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GAS IN THE KITCHEN

The earliest recorded use of gas for cooking was in 1802 when a Moravian chemical manufacturer Zachaus Winzler (no relation to Friedrich Winzler as far is as known) gave dinner parties at which the food was prepared on a gas cooker consisting of four burners and a small oven.

In 1826 James Sharp, Assistant Manager of the Northampton Gas Company, installed an experimental gas cooker in his home and in 1834, under the patronage of Earl Spencer, began producing cookers commercially. Gas cooking became popular in the 1880s when rental schemes were introduced.

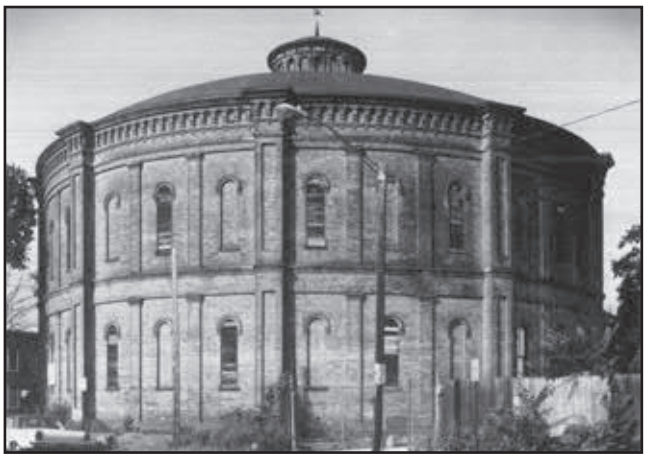
The development of domestic appliances continued with gas water heaters, irons, washing machines and refrigerators.

ABOVE
Enamelling and the automatic oven thermostat were introduced in the 1920s.

ABOVE RIGHT AND RIGHT
Gas irons and washing machines on display in the UK's National Gas Museum.

GAS HISTORY WEBSITE AND EXHIBITION

At this time of liberalisation and restructuring in the industry it is important to preserve the history of gas, including collections and archives, for the future. This is the aim of a project to integrate gas museums and collections worldwide into a virtual network and provide information to the general public. The website www.gashistory.org has been set up and there will be a small exhibition about the history of gas at the World Gas Conference in Amsterdam in June.



ABOVE RIGHT
www.gashistory.org

RIGHT
This gasholder house was built by the Troy Gas Light Company in New York state in 1873.

US AND NORWEGIAN MUSEUMS

In 1859 Edwin L. Drake, partly financed by Peter Wilson, drilled the oil well that launched the modern petroleum industry. (See picture in the US feature page 139, which was taken at the well in 1866. Drake is on the right and Wilson on the left).

Drake Well Museum in Titusville, Pennsylvania, USA, tells the story of the beginning of the modern oil industry with orientation videos, exhibits, operating oil field machinery and historic buildings in a park setting (www.drakewell.org).

The Norwegian Petroleum Museum in Stavanger was opened in May 1999 and houses exhibits related to all aspects of oil and gas exploration and production (www.norskolje.museum.no). It was partly financed through IGU's fellow energy organisation, World Petroleum Congress, which donated surplus funds from the 14th WPC (Stavanger, 1994).

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The Dutch Natural Gas System

By Marjet Siegers

Of IGU's seven founder members, The Netherlands has seen the largest growth rate in gas consumption thanks to the discovery of domestic natural gas reserves and the development of a nationwide transmission and distribution network. IGU figures (see page 88) show that Dutch consumption of manufactured gas in 1932 was 642 mcm; by 2004 gas consumption (now all natural gas) had increased 67-fold to 43.5 bcm. Over the same period the German market increased 24-fold and the British 11-fold.

Natural gas was first discovered in The Netherlands in 1924, although it was only after World War II that it began to be marketed in certain regions. It was the discovery of the huge Groningen field in 1959 that kick-started the Dutch natural gas industry, which today supplies 48% of the country's primary energy demand.

The key to the successful exploitation of the Groningen field was a policy established by the then Minister of Economic Affairs, Jan Willem de Pous, that saw the public and private sectors working together. Firstly, in order to generate maximum revenues for the Dutch state and the holder of the concession, the Nederlandse Aardolie Maatschappij (NAM, a 50/50 joint venture of Shell and Esso – now part of ExxonMobil), the minister introduced the "market value" principle as the basis on which the gas should be marketed. This established a price linkage so that consumers would never have to pay more for gas than for alternative fuels, but neither would they pay less.

An essential precondition for maintaining the market value principle was that no alternative

The agreement setting up Gasunie was signed in 1963 by the then Minister of Economic Affairs, Jan Willem de Pous (seated), and representatives of DSM, Esso and Shell.

supplies of low-priced gas could reach the segmented market. To this end, the second main principle in the Dutch gas policy stated that exploitation of the country's gas resources should proceed "in harmony" with the sales of gas achieved, in order to avoid disruptions of the energy market. Control over the supply of gas was thus seen as a government responsibility, although exploitation and marketing of the gas reserves was undertaken by the private concession holder.

In 1963 the Dutch government and NAM agreed upon a structure that united these principles and Gasunie was set up to coordinate the commercialisation of Dutch natural gas reserves. Its shares were held by the Dutch State Mines – DSM (40%), the Dutch state directly (10%), Esso (25%) and Shell (25%). Gasunie started work on building a domestic pipeline network and also on developing export markets. By December 1968 the entire Dutch mainland was covered and in 1986 the small island of Vlieland became the last place in The Netherlands to be connected to the network, which now had 11,000 kilometres of pipelines.

From the mid-1960s onwards, Dutch gas exports stimulated the construction of a European gas transport network. This laid the foundation for an integrated gas market and established the principles and patterns of European gas trade. Despite some adjustments, the institutional set-up and principles that governed gas production, marketing and pricing, and the distribution of the profits have prevailed until present times.

Revision

The 1973/1974 oil crisis gave rise to the first revision of Dutch gas policy. Seeking security of supply, exports of gas were discouraged while the exploration and exploitation of new on- and offshore deposits was stimulated. Post-1974, oil companies were encouraged to find more new gas deposits by a guarantee that Gasunie – having the right of first refusal – would purchase their gas immediately, against acceptable prices and at an adequate rate of depletion. The Groningen field's role was to supply the volumes of gas necessary to fill the gap between the increasing production of the new fields and Gasunie's falling total requirements, associated with a decline in exports.

One of the installations of the enormous Groningen field.

From around 85 bcm in 1976, production at Groningen fell to 45 bcm in the early 1980s and 30 bcm in the early 1990s. In 2004 it was 25 bcm out of total Dutch production of 68.8 bcm. Many of the smaller fields contained gas of much higher or lower calorific value than the gas from Groningen, to which all (domestic) appliances were adjusted. Consequently, measures had to be taken to include these flows. Installations of large industrial users were converted to high-calorific gas (H-gas) and a second transmission system was built to transmit the H-gas. High- and low-calorific-gas were mixed to produce a gas of Groningen quality and H-gas was mixed with nitrogen to produce Groningen quality.

After 1983 the emerging perception of abundance in energy supply inspired the renewal of export contracts, as long as Gasunie was able to guarantee that it would be able to supply its inland customers for at least 25 years, on the basis of the

The Dutch pipeline network has been steadily developed.

Dutch reserve position and the estimated evolution of demand.

Subsequently, an overall cap of 80 bcm was set for Dutch gas production.

Move to liberalisation

In the mid-1990s and reacting to initiatives of the EU Commission for a liberalisation of energy markets, the Dutch government started re-evaluating the organisation and operation of the country's gas industry. Before new legislation had been drafted, Gasunie acted pro-actively by introducing transportation and services for third parties in 1998. This gave large gas consumers a choice of suppliers. By March 1999 a proposal for a Gas Act was sent to Parliament and in June 2000 the new Act was passed. Its key elements were:

- Allowing all consumers to choose their supplier;
- Establishing the non-discriminatory provision of transport and storage combined with regulatory oversight of those operations;
- Providing for negotiated Third Party Access (TPA) on the basis of indicative published tariffs, enabling traders, producers and consumers to contract transport and storage services from Gasunie and the local network operators; and
- Freeing Gasunie of its responsibility for the long-term security of supply to domestic consumers. The traditional need to obtain ministerial approval for volumes, prices and destinations of gas to be exported was abolished.

Implementation

To achieve the non-discriminatory provision of transport and storage, Gasunie agreed to separate its high-pressure transport and storage facilities from its trading activities, while the local distribution companies were split up into gas suppliers and network operators. Gasunie's first step was to set up a transmission subsidiary called Gas Transport Services in July 2004. That month also marked the introduction of supplier choice for small-volume gas consumers.

Then in July 2005 Gasunie was split into a transport company wholly-owned by the state (NV Nederlandse Gasunie, Gas Transport Services being its 100% subsidiary) and a trading company called Gasunie Trade & Supply. The latter is owned by Energie Beheer Nederland to which DSM's interest in the old Gasunie had been transferred in 1989 (40%), the Dutch state (10%), Esso (25%) and Shell (25%).

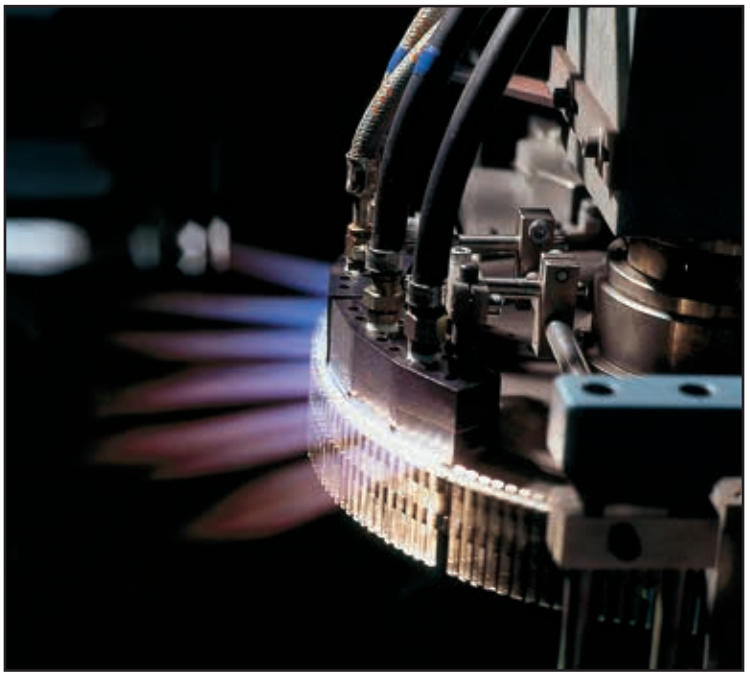
As far as production is concerned, in late December 2005 the Minister of Economic Affairs, Laurens Jan Brinkhorst, decided to move from the overall Dutch gas production cap to one on the Groningen field production. Over the next 10 years (2006-2015) the maximum volume produced from the Groningen field will be 425 bcm.

The staged implementation of the new policy has seen much debate and several clashes between Directie Toezicht Energie (DTe), the Dutch energy regulator, and Gasunie. These have a wider implication for the European gas market. Whereas the EU directives are focused on introducing customer choice in domestic markets, the upstream gas industry involves major non-EU producers and long-term contracts. The industry expects market stabilisation and oil-parity to remain the key principles for securing stable supplies over the longer term. Regulating one interconnected segment of a much larger system demands a balanced approach.

For example, the impact of liberalisation in reducing transportation tariffs has made the Dutch system one of the cheapest in western Europe. Further reduction could induce a rerouting of gas flows from the German network to the Dutch network. In periods of high demand, such as the peak winter season, this may lead to congestion in the network as access in an entry/exit system must be given on a non-discriminatory basis and transit cannot be identified. This could see supplies to Dutch consumers being crowded-out by transit flows. Moreover, within the EU the gas directives are being implemented in varying ways by member states and reciprocity in market access has not yet fully materialised.

The strong position of The Netherlands as a gas producer and exporter combined with its storage facilities and geographical location give it a key role in the western European gas market. New international pipeline connections are under development and LNG import terminals at Eemshaven and Rotterdam are under evaluation, while the country's underground storage capacity using depleted gas reservoirs is around 35 bcm. As the Dutch Presidency of IGU comes to an end, the Dutch natural gas industry has much to celebrate and much to look forward to.

Marjet Siegers works in the Gas Transmission Planning Department of N.V. Nederlandse Gasunie.
The author would like to acknowledge as sources of information a paper by Aad F. Correljé of the Delft University of Technology, The Re-regulation of the Dutch Natural Gas System*, and documents from the website of DTe (www.dte.nl).*



The Dutch natural gas industry has much to celebrate and much to look forward to.

NAM: Pivoting Role in Current and Future European Gas Supply

NAM A reliable source

NAM produces gas from the immense Groningen field and from some 100 small fields onshore and offshore The Netherlands. Operating in a mature area, by definition NAM faces a future decline in production. But the Shell / ExxonMobil venture – established in 1947 – works hard to push that future as far ahead as possible.

According to NAM Director Roelof Platenkamp, "the Groningen field has been and will remain essential to Dutch and European gas supply. The field, initially containing around 2,700 bcm of gas, has been producing since 1963. Approximately 1,600 bcm of gas has flowed from the reservoir, leaving scope for around 1,100 bcm to be produced."

The Dutch government wants the field to continue its special balancing role over the next 25 years. What does this mean for NAM?

Mr Platenkamp: "We are currently executing the Groningen Long Term (GLT) project to rejuvenate the 29 production facilities. This includes the installation of compression. The GLT project started in 1996 and will run for some 15 years. Total investment will be well over $2 billion. This project is recognised as one of the best managed projects within the Shell Group, and we are of course proud of that. Each year three facilities are delivered, on time, within budget and with a zero punch action list.

"But we will also continue exploration of small fields, although the role of The Netherlands will slowly decrease in that respect. The larger 'small' fields have now been discovered and we are now discovering increasingly smaller 'small' fields."

So how can NAM continue its successful quest for new gas fields?

"We need to contain our exploration and development costs, in order to keep our activities economically feasible," says Mr Platenkamp. So, we are reducing our drilling costs. We developed a new, light onshore drilling rig to achieve that. And we are innovative when it comes to well engineering as well.

NAM Director Roelof Platenkamp: "Tremendous opportunity to play an essential role in the future of European gas supply."

"Reducing cost is also necessary for developing small discoveries," Mr Platenkamp adds. "One example has been the introduction of small, skid-mounted production modules. These units are mobile, meaning that we can move them from one location to another once a field has been depleted."

Offshore, this concept of low cost, minimal facilities has been translated into the installation of two so-called monotowers, one in the Dutch sector of the North Sea, and one in the UK Southern North Sea, where NAM is operator on behalf of Shell EP in the UK.

Platenkamp: "The name of the game is cost reduction through innovation. I think we are pretty good at this in NAM. And being part of Shell's European EP organisation helps a lot."

Future

What about the far future, when small fields will be empty? Will there be a role for NAM then?

"The perfect situation of The Netherlands in the centre of the European gas market and the European pipeline grid, offers us a tremendous opportunity to play an essential role in the future European gas supply. And the geological structure of our gas fields makes them ideal storage for shifting a continuous supply from for instance Russia, Norway or Algeria, to supply on demand to countries like Germany or the UK. Our experience as a main and reliable gas producer and as operator of two gas storage facilities will put us in the right position to do so," Mr Platenkamp concludes.

Norg: one of the NAM underground gas storage facilities.




NAM - A reliable source

Nederlandse Aardolie Maatschappij (NAM) B.V., a joint venture of Shell and ExxonMobil, is the largest natural gas producer in the Netherlands. Founded as an oil exploration and production company in 1947, real growth came after NAM discovered the Groningen gas field in 1959.

Since 1963, production from this giant gas field, with original producible gas reserves of 2,700 billion m^3, laid the foundation for the Dutch and European gas markets. Due to prudent implementation of the Dutch government's Small Fields Policy - developing smaller fields first and keeping the Groningen gas field as much as possible as reserve - after more than 40 years of production, some 1,100 billion m^3 still remains. To enhance production from this field, a large compression and renovation programme was started in 1996, lasting 15 years and requiring an investment of some $2 billion.

The discovery of the Groningen field also opened the door for offshore gas exploration and production, and in 1961 NAM was the first company in Western Europe to drill for gas in the North Sea. NAM now operates some 30 offshore production platforms.

NAM's annual natural gas production exceeds 50 billion m^3. A little more than half of this gas originates from the Groningen field and the rest from various smaller fields elsewhere on the mainland and in the North Sea. NAM gas meets about 75% of the Dutch demand. NAM also continues to produce oil, approximately 0.45 million m^3 a year. NAM accounts for about 25% of the oil produced in the Netherlands.

NAM anticipates future needs. For example, in 1997 NAM constructed underground gas storage facilities at Langelo and Grijpskerk that enable us to meet energy demands on even the coldest days. In order to bring smaller gas fields on stream in an economically viable way, smarter exploration methods and smaller production units are being developed and put into operation.

Meanwhile, NAM continues to search for new gas fields in the Netherlands – both onshore and offshore.




NAM A reliable source

Schepersmaat 2, 9405 TA Assen, P.O. Box 28000, 9400 HH Assen, The Netherlands
Telephone: + 31 592 369 111, telefax: +31 592 362 200, internet: www.nam.nl




Gas in Japan

By Hiroshi Hashimoto

The 21st century is the "Century of Natural Gas" as was stressed at the 22nd World Gas Conference in Tokyo in 2003. The role of natural gas as an efficient and environmentally-friendly energy source is becoming increasingly important as human beings around the globe seek an economic and social structure that leads to sustainable growth. Currently Japan accounts for over 40% of global LNG imports but natural gas only represents 13% of the country's total primary energy supply, leaving much room to expand markets. The share of natural gas in Japan is expected to grow to as much as 18% in 2030 in order to meet the incremental energy demand and address environmental concerns, according to the "Long-term outlook of energy supply and demand" issued by the Japanese government in March 2005.

Japan started manufacturing gas from coal in the middle of the 19th century. By 1966 oil had become the dominant manufactured gas source. Meanwhile, natural gas was beginning to attract attention as a cleaner alternative with higher heating values. Teikoku Oil Company started to deliver natural gas from its domestic gas field in Niigata as a city gas source in October 1962. However, natural gas represented less than 1% of the primary energy supply in the country by the end of 1960s due to lack of domestic resources, whereas oil represented more than 70%, even though it was imported from overseas.

Residential fuel cell co-generation systems are being developed to increase gas demand.

LNG imports

Tokyo Gas spent nearly 10 years first studying the feasibility of importing natural gas as LNG and then preparing its introduction as a city gas source and a power generation fuel, the latter in conjunction with the Tokyo Electric Power Company (Tepco). The era of LNG in Japan was inaugurated with the arrival from Alaska at Tokyo Gas Company's Negishi receiving terminal of the first cargo onboard *Polar Alaska* on November 4, 1969. The initial contract quantity was less than 1 million tonnes per year (mtpa) for the two companies.

There were several challenges to overcome to introduce LNG in an economically viable manner at that time: construction of a receiving terminal that could accommodate large LNG tankers; developing the scale of consumption required; and a 20% import duty on natural gas that could have jeopardised the competitive position of natural gas against oil.

Tokyo Gas, led by then Executive Vice President Mr Hiroshi Anzai (who was President 1967-1972 and Chairman 1972-1989), addressed the challenges one by one. The decision to introduce LNG was made in 1960. The company acquired a site for the receiving terminal in Negishi, Yokohama, and the 20% import duty was suspended through requests to the Ministries of Finance and International Trade and Industry.

Meanwhile Tepco, which was planning an oil-fired thermal power plant at Minami-Yokohama, instead decided to adopt an LNG-fuelled system for the plant for the first time in the world. This was partly because of the pressure to switch to a cleaner fuel from the Yokohama city government,

which was enforcing strict pollution regulations. Without a joint initiative with Tepco, the introduction of LNG would have been an unachievable project at that time.

Osaka Gas and Toho Gas followed the move to introduce LNG in 1972 and 1977, respectively. Currently 25 receiving terminals handle around 80 mtpa of LNG for eight city gas companies and seven power generators.

Initiatives to extend the penetration of natural gas

The city gas industry has been working to increase natural gas use all over the country. Initiatives include converting millions of customer appliances (which had received manufactured gas), marketing industrial applications (e.g. co-generation, highly efficient boilers and commercial gas cooling systems) and promoting NGVs. Residential fuel cell co-generation systems are also being developed to further increase demand. In addition to wholesale supplies to smaller gas distribution companies via pipelines and tanker trucks, secondary deliveries of imported LNG by coastal tankers have commenced.

Expansion of LNG markets and activities

As the global LNG business continues to expand, major Japanese LNG importers are expected to leverage their shipping and trading positions to become more active on international fronts. They will have greater participation in LNG upstream and shipping activities in the future, contributing not only to volumetric growth, but also to qualitative improvements in the natural gas business, such as enhancing the competitiveness of natural gas, ensuring security of supply and establishing new types of transactions and business models.

An archive picture of the *Polar Alaska* delivering LNG.

Hiroshi Hashimoto is the Manager of the International Business Coordination Section, Business Development Department, Tokyo Gas Co. Ltd. For further information on gas in Japan contact the Japan Gas Association (www.gas.or.jp).

Road tanker facilities at the LNG terminal in Nagasaki for deliveries to satellite storage locations.

It took us 125 years to use the first trillion barrels of oil.

We'll use the next trillion in 30.

So why should you care?

Delivering the Promise of Natural Gas in the 21st Century

By John D. Gass, President, Chevron Global Gas

This is an exciting time for all of us in the gas industry because natural gas has very much come of age. In fact, the future of the global energy industry can be summed up in two words: natural gas. What was in the past viewed as a second prize, and sometimes even an unwanted byproduct, is now a valuable commodity in its own right.

Yes, it's clear that oil will continue to be the predominant energy source for some time to come. And yes, renewable and alternative energies will play an increasing role in the energy mix – although not on the scale of petroleum products. However, the role of natural gas in meeting global energy demand is forecast to grow strongly.

While global demand for energy is expected to increase by more than 47% over the next 20 years, the real growth in demand is for natural gas. According to "International Energy Outlook 2005" – from the U.S. Department of Energy's Energy Information Administration (EIA) – natural gas is projected to increase nearly 70% over the next 20 years, whereas oil is expected to grow roughly 40% over the same period.

With projected demand like that, we are at a tipping point in the evolution of the natural gas industry. We are making a transition from an industry based almost solely on dedicated projects and long-term contracts to a global commodity market, one in which gas can be more effectively developed, transported and marketed so that its economic value is fully realised.

To successfully accomplish that, we must build an infrastructure that delivers natural gas safely, efficiently and cost-effectively anywhere in the world. The successful development of the world's natural gas supplies through the liquefied natural gas (LNG), gas-to-liquids and long-distance pipeline projects that are now under way globally will help diversify the world's energy portfolio. They will deliver the full promise of gas for our host countries' economies, for local communities, for consumers, for the environment and for our companies.

To successfully develop projects of this scope and scale is not easy. It requires an unrelenting focus on what I believe are three fundamental challenges common to all gas projects. I call them the "Three C's": cost competitiveness, cycle time and complexity.

Let's look first at cost competitiveness. The EIA estimates that in order to meet the projected rate of gas-demand growth, roughly $2.7 trillion in investment, or $100 billion per year, is required across the entire gas value chain by 2030. Given this level of investment and the long development timeline inherent in gas projects, it's absolutely essential that costs be managed aggressively from start to finish. Because of the scale of projects today, even small overruns can be huge in absolute dollars. The unprecedented number of projects on the drawing board and the demands they are placing on contractors and suppliers are causing costs to rise and putting project schedules under pressure.

This brings us to the second "C": cycle time, or more specifically, reducing cycle time so that projects come online sooner. Historically, long cycle times have been inherent in gas projects. Building a new industry requires a dynamic balance between a whole range of factors, including markets, technology, commercial arrangements, investments, policies and partners. But even if the history of natural gas projects is one of going slowly, we cannot let the past define the future. Reducing cycle time is absolutely critical if we are to keep up with global demand for natural gas.

Some words of caution are necessary, however: Managing cycle times aggressively does not mean abdicating prudent decision making and capital stewardship. Those are absolutely imperative, especially in today's hyperactive gas-project environment.

The third "C" is complexity. How do we manage the inherent complexity of projects in ways that add value but do not add to costs and cycle times? Today's gas projects today involve complex commercial arrangements and multiple interfaces covering many different markets, and often involve institutions such as the World Bank and the International Monetary Fund.

Going forward, successful projects will require new levels of collaboration and strong partner alignment like that of our Greater Gorgon project. There's just no way around it. I think that we can agree that the challenge is laid out before us.

Successfully meeting the challenge of the Three C's, however, cannot happen without an investment environment that ensures stable, long-term returns. Transparency, predictability and discipline must guide the investment environment for a successful gas project. We cannot succeed unless investors have confidence in the rules of the game. Taxes, fiscal regimes, protection of intellectual property, sound regulatory structures and sanctity of contracts: All these things have to be in place and fit together. Otherwise, investors cannot make the big decisions and commitments needed to move ahead at a competitive pace.

Effective partnerships are the catalysts that really bring the Three C's to life. Almost all of today's gas projects involve multiple stakeholders. Building not just partnerships, but effective partnerships, among those stakeholders is critical to pool resources, share risk appropriately, link multiple markets, and leverage technology and best practices.

As we continue to build the global gas industry, new levels of collaboration and partner alignment will be required. The challenge is set out before us.

Managing the Three C's is critically important for bringing successful gas projects to life. But I believe there is a higher purpose in building the global gas industry of the 21st century. Those of us in the energy industry are all custodians of the world's natural gas resources. We have a responsibility to develop gas projects not only for the benefit of our companies, our investors and our stockholders, but also for the benefit of millions of people worldwide.

By mastering natural gas projects and partnerships, the global energy industry can continue to grow and prosper. And by mastering gas projects and partnerships, we will deliver the energy needed to fuel global economic development and a better way of life for millions. Clearly, the opportunities are enormous and the responsibility great. But I am confident that, together, we can seize those opportunities and meet the responsibility we all share for delivering the promise of natural gas.

Adapted from a speech delivered to the World Petroleum Congress, Johannesburg, South Africa, 28 September 2005.

John D. Gass is a vice president of Chevron Corporation and president of Chevron Global Gas, responsible for the company's global natural gas business. He also oversees Chevron's shipping company and pipeline operations.

Mr. Gass joined Chevron U.S.A. Inc. in 1974 as a design engineer. Over the years, he has held a number of positions of increasing responsibility in engineering, operations and management. In addition to working in the United States, he has worked in Indonesia, the U.K. North Sea region, Australia and Angola. He was named to his current position in June 2003, when Chevron Global Gas was formed to commercialise the company's vast natural gas resources. Mr. Gass graduated from Vanderbilt University in 1974 with a bachelor's degree in civil engineering. He earned a master's degree in civil engineering from Tulane University in 1980.

What Will the Gas Market Look Like When IGU is 100?

By Iain Esau

During IGU's 75 years the gas industry has developed dramatically and its future looks exceedingly healthy. Most projections forecast natural gas will become the world's 21st century fuel of choice surpassing coal as the number two energy source, and that demand in the coming decades will increase at a higher rate than for any other conventional form of energy.

In its World Energy Outlook[1] reference scenario for the coming quarter century, the International Energy Agency (IEA) sees demand for natural gas growing at a healthy annual rate of 2.1% compared to the 1.5% growth rate for both oil and coal. This would see gas consumption rising to 4,800 bcm by 2030, about 80% higher than the 2004 level.

These forecasts are roughly in line with those of ExxonMobil. The world's largest oil and gas company, working from a base year of 2000 rather than the IEA's 2003, assesses gas growth through to 2030 to be 1.8% per year, the same as coal and higher than oil which is expected to grow at 1.4% each year.

The supermajor's recently appointed Chairman and Chief Executive Officer, Rex W. Tillerson, says: "We see demand for natural gas rising ... increasing to a 25% share of total energy by 2030", compared to oil's 35% predicted market share at this time. This future surge in the need for gas is driven by the fuel's intrinsic benefits compared to other fuels. "Because gas is both economically and environmentally attractive," Tillerson explains, "it is a preferred fuel for power generation in many markets" which has made it "the fastest-growing source of conventional energy."

Royal Dutch Shell even suggests that the IEA's projection could underestimate global gas growth. Calling it "a prediction that may turn out to be conservative", Linda Cook, Executive Director of Shell Gas & Power, says her company believes in gas: "Today it is the fuel of choice, a major contributor to sustainable development. We believe in its qualities as a clean resource, in its future, and also in its profitability. Gas is the fuel of the 21st century. In 100 years time, when people look back at this period, I believe they'll say the move to gas was a wise one."

Equally enthusiastic about the future is the aptly named John D. Gass, President of Global Gas at Chevron: "This is an exciting time for all of us in our industry because ... natural gas has very much come

1 *World Energy Outlook 2005*, IEA, Paris.

Rex W. Tillerson: gas is both economically and environmentally attractive.

Linda Cook: move to gas will be seen as a wise one.

John D. Gass: we are at a tipping point in the evolution of the natural gas industry.

of age. What was in the past viewed as a second prize, and sometimes even an unwanted by-product, is now a valuable commodity in its own right."

Gass reckons: "We are at a tipping point in the evolution of the natural gas industry. We are making a transition from an industry based almost solely on dedicated projects and long-term contracts, to a global commodity market – one in which gas can be more effectively developed, transported and marketed, and its economic value fully realised."

Clearly a global market requires a well-developed and cost-effective transport infrastructure. As far as the gas business is concerned, its growth will be dependent upon further investment in LNG supply chains and long-distance pipelines bringing gas to the centres of demand.

Demand

By 2030 the world's population is forecast to grow by about one-third to reach 8 billion, generating a need for huge additional amounts of energy.

According to the IEA[2], the prime driver behind soaring gas demand will be the power generation sector which is expected to account for 59% of the rise in consumption, with its share of the world gas market itself set to surge from 36% in 2002 to 47% in 2030. The IEA believes natural gas will remain the preferred fuel for new combined-cycle gas tur-

2 *World Energy Outlook 2004*, IEA, Paris.

A well-developed LNG and pipeline infrastructure is crucial in gas finding its way to centres of demand.

RIGHT
The popularity of CCGT power stations is helping to drive gas demand.

BELOW
Table 1.

GAS CONSUMPTION 2004 AND FORECAST DEMAND 2030 (BCM)

	2004		*2030*	
North America*	784	29.2%	1,039	21.7%
OECD Europe	490	18.2%	778	16.3%
OECD Asia-Pacific	132	4.9%	244	5%
OECD Total	1,406	52.3%	2,061	43%
Russia	402	14.9%	591	12.3%
Other transition economies	216	8%	334	7%
China	39	1.5%	152	3.2%
India	32	1.2%	98	2%
Other non-OECD Asia-Pacific	165	6.2%	387	8.1%
Africa	69	2.5%	232	4.9%
Middle East	242	9%	615	12.9%
South & Central America	118	4.4%	318	6.6%
World	2,689		4,788	

Source: 2004 consumption figures from BP Statistical Review of World Energy June 2005; 2030 forecast demand from World Energy Outlook 2005, IEA.

* North America = US, Canada and Mexico which are all OECD members.

bine (CCGT) power stations, despite rising gas prices.

Natural gas lends its self to power generation due to its inherent environmental advantages over other fossil fuels including a lower carbon content and fewer emissions of noxious gases, while both capital costs and lead times to build CCGT plants are lower than for other thermal power plants. Many of the new CCGT plants will be built in developing countries where electricity demand is predicted to escalate most rapidly, particularly in Asia. However, demand for gas in the residential and service sectors is forecast to be "modest".

Other growing markets for gas – although their size is difficult to forecast – are likely to be as feedstock for gas-to-liquids (GTL) plants, primarily in the Middle East, and to produce hydrogen for fuel cells.

Based on rising populations, Africa, Brazil, China and India are set to experience the greatest annual growth rates in gas demand with natural gas taking market share from coal in China and India. Other developing countries will also see significant growth (*see Table 1*). The growth rates in

today's OECD members will be lower and by 2030 their share of global consumption will be smaller, as will Russia's.

Supply

The industry consensus is that natural gas resources will comfortably meet the projected increase in global demand. Proven reserves have increased steadily in recent decades – according to estimates from Cedigaz they stood at 180 tcm in 2004, nearly twice as high as 20 years ago – with additions to reserves outpacing production by a wide margin. Reserve increases have been driven by improved technology, sustained exploration and appraisal drilling and the move to gas-focused exploration.

Russia has the world's largest gas reserves, accounting for 26.7% of the total, followed by Iran with 15.3% and Qatar with 14.4%. The OECD countries hold 8.6%.

Potential gas resources are as substantial as proven reserves with a five-year old report from the US Geological Survey suggesting 147 tcm of gas remain to be discovered and ultimate resources could stand at an enormous 436 tcm.

Development and transport costs are expected to fall and production volumes are expected to grow most strongly, in volume terms, in Russia and the Middle East although Africa and Latin America will experience the fastest growth rates. New output from these regions will be fed to consumers in North America, Europe and Asia where imports will rise significantly.

Development of non-conventional gas, such as coal-bed methane (CBM), tight gas and shale gas, is expected to grow, particularly in North America where CBM already accounts for a substantial amount of US and Canadian production. In the rest of the world non-conventional resources have remained lightly exploited, but this could change in future particularly in the booming Chinese and Indian economies.

Gas hydrate is a non-conventional resource with immense potential, but technical and environmental challenges must be overcome before it can be developed economically. Japan, Canada, the US and India are among those countries working hard on these issues, and if deepwater and Arctic resources can be tapped in a cost-effective, safe and green manner, it could open the way for vast hydrate resources around the world to be exploited.

According to the IEA, some 7.3 tcm of new gas production capacity will be needed over the next 25 years. Only one-third of this additional capacity will go to meet rising demand with the rest destined to replace existing production. One-quarter of capacity additions will be in North America, but Russia and the Middle East are also set to host significant capacity boosts.

Gas trade

The decline in domestic production in some major gas-consuming countries will be one of the key factors affecting global gas trading. According to Cedigaz figures, international trade in gas in 2004 amounted to 680 bcm with about three-quarters moving by pipeline and a quarter as LNG. The largest exporter was Russia with 148 bcm, followed by Canada (102 bcm)[3] and Norway (75 bcm). The African nations had net exports of 75 bcm and the

3 Canada also imported just under 9 bcm so its net exports were 93 bcm.

CBM already accounts for a substantial amount of US production – a development in Montana.

Chinese Premier Wen Jiabao makes a state visit to India – the two countries have agreed to cooperate in sourcing new foreign petroleum supplies.

Middle East figure was 39 bcm.

The IEA forecasts that the Middle East will become the world's largest exporting region and Africa the number two by 2030, with gas volumes destined for overseas markets rising to 300 bcm and 250 bcm respectively. Most of the Middle East's gas exports and at least a quarter of Africa's will be as LNG. This will see global LNG trade more than tripling to 680 bcm by 2030 when it will account for more than half of inter-regional gas trade, albeit a smaller proportion of total international trade.

Long-term contracts will continue to dominate the LNG business in the near future, but spot sales are set to increase in importance and increased competition in gas markets will stimulate more flexible pricing mechanisms and shorter-term contracts. More contractual flexibility and more LNG trade will allow buyers in different countries, which have differing times of peak demand, to swap supplies for different time periods, thus reducing purchase costs.

This rapidly changing trading environment will, much like the oil business, shape geopolitical events in the future and influence the foreign policies of consuming and producing countries.

The contribution of offshore fields to global gas production is set to rise.

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In a world that needs more energy and less emissions, natural gas is one of the cleanest fuels that exist. Experts predict that for the year 2020, natural gas will satisfy 25% of the world-wide energy demand.

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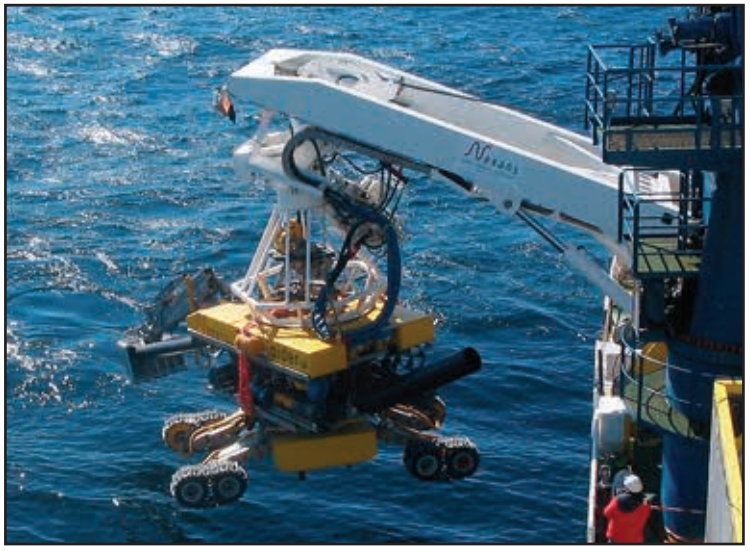

Norway is ramping up its gas production. A "Spider" digging machine is lowered into the North Sea where pipes are being laid as part of the Ormen Lange project which is set to come onstream in 2007.

Investment

The IEA estimates that in order to meet the projected rate of gas demand growth, no less than $2.7 trillion of capital – equivalent to roughly $100 billion per year – must be invested across the entire gas value chain by 2030 with about half ear-marked for exploration and development work and the rest for downstream infrastructure.

OECD countries will account for more than half of global spending with about 50% of this amount taken in by North America. Outside the OECD, the Middle East, Russia, Africa and the Caspian will attract the most investment.

The exploration for and development of more expensive-to-produce offshore areas will contribute to a rise in upstream expenditure, while further development in Russia will account for the largest share of spending on gas transmission networks.

Regional trends

North America will remain the largest regional gas user with consumption forecast to grow at 1.1% each year. The first new continental US LNG import terminal for over 20 years opened in March 2005 and many more are in the planning stages, while up to two major new pipelines are set to be on-stream after 2010 supplying gas to the continental US market from the Mackenzie Delta in the Canadian Arctic and from Alaska.

The region's proven reserves of 7.3 tcm – about three-quarters in the US – only represent about 4% of the world total, although production from new areas is expected to offset output from mature basins. Some of the key frontier plays are likely to be the deepwater Gulf of Mexico, Canadian reserves off Newfoundland, Labrador, Nova Scotia and in the Mackenzie Delta, and in the Beaufort Sea off Alaska. Non-conventional plays in the US Rocky Mountains will also provide a new source of supply.

These developments present not just technical challenges but also environmental ones. It will be crucial for the industry to work closely with all stakeholders to strike a balance between the demand for energy to fuel the economy and environmental protection.

Annual North American gas production is expected to rise from 763 bcm in 2004 to 900 bcm by 2030, with 200 bcm of LNG imports filling the demand-supply gap.

In Europe, gas demand in OECD countries is expected to rise about 1.5% each year. The key trends here will be in the production rates of the current three biggest producers, with Norway's continuing to grow and those of The Netherlands and UK declining. Indeed, the European Union's gas production is predicted by the IEA to fall to 147 bcm in 2030 from 215 bcm in 2004. Norway's output is expected to increase to 135 bcm by 2030 and counteract this somewhat[4], but more gas will have to be imported from outside the region.

OECD Europe will need to import around 500 bcm a year by 2030, chiefly via pipeline from Russia but also from Algeria, Egypt, Iran, Libya, Nigeria, Qatar and Trinidad and Tobago using a mixture of LNG and pipeline infrastructure.

What the IEA calls the "transition economies" – essentially Russia and its fellow members of the

4 While Norway, The Netherlands and UK are all OECD members, Norway is not in the European Union.

African LNG exports to North America will grow – Nigeria LNG's Bonny Island plant where a sixth train is due to become operational in 2007.

Commonwealth of Independent States (CIS)[5] – will remain the world's second largest gas market with demand set to rise from 618 bcm in 2004 to 925 bcm in 2030. While its current position as the top exporting region will be overtaken by the Middle East and Africa, the CIS will still be a major exporter in volume terms. Azerbaijan, Kazakhstan, Turkmenistan and Uzbekistan are expected to join Russia as key gas exporters both to Europe and perhaps also to China and India.

In OECD Asia-Pacific, Japan and South Korea – who have minimal domestic production – will experience rising gas demand of 2.5% per annum with consumption forecast to reach just under 200 bcm in 2030 (two-thirds of this in Japan). In Australia and New Zealand, demand is projected to rise 67% to 50 bcm by 2030 although both countries will be self-sufficient as a result of which Australian LNG exports will double to about 50 bcm, chiefly supplying key markets in Asia.

Gas demand in non-OECD Asia-Pacific is predicted to grow faster than anywhere else, nearly tripling to 637 bcm in 2030 with power generation accounting for over 50% of additional demand and – unusually compared to elsewhere – industrial users contributing 23%. China's gas market is set to take off in the coming five years as major investments in domestic transmission pipelines bear fruit and LNG imports start. Future supplies could be piped from Siberia.

Surging Indian demand will be fed by LNG imports although there is the potential for significant gas resources to continue to be found in the country's deep and shallow water plays. Also possible are new pipelines that could take gas to India from Bangladesh, Iran, Myanmar and Turkmenistan.

In the Middle East gas demand is projected to surge from 242 bcm in 2004 to 615 bcm by 2030, sparked by the rising needs of power markets in Iran and Saudi Arabia. Remarkably, in a region known for its oil wealth, natural gas will have overtaken crude oil as its main energy source by 2030 providing feedstock for power, petrochemical and desalination plants as well as GTL projects, particularly in Qatar.

Production is predicted to grow significantly and Europe and North America will displace Asia as the Middle East's main export markets as 2030 approaches. There is a possibility that pipelines could be built to link Iran – and maybe even Iraq – with Europe. However, despite the region's resources, geopolitics will play a key role in any major decision to invest in huge, capital-intensive infrastructure projects with cross-border pipelines considered particularly risky.

Africa, whose population is set to increase significantly by 2030, will experience rapid growth in primary gas demand but from a very low base and consumption will still be lower in absolute and per capita terms than elsewhere. The continent's gas resources are being and will be tapped via new LNG export projects in North and West Africa and pipelines running across the Mediterranean to Europe. There are even discussions about building a pipeline from Nigeria across the Sahara to

5 The "transition" category also includes Bulgaria and Romania, which are set to join the EU in 2007.

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Europe. Within the continent itself, there are signs of gas infrastructure developing with the West African Gas Pipeline being built and a line linking Mozambique and South Africa operational.

Latin American consumption is set to grow at 4.1% annually, reaching 318 bcm in 2030 with Brazil in particular poised for rapid growth. Production growth will outstrip demand with more LNG schemes set for Trinidad and Tobago and maybe others for Bolivia, Peru and Venezuela. LNG exports are predicted to hit 90 bcm by 2030 with the US and Europe being the key markets.

Future for IGU

Clearly the next 25 years will see tremendous growth in the gas industry making IGU's role even more important. The Union's membership and workload will increase and the Secretariat is increasing its personnel to cope. The rotating Presidency, which in the 20th century was held exclusively by European and North American countries, will reflect the global nature of the business in the 21st century. The mould was broken by Japan for 2000-2003 and this year sees Argentina taking over for 2006-2009, while Malaysia was recently elected to the Presidency for 2009-2012. African and Middle Eastern countries already make valuable contributions to the work of IGU's Committees and in the future will undoubtedly bring the Presidency to their regions.

Meanwhile, a new Secretary General will assume his duties in 2007, only the ninth person to hold the post since IGU's foundation. This continuity of administration, combined with the professionalism and dedication that all the occupants have shown, has served and will continue to serve the Union well.

Iain Esau is the London Correspondent of Upstream *newspaper. The author gratefully acknowledges the forecasting work of the IEA and for more information on the Agency see www.iea.org.*

Loading LNG at Point Fortin - Trinidad and Tobago is also set to boost its LNG production.

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FEATURES

This issue's feature section contains articles on the renaissance of LNG in the US gas market and LNG shipping, a report on the work of Working Committee 2 on underground storage and a look at distributed energy resources. We round up with a description of the publications and documents available from IGU and the events calendar.

The Quest for Energy Independence, Globalisation of US Gas Supplies and Renaissance of LNG

By David M. Sweet

While the founding fathers of the United States may have struggled for democracy, freedom and political independence, they did not need to concern themselves much about energy independence. However, today's record energy prices have sparked an outcry for action that will not only bring prices down, but will also make the US economy less dependent on foreign energy supplies.

The politicians in Washington listened and, in response, the House and Senate passed landmark comprehensive energy legislation during the summer of 2005. The 1,725-page Energy Policy Act of 2005 was signed into law by President George W. Bush on August 8, 2005 and marks the first major energy legislation passed by Congress in 13 years. While the new legislation is not likely to have much short-term impact on energy prices or deliver energy independence to the US, it does at least begin to address a number of complex issues that will ultimately lead to the availability of more energy supplies and increased efficiency.

Meanwhile, industry leaders, such as former ExxonMobil Chairman Lee Raymond, have called the idea of energy independence a "flawed notion" as the US "will be an energy importer for an extended period into the future". Yet others attack globalisation as counter to environmental and sustainability goals, without understanding the benefits that can flow to developed as well as developing nations. Part of the problem, according to *In Defense of Globalization*[1], by noted trade expert Jagdish Bhagwati, is that "we lack a clear,

1 Bhagwati, J., *In Defense of Globalization*, Oxford University Press, 2004.

Cove Point on the Chesapeake Bay in Maryland was one of the original US LNG import terminals and opened in 1978. It is owned and operated by Dominion.

coherent, and comprehensive sense of how globalisation…works and how it can do better".

The fact that the US economy is growing more global in nature should be apparent to even the casual observer, given the movement offshore of a growing number of service, support and technical jobs to lower-cost centres such as India. In addition, energy-hungry nations, such as China, are scouring the world for energy supplies to fuel a truly remarkable period of economic growth and expansion. One example is last year's battle between CNOOC and Chevron to acquire Unocal (which was eventually won by Chevron after a heated lobbying push that included intervention by Congress in the Energy Policy Act).

Public opinion polls have validated that having home-grown natural gas supplies is important to most Americans (over 90%). The hostility towards imported energy is, in part, directed toward the experience with oil markets and OPEC, as the US has reached the point where a great deal more oil is imported than produced domestically. With oil prices going over $60 per barrel and prices at the pump also setting records, there is concern that the same fate awaits us if we begin to also import a significant portion of our natural gas supplies.

The idea that there might be a gas version of OPEC (an OGEC) or the knowledge of the April 2005 meeting of the Gas Exporting Countries' Forum (GECF) in Port of Spain, Trinidad, further stokes the demands for energy independence. Even though Trinidad and Tobago's Energy Minister Eric Williams stated that the GECF "does not seek to control the formative LNG market in terms of pricing and supply, but rather instead to promote stability and sustainability within the industry", there is likely to be continued and growing suspicion about the perceived cartelisation of natural gas supplies and the potential threat that some see that this poses to the US economy and national security.

In light of our need for additional natural gas supplies and the forecasted growing dependence on foreign suppliers, it is timely to closer examine some of the dynamics of the North American market and experience in the hope that we can begin to understand, and not fear, the coming globalisation of our natural gas supply.

LEFT
Table 1.

US LNG IMPORTS

Year	*LNG imports bcm*	*Share of total gas consumption*
2002	6.48	0.97%
2003	14.35	2.28%
2004	18.47	2.86%

Source: BP Statistical Reviews of World Energy 2003, 2004, 2005

The renaissance of LNG in North America

While LNG today accounts for a relatively small component of the total supply picture there are predictions that this will rise dramatically, to over one-fourth of total supply, as existing import terminals are expanded and new ones come on-line. The confluence of the emerging trends of increased demand for natural gas, declining production from mature indigenous supply basins, and declining costs along the LNG value chain has given rise to the renaissance of LNG. The manifestation of this LNG renaissance has been a flurry of proposals to build receiving terminals and record levels of imports set in 2003 and 2004 (*see Table 1*), with supplies coming from seven countries, Trinidad and Tobago serving as the leading supplier.

Our journey toward growing reliance on imports was set in motion by a number of market and policy developments. Deregulation of natural gas prices as a result of the Natural Gas Policy Act and Natural Gas Wellhead Decontrol Act was instrumental in the creation of a market long on supply, creating a gas bubble that kept prices down for consumers. As Federal Energy Regulatory Commission (FERC) Orders 436 and 636 opened up transportation markets and unbundled the

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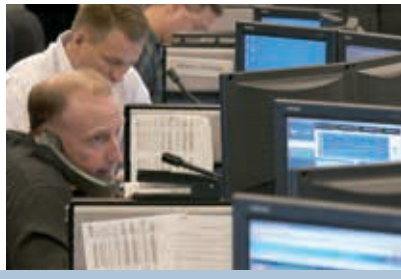
The activities of SUEZ cover the entire gas supply chain.The wide scope of its operations means that companies such as Distrigas, Fabricom, Fluxys, SUEZ Energy International, Tractebel Engineering, are able to provide tailor-made solutions to meet the numerous challenges of any project in either the private or public sector.



SUEZ starts with one advantage over most other global energy companies: it is involved in both gas and electricity supply and distribution; and it can also provide a range of other value-added services such as consultancy, engineering, management and maintenance. As far as natural gas is concerned, SUEZ operates in almost all parts of the gas supply chain: supply contracts, gas processing and transportation, gas storage, gas marketing, gas trading (wholesale and retail) and LNG activities.
The SUEZ Group operates a unified business model that integrates electricity and gas operations around central portfolio management.

To summarise, it is **SUEZ**'s unique combination of skills and expertise across the full spectrum of the natural gas and electricity business, and its proven ability to harness these in an effective and efficient business model, which has been the driving force behind the company's success even in today's difficult energy markets.
If you want to capitalise on this experience, don't hesitate to contact us.



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merchant service function, the natural gas delivery system was transformed from a model based on long-term commitments and contractual rigidity to one providing just-in-time gas supplies in a more flexible and transparent (if not wholly competitive) manner. In contrast, the natural gas supply market had become completely deregulated because it was so highly competitive. Natural gas supplies were now largely being produced through an army of thousands of independents who supplied two-thirds of the gas and drilled 85% of the wells. These independent producers proved extremely capable in finding abundant supplies notwithstanding the existence of a gas bubble that kept prices at levels around $2 per mcf (but were often lower). Natural gas imports into the US were for the most part from Canadian suppliers who had abundant resources and little native load.

Alas, this situation could not last forever, as demand for clean-burning natural gas increased for power generation loads (to meet more stringent clean air emission targets) and as the low gas prices failed to offer an adequate signal to producers to stimulate more production. When natural gas prices began to climb upwards to recent levels of $10 per mcf and higher, imported LNG, even from beyond the Atlantic Basin, became not only viable, but potentially highly profitable.

Mind the gap

The North American natural gas market today is characterised by strong and growing demand from over 68 million customers, an extensive pipeline grid with numerous options for transportation and trading, and dwindling domestic supplies. Natural gas accounts for about one-fourth of the energy use in the US and consumption is forecast to increase 40% by 2025. About 84% of gas used in the US is produced domestically, with 13% coming from Canada and only 3% delivered as LNG.

Production in the continental US will continue to dominate the supply picture and record price levels have set in motion record rates of drilling rigs directed at natural gas formations. However, even with all of this activity producers are fighting a production decline curve that grows steeper and steeper, and are barely keeping up with existing demand, let alone able to meet the projected demand growth. For too many years our energy policy was one designed to encourage use of clean-burning natural gas but discourage those who seek to explore for and produce it.

While significant resources remain in place throughout North America, there are often numerous roadblocks in the way that prevent access and development. Exports from Canada are expected to decline and Alaskan gas remains stranded until a pipeline is constructed. Thus, there is a great deal of excitement about the role that LNG can play in filling the looming supply gap.

The sky is falling, or is it?

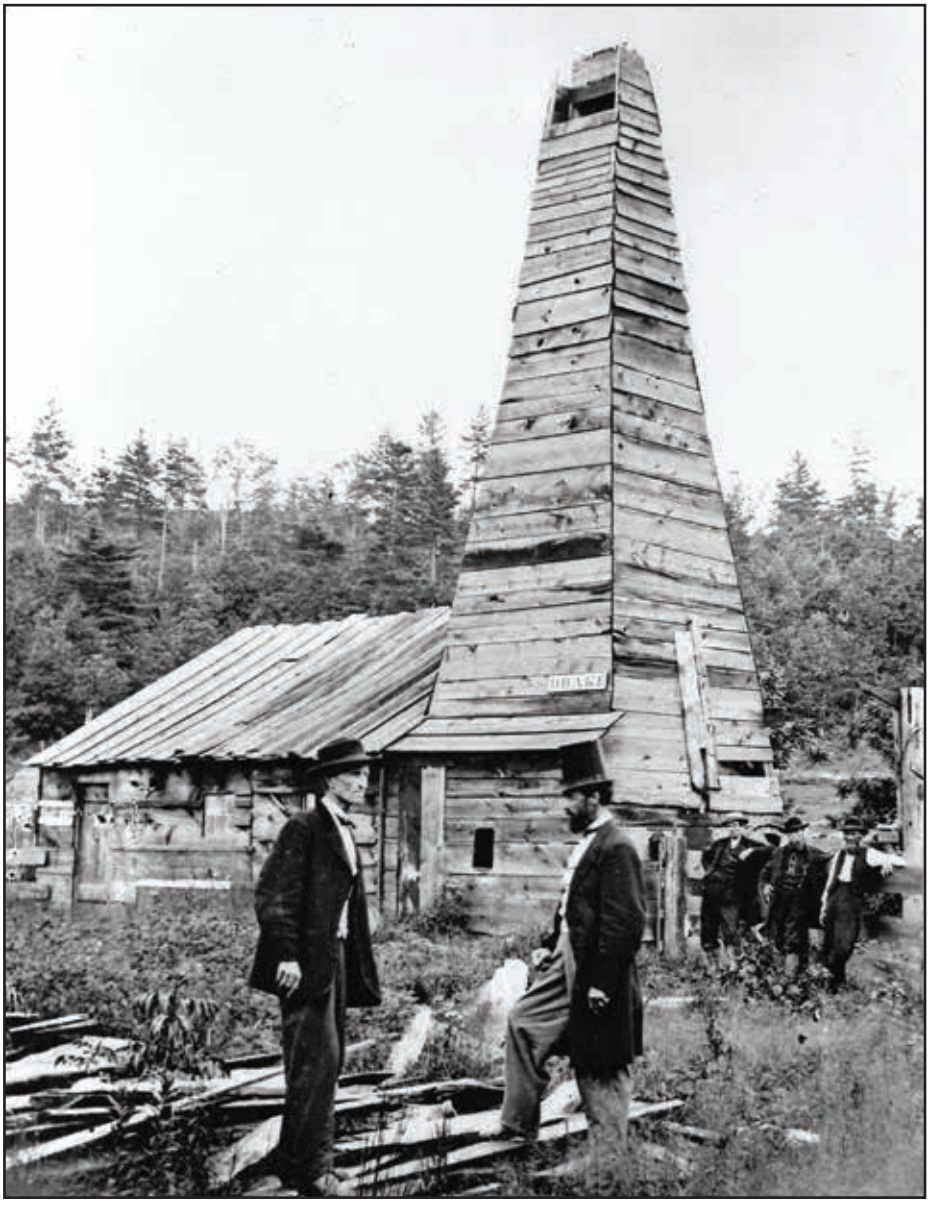
Even though the process of producing natural gas, converting it into liquid form, shipping it across the seas, and then warming it so that it can be re-delivered in gaseous form once again is complex and capital intensive, there would not be this level of excitement and activity about LNG unless the market thought that energy prices would justify this investment for many years into the future. The market is starting to believe that these price levels are not some short-term phenomena, but rather are based on sound fundamentals and sustainable. In options parlance, the question is whether LNG will remain "in the money" or will prices plummet and LNG terminals go dormant once again. If the current crop of energy doomsday books can serve as an accurate barometer, then it appears that we are indeed experiencing a long-term shift in the energy markets.

There are predictions that world oil production will soon reach its peak and necessitate a shift to other fuels such as natural gas, based on the dimension of the global natural gas resource base and our improved ability to deliver it around the planet. "As early as 2025, gas, not oil, could be

the world's dominant energy source," declares energy journalist Paul Roberts.[2]

But gas too is a finite resource. "The world will soon run out of conventionally produced, cheap oil. If we manage somehow to overcome that shock by shifting the burden to coal and natural gas, [...] life may go on more or less as it has been – until we start to run out of all fossil fuels by the end of this century," points out David Goodstein, a physicist and vice-provost at the California Institute of Technology[3].

Much of this negativity about our energy future is based, in part, on the work done by Marion King Hubbert, a Shell geophysicist, who in the 1950s was able to accurately predict that US oil production would peak at 9 million barrels a day in 1970 and then decline forever. Essentially, Hubbert predicted that oil production would follow a bell-shaped curve, rising at first, reaching a peak and then going into permanent decline. While there is some disagreement over Hubbert's peak analysis, the fact that his predictions were dead on the money has produced a strong following.



Colonel Drake's well drilled in 1859 that went down just 69 feet (21 metres) cost more per unit produced than today's deep offshore wells.

Of course, there are some contrarian voices on the subject. In their book[4], Peter Huber, a senior fellow at the Manhattan Institute's Center for Legal Policy, and Mark Mills, a partner of Digital Power, attempt to change the way we look at accepted notions of energy policy by putting forth their seven great heresies. For example, they believe that:

- "The cost of energy as we use it has less and less to do with the cost of fuel. Increasingly, it depends instead on the cost of the hardware we use to refine and process the fuel."

2 Roberts, P., *The End of Oil: On the Edge of a Perilous New World*, Houghton Mifflin, 2004.

3 Goodstein, D., *Out of Gas: The End of the Age of Oil*, W. W. Norton, new ed. 2005.

4 Huber, P. W. and Mills M. P., *The Bottomless Well: The Twilight of Fuel, the Virtue of Waste and Why We Will Never Run Out of Energy*, Basic Books, 2005.

THE LNG HORSE RACE – US IMPORT TERMINALS

Existing	*mcf/d*
Everett, MA	755
Cove Point, MD	1,800
Elba Island, GA	805
Lake Charles, LA	1,200
Energy Bridge, GOM	500
Under construction or licensed pending construction	
Bear Head, NS	775
Canaport, NB	1,000
Cameron, LA	1,500
Corpus Christi, TX	2,600
Costa Azul*	1,000
Freeport, TX	1,500
Golden Pass, TX	1,000
Gulf Landing, GOM	1,200
Ingleside Energy Center, TX	1,000
Sabine Pass, LA	4,000
Weaver's Cove, MA	400
Total bcf/day	**21,035**
Total tcf/year	**7.7 = 216 bcm**

Notes: GOM = Gulf of Mexico, *In Baja California, Mexico, but will also supply US markets.
Source: Pan EurAsian Enterprises, Inc.

RIGHT
Table 2.

- "The more efficient our technology, the more energy we consume. More efficient technology lets more people do more, and do it faster – and more/more/faster invariably swamps all the efficiency gains. To curb energy consumption, you have to lower efficiency, not raise it."
- "The raw fuels are not running out. The faster we extract and burn them, the faster we find still more. .. Energy supplies are infinite."

The authors note that Colonel Drake's well drilled in 1859 that went 69 feet deep cost more per unit produced than today's wells that go under 2 miles of water, 4 miles of rock and 6 miles horizontally.

One could apply this logic to LNG and argue that we have, in effect, "discovered" significant quantities of new LNG by virtue of bringing down the costs throughout the value chain by deploying new and better technology and making the LNG option competitive with other indigenous sources of gas. Or, on the other hand, if you believe the doom-sayers and see the peak in fossil fuel production arriving soon, then the likelihood of a steep drop in gas prices making an investment in LNG infrastructure obsolete would have to be considered remote.

Of course you would also need to factor in the demand side of the equation and that the US is using oil and gas much more efficiently. The amount of oil and gas used to produce a dollar of economic growth dropped by 55% between 1973 and 2003 and energy expenditures declined to 7% of GDP from almost 14% in 1981. Moreover, energy prices today, even at $60 per barrel oil, are relatively cheap compared to other consumer goods in relative terms. Since the early 1980s, gasoline has increased in price by 67% compared to tuition and childcare, 330%, medical care, 219%, and rent, 115%. No matter which camp you fall in, it would appear that the market is convinced that over the long term, energy prices will be high enough to maintain the viability of an investment in the LNG value chain.

The LNG horse race

A great deal of the current excitement centres around the numerous proposals for receiving terminals in the US. With over 50 projects on the drawing board there is no shortage of ideas and concepts, including proposals for facilities onshore (using private lands, public lands and even sovereign Indian lands), offshore and floating.

While many of these projects are backed by solid players and represent commercially viable options, the market is sure to weed out the fatal

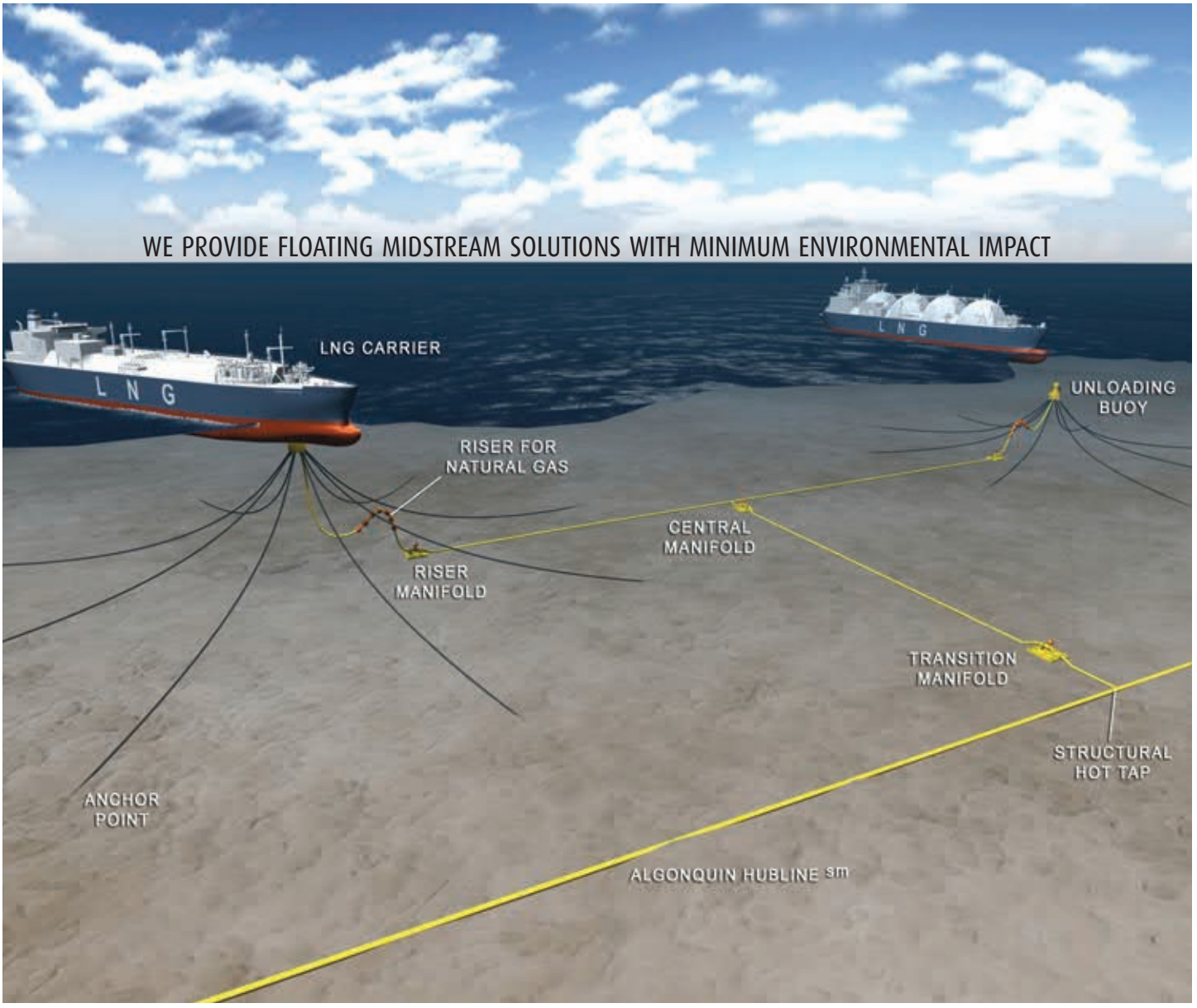


PHOTO: © INDOK AS

This is an artist view of the Neptune LNG receiving terminal which Höegh LNG is developing together with Suez LNG North America. The terminal will be located in Massachusetts Bay offshore Boston in the United States. The new terminal will complement the existing onshore receiving terminal in Boston operated by Suez. With 30 years experience in transporting LNG world-wide, Höegh LNG has since 2001 made a considerable effort to develop and promote floating LNG regasification terminals. Höegh LNG can now offer LNG shipping related solutions, such as our proprietary system, the "LNG Shuttle and Regasification Vessel" or "SRV". The SRV is a combined LNG carrier and floating regasification terminal, and it can be adapted to operate as a Floating Storage and Regasification Unit (FSRU). We are also developing an ocean-going Compressed Natural Gas (CNG) shuttle tanker in co-operation with partners. Both the SRV and the CNG Shuttle will be able to use the same receiving terminal system.

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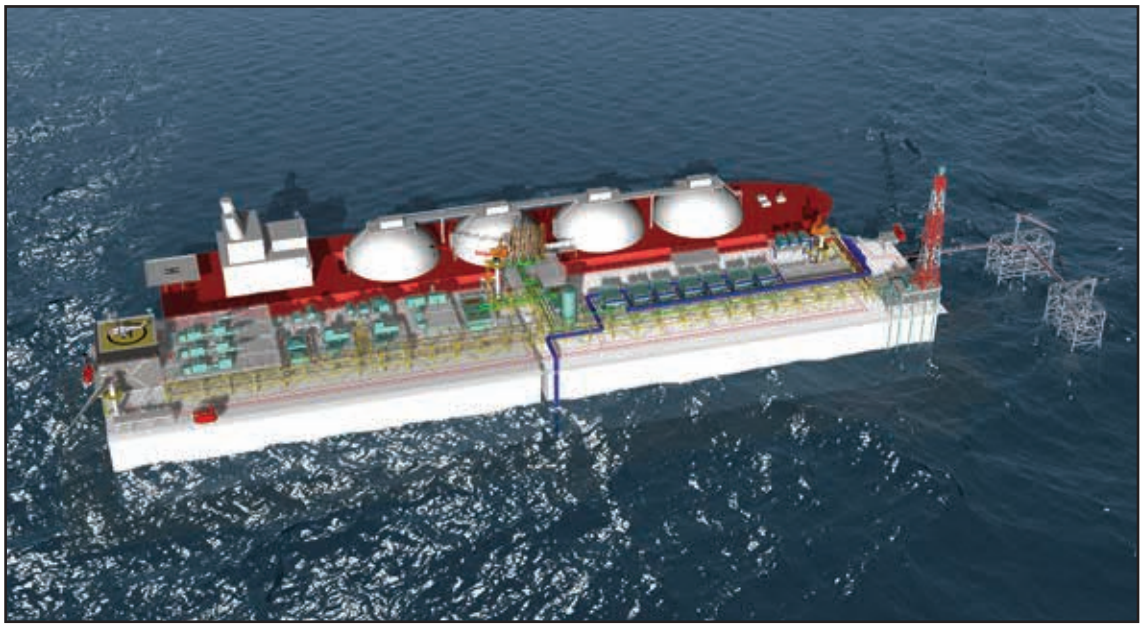
Excelerate's Gulf Gateway terminal is 116 miles (187 kilometres) offshore Louisiana in the Gulf of Mexico. The Energy Bridge system uses regasification vessels (the *Excelsior* is pictured) for the transportation and vaporisation of LNG. On arrival at the terminal these vessels connect to a submerged turret loading buoy (STL) and commence regasification of the LNG on-board. Natural gas is then discharged through the STL buoy, into a flexible riser and delivered through an offloading pipeline to the metering platform.

flaws of the weak and inferior business models. The current state of play looks like a classic horse race with numerous players jockeying for position and a shot at crossing the finish line and a place in the winner's circle. While it is a crowded field and a risky race, the size of the North American natural gas market and potential pay-off for a winner has proven to be a strong attraction. *Table* 2 provides a snapshot of those projects that are already in operation as well as those that have gone through the permitting process.

There are signs that the talk about LNG is beginning to match the reality. The first new terminal in the continental US for over 20 years went into operation in March 2005. Excelerate's Energy Bridge was the first to cross the finish line due, in large measure, to the fact that this technology is able to overcome NIMBY (not in my backyard) concerns by keeping the terminal out of sight and out of mind. While they were successful in crossing the finish line, it is too early to determine whether this model will prove to be a winning bet over the long haul, as other terminals come on-line and competition among the winners heats up.

There is also a great deal of interest in the proposals of another new entrant into the LNG game, Cheniere Energy, a small company that is not one of the LNG value chain players, but has managed to bring two terminals to the construction phase while it is developing yet two others. Part of Cheniere's success can be attributed to the vision of its management, who early on recognised the value of potential sites and then acquired some of the premier sites along the Gulf Coast. By focusing on areas where the energy industry was already accepted and welcomed and by communicating early and often with local interests about the impact that an LNG terminal would have on the area, Cheniere was also able to overcome the NIMBY concerns about its proposals.



Shell's Gulf Landing project is also being developed offshore Louisiana (38 miles/61 kilometres). Construction is expected to begin in 2007.

All politics is local

Another interesting development in the terminal siting race comes from Massachusetts and the hotly contested Weaver's Cove project. Because of its location in the east coast market area, it attracted the attention of high profile political leaders, including the 2004 presidential candidate Senator Kerry and Senator Kennedy. Even though there was strong local opposition against this project, FERC ultimately gave its approval based on the need for natural gas supplies to serve New England customers. On peak days during the winter New England already receives close to half its gas supply in the form of imported LNG via the Everett terminal. However, notwithstanding that this region of the country would be crippled without LNG and that the Everett facility has a long-standing track record of safe and secure operation, it is by no means certain that the Weaver's Cove project will make it to the winner's circle even with a FERC permit. Local opposition is still strong and gearing up for a continued fight.

It is interesting to look at the results from the 2004 presidential election in terms of proposed LNG facilities. Although Senator Kerry and the Democrats were beaten by the Republicans led by President George W. Bush, those states that were carried by the Democrats – with the exception of the Gulf Coastal region – dominate the coastal areas of the country where LNG terminals are either in existence or have been proposed. For LNG development to be truly successful over the long term it will have to have bi-partisan support from national as well as local political leadership.

NIMBY, BANANA and NOPE

The proposed construction of LNG infrastructure has given rise to a number of passionate and vocal opponents whose philosophy seems to range from NIMBY, BANANA (Build Absolutely Nothing Anywhere Near Anyone) and NOPE (Not on Planet Earth). The only place that some of these zealots might consider not opposing LNG is on Titan, the moon of Saturn that was recently discovered to have naturally-occurring LNG rain.

As a result of the hysteria generated by project opponents, LNG still faces an uphill battle on many fronts. A thoughtful educational effort where the

public sector works hand in hand with private interests (public-private partnerships) that involves a broad range of stakeholders and interest groups will prove to be the most effective way to neutralise the barrage of negativity. As seen from research done in California (see *Figure 1*), there is in fact a great deal of concern about our energy situation, a mass of people who have not yet made up their mind concerning LNG and the ability to persuade the undecided that LNG is a worthy option for the problems on the horizon. The figure illustrates the shift in attitudes towards LNG after receiving positive messaging. Post-messaging the vast number of those who were undecided about LNG adopted favourable attitudes. Interestingly, the education also was effective in shifting the attitudes of some who were previously opposed.

Federal energy legislation in Congress

Recent passage of the Energy Policy Act offers hope that the public and Congress may finally be starting to recognise that action is needed for a secure energy future. The legislation contains a number of provisions designed to stimulate development of energy supplies, increase energy efficiency and promote investment in energy infrastructure, including some directed specifically at natural gas and LNG.

With respect to natural gas supply, the Energy Policy Act addresses a wide range of issues:

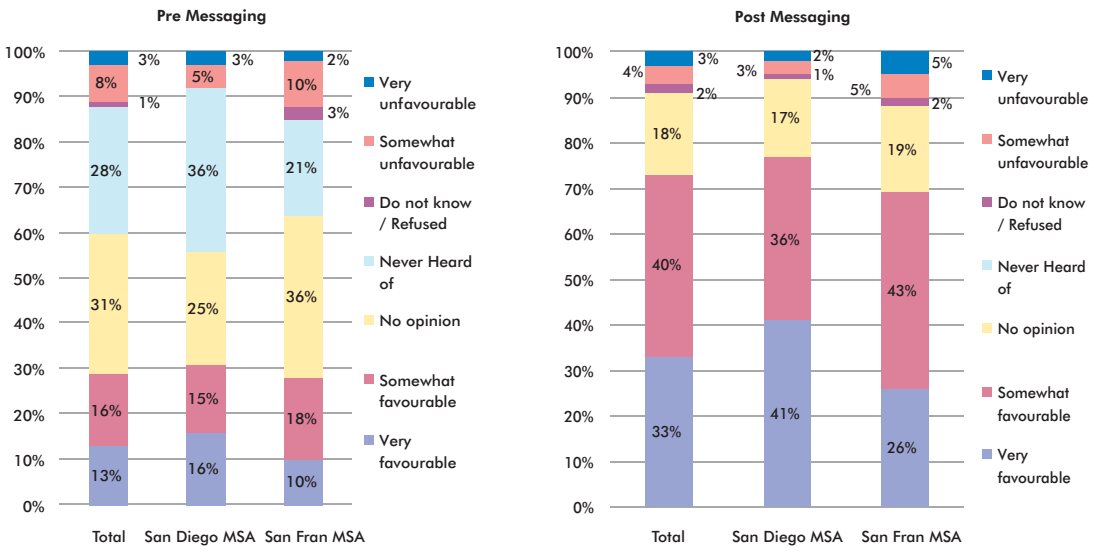
Permitting and process items

- Improves the process for issuing permits to drill on federal lands;
- Creates a federal pilot project to streamline permitting in the Intermountain West;

RIGHT
Figure 1.

RESULTS OF RESEARCH INTO PUBLIC OPINION IN SAN DIEGO AND SAN FRANCSICO

Question asked: Now that you know a little about liquefied natural gas, please tell me if you have a favourable or unfavourable view of liquefied natural gas?



Overall, residents of the San Diego metropolitan statistical area (MSA) tend to view LNG more favourably than San Francisco MSA residents (77% as opposed to 69%). Further, favourables for San Diego MSA residents grew by 46% post messaging, compared to 41% for San Francisco MSA residents.

Source: USEA.

- Requires expeditious compliance with the National Environmental Policy Act and timely action on applications for oil and gas permitting on federal lands;
- Requires review of federal land-leasing practices; and
- Requires a memorandum of understanding between the US Interior and Agriculture Departments on leasing in public lands.

Regulatory certainty

- Resolves conflicts over authority to regulate hydraulic fracturing; and
- Resolves issues under the Federal Water Pollution Control Act surrounding oil and gas exploration and production.

Assessment of energy resources

Calls for a scientific inventory of natural gas and oil resources on the Outer Continental Shelf (OCS).

Encouragement of continued US natural gas production

- Provides royalty incentives to encourage production from deep wells (20,000 feet or more) in shallow Gulf of Mexico waters;
- Provides royalty incentives for deepwater wells in the Gulf of Mexico; and
- Frees up capital for further production by allowing producers to amortise geological and geophysical costs over two years.

Promote LNG

- Clarifies FERC's exclusive authority to approve or deny applications for new or expanded LNG terminals, while affirming states' rights to review such proposals under the Coastal Zone Management Act, the Clean Air Act and the Federal Water Pollution Control Act; and
- Encourages federal and state officials to hold public forums on LNG.

Foster futuristic sources of natural gas

- Allows the US Interior Department to grant royalty relief for production of methane hydrates.

Even though the ink was barely dry on the Energy Policy Act, upon the return of Congress from the summer recess energy legislation was once again on the agenda. A number of proposals that would have opened up the Arctic National Wildlife Refuge (ANWR) and areas of the OCS for further energy exploration and production were debated. However, as of the end of 2005 opponents to development of these resources had scored continued success in defeating these proposals. Supporters of ANWR development are no doubt encouraged by the narrow margin of defeat, giving hope that a political solution lies ahead in 2006. Given the forecasts of record increases in energy bills for the winter heating period, voters are likely to continue to make energy policy an issue for the mid-term elections in November when they go to the polls to select the entire US House of Representatives, one-third of the Senate and 36 Governors.

Gas quality

FERC is in the process of addressing the looming issues surrounding gas quality including "interchangeability" which refers to a measure of the degree to which the combustion characteristics of vaporised LNG are the same as those of domestic pipeline gas. While there are various proceedings where these issues are in the process of being addressed, there has also been a collaborative effort where the LNG industry worked with other segments of the natural gas industry and regulators to try and identify and resolve the technical issues surrounding gas quality prior to adoption of new regulations on either a system by system or generic basis.

The interim guidelines established through this collaborative process include a maximum Wobbe of 1400 plus or minus 4%; maximum heating value of 1110 Btu as well as limits for butanes and


New platforms' topsides


1600 km of oil & gas pipelines


Onshore Processing Facility


LNG tank roof raising

Russian LNG is Coming

Expected Summer 2008

75% of LNG plant capacity firmly contracted

Sakhalin Energy

www.sakhalinenergy.com

The controversy over protecting the Arctic National Wildlife Refuge is likely to continue.

inerts. FERC has not formally adopted or implemented these guidelines but may do so, possibly in response to requests for adoption of generic rules. Once these rules of the game are in place and the regulatory risk and uncertainty are gone it will help the US access even greater supplies of LNG which can then be produced to meet known standards.

Conclusion

It should come as no surprise that when globalisation leads to loss of American jobs and possible loss of entire American companies to foreign buyers, it fans the fires of xenophobia and pushes elected officials and the general public into a reactive mode. However, when it comes to meeting US energy needs, the natural gas market is sending a strong signal that imports are needed and are economically viable. While we might feel better if we could return to those days when we worried more about imports of tea than energy, the global LNG game is in full swing and it is only a matter of time before we become even more dependent on imported energy. Thus, the market for natural gas and not the politicians will determine whether or not the idea of energy independence is a "flawed concept". Right now the market is sending strong signals that natural gas is no longer the fuel of the future, but rather the fuel of the present given the need for clean and efficient supplies to meet energy and environmental targets. LNG is the future for natural gas.

David M. Sweet serves as Director of Special Projects for the United States Energy Association (USEA), the US arm of the World Energy Council. He has over 25 years of broad energy policy, commercial and technical experience, including service as Executive Director of the International LNG Alliance, and is the US representative on PGC D. He can be contacted at dsweet@usea.org.