LNG journal
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July/August 2017

In this issue:

Importance of LNG trade grows with global gas markets through 2020

BP Review says the equivalent of one new production Train is coming onstream every two or three months

The past year has been the first showing of the growth spurt previously forecast in the liquefied natural gas sector and BP expects to see global supplies increase by around a further 30 percent by 2020.

That is one of the main points made in the Annual Statistical Review of World Energy 2017 just published by BP and which also noted that consumption of natural gas worldwide increased by 1.5 percent, or 63 billion cubic metres, quite a bit weaker than its 10-year average (2.3 percent).

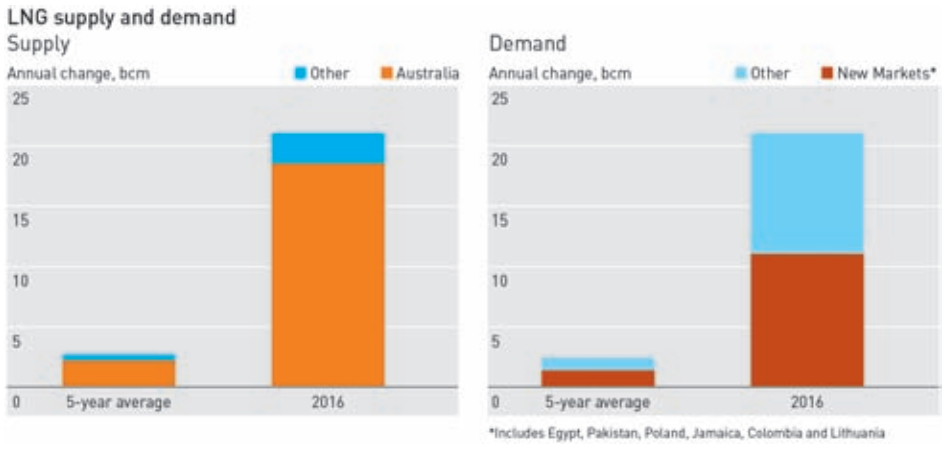

Figure 1: The current global LNG picture with new markets

New Trains

However, on the LNG front the equivalent to a new production Train is coming onstream every two-to-three months for the next four years and this is "quite astonishing" growth, BP said.

"As the importance of LNG trade grows, global gas markets are likely to evolve quite materially.

"Alongside increasing market integration, we are likely to see a shift towards a more flexible style of trading, supported by a deeper, more competitive market structure.

"Indeed, this shift is already apparent, with a move towards smaller and shorter contracts and an increase in the proportion of LNG trade which is not contracted and is freely traded," said the report.

"A particularly interesting market in the context of the growing LNG supplies is Europe," it noted.

"On the one hand, Europe's large and increasing need for imported gas, combined with its relatively central location amongst several major LNG suppliers, means Europe is often highlighted as a natural growth market for LNG.

"On the other hand, Europe's access to plentiful supplies of pipeline gas, particularly from Russia, means LNG imports are likely to face stiff competition," the UK company said.

"In terms of this battle of competing supplies, Round 1 went to pipeline gas," it stated.

The BP Annual Statistical Review, much awaited by the industry, said there was sub-par growth in global natural gas production as the US benchmark Henry Hub price was 5 percent lower than in 2015, European and Asian gas markers were down 20-30 percent and the pricing environment continued to adjust to increased LNG supplies.

That's as gas production was essentially flat at 0.3 percent, or 21 Bcm, the weakest growth in gas output for 34 years, other than in the immediate aftermath of the financial crisis.

Increase

"Even so, exports of LNG increased strongly, as a number of major LNG projects in Australia came onstream," said BP Chief Executive Bob Dudley in presenting the Review.

"The growth spurt in LNG supplies expected over the next few years is likely to have a major influence on global gas markets, leading to greater integration of markets across the globe and a move towards more flexible, competitive markets," said the BP CEO.

Lacklustre

The UK major said that much of the lacklustre performance can be traced back to the US, particularly on the supply side where falls in gas (and oil) prices caused US gas production to fall by 2.5 percent, or 17 Bcm.

"This was for the first time since the US shale-gas revolution started in earnest in the mid-2000s," said BP.

"Outside of the US, on the demand side, gas consumption in Europe rose strongly (6 percent, 28 Bcm) helped by both the increasing competitiveness of gas relative to coal and weakness in European nuclear and renewable energy," the company added.

"The Middle East (3.5 percent, 19 Bcm) and China (16 Bcm, 7.7 percent) both also recorded strong increases aided by improving infrastructure and availability of gas," the report said of the global natural gas market.

"The largest falls were in Russia (-12 Bcm, -3.2 percent) and Brazil (-5 Bcm, -12.5 percent) both of which benefited from strong increases in hydropower," according to BP.

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"On the supply side, Australian production (19 Bcm, 25.2 percent) was the standout performer as several new LNG facilities came onstream.

Source

"Looking at the growing market for LNG, although China continued to provide the main source of growth, it's striking that the increasing availability of supplies has prompted a number of new countries, including Egypt, Pakistan and Poland, to enter the market in the last year or two.

"These new entrants were helped by the increased flexibility afforded by plentiful supplies of floating storage and regasification units (FSRUs)," it added.

Europe's gas imports increased markedly last year, reflecting the strong increase in demand, together with weakness in the domestic production of natural gas.

But virtually the entire rise in European imports was met by pipeline gas, from a combination of Algerian and Russian supplies, with imports of LNG barely increasing.

"The economic incentives in this battle of competing supplies are clear: just as with OPEC's response to the emergence of US tight oil, Russia has a strong incentive to compete to maintain its market share in the face of growing competition from LNG supplies," BP explained.

Competitive

"But this competitive process is complicated by possible concerns about Europe being overly dependent on a single source of large amounts of LNG imports in 'normal' times, but it has the option of doing so if the need arises," it added.

"Stability and energy markets don't go together. It's like England and summer or, perhaps after last week, predictability and elections," said the main author of the Review, BP Group Chief Economist Spencer Dale, at the London presentation.

"Booms and busts, rebounds and reversals are the norm.

"But the movements and volatility seen last year in energy markets were particularly interesting since they were driven by two separate forces: the continued adjustment to the short-run - cyclical - shocks that have rocked energy markets in recent years; overlaid by the growing gravitational pull from the longer-run energy transition that is underway," explained Spence.

Slowdown

"This brake in China's energy consumption partly reflects the general slowdown in economic growth. But it has been greatly compounded by the particularly pronounced weakness in China's most energy-intensive sectors, particularly iron, steel and cement, whose outputs have fallen in absolute terms in recent years.

"The key point here is that these sectors account for around a quarter of China's total energy consumption and have played a major role in the recent slowing in China's energy demand," said Spence.

"Some of the weakness in these sectors, which were the powerhouse of China's rapid growth and industrialization over much of the past 20 years, reflects the structural rebalancing of the economy towards more consumer and service facing sectors. But the scale of the slowdown suggests that some bounce-back is perhaps likely," he said.

Russia has a strong incentive to compete to maintain its market share in the face of growing competition from LNG supplies

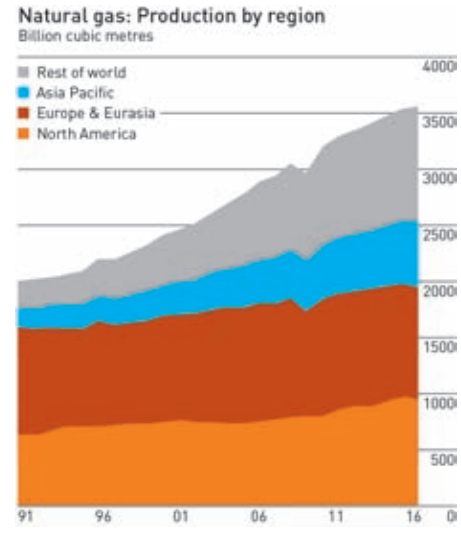

Figure 2: Output is growing because of unconventional gas fields

"On the LNG supply side, Australian production (up 25.2 percent, 19 Bcm) was the standout performer as several new LNG facilities came on stream," said Spence.

Alongside greater market integration there was a shift to a more flexible style of trading, supported by a more competitive market structure.

He touched on the economic incentives in the battle of competing supplies of LNG and pipeline.

Complicated

"But this competitive process is complicated by possible concerns about Europe being overly dependent on a single source of supply and the energy security issues this might raise," he stated.

"This is the third Statistical Review that I have managed. And I must admit I approach the task with equal amounts of honour and trepidation," said Spence.

"The Stats Review has a well-earned reputation, built up over many years, for being THE reference source for comprehensive, accurate and timely global energy data," he added.

"My role as guardian of this valued asset is made hugely easier by the work of the Economics team who, as always, have worked tirelessly over the past couple of months to produce this year's Review.

"And by the team from Heriot-Watt University (in Edinburgh), led by Mark Schaffer and Erkal Ersoy, who yet again provided great help and support," he said. ■

LNG market place becomes more complex and interconnected as US output capacity expands

Two European gas benchmarks will be key to gauging American cargo competitiveness on a global basis

Global gas markets have grown more complex and interconnected. As US LNG capacity expands, a view on US gas prices will increasingly require an opinion on international gas and oil balances, global coal markets and European carbon prices, according to a new report.

The latest commodities research report from the investment bank unit of Barclays shows US LNG has so far had little effect on European gas prices.

"However, as US LNG volumes ramp up, any sign of increased US LNG cargoes moving into Northwest Europe will mean that the US LNG is struggling to compete globally and will be a bearish signal for US gas prices," the report said.

In its report Barclays said it was initiating forecasts on the UK National Balancing Point benchmark and the Dutch Title Transfer Facility hub in the Netherland, two benchmarks which the bank says will be key in gauging US LNG's competitiveness in a global market as Europe sets the price floor.

"Our current Henry Hub and Northwest European (NWE) price forecasts suggest that NWE prices will continue to be high enough to support US LNG imports over 2017-2018.

Supportive

"This will be supportive of high utilization rates at US LNG export terminals and on the margin bullish for Henry Hub prices," it said.

The Barclays report sees Europe being the sink for excess LNG cargoes in the coming years and can, thus, expect lower gas prices compared with historical averages.

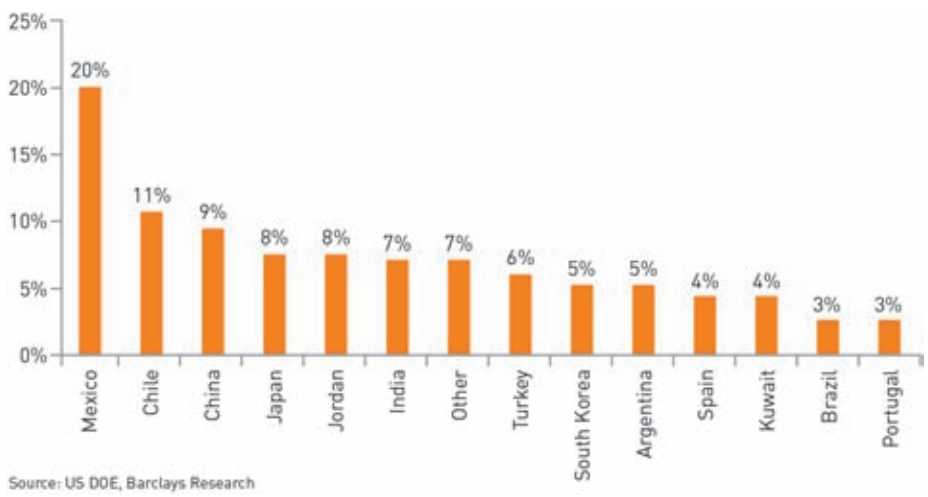

Figure 1: From the start of 2016 through May 2017, about 40 percent of US LNG exports have gone to markets in the America

This will boost natural gas's competitiveness in the European power sector at the expense of coal.

The major supply sources with pricing power over the European market will include Russian pipeline gas, non-US LNG and US LNG.

"Of these, US LNG will have the highest cost structure. We expect that prices will find a ceiling at the coal to gas switching level, which currently supports all three of these supply sources," the bank explained.

Complex

"Following and forecasting US gas prices is starting to become much more complex. Gone are the days when US natural gas watchers can simply follow their own North American gas island," the report stated.

In addition to the Sabine Pass plant in Louisiana owned by Cheniere Energy, the US Department of Energy reported that the latest list of US LNG projects under construction includes five projects and 13 liquefaction Trains.

Combined, these will, in aggregate, provide the US with the option of exporting as much as 62 million tonnes per annum by 2020, amounting to 8.2 billion cubic feet per day.

"As US LNG exports contribute a larger portion of the overall domestic supply-demand balance, understanding the role these exports play in the global market helps reinforce a view on the direction of US gas prices.

"Given the way that US LNG contracts are structured, offtakers have the option of not lifting cargoes, an event that would be bearish for US prices.

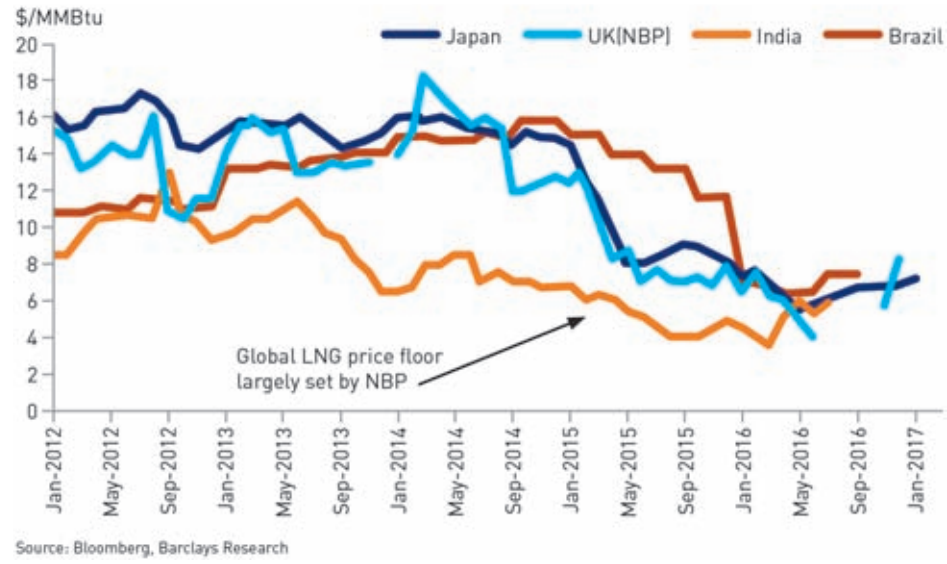

Figure 2: Northwest European prices (NBP-TTF) will continue to set the floor for global LNG prices as the market of last resort

"If US LNG arbitrage economics are not attractive, the gas will be left in the US system. This will put downward pressure on prices until the arbitrage window is once again open with international markets," the report explained.

"Eventually, as volumes ramp up in the coming years, US short run marginal cost (SRMC) LNG should start to set a new long-term ceiling for US gas prices likely occurring by as soon as late 2018-early 2019," said Barclays.

Speculation

"There has been much speculation about the eventual flood of global LNG headed for Europe's shores. Global LNG volumes will likely grow by about 40 percent by 2020, driven by large capacity build outs in the US, Australia, and Russia.

"Given the finite amounts of incremental demand in the premium markets of Asia, the Middle East, and South America, increasing volumes of LNG will likely be imported into Europe, especially northwest Europe, given the region's liquidity relative to other global gas markets (the UK, Belgium, and the Netherlands)," it added.

The bank report said that as long as European prices remain above the SRMC of US LNG, this should bode well for utilization levels at US export facilities and, thus, be bullish for US natural gas prices.

"Our US and European price forecasts point to US SRMC LNG costs continuing to be below Northwest European (NWE) prices markers UK NBP and Dutch TTF for 2017 and 2018.

"We define US SRMC LNG as 115 percent of Henry Hub + shipping + regas. We have assumed 45 cents/MMBtu shipping to NWE and a 30 cent/MMBtu regas charge.

"By the end of 2018, operational US LNG projects will include Sabine Pass (four Trains), Cove Point (one Train), Freeport LNG (one Train) and Cameron LNG (two Trains). We are estimating that US LNG exports average 2.1 Bcf/d in 2017 and 3.2 Bcf/d in 2018, compared with just 600 MMcf/d in 2016," the report added.

"The NWE-US SRMC spread will come under the most pressure during the summer when NWE prices are typically at their lowest and US prices have found strength on the back of higher gas usage in the power sector.

"We expect the spread to fall to just 37 cents/MMBtu in Q3 17 and the spread to reach its annual low in Q3 2018. The window for long run marginal cost LNG (LRMC), which includes the fixed commodity charge, will remain closed into Europe during 2017/18, according to our forecasts," said the report.

Risks

"We see the largest risks to the NWE-US SRMC spread coming from a collapse in oil prices or a spike in US Henry Hub prices.

"All else equal, a 25 percent lower Brent price compared with our current forecast results in the NBP-SRMC US LNG arb (window) closing, while, similarly, a 30 percent higher Henry Hub cash price compared with our current forecast would also close the arb," it said.

2017	Henry Hub	NBP	TTF	NBP-HH
Q1	2.98	6.01	5.79	3.03
Q2	2.97	4.86	4.91	1.89
Q3	3.19	4.79	4.80	1.60
Q4	3.35	5.24	5.01	1.89
Annual Avg	3.12	5.23	5.13	2.10
2018				
Q1	3.27	5.64	5.42	2.37
Q2	3.14	5.38	5.41	2.24
Q3	3.17	5.15	5.16	1.98
Q4	3.09	5.51	5.28	2.42
Annual Avg	3.17	5.42	5.32	2.25

Source: Barclays Research

Figure 3: US Henry Hub, UK NBP and the Netherland's TTF gas price forecasts

The report also explained that European gas prices, which have historically been linked to oil and oil products, continue to have a correlation with the oil price.

Although higher amounts of gas volumes are being indexed to hub pricing, oil still affects European natural gas prices

Stopped

"Despite LNG production that was up 7.5 percent last year, a cold winter in East Asia, a handful of LNG project outages and growing niche market demand has, so far, prevented this deluge of LNG from entering European markets.

"European LNG imports have been largely flat year-on-year with imports into Northwest Europe down about 25 percent through May 2017.

"European imports are up by 2.5 percent y/y, driven by higher imports into Southern Europe.

"However, Northwest European markets have been largely ignored, with import levels down 50 percent y/y. The lack of deliveries has helped support European price levels. Although US LNG cargoes have been imported into Southern Europe, the first cargo into Northwest Europe (Netherlands) was in early June," Barclays explained.

The thesis that prices in Europe will be pushed below the SRMC in the coming years, affecting US LNG utilization rates, is, of course, predicated on the idea that large amounts of "homeless" LNG will find their way to European markets.

"The most severe pressure on European prices is likely to occur in 2018/2019, coinciding with the peak in incremental LNG supply growth.

Spot cargoes

"During these years, it is most likely that higher levels of spot LNG enter Europe, pushing prices below the coal to gas switching level to create higher demand.

"Of course, unforeseen circumstances, such as weather and global demand for LNG in premium markets or unforeseen supply disruptions, would create a scenario in which prices would not come under as much pressure as otherwise anticipated," the report said.

It noted that key signposts that Europe is about to start receiving higher volumes of LNG imports include any weakness in Chinese LNG imports. China is expected to be the largest incremental demand source for LNG in the coming years.

"A slowdown there will bode poorly for the LNG market and likely result in higher volumes targeting Europe.

"Another signpost to watch out for will be an increase in east to west trade volumes.

"Typically, Asia-Pacific basin LNG will stay within the basin, given its proximity to the premium markets of Asia.

"However, if there starts to be an increase of Asia-Pacific cargoes moving outside the basin, this will be a sign of an oversupplied market and a sign that Europe will soon begin to experience higher volumes.

"This trend will likely start with more Asia-Pacific cargoes looking for homes in the Middle East markets, before eventually spilling over into Europe," it stated.

Three supply sources can affect prices in the coming years: Russian pipeline gas, US LNG, and non-US LNG.

"Each of these can play a swing role in supplying gas into Europe. Although other exporters such as Algeria, Norway,

and Libya (Azerbaijan early next decade) are important sources of supply into Europe, we do not view them as having the ability to dramatically increase delivered volumes in the coming years.

Control

"The suppliers with the lowest short-run marginal costs will have the most control and the widest range of options in dealing with Europe's new role as a global gas backstop.

In its conclusion to their report, the analysts said that the ultimate floor price in Europe will be non-US LNG projects that have fully depreciated upstream and liquefaction capital costs.

Many of these projects also have the benefit of associated liquids production, which further lowers variable costs.

Using Qatar as an example, we estimate that volumes could be delivered into Europe at $1.75-2.00/MMBtu, not including the cost of regasification. Given these low levels, shut-ins are highly unlikely.

However, many of these projects are contracted under long-term arrangements and given that Europe will set the price floor for the LNG market, projects will only send cargoes into Europe as a last option.

Regarding Russian pipeline gas, Gazprom has supplied almost 30 percent of total EU-28 gas supply since 2010. Gazprom has played the role of Europe's swing supplier and Gazprom's estimates point to potential spare capacity close to 200 Bcm/y.

Gazprom's variable costs into Europe are likely about $2.50/MMBtu, but could be lower, dependent on Russian tax policy (closer to $2.00/MMBtu).

"Given the way that US LNG offtake arrangements are structured, this supply source will likely have the highest short-run marginal cost of the ones discussed so far," it added.

The bank's formula shows that at $3.00/MMBtu Henry Hub (US gas price benchmark), the short-run marginal cost of US LNG into Europe would be about $4.20/MMBtu. ■

The article is based on extracts from a report by Barclays commodities research first published on 7 June 2017.

For the Record

AUSTRALIAN LNG export plants performed strongly last month with the established West Coast facilities, North West Shelf, Pluto and Darwin all producing at above contract levels, while the new Gorgon plant continued to ramp up. Despite problems with Train 1, the Chevron-operated Gorgon facility produced more than its two-Train nameplate capacity, according to the latest report from Australian consultants EnergyQuest. Shipments from the Australia Pacific LNG plant in the East Coast state of Queensland also exceeded nameplate capacity as the plant underwent its operational test, suggesting APLNG will have future capacity for spot cargoes. West Coast plants shipped 2.8 million tonnes (up from 2.2MT in April) and Queensland plants delivered 1.7MT, up from 1.6MT in April. The new Wheatstone project being developed by Chevron and with Woodside Petroleum as a partner is due to start production in August. The volume of LNG deliveries from Australia was higher in May than April, rising to 4.3MT compared with 4.0MT. "Australia is more than holding its own in its key North Asian markets. Australia continues to be the largest LNG supplier to Japan and China and the second-largest to Korea after Qatar," said EnergyQuest. Based on April import data, Australia supplied 46 percent of Chinese LNG imports, 29 percent of Japanese imports and 21 percent of Korean imports. In April, there were only two cargoes to North Asia from the US, which is now a key competitor. "Both US cargoes appear to have been spot shipments and therefore at lower prices than Australian cargoes under oil-linked contracts," the report said. "State-owned Chinese LNG importers have been given the green light to negotiate long-term contracts for US LNG but China already imports more LNG than it needs," it noted. "Japan, China and Korea continue to be the dominant destinations for Australian exports, comprising 89 percent of deliveries in May (90 percent in April)," said EnergyQuest. May deliveries to Japan were the lowest this year at 30 cargoes but 21 cargoes were delivered to China, up from 14 in April, with increased deliveries from most plants but particularly APLNG, where Sinopec has a stake. According to the Australian Bureau of Statistics, the May LNG export revenue is likely to have passed $2.0 billion compared with revenue in April of $1.85 billion.

BANGLADESH has chosen Swiss commodities company Astra Transcor Energy (AOT) to help procure liquefied natural gas shipments for a new floating storage and regasification project scheduled to come on line in mid-2018 on an island in the Bay of Bengal. A memorandum of understanding just signed commits AOT to help supply state-run oil and gas company PetroBangla with LNG cargoes. AOT has widespread commodity interests and operates from a group headquarters in the town of Zug, central Switzerland. Excelerate Energy, the US FSRU project specialist, is chartering the vessel to Bangladesh as its first floating import terminal at Moheshkhali Island, scheduled to begin commercial operations by May 2018. Excelerate and the International Finance Corp. (IFC), a lending institution of the World Bank, are setting up the import facility and related infrastructure, supported by the Bangladesh Energy Ministry and PetroBangla. The US company will deliver the Bangladesh FSRU on a build-own-operate-transfer basis. The vessel will have storage capacity of 138,000 cubic metres and regasification capacity of 500 million standard cubic feet per day. Excelerate has completed the required geotechnical and geophysical studies for the implementation of the Moheshkhali floating terminal. Bangladesh has said it needs at least two more LNG import terminals in addition to the Excelerate FSRU to meet its natural gas needs. The Asian nation, whose neighbours India and Pakistan are both LNG importers, is estimated to need 35 percent more natural gas than it currently consumes just to eliminate shortages. Bangladesh's huge unmet gas demand is particularly felt in the power generation sector. Excelerate will own and operate the FSRU terminal under a 15-year agreement with PetroBangla.

BP of the UK and one of India's largest conglomerates, Reliance Industries, plan to develop two deepwater natural gas fields to bring new production to India at a time when the nation is also increasing its LNG imports and expanding its regasification and pipeline infrastructure. BP and Reliance said they would award contracts to advance development of the deepwater gas fields in Krishna Godavari Dhirubhai Block 6 offshore the East Coast of India. The project takes its name from India's Krishna-Godavari Basin, which covers more than 19,000 square miles offshore the state of Andhra Pradesh in the Bay of Bengal. The KG-D6 block was Reliance's first offshore gas field development and its first underwater discovery. It was also India's largest deposit of natural gas when first found in 2002. The new BP-Reliance project will be known as the "R-series (D34)" project, a gas development in water depths of more than 2,000 metres and about 70 kilometres offshore. The KG-DG well pressure and overall complexity of the offshore area in the Bay of Bengal will make it a difficult project. The R-series fields will be developed as a subsea tieback to the existing control and riser platform off Block KGD6. The project is expected to produce up to 12 million cubic metres (425 million cubic feet) of gas a day, coming on stream in 2020. "This is the first of three planned projects in Block KGD6 that are expected to be developed in an integrated manner, producing from about 3 trillion cubic feet of discovered gas resources," said the statement from BP and Reliance. Development of the three projects will involve total investment of 40,000 crore of Indian rupees ($6 billion) and is expected to bring a total 30-35 million cubic metres (1 billion cubic feet) of gas a day in new domestic production. The gas will come on stream in a phased manner between 2020 and 2022. "We are delighted to progress these developments, which will provide India with much needed indigenous energy and support the Prime Minister's call for import substitution and the development of a gas-based economy," said Mukesh Ambani, Chairman and Managing Director of Reliance. "The solid relationship between our two companies is a great example of what can be achieved while working together at scale," added Ambani. The two companies have also agreed to deepen and expand their partnership to work jointly across a wide range of areas throughout India's energy sector. Speaking in New Delhi after the project was announced, BP Chief Executive Bob Dudley stated: "This is an important step forward for BP in India. Working closely together, Reliance and BP are now able to develop these major deepwater gas resources offshore India efficiently and economically." India currently consumes more than 5 billion cubic feet a day of natural gas and aspires to double gas consumption by 2022. "Gas production from the integrated development is expected to help reduce India's import dependence and amount to over 10 percent of the country's projected gas demand in 2022," said BP and Reliance.

BP has advanced with more feed-gas plans for the Atlantic LNG export plant in Trinidad by signing a contract with US energy engineers McDermott International Inc. for a new natural gas field development. BP said the engineering, procurement, construction, installation, and commissioning (EPCIC) contract was signed for the Angelin natural gas field 25 miles offshore eastern Trinidad and Tobago. The Angelin project is 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 at Point Fortin and the liquids produced will go to Galeota terminal via a new 13-mile pipeline. BP is also 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. 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. McDermott declined to disclose the value of the award from BP but said the "large lump-sum contract" would be reflected in McDermott's second-quarter 2017 backlog. The US company said the EPCIC contract for Angelin followed its successful completion of front-end engineering and design and a pre-execution contract for the field. McDermott said its teams in Houston, Texas, led the engineering and execution planning efforts for that work with support from the company's engineering centre in Chennai, India. "This is a great opportunity for us to build on the relationship and trust developed through the execution of the FEED for the Angelin project," said Scott Munro, McDermott Vice President for Americas, Europe and Africa. "Through early engagement and aligning our respective goals, McDermott

and BPTT have partnered to optimize the delivery of this very important project," added Munro. McDermott said its turnkey EPCIC work includes design, procurement, fabrication, transport, installation and commissioning of a six-slot wellhead platform and 26-inch subsea pipeline using its project management and engineering team in Houston. The 992-tonne, four-legged main pile jacket and 1,323-tonne four-deck topside for the Angelin project will be constructed at the Altamira fabrication facility on the Gulf Coast of Mexico. The platform and pipeline are scheduled to be installed by McDermott's "DLV 2000" work vessel, the flagship of the McDermott's global offshore pipelaying and construction fleet. "The project demonstrates the versatility of the DLV 2000 for installations of both pipelines and platforms in a single mobilization," the company said.

BUNKERING of LNG fuel is making more progress in Northwest Europe. The bunkering vessel "Engie Zeebrugge" has performed its first regular deliveries of fuel to two new gas-propelled pure car and truck carriers in the Belgian port of Zeebrugge. The 5,000 cubic metres capacity fueling ship is owned by the France-Japan bunkering venture set up in 2016 by French energy company Engie and with the Japanese trading house Mitsubishi Corp. and Japan's NYK Line shipping company as shareholders. The "Engie Zeebrugge" is using Zeebrugge as its home port and the regular operations now underway will also involve the LNG terminal owner, Fluxys of Belgium. Two LNG-fueled vessels operated by United European Car Carriers, the "Auto Eco" and the "Auto Energy" were re-fueled in the first of many planned regular operations. The "Engie Zeebrugge" carried out its first trial bunkering operation at Zeebrugge in April with LNG loaded at the terminal. "She is now executing a weekly service to the two new gas-propelled pure car and truck carriers of UECC and is the world's first LNG bunkering vessel to perform regular ship-to-ship bunkering services," said Fluxys. The bunkering vessel was built at the Hanjin Heavy Industries and Construction Company shipyard in the port of Busan in South Korea and delivered to Engie in February 2017. Engie, Mitsubishi and NYK have set up a marketing company called Gas4Sea to develop the LNG fuel market in northwest Europe and elsewhere. The vessel will regularly take on LNG at Zeebrugge where carriers deliver shipments from Qatar and elsewhere and where docking is also provided for small-scale tankers supplying the regional market on a break-bulk basis. Under the Gas4Sea brand, the three partners intend to support the development of LNG as a marine fuel. Currently, the bunker market amounts to approximately 250 million tons of heavy fuel oil per year. The companies said the challenge is to make LNG grow in the bunker market by also supplying the delivery infrastructure.

CANADA has given approval for a small-scale export project, Woodfibre LNG, to export cargoes to Asia for 40 years. The venture is backed by Indonesian billionaire Sukanto Tanoto and his Pacific Oil and Gas company. Tanoto and his company are building their export plant through a privately-held venture firm at the site of an old pulp mill near the town of Squamish, north of Vancouver. The facility in 2016 became the first LNG export project in the province of British Columbia to receive its full environmental approval from the federal government and had previously held a 25-year export licence, now extended by 15 years. "We know there is tremendous demand for natural gas, especially in the fast-growing countries of Asia," said Canadian Minister of Natural Resources Jim Carr. "The approval of Woodfibre LNG's 40-year export licence provides certainty for investors while creating jobs for Canadians as the world moves toward a low-carbon future," added Carr. "This project also underscores the significance of working together with First Nations communities, as it will lead to environmental protection and economic benefits for the Province of British Columbia and the Squamish Region," he added. Before the liquefaction project was even approved Woodfibre managed to sign a contract to supply China's Guangzhou Gas Group with 1 MTPA of LNG over 25 years, starting in 2020. The Pacific Oil and Gas parent company of which Tanoto is Chairman has offices in Singapore and Jakarta as well as three in China, located in Hong Kong, Nanjing and Beijing. Woodfibre is the only BC LNG liquefaction plant moving forward after receiving all its permits with 25 conditions attached. It is also supported by its local native North American tribe, the Squamish First Nation, and has taken its own final investment decision to proceed. However, the much larger Pacific Northwest LNG project led by Malaysian energy company Petronas is currently on hold as Petronas and its Asian energy partners consider the economics of their venture that has been complicated by 190 conditions attached for environmental approval. The Woodfibre project is the smallest international venture put forward in BC and will only produce 2.1 MTPA of LNG. In contrast to the tiny Woodfibre project, the Pacific Northwest venture and the postponed Royal Dutch Shell-led LNG Canada project would each ship roughly 10 times more LNG and bring about 30 times more investment.

CHART Industries of the US, one of the main suppliers of liquefaction and LNG storage equipment, has completed the sale of a range of non-core assets to RIX Industries for an undisclosed sum. "For the past several years Chart has developed and supplied QDrive technologies to RIX in support of liquid oxygen systems," said Chart. "We have built a great partnership with RIX over the years and this transaction will allow both of our companies to focus on delivering high-quality products and services to our valued customers," stated Earl Lawson, Chart's President of its biomedical unit. "This is part of our strategic efforts to focus our energy on our core businesses while improving efficiency," added Lawson. The Qdrive operations are currently located in Troy, New York state, and will be relocating to RIX's facilities in Benicia, California. In its latest earnings reported at the end of April 2017, Chart narrowed its net loss in the first quarter amid mixed LNG results. It also continued with its restructuring process ahead of the company moving its headquarters from Cleveland, Ohio, to Canton in the US state of Georgia. Chart said the net loss amounted to $2.91 million, down from the $4.65 loss registered in the same three months a year ago. However, the company expects performance to improve as the year progresses with forecast 2017 sales just short of $1 billion. The Energy & Chemicals division, including LNG liquefaction equipment, saw orders increase in the first three months to $38M compared with $20.5M in the fourth quarter of 2016. Chart's order backlog at the end of March 2017 totalled $348.6M, up from $342.6M at the end of 2016. The company said E&C order growth in its core LNG market reflected continued signs of recovery in energy-related sectors. Restructuring projects continue to be on track to achieve $10 million of annualized savings. The company is in the middle of a previously announced ending of an executive era whereby Samuel F. Thomas, current Chairman and Chief Executive, moves to the position of Executive Chairman on May 25, 2017, before retiring from the company in May 2018. William (Bill) C. Johnson, the current President and Chief Operating Officer, will become the company's CEO and President in May next year.

CHEVRON Corp. has provided an overview of the company's operational performance and future growth plans at its 2017 annual meeting in Midland, Texas, where executives said the Wheatstone LNG project in Western Australia was on track for its start up. Chevron Chairman and Chief Executive John Watson said the US major had undergone a year of transition and was looking forward to major projects coming on stream, including Wheatstone by August 2017. "We took significant actions to reduce costs, limit cash consumption and protect the balance sheet. As oil prices improved, recovery in earnings was evident in the second half of the year. This progress has continued into 2017," said the Chevron CEO. "We are well positioned with a strong portfolio and the right business model, including a profitable downstream and chemical business and an upstream portfolio of shorter cycle opportunities, highlighted by our enviable position in the Permian Basin," said Watson. "Our long-term strength is also underpinned by projects in Kazakhstan, Australia, the deepwater Gulf of Mexico, and attractive future options in West Africa, South America, Asia and North America," he stated. Chevron executives said the $US37-billion Wheatstone LNG project had followed a phased start-up of its offshore feed-gas resources. This ensured that bulk gas was available onshore for the first production Train to begin producing commercial cargoes at the plant near Onslow in the Pilbara region of Western Australia. The executives said the Wheatstone facilities, both onshore and offshore, had now gone through the start-up sequence to meet production and commissioning schedules. According to the timetable, the Train 1 is ready to be ramped-up followed by Train 2 in early 2018. Chevron owns just over 64 percent of the Wheatstone project and the other shareholders include Australian

energy company Woodside with a 13 percent stake. Kuwait Foreign Petroleum Exploration Co. also holds a 13 percent stake in the project and the balance is owned by Japanese cargo buyers Jera Co. Inc and Kyushu Electric Power. Chevron is also operator of the Gorgon LNG plant on Barrow Island in Western Australia where one of three Trains is until mid-June because of the latest technical fault at the 15-month-old plant. It is the second time in six months that Train 1 has been closed for engineering investigations. Production stopped in November 2016 to "address some performance variations" and was restarted in January. The Gorgon plant's Train 3 only started up in March 2017 and that landmark coincided with a scheduled temporary shutdown of Train 2 for planned work to improve its reliability. Most LNG production plants suffer output stoppages in the first 18 months or so and are often temporarily shut as part of the medium-term ramp-up process to make sure operations are running smoothly and safely. While the Gorgon LNG project has experienced several production interruptions since it shipped its first cargo on 21 March 2016, it has continued with steady production and has managed to deliver around 60 cargoes to customers by the start of May.

CHIYODA Corp. of Japan, one of the leading LNG engineering companies, has been chosen by Qatar Petroleum to conduct a detailed study to identify modifications required to boost the capacity of the world's largest production complex at Ras Laffan. The additional feed-gas will come from more Qatari output from its North Field gas fields in the Arab Gulf. Qatar has lifted a self-imposed 12-year moratorium and resumed development of the world's largest single natural gas field. The moratorium had been in place since 2005. Qatar Petroleum aims to produce an additional 15 million tons of LNG a year by the early 2020s. Qatar has become the world's largest LNG supplier in just the 20 years since it first began exporting LNG in 1997. Chiyoda was one of the main However, the government had halted development of the massive North Field, citing the need to study the impact of rapid gas field development on reserves. The Ras Laffan plant has the world's largest processing Trains, including six of them with 7.5 MTPA of capacity, giving annual output of over 77 MTPA. "As part of its efforts to reinforce Qatar's leading position in the global gas industry, this agreement provides Qatar Petroleum with the option of increasing its LNG production with minimum investment, by leveraging the existing massive, world-class infrastructure and valuable synergies available in Ras Laffan," said Saad Sherida Al-Kaabi, Qatar Petroleum's President and Chief Executive. The agreement with Chiyoda was signed at Qatar Petroleum's headquarters in Doha by Al-Kaabi and Masaji Santo, a Senior Executive Vice President of Chiyoda, in the presence of other senior executives from both companies. Qatar had announced in April its intention to develop a new gas project in the southern sector of the North Field with a capacity of about 2 billion cubic feet per day for export. While Doha calls the giant gas reserves North Field the resource basin is shared with Iran, which calls its demarcated zone the South Pars gas field. Iran, which suffers severe domestic gas shortages, has recently made a rapid increase in production from South Pars a top priority since Western sanctions were ended over the nuclear issue. The Chiyoda study for Qatar is expected to be completed before the end of this year, which will allow the Qataris to start front-end engineering and design work early in 2018, if it concludes that this option will achieve the optimum value for the State of Qatar. Chiyoda is currently working on LNG production projects in the expansion at Tangguh in Indonesia, the Yamal plant in Russia and two export ventures in the US and Ichthys LNG in Australia. It is also carrying out pre-construction work for LNG production in the southeast African nation of Mozambique. The Yokohama-based company recently recorded an annual loss of more than $360 million as it installed a new management team to recover from problems of a subsidiary in the subsea market and the low oil price environment. Chiyoda had posted a loss of 41.1 billion yen ($361.4 million) versus a profit of 3.4Bln yen ($30.7 million) for the first fiscal year ended in March 2017. Annual revenues held up amid the subsea losses and came in 1.3 percent lower than fiscal 2016 at 603.7Bln yen ($5.30Bln).

CORPUS CHRISTI LNG, the second Cheniere Energy liquefaction and export plant to add to the Houston-based company's volumes from the Sabine Pass facility in Louisiana, said the first processing Train would be ready for commercial operations ahead of schedule in the first half of 2019 and that pipeline supply infrastructure has also been secured. The Texas liquefaction plant is being built on the shore of Corpus Christi Bay, at the north end of the La Quinta Channel. Cheniere said in its latest statement to investors that stage one of the project, comprising the construction of the first two Trains was 61.7 percent complete overall. "We are targeting substantial completion by mid-2019, several months ahead of guaranteed completion dates," said Cheniere. "Sufficient firm pipeline capacity for Train 1 and Train 2 operations has been secured," Cheniere said. The venture has potential pipeline supply points on five pipelines, namely Natural Gas Pipeline Company of America, Tennessee Gas, Houston Pipe Line, Kinder Morgan Tejas and Transco. "Commissioning is scheduled to begin in the fourth quarter of 2017," said Cheniere. "Gas supply will be ready to commission the pipelines and compression needed for Corpus Christi Liquefaction's commissioning in 2018," Cheniere said. US engineering company Bechtel Inc., the world's leading liquefaction plant builder and whose corporate headquarters are in San Francisco, has been building Sabine Pass and will construct all three Trains planned. The Phase 1 engineering procurement and construction contract for Corpus Christi includes building two LNG Trains, each with 4.5 million tonnes per annum of capacity, two storage tanks, one complete berth and a second partial berth. The contract for Phase 2 includes one LNG Train, one additional tank, and completion of the second berth. The total capacity will be 13.5 MTPA. The Texas plant's current cargo sales agreements amount to more than 9 MTPA, or two whole Trains of production. Foundation customers include Indonesian energy company Pertamina, Australian LNG producer Woodside and the European-based utilities Endesa, Iberdrola, Gas Natural Fenosa and Electricite de France. The first Train at Cheniere's Sabine Pass was able to ship its first commissioning cargo in February 2016. Each of the six Sabine Pass Trains also has a nameplate capacity of 4.5 MTPA for a total planned output at the Louisiana facility of 27 MTPA. Currently three Trains are exporting cargoes and a fourth is set to enter commercial operations.

DELFIN LNG, the first floating liquefied natural gas production project in North America, has received an export permit for its plant proposed for the Gulf of Mexico offshore Louisiana. The FLNG project is owned by a US-Asian joint venture called Fairwood Peninsula Energy and is planning to deploy a floating liquefaction facility with four moored production and storage vessels to produce up to 13 million tonnes per annum of LNG. The Delfin developers have already been awarded a deepwater port licence by the US Maritime Administration and the venture has been approved by the US Coast Guard, clearing the way for the first US FLNG project to proceed. "The Department determined that exports from the Delfin LNG terminal, jointly owned by the India and Singapore-based Fairwood Group and the US-based Peninsula group, for a period of 20 years, was not inconsistent with the public interest," stated the DoE. US Secretary of Energy Rick Perry stated he was pleased to give the authorization from the Administration for further exports "of our abundant amounts of natural gas" resources. "Investing in American natural gas not only helps our economy and our jobs, but also helps our allies maintain their energy security," said Perry. "This represents a true win-win for everyone involved," stated the Energy Secretary. Delfin proposes to activate the formerly abandoned offshore system pipeline for the FLNG project and construct new connecting pipelines, a compressor station and associated facilities. Delfin has also required onshore facilities to be reviewed by the Federal Energy Regulatory Commission in Cameron Parish. The company signed a joint development agreement with Hoegh LNG of Norway two years ago for the supply of FLNG vessels to be built in South Korean shipyards. In June 2016 it also signed a $1.5 billion financing contract with the state-owned Korean Development Bank to help guarantee the construction of the three project vessels in Korea. The Delfin FLNG financing contract was signed by KDB Chairman Lee Dong-Geol and Delfin founder Frederick Jones. The KDB finances overseas projects by providing industrial capital if that adds to South Korean economic development and guarantees jobs. Front-end engineering design for the FLNG project has been awarded to US construction and engineering company Bechtel. "The Department of Energy has now authorized a total of 21 billion cubic feet per day of natural gas exports to non-free trade agreement (non-FTA) countries from planned facilities in Texas, Louisiana, Florida, Georgia, Maryland,

and now, with Delfin, from the Gulf of Mexico," the DoE said. "The Delfin project would further position the United States to become the predominant LNG supplier to the rest of the world," it added. "The DoE is eager to bring this clean burning resource and its benefits to all of our international trading partners. Secretary Perry will take this message to Japan, and then to China for the Clean Energy and Mission Innovation ministerials, where he plans to strengthen the US-China LNG export partnership and continue working together towards a clean and affordable energy future," stated the DoE.

DNV GL, the European classification society, awarded Kawasaki Heavy Industries of Japan an approval in principle for its newly developed non-spherical Moss-type LNG storage tank. The new tank is an International Maritime Organization Independent Type B LNG tank that has been developed for use in 180,000 cubic metres capacity LNG carriers designed to pass through the expanded Panama Canal. "It is always a great pleasure to work with KHI, to continue what has been such a long and enjoyable cooperation," said Johan Petter Tutturen, Business Director for Gas Carriers at the Maritime division of DNV GL. "We worked with KHI on the delivery of the first Japanese built LNG carrier – 'Golar Spirit' - in 1981 and that cooperation continues to this day, as she remains in DNV GL class after her successful conversion to a Floating Storage and Regasification Unit (FSRU), a world's first," added Tutturen. KHI says that the new tank has the same reliability as a spherical Moss-type tank but has an increased cargo capacity of 15 percent. DNV GL said it carried out comprehensive sloshing and buckling analyses together with KHI, which demonstrated that the new tank provided an equivalent level of safety performance to the well-known spherical MOSS tank with no filling restrictions. It can also be used with the Kawasaki Panel System, an advanced heat insulation system developed by KHI. "As DNV GL's experience with LNG has grown over the

years, so too has our conviction that LNG can make a significant and positive contribution to the efficiency and sustainability of the energy and maritime industries," added Tutturen. "To keep this momentum for the use of LNG growing, DNV GL will continue to work with innovative partners like KHI to ensure that owners and yards can be confident that this technology will continue to advance, while meeting strict safety and reliability standards," he concluded. An approval in principle is an independent assessment of a concept within an agreed framework, confirming that the design is feasible and no significant obstacles exist to prevent the concept from being realized.

EDISON Italian utility said it was planning to sell its stake in the Adriatic LNG import terminal owned as a joint venture with Qatar Petroleum and ExxonMobil for shipping cargoes into northern Italy. Edison is a subsidiary of French utility and LNG player Electricite to France and has held a 7.3 percent stake in the terminal since it began operations from a gravity-based structure in the Northern Adriatic Sea. The company said talks were also underway to sell the pipeline connecting the LNG terminal to the Italian natural gas network. "The market will be fully informed on the progress of negotiations," said Edison. The possible transaction comes at a time when the state of Qatar and Qatar Petroleum, the world's largest LNG producer is facing financial pressure from its Gulf Cooperation Council neighbours because of a dispute over its anti-terrorism policy. "The market will be fully informed on the progress of negotiations," said Edison. The LNG terminal became operational in the second half of 2009 and is capable of importing 6 million tonnes per annum of LNG to cover about 10 percent of Italian natural gas needs. In addition to regular cargoes from Qatar, the Adriatic facility has also handled shipments from nations such as Trinidad and Norway. Qatar said in March 2017 that it had shipped its 500th cargo to the Adriatic terminal from the Qatar Gulf production complex at Ras Laffan. Net Italian LNG imports amounted to 5.47 million in 2016 compared with 4.32MT the previous year. Prior to Adriatic LNG being commissioned Italy had just one small onshore terminal, the long-established Panigaglia facility near Genoa, in operation since 1969 and owned by Snam Rete. Italy added a third terminal in 2013 when the "FSRU Toscana" was moored off the west coast of Italy between the cities of Livorno and Pisa and connected to the Italian national gas transmission network by a pipeline. The "FSRU Toscana" imports have included one from the US Sabine Pass plant in Louisiana. Edison is currently working to boost its pipeline natural gas imports from Russia's Gazprom and has signed up for a project creating a southern route for Russian supplies from Russia to Europe, which would run across Turkey and Greece to Italy. The regional utilities will coordinate the development and implementation of the TurkStream project and of the Poseidon pipeline venture from the Turkish-Greek border to Italy.

ENI, the Italian Energy company, has held a contract-signing ceremony in Mozambique to signal the advance of the Coral floating liquefied natural gas project, the first joint venture to tap the huge gas resources discovered by Eni in the Area 4 licence block of the southeast African nation's offshore Rovuma Basin. The ceremony in the Mozambican capital Maputo was led by Mozambique President Filipe Nyusi, the Minister of Mineral Resources Leticia Klemens and Eni Chief Executive Claudio Descalzi. The Coral field was discovered in May 2012 and contains around 16 trillion cubic feet of gas in place. Eni and its Area 4 partners have already signed an agreement with BP of the UK for the sale of the entire volumes of LNG produced by the Coral project for a period of more than 20 years. "During the ceremony all the drilling, construction and installation contracts for the production facilities were signed, as well as agreements with the Mozambican government for the regulatory framework and financing of the project," said Eni. The Eni Coral FLNG venture will produce around 3.4 million tonnes per annum of LNG and will match similar projects proposed for offshore Equatorial Guinea and Cameroon in West Africa. "This achievement comes just three years since the drilling of the final exploration well in a country that is a newcomer to the global gas market," said Eni. "Despite the challenging price environment in the last few years, the launch of this project is testament to the quality of the assets in place and to Eni's technological leadership in the development of deep-water gas fields," said the Milan-based company. Eni explained that the FLNG facilities had attracted project finance for 60 percent of the project cost. The financing agreement has been subscribed to by 15 major international banks and guaranteed by five export credit agencies. "As the world transitions to a low-carbon energy mix, Eni believes that the use of gas is critical to achieving a more sustainable future," said Eni CEO Descalzi. "Our ambition to become a global integrated gas and LNG player is based on working alongside key partners such as Mozambique. The Coral project will deliver a reliable source of energy while contributing to Mozambique's economic development," stated the CEO. The heads of all the shareholders in the Rovuma Basin Area 4 licence were in attendance at the ceremony. They included Wang Yilin, Chairman of China National Petroleum Corp., Carlos Gomes da Silva, Chief Executive of Portuguese energy company Galp, Lee Seung-Hoon, the CEO of Korea Gas Corp., and Omar Mitha, the head of the African state's energy company Empresa Nacional de Hidrocarbonetos. A second set of shareholders have equally large resources in the Area 1 licence block of the Rovuma Basin, held by US company Anadarko Petroleum and shareholders from Japan, India and Thailand. They have yet to proceed far with their planned onshore project.

EXXONMOBIL, the US oil and gas major and one of the largest LNG producers with stakes in liquefaction plants in nations such as Australia, Qatar and Papua New Guinea said it was being subjected to a witch hunt by New York Attorney General Eric Schneiderman over climate-change policies. ExxonMobil has issued a statement to claim that Schneiderman had made "inflammatory, reckless and false allegations" when he misstated how ExxonMobil assesses the potential impacts of climate policy on its business to justify expanding a politically-based investigation he is carrying out. "From the outset of this investigation, it has been clear that the attorney general is working backwards from an assumption of ExxonMobil's guilt, searching in vain for some theory to support his prejudgment," the company said in a brief to the New York Supreme Court. Former ExxonMobil Chief Executive Rex Tillerson is now the US Secretary of State in the Trump Administration and the major now has Darren Woods as its CEO. The legal brief was filed by ExxonMobil's lead lawyer, Ted Wells, Jr., of Paul, Weiss, Rifkind, Wharton & Garrison LLP. ExxonMobil's brief explained how the company uses a proxy cost of carbon to assist its assessment of potential impacts of climate-change polices on global energy demand in its annual forecast, the Outlook for Energy. In addition, where appropriate, ExxonMobil considers the impacts of current and potential future greenhouse gas (GHG) regulations as one of many factors when assessing the economics of individual projects. In addition to owning LNG stakes in the Middle East and the Asia-pacific region, ExxonMobil is developing new projects and recently paid $2.8 billion for a share of a floating LNG venture offshore Mozambique in southeast Africa. It is also developing the US Golden Pass LNG export project in Texas with Qatar Petroleum. ExxonMobil also said in its brief that the New York attorney general inaccurately alleged in a court filing on June 2 that the company's carbon-pricing practice amounted to a "sham" because the company used what he described as publicly stated figures of the proxy cost of carbon and a "secret internal version" in its analyses. "For a prosecutor proceeding in good faith, the absence of any evidence of wrongdoing is grounds for closing an investigation, not expanding it," said the ExxonMobil brief. "Even more frivolous is the attorney general's claim that it was inappropriate to use the actual cost of carbon ... when assessing overall project economics, rather than hypothetical figures. There is no basis in law or logic to find fault for relying on actual costs when available," stated ExxonMobil. The attorney general's latest claim - that ExxonMobil was internally underestimating the impact of climate change on its business - is in direct contradiction to the thesis that led to the investigation in the first place. When he launched the investigation at a press conference in 2015, Schneiderman accused ExxonMobil of downplaying the risks of climate change, but secretly taking the effects of climate change into account in its business decisions. "This is just another example of the 'heads I win, tails you lose' approach to investigating employed by the attorney general," said ExxonMobil's brief. "While it might be too much to expect consistency from the attorney general, his failure to present a coherent rationale for further investigation is fatal to his current plea to this court," the company said. ExxonMobil's brief was in support of an application to quash additional subpoenas issued by the attorney general. "The attorney general offers one

justification for his new document subpoena: rank speculation that ExxonMobil's public statements about a proxy cost of carbon were false or misleading. Despite having 2.8 million pages of ExxonMobil's documents and eighteen months to review them, the attorney general has found no valid basis for believing misrepresentations have taken place," said the company. ExxonMobil also called out the attorney general for distributing the filing to media before submitting it to the court in a transparent attempt at headlines. "No further evidence is required to establish the political motivation of the attorney general's fruitless year-and-a-half long investigation pursing his ever-shifting and unravelling investigative theories. It is an abuse of the powers of his office and the court system itself, furthering only the attorney general's transparent political ambitions and ultimately bound to taint a prospective jury pool, thereby depriving ExxonMobil of a fair trial in the event this political witch hunt were to reach that unlikely stage," said the ExxonMobil brief.

FERC, the US Federal Energy Regulatory Commission, has issued a notice of its intent to prepare an environmental impact statement for the Jordan Cove LNG export project proposed for Coos Bay in the northwest state of Oregon. The FERC said its assessments would also involve the Pacific Connector Pipeline and comments on the scope of the EIS were due on July 10, 2017. Jordan Cove's development was led until recently solely by Canadian energy company Veresen Inc, though Veresen is now in the process of being taken over by Canadian peer Pembina Pipeline Corp. in a transaction valued at US$4.3 billion. Veresen and Pembina, both based in the city of Calgary in the Canadian province of Alberta, said their transaction is expected to bolster the delivery of their existing strategy and portfolio of projects. The Jordan Cove LNG venture is one of those projects, though it is being temporarily held up by a lack of a quorum currently at the FERC. The regulator also rejected the Jordan Cove venture in 2016, ruling that it lacked market support. However, since then the project has received backing from LNG buyers in Japan and has applied to re-enter the permitting process. "The Commission will use this EIS in its decision-making process to determine whether the Jordan Cove LNG Terminal is in the public interest and the Pacific Connector Pipeline is in the public convenience and necessity," the regulator stated. "This notice announces the opening of the public comment period, commonly referred to as scoping. You can make a difference by providing your comments," the FERC said. The review of the Jordan Cove project is likely to attract protests from environment protesters who are extremely active in Oregon. "Your comments should focus on potential environmental impacts, reasonable alternatives, and measures to avoid or lessen environmental impacts. This scoping opportunity is for the entire project, including actions and proposed plan amendments," the FERC said. The Chief Executive of the Jordan Cove project is Betsy Spomer, a former senior executive of BG Group of the UK, which helped establish LNG in the US Gulf Coast at the Lake Charles terminal. The Jordan Cove venture has industry groups such as the Washington-based Center of Liquefied Natural Gas standing by to support it in the regulatory process. Aware that Jordan Cove has faced opposition from very organized environmental groups in Oregon, the CLNG has said it was keen to "raise awareness of the many uses of LNG, to educate the public on the successes of LNG" and to bring the fuel safely to market.

FERC is restoring its board quorum to give approval to large LNG export projects and natural gas pipelines and infrastructure nationwide. The US Senate Energy and Natural Resources Committee voted 20-3 to refer the nominations of Neil Chatterjee and Robert Powelson to the full Senate for final approval. It has been five months since the FERC has had the necessary minimum of three members on the Commission to take significant decisions and approve major projects. While regulators delegated some authorities to other staff, the Commission normally

comprising five members has been unable to make major decisions on multi-billion ventures. Three Democratic members of the Senate Committee voted against Chatterjee and Powelson. One senator who voted against was Bernie Sanders of Vermont who ran against Hillary Clinton for the Democratic presidential nomination. The three opponents also included Ron Wyden of Oregon, the northwest state where the Jordan Cove LNG project is seeking a permit, and Mazie Hirono of Hawaii, the Pacific US state that is trying to upgrade its energy infrastructure. The current acting Chair of the FERC is Cheryl LaFleur who said the agency had gone from issuing 100 orders per month to about a quarter of that volume. "We normally issue about a hundred orders a month, and since losing the quorum commission staff have been able to get 58 orders under the new or existing delegating authority," added LaFleur. President Donald Trump appointed LaFleur, an experienced businesswoman and lawyer as well as a Democrat, as the acting head of the FERC to start re-building the agency's management after resignations. The FERC's five commissioners are essentially political appointees. It previously consisted of three Democrats and two Republicans. However, two Republicans had resigned during the Obama Administration in 2015 and 2016, leaving only three Democrats at the turn of the year then two after a Democrat resigned. There are presently about 20 US LNG export projects under development and being overseen by the FERC, as well as dozens of other ventures in sectors such as pipelines. With current commissioners LaFleur and Colette Honorable, both Democrats, the Republicans have now nominated two new commissioners in Chatterjee and Powelson and two more need to be named. When Chatterjee and Powelson are confirmed by the full Senate as is likely, that would give the FERC board four members. However, Commissioner Colette Honorable has said she intends to step down at the end of June when her term ends. Powelson is a member of the Pennsylvania Public Service Commission and Chatterjee is a former aide to Senate Majority Leader Mitch McConnell, the Kentucky Republican.

FLUXYS of Belgium, owner of the Zeebrugge liquefied natural gas terminal at the port of Zeebrugge, has signed a cooperation accord with Russian natural gas company Novatek, the main shareholder in the Yamal LNG project, to make sure its regasification facility benefits from new Russian volumes and develops its small-scale project portfolio. The memorandum of understanding was signed at the 21st Saint Petersburg International Economic Forum. According to the agreement, the parties intend to pursue strategic cooperation in developing small-scale LNG projects in Europe, marketing in Europe and Latin America, optimizing LNG logistics and other potential ventures involving the fuel. "Small-scale LNG in our view ticks all the boxes to curb the carbon and health impact of heavy-duty road transport, shipping and remote industry," said Fluxys Chief Executive Pascal De Buck. "We are pleased to broaden our mutually beneficial cooperation with Novatek to make small-scale LNG realize its potential today and in the future," said the Belgian company's CEO. The Chairman of Novatek, Leonid Mikhelson, said it was mutually beneficial to sign an accord with a natural gas infrastructural company such as Fluxys that will help develop new LNG markets. "This cooperation will increase the efficiency of our LNG projects, utilizing our resource base on the Yamal and Gydan peninsulas," added Mikhelson. The Novatel Chairman was referring to the Yamal LNG joint venture with France's Total and China National Petroleum Corp, coming on stream at the end of 2017, and a second production project called Arctic LNG-2 planned for northwest Siberia. The Arctic LNG-2 project envisages the installation of three gravity-based structures (GBS) in Ob Bay and construction of the LNG plant on these platforms. Novatek's aim is to make the Arctic LNG-2 project more economic than the Yamal plant. The venture could go ahead in tandem with a fourth Train being constructed at Yamal to take output there to more than 20 million tonnes per annum. For the Arctic LNG-2 venture the LNG and condensate storage are likely to be located within the hulls of the structures attached to the seabed. The GBSs are expected to be built in the Novatek-owned Kola Yard near the Russian port of Murmansk. To this end, Novatek also used the St Petersburg event to sign a cooperation agreement with the Russian Ministry of Industry and Trade and the Murmansk Regional Government. According to that accord, the parties intend to sign a tripartite special investment contract creating a centre for the construction of the LNG offshore structures in the Murmansk region. "To efficiently develop our vast resource base in the Far North, decrease construction costs and increase the competitiveness of our future LNG project, it is very important to create a centre to construct large-scale offshore structures in Russia," explained Mikhelson. "With the construction of the Kola Yard we plan to meet the challenge of maximizing the localization of production of LNG plants based on the gravity-based structures, ready-made for producing LNG," he stated.

GTT, the French owner of liquefied natural gas maritime and other storage technologies, said it received an order from Samsung Heavy Industries in South Korea to equip a floating hull with storage for the Mozambique Coral FLNG project. GTT said this new FLNG hull, with a capacity of 238,700 cubic metres capacity, will integrate eight LNG tanks equipped with the Mark III membrane containment system. "It will be the second-biggest FLNG in the world," it added. The unit will be built at SHI Shipyard, based in South Korea on behalf of Italian energy company Eni and its delivery is scheduled in 2021. "This FLNG will be operated off the coast of Mozambique," said GTT. "We are very pleased to be part of this new FLNG project. After the recent delivery of the very first FLNG and the up-coming delivery of the largest FLNG ever built, this award demonstrates GTT technologies are the solution of choice for these offshore LNG units," said Philippe Berterottière, Chairman and Chief Executive of GTT. In addition to this new order, the GTT membrane technology has been selected to equip the three FLNG production hulls already ordered in the world. These units are being equipped with the No. 96 system as well as the Mark III system. As sector leader in LNG storage for ships, GTT sells licensing agreements around the world for up to $10 million per licence to install its membrane technology in vessels, mostly built up until now at South Korean shipyards. The Euronext-listed company recently launched the No. 96 Max, an optimized version of the No. 96 system used in more than 120 LNG carriers to date. GTT continually advances its research and development work and has also successfully marketed its very latest Mark V membrane technology.

GTT has signed a cooperation agreement with the new Zvezda shipyard complex in the Russian Far East where there are plans to build LNG carriers. The new Zvezda yard is owned by a consortium, including Russian state oil company Rosneft, its natural gas subsidiary Rosneftegaz and the banking unit of gas company Gazprom. The Zvezda complex is being built as part of an expansion to the existing Zvezda shipyard owned by United Shipbuilding Corp. in the town of Bolshoi Kamen. The total cost of construct of the new yard is around 44.2 billion. On completion, the Zvezda yard will be the biggest shipbuilding complex in Russia and equipped to build all types of naval and merchant ships, including LNG carriers. The Far Eastern Shipbuilding and Ship Repair Center (FESRC) is developing the shipbuilding complex in Russia's far-east as part of the development works to organise domestic shipbuilding in the north-west, far-east and south. "The cooperation agreement evaluates the shipyard capacity to meet GTT construction standards, particularly focused on safety and quality issues," said GTT. As sector leader in LNG storage for ships, GTT sells licensing agreements around the world for up to $10 million per licence to install its membrane technology in vessels, mostly built up until now at South Korean shipyards. The Euronext-listed company recently launched the No. 96 Max, an optimized version of the No. 96 system used in more than 120 LNG carriers to date. GTT continually advances its research and development work and has successfully marketed its very latest Mark V membrane technology. "This new partnership will permit the building of efficient LNG carriers in Russia, dedicated to the transport of LNG coming from offshore plants. GTT will provide its expertise to the shipyard for the membrane containment system construction and the material supply, as well as personnel training", the company stated. A signing ceremony took place in Russia involving Philippe Berterottiere, Chairman and Chief Executive of GTT, and his Russian counterparts. "It is a great opportunity for GTT to contribute to the development of the Zvezda Shipbuilding complex," said Berterottiere. The French company explained that GTT membrane storage tank technology had already been chosen to equip the ice-breaking LNG carriers for the Yamal LNG project in Arctic Russia. The Yamal venture is being built by Russian natural gas company Novatek with shareholders

including French energy company Total and China National Petrolem Corp. "Russia should see an increase of its LNG production in the coming years, opening the way to new ambitious LNG carrier and infrastructure projects," said GTT, citing analyst forecasts.

INDIAN businessman Darshan Hiranandani and his H-Energy company is making progress in his floating storage and regasification project by formally signing its charter agreement for the vessel with French energy company Engie. The H-Energy subsidiary Energy Gateway Private Ltd signed the accord with Engie to secure the FSRU "GDF-Suez Cape Ann". Under the agreement with the French company first disclosed on 25 April 2017, H-Energy Chief Executive Hiranandani said his company would be able to import up to 4 million tonnes per annum using the FSRU deployed at Jaigarh port. The "GDF Suez Cape Ann" has storage capacity of 145,000 cubic metres and is also capable of reloading LNG to ship the fuel to other destinations. Jaigarh port is near the West Coast city of Mumbai in the latest natural gas project to proceed in the state of Maharashtra. The facility would be the fourth LNG import terminal situated near Mumbai, with the three others located at Hazira, Dahej and Dabhol for use by importers Shell, Petronet LNG and Gas Authority of India. "The FSRU has been chartered by H-Energy for a period of five years and will arrive at the LNG jetty at Jaigarh by the third quarter of 2018," the Energy Gateway unit said. However, India's East and Northeast regions are still not connected to LNG terminals, though about half a dozen projects are being planned, including the use of FSRUs in eastern states such as Andhra Pradesh. "The companies have an option to extend the charter party agreement beyond the initial term," Energy Gateway's statement added. The Hiranandani Group is one of the largest Indian companies with its main offices in Mumbai and Dubai in the United Arab Emirates. While it started as a property investment business it has broadened its interests into other areas such as energy and power. CEO Hiranandani said he valued the relationship with Engie and looked forward to "various collaboration" activities in the future. H-Energy had previously awarded the engineering, procurement and construction contract for a 60-kilometres tie-in pipeline from Jaigarh port to Dabhol, where another Indian LNG import terminal is located. The contract was awarded to Engineers India Ltd (EIL), a leading consultancy and EPC company in India. The pipeline construction is expected to be completed by the third quarter of 2018. H-Energy added that work had already started at Jaigarh port to construct the jetty to accommodate the FSRU.

JAPANESE liquefied natural gas imports jumped 13 percent in May compared with a year ago and the cost to Japan of the shipments was $1.13 billion more in terms of higher volumes and rising prices. Cargo deliveries to Japan increased to 6.23 million tonnes in May compared with 5.52MT in May 2016. A decline in Asia cargo volumes was offset by rises in deliveries from Australia, the Middle East and Russia and the start of a steady trickle of US cargoes, set to rise in the future. Shipments to Japan last month also reflected a higher year-on-year cost of the fuel to the tune of more than 68 percent on a weaker yen against the dollar. May 2017 shipments cost 309.54 billion yen ($2.78Bln) compared with 183.62Bln yen ($1.65Bln) in the same month a year ago Imports in April 2017 had increased 3 percent to 6.57MT compared with 6.38MT in April 2016. The latest thermal coal imports dropped 10.8 percent in May to 7.68MT as LNG was preferred to coal for power generation use or storage. Imports of thermal coal to Japan, a competitor to LNG, dropped 10.8 percent to 7.68MT year-on-year, according to the trade figures from the Japanese Finance Ministry. The Ministry data on LNG imports showed that Asian shipments in May from nations such as Malaysia and Indonesia, Papua New Guinea and Brunei fell 15.3 percent from a year ago to 1.58MT. Imports from the Middle East region rose 7.6 percent compared with May 2016. The shipments from countries like Qatar, the United Arab Emirates and Oman totalled 1.34MT. While there were no shipments from the US in April, the Japanese logged 143,000 tonnes of US LNG in May. Monthly Russian shipments, mostly from the Sakhalin Island plant in the Far East, rose 35 percent to 803,000 tonnes. The balance of March LNG imports from other nations in the preliminary figures rose year-on-year to 2.62 million tonnes (versus 2.62MT in April 2017), covering shipments from countries such as Australia and Nigeria, as well as from the spot market. Japanese LNG imports for all of 2016 amounted to 83.34MT, a decline of 2 percent on the previous year. Those shipments cost the equivalent of $28.94Bln, a drop of 40.4 percent compared with 2015. Japanese figures reported earlier in June showed that the average delivered price of spot liquefied natural gas shipments arriving in Japan was $1.40 per million British thermal units higher at $5.70 per MMBtu in May compared with $4.30 per MMBtu in the same month of 2016. The preliminary average May 2017 contracted spot price was also up compared with a year ago and was also given as $5.70 per MMBtu versus $4.10 per MMBtu in May 2016. The April 2017 spot price contracted but not yet delivered had been $5.70 per MMBtu and $5.90 per MMBtu on an arrived basis. 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.

KINDER MORGAN, the US pipeline and infrastructure company, is advancing again with its Gulf LNG export project at an existing terminal in the port of Pascagoula in the state of Mississippi. The Gulf LNG project had previously been paused rather than postponed for design development reasons. The Gulf terminal at Pascagoula had originally been constructed to import LNG cargoes from Angola in southwest Africa from a production plant developed by international oil companies, including Chevron Corp. However, the shale-gas boom made LNG imports into the US uneconomic and Kinder later decided to pursue the export plan. The Gulf terminal was originally owned by US pipeline company El Paso and later acquired by Kinder. The export venture was started with plans to build two LNG Trains with each expected to have on average production of at least 5 million tonnes per annum. The existing Pascagoula terminal, located next to the Bayou Casotte Navigation Channel, already includes a five-mile send-out pipeline. It is interconnected to several downstream pipelines, including Transco, Florida Gas Transmission, the Destin Pipeline and the Gulfstream Natural Gas Pipeline from where feed-gas can be transported for processing and export from Pascagoula. The US Federal Energy Regulatory Commission has just released an update on the status of its review of

Gulf LNG's application to transform and expand the existing facilities. The FERC said it was currently analysing data submitted with the original application and preparing a draft environmental impact statement for the project to be released for public comment. The Kinder affiliates Gulf LNG Liquefaction Co., Gulf LNG Energy and Gulf LNG Pipeline are the applicants for the venture permit. This is the pipeline company's second LNG export project as it is also progressing with the transformation of the existing Elba Island import facility in the state of Georgia into an export plant. The proposed Gulf project will include the installation of natural gas pre-treatment, liquefaction, and export facilities at the terminal with a total capacity of up to 11.5 MTPA. "These facilities would allow the terminal to liquefy domestic natural gas delivered by pipeline, store the LNG in the terminal's existing LNG storage tanks, and load it into LNG vessels via the terminal's existing marine jetty," the FERC said. The regulator was informed in the original application that the project would use many of the facilities at the existing terminal, including the LNG storage tanks and the marine berthing facility. "Major new facilities would include two separate systems that liquefy natural gas, refrigerant make-up and condensate product storage, a truck loading-unloading area, two supply docks and flare towers. Gulf LNG would also modify three existing natural gas pipeline interconnections and metering stations," the company told the FERC. The regulator noted that it had approved Gulf LNG's request to use the FERC pre-filing process on May 21, 2014. "During this pre-filing period, we attended one company-sponsored open house meeting in the project area, issued a notice of intent to prepare an environmental impact statement (EIS) on July 31, 2014, which sought public comments on the project," it added. "Additionally, between April 2016 and March 2017, our work on the project was delayed, and temporarily placed on hold by Gulf LNG while responses to our information requests were being prepared," the FERC said. Kinder had also in 2015 sold stakes in Gulf LNG to US equity firms, including one of the world's largest, the New York-based Blackstone Group. The Gulf project has already received a US Department of Energy export permit for Free Trade Agreement countries and non-FTA authority was pending. As regards Kinder's Elba Island project in Georgia, the company said in March 2017 it had taken investment fund firm EIG Global Energy as its partner. Kinder said EIG had purchased a 49 percent participation in Elba Liquefaction for $385 million in cash and agreed to fund its share of future capital expenditures under commissioning of the LNG plant. Elba Island would produce an initial 2.5 million tonnes per annum of LNG. Royal Dutch Shell was the former partner of Kinder in the Elba Island project and while it sold its stake, it remains the main customer for the venture when completed.

LNG LTD, the Australian developer, has formally extended its final turn-key engineering and construction contract for the Magnolia LNG export venture in Louisiana by six months as it seeks to finalize supply agreements with customers. A joint venture involving US engineering company KBR Inc. and South Korea's SK Engineering & Construction had agreed the contract in 2015 amounting to $4.35 billion to build four liquefaction Trains, each with a capacity of around 2 million tonnes per annum. LNGL said at the time that the KBR-SK contract would give an installed capacity at a cost-per-tonne range of US$495 to US$544, based on the final design when the final investment decision is made. The company said the binding lump-sum, turnkey engineering, procurement and construction contract was now valid through December 31, 2017. "The extension of our agreement with KBR-SK E&C provides us with additional confidence as we focus on finalizing offtake agreements and moving toward a final investment decision (FID) for Magnolia, while we also maintain Magnolia's standing as the low cost, low risk, construction ready Gulf Coast LNG export project," said LNGL Managing Director and Chief Executive Greg Vesey. The Magnolia liquefaction plant will be sited on a 115-acre parcel of land in an area of Louisiana where three other export ventures are being developed next to the Calcasieu Shipping Channel. The other plant infrastructure includes two 160,000 cubic metres capacity storage tanks, marine and ship-loading facilities and support services. The project would also involve using LNGL's patented OSMR processing technology. LNGL is additionally developing the medium-scale Bear Head LNG export project in Nova Scotia, Canada. All the permits are in place for this venture and Magnolia. The Magnolia project in January 2017 signed a Heads of Agreement with Vessel Gasification Solutions Inc. (VGS) in relation to shipping cargoes to India. The accord, if it becomes a full Supply and Purchase Agreement (SPA), would see Magnolia supply LNG to the East Coast of India for the first time as all the Asian nation's four existing terminals are on the West Coast. Indian group VGS describes itself as an Indo-American company. VGS has apparently ordered a floating storage and regasification vessel from the Nantong shipyard of China-based Wison Offshore & Marine to be deployed as an import facility. A mooring site has been found at Kakinada Deepwater Port and the project will supply natural gas to the eastern Indian states of Andhra Pradesh and Orissa.

LNG LTD said it was exploring the possibility of basing the company in the US and listing its shares on either the New York Stock Exchange or Nasdaq global exchange. The company is still progressing with the Magnolia LNG project in Louisiana and with the Bear Head project in Nova Scotia. Both projects have received all their permits from regulators for construction and exports and the company itself has said it is awaiting firm supply contracts before building starts. LNG Ltd, currently listed on the Australian Securities Exchange, said it had been evaluating a US listing and now believes that such a transaction may be of benefit to the company and its shareholders as it progresses towards the development of its US and Canadian projects. "At this stage, the board has not specified a timetable for a decision on the potential transaction. Further details will be announced once any decisions are made, and once the structure and timing of any proposed transaction have been determined, including whether the company will remain listed on the ASX," it added. "Any proposal will be subject to approval of the company's shareholders," it stated. The Magnolia project in May 2017 received a notice to proceed from the US Federal Energy Regulatory Commission, opening the way for preparation work to begin on the site for the liquefaction plant on the Calcasieu Shipping Channel near the Port of Lake Charles. Magnolia is proposing to produce 8 million tonnes per annum from its liquefaction plant and Bear Head has similar plans. LNG Ltd also has its own patented liquefaction processing technology called the optimized single mixed refrigerant (OSMR) system. The Magnolia project has also previously signed a Heads of Agreement with Vessel Gasification Solutions Inc. in relation to shipping cargoes to the East Coast of India for the first time once a terminal is built. LNG Ltd first signalled the possibility of a move when it declined to extend a lease on it site at Fisherman's Landing near Gladstone in Australia for a proposed coal-seam-gas-to-LNG plant. The Fisherman's Landing site is close to the three existing CSG-to-LNG plants operated by ConocoPhillips, Australia's Santos and Queensland Gas Co., a subsidiary of Royal Dutch Shell. The LNG Ltd's lease was originally signed in May 2010 - before building had even started on any of the other three plants. However, the company could never secure joint venture partnerships nor feed-gas commitments from third parties.

MITSUI OSK Lines, the Japanese shipping company, said the latest LNG carrier it will operate was delivered from the Hudong-Zhonghua Shipyard in the Chinese port of Shanghai to transport cargoes from Australia to China. As well as managing the ship, MOL will have a 20 percent stake, while the other owners in the joint venture include China Petroleum and Chemical Corp. known as Sinopec, and China COSCO Shipping Corp. The "Cesi Beihai" is the third vessel built to lift free-on-board (FOB) cargoes under long-term charter to Sinopec from the Australia Pacific LNG plant near the port of Gladstone in Queensland. The ship is named after an LNG terminal Sinopec owns at Beihai in Guangxi province of southwest China, near the border with Vietnam. A total of six LNG carriers are being built at Hudong yard to work for the APLNG project. The first vessel, the "Cesi Gladstone", was delivered in October 2016 and the second, the "Cesi Qingdao" in January 2016. The remaining three ships will be delivered in succession by the end of 2018. All six vessels are of the most modern design with 174,100 cubic metres capacity and membrane storage tanks. They also have duel-fuel, diesel-electric propulsion allowing optimum speeds of 19.5 knots. The "CESI Gladstone" also has membrane type storage tanks and duel-fuel, diesel-electric propulsion allowing optimum speeds of 19.5 knots. "MOL strives to meet expanding and diversified transport needs associated with growing worldwide demand for LNG by leveraging the experience accumulated in international joint projects, while providing value-

added transport services to customers," said the Japanese company on announcing the delivery. Sinopec has signed up for 7.7 million tonnes per annum of LNG from APLNG for 20 years from the two processing Trains now in operation. US major ConocoPhillips and Australian utility and energy company Origin each hold 37.5 percent stakes in the APLNG plant, located on Curtis Island, near Gladstone. Sinopec holds the remaining 25 percent. Deliveries were started in 2016 to the Chinese import terminals owned by Sinopec such as the facility at Qingdao in Shandong province of northeast China, at Beihai in Guangxi and soon to the newest terminal being completed at Tangshan in Hebei province, east of Beijing.

QATARGAS, the world's largest LNG exporting company, said it signed a new sales agreement with Royal Dutch Shell to deliver up to 1.1 million tonnes to the European energy major for up to five years. The deal with the Gulf state of Qatar boosts the volumes of cargoes available to the Anglo-Dutch company to a new high following its takeover of LNG portfolio player BG Group of the UK. The Qatargas-Shell accord provides for the supply to begin from January 2019. "It is expected that the LNG will be delivered to either the Dragon LNG Terminal in the United Kingdom or the Gate LNG Terminal in the Netherlands," said Qatargas. Shell acquired a stake in the UK Dragon terminal in Milford Haven in Wales as part of the BG takeover. Qatari volumes are already shipped into the UK South Hook terminal in Milford Haven, owned by Qatar Petroleum and ExxonMobil. Shell sold 15.84 million tonnes of LNG in the first three months of 2017 and 15.34MT in the fourth quarter of 2016. The full-year 2016 LNG sales by Shell had been 57.11MT compared with 39.24MT in 2015, an increase of over 45 percent. "We are pleased to have signed this agreement, strengthening our relationship with Qatargas," said Maarten Wetselaar, Director of the Integrated Gas division at Shell. "Agreements like this support our ability to provide reliable, flexible LNG supply to our customers. We strongly believe natural gas has a vital role to play in providing secure and cleaner energy for decades to come," stated Wetselaar. Shell is also a shareholder with Qatargas in Train 4 at the Ras Laffan production complex, one of Qatar's mega-Trains producing 7.8 million tonnes per annum from the Gulf state's annual total of over 77 MTPA. Saad Sherida Al-Kaabi, Chairman of Qatargas and President and Chief Executive of its parent company Qatar Petroleum, said Qatargas continued to win new business in an evolving market. "We are pleased with the conclusion of this agreement, which further strengthens our relationship with Shell, one of the largest energy traders in the world," said Al Kaabi. "This Sales and Purchase Agreement demonstrates Qatargas's ability and flexibility to capture new opportunities," he added. This is Shell's second accord with Qatar on LNG during the month of June. Shell Chief Executive Ben van Beurden signed an accord with Qatar on June 13 on developing LNG as a maritime fuel as well as the infrastructure to deliver it at strategic shipping locations across the globe. The Qatar-Shell agreement on LNG bunkering was signed amid the continued disagreements between Qatar and its Gulf Cooperation Council neighbours over policies to combat terrorism.

RUSSIA has wished success to the Yamal LNG project in the Arctic region of Siberia being completed by natural gas company Novatek and French energy company Total, whose late Chief Executive Christophe de Margerie has been commemorated by an LNG carrier named after him and set to deliver cargoes from the joint venture. A ceremony for the world's first icebreaking LNG carrier has taken place at Port Bronka in St. Petersburg where the 172,600 cubic metres capacity Arc7 LNG carrier was formally named "Christophe de Margerie". Total CEO De Margerie was killed in October 2014 when his corporate jet collided with a snow plough at an airport near Moscow. All four people on board were killed. De Margerie was aged 63 at the time and had been CEO of Total since 2007. At the company, where he spent his entire career, he was nicknamed "Big Moustache" because of the large whiskers which made him an instantly recognisable character within the industry where he was highly regarded. The ship was constructed for Russian fleet owner Sovcomflot at the South Korean shipyard of Daewoo Shipbuilding & Marine Engineering. "I am extremely glad to welcome you at this solemn ceremony dedicated to the naming of Sovcomflot's new Arctic LNG carrier," said Russian President Vladimir Putin "After successfully going through ice testing in March, the tanker has made her first call at the Russian port of Sabetta in the North. From now on, this modern vessel will bear the name of Christophe de Margerie, a French entrepreneur and a real, big friend of our country of Russia," stated Putin. "He possessed a unique strategic vision and did so much to strengthen friendly, partnership relations with Russia, while being the driving force behind the implementation of a range of large joint energy projects. Naming the ship in his honour serves as another symbol of our sincere and kind disposition to this outstanding man, and as a commemoration of his memory," said the Russian President. The event was also attended by Russian ministers and leading executives of the Yamal LNG project investors including Novatek Chairman Leonid Mikhelson, the current Chief Executive of Total, Patrick Pouyanne, as well as the President and CEO of Sovcomflot, Sergey Frank. Total CEO Pouyanne said at the ceremony that De Margerie had done a lot for the company and its partnership with Russia. "He forged a strong relationship, with passion and honesty. He believed in the success of the Yamal LNG project and this vessel is a symbol of the reality of this project," said the Total CEO. "I'm sure that Christophe would have been very proud of what we have achieved," he added. The "Christophe de Margerie" is the first vessel in a series of 15 LNG carriers planned for the Yamal project. The tankers are being built for Sovcomflot to provide year-round transportation for LNG cargoes in the difficult ice conditions of the Kara Sea and Gulf of Ob in the area of the Yamal plant. "Guests of honour at the ceremony included family members of Christophe de Margerie, his widow Bernadette de Margerie, his brother Jean-Marc de Margerie and others," added Sovcomflot.

SANTOS, the Australian company, a stakeholder in three Asia-Pacific liquefied natural gas production plants, reported a positive production well test result from the Muruk ST3 gas exploration in the Papua New Guinea Highlands to help underpin PNG LNG plant expansion. The Muruk 1 gas discovery was first

announced in December 2016 and an additional sidetrack has been successfully drilled through the Toro reservoir objective to the southwest of the gas discovery. "The production test was undertaken to assess reservoir productivity and recover hydrocarbon samples over the gas saturated Toro Sandstone interval, between 3,968 metres to 4,065 metres," said Santos. "The well flowed gas and condensate at a rate of 16 million standard cubic feet per day (mmscf/day) of gas on a 32/64-inch choke. The well rate was constrained by test facilities which limited tests to short flow and build up periods. Multiple hydrocarbon samples were collected for further analysis," said Santos. "The Muruk drilling programme confirms the discovery of a potentially significant new gas field, 21 kilometres northwest of the Hides production facilities," the company added. Santos said the data from the latest Muruk drilling programme would be evaluated to assist in the definition of forward appraisal options. "Well site preparations are being scheduled for late 2017 ahead of a potential Muruk appraisal programme in 2018," it said. In addition to holding a stake in the PNG LNG plant, Santos is operator of the Gladstone coal-seam-gas-to-LNG plant in the eastern Australian state of Queensland. Its partners are the French company Total, Petronas of Malaysia and Korea Gas Corp. Santos also has a stake in the ConocoPhillips-operated Darwin plant in Australia's Northern Territory. The Muruk licence participants along with Santos are ExxonMobil and Oil Search Ltd. The existing two Trains at the PNG LNG plant, located northwest of the capital Port Moresby, produced at an average rate of 7.9 million tonnes per annum during 2016 compared with their combined nameplate capacity of 6.9 MTPA. An independent gas certification of the Elk-Antelope fields, which would provide additional LNG production for PNG, recently took place. Together with existing resources and the upgrade in PNG LNG reserves, the certification supported the view that there are sufficient gas resources available to support further expansion of PNG LNG production as well as two new PNG LNG-sized Trains.

SHELL Chief Executive Ben van Beurden has signed a further agreement with Russian natural gas company Gazprom to make progress for plans to build an LNG export plant on the northwest Russian coast with cargoes pointing at Europe and South America. Van Beurden signed the latest accord with Gazprom Chairman Alexey Miller at St Petersburg International Economic Forum. The document describes the concept behind the joint venture, which will secure financing for and carry out the design, construction and operation of the LNG plant on the coast about 110 kilometres west of Saint Petersburg. Gazprom and Shell said they would take further steps in the implementation of the Baltic LNG project. They signed the joint study framework agreement on the Baltic project primarily targeted at the European and Latin American markets. The Baltic project replaced the LNG portion of the delayed offshore development of the huge Shtokman natural gas project in the Russian sector of the Barents Sea. It had included a liquefaction plant with a capacity of 30 million tonnes per annum to have been constructed on the Orlovka River near the port of Murmansk. "The signing of this document will allow the companies to start developing preliminary project documentation as soon as possible," said Gazprom. Gazprom and Shell signed a memorandum of understanding on June 2016 on making progress on the Baltic LNG project. It proposes the construction of the LNG plant with an annual capacity of 10 MTPA in the port of Ust-Luga on the Baltic Coast of the Leningrad Region. Gazprom and Shell are already shareholders in the Sakhalin II project in the Russian far east where two Trains process over 10 MTPA of LNG. Both companies are also considering construction of a third production Train at the plant as well as the expansion of their joint project portfolio, including a potential asset swap. Sakhalin last year produced 10.9 million tonnes of LNG, exceeding the design capacity by over 1.3 million tonnes. Most of the cargoes are delivered to Japanese utilities. Gazprom holds 50 percent plus one share in the Sakhalin plant while Shell has 27.5 percent and Japanese trading house Mitsui & Co has 12.5 percent, while Mitsubishi Corp owns 10 percent.

SOUTH KOREA is continuing to expand its liquefied natural gas infrastructure as it imports more volumes from new plants in Australia and from other liquefaction and export facilities coming on stream over the next two years on the US Gulf Coast. The South Koreans have just expanded an existing terminal, are ramping up a sixth facility and plan to start a seventh terminal by the end of 2017. Korea Gas Corp. said it was completing tests on three large-scale LNG storage tanks, each with capacity of 270,000 cubic metres capacity, at its newest import terminal in the eastern South Korean port of Samchoek. The Samcheok facility, located 300 kilometres east of Seoul, currently operates nine 200,000 cubic metres capacity storage tanks. The Samcheok terminal began operations in 2014 with three storage tanks, each with 200,000 cubic metres of capacity, and it then built a further six tanks during 2015 and 2016 to give a capacity of 1.8 million cubic metres. The three newest tanks with a combined 810,000 cubic metres of storage have now been completed to give the facility 2.6 million cubic metres of storage. Samchoek is still only the fourth-largest of Korea's six import terminals after three other Kogas-owned facilities, Pyeong-Taek, Incheon and Tong-Yeong. However, Samchoek is twice as large as the biggest UK terminal at the Isle of Grain on the Medway River, south east of London. During 2017, Kogas also plans to open the company's fifth import terminal at Jeju Island off the southern coast. South Korean imports rose 2.3 percent last year to 34.19 million tonnes as volumes rose from new projects in Australia and will rise in the future from the US export plant build-out. State-owned Kogas is also facing more competition as one of the newest terminals, the Boryeong facility, began commercial operations in early 2017 after being completed in November 2016 as the country's newest and sixth terminal. Boryeong was developed as a joint venture between GS Energy Corp. and SK E&S, the city-gas provider, as the government eases import restrictions on non-state bodies. Another non-Kogas import facility at Kwangyang opened in 2005 and is owned by steelmaker POSCO for its own gas-fired plant powers.

SPAIN, the largest European importer of LNG, posted a 15 percent increase in shipments last month at its six operating regasification facilities compared with the same period a year ago. Imports came from Qatar, Nigeria, Algeria, Norway and Peru, according to data from the national gas transmission company and terminal owner Enagas. The Barcelona regasification terminal received six out of the total of 15 shipments brought into Spain. The Huelva terminal in the southwest of the country received four cargoes while the southeast Sagunto facility and the northwest Bilbao terminal each received two shipments in May. The Cartagena LNG terminal received one cargo. 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. The first cargo to arrive in Spain last month was on May 1 when the 148,300 cubic metres capacity "LNG Ondo" unloaded a Nigerian cargo at the Sagunto terminal. Enagas has four fully owned regasification terminals in Barcelona, Cartagena, Huelva and Gijon. It also has 50 percent of the Bahía Bizkaia Gas (BBG) plant in Bilbao and 72.5 percent of the Saggas terminal in Sagunto. All of them have the necessary technology for the unloading and reloading of carriers, which allows the company to reinforce the supply structure in Spain. However, during May there were no re-loaded cargoes recorded for re-export. Qatari cargoes that arrived in May included one onboard the 145,700 cubic metres capacity vessel "Al Jassasiya" on May 23 at the Barcelona facility from the Ras Laffan export terminal in Qatar. One Algerian cargo shipped to the country was unloaded from the 75,000 cubic metres capacity "Cheikh Bouamama" on May 25 at the Huelva terminal. An additional cargo

Diary of events

September
CWC World LNG & Gas Series
9th Asia Pacific Summit
September 19-22
Singapore
www.asiapacific.cwclng.com/

October
3rd International LNG Congress
October 17-17
Barcelona,
Spain
http://lngcongress.com/

LNG Solutions 2017
Fuelling the Future Summit
October 24-25, 2017
Nice, France
www.futurelng.com/LNG/Solutions

that will be logged in June was the 160,500 cubic metres capacity carrier "Sonangol Benguela" delivering a cargo overnight on May 31-June 1 to the Mugardos terminal at El Ferrol in northwest Spain from the Soyo export plant in Angola, southwest Africa. Now that the Angola terminal is operating normally at full capacity, Spain could receive more shipments in 2017 to consume or for re-export. LNG imports reached the equivalent of 13.09 terawatt hours (TWh) in May compared 11.37 TWh in the same month of 2016.

STATOIL, the Norwegian energy company, has committed itself to continuing the deepwater offshore exploration programme in the Great Australian Bight offshore South Australia that was vacated by BP of the UK in October 2016. The decision by BP to abandon its planned exploration and drilling programme in the Great Australian Bight, known as the GAB, left the state government and the region disappointed. Statoil has signed a swap agreement with BP and has been granted regulatory approval to take over two exploration permits and extend its work programme in the GAB. The agreement between Statoil and BP covers four offshore titles. BP was awarded exploration licences for four blocks in the Ceduna area of the GAB in January 2011. Seismic data was acquired in the area in late 2011 and early 2012. Norwegian energy company Statoil then acquired a 30 percent interest in the licences in 2013, with BP remaining the operator with 70 percent. "We are very pleased to have reached these agreements and found a way forward for our exploration project in the Bight," said Pal Haremo, Statoil Vice President of Exploration in Australasia. "With this transaction, we have strengthened our position in this promising, unproven basin with a large exploration upside. This is in line with Statoil's global exploration strategy of accessing at scale and targeting high-impact opportunities," added Haremo. Statoil is owner of Europe's only baseload LNG production plant at Hammerfest in northern Norway. The LNG facility processes feed-gas from the Snohvit field in the Barents Sea. BP's cancellation of the GAB programme followed a review of BP's upstream strategy, including its decision to focus exploration on opportunities likely to create value in the near to medium term. BP said it had determined that the project in the GAB, which would have cost an initial A$600 million ($US455M), would not be able to compete for capital investment with other upstream opportunities in its global portfolio. The UK major has other Australian project stakes, including in the country's oldest LNG export plant, the Northwest Shelf Venture in Western Australia, which is currently investing in new feed-gas sources to prolong its lifespan. BP also has stakes in natural gas discoveries offshore northwest Australia in the Browse Basin, which are expected to be used for LNG production. Exploration potential in the GAB remains significant and the economic and energy benefits of developing those resources will be substantial. Success in the Bight would ease Australia's reliance on imported oil and deliver South Australia much-needed new investment and jobs.

TECHNIP FMC, the French-US engineering company and two other firms, will be partners in a contract for the Coral floating LNG project being developed offshore the southeast African nation of Mozambique. The engineering and construction work will be shared between TechnipFMC, Japan's JGC Corp. and Samsung Heavy Industries of South Korea. The TJS consortium has the contracts for the engineering, procurement, construction, installation, commissioning and start-up (EPCIC) of the Coral FLNG facility. The contracts include the installation of subsea associated risers and flowline systems, as well as umbilicals and other equipment. The subsea work will be carried out at depths of 2,000 metres in the straits of the Rovuma Basin between Mozambique and Madagascar where the FLNG hull will be deployed. "We are honored to be the leader of the execution of this prestigious contract awarded by Eni and its partners to the TJS consortium," said Doug Pferdehirt, Chief Executive of TechnipFMC. "Combining TechnipFMC unique capabilities in both FLNG and subsea, we have been able to propose to our client an optimum combination, demonstrating the strength of our integrated offerings," added Pferdehirt. Nello Uccelletti, President of TechnipFMC's Onshore-Offshore business, commented: "This FLNG award confirms our pioneering and leading position on the floating LNG market." Japan's JGC explained that it and TechnipFMC would be responsible mainly for the engineering and procurement work for the FLNG topside and the management of the overall project "In addition, consortium partner Samsung will be responsible for the EPC work for the FLNG hull and the fabrication of the topside," explained JGC. "This project is the fourth FLNG project to achieve a final investment decision in the world. JGC will be responsible for the EPC work for two of them, the other being the FLNG project for Petronas of Malaysia," stated the Japanese company.

US LNG export company Cheniere Energy has delivered its first cargo from the Sabine Pass plant in Louisiana to Poland, one of the European nations that built a regasification terminal on the Baltic Coast to lessen its dependence on Russian pipeline gas. The 155,900 cubic metres capacity vessel "Clean Ocean" is scheduled to unload its shipment on June 8 after lifting the cargo on May 22 at Sabine Pass and transporting the LNG across the Atlantic. Poland is the second northwest European country to receive a cargo after another arrived on June 7 at the Dutch Gate import terminal in Rotterdam on board the 140,000 cubic metres capacity carrier "Arctic Discoverer". Poland is the sixth European country to receive a US cargo after Holland, Italy, Portugal, Spain and Turkey. The cargo shipped to Poland was at the Swinoujscie LNG terminal in northwest Poland that was completed amid great fanfare in 2015 and was described by Polish politicians as a bulwark against reliance on Russian energy imports and with a grant from the European Union. The Swinoujscie terminal received its first cargo from Qatar for commissioning purposes on December 9, 2015. The regasification facility allows Poland to import about 3.7 million tonnes per annum of LNG, amounting to 30 percent of the country's natural gas needs, meaning 70 percent will still have to be provided by pipelines from Russia. The terminal project was started by Polskie LNG, established in 2007 by national oil and gas company PGNiG. Ownership of the Swinoujscie terminal was then transferred to national gas transmission network operator Gaz-System SA. The Polish terminal is the first onshore LNG import facility built in Eastern Europe, including the former Soviet Union. The Baltic state of Lithuania, a former part of the Soviet Union and now an EU member, has a floating import facility located in the Baltic port of Klaipeda, called the "Independence". Lithuania receives shipments mostly from Qatar and Norway.

WOODSIDE, the Australian operator of two liquified natural gas export plants, said it entered into a long-term sale agreement with Indonesian energy company Pertamina. The sale and purchase agreement was signed between the Singapore-based subsidiary Woodside Energy Trading Singapore Ltd and the state-owned Indonesian company. The supply of the LNG cargoes to Indonesia under the Woodside contract starts in 2019. Woodside Singapore has committed to supply initial ramp-up quantities building to around 600,000 tonnes per annum from 2022 to 2034. The Australians also have the option to increase the supply to approximately 1.1 million tonnes per annum from 2024 to 2038. LNG to be supplied to Pertamina under the SPA will be sourced from Woodside's global portfolio and will result in Woodside becoming a significant supplier of LNG to Indonesia. Woodside Chief Executive Peter Coleman welcomed the finalization of the SPA with a respected company in a competitive LNG market. "Our track record as a reliable supplier of LNG and the proximity of our key sources of LNG to Indonesia were key to achieving this deal," said Coleman. "As more regional buyers enter the market, we are well placed to become the supplier of choice," added the CEO. Woodside is also looking at plans to extend the lifespans of the Western Australian North West Shelf LNG plant and the Pluto LNG facility by 25 years or more using existing offshore resources, including in the Browse basin. Woodside is also a shareholder in the Wheatstone onshore LNG export project in the Pilbara region of Western Australia, set to come on stream by the end of July 2017. The Woodside CEO said in May that the company was also pressing ahead with his strategy of developing the LNG fuel market using the company's second liquefaction plant in the Pilbara region, Pluto LNG. Coleman said his company was finalizing plans to support supplying LNG from Pluto to fuel the local mining and marine sectors, which currently rely heavily on imported diesel. The CEO said his company would be "utilizing recent US Gulf Coast LNG experience to target a low-cost, mid-sized Train design" for the Pluto LNG expansion. "At a time when large greenfield projects are challenging, Woodside is preparing to capture new value from low-cost brownfield developments," he stated. ■

Africa is currently an exporter of LNG and pipeline gas but is also a big import market

Anne-Sophie Corbeau of the King Abdullah Petroleum Studies and Research Center reports on LNG potential in Africa

Until recently, financing issues, market conditions, price sensitivity and the small size of the individual gas markets were all strong deterrents to sellers looking at Africa as an LNG destination, even though the region's per capita energy consumption is very low and there are hundreds of millions without electricity and modern cooking facilities.

But now the situation has fundamentally changed because, faced with the slowdown in Asian LNG demand and a global LNG oversupply, sellers are looking for new markets.

At the same time, LNG has become more affordable, more flexible and is increasingly sold on a spot basis.

So now, gas can be part of the solution to developing Africa's electricity generation, along with renewables.

Volumes

Most African countries would need small initial volumes to feed the integrated LNG-to-power projects that sponsors are considering.

This could lead to a further development of gas demand in other sectors as gas supply becomes available and infrastructure is developed.

Most countries are opting for floating storage and re-gasification units (FSRUs), enabling faster implementation.

The new markets could benefit from the proximity of existing African LNG suppliers, and future projects in Cameroon and Eastern Africa as suppliers optimize shipping distances.

The key issues of financing and the role of the state see investors looking for governments to provide regulatory and political clarity to prospective sellers, financial institutions to facilitate access to capital and LNG suppliers that will accept the risk of delivering to these new markets.

The choice of pricing mechanism and contract commitment will be key for their viability.

Liabilities

The intended gas and power markets for these new LNG projects will only be developed if domestic gas and electricity buyers can secure their offtake liabilities and ability to pay for the energy to the satisfaction of lenders.

We are looking in the report at countries with have a coastline and able to build their own LNG import terminal, but which do not have sufficient domestic gas production to meet their needs over the short to medium term.

Markets

Accordingly, it excludes countries such as Nigeria, Mozambique and Tanzania, even though Mozambique also has a proposed LNG import project.

Nor do we consider landlocked resource-poor countries in this report because they would need to build additional gas and power transmission infrastructure.

This is not to imply that landlocked markets could not benefit from the development of LNG import infrastructure through the development of regional infrastructure projects, but this would be in a second phase.

In practice, though, most import projects considered so far are aimed at domestic markets, except the planned project in Benin.

As of 2017, the list of potential LNG importers includes Benin, Congo, Côte d'Ivoire, Djibouti, the Democratic Republic of the Congo, Egypt, Eritrea, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Liberia, Mauritania, Morocco, Namibia, Senegal, Sierra Leone, Somalia, Sudan, South Africa, Togo and Tunisia.

The population of these countries totals 495 million.

Only Ghana so far has an FSRU on site. Africa could be a growing LNG importer: while individual countries represent small volumes - all markets begin small up 2 million tonnes per annum, the aggregate could be significant in the medium term.

A further development of demand in other sectors is also envisaged. The short shipping distances to neighboring producers could make these markets more attractive.

By 2020, five Africa countries will export LNG, with Mozambique and Tanzania potentially joining them later.

The road to developing LNG imports may be a long one, though. The key issue is how to attract investors and reduce the risks, given the initial small size of markets, the countries' low credit ratings, low domestic energy prices and higher project risks.

TABLE 1. COMPARISON OF THE LNG IMPORT PROJECTS

Country	Project	Capacity (bcm/y)	Status	Sponsor	FSRU Provider	Gas Demand (2015)	Duration
Egypt	Ain Sokhna (BW)	7.8	Op 2015	Egas	BW	47.8	Medium-term (depends on Zohr)
	Ain Sokhna (Hoëgh)	5.2	Op 2015	Egas	Hoëgh		
	Third FSRU	7.5	PI 2017	Egas	*tender*		
Morocco	Jorf Lasfar	5.0	PI 2021	ONEE	Onshore	1.2	Long-term
Benin	Cotonou	1.6 (2.7 later)		Gasol		0.0	Long-term
Côte d'Ivoire	Grand Bassam	5.0		Total (and others)	Golar	2.1	Long-term
Ghana	Tema (Golar Tundra)	1.8	UC 2017	WAGL	Golar	2.0**	Medium-term (domestic gas development)
	Tema	2.6 (4.6 later)		Quantum Pacific	Golar?		
	Ghana 1000	3.7		Endeavor, GE	Excelerate		
	Rotan Gas	Tbd		EOSon, Mitsui	Tbd		Long-term
Kenya	Mombasa	Tbd		Tbd	Tbd	0.0	Depends on development of domestic gas
Namibia	Walvis Bay	0.6*	PI 2017	Xaris Energy	Excelerate	0.0	Long-term if Kudu not developed
Senegal	Dakar	Tbd		Nebras Power/ Mitsui	Tbd	0.1	Depends on development of domestic gas
South Africa	Saldanha Bay/ Richards Bay	Tbd		Tbd	Tbd	4.7	Depends on development of domestic gas
Sudan	Tbd	Tbd	Tbd	Tbd	undetermined	0.0	Depends on development of domestic gas

Some of the principal LNG operating and developing import projects in Africa. They represent new demand for the over-supplied global market

Floating

Most projects have opted for the more flexible FSRU, which can be put more rapidly into operation, has lower capital costs, and is often leased rather

Meanwhile, Africa's gas consumption amounted to an estimated 135 billion cubic metres in the most recent BP Global Survey.

Egypt is the largest gas consumer in Africa (48 Bcm), followed by Algeria (39 Bcm) and Nigeria (18 Bcm).

The two latter are not included here as they are natural gas producers and exporters. Gas has a relatively important share in energy demand in Egypt and Tunisia, with the latter consuming 7 Bcm in 2015. Besides those two countries, none of the markets considered here consumes more than 5 Bcm.

There are around 600 million people without access to electricity in Sub-Saharan Africa (World Bank 2016). It has been estimated that around 210 million inhabitants in the countries studied here are without electricity (IEA).

Electricity

The average national electrification rate in those areas is 32 percent, much lower than in North Africa. Electricity generated by these countries amounts to 531 terawatthours (TWh) and electricity consumed 452 TWh, similar to the electricity consumption of France.

These numbers imply a significant loss factor. Two countries dominate the

electricity generation and consumption picture: Egypt and South Africa.

Without them the electricity generated and consumed by the other countries amounts to only 107 TWh and 97 TWh, respectively.

The demand for electricity in Sub-Saharan Africa is undeniable and pressing. Consultants McKinsey forecast that by 2040 that region will consume as much electricity (1,570 TWh) as India and Latin America together in 2010.

Gross national income in Sub-Saharan Africa has already tripled over the period 2003-15, according to World Bank data, albeit from a relatively low base, boosting household consumption.

Africa's demand for electricity is demonstrable, how to power it remains under debate. The electricity mix in the countries considered - excluding Egypt, where gas dominates - is heavily biased toward coal, due to the weighting of South Africa's power demand, followed by oil, which is the default solution for many resource-poor countries.

Most of these countries want to diversify by adding renewable solutions - including off-grid and mini-grid solutions, as well as natural gas - to their power generation mix.

Renewables

Many power generation development programs in Africa focus on renewables. These resources are domestic and their falling cost makes them increasingly commercially viable.

They can also be used for remote applications. There are significant hydro resources which could generate 1,584 TWh per year, although it is uncertain how much of this capacity could move ahead.

A large proportion is in Central and Eastern Africa, for example in the DR of the Congo, where the Inga project has a total capacity of over 40 GW. Hydropower is less expensive than most technologies: costs in Africa are on average $0.1/kWh.

Africa's solar photovoltaic (PV) capacity has increased significantly, reaching 1,334 MW as of end-2014.

In South Africa alone 780 MW was added between 2013 and 2014. Meanwhile 14 gigawatts (GW) of PV and 6 GW of concentrated solar power (CSP) are either announced or in the pipeline.

As of 2015, Algeria, Egypt, Morocco and South Africa had deployed around 180 MW of CSP projects while another 6.4 GW were underway. Wind power has also been growing, with around 2.5 GW of wind capacity installed at the end of 2014.

Morocco has taken the lead in this. Additionally, 140 African wind farms totaling 21 GW are expected to become operational between 2014 and 2020.

There are also large coal resources in Southern African regions, notably in South Africa, Botswana and Mozambique (IEA).

While the cost of power from LNG is less than from liquid fuels - assuming these prices are not subsidized - coalfired plants are still more competitive than gas-fired plants (IEA).

However, unlike in Southeast Asia, very few African countries have coal-fired power plants or are considering coal for future power generation.

In addition, financial support for coal from key lending institutions is declining.

Though Sub-Saharan Africa includes large uranium resource-holders, nuclear power seems a far-fetched option, considering not least the high capital costs and long approval and construction times.

Many large funding institutions are giving priority to renewables as sources of sustainable energy.

There is also a strong rationale for countries and power companies to consider natural gas. Not only for gas rich countries such as Nigeria, Mozambique and Tanzania, but also for countries opting for imports, for example from LNG.

Gas as a power generation fuel could be particularly relevant for developing African markets because of factors like cost effectiveness, speed of construction, low capital risk and operational flexibility.

Capital costs for combined cycle gas turbine (CCGT) plants - and even more for open cycle gas turbine (OCGT) plants - are usually lower than alternatives (IEA).

Overnight costs for CCGTs in OECD countries range from $845 per kilowatt-electric (kWe) in Korea to $1,289/kWe in New Zealand.

In 2015, General Electric Co. calculated that gas-to-power solutions could deliver electric power at between $0.1/kWh (integrated LNG-to-power) and $0.15/kWh (small-scale LNG and distributed power).

Integrated

The integrated version, assuming a price for LNG of $9 per million British thermal units (MMBtu), represents a drop compared with reported costs of generating electricity in Africa ($0.18/kWh).

Gas-fired plants are flexible and can complement renewable energy sources; gas can act as an enabler for solar and wind energy by solving the intermittency problem.

Gas-fired solutions are modular and available from small scale (several MW) to large scale (hundreds of MW), recognizing that developing large scale power projects may not always be the best approach in some parts of Africa.

Some turbines are multifuel; LNG can thus replace oil.

LNG technology components (including FSRUs) are well established and available, diminishing the risks for the countries opting for such. Gas-fired plants are very efficient (60 percent for a CCGT) compared with coal-fired plants (up to 47.5 percent) and existing oil-fired fleet (GE 2016).

However, gas may not be the best solution for remote inland areas, even if some small units exist.

Options

There is still the need to develop a pipeline network, unless LNG is transported by truck as is done in China, but as previously noted, this is more expensive.

It is important to remember that residential electricity in African countries can be quite expensive, considering the low per capita incomes.

According to a World Bank study, residential tariffs were more than $0.12/kWh as of 2010 in Senegal, DR of the Congo, Kenya, Benin, Côte d'Ivoire and Namibia.

This is also true in countries not considered here such as Burkina Faso, Cape Verde, Uganda, Madagascar, Mali and Chad.

This meant that Africa's residential power prices were between 50 and 150 percent higher than the average residential tariffs in Latin America, Eastern Europe and East Asia.

Unpaid bills

Consequently, many companies have the problem of unpaid bills, threatening their finances and future investments.

LNG-to-power is a new solution, particularly for the African LNG projects.

However, as with any major energy development, to properly assess the risks it is necessary to fully understand the gas and power markets the proposed project will serve.

Even though it is not as capital intensive as liquefaction - and many countries have opted for FSRUs - a combined LNG-to-power solution is likely to cost more than $1 billion and possibly more depending on the scale of the gas-fired capacity.

As demonstrated by Haug and Cumberland (2013), the option of developing LNG import terminals and power plants together can be successful. This was the case in Puerto Rico, which in the late 1990s developed its EcoElectrica power plant and associated LNG receiving terminal.

That plant was the first to simultaneously finance and build LNG and power as a single facility, achieved through having matching LNG supply and power offtake contracts.

Many developing countries in Central America, Africa and Southeast Asia have since tried to replicate this, but without

Country	LNG-to-power	Credit Rating (S&P)	Credit Rating (Moody's)	Debt ($million) (2014)	GNI ($million) (2015)
Egypt		B-	B3	39,634	305,861
Morocco	Yes (+industry)	BBB-	Ba1	42,772	106,073
Benin		N/A	N/A	1,984	9,364
Côte d'Ivoire	Yes	N/A	Ba3	10,857	32,053
Ghana		B-	B3	17,612	40,615
	Yes				
	Yes				
	Yes				
Kenya	Yes	B+	B1	16,179	61,824
Namibia	Yes	N/A	Baa3	N/A	12,814
Senegal	Yes	B+	B1	5,655	15,104
South Africa	Yes	BBB-	Baa3	144,006	332,593
Sudan	Yes (+industry)	N/A	N/A	21,759	73,985

Source: Credit ratings: http://www.tradingeconomics.com/country-list/rating;debt: World Bank (defined as "External debt stocks"), GNI: World Bank (Atlas method). KAPSARC, IEA statistics.

*based on 1.4 million cm of LNG per annum. **author's estimate.

Some of LNG-to-power ventures with credit ratings and debt forecasts

much success, even though, as noted previously, the high oil prices of the past decade have often resulted in power prices high enough to support such a facility.

There is an appetite to invest in power generation and import facilities, but less to fund gas transmission and distribution pipelines

Successes

Egypt and Jordan are other successful FSRU development stories, but both benefited from existing markets and infrastructure.

Resource-poor countries considering developing an LNG terminal face many challenges. The first is the existing and future size of the prospective gas market.

All the African countries considered here, except Egypt, currently consume less than 5 Bcm/y, or even less than 2 Bcm/y.

While the power generation sector is expected to serve as an anchor customer - 1 GW running 5,000 hours would require around 1 Bcm - governments may want to develop demand from industry, cooking and transportation, which creates further upward uncertainties on demand.

Some additional independent power producers (IPPs) may later want to use the LNG plant, raising issues of third party access to the LNG terminal.

The second issue is the duration of the import needs. Some imports may be considered only as a bridging solution during the period when domestic production recovers or increases.

This is the case for Egypt and potentially also for Ghana, Senegal, Namibia and South Africa. FSRUs can prove the best option to support the import of small volumes of LNG, or to work with small-scale LNG vessels to meet smaller sized markets.

Demand

Some countries find that once the gas infrastructure is in place, this drives new gas demand.

There is often no established existing LNG (or gas) consumer and sometimes no gas company. Some markets currently consume almost no gas, which implies that the gas infrastructure - not only the LNG import facility but also some pipelines - has to be developed and the authorities need to familiarize themselves with gas issues and develop a regulatory framework.

A reliable offtaker able to pay a price high enough to support gas imports must be found. Benin, Togo and Ghana have some experience due to the existence of the 8 bcm/y West African Gas Pipeline (WAGP) from Nigeria, which was also aiming at power plants.

Countries such as Senegal, Namibia, South Africa, and Kenya face the chicken-and-egg problem: which comes first, the LNG supply or the consumer? (Haug and Cumberland 2013).

Puerto Rico and the Dominican Republic solved that by developing both together. In Jordan, the presence of existing power and transport infrastructure was a decisive factor.

Typically, most sellers would prefer a customer with reliable credit, able to sign a long-term contract based on oil indexation and to pass on costs to final end-users.

Credible

Such customers can be few. However, having financially credible gas offtakers is crucial for a project.

Most countries considered here have relatively weak credit ratings, the highest rated being South Africa and Morocco.

Government guarantees may not be considered sufficient for this. A long-term contract represents an important financial commitment, along with take-or-pay (TOP) commitments.

Gas-fired IPPs in emerging markets will almost always put dispatch risk with the offtaker, insofar as capacity charges will be payable for availability and regardless of power demand (Down and Wilby 2015).

However, if/when the LNG is not needed, the new conditions on the global LNG market may help mitigate this risk by allowing the cargo to be resold as a spot cargo.

In that eventuality, long-term, oil-indexed and inflexible take-or-pay contracts are likely to be too ridged to permit the kind of capital and operational flexibility required for projects with variable demand to evolve as markets develop.

Funding

Another challenge is the funding of the downstream infrastructure. There is an appetite to invest in power generation and import facilities, but less to fund gas transmission and distribution pipelines (Smedley 2016).

Downstream and LNG import infrastructure development can be delayed by the lack of an appropriate regulatory regime.

For example, the FSRU Golar Tundra has been reported as waiting outside the port of Tema, in Ghana, for permission to dock and connect to the country's gas transport system, allegedly due to the fact that the port's infrastructure was not ready (Elston 2016).

This leads to the relationship between the different elements of the project: the FSRU, the pipeline(s), the IPP and the marine infrastructure. The link between the power plant and LNG supply/ import development is particularly important, not only for the development of the project, making sure that the elements arrive simultaneously, but also for the contractual terms during the life of the project and for issues such as *force majeure*.

The linking of different parts of the chain, and their development timetable, is key to developing a strong gas supply chain. South Africa's tenders distinguish between bundled and unbundled projects: in the bundled project the developer consortium would be in charge of everything from sourcing the LNG to building the FSRU and the power plant.

In general, there are four different, main models for LNG-to-power projects, regardless of the regasification plant type, onshore or FSRU. These reflect the different types of LNG import terminal investment structures across the world and whether the company investing is a power company or a gas company.

Investor

A first option would be for the investor to develop and own the LNG import and power infrastructure. This requires an LNG sale and purchase agreement (SPA) with a supplier, which is also supported by a power purchase agreement (PPA) guaranteeing the revenue flow.

It allows the investor to receive credit from lenders, with the SPA and PPA serving as credit guarantees. This does, however, require power offtake guarantees from a credible power offtaker.

In the case of Puerto Rico, this option succeeded because the power plant had long-term LNG supply contracts as well as power offtake contracts with matching escalations, and long-term non-recourse financing matching the LNG and power contract terms.

Another option is for the investor to draw up the LNG SPA supported by the PPA, as above. The difference here is that another company will build, own and operate (BOO) the FSRU and the power plant. In that case, the investing company does not need to finance the facilities, though the PPA will serve as a guarantee for the other investor operating them.

There may also be two different companies managing the FSRU and the power plant, as these require different competencies. The greater number of counterparties and companies involved can complicate the development of a project structured like this.

In a third option, the investor concludes the LNG SPA and the PPA. It is a shareholder of the power plant, but the regasification plant is operated by another company.

A terminal use agreement is concluded between the investor and the terminal operating company.

European

Fourthly, the investor could opt to operate only the LNG terminal and the power plant. The independent power producer (IPP) would then import LNG itself, under a long-term purchase agreement with an LNG seller.

The LNG terminal would then be operated under a tolling model, with capacity reserved by the IPP on a long-term basis, similar to the models used for the terminals at Gate and the Isle of Grain. In this case, other IPPs could also use the terminal in the same way.

The cases where the LNG terminal is operated by a company that is not the investor are often typical for FSRUs, as very few companies are specialized in operating them (Dameno and Lopez 2013). This option could also be easier for a company with no experience in LNG, such as Gasol in Benin.

There is also the possibility that the BOO could include the acquisition of the facilities after a certain duration. This is known as build, own and transfer (BOT), or build, own, operate and transfer (BOOT).

The investment solution will also depend on the development of the importing market: is there a gas or a power company and is it sufficiently creditworthy? In most cases, the investment is led by foreign private investors.

The role of the state as a potential source of guarantee is also important, even though most countries considered are not highly rated, as previously noted.

Interests

To succeed, project stakeholders must sometimes align conflicting interests. The LNG supplier will want the highest price for its gas; the IPP will want a viable and profitable power project; and the government will want to minimize the costs for the end-consumer and the environmental costs, while supporting economic development.

Electricity prices often do not reflect the cost of generation: in 2010, the average effective tariff in Africa was $0.14/kWh, against an average of $0.18/kWh in production costs (AfDB 2013).

Strength

This implies losses for the power company, meaning an inability to invest further. But these tariffs are not very low by international standards: in the U.S., the average price of electricity for end-users was around $0.10/kWh in early 2016.

The average price of electricity for household consumers in the EU was €0.21/kWh in the second half of 2015, with prices varying between €0.30/kWh and €0.096/kWh (Eurostats 2016).

When there is no properly functioning market, strong power projects require a strong PPA that will enable cost recovery and protect the private investor against political intervention.

Commercial and legal terms, as well as contracts, must align to encourage proper performance of all contractual obligations. Finally, the formulae in LNG SPAs could lead the gas price to vary substantially, as has been observed on gas markets over the past 10 years.

Due consideration must be given as to how this may impact the PPA, for example whether the gas costs will be fully transferred to the end-user, which also has political implications.

A successful LNG-to-power project is more likely when project risks are allocated to those best able to mitigate them.

The power and the regasification elements of an integrated project are significantly interdependent and a default by one party of the overall project will prevent the other(s) from generating cash flow.

Accordingly, many LNG-to-power projects place more importance on flexibility. The choice of an FSRU can help mitigate construction delays on the power side because the FSRU can be redeployed elsewhere in the interim as an LNG carrier to generate extra revenue, if there is a market for that.

Several technical, operational and legal challenges need to be considered and, where applicable, addressed in order to ensure the success and long-term viability of the project (White 2015).

Access to a liquid and well functioning market is the critical precondition for doing so cost effectively.

In an ideal case, as previously noted, the LNG contract and the power contract back one other. That is, the fuel supplier's delivery obligations are guaranteed to the power generator and the power producer's obligation to take deliveries of gas are similarly supported. However, this rarely happens and, in practice, investors structure the projects on a limited recourse basis, which requires the lenders to analyze the entire contractual matrix.

Part 2 of the Africa Report will be published in the September 2017 *LNG Journal*. ■

This article is based on extracts from a 36-page report on African LNG. The author of the original paper, Anne-Sophie Corbeau, is an associate of the King Abdullah Petroleum Studies and Research Center, located in Riyadh, Saudi Arabia. This is a non-profit global institution dedicated to independent research into energy economics, policy, technology and the environment across all types of energy.

Siemens explains how early planning and design decisions can drive success for LNG projects

Dan Kinsey, Vice President of Global LNG at Siemens

In recent years, cost overruns, rebids and schedule delays have plagued liquefied natural gas projects worldwide. This, coupled with increased liquefaction capacity set to come online from projects currently in development or post-final investment decision, has created a business environment where plant owners and developers must drive to reduce the total cost of ownership of their projects to remain competitive.

An LNG project typically takes five or more years to get from concept to FID. There are a number of key technical and commercial decisions stakeholders have to make early in the development stage that play a critical role in the overall success of an LNG project.

Some of these include location, gas supply, plant capacity, driver type, technology selection, power source, and transportation/shipping method.

Historically, it has been the tendency of some stakeholders to make many of these decisions before fully engaging with original equipment manufacturers (OEMs) and solutions providers.

However, many financial and operational benefits can be realized by partnering with OEMs in the early development phases to achieve an optimized solution that spans the entire LNG value chain.

Changing landscape

Since 1995, the global LNG market has quadrupled in size and doubled its share of global natural gas trade[1]. This trend is expected to continue over the next two decades and will be driven in large part by the increased push for clean power in advanced economies (i.e., Europe and Asia), along with power plant and infrastructure development in emerging countries.

These trends will increase demand for inexpensive, abundant fuel supplies. Overall, annual global consumption of natural gas is forecasted to rise 44 percent through 2035.

During that period, natural gas use in transportation is expected to double, while demand from utilities is expected to increase by more than 50 percent[2].

Despite the relatively bright long-term outlook, today's LNG projects face a number of difficult challenges. First and foremost, as developers have poured into the industry to capitalize on its expected growth, competition on the supply side has become increasingly fierce.

As of January 2016, proposed liquefaction projects totaled 890 million tons per annum (MTPA)[3]. The vast majority of these projects have been proposed in the U.S. and Canada; however, capacity is also being evaluated in Australia, Asia, Africa, and Russia.

Supply

With approximately 115 MTPA of liquefaction capacity currently under construction, the most significant near-term challenge will be global oversupply[4].

Many reports forecast that demand will not exceed supply until 2022 or 2023. Based on this forecast, the next wave of LNG projects will need to reach FID by 2018.

The increasing number of unconventional offtakers demanding more flexible sales and purchase agreements (SPAs) also poses a challenge for LNG projects.

Of the dozens of proposed LNG projects across the globe competing with each other for offtake agreements, only the most competitive projects will move forward.

While in the past, success was often synonymous with speed-to-market, the deciding factor today is which projects can provide the lowest cost gas to their end-users. Achieving this will require project stakeholders to reduce TCO by lowering capital expenditures (CAPEX), optimizing maintenance, increasing efficiencies and availability, and reducing emissions.

It will also require suppliers to become more agile and adapt their business models by taking a holistic approach that encompasses the entire LNG value chain.

With demand forecast to exceed supply in 2022 or 2023, the next wave of LNG projects will need to reach final investment decisions by 2018

Maximizing LNG project success in today's climate requires careful consideration of all aspects of the gas to power linkage - from upstream and midstream components (i.e. gas supply, pipelines, liquefaction plant), to transport and shipping, to downstream regasification and power generation.

The supply chain has many parts, any one of which can drive a project to be uncompetitive, particularly if it is addressed "on an island."

Economics

Shipping costs, for instance, can increase the total cost of providing gas to the end-user by 10-15 percent, which potentially is substantial enough to make a project uneconomic, regardless of other important links such as liquefaction and regasification.

Engaging with strategic partners to make critical decisions in the conceptual phase will help ensure that all parts of the LNG value chain align, thus allowing the project to be the most competitive.

For example, early decisions regarding gas source and pipelines impact whether the liquefaction plant will be mid-scale to support the market for smaller, more flexible LNG demand (1 to 2 MPTA), or if it will be a conventional large-scale facility.

Gas source also determines raw gas composition, which plays a role in the type of treatment systems and equipment required to meet specified gas quality criteria.

It also affects location of the plant, which in turn impacts capacity, as well as other aspects. Driver selection is another important decision that affects LNG plant economics.

Certain variables that have to be taken into account when evaluating location, include ambient conditions, environmental requirements, available power infrastructure to support an electric drive (eLNG), use of aeroderivative or industrial gas turbines, etc.

It becomes evident when examining the LNG value chain that one link has the potential to impact many others.

This, combined with today's highly competitive business environment, means that there is little tolerance for error.

Partnering early with a total solutions provider that has a regional presence across the entire value chain is the first step in adopting a holistic approach and developing a full-lifecycle solution that has the best chance for reaching FID.

From OEM to solutions partner: During project development, after siting studies have been conducted and a location has been selected, two key decisions that need to be made relate to the specific type of LNG liquefaction technology to be used (propane-precooled mixed refrigerant, Optimized Cascade, mixed fluid cascade, dual mixed refrigerant, etc.) and the mechanical driver that will be used for compression (variable frequency drive, aeroderivative gas turbine or industrial gas turbine).

Determining the optimal configuration requires careful examination of several factors, including gas composition, production volume, ambient conditions, and electrical grid stability.

Configuration

Each configuration presents its own unique advantages / disadvantages with regard to CAPEX, operating expenditures

[1] http://www.igu.org/publications/2016-world-lng-report

[2] https://www.strategyand.pwc.com/reports/navigating-transformation-gas-market

[3] http://www.igu.org/publications/2016-world-lng-report

[4] http://www.igu.org/news/igu-releases-2017-world-lng-report

Driver configuration plays a critical role in the plant's performance

(OPEX), efficiency, maintenance, emissions, and availability.

Ambient temperature plays a particularly important role in driver selection because of its effect on turbine performance. As air temperature rises, mass flow rate through the turbine decreases, which results in a corresponding reduction in power output.

If a plant is located in a region that experiences large temperature fluctuations, important design decisions will have to be made that can significantly impact production and life cycle costs.

Engaging early with the OEM to make these decisions is critical to ensuring that the solution implemented aligns with environmental conditions and project objectives. This will deliver the lowest TCO to the owner.

Evaluating the equipment design for the liquefaction island early on is also important because as the project approaches final investment decision it becomes increasingly difficult and costly to make design changes.

Generally speaking, once a design decision has been made, certain costs become locked in. In such instances, the impact that equipment selection can have on the overall efficiency, performance and TCO of the project is limited to how well the design is executed.

Too often the traditional stakeholder approach results in selection of a design that is the least costly to implement, rather than the one that delivers the most value to the owner over the life of the plant.

Initial phases

Engaging early with the LNG equipment solutions provider in the initial project phases facilitates the formation of cross-functional teams that can improve the overall chance of project success by aligning key equipment decisions with project-specific variables and optimizing designs based on local and/or regional factors.

In such cases, all parties work together to reduce TCO and make the project the most profitable for the owner.

Additionally, collaboration between the EPC and solutions provider early on can result in arrangements that achieve higher efficiency levels than originally considered in the preliminary design phase.

It also reduces the chance of cost overruns during project execution, installation and commissioning, as well as when the plant comes online.

Leveraging digitalization: Determining early on how digitalization will be built into an LNG plant is another critical design decision that can reduce TCO by lowering OPEX, reducing complexity and offering increased flexibility to accommodate project changes outside of the digital solutions / automation discipline.

In recent years, the development of new liquefaction technologies, along with greater focus on energy efficiency and product quality, has increased the demand for advanced process analytical solutions in the LNG space.

Manifold measuring points with different analysis tasks are located along the value chain from the well head, to the liquefaction plant, to the regasification terminal.

Process gas chromatographs are the prevailing type of process analyzers used in LNG plants to collect the required information for plant performance optimization, as well as timely and reliable determination of calorific value.

The chromatographs provide all information pertaining to natural gas quality and its physical properties, which are required for fiscal energy measurement.

Digitalization of analyzer systems enables operators to collect, manage, store, and evaluate data from multiple analyzer systems in a central platform so their performance can be monitored and improved over time.

Costs

This leads to lower labor costs through fewer manual validations, increased equipment uptime through preventative maintenance, and more precise control of the quality and composition of end products.

For a cost-effective and functional analyzer system solution, stakeholders should involve the analyzer vendor with their comprehensive analyzer and system knowledge expertise early on and consider factors such as utilities, maintenance and simplicity when making decisions related to specific technology, system solution and life-cycle support.

Digitalization can also be leveraged to develop digital twins of important LNG equipment assets, such as turbomachinery. A digital twin is a software model that uses sensor data to mirror the status, working condition or position of an object or piece of equipment in the virtual space.

Real-time data from equipment is loaded into a model, which enables operators to perform simulations and gain insight into what operational measures can be taken to produce better outcomes, such as reduced energy consumption.

Digital simulations can also help identify key performance indicators (KPIs) associated with equipment assets and provide increased visibility to predict potential failures before they occur in the actual plant.

These are just two examples of areas where digitalization can help reduce the TCO of an LNG plant. There are many other areas along the value chain where early investment in a comprehensive digital solution can be leveraged to generate economic benefits that far exceed the simple cost of system implementation.

Conclusion

An LNG project typically takes five or more years to get from concept to FID. During that time tremendous effort is expended in design development, regulatory approvals, establishing the financing, and negotiating offtake agreements.

Once a project moves past FID, it takes several more years for detailed design, manufacturing and construction for a project to achieve commercial operation and start seeing any return on the investment.

Understanding the economic drivers of the project – from gas supply and liquefaction, to transport and consumption – is critical to success in today's evolving business environment.

The world is complex, and there is a wide range of concepts, geographies, technical solutions, and regional market drivers that play a factor in key project decisions. No two LNG projects are the same and today's owners and developers have many choices.

By engaging early and leveraging the expertise of OEMs that can provide solutions and support throughout the entire LNG value chain, stakeholders can lower the TCO of their facilities, improve supply flexibility and greatly increase the overall likelihood of project success. ■

As LNG projects approach FID, it becomes increasingly difficult to make design changes

Japan's ClassNK examines ways of addressing the impending SOx regulations and the place of LNG

Nippon Kaiji Kyokai, the ship classification society, reports on how to meet new sulfur restrictions

The maritime industry has seen many changes over its long history, drastically transforming how things are done.

The changes we are seeing today are no less influential. Spurred by the development of new technologies, change is in fact a constant for our industry. Adaptability has been the key to success.

Of course, supporting the development of these technologies is part of the ClassNK mission, ensuring the safety of our classed fleet during these changes is our primary objectives.

Measures

One hot topic in the industry is the upcoming SOx regulations and what measures can be adopted to stay in compliance in the face of the new challenges.

With the introduction of a global cap of 0.5 percent sulfur emissions from 1 January 2020, all ships are faced with important legislation to comply with.

The implementation date, stated in MARPOL ANNEX VI, was confirmed by the International Maritime Organization to reduce air pollution from ships.

While lauded for the positive impact on the atmospheric environment, bringing down the level of sulfur emissions from the current 3.5 percent cap outside Emission Control Areas will require significant investments on the part of the shipowners and the support of the maritime industry.

Another possible solution that is gaining traction in the industry is the use of alternative fuels to meet the stricter levels.

Although the use of fuels such as methanol, biofuels, liquefied petroleum gas and others are still in the research stage, liquefied natural gas (LNG) is already a viable candidate for the industry.

Advantages

Due to its low carbon content, LNG has lower greenhouse-gas emissions compared to Heavy Fuel Oil (HFO) when used in propulsion systems.

In addition to the near 100 percent elimination of SOx emissions, particulate matter (PM) emissions are also virtually non-existent, and nitrous oxide (NOx) emissions can be potentially lowered by 85-90 percent, compared to conventional diesel engines burning HFO.

However, the upfront costs required to use LNG may not be viable for some shipowners, especially in the case of older existing vessels.

Gas-fueled engines and the infrastructure for refueling are clearly more complicated than that for the conventional liquid fuel.

With the cost of retrofitting taken into account, this option may prove more expensive than the combined MGO and HFO fuel route if the vessel is not in service long enough to recoup the initial expenses.

Therefore, the IMO forecasts that up to only 170 vessels including bulk carriers, container ships, and tankers operating within ECAs and on short-haul routes will use LNG as a fuel by 2020.

Options

Fortunately, shipowners have a number of options available to reach compliance.

Alternative fuels as well technologies such as Exhaust Gas Cleaning Systems (EGCS) are recognized by the regulations.

All of these mitigation measures are already widely - and commercially - employed by on-land sources. However, a lot must be taken into consideration when applying their use onboard.

For shipowners, the foremost concern is cost. According to research carried out by the IMO, the price of applicable fuels at 2020 such as Marine Gas Oil (sulfur content 0.10 percent) and HFO (sulfur content 0.50 percent) are expected to cost around US$616 and US$595 per ton respectively, compared to current usable HFO (sulfur content 3 percent) at the costs estimated at US$466 per ton, a cost increase of roughly 32 percent and 27 percent respectively.

While these figures are not set in stone, they provide an indication of what is yet to come.

Some fluctuations can also be expected geographically at the outset.

Application

So while the use of these fuels may be the most practical choice in terms of ease of application, there are still many other factors to consider.

The low viscosity of the new fuel oils can lead to problems such as fuel leakage, and the new specification among the

ClassNK has issued Exhaust Gas Cleaning System Ready Full notations to nine ships operated by Japan's Mitsui O.S.K. Lines

scrubbers and residual oil could cause other irregularities.

Also, the financial burden of these fuels alone may likely prompt owners to seek other SOx mitigation measures.

Exhaust Gas Cleaning System (EGCS) technology, also known as SOx scrubbers, is another way to meet the SOx emission standard.

SOx scrubbers have been used in on-land SOx anthropogenic sources since the 1970s, and have recently been adopted for marine use.

The technology commonly uses water jet injection/spray to dissolve sulfur as well as particle matter from exhaust gases and discharge them in washwater to receiving water.

In addition, some residue may be stored as a slurry to be disposed of at a later stage.

The IMO has already established the discharge criteria for washwater, and some local authorities have enforced regulation on discharge at their ports and estuaries. Such additional requirements will increase operating expenditure.

The application of EGCS on vessels, while widely covered in theory, is yet to come into mainstream use.

However, an IMO study estimates that roughly 3,800 vessels will have EGCS installed by 2020, mainly used in the ECAs.

In order to provide a roadmap for the industry, ClassNK teamed up with Mitsui OSK Lines (MOL), Minaminippon Shipbuilding Co., Sanwa Dock Co. and Wartsila Japan to examine SOx scrubber retrofitting in ships in service.

Using a Pure Car Carrier, EGCS was retrofitted on the vessel to investigate the associated technical challenges such as those presented by the confines of the engine room.

Retrofits

ClassNK confirmed that retrofit plans developed during the project fully complied with project requirements along with corresponding class and statutory requirements, and subsequently issued its first EGCSR-F (Exhaust Gas Cleaning System Ready Full) notation.

With this notation scheme coming into place within 2017, shipowners will have a set of clear guidelines to equip their vessels with EGCS.

ClassNK subsequently issued EGCSR-F notations to nine ships operated by MOL.

Another EGCS project that ClassNK supported was Drive Green Highway, which was headed by K Line in cooperation with Mitsubishi Heavy Industries (MHI), Japan Marine United (JMU) and Japan's Ministry of Land, Infrastructure, Transport and Tourism (MLIT).

The project saw a Pure Car/Truck Carrier (PCTC) fitted with hybrid SOx scrubbers in addition to a wealth of environmentally-friendly solutions such as composite NOx and CO2 emissions reduction technology and auxiliary engine exhaust gas recovery systems (EGR).

The road to SOx emission compliance is by no means an easy task, but by working together with the relevant industry, ClassNK is committed to supporting the development of viable solutions. ■

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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
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
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 Abuja	126,530	Bonny Gas Transport	GD Quincy	Sep-80	Bahamas	S	Moss	5	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
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
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 OII	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
	Sunrise LNG	Woodside, Osaka Gas, ConocoPhillips, Shell	2020+	1	3.5
	Wheatstone LNG	Chevron, Apache, Shell , Kuwait FPEC	2017	2	9.0
CANADA	Aurora LNG BC	CNOOC, Inpex Corp. and JGC Corp.	2024	4	24.0
	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
	Grassy Point LNG	Woodside Petroleum	2024	studies	
	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		
	Pacific Northwest LNG, BC	Petronas, Japex, Sinopec, Indian Oil, Brunei Petroleum	2021	2	12.0
	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 and Golar LNG	2019	1	2.0
INDONESIA	Sengkang LNG	Energy World Corp.	2017	4	2.0
MALAYSIA	Rotan FLNG (Sabah)	Petronas	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, InterOil, 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
	Cove Point LNG, Maryland	Dominion	2018	1	5.25
	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	2016-19	5	22.5
	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
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, Suez, 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	1	4.5	5	800,000
	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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