sectors for gas can be distinguished where the future development of the load factor differs considerably: gas for heating purposes and gas for power generation.

- The load factor of gas for power generation is dependent on the position of gas in the future fuel mix for power generation. In particular the impact of renewable energy sources (RES), which often have a zero marginal price, and the competition with coal will influence the position of gas in the 'merit order'. This determines when and how often gas-fired power stations are operated to dispatch electricity. At the same time, the role of gas as a backup supplier on dark and still days remains important.

  The future load factor in this sector thus depends on the assumptions in different scenarios about the share of RES and the competition with other fuels. A large share of RES and low coal prices will limit volume demand of gas—but at the same time it will decrease the load factor, leaving the demand for peak capacity as high or higher than it was before. High coal prices and a lower share of RES will increase the volume of gas demand, but will also increase the load factor of gas for power generation, moderating any potential increase in peak demand.

  In other words, whatever the variability in the future track of the volume of gas demand in this sector, the demand for peak capacity in this sector is likely to be more stable.

- The load factor of gas for heating purposes is also subject to changes but these are minor compared with gas for power generation. An impact may be expected from electric heating using hybrid heat pumps. These run on both electricity and gas where gas is used for peak situations causing a decrease in load factor for gas—again, maintaining peak demand for gas even as the volume of demand declines.

3.2. Volume and capacity demand in north-west Europe

North-west European gas demand will develop differently in the conditions described by the three scenarios presented in chapter 2.

Green Focus

In this scenario electricity production will be driven by environmental concerns. Gas loses market share to renewable energy sources such as biomass, solar and wind power. Conversely, gas will win back market share from coal, which becomes less attractive in view of more stringent implementation of CO_2 targets. The imposition of these more stringent measures will cause coal-fired power stations to become less attractive and gradually to be replaced by gas-fired power stations. This is expected by 2020 in the UK, and by 2025 elsewhere in north-west Europe. Overall, demand for coal for electricity production in this scenario declines by approximately 85% over the next 20 years.

The decline in the share of capacity in the power sector will be smaller than implied by the loss of market share to renewables; indeed a modest increase in peak capacity is expected in the medium term. This is because gas-fired power stations will need to be available for when intermittent energy sources (sun and wind) are not. Moreover, there is a risk that extension of electric home heating will provoke extreme calls on electric power at times of peak heating demand, increasing the need for expansion of local electricity grids and increasing the need in demand for peak gas capacity in the power sector. Alternatively, hybrid heat pumps will hold down peak electricity demand, replacing it with direct peak gas demand in the non-power sector, while making use of currently available infrastructure.

Under this scenario, demand for gas in the non-power sectors will fall sharply. In north-west Europe total volume demand for gas falls sharply by approximately 650 TWh in 20 years, i.e. at an average rate of about minus 1.3% per year. Capacity in the non-power sectors will fall less sharply.

Cooperative Growth

Demand for electricity rises in this scenario in response to positive economic developments. Demand for gas for electricity production will also gradually increase, initially at the cost of coal, then subsequently in response to a decline in nuclear production.

The demand for capacity in the power sector will initially fall slightly, but will rise again in the long term: gas will continue to be available and attractive, leading to steady replacement of coal-fired power stations by gas-fired equivalents.

Demand for gas by the non-power sectors will remain stable: the downward pressure on demand for gas due to the improvement of home insulation and an increase in energy efficiency (existing programmes) will be offset by growing demand prompted by economic growth in both industry and commerce, and by increasing living space for households.

In this scenario, capacity demand for the non-power sectors will remain relatively stable. This trend will be driven by two opposing developments. On the one hand, there will be a (moderate) decline in capacity demand due to increased energy awareness, insulation and efficiency. On the other hand, capacity demand will rise as economic growth stimulates more industrial activity and commercial sector and in response to the winter needs of households with their greater living space. Both effects will be roughly equal, as a result of which demand for gas capacity will on balance remain unchanged for these sectors taken as a whole.

Limited Progress

In this scenario, continuing economic difficulties limit the scale of changes that are brought about in the electricity mix. Coal will continue to occupy an important place in the energy mix, with consequently limited increase in the volume of gas for power generation.

Gas will have a back-up role for renewable energy sources when these are not available. This will cause peak capacity demand to remain relatively stable. Coal-fired power stations will continue to play a more important role than gas-fired power stations for many more years to come.

Demand for gas for the non-power sector will decline on average by 0.5% per year, due to improvements in home insulation and an increase in energy efficiency (existing programmes). Total demand for gas would decline by 0.3% per annum.

Capacity will also decline slightly in this scenario due to slow growth, both of the economy and of renewable forms of energy.

Figure 3.1 shows the evolution of total demand for gas in north-west Europe in each scenario for an average year. For all scenarios, the starting point is today's (2015) annual level of demand for gas in north-west Europe, which is estimated to be slightly more than 3000 TWh (given normal weather conditions). By 2035, the annual level could have increased to more than 3300 TWh or could have declined to approximately 2300 TWh, according to how the drivers of demand in each scenario develop.

FIGURE 3.1 VOLUME OF TOTAL GAS DEMAND IN NORTH-WEST EUROPE, AVERAGE VS COLD YEAR

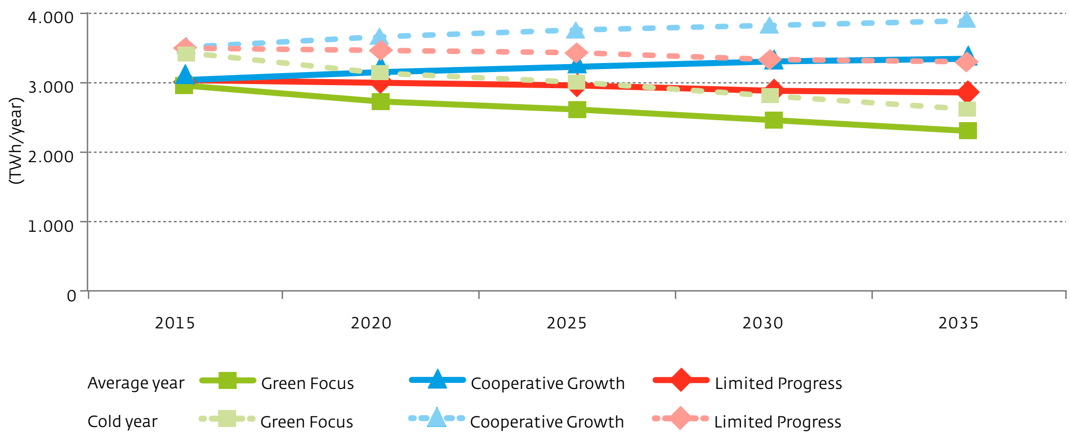
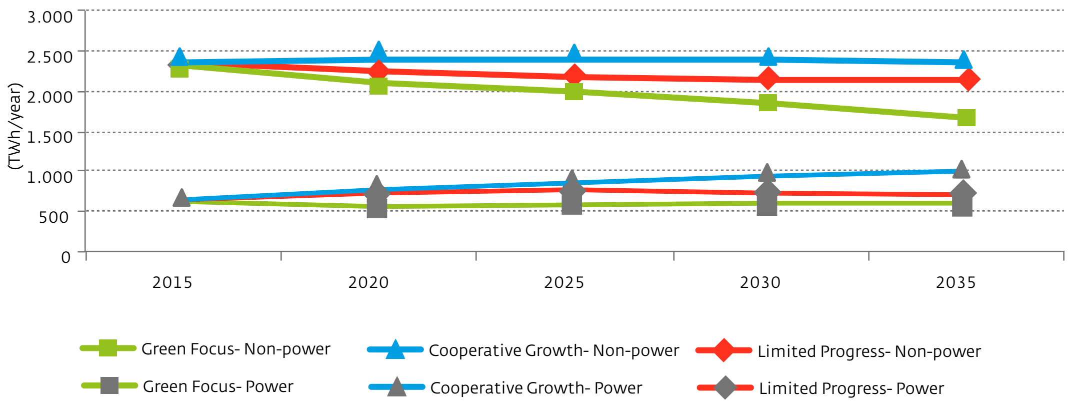


Figure 3.1 shows also the influence of a cold year compared to an average year on the yearly demand in north-west Europe.

The analysis of the sectoral breakdown of demand suggests that any increase in long-term annual levels of demand will most likely be attributable to developments in the power sector. This is most visible in the Cooperative Growth scenario (see Figure 3.2).

By contrast, a decrease in long-term annual levels of demand is more likely to be driven by developments in the non-power sectors (see Figure 3.2) which is most visible in the Green Focus scenario.

Figure 3.2 Volume of gas demand in the power and non-power sector in north-west Europe, average year



3.2.1. Volume demand in the Netherlands

This section details the development of gas demand in the Netherlands following the storylines of the three scenarios. The general characteristics of the scenarios as they apply to the Netherlands, and key assumptions about the amount of installed wind and solar electricity generating capacity, are presented in the table below.

FIGURE 3.3 MAIN SCENARIO CHARACTERISTICS NETHERLANDS, 2015-2035

	Green focus	Cooperative growth	Limited progress[5]
Installed wind capacity	- 12 GW	- 8 GW	- 10,5 GW
Installed solar capacity	- 8 GW	- 4 GW	- 4 GW
Merit order gas/coal	- Gas and coal change merit order starting around 2020	- Gas and coal change merit order starting around 2025	- Merit order does not change
Sustainability	- CHP continues to play a dominant role - Over 100,000 hybrid heat pumps per year enter the market	- Limited penetration other than condensing boiler techniques for heating	- Limited penetration other than condensing boiler techniques for heating

The trends in volume demand in the Netherlands follow the main lines of development in the rest of north-west Europe, but with a greater decline in annual demand in the Limited Growth scenario, due to the greater sensitivity of gas demand to general economic trends, because of the relatively high share of gas in the Dutch energy economy.

Today's (2015) annual level of demand for gas in the Netherlands is estimated to be around 420 TWh in an average year. The Green Focus scenario and the Limited Growth scenario would each result in a reduction in annual demand for gas of approximately 50 TWh over ten years, and as much as 85 TWh over 20 years. The Cooperative Growth scenario shows a stable level of demand for gas through to 2025, and a slight increase in demand thereafter (see Figure 3.4).

5 *See http://www.energieakkoordser.nl/*

Figure 3.4 Volume of total gas demand in the Netherlands, average vs cold year

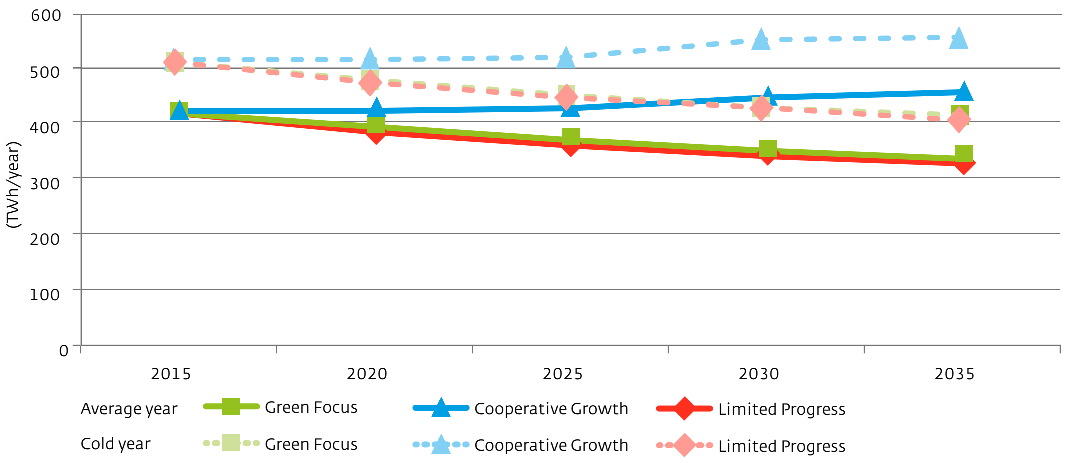
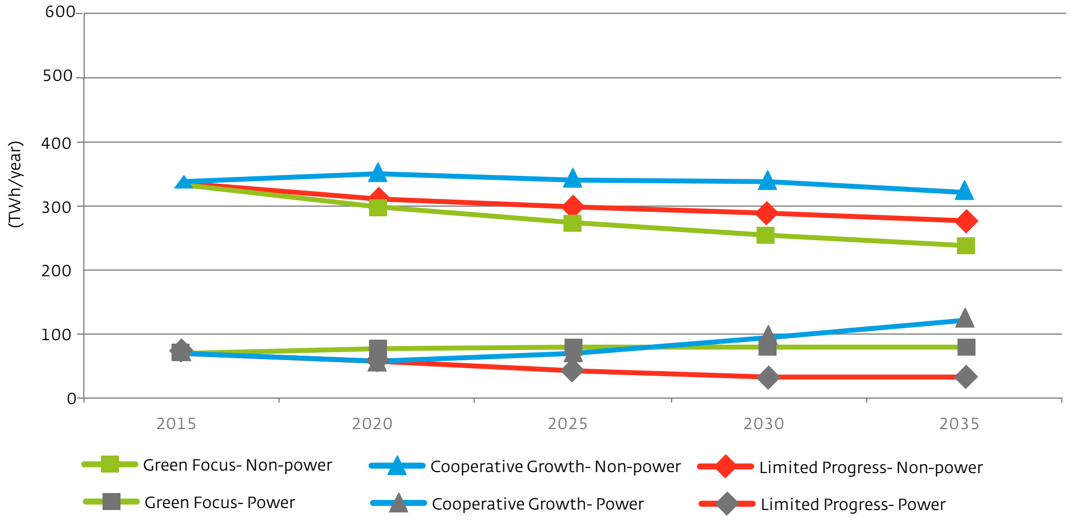


Figure 3.4 shows also the influence of a cold year compared to an average year on the yearly demand in the Netherlands in each scenario.

Within this overall picture, Figure 3.5 shows the breakdown of volume demand developments between the non-power and power sectors.

- In all scenarios, demand for gas by customers in the non-power sector is in decline. This reduction will vary from about 90 TWh by 2035 under the Green Focus scenario to approximately 15 TWh under the Cooperative Growth scenario, and is due to the stronger investment in alternative energy sources and energy efficiency.
- The volume of demand for gas in the power sector reflects a more diverse picture. In the Limited Progress scenario, demand for gas declines by about one third by around 2025, and by a half by 2035, whereas in the other scenarios a modest increase (Green Focus plus 10 TWh by 2035) or a strong increase (Cooperative Growth plus 50 TWh by 2035) is expected. The major differences between the scenarios are driven by the consequences for demand of coal versus natural gas prioritisation in electricity production, as well as the overall increase of renewable energy within the different sectors.

Figure 3.5 Volume of gas demand by sector in the Netherlands, average year



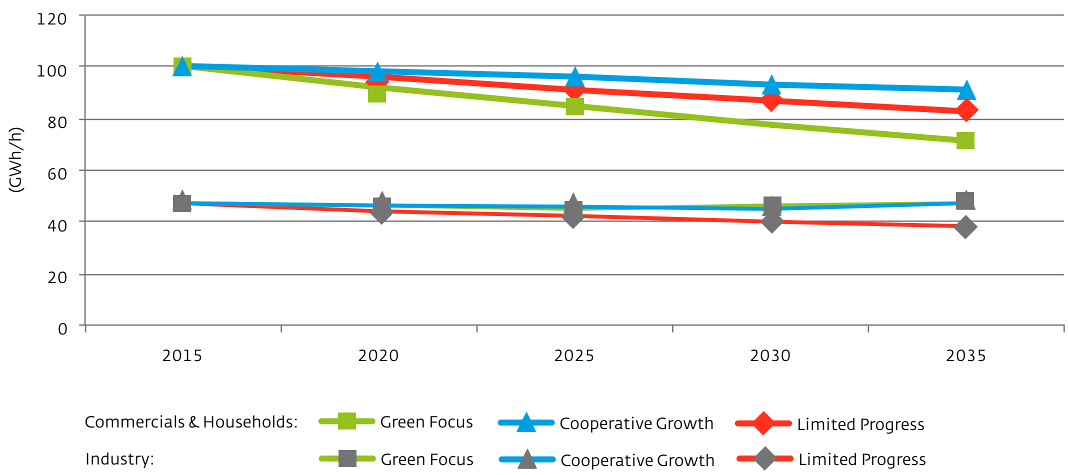
3.2.2. Capacity demand in the Netherlands

The non-power sectors

The lion's share of domestic demand for capacity—at around 100 GWh/h in the Netherlands—comes from space heating demand. The long-term trend of energy conservation and a progressive trend towards sustainability in heat generation will continue in all the scenarios. Demand for capacity to support industrial uses of gas will also be strongly influenced by the rate of innovation and investment in energy conservation.

As a result, a decline in peak demand is visible in all the scenarios (see Figure 3.6). But the degree to which this happens, and the choices that are made concerning the techniques to be applied, will ultimately determine the rate of decline of demand for capacity. These will vary by scenario.

Figure 3.6 Demand for gas capacity in the non-power sectors



- In the Green Focus scenario, where heating appliances will partly be electrified, and investment in energy efficiency will accelerate, demand for gas capacity will decline at an annual rate of 1.5%. But the rate of decline in capacity demand will be moderated—in the Netherlands just as elsewhere in north-west Europe—owing to the entry into the market of hybrid heat pumps. These hybrid heat pumps switch to gas in case of high heating demand, thus avoiding a peak in electricity demand (which would require expensive reinforcement of electricity infrastructure) but maintaining a high peak gas demand. In the Netherlands this scenario envisages a roll-out of hybrid heat pumps at a rate of up to 100,000 per year.
- In the Cooperative Growth scenario, on the one hand there will be a decline in demand due to the continuing trend of energy awareness, insulation and efficiency in households. On the other hand, against a background of continued economic growth, the domestic market will be characterised by a large number of smaller households with comparatively more residential space per person, and the number of economic agents in the commercial sector will increase. The combination of these effects results in a net effect of a 0.5% reduction per year in the demand for capacity.
- In the Limited Progress scenario, there is a similar continuation of the trend of recent years in households towards more insulation, greater energy awareness, and installation of high-efficiency boilers. These developments result in an anticipated annual decline of 1% in peak hour demand for capacity in this sector. The difficult financial and economic situation will lead to a general decline in industrial activity, including deployment of CHP, which in turn reduces demand for capacity in the sector.

The power sector

The requirement for gas capacity in the power sector depends not just on the volume of gas demand, but also on the position of gas in the merit order for dispatch of electricity. The role of gas as a backup supplier will be crucial. Although the intermittent sources, solar and wind, may generate large amounts of electricity in volume terms, the firm availability of these sources at times of peak power demand (which is also likely to be a time of peak gas demand) will remain very limited.

Only the fraction of the installed capacity that is available under all conditions can be considered as available in peak conditions. Literature on this subject, and those responsible for dispatching power, refer to this fraction as 'capacity credit'. There are some (small) differences in the values for the capacity credit of different energy sources that are adopted in the various north-west European states. GTS has adopted the following values:

- For solar power—0% (zero per cent): peak demand for both electricity and heat arises when it is dark and the sun is not shining.
- For wind power—10% (ten per cent): this is in line with the European Wind Energy Association report 'Trade Wind, Integrating Wind'.[6]

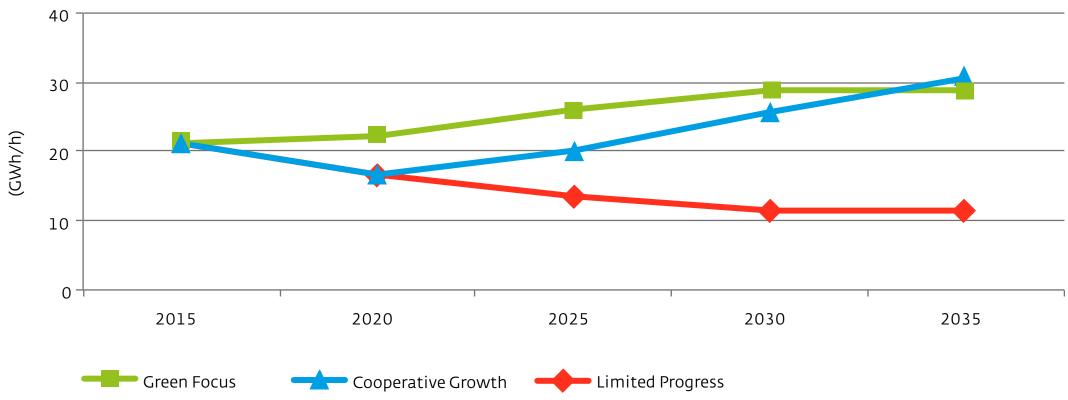
This means that non-intermittent energy sources for power generation (gas, coal, biomass, nuclear) need to be available in peak demand situations.

The scenario assumptions about the share of renewable energy sources and the competition with other fuels thus drive the capacity requirements in this sector. A large share of renewables and low coal prices will limit volume demand of gas but will not limit the capacity demand because of the backup role of gas. A more limited role for coal will increase gas demand thus also increase capacity demand of gas for power generation.

In both the Green Focus and the Cooperative Growth scenarios therefore, there will be an increase in demand for gas capacity in the power sector (see Figure 3.7). Only in the Limited Progress scenario will demand for gas capacity decline in this sector, driven by low rates of economic growth and a strong continuing role for coal.

6 *http://www.uwig.org/TradeWind.pdf*

Figure 3.7 Demand for gas capacity in the Dutch power sector

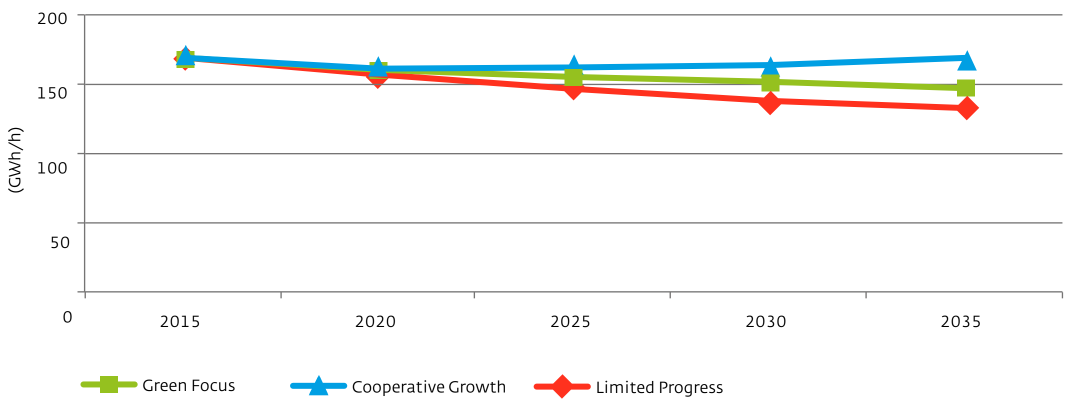


In general, in each of these scenarios the track of demand for gas capacity in the power sector will be in line with similar trends throughout Europe. This is reflected in analyses conducted by other bodies concerned with these issues, including for example ENTSO-E, the body that represents European electricity transmission system operators, and ACER, the EU agency for cooperation among national energy regulators.[7]

Total demand for capacity

Summing together the trends in each market sector for each scenario gives a projection of total demand for gas capacity in the Dutch market. Aggregating the figures (see Figure 3.8) suggests that total capacity is expected either to stabilise at its current level over the coming 20 years or else may decline slightly.

Figure 3.8 Total Dutch demand for gas capacity



7 See for example ENTSO-E https://www.entsoe.eu/publications/system-development-reports/tyndp/Pages/default.aspx and ACER : http://www.acer.europa.eu/Events/Presentation-of-ACER-Gas-Target-Model-/Documents/European%20Gas%20Target%20Model%20Review%20and%20Update.pdf, January 2015, page 11

4. The supply of gas

This chapter describes developments in the supply of gas. It begins by outlining domestic gas production in north-west Europe assuming that conventional production in the region and imports of gas from Norway will evolve in line with general energy industry expectations.

The chapter then analyses the extent to which gas demand and supply volume are out of balance, by comparing demand for gas in each scenario with domestic production in north-west Europe, the development of imports from Norway, and the current supplies of LNG from world markets and of gas from Russia.

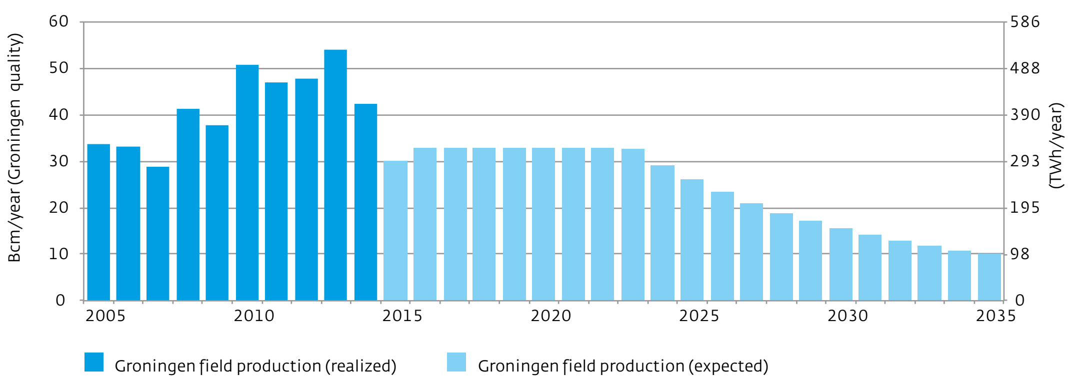
4.1. Conventional production in north-west Europe and imported Norwegian gas

4.1.1. Conventional production in the Netherlands: Groningen and the small fields

Groningen production

For many years, based on Dutch government decisions, the Groningen field has been preserved and preference has been given to production from the small fields. This has led to a production cap on the Groningen field of 425 bcm for the period 2006-2015. Early in 2014 additional restrictions on the production of the Groningen field were introduced in response to the earthquakes in the Groningen area. In December 2014 the Minister of Economic Affairs decided to reduce the allowed annual production volume from the Groningen field to 39.4 bcm for each calendar year 2015 and 2016. On June 23 2015 the Minister announced[8] a further reduction of the production out of the Groningen field to 30 bcm in 2015 and 33 bcm for gas year 2015 (Oct 2015 – Sep 2016). This was the last decision on yearly allowed production at the moment of writing this NOP, and for that reason it is also taken as the basis for expected yearly allowed production until such time as the technical capacity of the Groningen field does not allow the production of this volume anymore.

Figure 4.1 Outlook for Groningen field production



8 *http://www.rijksoverheid.nl/documenten-en-publicaties/kamerstukken/2015/06/23/kamerbrief-besluit-gaswinning-groningen-in-2015.html*

Figure 4.1[9] shows the latest public information on the Groningen production (2013) amended with realized production 2013 and 2014 and above mentioned restriction in the future of 30 bcm in 2015 and 33 bcm per year as of 2016. For the year 2015 the volume cap is divided into sub-caps for specific areas of the Groningen field.[10]

GTS has assessed[11] that in a relatively warm year, and where gas that is imported to the Netherlands has a relatively low average Wobbe level of 52, a total yearly volume of 21 bcm Groningen production would be sufficient to assure security of supply, given maximum use of the current quality conversion assets of GTS. In a cold year, however, and with a relatively high average import Wobbe level of 53, the required yearly volume of Groningen for security of supply with maximum use of the quality conversion assets would be 33 bcm. With the decision of the Minister to allow a level of 30 bcm for 2015 (and in addition a one time extra production volume of 3 bcm out of the Norg storage facility) and 33 bcm for gas year 2015 security of supply is guaranteed. In addition to the allowed production a reserve of 2 bcm would be permitted in case of unforeseen technical problems (for example in the technical availability of the quality conversion installations of GTS). Despite those volume restrictions, the capacity of the Groningen field will not be restricted for reasons of security of supply[12]: all parts of the field must reserve sufficient volume to contribute to the delivery of capacity in severe winter circumstances

9 *http://www.nlog.nl/nl/oilGas/grafiek_prod_profielen_2013-2037_PUBLIC.xls*
Figure adjusted for realised values for 2013 and 2014 (source: GTS)
Figure adjusted for the latest known production volume in 2015 and 2016 as decided by the Minister of Economic Affairs. Figure for 2017 and later are conform the 2016 figure until the technical capacity of the Groningen field does not allow the production of this volume

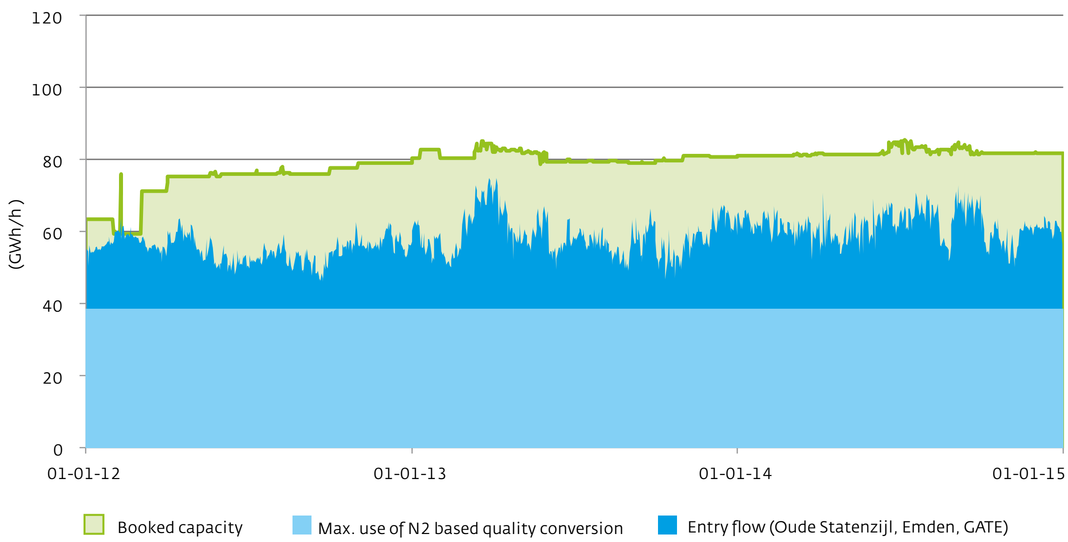
10 *Loppersum 3.0 bcm/year, Southwestern region 9.9 bcm/year, Cluster Eemskanaal 2.0 bcm/year, Eastern region 24.5 bcm/year.*

11 *http://www.rijksoverheid.nl/onderwerpen/aardbevingen-in-groningen/documenten-en-publicaties/rapporten/2014/01/17/onderzoek-geschikt-maken-van-ander-gas.html*

12 *An interim court ruling in April 2015 established that production from the five well clusters around Loppersum, "the area known to be at greatest risk of earthquakes", which was already restricted to 3.0 bcm/year, should be further restricted to extracting "small volumes … solely with a view to keeping them open so that they can meet exceptionally high demand for gas during very cold spells or if there are problems at other clusters."*

Gas from the Groningen field can be replaced by H-gas converted to G-gas by quality conversion. Additional H-gas can be imported at the main import points Oude Statenzijl, the GATE terminal and Emden within the available entry capacity. Figure 4.2 below shows the booked capacity during the last three years [13]. The dark blue area indicates the actual amount of physical entry flow at these points. The light blue area shows the maximum amount of H-gas which can in principle be converted to G/L-gas if fully using the quality conversion capacity with nitrogen that is available.

FIGURE 4.2 ADDITIONAL H-GAS IMPORT POSSIBILITIES AT MAIN IMPORT POINTS

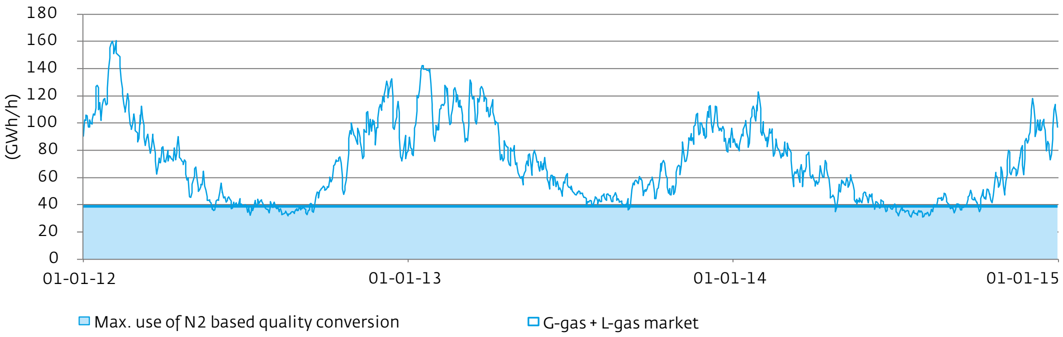


From the figure it can be concluded that the system is technically able to import enough H-gas in order to maximize the conversion of H-gas to G/L-gas with use of the current quality conversion capacity with nitrogen. In the warmer periods of the year—in the summer, but not limited to the summer—the technically available conversion capacity is not fully used, as the size of the G/L-gas market (including the filling of the storages) is not sufficient to require it.

In the current situation the Summer-Winter profile is for a large part delivered by the Groningen gas field and G-gas storages. Figure 4.3 shows the capacity needed for the G-gas and L-gas market in the last three years[14] and the H-gas that can be converted to G-gas using the existing quality conversion capacity with nitrogen. Both figures in this section show that there is not enough H-gas supply capacity and not enough quality conversion capacity available for replacing Groningen and the G-gas storages in delivering the required peak capacity. For that reason it is inevitable that Groningen, even if its annual volumes will decline in coming years, and the G-gas storages will keep playing a significant role in supply of capacity at peak time.

13 *Storages excluded.*
14 *Required peak capacity during severe winter circumstances will of course be higher.*

Figure 4.3 Max quality conversion using nitrogen and the size of the G/L-gas market demand

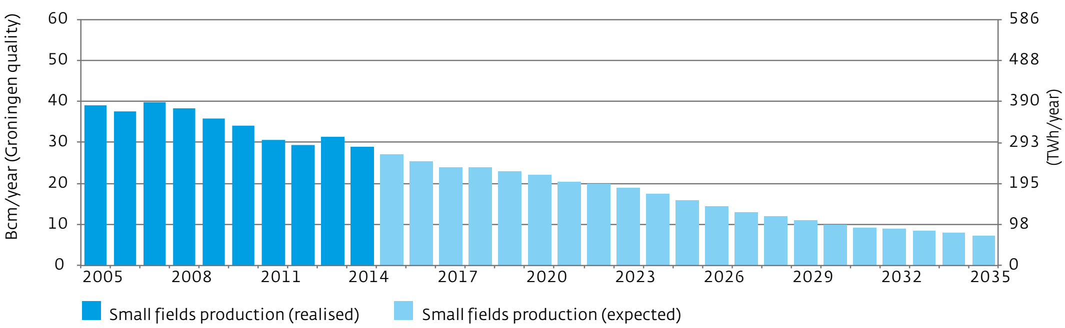


The Minister announced that there will be a new decision at the end of 2015 on the production in 2016 and subsequent years. In the mean time two further studies have been announced. One study by NAM (Nederlandse Aardolie Maatschappij) with advice of the Staatstoezicht op de Mijnen (the agency for State Supervision of Mines) on the combined gas production level and preventive strengthening of buildings to attain acceptable safety levels. A second study will examine the consequences of adopting a different mechanism for setting the annual allowed Groningen production level in the longer term. The current system allows a certain maximum production level with additional quality conversion to accommodate the total yearly market demand of G-gas and L-gas. An alternative approach could be to maximize the conversion of H-gas to G/L-gas with use of current quality conversion capacity and balance the needed supply of that quality of gas to the actual market demand with production of Groningen gas. The Minister of Economic Affairs announced a study by December 2015 on this alternative approach. For the NOP the most recent formal decision of the Minister, made in June 2015, allowing a production volume of the Groningen field of 33 bcm in 2016 (see Figure 4.1 above), and the availability of the capacity only if needed for security of supply, was the reference for the long-term outlook.

The small fields production

Annual gas production from the remaining gas fields on Dutch soil, collectively known as the 'small fields', will decline sharply over the coming years[15]. The 2013 annual report 'Minerals and geothermal energy'[16] includes a forecast suggesting that over the next 20 years, the small fields will yield a maximum of approximately 300 bcm, as shown in the bar chart in Figure 4.4 below.

Figure 4.4 Outlook for small fields production



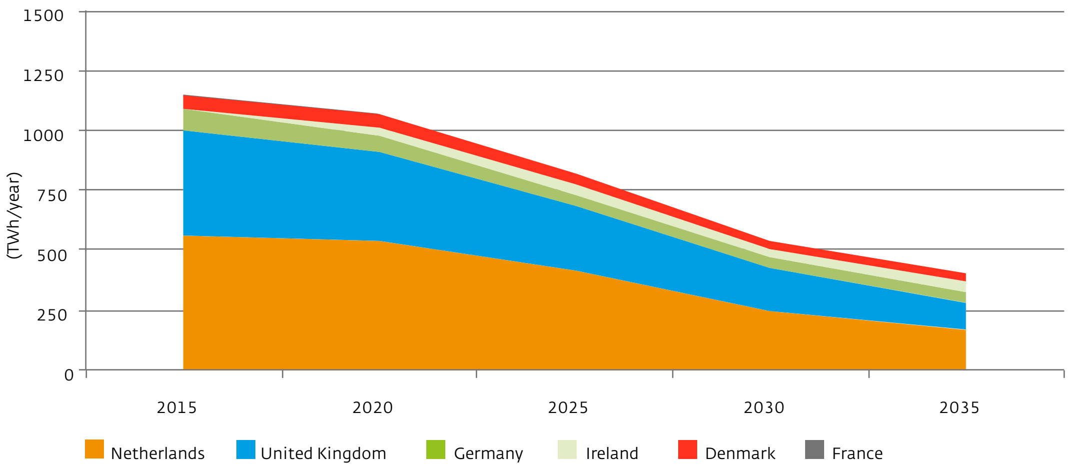
15 *http://www.nlog.nl/nl/oilGas/grafiek_prod_profielen_2013-2037_PUBLIC.xls*
Figure adjusted for the realised values of 2013 and 2014 (source: GTS)

16 *http://www.nlog.nl/resources/Jaarverslag2013/Jaarverslag_2013_versie_0_NLOG.pdf*

4.1.2. Conventional production in all north-west European countries

Indigenous conventional gas production in Europe has been declining for several years now. In each of the scenarios, this declining production from local fields is expected to accelerate. In 2015, gas production by conventional means in Europe excluding Norway totalled approximately 1,150 TWh; by 2025 conventional production could be about 825 TWh, and by 2035 this will have further reduced to approximately 400 TWh. This decline will be especially marked in the Netherlands, the United Kingdom and, to a lesser extent, in Germany (see Figure 4.5[17]).

Figure 4.5 Conventional production in north-west Europe

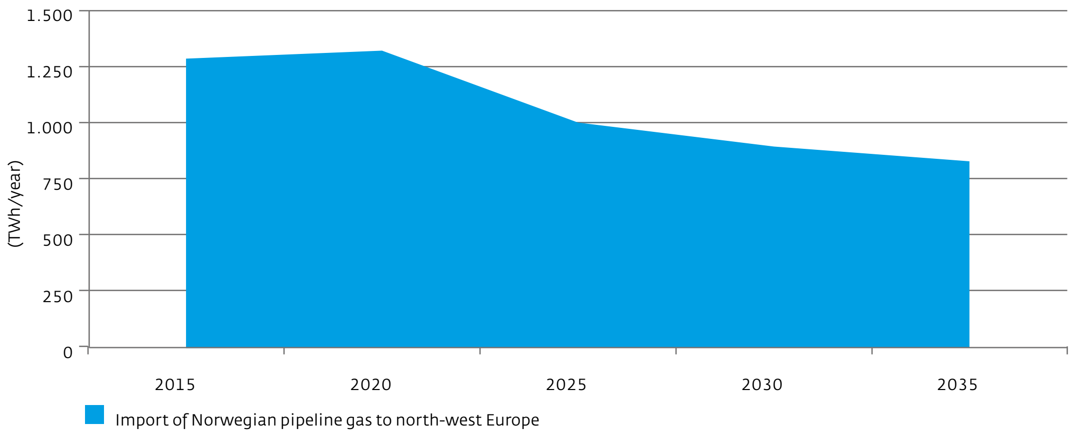


4.1.3. Developments in the import of Norwegian gas

After 2020, the Norwegian fields that supply gas to north-west Europe will see their production gradually decline. Most new gas fields that are currently under development in Norwegian waters are not directly connected by pipe to Europe. As a result, the Norwegian supply of gas to north-west Europe will gradually decrease from approximately 2020 onwards. The NOP incorporates an export forecast which is identical for all three scenarios. In 2015, production still totalled approximately 1,250 TWh; by 2025 it is forecast to be approximately 1000 TWh and in 2035 to have declined to approximately 800TWh (see Figure 4.6). Assumed is that no major investments in Norwegian infrastructure are carried out.

17 *Source: IHS CERA, GTS analyses*

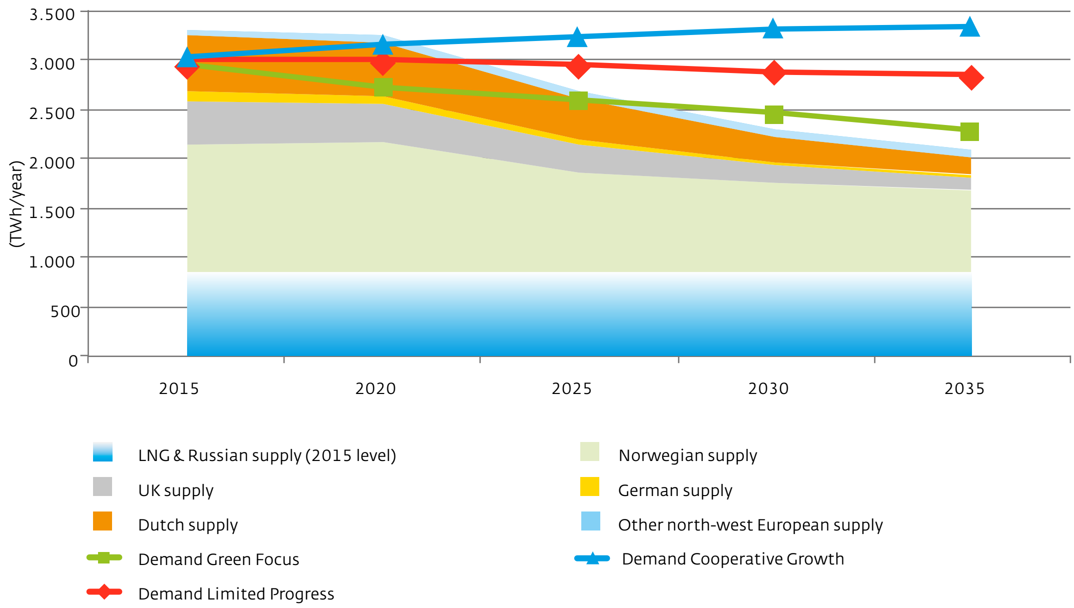
FIGURE 4.6 IMPORT OF NORWEGIAN PIPELINE GAS TO NORTH-WEST EUROPE[18]



4.2. North-west European volume balance: requirement for additional gas

Figure 4.7[19] below shows for each scenario a volume balance that indicates how much gas the market in north-west Europe requires, how much can be expected to be produced locally with reasonable certainty, and how much is supplied from Norway. Supplies of LNG and of Russian gas are assumed to continue to be available at the stable level of 2015 supplies. New developments such as shale gas and green gas are not included in this balance.

FIGURE 4.7VOLUME BALANCE IN NORTH-WEST EUROPE

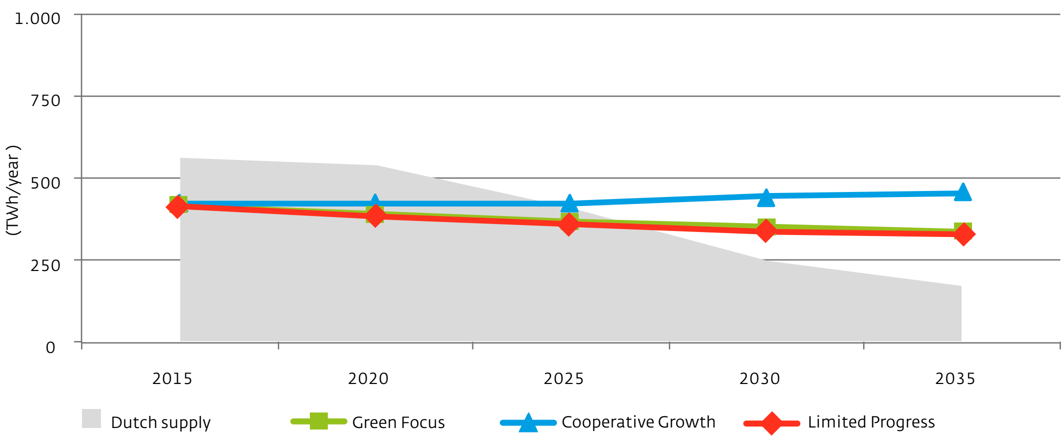


18 Source: Gassco
19 Source: several external sources, GTS analyses

4.3. The Netherlands volume balance: requirement for additional gas

The production surplus that has characterised the Netherlands for so many years will no longer be in place by around 2025; the precise year will depend on the demand profiles in the three scenarios and the production profile, both shown in the graphs in Figure 4.8 below. From then on, the Netherlands will be a net gas importer. The production surplus, then eventual deficit, in each scenario has been calculated on the basis of the anticipated domestic production minus the demand for gas.

Figure 4.8 Volume balance in the Netherlands



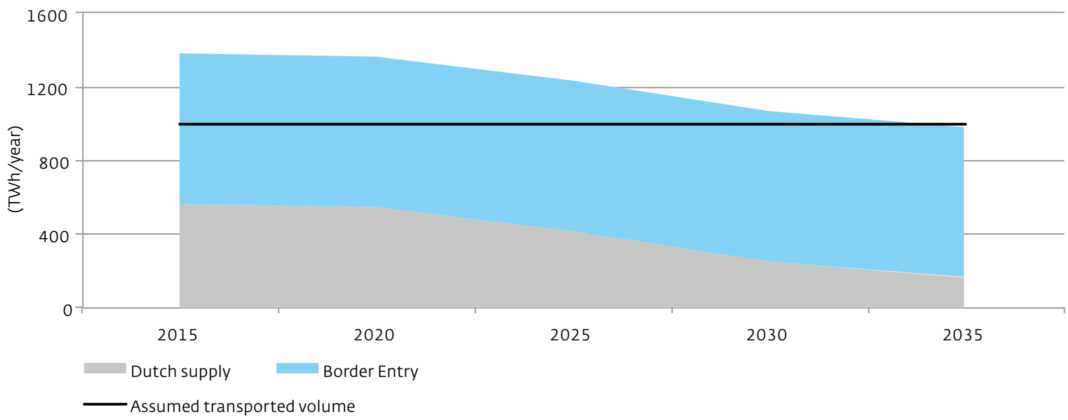
The Dutch transport system, as developed over more than 50 years, is an asset whose purpose is broader than simply to deliver Dutch gas on behalf of domestic and export customers. It is not only used to transport Dutch production to the market and export stations, but also to import large volumes of gas. Its future use, as gas production declines in the Netherlands, will be influenced strongly by the sources and scale of future gas imports and export needs, according to customer demand.

In 2014 GTS transported over 1000 TWh of gas, while the Dutch production was less than 700 TWh; about 300 TWh was imported into the Netherlands. The export flow was also very large: demand in the Netherlands was about 400 TWh, export demand was about 600 TWh (See also Appendix III).

Figure 4.9 shows the volumes that can enter into the Dutch transport system if the potential of importing flows is fully taken into account. Assuming that the exit volumes in recent years remain at the same level over the next decades (since 2007 the transported volume has been at least 1000 TWh every year), the potential of the entry volume of the Dutch grid is sufficient to meet the exit volumes until 2030/2035.

The volume balance shown in Figure 4.9 does not take into account possible future developments as described in chapters 6 and 7.

Figure 4.9 Volume capability of Dutch gas transport system including import and export



4.4. Conclusion: requirement for additional gas

In all scenarios, north-west Europe including the Netherlands will need an additional supply of gas. The scale of the shortage and the year in which a shortage will appear for the first time, differs according to scenario.

The next chapter considers which gas flows could be called upon to make up this additional supply. In turn, the identified flows will signal where transport capacity is needed to enable access for the additional supplies to the Dutch gas roundabout.

5. Additional supply

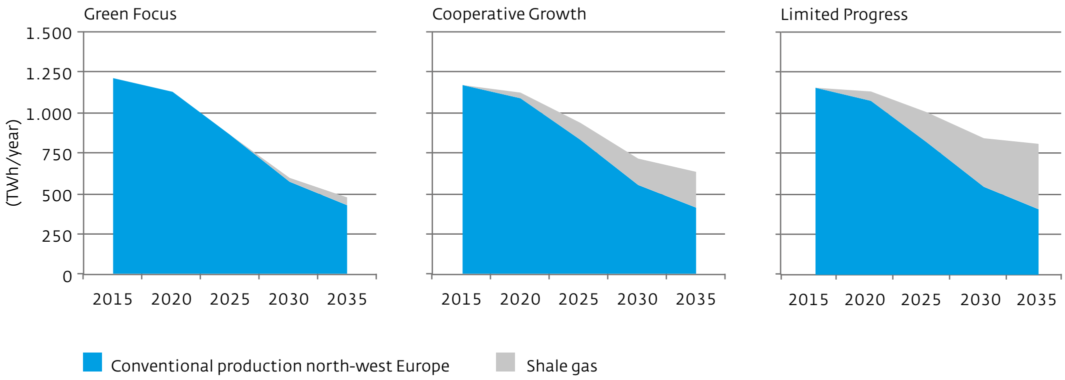
GTS conducts its planning so that diverse supply routes are made available in line with the objectives described in section 1.1 above. In any scenario, therefore, an additional gas supply mix will include—in varying proportions and volumes—domestic gas from new producing horizons such as shales, biogas, LNG from global sources, and gas from Russia.

5.1. Shale gas

The potential for producing shale gas in north-west Europe is uncertain. This uncertainty is accounted for as follows:

- The Green Focus scenario is combined with an assumption of highly limited volumes of north-west European shale gas (approximately 50 TWh even by 2035). Public objections to shale gas extraction would compromise its development. Only in the UK will a limited volume of shale gas production be developed.
- The Cooperative Growth scenario is combined with more modest volumes of shale gas production in north-west Europe (approximately 220 TWh by 2035).
- The Limited Progress scenario is combined with a high production of shale gas, although not on a scale that would be at all comparable with North American standards. Limited transformation of the energy system will increase the need to produce more gas in Europe itself. As well as in the UK, shale gas will also be developed in Germany, France and Denmark. Total production could grow to approximately 400 TWh by 2035.

Figure 5.1 Prospects for shale gas production in north-west Europe



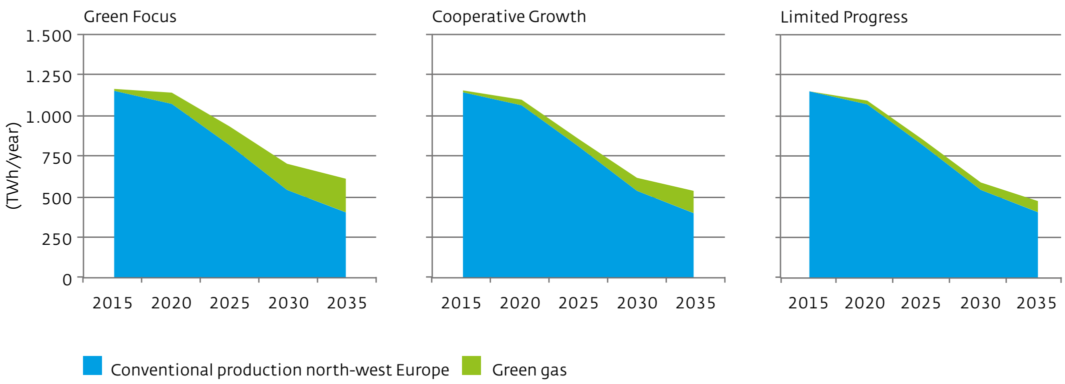
5.2. Green gas

Green gas production will develop steadily, but in the medium term volume will stay rather limited compared to total gas consumption. In a 'best case' scenario (the Green Focus Scenario), green gas production in the eight north-west European countries will amount to about 5% of total gas consumption by 2025. In the following ten years, green gas production in north-west Europe could increase to almost 10% of total gas consumption. The growth of green gas production in the Netherlands is expected to be consistent with experience in north-west Europe as a whole up to 2025.

A green gas target of approximately 30 TWh in 2030 for The Netherlands is assumed to be met in the Green Focus scenario. Under the Limited Progress scenario and the Cooperative Growth Scenario it is assumed that green gas percentages will be substantially lower.

The figures do not include the volumes generated by power to gas, which will stay low in the planning period.

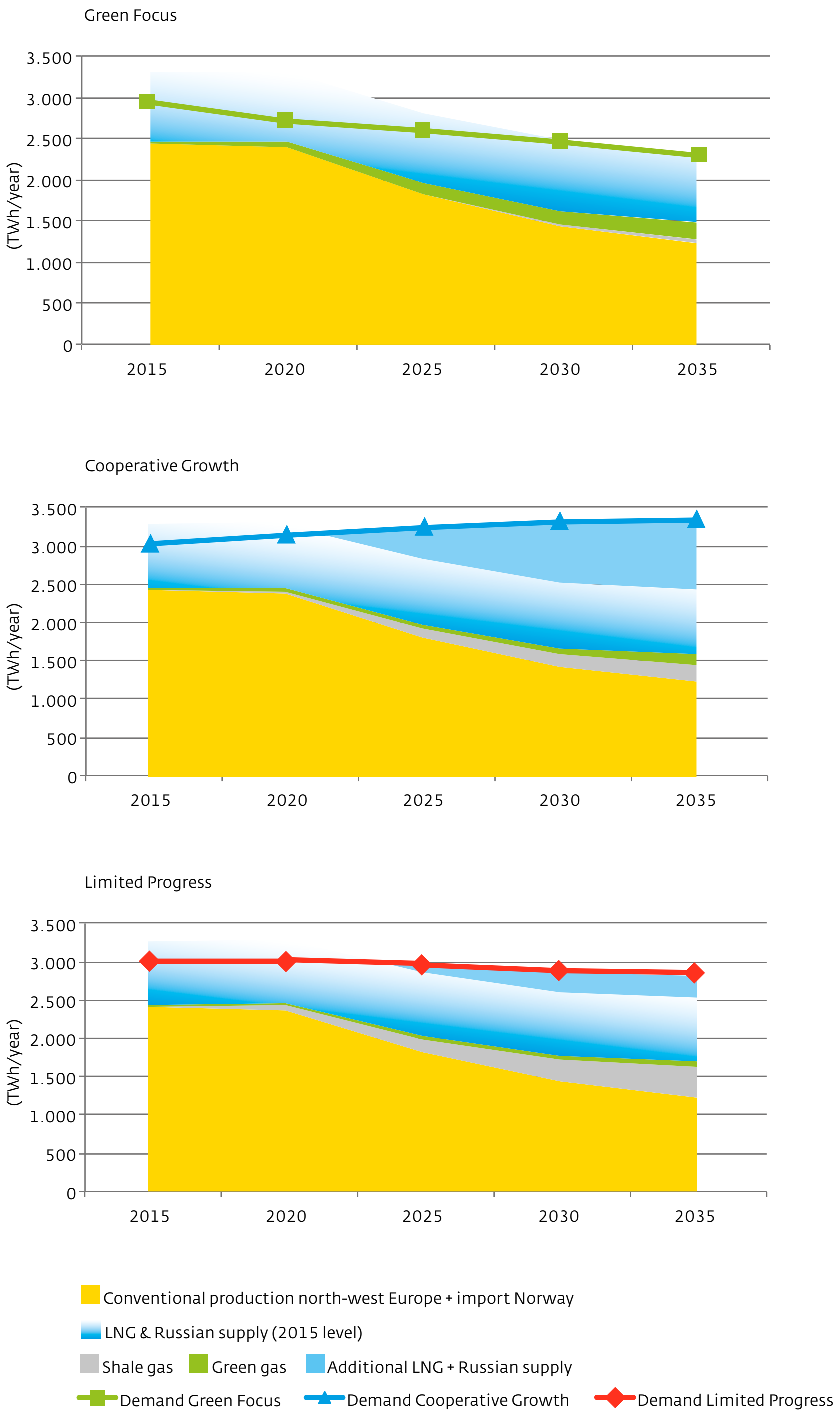
Figure 5.2 Prospects for green gas production in north-west Europe



5.3. LNG and Russian gas

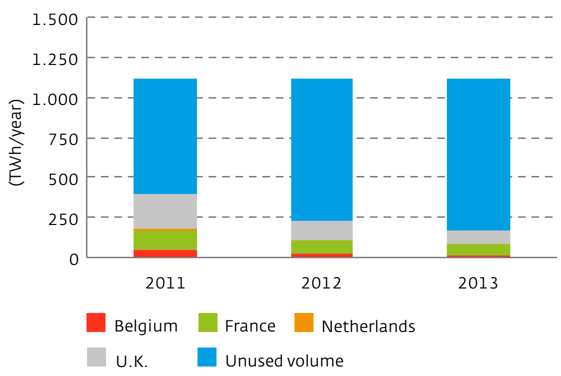
The main sources of gas to close the anticipated supply gap for north-west Europe are likely to be additional LNG and additional Russian gas. Figure 5.3 below shows the balance between demand and supply for the three scenarios in the filling of this gap for north-west Europe. There are significant differences between the scenarios, in the size of the gap to be filled.

Figure 5.3 Additional LNG and Russian supply



The infrastructure to deliver LNG and Russian gas into north-west Europe is more than adequate for today's level of demand. The spare capacity that is available in existing LNG receiving terminals, and from planned expansions, clearly show that, if supply is available from world markets on commercially attractive terms, there will be no infrastructure constraint on significantly increasing LNG imports. The combined volume of the terminals is approximately 1,100 TWh per year. LNG import in 2011—the highest year of supply for LNG over the last four years—was only 400 TWh (see Figure 5.4[20]). This implies that, in these last four years, up to 700 TWh per year of unused volume was available for additional LNG import.

Figure 5.4 LNG import and unused annual volume



The availability of LNG for north-west European markets will be determined by the interplay of supply of LNG and demand for gas in world markets. A large number of variables on both demand and supply sides will play out over the ten years to 2025—for example the level of Chinese and Indian demand for gas, the level of US and Australian supply, and patterns of trade that will involve the Middle East and Latin America. These global factors will mean that the economic competitiveness of LNG in European markets can vary not only over the long term, but on a year-to-year basis.

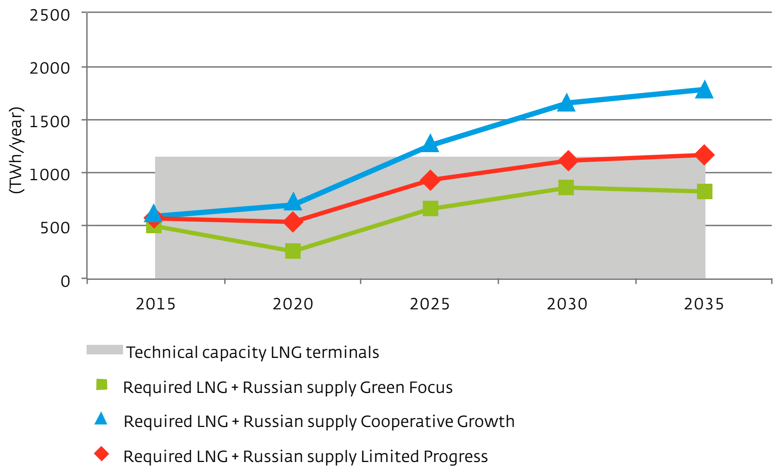
Similarly, existing major pipeline systems from Russia today have considerable spare capacity, the Russian resource base remains large, and a significant increase in the volume of imports is possible. Over the past few years, the combined annual utilisation of the two northern import points in Germany, Greifswald and Mallnow, was approximately 60% of their capacity[21] of 975 TWh per year. This implies that there is still spare volume available for up to 400 TWh per year of additional import on these two points.

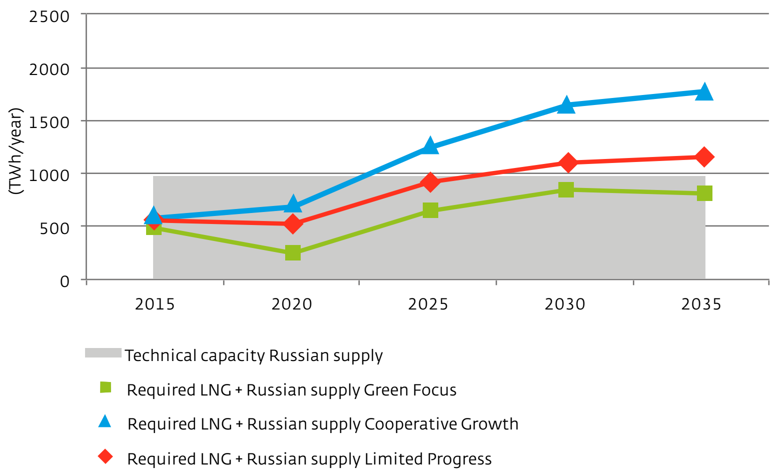
The entry capacity of LNG and Russian supplies into north-west Europe provides ample opportunity to deliver the required amount of supply that was identified earlier on an annual basis, see Figure 5.5. None of the scenarios suggest that, up to 2035, there may be a supply gap that is too large to fill by some combination of LNG and Russian gas. It may reasonably be concluded that the volumes of gas that can be brought into north-west Europe are big enough to fulfil the demand of the market.

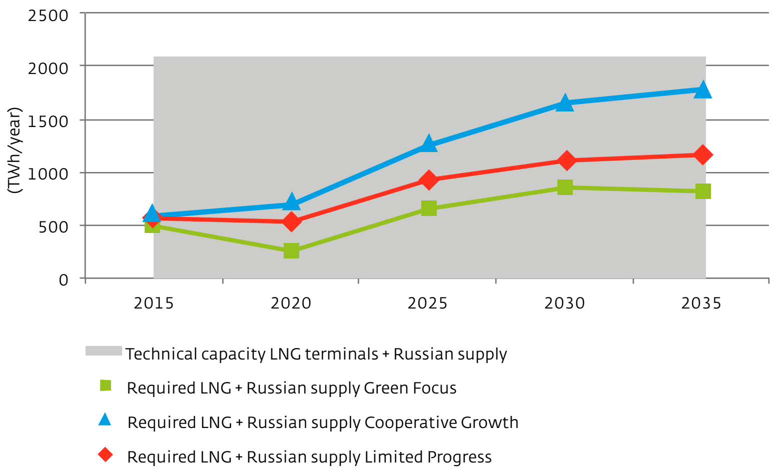
20 For the realized volumes of LNG terminals: http://www.giignl.org/
For the LNG terminal capacities: http://www.gie.eu/index.php/maps-data/lng-map

21 For the realized Russian supply volumes http://www.iea.org. For the border capacities: http://www.entsog.eu/public/uploads/files/maps/transmissioncapacity/2014/ENTSOG_140612_CAP_JUNE2014.pdf

Figure 5.5 potential LNG and Russian gas supply







5.4. European transport routes for additional supply

As described above, additional gas from outside Europe will be mainly a combination of Russian gas and LNG – but the exact combination cannot be known, and is indeed certain to change from year to year. The diagram below illustrates the possible supply points through which Russian gas and LNG can be delivered to north-west Europe.

Gas from Russia can enter the north-west European market place through three major routes: Nord Stream (via the Baltic Sea and Germany), Yamal (via Belarus, Poland and Germany) or Northern Lights/Brotherhood/Transgas (via Ukraine, Slovakia, Czech Republic and Germany). Russia also proposes to reinforce its capacity to supply gas to and through Turkey (Eastring) offering gas to European buyers at the border of Turkey with the EU. This route, and any associated capacity in South East Europe, has yet to be developed.

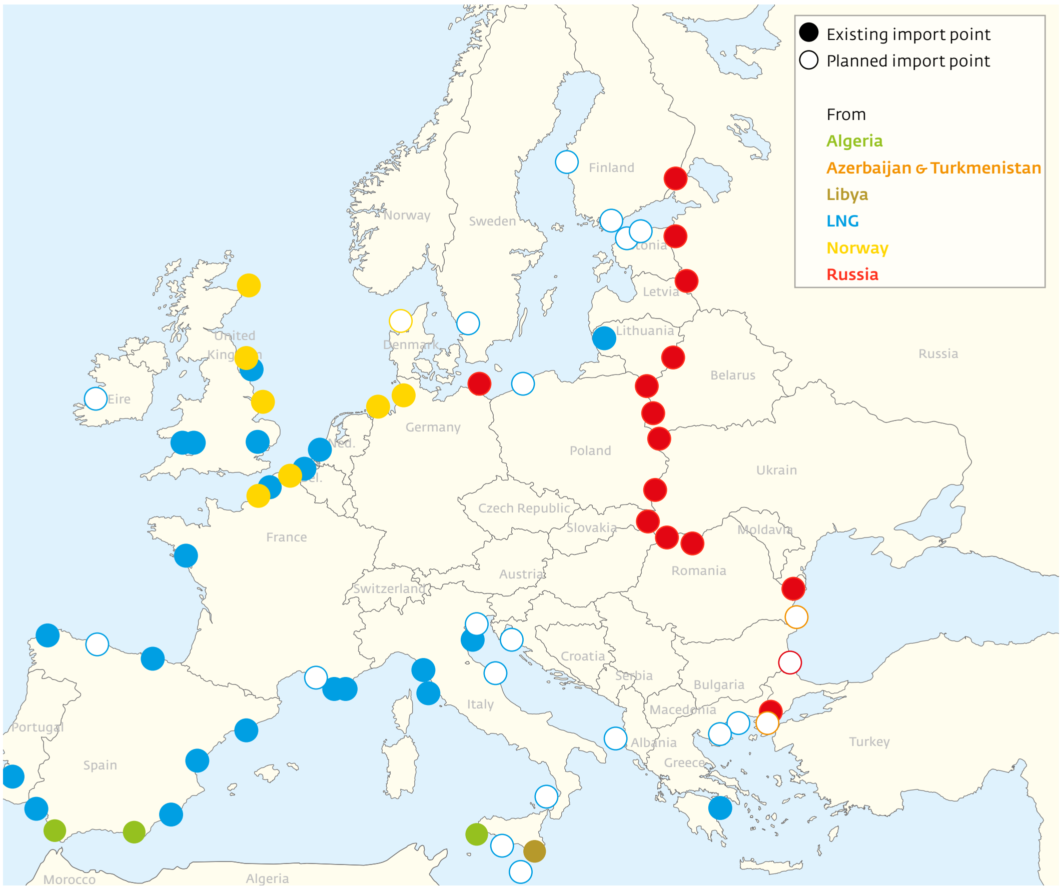
If additional gas is supplied from Russian pipelines, it is assumed that this gas will enter the Dutch system from the north-east at Oude Statenzijl. This would place a relatively heavy load on the northern route, and a significant burden on the future demand for gas transport.

Figure 5.6 Transport supply routes into north-west Europe

Additional supplies of LNG can be brought into northern Europe through several existing LNG terminals in north-west Europe and from southern Europe. North-west European terminals at GATE (Netherlands), Zeebrugge (Belgium), Dunkirk and Montoir (France) offer physical access to the continental north-west European networks. The terminals at Milford Haven and Grain in the UK are linked by the two-way IUK interconnector pipeline to continental Europe. Virtual reverse flow can readily be arranged through the BBL pipeline. Southern European terminals offer more limited possibilities: terminals in Spain and Portugal are isolated by lack of pipeline capacity into France, and Italian terminals lack physical possibility of northward supply through the TENP pipeline, although virtual reverse flow is possible given the volume of trade through the TENP and its major interconnected transmission systems.

But at times when additional supply will primarily take the form of LNG, the new supply of LNG will be brought into north-west Europe since this is where demand would be greatest. Because the new supply would be delivered close to the market, this will only place a modest load on the transport system, although reinforcements of some grids will be required to cope with any increases in capacity at specific terminals[22]. In principle, an alternative could be for the LNG not to be brought into north-west Europe, but into southern Europe instead. The gas would then need to be transported from the south to the north. This would place a heavy load on international transport systems and would be likely to require large scale investments, especially if the supply of gas from Russia via the central European route was to be heavily loaded. As modern LNG contracts do not contain destination clauses, there will be ample possibilities instead to reroute LNG ships to the market where the gas is needed. For that reason it is not realistic to assume that LNG gas will be transported to the south of Europe when the terminals in north-west Europe are low used. This south to north pipeline option is therefore not taken into account.

Figure 5.7 EU import possibilities



22 *Some such pipeline investments are identified in ENTSOG's Ten Year Network Development Plan, http://www.entsog.eu/publications/tyndp and in the north-west Europe Regional GRIP, http://www.entsog.eu/publications/gas-regional-investment-plan-grips/.*

5.5. From supply needs to investment measures

5.5.1. The capacity balance in the Netherlands

Taking account of the requirements of the markets both in the Netherlands and in the neighbouring markets, the demand/supply capacity balance in the transport system of the Netherlands is shown in Figure 5.8 below. The supply side includes peak production from the Groningen and other Dutch fields, cross-border and LNG import capacity, and the peak send-out capability of underground storages (UGS). For the border points, the available transport capacity is taken into account, with the exception of Emden (the import point for Norwegian gas) where the expected decline of available Norwegian gas has been incorporated. For the particular case of the L-gas export stations, two situations have been considered: one where H-gas for neighbouring L-gas markets (after conversion to H-gas) is completely transported via the Netherlands, and one where no gas for these markets is transported through the Netherlands.

Figure 5.8 then explores the widest demand ranges implied by these assumptions: namely, as a maximum, the Cooperative Growth demand scenario with transport of the substituted H-gas through the Netherlands to the converted L-gas markets, and as a minimum, the Limited Progress demand scenario and declining L-gas exports without H-gas being transported via the Netherlands to the converted L-gas markets.

In the coming years there is sufficient supply capacity available in the Netherlands for the minimum variant, as shown in Figure 5.8. For the maximum variant there is sufficient supply capacity available in the Netherlands until around 2023. The equilibrium in the volume balance will be mainly restored through imports. The capacity balance can also be restored by creating additional underground storage capacity.

As can be seen from Figure 5.8, storage capacity is absolutely necessary in peak demand situations.

In which locations this additional supply will occur will be largely determined by market initiatives in neighbouring networks and among operators of LNG terminals and underground storage facilities.

Figure 5.8 Capacity balance in the Netherlands

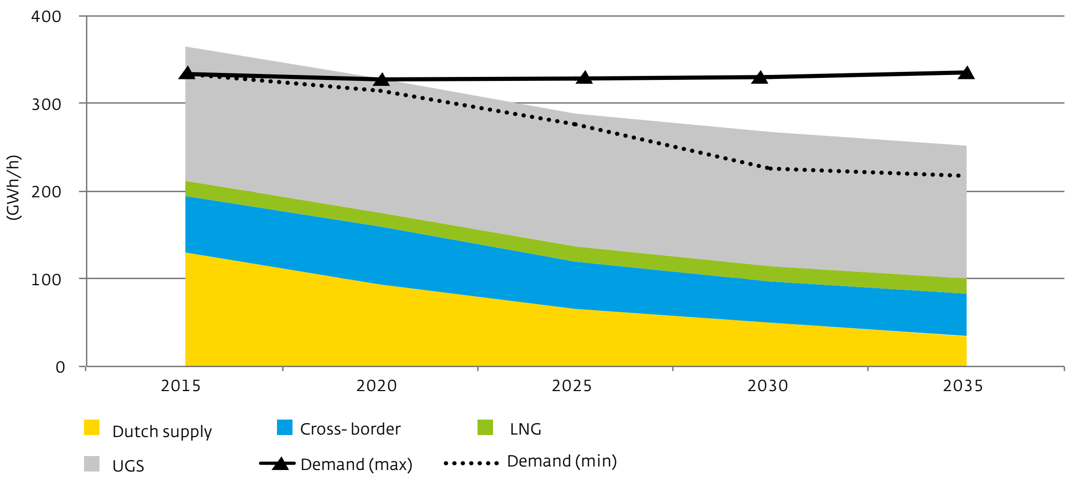
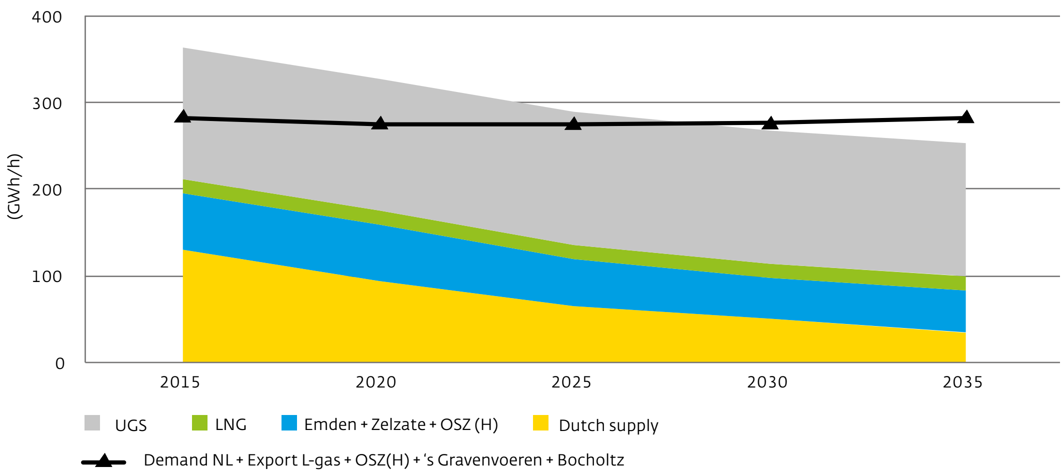


Figure 5.8. presents a situation where all entries and exits are used simultaneously, a situation which will probably not occur in practice. Figure 5.9 represents one of many, more realistic, flow patterns where a lot of LNG is available in north-west Europe. As a result, no exit flow is expected in Julianadorp and Zelzate, as UK and Belgium will have enough LNG to cover demand. The figure shows that at least until ca. 2030 there is enough capacity available to supply domestic demand (under Cooperative Growth), the former L-gas export markets and the H-gas export points in the east and the south-east of the Netherlands.

Figure 5.9 Capacity Balance: High LNG entry, max export (excluding Zelzate and julianadorp)



The capacity balances shown in Figures 5.8 and 5.9 do not take into account possible future developments as described in chapters 6 and 7.

The additional imported supply volume will enter the Netherlands with a high load factor—that is, the rate of peak supply will be close to the rate of average supply. The storage facilities will be used to convert the load factor of this supply into a load factor required by the market (load factor conversion). A high proportion of the working volume of the storage facilities will be needed to facilitate this.

5.5.2. Implications of the need for new supply

The scenario analysis shows that peak demand for gas on the GTS system is likely to remain fairly stable over the next ten or twenty years, against a range of possible demand outcomes. Neither the volume of demand nor the need to enhance demand capacity is identified in this NOP as a primary driver of new investment needs.

Additional import volumes can enter the GTS system from three different ways: from the north-east (Oude Statenzijl), from the west (GATE and Zelzate), and from the south (reverse flow at Bocholtz). GTS has looked at reasonable extremes to determine which investment measures are necessary to accommodate new flows.

- The change in gas sources requires that particular attention must be given to the ability of the system to provide sufficient **quality conversion**, since the new sources will be of a different quality from the bulk of Dutch domestic gas production, and will change the quality mix. In addition, the risks associated with back-up supplies of G-gas to Dutch and other European customers are changing as production declines from the Groningen field; this must be taken into account in deciding how much quality conversion is needed. Liquidity and good functioning of the TTF also depend on GTS' ability to provide the market with sufficient quality conversion.
- **Access to the gas roundabout** will need to be reinforced to accommodate new supply routes. The gas roundabout itself is robustly designed to handle changes in flows, especially following recent investments.
- **Specific investment proposals** from neighbouring network operators and from market players in the Netherlands, for expanding entry capacity at Oude Statenzijl, at the GATE LNG terminal, and at storage facilities in the west of the country, will require the engagement of GTS to make commensurate investments in the GTS grid.

Where these will improve **market choices**, reinforce **security of transport**, or offer economically attractive **cross border opportunities** for customers, GTS is willing to engage. GTS considers that the capacity measures that are put forward in this NOP, and described in chapter 6 and 7 below, will fulfil these quality, access and market needs.

6. Capacity measures 2015-2025

6.1. General remarks

Gas marketers, shippers, and other private operators are examining options to invest in the expansion of various facilities that can contribute to the positive development of the gas industry in the Netherlands, especially in the context of expected future declining deliverability of G-gas to the market. GTS reviews such options, when they become public or are brought to the attention of GTS, to see what implications there may be for investment measures in the transmission network.

Within the investment horizon 2015 – 2025, analyses of the three scenarios show that the main gas transport system in the Netherlands (the Dutch gas roundabout) and the transport system connected to the market are robust enough to absorb expected changes in the level of market demand for gas over the next ten years. The sharp decline in production in the Netherlands and, in time, declining imports from Norway, will require an additional supply from outside the Netherlands. This additional supply exceeds the possibilities of the entry part of the system, which needs to be expanded.

This chapter describes the measures that, at the date of writing the NOP, are anticipated in the coming years (abstracting from small scale measures).

Most measures result from, or are associated with, initiatives that players in the market are taking or propose to take. These initiatives themselves are a response to the same shortfalls in volume and capacity that are identified and explored in the scenario framework described above and fit in all three scenarios.

6.2. Investment projects in the high pressure grid

6.2.1. Additional quality conversion

The Dutch market is physically divided into H-gas customers (large industries and power generation) and G-gas customers (households and small industries). There are differences between the calorific value of the two types of gas, and the differences in gas quality are most often expressed in terms of the Wobbe index. The large Groningen field produces G-gas, small fields produce a broad range of H-gas qualities. In the Netherlands there are storage facilities for both G-gas and H-gas.

There is no commercial separation between H-gas and G-gas markets, and transmission contracts are expressed in energy units rather than in cubic metres of a particular quality. Market players (shippers) are responsible for balancing their energy based portfolio. GTS has to solve any physical imbalances in the H-gas or in the G-gas grid. GTS has the statutory mandate to convert H-gas to G-gas.

The main method for reducing the calorific value and the Wobbe index of the H-gas is the addition of nitrogen to obtain the required G-gas quality.

The outlook for the future is for a further decline of volume and capacity of the Groningen field (in common with all north-west European gas production). Furthermore, there is also the decision by the Minister of Economic Affairs to limit production out of the Groningen field due to the earthquakes (see section 4.1.1. above). Because of the declining G-gas production the market for low calorific gas (L-gas) in Germany, Belgium and France will be converted to H-gas. The decline of capacity demand at the border stations with Germany will start in 2020 with an annual rate of decline of 10%, and will continue until 2030, by which time no L-gas is expected to be needed in Germany. The demand capacity decline towards Belgium will start in 2023 at a rate of about 15% per year, resulting in no more L-gas exports from 2030. The conversion of the Dutch market will not start before 2030, since gas-using appliances that can be adapted for market conversion still need to be introduced.

These two factors – possible future volume and capacity levels available and allowed from the Groningen field and the market conversion in neighbouring L-gas markets – need to be taken into account alongside the domestic demand scenarios and current G-gas storage capacities in order to identify when there will be a shortage in G-gas supply capacity. On today's evidence, the shortage will arise as from 2019.

A study covering the 2018-2026 period explored alternative ways to resolve this shortage. One approach would be to reduce the size of the G-gas market (i.e. reduce the need for G-gas demand capacity) by converting part of it to H-gas in the short term. Given the fact that market conversion can only take place in the Netherlands after a large proportion of the existing appliances, not suitable for H-gas, has been replaced, this option cannot be realised before 2030.

The most appropriate approach to overcome the foreseen G-gas supply capacity shortage is to increase the quality conversion capacity by building a new nitrogen plant. For the period from 2018, a number of alternatives have been studied in which production from the Groningen field varies both in volume and in capacity. Decisions limiting the production are applied both to the allowed annual overall volume and in the limit on the allowed production from each cluster or area in the field. Because of the uncertainty several options were examined, ranging from continuing the current allowed volume and capacity levels to further reducing both.

The following assumptions were made in the analyses to gauge the likely demand for additional nitrogen capacity:

- The quality of the H-gas which will be converted in blending stations is based on the quality level of Russian and Norwegian gas expected in the longer term (Wobbe index 53 MJ/m^3).
- A range of G-gas storage facilities, caverns and depleted gas fields are connected to the transport system. At different times of year, production of gas from those storage facilities reduces the need for quality conversion, while filling them increases the need for conversion. The analyses approached these storage facilities as follows:
  - The G-gas storages that are operational at this moment are all assumed to continue to be available with their current capacity;
  - Caverns were modelled in accordance with current practice at different temperatures;
  - The seasonal storage facility at Norg, with its large working volume (7 bcm), will need

to fill to maximum capacity during the summer season (April-September) in order to have sufficient gas in stock before the following winter season. It is then produced during the winter season. If the spring is cold this will generate a high demand for nitrogen: quality conversion will then be needed to convert a large volume of H-gas to G-gas, to fill the G-gas storage facility as well as for the G/L-gas market.

- The study used gas demand prognoses based on the temperature profiles of the past from 1960, giving each year's profile equal weighting in order to determine what level of nitrogen requirement to add.
- For many years, based on Dutch government decisions, the Groningen field has been conserved and the small fields have been preferentially produced. Production of small fields (H-gas) ran at such a level that a significant part had to be delivered to the G-gas market, leading to the need for quality conversion capacity and the building of the current nitrogen facilities. Those facilities have been built knowing that the Groningen field could always serve as an immediate back up in case of a temporary shortage of nitrogen capacity, because the Groningen field was able to deliver sufficient capacity and volume. An alternative now has to be found to this back-up role as a result of the capacity decline of the Groningen field. For the sake of G/L-gas customers throughout the Netherlands and abroad, the available capacity to deliver to this market must have a high degree of certainty. The loss for technical reasons of a single major facility, such as a particular production cluster in the Groningen field, a storage cavern, or a GTS conversion facility must be capable of being covered.
- When determining the spare capacity needed to assure supply in the event of technical failure, it is assumed that the system must be robust enough to accommodate the loss of one of the available means of supply. No account is therefore taken of the risk of a combination of losses. The conclusion reached was that 60,000 m^3/h of spare capacity was required to provide this assurance.

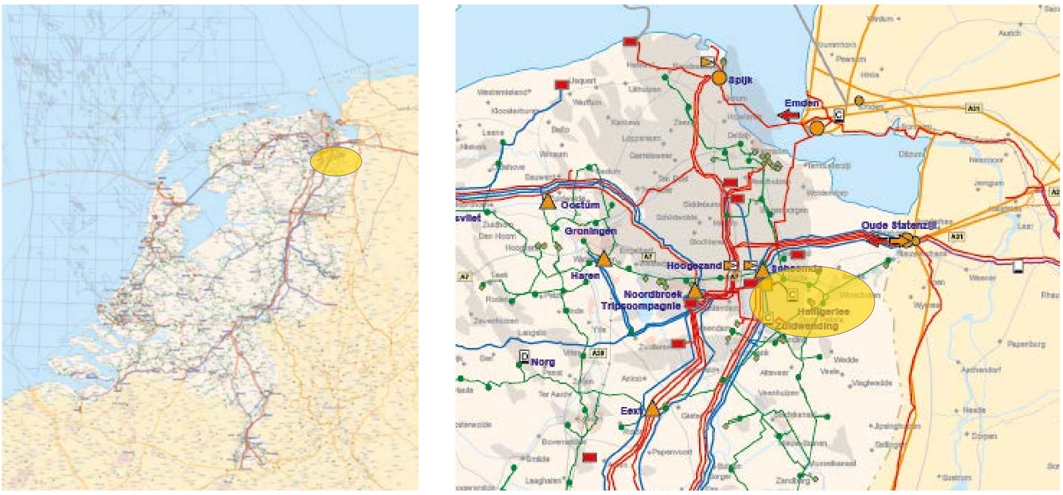
The 2019 – 2024 period will see an increase in capacity demand for nitrogen, especially in winter and in a cold spring. In such situations, both the winter and spring periods determine the required size of the investment. The analyses show that a new nitrogen production facility and a blending installation with a capacity of 180,000 m^3/h nitrogen is required. A rough cost estimate of this type of installation would be about EUR 220 million.

According to current expectations (largely based on the conversion plans of neighbouring markets), G-gas/L-gas demand capacities will decline faster from 2024 than the G-gas/L-gas supply capacities. This would gradually relax the need for additional quality conversion. If developments proceed less favourably, for example because additional restrictions are imposed on production from the Groningen field, then additional measures may be required. This issue will be revisited and addressed more fully in the next NOP.

The new nitrogen production facility will, due to the strict control of the oxygen content in natural gas, and the size of production, be a cryogenic air separation installation (in line with the existing nitrogen production facilities). The area around Zuidbroek in Groningen is the most suitable location, since it provides sufficient opportunities for the use of existing infrastructure for the supply of H-gas and a good connection to the G-gas infrastructure. To have the quality conversion plant operational in October 2019, GTS has started the preparations, including the start of the "Rijkscoördinatieregeling" with an announcement to the Ministry of Economic Affairs in December 2014.

Figure 6.1 shows the geographical location of the proposed measures.

Figure 6.1 Additional quality conversion Zuidbroek

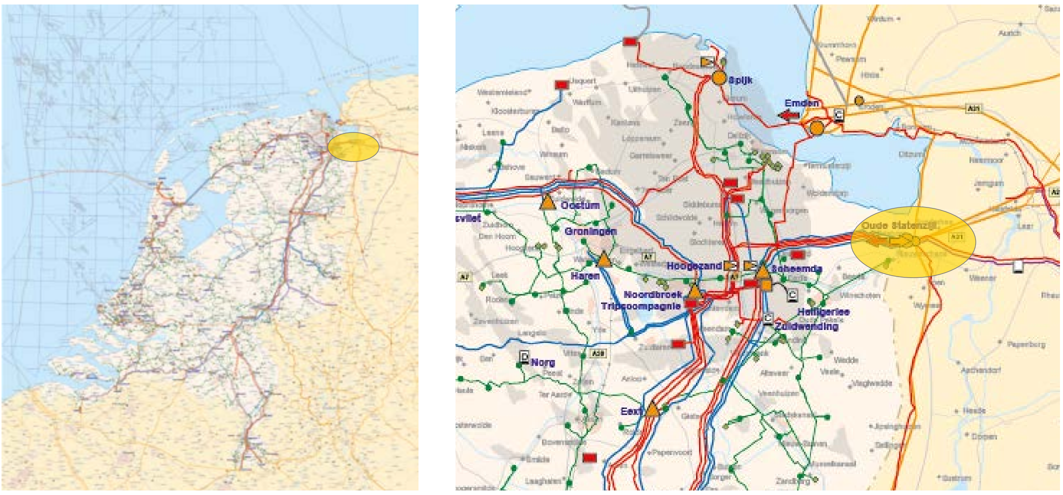


6.2.2. Expanding entry capacity at Oude Statenzijl

This project[23] is closely linked to the project of the neighbouring network operator GUD for the expansion of capacity at Oude Statenzijl[24]. The projects will jointly increase the transport capacity at Oude Statenzijl in both directions, which means that the two-way capacity on this interconnection point will be increased.

Figure 6.2 shows the geographical location of the proposed measures.

Figure 6.2 Oude Statenzijl



Both projects have been registered as candidate projects for PCI (Project of Common Interest) status, as outlined in EU Regulation 794/2013.

23 Recorded in the ENTSOG code as TRA-N-314
24 Recorded in the ENTSOG code as TRA-N-316

The overall project (the Dutch and German projects combined) will generate an additional exit capacity, from the Netherlands to Germany, of 3.5 GWh/h and an additional entry capacity, from Germany to the Netherlands, of 8.5 GWh/h with effect from 2019.

The project will play an important structural role in opening up opportunities for shippers in north-west Europe to import more gas, using the northerly transport routes. It will also play a significant role in widening opportunities for diversity of supply in the northern part of Germany through an improved connection to LNG and underground storage facilities.

The investment at the border station is related to the debottlenecking of the gas cleaning section, but this investment is rather limited (ca. € 1 million).

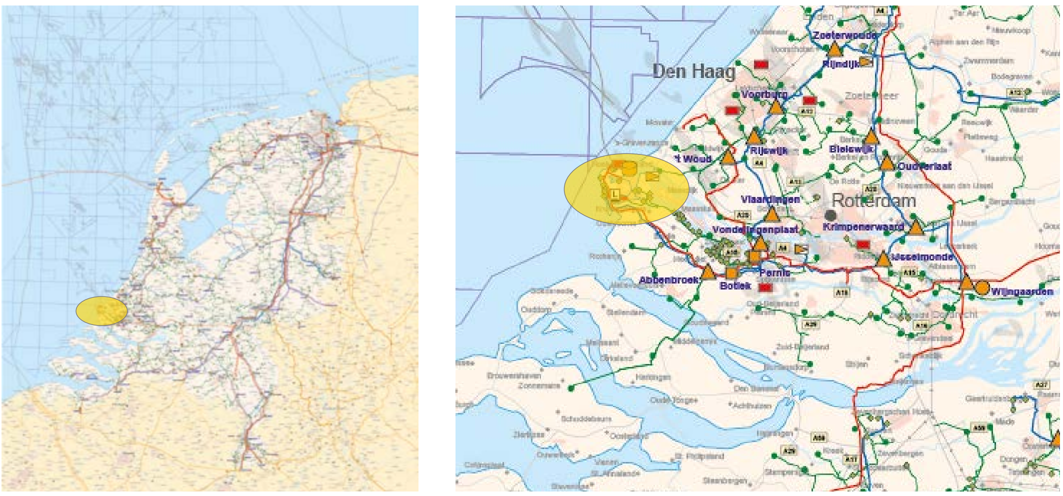
6.2.3. Expanding entry capacity due to additional supply GATE terminal

GATE has announced that it is considering installing a fourth LNG storage tank alongside the three existing ones. This will increase the annual LNG throughput from 12 to 16 billion m^3 and boost the terminal's distribution capacity. GTS will need in that case to expand the discharge capacity in the network by 5.6 GWh/h by laying pipelines on part of the Maasvlakte to Wijngaarden route. This would involve laying about 12 kilometers of pipeline in difficult terrain: half of the pipeline would have to be drilled rather than trenched. The blending station at Botlek, which is used to bring gas with too high a calorific value/Wobbe index down to market H-gas quality, would also have to be expanded. The proposed measures are subject to more detailed design considerations and, depending on developments in the rest of the transport system, may be altered.

The project has been registered as a candidate for PCI status[25], as has the proposed expansion of the LNG terminal itself[26]. A cost estimate will amount roughly EUR 80 mln, measures are planned to be operational in 2019.

Figure 6.3 shows the geographical location of the proposed measures.

Figure 6.3 Expanding entry capacity due to additional supply GATE terminal



25 *Recorded in the ENTSOG code as TRA-N-192*
26 *Recorded in the ENTSOG code as LNG-N-050*

6.2.4. Adjusting entry and exit capacity of PGI Alkmaar and Bergermeer

The project development, which relate to entry and exit capacity of the storages at PGI Alkmaar and Bergermeer, is still in an early stage. The measures in the GTS system are under investigation.

Figure 6.4 shows the geographical location of the proposed measures.

Figure 6.4 PGI Alkmaar, Bergermeer

6.3. Medium- and low-scale investments in the medium pressure grid (RTL)

The main developments, medium or small scale investments, that might affect the RTL are:

- Biogas, green gas booster and Power to Gas (P2G) connections.
- Conversion of small fields from the main transmission network (HTL) to the RTL.
- Investments and adjustments in several fiscal metering stations.
- Connections to, reinforcements and pipeline connections of the high pressure and the medium pressure grids.

The total amount of money that is related to these investments has an order of magnitude of € 10 mln per year.

6.4. Implementation and authorisation

GTS experience suggests that the study, planning, and implementation of engineering works on the high pressure system typically has a lead time of about four or five years from the date on which an investment decision is taken. Such projects must take account of the safety and environmental standards as well as local sensitivities.

GTS stands ready to implement the measures that are described in this chapter, including those that have a connection with external parties' initiatives. This statement is without prejudice to any eventual need for further study by GTS, in the event that variations or deviations in the scope of external parties' proposed initiatives should make it unreasonable for GTS to proceed.

This NOP will enable GTS to undertake the necessary capacity measures to satisfy future customer needs in a timely manner.

7. Cross Border Cooperation

Cross border cooperation is of utmost importance to support a well-functioning EU energy market. In their response to the consultation version of the NOP 2015, stakeholders supported the approach taken by GTS to consider not just the Netherlands but also to focus on the northwest European gas market. The gas industry in Northwest Europe has a long history of cooperation and the Netherlands have played a significant role both as a major reliable gas exporter and also as a transit country for gas.

There are currently two levels of cooperation among TSOs. At a European level the ENTSOG Ten Year Network Development Plan (TYNDP) is prepared and published bi-annually. Projects included in the TYNDP can be identified as Projects of Common Interest (PCI) that contribute to the goals of the European energy policy. On a regional level the Gas Regional Investment Plans (GRIPs), are also published bi-annually. These plans consider projects identified at a national level. However, where there are regional impacts, joint identification of projects could be a result of cooperation between member states and TSOs organized in the Pentalateral Gas Platform.

The economic context in which TSOs operate is primarily determined by their regulatory authorities. Although EU-wide regulatory cooperation is encouraged through ACER, there are few formal mechanisms for bilateral consultation between national regulators. These could be necessary if the right context is to be in place for economically efficient solutions to be developed and agreed between neighbouring TSOs.

A reliable alignment of the Dutch NOP 2015 and the German NEP 2015 is a major goal of further cooperation. This will help to achieve a solid common understanding on both sides of the border for the expectations about and the possibilities of import and export flows as well as of storage usage.

Three areas have been identified for further intensified and detailed cooperation between TSOs, with a view to providing the best possible solutions for customers on both sides of the border:

- Further alignment of cross border capacities taking into account L-gas and H-gas.
- Shared views on the role and potential of storage facilities which are connected to both the Dutch and German networks.
- Cross border investment measures.

These topics will be addressed in the following paragraphs.

7.1. Further alignment of cross border capacities

L-gas capacities

Future development and change of L-gas capacities play an important part in the cross border exchange. Because of the decline of the Groningen field L-gas export capacities will reduce stepwise as of 2020. L-gas export capacity figures for the expected reduction of the L-Gas exports to Germany and Belgium are given in Appendix VII. Data in the consultation version of the NOP were drawn from an earlier TYNDP and were not consistent with official cross border interconnection point (IP) capacity as available on PRISMA. For the physical capacities at each cross border point towards Germany, GTS assumes that there will be an even distribution of the capacity reduction over the respective interconnection points.

For the cross border capacities at the particular points it is possible that available firm capacities at both sides of the Dutch/German border may differ from each other, and for that reason may be perceived as either too high or too low at the Dutch side of the border. An important reason for this is the difference in rules regarding cancellation of booked capacity in the two countries. In the event that there is contractual congestion caused by physical limitations (which is not the case at the moment), GTS is of course willing to find solutions for that type of problem. Physical cross border solutions will be coordinated by the TSOs involved and they will endeavour to find a cost effective solution.

H-gas capacities

There is a particular issue in relation to the available transport capacity in Germany towards Oude Statenzijl which is roughly 10 GWh per hour lower than the capacity for the GTS network. For its analysis, GTS applied the lesser rule, which means that in this case the capacity as mentioned in the German NEP 2015 is used in this NOP as the available cross border capacity.

Gas entering Germany at the entry points Mallnow and Greifswald is needed at peak times for German demand. In off-peak situations additional gas can also be imported for other markets. The transmission capacity required to reach these markets must be sufficient. Future H-gas capacities and flow scenarios need to be aligned between European TSOs to identify potential infrastructure bottlenecks for gas from outside northwest Europe when local production is further reduced.

7.2. Shared view on storage sites connected to both the Dutch and German networks

A number of storage facilities in Germany have entry and exit capacities that link with both the GTS network and German networks. Connection of storages to both the Netherlands and German transport systems can give rise to complications in practical use: often there is optionality in the connection of the storages to both countries, with the result that the total capacity which is booked with the TSOs is higher than the send out capacity of the storage. The question is what level of capacity can appropriately be used by each TSO in its own balance analysis.

The assumptions used in the NOP and German NEP about the send out capacities of storages connected to the Dutch and German networks need to be further investigated together with storage operators in order to have a good assessment on the role of storage capacity in peak circumstances.

7.3. Cross Border Investment Measures

The TSOs' major challenge for the future, as GTS sees it, will be to provide the capacity that the market needs in circumstances where demand for capacity is not likely to increase – it will remain almost constant or may reduce – but where there will be a large change in the sources of gas supply. Good cross border cooperation between TSOs offers a way to meet these circumstances: existing infrastructure has to be assessed as a priority whether it is able to be adapted to cover most of the capacity needs for the future in a most economical manner.

It is in this context that GTS has developed the proposal to invest in expanding the H-gas export and import capacity between the Netherlands and Germany, to support L-gas market conversion in Germany.

From around 2020, the L-gas export capacity from the Netherlands to Germany will steadily decrease as a result of the declining Groningen production. Declining supply from the Netherlands will lead to growing demand in Germany for gas to be imported from elsewhere.

The German L-gas market in the Ruhr area could, following market conversion, be supplied with H-gas that is transported to this region via the Dutch network through the existing supply points at Winterswijk, Zevenaar and Tegelen, which currently supply L-gas. This requires investment measures in the Dutch network and also on German territory. These measures would provide for capacity at the following exit points:

Realizing three H-gas exit points at existing L-gas exit points, labelled A, B and C in Figure 7.1 below:

A: Tegelen 10 GWh/h as at 2020

B: Winterswijk 7.5 GWh/h as at 2020

C: Zevenaar 20 GWh/h as at 2025

Use of this new infrastructure would gradually increase and keep pace with the declining use of the existing L-gas export points, as the relevant areas of the German market are converted to H-gas.

In addition to measures taken at the exit points A, B and C, measures are also planned at the existing exit point at Bocholtz, labelled D in Figure 7.1. A physical entry requirement will also eventually arise at this point, depending on the timing and scale of any build-up in gas flows from southern sources, such as proposed major new pipelines from the south east, or LNG terminals in the Mediterranean. One result of such developments would be that the Bocholtz point will become two-way (with a possible capacity of 10 GWh per hour).

In total, the measures described above will involve the laying of 65 km of pipeline, three compressor stations and four import/export stations. It is likely that a slightly larger proportion of these measures will need to be taken in Germany than in the Netherlands. A more accurate definition of the package of measures will need to be agreed in consultation with the German TSOs.

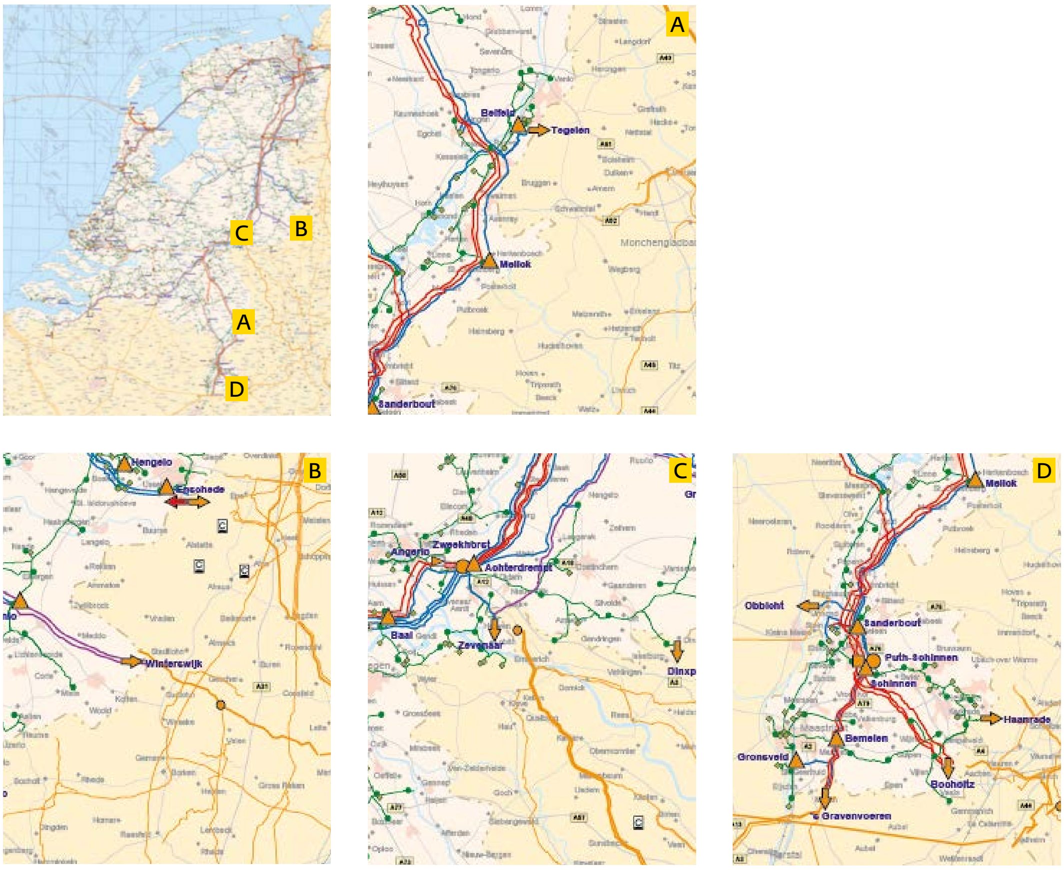
This project has also been registered as a candidate for PCI status[27].

This expansion project for future cross border H-gas supply is an alternative to the ZEELINK pipelines proposed by OGE and Thyssengas. This project probably is likely characterized by lower technical effort and costs than the ZEELINK project. With the right regulatory environment this project, using already existing comprehensive infrastructure in Northwest Europe, can provide better value and sustainability for customers on both sides of the German-Dutch border.

The investment costs in the Netherlands and Germany are roughly € 385 mln, of which indicatively less than half will be spent in the Netherlands[28].

Of course cooperation between NNOs needs to be assured. This project should only be carried out if similar capacity is or will become available on the other side of the border. Without this there would be no clear justification for the investment. GTS will seek further cooperation with neighbouring TSOs to come to a joint view on future cross border capacities.

Figure 7.1 Expanding H-gas export and import capacity between the Netherlands and Germany for L-gas market conversion in Germany



27 Recorded in the ENTSOG code as TRA-N-313
28 Transportalternative NL: H-Gas-Transportmöglichkeiten unter Einbeziehung des niederländischen Fernleitungsnetzes, available at GTS website: http://www.gasunietransportservices.nl/en/transportinformation/nop-2015-2035

Appendices

Appendix I.A: External Data sources

The following sources have been taken into account:

- BP Energy Outlook 2030 (Jan 2013)
- BP Statistical review of World Energy Scenarios (June 2013)
- CBS – Various statistics
- EIA Energy Outlook 2013 (April 2013)
- Energy Forum NL - Optimized pathways to CO2 reduction in the Dutch context
- ENTSO-E Scenario Outlook and Adequacy Forecast 2012 – 2030 - including underlying data
- ENTSOG north-west Gas Regional Investment Plan (GRIP) 2013-2022 (Oct. 2013)
- ENTSOG Ten Year Network Development Plan (TYNDP) 2013-2022 (July 2013)
- European Commission - Energy Roadmap 2050, Impact Assessment
- European Commission – Energy Roadmap 2050, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions
- European Commission - EU Energy, Transport and GHG Emissions Trends to 2050, Reference Scenario 2013
- Eurostat – Various statistics
- Exxon Mobil - The Outlook for Energy: a view to 2040
- IEA World Energy Outlook 2013 (2013)
- Eurogas Roadmap 2050 (Oct. 2011), including underlying documents
- FOB – Prospectieve studie betreffende de zekerheid van aardgasbevoorrading tot 2020 (juli 2011)
- GRTgaz - Ten Year Development Plan for the GRTgaz Network, 2013-2022 period
- IEA World Energy Outlook 2013
- IHS CERA world scenarios (Nov/Dec 2013)
- National Grid UK Future Energy Scenarios (July 2013 and July 2014)
- National Grid 2013 Gas Ten year Statement
- Russian Academy of Sciences - Global and Russian Energy Outlook up to 2040 (2013)
- Shell New Lens scenarios (March 2013)
- Szenariorahmen für den Netzentwicklungsplan Gas 2014 der Fernnetzbetreiber (Juli 2013) including final document approved by the BNetzA (August 2013) and reference documents of EWI, IER

For some of the above reports updates have been published during the development of this NOP. These reports have been consulted and have been partly taken into account:

- BP Energy Outlook 2035 (Feb 2014)
- Entscheidung der Bundesnetagentur zum Szenariorahmen für den Netzentwicklungsplan Gas 2015 der Fernleitungsnetzbetrieber 08.09.2014
- Entwurf Netzentwicklungsplan Gas (NEP Gas) 2015, Berlin, 01.04.2015
- IEA World Energy Outlook, November 2014
- IHS CERA World Scenarios 2014 (July 2014)
- Szenariorahmen für den Netzentwicklungsplan Gas 2015 der Fernnetzbetreiber (Juli 2014)
- Szenariorahmen für den Netzentwicklungsplan Gas 2015 der Fernleitungsnetzbetreiber, Berlin, 08. September 2014

Appendix I.B: Internal Data sources

Various GTS publications relevant to the NOP can be found on: http://www.gasunietransportservices.nl/en/about-gts/publications

- Security of supply 2014
- Gas balance 2014
- KCD report 2013 (quality and capacity document)
- Small fields survey 2014

Older versions of these reports can be found on the download section of the GTS website: http://www.gasunietransportservices.nl/en/downloads-en-forms

Historical data about booked capacities, realized flows and allocations can be found on the GTS website dataport section: http://www.gasunietransportservices.nl/en/transportinformation/dataport

Information about the GTS transport system and the capacity planning method can be found on: http://www.gasunietransportservices.nl/en/transportinformation/capacity-of-the-transportation-network

Specific information about gas quality aspects can be found on http://www.gasunietransportservices.nl/en/transportinformation/quality

Specific information about development of the TTF can be found on http://www.gasunietransportservices.nl/en/transportinformation/ttf-volume-development

Information about transparency requirements can be found on http://www.gasunietransportservices.nl/en/transportinformation/transparancy-requirements

A high-resolution map of the GTS grid can be found on (search criteria: map) http://www.gasunietransportservices.nl/en/downloads-en-forms

General information about GTS and its tasks can be found on http://www.gasunietransportservices.nl/en/about-gts

Appendix II: The Consultation Response

Introduction

A draft of the NOP 2015 was published on May 13th 2015 opening a month-long consultation period, which closed on June 10th 2015. During this period, a consultation meeting, open to all interested parties, was held in Amsterdam on May 28th 2015.

Twelve communications were submitted to GTS in response to the consultation process. Shippers, representative organizations, storage operators and neighbouring network operators all offered comments. Communications were received from the Netherlands (GasTerra, Vereniging Gasopslag Nederland and VEMW), France (ENGIE), Germany (Astora, FNB Gas, OGE, RWE Gasspeicher, Thyssengas and WINGAS) and the United Kingdom (National Grid). Most communications were by letter, and were sent on a non-confidential basis. All non-confidential communications are available on the NOP internet site of GTS[29].

Chapter 7 above addresses those consultation responses that specifically concerned cross border capacity and investment topics. The present appendix addresses the other topics, relevant to the content of this NOP, that GTS received as input from the parties to the consultation.

Response of GTS to topics raised

Respondents to the consultation asked for clarification on various methodological points in the scenario analysis undertaken by GTS, in its analysis of storage use, and in its calculation of volume and capacity balances.

Respondents also raised questions about proposed investments, and about alternative approaches to some of these, particularly as concerned the timing and progress of quality conversion.

And questions were raised about the extent to which specific investment measures would depend on decisions taken by third parties and about the risks of overinvestments.

GTS has grouped its responses to these questions in the four sections below.

29 *http://www.gasunietransportservices.nl/en/transportinformation/nop-2015-2035*

The NOP scenarios and the quantification of demand

The relation between the demand scenarios and the various possible future supply routes

- GTS has a decoupled entry exit system, with a main characteristic that all firm entry capacities can be transported to all exits within the transport system. This feature of the system will apply in any of the three demand scenarios described in the NOP.

The basis for the data for power production

- For the analysis of power generation, GTS made use of data coming from ENTSO-E, the European Network of Transmission System Operators for Electricity. For the Dutch market, these data comes from system operator TenneT.

The status of decommissioning of coal power plants as mentioned in the Dutch "Energieakkoord"

- The "Energieakkoord" as published by the Social and Economic Council of the Netherlands (SER) was taken for the Dutch energy demand and supply as a frame of reference for the Limited Progress scenario. The investments in renewable energy that were agreed in the Energieakkoord were adopted in this scenario. The rate at which decommissioning of coal fired power plants is expected to occur as a result of the Energieakkord was also taken as a reference, but with some delays.

Cross border capacity towards Belgium in relation to power production

- Import and export of electricity was not considered in the methodology that was used for estimation of the gas needed for power generation in the Netherlands.

Sources and assumptions for storage and entry capacity

The modelling of storages

- GTS uses the existing storage capacities as given by Gas Storage Europe (GSE) as input. Typically, the sensitivity of send-out capacity to any given remaining working volume depends on the amount of cushion gas in place. Dutch storages tend to be less sensitive than the European average for this as the Dutch storages have large volumes of cushion gas.
- GTS has not observed circumstances in which seasonal storages are not filled at the start of the winter period and has no reason to expect this in the years to come.

The basis for the working volume of the storage near Norg

- GTS used information from the operator NAM

Investments in supply capacity and quality conversion

Are the investments in supply capacity needed in all scenarios?

- The proposed investments can be needed in all the scenarios so that shippers and their customers are provided with optionality for gas purchasing. As described in 6.1. initiatives for additional capacity in LNG or for gas entering at Oude Statenzijl are both a response to future shortfalls in local production.

Can more aggressive use of storage and/or faster market conversion from G-gas/L-gas to H-gas in the Netherlands, Belgium and France act as alternative for the expansion of quality conversion?

- Additional G-gas capacity is needed at the lowest temperatures. In the analyses GTS calculated with the maximum send out capacities of existing storages and caverns, so the need for additional G-gas capacity can only be solved by developing new G-gas capacity. The construction of new G-gas storages or caverns is much more expensive than investing in new quality conversion capacity based on the blending of nitrogen with high calorific gas. GTS therefore decided not to pursue further examination of the development of new storages.
- Market conversion in The Netherlands starting before 2030 was also not taken into consideration. The reasoning behind this difference with Germany is clear and can be readily explained with reference to the structure of the existing stock of heating and other gas-using appliances in the two countries. In Germany almost all of the existing appliances can be adjusted from L-gas to H-gas and are fit for a higher gas quality bandwidth, and the necessary regulation is in place. In the Netherlands the situation is completely different. The existing appliances are suitable for gas from the Groningen field and are designed for safe operation within a very small range of gas quality: the Wobbe index of the gas delivered to these appliances needs to be between 43.46 MJ/m^3 and 44.41 MJ/m^3. Such appliances are not suitable for the new situation, when gas will be high calorific and the range of the gas quality will be much broader. At this moment it is expected that regulation in the Netherlands for installing appliances capable of safe operation with a broader range of Wobbe index will be in place in 2017. Natural replacement of a large part of the more than ten million appliances will then take many years; starting earlier will be a very expensive solution and will impose costs and inconvenience on millions of households. For that reason the policy of the Netherlands is not to convert the market before 2030. By that date, the natural rate of replacement will be likely to have reached a level which will mean that a critical mass of 'broad bandwidth' appliances will be in place (comparable to the current situation in Germany).
- GTS has based its analyses regarding the rate of market conversion in Belgium and France on the aligned capacity reduction at the export point Hilvarenbeek with Fluxys and GRTGaz. Both TSOs are currently developing their national conversion plans; there is currently no decision on the exact timing of the conversion.

Why did GTS choose to use the last fifty years as basis to define needed additional quality conversion instead of thirty years which the World Meteorological Organization (WMO) recommends?

- GTS has the legal responsibility to provide sufficient transport capacity for a temperature of -17 degrees Celsius. Such a low temperature statistically occurs once every 50 years. That is why GTS considered a longer period than is recommended by the WMO, which recommends to take into account only the latest 30 years, on the basis that some account needs to be taken of already occurring climate change. GTS is aware that analysis from the Dutch Meteorological Institute (KNMI) shows that although an increase the average yearly temperature is observed over the last few years, the probability of extreme cold temperatures remains the same.

The medium- and low-scale investments in the medium pressure grid (RTL)

- Typical expansion investments are mentioned in Paragraph 6.3. and Appendix VI. These are usually small investments related to gas receiving stations or small adjustments in the transport system which cannot be foreseen on the long term, but do not tend to vary much over the years.

Conditionality of projects and risk of overinvestments

Conditionality of projects, need for certain investments and processes

- The proposed investment in additional quality conversion (the nitrogen plant) is the only project in the high pressure grid which is independent of other initiatives. This new facility will be needed in peak gas situations in winter and in a cold spring (when there is a need for storage fill of that quality of gas).
  Based on current information, the nitrogen is needed many years. The highest load factor is expected to occur in the period 2019-2024, in later years the load factor slowly decreases as market conversion from L-gas to H-gas proceeds in the export markets. This does not mean, however, that the maximum available conversion capacity will never be necessary.
  If developments proceed less favourably, for example because additional restrictions are imposed on production from the Groningen field, or because of a slower rate of market conversion in some markets, additional measures may be required, potentially leading to a higher load factor (both for peak and for volume).
- All other proposed investments in the high pressure grid are dependent on a final investment decision of a third party. GTS plans to execute the proposed adjustments in the GTS grid only in the case that the third party concerned (whether GATE, the storage operator TAQA, or the relevant German TSOs) takes a final investment decision on the linked projects.

The risk of overinvestments

- GTS has to take care to avoid the equal faults of investing too little, or of investing too much. In this NOP 2015 GTS analyzes the north-west European gas market and not only the Dutch gas market. Cooperation with NNOs is crucial for GTS to determine and optimize cross border investments. A new consultation process is introduced in which market parties can give their vision on the plan. In this way the risk of overinvestments will be limited.
- In the draft law it is stated that in case of significant changes of a project, a new intermediate consultation process should be organized. Also this limits the risk of overinvestments.

Appendix III: Use of the GTS Transport System

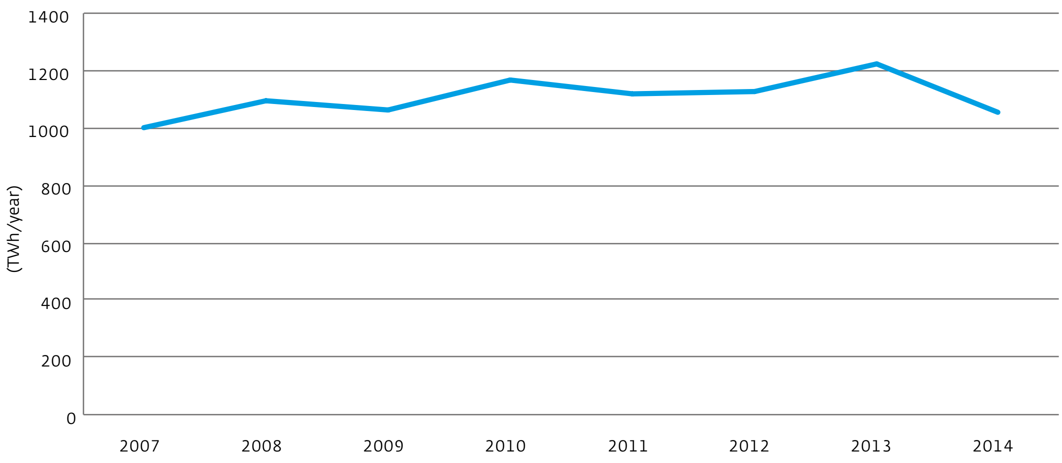
This appendix provides information on the actual use of the GTS grid in recent years.

It begins with the overall picture for the past eight years, then shows the annual entry and exit capacity used over those years by main category of entry and exit—production, import, domestic consumption, export and storage movements.

It then gives the hourly flows for these categories for the two most recent full calendar years (2013 and 2014). Finally it shows the detailed way in which hourly capacity has been booked and used in each month of these two years at the main border entry and exit points.

First, the graph in Appendix Figure III-1 shows the total volume of gas transported through the GTS grid on an annual basis from 2007 through to 2014—the total throughput of gas.

Appendix Figure III-1 Yearly transported volume

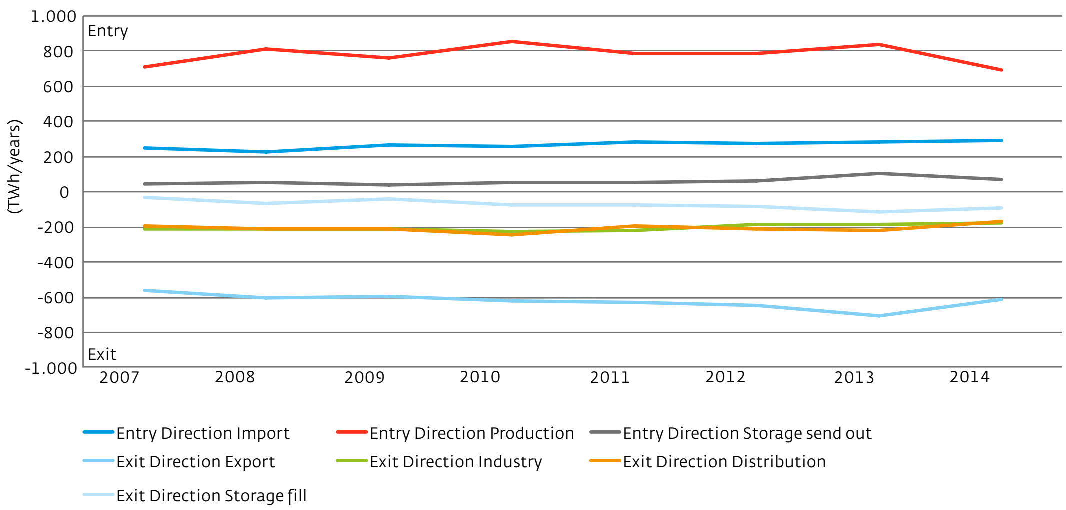


The throughput of gas can be looked at in terms of entry volumes—the supply—or in terms of exit volumes—the demand. These are both visualised in the next graph.

The supply of gas into the grid is made up of the volume of gas that is produced in the Netherlands, plus gas that is imported, plus gas that is drawn out of storage (storage send out). The demand for gas from the grid is made up of the volume of gas that is used by Dutch industrial customers and distribution network customers, plus gas that is exported, plus gas that is used to fill storage.

Second, the graph in Appendix Figure III-2 shows the detailed information about annual entry and the exit volumes for each of these sources of supply and of demand over the same eight-year period.

Appendix Figure III-2 Yearly transported volume by category



On average 700-800 TWh/year (roughly 70-80 Bcm/year) has been produced in the Netherlands in recent years. This is the total of the Dutch small fields and Groningen field production.

Gas consumption in the Netherlands amounts to roughly 400-450 TWh/year (40-45 Bcm/year), which in the graph is the total of "Exit direction Industry" and "Exit direction Distribution".

Imported gas (gas produced outside the Netherlands) has increased from 250 TWh in 2007 to almost 300 TWh in 2014.

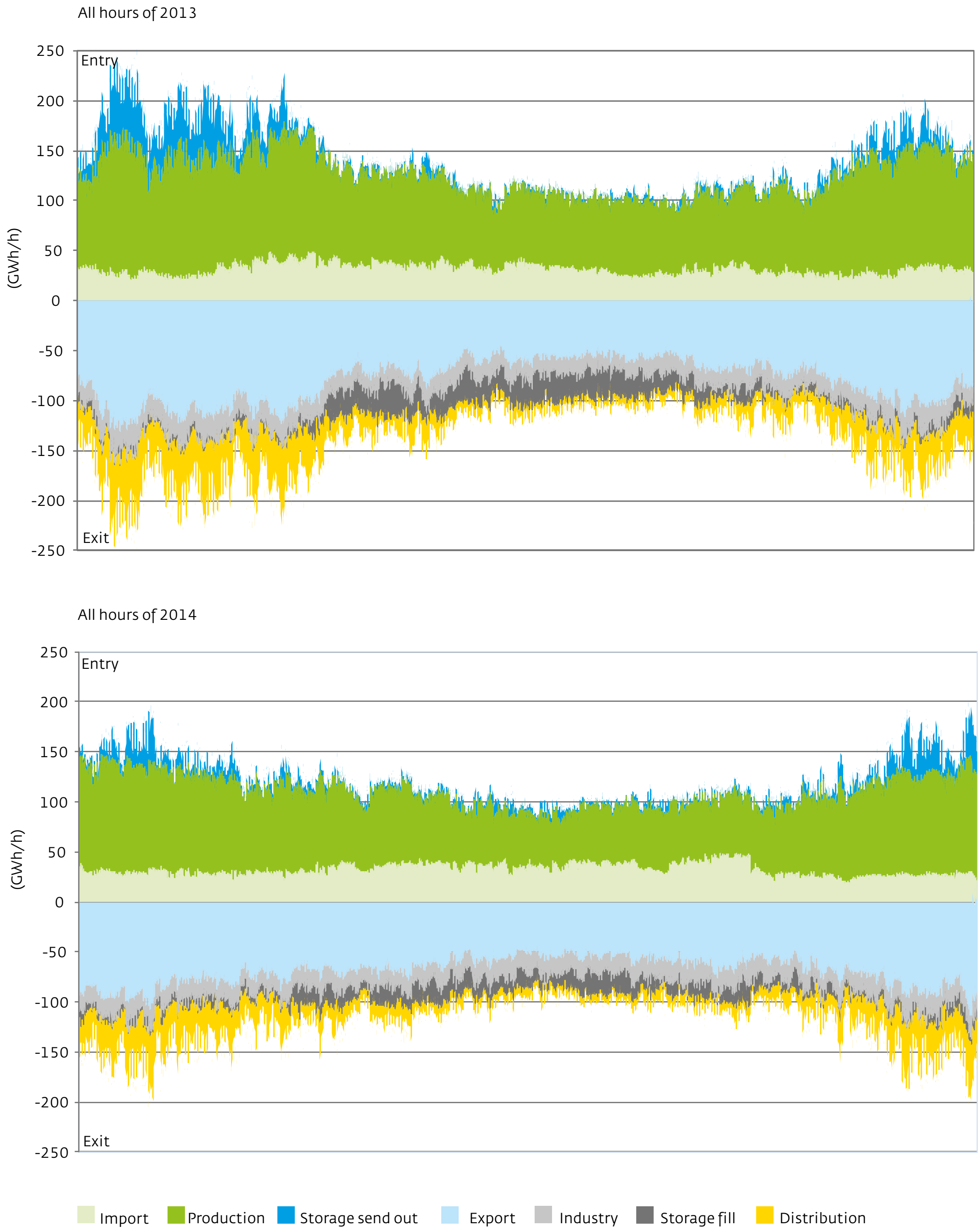
Exported gas (gas transported through the GTS grid and used outside the Netherlands) is on average between 600 and 700 TWh/year. This means that approximately 60% of the transported volume through the GTS grid will be used in other countries, which underpins the role of the GTS system as a gas roundabout for north-west Europe.

The use of storage has increased from 50 TWh in 2007 to 100 TWh in the last two years.

Third, the graphs in Appendix Figures III-3 and III-4 below show the hourly demand (exit) and supply (entry) capacity balance for the years 2013 and 2014.

The graphs show that the year 2014, when the winter was mild, needed less transport capacity than the year 2013, when the winter was colder—although 2013 was also not an extremely cold winter.

Appendix Figure III-3 Demand/supply capacity balance



“Production” is the aggregated supply capacity of the Dutch small fields and the Groningen field. “Import” is the supply capacity for gas produced outside the Netherlands.

“Export” is the demand capacity for gas which is transported through the GTS grid and which has delivered at the border stations.

"Storage fill" is the demand capacity that is used for filling the storage facilities. "Storage send out" is the realised supply capacity when storage feeds into the GTS grid.

"Distribution" is the realised demand capacity for households and industrial customers which is delivered by GTS at gas delivery stations with a connection to regional transmission operators.

"Industry" is the realised demand capacity for industrial customers whose deliveries are made directly by GTS from the main transmission grid.

Finally, the charts on the following pages show the way in which capacity has been utilised in the years 2013 and 2014 for a number of border points and 'clusters'. The grouping into (geographical) cluster points at the borders are shown in Appendix Figure III-4 below.

Appendix Figure III-4 Clusterpoints at the borders

The charts show the entry and exit at the key low calorific gas (L-gas) border exit stations or clusters (Oude Statenzijl, Winterswijk-Zevenaar and Hivarenbeek), at the high calorific gas (H-gas) entry points (Emden-Oude Statenzijl, the GATE LNG terminal) and at the transit exit points (Zuid Limburg, Julianadorp, and the bi-directional Zelzate point).

Each chart shows the capacity that was technically available and booked on a firm basis for each month (respectively the grey areas and the solid black lines). These are given for both directions: entry (the incoming GTS system) in a positive direction, and exit (the outgoing GTS system) in a negative direction.

The charts also show the actual capacity that was allocated for peak gas flows in each month (the green bars)—again in both directions. The top of the green bar represents the maximum allocated entry capacity in a month, the bottom of the bar represents the maximum allocated exit capacity in a month.

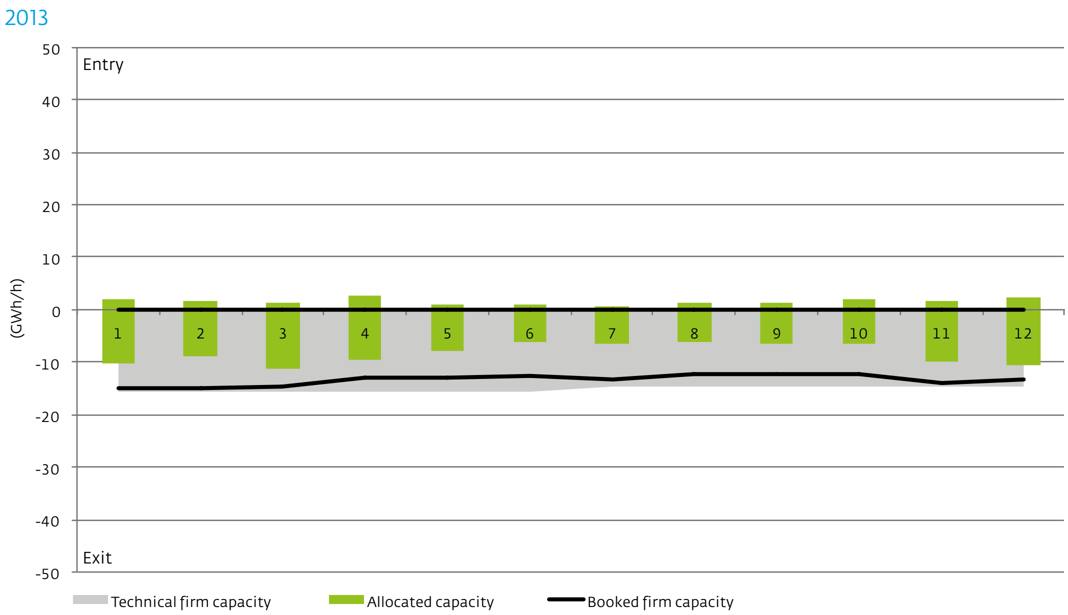
For 2014, the introduction of new regulations allowed for the oversubscription and buyback of firm capacity. These are shown in blue on the relevant charts.

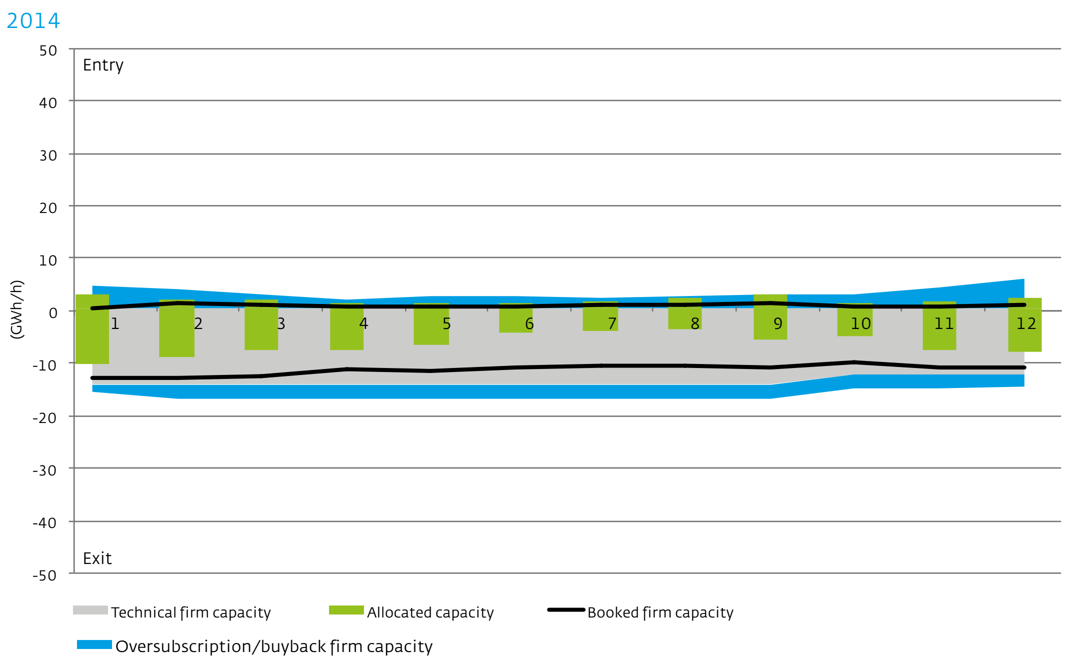
L-gas Exits

The maximum allocations of the L-gas exits throughout the year show the typical pattern of gas use for heating purposes, which is the largest component of the L-gas flow. Peak demand is in the winter months, low demand in the summer: this is typical temperature-driven gas demand. One can see the difference between a fairly cold winter (2013) with a higher demand than a mild winter (2014) with higher temperatures and a lower demand.

The first three charts show the use of the two L-gas exit clusters to Germany, Oude Statenzijl, Winterswijk/Zevenaar and the L-gas border point to Belgium, Hilvarenbeek.

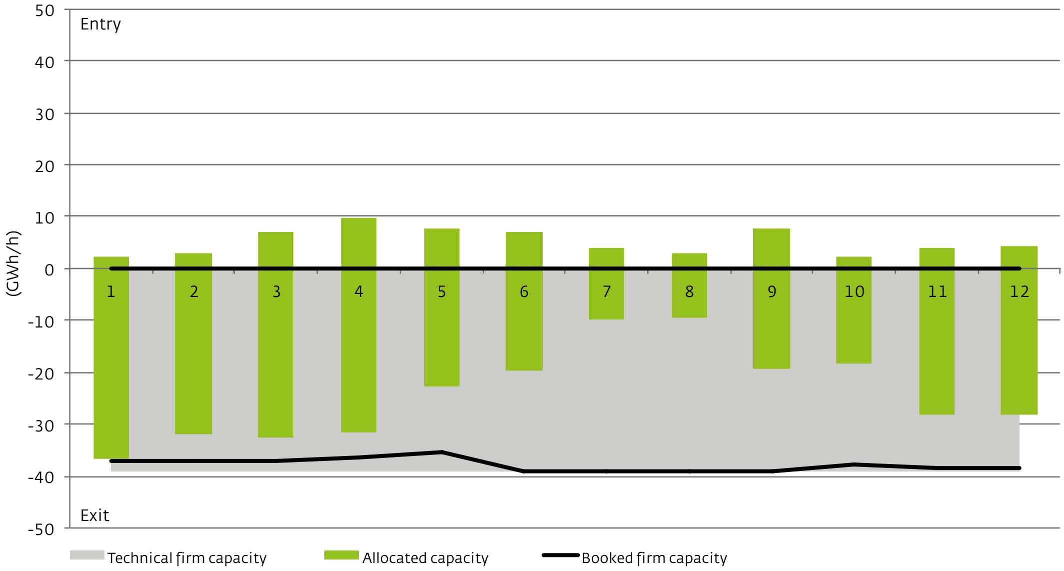
Appendix Figure III-5 Oude Statenzijl exit cluster L-gas



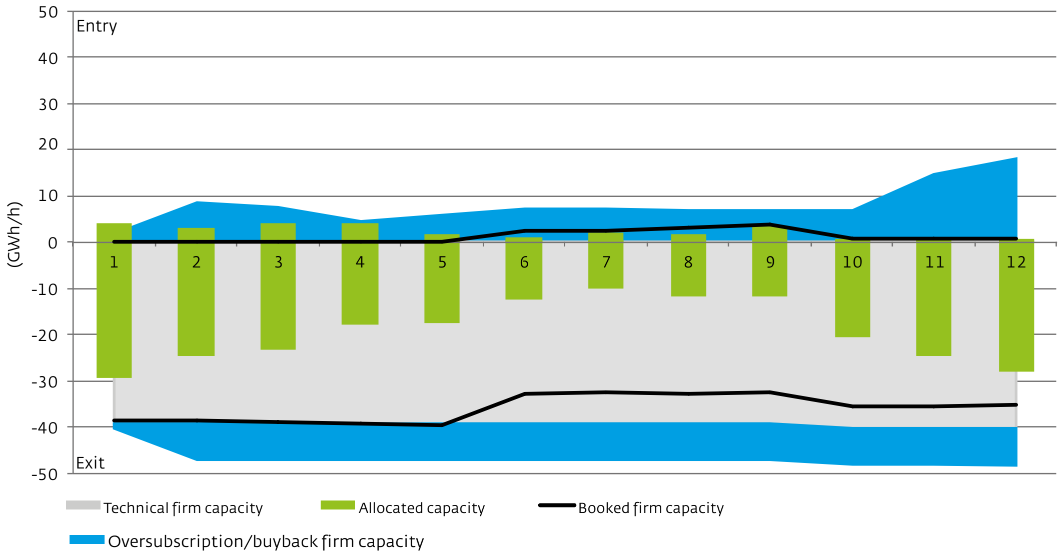


Appendix Figure III-6 Winterswijk-Zevenaar exit cluster L-gas

2013

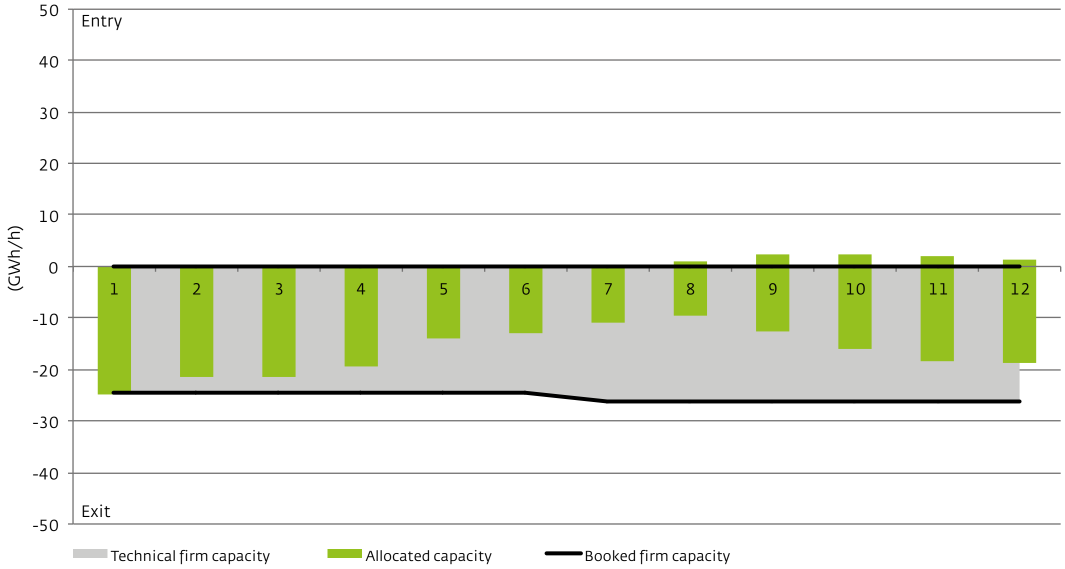


2014

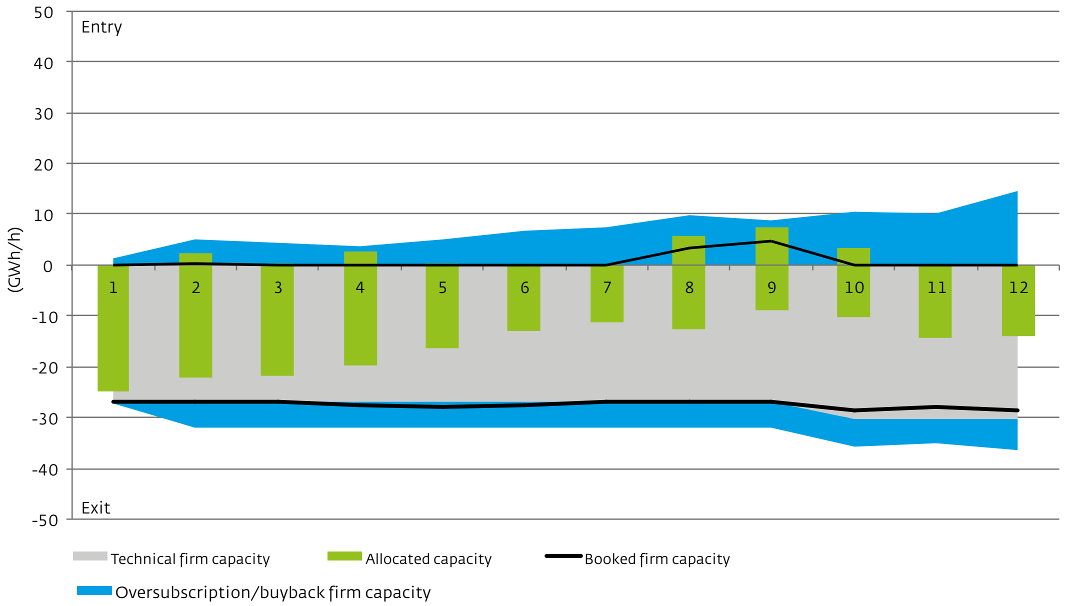


Appendix Figure III-7 Hilvarenbeek exit L-gas

2013



2014



H-gas Entries

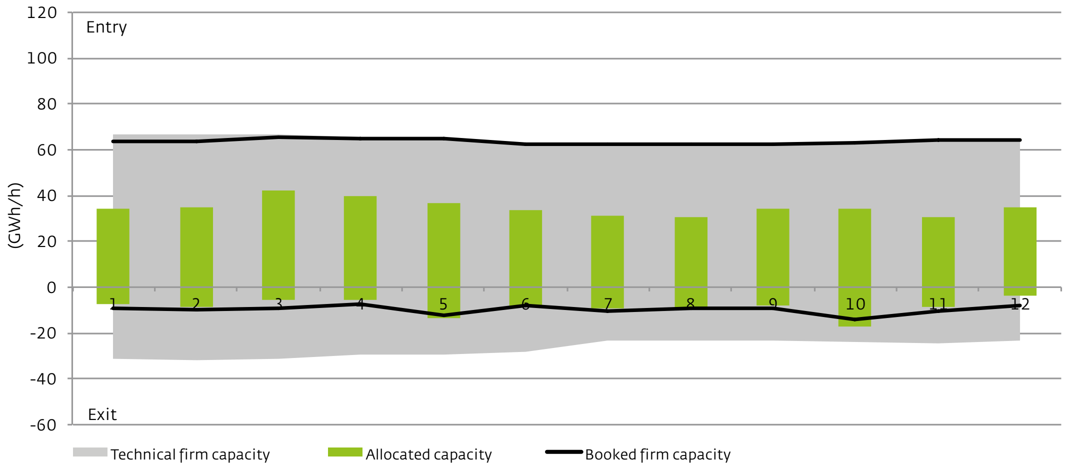
High calorific value gas is used in three different ways in the GTS system:

- For direct use at several industrial plants
- For use in G-gas/L-gas market by applying quality conversion through blending and the addition of nitrogen
- For transit purposes to the UK (via the BBL pipeline starting at Julianadorp, or through the IUK pipeline via Zelzate and Zeebrugge), to Germany (via Bocholtz) and to Belgium (via 's Gravenvoeren or Zelzate) made possible by the gas roundabout facilities available in the GTS grid.

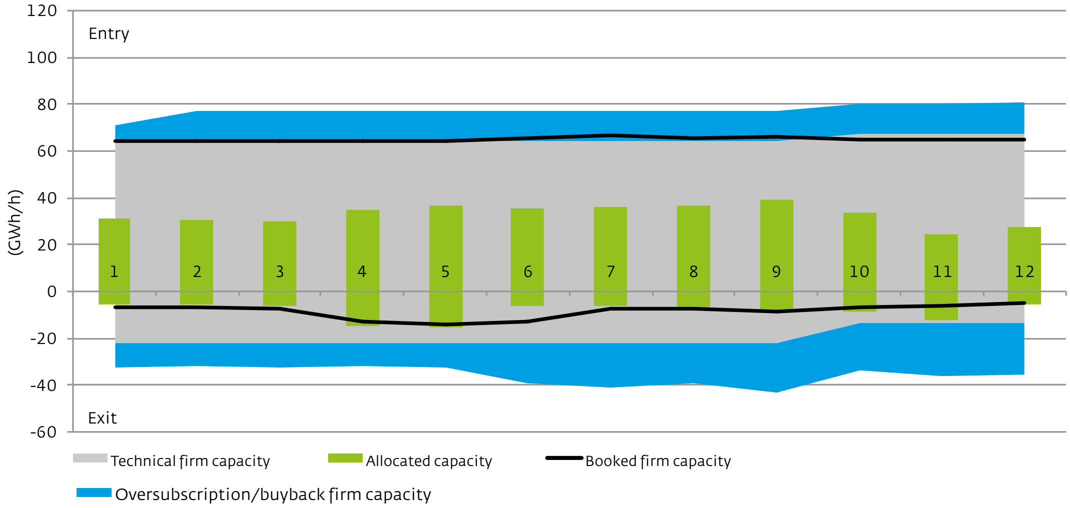
The following six charts show the way in which these points have been used for entry and exit on a monthly basis over the past two full calendar years.

Appendix Figure III-8 Emden-Oude Statenzijl without storages: entry, exit cluster H-gas

2013

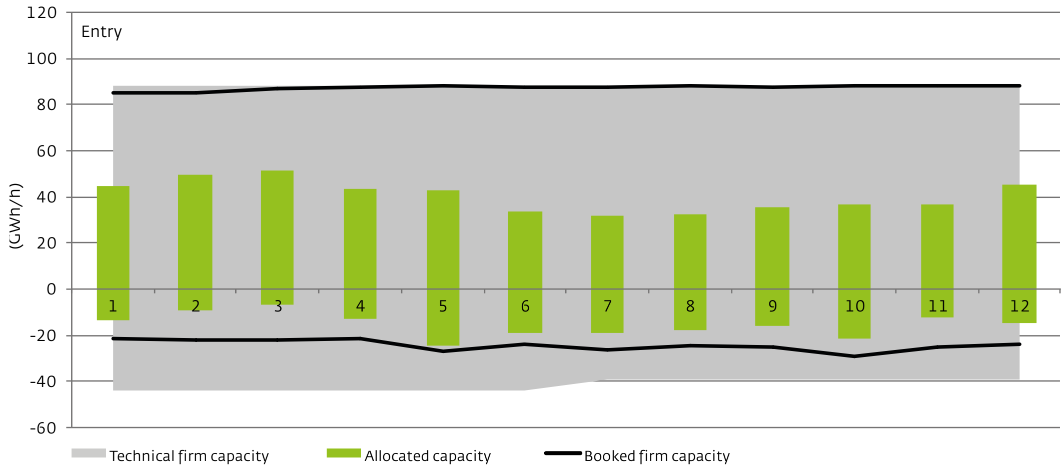


2014

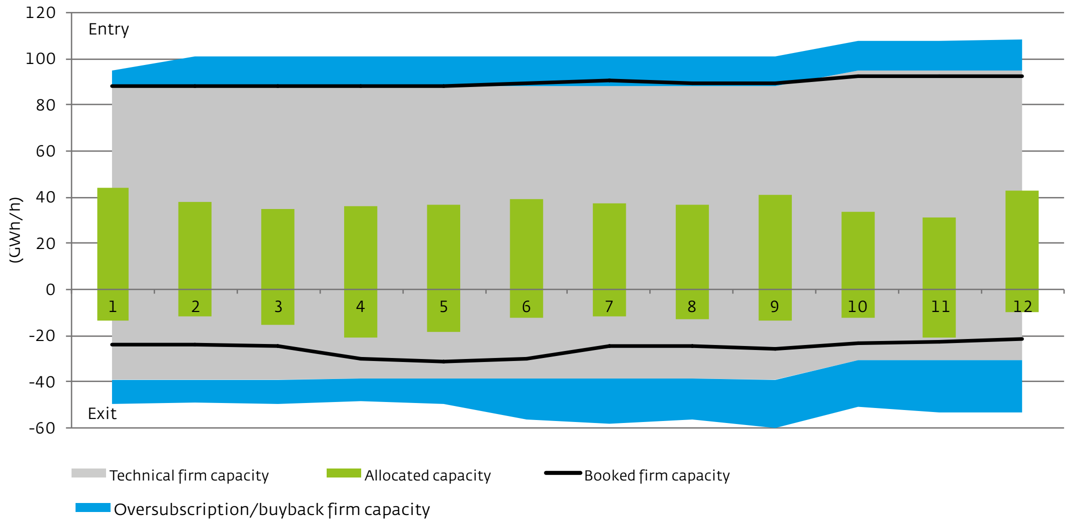


Appendix Figure III-9 Emden-Oude Statenzijl including storages entry, exit cluster H-gas

2013

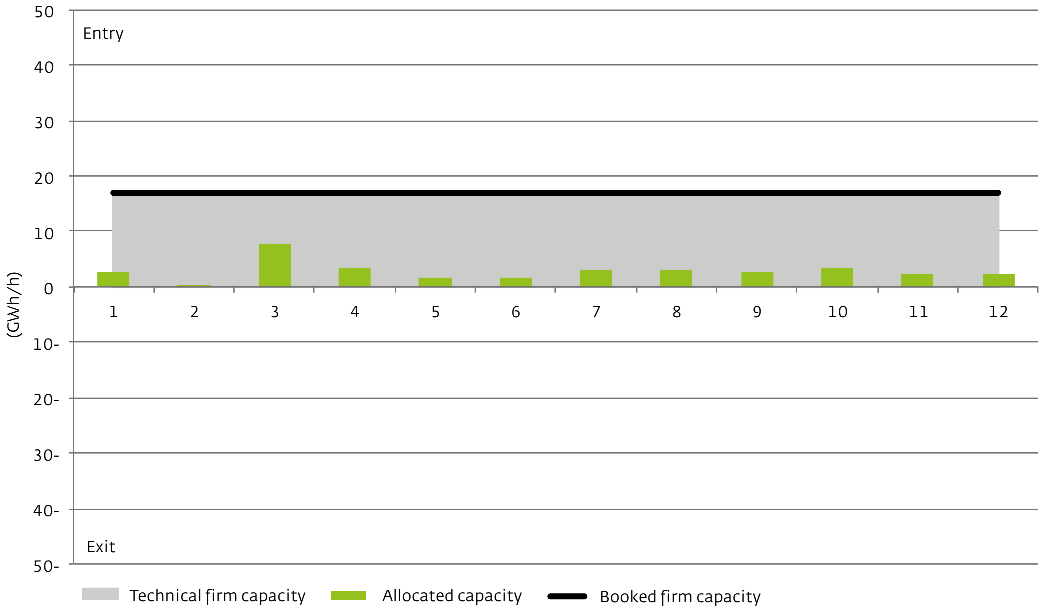


2014

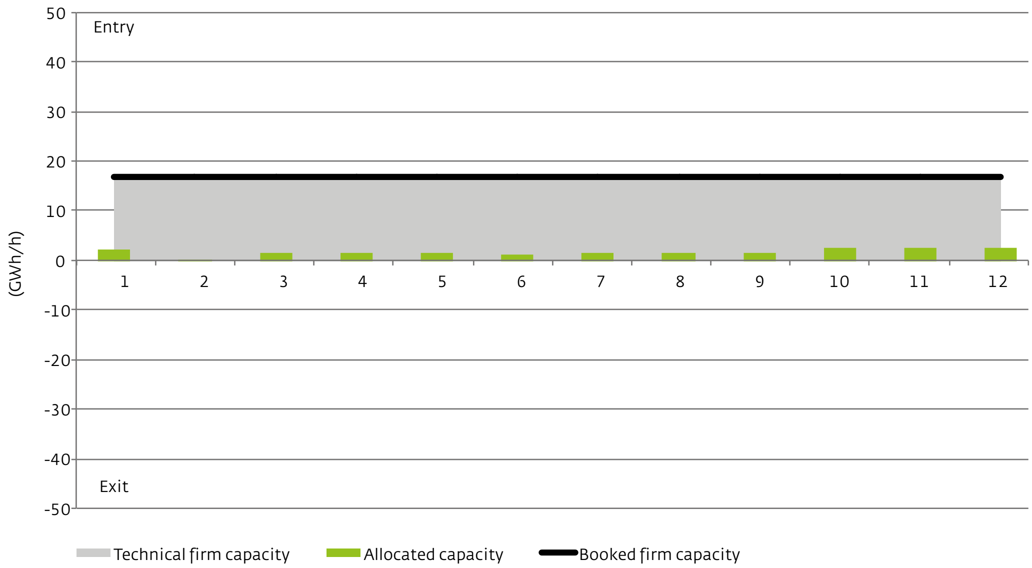


Appendix Figure III-10 GATE entry H-gas

2013

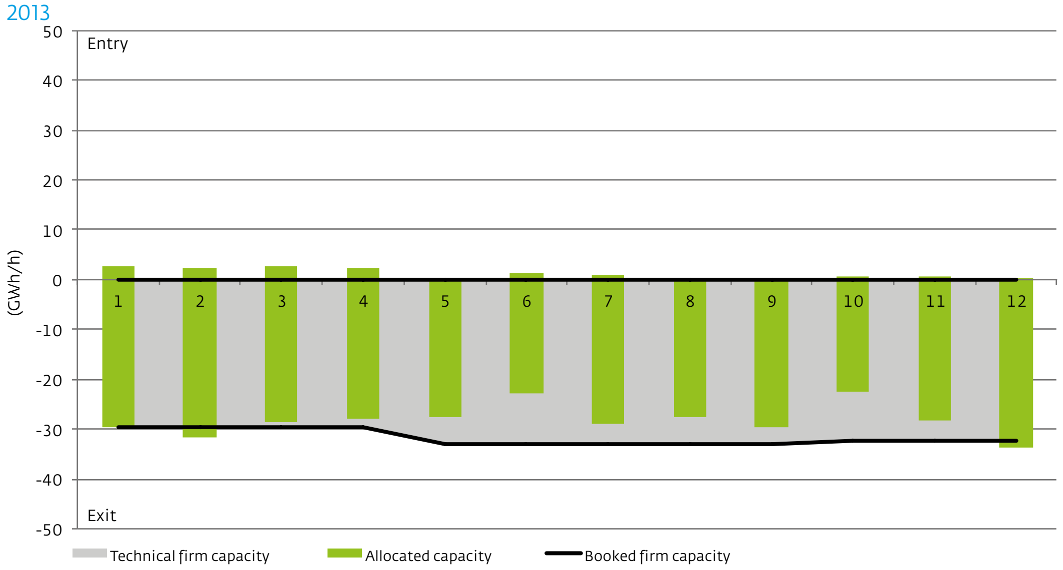


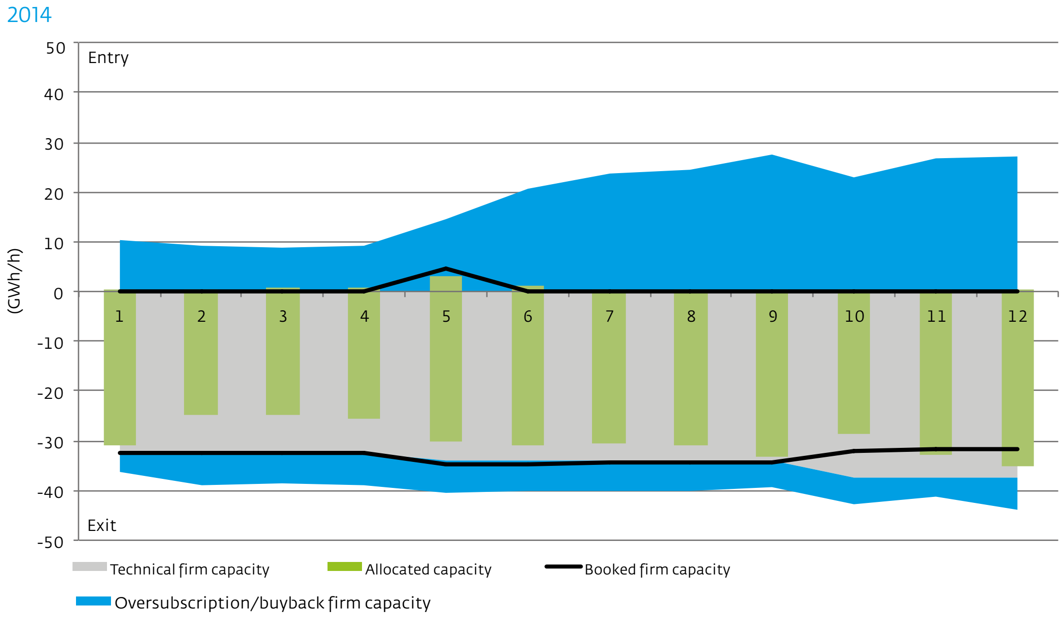
2014



H-gas exits: transit

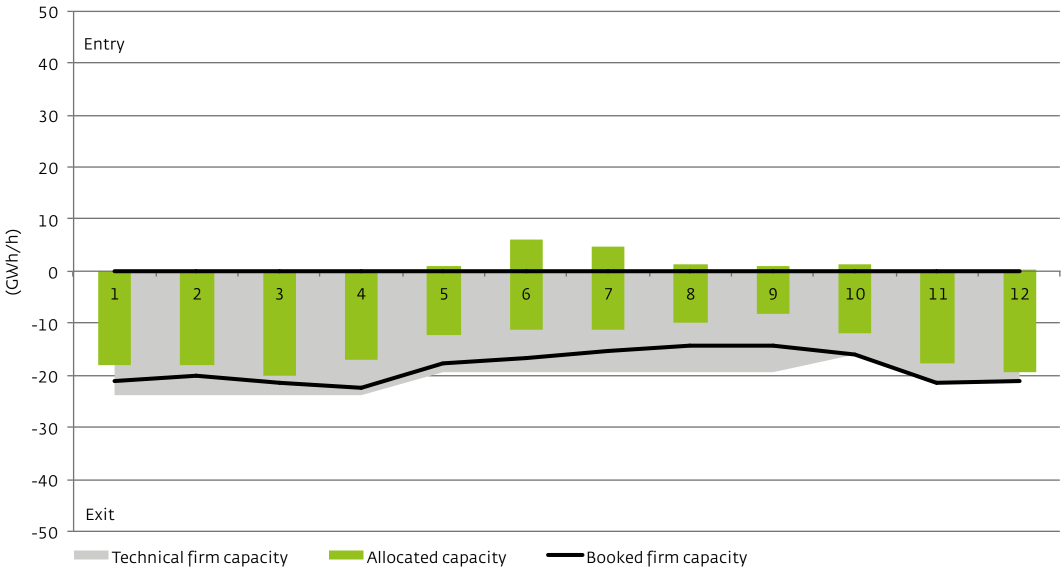
Appendix Figure III-11 Zuid Limburg exit cluster H-gas



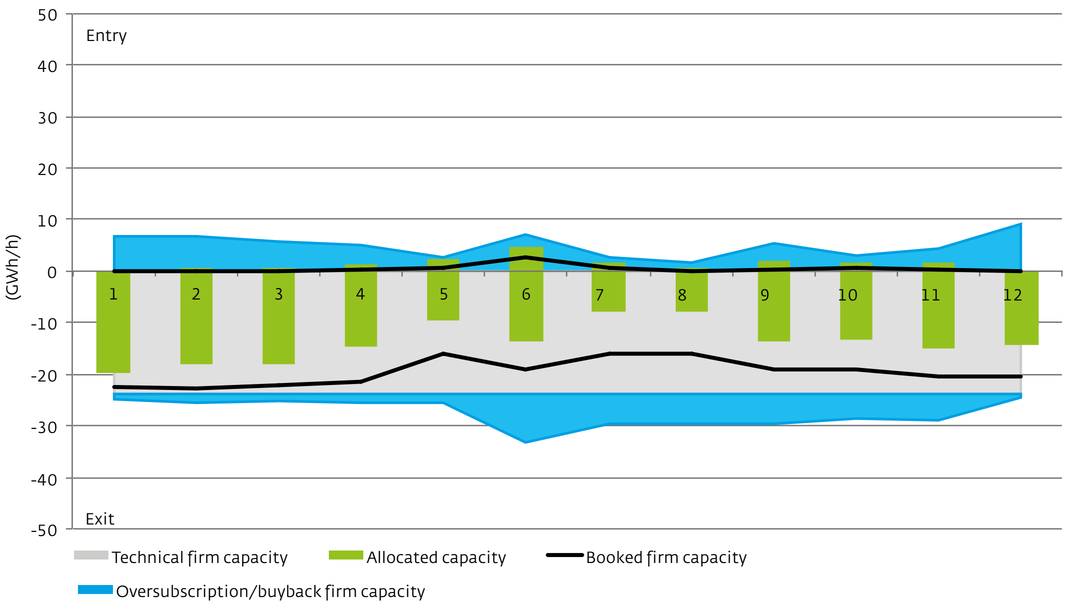


Appendix Figure III-12 Julianadorp exit cluster H-gas

2013

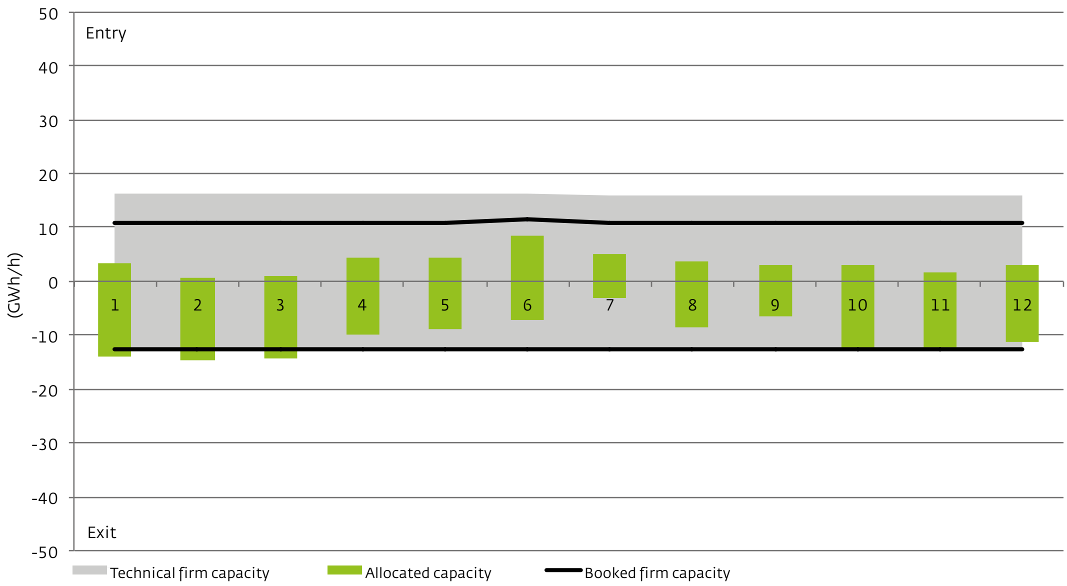


2014

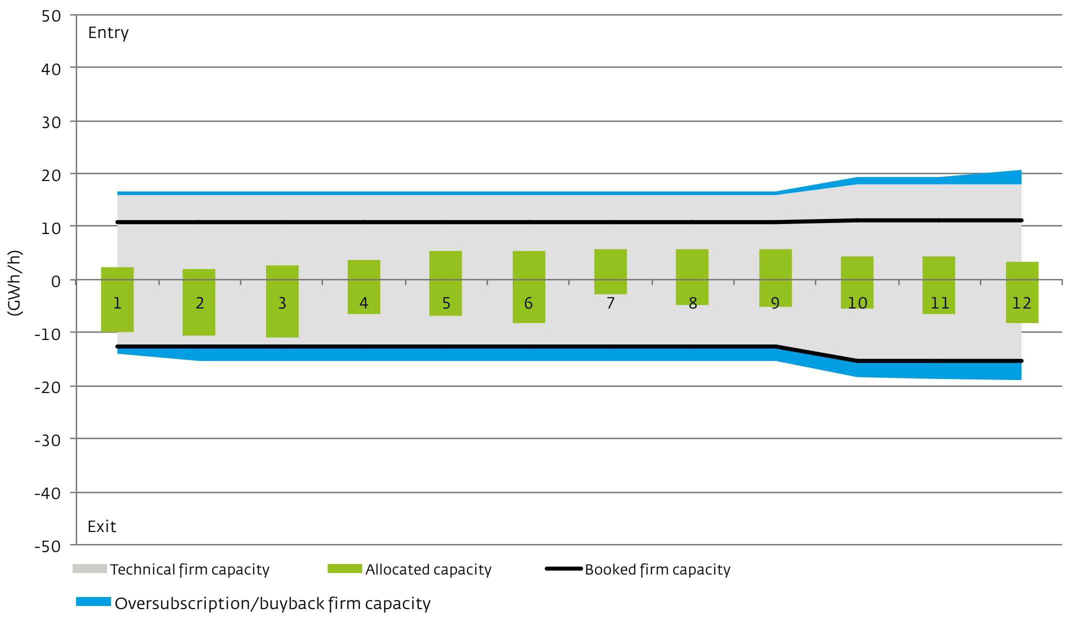


Appendix Figure III-13 Zelzate entry, exit cluster H-gas

2013



2014



Appendix IV: Security of Supply

This appendix, in combination with the relevant paragraphs in the main document (referred to below), covers the obligation to prepare the Security of Supply Report for 2015[30]. The report provides an overview of the level of security of supply in the Netherlands for a 20-year period. It contributes as input for the Dutch monitoring report to the European Commission[31].

The volume and capacity balance

The Security of Supply report analyses whether sufficient infrastructure is available to bring gas to the market from the sources of additional gas supply that will be needed and that are potentially available over the next twenty years. These elements are covered in the following sections of the main document of this NOP.

Paragraphs 4.2. and 4.3. of the NOP assess which additional volumes (compared to expected north-west European regional production and import at the 2015 level) are required for both the Dutch market and the north-west European market as a whole. Chapter 5 describes which additional volumes can be made available to cover the total supply demand of the north-west European and Dutch market[32].

The capacity balance in the main report (paragraph 5.5.1.) reveals the likelihood of a shortfall during the second decade of the planning period of this NOP. Since the decline of domestic and local production is likely to be substantial, there will be a requirement for additional volumes of gas supply. The additional gas supply that will be needed will include additional pipeline gas from Russia, additional LNG, shale gas and green gas. New supply will primarily be imports, and these will need to be connected to the Dutch network, with sufficient entry capacity for GTS customers to be able to exercise choice in their purchasing decisions. GTS has looked at reasonable extremes to determine which investment measures are necessary to accommodate new flows. Paragraph 5.5.2. sets out these implications of the need for new supply. The resulting capacity measures to guarantee sufficient infrastructure, are listed in chapter 6.

Although GTS can assure the ability of shippers to deliver gas to their customers through the infrastructure, and proposes to invest to enable shippers to have a wide choice of supply sources, GTS is not in a position to assess whether in aggregate the shippers will always be able to obtain sufficient gas to assure the gas supply itself. That is a matter for the market, and will depend on global market conditions that are outside GTS control.

30 In December 2008, the Ministry of Economic Affairs, as the Dutch competent authority for reporting on security of supply, delegated the task to write this report to GTS. This task is laid down in Article 52a of the Gas Act (see also Staatscourant ETM/10058269 of 16 april 2010), http://wetten.overheid.nl/BWBR0011440/Hoofdstuk1/Paragraaf14/geldigheidsdatum_07-05-2015.

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

32 For an overview of the total potential gas resources in non-EU gas producing countries see ENTSOG TYNDP chapter 5.3 Supply scenarios at: http://www.entsog.eu/public/uploads/files/publications/TYNDP/2015/entsog_TYNDP2015_main_report_lowres.pdf.

Peak supply

In order to ensure that domestic consumers do not run out of gas during periods of extreme cold, GTS has a statutory responsibility to reserve enough volume and capacity to supply protected consumers[33], defined as consumers with a maximum supply connection of 40 m^3/hour. GTS is obliged to put in place the necessary measures to cover supply as efficiently as possible.

'Peak supply' is the extra volume and capacity required to deliver gas for an effective daily temperature of between -9°C and -17°C, measured at the De Bilt weather station. An average effective daily temperature of -9°C occurs approximately once every two years, and a temperature of -17°C occurs once every 50 years and was last recorded on 14 January 1987.

Under these specific circumstances, a licensed gas supplier must obtain the extra volume and capacity that is required through GTS. Together with the freely contractable basic supply to -9°C, the supplier can then offer a complete supply to domestic consumers down to temperatures of -17°C, as long as the supplier is in a position to obtain sufficient gas on the open market to meet its own obligations down to -9°C.

Peak supply covers only a fraction of total consumption, namely the volume which is additional to demand at -9°C. Depending on the actual temperature fluctuations during a given day, only part of the day - notably the morning and evening peaks – will be covered by peak supply gas. The maximum contracted capacity will only be required at an effective day temperature of -17°C during a limited number of hours.

The volume and capacity contracts related to peak supply may only be claimed by GTS on the day when official weather forecasts predict an effective daily temperature for the next day in the city of the Bilt with a maximum of -9ºC. When there is no effective -9C or lower situation, the capacity and volume can be used by the market. In the Dutch balancing regime it is not possible to wait for the end of the gas day to allocate the peak supply amounts. As shippers are responsible for balancing their portfolio, it is necessary to allocate the amount of gas delivered by GTS near real time and to adjust the portfolios accordingly. Therefore, the allocation rule is: if during an hour in a portfolio, the sum of all allocations for household customers exceeds the capacity for that portfolio associated with a -9ºC day, the excess volume will be allocated to the shippers as a peak supply delivery by GTS. The capacity associated with a -9ºC day is equal to the exit capacity that is invoiced in winter (December/January/February).

For the most recent 2014-2015 Winter, a total peak supply capacity of 23.24 GWh/h was contracted through GTS, with a volume of 0.96 TWh. Out of the past six winters, in three winters GTS supplied gas under this regulation.

Emergency supply

GTS is statutorily responsible for the uninterrupted supply of gas to protected customers in order to manage disruptions that may arise from commercial default, such as bankruptcy of a retail supplier. In such an event, GTS will guarantee payment for the gas bought by the retail suppliers to wholesale suppliers and will co-ordinate the re-distribution of protected customers of the bankrupt retail supplier among the remaining retail suppliers. In such a

33 *Decision on security of supply (Gas Act).*

case GTS has a coordinating task to make sure that the customers of the non-compliant retail supplier continue to receive gas. Non-compliance of a retail supplier does not imply shortage of gas, and can therefore be solved by the market. The role of GTS as guarantor and coordinator will enable affected customers to choose a new retail supplier within a reasonable time without an interruption in their gas supply. Bankruptcy of a retail supplier does therefore not imply shortage of gas towards the protected customers.

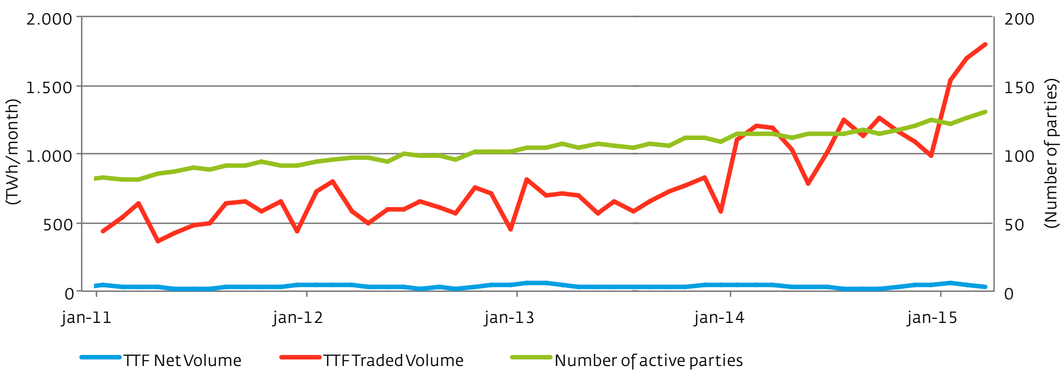
Liquidity of the gas market

A smoothly operating virtual trading platform ensures that supply and demand can operate effectively and therefore strengthens security of supply. The Title Transfer Facility (TTF) is the virtual trading market place where GTS gives market players the opportunity to transfer gas that is already in the GTS system ('entry-paid gas') to another party. The TTF enables gas that has been fed into the gas transport network via an entry point to be transferred very easily to another owner before it leaves the network via an exit point.

As the Netherlands Authority for Consumers and Markets (ACM) noted in 2014[34], the rising trend in trading volumes on the gas wholesale market together with the positive development of other liquidity indicators such as declining price volatility and a declining bid-offer spread, point to growing liquidity on the gas market. Higher trading volumes and increased liquidity promote competition on the wholesale market and make it easier for market players to make efficient decisions when buying and selling gas.

The lion's share of trade on the TTF takes the form of OTC (over-the-counter) trading. This involves direct trade between two parties. In Europe, there are two gas hubs that are far bigger than any other gas trading platform in Europe (together accounting for over 80%): the NBP (National Balancing Point) in the UK and the TTF. The remaining trade in gas takes place via a commodity exchange, mainly through the ICE (the Intercontinental Exchange). Here, too, TTF is gaining ground. Relevant growth figures[35], illustrated in Appendix Figure IV-1, show that the Netherlands has grown rapidly to become one of the most attractive gas trading platforms in Europe.

Appendix Figure IV-1 TTF Development



34 ACM, 2014 Liquidity report, wholesale market in gas and electricity
35 Source: http://www.gasunietransportservices.nl/en/transportinformation/ttf-volume-development

Appendix V: Report on overview of estimates of gas from Dutch Small Fields (2015)

Articles 54a and 54b of the Gas Act specify the obligations with which the national gas transport network operator has to comply with regard to the intake and transport of gas from the gas reserves in areas within the Netherlands and on the Dutch Continental Shelf[36]. This appendix describes how GTS meets these obligations in the case of the 'small fields'— that is all Dutch gas fields, except the Groningen field.

Method

In early 2015, GTS asked the gas producers who are members of NOGEPA (Netherlands Oil and Gas Exploration and Production Association) to report the quantities of gas they expected to produce in the coming 20 years. These are the "developed reserves" and "undeveloped reserves where production is expected to start between 2015 and 2019". All the producers approached, responded to this request. They are listed in Appendix Table V-1 below.

In the case of fields belonging to several producers, only the operator was approached. The operator provided information about the whole field, including those parts over which it has no control. This reservation was pointed out in the reports submitted to GTS. GTS nevertheless believes that these reports are sufficiently reliable to serve as a basis for its planning activities.

GTS asked TNO (Dutch organization for Scientific Research) to submit a report on expected supply from reserves that have not yet been discovered. TNO responded to this request and divided the report into the geographically closest entry point, taking the existing infrastructure into account. As the application of techniques for extracting gas from unconventional sources (e.g. shale gas) is still in the early stages of development in the Netherlands, TNO has for the time being restricted its estimate of supply to conventional reserves.

Analysis

The forecasts obtained by this method are grouped by entry point. The capacity of the future gas supply is determined for each entry point, and the quality of this gas is also recorded. The only quality parameters mentioned are those which play an important role in the various transport contracts at both entry and exit points.

The transport analyses contain flow and quality assumptions for combinations of supply from various fields, assumptions for the imported gas and assumptions for domestic and foreign market demand. Because the gas shippers decide which entry and exit points they wish to use and will use, GTS as the network operator has no influence on the actual combinations that will arise, and has to rely on its own estimate of market demand and supply. It is emphasised that patterns which deviate from this assessment may temporarily mean that gas cannot be fully received in the combination desired by the shipper.

36 *http://wetten.overheid.nl/BWBR0011440/Hoofdstuk5/Paragraaf54/Artikel54a/geldigheidsdatum_07-05-2015*
http://wetten.overheid.nl/BWBR0011440/Hoofdstuk5/Paragraaf54/Artikel54b/geldigheidsdatum_07-05-2015

Results

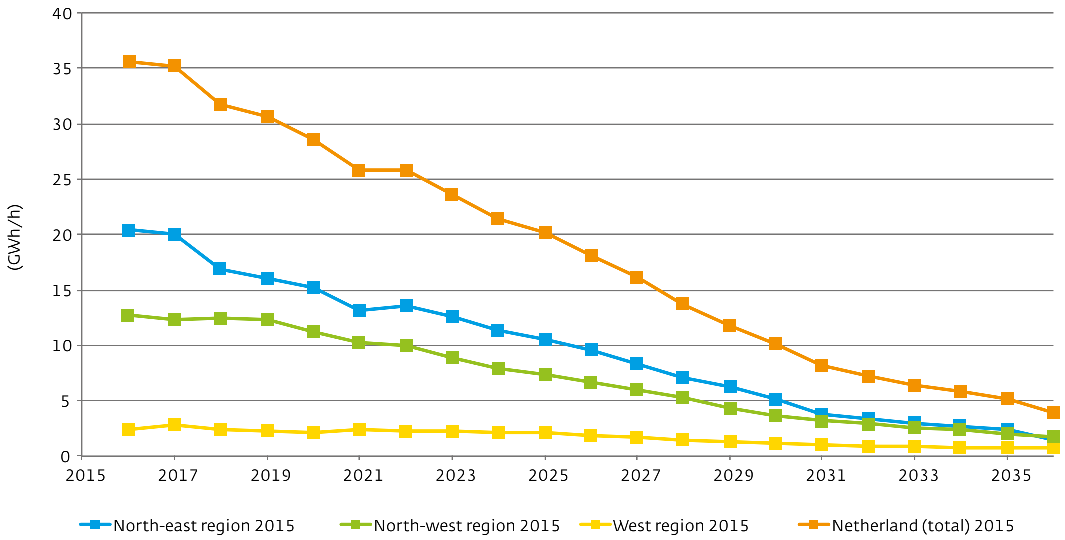
Appendix Figure V-1 below shows the trends in supply capacity from the small fields, including supply from yet-to-be-discovered reserves as assessed by TNO. Appendix Table V-2 gives the underlying data, and shows the current trends in supply compared to the forecasts made the previous year.

The sources of supply are divided into three regions:

- North-east Netherlands (entry points located in the provinces of Groningen, Friesland, Drenthe and Overijssel);
- North-west Netherlands (entry points located in the province of Noord Holland);
- West Netherlands (entry points located in the provinces of Zuid Holland and Noord Brabant).

Appendix Table V-3 shows the allocation of each entry point to the three regions.

Appendix Figure V-1 Supply from small gas reserves by region within the Netherlands[37]



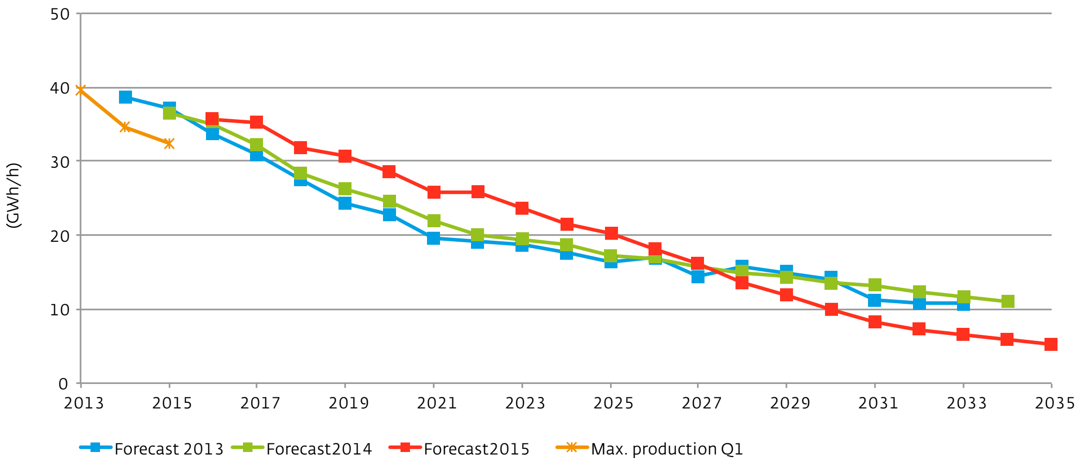
The current capacity forecasts are very close to those in the previous GTS report, "Overview of estimates of gas from small fields in 2014", although with a slight increase on that report. This is due to a few new fields and to higher expected output from a number of existing fields than was expected in the previous report.

Appendix Figure V-2 shows the capacity expectations (Q1 values) from the last three small field reports prepared by GTS together with the maximum hours realised in the first quarters of 2013, 2014 and 2015. The total sum of gas realised from small fields in 2013 Q1 was practically identical to the forecast in the 2012 small field report. The 2014 Q1 realisation figure was slightly lower than the expectations contained for that period in the 2013 small field report. This was also the case for 2015 Q1 relative to the 2014 report.

Overall, the forecasts provide a reasonably accurate estimate of the gas flows realised.

37 *Source: Producers mentioned in Appendix table V-1*

Appendix Figure V-2 Gas supply capacity: realised vs. predictions[38]



On the basis of the totals given above, assuming the distribution of capacities per entry point as indicated by the operators, GTS expects no capacity bottlenecks within the investment horizon of 2015-2025 that would result directly from the supply forecasts of small fields gas reserves in areas within the Netherlands.

Quality

The quality of supply from gas reserves in areas within the Netherlands is, at practically all entry points, such that no intake problems are expected in the light of the existing agreements between GTS and producers/shippers. GTS is continuing to closely monitor the carbon dioxide content of the gas offered at the NGT entry point (Uithuizen). There has been no significant change at this point compared to the status of the 2014 report.

No new bottlenecks have been observed for the intake of gas from the small fields.

New entry points

No new projects are in preparation which can result in new location for the intake of supply from small fields.

Conclusions

The forecasts made by GTS do not indicate any possible capacity bottlenecks in the intake of gas from small fields. However, gas quality remains an issue that will continue to be monitored.

38 *Source: Producers mentioned in Appendix table V-1, GTS analyses*

Appendix Table V-1: Producers reporting quantities of gas they expect to produce (alphabetical order)

1. Centrica Production Nederland B.V.
2. Dana Petroleum Netherlands B.V.
3. GDF SUEZ E & P Nederland B.V.
4. Nederlandse Aardolie Maatschappij B.V.
5. Oranje Nassau Energie Nederland B.V.
6. Petrogas (previously Chevron)
7. TAQA (Abu Dhabi National Energy Company PJSC)
8. Total E & P Nederland B.V.
9. Tulip Oil
10. Vermilion Oil & Gas Netherlands B.V.
11. Wintershall

Appendix Table V-2: Small field capacity forecasts

Capacities in GWh/h

	North-east		North-west		West		Total Netherlands	
	Estimate		Estimate		Estimate		Estimate	
	2014	2015	2014	2015	2014	2015	2014	2015
2015	20.2		13.8		2.4		36.4	
2016	20.2	20.5	12.7	12.7	2.0	2.4	34.9	35.6
2017	18.1	20.0	12.3	12.3	1.7	2.9	32.1	35.2
2018	15.2	16.8	11.5	12.5	1.6	2.4	28.4	31.7
2019	14.0	16.0	10.6	12.3	1.6	2.3	26.1	30.6
2020	12.6	15.3	10.2	11.2	1.7	2.1	24.5	28.6
2021	11.3	13.1	9.3	10.3	1.3	2.4	21.9	25.8
2022	10.5	13.5	8.8	10.0	0.8	2.3	20.1	25.8
2023	9.7	12.5	8.9	8.9	0.8	2.2	19.5	23.7
2024	9.3	11.4	8.7	7.9	0.8	2.2	18.7	21.5
2025	8.4	10.6	8.1	7.4	0.7	2.1	17.2	20.1
2026	8.0	9.6	8.4	6.7	0.5	1.9	16.8	18.2
2027	7.3	8.4	7.9	6.0	0.5	1.7	15.7	16.1
2028	6.7	7.0	7.7	5.2	0.5	1.4	14.8	13.7
2029	6.3	6.2	7.5	4.3	0.5	1.3	14.3	11.8
2030	6.0	5.2	7.1	3.7	0.5	1.2	13.6	10.1
2031	5.8	3.8	7.0	3.3	0.5	1.1	13.2	8.1
2032	5.4	3.4	6.5	3.0	0.5	0.9	12.4	7.3
2033	5.1	3.0	6.0	2.6	0.5	0.9	11.6	6.4
2034	4.9	2.7	5.6	2.4	0.5	0.8	11.0	5.8
2035		2.4		2.0		0.8		5.2

Appendix Table V-3: Allocation of entry points by region

NE = North-east Netherlands (entry points located in the provinces of Groningen, Friesland, Drenthe and Overijssel);

NW = North-west Netherlands (entry points located in the province of Noord Holland);

W = West Netherlands (entry points located in the provinces of Zuid Holland and Noord Brabant);

Entry point	Region
Anjum	NE
Annerveen	NE
Balgzand HC	NW
Balgzand LC	NW
Balgzand NOGAT	NW
Barendrecht	W
Bedum	NE
Beverwijk	NW
Blija	NE
Botlek	W
Brakel/Wijk & Aalburg	W
Emmen	NE
Gaag	W
Garijp	NE
Grijpskerk	NE
Grootegast	NE
Harlingen	NE
Hemrik	NE
Koedijk	NW
Kootstertille	NE
Maasvlakte	W
Middelie	NW
Middenmeer	NW
Monster	W
Oude Pekela	NE
Rotterdam Westgas	W
Ten Arlo	NE
Uithuizen	NE
Ureterp	NE
Vries	NE
Waalwijk	W
Warffum	NE

Appendix VI: The Capacity Section of the Quality and Capacity Report

GTS has an obligation to produce in 2015 a Quality and Capacity document (Dutch abbreviation KCD). In this appendix to the NOP, GTS is providing the capacity section for this document. A separate quality section of the document will be published around 1st of December 2015. Both documents together will constitute the KCD 2015.

In order to conform to a new Gas Act, which is expected to be effective on 1st of January 2016, the KCD will need to be replaced by an investment plan. This will be the full Network Development Plan (the NOP), which describes both expansion and replacement investments. This first 2015 NOP anticipates this replacement as regards expansion investments. The quality document will include an overview of the replacement investments. This appendix therefore provides a link between how GTS produced the capacity part of the KCD in the past, and how the NOP is to be produced in the future.

Information that has not been changed compared to that provided in the previous KCD (KCD 2013) is not included in this appendix, but where there is new evidence relating to bottlenecks in the system, evaluations are included here.

The integrated planning approach in the KCD and the NOP

The method used by GTS to estimate the transport capacity required and the method used to determine capacity bottlenecks are combined in an integrated planning approach to form the capacity management process. This process has been described in the previous KCDs produced by GTS.

From 2015 onwards the approach used in the NOP will form the basis of the capacity management process.

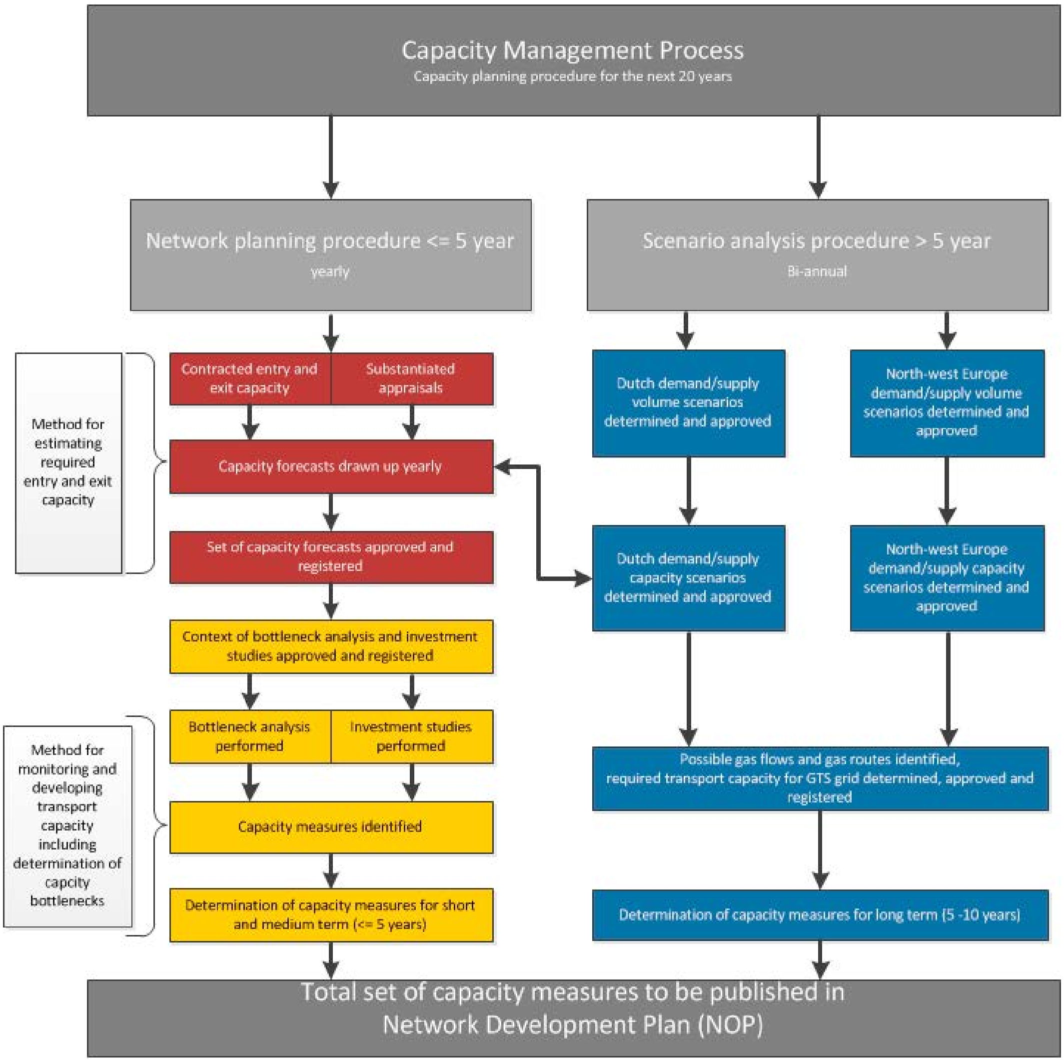
For each of the three scenarios developed in the NOP, a transport analysis will be executed on the basis of the scenario data and will follow the GTS planning method[39]. Each fifth year is to be analysed (2015, 2020, 2025, etc.) to determine necessary long-term capacity measures. Investments needed for expansion of the transport capacity typically have a lead time to realize of at least five years from the moment an investment decision is taken.

For the first five years of the planning period, GTS undertakes a transport analysis for each year. The results are used for small scale investment decisions, and for various other purposes, including the determination of the capacity that is commercially available at entry and exit points. This capacity will be offered in the various auctions and FCFS capacity on PRISMA. The capacity resulting from these yearly analyses lies within the range of outcomes of all three NOP demand scenarios for the first five years; this is consistent with the small differences between the scenarios in the first years.

Appendix Figure VI-1 shows how both methods together form the total capacity planning process for the next 20 years and beyond.

39 Further information about the GTS transport system and the capacity planning method can be found at: http://www.gasunietransportservices.nl/en/transportinformation/capacity-of-the-transportation-network

Appendix Figure VI-1 Capacity management process

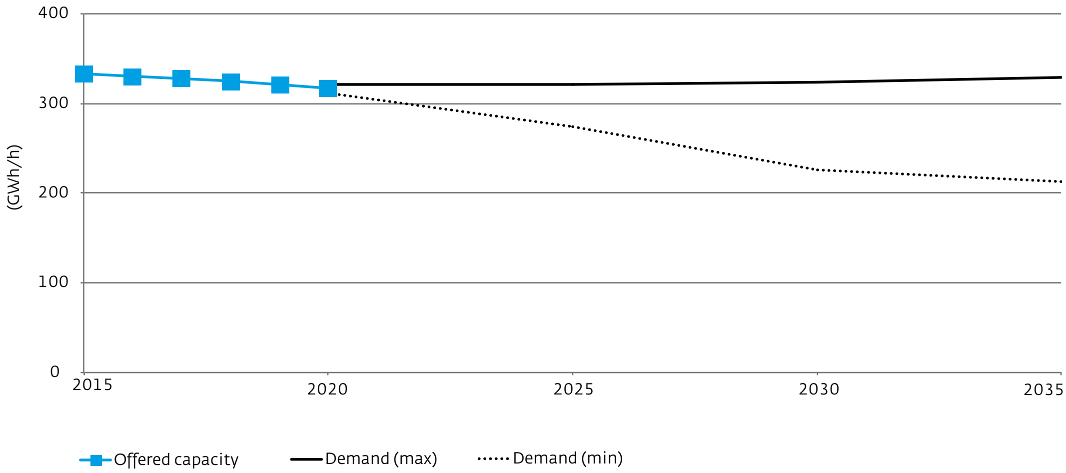


The reliability of the estimates and the risk of unforeseen events

GTS develops its network on the basis of estimates based on contracted capacity and substantiated appraisals. With regard to capacity for the household market, GTS is required by law to have enough capacity available for a demand at a daily average effective temperature of -17 ^{0}C. This is statistically likely to occur once every 50 years, so there is little chance of a higher capacity demand. With regard to other capacity—industry and power plants—GTS develops the network on the basis of contracted or expected capacities. For the coming five years, underlying contracts give a good idea of demand for transport capacity, which means that the estimate has a high degree of certainty.

The NOP process tests whether the available transport capacity is sufficient to provide the needed entry and exit to the market for the longer term, more than five years ahead. Over this period, a widening divergence of needs may have to be covered (see Appendix Figure VI--2 below). Accordingly, the basis for the analyses is a set of three extreme but realistic demand scenarios. This way of working minimizes the risk that a transport situation will appear that is not covered by the available transport system. If more capacity is needed cost effective measures are developed.

Appendix Figure VI-2 Exit capacity estimates (excluding storage fill)



Evaluation of bottlenecks as described in the 2013 KCD

High-pressure transport network bottlenecks

2013 KCD: The bottleneck relating to the integration of Groet Oost had already been highlighted by previous analyses. An operational solution consisting of a possible pipeline switch within GTS, agreement with the producer and the completion of a small alteration to the Beverwijk mixing station was to limit the duration and extent of the bottleneck.

Evaluation: a regulator was placed at the Beverwijk mixing station allowing the full integration of Groet Oost. This minor measure was implemented at the end of 2014.

2013 KCD: The bottleneck relating to the transport of high calorific gas from the north-east of the Netherlands to the north-west of the Netherlands arises from the decline in small field production (entry) and the introduction of exit capacity in this region (Bergermeer and the BBL), together with the increased need for quality conversion (Wieringermeer mixing station) due to the predicted decline in Groningen production. Closer analysis indicated that more pipelines would have to be laid and come into use around 2018 / 2019.

Evaluation: closer analysis, looking into the extent of the potential problem, the likelihood of it occurring and the consequences for gas transport requirements, shows that the current situation is acceptable, contrary to what was indicated in 2013. No investment was made and none is planned.

Regional transport network bottlenecks

2013 KCD: One gas receiving station is starting to run short of sufficient heating capacity to meet its forecast needs. This bottleneck will arise from 2013 onwards. It is a known bottleneck, but remained within margins in previous bottleneck analyses. A heating boiler is to be installed to resolve the bottleneck.

Evaluation: the heating boiler has now been installed and taken into use.

2013 KCD: An increase in the forecasts for the region around Dinteloord leads to bottlenecks for six gas receiving stations. A study has begun to deal with them.

Evaluation: the capacity of the regional transport network is to be increased by making a pipeline in the high-pressure transport system suitable for use in this network, and laying a new small-diameter pipeline to resolve the bottlenecks. The measures have now been taken and the installations came into service in early 2015.

Appendix VII: Capacity of border stations 2015 - 2034

In the table below the capacity in GWh/h at the GTS border stations is shown, the reference date is January 1st of each year. Actual data, also for other dates within a gas year, can be found on the GTS website: http://www.gasunietransportservices.nl/en/transportinformation/dataport

Conform the booking method of GTS the L-gas exit interconnection points at Winterswijk and Zevenaar have been clustered in the table. The same counts for the L-gas exit interconnection points at Oude Statenzijl. There are technical limitations to the possibilities to book any capacity within the cluster capacity at the interconnection points. For that reason the decrease of L-gas export from the Netherlands to Germany is divided equally (relative to the capacity of these interconnection points) over the interconnection points within the cluster.

Part One: 2015 - 2024 Capacity border stations in GWh/h

NAME LOCATION	NWP	FLOW	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Epe (DE) (Eneco) / Enschede (NL)	301397	entry	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9
		exit	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Epe (DE) (Essent) / Enschede (NL)	301198	entry	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9
		exit	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Epe (DE) (Nuon) / Enschede (NL)	301309	entry	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9
		exit	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Etzel (DE) (Crystal) / Oude Statenzijl (NLStatenzijl (NL)	301400	entry	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
		exit	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Etzel (DE) (EKB) / Oude Statenzijl Etzel (NL)	301360	entry	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3
		exit	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Etzel (DE) (OMV) Freya / Oude Statenzijl Etzel	301401	entry	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
		exit	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Jemgum (DE) (astora) / Oude Statenzijl (NL)	301391	entry	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
		exit	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2
Jemgum (DE) (EWE) / Oude Statenzijl (NL)	301453	entry	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
		exit	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2
Nüttermoor (DE) (EWE) H / Oude Statenzijl (H) (NL)	301361	entry	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
		exit	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Nüttermoor (DE) (EWE) Renato / Oude Statenzijl (NL)	301185	entry	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
		exit	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Vlieghuis (NL) / Kalle (DE) (RWE)	301276	entry	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
		exit	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Emden (EPT1) (Emden (EPT1) (GTS)	301113	entry	20.8	20.8	20.8	20.8	20.8	20.8	20.8	20.8	20.8	20.8
		exit	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Emden (NPT) (Emden (NPT) (GTS)	301112	entry	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0
		exit	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bocholtz	300139	entry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		exit	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0
Bocholtz-Vetschau	301368	entry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		exit	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7
Bunde (DE) / Oude Statenzijl (H) (NL) (GASCADE)	300147	entry	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5
		exit	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5
Bunde (DE) / Oude Statenzijl (H) (NL) (GUD)	300146	entry	3.3	3.3	3.3	3.3	11.8	11.8	11.8	11.8	11.8	11.8
		exit	10.2	10.2	10.2	10.2	13.7	13.7	13.7	13.7	13.7	13.7

NAME LOCATION	NWP	FLOW	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Bunde (DE) / Oude Statenzijl (H) (NL) I (OGE)	300145	entry	23.2	23.2	23.2	23.2	23.2	23.2	23.2	23.2	23.2	23.2
		exit	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4
Dinxperlo	300140	entry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		exit	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Haanrade	300141	entry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		exit	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Julianadorp (GTS) /Balgzand (BBL)	301214	entry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		exit	23.9	23.9	23.9	23.9	23.9	23.9	23.9	23.9	23.9	23.9
Poppel (BE) // Hilvarenbeek (NL)	300131	entry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		exit	27.2	27.7	27.7	27.7	27.7	24.8	24.8	24.8	24.8	24.8
's Gravenvoeren Dilsen (BE) / 's Gravenvoeren/Obbicht (NL)	300143	entry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		exit	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4
Tegelen	300138	entry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		exit	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Vlieghuis	300142	entry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		exit	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Zandvliet H-gas	301184	entry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		exit	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Zelzate	301111	entry	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8
		exit	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3
GATE Terminal (I)	301345	entry	17.0	17.0	17.0	17.0	17.0	22.6	22.6	22.6	22.6	22.6
		exit	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cluster Emden-OSZ (H)		entry	63.2	63.2	63.2	63.2	71.7	71.7	71.7	71.7	71.7	71.7
		exit	7.5	7.5	7.5	7.5	11.0	11.0	11.0	11.0	11.0	11.0
Cluster OSZ (L)		entry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		exit	14.9	15.1	12.8	14.0	12.7	10.3	9.2	8.2	7.2	6.2
Cluster Winterswijk/Zevenaar		entry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		exit	40.3	42.8	42.0	43.6	40.7	37.5	33.7	30.0	26.2	22.5

Part Two: 2025 - 2034 Capacity border stations in GWh/h

NAME LOCATION	NWP	FLOW	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Epe (DE) (Eneco) / Enschede (NL)	301397	entry	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9
		exit	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Epe (DE) (Essent) / Enschede (NL)	301198	entry	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9
		exit	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Epe (DE) (Nuon) / Enschede (NL)	301309	entry	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9
		exit	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Etzel (DE) (Crystal) / Oude Statenzijl (NLStatenzijl (NL)	301400	entry	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
		exit	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Etzel (DE) (EKB) / Oude Statenzijl Etzel (NL)	301360	entry	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3
		exit	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Etzel (DE) (OMV) Freya / Oude Statenzijl Etzel	301401	entry	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
		exit	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Jemgum (DE) (astora) / Oude Statenzijl (NL)	301391	entry	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
		exit	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2
Jemgum (DE) (EWE) / Oude Statenzijl (NL)	301453	entry	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
		exit	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2
Nüttermoor (DE) (EWE) H / Oude Statenzijl (H) (NL)	301361	entry	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
		exit	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Nüttermoor (DE) (EWE) Renato / Oude Statenzijl (NL)	301185	entry	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
		exit	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Vlieghuis (NL) / Kalle (DE) (RWE)	301276	entry	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
		exit	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Emden (EPT1) (Emden (EPT1) (GTS)	301113	entry	20.8	20.8	20.8	20.8	20.8	20.8	20.8	20.8	20.8	20.8
		exit	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Emden (NPT) (Emden (NPT) (GTS)	301112	entry	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0
		exit	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bocholtz	300139	entry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		exit	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0
Bocholtz-Vetschau	301368	entry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		exit	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7
Bunde (DE) / Oude Statenzijl (H) (NL) (GASCADE)	300147	entry	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5
		exit	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5
Bunde (DE) / Oude Statenzijl (H) (NL) (GUD)	300146	entry	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8
		exit	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7
Bunde (DE) / Oude Statenzijl (H) (NL) I (OGE)	300145	entry	23.2	23.2	23.2	23.2	23.2	23.2	23.2	23.2	23.2	23.2
		exit	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4
Dinxperlo	300140	entry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		exit	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Haanrade	300141	entry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		exit	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Julianadorp (GTS) /Balgzand (BBL)	301214	entry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		exit	23.9	23.9	23.9	23.9	23.9	23.9	23.9	23.9	23.9	23.9
Poppel (BE) // Hilvarenbeek (NL)	300131	entry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		exit	21.1	17.4	13.6	9.9	6.2	2.5	0.0	0.0	0.0	0.0
's Gravenvoeren Dilsen (BE) / 's Gravenvoeren/Obbicht (NL)	300143	entry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		exit	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4
Tegelen	300138	entry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		exit	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2

NAME LOCATION	NWP	FLOW	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Vlieghuis	300142	entry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		exit	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Zandvliet H-gas	301184	entry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		exit	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Zelzate	301111	entry	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8
		exit	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3
GATE Terminal (I)	301345	entry	22.6	22.6	22.6	22.6	22.6	22.6	22.6	22.6	22.6	22.6
		exit	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cluster Emden-OSZ (H)		entry	71.7	71.7	71.7	71.7	71.7	71.7	71.7	71.7	71.7	71.7
		exit	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0
Cluster OSZ (L)		entry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		exit	5.1	4.1	3.1	2.1	1.0	0.0	0.0	0.0	0.0	0.0
Cluster Winterswijk/Zevenaar		entry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		exit	18.7	15.0	11.2	7.5	3.7	0.0	0.0	0.0	0.0	0.0

Appendix VIII: Demand and Supply Tables

The demand and supply tables for north-west Europe and the Netherlands that were used in the scenario analysis for the NOP can be found on the GTS website at:
http://www.gasunietransportservices.nl/en/transportinformation/nop-2015-2035.

Appendix IX: Glossary and Abbreviations

Abbreviation	Description	Explanation/Reference
ACER	Agency for the Cooperation of Energy Regulators	The overall mission of ACER as stated in its founding regulation is to complement and coordinate the work of national energy regulators at EU level and work towards the completion of the single EU energy market for electricity and natural gas. Source: http://www.acer.europa.eu/The_agency/Mission_and_Objectives/Pages/default.aspx
ACM	Authority for Consumers and Markets	Dutch regulator Source: www.acm.nl/en/
ASTORA		SSO operating in Germany and the Netherlands. Source: http://www.astora.de/en.html
Average year		Average temperature of a year in which the number of "graaddagen" (heating degree days) conform the CBS definition has an average value. GTS has chosen for 2011, a year that on European level was average. Source: http://statline.cbs.nl/StatWeb/publication/?VW=T&DM=SLN-L&PA=80182NED&LA=NL
Biogas		Biogas is gas produced from renewable biomass. The quality of biogas is not suitable for direct injection for transportation in the G-gas and H-gas grids
Capacity credit		The part of the installed capacity for solar or wind that can be considered as reliably available in peak conditions
CBS	Centraal Bureau voor de Statistiek (Statistics Netherlands)	Dutch CBS is responsible for collecting and processing data in order to publish statistics to be used in practice, by policymakers and for scientific research. Source: http://www.cbs.nl/en-GB/menu/home/default.htm
CHP	Combined heat and power	Use of a gas-fired heat engine to simultaneously generate electricity and useful heat
CO_2	Carbon dioxide	
Cold year		Average temperature of a year in which the number of "graaddagen" (heating degree days) conform the CBS definition has a high value. GTS has chosen for 1956, a year that on European level was cold. Source: http://statline.cbs.nl/StatWeb/publication/?VW=T&DM=SLN-L&PA=80182NED&LA=NL

Abbreviation	Description	Explanation/Reference
EC	European Commission	The European Commission (EC) is the executive body of the EU responsible for proposing legislation, implementing decisions, upholding the EU treaties and managing the day-to-day business of the EU. Source: http://ec.europa.eu/index_en.htm
ENGIE		Shipper in the GTS grid (former GdF Suez). Source: http://www.engie.com/en/
ENTSO-E	European Network of Transmission System Operators for electricity	The mission of ENTSO-E is to fulfil its various legal mandates for the benefit of electricity customers, and to leverage its mandated work products to shape future energy policy for the benefit of society. Source: https://www.entsoe.eu/about-entso-e/inside-entso-e/mission-and-vision/Pages/default.aspx
ENTSOG	European Network of Transmission System Operators for Gas	The role of ENTSOG is to facilitate and enhance cooperation between national gas TSOs across Europe in order to ensure the development of a pan-European transmission system in line with European Union energy goals. Source: www.entsog.eu/mission
EU-28		Refers to the 28 member states of the European Union (EU)
FCFS	First come, first served	Service policy whereby the binding booking requests of shippers are attended to in the order that they arrived, without other biases or preferences.
FNB	Fernleitungsnetzbetreiber	The association of transmission system operators, i.e. the operators of the major supra-regional and cross border gas pipelines in Germany. Source: www.fnb.de/en
G-gas	Low calorific gas, produced by the Groningen fields.	G-gas is used in Dutch gas appliances for households and part of the Dutch industry. Source: https://zoek.officielebekendmakingen.nl/stcrt-2014-20452.html
G-gas grid		Part of the physical GTS grid which transports G-gas (and L-gas)
Gas day		A Gas day refers to the 24 hours period from 06:00:00 until 05:59:59 local time on the following day.
Gas year		A Gas Year refers to the Gas Days of the 12-month period from 1 October of a particular calendar year and ending on 30 September of the following calendar year. The title of the Gas Year always refers to the year in which the contract commences. For example, Gas Year 2015 starts on 1 October 2015.

Abbreviation	Description	Explanation/Reference
GASSCO		GASSCO is the operator for the integrated system for transporting gas from the Norwegian continental shelf to other European countries. Source: https://www.gassco.no/en/
GasTerra		Shipper in the GTS grid. Source: http://www.gasterra.nl/en/homepage
GATE	Gas Access to Europe	LNG Terminal, located on the Maasvlakte Rotterdam, operated by GATE. Source: http://gate.nl/en/home.html
GHG	Greenhouse gas	The primary greenhouse gases in the earth's atmosphere are water vapour, carbon dioxide, methane, nitrous oxide, and ozone. Greenhouse gases greatly affect the temperature of the Earth.
Green gas		Green gas is a gas, produced from renewable biomass (i.e. biogas), with a quality adjusted to natural gas and which can be transported in the G-gas or H-gas grid
GRIP	Gas Regional Investment Plan	Regional investment plan prepared by ENTSOG. Source: http://www.entsog.eu/publications/gas-regional-investment-plan-grips#NORTH-WEST
GSE	Gas Storage Europe	GSE is part of the Gas Infrastructure Europe (GIE) - the European association of the transmission, storage and LNG terminal operators. GSE represents the interests of storage system operators vis-à-vis the European Commission, the regulators and other stakeholders. Source: http://www.gie.eu/
GTS	Gasunie Transport Services	Dutch TSO for gas transport Source: http://www.gasunietransport-services.nl/
GUD	Gasunie Deutschland	German TSO for gas transport Source: http://www.gasunie.de/en/gasuniede
GWh/h	Gigawatt hour per hour	Unit for gas capacity
H-gas	High calorific gas	H-gas is used in Dutch industry, for QC and for transit. Source: https://zoek.officielebekendmakingen.nl/stcrt-2014-20452.html
H-gas grid		Part of the physical GTS grid which transports H-gas
HTL	Hoofdtransport leidingnet (the high pressure grid)	Part of the G-gas grid and H-gas grid being operated on 40-80 bar

Abbreviation	Description	Explanation/Reference
Hybrid heat pumps		A hybrid heat pump is a combination of an electric heat pump with a condensing boiler. Under normal conditions, heat will be provided by the heat pump alone. Under more severe conditions, when heat pumps have a lower efficiency, the condensing boiler acts as a secondary heater. Switching can also be done for economic reasons (relative electricity and gas prices) or to reduce peak power demand.
IEA	International Energy Agency	The IEA is an autonomous organization which works to ensure reliable, affordable and clean energy for its 29 member countries and beyond. Source: http://www.iea.org/
IHS CERA	IHS Cambridge Energy Research Associates	A consulting company that specializes in advising governments and private companies on energy markets, geopolitics, industry trends, and strategy. Source: https://www.ihs.com/industry/energy-services.html
IOS-NL	Integrated Open Season (Dutch part)	GTS and GUD have conducted an Integrated Open Season (IOS). IOS-NL was initialised at the end of 2008 and measures were completed by 1st of October 2014.
KCD	Kwaliteits en capaciteits document (Quality and capacity document)	Formal document to be published bi-annually by GTS.
L-gas	Low calorific gas	L-gas is used for export to Germany, Belgium and France . Source: https://zoek.officielebekendmakingen.nl/stcrt-2014-20452.html
LNG	Liquefied Natural Gas	
Load factor		Average hourly demand for gas divided by the peak hourly demand.
NAM	Nederlandse Aardolie Maatschappij	NAM explores for and produces oil and gas onshore and offshore in the Netherlands. Source: https://www.nam.nl/en/about-nam.html
National Grid		TSO in the UK for gas and electricity transport. Source: http://www2.nationalgrid.com/uk/
NBP	National Balancing Point	UK gas hub
NNO	Neighbouring Network Operator	Transmission system operators in countries neighbouring the Netherlands, onshore or offshore
NOGEPA	Netherlands Oil and Gas Exploration and Production Association (Nederlandse Olie en Gas Exploratie en Productie Associatie)	NOGEPA represents the interests of businesses with licences to explore for or produce oil and gas in the Netherlands. Source: http://www.nogepa.nl/en-us/
NOP	In Dutch: Netwerk Ontwikkelingsplan, in English: Network Development Plan	This report

Abbreviation	Description	Explanation/Reference
NWE-8	North-west Europe - 8	North-west Europe in this report includes eight countries: the Netherlands, Belgium, Luxembourg, Germany, Denmark, the UK, Ireland and France.
OGE	Open Grid Europe	German TSO for gas transport Source: https://www.open-grid-europe.com/cps/rde/xchg/open-grid-europe-internet/hs.xsl/home.htm?rdeLocaleAttr=en
Open season		Open season procedure is an instrument that has been used by GTS for determining market demand for development of transmission networks and for providing long-term transmission capacity to shippers
PCI	Projects of Common Interest	Infrastructure projects which have been identified as helping to create an integrated EU energy market. Source: https://ec.europa.eu/energy/en/topics/infrastructure/projects-common-interest
PE	Propane equivalent	PE is determined by the heavier hydrocarbons (such as ethane and propane). PE for low-calorific gas is lower than 5 to prevent incomplete combustion
PGI Alkmaar	Peak Gas Installation Alkmaar	Underground natural gas reservoir used to store and deliver natural gas to meet peak demand from the Dutch national grid. TAQA is the operator of PGI Alkmaar. Source: http://www.taqaglobal.com/our-regions/netherlands/overview?sc_lang=en
PRISMA		PRISMA is the platform for European gas capacity booking. PRISMA offers shippers the possibility to book primary and secondary capacities directly from various European transmission system operators through one single tool. Source: https://www.prisma-capacity.eu/web/start/
QC	Quality conversion	Blending of H-gas and nitrogen to G-gas quality
RES	Renewable Energy Source	Wind, solar, biomass, hydropower and geothermal
RTL	Regionale transport leidingnet (low pressure grid)	Part of the G-gas grid and H-gas grid being operated on 8 - 40 bar
RWE Gasspeicher		SSO operating in Germany and the Netherlands. Source: http://www.rwe.com/web/cms/en/531750/rwe-gasspeicher/
SER	Sociaal Economische Raad (Social and Economic Council of the Netherlands)	The SER advises the Dutch government and parliament on the outlines of social and economic policy and on important legislation on social and economic issues. Source: https://www.ser.nl/en/

Abbreviation	Description	Explanation/Reference
Shale gas		Shale gas is natural gas that is found trapped within shale formations
Small Fields		Dutch gas fields other than the Groningen field
SODM	Staatstoezicht op de Mijnen	Dutch agency for State Supervision of Mines. Source: http://www.sodm.nl/english
Solar PV	Solar photovoltaic	A power system designed to supply usable solar power by photovoltaic means
SSO	Storage System Operator	
TAQA		In NOP context: SSO for PGI Alkmaar and Bergermeer. Source: http://www.taqaglobal.com/our-regions/netherlands/overview?sc_lang=en
TenneT		Dutch and German TSO for electricity transport. Source: http://www.tennet.eu/nl/en/home.html
Thyssengas		German TSO for gas transport Source: http://www.thyssengas.com/en/
TSO	Transmission system operator	
TTF	Title Transfer Facility	Dutch gas hub Source: http://www.gasunietransport-services.nl/en/transportinformation/ttf-volume-development
TWh/year	Terawatt hour per year	Unit for gas volume on an annual basis.
TYNDP	Ten Year Network Development Plan	Europe-wide network development plan prepared by ENTSOG. Source: http://www.entsog.eu/publications/tyndp
UGS	Underground storage	An UGS facility is enable to smooth out seasonal fluctuations in gas demand and/or reduce peak loads and/or provide for flexibility and reliability of gas supply.
UK	United Kingdom	
USA	United States of America	
VEMW	Vereniging voor Energie, Milieu en Water	Representative organization for industrial gas users. Source: http://www.vemw.nl/#
VGN	Vereniging Gasopslag Nederland	Representative organization for SSO's operating in the GTS grid. Source: http://www.gasopslagneder-land.nl/en
VZG	Voorzieningszekerheid gas (Security of supply)	Formal document about security of supply to be created on an annual basis by GTS and to be submitted to the European Commission by the Dutch Ministry of Economic Affairs.

Abbreviation	Description	Explanation/Reference
WINGAS		Shipper in Germany and the GTS grid. Source: https://www.wingas.com/en.html
WMO	World Meteorological Organization	The WMO is a specialized agency of the United Nations. It is the UN system's authoritative voice on the state and behaviour of the Earth's atmosphere, its interaction with the oceans, the climate it produces and the resulting distribution of water resources. Source: https://www.wmo.int/pages/index_en.html
Wobbe index		Wobbe index is an indicator of the interchangeability of fuel gases such as natural gas
ZEELINK		A proposed German pipeline. Source: http://www.fnb-gas.de/en

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