Intended for
GAZ-SYSTEM S.A. and Energinet.dk

Document type
Abstract of feasibility study

Date
April, 2017

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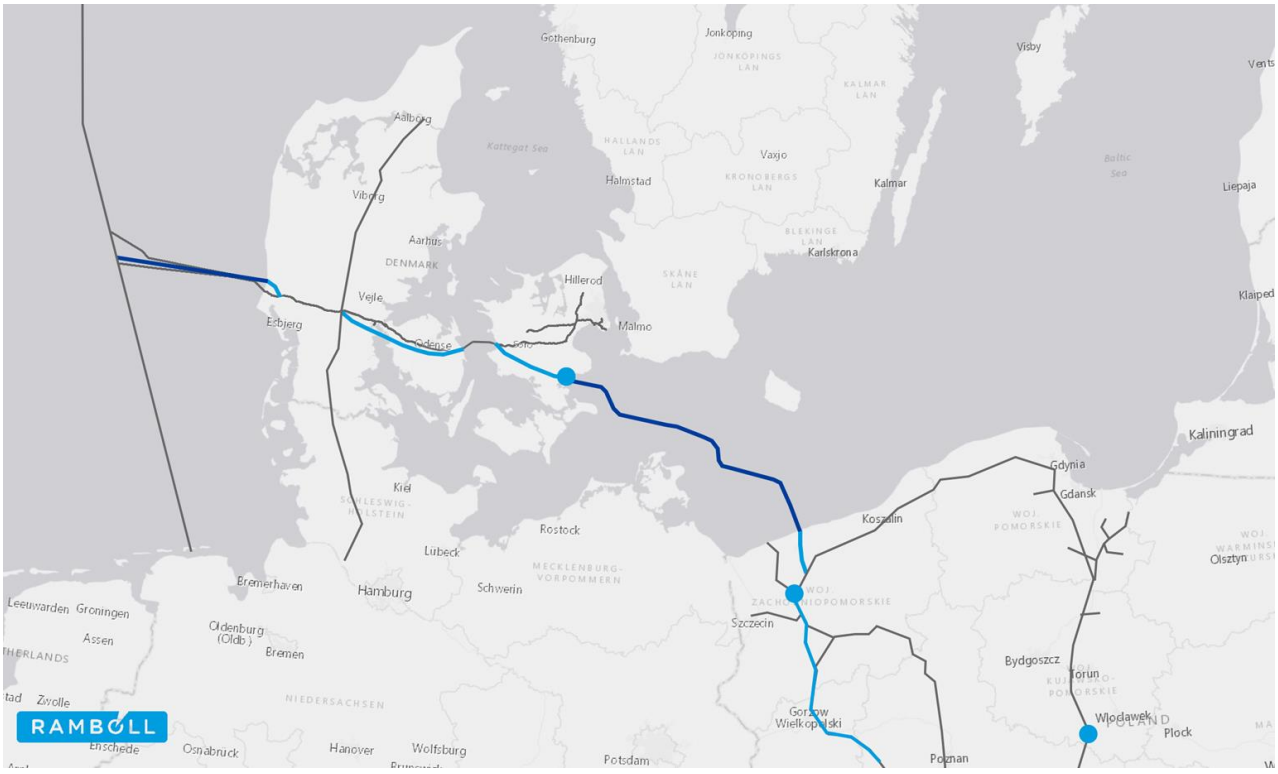
BALTIC PIPE PROJECT



RAMBOLL

Co-financed by the European Union
Connecting Europe Facility

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BALTIC PIPE PROJECT

Revision	**E**
Date	**24/04/2017**
Made by	**FIO**
Checked by	**SLC**
Approved by	**SLC**
Description	**Abstract of feasibility study of the Baltic Pipe Project**

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1. INTRODUCTION

The Baltic Pipe Project is a major gas infrastructure project that aims at creating a new supply corridor for gas in the European gas market. The project will enable transport of gas directly from Norway to the markets in Denmark and Poland together with their neighboring markets. Moreover, it will also enable shippers to flow gas bidirectional from Poland to the Danish and Swedish markets, and thus allow Denmark and Sweden access to Liquefied Natural Gas (LNG) through the LNG import terminal in Poland.

The Baltic Pipe is recognized as the EU 'Project of Common Interest' (PCI) project and has the purpose to further strengthen the European internal energy market by reaching the EU's energy policy objectives of affordable, secure and sustainable energy.

This paper summarizes a feasibility study performed by Ramboll Denmark, Gazoprojekt, and EY Poland for the project promoters GAZ-SYSTEM S.A. and Energinet.dk. The "Feasibility Study regarding the PCI Poland – Denmark interconnection 'Baltic Pipe' TRA – N - 271" was co-financed by the European Union's Connecting Europe Facility. The feasibility study has analyzed the technical and the economic feasibility of the Baltic Pipe Project.

The feasibility study concludes that the Baltic Pipe Project is feasible. The feasibility study has looked into several feasible technical solutions of how to build and conclude the Baltic Pipe Project. Further, the socioeconomic analysis showed large net socioeconomic benefits for all countries involved. Finally, the study showed that the market has an interest in the project. As the cost of infrastructure is levied upon the shippers via tariffs, the market interest is key to the business case of the project.

Going forward, there are especially two issues to ensure. First, the average cost of transportation – or more accurately the capital expenditure (CAPEX) and operational expenditure (OPEX) – shall be low enough to be attractive for the market participants. If the costs exceeds alternative sources of gas (import from Germany or via the LNG terminal), the utilization of Baltic Pipe Project route will drop with a resulting increase in the average cost of transportation.

Second, the Baltic Pipe Project shall be operational by October 2022. The market has clearly indicated the importance of meeting this deadline, and it is crucial that this deadline is met. With the level of technical complexity in addition to the many permits to be obtained from the many countries and stakeholders involved, attention should be kept at optimizing and keeping the time schedule. The feasibility study presents a feasible time schedule that has been optimized to allow for first gas to flow by 1 October 2022.

The feasibility study concludes that the project is feasible from a technical, environmental and economic point of view. To progress further, commitment from the market players should be ensured, and a number of more detailed technical studies and an environmental impact assessment (EIA) should be carried out. This is also key for the permitting and the associated stakeholder dialogue.

2. WHAT IS THE BALTIC PIPE PROJECT?

The Baltic Pipe Project is the construction of a gas pipeline connecting the existing gas transmission systems of Denmark and Poland with Norwegian exporting gas pipelines.

The feasibility study has looked at three different options of the connection with three different capacities, of 3 bcm per year (34,5 TWh/year[1]), 6-7 bcm per year (69-81 TWh/year) and 10 bcm per year (115 TWh/year). The technical requirements and solutions - and thus also the cost – differ between the three capacities.

As part of the feasibility study, a market test was carried out to examine the interest in the market for the Baltic Pipe Project. 488 companies in 15 countries were invited to give an indication of interest in capacity bookings. The result from the market was a clear interest corresponding to a capacity of (more than) 10 bcm per year (115 TWh/year). All results reported here, corresponds to an annual capacity of 10 bcm (115 TWh/year), which has been selected as the target capacity and as a base case scenario for further works.

2.1 The five major components of the Baltic Pipe Project

The scope of work for the Baltic Pipe Project can be broken down into five major components:

i. A Danish upstream tie-in from the Norwegian system in the North Sea to the Danish landing point (the "Norwegian tie-in").
ii. Expansion of the existing west-east capacity in the Danish onshore transmission system (the "Danish Expansions").
iii. Compressor Station Zealand located on the Danish shore ("CS Zealand").
iv. A transmission offshore pipeline between Denmark and Poland, from Southeast Zealand through the Baltic Sea, and the receiving terminal and onshore pipeline to connection to existing transmission system in Northwest Poland (the "Offshore Interconnector").
v. Expansion of Polish transmission system (the "Polish Expansions").

[1] Using a conversion factor of 11.5 kWh/Nm3 natural gas. This conversion rate has been applied throughout this report.

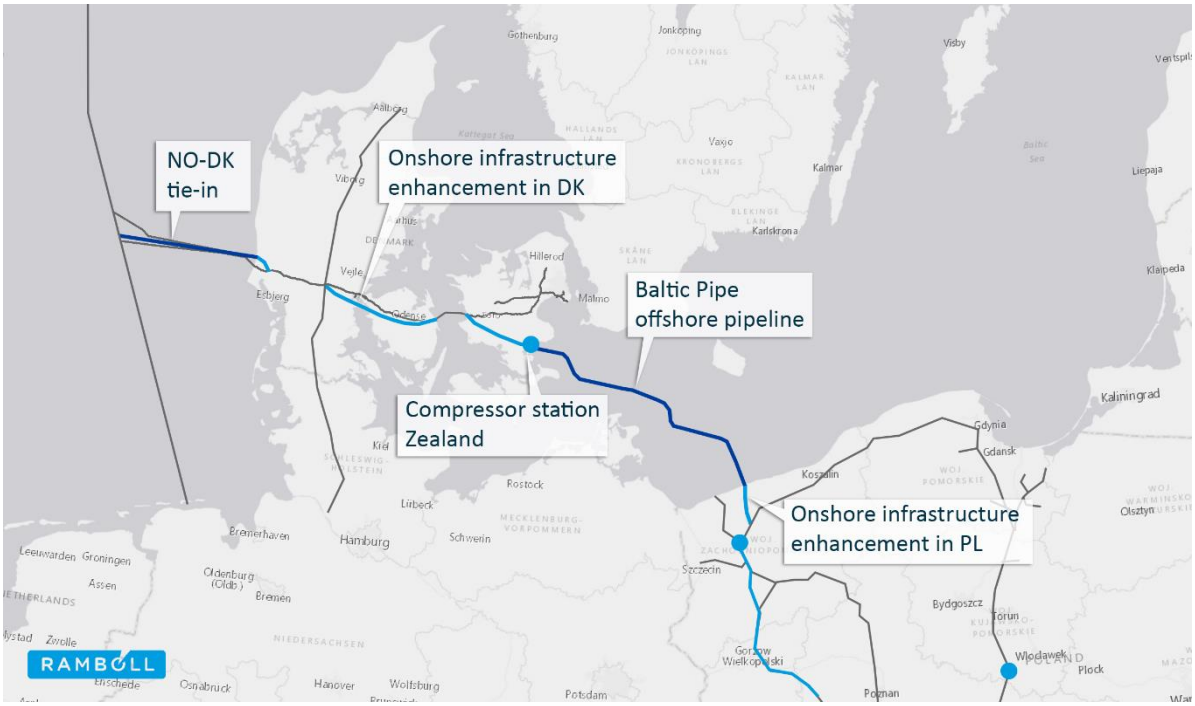

Figure 1 Overview of the five components of Baltic Pipe. Route and compressor station location are indicative, and not specific.

2.1.1 Tie-in to the Norwegian upstream system in the Danish part of the North Sea

The Norwegian gas is exported to Europe via large pipelines, most notably the pipelines Europipe I and Europipe II. It is technically feasible to connect a new pipeline to one of the existing Europipes via a so-called offshore tie-in. The feasibility study has examined six different connections (including all necessary valves, metering stations, and security measures) of how to connect the Danish receiving terminal Nybro to Norwegian export pipelines. The offshore pipeline length is approx. 120 km.

2.1.2 Expansion of the transmission system throughout Denmark

Approx. 3.5 bcm per year (40 TWh/year) natural gas is transported through the Danish gas grid to Denmark and Sweden annually. After the Baltic Pipe Project, the annual transport will increase with up to 10 bcm per year (115 TWh/year) additional volumes. Parts of the Danish transmission system are able to accommodate these additional volumes, for instance the pipeline through the Great Belt. Other parts of the Danish gas transmission grid will need to be enhanced in order to accommodate the increase in annual gas transportation. Further, new pipelines needs to be installed towards the landfall of the offshore part of the Baltic Pipe (see 2.1.4). The total length of the Danish enhancements is expected to be approx. 200 km pipeline.

The study has for model purpose identified a possible route through Denmark, yet the exact routing has not been decided at this point and an Environmental Impact Assessment (EIA) has to be performed. The actual routing will be subject to dialogue and approvals from relevant stakeholders and relevant authorities.

2.1.3 Compressor station Zealand

To build pressure that can transport the gas to Poland, a compressor station is needed. The main tasks of the compressor station are bidirectional gas compression (with an arrival pressure in Poland of 84 barg) and enabling the measurement of gas flow in both directions. It is a technical requirement that this compressor station is located at Zealand, close to the shore and the offshore part of Baltic Pipe. The compressor station is assumed on electricity, with an estimated

required power of up to 36 MW (theoretical power resulting from performed hydraulic calculations of compression needs for 10 bcm per year (115 TWh/year)). The required land demand is approximately 17.5 ha - 19 ha for the entire compressor station. The exact location of the compressor station is not yet decided, and will in part depend on the routing and position of the landfall of the offshore Baltic Pipe. An Environmental Impact Assessment has to be performed (EIA). The actual position will be subject to dialogue and approvals from relevant stakeholders and relevant authorities.

2.1.4 Offshore pipeline from Denmark to Poland

From the east coast of Zealand in Denmark to the north coast of Poland, an offshore pipeline is planned. Different possible route corridors have been evaluated, and two alternative routes through Swedish or German Exclusive Economic Zone (EEZ) have been established. The length of the offshore pipeline varies with landfall options, but it is estimated between 227 km. and 286 km. For pipeline sizing the design premises have been developed in an iterative method in the sense that three pipeline sizes, 24", 30" and 36" have been analyzed together with required compressed effect. The result indicates that 36" pipeline with related compressor is the optimal solution.

The basis of the mechanical design is DNV SAWL 450 FD line pipe steel with a 3 mm PE anticorrosion coating. Standard API wall thickness values are assumed. It can later be decided that the wall thickness shall be made specifically to this project which is technically and economically attainable for this size project. To secure weight the pipeline is further coated with concrete. Further protection in the form of trenching the pipeline below seabed level is evaluated, especially at landfall locations where it is assumed that the pipeline needs to be trenched.

Offshore in the Baltic Sea, all route alternatives pass the Arkona basin which is characterized by extremely soft clay in a considerable thickness. The Arkona basin sediments will likely result in the pipeline sinking into the seabed completely. The strength will increase with depth and calculations shall be made how much the pipe will sink into the seabed. The pipeline can then be designed with a suitable weight to get a moderate penetration.

2.1.5 Expansion of the national transmission system in Poland

Onshore part of the Baltic Pipe Project in Poland includes linear and nonlinear investments directly related to the connection to the Polish gas Transmission System (PTS). A variety of combinations of landfalls, receiving terminal location, connection pipeline in Poland, and tie-in to the Polish gas transmission system have been analyzed. The receiving terminal in Poland will be located in direct vicinity of the landfall or further inland. Depending on selected Receiving Terminal location, the distance from landfall area could be from approx. 0.1 km to 4.9 km. The receiving terminal will measure gas flow in both directions, and protect against exceeding the maximum operating pressure of connection pipeline in case of gas import from Denmark. Initially determined land demand for Receiving Terminal in Poland is estimated at the level of approx. 3.3 ha – 4.3 ha (for target capacity 10 bcm per year (115 TWh/year)). The construction of receiving terminal and connection pipeline (from receiving terminal to the Polish transmission system tie-in) is an integrated part of the Baltic Pipe Project, as it allows the gas to enter the Polish transmission system.

Further, reinforcements of the Polish transmission system are needed to accommodate the expected increase in annual gas transportation from this direction.

2.2 The cost of the Baltic Pipe Project

The total cost of the Baltic Pipe Project has been divided into two categories. The capital expenditure during the construction (CAPEX) and the operational expenditure over the life time of

the Baltic Pipe Project (OPEX). The analysis has a 26 year time horizon, with 6 years of construction and 20 years of operation.

All prices are given in 2016 prices. To allow for cost discounting, discount factors usually applied by Energinet.dk and GAZ-SYSTEM S.A. have been applied.

In the feasibility study, where many aspects of the Baltic Pipe Project is still unknown, the cost estimates are given with an estimated +/- 30 per cent accuracy. The costs are given for the proposed technical model solutions.

The construction cost will be distributed over the years up until completion in 2022, and as the project matures a detailed liquidity plan for the project shall be constructed to allow for appropriate discounting.

The CAPEX depends very much on the chosen route and dimension. A suggested route has for modelling purpose been chosen, and given the target capacity of 10 bcm per year (115 TWh/year), the table below summarizes the CAPEX for each of the five components.

The OPEX have been estimated, and will begin in 2023 when the Baltic Pipe Project is scheduled for operation. The OPEX ends in 2042, such that the estimated life time of the project is 20 years. All OPEX are discounted with the relevant discount rates for Energinet.dk and GAZ-SYSTEM S.A. For illustrative purposes, the annual expenditure is indicated in the table below.

Table 1: CAPEX and OPEX

	Estimated range of CAPEX **mEUR**	**Estimated annual OPEX** **mEUR**
GAZ-SYSTEM S.A.	841 to 1,093	35.6
Energinet.dk	744 to 968	16.7
TOTAL	1,585 to 2,060	52.3

The figures reflect the CAPEX and OPEX, as per the study's cost freeze at 12-10-2016. The CAPEX and OPEX estimates will continuously be improved by GAZ-SYSTEM and Energinet.dk towards the Open Season procedure expected in Spring 2017.

The compressor station OPEX is calculated assuming a load factor of 90 per cent.

Important Notice: The exact division of cost between GAZ-SYSTEM S.A. and Energinet.dk is yet undetermined. Allocation of Compressor Station costs is still subject to discussion between Promoters and NRAs and should be finalized before launching of the II phase of the Open Season Procedure.

3. IDENTIFIED BENEFITS

The Baltic Pipe project can bring significant positive level of socioeconomic profitability to societies in Poland, Denmark and other countries. The Baltic Pipe induced benefits relate to increased market integration, competitiveness, sustainability and security of gas supply. Implementation of the Project can spur the development of local gas markets in the direction of the EU targeted common energy market.

The main objectives of the Baltic Pipe Project are to further strengthen supply diversification, market integration, price convergence and security of supply in primarily Poland and Denmark and secondarily in Sweden, Central and Eastern Europe (CEE) and the Baltic region.

The Baltic Pipe Project is recognized by the European Commission as a Project of Common Interest (PCI), and accordingly an integrated part of the Ten Year Network Development Plan (TYNDP). Thus, the relevance of the Baltic Pipe Project for the broader region and Europe as a whole is recognized.

The benefits to Norway and Norwegian gas producers have not been included in the scope of work for the feasibility study.

Each element has been analyzed separately.

3.1 Security of Supply

When the countries in the region strengthen their supply diversification, they increase their Security of Supply. Security of Supply is a term that captures the level of dependence a country or a region has on a single source of gas. Most notably, primarily Poland (and secondarily Denmark, Sweden, Central and Eastern Europe and the Baltic states) will decrease their dependency on Russian gas. Hence, the Baltic Pipe Project will allow a balance in supplies from more than a single supplier.

Decreasing dependency on a single supplier has significant advantages. First, the cost of disruption of gas supplies is reduced, as more than one supplier is readily available. Second, the negotiation power is increased as alternatives are available. Third, gas as a fuel becomes more accessible as a cleaner substitute for coal in certain regions.

As such, the Baltic Pipe Project can bring Norwegian gas to a part of Europe that today is de facto dependent on Russian gas supplies.

3.2 Formation of an Internal Energy Market

The Baltic Pipe Project is part of the North-South Corridor and Baltic Energy Market Interconnection Plan (BEMIP), which constitute one of the priorities for the development of the energy infrastructure marked by the EU. Their purpose is to integrate the gas markets within the Central Eastern Europe, contributing to the improvement of market competition and security of gas supply and allowing for unconstrained trade of energy.

Realization of the Baltic Pipe Project itself is in line the mentioned policies, and if remaining interconnections with the Polish market are built, can spur trade between countries within Central Eastern Europe thanks to providing an additional supply source to the region.

The overall gas market quality of countries within the Baltic Pipe Market Region (including Poland, Denmark, Sweden, Lithuania, Latvia, Estonia, Ukraine, Czech Republic, Slovakia and Hungary) is far from satisfactory according to ACERs gas target model. Thus, there is an urgent need for further liberalization and competition reforms as well as additional cross-border investment projects. This is in contrast to the very well-developed North-West European market region. Further linkages between the regions could help spur further market development.

The current development of gas systems in region does not allow countries to effectively transport gas in direction from North to South or from South to North. The main gas flow direction is from East to West. The second direction is from West to East and has many bottlenecks in transmission capacity. The region has (a part from Denmark) a dependency on single supplier and lack of system capability leads to price disproportion in gas markets between western market and markets impacted by the Baltic Pipe Project.

The Baltic Pipe Project will increase the market quality of the countries in the region. Poland has the potential to increase its role as a hub for gas in the Eastern European market zone to the benefit of Poland, the Baltic States, and the entire Central Eastern Europe.

The Baltic Pipe Project will allow Denmark (and Sweden) to gain access to the LNG import facility in Świnoujście, Poland. Hence, Danish (and Swedish) gas consumers will have access to the world market in LNG through the Baltic Pipe Project. It is the aim of the European Commission that all markets have direct access to a LNG terminal.

3.3 Saved cost of gas transportation

The Polish import of Norwegian gas will be transported through the Danish transmission system. The Danish transmission system is operated to recoup the costs associated with the transport of gas. As the flow through Denmark will increase from approx. 3.5 bcm per year to 13.5 bcm per year (40 TWh/year to 155 TWh/year), the cost per unit of gas transported will decrease (even after the investments for the Baltic Pipe Project is factored in). Hence, a Danish gas consumer (households and industries) will experience a significant drop in the price of transport of gas.

3.4 Strengthening EU Member States' energy solidarity

The Baltic Pipe Project creates foundations for development of energy solidarity between EU member states in case of potential gas disruptions, reducing the risk of supply shortages.
In the case of disruption from the currently leading sources / routes of gas supply, it will be possible to direct additional gas volumes to both Denmark and Sweden, as well as to Poland and other Central Eastern European states. This can significantly increase the energetic security of the region.

3.5 Increasing market sustainability

Through addition of new supply sources to all countries involved, and potentially reducing regional gas price differences, the implementation of the Baltic Pipe Project can promote the increased use of gas as a fuel for final consumption and energy production, potentially substituting the use of less clean fuels, like e.g. coal. As a result, the sustainability of the region could increase by the reduction of CO2 emissions.

3.6 Addition of new gas supply sources and routes

At present, Denmark and Sweden are primarily supplied by the Tyra field and have only one foreign import supply source (Germany via Ellund). The Baltic Pipe Project will add two new supply sources and routes, one in the north (Norwegian gas supplies via Nybro) and the second one from the south (e.g. LNG supplies via the Polish LNG in Świnoujście). The major gas supply source for the Central Eastern Europe (and for many markets the only source of gas supply) has historically been Russia, with gas flowing primarily from East to West.

The Baltic Pipe Project will bring diversification in terms of gas supply sources to Central Eastern Europe, by enabling regional markets to purchase Norwegian gas. This is a gas supply source currently not present in the gas supply mix of these countries.

The Baltic Pipe Project could mark a fundamental change to the architecture of gas flows in the region, due to the fact that it would add a major gas supply route from the North Sea. This would provide the region with much needed diversification of not only gas supply sources, but also supply routes.

3.7 Increasing the role of Denmark as a transit country

Norwegian gas transmitted through Denmark will be of significant importance to the Central Eastern European region, since it will constitute an instrument boosting the energy independence and bargaining power of states against Russia. As a result, Denmark's role as key transit country for the region will increase. Significant transit activity is expected to increase gas volume transmitted via the Danish gas network, which can be used to lower the tariffs for hitherto users of the Danish transmission network (domestic users in Denmark and Swedish gas importers). The

degree of tariffs' decrease depends on the methodology of structuring tariffs in the Danish system post the Baltic Pipe Project implementation.

3.8 Increased bargaining power vs the current dominant gas supplier

Given the increased diversification of supply sources, the bargaining power of Central Eastern European countries against Russia, the currently dominant gas supplier to the region could increase.

This could result in the countries being able to negotiate better supply contract terms, e.g. price- or flexibility-wise (e.g. lower take-or-pay) by threatening to switch gas supplier to Norway, currently Russia's largest competitor in terms of gas volumes supplied to Europe.

3.9 Increased market quality / regional gas hub

Because of increased security of supply, competition and potential gas surpluses on the market, the Baltic Pipe Project may spur the growth of trading, market liquidity and even development of other interconnection pipelines in the Central Eastern European region.

Consequently, the Baltic Pipe Project can be the backbone of a well-functioning gas market hub, where each country is sufficiently interconnected and gas can be efficiently traded at competitive prices. As a result, the Baltic Pipe Project can help realize the ACER-backed vision of the European gas market, composed of strong and liquid regional hubs.

4. CONCLUDING REMARKS

The feasibility study that has now been performed has analyzed the technical, environmental and economic feasibility of the Baltic Pipe Project. The main conclusion is that the project is technically and economically feasible. This is the basis for more detailed studies.

Many variations of possible technical solutions, routes, and locations have been performed. In time to come, the project should be defined even narrower, and exact routes, locations and technical solutions should be decided. Also, work on the Environmental Impact Assessment (EIA) should be initiated, just as marine surveys, and other analysis will be performed involving municipalities and the public. As an integrated part of this public hearings and consultations will take place.

The project will be subject to authorization subject to environmental regulation and to building/construction regulation in Denmark and Poland and, dependent on the project concept and the routing chosen, in Sweden or Germany. The regulations of those countries will apply just as the project will have to be considered under EU regulation, the Espoo convention on transboundary impact and the HELCOM Convention. The Baltic Sea connection will due to its possible transboundary impacts require an Espoo process subject to the decision and handling by the respective national authorities designated as responsible for compliance to the Convention.

On the economic side, the process of Open Season has been prepared. Open Season is an invitation to the market to make a binding commitment of capacity booking in the Baltic Pipe Project. Also, the feasibility study is a requirement in the process of receiving EU support, in particular support from the Connecting Europe Facility (CEF). The actual commitment for market players will clearly demonstrate the demand and the willingness to pay for the new capacity. This is a key element in the business case.

Thus, the feasibility study shall be regarded as a stepping stone for the future works with the Baltic Pipe Project.