Treasure Chambers of Supply Security

Natural Gas Storage Projects in Germany

GAZPROM GERMANIA



True to its corporate motto “Energy Unites People and Markets”, GAZPROM Germania GmbH, since its foundation in 1990, has successfully been implementing its corporate objective to bring Russian natural gas reserves onto the European energy markets. We have been supporting GAZPROM as the world’s largest natural gas producer and exporter in achieving its strategic goals ever since and are well aware of our special responsibility in the European gas business. As GAZPROM’s German-based subsidiary, we are expanding our business portfolio by developing new projects and opening up new market segments.

For four decades now, Russia has been sustainably supplying natural gas to European countries. Today, millions of German households use this environmentally friendly source of energy as a fuel. In order to fulfil our responsibilities for guaranteeing sustainable energy supply security, we are making investments in the expansion of the natural gas infrastructure, the diversification of transportation routes such as the Nord Stream pipeline through the Baltic Sea and in the exploration of new geological formations which could serve as gas storage facilities such as the structures in Hinrichshagen (state of Mecklenburg-Western Pomerania) and Schweinrich (state of Brandenburg). For this purpose, the underground rock structures are currently being examined for their suitability as strategic natural gas storage facilities. The natural gas capacities stored in such a facility can make a major contribution to sustainably provide the European countries with Russian natural gas.

In the aggregate, we have already made investments in the amount of EUR 4 billion in guaranteeing supply security in Germany and other European countries. To this end, we have entered into strategic partnerships with companies and institutions in different geographical regions. We have representations in more than 20 countries in Europe and Central Asia. We can justifiably say that the GAZPROM Germania Group has become a significant player in the international gas industry.

The dynamic development of our company and the continuous growth of its natural gas sales, turnover, profit and personnel show that we have a sound economic standing. On this solid basis, we intend to gradually further increase our activities along the value chain and consolidate our position. Our programme maintains its validity also in the current crisis. We are convinced that, also in future, Russian natural gas will be associated with supply security for European consumers.

Therefore, we are committed to implementing the projects on the exploration of new storage capacities in Hinrichshagen and Schweinrich as presented in this publication. The construction of gas storage facilities is a challenging, protracted and cost-intensive process in terms of technology and administrative law. For the first stage of development of the Hinrichshagen and Schweinrich structures alone we have earmarked investments in the amount of EUR 20 to 25 million.

Against this background, working principles such as reliability, partnership and responsibility are all the more important for successful project work. I would like to express my sincere gratitude to everyone who assists us with the development of potential treasure chambers. On the following pages, you will find a cross-section of this assistance including selected examples with regard to our corporate partners and other project-related parties. In my view, this will be for the benefit of all of them. Thank you for so much positive energy.

Hans-Joachim Gornig
Managing Director of GAZPROM Germania GmbH

“For four decades now, Russia has been sustainably supplying natural gas to European countries. Today, millions of German households use this environmentally friendly source of energy as a fuel. In order to fulfil our responsibilities for guaranteeing sustainable energy supply security, we are making investments in the expansion of the natural gas infrastructure, the diversification of transportation routes such as the Nord Stream pipeline through the Baltic Sea and in the exploration of new geological formations which could serve as gas storage facilities such as the structures in Hinrichshagen (state of Mecklenburg-Western Pomerania) and Schweinrich (state of Brandenburg).”


"Europe must meet its growing natural gas demand which might increase by 70 Gm³ to 200 Gm³ by 2020. Together with our European partners, we are prepared to meet the future challenges. Europe's energy supply security requires transparency, reliability and dialogue between all parties concerned. GAZPROM is well aware of its responsibility in this respect and prepared to make its contribution."

Alexander Medvedev
Deputy Chairman of GAZPROMS's Management Committee, Director General of Gazprom export LLC

European Energy Demand Will Grow

Guaranteeing European energy supply security is a big challenge and task for the future. Today, everything related to energy attracts higher public interest than in the 1990s. This is not only attributable to increased prices and consumer-related issues. It is also caused by growing environmental pollution as the utilization of fossil fuels emits greenhouse gases, in particular carbon dioxide, which have an adverse effect on the climate.

Environmental and climate protection can be increased, if both the economy and end customers waste less energy. Therefore, the governments of many countries place programmes with a view to both economizing on energy and enhancing energy efficiency in the focus of their policy. However, the progress made in this area is by far not enough to meet the growing energy demand in Germany and the other European countries.

Out of all fossil fuels, natural gas is the most environmentally friendly fuel. For example, a natural gas-fired power station causes 50% less carbon dioxide emissions than a coal-fired power station. The European countries have good reason to consider natural gas in its capacity as fuel a bridge in direction of renewable sources of energy (such as wind power and solar energy). Therefore, the demand for natural gas as a fuel is growing worldwide.

According to forecasts by the European Union, the demand for natural gas will increase by 30% to 50% within the next 25 to 30 years. In the same period, the EU's own natural gas production will decrease from currently 45% to approximately 15%. The world's largest natural gas reserves are deposited in Russia. The Russian GAZPROM Group is the world's largest natural gas producer and the most important gas supplier for the European countries. Over one third of the natural gas consumed in Germany originates from Western Siberia.

Additional Gas Transmission Pipeline through the Baltic Sea

The Nord Stream AG's Baltic Sea gas transmission pipeline project will create a new natural gas transportation system through which Russian natural gas will be supplied to Germany and the other European countries. The pipeline is being constructed by a consortium consisting of GAZPROM, the German companies Wintershall and E.ON Ruhrgas and the Dutch Gasunie. The natural gas will be transported from the Siberian deposits to the town of Vyborg at the Baltic Sea coast and then injected into the Nord Stream pipeline. Covering a distance of 1,200 km, the pipeline will end at the German Baltic Sea coast near the town of Greifswald. From here it will branch off in two directions: in a Western direction to supply natural gas to the Central and Western European countries and in a Southern direction to supply natural gas to the Central and Southern European countries. 55 Gm^3 per annum can be delivered through the Nord Stream pipeline system at its full load capacity, thus becoming one of the large European supply systems of Russian natural gas.

The supply of natural gas coincides with the construction of storage facilities with a view to balancing supply disruptions and seasonal variations in gas demand. In this respect, it is desirable that the storage facilities are located in the near vicinity of pipeline landing points. In connection with the construction of the Nord Stream pipeline, GAZPROM Germania intends to conduct investigations and to provide proof whether selected regions in the states of Mecklenburg-Western Pomerania and Brandenburg are suitable to serve as underground natural gas storage facilities.

An expert opinion prepared by the Moscow-based Scientific Research Institute of Natural Gases and Gas Technologies of GAZPROM established that any gas storage facility in the aforementioned regions must have a storage capacity of at least 2 Gm^3. Underground structures such as those envisaged in the states of Mecklenburg-Western Pomerania and Brandenburg will serve as the basis for the creation of strategic gas reserves.

"In conjunction with the Baltic Sea pipeline, natural gas storage facilities with a capacity of up to 10 Gm^3 are being built in Germany. This volume is equivalent to approximately 10 % of Germany's annual natural gas consumption. The pipeline can make a major contribution to sustainably provide Germany and the Central and Western European countries with Russian natural gas."

Dr. Andreas Hieckmann
Director of GAZPROM Germania's Oil and Gas Projects Department



"The storage of natural gas in deep underground formations has been used as a safe storage method for many decades. By exploring the structure of Schweinrich, GAZPROM Germania has selected geological formations which are most suitable for storing natural gas in the state of Brandenburg. We will be responsible for the permission process required for each development stage from the exploration to the construction of the gas storage facility, including its surface facilities. To provide the public with information on project-related details forms an integral part of the transparent permission process."

Dr.-Ing. Klaus Freytag
President of the Brandenburg State Authority for Mining, Energy and Geology (LBGR)

Natural Gas Storage Facilities are a Prerequisite for Demand-driven Supply

Nature is more than we can perceive with our eyes. Geologists, for example, are capable of discovering underground treasure chambers. Thinking of such treasure chambers, it is mainly diamond and gold mines or crude oil and natural gas deposits that come to mind. But what about underground rock formations underneath an ordinary landscape?

Different supply functions require different types of storage facilities. Cavern storage facilities serve to cover temporary peak loads of natural gas demand, e. g. to balance short-lasting disruptions or fluctuations in consumption. A single cavern storage facility can store gas quantities between 40 Mm^3 and 100 Mm^3.

As distinct from this type of storage facility, a porous rock storage facility is suitable to store large volumes of natural gas as required for balancing seasonal fluctuations of deliveries via the Baltic Sea pipeline. A porous rock storage facility can store some billion cubic meters of natural gas. Hence such facilities are real treasure chambers of supply security.

Porous rock storage facilities are geological rock structures filled either with crude oil, natural gas or water. They are natural crude oil or gas traps tightly covered against the surface by the overlying cap rock consisting of clay or salt. If porous rock storage facilities are filled with water (so-called aquifer storage facilities) the gas tightness of the waterproof cap rock must be tested by well drilling. What nature offers, can be utilized by man. Worldwide, large numbers of porous rock storage facilities have been used for storing natural gas for many years now.

Natural Gas Storage Center Germany

Germany currently operates over 40 natural gas storage facilities with a capacity of approximately 20 Gm^3 of natural gas. Further storage facilities are being planned or constructed. Germany is one of the natural gas storage centers of Europe. The existence of natural gas storage facilities provides supply security for a couple of weeks in the event of delivery disruptions or transit problems with third countries. Thus gas reserves from well-filled German storage facilities could be offered to other countries when Ukraine and Russia were quarrelling over natural gas at the beginning of 2009.

During the past few months, the media have reported about the gas storage issue in great detail. The interested public was informed about the role of storage facilities for guaranteeing energy supply security in Europe and the requirement to construct further storage facilities. In this context, the media also paid increased attention to GAZPROM Germania's storage projects.

The corresponding authorities of the former German Democratic Republic had the rock structures around Hinrichshagen in the Mueritz region already geologically explored as early as in the 1970s. Now the rock formations are again being tested down to a depth of 700 m for their suitability as a natural gas storage facility. Geologists have established that the rock structures around Schweinrich near the town of Wittstock might also be suitable to serve as an underground gas storage facility. However, as there is only insufficient information on this aquifer structure so far, thorough exploration work must be carried out first.

In this place, sandstone located at a depth between 1,300 m and 1,700 m could serve as reservoir rock. The sand which was originally deposited in the ocean was compressed into sandstone over millions of years. As the porosity of sandstone formations however ranges between 15 % and 25 %, they are suitable for storing natural gas. In the course of earth history, the sandstone formations were shaped into large anticlines which provide much space for gas to be stored. Experts regard such sandstone structures as a real gem.

"GAZPROM Germania's long-term storage development projects envisaged for Hinrichshagen and Schweinrich form an integral part of the company's strategic investments into German and European energy supply security. As these projects are receiving wide media coverage, public awareness has been raised regarding the issues concerned. In addition, the projects serve to further demonstrate our responsibility as a reliable natural gas supplier."

Burkhard Woelki
Head of GAZPROM Germania's Corporate Communications Department and Press Spokesperson



"The construction and operation of underground storage facilities are subject to stringent safety regulations with regard to both the equipment and the quality of the underground geological structures. Compliance with these safety regulations is monitored and controlled by the competent mining authority during both the permission process and the entire construction and operation stages. Experience has shown that safe operation of underground storage facilities can thus be ensured."

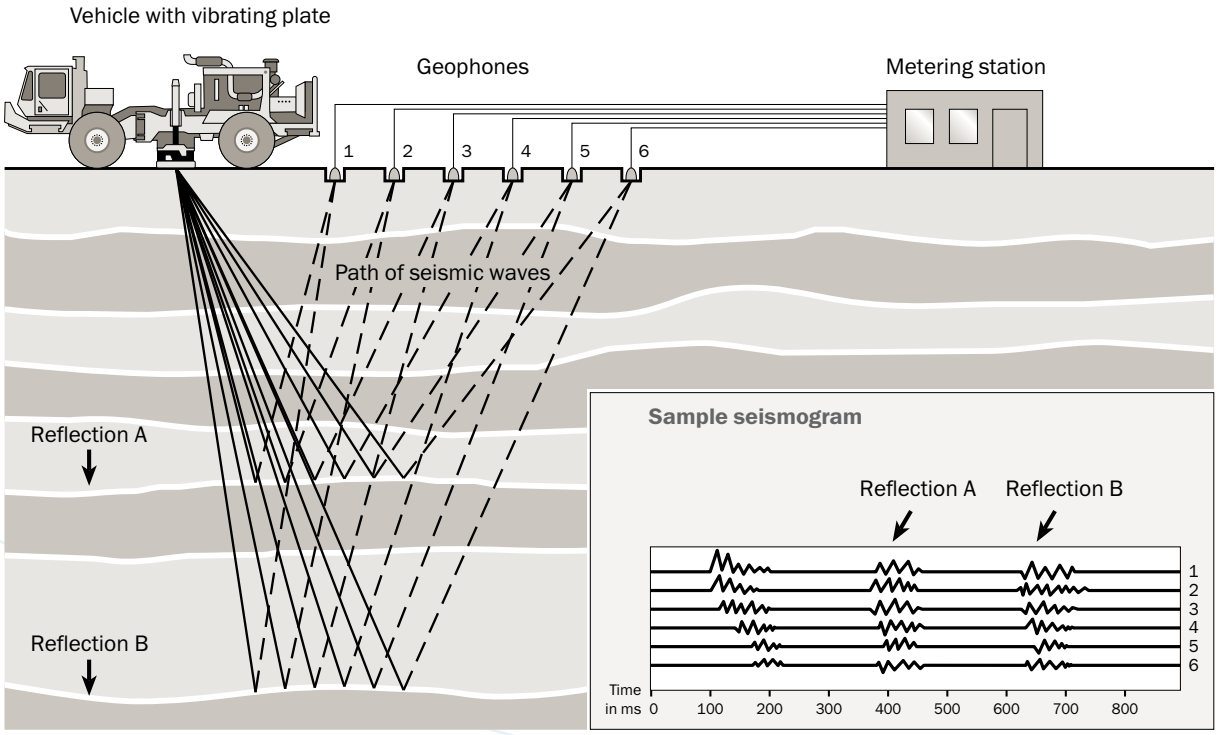
Dr. Falk Ebersbach
Person in charge of the projects at the Drilling Operations and Mine Surveying Sub-Division at the Stralsund-based Mecklenburg-Western Pomerania State Mining Authority

Constructing Natural Gas Storage Facilities is a Challenging Task

Before starting any geological surveying with a view to constructing an underground gas storage facility, a company is required to inform the competent supervisory bodies accordingly, submit general and specific operation plans and comply with stringent safety standards. In order to guarantee that construction work will run in full compliance with statutory regulations, the competent mining authority must issue the required permission pursuant to the provisions of the Federal Mining Act (Bundesberggesetz) first.

Surveying starts with drilling an exploration well into the geological structures selected to serve as an underground gas storage facility. Constructing and equipping a well site per se is a challenging task. In order to obtain drilling permission, the company must comply with rigorous requirements with regard to environmental and nature protection. If exploration well drilling has produced proof that the underground rock structures are suitable to serve as a gas storage facility, seismic measurements are carried out in the area next. Pursuant to the provisions of the Federal Mining Act, the property owners and tenants concerned must be notified about such measurements and their consent must be obtained in advance. Seismic measurements are carried out by lorry-type vehicles equipped with vibrating plates which produce ground vibrations. Similar to an echo, the seismic waves sent down into the earth's crust are reflected back to the surface by certain rock structures. Here, the signals are recorded by geophones and transmitted to a metering station via above-ground cables, thus producing images of the underground rock structures.

Where it is impossible to use lorries, the underground is investigated by using the so-called explosion seismic method. For this purpose, small shot holes, which only have an insignificant impact on the earth's crust, are drilled down to a minimum depth of ten meters and are filled with a small amount of explosive charges. The seismic waves produced as a result of the explosion and reflected (as in the case of vibrations) by certain rock structures are recorded by microphones installed on the surface and transmitted via cable to the metering station. All installations will be completely removed after a short time, and the small shot holes will be plugged. Seismic reflection measurements have no long-term impact on the environment. Should, however, any damage be caused to agricultural land and/or crops, their owners will be fully compensated by GAZPROM Germania.



"The implementation of such a project is of great significance to our region, and I am hopeful that this will create additional jobs. GAZPROM Germania has involved the Mueritz administrative district in the planning process in a transparent manner already at a very early stage. I would like to emphasize that the company notified the general public about its activities in a timely manner, and could thus, as far as possible, gradually eliminate fears and concerns among the public."

Bettina Paetsch
Head of the Mueritz Administrative District Authority

Fresh Impetus Is Given to The Region's Economy

It cannot be denied that both geological surveying and storage facility construction will have a short-term impact on the region. On the other hand, however, a sustainable economic stimulus will emerge from these activities for the benefit of the local population in the medium run. Local companies, as well as companies from the neighbouring regions, will be involved in the construction work. Furthermore, trade, the hotel and catering industries, as well as the service sector, will also benefit from these activities.

Exploration implies technologically challenging work lasting several months. GAZPROM Germania must allocate large funds for this purpose. The company has earmarked up to EUR 25 million for investment in the initial development stage of the Hinrichshagen and Schweinrich storage projects alone.

Once the suitability of the aquifer structure as a natural gas storage facility has been determined, the company can enter the investment decision process. Investment decisions in connection with such a large development project costing hundreds of millions of euro are made by GAZPROM in Moscow. If the decision is positive, the planning process of the storage facilities can commence. The overall planning process comprises the following three stages:

- Drilling of injection and production wells, construction of several well sites;
- Installation of the surface facilities including the technological units of gas separation, dehydration, compression, cooling and volume measurement, and the control station with safety equipment;
- Construction of flow lines between the well sites and the surface facilities, as well as between the connecting pipelines of the surface facilities to the trans-European natural gas transmission pipelines.

How Does a Storage Facility Work?

The design of the surface storage facilities will be adapted to site-specific landscape characteristics. The facilities will be located at a sufficient distance from residential areas. Site construction will only cover the minimum area required. Noise pollution, as well as any adverse effects on water and air, will be kept to a minimum during the operation of the storage facility. Upon completion of the connecting pipeline construction, their routes will be recultivated. These measures are aimed at preserving the value of the region as a tourist destination.

The projects are based on advanced technological concepts combining the efficiency and economic viability of the storage facility with highest safety standards. The natural gas will be injected into and withdrawn from the underground structures through several wells. Injection is performed by means of compressors which guarantee that the natural gas transmitted through the pipelines enters the storage facility at the required pressure. The gas passes through a filtering station where solid and liquid substances are separated. Heated by compression, the gas is subsequently cooled, before it is injected through the wells into the porous rock storage facility.

The gas is withdrawn from the storage facility through the same wells through which it was injected. A control device and compressors produce the gas pressure required for pipeline transmission. Since natural gas stored in an underground facility constantly absorbs moisture, it is dehydrated before transportation in order to avoid corrosion and moisture formation in both the downstream equipment and gas transmission pipelines. After the quantities of natural gas destined for transportation had been metered accordingly, they can be injected into the pipeline system in keeping with the quality requirements.

"We have been constructing underground gas storage facilities for over 40 years now. Furthermore, we have participated in the planning and implementation of various storage projects. Thus, our long-standing experience qualifies us to conclude that underground storage facilities are not only extremely reliable but also very safe, subject to careful exploration, planning and construction."

Dr. Klaus Ziegler
Managing Director of Untergrundspeicher- und Geotechnologie-Systeme GmbH (UGS)



"Close team work and partnership with our contractors is the key to success. Ensuring personal safety and protecting the environment is a top priority for all project-related parties. We do not see any security problems in connection with the military training area in Kyritz-Ruppiner Heide and rule out the possibility of any such problems occurring in the future."

Dr. Klaus Cares
Project Manager at GAZPROM Germania

Safety First

Compliance with all regulations will be fully ensured during both the different project development stages and the operation of the gas storage facility. Appropriate equipment will contribute to prevent water, waste water and air pollution. Any adverse impact on groundwater will be excluded during earth work at the site and drilling operations. All emerging liquid and solid substances will be collected and disposed of pursuant to statutory regulations.

The design of the storage facilities will guarantee virtually noiseless storage operation. As the location was selected with due care, storage facility construction will have no adverse effect on residents.

The compressors used will be driven by electrical energy. The surface facilities will be equipped with a state-of-the-art flow control system, the control systems certified by the German Technical Inspection Association (TÜV) and gas and fire alarm systems. By means of these systems, even the slightest deviations from normal operation can be detected at an early stage, and the facilities concerned will immediately be shut off and locked automatically.

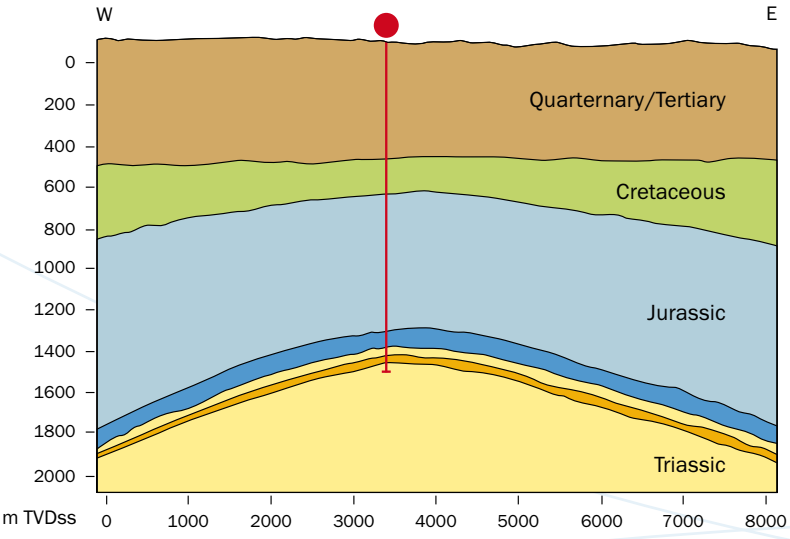
In the event of failure, special safety shut-off valves located at the well sites will seal off the wells on the surface. An additional safety valve will be located at a depth of 30 meters inside the production casing. The storage wells will be monitored and automatically operated from a central monitoring station. In the event of damage, subsurface safety valves ensure that the wells will be automatically locked. The various casings installed inside the well along its entire length and sealed with cement up to the surface will prevent any accidental escape of gas into other rock structures or into the air.

Infrastructure Projects Require Strong Partnerships

Planning and implementing infrastructure projects have become an extremely complex and long-term undertaking. Permission processes and citizen involvement measures require a high degree of readiness to communication and commitment from all parties concerned.

Already at the very beginning of storage project development, GAZPROM Germania was well aware that an intensified dialogue with citizens was crucial to gaining public support in the states of Mecklenburg-Western Pomerania. Thus, information measures were strategically planned well before exploration work started. Since gas storage facilities are of great significance to guarantee energy supply security to the benefit of all consumers, an open dialogue between politicians, authorities and citizens is vital for public acceptance of the projects and their successful implementation.

As safety issues were discussed in great detail with politicians and authority representatives concerns in this respect could be largely eliminated. At the same time, it was pointed out that storage development will open up new economic opportunities as local companies will be involved in the construction process. As a result of this approach, cooperation on the basis of partnership could be established.



"GAZPROM Germania initiated a project-related public forum already at an early stage. A wide range of safety issues were discussed at this forum. I personally have no concerns in this regard and hope that fresh impetus will be given to the region's economy. No doubt, GAZPROM kept its promise immediately upon commencement of the project and commissioned the companies in the region to carry out all work at the well site."

Jörg Gehrmann
Mayor of the town of Wittstock/ Dosse

Schweinrich Structure

Exploration well

Storage horizon



Openness and Dialogue Promote Better Understanding of the Project

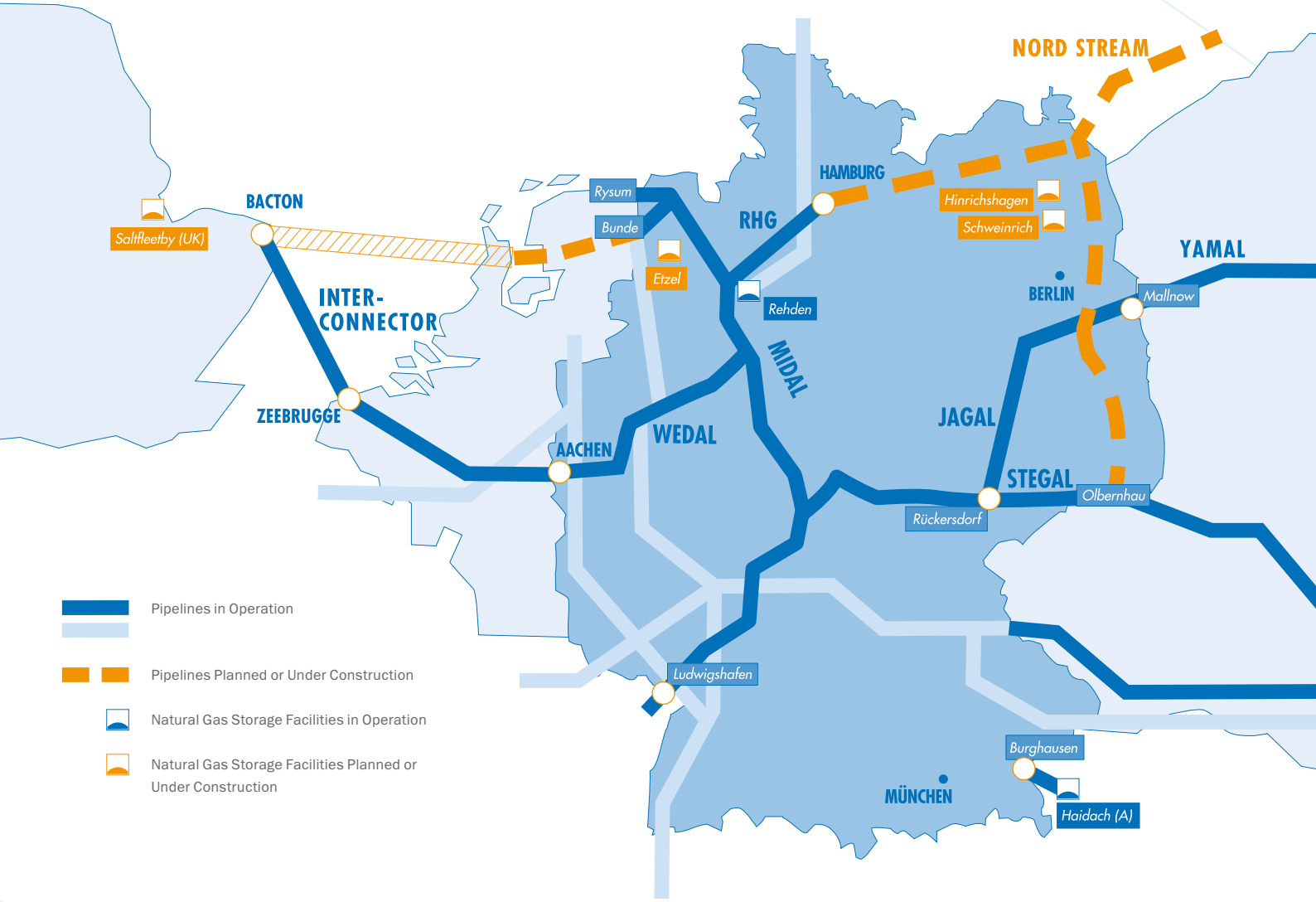
Public awareness campaigns and citizens' meetings were organised in connection with storage project development in Hinrichshagen and Schweinrich long before geological surveying of the potential storage structures started. All residents from the areas covered by geological surveying were invited to attend the project presentation event. The enthusiastic response to this initiative was reflected in the large number of participants and the lively discussions.

In order to give the interested public the possibility to ask questions, GAZPROM Germania has set up a free project hotline, a PO Box and an email address for Hinrichshagen and Schweinrich. Competent personnel are ready to answer any questions the citizens in the region may have. Should any need arise, further measures are planned by the Corporate Communications Department for the duration of the project in order to regularly inform the public about future developments and thus to ensure transparency.

"Local companies will surely be awarded orders as a result of surveying. And should surveying prove successful, the town of Wittstock will be able to improve its image, as so far this region has been negatively associated with the controversy over the bombing training range located here. Should one of the largest gas storage facilities in Europe be built, the region will be associated with such positive subjects as energy resources."

A local resident from the Schweinrich region at the public forum held in Sewekow on 21 January 2009

European Natural Gas Transmission Pipeline System



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