

**Millions of
Europeans put
their trust in
Gassco every
single day.**

	<p>04</p> <p>A UNIQUE AND WELL- FUNCTIONING TRANSPORT SYSTEM</p>		<p>06</p> <p>HOW GASSCO HELPS TO BOOST THE COMPETI- TIVENESS OF NORWEGIAN GAS</p>
	<p>08</p> <p>THE GAS JOURNEY</p>	<p>10</p> <p>ROUTING GAS THE RIGHT WAY</p>	
<p>14 INDUSTRIAL FACILITIES WITH KEY ROLES</p> <p>16 FINAL CHECK BEFORE THE MARKET</p>	 <p>17</p> <p>NATURAL GAS – AN ESSENTIAL COMMODITY</p>	<p>20</p> <p>THE GREEN SHIFT</p>	

*"Norway is the European
community's most
reliable energy supplier"*

From the European Commission's action plan for energy security.

A UNIQUE AND WELL-FUNCTIONING TRANSPORT SYSTEM

A well-functioning and ever more extensive transport system has been crucial for Norway’s position as one of the world’s largest exporters of natural gas.

Gassco is responsible for safe and efficient operation of this network. It also serves as the architect for ensuring integrated further development of the infrastructure.

The transport system from the Norwegian continental shelf (NCS) to continental Europe and the UK has evolved in line with Norway’s gas production. What began in 1977 with a single export pipeline from Ekofisk to Germany has grown over 40 years to nearly 9 000 kilometres of steel tubes on the seabed. This unique value chain, extending from production in rough seas to consumers in Europe, also comprises large process plants in mainland Norway, offshore platforms where gas is blended, and terminals in four European countries.

Gassco was established by the Norwegian Storting (parliament) in 2001. At the same time, the decision was taken to locate its head office in Karmøy on Norway’s west coast. The Ministry of Petroleum and Energy

has assigned two primary roles to Gassco in relation to the transport system for Norwegian gas: **the normal operatorship and the special operatorship.**

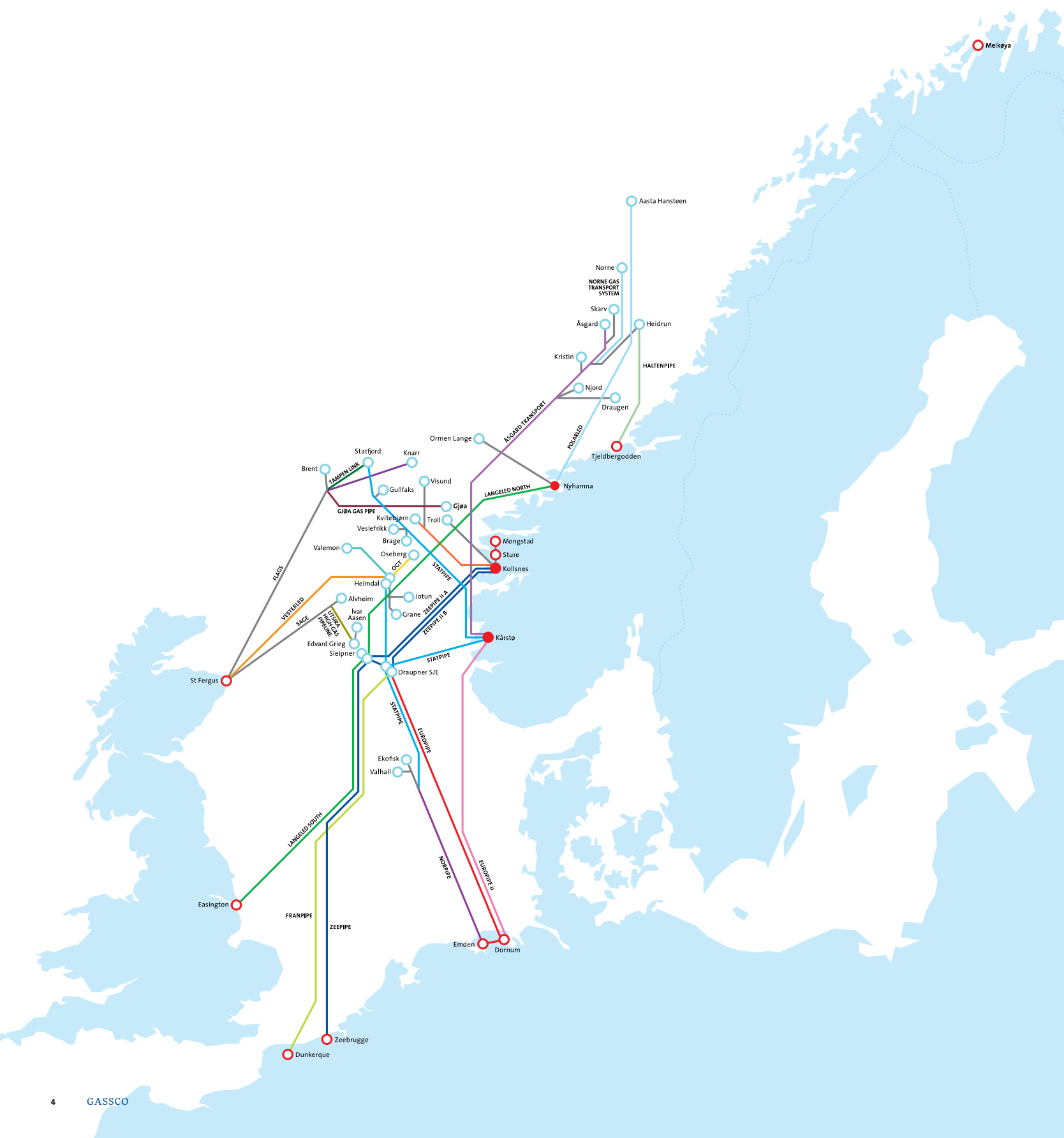
Gassco’s normal operatorship covers management of assets, administration of licences and development of projects. An important part of asset management involves seeing to it that health, safety and environmental (HSE) requirements at these facilities are met. Within the normal operatorship, Gassco is subject to the authority of the asset owners to issue instructions to it under agreements with these companies.

Gassco’s special operatorship deals with duties allocated by the government under national legislation and regulations. These cover planning, supervising, coordinating and managing the movement of gas from fields to terminals. In addition come administration of capacity in the transport system as well as studies on and development

of new gas infrastructure. Within the special operatorship, Gassco is not subject to instructions from owners or users.

Gassco is not intended to earn revenues or to make a profit from its activities, but administers large cash flows on behalf of the transport system’s owners and users. Tariff revenues in the system amount to around NOK 33 billion per year. Agreements have been reached by Gassco with other companies on the purchase of operating services. These include day-to-day operation of the big processing plants in mainland Norway.

Gassco is owned by the Norwegian state and had 352 employees in 2021. Most of the infrastructure it operates is owned by the Gassled partnership. Important facilities are also owned by the Nyhamna and Polarled partnerships. The transport system’s owners finance Gassco’s operations.



Frode Leversund,
CEO



Photo: Haakon Nordvik

HOW GASSCO HELPS TO BOOST THE COMPETITIVENESS OF NORWEGIAN GAS

"Our expertise relates to virtually all the activities which collectively form the value chain for Norwegian gas exports. We are able to manage an overall system which incorporates over 30 gas exporters from more than 50 fields."

That is how CEO Frode Leversund sums up Gassco's contribution to value creation from and increased competitiveness of Norwegian gas as an energy source in continental Europe and the UK.

In its action plan for energy security, the European Commission has described Norway as Europe's most reliable energy supplier. Gassco bears its share of the credit for that status.

"Security of supply and reliability are key concepts for us, and concern the number of hours in the day that the transport system is available to deliver gas from the fields," Leversund explains. "Our system operation people must handle 500-700 incidents large and small during a year with just one goal in mind: none of these will have any consequences for the exporters or their customers. Figures for up-time show that we're very good at this."

The competitiveness of Norwegian gas also requires a good performance for HSE, both by Gassco as the operator and by the companies which run facilities on its behalf.

"Our plants and installations must be operated safely," Leversund affirms. "Huge quantities of energy flow through this system, and we're not going to have gas going astray. Risk-reduction measures accordingly occupy a key place. We deal with risk from field to terminal, and offset it with measures based on our expertise. As in every aspect of our business, HSE is also a matter of learning across the company and from others."

"At the same time, enhancing the competitiveness of Norwegian gas means we need to operate more efficiently and sustainably. All the players must pull together here as well. We must get unit costs down, and simultaneously achieve climate gains and reduce our emissions. To succeed in this, we've got to be able to look far ahead. As a company, we must renew ourselves through new knowledge and always think long-term. That's the social perspective. We must ensure that the gas transport system is competitive and also look at how new ways of utilising this infrastructure would be possible in a longer time frame. We must ensure value creation, and spot the opportunities offered by the changing nature of the world's energy system."

THE GAS JOURNEY

Not everyone is aware that the NCS conceals the world’s largest fully integrated pipeline network for transporting natural gas. The system linking producing fields, process plants and terminals represents one of the finest examples of Norwegian engineering skills and creates huge value for the country.

But how is this value actually created?

Many believe that gas is pumped up from below ground, but that is not entirely correct. **Gas reservoirs** often have a natural overpressure, and their contents flow out under their own force once the overlying rock has been penetrated. That is the case to start with, at least. As this driving force gradually declines, water can be pumped down into the reservoir to provide pressure support.

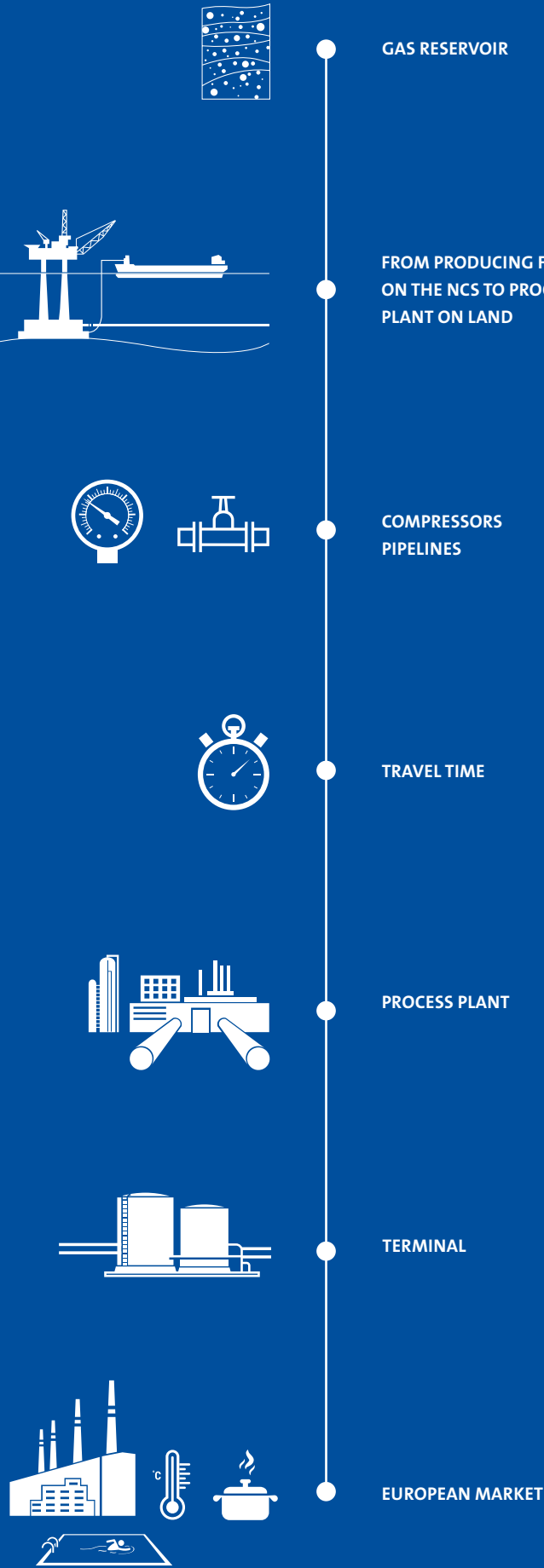
For the gas to flow **from the offshore field to the process plant on land**, however, it needs a little mechanical support. Pressure is again the key.

Big **compressors** are used to raise the pressure of the gas in order to drive it through the pipeline. Its speed varies with pressure and temperature, but will always be highest at the end of the pipeline where the pressure is lowest. To convey some sense of the **journey time**, a gas molecule from the northernmost fields in the pipeline network can be said to take roughly five days to reach Germany. That is a distance of 1 480 kilometres, one of the longest runs in the system.

About 30 per cent of the gas brought up is sent directly from producing fields to receiving terminals. This “rich” gas must first pass through a **processing plant** on land. A separation unit removes the heavier components, known as natural gas liquids (NGL). These can be sent in turn to a fractionation unit and split into such products as ethane, propane, normal butane, isobutane and naphtha, which are then exported by ship. The remaining “dry” gas – largely methane – is piped to continental Europe or the UK, again with the aid of large compressors.

Land-based **terminals** in Britain and the European mainland are the end-points in Gassco’s pipeline network. These perform a final quality check before the consumer-ready gas flows on to the end user. But Gassco’s job is done once the gas leaves the terminal.

The control room at the company’s Karmøy head office has directed the gas molecules on a long journey from raw material in an offshore reservoir, via processing in a Norwegian plant, to user-friendly energy ready for **the European market**.



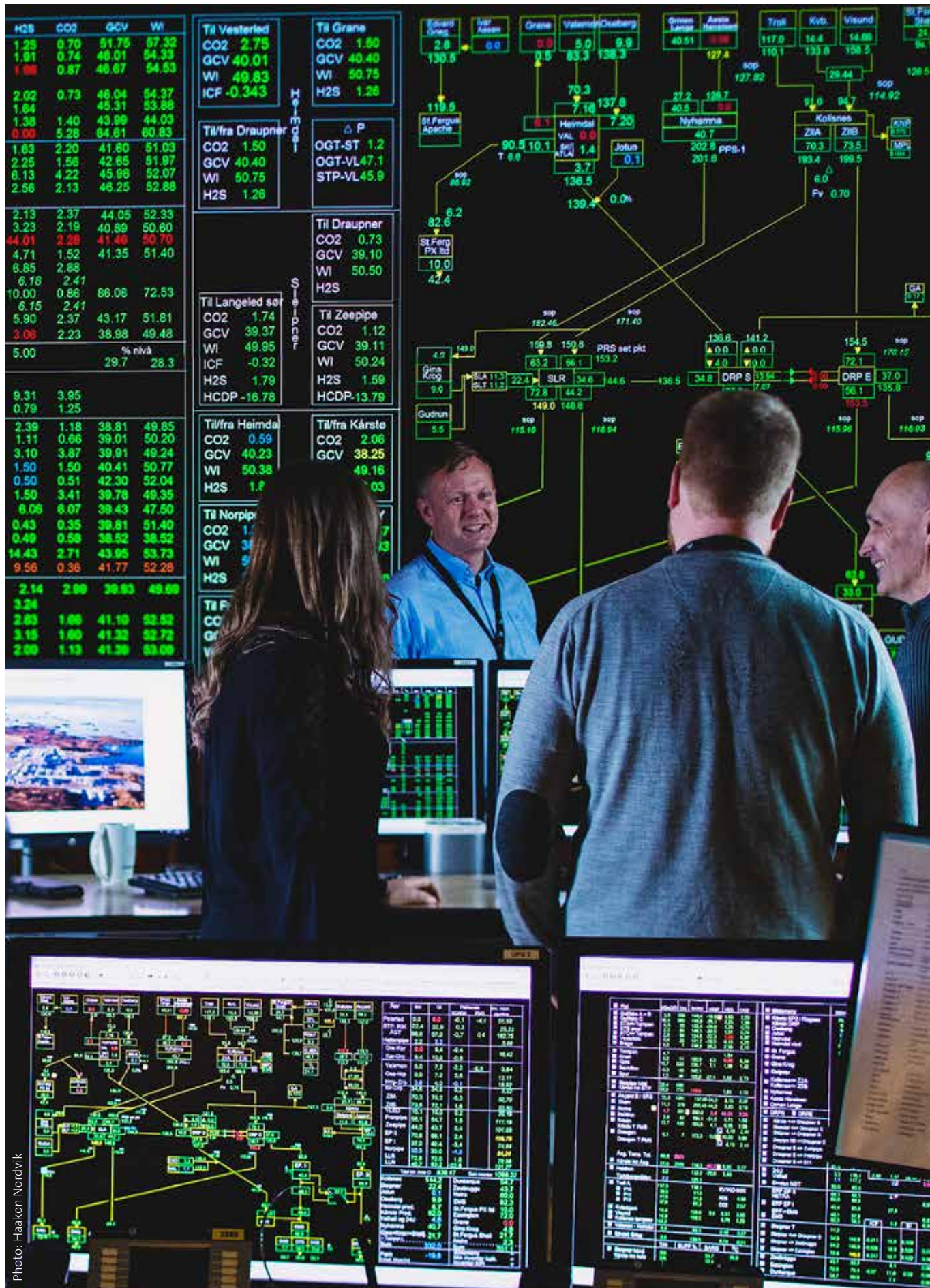


Photo: Haakon Nordvik

ROUTING GAS THE RIGHT WAY

Managing and coordinating the gas flowing from the offshore fields, via land plants and pipeline systems, to the various terminals occupies a key place in Gassco's business.

Personnel in the transport control centre (TCC) at Gassco's Karmøy head office have a lot to keep track of. Staffed around the clock, this advanced facility has big screens which allow the transport engineers to check gas pressure, temperature and composition as well as how much each field is producing. On a daily basis, they also have to handle incidents large and small in the extensive system with one clear ambition: transporting the right amount of gas of the right quality to its destination at the agreed time – day and night year-round. And the TCC delivers on that goal. Even though new fields with differing gas qualities are constantly being connected to the network, Norwegian exports reach the market with almost 100 per cent regularity.

"We depend on ultra-reliable ICT solutions to maintain stable operation," explains TCC manager John Kristian Økland. "If faults occur, we've developed systems to alert us. The TCC is vital not only for us, but also for European energy supply. So we have stringent security requirements and back-up opportunities both for the ICT systems and at the operating location."

Companies which own and export gas from the NCS are known as shippers. Some possess interests in many fields, while others have more limited holdings. But all of them want

the best possible price for their gas at any given time. With its many pipelines and with terminals in four different countries, the transport system also contributes flexibly to meeting this requirement.

"The shippers want to exploit sales opportunities in alternative markets," observes Økland. "This means we can experience big variations in delivered volumes during a day. For their part, the field operators want to maintain the most stable and predictable operation possible in order to maximise their production. Our job is to balance these different needs."

Information on gas flow in the transport system can be market sensitive. So Gassco reports incidents on fields and in its network which could be significant for gas deliveries. This information is posted to its web portal for market information, which is followed by many people both in Norway and in the rest of Europe.

Gassco operates the big Kårstø, Kollsnes and Nyhamna onshore plants, which are all large consumers of electricity from the grid. The TCC estimates on a daily basis how much power must be purchased in the market. Should substantial unplanned operational disruptions occur, it must also report changes in electricity consumption to the NordPool portal for the Nordic power market.

Leak detection in the pipelines operated by Gassco is also conducted by the TCC. Computer models which simulate parameters such as pressure, temperature and flow help to identify changes. These trigger alarms which the staff must react to.

The system operation department, which incorporates the TCC, has a number of other responsibilities. These include capacity administration, allocation, metering, shipment planning, operating preparations for new fields, and developing ICT systems.

Coordinating maintenance is a key job in addition to day-to-day operation, particularly during the annual overhaul season from April to October when many activities must be synchronised. Harmonising maintenance projects reduces the capacity reduction and optimises value creation from gas production.

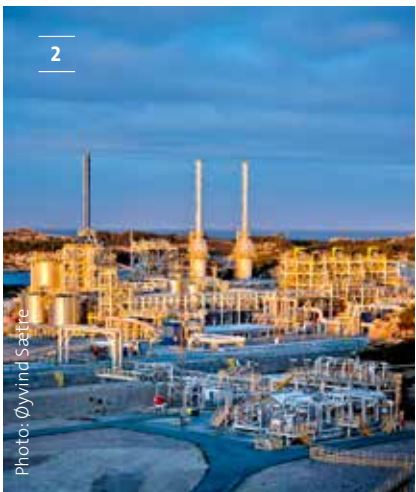


John Kristian Økland, TCC manager.



INDUSTRIAL FACILITIES WITH KEY ROLES

Three large plants in western Norway play a crucial part in ensuring that continental Europe and the UK meet their needs for Norwegian gas. They also create big value for the country through jobs, government revenues, and property taxes paid to their host communities.



- 1. Kårstø process plant in Tysvær local authority.
- 2. Kollsnes process plant in Øygarden local authority.
- 3. Nyhamna process plant in Aukra local authority.

These industrial facilities process, store and export natural gas and light oils from most of the fields on the NCS. Located at Kårstø near Stavanger, Kollsnes close to Bergen, and Nyhamna near Molde, this trio all play key roles in Norway's gas transport system and more than half of all Norwegian gas exports pass through them. Process plants for gas have been established on land for several reasons. The Storting decided in 1971 that, as a general rule, petroleum from the NCS should be brought ashore in Norway. These installations also form part of offshore field developments where landing gas has proved the best solution in technical terms.

THE KÅRSTØ PROCESS PLANT was the first of the onshore facilities to be built, and its establishment was related to developing the big Statfjord field. Capacity at the plant has increased many times over since it became operational in 1985. It now receives products from more than 40 North and Norwegian Sea fields through the Statpipe, Åsgard Transport and Sleipner condensate pipelines. It separates out NGLs and splits them into propane, normal butane, isobutane, naphtha and ethane. These products are exported by ship, as are condensate and light oil. Dry gas (mostly methane) is exported by pipeline to Europe. Because of the extensive processing required to separate out and split the NGLs, many people regard Kårstø as the most complex of the three land plants in technical terms.

THE KOLLSNES PROCESS PLANT was established in connection with developing the giant Troll field, and became operational in 1996. In addition to Troll, it currently receives gas from Kvitebjørn, Visund and Fram. Kollsnes has the biggest capacity for pipeline export of dry gas among the three land plants. These exports utilise the pipeline system to Europe. Condensate and NGLs are separated out at the plant and piped to the nearby oil refinery at Mongstad through the Vestprosess system, which forms an integrated part of the Norwegian gas transport system. The whole Kollsnes facility, which includes six large export compressors, is driven by hydropower from the Norwegian electricity grid.

THE NYHAMNA PROCESS PLANT became operational in 2007 in connection with developing Ormen Lange in the Norwegian Sea off mid-Norway. Gas and condensate from this field are carried in two pipelines to the facility, where the condensate is separated out for export by ship. The gas is compressed for onward transport through the Langeled facility. Running for 1 300 kilometres, this ranks as the longest gas export pipeline in the Norwegian network. Nyhamna has been expanded more recently to receive additional gas from Aasta Hansteen and other future developments in the Norwegian Sea through the new Polarled pipeline.

FINAL CHECK BEFORE THE MARKET

The Norwegian gas molecules undergo a last check at the terminals before disappearing into the wide-ranging European and British distribution networks.



These facilities are located in Germany, Belgium, France and the UK, and their positions have not been chosen at random. Through them, Norwegian gas reaches the most important European consumer nations. The terminals perform fiscal metering, check gas quality, regulate its pressure and temperature, and remove possible liquid residues and solid particles. They employ about 140 members of Gassco’s workforce, whose most important job is to ensure that the terminals are in operation and available for Norwegian gas deliveries around the clock. Since uptime needs to be almost 100 per cent, terminal personnel do not have many hours in the course of the year to do work which calls for a full shutdown.

WHERE THE TERMINALS FOR NORWEGIAN GAS ARE LOCATED

- GERMANY (1):** Emden and Dornum in Lower Saxony.
- UK (2):** Easington in East Yorkshire, England, and St Fergus near Peterhead, Scotland.
- BELGIUM (3):** Zeebrugge in West Flanders.
- FRANCE (4):** Dunkerque in the Nord department.

NATURAL GAS – AN ESSENTIAL COMMODITY

What is natural gas? A chemist’s answer would be something along the lines that it is a colourless combustible substance consisting primarily of the hydrocarbon gases methane, ethane, propane, butanes and naphtha, and is normally divided into rich gas, NGLs and dry gas. That is naturally quite correct. However, if you ask a couple of ordinary Europeans who use Norwegian natural gas every single day, you might get a rather different response. Where they are concerned, natural gas is quite simply essential.



WARM HOMES: Countless households are heated with the aid of natural gas.



In practice, this commodity represents heat on cold days – in the shower, in the living room, at work and in the pool. It is the energy source which allows power stations to generate electricity and permits people to cook in their kitchen. Gas from the NCS is quite simply the everyday energy source for millions of people. Gassco's job is to ensure that it is available every single day.

Natural gas is not only the most environment-friendly fossil energy source but also very flexible, and it can be used in many important applications. Millions of people in Europe use Norwegian natural gas to meet their energy requirements every single day. Its availability on demand, immediately and without delay, is taken for granted by millions of consumers.

The natural gas produced on the NCS and piped beneath the sea to Britain and continental Europe is actually crucial for meeting a range of requirements in these countries. But what is it used for? What do these requirements comprise, and why is gas so essential? Its applications can be divided into three main categories: heating homes and commercial buildings, electricity generation, and feedstock for petrochemicals production.

HEATING Private and commercial consumers primarily use gas for heating, hot water and cooking. Large gas-fired boilers for waterborne central heating are very widespread in European blocks of flats and commercial buildings. Norwegian natural

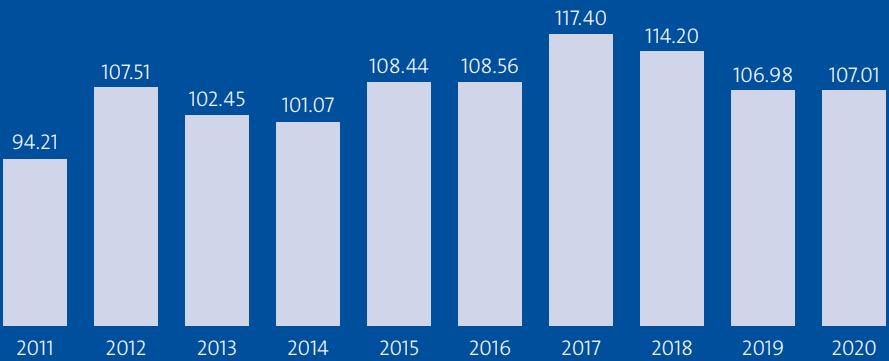
gas is an excellent energy source for such facilities. But water also needs to be heated at the individual household level. Modern gas-fired boilers have become highly energy-efficient. At the same time, energy-dense, clean-burning gas means low local emissions and consequent good air quality – particularly important in built-up areas on cold days. Many European kitchens, both professional and private, are equipped with gas rather than electric hobs. A naked gas flame gives cooks a quick, efficient and flexible heat source, and many prefer it to the various electrical solutions.

ELECTRICITY GENERATION with the aid of natural gas is highly efficient and environment-friendly compared with other fossil fuels. That is particularly true when the residual heat from initial generation is exploited to provide a high level of energy efficiency. Gas-fired power stations are energy efficient and important for balancing renewable energy sources which depend on the vagaries of wind and sun. Electricity generated by natural gas can also replace coal-fired power stations and thereby reduce carbon emissions to the atmosphere – which is again positive for air quality, particularly in big cities.

FEEDSTOCK FOR PETROCHEMICALS Much of Europe's petrochemical sector uses Norwegian natural gas as feedstock for producing such materials as plastics, paints and textiles. The gas is split into various components, which are reassembled into specialised products for applications like

household articles. Establishing carbon capture will allow natural gas to be converted into emission-free energy sources such as ammonia or synthetic fuels. Hydrogen is rapidly being introduced as an emission-free energy source, and big commitments are being made both internationally and in Europe to enable the use of this gas as an energy bearer in a number of areas. It can be produced both by electrolysis with the aid of electricity or from natural gas. Norwegian natural gas combined with carbon capture and storage will play a key role in the successful decarbonisation of the energy system.

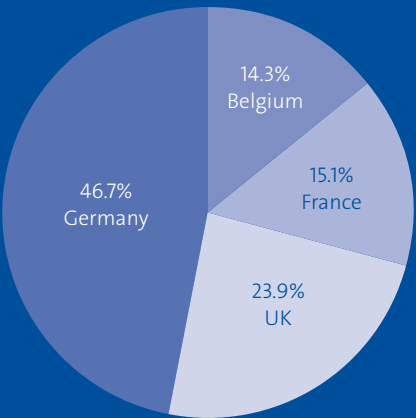
So what is natural gas? It is hydrocarbons, hot water in the shower, primarily methane, a cook's tool, a petrochemical feedstock, and a warm living room. And it will not least make possible the decarbonisation of the entire energy system.



ANNUAL DELIVERIES FOR THE PAST 10 YEARS
(in billion scm)
Norwegian gas exports have increased many times over since they began in the 1970s. This graph shows developments over the past decade, with the most recent annual record of 117.4 billion standard cubic metres set in 2017. These volumes are gas delivered to foreign destinations within Gassco's area of responsibility as operator.

NORWEGIAN GAS EXPORTS IN 2020 BY RECIPIENT COUNTRY

This graph shows the percentage breakdown of Norwegian gas exports by recipient country. Note that this distribution does not necessarily correspond with the amount of gas from Norway which these four countries consume, since deliveries to Belgium, for example, can be transmitted to and sold in other countries.



THE PLACE OF GAS IN TOMORROW'S ENERGY MIX

Most of the many forecasts produced for the world's future energy mix show that global energy consumption will increase, even when more efficient utilisation has been taken into account. A general trend is that renewable energy generation will increase while the use of coal declines up to mid-century. The various predictions differ over how fast renewables will expand and how much the consumption of coal will decline. Gas will play a key role in the global energy mix far into the future, and its consumption is set to rise in several parts of the planet up to 2040. By then, most projections put the proportion of gas in the world's energy mix at 20-25 per cent.

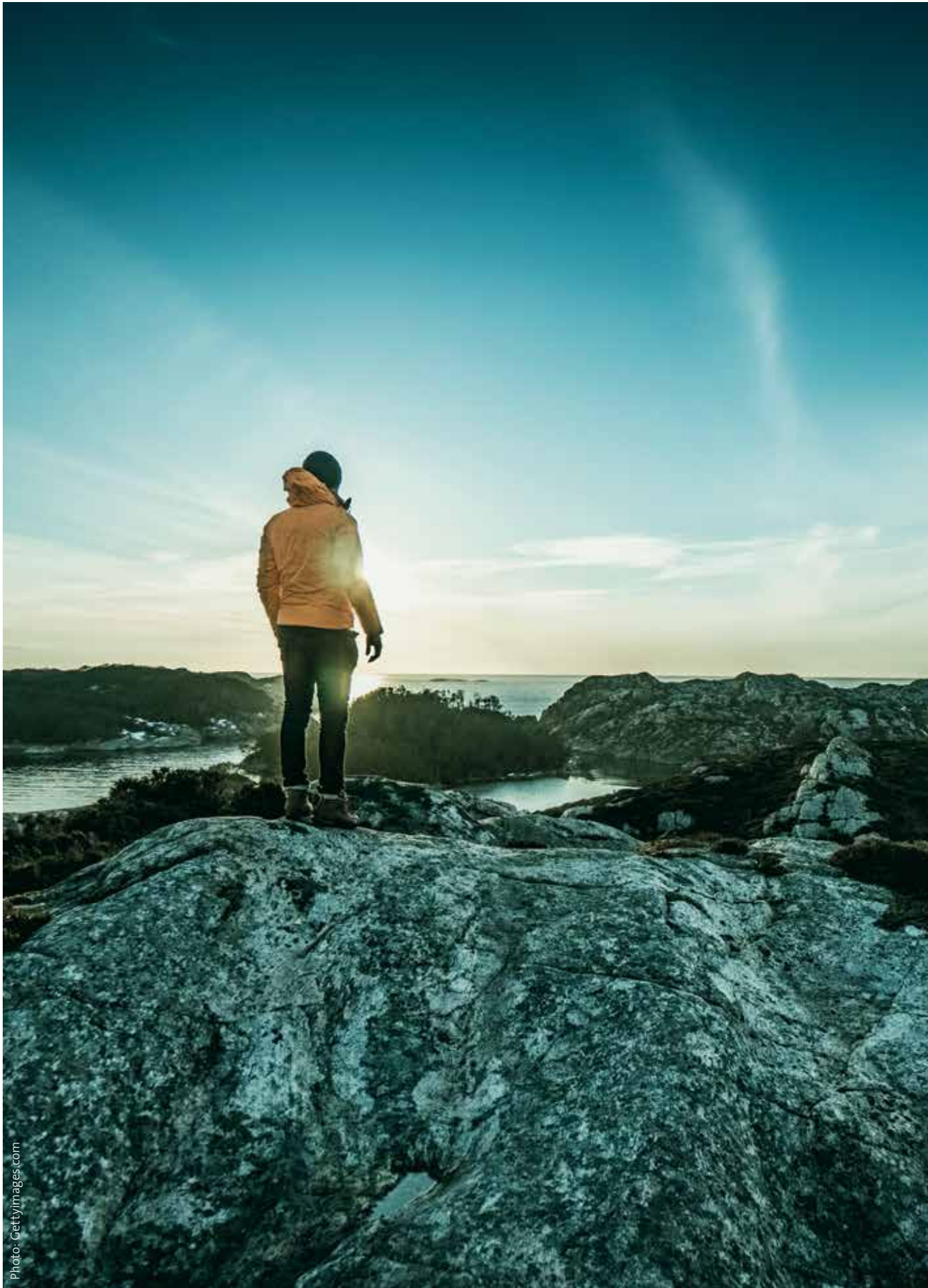


Photo: Gettyimages.com

THE GREEN SHIFT

Gassco's task is to secure a supply of energy with the lowest possible climate footprint, in line with UN sustainable development goals 7 – affordable and clean energy – and 13 – climate action.

The climate challenge is something the company discusses through a good and close dialogue with its stakeholders, and it has an active relationship to this subject. Gassco does not own either the infrastructure in or the natural gas exported through the transport system it operates. Its job is to run the system with the lowest possible climate impact, and to present and mature proposals for emission-reducing measures to the stakeholders.

One of Gassco's strategic goals is to reduce climate impact. In that connection, it has drawn up a climate roadmap for the period up to 2030 in close dialogue with its stakeholders. This provides a strategic tool in defining areas and tasks which Gassco is to work with.

NEW VALUE CHAINS

Gassco has a competitive gas infrastructure today. This is flexible, with low operating costs and high regularity. In a long-term perspective, however, several factors could require changes in order to ensure continued competitiveness. That consideration has prompted Gassco to establish a process

which will help build knowledge about how it can continue developing a competitive and sustainable gas infrastructure. Attention in this work is focused on how to keep down operating costs and reduce emissions. These efforts also include assessments of opportunities for alternative utilisation of the infrastructure, such as transporting hydrogen.

CARING FOR NATURE

Gassco's object is to pursue its operations without harming the environment. This goal applies to all its business areas, from emissions and the expansion of facilities to arrangements for its environmentally conscious employees.

Gassco's aim of conducting a business which does not cause environmental harm is in line with the UN's sustainable development goals. It devotes great attention at all times to this work, which includes the following measures:

- continuous monitoring of emissions to the air and discharges to the sea
- thorough environmental analyses ahead of possible expansions to or changes in the operation of the facilities

- regular emergency response drills and the use of less harmful chemicals
- managing waste from all its activities in an acceptable manner
- efficient digital solutions able to replace meetings and other travel activity
- creating environmentally conscious attitudes among employees
- a sponsorship strategy which gives priority to measures related to the protection of animal life and natural diversity.

Gassco is responsible for safe and efficient operation of the network. It also serves as the architect for ensuring integrated further development of this infrastructure.



Securing energy supply