



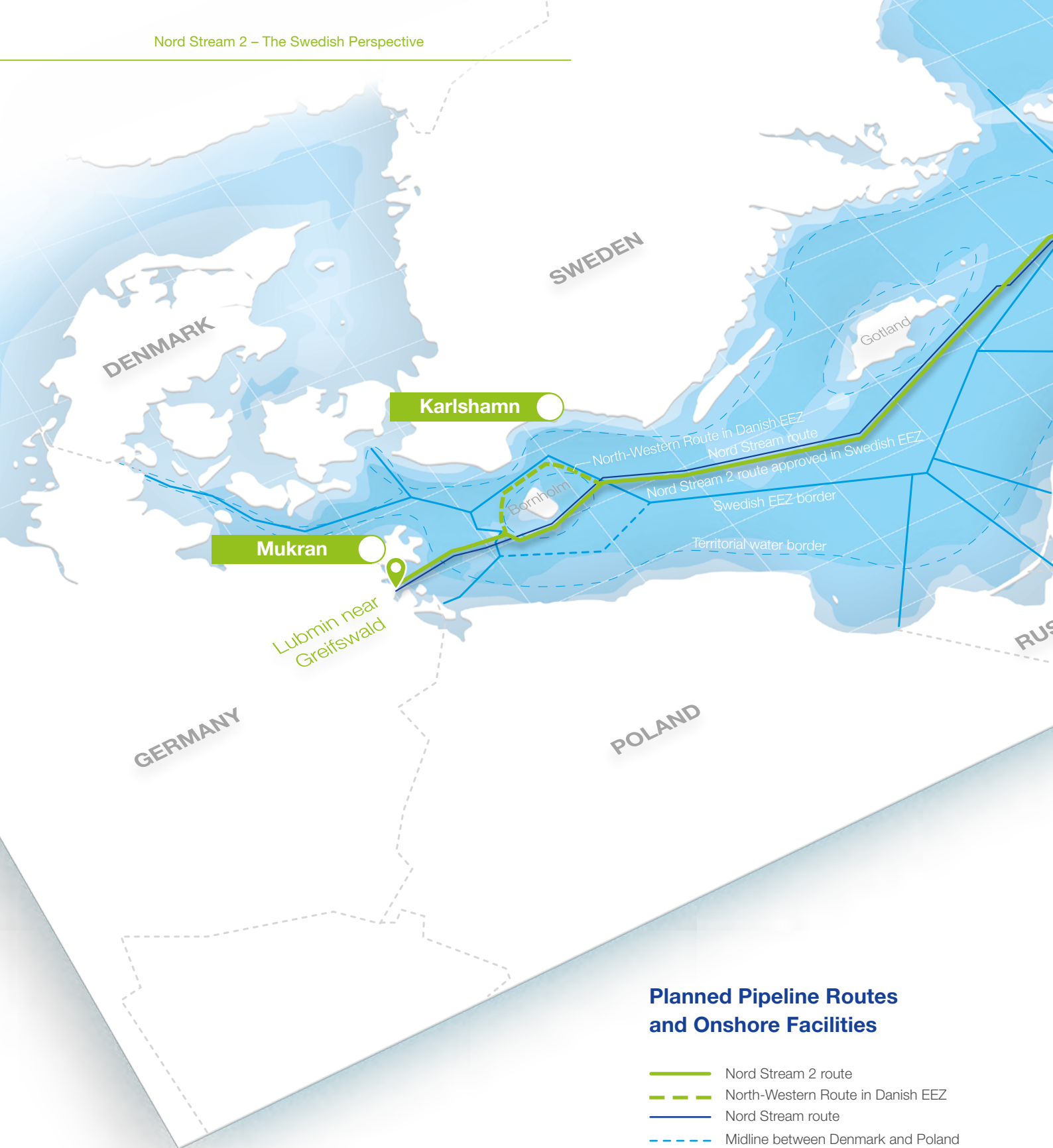
Nord Stream 2

Committed. Reliable. Safe.

A Natural Gas Pipeline Through the Baltic Sea

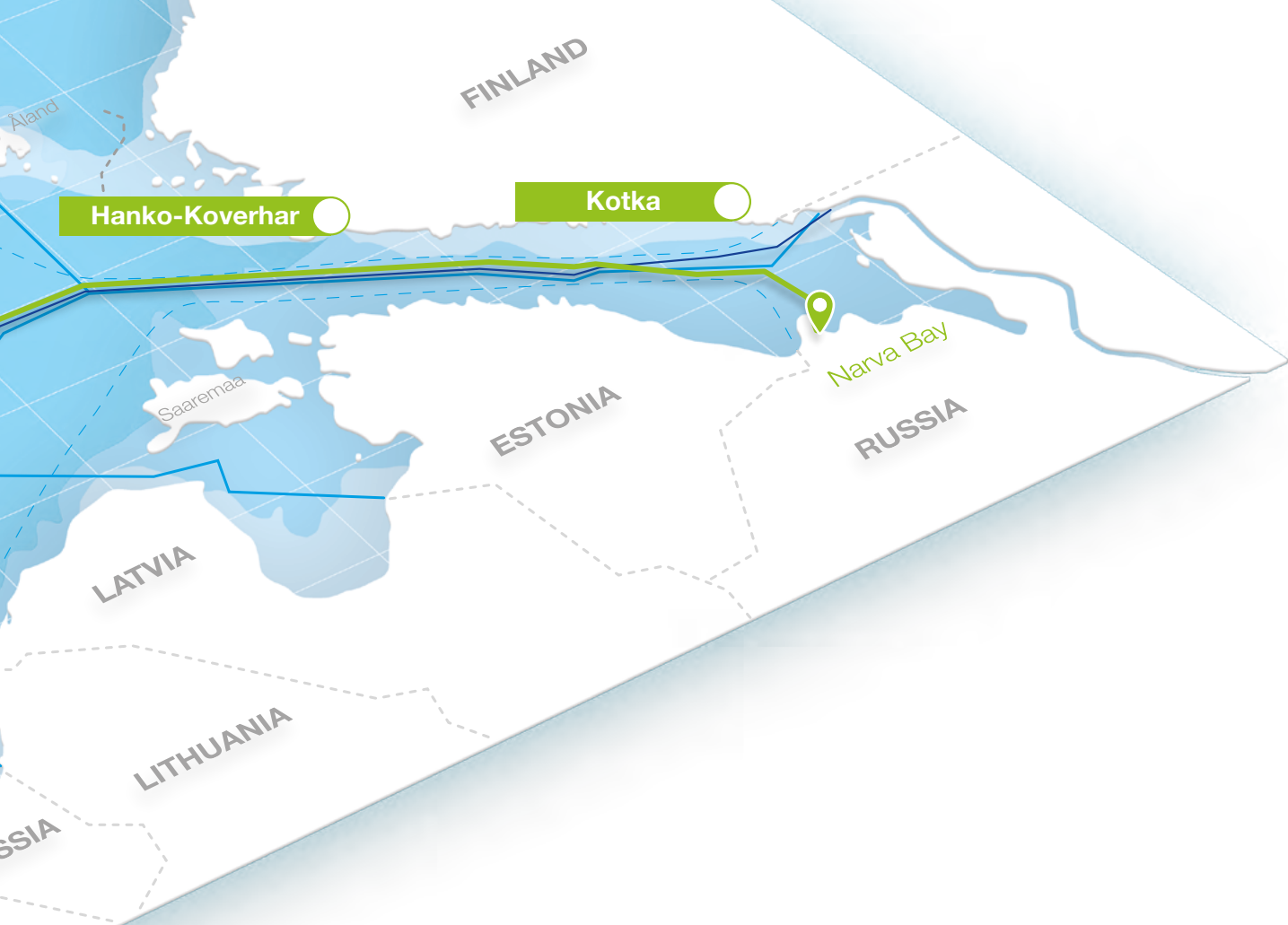
The Swedish Perspective





Planned Pipeline Routes and Onshore Facilities

- Nord Stream 2 route
- - - North-Western Route in Danish EEZ
- Nord Stream route
- - - Midline between Denmark and Poland
- Exclusive Economic Zone border
- - - Territorial water border
- Onshore facility
- 📍 Landfall



Securing Additional Gas Supplies for Europe

Nord Stream 2 will build on the successful experience of the existing Nord Stream Pipeline. The planned twin pipeline system will have the capacity to supply about 55 billion cubic metres of gas per year.

Nord Stream 2 will offer reliable, environmentally sound natural gas supplies to Europe over the coming decades. The pipeline system will provide the most direct access to the Yamal gas fields in western Siberia, where the world's largest gas reserves are found, and be significantly shorter than the pipelines stretching through Central Europe.

The twin pipeline system will stretch for some 1,230 kilometres across the Baltic Sea, from the Narva Bay in Russia to Germany's Baltic coast. Each line of the pipeline has a design capacity of around 27.5 billion cubic metres (bcm) of gas per year.

The new pipelines will increase Europe's energy security by offering an additional transportation route to import natural gas and supplement declining European Union (EU) and Norwegian gas production.

Enabling a Climate-Friendly Energy Transition

The Nord Stream 2 Pipeline will be based on the strong track record of the twin Nord Stream Pipeline, put in operation in 2011 and 2012. The existing pipeline system has proved to provide reliable, affordable and efficient gas deliveries, with a minimal impact on the environment in the Baltic Sea. With Nord Stream 2, the EU will have direct access to the world's biggest gas reserves.

Gas plays a vital role in Europe's energy mix, as one of the most flexible and reliable sources of energy. While EU gas production is set to drop by about half by 2035, demand is simultaneously projected to remain stable. Europe will need additional gas imports to cover this resulting import gap. Nord Stream 2 will be able to meet part of this demand, complementing other supply options.

Additional Gas Supplies Stimulate Competition

Once the natural gas delivered by the pipeline system reaches Germany, it can – in the future – be transported anywhere within the EU's internal gas market, guided by price signals (see map on p. 5). This increased availability of gas will stimulate competition as well as inter-country connections, further improving the integration of the EU's internal energy market to the benefit of the consumer. Nord Stream 2 will make the EU's gas supply more robust and contribute to an improved security of supply across the region. Gas market studies show that the EU's wholesale gas prices will be up to 13 percent lower in 2020 if Nord Stream 2 is available.

“Nord Stream 2 will provide a direct link between gas producers and consumers, as a privately financed project. Gas market studies show that the EU's wholesale gas prices will be up to 13 percent lower in 2020 if Nord Stream 2 is available.”

Offshore Pipelines, the Best Way to Transport Gas

Offshore gas pipelines are the most ecologically sensible way to transport gas because unlike onshore pipelines, no interim compressor stations are required. Gas delivered by pipelines also compares well with liquefied natural gas (LNG), both economically and ecologically, since it does not require the energy-intensive liquefaction, transport and regasification processes associated with LNG. Nord Stream 2 will be able to annually deliver the equivalent of the energy transported by up to 700 LNG tankers.

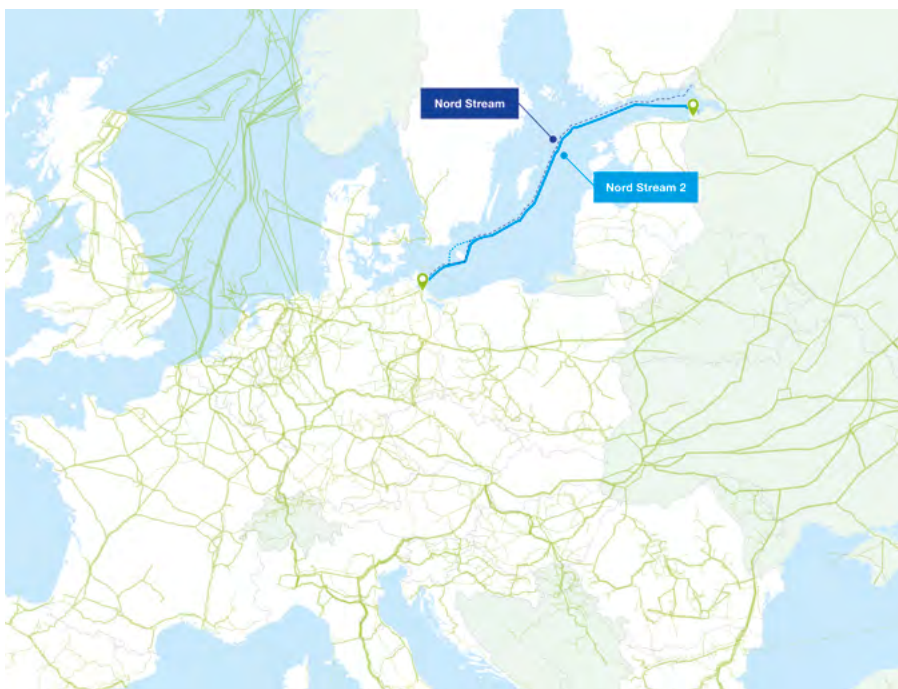
An Environmentally Sound Alternative to Coal and Nuclear Energy

Because the EU is looking to cut its CO₂ emissions by 40 percent by 2030 compared to 1990 levels, it must find economically viable solutions to achieve this target. To meet these goals, coal-fired power generation needs to be significantly reduced by 2030. The required decarbonisation of the energy sector is a major shift in most European countries.

Their power utilities, heating sector, industries and transport sector need to find sustainable solutions. This process will be intensified by the phasing out of nuclear power in some major markets. The share of renewable energy sources is expected to more than double in the European energy mix in the coming two decades, triggering a greater need for reliable, complementary power generation with low-carbon emissions. Gas-fired energy generation will play a key role in complementing the much-favoured, but still intermittent, renewable sources such as wind and solar energy. Replacing coal with gas is another cheap and fast way to meet the EU's CO₂ emissions reduction targets.

A Competitive and Highly Efficient Energy Source

Gas offers significant advantages for electricity production when compared to other fuels. Combined-cycle gas turbines (CCGT) can, for instance, reach a 60 percent efficiency, with the prospect of even higher efficiency in future plants, compared with 25 percent to 45 percent for coal. Gas is also easier and more affordable to store and transport than electricity, with much lower energy losses than electricity grids. Transporting energy through offshore gas pipelines can actually be up to 20 times cheaper than through offshore electricity lines. Efficiently produced gas and an improved price differential to coal also further drive demand for gas. Gas can actually compete with coal in well-supplied markets, and already does so in the United Kingdom. Natural gas is not just reliable. It is also a cost-efficient, competitive and sustainable way to contribute to reaching the EU's climate protection targets. Nord Stream 2 will clearly be part of the solution to secure Europe's future energy needs.



Physical European Gas Flows in December 2017

Once the natural gas delivered by Nord Stream 2 reaches northern Germany, it can be transported onwards across Europe. The thickness of the lines represents the gas flow volumes.

Source: OECD/IEA 2018

Nord Stream Operates Close to Full Capacity

The existing Nord Stream Pipeline has been operating flawlessly since 2011 when gas started flowing through the system. Its utilisation rate has steadily risen over the past five years, reaching an annual average of 93 percent in 2017. The results of environmental monitoring studies have confirmed that its presence on the seabed had only negligible impact, or none at all.

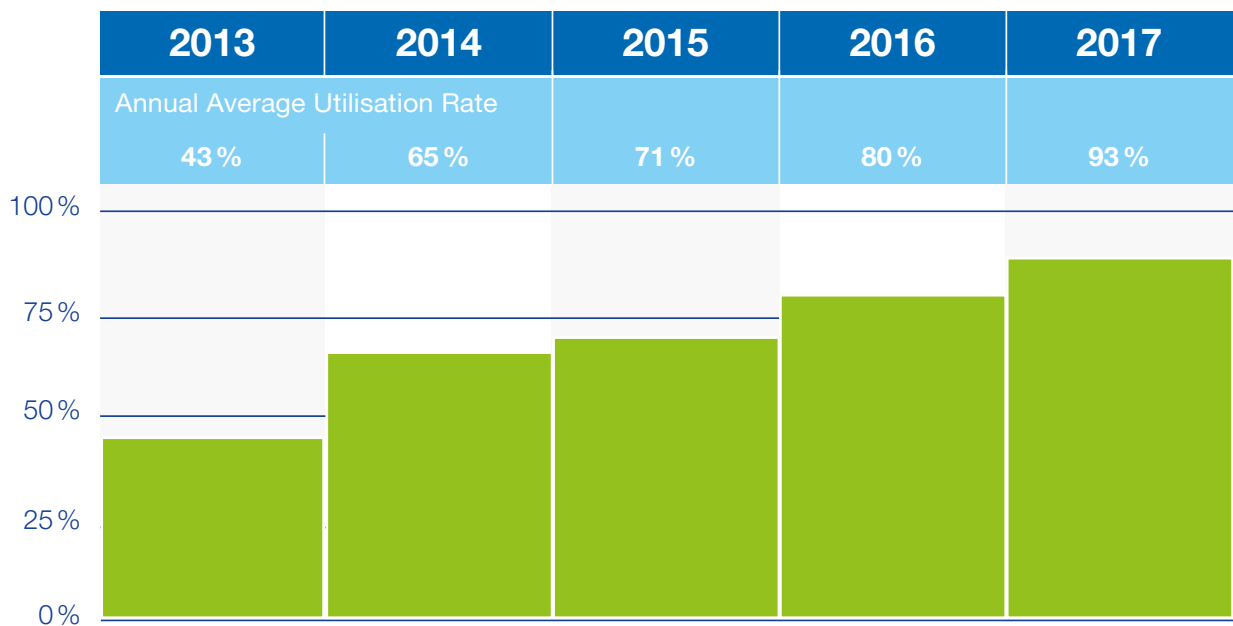
“In 2017, the average utilisation rate of the existing Nord Stream pipelines was 93 percent, with both lines operating at full capacity during the colder months of the year.”

No Incidents Since Start of Operation

The existing twin Nord Stream pipelines have been reliably delivering gas since they started operations. To enable the flawless transport of natural gas, both pipes undergo regular inspections, as well as thorough maintenance during an annual shut-down period occurring outside the winter months. The pipes are inspected both externally with cameras and scanners, and internally with special pipeline inspection gauges known as PIGs. (See illustration on p. 13)

No Long-Term Environmental Impact on the Seabed

Environmental monitoring studies carried out between 2010 and 2015 have shown that the construction of the pipelines did not cause any unforeseen environmental impact. Construction-related impacts were limited, local and short term, while the environmental recovery of the seabed following the construction phase was confirmed.



Source: Nord Stream AG



The Company

The project's developer, Nord Stream 2 AG, is headquartered in Zug, Switzerland. The 8-billion-euro infrastructure project is privately financed.

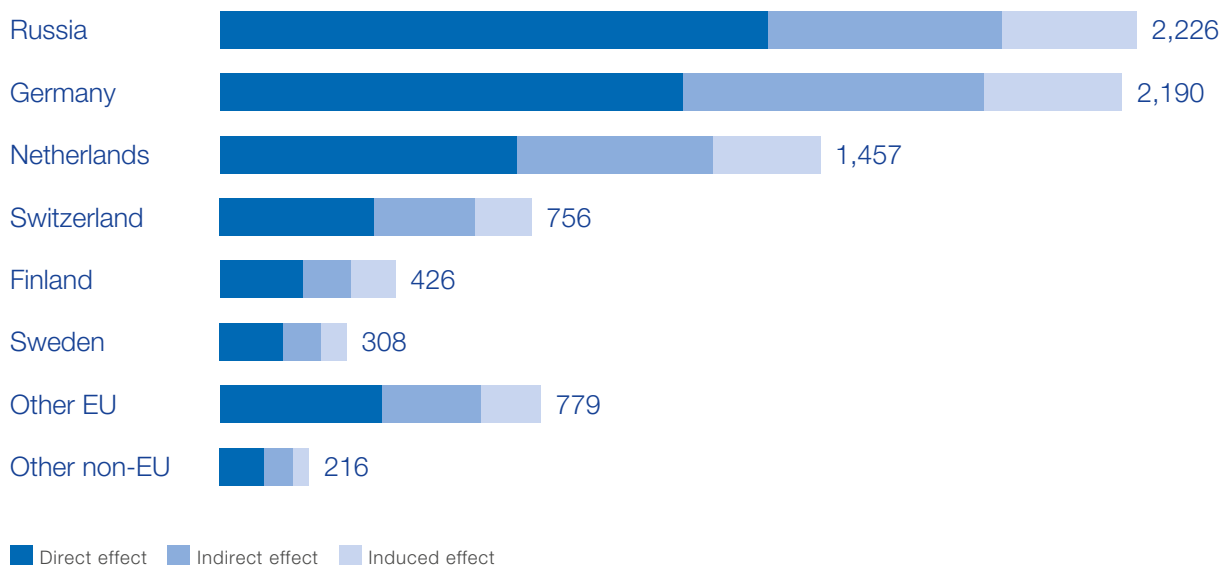
The planned pipeline project draws upon the permitting, survey and engineering work initiated by Nord Stream. The new pipeline also builds on Nord Stream's experience and knowledge by largely following its organisation and logistics concepts. The project, run by a team of about 220 experts from more than 20 countries, naturally complies with all applicable EU laws, national legislations and international conventions.

A Privately Funded Project

Nord Stream 2 is a privately funded project, with estimated construction costs of around 8 billion euros, equivalent to approximately 80 billion Swedish krona. The company has issued international tenders for the procurement of the pipes, pipelaying and logistics work, to ensure competition and economic pricing. All tenders were contracted in accordance with international practice, as well as the company's code of conduct and procurement guidelines.

Total Economic Impact of the Nord Stream 2 Project*

in million euros



*Estimate based on the 4.4 billion euros committed by July 2017.

Source: Arthur D. Little, "Economic impact on Europe of the Nord Stream 2 project," Sept. 2017.

The Technology Behind the Pipeline

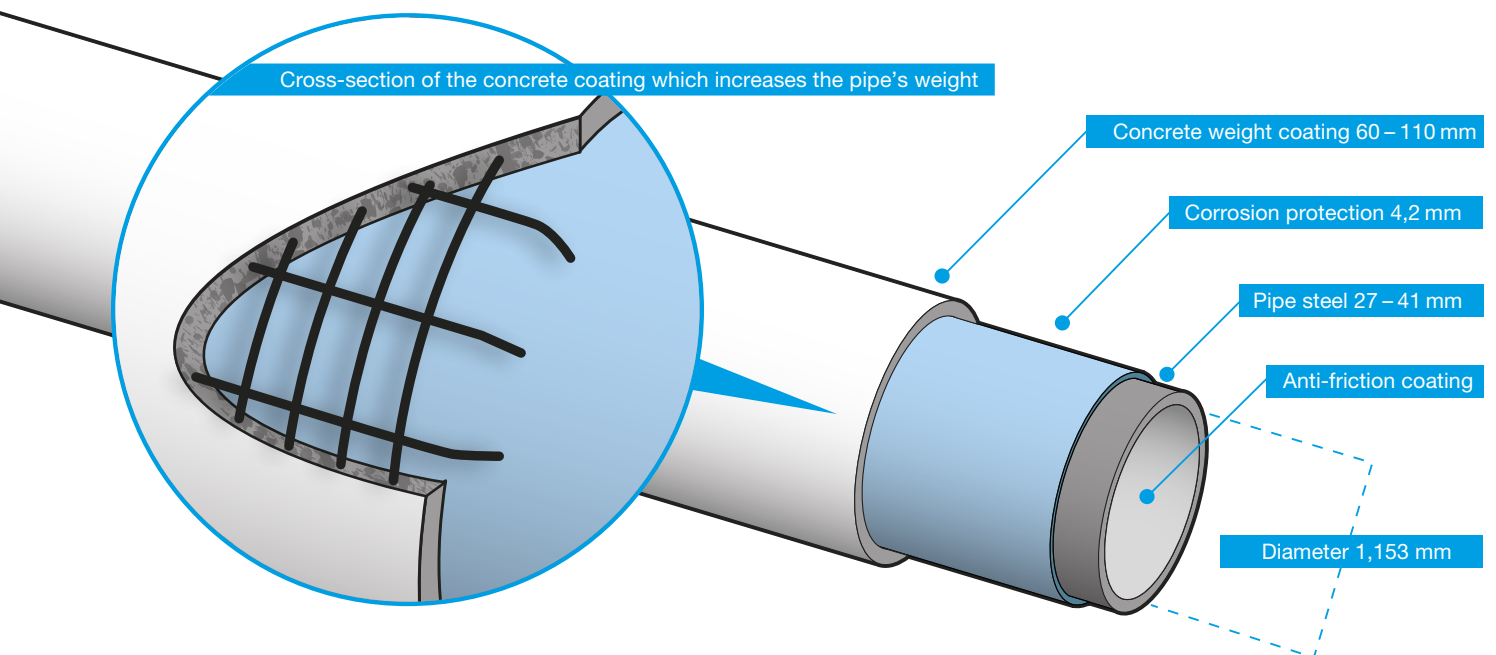
The Nord Stream 2 pipeline will be built of steel pipes laid on the Baltic seabed.

State-of-the-Art Technical Design

The two parallel pipelines will require approximately 100,000 steel pipes each, out of which about 50,000 pipes produced in Germany will be stored or pass through the port of Karlshamn, Sweden. Each coated steel pipe will have a length of 12.2 m with a variable outer diameter of approximately 1,400 mm and weigh up to 24 tonnes. The pipes will be protected by an anti-corrosion coating and concrete coating (see illustration below). The inner diameter of the pipes will be kept constant at 1,153 mm throughout the entire length of the pipelines to facilitate inspection and maintenance operations.

Independent Technical Design Certification

The pipeline system's technical design, construction and operation will draw on the extensive experience acquired through the already operating Nord Stream twin pipeline system. Independent certification bodies, including Norway's DNV GL, will witness, audit, participate in, and certify the technical design and construction of the pipes.

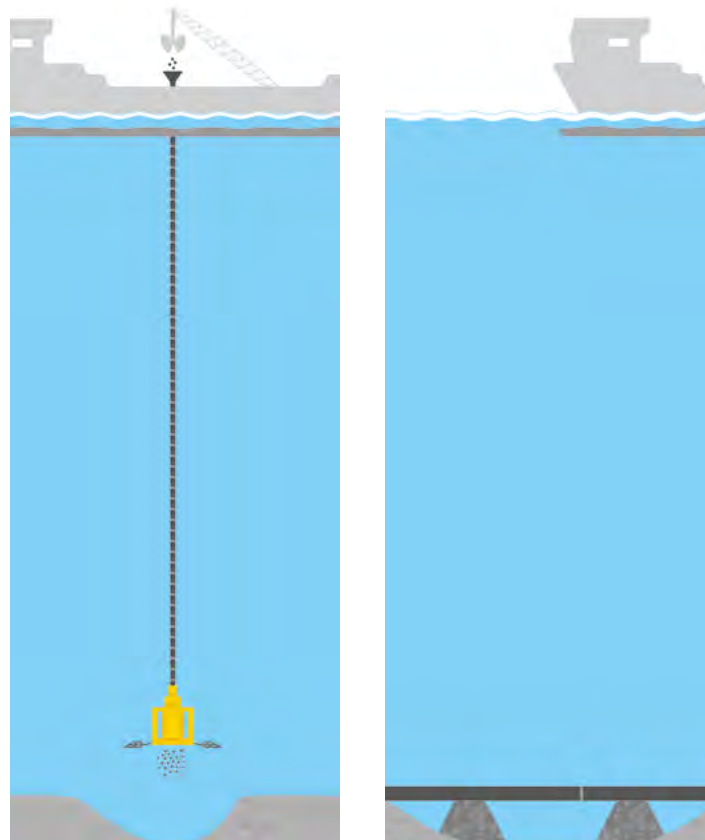


Rock Placement Needed in the Swedish EEZ

Conditions require intervention works to be carried out both before and after pipelay to ensure a stable foundation for the pipeline on the seabed. These works mainly involve the placement of rocks as well as some trenching at a few locations along the Swedish route.

The placement of rocks aims to protect the pipeline from excessive stress caused by freespans – where the pipeline “floats” from crest to crest on uneven sections of the seabed and thus requires support. Strategically positioned rocks and/or gravel stabilise the pipeline and diminish exposure to excessive movements resulting from currents, waves, vibrations and temperature variations.

Rocks are placed at specific sections along the route to stabilise the seabed so that the pipeline does not move.



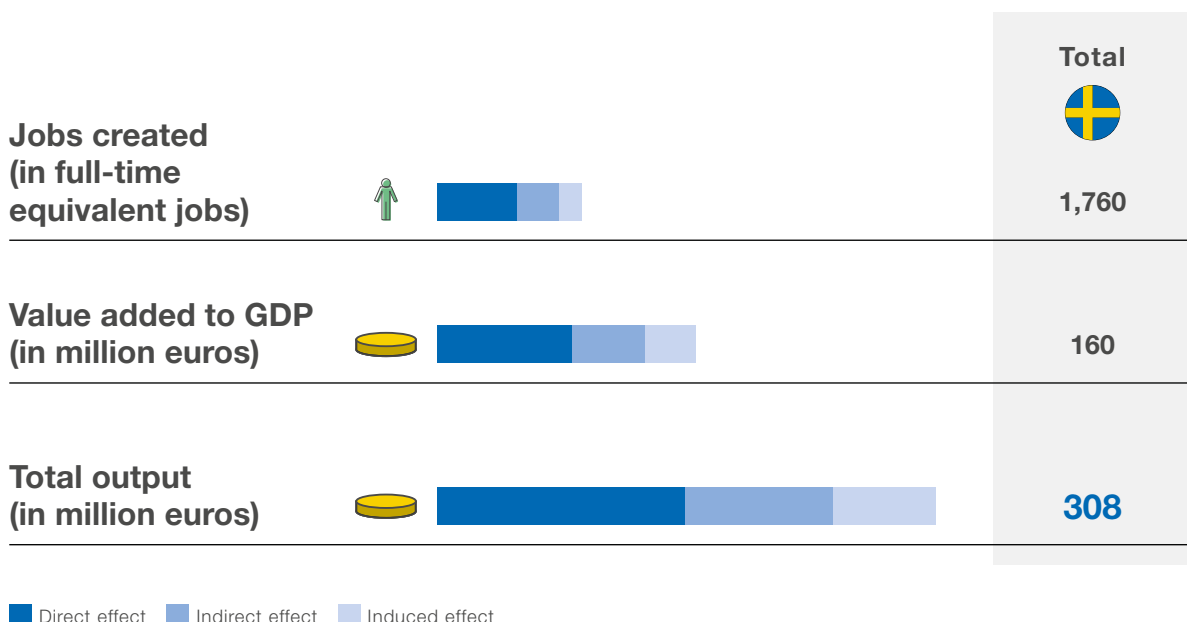
The rock material used will be either basalt, gabbro or granite with an average size of 50 mm. These rocks will not contain any contaminants, such as heavy metals that can be dissolved into the water, nor any clay, silt, lime or vegetation. To minimise the environmental impact, only clean and new rocks will be used. These intervention works will only be carried out at specific locations along the Nord Stream 2 route that have been indicated in the application.

In addition to the locations along the Swedish route that require rock placement, some power and telecommunications cables, and the already operational Nord Stream Pipeline, will be crossed within the Swedish EEZ. The various pre-lay seabed intervention works began during the summer of 2018.

Nord Stream 2 informed the relevant Swedish authorities and other interested parties at least one month before the start of the seabed intervention works in the Swedish EEZ, and continuously provides updates about the ongoing work.

Nord Stream 2 will have multiple vessels working on the installation of the pipeline system at various places along the Baltic Sea simultaneously. Within the Swedish EEZ, the current construction plan schedules the pipelaying to start during the first quarter of 2019. The overall aim is to have Nord Stream 2 operational at the end of 2019.

Overall Impact on the Swedish Economy*



*Estimate based on the 4.4 billion euros committed by July 2017.

Source: Arthur D. Little, "Economic impact on Europe of the Nord Stream 2 project," Sept. 2017.

Highly Specialised Vessels Carry Out the Pipelay

The pipes will be welded together into a continuous string during the construction process on board highly specialised vessels. The illustrations on the following page show each step in detail.

The main contractor for the pipelay, Swiss-based Allseas, will carry out of the pipelaying with dynamically positioned (DP) vessels. These vessels do not require any anchoring, and therefore have a smaller environmental impact on the seabed and water column because less sediment is spread. Instead of anchors, DP vessels have a number of thrusters placed around their keels to maintain the right position with the aid of GPS-based navigational systems.

Pioneering Spirit, the world's largest construction vessel, is one of the two pipelay vessels that will work in the Swedish EEZ, with an anticipated average daily construction rate of 3.8 km. The other pipelay vessel is Solitaire, with an estimated average daily rate of 3.4 km.

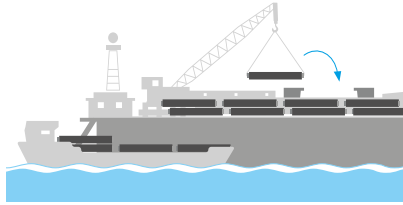
Pioneering Spirit, the world's largest construction vessel, is one of the two pipelay vessels that will work in the Swedish EEZ. The vessel is more than 380 m long and 120 m wide.



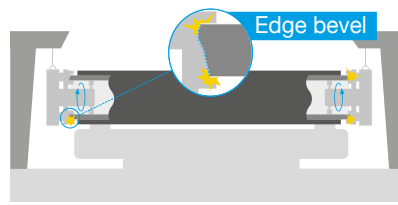
The two pipelay vessels will require continuous logistical support from the project's four ports around the Baltic Sea (see map on p. 2–3). The pipes used for the Swedish section of the route will either come from the port of Karlshamn – where pipes have been temporarily stored since October 2017 – from Hanko in Finland, or directly from the concrete weight coating plant in Mukran, on the German Baltic coast. Some 50,000 pipes will eventually pass through or be stored at the port of Karlshamn until they are shipped to the pipelay vessel. The interim storage in Karlshamn will result in the creation of approximately 100 jobs in the Swedish port during the most intense period of pipelay in the Swedish EEZ.

The Pipelaying Process

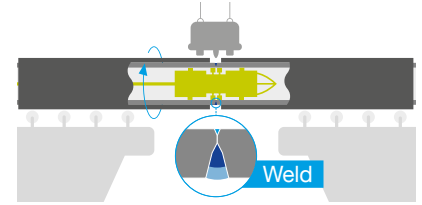
Construction of the Nord Stream 2 Pipelines will be carried out around the clock.



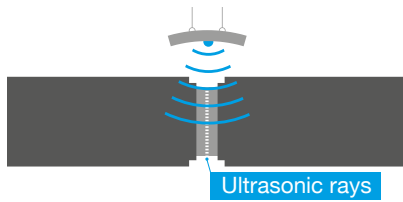
1 The pipes are unloaded from the pipe carrier vessels and stacked on each side of the laybarge. Pipe deliveries occur regularly to ensure that there is always an adequate linepipe on board to maintain the 24-hour pipelay schedule.



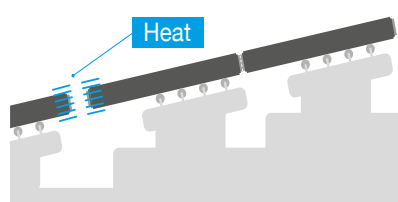
2 To prepare the pipes for welding, the ends are beveled to make them exactly the right shape to be fitted together. The inside of the pipe is then cleaned using compressed air before it is conveyed to the double-joint welding station.



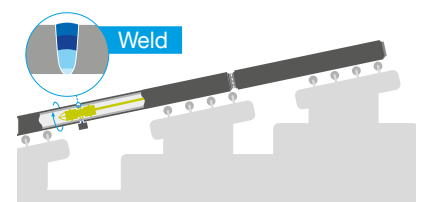
3 Here, 12-metre pipe joints are aligned and welded together to create a double-joint segment measuring 24 metres. These sections will later be connected to the main pipe string.



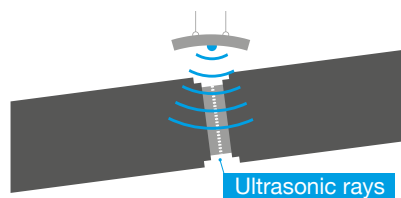
4 The double-joint is moved to a non-destructive testing station where every millimetre of the weld undergoes automatic ultrasonic testing (AUT) to detect any unacceptable flaws. If required, the defect will be removed and the weld rescanned to ensure it meets international standards.



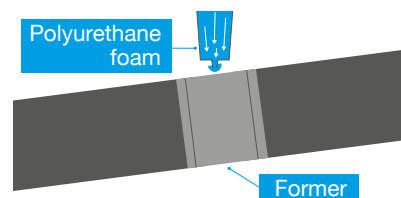
5 Following AUT, the double-joint is moved in a pipe elevator to the central assembly line. There, the insides are checked for debris and the double joint is aligned with the main pipe string in preparation for welding.



6 The double-joint is now joined to the end of the pipeline using a semi-automatic welding process. Qualified inspectors oversee each of the steps to ensure that welding is performed in accordance with Nord Stream 2's and authority approved procedures.



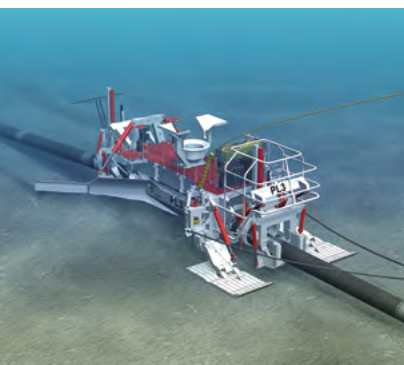
7 The weld between the double-joint and the main pipeline then undergoes automatic ultrasonic testing (AUT). Any unacceptable flaws will be removed, and the weld rescanned to ensure it meets international standards.



8 Once the weld is confirmed acceptable, a corrosion resistant, heat-shrink sleeve is applied over the circumferential girth weld. Then, polyurethane foam is poured into a former surrounding the weld area. This foam hardens, providing further protection.

Trenching and Testing Required Ahead of Operation

The pipelines will undergo thorough testing before going to operation. But before this stage some trenching will be required in the Swedish EEZ.



Trenching ploughs, like the one pictured above, are used to stabilise the pipelines on certain sections of the seabed after the pipelay.

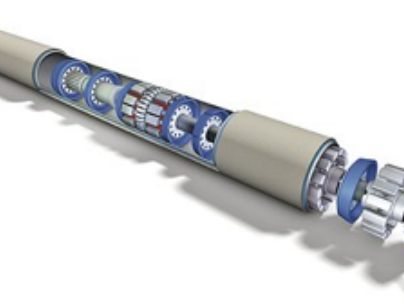
Over longer sections, generally over several kilometres, pipeline instability on the seabed due to wave action and currents is counteracted by trenching the pipe into the seabed rather than stabilising it with rocks. A ploughing tool will be used for this purpose along a total of approximately 20 kilometres per pipeline after they have been laid. This includes six sections of the route all located in the southern part of the Swedish EEZ.

Pre-Commissioning Pipes without Using Seawater

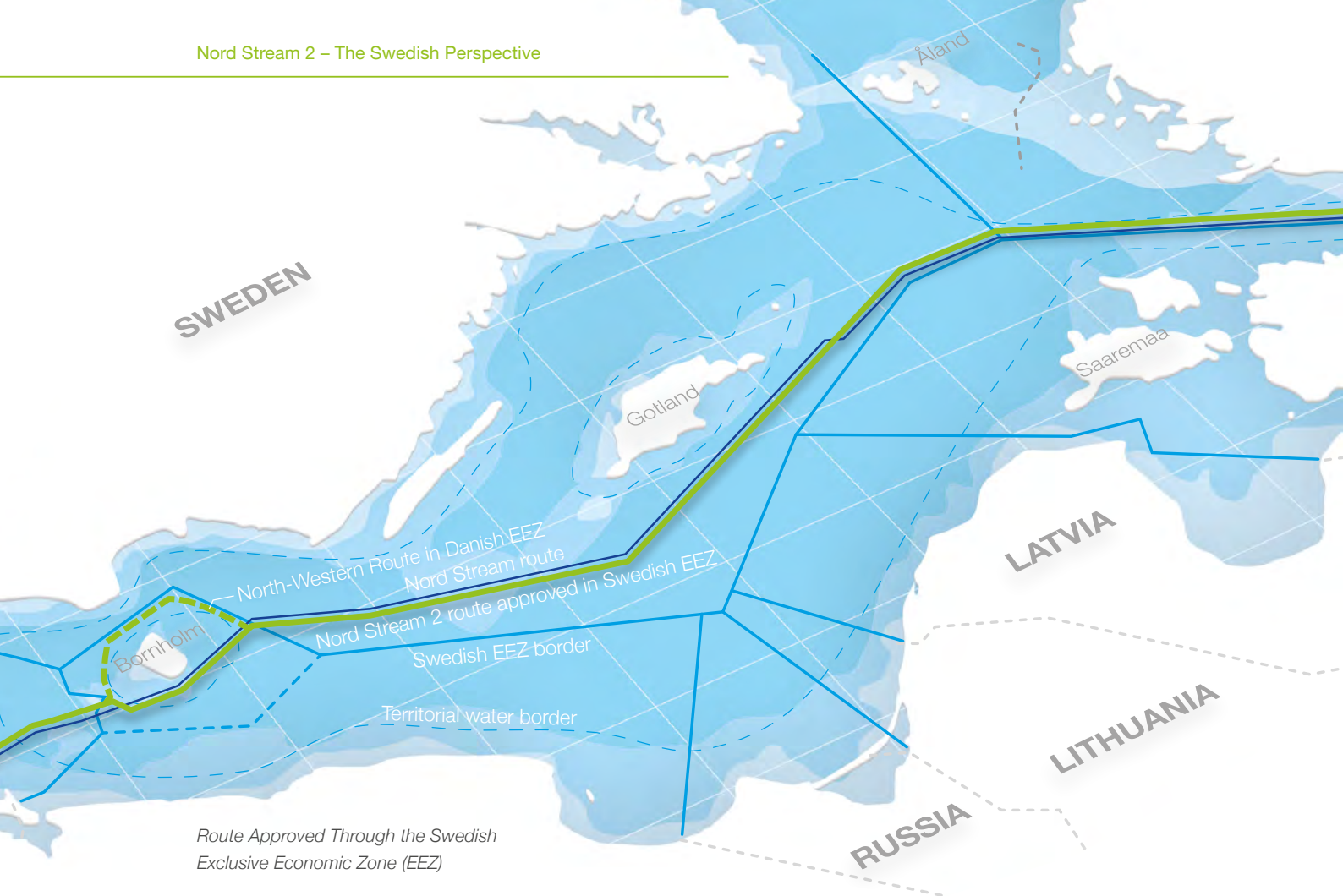
Once the pipelay and all the seabed intervention works are completed the two pipelines must be thoroughly tested before being put into operation. The offshore pipelines will be cleaned with dry air and checked using pipeline inspection gauges, called PIGs (see adjacent picture). These will be dispatched from the landfall in Russia and travel to the landfall in Germany. The pipelines will not be pressure-tested with water as they were with Nord Stream, so no dewatering and drying will be required, resulting in less environmental impact.

Nord Stream 2 Ready to Deliver in late 2019

Once the pipelines have passed all the pre-commissioning tests, the commissioning phase, during which the pipes are filled with gas, will be carried out in two stages. The first stage involves replacing the air in the pipes with nitrogen gas, used as a buffer to separate the air that is present in the pipelines from the natural gas which is to be fed in. During this phase, the pipeline is not be pressurised to any significant extent. The pipelines will only be pressurised once the valves at the landfall in Germany have been closed and the natural gas is injected into the system at the landfall in Russia. Filling the pipeline with natural gas typically takes three to four days, while the pressurisation of the pipeline up to approximately 100 bar can take up to 15 days. Nord Stream 2 will be ready to transport natural gas at the end of 2019.



A pipeline inspection gauge, or PIG, is used to clean and inspect a pipeline. The type of information gathered includes the pipeline's curvature, bends, temperature and pressure, as well as corrosion or metal loss. Source: Nord Stream



Optimising the Route to Minimise Environmental Impact

The proposed route for Nord Stream 2 has been carefully selected to minimise environmental and other impacts.

The twin pipelines will stretch for approximately 510 kilometres in the Swedish Exclusive Economic Zone and run broadly parallel to the existing Nord Stream pipelines. Specific technical, socioeconomic and environmental constraints were considered during the preparatory work and route selection process. More than 55,000 line kilometres of the seabed were surveyed by cameras or sensors placed on remotely operated underwater vehicles (ROVs) during the various surveys. These have gathered detailed information about seabed characteristics, topography, and potential shipwrecks and munitions along the route.

“The twin pipeline will stretch for approximately 510 kilometres in the Swedish Exclusive Economic Zone.”

Technical and Socioeconomic Considerations

Technical considerations in the pipeline’s design concept included components and installation methods, along with water depth and seabed roughness for the best pipeline stability, and proximity to and crossing of shipping lanes, cables and pipelines. With regard to socioeconomic criteria, the aim was to minimise restrictions on marine users, such as those in the

shipping and fishing sectors, or within military practice and recreation areas. Munitions and cultural heritage sites such as shipwrecks were also thoroughly surveyed along the route.

Minimal Environmental Impact on the Baltic Sea

Environmental considerations included the assessment of potential impact to the physical, chemical and biological environment of the Baltic Sea, including protected and/or environmentally sensitive areas. Based on the experience gathered from the successful Nord Stream project, the planned pipelines are expected to have limited environmental impact. The comprehensive environmental study and investigations carried out prior to filing the Swedish permit application show that the Nord Stream 2 project will have no or only negligible impact on water quality, seabed sediment, fish, birds, existing infrastructure and cultural heritage, to name just a handful of the receptors that were reviewed. With the mitigation measures proposed, no significant impacts are anticipated on any receptors, or existing or proposed Natura 2000 sites within Sweden such as Hoburgs Bank and the Northern Midsjö Bank (see table below and on p. 16).

Sediment samples were collected along the route and analysed for contaminants.



Key receptors	Potential impacts during construction	Overall assessment of impact
Seabed environment	Sediment spreading, spreading of nutrients and contaminants	None or negligible
Fish	Sediment spreading, spreading of nutrients and contaminants	None or negligible
	Generation of underwater noise	None or negligible
Birds	Sediment spreading and sedimentation	None or negligible
	Generation of noise and physical disturbance	None or negligible
Marine mammals	Sediment spreading and sedimentation	None or negligible
	Generation of underwater noise	Minor
Protected areas (Natura 2000)	Sediment spreading and sedimentation	None or negligible
	Generation of noise and physical disturbance	None or negligible

Key receptors	Potential impacts during construction	Overall assessment of impact
Shipping and shipping lanes	Implementation of safety zone around project vessels	Minor
Existing and planned installations (e.g. telecoms cables and wind farms)	Hindered possibility to use or repair existing cables	None or negligible
Cultural heritage	Disturbance to the seabed	None or negligible
Locations for the extraction of raw materials and other natural resources	Conflicts with prospect drilling	None or negligible
Commercial fishing	Implementation of safety zone around project vessels	Minor
	Sediment spreading and sedimentation	None or negligible
	Increased ship traffic	None or negligible

Overall importance of impacts during operational phase

Key receptors	Potential impacts during operation	Overall assessment of impact
Seabed environment	Presence of the pipelines on the seabed	Minor
Fish	Presence of the pipelines on the seabed	None or negligible
Birds	Generation of noise and physical disturbance	None or negligible
Marine mammals	None	No impact
Protected areas (Natura 2000)	Generation of noise and physical disturbance	None or negligible
Shipping and shipping lanes	Implementation of safety zone around project vessels	None or negligible
Existing and planned installations (e.g. telecoms cables and wind farms)	Hindered possibility to use or repair existing cables	None or negligible
Cultural heritage	Changing sedimentation patterns	None or negligible
Locations for the extraction of raw materials and other natural resources	Conflicts with prospect drilling	None or negligible
Commercial fishing	Presence of the pipelines on the seabed	Minor

No Unforeseen Environmental Impacts from Nord Stream

The environmental impacts of Nord Stream stayed below the thresholds identified in the Environmental Impact Assessment (EIA) studies. The data and the experience gathered during the construction of Nord Stream between 2010–2012 will help to ensure that Nord Stream 2 meets the same stringent international standards and can be built and operated without any adverse effects on the environment.

Environmental Monitoring During Construction and Operation

During the construction and operation of the Nord Stream 2 Pipeline, a monitoring programme will verify the findings of the Environmental Study filed with Nord Stream 2's permit application. This programme will be set up based on the experiences gained from the Nord Stream project, as well as surveys and other assessments.

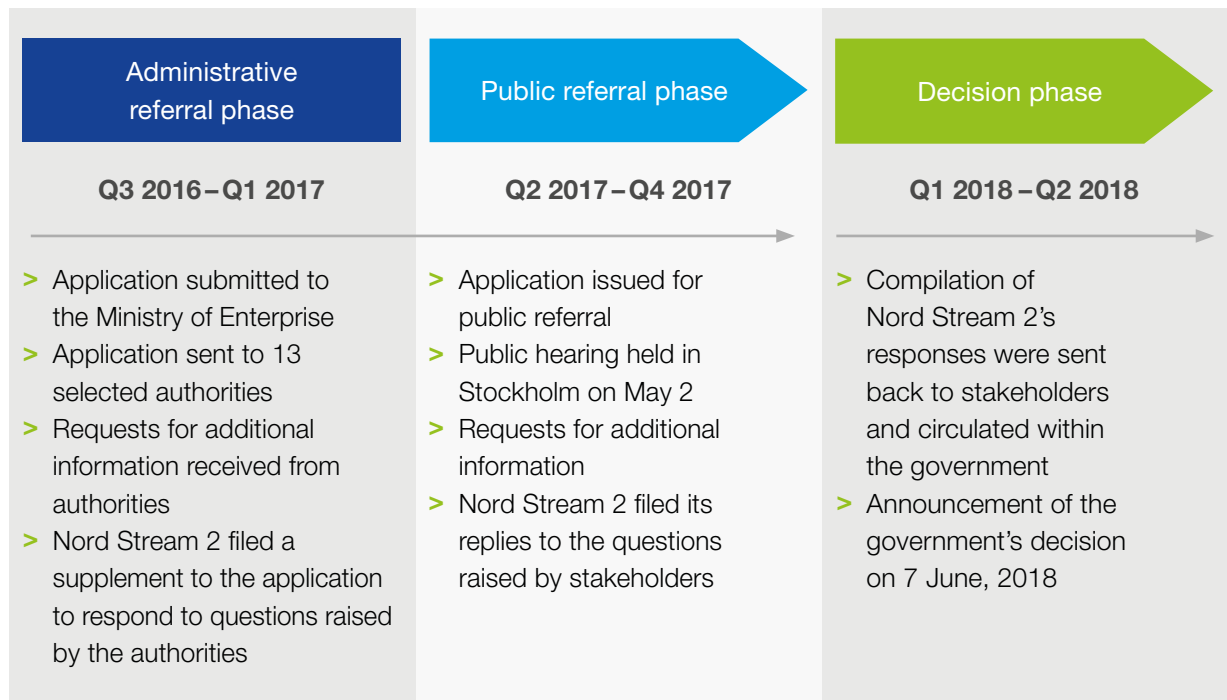
The monitoring programme is currently being drafted in consultation with the relevant Swedish authorities, including the Coast Guard, the Environmental Protection Agency, the Swedish Maritime Administration and the Swedish Agency for Marine and Water Management.

The surveys carried out during the construction and operational phases will be made available to the authorities. They will closely monitor the spread of sediment and environmental contaminants during trenching, along with the potential impact on mussel banks.



More than 950 sediment samples have already been taken to confirm the geology of the seabed. The spread of sediment will be closely monitored during pipelay.

Permitting Process and Decision Phases 2016–2018



The Swedish Permitting Process in a Nutshell

The national permitting processes for the construction of gas pipelines vary in each of the five countries where Nord Stream 2 will be constructed. In Sweden, the Ministry of Enterprise and Innovation is in charge of the permit application.

“There is a clear legal framework stipulating the right for all to lay cables and pipelines on the continental shelves outside coastal states’ territories.”

In order to lay pipelines on the continental shelf outside of Swedish national territory, a permit is required according to the Swedish Continental Shelf Act (SFS 1966:314). The act implements parts of the United Nations Convention on the Law of the Sea (UNCLOS), and specifically the right for all to lay cables and pipelines on the continental shelves outside coastal states’ territories.

Nord Stream 2 filed its permit application to the Swedish government, more precisely to the Ministry of Enterprise and Innovation in charge of the dossier, on September 16, 2016. The application contains the formal legal application, a comprehensive environmental study, a detailed technical description, an



atlas and several appendices with detailed background reports. The information disclosed in these documents contains detailed project information focusing on the construction of the twin pipeline system in the Swedish EEZ.

Several Referral Rounds

Nord Stream 2's application first went through a so-called administrative referral round during fall 2016, when the Ministry of Enterprise and Innovation and 13 selected authorities assessed the completeness of the application. Once they had given their green light, a Swedish and an international public consultation phase, also known as the Espoo consultation process, followed between April and June 2017. Both consultations were open to all interested stakeholders, ranging from non-governmental organisations (NGOs), fishermen and authorities, to municipalities located along the Baltic Sea. During this period, stakeholders had the opportunity to comment or raise their questions about the planned pipeline system. Additionally, a public hearing was held on May 2, 2017 in Stockholm, where Nord Stream 2 representatives presented the project and answered questions from the audience.

Nord Stream 2 responded to the questions and requests for additional information filed by the stakeholders during the public consultation phase in several supplements. This additional information was handed in to the Ministry of Enterprise and Innovation during the second half of 2017.

Permit Granted in June 2018

The Swedish government granted a permit for the construction and operation of the Nord Stream 2 pipeline within Swedish EEZ on June 7, 2018. "The starting point in international law is that all states are entitled to lay pipelines through the Exclusive Economic Zone of the coastal state," the Swedish Minister of Enterprise Mikael Damberg said in a press release following the announcement.

Nord Stream 2 has also obtained the permits and license required for the construction and operation of the pipeline system in Germany, Finland and Russia. The national permitting procedures in the remaining country along the route – Denmark – is ongoing.

Nord Stream 2 will be ready to transport gas to European consumers at the end of 2019.

"The starting point in international law is that all states are entitled to lay pipelines through the Exclusive Economic Zone of the coastal state."

Mikael Damberg,
Minister of Enterprise
and Innovation

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mc-quadrat OHG:
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