PACIFIC
ENERGY SUMMIT

Evolving Roles of LNG and Asian Economies in the Global Natural Gas Markets

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Advance Summit paper from the 2011 Pacific Energy Summit,
held February 21-23, 2011, in Jakarta, Indonesia.

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EXECUTIVE SUMMARY

This paper explores recent developments in the production and consumption of liquefied natural gas (LNG) and highlights the benefits and challenges Asian nations face in the global gas market.

Main Argument

The past decade has seen a significant expansion of LNG production capacity that has turned the once limited and expensive fuel into a less costly alternative energy source. Asia itself has seen production centers grow and sustained demand in traditional LNG consumption centers as well as emerging economies. The unprecedented opportunities of LNG liquefaction and gasification capacity as well as the prospect of discounted gas prices have also brought about numerous challenges. LNG project development has been spurred by consistent demand from traditional consumers in Japan as well as by the prospect for growth in India and China. While numerous projects are under way in the Asian gas market, difficulties with existing production, costs delays in construction, and regional pricing make LNG a complex venture in the Asia-Pacific.

Policy Implications

- The globalization of the LNG market means that many nations may have several sources of LNG and will look outside regional markets for gas imports, particularly given a post-recession rebound in LNG demand.
- LNG production in Asian states continues to be hampered by challenges such as high capital costs, shortages of skilled labor, and long-term sales contract requirements.
- Promotion of more efficient uses of gas and LNG, including use of gas-fired combined heat and power plants and distributed power systems, may allow Asian states to fully capitalize on the advantages of the contemporary gas market.
- The inherent difficulty and cost of LNG projects require incentivized policies on taxes, royalties, project financing, and pricing reform by Asian governments to encourage stronger commitment from hesitant natural gas developers.

The global natural gas market has experienced a series of profound developments in recent years. A massive expansion of liquefied natural gas (LNG) production capacity, in parallel with a dramatic increase in gas production in the United States, has created a downward pressure on international gas prices. Prospects of affordable LNG prices—although still higher than domestic gas prices in some individual gas markets in emerging economies—have accelerated the growth in demand in emerging markets.

These global market developments are manifesting themselves in important ways in Asia. Notably, the expansion of LNG availability and the concurrent development of robust demand from emerging markets have created a hybrid LNG market structure in Asia. Traditional large consumers under long-term contracts, such as Japan, form the base of the LNG market, providing stability and the promise of cost recovery to producers, while emerging economies represent promising high-growth markets.

These trends in the gas market have both cheering and challenging aspects. The proliferation of suppliers for gas-consuming countries and customers for producing ones enhances market security for players at both ends of the gas value chain. At the same time, increasing interactions between different gas markets create pressure on gas pricing in individual markets to be adjusted to cope with international prices, often pushing the domestic prices upward in developing markets.

LNG Expands Massively, Triggering Unprecedented Events

An unprecedented massive expansion of global LNG liquefaction (and regasification) capacity has been underway since 2009. A 50% liquefaction capacity expansion is expected in the 2009–13 period. Whether this will directly lead to a comparative expansion of the global LNG trade is an open question, although trade apparently grew significantly in 2010. Most of those new LNG projects do not rely on a single market but instead have multiple regional markets to underpin their development.

Global LNG trade grew by 5% to 182 million tonnes (247 billion cubic meters, or bcm) in 2009, owing to the massive expansion of LNG liquefaction capacity, mainly in Qatar, as well as the switch from Russian pipeline gas to LNG in northwest Europe. The shares of the Middle East in the global LNG exports and Europe in the LNG imports also

rose. This trend of expansion is gaining even greater momentum in 2010.[1] Even before the current huge expansion, the global LNG market grew by around 50% in five years from 2002 to 2007, followed by virtually no growth in 2008.

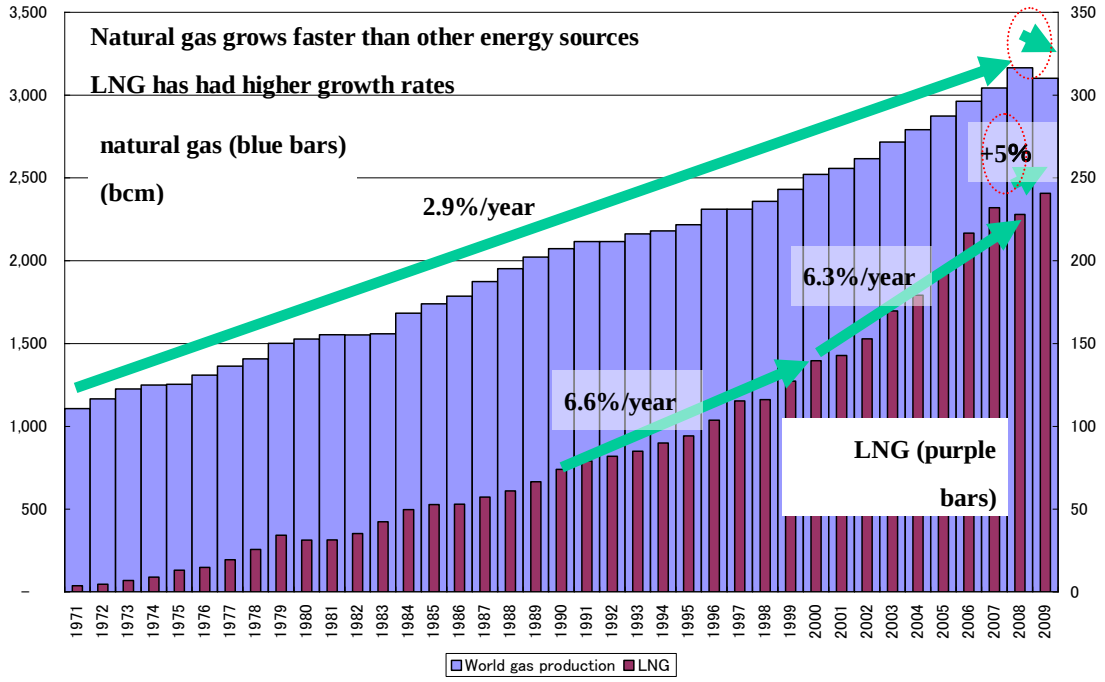
Unprecedented Events in the LNG Industry

At the same time, there has been another series of unprecedented events in the global gas industry:

1. There was a significant reduction of overall global gas consumption in 2009 for the first time in modern history, followed by relatively stronger rebounds in demand in the Asia-Pacific region in 2010.
2. The apparently sustainable discounting of gas prices against oil and the prospect of abundant LNG supply are encouraging LNG import initiatives in emerging markets.
3. Price convergence and divergence—global exchange of LNG cargoes between regions and the coexistence of various prices in one-country markets have significantly influenced pricing at both international and domestic levels. "Convergence" of regional gas prices has been mentioned for some years. Recently gaps between oil-linked long-term contract prices and spot gas and LNG prices have resulted in calls to delink gas prices from those of oil and to reduce long-term contract prices, particularly in Europe. In the Asia-Pacific, the coexistence of various gas prices in individual markets—"divergence"—has led to recognitions of necessity of gas pricing reforms in various countries. These pricing reforms are necessary to promote efficient use of resources and to cope with increasing demand in individual markets.

[1] In the first three quarters of 2010, LNG trade is estimated to have increased by 23%.

FIGURE 1 **Unprecedented Events in 2009: Contrasts of Gas and LNG Production, 1971–2009**



Left axis: natural gas (blue bars); Right axis: LNG (purple bars); Unit:

SOURCE: *Natural Gas Information 2010*, International Energy Agency (IEA).

There is much less, although certainly some, appetite for LNG in the United States than originally targeted several years ago due to a sharp increase in gas production in the country. Buyers in other markets are trying to take advantage of the reduced LNG requirement in the United States. Expected greater availability of LNG at palatable prices in the years to come is prompting more LNG import projects in Organization for Economic Co-operation and Development (OECD) countries, as well as in emerging markets. China is quickly increasing LNG imports, following both the opening of commercial operations at two new LNG receiving terminals at Fujian and Shanghai and long-term contract delivery from Indonesia, Malaysia, and Qatar in 2009. But China is not the only country expanding imports. More LNG markets are emerging around the world, taking advantage of expected incremental availability of LNG supply in coming years and quick-start floating LNG receiving applications.

From 2006 until at least the first half of 2008, higher gas prices and tighter market balances accelerated the global exchange of LNG cargoes, notably from the Atlantic to the Asia-Pacific markets. Those interregional movements of LNG underpin the globalizing trends of gas markets. Some observers and industry experts have predicted that 2009–11 could see a return to regional markets, along with expected significant increases in both liquefaction and regasification capacity around the world, assuming that any extraregional requirements would be met by extra output within the regions or at least via shorter-distance voyages. Particularly for North American markets, the increase in production from shale gas sources has apparently eliminated the need for significant increases of imported LNG.

However, the trends in these years of globalization have already transformed the business to an irreversible extent: A number of players want to have multiple supply sources to support deals in multiple markets in different regions. All LNG export projects that started incremental and new production in 2009 have supply commitments in multiple OECD (and non-OECD) markets.[2] More emerging markets mean a more diversified flow of LNG around the world. There are now even proposals to export gas from North America as LNG.

Due to construction and commissioning delays and initial troubles that were experienced by all those new projects, combined with problems at existing liquefaction plants and incremental LNG appetite from some markets, there was not a big LNG supply surplus in 2009. Now that the new projects are ramping up to capacity and additional projects went online in 2010, the resilience and flexibility of global markets—whether they can absorb the huge increase in LNG production—is being tested, and they are apparently passing this test. The consuming markets are for the moment responding with a significantly larger appetite than a year ago.

Global LNG markets have mixed signals. Various factors can easily affect

[2] In the case of Peru LNG, which started exporting LNG in 2010, because of its location, global LNG market access is currently relatively limited. The majority of the planned LNG volume is contracted to Mexico's Manzanillo terminal under construction on the Pacific Coast through Repsol. Before the terminal is completed, alternative outlets must be found. Some volume may be sold to Asian LNG buyers. The planned expansion of the Panama Canal after 2014 would expand flexibility in marketing from the project if there were additional availability of LNG.

short-term LNG demand, such as prices of other energy sources (coal, oil, and even pipeline gases) and nuclear power developments. One example was observed in Spain in 2010, where a significant increase in industrial and residential gas demand was virtually offset by a reduction in power-generation gas demand caused by increased use of nuclear, hydro, and renewable power.[3]

Massive Expansion of LNG Liquefaction Capacity: Changing the Equation

Qatar—a swing supplier to global markets. Qatar exported 37 million tonnes (50 bcm) of LNG in 2009, setting a new record of LNG export volume by a single country, after surpassing Indonesia as the largest LNG-exporting country in the world in 2006. The previous record was Indonesia's 29 million tonnes (40 bcm) in 1999. The Middle East emirate is expected to double this amount fairly quickly after completing its remaining "mega-trains" in 2010 and 2011. These mega-trains represent the biggest expansion of liquefaction capacity in the world in 2009–11. The size of expansion is enormous and unprecedented, from 30 million tonnes (41 bcm) per year at the end of 2008 to 77 million tonnes (105 bcm) per year in 2010–11, representing 27% of the global total. The unprecedented scale of expansion has begun to have a significant impact on balance in the global LNG market and subsequently on Qatar's own LNG marketing strategy. Whether this will result in changes in its LNG pricing and regional allocation of volumes is to be seen in the next couple of years.

Qatar has been expanding and diversifying its market reach since it started exporting LNG to Japan in 1997. The current expansion phase was originally proposed to target markets in the United Kingdom and United States. But from 2006 the Qataris started to market some of the expected mega-train output to other regional markets on a medium- and long-term basis—notably to China and, to a lesser extent, new LNG markets in Europe. As Qatari marketers distinguish pricing strategies into different markets and insist on prices closer to oil in the North Asian markets, Japanese buyers have not made additional long-term purchase commitments beyond the original Qatargas

[3] "La demanda convencional de gas natural crece un 10% en 2010," January 3, 2011, http://www.enagas.es/cs/Satellite?cid=1146235782013&language=es&pageid=1142417698307&pagename=ENAGAS%2FENAG_Multimedia_FA%2FENAG_pintarNotaPrensa.

1 contracts but are trying to buy LNG from other sources.

Sakhalin 2—Russia's debut in the Pacific gas market. Another notable recent event on the supply side is the emergence of Sakhalin LNG on the Pacific coast of Russia. The Sakhalin 2 project exported five million tonnes of LNG in 2009 and reached its nominal production capacity of 9.6 million tonnes per year in the second half of 2010. More than half its output is sold to Japan, and Russian LNG has also already been delivered to Korea, India, China, and Chinese Taipei, as well as to Kuwait. The project represents the first physical appearance of Russian gas in the Pacific market, and customers in the region have gained access to another huge supply source, accompanied with expansion potential.

The project has also demonstrated how many years a project may take to be implemented, implying that long-term investment is important to secure natural gas. More than 30 years have passed since exploration activities started around the island of Sakhalin and 15 years since the production sharing agreement (PSA) was signed between the Russian Federation, the Sakhalin Oblast Administration, and the Sakhalin Energy Investment Company (SEIC). Since then, the project operator in the company was transferred from Marathon to Shell in 2000 and to Gazprom in 2007. While early marketing successes, such as signing up Tokyo Gas and Tokyo Electric Power (Tepco) of Japan in 2003, as well as early oil production in 1999, helped the project advance ahead of rival LNG projects in the Asia-Pacific region, the project attracted a lot of attention during its implementation stage. In summer 2005 the then project operator Shell abruptly announced a massive cost increase and one-year delay of LNG production from 2007 to 2008.

Shell and its existing partners in SEIC, Mitsui and Company, and Mitsubishi Corporation of Japan, agreed in December 2006 to hand over a controlling stake of 50% plus one share in the export venture to Gazprom. The project's inauguration ceremony was finally held in February 2009 and was attended by Russia's president Dmitry Medvedev and Japan's then prime minister Taro Aso, along with ministers from some other countries. Debottlenecking[4] could expand the capacity from 9.6 million tonnes to

[4] "Debottlenecking" means upgrading works to remove bottlenecks in the process in order to increase processing capacity.

11 million tonnes. The expanded capacity, as well as a possible third train expansion, could be fed by Sakhalin 1 gas or by Sakhalin 3 or 4. In the future Russia may also consider sending LNG to Asia-Pacific markets from its Arctic ventures, including Yamal LNG and Shtokman LNG, utilizing the Northern Sea Route (NSR).[5]

TABLE 1 **Sakhalin II—25 Years in the Making**

1984–86	Lunskoye and Piltun-Astokhskoye fields are discovered
1992	A feasibility study agreement by MMM (Marathon, McDermott, and Mitsui) and the Russian Federation
	Shell and Mitsubishi join
1994	Sakhalin 2 PSA by the Russian Federation, the Sakhalin Oblast Administration, and Sakhalin Energy
1997	McDermott withdraws
1999	First oil production at Piltun-Astokhskoye, Russia's first offshore oil production
2000	Marathon withdraws
2001	Supervisory Board approves Phase 2
2003	Sakhalin Energy signs sales with Japan's Tokyo Gas, Tepco, and Kyushu Electric
	Full development of both Piltun-Astokhskoye and Lunskoye fields starts
2005	A major cost increase and project delay (2007–08) is revealed
Dec 2006	A protocol is concluded to bring Gazprom into the Sakhalin Energy as a leading shareholder
Apr 2007	Gazprom acquires 50% plus one share and the leading role
Jun 2008	A project financing deal is agreed to with JBIC and other lenders
Apr 2009	The first cargo is delivered to Tokyo
2010	9.6 million tonnes per year LNG capacity is reached

SOURCE: Sakhalin Energy and media reports.

[5] The Northern Sea Route (Russian: Се́верный морско́й путь, Severnyy morskoy put, shortened to Sevmorput) is a shipping lane from the Atlantic Ocean to the Pacific Ocean along the Russian Arctic coast from the Barents Sea, along Siberia, to the east. Novatek shipped out a condensate cargo from Murmansk to China via NSR for the first time in summer 2010.

Other producers also expand. In addition to the Qatar mega-trains and Sakhalin 2, Indonesia's Tangguh, Yemen LNG, and Peru LNG have started exporting LNG in the current expansion phase of 2009–11. Australia's Pluto is expected to start LNG production in 2011.

Indonesia's Tangguh project exported its first cargoes to Korea, for Posco and K-Power, and to Fujian, China, in July 2009. Sempra Energy's Costa Azul LNG terminal in Baja California, Mexico, received its first Tangguh cargo in August 2009. The Tangguh venture has original long-term sales contracts to customers in China, Korea, and Mexico. Half of the 3.7 million tonnes (5 bcm) per year contracted to Mexico can be diverted to other markets with compensating fees to the original buyer and some has already been diverted to customers in Asia. Likewise, the Yemen LNG project exported its first cargo to Korea in early November 2009, and Peru LNG shipped out its first LNG cargo in June 2010.

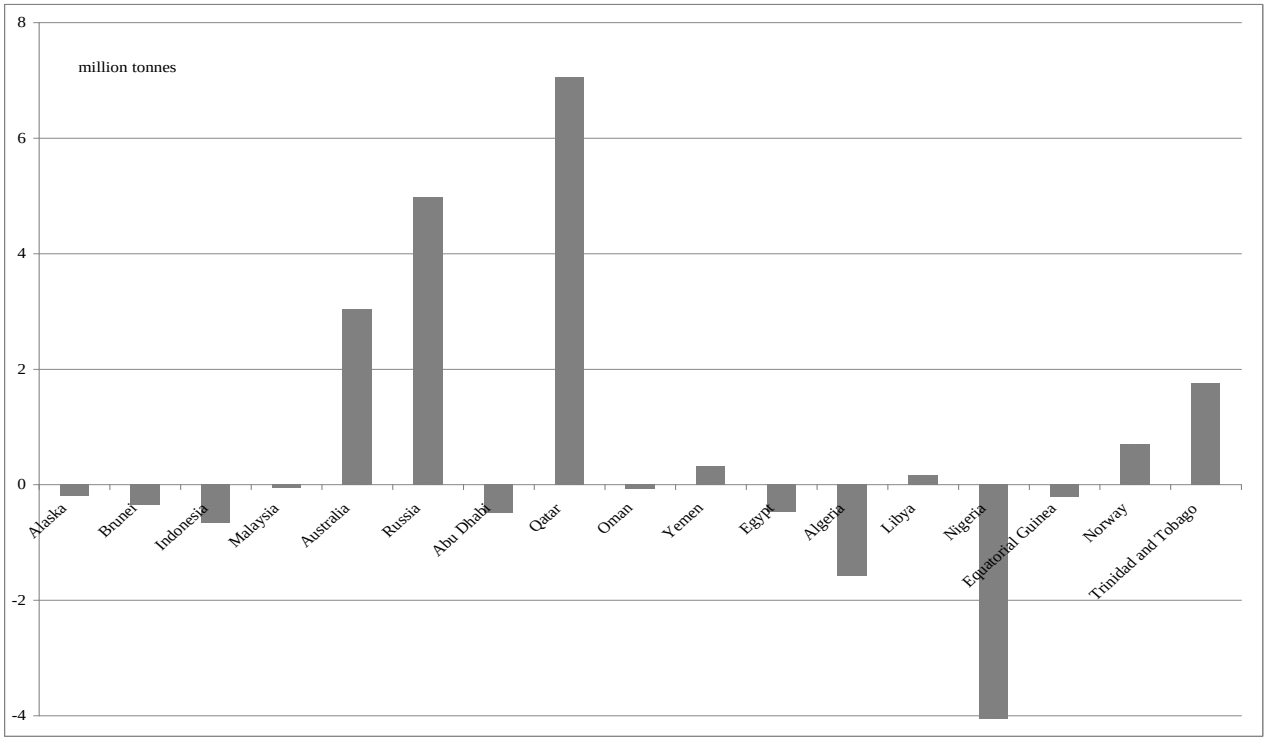
TABLE 2 **LNG Export Projects Under Construction or Sanctioned**

Production start	**Project (sponsors) and capacity**	Final investment decision (**FID)**
August 2011	Pluto, Australia (Woodside, Tokyo Gas, Kansai), 4.8 million tonnes per year	July 2007
Early 2012	Angola LNG (Chevron, Sonangol, Eni, Total, BP), 5.2 million tonnes per year	December 2007
2013 (delayed from 2011)	Skikda, Algeria (Sonatrach), 4.5 million tonnes per year	July 2007
2013 (delayed from 2012)	Arzew (Gassi Touil), Algeria (Sonatrach) 4.7 million tonnes per year	July 2008
2014	Gorgon (Chevron, Shell, ExxonMobil, and buyers), 15 million tonnes per year	September 2009
2014	Papua New Guinea LNG (ExxonMobil and others), 6.3 million tonnes per year	December 2009
2014	Queensland Curtis LNG (BG, CNOOC), 8.5 million tonnes per year	November 2010
2015	Gladstone LNG (Santos, Petronas, Total, and Kogas) 7.8 million tonnes per year	January 2011

Sluggish Performance of Existing LNG Plants

Increases in production from new liquefaction trains are to some extent offset by sluggish performance at some of the existing producers in 2009 and 2010. While reductions in the Asia-Pacific LNG producers in 2009 were mostly caused by depressed demand from their long-term buyers and can be classified as planned reductions, feedgas shortages and upstream problems have led to significant decreases in LNG production in Nigeria, Algeria, and Egypt. While new upstream production has helped Nigeria LNG recover its production levels, difficulties apparently continue in Algeria and Egypt. Similar issues may arise for other LNG producing regions—higher domestic gas demand and decreasing gas production—especially when right policies are not undertaken.

FIGURE 2 **Changes in LNG Production between 2008 and 2009 by Country**



Unit: million tonnes

SOURCE: Trade statistics, company information, media information, GIIGNL.[6]

[6] See http://www.giignl.org/.

New LNG Projects Take More Time than Previous Ones

Although LNG grows faster than other types of gas businesses, the LNG liquefaction sector seems unlikely to be expanded as planned and scheduled. There are indications of implementation and decision-making delays across the industry caused by skilled labor shortages and higher material and engineering costs, as well as more recently by market uncertainty.

Project sponsors sometimes must recalculate their project economics at much lower international gas prices. LNG buyers may be more reluctant to make long-term offtake commitments due to uncertainty over market demand. Only a few liquefaction projects have reached final investment decisions (FIDs) without long-term sales contracts that were only possible by the sponsor with already established market portfolio (such as Algeria), as it is difficult to obtain financing without revenue assurance from stable sales. Firm sales commitments are increasingly more important to decision-making.

Even when projects begin operations, initial troubles, as well as occasional shortages of feedgas, often prevent them from producing at design capacity for a prolonged period. Production capacity no longer means the actual level of production occurs, as was the case ten years ago.

After only one FID in 2006 (Peru LNG) and three in 2007 (Pluto LNG in Australia, the Skikda replacement train in Algeria, and Angola LNG), there was only one in 2008 (Gassi Toil), followed by two in 2009 and one each in October 2010 and January 2011. Thus, the expansion in the coming few years after the scheduled completion of the Qatar mega-trains in 2011 is already expected to be smaller than in the previous period. In addition, Algeria has announced delays of its two liquefaction trains into 2013 from 2011 and 2012. Several projects did not reach FIDs between 2008 and 2010, as previously targeted.

Capital costs of LNG liquefaction plants, which fell from the late 1990s until the early 2000s, are now estimated to be much higher for new plants. It should also be noted that cost figures are highly dependent on site-specific factors. Some cited figures include jetty and utility facility costs, whereas others do not. One reason why sponsors are taking time to make decisions is because they are trying to reduce this unit cost as much as possible.

Completion times have also escalated. Plants completed in 2005 and 2006 (Darwin LNG, Australia, Qalhat LNG, and Oman) were commissioned in less than three years after their FIDs. The projects starting exports in 2009 and later have been taking more time. For example, completion of the first of Qatar's mega-trains took 50 months after the engineering, procurement, and construction (EPC) contract was awarded in December 2004.[7] These days, few new projects are completed on time. While Australia is expected to be a major source of LNG expansion in coming years, constraints in the skilled labor force will be a major issue to be addressed. When project delays occur, LNG from other existing liquefaction projects is often used to compensate losses of cargoes from new projects. This is another role of LNG in balancing markets.

There is yet another factor, which is rather simple to describe: LNG projects are becoming difficult. But the issue is complicated. New projects are becoming much bigger, more remote, and more difficult, technically and engineering-wise. Not only national oil and gas companies (NOGC) but even some big international oil and gas companies (IOGC) may need additional skilled human resources. Project sponsor companies are more diversified, which may require EPC contractors to educate sponsors.

Project structures sometimes make projects difficult. If the project is integrated with upstream development, it is generally simpler. If the upstream venture has a separate organization or sponsors, more coordination is required. If the feedgas is supplied by third parties, transactions and transfers of feedgas tend to be more complicated. The same feedgas sources may sometimes need to supply alternative markets (often quickly expanding domestic markets). Clearer fiscal and legal frameworks are needed in some countries to make decisionmaking easier.

The Hybrid Structure of the Asia-Pacific Accelerates LNG Project Development

Evolving Features of the Asia-Pacific LNG Markets

In the Asia-Pacific region, LNG is expected to keep its role as a core and cleaner energy source for traditional markets, including Japan and Korea, and to expand its role

[7] "Chiyoda / Technip: A $4 Billion LNG Contract in Qatar," December 16, 2004, http://www.chiyoda-corp.com/news/en/2004/post_19.html.

in fulfilling the increasing energy demand in emerging markets—China and India for the moment and Southeast Asia in the future. While the current period (2009–11) is one of a massive expansion of LNG trade, it is also a critical time for the next generation LNG supply projects. Final investment decisions (FID) in this period will determine the supply window in 2014 and 2015.

Four projects have made FIDs since 2009—the Gorgon LNG, Queensland Curtis LNG (QCLNG), and Gladstone LNG (GLNG) projects in Australia and Papua New Guinea LNG (PNG LNG)—and some others have seen significant progress in marketing their planned volumes, including other CBM-to-LNG projects (converting coal bed methane (CBM) to LNG) in Queensland and a few projects in Western Australia. Those projects have been helped by a unique nature of the Asia-Pacific LNG markets—a combination of traditional reliable buyers in Japan and the huge growth prospects of emerging markets in China and India. Developers of large-scale greenfield and expansion LNG projects tend to secure purchasing commitments from both high-growth and traditional LNG markets. This is the case for all the projects sanctioned since 2009.

After 2011–12, Southeast Asia will become an LNG-consuming region, adding to its traditional roles as pipeline gas market and LNG-exporting region and further expanding the multifaceted nature of the Asia-Pacific gas markets. Although future natural gas demand will be highly dependent on energy and environmental policies and developments in other energy sources—including nuclear and renewable—Japan is expected to continue providing reliable long-term demand to support LNG project development. The new gas demand center in Southeast Asia may also contribute as a balancer of the wider region and may even provide an alternative benchmark for contract gas pricing, once the region has a greater network of gas trading infrastructure pipelines and LNG shipping plants and receiving terminals.

Japan Progresses on Contract Purchases and Infrastructure Development

Japan's LNG imports decreased by 7% in 2009 to 64 million tonnes (88 bcm). Due to the expected reduction in demand from the power and industrial sectors before the beginning of the 2009 contract year, utility LNG buyers in the country exercised downward quantity tolerance (DQT) clauses in their long-term LNG purchase contracts.

Japan's share in the global LNG market declined to 36% in 2009 from 40% in 2008. However, the country's LNG imports rebounded sharply in 2010. From January to November 2010, the country imported 10% more LNG than it did during the same period in 2009.

In 2010, Japan imported LNG from 14 countries: Alaska in the United States, Brunei Darussalam, Indonesia, Malaysia, Australia, Russia, Abu Dhabi in the United Arab Emirates (UAE), Qatar, Oman, Yemen, Egypt, Nigeria, Equatorial Guinea, and Trinidad and Tobago. Some major infrastructure enhancement projects are progressing, backed by expected medium- and long-term growth in demand from traditional LNG buyers and by new entrants. Long-term LNG procurement activities are at their height, reflecting the need to meet incremental demand and to replace existing long-term contracts. Those procurement activities are often accompanied by acquisition of upstream and liquefaction stakes by the buyers.

Environmental policies will have significant implications for the gas business and LNG procurement in the country. Stricter emission-controlling measures can encourage a shift from other fossil fuels to natural gas, as well as from natural gas to nuclear and renewable energy sources. The net result can be an increase or a decrease in natural gas consumption.

Japan is the fourth-largest gas consumer after the United States, Russia, and Iran, according to the 2009 figures in the *Natural Gas Information 2010* by the International Energy Agency (IEA). The country's total gas consumption grew at a rate of 2.0% per year from 2000 to 2009, mainly driven by industrial and commercial sectors. About 60% of LNG in Japan is imported by electricity companies for power generation. These utilities, and some large industrial users, import their gas independently from the city gas industry. Electric utilities also supply regasified LNG to their own industrial and commercial gas customers. At the same time, gas companies have edged into the electricity market.

While the short-term prospects are unclear, in the medium- and long-term gas demand is expected to grow steadily again. While Indonesia and Malaysia were still the largest LNG suppliers to Japan in 2009, Australia is expected to increase its share of the Japanese market in the longer term. Indonesia's share in the Japanese market is expected

to decrease sharply after the long-term contract volume is cut in 2011. In a country which already has 28 LNG import receiving terminals (as of December 2010), an additional 10 are planned or already under construction, and several expansion plans are underway at existing terminals.

China Grows Both Pipeline Gas and LNG Significantly

China is expected to increase LNG imports significantly in coming years. It was already the fifth-largest gas-consuming country in the world in 2009. China's natural gas output increased by 7.7% year-on-year in 2009, with production totaling 83 bcm, according to official data. However, the China Petroleum and Chemical Industry Association reported in January 2010 that consumption, which outstrips supply, grew by 11.5% to 87.45 bcm. The country imported 5.5 million tonnes (7.5 bcm) of LNG in 2009, up from 3.3 million tonnes (4.5 bcm) in 2008. Long-term contract delivery started from Indonesia, Malaysia, and Qatar in 2009, in addition to long-term contract cargoes from Australia and spot cargoes from other sources. First cargoes from Belgium and Yemen arrived in January 2010. In 2010, China imported 9.36 million tonnes of LNG—a two-third increase against 2009.

China National Offshore Oil Corporation (CNOOC) started construction of LNG terminals in Zhejiang in October 2009 and in Zhuhai, Guangdong, in October 2010, after beginning commercial operations of the second and third terminals at Fujian and Shanghai, respectively, in 2009. The firm plans to bring the Zhejiang terminal on-stream by 2012 and the Zhuhai one by 2013.

The National Development and Reform Commission (NDRC) granted approval to Sinopec's (China Petroleum and Chemical Corporation) application to construct a new LNG terminal in Qingdao, Shandong, shortly after Sinopec signed a binding long-term sale and purchase agreement with PNG LNG in Papua New Guinea in early December 2009. The terminal could be online by 2013.

PetroChina received its first LNG cargo from Russia's Sakhalin 2 project in January 2010 at the Shanghai LNG terminal, in which it leases capacity from CNOOC to meet gas shortages in its own supply area caused by record-low temperatures and high snowfall. PetroChina is constructing LNG receiving terminals in Rudong, Jiangsu, and

Dalian, Liaoning, in the north of the country for contract purchases in 2011 from Australia and Qatar. The company also is planning terminals in Tangshan, Hebei, and Dachan Island, Shenzhen, and is expected to start operations in 2014 or later.

The Unique Nature of Southeast Asia

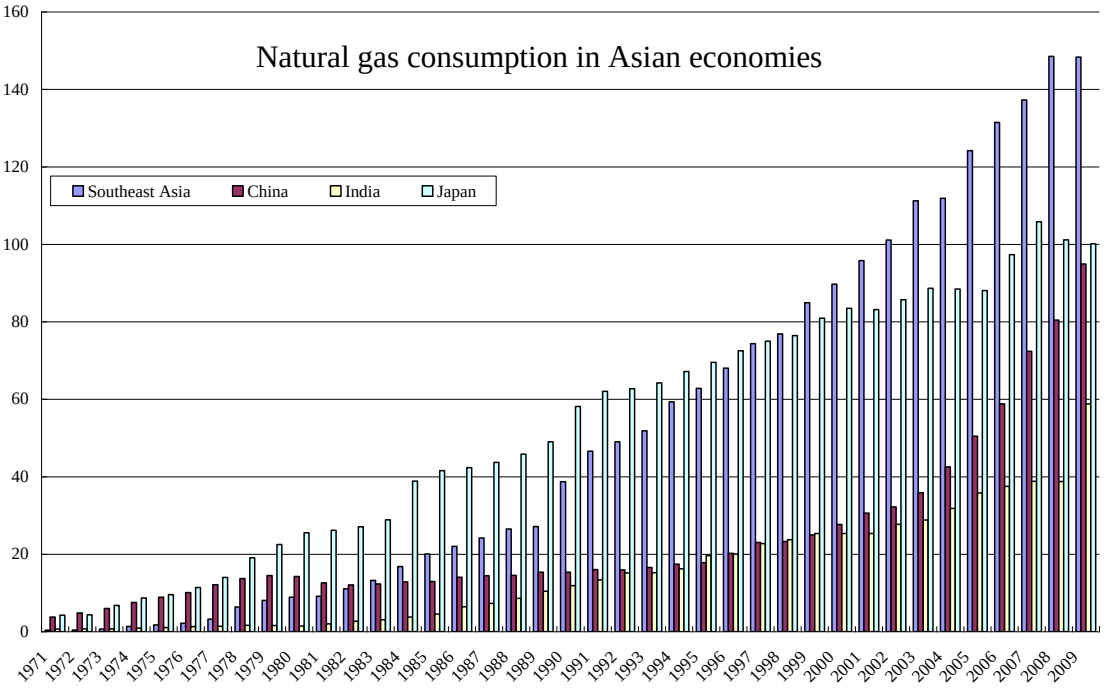
Southeast Asia (the area including Malaysia, Indonesia, Thailand, Vietnam, Singapore, Philippines, and Brunei—the ASEAN APEC members) was long considered a gas-supplying region for North Asia's traditional LNG markets. But the region's rapid economic growth and the shift of manufacturing centers to the region have been encouraging increased use of natural gas. While the region is expected to continue its role as an important supplier of natural gas in the Asia-Pacific basin, it is also expected to be a significant consumer of natural gas. In fact, Southeast Asia has already grown into a big market comparable to Northwest Europe.[8]

LNG receiving terminals are under construction in Thailand and Singapore. Indonesia and Malaysia have likewise advanced planned terminals, and there are also less advanced plans in Vietnam and the Philippines. While historically Thailand and Singapore have depended on pipeline gas produced domestically and imported from neighbors, they have decided to introduce LNG based on goals to enhance security of supply for expanded demand in the future.[9] Indonesia and Malaysia have big LNG production centers and large consuming centers apart from each other without significant pipeline connections between the two, necessitating LNG imports to the demand centers.

[8] The United Kingdom, the Netherlands, and Belgium combined.

[9] Since pipeline gas supply from Indonesia to Singapore began in 2001, gas deliveries were interrupted a few times, causing power outages. The worst of these outages in recent years happened in June 2004, causing a two-hour blackout in Singapore. The incident accelerated the government's move to proceed with a plan to install an LNG receiving terminal.

FIGURE 3 **Comparison of Gas Market Sizes in Asia**



SOURCE: *Natural Gas Information 2010*, IEA.

Combined gas consumption by the seven ASEAN APEC members was 148 bcm in 2009, larger than Japan or China. Once those traditionally stranded markets are connected with the LNG trade, if not through the grandiose pipeline network that has been considered for decades, the expected improvement of liquidity in the regional gas markets will help the region make significant impacts on gas pricing in the international markets. While Singapore and Thailand are constructing conventional land-based LNG receiving terminals, Indonesia and Malaysia are trying to fast-track their respective LNG import projects by converting existing LNG carriers to floating storage units (FSU) or floating storage and regasification units (FSRU). Elsewhere in Asia, Pakistan and Bangladesh also have fast-tracked LNG import proposals. Those LNG infrastructure projects, supplemented by the piecemeal expansion of pipeline networks, will help connect the individual markets with each other as well as with global gas markets.

The Evolution and Implications of LNG

LNG has evolved from a premium energy source and the most expensive fossil fuel for the exclusive club of importers (mostly OECD countries) to a less expensive alternative to oil and pipeline gas, especially for the emerging economies in Southeast Asia. LNG is growing faster than other sectors of the gas industry, with long-term trades as its core, and increasing flexibility to provide shorter-term volumes adding to global security of supply, to a limited extent. While LNG has provided long-term security of supply to traditional LNG buyers, it has also provided gas-producing countries with long-term security of demand and, in turn, the means to develop gas resources in places distant from consuming centers.

Roles in Traditional LNG markets

LNG has played different roles in different regions. In OECD North Asia (Japan and Korea), LNG is still almost the exclusive source of natural gas and plays a base-load role, sometimes providing a swing role in the electricity generation mix. In OECD Europe, it is mainly an alternative and supplemental source to pipeline imports and the regional production of gas. In OECD North America, LNG provides a supplemental source to regional gas production. The market has also provided supplemental demand to the global LNG market in summer when demand in other markets is weak. Yet LNG is expected to remain marginal in the region's gas supply mix, particularly if recent increases in the United States' gas production continue.

Roles of LNG in Southeast Asia

In Southeast Asia, LNG is expected to continue providing the means, or one of the options, to develop remote gas resources. At the same time, it will also provide a way to utilize gas locally where pipeline connections have been difficult to implement. LNG could bridge the gap between markets in the region until a wide-area pipeline network is built. Small-scale terminals and transportation may be possible to supply smaller provincial markets.

Business Models of LNG Importers

Business models of LNG importers are also different between regions and reflect perceived roles of LNG at the time of introduction in individual markets. In Japan, LNG has been bought by individual utility companies, sometimes in consortia of buyers. In Korea and Chinese Taipei, designated governmental corporations have dominated LNG purchasing activities. In Europe, until around 2000, LNG had been purchased by national champion gas utility or wholesale companies. More recently, other companies are entering the LNG importing business.

As new LNG importing countries in the 21st century tend to have government-backed entities or aggregators to conduct centralized purchasing activities, and national champion companies continue to play an important role in some countries, the business models of LNG importers continue to be a critical issue. While LNG represents a core natural gas supply source to Japan, LNG's share in the global gas market as a whole is still less than 8%. Thus, it is growing faster than other parts of the gas industry. As the LNG business is capital intensive at both liquefaction and regasification ends, a majority of international trades are still carried out under long-term contracts. However, as flexible capacity to supply short-term volumes grows, LNG's role in securing the gas supply is expanding.

Conclusion

LNG is expected to continue growing faster than other parts of the gas business. While traditional markets are still important, more emerging markets are expected. As LNG enhances connectivity and flexibility in the global gas markets—affecting regional prices—the resulting convergence and divergence of gas prices is affecting pricing in individual gas markets, as well as physical gas flows.

LNG assumes more and newer roles, as it evolves from a premium energy source to a core and widely used precious energy source. In particular, Southeast Asia is becoming an important producing and consuming region, resulting in new opportunities as well as new risks.

TABLE 3 **LNG in the 20th and 21st Centuries—Profound Changes**

	1990	**2011**
LNG as. . .	the most expensive fossil fuel	less expensive alternative to oil and pipeline gas
Importers	Exclusive club, mostly OECD members	Affordable to emerging economies
Value chains	Parallel, point-to-point	Crisscrossing, multiplied
Projects	Capital intensive, bigger and bigger	Even more super-giant, but also small-scale models emerging
Gas fields	Large, easy to tap	Frontier, difficult to exploit
Carrier ships	Bigger and bigger, expensive	Even bigger, but also smaller ones and used ones exist
Regions	Pacific and Atlantic independent to each other; Middle East annexed to the Pacific	Closer linkage between regions; Middle East (and some others) supply to global
Southeast Asia	The main supplier to North Asia	The main supplier to North Asia and a big gas consumer; a potential LNG supplying and consuming region
Pricing	Pacific and Atlantic independent	Regional interaction causing convergence and divergence

In order to take advantage of the profound changes in the gas and LNG markets, more competitive and efficient use of gas should be promoted—for instance, gas-fired combined heat and power (CHP) plants and distributed power systems. To ensure timely development of LNG supply sources, clearer policy frameworks, including tax and royalty and financing, should be developed. Finally, to promote efficient use of gas and to enhance reliability of the supply system, balanced gas pricing policies in individual markets are required.