gasunie
transport services

Draft GTS investment plan for 2022 - 2032

1 November 2021

Foreword

We present to you our draft 2022 Investment Plan. In this new draft investment plan – the second to be published by GTS – we provide an up-to-date overall view of all planned expansion and replacement investments. We also look back at the 2020 investment plan and explain variances where necessary.

Although it has only been just over a year since we finalised the 2020 investment plan, this new draft investment plan is a valuable document for us. Developments in the Dutch energy market are moving quickly, if possible even faster than was the case two years ago. With the closure of the Groningen field quickly approaching, it is becoming increasingly imperative to effectively safeguard the security of supply on the gas market. The energy transition is also gaining momentum, which means that it will become clearer in the coming years what contribution our network will make to this.

It is now clear that it will be possible to shut down the Groningen field for good in 2023 or 2024, provided that the Grijpskerk gas storage facility has been switched from the storage of high-calorific gas to low-calorific gas. GTS is adapting the connection of the gas storage facility accordingly.

The use of hydrogen as a sustainable energy carrier and feedstock will require the development of a national hydrogen transmission network over the coming years. Some pipelines that are currently part of GTS' natural gas network will eventually become part of this hydrogen network. In the midst of these developments, we still need to carry on maintaining and operating our network effectively in the coming years, and this will have our full attention.

I cordially invite you to read this draft investment plan and I look forward to your written response. We will process all responses in the final draft investment plan, which we will then submit to the Netherlands Authority for Consumers and Markets and the Ministry of Economic Affairs and Climate Policy before 1 January 2022.

Bart Jan Hoevers
Managing Director

Summary

Gasunie Transport Services (GTS) owns and operates the national gas grid in the Netherlands, meaning that we are responsible for the management, functioning and further development of the Dutch gas grid.

Under the Dutch Gas Act, GTS has a statutory duty to draw up a draft IP on a periodic basis. The draft IP gives a rundown of all intended expansion and replacement investments over the period, including the background and supporting information. To comply with the law, the draft IP must cover three elements: developments in the energy market, a bottleneck analysis to identify capacity and quality bottlenecks, and the details of the investments.

The draft IP will be submitted to the Dutch Ministry of Economic Affairs and Climate Policy and the Netherlands Authority for Consumers and Markets (ACM) for inspection. Investments to meet a need established through another process, such as investments required to connect small fields to the network or facilitate incremental capacity, are outside the scope of this draft IP.

Developments in the energy market

The basis for the scenarios in this draft IP is the climate agreement concluded on 28 June 2019 between the Dutch government and various market parties and civil society organisations (the 'Dutch Climate Agreement', or DCA). This climate agreement aims to reduce greenhouse gas emissions by 49% in 2030 compared to 1990. Where relevant, the results of the calculations made by PBL Netherlands Environmental Assessment Agency in November 2019 relating to the DCA have also been included in the quantification. In addition to the DCA scenario, two flanking scenarios have been drawn up: the National Driver (ND) and International Ambition (IA) scenarios. These two flanking scenarios have been defined in alignment with the final visions of the Comprehensive Infrastructure Survey for 2030-2050 (II3050), as also illustrated in Figure 0.1.

FIGURE 0.1. SUMMARY OF THE DIFFERENT SCENARIOS

Dutch Climate Agreement (DCA)	National Driver (ND)	International Ambition (IA)
• CO_2 for 2030 probably not reached target • Expansion of solar PV and wind capacity • Mix of heating technologies in the built environment • Increase in EVs and FCEVs • Limited P2H in industry • 2 bcm green gas • 3.5 GW electrolysis • 7MT CCS	• CO_2 reduction> 49% • Targets energy autonomy in the long term • Even more solar PV and wind (in line with RESs) • More circularity and energy savings • Focus on all-electric heat pumps • More EVs, fewer FCEVs • Further system integration via P2G and P2H • Limited CCS	• CO_2 reduction> 49% • Import dependency continues • Less solar PV, more green gas • Growth in industry, there appears to be room for CHP • Focus on hybrid applications • Fewer EVs, more gas in heavy transport • Growth of H_2 (mainly blue and import) • More CCS (10MT)

The main conclusion to draw from the scenarios is that transmission volumes will decrease through to approximately 2025 due to falling exports of low-calorific gas (L-gas) to Germany, Belgium and France. In these three countries, end users of L-gas will be switched to high-calorific gas (H-gas) over the coming ten years, eventually reducing L-gas exports to zero. Next to that gas demand in the Netherlands and neighbouring countries will decline over the period covered by the analysis. From 2025 onwards, L-gas export flows will partly be replaced by additional H-gas transit flows. At the same time, transmission capacity will decrease less rapidly than transmission volumes.

Given that production in the Netherlands will be phased out at a slower rate than the decline in domestic gas demand in the Netherlands, it is evident that additional gas imports will be needed to compensate for cessation of production from the Groningen field. The additional imports are expected to be filled by Russian gas (via Germany) or LNG (via Gate Terminal and/or Belgium). Analyses show that this additional volume is available in Europe.

The market mechanism

GTS approaches matters such as security of supply and a well-functioning gas market from an infrastructure perspective. Analyses show that security of supply will require continued availability of seasonal L-gas storage facilities through to 2030 at least. Furthermore, additional imported H-gas will need to be supplied. It is important for GTS, being the advisory authority on security of supply for the L-gas market, that this point be stressed.

With regard to the H-gas supply capacity, the German Gas Network Development Plan 2020–2030 (Netzentwicklungsplan) takes into account the security of supply in the Netherlands by investing in additional transport capacity between Germany and the Netherlands. This addresses a possible bottleneck.

The L-gas storage facilities will be well filled at the start of the 2021/2022 gas year as a result of agreements made via the Gasgebouw joint venture. In the calculations for the security of supply for the L-gas market, we have assumed that sufficient H-gas is available (via Dutch small-field production, import, LNG) to convert into pseudo G-gas. For this reason, the H-gas storage facilities are not included in the market supply for the L-gas market.

The seasonal H-gas storage facilities are needed in the winter to supply industry and power stations, meaning there will not be sufficient H-gas capacity via small fields, import and LNG to supply the entire market. With this in mind, when GTS presented its half-year report in mid-2021, we drew attention at that time already to the low occupancy rate of the H-gas seasonal storage facilities at the start of the 2021/2022 gas year.

Our current estimate is that sufficient infrastructure is available to meet current and future needs (supply capacity, storage facilities, QC capacity), but it is the responsibility of the market parties to supply sufficient gas to the Dutch gas market on time to fill the storage facilities (which must be done in the summer). In other words, once this gas can no longer be sourced from the Groningen gas field, it will be even more important that all market parties accept this responsibility.

The phasing out of production from the Groningen field is progressing as planned. For the 2021/2022 gas year, only 3.9bcm is needed for an average winter. After completion of our new nitrogen installation (2022), regular production from Groningen will be zero. Once the Grijpskerk H-gas storage facility has been repurposed to store L-gas and has been sufficiently filled with L-gas, Groningen will no longer be needed as a back-up source and the field can be closed for good.

On 1 October 2021, the consolidation of the German market became a reality when GASPOOL and NCG merged to form Trading Hub Europe (THE), leaving Germany with one single market area. Since the consolidation, the TTF market area has been connected to THE. One consequence of the consolidation is that the existing H-gas and L-gas VIPs will be merged into the new H-gas and L-gas VIPs that will be created between TTF and THE. GTS will transfer all current VIP capacity contracts to the corresponding new VIP.

This has already been done for the old L-gas VIPs. The German TSOs have stated that they need more time to merge the H-gas VIPs. It is currently expected that this category will be converted as of 1 April 2022; until then, the existing H-gas VIPs with Germany will remain in place.

Thanks to the solid infrastructure, the TTF not only serves the Netherlands, but also the surrounding countries. For example, the volume traded on the TTF in 2020 was more than 20 times the gas consumption in France, Germany, Austria, the Czech Republic and the Benelux combined. About 75% of the volume of gas traded in Europe now bears a TTF label. The TTF is also increasingly becoming a global gas marker and appears to be developing into the 'Brent Crude' of the gas market. EU reserves are dwindling, further increasing the need for imports. Despite the fact that the once enormous level of production from the Groningen field has been cut back severely, the European gas market continues to function excellently. TTF currently plays an important role in this and will continue to do so in the coming years.

It is expected that in the course of 2023 the current Gas Act will be replaced by the Dutch Energy Act, which brings together the Gas Act and the Electricity Act into one piece of legislation. The reason for integrating the Gas Act and the Electricity Act 1998 is the anticipated increasingly extensive integration of energy systems. The Energy Act serves to implement the new EU regulation on the internal market for electricity, but also gives substance to national policy objectives, like those stated in the Dutch Climate Agreement. Although the changes are less drastic for gas than for electricity, the Energy Act will nevertheless have noticeable consequences for gas network users and gas network operators. For example, the term 'programme-responsible party' will be replaced by 'balance-responsible party'. The Energy Act is expected to offer network operators the option of taking in biogas and hydrogen gas, provided that this can be blended to the correct delivery specifications for natural gas.

Hydrogen

GTS foresees a growing role for hydrogen as a sustainable energy carrier and feedstock. Existing natural gas pipelines can eventually be repurposed for the transmission of hydrogen and this way be given a second life. Towards the summer of 2021, in collaboration with relevant stakeholders the Ministry of Economic Affairs and Climate Policy completed the Hyway2740 project, which details the possible use of the existing natural gas pipelines for hydrogen. The State Secretary for Economic Affairs and Climate Policy stated in a letter to parliament[1] that she will ask Gasunie to take on the task of developing a national hydrogen transmission network.

The hydrogen transmission network is ultimately expected to consist largely (about 85%) of repurposed natural gas pipelines. These pipelines are currently part of the GTS natural gas network. Research has shown that the pipelines can be technically modified in such a way as to enable the safe transmission of hydrogen.

Bottleneck assessments

GTS checks for three potential bottlenecks: capacity bottlenecks, quality bottlenecks, and IT bottlenecks. Capacity bottlenecks are determined using pressure drop calculations based on the identified scenarios; this has revealed that there are no capacity bottlenecks. Quality bottlenecks prompt replacement investments and are identified through risk analyses or findings during management and maintenance work. This concerns bottlenecks that contravene one or more of the company's values or are required under legislation and regulations. Bottlenecks are prioritised based on a risk assessment, while also taking feasibility into account. The prioritisation method is specified in the quality assurance system (QAS). Replacements necessitated as a result of external reasons, such as planning developments, are also classed as replacement investments. Most future investments are prompted by quality bottlenecks. IT bottlenecks mainly arise as the result of new statutory duties/obligations, end of support by suppliers (giving rise to cybersecurity and continuity risks), replacement parts no longer being available, or too little knowledge concerning a certain technology being available to be able to guarantee continuity.

1 *www.rijksoverheid.nl/documenten/kamerstukken/2021/06/30/kamerbrief-over-ontwikkeling-transportnet-voor-waterstof*

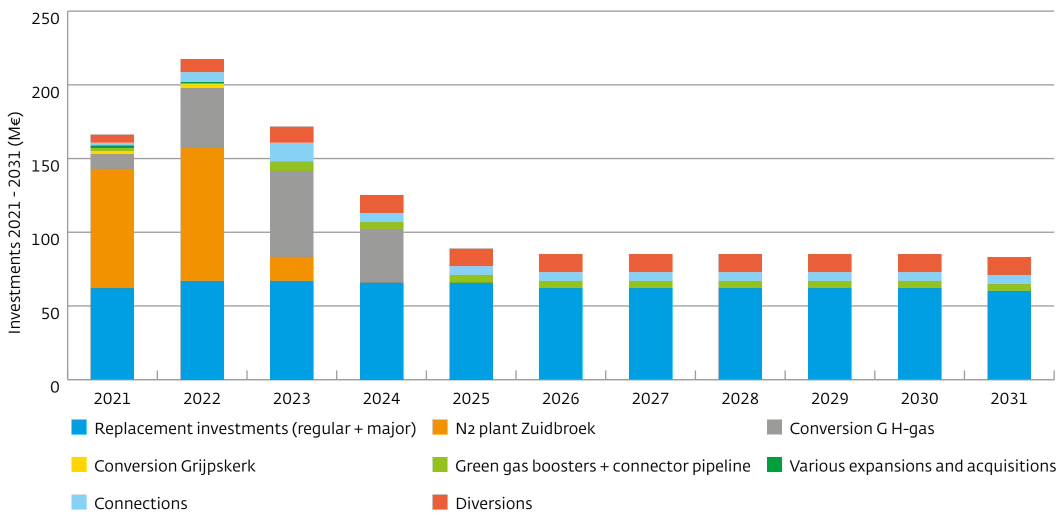
Total overview of GTS' investment portfolio

GTS' total investment portfolio can be divided into two periods, the first up to the end of 2023 and the second from 2024 to 2031.

In the period up to and including 2024, GTS' investment portfolio will be largely determined by measures to accelerate the phase-out of gas extraction from the Groningen field, i.e. the construction of the Zuidbroek nitrogen installation and switching large industrial consumers from G-gas to H-gas. Investments over the period between 2022 and 2024 will amount to between approximately € 125 and € 218 million per year. Total investments in 2022 amount to € 151 million and to € 116 million in 2023.

From 2024 onwards, as the Groningen measures are set to be completed, the total annual investment level is expected to fall sharply to approximately € 85 million, which is the normal level needed to maintain the transmission network, through to 2031. At this point, no additional investments are deemed necessary for the period starting in 2024, other than investments in measures for the energy transition (green gas) and footprint reduction.

Figure 0.2. Total investments 2021-2031.



Contents

Introduction

Gasunie Transport Services (GTS) owns and operates the national gas grid in the Netherlands. Being the operator of the national gas grid, GTS is responsible for the management, functioning and further development of the Dutch gas grid. Other duties include connecting customers to the network, monitoring gas quality, balancing, gas intake from small fields, connections to other national and international networks, guaranteeing sufficient transmission capacity and public duties with respect to security of supply (including peak supply and emergency supply), and giving advice regarding estimates on required production/capacity of the Groningen gas field.

Mission

We deliver gas transport services in a customer-focused and transparent way. Safety, reliability, sustainability and cost-effectiveness are central in everything we do. We serve the public interest, and work as professionals to create value for our stakeholders.

Vision

We aim to be an organisation that best serves the market, responds flexibly to changes in its surroundings, enables new gas flows, facilitates the introduction of sustainable energy and thus plays a key role in the north-western European gas market.

To be able to continue to fulfil the above duties with the required level of quality, GTS needs to invest in the expansion and maintenance of the gas transmission network. This draft investment plan (draft IP) details the investments that we deem necessary.

Statutory basis

Under the Dutch Gas Act, GTS has a statutory duty to draw up a draft IP on a periodic basis. The draft IP gives a rundown of all intended expansion and replacement investments over the period, including the background and supporting information. To comply with the law, the draft IP must cover three elements: developments in the energy market, a bottleneck analysis to identify capacity and quality bottlenecks, and the details of the investments. The law goes on to state that the information concerning investments must be further broken down into three parts: a look back on the progress and realisation of investments scheduled to be carried out over the previous two years, a quantitative look ahead to the investments planned for the 2022-2026 period, and a qualitative look ahead to investments planned for the 2027-2031 period.

Further to the Dutch Gas Act, the Dutch government passed an Order in Council (the Decree) in 2018 and the Ministry of Economic Affairs and Climate Policy issued a ministerial regulation (the Regulation).[2] Both the Decree and the Regulation specify further rules concerning the investment plan. The main rule concerns the assessment of the draft IP: GTS must submit the draft IP to the Ministry of Economic Affairs and Climate Policy and the Authority for Consumers and Markets (ACM) for review. ACM assesses whether a network operator can in all reasonableness be deemed to have been able to put together the draft IP, while the Ministry of Economic Affairs and Climate Policy verifies whether GTS has rendered sufficient account on developments in the energy market. Both these assessments are made within 12 weeks of the date the draft IP is submitted.

GTS considers the draft IP to be a guiding document when it comes to assessing the necessity for investments by GTS. The manner in which capital costs (including those involved in new investments) are compensated is set out in the Method Decision. GTS only includes investments in this plan on the condition that GTS will be able to recover the efficient costs of these investments.

This draft IP is the plan drafted under the regulations. On approval, this IP will be valid for a period of two years, from 1 January 2022 to 31 December 2023, after which time GTS will submit a new draft IP to ACM and the Ministry on 1 January every other year (in even years). These subsequent investment plans will be valid for two years. Should significant changes occur in the interim, the IP may be revised through an addendum at any time.

In addition to the obligation to submit a draft IP every two years, GTS has been tasked by the Ministry of Economic Affairs and Climate Policy with drawing up an annual security of supply report. Given the overlap between the IP and the security of supply report, this draft IP meets both these statutory requirements. Two components of the security of supply report are not included in the draft IP, i.e. peak supply and emergency supply. To address this, these are discussed separately in Appendix V.

Scope

This draft IP covers the CAPEX investments for which a final investment decision (FID) will be made between 2022 and 2031. Investments to meet a need identified in another process, such as investments required to connect small fields to the network or facilitate incremental capacity, are outside the scope of this draft IP. The need for these investments is determined by national legislation or a European process. However, given that GTS wants to present its full investment portfolio, these investments are also included in our draft IP for information purposes.

2 *Dutch Ministry of Economic Affairs and Climate Policy: Regulation of the Minister of Economic Affairs and Climate Policy of 7 November 2018, No. WJZ/18038636, containing further rules on the investment plan and the quality assurance system of operators of electricity grids and gas transmission networks and on several other subjects (Regulation on the investment plan and quality of electricity and gas), 2018 (in Dutch).*
Bulletin of Acts and Decrees of the Kingdom of the Netherlands, 2018, 375: Decree of 16 October 2018 on investment plans of operators of electricity grids and gas transmission networks and on several other subjects (Decree on investment plan and quality of electricity and gas) 2018 (in Dutch).

Document arrangement

The first section of this draft IP explains the methodology and the second describes and explains the various scenarios. Section 3 expounds on developments on the gas market both inside and outside the Netherlands. Following this, the results of the bottleneck analysis are described in section 4. Section 5 then presents an overview of the required investments and, finally, section 6 details the progress of major investments and provides a retrospective of investments realised in 2020.

Coordination with other network operators

In September 2020, trade association Netbeheer Nederland, which represents Dutch TSOs and DSOs, launched an 'IP2022' project team with representatives from all grid operators. The project team was tasked with gaining a full picture, from the perspective of the grid operators collectively, of what is necessary and desirable in the IP. The joint findings were then discussed with and assessed by the Ministry of Economic Affairs and Climate Policy and regulatory authorities ACM and SSM.

In view of the uncertainties concerning future developments, the investment plans are reviewed, consulted and published every two years. The network operators are committed to making the investment plans increasingly concrete and transparent for stakeholders and the regulatory authorities. At the moment it is being explored how the drafting of IPs can be further developed and improved. Collaboration with stakeholders, data transparency and readability are topics that play a role in this.

Aside from that, GTS has, like in previous years, teamed up with TenneT and all the regional TSOs in developing three scenarios for the draft IP to provide a comprehensive picture of developments in the Dutch energy system. These scenarios were completed with data on import/export and transport/transmission flows from the 2020 Ten Year Network Development Plan (TYNDP) of the European Network of Transmission System Operators for Electricity (ENTSO-E) and the European Network of Transmission System Operators for Gas (ENTSOG). One of these scenarios, i.e. the Dutch Climate Agreement (DCA) scenario, is used as the reference scenario for all Dutch network operators.

Stakeholder involvement

GTS organised two information sessions for the various parties that operate in the energy market. The first information session about the process and the scenarios for the draft IP was held in the autumn of 2020, while the second focused on the investments and was held in the spring of 2021. Dutch legislation furthermore provides for a market consultation process that spans four weeks. The members of grid operators trade association Netbeheer Nederland have agreed to submit all draft IPs for consultation at the same time wherever possible, over the period from 1 to 30 November 2021. Feedback from these public consultations will be appended to this document.

1 Methodology

1.1 Process for composing the investment portfolio

This section describes the methodology used to compose and adopt the investment portfolio.

The investment portfolio is made up of three types of investments:

- expansion investments to increase the available capacity, acquisitions, and connections for new customers;
- replacement investments to maintain the quality/condition of the network and for pipeline rerouting, i.e. when a pipeline is moved to another location at the request of a third party, such as Rijkswaterstaat; and
- network-related investments, i.e. investments in IT systems.

As part of GTS' current investment portfolio process, GTS sets the budget required for year n+1 in mid-August of every year. Aside from that, data on current expansion and replacement investments is available for the period 2022 to 2026 inclusive. This data has been included in this draft IP.[3]

As a result of the above, GTS noted that the portfolio process for its technical and IT investments is not effectively aligned with the approval period under relevant legislation governing the draft IP. To align with the approval periods, GTS has brought forward the internal formation of the investment portfolio where possible.

For network-related investments, new investments in IT from 2022 will no longer be made by GTS, but by Gasunie. This is explained in more detail in section 5.4.

1.2 Based on scenarios

The development of scenarios roughly consists of two steps. This process starts with drawing up storylines, i.e. qualitative descriptions of what the world might look like in the future. An important criterion is that the storylines for the various scenarios must cover the most important uncertainties. This mainly concerns the uncertainties that are relevant for the development of the energy infrastructure. In the second step the storylines are quantified, meaning that the specifics of the supply and demand of energy (gas, electricity, etc.) are accurately determined and documented.

Storylines

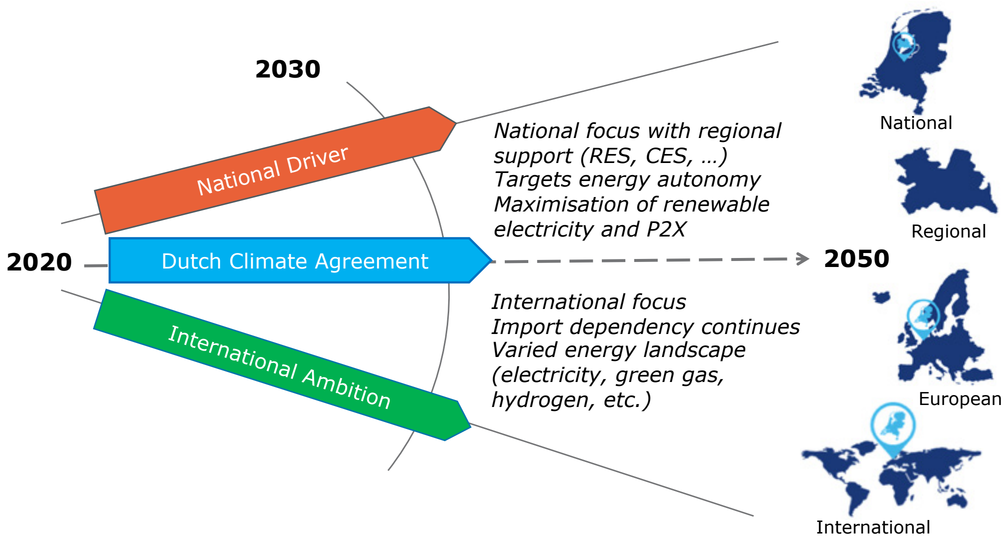
The scenarios drawn up are the result of intensive collaboration between national and regional grid operators. In April 2020, the various parties made a start on drawing up storylines and developing the various scenarios.

3 *See Section 5.1 General for a summary of the investment data that GTS has included in the draft IP.*

The basis for the scenarios in this draft IP is the climate agreement concluded on 28 June 2019 between the Dutch government and various market parties and civil society organisations (the 'Dutch Climate Agreement', or DCA).4 This climate agreement aims to reduce greenhouse gas emissions by 49% in 2030 compared to 1990. The implementation of the Dutch Climate Agreement will have a major impact on energy developments in the Netherlands in the period leading up to 2030. As such, the DCA has been used as a reference scenario (starting point), in which the measures described in the Dutch Climate Agreement have been taken as the starting point. Where relevant, the results of the calculations made by PBL Netherlands Environmental Assessment Agency in November 2019 relating to the DCA have also been included in the quantification.[5]

In addition to the Dutch Climate Agreement (DCA) scenario, two flanking scenarios have been drawn up: the National Driver (ND) and International Ambition (IA) scenarios. These two flanking scenarios have been defined in alignment with the final visions of the Integral Infrastructure Exploration 2030-2050 (II3050)[6], as also illustrated in Figure 1.1. In addition, where available information has been drawn from the Regional Energy Strategies (RESs) and included in this draft IP.[7] In anticipation of a further tightening of the emission reduction target for 2030, these two flanking scenarios assume an even higher level and more extensive scope of sustainability.[8] The three scenarios together reflect the key potential developments and uncertainties that affect the design of the grids.

Figure 1.1: Relationship between IP2022 and II3050 scenarios



4 www.klimaatakkoord.nl/documenten/publicaties/2019/06/28/klimaatakkoord
5 www.pbl.nl/publicaties/het-klimaatakkoord-effecten-en-aandachtspunten
6 www.netbeheernederland.nl/dossiers/toekomstscenarios-64
7 For more information, see https://www.regionale-energiestrategie.nl/default.aspx.
8 https://ec.europa.eu/commission/presscorner/detail/en/ip_20_1599

Quantification for the Netherlands

The three scenarios have been quantified for the Netherlands using the Energy Transition Model (ETM) developed by Quintel Intelligence.[9] Using the ETM, volume balances of annual demand for gas, electricity and other energy carriers like oil, coal, hydrogen and biomass were defined for each of the three scenarios. Where possible, external sources have been used to provide support for the assumptions used in the scenarios. Where a supporting external source was not available, the network operators used their own analyses to provide support for the assumptions applied. The data freeze date for the quantification of the scenario assumptions was 1 December 2020.

From this quantified data, TenneT subsequently assessed supply and demand in the electricity market on an hourly basis. RES information up to spring 2021 is included in this analysis, however. This analysis allowed TenneT to determine gas demand from power stations among other things, which has been included in this draft IP. GTS furthermore used the quantification to estimate peak gas capacity for end user sectors. When it comes to cross-border gas flows, this draft IP is based on supply and demand figures and flow simulations from the ENTSOG 2020 TYNDP.[10]

1.3 Based on bottlenecks

1.3.1 Bottleneck definition

This draft IP uses the definition of bottleneck as specified in Article 1.1 of the Regulation on the investment plan and quality of electricity and gas (hereinafter: the Regulation), i.e. '... parts of the grid or gas transmission network that are expected to pose a considerable risk to the adequate fulfilment of the duties assigned to the network operator by or under the Dutch Electricity Act of 1998 or the Dutch Gas Act'. GTS uses three definitions for 'considerable risk', one for capacity bottlenecks, one for quality bottlenecks, and one for IT bottlenecks:

- In the case of a capacity bottleneck, 'considerable risk' is defined as a situation ensuing from one or multiple pressure drop calculations (as specified in section 1.3.2 Capacity bottleneck identification), where the entry and/or exit capacity cannot be transported, while factoring in entry and exit specifications.
- In the case of a quality bottleneck, 'considerable risk' is defined as a breach of one or several of the company values, determined based on the combination of the frequency of occurrence of the unwanted event and the potential severity of the impact. This risk is measured in financial terms.

1.3.2 Identifying capacity bottlenecks

GTS has been tasked with facilitating the transmission of gas to consumers connected to the grid in an economically effective manner and, to make this possible, developing the national gas grid in a safe, efficient and reliable manner. Under EU regulations, GTS operates its network as a decoupled entry-exit system, which gives grid users the right (and freedom) to use the available capacities independently from each other, provided that gas quality and system balance are secured.

9 *https://energytransitionmodel.com/*
10 *www.entsog.eu/tyndp#entsog-ten-year-network-development-plan-2020*

Simultaneous combinations of entry and exit capacity may occur that generate a high level of activity on the grid. GTS sets up the network in such a way that it can accommodate these kinds of peak transmission situations, taking into account grid users' behaviour – realistically speaking – at entry and exit points, so as not to have to invest to cover unrealistic extremes. This approach makes it possible to set up the national gas transmission network in a targeted manner.

GTS conducts the bottleneck analysis based on forecasts of capacity at entry and exit points. These forecasts are based on current contracts and anticipated developments in these contracts.

Main gas grid and regional distribution network

GTS' network has two components. The high-pressure gas grid (HTL) transports gas over long distances and operates at pressures ranging from 40 to 80 bar, meaning that the HTL is used as a transit network for transmission from and to other countries, while also transporting gas to high-volume users such as large industrial companies and power stations. The regional distribution network (RTL) is made up of branches from the HTL that operate at pressures ranging from 8 to 40 bar. The RTL is the network that supplies directly to smaller industrial companies and distribution network operators that supply to the small users' market.

The HTL is split up into two networks, one for transmission of high-calorific gas and one for low-calorific gas (originally known as Slochteren gas). High-calorific gas can be converted into low-calorific gas at several points in the system by mixing different gases or adding nitrogen. The RTL distributes virtually exclusively low-calorific gas.

The largest gas flows and the most dynamic part of the entry-exit system are found in the HTL. The major import and export flows, industrial demand, the alternating filling of and withdrawal from storage facilities, and the mixing of different gas qualities all converge in the HTL. The HTL has long pipelines with large diameters of up to 48 inches, compressors to increase the pressure, and mixing stations to convert high-calorific gas to low-calorific gas by injecting nitrogen. The RTL is of an entirely different nature, as it accommodates smaller gas flows over average distances of only a few kilometres from the HTL to grid users. The RTL pipelines have smaller diameters (typically between 4 and 20 inches), while compressors and mixing stations are not needed due to the small transmission distances.

Capacity testing

Models are used to test network capacity. Given the differences between the HTL and the RTL, a different testing method is used for each network. However, what both have in common is that pressure drop calculations are made for the key extreme transmission situations for each of them. Pressure drop calculations are made using the Multi-Case Approach (MCA) tool.

Capacity testing for the HTL starts by generating a complete set of realistic heavy-load transmission situations in a certain forecast year. These situations are based on a broad range of possible circumstances (summer versus winter, high and low temperatures, technical outages at entries and exits, etc.), as well as on relevant combinations of expected entries and exits. Owing to the temperature dependence of part of the demand, calculations for each month are based on the lowest possible temperature that can occur in that month (as shown by weather and climate analyses). In addition, the following parameters are used in the analyses: the risk of technical unavailability of major supply points; behaviour of storage facilities; possible correlations between various entry and exit points; and the latest insights with respect to the phase-out of the Groningen field. In each of the forecast years for which calculations were made, this has led to roughly two hundred balanced entry and exit combinations that were tested for transmissibility by performing the associated pressure drop calculations. Tests are subsequently performed to assess transmissibility within the network's pressure and flow limits. If pressure remains under the minimum or the flow limit is exceeded at a point or in a pipeline during one or several of the tested transmission situations, this constitutes a capacity bottleneck.

Capacity testing on the RTL is based on an analysis of network load at the peak time of a day in January or February with an average effective 24-hour temperature of minus 17°C.[11] If transmission can be accommodated in these extreme conditions, there are no bottlenecks. This basically covers all reasonably possible transmission situations. Recent developments, such as green gas feed-in at specific points of the RTL, could lead to other types of bottlenecks.

The severity of any capacity bottleneck identified will be determined through a follow-up test. The criteria used are the expected frequency of occurrence and the degree by which the capacity limit is exceeded and/or pressure remains below the minimum. Some capacity bottlenecks can be solved by switching the network differently, for example by setting a valve or coupling piece differently (possibly temporarily). To eliminate larger capacity bottlenecks, more substantial measures may be needed, such as laying a new pipeline section, expanding a compressor station, building an entirely new station, or installing a new connection.

Especially in the HTL, but sometimes also in the RTL, the cause of a capacity bottleneck may be elsewhere in the network, i.e. not where the capacity limit is actually exceeded or where pressure actually stays below the minimum level. The location of a capacity bottleneck is generally not a good indicator for the place where it would be most efficient and effective to take measures.

11 *In accordance with Article 10a(1) of the Dutch Gas Act, GTS has a general duty to ensure security of supply. Article 10a(4) then refers to the Security of Supply (Gas Act) Decree, where Article 2(1) includes the peak delivery duty at a temperature of minus 17°C or higher.*

In the context of this draft IP, the bottleneck analysis was carried out for the three scenarios – Dutch Climate Agreement (DCA), National Driver (ND) and International Ambition (IA) – for the forecast years 2022, 2027 and 2032. It should be noted that these are 'gas years', which means that 2032, for example, runs from 1 October 2031 to 30 September 2032.

The methodology that GTS uses for capacity assessment is also described on the GTS website.

1.3.3 Identifying quality bottlenecks

GTS manages its operating assets based on the philosophy of risk-based asset management. This means that whenever a decision is needed on expenditure, the required outlay will be weighed against the level of risk mitigation that it would deliver. To simplify this comparison, risks are expressed in monetary terms, specifically the potential expenditure over a 25-year period expressed as a net present value. The discount rate used for that is calculated as follows:

Based on the failure frequency $\lambda\,[\mathrm{year}^{-1}]$, the losses S [€] and aversion factor a, the number of points P in the risk matrix equals

$$\mathrm{P} = \frac{\lambda}{\sqrt{10}\cdot 10^{-2}\ \mathrm{year}^{-1}} \cdot \frac{\mathrm{S}}{10^{6}€} \cdot \mathrm{a}^{\log_{10}\left[\frac{\mathrm{S}}{10^{6}€}\right]}$$

Select the economically relevant period N years (generally N=25 years). With a WACC equal to W and inflation equal to I, the discount rate r equals: $\mathrm{r} = \frac{1+\mathrm{I}}{1+\mathrm{W}}$

So for the present value CW of a risk R over a period of 1...N years:

$$\mathrm{CW} = \mathrm{R}\cdot\sum_{\mathrm{j}=1}^{\mathrm{N}} \mathrm{r}^{\mathrm{j}-1} = \mathrm{R}\cdot\frac{1-\mathrm{r}^{\mathrm{N}}}{1-\mathrm{r}}$$

For example: let's say the risk has been set at C3 (1 point, €31,600 per year), the WACC is 3.83% per year (before tax) and inflation is 1.5% per year. In that case:

$$r = \frac{1+0.015}{1+0.0383}\ \ 0.9775$$

This means that the present value over a period of 25 years equals:

$$\mathrm{CW} = €\ 31{,}600\ \text{per year}\cdot\frac{1-0.9775^{\,25}}{1-0.9775}\ \text{year} = €\ 31{,}600\cdot 19.296 = €\ 610{,}000$$

Risks are assessed based on the four company values that GTS goes by:

- safety
- transport security
- sustainability
- financial loss acceptance.

Product quality, i.e. the quality of the gas, is part of the company values of safety and transport security. GTS takes its lead for determining gas quality from the Ministerial Regulation on Gas Quality. The total risk is the sum of the scores on these four company values, each of which have the same weighting.

As stated in our mission and vision, we aim to best serve the market by delivering our transport services in a customer-focused and transparent way.

In the domain of management and maintenance, this makes it possible to choose from different maintenance strategies. Using a risk assessment of the four company values, the various possible investment projects can be ranked by risk efficiency. This ranking is one of the inputs in deciding in what order to handle the various projects.

Aside from that, the absolute risk involved in using the assets in each of the asset categories is assessed on a regular basis. This absolute risk is assessed using the risk matrix, as specified in the 'Description of the quality assurance system'.[12] This assessment can have the following outcomes:

- For risks that are not acceptable (red), measures are taken right away. These are the projects included in the investment portfolio.
- For risk that are undesirable (orange), measures are taken in an ongoing, systematic manner. These are captured in policy and translated to maintenance and management interventions or projects.
- Risks that are acceptable on certain conditions (yellow) will be monitored based on the ALARA (as low as reasonably achievable) principle and on the condition of performance monitoring and periodic evaluation of control measures through audits or safety studies.
- For risks that are acceptable without further conditions (green), no additional measures are taken. These are logged in the risk management system and monitored as part of the continuous improvement management process.

It may be that an unacceptable risk cannot be mitigated further and has therefore been accepted as such by the board of GTS, which must be recorded in writing if it hasn't already.

There are two prioritisation rounds:

1. The first round involves ranking the risks. For risks that are not acceptable (red), measures are taken right away. For risks that are undesirable (orange), measures are taken in a systematic and structural manner, while risks that are acceptable on certain conditions (yellow) are monitored based on the ALARA principle. Risks that need to be resolved are scheduled and tackled in a certain year of implementation.

2. The second round involves drawing up the plans/timeline for a particular year of implementation. In this round, the following aspects are decisive:
    - technical gas transport possibilities;
    - permit procedures;
    - synergy with other activities, such as cost savings, reduction of impact on safety and gas transmission;
    - the organisation, availability of technical and other staff;
    - the budget;
    - impact of and on regular maintenance;
    - the energy transition.

12 *Gasunie Transport Services: Description of GTS' quality assurance system, 2021.*

1.3.4 Identifying IT investments

As far as IT investments are concerned, new investments in IT from 2022 will no longer be done by GTS, but by Gasunie. This will be explained in more detail in section 5.4.

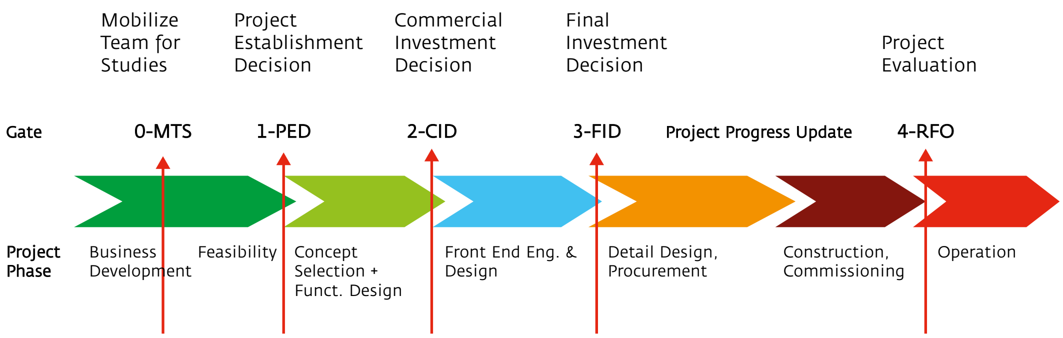
1.4 Measures

1.4.1 Governance and project phases

Engineering and IT project governance is based on the GTS Project Governance System, which details project development from initiation through study, assessment and substantiation (market, technical and/or business case), approval (CID/FID), and construction to commissioning.

The governance process is set up as a phase-gate process (see Figure 1.2 Phase-gate process). It is an integrated working process with clearly defined roles and responsibilities.

FIGURE 1.2. PHASE-GATE PROCESS



Gate details:

- Gate 0-MTS: project initiation (definition of the project drivers; specification of the need and start of studies)
- Gate 1-PED: evaluation of possible alternatives and selection of preferred alternative
- Gate 2-CID: specification of functional principles (function specification)
- Gate 3-FID: approval of the project, including the scope, schedule and costs based on project specifications
- Gate 4-RFO: completion and project evaluation, approx. one year after RFO (ready for operation)

Through the Project Governance System, GTS ensures that projects are developed and executed in a controlled and cost-effective way. Depending on the nature and size of a project, one or more gates may be included.

Relevant information relating to a project is recorded in a project file and in reports from the project board.

1.4.2 Budgeting methodology

The costs for an investment project concern both primary costs, including material costs and work by third parties, and secondary costs such as hours worked by GTS employees. Projects are approved/authorised based on the basic budget for the project, which comprises the following cost components:

- indirect engineering and land-use/real-estate matters
- management, design and supervision
- materials, and
- construction.

The basic project budget does not include allowance, indexation, contingency or management reserve.

The Final Investment Decision (FID) for a project provides insight into the risk of a budget overrun through the 'contingency' (P50 estimate) and 'management reserve' (P90 estimate) items.[13] The size of these items is based on the inaccuracy of the basic budget and the budget overrun probability.

The costs of projects for which an FID has not yet been made are based on study estimates or indicators with an uncertainty margin of 40%.

As soon as an FID has been taken, the development of the financial aspects of a project is monitored and recorded, which ultimately results in production on a project that is the basis for capitalisation of projects.

1.4.3 Portfolio and budget

The investment portfolio includes investments relating to expansion (capacity and connections), replacement (quality), rerouting of infrastructure, and network-related investments (IT). Measures (investments) may be needed to address the following matters:

- quality issues identified through general policy or through regularly scheduled risk analyses;
- quality issues – corrective action following findings from management and maintenance activities as specified in the quality assurance system;[14]
- capacity issues that arise due to market demand;
- external drivers (including spatial planning developments, legislation and software/ hardware compatibility);
- efficiency measures (business cases); and/or
- CSR initiatives, including emission reduction measures.

13 *The P50 estimate includes the Basic estimate + Allowance + Indexation + Contingency. The sum of these four items is the most probable level of capital investment needed to carry out the project (50/50 value). With a P50 estimate, there is a 50% chance of either exceeding the budget or remaining below budget. The P90 estimate is the P50 estimate plus the management reserve (overrun allowance). The management reserve is an unallocated sum set aside to cover parts of a project or events that occur during a project that cannot be predicted, the 'unknown unknowns'. With the P90 estimate, there is a 90% probability of staying under budget and only 10% of exceeding it.*

14 *Gasunie Transport Services: Description of GTS' quality assurance system, 2020.*

There are three factors that complicate clear multi-year forecasts for the investment portfolio, as explained below.

Investment portfolio adoption process

As part of GTS' investment portfolio process, GTS sets the budget required for year n+1 in mid-July of each year. Additionally, when it comes to network-related investments, the highly dynamic nature of the IT industry makes investment terms, by definition, very short.

GTS has accordingly noted that the portfolio process for GTS' technical and IT investments is not effectively aligned with the approval period under relevant legislation governing the draft IP. This complicates the multi-year forecast.

Asset management

In GTS' mission, vision and strategy, we express our aim to serve the market well with due care for safety, reliability, sustainability and cost awareness, which we do by managing our operating assets based on a risk-based asset management philosophy. This means that GTS regularly inspects its assets and invests only when necessary; as a result, a small portion of the replacement investments is made up of preventive (and therefore predictable) measures. The majority of the replacement investments are made based on an asset's current condition and can therefore be planned ahead to a limited degree only. Experience with similar operating assets gives GTS an idea of how many replacement investments will be needed in the long term and of the funds involved. Based on the risk scores, GTS will decide in the short term whether assets need replacing, and if so, which ones.

The risk-based asset management philosophy enables GTS to make the most of its operating assets and limit the investment levels (and the ensuing tariffs), while at the same time offering its customers a reliable, future-proof gas grid.

Developments prompted by third parties

Part of the portfolio is determined by developments prompted by third parties rather than driven by GTS itself, such as connection requests, rerouting, and expiry of software support licences.

GTS factors in that the investment portfolio and ultimate financial realisation during the year may be subject to change as a result of contingencies and disruptions in the system and other (unforeseen) circumstances.

1.4.4. Divergence during realisation

There are numerous factors, both internal and external, that could lead to the planned investment project not staying on schedule, with the result that it may not be possible to complete the project within the allotted time frame. Annex IV provides an overview of the deviations per projectand section 6 goes into the main factors that could lead to delays, as well as into measures to prevent and/or mitigate delays.

2 Developments and scenarios

2.1 Scenario details

In this draft IP, GTS uses the three scenarios shown in Figure 2. These scenarios comprise a realistic estimation of the future to the extent that it has an impact on the design of the gas transmission network GTS manages. This section details the storylines of these three scenarios.

Figure 2.1: Summary of the different scenarios

Dutch Climate Agreement (DCA)	National Driver (ND)	International Ambition (IA)
• CO_2 for 2030 probably not reached target • Expansion of solar PV and wind capacity • Mix of heating technologies in the built environment • Increase in EVs and FCEVs • Limited P2H in industry • 2 bcm green gas • 3.5 GW electrolysis • 7MT CCS	• CO_2 reduction> 49% • Targets energy autonomy in the long term • Even more solar PV and wind (in line with RESs) • More circularity and energy savings • Focus on all-electric heat pumps • More EVs, fewer FCEVs • Further system integration via P2G and P2H • Limited CCS	• CO_2 reduction> 49% • Import dependency continues • Less solar PV, more green gas • Growth in industry, there appears to be room for CHP • Focus on hybrid applications • Fewer EVs, more gas in heavy transport • Growth of H_2 (mainly blue and import) • More CCS (10MT)

2.1.1 Dutch Climate Agreement (DCA) scenario

In 2015, the signatories to the Paris Agreement agreed to keep global temperature rise below two degrees Celsius, compared to pre-industrial levels. The aim is to limit temperature increases to 1.5 degrees Celsius. In the Netherlands, this global ambition was translated to a national Climate Agreement, which was presented by the Dutch government in June 2019. The Dutch Climate Agreement (DCA) contains an extensive package of agreements, measures and instruments all aimed at reducing carbon emissions in the Netherlands by at least 49% in 2030 compared to 1990.

The plans and ambitions set out in the DCA have an impact on all industries and sectors in the Netherlands. New homes are being built without a natural gas connection, and existing homes are being made more sustainable using a mix of technologies like heat grids and electric and hybrid heat pumps. For the remaining gas demand, there is a strong ambition to make it more sustainable in part by using green gas. The uptake of electric vehicles is incentivised through tax breaks, resulting in a significant increase in the number of EVs.

Aside from that, measures are also being taken in the industrial domain to reduce carbon emissions. Carbon Capture and Storage (CCS) efforts financed from the SDE++ grant scheme play a key role in making this happen. Demand for hydrogen is increasing, with a mix of grey, green and blue hydrogen being available. A portion of the German hydrogen demand is met through imports that enter Europe through the Netherlands. The role of Power-to-Heat (P2H) in industry remains limited. In the period leading up to 2030, the amount of land devoted to commercial greenhouse operations is declining, while cultivation is intensifying. The number of combined heat and power (CHP) installations is decreasing, while the supply of electricity to commercial greenhouses from the grid is increasing. On balance, the total electricity demand has remained the same.

The energy supply has also gradually been moving towards energy generated from renewables. Scheduled coal-fired power station closures are being brought forward. Installed solar and offshore wind capacity is increasing considerably. A decision will be made not to use the option of burning biomass in coal-fired power stations from 2030

2.1.2 International Ambition (IA) scenario

The International Ambition scenario is in line with the storyline of the International Governance scenario from II3050: it depicts strong international collaboration and free trade. In 2015, the signatories to the Paris Agreement agreed to keep global temperature rise below two degrees Celsius, compared to pre-industrial levels. It is becoming increasingly clear that the international community will need to work together closely if we are to reach this target. To accelerate cuts to greenhouse gas emissions international collaboration is being intensified, while a strong climate policy is also being pursued at a global level. Policy measures are coordinated internationally so that emission reductions take place everywhere and not just in the regions at the forefront.

The internal energy market is being bolstered and free trade is being stimulated. In 2030, the first steps will be taken towards a global energy market based on sustainable energy carriers such as hydrogen. While the Netherlands is developing its trade-oriented and industrial economy and increasing sustainable energy production with competitive technologies, it is still set to remain highly dependent on energy imports in the longer term. This will increasingly be the import of sustainable and renewable energy. In addition, the Netherlands is developing as a transit country for hydrogen, to Germany for example. To guarantee security of supply, the government is focusing on developing international trade relations. Moreover, the Netherlands is providing infrastructures with strategic reserves to enable the transmission, transport and storage of various renewable energy carriers in very large volumes.

Thanks to free trade, a wide range of energy carriers (electricity, hydrogen, biofuel) is available. The share of green gas and hydrogen in the energy mix is increasing substantially. Some of these renewable gases come from abroad. The production of renewable energy is increasing in the Netherlands as well. With the phasing out of the netting (feed-in credit) scheme, the growth of solar PV in the Netherlands will gradually level off before 2030 already. In southern Europe and other countries with a large supply of solar energy, solar PV is booming; this will eventually allow these countries to start exporting green hydrogen produced using solar energy.

The growing supply of cheap renewable gas means that the number of hybrid heat pumps is on the rise, especially in the built environment. Until 2030, this will be in combination with natural gas and green gas; after 2030 hydrogen will also become increasingly important. The idea of weaning residential areas off natural gas completely in one go is being abandoned; the built environment is now gradually being made more sustainable. Each neighbourhood goes through a transition path drawn up for it specifically. With this approach, savings will be made in many more homes but fewer will be gas-free by 2030. As a result, homes and buildings can be made more sustainable without the need for expensive renovations and extensive insulating measures. All-electric heating and heat networks are growing, but hold a relatively limited market share.

Favourable conditions for commercial greenhouse operators – partly thanks to the availability of green gas – mean that the land devoted to commercial greenhouses and the number of CHP installations will remain the same up to 2030.

The transport sector will continue to make extensive use of fossil fuels in the coming years. The relatively high purchase price of EVs is slowing the electrification of transportation overall compared to the growth rate targeted in the DCA. Both electric and hydrogen are set to gain market share after the carbon tax is increased later. For heavy transport and shipping, the focus is on hydrogen and gas (both gaseous and liquefied).

The Netherlands is focusing on its knowledge economy so that the technologies developed here can be applied abroad. As a result, the Netherlands has retained its strong competitive position, making Dutch knowledge and products attractive to foreign countries. This also means that industry in the Netherlands is continuing to grow. Despite this growth, emissions in this sector are being drastically reduced, among other things through efficiency improvements, increased use of renewable energy and the application of CCS.

2.1.3 National Driver (ND) scenario

The National Driver scenario is in line with the storyline of the National Governance scenario from II3050. In this scenario, the national government takes the lead. At a national level, specific guidance is given on matters such as the direction and pace of the transition, what the transition choices will be and when these come into effect, and concerning required changes in land use (spatial planning). These choices are made in consultation with local authorities and bodies representing civil society. There is support at regional level for more detailed elaboration of the plans, including in the Regional Energy Strategies (RESs), the National Charging Infrastructure Agenda, and in the Cluster Energy Strategies. In this scenario, the Netherlands aims for a high degree of self-sufficiency, a large amount of sustainable energy, and a circular economy. The strong government control, together with strong motivation at regional and local level, ensures that the energy transition is shaped such that the Netherlands is completely climate-neutral by 2050 and the energy demand in the Netherlands is met by domestically produced energy.

The Netherlands is working hard to realise a large supply of sustainable energy in the country. This happens through the RESs where the regions are exceeding their targets, mainly through solar PV. This is generously supported by government incentives (SDE++, alternative to netting [feed-in credit] scheme, etc.). On a national level, large projects like offshore wind are made possible because this is also stimulated by the government.

The large supply of renewable energy generated through a source that cannot be controlled (i.e. sun, wind) leads to a serious and increasing need for flexibility in the energy system. Flexibility is achieved through energy storage, demand management and conversion to heat and sustainable gases. Power-to-Heat conversion is mainly used for industry and the heat grids. Green hydrogen produced by conversion is mainly used in industry – as a fuel and a feedstock – and for flexible electricity generation. With this flexibility, the assorted energy systems are becoming increasingly integrated. The system choices required for this are identified in good time, and policy measures are taken to advance the most favourable alternatives.

Energy savings and efficiency improvements are reducing energy demand in the Netherlands. Some of the efficiency improvements are achieved through electricity making up an increasing portion of the energy demand. While the focus on electrical applications has been increasing, the demand for gas has continued to decline. Improvements in energy efficiency are being realised in the energy-intensive industrial sectors in the Netherlands, and this in turn is reducing demand. In addition to efficiency improvements and electrification, industry is also increasingly using a higher proportion of renewable raw materials/feedstock and circular ways of using these. After 2030, the refining and fertiliser sector are set to shrink due to lower demand for these products. The mobility, built environment and agriculture sectors will also be further electrified. In the mobility sector, the development of electric passenger transport is moving very quickly and smart charging is becoming the norm. The number of electric HGVs is also growing. The amount of land required for the commercial greenhouse sector is shrinking while cultivation is intensifying and electrification increasing. The number of CHP installations is decreasing, while the supply of electricity from the grid is increasing.

In addition, sustainable gases (LNG, hydrogen) and other liquid biofuels are becoming important fuels for heavy transport. In the area of housing the national government is taking the lead. There is a sharp increase in the construction of new sustainable homes in this scenario. In the built environment, the fully electric heat pump combined with solar PV is a common sight inside or outside (well-insulated) homes. Optimum use is being made of residual heat sources, resulting in a significant expansion of the number of heat grids in the Netherlands. In addition, geothermal energy, thermal energy storage and biomass boilers play an increasingly important role in these heat grids.

Biomass and biofuels are used to a limited extent in the other sectors. There is some use of biofuels – mainly for heavy transport – and solid biomass is being used as a fuel for the boilers of district heating networks and as a transitional fuel in former coal-fired power stations. Availability of biomass for green gas remains limited.

Use of hydrogen in the Netherlands has increased compared to 2021. The additional demand is mainly being met through green hydrogen produced using electrolysis. In the medium term, blue hydrogen production is also contributing to meeting the carbon reduction targets. As a result, the development of carbon capture and storage (CCS) is also progressing, but the role of CCS remains relatively limited.

2.2 Developments

This section, which describes the developments relevant to GTS in the three different scenarios, is divided into four parts. Part 1 deals with the demand for gas on a national level. This is followed by the national supply of gas, which is covered in part 2. Part 3 describes developments outside the Netherlands. And lastly, part 4 provides an overview of the gas flows in the GTS network.

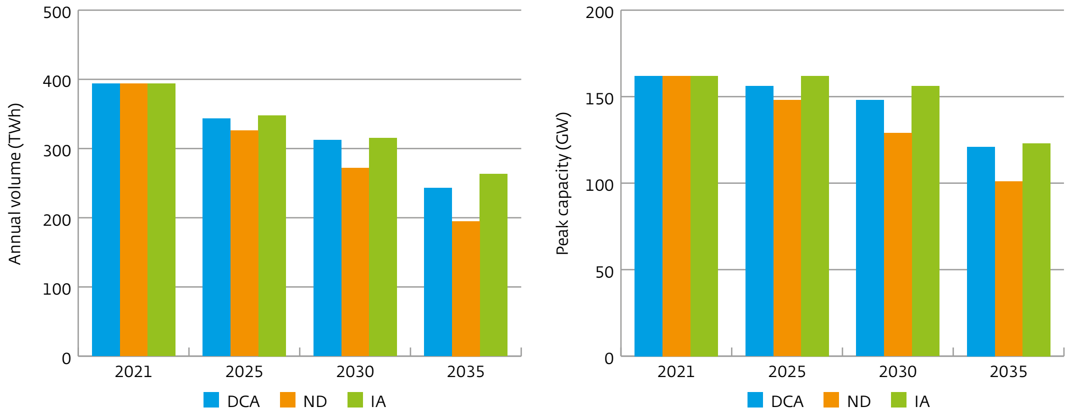
This section makes a distinction between volume developments and peak capacity developments. Volume in this case means the total volume of gas consumed in one year, based on a year with average weather and temperature conditions. The annual volume is expressed in terawatt hours (TWh), based on the gross calorific valuefor natural gas. Peak capacity means, in this context, the peak hourly demand in a particular year, i.e. the demand that arises during a period of extremely cold weather. In line with the Security of Supply (Gas Act) Decree, the assumption is the peak hourly demand on a day with an average effective temperature of minus 17°C, as measured at the Royal Netherlands Meteorological Institute in De Bilt. Capacity is expressed in gigawatts (GW).

In this section, gas means methane (natural gas and green gas), unless explicitly stated otherwise.

2.2.1 Gas demand in the Netherlands

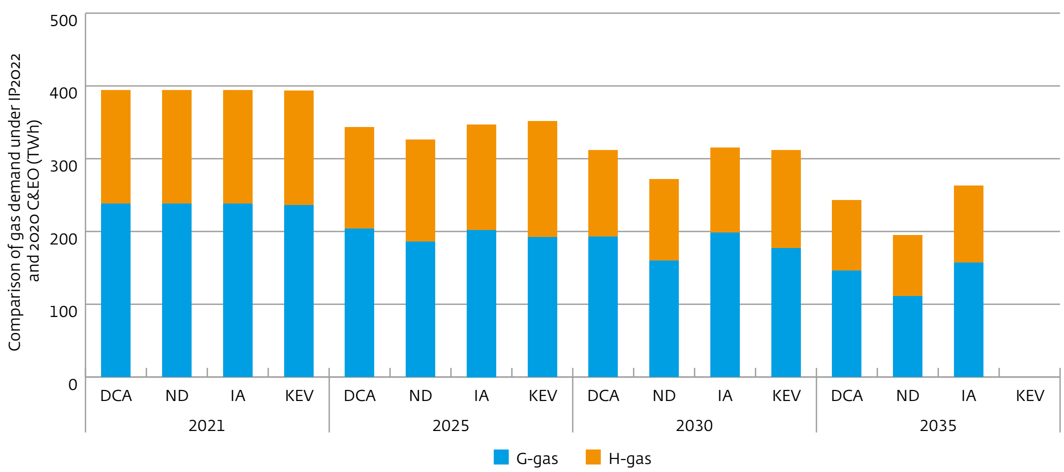
The graphs below illustrate the volume and capacity trends for domestic demand in each of the IP2022 scenarios. These graphs show that both annual consumption (volume) and peak capacity will decrease in the coming years. Given that the developments that have led to this decrease vary per sector, below we explain the developments in each sector individually.

Figure 2.2: Trend in both volume and required transmission capacity



For a number of reference years, the scenarios have also been compared with the 2020 Climate and Energy Outlook (C&EO)[15], which was based on the then current and proposed government policy. Given that much of the content of the Dutch Climate Agreement had not yet been incorporated into the C&EO, the IP2022 scenarios assume a higher level and more extensive scope of sustainability. In the ND scenario in particular, we see that, as a result, gas demand is significantly lower due to the focus on electrification. In terms of gas demand, the DCA and IA scenarios are reasonably in line with the C&EO. This is partly due to a greater focus on renewable gas and an additional need for natural gas for hydrogen production, including blue hydrogen.

Figure 2.3: Comparison of gas demand under IP2022 and 2020 C&EO

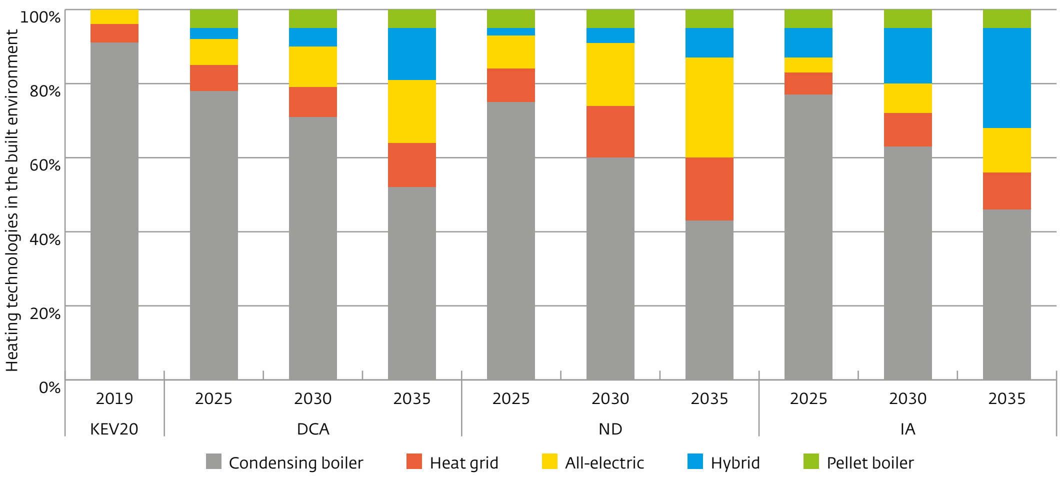


15 *www.pbl.nl/publicaties/klimaat-en-energieverkenning-2020*

Built environment

The built environment encompasses all residential and commercial buildings in the Netherlands. In these homes and buildings, natural gas is used for heating and/or cooking. The gas demand in these sectors is influenced by two factors: the demand for heating and so also for gas is decreasing thanks to the energy savings realised through better insulation, and the scenarios also assume a transition to alternative ways of heating, which would apply as well to homes and commercial buildings. Figure 2.4 illustrates the distribution of heating technologies in the built environment (homes and buildings) and how this changes in each scenario.[16] Depending on the type of heating, homes and commercial buildings will use less gas or none at all. Hybrid heat pumps heat with electricity for much of the year, but use gas in peak demand situations. For district heating networks, part of the peak demand is also supplied with auxiliary gas boilers in the districts. The other types of heating (all-electric, pellet stoves) do not use gas at all.

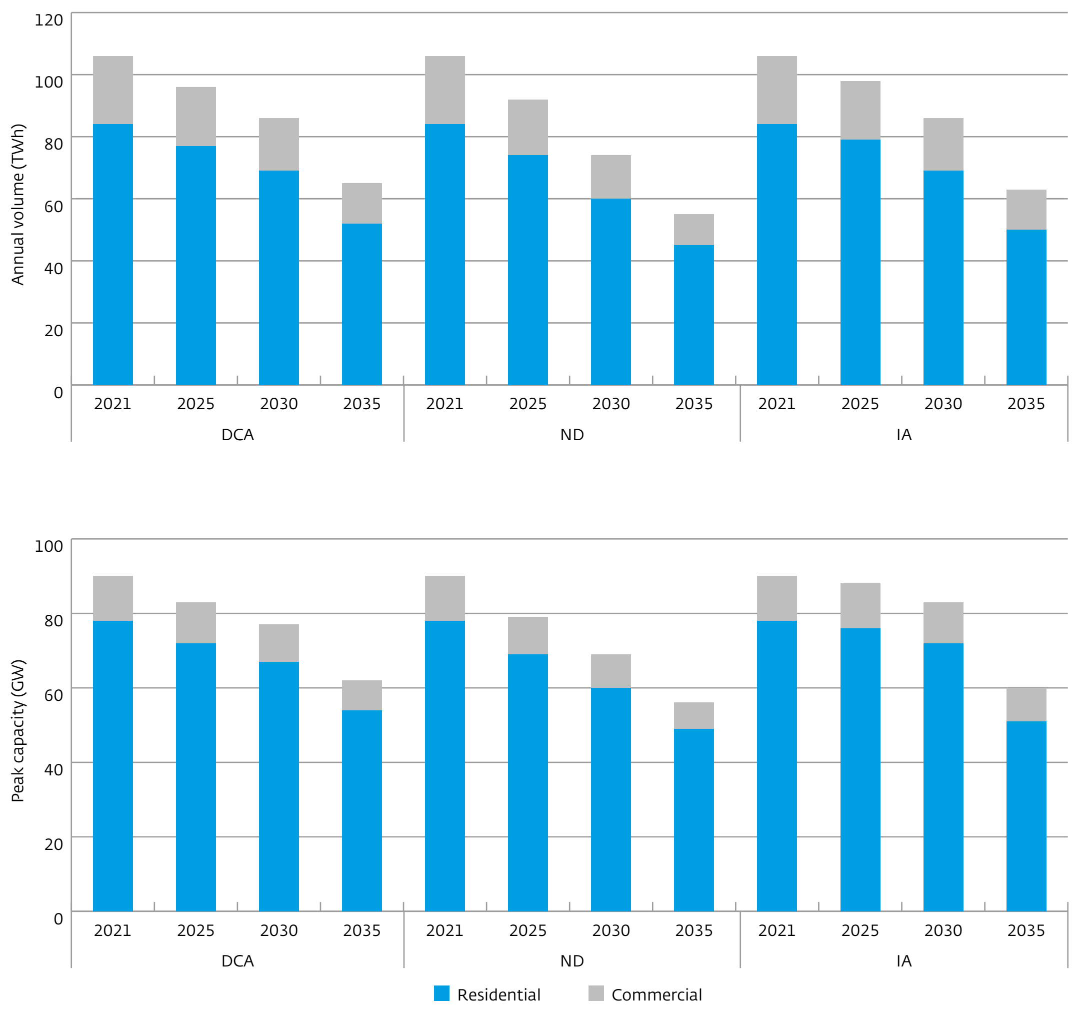
Figure 2.4: Heating technologies in the built environment



16 *For homes, the market share is determined on the basis of the number of connections, for buildings on the basis of floor space.*

Figure 2.5 shows how annual volume and peak capacity are expected to develop in the built environment. In both graphs we see a downward trend, with volume declining by between 18% and 29% between now and 2030 and peak capacity declining less rapidly, by between 7% and 23%. This is because, for hybrid applications and district heating networks, gas is then still being used to handle peak demand situations.

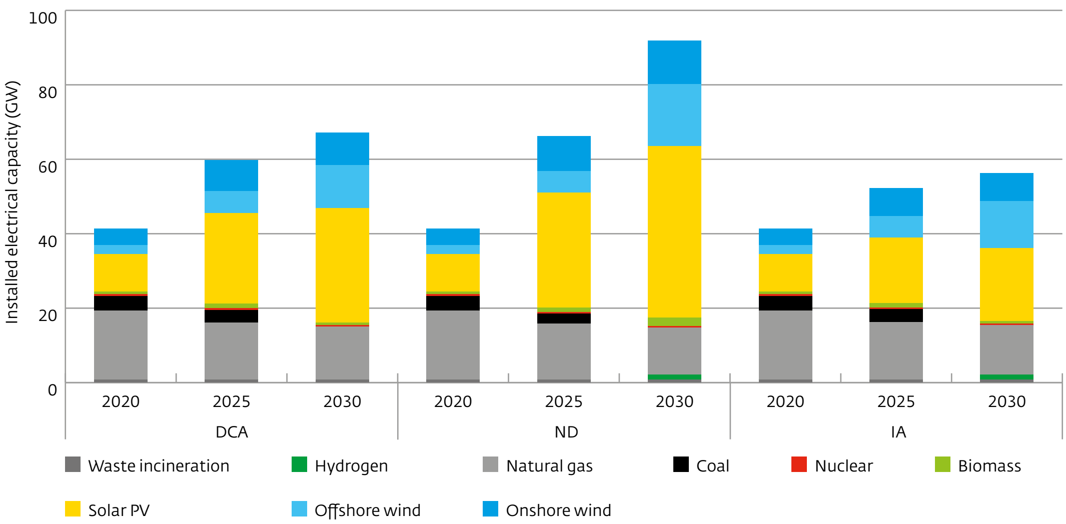
FIGURE 2.5: TREND IN THE ANNUAL VOLUME AND IN TRANSMISSION CAPACITY FOR THE BUILT ENVIRONMENT



Electricity generation

In the Netherlands, gas is also used to generate electricity, at power stations and in combined heat and power (CHP) installations, for example. In this regard, gas competes with other forms of electricity generation, such as coal, solar power and wind. Figure 2.6 illustrates the installed electrical capacity in the various scenarios. Some of this is gas-fired (natural gas and hydrogen) power. In all scenarios, we see an increase in the use of renewables and a decline in capacity from conventional sources. This is mainly due to the closure of coal-fired power stations, though capacity from gas-fired power stations will decline somewhat as well. In the ND and IA scenarios, hydrogen accounts for a portion of the gas capacity.

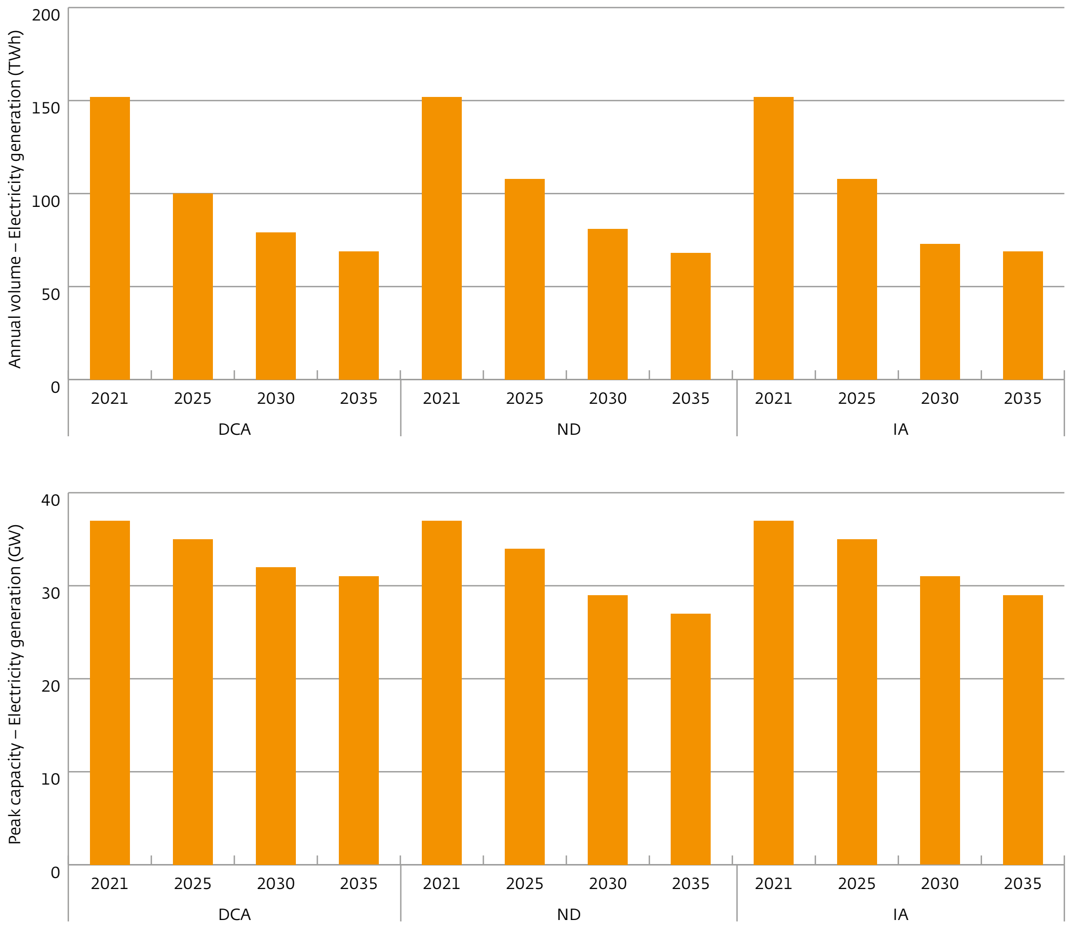
Figure 2.6: Total installed electrical capacity in the Netherlands per scenario



The use of gas-fired capacity depends entirely on the conditions on the electricity market. A large supply of solar and wind power will likely mean that little use will be made of the capacity of gas-fired power stations; they would, however, be in full operation during periods with little sun and little wind. Furthermore, use of power stations still depends on developments on the electricity market in countries outside the Netherlands. To estimate gas consumption for the generation of electricity, GTS uses TenneT's calculations in this draft IP.

Figure 2.7 shows the levels of gas consumption for generating electricity, with one graph illustrating the annual volumes and the other peak capacity. The annual volume shows a sharp decline in the use of gas-fired power in all scenarios. This is related to the increase in electricity generated from solar, wind and other sources. Peak capacity will also decrease in the coming years.

Figure 2.7: Trend in gas utilisation for the generation of electricity



Industry

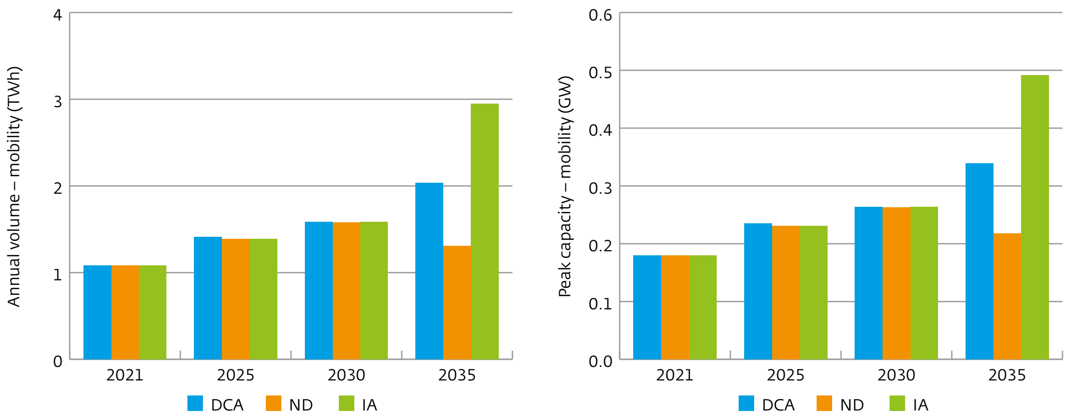
Natural gas is used in industry for a wide range of applications, like for heating or as a feedstock for artificial fertiliser. Figure 2.8 shows the gas demand in industry in the various scenarios. It is notable that in the DCA and the IA scenario, industrial demand shows an increasing trend (up to a maximum of 14%) until 2030. This is due to the assumed increase in industrial activity in the Netherlands. After 2030, gas demand will start to fall, partly due to the switch to other energy carriers, like hydrogen for example. In contrast, the ND scenario assumes a decline in industrial activity while also envisioning a strong focus on electrification, with the result that, in this scenario, the demand for gas from industry decreases each year. Peak capacity will decrease by about 10% by 2030, while annual volume shows a faster decline.

Figure 2.8: Trend in gas demand in industry

Mobility

In terms of gas demand, mobility is currently a relatively small sector consuming an annual volume of approximately 1TWh. All three scenarios show a growth trend in this area; still, the role of natural gas in mobility remains limited. In the ND scenario, natural gas is mainly being used as a transitional fuel. This can all be seen in Figure 2.9. The figures do not include LNG for trucking and shipping, which is not transmitted in the national gas grid.

Figure 2.9: Gas consumption for mobility in the various scenarios



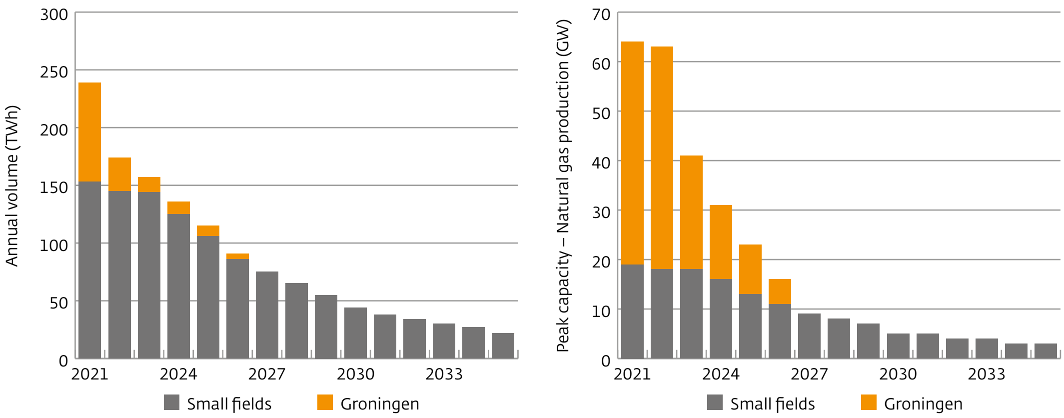
2.2.2 Gas supply in the Netherlands

In the previous section, we saw that gas demand in the Netherlands decreases in all scenarios. However, the domestic supply of natural gas is decreasing even faster. The main cause is the accelerated phasing out and the planned closure of production from the Groningen field. In the coming years, the production of natural gas in the Netherlands will decrease further, as can also be seen in Figure 2.10. In 2021, approximately 240TWh was still being produced, 86TWh of this coming from the Groningen field.[17] A sharp decline in Groningen production is expected in 2022 with the commissioning of the new GTS nitrogen plant. From 2023, production from the Groningen field will be down to virtually nothing, but the field will still be available as a backup in the event of supply problems or extreme cold. Only the small fields will then remain open for production. With the depletion of the reserves from the small fields, only 44TWh will be produced in 2030.[18] The assumptions for natural gas production are the same for all scenarios.

17 *Production volume from the Groningen field based on www.rijksoverheid.nl/binaries/rijksoverheid/documenten/kamerstukken/2020/01/31/advies-leveringszekerheid-voor-benodigde-groningenvolumes-en--capaciteiten/bijlage-advies-leveringszekerheid-voor-benodigde-groningenvolumes-en-capaciteiten.pdf. The volume for 2021 has been adjusted downward, in line with www.rijksoverheid.nl/documenten/kamerstukken/2020/09/01/nieuwe-mogelijkheid-om-groningenproductie-voor-gasjaar-2020-2021-verder-te-reduceren. Production volumes are shown per calendar year and therefore diverge from the figures in the GTS reports, which are calculated per 'gas year'.*

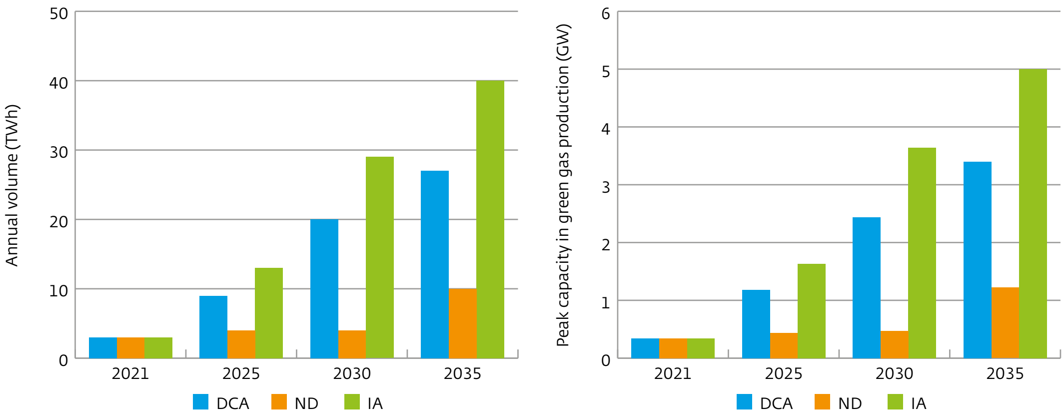
18 *Figures for small fields come from the 2019 annual review on natural resources and geothermal energy in the Netherlands. Only current and conditional reserves were considered: www.nlog.nl/sites/default/files/2020-11/jaarverslag_2019_delfstoffen_en_aardwarmte_nl_18-11-2020.pdf*

Figure 2.10: Total domestic natural gas production, split into Groningen and other gas fields



On the other hand, the supply of green gas will increase in the coming years. Green gas is methane produced from organic material via anaerobic digestion or gasification. Since the resulting gas is chemically identical to natural gas it can be injected directly into the gas grid. The ND scenario envisions relatively limited use of green gas. In 2030, the total gas production is around 4TWh.[19] The availability of gasification technology will still be limited at that time but will increase in the following years. The IA scenario, on the other hand, foresees a substantial growth in green gas production, both via anaerobic digestion and gasification, with total production in 2030 of around 29TWh.[20] With approximately 20TWh, the DCA scenario falls in between the two flanking scenarios.

Figure 2.11: Production of green gas in the Netherlands

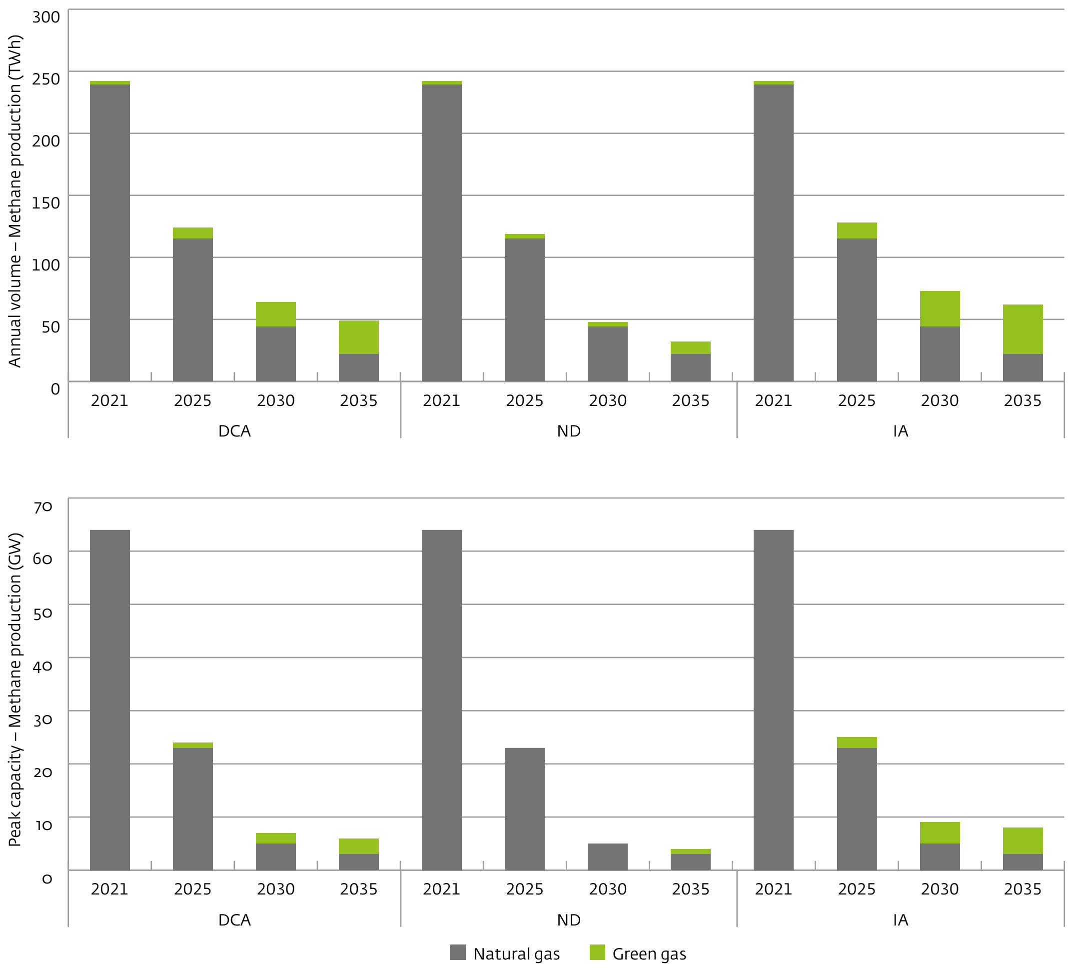


19 *www.ce.nl/publicaties/2415/potentieel-van-lokale-biomassa-en-invoedlocaties-van-groengas, scenario C*

20 *https://cedelft.eu/publications/green-gas-roadmap-for-2020-2050-contours-and-policy-instruments/ envisions an upper limit of 3.6 bcm in 2030, but this also includes production from seaweed. 36 The share of hydrogen produced via SMR in total hydrogen production is currently approximately 58% (28TWh); the remainder is obtained as a by-product from residual flows from industrial processes. Also see: www.rijksoverheid.nl/binaries/rijksoverheid/documenten/rapporten/2020/06/24/the-dutch-hydrogen-balance-and-the-current-and-future-representation-of-hydrogen-in-the-energy-statistics/waterstofrapport-tno.pdf*

If we add up the production of natural gas and green gas, we get the total gas production in the Netherlands. This is illustrated in Figure 2.12, which indicates a sharp decrease in the production of gas, despite the increase in green gas. In 2021, the total gas production is around 240TWh, virtually all of which comes from the small fields and Groningen. In 2030, gas production varies between 48 and 73TWh, depending on the scenario. The share of renewable gas increases substantially, from around 2% in 2021 to between 7% (ND) and 40% (IA) in 2030.

Figure 2.12: Total methane production in the Netherlands

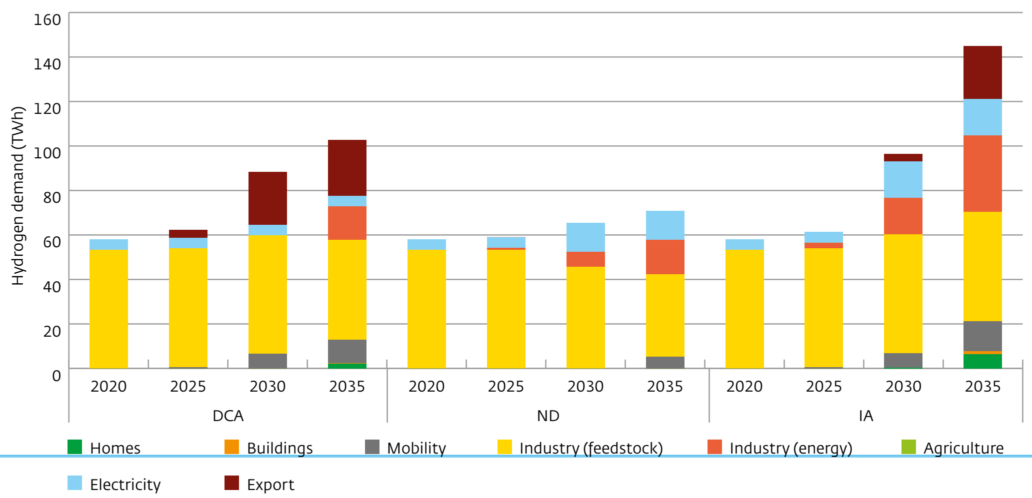


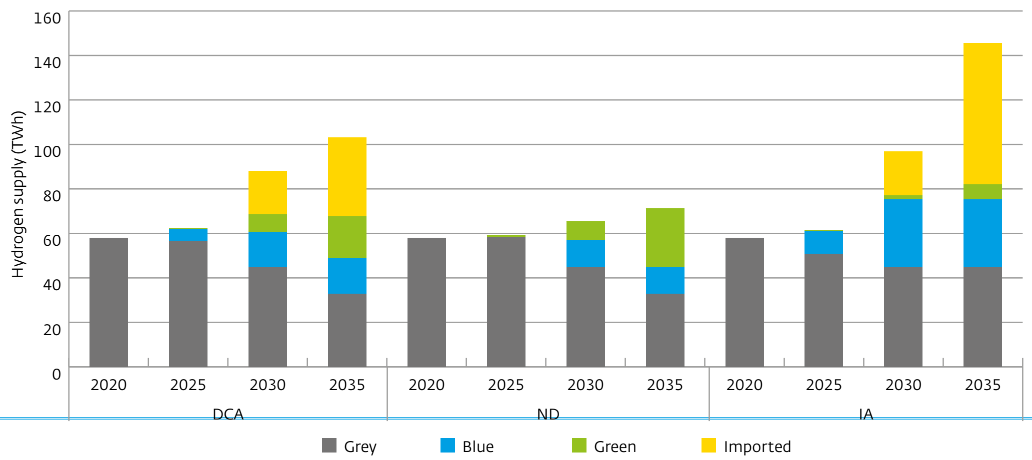
Hydrogen in the Netherlands

The demand for hydrogen has also been quantified in the IP2022 scenarios. Approximately 60TWh[21] of hydrogen is currently produced in the Netherlands, mainly for use in fertilisers and oil refining. About 40% of this comes from residual flows from industrial processes. The other 60% is produced from natural gas via steam methane reforming (SMR[22]). The volume of natural gas required for this has been included in the scenario forecasts for industry (see section 1.2.1).

Figure 2.13 illustrates the current and future supply of and demand for hydrogen in the three scenarios. Hydrogen supply and demand rises in all scenarios, but the extent of the growth and the relationship between the various forms of hydrogen supply differ per scenario.

FIGURE 2.13: TREND IN HYDROGEN SUPPLY AND DEMAND IN THE NETHERLANDS





21 *Based on gross calorific value, 142MJ/kg.*
22 *www.rijksoverheid.nl/binaries/rijksoverheid/documenten/rapporten/2020/06/24/the-dutch-hydrogen-balance-and-the-current-and-future-representation-of-hydrogen-in-the-energy-statistics/waterstofrapport-tno.pdf*

The ND scenario envisions relatively limited growth of hydrogen[23], with industrial demand for use as a feedstock decreasing. This is due to the decrease in industrial activity in this scenario. There is, on the other hand, an increase in the use of hydrogen to provide heating. On balance, industrial hydrogen demand remains more or less stable. In addition, the ND scenario foresees growth of hydrogen in the electricity sector, partly driven by the focus on electrification in this scenario. In the ND scenario, the conversion of the Magnum power station to hydrogen[24] will start in 2027. The extra hydrogen supply required for this is mainly produced via electrolysis using renewable electricity.

The highest level of growth for hydrogen is assumed in the IA scenario. This growth is visible in almost all sectors: industry, mobility and electricity generation. In the built environment, for the time being hydrogen demand will be limited to a few pilot projects; however, from 2035 the share of hydrogen will start to grow in this sector too. In the IA scenario, the extra supply of hydrogen mainly comes from blue hydrogen production. In addition, in this scenario, an international hydrogen market will develop around 2030, creating the option of importing hydrogen. This also means that the Netherlands will also become a transit country for hydrogen going to Germany. This hydrogen transit flow will still be limited in 2030 but will increase in the following years.

In terms of hydrogen, the DCA scenario lies between the ND and IA scenario, and in terms of domestic hydrogen demand, the DCA scenario shows similarities with the ND scenario. When it comes to supply, this scenario envisions a mix of grey, blue and green hydrogen. In addition, this scenario also assumes a transit flow of hydrogen to Germany, in line with the Dutch government's vision on hydrogen[25], the German national hydrogen strategy[26] and the German Netzentwicklungsplan (Grid Development Plan).[27]

23 *Hydrogen supply and demand is based on: www.gasunie.nl/expertise/waterstof/scenarios-voor-vraag-en-aanbod-waterstof/$4229/$4230. The ND and DCA scenarios are similar to the low scenario; the IA scenario is based on the middle scenario.*

24 *In the ND and IA scenarios, it is assumed that in 2027 one turbine (approx. 0.5GW) will be converted for the production of hydrogen, with a full capacity of 1.4GW in 2030.*

25 *In the government's vision on hydrogen, a portion of the German hydrogen demand is met through imports that enter Europe via the Netherlands. www.rijksoverheid.nl/binaries/rijksoverheid/documenten/kamerstukken/2020/03/30/kamerbrief-over-kabinetsvisie-waterstof/Brief+kabinetsvisie+waterstof+.pdf.*

26 *www.bmwi.de/Redaktion/EN/Publikationen/Energie/the-national-hydrogen-strategy.html*

27 *www.fnb-gas.de/media/fnb_gas_2020_nep_entwurf_en.pdf*

2.2.3 Developments outside the Netherlands

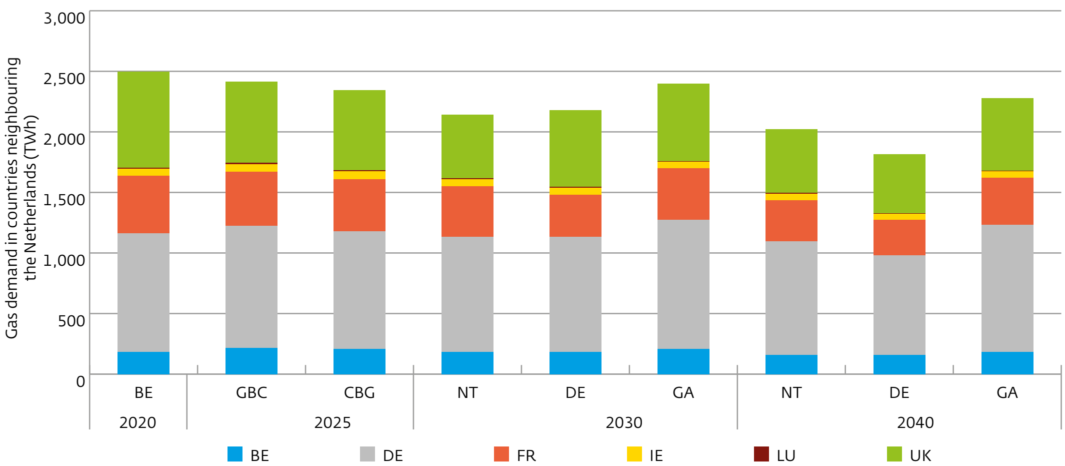
Since the gas demand and gas supply trend abroad has an impact on gas flows through the Netherlands, the developments in surrounding countries are also considered in this draft IP. For this purpose, this draft IP uses data from the 2020 TYNDP joint scenario report of ENTSOG and ENTSO-E.[28] This section looks at the basic assumptions for gas demand and gas supply in neighbouring countries, with specific attention paid to the supply and demand of methane.

Gas demand

The 2020 TYNDP has two scenarios for 2025 and three for 2030. These scenarios are illustrated in Figure 2.14. The two scenarios for 2025 are based on a best estimate of the TSOs, but have a different merit order for coal-fired and gas-fired power stations. In CBG (coal before gas), coal is cheaper than gas, resulting in a lower demand for gas for electricity generation. In GBC (gas before coal), the gas-fired power stations are producing more electricity than the coal-fired power stations, leading to an increased demand for gas.

For 2030, the 2020 TYNDP has three different scenarios. The National Trends (NT) scenario is in line with the national energy and climate plans (NECPs) of the EU member states.[29] In addition, ENTSO-E and ENTSOG have developed two top-down scenarios based on storylines. The storylines of these TYNDP scenarios are broadly similar to those of IP2022. Distributed Energy (DE) envisions a drop in gas demand, partly due to a focus on electrification. In the Global Ambition (GA) scenario, gas demand in neighbouring countries remains more or less constant. In 2030, gas demand in neighbouring countries will have decreased by between 4 and 14% compared to 2020. We therefore see a less sharp decline in neighbouring countries compared to the Netherlands.

Figure 2.14: Trend in gas demand in countries neighbouring the Netherlands

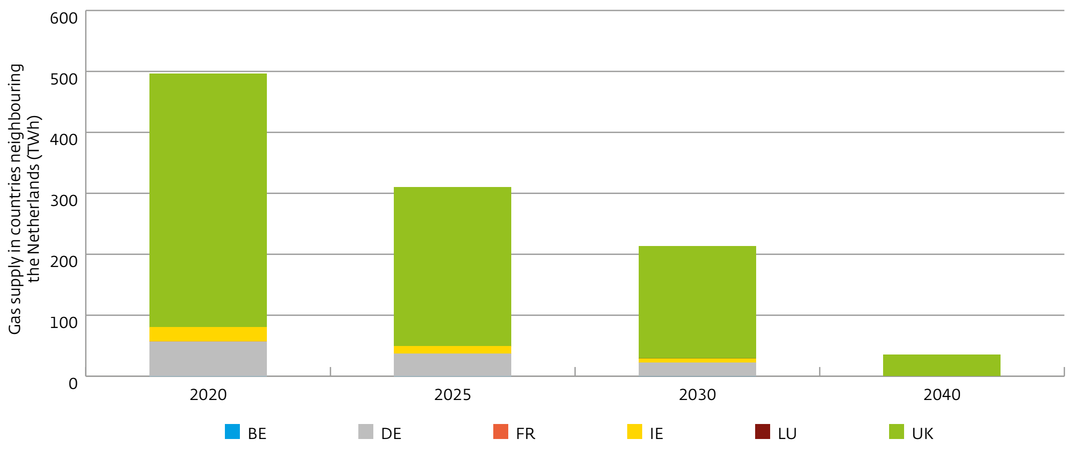


28 https://2020.entsos-tyndp-scenarios.eu/
29 https://ec.europa.eu/energy/topics/energy-strategy/national-energy-climate-plans_en

Gas supply

As in the Netherlands, natural gas production in the rest of north-western Europe is also declining. Alongside the Netherlands, the United Kingdom and, to a lesser extent, Germany and Ireland are the main gas producers at the moment. Figure 2.15 shows the development in gas production in the Netherlands' neighbouring countries, all of which show a decline in gas production. By 2040, almost all natural gas production in north-western Europe will have vanished.

Figure 2.15: Trend in gas production in countries neighbouring the Netherlands



In contrast to the dwindling natural gas production, renewable gas production will grow in the surrounding countries too. Figure 2.16 below illustrates the production of renewable methane in the countries around the Netherlands. These scenario forecasts include both green gas and synthetic methane produced via electrolysis (power to methane). A significant (potential) increase in renewable methaneis forecast for France, Germany and the UK in particular. In the maximum scenario of Distributed Energy, renewable gas production in surrounding countries will grow to more than 130TWh by 2030 and nearly 400TWh by 2040.

Figure 2.16: Renewable methane production (green gas and syngas) in countries surrounding the Netherlands

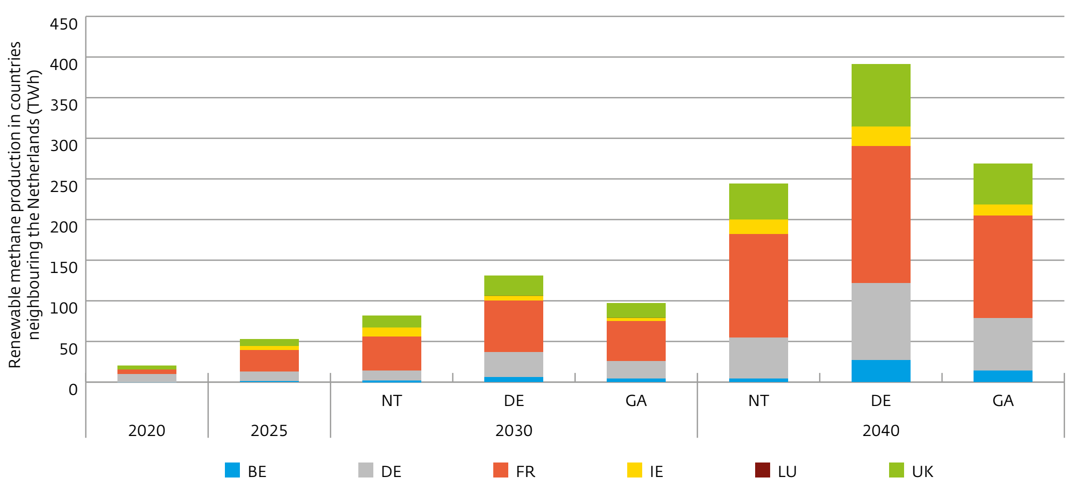
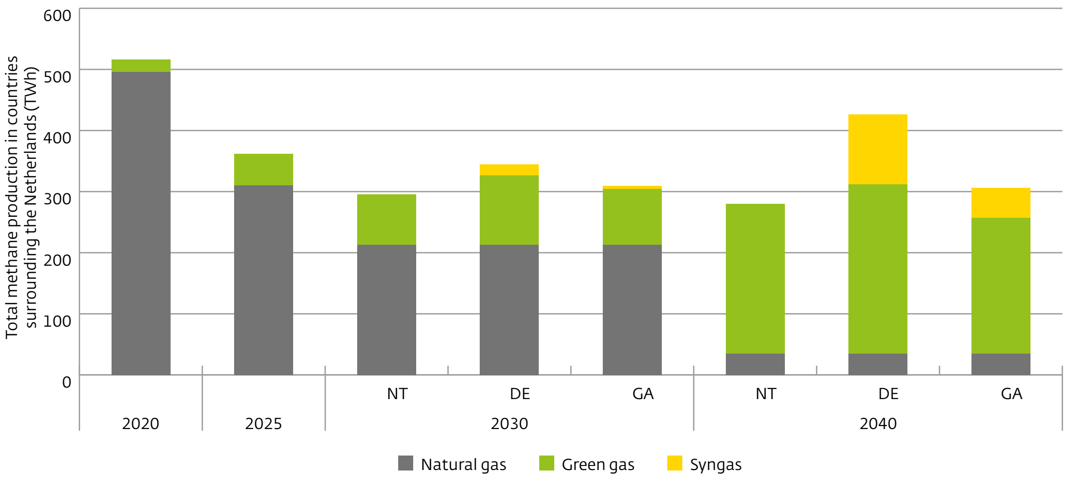


Figure 2.17 illustrates the total production of renewable methane in the countries around the Netherlands. It is notable that methane production is expected to stabilise somewhat after 2025. The decline in natural gas production is more or less compensated by the growth in the production of green gas and syngas. After 2030, the share of renewable gas production will increase further, to about 90% by 2040. In the Distributed Energy scenario, in the long term there is growth compared to the expected production level in 2025.

FIGURE 2.17: TOTAL METHANE PRODUCTION IN COUNTRIES SURROUNDING THE NETHERLANDS

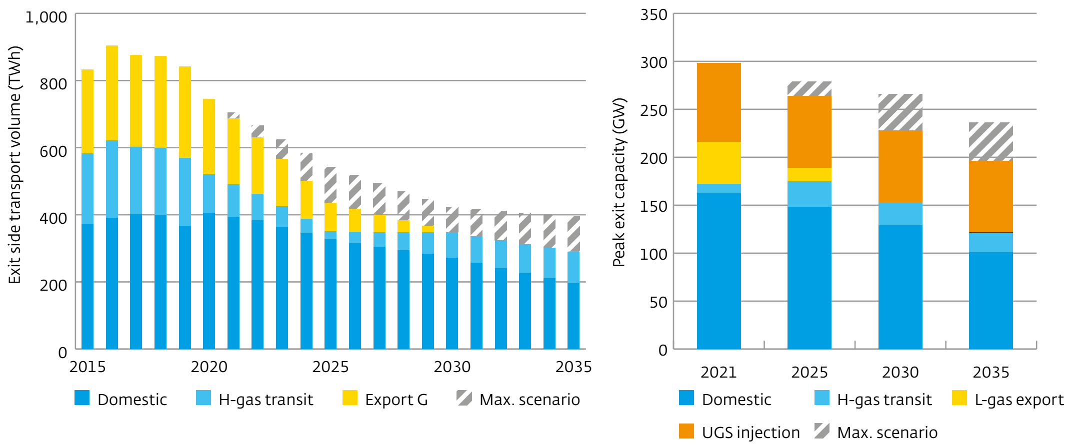


2.2.4 Utilisation of the GTS network

The previous sections provide an overview of domestic and foreign developments in gas supply and demand. Naturally, domestic developments directly affect the gas flows through the GTS network, but GTS also transports gas abroad. The Netherlands will, for example, remain an exporter of low-calorific gas between now and 2030. In addition, the Netherlands also handles 'transit flows', like the flow of gas from Russia to the United Kingdom via the Netherlands, or the LNG that passes through the Netherlands on its way to Germany.

ENTSOG simulation for 2020 TYNDP were used to gain insight into the cross-border natural gas flows. Figure 19 illustrates the total transport volume through the GTS network, both in terms of annual volume and peak capacity. What jumps out from the graph is the sharp decline in the total annual volume between now and 2030. There are several reasons for this. Firstly, a large part of the decrease is caused by the phasing out of obligations regarding the export of low-calorific gas. Secondly, domestic demand will also be declining, as described in section 1.2.1. Finally, we see a decrease in the transport of high-calorific gas, especially in the period up to 2025, which is due to the higher demand for high-calorific gas (for quality conversion) in the Netherlands at that time. All of this will result in a decline of between 27% and 41% compared to the 2020 levels up to 2025. Over the five years after that, the decline will continue by another 10 to 15%, to between 43% and 53% of the 2020 levels. After 2025, the decline in the export of low-calorific gas will be somewhat offset by additional transport of high-calorific gas.

Figure 2.18: Utilisation of the GTS network



Peak transport capacity basis will also decrease in the coming years, with the volume declining by between 11% and 23% between 2021 and 2030. So, compared to the annual transmission volume, peak capacity does not decrease as quickly, thanks to the introduction of hybrid applications that only use gas in peak demand situations, for example.

Though total exit transport (demand) will decrease in the coming years, the domestic supply (Groningen and small fields) will decrease even faster. As a result, the Netherlands will have to import more gas from abroad, with a peak of around 500TWh (normal year[30]) occurring in the early 2020s. How this import requirement will be met is uncertain at this time; this depends largely on the relative price levels of the various suppliers. Because Norway's production has plateaued for some time, it is unlikely that imports to Emden will increase by much. This means that the additional import is expected to be filled by Russian gas (via Germany) or LNG (via the Gate terminal in Rotterdam and/or through Belgium).

30 *In a cold year, gas demand is roughly 15% higher than in a normal year. After the closure of the Groningen field, the required extra volume will have to be provided entirely through additional imports.*

2.3 Sources

The table below lists the sources used in compiling the scenarios.

FIGURE 2.19. LIST OF SOURCES USED IN COMPILING THE SCENARIOS

Source		Data used
1.	Berenschot, Kalavasta (2020), Klimaatneutrale energiescenario's 2050 (Climate-neutral scenarios 2050)	Future scenarios for 2050 and the quantification of these
2.	CE Delft (2018), Contouren en instrumenten voor een routekaart groen gas 2020-2050 (Contours and instruments for a green gas roadmap for 2020 to 2050)	Assumptions for the development of green gas
3.	CE Delft (2020), MRA-brede Strategie Datacenters (AMA-wide strategy for data centres)	Scenarios for data centre expansion in the Amsterdam metropolitan area (AMA)
4.	CE Delft (2020), Potentieel van lokale biomassa en invoedlocaties van groen gas (Potential of local biomass, and feed-in locations for green gas)	Assumptions for the development of green gas
5.	Statistics Netherlands (CBS)	Historical consumption figures and production data
6.	CertiQ	Production capacity of, in particular, entities with renewable generation
7.	DNV GL (2017), Biomassapotentieel in Nederland (Biomass potential in the Netherlands)	Biomass potential in the Netherlands
8.	DNV GL (2018), Electrification of industry, facilitating the integration of offshore wind with power-to-heat in industry	Power-to-Heat capacity
9.	DNV GL, Gasunie (2019), Waterstof vraag en aanbod nu-2030 (Hydrogen supply and demand between now and 2030)	Assumptions for developments in the area of hydrogen
10.	Dutch data center association (2020), State of the Dutch Data Centers 2020	Reference values for data centres in 2020
11.	Elaad (2019), Naar 100% Z.E. in het OV, de ontwikkeling van elektrische bussen en hun laadlocaties in Nederland tot en met 2035 (Towards 100% Z.E. in public transport: the development of electric buses and their charging locations in the Netherlands up to and including 2035)	Scenarios with figures for number of electric buses
12.	Elaad (2019), Volgeladen naar zero-emissie stadslogistiek (Fully loaded to achieve zero-emission city logistics)	Scenarios with figures for number of electric HGVs and lorries (city logistics)

Continued on next page

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Source	Data used
13. Elaad (2019), Waar rijden en laden EV's in de toekomst? De ontwikkeling van elektrische voertuigen en laadpunten in Nederland t/m 2035 (Where will EVs travel to and charge in the future? The development of EVs and charging stations in the Netherlands up to 2035)	Scenarios with figures for number of electric cars
14. Elaad (2020), Elektrisch op bestelling, de ontwikkeling van elektrische bestelvoertuigen in Nederland t/m 2035 (Electric to order: the development of electric delivery vans in the Netherlands up to 2035)	Scenarios with figures for number of electric delivery vans
15. Elaad (2020), Truckers komen op stroom (Truckers power up)	Scenarios with figures for number of electric HGVs
16. ENTSO-E (2021), 2020 Ten Year Network Development Plan	Data on consumption, production and interconnection capacity in other countries in Europe; tax profiles for other countries in Europe; profiles for availability of weather-dependent sources; figures for long-term transmission capacities; thermal capacities of connections between countries
17. ENTSOG (2021), 2020 Ten Year Network Development Plan	Data from neighbouring countries on consumption, production and interconnections capacity
18. ENTSOG, ENTSO-E (2021), 2020 TYNDP Scenario Report,	Fuel costs, costs of carbon emission rights, development of supply and demand in neighbouring countries
19. European Commission (2020), State of the Union, Commission raises climate ambition and proposes 55% cut in emissions by 2030	Emission reduction targets
20. Federal Ministry for Economic Affairs and Energy (2020), The National Hydrogen Strategy	Developments in Germany
21. FNB Gas (2020), 2020-2030 Gas Network Development Plan	Developments in Germany
22. Gasunie Transport Services (2020), Advies leveringszekerheid voor benodigde Groningenvolumes en - capaciteiten (Recommendations on the security of supply for the required Groningen volumes and capacities)	Assumptions for natural gas production from the Groningen field
23. Green Liaisons (2018), Hernieuwbare moleculen naast duurzame elektronen, (Renewable molecules alongside sustainable electrons)	Assumptions for the development of green gas
24. Large-scale consumers	Forecast of demand from large-scale consumers
25. Klimaatberaad (2019) (Dutch Climate Council), Klimaatakkoord (Dutch Climate Agreement)	Basic Dutch Climate Agreement scenario

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Source	Data used
26. Ministry of the Interior and Kingdom Relations (2020), Staat van de Woningmarkt - Jaarrapportage 2020 (State of the housing market: annual report 2020)	Assumptions and bandwidths for the built environment
27. Ministry of Economic Affairs and Climate Policy (2020), Delfstoffen en aardwarmte in Nederland, jaarverslag 2019 (Minerals and geothermal energy in the Netherlands: annual report 2019)	Assumptions for natural gas production from small fields
28. Ministry of Economic Affairs and Climate Policy (2020), Kabinetsvisie waterstof (Dutch government's vision on hydrogen)	Assumptions for developments in the area of hydrogen in the Netherlands
29. NAM (2019), NAM overlegt met omgeving over toekomst locatie Grijpskerk (NAM consults with local communities on the future of the Grijpskerk facility)	Assumptions concerning the future of Grijpskerk UGS facility
30. Netbeheer Nederland (2021), Integrale infrastructuurverkenning 2030-2050 (2030-2050 Comprehensive Infrastructure Survey)	Future scenarios for 2050 and the quantification of these
31. PBL Netherlands Environmental Assessment Agency (2019), Effecten Ontwerp Klimaatakkoord (Effects of the Draft Dutch Climate Agreement)	Assumptions for Power-to-Heat in the Dutch Climate Agreement
32. PBL Netherlands Environmental Assessment Agency (2019), Achtergronddocument effecten ontwerp klimaatakkoord, gebouwde omgeving (Background document on the effects of the climate agreement, built environment)	Assumptions and bandwidths for the built environment
33. PBL Netherlands Environmental Assessment Agency (2019), Het Klimaatakkoord: effecten en aandachtspunten (The Dutch Climate Agreement: effects and points for attention)	PBL calculations for the Dutch Climate Agreement
34. PBL Netherlands Environmental Assessment Agency (2020), Klimaat en energieverkenning 2020 (2020 Climate and Energy Outlook)	General macroeconomic and demographic developments
35. Quintel Intelligence, Energy Transition Model (ETM)	Assessment of scenario assumptions
36. Regional network operators	Assumptions on the development of demand and production capacity at regional level
37. Dutch central government (2019), Letter to Parliament Progress on the implementation of Offshore Wind Energy Roadmap for 2030	Assumptions for developments in the area of offshore wind

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Source	Data used
38. Dutch central government (2019), Kolencentrale Hemweg volgend jaar dicht, (Hemweg coal-fired power station to close next year)	Intention to close the Hemweg coal-fired power station
39. Dutch central government (2019), Wet verbod op kolen bij elektriciteitsproductie (Act on the prohibition of coal in the generation of electricity)	Assumptions for change to defined production capacity of coal-fired power stations in the Netherlands
40. Dutch central government (2020), Nieuwe mogelijkheid om Groningenproductie voor gasjaar 2020-2021 verder te reduceren (New possibility to further reduce Groningen production for 2020-2021 gas year)	Assumptions for natural gas production from the Groningen field
41. Dutch central government (2019), Rapportage Routeradar Brandstofvisie Duurzame energiedragers in mobiliteit (Report on the use of renewable energy carriers in mobility)	Development of vehicles that use sustainable gas
42. Dutch central government (2019), Ruimtelijke Strategie Datacenters - Routekaart 2030 voor de groei van datacenters in Nederland (Spatial strategy for data centres: 2030 roadmap for the growth of data centres in the Netherlands)	General principles for data centre development and regionalisation
43. TenneT	Forecast of production from electricity producers
44. TNO (2020), The Dutch hydrogen balance, and the current and future representation of hydrogen in the energy statistics	Reference for hydrogen production in 2020
45. Wageningen University (2018), Kompas op 2030, verduurzamingsrichtingen energievoorzieningen Westlandse glastuinbouw (Compass on the way to 2030: ways to make energy supplies more sustainable in Westland commercial greenhouse operations)	Assumptions for developments in the area of the commercial greenhouse sector

3 Developments in the Dutch gas market

3.1. Phase-out of production from the Groningen field

After the earthquake in January 2018 near Zeerijp, the Minister of Economic Affairs and Climate Policy decided to end gas extraction from the Groningen field while preserving the security of supply and the 'gas-quality-neutral' gas market. To achieve this, a large number of measures have been initiated, including on the instructions of the Minister. Most of these measures have already been implemented, i.e.:

1. increased use of the baseload nitrogen installations, from 85% to 100%;
2. procurement of an additional 80,000m^3/hr of nitrogen for the Wieringermeer blending station;
3. export of pseudo L-gas via the Oude Statenzijl export station;
4. blending station built by GTG-Nord in Germany, from where about one third of the German L-gas market in the GTG-Nord area is supplied with H-gas;
5. filling Norg gas storage facility with pseudo L-gas.

In addition, a number of measures are currently being implemented in the Netherlands and in[31] other countries[32], specifically:

1. converting nine industrial large-scale consumers from L-gas to H-gas;
2. expanding nitrogen capacity through the construction of the Zuidbroek nitrogen installation;
3. repurposing the LNG peak shaver facility as a blending station;
4. converting the foreign L-gas market to H-gas (in order to reduce L-gas exports to zero);
5. converting Grijpskerk gas storage facility from H-gas to L-gas.

Based on the measures already implemented and those in progress, calculations by GTS show that the Groningen field can be closed for good sometime between mid-2025 and mid-2028. Figure 3.1 distinguishes between the production mode and the standby mode for the Groningen field. From gas year 2022/2023, the Groningen field will be in standby mode – on the pilot flame so to speak. After that time, the Groningen field will only be needed for times of extreme cold or in the event of a major interruption of supply from the nitrogen installations or an insufficient supply of H-gas.

31 See section 5.2 for more information about measures being implemented in the Netherlands.
32 For more information about measures being implemented in other countries, see the summer and winter reports of the Monitoring L-Gas Market Conversion Task Force: www.rijksoverheid.nl/documenten/rapporten/2020/02/21/task-force-monitoring-l-gas-market (in Dutch)

Figure 3.1 Development of required volume from Groningen in a cold, average and warm year (base case).

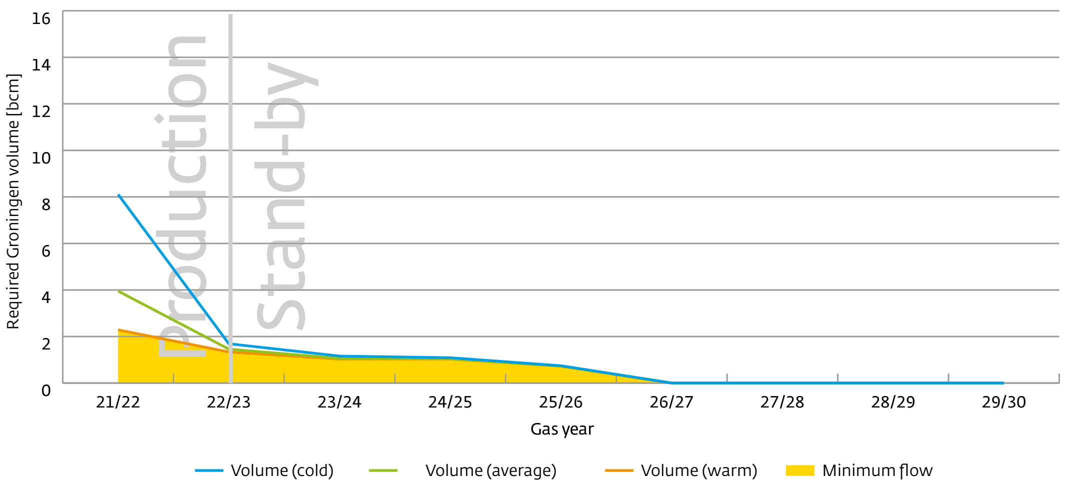
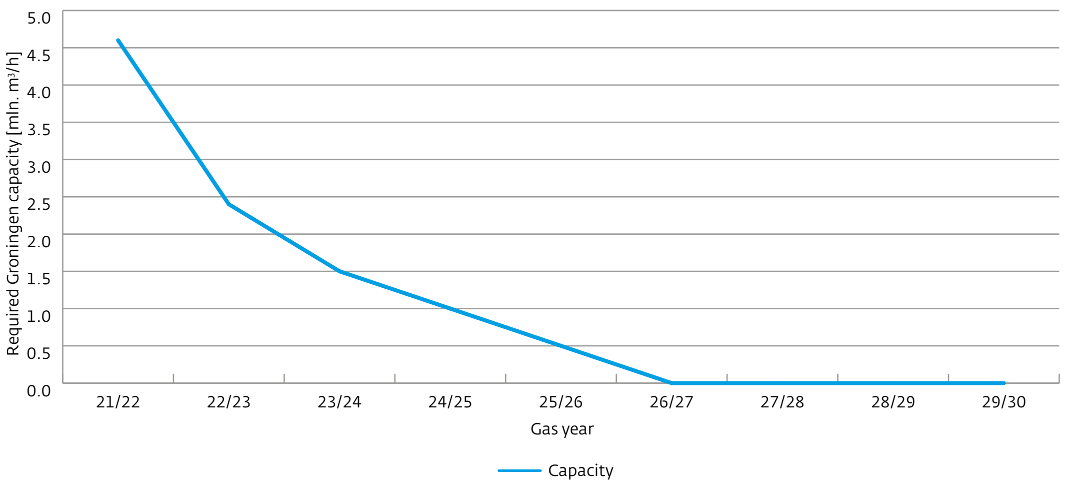


Figure 3.2 Development of required capacity from Groningen (base case).



3.2 Converting Grijpskerk gas storage facility from H-gas to L-gas

In September 2020, the Minister of Economic Affairs and Climate Policy asked GTS to investigate whether converting the Grijpskerk gas storage facility from H-gas to L-gas is technically possible (in terms of transmission) and what contribution the switch-over of Grijpskerk could make towards closing the Groningen field. In June 2021, GTS informed the Minister about the feasibility and the possible consequences of the conversion of the gas storage facility. The analysis by GTS revealed that, in view of the conversion of the gas storage and the accelerated conversion in Belgium, the Groningen field can be closed for good in the third quarter of 2023 or the third quarter of 2024.

Converting Grijpskerk to an L-gas storage facility ensures that full closure (meaning the Groningen field would also no longer be available as a backup) can take place three years earlier than without this switch. The investments GTS needs to enable the conversion of the Grijpskerk gas storage facility were submitted to the market parties, ACM and the Minister of Economic Affairs and Climate Policy in 2021 in an addendum to the 2020 investment plan. GTS officially added the addendum on 1 July 2021. In September 2021, the Minister of Economic Affairs and Climate Policy decided that the Grijpskerk gas storage facility will be converted from H-gas to L-gas, subject to the required permits being granted.

3.3. H-gas supply and use of storage facilities crucial for security of supply

With production from the Groningen field shutting down, the only natural G-gas source will disappear, which means that the entire G-gas and L-gas market must be supplied with pseudo G-gas and pseudo L-gas, both made from H-gas blended with nitrogen. This means that the availability of H-gas will play an essential role in maintaining security of supply. There must therefore be sufficient H-gas supply capacity, as well as sufficient storage capacity and storage volume in combination with sufficient nitrogen capacity. The Netherlands' dependence on imports will increase further as a result.

The German Gas Network Development Plan 2020–2030 (Netzentwicklungsplan, section 7.1.5) takes into account the security of supply in the Netherlands by investing in additional transport capacity between Germany and the Netherlands. This addresses a possible bottleneck in the German transport network.

In the Netherlands, key steps have now been taken to preserve and expand the L-gas storage facilities of the parties in the Gasgebouw joint venture for the Dutch market and to fill them in the summer, also for the period after 31 December 2024 (when GasTerra shuts down). This has been arranged via the Norg Agreement, in which the Dutch State, Shell, ExxonMobil and NAM have set out agreements regarding the timely filling of L-gas storage facilities to an adequate level each year.

The consequences of the Dutch dependence on imports of Norwegian and Russian pipeline gas became evident last winter. The high demand for LNG in Asia meant a lower supply of LNG to the European market. Large volumes of transit gas also passed through the Dutch network en route to the UK market. Gas storage facility occupancy rates dropped to a relatively low level of 18% by the end of the winter.

In addition, H-gas storage facilities in countries without legal or regulatory obligations in the area of gas facility occupancy and such experienced a much lower occupancy rate in the summer of 2021 than in the past 10 years. This applies in any case to Dutch, German and Austrian storage facilities. The main reason for this was the summer-winter spread expected by the market parties (high summer prices combined with lower winter prices).

The table below shows the occupancy rate of the Dutch seasonal storage facilities on 1 October 2021.

Gas storage	Gas quality	% filled	Max (bcm)
Norg UGS	G-gas	81%	6.0
Alkmaar PGI	G-gas	99%	0.5
Bergermeer UGS	H-gas	27%	4.8
Grijpskerk UGS	H-gas	50%	2.7

We drew attention to this potential problem already in the previous investment plan (IP2020; see section 3.3.4), though the focus there was on L-gas storage facilities (now regulated by Gasgebouw's Norg Agreement, including after GasTerra shuts down). Stored volumes of L-gas and H-gas are needed in the winter months to provide the market with sufficient capacity. GTS' H-gas supply capacity and QC capacity are insufficient to serve the entire market. Under its peak supply duty, GTS is obligated by law to provide gas when temperatures drop to minus 9°C or lower. GTS procures the capacity and volume required to fulfil its peak supply duty through a tender procedure. This means that the suppliers are responsible for gas supply at temperatures above minus 9°C. These parties need to be aware that during cold winters the import capacity at the border is already being fully utilised and that, if the market is to be provided with sufficient gas, the remaining volume must come from storage.

Our current estimate is that sufficient infrastructure is available to meet current and future needs (supply capacity, storage facilities and QC capacity), but it is the responsibility of the market parties to supply sufficient gas to the Dutch gas market on time to fill the storage facilities. In other words, once this gas can no longer be sourced from the Groningen gas field, it will be even more important that the market parties accept this responsibility.

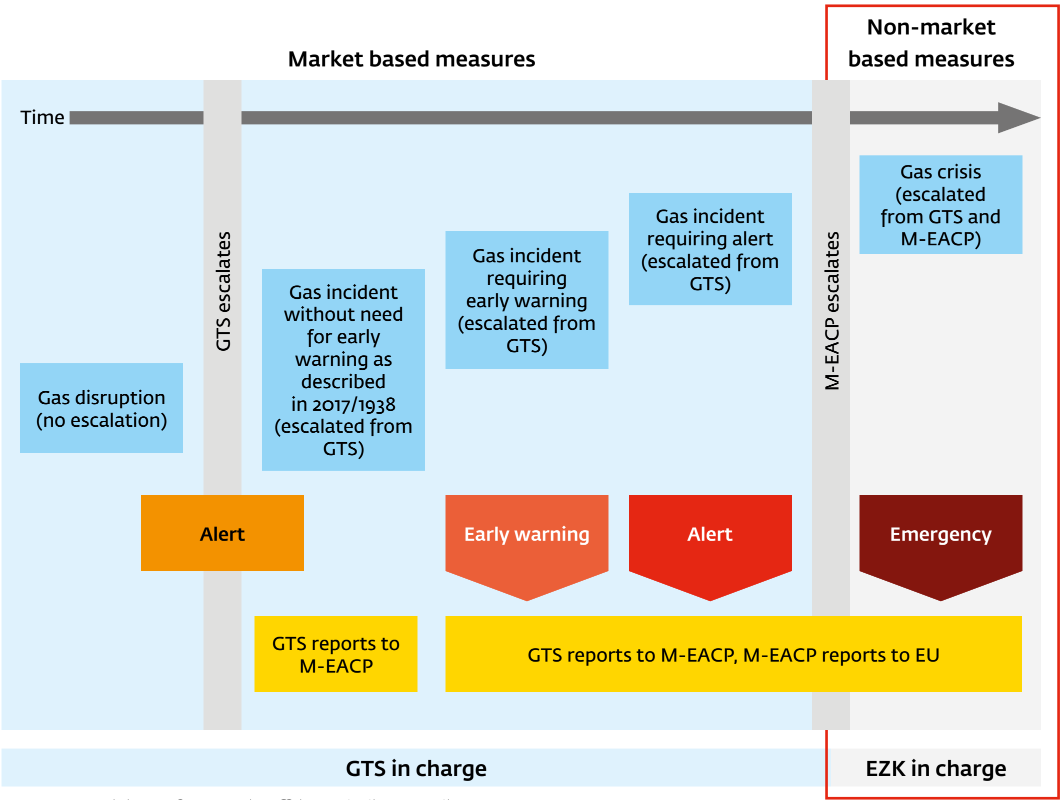
GTS explicitly asks for attention to be paid to ensuring the security of supply, given that the Groningen field will soon be closed and will then no longer be available for times of extreme cold or if supply from installations is interrupted.[33]

Without sufficient gas volumes, we will have to resort to implementing the Gas Protection and Recovery Plan[34], the Dutch implementation of a contingency plan under a European regulation.[35] The figure below shows that the Ministry of Economic Affairs and Climate Policy will be in charge should a gas crisis/emergency be declared.

33 *Information session II 2022 Investment Plan*
34 *www.rijksoverheid.nl/documenten/publicaties/2019/10/04/bescherm-en-herstelplan-gas (in Dutch)*
35 *Regulation (EU) 2017/1938 of the European Parliament and of the Council of 25 October 2017*

Although processes, procedures, roles and measures have been defined, GTS assumes that the market parties will take their responsibility and take the measures needed to avert such a crisis. The contingency plan describes actions to reduce gas demand by shutting down – in particular – industries. This is an undesirable situation.

FIGUUR 3.3 MARKET BASED MEASURES



M-EACP = Ministry of Economic Affairs and Climate Policy.

3.4. Legislation and regulations

It is expected that in the course of 2023 the current Gas Act will be replaced by the Dutch Energy Act, which brings together the Gas Act and the Electricity Act into one piece of legislation. The reason for integrating the Gas Act and the Electricity Act is the anticipated increasingly extensive integration of energy systems. The Energy Act serves to implement the new EU regulation on the internal market for electricity while also giving substance to national policy objectives, like those stated in the Dutch Climate Agreement. Although the changes are less drastic for gas than for electricity, the Energy Act will nevertheless have noticeable consequences for gas network users and gas network operators.

The Energy Act is expected to offer network operators the option of taking in biogas and hydrogen gas, provided that this can be blended to the correct delivery specifications for natural gas. The Energy Act also provides for a change in the legal status of the codes, and a number of codes will be included in whole or in part elsewhere in the system of laws and regulations (in a Ministerial Regulation and/or Order in Council). The Energy Act will also contain the legal foundations for a new system of data governance for the sector. Where EU regulations, which have direct effect, already assign duties to GTS as TSO, this is not repeated in the new Energy Act. In addition, more so than in the Gas Act, the terminology used in EU regulations is being used in the Energy Act as well; for example the term 'programme-responsible party' is being replaced by 'balance-responsible party'. The Ministry of Economic Affairs and Climate Policy consulted the bill early in 2021. The consultation version of the bill (in Dutch) can be seen on internetconsultatie.nl. It is expected that the amended version of the bill that will be sent to the regulatory authorities to assess the feasibility and enforcement will also be made available via this link. Secondary legislation, in which various matters will be defined and elaborated will be drafted in the first half of 2022. The Ministry of Economic Affairs and Climate Policy expects that the Energy Act, including the secondary legislation, can come into force in the course of 2023.

Legislative amendment 'After zero, what then?'

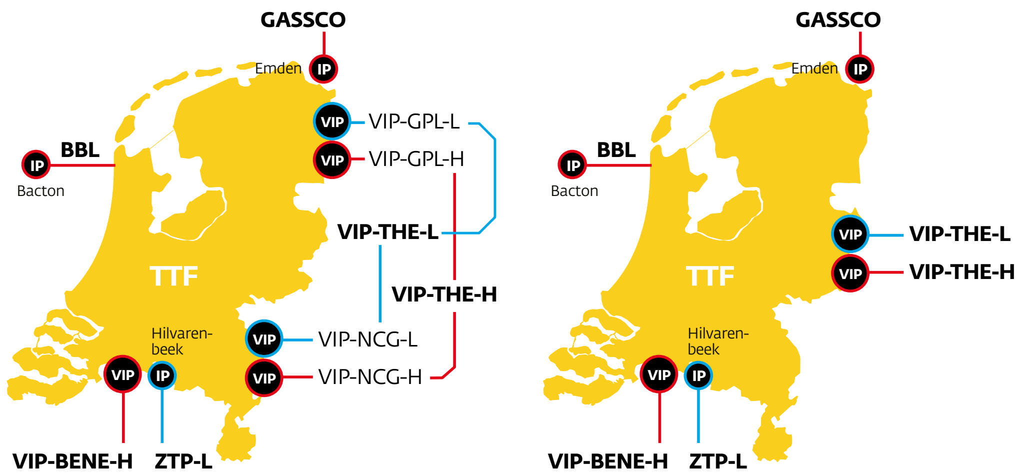
In anticipation of the Energy Act coming into effect, the current Dutch Gas Act (and the Dutch Mining Act) is expected to be amended in the course of 2022 to provide clarity to market parties and the residents of Groningen on the closure of the Groningen field. The amendment to the Gas Act is necessary because the current legislation with regard to the provisions for Groningen and environs are no longer sufficient in the final phase of production.

The amendment to the law provides for two distinct phases for production from the Groningen field: the phase in which the Groningen field is only required as a back-up option and for in extremely cold periods, and the phase in which the Groningen field will be shut down completely. It has not yet been determined when each of these phases will start.

3.5. German market consolidation: Trading Hub Europe

On 1 October 2021, the consolidation of the German market became a reality when GASPOOL and NCG merged to form Trading Hub Europe (THE), leaving Germany with one single market area.
Since the consolidation, the TTF market area has been connected to THE. A consequence of the consolidation is that the existing H-gas and L-gas VIPs (between, respectively, the TTF and the former GASPOOL and TTF and the former NCG) will be merged into the H-gas and L-gas VIP between TTF and THE. GTS will transfer all capacity contracts that were in place for the existing VIPs prior to 1 October 2021 to the corresponding new VIP. The only thing that will change for shippers is the name of the VIP. Contracts for the underlying IPs will only be transferred to the corresponding VIP at the shipper's request through the VIP Transfer Service. In the meantime, the above has been carried out for the L-gas VIPs. The German TSOs have stated that they need more time to consolidate the H-gas VIPs. It is expected that this category will be converted as of 1 April 2022; until then, the existing H-gas VIPs with Germany will remain in effect. The figure 3.4 shows the situation prior to 1 October 2021 and the final situation as at 1 April 2022.

Figure 3.4: Situation prior to 1 October 2021 and situation as at 1 April 2022



The German network operators have given preference to market-based measures (wheeling, transit through foreign TSOs' networks, and exchange-based spread products) to network expansion to avoid capacity constraints after the consolidation. Capacity constraints are largely the result of the limited physical transport capacity between the former NCG and GASPOOL. Using the market-based instruments prevents capacity bottlenecks. For the full details and explanation, we refer you to the German Gas Network Development Plan (Netzentwicklungsplan; NEP 2020[36]).

The German network operators' decision to use market-based instruments is expected to have a positive effect on capacity sales in the GTS network given that the part of the required transport that is not physically possible between GASPOOL and NCG is possible using the Dutch transport network. This physical capability can be put to use through new capacity contracts with GTS.

3.6. TTF

The TTF (Title Transfer Facility) was established in 2003 as a virtual marketplace where ownership could pass from one hand to another. Since its launch, gas trading and liquidity in the region has expanded massively, making TTF the benchmark of choice for the European mainland and elsewhere. Thanks to the solid infrastructure, the TTF not only serves the Netherlands, but also the surrounding countries. For example, the volume traded on the TTF in 2020 was more than 20 times the gas consumption in France, Germany, Austria, the Czech Republic and the Benelux combined. About 75% of the volume of gas traded in Europe now bears a TTF label. The TTF is also increasingly becoming a global gas marker and appears to be developing into the 'Brent Crude' of the gas market

The ever-increasing liquidity of the TTF is no guarantee for low gas prices, at least not on a permanent basis. Factors such as supply and demand and the presence or absence of transmission/transport bottlenecks are much more decisive for the price level. This can also cause significant price fluctuations on liquid gas markets.

36 *www.fnb-gas.de/en/network-development-plan/network-development-plan/network-development-plan-2020/*

Domestic reserves in Europe are dwindling, further increasing the need for imports; TTF is an important facilitator in directing new sources of gas to Europe.

Historically, most of the EU's foreign gas has come from Russia, Norway and Algeria. However, the rapid increase in LNG has been instrumental in boosting global gas trade. The shale revolution in the US and the subsequent increased US LNG exports have contributed to strengthening the TTF.

The advance of LNG in the world market and the further growth of the TTF are closely linked. Previously, most international trades were made on the basis of long-term contracts with prices linked to oil. The growing LNG industry has provided the global gas market with an increasing degree of flexibility and liquidity relative to the regional gas markets based on pipeline infrastructure.

With ever decreasing EU reserves, LNG imports will continue to be an important contributor to the natural gas supply-scape, alongside the traditional pipeline-based supply. With the increasing use of flexible pricing and liquidity, the TTF is likely to grow further, strengthening its role as a global benchmark.

The TTF is therefore 'most likely to remain the European gas price benchmark as well as a global benchmark'.[37]

3.7. Network optimisation in anticipation of declining utilisation

In recent decades, the GTS network has been arranged in such a way as to meet, over the long term, the continuously increasing demand for transmission capacity, both for supplying the Netherlands and for export and international transit. This integration creates economies of scale for larger transmission volumes. After all, the marginal costs are low, which means that transporting more gas is relatively cheap. This synergy between domestic transmission, export and transit is one of the reasons that the GTS tariffs have been among the lowest in Europe in recent years. As a result of falling demand the economies of scope have decreased.

In the coming years, GTS will adjust the capacity of the grid to bring it more in line with the falling demand, taking a number of installations out of operation for this purpose. This concerns L-gas compressors that are no longer needed for gas transmission due to the phasing out of L-gas exports. This move allows GTS to save on maintenance and upkeep costs. The prerequisite for decommissioning is that security of transmission is ensured at all times. The pipeline network will still be needed to a large extent to meet the regular and peak demand for transmission capacity.

37 *European Traded Gas Hubs: German hubs about to merge, OIES Paper NG 170.*

3.8. Green gas developments

GTS expects the production of green gas to increase in the coming years. In order to accommodate the introduction of this green gas, GTS will have to make the grid suitable in a number of places. Two types of investments are available for this. The first type concerns the installation of green gas booster units, which are used to transfer green gas from the regional gas grid to the GTS network. In 2019, GTS installed the first green gas booster unit in Wijster and expects to install an average of one booster unit per year over the coming years. GTS is also investigating the possibility of using mobile booster units to minimise the costs of overflow.

The second type of investment concerns the development of green gas aggregator pipelines. This option makes it possible to centrally feed green gas into the GTS network and thus limit the number of separate feed-in points. In some situations, this solution is more efficient than placing one or more booster units. GTS is currently conducting a study into the development of a gathering pipeline.

3.9. Hydrogen transmission network

GTS foresees a growing role for hydrogen as a sustainable energy carrier and feedstock. Existing natural gas pipelines will eventually be repurposed for the transmission of hydrogen. This is attractive for the users of the hydrogen transmission network because it means that there will be less need for new, more expensive construction. It is also attractive for GTS customers because it will reduce the costs of the remaining natural gas network.

Role for Gasunie

The State Secretary for Economic Affairs and Climate Policy stated in a letter to parliament[38] that she will ask Gasunie to take on the task of developing a national hydrogen transmission network. Gasunie has started preparations for the development of the hydrogen transmission network, such as bringing supply and demand into sharper focus and collecting initial commitment from producers and customers, as well as making suggestions on the phasing for the development of the hydrogen transmission network.

The purpose of the hydrogen transmission network is to link supply, demand and storage of hydrogen on a national scale. Gasunie intends to build a 1200km hydrogen transmission network that will connect the five key industrial regions in the Netherlands with storage and industrial regions in Germany and Belgium.
This network will be realised in phases, with the first step being to connect the industrial clusters, followed by establishing connections within and between the regions and over the border. The capital investment required for this is estimated at € 1.5 billion, with annual operating costs of approximately € 40 million (2020 price level).
Higher capacities can be achieved at a later time by installing compressors or by making use of additional natural gas pipelines.

38 *www.rijksoverheid.nl/documenten/kamerstukken/2021/06/30/kamerbrief-over-ontwikkeling-transportnet-voor-waterstof*

Use of existing GTS assets

Towards the summer of 2021, in collaboration with relevant stakeholders the Ministry of Economic Affairs and Climate Policy completed the Hyway27[39] project, which details the possible use of the existing natural gas pipelines for hydrogen. The hydrogen transmission network is ultimately expected to consist largely (about 85%) of repurposed natural gas pipelines. These pipelines are currently part of the GTS natural gas network. GTS has made an analysis of the expected future transmission flows of natural gas. The required transmission capacity for natural gas in the Netherlands will decrease by between 11% and 23% in the period up to 2030, partly as a result of declining exports relating to the phasing out of gas extraction in Groningen. The main natural gas transmission network consists of several parallel pipelines. As the transmission of natural gas decreases, it is possible that transmission pipelines will gradually become available for the transmission of hydrogen. GTS has identified routes that match the required connections in the hydrogen transmission network. Research has shown that the pipelines can be technically modified in such a way as to enable the safe transmission of hydrogen. Technical adjustments concern, for example, replacing valve set-ups and cleaning the pipelines. In the province of Zeeland, Gasunie has already gained experience in preparing existing natural gas transmission pipelines for the transmission of hydrogen: hydrogen has been transported in this province between Dow in Terneuzen and Yara in Sluiskil since 2018.

Asset transfer

Given that GTS currently has no statutory duty to transmit hydrogen, GTS cannot invest in new infrastructure for hydrogen transmission or in repurposing existing gas pipelines for hydrogen transmission. This means that under the current laws and regulations GTS' natural gas pipelines would need to be transferred to a new network operator in the Gasunie group.

Consideration will have to be given both to the technical aspects relating to the required transmission and to the socio-economic aspects. The 'technical aspects' concern GTS being able to continue to fulfil its statutory duty with regard to natural gas transmission, i.e. it must be able to continue to guarantee the security of supply and transmission of natural gas. The transmission network for hydrogen will also have to be safe, future-proof and robust, however.

The 'socio-economic aspects' relate to GTS' duty to develop the gas transmission network in a way that guarantees the efficiency of that network and the supply of gas. In light of an expected decrease in demand for natural gas transmission, the development of a hydrogen market and infrastructure in which GTS assets are used/repurposed may have a positive effect on GTS tariff development, given that GTS would transfers these assets and ACM would then include the proceeds when setting the natural gas tariffs. Some of the GTS customers will probably also switch to the hydrogen network. For the hydrogen network, the use of existing GTS assets should in any case not result in costs higher than would be required for the 'new build' alternative.

39 www.hyway27.nl/

In order to simplify this issue and offer grid users as much clarity and predictability as possible, a uniform valuation method for the intended assets needs to be established – in coordination with the relevant stakeholders (including ACM and the Ministry of Economic Affairs and Climate Policy) – which can be used to set a standard price per kilometre of pipeline to be transferred. Clearly, this valuation method would be based on the value of the assets in GTS' regulated asset base (RAV). After all, the assets will be transferred from GTS to another, eventually to be regulated grid operator, with the users of both grids also increasingly being the same in the long term. A standard price based on the average RAV makes it possible to choose the best solution (in terms of technical and other aspects) for each situation with the lowest total societal costs (for example by initially using pipes with a smaller diameter), without this resulting in adverse effects for GTS customers. After assets have been transferred to the operator (or proposed operator) of the hydrogen transmission network, they will no longer be part of the costs of the natural gas network. This will have a positive effect on tariff development.

4 Bottlenecks

4.1 Capacity bottleneck analysis findings

The bottleneck analysis was performed separately for GTS' HTL and RTL. The transmission capacity of both networks has been assessed for all three scenarios: DCA, ND and IA.

HTL

For the HTL, the bottleneck analysis is based on the complete set of high transmission load situations that can occur in a scenario based on the method for capacity assessment as described in section 1.3.2.

The transmission calculations have shown that, in all three scenarios, all transmission situations can be accommodated. In all scenarios, the available capacities at the entry and exit points are at or above the required values as currently envisaged for the period concerned. Investments to create more capacity are therefore not necessary.

Only final decisions regarding the closure of the Groningen gas field have been included in this bottleneck analysis.

RTL

The RTL capacity analysis has not revealed any bottlenecks under any of the three scenarios.

4.2 Quality assurance system findings

Various quality bottlenecks have been identified using the methods described in the quality assurance system. These quality bottlenecks and the resulting investments are shown in Appendix III. Furthermore, no quality bottlenecks have been identified that lead to an investment of more than € 5 million or investments that fall under the Rijkscoordinatieregeling (National Coordination Scheme (RCR)) for which no FID has yet been taken.

5. Investments proposed for 2022–2031

This section provides insight into the scope and structure of the portfolio of proposed investments over the next 10 years.

5.1 General

The following categories are used in the Kader *Informatiebehoefte Investeringsplannen 2022* [2022 Information Requirement Framework for Investment Plans] that ACM has sent to GTS for the purpose of assessing the 2022 Investment Plan (2022IP):

- Regular investments: replacement and expansion investments of less than € 5 million, with the exception of connections, diversions and investments to meet a need identified in another process.
- Major investments: investments under the National Coordination Scheme or replacement and expansion investments greater than or equal to € 5 million, excluding connections, diversions and investments to meet a need identified in another process.
- Connections and diversions: investments in existing and new connections initiated by third parties, including green gas connections, and changes to the national gas transmission network at the request of third parties.
- Network-related: this does not concern investments in the physical parts of the grid but rather grid-related investments in aspects of the business that pose a significant risk to fulfilling the statutory duty.

Expansion investments

An expansion investment is defined as an investment that a) leads to an increase in the length, capacity or functionality of the gas transmission network; and b) is based on an external requirement.

Replacement investments

The assets in the national gas grid originate from different periods, the oldest being approximately 55 years old. Given this fact, regular and major maintenance investments are made to keep the transmission system operating safely, reliably, and in a risk-efficient manner. The maintenance investments mainly consist of corrective measures (performance of assets compared to the standard), replacements in line with policy concerning, for example, obsolete parts (e.g. electronics), regularly scheduled activities (e.g. civil engineering maintenance), and CSR (reducing the carbon footprint).

In the context of risk-based asset management (RBAM), GTS has switched from preventive replacement to a more corrective maintenance strategy. This development will mean that making preventive replacements based on identified risks will be weighed – with the expectation that these will decrease – and that corrective management and maintenance activities will increase as a result.

Available data
GTS has available a full list of projects for the years 2022 and 2023, i.e. projects that have already been approved or are already in the preparatory phase. Additionally, data with respect to ongoing investments for 2024 onwards is included in the following categories:
- regular expansion investments
- major investments
- connections and diversions.

For the new investments and investments in diversions and IT in 2024 and the following years, the investment levels as calculated for the Investment Outlook are assumed; this is GTS' estimate of the investment levels over the next 15 years based partly on historical data. This investment level is used to, among other things, determine GTS' financing needs.

If applicable GTS must account for technical investments of more than € 5 million and IT investments of more than € 4 million for which no FID has yet been made, based on an alternatives analysis.

The reference date for the investment portfolio is 1 August 2021, meaning that information provided with respect to aspects such as the status of an investment or a financial forecast is valid as at 1 August 2021.

Notes to the tables
The following sections include tables showing expected costs per year. The forecast costs are aggregated at asset category level. In many cases, an investment can be allocated to a single asset category. Where an investment relates to several categories of assets, this is listed under the designation 'multiple asset categories'.

5.2 Regular and major investments
This section provides an explanation of various replacement and expansion investments that will determine the size and structure of the investment portfolio in the coming years.

Conversion projects
In 2018, the Minister of Economic Affairs and Climate Policy announced that gas extraction from the Groningen field would be phased out completely as soon as possible.[40] As a result, GTS has been given the statutory duties needed to help minimise use of G-gas by means of quality conversion and switching.[41] The projects being carried out at this time were already included in the 2020IP or in the related addendum:
- Zuidbroek nitrogen plant
- G-to-H conversion of large industrial consumers
- Conversion of Grijpskerk UGS to G-gas

Any future measures for the closure of the Groningen field may lead to amendments to the IP.

40 *Dutch Ministry of Economic Affairs and Climate Policy: Letter to parliament on the termination of gas extraction in Groningen , 2018 (in Dutch).*
41 *Converting H-gas to G-gas by injecting nitrogen.*

Renovation of valve set-ups

A large portion of the valve set-ups were replaced between 2011 and 2017. A condition-based maintenance strategy has been adopted for the remaining part of the system. From 2022 onwards, around 50 valve set-ups will be replaced each year, accounting for an expected average investment of € 32 million per year.

ZEBRA network integration

After the acquisition of the ZEBRA gas pipeline and the extra high-pressure networks in the south-western region of the Netherlands, on 1 January 2021 these assets became part of GTS' national gas transmission network. In 2020, technical adjustments were made to integrate these networks into the GTS network. Further modifications are expected in 2022 and subsequent years with a view to ensuring that the system can be maintained and operated. Where these concern investments, relevant measures are included under regular investments.

5.2.1 Regular investments for 2022–2023

The regular investments concern all investments in the national grid amounting to less than € 5 million per investment. The new regular investments for 2022IP, together with the previously approved regular investments, are shown in Table 5.1.

Table 5.1 Regular investments per asset category from 2021 onwards

Regular (€ millions)	Forecast for 2021[42]	Forecast for 2022	Forecast for 2023
Valve set-ups	24.3	27.2	38.4
Compressor stations	10.1	9.9	4.0
Export stations	0.1		
Gas receiving stations	6.1	8.7	3.0
Pipelines	3.5	3.8	6.4
LNG	0.7	3.5	3.7
M&R	2.8	1.7	0.4
Multiple asset categories	5.0	8.5	4.6
Blending stations	0.6	0.4	1.0
Other	2.6	0.9	1.1
Reducing stations	0.1	0.2	1.3
Nitrogen installations	0.9	0.1	
Total	56.8	64.9	63.9

Appendix III details the underlying regular investments for the period 2022–2023.

42 *Forecast as per 1 August 2021.*

5.2.2 Major investments for 2022–2023

Major investments comprise all investments in the national gas grid amounting to € 5 million or more per investment, and NCS investments for the maintenance and development of the national gas grid.

The new major investments for 2022IP, together with the previously approved major investments, are shown in Table 5.2.

TABLE 5.2 MAJOR INVESTMENTS PER ASSET CATEGORY FROM 2021 ONWARDS

Major (€ millions)	Forecast for 2021[43]	Forecast for 2022	Forecast for 2023
Afsluiterschema's	3.0	0.1	
Compressorstations	0.4		
Gasontvangstations			0.3
Leidingen	0.1	0.1	5.0
LNG	0.5		
M&R	0.1	0.1	0.1
Meerdere assetcategorieën	8.7	38.0	59.6
Overig	2.3	3.2	
Stikstofinstallaties	87.6	95.4	18.4
Eindtotaal	102.7	136.9	83.4

5.2.3 Regular and major long-term investments

The Investment Outlook shows an annual investment level of approximately € 67 million for the regular and major replacement investments. Given the declining demand in the G-gas market, GTS has investigated the consequences for the utilisation of the transmission grid capacity and it has emerged that the use of G-gas compression stations in particular can be reduced. These will be completely or partially shut down (possibly temporarily). This will serve to reduce the level of maintenance investments starting partway through 2026 and onwards.

GTS also takes into account regular and major investments to enable the injection of green gas into the grid. The IP includes the study into the GZI gathering pipeline. For the longer term, an estimate has been made of the annual investment level for these specific green gas investments. For the time being, € 5 million per year from 2024 has been assumed. The regular and major investments up to and including 2031 are shown in Table 5.3.

43 *Forecast as per 1 August 2021.*

Table 5.3 Regular and major long-term investments

Regular and major long-term investments per project											
Forecast (€ millions)	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Replacement investments	62	67	67	66	66	62	62	62	62	62	60
Zuidbroek N2 plant	81	90	16								
Conversion G-gas to H-gas	10	41	59	36							
Grijpskerk UGS conversion	2	3									
Green gas boosters + gathering pipelines	2		6	5	5	5	5	5	5	5	5
Various expansions and acquisitions	2	1									
Total Regular + Major	160	202	147	107	71	67	67	67	67	67	65

The expected replacement investments (regular + major) totalling approx. € 62-67 million per year for the 2022–2026 period break down as follows (Table 5.4) by asset category:

Table 5.4 Replacement investments (regular + major) per asset category

Replacement investments (regular + major) per asset category						
Forecast (€ millions)	2021[44]	2022	2023	2024	2025	2026
Total	62	67	67	66	66	62
Valve set-ups	27.4	27.3	38.4	32	32	32
Compressor stations	10.4	9.9	4.0	6.5	6	3
Export stations	0.1			0.5	0.5	0.5
Gas receiving stations	6.1	8.8	3.2	7	7	7
Pipelines	2.4	3.9	6.4	5	5	5
LNG	1.2	2.3	3.7			
M&R	2.8	1.8	0.5	3.1	3.9	3.9
Multiple asset categories	2.1	5.8	5.6	2.8	2.8	2.8
Blending stations	0.6	0.4	1.0	1.2	1.2	1.2
Other	2.6	0.8	0.7	1.4	1.4	1.4
Reducing stations	0.1	0.2	1.3	1.0	0.7	0.3
Nitrogen installations	6.6	5.9	2.1	5	5	5

44 Forecast as per 1 August 2021.

5.2.4 Studies into possible major investments

GTS is currently carrying out a number of studies from which investments may possibly follow. These studies are still in the preparatory phase. Because these investments may come within the scope of the 2022IP, GTS feels it should include these studies for information purposes. Should the studies described below actually reach the realisation phase and come within the scope of the 2022IP, GTS can add an addendum if the required investment would result in a significant variance. The expected investment costs are a rough estimate.

PG-I.014513 - CSR Making M&R stations emission-free

Study into the possibilities for converting the continuously emitting regulating systems at the metering and regulating stations in the period from 2023 to 2030 to non-gas-emitting regulating systems to reduce methane emissions. GTS expects to take an FID in 2023.

PG-I.014442 - Replacement of CRS and TMX

The GTS capacity registration systems (CARS) and telemetry systems (TMX) are obsolete and need to be replaced in due course. A capacity registration system is part of the gas metering installations that ensure accurate registration of the energy content of the gas flow. GTS expects to take an FID in 2022.

PG-I.014428 - Replacement of OI/OL gas chromatographs

The GTS gas chromatographs (GC) and data acquisition systems (DAS) are obsolete and need to be replaced in due course. An adequately functioning GC is a legally required part of the gas metering installations that ensure accurate determination of the energy content of the gas flow.

PG-I.014510 - Replacement of E-VCDs with new devices in 2023 and beyond

Several types of electronic volume conversion devices (E-VCDs) used in GTS installations are obsolete and need to be replaced in due course. An E-VCD is a legally required part of the gas metering installations that ensure accurate determination of the energy content of the gas flow.

PG-I.013799 - GZI green gas collector pipeline Emmen

In the investment plan 2020 (IP2020), GTS has included a study into a collector pipeline for green gas at the GZI site in Emmen. GTS has now made further progress with this study. In the area concerned, a lot of green gas is fed into the RTL of GTS and the regional networks of Rendo, Coteq and Enexis. However, the future gas withdrawal is too low to accommodate the production of green gas. Producers can feed in green gas via a collector pipeline and, moreover, surpluses from the network of RNBs can be accommodated.

5.3 Connections and diversions

This concerns investments in existing and new connections, including green gas connections.

Diversions concern investments required due to developments relating to spatial planning by third parties (e.g. municipalities, Rijkswaterstaat) that result in GTS assets having to be relocated. This mainly concerns pipelines and, once every two to three years on average, a gas receiving station. The party requesting the diversion pays GTS compensation of, on average, two-thirds of the costs; the actual amount depends on the legal position. The new investments for connections and conversions for the 2022IP, together with the previously approved investments for these, are shown in Table 5.5. The amounts shown in Table 5.5. Investments in connections and diversions per asset category from 2021 onwards and the Appendix III do not include contributions from third parties, where applicable.

The 2022–2023 diversion portfolio is expected to amount to € 8.8 million in 2022 and € 10.9 million in 2023.[45]

Table 5.5 Investments in connections and diversions per asset category from 2021 onwards

(€ millions)	Forecast for 2021[46]	Forecast for 2022	Forecast for 2023
Connections			
Valve set-ups	0.1	1.4	7.3
Gas receiving stations	0.5	1.2	0.1
Pipelines	0.3		
Multiple asset categories	0.9	4.0	5.2
Subtotaal aansluitingen	1.8	6.6	12.6
Diversions[51]			
Pipelines	4.0	8.7	10.9
Multiple asset categories	1.4	0.1	
Subtotal, diversions	5.4	8.8	10.9
Total, connections and diversions	7.2	15.4	23.5

In the long term, an annual average investment level of € 6 million is expected for new connections and € 12 million[47] for diversions (see Table 5.6). The level of investment depends in part on economic developments.

45 *Excl. third-party contributions.*
46 *Forecast as per 1 August 2021.*
47 *Excl. third-party contributions.*

Table 5.6 Investments in connections and diversions over the long term

Connections and diversions over the long term											
Forecast (€ millions)	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Connections	1.8	6.6	12.6	6	6	6	6	6	6	6	6
Diversions[48]	5.4	8.8	10.9	12	12	12	12	12	12	12	12
Total, connections and diversions	7.2	15.4	23.5	18	18	18	18	18	18	18	18

Appendix III details the underlying investments in connections and diversions for the period 2022–2023..

5.4 Grid-related IT investments

GTS currently still owns a number of IT assets that are used by both GTS and other Gasunie participations. The associated costs are distributed pro rata among the users. The use of these IT assets by non-GTS entities is likely to increase in the coming years. As a result, ownership of GTS is becoming less and less logical.

For this reason, it has been decided to transfer the IT assets to Gasunie as of 1-1-2022. The consequence of this decision is that GTS will no longer make CAPEX IT investments in the future. GTS will, however, pay an annual fee (OPEX) to Gasunie for the use of these assets. The proportion of use does not change as a result of the asset transfer. Due to this transfer, GTS does not list IT investments for approval in the IP2022.

5.5 'Need identified in another process' investments

These are investments for which the need has already been identified in relation to a different process, being required under national or European legislation, for example. This concerns connecting small fields and facilitating cross-border transport (incremental capacity).

Small fields

In accordance with Article 54a of the Dutch Gas Act, GTS must take in gas from small fields. Production from small fields (onshore) has been declining for years and there is little likelihood that new feed-in points for small fields will be arranged even in the short and medium term. Any investments are not expected to extend beyond modifying existing connections.

48 Excl. third-party contributions.

Incremental capacity

In line with EU Regulation 2017/459 (Network Code on Capacity Allocation Mechanisms; NC CAM), the incremental capacity process has been introduced. This is an EU-wide harmonised process to identify the market demand for incremental capacity by TSOs.
In the 'market interest survey' for the 2019–2021 incremental capacity process, GTS received one non-binding request for 10.7GW for the period 2025–2040 on the border between TTF and Trading Hub Europe. However, no investments have arisen for GTS from the 2019–2021 incremental capacity process.
The 2021–2023 incremental capacity process started in August 2021. The market interest assessment process has now been completed and GTS has not received any non-binding demand indications.
The 2021–2023 incremental capacity process has accordingly been completed.

5.6 Total investments (2022–2031)

Up to and including 2023, GTS' investment portfolio will be largely determined by measures to accelerate the phase-out of gas extraction from the Groningen field.
From 2025 onwards, as the Groningen measures are set to be completed, the total annual investment level is expected to fall sharply to approximately € 85 million, this being the level needed to maintain the transmission network through to 2031.

Table 5.7 Total investments over the long term

Total investments over the long term											
Forecast (€ millions)	2021[49]	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Regular + Major											
Investments (regular + major)	62	67	67	66	66	62	62	62	62	62	60
N2 plant Zuidbroek	81	90	16								
Conversion G-gas to H-gas	10	41	59	36							
Grijpskerk UGS conversion	2	3									
Green gas boosters + gathering pipeline	2	0	18	5	5	5	5	5	5	5	5
Connections	1.8	6.6	12.6	6	6	6	6	6	6	6	6
Diversions	5.4	8.8	10.9	12	12	12	12	12	12	12	12
Total	167	218	171	125	89	85	85	85	85	85	83

49 *Forecast as per 1 August 2021.*

6. Review of the 2020 Investment Plan (2020IP)

In the previous investment plan (2020IP), GTS offered an overall view of all investments required for expansion of and replacements in the national gas grid.

This section provides an overview of the progress and completion of the investment projects scheduled to be carried out over the previous two years, comparing the original schedule and cost estimate with the actual completion time and costs.

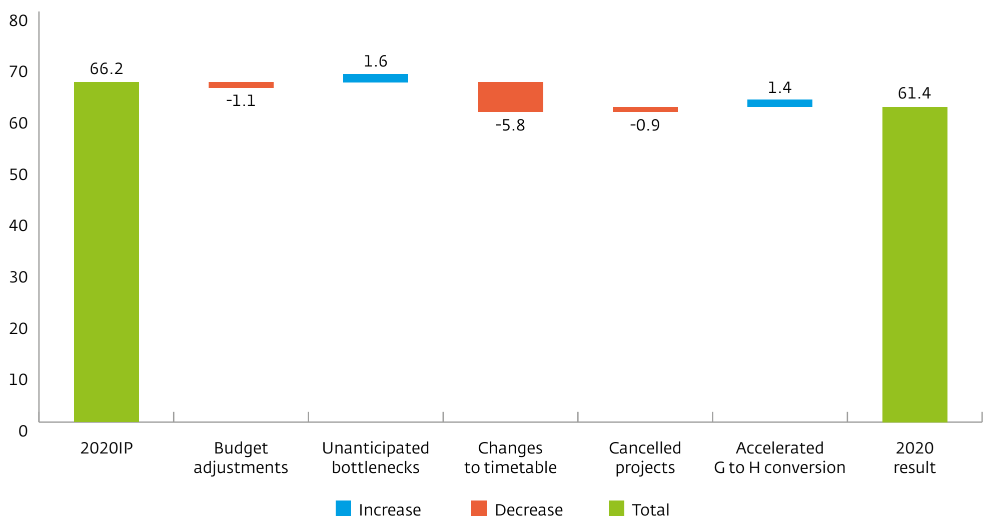
6.1. List of completed investment projects

Appendix IV provides an overview of the completed investment projects per category. For the projects completed in 2020, the variances can be broadly broken down as follows:

- Budget adjustment: to ensure that the project is delivered with the intended functionality and quality level, the investment budget is adjusted upwards or downwards to reflect the actual project costs.
- Unanticipated bottlenecks: this concerns an emergency situation or serious disruptions. Investments to resolve these bottlenecks could not be foreseen in the annual plan process.
- Adjustments to schedule: changing when the project is carried out.
- Cancelled projects: planned projects for which there is no longer a need.
- Acceleration of G-H conversion: costs in 2020 to complete the G-H conversion project sooner.

Figure 6.1 gives an overview of the variances between the expected investments from the 2020IP and the actual investments.

FIGURE 6.1 VARIANCES BETWEEN THE 2020IP AND ACTUAL INVESTMENTS FOR PROJECTS IN 2020



If a project deviates by more than 25% from the original schedule and cost estimate, the cause of the difference and the consequences for GTS' statutory duty are described in Appendix V.

Sections 6.2.1 and 6.2.2 provide an explanation of the causes and consequences. Finally, section 6.2.3 describes the measures taken by GTS to minimise such variances.

6.2 Variances in completed 2020IP projects

In the 2020IP, GTS offered an overall view of all investments required for expansion of and replacements in the national gas grid. There are a number of factors, both external and internal, that have resulted in planned projects being delayed or adjusted.

6.2.1 Causes of project variances

A variance may arise due to changes in project implementation or adjustments to the project portfolio.

Changes in project implementation

The main reasons for deviations from the project timetable are described below:

- Gas transport restrictions: there are limited time windows during which gas flows can be interrupted or diverted.
- Permit procedures: long procedures or additional requirements of the competent authority.Unavailability of technical or other personnel: GTS has limited resources available.
- Delivery time for materials: longer lead times for ordering and delivering required materials.
- External circumstances: encountering unexpected situations such as soil contamination, a change to a scheduled shutdown at a connected party, extreme winter weather, etc.

Adjustments to the project portfolio

Further reasons for deviations regarding the implementation of projects compared to the schedule and cost estimate as stated in the 2020IP are as follows:

- Budget adjustments: the costs of a project may come out higher or lower than anticipated due to aspects like market price developments for materials and contractors or the required deployment of resources.
- Bottlenecks classified as emergency situations: this includes serious disruptions (urgent situations) that have a major impact on external/internal safety and/or transmission security. Action to resolve these bottlenecks is taken immediately; these corrective action projects fall outside the annual plan process.
- Economies of scope: a situation can arise where a cost advantage can be achieved by combining projects and implementing them simultaneously, for example by bringing forward a project from a later annual plan so that it can be carried out jointly with a project from the current annual plan.

6.2.2 Consequences of the variances

With most of the projects covered under the 2020IP, the project could be completed on schedule and with the envisioned functionality and quality level despite the occurrence of a situation as described, meaning this situation had no consequences.

For several projects covered under the 2020IP, due to disruptions during implementation, the timetable or the budget for the project concerned has been adjusted.

- Due to changes to the schedule, a number of investments have shifted in part to the following implementation year or been postponed to the extent that these will fall under a following annual plan. An investment project may therefore not be completed within the allotted timescale. External agreements have been taken into account for the prioritisation of projects and for risk ranking.
- In a number of cases the budget has been adjusted so that the project can be delivered with the intended functionality and quality level.

6.2.3 Measures to minimise project variances

GTS uses a professional project management system and has largely delivered the projects described in the 2020IP on budget and within the stated timescale.
In the following, we describe the main measures to prevent and/or mitigate variances.

Gas transport restrictions

For projects it is often necessary to purge the gas from the system and/or to interrupt the gas flow. Given that, due to seasonal factors, there are limited time windows when gas flows can be interrupted or diverted, a delay in the project timeline can mean that the project can no longer continue uninterrupted and that further works must be postponed to a time window in the following season or year.
To effectively include these dependencies in the project timeline, GTS consults on the technical gas transmission options and time windows early on in the project.

Permit procedures

Whenever we decide to expand or replace parts of the gas transmission network, we need permits before the work can go ahead. These can be temporary permits for the work involved, such as a permit for excavation work, or permanent permits for high-pressure gas transmission. In some cases, the permit procedures can be lengthy as a result of required soil surveys and/or other procedures or requirements set by the competent authority to take additional measures relating to air, soil or water quality for example.
To prevent project delays, GTS starts permit procedures at an early stage and maintains close contact with the competent authorities and local communities.
Where obtaining a permit turns out to take longer than expected, GTS will look into the option of rescheduling the work, with part of the work being done at the initially scheduled time and the rest after the permit has been granted.

Shortage of technical and other staff

GTS and Gasunie, the energy infrastructure company of which GTS is a part, have limited in-house staff available. That is why a liquid workforce (or 'flex layer') comprising external employees and contractors is used in many investment projects.
The Dutch labour market is currently under considerable strain, especially when it comes to technical staff. Gasunie actively encourages secondary school pupils (especially those in vocational education) to consider technical studies like installation technology, building engineering and electrical engineering when deciding what to study after secondary school. We do so by organising information sessions on the energy future and treating students to tours of our sites.

Material delivery time

Certain materials, such as custom materials, are subject to long delivery times. To make sure projects can stay on schedule, GTS tries to use standardised materials as much as possible. Whenever customisation is inevitable, we order non-standardised materials well ahead of the construction phase.
The delivery time for materials can be longer than planned due to unforeseen circumstances at suppliers. Where, despite our best efforts, delays occur, we take appropriate control measures, such as relocating standardised materials from one project to another, provided that the former project can then still be executed as planned, or by scaling up by switching from on-site manufacturing alone to both on-site and off-site manufacturing or prefabrication.

External circumstances

When working on the gas transmission network, unanticipated situations may be encountered, such as detection of soil contamination or the presence of harmful dust or aerosols containing chromium-6 originating from coated surfaces, a change to the planned production shutdown of a connected party, extreme winter weather conditions, required soil surveys and/or other procedures or an obligation under the Dutch government's Integrated Approach to Nitrogen (PAS) programme to take additional measures to prevent nitrogen deposition. To account for delays should such circumstances arise and keep projects on schedule, GTS always tries to include some leeway in its project timelines.

In 2020/2021, GTS also had to deal with external circumstances relating to the Covid-19 pandemic. The impact of the pandemic on the progress of projects has been limited as far as possible through the implementation of additional measures. Supplies of critical materials from abroad have been delayed due to the restrictions and limitations production companies have encountered.

Appendices

Appendix I: References

Bulletin of Acts and Decrees of the Kingdom of the Netherlands, 2018, 375: Besluit van 16 oktober 2018, houdende regels over investeringsplannen voor elektriciteitsnetten en gastransportnetten en enkele andere onderwerpen (Besluit investeringsplan en kwaliteit elektriciteit en gas) (Decree of 16 October 2018 on investment plans of operators of electricity grids and gas transmission networks and on several other subjects (Decree on investment plan and quality of electricity and gas)) 2018.

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Gasunie Transport Services: Description of GTS' quality assurance system, 2021.

Gasunie Transport Services: Presentation information session II IP 2022, 2021

FNB Gas: Network Development Plan 2020, 2020.

Hyway27, 2021.

Ministry of Economic Affairs and Climate Policy: Bescherm en Herstelplan Gas, 2019.

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Ministry of Economic Affairs and Climate Policy: Ministerie van Economische Zaken en Klimaat: Klimaatakkoord, 2019. (Ministry of Economic Affairs and Climate Policy: Climate Agreement, 2019.

Ministry of Economic Affairs and Climate Policy: Regeling van de Minister van Economische Zaken en Klimaat van 7 november 2018, nr. WJZ/18038636, houdende nadere regels over het investeringsplan en het kwaliteitsborgingssysteem van beheerders van elektriciteitsnetten en gastransportnetten en enkele andere onderwerpen (Regeling investeringsplan en kwaliteit elektriciteit en gas) (Regulation of the Minister of Economic Affairs and Climate Policy of 7 November 2018, No. WJZ/18038636, containing further rules on the investment plan and the quality assurance system of operators of electricity grids and gas transmission networks and on several other subjects (Regulation on the investment plan and quality of electricity and gas)), 2018.

Ministry of Economic Affairs and Climate Policy: Task Force Monitoring L-Gas Market, 2020.

Regulation (EU) 2017/1938 of the European Parliament and of the Council of 25 October 2017, 2017.

Appendix II: Terms and abbreviations

ACM	Netherlands Authority for Consumers and Markets
ALARA	As low as reasonably achievable
BCM	Billion cubic metres
BNetzA	BundesNetzAgentur (German regulator)
CAPEX	Capital Expenditure
CBG	Coal before gas (2018 TYNDP) (scenario)
CCS	Carbon Capture and Storage
CID	Commercial Investment Decision
DNV-GL	Det Norske Veritas- Germanischer Loyd, consultancy firm
ENTSO-E	European Network of Transmission System Operators for Electricity
ENTSOG	European Network of Transmission System Operators for Gas
ETM	Energy transition model
EUCO	European Commission (2018 TYNDP) (scenario)
EZK	Dutch Ministry of Economic Affairs and Climate Policy
FID	Final investment decision
GASPOOL	Market area in Germany
GBC	Gas before coal (2018 TYNDP) (scenario)
GNIP	Gasunie Network Improvement Plan
GTG-Nord	German TSO
GTS	Gasunie Transport Services
GW	Gigawatt (capacity)
H-gas	High-calorific gas
HPGG	High-pressure gas grid
IA	International Ambition (scenario)
IP	Investment Plan
DCA	Dutch Climate Agreement (scenario)
C&EO	Climate & Energy Outlook
L-gas	Low-calorific gas
LNG	Liquid natural gas
MCA	Multi-Case Approach, GTS simulation software for network planning based on the pressure drop calculation for the gas grid. MCA is highly suited to calculations relating to adding nitrogen to natural gas.
M&R	Metering and regulating station
CSR	Corporate Social Responsibility
NCG	Net Connect Germany, market area in Germany
ND	National Driver (scenario)
Netbeheer Nederland	Industry organisation for all network and grid operators
OPEX	Operational Expenditure
P50	Indication of probability (see footnote 9 for explanation)

P90	Indication of probability (see footnote 9 for explanation)
P2H	Power-to-Heat
PAS	Programma Aanpak Stikstof (Dutch government's Integrated Approach to Nitrogen)
PBL	PBL Netherlands Environmental Assessment Agency
PV	Photovoltaics
QC	Quality conversion
NCS	National Coordination Scheme
RES	Regional Energy Strategies
RFO	Ready for Operation
RDN	Regional distribution network
SDE	Dutch subsidy scheme designed to promote the production of sustainable energy
SMR	Steam Methane Reforming
ST	Sustainable transition (2018 TYNDP) (scenario)
TenneT	National grid operator for electricity
TSO	Transmission System Operator
TTF	Title Transfer Facility
TWh	Terawatt hour (volume)
TYNDP	Ten Year Network Development Plan
EI	Expansion investment
UGS	Underground storage facility
RI	Replacement investment
Wheeling	Transporting gas from a single entry point to a single exit point (service)
WoZ	Wind op Zee (offshore wind energy)

Appendix III

Overview of bottlenecks and investments

III.1 Investment classification and available information

For the assessment of GTS' draft 2022IP, ACM has drawn up the document *Kader Informatiebehoefte Investeringsplannen 2022* [2022 Information Requirement Framework for Investment Plans]. In this document, investments are grouped under the following classifications:

Table III.1. Investment classification

Investment classification	Period
Regular maintenance investment	2022 – 2026
Connections and diversions	2022 – 2026

GTS notes that a complete overview can only be provided for the projects already approved or in preparation for the years 2022 and 2023 and their related bottlenecks. For 2024 and later, the investment levels assumed are those used for the '15-year investment outlook'. This is because the portfolio for those years is largely determined by corrective measures and/or external factors, the necessity of which is determined only after the IP has been presented. Where possible, details are given for the years 2024 and beyond.[50]

Table III.2. Available information.

Years	2022 and 2023	2024 – 2031
Basis of information	Portfolio overview	15-year investment outlook

Due to the way in which GTS records project information in its data systems, the information available for the period 2022–2023 does not always line up perfectly with ACM's information requirements. Often only limited information is available in the early stages of a project, with the amount of information increasing as a project progresses. GTS therefore feels it necessary to specify the information for certain projects in a more general or, in some cases, more detailed way.

50 *The 15-year investment outlook is an estimate of the investment level over the next 15 years for GTS' financing needs, among other things.*

III.1.1 Notes to the tables

In the table below, GTS explains both the choices made when collecting the data and the terminology.

Table III.3. Notes to the investment tables.

Information	Notes
Bottleneck code	Code identifying the project/aggregate projects
Investment	Name of the investment
Bottleneck	Indication quality or capacity bottleneck
Asset/network component category	Certain projects include more than one asset category. The dominant category is shown, or the description 'multiple asset categories' is stated.
Network pressure (RTL/HTL)	Certain projects include more than one pressure level. Either the dominant pressure level or multiple pressure levels are stated.
Classification by expansion project or replacement project	Expansion investment project is indicated as EP and replacement investment as RP.
Physical location of bottleneck	Location of bottleneck in the GTS network
Asset	Type of asset in that part of the network
Numbers of individual assets or kilometres per year	Certain projects include several individual assets. The actual number is specified where possible; otherwise the designation 'multiple' or 'km TBD' is used.
Bottleneck starting year	Year in which the bottleneck first arose.
Year of CM	For the commissioning (CM) date the technically complete (TECO) date or the AM3 date – the agreed milestone (date) when the measure will be put into technical use – is shown.
On schedule	If the project is on schedule: Yes, otherwise No
Replacement investments: classification according to partial or complete replacement	Certain projects include partial and full replacement of assets. This is indicated where applicable.
Statutory duty	GTS' statutory duty affected by the bottleneck
Key aspect	The most important aspect arising from the risk assessment
Investment amounts per year (2022/2023)	The amounts are approved budgets (or approved budgets for preparations) and forecast amounts, excluding risk premiums; see explanation of budget methodology.
Investment amounts after 2023 (2024 and beyond)	The amounts are forecast amounts based on '15-year investment outlook'.

For all investments below, see the blue sheets in this Excel workbook.

III.2 Regular investments

Bottleneck code	Investment	Bottleneck	Category of asset/ network component	Network pressure – RTL/ HTL	Expansion or replacement investment	Physical location of bottleneck	Asset	No. of separate network components or km/year
Total (€)								
AGREGATIE014425	I.014425 -Automation of CP readings using IoT	Quality	Pipelines	RTL	RP	Pipeline cluster	CP	multiple
AGREGATIE014427	I.014427 - Repl. OBBU Odorant injection control system	Quality	Metering and regulating station	HTL	RP	M&R cluster	Odorisation system	multiple
AGREGATIE014505	I.014505 - Install. AC drains National 2024	Quality	Pipelines	RTL	RP	Pipeline cluster	CP	multiple
AGREGATIE014511	I.014511 - Upgrade std. SCADA and PCS syst. WE4>WE5	Quality	Compressor station	HTL	RP	CSs cluster	SCADA	multiple
AGREGATIE014351	I.014351 - Repl. AMB control panels GRK and WIJN	Quality	Compressor station	HTL	RP	CS Grijpskerk, Wijngaarden	Unit control panel	multiple
AGREGATIE014353	I.014353 - Systematic civil engineering maintenance OIR 2023	Quality	Compressor station	HTL	RP	CS Ravenstein	Building and grounds	multiple
AGREGATIE014420	I.014420 - Repl. S-3211 Nedschroef and dismtl. Z-211	Quality	Valve set-up	RTL	RP	S-3211	Valve set-up	1
AGREGATIE014421	I.014421 - Install. AC drains National 2022	Quality	Pipelines	RTL	RP	Pipeline cluster	CP	multiple
AGREGATIE014504	I.014504 - Install. AC drains National 2023	Quality	Pipelines	RTL	RP	Pipeline cluster	CP	multiple
AGREGATIE013956	I.013956 - Replacement Kessel S-3263 and S-8314	Quality	Valve set-up	RTL	RP	S-3263;S-8314	Valve set-up	multiple
AGREGATIE014519	I.014519 -Planned civil OH OIM 2022 fase 1	Quality	Multiple asset categories	HTL	RP	Maasvlakte	Building and grounds	multiple
AGREGATIE014549	I.014549 - Planned civil OH OIM 2023 fase 2	Quality	Multiple asset categories	HTL	RP	Maasvlakte	Building and grounds	multiple
014487	I.014487 - Repl. S-5543 Caland canal	Quality	Valve set-up	RTL	RP	S-5543	Valve set-up	1
013988	I.013988 - Repl. v set-up Rotterdam S-2070 Keilehaven	Quality	Valve set-up	RTL	RP	S-2070	Valve set-up	1
014423	I.014423 - Increase LNG PS capacity H-gas conv.	Capacity	Peak shaver	HTL	RP	LNG peak shaver	Peak shaver	1
013990	I.013990 - Inst. Levelling CS Grijpskerk	Quality	Compressor station	HTL	RP	CS Grijpskerk	Manifold	1
013870	I.013870 - Repl. v. set-up S.P. Wormer S-5035	Quality	Valve set-up	RTL	RP	S-5035	Valve set-up	1
AGREGATIE014498	I.014498 - Systematic civil engineering maintenance OLZ 2023	Quality	Valve set-up	RTL	RP	Valve set-up cluster	Valve set-up	multiple
AGREGATIE014508	I.014508 - MVO solve BN RS-B and MS A-443 MS Pernis	Quality	Blending station	HTL	RP	MS Pernis	Regulating system	1

Bottleneck starting year	Year of CM	On schedule	Complete or partial replacement	Statutory duty	Key aspect	Forecast: cumulative	Forecast: 2022	Forecast: 2023	Forecast: 2024 and beyond
						103.621.026	23.134.432	48.742.038	27.755.000
2021	2024	YES	Partial	Gas transmission duty	Reliability				
2021	2030	YES	Partial	Gas transmission duty	Product quality				
2021	2024	YES	Partial	Gas transmission duty	Reliability				
2021	2026	YES	Partial	Gas transmission duty	Reliability				
2020	2024	YES	Partial	Gas transmission duty	Reliability				
2020	2023	YES	Partial	Gas transmission duty	Safety				
2020	2024	YES	Complete	Gas transmission duty	Safety				
2020	2022	YES	Partial	Gas transmission duty	Reliability				
2021	2023	YES	Partial	Gas transmission duty	Reliability				
2021	2023	YES	Complete	Gas transmission duty	Safety				
2021	2022	YES	Partial	Gas transmission duty	Safety				
2022	2023	YES	Partial	Gas transmission duty	Safety				
2020	2023	YES	Complete	Gas transmission duty	Safety				
2021	2023	YES	Complete	Gas transmission duty	Safety				
2021	2022	YES	Partial	Gas transmission duty	Reliability				
2020	2022	YES	Partial	Balancing duty	Reliability				
2020	2023	YES	Complete	Gas transmission duty	Safety				
2021	2023	YES	Partial	Gas transmission duty	Safety				
2021	2023	YES	Partial	Gas transmission duty	Loss tolerance				

continued on next page

III.2 Regular investments continued previous page

Bottleneck code	Investment	Bottleneck	Category of asset/ network component	Network pressure – RTL/ HTL	Expansion or replacement investment	Physical location of bottleneck	Asset	No. of separate network components or km/year
AGREGATIE014441	I.014441 - Repl. turbine gas meters > 30 yr 2023	Quality	Gas receiving station	RTL	RP	GRS cluster	Gas meters	multiple
AGREGATIE014413	I.014413 - Repl. v set-ups Hilversum S-6210 and S-6365	Quality	Valve set-up	RTL	RP	S-6210; S-6365	Valve set-up	multiple
014488	I.014488 - Repl. S-7814 Hulsterbrug Geldrop	Quality	Valve set-up	RTL	RP	S-7814	Valve set-up	1
014507	I.014507 - CSR repl. reg. stop gas emiss. A-482 Meteren	Quality	Reducing station	HTL	RP	RS Meteren	Regulating system	1
014474	I.014474 - Modifications for pigging A-620	Quality	Pipeline system	HTL	RP	A-620	Pipeline system	1
AGREGATIE013881	I.013881 - Repl. v. set-up S-2230 S-5973 Sch'dam Kethe	Quality	Valve set-up	RTL	RP	S-2230	Valve set-up	1
013583	I.013583 - Repl. v. set-up S-5561 CABOT car park	Quality	Valve set-up	RTL	RP	S-5561	Valve set-up	1
014360	I.014360 - Repl. v. set-up S-5545 Moezelweg - Merw	Quality	Valve set-up	RTL	RP	S-5545	Valve set-up	1
014418	I.014418 - Repl. v. set-up S-5030 Nauernasevaart	Quality	Valve set-up	RTL	RP	S-5030	Valve set-up	1
013978	I.013978 - Repl. v. set-up S-5559 Moezelweg	Quality	Valve set-up	RTL	RP	S-5559	Valve set-up	1
013976	I.013976 - Repl. v. set-up S-5568 Theemsw by Humber	Quality	Valve set-up	RTL	RP	S-5568	Valve set-up	1
AGREGATIE014363	I.014363 - Systematic civil engineering maintenance OLO 2022	Quality	Valve set-up	RTL	RP	Valve set-up cluster	Valve set-up	multiple
013912	I.013912 - Repl. v. set-up Suameer S-1135	Quality	Valve set-up	RTL	RP	S-1135	Valve set-up	1
013987	I.013987 - Repl. v. set-up S-8104 't Hof	Quality	Valve set-up	RTL	RP	S-8104	Valve set-up	1
AGREGATIE013872	I.013872 - Repl. S-2053 and S-5669 Haarlem Parkweg	Quality	Valve set-up	RTL	RP	S-2053;S-5669	Valve set-up	multiple
AGREGATIE014436	I.014436 - Dummy CP improv. prog. OL 2022	Quality	Pipelines	RTL	RP	Pipeline cluster	CP	multiple
AGREGATIE014437	I.014437 - Dummy CP improv. prog. OL 2023	Quality	Pipelines	RTL	RP	Pipeline cluster	CP	multiple
014445	I.014445 - Repl. v. set-up Woudenberg S-6298	Quality	Valve set-up	RTL	RP	S-6298	Valve set-up	1
014446	I.014446 - Repl. S-6207 Baarn RW A-1 hlm 28.3	Quality	Valve set-up	RTL	RP	S-6207	Valve set-up	1
014471	I.014471 - Repl. Aalsmeer v. set-up S-5994 Pumping st.	Quality	Valve set-up	RTL	RP	S-5994	Valve set-up	1

Bottleneck starting year	Year of CM	On schedule	Complete or partial replacement	Statutory duty	Key aspect	Forecast: cumulative	Forecast: 2022	Forecast: 2023	Forecast: 2024 and beyond
2021	2023	YES	Partial	Balancing duty	Reliability				
2020	2024	YES	Complete	Gas transmission duty	Safety				
2021	2024	YES	Complete	Gas transmission duty	Safety				
2021	2023	YES	Partial	Gas transmission duty	Loss tolerance				
2021	2023	YES	Partial	Gas transmission duty	Safety				
2020	2024	YES	Complete	Gas transmission duty	Safety				
2020	2024	YES	Complete	Gas transmission duty	Safety				
2020	2023	YES	Complete	Gas transmission duty	Safety				
2020	2023	YES	Complete	Gas transmission duty	Safety				
2020	2023	YES	Complete	Gas transmission duty	Safety				
2020	2023	YES	Complete	Gas transmission duty	Safety				
2020	2022	YES	Partial	Gas transmission duty	Safety				
2020	2023	YES	Complete	Gas transmission duty	Safety				
2020	2023	YES	Complete	Gas transmission duty	Safety				
2020	2022	YES	Complete	Gas transmission duty	Safety				
2021	2022	YES	Partial	Gas transmission duty	Reliability				
2021	2023	YES	Partial	Gas transmission duty	Reliability				
2021	2023	YES	Complete	Gas transmission duty	Safety				
2021	2024	YES	Complete	Gas transmission duty	Safety				
2021	2024	YES	Complete	Gas transmission duty	Safety				

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Bottleneck code	Investment	Bottleneck	Category of asset/ network component	Network pressure – RTL/ HTL	Expansion or replacement investment	Physical location of bottleneck	Asset	No. of separate network components or km/year
013884	I.013884 - Repl. v. set-up S-2120 GRS Boskoop	Quality	Valve set-up	RTL	RP	S-2120	Valve set-up	1
014398	I.014398 - Replacement Zweekhorst A-406 air handling units	Quality	Compressor station	HTL	RP	CS Zweekhorst	Air handling units	1
013925	I.013925 - Replacement Joure S-1355	Quality	Valve set-up	RTL	RP	S-1355	Valve set-up	1
013907	I.013907 - Repl. v. set-up S-5931 Alphen - Gouda	Quality	Valve set-up	RTL	RP	S-5931	Valve set-up	1
013871	I.013871 - Repl. S-5009 connection CSM Halfweg	Quality	Valve set-up	RTL	RP	S-5009	Valve set-up	1
014494	I.014494 - Repl. S-5581 M&R station Abbenbroek	Quality	Valve set-up	RTL	RP	S-5581	Valve set-up	1
AGREGATIE014447	I.014447 - Repl. v. set-up Hoofddorp S-5996 S-5997	Quality	Valve set-up	RTL	RP	S-5996; S-5997	Valve set-up	multiple
013584	I.013584 - GNIPA-S-5588 Oude Trambaan Nearby	Quality	Valve set-up	RTL	RP	S-5588	Valve set-up	1
013927	I.013927 - Replacement Oss S-3274 Thomassen & Drijver	Quality	Valve set-up	RTL	RP	S-3274	Valve set-up	1
013958	I.013958 - Replacement Weert S-3085 Vrakker	Quality	Valve set-up	RTL	RP	S-3085	Valve set-up	1
013960	I.013960 - Replacement Zwolle S-1496 Laag Zuthem	Quality	Valve set-up	RTL	RP	S-1496	Valve set-up	1
013921	I.013921 - Replacement Oss S-3351 Unilever	Quality	Valve set-up	RTL	RP	S-3351	Valve set-up	1
013926	I.013926 - Replacement Bergharen S-9929 Oude Wetering	Quality	Valve set-up	RTL	RP	S-9929	Valve set-up	1
014419	I.014419 - Repl. v. set-up The Hague S-5841 Trambaan	Quality	Valve set-up	RTL	RP	S-5841	Valve set-up	1
013982	I.013982 - Repl. v. set-up S-5446 Botlekweg	Quality	Valve set-up	RTL	RP	S-5446	Valve set-up	1
AGREGATIE014434	I.014434 - Repl. upgr. WIROX Wobbe Index meas. device	Quality	Gas receiving station	HTL	RP	GRS cluster	Wobbe Index measuring device	multiple
014509	I.014509 - CSR purchase mini flare for gas emissions	Quality	Other	RTL	RP	Deventer	Mini flare	1
013869	I.013869 - Repl. S-9862 Globe v. set-up Harderwijk	Quality	Valve set-up	RTL	RP	S-9892	Valve set-up	1

Bottleneck starting year	Year of CM	On schedule	Complete or partial replacement	Statutory duty	Key aspect	Forecast: cumulative	Forecast: 2022	Forecast: 2023	Forecast: 2024 and beyond
2020	2022	YES	Complete	Gas transmission duty	Safety				
2020	2022	YES	Partial	Gas transmission duty	Safety				
2020	2023	YES	Complete	Gas transmission duty	Safety				
2020	2024	YES	Complete	Gas transmission duty	Safety				
2020	2024	YES	Complete	Gas transmission duty	Safety				
2021	2023	YES	Complete	Gas transmission duty	Safety				
2021	2023	YES	Complete	Gas transmission duty	Safety				
2020	2023	YES	Complete	Gas transmission duty	Safety				
2020	2023	YES	Complete	Gas transmission duty	Safety				
2020	2024	YES	Complete	Gas transmission duty	Safety				
2020	2023	YES	Complete	Gas transmission duty	Safety				
2020	2023	YES	Complete	Gas transmission duty	Safety				
2020	2023	YES	Complete	Gas transmission duty	Safety				
2020	2023	YES	Complete	Gas transmission duty	Safety				
2020	2023	YES	Complete	Gas transmission duty	Safety				
2021	2022	YES	Partial	Quality conversion	Product quality				
2021	2024	YES	Complete	Gas transmission duty	Safety				
2020	2022	YES	Complete	Gas transmission duty	Safety				

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Bottleneck code	Investment	Bottleneck	Category of asset/ network component	Network pressure – RTL/ HTL	Expansion or replacement investment	Physical location of bottleneck	Asset	No. of separate network components or km/year
013963	I.013963 - Repl. v. set-up S-3174 Vught	Quality	Valve set-up	RTL	RP	S-3174	Valve set-up	1
013964	I.013964 - Repl. v. set-up S-3157 Berlicum	Quality	Valve set-up	RTL	RP	S-3157	Valve set-up	1
013954	I.013954 - Replacement Echt S-3296 Echt Havenweg	Quality	Valve set-up	RTL	RP	S-3296	Valve set-up	1
013962	I.013962 - Repl. v. set-up S-8113 Insteekhaven	Quality	Valve set-up	RTL	RP	S-8113	Valve set-up	1
AGREGATIE014456	I.014456 -V unspecifiable CAPEX for O 2023	Quality	Multiple asset categories	N/A	RP	N/A	N/A	N/A
AGREGATIE014458	I.014458 -V unspecifiable CAPEX for O 2024	Quality	Multiple asset categories	N/A	RP	N/A	N/A	N/A
014451	I.014451 - Replacement Nunspeet S-1100 Nestle	Quality	Valve set-up	RTL	RP	S-1100	Valve set-up	1
014376	I.014376 - Replacement Oldenzaal S-9099 incl. pipeline rearrangement	Quality	Valve set-up	RTL	RP	S-9099	Valve set-up	1
014472	I.014472 - Repl. v. set-up S-3177 Oosterhout	Quality	Valve set-up	RTL	RP	S-3177	Valve set-up	1
014470	I.014470 - Repl. v. set-up S-7517 PLM Dongen	Quality	Valve set-up	RTL	RP	S-7517	Valve set-up	1
013967	I.013967 - Repl. v. set-up S-7366 Ettensebaan	Quality	Valve set-up	RTL	RP	S-7366	Valve set-up	1
014368	I.014368 - Design/ purchase new AGC tap equip.	Quality	Other	RTL	RP	Deventer	AGC tap equipment	1
014482	I.014482 - Replacement Grijpskerk S-1083 Westerkwartier	Quality	Valve set-up	RTL	RP	S-1083	Valve set-up	1
014483	I.014483 - Replacement Saaksum S-1116	Quality	Valve set-up	RTL	RP	S-1116	Valve set-up	1
014450	I.014450 - Replacement Nunspeet S-9850 Harderwijk-erweg	Quality	Valve set-up	RTL	RP	S-9850	Valve set-up	1
014486	I.014486 - Repl. S-2240 Alblasserdam RED GRS	Quality	Valve set-up	RTL	RP	S-2240	Valve set-up	1
014485	I.014485 - Replacement S-5566 Theemsweg/Rijksweg A-15	Quality	Valve set-up	RTL	RP	S-5566	Valve set-up	1
AGREGATIE014455	I.014455 - FP unspecifiable CAPEX-active 2023	Quality	Multiple asset categories	N/A	RP	N/A	N/A	N/A

Bottleneck starting year	Year of CM	On schedule	Complete or partial replacement	Statutory duty	Key aspect	Forecast: cumulative	Forecast: 2022	Forecast: 2023	Forecast: 2024 and beyond
2020	2022	YES	Complete	Gas transmission duty	Safety				
2020	2022	YES	Complete	Gas transmission duty	Safety				
2020	2022	YES	Complete	Gas transmission duty	Safety				
2020	2023	YES	Complete	Gas transmission duty	Safety				
2021	2023	N/A	N/A	N/A	N/A				
2021	2024	N/A	N/A	N/A	N/A				
2021	2023	YES	Complete	Gas transmission duty	Safety				
2020	2022	YES	Complete	Gas transmission duty	Safety				
2021	2023	YES	Complete	Gas transmission duty	Safety				
2021	2023	YES	Complete	Gas transmission duty	Safety				
2020	2022	YES	Complete	Gas transmission duty	Safety				
2020	2022	YES	Complete	Gas transmission duty	Safety				
2021	2023	YES	Complete	Gas transmission duty	Safety				
2021	2024	YES	Complete	Gas transmission duty	Safety				
2021	2024	YES	Complete	Gas transmission duty	Safety				
2021	2023	YES	Complete	Gas transmission duty	Safety				
2021	2023	YES	Complete	Gas transmission duty	Safety				
2021	2023	N/A	N/A	N/A	N/A				

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Bottleneck code	Investment	Bottleneck	Category of asset/ network component	Network pressure – RTL/ HTL	Expansion or replacement investment	Physical location of bottleneck	Asset	No. of separate network components or km/year
AGREGATIE014457	I.014457 - FP unspecifiable CAPEX-active 2024	Quality	Multiple asset categories	N/A	RP	N/A	N/A	N/A
013920	I.013920 - Replacement Emmen S-1378	Quality	Valve set-up	RTL	RP	S-1378	Valve set-up	1
014357	I.014357 - Repl. v. set-up S-5111 Spaarnwoude	Quality	Valve set-up	RTL	RP	S-5111	Valve set-up	1
013906	I.013906 - Repl. S-5877 Kortelandse Dreef	Quality	Valve set-up	RTL	RP	S-5877	Valve set-up	1
014480	I.014480 - Replacement Hoogezand S-1218 Kappa	Quality	Valve set-up	RTL	RP	S-1218	Valve set-up	1
014481	I.014481 - Replacement Noordhoorn S-1088 Westerkwartier	Quality	Valve set-up	RTL	RP	S-1088	Valve set-up	1
014464	I.014464 - Replacement Hoogeveen S-1474 Vos v S	Quality	Valve set-up	RTL	RP	S-1474	Valve set-up	1
014465	I.014465 - Replacement Stadskanaal S-4802 Vleddermond	Quality	Valve set-up	RTL	RP	S-4802	Valve set-up	1
014452	I.014452 - Replacement Eerbeek S-1098 Mayr Melnhof	Quality	Valve set-up	RTL	RP	S-1098	Valve set-up	1
014467	I.014467 - Replacement Pannerden S-1331 GRS Pannerden	Quality	Valve set-up	RTL	RP	S-1331	Valve set-up	1
014476	I.014476 - Replacement Lobith S-1259 bf Sereco	Quality	Valve set-up	RTL	RP	S-1259	Valve set-up	1
014522	I.014522 - Replacement Well S-3287 GRS Well	Quality	Valve set-up	RTL	RP	S-3287	Valve set-up	1
014496	I.014496 - Replacement Gronsveld S-3053 GRS Gronsveld	Quality	Valve set-up	RTL	RP	S-3053	Valve set-up	1
014439	I.014439 - Repl. contingency pipeline ULS	Quality	Other	N/A	RP	Deventer	Contingency pipeline	1
014393	I.014393 - Design and purchase mob. gas booster unit	Capacity	Other	RTL	RP	Deventer	Mobile gas booster unit	1
013914	I.013914 - Repl. v. set-up Wommels S-1182	Quality	Valve set-up	RTL	RP	S-1182	Valve set-up	1
013911	I.013911 - Replacement Emmeloord S-4068 KD weg	Quality	Valve set-up	RTL	RP	S-4068	Valve set-up	1

Bottleneck starting year	Year of CM	On schedule	Complete or partial replacement	Statutory duty	Key aspect	Forecast: cumulative	Forecast: 2022	Forecast: 2023	Forecast: 2024 and beyond
2021	2024	N/A	N/A	N/A	N/A				
2020	2022	YES	Complete	Gas transmission duty	Safety				
2020	2023	YES	Complete	Gas transmission duty	Safety				
2020	2022	YES	Complete	Gas transmission duty	Safety				
2021	2024	YES	Complete	Gas transmission duty	Safety				
2021	2023	YES	Complete	Gas transmission duty	Safety				
2021	2023	YES	Complete	Gas transmission duty	Safety				
2021	2023	YES	Complete	Gas transmission duty	Safety				
2021	2023	YES	Complete	Gas transmission duty	Safety				
2021	2024	YES	Complete	Gas transmission duty	Safety				
2021	2023	YES	Complete	Gas transmission duty	Safety				
2021	2024	YES	Complete	Gas transmission duty	Safety				
2021	2023	YES	Complete	Gas transmission duty	Safety				
2020	2023	YES	Partial	Gas transmission duty	Safety				
2020	2023	YES	Complete	Gas transmission duty	Reliability				
2020	2024	YES	Complete	Gas transmission duty	Safety				
2020	2024	YES	Complete	Gas transmission duty	Safety				

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Bottleneck code	Investment	Bottleneck	Category of asset/ network component	Network pressure – RTL/ HTL	Expansion or replacement investment	Physical location of bottleneck	Asset	No. of separate network components or km/year
013915	I.013915 - Replacement Gieten S-1318	Quality	Valve set-up	RTL	RP	S-1318	Valve set-up	1
013919	I.013919 - Replacement Rolde S-1480	Quality	Valve set-up	RTL	RP	S-1480	Valve set-up	1
013873	I.013873 - Replacement Renkum S-1096 Parenco	Quality	Valve set-up	RTL	RP	S-1096	Valve set-up	1
013918	I.013918 - Replacement Miedum S-4406	Quality	Valve set-up	RTL	RP	S-4406	Valve set-up	1
014475	I.014475 - Repl. S-3155 Den Bosch De Vliert	Quality	Valve set-up	RTL	RP	S-3155	Valve set-up	1
013959	I.013959 - Replacement Deventer S-9211 Zutphenseweg	Quality	Valve set-up	RTL	RP	S-9211	Valve set-up	1
AGREGATIE014440	I.014440 - Replacement of turbine gas meters > 30 years 2022	Quality	Gas receiving station	RTL	RP	GRS cluster	Gas meters	multiple
014356	I.014356 - Repl. v. set-up S-3319 Hunter Douglas	Quality	Valve set-up	RTL	RP	S-3319	Valve set-up	1
014067	I.014067 - Replacement Meerssen S-3237 Meerssen Papier	Quality	Valve set-up	RTL	RP	S-3237	Valve set-up	1
013948	I.013948 - Replacement Dreumel S-1290 Aansl. Dreumel	Quality	Valve set-up	RTL	RP	S-1290	Valve set-up	1
013937	I.013937 - Repl. Workum S-1482 Goede Verwachting	Quality	Valve set-up	RTL	RP	S-1483	Valve set-up	1
013924	I.013924 - Repl. v. set-up Jubbega S-1190	Quality	Valve set-up	RTL	RP	S-1190	Valve set-up	1
013969	I.013969 - Repl. v. set-up S-1461 Godlinze	Quality	Valve set-up	RTL	RP	S-1461	Valve set-up	1
013971	I.013971 - Replacement of a Dynamic No-Break system with a Static No-Break system.	Quality	Compressor station	HTL	RP	CS Beverwijk	No Break	1
014477	I.014477 - Replacement of a Dynamic No-Break system with a Static No-Break system CS Grijpskerk	Quality	Compressor station	HTL	RP	CS Grijpskerk	No Break	1
014473	I.014473 - Repl. heating install. W-441 Exxon	Quality	Gas receiving station	RTL	RP	W-441	Heating installation	1
014352	I.014352 - Repl. air compressors MS Beekse Bergen	Quality	Compressor station	HTL	RP	MS Beekse Bergen	Air compressor	1

Bottleneck starting year	Year of CM	On schedule	Complete or partial replacement	Statutory duty	Key aspect	Forecast: cumulative	Forecast: 2022	Forecast: 2023	Forecast: 2024 and beyond
2020	2024	YES	Complete	Gas transmission duty	Safety				
2020	2024	YES	Complete	Gas transmission duty	Safety				
2020	2022	YES	Complete	Gas transmission duty	Safety				
2020	2024	YES	Complete	Gas transmission duty	Safety				
2021	2023	YES	Complete	Gas transmission duty	Safety				
2020	2023	YES	Complete	Gas transmission duty	Safety				
2021	2022	YES	Partial	Balancing duty	Reliability				
2020	2024	YES	Complete	Gas transmission duty	Safety				
2021	2024	YES	Complete	Gas transmission duty	Safety				
2020	2022	YES	Complete	Gas transmission duty	Safety				
2020	2022	YES	Complete	Gas transmission duty	Safety				
2020	2023	YES	Complete	Gas transmission duty	Safety				
2020	2022	YES	Complete	Gas transmission duty	Safety				
2020	2021	YES	Partial	Gas transmission duty	Loss tolerance				
2021	2023	YES	Partial	Gas transmission duty	Loss tolerance				
2021	2021	YES	Partial	Gas transmission duty	Safety				
2020	2022	YES	Partial	Gas transmission duty	Reliability				

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Bottleneck code	Investment	Bottleneck	Category of asset/ network component	Network pressure – RTL/ HTL	Expansion or replacement investment	Physical location of bottleneck	Asset	No. of separate network components or km/year
AGREGATIE014489	I.014489 - Replacement HK-2 & K-8 Spijk	Quality	Compressor station	HTL	RP	CS Spijk	LSV	1
014461	I.014461 - Replacement Tegelen S-3051 valve 21	Quality	Valve set-up	RTL	RP	S-3051	Valve set-up	1
014503	I.014503 - CRS repl. gas act. A-486 Rijndijk	Quality	Reducing station	HTL	RP	RS Rijndijk	Regulating system	1
014416	I.014416 - CSR Repl. actuators A-496 RS Zelzate	Quality	Reducing station	HTL	RP	RS Zelzate	Regulating system	1
014479	I.014479 - Repl. S-5417 Botlekweg near D.S.M.	Quality	Valve set-up	RTL	RP	S-5417	Valve set-up	1
014417	I.014417 - Repl. boilers GRS W-100 Briele	Quality	Gas receiving station	RTL	RP	W-100	Central heating boilers	1
AGREGATIE014389	I.014389 - Replacement SNB RS Beekse Bergen & CS Spijk	Quality	Compressor station	HTL	RP	CS Spijk; RS Beekse Bergen	No Break	1
014530	I.014530 - Various components N-380 Wolvega	Quality	Gas receiving station	RTL	RP	N-380	Metering & regulating system	1
014355	I.014355 - Repl. valves 2,3 GOS Z107 Sliff.weg	Quality	Gas receiving station	RTL	RP	Z-107	Metering & regulating system	multiple
014379	I.014379 - Inst. above-ground diesel stor. 05C Ommen	Quality	Compressor station	HTL	RP	CS Ommen	Diesel storage	1
AGREGATIE014063	I.014063 - Repl. 25 elect. Rotork actuators OLN	Quality	Valve set-up	RTL	RP	Valve set-up cluster	Valve set-up	multiple
014531	I.014531 - Repl. components N-027 Haulerwijk	Quality	Gas receiving station	RTL	RP	N-027	Metering & regulating system	1
014444	I.014444 - Repl. reg valves GRS Westergas W-110	Quality	Gas receiving station	RTL	RP	W-110	Metering & regulating system	multiple
014532	I.014532 - Repl. GVs line 1 and 2 W-045 Enci	Quality	Gas receiving station	RTL	RP	W-045	Metering & regulating system	1
014490	I.014490 - Repl. misc. components N-180 Ameland	Quality	Gas receiving station	RTL	RP	N-180	Metering & regulating system	multiple
013997	I.013997 - Purchase pressure plugs OLS	Quality	Other	N/A	RP	Deventer	Pressure plugs	1
014466	I.014466 - Repl. valves GRS W-363 Tata Steel	Quality	Gas receiving station	HTL	RP	W-363	Gas receiving station	1
014411	I.014411 - Repl. pipeline rearrangement valve GRS W-097 The Hague	Quality	Gas receiving station	RTL	RP	W-097	Gas receiving station	1
013995	I.013995 - Repl. actuator valve 21 S-094 Putten	Quality	Valve set-up	HTL	RP	S-094	Valve set-up	1

Bottleneck starting year	Year of CM	On schedule	Complete or partial replacement	Statutory duty	Key aspect	Forecast: cumulative	Forecast: 2022	Forecast: 2023	Forecast: 2024 and beyond
2021	2023	YES	Partial	Gas transmission duty	Safety				
2021	2023	YES	Partial	Gas transmission duty	Safety				
2021	2023	YES	Partial	Gas transmission duty	Loss tolerance				
2020	2023	YES	Partial	Gas transmission duty	Loss tolerance				
2021	2023	YES	Complete	Gas transmission duty	Safety				
2020	2021	YES	Partial	Gas transmission duty	Safety				
2020	2023	YES	Partial	Gas transmission duty	Loss tolerance				
2021	2023	YES	Partial	Gas transmission duty	Safety				
2020	2022	YES	Partial	Gas transmission duty	Safety				
2020	2022	YES	Partial	Gas transmission duty	Safety				
2021	2023	YES	Partial	Gas transmission duty	Safety				
2021	2023	YES	Partial	Gas transmission duty	Safety				
2021	2022	YES	Partial	Gas transmission duty	Safety				
2021	2023	YES	Partial	Gas transmission duty	Safety				
2021	2023	YES	Partial	Gas transmission duty	Safety				
2020	2022	YES	Partial	Gas transmission duty	Safety				
2021	2023	YES	Partial	Gas transmission duty	Safety				
2020	2023	YES	Partial	Gas transmission duty	Safety				
2021	2021	YES	Partial	Gas transmission duty	Safety				

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Bottleneck code	Investment	Bottleneck	Category of asset/ network component	Network pressure – RTL/ HTL	Expansion or replacement investment	Physical location of bottleneck	Asset	No. of separate network components or km/year
014438	I.014438 - Purchase mob. workshop OLS	Quality	Other	N/A	RP	Deventer	Mobile workshop	1
014431	I.014431 - Repl. GV 3-1 Santpoort W-270	Quality	Gas receiving station	RTL	RP	W-270	Pressure safety devices	1
014491	I.014491 - Repl. valves N-476 Lemmer	Quality	Gas receiving station	RTL	RP	N-476	Valves	multiple
014433	I.014433 - Replc. GV 1-1 for HV Zandvoort W-145	Quality	Gas receiving station	RTL	RP	W-145	Pressure safety devices	1
014443	I.014443 - Repl. boilers GRS Z-072 Bergeyk	Quality	Gas receiving station	RTL	RP	Z-072	Central heating boilers	1
013999	I.013999 - Repl. reg. line 3 Z177 Oosterhout	Quality	Gas receiving station	RTL	RP	Z-177	Metering & regulating system	1
014430	I.014430 - Repl. safety shut-off GRS Bergen W-241	Quality	Gas receiving station	RTL	RP	W-241	Metering & regulating system	1
014432	I.014432 - Repl. reg. monitor line 3 Slootdorp W-407	Quality	Gas receiving station	RTL	RP	W-407	Metering & regulating system	multiple
014405	I.014405 - Repl. reg en gasmtr line 1 Z214 Schijndel	Quality	Gas receiving station	RTL	RP	Z-214	Metering & regulating system	multiple
014526	I.014526 - Repl. components Gos N-278 Duiven	Quality	Gas receiving station	RTL	RP	N-278	Metering & regulating system	1
014350	I.014350 - Repl. monitor line 3 + reg line 1 Z-308	Quality	Gas receiving station	RTL	RP	Z-308	Metering & regulating system	multiple
014453	I.014453 - Replacement GV 2-1 GRS W-057 Schiphol West	Quality	Gas receiving station	RTL	RP	W-057	Pressure safety devices	1
014064	I.014064 - Repl. reg. line 1 N-078 Harderwijk	Quality	Gas receiving station	RTL	RP	N-078	Metering & regulating system	1
014391	I.014391 - Repl. valve GRS Z101 Mars	Quality	Gas receiving station	RTL	RP	Z-101	Valves	1
014065	I.014065 - GRS Repl. heat exchanger Katwijk W-111	Quality	Gas receiving station	RTL	RP	W-111	Heat exchanger	1
013998	I.013998 - Repl. reg. line 2 Z-144 Sleeuwijk	Quality	Gas receiving station	RTL	RP	Z-144	Metering & regulating system	1
014459	I.014459 - Repl. reg. line 1 & 2 N-275 Hoogkerk	Quality	Gas receiving station	RTL	RP	N-275	Metering & regulating system	multiple
AGREGATIE014478	I.014478 - PIG-22 Construction costs Pigging 2022	Quality	Pipeline systems cluster	HTL	RP	multiple	Pipeline system	multiple

Bottleneck starting year	Year of CM	On schedule	Complete or partial replacement	Statutory duty	Key aspect	Forecast: cumulative	Forecast: 2022	Forecast: 2023	Forecast: 2024 and beyond
2020	2022	YES	Partial	Gas transmission duty	Safety				
2021	2022	YES	Partial	Gas transmission duty	Safety				
2021	2022	YES	Partial	Gas transmission duty	Safety				
2021	2022	YES	Partial	Gas transmission duty	Safety				
2021	2021	YES	Partial	Gas transmission duty	Safety				
2020	2022	YES	Partial	Gas transmission duty	Safety				
2021	2022	YES	Partial	Gas transmission duty	Safety				
2021	2021	YES	Partial	Gas transmission duty	Safety				
2020	2022	YES	Partial	Gas transmission duty	Safety				
2021	2023	YES	Partial	Gas transmission duty	Safety				
2020	2022	YES	Partial	Gas transmission duty	Safety				
2021	2022	YES	Partial	Gas transmission duty	Safety				
2021	2022	YES	Partial	Gas transmission duty	Safety				
2020	2022	YES	Partial	Gas transmission duty	Safety				
2021	2021	YES	Partial	Gas transmission duty	Safety				
2020	2022	YES	Partial	Gas transmission duty	Safety				
2021	2022	YES	Partial	Gas transmission duty	Safety				
2021	2022	YES	Partial	Gas transmission duty	Safety				

III.3 Connections and diversions

Bottleneck code	Project definition	Bottleneck	Category of asset/network component	Network pressure – RDN/ HPGG	Connections or diversions	Expansion or replacement investment	No. of separate network components or km/year
Total (€)							
14369	I.014369 - Increase throughput capacity GRS Schiedam W-230	Capacity	Gas receiving station	RDN	Connections	EP	1
14370	I.014370 - SOLAR phase 2 - Install connection Moerdij	Capacity	Valve set-up	HPGG	Connections	EP	1
14386	I.014386 - New HPGG connection Shell Pernis	Capacity	Valve set-up	HPGG	Connections	EP	1
14435	I.014435 - Increase capacity W746 Neste Oil	Capacity	Gas receiving station	HPGG	Connections	EP	1
14454	I.014454 - New connection Neste Oil	Capacity	Valve set-up	HPGG	Connections	EP	1
14484	I.014484 - New connection Sky NRG Delfzijl	Capacity	Valve set-up	HPGG	Connections	EP	1
14501	I.014501 - New KISTOS feed-in near TATA	Capacity	Valve set-up	HPGG	Connections	EP	1
14502	I.014502 -Two new gas connections Edgeconnex	Capacity	Valve set-up	RDN	Connections	EP	multiple
14515	I.014515 -Acquis. 3 connection lines Liander	Capacity	Pipelines	RDN	Connections	EP	2.5km
14516	I.014516 -Acquist. 4 connection lines (NC-TAR)	Capacity	Pipelines	RDN	Connections	EP	10.4km
13989	I.013989 - Diversion of W-529-01 Aalsmeer Spoorl	Third-party diversion request	Pipelines	RDN	Diversions	RP	1 asset
14066	I.014066 - Maint. free W-515-03/05 Leiderd./E'daal	Third-party diversion request	Pipelines	RDN	Diversions	RP	1 asset
14366	I.014366 - Diversion of Haaften W-527-19 dike reinforcement GOWA	Third-party diversion request	Pipelines	RDN	Diversions	RP	1 asset
14367	I.014367 - Diversion of Juliana canal Z-530-01	Third-party diversion request	Pipelines	RDN	Diversions	RP	1 asset
14371	I.014371 - Diversion of W-531 at Waardenburg	Third-party diversion request	Pipelines	RDN	Diversions	RP	1 asset
14373	I.014373 - Diversion of Tilburg Z-522-01 Industrial harbour	Third-party diversion request	Pipelines	RDN	Diversions	RP	1 asset
14374	I.014374 - Diversion of Keldonk Z-542-01 due to expansion of N279	Third-party diversion request	Pipelines	RDN	Diversions	RP	1 asset
14403	I.014403 - Diversion of N-568-10 for ProRail Renkum	Third-party diversion request	Pipelines	RDN	Diversions	RP	1 asset
14412	I.014412 - Diversion rail crossing A-555 Meteren ProRail	Third-party diversion request	Pipelines	HPGG	Diversions	RP	1 asset
14426	I.014426 - Diversion of W-572-01 and 03 Klaprozenbuurt Amst	Third-party diversion request	Pipelines	RDN	Diversions	RP	1 asset
14492	I.014492 - Diversion Spoorlaan W-536-06 Pr Clausplein	Third-party diversion request	Pipelines	RDN	Diversions	RP	1 asset
14493	I.014493 - Diversion Kooijweg W-514-01 Rijswijk	Third-party diversion request	Pipelines	RDN	Diversions	RP	1 asset
14512	I.014512 - Diversion of Reuver Z-509-15	Third-party diversion request	Pipelines	RDN	Diversions	RP	1 asset
14517	I.014517 - Diversion of Swalmen Z-509-11	Third-party diversion request	Pipelines	RDN	Diversions	RP	1 asset
14520	I.014520 - Diversion of W-533-10 Bloemendalerpolder Weesp	Third-party diversion request	Pipelines	RDN	Diversions	RP	1 asset

Bottleneck starting year	Year of CM	On schedule	Complete or partial replacement	Statutory duty	Key aspect	Forecast: cumulative	Forecast: 2022	Forecast: 2023	Forecast: 2024 and beyond
						22.737.952	6.099.378	13.396.460	1.481.000
2021	2022	YES	N/A	Gas transmission duty	Product quality				
2021	2022	YES	N/A	Gas transmission duty	Reliability				
2021	2023	YES	N/A	Gas transmission duty	Connection duty				
2021	2022	YES	N/A	Gas transmission duty	Connection duty				
2021	2024	YES	N/A	Gas transmission duty	Connection duty				
2022	2023	YES	N/A	Gas transmission duty	Connection duty				
2021	2022	YES	N/A	Gas transmission duty	Connection duty				
2022	2023	YES	N/A	Gas transmission duty	Connection duty				
2021	2022	YES	N/A	Gas transmission duty	Energy Act pressure threshold				
2021	2022	YES	N/A	Gas transmission duty	Connection duty				
2020	2021	YES	Partial	Gas transmission duty	Reliability				
2021	2022	YES	Partial	Gas transmission duty	Reliability				
2021	2023	YES	Partial	Gas transmission duty	Reliability				
2020	2022	YES	Partial	Gas transmission duty	Reliability				
2020	2022	YES	Partial	Gas transmission duty	Reliability				
2020	2022	YES	Partial	Gas transmission duty	Reliability				
2020	2023	YES	Partial	Gas transmission duty	Reliability				
2020	2023	YES	Partial	Gas transmission duty	Reliability				
2021	2024	YES	Partial	Gas transmission duty	Reliability				
2021	2023	YES	Partial	Gas transmission duty	Reliability				
2021	2023	YES	Partial	Gas transmission duty	Reliability				
2021	2023	YES	Partial	Gas transmission duty	Reliability				
2021	2023	YES	Partial	Gas transmission duty	Reliability				
2021	2023	YES	Partial	Gas transmission duty	Reliability				
2021	2023	YES	Partial	Gas transmission duty	Reliability				

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III.3 Connections and diversions continued previous page

Bottleneck code	Project definition	Bottleneck	Category of asset/network component	Network pressure – RDN/ HPGG	Connections or diversions	Expansion or replacement investment	No. of separate network components or km/year
14524	I.014524 - Diversion of Maastricht Z-500-15 Sappi	Third-party diversion request	Pipelines	RDN	Diversions	RP	1 asset
14529	I.014529 - Diversion of Emmeloord N-501-25 de Munt B company	Third-party diversion request	Pipelines	RDN	Diversions	RP	1 asset

Bottleneck starting year	Year of CM	On schedule	Complete or partial replacement	Statutory duty	Key aspect	Forecast: cumulative	Forecast: 2022	Forecast: 2023	Forecast: 2024 and beyond
2021	2023	YES	Partial	Gas transmission duty	Reliability				
2021	2023	YES	Partial	Gas transmission duty	Reliability				

Appendix IV Projects completed in 2020

Code identifying the project/ aggregate projects	Regular/ Major	Bottleneck	Network component category	Network pressure RTL/HTL	Expansion or replacement investment	No. of separate network comp.	Kilometres per year
Total (€)							
I.013586 - Extra N2 Linde incl. adjustment OLT and Wiermr	major	Capacity	Nitrogen installation	HTL	EP	multiple	0
I.014396 - ZON: acquisition ZEBRA network 31/12/2020	major	Capacity	Pipelines	HTL	EP	1	
I.013629 - Replacement of set-up S-5447 Baanhoek	regular	Quality	Valve set-up	RTL	RP	1	0
I.013638 - Replacement of gearsets MACs Phase M	regular	Quality	Nitrogen installation	HTL	RP	1	0
I.012569 - Upgrade QC Ommen: N2 installation	regular	Capacity	Nitrogen installation	HTL	EP	1	0
I.012960 - GNIPA-1914 MR Nijkerk - Barneveld	regular	Quality	Valve set-up	RTL	RP	multiple	0
I.013303 - Adjustment of natural gas condensate storage system OIO	regular	Quality	CS	HTL	RP	1	0
I.012957 - GNIPA-1911 Reijerwaard - Spui	regular	Quality	Valve set-up	RTL	RP	multiple	0
I.013020 - Replacement of data acquisition system export (DEX) OLZ	regular	Quality	Export stations	HTL	RP	1	0
I.011869 - Relocation GRS Baarn (dism. and new build)	regular	Quality	GRS	RTL	RP	1	0
I.012950 - GNIPA-1904 Zuid Kennemerland - Zandvoort	regular	Quality	Valve set-up	RTL	RP	multiple	0
I.012948 - GNIPA-1902 To Denekamp	regular	Quality	Valve set-up	RTL	RP	multiple	0,985
I.012865 - Nieuw Beek Z-276 LOKU 1	regular	Quality	GRS	RTL	RP	1	0
I.012967 - CDM18 A-525-02 Overbk-Scheepers Oirschot	regular	Quality	Pipelines	HTL	RP	1	0
I.013588 - Modification of drainage pipe scrubbers Zwe/Rav	regular	Quality	CS	HTL	RP	2	0
I.012408 - GNIPA-1639 AS W-118 Bussum	regular	Quality	Valve set-up	RTL	RP	1	0
I.013633 - Adjustment of natural gas condensate storage system Scheemda	regular	Quality	CS	HTL	RP	1	0
I.012956 - GNIPA-1910 Agelerbrug - Oldenzaal	regular	Quality	Valve set-up	RTL	RP	multiple	0,265
I.013554 - Replacement 16 blow-off valves in Wieringermeer	regular	Quality	CS	HTL	RP	1	0
I.013672 - Diversion of Gorinchem W-528-01-KR-017 A27 HDD	regular	Quality	Pipelines	RTL	RP	0	0,355
I.013490 - GNIPA-S-5938 Middelweg	regular	Quality	Valve set-up	RTL	RP	1	0
I.013523 - GNIPA-S-1175 St. Nicolaasga	regular	Quality	Valve set-up	RTL	RP	1	0

Project forecast: cumulative	2020IP forecast: cumulative	IP forecast variance	Percentage	Nature of variance	Variance cause/reason	Impact of variance
96.971.417	93.722.484	1.798.933				
			4			
			-			
			89	budget adjustments	Project implementation costs higher due to more complex soil conditions than expected	None, project will be delivered on schedule
			7			
			2			
			-3			
			0			
			-1			
			22			
			-15			
			-22			
			-6			
			-0			
			-7			
			-16			
			-1			
			11			
			-10			
			126	budget adjustments	Construction costs higher than anticipated. Work more complex than anticipated	None, project will be delivered on schedule
			-7			
			0			
			8			

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Projects completed in 2020 continued previous page

Code identifying the project/ aggregate projects	Regular/ Major	Bottleneck	Network component category	Network pressure RTL/HTL	Expansion or replacement investment	No. of separate network comp.	Kilometres per year
I.013272 - Nieuw Beek S-3276 GRS LOKU 1	regular	Quality	Valve set-up	RTL	RP	1	0
I.013399 - Diversion of Terschuur N-570-39 crossing RW A1	regular	Quality	Pipelines	RTL	RP	0	0,4
I.013613 - Systematic civil engineering maintenance OIS 2019	regular	Quality	CS	HTL	RP	multiple	0
I.013383 - Systematic civil engineering maintenance OLOG 2020	regular	Quality	Valve set-up	HTL	RP	1	0
I.013555 - GNIPA S-9983 Bemmel Kleine Baalsche Zeeg	regular	Quality	Valve set-up	RTL	RP	1	0
I.014394 - Repl. machine 3.1 (refurbished) W'meer	regular	Quality	CS	HTL	RP	1	0
I.013567 - GNIPA-S-7862 Lage Beemden	regular	Quality	Valve set-up	RTL	RP	1	0
I.013400 - Diversion of Hoevelaken W-520-01 crossing RW A1	regular	Quality	Pipelines	RTL	RP	0	0,36
I.014395 - Repl. machine 3.3 (refurbished) W'meer	regular	Quality	CS	HTL	RP	1	0
I.013562 - GNIPA-S-8100 Haagse Beemdweg	regular	Quality	Valve set-up	RTL	RP	1	0
I.013843 - Laying Arum N-502-40 deeper	regular	Quality	Pipelines	RTL	RP	0	0,66
I.013500 - GNIPA S-3076 Amstenrade GRS	regular	Quality	Valve set-up	RTL	RP	1	0
I.013724 - Diversion of Pannerden N-567 Hulshoff	regular	Quality	Pipelines	RTL	RP	0	0,34
I.012926 - Replacement of data acquisition system export (DEX)	regular	Quality	Export stations	HTL	RP	1	0
I.013557 - Energy savings HVAC systems OIO	regular	Quality	CS	HTL	RP	1	0
I.013563 - GNIPA-S-8102 Aarle - Rixtel	regular	Quality	Valve set-up	RTL	RP	1	0
I.013068 - GNIPA-S-1439 Koudum	regular	Quality	Valve set-up	RTL	RP	1	0
I.013386 - Replacement of Zeeland S-7852 connct.	regular	Quality	Valve set-up	RTL	RP	1	0
I.012742 - Replacement Unimeet incl. construction comm. prototype	regular	Quality	Other	N/A	RP	1	0
I.013565 - GNIPA-S-3117 Het Laar Tilburg	regular	Quality	Valve set-up	RTL	RP	1	0

Project forecast: cumulative	2020IP forecast: cumulative	IP forecast variance	Percentage	Nature of variance	Variance cause/reason	Impact of variance
			-3			
			-26	budget adjustments	Construction costs lower than anticipated due to economies of scope from joint implementation with I.012960	None
			-7			
			36	budget adjustments	Maintenance postponed for one year. Wider scope due to end-of-life assets	New delivery date agreed
			-8			
				Unanticipated bottlenecks	Unexpected defect	None
			-12			
			-6			
				Unanticipated bottlenecks	Unexpected defect	None
			-5			
			-17			
			-1			
			10			
			-0			
			50	budget adjustments	Contract price higher than forecast due to additional work on part of contractor and cost underestimation of post outsourced drawing work	None, project will be delivered on schedule
			-21			
			9			
			8			
			0			
			-30	budget adjustments	Construction costs lower than anticipated due to economies of scope from working on several other set-ups at the same time	None

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Projects completed in 2020 continued previous page

Code identifying the project/ aggregate projects	Regular/ Major	Bottleneck	Network component category	Network pressure RTL/HTL	Expansion or replacement investment	No. of separate network comp.	Kilometres per year
I.013698 - Replacement DRUPS-NB2 (H-gas) for S-UPS Rav.	regular	Quality	CS	HTL	RP	1	0
I.013037 - GNIPA S-1020 Gasselternijveenschemond	regular	Quality	Valve set-up	RTL	RP	1	0
I.013502 - GNIPA S-3070 Heel GRS	regular	Quality	Valve set-up	RTL	RP	1	0
I.013498 - GNIPA S-3044 Herkenbosch GRS	regular	Quality	Valve set-up	RTL	RP	1	0
I.013663 - Halfweg CDM Spaarnwoude W-534-01-KR-017	regular	Quality	Pipelines	RTL	RP	0	0,31
I.013545 - GNIPA-S-4671 Lieving	regular	Quality	Valve set-up	RTL	RP	1	0
I.013285 - Corrosion defect conduit W-521-01 OLNZ	regular	Quality	Pipelines	RTL	RP	0	0,06
I.013707 - LNG PS HVAC systems 2020 long-term maintenance plan	regular	Quality	LNG	HTL	RP	1	0
I.013315 - GNIPA Ter Apel S-4737,S-4715,S-4738 Adjustment	regular	Quality	Valve set-up	RTL	RP	1	0
I.013355 - Systematic civil engineering maintenance OLOO 2020	regular	Quality	Valve set-up	HTL	RP	1	0
I.013529 - GNIPA-S-4450 De Hond	regular	Quality	Valve set-up	RTL	RP	1	0
I.013239 - Revision of Ledeen and Cameron valves	regular	Quality	Valve set-up	HTL	RP	multiple	0
I.013354 - Systematic civil engineering maintenance OLOH 2020	regular	Quality	Valve set-up	HTL	RP	1	0
I.013768 - Replacement Wierden N-557-30 dealing with corrosion	regular	Quality	Pipelines	RTL	RP	0	0,26
I.013725 - Replacement Ressen S-1493 external leakages	regular	Quality	Valve set-up	RTL	RP	1	0
I.013614 - Replacement GVs lines 1, 2 and 3 W-130 Leerdam	regular	Quality	GRS	RTL	RP	1	0
I.013066 - GNIPA S-1379 Valthe	regular	Quality	Valve set-up	RTL	RP	1	0
I.012623 - GNIPA S-1251 Norg	regular	Quality	Valve set-up	RTL	RP	1	0
I.013023 - Replacement of data acquisition system export (DEX) OLN	regular	Quality	Export stations	HTL	RP	1	0
I.013787 - Adjustment of Borculo N-720 heating	regular	Quality	GRS	HTL	EP	1	0
I.013519 - GNIPA S-9996 Echteld Hoogbroek	regular	Quality	Valve set-up	RTL	RP	1	0

Project forecast: cumulative	2020IP forecast: cumulative	IP forecast variance	Percentage	Nature of variance	Variance cause/reason	Impact of variance
			84	budget adjustments	Wider scope in implementation (including adjusting software, adjusting control panels)	None, functionality and quality will be maintained
			0			
			-8			
			-10			
			-1			
			-8			
			-5			
			9			
			5			
			9			
			-2			
			-23			
			91	budget adjustments	Maintenance postponed for one year. Wider scope due to end-of-life assets	New delivery date agreed
			-7			
			-15			
			123	budget adjustments	Higher costs due to work being more complex than anticipated and so being outsourced instead of carried out by our own organisation	None, project will be delivered on schedule
			-2			
			-24			
			19			
			30	budget adjustments	Wider scope in implementation	None, functionality and quality will be maintained
			-6			

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Projects completed in 2020 continued previous page

Code identifying the project/ aggregate projects	Regular/ Major	Bottleneck	Network component category	Network pressure RTL/HTL	Expansion or replacement investment	No. of separate network comp.	Kilometres per year
I.013860 - Diversion of Valkenswaard Z-511-01-KR-019 N69	regular	Quality	Pipelines	RTL	RP	0	0,1
I.013668 - Repair leak S316,576,356 A577 OLOH	regular	Quality	Valve set-up	HTL	RP	2	0
I.013777 - CDM Lutjegast N-505-10-KR-001	regular	Quality	Pipelines	RTL	RP	0	0,25
I.013732 - Installation of rectifier N-531 and N-527 OLZD	regular	Quality	Pipelines	RTL	RP	1	0
I.013592 - Int. leak GV str.3 W-027 Puttershoek	regular	Quality	GRS	RTL	RP	1	0
I.013344 - Systematic civil engineering maintenance Zuidbroek 2019	regular	Quality	Nitrogen installation	HTL	RP	1	0
I.013774 - Repairing insufficiencies W-118 ROS Bussum	regular	Quality	GRS	RTL	RP	1	0
I.013679 - Connection point for Schaap Biogas St Nicolaasga	regular	Capacity	Pipelines	RTL	EP	1	0,03
I.013779 - Replacement GV str.1,2 Reg. str.1 W-418 Vopak	regular	Quality	GRS	RTL	RP	1	0
I.013765 - Diversion of Druten N-575-52 culvert upgrade	regular	Quality	Pipelines	RTL	RP	0	0,025
I.013641 - Upgrade of KB systems OIR - 2019	regular	Quality	CS	HTL	RP	1	0
I.013775 - Replacement of welding machines welding workshop OLS	regular	Quality	Other	N/A	RP	1	0
I.013630 - Replacement of Schlumberger regulators Z-041 Born	regular	Quality	GRS	RTL	RP	1	0
I.013812 - GRS Replacement of reg. str.2 and 3 Z159 Den Bosch	regular	Quality	GRS	RTL	RP	1	0
I.013782 - Replacement of GV str. 1 and 2 GRS W-409 AVR	regular	Quality	GRS	RTL	RP	1	0
I.013718 - KB upgrades anchor blocks S-079	regular	Quality	Valve set-up	HTL	RP	1	0
I.013750 - Replacement HPSD best. contingency M&R OLAlg.	regular	Quality	Other	HTL	RP	2	0
I.013807 - Replacement of hall lighting at CS Spijk	regular	Quality	CS	HTL	RP	1	0
I.013684 - Replacement Aalten N-569-80 KB flange for IK	regular	Quality	Pipelines	RTL	RP	1	0
I.013763 - PIG-20 Construction costs Pigging 2020	regular	Quality	Pipelines	HTL	RP	1	0
I.013786 - Replacement Mill Z-166 shut-off valve and IK	regular	Quality	GRS	RTL	RP	1	0
I.013817 - Installation of drainages Z-540-01 OLZ specifying Tenn	regular	Quality	Pipelines	RTL	RP	1	0

Project forecast: cumulative	2020IP forecast: cumulative	IP forecast variance	Percentage	Nature of variance	Variance cause/reason	Impact of variance
			9			
			58	budget adjustments	Reduced scope and so lower costs	None, functionality and quality will be maintained
			-32	budget adjustments	Construction less expensive	None
			21			
			-0			
			61	budget adjustments	Moved back due to Covid-19 measures and timing work to coincide with maintenance stops	New delivery date agreed
			-29	budget adjustments	Construction costs lower than anticipated due to economies of scope through previously installed contingency facilities	None
			-1			
			-2			
			-11			
			-49	budget adjustments	Costs of construction lower due to overestimation of work required during budget preparation	None
			3			
			-28	budget adjustments	Materials and overhead lower than anticipated	None
			-18			
			-12			
			-7			
			2			
			7			
			-19			
			45	budget adjustments	Overhead costs lower than anticipated. Absolute difference less than 25,000	None
			-17			
			-0			

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Projects completed in 2020 continued previous page

Code identifying the project/ aggregate projects	Regular/ Major	Bottleneck	Network component category	Network pressure RTL/HTL	Expansion or replacement investment	No. of separate network comp.	Kilometres per year
I.013691 - Replacement of regulator Z-135 Oeffelt GRS	regular	Quality	GRS	RTL	RP	1	0
I.013939 - Rectifier Nijmegen T22566 N-576-70	regular	Quality	Pipelines	RTL	RP	1	0
I.013743 - Z-222 Aarle-Rixtel resolve bottleneck OLWB	regular	Quality	GRS	RTL	RP	1	0
I.013813 - Replacement TVA2020 LDAR meters OL	regular	Quality	Other	N/A	RP	1	0
I.013357 - Replacement of EVHI ISM999 MR Heerhugowaard	regular	Quality	M&R	HTL	RP	1	0
I.013974 - Replacement of 2 anode beds Hichtum/Lelystad	regular	Quality	Pipelines	RTL	RP	1	0
I.013952 - Repl. regulator W-144 line 2 GRS Ouderkerk	regular	Quality	GRS	RTL	RP	1	0
I.013811 - GRS Replacement of regulator str.2 Z108 Oirschot	regular	Quality	GRS	RTL	RP	1	0
I.013825 - Replacement. reg. street 2 GRS Z302 Dom Bosch	regular	Quality	GRS	HTL	RP	1	0
I.013599 - S-9942 Maas-Waalkan. installation of insulating joint	regular	Quality	Valve set-up	RTL	RP	1	0
I.013861 - Replacement of anodes G2040 Amsterdam, G2098 Mijdrecht	regular	Quality	Pipelines	RTL	RP	1	0
I.013866 - Rectifier Drogeham T22260 N-505-60	regular	Quality	Pipelines	RTL	RP	1	0
I.013773 - Procurement of purge actuator with control OL	regular	Quality	Other	N/A	RP	1	0
I.013864 - Rectifier Fleringen, T22451,N-531-10	regular	Quality	Pipelines	RTL	RP	1	0
I.013863 - Rectifier Purmerend,T21166, W-570-23	regular	Quality	Pipelines	RTL	RP	1	0
I.013831 - KB upgrade GLR Buinerveen	regular	Quality	Pipelines	RTL	RP	1	0

Project forecast: cumulative	2020IP forecast: cumulative	IP forecast variance	Percentage	Nature of variance	Variance cause/reason	Impact of variance
			-26	budget adjustments	Material and overhead costs lower than anticipated. Absolute difference less than € 25,000	None
			30	budget adjustments	Contract price higher than anticipated. Absolute difference less than € 25,000	None
			-72	budget adjustments	Construction costs lower than anticipated due to economies of scope from working on several other set-ups at the same time	None
			-10			
			44	budget adjustments	Additional costs due to remediation of chromium-6 contamination	None, project will be delivered on schedule
			61	budget adjustments	Contract price higher than anticipated. Absolute difference less than € 25,000	None
			-21			
			-57	budget adjustments	Material and overhead costs lower than anticipated. Complexity of work overestimated at the time of approval.	None
			-66	budget adjustments	Material and overhead costs lower than anticipated. Complexity of work overestimated at the time of approval.	None
			1			
			2			
			-29	budget adjustments	Contract price lower than anticipated. Absolute difference less than € 25,000	None
			-7			
			-31	budget adjustments	Contract price lower than anticipated. Absolute difference less than € 25,000	None
			-37	budget adjustments	Contract price lower than anticipated. Absolute difference less than € 25,000	None
			-54	budget adjustments	Contract price lower than anticipated.	None

continued on next page

Projects completed in 2020 continued previous page

Code identifying the project/ aggregate projects	Regular/ Major	Bottleneck	Network component category	Network pressure RTL/HTL	Expansion or replacement investment	No. of separate network comp.	Kilometres per year
I.013801 - Replacement Wesepe N-072 GRS GV & reg. str. 2	regular	Quality	GRS	RTL	RP	1	0
I.013879 - Install rectifier Waddinxvn T21225 W-517-01	regular	Quality	Pipelines	RTL	RP	1	0
I.014408 - Install AC drain line A 538 06 Tata steel	regular	Quality	Pipelines	HTL	RP	1	0

Project forecast: cumulative	2020IP forecast: cumulative	IP forecast variance	Percentage	Nature of variance	Variance cause/reason	Impact of variance
			-47	budget adjustments	Material and overhead costs lower than anticipated. Absolute difference less than € 25,000	None
			-47	budget adjustments	Contract price lower than anticipated. Absolute difference less than € 25,000	None
			-			

Appendix V Report on security of supply

Article 52a of the Dutch Gas Act stipulates that the Minister must submit an annual report on the security of supply to the European Commission. Pursuant to the Decree on the performance of duties under Article 52a of the Dutch Gas Act dated 1 July 2011 the Minister has assigned this responsibility to GTS. Most of the topics are included in this draft IP. The two remaining topics, peak supply and supply in the event of a licence holder's insolvency, are addressed below.

To guarantee the supply of gas to small-scale consumers, GTS has been assigned two statutory duties: firstly, it must ensure the supply to small-scale consumers during peak periods, and secondly, it must take certain actions in the event that a licence holder can no longer meet its financial obligations and the supply to small-scale consumers is endangered as a result.

Peak supply

Pursuant to the Security of Supply (Gas Act) Decree dated 13 April 2004, GTS has a statutory obligation to take measures to allow licence holders to continue to supply small-scale consumers (consumer category G1A and G2A) with natural gas during 'peak supply periods'. A peak supply period is deemed to be a period during which the mean effective 24-hour temperature is minus 9°C or lower. GTS provides all necessary facilities to enable licence holders to continue to supply all small-scale consumers in the Netherlands during such periods, including gas purchasing, flexibility services and gas transmission over the national gas grid. The measures taken and facilities provided must be such that peak supply can be provided on a day with a mean effective 24-hour temperature of minus 17°C, as measured at the Royal Netherlands Meteorological Institute in De Bilt.

Each year, GTS determines the capacity and volume required for peak supply for this service. The required volume and capacity is determined on the basis of historical temperature data series and consumption information for the previous winters at the relevant exit points. GTS arranges gas procurement and the procurement of flexibility services by tender; the required transmission capacity is reserved by GTS.

For the winter of 2019–2020, GTS has procured flexibility services with a capacity of 22GWh and a volume of 816GWh. The winter of 2017–2018 was the last winter in which a mean effective 24-hour temperature of minus 9°C or lower occurred.

GTS charges the transmission costs (entry and exit) it reserves for peak supply during the winter months of December, January and February to the licence holders in these winter months in proportion to their market share in the small-scale consumer segment. The licence holders are charged the peak production tariff on a monthly basis, also in proportion to their market share in the small-scale consumer segment.

Supply in the event of a licence holder's insolvency

When a licence holder is no longer able or deemed to be able to meet its financial obligations, ACM can make a decision to revoke that holder's licence. The decision will take effect no later than twenty working days after the decision is made. GTS can be asked to guarantee the payment of the procurement of gas for supply to small-scale consumers during this period.

If, on the tenth working day after the decision has been made, not all of the licence holder's small-scale consumers have been transferred to another licence holder, GTS will assign the remaining small-scale consumers to another licence holder. GTS will provide the receiving licence holder with the relevant data of the allocated small-scale consumers. If the credit facility of a receiving licence holder proves to be insufficient, it can request a guarantee from GTS for the purchase of gas for the allocated small-scale consumers.

The Dutch Energy Data Exchange Association (NEDU) has drawn up a description of the processes relating to the administrative handling of a case of insolvency of a licence holder and the distribution of small-scale consumers among the other licence holders.

A protocol has been drawn up by ACM, TenneT and GTS for mutual cooperation and for cooperation with EDSN (Energie Data Services Nederland) in the event that the supply by a licence holder is endangered.

The situation in which a licence holder has become insolvent and their licence withdrawn has arisen several times in the past. Pursuant to the Security of Supply (Gas Act) Decree, GTS has guaranteed payment for the procurement of gas for supply to small-scale consumers. Based on these experiences, in consultation with TenneT, GTS has drawn up sample texts that can be used for the guarantees. The process regarding guarantees and payments under the guarantees is still being set up further at GTS. In another case, GTS allocated the small-scale consumers of a licence holder to other licence holders. This was done in collaboration with TenneT and EDSN. This method was successful and can be used again should such a situation arise in the future.

Appendix VI Capacity at cross-border stations

			GW						
NAME VIP/IP	NWP	DIRECTION	okt.-21	okt.-22	okt.-23	okt.-24	okt.-25	okt.-26	okt.-27
VIP TTF-THE-L	301568	entry	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		exit	38.5	33.7	28.9	24.2	19.4	14.6	9.8
underlying IPs:									
Winterswijk (OGE)	300133								
Zevenaar (OGE)	300132								
Tegelen (OGE)	300138								
Haanrade (Thyssengas)	300141								
Dinxperlo (BEW)	300140								
Oude Statenzijl (GTG Nord-G)	300136								
Oude Statenzijl (GUD-G)[OBEBG]	300144								
Oude Statenzijl (GTG NORD-H)	301550								
VIP-TTF-NCG-H	301545	entry	19.0	19.0	19.0	19.0	19.0	19.0	19.0
		exit	26.0	26.0	26.0	26.0	26.0	26.0	26.0
underlying IPs:									
Bocholtz TENP (OGE - Flx TENP)	300139								
Bocholtz Vetschau (Thyssengas)	301368								
Oude Statenzijl (OGE]	300147								
VIP-BENE	301546	entry	14.1	14.1	18.0	18.0	18.0	18.0	18.0
		exit	33.4	33.4	33.4	33.4	33.4	33.4	33.4
underlying IPs:									
's Gravenvoeren (Fluxys)	300143								
Zandvliet (Fluxys-H)	301184								
Zelzate (Fluxys)	301111								
VIP-TTF-GASPOOL-H	301548	entry	17.9	17.9	17.9	17.9	17.9	17.9	17.9
		exit	12.2	12.2	12.2	12.2	12.2	12.2	12.2
underlying IPs:									
Oude Statenzijl (GUD-H)[OBEBH]	300146								
Oude Statenzijl (Gascade-H)	300147								
HILVARENBEEK (FLUXYS)	300131	entry	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		exit	24.8	24.8	24.8	21.1	17.4	13.6	9.9
VLIEGHUIS (RWE)	300142	entry	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		exit	3.0	3.0	3.0	3.0	3.0	3.0	3.0
EMDEN EPT (GASSCO)	301113	entry	40.2	40.2	40.2	40.2	40.2	40.2	40.2
		exit	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ROTTERDAM (GATE)	301345	entry	18.5	18.5	18.5	18.5	18.5	18.5	18.5
		exit	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	okt.-28	okt.-29	okt.-30	okt.-31	okt.-32	okt.-33	okt.-34	okt.-35	okt.-36	okt.-37	okt.-38	okt.-39	okt.-40
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	5.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0
	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0
	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0
	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4	33.4
	17.9	17.9	17.9	17.9	17.9	17.9	17.9	17.9	17.9	17.9	17.9	17.9	17.9
	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	6.2	2.5	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
	40.2	40.2	40.2	40.2	40.2	40.2	40.2	40.2	40.2	40.2	40.2	40.2	40.2
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Colophon

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