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Australian LNG report gives forecasts on existing and new Asian customers

Export volumes from WA and Queensland are forecast to hold steady at 81 million tonnes in 2020-2021

Australian LNG export prices are forecast to decline slightly in 2019-2020 and 2020-2021, due to an easing of oil-linked contract prices at which most Australian LNG is sold.

Australia's LNG export volumes are forecast to increase from 75 million tonnes in 2018-2019 to 81 million tonnes in 2019-2020, as the last two projects in Australia's recent wave of LNG investment ramp up.

Chinese natural gas consumption continues on its upwards curve for the 2020s

Steady

Export volumes are forecast to hold steady at 81 million tonnes in 2020-2021 from Western Australia and Queensland, according to the latest resources and energy report from the Australian Government's Office of the Chief Economist.

The value of Australia's LNG exports is forecast to decline from A$50 billion in 2018-2019 to A$49 billion in 2019-2020, and fall back further to A$47 billion in 2020-2021, driven by declining oil-linked contract prices.

Asian spot prices for LNG have recovered from the record lows seen in the September 2019 quarter .

The Asian LNG spot price averaged an estimated US$5.70 per million British thermal units (MMBtu) or A$8.80 a gigajoule (GJ) in the December 2019 quarter, 25 percent higher than the September quarter, but 40 percent lower year-on-year.

The modest price increase in recent months has been driven by stronger demand, in the lead up to winter in the northern hemisphere.

Minor disruptions to supply in Australia, the US and Qatar have also supported prices.

Nevertheless, the overarching narrative for LNG markets remains unchanged: the long-anticipated overcapacity in LNG markets has arrived, placing downwards pressure on LNG spot prices, which remain at multi-year lows.

New capacity in the US, Australia and Russia are ramping up operations.

Meanwhile, growth in China's LNG imports (the world's second-largest importer) has slowed, and imports from Japan and South Korea - the world's largest and third-largest LNG importers, respectively - have declined.

Despite low LNG spot prices, there has been a relatively weak demand response, as most of the LNG traded in Asia is sold on long-term contracts (70 percent in 2018).

The price of LNG in these contracts is linked to the price of oil - commonly the Japan customs-cleared crude oil price (also known as the JCC) - by a time lag of several months.

Patchwork

There is no single oil-linked contract price in Asia, with a patchwork of different contractual pricing arrangements agreed at different points in time.

The indicative oil-linked contract price is estimated to be around US$10.50 per MMBtu (A$16.29/GJ) in the December quarter, down slightly from US$10.60 per MMBtu in the September quarter.

Although the differential between spot and long-term contract prices has narrowed in recent months, it is still very large in historical terms.

There are potential implications for long-term contracts if this gap persists for a sustained period of time.

Reductions

Buyers are reportedly reducing purchases on long-term contracts - and increasing purchases of spot cargoes - where their contractual flexibility permits, and pushing to have contract prices lowered during the periodic price reviews that are built into long-term supply agreements.

In the longer term, low spot prices relative to oil-linked prices may encourage buyers to push for shorter, more flexible contracts and gas-based pricing (as opposed to oil-linked pricing).

The outlook for nuclear generation in Japan has been complicated by new security measures announced by Japan's nuclear regulator in April 2019.

Operations that miss deadlines to implement counterterrorism upgrades will be halted. In October, Kyushu Electric Power announced that operations at two of its reactors - Sendai 1 and 2 - would be taken offline in 2020 to complete the necessary upgrades.

The forecast for Japanese imports of LNG for 2020 has thus been revised up slightly from the September 2019 Resources and Energy Quarterly.

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The potential for a further two nuclear reactors - Kansai Electric Power's Takahama 3 and 4 - to be closed to complete upgrades could further boost Japan's LNG imports over the outlook period to 2021.

China's LNG imports expected to grow, but at a slower pace China was the second largest LNG buyer in the world in 2018, importing 51 million tonnes of LNG, or 69 billion cubic metres (bcm).

China's LNG imports continued to grow in the first ten months of 2019, rising by 14 per cent on the same period a year earlier.

However, the pace of growth has slowed considerably from previous years, due to a range of factors. The Jiangsu Rudong LNG terminal, one of China's largest, was offline for more than a month from late September, after it was damaged during a typhoon.

Growth in gas demand has also moderated in recent months. Authorities are reportedly relaxing the coal-to-gas switching policy to allow more flexibility in the choice of fuel, against a backdrop of slowing economic growth and low coal prices.

China's gas stockpiles are also higher than usual, due to a relatively mild summer. Combined with improved storage infrastructure, it appears unlikely that there will be a substantial surge in LNG imports to meet winter demand, in contrast to previous years.

Despite the slowing pace of growth, China's gas

Authorities are reportedly relaxing the coal-to-gas switching policy to allow more flexibility in the choice of fuel...

aconsumption is expected to rise over the outlook period, driven by China's efforts to reduce air pollution and raise the share of gas in the overall energy mix from 7.0 percent in 2017 to 8.3-10 percent in 2020.

In 2021, China's gas consumption is forecast to reach 364 Bcm, up from an estimated 280 Bcm in 2018.

While China's domestic gas production and pipeline imports are the lowest cost source of gas, they are not expected to keep pace with rising domestic demand.

LNG imports are thus expected to grow to service rising Chinese gas demand. China's LNG imports are forecast to rise from an estimated 57 million tonnes in 2019 to 72 million tonnes (98 Bcm) in 2021.

Beyond the outlook period, China's LNG import capacity could more than double from current levels by the mid-2020s, based on project development plans, and China is likely overtake Japan as the world's largest importer of LNG.

China is targeting domestic gas production of 207 Bcm in 2020, up 30 percent from around 160 Bcm in 2018.

However, the country faces difficulties in lifting domestic output, including challenging geology and the fact that gas resources are located in heavily populated or cultivated areas.

As a result, China's gas production could fall short of its production target, requiring higher imports to meet demand. China's pipeline gas imports are also expected to rise over the next few years.

Russia's "Power of Siberia" pipeline to north-eastern China opened on 2 December 2019, and is expected to deliver 10 Bcm by 2021 as it ramps up towards full capacity of 38 Bcm by 2025.

The Central Asia-China Gas Pipeline expansion is also on track for completion by 2020.

Demand for LNG is also forecast to increase amongst emerging Asian economies such as India, Pakistan, Bangladesh, Indonesia, Malaysia and Thailand.

While these countries are relatively small importers of LNG individually, collectively they are expected make a substantial contribution to rising global LNG demand.

As a group, emerging Asian economies are expected to surpass China as the world's second largest importer of LNG by 2021.

India is expected to account for a large share of the growth in emerging Asian demand, with LNG imports forecast to increase from an estimated 22 million tonnes in 2019 to 28 million tonnes in 2021.

The Indian government is aiming to lift the share of gas in the energy mix from just under 6 percent currently to 15 percent by 2030, although the target is considered ambitious.

The increase in gas consumption will be supported by policy and price reforms, and by investment in pipeline and port infrastructure.

While India's domestic gas production is also forecast to grow, it is not expected to keep pace with demand, with the gas sector constrained by a range of challenges.

Europe expected to increase LNG imports but challenges are looming Europe - the "destination of last resort" for LNG due to its extensive storage capacity - has absorbed much of the increase in LNG production over 2019 to date.

However, with storage quickly filling up and the potential for a milder-than-usual winter, a growing glut of LNG in Europe is raising questions over how much more LNG can absorbed in the coming months.

Over the outlook period, Europe's LNG imports are forecast to climb from 51 million tonnes in 2018 to 60 million tonnes in 2021.

While overall European gas consumption is expected to remain relatively flat, rising LNG imports are expected to be driven by declining gas production in the region.

Resource depletion in the North Sea and efforts to reduce seismic activity at the Groningen gas field in the Netherlands, are both expected to reduce European gas production.

Partially offsetting the impacts of declining domestic production, LNG imports are expected to face increasing competition in Europe from pipeline gas.

The Nord Stream II gas pipeline, with a capacity of 55 Bcm per annum (equivalent to around 40 million tonnes of LNG), will connect Russian gas fields to the EU pipeline network at Germany's Baltic coast.

With several hurdles remaining, it is unlikely that the project will commence operations until the June quarter of 2020. ■

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Associated gas remains a main upstream link between oil and natural gas and LNG markets

The 200 billion cubic metres flared or vented is greater than Japanese and Chinese LNG imports

Spending on large-scale, capital-intensive LNG projects has been increasing and this is in contrast to the oil industry's focus on smaller, less complex short-cycle projects.

Rising gas-on-gas competition is also challenging the rationale for oil indexation, according to a report by the International Energy Agency.

Linked

However, because oil rarely rises to the surface without gas, the two fuels are unlikely ever to be completely delinked.

Associated gas from oil fields is also the main source of flaring as well as a major source of gas that is vented directly to the atmosphere.

These are both major sources of greenhouse-gas (GHG) emissions and it is important to understand the environmental footprint of this source of gas supply.

The report considers the extent of global associated gas production and use and explores in various cases how upstream linkages between oil and gas continue to affect the outlook for gas in production areas such as the Middle East and the US.

"Most wells that are drilled to target oil formations also yield a mixture of other hydrocarbons such as condensates, natural gas liquids and natural gas," said the report.

By-product

This is "associated gas", a by-product from an oil well or field and non-associated gas comes from a well or field that is primarily geared for natural gas production.

"Associated gas has often been seen as an inconvenient by-product of oil production and it is generally less valuable than oil per unit of output and is costlier to transport and store," noted the IEA.

"It is often used on-site as a source of power or heat. It can also be reinjected into oil wells to create pressure for secondary liquids recovery (as is common, for example, in Norway, Iran and Venezuela)," said the report.

"Under the right geological conditions, it can also be stored and sold to the market at a later stage," it added.

The 200 billion cubic metres of associated gas that is flared, 140 Bcm, or escaped into the atmosphere or is vented, 60 Bcm, is greater than the annual LNG imports of Japan and China combined.

Globally, only 75 percent of associated gas is used or brought to market.

The IEA explained that while gas is often flared temporarily while operators test equipment and undergo pre-commissioning works or for safety reasons, "routine" flaring occurs when there is a failure to put associated gas to productive use.

Remoteness

"This may be because of the remoteness of fields or the topography of the surrounding area or because the local price of gas discourages operators from developing costly gas transportation infrastructure to reach existing or potential new markets," said the report.

"Associated gas also often comes with a combination of water vapour, hydrogen sulphide, nitrogen or carbon dioxide, and the cost of separating out these unwanted elements may be higher than the potential profits from the gas," it added.

"Although several countries have imposed regulatory measures to restrict flaring, these are often inadequately enforced," it stated.

"Even in countries with well-developed gas markets, such as the United States, around 10 percent of associated gas extracted today

is usually collected via a network of gathering pipelines for further processing or direct injection into gas grids," said the IEA.

Liquids rich

When the gas is rich in natural gas liquids, extra processing is required to separate out the heavier hydrocarbons such as ethane, butane and propane.

The US is the largest producer of associated gas, accounting for over a third of the global total, nearly equal to the next five countries combined.

In most countries, associated gas constitutes less than a fifth of total marketed gas production, but in some large oil and gas-producing countries, such as Mexico, Saudi Arabia, Brazil and Nigeria, it makes up a much larger share.

Up in smoke: Flaring sometimes cannot be avoided but delivering the natural gas to customers is more sound economics and better for the environment

On average, gas makes up around 10 percent of the energy content of an oil field, but this is subject to wide variation depending on geological conditions, well design and production method.

Gulf resources

"The Middle East holds nearly 40 percent of global proven gas reserves, but these are not spread evenly across the region," said the IEA.

"In the two largest gas-producing countries, Iran and Qatar, natural gas and condensate resources have been developed independently of oil," it explained.

"However, more than 80 percent of the gas in Saudi Arabia and Kuwait is associated gas, and there are also significant volumes in Iraq and Oman," said the report.

"Associated gas has underpinned the rise of gas demand in many of these countries since it has largely been available at close to zero cost as a by-product of oil production. It has also provided a basis for economic diversification away from oil," it added.

In recent years, associated gas production in the Middle East has struggled to keep pace with soaring domestic demand, which has tripled since 2000.

Gas has been used as a substitute for oil in the power sector in producer countries because it frees up additional volumes of crude for export. It has also become a crucial fuel for water desalination plants.

"However, these end-uses cause significant peaks in consumption in summer months and, in the absence of significant storage capacity, associated gas has struggled to accommodate this seasonal variability," said the IEA.

"Unable to keep pace with demand, Kuwait and the United Arab Emirates have resorted to seasonal LNG imports, while Oman had a couple of years ago had to cut back LNG exports to redirect supply to the domestic market," noted the agency.

US output

Associated gas production in the US has doubled over the last decade, reaching nearly 200 Bcm in 2018. It accounts for around 20 percent of the gas produced in the US today.

More than half of associated gas production comes from tight oil plays and significant further growth is expected.

"The Bakken formation in North Dakota and the Eagle Ford play in Texas, developed in the early 2010s, were the first basins to yield significant quantities

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of both gas and oil from horizontal drilling," said the report.

Since 2017, the Permian Basin in southwest Texas has been the main source of growth reflecting a huge ramp up in drilling activity and major productivity gains that have increased the amount of oil and associated gas output per well.

As drilling has increased, so have estimates of remaining technically recoverable resources. The Permian is now estimated to hold nearly 7 trillion cubic metres of gas, alongside 80 billion barrels of oil.

Permian

Drilling in the Permian primarily targets more valuable liquids and gas is essentially a very low-cost, by-product of this activity.

This has created a number of dilemmas for US producers. While crude oil can be transported by road or rail, associated gas must be transported through dedicated pipelines.

"The strong production growth seen over the past three years has outpaced mid-stream processing and pipeline transport capacity, creating bottlenecks that have put strains on upstream operations," said the IEA.

"Companies have responded by leaving drilled wells uncompleted and selling off associated gas at very low, and at times even negative, prices," explained the report.

"They have also increased the amount of flaring; in the Permian alone, levels of flaring have risen more than twenty-fold since 2011, when total flared volumes were estimated at 250 million cubic metres," it added.

"Recent data suggest that as much as 7 Bcm could have been flared in the Permian in 2019," stated the IEA.

As earlier experience in the Bakken formation started a trend. As much as 30 percent of extracted gas was flared in the early 2010s, and where levels have come down only slightly since, flaring on this scale invites a regulatory response and is extremely damaging to the reputation of the upstream industry at a time of ever-increasing scrutiny of its environmental performance.

Capacity

"Constraints on pipeline capacity to transport associated gas away from where it is extracted are visible in widening price differentials between associated gas-producing basins and the Henry Hub benchmark," said the IEA. It is not clear which demand centres have the greatest capacity to absorb this low-cost gas.

Pipeline exports to Mexico have increased more than fourfold since 2010, but the prospects for exporting additional quantities are limited by the need for further development of pipeline infrastructure within Mexico, as well as by Mexico's own gas production prospects.

Taken together, additional exports to Mexico and further coal-to-gas switching would only absorb around 40 percent of the growth in associated gas from the Permian Basin.

LNG export terminals are expected to be the main outlet for associated gas.

"Around 80 percent of liquefaction plant capacity in operation in the US today is on the coast of the Gulf of Mexico," said the report.

Transportation

New pipelines that link low-cost Permian gas to these export facilities, such as the recently completed 20 Bcm Gulf Coast Express, have a critical role to play in relieving the pressure on upstream producers by providing a route to market for their associated gas," stated the IEA.

"Several proposed LNG export projects have made sourcing lower cost gas from the Permian a key part of their business model, which means that new pipelines will also help support the commercial case for the next wave of US LNG export expansion," it concluded. ■

For the Record

AIR LIQUIDE, the French industrial gases company, said it was marketing an exclusive, patented technology that is perfectly suited to the needs of liquefied natural gas carriers and LNG bunkering vessels. "Its benefits, such as helping LNG carriers save cargo while lowering greenhouse gas emissions, are widely acknowledged on the natural gas transportation market," stated the French company. Air Liquide's cryogenic equipment is based on the Turbo-Brayton technology, and it reliquefies natural gas boil-off thanks to the principle of sub-cooling, maintaining it in liquid form in vessel storage tanks. "Quick and easy to install, this patented system is a reliable and economical solution suited to all types of storage, on new and existing vessels," said the company.

Air Liquide said the system was oil-free and required zero maintenance for five years and in addition has proven efficiency. "Air Liquide sold more than 30 of the Turbo-Brayton cryogenic equipment sets intended for LNG carriers and bunker vessels in 2019," it said. "This commercial success is helping to meet the challenge of climate change, as part of the Group's climate objectives, and illustrates Air Liquide's capacity to develop innovative technological solutions," stated the company. The Turbo-Brayton technology for boil-off gas reliquefaction has been specifically developed for marine applications for shipyards, charterers or ship-owners. "It is a fast and easy-to-install skid-mounted product, that is suited to both atmospheric and pressurized storage," explained Air Liquide. "With cooling power available instantaneously from stand-by mode to full capacity and low electrical consumption, Turbo-Brayton technology is extremely reliable," it added. The French company's Turbo-Brayton range has reliquefaction capacities varying from 0.2 t/h to 1.8 t/h, and more by duplicating modules. "This boil-off reliquefication system can be installed on both new constructions and retrofitted vessels," said Air Liquide.

ALASKA may have another LNG export plant development. A new North American LNG company said it was proposing to build a $12 billion LNG export plant in Southeast Alaskan waters near the Canadian port of Prince Rupert in British Columbia. The company is called AlaskCAN LNG and the President is Byng Giraud, a former Vice President of the Canadian Woodfibre LNG project proposed for the district of Squamish in British Columbia. Giraud, who outlined the project plans to Public Service Broadcasting in Alaska, was one of the executives who reached final agreement with the Squamish First Nation for Woodfibre LNG, giving the native people benefits of more than C$225 million (US$170M) in cash over the planned 40 years of operations. According to Giraud, AlaskCAN LNG hoped to capitalize on natural gas trapped in northern British Columbia.

"With the shale gas revolution, directional drilling and all those technological advances of the past 15 years, we're awash with gas, and so that gas is looking for a market," he said. Giraud said his company was investigating sites in Southeast Alaska just over the border from BC. The idea is to take the gas from northern BC, liquefy it on a floating platform attached to a small island and put up to 12 million tonnes per annum of LNG on ships bound for Asia. Giraud added that the was also domestic market potential for the BC LNG in Alaska. "Certainly, it could help a lot of Alaska communities and remote mining projects, that sort of thing, maybe switch from diesel to natural gas," he explained.

Giraud also stated why the liquefaction plant would be better suited to Alaska rather than BC. "We like the Alaska side, partially because it makes the pipeline shorter. It saves about 60 kilometres. And Alaska has a fairly clear and robust permitting process," he stated. The Giraud-run project would be a third LNG export proposal for Alaska. The first is Alaska LNG, led by Alaska Gas Line Development Corp, and the second is Qilak LNG, an Alaska-based firm whose Chief Executive is the former deputy governor of the US state Mead Treadwell.

Qilak has signed a Heads of Agreement with ExxonMobil Corp. on the potential supply of natural gas from the Point Thomson field in Alaska's North Slope to a near-shore floating LNG export plant. Qilak said the agreement foresees ExxonMobil providing at least 560 million standard cubic feet per day of natural gas to the first phase of the project, based on the design concept of offshore liquefaction and loading and ice-breaking LNG carriers. The project envisages exporting around 4 MTPA of LNG under a future firm 20-year supply deal with ExxonMobil. According to Treadwell, the Qilak project would deliver on Alaska's long-held goal of commercializing North Slope natural gas. Qilak said it would now begin more feasibility studies and make preliminary permit applications with a planned final investment decision in 2021.

ARGENTINE President Alberto Fernandez said he would send a bill to Congress to attract investment for the production of conventional and unconventional hydrocarbons in the world-class Vaca Muerta shale formation. The announcement came after Fernandez, a centre-left politician who took office at the beginning of December, held a meeting with executives from the main energy companies present in Argentina. These included Argentina's state-owned Yacimientos Petroleiferos Fiscales (YPF), and its company President Guillermo Nielsen. "I will send a bill that will establish a regulatory framework to allow for the exploitation of conventional and unconventional hydrocarbons," said the Argentine leader.

For now, only about 1,000 wells have been drilled, 300 or so of which have been fracked in the Vaca Muerta Shale. Covering a region the size of a small European country, it has become one of the world's leading shale basins and has attracted international companies such as US majors ExxonMobil and Chevron Corp., Qatar Petroleum, French major Total and Equinor of Norway. Both the previous and current governments are seeking to increase output to boost export revenues. YPF also last year started its first small-scale LNG production from a floating liquefaction facility, "Tango FLNG", and this was quickly followed by its submission to the government of a request to promote development of an onshore LNG liquefaction plant. The proposals are for a pre-front-end engineering design for a liquefaction plant with 5 million tonnes per annum of LNG capacity and with the option to expand to 10 MTPA. This could also be the blueprint for other plants.

Analysts said that in that context, developing the country's large reserves of natural gas, both in shale and tight gas reservoirs, presents an opportunity to overcome short-term pricing issues. Recent developments such as difficulties with servicing its sovereign debt have investors concerned that Argentina is backsliding after years of market-oriented reform. Activities by both YPF and the international companies resulted in a 95 percent shale-gas production growth from May 2017 to mid-2019. The Argentine natural gas market is also going through a transition, specifically with regards to price formation. While productivity has improved as a result of increased fracking stages and longer laterals, production costs at the Vaca Muerta shale formation are still too high for international markets. In 2019, YPF reported declining costs of $3.72 per million British thermal units, down from $4.65 per MMBtu a year earlier. In addition to reducing production costs, further investment is needed to overcome the transportation bottlenecks and a lack of pipelines and infrastructure to reach the markets. At current capacity, the transportation infrastructure is at its limit. Though in late July 2019, the government launched the tender for a $2 billion pipeline from Neuquén province and the Vaca Muerta Shale. Analysts added that it was now also a question of providing financial and tax incentives for the majors to invest the appropriate funding.

AUSTRALIAN LNG plant operator Woodside Petroleum said the Greater Enfield offshore venture underpinned a solid result in a quarter in which significant progress was achieved on the Perth-based company's growth projects. "Production and sales revenue increased compared with the third quarter of 2019 due to the strong performance from Greater Enfield," said Chief Executive Peter Coleman. "Subsequent to the period, we took unconditional FID for the Sangomar Field Development Phase 1 offshore Senegal, delivering on our Horizon II growth strategy," explained the CEO. "This is a significant milestone and the joint venture has commenced the execute phase of the development, expected to produce first oil in early 2023," he added. Coleman said the company also moved forward with the Scarborough gas field development off Western Australia, with a 52 percent increase in the estimated gross contingent resource and a heads of agreement with Anglo-Australian commodities company BHP.

This included a tolling price for the processing of Scarborough gas through

Pluto Train 2 and the existing Pluto facilities. "For Browse, Woodside is ready to enter front-end engineering and design subject to finalising the gas processing agreement and we are progressing key approvals, including the release of the environmental impact statement and environmental review documents for public comment," stated Coleman. The company additionally increased the estimated gross contingent resource dry gas volume for the Scarborough field to 11.1 trillion cubic feet. During the quarter, Woodside agreed a tolling price with the Scarborough joint venture for processing Scarborough gas through Pluto LNG. The company also achieved a final investment decision on the pipeline component of the Pluto-Karratha Gas Plant Interconnector. Woodside said it had also achieved start-up from a Pluto LNG infill well and on the Julimar-Brunello phase two development. Subsequent to the fourth-quarter period, Woodside said the Sangomar Field Development offshore Senegal in West Africa, was approved by the government of Senegal.

BHP, the Anglo-Australian global commodities, mining and energy company whose assets include Australian LNG and gas stakes, said it would award a contract in the first quarter of 2020 after receiving 17 bids for the provision of LNG-powered bulk carriers for transporting iron ore to Asia. BHP, a shareholder in North West Shelf LNG plant and the Scarborough gas field, said it was reviewing bids from natural gas producers, shipbuilders and financial institutions. "Through this tender, we are seeking potential partners who share our ambition of lowering emissions to the maritime supply chain," said BHP.

The company had opened the tender to what it described as a select group of industry leaders, from ship owners, banks and LNG fuel network providers. The aim of the tender was to find a partner for an LNG-powered newbuild iron-ore carrier, or a shipping company willing to order one or several with pre-booked charters from BHP. BHP, the largest charterer of bulk carriers in the world, launched its tender in August 2019 for the design and supply of LNG-fueled ships to transport up to 27 million tonnes of its iron ore exports to Asia. "We sent requests for tender to 19 organisations, including banks, entrepreneurs, vessel owners and shipyards and 17 of them came back with very detailed offers two months ago," said BHP Maritime Vice-President Rashpal Bhatti. BHP said it was evaluating the detailed submissions before progressing to a clarification stage with the companies in January and subsequent negotiations in February before a contract award in March or April.

As well as shipping companies, BHP said the bidders include energy companies such as Royal Dutch Shell, Australia's Woodside Petroleum and Pavilion Energy of Singapore. "This tender adds to the work BHP is doing with customers, suppliers and parties along our value chain to influence emissions reductions from the transport and use of our products," stated BHP's Bhatti. BHP said that introducing LNG-fueled ships into its iron ore maritime supply chain would eliminate nitrogen oxide and sulphur oxide emissions and significantly reduce carbon-dioxide emissions along the busiest bulk transport route globally from Western Australia to North Asia. From January the global shipping industry will have to follow tougher emission regulations under the International Maritime Organization sulfur cap in marine fuel to reduce pollution, especially from ships entering or leaving ports.

CHINA Merchants Energy Shipping (CMES), the energy ship operator of the Hong Kong-based China Merchants Group, said it planned to acquire stakes in LNG vessels dedicated to Russian Yamal LNG deliveries and the dry-bulk vessel assets of its subsidiary Sinotrans. CMES is a state-owned Chinese company and completed a merger in 2017 with China's leading logistics firm, Sinotras & CSC Holdings, also government owned, and has gradually been consolidating shipbuilding assets from Sinotrans and its logistics units. Under the latest deal, CMES will spend 6.57 billion Chinese yuan ($952 million) to acquire several Sinotrans & CSC subsidiaries that control nine capesize bulkers, 11 panamax bulkers, 21 handysize bulkers and 25.5 percent equity interest in five Yamal LNG carriers, as well as Sinotrans Ship Management.

CMES said it would use a combination of internal capital and overseas loans to fund the acquisition. The Chinese group said the latest acquisition would entirely solve the competition issue between the two companies and will significantly expand the company's dry bulk fleet. The company currently owns a bulker fleet of 21 capesizes and 12 ultramaxes. CMES already owns six LNG carriers specializing in delivering shipments from Australia to China, including the 147,000 cubic metres capacity vessels, the "Dapeng Moon" and the "Dapeng Sun". CMES was jointly established by China Merchants Group, Sinopec Group, COSCO and China National Offshore Oil Corp. in December 2004.

Two years later CMES successfully launched and initial public offering to have its shares listed on the Shanghai Stock Exchange. Two more rounds of direct issuance of shares have been held by CMES in the following few years, which provided capital for the expansion. CMES provides a full range of energy transportation services running a diverse fleet, including crude oil tankers and dry bulk carriers.

CHINA National Offshore Oil Corp., the owner of nine Chinese LNG import terminals and multiple oil and gas stakes, has outlined its business strategy and development plan for 2020 with 10 new projects scheduled to come on stream.

The company's Hong Kong-listed unit CNOOC Ltd said its targeted net production for 2020 was 520 million to 530 million barrels of oil equivalent (BOE), of which, production from China and overseas accounts for approximately 64 percent and 36 percent respectively.

CNOOC said its final net production for 2019 is expected to be approximately 503 million Boe. For 2021 and 2022 the output forecasts are for around 555 million Boe and 590 million Boe. CNOOC's future project stakes include in the Arctic II LNG project led by Novatek of Russia. The Chinese major also has LNG volumes from facilities such as BP's the Tangguh plant in Indonesia and the Woodside-operated North West Shelf plant in Western Australia as well as the Shell-operated Queensland Curtis plant near Gladstone. "In 2020, the company will steadily increase its oil and gas reserves and production, pursue profitable reserves and production, lay a solid foundation for high-quality development through technology innovations and management enhancement, and create excellent returns for our shareholders," stated Xu Keqiang, CNOOC Chief Executive President. In 2020, CNOOC said 10 new projects were expected to come on stream in China, namely the Penglai 19-3 oil field block 4 adjustment-Penglai19-9 oil field phase II, Qinhuangdao 33-1 South oil field phase I and the Bozhong 19-6 natural gas field pilot area development project.

In addition progress is being made on the Luda 16-3/21-2 joint development project, the Nanbao 35-2 oil filed S1 area, the Jinzhou 25-1 oil field 6/11 area, the Liuhua 29-1 gas field development project and the Liuhua 16-2 oil field/20-2 oil field joint venture offshore China. Ventures also include the Liza oil field phase 1 in Guyana, in Central America, and the Buzzard oil field phase II in the UK. The company noted that the Liza oil field phase 1 in Guyana had already come on stream ahead of schedule. "The company will continue to maintain cost competitiveness, maintain prudent investment decision-making, and ensure the effective implementation of the capital expenditure plan to fully promote the o a new phase of high-quality developments," said Xie Weizhi, CNOOC Chief Financial Officer. CNOOC's total capital expenditure for 2020 is budgeted at 85 billion Chinese yuan ($12.3 billion) to 95Bln yuan ($13.7Bln). "The capital expenditures for exploration, development, production and others will account for approximately 20 percent, 58 percent, 20 percent and 2 percent of the total capital expenditure, respectively," said CNOOC. Plans for this year include drilling 227 exploration wells and collect approximately 27,000 square kilometres 3-Dimensional seismic data.

DELEK Group of Israel and US company Noble Energy said that they had brought on stream the Leviathan natural gas field in the Eastern Mediterranean to supply Egypt and Jordan and with a floating LNG project under consideration. "The partnership is pleased to announce that today, December 31, 2019, the piping of natural gas from the Leviathan reservoir has commenced," said the statement. "The capacity of natural gas flow from the Leviathan reservoir is expected to ramp up gradually and accordingly, in the coming days, natural gas supply from the reservoir to Egypt will also commence," they added. The Israeli Leviathan gas field has resources of around 21.4 trillion cubic feet while the nearby Tamar gas field reserves are 11.2 Tcf.

The group's East Med energy operations are carried out by its subsidiary, Delek Drilling. Delek said the Leviathan field was now set to supply natural gas to Egyptian company Dolphinus Holdings via the East Mediterranean Gas (EMG) pipeline. The

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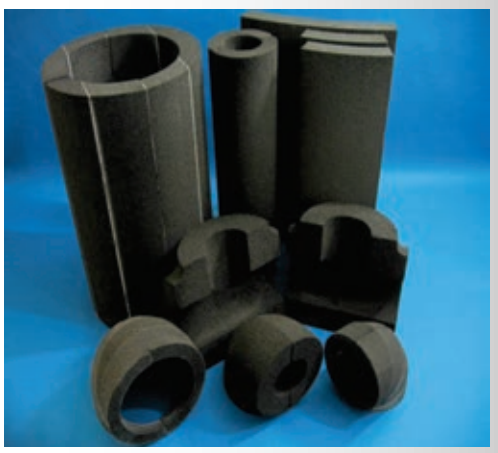


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EMG pipeline runs from Ashkelon in Israel to El Arish in Egypt.

Both Delek and Noble said that the mechanical integrity of the EMG pipeline had been confirmed and certified by a third party. The Leviathan field, located about 80 miles (130km) west of Haifa, was discovered in December 2010. Delek and Noble have also signed a 15-year agreement to supply 1.6 Tcf to Jordan's National Electric Power Company. The planned FLNG project is still at the study stage, though with proposals already made for detailed engineering and design work for building an LNG production hull for the Leviathan project in Israel's exclusive economic zone. The EMG pipeline is majority-owned by Egyptian General Petroleum Corp. However, although originally intended for transporting gas from Egypt to Israel it can now be used to operate in the opposite direction from Israel to Egypt. The Leviathan and Tamar gas field partners agreed to pay a total sum of $250 million to become capacity holders and stake owners.

Delek and Noble also recently amended their pipeline gas agreements with Egypt's Dolphinus. The accords now provide for total combined firm contract quantities of 3 Tcf of natural gas, more than double the firm commitments previously agreed. In addition, each pipeline agreement has been extended by five years to reflect 15-year terms. Beginning on the 1st of January 2020 and throughout the contract term, Noble and Delek have committed to supply the volumes to Dolphinus in various sizes. From January to June 2020 the Leviathan field will provide 200 million cubic feet per day (MMcf/d) of natural gas. This will rise from July 1, 2020 to June 30, 2022 to 350 MMcf/d from Leviathan and 100 MMcf/d from the Tamar field. Then from July 2022 until the end of December 2034, the Leviathan field would supply 450 MMcf/d and Tamar 200 MMcf/d. Both contracts include take-or-pay commitments. During the two-year period ended June 30, 2022, Leviathan will backstop any volume commitment that Tamar is unable to deliver under the amended agreement.

DELTA LNG, the third of three export plants being development in Louisiana by the company Venture Global, slightly delayed filing for its regulatory permits from December 2019 to January 2020 to allow more time to address some issues raised. Under current plans, the Delta liquefaction plant and export terminal will be located on about 525 acres on the Mississippi River, south of New Orleans. The affiliated Delta Express Pipeline will connect the terminal with natural gas pipeline interconnections near Alto in Louisiana. The Arlington, Virginia-based company is also developing the Plaquemines venture sited near river mile-marker 55 on the west side of the Mississippi River, 30 miles south of New Orleans. That project will include multiple small-scale liquefaction Trains, four LNG storage tanks and three marine loading berths along with 20 MTPA of output.

The company's most advanced plant in terms of construction is at Calcasieu Pass in Louisiana with current nameplate export volumes of 12 MTPA. As regards Delta LNG and the Express pipeline, Venture Global was expected to have filed its application with the Federal Energy Regulatory Commission on January 10, 2020, after delaying the filing since December 13, 2019. The Delta LNG liquefaction facility will include 36 small-scale liquefaction Trains, each with 0.626 MTPA of capacity configured in 18 blocks, for a total of just over 22.5 MTPA of output. The venture will also include four 200,000 cubic metres capacity storage tanks, three marine loading berths and 1,240 megawatts of combined-cycle power generation. Delta LNG will utilize the same modular, small-scale configuration being successfully implemented by its Calcasieu Pass project in Cameron Parish, Louisiana. "The additional time will allow Delta LNG-Express to address comments on the second set of draft Resource Reports issued by the FERC and United States Army Corps of Engineers (USACE) Vicksburg District on November 22, 2019 and to further evaluate pipeline route alternatives raised by the National Marine Fisheries Service, to reduce impacts in tidal marsh environments," explained Venture Global.

"About 85 percent and 69 percent of the accessible areas have been surveyed for wetlands and cultural resources, respectively," it told the FERC. "The results of these surveys will be included in the FERC application and other applicable federal permit applications," it added. "Survey crews will re-enter the field in early 2020 after sugar cane has been harvested to further survey open areas, additional workspaces, and access roads, and will prepare supplemental survey reports for submittal," stated Venture Global. The Delta LNG and Express pipeline project have conducted five public open houses in the project area during the week of November 11, 2019, to inform the public of proposed reroutes of the pipeline and the relocation of one of the compressor stations.

"Approximately 100 people attended the open houses. Most of the attendees were affected landowners who expressed general concern with the project or had questions regarding compensation and restoration," the company explained. "Several landowners suggested minor reroutes to reduce impacts on their properties. Delta LNG-Express is evaluating these requests and remains in communication with the landowners," stated Venture Global. The Delta LNG terminal site is near Mile 54 of the Mississippi River and has approximately 3,100 feet of river frontage with easy access to the Gulf of Mexico. Venture Global said it had carried out marine simulations with local river pilot organizations and found that the Mississippi River was sufficiently wide at this location to allow LNG carriers to safely manoeuver and turn as they call at the terminal. Furthermore, the company said that it found there was a substantial water depth at the terminal location, meaning that no dredging would be required. The company's Calcasieu Pass plant is expected to come on stream in 2022, along with associated facilities, including the TransCameron Pipeline. Venture Global is owned by former investment banker Michael Sabel and lawyer Robert Pender, who act as joint chief executives.

EXXONMOBIL Corp, the US major with some of the largest LNG production and project stakes in Qatar and elsewhere, has acquired more than 1.7 million acres offshore Egypt where large natural gas finds such as the East Mediterranean Zohr field have been made in recent years. The ExxonMobil acreage includes a block in the central part of the East Med, north of the Egyptian city of Alexandria. The US company said the award adds to its Egyptian interests that have largely focused on its longstanding downstream business in the Arab nation. The acquisition includes acreage in the 1.2 million North Marakia offshore block, which is located about five miles offshore Egypt's northern coast in the Herodotus basin. The remaining 543,000 acres are in the North East El Amriya offshore block in the Nile Delta.

ExxonMobil will operate both Egyptian blocks and hold a 100 percent interest. The company said that operations, including acquisition of seismic data, were scheduled to begin in 2020. Egypt will see its natural gas surplus rising through 2020 as it satisfies demand from the power and industry sectors and to meet LNG export obligations as its overall output reaches more than 5 billion cubic feet per day. Egypt's natural gas fields on the West Nile Delta, at Noor in North Sinai, the Atoll field in the East Nile Delta and the giant Zohr field have turned it from an LNG importer in 2017 to an exporter again in 2018 and 2019. Egypt's East Med Zohr field was discovered by Italian energy company Eni in 2016 and in particular helped transform the nation's natural gas and LNG fortunes. "These awards strengthen our exploration portfolio in the Eastern Mediterranean," said Mike Cousins, senior vice president of exploration and new ventures at ExxonMobil.

"We look forward to working with the government and deploying our proven expertise and advanced technology," added Cousins. ExxonMobil has already partnered in a successful exploration programme in the East Med offshore Cyprus with its Middle East LNG partner Qatar Petroleum. In March 2019, they made a large natural gas discovery in Cypriot waters. ExxonMobil's priorities in Qatar remain LNG production and to advance other worldwide ventures with the Qataris, including the Golden Pass LNG export project in Texas. The US major also has extensive LNG and natural gas interests in Western Australia and in Mozambique in southeast Africa. The Egyptian plans will give ExxonMobil exploration incentives in a proven natural gas province, which the East Med has become. "ExxonMobil has been a partner in Egypt's growth for more than 115 years, and these awards reaffirm our commitment to pursuing high-quality opportunities in the country," said Hesham Elamroussy, Chairman and Managing Director of ExxonMobil Egypt. Elamroussy noted that the acreage adds upstream interests to ExxonMobil's downstream presence in Egypt, where it has been a leading fuels, lubricants and specialties marketer since 1902.

FLUXYS Belgium said that the Zeebrugge import terminal had formally started its long-term trans-shipment contract with the Russian Yamal export plant in Russia with the loading of the 155,000 cubic metres capacity carrier "Yenisei River" from the newly

commissioned fifth storage tank. "The loading operation (in late December) marked the start of the long-term contract for trans-shipments concluded in 2015 with Yamal Trade," said Fluxys. Pascal De Buck, Chief Executive of Fluxys Belgium, said the start of the service was a boost for the Belgian facility. "Our LNG services at the Zeebrugge terminal accommodate the need for low-emission energy," explained De Buck.

"With the start of the long-term contract for trans-shipments we are taking yet another step in the continuous development of our LNG services offer," he added. "The terminal is now also a fully-fledged link in the logistics chain for the worldwide delivery of LNG from the Yamal production terminal in Siberia," stated the CEO. "The trans-shipment activity is an important new business line and the port of Zeebrugge will see a significant increase in ship movements," said De Buck. The fifth LNG storage tank has a capacity of 180 000 cubic metres and its associated process facilities were built at the Zeebrugge terminal with a view to fulfilling the needs of the long-term contract with Yamal Trade. "The additional capacity allows trans-shipments between icebreaker LNG vessels coming from the Yamal production plant and conventional LNG carriers without the two having to be docked simultaneously," said Fluxys.

Construction of the new storage tank and facilities started in mid-2015 and in early December 2019 they were ready for test operations, which were concluded successfully. "With loading rates exceeding 12,500 cubic metres of LNG per hour from one storage tank, the newly commissioned facilities proved to deliver world-class performance," added the Belgian company. The Yamal contract could mean additional ship traffic of up to 214 LNG carriers per year. Under the 20-year contract with Yamal Trade up to 8 million tonnes of LNG can be trans-shipped at the Zeebrugge terminal annually. This corresponds to potentially that number of ships being needed for the operations. Fluxys noted that ahead of the new storage capacity becoming available, the terminal had already performed since May 2018 an array of direct trans-shipments between two simultaneously docked ships.

GASSCO, the Norwegian natural gas pipeline operator and one of the main competitors to LNG, transported 106.99 billion cubic metres of gas through the pipeline systems from Norway to Europe and the UK in 2019, less than in the previous year. The Norwegian natural gas supplies were the equivalent to 79 million tonnes of LNG, just above the volume of LNG shipped in 2019 by Australia, the world's No.1 exporter after overtaking Qatar. "Despite a small decline from 114.2 Bcm in 2018, the year ranked as one of the best ever for gas deliveries from the Norwegian Continental Shelf (NCS)," said Gassco. The Norwegian deliveries compare favourably in terms of energy security with pipeline volumes shipped to the European Union by Russia's Gazprom. The Russian company's pipeline gas exports to European countries and Turkey reached almost 202 Bcm in 2018, according to the last available official figures. "Even in a year with a big rise in European imports of LNG, Norway's gas deliveries were well above the average for the past decade," said Frode Leversund, Chief Executive of Gassco.

The operator noted that stable Norwegian pipeline volumes were transported to Europe even as extensive maintenance work on the NCS took place. "The availability for delivery of gas to the transport system in 2019 was more than 99 percent," added Leversund. "That's a solid result, and demonstrates good interaction from field to delivery points in Europe," stated the CEO. Gassco said that in addition to gas, deliveries of natural gas liquids (NGL) and condensate from the process plants at Karsto, Kollsnes (via Vestprosess) and Nyhamna totalled 10.1 million tonnes in 2019. "We in Gassco will ensure that this availability is maintained by concentrating on secure, reliable and efficient operation with a steadily decreasing environmental footprint," said Leversund. "As the gas transport architect on the NCS, we'll also work to find the right integrated infrastructure solutions for the future," added the CEO.

GASTRADE, a Greek utility company and developer of the Alexandroupolis floating LNG terminal, has launched the second phase of a market test for the project to gauge demand in Greece and the Balkan states. "The project aims to provide a new gateway for gas supply to southeast European markets and will offer to the region security of supply, diversification of gas routes and sources, price flexibility and enhanced competition," said Gastrade. The first phase of a market test was conducted in late 2018 and was completed with great success after 20 companies expressed interest in the project. Gastrade now says there is a revised and extended deadline for expressions of interest for the Alexandroupolis Independent Natural Gas System Project set for February 2020.

The venture comprises a floating storage and regasification unit for the reception, storage and regasification of LNG, a mooring and a system of a subsea and onshore gas transmission pipelines, through which natural gas will be delivered to the Greek National Natural Gas Transmission System (NNGTS) and onwards to the final consumers. The FSRU will be stationed in the sea off Thrace in northeast Greece, 17.6 kilometres southwest of the town of Alexandroupolis. The pipeline will be connecting the FSRU to the NNGTS near the village of Amphitriti, 5.5km northeast of Alexandroupolis. In December 2019, Greek gas company DEPA and Gastrade signed a final agreement for the acquisition of a 20 percent share in Gastrade by DEPA. Then on the 8th of January 2020, Bulgartransgaz, the Bulgarian gas transportation company, concluded terms of an agreement for a 20 percent participation in Gastrade. The FSRU venture and gas hub have been listed by the European Union as a project of European Common Interest, thus attracting EU grants.

The Alexandroupolis FSRU project will double Greece's current LNG import capacity. "For Bulgaria, Romania, Serbia and other markets in southeast Europe, the project will transmit natural gas through the Interconnector Greece-Bulgaria which is under construction and the other existing or planned pipelines in the region," explained Gastrade. "This is the binding bidding phase for capacity reservations in the project," it added. "Companies that have already expressed interest in the first phase of the market test are eligible to submit binding offers to Gastrade," it stated. The test guidelines set out the terms under which new interested participants are also allowed to enter this second phase of the test. The deadline for interested participants to submit their offers was the 24th of February 2020.

In the first phase of the Market Test, 20 companies submitted relevant Expressions of Interest for a total of up to 12.2 billion cubic metres (Bcm) per year of reserved regasification capacity at the floating terminal. The Expressions of Interest surpassed the technical capacity of the Project which is designed at 5.5 Bcm per annum. Gastrade said it expected to receive binding offers from a wide range of participants including gas supply companies, power utilities, other end users, gas distribution companies and traders. "The tender process for the construction of the project is underway," said Gastrade. "The commercial operation date for the project is planned for the third quarter of 2022," it added.

GAZODUQ Inc., the Québec natural gas pipeline developer, has completed the solicitation process for non-binding expressions of interest for transportation services on its proposed 780-kilometre underground natural gas line leading to the GNL Québec liquefaction and export plant. The line will run from the northeast of the Canadian province of Ontario to Saguenay in Québec where the GNL Québec export project is planned. Non-binding requests for service were accepted from December 4, 2019, until 5pm Eastern time on January 6. "Gazoduq is pleased to announce the successful conclusion of its non-binding open season on January 6," said the company. Gazoduq will now move to the next phase of its project development, which will include submitting comprehensive applications for the necessary regulatory approvals, completion of binding commercial agreements with shippers, and ongoing consultations with Indigenous groups and stakeholders. "The completion of the non-binding open season represents another important milestone in the advancement of our project," stated Louis Bergeron, President of Gazoduq. "We look forward to continuing our consultations with Indigenous and local communities to help us develop this exciting project that will benefit the environment and the economy," added Bergeron. "The Gazoduq project represents an investment of approximately $5 billion, and will generate significant economic spinoffs for Quebec, Ontario and Canada as well as contribute to the reduction of GHG emissions on a global scale," stated the Bergeron.

Gazoduq and the GNL Québec projects will transport feed-gas from Western Canada and export it as LNG from Saguenay, a town located about 200 miles north of Quebec City on a tributary leading to the St Lawrence River. Both Gazoduq and GNL Québec had previously filed preliminary documents with the former regulatory regime, the Canadian

National Energy Board. The NEB has been replaced by the new Canadian federal energy body, the Impact Assessment Agency of Canada, backed up by the Canada Energy Regulator (CER). Gazoduq is the pipeline builder and will operate the transmission line from an inter-connection with the existing mainline near Ramore, Ontario, owned by Canada's largest pipeline operator, TC Energy. Gazoduq will bring feed-gas to the liquefaction plant in the French-speaking province to what will be its main customer, GNL Québec. The natural gas pipeline is designed to transport around 51 million cubic metres (1.8 billion cubic feet) of natural gas per day. Gas transportation services on the new transmission line will also be available for contracting by local distribution companies in northern Ontario and Québec. Gazoduq has said that the full extent of the economic benefits stemming from the gas and LNG project will be presented in 2020 within the framework of the impact study.

GERMANY, the largest natural gas pipeline consumer in the European Union and a future LNG importer, is set to be the first country to end both nuclear and brown coal power under an agreement to compensate workers, companies and regional governments as it switches off coal-fired plants by 2038. The Berlin government said it had concluded a deal worth more than 40 billion euros ($44.5 billion) with the premiers of Germany's coal-mining regions.

Once the heartland of Germany industry, the coal regions of North-Rhine Westphalia have fallen on hard times as traditional heavy industries have lost ground, while coal regions further east have yet to escape the economic impact of four decades of Communism in East Germany. Designed to ensure Europe's largest economy meets its 2030 target for cutting greenhouse-gas emissions, the exit from coal will also be accompanied by increased investments in renewable energy such as wind power.

"Germany, one of the strongest and most successful industrial nations in the world, is taking huge steps towards leaving the fossil fuel era," said Finance Minister Olaf Scholz. Analysts said that the decision marks a major turnaround for Chancellor Angela Merkel's conservative-Social Democrat coalition.

It previously abandoned as unachievable a key emissions target shortly before taking office in 2017, only to change course after growing public concerns about climate change fuelled a surge in polls by the Green Party.

"These were tough negotiations," said Environment Minister Svenja Schulze.

"But you can see the result - we are the first country that has a binding agreement to exit coal and nuclear power - and that's an important signal internationally," added Schulze.

Germany is one of the main customers for pipelines from both Russia and Norway and although it has the largest economic in the European Union.

However, it is one of the few larger EU nations currently without LNG import capability, though two are planned, one on the Elbe River near Hamburg and another at the North Sea port of Wilhelmshaven.

GREECE, Cyprus and Israel have signed an agreement to build a 1,900-kilometre subsea pipeline to transport natural gas from the East Mediterranean to West European markets in competition to LNG. The three countries said they intended to reach a final investment decision in 2022 and the pipeline is scheduled for completion by 2025. European governments and Israel already have a preliminary accord on developing the EastMed project at an estimated cost 6 billion euros ($6.7Bln). It will carry an initial 10 billion cubic metres of gas per annum from Israeli and Cypriot waters to the Greek island of Crete and then on to the Greek mainland and into Europe's gas network via Italy. The energy ministers of Greece, Israel and Cyprus, Kostis Hatzidakis, Yuval Steinitz and Yiorgos Lakkotrypis, signed the agreement at a ceremony in Athens. Greece has said the agreement will be concluded after Italy also becomes a signatory. The East Med pipeline project is owned by IGI Poseidon, a joint venture between Greek gas network company DEPA and Italian energy group Edison. "With Italy taking part, the project will take its final shape as the most dynamic option to guarantee the European Union's energy security from gas reserves in the Southeastern Mediterranean," said Greek Energy Minister Hatzidakis.

A number of large gas fields have been discovered in the East Med since 2009 by Egypt, Israel and Cyprus. At the end of December 2019 the Israeli Leviathan gas field with resources of around 21.4 trillion cubic feet came on stream to supply Egypt and Jordan. Israeli waters also contain the Tamar gas field with reserves of 11.2 Tcf. These East Med fields have been developed by Noble Energy of the US and the Delek Group of Israel. The Leviathan gas field developers are also studying prospects for a floating LNG project. Other Delek-Noble interests in the East Med include the Aphrodite gas field offshore Cyprus with an estimated 4 Tcf of recoverable resources. The signing for the EastMed pipeline came after an accord agreed in November 2019 by Turkey and Libya on extending sea boundaries in the Mediterranean, a move which Greece, Cyprus and Israel have opposed.

JAPANESE spot liquefied natural gas cargoes delivered in December cost almost $4 per million British thermal units less than the price in the same month of the previous year as Northern Hemisphere winter season supplies remained abundant. Spot cargoes delivered to Japan in December 2019 cost $6.70 per MMBtu compared with $10.60 per MMBtu in December 2018, which was $3.90 per MMBtu less, while the delivered price in the previous month of November 2019 was $5.50 per MMBtu, giving a rise of $1.20 per MMBtu month-to-month. Prices for cargoes contracted in December 2019 averaged $6.40 per MMBtu versus $9.20 per MMBtu in the same month the previous year. The monthly 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.

Overall LNG imports by Japan declined in November 2019 (the last official numbers available) and cost around 18 percent less than a year ago. The volume of LNG cargoes delivered to Japan in November fell by 1.2 percent to 6.27 million tonnes compared with 6.34MT in November 2018, according to preliminary figures from the Ministry of Finance. This volume of deliveries amounts to around 90 cargoes. Imports in October had fallen by 3.6 percent to 6.30MT compared with 6.53MT in October 2018. According to LNG Journal estimates, Japan is on track to import around 77.80MT for all of 2019, if the official figure for volumes received in December 2019 are in line with last year. That would be 5.04MT less than the 82.85MT imported in 2018 and 5.83MT below the 83.63MT of cargoes delivered in 2017. The cost of the November 2019 cargoes dropped by 18.4 percent to 333.48 billion yen ($3.05Bln) compared with November 2018 when the cost of shipments was 408.83Bln yen ($3.76Bln).

MSC Cruises, the Swiss-based cruise ship operator, said it signed an agreement with French shipyard Chantiers de l'Atlantique for its third and fourth LNG-powered vessels. The contract with MSC Cruises is such a boost for French shipbuilding that it was signed at the Paris office of the French Prime Minister. The MSC "World Class" ships will be delivered in 2025 and 2027. The first of the initial two ships in the class is currently under construction at the Chantiers de l'Atlantique shipyard in Saint-Nazaire, Western France, and is due to enter service in 2022.

MSC said the Saint-Nazaire LNG-fueled newbuild contracts are valued at more than 2 billion euros ($2.22Bln). The company said the order guarantees over 2,400 full-time equivalent jobs for the next three-and-a-half years. "The signatures also allows the shipyard to start working with the hundreds of suppliers and subcontractors involved in the projects, setting in motion a new cycle that will greatly benefit the French economy," said MSC. The first newbuild will become the biggest vessel operated by a European cruise line as well as the first LNG-powered cruise ship built in France. Compared to standard marine fuel, LNG decreases sulphur emissions and particulate matter by 99 percent, nitrogen-oxide emissions by 85 percent and carbon-dioxide emissions by 20 percent.

The signing ceremony took place at the Hotel Matignon, the French Prime Minister's official residence. French Prime Minister Edouard Philippe was in attendance along with Gianluigi Aponte, the MSC Group's Founder and Executive Chairman as well as Pierfrancesco Vago, MSC Cruises's Executive Chairman and Laurent Castaing, the General Manager of Chantiers de l'Atlantique. A second accord saw MSC Cruises partnering with Chantiers de l'Atlantique in the development of yet another innovative prototype ship class concept. This explores opportunities that wind power and other advanced technologies could bring to passenger shipping. MSC said the three agreements signed in Paris represented an investment in excess of 6.5bln euros ($7.3Bln) in the French economy. "The three agreements extend our investment plan up to 2030," said MSC's Chairman Vago. "They stem from an exceptional partnership, with

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Chantiers de l'Atlantique, that has already delivered 15 highly-innovative cruise ships over the past two decades and will see many more vessels come to life at Saint-Nazaire's docks in the next 10 years," explained Vago. "They also confirm this industry's commitment to environmental sustainability, in this case helping the French national industry further position itself as a world leader in the development of next-generation technologies and other solutions," he added. Shipyard Manager Castaing said Chantiers de l'Atlantique was really proud and happy to have built such an outstanding relationship with MSC Cruises. "This is based on mutual trust and driven by the spirit of innovation. We are both committed to shaping the cruise of tomorrow and to developing ship concepts which go far beyond current environmental standards.," said Castaing.

MYANMAR is making progress in constructing a liquefied natural gas import terminal to support a regional power plant project backed by a Chinese company. The LNG facility will be built for the power generation project at Mee Laung Gyaing in the Ayeyarwady Region. Zhefu Holding Group of China and the Myanmar company, Supreme Trading Co., plan to invest US$2.57 billion to build the power plants and the terminal. The project will include berths for LNG carriers to dock in the Mee Laung Gyaing area, which is 40 miles to the north of Chaung Tha beach resort. Supreme Trading said the LNG-to-power project would be transferred back to the government under a 30-year build, operate and transfer system. The project will guarantee maximum power supplies for regional industrial zones, hotels and the city of Yangon, formerly known as Rangoon.

The Mee Laung Gyaing project is one of three LNG import projects being studied by the Government. It has pledged to make Myanmar a key regional LNG importer to help meet the growing energy demands. The other two projects will be located at Kanbauk in the Tanintharyi region of southwest Myanmar and at Ahlone near Yangon. Supreme Trading said its project was expected to take four years to complete. It will be start with a 500-megawatt plant by the end of 2022 and 900MW od capacity a year or two later. A power purchasing agreement is also being finalized by Supreme Trading and is expected to be concluded in the first quarter of 2020. Supreme Trading added that while the shareholding structure has not yet been fixed, Zhefu Holding will be the majority shareholder and the Myanmar company would have a 20 percent stake. "Feasibility studies are currently taking place at Mee Laung Gyaing, including the necessary environment and social impact assessments, while soil and water conditions are being tested near the area where the jetty will be constructed," said Supreme Trading.

NOBLE Energy, the US exploration and production company, has explained the solid progress made by the Leviathan Eastern Mediterranean natural gas field offshore Israel since it was brought on stream at the year-end to supply Egypt and Jordan. Noble said first gas sales from Leviathan commenced on December 31, 2019. "All four wells and both subsea flowlines are currently fully operational, with well productivities in line with or better than pre-production expectations," said Houston-based Noble. "Venting operations associated with start-up were successful, resulting in no impact to onshore communities and with emissions levels substantially below permitted limits," added the US company. "Natural gas sales have been established to Israel, Jordan, and Egypt," said Noble. "Gas sales to Jordan began on January 1, with gas exports to Egypt beginning on January 15. Gas sales into Egypt are utilizing the East Mediterranean Gas Pipeline as planned," added Noble. "Interconnects between the Israeli, Jordanian and Egyptian pipeline networks are now fully operational," stated the company.

Noble said that combined gross natural gas sales from the Leviathan and the nearby Tamar gas field have averaged 1.5 billion cubic feet equivalent per day in January 2020, with peak days up to 1.7 Bcfe per day. The partner of Noble in the Leviathan venture is the Delek Group of Israel. Leviathan field resources are around 21.4 trillion cubic feet while the Tamar gas field reserves amount to 11.2 Tcf. The Israeli group's East Med energy operations are carried out by its subsidiary, Delek Drilling. Egyptian company Dolphinus Holdings is the main recipient of Leviathan gas via the EMG pipeline. The EMG pipeline runs from Ashkelon in Israel to El Arish in Egypt. The Leviathan field, located about 80 miles (130km) west of Haifa, was discovered in December 2010. Delek and Noble have also signed a 15-year agreement to supply 1.6 Tcf to Jordan's National Electric Power Company and Israeli customers. There is also a planned floating LNG project attached to the development plan and is in the study stage. The proposal is for building an LNG production hull for the Leviathan project to be deployed in Israel's exclusive economic zone.

QATAR Petroleum has signed a long-term supply agreement with Arab Gulf neighbour Kuwait for the supply of liquefied natural gas cargoes for a period of 15 years at a new larger Kuwaiti onshore regasification terminal currently under construction. Qatar signed the Sale and Purchase Agreement with Kuwait Petroleum Corp. for the supply of up to 3 million tonnes per annum. The deal was signed in Kuwait City by Khaled A. Al-Fadhel, the Kuwaiti Minister of Oil and Electricity and Water and Qatari Minister of State for Energy Affairs Saad Sherida Al-Kaabi, whose is also President and Chief Executive of Qatar Petroleum. Kuwait's domestic natural gas demand is increasing in line with other Middle East nations and it is already receiving additional deliveries from new suppliers such as the US. Cargoes of LNG are shipped at present to the dockside facility at Mina Al-Ahmadi in Kuwait which has been in operation since 2009. However, the Gulf nation is building a second and larger onshore terminal close to a new refinery complex at Al-Zour, about 90 kilometres south of Kuwait City.

The new Kuwaiti terminal is being constructed by a consortium led by Hyundai Engineering Co. of South Korea. "Under the 15-year agreement, LNG deliveries to Kuwait's new world-class LNG receiving terminal at Al-Zour Port will commence in 2022 to support Kuwait's growing energy needs, particularly in the power generation sector," said the joint statement. The expansion in infrastructure comes as the Gulf state and its neighbour, the United Arab Emirates, are already among the top 20 destinations for shipments from US exporters such as Cheniere's Energy's Sabine Pass export plant in Louisiana. "We are pleased and proud to join hands with Kuwait Petroleum and we look forward to providing reliable LNG supplies to our brothers in the State of Kuwait for decades to come," said Qatar Petroleum CEO Al-Kaabi. "This agreement extends Qatar's long-standing LNG supply relationship with Kuwait well into the 2030s and highlights our commitment to meeting Kuwait's LNG requirements," added Al-Kaabi. "We are confident that the exceptional reliability of our LNG supplies will provide KPC with the required flexibility and supply security to fuel the State of Kuwait's impressive growth," he stated. Kuwait Oil Minister Al-Fadhel said he was delighted with the Qatar Petroleum LNG deal. "The state of Kuwait is embarking on an ambitious path of economic growth, which requires cleaner energy sources such as natural gas that will contribute to reducing emissions and improving local air quality," added Al-Fadhel.

REPSOL of Spain, a maritime fuel sector participant with plans to re-fuel Spain-UK ferries with LNG, said the International Maritime Organization sulfur curbs had led to it selling around 150,000 metric tons of low-sulfur fuel at Spanish ports and nearly 1 million tons in Singapore. At the beginning of 2020, new regulation from the IMO entered into force, aimed at reducing emissions in maritime transportation. Repsol said that to satisfy the high demand for new fuels, Repsol has one of the most competitive refining systems in Europe and one of the most active sales teams on the market for these products. The company said it was producing this new type of maritime fuel at its refineries in Spain and Peru and selling low-sulfur fuel oil at Spanish port such as Algeciras, Barcelona, Valencia and La Coruña, as well as in the Asian port of Singapore.

Repsol has also signed a deal to supply LNG to Brittany Ferries, the shipping line connecting passengers and freight in France, Spain, the UK and the Republic of Ireland. Brittany Ferries requires the volumes for three LNG-powered newbuilds. Repsol is building two LNG bunker terminals at the northwest Spanish ports of Bilbao and Santander. The LNG bunker agreement between Brittany Ferries and Repsol provides the basis for the long-term supply of LNG maritime fuel and key shoreside infrastructure to the new LNG-powered cruise-ferries "Salamanca" and "Santoña", which are scheduled to enter service from 2022. The two vessels will be delivered after the first LNG-powered ferry, the "Honfleur" currently under construction in Germany, enters service in 2020. Each terminal will include an intermediate storage tank of 1,000 cubic metres to guarantee an uninterrupted supply.

The ferries "Salamanca" and "Santoña" will serve on routes linking Portsmouth

in the UK to northern Spain, beginning in 2022. "Repsol supports all measures that help make transportation more sustainable," said José Correa, Director of Crude Oils and Heavy Products at Repsol. "And the strategy pursued in accordance with this regulation, placing our bets on a line of maritime fuels that produce less sulfur oxide (SOx) emissions, is framed by our recently announced commitment to become a net zero emissions company by 2050," added Corea. The new IMO specification, known as IMO 2020, which regulates maritime traffic worldwide, will restrict the maximum sulfur content of maritime fuels used in international waters to 0.5 percent, a significant reduction from its current 3.5 percent. The International Energy Agency had forecast that Very Low Sulfur Fuel Oil (VLSFO) will replace at least half the volume of High Sulfur Fuel Oil (HSFO) that was consumed as bunker fuel in 2019. "The drastic fall in HSFO demand has severely lowered its market price, as well as that of the crudes used to produce this product (heavy and medium crudes with a high sulfur content)," said Repsol. "In addition, the increase in marine gasoil demand will lead to a rise in the market price of gasoils," added the company.

Repsol's refineries in Spain are in the top 25 percent in Europe in terms of conversion capacity. Four of its five refineries in Spain are equipped with cokers, industrial plants that enable the facilities to make use of the heavy part of the crude to transform HSFO components into fuels with greater added value, chiefly distillates and gasolines. Repsol's sixth refinery, located in La Pampilla in Peru, has required additional efforts in order to adapt to this new context. "Repsol's advantage is also based on the capacity of our refineries to process heavy crudes (a high-sulfur raw material that will become cheaper) as well as on the demand for distillates which will go up in price as they will be needed to produce fuel with a 0.5 percent sulfur content or will be used directly as maritime fuel," explained Juan Carlos Ramírez, Director of Scheduling and Logistics for Refining Operators.

SEMPRA ENERGY, the California-based utility and liquefied natural export plant developer, said it signed an accord for Saudi Aramco, the oil company of Saudi Arabia, to take a stake in the proposed Port Arthur LNG project in Texas. The Sempra LNG unit said the agreement with Aramco Services Company was an Interim Project Participation Agreement (IPPA) for the Port Arthur joint venture in Jefferson County. "The IPPA represents another milestone for both companies after having signed a heads of agreement in May last year for the purchase of 5 million tonnes per annum (MTPA) of LNG and a 25 percent equity investment in the Port Arthur project," said Sempra. The initial phase of the Port Arthur LNG project is fully permitted and it is expected to include two liquefaction Trains, up to three LNG storage tanks and associated facilities to enable the export of around 11 MTPA of LNG on a long-term basis and with a possible expansion. "The announcement is a reflection of the growing alignment between our companies' interest in the overall success of the Port Arthur LNG project," said Jeffrey W. Martin, Chairman and Chief Executive of Sempra Energy.

The company already operates the Cameron LNG export plant at Hackberry in Louisiana with two Trains already on stream. "We have a tremendous amount of respect for Saudi Aramco and its leadership team and we are pleased we can support their success in the global natural gas markets," added Martin. Saudi Aramco's President and CEO Amin H. Nasser said that global demand growth for LNG is expected to continue in the coming years and the company saw significant opportunities in this market. "This agreement with Sempra Energy is another step forward for Saudi Aramco's long-term gas strategy, and towards becoming the global leading integrated energy and chemicals company," added Nasser. Shares in Saudi Aramco made their debut in December 2019 on the Saudi Tadawul stock exchange after an initial public offering. Aramco shares most recently changed hands at 35.20 Saudi riyals ($9.40), after debuting at 32 riyals in the sale of 1.5 percent of the company's shares. The first day share price of 35.20 Saudi riyals ($9.40) brought Saudi Aramco's value up to $1.88 trillion.

In securing its deal with Saudi Aramco, Sempra noted that it had also initiated the Federal Energy Regulatory Commission pre-filing review for a subsequent potential expansion of the proposed project that would add two additional liquefaction Trains for a total export capacity of around 22 MTPA of LNG. "Port Arthur LNG is expected to play a critical role in helping shape the future of global energy trade," added Martin. "This multibillion-dollar initiative is among the largest LNG projects in development anywhere in the world and is expected to deliver a cleaner energy supply to foreign markets, while creating important, high-skilled jobs right here at home," stated the Sempra CEO. Sempra explained that the definitive agreements in the Port Arthur LNG project remain subject to finalization and corporate approvals by each party in its sole discretion before they are executed. "The IPPA sets forth certain mechanisms for the parties to work towards these and other pre-FID activities," said the San Diego-based utility. "Port Arthur LNG is one of Sempra LNG's five strategically located LNG development opportunities in North America and is a component of Sempra LNG's goal of developing the infrastructure to export 45 MTPA to global LNG market," said the company.

SEMPRA said it was opening a new "Center of Excellence" in Houston to attract more LNG and utility sector personnel. Sempra said the office was scheduled to open later in 2020. "We are committed to building the premier energy infrastructure company in North America, and creating a regional headquarters in Houston advances our business strategy," said Jeffrey W. Martin, Chairman and Chief Executive of Sempra Energy. "Texas is a remarkable market, and our Houston Center of Excellence will allow us to add hundreds of new engineering and construction positions to support our growing LNG business in the Gulf region, while also allowing us to showcase our company's commitment to innovation, technology and leadership within the energy industry," explained Martin. "Sempra is also the majority owner of Oncor Electric Delivery Company LLC (Oncor), the largest electric transmission and distribution utility in Texas, serving more than 10 million consumers," said the California-based utility.

Most recently, in May 2019, the company acquired a 50 percent limited-partnership interest in Sharyland Utilities. The new Sempra regional headquarters will be located in Uptown Houston and will include the relocation of existing employees in the greater Houston area to the new site. "Sempra Energy has already made a strong commitment to Texas with big investments in Oncor, Sharyland and natural gas infrastructure," said Texas Governor Greg Abbott of the San Diego, California-based utility. "Their new Houston office is a symbol of confidence in Texas' energy leadership, workforce and regulatory climate," added Abbott. "Houston is the world's premier energy community and I welcome Sempra's expansion in Texas," he added. In addition to expanded office space for regional business operations, the Houston Center of Excellence will showcase innovative technologies developed by Sempra companies to support evolving energy market.

"The exhibit space will display interactive technologies that improve the delivery of more secure and resilient energy supplies to customers, such as the expansion of natural gas into the electricity mix," said Sempra. "This is to support grid stability and integration of digital and meteorological technologies to improve power reliability, as well as virtual reality experiences connected to the Cameron LNG liquefaction-export facility," it added. Sempra Energy began operating in Texas more than 20 years ago. Additionally, Sempra Energy's subsidiary Sempra LNG is developing the proposed Port Arthur LNG export project in Jefferson County, Texas. "Port Arthur LNG is a potential multibillion-dollar infrastructure development project that will enable the delivery of natural gas sourced from Texas to world markets," said Sempra of the venture that will benefit from investment by Saudi Aramco. "The project will also support manufacturing, small businesses and the community by creating thousands of jobs and contributing to the local economy," it added.

SINGAPORE, through the Energy Market Authority, is advancing with plans for a second regasification and storage terminal in the city state as it aims to confirm its position as an Asian LNG hub with a high representation of global trading firms and LNG bunkering availability. Singapore's plan was explained in the government's published expression of interest in building the country's second terminal, which would a floating facility. The terminal would be used for break-bulk cargoes whereby shipments would be broken up into smaller parcels in delivered to southeast Asian customers such as Thailand, Vietnam and the Philippines. Analysts said that Asian emerging economies would become more reliant on LNG, with China and India already major buyers

and other southeast Asian nations becoming importers.

The Singapore EMA awaits expressions of interest from third-parties to take part in the development of the second terminal with the closing date for submissions set for 28th February 2020. Singapore LNG Corp. owns and operates the current single terminal on Jurong Island with peak regasification capacity of 11 million tonnes per annum. The terminal was built in 2013 and then expanded capacity. In 2018, the country introduced a spot LNG import policy that allowed buyers to respond to changing market demand. As far as being a centre of LNG trading, the government has confirmed that this has already been achieved with almost 50 LNG trading and shipping firms having offices in Singapore. The EMA said its plans for a second terminal followed several private sector companies having approached the government individually to indicate their interest in building, owning and operating an offshore LNG terminal (OLT) in Singapore for various purposes. "The OLT could be used for the provision of storage and reload, gassing up-cool down and-or bulk-breaking services to enable LNG bunkering and small-scale supply to the region," said the EMA. "It could also import and supply regasified LNG into the Singapore gas network," it added.

Singapore currently generates 95 percent of its electricity from imported natural gas, according to the EMA. Indonesia and Malaysia provide about 70 percent of imports via pipeline, with the remaining 30 percent coming from LNG shipments. However, Indonesia has recently notified Singapore that it would stop supplying gas from Sumatra when the current contract expires in 2023 and divert the supplies instead to its own domestic market. In October 2019 the Singapore Exchange (SGX) stopped publishing its spot LNG price indexes, which were launched in 2016 as part the country's goal of becoming a hub. This was due to low participation over the past few years amid competition from more established pricing agencies. The SGX said it was now focusing on the carriage of LNG as an internationally traded seaborne commodity. It has created three LNG freight indexes through its Baltic Exchange subsidiary in London, with the first index already launched in early 2019.

Diary of events

February 2020
International Gas Union (IGU) Research Conference For Gas Innovations
24 - 26 February 2020
Oman Convention & Exhibition Centre, Muscat,
Sultanate of Oman
https://www.igrc2020.com

March 2020
6th International LNG Congress
2 - 3 March 2020
Tangla Hotel Brussels.
Avenue Emmanuel Mounier 5,
Woluwé St Lambert, Brussels 1200
Belgium
https://lngcongress.com

Australasian Oil & Gas Exhibition & Conference
11-13 March 2020
Perth Convention & Exhibition Centre
21 Mounts Bay Road, Perth, WA, 6000,
Australia

April 2020
CWC Japan LNG & Gas Summit
23-24 April 2020
Tokyo Marriott Hotel,
4-7-36 Kitashinagawa,
Shinagawa City, Tokyo,
140-0001 Japan

TECHNIPFMC, the LNG and energy engineering company, reaffirmed that its planned transaction to separate into two companies, TechnipFMC and Technip Energies, is well on track for completion in the first half of 2020. The company anticipates completing the transaction in the second quarter of 2020 and intends to host a capital markets event in Paris for Technip Energies before completion of the spin-off. TechnipFMC is one of the leading engineering, procurement and construction companies whose current contracts include projects in the US, as well as the Russian Arctic LNG II project proposed for the Gydan Peninsula and the Mozambique LNG joint venture in southeast Africa.

TechnipFMC said in August 2019 that it had decided to spin off its European-based engineering and construction operations into a separate business, leaving the Houston-based half of the firm as a technology-focused equipment supplier to the oil and gas sector.

The strategy is to reverse the 2017 merger of Technip of France and FMC Technologies of the US, a transaction valued at the time at $20Bln as it created TechnipFMC as a fully-integrated subsea provider. TechnipFMC also said the European Union Prospectus for the spin-off of Technip Energies will now include audited IFRS financial statements for Technip Energies for each of the fiscal years ended December 31, 2016 through 2019. "In order to provide financial statements for the full year 2019, which will afford greater visibility into recent historical performance, the company anticipates the release of its EU Prospectus after its annual filings," said the company. "In addition to the approval of the EU Prospectus by the Dutch Authority for the Financial Markets (AFM), the successful completion of the planned spin-off also remains subject to general market conditions, regulatory approvals, and final Board approval," it said. "While awaiting receipt of all final approvals, the company and its employees will stay focused on delivering operational excellence and world-class service to its clients," added TechnipFMC.

Technip Energies (the spin-off) would have around 15,000 employees and be one of the largest engineering and construction companies and is poised to capitalize on the global energy transition. "Technip Energies will be well positioned to capture LNG opportunities as a result of its disciplined project delivery model, diversified capabilities and track record," it added. "In addition, the new company will benefit from its leadership position, in terms of backlog, in the downstream market, as well as future growth opportunities in biofuels, green chemistry and other energy alternatives." stated TechnipFMC. Technip Energies will be incorporated in the Netherlands with headquarters in Paris and listed on the Euronext Paris exchange. The remainder of TechnipFMC with around 22,000 employees would be a fully-integrated technology and services provider, continuing to drive energy development. TechnipFMC will remain incorporated in the UK with headquarters in Houston, Teas, and listed on both the New York Stock Exchange and the Euronext Paris exchange.

TOKYO GAS, the Japanese LNG importer, has acquired more US shale gas assets in East Texas and Louisiana after closing a transaction with a subsidiary of Royal Dutch Shell. Tokyo Gas America has closed the latest transaction through its stake in Castleton Resources to acquire oil and gas assets in the East Texas and Louisiana region from BG US Production Co., a unit Shell. The value of the transaction was not disclosed. The Japanese utility, which has four LNG import terminals and 13 LNG carriers owned or managed, has a strategy to diversify and expand raw materials procurement and overseas upstream projects including in the LNG value chain. Tokyo Gas already has a tolling agreement share in the Dominion Energy Cove Point plant in Maryland and is also involved in upstream projects in the Eagle Ford and Barnett shale-gas basins in Texas.

The Japanese company said that the transaction with Shell was accompanied by a capital injection and means Tokyo Gas has also increased its shareholding in Castleton from 30 percent to around 46 percent. This deal will increase the net production of Castleton from 238 million cubic feet equivalent per day to 343 million cubic feet equivalent per day. Castleton was originally formed to acquire and develop oil and gas assets in East Texas and Louisiana, focusing specifically on the Haynesville Shale. Before this latest deal Castleton owned more than 160,000 net acres of leaseholds in East Texas with access to the Cotton Valley and Haynesville Shale with operations comprising more than 1,900 producing wells. After the transaction with Shell, Castleton will have 222,400 net acres, or about 900 square kilometres as assets. "Castleton is strategically important for our upstream business in the US," said Jun Tabei, President and Chief Executive of Tokyo Gas America. "We are eager to expand our footprint in the East Texas-Louisiana area through Castleton," added Tabei.

"Shell and Tokyo Gas have worked together in the LNG world since 1972. I am delighted to have this deal closed as this is the first transaction for Tokyo Gas and Shell in North America," stated the CEO. Craig Jarchow, President and Chief Executive of Castleton Resources, said the transaction was consistent with its strategy of asset aggregation in the Arkansas-Louisiana-Texas region. "With the help of our partner, Tokyo Gas America, we are well positioned to continue building a world-class Haynesville gas portfolio," added Jarchow. Tokyo Gas, whose imports of LNG amount to around 14 million tonnes per annum, receives most of its volumes from Australia where it has foundation customer stakes in five projects. These are the Chevron-operated Gorgon plant, Woodside Petroleum's Pluto LNG, the Inpex-run Ichthys project at Bladin Point, the Darwin LNG plant and the Shell-operated Queensland Curtis LNG facility. Tokyo Gas also has stakes in southeast Asia and is expanding its business in Thailand and Vietnam.

US and Australian liquefaction and export plants met lukewarm Asia-Pacific demand growth and with no other viable outlet spot LNG shipments were sold at a

discount into European terminals, something that is forecast to be repeated this year. "In 2020, Europe will again be called upon to save the day. However, unlike 2019, European gas inventory will start the year at record high levels," said UK-based energy analysts Wood Mackenzie in an Asian report. "Europe will thus need to rely even more on flexible supply, or increased demand creation from within the power sector, compared to last year," said Wood Mackenzie. "Both indicate an even lower Title Transfer Facility (TTF) price for 2020 which in turn suggests lower spot prices in Asia," added the report. "However, ever-present is the risk to LNG supplies from Qatar should US-Iran tensions escalate in 2020 to a point of causing disruption to shipping through the Strait of Hormuz," it stated.

Wood Mackenzie noted in its Asian overview that market liberalization finally took place in Malaysia and Thailand. Royal Dutch Shell last year imported a spot LNG cargo into Malaysia, breaking the monopoly of state-backed energy company Petronas for the first time. "With third-party access now successfully tested, the purchasing arm of Malaysia's power generation company is expected to look for additional cargoes in 2020," said the Asian report. In neighbouring Thailand, the Electricity Generating Authority of Thailand (Egat) imported its first LNG cargo in December 2019. This was the first test of the country's third-party access regulation, after previously being monopolized by Thai state oil and gas company PTT.

The report added that in South Korea, new power and industrial consumers are also looking to self-procure, joining the likes of POSCO, SK E&S, GS Energy, and others who already independently import and bypass state-owned Korea Gas Corp. "Low LNG spot prices have helped make the case for these emerging buyers. The incumbents, whether Petronas, PTT or Kogas, have a supply portfolio of long-term supply contracts with relatively high prices," explained Wood Mackenzie. "Being able to self-purchase LNG from the spot market will provide additional margin for these end users, and boost competitiveness in their respective markets," it added. Additionally, China's gas and LNG demand continues to face headwinds. China's gas demand growth decelerated in 2019 to around 9 percent from 17 percent in 2018.

"The trade war (with the US) has had a domino effect on China's domestic economy," said the report. "The economic slowdown affected overall energy demand and limited the government's fiscal ability to create gas demand," it stated. "With the Power of Siberia pipeline in operation and first gas from Russia to northern China, next winter's LNG requirements could be limited," said the Wood Mackenzie report. "In addition, domestic gas production is still ramping up at a faster pace than previous years. Should this persist in 2020, gas imports will face slower growth," it added. "Despite a moderation in coal-to-gas switching in 2019, gas has shown resilience and gained a higher share in the energy mix, still outpacing coal and oil," said the report. "The year 2020 is the last year of the 13th five-year plan period. The silver lining for China's gas demand is if policymakers re-emphasize environmental targets in its next 5-year plan," the report added.

US states, including New York, California and Maryland and number 16 in total are opposing proposals to transport liquefied natural gas by railcars because of what they see as the risk of potential accidents. Lawyers for the states opposed to delivering LNG by rail have urged the Department of Transportation's Pipeline and Hazardous Materials Safety Administration (PHMSA) to withdraw the proposal pending the completion of safety studies and the development of an environmental impact statement. The American Association of Railroads, an industry group that supports shipping LNG by rail, said that US railroads already moved much of the hazardous materials transported nationwide without releases caused by an incident. The states in opposition to transporting LNG by rail have asked their attorneys general to block the proposition. US regulators have said that specially-built railcars, whose design has been approved by the Department of Transport, would be able to move LNG across country.

The PHMSA in December 2019 approved the use of trains to ship LNG from northeast Pennsylvania to southwest New Jersey. A company called Energy Transport Solutions, a subsidiary New Fortress Energy, is aiming to use rail transportation for Pennsylvania shale-gas produced of at a small-scale liquefaction plant to transport volumes to a planned terminal on the Delaware River for shipping to global markets. The company is developing two such small-scale projects in the Marcellus Shale Basin in Northeast Pennsylvania that would have a combined capacity of 7.3 million gallons per day, according to regulatory filings. New Fortress Energy is an affiliate of the private equity group Fortress Investment. A site is being prepared for the first small-scale facility in the Marcellus Basin in Bradford County. Previous rail approvals have been made for companies in states such as Florida and Alaska.

In the US trucks and ships are the only two forms of bulk transportation for LNG. Currently, LNG may only be transported via rail in a portable tank with a special approval from the Federal Railroad Administration (FRA). The proposal backed by the Administration would relax this rule. The move could also boost the market for ISO container exports from ports not already served by the Coast-based LNG production expansion. The PHMSA has called rail transport a "safe, reliable, and durable mode of transportation" for LNG. The Department of Transport has prioritized safety as well as supporting the economic benefits of enhanced transportation options for American energy resources. In Europe, US LNG equipment-maker Chart Industries, based near Atlanta, constructed the first European LNG tank car in co-operation with Germany's VTG AG, a leading wagon hire and rail logistics company, and those units can be leased or purchased. "Safety is the number one priority of PHMSA and we understand the importance and will make it a top priority to evaluate all public comments and concerns raised throughout the rulemaking process," said the agency. The PHMSA pointed out that the rulemaking process is consistent with the systemic approach to accident prevention, mitigation and emergency response preparedness. ■

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RINA study for Panama Canal Authority LNG terminal highlights opportunities for gas-to-power

Italian maritime classification society, RINA, outlines LNG opportunities in Central American nation

The official opening of the expanded Panama Canal on June 26, 2016 dramatically increased the waterway's ability to handle larger size vessels and, for the first time, it allowed the passage of greater volumes of global LNG (Liquified Natural Gas) tanker traffic.

The expanded Panama Canal allows approximately 90% of the global LNG tanker fleet to utilize the critical waterway for timely and cost effective transit between the Atlantic and Pacific oceans.

Opportunities

The ACP is interested in exploring opportunities for LNG-related infrastructure in the Canal territory to:

1) facilitate the delivery of LNG bunkers to vessels transiting the Canal;
2) provide LNG for power generation facilities;
3) transform Panama into a regional energy hub.

All of the above mentioned goals will ultimately increase the competitiveness of the Canal route in the global trade and shipping marketplace and will help increase revenues for the Canal, the Panamanian government and enhance the lives of the Panamanian citizens.

The US Trade and Development Agency (USTDA) provided a Grant to ACP to fund a Feasibility Study for the Panama Canal LNG Terminal Project in Panama.

In November 2016, RINA USA Inc. (hereinafter referred as RINA) was awarded the contract for the execution of the "Feasibility Study for the Panama Canal LNG Terminal Project".

This article will provide some extracts from the full paper:

Evaluations

Over the past years, Central America countries have evaluated the use of LNG Import terminals; several countries are currently importing LNG or have projects under development or study.

- The following is a list of considerations relative to the existing local landscape for a Panama Canal LNG Terminal Project:
- The Panama LNG Import Terminals (AES- Engie-Costa Norte) is currently operating since 2018 in Colon (Atlantic side);
- Two other Power Purchase Agreement (PPAs) have been awarded by the National Secretariat of Energy on the Atlantic-Colon side of the Panama Canal;
- At present, there are no existing plans for a Pacific side / Panama City LNG Import Terminal, even though large regional population centers reside along Pacific side and no PPA - has been yet awarded with a Pacific location;
- Ship bunkering is viewed as a potential LNG consumer, leveraging the Panama Canal strategic location on maritime trade routes;
- Incremental industrial consumer opportunities have been identified to bolster Panama Canal LNG Terminal throughput.

LNG Price estimates

While the price of crude oil is relatively low at this point in time (the low $50/bbl range for both WTI and Brent benchmarks), long-term price forecasts expect these values to recover to some degree over the next 15-20 years as global demand for fossil fuels increases.

Based on a relatively constant projected oil price of $100 per barrel through to 2030, future oil-indexed LNG contracts at $10-15/MMBtu have been used in numerous studies assessing the costs and benefits of LNG as a shipping fuel.

Indexing LNG prices to the US Henry Hub benchmark, or other natural gas hubs globally, has the potential to result in lower prices for LNG, but this is not yet the established pricing practice globally.

Even without widespread natural gas indexation, many private sector firms and regulatory bodies expect to see lower LNG bunker fuel prices relative to other marine fuels in the future.

There are three probable scenarios for future LNG pricing:

Output

1.Prices under long-term pressure: considerable amounts of new LNG production continue to enter the market, demand remains sluggish and prices fall. There is currently a glut of LNG supply in the Atlantic basin and greater US exports are expected to enter the market between 2017-2020 which could put further pressure on future LNG prices.

2. Prices experience short-term weakness: Prices weaken in the short term due to low global demand and a glut of LNG. In the midterm, however, the traditional pricing link between oil and gas remains in place. An eventual recovery in the price of crude will thus result in stronger LNG prices. In this type of market LNG trading and investment in storage capacity increases.

3. Prices remain at elevated levels: In this pricing environment LNG buyers will seek security of supply and long-term contracts will flourish. Buyers under long-term purchase contracts have limited ability to switch to other forms of energy which results in strong continued demand for LNG.

FORECAST LNG LANDED PRICE 2017-2030

Cost LNG Delivered Panama,														
2017-2030	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
NG Spot Price at Henry Hub														
(2016 dollars per million Btu)	3.00	3.40	3.96	4.51	4.39	4.26	4.28	4.41	4.51	4.64	4.75	4.86	4.96	5.00
Cost HH Gas Export Premium	3.45	3.91	4.56	5.18	5.05	4.89	4.92	5.08	5.18	5.34	5.47	5.59	5.71	5.76
Liquefaction Fee	2.75	2.75	2.75	2.75	2.75	2.75	2.75	2.75	2.75	2.75	2.75	2.75	2.75	2.75
Shipping from US Gulf	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
Fees & Taxes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Total (US$)	**7.95**	**8.41**	**9.06**	**9.68**	**9.55**	**9.39**	**9.42**	**9.58**	**9.68**	**9.84**	**9.97**	**10.09**	**10.21**	**10.26**

This forecast price range was obtained using Henry Hub price data

Price range

The LNG market continues to develop in America. The US is expected to become the third largest LNG exporter once the five liquefaction terminals under development enter service.

LNG markets have become increasingly globalized and US export cargoes have thus far been sold into Europe, the Far East and South America. Panama has the potential to become a regional LNG hub with product landed into this market between $7.95 and $10.26 from 2017 to 2030.

This forecasted price range was obtained using Henry Hub price data, the US EIA long term energy outlook for 2017, Cheniere's Sabine Pass natural gas pricing, liquefaction costs and relevant shipping and terminal fees for LNG delivered from the US Gulf Coast to Panama.

The review and analysis of current bunker markets activity, changing global regulations and the prospects for LNG bunkers in Panama and the surrounding region provides the following takeaways:

- The bunker market in Panama remains robust with volume increases reported by industry participants;
- There is more than adequate tankage infrastructure to handle current volumes and expected increases in fuel oil bunker volumes in the future;
- Most fuel suppliers/consumers have interest in new, cleaner sources of energy, such as LNG;
- Potential opportunities are present to supply LNG within Panama and regionally.

Any significant market transformation, in this case the move from high sulfur fuel oil to LNG bunkers, takes time. Infrastructure must be developed and sufficient demand must either be present or expected to materialize to justify the investment.

The case for LNG bunkers in Panama is in its infancy. While approximately 20 percent of the thousands of vessels transiting the Canal annually take on bunkers, the number of LNG-fueled vessels currently operating globally is roughly 100 and the vast majority of these are not operating in Panamanian waters.

Market conditions

This situation is not expected to change much over the next three years. If one looks forward to the next 3-5 years,

Potential LNG port locations around coastline of Central America

however, market conditions may be very different for the following reasons.

1. New IMO maximum sulfur content fuel regulations since January 1, 2020. These will put a ceiling of 0.5 percent on sulfur emissions produced from fuel burned by vessels.
2. US LNG export volumes are expected to ramp-up to approximately 10 bcf/d, making the US the third largest LNG exporter globally.
3. Greater numbers of LNG-fueled vessels of all types are being built, will operate globally and are expected to transit the Panama Canal.

The approach to be undertaken when developing an LNG Terminal on the Pacific side of the Panama Canal falls into two different concepts:

- Concept 1 - Full Project Development;
- Concept 2 - Phased Expansion Approach.

The concept of Full Development is to build a large-scale LNG terminal that accommodates and receives the entire cargo of an LNG carrier. This requires the construction of a large berth and sizable storage tank(s).

Capital

Traditionally, this approach involves a large capital investment spread over about three years, and requires a corresponding large gas demand in the form of a power plant, gas distribution grid or large industrial users.

In the absence of a large LNG demand, this approach is considered to be unfeasible until a guaranteed demand is attained, followed by a sustainable and expandable end-user LNG market.

One benefit of this Full Development approach is the upfront project mobilization that involves permitting, engineering, procurement, logistics, construction, start-up and demobilization. Community disruptions during the construction effort have a window that ends after start up.

As with the recent AES- Costa Norte LNG Terminal on the Atlantic side, and many other full development LNG Terminals, justification of a full development coincides with the creation of a new power plant.

Recognizing that several future PPAs will be tendered by Panama post 2020 with an intended power generation start up post 2025, it is safe to conclude that any LNG full development Import Terminal scenario will require the creation of a new power plant fueled by gas from the LNG Terminal.

The Pacific side of the Panama Canal area has land site locations and surrounding infrastructure that can accommodate an LNG Terminal and adjoining power plants.

The close proximity of Panama City, transiting ships, and the Pan American Highway make this Pacific side area desirable for locating an LNG Terminal.

Expansion

As an alternative to constructing an upfront large-scale LNG Terminal, it is possible to gradually expand the facilities to be more synchronized with the Terminal throughput volumes, whereby the Terminal infrastructure is built in two different phases to optimize Terminal throughput with respect to the potential LNG demand.

Numerous development cases for the LNG Terminal have been identified and evaluated for a selected number of sites. The two key drivers that come into play when conducting an evaluation of the cases are the capital outlay profile (spend schedule), and the Terminal LNG throughput demand (revenue).

After numerous cycles of preliminary scrutiny, ranking and rejection of the more obvious cases with shortcomings, a list of the most viable cases is shown below:

Full Development Concept.

- Lower Miraflores,
- Lower Cocoli,
- Farfan.

Phased Expansion Concept.

- Lower Miraflores (Phased).

Suggestion

RINA envisions an investor forming a special purpose company-Special Purpose Vehicle (SPV or Project Company) to develop, construct and operate the Project. The SPV will enter into all agreements pertaining the Project, including:

- Terminal Use Agreement or similar agreement with the LNG counterparty;
- Engineering, Procurement and Construction (EPC) contract(s) and Operation and Maintenance (O&M) agreement, with EPC and O&M contractors respectively;
- Concession contract, including terms and conditions, with ACP;
- Funding agreements with the Project sponsor (equity investor);
- Financing agreement with lenders.

It is likely that the Project sponsor will seek to limit to its financial exposure to the Project, ensuring that the loans to the Project are on a limited recourse basis

The goal of the economic analysis is to provide a competitive assessment of the terminal for the intended demand segments.

To this end, the study includes the comparison of LNG prices ex-terminal (LNG price landed in Panama plus terminal charges) versus a relevant benchmark or alternative.

The goal of the economic analysis is to estimate the price of LNG ex-terminal, which allows a competitiveness

assessment of the Project.

This is the sum of the cost of LNG landed in Panama (ex-ship) plus the Terminal charges.

The objective of the financial analysis is to establish the Terminal charge of the Project on per USD/MMBtu, given capital costs, cost of capital, and other assumptions.

Furthermore, the goal of the economic analysis is to provide a term of comparison between different sites and development concepts for the Project. RINA has reviewed different sites and development concepts for the Project.

Each option has associated capital costs assumptions, timing assumptions (i.e. the construction duration may vary among scenarios), and operating costs assumptions. In addition, each option may be constrained by the LNG demand it can accommodate.

Configurations

Each configuration yields a terminal charge which can be compared with a relevant benchmark.

For capital projects, investors, through a financial model, expect to calculate their expected levered and unlevered returns and how these returns change due to a change in base case assumptions.

Similarly, lenders use a financial model to understand if the cash flows generated by the project they are lending to are robust enough to be able to service the loan in every single period throughout the life of the loan.

Therefore, project Internal Rate of Return (Project IRR) and equity IRR, and minimum and average Debt Service Coverage Ratios (DSCR), are the main results of a typical financial model, given a multitude of assumptions.

The financial model developed by RINA reverses the typical model flow and calculates a terminal fee (now an output), given a required Project IRR.

Analysis

Also, the financial analysis has identified the concept of a Full Development as the best solution for the Lower Cocoli site.

A wharf to accommodate large LNG carriers will be built, with the required mooring arrangements and LNG loading/unloading arms. This LNG wharf will also serve as a bunker barge loading facility.

Large, above ground, LNG storage tank(s) will be foreseen. The total storage requirement for the facility must take into account the replenishment volume (the minimum storage requirement for the full cargo of an LNG carrier) and the necessity to limit the disruption of the Panama Canal operation.

This study has identified a minimum total capacity of 180,000 cubic metres for the storage, and a frequency for the LNG carrier delivery of 1 cargo every 13 days.

Conclusions

The following is a list of concluding observations, which summarize the main results of the Feasibility Study:

Business Climate:

- The business climate in Panama is conducive for a green field energy project,
- There is ongoing expanding regional energy demand,
- ACP has available land with market access, suitable for the installation of an LNG Import/Export Terminal and new Power Plant(s),
- Panamas is characterized by a friendly business and investment environment.

Technical Feasibility:

- Similar LNG Import Terminals and facilities have been in existence for many years,
- Within the Panama Canal area, adequate industrial fabrication and construction resources are available,
- Large capital projects have been executed recently in Panama,
- The selected geographical locations are within realm of typical industry projects,
- In the Panama Canal area, there are several Pacific sites (Lower Cocoli being the preferred) available for development.

Economic Viability:

- There are sufficient LNG producers available worldwide to provide highly competitive LNG supply resource,
- Project capital costs are within typical energy project orders of magnitude,
- Funding resources are available,
- The LNG Terminal can compete as a supplier to power plants, bunker market and local/regional distribution,
- A new, large power plant is required to anchor the Project. ■

This article is based on extracts from a paper by Matteo Tirindelli, Project Manager, Oil and Gas Consulting, RINA, Angelo Lo Nigro Senior Director, Energy Americas Region, RINA, and Priscilla Mendez B., Business Development Specialist, Vicepresidency for Complimentary Business at ACP

Singapore-based Delta Offshore Energy emerges with approved LNG and power project in Vietnam

Vietnamese province of Bac Lieu gives go ahead to power project to be fuelled by US LNG

Delta Offshore Energy, whose headquarters are in Singapore, has had its plans approved for the development of a $4-billion power project on the Mekong Delta fuelled by imports of liquefied natural gas from the US state of Louisiana.

The Bac Lieu provincial committee chairman, Duong Thanh Trung, said the LNG-led project is the biggest foreign investment in the Mekong Delta region so far and would play a role in transforming the province's economic development.

Integrated

The LNG-for-power project in Bac Lieu is one of several planned to advance the Vietnamese natural gas and power industries.

The integrated project is expected to commence operations in 2023.

The US Magnolia LNG project developer supplying the LNG is the Australian-listed company LNG Ltd, which in September 2019 signed an agreement with the Bac Lieu import terminal.

LNG Ltd has said its Magnolia plant near Lake Charles would supply 2 million tonnes per annum to Vietnam.

The Louisiana shipments would be on a free-on-board (FOB) basis for a 20-year term with options to extend the term.

The Magnolia plant in Louisiana has also recently received authorization from US regulators to expand production from 8 MTPA to 8.8 MTPA.

Signatories

The Magnolia plant's Vietnam supply accord has been signed with Delta Offshore Energy.

LNG Ltd has said its supply deal would allow Vietnam to have a stronger relationship with the US market and the long-term stability of the Henry Hub natural gas price.

The Asian nation has plans to import 5 MTPA by 2020, 10 MTPA by 2030 and 15 MTPA by 2035.

Power plant designs for the Delta Offshore-led venture envisage capacity of 3,200 megawatts with four gas turbine units with a capacity of 750 MW each and one unit with a capacity of 200 MW.

Vietnam is planning to develop a second LNG import terminal and adjacent gas-fired power station in Ninh Thuan province south of Cam Ranh Bay.

Delta Offshore has been the project developer with support from strategic partners, including General Electric Co. of the US, Magnolia LNG and risk advisors Marsh Inc.

Consortium

The consortium has signed an agreement with GE, including for the supply of its leading Combined Cycle Gas Turbine (CCGT) 9HA.02 technology.

Delta Offshore believes the combined expertise, technology and supply from these world-class US companies will underpin the $30Bln in exports over the 25-year period of the project.

The venture will also significantly help balance the bilateral trade and deepen economic interests between the US and Vietnam.

In September 2019, the project was included in the advocacy program of the US Government on its merits of promoting significant US exports to Vietnam.

Delta Offshore is also committed to providing Vietnam with affordable, clean and reliable energy security through a long-term bankable Power Purchase Agreement (PPA) with offtaker Electricity Vietnam Group (EVN).

It expects to complete the development phase within 12 months to achieve a final investment decision .

Incorporated

Delta Offshore was incorporated in Singapore to originate and develop opportunities in sustainable energy infrastructure for clean, affordable and secure energy.

It is strategically focused on opportunities in the Energy Sector in the Mekong Delta to address the region's power deficit and support its socio-economic development in a sustainable manner.

In parallel with this, Delta Offshore is also considering various synergistic project opportunities, both vertically and horizontally, that are within strategic proximity to the project in Bac Lieu Province.

The primary responsibility of the senior management team of Delta Offshore is to innovate, structure and coordinate an integrated LNG-to-Power solution that is competitive, transparent and independent to balance the various and complicated needs of all sides.

Project participants with members of the Bac Lieu provincial committee

Management

Senior decision-making on the ground in Vietnam has been necessary in order to achieve the project's principle objectives of feasibility and bankability in a timely manner.

The senior management team have more than 60 years of combined international experience in oil & gas, maritime, investment banking and investment management with world-leading multinational corporations and global institutions.

The senior management team also has over 20 years of operating experience in Vietnam as investors, advisors and entrepreneurs.

The executive team and board have access to the boards of hundreds of industry leading corporates.

They have worked in capital markets, or as advisors on the sell-side and as investors on the buy-side.

They have access to the leading financial institutions in key money-centre cities in all hemispheres and timezones.

Their network includes thousands of senior contacts at the global investment banks, insurance companies, sovereign wealth funds, private banks, the institutional investment funds, asset managers, private equity funds and hedge funds.

No other developer in Vietnam can offer the much needed combination of multi-disciplinary expertise, breadth of experience and network access on a global and local level.

Senior executive officers:

Spencer Damian White, CFA, Managing Director, Projects: White has more than 25 years of experience in Asia in both capital markets and as an entrepreneur. He leads overall project management with a specific focus on structuring and financing. He worked in Investment Banking, Investment Management and Shipping. Most notably he was a Managing Director and Asia Chief based in Hong Kong at the American Investment Bank, Merrill Lynch.

Bobby Quintos, Managing Director, Technology & Engineering: Based in Houston, Quintos leads all of the technical and engineering-related elements of the projects, with a specific focus on LNG, power and offshore & maritime. His professional career was mostly in Oil & Gas, Power and Maritime. He was most notably an executive with the UK major BP on various global gas and LNG projects.

Ian Nguyen, Managing Director, Origination and Stakeholder Relations: Based in Hanoi, he is primarily responsible for deal origination as well as stakeholder relations. His professional career was primarily in Investment Banking and Investment Management. He was most notably the former Asia CEO based in Singapore for the European Hedge Fund, Cheyne Capital. ■

ZR-LNG can offer self-refrigeration liquefaction technology for LNG with integrated liquids removal

Gasconsult Ltd data provided for modularized unit with 1.5 million tonnes per annum of output

Gasconsult Limited has developed and patented a mid-scale liquefied natural gas liquefaction technology termed ZR-LNG. The technology uses a dual methane expander configuration with a number of innovative features.

Safety, simplicity and low power demand were key drivers in developing the process configuration.

Adaptable

ZR-LNG is well suited to land-based application but its benefits are significantly amplified on Floating LNG ventures. A design development programme was undertaken by CB&I (now McDermott) to confirm the technical viability and quantify the benefits of the system.

This work was undertaken for a standardised FLNG liquefaction module. A principle behind the design development was that the standard modular design could remain unchanged and be deployed in alternative locations where differing factors would impact available gas turbine power and LNG production capacity.

The benefits of this standardisation include a reduction in ongoing engineering costs and project schedules.

The process equipment and piping were designed for an LNG output of 1.5 million tonnes per annum of 365 days under the Basis of Design (BoD).

The actual LNG output will depend on the feed-gas composition-pressure, the ambient air and seawater temperatures and on the power available from the selected gas turbine under specific site conditions.

The main refrigerant compressor was assumed to be driven by either a BHGE LM6000PF+ or Siemens SGT-A65 gas turbine.

At the time of the engineering development, the 46-47 MW power from the gas turbines under the BoD conditions limited the LNG production to circa 1.4 MTPA.

With subsequent development of higher power outputs by BHGE and Siemens the full 1.5 MTPA LNG production is now feasible, justifying the decision to size the standardised module for 1.5 MTPA. The basis includes the specific inputs to the liquefaction module design and a generic FLNG vessel incorporating the installed modules.

The FLNG vessel was assumed to be located in deep water off the West African coast with warm ambient air and seawater temperatures.

The metocean data has been selected to be typical for the environment and the accelerations imposed upon the liquefaction module are based on the sea state typical for such a location.

Process configuration

The basic ZR-LNG liquefaction of the natural gas is achieved through the use of two expander-compressor circuits providing two temperature levels of refrigeration with heat exchange across a manifolded plate fin heat exchanger block located in a single cold box structure.

The High Pressure (HP) expander EX1 provides a warmer level of cooling of the feed gas, with the expander outlet stream reheated and returned to the suction of the recycle compressor.

The shaft power produced by EX1 is typically used in an expander-driven compressor CX1 to compress the feed gas to a higher pressure than the feed gas; improving the efficiency of the liquefaction process.

The Low Pressure (LP) expander EX2 provides a partially condensed stream from which the vapour is separated and used as a lower temperature, lower pressure refrigerant to condense the feed gas to LNG.

The shaft power produced by EX2 is typically used in a second expander-driven compressor CX2 to compress the recycle gas stream discharged from the recycle compressor prior to mixing with feed gas.

The mixture of feed gas and recycle gas typically exits the cold box HX1 as a dense phase at around -110°C and is then let down to an intermediate pressure across a hydraulic turbine HT1 (or optionally, across a Joule-Thomson (JT) valve) before being further reduced in pressure prior to LNG storage.

TABLE 1 BASIS OF DESIGN SUMMARY

Parameter	Unit	Basis Value
Feed Composition		
Nitrogen	Mol%	0.50
Methane	Mol%	96.04
Ethane	Mol%	2.80
Propane	Mol%	0.40
C4+[1]	Mol%	0.26
Feed Gas Arrival Temperature	°C	27
Feed Gas Arrival Pressure	barg	65
Target Production Rate	Mtpa	1.5
Ambient Air Temperature	°C	25
Cooling Water Loop Supply Temperature	°C	23
Process/Cooling Water Approach	°C	4

Composition is based on feed gas having been treated by NGL extraction

Flash gas generated at both of these pressure let-down stages is used to provide additional refrigeration and to facilitate nitrogen rejection.

Gasconsult's analysis has shown that with the ZR-LNG process this pressure let-down approach is as efficient and more cost effective than provision of a sub-cooling arrangement to cool the liquefied product to the temperature of around -150°C typical of conventional LNG liquefaction practice.

ZR-LNG is similar in operating principle to nitrogen expander schemes.

However, it enjoys certain advantages over nitrogen. Methane has a higher specific heat - this significantly reduces circulating flows, reducing power consumption and pipe sizes.

Moreover, methane is more compressible than nitrogen at the typical compressor discharge pressures.

Compressible

A patented feature is the partial liquefaction that takes place in the LP expander EX2 - this very efficiently converts latent heat directly into mechanical work and also permits a reduction in heat transfer area and cost of the main cryogenic heat exchanger HX1.

The features described in the ZR-LNG process configuration make for a highly efficient system, with a simulated specific power of 313 kWh/tonne under the BoD conditions.

Due to condensation of the C2+ components of the feed gas at the cold end of the process, the composition and flowrate of the recycle gas are little affected by changes in composition of the feed gas; the recycle gas consisting mainly of methane with some accumulated nitrogen.

Monitor

As a result, the requirement to monitor and adjust the refrigerant composition for changes in feed composition is eliminated, a significant operational advantage over Mixed Refrigerant (MR) processes.

LNG production in actual operation can be maximised by minor adjustments in the flow ratio between the expanders.

An increase in the C2+ content of the feed gas can be expected to reduce the compression power within the same equipment due to the higher overall condensing temperature.

The required gas turbine power demand will therefore be reduced, and, as this is the limiting equipment item in the 1.5 MTPA standard design, the LNG production may increase within the limits of the available gas turbine power.

Conversely, a reduction in C2+ content results in an increase in the specific power and so a reduction in the LNG production rate.

An increase in feed gas nitrogen also increases the liquefaction specific power, resulting in a reduction in LNG production for a fixed gas turbine available power. The recycle loop concentrates the nitrogen so the specific compression power increases.

Typically, 3 - 4 % N2 in the feed gas can be accommodated, the limitation being the nitrogen content acceptable in the gas turbine fuel gas.

However, the process naturally removes nitrogen as part of the fuel gas bleed which ensures that the product LNG specification is robust to increased nitrogen without a change to the design.

Ambient impact

The impact of ambient air temperature is similar to that on other gas turbine driven liquefaction processes in that the available power for the main recycle compressor falls at increased ambients so reducing the LNG production rate.

Conversely, reduced ambients allow the gas turbine to deliver increased power and production can be increased up to and potentially in excess of the maximum of the standardised equipment capacity of 1.5 MTPA.

There will be an increase in liquefaction efficiency if the cooling water loop is able to provide more cooling due to colder seawater than design. The impact will be the opposite with warmer water.

All liquefaction technologies consume more power at lower feed gas pressures.

Dynamic analysis

A dynamic simulation of the liquefaction unit was performed to validate the robustness and integrity of the process configuration and equipment for normal operating and transient conditions such as start-up, shut down and trip scenarios.

The dynamic model was initially configured to operate at steady state conditions (1.5 MTPA) to confirm functionality and to develop the control scheme.

Following this, a number of transient cases were analysed to assess performance of the module equipment and controls during unsteady conditions. The following transient cases were reviewed:

- Trip of one or two of the HP expander-compressors
- Trip of the LP expander-compressors
- System start-up

The completed dynamic simulation demonstrated that ZR-LNG operates stably in steady state operation.

The expander trip cases were all found to be survivable with simple trip sequences incorporating feed forward step reductions in LNG and refrigerant flows and in the extreme case of both HP expanders tripping, keeping the HP JT valve closed until a suitable temperature profile across the cryogenic exchanger is achieved.

The start-up sequence developed demonstrated the simplicity of the system and introduced a number of control elements required for start-up.

The sequence indicated that full production could readily be reached in 12 hours from start-up from "warm".

This time is well within the cooldown and operational constraints of the ancillary equipment, so substantial improvements to this time-scale are considered possible.

Alternative configuration

As an open methane cycle process ZR-LNG lends itself to three interesting process configurations not possible with MR or nitrogen expander schemes.

Integrated heavies removal

Liquefaction systems require removal of C5+ and aromatics to avoid freezing and plugging of the main cryogenic exchanger and ancillary equipment. This heavies removal is widely carried out in a scrub column upstream of liquefaction and heat integrated with the liquefaction system.

For feed gases close to their critical pressure achieving satisfactory operation of the scrub column and effective vapour/liquid separation may be problematic and may require operation of the scrub column at a pressure sub-optimal for liquefaction.

Leaner feed gases with reduced levels of C2 and C3+ can also create instability in the scrub column due to lack of liquid reflux. Faced with either of these scenarios a typical solution is to install an upstream NGL recovery unit, expanding the feed gas to a sub-critical pressure, condensing the liquids and recompressing the depleted gas to recover liquefaction efficiency.

This adds cost and complexity to the overall liquefaction scheme. At its simplest it requires additional heat transfer equipment and turboexpander with recompression of the feed gas to liquefaction pressure.

ZR-LNG provides an elegant solution for lower pressure feed gases which can be routed after liquids separation back to an inter-stage point in the recycle gas compression train.

This allows consolidation of all compression power input into the liquefaction scheme itself, simplifying the configuration.

TABLE 2 BASIS OF DESIGN SUMMARY KEY LOCATION & FLNG ASPECTS

Parameter	Unit	Basis Value
LNG Storage Capacity[2]	m^3	210,000
Condensate Storage Capacity	m^3	50,000
Seawater Temperature	°C	20
Guide Module Envelope	L x B x H	45 x 24 x 30
FLNG Dimensions	L x B x D	380 x 65 x 33
Maximum Operating Sway on Module	G	0.2

Floating LNG project aspects of the design with membrane storage

Parameters

By optimising the pressure parameters of the compressors CX1, CX2 and CP1 a higher liquefaction pressure decoupled from the feed gas pressure can be achieved, enhancing liquefaction efficiency without need for a separate feed gas compression plant.

For the specified feed gas and site conditions, approximately 50 MW of shaft power is required to drive the refrigerant compressor for the required LNG output of 1.5 MTPA.

The largest available aero-derivative gas turbines in this range were selected to define the achievable LNG capacity and to select appropriate recycle compressors.

Both BHGE and Siemens were approached to provide performance and cost data for the LM6000PF+ and SGT-A65 respectively. Either gas turbine or an electric motor drive is suitable for a modular design execution strategy.

The expander-compressors units are key to the performance and layout of the liquefaction module.

Both BHGE and Mafi-Trench (Atlas Copco) were approached for budgetary selections with a 2 x 50% arrangement for the HP units and a 1 x 100% arrangement for the LP units.

Concerns have been raised in the past concerning the concept of performing a partial liquefaction in the LP expander. Both vendors advised numerous references for units running with up to 40 percent liquids in the expander outlet.

Main cryogenic heat exchanger

The ZR-LNG technology includes an LNG exchanger comprising several brazed aluminium heat exchangers (BAHX), manifolded together and supplied as a package in a cold box.

The ZR-LNG cold heat exchanger group is designed to operate in dense phase which simplifies the cold box design due to the lack of any separate liquid phases and associated concerns over internal fluid distribution.

This provides greater robustness than may be the case with other hydrocarbon-based liquefaction technologies.

The cost estimate for the 1.5 MTPA production module is US$195 million based on a first-quarter 2018 instant execution basis.

The following methodology was applied to develop the cost estimate.

Home Office Engineering

Engineering costs were developed from typical manhour ratios from relevant reference projects. The costs comprise home office project management services, procurement and subcontracts management for a single module.

Mechanical Equipment

A costed equipment list was developed for the estimate. The majority of equipment items were costed based on budget proposals received from equipment suppliers.

Budget proposals from suppliers were benchmarked against proposals and actual costs from other projects to arrive at an overall anticipated cost. An allowance for 2 years' spares and an allowance for first fill of lubricants were also included in the mechanical equipment cost.

Bulk Materials

Bulk materials costs were developed from estimated weights included in the weight report. Primary structural steel and large bore piping weights were developed from the MTOs, giving an increased confidence in these quantities. The primary steel MTO was generated from the structural analysis software. The piping MTO was generated from the 3D model including a split between carbon steel and stainless steel. Other weights were factored using in-house benchmarks.

Freight

Freight and Logistics costs were

calculated on a percentage of the mechanical equipment and bulk materials costs.

Yard Fabrication Costs

The direct fabrication cost estimate was obtained by using an All-In Rate (USD/MT) applied to a total number of man-hours derived from key quantities. Indirect costs for supervision and pre-commissioning were factored from the direct costs. The All-In Rate was based on labour rates and productivity factor data in South East Asia.

Conclusions

At the time of writing LNG schemes face difficult financial hurdles arising from low energy prices and expanding LNG production capacity. This difficulty is exacerbated for mid-scale and FLNG schemes as, by their nature, they are lower capacity than current base load plants, introducing a further challenge in the form of economy of scale.

The methane expander based ZR-LNG process with its high efficiency and elimination of the complete refrigerant infrastructure (storage, blending, transfer and extraction) offers a low capital cost solution.

Indications are that weight/footprint can be reduced significantly relative to MR schemes.

Further substantial savings may be secured when the Integrated Heavies Removal variant allows elimination of a conventional expander based NGL removal unit. ZR-LNG combines these advantages with the following safety, operations and logistics benefits:

- No liquid refrigerants are required, the only hydrocarbon in the liquefaction module is the feed natural gas itself. This provides an intrinsically safer scheme than MR processes.
- There are no refrigerant make-up costs.
- There is no need for ongoing refrigerant composition adjustment.
- There is no requirement to import refrigerant components such as ethylene or isopentane required to optimise the refrigeration system and ensure maximum liquefaction efficiency.
- The methane refrigerant is always in a single-phase providing advantages over MR schemes on floating facilities subject to motion.

The level of engineering performed during the CB&I development has demonstrated the commercial readiness of the ZR process.

Quality data is now available to allow detailed assessment of ZR-LNG for project opportunities. ■

This article is based on extracts from a paper presented at Gastech in Houston in 2019 by Bill Howe, Geoff Skinner of Gasconsult Ltd, and Martin I. Mayer and Simon Smith of US engineering firm McDermott.

LNG
JAPAN
CORPORATION

LNG OneWorld.com

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	GTT	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	GTT	4	Nigeria LNG
Adam LNG	162,000	Oman LNG	Hyundai	Dec-14	Marshall Is.	DFDE	GTT	4	Oman LNG
Adriano Knutsen	180,000	Knutsen	Hyundai	Jul-19	Spain	MEGI-DF	GTT	4	charter
Al Aamriya	210,100	J5 Consortium	Daewoo	Feb-08	Marshall Is.	DRL	GTT	4	Qatargas
Al Areesh	151,700	Teekay LNG	Daewoo	Jan-07	Qatar	S	GTT	4	Ras Gas II
Al Bahiya	210,185	QGTC	Samsung	Oct-09	Liberia	DRL	GTT	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	GTT	4	RasGas II
Al Dafna	266,000	QGTC	Samsung	Oct-09	Marshall Is.	LR DRL	GTT	4	Qatar-Atlantic
Al Deebel	145,000	Peninsular LNG	Samsung	Dec-05	Bahamas	S	GTT	4	Qatargas
Al Gattara	216,200	OSG/Nakilat	Hyundai	Oct-07	Marshall Is.	DRL	GTT	4	Qatargas II
Al Ghariya	210,100	ProNav	Daewoo	Feb-08	Bahamas	DRL	GTT	4	Qatargas
Al Gharaffa	216,200	OSG/Nakilat	Hyundai	Jan-08	Marshall Is.	DRL	GTT	4	Various
Al Ghashamiya	216,000	QGTC	Samsung	Mar-09	Liberia	DRL	GTT	4	Qatar-Atlantic Basin
Al Ghuwairiya	261,700	QGTC	Daewoo	Aug-08	Marshall Is.	DRL	GTT	5	Qatar-Atl'c Basin
Al Hamla	216,000	OSG	Samsung	Feb-08	Marshall Is.	DRL	GTT	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	GTT	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	GTT	4	RasGas
Al Kharaitiyat	216,200	QGTC	Hyundai	May-09	Liberia	DRL	GTT	4	Qatargas III
Al Kharaana	210,000	QGTC	Daewoo	Oct-09	Marshall Is.	DRL	GTT	4	Qatargas IV
Al Kharsaah	217,000	Teekay	Samsung	May-08	Bahamas	DRL	GTT	4	RasGas III
Al Khattiya	210,000	QGTC	DSME	Oct-09	Marshall Is.	DRL	GTT	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	GTT	4	RasGas
Al Mafyar	266,000	OSG/Nakilat	Hyundai	Oct-07	Marshall Is.	DRL	GTT	4	Qatargas II
Al Marrouna	151,700	Teekay	Daewoo	Nov-07	Bahamas	S	GTT		Ras Gas I
Al Mayeda	266,000	QGTC	Samsung	Jan-09	Liberia	DRL	GTT	5	Qatar-US/Var.
Al Nuaman	210,000	QGTC	DSME	Dec-09	Marshall Is.	DRL	GTT	4	Qatargas IV
Al Oraiq	210,000	J5 Consortium	Daewoo	Apr-08	Marshall Is.	DRL	GTT	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	GTT	4	Qatar-Atlantic
Al Ruwais	210,100	ProNav	Daewoo	Nov-07	Germany	DRL	GTT	4	Qatargas II
Al Sadd	210,100	QGTC	Daewoo	Mar-09	Liberia	DRL	GTT	4	Qatar-Atlantic Basin
Al Safliya	210,100	ProNav	Daewoo	Dec-07	Bahamas	DRL	GTT	4	Qatargas II
Al Sahla	216,200	J5	Hyundai	Jun-08	Japan	DRL	GTT	4	Ras Gas III
Al Samriya	261,700	QGTC	Daewoo	Sep-08	Marshall Is.	DRL	GTT	5	Qatargas II
Al Sheehaniya	210,100	QGTC	Daewoo	Feb-09	Liberia	DRL	GTT	4	Qatar-Atlantic Basin
Al Shamal	217,000	Teekay LNG	Samsung	Jun-08	Qatar	DRL	GTT	4	RasGas
Al Thakhira	145,000	Peninsular LNG	Samsung	Sep-05	Bahamas	S	GTT	4	Qatargas
Al Thumama	216,000	J5 Consortium	Hyundai	Apr-08	Japan	DRL	GTT	4	Rasgas
Al Utouriya	215,000	J5	Hyundai	Sep-08	Panama	DRL	GTT	4	RasGas
Al Utourma	215,000	J5	Hyundai	Sep-08	Panama	DRL	GTT	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	GTT	4	Brunei LNG
Amanl	154,800	Brunei-Shell	Hyundai	Nov-14	Brunei	DFDE	GTT	4	Brunei LNG
Aman Bintulu	18,928	Perbadanan / NYK Line	NKK Tsu	Oct-93	Malaysia	S	GTT	3	Petronas
Aman Hakata	18,800	Perbadanan / NYK Line	NKK Tsu	Nov-98	Malaysia	S	GTT	3	Petronas
Aman Sendai	18,928	Perbadanan / NYK Line	NKK Tsu	May-97	Malaysia	S	GTT	3	Petronas
Arctic Aurora	160,000	Dynagas	Hyundai	Jul-13	Marshall Is.	DFDE	GTT	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	GTT	4	Brunei LNG
Arwa Spirit	165,000	Teekay LNG	Samsung	Sep-08	Marshall Is.	DFDE	GTT	4	Various
Aseem	154,850	K Line-Petronet	Samsung	Nov-09	Malta	S	GTT	4	Qatar-India
Asia Endeavour	160,000	Chevron	Samsung	Dec-14	Bahamas	DFDE	GTT	4	Various
Asia Energy	160,000	Chevron	Samsung	Sept-14	Bahamas	DFDE	GTT	4	Various
Asia Excellence	160,000	Chevron	Samsung	Sept-13	Bahamas	DFDE	GTT	4	Various
Asia Venture	160,000	Chevron	Samsung	Sept-17	Bahamas	DFDE	GTT	4	Various
Asia Vision	160,000	Chevron	Samsung	June-14	Bahamas	DFDE	GTT	4	Various

Bahrain Spirit	173,000	Teekay	Daewoo	Sept-18	Bahamas	DFDE	GTT	4	Various
Barcelona Knutsen	173,400	Knutsen	Daewoo	May-10	N.I.S.	DFDE	GTT	4	Various
Bebatic	75,060	Brunei Shell Tankers	Atlantique	Oct-72	Brunei	S	GTT	6	Brunei LNG
Beidou Star	172,000	MOL	Hudong	Oct-15	Hong Kong	DRL	GTT	4	Various
Berge Arzew	138,088	BW Gas	Daewoo	Jul-04	Norway	S	GTT	4	Sonatrach
Bilbao Knutsen	138,000	Knutsen / Marpetrol	IZAR Sestao	Jan-04	Spain	S	GTT	4	Atlantic LNG
Bilis	77,730	Brunei Shell Tankers	La Seyne	Mar-75	Brunei	S	GTT	5	Brunei LNG
Bishu Maru	162,000	K Line-Transpacific	Kawasaki Sakaide	Dec-15	Panama	S	Moss	4	Australia-Japan
Boris Davydov	172,600	Dynagas	Daewoo	Sept-18	Cyprus	DFDE	GTT	4	Yamal LNG
Boris Vilkitsky	172,600	Dynagas	Daewoo	Jan-17	Cyprus	DFDE	GTT	4	Yamal LNG
British Achiever	173,644	BP Shipping	Daewoo	June-18	IOM	MEGI-DF	GTT	4	Various
British Contributor	173,644	BP Shipping	Daewoo	Oct-18	IOM	MEGI-DF	GTT	4	Various
British Diamond	155,000	BP Shipping	Hyundai	Sep-08	IOM	DFDE	GTT	4	Indonesia-Various
British Emerald	155,000	BP Shipping	Hyundai	Jun-07	UK	DFDE	GTT	4	Tangguh LNG
British Innovator	138,200	BP Shipping	Samsung	Jul-03	Isle of Man	S	GTT	4	Various
British Merchant	138,000	BP Shipping	Samsung	Apr-03	Isle of Man	S	GTT	4	Various
British Partner	173,644	BP Shipping	Daewoo	Mar-18	IOM	MEGI-DF	GTT	4	Various
British Ruby	155,000	BP Shipping	Hyundai	Jan-08	U.K.	DFDE	GTT	4	Various
British Sapphire	155,000	BP Shipping	Hyundai	Sep-08	IOM	DFDE	GTT	4	Tangguh
British Trader	138,000	BP Shipping	Samsung	Dec-02	Isle of Man	S	GTT	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	GTT	5	Qatargas
BW GDF Suez Boston	138,059	BW Gas	Daewoo	Jan-03	Norway	S	GTT	4	Suez LN
BW GDF Suez Everett	138,028	BW Gas	Daewoo	Jun-03	Norway	S	GTT	4	Suez LNG
BW Integrity	170,000	BW Gas	Samsung	May-17	Singapore	DFDE	GTT	4	FSRU
BW Lilac	173,400	BW Gas	Daewoo	Mar-18	Malta	MEGI-DF	GTT	4	various
BW Pavilion Leeara	161,880	BW Gas	Hyundai	Feb-15	Singapore	DFDE	GTT	4	Various
BW Pavilion Vanda	161,880	BW Gas	Hyundai	Feb-15	Singapore	DFDE	GTT	4	Various
BW Singapore	170,000	BW Gas	Samsung	May-15	Singapore	DFDE	GTT	4	FSRU
BW Suez Brussels	162,400	BW Gas	Daewoo	May-09	N.I.S.	DFDE	GTT	4	Yemen-Atlantic
BW Suez Paris	162,400	BW Gas	Daewoo	May-09	N.I.S.	DFDE	GTT	4	Yemen-Atlantic
BW Tulip	173,400	BW Gas	Daewoo	Jan-18	Malta	MEGI-DF	GTT	4	various
Cadiz Knutsen	138,826	Knutsen / Marpetrol	IZAR Puerto Real	Jun-04	Spain	S	GTT	4	Engas
Cape Ann	145,000	Hoegh LNG/MOL	Samsung	May-10	Liberia	DFDE	GTT	4	Various
Castillo de Santisteban	173,600	Elcano	STX	Aug-10	Malta	S	GTT		Various
Castillo de Villalba	138,000	Elcano	IZAR	Nov-03	Spain	S	GTT	4	Sonatrach
Catalunya Spirit	138,000	Teekay LNG Partners	IZAR Sestao	Mar-03	Liberia	S	GTT	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	GTT	4	Australia-China
Cesi Gladstone	174,100	MOL-China LNG	Hudong	Oct-16	Hong Kong	S	GTT	4	Australia-China
Cesi Lianyungang	174,100	MOL-China LNG	Hudong	June-18	Hong Kong	S	GTT	4	Australia-China
Cesi Qingdao	174,100	MOL-China LNG	Hudong	Nov-16	Hong Kong	S	GTT	4	Australia-China
Cesi Tianjin	174,100	MOL-China LNG	Hudong	Sept-17	Hong Kong	S	GTT	4	Australia-China
Challenger FSRU	263,000	MOL LNG	Daewoo	Oct-17	St Kitts	DFDE	GTT	4	Various
Cheikh Bouamama	75,500	Skikda LNG Transport	USC	Jul-08	Bahamas	S	GTT	4	Sonatrach
Cheikh El Mokrani	75,500	Med LNG Corp	USC	Jun-07	Bahamas	S	GTT	4	Sonatrach
Christophe de Margerie	172,600	SCF	Daewoo	Nov-16	Cyprus	DFDE	GTT	4	Various
Clean Energy	150,000	Dynagas	Hyundai	Mar-07	Marshall Is.	S	GTT	4	Various
Clean Force	150,000	Dynagas	Hyundai	Jan-08	Marshall Is.	S	GTT	4	Various
Clean Ocean	155,900	Dynagas	Hyundai	Mar-14	Marshall Is.	DFDE	GTT	4	Various
Clean Planet	155,900	Dynagas	Hyundai	Mar-14	Marshall Is.	DFDE	GTT	4	Various
Clean Vision	160,000	Dynagas	Hyundai	Jun-15	Marshall Is.	DFDE	GTT	4	Various
Cool Explorer	160,000	Thenamaris	Samsung	Oct-13	Bermuda	DFDE	GTT	4	Various
Cool Runner	160,000	Thenamaris	Samsung	May-14	Bermuda	DFDE	GTT	4	Various
Cool Voyager	160,000	Thenamaris	Samsung	Oct-13	Bermuda	DFDE	GTT	4	Various
Corcovado LNG	160,106	TMSC Gas	Daewoo	Jun-14	Malta	TFDE	GTT	4	Various
Creole Spirit	174,000	Teekay	Daewoo	Jan-16	Bahamas	MEGI-DF	GTT	4	Cheniere
Cubal	160,400	Mitsui/NYK/Teekay	Samsung	Jan-12	Bahamas	DFDE	GTT	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	GTT	4	Various
Dapeng Star	147,000	China Ships	Hudong	Nov-09	China	S	GTT	4	Various
Dapeng Sun	147,000	China Ships	Hudong	Jul-07	China	S	GTT	4	Woodside Energy
Diamond Gas Orchid	165,000	MOL-Jera	MHI-Nagasaki	Aug-18	Japan	S-gas	Moss	4	US-Japan
Diamond Gas Rose	165,000	MOL-Jera	MHI-Nagasaki	Aug-18	Japan	S-gas	Moss	4	US-Japan
Disha	136,000	Petronet LNG Ltd.	Daewoo	Jan-04	Malta	S	GTT	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	GTT	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
Eduard Toll	172,000	Teekay-CLNG	Daewoo	Dec-17	Bahamas	MEGI-DF	GTT	4	Various
Ejnan	145,000	4J	Samsung	Jan-07	Bahamas	S	GTT		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	GTT	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 Glory	165,000	Tokyo LNG Tankers	JMU	Sept-18	Japan	S	Moss	4	Various
Energy Horizon	177,000	Tokyo LNG Tankers	Kawasaki	Jul-11	Japan	S	Moss	4	Pluto LNG
Energy Liberty	165 000	MOL	JMU Tsu	Oct-18	Japan	TFDE	IHI-SPB	4	Various
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
Enshu Maru	165,257	K Line	Kawasaki	June-18	Japan	S	Moss	4	Various
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	GTT	4	Various
Excel	138,106	Exmar/ MOL	Daewoo	Sep-03	Belgium	S	GTT	4	Various
Excelerate	138,000	Exmar/Excelerate	Daewoo	Oct-06	Belgium	S	GTT	4	Various
Excellence	138,000	GKFF Ltd.	Daewoo	May-05	Belgium	S	GTT	4	Excelerate Energy
Excelsior	138,000	Exmar	Daewoo	Jan-05	Belgium	S	GTT	4	Various
Exemplar	150,900	Excelerate	Daewoo	Jun-10	Belgium	S	GTT	4	Various
Expedient	151,000	Excelerate	Daewoo	Nov-09	Belgium	S	GTT	4	Various
Experience RV	174,000	Exmar/Excelerate	Daewoo	Jul-14	Marshall Is.	DFDE	GTT		Various
Explorer	150,900	Exmar/Excelerate	Daewoo	Mar-08	Belgium	S	GTT	4	Excelerate
Express	151,000	Exmar/Excelerate	Daewoo	May-09	Belgium	S	GTT	4	Various
Exquisite	150,900	Excelerate	Daewoo	Sep-09	Belgium	S	GTT	4	Various
Fedor Litke	172,636	Dynagas	Daewoo	Nov-17	Cyprus	DFDE	GTT	4	Various
Flex Endeavour	173,400	Flex LNG	Daewoo	Jan-18	Marshall Is.	MEGI-DF	GTT	4	Various
Flex Enterprise	173,400	Flex LNG	Daewoo	Jan-18	Marshall Is.	MEGI-DF	GTT	4	Various
Flex Rainbow	174,000	Flex LNG	Samsung	July-18	Marshall Is.	MEGI-DF	GTT	4	Various
Flex Ranger	174,000	Flex LNG	Samsung	April-18	Marshall Is.	MEGI-DF	GTT	4	Various
Fraiha	210,100	J5 Consortium	Daewoo	Sep-08	Marshall Is.	DRL	GTT	4	Qatargas
FSRU Independence	170,000	Hoegh	Hyundai	Feb-14	NIS	DFDE	GTT	4	Various
FSRU Lampung	170,000	Hoegh	Hyundai	May-14	Indonesia	DFDE	GTT	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	GTT	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	GTT	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	GTT	4	Various
Gaslog Geneva	174,000	GasLog	Samsung	Sept-16	Bermuda	TFDE	GTT	4	Shell charter
Gaslog Genoa	174,000	GasLog	Samsung	Jun-18	Bermuda	TFDE	XDF	4	Various
Gaslog Gibraltar	174,000	GasLog	Samsung	Oct-16	Bermuda	TFDE	GTT	4	Shell charter
Gaslog Glasgow	174,000	GasLog	Samsung	Jun-16	Bermuda	TFDE	GTT	4	Shell charter
Gaslog Gladstone	174,000	GasLog	Samsung	May-19	Bermuda	XDF	GTT	4	Various
Gaslog Greece	174,000	GasLog	Samsung	Mar-16	Bermuda	TFDE	GTT	4	Shell charter
GasLog Hongkong	174,000	GasLog	Hyundai	Jun-18	Bermuda	XDF	GTT	4	Various
GasLog Houston	174,000	GasLog	Hyundai	Jan-18	Bermuda	XDF	GTT	4	Various
GasLog Salem	165,000	GasLog	Samsung	Apr-15	Liberia	TFDE	GTT	4	Various
GasLog Santiago	155,000	GasLog	Samsung	Mar-13	Liberia	TFDE	GTT	4	Various
GasLog Saratoga	155,000	GasLog	Samsung	Dec-14	Bermuda	TFDE	GTT	4	Various
Gaslog Savannah	155,000	GasLog	Samsung	May-10	Bermuda	DFDE	GTT	4	Various
GasLog Seattle	155,000	GasLog	Samsung	Oct-13	Bermuda	TFDE	GTT	4	Various
GasLog Shanghai	155,000	GasLog	Samsung	Jan-13	Liberia	TFDE	GTT	4	Various
Gaslog Singapore	155,000	GasLog	Samsung	Jul-10	Bermuda	DFDE	GTT	4	Various
Gaslog Skagen	155,000	GasLog	Samsung	Oct-13	Bermuda	DFDE	GTT	4	Various
Gaslog Sydney	155,000	GasLog	Samsung	May-13	Bermuda	DFDE	GTT	4	Various
Gaslog Warsaw	174,000	GasLog	Samsung	May-19	Bermuda	TFDE	GTT	4	Various
GDF-Suez Global Energy	74,000	Gaz de France	Chantiers	Dec-06	France	DFDE	CS1	4	Sonatrach
GDF-Suez Point Fortin	154,200	LNG Japan	Imabari/Koyo	Feb-10	Panama	DFDE	GTT	4	Various
Gemmata	138,100	Shell Shipping	Mitsubishi Nagasaki	Mar-04	Singapore	S	Moss	5	Shell
Georgiy Brusilov	172,000	Dynagas	Daewoo	Jun-18	Cyprus	DFDE	GTT	4	Yamal LNG
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	GTT	4	Various
Golar Arctic	140,645	Golar LNG	Daewoo	Dec-03	Marshall Is.	S	GTT	4	Shell Spot
Golar Bear	160,000	Golar	Samsung	Mar-14	Bermuda	TFDE	GTT	4	Various
Golar Celsius	160,000	Golar LNG	Samsung	Sep-13	Bermuda	DFDE	GTT	4	Various
Golar Crystal	160,000	Golar LNG	Samsung	Oct-13	Bermuda	TFDE	GTT	4	Various
Golar Eskimo (FSRU)	160,000	Golar LNG	Samsung	Jan-15	Bermuda	DFDE	GTT	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.	TFDE	GTT	4	Various
Golar Grand	145,880	Golar LNG	Daewoo	2006	IoM	S	GTT	4	Various
Golar Ice	160,000	Golar LNG	Samsung	Feb-15	Bermuda	DFDE	GTT	4	Various
Golar Igloo (FSRU)	160,000	Golar LNG	Samsung	Oct-13	Bermuda	DFDE	GTT	4	Various
Golar Kelvin	160,000	Golar LNG	Samsung	Jan-15	Bermuda	DFDE	GTT	4	Various
Golar Maria	145,950	Golar LNG	Daewoo	2006	Marshall Is.	S	GTT	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.	TFDE	GTT	4	Various
Golar Seal	160,000	Golar LNG	Samsung	Aug-13	Bermuda	TFDE	GTT	4	Various
Golar Singapore (FSRU)	160,000	Golar LNG	Samsung	June-15	Bermuda	TFDE	GTT	4	Various

Golar Snow	160,000	Golar LNG	Samsung	Jan-15	Bermuda	TFDE	GTT	4	Various
Golar Tundra (FSRU)	160,000	Golar LNG	Samsung	Dec-15	Bermuda	TFDE	GTT	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	GTT	4	Petrobras
Grace Acacia	150,000	Algaet Shipping	Hyundai	Jan-07	Japan	S	GTT	4	Various
Grace Barleria	150,000	Swallowtail Ship	Hyundai	Oct-07	Japan	S	GTT	4	Various
Grace Cosmos	150,000	AGH Shipping	Hyundai	Mar-08	Japan	S	GTT	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	GTT	4	Shell BG
Granatina	140,645	Shell Shipping	Daewoo	Dec-03	Singapore	S	GTT	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	GTT	4	Oman Gas
Hanjin Pyeong Taek	130,600	Hanjin Shipping	Hanjin	Sep-95	Panama	S	GTT	4	Pertamina
Hanjin Ras Laffan	138,214	Hanjin Shipping	Hanjin	Jul-00	Panama	S	GTT	4	QatarGas
Hanjin Sur	138,333	Hanjin Shipping	Hanjin	Jan-00	Panama	S	GTT	4	Oman Gas
Hispania Spirit	140,500	Teekay LNG Partners	Daewoo	Sep-02	Spain	S	GTT	4	Atlantic LNG
Hoegh Esperanza FSRU	170,000	Hoegh	Hyundai	April-18	Norway	DFDE	GTT	4	Various
Hoegh Gallant FSRU	170,050	Hoegh LNG	Hyundai	May-14	Marshall Is.	DFDE	GTT	4	chartered
Hoegh Giant FSRU	170,050	Hoegh LNG	Hyundai	Jan-18	Marshall Is.	DFDE	GTT	4	various
Hoegh Grace FSRU	170,050	Hoegh LNG	Hyundai	May-15	Marshall Is.	DFDE	GTT	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	GTT	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	GTT	4	Oman LNG
Ibri LNG	145,000	Oman Gas	Mitsubishi	Jul-06	Panama	S	GTT	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	GTT	4	Oman Gas
K Freesia	135,256	Korea Line	Daewoo	Jun-00	Panama	S	GTT	4	RasGas
Kinisis	173,400	K-Line	Daewoo	Jan-18	Liberia	MEGI-DF	GTT	4	Various
K Jasmine	145,700	Korea Line	Daewoo	Mar-08	Panama	S	GTT	4	Kogas offtake
K Mugungwha	152,000	K Line	Daewoo	Nov-08	Panama	S	GTT	4	Various
Kita LNG	160,106	TMSC Gas	Daewoo	Jun-14	Malta	TFDE	GTT	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	GTT	4	PNG-Asia
Lalla Fatma N'Soumer	145,000	Algeria Nippon Gas	Kawasaki Sakaide	Dec-04	Bahamas	S	Moss	4	Various
Lijmilya	261,700	QGTC	Daewoo	Sep-08	Marshall Is.	DRL	GTT	5	Various
LNG Abalamabie	174,900	Bonny Gas	Samsung	Nov-16	Bermuda	DFDE	GTT	4	Nigeria LNG
LNG Abuja	126,530	Bonny Gas Transport	GD Quincy	Sep-80	Bahamas	S	Moss	5	Nigeria LNG
LNG Abuja II	174,900	Bonny Gas	Samsung	Oct 16	Bermuda	DFDE	GTT	4	Nigeria LNG
LNG Adamawa	141,000	Bonny Gas Transport	Hyundai	Jun-05	Bermuda	S	Moss	4	Various
LNG Akwa Ibom	141,000	Bonny Gas Transport	Hyundai	Nov-04	Bermuda	S	Moss	4	Various
LNG Aquarius	126,300	MOL/LNG Japan	GD Quincy	Jun-77	Marshall Is.	S	Moss	5	Various
LNG Barka	153,000	NYK	Kawasaki	Jan-09	Bahamas	S	Moss	4	Various
LNG Bayelsa	137,500	Bonny Gas Transport	Hyundai	Feb-03	Bermuda	S	Moss	4	Nigeria LNG
LNG Benue	145,700	BW Gas	Daewoo	Mar-06	Bermuda	S	GTT	4	Nigeria LNG
LNG Bonny	177,000	Bonny Gas Transport	Hyundai	Oct-15	Bermuda	DFDE	GTT	4	Nigeria LNG
LNG Borno	149,600	NYK Line	Samsung	Aug-07	Japan	S	GTT	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 Dubhe	174,000	MOL-Cosco	Hudong	Sept-19	China	S	GTT	4	Russia-Asia
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	GTT	4	Nigeria LNG
LNG Fimina	175,000	Bonny Gas Transport	Samsung	Oct-15	Bermuda	DFDE	GTT	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	GTT	4	Nigeria LNG
LNG Jamal	135,330	Osaka Gas/J3 Consortium	Mitsubishi Nagasaki	Oct-00	Japan	S	Moss	5	Oman Gas
LNG Juno	177,300	MOL-Osaka	Mitsubishi	Oct-18	Marshall Is.	DFDE	Moss	4	Freeport LNG/Various
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	GTT	4	NLNG
LNG Lagos	177,000	Bonny Gas	Hyundai	Oct-15	Bermuda	DFDE	GTT	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	GTT	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	GTT	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	GTT	4	Nigeria LNG
LNG Ondo	148,300	BW Gas	Daewoo	Sep-07	Bermuda	S	GTT	4	Nigeria LNG
LNG Oyo	140,500	BW Gas	Daewoo	Dec-05	Bermuda	S	GTT	4	Nigeria LNG
LNG Pioneer	138,000	MOL	Daewoo	Jul-05	Bahamas	S	GTT	4	Idku
LNG Port Harcourt	175,000	Bonny Gas	Samsung	Oct-15	Bermuda	DFDE	GTT	4	Nigeria LNG
LNG Portovenere	65,000	Exmar	Italcantieri Sestri	Jun-96	Italy	S	GTT	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	GTT	4	Nigeria LNG
LNG Rivers	137,231	Bonny Gas Transport	Hyundai	Jun-02	Bermuda	S	Moss	4	Nigeria LNG
LNG Sakura	177,000	NYK-Kepco	Kawasaki	Mar-18	Bahamas	DFDE	GTT	4	Various
LNG Saturn	153,000	MOL	MHI	Nov-15	Japan	S	Moss	4	Various
LNG Schneeweisschen	180,000	MOL-Itochu	Daewoo	Aug-18	Panama	XDF	GTT	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	GTT	4	Various
Lusail	138,000	Peninsular LNG	Samsung	May-05	Bahamas	S	GTT	4	Qatar
Macoma	173,400	Teekay	Daewoo	Oct-17	Bahamas	DFDE	GTT	4	Various
Madrid Spirit	138,000	Teekay LNG Partners	IZAR Puerto Real	Jan-05	Spain	S	GTT	4	Engas
Magdala	173,400	Teekay	Daewoo	Feb-18	Bahamas	DFDE	GTT	4	Various
Magellan Spirit	165,500	Teekay LNG Partners	Samsung	Sep-08	Denmark	DFDE	GTT	4	Various
Malanje	160,400	Mitsui/NYK/Teekay	Samsung	Jul-11	Bahamas	DFDE	GTT	4	Various
Maran Gas Achilles	174,000	Maran	Hyundai Samho	Feb-16	Greece	DFDE	GTT	4	Various
Maran Gas Agamemnon	174,000	Maran	Hyundai Samho	May-16	Greece	DFDE	GTT	4	Various
Maran Gas Alexandria	161,870	Maran	Hyundai Samho	Sep-15	Greece	DFDE	GTT	4	Various
Maran Gas Amphipolis	173,400	Maran	Daewoo	Aug-16	Greece	DFDE	GTT	4	Various
Maran Gas Apollonia	161,870	Maran	Daewoo	Jan-14	Greece	DFDE	GTT	4	Various
Maran Gas Asclepius	145,000	Kristen Navigation	Daewoo	Jul-05	Bermuda	S	GTT	4	Qatar
Maran Gas Coronis	145,700	Maran	Daewoo	Sep-07	Greece	S	GTT	4	Rasgas II
Maran Gas Delphi	159,800	Maran	Daewoo	Feb-14	Greece	DFDE	GTT	4	Various
Maran Gas Efessos	159,800	Maran	Daewoo	Jun-14	Greece	DFDE	GTT	4	Various
Maran Gas Hector	174,000	Maran	Hyundai Samho	Nov-16	Greece	DFDE	GTT	4	Various
Maran Gas Lindos	159,800	Maran	Daewoo	Jun-15	Greece	DFDE	GTT	4	Various
Maran Gas Mystras	155,900	Maran Gas	Daewoo	May-15	Greece	DFDE	GTT	4	Various
Maran Gas Olympias	174,500	Maran	DSME	Feb-17	Greece	DFDE	GTT	4	Various
Maran Gas Pericles	174,000	Maran	Hyundai Samho	June-16	Greece	DFDE	GTT	4	Various
Maran Gas Posidonia	161,870	Maran	Daewoo	May-14	Greece	DFDE	GTT	4	Various
Maran Gas Roxana	173,400	Maran	Daewoo	Jan-17	Greece	DFDE	GTT	4	Various
Maran Gas Sparta	161,870	Maran	Hyundai Samho	April-15	Greece	DFDE	GTT	4	Various
Maran Gas Spetses	174,000	Maran	Daewoo	Feb-18	Greece	DFDE	GTT	4	Various
Maran Gas Troy	155,900	Maran Gas	Daewoo	May-15	Greece	DFDE	GTT	4	various
Maran Gas Ulysses	174,000	Maran	Hyundai Samho	Jan-17	Greece	DFDE	GTT	4	Various
Maria Energy	174,000	Tsakos	Hyundai	Mar-15	Marshall Is.	TFDE	GTT	4	Various
Marib Spirit	165,000	Teekay LNG	Samsung	May-08	Marshall Is.	DFDE	GTT	4	Various
Marvel Crane	177,000	NYK-Mitsui	Mitsubishi	Mar-19	Singapore	S	Moss	4	US/Various
Marvel Eagle	155,000	MOL-Osaka	Kawasaki	Sept-18	Marshall Is.	S	Moss	4	Cameron LNG/Various
Marvel Falcon	174,000	NYK-Mitsui	Samsung	Dec-18	Singapore	XDF	GTT	4	Cameron LNG/Various
Marvel Hawk	174,000	NYK-Mitsui	Samsung	Dec-18	Singapore	XDF	GTT	4	Cameron LNG/Various
Marvel Kite	174,000	NYK-Mitsui	Samsung	Dec-18	Singapore	XDF	GTT	4	Various
Matthew	126,540	Suez LNG Shiping	Newport News	Jun-79	Bahamas	S	GTT	6	Atlantic LNG
Megara	173,000	Teekay	Daewoo	Oct-18	Bahama	MEGI-DF	GTT	4	Various
Mekaines	266,000	Naklilat	Samsung	Mar-09	Liberia	DRL	GTT	4	Qatar-Atlantic Basin
Meridian Spirit	165,500	Teekay LNG	Samsung	Jan-10	Denmark	DFDE	GTT	4	Various
Mesaimeer	210,100	Naklilat	Hyundai	Mar-09	Liberia	DRL	GTT	4	Qatar-Atlantic Basin
Methane Alison Victoria	145,000	GasLog	Samsung	Aug-07	Bermuda	S	GTT	4	Eq.Guinea LNG
Methane Becki Anne	170,000	GasLog	Samsung	Sep-10	Bermuda	TFDE	GTT	4	Various
Methane Heather Sally	145,000	GasLog	Samsung	Jul-07	Bermuda	S	GTT	4	Eq.Guinea LNG
Methane Jane Elizabeth	145,000	GasLog	Samsung	Jun-06	Bermuda	TFDE	GTT	4	Engas
Methane Julia Louise	170,000	GasLog	Samsung	Dec-09	Bermuda	TFDE	GTT	4	Various
Methane Kari Elin	138,200	Shell	Samsung	Jun-04	Bermuda	S	GTT	4	Various
Methane Lake Charles	145,000	Shell	Samsung	Feb-07	Bermuda	S	GTT	4	Marathon Oil
Methane Lydon Volney	145,000	Shell	Samsung	Aug-06	Bermuda	S	GTT	4	Engas
Methane Mickie Harper	170,000	Shell-GasLog	Samsung	Nov-10	Bermuda	TFDE	GTT	4	Various
Methane Nile Eagle	145,000	Shell-GasLog	Samsung	Dec-07	Bermuda	S	GTT	4	Engas
Methane Patricia Camila	170,000	Shell-GasLog	Samsung	Oct-10	Bermuda	TFDE	GTT	4	Various
Methane Princess	138,159	Golar LNG	Daewoo	2003	UK	S	GTT	4	Spot BG
Methane Rita Andre	145,000	GasLog	Samsung	Mar-06	Bermuda	S	GTT	4	Engas
Methane Shirley Elizabeth	145,000	GasLog	Samsung	Apr-07	Bermuda	S	GTT	4	Marathon Oil
Methane Sprit	165,000	Teekay LNG	Samsung	Mar-08	Singapore	DFDE	GTT	4	Various
Milaha Qatar	145,000	Milaha	Samsung	Apr-06	Denmark	S	GTT	4	Qatar
Milaha Ras Laffan	138,270	Milaha	Samsung	Mar-04	Denmark	S	GTT	4	RasGas II

Min Lu	147,000	China Ships	Hudong	Aug-09	China	S	GTT	4	Various
Min Rong	147,000	China LNG Ships	Hudong	Feb-09	Hong Kong	S	GTT	4	Australia-China
Mourad Didouche	126,130	Hyproc Shipping	Atlantique	Jul-80	Algeria	S	GTT	5	Sonatrach
Mozah	266,000	QGTC	Samsung	Aug-08	Qatar	DRL	GTT	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	GTT	4	Qatar-Atlantic Basin
Murex	173,400	Teekay	Daewoo	Oct-17	Bahamas	DFDE	GTT	4	Various
Murwab	210,100	J5 Consortium	Daewoo	May-08	Marshall Is.	DRL	GTT	4	Qatargas
Muscat LNG	149,170	Oman Gas/MOL	Kawasaki Sakaide	Mar-04	Japan	S	Moss	4	Oman Gas
Myrina	173,000	Teekay	Daewoo	Sept-18	Bahamas	MEGI-DF	GTT	4	Various
Neo Energy	149,700	Tsakos	Hyundai	Feb-07	Liberia	S	GTT	4	Various
Neptune	145,000	Hoegh LNG/MOL	Samsung	Dec-09	Liberia	DFDE	GTT	4	Various
Nikolay Yevgenov	172,600	Teekay	Daewoo	Oct-18	Bahamas	MEGI-DF	GTT	4	Various
Nikolay Zubkov	172,600	Dynagas	Daewoo	Nov-18	Cyprus	DFDE	GTT	4	Yamal LNG
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	GTT	4	NWS
Northwest Swift	127,590	J3 Consortium	Mitsubishi Nagasaki	Sep-89	Japan	S	Moss	4	NWS
Noshu Maru	180,000	MOL-Jera	MHI-Nagasaki	Feb-19	Japan	S-gas	Moss	4	US-Japan
Oak Spirit	173,400	Teekay	Daewoo	Jan-16	Bahamas	MEGI-DF	GTT	4	Cheniere
Ob River	150,000	Lance Shipping	Hyundai	Oct-07	Marshall Is.	S	GTT	4	Various
Oceanic Breeze	155,300	K-Line	Mitsubishi-Nagasaki	June-18	Japan	S	Moss	4	Darwin-Japan
Onaiza	210,100	Nakilat	Daewoo	Apr-09	Liberia	DRL	GTT	4	Qatar-Atlantic Basin
Ougarta	171,866	Hyproc Shipping	Hyundai	Mar-17	Algeria	DFDE	GTT	4	Sonatrach
Pacific Arcadia	147,200	NYK Line	MHI	Oct-14	Bahamas	S	KM	4	Various
Pacific Breeze	182,000	K Line	Kawasaki	Mar-18	Marshall Is.	DFDE	Moss	4	Ichthys LNG
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 Mimosa	155,300	NYK Line	MHI	Nov-17	Bahamas	S	Moss	4	Australia-Japan
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	GTT	4	Various
Pan Americas	174,000	Teekay	Hudong	Mar-18	Hong Kong	TFDE	GTT	4	US-Asia
Pan Asia	174,000	Teekay	Hudong-Zhonghua	July-17	Bahamas	TFDE	GTT	4	Cheniere
Pan Europe	174,000	Teekay	Hudong	Sept-18	Hong Kong	TFDE	GTT	4	US-global
Papua	171,800	MOL-China	Hudong	Jan-15	Hong Kong	DFDE	SSD	4	PNG LNG
Patris	173,400	K-Line	Daewoo	Feb-18	Liberia	MEGI-DF	GTT	4	Various
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	GTT	4	Petronet
Provalys	153,500	Gaz de France	Chantiers	Nov-06	France	DFDE	CS1	4	ELNG
Pskov	170,200	SovComFlot	STX	Mar-14	Liberia	DFDE	GTT	4	Various
Puteri Delima	130,400	MISC	Atlantique	Jan-95	Malaysia	S	GTT	4	Petronas
Puteri Delima Satu	137,100	MISC	Mitsui Chiba	Apr-02	Malaysia	S	GTT	4	Petronas
Puteri Firuz	130,400	MISC	Atlantique	May-97	Malaysia	S	GTT	4	Petronas
Puteri Firuz Satu	137,100	MISC	Mitsubishi Nagasaki	Sep-04	Malaysia	S	GTT	4	Petronas
Puteri Intan	130,400	MISC	Atlantique	Aug-94	Malaysia	S	GTT	4	Petronas
Puteri Intan Satu	137,100	MISC	Mitsubishi Nagasaki	Dec-01	Malaysia	S	GTT	4	Petronas
Puteri Mutiera Satu	137,100	MISC	Mitsui Chiba	Apr-05	Malaysia	S	GTT	4	Petronas
Puteri Nilam	130,400	MISC	Atlantique	Jun-95	Malaysia	S	GTT	4	Petronas
Puteri Nilam Satu	137,100	MISC	Mitsubishi Nagasaki	Sep-03	Malaysia	S	GTT	4	Petronas
Puteri Zamrud	130,400	MISC	Atlantique	May-96	Malaysia	S	GTT	4	Petronas
Puteri Zamrud Satu	137,100	MISC	Mitsui Chiba	Apr-87	Malaysia	S	GTT	4	Atlantic LNG
Raahi	136,000	Petronet LNG Ltd	Daewoo	Dec-04	Malta	S	GTT	4	Qatargas
Ramdane Abane	126,130	Hyproc Shipping	Atlantique	Jul-81	Algeria	S	GTT	5	Sonatrach
Rasheeda	266,000	QGTC	Samsung	Jun-10	Liberia	DRL	GTT		Various
Rias Baixas Knutsen	180,000	Knutsen	Hyundai	Aug-19	Spain	MEGI-DF	GTT	4	Various
Ribera del Duero Knutsen	173,400	Knutsen	Daewoo	Nov-10	Nor-NIS	DFDE	GTT	4	Various
Rioja Knutsen	176,300	Knutsen	Daewoo	Dec-16	Nor-NIS	DFDE	GTT	4	Various
Rudolf Samoylovich	172,652	Teekay-CLNG	Daewoo	Oct-18	Bahamas	MEGI-DF	GTT	4	Various
Salalah LNG	147,000	Oman Gas/MOL	Samsung	Dec-05	Japan	S	GTT	4	Oman
SCF Polar	71,500	Sovcomflot	Kockums	Aug-69	Liberia	S	GTT	6	Sonatrach
Sean Spirit	174,000	Teekay	Hyundai Samho	Feb-19	Bahama	MEGI-DF	GTT	4	Various
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	GTT	4	Yemen LNG
Seri Amanah	145,000	MISC	Samsung	Mar-06	Malaysia	S	GTT	4	Yemen LNG
Seri Anggun	145,000	MISC	Samsung	Nov-06	Malaysia	S	GTT	4	Yemen LNG
Seri Angkasa	145,000	MISC	Samsung	Feb-07	Malaysia	S	GTT	4	Petronas
Seri Ayu	145,000	MISC	Samsung	Oct-07	Malaysia	S	GTT	4	Various
Seri Bakti	152,300	MISC	Mitsubishi	Mar-07	Malaysia	S	GTT	4	Petronas

Seri Balhaf	152,000	MISC	Mitsubishi	Sep-08	Malaysia	S	GTT	4	Various
Seri Balquis	152,000	MISC	Mitsubishi	Dec-08	Malaysia	S	GTT	4	Various
Seri Begawan	152,300	MISC	Mitsubishi	Dec-07	Malaysia	S	GTT	4	Various
Seri Bijaksana	152,300	MISC	Mitsubishi	Feb-08	Malaysia	S	GTT	4	Petronas
Seri Camar	150,200	MISC	Hyundai	Feb-18	Malaysia	S	Moss	4	Petronas
Seri Camellia	150,000	MISC	Hyundai	Nov-16	Malaysia	S	Moss	4	Petronas
Seri Cemara	150,200	MISC	Hyundai	Apr-18	Malaysia	S	Moss	4	Petronas
Seri Cempak	150,200	MISC	Hyundai	Feb-18	Malaysia	S	Moss	4	Petronas
Seri Cenderawasih	150,000	MISC	Hyundai	Jan-17	Malaysia	S	Moss	4	Petronas
Sestao Knutsen	138,000	Knutsen	IZAR Sestao	Jan-07	Spain	S	GTT	4	Atlantic LNG
Sevilla Knutsen	173,400	Knutsen	Daewoo	Jun-10	N.I.S.	DFDE	GTT	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	GTT	5	Qatargas IV
Shen Hai	147,100	China LNG	Hudong Zhonghua	Sep-12	China	AB/CC Steam	GTT	4	Various
Simaisma	147,700	Maran Gas Maritime	Daewoo	Jul-06	Greece	S	GTT	4	Qatar
SK Audace	180,000	SK-Marubeni	Samsung	Jul-17	Panama	XDF	GTT	4	Various
SK Resolute	180,000	SK-Marubeni	Samsung	Jun-18	Panama	XDF	GTT	4	Various
SK Splendor	138,375	SK Shipping	Samsung	Mar-00	Panama	S	GTT	4	Oman Gas
SK Stellar	138,375	SK Shipping	Samsung	Dec-00	Panama	S	GTT	4	RasGas
SK Summit	138,000	SK Shipping	Daewoo	Aug-99	Panama	S	GTT	4	RasGas
SK Sunrise	138,306	I. S. Carriers	Samsung	Sep-03	Panama	S	GTT	4	RasGas
SK Supreme	138,200	SK Shipping	Samsung	Jan-00	Panama	S	GTT	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	GTT	4	Various
Sonangol Benguela	160,500	Sonangol	Daewoo	Sep-11	Bahamas	S	GTT	4	Angola LNG
Sonangol Etosha	160,500	Sonangol	Daewoo	Sep-11	Bahamas	S	GTT	4	Angola LNG
Sonangol Sambizanga	160,500	Sonangol	Daewoo	Sep-11	Bahamas	S	GTT	4	Angola LNG
Southern Cross	172,000	MOL	Hudong	May-15	Hong Kong	DRL	GTT	4	Various
Soyo	160,400	Mitsui/NYK/Teekay	Samsung	May-11	Bahamas	DFDE	GTT	4	Various
Spirit of Hela	177,000	MOL	Hyundai	Oct-09	Panama	DFDE	GTT	4	Various
Stena Blue Sky	145,700	Stena	Daewoo	Jan-06	Panama	S	GTT	4	Various
Stena Clear Sky	171,800	Stena	Daewoo	Sep-10	Panama	DFDE	GTT	4	Various
Stena Crystal Sky	171,800	Stena	Daewoo	Jul-10	Panama	DFDE	GTT	4	Various
STX Kolt	145,700	STX Panocean	Korea Hanjin	Nov-08	Panama	DFDE	GTT	4	Various
Suez Point Fortin	154,200	Trinity LNG	Koyo Japan	Nov-09	Panama	S	GTT	4	Yemen LNG
Symphonic Breeze	147,608	K-Line	Mitsubishi Nagasaki	Oct-07	Bahamas	DFDE	Moss	4	Australia-Japan
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	GTT		Tangguh
Tangguh Foja	155,000	K Line	Samsung	Jul-08	Panama	DFDE	GTT	4	Tangguh LNG
Tangguh Hiri	155,000	Teekay LNG	Hyundai	Nov-08	IOM	DFDE	GTT	4	Tangguh
Tangguh Jaya	145,700	K Line	Samsung	Nov-08	Panama	DFDE	GTT	4	Tangguh
Tangguh Palung	155,000	K Line	Samsung	Mar-09	Panama	DFDE	GTT	4	Tangguh
Tangguh Sago	155,000	Teekay LNG	Hyundai	Mar-09	IOM	DFDE	GTT	4	Tangguh LNG
Tangguh Towuti	145,700	Sovcomflot/NYK	Daewoo	Oct-08	Cyprus	S	GTT	4	Tangguh
Tembek	216,200	OSG/Nakilat	Samsung	Sep-07	Marshall Is.	DRL	GTT	4	Qatargas II
Tenaga Satu	130,000	MISC	Dunkerque	Sep-82	Malaysia	S	GTT	5	Petronas
Tessala	171,866	Hyproc Shipping	Hyundai	Dec-16	Algeria	DFDE	GTT	4	Sonatrach
Torben Spirit	173,000	Teekay	Daewoo	Feb-17	Bahama	MEGI-DF	GTT	4	Various
Trinity Arrow	154,900	K Line	Imabari Shipbuilding	Mar-08	Panama	S	GTT	4	Various
Umm Al Amad	210,100	J5	Daewoo	Aug-08	Marshall Is.	DRL	GTT	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	GTT	4	Qatargas
Umm Slaal	266,000	QGTC	Samsung	Nov-08	Qatar	DRL	GTT	5	Qatargas
Valencia Knutsen	173,400	Knutsen	Daewoo	Sep-10	Nor-NIS	DFDE	GTT	4	Various
Velikiy Novgorod	170,200	SovComFlot	STX	Feb-14	Liberia	DFDE	GTT	4	Various
Vladimir Rusanov	172,000	MOL-China Shipping	Daewoo	Mar-18	Hong Kong	DFDE	GTT	4	Yamal
Vladimir Viz	172,000	MOL-China Shipping	Daewoo	Sept-18	Hong Kong	DFDE	GTT	4	Yamal
Vladimir Voronin	172,600	Teekay	Daewoo	Jun-19	Bahamas	MEGI-DF	GTT	4	Various
Wakaba Maru	125,000	J3 Consortium	Mitsui Chiba	Apr-85	Japan	S	Moss	5	Pertamina
WilForce	156,000	Teekay LNG	Daewoo	Aug-13	NIS	DFDE	GTT	4	Various
WilPride	156,000	Teekay	Daewoo	June-13	NIS	DFDE	GTT	4	Various
Woodside Cheney	174,000	Maran	Hyundai Samho	Mar-16	Greece	DFDE	GTT	4	Various
Woodside Donaldson	165,500	Teekay LNG	Samsung	Dec-09	Singapore	DFDE	GTT	4	Various
Woodside Goode	159,800	Maran	Daewoo	Jul-14	Greece	DFDE	GTT	4	Various
Woodside Reeswithers	173,400	Maran	Daewoo	Nov-16	Greece	DFDE	GTT	4	Various
Woodside Rogers	155,900	Maran Gas	DSME	Jul-13	Greece	DFDE	GTT	4	Various
Yamal Spirit	174,000	Teekay	Hyundai Samho	Jan-19	Bahama	MEGI-DF	GTT	4	Various
Yari LNG	159,983	TMSC Gas	Daewoo	Jun-14	Malta	TFDE	GTT	4	Various
Yenisei River	155,000	Dynagas	Hyundai	Jul-13	Marshall Is.	DFDE	GTT	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	GTT	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

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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, Ameris Capital AGF	2010	1	175,000
China	Beihai LNG, Guangxi	Sinopec	2015	4	640,000
	Dalian	PetroChina	2011	3	480,000
	Dapeng ND Guangdong	CNOOC	2018	4	640,000
	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
	Qidong, Jiangsu	Guanghui Energy	2018	1	60,000
	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 North	Sinopec	2017	2	320,000
	Yuedong, Guangdong	CNOOC	2016	2	320,000
	Zhoushan Zhejiang	Enn Group	2018	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
	Tornio	Gasum Skangas	2018	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
Gibraltar	Gasnor	Shell	2018	1	5,000
Greece	Revithoussa	DEPA	2000	3	225,000
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
	Mundra	Gujarat State Petroleum, Adani Group	2018	2	320,000
	Kamarajar (Ennore), Tamil Nadu	Indian Oil, DFC, ICICI Bank	2019	2	360,000
Indonesia	Arun	Pertamina	2015	5	507,000
Italy	Panigaglia	Snam	1969	2	100,000
	Porto Levante (offshore GBS)	ExxonMobil, Qatar Petroleum, Edison Gas	2009	2	250,000
Japan	Negishi	Tokyo Gas	1969	14	1,180,000
	Sodegaura	Tokyo Gas	1973	35	2,660,000
	Ohgishima	Tokyo Gas	1998	4	850,000
	Higashi-Ohgishima	Tokyo Electric	1984	9	540,000
	Futtsu	Tokyo Electric	1985	10	1,110,000
	Yokkaichi LNG	Chubu Electric	1988	4	320,000
	Kawagoe	Chubu Electric	1997	6	840,000
	Yokkaichi Works	Toho Gas	1991	2	160,000
	Chita LNG Joint	Toho Gas, Chubu Electric	1978	4	300,000
	Chita LNG	Toho Gas, Chubu Electric	1983	7	640,000
	Chita - Midorihama	Toho Gas	2001	3	600,000
	Senboku I	Osaka Gas	1972	4	180,000
	Senboku II	Osaka Gas	1977	18	1,585,000
	Himeji	Osaka Gas	1984	8	740,000
	Himeji LNG	Kansai Electric	1979	7	520,000
	Yanai	Chugoku Electric	1990	6	480,000
	Niigata	Nihonkai LNG, Tohoku Electric	1984	8	720,000
	Oita	Oita Gas, Kyushu Electric	1990	5	460,000
	Tobata	Kitakyushu LNG	1977	8	480,000
	Fukuoka	Saibu Gas	1993	2	70,000
	Sodeshi	Shizuoka Gas	1996	3	337,200
	Hatsukaichi	Hiroshima Gas	1996	2	170,000
	Kagoshima	Nippon Gas	1996	2	136,000
	Shin-Minato	Sendai City Gas	1997	1	80,000
	Nagasaki	Saibu Gas	2003	1	36,000
	Sakai	Kansai Electric, Cosmo Oil	2006	3	420,000

LNG Import Terminals (continued)

Country	Location (Project)	Owners	Start up	Storage Tanks	Storage Capacity
	Mizushima	Nippon Oil, Chugoku Electric	2006	2	320,000
	Sakaide	Shikoku Electric, Cosmo Oil	2011	1	180,000
Japan (continued)	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
	Soma Fukushima	Japan Petroleum Exploration	2017	1	225,000
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
Malaysia	Pengerang Johor	Petronas Gas	2017	2	400,000
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
Panama	Costa Norte	AES	2018	1	130,000
Phillipines	Pagbilao LNG	Energy World Corp.	2017	1	130,000
Poland	Swinoujscie	Baltic Gaz System	2015	2	320,000
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
	Mugardos, El Ferrol	Reganosa, Sonatrach, Sojitz Corp.	2006	2	300,000
	El Musel, Gijón,	Enagas	2013	2	300,000
Taiwan	Yung-An	CPC	1990	6	690,000
	Tai-Chung	CPC	2009	5	800,000
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
	Freeport	Freeport LNG Development	2008	2	320,000
	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	Shenzhen	CNPC Yudean Power	2021	2	120,000
	Tianjin (Nangang)	Beijing Energy	2022	10	2,000,000
	Yangjiang	CNPC Yudean Power	2023	2	120,000
	Zhangzhou Fujian	CNOOC	2022	2	160,000
India	Dhamra Odisha	Indian Oil, Adani, GAIL	2020	2	320,000
	Jaigarh	Hiranandani Group	2019	2	320,000
	Kodinar	Hindustan Petroleum Corp.	2022	1	160,000

LNG FSRU Import Facilities

Country	Location (Project)	Owners	Start up
Argentina	Bahia Blanca GasPort	Excelerate/YPF Repsol	2008
	Escobar GasPort	Excelerate/Enarsa	2011
Bangladesh	Moheshkhali	Excelerate, PetroBangla	2018
	Cox's Bazar	Summit Power International, Excelerate Energy	2019
Brazil	Pecem, FSRU	Petrobras	2009
	Guanabara Bay FSRU	Petrobras	2009
	Salvador, Bahia FSRU	Petrobras	2013
China	Tianjin FSRU	CNOOC, Hoegh, various	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
	Port Qasim	BW-Mitsui, PGP Consortium	2017
Turkey	Aliaga FSRU, Turquoise FLNG	Etki LNG	2016
	Dortyol FSRU Challenger	Botas	2018
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	Pluto LNG expansion	Woodside	2021+	2	10.0
CANADA	Bear Head LNG, Nova Scotia	LNG Ltd.	2024	4	8.0
	Goldboro LNG, Nova Scotia	Pieridae Energy	2024	2	10.0
	Kitimat LNG, BC	Woodside, Chevron	2024	2	10.0
	LNG Canada, BC	Shell, Mitsubishi, Kogas, PetroChina, Petronas	2024	2	12.0
	Kwispaa FLNG, Vancouver	Steelhead LNG	2024	4	12.0
	Vancouver Tilbury	WesPac Midstream	2021	1	3.25
	Woodfibre LNG, Squamish	Pacific Oil & Gas Co	2020	2	2.1
EQ.GUINEA	Equatorial Guinea Fortuna FLNG	Ophir, Golar LNG, GEPetrol	2020+	1	2.0
INDONESIA	Sengkang LNG	Energy World Corp.	2019	4	2.0
MALAYSIA	Rotan FLNG (Sabah)	Petronas, Murphy Oil	2021	1	1.5
MOZAMBIQUE	Area 1 Onshore	Anadarko Petroleum and partners	2023+	2	10.0
	Area 4 Onshore	Eni and partners	2023+	2	10.0
	Area 4 FLNG	Eni and partners	2022	1	3.4
NIGERIA	NLNG Train 7	NNPC, Shell, Eni, Total	2022+	1	7.0
PAPUA NEW GUINEA	Elk-Antelope LNG	Total, ExxonMobil Oil Search, Petromin	Studies		
RUSSIA	Sakhalin II expansion	Gazprom, Shell, Mitsui, Mitsubishi	2021	studies	
	Vladisvostok LNG	Gazprom, Itochu, various	2023+	2	10.0
	Arctic LNG II Siberia	Novatek, Total	2023	3	19.8
USA	Alaska LNG Nikiski	Alaska Gasline Development Corp.	2023+	3	20.0
	Annova LNG, Brownsville	Exelon Corp.	2023+	6	6.0
	Commonwealth LNG, Louisiana	Commonwealth LNG LLP	2023+	8	9.0
	Corpus Christi Liquefaction, Texas	Cheniere	2019	2	9.0
	Delfin LNG, Louisiana	Delfin	2023+	3	9.0
	Driftwood LNG, Louisiana	Tellurian, Total and others	2023	6	27.6
	Freeport LNG, Texas	Freeport LNG	2019	3	15.3
	Galveston Bay LNG	NextDecade	2023+	6	27.0
	Golden Pass, Texas	Qatar Petroleum, ExxonMobil	2021	3	15.6
	Jordan Cove, Coos Bay	Pembina Corp.	2024	2	7.8
	Lake Charles, Louisiana	Shell, ETE	2024	3	15.0
	Magnolia LNG	Louisiana LNG Ltd.	2023+	4	8.0
	Port Arthur LNG	Sempra	2023+	2	10.0
	Rio Grande LNG	NextDecade	2023+	6	27.0
	Sabine Pass LNG, Louisiana	Cheniere	2016-19	1	4.5
	Texas LNG Brownsville	Chandra, Meyer, Samsung, others	2023+	2	4.0
	VG LNG (Cameron Parish)	Venture Global	2022	5	12.0
	VG LNG (Plaquemines)	Venture Global	2022	10	20.0
	VG LNG (Delta-Plaquemines)	Venture Global	2024	36	22.5

LNG Exporters

Country	Location/Project	Shareholders	Start up	Liquefaction		Storage	
				Trains	capacity (nominal) mtpa	No. of tanks	Total capacity m³
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
ARGENTINA	FLNG Tango	Bahia Blanca	2019	1	0.5	1	16,100
AUSTRALIA	Karratha	NWS Woodside, Shell, BHP	1989	2	5.0	4	260,000
		(BP, Chevron	1992	1	2.5	1	130,000
		(Mistubishi/Mitsui)	2004	1	4.4	1	130,000
		NWS partners	2008	1	4.4	1	130,000
	Darwin	Darwin (Bayu Undan) ConocoPhillips, Santos, Eni, Inpex, TEPCO, Tokyo Gas	2006	1	3.5	1	188,000
	Australia Pacific LNG	ConocoPhillips, Origin Energy, Sinopec	2016	2	7.5	2	320,000
	Gladstone LNG	Santos, Petronas, Total, Kogas	2015	2	7.8	2	280,000
	Gorgon LNG	Chevron, Shell, ExxonMobil	2016	3	15.6	2	360,000
	Pluto LNG	Woodside, Tokyo Gas, Kansei	2012	1	4.8	2	240,000
	QCLNG	Shell, CNOOC	2014	2	8.0	2	280,000
	Wheatstone LNG	Chevron, Woodside, Kuwait (KUFPEC), Jera, Kyushu	2017	2	8.9	2	300,000
	Ichthys LNG	Inpex Corp., Total	2018	2	8.9	2	330,000
	Prelude FLNG	Shell, Inpex, Kogas CPC	2019	1	3.5		
BRUNEI	Lumut	Brunei/Shell/Mitsubishi/Total	1972-74	5	7.2	3	176,000
CAMEROON	Hilli Episeyo FLNG	Kribi Perenco	2018	1	1.2	1	125,000
EGYPT	Damietta	Union Fenosa, EGPC, EGAS	2004	1	5.0	2	300,000
	Idku	EGPC, EGAS, Shell, Total, 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	Equinor, Total, Petoro	2007	1	4.2	2	280,000
OMAN	Oman LNG	Oman Govt., Shell, Total, Korea LNG	2000	2	7.1	2	240,000
		Mitsubishi, Mitsui, Partex and Itochu					
		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
	Yamal LNG Siberia	Novatek, Total, CNPC, Silk Fund	2017	3	16.5	4	640,000
TRINIDAD & TOBAGO	Point Fortin Train 1	BP, Shell, CIC, NGC	1999	1	3.0	2	204,000
	Train 2	BP, Shell	2002	1	3.3	1	160,000
	Train 3	BP, Shell	2003	1	3.3	1	160,000
	Train 4	BP, Shell, NGC	2005	1	5.2	1	160,000
USA	Cheniere Sabine Pass	Cheniere Energy	2016	5	22.5	5	800,000
	Cove Point LNG	Dominion Energy	2017	1	5.3	7	695,000
	Cheniere Corpus Christi	Texas Cheniere	2018	2	9.0	3	480,000
	Cameron Hackberry	Sempra, Total, Mitsui, Mitsubishi	2019	2	9.8	3	480,000
	Elba Island Georgia	Kinder Morgan, EIG Energy	2019	10	2.5	5	535,000
	Freeport LNG,Texas	Freeport LNG	2019	2	10.2	3	483,000
YEMEN	Bal-Haf	Yemen LNG, Total, Yemen Gas, Hunt Oil, SK Group, Hyundai	2009	2	6.7	2	320,000

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