



ING Economics Department

# From a successful past to a promising future

Challenges and opportunities for the Dutch gas infrastructure

# Content and summary

## Introduction

The Dutch are leading the North West European gas market with a model that we believe serves as an example internationally. What makes this model so successful? And what are the main challenges and strategies required for it to remain successful in the future? ING's Economics Department addresses these topics in this publication.

pages 3-5

## From a successful past

The discovery of large gas reserves in the Netherlands has made it a top 10 gas producing country in the world and a major gas exporter in North West Europe. It has state-of-the-art gas infrastructure both in terms of hardware (pipelines, storages and LNG facilities) and in terms of software (gas market place and knowledge centres).

pages 6-11

## Main challenges on the way to a promising future

1. Running out of reserves: the Netherlands will be a net importer of gas somewhere around 2025.
2. The role of gas in a low carbon economy will be limited.
3. Gas markets are international but energy policies seem to stop at borders.

pages 12-14

## An uncertain future: three scenarios for gas

- Business as usual: gas demand is at its peak and will decline slowly in the future.
- Merit order change: gas will substitute coal due to effective carbon pricing.
- Strong climate action: the demand for gas will fall sharply because of faster-than-anticipated implementation of energy-saving technologies and renewables.

The last scenario, in particular, will have far reaching consequences for the gas infrastructure as it will require an entirely different structure of the grid as energy production will be more decentralised.

pages 15-16

## Strategies to support a promising future

### Deepening of own market

The North West European gas market is more-or-less complete. Strengthening the region's position is not so much a matter of new infrastructure but one of better utilisation of current facilities, such as increasing the deal flow on the TTF and LNG markets.

### Dutch-Belgian collaboration

The Netherlands and Belgium compete with one another in the LNG market and market for transit flows. On the one hand this is healthy, but on the other hand it creates inefficiencies and does not always make sense from a European perspective. By joining forces, the North South infrastructure of Belgium and the East West infrastructure of the Netherlands could be integrated more efficiently on a European scale.

### Build gas infrastructure abroad

We believe the main infrastructure opportunities lie outside North West Europe as many regions lack a sizable gas market, are dependent on one or a limited number of pipelines through which gas can enter the market, or are dependent on one supplier. The future of gas infrastructure lies in new markets and regions. As a result, the Dutch position in the European gas market could be strengthened by investing abroad.

### Create market places for gas abroad

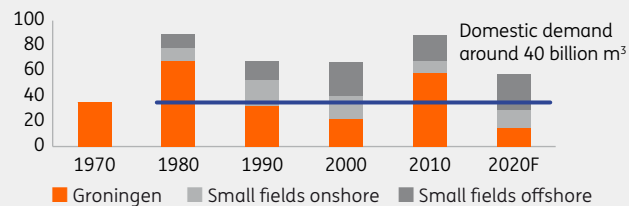
Investing in market-making facilities abroad matches the trade mentality of the Dutch. As a market maker, the Netherlands benefits from foreign gas flows even if the gas does not enter the Dutch grid. This resembles the Dutch Flower Auction model where traders in Aalsmeer are in charge of global trade flows even if the flowers don't enter or leave the Netherlands.

From a successful past

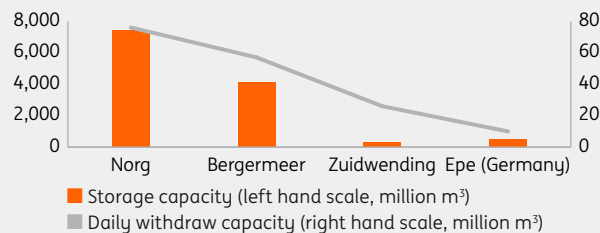
# Dutch 'gasrotonde' policy serves as an example in the EU

## Hardware of Dutch gas infrastructure

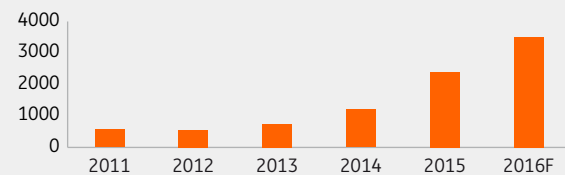
**Gas production** larger than domestic demand although Groningen capacity is reduced (billion m<sup>3</sup>)



**Gas storage** increases grid flexibility



**LNG** provides alternative for Groningen and Russian Gas (LNG transfers GATE terminal in metric tonnes)



## Software of Dutch gas infrastructure

### Market place for gas

Infrastructure alone is not a sufficient condition for a thriving gas market. A liquid and transparent market will yield efficient prices and attract many parties to participate in the market. The Title Transfer Facility (TTF) is a virtual gas exchange that provides both spot and futures markets.

### Knowledge

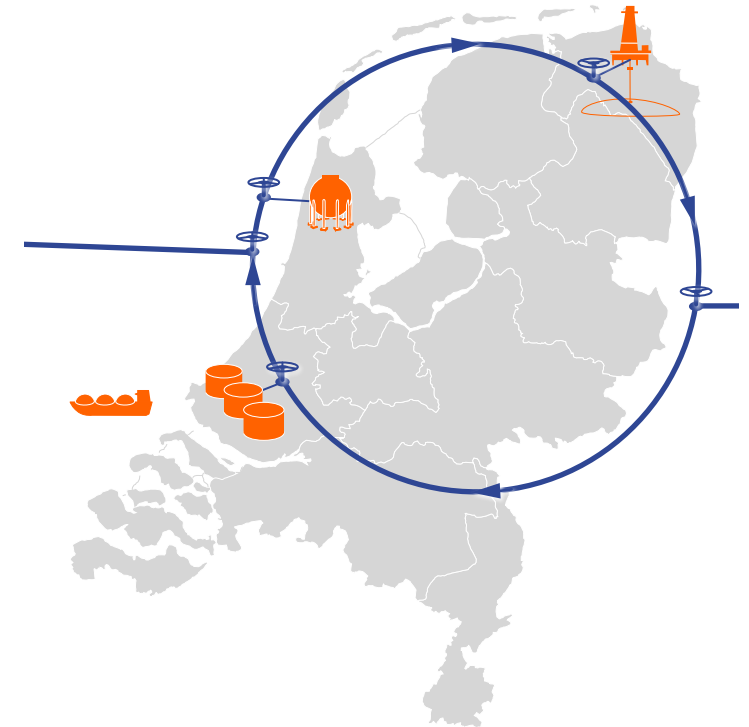
Research and science institutes have been created to provide the Netherlands with a leading role in gas and any developments in this sector. Think, for example, of TNO, Clingendael International Energy Programme (CIEP) and the Energy Academy Europe. An extensive knowledge of gas stimulates innovation and improves the business climate.

### Interconnecting pipelines

With Germany, Belgium and the UK have created a North West European gas market

### Gas blending stations

Have been created to adjust the quality from different sources and locations in the world.



Since the discovery of the Groninger gas field in the 1960s, the Dutch have built an extensive gas infrastructure, both in terms of hardware (production and pipelines) and software (market place and knowledge). As such, the Dutch are leading the North West European gas market and serve as an example for many other regions in the EU. A commonly held view is that the Dutch 'gasrotonde' strategy is almost completed; our report seeks to challenge this view as we believe gas markets are facing fundamental change.

From a successful past (continued)

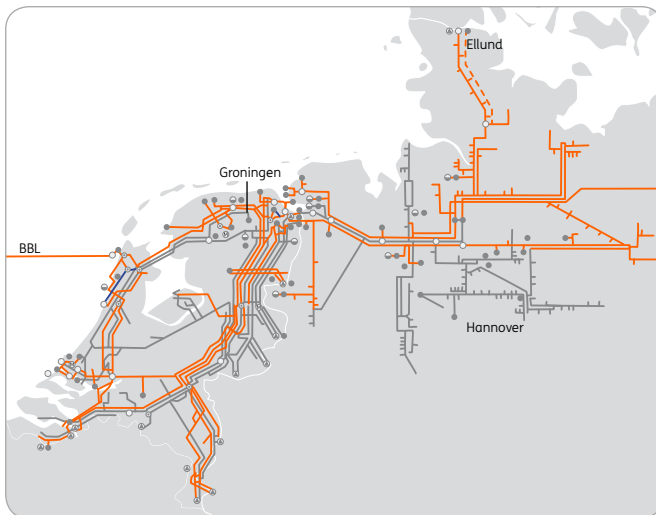
# The Netherlands are the leading gas producer and transporter in the North West European gas market

## Production

The Netherlands is one of the most important gas producers in the EU, accounting for 30% of production in the EU, which meets around 12% of European gas consumption. Within the North West European market, the Netherlands accounts for half of the gas production, which meets about a quarter of demand in the region.

## Infrastructure

The gas infrastructure allows gas molecules to flow freely to and from the Netherlands. Actual trade flows are determined by traders who act on price signals in the market.



Source: Gasunie.

- In 2013, the Netherlands was the **eighth-largest gas producing country in the world** producing 86 billion cubic metres (bcm) of gas...
- ...and the **second-largest gas producer in Europe** after Norway.
- In 2013, the Netherlands was the **largest net exporter of gas in the EU**, exporting 40bcm.
- Natural gas reserves (excluding shale gas) amount **1,000bcm**, of which 700bcm in the Groningen field. This represents a value of around €150bn to the Dutch government.
- Depending on the rate of extraction, the Dutch gas reserves are forecast to be exhausted in **25 to 50 years** time. On a global scale reserves account for 230 years of current global gas consumption.
- The combined gas infrastructure of Gasunie in the Netherlands and Germany totals approximately **15,500 kilometres** of gas pipelines.
- Gasunie's system has **14 export stations** through which gas is imported or exported...
- ...as well as **1,300 'endpoints'** that deliver gas to regional infrastructure or directly to large energy users, such as gas-fired power stations or manufacturing companies.
- Annually, **100bcm of natural gas flows through the pipelines** in the Netherlands, which equates to two and a half times domestic demand.
- **45bcm of gas** is delivered through the virtual trading place TTF...
- ...trade on the platform is much higher as gas, on average, **is traded 18 times** before deliverance.
- The German infrastructure is directly connected to Norwegian and Russian gas supplies (**Nord Stream pipeline** with a capacity of 55bcm)...
- ...while the Dutch infrastructure is directly connected to UK gas supplies (**BBL pipeline** with a capacity 15bcm).
- The **GATE terminal** has the potential to feed 12bcm of LNG into the grid.
- **98%** of Dutch households are connected to the grid.
- The Dutch grid is one of the most **reliable** grids in the world. Failure of the grid, on average, is limited to only a few seconds a year.



From a successful past (continued)

# Gas is and will remain important for the Dutch economy

## The Dutch apply their trade mentality to gas...

The mining sector comprises 4.4% of the Dutch economy which equates to €26bn of economic value added. Almost all the mining activities are related to gas (98%) as hardly any oil is mined in the Netherlands. While 'only' half of the physical gas flows are exported, export activities account for two-thirds of the economic value (65%). Applying the Dutch trading mentality to the gas sector has yielded increasingly higher economic value from export activities than from domestic consumption. While the role of exports is coming under pressure due to the widening Groninger production gap, it is likely to remain high in coming years because of legal obligations for gas exports.

## ...and make use of it in industries that drive innovation and growth in the Netherlands

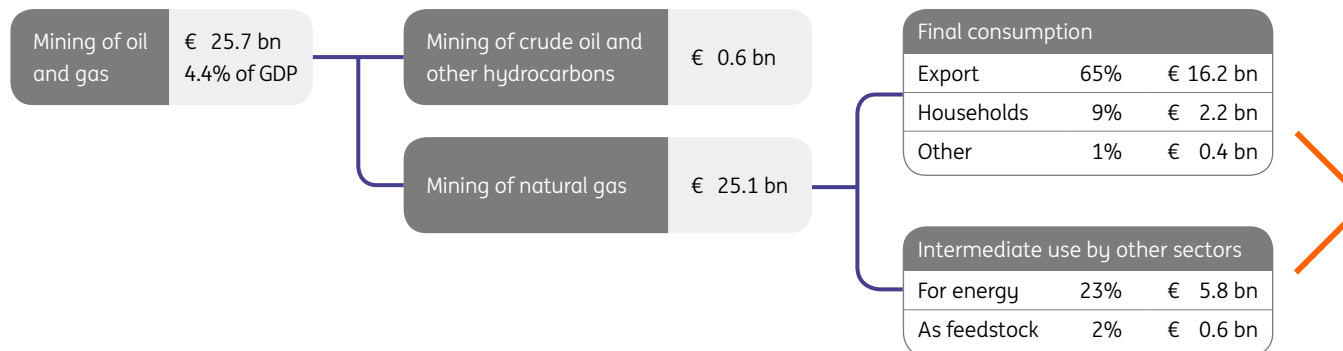
In monetary terms, only 9% of the economic value is related to the use of gas by Dutch households. Considerably more value is related to the intermediate use of gas in industries as a means of production. For example, the energy sector uses gas to produce heat and electricity. The chemical industry uses gas as an energy source as well as a raw material to produce other molecules and materials (feedstock).

The Netherlands has a strong position in chemicals, agriculture and high-tech manufacturing.

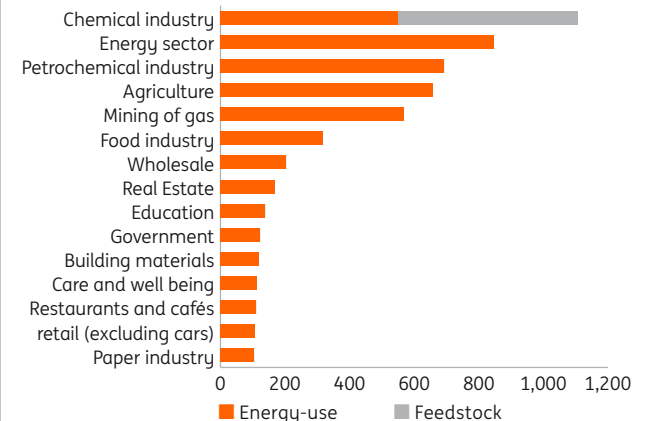
These industries are known for quality, innovation, productivity, trade mentality or international focus. Consider companies such as AkzoNobel, Dow Chemical, DSM and Shell in the chemicals sector, Friesland Campina and Aviko in agriculture, or ASML, VDL and Philips in manufacturing. Despite increased focus on energy efficiency and renewable energy, these industries will remain major users of gas in the coming years. These companies are not expected to offshore their production facilities in the near future, so it is anticipated that they will import more gas from abroad in response to declining production in the Netherlands.

There is limited potential to reduce gas exports in the short term due to long term legal commitments.

## Source and destination of gas activities in the Netherlands (€bn value added)



## Use of gas in Dutch industries (€m value added)



Source: TNO, based on CBS and Eurostat data for 2013.

## Challenges and dilemmas

# Challenges on the way to a promising future

We see several major challenges for the Dutch gas infrastructure and believe these challenges provide the context in which decisions regarding the gas infrastructure will have to be made.

### 1. Lower production in the Netherlands

The position of the Netherlands in international gas markets will change as it makes the transition from being a major gas producer to becoming a gas importer in the coming years.

### 2. The role of gas in a low carbon economy

The Dutch government is aiming to reduce carbon emissions by 80-95% by 2050. A low carbon economy inevitably raises uncertainty about the future role of gas. In the medium term, gas could aid the transition to a low carbon economy but, in the long run, it remains to be seen what role a fossil fuel can play in a low carbon economy based on renewable energy.

### 3. International markets need international policies

Gas markets have become large international markets in which gas molecules flow freely across borders. Despite commitments to form a European Energy Union, energy policies are still the responsibility of individual member states and, as such, can differ significantly across borders. This dichotomy poses challenges to the future development of gas infrastructure.

We elaborate on these major challenges and their implications for the gas infrastructure in the following slides. Lastly, we present the strategies that we believe offer the Dutch gas infrastructure a promising future.



## First challenge

# The times they are a'changing...

...the Netherlands will become a net importer of gas somewhere between 2025 and 2030

### From net exporting country...

The Netherlands has produced, on average, 80bcm of natural gas a year making it currently the eighth-largest producer of natural gas in the world and the largest in the European Union.

In past decades, production has been about twice as high as domestic demand, making the Netherlands a large gas exporter for the North Western European market.

### ...to net importing country

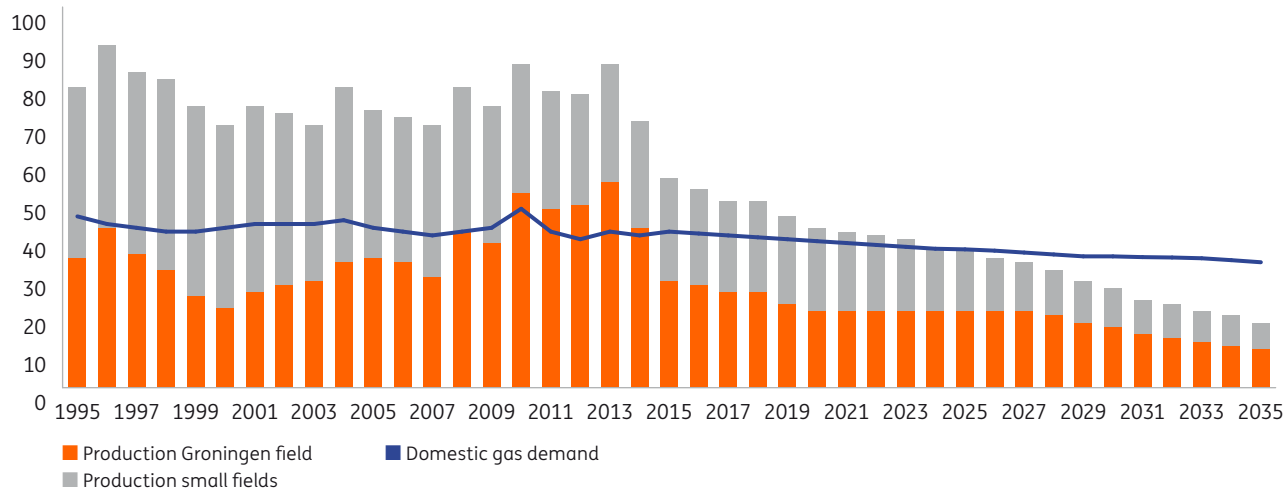
However, gas production in the Netherlands is declining. In the short term this is due to the imposition of an annual production ceiling of 27bcm at the Groningen field in an attempt to limit the risk of earthquakes. In the long run it is due to depletion of the gas fields. Over the past 60 years,

the Netherlands has extracted a total of about 3,600bcm from its fields. It is believed that a further 1,000bcm is still available for extraction.

Given that production will decline at a faster pace than domestic demand, it is estimated that the Netherlands will become a net importing country within 10 to 15 years (somewhere between 2025 and 2030), depending on political decisions regarding the production gap for the Groningen field in the coming years.

With the scheduled building of new nitrogen blend installations, the infrastructure will be soon in place to rely more on gas imports than own production. As such, the Netherlands can retain its gas hub function within the North Western European gas market. The system, however, will become more dependent on foreign gas resources and require a trade-orientated approach rather than production-orientated. The role of mining activities will diminish and the role of trade, the market place (TTF exchange) and storage will increase.

Gas production and domestic demand in the Netherlands (bcm)



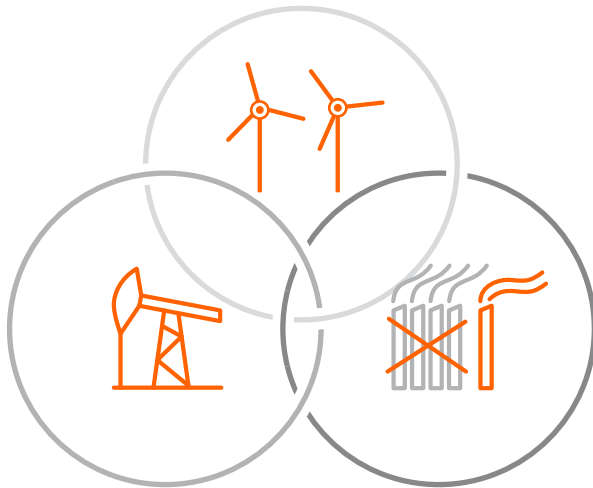
Source: ING Economics department based on Gasunie, CBS and TNO.

## Second challenge

# While gas is the cleanest fossil fuel, it's role in a low carbon economy is likely to be marginal

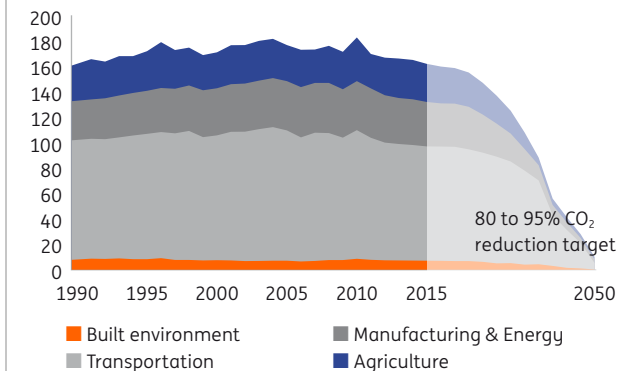
### Low carbon economy requires a different energy system

The EU has set ambitious targets for the transition to a low carbon economy with the need to cut CO<sub>2</sub> emissions by 80-95% by 2050. As technology is progressing rapidly, nobody yet knows what the energy mix of a low carbon economy will look like. Nevertheless, it is clear that the system has to change fundamentally in order to meet such goals. The turnaround in CO<sub>2</sub> emissions is likely to require change along the following lines:



1. Majority of energy derived from **renewable energy sources**.
2. **Fossil fuels will still play a role** in a low carbon economy but as a backup provider of energy. Renewable energy alone – even in combination with good energy storage facilities – most likely cannot meet the needs of every type of energy user. The transition to a low carbon economy is not about phasing out fossil fuels entirely as some advocate.
3. Where fossil fuels continue to play a role in a low carbon economy, the emissions that they cause will need to be captured and stored (CCS). Initially this will be done for gas-fired installations in, for example, the chemicals and manufacturing sectors as they run 24/7, and to a lesser extent for gas-fired power plants as they operate only if needed as a back up (point 2). CCS is not possible for millions of buildings and cars and, as such, **the number of emission points in a low carbon economy will have to be cut drastically**. This can be achieved by replacing household central heating boilers with electric heat pumps, or through the introduction of district heating systems that emit more centralised CO<sub>2</sub>. The introduction of electric vehicles with a view to phasing out the internal combustion engine is also required to reduce emissions.

### Dutch CO<sub>2</sub> emissions have to come down a long way (mtoe)



Source: CBS and PBL.

### The need to think out of the box

To support its Groningen gas field an intricate gas infrastructure in the Netherlands has been established to which 98% of Dutch households are directly connected. It is striking that most visions of future developments take this infrastructure as a starting point and yet this does not match well with the idea of a low carbon economy. Discussions on grid developments often start with the current situation and then look forward when, in fact, it might be more useful to start from the future and reason backwards ...even if that means the current gas infrastructure is not the first option in light of falling gas reserves and the transition to a low carbon economy.



## Third challenge

# Gas markets are international markets...

### Introduction

The next three slides deal with the topic of the large dichotomy in European gas markets. On the one hand, the North Western European gas market is highly international, not in the least part supported by the 'gasrotonde' strategy of the Dutch. On the other hand, energy policies are still largely in the domain of governments. As such, national energy policies can differ substantially across borders which poses challenges to the development of gas infrastructure.

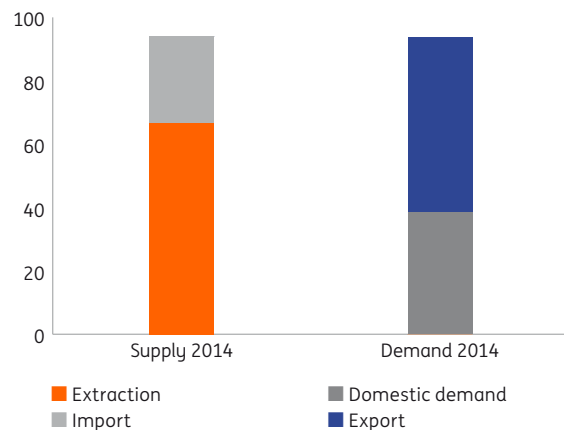
### Large trade flows of gas...

Following the discovery of the Groningen field, the Netherlands soon started exporting gas to neighbouring countries. Export levels varied between 30bcm and 60bcm a year against a fairly stable domestic demand of 40bcm. Since the start of the millennium, imports have risen to approximately 25bcm annually.

### ...put the Netherlands in the driving seat of the North West European gas market

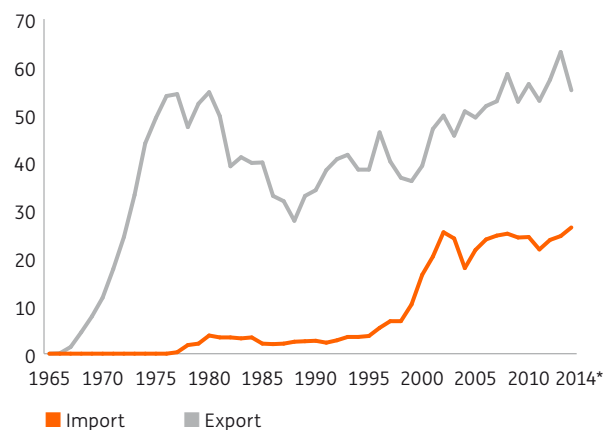
The Dutch gas infrastructure is highly connected with neighbouring infrastructure, especially the German grid. German interconnectivity has improved significantly since Gasunie acquired the northern part of the German grid by acquiring German transmission system operator, BEB. It will improve even further if Nord Stream 2 is completed, which adds two additional pipelines to Nord Stream 1. The Belgian and French networks are also interconnected. Most parts of Belgium and the Northern part of France are heavy users of Groningen gas.

### Dutch supply and demand for gas (billion cubic metres)



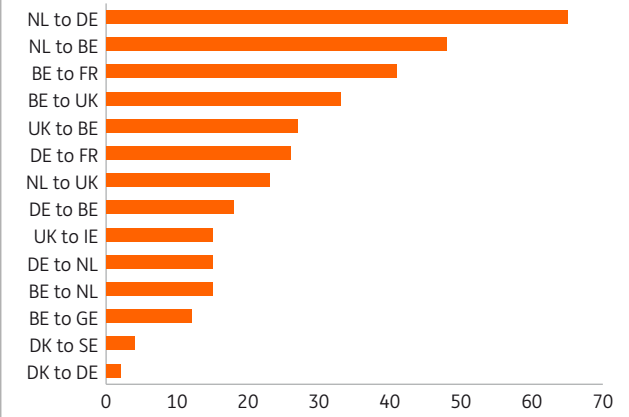
Source: CBS.

### The Dutch trade heavily in gas (billion cubic metres)



Source: CBS.

### The Dutch have most integrated network (GW interconnection capacity)



Source: ENTSG.

## Third challenge (continued)

# ...with highly integrated infrastructure

### Benefits of an interconnected grid

Internationalisation of the grid has yielded several benefits.

#### 1. Abundant

Security of supply has improved in North West Europe as there are now multiple gas routes, as well as alternatives for Russian gas (such as LNG and Norwegian gas). However, Germany is still dependent on Russian gas for 37% of its supplies while dependency for France (16%) and the Netherlands (5%) is much lower.

#### 2. Affordable

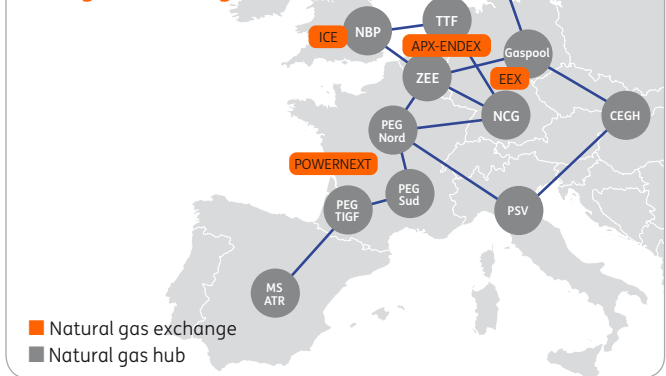
Internationalisation brought the possibility of trade. Some international gas hubs have set up gas exchanges in which gas can be traded freely without ownership of the commodity.

Increased trading facilities have resulted in efficient gas pricing. In recent years, gas prices in the major European gas hubs have converged. There are still small fluctuations but these reflect differences in transportation costs.

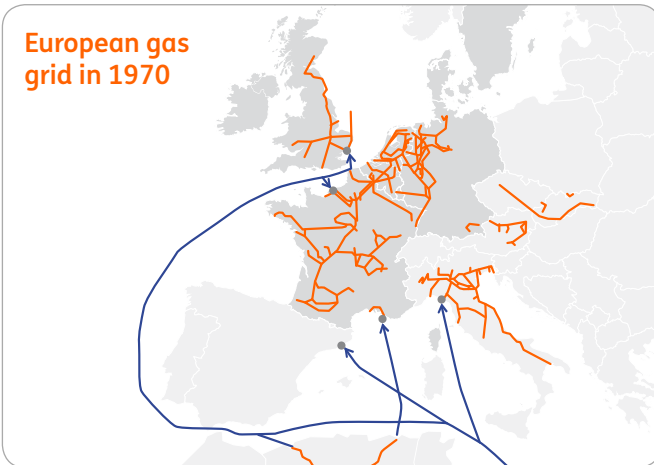
#### 3. Sustainable

The transition to a low carbon economy is leading to rapid growth of renewable energy sources, most notably solar and wind energy. Unfortunately, the output of these sources is highly variable depending on weather conditions. Through an interconnected grid, supply can flow freely to the places it is needed. Think of offshore wind energy in the north of Germany to energy-intensive industries in the south of Germany as well as in the Netherlands and Belgium.

### European gas hubs and gas exchanges

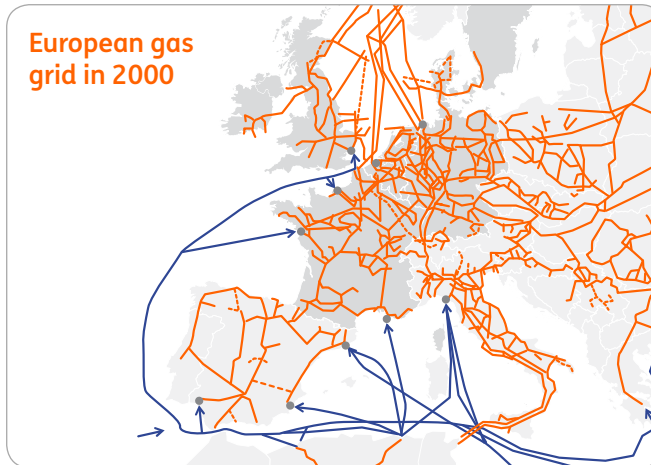


### European gas grid in 1970

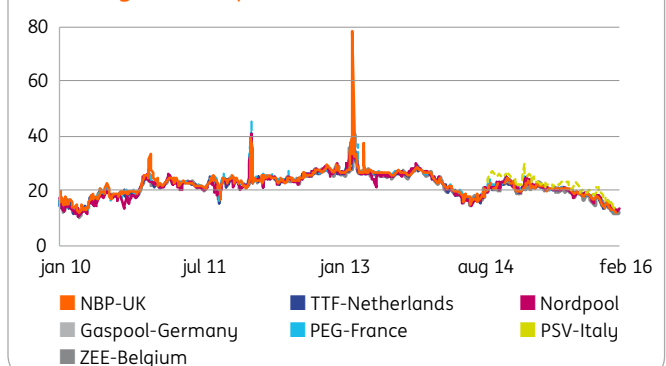


Source: Fluxys in ENTSG.

### European gas grid in 2000



### European day ahead gas prices on different gas exchanges (euro per MWh)



Source: Bloomberg.

## Third challenge (continued)

# While markets and gas infrastructure are international, energy policies differ tremendously across borders

### Different energy policies create uncertainty for grid operators

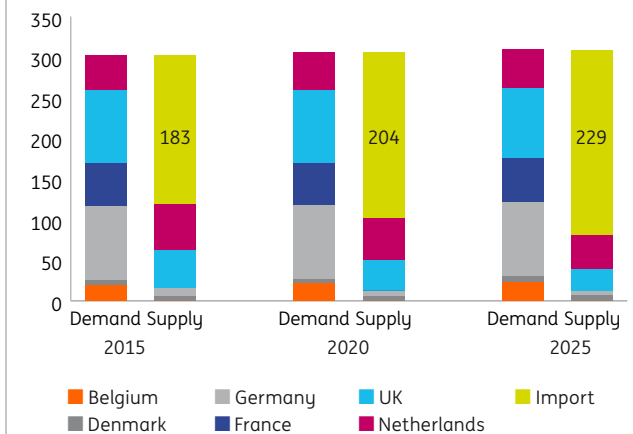
The energy mix has always been the domain of national policy. Due to differences in geographical location, culture, preferences and politics, energy policies differ significantly between countries. This creates uncertainty for the operators of the gas grid as they have to interconnect the infrastructure. But while gas markets become increasingly international and gas imports rise, energy policies effectively stop at a country's border. From an international perspective, grid operators face the challenge of designing

an international grid based on different policies. This is suboptimal as an energy mix in which renewables provide the bulk of energy requires an entirely different grid in comparison with an energy mix based on centralised energy production from nuclear, gas or coal fired power plants. The 'market' won't solve this problem as the energy mix is highly determined by government policies. As such, it is highly desirable that neighbouring countries better align their energy policies in order to create a stable environment for investments in gas infrastructure.

### Energy policies continue to differ

	Use of gas (2012, bcm)	Share of gas in energy mix	Main focus of country specific energy policies
Netherlands	44	42%	Increase in renewable energy, closing of five old coal fired power stations.
United Kingdom	88	33%	Building of new nuclear power plants as well as increase the share of renewable energy.
Belgium	18	24%	Reduction of nuclear energy and increasing connectivity with the Netherlands.
Germany	93	22%	Phasing out of nuclear energy entirely and maintaining its leading role the transition to a renewables based society.
Denmark	4	19%	Renewable energy and strong focus on energy efficiency.
France	50	15%	Reduction in nuclear share from 75% to 50% in 2025 and increase the share of renewables.
Sweden	1	2%	Increased efficiency in nuclear power plants as well as an increase in wind energy.

### Further internationalisation of North West European gas markets shows itself in increasing imports (bcm natural gas)



Source: ING Economics Department based on EZ and Eurogas

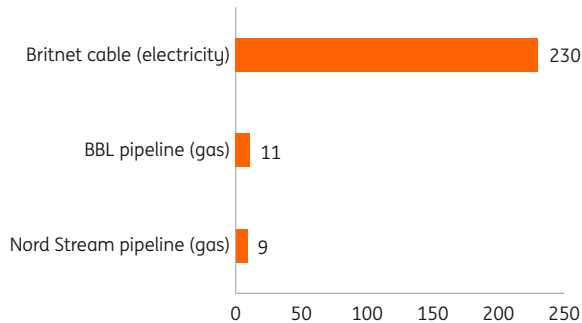
To a promising future

# Gas has many benefits...

## Gas transport is a cheap and highly efficient form of energy transport

In comparison to electricity, gas is a much cheaper form of energy to transport. For example, transportation of 1kW of energy over 100 kilometres is more than 20 times cheaper for gas than for electricity. Gas pipelines are made out of steel which is much cheaper than the copper and aluminium that is used for high voltage cables. And as gas infrastructure is placed in the ground and therefore out of sight it is less sensitive to 'not in my backyard' protests from the local community that is typical of the high voltage electricity grid and wind farms.

### Energy can be transported efficient through gas (euro per kW per 100km)

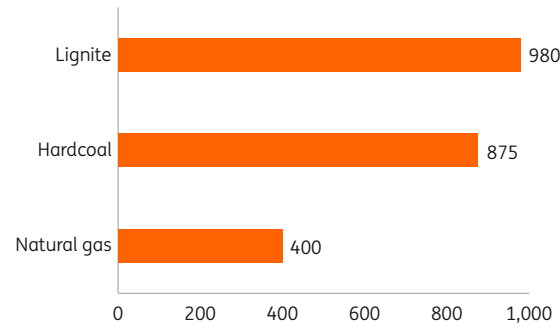


Source: Gasunie

## Capacity of gas infrastructure is higher than for the electricity grid

The capacity to transport energy is 8 times higher for the gas infrastructure than for the electricity grid (approximately 200GW/h versus 25GW/h). Electrification is a major driver for the energy system (think of e-mobility and heat pumps) but, in terms of capacity, the current gas infrastructure is of utmost importance for the energy system. In light of the higher transportation costs and 'not in my backyard' arguments it is questionable whether an 'all electric grid' is a technically feasible or economically desirable option.

### Gas emits much less CO<sub>2</sub> than coal (grammes CO<sub>2</sub> per kWhel)



Source: IEA, 2012

## Gas can play an important role in the transition towards a low carbon economy

Gas is the most sustainable fossil fuel. It emits about half the CO<sub>2</sub> level of coal and does not pollute the air with small particles. In other words, for the same amount of CO<sub>2</sub> emitted, gas yields much more energy than coal. This is an important policy driver in the climate change debate. Scientists have determined that in order to be 80% certain of being able to stay below a 2°C temperature rise, global emissions need to be capped at 565Gt of CO<sub>2</sub> until 2050. Filling this so called 'carbon budget' by gas yields 60% more energy in comparison to coal. Exploiting energy sources that produce a large amount of energy per unit of carbon emitted can help the world meet its increasing energy need without clashing with the climate goals. Or it would give policymakers more time for the transition towards a fully low carbon economy based on renewable energy (CIEP, 2015).



To a promising future

# ...but despite its benefits the role of gas in the transition towards a low carbon economy remains uncertain

## Gas markets in transition

Future demand for gas in the North West European region critically depends on both economic growth and progress in sustainability. While economic growth, like weather conditions, merely determines the level of demand within a given structure of the gas market, sustainability has a more profound impact on gas demand as it leads to structural change. The figure depicts three different scenarios with regard to sustainability and structural change in gas demand.

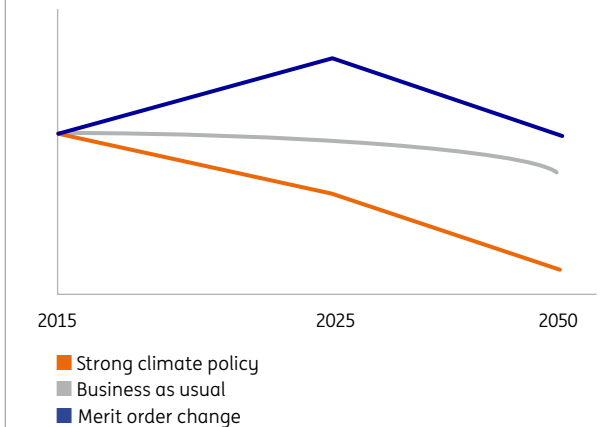
- **Business as usual.** In this scenario, sustainability is implemented at the current pace. Energy savings measures and renewable energy will slowly reduce the demand for gas as a result. Coal and CO<sub>2</sub> prices will remain low and coal-fired power plants will continue to displace gas-fired ones in the coming years. In this scenario gas demand is currently at its peak and will gradually reduce over time.
- **Merit order change.** In this scenario, governments in the North West European region implement effective CO<sub>2</sub> pricing that will change the merit order. Through CO<sub>2</sub> pricing gas-fired power stations will be cheaper to run than coal-fired ones. As a result, gas demand will increase strongly in the coming years and will peak much later as gas replacing technologies kick in.

- **Strong climate policy.** In this scenario, the pace of sustainability increases as renewables and gas replacing technologies are implemented at a faster pace than the business-as-usual scenario. More buildings are renovated and the electrification of the energy system progresses rapidly. However, the merit order is unchanged as coal and CO<sub>2</sub> prices continue to be low. Gas demand is currently at its peak and will strongly decline over time, especially as electrification of the energy system sets in within a few years time.

## The need for clear and stable government policies

Our scenario analysis clearly shows that future gas demand is heavily impacted by government policies with regard to CO<sub>2</sub> pricing and sustainability. In fact, outcomes differ from gas being an important intermediate fossil fuel towards the transition to a low carbon economy (merit order change scenario) to a marginalisation of the role of gas in the strong climate policy scenario. As such, governments need to guide the market with long-term and stable policies in order to facilitate the necessary changes in the gas infrastructure.

## Sustainability scenario's for gas demand in North West European market



## Box 1: Examples of gas replacing technologies in strong climate policy scenario

- Increasing the efficiency of power plants with cogeneration (CHP)
- Electrification of houses through heat pumps or electric cookers
- Energy-saving measures in built environment, manufacturing and transportation
- District heating systems
- Heating of buildings through geothermal energy
- Electric vehicles
- Smart metering

## To a promising future

# The low carbon economy requires a different gas infrastructure Governments need to give clear and credible guidance

### Two scenarios, two different gas infrastructures

This slide shows that the outcomes of both scenarios in terms of gas infrastructure use are quite different. In the **'merit order change'** scenario the current high pressure transmission system will continue to transport large volumes over long distances to central production facilities such as gas fired power plants. The implementation of **strong climate change policies** however, will have far reaching implications in the way the gas infrastructure is used. Gas demand will decline substantially. More importantly gas will fulfil a different role in the energy mix: from a provider of base load energy into a means to meet peak load energy demand and as a back-up facility if renewables are in short supply. It will also play a more prominent role in areas where renewables cannot be applied easily such as manufacturing and transportation (trucking, aviation and shipping) and continue to play an important role in industries where electrification is not feasible, high temperature heating is needed or where gas is used as a feedstock.

### Scenarios might seem distant future but require grid operators to act sooner rather than later

Sustainability targets are set for reference years somewhere between 2020 to 2030 depending on the country. That might seem far away and as such one could say that the 'business as usual' scenario in which gas is likely to peak soon and start a slow decline shortly afterwards, is the most likely scenario for the coming years. If one however takes into account the planning horizon of 5 to 15 years of major grid investments, these scenarios are closer by than one thinks. As the likelihood of each scenario depends on government policy the grid operators are faced with a dilemma: at this stage

it is impossible to predict, which scenario will materialize. If one invests now, there is the risk of current investments becoming obsolete in the future. A wait and see policy might be the optimal response to this uncertainty for a grid

operator but could be suboptimal for society if at some point climate policies need to be intensified. Governments need to give clear and credible guidance to overcome this deadlock.

	Gas infrastructure if gas changes coal in the merit order	Gas infrastructure if governments implement strong climate change policies
Demand for gas	Increasing.	Declining.
Electricity production	Centralised: gas provides base load as well as peak demand.	Decentralised: gas provides peak demand and act as a backup.
Transportation of gas	Long distance: e.g. transit flows from Russia to Germany, Netherlands and UK and LNG flows from Netherlands to Germany.	The volume of imports and long distance transit is lower but production from green gas facilities is higher. Many of them will be small and local while a few major central facilities might be operational.
Role of gas in the energy mix	Bulk energy carrier.	Provider of peak demand and backup for intermittent renewables
Gas storage	Centralised gas storage facilities to balance seasonal gas demand (inject in summer and extract in winter).	More flexible gas storage functions to balance within day-fluctuations due to higher volatility of renewables.
Green Gas	Increasing amount of green gas but role will remain marginal in comparison to gas imports.	Strong role of green gas in decentralised regions through many small feed in stations (think of farmers and waste management companies). Some central conversion of biomass and waste to syngas and renewable gas.
TTF traders	Dominated by small number of large traders.	More diverse mix of traders as local smaller scale traders enter TTF market.
Pricing	Further convergence to one integrated gas market in which minor price differences reflect differences in transportation costs.	Small regional price differences can arise based on local supply and demand conditions. The value of flexibility is priced into market prices.
Focus of investments	Improving interconnectivity within the European market and increasing deal flow on TTF.	Smart local energy grids in which local heat networks and hybrid heat pump solutions are incorporated.
Likelihood	Realistic scenario for 2025 onwards given past experience with ETS and the fact that coal prices will most likely remain low in the coming years.	Increasing social pressure (Urgenda deal and the appeal to phase out coal-fired power plants) might trigger the Dutch government to intensify its climate policy.

To a promising future

# The Dutch 'gasrotonde' seems completed now but new challenges require action to keep it future proof

## Many believe that the Dutch gasrotonde is nearly complete...

It is generally believed that the Dutch gas strategy (known as 'gasrotonde') is more-or-less completed as it consists of (see page 2):

- Interconnecting pipelines with Germany, Belgium and the UK
- Nitrogen blending stations to adjust the quality of different sources of imported gas to fit Dutch requirements
- Gas storage facilities
- LNG terminals
- A liquid market place (TTF)

## ...but there is more work to be done:

This report lays out the challenges for gas markets, given: the transition to a low carbon economy; declining production from the Groningen gas field; further internationalisation of the gas market.

While the current 'gasrotonde' works well in today's markets, it is questionable if the current infrastructure is future-proof. The following points are relevant.

### 1) Interconnection capacity and nitrogen blending stations

A decline in Dutch gas production leads to less transportation in certain parts of the Dutch infrastructure. A decline in domestic production will create a rise in imports from abroad increasing gas flows in other parts of the network. Declining domestic production and increasing gas imports will demand more from interconnecting gas infrastructure between countries. Developments in foreign gas markets will have more impact on the Dutch market as a result. For example, gas prices on the TTF were not affected by the Ukrainian crisis in 2006 and 2009 since there was no infrastructure available to transport gas from North West Europe to the Ukraine. Interconnectors did exist during the crisis in June 2014 and gas prices on the TTF and NBP became more volatile during that period as a result. It remains to be seen how imports develop over the years and whether the current interconnection capacity is sufficient.

### 2) Gas storage facilities and LNG terminals

Currently, gas storage facilities are mainly used to manage seasonal fluctuations in demand and supply (store in summer, use in winter). The main characteristic of renewable energy is increased day-to-day volatility instead

of seasonality. As a result, the future gas infrastructure requires more fast-cycle storage capacity instead of slow-cycle seasonable capacity. It remains to be seen whether the current facilities are up to that task.

The LNG market will also become more volatile as a result of an increased share of wind and solar energy. The current LNG facilities, however, seem to be better equipped to handle short-term variability.

### 3) A liquid market place

Dutch gas production is shrinking as a result of depletion of current gas fields and the production gap at the Groningen field. If less domestically produced gas is traded on the TTF market it might limit the highly-valued liquidity of the market. Increased import flows can also be traded on the TTF market and could increase liquidity. However, the Netherlands could be by-passed with regard to import flows by other countries such as Germany and Belgium.

So we have arrived at a point where the Netherlands has a fairly complete gas infrastructure for the current market. That market, however, is changing rapidly. Continued investments are needed to keep the 'gasrotonde' future-proof.

To a promising future

# Going East? Main opportunities are outside the Dutch market

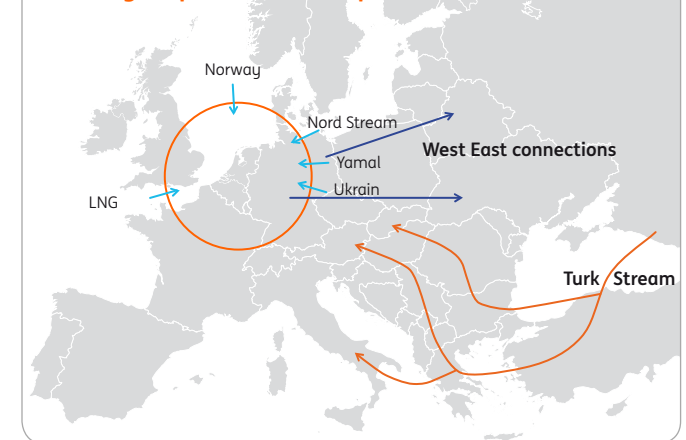
## The need for improvement...

While the North West European gas market is functioning well, the situation in other parts of Europe is quite different. Many regions lack a sizable gas market, are dependent on one or a limited number of pipelines through which gas can enter the market or are dependent on one supplier.

## ...covers both hardware and software.

The table summarizes the main challenges and opportunities on a European scale. Most challenges apply to East and South East European countries. They are still a long way from reaping the benefits of a North West European style gas market. Opportunities are not limited to physical infrastructure alone (hardware) but also involve the development of gas markets (software).

## Strategic options for European infrastructure



	Challenge	Opportunity
Nord Stream 2	Declining supply in the North West European region makes it more dependent on gas imports. While LNG capacity is rising, the vast majority has to be met by Russian gas.	The capacity of the Nord Stream pipeline from Russia to Germany and the Netherlands can be increased by adding two extra pipelines next to the existing ones. This is especially relevant if gas and coal will change position in the merit order resulting in a sharp increase in the demand for gas.
West East infrastructure	While the North West European region can be supplied through multiple gas routes including LNG, this is not the case for many East European countries. Most of them are heavily dependent on Russian gas as the current infrastructure is East West oriented.	Increased geopolitical tension between Russia and the EU has led to the ambition to make Eastern European countries less dependent on Russian gas. This creates the need for West East European gas infrastructure so that these countries can be supplied from multiple sources including gas from the North West European region.
Turk Stream	The efficiency of gas markets in South East European region with countries like Turkey, Greece, (the south of Italy) and the Balkans can be greatly improved as they lack multiple supply sources and trading hubs with multiple market makers.	The Turk Stream pipeline from Russia through Georgia and Turkey (Trans Anatolian gas pipeline) and Greece and Italy (Trans Adriatic pipeline) greatly improves the gas supply in the Balkan countries and the South Eastern European countries. While the geopolitical situation has put the project on hold the strategic importance of the project for the region hasn't changed. It is highly likely that it is put on the agenda again as the political situation improves.
Regional gas hubs	Infrastructure alone is not a guarantee for well functioning gas markets. One needs to have a well functioning marketplace as well in order to have efficient gas prices. In the end, trade determines if gas flows through the pipelines.	In analogy to the North West European region other European regions need better functioning gas hub facilities and gas exchanges. In regions like France, Spain and Northern Italy the existing facilities need to be deepened by attracting more trade volume and traders. In East European countries and the Balkan countries these facilities can be set up if new infrastructure allows other parties to enter the market and compete with Russian suppliers



To a promising future

# Strategies to keep the Dutch 'Gasrotonde' alive

## 1. Deepening of own market

### Strengthening the position of the North West European gas market

Strengthening the North West European gas market is not so much a matter of new infrastructure but a better utilisation of the supporting facilities. Think of:

- Increasing the number of nitrogen blending stations so that gas of different qualities can be put into the grid
- Increasing the deal flow on the TTF market
- Increasing the LNG flows through the system
- Strengthening of the knowledge, education and innovation climate for gas in the Netherlands.
- More collaboration between the Dutch and Belgium players in the gas market.

The last strategy needs a bit more explaining. Belgium has adopted a gas ambition that is similar to the Dutch one. While this creates a healthy competition between the two countries it also creates inefficiencies. Both countries, for example, are investing in LNG and gas storage facilities while the current facilities have a long way to go before full utilisation. From a North West European perspective it makes sense that the two countries join forces. The East-West infrastructure from the Netherlands fits nicely with the North-South infrastructure in Belgium and supporting facilities could be utilized better.

Lastly, Dutch players have to prepare themselves for a revolutionary transformation of the grid if countries in the North West European region start to implement strong climate change policies.

## 2. Dutch Belgium collaboration

### Exporting the success of the Dutch 'Gasrotonde' to other European markets

While the position of the Dutch 'Gasrotonde' could indeed be strengthened, we believe the real opportunities present themselves outside the North West European market. This gives the Netherlands the opportunity to export its gas market model to other parts of Europe. This is in line with the EU's ambition to implement features of the North West European market in other regions. This could be done on two different lines:

- Investing in gas infrastructure outside the North West European market. While this does not necessary improve the supply security in the home country, it does so for the EU as a whole and strengthens the position of the Netherlands in the European market.
- While ownership of foreign grids does strengthen the Dutch position in local markets, it is not a guarantee for increased trade revenues. Traders eventually determine gas flows based on market prices. Therefore the Netherlands could also invest in the software by setting up trading hubs abroad. As a marketmaker it would benefit from foreign gas flows even if the gas does not enter the Dutch grid. This resembles the Dutch Flower Auction model where traders in Aalsmeer are in charge of global trade flows even if the flowers don't enter or leave the Netherlands.

## 3. Build gas infrastructure abroad

## 4. Create market places for gas abroad

### Regulatory requirements

The European gas markets provide interesting investment opportunities. Strengthening the North West European market has obvious benefits in terms of affordability, sustainability and security of supply for Dutch citizens. In the case of investments outside the region, Dutch citizens benefit from increased trade possibilities. The Dutch are renowned for their trading mentality. But in order to be successful:

- The Dutch government and Parliament need to be in favour of increasing the Dutch role in European gas markets. This requires a European scope on affordability, security of supply and sustainability instead of applying these principles to the Dutch economy only;
- The regulators need to incorporate the financing of investments into their supervisory models which are predominantly focused on efficiency;
- Regulatory frameworks between countries need to be harmonised within Europe so that cooperating countries can coordinate their investment agendas;
- Regulators, shareholders and governments need to support the legal entities for effective cross-border cooperation ranging from minority equity stakes to a full merger of companies as joint ventures have a limited capacity to stimulate cooperation.

# Closing remarks and colophon

## From a successful past...

The Dutch 'gasrotonde' strategy has been very successful in the past. In fact it serves as a role model in many European countries. However, Dutch sentiment has changed dramatically in recent years as a result of gas-related earthquakes, lower production ceilings, potential negative consequences of shale gas and the geopolitical situation in relation to Russian gas. As such, it is not an ideal time to discuss potential strategies for strengthening the Dutch 'gasrotonde'.

## ...to a promising future

These discussions, however, are urgently needed as the North West European gas market is fully in transition. The Netherlands will become a net importing gas country within the next ten years, markets are becoming increasingly international and future demand for gas will depend on government policies. If policies facilitate the substitution of coal by gas in the merit order, demand for gas will thrive in the transition towards a low carbon economy. At the same time, the role of gas will be marginal in the final stages of transition to a low carbon economy.

The Netherlands has all the qualities required to continue to play a leading role in the North West European gas market. Moreover, since the main challenges lie outside this region, it could continue to export its model to other parts of Europe. The European Commission would welcome such a move. It is now up to Dutch stakeholders to continue to play a leading role in the gas market even if that market will be very different to the one we know today.

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<b>ACM</b>	J. de Maa R. de Rooij M. van Liere P. Molengraaf R. Vermeeren W. Peeraer H. Coenen P. van der Laan E. Vasbinder G. Lankhorst H. Feenstra W. van 't Hof E. Houtman J. Nieuwenhuijzen Kruseman
<b>Alliander European Commission Fluxys Gasunie</b>	
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<b>Ministry of Finance</b>	
<b>TNO</b>	T. Bulavskaya F. Reynès E. Rietveld J. van de Worp
<b>VEMW</b>	

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