TurkStream

Reliable energy for the future

Contents

TurkStream Gas Pipeline System

The TurkStream pipeline will directly connect the Russian gas reserves to the Turkish network and provide reliable energy supplies for Turkey, as well as South and Southeast Europe. Its offshore section will be developed by South Stream Transport B.V., a wholly-owned subsidiary of Gazprom, and consist of two parallel pipelines running through the Black Sea. Both strings will start near the Russian city of Anapa and end near Kıyıköy, 100 kilometres from Istanbul. The first of the onshore pipelines, connecting to the Turkish network at Lüleburgaz, will be developed by the BOTAŞ corporation. The second line, which will be directed to the Turkish-European border, will be developed by a joint venture of BOTAŞ and Gazprom.

Natural gas: a safe and environmentally friendly choice

Natural gas is the most ecologically friendly fossil fuel we have at our disposal. Easy to store and transport, both affordable and abundant, it is the best and most reliable fuel to complement renewables as part of a sustainable energy mix. Using natural gas instead of oil reduces CO_2 emissions by 20 percent and, when used as a replacement for coal, by up to 60 percent. Natural gas can be used in a range of applications, from heating to transport and from industrial use to electricity generation. Moreover, global gas reserves are estimated to last another 250 years at current consumption rate. As a result, natural gas is the only fossil fuel whose global consumption is expected to rise in a 30-year horizon.

— "The implementation of our Project will strengthen Turkey's energy security for decades to come."

Dr. Oleg Aksyutin,
Chief Executive Officer

Fuelling growth

Natural gas is the most popular fuel in Turkish households, as consumers have had the chance to witness first-hand its practicality, high calorific performance and environmental benefits since Turkey and Russia started gas trade more than 30 years ago. Being familiar with the benefits of natural gas, Turkey is well positioned to make use of this key fuel to cater for its economic growth. TurkStream will improve the country's access to natural gas by reducing reliance on outdated pipelines running through a number of countries before reaching Turkey, making it a direct recipient instead. The pipeline will diversify Turkey's supply routes, alleviating the adverse impacts of disruptions from alternative suppliers and immensely boosting its energy supply security.

The construction of TurkStream will also have positive economic effects as a result of direct foreign investments. The development of the TurkStream infrastructure in Turkey and beyond will support the further modernization of the industry. Along with its economic and environmental benefits, TurkStream pipeline will also make a critical contribution to Turkey's geostrategic significance. Acting as a bridge between East and West, Turkey will become a key supply link for Southeast and South Europe via TurkStream.

Energy availability is one of the cornerstones for economic stability.

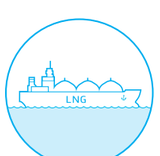
— How much is 31.5 bcm of gas?

The TurkStream Pipeline System can transport 31.5 billion cubic metres of gas each year. But how does it compare to other options?

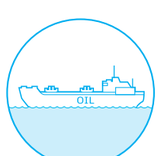
This is enough energy to fully supply 15 million European households.

The power capacity of 126,000 wind turbines.

The energy equivalent of 39 nuclear power units.



The amount of gas delivered by almost 370 LNG tankers.

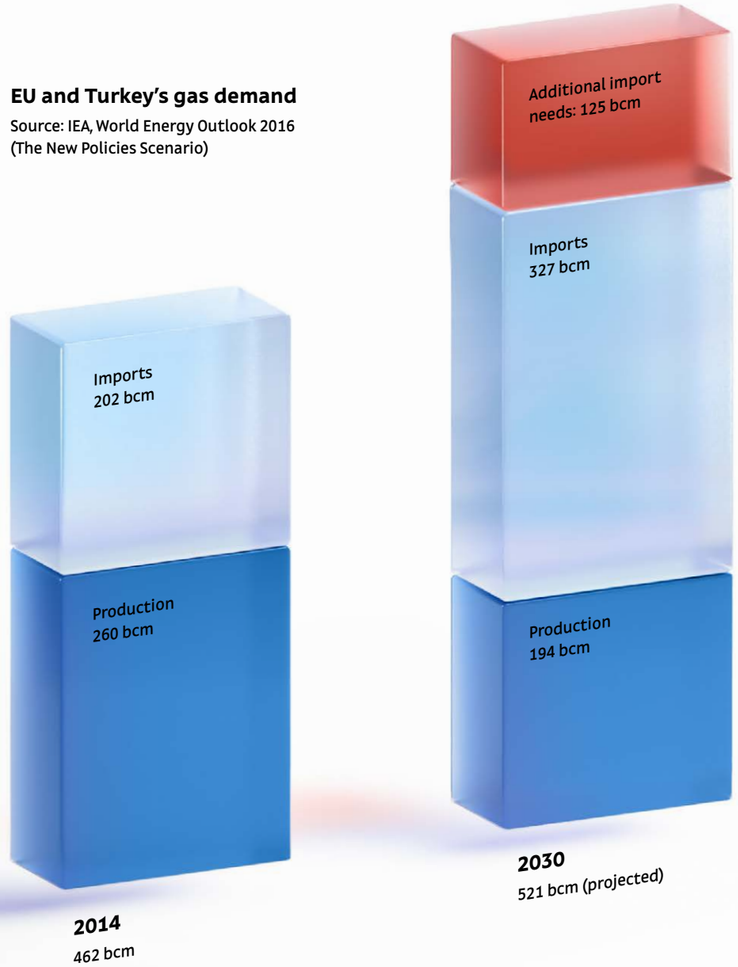


As much energy as delivered by 80 oil tankers.

Securing energy stability in Europe

EU and Turkey's gas demand

Source: IEA, World Energy Outlook 2016 (The New Policies Scenario)



Europe's domestic gas production declines, increasing the demand for new supply routes.

— "We have brought together the best international experts to construct a safe and reliable offshore gas transportation system."

Jay Chauduri,
Offshore Project Manager

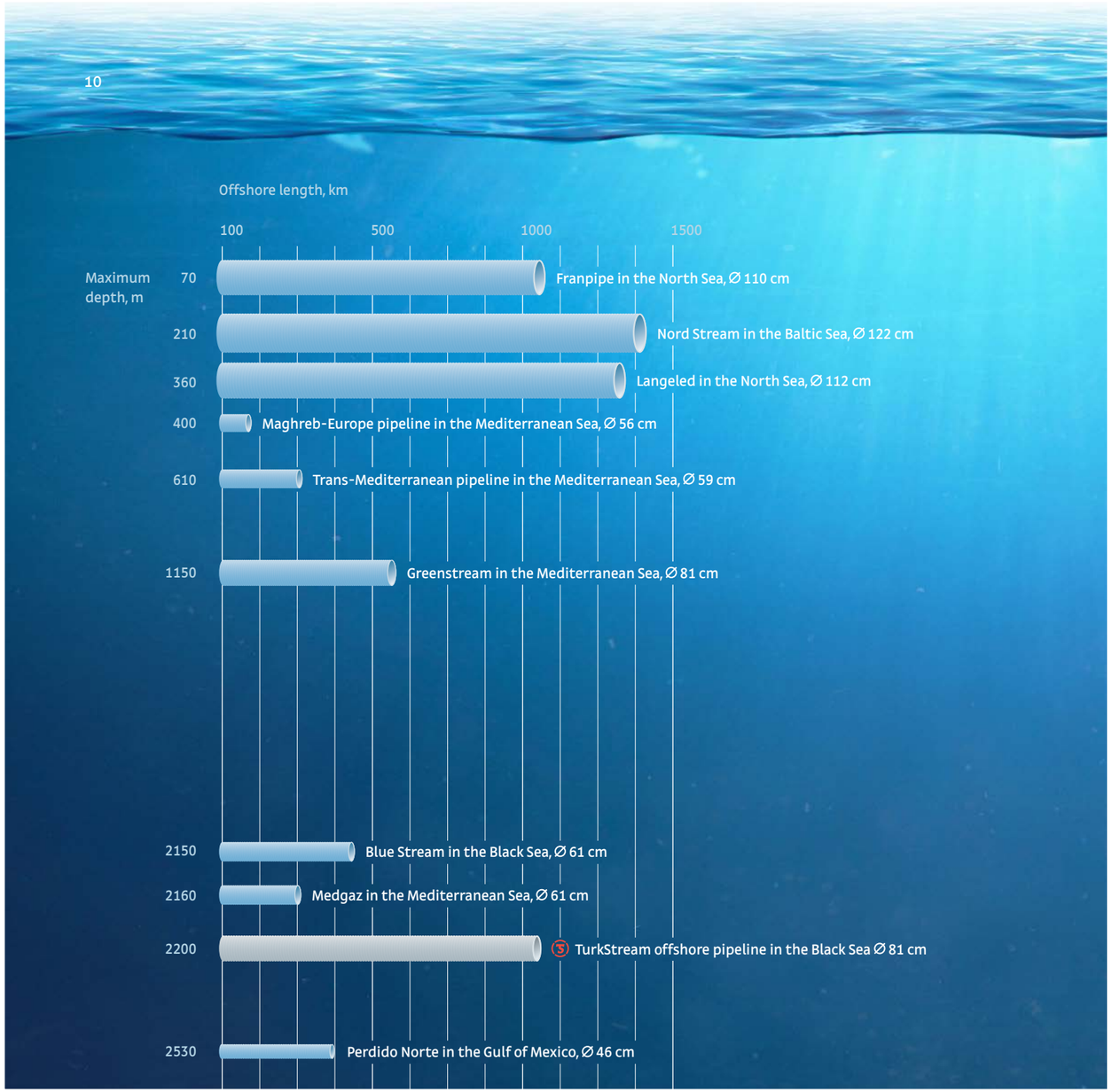
The International Energy Agency projects that as Europe's gas consumption rises and domestic production drops, annual gas imports by the EU and Turkey will rise by some 100 bcm by 2030. Therefore, the region needs new supply sources and routes to safeguard its energy future. Several pipelines already transport gas directly to Northwest and Eastern Europe from Norway and Russia, while Southeast Europe is still poorly connected to the regional gas grid. This region is in need of an environmentally friendly fuel to underpin its green energy transition. TurkStream will decrease the reliance on coal, and provide the backbone of many new energy projects in development to expand the European gas grid.

Supplying energy for the future

Gazprom takes its responsibility as a reliable gas supplier very seriously and has always fulfilled its contractual obligations. Its Nord Stream pipeline provides uninterrupted gas flow to Germany and other European countries, and the Blue Stream pipeline, established in 2003, enables direct gas supplies to the eastern part of Turkey. The western part of Turkey, however, as well as a number of European countries, relies on the older pipeline system which runs through Ukraine.

Over the past 20 years, the lack of investments and modernization has affected the system's reliability, posing a threat for the countries that rely on it. The TurkStream Project will address this issue, while providing a direct connection to the Russian gas reserves and allowing to transport 31.5 billion cubic metres of gas each year.

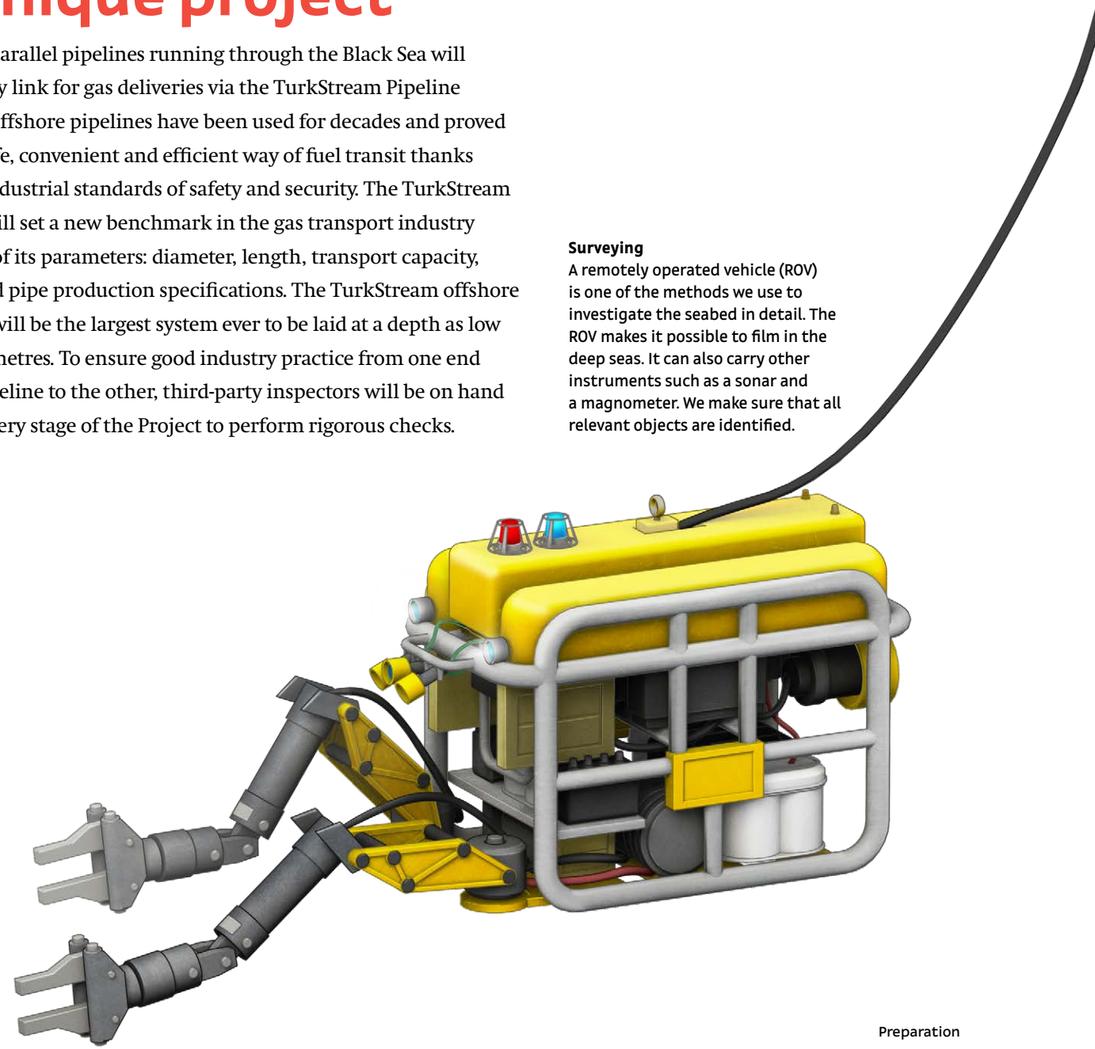
Modern pipeline systems like TurkStream will secure Turkey's gas supply for decades to come.



A unique project

The two parallel pipelines running through the Black Sea will form a key link for gas deliveries via the TurkStream Pipeline System. Offshore pipelines have been used for decades and proved to be a safe, convenient and efficient way of fuel transit thanks to high industrial standards of safety and security. The TurkStream System will set a new benchmark in the gas transport industry in terms of its parameters: diameter, length, transport capacity, depth and pipe production specifications. The TurkStream offshore pipeline will be the largest system ever to be laid at a depth as low as 2,200 metres. To ensure good industry practice from one end of the pipeline to the other, third-party inspectors will be on hand during every stage of the Project to perform rigorous checks.

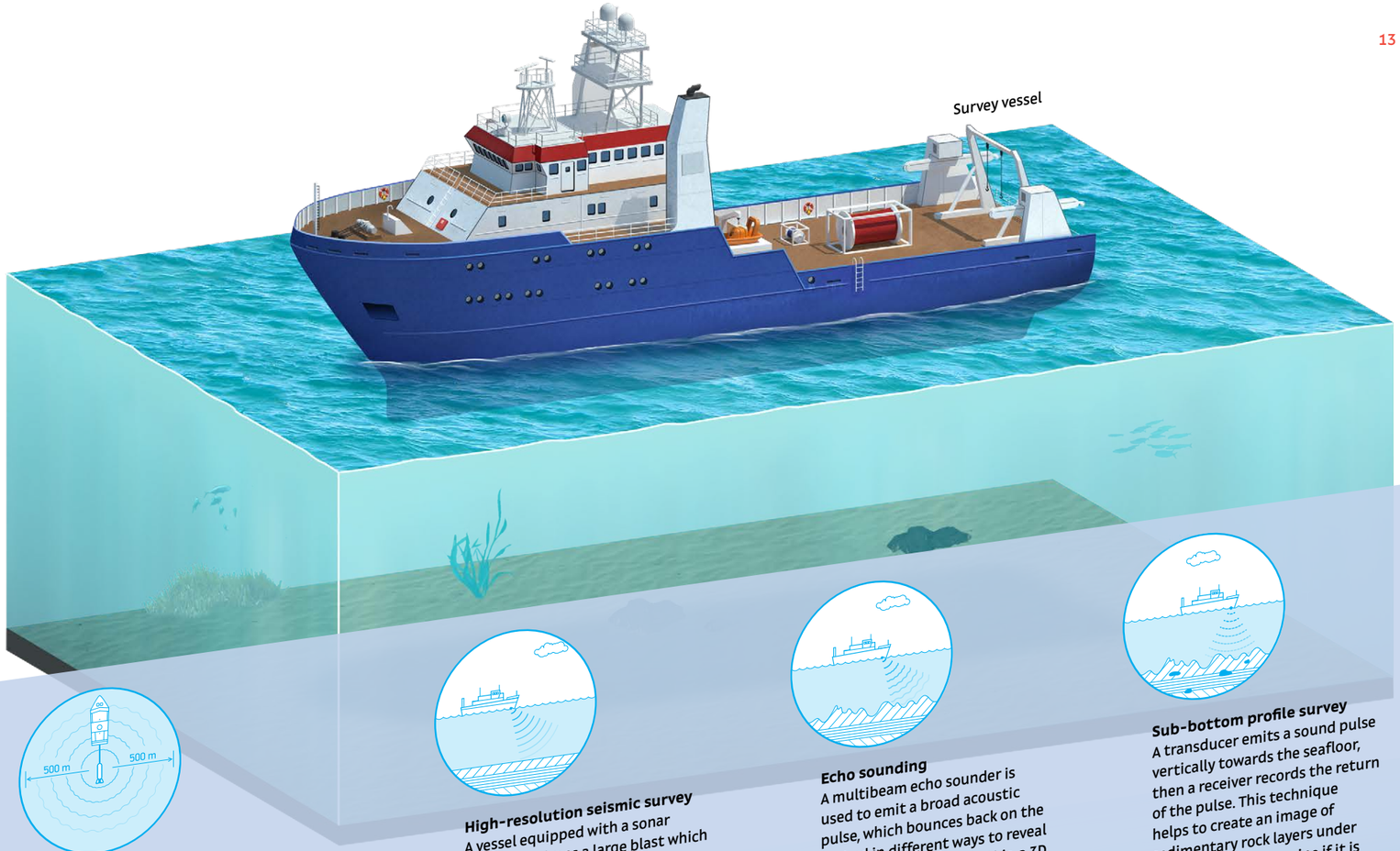
Surveying
A remotely operated vehicle (ROV) is one of the methods we use to investigate the seabed in detail. The ROV makes it possible to film in the deep seas. It can also carry other instruments such as a sonar and a magnometer. We make sure that all relevant objects are identified.



Identifying the best route

Thousands of kilometres of offshore surveys have been performed to find the most suitable path to lay the pipeline across the Black Sea. The Anapa–Kıyıköy route has been chosen based on the data compiled in extensive surveys, both onshore and offshore, where engineers have created a detailed profile of the seabed and analysed different soil types.

The Black Sea, which will host TurkStream for more than 50 years, offers its peculiar advantages and challenges. Due to high levels of hydrogen sulphide, there is little to no oxygen below depths of 100–200 metres, which means that there is virtually no life in deep waters, minimizing the potential environmental impacts of the Project. However, the seabed suddenly plunges from about 80 to over 1,500 metres deep at the continental shelf break, creating a considerable technical challenge for the pipeline route. Techniques such as mass flow excavation or peak shaving with a subsea rock cutter will be used to ensure stability on the bottom of the sea for the pipelines along this difficult stretch.



Advanced subsea surveys

Seabed samples
A range of different techniques is used to take samples from the seabed at different depths. The soil is then analysed in the laboratory to determine if the seabed is suitable for pipeline laying.

Side-scan sonar survey
Used to create an image of large areas of the seafloor by scanning left and right with a 500-metre range for any possible obstacles near the route.

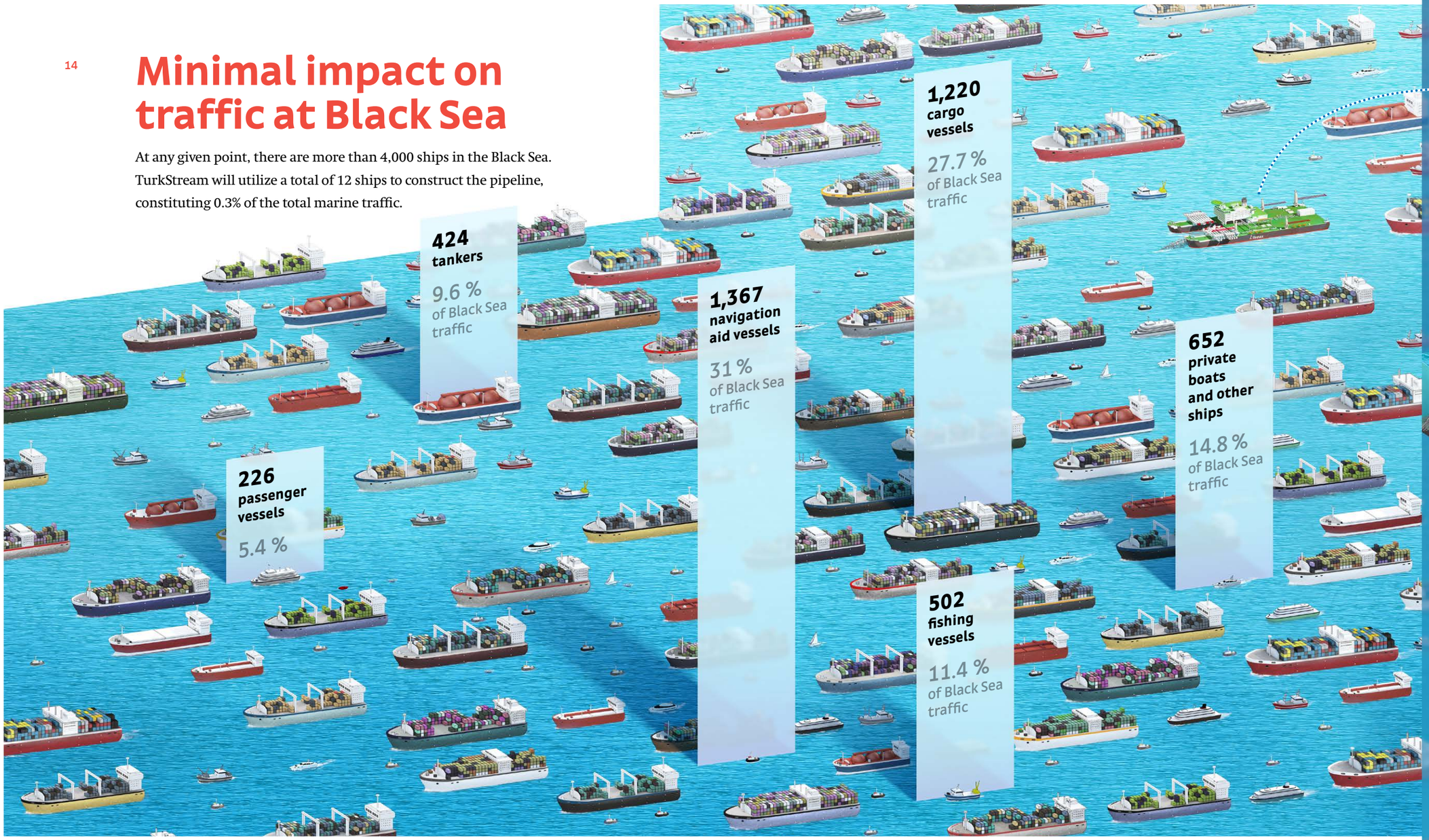
High-resolution seismic survey
A vessel equipped with a sonar system produces a large blast which hits the seabed and propagates under the surface. Surveyors analyse the return pulse to build up a subsea soil acoustic image. This helps to analyse different soil layers of the seabed and is especially helpful in areas were the pipeline will be buried.

Echo sounding
A multibeam echo sounder is used to emit a broad acoustic pulse, which bounces back on the seabed in different ways to reveal the seabed profile. From this, a 3D model is formed which shows the depth of the water and the shape of the seabed.

Sub-bottom profile survey
A transducer emits a sound pulse vertically towards the seafloor, then a receiver records the return of the pulse. This technique helps to create an image of sedimentary rock layers under the seabed to determine if it is suitable for pipeline laying.

Minimal impact on traffic at Black Sea

At any given point, there are more than 4,000 ships in the Black Sea. TurkStream will utilize a total of 12 ships to construct the pipeline, constituting 0.3% of the total marine traffic.



12
Turkstream vessels

0.3%
of Black Sea traffic

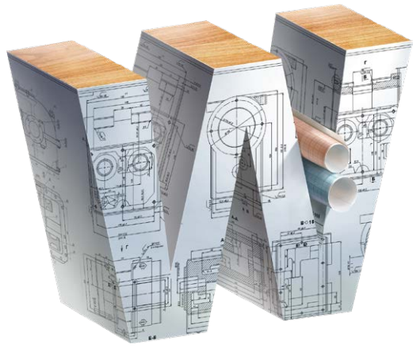
2
pipe-laying vessels

7
supply and support vessels

3
survey, rock-placement and dredging vessels

Sharing the sea with fisheries

The nearshore construction activities include dredging and pipe laying. There will be a safety zone around construction vessels to avoid interaction with other vessels, but fishing activities can continue as normal outside of this safety zone. We are engaged in a continuous dialogue with local authorities and fishing cooperatives to share information about ongoing construction and to avoid any disturbance to fishing activities. The harbours in Anapa and Kıyıköy will remain open and can do business as usual.



With its capacity of delivering 31.5 bcm of natural gas from Russia, TurkStream will ensure stable long-term energy supplies for Turkey and Europe alike.

The Environmental Impact Assessment

With a thorough design and assessment process, we seek to minimize any impact on the environment and communities. We implement mitigation measures to support its safe construction.

The Russian sector of the pipeline is being developed entirely in line with national permitting requirements to ensure that both onshore and offshore sections of the pipeline are assessed from an environmental perspective. Communities in the Anapa region along with non-government organisations and other interest groups have been engaged in these assessments, and their feedback has been used in the development of the Project.

— "We actively consult stakeholders throughout our project. Their views are valuable to us when we develop measures to minimize our impact."

Elvan Batan,
Environmental Expert

The Environmental Impact Assessment (EIA)

Baseline research
Experts conduct surveys on land and at sea to document what the current environment looks like, so we know what to consider in the design and construction of the pipeline. This also gives a clear baseline to monitor the changes in the environment after construction is completed.

Stakeholder feedback
The preliminary results of the baseline studies are published to receive feedback. In accordance with Turkish procedures, all the topics which will be considered in further research are summarised in the EIA Application File.

Impact assessment
A thorough study is conducted to assess the effects of the planned pipeline on the environment. It includes onshore and offshore ecology, potential archeological findings, social and economic topics.

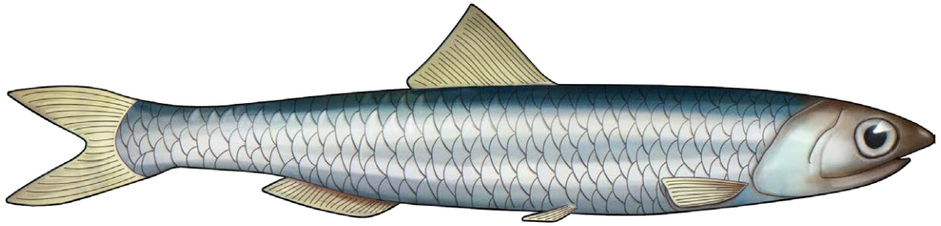
Mitigation and protection measures
In case the studies show that the pipeline construction or operation may have a significant negative effect on the environment, special mitigation measures will be taken. Examples include the restoration of the beach or planting new trees to compensate for those that were cut down.

Publication of EIA Report
The impact assessment and all mitigation measures are published in the Environmental Impact Assessment Report and other documents. People can submit their feedback on the report to be considered in the development of the Project.

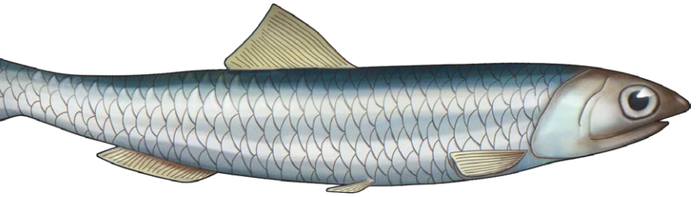
Construction & monitoring
Construction of the pipeline can only take place after the EIA Report has been approved by the Turkish Ministry of Environment and Urbanisation and all permits have been granted. After the pipeline is built, the area will be regularly checked to ensure that flora and fauna remain in good condition.

The Environmental Impact Assessment (EIA) in Turkey has taken into account local environmental conditions, communities and overall pipeline safety in the development of the TurkStream Offshore Pipeline to minimize the impact of the Project.

A number of activities are conducted in order to ensure that the construction works will not have any lasting effect on the environment.



Black Sea adult anchovies
can reach a length of 12 to 15 cm

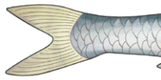


Anchovy

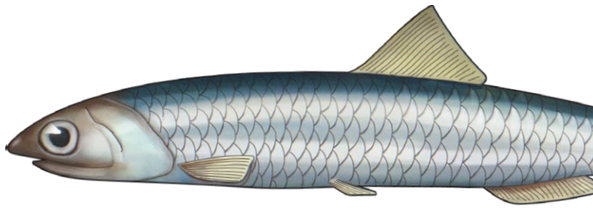
Anchovies are an important stock for the Turkish fishing industry, migrating around the Black Sea in large schools. We strive to avoid that anchovy populations are affected by pipeline construction. A fisheries study conducted in 2014 with the help of fishery cooperatives and academic experts showed that the offshore pipeline is unlikely to impact fish migrations or fish populations. Our Environmental Impact Assessment indicates that near shore, dredging activities might have impact. We will issue further studies to minimize the impact on fishing stocks during construction.

Cultural heritage

South Stream Transport is one of the first companies ever to survey the entire Black Sea bed in a 500-metre corridor from east to west. These surveys have helped find a number of sites and objects of potential cultural importance, including shipwrecks that may date as far back as the late Byzantine period (11–14th century). Due to low levels of oxygen, artifacts found at the bottom of the Black Sea are often well preserved. For example, an ancient amphora was discovered in Russia and carefully recovered for further study and preservation. Apart from a crack, the amphora remains well preserved, even though it is over 1300 years old. The pipeline route has been adjusted to avoid such sites, allowing continued preservation.



An amphora is an ancient Greek or Roman jar, commonly used to carry oil or wine.

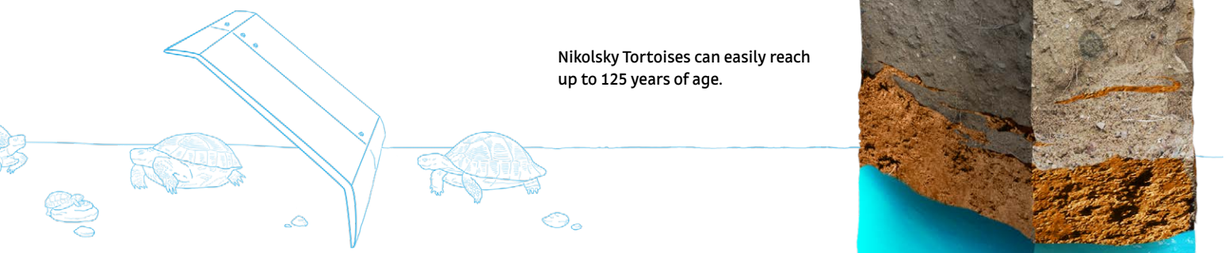


Juniper trees

Juniper trees are among the endemic species of the Russian landfall area that the Project took special care to preserve. A survey was conducted in December 2013 to find and record the coordinates of protected plants within the construction area. In total, over 200 plants were tagged by a special field team. These were then carefully dug out and translocated to another area. Special attention was paid to their size and orientation towards the sun to ensure they were planted properly.

Nikolsky Tortoises

Environmental studies in Russia have demonstrated that special attention needs to be paid to a number of protected species, including the Nikolsky Tortoise population. The Nikolsky Tortoise is included into the IUCN Red List of Threatened Species and the Krasnodar Region is the only place on earth where they live. Ecologists have carefully moved the tortoises from the construction site in special bags. Furthermore, a special fence was built to ensure that turtles can safely leave the area, but cannot return while the construction is underway. After the construction is completed, the fences will be removed and the tortoises will be able to inhabit the area again.



Nikolsky Tortoises can easily reach up to 125 years of age.

Combining strength and precision

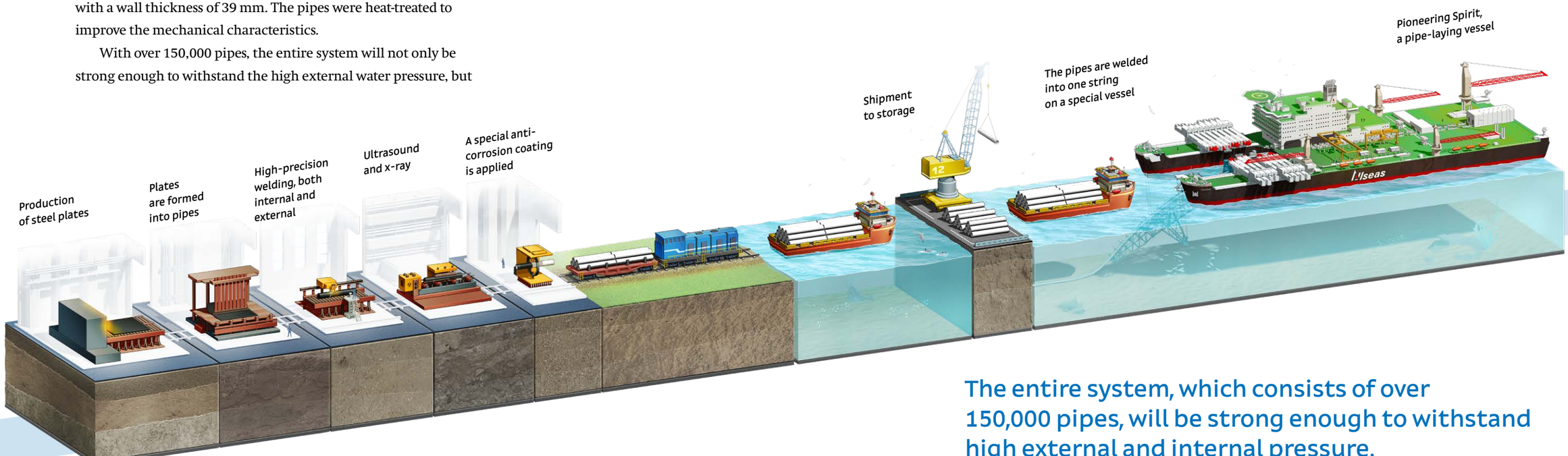
The TurkStream Offshore Pipeline will consist of two parallel pipelines, each constituted of 75,000 individual 12-metre pipe joints, with the total length of 930 kilometres. Each pipe is designed, manufactured and tested to withstand the challenges posed by the deep-sea environment.

Using the latest techniques in steel production and high-precision pipe manufacturing, our engineers designed strong pipes with a wall thickness of 39 mm. The pipes were heat-treated to improve the mechanical characteristics.

With over 150,000 pipes, the entire system will not only be strong enough to withstand the high external water pressure, but also to resist an internal design pressure of 300 bar, thus enabling the safe and reliable transport of large volumes of natural gas.

Throughout production, the pipes are repeatedly measured and inspected via ultrasound and x-ray scans to ensure precision and rule out defects. Each pipe is then hydrotested, i.e. filled with water at a high pressure to verify that it is genuinely strong enough to form a part of the TurkStream Offshore Pipeline. In addition to experienced factory supervisors, third-party inspectors examine and certify the quality of the pipes.

After production, individual pipes are brought to storage yards on the coast, and from there to the pipe-laying vessel.

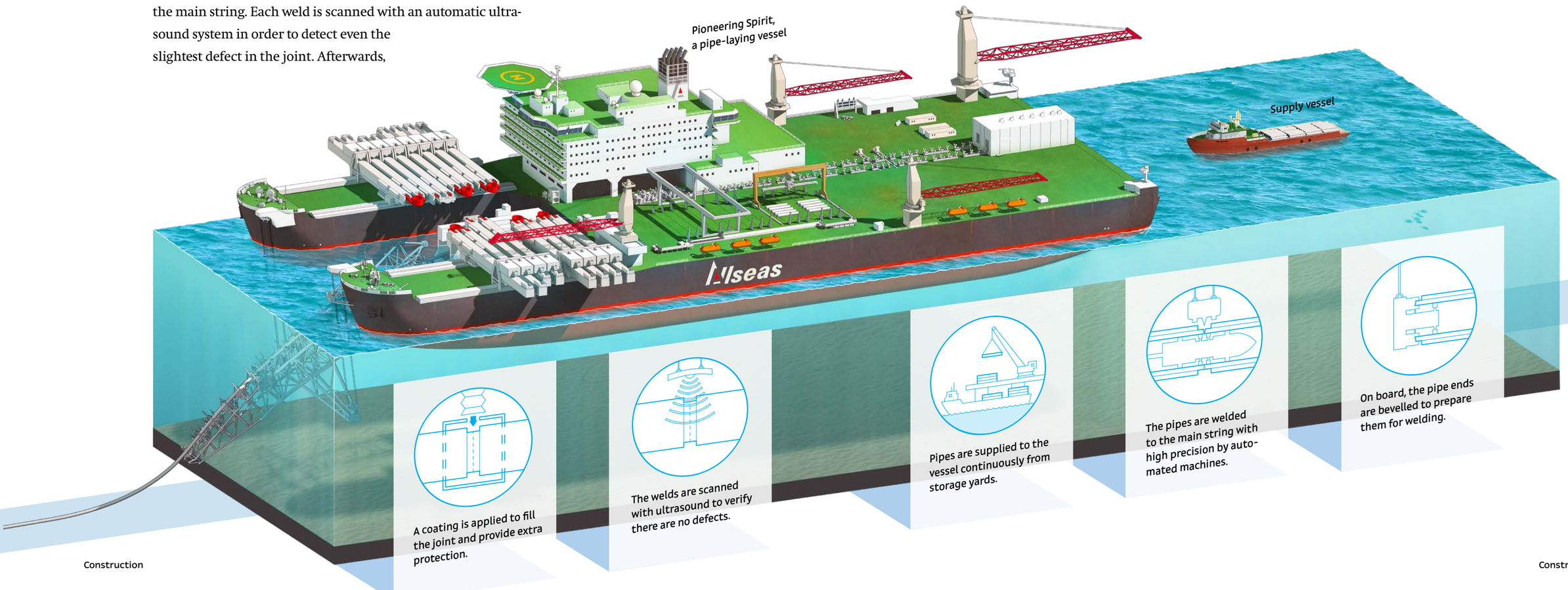


The entire system, which consists of over 150,000 pipes, will be strong enough to withstand high external and internal pressure.

Construction at sea

The offshore section of TurkStream Pipeline System is constructed by Pioneering Spirit, the largest construction vessel in the world.

Onboard Pioneering Spirit, the pipe joints are welded onto the main string. Each weld is scanned with an automatic ultrasound system in order to detect even the slightest defect in the joint. Afterwards, polypropylene coating will be applied on the welded area for protection against external corrosion. The welded, coated and tested pipeline section is then lowered into the water. Pioneering Spirit traverses the Black Sea adding new sections to the pipe string as it moves, laying up to 5 kilometres of pipeline each day.

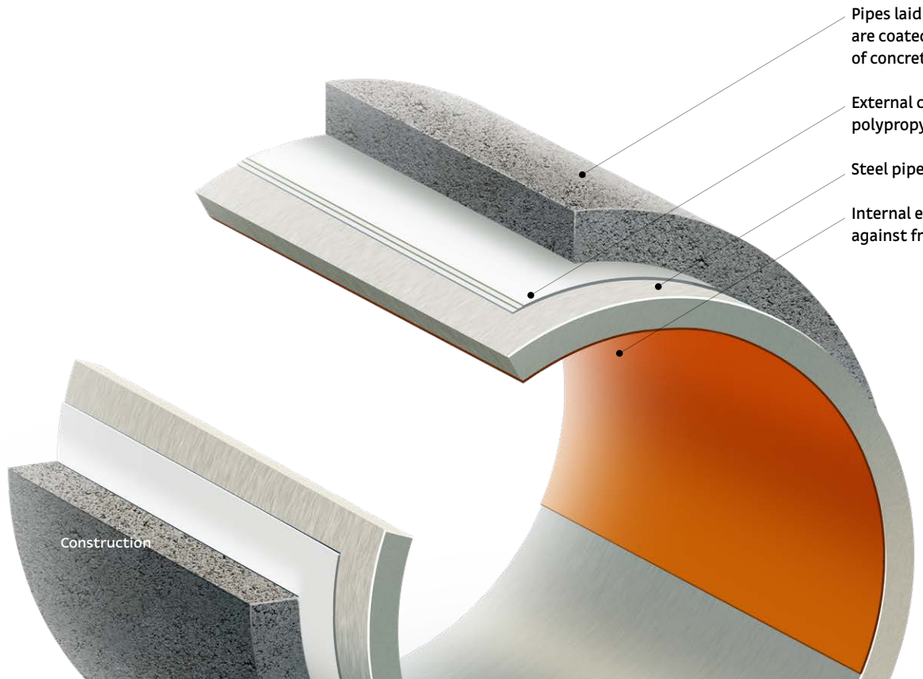


Stringent safety and certification

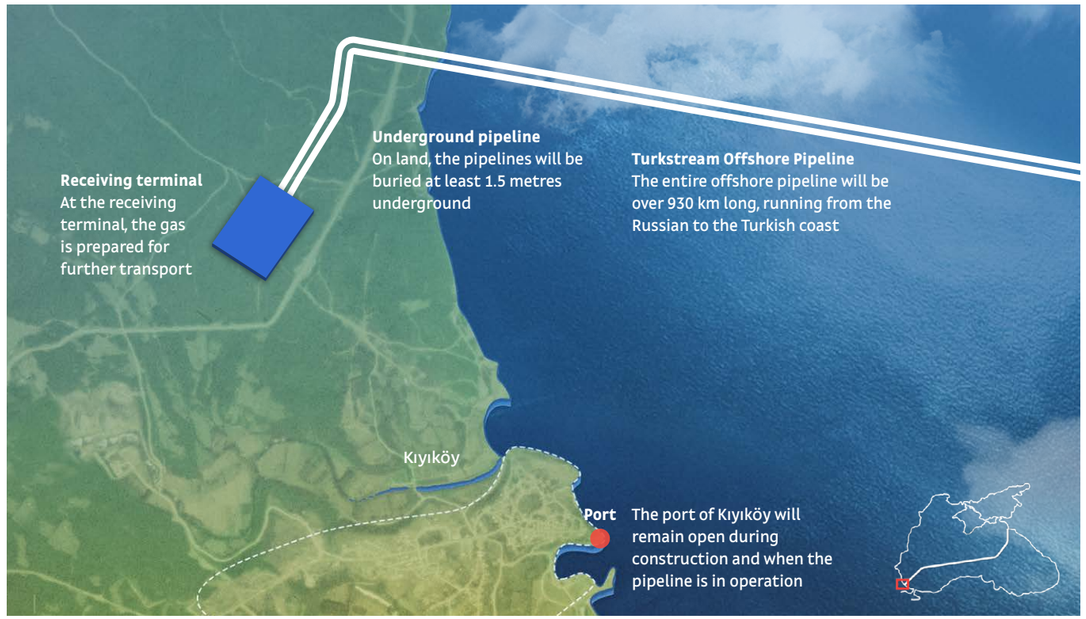
From the design phase right through pipe production and construction, we are working with experienced engineers and international specialists to ensure the TurkStream Project is realised in accordance with pipeline industry standards. Our comprehensive risk analysis and hazard identification as well as our detailed inspection and maintenance systems will ensure that the gas pipeline meets international safety standards during its entire lifecycle. We will use safe and proven technology, as well as state-of-the-art materials and equipment, to guarantee safe operation for several decades.

— "We have stringent safety measures in place to guarantee the safety of our staff, our contractors and communities surrounding our facilities."

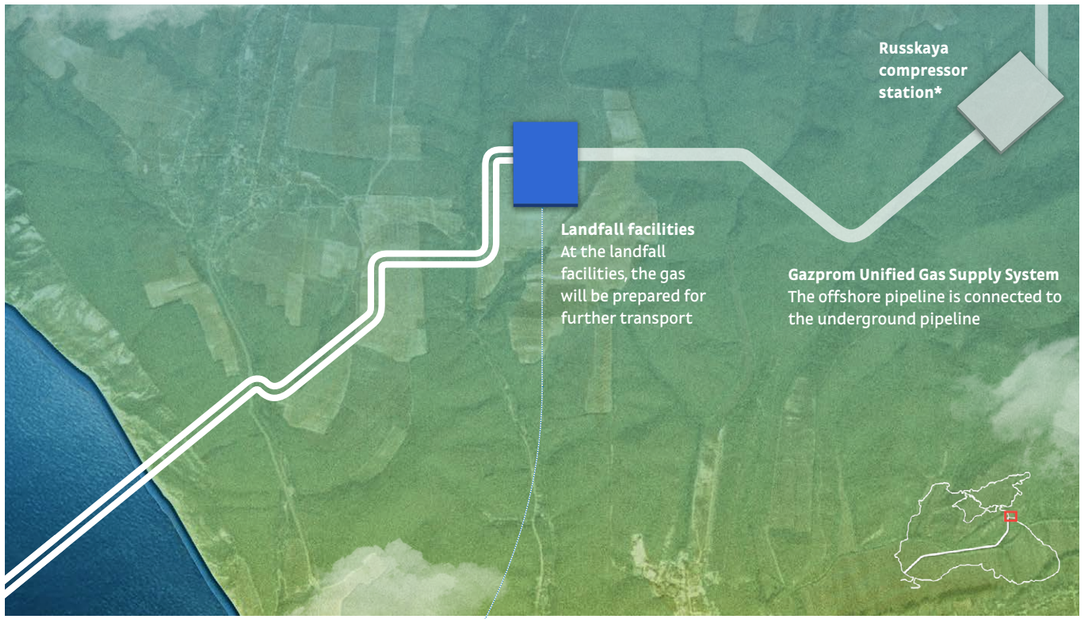
Umut Yoldas,
HSSE Expert



Construction



We aim to construct the pipeline with as little impact on the environment and the community as possible, following Turkish and international standards for health, safety and the environment. Kıyıköy is to remain a beautiful and flourishing community. We will take a number of measures during construction to ensure this, ranging from traffic management to planting new trees around the receiving terminal. The pipelines will not be visible while in operation, while the receiving terminal will be visible from some vantage points.



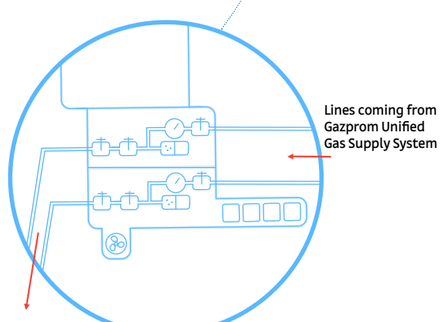
Maintenance and staff buildings, control room

Entry point for Pipeline Inspection Gauge (PIG)

Venting tower (in case gas release is required)

Shut-down valves

Metering equipment



***Russkaya compressor station**
One of the most powerful compressor stations in the world, providing enough pressure to pump up 31.5 billion cubic metres of gas through the TurkStrream Pipeline.

Approaching land

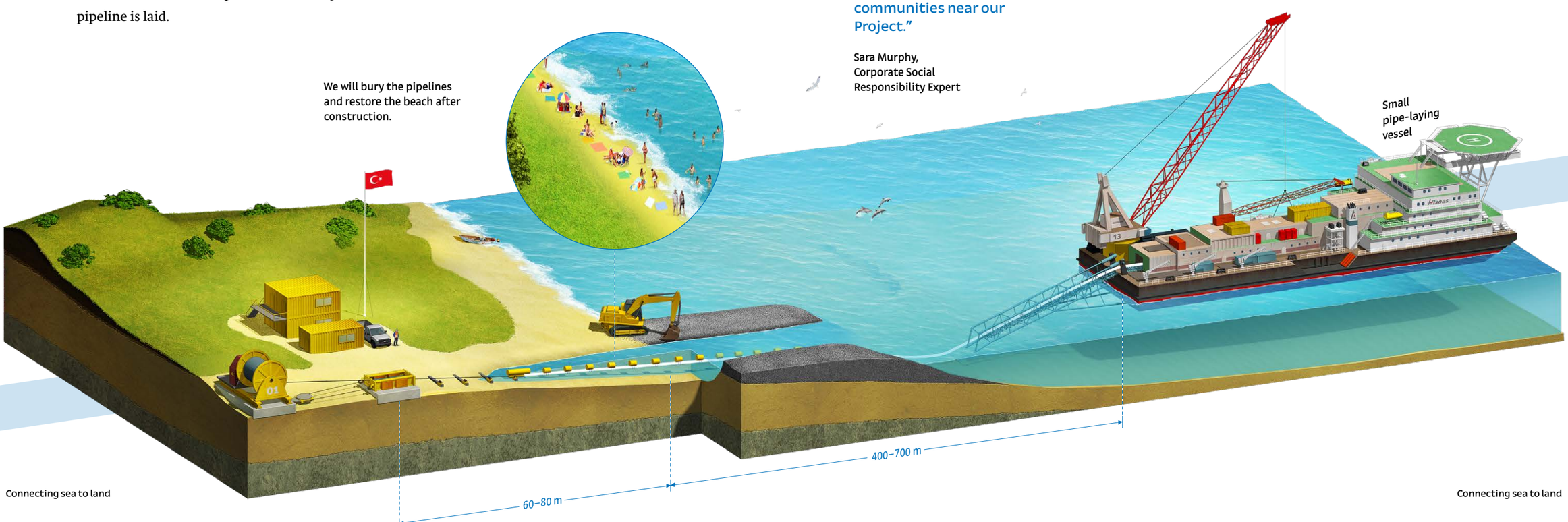
For most of the offshore route, the pipelines will rest deep at the bottom of the Black Sea. But in shallower coastal waters there can be a stronger current on the sea bottom, in addition to potential disturbances from anchors or fishing boats. For added protection at these locations, we coat the pipeline in 5 to 8 cm of heavyweight concrete. Moving even closer to the shoreline, sections of the pipeline will be installed in trenches under the seabed. Trenches will be at least 1.5 m deep and are carefully covered after the pipeline is laid.

— "For our community investment program, we engage with local stakeholders to find opportunities that contribute to communities near our Project."

Sara Murphy,
Corporate Social
Responsibility Expert

Landing in Kıyıköy

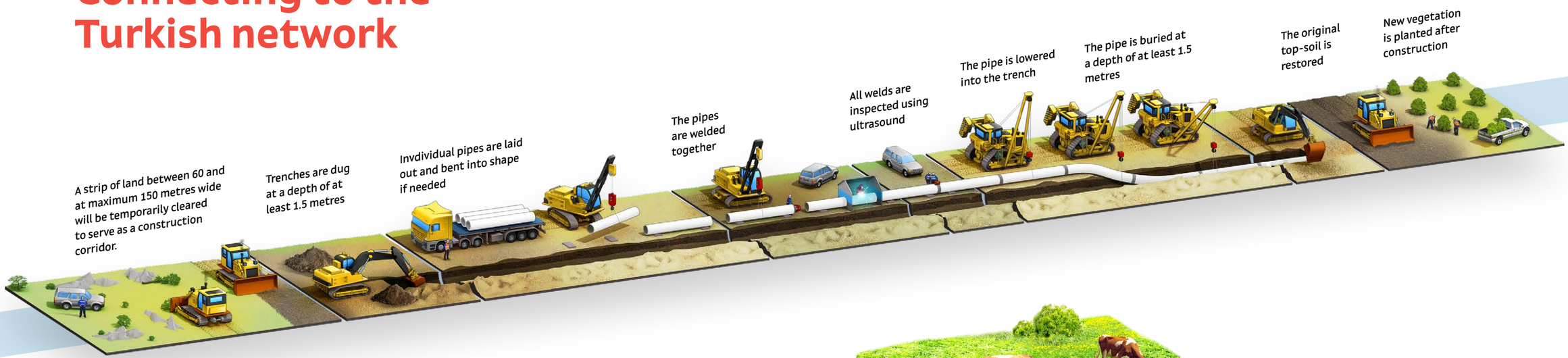
When both shore-crossing sections and the subsea stretch of the pipeline are complete, the separate components are welded together using a so-called above water tie-in procedure. When coming to land in Kıyıköy, the pipelines will cross the shore using an open-cut technique. This will involve digging a trench and then laying and burying the pipeline. The beach will be restored, making the pipeline invisible for visitors.



Connecting sea to land

Connecting sea to land

Connecting to the Turkish network



On land, a short underground pipeline will connect the offshore pipeline to the receiving terminal. The chosen area is located 2 km north of Kıyıköy. At the receiving terminal, we monitor the temperature, pressure and composition of the gas flowing in from the offshore pipelines. Special safety valves are in place that automatically shut off the gas flow if needed. The terminal connects to two underground pipelines, one to Lüleburgaz, where the gas is fed into the Turkish distribution grid, and the other all the way to the Turkish-European border.

It will be necessary to cut shrubs to be able to lay the onshore section of the pipeline and to build the receiving terminal. Therefore, we will initiate a replantation program in order to minimize the visual impact of the project.

The receiving terminal

The terminal in Kıyıköy receives the incoming gas from the offshore pipeline. Firstly, the volume of gas is measured. Secondly, the gas is pressure controlled and heated to transfer it further into the onshore pipeline.

The receiving terminal will be set up within an area approximately 300 × 450 metres in size, and will be designed and built in accordance with internationally recognized health, safety, security and environmental standards. We aim to develop the receiving terminal with the least possible visual impact.

Pipeline inspection gauge

The pipe will be regularly inspected from the inside by running pipeline inspection gauges, or PIGs, through it. The PIGs will enter the pipeline at the Russian landfall facilities and be propelled by the gas flow towards the landfall facilities near Kıyıköy, where they will be removed via special PIG receivers. Critical sections of the pipeline route, including slopes, trenches, anomalous seabed areas and the continental shelf break, will be surveyed more frequently: first annually, and then as often as necessary based on monitoring results.

— "The pipes will receive a thorough inspection after production, but we will also actively monitor the pipeline system when it's in operation."

Erol Yazici,
Construction Lead
(Turkish section)

Central control for safe operation

Offshore gas pipelines are an inherently safe means of transporting energy: large-diameter pipelines have been operating safely since as far back as the 1950s. We aim to maintain this record through stringent monitoring of our offshore pipeline.

Day-to-day operations of the TurkStream Offshore Pipeline will be managed from a central control room in Amsterdam, the Netherlands. This system will be connected to the landfall sites in Russia and Turkey, where the underwater and onshore sections of TurkStream meet. The landfall sites feature metering equipment, Emergency Shutdown (ESD) valves, block valves (three per pipeline), fire and gas detection systems and other auxiliary systems for safeguarding the stability and safety of gas transport. Two independent communication links will connect the equipment in Russia and Turkey with the central control room, and a satellite link will provide a backup. In addition, a fully-functional centre will be established at a nearby location to take over in case of unforeseen problems.

The pipeline will be monitored from a control room, similar to this one used for the Nord Stream Pipeline. Image courtesy of Nord Stream AG.

High-pressure gas transport

When fully operational, each of the two offshore pipelines can transport up to 15.75 billion cubic metres of gas per year — 31.5 bcm in total. This is the equivalent of more than 40 million cubic metres of gas flowing through each pipeline per day.
The pressure required to transport these vast amounts comes from the Russkaya compressor station in Russia, which is built and operated by Gazprom. The pipeline is built to withstand an internal pressure of up to 300 bar, called the 'design pressure'. However, the actual operating pressure will be somewhat lower to allow for an additional safety margin. At the inlet in Russia, gas is pumped in with a maximum pressure of about 284 bar. The offshore pipeline operates without any interim compressor stations, so the pressure drops steadily during the 930–kilometre journey. Once it reaches the Turkish landfall facilities, the operational pressure is less than 100 bar.

Secure energy for Turkey and Europe

The TurkStream Pipeline System brings along vital benefits to Turkey and Europe. Building on decades of successful energy cooperation between Russia, Turkey and Europe, TurkStream will:

— cater for Turkey's economic growth, which implies growing energy needs;

— boost Turkey's strategic position as important gas transit country;

— increase Turkey's energy supply security by diversifying gas supply routes;

— tap into Russia's vast reserves through a direct pipeline that will make Turkey the first rather than the last in line to receive gas from the supplier;

— improve access to a clean, affordable and abundant fuel in Turkey and Southeast Europe.

Find out more

We hope this brochure will help you learn more about the planned TurkStream pipeline, which will carry gas across the Black Sea from Russia to Turkey. Here you will find information on why the pipeline is needed and how it will be built. If you have any questions or comments upon reading this brochure, you can reach us directly via e-mail or post:

www.turkstream.info
contact@turkstream.info

South Stream Transport B.V.
TurkStream Project
Parnassusweg 809, 1082 LZ Amsterdam,
The Netherlands

TurkStream