



THE ROLE OF INTERNATIONAL OIL COMPANIES (IOC) IN CREATING GAS MARKETS

Roger Bounds, Global Head,
Shell LNG, Singapore

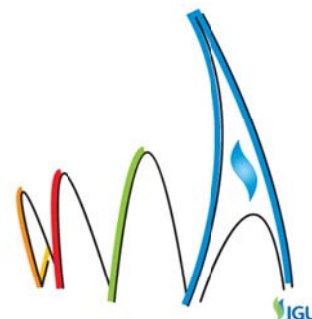


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Background

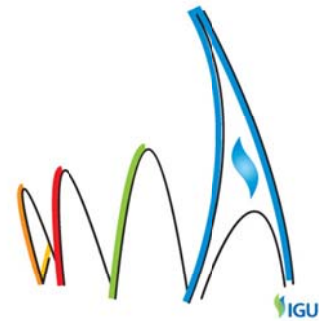
Global demand for energy is increasing due to the growing world population, rising economic output and improved standards of living. The energy industry faces a major and urgent challenge in meeting this higher demand for energy while trying to reduce the environmental impact.

We believe natural gas, which offers many economic and environmental benefits as the cleanest burning fossil fuel, is uniquely positioned to help meet this twin challenge.

There is a role for International Oil Companies (IOC) in working with governments, customers and stakeholders to sustainably grow gas demand by putting in place the supportive technical, regulatory and market mechanisms, which allow consumers to choose this fuel which offers many benefits.

First, gas produces around half the carbon dioxide and just one tenth of the air pollutants that coal does when burnt to generate electricity. With fossil fuels still constituting 80% of the energy mix, and being the dominant energy source for decades to come, there is enormous potential to reduce near term CO₂ emissions and air pollution by using gas instead of coal. This is being addressed in Beijing, for example, where steps are being taken to switch some power generation from coal to lower-carbon gas.

Second, natural gas is abundant and widely available. According to International Energy Agency (IEA), there are enough recoverable natural gas resources to last around 230 years at current levels of consumption. Its wide availability has helped countries deal with short-term supply disruptions. In the aftermath of the Fukushima disaster, for instance, Japan was able to tap into the global gas market to make up for much of the lost energy supply stemming from the shutdown of the country's nuclear reactors.



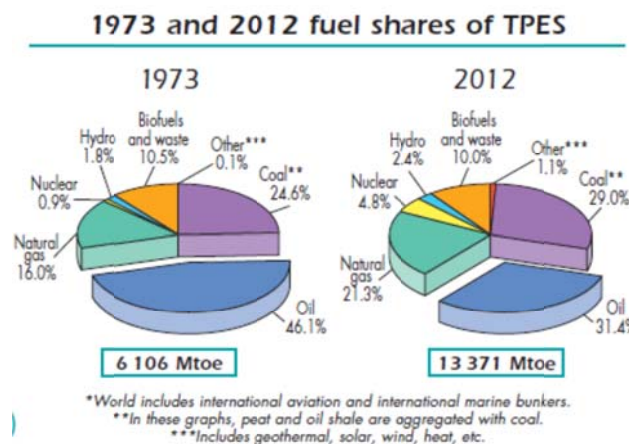
Third, gas is flexible. It can be cooled to a liquid, making it easier to store and transport from supply sources far away from the markets. A gas-fired plant takes much less time to start and stop than a coal-fired plant. This makes gas an ideal complement for renewable energy sources like solar and wind power.

In many cases, gas also has economic advantages. The Indian state of Gujarat is estimated to have saved US\$8 billion over 10 years as a result of a government decision to encourage greater use of natural gas over more expensive fuels like diesel and naphtha. Natural gas now makes up a quarter of the energy mix in Gujarat, compared with the national average of 9%.

In some instances, the cost of producing energy using gas is cheaper than coal. For example, the investment cost of the most efficient coal plant comes in at \$3,700 per kilowatt, compared with \$1,100 for the most efficient gas-fired plant. Gas-fired power becomes even more competitive when the immediate production costs are added to the long-term costs associated with climate change and the impact of air pollution on both people and the environment.

Another advantage of gas is its expanding range of uses. While it is traditionally been used to heat and light homes and businesses and power industries, other exciting markets are opening up, including using liquefied natural gas as an alternative to diesel and heavy fuel oil in transportation.

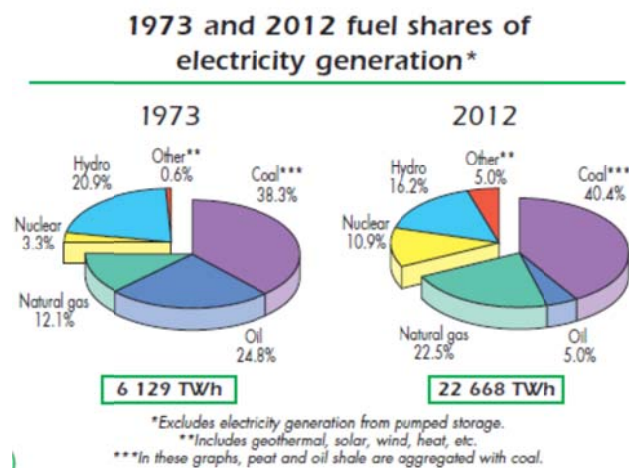
Given its strengths, we see gas increasing its share in the total primary energy demand. According to IEA and as shown in the graph below, the share of natural gas in the total primary energy supply has increased from 16% in 1973 to 21.3% in 2012. In terms of volume, it has increased from 977 million tonnes of oil equivalent (Mtoe) in 1973 to 2,848 Mtoe in 2012¹.



¹ International Energy Agency (IEA) - Key World Energy Statistics 2014.

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The largest market sector for gas demand has been electricity generation and will continue to be so in the foreseeable future. As shown in the graph below, the natural gas fuel share in electricity generation has increased from 12.1% in 1973 to 22.5% in 2012. By volume, it has increased from 741 terawatt-hours (TWh) in 1973 to 5,100TWh in 2012². This significant increase has demonstrated the important role of gas in the electricity generation mix and gas is expected to play an even bigger role in the power generation sector in future. Strong growth is also expected in other sectors such as industrial, fertilizer and transport.

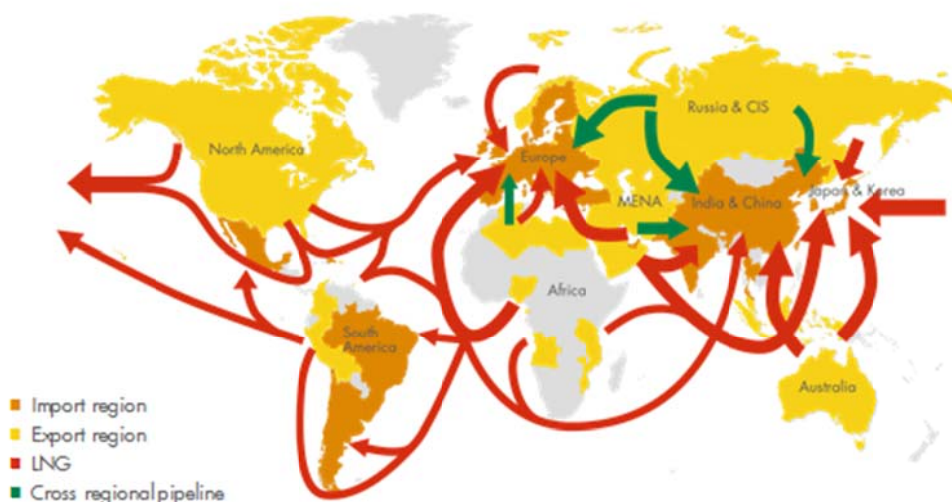


As gas use continues to increase, there will be a continued growth in cross-border gas trade through both pipeline and LNG, as shown in the graphic below³.

² International Energy Agency (IEA) - Key World Energy Statistics 2014.

³ Shell Analysis.

Main cross-regional trade flows by 2025

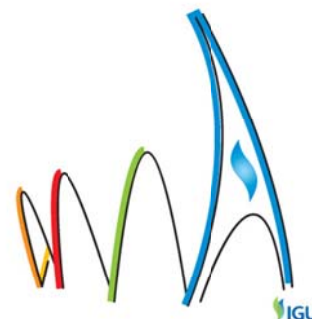


Major new pipeline projects continue to progress. For example, the Russia-China gas pipeline export project announced last year should result in initially 38 bcm per year of gas flow between the two countries, with expansion capabilities.

LNG also forms a major part of the gas trade. While LNG accounts for 10% of gas traded today, it will account for 15% of the gas trade by 2025.

In recent years, both LNG demand & supply have substantially diversified with currently approximately thirty importing and twenty exporting countries today, expected to grow to as many as approximately fifty and twenty-five respectively by early next decade. This compares to the situation in 1990, where the fifty million tonne per annum global LNG market consisted of only eight exporting and nine importing countries.

The global LNG market has grown by approximately 7.6% per annum since 2000. The LNG market is expected to almost double by 2025 with growth of around 5% per annum to around 430 million tonnes per annum.



Aims

The healthy growth of the global gas market did not happen by chance. IOCs have played an active role in creating and developing this market. I have a personal admiration for the pioneers in the business who took LNG from Brunei to Tokyo over 40 years ago. This meant taking risks commercially and technically to start this business.

This paper examines the role IOCs play in growing and creating new gas markets, as well as the commercial and gas advocacy insights and examples we draw from the role. It also includes a discussion on the regulatory and infrastructure challenges and the request for co-development or facilitation from the host governments and non-governmental organisations (NGOs).

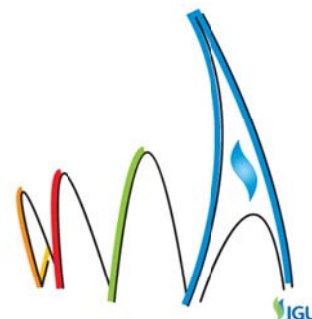
Role of IOCs

IOCs have played a major role in creating and growing gas markets in both emerging and advanced economies. Shell, for example, has successfully collaborated with governments, private sector partners and demand resource holders to create and develop gas markets around the world.

A big part of that history is the development and management of the Groningen field – discovered in 1959 and one of the biggest gas finds ever. Groningen is managed by Nederlandse Aardolie Maatschappij (NAM), a 50-50 exploration and production partnership between Shell and ExxonMobil, which dates back to 1947.

Availability of this new source of gas led to a coordinated expansion of the infrastructure from northern Netherlands to north-western Germany, Belgium and France. Over the following four decades, the European gas grid has developed into a large, effective network, facilitating the development of additional sources from the north and east through a transport infrastructure.

Following this is a number of other contributions such as regasification terminals that have directly contributed to the establishment and growth of LNG and gas markets around the world. Shell has equity participation and/or firm capacity rights in regasification terminals spanning North America, Europe and India. It has also supplied LNG either directly or through its joint ventures into many terminals in Japan, Korea, the Middle East and South America.



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Notable examples of Shell's leadership role in developing the gas markets in these regions include:

- **United Arab Emirates:** Shell is a key supplier of LNG and serves as the technical and safety advisor for several major users, including the Dubai Electricity and Water Authority (DEWA), Dubai Aluminum Company (DUBAL), ENOC (Emirates National Oil Company) and Dubai Petroleum Establishment, which uses gas as fuel for power generation, water desalination and other industrial applications.
- **Mexico:** Shell is the lead project developer managing the design and construction of the Altamira LNG terminal in northeast Mexico. The terminal mainly serves gas fired power plants in the region, and is also connected to the national transmission grid at Tamazunchale project. Shell is also one of the founding capacity holders at the Costa Azul LNG Terminal in Ensenada, northwestern Mexico.
- **India:** Shell was the lead project developer for the Hazira Terminal in India. The terminal now operates and supplies LNG to a large number of customers in different industrial segments ranging from power and fertilizer to ceramic, steel, small and medium industries. It is interconnected with the Hazira-Bijaypur-Jagdishpur line (HBJ), Dahej-Uran pipeline (DUPL), Gujarat State Petronet Limited (GSPL) and East West pipelines at Mora, enabling the terminal to supply gas to North, West, Central and even South India.

IOCs also play a significant role in helping to address the social impact of gas projects. For example, in Hazira, India, Hazira Group of Companies contributes to a Sustainable Development Programme which has a special focus on Hazira and its surrounding villages. Under the programme, various activities are implemented in partnership with village institutions (Gram Panchayats and various village committees), NGOs and Government Departments. The partnerships with local institutions have resulted in initiatives around environment, health, capacity building and road safety for the surrounding community.

Regulatory Challenges

Bringing natural gas to the people who need it involves huge investments across the entire value chain, as well as skills and expertise of people from many disciplines. Robust and stable policies and regulatory structures are also required for the development of the value chain.

There are challenges in both the mature and developing markets. In mature markets in North America, Europe and parts of North Asia, there are challenges associated with carbon pricing, combined with the use of renewables and coal.



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In Germany, for example, we have seen that the government paired its growing support for renewable energy with increased use of coal plants as a back-up. According to the European statistics agency, Eurostat, this led to an increase in Germany's CO₂ emissions in 2012 and 2013. This paradox demonstrates the issues we face.

Such policy impediments can also be found in the growing markets of South Asia, South America and Africa. They are, however, less visible as the more significant challenges involve rapid growth, competing land use, capital market failures or shortage, credit rating issues and others.

In developing markets, the regulatory environment continues to play a strong role in shaping the consumption of natural gas. End-user price regulations, gas pooling mechanisms and timely approval processes are examples of regulatory instruments that can open up new gas sources for developing countries.

In recent years, several South-east Asian countries including Malaysia have introduced price reforms to shift end-user gas prices towards international market levels. With a gas price that is more market and cost reflective, countries will be able to open up new opportunities to incentivize the availability of new gas sources for domestic end-users.

There have been a number of instances demonstrating the effectiveness of using an aggregated gas pool to introduce new sources of gas to a country. In Thailand, customers in the power sector have been able to access new sources of gas, essentially replacing declining domestic upstream production in the country. Most recently, India has also shown interest in the use of a gas pooling mechanism to encourage adoption of LNG in the fertilizer sector.

Regulators are also starting to recognize the importance of transparent and streamlined approvals to accelerate the process of bringing new sources of gas into their countries. Most recently Indonesia has recognized the need to streamline its process for the sale and purchase of both LNG and gas in the country. The country has announced numerous positive steps, including setting up a "one-stop service for the approval process" and potential revisions to the existing law governing oil and gas.

Technical Challenges

There are a number of technical challenges to overcome if the gas industry is to grow faster, especially those involving the reliability and cost effectiveness of the infrastructure needed, and the speed at which they can be built.

The good news is that recent developments in the Middle East and South Asia have demonstrated the development cycle has been considerably shortened to 14 months from Final Investment Decision in some cases, with the deployment of Floating Storage & Regasification Unit (FSRU). A key enabler of this efficiency has been the technological

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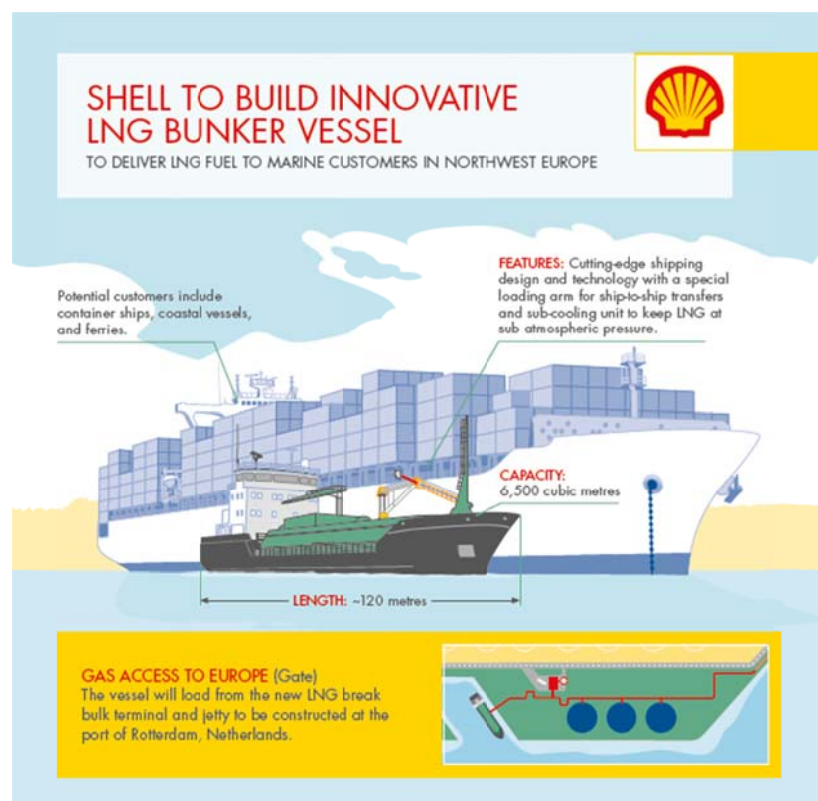
development of floating terminals such as FSRU, which can present proven and off-the-shelf solutions adapted to local infrastructure to deliver quick, cost-effective solutions.

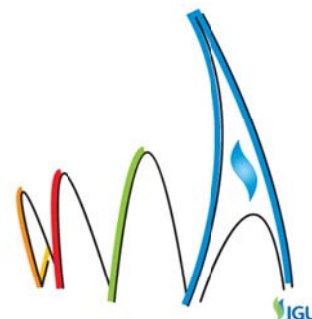
In mature markets where there is greater liquidity, it is easy to overlook new options such as switching to LNG for transport, using less coal or complementing depleting natural gas reserves with imports.

As such, the market may not adopt a relatively new fuel despite its benefits. In such cases, industry leaders and IOCs play an important role in promoting the new uses for gas.

For example, while LNG to power transport is still an emerging sector, it has grown over the last few years. China is leading the way with more than 100,000 heavy-duty trucks powered by LNG.

For its part, Shell has acquired a Norwegian company, Gasnor, which provides LNG fuel for ships and industrial customers. We have also committed to be the first customer to use the new LNG transport infrastructure at the Port of Rotterdam in the Netherlands. We have committed to building a specialised LNG bunker vessel to deliver gas to LNG-fuelled vessels in northwest Europe, to be based at the port of Rotterdam.





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Shell's support helped launch Greenstream and Green Rhine, the world's first 100% LNG-powered barges to carry goods along Europe's River Rhine.

Shell and Harvey Gulf International have also combined to put in service, the first LNG powered Offshore Supply Vessel in the Gulf Coast which will bring supplies and equipment to Shell's deep water operations in the Gulf of Mexico. LNG fuel is a new alternative for vessel operators in the Gulf of Mexico responding to new sulphur and nitrogen oxide emissions regulations, as part of the North American Emission Control Area (ECA).

Furthermore, Shell opened its first two European refuelling stations to supply LNG to trucks in Rotterdam, the Netherlands this year. Shell also has an agreement with TravelCenters of America LLC to develop a network of LNG fuelling stations for heavy-duty road transport customers, with sites phased to customer demand. The first of these LNG fuelling stations was opened in May 2014 in Ontario, California.

Energy Choices

Gas is vital as it contributes to a sustainable energy future. So it is critical that we work hard to convince governments across the globe of the benefits of gas, because, ultimately, the make-up of the long-term energy mix is driven more by government policy and national politics than market dynamics.

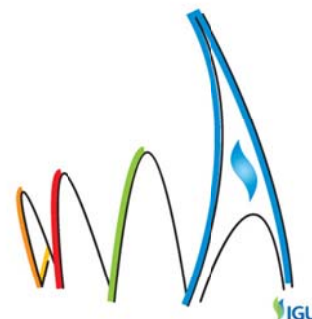
The gas value chain covers market access, pipelines and distribution systems, regulations and pricing which can be provided by competent industry players. However, robust policies are required to integrate each element of the value chain and make it viable for the gas market to develop.

These policies will not just benefit our industry. They will also benefit our customers, who are prepared to choose gas as a cleaner, more flexible fuel but cannot do so unless governments create an attractive environment for long-term investment in gas infrastructure.

For example, countries such as Singapore, Vietnam, Pakistan, Ghana and Jordan recognized the benefits of LNG and have built or are in the midst of putting in the supply chains to import gas. Jordan⁴, which annually imports about 96 per cent of its energy needs, is seeking to diversify its energy sources following repeated cuts in natural gas supplies via its main gas pipeline from Egypt. This has forced the Kingdom to replace gas with more expensive heavy fuel and diesel for power generation. Jordan is constructing a new LNG terminal and Shell has signed an agreement to supply LNG to the Kingdom.

There are also opportunity costs for not using gas. If more coal is burnt instead of gas, the challenges of global warming and air pollution will be increasingly tougher to manage.

⁴ <http://www.constructionweekonline.com/article-32481-site-visit-lng-terminal-aqaba-jordan/>



Conclusions

IOCs can bring their expertise across the value chain to the table. Shell, for example, is involved in every stage of the LNG value chain, from the upstream (finding the fields and extracting the gas from them) to the downstream (liquefying the gas, shipping, turning the LNG back into gas and distributing it to customers).

We also have the necessary logistical, contractual, financing and marketing expertise and experience to deliver a complex LNG mega-project. That breadth of expertise is essential in creating confidence with key stakeholders: investment banks, contractors, partners and resource-holding nations.

But we need to better integrate the entire gas value chain if we are to bring more gas to the people who need it. With the emergence of North America as a substantial gas exporter, many industry players now have the LNG capability and portfolio. However, the market is growing less quickly than supply. There are opportunities to lower the entry barriers so as to connect the supply to the markets.

IOCs can provide the technical solutions, in a favourable regulatory context, to provide gas to customers who want cleaner and more flexible fuel. Integration is key to putting all the different components together.

The future development of gas markets will depend on the successful collaboration between IOCs, governments and demand holders. They need to work together to overcome economic, technical and policy challenges to build sustainable regulatory, financial and physical frameworks that facilitate investment, not only in traditional markets but increasingly in emerging markets such as South-east Asia and Sub-Saharan Africa.