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40 pages essential LNG news!
October 2017

In this issue:

Second wave of LNG well underway in LNG export capacity development

International Energy Agency says Australia, the US and Qatar will make up half the total global supply capacity

A major boost to global export capacity is expected through 2019 with average capacity additions of around 50 billion cubic metres each year amid the start-up of large projects in Australia and the United States, though that capacity increase will slow after 2020.

In its latest forecasts, the France-based International Energy Agency said that by 2022, Australia would have the largest LNG export nameplate capacity, 117.8 billion cubic metres of natural gas (87.1 million tonnes of LNG) per year, and the US would become the second-largest with 106.7 Bcm per year, slightly above Qatar with 104.9 Bcm per year.

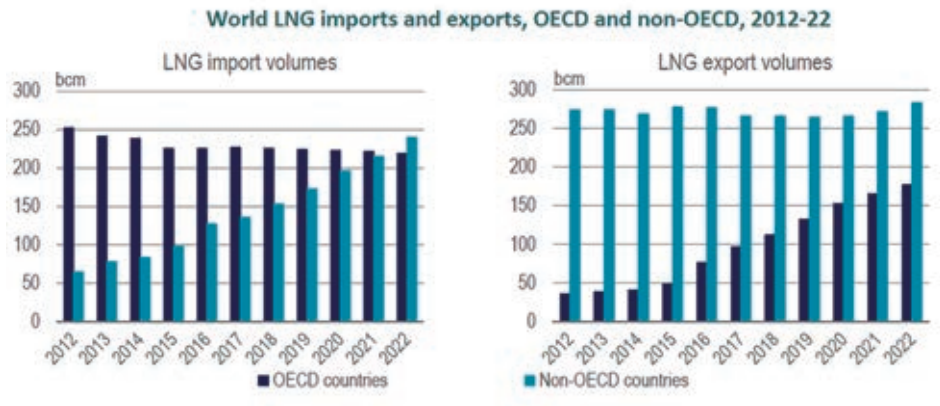

Figure 1: Development of import and export markets

Big three

"These three big LNG export countries will make up half of the global total LNG export capacity of 650 Bcm per year by the end of 2022, and the picture of future LNG trade in the world will be affected by these big LNG export countries located in Oceania, North America and the Middle East," said the IEA report.

"LNG export nameplate capacity of 650 Bcm by 2022 is much higher than the 460 Bcm of forecast demand," it said.

"While some LNG export plants will be unavailable due to feed-gas issues and security problems, available export capacity will be more than the expected demand, and the highest surplus is expected by 2020 and then will shrink towards the end of forecast period," explained the report.

For LNG exports, the IEA highlighted the role of the new liquefaction projects, particular those ventures in the US, giving destination flexibility.

"The expiring contracts in many existing liquefaction projects will reduce utilisation, especially in those with higher exposure to spot sales.

"The role of portfolio players is crucial to unlock new demand, and their market power with their aggregated volumes should not be underestimated," said the IEA.

LNG trade grew by around 25 Bcm last year and it is expected to grow faster than pipeline trade, by an annual rate of 4.5 percent, so that by 2022 LNG trade equals 460 Bcm.

Growth in LNG supply capacity will be faster than the growth in LNG demand, and the 75 percent of new supply capacity will come from two countries, Australia and the US.

China is also seen as the main driver of the global LNG demand growth and relatively new importers will also show large increases in LNG demand.

Countries in the Organization for Economic Cooperation and Development (OECD) have traditionally been the largest source of global LNG demand, but LNG import volumes of these countries have decreased and the agency said this tendency would continue throughout the forecast period.

Contrast

"By contrast, LNG demand of non-OECD countries has increased rapidly, backed by the growing gas demand of these countries, and LNG import volumes of non-OECD countries will exceed those of OECD countries in 2022. The LNG export side shows a different picture.

"Historically, LNG exports have come predominantly from non-OECD countries, but the surge of new liquefaction capacity in Australia and the US and the stagnation of LNG export capacity in non-OECD countries means a more balanced picture," it said.

Demand

A new group of thirsty LNG importers is emerging. The IEA forecasts that global demand will reach 460 Bcm in 2022, increasing by more than 100 Bcm compared with the 2016 level, or more than 30 percent growth over the forecast period.

"From 2016 to 2022, China will show the largest LNG import increase in the global LNG market, and its LNG demand will increase more than 40 Bcm by 2022 from the 2016 level.

"Non-OECD Asia (excluding China) is expected to experience a steady growth path through the forecast period, adding around 70 Bcm to 2016 LNG demand.

"India is also seen as an emerging LNG importer, capable of generating a meaningful demand increase with impressive growth rates of around 11 percent per year, and its LNG import volume will be double the 2016 level.

"Bangladesh, Indonesia and the Philippines are forecast to join the LNG import club and to start importing LNG before 2020," it said.

This report expects 97 percent of the

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additional capacity to come from already-sanctioned projects.

Assumptions

The outlook assumes four additional projects - Sabine Pass Train 6 and Corpus Christi Train 3 in the US, the Fortuna FLNG project offshore Equatorial Guinea, and Sakhalin II Train 3 in Russia - would take final investment decisions in time for a production start-up within the forecast horizon of the report.

"Three of these projects will be expansions to existing facilities with relatively low costs, and one will be FLNG, and therefore these four projects should come on line with short construction times," it added.

The IEA noted that in OECD Asia-Oceania, Japan and South Korea together continue to make up the largest LNG-importing region, but its imports will decline by 12 percent between 2016 and 2022, in contrast with the strong growth observed over the last decade.

In Japan, assuming a modest recommencement of nuclear power, demand may be below contracted volumes from 2017.

In South Korea, the government changed in second quarter of 2017 and its target is to reduce nuclear and coal power generation output, creating new possibilities for gas.

Old and new

Stagnating demand and decreasing production will increase European import needs over the forecast period.

"Europe's LNG demand has been and will be lower than the contracted LNG volumes, mainly because of weak gas demand after the euro crisis and competition from pipeline gas.

"The expiration of LNG contracts in the coming years will allow Europe to rebalance the long positions," it said.

In Latin America, there will be some LNG demand increases with the addition of Colombia, Haiti, Panama and Uruguay to the pool of importing nations.

Though Ghana and Namibia are assumed to start importing LNG in the coming years, overall African LNG demand in 2022 will be low, mainly because Egypt is expected to benefit from domestic production of its new gas fields and ease its existing importing needs substantially.

"One of the most interesting aspects in the recent LNG trade is the growing role of the new but small players.

"The group of small importers, mostly

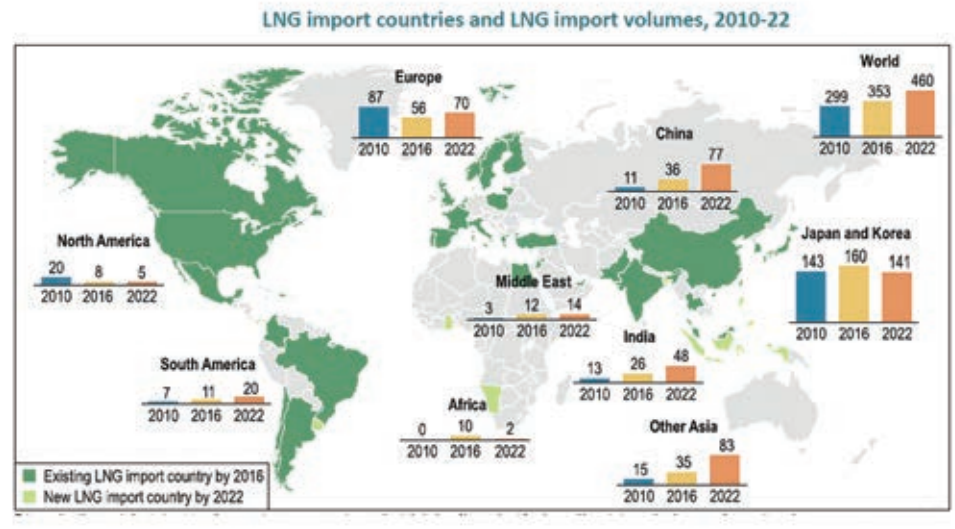


Figure 2: Shipments made to regions around the world

with a short history in the LNG market or at least not importing large volumes traditionally, has grown significantly over the last few years.

Volumes

"Three of those importing countries, Egypt, Jordan and Pakistan, started importing LNG from 2015 and imported more than 18 Bcm in 2016, as much LNG as imports by the United Kingdom and France combined," the IEA noted.

"Other relatively new small players such as the United Arab Emirates, Kuwait, Thailand and Singapore grew significantly, importing in 2016 more than two times the volumes imported in 2013," it said.

"Pakistan will increase its LNG import significantly to around 20 Bcm in 2022 and become the sixth largest LNG import country just behind Chinese Taipei.

"In addition, from 2014, other countries such as Colombia, Finland, Jamaica, Lithuania, Malta and Poland have joined the club of LNG importers, and Bahrain, Bangladesh, Ghana, Haiti, Indonesia, Namibia, Panama, the Philippines and Uruguay are expected to start importing LNG during the forecast period.

"However, actual demand will depend on LNG prices and competitiveness against alternative fuels in their respective domestic markets.

"This surge of new and small importers will bring new pockets of demand. LNG imports of these new and small players will be more than double the 2016 level and account for around 20 percent of global LNG trades, close to those of Japan or China.," added the report.

Supply front

The US takes the lead on global supply as the shale revolution gets a second wind, aiding the growth of LNG export projects.

"As the world's largest gas producer, the US will increase production more than any other country over the next five years, accounting for almost 40 percent of global output growth.

"While overall US production fell in 2016, output from the Marcellus basin continued to grow, underscoring the ability of US gas drillers to counter the effect of lower prices by improving efficiency and producing more gas with fewer rigs.

"The continuing development of the Marcellus and Utica shales is being supported by the extension of pipeline infrastructure from the Appalachian region to ship more gas to markets in the Northeast, Midwest, and Southeast regions of the US and in Eastern Canada.

"Over the forecast period, US gas output is expected to grow by 2.9 percent per year, adding around 140 Bcm to global production.

"By 2022, the United States will produce approximately 890 Bcm, or 22 percent of the total gas produced worldwide.

"Although US domestic demand for gas is growing due to increased demand in industry, more than half of the production increase will be turned into LNG for export.

"By the end of our forecast period, the United States will be well on course to challenging Australia and Qatar for global leadership among LNG exporters," stated the IEA.

Pipelines

The agency's report also gave an overview of the pipeline natural gas trade, which continues to grow but faces strong competition in many markets.

"Pipeline trade between the US and Mexico has expanded rapidly in recent years, and pipeline supplies to Europe held their ground in 2016 despite the availability of LNG.

"Europe saw little change in LNG imports as Russia, Norway and Algeria

ensured that they maintained their strategic position as suppliers to the European market. Europe's import needs are set to grow in the coming years, mainly because of the continued decline in indigenous production.

"Two long-awaited new gas trade routes are anticipated to start operation in the next five years: an expanded connection between Azerbaijan, Turkey and the main European markets via the TANAP and TAP pipelines; and the "Power of Siberia" connection between Russia and China, which has the potential to become a major artery of global gas trade in the future," explained the EIA.

"In Australia, higher LNG exports have raised domestic security of supply concerns. Gas prices in Australia's major eastern market have traditionally been very low but have now risen sharply, in part because new export projects have created a pricing link with international markets.

Competitiveness

"Higher end-user prices have led to concerns about the impact on industrial competitiveness.

"In response, the Australian government has introduced a domestic gas security mechanism that gives it the power to restrict exports if there is a risk of shortfalls on the domestic market," the report added.

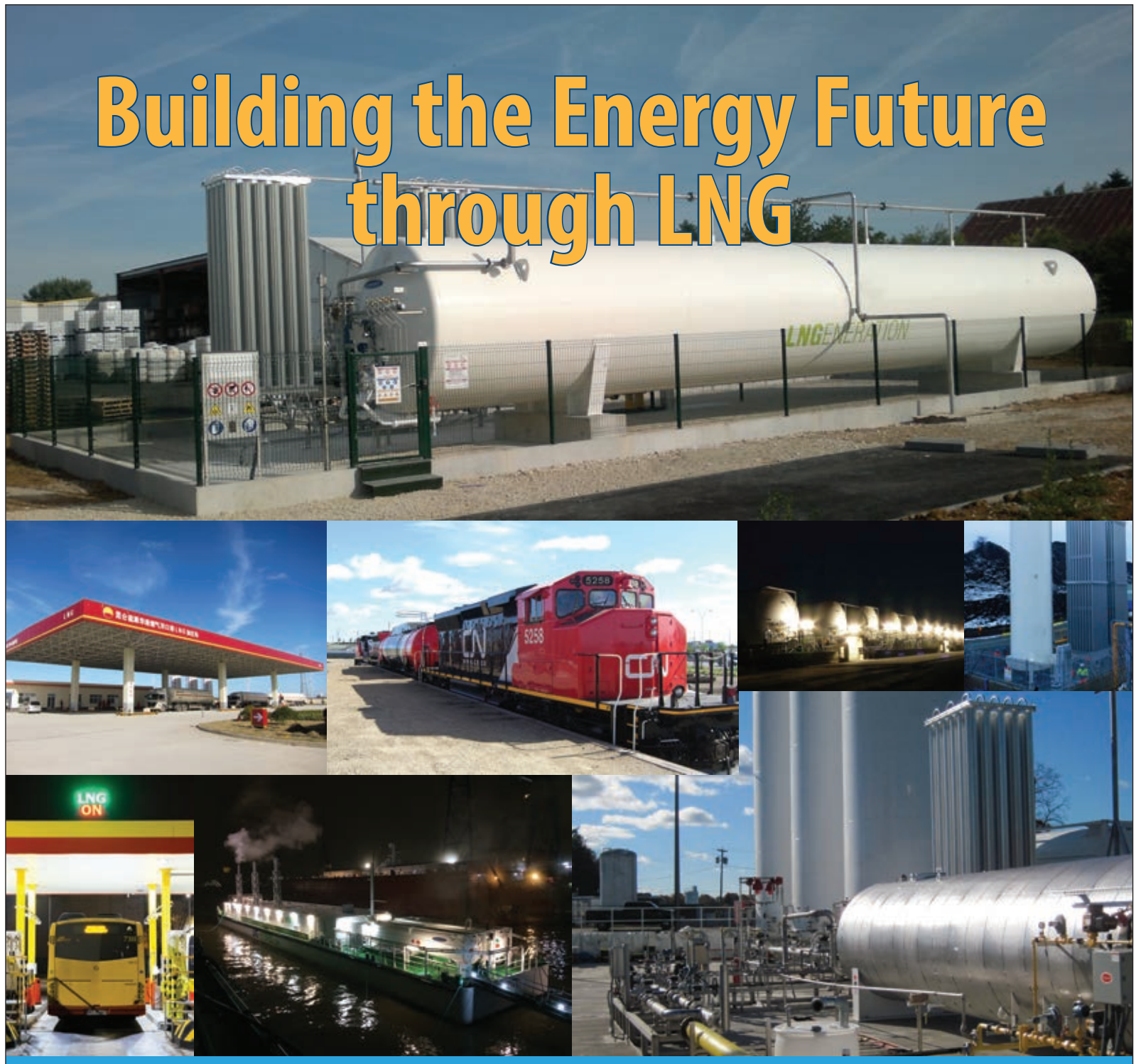
Concerns about security of gas supply have appeared in some other major producing countries.

"In Nigeria, Africa's biggest economy, militant attacks on gas facilities, the absence of political reforms and a lack of investment have led to structural gas shortages.

"The reduction in gas-fired power generation by 5 percent from recent average levels has deprived millions of electricity and hurt the economy," the IEA said.

It also referred to the recent standoff between Qatar and some of the other Gulf States and Egypt. This tension helped underscore some potential risks to gas supply security from the Middle East as Qatar currently supplies around 30 percent of the world's LNG. ■

This article is based on extracts from the International Energy Agency's "Medium-Term Gas Market Report" for 2017.



US report analyses the growth of LNG and gas trade in face of competition from renewables

European and Northeast Asian gas markets hold out against projects driven by ambitious emission targets

US LNG export levels vary across cases and reflect both the level of global demand and the difference between domestic and global natural gas prices, with the latter more heavily influenced by oil prices, according to the Annual Long-Term Energy Outlook of the US Government.

"Currently, most LNG is traded under oil price-linked contracts, in part because oil can substitute for natural gas in industry and for power generation.

Expansion

"However, as the LNG market expands, contracts are expected to change, weakening their ties to oil prices," said the report compiled by the US Energy Information Administration.

The US forecasts world LNG trade is projected to nearly triple, from 12 trillion cubic feet (Tcf) to 31 Tcf, between 2015 and 2040, though pipeline trade will hold its own in the years ahead.

"Despite strong growth in the LNG trade, pipeline flows are projected to continue to account for 48 percent of the interregional natural gas flows in 2040 as pipeline infrastructure is further developed," the report said.

Europe is projected to remain largely dependent on Russian pipeline gas, while Asia is projected to import a large share of the traded LNG.

North America will become a major exporter of natural gas by 2020, even though pipeline flows from Russia to Europe and Asia are expected to show the largest growth in volumes of trade.

Gas dilemma

European nations are forecast to have flat natural gas growth for electricity generation, including in LNG, in the next 10 years as they concentrate on renewable projects such as wind and sun for power before having to return to large-scale gas use by 2030.

Japan's reliance on fossil fuels like natural gas remains intact, along with its more limited nuclear use, as it struggles to meet greenhouse-gas emission targets.

"Japan's commitment to reducing its greenhouse-gas emissions 25 percent by 2030 is a challenge without a substantial nuclear contribution," according to the US report. "In an environment with flat

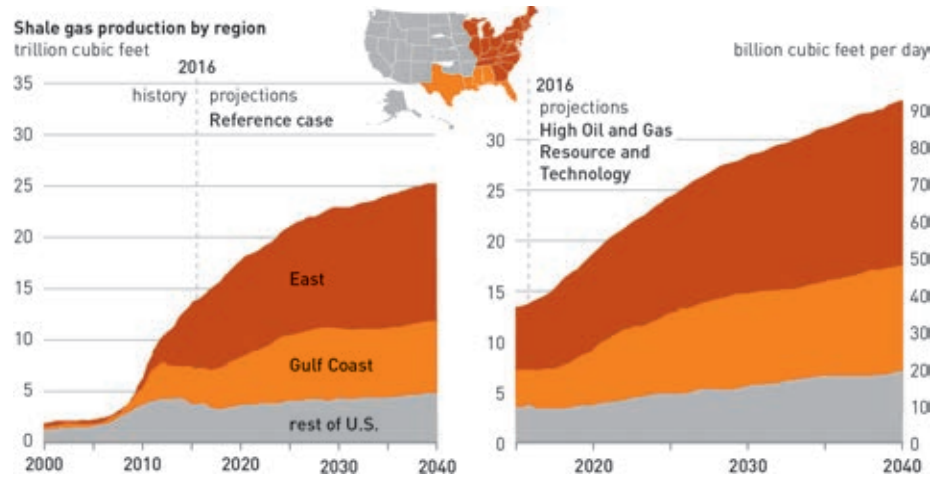


Figure 1: Regional distribution of shale-gas revolution

demand and growing nuclear, renewable growth is limited after 2025. Fossil fuels account for 70 percent of Japan's electricity generation mix in 2040, while nuclear accounts for 11 percent and renewables the remainder," according to the US report.

In Japan, in the near term, the electric power sector continues to recover from the 2011 Fukushima nuclear disaster with continued but limited N-plant usage.

Power mix

However, net electricity generation in Organization for Economic Cooperation and Development (OECD) Europe is expected to increase slowly, by an average of 1.1 percent a year compared with the world average increase of 1.5 percent a year.

"The generation mix in OECD Europe changes considerably by 2040, with renewables and natural gas growing, coal remaining flat and nuclear power and liquid fuels declining.

"Nuclear generation's share is expected to decline from around 25 percent in 2015 to less than 15 percent by 2040 because of stated policies to either cap or phase out nuclear power, including those adopted in France, Germany, and Sweden.

"The use of natural gas electricity generation in OECD Europe does not expand until 2030, mostly because of the large increases in projected renewables generation.

"In OECD Europe, when natural gas begins to gain market share in 2030, it displaces nuclear power, coal and renewable generation," the US report stated.

Production

In natural gas production, the US and China increase output to 2040, mainly from the development of shale resources.

"Russia's growth in natural gas production over the period of 2015-2040 is supported by an increased development of resources in the country's Arctic and the Eastern regions. "Newly developed offshore fields in Mozambique and Tanzania and increasing production in Egypt's Zohr field support LNG exports from Africa," the report said. "Shale resource development accounted for 50 percent of US natural gas production in 2015, increasing to nearly 70 percent in

2040, as the country leverages advances in horizontal drilling and hydraulic fracturing techniques and taps into newly discovered technically recoverable reserves," it added.

Shale resource developments are also projected to account for nearly 50 percent of China's natural gas production by 2040, making the country the world's largest shale-gas producer after the US.

In Canada, future natural gas production is expected to come mainly from tight resources, from several regions in British Columbia and Alberta.

Production from coalbed methane resources continues to remain low.

Imports

"China's imports of natural gas remain at 32 percent of supply in 2015 and 2040 as the country's domestic shale gas production grows from 2 percent in 2015 to 33 percent over the same period.

"Despite China's prolonged developmental efforts in the past, coalbed methane is expected to remain a modest source of natural gas from 2015 to 2040 because of lower productivity compared with other production methods.

"Russian exports account for a growing share of China's pipeline imports as pipeline capacity expands.

"China's LNG imports are also projected to grow, supplied by an increasingly diversified pool of exporters.

The largest increases in natural gas production involves the US and China through 2040, as well as the Middle East.

The Middle East, the US and China count for 12 percent, 20 percent and 18 percent of growth respectively.

US shale

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Various cases

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Overall US domestic energy consumption remains relatively flat in the reference case, rising 5 percent from the 2016 level by 2040 and somewhat close to its previous peak. There are also varying assumptions about economic growth rates and energy prices.

"US natural gas use increases more than other fuel sources in terms of quantity of energy consumed, led by demand from the industrial and electric power sectors," stated the report.

"Petroleum consumption remains relatively flat as increases in energy efficiency offset growth in the transportation and industrial activity measures. "Coal consumption decreases as coal loses market share to natural gas and renewable generation in the electric power sector.

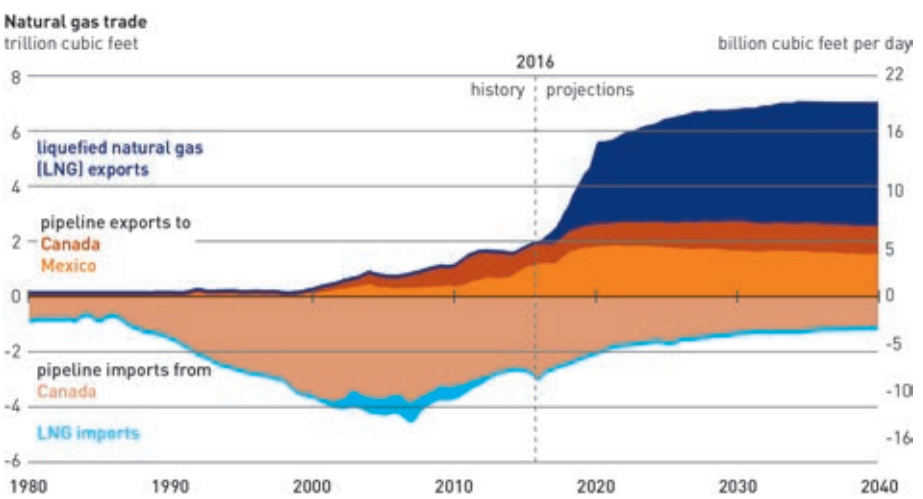

Figure 2: US natural gas trade development by sources

Penetration

"On a percentage basis, renewable energy grows the fastest because capital costs fall with increased penetration and because current state and federal policies encourage its use," the report said its US domestic overview.

The report noted that in the US market natural gas prices are projected to increase and are sensitive to the availability of new technology and resources

"The range of projected Henry Hub natural gas prices depends on the assumptions about the availability of oil and natural gas resources and drilling technology.

"In the Reference case, the natural gas spot prices at the US benchmark Henry Hub in Louisiana rise because of increased drilling levels, production expansion into less prolific and more expensive-to-produce areas, and demand from both petrochemical and liquefied natural gas export facilities.

"Reference case prices rise modestly from 2020 through 2030 as electric power consumption increases; however, natural gas prices stay relatively flat after 2030 as technology improvements keep pace with rising demand.

High oil-gas

"In the High Oil and Gas Resource and Technology case, lower costs and higher resource availability allow for increased levels of production at lower prices, increasing domestic consumption and exports.

"In the Low Oil and Gas Resource and Technology case, prices near historical highs drive down domestic consumption and exports," the report explained.

It sated that US Shale plays in the East lead production of natural gas in the

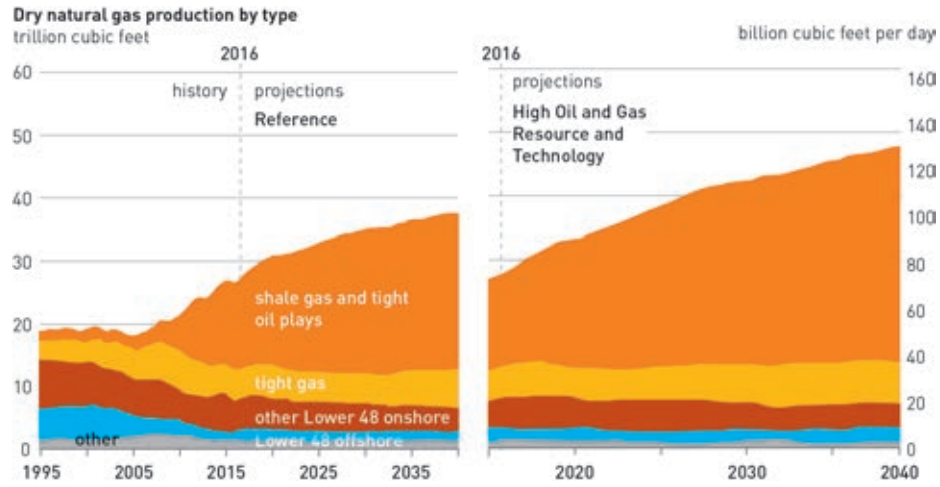

Figure 3: Changing US output and how it is progressing

Reference case - but Gulf Coast onshore production also grows.

"Continued development of the Marcellus and Utica plays in the East is the main driver of growth in total US shale gas production and the main source of total US dry natural gas production.

"Production from the Eagle Ford and Haynesville plays along the Gulf Coast is a secondary contributor to domestic dry natural gas production, with production largely leveling off in the 2030s.

"Continued technological advancement and improvement in industry practices is expected to lower costs and to increase the expected ultimate recovery per well.

Changes

"These changes have a significant cumulative effect in plays that extend over wide areas and have large undeveloped resources (Marcellus, Utica, and Haynesville)," it noted.

When the oil-to-natural gas price ratio is highest, as in the High Oil Price case, US LNG exports are at their highest levels.

"Demand for LNG generally increases as consumers move away from petroleum products, and LNG produced in the US has the advantage of domestic spot prices that are less sensitive to global oil prices than supplies from other sources.

"In the Low Oil Price case, LNG exports from the US are at their lowest levels throughout the projection period.

"In the High Oil and Gas Resource and Technology case, low US natural gas prices make US LNG exports competitive relative to other suppliers.

"Conversely, higher US natural gas prices in the Low Oil and Gas Resource and Technology case result in lower US LNG exports," it said. ■

This article is based on extracts from the "International Energy Outlook 2017" published by the US Energy and Information Administration.

Who developed the world's first LNG tanker?

Who opened up the Asia-Pacific market by exporting LNG to Japan in 1969?

Who licensed their Optimized Cascade® Process for four of the last seven LNG projects in Australia? *(Hint: It's the same liquefaction technology that is expected to produce nearly 25% of the world's LNG by 2021.)*

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For the Record

ABS, the American Bureau of Shipping classification society, said it completed a joint development project with Monaco-based LNG fleet owner GasLog focusing on boil-off gas efficiency in operations. The companies said the project demonstrated a new approach to evaluating LNG boil-off rate (BOR) for conventional carriers and for Floating Storage and Regasification Units (FSRUs). GasLog has around 27 LNG carriers in its fleet, including newbuilds, and has prime customers such as Royal Dutch Shell from previous contracts with BG Group. The shipping company will supply the FSRU to the Greek-owned project company Gastrade for a hub project in Northern Greece. "By expanding the application of computational fluid dynamics analysis to simulate the LNG BOR in cargo tanks, owners are able to better predict boil-off gas and account for it in future designs and operations of LNG carriers," said ABS Chief Technology Officer Howard Fireman. Boil-off gas is the vapor phase of LNG carried in a cargo tank. Accurate assessment of the rate of LNG boil-off gas generation is critical for the design of the cargo tank and the boil-off gas processing system. "To support this collaborative project, a robust CFD analysis procedure was developed modeling the physics of heat transfer, boiling, phase change and vapor flow," said ABS. "Extensive simulations were run on a representative LNG carrier and actual BOR measurements were taken to demonstrate the accuracy of the analysis results," the class society explained. GasLog said that by taking a collaborative approach with ABS on this project, it was able to demonstrate and prove the viability of its CFD analysis to determine LNG BOR "Being able to predict BOR in various operating conditions will allow us to build efficiencies into future designs," said Vassilis Millas, GasLog's Project Engineer for FSRUs. In addition to operating in the conventional LNG shipping market GasLog signed an agreement in 2017 to acquire a 20 percent shareholding in Gastrade, which has received a licence to develop an independent natural gas system offshore Alexandroupolis, the capital of the Evros area in the northern Greek region of East Macedonia and Thrace. The northern Greek floating LNG and natural gas hub was first announced as a viable joint venture involving GasLog in December 2016, though Gastrade has been involved in the development of the FSRU project for several years.

ABS said it granted approval in principle to a floating liquefied natural gas ship conversion design from South Korean shipyard Hyundai Heavy Industries. ABS said it collaborated with Hyundai with the objective of developing a technically feasible and class-compliant FLNG hull design, using the latest industry trends while maintaining high safety standards. The class society previously approved another design for a hull targeting LNG projects to be located near-shore for North American shale-gas exports or other ventures. Hyundai plans to eventually build the production hulls at its shipyard which stretches over four kilometres along the Korean coast at Mipo Bay in Ulsan. ABS said its approval showed that the design substantially complies with regulatory requirements and minimizes risk to project schedules and safe operations. "ABS has a strong history of collaborating with the offshore industry to evaluate novel designs that enable industry efficiency," said ABS Executive Vice President, Global Offshore Ken Richardson. "Our work with HHI is another example of ABS's technical leadership promoting safety in innovative concepts," added Richardson. "The newbuilding conversion FLNG hull design can be constructed for about half the cost as compared to a standard FLNG hull," said Jae-Eul Kim, HHI Senior Vice President for shipbuilding. "In the current difficult energy market, a Ready-to-Convert FLNG hull with ABS AIP gives the FLNG market an efficient approach, with a competitive price and schedule, helping investors take financial investment decisions," he added. With continued global concern for the environment, clean gas-based energy plants are set to grow in number after signs of a reversal in the recent fall in final investment decision for liquefaction projects.

AIR PRODUCTS, the leading US supplier of LNG production technology and equipment, said it had formed a $1.3 billion joint venture with a Chinese company for a coal-to-synthetic gas project in China's northern Shanxi province. The US company, based in Lehigh Valley, Pennsylvania, is developing the project with a company called Lu'An Clean Energy Co. The joint venture is a follow on from a long-term agreement Air Products signed in February to supply China's Lu'An Mining Group with four air separation units (ASUs) for multiple process trains at a coal gasification facility planned for Changzhi City in Shanxi. "Under the new agreement, Air Products will contribute the ASUs (worth $300 million) and invest a further $500M for a 60 percent ownership in the new joint venture," the US company said. The new joint venture company will be called Air Products Lu'an (Changzhi) Co. and will own and operate the ASUs and gasification and syngas clean-up system. It will also supply syngas to Lu'An under a long-term contract. Air Products has been a supplier of LNG heat-exchangers for most of the world's baseload liquefaction plants and most recently was awarded a contract for the Coral floating LNG venture offshore Mozambique in southeast Africa. The Chinese government has been encouraging greater use of abundant coal resources and conversion projects for coal to cleaner and higher value products like syngas and chemicals. China already produces significant amounts of coal-seam gas. However, the syngas produced is used almost entirely in the chemicals industry. The country already has more than 70 gasification facilities directed towards syngas for chemicals and manufacturing. "We are delighted to have Lu'An, a leading clean energy company in China, as our joint venture partner," said Seifi Ghasemi, Chairman, President and Chief Executive of Air Products. "The creation of this world-class JV is perfectly in line with our stated strategy of deploying our significant cash to grow by acquiring existing assets and expanding our scope of supply to include syngas," added Ghasemi. Li Jinping, Chairman of the Lu'An group, said he was very pleased with the agreement. "Extending our strong partnership-relationship with Air Products through this new joint venture enables us to take advantage of world-leading project management and operational expertise to deliver syngas for this landmark energy project," stated Li. Air Products said that the final agreement was subject to government and regulatory approvals.

ANGOLA LNG, the revitalized southwest African export plant, has signed its second European sales agreement of September with German utility and energy company RWE after concluding a similar deal with Swiss-based global commodities firm Vitol. The accord will see Angola deliver cargoes from its plant in the port of Soyo in southwest Africa to RWE Supply & Trading at destinations around the world. "Angola LNG is operating safely and reliably. This agreement is a further demonstration of Angola's increasing role in global LNG, providing LNG all over the world and establishing relationships with a series of important international market players," said Angola LNG Marketing Ltd. The plant opened in 2012 and produces 5.2 million tonnes per annum from one liquefaction Train. However, in April 2014 it experienced a failure in the flare blow-down piping system, resulting in a fire and an extended plant closure. The facility cost an initial $10 billion to build and is a joint venture involving Chevron with partners including the Angolan energy company Sonangol, BP of the UK, Italy's Eni and France's Total. It was the world's first LNG plant built to be supplied solely with associated gas, whereby the natural gas is a by-product of crude oil production. It resumed regular production in June 2016 and began shipping cargoes worldwide by international tender after a two-year shutdown. Production at the facility had originally been scheduled to re-start in December 2015 but the completion of modifications and repairs suffered delays. Recent recipients of cargoes from the revitalized Angolan plant have included Brazil, France, Spain, the United Arab Emirates, Jordan, China and India. "We are pleased to be working with RWE and look forward to a mutually beneficial relationship," the company said about its accord with the German company. RWE said it was "very pleased" to have entered into this agreement with Angola. "These LNG purchases will be added to our portfolio and enable us to expand our business further to take advantage of the significant opportunities we see in the global LNG market," the German company said. The other new European contract holder for cargoes is Vitol. Based in the Swiss city of Geneva, Vitol said it had already purchased many LNG cargoes from Angola before it signed its "multi-year" agreement.

ATLANTIC LNG, the production plant in Trinidad, was shut down and evacuated when fire enveloped one of its

power generating units sending black smoke and fire into the air at Point Fortin on the southwest of the Caribbean Island. The company said Atlantic's response and safety teams extinguished the fire. No injuries were reported. Technical teams conducted checks of the four-Train facility and the stakeholders were advised of the situation. "At around 2:15 pm today (September 12) there was a fire at one of the power generation units on Atlantic's Point Fortin plant. The company's response and safety systems immediately activated," the company said. Trinidad & Tobago has suffered from natural gas curtailment generally and at the plant over the last four years and has cost the government hundreds of millions of dollars in taxes. The four processing Trains at Atlantic LNG are running below capacity. Last year they produced 10.46 million tonnes of LNG compared with 11.81MT the previous year. The main shareholders in the plant are Royal Dutch Shell, BP of the UK, the National Gas Company of Trinidad and Tobago, while 10 percent is held by the Chinese wealth fund China Investment Corp., acquired from the predecessor company of France's Engie. The Trinidad plant has gone in the last 10 years from being the biggest supply of LNG to the US to pointing its cargoes at other markets because of the shale-gas boom and its North American neighbour becoming an exporter itself. The Caribbean nation's biggest LNG volumes were directed at South America last year to where 7.37MT were delivered. The largest customer was Chile with 2.38MT. A further 1.19MT was shipped to the Middle East, with the main customers being Egypt and Jordan. The largest European importer of Trinidad's LNG last year was Turkey with 490,000 tonnes of deliveries from a total of 950,000 tonnes shipped to Europe. Trinidad also shipped 960,000 tonnes to Asian customers. The fire and temporary shutdown comes amid plans to expand feed-gas supplies for Atlantic LNG and to upgrade facilities. BP is currently completing the construction of the Juniper project to supply more feed-gas to the LNG plant from 50 miles off the southeast coast of

Trinidad. Other work under way is on the Angelin venture, a dry gas development in the northern Columbus Basin of the Caribbean in over 210 feet (65 metres) of water. With a design throughput of 600 million standard cubic feet of gas per day, production will be sent to the Cassia platform for processing. The feed-gas from the venture will be transported by pipeline to the Atlantic LNG plant and the liquids produced will go to Galeota terminal via a new 13-mile pipeline.

AUSTRALIAN East Coast LNG production in the state of Queensland and domestic natural gas output increased in the second quarter by around 19 percent and 12 percent respectively as oil output plunged to a 40-year low, leaving the nation possibly vulnerable to Asian refinery disruptions. The three Queensland coal-seam-gas-to-LNG facilities, Asia Pacific LNG, Gladstone LNG and Queensland Curtis LNG produced 5 million tonnes of cargoes and the state had 193.2 petajoules of output in the second quarter for domestic use. Queensland coal seam gas production rose overall by 20 percent to 333 petajoules, according to estimates in the September quarterly review by Australian consultancy EnergyQuest. EnergyQuest also noted a 27 percent annual rise in Australian natural gas output at the same time as the nation's oil production hit a 40-year low. "Surging production lifted total Australian natural gas output to a record 3,770 petajoules," said the report. EnergyQuest Chief Executive Graeme Bethune said East Coast natural gas production was now catching up with demand following concerns that too much of the state's feed-gas was being reserved for LNG processing at the three plants on Curtis Island. Bethune also explained that plummeting national oil production in Australia was in sharp contrast to the rest of the petroleum industry. "Oil production fell to 54.4 million barrels, down 24.7 percent compared to the previous year. On current trends, oil will soon be eclipsed by condensate produced as a by-product of gas and LNG projects," he stated. "National oil output has fallen to the lowest level in more than 40 years at just 140,000 barrels of oil per day (b/d), compared to consumption of more than 1 million b/d. This decline and the well-documented shortfall in our oil security arrangements makes Australia particularly vulnerable to disruptions to shipping routes from refineries in Singapore, Korea and Japan," the report concluded. The latest EnergyQuest report's release comes after recent accusations by politicians and others that LNG feed-gas demand was ramping up prices on Australia's East Coast domestic gas market. "Queensland is importing (from other states) less gas to the point where it is increasingly self-sufficient," said the report. "Even with its LNG plants, the State is importing only about 2 petajoules per month, or 1.4 percent of the east coast supply. There has also been a net flow of gas south from Queensland since the first week of June, for the first time since November 2015," it added. However, New South Wales, South Australia and Tasmania are increasingly reliant on gas imports from Queensland and offshore Victoria. "NSW imports around 10 petajoules per month and even South Australia nearly 4 petajoules," the report said. EnergyQuest also said that East Coast short-term natural gas and new contract prices remained high when compared with others in South East Asia. The latest East Coast price quoted by the Australian Energy Market Operator was A$7.00 per gigajoule, the equivalent of US$5.28 per million British thermal units. "On a comparable basis, short-term east coast gas prices in the second quarter were A$0.26-A$1.77 per gigajoule below Japanese LNG import prices, Japanese prices are among the highest in the world, as are now east coast short-term prices and prices for new gas contracts," the report said. Overall national petroleum production was a record 767 million barrels of oil equivalent (MMboe) in fiscal 2017, up 19.5 percent from the previous year, driven by surging LNG production, which climbed to 51.5MT in fiscal 2017, up by 38.7 percent. "LNG exports were almost 2.5 times the volume of national domestic gas production, which was steady at 1,119 petajoules," it added. CEO Bethune said the past year had marked a major shift in the petroleum industry as the LNG investment boom moved deeper into its production phase. "The start-up of the Gorgon LNG project has also shaken up the order of Australia's petroleum heavyweights," said Bethune. "With production of 111 MMboe, Shell overtook Woodside (94 MMboe), BHP (90 MMboe) and Chevron (72 MMboe) to become Australia's largest petroleum producer in FY 2017. The rankings will change again this year, with Chevron already up in second place on a quarterly basis," he added.

BP of the UK, a leading global LNG market participant and North America's largest natural gas supplier, is now delivering 200,000 million British thermal units per day to Mexico's industrial users and local distribution companies in eight states. BP Energia Mexico, the company's marketing and trading unit in Mexico, has thus become the first private company to supply natural gas to the domestic market under the Mexican energy reform measures. The UK major's Mexican subsidiary had been awarded pipeline transportation rights at an auction hosted earlier in 2017 by Cenagas, Mexico's national body for natural gas control. BP Energia Mexico has also executed a firm transport agreement with Cenagas in addition to accords with other transporters and local distribution companies for delivery of natural gas. Delivery has begun across eight states - Nuevo Leon, Coahuila, San Luis Potosi, Veracruz, Mexico State, Guanajuato, Tamaulipas and Queretaro. Mexico is also the biggest recipient of US LNG deliveries at its two main import terminals at Altamira on the Gulf of Mexico and at Manzanillo on the Pacific Coast. Since Cheniere Energy's Sabine Pass export plant in Louisiana began its shipments in February 2016, Mexico has received more than 40 shipments, a long way ahead of the second-largest recipient, the South American nation of Chile with 16 cargoes. "We see this as an important milestone in BP's increasing involvement in and commitment to Mexico," said Orlando Alvarez, Chief Executive of BP's North America energy marketing and trading group. "We intend to continue to grow our Mexican customer base and be a reliable supplier of natural gas into the country for many years to come," added Alvarez. BP noted that it had invested in Mexico for more than 50 years, starting with marketing and distribution of the Castrol brand. The UK company also participated in Mexico's first tender at the end of 2016 for deepwater exploration licences, winning interests in two blocks in Cuenca Salina in the Southeast Basin.

CHART Industries, the US LNG equipment-maker, continues to expand its business by acquiring German company VCT Vogel, a servicer of cryogenic and mobile gas tank equipment and trucks and a European leader in truck-mounted drive and control systems for the operation of LNG pumps on trailers and containers. The takeover of the German company follows its $410 million cash purchase of smaller US sector rival Hudson Products Corp. Hudson, based in Beasley, Texas, makes a range of heat-transfer equipment for the refining, petrochemical, natural gas and other industrial markets. Hudson, based in Beasley, Texas is a North American leader in air-cooled heat exchangers and a global leader in axial flow cooling fans. Chart said the German acquisition expands and strengthens Chart's service and aftermarket presence in Southern Germany, Austria and Switzerland, and adds highly complementary truck drive systems to Chart's mobile equipment offering. The US company did not disclose the value of the transaction to purchase VCT, which will become part of the Distribution & Storage division of Chart. Chart said the German company VCT was expected to generate net sales of approximately $4 million in 2017. Services account for approximately 55 percent of VCT's sales. "VCT is a market leading company for cryogenic services in Germany, Austria and Switzerland with a proven competence to fulfil customer needs on short notice while maintaining a high standard," said Hans Lonsain, Chart's European Distribution & Storage business unit president. "It has an excellent reputation for outstanding technical capabilities throughout the markets it serves. In addition to its service offering, VCT manufactures state-of-the-art systems that are needed to drive and control cryogenic pump units," added Lonsain. "Both VCT's services and its product range are a great complement to Chart's existing European offering. In the future, VCT will become a regional service provider for Chart Ferox and Flow Instruments products," he said. VCT's previous major shareholder and Managing Director, Xaver Vogel, will stay with the company after the Chart takeover. "When I considered an external succession plan for the company, it was very obvious for me that Chart, with its outstanding position in the market for cryogenic equipment and its global footprint, would clearly be the best option for VCT," said Vogel. "The opportunity to expand our truck drive and control technology on a more international scope, and expand our service offerings to the European cryogenic industry will greatly enhance our ability to offer valuable solutions to customers all across Europe," he added.

CHINA National Offshore Oil Corporation (CNOOC) has become that latest global energy company to pull out

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of Canadian LNG development with the formal cancellation of its Aurora LNG project on Digby Island in British Columbia. CNOOC had planned the venture with Asian partners, including Japan Oil, Gas and Metals National Corp., a state energy body that promotes Japanese projects overseas and Japan's main LNG project developer, Inpex Corp. The Chinese company was pursuing the Aurora LNG project through a Canadian gas exploration and production company it acquired in 2012 called Nexen Energy. CNOOC bought Nexen for just over $15 billion and also acquired shale-gas holdings in northeast BC province which were to have been transported by pipeline to a proposed liquefaction plant on Digby Island on the Pacific Coast. The Aurora project developers planned to export up to 24 million tonnes per annum of cargoes over a 25-year period. Another stakeholder in the project was JGC Corp., one of the world's leading energy engineering companies and a builder of LNG plants. The fall in the oil price, which altered LNG project economics, as well as the ultra-environmentalist attitudes in the Canadian federal capital Ottawa to the oil and gas industry, had already forced other LNG projects led by US and European energy majors to cancel their ventures. "Over the past four years, Aurora LNG has been conducting a thorough feasibility study on liquefying and shipping LNG from the northwest coast of British Columbia to Asian markets," said a statement from the joint venture company. "Through this feasibility study, Aurora LNG has determined that the current macro-economic environment does not currently support the partners' vision of developing a large LNG business at the proposed Digby Island site," it stated. The province of BC had previously planned more than 20 LNG export terminal projects and now only one small-scale venture is moving forward, Woodfibre LNG. The Woodfibre project is planned for a brownfield site at the town of Squamish, north of Vancouver. Pacific NorthWest LNG, led by Malaysia's state-owned company Petronas, was the most recent to cancel its construction plans for northwest BC in July 2017. The Canadian federal government gave conditional approval to the Pacific NorthWest LNG project in September 2016, though with 190 mitigation measures attached, including for the first time the imposition of a maximum cap on greenhouse-gas emissions. Petronas and its partners, including India Oil Corp., Japan Petroleum Exploration Co., China's Sinopec and Petroleum Brunei, later had a review of their plans and decided not to proceed.

DYNAGAS LNG Partners, the Greek-owned carrier operator with six vessels, posted first-quarter operating income of $8.7 million and a net loss $5.2M amid extra expenses for a scheduled class survey and dry-dock costs for the company's three steam turbine-powered vessels. Voyage revenues dropped 25 percent in the second quarter and amounted to $31.97M compared with $42.63M in the same three months of 2016. Dynagas said the decrease was primarily due to the scheduled off-hire periods for the LNG vessels "Clean Energy", "Ob River" and "Amur River". Operating expenses for the fleet in the quarter rose by 12.4 percent to $7.5M from $6.7M in the same period of 2016. "We are pleased to report our earnings for the financial quarter ended June 30, 2017, which were within our expectations," said Tony Lauritzen, Chief Executive of the partnership. "We have previously communicated that this quarter would be affected by scheduled class surveys and related dry dockings for three of our six vessels which would result in cost items and would also qualify as off-hire under the relevant contracts," he explained. "We are satisfied that the class surveys, including dry dockings, were completed in a quick and efficient manner with an average of approximately 15 days per vessel from arrival to departure at the shipyard," he added. "The 'Clean Energy' became available for employment, at which time we entered into two consecutive short-term charters to employ the vessel through the end of August 2017," added the CEO. Dynagas said its earnings were also affected by its decision to reduce the charter hire rate charged to Russian company Gazprom Global LNG on two vessels, the "Yenisei River" and the "Lena River", in exchange for a long-term charter on the "Clean Energy" for an almost eight-year term. "Part of our strategy has been to enter into longer term charters for the employment of the vessels in our fleet," stated CEO Lauritzen. "With our fleet 84 percent contracted through 2017 and 75 percent contracted through each of 2018 and 2019, and with estimated fleet-wide average remaining contract duration of 10.2 years, we believe we have significant cash flow visibility," he added. "Our revenues are derived from the employment of our vessels on fixed multi-year charter contracts. The revenues we earn under those charter contracts are earned on a fixed day-rate basis and not linked in any way to commodity price fluctuations," said Lauritzen.

ENAGAS, the Spanish liquefied natural gas terminal operator and transmission company, reported the country's biggest domestic demand growth for the month of August after an 18 percent increase compared with August 2016. "The national demand for natural gas in August increased compared to the same month of the previous year, reaching 25,100 gigawatt hours," the company said. In addition to running the pipeline network, the Madrid-based company has four fully owned LNG regasification terminals in Spain at Barcelona, Cartagena, Huelva and Gijon. It also has 50 percent of the Bahía Bizkaia Gas plant in Bilbao and 72.5 percent of the Saggas terminal in Sagunto. Enagas said that demand for natural gas for the nation's electricity generation rose more than 60 percent, reaching 7,800 GWh, the highest August level since 2011. "So far this year, demand for natural gas in Spain has increased by about 9 percent over the same period in 2016 due to growth in conventional demand and natural gas deliveries for electricity generation," said Enagas. The company in July reported a 25.6 percent rise in first-half net profit to 269.1 million euros ($310M), including a gain from the Chilean Quintero LNG business and more revenue from higher gas demand in Spain. Spanish domestic demand reached 169,075.5 gigawatt hours during the first half, which was 6.5 percent up on the same six months of last year. Income from operations rose just over 16 percent to 481.2 million euros due to higher dividends from Enagas affiliates of 84.5M euros versus 49.6M euros last year. Operating cash flow reached 604.9M euros, 55.7 percent higher than the 388.5M euros in the first half of last year. Enagas also has shares in the Mexican import terminal at Altamira and pipeline operations in Latin America.

FOURCHON LNG, the US export venture owned by a subsidiary of Hong Kong-based Energy World Corp. and planned for Belle Pass in Louisiana, has applied to regulators for multi-year permits to ship cargoes for 30 years to countries with a Free Trade Agreement (FTA) with the US and for 20 years to any countries without an FTA. The application with the Department of Energy (DoE) for multi-contract authorization to export up to 260 billion cubic feet a year of natural gas follows the Fourchon project's recent receipt of a letter from the Federal Energy Regulatory Commission giving permission to start its pre-filing environmental review process. The Fourchon developers, who also have offices in Houston and Sydney, Australia, plan a two-phase construction of the liquefaction facilities with initial production of 2 million tonnes per annum and a second phase expanding output to a total of 5 MTPA. The Louisiana project also plans to reserve up to 500,000 tonnes a year of LNG for domestic use, with the intention of providing fuel for offshore supply vessels powered by LNG and operating in the Gulf of Mexico. Fourchon is being developed by Energy World Corp. subsidiary Energy World (USA) Inc. EWC is engaged in the business of infrastructure, power generation and energy-related projects mainly in the Asia-Pacific region. The company recently completed a small-scale LNG import terminal in the Philippines linked to a power venture and is in the final stages of building LNG liquefaction and power plants in Indonesia. EWC director Graham Elliott is running the Louisiana project and has pointed out to regulators that the company has 20 years of experience in the LNG industry. EWC completed the LNG terminal in the Philippines, located at Pagbilao in Quezon Province, in late 2016. It is developing an LNG hub in Pagbilao with two storage tanks, each with total capacity of 130,000 cubic metres. The company is additionally constructing a 650-megawatts, combined-cycle gas-fired power station at Pagbilao adjacent to the terminal. This facility will provide electricity sold to the Luzon transmission grid in line with the Philippines Government's vision for a clean energy future. EWC is also constructing an LNG liquefaction plant in Indonesia at Sengkang in South Sulawesi. The small-scale Sengkang venture is almost complete and has one modular liquefaction Train. EWC sees the facility as a reference point for the proposed Fourchon venture in Louisiana It will have capacity to produce 500,000 tonnes per annum, with three additional Trains planned of the same capacity depending on gas field development, giving a potential total output of 2 MTPA. GTT, or Gaztransport and Technigaz, the French LNG maritime storage technology

company, continues to build its order book for floating storage and regasification units with South Korean shipyard Hyundai Heavy Industries booking tanks for a project in India. The order from Hyundai concerns the Indian Swan LNG import project planned for Jafrabad in the northwest state of Gujarat. GTT said the design of the integrated tanks would fit a ship with a total capacity of 180,000 cubic metres. Delivery of the vessel is scheduled for late 2019. "These tanks will be equipped with the membrane containment system Mark III, a sea-proven technology developed by GTT," said the French company listed on the Euronext exchange. GTT noted that the insulation system has already been used to equip more than 140 vessels which are still in service. "We are very pleased to continue our long-term partnership with Hyundai Heavy Industries with which we have already managed the new build of over 40 LNGC and FSRU," said GTT Chairman and Chief Executive Philippe Berterottiere. The Swan Energy company behind the Jafrabad project is part of an Indian industrial conglomerate. "We are very glad to accompany a new operator in their first steps in the LNG arena," added the GTT CEO. The Swan LNG project will help develop the Indian gas market, which is projected to be one of the fastest growing in the world during the next two decades. The facility would be the fifth terminal on the west coast, while none has so far started operations on the east coast, though several are planned. GTT posted a first-half rise in net income as 13 new contracts contributed to the reconstruction of its order book with more activity in the FSRU sector. The company said there were eight orders for LNG carrier tanks, including four from two Korean yards, Hyundai and Daewoo Shipbuilding & Marine Engineering. There were also four others from Chinese shipyard Hudong Zhonghua. These vessels will be equipped with recent GTT technologies, the No 96 GW, No. 96-L03+ and the Mark III Flex tanks. One first-half order was received for a floating production vessel tank. This vessel, with a total capacity of 238,700 cubic metres, will be constructed by Korea's Samsung Heavy Industries on behalf of Italian energy company Eni and its Coral FLNG project offshore Mozambique.

INPEX Corp., the Japanese energy company and liquefied natural gas developer, has held a naming ceremony in Japan for an LNG carrier that will transport cargoes from the Ichthys export project near Darwin in Australia's Northern Territory to Taiwan. The naming of the "Pacific Breeze" carrier took place at the Sakaide shipyard in Kagawa Prefecture of Kawasaki Heavy Industries. The 182,000 cubic metres capacity carrier will transport 1.75 million tonnes per annum of LNG from the liquefaction plant near Bladin Point to LNG import terminals operated by CPC Corp of Taiwan. Taiwan has been an LNG importer for longer than mainland China and in 2016 handled 15.07 million tonnes of deliveries compared with 27.42MT received by China from global projects. Taiwan is the fifth-largest LNG importer in Asia and China is the third biggest. The naming ceremony for the "Pacific Breeze" was attended by CPC executives and numerous other guests, including Inpex President and Chief Executive Toshiaki Kitamura. The nameplate capacity of the Ichthys plant is 8.9 MTPA from the two processing Trains. Following various delays, the first cargo from the Australian liquefaction plant is expected to be shipped at the end of 2017 or early 2018. Inpex CEO Kitamura has said that the Ichthys venture was likely to be expanded with the building of additional liquefaction Trains near the Bladin Point plant site. In addition to supplying Taiwan, the Ichthys plant has long-term contracts to deliver cargoes to Japanese utilities Tokyo Gas, Osaka Gas, Kansai Electric Power, Toho Gas and Jera Co. Inc., the joint procurement venture between Tokyo Electric Power and Chubu Electric. Inpex is also a shareholder in the Prelude floating LNG project being developed by Royal Dutch Shell off the northwest coast of Australia, adding more volumes to its future LNG portfolio. The vessel "Pacific Breeze" is owned by a joint venture comprising French energy company Total, a partner in the Ichthys LNG project, and Japanese shipping line Kawasaki Kisen Kaisha, known as

K-Line. The LNG tanker is approximately 300 metres in length with a beam of 52 metres. Inpex pointed out that it is the world's first Moss-type LNG tanker to adopt an electric propulsion system that features a diesel engine fueled by both natural gas and bunker fuel and provides high fuel efficiency. Inpex said it would also use another newbuild LNG carrier, the "Oceanic Breeze", owned jointly with K-Line to deliver Australian shipments to Inpex's own Naoetsu LNG import terminal at Joetsu in the Japanese Niigata Prefecture. The vessel is currently undergoing the final stages of construction work at the Nagasaki shipyard owned by Mitsubishi Heavy Industries. "Inpex will continue to work toward the success of the Ichthys LNG project with the understanding and cooperation of all its stakeholders, including its joint venture partners, the local communities, the Australian federal government and the governments of Western Australia and the Northern Territory," stated the Japanese company.

INTERNATIONAL Gas Union members will hold an election of a new President to serve from 2021 to 2024 and has three candidates to choose from representing Canada, China and Egypt. The election for the three-year Presidency will be held on October 26, 2017 and will decide the holder of the office for the 2021-2024 period as well as the host of the 29th World Gas Conference in 2024. The IGU was established in 1931 and brings together natural gas associations and corporations, including 91 charter members and 51 associate members, representing 97 percent of the global gas industry. The US holds the current Presidency under David C. Carroll and will also host the next World Gas Conference to be held in Washington DC on June 25-29 in 2018. For the 2018-2021 triennium, South Korea has already been elected to assume the next IGU Presidency and to host the 28th World Gas Conference in Daegu, South Korea, in June 2021. The IGU October election is for the next Presidency after that. The President is elected by the IGU Council for a three-year period and is responsible for preparing the next World Gas Conference. A feature of the forthcoming October election for the 2021-2024 Presidency is that Egypt and the Oman are jointly standing, with an Egyptian put forward for the presidency and the Sultanate of Oman seeking to host the 2024 WGC Conference. It is the first time that two member-countries of the IGU have presented a candidacy jointly. The Egyptian-Oman candidate for President is Khaled AbuBakr, an engineer who is Chairman of private sector energy company Taqa Arabia and President of the Egyptian Gas Association (EGA). The suggested location for WGC 2024 is the Oman Convention & Exhibition Centre in the Omani capital Muscat. Egypt joined the IGU in 1989 while Oman became a member in 2002. Both are big participants in the gas and LNG industries. Egypt was a one-time LNG exporter and is now an importer and will soon bring on stream large gas discoveries in the Eastern Mediterranean. Oman is an LNG producer and exporter and has pipeline services as well. Egypt currently holds one seat on the Executive Committee as Regional Coordinator for the Middle East and Africa. China has put forward a woman candidate for President in Li Yalan, Chairman of Beijing Gas Group Ltd and Executive Chair of the China Gas Association The suggested location for the Chinese WGC in 2024 is in Beijing at the China National Convention Center (CNCC) at Beijing Olympic Park. China has held its IGU membership since 1986. China holds two seats on the Executive Committee of the IGU, one as an elected Charter member and one as Regional Coordinator for Asia and Asia Pacific. The Canadian candidate for President is Menelaos Ydreos, Executive Director of Energy Vantage Inc. The suggested location for the conference is the Vancouver Convention Centre in the province of British Columbia. Canada has been a member of IGU since 1933 and has hosted the World Gas Conference on one earlier occasion in Toronto in 1979. The country holds one seat on the IGU Executive Committee, as Regional Coordinator for North America. The separate office of Secretary General of the IGU is by election from the membership and the appointment is for a minimum of six years. The headquarters of the IGU is at the offices of the current Secretary General in Barcelona, Spain. The Secretary General is Luis Bertran of Spanish company Gas Natural Fenosa. Bertran most recently attended the YPFB Gas y Petroleo 2017 conference in La Paz, Bolivia, in July 25-26. He participated as a speaker and on a panel and spoke about the current status and future of the gas market.

JAPANESE government figures show that the average delivered price of spot liquefied natural gas that arrived in Japan in August was $5.60 per million British thermal units, just $0.20 per MMBtu higher than the $5.40 per MMbtu price given for August 2016. The government said spot cargoes contracted in August 2017 but not yet delivered were at an average of $5.80 per MMBtu while there were no contracted prices issued in August 2016. The spot cargo numbers come from the commerce division of the Japanese Ministry of Economy, Trade and Industry and are only issued if a minimum number of two trades are recorded. The average contracted spot price for July 2017 was $5.60 per MMBtu for a delivered shipment and for a contracted cargo versus $5.80 per MMbtu contracted and $6.00 per MMBtu delivered in July 2016. The ministry emphasizes that "spot LNG" refers to fuel traded on a cargo-to-cargo basis and does not mean shipments under contracts on a short-term, medium-term or long-term basis. The statistical accounting of the spot prices started in March 2014. "Subjects of these statistics are companies which are end-consumers of spot LNG. In order to avoid double counting, companies that mediate transactions (for example trading companies) are excluded from subjects of these statistics," the Ministry noted. Overall Japanese LNG imports had rebounded in July as a fall in shipments from other Asian countries was offset by more Middle East cargoes as well as Russian and US deliveries. LNG shipments in July amounted to 6.81 million tonnes compared with 6.57MT in July 2016, a rise of 3.6 percent. The latest imports of mostly long-term contract cargoes linked to oil cost a total of 316.19 billion yen ($2.89Bln), 42 percent more in dollar terms than in the same month in 2016, when the monthly LNG bill was 224.90Bln yen ($2.05Bln), according to the trade figures from the Japanese Finance Ministry. July thermal coal imports surged 13.6 percent to 10.59 million tonnes. The nation's overall LNG shipments in June had fallen by 1.2 percent to 6.18MT compared with 6.26MT in the year-ago period. The Ministry data on July imports showed that Asian shipments in June from nations such as Malaysia and Indonesia, Papua New Guinea and Brunei dropped 16.8 percent from a year ago to 2.00MT. Imports from the Middle East region rose just over 15 percent compared with July 2016. The shipments from countries like Qatar, the United Arab Emirates and Oman totalled 1.46MT. The balance of July imports from other nations in the preliminary figures edged lower to 2.63MT versus 2.66MT in June 2017, covering shipments from countries such as Australia and Nigeria, as well as from the spot market.

KING and Spalding, the international law firm, said it represented one of the main parties in an agreement signed to develop the Swan LNG import project planned for some time in the northwest Indian state of Gujrat, where three other regasification terminals already operate. King and Spalding said it advised Mitsui OSK Lines, the Japanese LNG carrier operator, in the Indian project negotiations. Swan Energy, part of an Indian industrial conglomerate, plans to deploy two floating storage and regasification units at Jafrabad Port, north of Mumbai. The facility would be the fifth terminal on the Indian west coast, while none has so far started operations on the east coast, though several are planned. The LNG terminal will have a receiving capacity of 5 million tonnes per annum and will use a dual floating storage and regasification unit (FSRU) and floating storage unit (FSU) solution. The FSRU tank capacity will be 180,000 cubic metres and the FSU tank capacity will be between 135,000m to 145,000 cubic metres. "MOL has agreed to provide the FSU and the long-term operation/maintenance of both the FSU and the FSRU, which will be constructed by Hyundai Heavy Industries in South Korea," said the law firm. The Singapore-based King and Spalding that advised MOL was led by projects and energy partner Richard Nelson and also included associates Kristian Whitaker, Christophe Vauthier and Ji Nin Loh. Black and Veatch, the US energy engineering company, was awarded the engineering, procurement and construction contract to deliver the jetty topside and onshore facilities. Rajiv Menon, Managing Director of B&V in India, said the government aims to significantly increase LNG import capacity by 2022 and this venture would be a major step in that direction. B&V, based in the US state of Kansas, is known in the industry for having its own liquefaction process and played a part in building the first floating LNG production plant for Belgian shipping and project company Exmar. The Antwerp-based company's vessel was built for a Caribbean LNG project that was later cancelled and it is still awaiting charter.

MAN Diesel and Turbo, the German propulsion maker said its marine fuel-gas system subsidiary had signed a contract

with Sweden's gas network operator Swedegas to deliver a liquefied natural gas bunkering facility in the Port of Gothenburg. The new facility will enable vessels to bunker LNG from trucks or containers while simultaneously loading or unloading cargo at two specialized jetties at the Swedish port. The MAN Diesel subsidiary, MAN Cryo, is based in Gothenburg and is a leading European manufacturer of LNG storage, distribution and handling equipment. "We are very happy to have won the contract to build this first such bunkering facility in the important Port of Gothenburg," said Mikael Adler, Managing Director of MAN Diesel & Turbo in Sweden. "Our strategy to offer LNG solutions to the marine market, both on board vessels as fuel-gas supply systems but also as bunkering infrastructure, dovetails perfectly with the general development towards cleaner ship propulsion," he added. The German company said the Gothenburg facility would comprise a discharge station for LNG trailers or containers, feeding pumps, vacuum-insulated piping and bunkering equipment to facilitate efficient operations. The installation will also satisfy the "stricter sulphur directive for shipping" designated by the European Union as a prioritized infrastructure project. MAN Cryo will oversee the project as holder of the engineering, procurement and construction contract and will be managed from MAN's Gothenburg office. The facility is scheduled to open during 2018 and will be operated and managed by Swedegas in close cooperation with the Port of Gothenburg. Gothenburg is the largest port in the Nordic region with more than 6,000 ship visits per year. It is expected to see LNG customers increase as companies comply with stricter pollution regulations in the Emission Control Areas of Northwest Europe. The existence of the ECAs and new sulphur reductions in fuel overseen by the International Maritime Organization has seen shipping companies order more dual-fuel and LNG-powered vessels for several sectors including for ferries and cruise liners.

MITSUI, the Japanese conglomerate, and Russian natural gas and LNG supplier Gazprom have signed a framework agreement for cooperation on small-scale and mid-scale LNG projects. Mitsui & Co., the energy unit of the Japanese trading house, and Gazprom signed the agreement at an economic forum in Vladivostok in the Russian Far East. The signatories were Gazprom Chairman Alexey Miller and his Mitsui & Co. counterpart Masami Iijima. "The document reflects the commitment of the parties to collaborate in producing, transporting and marketing small-scale and mid-scale LNG in Japan, as well as in LNG bunkering in the Sea of Japan," said Gazprom Gazprom and Mitsui are already partners in the Sakhalin LNG project in the northeast of Russia's Sakhalin Island in the Far East. The Sakhalin facility is currently Russia's only LNG liquefaction plant and supplies mainly for Japanese customers. The other stakeholder in the Sakhalin plant, which last year produced 10.4 million tonnes of LNG from two Trains, include Royal Dutch Shell and Japanese company Mitsubishi. Gazprom noted that in September 2016, Gazprom and Mitsui signed a memorandum of understanding that was hoped would lead to the development of LNG bunkering projects. This was followed in December last year by Gazprom and Mitsui signing an agreement on strategic cooperation. "The document envisaged collaboration in various areas, including Sakhalin project expansion and LNG bunkering," explained Gazprom.

NEXTDECADE Corp., the US LNG export developer planning the Rio Grande LNG and Rio Bravo Pipeline projects in Texas, has named former senior BG Group executive Matt Schatzman to the newly created position of President. Schatzman, aged 51, was BG's Executive Vice President for Global Energy Marketing and Shipping and a member of the Group Executive Committee before the UK LNG portfolio company has taken over by Royal Dutch Shell. Schatzman will report to NextDecade's Chairman and Chief Executive Kathleen Eisbrenner, herself a former Shell LNG executive before she founded the US company. "During his tenure with the company, Schatzman played a pivotal role in the success and

growth of BG's LNG business, transforming it from a US market focused business into a global leader in flexible LNG supply and trading," said NextDecade in announcing the appointment. Prior to joining NextDecade, Schatzman was President of MKS Energy where he provided energy advisory and consulting services. "I am thrilled to have Matt join me at NextDecade to help lead our organization," said Eisbrenner, whose role at Shell was as Executive Vice President for Global LNG Development. "Matt has extensive experience operating global LNG and US natural gas businesses and a proven track record that will help NextDecade deliver the Rio Grande LNG and Rio Bravo Pipeline projects," the CEO stated. The Rio Grande export venture, which is advancing through the Federal Energy Regulatory Commission permitting process, will produce 27 million tonnes per annum of LNG when completed. NextDecade recently competed a reverse merger transaction to obtain a stock listing on the Nasdaq global exchange to make it easier to raise finance for the liquefaction plant and its affiliated pipeline. The Rio Grande plant will have six liquefaction Trains when completed and will be among the leading projects in the second wave of the US Gulf Coast export build-out. Schatzman is the second major appointment by Eisbrenner this month. NextDecade on September 6 appointed former banker Patrick Hughes as Vice President for Corporate Strategy with responsibility for areas such as planning and joint ventures. In addition, Hughes will oversee Investor Relations for NextDecade.

OMAN, a producer of LNG supplying nations such as Japan and South Korea, has opened four onshore blocks to tender, three with oil and natural gas discoveries in place and with bidding open from September 20 until the end of December 2017. The Omani Ministry of Oil and Gas also plans to offer a further six blocks for tender from 2018. In the current round only the Dhahirah block (43B) is on offer which contains no discoveries. However, the Ministry said two wells had been drilled in the Dhahirah block covering 11,967 square kilometres. The three other blocks, Jebel Hammah (Block 47), Baqlah (Block 51) and Block 65 each contain conventional oil and gas discoveries. The Ministry noted that all three blocks have potential for tight gas and oil. Unconventional oil and gas development has only begun in Oman and is being targeted across the northern part of the country. In May 2017, the ministry also granted Italy's Eni and Oman Oil Co., the sultanate's energy investment company, exploration rights for Block 52, a 90,000 square kilometres area offshore Oman. The offshore area is largely unexplored, and was awarded following an international bid round launched in October 2016. Block 43B: Located north of the Hajar Mountains, was previously relinquished by Hungarian energy group MOL and has been previously owned by several players, including Amoco. Block 47: Adjoining Bloc 43B on its southern boundary is Block 47, which was relinquished recently by Norwegian company DNO. Tight gas is the predominant play in the 8,524 sq km concession located in the interior of Oman. Block 51: Among the most promising of the four blocks on offer, Block 51 is a 10,132 sq km licence also located in the interior of the country. "A total of 19 wells have so far been drilled by the block's many owners over the past decades, revealing evidence of gas and condensate," said the Ministry. Block 65: This is a relatively small onshore block of 1,230 sq km owned until recently by Oman Oil Company Exploration & Production. According to the ministry, there are two plays within this block. The first is conventional oil and gas and the second is an unconventional oil play. Oman has been an LNG producer since 2000. Oman LNG, owned by a consortium including the government, Royal Dutch Shell and Total, operates three liquefaction Trains at the company's plant near the town of Sur on the Gulf of Oman.

OPHIR Energy of the UK, the leader of the Fortuna floating liquefied natural gas project offshore Equatorial Guinea, said intensive efforts were being made by all partners to achieve a final investment decision before the end of the fourth quarter of 2017. The latest Fortuna FLNG update came as Ophir posted its first-half earnings showing a wider loss of $84.6 million compared with losses of $48.4M in the first six months of 2016. "Given that the remaining milestones are dependent on multiple stakeholders, it has proven difficult to precisely forecast FID timing," explained Ophir. "However, with the strong progress seen in the first half of 2017 and the current intensive effort from all parties, we presently still expect FID of the Fortuna Project to be achieved in fourth quarter," said the UK exploration and production company. "The key milestone outstanding prior to FID is the completion of the project funding," said Ophir. The Fortuna partners include shipping and project company Golar LNG, oil services firm Schlumberger and the Equatorial Guinea government and state energy firm. "Once the project funding has been finalised, the board of Ophir will be in the position to take the FID, which will also be subject to approval by Ophir's shareholders after which the approval of the President of Equatorial Guinea will be sought," it stated. During the first half, the project partners signed an agreement that established the full legal and fiscal framework for the FLNG joint venture and more recently they nominated global commodities company, the Gunvor Group, as their preferred LNG buyer for the offtake. Ophir said a final Sale and Purchase Agreement for the offtake was expected to be signed with Gunvor ahead of the FID. The engineering, procurement and construction contract for the liquefaction hull and topsides was awarded to Keppel of Singapore and US company Black & Veatch in May. Ophir's other operations include production in the Kerendan gas field in Indonesia and the Bualuang oil field in Thailand. Oil and gas revenues in first half 2017 totalled $88M, an increase of 69 percent on the same period in 2016. Ophir took the investment decision to commence the fourth development phase of the Bualuang oil field. The capital cost is expected to be $145M. The company said that for the first time "a significant contribution" was being made to earnings from Kerendan field. "Kerendan generated revenue of $8M at an average gas realisation price of $5.23 per thousand standard cubic feet. An additional amount of $2M arose in relation to the take-or-pay gas received from the offtaker," it added. Ophir Chief Executive Nick Cooper said that in a comprehensive operational review, the board had noted that Ophir's competitive advantages were its material discovered resources and its healthy balance sheet. "The careful use of this balance sheet to monetise our four resource plays offer a differentiated proposition of lower risk and quicker returns," said Cooper. "Our priorities in 2017 are achieving the Fortuna FLNG Project FID and realising incremental value across our operated production base," added the CEO. The Ophir management said it expected that the investment in Fortuna FLNG will deliver an internal rate of return of 25-35 percent. "Similarly, the next phase of investment in the Bualuang field will deliver an expected IRR of approximately 40%. Beyond these actions we have plans to further monetise our contingent resources in Indonesia, Equatorial Guinea and Tanzania," said Ophir. "Our recently acquired Mexico and Myanmar acreage positions are promising and offer attractive drilling options for 2018 and 2019," it added.

ORIGIN Energy, a stakeholder in the Australia Pacific LNG plant in Queensland, and Gladstone LNG operator Santos, said they had both heeded calls to help Australian industry in the supply of gas and have signed a joint deal with a major Sydney company. Origin has a more than one-third stake in the $24.7-billion APLNG project that started up in late 2015 to supply LNG to Asia from the liquefaction plant on Curtis Island and it has now joined Santos in a new supply deal for industry. Origin and Santos, as Australian LNG companies, have led meetings with the government with other shareholders to act on real or perceived gas shortages in the domestic market amid continued exports of LNG cargoes. Both companies have now signed a new agreement to continue to support industry through the supply of ethane gas to Qenos, Australia's sole producer of polyethylene and a leading supplier of polymers for plastics and resins. Under the agreement, Santos and Origin will supply an estimated 27 petajoules to Qenos for the remainder of 2017 and until the end of 2019. The ethane is processed at the Santos-operated Moomba gas plant and delivered via a pipeline of 1,375 kilometres from Moomba to Qenos's operations at Botany Bay in Sydney for use as a feedstock in the manufacture of polyethylene. A typical natural gas has between 1 percent and about 5 percent ethane content and the main technique to extract ethane from natural gas is low-temperature separation. The US shale-gas surge has led to renaissance for the US chemicals industry as more ethane is readily available at low prices for petrochemical processing. Santos explained that the polyethylene produced by Qenos is used across a range of industries and applications, including consumer and industrial packaging, water conservation, waste management and agriculture. The Qenos company is majority-owned by the China National BlueStar Group. Santos Chief Executive Kevin Gallagher said he was pleased Santos could continue to provide ethane to the New South Wales manufacturer. "The Cooper Basin has been supplying

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ethane to Qenos for over 20 years, and I am delighted we have been able to agree new supply arrangements with the company and reinforce our support for Australia's manufacturing industry," explained Gallagher. "The agreement also highlights the point that gas is not only a clean, reliable energy source, it is a critical constituent in a range of manufactured products," he stated.

PAPUA NEW GUINEA has started paying local landowners cash benefits from royalties from the US$19-billion PNG LNG project in the Oceania nation operated by ExxonMobil Corp. The PNG liquefaction plant is located northwest of the capital Port Moresby and has been exporting cargoes for the past three years during which there have been more than 200 shipments. The royalty funds have been held in trust by the government so that it could verify the identities of the thousands of landowning claimants and clan members in many areas such as the PNG Highlands. The money is paid by the government's Mineral Resources Development Company (MRDC). The MRDC is in the list of shareholders along with ExxonMobil, Australia-registered Santos and Oil Search as well as French energy company Total and Japan's JX Nippon Oil & Gas Exploration. The MRDC has started to distribute the 2 percent royalty payments to the landowners from the fund it oversees. New banks have also been built in energy producing areas such as Kikori and Kutubu to distribute landowner equity benefits through modern banking services. Royalties are to be shared by upstream landowners, about 72 percent of the total, who live around the gas fields where feed-gas is produced and to landowners on pipeline routes and around the LNG plant, who form the remaining 28 percent of those eligible. Much of the indigenous population of more than 7 million people in PNG live in customary communities. The initial royalty payments will be made to more than 50 clans who will share the equivalent of US$4.8 million in cash. According to the government rules, only 40 percent of the royalties will be made in cash distributions. The remaining 60 percent is set aside in two trusts, the Future Generation Trust Fund and the Community Investment Trust Fund, to help develop the nation and partly finance facilities and infrastructure. The government had made the resolution of the landowner payment issue a priority following elections in PNG in July in which Prime Minister Peter O'Neill retained power. The pay-outs to PNG nationals will last over the next 30 years or so during which the LNG plant will sell 9 trillion cubic feet of the nation's natural gas resources. Plans are also being drawn up for an expansion of LNG production at the existing plant by the addition of two processing Trains.

PAVILION Energy of Singapore and its gas subsidiary signed a preliminary agreement to cooperate with state-owned Indonesian electricity company Perusahaan Listrik Negara (PLN) on small-scale LNG projects with another Singaporean firm Keppel Offshore & Marine. The signing of the agreement took place during a visit to Singapore by Indonesian President Joko Widodo for talks with Singapore Prime Minister Lee Hsien Loong. The small-scale LNG agreement was one of several memoranda of understanding signed during the talks on September 7. "We are pleased with this opportunity to collaborate with PLN to deliver small-scale LNG to remote locations in Indonesia for power generation, and to enhance energy cooperation between Indonesia and Singapore," said Seah Moon Ming, Chief Executive of Pavilion Energy and Pavilion Gas. "Small-scale LNG enhances Singapore's role as a regional hub for LNG storage and reloading, break-bulk and distribution," added the CEO. The collaboration involves the distribution of LNG to remote islands and locations in West Indonesia, according to Pavilion, whose parent company is Singapore wealth fund Temasek. "LNG will be delivered to floating and onshore LNG terminals using small LNG vessels, where it will be regasified and used to generate electricity at PLN's power plants of between 25 megawatts (MW) to 100 MW in capacity," the Singaporean company explained. Small-scale LNG allows LNG to be transported and distributed in smaller quantities to remote locations where pipelines do not exist as is the case with Indonesia, "It is a fitting solution for the Southeast Asian region, which is home to thousands of small islands - of which many are inhabited and require power," said Pavilion. "Pavilion has identified small-scale LNG supply and distribution as a key business area for the company, and has built up its capabilities in small-scale LNG supply chain and engineering to provide a reliable, efficient and cost-effective solution," it added.

SAMSUNG Heavy Industries, one of the three major global shipyards based in South Korea, has showcased to around 20 shipping companies its own liquefied natural gas regasification system for future installation on floating storage and regasification unit (FSRU) newbuilds. Samsung said its system is called S-Regas (GI) and was available for vessels that can operate as import facilities. The company, which competes with the Korean yards Daewoo Shipbuilding and Marine Engineering and Hyundai Heavy Industries for orders, has reorganized like its rivals to emerge healthier from the latest shipping industry slump. The Korean company said its regas system presentation was attended by LNG fleet operators such as Hoegh of Norway, Bermuda-based Golar LNG and Greek-owned GasLog, whose main offices are in Monaco. Samsung said the S-Regas (GI) system utilizes glycol to regasify LNG into gas. "S-Regas (GI) reduces the chance of corrosion from the traditional method of heating LNG directly with seawater and is another energy-efficient solution from SHI, with energy savings of 5 percent," the company said. "The in-house regasification system enables not only cost savings but also improvements in schedule and quality management, further enhancing Samsung's leadership in the LNG-FSRU market," it added. "Samsung will continue to lead the market by developing the next generation technologies in the whole LNG value chain," it stated. "With our proven track record and experience we will meet customer's needs such as saving operating costs for LNG-FSRUs backed by a reliable performance," said the company. While it is seeking more FSRU orders, Samsung is already the leader in constructing floating LNG production vessels, though with liquefaction processes licensed to other companies. It built the world's first FLNG production hull at its shipyard in Geoje. The "PLNG Satu" began operations at the end of 2016 for Malaysian energy company Petronas over a gas field offshore Sarawak. Samsung also built the Prelude FLNG hull currently being commissioned offshore northwest Australia by Royal Dutch Shell. It also captured the most recent order made by Italian energy company Eni for its Coral FLNG project offshore Mozambique in southeast Africa.

SANTOS, the Australian energy company and its Gladstone LNG plant international partners will supply the East Coast domestic market with volumes of natural gas during 2018 and 2019 that is not required for liquefaction and export. "The gas, which would otherwise have been exported as LNG, is being sold to East Coast customers including power companies," said Santos. The volume of gas pledged is 30 petajoules, enough to satisfy the needs of over 300,000 homes for two years. The Gladstone LNG plant partners include Malaysian energy company Petronas, France's Total and Korea Gas Corp. Feed-gas for liquefaction is delivered from coal-seam gas tenements in the Bowen and Surat Basins of southwest Queensland in a 420-kilometre underground pipeline to the GLNG plant on Curtis island near the port of Gladstone. The Santos move follows a proposal from the Australian government in May 2017 to temporarily block LNG exports if necessary to ensure adequate domestic gas supplies in Queensland and other eastern states and at lower prices. Prime Minister Malcolm Turnbull said at the time the planned blockage was in response to shortages and concern over future shortfalls on the East Coast, where coal-seam gas is used for three CSG-to-LNG plants brought on stream in the past three years. The three plants combined have a total nameplate capacity of 23.3 million tonnes per annum of LNG, with the GLNG facility operated by Santos having output of 7.8 MTPA. The other two plants are the Royal Dutch Shell-owned Queensland Curtis LNG plant and the Australia Pacific plant, operated by ConocoPhillips and whose other main shareholder is Chinese energy company Sinopec. Turnbull had said it was unacceptable for Australia to soon become the world's largest exporter of LNG but not have enough domestic supply for Australian households and businesses. "Over the last few months, Santos has been working constructively with the Federal Government and our GLNG partners to supply additional gas to the east coast domestic market," said Santos Chief Executive Kevin Gallagher in announcing the GLNG plant's volume pledge for 2018 and 2019 for the domestic market. He said 30 petajoules of natural gas was being supplied as it was volume of gas which could power a 228 megawatts power station or 330,000 homes over the two-year period. "It is further proof of our readiness to work with our partners in responding to market dynamics and meeting local gas demand and I would like to thank them for their support," added Gallagher. "As an Australian company we

are committed to improving energy reliability and affordability for all Australians, both householders and industry," he stated. "We have been producing and marketing domestic gas for many years, and we have the capacity to leverage our various assets and partnerships to ensure this energy security," the CEO said. These arrangements follow recent Santos announcements for the delivery of up to 72 petajoules of gas over four years into the south-east market through a swap agreement and the sale of 15 petajoules to the Pelican Point Power Station in South Australia.

SKANGAS, a leading supplier of liquefied natural gas in the Nordic market, said its 5,800 cubic metres capacity LNG bunkering and distribution vessel "Coralius" had made its maiden commercial voyage. The "Coralius" delivered a cargo to the Ora peninsula terminal at Fredrikstad in Norway. The cargo was lifted from Skangas's own small-scale liquefaction plant at Risavika near the Norwegian port of Stavanger. Commissioned by Dutch shipping company Anthony Veder and Sirius Shipping in 2015 and built at the Royal Bodewes shipyard in the Netherlands, the vessel is on long-term charter to Skangas. Skangas intends to use the ship to increase its offering of LNG bunkering and distribution services in the North Sea, the Skagerak area and the Baltic Sea. "We are very content with further developing marine LNG availability in Northern Europe with our new ship," said Kimmo Rahkamo, Chief Executive of Skangas, which is a subsidiary of Finnish natural gas company Gasum. "We look forward to serving our existing and new customers wherever they need LNG by ship-to-ship. The technology and ship engines are sound for gas and we are more than ready to supply it by our supply chain," added the Skangas CEO. Skangas said that before the Norwegian delivery the "Coralius" had arrived on September 4 in Sweden directly from the Royal Bodewes shipyard in Eemshaven, the Dutch port in the province of Groningen. The LNG company said it was able to showcase its new chartered carrier at the "Donso Shipping Meet", a two-day conference held on an island off the west coast of Sweden. "More than 1,000 visitors, including many customers of Skangas, came on board the 'Coralius'. They were able to discover the latest technology all the way from the big monitoring screens on the bridge to the modern bunkering facilities and the latest in gas engines," added Skangas.

SPAIN imported 19 LNG cargoes last month as natural gas demand growth reached record levels and its six operating regasification facilities supplied gas-fired power plants. A monthly report from terminal operator and transmission company Enagas showed that six of the shipments were received at the Barcelona terminal in northeast Spain. Four more cargoes were delivered to the southwest terminal at Huelva and four shipments also arrived at the Bilbao facility in the northwest of Spain. A further three cargoes were delivered to the southwest Sagunto terminal, located just north of the city of Valencia, while the Cartagena terminal in the south near Murcia and Mugardos at the port of El Ferrol in the northwest each unloaded a single shipment. The imports came from Qatar, Nigeria, Algeria, Norway, Peru, Trinidad and the US. Spain received a net 10.17 million tonnes of LNG in 2016 compared with 8.82MT the previous year when it re-exported more shipments. It was the largest European importer last year followed by the UK, France and Turkey. Enagas fully owns the regasification terminals in Barcelona, Cartagena, Huelva and Gijon. It also has 50 percent of the facility in Bilbao and over 70 percent of the Saggas terminal in Sagunto. LNG imports for Spain's network of gas-fired power stations amounted to 19.15 terawatt hours (TWh) in August, a rise of 156 percent compared with the 7.47 TWh logged in the same month of 2016. Enagas earlier said August domestic natural gas demand growth was 18 percent compared with August 2016. The company said that demand for gas for electricity generation rose more than 60 percent, reaching 7,800 gigawatt hours, the highest August level since 2011.

TELLURIAN Inc., developer of the Driftwood LNG project on the Gulf Coast of Louisiana, said it had agreed to acquire acreage in Haynesville Shale play in the northwest of the state to add potential gas assets to its portfolio for future export. Tellurian's LNG project involves constructing a liquefaction and export plant near Lake Charles to match the nearby Sabine Pass venture of Cheniere Energy with 27 million tonnes per annum of output. Tellurian has now entered into an agreement with a private seller to acquire natural gas producing assets and undeveloped acreage in northern Louisiana for $85.1 million. The transaction by Nasdaq-listed Tellurian is scheduled to close by the end of November 2017. The seller was described in Tellurian's Securities and Exchange Commission documents as an unrelated third party. Tellurian was founded by former Cheniere CEO Charif Souki and by Martin Houston, who ran the operations of the LNG portfolio company, BG of the UK, and has already made progress in the regulatory and permit processes. Analysts pointed out that Tellurian's new gas assets in addition to providing future feed-gas from shale at competitive prices will also require investment funds for the development of the plays located in Red River, DeSoto and Natchitoches Parishes of Louisiana. After the transaction was announced, Tellurian shares rose 14 percent to $10.20 on the Nasdaq, their highest level since July 3. The company said the 9,200 net acres have 138 operated Haynesville and Bossier drilling locations. Tellurian added that the Haynesville plays had around 1.3 trillion cubic feet of potential gas resources from 19 producing and operated wells with net current production of 4 million cubic feet per day. The asset purchase also comes with associated natural gas gathering and processing facilities. "The assets are 100 percent held by production and 92 percent operated, allowing Tellurian to control the pace of development for its multi-year drilling inventory," said Tellurian. The company's Chief Executive Meg Gentle said the acquisition of natural gas producing assets was integral to its growing business. "We expect our full cycle cost of production and transport to markets will be approximately $2.25 per million British thermal units, which represents a significant savings to natural gas we will purchase at Henry Hub and other regional liquidity points," said Gentle. The Haynesville shale covers areas of northeast Texas as well as northwest Louisiana and is one of the most prolific in the US with more than 13 Tcf of historical production an array of active drilling rigs and access to multiple pipelines. Tellurian has previously submitted applications to the Federal Energy Regulatory Commission to construct and operate the Driftwood liquefaction plant on a 1,000-acre site on the west bank of the Calcasieu River near the town of Carlyss in Calcasieu Parish. Construction of the plant is scheduled to

begin in 2018 and first cargoes could then be shipped by 2022.

US subsea and energy services company BHGE, or Baker Hughes-GE Oil and Gas, has signed its highest-profile contract yet under the BHGE banner for Phase Two development of the Zohr gas field in the east Mediterranean that will boost Egyptian natural gas supplies and reduce LNG needs. BHGE signed the subsea contract with Petrobel for the "supergiant" Zohr field, part of the Shorouk licence concession mainly owned by Eni of Italy, the operator and BP of the UK. Petrobel is a subsidiary in Egypt of Eni, the licence holder and Egyptian General Petroleum Corp. "As a long-term partner to Egypt, BHGE will provide project management, engineering procurement, fabrication, construction, testing and transportation of a subsea production system," the US company said. The Zohr field when it comes on stream in late 2017 will affect regional LNG markets, especially for main player Egypt which was once an exporter and now imports LNG cargoes. Egypt has two Floating Storage and Regasification Units deployed at the port of Ain Sokhna in the Gulf of Suez to import cargoes and satisfy natural gas demand. During 2016, Egypt took delivery of almost 100 LNG cargoes from the spot and short-term market and it recently announced the result of a tender to buy a further 45 cargoes in the months ahead. Tarek El-Molla, Minister of Petroleum and Mineral Resources for Egypt, and BHGE executives took part in a signing ceremony for the subsea contract. El-Molla said Egypt was maximizing domestic energy resources and optimizing reliability of their supplies with the Zohr project. "We are able to increase the value and efficiency of the sector by driving a sustainable and energy-efficient economy through the ministry's Modernization Program in partnership with companies such as BHGE," stated the minister. "The Zohr gas field is playing a major role in the development of Egypt's domestic energy resources, revenue generation and economic growth," he added. Lorenzo Simonelli, President and Chief Executive of BHGE, said the Zohr contract was a landmark one for the merged company. "The Zohr Field is one of the most significant developments of its kind, and through this project we can show the efficiency gains that such complex projects can achieve through our enhanced portfolio," added Simonelli. "This project has the potential to meet Egypt's growing gas demand and save the country billions of dollars that would otherwise be spent on importing gas," the CEO said.

US Department of Energy regulatory officials will give faster approval of small-scale LNG projects from export facilities to target small-volume customers in the Caribbean, Central America and South America. The plan was outlined by US Secretary of Energy Rick Perry and is part of general proposals for "deregulatory measures" in the US energy industry. Many of the countries in these regions, the closest neighbours to the US, do not generate enough natural gas demand to support the economies of scale required to justify large volumes of LNG imports from large-scale plants on full-sized conventional tankers. The small-scale natural export market has developed as a solution to the practical and economic constraints limiting natural gas exports to these countries. "The Trump Administration is focused on finding ways to unleash American energy and providing a reliable and environmentally friendly fuel to our trading partners who face unique energy infrastructure challenges," said Perry. "The Department of Energy and this Administration are wholeheartedly committed to strengthening the energy security of the United States and our allies," he stated. "This deregulatory measure will expedite the review and approval of applications to export small amounts of natural gas in the emerging small-scale LNG export market. Under the Natural Gas Act, the DoE has jurisdiction over imports and exports of natural gas," the department pointed out. Caribbean Islands such as Barbados already receive shipments of US LNG by ISO containers onboard cargo ships from ports in Florida. The Sabine Pass plant in Louisiana, operated by Cheniere Energy, already delivers large-scale loads to nations such as Mexico, Argentina, Brazil and Chile. Under the DoE proposals it will be easier to ship ISO containers, for example, or cargoes on small-scale carriers to smaller nations in the Caribbean and Latin America. For applications to export natural gas to countries without a qualifying free trade agreement (non-free trade agreement countries), the DoE must conduct a public interest review before authorizing an export. This proposed rule provides that DoE, upon receipt of any completed request to export natural gas (including LNG) to non-free trade agreement countries, will grant the request provided that the application meets two criteria - it proposes to export no more than 0.14 billion cubic feet per day (Bcf/d), and the proposed export qualifies for a categorical exclusion under the DoE's National Environmental Policy Act (NEPA) regulations. For applications meeting these criteria, the exports are considered "small-scale natural gas exports" and are deemed in the public interest under the Natural Gas Act. Exports of natural gas to free trade agreement countries are already deemed in the public interest under the Act.

VERESEN Inc., the Canadian energy company currently being acquired by Calgary-based Pembina Pipeline in an agreed US$7.5 billion takeover, has formally re-applied to develop a US LNG export plant across the border in the US state of Oregon. The project includes a liquefaction plant in Coos Bay in Oregon and a 370-kilometre pipeline that will bring natural gas originating in the US Rockies and the Canadian province of British Columbia from a southern Oregon hub to the plant. Veresen Chief Executive Don Althoff said the new proposal submitted to the US Federal Energy Regulatory Commission had undergone changes to overcome objections, including one that demand for the project had not been adequately demonstrated. The new Jordan Cove venture has also dropped the construction of an affiliated 420-megawatt power plant and makes more than 50 pipeline route adjustments, as well as promising to use trenchless drilling techniques to minimize environmental impacts at water crossings. If Jordan Cove receives FERC approval it would be the first LNG export facility on the US West Coast and closer to important Asian markets. Veresen said it hopes to make a final investment decision on the project in 2019 and start shipping LNG in 2024. The FERC is expected to issue a draft environmental impact statement early in 2018 with a further year of consideration of mitigation and opposition, which in the past has been organized by anti-hydrocarbon industry activists. The project will be pursued by the merged Veresen-Pembina combination with a combined capitalization of around US$18Bln, bringing more expertise and investment to the project. Veresen's main business at present includes a pipeline transportation business comprised of interests in the North American Alliance Pipeline, the Ruby Pipeline and the Alberta Ethane Gathering System, and a midstream business with assets in western Canada. Pembina is also a leading transportation and midstream service provider. The company owns and operates an integrated system of pipelines for petroleum and hydrocarbon products derived from natural gas and hydrocarbon liquids and produced primarily in western Canada. Pembina also owns and operates gas-gathering and processing facilities and an oil and natural gas liquids infrastructure and logistics business. The merged Pembina-Veresen company will be listed on both the New York Stock Exchange and the Toronto Stock Exchange. The revised Jordan Cove venture retains its Pacific Connector Gas Pipeline project in combination with the liquefaction plant producing 7.8 million tonnes per annum of LNG. "Completing the pre-filing phase and submitting the formal applications to FERC is a major milestone for the projects," said Veresen CEO Althoff. "Our significant efforts to optimize the design to minimize its environmental footprint and accommodate landowner requests, as well as the support of our world-class LNG buyers, should result in the receipt of the positive regulatory decisions required to build Jordan Cove," explained the CEO. "We look forward to continuing our work with the local community, Tribal leaders and FERC, as well as other federal and state agencies to advance Jordan Cove," stated Althoff. The total engineering, procurement and construction cost of both the LNG export terminal and Pacific Connector is estimated by Veresen at around US$10BL, with about 90 percent of US content. "Additionally, the project will generate approximately US$60 million in annual property taxes, including US$20 million from Pacific Connector in the counties through which the pipeline traverses. The project will require approximately 6,000 workers during construction and more than 200 new permanent jobs upon commissioning," added Veresen. ■

Diary of events

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Improved monitoring onboard FSRUs is required to enhance operating performance and cut cargo loss

Maksym Kulitsa, FSRU consultant and David A. Wood, DWA Energy Limited, Lincoln, UK

Significant effort has been made in recent years to minimize the consumption of LNG, and boil-off gas (BOG) emanating from it, during its transport and storage in the marine environment on LNG carriers, floating storage units (FSUs) and floating storage regasification units (FSRUs).

During the past decade, more advanced types of LNG carriers have come into service -the Dual-Fuel Diesel Electric (DFDE).

Additionally, LNG tank designers are striving to improve the tank containment system's insulation to reduce tank's Normal Boil-off Rate (NBOR). In the past decade improvements in tank designs have led to reductions in their NBOR.

For the older LNGC vessels NBOR was approximately 0.15 vol% /day (meaning 0.15% by volume of a tank's total cargo capacity could be expected to boil off each day).

Currently GTT Mark III Flex system tanks guarantee NBOR of 0.085vol%/day, and GTT Mark V systems guarantee NBOR of 0.070vol%/day. T

These trends in LNGC and FSRU engine design and LNG tank containment fuel underline the industry's desire to minimize losses of LNG cargo during marine storage and transport.

FSRU Specifics

The existing FSRU and vessels being built today are less constrained by tank structure requirements from the perspective NBOR due to the operating pattern of FSRU and the availability of recondensers.

Newbuild FSRU are therefore of the DFDE type with NBOR in the range 0.125 to 0.155 volume %/day. This NBOR range is acceptable as the recondenser makes it easy and efficient to handle the excess BOG that is not used for power generation.

The most advance technology in operation today is DFDE, in which FSRU are equipped either with recondensers or Latent Heat Capture Systems (LHCS), which enable them to recondense boil-off gas vapor, as required, to avoid wasting BOG that is surplus to shipboard requirements.

These DFDE FSRUs are also more efficient in the way that BOG is used as a fuel ("regasification fuel") to run the shipboard plant. Such features further demonstrate the industry's objective to operate more efficiently and minimize shipboard consumption of LNG cargo.

Here we identify potentially "hidden or unrecorded" loss of cargo, due to less than optimal operating strategies of FSRU, that occur despite the advanced technological features with which they are equipped.

Performance

Such operating inefficiencies can lead to unnecessary shipboard gas consumption that represent significant losses in value for vessel charterers. Our intention is to explain the causes of such excess gas consumption, how to reveal unnecessary losses in gas handling/ consumption operating records, and how to prevent it (i.e., improve operating efficiency) while maintaining required FSRU operating safety standards.

Unlike liquid petroleum gas (LPG) cargoes, the monitoring of LNG cargoes involves additional factors, particularly the use of some of the LNG as BOG for engine room fuel, and that ongoing preferential boil-off of the lighter gas components (with lower boiling points) causes LNG to change its composition (i.e., "age" to a slightly higher density) over a time.

Unlike LPG, this "aging" process means that LNG is typically loaded with one composition, but discharged at the end of a voyage or storage period in a FSU or FSRU with a slightly different composition and quantity.

This preferential emission of the lighter components from LNG in a tank means that BOG has a slightly different (lighter) composition than the liquid LNG from which it evaporated.

Cargo-related values

LNG cargoes are typically sold at values that relate to their unit energy contents (e.g. US$/MMBtu), that energy content varies as a loaded LNG cargo ages over time.

EXTRACTS FROM CARGO UNLOADING SURVEY REPORTS FOR TWO LNGC CARGOES IDENTIFYING BOG CONSUMED DURING VOYAGE		
Type of LNG Carrier	**Steam-powered LNGC**	**Tri-Fuel Diesel Electric LNGC**
Vessel design capacity (cubic metres)	138,000	150,000
Bill of lading cargo volume loaded (cubic metres)	137,002	148,421
Tank pressure during loading as reported by custody transfer management system (CTMS) (mbarA)	1010	1088
Volume of cargo unloaded (CTMS) (cubic metres)	132,114	148,809
Tank pressure during unloading as reported by custody transfer management system (CTMS) (mbarA)	1152	1181
Voyage duration (days)	20.58	7.82
Corrected loss of cargo during voyage (cubic metres)	1,866.7	4,876.8
Intransit loss of total cargo (%)	3.55%	1.24%
Estimated LNG boil-off during voyage (BOR) (%/day)	0.17%	0.14%
Vessel LNG boil-off design limits (NBOR) (%/day)	0.15%	0.15%
Conclusion	BOG exceeded design limits	BOG was within design limits

Table 1: Example cargo survey report at unloading destination conducted by an independent cargo surveyor made after an LNGC delivered its cargo to FSRU (extracts only). Such information makes it possible to compare actual average BOR achieved during a specific voyage with the declared NBOR design limits

Every LNG cargo composition therefore has its own energy content that is changing over time, which has to also be taken into account when comparing and valuing the quantity (mass and/or volume) of the cargo loaded versus the cargo delivered by a LNGC or FSRU.

During marine transport and storage of LNG a check is performed on the basis of the average boil-off gas (BOG) consumption per day versus declared (by tank manufacturer) normal boil-off gas rate (NBOR) per day for the ship (for current guidance see GIIGNL, 2015).

NBOR varies according to tank design and is specified by tank manufactures, typically in the range of 0.10% to 0.15% of tank capacity/day.

The latest LNGC designs achieve slightly lower NBOR of about 0.08 % of tank capacity/day for the laden voyage and from 0.06 to 0.10 % for the ballast voyage (Głomski and Michalski, 2011.)

An LNG carrier (and FSRU) typically has four or five LNG tanks each with a slightly different declared NBOR. The weighted average of the NBOR values for all the LNG tanks is used for the ship's NBOR on a full-cargo basis.

NBOR defines the designed mass of boil-off vapor that needs to be disposed of (i.e., evacuated from a tank) in order to keep tank pressure stable (i.e., heat ingress to tank = heat egress from tank).

Boil-off Gas Quantity

The actual daily quantity of BOG is typically calculated in terms of the boil-off rate (BOR) (e.g. Chen et al. 2004) on a LNGC or FSRU using equation (1):

$$BOR = \frac{q}{\rho V h_{fg}} \times 24 \times 3600 \times 100\%$$

Where:

q is the total heat leaking through the insulation to the cargo

hfg is the latent heat of vaporization

ρ density

V volume of the LNG inside the tank

Equation (1) shows that BOR is directly related to variations in heat leakage, LNG density and total volume of LNG in tank. Because LNG composition (and therefore its density) can vary from cargo to cargo (and over time as the cargo ages), BOR varies for the same ship depending upon its prevailing cargo composition, in relation to the LNG density term (p) in equation (1).

For the typical range of commercial LNG cargo compositions (i.e., density ranging from 422 kg/m3 to 450 kg/m3) the calculated boil-off, in mass/hour terms, can vary over a range of about 500 kg/h.

Typical LNGC (FSRU), with NBOR of 0.15 vol%/day, must consume or dispose of about 4200 kg/h of boil-off vapor on average, varying between ~4450 kg/h for low-density Australian LNG (SG of 0.422) and ~3950 kg/h for high-density Nigerian LNG (SG 0.450).

Monitoring

Monitoring cargo performance (i.e., the measured loss of cargo during a voyage in terms of the volume loaded versus the volume delivered, and also providing information on the mass delivered and its energy content) for LNGC vessels is relatively straightforward and historically the reporting method for this has been standardized (Figure 1).

If the LNGC has tank designs with NBOR 0.15vol%/day, then if the average consumption of boil off gas (BOG) during the voyage is equal to or below that declared NBOR value, then contractual conditions are met.

However, in cases where BOG consumption during voyage exceed the declared value, then explanations are required and commercial issues usually arise.

If the LNGC is unable to justify why its gas consumption has breached the upper limits of the contract (related to the declared NBOR for the vessel) it may be charged a penalty (as specified by penalty clauses in its contract/charter agreement).

The measured BOG consumption is calculated on the basis of cargo surveys (i.e., derived from a ship's custody transfer measurement systems, CTMS) verified by independent cargo surveyors in the loading port and the port of discharge (Table 1 on previous page).

The cargo monitoring procedures for FSRU are more complicated as uniform practices are not yet established.

The procedures vary depending on the requirements of specific FSRU owners/operators or charterers, but a range of key measurement indicators are typically rigorously recorded and reported to the satisfaction of related parties.

However, the same criteria cannot be uniformly applied to all FSRU as the

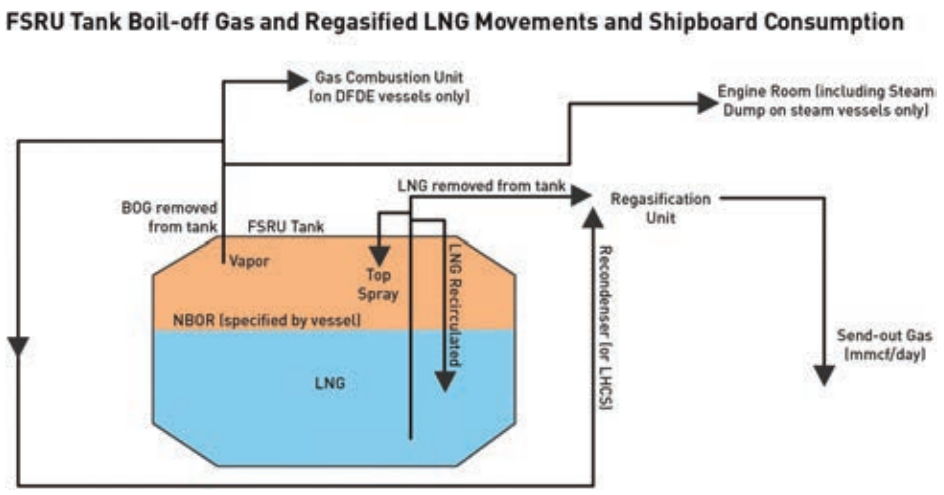

Figure 1: Schematic showing gas movements and usages on board a modern FSRU (DFDE and steam type) that typically are fitted with a recondenser or latent heat capture systems (LHCS)

vessels include a range of technologies and equipment (e.g., with or without recondensers) and operate in widely different conditions.

FSRU employing open-loop-seawater regasification technology (i.e., using as heating media seawater taken onboard used to regasify the LNG and then returned in a colder state to the sea) will involve much less gas consumptions compared to FSRU that operate closed-loop regasification technologies (where a fixed quantity of water is recirculated in a closed loop and heated to a necessary temperature by steam).

The latter regasification technology involves significant gas consumption to provide the necessary heat input. The open-loop FSRU cannot operate in locations where seawater is less than 14º to 15ºC. Closed loop FSRU can operate in any seawater temperature conditions, but are relatively more expensive than open-loop systems in places with warm seawater (i.e., they are economically less attractive, yet have no impact on marine life, in contrast to open loop systems).

DFDE FSRUs consume less gas than steam-powered FSRU, if they are operating in open-loop regasification mode.

Consequently, the performance criteria and measurements must be established for each FSRU individually, and take into consideration the operating conditions relevant to its specific location.

New parameter

This focus of this article is not about establishing better ways to record the cargo performance measurements in typical current use, but rather to suggest an additional, distinct monitoring metric for FSRU that is typically overlooked, but is highly relevant to shipboard gas consumption and cargo losses.

This measure relates to the gas consumed in the gas combustion unit (GCU) or steam dump (SD) equipment which can often identify avoidable loss of cargo during FSRU operations and help to prevent such loss.

This measure does not relate directly to measurements of gas-sales quantities delivered (usually measured in energy terms, e.g., millions of British thermal units, or in volume terms, e.g., standard cubic metres), but to more detailed monitoring of shipboard use of boil-off gas from the tanks of the FSRU, and to identify gas loss in that context.

Monitoring typically compares the total BOG consumption with the gas consumption contracted for an FSRU. Ideally, it should consist only of BOG used to run the FSRU, but in practice there is often an additional BOG consumption in the GCU/SD designated as used "for safety reasons". Such a designation is only appropriate if the tank pressure is imminently about to rise above the safe operating pressure range for the tank, as specified by the tank manufacturer. Often the GCU/SD consumption is said to be "for safety reasons", when the tank pressure remains well within safe operating pressure limits; yet that consumption cannot be justified "for safety reasons", because the safety threat is not immediate.

To differentiate, cargo "loss" is considered as BOG disposed of in the FSRU's GCU or SD or similar safety equipment without a justified reason (i.e., there is no immediate safety threat and the decision to consume gas in the GCU is due to poor / misguided practices by shipboard operators). Eliminating such avoidable loss reduces BOG consumption and inevitably improves FSRU performance. Gas preserved in this way may be used for benefit as regasification fuel / power production on the FSRU, or recondensed and sent ashore as send-out gas (Figure 1).

Recommended efficiency check

It is therefore recommended that FSRU conduct more rigorous monitoring that incorporates an additional separate check of the usage of GCU or steam dump equipment and gas consumption associated with that usage with reference to tank pressure at the time (i.e. when was the GCU steam dump in use, hourly record of that usage and tank pressures, and record of boil-off gas consumed in the engine room before and during GCU/steam dump use).

Such monitoring can determine whether the FSRU is operating as efficiently as possible (i.e., no cargo "lost") and providing the best service to the charterer by avoiding any unnecessary cargo losses, even if such losses were within the specified NBOR or other monitoring values.

Experience suggests that unnecessary cargo consumption in the GCU can range between US$ 0.5 million and US$ 1.5 million annually of equivalent cargo value, depending on the FSRU design and degree of technological operating inefficiency.

Often, the outcome passes un-noticed, as it is typically included in the total (or summary) BOG consumption reported and usually remains within the guaranteed maximum contracted BOG consumption limit. Namely, it may be within the NBOR and regasification fuel limits (i.e., BOG mass as a percentage of cargo mass regasified, which varies between about 0.5% to 2 %, depending upon the type of regasification equipment used).

It is necessary to clarify that not all gas consumption in the GCU and steam dump equipment should be categorized as "lost" gas. "Lost gas" in this context means gas consumption that could have been saved and subsequently sold as send-out gas or used for power generation on the ship (i.e., a positive use). Often the total BOG consumption in the GCU/SD equipment consists in part that disposed of for obvious safety reason, and, in part also, due to over-consumption by the operator.

Main Challenge

The challenge is to distinguish between two key reasons for gas consumed in the GCU and steam dump equipment: (1) gas "consumed for safety reasons"; and, (2) gas "lost as result of poor operating practice(s) adopted".

It is often not possible to definitively allocate all gas consumed in the GCU or steam dump equipment to one or other of these two gas consumption categories, but for the most part a distinction can be made, as the following five cases explain.

As certain examples reveal, it is particularly difficult to establish precisely the quantity of boil-off gas "loss" to attribute to excessive GCU/steam dump equipment usage in some cases, but it is qualitatively easy to establish whether it involved loss or not, and to estimate the magnitude of identified losses. ■

In next month's "LNG Journal" we will look at particular cases in Part II of "Improved monitoring onboard FSRUs is required to Enhance operating performance and reduce cargo losses" by David A. Wood and Maksym Kulitsa, FSRU consultant.

About the Authors

Maksym Kulitsa is an FSRU onboard operator with more than eight years of experience on different regasification systems and at various terminals. FSRUs are a relatively recent addition to the LNG industry and he has some expertise in optimizing or fine-tuning FSRU-related operations with regard to particular ship designs and operating conditions.

David A. Wood is the Principal Consultant of DWA Energy of the UK, specializing in the integration of technical, economic, fiscal, risk and strategic information to aid project planning decisions. He has more than 35 years of international oil and gas experience, with companies including Phillips Petroleum and Amoco, spanning project operations, technical evaluations and senior management.

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FUELING THE FUTURE

Questions raised by Japan's competition regulator on LNG destination clauses in supply contracts

Eric W. Sedlak, Steven C. Sparling and Tsuguhito Omagari of international law firm K&L Gates

The Japan Fair Trade Commission (JFTC), Japan's competition regulator, recently published results of an investigation into destination restrictions in liquefied natural gas ("LNG") supply contracts.

The results of the investigation were published in a report on June 28, 2017, entitled "Survey on LNG Trades.

The JFTC appears to have undertaken the preparation of the Report in response to changing market conditions, where an increase in LNG supply (and suppliers) and the associated drop in prices could make inflexible long-term contracts unattractive to buyers, including in Japan, which consumed approximately 34% of the world's LNG in 2015.

Relevance

The market view, however, is that Japanese buyers probably have contracted for LNG in excess of their needs in the short and medium term, making the enforceability of destination clauses of paramount relevance.

Destination restriction clauses prohibit the buyer under an LNG sale and purchase agreement from redirecting or reselling the LNG in any particular cargo.

Japanese electrical utilities in particular believe that the clauses unfairly disadvantage them, because they are less able to react quickly to changes in the domestic generation mix, where coal has taken over much of the baseload from nuclear, and where renewables, solar in particular, have an increasing market share.

Destination restriction clauses also make the buyers less nimble in the face of price changes (which from the sellers' perspective, is precisely the point -- any windfall should accrue to the seller).

The Report, while not having the force of law, indicates that JFTC generally takes a dim view of arrangements whereby a seller limits the flexibility of a buyer to resell a product. Looked at cynically, the JFTC has signaled that it intends to treat LNG destination restriction clauses much like it does resale price maintenance undertakings for retail goods, notwithstanding the complexity, exceptionally high capital costs and peculiarities of the global LNG market.

Views

JFTC's views, largely in its own words, as set forth in the approved but unofficial English version of the Report, are as follows:

Not surprisingly, much of the concern has revolved around whether JFTC's positions are intended to have retrospective effect, which could of course imply the possibility of forced renegotiation of LNG sale and purchase agreements.

Fixed-Term FOB Contracts: A key takeaway is that JFTC believes that no destination restriction in a fixed-term FOB contract is compliant. JFTC believes that the passage of title to the buyer at the flange at the port of loading strongly supports the position that any attempt to contractually restrict sales after that point is anticompetitive.

Fixed-Term DES Contracts: JFTC's views on destination restriction clauses in fixed-term DES contracts are more nuanced. JFTC believes that clauses whose purpose is to define a delivery point would be compliant, and if the provision requires seller's consent to diversion (as long as the seller's consent my not be unreasonably withheld), then the provision may be compliant.

If seller's consent is required even if buyer can demonstrate the need for the change and a reasonable basis fair necessity and reasonableness; however, then JFTC believes that the consent requirement could have an anticompetitive effect. In particular, if consent is conditioned on the buyer agreeing to or imposing competition-restraining requirements, then JFTC believes that the provision would be non-compliant.

Profit-Sharing Clauses: Profit-sharing clauses whereby a seller requires compensation in the form of a profit share from a resale of the cargo in exchange for the seller's consent to diversion are in principle permissible but may be questioned if the seller's share is particularly high (the commentary suggests that 50% would be appropriate, in particular if the seller contributed in some way to achieving the profit) or if the buyer will feel constrained from reselling because of a reluctance to disclose the cost structure or terms of sale. A contract that does not require the buyer to provide a breakdown of resale costs is "desirable."

Provision	Specific Concepts	Position Under the Antimonopoly Act
Destination clauses in Fixed-Term Free On Board ("FOB") Contracts		Highly likely to be in violation
	Providing profit share clause	Not considered as reasonable; highly likely to be in violation
Destination clauses in Fixed-Term Deliver Ex Ship ("DES") Contracts	If in order to define a delivery point	Not in itself problematic
	If a provision is included to require "seller's consent" to diversion or the provision of the requirements of "fairly necessity [sic]" and reasonableness to diversion	Not in itself problematic
	If seller's consent is required even if fair necessity and reasonableness are demonstrated	A refusal is likely to be in violation
	When a seller, on an operational or contractual basis, requests competition-restraining requirements for diversion	Highly likely to be in violation
	Providing a profit share clause when a seller requires from a buyer compensation in exchange for giving consent on a diversion of contract requirements (destination) according to a request from the buyer and for an agreement to allow them to resale	Cannot be said that it is unreasonable; not in itself problematic
	When a profit share clause contributes to unreasonable profit sharing with a seller: (i) by setting a high percentage of the resale profit without properly considering seller's actual contribution to resale or by using a gross profit as a resale profit; or (ii) when such clauses have some effects to prevent a buyer from reselling due to a seller's request for the disclosure of the profit or cost structure	Likely to be in violation
Disclosure of information regarding resale	When clauses requiring disclosure of information regarding resale have the effect of "prevent[ing] a buyer from reselling due to a seller's request for the disclosure of the profit or cost structure"	Likely to be in violation
	When seller does not require a breakdown of resale costs in detail and evidence therefor, and information sharing is minimized	Therefore, it is desirable
Take or Pay	When a seller's bargaining position is superior to that of a buyer and the seller unilaterally imposes Take or Pay clauses and strict minimum purchase obligation without sufficient negotiation with the buyer even after the seller has already got sufficient return for initial investment, strict minimum purchase obligation as well as providing Take or Pay clauses	Likely to be in violation

It is odd for a competition regulator to step into the contractual relationship on the basis of an unusual statutory scheme (note that determining the existence of "superior bargaining position" is more difficult than establishing the existence of market dominance, a more common measure) in an arrangement where the power dynamics are difficult to evaluate.

Take or Pay: Take or pay provisions are very common in long-term supply contracts. Sellers often have high fixed costs and even variable costs that must be locked in for long periods of time, such as multiple year charter parties. Technical, efficiency, and yield considerations may dictate that production continue at predictable levels for extended periods of time.

Substantial parties

In many LNG contracts, both buyer and seller are substantial parties, and while a national oil company may have a "superior" position in relation to its own reserves, and a utility may similarly have substantial buying power in its home market, both parties are at some level competing against dozens of buyers and sellers in a worldwide market.

There has been a good bit of speculation as to both market reaction and future JFTC action. Many sellers hope or believe that JFTC will apply the principles prospectively. Shinji Kakiuchi, Director of JFTC's Trade Practice Research Office, said that JFTC would consider on a "case-by-case" basis whether to take punitive action.

some LNG buyers believe that, at minimum, FOB contracts will be "destination free"

Two months on, the market has had an opportunity to ponder the implications. First, sellers take solace, and buyers no doubt feel a bit of disappointment, that this announcement was not binding but was only intended as a suggestion.

METI, the Japanese Ministry of Economy, Trade and Industry, which may have played a role in initiating and supplying material for the Report, wants to "show its attitude" to LNG suppliers: "We will strongly support this policy as being in Japan's national interest."

Through their reading of the likely approach to be taken by JFTC and other Japanese government actors, at least some LNG buyers believe that, at minimum, FOB contracts will be "destination free".

Questions

Whether prospectively or retrospectively remains an open question. LNG suppliers, of course, have reacted with dismay, to say the least, believing that it is unfair for JFTC to question contracts entered into at arm's length between sophisticated parties by effectively prescribing that what they see as an unfair "destination free" provision.

Notwithstanding the risks the sellers have taken in incurring enormous capital costs, in their view, buyers would reap any windfall profits.

Market chatter suggests that the major players are pleased with this development. Medium and small sized players, however, worry that requiring flexibility on resale this clause will alter the balance in their negotiations with suppliers, who will demand higher prices or margins in the spreads to factor in the possibility that their customers will reap the benefit of any resale.

Concern remains about whether and how JFTC will take action. Perhaps JFTC was simply trying to send a message and hopes that, given the possible use of its enforcement powers, counterparts of Japanese LNG buyers will "voluntarily" modify existing contracts and accept Antimonopoly Act-compliant terms in the future. In the meanwhile, a fuel mix mismatch will likely persist among Japanese power generators and industrial users.

JFTC's Key Findings

Fixed-Term FOB Contracts: "The restrictions on diversion as well as providing destination clauses are highly likely to be in violation of the Antimonopoly Act (Unfair Trade Practices: Trading on Restrictive Terms), because its necessity and reasonableness under an FOB contract is less likely to exist than that under a DES contract."

Fixed-Term DES Contracts: "...providing destination clauses in a fixed-term DES contract in order to define a delivery point is not in itself problematic under the Antimonopoly Act."

" ....under a fixed-term DES contract, the provision to require "seller's consent" to diversion or the provision of the requirements of fairly necessity [sic] and reasonableness to diversion are not in itself problematic under the Antimonopoly Act."

"However, in the operation of such requirements, even if a buyer's request meets any requirements of necessity and reasonableness from a seller, when the seller refuses its consent to diversion, such refusals are likely to be in violation of the Antimonopoly Act (Unfair Trade Practices: Trading on Restrictive Terms)."

"When a seller, on an operational or contractual basis, requests competition restraining requirements for diversion, such requirements are highly likely to be in violation of the Antimonopoly Act (Unfair Trade Practices: Trading on Restrictive Terms)."

Profit Share Clauses

Under FOB Terms: "...under a fixed-term FOB contract, in general, as providing profit share clauses is not considered as reasonable, providing profit share clauses is highly likely to be in violation of the Antimonopoly Act (Unfair Trade Practices: Trading on Restrictive Terms)."

Necessity and Reasonableness of Profit-Sharing Clauses Under DES Terms: "...it cannot be said that it is unreasonable for a seller to require from a buyer compensation in exchange for giving consent on a diversion of contract requirements (destination) according to a request from the buyer and for an agreement to allow them to resale under a DES contract. Providing profit share clauses is not in itself problematic under the Antimonopoly Act."

"However, when such clauses contribute to unreasonable profit sharing with a seller, (i) by setting a high percentage of the resale profit without properly considering seller's actual contribution to resale or by using a gross profit as a resale profit ((A) below), or (ii) when such clauses have some effects to prevent a buyer from reselling due to a seller's request for the disclosure of the profit or cost structure ((B) below), these are likely to be in violation of the Antimonopoly Act (Unfair Trade Practices: Trading on Restrictive Terms)."

Disclosure of information regarding resale: "...when clauses requiring disclosure of information regarding resale have the effect of "prevent[ing] a buyer from reselling due to a seller's request for the disclosure of the profit or cost structure, such a request is likely to be in violation of the Antimonopoly Act. (Unfair Trade Practices: Trading on Restrictive Terms).

"Therefore, it is desirable that, at least, a seller should not require a breakdown of resale costs in detail and its evidence, and sharing information should be minimized."

Take or Pay: "...when a seller's bargaining position is superior to that of a buyer and the seller unilaterally imposes Take or Pay clauses and strict minimum purchase obligation without sufficient negotiation with the buyer even after the seller has already got sufficient return for initial investment, strict minimum purchase obligation as well as providing Take or Pay clauses are likely to be in violation of the Antimonopoly Act (Unfair Trade Practices: Abuse of Superior Bargaining Position)" ■

Spring-energized seals form critical thermoplastic parts to make difference in cryogenic valves for transfers

Christophe Valdenaire, Global Market Manager O&G, Saint-Gobain Seals

Driven by industry standards, strict regulations and end user demands, manufacturers of cryogenic valves and transfer equipment are faced with the daunting responsibility of finding sealing solutions that cope with low leakage challenge requirements while lowering operating costs.

One of the biggest challenges is achieving reliable sealing with liquefied gasses.

Conventional sealing materials such as elastomers cannot be used because of their inability to maintain consistent viscoelasticity properties.

Standards

At extremely low temperatures - below glass transition temperature - elastomers become brittle and may crack. As a result, several O&G industry standards restrict the use of elastomers in fluid handling equipment when operating temperature reaches below -29°C.

Polymer spring-energised seals, commonly called "PTFE lip seals" (Figure 1) due to seal lips loading against the mating hardware, then became an alternative sealing solution for reliable and long-lasting performance in cryogenic operating conditions due to chemical compatibility, pressure, temperature, friction and high-speed dynamics.

Saint-Gobain Seals was the first company with this solution upon introduction of their OmniSeal® RACO™ seal (Figure 2) in the mid-1950s at the start of the NASA space program.

Since this time, the company has improved performance of these seals to serve a wider variety of applications in extreme environments, which became ideal for cryogenic valves and transfer equipment serving the LNG value chain (Figure: 3): export and import terminals, carriers and bunkering

To further save manufacturers of cryogenic valves and transfer equipment downtime and cost by using pre-validated sealing solutions, Saint-Gobain Seals created a cryogenic platform consisting of a transversal R&D project that involved their material scientists at worldwide research sites, their local application testing team at the Belgium facility, global application engineering teams, and customers.

The main objectives of the project were to investigate chemical composition and behaviour of thermoplastic materials when exposed to cryogenic temperature and optimise the seal design of polymer lip seals by FEA virtual simulation and internal testing campaign compliant with industry standards to pre-validate designs as close as possible to the end applications.

To validate the performance of such sealing solutions, material models were developed to capture thermo-mechanical behaviour of thermoplastics at -196°C.

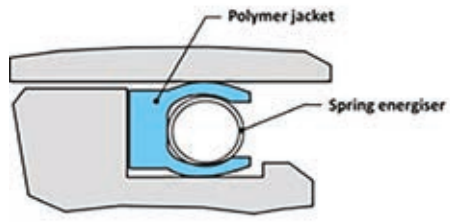

Figure. 1: PTFE lip seals are spring actuated, pressure assisted sealing devices consisting of a polymer jacket encapsulating a corrosion-resistant, metallic spring-energiser

Figure 2: OmniSeal® RACO™

Why were thermoplastic materials used in this project? With new developments of space, superconducting, electronic and defense technologies as well as large cryogenic engineering projects, thermoplastic materials' use in cryogenic environments have increased significantly. In these applications, thermoplastics must withstand severe cryogenic environment and thermal cycling; therefore, mechanical and physical properties of thermoplastics are critical parameters for determining the applicability of polymers for use in these severe environments.

Saint-Gobain Seals considered two applications with facial and radial sealing configurations presenting major technical gaps in current sealing solutions.

1. Single-Piston Effect Seat Seals for Cryogenic Trunnion-Mounted Ball Valves (Fig. 4)
2. Primary Face Seals for Cryogenic rotary swivels used in Marine Loading (Fig. 5)

For cryogenic trunnion-mounted ball valves, the global seat leak rate performance is governed by several industry and IOC standards: BS6364, ISO 28921-2, Total GS EP PVV 150 and Shell MESC SPE 77-300. To date, manufacturers of these specific ball valves are struggling to meet the above strict seat leakage performance standards. For cryogenic loading arms, there are several standards containing requirements applicable to rotary swivels: ISO 16904 and EN 1474.

These two applications present several sealing challenges when designing PTFE lip seals for cryogenic conditions:

- Control of the seal hardware interface vs. shrinkage
- Seal should be flexible to cope with misalignment or surface deflection that may occur in dynamic oscillating motion for swivels
- Seal should be forgiving and able to maintain low leakage rate, below the max allowed by standards with a wide range of counter surface roughness
- Seal should generate low friction. For cryogenic trunnion-mounted ball valves, seat in SPE configuration must be free to move for over-pressure body cavity relief
- Seal should be easy to install for radial sealing
- Some of the industry specifications (i.e. SHELL MESC SPE 77-300)

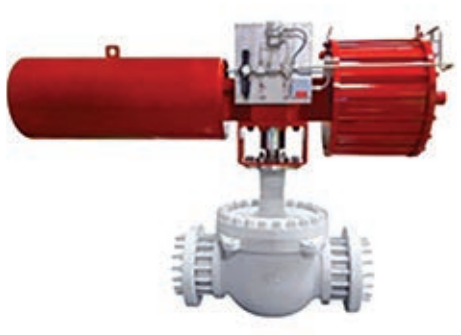

Fig. 4: Cryogenic Top Entry Trunnion-Mounted Ball Valve 14" 600 (photo courtesy from IMI Truflo Rona)

Fig. 5: Marine Loading Arms at LNG Jetty (photo courtesy from Oman LNG)

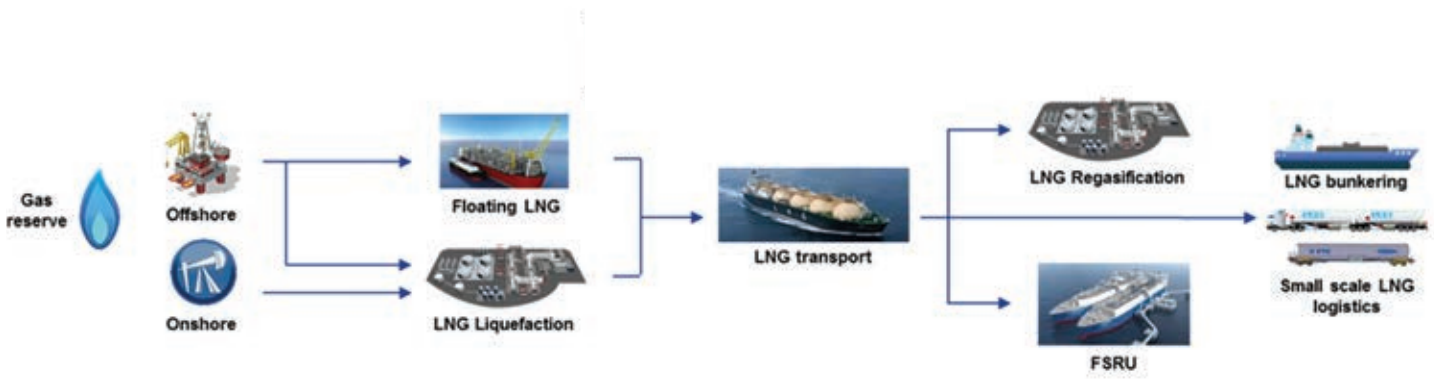

Fig 3: LNG value chain

require pre-heating cycle at 120°C or 150°C that does not allow to use of conventional polymers for cryogenic applications

- Ranging from -196°C to +150°C
- Up to class 2500 (420 bar)
- Able to cope with 0.4mm misalignment of valve trim
- Can work with roughness of hardware sealing surface of Ra 0.2-0.4µm
- No need to modify the existing hardware. No additional parts required.
- Cost effective design rules have been defined by pressure class, temperature and size. ■

Using a unique and proprietary FEA thermo-mechanical simulation tool, Saint-Gobain Seals first evaluated several materials, including newly developed formulations, and studied hardness, tensile strength, modulus, elongation at break, thermal expansion, and thermal conductivity from -196°C up to +150°C. Material models were created including features such as elasticity, visco-plasticity and temperature dependency to study the evolution of interaction between sealing force and contact length with the hardware.

Secondly, in a parametric study, several seal designs were tested on mock-ups utilizing their unique modular cryogenic test rig: pressure up to 420bar He and temperatures from -196°C up to +150°C. For each parameter (jacket profiles, springs and hardware conditions and cooling down procedures), tests were conducted to understand leakage impact in order to identify factors that could affect sealing performance. The extensive test program resulted in pre-validation of a new generation of lip seals in full accordance with the most stringent LNG industry specification for cryogenic trunnion-mounted ball valves and rotary swivels in marine loading arms as Saint-Gobain Seals was not able to measure any leakage through the flow meter.

The data collected for a wide range of pressure and temperature through FEA and application testing on many parameters also provided a much better understanding of their interaction.

Some of the benefits of using this new design with thermoplastic material:

World LNG Carrier Fleet

LNG carrier	Capacity m^3	Owned or Ordered by	Builder	Delivery Date	Flag	Power Plant	Cargo System	No. of tanks	Ship built for Export plant
Aamira	266,000	QGTC	Samsung	Dec-10	Liberia	DRL	TZ Mk. III	5	Qatargas IV
Abadi	135,000	Brunei Gas Carriers	Mitsubishi Nagasaki	Jun-02	Brunei	S	Moss	5	Brunei LNG
Abalamabie	174,900	Bonny Gas	Samsung	June-16	Bermuda	DFDE	TZ Mk III	4	Nigeria LNG
Adam LNG	162,000	Oman LNG	Hyundai	Dec-14	Marshall Is.	DFDE	TZ Mk. III	4	Oman LNG
Al Aamriya	210,100	J5 Consortium	Daewoo	Feb-08	Marshall Is.	DRL	GT NO 96	4	Qatargas
Al Areesh	151,700	Teekay LNG	Daewoo	Jan-07	Qatar	S	GT NO 96	4	Ras Gas II
Al Bahiya	266,000	QGTC	Samsung	Oct-09	Liberia	DRL	TZ Mk. III	5	Qatar-Atlantic
Al Biddah	135,275	J4 Consortium	Kawasaki Sakaide	Nov-99	Japan	S	Moss	5	Qatargas
Al Daayen	151,700	Teekay LNG	Daewoo	Apr-07	Qatar	S	GT NO 96	4	RasGas II
Al Dafna	266,000	QGTC	Samsung	Oct-09	Marshall Is.	LR DRL	GT NO 96	4	Qatar-Atlantic
Al Deebel	145,000	Peninsular LNG	Samsung	Dec-05	Bahamas	S	TZ Mk. III	4	Qatargas
Al Gattara	216,200	OSG/Nakilat	Hyundai	Oct-07	Marshall Is.	DRL	TZ Mk. III	4	Qatargas II
Al Ghariya	210,100	ProNav	Daewoo	Feb-08	Bahamas	DRL	GT No. 96	4	Qatargas
Al Gharaffa	216,200	OSG/Nakilat	Hyundai	Jan-08	Marshall Is.	DRL	TZ Mk. III	4	Various
Al Ghashamiya	216,000	QGTC	Samsung	Mar-09	Liberia	DRL	TZ Mk. III	4	Qatar-Atlantic Basin
Al Ghuwairiya	261,700	QGTC	Daewoo	Aug-08	Marshall Is.	DRL	GT NO. 96	5	Qatar-Atl'c Basin
Al Hamla	216,000	OSG	Samsung	Feb-08	Marshall Is.	DRL	TZ Mk. III	4	QatarGas
Al Hamra	137,000	National Gas Shipping	Kvaerner-Masa	Jan-97	Liberia	S	Moss	4	ADGAS
Al Huwaila	217,000	Teekay	Samsung	May-08	Bahamas	DRL	TZ Mk. III	4	RasGas III
Al Jasra	137,100	J4 Consortium	Mitsubishi Nagasaki	Jul-00	Japan	S	Moss	5	Qatargas
Al Jassasiya	145,700	Maran-Nakilat	Daewoo	May-07	Greece	S	GT No 96	4	RasGas
Al Kharaitiyat	216,200	QGTC	Hyundai	May-09	Liberia	DRL	TZ Mk. III	4	Qatargas III
Al Kharaana	210,000	QGTC	Daewoo	Oct-09	Marshall Is.	DRL	GT NO 96	4	Qatargas IV
Al Kharsaah	217,000	Teekay	Samsung	May-08	Bahamas	DRL	TZ Mk. III	4	RasGas III
Al Khattiya	210,000	QGTC	DSME	Oct-09	Marshall Is.	DRL	GT No. 96	4	Qatargas IV
Al Khaznah	135,500	National Gas Shipping	Mitsui Chiba	Jun-94	Liberia	S	Moss	5	ADGAS
Al Khor	137,350	J4 Consortium	Mitsubishi Nagasaki	Dec-96	Japan	S	Moss	5	Qatargas
Al Khuwair	217,000	Teekay LNG	Samsung	Jul-08	Korea	DRL	TZ Mk. III	4	RasGas
Al Mafyar	266,000	OSG/Nakilat	Hyundai	Oct-07	Marshall Is.	DRL	TZ Mk. III	4	Qatargas II
Al Marrouna	151,700	Teekay	Daewoo	Nov-07	Bahamas	S	GT NO 96		Ras Gas I
Al Mayeda	266,000	QGTC	Samsung	Jan-09	Liberia	DRL	TZ Mk. III	5	Qatar-US/Var.
Al Nuaman	210,000	QGTC	DSME	Dec-09	Marshall Is.	DRL	GT No. 96	4	Qatargas IV
Al Oraiq	210,000	J5 Consortium	Daewoo	Apr-08	Marshall Is.	DRL	GT No. 96	4	Various
Al Rayyan	135,360	J4 Consortium	Kawasaki Sakaide	Mar-97	Japan	S	Moss	5	Qatargas
Al Rekayyat	216,200	QGTC	Hyundai	Jun-09	Bahamas	DRL	TZ Mk.III	4	Qatar-Atlantic
Al Ruwais	210,100	ProNav	Daewoo	Nov-07	Germany	DRL	GT NO 96	4	Qatargas II
Al Sadd	210,100	QGTC	Daewoo	Mar-09	Liberia	DRL	GT NO 96	4	Qatar-Atlantic Basin
Al Safliya	210,100	ProNav	Daewoo	Dec-07	Bahamas	DRL	GT NO 96	4	Qatargas II
Al Sahla	216,200	J5	Hyundai	Jun-08	Japan	DRL	TZ Mk. III	4	Ras Gas III
Al Samriya	261,700	QGTC	Daewoo	Sep-08	Marshall Is.	DRL	GT NO. 96	5	Qatargas II
Al Sheehaniya	210,100	QGTC	Daewoo	Feb-09	Liberia	DRL	GT NO 96	4	Qatar-Atlantic Basin
Al Shamal	217,000	Teekay LNG	Samsung	Jun-08	Qatar	DRL	TZ Mk. III	4	RasGas
Al Thakhira	145,000	Peninsular LNG	Samsung	Sep-05	Bahamas	S	TZ Mk. III	4	Qatargas
Al Thumama	216,000	J5 Consortium	Hyundai	Apr-08	Japan	DRL	TZ Mk. III	4	Rasgas
Al Utouriya	215,000	J5	Hyundai	Sep-08	Panama	DRL	TZ Mk. III	4	RasGas
Al Utourma	215,000	J5	Hyundai	Sep-08	Panama	DRL	TZ Mk. III	4	Ras Gas III
Al Wajbah	137,350	J4 Consortium	Mitsubishi Nagasaki	Jun-97	Japan	S	Moss	5	Qatargas
Al Wakrah	135,360	J4 Consortium	Kawasaki Sakaide	Dec-98	Japan	S	Moss	5	Qatargas
Al Zhubarah	137,570	J4 Consortium	Mitsui Chiba	Dec-96	Japan	S	Moss	5	Qatargas
Alto Acrux	147,000	LNG Marine Transport	Mitsubishi	Mar-08	Bahamas	S	Moss	4	Various
Amali	148,000	Brunei-Shell	DSME	Jul-11	Brunei	DFDE	GT No. 96	4	Brunei LNG
Amanl	154,800	Brunei-Shell	Hyundai	Nov-14	Brunei	DFDE	TZ Mk. III	4	Brunei LNG
Aman Bintulu	18,928	Perbadanan / NYK Line	NKK Tsu	Oct-93	Malaysia	S	TZ Mk. III	3	Petronas
Aman Hakata	18,800	Perbadanan / NYK Line	NKK Tsu	Nov-98	Malaysia	S	TZ Mk. III	3	Petronas
Aman Sendai	18,928	Perbadanan / NYK Line	NKK Tsu	May-97	Malaysia	S	TZ Mk. III	3	Petronas
Arctic Aurora	160,000	Dynagas	Hyundai	Jul-13	Marshall Is.	DFDE	TZ Mk. III	4	Various
Arctic Discoverer	140,000	K Line	Mitsui Chiba	Jan-06	Bahamas	S	Moss	4	Various
Arctic Lady	147,200	MOL/Hoegh LNG	Mitsubishi Nagasaki	Apr-86	Norway	S	Moss	4	Various
Arctic Princess	147,200	MOL/Hoegh LNG	Mitsubishi Nagasaki	Jan-06	Norway	S	Moss	4	Various
Arctic Sun	89,880	Arctic LNG Shipping	IHI Chita	Dec-93	Liberia	S	IHI SPB	4	ConocoPhillips/Marathon
Arctic Voyager	140,000	K Line	Kawasaki	Jul-06	Bahamas	S	Moss	4	Statoil
Arkat	148,000	Brunei-Shell	DSME	Feb-11	Brunei	DFDE	GT. No. 96	4	Brunei LNG
Arwa Spirit	165,000	Teekay LNG	Samsung	Sep-08	Marshall Is.	DFDE	TZ Mk. III	4	Various
Aseem	154,850	K Line-Petronet	Samsung	Nov-09	Malta	S	GT No 96	4	Qatar-India
Asia Endeavour	160,000	Chevron	Samsung	Dec-14	Bahamas	DFDE	TZ Mk. III	4	Various
Asia Energy	160,000	Chevron	Samsung	Sept-14	Bahamas	DFDE	TZ Mk. III	4	Various
Asia Excellence	160,000	Chevron	Samsung	Sept-13	Bahamas	DFDE	TZ Mk. III	4	Various
Asia Vision	160,000	Chevron	Samsung	June-14	Bahamas	DFDE	TZ Mk. III	4	Various
Barcelona Knutsen	173,400	Knutsen	Daewoo	May-10	N.I.S.	DFDE	GT NO 96	4	Various
Bebatic	75,060	Brunei Shell Tankers	Atlantique	Oct-72	Brunei	S	TZ Mk. I	6	Brunei LNG
Beidou Star	172,000	MOL	Hudong	Oct-15	Hong Kong	DRL	GT NO. 96	4	Various
Berge Arzew	138,088	BW Gas	Daewoo	Jul-04	Norway	S	GT NO 96	4	Sonatrach
BW GDF-Suez Boston	138,059	BW Gas	Daewoo	Jan-03	Norway	S	GT NO 96	4	Suez LN
BW GDF Suez Everett	138,028	BW Gas	Daewoo	Jun-03	Norway	S	GT NO 96	4	Suez LNG
BW Integrity	170,000	BW Gas	Samsung	May-17	Singapore	DFDE	TZ Mk. III	4	FSRU
BW Pavilion Leeara	161,880	BW Gas	Hyundai	Feb-15	Singapore	DFDE	TZ Mk. III	4	Various
BW Pavilion Vanda	161,880	BW Gas	Hyundai	Feb-15	Singapore	DFDE	TZ Mk. III	4	Various
BW Singapore	170 000	BW Gas	Samsung	May-15	Singapore	DFDE	TZ Mk. III	4	FSRU
BW Suez Paris	162,400	BW Gas	Daewoo	May-09	N.I.S.	DFDE	GT NO 96	4	Yemen-Atlantic
Bilbao Knutsen	138,000	Knutsen / Marpetrol	IZAR Sestao	Jan-04	Spain	S	GT NO 96	4	Atlantic LNG
Bilis	77,730	Brunei Shell Tankers	La Seyne	Mar-75	Brunei	S	GT NO 82	5	Brunei LNG
Bishu Maru	162,000	K Line-Transpacific	Kawasaki Sakaide	Dec-15	Panama	S	Moss	4	Australia-Japan
British Diamond	155,000	BP Shipping	Hyundai	Sep-08	IOM	DFDE	TZ Mk. II	4	Indonesia-Various
British Emerald	155,000	BP Shipping	Hyundai	Jun-07	UK	DFDE	TZ Mk. III	4	Tangguh LNG
British Innovator	138,200	BP Shipping	Samsung	Jul-03	Isle of Man	S	TZ Mk. III	4	Various

British Merchant	138,000	BP Shipping	Samsung	Apr-03	Isle of Man	S	TZ Mk. III	4	Various
British Ruby	155,000	BP Shipping	Hyundai	Jan-08	U.K.	DFDE	TZ Mk. III	4	Various
British Sapphire	155,000	BP Shipping	Hyundai	Sep-08	IOM	DFDE	TZ Mk. III	4	Tangguh
British Trader	138,000	BP Shipping	Samsung	Dec-02	Isle of Man	S	TZ Mk. III	4	Engas
Broog	135,466	J4 Consortium	Mitsui Chiba	May-98	Japan	S	Moss	5	Qatargas
Bu Samara	266,000	QGTC	Samsung	Dec-08	Qatar	DRL	TZ Mk. III	5	Qatargas
BW Suez Paris	162,400	BW Gas	Daewoo	May-09	N.I.S.	DFDE	GT NO 96	4	Yemen-Atlantic
BW Suez Brussels	162,400	BW Gas	Daewoo	May-09	N.I.S.	DFDE	GT NO 96	4	Yemen-Atlantic
Cadiz Knutsen	138,826	Knutsen / Marpetrol	IZAR Puerto Real	Jun-04	Spain	S	GT NO 96	4	Engas
Castillo de Santisteban	173,600	Elcano	STX	Aug-10	Malta	S	GT NO. 96		Various
Castillo de Villalba	138,000	Elcano	IZAR	Nov-03	Spain	S	GT NO 96	4	Sonatrach
Catalunya Spirit	138,000	Teekay LNG Partners	IZAR Sestao	Mar-03	Liberia	S	GT NO 96	4	Atlantic LNG
Celestine River	145,000	KLNG	Kawasaki	Dec-07	Bahamas	S	Moss		Various
Cesi Beihai	174,100	MOL-China LNG	Hudong	June-17	Hong Kong	S	GT No 96	4	Australia-China
Cesi Gladstone	174,100	MOL-China LNG	Hudong	Oct-16	Hong Kong	S	GT No 96	4	Australia-China
Cesi Qingdao	174,100	MOL-China LNG	Hudong	Nov-16	Hong Kong	S	GT No 96	4	Australia-China
Cesi Tianjin	174,100	MOL-China LNG	Hudong	Sept-17	Hong Kong	S	GT No 96	4	Australia-China
Cheikh Bouamama	75,500	Skikda LNG Transport	USC	Jul-08	Bahamas	S	TZ Mk. III	4	Sonatrach
Cheikh El Mokrani	75,500	Med LNG Corp	USC	Jun-07	Bahamas	S	TZ Mk. III	4	Sonatrach
Christophe de Margerie	172,600	SCF	Daewoo	Nov-16	Cyprus	DFDE	GT NO 96	4	Various
Clean Energy	150,000	Dynagas	Hyundai	Mar-07	Marshall Is.	S	TZ Mk. III	4	Various
Clean Force	150,000	Dynagas	Hyundai	Jan-08	Marshall Is.	S	TZ Mk. III	4	Various
Clean Ocean	155,900	Dynagas	Hyundai	Mar-14	Marshall Is.	DFDE	TZ Mk. III	4	Various
Clean Planet	155,900	Dynagas	Hyundai	Mar-14	Marshall Is.	DFDE	TZ Mk. III	4	Various
Clean Vision	160,000	Dynagas	Hyundai	Jun-15	Marshall Is.	DFDE	TZ Mk. III	4	Various
Cool Explorer	160,000	Thenamaris	Samsung	Oct-13	Bermuda	DFDE	TZ Mk. III	4	Various
Cool Runner	160,000	Thenamaris	Samsung	May-14	Bermuda	DFDE	TZ Mk. III	4	Various
Cool Voyager	160,000	Thenamaris	Samsung	Oct-13	Bermuda	DFDE	TZ Mk. III	4	Various
Corcovado LNG	160,106	TMSC Gas	Daewoo	Jun-14	Malta	TFDE	GT No 96	4	Various
Creole Spirit	174,000	Teekay	Daewoo	Jan-16	Bahamas	MEGI-DF	NO. 96 GW	4	Cheniere
Cubal	160,400	Mitsui/NYK/Teekay	Samsung	Jan-12	Bahamas	DFDE	TZ Mk. III	4	Various
Cygnus Passage	145,400	Cygnus LNG	Mitsubishi	Feb-09	Panama	S	Moss	4	Various
Dapeng Moon	147,000	China Ships	Hudong	Jul-09	China	S	GT NO 96	4	Various
Dapeng Star	147,000	China Ships	Hudong	Nov-09	China	S	GT NO 96	4	Various
Dapeng Sun	147,000	China Ships	Hudong	Jul-07	China	S	GT NO 96	4	Woodside Energy
Disha	136,000	Petronet LNG Ltd.	Daewoo	Jan-04	Malta	S	GT NO 96	4	Qatargas
Doha	137,350	J4 Consortium	Mitsubishi Nagasaki	Jun-99	Japan	S	Moss	5	Qatargas
Duhail	210,100	ProNav	Daewoo	Jan-08	Germany	DRL	GT NO 96	4	Various
Dukhan	135,000	J4 Consortium	Mitsui Chiba	Oct-04	Japan	S	Moss	4	Qatargas
Dwiputra	127,385	Humpuss Consortium	Mitsubishi Nagasaki	Mar-94	Bahamas	S	Moss	4	Pertamina
Ebisu	147,547	Golar LNG	Kawasaki	Sep-08	Bahamas	S	Moss	4	Various
Ejnan	145,000	4J	Samsung	Jan-07	Bahamas	S	TZ Mk. III		RasGas
Ekaputra	136,400	Humpuss Consortium	Mitsubishi Nagasaki	Jan-90	Liberia	S	Moss	5	Pertamina
Energy Advance	145,000	Tokyo LNG Tankers	Kawasaki Sakaide	Mar-05	Japan	S	Moss	4	Darwin
Energy Atlantic	159,924	Alpha	STX Jinhae	Sep-15	Malta	DFDE	No. 96	4	Various
Energy Confidence	155,000	Tokyo LNG Tankers	Kawasaki	Apr-09	Panama	S	Moss	4	Various
Energy Frontier	147,600	Tokyo LNG Tankers	Kawasaki Sakaide	Sep-03	Japan	S	Moss	4	Darwin
Energy Horizon	177,000	Tokyo LNG Tankers	Kawasaki	Jul-11	Japan	S	Moss	4	Pluto LNG
Energy Navigator	147,000	Tokyo LNG Tankers	Kawasaki Sakaide	May-08	Japan	S	Moss	4	Various
Energy Progress	145,000	MOL	Kawasaki	Nov-06	Japan	S	Moss	4	Bayu Undan LNG
Esshu Maru	162,000	K Line-Transpacific	Kawasaki Sakaide	Dec-14	Panama	S	Moss	4	Australia-Japan
Excalibur	138,200	Exmar/ Excelerate	Daewoo	Oct-02	Belgium	S	GT NO 96	4	Various
Excel	138,106	Exmar/ MOL	Daewoo	Sep-03	Belgium	S	GT NO 96	4	Various
Excelerate	138,000	Exmar/Excelerate	Daewoo	Oct-06	Belgium	S	GT NO 96	4	Various
Excellence	138,000	GKFF Ltd.	Daewoo	May-05	Belgium	S	GT NO 96	4	Excelerate Energy
Excelsior	138,000	Exmar	Daewoo	Jan-05	Belgium	S	GT NO 96	4	Various
Exemplar	150,900	Excelerate	Daewoo	Jun-10	Belgium	S	GT NO 96	4	Various
Expedient	151,000	Excelerate	Daewoo	Nov-09	Belgium	S	GT NO 96	4	Various
Experience RV	174,000	Exmar/Excelerate	Daewoo	Jul-14	Marshall Is.	DFDE	GT NO 96		Various
Explorer	150,900	Exmar/Excelerate	Daewoo	Mar-08	Belgium	S	GT NO 96	4	Excelerate
Express	151,000	Exmar/Excelerate	Daewoo	May-09	Belgium	S	GT NO 96	4	Various
Exquisite	150,900	Excelerate	Daewoo	Sep-09	Belgium	S	GT NO. 96	4	Various
Fraiha	210,100	J5 Consortium	Daewoo	Sep-08	Marshall Is.	DRL	GT NO 96	4	Qatargas
FSRU Independence	170,000	Hoegh	Hyundai	Feb-14	NIS	DFDE	TZ Mk. III	4	Various
FSRU Lampung	170,000	Hoegh	Hyundai	May-14	Indonesia	DFDE	TZ Mk. III	4	Various
Fuji LNG	147,895	TMSC Gas	Kawasaki	Jun-04	Malta	S	Moss	4	Various
Fuwairit	138,000	Peninsular LNG	Samsung	Jan-04	Bahamas	S	TZ Mk. III	4	RasGas II
Galea	134,425	Shell Shipping	Mitsubishi Nagasaki	Oct-02	Singapore	S	Moss	5	Shell
Galicia Spirit	140,620	Teekay LNG Partners	Daewoo	Jul-04	Liberia	S	GT NO 96	4	Engas
Gaselys	153,500	GdF/NYK	Atlantique	Mar-07	France	DFDE	CS 1	4	Engas
Gallina	134,425	Shell Shipping	Mitsubishi Nagasaki	Oct-02	Singapore	S	Moss	5	Shell
GasLog Chelsea	153,000	GasLog	Hanjin Korea	Dec-09	Panama	TFDE	TZ Mk. III	4	Various
Gaslog Geneva	174,000	GasLog	Samsung	Sept-16	Bermuda	TFDE	TZ Mk. III	4	Shell charter
Gaslog Gibraltar	174,000	GasLog	Samsung	Oct-16	Bermuda	TFDE	TZ Mk. III	4	Shell charter
Gaslog Glasgow	174,000	GasLog	Samsung	Jun-16	Bermuda	TFDE	TZ Mk. III	4	Shell charter
Gaslog Greece	174,000	GasLog	Samsung	Mar-16	Bermuda	TFDE	TZ Mk. III	4	Shell charter
GasLog Salem	165,000	GasLog	Samsung	Apr-15	Liberia	TFDE	TZ Mk. III	4	various
GasLog Santiago	155,000	GasLog	Samsung	Mar-13	Liberia	TFDE	TZ Mk. III	4	Various
GasLog Saratoga	155,000	GasLog	Samsung	Dec-14	Bermuda	TFDE	TZ Mk. III	4	Various
Gaslog Savannah	155,000	GasLog	Samsung	May-10	Bermuda	DFDE	TZ Mk. III	4	Various
GasLog Seattle	155,000	GasLog	Samsung	Oct-13	Bermuda	TFDE	TZ Mk. III	4	Various
GasLog Shanghai	155,000	GasLog	Samsung	Jan-13	Liberia	TFDE	TZ Mk. III	4	Various
Gaslog Singapore	155,000	GasLog	Samsung	Jul-10	Bermuda	DFDE	TZ Mk. III	4	Various
Gaslog Skagen	155,000	GasLog	Samsung	Oct-13	Bermuda	DFDE	TZ Mk. III	4	Various
Gaslog Sydney	155,000	GasLog	Samsung	May-13	Bermuda	DFDE	TZ Mk. III	4	Various
GDF-Suez Global Energy	74,000	Gaz de France	Chantiers	Dec-06	France	DFDE	CS1	4	Sonatrach
GDF-Suez Cape Ann	145,000	Hoegh LNG/MOL	Samsung	May-10	Liberia	DFDE	TZ Mk. III	4	Various
GDF-Suez Neptune	145,000	Hoegh LNG/MOL	Samsung	Dec-09	Liberia	DFDE	TZ Mk. III	4	Various
GDF-Suez Point Fortin	154,200	LNG Japan	Imabari/Koyo	Feb-10	Panama	DFDE	TZ Mk. III	4	Various
Gemmata	138,100	Shell Shipping	Mitsubishi Nagasaki	Mar-04	Singapore	S	Moss	5	Shell
Ghasha	137,510	National Gas Shipping	Mitsui	Jun-95	Liberia	S	Moss	5	ADGAS

Gigira Laitebo	177,000	MOL-Itochu	Hyundai	Feb-09	Panama	DFDE	TZ Mk. III	4	Various
Golar Arctic	140,645	Golar LNG	Daewoo	Dec-03	Marshall Is.	S	GT NO 96	4	Shell Spot
Golar Bear	160,000	Golar	Samsung	Mar-14	Bermuda	DFDE	TZ Mk. III	4	Various
Golar Celsius	160,000	Golar LNG	Samsung	Sep-13	Bermuda	DFDE	TZ Mk. III	4	Various
Golar Crystal	160,000	Golar LNG	Samsung	Oct-13	Bermuda	DFDE	TZ Mk. III	4	Various
Golar Eskimo (FSRU)	160,000	Golar LNG	Samsung	Jan-15	Bermuda	DFDE	TZ Mk. III	4	Various
Golar Freeze	125,850	Golar LNG	HDW	Feb-77	UK	S	Moss	5	Various
Golar Glacier	162,000	Golar LNG	Hyundai	Sep-14	Marshall Is.	DFDE	TZ Mk. III	4	Various
Golar Grand	145,880	Golar LNG	Daewoo	2006	IoM		GT NO 96	4	Various
Golar Ice	160,000	Golar LNG	Samsung	Feb-15	Bermuda	DFDE	TZ Mk. III	4	Various
Golar Igloo (FSRU)	160,000	Golar LNG	Samsung	Oct-13	Bermuda	DFDE	TZ Mk. III	4	Various
Golar Kelvin	160,000	Golar LNG	Samsung	Jan-15	Bermuda	DFDE	TZ Mk. III	4	Various
Golar Maria	145,950	Golar LNG	Daewoo	2006	Marshall Is.		GT NO 96	4	Various
Golar Mazo	135,225	Golar LNG/CPP	Mitsubishi	Jan-00	Liberia	S	Moss	5	Pertamina
Golar Penguin	160,000	Golar LNG	Samsung	Mar-14	Marshall Is.	DFDE	TZ Mk. III	4	Various
Golar Seal	160,000	Golar LNG	Samsung	Aug-13	Bermuda	DFDE	TZ Mk. III	4	Various
Golar Singapore (FSRU)	160,000	Golar LNG	Samsung	June-15	Bermuda	DFDE	TZ Mk. III	4	Various
Golar Snow	160,000	Golar LNG	Samsung	Jan-15	Bermuda	DFDE	TZ Mk. III	4	various
Golar Tundra (FSRU)	160,000	Golar LNG	Samsung	Dec-15	Bermuda	DFDE	TZ Mk. III	4	Various
Golar Viking	140,000	Golar LNG	Hyundai	Jan-05	Marshall Is.	S	Moss	4	Various
Golar Winter	138,250	Golar LNG	Daewoo	Apr-04	Marshall Is.	S	GT NO 96	4	Petrobras
Grace Acacia	150,000	Algaet Shipping	Hyundai	Jan-07	Japan	S	TK MK III	4	Various
Grace Barleria	150,000	Swallowtail Ship	Hyundai	Oct-07	Japan	S	TZ Mk. III	4	Various
Grace Cosmos	150,000	AGH Shipping	Hyundai	Mar-08	Japan	S	TZ Mk. III	4	Various
Grace Dahlia	177,000	Tokyo Gas	Kawasaki	Oct-13	Japan	S	Moss	4	Various
Gracilis	138,830	Golar LNG	Hyundai	Jan-05	Marshall Is.	S	TZ Mk III	4	Shell BG
Granatina	140,645	Shell Shipping	Daewoo	Dec-03	Singapore	S	GT NO 96	4	Shell
Grand Aniva	147,200	Sovcomflot/NYK	Mitsubishi	Jan-08	Japan	S	Moss	4	Various
Grand Elena	147,200	Sovcomflot/NYK	Mitsubishi	Oct-07	Japan	S	Moss	4	Various
Grand Mereya	147,200	Primorsk/MOL/K Line	Chiba	May-08	Japan	S	Moss	4	Sakhalin II
Hanjin Muscat	138,200	Hanjin Shipping	Hanjin	Jul-99	Panama	S	GT NO 96	4	Oman Gas
Hanjin Pyeong Taek	130,600	Hanjin Shipping	Hanjin	Sep-95	Panama	S	GT NO 96	4	Pertamina
Hanjin Ras Laffan	138,214	Hanjin Shipping	Hanjin	Jul-00	Panama	S	GT NO 96	4	QatarGas
Hanjin Sur	138,333	Hanjin Shipping	Hanjin	Jan-00	Panama	S	GT NO 96	4	Oman Gas
Hispania Spirit	140,500	Teekay LNG Partners	Daewoo	Sep-02	Spain	S	GT NO 96	4	Atlantic LNG
Hoegh Gallant FSRU	170,050	Hoegh LNG	Hoegh Hyundai	May-14	Marshall Is.	DFDE	TZ Mk. III	4	chartered
Hoegh Grace FSRU	170,050	Hoegh LNG	Hoegh LNG Hyundai	May-15	Marshall Is.	DFDE	TZ Mk. III	4	various
Hyundai Aquapia	135,000	Hyundai MM	Hyundai	Mar-00	Panama	S	Moss	4	Oman Gas
Hyundai	135,000	Hyundai MM	Hyundai	Jan-00	Panama	S	Moss	4	RasGas
Hyundai Ecopia	145,000	Hyundai	Hyundai	Nov-08	Panama	S	TZ Mk. III	4	Various
Hyundai Greenpia	125,000	Hyundai MM	Hyundai	Nov-96	Panama	S	Moss	4	Pertamina
Hyundai Oceanpia	135,000	Hyundai MM	Hyundai	Jul-00	Panama	S	Moss	4	Oman Gas
Hyundai Technopia	135,000	Hyundai MM	Hyundai	Jul-00	Panama	S	Moss	4	RasGas
Hyundai Utopia	125,182	Hyundai MM	Hyundai	Jun-94	Panama	S	Moss	4	Pertamina
Iberica Knutsen	138,000	Knutsen OAS	Daewoo	Aug-06	Norway	S	GT 96	4	Gas Natural
Ibra LNG	147,100	Oman Gas	Samsung	Jun-06	Panama	S	TK Mk. III	4	Oman LNG
Ibri LNG	145,000	Oman Gas	Mitsubishi	Jul-06	Panama	S	TK Mk. III	4	Oman LNG
Ish	137,540	National Gas Shipping	Mitsubishi Nagasaki	Nov-95	Liberia	S	Moss	5	ADGAS
K Acacia	138,017	Korea Line	Daewoo	Jan-00	Panama	S	GT NO 96	4	Oman Gas
K Freesia	135,256	Korea Line	Daewoo	Jun-00	Panama	S	GT NO 96	4	RasGas
K Jasmine	145,700	Korea Line	Daewoo	Mar-08	Panama	S	GT NO 96	4	Kogas offtake
K Mugungwha	152,000	K Line	Daewoo	Nov-08	Panama	S	GT NO 96	4	Various
Kita LNG	160,106	TMSC Gas	Daewoo	Jun-14	Malta	TFDE	GT No 96	4	Various
Kotawaka Maru	125,200	J3 Consortium	Kawasaki Sakaide	Jan-84	Japan	S	Moss	5	Darwin
Kumul	172,000	MOL	Hudong	May-16	Hong Kong	DRL	GT NO. 96	4	PNG-Asia
Lala Fatma N'Soumer	145,000	Algeria Nippon Gas	Kawasaki Sakaide	Dec-04	Japan	S	Moss	4	Sonatrach
Larbi Ben M'Hidi	129,750	SNTM-Hyproc	La Seyne	Jun-77	Algeria	S	GT NO 85	5	Sonatrach
Lijmilya	261,700	QGTC	Daewoo	Sep-08	Marshall Is.	DRL	GT NO. 96	5	Various
LNG Abalamabie	174 900	Bonny Gas	Samsung	Nov-16	Bermuda	DFDE	TZ Mk III	4	Nigeria LNG
LNG Abuja	126,530	Bonny Gas Transport	GD Quincy	Sep-80	Bahamas	S	Moss	5	Nigeria LNG
LNG Abuja II	174 900	Bonny Gas	Samsung	Oct 16	Bermuda	DFDE	TZ Mk III	4	Nigeria LNG
LNG Adamawa	141,000	Bonny Gas Transport	Hyundai	Jun-05	Bermuda	S	Moss	4	Various
LNG Akwa Ibom	141,000	Bonny Gas Transport	Hyundai	Nov-04	Bermuda	S	Moss	4	Various
LNG Aquarius	126,300	MOL/LNG Japan	GD Quincy	Jun-77	Marshall Is.	S	Moss	5	Various
LNG Barka	153,000	NYK	Kawasaki	Jan-09	Bahamas	S	Moss	4	Various
LNG Bayelsa	137,500	Bonny Gas Transport	Hyundai	Feb-03	Bermuda	S	Moss	4	Nigeria LNG
LNG Benue	145,700	BW Gas	Daewoo	Mar-06	Bermuda	S	GT NO 96	4	Nigeria LNG
LNG Bonny	177,000	Bonny Gas Transport	Hyundai	Oct-15	Bermuda	DFDE	TZ Mk III	4	Nigeria LNG
LNG Borno	149,600	NYK Line	Samsung	Aug-07	Japan	S	TZ Mk. III	4	Nigeria LNG
LNG Capricorn	126,300	MOL/LNG Japan	GD Quincy	Jun-78	Marshall Is.	S	Moss	5	Pertamina
LNG Cross River	141,000	Bonny Gas Transport	Hyundai	Sep-05	Bermuda	S	Moss	4	Various
LNG Dream	145,000	Osaka Gas	Kawasaki	Sep-06	Japan	S	Moss	4	Woodside Energy
LNG Ebisu	147,500	MOL	Kawasaki	Sep-08	Bahamas	S	Moss	4	Various
LNG Edo	126,530	Bonny Gas Transport	GD Quincy	May-80	Bahamas	S	Moss	5	Nigeria LNG
LNG Enugu	145,000	BW Gas	Daewoo	Oct-05	Bermuda	S	GT NO 96	4	Nigeria LNG
LNG Fimina	175,000	Bonny Gas Transport	Samsung	Oct-15	Bermuda	DFDE	TZ Mk III	4	Nigeria LNG
LNG Flora	127,700	J3 Consortium	Kawasaki Sakaide	Mar-93	Japan	S	Moss	4	Pertamina
LNG Fukurokuju	165,000	MOL	Kawasaki	June-15	Japan	S	Moss	4	Various
LNG Gemini	126,300	MOL/LNG Japan	GD Quincy	Sep-78	Marshall Is.	S	Moss	5	Pertamina
LNG Imo	148,300	BW Gas	Daewoo	Jun-08	Bermuda	S	GT NO 96	4	Nigeria LNG
LNG Jamal	135,330	Osaka Gas/J3 Consortium	Mitsubishi Nagasaki	Oct-00	Japan	S	Moss	5	Oman Gas
LNG Jupiter	145,000	NYK Line	Kawasaki	Jul-09	Bahamas	S	Moss	4	Various
LNG Jurojin	155,300	MOL	MHI Nagasaki	Nov-15	Japan	S	KM	4	Various
LNG Kano	148,471	BW Gas	Daewoo	Jan-07	Bermuda	S	GT No. 96	4	NLNG
LNG Lagos	177,000	Bonny Gas	Hyundai	Oct-15	Bermuda	DFDE	TZ Mk III	4	Nigeria LNG
LNG Leo	126,400	MOL/LNG Japan	GD Quincy	Dec-78	Marshall Is.	S	Moss	5	Pertamina
LNG Lerici	65,000	Exmar	Italcantieri Sestri	Mar-98	Italy	S	GT NO 96	4	Sonatrach
LNG Libra	126,400	Hoegh LNG	GD Quincy	Apr-79	Marshall Is.	S	Moss	5	Various
LNG Lokoja	148,300	BW Gas	Daewoo	Dec-06	Bermuda	S	GT No. 96	4	Nigeria LNG
LNG Mars	155,000	MOL/Osaka Gas	Mitsubishi	Oct-16	Marshall Is.	S	Moss	5	Various
LNG Ogun	148,300	NYK Line	Samsung	Aug-07	Japan	S	TZ Mk. III	4	Nigeria LNG
LNG Ondo	148,300	BW Gas	Daewoo	Sep-07	Bermuda	S	GT NO 96	4	Nigeria LNG

LNG Oyo	140,500	BW Gas	Daewoo	Dec-05	Bermuda	S	GT NO 96	4	Nigeria LNG
LNG Pioneer	138,000	MOL	Daewoo	Jul-05	Bahamas	S	GT No 96	4	Idku
LNG Port Harcourt	175,000	Bonny Gas	Samsung	Oct-15	Bermuda	DFDE	TZ Mk III	4	Nigeria LNG
LNG Portovenere	65,000	Exmar	Italcantieri Sestri	Jun-96	Italy	S	GT No 96	4	Sonatrach
LNG River Niger	141,000	Bonny Gas Transport	Hyundai	May-06	Bermuda	S	Moss	4	Various
LNG River Orashi	145,910	BW Gas	Daewoo	Nov-04	Bermuda	S	GT No 96	4	Nigeria LNG
LNG Rivers	137,231	Bonny Gas Transport	Hyundai	Jun-02	Bermuda	S	Moss	4	Nigeria LNG
LNG Saturn	153,000	MOL	MHI	Nov-15	Japan	S	Moss	4	Various
LNG Sokoto	137,231	Bonny Gas Transport	Hyundai	Aug-02	Bermuda	S	Moss	4	Nigeria LNG
LNG Taurus	126,300	MOL/LNG Japan	GD Quincy	Aug-79	Marshall Is.	S	Moss	5	Various
LNG Venus	155,000	Osaka/MOL	MHI	Oct-14	Japan	S	Moss	4	Various
LNG Vesta	127,547	Tokyo Gas Consortium	Mitsubishi Nagasaki	Jun-94	Japan	S	Moss	4	Pertamina
LNG Virgo	126,400	MOL/LNG Japan	GD Quincy	Dec-79	Marshall Is.	S	Moss	5	Pertamina
Lobito	160,400	Mitsui/NYK/Teekay	Samsung	Oct-11	Bahamas	DFDE	TZ Mk. III	4	Various
Lusail	138,000	Peninsular LNG	Samsung	May-05	Bahamas	S	TZ Mk. III	4	Qatar
Madrid Spirit	138,000	Teekay LNG Partners	IZAR Puerto Real	Jan-05	Spain	S	GT No 96	4	Engas
Magellan Spirit	165,500	Teekay LNG Partners	Samsung	Sep-08	Denmark	DFDE	TZ Mk. III	4	Various
Malanje	160,400	Mitsui/NYK/Teekay	Samsung	Jul-11	Bahamas	DFDE	TZ Mk. III	4	Various
Maran Gas Achilles	174,000	Maran	Hyundai Samho	Feb-16	Greece	DFDE	GT No 96	4	Various
Maran Gas Agamemnon	174,000	Maran	Hyundai Samho	May-16	Greece	DFDE	GT No 96	4	Various
Maran Gas Alexandria	161,870	Maran	Hyundai Samho	Sep-15	Greece	DFDE	TZ Mk. III	4	Various
Maran Gas Amphipolis	173,400	Maran	Daewoo	Aug-16	Greece	DFDE	GT No 96	4	Various
Maran Gas Apollonia	161,870	Maran	Daewoo	Jan-14	Greece	DFDE	GT No 96	4	Various
Maran Gas Asclepius	145,000	Kristen Navigation	Daewoo	Jul-05	Bermuda	S	GT No 96	4	Qatar
Maran Gas Coronis	145,700	Maran	Daewoo	Sep-07	Greece	S	GT No 96	4	Rasgas II
Maran Gas Delphi	159,800	Maran	Daewoo	Feb-14	Greece	DFDE	GT No 96	4	Various
Maran Gas Efessos	159,800	Maran	Daewoo	Jun-14	Greece	DFDE	GT No 96	4	Various
Maran Gas Hector	174,000	Maran	Hyundai Samho	Nov-16	Greece	DFDE	GT No 96	4	Various
Maran Gas Lindos	159,800	Maran	Daewoo	Jun-15	Greece	DFDE	GT No. 96	4	Various
Maran Gas Mystras	155,900	Maran Gas	Daewoo	May-15	Greece	DFDE	GT No 96	4	various
Maran Gas Pericles	174,000	Maran	Hyundai Samho	June-16	Greece	DFDE	GT No 96	4	Various
Maran Gas Posidonia	161,870	Maran	Daewoo	May-14	Greece	DFDE	GT No 96	4	Various
Maran Gas Roxana	173,400	Maran	Daewoo	Jan-17	Greece	DFDE	GT No 96	4	Various
Maran Gas Sparta	161,870	Maran	Hyundai Samho	April-15	Greece	DFDE	G TZ Mk. III	4	Various
Maran Gas Troy	155,900	Maran Gas	Daewoo	May-15	Greece	DFDE	GT No 96	4	various
Maran Gas Ulysses	174,000	Maran	Hyundai Samho	Jan-17	Greece	DFDE	GT No 96	4	Various
Maria Energy	174,000	Tsakos	Hyundai	Mar-15	Marshall Is.	TFDE	GTT Mk II	4	Various
Marib Spirit	165,000	Teekay LNG	Samsung	May-08	Marshall Is.	DFDE	TZ Mk. III	4	Various
Matthew	126,540	Suez LNG Shiping	Newport News	Jun-79	Bahamas	S	TZ Mk. I	6	Atlantic LNG
Mekaines	266,000	Naklilat	Samsung	Mar-09	Liberia	DRL	GT No 96	4	Qatar-Atlantic Basin
Meridian Spirit	165,500	Teekay LNG	Samsung	Jan-10	Denmark	DFDE	TZ Mk. III	4	Various
Mesaimeer	210,100	Naklilat	Hyundai	Mar-09	Liberia	DRL	GT No 96	4	Qatar-Atlantic Basin
Methane Alison Victoria	145,000	GasLog	Samsung	Aug-07	Bermuda	S	TZ III	4	Eq.Guinea LNG
Methane Becki Anne	170,000	GasLog	Samsung	Sep-10	Bermuda	TFDE	TZ Mk. III	4	Various
Methane Heather Sally	145,000	GasLog	Samsung	Jul-07	Bermuda	S	Tz Mk. III	4	Eq.Guinea LNG
Methane Jane Elizabeth	145,000	GasLog	Samsung	Jun-06	Bermuda	TFDE	TZ Mk. III	4	Engas
Methane Julia Louise	170,000	GasLog	Samsung	Dec-09	Bermuda	TFDE	TZ Mk. III	4	Various
Methane Kari Elin	138,200	Shell	Samsung	Jun-04	Bermuda	S	TZ Mk. III	4	Various
Methane Lake Charles	145,000	Shell	Samsung	Feb-07	Bermuda	S	TZ Mk. III	4	Marathon Oil
Methane Lydon Volney	145,000	Shell	Samsung	Aug-06	Bermuda	S	TZ Mk. III	4	Engas
Methane Mickie Harper	170,000	Shell-GasLog	Samsung	Nov-10	Bermuda	TFDE	TZ Mk. III	4	Various
Methane Nile Eagle	145,000	Shell-GasLog	Samsung	Dec-07	Bermuda	S	TZ Mk. III	4	Engas
Methane Patricia Camila	170,000	Shell-GasLog	Samsung	Oct-10	Bermuda	TFDE	TZ Mk. III	4	Various
Methane Princess	138,159	Golar LNG	Daewoo	2003	UK	S	GT No 96	4	Spot BG
Methane Rita Andre	145,000	GasLog	Samsung	Mar-06	Bermuda	S	TZ Mk. III	4	Engas
Methane Shirley Elizabeth	145,000	GasLog	Samsung	Apr-07	Bermuda	S	TZ Mk. III	4	Marathon Oil
Methane Sprit	165,000	Teekay LNG	Samsung	Mar-08	Singapore	DFDE	TZ Mk. III	4	Various
Milaha Qatar	145,000	Milaha	Samsung	Apr-06	Denmark	S	TZ Mk. III	4	Qatar
Milaha Ras Laffan	138,270	Milaha	Samsung	Mar-04	Denmark	S	TZ Mk. III	4	RasGas II
Min Lu	147,000	China Ships	Hudong	Aug-09	China	S	GT No 96	4	Various
Min Rong	147,000	China LNG Ships	Hudong	Feb-09	Hong Kong	S	GT No 96	4	Australia-China
Mourad Didouche	126,130	SNTM-Hyproc	Atlantique	Jul-80	Algeria	S	GT No 85	5	Sonatrach
Mozah	266,000	QGTC	Samsung	Aug-08	Qatar	DRL	TZ Mk III	5	Qatargas II
Mraweh	137,000	National Gas Shipping	Kvaerner-Masa	Jun-96	Liberia	S	Moss	4	ADGAS
Mubaraz	137,000	National Gas Shipping	Kvaerner-Masa	Jan-96	Liberia	S	Moss	4	Various
Muraq	210,100	J5-K Line	Daewoo	May-08	Marshall Is.	DRL	GT No 96	4	Qatar-Atl'c Basin
Murwab	210,100	J5 Consortium	Daewoo	May-08	Marshall Is.	DRL	GT No. 96	4	Qatargas
Muscat LNG	149,170	Oman Gas/MOL	Kawasaki Sakaide	Mar-04	Japan	S	Moss	4	Oman Gas
Neo Energy	149,700	Tsakos	Hyundai	Feb-07	Liberia	S	GTT Mk II	4	Various
Nizwah LNG	145,000	Oryx LNG Carriers	Kawasaki Sakaide	Dec-05	Japan	S	Moss	4	Oman Gas
Northwest Sanderling	127,525	Australia LNG	Mitsubishi Nagasaki	Jun-89	Australia	S	Moss	4	NWS
Northwest Sandpiper	127,500	Australia LNG	Mitsui Chiba	Feb-93	Australia	S	Moss	4	NWS
Northwest Seaeagle	127,450	Australia LNG	Mitsubishi Nagasaki	Nov-92	Bermuda	S	Moss	4	NWS
Northwest Shearwater	127,500	Australia LNG	Kawasaki Sakaide	Sep-91	Bermuda	S	Moss	4	NWS
Northwest Snipe	127,747	Australia LNG	Mitsui Chiba	Sep-90	Australia	S	Moss	4	NWS
Northwest Stormpetrel	127,600	Australia LNG	Mitsubishi Nagasaki	Dec-94	Australia	S	Moss	4	NWS
Northwest Swallow	127,708	J3 Consortium	Mitsui Chiba	Nov-89	Japan	S	Moss	4	NWS
Northwest Swan	138,000	Australia LNG	Daewoo	Mar-04	Australia	S	GT NO 96	4	NWS
Northwest Swift	127,590	J3 Consortium	Mitsubishi Nagasaki	Sep-89	Japan	S	Moss	4	NWS
Oak Spirit	173,400	Teekay	Daewoo	Jan-16	Bahamas	MEGI-DF	NO. 96 GW	4	Cheniere
Ob River	150,000	Lance Shipping	Hyundai	Oct-07	Marshall Is.	S	TZ Mk. III	4	Various
Onaiza	210,100	Nakilat	Daewoo	Apr-09	Liberia	DRL	GT NO 96	4	Qatar-Atlantic Basin
Pacific Arcadia	147,200	NYK Line	MHI	Oct-14	Bahamas	S	KM		Various
Pacific Enlighten	145,000	LNG MT	Mitsubishi	Mar-09	Japan	S	Moss	4	Various
Pacific Eurus	137,000	LNG Marine Transport	Mitsubishi Nagasaki	Mar-06	Bahamas	S	Moss	4	Darwin
Pacific Notus	137,006	Pacific LNG Shipping	Mitsubishi Nagasaki	Sep-03	Bahamas	S	Moss	5	Darwin
Palu LNG	160,106	TMSC Gas	Daewoo	Jun-14	Malta	TFDE	GT No 96	4	Various
Pan Asia	174,000	Teekay	Hudong-Zhonghua	July-17	Bahamas	TFDE	NO. 96 GW	4	Cheniere
Papua	171,800	MOL-China	Hudong	Jan-15	Hong Kong	DFDE	SSD	4	PNG LNG
Polar Eagle	89,880	Polar LNG	IHI Chita	Jun-93	Liberia	S	IHI SPB	4	ConocoPhillips/Marathon
Prachi	173,000	NYK-SCI	Hyundai	Nov-16	Singapore	TFDE	GT No 96	4	Petronet

Provalys	153,500	Gaz de France	Chantiers	Nov-06	France	DFDE	CS1	4	ELNG
Puteri Delima	130,400	MISC	Atlantique	Jan-95	Malaysia	S	GT NO 96	4	Petronas
Puteri Delima Satu	137,100	MISC	Mitsui Chiba	Apr-02	Malaysia	S	GT NO 96	4	Petronas
Puteri Firuz	130,400	MISC	Atlantique	May-97	Malaysia	S	GT NO 96	4	Petronas
Puteri Firuz Satu	137,100	MISC	Mitsubishi Nagasaki	Sep-04	Malaysia	S	GT NO 96	4	Petronas
Puteri Intan	130,400	MISC	Atlantique	Aug-94	Malaysia	S	GT NO 96	4	Petronas
Puteri Intan Satu	137,100	MISC	Mitsubishi Nagasaki	Dec-01	Malaysia	S	GT NO 96	4	Petronas
Puteri Mutiera Satu	137,100	MISC	Mitsui Chiba	Apr-05	Malaysia	S	GT NO 96	4	Petronas
Puteri Nilam	130,400	MISC	Atlantique	Jun-95	Malaysia	S	GT NO 96	4	Petronas
Puteri Nilam Satu	137,100	MISC	Mitsubishi Nagasaki	Sep-03	Malaysia	S	GT NO 96	4	Petronas
Puteri Zamrud	130,400	MISC	Atlantique	May-96	Malaysia	S	GT NO 96	4	Petronas
Puteri Zamrud Satu	137,100	MISC	Mitsui Chiba	Apr-87	Malaysia	S	GT NO 96	4	Atlantic LNG
Raahi	136,000	Petronet LNG Ltd	Daewoo	Dec-04	Malta	S	GT NO 96	4	Qatargas
Ramdane Abane	126,130	SNTM-Hyproc	Atlantique	Jul-81	Algeria	S	GT NO 85	5	Sonatrach
Rasheeda	266,000	QGTC	Samsung	Jun-10	Liberia	DRL	TZ Mk. III		Various
Ribera del Duero Knutsen	173,400	Knutsen	Daewoo	Nov-10	Nor-NIS	DFDE	GT NO. 96	4	Various
Rioja Knutsen	176,300	Knutsen	Daewoo	Dec-16	Nor-NIS	DFDE	TZ Mk III	4	Various
Salalah LNG	147,000	Oman Gas/MOL	Samsung	Dec-05	Japan	S	TZ Mk. III	4	Oman
SCF Polar	71,500	Sovcomflot	Kockums	Aug-69	Liberia	S	GT NO 82	6	Sonatrach
Seishu Maru	162,000	K Line-Transpacific	Kawasaki Sakaide	Jan-15	Panama	S	Moss	4	Australia-Japan
Seri Alam	138,000	MISC	Samsung	Oct-05	Malaysia	S	TZ Mk. III	4	Yemen LNG
Seri Amanah	145,000	MISC	Samsung	Mar-06	Malaysia	S	TZ Mk. III	4	Yemen LNG
Seri Anggun	145,000	MISC	Samsung	Nov-06	Malaysia	S	TZ Mk. III	4	Yemen LNG
Seri Angkasa	145,000	MISC	Samsung	Feb-07	Malaysia	S	TZ Mk. III	4	Petronas
Seri Ayu	145,000	MISC	Samsung	Oct-07	Malaysia	S	TZ Mk. III	4	Various
Seri Bakti	152,300	MISC	Mitsubishi	Mar-07	Malaysia	S	GT NO 96	4	Petronas
Seri Balhaf	152,000	MISC	Mitsubishi	Sep-08	Malaysia	S	GT NO 96	4	Various
Seri Balquis	152,000	MISC	Mitsubishi	Dec-08	Malaysia	S	GT NO 96	4	Various
Seri Begawan	152,300	MISC	Mitsubishi	Dec-07	Malaysia	S	GT NO 96	4	Various
Seri Bijaksana	152,300	MISC	Mitsubishi	Feb-08	Malaysia	S	GT NO 96	4	Petronas
Seri Camellia	150,000	MISC	Hyundai	Nov-16	Malaysia	S	Moss	5	Petronas
Seri Cenderawasih	150,000	MISC	Hyundai	Jan-17	Malaysia	S	Moss	5	Petronas
Sestao Knutsen	138,000	Knutsen	IZAR Sestao	Jan-07	Spain	S	GT NO 96	4	Atlantic LNG
Sevilla Knutsen	173,400	Knutsen	Daewoo	Jun-10	N.I.S.	DFDE	GT NO 96	4	Various
Shahamah	135,500	National Gas Shipping	Kawasaki Sakaide	Oct-94	Liberia	S	Moss	5	ADGAS
Shangra	266,000	QGTC	Samsung	Nov-09	Liberia	DRL	TZ Mk. III	5	Qatargas IV
Shen Hai	147,100	China LNG	Hudong Zhonghua	Sep-12	China	AB/CC Steam	GT NO 96	4	Various
Simaisma	147,700	Maran Gas Maritime	Daewoo	Jul-06	Greece	S	GT No 96	4	Qatar
SK Splendor	138,375	SK Shipping	Samsung	Mar-00	Panama	S	TZ Mk. III	4	Oman Gas
SK Stellar	138,375	SK Shipping	Samsung	Dec-00	Panama	S	TZ Mk. III	4	RasGas
SK Summit	138,000	SK Shipping	Daewoo	Aug-99	Panama	S	GT NO 96	4	RasGas
SK Sunrise	138,306	I. S. Carriers	Samsung	Sep-03	Panama	S	TZ Mk. III	4	RasGas
SK Supreme	138,200	SK Shipping	Samsung	Jan-00	Panama	S	TZ Mk. III	4	RasGas
Sohar LNG	137,250	Oman Gas/ MOL	Mitsubishi Nagasaki	Oct-01	Malta	S	Moss	5	Oman Gas
Solaris	155,000	GasLog	Samsung	Jul-14	Bermuda	TFDE	TZ Mk. III	4	Various
Sonangol Benguela	160,500	Sonangol	Daewoo	Sep-11	Bahamas	S	GT No. 96	4	Angola LNG
Sonangol Etosha	160,500	Sonangol	Daewoo	Sep-11	Bahamas	S	GT No. 96	4	Angola LNG
Sonangol Sambizanga	160,500	Sonangol	Daewoo	Sep-11	Bahamas	S	GT No. 96	4	Angola LNG
Southern Cross	172,000	MOL	Hudong	May-15	Hong Kong	DRL	GT NO. 96	4	Various
Soyo	160,400	Mitsui/NYK/Teekay	Samsung	May-11	Bahamas	DFDE	TZ Mk. III	4	Various
Spirit of Hela	177,000	MOL	Hyundai	Oct-09	Panama	DFDE	TZ Mk. III	4	Various
Stena Blue Sky	145,700	Stena	Daewoo	Jan-06	Panama	S	GT No 96	4	Various
Stena Clear Sky	171,800	Stena	Daewoo	Sep-10	Panama	DFDE	GT NO 96	4	Various
Stena Crystal Sky	171,800	Stena	Daewoo	Jul-10	Panama	DFDE	GT NO 96	4	Various
STX Kolt	145,700	STX Panocean	Korea Hanjin	Nov-08	Panama	DFDE	TZ Mk. III	4	Various
Suez Point Fortin	154,200	Trinity LNG	Koyo Japan	Nov-09	Panama	S	TZ Mk. III	4	Yemen LNG
Taitar No. 1	145,000	NYK Line	Mitsubishi	Oct-09	Liberia	S	Moss	4	Various
Taitar No. 3	145,000	NYK Line	Mitsubishi	Jan-10	Liberia	S	Moss	4	Various
Taitar No. 4	145,000	NYK	Mitsubishi	Jan-10	Liberia	S	Moss	4	Various
Tangguh Batur	145,700	Sovcomflot/NYK	Daewoo	Dec-08	Cyprus	S	GT NO 96		Tangguh
Tangguh Foja	155,000	K Line	Samsung	Jul-08	Panama	DFDE	TZ Mk. III	4	Tangguh LNG
Tangguh Hiri	155,000	Teekay LNG	Hyundai	Nov-08	IOM	DFDE	TZ Mk. III	4	Tangguh
Tangguh Jaya	145,700	K Line	Samsung	Nov-08	Panama	DFDE	TZ Mk. III	4	Tangguh
Tangguh Palung	155,000	K Line	Samsung	Mar-09	Panama	DFDE	TZ Mk. III	4	Tangguh
Tangguh Sago	155,000	Teekay LNG	Hyundai	Mar-09	IOM	DFDE	TZ Mk. III	4	Tangguh LNG
Tangguh Towuti	145,700	Sovcomflot/NYK	Daewoo	Oct-08	Cyprus	S	GT NO 96	4	Tangguh
Tembek	216,200	OSG/Nakilat	Samsung	Sep-07	Marshall Is.	DRL	TZ Mk. III	4	Qatargas II
Tenaga Satu	130,000	MISC	Dunkerque	Sep-82	Malaysia	S	GT NO 88	5	Petronas
Torben Spirit	173,000	Teekay	Daewoo	Feb-17	Bahama	MEGI-DF	No 96 GW	4	Various
Trinity Arrow	154,900	K Line	Imabari Shipbuilding	Mar-08	Panama	S	TZ Mk. III	4	Various
Umm Al Amad	210,100	J5	Daewoo	Aug-08	Marshall Is.	DRL	GT NO 96	4	Ras Gas III
Umm Al Ashtan	137,000	National Gas Shipping	Kvaerner- Masa	May-97	Liberia	S	Moss	4	ADGAS
Umm Bab	145,000	Kristen Navigation	Daewoo	Nov-05	Bermuda	S	GT NO 96	4	Qatargas
Umm Slaal	266,000	QGTC	Samsung	Nov-08	Qatar	DRL	TZ Mk. III	5	Qatargas
Valencia Knutsen	173,400	Knutsen	Daewoo	Sep-10	Nor-NIS	DFDE	GT NO. 96	4	Various
Velikiy Novgorod	170,200	SovComFlot	STX	Feb-14	Liberia	DFDE	GT No. 96	4	Various
Wakaba Maru	125,000	J3 Consortium	Mitsui Chiba	Apr-85	Japan	S	Moss	5	Pertamina
WilEnergy	125,500	Awilco LNG	Mitsubishi	Oct-83	NIS	S	Moss	5	Various
WilForce	156,000	Teekay LNG	Daewoo	Aug-13	NIS	DFDE	GT NO 96	4	Various
WilGas	125,500	Awilco LNG	Mitsubishi	Jul-84	NIS	S	Moss	5	Various
WilPower	125,500	Awilco LNG	Mitsubishi	Jul-84	NIS	S	Moss	5	Various
Woodside Cheney	174,000	Maran	Hyundai Samho	March-16	Greece	DFDE	GT No 96	4	Various
Woodside Donaldson	165,500	Teekay LNG	Samsung	Dec-09	Singapore	DFDE	TZ Mk. III	4	Various
Woodside Goode	159,800	Maran	Daewoo	Jul-14	Greece	DFDE	GT No. 96	4	Various
Woodside Reeswithers	173,400	Maran	Daewoo	Nov-16	Greece	DFDE	GT No 96	4	Various
Woodside Rogers	155,900	Maran Gas	DSME	Jul-13	Greece	DFDE	GT NO 96	4	Various
Yari LNG	159,983	TMSC Gas	Daewoo	Jun-14	Malta	TFDE	GT No 96	4	Various
Yenisei River	155,000	Dynagas	Hyundai	Jul-13	Marshall Is.	DFDE	TZ Mk. III	4	Various
YK Sovereign	127,125	SK Shipping	Hyundai	Dec-94	Panama	S	Moss	4	Pertamina
Zarga	266,000	QGTC	Samsung	Dec-09	Liberia	DRL	TZ Mk. III	5	Qatar-Atlantic
Zekreet	135,420	J4 Consortium	Mitsui Chiba	Dec-98	Japan	S	Moss	5	Qatargas

Any observations, additions or suggested revisions to the LNG journal World LNG Carrier Fleet list should be sent to editor@lngjournal.com

LNG Import Terminals

Explanatory Notes

- The tables do not include the following types of LNG facilities :
  - Small marine satellite terminals receiving LNG from liquefaction plants in their own country (such as exist in Norway) or which receive LNG transhipped from nearby reception terminals in their own country (such as in Japan)
  - Satellite LNG storage facilities that receive LNG transported only by road or rail
- Expansions of LNG reception terminals are only shown if they involve new storage tanks
- Where there is a blank in the table the information is uncertain or unknown.

Any comments on the tables, and corrections / additional information from terminal shareholders and project developers would be most welcome, and should be sent to John McKay e-mail editor@lngjournal.com

Country	Location (Project)	Owners	Start up	Storage Tanks	Storage Capacity
Belgium	Zeebrugge	Fluxys	1987	4	380,000
Canada	Canaport Saint John	Irving Oil, Repsol	2009	3	480,000
Chile	Quintero	ENAP, Metrogas, Enagas	2009	3	334,000
	Mejillones	Engie, Codelco	2010	1	175,000
China	Beihai LNG, Guangxi	Sinopec	2015	4	640,000
	Dalian	PetroChina	2011	3	480,000
	Dongguan, Guangdong	Jovo Group	2013	2	160 000
	Fujian LNG (Xiuyu)	CNOOC, Fujian I&D Corp.	2008	2	640,000
	Guangdong	CNOOC,BP	2006	3	480,000
	Haikou, Hainan LNG	CNOOC	2014	3	480,000
	Ningbo, Zheijang	CNOOC, Zhejiang Energy	2012	3	480,000
	Qingdao, Shandong	Sinopec	2014	3	480,000
	Rudong	PetroChina	2011	3	530,000
	Shanghai	CNOOC, Shenergy Group	2009	3	495,000
	Shanghai, Mengtougou	Shanghai Gas	2008	3	120 000
	Shenzen, Diefu	CNOOC	2016	2	320,000
	Tangshan, Hebei	PetroChina	2013	3	480,000
	Tianjin FSRU	CNOOC	2014	1	60,000
	Yuedong, Guangdong	CNOOC	2016	2	320,000
	Zhuhai, Gaolan	CNOOC	2013	3	480,000
Dominican Republic	Punta Caucedo	AES Andres	2003	1	160 000
Finland	Pori	Gasum Skangas	2016	1	30,000
France	Fos Tonkin	Elengy	1972	3	150,000
	Montoir-de-Bretagne	Elengy	1980	3	360,000
	Fos Cavaou	Engie, Total	2010	3	330,000
	Dunkirk LNG	EDF, Fluxys, Total	2016	3	570,000
Greece	Revithoussa	DEPA	2000	2	130,000
India	Dabhol	GAIL, NTPC (Ratnagiri Gas & Power)	2009	3	480,000
	Dahej	Petronet LNG	2004	4	592,000
	Hazira	Shell India, Total	2005	2	320,000
	Kochi, Kerala	Petronet LNG	2013	2	320,000
Indonesia	Arun	Pertamina	2015	5	507,000
Italy	Panigaglia	Snam	1969	2	100,000
	Porto Levante (offshore GBS)	ExxonMobil, Qatar Petroleum, Edison Gas	2009	2	250,000
Japan	Negishi	Tokyo Gas	1969	14	1,180,000
	Sodegaura	Tokyo Gas	1973	35	2,660,000
	Ohgishima	Tokyo Gas	1998	4	850,000
	Higashi-Ohgishima	Tokyo Electric	1984	9	540,000
	Futtsu	Tokyo Electric	1985	10	1,110,000
	Yokkaichi LNG	Chubu Electric	1988	4	320,000
	Kawagoe	Chubu Electric	1997	6	840,000
	Yokkaichi Works	Toho Gas	1991	2	160,000
	Chita LNG Joint	Toho Gas, Chubu Electric	1978	4	300,000
	Chita LNG	Toho Gas, Chubu Electric	1983	7	640,000
	Chita - Midorihama	Toho Gas	2001	3	600,000
	Senboku I	Osaka Gas	1972	4	180,000
	Senboku II	Osaka Gas	1977	18	1,585,000
	Himeji	Osaka Gas	1984	8	740,000
	Himeji LNG	Kansai Electric	1979	7	520,000
	Yanai	Chugoku Electric	1990	6	480,000
	Niigata	Nihonkai LNG, Tohoku Electric	1984	8	720,000
	Oita	Oita Gas, Kyushu Electric	1990	5	460,000
	Tobata	Kitakyushu LNG	1977	8	480,000
	Fukuoka	Saibu Gas	1993	2	70,000
	Sodeshi	Shizuoka Gas	1996	3	337,200
	Hatsukaichi	Hiroshima Gas	1996	2	170,000
	Kagoshima	Nippon Gas	1996	2	136,000
	Shin-Minato	Sendai City Gas	1997	1	80,000
	Nagasaki	Saibu Gas	2003	1	36,000
	Sakai	Kansai Electric, Cosmo OIl	2006	3	420,000
	Mizushima	Nippon Oil, Chugoku Electric	2006	2	320,000
	Sakaide	Shikoku Electric, Cosmo Oil	2011	1	180,000
	Ishikari LNG	Hokkaido Gas, Hokkaido Electric	2012	2	380,000
	Okinawa	Okinawa Electric Power	2012	2	280,000
	Naoetsu	Inpex	2013	2	360,000
	Joetsu	Chubu	2011	3	540,000
	Hachinohe LNG	Nippon Oil	2015	2	280,000
	Hitachi LNG	Tokyo Gas	2015	1	230,000
Korea	Boryyeong	GS Energy, SK E&S	2017	3	200,000
	Incheon	Kogas	1996	20	2,880,000
	Kwangyang	POSCO	2005	4	530,000
	Pyeong-Taek	Kogas	1986	23	3,360,000
	Samcheok	Kogas	2014	3	600,000
	Tong-Yeong	Kogas	2002	17	2,620,000
Mexico	Altamira	Vopak, Enagas	2006	2	300,000
	Energia Costa Azul	Sempra LNG	2008	2	320,000
	Manzanillo	Samsung, Kogas, Mitsui	2012	2	300,000
Netherlands	Gate LNG	Gasunie, Royal Vopak	2011	3	540,000
Poland	Swinoujscie	Baltic Gaz System	2015	2	320,000

LNG Import Terminals (continued)

Country	Location (Project)	Owners	Start up	Storage Tanks	Storage Capacity
Portugal	Sines	REN Atlantico	2004	3	390,000
Puerto Rico	Penuelas	EcoElectrica	2000	1	160,000
Singapore	Singapore	Singapore Energy Authority	2013	3	540,000
Spain	Barcelona	Enagas	1969	8	840,000
	Huelva	Enagas	1988	5	610,000
	Cartagena	Enagas	1989	5	587,000
	Bilbao	Enagas, EVE	2003	3	450,000
	Sagunto	GNF, Osaka Gas, Oman Oil	2006	4	600,000
	Reganosa, Ferrol	Galicia, Sonatrach, Tojeiro	2006	2	300,000
	El Musel, Gijón,	Enagas	2013	2	300,000
Taiwan	Yung-An	CPC	1990	6	690,000
	Tai-chung	CPC	2009	3	480,000
Thailand	Map Ta Phut	PTT LNG	2011	2	320,000
Turkey	Marmara Ereglisi	Botas	1994	3	255,000
	Izmir	EgeGaz	2006	2	280,000
USA	Everett	Suez LNG NA	1971	2	155,000
	Lake Charles	Shell, ETE	1982	4	425,000
	Elba Island	Kinder	2001	5	535,000
	Cove Point	Dominion	2003	5	530,000
	Freeport	Freeport LNG Development	2008	2	320,000
	Cameron	Sempra LNG	2009	3	480,000
	Golden Pass, TX	Qatar Petroleum, ExxonMobil	2010	5	775,000
	Pascagoula, MS	Gulf LNG, Kinder	2012	2	320,000
UK	Isle of Grain	National Grid	2005	8	1,000,000
	South Hook	ExxonMobil, Qatar Petroleum,Total	2009	5	775,000
	Dragon LNG, Milford Haven	Shell, Petronas	2009	2	310,000

LNG Import Terminal Projects

Country	Location/Project	Owners/Project Developers	Start up	Storage Tanks	Storage Capacity
China	Tianjin North	Sinopec	2017	2	320,000
	Zhoushan Zhejiang	Enn Group	2018	2	320,000
Finland	Tornio	Gasum Skanga	2018	1	30,000
Gibraltar	Gasnor	Shell	2017	1	5,000
India	Ennore	Indian Oil Corp	2018	2	320,000
	Mundra	Gujarat State Petroleum, Adani Group	2018	2	320,000
	FSRU Andhra Pradesh	Engie, Andhra Pradesh Gas	2018	1	135,000
	Pipovav LNG (FSRU), Gujarat	Swan Energy	2018	2	320,000
	Andhra Pradesh	Hindustan LNG, Andhra Pradesh	studies	1	135,000
Indonesia	Labuhan Maringgai	Perusahaan Gas Negara	2018	1	135,000
Japan	Soma, Fukushima	Japan Petroleum	2018	1	230,000
Malaysia	Lahad Datu LNG, Sabah	Petronas	2018	studies	
	Pengerang Johor	Petronas	2019	2	320,000
Panama	Costa Norte	AES	2018	1	130,000
Philippines	Pagbilao LNG	Energy World Corp.	2017	1	130,000
UK	Port Meridian, Barrow-in-Furness	Port Meridian Energy Ltd.	2018	1	150,000
Uruguay FSRU	Montevideo	Gas Sayago, Mitsui Osk Lines	2018	1	230,000

LNG FSRU Import Facilities

Country	Location (Project)	Owners	Start up
Argentina	Bahia Blanca GasPort	Excelerate/YPF Repsol	2008
	Escobar GasPort	Excelerate/Enarsa	2011
Brazil	Pecem, FSRU	Petrobras	2009
	Guanabara Bay FSRU	Petrobras	2009
	Salvador, Bahia FSRU	Petrobras	2013
Colombia	Cartagena FSRU	Promigas, Sociedad Portuaria El Cayao	2016
Egypt	Ain Sokhna, Suez	EGAS, Hoegh	2015
	Ain Sokhna, Suez	EGAS, BW Gas	2015
Indonesia	Lampung	Hoegh LNG, PGN LNG	2014
	Nusantara (Jakarta Bay)	Golar LNG, Pertimana	2012
Italy	Livorno	OLT Offshore LNG Toscana	2013
Jordan	Aqaba, Jordan	Golar LNG	2015
Kuwait	Mina Al-Ahmadi	KPC	2009
Lithuania	Klaipeda	Klaipedos Nafta Hoegh LNG	2014
Malaysia	Malacca FSRU	Petronas	2012
Malta	FSU Armada Mediterrana	ElectroGas	2016
Pakistan	Port Qasim	Excelerate, Engro Corp	2015
Turkey	Aliaga FSRU, Neptune	Etki LNG	2016
UAE	Ruwais, Abu Dhabi	Gasco (UAE)	2016
	Jebel Ali Port, Dubai	DSA (UAE)	2010
UK	Teesside GasPort	Excelerate	2007

LNG Export Projects

Country	Location/Project	Project Developers	Planned Start Up	Number of Trains	Capacity In MTPA
AUSTRALIA	Browse LNG	Woodside, BHP, BP Chevron, Shell, Mitsubishi, Mitsui	2021+	2	10.0
	Ichthys LNG	INPEX, Total	2017	2	8.4
	Prelude FLNG	Shell, Inpex, Kogas CPC	2018	1	3.5
CANADA	Bear Head LNG, Nova Scotia	LNG Ltd.	2024	4	8.0
	GNL Quebec, Saquenay	Freestone Capital and Breyer Capital	2024	4	10.0
	Goldboro LNG, Nova Scotia	Pieridae Energy	2024	2	10.0
	Kitimat LNG, BC	Woodside, Chevron	2024	2	10.0
	LNG Canada, BC	Shell, Mitsubishi, Kogas, PetroChina	2024	2	12.0
	Melford LNG project, Nova Scotia	H-Energy Hiranandani Group	Studies		
	Steelhead LNG, Bamfield	Steelhead LNG Corp	2021	2	12.00
	Vancouver Tilbury	WesPac Midstream	2021	1	3.25
	Woodfibre LNG, Squamish	Pacific Oil & Gas Co	2020	2	2.1
EQ.GUINEA	Equatorial Guinea Fortuna FLNG	Ophir, Golar LNG, Schlumberger, GEPetrol	2019	1	2.0
INDONESIA	Sengkang LNG	Energy World Corp.	2017	4	2.0
MALAYSIA	Rotan FLNG (Sabah)	Petronas, Murphy Oil	2019	1	1.5
MOZAMBIQUE	Area 1 Onshore	Anadarko Petroleum and partners	2021	2	10
	Area 4 Onshore	Eni and partners	2021	2	10
	Area 4 FLNG	Eni and partners	2019	1	2.5
NIGERIA	NLNG Train 7	NNPC, Shell, BP, Total	2020+	1	8.4
PAPUA NEW GUINEA	Elk-Antelope LNG	Total, ExxonMobil Oil Search, Petromin	Studies		
RUSSIA	Yamal LNG Siberia	Novatek, Gazprom, Total	2018	3	16.5
	Sakhalin II expansion	Gazprom, Shell, Mitsui, Mitsubishi	2021	studies	
	Vladisvostok LNG	Gazprom, Itochu, various	2021	2	10.0
USA	Alaska LNG Nikiski	Alaska Gasline Development Corp.	2022	3	20.0
	Annova LNG, Brownsville	Exelon Corp.	2021	6	6.0
	Cameron LNG, Louisiana	Sempra	2018	5	24.92
	Corpus Christi Liquefaction, Texas	Cheniere	2019	5	22.5
	Delfin LNG, Louisiana	Delfin, Hoegh	2021	3	9.0
	Driftwood LNG, Louisiana	Tellurian Investments	2022	6	26.0
	Elba Island, Georgia	Kinder Morgan, EIG Energy	2018	10	2.5
	Freeport LNG, Texas	Freeport LNG	2018	4	20.4
	Golden Pass, Texas	Qatar Petroleum, ExxonMobil	2021	3	15.6
	Jordan Cove, Coos Bay	Veresen Inc.	2024	2	7.8
	Lake Charles, Louisiana	Shell, ETE	2024	3	15.0
	Magnolia LNG	Louisiana LNG Ltd.	2021	4	8.0
	Port Arthur LNG	Sempra	2021	2	10.0
	Rio Grande LNG	NextDecade	2021	6	27.0
	Sabine Pass LNG, Louisiana	Cheniere	2018-19	2	9.0
	Texas LNG Brownsville	Chandra, Meyer, Samsung, others	2021	2	4.0
	VG LNG (Cameron Parish)	Venture Global	2021	5	10.0
	VG LNG (Plaquemines)	Venture Global	2021	10	20.0

LNG Exporters

Country	Location/Project	Shareholders	Start up	Liquefaction		Storage	
				Trains	capacity (nominal) mtpa	No. of tanks	Total capacity m^3
ABU DHABI (UAE)	Das Island (Adgas)	ADNOC, Mitsui, BP, Total	1977	2	3.2	3	240,000
			1994	1	2.5		
ALGERIA	Arzew	Sonatrach GL4Z	1964	3	1.1	3	35,000
	Arzew	Sonatrach GL1Z	1978	6	7.8	3	300,000
	Arzew	Sonatrach GL2Z	1980	6	8.0	3	300,000
	Arzew	Sonatrach	2014	1	4.7		
	Skikda	Sonatrach GL1K II	1980	3	3.0	5	308,000
	Skikda	Sonatrach (rebuild)	2013	1	4.5		
ANGOLA	Soyo	Sonangol, Chevron, BP, ENI, Total	2012	1	5.2	2	370,000
AUSTRALIA	Karratha	NWS Woodside, Shell, BHP	1989	2	5.0	4	260,000
		(BP, Chevron	1992	1	2.5	1	130,000
		(Mistubishi/Mitsui)	2004	1	4.4	1	130,000
		NWS partners	2008	1	4.4	1	130,000
	Darwin	Darwin (Bayu Undan) ConocoPhillips, Santos, Eni, Inpex, TEPCO, Tokyo Gas	2006	1	3.5	1	188,000
	Australia Pacific LNG	ConocoPhillips, Origin Energy, Sinopec	2016	2	7.5	2	320,000
	Gladstone LNG	Santos, Petronas, Total, Kogas	2015	2	7.8	2	280,000
	Gorgon LNG	Chevron, Shell, ExxonMobil	2016	3	15.6	2	360,000
	Pluto LNG	Woodside, Tokyo Gas, Kansei	2012	1	4.8	2	240,000
	QCLNG	Shell, CNOOC	2014	2	8.0	2	280,000
	Wheatstone LNG	Chevron, Woodside, Kuwait (KUFPEC), Jera, Kyushu	2017	2	8.9	2	300,000
BRUNEI	Lumut	Brunei/Shell/Mitsubishi/Total	1972-74	5	7.2	3	176,000
EGYPT	Damietta	Union Fenosa, EGPC, EGAS	2004	1	5.0	2	300,000
	Idku	EGPC, EGAS, Shell, Engie, Petronas	2005	2	7.2	2	280,000
EQ.GUINEA	Bioko Island	Marathon, Sonagas, Mitsui, Marubeni	2007	1	3.4	2	272,000
INDONESIA	Bontang I	Pertamina, VICO, JILCO, Total	1977	2	5.2	5	635,000
	Bontang II		1983	2	5.2		
	Bontang III		1989	1	2.8		
	Bontang IV		1993	1	2.8		
	Bontang V		1997	1	2.8		
	Bontang VI		1999	1	3.0		
	Sulawesi LNG	Medco Energi, Pertamina, Mitsubishi	2015	1	2.0	1	170,000
	Tangguh	BP, MI Berau, CNOOC, Nippon, LNG Japan	2008	2	7.6	2	340,000
MALAYSIA	Bintulu (MLNG Satu)	Petronas, Sarawak, Mitsubishi	1983	3	8.1	4	260,000
	Bintulu (MLNG Dua)	Petronas, Shell, Sarawak, Mitsubishi	1995	3	7.8	1	65,000
	Bintulu (MLNG Tiga)	Petronas, Shell, Sarawak, Mitsubishi, Nippon Oil	2003	2	6.8	1	120,000
	Bintulu Train 9	Petronas	2016	1	3.6		
	Kanowit FLNG	Petronas	2016	1	1.2		
NIGERIA	Bonny Island	NNPC, Shell, Total, Eni	1999	2	6.4	2	168,400
		Nigeria LNG (formed by above)	2002	1	3.2	1	84,200
		Nigeria LNG	2006	2	8.2		
		Nigeria LNG	2008	1	4.1	1	84,200
NORWAY	Snøhvit/Melkoya Island	Statoil, Total, GDF-Suez, Petoro	2007	1	4.2	2	280,000
OMAN	Oman LNG	Oman Govt., Shell, Total, Korea LNG Mitsubishi, Mitsui, Partex and Itochu	2000	2	7.1	2	240,000
		Oman Govt.,Oman LNG Union Fenosa, Osaka Gas, & Itochu	2006	1	3.7	2	240,000
PAPUA NEW GUINEA	PNG LNG	ExxonMobil, Oil Search, Santos, JX Nippon Oil	2014	2	6.9	2	320,000
PERU	Peru LNG	Hunt Oil, Shell, Marubeni, SK Group	2010	1	4.4	2	260,000
QATAR	Qatargas 1-T1&2	QP, ExxonMobil, Total, Marubeni, Mitsui	1997	2	6.4	4	340,000
	Qatargas 1-T3	QP, ExxonMobil, Total, Marubeni, Mitsui	1999	1	3.1		
	Qatargas II-T1	QP, ExxonMobil	2009	1	7.8		
	Qatargas II-T2	QP, ExxonMobil, Total	2009	1	7.8	8	1,160,000
	Qatargas III-T1	QP, ConocoPhillips, Mitsui	2010	1	7.8		
	Qatargas IV-TI	QP, Shell	2010	1	7.8		
	RasGas I- T1&2	QP, ExxonMobil, Kogas, Itochu, LNG Japan	1999	2	6.6		
	RasGas II- T3	QP, ExxonMobil	2004	1	4.7		
	RasGas II- T4	QP, ExxonMobil	2005	1	4.7	6	840,000
	RasGas II- T5	QP, ExxonMobil	2007	1	4.7		
	Rasgas III – T6	QP, ExxonMobil	2009	1	7.8		
	Rasgas III – T7	QP, ExxonMobil	2010	1	7.8		
RUSSIA	Sakhalin Island	(Sakhalin Energy) Gazprom, Shell, Mitsui, Mitsubishi	2009	2	9.6	2	200,000
TRINIDAD & TOBAGO	Point Fortin Train 1	BP, Shell, CIC, NGC	1999	1	3.0	2	204,000
	Train 2	BP, Shell	2002	1	3.3	1	160,000
	Train 3	BP, Shell	2003	1	3.3	1	160,000
	Train 4	BP, Shell, NGC	2005	1	5.2	1	160,000
USA	Cheniere Sabine Pass	Cheniere Energy	2016	4	18.0	5	800,000
	Cove Point LNG	Dominion Energy	2017	1	5.3	7	695,000
	Kenai - Alaska	ConocoPhilips, Marathon Oil	1969	2	1.3	3	108,000
YEMEN	Bal-Haf	Yemen LNG, Total, Yemen Gas, Hunt Oil, SK Group, Hyundai	2009	2	6.7	2	320,000

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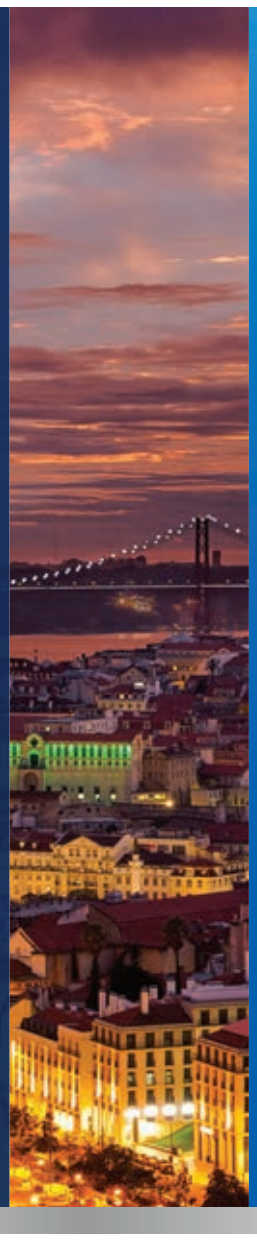

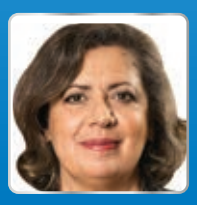

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