

ORYX GTL and the GTL Sector

Gas-to-liquids (GTL) technology as a commercial option for monetising gas reserves has been gathering momentum and growing in credibility since the Engineering, procurement and construction (EPC) contract for the ORYX GTL plant in Qatar was awarded in March of 2003.

Since then, ORYX GTL has been built and, at the time of writing, is ramping up to full production of 34,000 barrels per day of GTL products (approximately 24,000 b/d of GTL diesel, 9000 b/d of GTL naphtha and 1000 b/d of LPG). In size, ambition and in its method of funding; project financed by the international money markets, ORYX GTL is the first of its kind and the trailblazer for a new and exciting sector of the global energy industry. A joint venture between Qatar Petroleum (51%) and Sasol (49%), ORYX GTL has formed the vanguard for a series of projects by a variety of companies in a range of locations which, in combination with other initiatives by key customer groups, such as vehicle manufacturers, are serving to deliver the critical mass required for this newly commercialised energy production option.

For anyone involved in monetising gas reserves or in transport fuels, and for those who are looking to reduce greenhouse gas and other transport-related emissions, it is worth taking a moment to understand what is happening in the GTL industry today, how the industry is likely to develop and what it could deliver in terms of a cleaner transport future as well as the enhanced commercial opportunities it represents.



ORYX GTL is ramping up to full production of 34,000 b/d of GTL products.

► GTL in brief

To cover the GTL production process very briefly, natural gas is mixed with oxygen in a reaction to create a synthetic gas. This gas is then passed through a Fischer-Tropsch conversion process to produce a waxy syn-crude which is then upgraded in a hydrocracker. Companies involved in GTL production have their own proprietary technologies designed to integrate these three steps and optimise efficiency but the three stage process is common to all. Very high quality diesel and naphtha is produced and waxes and base oils can also feature on the product slate.

GTL diesel can be used in conventional compression ignition (diesel) engines and combines a very high cetane number (over 70 compared to a standard of 50-53) with a very low sulphur and aromatic content. These qualities enable significant reductions in exhaust gas emissions. The diesel is compatible with existing fuel distribution infrastructures and with current and envisaged-future engine and exhaust gas after-treatment technologies. GTL diesel can also be used as an efficient blend component for upgrading marginal middle distillate streams to on-road diesel fuel quality.

On a greenhouse gas emissions basis, from a life-cycle perspective

it is on a par with current crude-derived diesel technology, possibly slightly better¹. In engine tests carried out by DaimlerChrysler using neat GTL diesel, reductions in hydrocarbon and carbon monoxide emissions of over 80%, measured against a standard European Union diesel, were achieved. Reductions in NO_x, particulate matter and CO₂ were also recorded. Even when used in a 50:50 blend, the hydrocarbon and carbon monoxide emissions were reduced by at least 40%².

GTL naphtha is a highly paraffinic (95%+) material with a very low sulphur, naphthene and aromatic content. The light naphtha is ideally suited for producing ethylene and is an efficient liquid feedstock for ethylene cracking, which is an ideal application for the product.

The inherent qualities of GTL products make them well suited to their target markets. For GTL diesel, this is initially likely to be Europe, where a combination of extensive dieselisation; in some countries up to 50% of the vehicle fleet, together with a strong political emphasis on reducing emissions, makes it an

1. Gas-to-Liquids Lifecycle Assessment Synthesis Report, Five Winds International 2004.

2. Effect of GTL Diesel Fuels on Emissions and Engine Performance, DaimlerChrysler AG.

attractive proposition. In addition, in March 2006, the two leading GTL producers/marketers; Sasol Chevron and Shell, joined with DaimlerChrysler, Volkswagen and Renault to form the Alliance for Synthetic Fuels in Europe (ASFE) to promote the introduction of GTL and other synthetic fuels in Europe. The vehicle manufacturers are under pressures of their own to reduce transport emissions. One of the most effective means of doing this is to improve the quality of the fuel pool, which the addition of the synthetic fuel family (which includes biomass-to-liquids – BTL – as well as GTL) will undoubtedly do.

Whilst GTL products are attractive to the market and GTL diesel can actively address the environmental challenges involved with transport fuel use, in common with other energy sources, GTL must be able to answer questions about security and diversity of supply. In basic terms, this means creating a multi-plant industry capable of substantial production levels in different locations and based on a group of companies rather than on just one or two players. Though the process is at a relatively early stage with only one large-scale facility built, the industry is developing along these lines.

► Around the world

The EGTL plant in Nigeria, a 34,000 b/d plant based on the same technology as ORYX GTL, reached EPC award in April 2005 and is now under construction. The plant is scheduled to come onstream at the end of the decade and is co-owned by Chevron Nigeria Limited (75%) and the Nigerian National Petroleum Corporation (25%).



Sasol Chevron marked the opening of ORYX GTL with a GTL-fuelled rally from South Africa to Qatar. 34,000 b/d of GTL products.

In Qatar itself, which has publicly declared its ambition to be the GTL capital of the world, ORYX GTL is due to be followed by Shell's Pearl GTL project, a 140,000 b/d venture which is currently planned to begin production shortly after EGTL.

Qatar's GTL production is planned to be further increased by an expansion to ORYX GTL which will be overseen by Sasol Chevron and ExxonMobil has announced plans to build a 154,000 b/d facility.

In Algeria, Sonatrach has invited companies to bid on a GTL project based on Tinhert and, in addition to Sasol Chevron and Shell, companies such as Petro SA, Statoil and BHP Billiton have also shown an interest.

Australia and Russia are strong contenders to participate in the development of GTL as a global industry and there are signs that major gas owners are beginning to view the possession of a GTL



GTL diesel combines a very high cetane number with a very low sulphur and aromatic content.

production capability as a strategic play to maximise future monetisation options. Certainly the traditional view was that GTL production would be restricted to remote gas reserves since piping the molecules to market was by far the cheaper option, but this model does not fit current developments in places like Algeria nor does it explain growing interest from other gas producers with viable pipeline options.

GTL as an industry has made a solid start but challenges remain. There will be a great deal of focus on ORYX GTL during the first year or so of operations and there is a standing challenge on all would-be GTL players to continually attack costs and achieve a competitive economic performance compared to other gas monetisation options. Additionally, and in common with the rest of the energy industry, GTL is facing pressure from increased construction costs and even the cheapest plant, ORYX GTL, cost a US\$1 billion.

For GTL to achieve the cost reduction profile that LNG achieved will require ever more efficient operations, an effective method of capturing the lessons learned from operational experience and, above all, a significant and consistent investment in research and development.

On the plus side, the GTL industry is producing top quality products for growing markets and these products have an environmental profile in line with current legislative trends which are unlikely to change in the foreseeable future. In addition, the first large-scale commercial plant has now been built... and the first one is always the hardest.



European Pipeline Development – Securing Energy Supplies

By Adrian Giddings

The then 25 members of the European Union imported 53% of their gas consumption by pipeline from outside the Union in 2005, a share that is set to increase as production from mature domestic fields falls. Although investments in new receiving terminals will also see LNG imports rise, their 2005 share of 9% of EU gas consumption means pipeline imports will continue to dominate.

This feature focuses on some of the newly commissioned pipelines in Europe and those being developed in the near future, which are either



Andris Piebalgs: issue of energy security is on the table of every energy minister.

strengthening the gas transmission network within Europe or opening up new supply routes to diversify the sources of gas imports.

Last year saw events that have raised the issue of energy security to the top of the EU's political agenda. As Andris Piebalgs, EU Energy Commissioner points out: "The issue of energy security is on the table of every energy minister, as well as foreign, finance and industry ministers across Europe."

One of the key triggers for this was the Russian state-controlled company Gazprom's dispute with Ukraine over the price that Kiev pays for gas imports early in the year. Gazprom's long-term aim is to increase the prices it charges its Eastern European customers to bring them more in line with those for exports to Western European customers who pay above \$250 per 1000 cubic metres.

The temporary interruption of Ukraine's gas supplies linked to a greater-than-forecast demand for gas across Europe had a knock-on effect which was felt across the region causing shortfalls in supply and sharp rises in wholesale gas prices. In the UK, for example, a market that was already concerned with the possibilities of gas shortages in the latter part of 2005 had seen prices rise 550% that November, and early in 2006 prices rose by almost 650% over their previous levels before subsiding.

Later in the year the ability for one broken link in the electricity transmission network to effectively cripple the European grid highlighted the importance of diversified distribution routes to energy security in the region.

On November 4 widespread power cuts in Germany, France, Italy, Portugal and Spain that left millions without electricity were caused by the closing of just one line across the River Ems in north-western Germany to allow the safe passage of a newly-built cruise ship, the *Norwegian Pearl*. Austria, Belgium, Croatia and The Netherlands were also affected and the problems even reached as far as Morocco.



The Norwegian Pearl unwittingly caused blackouts across Europe.

Then at the end of the year the escalation of Gazprom's pricing dispute with Belarus raised the spectre of a fresh interruption to gas supplies. (About 20% of Russia's gas exports to Europe are routed through Belarus with the rest going through Ukraine.)

At the 11th hour a settlement was reached with the price Minsk pays for its Russian gas rising from \$47 to \$100 per 1000 cubic metres for 2007. There will be a staged increase thereafter to market rates and as part of the deal Gazprom will take a 50% stake in Beltransgas, which operates the transit pipeline.

● **Developments in the EU's internal network**

Investment within Europe on the existing gas transmission network, as well as in new storage capacity, will alleviate market fluctuations and local supply issues. For example, the GWWL pipeline in The Netherlands, which is due to be completed in November, will not only guarantee security of

supply for the west of the country but also strengthen the cross-border network. The project is divided into two phases: a 1220 millimetre (48 inch) pipeline covering the 80 kilometres between



Gazprom's Chairman Alexei Miller (right) and the Belarusian Prime Minister Sergei Sidorsky shake hands on their new contract.



Grijpskerk and Workum and a further 30-kilometre section between Workum and Wieringermeer. The possibility of converting compressor stations from single to bi-directional flow will also add flexibility to the existing European transmission grid.

With the vast costs and long time frames involved in the development of new transmission infrastructure projects – from the planning stages through to construction and commissioning – the importance of securing an acceptable return on investment for all parties involved is obviously vital to getting them started in the first place.

During the planning stages of the recently-opened Balgzand-Bacton (BBL) pipeline which links The Netherlands and the UK, new Gas Directives were about to come into force in the EU introducing a regulated third party access (RTPA) regime for all gas interconnectors and LNG import terminals. These measures seek to increase competition in the gas sector by allowing independent producers to gain access to transmission grids and

thus to potential consumers. However, balancing the needs of third parties wishing to access the network with those of pipeline operators seeking to recoup the large investments in infrastructure development is of great concern to all involved.

The Directives allow provision for exemption from RTPA to be granted by relevant regulatory authorities in certain circumstances and Gasunie, as the original promoter of BBL, applied for exemption from the Directives even before they were in place. Only when assurances that such exemptions would be granted when they came into force, by both the Dutch and UK regulators as well as the European Commission (which holds a veto in such matters), did construction work on the €500 million project go ahead.

Officially opened on December 1, 2006, BBL is the first pipeline to link The Netherlands with the UK. It consists of a compressor station on the Dutch side, 235 kilometres of pipeline (230 kilometres of which is offshore) with a diameter of 915



Norwegian Prime Minister Jens Stoltenberg (LEFT) and UK Prime Minister Tony Blair (RIGHT) at the opening ceremony for the first section of the Langeled pipeline.



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millimetres (36 inches) and a receiving terminal in Bacton on the Norfolk coast. It is able to transport approximately 15 bcm of gas per year which amounts to 15% of the UK's current gas needs.

Though the project was initially conceived independently by Gasunie, BBL Company which was formed to build, own and operate the pipeline, was established as a joint venture between a subsidiary of Gasunie, holding a 60% stake, and subsidiaries of Germany's E.ON Ruhrgas and Belgium's Fluxys, each with 20%. In October 2006 Gasunie signed a Memorandum of Understanding with Gazprom to receive 9% of the shares in Nord Stream AG in exchange for 9% of the shares in the BBL Company.

● **Langeled – bringing more Norwegian gas to the EU**

The first phase of the Langeled pipeline, which will soon see Norway's giant Ormen Lange field linked to the UK, was officially opened on October 16, 2006. This initial section links Statoil's Sleipner fields in the North Sea with Easington in England via a 1120 millimetre (44 inch) diameter pipeline, the largest submarine pipeline in the North Sea. The second section, scheduled for completion this October when the Ormen Lange field begins production, connects Ormen Lange to a gas processing plant in Nyhamna on the western coast of Norway and from there to the Sleipner Riser. At some 1200 kilometres in length it will be the longest underwater pipeline in the world and with an annual capacity of 27 bcm will supply one-fifth of the UK's projected gas needs in the coming decades.

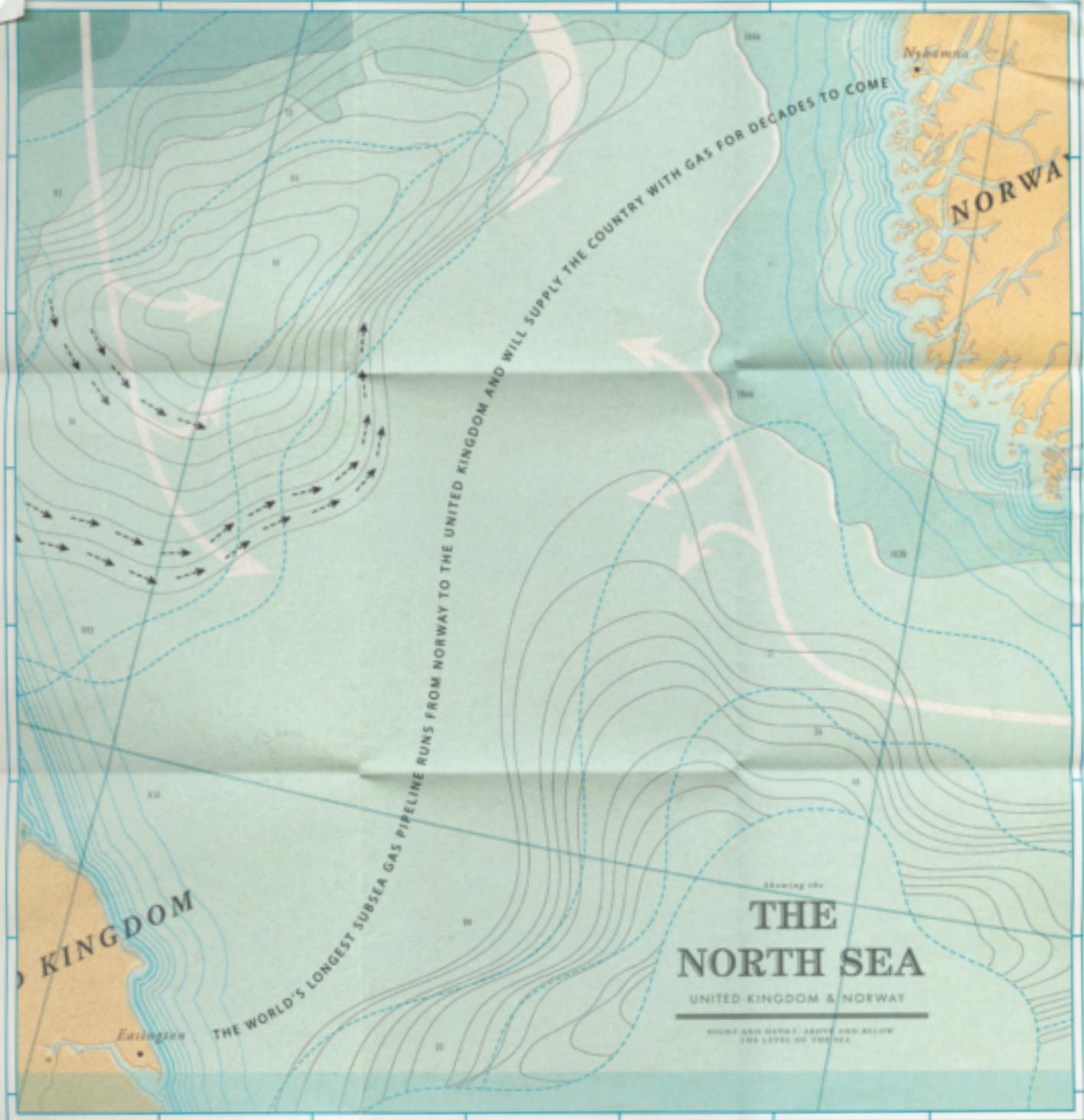
Langeled and BBL will go some way to addressing the UK's energy concerns. However, there is only one pipeline from the UK to continental Europe (the Interconnector from Bacton to Zeebrugge in Belgium) that has the capacity to let gas flow both ways. The BBL pipeline can only import gas to the UK, though, if the need arises, it will be possible to modify BBL to allow bi-directional flow in the future.

This situation became a problem last year during testing of the first section of the Langeled pipeline by its operator, Gassco, which sent large volumes through the pipeline regardless of the price it would fetch on the markets. With UK storage capacity full at the time, production had to be cut by North Sea producers to match demand, gas was being sent through the Interconnector to continental Europe and some energy traders were even forced to pay people to take gas from them.

● **Nord Stream – linking Russia directly to Germany**

Norway is the second largest supplier of gas to the EU with Russia, of course, in the top position and Nord Stream AG has been formed to build and operate a new supply route for Russian gas. Approximately 1200 kilometres in length and scheduled to start operation in 2010, Nord Stream (formerly named the North European Gas Pipeline) will connect Vyborg in Russia via the Baltic Sea to Greifswald in Germany creating the first direct pipeline from Russia to the markets of Western Europe. The €5 billion project will be realised in two phases, the first seeing the construction of a 1220 millimetre (48 inch) diameter pipeline with an annual capacity of 27.5 bcm. The second phase will double capacity to 55 bcm per year.

The majority shareholder in Nord Stream is Gazprom (51%) with E.ON Ruhrgas and Wintershall each having a 24.5% stake. As mentioned above, they will shortly be joined by Gasunie, whereupon the stakes of E.ON Ruhrgas and Wintershall will fall to 20%. Construction work on the 971-kilometre onshore link from Gryazovetz and the existing lines from the Siberian gas fields to Vyborg began in December 2005. Meanwhile, an Environmental Impact Assessment (EIA) is being carried out on the offshore portion of the project. This is expected



In October we opened Langeled, the 1200-kilometre long pipeline between Norway and the UK. When the Ormen Lange gas processing plant at Nyhamna off the coast of Western Norway comes on stream in October next year, the pipeline will transport large volumes of gas to Europe, efficiently and safely.

Ormen Lange is one of the most complicated and sophisticated projects in the world, and will strengthen Norway's role as one of the world's largest gas exporters. When Ormen Lange comes on stream, 20 per cent of the UK's gas needs will be met for decades to come.

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1 In 2000 President Bouteflika of Algeria renamed Transmed as the Enrico Mattei Gas Pipeline and MEG as the Pedro Durán Farrel. However, they are still widely known by their old names.



ABOVE Nord Stream's planned route. BELOW Construction of the Russian onshore link is underway.

to have been completed and approved by early 2008 with construction to follow soon after.

Now that Gazprom has decided against LNG exports from the Shtokman field in the Barents Sea, Nord Stream is likely to handle some of the Shtokman production. It is expected that a pipeline will be built across the Kola Peninsular to the Baltic to link up with Nord Stream.

● Algeria – new Mediterranean pipelines

In the number three position as an EU gas supplier is Algeria, which is developing two new pipelines in projects led by Sonatrach to increase capacity to Italy and Spain.

There are already two major pipelines from Algeria to Europe: the Trans-Mediterranean Pipeline (Transmed) and the Maghreb-Europe Gas Pipeline (MEG).¹ Transmed links the Hassi R'Mel field in Algeria via Tunisia to Sicily and mainland Italy. Constructed between 1978 and 1983, it was the first pipeline involving a deep-water crossing, shifting emphasis away from the LNG trade between Algeria and Europe. Transmed's capacity has been successively expanded. MEG transits Morocco, crosses the Mediterranean by the Straits of Gibraltar and, after making landfall in Cordoba, connects to the Spanish and Portuguese grids.

The first new pipeline will be Medgaz linking Beni Saf in Algeria with Almeria in Spain, which is due to enter service in 2009 and transport 8 bcm per year. Medgaz will be joined in 2011 by the



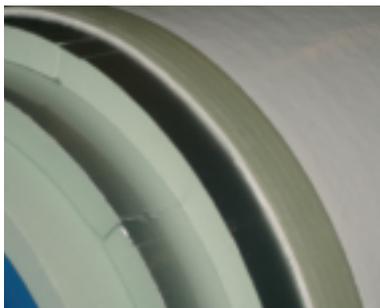


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The unit can protect pipes with a diameter up to 56", a length of 20 meter and a weight of 20 ton.



2 From the French: Gazoduc Algérie-Italie via la Sardaigne.

Galsi² pipeline of a similar capacity. This will leave the Algerian coast at El Kala, transit Sardinia and land on the Italian mainland at Castiglione della Pescaia.

● **New routes from the Caucasus and Middle East**

The South Caucasus Pipeline (SCP) began deliveries of gas from Azerbaijan's Shah Deniz field in the Caspian Sea in December 2006, as one of a series of projects designed to provide a transport route for gas from the Middle East and the Caspian region to Western Europe. Initially supplying Turkey and Georgia, SCP's route runs parallel to the BTC oil pipeline thus minimising the environmental and social impact of such a major project. Starting from the Sangachal terminal south-west of Baku, SCP's 692 kilometres run via Tbilisi in Georgia to Erzurum in Turkey. As a transit country Georgia has the right to take 5% of the annual projected 7 bcm of gas flowing through the line in lieu of tariffs, and can purchase a further 0.5 bcm at a discounted rate. The project consortium is a joint venture led by BP and Statoil.

SCP will link with the future Interconnector Greece-Italy (IGI) and proposed Nabucco pipelines. IGI will have an annual capacity of 8 bcm and run for 800 kilometres between the Greek-Turkish border and the Apulia region in southern Italy. The €950 million project is being developed by Edison and Depa, who expect to begin construction in 2008 with completion in 2011.

Nabucco is a much bigger project with a price tag of €5 billion and its partners led by OMV of Austria and including MOL (Hungary), Transgaz (Romania), Bulgargaz (Bulgaria) and BOTAS of Turkey have yet to approve a final go-ahead. The project calls for a 3300-kilometre pipeline linking the gas hub at Erzurum in Turkey with Baumgarten in Austria via Bulgaria, Romania and Hungary. Initial capacity would be around 8 bcm with the potential to expand up to 30 bcm in the long term.

The Erzurum hub is linked to Tabriz in Iran, while Baumgarten is a major gas hub for the European network. Approximately one-third of all gas exports from Russia to Western Europe currently pass through Baumgarten.

● **Security in diversification**

Commissioner Piebalgs has declared that the EU must diversify its sources of gas supply and secure adequate import capacity. Developing alternative pipeline routes from neighbouring gas producing countries, increasing internal transportation and storage capacity and developing LNG imports will go a long way to providing European energy security in the future.

Adrian Giddings is a Contributing Editor at International Systems and Communications.



Baumgarten in Austria is a major gas hub for the European network.

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- Vyborg, Russia—Greifswald, Germany
- 1200 km long
- 2 parallel pipelines
- 27.5 bcm p.a. capacity each
- 55 bcm p.a. total capacity
- 2010 — planned commissioning of 1st pipeline
- 2012 — planned commissioning of 2nd pipeline
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Preventing Third Party Interference to Pipelines

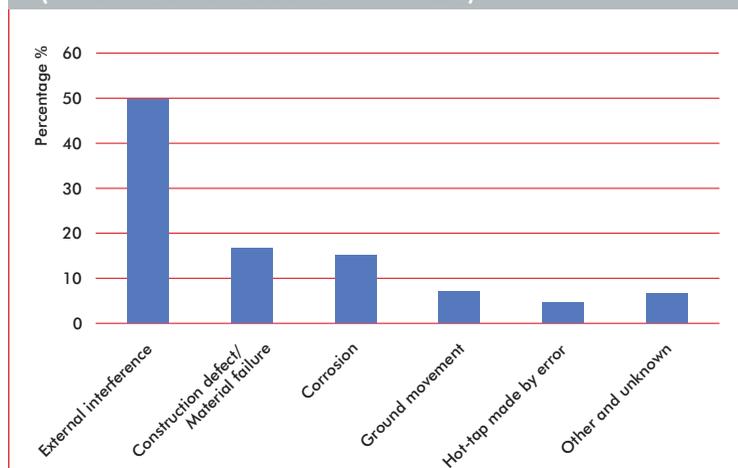
By Daniel Hec, Jean-Pierre Beringuier and Samir Akel

Incident statistics in Europe (see Figure 1), North America and Canada show clearly that third party interference damage is by far the most significant cause of gas pipeline incidents resulting in unintended releases of gas (ignited as well as unignited). However, this well-known fact has to be placed in the context of the excellent safety records of European gas operators in both transmission and distribution activities.

Recent studies on the subject of energy transportation and the results and analysis of reliable incident databases such as those produced by the European Gas Pipeline Incident Data Group (EGIG) show that failure frequencies of gas pipelines are low. Gas operators have a long tradition of self-regulation and over the years they have developed best practices to manage gas pipelines in a safe and cost-effective way. These best practices are now recognised at the European level, in particular via the high-level functional standards prepared by

BELOW
Figure 1.

DISTRIBUTION OF INCIDENTS PER CAUSE (FROM EGIG 2005 DATABASE)



Route markers signalling the presence of high-pressure gas pipelines are used to prevent third party damage.

the European Committee for Standardisation's (CEN) Technical Committee CEN/TC 234 "Gas Infrastructure", which covers all gas infrastructure activities from network design to operation.

As a means of highlighting the industry's constant efforts to reduce third party interference, Marcogaz, the Technical Association of the European Gas Industry, has issued a position paper, which is summarised in this article.

● Existing common practices

Third party interference is a key concern of European gas companies and to counter it they have developed a range of technical and organisational tools based on regulation and/or internal specifications. Each tool is balanced with the threat to be suppressed.

Examples of technical tools are:

- Route markers;

- Depth of cover; and
- Pressure control.

Examples of organisational tools are:

- Surveillance by foot, car and helicopter;
- Obligation to obtain information before digging; and
- Supervision by the operator.

The wide variety of tools is applied by each individual company, leading to good results in reducing third party interference. In addition, further innovative practices are under development but still have to prove their effectiveness and fitness-for-purpose compared to proven techniques.

On these subjects, the European gas industry has always been, and remains, proactive with a constant cooperation effort at European and international levels, more particularly through the auspices of Marcogaz, GERG (Groupe Européen de Recherche Gazière) and IGU.



Other means of preventing third party interference include surveillance (ABOVE) and depth of cover (BELOW).





● **Recommended additional practices**

Despite the above-recognised measures third party damage persists, with many non-declared works still being discovered by the gas operators. The following reasons can be put forward:

- Legal requirements controlling the behaviour of contractors and subcontractors in order to reduce third party interference can be insufficient or even non-existent;
- Due to the fact that there is often no legal constraint system for violation of instructions from operators, “time is money” sometimes has a higher priority than “safety first”;
- Although in some countries special training courses are performed for diggers, procedures are not always well known or not thoroughly followed by contractors or subcontractors;
- Only a small part of all the digging and excavation work is performed under the direct control of the gas industry. Hence it is of utmost importance that all digging and excavation work is performed by well-trained staff and under the full responsibility of the contractor.

One of the key issues concerning third party interference is therefore the establishment or the reinforcement of legal requirements and their full implementation where they already exist. The experience of gas operators clearly shows that contravention of legislation and procedures is the main cause of the majority of pipeline incidents which lead to failure. Moreover, the sharing of information and coordination among the different stakeholders are thought to contribute significantly to reducing pipeline incidents caused by third party interference. Here are some of the relevant recommendations issued by Marcogaz:

- Maintain and improve good relationships with third parties and inform them regularly about their own responsibility, the rules etc;
- Develop flexible tools for the direct exchange of information with all the stakeholders regarding the precise location of their underground infra-structures. Examples are the Klic system in The

Netherlands or the where2dig internet portal in Germany;

- Establish, for specific sensitive areas, a tailored survey procedure during the entire digging activity;
- As far as practicable, require a certification and/or a qualification of subcontractors as well as plant operators;
- Prepare in advance a special European standardised questionnaire on third party interference allowing rapid qualification of the digging company’s behaviour and showing whether or not the latter complies with the requirements;
- Provide emergency guidelines that the staff of digging companies must follow when damage occurs in order to minimise the consequences and avoid the incident becoming more serious.

● **R&D programmes and new technologies**

Investing in R&D and new technologies offers the opportunity of improving the integrity and safety of pipelines as regards third party interference. European gas operators have developed R&D cooperation in the following areas:

- Proactive or real-time intelligent survey systems (“smart networks”) based on new technologies such as fibre optics, GPS, ICT, etc;
- Assessing the possibility of installing active buried strips (for new pipelines) allowing simple and fast detection of the pipeline by means of special detecting instruments;
- New technologies for efficient gas leakage detection such as laser systems and acoustic techniques;
- Operators’ practices and safety procedures taking into account human factors;
- New spatial technologies taking into account the lessons learnt with the European “Presense” project¹.

The effectiveness of the above-mentioned preventive techniques will be measured before any recommendation is given on their application.

¹ The €4 million, 17-partner “Presense” project, Pipeline Remote Sensing for Safety and the Environment, ran from January 2002 to September 2004 and was part funded in the 5th EU Framework Programme for Research and Technological Development.

Gas Infrastructure... Connecting Countries Connecting Markets

The Mozambique to South Africa pipeline has been in operation since March 2004.

iGas is the South African national gas infrastructure company, responsible for developing and owning hydrocarbon gas infrastructure in Southern Africa.

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A Section of the Mozambique to South Africa Natural Gas Pipeline during construction

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Beyond these ambitious objectives, four main recommendations have been identified by Marcogaz:

- Gas industry initiatives to reduce third party interference should be co-funded by public authorities (through the 7th Framework Programme for Research and Technological Development in Europe, for instance). Maintaining the reliability and safety of gas infrastructure should be identified by the EU as one of the priorities of the 7th Framework Programme;
- Gas operators should continue collaborative R&D projects concerning pipeline safety and more particularly under the umbrella of GERG;
- The gas industry can contribute to different technology network initiatives taken at European and/or national levels such as the European Technology Platform concerning industrial safety and the technology network proposed by the Joint Research Centre of the European Commission;
- Gas operators should continue and expand their collaboration in collecting and reporting on pipeline incidents (EGIG²).

● Conclusion and general recommendations

Despite the non-harmonised procedures used by gas operators, fundamental principles (surveys, indicating signs, restricted areas, emergency plans, etc.) are commonly used and good results obtained. However, maintaining this satisfactory level demands continuous efforts in terms of human resources and significant operational and capital expenses at a time when the opening up of the European gas market is placing an emphasis on cost reduction.

Although in the previous paragraphs we have highlighted the gas operators' best practices and given some new recommendations to improve pipeline protection against third party interference, the outstanding key solution involves (sub) contractors and digging companies who sometimes ignore basic legal requirements, which directly

leads to pipeline disturbance and damage. Since the ability of gas operators to convince those companies to respect legal procedures is minimal, it is implicit upon public authorities to take adequate corrective measures (for example: more stringent regulation targeting third parties, severe penalties in case of recurrent damages). That would not only protect high pressure gas pipelines, but all other buried infrastructure including other types of pipelines and telecommunication and electricity cables. However, gas companies should play a role in directly advising, where appropriate, those national public authorities, a role left until now to Marcogaz at the European level.

Clearly, third party interference remains a complex problem to deal with. In addition, its consequences are not limited to those directly involved (digging companies and gas operators) but can affect gas customers and the public in general. Nevertheless, the success of any action in this field needs the total cooperation of all parties.

To conclude, it is thought that the following general recommendations deserve special attention on the part of the gas industry:

- All new practices/tools should be evaluated in terms of their effectiveness;
- Communication is a key aspect in helping contractors to understand the risks and steps they need to take to mitigate those risks;
- New technology developments should be encouraged with the aim of reducing risks in the medium-to-long-term; and
- Common key practices should continue to be harmonised at the European level, for example through CEN standards.

Daniel Hec is the Secretary General of Marcogaz (www.marcogaz.org), which is an organisation affiliated to IGU. Jean-Pierre Beringuier and Samir Akel, both of Gaz de France, are respectively the Chairman and Secretary of the Marcogaz Working Group on Third Party Interference.

² For more information go to www.egig.nl.

The Piglet System

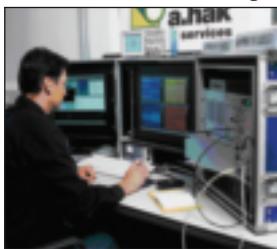
Designed by A. Hak Industrial Services especially for relatively short “non-standard piggable” pipelines, this is an intelligent versatile tethered intelligent pigging system which is still attached to an “umbilical”.



Despite this “umbilical” it still has the ability to inspect pipeline lengths up to 12 kilometres in one run, negotiate an unlimited number of bends, is able to travel in two directions, has the ability to inspect multiple diameters in one inspection run, and provide all ultrasonic measurements on-line.

An advanced data acquisition system stores all data simultaneously on discs, which will allow for a detailed post processing. This Piglet system has combined the advantages of a regular pigging system with the advantages of a cable-operated pigging system, whereby the disadvantages of both have been eliminated.

The success of the Piglet is based on the patented “umbilical” design and storage. The Piglet uses a glass fibre optic which has a diameter of less than 1 mm. This glass fibre optic is stored on a patented unwinding reel which is stored in the Piglet itself. This results in an



operational mode whereby the glass fibre optic is not pulled into the pipe whilst the Piglet is pumped into the pipeline, but merely unreels the glass fibre whilst it is progressing to the end.

► Inspection range

Diameter	Max. length*	Insp. speed
4"	2 km	500 m/h
6"	6 km	500 m/h
8"	12 km	500 m/h
10" – 18"	12 km	250 m/h
20" – 36"	12 km	125 m/h
40" – 48"	12 km	75 m/h

* Based on client requirements, we can redesign tools up to an inspection length of 35 kilometres

► Operational aspects

To send the Piglet through the pipeline, it requires a fluid in the pipeline for propulsion, and a differential pressure over the Piglet system. The Piglet can in such a manner be pumped forward and backward through the pipeline.

► A. Hak Industrial Services B.V.

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Dreams and Realities: Highlights of South American Gas Developments

By Terence H. Thorn

This is the second of two articles giving an update on developments in the gas industry in South America. The first article was published in the October 2006 issue and focused on Peru, which was then hosting the IGU Council meeting. Here, we broaden the scope to look at the rest of the continent.

Taken as a whole, South American economies are doing better than they have in a decade. Across the continent, inflation has been on a steady decline and in most places has dropped to the low single digits for the first time in decades. Economic growth, while far from spectacular, has been solid for the past five years. Regional GDP grew by around 4% in 2006, the best performance since 1997. Prices for Latin America's raw materials have soared thanks to voracious demand for them in China and foreign capital has been slowly trickling back.

But 2006 was also a year of electoral ferment. South America is experiencing another wave of nationalist fervour, fuelled by old resentments, rising energy prices, and a general disillusionment with free-market reforms that have left significant numbers of people in poverty. Politics dominated the news as 10 new governments were elected.

The natural gas industry has been swept up in these political storms. Inspired in part by the economic nationalism of Venezuelan leader Hugo Chávez, newly-elected leftist-populist governments in Bolivia and Ecuador have followed his path. Seeing record profits in the energy production sector, the new governments are pressuring foreign energy companies to cede greater shares of their revenues and are pursuing "nationalisation by taxation". At a time of ever-growing demand, gas consumers are concerned that the newly empowered national energy companies lack the skills necessary to manage and develop their natural gas resources and will drive away the foreign capital investment necessary to sustain natural gas production.

Not everyone has followed Venezuela's lead. The majority of countries have chosen long-time socialist presidents who tap into a more powerful force: the desire for economic stability. In Brazil, Peru, Chile and Colombia the people have elected governments which combine a populist social agenda with market-friendly economic policies. These governments are emphasising education, anti-poverty programmes, healthcare and housing within a more or less orthodox market approach.

Against this volatile backdrop, South American natural gas companies are scrambling to obtain energy supplies and find the capital to invest in needed infrastructure.

● **Bolivia: The corazón of South America's gas network skips a beat**

In January 2006, all eyes turned to Bolivia as Evo Morales took office and announced a series of sweeping reforms that have helped make him one

GAS RESERVES AND PRODUCTION FOR KEY SOUTH AMERICAN COUNTRIES IN 2005

Country	Proved Reserves (tcm)	Production (bcm)	Gas share of total primary energy consumption
Venezuela	4.32	28.9	37.7%
Bolivia	0.74	10.4	32.8%
Argentina	0.5	45.6	54.6%
Peru	0.33	1.6	11%
Brazil	0.31	11.4	9.4%
Colombia	0.11	6.8	22%

Source: BP Statistical Review of World Energy June 2006



“Nationalised, property of Bolivians” reads this banner put up on May 1, 2006 at the San Alberto gas field in Tarija, Bolivia.

of the most popular presidents in modern Bolivian history. He is the seventh president in six years.

As promised in the campaign, President Morales nationalised Bolivia’s oil and gas industry on May 1, 2006, giving foreign companies six months to hand over a majority stake in their Bolivian operations or abandon the country. The executive decree nationalised natural hydrocarbons resources and declared that the state “recovers the property, possession, and total and absolute control of these resources”.

Most of the stipulations of the May 1 decree are contained in the Hydrocarbons Law of May 2005 which annulled a 1996 statute that sold state-owned companies, downscaled government spending and regulation and courted foreign capital. Under the 1996 law, foreign investors poured billions of dollars into the exploration, production and transmission of natural gas. The resulting increase in proven and potential gas reserves was spectacular, and in 1999, natural gas

began to flow from Bolivian fields to São Paulo and Porto Alegre in Brazil through a new pipeline, Gasoduto Bolivia-Brasil (Gasbol), constructed at a cost of some \$2.2 billion. However, since 2002, political instability had reduced foreign investment in Bolivian hydrocarbons to a trickle.

The new law required that all contracts signed under the 1996 law for exploration, production and marketing be reissued within 180 days. The law also imposed a new tax of 32% (in addition to the existing 50% tax) on production, measured at the wellhead. All foreign energy companies had to surrender operational control to the state’s energy company, Yacimientos Petrolíferos Fiscales Bolivianos (YPFB). The intention is for YPFB to take a majority stake in the five companies that were privatised by the government in 1995.

This is not nationalisation in the classic sense. In the confiscations that took place in the region in the 1950s and 1970s, Latin American governments expropriated everything and kicked out the



Petrobras people
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This must be why we are
the most valuable company
in Latin America.

That Petrobras is growing, nobody doubts. In the last two years, it rose 68 positions in Business Week's global list of 1,200 companies. Now, Petrobras is the most valuable company in Latin America. In the gas sector alone, it is in eighth position on the list. This could be a surprise for some people, but not for those who know our commitment to work, and our constant will to overcome challenges.



Presidents Néstor Kirchner of Argentina (left) and Evo Morales of Bolivia (right) sign a 20-year gas deal. The ceremony took place in the Bolivian city of Santa Cruz de la Sierra on October 19, 2006.

companies the next day. This time Bolivia will exert greater control over the companies through significantly higher taxes and 51% state ownership. President Morales has pledged to create an environment conducive to private profit-making, and the government has repeatedly stated that it is “nationalisation without confiscation”, with no expulsion of foreign companies nor expropriation of their assets.

Realising that the state-run firm lacks the manpower and technological expertise to run the gas fields, the government issued a statement in August 2006 announcing the temporary suspension of the “full effect” of the nationalisation programme because of a lack of funds. Foreign firms will continue to operate them as talks continue. The main operators in Bolivia are Brazil’s state-owned company Petrobras, Repsol-YPF, BG Group, BP and Total.

Since May the energy talks have often been acrimonious and have periodically broken down, causing tensions between the neighbouring countries as Bolivia demanded higher prices for its natural gas and a controlling stake in the Bolivian operations of Petrobras. But in a signing ceremony just minutes before the October 29 midnight deadline, President Morales announced agreements that would quadruple Bolivia’s energy

revenues over the next four years, from a current \$1 billion.

The terms of the new agreement are less draconian for the companies than the May 1 Nationalisation Decree but are much harsher than their existing contracts. Petrobras, the biggest operator, with almost half of the gas reserves in Bolivia, will now pay royalties and taxes of 50% on its two biggest fields, down from 82% under the Decree. After Petrobras defrays its costs (including amortisation) it will split the remaining revenue with YPFB under a variable formula. In some mature fields the tax will total 80%. Other companies have signed similar new contracts. Companies will be “partners” with YPFB, which will have the right to participate in administration of the fields, supervise tender bids for goods and services and approve the value of operational costs and capital expenditures. How all of this will work in practice is unclear.

The deals are clearly a big political victory for the President and affirm his effort to give the state a larger role in the economy. Bolivia’s government gets 34% of its revenue from hydrocarbons, which also account for 9% of GDP. While Bolivia has received an economic boost from the rising prices of all the commodities it exports – including tin, copper and silver – it is still the poorest country in South America and heavily indebted to international institutions. Bolivian incomes are stagnant, and half of the population lives on less than \$2 a day.

However, it is not clear whether the new terms will reverse the precipitate fall in energy investment and enable Bolivia to develop its reserves of natural gas. At 0.74 trillion cubic metres (tcm) these are the second largest in South America after Venezuela. Without new investment Bolivia will not be able to fulfil the volumes in its export contracts with Brazil and Argentina by 2010.

Bolivia is gambling by picking a fight over its natural gas exports. Lacking pipelines to the sea, the landlocked country has one main customer – Brazil – and is seeking to renegotiate the price it



charges to \$5 per million btu (Mmbtu). While Bolivia supplies almost half of Brazil's natural gas needs, Brazil accounts for 70% of Bolivia's natural gas sales, some 26 million cubic metres (mcm) of gas a day. Petrobras insists it has made no new commitments and has no plans to expand in Bolivia, and earlier plans to double the capacity of the gas pipeline from Bolivia have been suspended as Petrobras focuses on investing to boost gas production at home.

Bolivia's best hopes of increasing gas exports lie with Argentina, whose President, Néstor Kirchner, signed a deal with President Morales in October 2006 under which imports of Bolivian gas would quadruple to match those of Brazil. Argentina agreed to pay an initial price of \$5 per Mmbtu, which is what Bolivia would like to charge Brazil. Increasing exports to the full extent envisaged by the deal will require a new pipeline costing \$1.2 billion, as well as investment in developing new

gas fields, and Argentina's state energy company Enarsa will participate in the exploration and development of Bolivia's reserves.

● **Brazil: Developing domestic production**

Home to 186 million people and South America's largest economy, Brazil remains the continent's economic engine. It is the third largest energy consumer in the Americas and the 11th largest in the world.

President Luiz Inácio Lula da Silva easily won a second four-year term in October 2006. Universally known simply as Lula, the former metalworker and union leader has been able to improve the lives of some 8 million of Brazil's poor, who previously were largely excluded from the country's developing economy and democracy. Lula's achievements have come without populist trappings, irresponsible fiscal policies or erosion of democracy. Lifting Brazil out of a somewhat

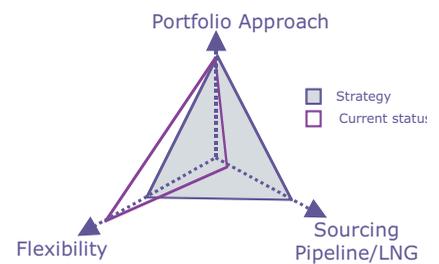


Brazil's Petrobras operates in challenging domestic environments both onshore (the Urucu oil and natural gas processing plant in the Amazon jungle is pictured) and offshore.

Execution of Nuon's Gas Strategy: A Foundation to Build Upon.

As the European Gas market has been relatively closed, Nuon since 2002 has been consistent in striving to acquire or develop flexibility for its customer books. To that end, Nuon evaluated the market from a bottom up approach. This approach led to an analytical approach to gas commodity sourcing, gas flexibility and portfolio management.

Nuon decided that the most critical aspect to its long term value proposition was to develop its own flexibility instruments that could be utilized as the market was opening. Currently a majority of Nuon's gas that is sold to retail, business and the power assets is purchased from Gasunie Trade and Supply. Nuon's strategy has been to develop a long term business approach that would allow a more balanced approach to gas sourcing.



Consequently, Nuon decided in 2004 to develop Epe Gas Storage. In late 2005, Nuon further committed to this strategy by agreeing to co-develop Zuidwending Gas Storage in a joint-venture with Gasunie B.V.

Assets

These storage assets are positioned to balance NL customer demand at the Title Transfer Facility and are designed to provide peak deliverability for the retail clients, to bundle gas sales to power assets and industrial consumers and to allow potential diversification via the growing LNG business, plus benefit from potential arbitrage opportunities in the different European Gas market with its diverse price drivers. An additional criterion that is inherent in our strategy is the connectability of the NL market to the UK market. LNG, existing pipeline gas as well as new pipeline projects have convinced us that by 2010 the market will be a real Northwest European gas market. The two storage projects form a solid foundation for Nuon to go forward in the ever changing European energy market and will allow Nuon to pull 1,100,000 m³/hr out of storage and inject 260,000m³/hr initially with a total working gas capacity of 238 million m³. Effectively it is possible to withdraw the total volume in 9 days and fill the caverns in 38 days.

Diversification

Pipeline gas from outside of the Netherlands and/or LNG will play an increasing role for the Dutch State as it attempts to manage the production from the Groningen gas field via legal production cap on the field. This cap was introduced due to the decline in production from the small fields, reservoir management concerns and a strong desire to manage the Groningen field for the long term. Following this cap, the Ministry of Economic Affairs is extremely favorable to the addition of one or more regasification terminal (s) to the Dutch coast. Nuon has developed an LNG strategy and is in negotiations discussions with the developers of regasification capacity in the Netherlands but most importantly with suppliers in the producing countries. Nuon is convinced that a successful LNG supply contract will allow for diversion of LNG to the most attractively priced market and that the pricing structure in Europe as well as Nuon's unique asset and geographic position will allow Nuon to participate in a type of sink and source role. Even in an illiquid market, Nuon can effectuate diversion due to its storage facilities, pipeline capacity and power plant optionality.



Thus, Nuon's historic investment decisions make it well positioned and able to make use of its integrated vertical model and portfolio of plants, storage, entry capacity and customer books to make an attractive offer to the producing community. In the next four years, the successful companies will primarily consist of those companies with the right assets, the right strategy and the ability to execute.

Rick Lorio
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 Jippe van Eynatten
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