CONSEQUENCES OF A DELAY OF NORD STREAM 2

Wintershall Dea
5 June 2019
## Overview

<table>
<thead>
<tr>
<th>Contents</th>
<th>Page(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Executive summary</td>
<td>3</td>
</tr>
<tr>
<td>Introduction</td>
<td>6</td>
</tr>
<tr>
<td>Limitation of scope of analysis</td>
<td>7</td>
</tr>
<tr>
<td>Object of the study</td>
<td>8</td>
</tr>
<tr>
<td>1 Consequences for security of supply</td>
<td>10-17</td>
</tr>
<tr>
<td>2 Consequences for gas and power prices</td>
<td>18-30</td>
</tr>
<tr>
<td>3 Impact on the EU’s CO₂ reduction objectives</td>
<td>31-36</td>
</tr>
<tr>
<td>4 Danish security of supply during Tyra redevelopment</td>
<td>37-40</td>
</tr>
<tr>
<td>5 Consequences of a delay of Nord Stream 2</td>
<td>41-43</td>
</tr>
<tr>
<td>References</td>
<td>44-47</td>
</tr>
</tbody>
</table>

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The Nord Stream 2 project of building a new additional pipeline to connect Russian gas fields to the European gas transmission system in Germany has been extensively discussed in Denmark during the past years.

In this study, the geopolitical dimension is put aside and instead the focus is on Nord Stream 2’s impact on EU security of gas supply, gas prices and climate objectives.

The main findings are:  
1. Nord Stream 2 improves EU security of gas supply.  
   • Gas continues to play a key role in European energy consumption with primary use in power generation, buildings and industry.  
   • Declining EU gas production means that over the next 10 years, the EU will need to increase gas imports by around 50 billion cubic meters (bcm). The majority of the increase is projected to come from increasing LNG imports. The LNG market is a global market where EU imports of LNG are in competition with Asian economies with rapidly growing LNG demand.  
   • The Nord Stream 2 pipeline will either reroute part of today’s export of Russian gas through the Ukrainian pipeline system or, to the extent Nord Stream 2 adds new gas to the Russian export, compete with LNG imports.  
   • The EU’s security of supply is improved by the increase in capacity for import of Russian gas and potentially by access to additional Russian gas.  
   • For many years, the EU has been relying on imports of Russian gas since Russia is the largest source of EU gas imports. Nord Stream 2 does not materially change such reliance.

2. Nord Stream 2 may lower EU and Danish gas prices.  
   • Insofar as Nord Stream 2 adds new gas volumes to the EU gas market, EU and Danish gas prices are likely to fall. The magnitude of the price reduction will depend on the impact on global LNG markets and EWI (2017a) has estimated the EU price reduction effect to 8 to 18 per cent in 2020.  
   • To the extent that Nord Stream 2 reroutes gas volumes from the Ukrainian pipeline system, gas prices are likely to fall in Northern Europe and rise in Central and Eastern Europe, mainly as an effect of ineffective implementation of the EU Energy Union.  
   • Lower gas prices may lead to lower power prices since gas-fired power plants in some situations are price-setting in Europe.
3. Nord Stream 2 results in a reduction of CO₂ emissions.
   - Transport of gas results in CO₂ emissions. The CO₂ emissions from pipeline gas transport is linked to the energy required for compressing the gas for transport whereas the CO₂ emissions from LNG is the sum of energy used for purification, liquefaction, shipment and regasification.
   - In case Nord Stream 2 reduces LNG imports, the CO₂ emissions may be reduced by around 19 million tonnes per year given the current origin of EU LNG imports.
   - In case Nord Stream 2 reroutes gas volumes currently imported through the Ukrainian pipeline system, the CO₂ emissions will be reduced by around 11 million tonnes per year.
   - As a comparison, Danish CO₂ emissions are around 54 million tonnes per year. Hence, the saving of 11 to 19 million tonnes per year corresponds to 21 to 36 per cent of Denmark’s annual greenhouse gas emissions.
   - Lower gas prices in Europe may provide incentives to accelerate the transition from coal-fired to gas-fired power plants.

4. Nord Stream 2 does not materially change the challenges to Danish security of supply during the Tyra redevelopment
   - The import capacity on the German-Danish import system is sufficient to cover Danish demand, however, a cold-year period will stress the system and careful use of the Danish gas storages is required.
   - Until today, security of supply is secured through Danish production and import from Germany as a backup (the n-1 criteria). During the Tyra redevelopment, import from Germany will be the main source and backup will be storage capacity. The Danish security of supply is in principle weakened and in particular during incidents or extreme weather conditions, Denmark will have to rely on cooperation with German counterparts.
Nord Stream 2 offers a number of advantages to the EU and Denmark and thus delaying Nord Stream 2 means postponing when the EU and Denmark benefit from such advantages. It is estimated that each year of delay is likely to result in:

- A potential negative effect on security of gas supply if the current negotiations of a new transit agreement between Russia and Ukraine is not completed before the end of 2019.

- A delay of lower gas prices in the EU. EWI (2017a) calculates a potential price drop of 11 to 23 per cent in Danish gas prices, which for Danish consumers would mean a loss of potential savings of DKK 600 to 1,200 million.

- For EU as a whole, EWI (2017a) calculates a potential loss per year to gas consumers of DKK 59,000 to 182,000 million.

- A delay of reduced CO₂ emissions of 11 to 19 million tonnes equal to 21 to 36 per cent of total Danish emissions.

- The effects on prices and emissions compound - a longer delay will lead to larger effects.
Introduction

Nord Stream 2 is currently under construction, and all permits - except approval by the Danish authorities - have been granted. The pipeline is scheduled to be completed in 2019 contingent on all relevant permissions.

Delays in the approval from Danish authorities may lead to costs to the investors of delay of the commissioning of the pipeline and/or potential additional costs of rerouting the pipeline. Such costs are not considered in this study.

But a delay may also have wider consequences for the EU gas and energy markets. These potential consequences are the focus of this report.

This study is based on a range of existing studies. As the primary baseline study we use IEA’s “World Energy Outlook 2018” with focus on “The New Policies Scenario”.

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Report structure

1. **Consequences for security of supply**
   In this section, we evaluate the consequences for the EU gas market of establishing Nord Stream 2.

2. **Consequences for gas and power prices**
   In this section, we analyse the consequences for the Danish and EU gas markets and the possible derived effect on the European power prices.

3. **Impact on the EU’s CO₂ reduction objectives**
   EU is driving an agenda to reduce green house gas emissions, and in this section we evaluate the consequences of Nord Stream 2 on achieving these objectives.

4. **Danish security of supply during Tyra redevelopment**
   During the Tyra redevelopment 2019-2022, Denmark is a gas importer rather than a gas exporter. In this section, we evaluate the consequences of Nord Stream 2 for Denmark’s security of supply during the Tyra redevelopment.

5. **Consequences of a delay of Nord Stream 2**
   Based on the evaluation of the impact of Nord Stream 2, we estimate the consequences per year of delaying Nord Stream 2.
In Denmark and the EU, the Nord Stream 2 pipeline project has been the subject of extensive discussion. This study does not include an analysis of political, military, security-related or geopolitical consequences of the Nord Stream 2 pipeline. The focus is entirely on the market consequences of establishing a new privately funded gas pipeline to the EU, and in this respect the pipeline could in principle originate from any country in Northern Europe.

Furthermore, this study does not contain any evaluation of the consequences a delay may have for investors or other stakeholders in the Nord Stream 2 project.

In addition, this study does not contain any analysis of the direct or indirect macro-economic impact - employment, GDP growth, etc. - of the investment in Nord Stream 2 or the changes in international gas transmission tariffs as a result of Nord Stream 2.

Finally, Europe is in transition from coal-fired power plants to gas-fired power plants. This study does not include any analysis of scale and speed of such transition.

Limitation of scope of analysis
Object of the study: The Nord Stream 2 project

The Nord Stream 2 project

The Nord Stream 2 is a new pipeline for the transport of Russian gas to the EU. Nord Stream 2 complements the Nord Stream 1 pipeline (2009) and the existing pipeline systems from Russia to the EU through Belarus and Ukraine.

The Nord Stream 2 project was initiated in 2011 and includes:

- A 1,230 km offshore pipeline from Ust-Luga in Russia to Greifswald in Germany. The pipeline passes through Finnish, Swedish, Danish and German waters. The pipeline has a total capacity of 55 bcm of natural gas per year.
- Onshore pipeline connection to gas fields on the Yamal peninsula, e.g. the Bovanenkovo gas field
- Onshore compression facilities in Ust-Luga, Russia.
- Onshore connection to the German gas transmission grid in Lubmin, Germany. From here, the gas may be distributed via the forthcoming EUGAL (2019) gas pipeline which runs from Lubmin through Germany to the Czech Republic.

Nord Stream 2 (2019) is a privately funded project with a CAPEX of around EUR 8 billion.

Source: Map from IEA adapted by OIES (2018a).
Scenarios for evaluation of Nord Stream 2 impact

In addition to offering a new route of gas exports from Russia to Germany, a key element in the evaluation of Nord Stream 2 is whether Nord Stream 2 will lead to an increase in Russian gas exports to the EU gas market or just offer an alternative route to the existing gas pipelines from Russia to the EU.

In this study, two opposite scenarios are considered:

1. In addition to a new pipeline route, Nord Stream 2 adds new gas volumes from Russia to the EU and leads to an increase in Russian gas exports to the EU.

2. Nord Stream 2 works as an alternative route to the existing Russian gas exports to the EU - in competition with Nord Stream 1 and the routes through Belarus and Ukraine - and does not increase the total gas exports from Russia to the EU.

The scenarios are chosen to illustrate the potential impact of Nord Stream 2. Scenarios between the two opposites are obviously also possible.
CONSEQUENCES FOR SECURITY OF SUPPLY
In this section, the impact on the EU’s security of gas supply is evaluated.

The main findings are:

- Gas continues to play a key role in EU energy consumption with primary use in power generation, buildings and industry.
- Declining EU gas production means that over the next 10 years, the EU will need to increase gas imports by around 50 bcm. The majority of the increase is projected to come from increasing LNG imports. The LNG market is a global market where EU LNG imports are in competition with Asian economies with rapidly growing LNG demand. In Europe, LNG and pipeline gas will compete to cover import demand.
- Nord Stream 2 is a new route for Russian gas to the EU, complementing the existing pipeline routes for Russian gas to the EU. Even if Nord Stream 2 in the short run does not add new gas volumes to the EU gas market, opening a new route for import of Russian gas improves the security of supply.
- Furthermore, Nord Stream 2 is connected to the gas developments in the Yamal region, and it therefore increases the potential imports of Russian gas. This also improves the EU’s security of supply and competition.
- For many years, the EU has been relying on importing Russian gas since Russia is the largest source of the EU’s gas imports. Nord Stream 2 does not change this reliance significantly.
Pipeline or LNG – two ways of transporting gas

Natural gas can be transported via pipeline or as liquefied natural gas (LNG).

Gas produced and processed from a gas field can be transported in two different ways:
- Through pipelines: pressurised by compressor stations and sent through transmission pipelines.
- As liquefied natural gas (LNG): When natural gas is cooled to -162 °C, it liquifies. The process makes it possible to transport the gas in a vessel. When it reaches its destination, a terminal regasifies the liquified gas to normal pipeline gas conditions.

LNG can be transported by special LNG tankers to any LNG terminal, whereas pipeline gas can only be transported between the origin and the destination of the pipeline.

EU has an extensive gas transmission system and a large number of LNG terminals.

EU has a very extensive network of internal gas transmission pipelines operated by a large number of Transmission System Operators. Furthermore, the transmission system includes import pipeline connections from Norway, Algeria, Morocco, Belarus, Ukraine and Russia.

In addition, 35 terminals in the EU enable import and regasification of LNG. The terminals are located in Belgium, Finland, France, Greece, Italy, Lithuania, Malta, the Netherlands, Norway, Poland, Portugal, Spain, Sweden, Turkey and the UK. The LNG terminals are connected to the local gas transmission grid, but internal pipeline bottlenecks mean the only 60 per cent of the LNG capacity can move from the receiving country to other EU countries.

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1 GIIGNL (2019)
Gas continues to play a key role in the EU energy consumption with primary use in power generation, buildings and industry.

IEA (2018) projects that gas will continue to play a key role in global energy consumption ...

IEA (2018) expects the global share of gas in the energy mix to increase from 22% to 25% between 2017 and 2040.

The EU’s share of gas in the energy mix is expected to increase from 25% to 28% between 2017 and 2040.

Similar increases are expected across other regions with China doubling from 7% to 14%.

... because gas continues to be used in power generation, buildings and industry.

In the EU, natural gas is used for power generation as well as heat in both buildings and industrial processes.

In the power sector, the continued use of gas is partly due to the closure of coal-fired and nuclear power plants.

The share of gas in the EU's energy mix is expected to increase ...

... and gas is expected to continue to be used across all major sectors.

The EU attracts imported gas, and new sources of gas are required to compensate for declining domestic production

The EU relies on imported gas...

EU domestic gas production is expected to decrease by roughly a third between 2017 and 2030 partly due to the expected closure of the Groningen gas field. This means that EU net import of gas is required to be around 400 bcm by 2030 compared to current imports of around 350 bcm annually.

... and new sources of import are required.

In 2017, the EU primarily imported gas through pipelines from Russia, Norway and North Africa. For 2025 and 2030, IEA (2018) projects that the majority of increasing requirement for gas imports will be met by LNG imports whereas imports by pipeline are expected to decline.

The EU is dependent on imported gas ...

... and new sources of import are required going forward.

The EU is expected to increase LNG imports from a global LNG market in competition with growing Asian economies so there is a potential for new Russian gas to the EU.

The EU needs new sources of gas imports...

New sources of gas are required to compensate for declining EU production. IEA (2018) projects that the EU will increase its LNG imports through 2040. The increase in imports is expected to be sourced primarily from the Middle East, Africa and the USA. At the same time, Asian economies are projected to have a substantially larger increase in gas imports which to a large extent will be sourced from LNG imports.

... and because the growing Asian economies need the same, there will be increasing global competition for LNG.

IEA (2018) projects that rapidly growing Asian economies may increase their share of global LNG trade from roughly 25% in 2017 to roughly 50% in 2030.

New LNG will origin from new LNG exporting countries with higher costs than current producers. This is the main driver for IEA (2018) forecasting increasing Asian, US and EU gas prices.

Asian economies are expected to increase LNG imports and share of global LNG trade.

Nord Stream 2 is a new route for gas to the EU and potentially a new source of gas. This improves EU security of supply.

The EU will need additional gas imports over the next 10 years.

Nord Stream 2 is a new route for Russian gas to the EU. It complements the existing pipeline routes for Russian gas to the EU. Furthermore, Nord Stream 2 is connected to the gas developments in the Yamal region, and it therefore increases the potential imports of Russian gas.

Security of supply means that the EU has both the capacity to import additional gas but also that there are alternative sources for gas and thereby sufficient competition. Nord Stream 2 adds both import capacity and potential gas supply and therefore contributes to improving the EU’s security of supply.

Russia is the largest source of EU’s gas imports and has been so for years. Nord Stream 2 may increase EU imports of Russian gas but will not fundamentally change the reliance on Russian gas delivery.

Russia is the largest supplier of natural gas to the EU, mainly through pipelines. In 2017, Russia accounted for around 40 per cent of trade in value of the EU natural gas import.

The construction of Nord Stream 2 may increase the Russian natural gas exports, which may further increase Russia’s share in EU gas imports. However, this also depends on European gas importers because these companies - at least in large parts of Europe - can freely choose source of supply.

However, if Nord Stream 2 gas reroutes gas which is currently transported via the Ukrainian and Belarusian pipelines, it may not increase the natural gas exports from Russia to the EU.

From 2012 to 2017, EU import of Russian gas has increased to roughly 100 million tonnes (around 135 bcm). Because of falling natural gas prices in the same period, the value of the gas imports from Russia has decreased in the same period.
CONSEQUENCES FOR GAS AND POWER PRICES
In the following section, the consequences of Nord Stream 2 for the gas and power prices in the EU are analysed.

The main findings are:

- To the extent that Nord Stream 2 adds new gas volumes to the EU gas markets, such gas will compete with LNG and may reduce the EU’s LNG imports. This may reduce global LNG prices, EU gas prices and thereby Danish gas prices. EWI (2017a) estimates that Danish gas prices in 2020 could fall between 11 and 23 per cent as a result of Nord Stream 2. EU gas prices are estimated to fall by 8 to 18 per cent.
- Lower Danish gas prices may lead to a reduction in consumer gas bill of DKK 600 to 1,200 million per year, while Danish gas producers - after the Tyra field is back in operation - may suffer a gross revenue loss of DKK 900 to 1,900 million per year.
- To the degree that Nord Stream 2 reroutes gas volumes from the Ukrainian pipeline system, gas prices are likely to fall in Northern Europe and increase in Central and Eastern Europe, mainly as an effect of ineffective implementation of the EU Energy Union.
- To the extent that gas-fired power plants are price-setting in the EU, lower gas prices will lead to lower wholesale power prices. This effect will be strengthened by the recent steep increase in the price of EU emission allowances.
Nord Stream 2 may lead to lower gas prices and possibly lower power prices

A number of studies have evaluated Nord Stream 2’s impact on gas and power prices in the EU.

The impact of Nord Stream 2 on gas prices in the EU have been the subject of a number of studies, including EWI (2017a), EWI (2017b), EWI (2018a), EWI (2018b), REKK (2016), Bruegel (2017) and IEA (2018).

The main topics of debate are whether Nord Stream 2 will reduce the overall EU gas prices and whether Nord Stream 2 will have a heterogenous price impact where prices drop in Germany but at the same time increase in Eastern and Central Europe.

Power generation in the EU includes gas-fired power plants so changes in gas prices may have a causal effect on power prices. The effect on EU power prices is the topic of EWI (2018b).

A major factor in the analysis of price impact is whether Nord Stream 2 is used to deliver additional gas to the EU gas market (and thus offsets LNG imports) or whether Nord Stream 2 is an alternative export route instead of the existing Ukrainian pipeline system.

The findings of the studies depend significantly on whether Nord Stream 2 provides additional gas to the EU gas market or not and on the effectiveness of the internal EU gas market.

In summary, the studies find that if Nord Stream 2 offers additional gas volumes to the EU gas market:

- The additional gas volumes will compete with LNG and is likely to reduce EU LNG imports. The reduced EU LNG imports may reduce global LNG prices and thereby reduce EU gas prices.
- The price impact will be heterogenous with the highest price reductions in Northern Europe. Although countries in Eastern and Central Europe no longer benefit from short distances to Ukraine transits, the overall decrease in global gas prices is expected to reduce local prices, also in Eastern and Central Europe.
- If Nord Stream 2 reduces EU gas prices, this will also reduce Danish gas prices.

If Nord Stream 2 moves gas volumes from the Ukrainian export route to Nord Stream 2:

- Gas prices are likely to fall in Germany and Northern Europe as a consequence of lower transit costs.
- Gas prices are likely to increase in Eastern and Central Europe as a consequence of weakened competition between suppliers in the area.
- The price increases in Eastern and Central Europe are a consequence of ineffectiveness of the internal gas market in some parts of the EU rather than a consequence of the construction of Nord Stream 2.

EWI (2018b) has evaluated the causal impact on EU power prices as a consequence of lower EU gas prices. The findings are that to the extent that gas-fired power plants are price-setting in the EU, Nord Stream 2 will lead to lower power prices.
The shale gas revolution in the US has changed the global LNG market with a significant impact on the EU gas markets.

Since 2009, the shale gas revolution in the US has decoupled the relationship between gas and oil markets. Until 2009, US gas and oil prices were closely linked, but the development of shale gas reserves has created a gas market which is less dependent of the oil market. Furthermore, the development of US gas reserves has led to a substantial LNG export from the US and a growth in global LNG trading.

LNG imports to the EU and in particular LNG spot imports mean that the gas prices in the EU today are a combination of both oil price-indexed contracts and spot market prices.

Furthermore, an increasing share of the traded LNG is sold on spot markets rather than long term contracts using availability of existing regasification and gas trading hub infrastructure.

New gas into the EU gas market has to be competitively priced to offset increasing spot market-driven LNG supplies.

IEA (2018) predicts a growing global gas demand and this leads to higher gas prices in all regions. New and more expensive sources of LNG are required to meet demand and this drives up prices.

Furthermore, an increasing share of the traded LNG is sold on spot markets rather than long-term contracts using availability of existing regasification and gas trading hub infrastructure.
If Nord Stream 2 adds new gas volumes to the EU gas market, such gas will compete with LNG imports

Nord Stream is a new route for imports of Russian gas. Furthermore, as Nord Stream 2 is connected to the Russian gas developments in the Yamal region, Nord Stream 2 may also be a source for increasing imports of Russian gas above the current levels.

The need for additional gas supply to the EU is in excess of the capacity of Nord Stream 2, and IEA (2018) predicts a significant growth in LNG imports to the EU. In effect, Nord Stream 2 is in direct competition with global LNG imports.

Part of the LNG imports to the EU is under long-term contracts, but a growing share are spot contracts with which Nord Stream 2 can directly compete. On long and medium terms, the declining EU gas production opens an opportunity for Nord Stream 2 gas imports in competition with LNG imports.

**LNG imports to the EU are increasing with a growing share of spot LNG cargoes.**

Source: GIIGNL (2019).

**Global LNG production is increasing, while capacity utilisation remains constant around 80 per cent.**

Source: GIIGNL (2019).
If Nord Stream 2 competition means that EU LNG imports are reduced, this is likely to lead to a reduction in global LNG prices and thereby in EU gas prices.

Additional gas from Nord Stream 2 will have to be competitive with LNG imports to gain market access.

EWI (2017a) uses the Columbus and TIGER models to calculate the potential impact on EU gas prices. Assuming that Nord Stream 2 will reduce LNG imports, EWI (2017a) calculates that Nord Stream 2 will lead to lower LNG prices and thus lower wholesale gas prices in each EU member state, as price signals will be spread across the EU internal market. The study finds that in 2020, Nord Stream 2 causes a price advantage for EU average wholesale gas prices of 8 to 18 per cent depending on the forecast of global LNG demand.

EWI (2017a) calculates a heterogeneous price effect across the EU because internal bottlenecks and transport costs will lead to continued price differences. The proximity to the landing point for Nord Stream 2 means that Denmark is one of the countries that benefits the most from the price-dampening effect of Nord Stream 2.

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**Source:** EWI (2017a).

**Note:** EWI (2017a) evaluates gas prices in the EU under two different scenarios for Asian LNG demand: “Low” where Asian LNG demand is 5 per cent lower than the IEA forecasts for global gas demand (New Policies Scenario in IEA (2016)) and “high” where Asian LNG demand is 20 per cent higher than the IEA forecasts.
Lower EU gas prices in turn lead to lower Danish gas prices, lower Danish consumer gas bills and lower gross revenues for Danish gas producers.

The Powernext exchange operates the PEGAS gas trading platform which enables gas trading through delivery points across a number of EU countries. The main trading hub is the Dutch Title Transfer Facility (TTF).

The Danish Exchange Trade Facility (ETF) hub is operated by Energinet.dk. It was launched in 2008 by Gaspoint Nordic and integrated into PEGAS in 2016. The development of the EU’s internal gas market has led to a convergence of spot prices including linking Danish gas prices to TTF. This means that a reduction in the EU’s TTF gas prices will lead to a reduction in the Danish ETF gas price.

Danish gas consumers will benefit from a reduction in the ETF gas price, but a reduction will also entail a revenue loss to Danish gas producers. In 2018, the total Danish gas consumption was 2.86 bcm, and since 2013, Danish gas production has averaged around 4.5 bcm/year (DEA 2019).

Based on an ETF gas price of 22.2 EUR/MWh (2018 average) a reduction in gas prices of 11 or 23 per cent will lead to a potential reduction in Danish consumer gas bills of DKK 600 to 1,200 million.

After the Tyra field is back in operation, the lower prices will entail a potential gross revenue loss to Danish gas producers of DKK 900 to 1,900 million which will also lead to a tax revenue loss for Denmark.

**Source:** Danish Energy Agency (2019), Powernext.com (2019) and own calculations.
If Nord Stream 2 does not add new gas volumes to the EU market, Nord Stream 2 will compete with other transport routes for Russian gas to the EU. Currently, the Russian gas exports to the EU run through Nord Stream 1 pipelines (directly to Germany) and through the transit pipelines through Belarus and Ukraine. Nord Stream 2 and the Belarusian pipelines are typically operated at high capacity utilisation whereas the Ukrainian pipeline system is operated as the marginal route. This means that Nord Stream 2 is likely to reroute gas from the Ukrainian pipeline system. In 2018, the flow through the Ukrainian pipeline system was around 80 bcm so Nord Stream 2 may reroute gas from the Ukrainian pipeline system but the system will continue to be required for the export of Russian gas.

The current transit contract between Gazprom and Naftogaz expires at the end of 2019. OIES (2018b) states that new contractual agreements are being negotiated, but that “Failure to reach agreement would result in supply disruptions; this could seriously damage the gas industry’s efforts to raise its status as part of Europe’s energy supply future”.

OIES (2017) projects the effects on the natural gas flows in the EU from the construction of Nord Stream 2 and connecting pipelines are realised. To a large extent, OIES (2017) projects that the establishment of Nord Stream 2 is expected to reroute gas transits from the Ukrainian pipeline system.
Rerouting gas volumes from the Ukrainian gas pipeline system may lead to lower gas prices in Northern Europe and higher gas prices in Eastern and Central Europe.

Breugel (2017) and REKK (2016) argue that Nord Stream 2 will lead to lower gas prices in Northern Europe at the expense of higher gas prices in Eastern and Central Europe.

The argument is that when less gas is flowing through the Ukrainian network, the internal flows in the EU will change and insufficient free capacity in the direction from east to west may lead to a situation with less competition in Eastern and Central Europe and thereby higher prices.

REKK (2016) calculates that Nord Stream 2 may lead to lower gas prices in Northern Europe and higher gas prices in Eastern/Central Europe as a consequence of insufficient internal transit capacity (effect in EUR/MWh).

Sources: REKK (2016).
However, IEA (2018) and ACER (2018) argue that this is more an indication of the need for strengthening the EU’s internal energy market than a problem with Nord Stream 2 per se.

IEA (2018) has made a detailed analysis of the effectiveness of the gas infrastructure in the EU. To illustrate the importance of developing necessary internal EU gas infrastructure and opening the access to existing infrastructure, IEA (2018) has made a comparison of two cases:

- An Energy Union case, where the vast majority of PCIs (projects of common interest) are successfully implemented. There are no regulatory impediments to the free flow of gas across the single market and solidarity principles are broadly applied during supply interruptions. This also applies to the contracting parties of the Energy Community in Southeast Europe.

- A Counterfactual case, where the majority of PCIs are not constructed. Flows of gas outside North Western Europe continue to suffer from contractual and regulatory congestion, and EU countries do not cooperate with one another, nor with the Energy Community countries, during periods of system stress.

The analysis shows that the Energy Union case leads to an effective internal market where consumers have access to alternative suppliers independent of location.

Specifically with respect to Nord Stream 2, IEA (2018) concludes:

“The debate over Nord Stream 2 underscores the tension between different visions of where the European market is today and where it might go in the future, a tension that is encapsulated in our two cases. The Energy Union case is one in which a well-functioning European market becomes part of a globalising gas market, meaning that European consumers - wherever they are - get enhanced access to competitive supply options. In this case, the physical location where gas enters Europe, and even the identity of the supplier, becomes less important. The Counterfactual case represents a concern that Europe’s gas market may remain relatively fragmented and less efficient, an environment in which geography, suppliers and supply routes matter - especially in Central and Eastern Europe - and price differentials and bargaining power continue to vary widely across the continent.”

ACER (2018) has made an analysis of the functioning of the EU gas trading hubs and concludes that effectiveness is high in North-Western Europe but that market effectiveness in Central and Eastern Europe can be improved by “abolishing any remaining barriers to market functioning, such as market distortive storage regulations, limitations on free cross-border trading of local gas production; distortive licensing requirements limiting market entry of traders, and the use of different definitions across the EU for firm capacity.”
The EU power markets are changing as a result of the expansion of renewable generation capacity

Historically, the EU power markets relied on baseload nuclear power plants and flexible hydro plants as well as gas-fired and coal-fired power plants. The emergence of wind power, solar PV and bioenergy means that the electricity system and the electricity markets needs to adapt to a future where inflexible renewable sources play a significant role.

IEA (2018) has made a detailed analysis of possible scenarios including an illustrative scenario for how the different technologies could interact in the future. IEA’s analysis confirms that lower gas prices will lead to lower wholesale electricity prices. However, the magnitude of impact on electricity prices will depend on the frequency at which gas-fired power plants are price-setting in the EU power markets.

IEA predicts that gas-fired power plants in the future will be the marginal provider in situations with insufficient renewable generation.

Lower EU gas prices may also lead to lower EU power prices

Since power generation in the EU is partly based on gas-fired power plants, changes in gas prices may have a causal effect on power prices.

Power prices in the EU are historically set by coal-fired or gas-fired power plants depending on their relative position in the marginal costs merit order. Until 2018, coal-fired power plants prevailed but the steep increase in the price of CO₂ emission rights has changed the merit order of coal-fired and gas-fired power plants. This will lead to gas-fired power plants more frequently being price-setting in the EU electricity market.

If gas prices in the EU are lower as a result of Nord Stream 2, this will further improve the competitiveness of gas-fired power plants and increase the frequency at which gas-fired power plants will be price-setting in the power markets.

IEA projects that gas-fired power production will continue to play a central role in the EU electricity generation.

Coal-fired and gas-fired power plants will probably continue to be price-setting. However, the frequency of each will depend on the price of gas, coal and emission rights.


Source: Business Insider (2019).
IMPACT ON THE EU’S CO₂ REDUCTION OBJECTIVES
Nord Stream 2 contributes to EU CO₂ reduction objectives

Nord Stream 2 results in a reduction in CO₂ emissions:
• If Nord Stream 2 reduces LNG imports, the CO₂ emissions will fall by around 19 million tonnes per year based on the current origin of EU LNG imports.
• If Nord Stream 2 reroutes gas currently imported through the Ukrainian pipeline system, the CO₂ emissions will be reduced by around 11 million tonnes per year.
• As a comparison, Danish CO₂ emissions are around 54 million tonnes per year. Hence, the saving of 11 to 19 million tonnes per year corresponds to 21 to 36 per cent of Denmark’s annual green house gas emissions.

Nord Stream 2 may accelerate German and EU conversion from coal-fired power plants to gas-fired power plants.
Lower gas prices may provide incentives to accelerate the transition from coal-fired to gas-fired power plants.
If Nord Stream 2 competes with LNG imports, EU green house gas emissions will be reduced by around 19 million tonnes of CO₂ equivalents (CO₂eq) per year.

The CO₂ emissions from pipeline gas transportation is linked to the energy required for compressing the gas.

The CO₂ emissions from LNG is the sum of energy used for purification, liquefaction, shipment and regasification.

Thinkstep (2018) has analysed the green house gas (GHG) emissions from LNG delivered to the EU based on existing and planned LNG facilities. In the analysis, the CO₂ impact of LNG sources is compared to the CO₂ impact of gas transported via Nord Stream 2.

LNG from Qatar has the lowest CO₂ emission and LNG from East Australia the highest, which reflects differences in production systems and transportation distances.

Thinkstep (2018) estimates the potential reduction in CO₂ emissions from replacing LNG imports with Nord Stream 2 pipeline gas.

Nord Stream 2 may reduce EU GHG emissions by around 19 million tonnes of CO₂eq, calculated as the weighted average of the savings from current LNG import channels.¹

The CO₂ saving corresponds to 36% of Denmark’s annual CO₂eq emissions of 53 million tonnes.

Notes: ¹ The calculation does not account for current import channels not analysed in Thinkstep (2018), i.e. Nigeria, Peru, Norway, and Trinidad and Tobago. Source: Eurostat (2018).
A number of studies confirm that Nord Stream 2 has lower CO₂ emissions than LNG imports

Thinkstep (2018) has verified the robustness of the findings by evaluating the effect of changes in the analysis assumptions.

In addition to the base case scenario, Thinkstep has considered alternative scenarios for Nord Stream 2 GHG emissions: double supply pipeline length, changed capacity and increased energy consumption.

Furthermore, Thinkstep evaluates additional scenarios with conceivable future technical developments of the LNG channels, including utilisation rates, liquefaction efficiency, length of pipelines, etc.

DBI (2016) corroborates the findings of Thinkstep (2018). They estimate that the carbon footprint of Nord Stream 2 is 7.1 g CO₂ eq/MJ per year, which is relatively close to Thinkstep’s (2018) estimate of 6.3 CO₂ eq/MJ.


All Thinkstep (2018) scenarios show that Nord Stream 2 has lower CO₂ emissions than LNG ...

| Carbon footprint (range of all scenarios) |
|-----------------|-----------------|-----------------|-----------------|
| NS2 import      | 5               | 12.8            | 28.7            |
| LNG import      | 13.3            | 30              |


... and the DBI (2016) study corroborates the conclusion.

Range from lowest to highest estimate

If Nord Stream 2 is rerouting gas from existing pipeline corridors, Nord Stream 2 will reduce EU GHG emissions by 9 to 11 million tonnes of CO$_2$eq per year.

DBI (2016) compares CO$_2$ emissions from Nord Stream 2 to existing major Russian pipeline corridors.

The Northern Corridor, the Nord Stream 1 route, is directly comparable to the Nord Stream 2 pipeline with regards to route and length (Thinkstep (2018)).

Based on the emission factors in DBI (2016), the difference in CO$_2$ emissions between Nord Stream 2 and the alternative pipeline routes can be calculated.

Based on a transport volume of 55 bcm/year, Nord Stream 2 may reduce EU GHG emissions by 9 to 11 million tonnes of CO$_2$eq per year.

The Northern corridor has the lowest CO$_2$ footprint of the pipeline routes...

... and replacing alternative pipeline corridors will result in a reduction of 9 to 11 million tonnes CO$_2$ per year.
Nord Stream 2 may accelerate German and EU phase-out of coal-fired power plants

Many EU countries, including Germany, have decided to phase out coal-fired power generation. IEA (2018) projects that coal-fired power plants will be replaced by gas-fired power plants and renewable power sources, primarily wind and solar PV.

With the increasing share of inflexible renewable power generation, the role of gas-fired and coal-fired power plants will be to deliver power in situations where demand exceeds production from renewables and other sources including nuclear and hydro power plants (the “kalte dunkelflaute” issue).

The transition from coal-fired to gas-fired power generation is likely to be driven by both technical investment/reinvestment requirements and commercial aspects.

For some time coal-fired power plants have had lower marginal costs than gas-fired power plants but the recent increase in CO₂ prices has made the merit order less clear.

If Nord Stream 2 results in lower gas prices, this will improve competitiveness of gas-fired power plants and thus contribute to the conversion of coal-fired power plants.

Note: Since the IEA (2018) report, Germany has decided to phase out coal-fired power plants by 2038.
DANISH SECURITY OF SUPPLY DURING TYRA REDEVELOPMENT
Danish security of supply during Tyra redevelopment

The Tyra Field has been the main gas-producing facility in the Danish gas system since 1984. The facility is currently being redeveloped and gas production and export is planned to be shut down from September 2019 to 2022.

For many years, Denmark has been self-sufficient with natural gas and has been exporting excess gas production to Germany and Sweden. During the Tyra redevelopment, Denmark will be importing natural gas from Germany and this could be a risk to the Danish security of supply.

In this section, the focus will be the impact on Danish gas security of supply during the Tyra redevelopment period.

The main findings are:

• The import capacity on the German-Danish import system is sufficient to cover Danish demand, however, a cold-year period will stress the system and so careful use of the Danish gas storages are required.

• Until today, security of supply is secured through Danish production and import from Germany as a backup (the n-1 criteria). During the Tyra redevelopment, import from Germany will be the main source and backup will be storage capacity. The Danish security of supply is in principle weakened and in particular during incidents or extreme weather conditions, Denmark will have to rely on cooperation with German counter-parts.
Danish security of supply may be stressed during the Tyra redevelopment period

Since 1984, Denmark has been relying on gas production from the Tyra Field. The Tyra Field production facilities are the hub for gathering, processing and exporting gas from the Tyra Field and the large majority of the other gas producing fields in the Danish part of the North Sea.

Due to subsidence and changing climate conditions, the operators have decided to redevelop the Tyra Field facilities by removing existing platforms and constructing new production facilities. This work means that gas export from the Tyra Field is planned to be suspended from September 2019 until 2022.

Since a production peak in 2005, the Danish gas production has declined 50 per cent in recent years. The decline in production has been accompanied by a drop in Danish consumption (partly driven by the biomass conversion of gas-fired power plants) and a reduction in exports to Germany, Sweden and the Netherlands.

Today, Danish gas production of around 4.5 bcm amounts to approximately 0.7 per cent of the total gas consumption in the EU.

Denmark is a net exporting nation, but Danish gas production has been in decline since the peak in 2005.

Sources: DEA (2016).
The main challenges during the Tyra redevelopment are management of Danish storage capacity and securing sufficient imports from Germany throughout the year.

During the Tyra redevelopment, gas will be imported via the German-Danish pipeline. Energinet, the Danish TSO, has evaluated the security of supply situation and finds that the pipeline capacity of 120 GWh/d combined with the Danish gas storage capacity is expected to be sufficient to cover gas consumption. However, in case of a “cold-year” event, the situation has to be managed carefully. Energinet (2017) concludes:

“The conclusion in relation to gas balances in extreme weather conditions is that the consumers can also be supplied gas in the years 2019-2022. However, the system becomes less flexible and more vulnerable to incidents. Energinet will take the appropriate measures regarding the market as well as the infrastructure in order to provide maximum security of supply. However, the situation mainly requires preparation and extreme awareness on the part of the market players in order to secure the gas supply also in extreme winter conditions.”

Until today, security of supply is secured through Danish production and import from Germany as a backup (the n-1 criteria). During the Tyra redevelopment, import from Germany will be the main source and backup will be storage capacity. The Danish security of supply is in principle weakened and in particular during incidents or extreme weather conditions, Denmark will have to rely on cooperation with German counterparts.
CONSEQUENCES OF A DELAY OF NORD STREAM 2
Nord Stream 2 offers a number of advantages to the EU and Denmark. Delaying Nord Stream 2 means postponing when the EU and Denmark benefit from such advantages.

In this section, we analyse the consequences of delaying the completion of Nord Stream 2. It is estimated that each year of delay is likely to result in:

- A potential negative effect on security of gas supply if the current negotiations of a new transit agreement between Russia and Ukraine is not completed before the end of 2019.
- A delay of lower gas prices in the EU. EWI (2017a) calculates a potential price drop of 11 to 23 per cent in Northern European gas prices which for Danish consumers would mean a loss of potential savings of DKK 600 to 1,200 million.
- For EU as a whole, the loss of potential savings are estimated at EUR 7,900 million (DKK 59,000 million) to EUR 24,000 million (DKK 182,000 million).
- A delay of reduced CO₂ emissions of 11 to 19 million tonnes equal to 21 to 36 per cent of total Danish CO₂ emissions.
Each year of delay has significant negative impacts on security of supply, additional costs to EU and Danish consumers and unnecessary CO₂ emissions

### Potential consequences per year of delay

**Negative impact on gas security of supply**
If alternative sources of supply are not readily available, a one-year delay may impact the EU’s security of supply on energy. The current transit contract of gas from Russia to the EU through the Ukrainian gas pipeline system expires at the end of 2019. OIES (2018b) states that new contractual agreements are being negotiated, but that “failure to reach agreement would result in supply disruptions; this could seriously damage the gas industry’s efforts to raise its status as part of Europe’s energy supply future”.

**Delay of gas price reduction**
EWI (2017a) calculates a potential price drop of 11 to 23 per cent in Danish gas prices in 2020 due to the establishment of Nord Stream 2. For the Danish consumers, a delay of such a price drop would equate to a loss of potential savings of DKK 600 to 1,200 million.

In principle, gas prices that are higher than necessary would equate to a potential gain for Danish gas producers. However, during the Tyra redevelopment from late 2019 until 2022, there is very limited gas production in Denmark, hence the gain for Danish producers is negligible in this period.

Across the EU, each year of delay results in a delay of potential savings in consumer gas bills of EUR 7,900 to 24,400 million.

**Increased CO₂ emissions**
A delay of Nord Stream 2 will delay the potential CO₂ savings from transporting gas via Nord Stream 2 compared to other pipelines or LNG. The delayed savings are projected to be in the magnitude of 11 to 19 million tonnes. The CO₂ saving corresponds to 36 per cent of Denmark’s CO₂ emissions in one year.

### Potential impact on consumers and CO₂ emissions per year of delay

<table>
<thead>
<tr>
<th>(million DKK)</th>
<th>Nord Stream 2 gas price impact</th>
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<tbody>
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<td></td>
<td>-11%</td>
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<td></td>
<td>-23%</td>
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</tbody>
</table>

**Delayed Danish consumer gas bill savings**
-600

-1,200

**Delayed EU consumer gas bill savings**

-59,000

-182,000

**Source:** EWI (2017a) and own calculations.

### Delay of CO₂ emissions reductions

<table>
<thead>
<tr>
<th>Mill. tonnes</th>
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</thead>
<tbody>
<tr>
<td>11</td>
</tr>
<tr>
<td>19</td>
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</tbody>
</table>

**Source:** Thinkstep (2018) and own calculations.
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