Norwegian gas to Europe >> reliable and forward-looking
Welcome to Gassco

We operate the integrated gas transport system from the Norwegian continental shelf (NCS) to continental Europe and the UK. This integrated network comprises pipelines, processing plants, platforms and receiving terminals in four countries.

We are a limited company wholly owned by the Norwegian state. Our head office at Bygnes in south-west Norway has 200 permanent employees. In addition come 150 personnel at the receiving terminals for Norwegian gas in Europe.

We regard ourselves as an organisation where people achieve good results through collective action. Via this brochure, we would like to invite you into our world. Read it, and learn more about us.
Envisage a transport system which starts in stormy seas far from human habitation. In these waters, various companies produce natural gas for use in heating, cooking, transport and industry around Europe. But this output only acquires value when it is made available to people as energy.

A well-functioning transport system managed in an equitable and non-discriminatory manner forms a key link in the value chain from producer to customer. All users of the network will get their gas molecules to market in Europe at the agreed time and to the right quality.

As operator, Gassco has several duties: to serve as the administrator who ensures safe and effective operation, and to be the architect who helps to make sure that the transport system is developed in an integrated and cost-effective way.

Norway ranks as one of the world’s largest gas exporters, and covers some 19-20 per cent of consumption in the 27 European Union members. The EU countries meet little more than 30 per cent of their gas requirements from domestic production, and accordingly depend on imports from such sources as Russia, Norway and the Middle East. At the same time, roughly 115 million customers were connected to Europe’s extensive gas distribution systems at 31 December 2010. That explains why security of supply is high on the agenda, both in the EU and in many of its member states.

After many years of growth, natural gas consumption declined in the EU during 2009. But this downturn proved short-lived. By 31 December 2010, the Eurogas organisation was able to report a 7.2 per cent increase in consumption from the year before. Most analysts believe that this rise will continue over the next few years. That applies particularly to electricity generation, where gas is increasingly expected to replace coal. Such a change is also seen as an important element in efforts to reduce greenhouse gas emissions.

When a family in Germany or the UK sits down to a well-cooked meal, it might well have been prepared with the aid of natural gas from Norway.
Hunting for expertise in a world of energy and change
Working in Gassco is about expertise, responsibility, unique opportunities, drive and a desire to contribute.

“We have unique expertise,” says Brian Bjordal. “People who seek jobs with us can hone their abilities on very interesting duties and – not least – get to work with energy.”

He is chief executive of Gassco, which operates the world’s largest offshore transport network for gas. The company carries energy worth several hundred million kroner every day. Industries and millions of people in Europe depend on Norwegian gas arriving as ordered. Despite the responsibility he bears, however, Mr Bjordal has a relaxed attitude.

“I feel secure in my job because I know how many able people we employ,” he comments. “I never feel I’m on my own.”

In a society experiencing constant change, adaptability, reliability and safety must always be top priorities.

“The world scene and society are changing all the time,” Mr Bjordal notes. “We can’t sit and wait for change to come. We must keep ahead of it. The outside world can’t be expected to adjust to us. We’ve got to adapt in step with our immediate surroundings and the wider world.”

Gassco’s operations include infrastructure development, capacity management, system operation and asset management. All these areas are characterised by complexity, and make big demands on the expertise of every employee.

“When people talk about expertise, it’s easy to think that this is just a matter of knowledge,” Mr Bjordal observes. “Yet somebody sitting on their sofa and watching a football match may know a lot about the game, but lack the actual playing skills needed on the pitch.”

But is adding skills enough in itself? He puts the question rhetorically, and answers it himself.

“No, because you also need willpower and motivation to do the job. Then come the overarching questions – what is that job, what strategy should we adopt to achieve our goal?”

“We need people in Gassco who have expertise and who can answer those two questions. Our employees must also feel that they contribute, that they help to make a difference. This sense of contributing is important, but the sense that you’re contributing to something as part of a group is even more so. These motivations are the be all and end all, and everyone knows that you can’t buy job satisfaction.”

He lets his gaze wander over the landscape, and a silence descends which is broken only by the sound of the wind and the surf.

“So the big question is this – what drives us to continue, to get up in the morning?”

“The answer is naturally complex, but I think it’s about dynamism and balance. Mixing with other highly interesting people, a feeling that you are significant and contribute – to friends, to family and to colleagues. All these factors play a part.”

Gassco’s employees cover a large number of specialist disciplines characterised by leading-edge expertise and collaborative working.

“We look for people who want to participate in taking us forward,” says Mr Bjordal. “You get to work with energy in a competent, committed and determined organisation. We offer the perfect workplace for anyone who wants to help supply Europe with Norwegian natural gas.”
Efficient utilisation

Gassco’s goal is to utilise the transport system’s capacity in the most effective possible manner. That makes capacity management one of the company’s most important jobs.

Gassco ensures that gas reaches the market at the agreed time, in the agreed amount and with the agreed quality. Just as a motorway has limits on the number of vehicles it can carry, however, the transport system has its capacity restrictions.

Capacity management is about making sure that all the shippers (gas owners) have the opportunity to carry their gas to market on equal terms. Gassco must do this job in an impartial, non-discriminatory and transparent way. The tariffs paid by shippers to have their gas transported are set by the Norwegian government.

One of the people working on capacity management is Hanne Gunn Våga.

A process engineer, she has been with Gassco since the company was founded in 2001 and was employed by Statoil before that.

“We hold booking rounds twice a year, when shippers book the capacity they need on the basis of estimated production,” she explains. “Any unsold capacity can then be bought on a first-come, first-served basis.”

Gassco currently has 31 qualified shippers. Although most of them operate on a long-term basis, Ms Våga is often in contact with them.

“Their needs are constantly changing,” she notes. “The season, production variations on the field, maintenance work or prices are among the factors which can affect their transport requirements.

“So we have daily trading in spare capacity which might be available in the system. Our dialogue with the shippers is close and professional.”

Spare capacity traded from day to day represents only the tip of the iceberg – a small percentage of the transport system’s total ability to deliver. It is nevertheless important.

“Our goal is to utilise network capacity in the most efficient possible way,” Ms Våga explains. “If a shipper doesn’t need the capacity booked, it can sell the surplus to other shippers and thereby reduce its own transport tariffs.”

At present, very little slack exists in the system. So a shipper wanting to transport more gas than it has booked must buy capacity from another.

Ms Våga has a good overview of how much is spare, who wants to sell and who wants to buy. All purchase and sale of capacity is done on-line through the Gassco booking system.

“There’s a lot of activity in this system,” she says. “When gas prices are high, shippers naturally want to sell as much as possible at the best possible rate. The European market needs less gas for heating in the summer than in the winter.

“It’s also colder during the winter on the seabed where the pipelines lie, and the gas is thereby compressed – it occupies less space. So capacity increases at a time when demand rises.

“Another variable is the life cycle of the various fields. A mature field with declining production will free up capacity for newer developments with higher output.”
“Our job is characterised by the daily coordination of gas transport all the way from the field to the receiving terminal in Europe,” explains Morten Carlsen.

As head of the gas transport control centre, he works in what is often called the heart of Gassco. The system operation and control room team ensures that each shipper’s gas arrives at the right delivery point and at the right time.

“Natural gas from the NCS varies in quality, and must therefore be blended in order to meet the contractual standard,” Mr Carlsen explains.

“So if a field with good-quality gas produces less than expected, fields with a poorer grade must restrict their output correspondingly. That maintains quality, but the volume of available gas could change.”

Gassco’s staff can use the big screens in the control room to check the gas stream down to the smallest detail: its pressure, temperature and composition, and how much each field is producing. These are important parameters, which call in part for the ability to monitor pipelines for possible leaks.

In order to maintain a steady flow, Gassco depends on very reliable systems. Warnings are issued if faults occur – which makes the company’s information and communication technology services very important.

The control room is a vital organ not only for Gassco but also for Europe’s energy supplies. So Gassco sets strict security standards, and can run the whole pipeline network if required from a different location.

In addition to day-to-day operation, coordinating maintenance throughout the transport system represents a key task.

“The annual maintenance period between April and October, in particular, calls for a great many activities to be coordinated,” says Mr Carlsen. “That helps to minimise capacity reductions for shippers.”

Gassco staffs its control room around the clock, and devotes at least six months to training up new employees.

“You need to avoid stress and keep a cool head in this job,” affirms Mr Carlsen.

“Shippers to the UK, in particular, want the gas stream tailored to the time of day. This means that capacity may be fully utilised in certain periods, while we have plenty to spare in others.

“That’s beneficial for the market, but sub-optimum for the transport system. Our goal is to keep production from fields and utilisation of the network steady and stable.

“This is an example of a new type of variable which can be difficult to handle, but for which we have to find solutions on a daily basis.”

NAME: Morten Carlsen
JOB: Head of the gas transport control centre

Without an operational control room, both Gassco and the transport of gas from the NCS to Europe would come to a halt.
Knowledge, curiosity and commitment characterise Gassco’s research and development work.

Since the world is constantly changing, updated knowledge and understanding will be crucial for an organisation like Gassco. R&D accordingly represent an important tool.

Gassco is committed to developing new technology and updating its expertise on a continuous basis. As operator, the need to lie in the forefront of technological progress goes without saying.

Millions of people in Europe depend on Norwegian gas, and that responsibility carries with it an obligation.

Gassco’s vision is to use R&D to continue boosting the competitive advantage enjoyed by gas from Norway in Europe.

The company’s commitment in this area will contribute through technological advances and value-creating procurement for the company’s business areas.

Ensuring a high level of expertise in the workforce and forging ties with the best partners are crucial for finding the best solutions.

Gassco has extensive contacts and collaborates closely with industry and research teams locally and nationally in Norway, as well as internationally.

The company’s newly graduated technologists are given interesting and varied challenges, combined with close and good follow-up.

**FACTS**

R&D activities are divided into three areas – plants, pipelines and capacity, and gas quality.

Environmental protection and safety are key elements in all R&D projects. Gassco invests substantial amounts in R&D work every year.
The way forward

Development of the gas infrastructure must keep pace with activity on the NCS. Each decision to expand the system is backed by extensive work and planning.

The gas transport infrastructure from the NCS to continental Europe and the UK has developed in step with gas production from Norway’s offshore fields. But expansion continues, and Gassco is constantly assessing opportunities for further development of the network.

This represents an important area of activity for the company, where it plays several roles. Gassco does not own the infrastructure, but is required to propose and coordinate work on it and to recommend investment in further expansion.

Øystein Rossebø is one of the people engaged in infrastructure development. With an education in petroleum technology, he has been employed by Gassco for three years.

“I work on the annual transport plan, on phasing in new fields and on early-stage projects,” he explains. “A decision to lay a gas pipeline is backed by detailed preparatory work, which goes through many phases.”

The whole process begins with Gassco seeing a requirement for additional transport capacity, or with shippers reporting that they need to export more gas.

“Our role is primarily to safeguard the overall integrity of the transport system and to ensure that optimum use is made of existing capacity at all times,” says Mr Rossebø. “Our starting point will therefore always be to use what’s already available as far as possible.

“It’s often the case that more companies than those involved in a specific field need a development. These requirements have to be identified and coordinated. When that’s done, we consider any proposals for further development – including possible ship-based transport.”

During this process, which can often take seven to 10 years from start to finish, new companies can register their interest in the project while others may withdraw. Once all the impacts have been assessed by Gassco and the gas owners, a decision is taken on whether to proceed. If the companies want an expansion, a plan for development and operation (PDO) will be submitted to the government for approval.

“It’s important to note that we don’t finance infrastructure developments,” observes Mr Rossebø. “The money comes from the companies which need increased capacity.

“We’re talking about big sums. So the financial strength of the companies and the profitability of developing gas resources on the NCS are crucial.”

Facts

Gassco is responsible for taking the initiative on and coordinating processes for further development of the gas transport system. It makes its own assessments, and submits proposals for such projects. The company also assesses solutions for transport by ship.

Gassco is required to present recommendations and investment proposals based on an overall assessment of the gas transport system and resource management considerations.
NAME: Øystein Rossebø
JOB: Project manager
Kårstø is one of Norway’s most important industrial facilities. This processing plant north of Stavanger has created great value for society over more than 25 years.
The processing plant at Kårstø is an essential link in a unique value chain, which has allowed Norway to become one of the world’s largest gas exporters.

The 25th anniversary of the first dry gas delivery from Kårstø via the Statpipe/Norpipe lines to Emden in Germany was celebrated on 15 October 2010. Capacity at the plant has more than tripled since it started up in 1985, and gas now arrives there from 30 fields on the NCS.

In reality, Kårstø was in continuous expansion from the late 1980s until 2005. Daily capacity rose from just under 20 million standard cubic metres (scm) in 1985 to 88 million scm today.

The plant now ranks as the biggest facility of its kind in Europe, and as one of the five largest worldwide.

Kårstø is also a busy port, with 600-700 ship calls per year. These vessels export millions of tonnes of liquefied gases and condensate (light oil) to a global market.

The plant is now one of Norway’s most important industrial facilities. Few if any land-based industries have created greater value for the community in the space of 25 years than Kårstø.

It also plays an important role for the supplies industry. Contracts worth more than NOK 20 billion have been awarded over the past 10 years for expansion, upgrading and maintenance work.

Kårstø is a large employer. Some 800 Statoil personnel are engaged there in normal operation, with an additional 500 work-years performed by various contractors.

By Norwegian standards, the plant is a big point source of carbon emissions and releases almost 1.2 million tonnes per year. The most important sources are gas-fuelled boilers and compressors as well as a small gas-fired power station which has generated electricity for internal consumption since 1985.

But Kårstø is also a very energy-efficient facility, where much of the waste heat in flue gases is used to produce steam. Measured per unit of energy produced, carbon emissions from the plant have declined in recent years.

Making its installations more robust has been a key priority at Kårstø over the past few years. Approved in 2007, the NOK 7.5 billion Kårstø expansion project (KEP) largely involves renewing old equipment. The aim is to create a safe and robust plant which can be run efficiently for many years to come.

FACTS

Rich gas arriving at Kårstø passes through a separation plant to remove natural gas liquids (NGL). The latter are sent on to a fractionation unit for splitting into propane, normal butane, iso-butane and naphtha. The remaining dry gas (methane) is piped on to Europe. Condensate from the Sleipner area is fractionated and stabilised in a separate facility.

Propane is stored in two large artificial rock caverns. Naphtha, ethane, normal and iso butanes, and stabilised condensate are held in tanks.

Gassco is the operator for Kårstø, with Statoil as its technical service provider. The plant is owned by the Gassled joint venture.
The Kollsnes processing plant near Bergen plays a key role in gas exports from Norway to continental Europe and the UK.
When the huge Troll field was declared commercial in 1983, a solution had to be found for landing, processing and sending its gas on to market. The choice fell on Kollsnes in Øygarden local authority. Built primarily to receive gas from Troll, this plant became operational in 1996 and now also processes gas from the Kvitebjørn, Visund and Fram fields.

The plant consists mainly of three dew-point processing facilities for gas, condensate and monoethyleneglycol. A new unit for separating NGL from Kvitebjørn and Visund gas also became operational in 2004.

Powerful compressors ensure that the dry gas has sufficient pressure to travel through the Zeepipe II A and II B export pipelines. The NGL is piped via the Sture terminal further north to the Vestprosess fractionation plant at the Mongstad refinery for further processing.

Kollsnes can justifiably be called a green plant. Since it is electrically powered, emissions to the air and discharges to the sea are minimal.

Like Kårstø, the plant has been constantly modernised and expanded. It is also frequently upgraded to maintain reliable operation, safety and high regularity.

The original gas processing capacity has been almost doubled to roughly 146.5 million scm per day. With such a huge capacity, Kollsnes is unquestionably the giant in Norway’s gas transport system.

Facts

Gassco is the operator for Kollsnes, with Statoil as its technical service provider. The plant is owned by the Gassled joint venture.

Two small gas pipelines from Kollsnes run to the Kollsnes Industry Park and the combined heat and power station at Mongstad.

The process plant covers 200 hectares, and some 350 people are normally employed there.
The gas carried through the pipelines must pass through receiving terminals before it can be sent on to the customers in Europe. Located in Germany, Belgium, France and the UK, these facilities are operated by Gassco and have some 150 employees between them.
Last stop before the market

The receiving terminals remove possible liquid residues and solid particles, and undertake a final quality check, fiscal metering, and regulation of pressure and temperature. They then pass the gas on to the downstream distributors and the European market.
Gassco - Norwegian gas to Europe

Dornum
Dunkerque

The Franpipe gas line comes ashore at Port Ouest in Dunkerque on the coast of northern France. Completed in the summer of 1998, the receiving terminal is owned by Gassled and Gaz de France.

Sales gas from the NCS began arriving through Franpipe at the Dunkerque terminal on 1 July 1998. Operations at this facility are remotely controlled from the terminal in Zeebrugge.

Dornum

Gas transported through the Europipe and Europipe II lines is brought ashore at the Dornum receiving terminal in northern Germany. Gassco has 84 employees split between this facility and the Emden terminals.
Emden

The Emden Metering Station and the Norsea Gas Terminal outside the north German port of Emden receive gas from the Europipe/Europipe II and Norpipe lines. Emden has been a hub for Norwegian gas deliveries since 1977, when Norpipe became operational.

Zeebrugge

The Zeepipe receiving terminal has been in operation since 1993 and is owned by Gassled and Belgium’s Fluxys downstream gas operator. This facility is located in Zeebrugge’s port area, about five kilometres from the landfall for the Zeepipe line. The Zeebrugge and Dunkerque facilities have 36 Gassco employees between them.

Easington

This terminal on the English east coast has been operational since October 2006 and is owned by Gassled. Gassco will take over day-to-day operation of the facility from Britain’s Centrica on 1 October 2011. The facility receives gas from the Ormen Lange field and other sources through the Langeled pipeline. Starting at Nyhamna on the Norwegian west coast, this line comes ashore at Easington. Gassco’s organisation at the terminal is due to total about 30 employees.

St Fergus

The receiving terminal in St Fergus lies 61 kilometres north of Aberdeen in Scotland. Operational since 1977, it now receives dry gas through the Vesterled system and Norwegian rich gas via Britain’s Flags system.
Offshore installations

Gassco also operates offshore riser platforms and compressor installations related to its pipelines.

The two Draupner platforms – Draupner S and E – form a central hub in the gas pipeline network on the NCS. Their principal function is to monitor pressure, volume and quality.

With seven risers of 28-42 inches in diameter and associated manifolds, the Draupner installations represent an important crossroads for Norwegian gas transport to continental Europe.

The B-11 platform stands in the German North Sea sector, south-east of the Ekofisk centre. It serves as a compressor station on the Norpipe line to Emden.

Heimdal Riser is a riser installation tied to the Heimdal platform and operated as an integral part of the latter. It serves as a hub where gas from the Oseberg Gas Transport line is allocated between the Statpipe, Vesterled and Grane lines, together with gas from the Huldra, Heimdal, Vale and Skirne fields.
When you brush your teeth in the morning, there is a very good chance that the implement you use is made from processed natural gas.

Shopping bags, clothes pegs, mobile phones and bottles – this raw material can be encountered in a vast range of everyday products.

Put briefly, the hydrocarbon molecules in the gas are broken down under high pressure and temperature to produce monomers. These are the smallest building blocks for plastics. Putting them together in different combinations yields a variety of properties. Further along the process, monomers are combined into long chains known as polymers.
Plastics fall into two main groups – thermoplastics and thermosetting plastics.

The thermoplastics have threadlike molecules and retain their malleability. They can be heated and remoulded. That is not the case with thermosetting plastics, which have molecules in a three-dimensional network which is chemically fixed during production. The thermoplastics are very much the dominant group in terms of both number of types and volume. They are easier to work with, cheaper and used in large quantities – earning them the name volume plastics.

**Polyethylene (PE)** is the world’s most widely used volume plastic. With the simplest molecular structure of any plastic, it occurs in many varieties. Shopping bags are made from it, as are much food packaging and many household articles as well as pipes and cable insulation.

**Polyvinylchloride (PVC)** is the largest of the volume plastics. It needs to be compounded with additives to produce finished products. Much PVC production is used in building materials, such as waste water piping, and a good deal can be found in packaging. PVC is also used for rainwear.

**Polypropylene (PP)** can withstand higher temperatures. It has good surface hardness, resistance to chemicals and electrical insulation properties. PP is used in medical equipment because the material can handle steam sterilisation. It is also very suitable for use as fibres. Other plastic types include polystyrene (PS), polyester (UP) and epoxy (EP).
Many words and expressions are used in relation to oil and gas. Petroleum is a collective term for hydrocarbons, whether these occur in solid, liquid or gaseous form.
**Gscm**
Giga standard cubic metres = one billion cubic metres of gas at a pressure of 1.01325 bar and a temperature of 15°C.

**CNG**
Compressed natural gas.

**LNG**
Liquefied natural gas – primarily methane which has been cooled to a temperature of -163°C at atmospheric pressure. One tonne of LNG corresponds to about 1 400 standard cubic metres of gas.

**LPG**
Liquefied petroleum gases. Consist primarily of propane and butane, which are produced at Kårstø by a combination of fractionation and cooling.

**Natural gas**
Petroleum consisting primarily of light hydrocarbons. Can be divided into dry gas and natural gas liquids (NGL). Dry gas consists mainly of methane, but can often contain a certain amount of ethane and small quantities of heavier hydrocarbons. Also called sales gas. NGL consists primarily of ethane, propane and butane, and small amounts of heavier hydrocarbons.

**Condensate**
The heavier components in natural gas – pentane, hexane, heptane and so forth. Condensate is liquid at atmospheric pressure and temperature.

**Naphtha** (natural gasoline)
A liquid condensate which contains fewer of the heaviest components.

**NGL**
Natural gas liquids. Comprises the heavier gases – ethane, propane and butane – and small quantities of pentane, hexane and heptane.

**ncm**
Normal cubic metre, with a reference pressure of 1.01325 bar and temperature of 0°C.

**oe**
Oil equivalent. Oil and gas are often measured collectively as oil equivalent. As a rule of thumb, one tonne of oe = one tonne of oil = 1 100 scm of sales gas.

**scm**
Standard cubic metre at a reference pressure of 1.01325 bar and a temperature of 15°C.

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### COMPOSITION OF THE VARIOUS GAS TYPES

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<th>Rich gas</th>
<th>Dry (sales) gas</th>
<th>LNG</th>
<th>NGL</th>
<th>LPG</th>
<th>Condensate</th>
<th>Gross calorific value (GCV) MJ/scm</th>
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<td>Methane</td>
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<td>Butanes</td>
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<tr>
<td>Naphtha</td>
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Energy content (gross calorific value/GCV) MJ/scm

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<th></th>
<th>43-46</th>
<th>39-40</th>
<th>38-40</th>
<th>90-100</th>
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Value chain for gas

How oil and gas are formed
Plant residues, algae, plankton and marine animals were converted to hydrocarbons under the influence of heat and pressure many millions of years ago.

A reservoir
A porous, permeable rock which holds petroleum.

Exploration and drilling
Oil and gas exploration uses modern computer technology, geological maps and geophysical studies. Wells are drilled from rigs or ships.

Production and separation of oil and gas
Petroleum production on the field uses a platform or advanced subsea installations. Oil and gas are separated for onward transport and processing.

Receiving terminal
These facilities receive Norwegian gas at Emden and Donnum in Germany, Zeebrugge in Belgium, Dunkerque in France, St Fergus in Scotland and Easington in England.

Dry gas
Often called sales gas. This is natural gas which consists largely of methane, but can also contain some ethane.

Gas transport
Gas is carried by sea on special liquefied natural gas (LNG) carriers, or through pipelines laid on the seabed.

Oil transport
Crude oil is transported from the field in tankers loaded via a special buoy or by pipeline direct to land.

Oil for refining
After the oil has reached a refinery, it is separated into its various components in a distillation column and further processed into such products as heating oil, diesel oil or petrol.

Natural gas liquids
These products – propane, butanes, naphtha and condensate – are transported by ship.

Gas processing
Rich gas is processed into various components by piping it into the base of a tall column and applying heat. The lightest fractions rise up the column and are extracted, with the rest piped to the base of the next column. This process continues until all the components have been separated.

Transmission/distribution
Norwegian gas passes from the receiving terminals to end users in households, industry and power generation.

End users
Gas is used in continental Europe and the UK by households, office buildings, market gardeners and other businesses, power stations and industrial companies.

End users
NGL is used for heating or as feedstock for petrochemical industry, yielding a number of everyday products – not least plastics.
Norwegian gas exports have enjoyed a decade of growth, and will remain stable at a high level for the next 10 years as well.

<table>
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Welcome back