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LNG is growing in importance as role in energy affected by new dynamics

European classification society DNV GL reports results of three research and survey projects

Natural gas is on track to overtake oil as the world's primary energy source by the middle of the next decade and much of this expected increase in gas supply will be delivered to market as LNG.

That's according to forecasts issued by the European classification society, DNV GL, the combined Norwegian firm Det Norske Veritas and Hamburg-based Germanischer Lloyd, merged in 2013.

Methods

The report explores the key issues driving LNG's increasingly important role in global energy markets and includes the findings from three of DNV GL's primary research and forecasting projects, the 2019 LNG Market Survey, the 2019 Oil and Gas Industry Outlook and the 2018 Energy Transition Outlook, as well as interviews with industry leaders.

"We present several findings relating to the diversification of LNG supply sources, and rapidly increasing demand, as well as the new dynamics in play in global gas markets," stated DNV GL.

Its projections followed polling of market participants and were as follow:

The majority of LNG-focused oil and gas professionals (85 percent) believes several new LNG infrastructure projects will need to be initiated in 2019 to ensure supply can meet demand post-2025.

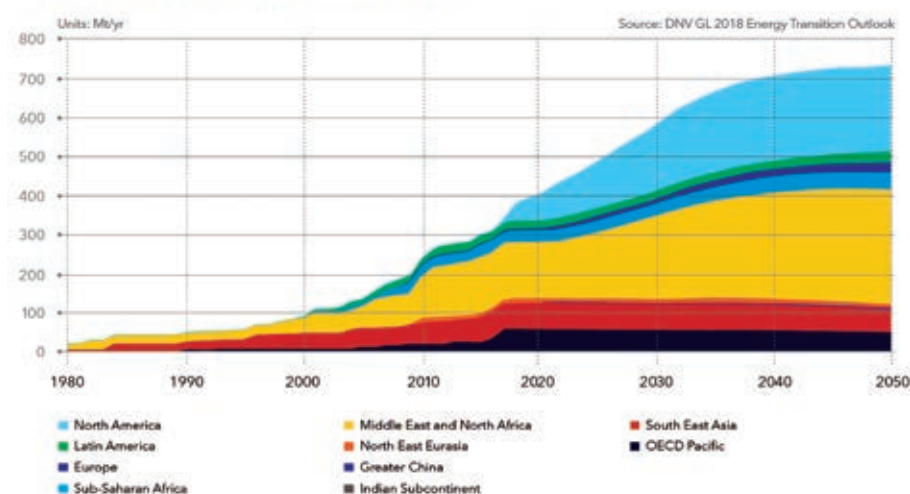
Seven in 10 (69 percent) believe price uncertainty is limiting investment in LNG mega-projects.

Nearly three-quarters (72 percent) believe LNG buyers need more flexibility in LNG contracts (e.g. to reduce volumes, shorten tenures, and change delivery locations).

Historically, global gas supply has been dominated by two major pipeline exporters, Russia and Norway, and one major LNG exporter Qatar.

However, since 2014, other sources have grown in prominence, most notably US shale and Australian offshore fields.

LNG liquefaction capacity forecast, by region



Global view of continuing growth in LNG export plant investments

Much of this market diversification has been driven by new LNG routes to growing consumer markets.

"According to our survey of more than 290 LNG-focused oil and gas professionals, the US is expected to have to deliver the biggest growth in LNG exports over the next three years," said DNV GL.

"The expansion of the Panama Canal in 2016 has been key to connecting US LNG to consumer markets in Asia. More recently, the easing of LNG transit restrictions through the Canal in 2018 has opened up even more slots for LNG shippers," added the report.

Many nations are initiating or expanding investment in LNG export capacity. This includes major projects by established LNG exporters.

US facilities

For example there are the six new liquefaction facilities under construction or completed in the US. They are Cove Point, Corpus Christi, Cameron, Elba Island, Sabine Pass and Freeport.

In Australia there is the development of the Barossa, Scarborough and Browse fields, as well as the deployment of Royal Dutch Shell's Prelude floating LNG vessel off Western Australia.

Then in Qatar, there are the plans for the Gulf nation's increase in capacity by 43 percent over the next five years by

investing in four new Trains.

LNG market growth accelerated last year at a rate of 8 percent, with deliveries amounting to 314 MT. These was more than three times the level reached in 2000.

DV GL estimates that global output will increase to around 630 MTPA by 2050.

Market share

Other oil and gas-producing nations are targeting a bigger slice of the LNG market.

For example, in October 2018, a Shell-led consortium announced the development of a major LNG project in British Columbia, Canada, which benefits from being a relatively short shipping distance to North Asia.

At the Yamal project in Russia, meanwhile, operations commenced at a third LNG Train, with a fourth to be commissioned in 2019, which would bring capacity at the nation's largest LNG project to 17.5 MTPA.

New nations are also looking to develop LNG export capabilities, particularly in Africa.

ExxonMobil, Anadarko and Eni are leading the development of several projects in Mozambique, while BP is leading the ultra-deepwater Tortue project, which will see Senegal and Mauritania become LNG exporters from 2022.

"Competition in the gas markets is more intense than ever, with several regions now competing in the LNG space,"

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The World's Leading **LNG** publication

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Subscription

Print & online **£655/€810/US\$1050**

Online only **£595/€795/US\$950**

See website for more details
www.lngjournal.com
gabi@lngjournal.com
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Printed by: Rabarbar s.c.,
Polna 44,
41-710 Ruda Śląska,
Poland

said Hans Coenen, vice president for corporate business development at Dutch natural gas network company Gasunie.

Small-sized FLNG

Technology continues to be a significant enabler of gas-supply diversification, including greater exploration and drilling efficiency, longer subsea tiebacks, and improved recovery techniques.

FLNG is another example, with substantial growth in the use of FLNG vessels proposed to unlock stranded offshore gas assets.

The FLNG hulls can be used to load carriers directly, without the need for costly pipeline infrastructure.

Shell's large-scale Prelude FLNG facility has grabbed the headlines for its record-breaking size with length of 488 metres long and 74m wide. Plus there is its staggering cost, estimated to be in the region of \$14 billion.

DNV GL believes, however, that the future in FLNG development appears to belong to smaller-scale projects.

Preference

In its industry survey, some 59 percent said that players would prefer smaller FLNG projects and tanker conversions over Prelude-sized units.

"Smaller vessels have many advantages. They are cheaper to build and operate, faster to deploy, and effective at exploiting smaller volumes of stranded gas and at serving the many markets looking to buy smaller volumes," noted DNV GL.

Eni's Coral FLNG, one of the newest vessels to be purchased, reflects this trend.

Construction began in 2018, and when it starts producing (from offshore Mozambique) in 2022, it will generate 3.3 MTPA compared to the 5.3 MTPA expected from Prelude FLNG.

"We are seeing more contractor-led models emerging, which involve smaller, faster, more agile solutions, such as the development of smaller-scale FLNG vessels and the conversion of existing LNG carriers into FLNG vessels," said Graham Bennett, vice president of DNV GL Oil & Gas.

Contractors

"In those situations, it's not likely that the operator will own the vessel. It's more likely that a contractor will liquify gas on behalf of the operator. This is a way to buy a service instead of a costly asset and thereby reduce risk," added Bennett.

Indeed, DNV GL said more than half (55 percent) of oil and gas executives believe operators will outsource or lease

critical field development assets (such as FLNG vessels) in 2019.

On the imports front, China's transformational demand for gas continues unabated.

China is on track to become the world's largest gas-importing country, and the nation's recent surge in demand for gas has been central to transforming LNG markets globally.

In our LNG survey, China is - by a large margin - the country expected to have the biggest growth in LNG imports over the next three years.

This appetite for LNG is driven largely by the Chinese government's "blue sky" policies, aimed at reducing fossil fuel emissions and improving air quality.

China mix

Indeed, in the DNV GL outlook, around 72 percent of senior oil and gas professionals based in China said their organizations' investments in natural gas and LNG were driven by the long-term energy transition, compared to just 47 percent across all respondents globally.

However, natural gas still only accounted for 7 percent of China's energy mix in 2018, compared to a global average of 22 percent. The mix in China is expected to increase to around 10 percent by 2020.

"China overall still lacks gas, and seasonal gas supply tensions exist," said Yuan Zhengang, deputy director of the Oil & Gas Institute at PetroChina Planning and Engineering Institute.

"LNG terminal construction and gas storage projects are set for relatively rapid growth, alongside investments in pipeline network systems and improvements," added Yuan.

Indeed, Chinese major Sinopec aims to build new infrastructure that will double its receiving capacity of LNG over the next six years.

China also has major plans to overhaul and liberalize its national gas pipeline network to ensure gas supply is not hindered by a lack of access to pipeline infrastructure.

China's National Development and Reform Commission has recommended that the nation's pipeline network be expanded by 99,000 kilometres between 2015 and 2025.

Sources

DNV GL transition forecasts that seaborne gas trade from North America to China will treble by 2050. But China is looking to source LNG from far and wide and invest in LNG projects around the world.

"China is currently the biggest driver

of LNG growth, but it is far from the only nation with rapidly growing demand for LNG or a long-term strategy to build it," said the report.

"Other emerging economies, particularly in the Indian Subcontinent and Sub-Saharan Africa, will also boost demand," it added.

India currently has five LNG receiving terminals, but plans to build 11 more over the next seven years, with the near-term goal of doubling the proportion of natural gas in its energy mix by 2022.

Elsewhere in Asia, new LNG importers have emerged in recent years, including Indonesia, Malaysia, Pakistan, Singapore and Thailand, while Bangladesh, Myanmar, the Philippines and Vietnam are expected to follow suit.

Meeting demand growth after 2025 will involve export capacity increasing by 45 percent between 2017 and 2022, with 90 percent of this capacity coming from projects already sanctioned in the US and Australia.

That said there are concerns about supply and infrastructure capacity beyond this point.

In DNV GL's 2019 Industry Outlook Survey, 43 percent of professionals polled said they believed demand for gas would exceed supply within five years.

Investment

This was especially the case among respondents from the Asia Pacific (61 percent).

Eirik Wærness, senior vice president and chief economist of Norwegian multinational energy company Equinor, shares this view: "We need more final investment decisions on new LNG projects globally to avoid having a very tight gas market when we get into the mid-2020s, even though the market right now is well supplied."

The LNG market has shifted gas closer than ever to the profile of a traditional commodity.

The flexibility, diversity, and responsiveness of global supplies can help markets hedge and adapt to political or trade-related developments.

At the same time, with so many interconnected markets in play, events that impact regional gas markets may trigger the same kind of global economic turmoil as oil price shocks of the past.

"I definitely see the geopolitical aspects of the market playing a larger role in the future than they have in the past for gas," added Gasunie's Coenen. "Energy and politics are always connected, but it seems to be playing an even bigger role in the debate," he added. ■



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France-based International Group of Liquefied Natural Gas Importers notes industry evolution

Regasification and production expands with cross-basin arbitrage and spot cargo volumes creating a more varied market

Supply volumes in the liquefied natural gas industry increased for a fifth consecutive year and were mostly driven by new production from Australia, the United States and Russia, though some existing exporters also boosted output.

The latest LNG industry update from the France-based International Group of Liquefied Natural Gas Importers (GIIGNL) is issued in its annual report presented at the LNG2019 conference in the Chinese city of Shanghai.

Feed-gas

The report said that increased feed-gas supply contributed to higher numbers of shipments from nations such as Oman, whose exports rose by 21.5 percent to 10.01MT and Trinidad, which exported 11.63MT in the year, a rise of 14.2 percent.

However, a number of countries saw shipments drop. These included Algeria whose exports fell by more than 18 percent year-on-year to 10.10MT.

Nigerian shipments declined 3.2 percent to 19.68MT and Malaysia exported 24.66MT, down 8.2 percent from 2017.

“Asia firmed up its position of leading importing region with a 76 percent share of global LNG imports, up from 73 percent in 2017,” said the report.

“Asian LNG imports grew by 13 percent to 238.6MT. Japan remained the leading importing country, with 82.5MT or a 26.3 percent market share, followed by China (54 MT),” said the GIIGNL.

“As was the case in 2017, global LNG import growth in 2018 was led by China and South Korea, the world’s second-largest and third-largest LNG importers, which together received 21MT more LNG than in the previous year,” said the report.

President

GIIGNL President Jean-Marie Dauger noted in his introduction to the report that on the demand side, two new countries, Bangladesh and Panama, joined the importers’ ranks last year, bringing the total number of importing countries to 42, compared with only 18 just 10 years ago.

“Several other countries are planning to commission or build onshore or floating LNG import infrastructure,” added Dauger.



US Gulf Coast liquefaction plants and projects are boosting industry with trans-Atlantic and Panama Canal shipments

“In Europe, cross-basin arbitrage opportunities continued to determine the level of LNG inflows as the reduction of price spreads led to a strong rise of import activity in Northwest Europe towards the end of the year,” said the GIIGNL President.

Forum

“Inversely, the combined LNG imports by emerging countries decreased last year, mainly due to rising domestic production in Egypt and in Argentina, showing that LNG demand remains hard to predict,” he stated.

The GIIGNL constitutes a forum for exchange of information and experience among its 81 members to enhance safety, reliability and efficiency of LNG import activities and the operation of import terminals in particular.

The group noted that since 1964 when LNG trading began, more than 97,000 cargoes have been safely delivered.

“As the LNG industry is maturing, I am confident in GIIGNL’s ability to address the challenges ahead and to continue fulfilling its missions: addressing issues common to importers, diffusing knowledge and best practices, with a particular and continuing focus on safety and on the contribution of LNG

to a sustainable energy future,” stated Dauger.

The share of spot and short-term volumes had tended to stabilize at around 27 percent of total imports in recent years and the share jumped in 2018 to 32 percent.

Spot and short-term volumes accounted in 2018 for 99.3 MT (up 21.7MT or a 28 percent increase over 2017).

“This expansion was supported by the ramp-up of flexible volumes from the US and from Russia and by the rise of LNG volumes handled by aggregators and traders who are able to optimize their portfolios by purchasing and selling LNG on different contract durations,” said the report.

Pacific Basin

“On the other hand, the output from several projects which started-up in the Pacific Basin in recent years was committed under long-term contracts between exporters and buyers,” it added.

“The overall increase in Australian exports and the diversion of a significant number of cargoes to China resulted in spot and short-term volumes supplied from Australia rising from 13 percent to 17 percent of global spot and short-term

imports last year,” stated the GIIGNL report.

Qatar’s market share shrank from 20 percent to 12 percent and the country lost its historical position as the leading supplier of flexible volumes, dropping to the third place behind Australia and the US.

There were 78.7MT of “true” spot volumes (i.e. LNG delivered within three months from the transaction date). This amounted to 25 percent of total imports in 2018 compared with 20 percent in 2017 (58.5MT).

China, South Korea and Japan together absorbed 52 percent of spot volumes amounting to 41MT.

India also recorded a strong increase in spot purchases (up 2.9MT) due to stronger natural gas demand growth which could not be met by domestic production.

Re-exports

“Re-exports recovered in 2018 as a result of better arbitrage opportunities between basins during the first half of the year, reaching 3.8MT globally,” said the report.

“These were supported by the output from Yamal, which is being trans-shipped from ice-class vessels to conventional LNG carriers in terminals in Northwest



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*The year was
marked by the first
LNG exports from
Cameroon*

November, in northern Norway or unloaded into the tanks at a terminal before being re-exported,” the GIIGNL explained.

Europe accounted for 77 percent (2.9MT) of the re-exported volumes. As in 2017, France had the largest market share (43 percent or 1.6MT), followed by Singapore (15 percent) and the Netherlands (14 percent).

Also a total of 3.8MT was re-exported from 12 countries to 22 other nations.

The year was marked by the first LNG exports from Cameroon with the Kribi facility (2.4 MTPA), the world's first floating liquefaction unit converted from an LNG carrier.

Capacities

The capacity increase was also driven by new Australian capacity (Ichthys LNG Train 1 & 2 and Wheatstone LNG Train 2), new US capacity (Corpus Christi LNG Train 1, Cove Point LNG and Sabine Pass Train 5) and new Russian capacity (Yamal LNG Train 2 & 3).

At the end of the year, approximately 66 MTPA of new liquefaction capacity was under construction, 53 MTPA of which was located in North America.

In 2019, around 25 MTPA of new liquefaction capacity is expected to come

online, 21 MTPA of which is located in the US.

Regasification

The report said that three import terminal expansions were also completed in Greece, Japan and Thailand.

“At the end of the year, eight new floating terminals and 14 new onshore terminals were reported to be under construction. Total regasification capacity under construction at year-end reached 95 MTPA,” added the report.

The second-largest LNG importer China was also in the midst of capacity increases, including phase two of the Ningbo LNG import terminal.

“The regasification capacity of the terminal will be increased to 6 MTPA from the current 3 MTPA with this expansion,” it said. Ningbo will also have three LNG storage tanks with a capacity of 160,000 cubic metres each.

That expansion project is expected to be completed in 2020.

China National Offshore Oil Corp also launched the construction of a 3 MTPA LNG terminal at Binhai in Jiangsu

province. “The project is expected to be completed by 2020-2021 and will include a wharf for berthing 100,000-ton vessels, a gas pipeline network between Jiangsu and Anhui provinces and 220,000 cubic metres of storage,” said the GIIGNL.

It also noted that in November 2018, PetroChina started construction works on the phase three of the Rudong LNG import terminal.

The project includes the construction of two 200,000 cubic metres storage tanks, bringing total capacity to 1.08 million cubic metres. The expansion is expected to be completed in 2021.

Sinopec and Zhejiang Energy are developing an import terminal at Wenzhou in Zhejiang province with initial capacity of 3 MTPA.

“The project includes four 200,000 cubic metres capacity storage tanks, a berth to dock tankers of 30,000 cubic metres to 266,000 cubic metres capacity, as well as a 26-kilometres pipeline. The first phase of the terminal is expected to start-up operations at the end of 2021,” said the report. ■

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For the Record

ABU DHABI National Oil Company (Adnoc) in the United Arab Emirates has awarded LNG producer Inpex Corp. of Japan an exploration licence for the onshore Block 4 area as the Japanese company also advanced with LNG bunkering plans for the UAE. The onshore Block 4 is located in a coastal area in the central part of the emirate of Abu Dhabi that includes Abu Dhabi City, and covers a surface area of around 6,116 square kilometres. “Inpex looks forward to working in close cooperation with Adnoc to help it unlock value from Abu Dhabi’s substantial hydrocarbon resources while further expanding and strengthening our own business portfolio,” said Takayuki Ueda, President and Chief Executive Inpex. The Japanese company recently became an LNG producer from the Ichthys liquefaction and export venture in the North Territory of Australia. Inpex also has a stake in the Royal Dutch Shell Prelude floating LNG venture offshore northwest Australia. The UAE is the oldest LNG producer in the Middle East from its Das Island plant offshore Abu Dhabi consisting of three Trains with nominal capacity of 5.5 million tonnes of LNG per annum. The Japanese company added that it was working to finalize a joint venture with Adnoc on LNG bunkering in the UAE and Southeast Asia. The logistics and services unit of Adnoc has signed the framework agreement with Inpex on developing the bunkering activities.

“We had already signed a memorandum of understanding with Adnoc about LNG bunkering, so I think there might be a lot of potential,” said Ueda. “We would like to quickly establish a joint venture with Adnoc in this area where there is demand,” added the Inpex CEO. The UAE is strategically located to become a major bunkering hub in the Gulf and the Arabian Peninsula. Inpex is a long-term investor in Abu Dhabi’s hydrocarbons industry, which accounts for 4.2 percent of the world’s crude production. Inpex’s subsidiary Jodco Exploration will hold and manage its interest in the onshore Block 4 as part of a 35-year concession deal. The Japanese company will hold a 100 per cent stake during the exploration phase for the concession, which straddles Abu Dhabi’s border with Dubai. There are two existing

undeveloped oil and gas fields in the new concession area, Ramhan and Hudairiat, which both will be appraised by Inpex. “The block’s proximity to the onshore oil producing fields of Al Dabb’iya and Rumaitha as well as the offshore field of Umm Al Dalkh, suggests it has very promising potential,” said the companies.

ALASKA Gasline Development Corp., the state agency overseeing the Alaska LNG project, said it signed an agreement with ExxonMobil Corp. and BP to cooperate on ways to advance the venture by working together to improve the project’s competitiveness and its progress to gain regulatory permits. “Our respective organizations share an interest in the successful commercialization of Alaska’s stranded North Slope natural gas,” said AGDC Interim President Joe Dubler. “BP and ExxonMobil possess world-class LNG expertise which may help AGDC responsibly advance this project with maximum efficiency for the benefit of Alaskans, and I welcome their collaboration,” he added. The Alaska LNG project is designed to liquefy 3.5 billion cubic feet per day of gas for sale to customers in the Asia-Pacific region from a facility to be built in Nikiski on the Kenai Peninsula south of Anchorage at a total cost of more than \$43 billion. It includes a 1,300 kilometres pipeline from the North Slope to southcentral Alaska. The US Federal Energy Regulatory Commission recently delayed the date scheduled for final decision on allowing the project to June 2020 from February 2020. AGDC added that it was continuing talks with potential buyers and investors, including companies such as China Petroleum & Chemical Corp., known as Sinopec, and Chinese banks.

AGDC took control of Alaska LNG from ExxonMobil Corp., BP and ConocoPhillips in 2017, after the producers determined it was no longer economic when compared to other LNG projects around the world. AGDC in early March received a major regulatory permit for its \$10-billion stand-alone North Slope pipeline. The permit was jointly issued by the US Army Corps of Engineers and the US Bureau of Land Management. The pipeline design includes a 36-inch diameter mainline and a 30-mile, 12-inch diameter lateral connecting the mainline to Fairbanks, as well as a gas conditioning facility at its starting point at Prudhoe Bay on the North Slope. The AGDC interim President Dubler replaced Keith Meyer in January as part of a board overhaul. AGDC is

governed by a seven-member board of directors, five public members and two principal department heads of the State of Alaska. Board members are appointed by the governor and subject to confirmation by the legislature. Republican Governor Mike Dunleavy named four new members to AGDC in January.

ARGENTINA said it would take some time before the nation becomes a global player in the liquefied natural gas export market from shale-gas production because of available volumes and costs as well as finding customers. Argentine Secretary of Energy Gustavo Lopetegui, who was appointed by President Mauricio Macri in December 2018, made his point at the CeraWeek energy conference in Houston, Texas. The first floating LNG production unit in South America arrived at the Argentine port of Bahia Blanca in February 2019. Argentine oil and gas producer Yacimientos Petroliferos Fiscales (YPF) has a 10-year agreement with Belgian shipping company Exmar to charter the former floating liquefaction unit, “Caribbean FLNG”, constructed for a cancelled venture in the South American state of Colombia and now renamed “Tango FLNG”. The “Tango FLNG” project will make the Argentines the first FLNG producing nation on the continent using feed-gas sent by pipeline from the Vaca Muerta shale play in the onshore Neuquen Basin of northwest Argentina. However, Energy Secretary Lopetegui said in Houston that it would take some time before Argentina becomes a globally competitive LNG market participant. “Shale-gas production could be increased by 50 percent over the next four years if we had the markets to supply and we don’t have them domestically,” said Lopetegui. “If Argentina wants to fully develop its shale resources, it has to find customers abroad to supply,” he added. It would also require additional liquefaction infrastructure.

YPF has said that it expected that around eight LNG cargoes per annum would be produced and exported from “Tango FLNG”. Bahia Blanca port is where Argentina established its first floating LNG import facility with Exmar and US partner Excelsior Energy in 2008 before the shale-gas resources were discovered. Energy Secretary Lopetegui explained that shale-gas production would be used firstly to reduce LNG import needs in the peak winter season and to supply neighbouring Chile by pipeline. Lopetegui noted that Argentina

began supplying pipeline gas to Chile only recently for the first time in many years, though he stated that the Vaca Muerta’s shale-gas production was not yet high enough to supply the Chileans with a steady flow of gas, especially in the Southern Hemisphere peak season from May to August. Analysts have said that Argentine shale-gas had been delivered to Chile at an average price of around US\$6.00 per million British thermal units, including pipeline transportation costs. This is at least US\$2.00 per MMBtu lower than the cost of winter gas in Europe. Lopetegui said that domestic gas prices in Argentina had fallen to around US\$4.50 per MMBtu, though he said that this was too high for a country to become a competitive LNG exporter. “The prices are attractive enough to continue with project developments and it is a matter of time before Argentina cuts production costs in the shale basin,” added Lopetegui. “We recently achieved the milestone of operating 1,000 shale wells,” he said. “Once we reach 3,000 wells, we will see an inflection point in the increase in the productivity and efficiency,” he added.

ARUP GROUP, the UK-based global engineering company, has been appointed by a US LNG export project planned for Cameron Parish to advise on the installation of the region’s first modular LNG storage tanks. The Arup energy unit has been asked by Commonwealth LNG to provide specialist engineering services for the development of the storage tanks at its project site on the West Bank of the Calcasieu Ship Channel at the entrance to the Gulf of Mexico. The innovative design of the modular tanks, an original concept by Arup, allows them to be constructed offsite at a dedicated fabrication yard in parallel with foundation construction at the site itself. Arup said that this approach significantly reduces onsite labour and shortens completion time by up to one year. “These benefits result in capital cost savings and overall project risk reduction,” said the engineering firm. Commonwealth LNG has a schedule to construct its facility in Cameron Parish for exports to begin by 2024. The plant will have a total liquefaction capacity of 8.4 million tonnes per annum and LNG storage capacity volumes of 240,000 cubic metres.

Arup is also supporting Commonwealth’s permit process with the Federal Energy Regulatory Commission by providing structural, mechanical and naval architecture engineering services in relation to the design of the modular

storage tanks. Once the FERC approves the latest Louisiana venture for LNG exports construction is expected to start in 2021. “This is a great step for the LNG industry and could lead the way for new mid-scale storage options,” said Brian Raine, head of Arup’s Energy Structures unit. “The innovative design brings great benefits and we look forward to working with Commonwealth throughout the project to make those benefits a reality,” added Raine. Rob Powers, Senior Vice President for engineering at Commonwealth LNG, said he was pleased to have Arup on his team. “Their broad experience, depth of resources, technical creativity and responsiveness to our requests have made them valued partners on our project,” stated Powers.

ATLAS COPCO, the Swedish turbomachinery manufacturer, said its Gas and Process division secured a breakthrough compressors order for the LNG carrier market. The order from Samsung Heavy Industries in South Korea is for a total of eight HD centrifugal gas compressors and eight oil-free gas screw compressors, along with the necessary heaters and vaporizers. The equipment will be installed on four 180,000 cubic metres capacity LNG vessels ordered from Samsung by Danish shipping line Celsius Tankers. Celsius, based in Copenhagen, currently operates a fleet of around 40 vessels in the chemicals, dry bulk and container shipping sectors. The new LNG vessels will use Atlas Copco’s new oil-free gas screw compressors to feed their XDF engines, a first in the LNG carrier sector. The company said the new compressor technology was specifically designed to meet modern carrier needs, including the XDF pressure requirements and the reduced flow of boil-off gas from improved insulation measures.

“The oil-free design also allows for significantly longer maintenance intervals compared to oil-flooded compressors and can be used with a reliquefaction system without any risk of oil contamination in heat exchangers or LNG cargoes,” explained Atlas Copco. The first units will be delivered from Atlas Copco Gas at the start of October 2019, with the remainder of the machinery being delivered in the second quarter of 2020. “This order is a milestone in our marine LNG product development,” said Robert Radimeczky, President of the Gas and Process division whose base is in Cologne, Germany. “To be able to provide the first ever oil-free gas screw compression technology for LNG

vessels is a significant step in the evolution of our products,” added Radimeczky. Atlas Copco said it would continue to provide advanced technologies for the LNG carrier market with end-to-end gas handling through to centrifugal compressors, screw compressors and supporting hardware.

CHART INDUSTRIES, the US LNG equipment-maker for production, storage and distribution, and Indian Oil Corp, owner of the first import terminal to start up on the Indian East Coast, have signed an accord to promote the development of the LNG market in the Asian nation. The memorandum of understanding was signed in Washington DC by executives of both companies. The accord covers the development of the various LNG applications offered by Chart such as modular liquefaction, regasification, LNG bunkering for barges and LNG and compressed natural gas fuel stations. The US company, based near Atlanta in Georgia, is also capable of supplying India with LNG transportation tanks for railways, ISO containers and systems to deliver the fuel to small-scale users. Chart and Indian Oil (IOCL), the state-backed refining and fuel marketing company, said they had signed their agreement based on complementary synergies and mutually beneficial business objectives arising from the demand growth of natural gas in India. They pledged to work together and explore opportunities for cooperation to promote natural gas and LNG development in multiple industrial and commercial sectors. “The LNG opportunity in India is significant, as evidenced by the government’s commitment for clean fuel, and the double-digit LNG growth forecasts,” said Jill Evanko, Chart’s President and Chief Executive. “We are excited about working with IOCL as it expands our reach into the LNG market in India, and provides IOCL with speed to market as well as expanded service access,” added Evanko.

“This opportunity originated from the recent acquisition of the VRV businesses now within our portfolio of offerings,” stated the CEO in reference to the Italian company that agreed to be acquired by Chart in September 2018. IOCL’s East Coast LNG import terminal at Kamarajar Port in the state of Tamil Nadu was inaugurated earlier in March by Indian Prime Minister Narendra Modi. The facility has 5 million tonnes per annum of import capacity and two tanks each with storage of 180,000 cubic metres. The Kamarajar facility is located about 25

kilometres north of Chennai Port and initially the imports will supply natural gas to industry in the Manali area, including Madras Fertilizers Ltd., Chennai Petroleum Corp. and Tamil Nadu Petroproducts. The terminal’s commissioning started at the end of on February with the arrival of an LNG cargo from Qatar. IOCL’s terminal at Kamarajar, formerly one of India’s main coal ports and previously called Ennore, is India’s sixth LNG import terminal to be completed and is expected to promote industrial growth in the area. This facility will also be a source for city-gas distribution networks, where natural gas would be supplied to domestic, transport, commercial and industrial sectors in various cities in Tamil Nadu.

CHENIERE Energy has taken over care, custody and control from engineers Bechtel Inc of the first liquefaction Train completed at the Corpus Christi export plant in Texas. “Train 1 at Corpus Christi has achieved substantial completion, becoming the first liquefaction train placed into operation at a greenfield liquefaction facility in the lower 48 states,” said Jack Fusco, President and Chief Executive of Cheniere. “This momentous achievement was made possible by Cheniere’s professionals and our EPC partner, Bechtel, who worked diligently together to ensure a seamless transition from construction to operations,” added Fusco. “I’d like to thank the Cheniere team and Bechtel for their world-class execution, which has enabled us to continue our impeccable record of bringing trains online safely, ahead of schedule, and within budget,” stated the CEO. Brendan Bechtel, Chairman and Chief Executive the privately-held Bechtel, whose corporate headquarters are in San Francisco, said his company was proud to be contributing to Cheniere’s success on the US Gulf Coast.

“It was three years ago that we were able to support Cheniere’s entry into the LNG export market with Train 1 at the Sabine Pass Liquefaction project,” explained the Bechtel Chairman. “With five trains now completed and operating well ahead of schedule, we are excited to continue working alongside Cheniere to deliver their next wave of trains with the reliability of outcome that Cheniere and Bechtel have become known for delivering,” he added. “This program is a great example of how a one-team approach can bring world-class results, and I want to congratulate Jack and the Cheniere team for fostering this

environment of collaboration and mutual success,” stated Bechtel. Cheniere explained that under the Corpus Christi plant’s sale and purchase agreements (SPAs) with Spanish utility Endesa and Indonesian state energy company Pertamina, the date of first commercial deliveries is expected to occur in June 2019, upon which the term of each of these SPAs commences. Additionally, volumes are expected to start being delivered in June 2019 under an SPA with a second Spanish utility Iberdrola.

CHENIERE has given notice to proceed to builders of the Midship Pipeline project to enable transportation of feed-gas and domestic volumes from the prolific Anadarko Basin in Oklahoma to the Gulf Coast. The \$1-billion natural gas pipeline had received environmental approval from the US Federal Energy Regulatory Commission and the pipeline financing has also just been agreed. Cheniere is joint owner of the Midship pipeline project along with the US equity fund, EIG Global Energy. The Midcontinent Supply Header Interstate Pipeline (Midship) project as it is called was notified in February 2019 by the FERC that construction could proceed. The Midship pipeline is designed to transport 1.44 billion cubic feet per day on almost 200 miles of new natural gas pipeline to existing pipelines near Bennington in Oklahoma for subsequent transportation to the Gulf Coast and Southeast markets and hubs. Binding marketing commitments totalling 825 million cubic feet per day are in place for the pipeline with Devon Gas Services, Marathon Oil Co., Gulfport Energy Corp. and Cheniere’s own Corpus Christi liquefaction and export plant.

The companies involved in the construction of the Midship pipeline and related compression and interconnection facilities are M.G. Dyess Inc., TRC Pipeline Services, Cenergy and Strike LLC. “The Midship project is expected to be placed in service by the end of 2019,” said Houston-based Cheniere. “To complete financing of the Midship project, Midship Pipeline entered into senior secured credit facilities with total commitments of up to \$680 million,” explained Cheniere. “The credit facilities consist of a \$615 million construction loan facility and a \$65 million revolving credit facility,” it added. “Proceeds from these credit facilities will be used to fund a portion of the costs of developing, constructing, and placing into service the Midship Project, to fund working capital requirements and for



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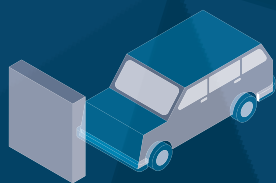
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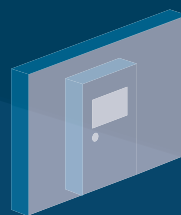
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related general corporate purposes,” stated Cheniere. Cheniere has started up its fifth liquefaction Train at Sabine Pass, taking overall output to 22.5 million tonnes per annum with one more Train being built at the facility. The company’s second export plant at Corpus Christi has one Train in operation and another set to start up later in 2019.

CHINA, the world's largest combined importer of liquefied natural gas and pipeline volumes, is moving forward with its plans to create a single pipeline company from the existing assets of the Chinese energy majors, a move that is expected to benefit LNG imports rather than hinder them. The new oil and gas pipeline company, which is likely to be established by around mid-2019, will operate in a market-oriented manner after the acquisition of the related pipeline assets. The National Development and Reform Commission (NDRC) is currently finalizing its proposals with the companies involved. They are China National Petroleum Corp. (CNPC), whose subsidiary is PetroChina, China Petroleum and Chemical Corp. (CPCC), also known as Sinopec, and China National Offshore Oil Corporation (CNOOC). The three companies will spin-off their pipeline assets to form a new company whose name has yet to be decided. China has more than 135,000 kilometres of pipelines with two-thirds of the network being operated by CNPC while Sinopec operates another 15 percent. CNOOC owns just a small gas-related portion of the pipeline network, though it is the owner of nine LNG import terminals out of 19 operating in the country. Following the spin-off, the country’s pipeline network will also be restructured to separate pipeline transport and sales. The newly formed Chinese national pipeline company could be worth at least US\$45 billion, according to some estimates. “The overall plan is for a state-level pipeline operator to govern long-distance and interconnection pipelines owned by the three majors and the pipelines that connect with LNG terminals,” said the NDRC. “The operator will also invest in and build new pipelines in the future,” it added.

Analysts note that the monopolized structure of the sector has restricted construction of new pipelines and has led to market inefficiencies. Better windows of access could spur plans to send more regasified LNG into the network by the few independent players who will likely have the same access as the state-run

energy majors. Natural gas transmission charges via long-distance pipelines vary in China and range from around 0.31 Chinese yuan per cubic metre (US\$0.046 per cubic metre) to 0.79 yuan per cubic metre (US\$0.11 per cubic metre). Chinese LNG and pipeline natural gas imports rose 9.2 percent in February compared with a year ago to 7.57 million tonnes. The imports for the first two months of 2019 reached 17.36MT, up 18.5 percent from a year ago. A more efficient pipeline system and a more competitive market is seen helping the development of the oil and gas sector and LNG import requirements. Over the next few years, the NDRC also plans to restructure other areas of China’s oil and gas industry with the next target likely to be the provision of better management of the exploration and production sector.

CHINA National Offshore Oil Corp., the largest liquefied natural gas terminal owner, is planning to open up several of its facilities to third-party access (TPA) and expressions of interest are required by the end of March in the proposal backed by the Shanghai Petroleum and Natural Gas Exchange. The initiative by CNOOC and the Shanghai Exchange are part of a series of natural gas market reforms to back increasing demand for imports to support both economic development and the government’s clean air policies. The Shanghai Petroleum and Natural Gas Exchange was inaugurated in November 2016 after a year-long trial operation as part of energy reforms in China. CNOOC, owner of nine of China's 19 onshore import terminals, sold imported LNG for the first time on the exchange in April 2018 for forward delivery. Under the Chinese TPA plans, each third-party user must take in a minimum of four cargoes, equivalent to 260,000 tonnes per annum, over 10 years. A statement by the Shanghai exchange said that this requirement may be increased in multiples of four cargoes. “The long-term TPA could be granted to more than one company, while there were no firm rules yet on the amount,” according to the statement.

Analysts said that while the initiative opens the way to allow more independent buyers to enter the market, there was concern about having to lock in third-party customers in terms of price and volumes for a 10-year term. Expressions of interest have to be submitted by March 31. The exchange said subsequent negotiations would then take place in April and May on pricing and delivery details. During a trial

for the process held in 2018 by CNOOC and the exchange, TPA was offered at the Yuedong LNG terminal in the southern province of Guangdong at the end of October and at the Ningbo facility in the eastern Zhejiang province in November. The Chinese proposal is a move towards the policies of the European Union requiring member states to provide open access to gas infrastructure, including LNG terminals. The conditions and tariffs of TPA to regulated LNG terminals in Europe must be published by terminal operators as well as approved by the national regulator. However, in the Europe market exemptions to the regulated TPA regime have been granted to six major operating terminals: three in the UK, the Isle of Grain, Dragon LNG and South Hook facility, one in France at Dunkirk LNG, one in Italy at the Adriatic terminal and one in the Netherlands at Gate LNG in Rotterdam.

ENAGAS, the Spanish natural gas network and LNG terminal owner, has entered the US energy infrastructure market by investing in Tallgrass Energy, whose assets include 11,000 kilometres of transmission pipelines. The Spanish company said the transaction is part of its strategy to invest in core business assets in growth markets on an international basis alongside strategic partners. Enagas, which already has investments in LNG import terminals on the American continent, at Altamira in Mexico and Quintero in Chile, has entered into an agreement with the equity funds, Blackstone of the US and GIC of Singapore, to invest \$590 million for a 10.93 percent indirect ownership interest in Tallgrass Energy. Tallgrass, based in Leawood in the Midwest state of Kansas, has assets including the Rockies Express Pipeline, one of the largest US pipelines that is being transformed into the nation’s northernmost bi-directional natural gas gathering system. Enagas explained that its investment is in the holding company that owns 100 percent of TGE’s general partner, as well as 43.91 percent of the economic interests in TGE. The investment is structured so that Blackstone retains a majority stake, GIC has a minority shareholding, as does Enagas with 24.90 percent of the holding company. Following the closing of the transaction, Enagas has agreed to acquire an additional 3.52 percent of the holding company for around \$83M, subject to completion of certain conditions. The Spanish company has also agreed to future investments of up to \$300M in

TGE. “As an industrial partner, Enagas will have a seat on the company's Board of Directors, contributing its know-how in operating and developing energy infrastructure,” said Enagas.

Enagas has four domestic LNG import terminals around Spain at Barcelona in the northeast, Cartagena in the southeast, Huelva in the southwest and Gijon in the northwest. It also owns a 50 percent stake in the facility serving the northwest city of Bilbao. Other investments held by Enagas include its stake in Trans Adriatic Pipeline, part of Europe’s Southern Gas Corridor. It is also part of a European gas grid group that acquired control of the Greek natural gas transmission operator DESFA. “Enagas embarked on its internationalisation in 2011 as a part of an ongoing strategy with two main objectives, maintaining the maximum efficiency and security in the operation of the Spanish gas system, and to continue expanding as a company,” it said. “This international expansion also helps drive the business of other Spanish industrial companies related to the energy sector,” added Enagas. “This acquisition allows Enagas to unlock the value of its vast experience in developing and operating gas infrastructure and strengthen its position as industry leader and expert,” stated the company. Wallace Henderson, Senior Managing Director in Blackstone Infrastructure Partners, said he was delighted Enagas had joined the investment consortium. “With extensive midstream operations around the world, they bring valuable perspectives to Tallgrass that will benefit our investment and we look forward to their contributions,” added Henderson.

ENI, the Italian Energy company, has sold a stake to Qatar Petroleum in an exploratory block offshore Mozambique, where several LNG projects are being developed from other blocks in the Rovuma Basin. Qatar Petroleum has acquired a 25.5 percent participating interest in Block A5-A located in the deep waters of the Northern Zambezi Basin, about 1,500 kilometres northeast of the capital Maputo. Eni was awarded the block in the fifth competitive Licensing Round launched by the government of Mozambique and an exploration and production concession contract was signed in October 2018. It extends over an area of 5,133 square kilometres in a water depth between 300 metres and 1,800 metres, in a completely unexplored zone in front of the town of Angoche. Eni is the

operator of the Block A5-A consortium with a 59.5 shareholding, which would be reduced to 34 percent after the farm out is approved. Other partners are South Africa's Sasol with 25.5 percent and the state energy company of Mozambique ENH with 15 percent.

"The transaction represents another milestone in the strategic path that Eni and QP undertook to further strengthen their partnership worldwide," said Eni Chief Executive Claudio Descalzi. Eni has been present in Mozambique since 2006 when it acquired the Area 4 licence in the offshore Rovuma basin where total gas in place is estimated to be more than 85 trillion cubic feet after discoveries in the Coral, Mamba and Agulha fields. The Coral field is subject to a floating LNG development with production capacity of 3.4 million tonnes per annum. Construction of the Coral FLNG joint venture began in June 2017 the start-up is scheduled for 2022. The development programme also includes the construction of an onshore plant composed by two liquefaction Trains for gas treatment and liquefaction capacity of 15.2 MTPA in the first phase of the Rovuma LNG project. The onshore joint venture is expected to be sanctioned in 2019 and production is being targeted for 2024. Eni and Qatar Petroleum are already partners in upstream developments in Oman and Mexico.

GASUM, the natural gas company of Finland, posted annual pre-tax profits little changed from the previous year even as the value of liquefied natural gas sales increased by 29 percent because of higher oil prices. The company's pre-tax profits were 100.55 million euros (\$113M) compared with 99.88M euros in the previous year. Gasum said its operating profits were 8.8 percent higher at 124.16M euros versus 114.17M euros in 2017. Sales in the LNG business, covering Finland, Norway and Sweden jumped 29 percent and came to 252.0M euros compared with 195.2M euros in the previous year, though sales volumes increased by just 4 percent. "LNG revenue growth was driven by the price development," explained Gasum. The figures were helped by an increase in LNG maritime fuel sales in the Nordic region. "The introduction of the bunkering vessel 'Coralus' increased the number of ship-to-ship bunkerings in 2018," said Gasum. "The vessel was taken into service in late 2017 and has strengthened Gasum's position as the leading small-scale player in the LNG market," said the company.

"Supply certainty was strengthened by the introduction of the world's first LNG carrier holding the Ice-Class 1A Super, the 'Coral EnergICE'. The vessel enables disruption-free deliveries in all weather conditions," noted Gasum. The completion of the Tornio Manga LNG import terminal joint venture in Finland at Roytta Harbor in the Port of Tornio gave the nation its second regasification facility. Gasum said that its overall annual revenues rose 27 percent to 1.177 billion euros compared with 925 million euros in 2017. The company was additionally making progress with its offering of LNG as a clean alternative for the truck transportation market. "Last year we announced our plan to construct a network of 50 filling stations in Finland, Sweden and Norway to serve heavy-duty vehicles," said Chief Executive Johanna Lamminen. "The investment will multiply the size of the Nordic heavy-duty vehicle filling station network, enabling considerable transport emission cuts," she added. "We took another important step to develop the Nordic gas market by acquiring the energy market services business of Enegia. The acquisition improves our opportunities to provide well-functioning energy solutions to an even broader spectrum of customers," explained the CEO.

"Thirdly, we increased our shareholding in our subsidiary Skangas from 70 percent to 100 percent in October 2018," she said. "This was part of the Gasum strategy with the development of the Nordic gas market and LNG infrastructure at its core. This also enables us to operate under a single strong brand throughout the Nordics," stated Lamminen. "We also made preparations for the opening up of the Finnish gas market effective from the beginning of 2020. We will continue this work and anticipate another strong year for Gasum in 2019," she added. Gasum's overall sales in the natural gas business came to 874.9M euros versus 678.7M euros in 2017. "The previous downward trend in natural gas volumes has been reversed and in 2018 sales volumes rose to a level clearly above those seen a year earlier, totaling 24.7 terawatt hours, up 11 percent year on year from 22.3 TWh in 2017," said Gasum. "Gas consumption was greater than a year earlier in combined heat and power production in particular. This was partly attributable to both a cold first part of the year and the rise in electricity market price due to a dry summer. The supply certainty of natural gas remained at an excellent level in

2018," added the company. However, sales of biogas made from waste increased only slightly to 48.7M euros compared with 47.9M in the previous year. Gasum explained that its transmission business would be unbundled by January 2020 in the manner required by the Natural Gas Market Act. As part of the preparations, Gasum has founded a new subsidiary, Suomen Kaasunsiirtopalvelut Oy, which is tasked with planning transmission network business development processes for the period after the unbundling. "At the end of 2018, Baltic Connector Oy, which is building a gas interconnector between Finland and Estonia, was transferred from the State of Finland to the Gasum Group," it added.

GULF LNG, the export project proposed by pipeline company Kinder Morgan for Pascagoula in Mississippi, is moving forward on the regulatory front with the Federal Energy Regulatory Commission and other agencies. Gulf LNG is an existing import terminal that is being transformed into a liquefaction plant to produce around 11.5 million tonnes per annum of LNG for export. The Pascagoula terminal had originally been constructed to import LNG cargoes from Angola in southwest Africa from a production plant developed by international oil companies, including Chevron Corp. However, the US shale-gas boom made LNG imports into the US uneconomic and Kinder later decided to consider the export option. Gulf LNG, co-owned by Kinder Morgan and several US equity funds, has just notified the FERC about the progress of the project and the issue of the final environmental impact statement. The company said that on March 15, 2019, the Pipeline and Hazardous Materials Safety Administration, now playing a more active part of the FERC process, issued its letter of determination. This stated that it had reviewed the company's application and determined that it had demonstrated that the siting of the project complies with Federal Pipeline Safety Standards. In addition, the company had submitted three replies through March 4, 2019, to data requests from FERC staff on the Draft Environmental Impact Statement (DEIS). Gulf LNG added that it was working on an update to the Mississippi Department of Environmental Quality's Permit to Construct and Operate Air Emissions Equipment and an update to the US Army Corps of Engineers certification in relation to the Rivers and Harbors Act.

"The comment period on the DEIS closed on February 25, 2019 and FERC is presently engaged in drafting the Final Environmental Impact Statement," said Gulf LNG. The Gulf terminal was originally owned by US pipeline company El Paso and later acquired by Kinder, which has sold 50 percent of the project to US equity funds. The Pascagoula terminal is located next to the Bayou Casotte Navigation Channel and already includes a five-mile send-out pipeline and two LNG storage tanks, each with a capacity of 160,000 cubic metres. It is interconnected to several downstream pipelines, including Transco, Florida Gas Transmission, the Destin Pipeline and the Gulfstream Natural Gas Pipeline from where feed-gas can be transported for processing and export from Pascagoula. This is Kinder's second LNG export project and it is currently completing the Elba Island export plant near Savannah in the state of Georgia. In addition to the storage tanks and pipeline, the terminal has a single dock facility that is currently permitted to receive LNG carriers of up to 170,000 cubic metres capacity and is designed to handle even larger vessels. An earthen berm would also be constructed extending from the northeast to the southeast boundaries of the terminal expansion site. This would be connected to new segments of the storm surge protection wall on the coast. The project is 50 percent owned by Kinder Morgan subsidiary Southern Gulf LNG Company, while 30 percent is held by Thunderbird LNG, a unit of the Blackstone Group fund managers. The remaining 20 percent is held by Gulf LNG Holdings, comprising Arc Logistics Partners and Lightfoot Capital Partners equity funds.

IGAS ENERGY, the largest UK onshore oil and gas exploration and production company, said it had made more progress with well developments in its shale-gas activities in central England targeting the Bowland Shale that could lessen the nation's needs for some of its LNG and pipeline imports. "I am delighted to report that we have recovered high quality hydrocarbon bearing cores at our Springs Road site," said Stephen Bowler, Chief Executive of IGas. "The data gathered to date shows that there are significant prospective resources in our East Midlands acreage and is another important step for the UK onshore industry," stated the CEO. "There is the potential for the gas beneath our feet to contribute materially to the UK energy needs. Gas is important for our

energy requirements, not least because over 80 percent of the homes across the country are heated by gas,” explained Bowler. “These results come at a time when we are importing more and more gas from overseas and could stimulate investment in the East Midlands basin as well as improving the country’s balance of payments,” added Bowler in reference to the UK’s imports of LNG and pipeline gas from Norway. IGas said that the current exploration well forms part of an integrated appraisal programme to better define the Basin consisting of a margin sited well at Tinker Lane in North Nottinghamshire and a Basin centred-well at nearby Springs Road.

IGas’s update covers the SR-01 well at Springs Road in North Nottinghamshire. “Further to our announcement on 15 February 2019, we have now encountered a hydrocarbon bearing shale sequence of over 250 metres, including the upper and lower Bowland Shale,” said IGas. “Significant gas indications were observed throughout the shale section and additionally within sands in the Millstone Grit sequence,” it added. IGas said it had now completed this phase of data acquisition which included the recovery of approximately 150 metres of shale core and an extensive wireline logging programme across the Millstone Grit, and Upper and Lower Bowland Shale. “Petrophysical and core analysis is currently being conducted, which will give us further insight into the resource potential and shale characterisation that will be utilised for future appraisal and development of the wider East Midlands area,” IGas explained. The company said it would give a further update following the completion of the majority of the analysis in the second quarter. “Having encountered both primary and secondary targets on prognosis we are now drilling into the tertiary target, to prove up the potential for multiple hydrocarbon bearing horizons within the Gainsborough Trough,” said IGas.

INDIA and its Prime Minister Narendra Modi have inaugurated the first Indian East Coast liquefied natural gas import terminal at Kamarajar Port that recently started its commissioning process with a cargo from Qatar. Prime Minister Modi dedicated the Ennore LNG project terminal at Kamarajar to the nation as he also laid foundation stones for national highway projects at a ceremony near Chennai in the state of Tamil Nadu. The facility owned by Indian Oil Corp., the

refining and fuel marketing company, has 5 million tonnes per annum of import capacity and two tanks each with storage of 180,000 cubic metres. “The LNG terminal will help in meeting the LNG demand in Tamil Nadu and neighbouring states,” said Modi. The Prime Minister was joined on the podium by Edappadi K. Palaniswami, an Indian regional politician and the current Chief Minister of Tamil Nadu. A statement said the regasified LNG would be transported by pipeline to customers en route to Tuticorin in South Tamil Nadu via Puducherry and Trichy. A pipeline has been laid to Bengaluru via Hosur to supply industrial customers. The Kamarajar facility is located about 25 kilometres north of Chennai Port and initially the imports will supply natural gas to industry in the Manali area, including Madras Fertilizers Ltd., Chennai Petroleum Corp. and Tamil Nadu Petroproducts. The terminal’s commissioning started on February 26 with the arrival of an LNG cargo from Qatar.

The Qatari shipment was unloaded from the 160,000 cubic metres capacity carrier “Golar Snow” after being lifted from the Qatargas export complex at Ras Laffan terminal on February 17 and delivered to Kamarajar. During the cool-down process all the systems and infrastructure at the newest Indian terminal are being made ready to safely receive and handle regular cargoes and regasified LNG. Indian Oil’s terminal at Kamarajar, formerly one of India’s main coal ports and previously called Ennore, is India’s sixth completed LNG import terminal and is expected to spur industrial growth in the area. Indian Oil is the main stakeholder in the facility, though other investors have been named as the Indian private equity fund, IDFC Alternatives, and ICICI Bank, part of an Indian multinational banking and financial services based in Mumbai. Once the Kamarajar terminal begins commercial operations it will join the five other facilities on the West Coast at Dahej, Dabhol, Hazira, Mundra and Kochi to supply India’s growing natural gas needs. Analysts said the coming on stream of this first regasification terminal on the East Coast is a landmark in efforts by Indian Oil and the government to improve natural gas infrastructure in the country. The venture and several others East Coast terminals under development will rebalance the nation’s regasification infrastructure with East Coast import capability. Indian Oil is also pursuing city-gas projects and another East Coast LNG

terminal with Gas Authority of India and the Adani Group. With GAIL and Adani, Indian Oil is developing the Dhamra project in the state of Odisha. The Dhamra terminal when completed will serve city-gas and power projects as well as industrial customers

JAPAN has been returning to nuclear power and now has nine units operating with a total electricity generation capacity of 8.7 gigawatts and a US report has forecast that imported LNG supplies for Japanese gas-fired power plants would likely decline in 2019. Power generation produced by natural gas-fired plants in Japan has been declining annually from its peak in 2014 and would now fall further while the use of nuclear power plants will rise. The US report from the Energy Information Administration recalled that in response to the 2011 Fukushima accident caused by an earthquake and subsequent tsunami, Japan suspended operations at all nuclear reactors for mandatory safety inspections and upgrades, leaving the country with no nuclear generation from September 2013 to August 2015. “Existing coal-fired power plants were already operating near full load and so as a consequence Japan’s power utilities had to import larger volumes of LNG to meet electricity demand,” said the EIA. “The outlook for further LNG import displacement is largely dependent on the number of nuclear restarts, assuming trends in other factors, such as electricity demand and energy efficiency, remain constant,” it added. “The pace of nuclear restarts has been slow, with the average reactor requiring nearly four years to come back online,” stated the report. Japan relies on imported LNG to meet all of its natural gas demand and imports more LNG than any country, averaging 11 billion cubic feet per day in 2016 through 2018. Between 2015 and 2018 Japanese LNG imports have dropped from a total of 85.04 million tonnes to 82.85MT. “Japan imports LNG from several countries worldwide and shipments from Australia have grown in the past two years to account for more than one-third of the total imports, and they have displaced imports primarily from Malaysia and Qatar,” explained the EIA.

In 2016 through 2018, these three suppliers accounted for 60 percent of Japan’s LNG imports. LNG imports from the US currently account for a small percentage of total imports, but they increased from 0.16 Bcf/d in 2017 to 0.3

Bcf/d in 2018, according to data from Japan’s Ministry of Finance. “Japan’s LNG importers have signed long-term contracts with US LNG export projects such as Freeport, Cameron, and Cove Point. Most of Japan’s LNG imports are under long-term contract with existing foreign suppliers, and these contracts are set to expire during the next decade,” noted the EIA. Japan’s long-term energy policy calls for the nuclear share of total electricity generation to reach 20 percent to 22 percent by 2030, which would require up to 30 reactors to be in operation. “Out of the remaining fleet of 35 operable reactors, nine are currently operating, six have received initial approval from Japan’s Nuclear Regulation Authority, 12 are under review and eight have yet to file a restart application,” explained the EIA. “Five nuclear reactors were gradually restarted in 2018, they began to offset natural gas-fired generation, and as a result, LNG imports decreased as the reactors reached full operation,” said the report. “In 2019, their first full year of operation, EIA estimates that the restarted nuclear reactors will further displace Japan’s LNG imports by about 5 million metric tons per year, or 0.7 billion cubic feet per day (Bcf/d) of LNG,” it added. “This amount is equivalent to 10 percent of Japan’s power sector natural gas consumption and 6 percent of Japan’s LNG imports in 2018,” stated the report.

JAPANESE liquefied natural gas imports plunged 11.4 percent with only Middle East volumes holding up as more coal-fired power use and nuclear generation offset the need for gas-fired power as the cost of LNG shipments also increased. Cargoes delivered to Japan in February 2019 amounted to 7.35 million tonnes compared with 8.29MT in February 2018. The January 2019 imports had amounted to 7.54MT, a drop of 8.7 percent compared with 8.26MT in January 2018. Nine of Japan’s nuclear power plants, which numbered 54 on line before the Fukushima disaster in 2011, have re-started to reduce LNG needs. Thermal coal imports were preferred over LNG in February as 9.24MT was imported, a fall of 2.2 percent compared with February 2018. The cost of the February 2019 cargoes came to 465.54 billion yen (\$4.18Bln), a rise of 8.6 percent from the 428.72Bln yen (\$3.85Bln) the cargoes cost in the same month a year ago. The Ministry of Finance data for February showed that Asian LNG shipments from nations such as Malaysia

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and Indonesia, Papua New Guinea and Brunei dropped 20 percent year-on-year to 2.04MT. Imports from the Middle East region rose by 1.8 percent versus 2018, with shipments from countries like Qatar, the United Arab Emirates and Oman totalling 1.54MT in February 2019.

US shipments of LNG amounted to 335,000 tonnes, more than double the volumes received in the same month last year. Japan imported 2.49MT of US cargoes for all of 2018 and that figure will rise in 2019 as the nation has booked more volumes from new plants. These will come from the Cheniere Energy-owned Sabine Pass plant in Louisiana and the Cove Point plant in Maryland operated by Dominion Energy, as well as the newest Cameron LNG plant in Louisiana set to start operations under Sempra Energy and with Japanese shareholders. Monthly Russian shipments from the Sakhalin Island plant in the Far East dropped 15 percent in February to 604,000 tonnes. The balance of imports from other countries amounted to 2.83MT, down 16 percent compared with the 3.37MT received in February 2018 mostly from Australia, though also including shipments from African nations and the spot market. Japanese LNG imports had declined by 0.9 percent in 2018. The 2018 imports amounted to 82.85MT versus 83.63MT received in 2017. Japan's 2018 import bill was 20.8 percent higher than in 2017 at 4,730Bln yen (\$43.14Bln). The Japanese had paid 19.3 percent more in 2017 with an LNG bill of 3,915Bln yen (\$35.58Bln).

JIANGNAN Shipyard Group, one of China's largest shipbuilders, said it was set to sign an agreement to construct five 15,000 TEU, or twenty-foot equivalent unit, dual-fuel container ships with LNG propulsion capabilities. "The order is from French shipping line CMA CGM," said Jiangnan Shipyard in a statement. CMA CGM, based in the French Mediterranean port of Marseille, is a container shipping specialist with more than 500 vessels operating worldwide and has been among the first to order ships with LNG propulsion. "The deal will be valued at \$750 million approximately in total, with each vessel worth around \$150 million," said the Chinese shipyard. The International Maritime Organization and nations such as China are implementing emission controls for shipping fuel use in ports to reduce pollution. An IMO cap on harmful sulfur emissions comes into force in 2020 and is forcing shipping companies to switch to have exhaust-cleaning

equipment or alternative fuels such as LNG or low-sulfur traditional bunkering fuels for in-port and general use.

"The new ships are equipped with bigger membrane LNG fuel tanks inside the hull, which is expected to provide strong support to long-haul container transportation," said Jiangnan Shipyard. The Shanghai-based shipyard company, dating back to the 19th century, is widely regarded as the cradle of China's shipbuilding industry. CMA CGM had previously ordered nine new ultra-large LNG-powered ships from China in 2017 and they start being delivered from China's Hudong-Zhonghua shipyards from 2020. The nine 22,000 TEU ships are being built with LNG storage tanks designed so that they load their entire bunker requirement for a round voyage before embarking on the journey. CMA CGM and French energy company Total signed an agreement in 2018 covering the supply of around 300,000 tonnes of LNG per annum for 10 years starting from 2020. This volume will fuel CMA CGM's nine newbuilds as well as the five dual-fuel vessels set to be ordered from the Jiangnan Shipyard.

KOSMOS ENERGY, the US partner of BP in the Mauritania-Senegal floating LNG projects, has completed its acquisition for more than \$1.22 billion of Deep Gulf Energy as it keeps faith in the deepwater Gulf of Mexico as other operators retreat to the US onshore shale basins. Kosmos, based in Dallas, said it purchased Deep Gulf Energy to expand its assets in the Atlantic Margin exploration area of the most distant parts of the Gulf that can have similar deepwater challenges to offshore West Africa. "By acquiring DGE, Kosmos adds to its deepwater Atlantic Margin portfolio an established business with attractive assets and a strong record of growing production and reserves through infrastructure-led exploration," said Kosmos. "This immediately accretive acquisition enhances the scale of the company and is expected to generate significant free cash flow," added Kosmos. Houston, Texas-based DGE was founded in 2005. The company has drilled 20 wells, 16 of which have been completed. The company achieved its first production in 2007 and the acquisition would add around 25,000 barrels of oil equivalent per day of production for Kosmos.

Kosmos notes that while many competitors have been leaving the Gulf of Mexico to pursue onshore shale plays, their

departures have created an opportunity to further open up the Gulf. "The best deepwater assets can compete with the best of shale, and now is a good time to enter the Gulf of Mexico," said Kosmos. The completion of the DGE deal comes as Kosmos and BP are moving forward with contract awards for the Tortue-Ahmeyim natural gas project in the Atlantic Margin of Mauritania and Senegal that will underpin several FLNG ventures. The Tortue-Ahmeyim project will produce gas from a deepwater subsea system and transfer it to an FLNG production facility at a nearshore hub located on the Mauritania and Senegal maritime border. The FLNG facility for Phase 1 is expected to deliver about 2.5 million tonnes per annum of LNG on average. The full project will target 10 MTPA of LNG output as well as making gas available for domestic use in both Mauritania and Senegal. First gas from the African project is expected in the first half of 2022.

LNG CANADA, the Royal Dutch Shell-led export joint venture in British Columbia, said that it was unlikely the continuing dispute over the Coastal GasLink feed-gas pipeline would stop the overall project advancing to completion. "I do not see a single scenario that would cause the construction of this pipeline to be stopped," said Andy Calitz, LNG Canada's Chief Executive. Opponents have mounted a legal challenge saying the pipeline was a federal undertaking and should have sought approval from the National Energy Board, rather than the province of British Columbia. The federal regulator agreed in December to consider the jurisdictional challenge and has requested evidence from all the parties. "It's a complex world, the paths are not clear," said Calitz, pointing out that any decision by the federal regulator could later be appealed in the courts. "But what I am clear about is that this pipeline, by the time that happens, will be in advanced construction," stated Calitz. The LNG Canada project is the largest private sector investment in Canada's history with spending of C\$40 billion (US\$30.2Bln). Shell and its four partners, Mitsubishi Corp. of Japan, Malaysian energy company Petronas, Chinese major PetroChina and Korea Gas Corp., had agreed in October 2018 to start immediate construction at the brownfield site near Kitimat that had been an energy products terminal before being acquired by Shell in 2011.

Shell was pressing ahead while recognizing that it was likely not possible

to get unanimous support for a major infrastructure venture project in BC. Calitz has said he believed that the Canadian economy would find it difficult to prosper without a growing and healthy resource sector. The US\$5-billion pipeline of 670 kilometres is being developed by TransCanada Corp. to bring the feed-gas from the Montney shale basin in northeast BC to the Pacific Coast. TransCanada is also seeking to sell a stake in the pipeline project. Calitz said that the pipeline company's stake sale was expected and did not reflect concerns about greater risk. "It has always been a part of the financing strategy for the project," Calitz said. "The sale plan has no impact on either the construction or the capacity or any other aspect of the project," he added.

MCDERMOTT International and Baker Hughes-GE, the US energy services companies, have been awarded substantial subsea contracts by BP to develop the Greater Tortue-Ahmeyim natural gas fields that will underpin several floating LNG projects offshore Mauritania and Senegal. The initial subsea infrastructure supplied will connect the first four of 12 wells consolidated through production pipelines leading to a floating production, storage, and offloading (FPSO) vessel. From here liquids are removed and the export gas is transported via a pipeline to the FLNG production hulls where the gas is liquefied. McDermott defines a substantial contract as between \$500 million and \$750M. The contract award will be reflected in McDermott's first-quarter 2019 backlog. McDermott and BH-GE said the contract follows an initial front-end engineering and design (FEED) phase awarded in March 2018 when both companies worked together to define the technology and equipment scope for a four-well development phase. Project management and engineering teams from BP, BHGE and McDermott will remain co-located at McDermott's London offices for this next phase. McDermott and BH-GE will supply subsea umbilicals, risers and flowlines (SURF) and subsea production systems (SPS) equipment. McDermott said it planned to use its upgraded "Amazon" vessel, "DLV 2000", "North Ocean 101" and third-party vessels to support the installation scheduled to begin in late 2020. "The 'Amazon' modifications are scheduled to be completed before the installation campaign begins and will include a multi-joint (hex) J-Lay system to handle the most challenging ultra-deepwater projects as well as the addition

of a multi-joint facility, dual pipe loading cranes and additional power generation,” explained McDermott.

McDermott-designed pipeline and riser structures will be fabricated at its yard in Batam, Indonesia. BH-GE will provide five large-bore deepwater horizontal xmas trees (DHXTs), a 6-slot dual bore manifold, a pipeline end manifold, subsea distribution units (SDUs), three subsea isolation valves (SSIVs), diverless connections and subsea production control systems, specifically designed to enable the future integration of additional wells for the first phase of the development. “This contract marks a number of firsts. Our first significant subsea EPCI project in West Africa, the first project using our state of the art pipelay vessel ‘Amazon’ and our support of BP’s first entry into Senegal and Mauritania,” said Tareq Kawash, McDermott’s Senior Vice President in the region. “Our collaboration with BH-GE allows us to offer BP an integrated approach that builds on our proven solutions. We look forward, along with BHGE, to delivering this landmark project to BP with the highest levels of safety and quality,” stated Kawash. Graham Gillies, BH-GE’s Vice President for Subsea Production Systems, said the company aimed to deliver the best-in-class solution to BP with cost-efficiency and industry-leading safety. “This major deepwater gas development is strategically important for Mauritania and Senegal’s domestic and global gas supply, and supports the industry’s drive for a more sustainable, lower carbon future,” added Gilles. BH-GE has also signed an agreement to become a “Country Partner” of “Invest in Africa’s (IIA) Senegal chapter”, of which BP is a founding member. The IIA helps local suppliers to connect with international oil and gas companies, increasing the opportunities for local businesses to support large-scale projects, and training African suppliers on core business skills and entrepreneurship.

OIL SEARCH, a shareholder in the Papua New Guinea LNG export plant and its expansion project, said that the next stage of PNG’s gas development must move forward in a timely and responsible way and be a project that is sustainable and beneficial for the nation. The company’s Managing Director Peter Botten stated that PNG was on the threshold of substantial new investment to double its LNG production to more than 16 million tonnes per annum in the coming years. Speaking at the PNG Petroleum

and Energy Summit in the capital Port Moresby, Botten said that the PNG partners must bear in mind that the global LNG market was now highly competitive with other major new projects already moving to final investment decisions. Botten, whose company is listed on the Australian Securities Exchange and focused on PNG gas and oil development, said good progress had been made on downstream pre-front-end engineering and design for the LNG plant expansion. The PNG LNG plant, located northwest of Port Moresby and operated by ExxonMobil Corp., already produces around 8 MTPA. Botten explained that the studies support new LNG capacity comprising three Trains each with 2.7 MTPA of output and the upstream pre-FEED study on the Elk-Antelope field providing feed-gas was also well advanced.

“Development concepts for our Associated Gas Expansion project planned for 2019 were also completed,” said Botten. An accord had been signed between Papua LNG and the PNG government, setting key terms and conditions for a gas agreement, including the equitable split of value between State and developers. “The Papua LNG Gas Agreement will likely be finalised in early April 2019 with a gas agreement between the State and the P’nyang field joint venture to be finalised soon after,” stated Botten. “Additionally, joint venture partners are progressing commercial agreements supporting integration, including site and facility access,” he added. Botten emphasised in his presentation the importance of maintaining operational stability through social initiatives and responsibility. “Whilst our core business may be oil and gas exploration and production, we operate in a socially responsible manner with strong values and high standards guiding our work. Our vision and values make this clear,” he said. “Respectful, open relationships with local landowners and all levels of government are at the heart of our current and future success,” he noted.

OMAN is planning to increase its natural gas production for domestic use and LNG exports to such an extent that the sultanate in the Arabian peninsula will see gas output levels overtaking oil by around 2025. This boost in natural gas resources has come about because of large natural gas discoveries and their development by companies such as BP of the UK. “Gas is on the rise in Oman and this transition is very timely,” said a report from Norwegian energy research and

consulting firm Rystad Energy. “Amidst rising global LNG demand and the increasingly lucrative domestic gas market, international players are favoring gas developments in Oman,” stated the report. “The strengthened gas market will help gas production levels to outshine Oman’s dwindling oil production, with gas output projected to overtake oil,” it added. The Omani Ministry of Oil and Gas agreed in January to work jointly towards a significant new exploration opportunity with BP and Italy’s Eni to build on BP’s onshore Khazzan natural gas discovery credited with revitalizing LNG production. The two companies are now working with Oman towards the award of a new exploration and production sharing agreement for Block 77 in central Oman. The country’s three existing LNG liquefaction Trains at the facilities near the town of Sur have been at full capacity since 2017 after previously suffering from a lack of feed-gas as supplies were diverted to fill domestic gas shortages. The Omani government allocates Oman LNG supplies from various gas fields and the Khazzan field production has ended all feed-gas concerns for the near future. The three Omani LNG processing Trains currently produce around 10.4 million tonnes per annum and supply nations such as South Korea, Japan India and Kuwait.

Oman LNG has also invited long-term contract holders to start negotiations on renewing contracts that expire in 2025 for 8 MTPA of Omani deliveries to Korea and Japan. The new gas exploration target Block 77, with a total area of almost 3,100 square kilometre, is located in central Oman, 30km east of the BP-operated Block 61, which contains the Khazzan gas field as well as the Ghazeer project currently under development. The Khazzan field began production in 2017 and now produces around 1 billion cubic feet of gas a day. The Ghazeer field is expected to add a further 0.5 bcf/d of production and is expected to come on stream in 2021. “Oil output declines over the last two years may indicate a point of no return for Omani oil, but the country’s sliding oil production is set to be replaced by gas,” explained the Norwegian report. At peak production in 2016, Oman’s oil output reached 900,000 barrels per day (bpd), declining to 870,000 bpd by 2018. The report estimates that by 2025 oil production will decrease by an additional 200,000 bpd, as output from older fields continues to slump. As new oilfield developments have failed to stabilize the country’s crude output, Oman has shifted

its focus to invest in natural gas developments. This will see gas production rise to around 130 million cubic metres per day by 2025, shifting Oman’s oil-gas production mix from about 35 percent gas in 2015 to over 50 percent in 2025. “This is a tremendous turnaround from the near-stagnant 80 million cubic metres per day of gas output from 2008 through 2016,” added the report.

POLSKA LNG, the operator of the nation’s first LNG terminal, has received a European Commission grant of 128 million euros (\$145M) to support the expansion of the facility at the Baltic port of Swinoujscie to enable regular future deliveries of US LNG. The expansion is scheduled to be completed by 2022 and is aimed at helping ensure gas supply security in Poland and the wider Baltic market. Regasification at the terminal will be increased to handle 5.55 million tonnes per annum of LNG, or 7.5 billion cubic metres of gas. A second phase of the expansion will be completed by 2023 and includes a third LNG storage tank along with trans-transshipment facilities for rail loading onto ISO containers. It will include the construction of an additional jetty. This project will be implemented in collaboration with the Szczecin and Swinoujscie Seaports Authority. The new jetty will enable the provision of small-scale tanker loading and bunkering activities. Polskie LNG, the terminal operator, has awarded a technical consulting contract to the European engineering company Tractebel, based in Belgium, to help with the terminal expansion programme.

The funding from the European Commission, the executive arm of the European Union, comes from the European Regional Development Fund and the Cohesion Fund under the 2014-2020 Infrastructure and Environment Operational Programme, which has among its priorities the improvement of energy security in Europe. “The project will contribute to ensuring security of gas supplies in Poland and in the Baltic countries by making supplies more diverse and promoting new gas transport routes in the region,” said an EU statement. Poland’s state-controlled oil and gas company is planning to increase its purchases of LNG to 7.5 MTPA, which is 2 MTPA more than the future handling capacity of the Swinoujscie terminal. This will enable the company to conduct some cargo trading on the international market. Under two US supply agreements, the

Poles will receive 2 MTPA of LNG for 20 years from Sempra Energy's Port Arthur plant planned for Texas and coming on stream in 2023, as well as volumes from Venture Global's Calcasieu Pass export facility in Louisiana to be completed in 2022. The main supplier to Poland is Qatargas under a long-term supply contract that started in 2016.

QATAR Petroleum, the leading liquefied natural gas producer, has signed an agreement to acquire a stake in 12 exploration blocks offshore Morocco as the Gulf nation continues to increase its international exploration and production activities. The agreement for a 30 percent participating interest for the Qataris in the Tarfaya offshore area is subject to the authorization of the Moroccan authorities. The Tarfaya blocks are in the southern part of the Moroccan offshore shallow waters in depths up to 1,000 metres and cover a total area of around 23,900 square kilometres. Eni and the Moroccan National Agency for Hydrocarbons and Mines currently hold shares of 75 percent and 25 percent respectively with the Italian company as the operator. "The parties are currently performing geological and geophysical studies as part of the first exploration period work programme under the Tarfaya Petroleum Agreement," said Eni.

Morocco is a net oil and gas importer and has been studying an LNG import project as well as broadening its

exploration activities. The country produces only marginal amounts of oil, gas and refined petroleum products, which are mainly consumed domestically. A portion of the Maghreb-Europe Pipeline between Algeria and Spain passes through Morocco. In lieu of transit fees, Morocco receives natural gas from the pipeline every year. Recently there has been increased interest in upstream activities, largely because Morocco is believed to hold untapped hydrocarbon shale resources as well as onshore and offshore conventional reserves. Eni has been present in Morocco since 2016 when it established its wholly-owned subsidiary Eni Maroc.

SANTOS, the shareholder in two Australian liquefied natural gas LNG export plants and in Papua New Guinea LNG, has priced a US\$600 million fixed-rate bond and said the transaction was many times over-subscribed with demand from global financial institutions. The bonds have been priced at a fixed coupon of 5.25 percent for a period of 10 years and maturing on 13 March 2029. The bonds will be guaranteed by Adelaide-based parent company Santos Ltd. "The book was approximately five times over-subscribed and received strong support from a mix of global asset managers and insurance companies from Asia, Australia and Europe," said Santos. The use of the proceeds from the bonds will include refinancing the US\$500M bridging facility used to partly-fund the acquisition by Santos of Western Australian natural gas and oil company Quadrant Energy and for general corporate purposes. Santos Chief Executive Kevin Gallagher said the offering was consistent with the company's strategy of securing competitively priced long-term capital.

"This is an excellent result for Santos, showing strong support from the capital markets and demonstrating our balance sheet is set up to support our growth strategy," added the CEO. He explained that the bond would replace an existing two-year bridging facility and would mean that all significant near-term debt maturities have been addressed with more efficient long-term debt funding. Santos is operator of the Gladstone LNG plant in Queensland and whose other shareholders are Petronas of Malaysia, Korea Gas Corp. and French major Total. The company also holds a stake in Darwin LNG, operated by ConocoPhillips, and in the ExxonMobil-led PNG LNG plant and its expansion project. Santos said joint lead managers of the transaction were

Australia and New Zealand Banking Group ANZ, Citigroup Inc. of the US and Commonwealth Bank of Australia.

SEA-LNG, a global coalition of energy and shipping companies backing the increased use of liquefied natural gas as a maritime fuel, has signed up its first North American port as a member. The latest member is the Vancouver Fraser Port Authority, the federal agency of the Port of Vancouver in the Pacific Coast province of British Columbia, Canada's largest port and the fourth port member to join the coalition. The other port company members are the Port of Rotterdam, Yokohama-Kawasaki International Port Corp. of Japan and most recently the Maritime and Port Authority of Singapore. "Together, the ports remain committed to supporting the coalition's vision of a competitive global LNG value chain for cleaner maritime shipping," said Sea-LNG. The Sea-LNG group, founded in 2016 to help provide strategic development of the emerging LNG marine fuel market and encourage the building of bunkering infrastructure, now has around 40 company and port authority members. Peter Keller, the Sea-LNG Chairman is also Executive Vice President of US shipping line TOTE Maritime Inc. "We are pleased to welcome the Vancouver Fraser Port Authority to our growing coalition and look forward to leveraging their expertise to realise our vision of developing LNG infrastructure in ports around the globe to enable quick, safe and cost-effective bunkering," said Keller.

Sea-LNG said that the Port of Vancouver was working closely with the regional gas supplier, Fortis BC and with industry and governments to advance LNG bunkering. "As part of our vision to be the world's most sustainable port, we engage in a number of emissions management initiatives that help support a healthy environment," said Duncan Wilson, Vice President of Environment, Community and Government Affairs for the Canadian port. "This partnership with Sea-LNG represents an opportunity for us to be part of a multi-sector group that is reducing marine shipping emissions and improving air quality," added Wilson. Sea-LNG said it was undertaking studies and developing tools with partners for the industry to better understand the true benefits of LNG from both an air quality and greenhouse-gas mitigation perspective. "The coalition continues to encourage meaningful debate using accurate, independent data

which has been academically verified through sound analysis," said Sea-LNG.

SOUTH KOREA, the world's third-largest liquefied natural gas importer, said it planned to sharply reduce the import surcharge imposed on LNG in line with the government's efforts to increase natural gas use at the expense of coal to reduce serious air pollution. The Ministry of Trade, Industry and Energy said the new rules would be introduced in April and cut the levy on LNG used for gas-fired power generation by 84 percent to 3.8 won (\$0.003) per kilogramme from the previous 24.2 won (\$0.021) per kilo. The Ministry said the decision came as the existing surcharge on natural gas was excessively high considering the environmental benefits and ability to lower the country's dependence on coal. As for thermal coal used for power generation in South Korea, the Ministry said it would increase its special consumption tax to 46 won (\$0.040) per kilo from the current 36 won per kilo. The Ministry said it will continue to roll out various projects to cut emissions and air pollution that are now regarded by the government as a major threat to public health. In the coming months, the government is also planning to partially suspend the operation of 48 coal-fired power plants from at least a week to 45 days over the March-June period, and fully shut down six plants.

About 40 percent of South Korea's electricity generation currently comes from coal, 30 percent from nuclear and just over 20 percent from natural gas. South Korean LNG imports rose 17.3 percent in 2018 to a record 44 million tonnes as shipments increased from traditional Middle East supplier Qatar and from new projects in Australia and the US. The country already has ample LNG import capacity to replace coal and access to global LNG volumes as the current biggest recipient of growing US exports. Korea Gas Corp. is the dominant LNG importer, though other companies also receive shipments at two of the nation's six import terminals. South Korea's previous annual record of LNG shipments was set in 2013 when it faced a series of nuclear reactor shutdowns due to a safety scandal over faulty parts, leading to an increase in gas-fired power generation. Four of Korea's import terminals at Incheon, Pyeong-Taek, Samcheok and Tong-Yeong are operated by state-controlled Kogas and have huge storage tank capacity. The two other terminals are owned by a utility and an industrial company. The Boryeong

Diary of events

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June
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Madrid, Spain
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September
Gastech
17-19 September 2019
NRG Center, Houston, TX, USA
www.gastechevent.com

Japan LNG Producer-Consumer
26 September 2019
Conference, Convention Center, Grand Prince Hotel New Takanawa, Tokyo, Japan
www.lng-conference.org/english/

October
Singapore International Energy Week
29 October - 1 November 2019
Marina Bay Sands, Singapore
www.siew.sg



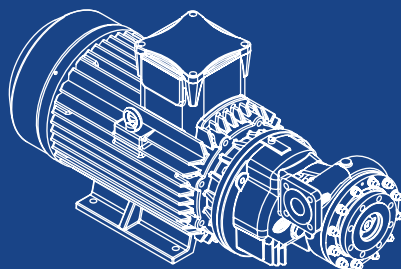
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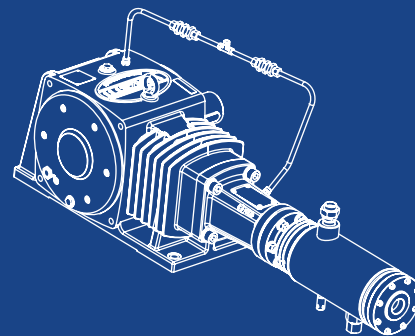
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terminal is operated by GS Energy and the Kwangyang facility by the steelmaker POSCO, whose shipments are organized by trading unit POSCO Daewoo.

SOUTH KOREA'S shipbuilding industry, the largest global constructor of LNG carriers, has just over a 50-50 chance of seeing the conclusion of a proposed merger between two of the nation's three largest shipbuilders, Hyundai Heavy Industries and Daewoo Shipbuilding and Marine Engineering. The merger is being planned by state-run Korea Development Bank, Daewoo Shipbuilding's main creditor, with ownership of a 55.7 percent stake. While KDB has agreed to sell its controlling stake in Daewoo Shipbuilding to Hyundai there are growing doubts about the transaction proceeding. KDB Chairman Lee Dong-gull is the architect of the Hyundai-Daewoo shipyard merger and he called for more progress in his plan to overhaul the industry amid growing opposition from labour unions. Unionized workers at Daewoo Shipbuilding have staged walk outs at the Geje shipyard and street protests have also taken place in the capital Seoul. The shipbuilding consolidation move comes as Qatar and other major LNG industry participants are planning a new round of orders for LNG carriers to transport additional global LNG production expected over the next five years. "This is the last chance to sell Daewoo Shipbuilding," stated KDB's Lee in a television interview. "We may have to wait another 20 years to see such a chance come again," said the bank's Chairman.

Lee explained that there were some obstacles hindering the deal, such as opposition from Daewoo Shipbuilding workers and regulatory approvals required from foreign competition authorities. "However, I see a more than 50 percent chance of the deal succeeding," stated Lee. If the takeover goes ahead, the South Korean shipbuilding industry would be dominated by just two major shipbuilders instead of three, the merged Hyundai-Daewoo and Samsung Heavy Industries. The shipbuilders, once a cornerstone of the country's economic growth, have suffered mounting losses in the past few years in an industrywide slump caused by an over-supply of vessels and tough competition from rival shipyards in China. Under the KDB deal outlined at the end of January, the bank would transfer its Daewoo Shipbuilding shares to Hyundai and also buy 1.5 trillion won (US\$1.35 billion) worth of Hyundai stocks to be issued later. The

state lender has also agreed to consider extending 1 trillion won (\$890 million) in financial aid to the new owner of Daewoo. In return, Hyundai would be split into two entities, with one part of it listed on the Seoul stock market. Should the bank's Hyundai-Daewoo deal proceed as planned, Hyundai Heavy Industries Holdings, the parent company of Hyundai Heavy, would hold a 26 percent stake in a new Hyundai shipbuilding entity, with KDB owning 18 percent and the shipbuilder itself owning 56 percent of the shares.

SOVCOMFLOT Group, the Russian shipping line with 12 liquefied natural gas carriers in its fleet, narrowed its annual net losses as charter rates improved for LNG and energy trading sectors amid continuing difficult conditions during mid-2018. SCF Group posted losses for 2018 of \$45.6 million compared with a loss of \$113M in the previous year. The company also made a fourth-quarter profit of \$11.9M versus a loss of \$106.2M in the same three months of the prior-year period. "There was a visible rebound in freight rates in the fourth quarter, reflecting a balancing between tanker supply and demand, following a sustained period of tanker fleet removals and an increase in crude oil demand from Asian refiners in particular," said SCF. The current fleet comprises 144 vessels with a total deadweight of 12.5 million tonnes and 80 of the vessels have an ice-class rating. The fleet services large oil and LNG projects at Sakhalin Island in the Russian Far East and other projects such as Novatek's Arctic Yamal LNG plant in Siberia and the Tangguh liquefaction and export facility in Indonesia. "The cooperation with Novatek has seen its further success, when the icebreaking LNGC 'Christophe de Margerie' loaded the first LNG cargo from Yamal LNG's third train," said Evgeniy Ambrosov, Senior Executive Vice-President for business development. "Our LNG carriers and 'SCF Melampus' started the open water ship-to-ship transfers of export cargo from Yamal LNG," added Ambrosov. "We are grateful to our clients for their loyalty and the responsibility entrusted to us for the safe transportation of their cargoes, however strong the winds are and thick the ice is," stated the SCF executive. SCF's President and Chief Executive Sergey Frank said the shipping line achieved solid operating and financial results despite another difficult year for the conventional tanker market.

"A strong performance from the group's gas and offshore divisions offset continued

weakness in the conventional tanker fleet over 2018 and helped drive the group's operating profit to \$187.3M," said Frank. "Looking forward, we remain firmly committed to growing our industrial businesses and this will be central to SCF's strategy through to 2025. The outlook for 2019 remains positive and our performance in the first quarter of 2019 has exceeded expectations," he added. The Russian company said it would take delivery of more ice-class LNG vessels during 2019. The company has additionally ordered newbuilds powered by LNG to meet global anti-pollution measures being implemented for ports and Emission Control Areas, underpinned by the International Maritime Organization's sulfur cap from 2020. "The world's first Aframax tanker to use LNG as her primary fuel 'Gagarin Prospect' (114,000 DWT) entered service in July 2018 on long-term time charter to Shell," said SCF. "In October, 'Gagarin Prospect' completed her first commercial voyage using LNG fuel, from Primorsk to Rotterdam as part of Sovcomflot's commitment to drive down tanker industry emissions," added the company. SCF also placed an order in December 2018 for three LNG-fuelled product tankers from the Zvezda shipbuilding complex in the Russian Far East. The 51,000-dwt series marks a step forward in the shipowner's fleet-renewal efforts, having previously ordered LNG-powered Aframax crude tankers. It is in the process of taking delivery of a series of LNG-powered Aframaxes from Hyundai Samho Heavy Industries in South Korea, which were ordered against long-term contracts with Shell. "Over 2018, we have implemented a series of projects in close cooperation with our partners," said SCF. "The start of commercial operations of our Aframax tanker series, with the flagship 'Gagarin Prospect', was the most conspicuous amongst them. This project was implemented with our partners Shell. Together we are leading the industry towards the adoption of LNG fuel," added SCF.

STENA BULK, the Swedish shipping line with 107 vessels in its fleet including three LNG carriers, has made a major investment in exhaust-cleaning technology to help meet the International Maritime Organization sulfur cap by 2020. Stena's three LNG carriers, the "Stena Blue Sky", the "Stena Clear Sky" and the "Stena Crystal Sky" will not be affected by the investment plans. The exhaust-cleaners, or scrubbers, are being installed in a total of

16 vessels. These comprise 10 tankers, five Suezmax ships and one standard medium-range tanker. "The total investment is worth \$55 million, including equipment, installation and time out of service," said Gothenburg-based Stena. "The payback time of investment is between 17 months and two-and-a-half years, which has already been secured by hedging the fuel spread," said Stena "Stena will comply with the upcoming IMO sulfur cap regulation, which limits the content in fuel oil used on board vessels globally to a maximum of 0.5 percent from today's 3.5 percent limit," said the company. "As a result of the new regulations the global shipping fleet will by January 2020 be required to either install scrubbers on board or to use a compliant fuel," added the company. Stena Bulk President and Chief Executive Erik Hanell remarked that the availability of low-sulfur fuel around the globe has now become a concern to many.

"We evaluated the different options and came to the conclusion that for our business by installing scrubbers we will secure greater availability of fuel for our vessels, and by doing so will limit our exposure to not finding the right fuel and will stay flexible in our trading," said Hanell. "Even doing so, we know it will require some changes and probably massive challenges in the planning and logistics," he added. Stena said the scrubbers to be installed are open-loop, hybrid ready with water cleaning, which not only removes the sulfur but also particles from the exhaust. "We have prepared our business teams to assure minimal-to-none disruption caused by the scenario we are now facing as from January 2020," said Hanell. "Going forward, our digital platform is one of many tools we will use to be able to confirm global supply to optimize the planning of our bunker operations, while supporting our commercial operations, bunker trading and chartering," he added.

TEXAS LNG, the export project proposed for Cameron County in the port of Brownsville, made more progress as the Federal Energy Regulatory Commission delivered a final environmental impact statement. "We determined that the impacts on the environment from the proposed project would be reduced to less than significant levels with the implementation of Texas LNG's proposed impact avoidance and minimization," said the FERC. The Texas LNG terminal would be constructed in an area currently zoned for industrial use along the existing



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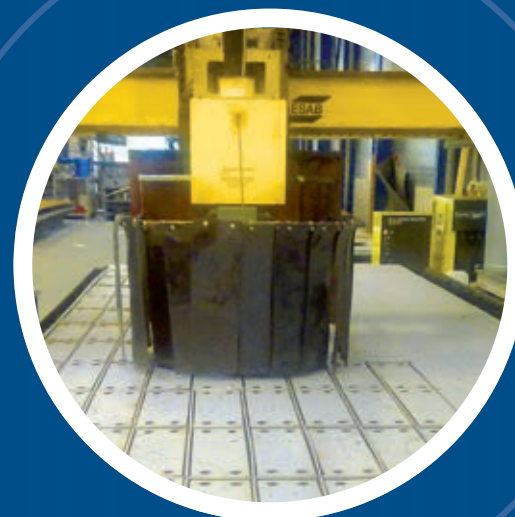
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Brownsville Ship Channel. The project is designed to produce up to 4 million tonnes per annum of LNG, which is around 550 million cubic feet per day of natural gas. Texas LNG, whose development is led by industry veterans, Chief Executive Vivek Chandra and Chief Operating Officer Langtry Meyer, is one of several ventures planned for the Brownsville area. The project involves building two liquefaction Trains and support facilities as well as two LNG storage tanks, each of around 210,000 cubic metres capacity. The LNG carrier berthing dock will be capable of receiving vessels with capacities of between 130,000 cubic metres and 180,000 cubic metres. “We look forward to receiving FERC approval in the next few months which is one of the important steps to allow construction to begin and LNG production to commence by 2024,” said COO Meyer. “This project will bring jobs and investment to Cameron County and deliver clean, safe, abundant Texas natural gas energy to the world,” he added. A final investment decision for Texas LNG is scheduled to be taken in the months ahead and is contingent on factors such as completing the required commercial agreements and obtaining financing.

Samsung Engineering of South Korea will provide all technical and engineering services for the project and is expected to take a minority stake in the venture. The development will involve Samsung ordering liquefaction modules to be fabricated elsewhere and transported to the site. “Off-the-shelf technology will be used for both the liquefaction process and the gas treatment plant that will be built on site to treat pipeline feed gas by removing any remaining natural gas liquids and other non-methane products before the liquefaction process,” said the company. In addition to Texas LNG, at least two other firms also want to build export facilities at Brownsville, Exelon Corp’s Annova Brownsville project and NextDecade Corp’s Rio Grande project. The US Coast Guard also issued a letter of recommendation indicating that the Ship Channel would be considered suitable for the projected LNG marine traffic associated with the project. The US Department of Transportation stated that it had no objection to Texas LNG’s methodology to comply with siting requirements for the terminal. However, it was also acknowledged by the regulator that there could be some cumulative environmental impacts from several LNG export projects operating in the area. “The Texas LNG Project, combined with other

projects in the geographic scope, including the Rio Grande LNG and Annova LNG projects, would result in significant cumulative impacts from sediment-turbidity and shoreline erosions within the Brownsville Ship Channel during operations from vessel transits,” noted the regulator.

TOTAL, the French energy major, has signed agreements with Russian natural gas company Novatek, operator of the Yamal LNG export plant, for the acquisition of a direct 10 percent stake in the Arctic LNG II joint venture proposed by Novatek for Russia’s Gydan Peninsula. Total already owns a 19.4 percent stake in the Novatek company so its 10 percent direct stake gives it 21.6 percent of the Arctic LNG II project, while Novatek intends to retain 60 percent of the venture. “Should Novatek decide to reduce its participation below 60 percent, Total will have the possibility to increase its direct share up to 15 percent,” said the French company. The Arctic LNG II project’s final investment decision is expected to be taken in the second half of 2019, with plans to start up the first liquefaction train in 2023. The Arctic II venture will have three Trains, each with a capacity to produce around 6.6 million tonnes per annum. The Trains will be installed on Gravity Based Structures (GBSs) made of concrete and including LNG storage facilities totalling 687,000 cubic metres capacity. “We are delighted to have concluded the definitive agreements for our entry into this new world-class LNG project based on the vast Russian gas resources alongside our partner Novatek,” said Patrick Pouyanne, Chairman and Chief Executive of Total. “Arctic LNG II builds on the success of Yamal LNG and will introduce several innovative solutions to further increase competitiveness,” added the Total CEO. “It fits into our strategy of growing our LNG portfolio through competitive developments based on giant low-cost resources primarily destined for the fast growing Asian markets,” stated Pouyanne. With total production capacity of 19.8 million tonnes per annum, or 535,000 barrels of oil equivalent per day, Arctic LNG II will develop huge resources in the Utrenneye onshore gas and condensate field.

The developers have said that Arctic LNG II production would be delivered to international markets by a fleet of ice-class LNG carriers using the Northern Sea Route and a trans-shipment terminal in Kamchatka for cargoes destined for Asia

and one close to Murmansk for those cargoes destined for Europe. Novatek started operations at the Yamal plant in December 2017 and already has all three LNG Trains in operation to produce its nameplate capacity of 16.5 MTPA. It has also made progress on its second venture with the awarding of equipment contracts for Arctic LNG II. German power equipment-maker Siemens signed a contract on providing compressors for three liquefaction Trains planned for the new plant. The scope of supply under the contract includes three feed-gas compressors and six boil-off gas compressors. The document also provides for Siemens to localize the equipment fabrication for the project’s third train in Russia. Saipem, the Italian energy and LNG engineering company, was awarded one of the first main construction contracts in December 2018 with Renaissance, a Turkish oil and gas services company. That contract is worth around \$2.5 billion and involves the design and construction of the platform-based venture. The Trains and storage will be on three 30-metre high concrete GBSs on a surface area of 330 metres by 52 metres. These concrete GBSs will be fabricated in two dry docks in a Novatek-provided facility in the Russian port of Murmansk. Subsequently, they will be towed and installed in Gydan.

TRANS GAS Solution, the South Korean engineering company and its partners in a joint project have received approval in principle from the maritime classification society Korea Register for the design of a liquefied natural gas bunkering barge. The company said that the LNG bunkering barge was expected to supply LNG to ships that will operate off the coast of Korea starting from 2022, after being built by the first half of 2021, tested and commissioned. The approved LNG bunkering barge, which is itself powered by LNG, is a 48.5-metre vessel with an IMO Type-C pressurized fuel tank and storage capacity of 500 cubic metres. Korea’s bunkering barge design additionally includes other advantages such as a low-pressure LNG fuel gas supply system. The LNG bunkering barge project is a joint venture supported by the Korean Ministry of Maritime Affairs and Fisheries and the Korea Research Institute of Ships & Ocean Engineering. The initial barge model called, KOLT-05B, consists of a bunkering arm that can bunker LNG and is configured to handle evaporative emissions.

Furthermore, by supplying power

required for operations via the gas engines, the vessel meets all of International Maritime Organization’s air pollutant emissions regulations in regard to sulphur dioxide, nitrogen oxide and carbon dioxide. “The development project provides LNG bunkering facilities along the Korean coast in response to increasing demands,” said Trans Gas Solution. The other project participants include steel-maker POSCO, EK Heavy Industries of South Korea, local firm Mytec based in the port of Busan and Korea’s Valmax Technology Corp. Trans Gas Solution is in charge of the main control systems of the vessel, including the cargo-handling system.

US natural gas production in the Mid-Atlantic and Ohio region from the Marcellus and Utica shale basins is continuing to grow, resulting in adequate domestic supplies being available in the northern region and feed-gas been transported south for LNG plants on the Gulf Coast. “LNG exports continue to grow, averaging 14 billion cubic feet per day by 2030,” according to the annual outlook of the Energy Information Administration. “In addition to increased US LNG exports from Gulf Coast facilities, both US natural gas pipeline exports to Mexico and US natural gas consumption in the industrial and electric power sectors also increase during the projection period,” added the EIA. “As a result, the South Central region is projected to become the fastest-growing demand market in the US,” stated the EIA report. The report explained that while the South Central region itself contains shale plays that produce natural gas, such as the Wolfcamp in the Permian Basin and the Haynesville Shale, natural gas consumption in the region outpaces production in the reference case. “This requires additional supplies of natural gas from other regions to meet growing demand both within the region and for liquefaction facilities that export natural gas to other countries,” said the EIA. Total US dry natural gas production across most cases in the outlook is driven by continued development of the Marcellus and Utica shale plays in the East region.

“In the reference case, natural gas production reaches nearly 120 billion cubic feet per day (Bcf/d) by 2050 compared with 75 Bcf/d in 2017,” said the EIA. Shale-gas production in the East accounts for over half of this growth as output more than doubles during the projection period from 24 Bcf/d in 2017 to 50 Bcf/d in 2050. “This forecast growth is driven by technological advancements and

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improvements in industry practices, which lower production costs and increase the volume of oil and natural gas recovery per well,” the EIA explained. “In the reference case, these advancements have a significant cumulative effect on plays that extend over wide areas that have large undeveloped resources, such as the Marcellus and Utica,” said the report. Flows of natural gas into the Northeast in 2008 averaged 12 Bcf/d. However, by 2013, these volumes had dropped to 5 Bcf/d, and today the region is a net natural gas exporter, primarily to the Eastern Midwest. “This reversal of flows was accompanied by increased bi-directional capacity on interstate pipelines and by new pipeline capacity to transport increased natural gas supplies from the Marcellus and Utica Basins to domestic and international demand markets,” said the report. “From 2008 to 2018, pipeline capacity out of the Northeast, which includes both the Mid-Atlantic and Ohio region and New England, grew from 5 Bcf/d to 23 Bcf/d,” it added.

VENTURE GLOBAL LNG said it planned to expand the scope of its LNG development business on the US Gulf Coast to 60 million tonnes per annum of production based on customer demand, almost doubling current plans for 32 MTPA of output. The company’s proposed liquefaction and export plant at Calcasieu Pass in Louisiana has current nameplate export volumes of 12 million tonnes per annum and is expected to come on stream in 2022, along with associated facilities, including the TransCameron Pipeline. Venture Global, owned by former investment banker Michael Sabel and lawyer Robert Pender who act as joint chief executives, is also constructing a second plant at Plaquemines near river mile-marker 55 on the west side of the Mississippi River, 30 miles south of New Orleans. The Mississippi River project has current output targets of 20 MTPA of LNG and was set to include small-scale liquefaction Trains, four LNG storage tanks and three marine loading berths. However, the company now says it is increasing the size of its 2016 process equipment supply agreement with Baker Hughes-GE to 60 MTPA, under which BHGE will deliver a comprehensive technology solution for Venture Global’s two LNG export facilities. “The agreement provides for the guaranteed supply of highly efficient and reliable modular liquefaction trains plus power generation and electrical distribution equipment that

will be standardized across the company’s Calcasieu Pass, Plaquemines LNG, and expansion projects,” said Venture Global.

The company said that with this expanded 60 MTPA commitment from BH-GE it can expand its business to meet the increasing demand from international customers. “Having fully contracted Calcasieu Pass and anticipating completion of Plaquemines LNG, we are pleased to announce this expansion to meet additional customer demand,” said Co-CEOs Pender and Sabel. “We believe our model of mid-scale modular liquefaction is the future of low-cost LNG production,” they added. Venture Global noted that the Calcasieu Pass project with its planned 10 MTPA of output has received all federal authorizations. The project’s engineering contractor, Kiewit Energy of Omaha, Nebraska, is mobilizing its workforce for the start of site preparation and construction. The Calcasieu Pass plant has signed binding 20-year sale and purchase agreements with companies such as Royal Dutch Shell, BP of the UK, Italian utility Edison, Portugal’s Galp Energia, Repsol of Spain and Poland’s national oil and gas company. The Plaquemines project is expected to receive its final regulatory authorization in August and commence construction later in 2019.

WOODSIDE, the Western Australian liquefied natural gas producer, said its Burrup Hub for LNG is making progress with plans for third-party participation in liquefaction and pipelines, LNG maritime fuel availability for big ore carriers headed for Asia and truck-loading for remote users in the Outback. The plans for the combined Scarborough gas field and Browse Basin gas resources offshore Western Australia were presented at a conference by Meg O’Neill, Chief Operations Officer of Woodside Energy. “We are proposing the development of some 20 to 25 trillion cubic feet of gross dry gas resources, more than the entire volume processed through the Karratha Gas Plant since its start-up in 1984,” said O’Neill in outlining the scale of the project to the Australasian Oil and Gas Exhibition & Conference in Perth, Western Australia. In the first phase of the development, Woodside is bringing the Scarborough resources to the existing Pluto LNG plant where a second Train will be built and has already started front-end engineering and design activities on the upstream portion. “Work is already underway on the design of a second LNG train at Pluto,” said O’Neill. “We also

propose to bring the Browse resources through 900km of subsea pipeline to the North West Shelf’s Karratha Gas Plant,” she added in reference to the existing North West Shelf LNG plant. “This makes commercial sense because it optimises the emerging capacity in the Karratha Gas Plant and provides a cost-effective approach for LNG production from Browse,” stated the COO. The overall plan includes building a pipeline linking Pluto and the Karratha Gas plant for North West Shelf LNG, creating an integrated 7-Train LNG production centre on the Burrup Peninsula, using six existing Trains.

“And we are looking to open up those facilities to other players,” explained the Woodside executive. “By bringing the Scarborough and Browse resources through these facilities as anchor tenants, we will be in a position to facilitate the potential development of smaller gas reserves that would otherwise be stranded,” she said. “Such arrangements are common overseas. In the North Sea and in the Gulf of Mexico, operators, contractors and service firms are developing new business models as a way to lower costs and keep the local industry moving forward,” added O’Neill. “But it’s the first time in Australia that gas processing facilities have been opened up to other resources,” she said. LNG maritime fuel and truck-loading services are also being developed at the Burrup Hub and Woodside said these were growing sectors of the industry. “The International Maritime Organisation’s 2020 deadline for low-sulphur marine fuel approaches,” said O’Neill. “Woodside has been talking to the big miners about using LNG to fuel the busy marine trade routes from Western Australia to Asia and we are tendering for a bunkering vessel to ensure the ships can be readily refuelled in Western Australia, using Western Australian LNG,” she said. The company also said that in addition to its new natural gas pipeline, Woodside would soon open its LNG truck-loading facility at the Pluto plant. “It will supply LNG as a locally-produced lower-emissions fuel to customers and communities in remote areas across northern Western Australia,” said O’Neill.

WOODSIDE said it had made investments in two online LNG trading and data platforms in a move to bring greater price transparency, efficiency and compliance to markets. “The platforms will support the evolution of the LNG trading market and the provision of precise real-

time information, enabling market participants to more effectively match supply with demand under clearly defined governance frameworks,” said Woodside. The platforms, the existing GLX company and newly launched Gastrayda firm, have both been started in Australia and include former employees of Woodside and other regional energy companies. GLX was launched in 2016 and its LNG trading platform became operational the following year. Damien Criddle, a Perth-based executive and former Royal Dutch Shell lawyer, launched the GLX platform with other energy executives, including Rob Cole, an ex-Woodside director. Woodside became a foundation member of GLX in July 2017. GLX now has 55 members from around the world signed up under a clearly defined governance framework. “Woodside has now become an equity investor to further support GLX as it seeks to deepen its trading relationships in the LNG sector,” said the Perth-based company. The Perth oil and gas company said it would also look to support GLX by facilitating the trading of LNG cargoes on the GLX platform where the opportunity arises.

Gastrayda is a start-up that is preparing for commercial launch. It is described as an LNG trade management and compliance platform that caters for the complex pricing associated with LNG cargoes and enables real-time comparison of competing cargo trade options. Woodside has provided technical know-how and support to Gastrayda and now becomes a warrant holder, giving Woodside the option to become an equity investor. Woodside will look for opportunities to use the platform following commercial launch. The LNG operator and exporter emphasized that both GLX and Gastrayda would remain independent platforms.

Woodside CEO Peter Coleman said the platforms both originated in Western Australia and deserved the company’s support. “As the pioneer of the Australian LNG industry, Woodside is proud to be supporting two homegrown technology solutions that promote a market that is more efficient, transparent and compliant for buyers and sellers,” Coleman explained. “As the LNG market continues to evolve, we see a place for long-term and mid-term contracts as well as transparent and efficient spot trading on technologically advanced platforms,” he added. “These sorts of platforms provide an additional tool for producers to market and manage their volumes and for buyers to manage their supply requirements,” stated Coleman. ■



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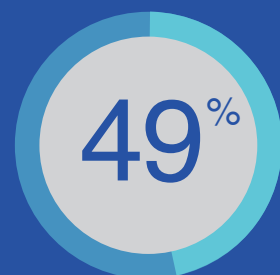
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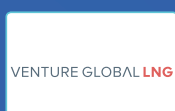
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LNG bunkering is expanding gradually with a fleet of small ships and shoreside infrastructure

The number of vessels needing the fuel will number over 420 by 2026 and is set to grow as older vessels are replaced

There are 16 ports offering bunkering in Europe for the LNG fuel sector and the number is likely to rise steadily as new ports add services in the coming few years.

Their ease of use and scalability means road trucks are currently also used most often to offer LNG bunkering to vessels running on the fuel.

Coastal

For small bunker vessels and other shipping applications operating close to the shore, such as tugs, trawlers and dredgers, truck-loading may continue to be the best way to supply LNG as a fuel to these vessels.

However, for larger vessels and those that cannot easily come into ports there is already a developing market for ship-to-ship (STS), and in some ports pipe-to-ship, bunkering services.

If the huge, intercontinental vessels that drive world commerce begin running on LNG too in order to meet the International Maritime Organization's 2020 cap on sulphur, it is likely that waterborne LNG bunkering, rather than land-based, will become the norm.

For larger vessels, which may require up to a dozen trucks of LNG to load their tanks, the advantages of loading either from a vessel with far greater capacity, or even directly from the tanks of a regasification terminal are clear.

A fast-growing part of the northwest European small-scale LNG sector is river barges, which allow LNG to make its way along inland waterways and could be a good link between truck-loading and seagoing STS.

Companies such as Titan LNG are pioneering these types of vessels in and around Amsterdam, Rotterdam and Antwerp.

Small-scale, seagoing vessels connecting markets without bulk LNG infrastructure are another feature. Rail is also being pressed into service to carry LNG.

There were about a dozen vessels involved in transporting and distributing LNG in the small-scale sector in Europe, although the number is rising. It is not just the number of vessels, equally significantly is their growing size which highlight vividly the investments that both the gas and the shipping sectors are now making.

Europe's first bunker vessel, the "Sea Gas", has been in operation in Stockholm since 2013.

Near-shore

Other recent near-shore bunkering vessels such as the "Oizmendi" and "Bunker Breeze", both of which operate in Spain, each have a capacity of 600 cubic metres and have come into operation in the last couple of years.

A range of vessels of between 5,000-18,000 cubic metres capacity have also entered operation in recent years.

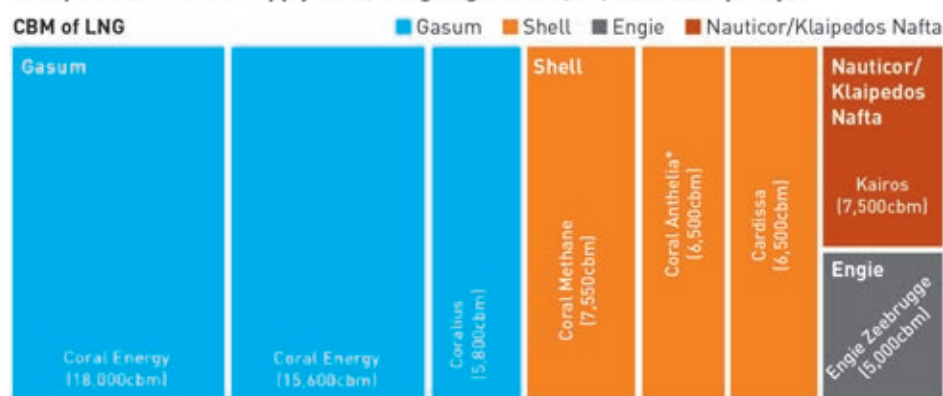
At the smaller end of the market there tend to be bunker vessels that offer LNG as a fuel, while at the larger end there are feeder vessels that transport LNG, usually from large-scale terminals, to smaller distribution points, although some in the fleet are multi-purpose vessels that can perform both roles.

In 2017, Royal Dutch Shell unveiled its first dedicated LNG bunker vessel, the "Cardissa".

Larger

At 6,500 cubic metres capacity, this ship was designed and built predominantly to supply the nascent northern European LNG bunker market and was around 35 times the size of the early vessel "Sea Gas" and more than 10 times the size of the Spanish vessels.

Europe's small-scale supply feet (sea-going vessels, >5,000CBM Capacity)



*Coral Anthelia is believed to be with Shell but not confirmed
Vessel can also be used to carry ethane as well as LNG.

Source: ICIS, vessel operators and charterers

Small-scale vessels already offering LNG as a maritime fuel

The scales will tip further in 2020 when French oil major Total takes delivery of its first LNG bunker ship, a vessel with a capacity of 18,600 cubic metres capacity underpinned by a 0.3 million tonnes per annum contract to supply French containership operator CMA CGM.

Another Shell vessel, the 7,550 cubic metres capacity "Coral Methane", has been used to refuel cruise liners as far south as the Canary Islands on several occasions.

The 5,000 cubic metres capacity "Engie Zeebrugge" is a bunker vessel operating out of the port of the same name, while the 5,800 cubic metres capacity "Coralus" operates as a bunker-feeder (essentially a gas transporter) vessel in Scandinavia for Finland's Gasum.

Most recently, further competition has come to the Baltic region in the shape of the 7,500 cubic metres capacity "Kairos". Operated by a consortium led by Hamburg-based Nauticor (part of Linde Group), the vessel started supplying LNG at the start of the year.

Until now, ship owners have been reluctant to invest in LNG-fuelled tonnage due to a lack of available LNG supply infrastructure, while LNG suppliers have held off investing in infrastructure such as bunker vessels, because of insufficient demand.

Agreements

Total's deal to supply CMA CGM from 2020, and a deal thought to be of a similar size between Shell and Russian fleet

operator Sovcomflot, for which supply began in 2018, appear to have deepened the market.

As one fleet operator recently explained, it used to be that no owner would commission an LNG-powered vessel without first having negotiated a supply contract.

Now, LNG-powered vessels are being ordered without supply contracts, such is the confidence that supply will be forthcoming from a variety of LNG sellers.

The signing of other long-term LNG bunker deals can only deepen further the pool of LNG as a ship fuel in Europe.

Aside from vessels offering STS services, other classes of vessel of this size are in operation as supply vessels, effectively mini tankers.

Chartered

The 18,000 cubic metres capacity "Coral EnergIce" and the 15,600 cubic metres capacity "Coral Energy" are both chartered by Finland-based Gasum.

They are employed to transport LNG from large terminals such as Gate in Rotterdam and Belgium's Zeebrugge to smaller storage and distribution facilities such as Gasum's plants in Sweden at Lysekil and Ora and in Finland at Pori and Manga, as well as taking on LNG from Gasum's own small-scale liquefaction terminal at Risavika in Norway.

As a road fuel, LNG already has many admirers in western Europe, and manufacturers like Scania, Iveco and Volvo already make LNG-powered engines.

A fast-growing part of the northwest European small-scale LNG sector is river barges

Its success in parts of Europe further from the coast is taking more time.

However, the potential for big uptake of LNG is high, especially if the European road transport network starts to appreciate LNG as a means of reducing the noisiness of trucks, something that is becoming a big area of contention in Austria, for example.

In industry, LNG has cost benefits over LPG for heavier users that outweigh its higher installation costs.

But it is the bunkering sector where there is arguably the most scope for volume growth.

The decision of the IMO to limit the sulphur content of ship fuel to 0.5 percent worldwide, and a further ambition to reduce greenhouse gas emissions by 50 percent by 2050 have the potential to become game changers.

Competition

Although LNG is not the only fuel being considered to deal with the effects of the IMO's rules, it is a frontrunner because of its scalability and the existence already of a wide LNG supply network.

Other options being considered by ship owners range from more conservative ones, such as low sulphur fuels and the fitting of scrubbers to remove and store the most harmful emissions.

Methanol and LPG are under consideration, but offer less power output than marine fuels and LNG. Longer term, large-scale hydrogen fuel cells have potential, but are far too immature to be viable now.

LNG scores well against all of these options because although it is more expensive to implement than continuing to use low-sulphur fuels or scrubbers, at least initially, some modelling suggests it sees savings on a longer-term basis.

Just as importantly, LNG supply is already greater than global shipping can consume, even if the entire global fleet were to run on LNG, according to calculations by European classification society DNV GL.

Supported

As a much lower emitter of greenhouse gases than conventional fuels, LNG has won financial support from the European Union, in the form of EU Directive 2014/94 on the deployment of alternative fuels infrastructure (Clean Power for Transport).

This directive aims to establish the infrastructure needed to supply LNG as fuel to the maritime sector.

Its negligible emissions of sulphur

oxides, nitrogen oxides and particulate matter have made it favourite to replace heavy fuel oil in tankers and cruise ships around ports.

Nonetheless, the CO₂ emissions associated with burning natural gas are also around 30 percent lower than those of traditional fuels and derivatives.

In the deep-sea shipping sector, which features large, oceangoing vessels covering long routes, often without a regular schedule, the most important parameter is fuel availability in all ports of call.

This sector is likely to be influential in dictating uptake of LNG as a bunkering fuel.

By the end of 2019, there are expected to be 256 LNG-fuelled and LNG-ready vessels in operation.

The class society calculates that in 2019 a further 63 LNG-fuelled vessels will be on order, pushing the number of LNG-fuelled vessels to more than 420 in total by 2026.

This paper looks at Europe, but the investments in bunkering are not confined there.

Significant investments in LNG bunkering have also been announced in Singapore and Oman, to name just two.

This will have to happen if bunkering trends established in Europe are indeed to go global, which is essential if LNG is seriously to emerge as a viable alternative to low-sulphur marine fuels in the post-2020 environment. ■

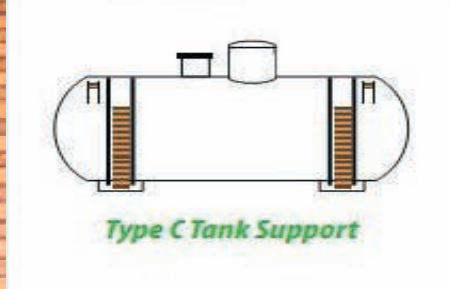
The article is based on extracts from a report by the international petrochemical industry data company ICIS and its analyst Rob Songer.



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Norwegian firm points to LNG fuel growth for vessels through better gas system integration

Peter Morsbach, Director of Projects, Høglund Gas Solutions

The growth of the LNG-powered shipping sector is at new highs and orders for LNG carriers that deliver the fuel are also rising at South Korean shipyards.

Demand for LNG in China has led to the introduction of two entirely new vessel classes, a mid-sized vessel with 40,000 cubic metres of capacity called the Wuhumax, and a smaller version, the Wuhanmax, with 28,500 cubic metres of capacity.

Alternatives

The viability of LNG as an alternative fuel to Heavy Fuel Oil (HFO) is growing, with new infrastructure projects cropping up at a steady pace.

Indeed, the Port of Rotterdam estimates that by 2020 it will have granted nine licenses to LNG bunker providers to operate at the port.

Technical expertise in LNG-fuelled vessels is also developing quickly.

According to the industry alliance, Sea-LNG, the high capital costs of LNG engines and fuel tanks that used to be a barrier to adoption has diminished, with much smaller premiums from shipyards on LNG newbuilds compared to traditional vessels.

As yards gain LNG experience and technology improves, the case for investing in LNG increases.

As the sector grows, the challenges that suppliers to the sector must resolve have become increasingly complex.

Handling

Retrofits must integrate LNG handling systems and tanks within the hull of ships designed for a completely different fuel; a challenge that is particularly difficult within the cruise sector.

Newbuilds and retrofits alike are under pressure to be cleaner than the generations of vessels that have preceded them, minimising boil-off gas and methane slippage, and in some cases, being ready to run on biogas. And at the same time, the vessels we create must fit in with a wider infrastructure that is evolving rapidly.

Overcoming these challenges requires collaboration, innovation and co-operation between a broad range of

stakeholders - owners, yards, operators, designers and more.

Similarly, on board an LNG carrier, or LNG-fuelled vessel, all the systems involved need to interact effectively. However, this often doesn't happen.

Typically, systems integration is seen as a low-priority item. Compounded by a lack of expertise at the design stage, the solutions used are typically standard packages, each coming with its own stand-alone automation. This leads to a large number of interfaces, respectively high costs and an increase in potential failure sources.

There are few standards that specify the level of detail required in systems integration; standards that would make sure that data is not lost when systems are just interfaced, or that could ensure that it is easy to play back logs of incidents or failures.

Standards

The recent ISO standards for LNG bunkering are a welcome start. ISO 20519 aims to align safety standards by ensuring a common set of requirements on hardware (liquid and vapour transfer systems), operational procedures, and the requirement for LNG providers to provide an LNG bunker delivery note.

However, these requirements are necessarily fluid - at such an early stage, future revisions will be necessary to include any likely lessons learned and technological developments that may occur.

In terms of sharing knowledge between owners, designers, operators and suppliers, there is much more that could be done to align standards in service of building a safer, cleaner, more reliable segment from the ground up.

Because of this, it falls to suppliers to raise awareness of the importance of the systems that handle LNG, and the way they share information.

At Høglund, we've been at the forefront of the development of these systems.

Dedicated

Drawing on decades of expertise in automation systems, we prioritise the same principles of integration and



Systems installed on Babcock Schulte Energy's vessel 'Kairos'

interoperability, attention to detail, and easy access to data in gas handling that we have applied in our work elsewhere.

In 2017, we established Høglund Gas Solutions, a dedicated business entity specialising in the design and delivery of gas handling systems, such as Fuel Gas Supply Systems (FGSS) and Cargo Handling Systems (CHS).

One area that exemplifies the complexities of this segment and the need for specialist expertise is the LNG Bunkering Vessel (LNBV) segment.

At Høglund, we've been leading the development of these systems from the start, with automation deliveries to the pioneering LNG bunkering vessel "Sea Gas" for Sirius Shipping in 2013.

Since then, our systems have been installed on Shell's "Cardissa" and most recently Babcock Schulte Energy's "Kairos".

Control

LNBVs use boil-off gas in their engines, a process which is managed by a fuel gas control system. LNBVs may also extract vapour from receiving ships to use as fuel.

Despite this, there is currently no requirement for additional integration between the gas handling system and the rest of the ship. The consequence is increased complexity when commissioning the vessel, during its

future service, as well as lower safety and functionality during operations.

It also makes it harder to extract necessary and useful data from such fragmented systems.

On all of the LNBVs we've worked on, we've had to work closely with our partners to design the systems we supply to fit the project, and integrate systems as coherently as possible within the parameters of each project.

Adapting

Throughout the design, build and testing phases, we've worked to adapt our solutions to the unforeseen challenges that may occur when engineering a new vessel segment.

Working on these vessels and seeing the evolution of the LNG shipping sector gives a unique view into some of the wider challenges that attention to detail and dedicated expertise in automation and gas handling systems can help to solve.

We see great further potential for improvement if systems integration, with a focus on what is important for the future operation, is considered early in the design stage.

One such challenge that is yet to be fully appreciated by the industry when it comes to bunkering is fuel quality.

The industry is acutely aware of the need for increased transparency and trust in the marine fuels supply chain, with

Intertanko warning last year of an “epidemic” of bad bunkers.

With 2020 months away, the need to prove that fuel is compliant is spawning a flourishing number of technologies and start-ups aimed at increasing quality along the supply chain.

Perhaps it's because it's always been seen as the cleaner alternative to HFO, LNG seems to have escaped the same scrutiny, with many in shipping less aware that LNG can come in many forms, with fuel quality variations.

Compliant

For example, the methane number of LNG around the globe is highly variable. This has an effect on the engines of vessels that use it, which will be designed to handle gas at specific methane numbers.

If the methane number of the fuel is wrong, this can cause knocking, and damage the engine. This then can lead to expensive insurance claims, in which it is necessary to prove that the vessel was supplied with compliant fuel.

Automation and gas handling systems

have the potential to provide essential data in proving accurate quality and quantity data.

This is why it's vital to ensure that the systems we create prioritise the handling not just of gas, but also of data.

There's a role to play, for example, for a Custody Transfer System (CTS) to measure the quality (and quantity) of LNG being bunkered.

There is similar potential for operational improvements when it comes to the design and specification of Fuel Gas Supply Systems (FGSS).

Fully integrating FGSS with other on-board systems such as power management, alarm systems, fire and gas detection and emergency shutdown system, and an overarching IAS can achieve greater reliability and control over the system.

Operational

Integrating the FGSS to the IAS gives visibility into the complete gas storage and processing - affording more scope to customise and fine-tune.

It also provides the ability to identify

the source of an operational issue, isolating the source of the problem and then creating a strategy to address it.

Making the most of the data and information within LNG handling systems doesn't just help with fuel quality; Høglund ensures that users of our systems can access the potential goldmine of data they generate.

This can take the form of logging and playback systems, which record all inputs and outputs for a system. It allows users to play back events and analyse them, which is invaluable for diagnostics, optimisation and bug-fixing.

When it comes to LNG - and particularly bunkering systems, multiple different suppliers will tend to be involved, so it's vital that our systems can talk to each other.

It's essential that the systems we create are not “black boxes”, but utilise common open standards for information sharing.

It's also important that we create solutions that reduce the number of interfaces between items when sharing data.

The more interfaces in a system, the greater risk that signals and information will be lost, decreasing efficiency - not to mention adding to the complexity and cost of a project.

Specification

All of this can be addressed at the design stage - or in the case of a retrofit, the specification stage. In the marine sector overall, this is typically where the problem lies.

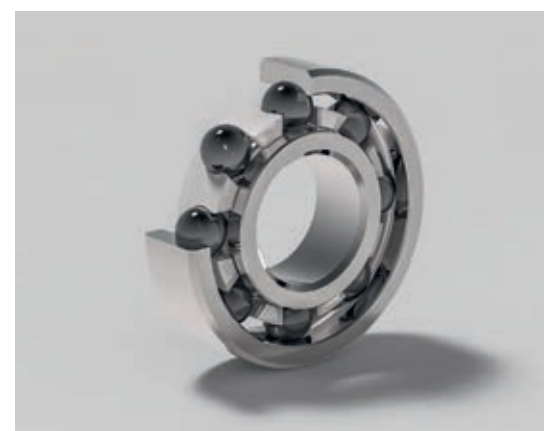
Between owners, yards and designers, there is little understanding of automation and systems integration, and the difference that a considered approach can make to the issues raised above.

The coming year may be the most important for LNG yet, but there's no reason to think that there isn't much further to go.

As the development of the sector accelerates, it's vital that that owners, operators, yards and designers further raise and align standards of system integration, delivering long-term benefits for the safety, reliability, and efficiency of the sector. ■

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French storage tank technology company GTT caters for ships requiring small fuel quantities

The GTT package for storage of gas for LNG propulsion is making market progress

With the rise in the use of LNG as a maritime fuel, the shipping industry requires new cryogenic storage solutions which are both compact and easy to install on vessels.

In response to this demand, Gaztransport and Technigaz (GTT), the Paris company listed on the Euronext exchange, has now fully developed its LNG Brick® technology after completing a successful test campaign.

Concept

GTT is taking the Bick concept forward and is also signing commercial agreements with other companies in nations where LNG-powered vessels will be constructed and LNG fuel will be available.

The French company and Dongsung Finetec, the South Korean company specialised in thermal insulation, signed a memorandum agreement in October 2018 to commercialise GTT's LNG Brick technology.

GTT and Dongsung Finetec wish to promote the innovative and promising Brick for LNG as a fuel application.

The LNG Brick will eventually be built by Dongsung Finetec and will be outfitted on a large range of commercial vessels such as container vessels, bulk carriers and car carriers.

GTT has developed the Brick technology based on its integrated tank techniques and notably its Mark III technology to offer a cost effective and competitive solution to this new market with an LNG fuel

tank capacity below 3,000

LNG Brick is a package for storage of gas for propulsion dedicated to ships requiring a small quantity of LNG

cubic metres capacity.



Membrane tank construction and the LNG Brick prototype were at the heart of the latest GTT solution

Dongsung Finetec has been closely associated in its industrialisation through the construction of a prototype.

The tests, carried out under cryogenic conditions, have demonstrated the satisfactory performance of this new system.

Integrated

LNG Brick is a package for storage of gas for propulsion dedicated to ships requiring a small quantity of LNG (less than 3000 cubic metres). It includes storage and the gas preparation room. LNG Brick is delivered as a block ready to be integrated into the ship structure.

The first step is standardisation. The concept is intended to keep the design as simple as possible without jeopardising a customer's requirements.

Unlike the typical membrane design that allows complex geometries, the Brick is limited to cubic tanks, which limits the number of references and simplifies its installation.

Besides, the tank will keep full flexibility on its three main dimensions (length, breadth, height) thanks to a specific arrangement and a "set-up area".

When a cubic design is required,

this means that the tank can be adapted to the exact dimensions required by the vessel arrangement.

The reduction of the number of references is possible thanks to a new panel arrangement where a set-up area is located in the middle of the tank.

The panel arrangement outside this set-up area is standard and will contribute to reducing the required engineering for the membrane design.

Below 3,000 cubic metres, a lot of LNG fuel tanks will be installed in a box space with rarely any need for complex geometry. Of course, current membrane technologies remain more relevant for projects requiring complex shapes in order, for example, to optimise the LNG fuel tank capacity.

Concentrate

A second step is to concentrate the construction of Brick on companies already experienced in membrane tank use.

As an order of magnitude, in a suitable location it can take a skilled team up to three times less time to build a membrane tank compared to newcomer crews working in a location where working constraints are complex.

In this way, construction cost will be significantly reduced. Moreover, by concentrating the erection on a limited number of companies, investment in tools and training of welders and bonders will

be amortised on more projects, leading to a dilution of fixed cost.

Delivery

Additionally, the LNG tank will be delivered already outfitted and tested, no specific knowledge on the membrane will be required by the shipyard.

This new technology is therefore very accessible and any shipyard could consider it.

The Brick has also been designed to bring operational flexibility in simplifying pressure management and increasing autonomy.

Firstly, Brick boasts a high volumetric efficiency. For instance, compared to independent type C tanks, it is possible to load 50 percent to 100 percent extra LNG fuel in the same given space.

It means that the vessel autonomy could be significantly increased, allowing operational flexibility and extended availability of the vessel. Therefore, the ship-owner will have more options when considering its bunkering strategy.

The maximum setting pressure of Brick is increased in order to ensure more than 15 days of holding time (tank closed).

Regulations

Since the IGC code and now the IGF code historically limit the maximum pressure in the membrane tank to 0.7 barg, the main challenge of this pressure increase

has been the regulatory aspect.

GTT has demonstrated with class societies the feasibility and has now been endorsed by approvals in principle from classification societies such as DNV, the American Bureau of Shipping, Lloyds Register of the UK and France's Bureau Veritas.

Moreover, a pressure test under cryogenic conditions was performed on the Brick prototype, demonstrating the full membrane ability to sustain an increased vapour pressure.

In fact, the pressure at the bottom of an LNG fuel tank will remain at the same order of magnitude as the pressure at the tank bottom of the largest LNG carriers (with lower operating pressure but higher hydrostatic pressure due to higher tank height).

In addition, the Brick is also fitted with a sump to minimise the unpumpable LNG at sea. Indeed, at low filling levels with liquid motions the inlet suction can briefly emerge out of the liquid causing the pump to trip.

A sump will ensure that the inlet remains submerged, guarantee good

behaviour with low filling level and increase the usable capacity of the tank.

Sloshing

The analysis on sloshing, or liquid motion in the tanks, has been performed and, since the quantity of LNG involved and the tank breadth remain low, no specific design is required whatever the filling level.

All in all, the operators will have full freedom to operate the tank between empty and 95 percent full and with no restriction on intermediate fills.

The Brick has been based on the Mark III membrane technology with some slight modifications, notably in order to simplify design and construction. The Mark III is already fitted today in over 150 LNG carriers around the world and has an excellent track record.

A Brick prototype was built to demonstrate tank performance such as boil-off rate and holding time, and to give a test platform able to demonstrate its relevance for smaller LNG fuel tanks.

The aim of this prototype was also to

identify and put in place cost reduction actions in adapting, for example, erection procedures to small tanks.

The tank dimensions were 10 metres by 5 metres with its height at x 4 metres and capacity of 115 cubic metres.

Structure

The steel structure was the subject of a hydrotest at 2.6 barg prior to membrane tank construction.

Once the membrane was completed, the usual tests were performed to ensure tank integrity and tightness of primary and secondary barriers under cryogenic conditions.

Moreover, the construction was carried out in six months and confirmed the short schedule required to build a membrane tank.

An action plan has also been put in place to reduce the delivery time even more. All in all, the lead time for forthcoming applications should be between six and 12 months depending on tank size.

The LNG Brick technology is mainly dedicated to vessels with high space

constraints where cubic geometry makes sense such as for ferries, Ro-Ros and container vessels.

GTT believes it will contribute significantly to increasing the autonomy in gas mode with a minimum impact on cargo capacity.

In case of a project, a first step will be to determine the exact tank dimensions optimising the vessel arrangement. Then, the steel structure design and membrane arrangement will be determined during the engineering phase.

At this stage, GTT will quickly define the number of standardised components in order to launch the panels and membranes fabrication as soon as possible.

Validation

Once the validation is completed and the components are fabricated, GTT industrial partners will be in charge of the tank construction, membrane building and tests.

Finally, the Brick will be delivered to the shipyard, ready to be integrated inside the vessel under construction. ■

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World LNG Carrier Fleet

LNG carrier	Capacity m ³	Owned or Ordered by	Builder	Delivery Date	Flag	Power Plant	Cargo System	No. of tanks	Ship built for Export plant
Aamira	266,000	QGTC	Samsung	Dec-10	Liberia	DRL	TZ Mk. III	5	Qatargas IV
Abadi	135,000	Brunei Gas Carriers	Mitsubishi Nagasaki	Jun-02	Brunei	S	Moss	5	Brunei LNG
Abalamabie	174,900	Bonny Gas	Samsung	June-16	Bermuda	DFDE	TZ Mk III	4	Nigeria LNG
Adam LNG	162,000	Oman LNG	Hyundai	Dec-14	Marshall Is.	DFDE	TZ Mk. III	4	Oman LNG
Al Aamriya	210,100	J5 Consortium	Daewoo	Feb-08	Marshall Is.	DRL	GT NO 96	4	Qatargas
Al Areesh	151,700	Teekay LNG	Daewoo	Jan-07	Qatar	S	GT NO 96	4	Ras Gas II
Al Bahiya	210,185	QGTC	Samsung	Oct-09	Liberia	DRL	TZ Mk. III	5	Qatar-Atlantic
Al Biddah	135,275	J4 Consortium	Kawasaki Sakaide	Nov-99	Japan	S	Moss	5	Qatargas
Al Daayen	151,700	Teekay LNG	Daewoo	Apr-07	Qatar	S	GT NO 96	4	RasGas II
Al Dafna	266,000	QGTC	Samsung	Oct-09	Marshall Is.	LR DRL	GT NO 96	4	Qatar-Atlantic
Al Deebel	145,000	Peninsular LNG	Samsung	Dec-05	Bahamas	S	TZ Mk. III	4	Qatargas
Al Gattara	216,200	OSG/Nakilat	Hyundai	Oct-07	Marshall Is.	DRL	TZ Mk. III	4	Qatargas II
Al Ghariya	210,100	ProNav	Daewoo	Feb-08	Bahamas	DRL	GT No. 96	4	Qatargas
Al Gharaffa	216,200	OSG/Nakilat	Hyundai	Jan-08	Marshall Is.	DRL	TZ Mk. III	4	Various
Al Ghashamiya	216,000	QGTC	Samsung	Mar-09	Liberia	DRL	TZ Mk. III	4	Qatar-Atlantic Basin
Al Ghuwairiya	261,700	QGTC	Daewoo	Aug-08	Marshall Is.	DRL	GT NO. 96	5	Qatar-Atl'c Basin
Al Hamla	216,000	OSG	Samsung	Feb-08	Marshall Is.	DRL	TZ Mk. III	4	QatarGas
Al Hamra	137,000	National Gas Shipping	Kvaerner-Masa	Jan-97	Liberia	S	Moss	4	ADGAS
Al Huwaila	217,000	Teekay	Samsung	May-08	Bahamas	DRL	TZ Mk. III	4	RasGas III
Al Jasra	137,100	J4 Consortium	Mitsubishi Nagasaki	Jul-00	Japan	S	Moss	5	Qatargas
Al Jassasiya	145,700	Maran-Nakilat	Daewoo	May-07	Greece	S	GT No 96	4	RasGas
Al Kharaitiyat	216,200	QGTC	Hyundai	May-09	Liberia	DRL	TZ Mk. III	4	Qatargas III
Al Kharaana	210,000	QGTC	Daewoo	Oct-09	Marshall Is.	DRL	GT NO 96	4	Qatargas IV
Al Kharsaah	217,000	Teekay	Samsung	May-08	Bahamas	DRL	TZ Mk. III	4	RasGas III
Al Khattiya	210,000	QGTC	DSME	Oct-09	Marshall Is.	DRL	GT No. 96	4	Qatargas IV
Al Khaznah	135,500	National Gas Shipping	Mitsui Chiba	Jun-94	Liberia	S	Moss	5	ADGAS
Al Khor	137,350	J4 Consortium	Mitsubishi Nagasaki	Dec-96	Japan	S	Moss	5	Qatargas
Al Khuwair	217,000	Teekay LNG	Samsung	Jul-08	Korea	DRL	TZ Mk. III	4	RasGas
Al Mafyar	266,000	OSG/Nakilat	Hyundai	Oct-07	Marshall Is.	DRL	TZ Mk. III	4	Qatargas II
Al Marrouna	151,700	Teekay	Daewoo	Nov-07	Bahamas	S	GT NO 96		Ras Gas I
Al Mayeda	266,000	QGTC	Samsung	Jan-09	Liberia	DRL	TZ Mk. III	5	Qatar-US/Var.
Al Nuaman	210,000	QGTC	DSME	Dec-09	Marshall Is.	DRL	GT No. 96	4	Qatargas IV
Al Oraiq	210,000	J5 Consortium	Daewoo	Apr-08	Marshall Is.	DRL	GT No. 96	4	Various
Al Rayyan	135,360	J4 Consortium	Kawasaki Sakaide	Mar-97	Japan	S	Moss	5	Qatargas
Al Rekayyat	216,200	QGTC	Hyundai	Jun-09	Bahamas	DRL	TZ Mk.III	4	Qatar-Atlantic
Al Ruwais	210,100	ProNav	Daewoo	Nov-07	Germany	DRL	GT NO 96	4	Qatargas II
Al Sadd	210,100	QGTC	Daewoo	Mar-09	Liberia	DRL	GT NO 96	4	Qatar-Atlantic Basin
Al Safliya	210,100	ProNav	Daewoo	Dec-07	Bahamas	DRL	GT NO 96	4	Qatargas II
Al Sahla	216,200	J5	Hyundai	Jun-08	Japan	DRL	TZ Mk. III	4	Ras Gas III
Al Samriya	261,700	QGTC	Daewoo	Sep-08	Marshall Is.	DRL	GT NO. 96	5	Qatargas II
Al Sheehaniya	210,100	QGTC	Daewoo	Feb-09	Liberia	DRL	GT NO 96	4	Qatar-Atlantic Basin
Al Shamal	217,000	Teekay LNG	Samsung	Jun-08	Qatar	DRL	TZ Mk. III	4	RasGas
Al Thakhira	145,000	Peninsular LNG	Samsung	Sep-05	Bahamas	S	TZ Mk. III	4	Qatargas
Al Thumama	216,000	J5 Consortium	Hyundai	Apr-08	Japan	DRL	TZ Mk. III	4	Rasgas
Al Utouriya	215,000	J5	Hyundai	Sep-08	Panama	DRL	TZ Mk. III	4	RasGas
Al Utourma	215,000	J5	Hyundai	Sep-08	Panama	DRL	TZ Mk. III	4	Ras Gas III
Al Wajbah	137,350	J4 Consortium	Mitsubishi Nagasaki	Jun-97	Japan	S	Moss	5	Qatargas
Al Wakrah	135,360	J4 Consortium	Kawasaki Sakaide	Dec-98	Japan	S	Moss	5	Qatargas
Al Zhubarah	137,570	J4 Consortium	Mitsui Chiba	Dec-96	Japan	S	Moss	5	Qatargas
Alto Acrux	147,000	LNG Marine Transport	Mitsubishi	Mar-08	Bahamas	S	Moss	4	Various
Amali	148,000	Brunei-Shell	DSME	Jul-11	Brunei	DFDE	GT No. 96	4	Brunei LNG
Amanl	154,800	Brunei-Shell	Hyundai	Nov-14	Brunei	DFDE	TZ Mk. III	4	Brunei LNG
Aman Bintulu	18,928	Perbadanan / NYK Line	NKK Tsu	Oct-93	Malaysia	S	TZ Mk. III	3	Petronas
Aman Hakata	18,800	Perbadanan / NYK Line	NKK Tsu	Nov-98	Malaysia	S	TZ Mk. III	3	Petronas
Aman Sendai	18,928	Perbadanan / NYK Line	NKK Tsu	May-97	Malaysia	S	TZ Mk. III	3	Petronas
Arctic Aurora	160,000	Dynagas	Hyundai	Jul-13	Marshall Is.	DFDE	TZ Mk. III	4	Various
Arctic Discoverer	140,000	K Line	Mitsui Chiba	Jan-06	Bahamas	S	Moss	4	Various
Arctic Lady	147,200	MOL/Hoegh LNG	Mitsubishi Nagasaki	Apr-86	Norway	S	Moss	4	Various
Arctic Princess	147,200	MOL/Hoegh LNG	Mitsubishi Nagasaki	Jan-06	Norway	S	Moss	4	Various
Arctic Sun	89,880	Arctic LNG Shipping	IHI Chita	Dec-93	Liberia	S	IHI SPB	4	ConocoPhillips/Marathon
Arctic Voyager	140,000	K Line	Kawasaki	Jul-06	Bahamas	S	Moss	4	Statoil
Arkat	148,000	Brunei-Shell	DSME	Feb-11	Brunei	DFDE	GT. No. 96	4	Brunei LNG
Arwa Spirit	165,000	Teekay LNG	Samsung	Sep-08	Marshall Is.	DFDE	TZ Mk. III	4	Various
Aseem	154,850	K Line-Petronet	Samsung	Nov-09	Malta	S	GT No 96	4	Qatar-India
Asia Endeavour	160,000	Chevron	Samsung	Dec-14	Bahamas	DFDE	TZ Mk. III	4	Various
Asia Energy	160,000	Chevron	Samsung	Sept-14	Bahamas	DFDE	TZ Mk. III	4	Various
Asia Excellence	160,000	Chevron	Samsung	Sept-13	Bahamas	DFDE	TZ Mk. III	4	Various

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Asia Integrity	160,000	Chevron	Samsung	Jan-18	Bahamas	DFDE	TZ Mk. III	4	Various
Asia Venture	160,000	Chevron	Samsung	Sept-17	Bahamas	DFDE	TZ Mk. III	4	Various
Asia Vision	160,000	Chevron	Samsung	June-14	Bahamas	DFDE	TZ Mk. III	4	Various
Bahrain Spirit	173,000	Teekay	Daewoo	Sept-18	Bahamas	DFDE	No 96 GW	4	Various
Barcelona Knutsen	173,400	Knutsen	Daewoo	May-10	N.I.S.	DFDE	GT NO 96	4	Various
Beidou Star	172,000	MOL	Hudong	Oct-15	Hong Kong	DRL	GT NO. 96	4	Various
Berge Arzew	138,088	BW Gas	Daewoo	Jul-04	Norway	S	GT NO 96	4	Sonatrach
Boris Vilkitsky	172,000	Dynagas	Daewoo	Oct-17	Cyprus	DFDE	GT No. 96	4	Various
BW GDF-Suez Boston	138,059	BW Gas	Daewoo	Jan-03	Norway	S	GT NO 96	4	Suez LN
BW GDF Suez Everett	138,028	BW Gas	Daewoo	Jun-03	Norway	S	GT NO 96	4	Suez LNG
BW Integrity	170,000	BW Gas	Samsung	May-17	Singapore	DFDE	TZ Mk. III	4	FSRU
BW Lilac	173,400	BW Gas	Daewoo	Mar-18	Malta	MEGI-DF	GT NO 96	4	Various
BW Pavilion Leeara	161,880	BW Gas	Hyundai	Feb-15	Singapore	DFDE	TZ Mk. III	4	Various
BW Pavilion Vanda	161,880	BW Gas	Hyundai	Feb-15	Singapore	DFDE	TZ Mk. III	4	Various
BW Singapore	170,000	BW Gas	Samsung	May-15	Singapore	DFDE	TZ Mk. III	4	FSRU
BW Suez Paris	162,400	BW Gas	Daewoo	May-09	N.I.S.	DFDE	GT NO 96	4	Yemen-Atlantic
BW Tulip	173,400	BW Gas	Daewoo	Apr-18	Singapore	MEGI-DF	GT NO 96	4	Various
Bilbao Knutsen	138,000	Knutsen / Marpetrol	IZAR Sestao	Jan-04	Spain	S	GT NO 96	4	Atlantic LNG
Billis	77,730	Brunei Shell Tankers	La Seyne	Mar-75	Brunei	S	GT NO 82	5	Brunei LNG
Bishu Maru	162,000	K Line-Transpacific	Kawasaki Sakaide	Dec-15	Panama	S	Moss	4	Australia-Japan
Boris Davydov	172,600	Dynagas	Daewoo	Sept-18	Cyprus	DFDE	GT No. 96	4	Yamal LNG
British Achiever	173,644	BP Shipping	Daewoo	June-18	IOM	MEGI-DF	GT No. 96	4	Various
British Contributor	173,644	BP Shipping	Daewoo	Oct-18	IOM	MEGI-DF	GT No. 96	4	Various
British Diamond	155,000	BP Shipping	Hyundai	Sep-08	IOM	DFDE	TZ Mk. II	4	Indonesia-Various
British Emerald	155,000	BP Shipping	Hyundai	Jun-07	UK	DFDE	TZ Mk. III	4	Tangguh LNG
British Innovator	138,200	BP Shipping	Samsung	Jul-03	Isle of Man	S	TZ Mk. III	4	Various
British Merchant	138,000	BP Shipping	Samsung	Apr-03	Isle of Man	S	TZ Mk. III	4	Various
British Partner	173,644	BP Shipping	Daewoo	Mar-18	IOM	MEGI-DF	GT No. 96	4	Various
British Ruby	155,000	BP Shipping	Hyundai	Jan-08	U.K.	DFDE	TZ Mk. III	4	Various
British Sapphire	155,000	BP Shipping	Hyundai	Sep-08	IOM	DFDE	TZ Mk. III	4	Tangguh
British Trader	138,000	BP Shipping	Samsung	Dec-02	Isle of Man	S	TZ Mk. III	4	Engas
Broog	135,466	J4 Consortium	Mitsui Chiba	May-98	Japan	S	Moss	5	Qatargas
Bu Samara	266,000	QGTC	Samsung	Dec-08	Qatar	DRL	TZ Mk. III	5	Qatargas
BW Suez Paris	162,400	BW Gas	Daewoo	May-09	N.I.S.	DFDE	GT NO 96	4	Yemen-Atlantic
BW Suez Brussels	162,400	BW Gas	Daewoo	May-09	N.I.S.	DFDE	GT NO 96	4	Yemen-Atlantic
Cadiz Knutsen	138,826	Knutsen / Marpetrol	IZAR Puerto Real	Jun-04	Spain	S	GT NO 96	4	Engas
Cape Ann	145,000	Hoegh LNG/MOL	Samsung	May-10	Liberia	DFDE	TZ Mk. III	4	Various
Castillo de Santisteban	173,600	Elcano	STX	Aug-10	Malta	S	GT NO. 96		Various
Castillo de Villalba	138,000	Elcano	IZAR	Nov-03	Spain	S	GT NO 96	4	Sonatrach
Catalunya Spirit	138,000	Teekay LNG Partners	IZAR Sestao	Mar-03	Liberia	S	GT NO 96	4	Atlantic LNG
Celestine River	145,000	KLNG	Kawasaki	Dec-07	Bahamas	S	Moss		Various
Cesi Beihai	174,100	MOL-China LNG	Hudong	June-17	Hong Kong	S	GT No 96	4	Australia-China
Cesi Gladstone	174,100	MOL-China LNG	Hudong	Oct-16	Hong Kong	S	GT No 96	4	Australia-China
Cesi Lianyungang	174,100	MOL-China LNG	Hudong	June-18	Hong Kong	S	GT No 96	4	Australia-China
Cesi Qingdao	174,100	MOL-China LNG	Hudong	Nov-16	Hong Kong	S	GT No 96	4	Australia-China
Cesi Tianjin	174,100	MOL-China LNG	Hudong	Sept-17	Hong Kong	S	GT No 96	4	Australia-China
Challenger FSRU	263,000	MOL LNG	Daewoo	Oct-17	St Kitts	DFDE	GT No. 96	4	Various
Cheikh Bouamama	75,500	Skikda LNG Transport	USC	Jul-08	Bahamas	S	TZ Mk. III	4	Sonatrach
Cheikh El Mokrani	75,500	Med LNG Corp	USC	Jun-07	Bahamas	S	TZ Mk. III	4	Sonatrach
Christophe de Margerie	172,600	SCF	Daewoo	Nov-16	Cyprus	DFDE	GT NO 96	4	Various
Clean Energy	150,000	Dynagas	Hyundai	Mar-07	Marshall Is.	S	TZ Mk. III	4	Various
Clean Force	150,000	Dynagas	Hyundai	Jan-08	Marshall Is.	S	TZ Mk. III	4	Various
Clean Ocean	155,900	Dynagas	Hyundai	Mar-14	Marshall Is.	DFDE	TZ Mk. III	4	Various
Clean Planet	155,900	Dynagas	Hyundai	Mar-14	Marshall Is.	DFDE	TZ Mk. III	4	Various
Clean Vision	160,000	Dynagas	Hyundai	Jun-15	Marshall Is.	DFDE	TZ Mk. III	4	Various
Cool Explorer	160,000	Thenamaris	Samsung	Oct-13	Bermuda	DFDE	TZ Mk. III	4	Various
Cool Runner	160,000	Thenamaris	Samsung	May-14	Bermuda	DFDE	TZ Mk. III	4	Various
Cool Voyager	160,000	Thenamaris	Samsung	Oct-13	Bermuda	DFDE	TZ Mk. III	4	Various
Corcovado LNG	160,106	TMSC Gas	Daewoo	Jun-14	Malta	TFDE	GT No 96	4	Various
Creole Spirit	174,000	Teekay	Daewoo	Jan-16	Bahamas	MEGI-DF	NO. 96 GW	4	Cheniere
Cubal	160,400	Mitsui/NYK/Teekay	Samsung	Jan-12	Bahamas	DFDE	TZ Mk. III	4	Various
Cygnus Passage	145,400	Cygnus LNG	Mitsubishi	Feb-09	Panama	S	Moss	4	Various
Dapeng Moon	147,000	China Ships	Hudong	Jul-09	China	S	GT NO 96	4	Various
Dapeng Star	147,000	China Ships	Hudong	Nov-09	China	S	GT NO 96	4	Various
Dapeng Sun	147,000	China Ships	Hudong	Jul-07	China	S	GT NO 96	4	Woodside Energy
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	GT NO 96	4	Qatargas
Doha	137,350	J4 Consortium	Mitsubishi Nagasaki	Jun-99	Japan	S	Moss	5	Qatargas
Duhail	210,100	ProNav	Daewoo	Jan-08	Germany	DRL	GT NO 96	4	Various
Dukhan	135,000	J4 Consortium	Mitsui Chiba	Oct-04	Japan	S	Moss	4	Qatargas
Dwiputra	127,385	Humpuss Consortium	Mitsubishi Nagasaki	Mar-94	Bahamas	S	Moss	4	Pertamina
Ebisu	147,547	Golar LNG	Kawasaki	Sep-08	Bahamas	S	Moss	4	Various



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Eduard Toll	172,000	Teekay-CLNG	Daewoo	Dec-17	Bahamas	MEGI-DF	GT No. 96	4	Various
Ejnan	145,000	4J	Samsung	Jan-07	Bahamas	S	TZ Mk. III		RasGas
Ekaputra	136,400	Humpuss Consortium	Mitsubishi Nagasaki	Jan-90	Liberia	S	Moss	5	Pertamina
Energy Advance	145,000	Tokyo LNG Tankers	Kawasaki Sakaide	Mar-05	Japan	S	Moss	4	Darwin
Energy Atlantic	159,924	Alpha	STX Jinhae	Sep-15	Malta	DFDE	No. 96	4	Various
Energy Confidence	155,000	Tokyo LNG Tankers	Kawasaki	Apr-09	Panama	S	Moss	4	Various
Energy Frontier	147,600	Tokyo LNG Tankers	Kawasaki Sakaide	Sep-03	Japan	S	Moss	4	Darwin
Energy 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	GT NO 96	4	Various
Excel	138,106	Exmar/ MOL	Daewoo	Sep-03	Belgium	S	GT NO 96	4	Various
Excelerate	138,000	Exmar/Excelerate	Daewoo	Oct-06	Belgium	S	GT NO 96	4	Various
Excellence	138,000	GKFF Ltd.	Daewoo	May-05	Belgium	S	GT NO 96	4	Excelerate Energy
Excelsior	138,000	Exmar	Daewoo	Jan-05	Belgium	S	GT NO 96	4	Various
Exemplar	150,900	Excelerate	Daewoo	Jun-10	Belgium	S	GT NO 96	4	Various
Expedient	151,000	Excelerate	Daewoo	Nov-09	Belgium	S	GT NO 96	4	Various
Experience RV	174,000	Exmar/Excelerate	Daewoo	Jul-14	Marshall Is.	DFDE	GT NO 96		Various
Explorer	150,900	Exmar/Excelerate	Daewoo	Mar-08	Belgium	S	GT NO 96	4	Excelerate
Express	151,000	Exmar/Excelerate	Daewoo	May-09	Belgium	S	GT NO 96	4	Various
Exquisite	150,900	Excelerate	Daewoo	Sep-09	Belgium	S	GT NO 96	4	Various
Fedor Litke	172,636	Dynagas	Daewoo	Nov-17	Cyprus	DFDE	GT No. 96	4	Various
Flex Endeavour	173,400	Flex LNG	Daewoo	Jan-18	Marshall Is.	MEGI-DF	NO. 96 GW	4	Various
Flex Enterprise	173,400	Flex LNG	Daewoo	Jan-18	Marshall Is.	MEGI-DF	NO. 96 GW	4	Various
Flex Rainbow	174,000	Flex LNG	Samsung	July-18	Marshall Is.	MEGI-DF	NO. 96 GW	4	Various
Fraiha	210,100	J5 Consortium	Daewoo	Sep-08	Marshall Is.	DRL	GT NO 96	4	Qatargas
FSRU Independence	170,000	Hoegh	Hyundai	Feb-14	NIS	DFDE	TZ Mk. III	4	Various
FSRU Lampung	170,000	Hoegh	Hyundai	May-14	Indonesia	DFDE	TZ Mk. III	4	Various
Fuji LNG	147,895	TMSC Gas	Kawasaki	Jun-04	Malta	S	Moss	4	Various
Fuwairit	138,000	Peninsular LNG	Samsung	Jan-04	Bahamas	S	TZ Mk. III	4	RasGas II
Galea	134,425	Shell Shipping	Mitsubishi Nagasaki	Oct-02	Singapore	S	Moss	5	Shell
Galicia Spirit	140,620	Teekay LNG Partners	Daewoo	Jul-04	Liberia	S	GT NO 96	4	Engas
Gaselys	153,500	GdF/NYK	Atlantique	Mar-07	France	DFDE	CS 1	4	Engas
Gallina	134,425	Shell Shipping	Mitsubishi Nagasaki	Oct-02	Singapore	S	Moss	5	Shell
GasLog Chelsea	153,000	GasLog	Hanjin Korea	Dec-09	Panama	TFDE	TZ Mk. III	4	Various
Gaslog Geneva	174,000	GasLog	Samsung	Sept-16	Bermuda	TFDE	TZ Mk. III	4	Shell charter
Gaslog Genoa	174,000	GasLog	Samsung	June-18	Bermuda	TFDE	TZ Mk. III	4	Various
Gaslog Gibraltar	174,000	GasLog	Samsung	Oct-16	Bermuda	TFDE	TZ Mk. III	4	Shell charter
Gaslog Glasgow	174,000	GasLog	Samsung	Jun-16	Bermuda	TFDE	TZ Mk. III	4	Shell charter
Gaslog Greece	174,000	GasLog	Samsung	Mar-16	Bermuda	TFDE	TZ Mk. III	4	Shell charter
GasLog Hongkong	174,000	GasLog	Hyundai	June-18	Bermuda	TFDE	GT NO 96	4	Various
GasLog Houston	174,000	GasLog	Hyundai	Jan-18	Bermuda	TFDE	GT NO 96	4	Various
GasLog Salem	165,000	GasLog	Samsung	Apr-15	Liberia	TFDE	TZ Mk. III	4	Various
GasLog Santiago	155,000	GasLog	Samsung	Mar-13	Liberia	TFDE	TZ Mk. III	4	Various
GasLog Saratoga	155,000	GasLog	Samsung	Dec-14	Bermuda	TFDE	TZ Mk. III	4	Various
Gaslog Savannah	155,000	GasLog	Samsung	May-10	Bermuda	DFDE	TZ Mk. III	4	Various
GasLog Seattle	155,000	GasLog	Samsung	Oct-13	Bermuda	TFDE	TZ Mk. III	4	Various
GasLog Shanghai	155,000	GasLog	Samsung	Jan-13	Liberia	TFDE	TZ Mk. III	4	Various
Gaslog Singapore	155,000	GasLog	Samsung	Jul-10	Bermuda	DFDE	TZ Mk. III	4	Various
Gaslog Skagen	155,000	GasLog	Samsung	Oct-13	Bermuda	DFDE	TZ Mk. III	4	Various
Gaslog Sydney	155,000	GasLog	Samsung	May-13	Bermuda	DFDE	TZ Mk. III	4	Various
GDF-Suez Global Energy	74,000	Gaz de France	Chantiers	Dec-06	France	DFDE	CS1	4	Sonatrach
GDF-Suez Point Fortin	154,200	LNG Japan	Imabari/Koyo	Feb-10	Panama	DFDE	TZ Mk. III	4	Various
Gemmata	138,100	Shell Shipping	Mitsubishi Nagasaki	Mar-04	Singapore	S	Moss	5	Shell
Georgiy Brusilov	172,000	Dynagas	Daewoo	June-18	Cyprus	DFDE	GT No 96	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	TZ Mk. III	4	Various
Golar Arctic	140,645	Golar LNG	Daewoo	Dec-03	Marshall Is.	S	GT NO 96	4	Shell Spot
Golar Bear	160,000	Golar	Samsung	Mar-14	Bermuda	DFDE	TZ Mk. III	4	Various
Golar Celsius	160,000	Golar LNG	Samsung	Sep-13	Bermuda	DFDE	TZ Mk. III	4	Various
Golar Crystal	160,000	Golar LNG	Samsung	Oct-13	Bermuda	DFDE	TZ Mk. III	4	Various
Golar Eskimo (FSRU)	160,000	Golar LNG	Samsung	Jan-15	Bermuda	DFDE	TZ Mk. III	4	Various
Golar Freeze	125,850	Golar LNG	HDW	Feb-77	UK	S	Moss	5	Various
Golar Glacier	162,000	Golar LNG	Hyundai	Sep-14	Marshall Is.	DFDE	TZ Mk. III	4	Various
Golar Grand	145,880	Golar LNG	Daewoo	2006	IoM		GT NO 96	4	Various
Golar Ice	160,000	Golar LNG	Samsung	Feb-15	Bermuda	DFDE	TZ Mk. III	4	Various
Golar Igloo (FSRU)	160,000	Golar LNG	Samsung	Oct-13	Bermuda	DFDE	TZ Mk. III	4	Various
Golar Kelvin	160,000	Golar LNG	Samsung	Jan-15	Bermuda	DFDE	TZ Mk. III	4	Various
Golar Maria	145,950	Golar LNG	Daewoo	2006	Marshall Is.		GT NO 96	4	Various

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Golar Mazo	135,225	Golar LNG/CP	Mitsubishi	Jan-00	Liberia	S	Moss	5	Pertamina
Golar Penguin	160,000	Golar LNG	Samsung	Mar-14	Marshall Is.	DFDE	TZ Mk. III	4	Various
Golar Seal	160,000	Golar LNG	Samsung	Aug-13	Bermuda	DFDE	TZ Mk. III	4	Various
Golar Singapore (FSRU)	160,000	Golar LNG	Samsung	June-15	Bermuda	DFDE	TZ Mk. III	4	Various
Golar Snow	160,000	Golar LNG	Samsung	Jan-15	Bermuda	DFDE	TZ Mk. III	4	Various
Golar Tundra (FSRU)	160,000	Golar LNG	Samsung	Dec-15	Bermuda	DFDE	TZ Mk. III	4	Various
Golar Viking	140,000	Golar LNG	Hyundai	Jan-05	Marshall Is.	S	Moss	4	Various
Golar Winter	138,250	Golar LNG	Daewoo	Apr-04	Marshall Is.	S	GT NO 96	4	Petrobras
Grace Acacia	150,000	Algaet Shipping	Hyundai	Jan-07	Japan	S	TK MK III	4	Various
Grace Barleria	150,000	Swallowtail Ship	Hyundai	Oct-07	Japan	S	TZ Mk. III	4	Various
Grace Cosmos	150,000	AGH Shipping	Hyundai	Mar-08	Japan	S	TZ Mk. III	4	Various
Grace Dahlia	177,000	Tokyo Gas	Kawasaki	Oct-13	Japan	S	Moss	4	Various
Gracilis	138,830	Golar LNG	Hyundai	Jan-05	Marshall Is.	S	TZ Mk III	4	Shell BG
Granatina	140,645	Shell Shipping	Daewoo	Dec-03	Singapore	S	GT NO 96	4	Shell
Grand Aniva	147,200	Sovcomflot/NYK	Mitsubishi	Jan-08	Japan	S	Moss	4	Various
Grand Elena	147,200	Sovcomflot/NYK	Mitsubishi	Oct-07	Japan	S	Moss	4	Various
Grand Mereya	147,200	Primorsk/MOL/K Line	Chiba	May-08	Japan	S	Moss	4	Sakhalin II
Hanjin Muscat	138,200	Hanjin Shipping	Hanjin	Jul-99	Panama	S	GT NO 96	4	Oman Gas
Hanjin Pyeong Taek	130,600	Hanjin Shipping	Hanjin	Sep-95	Panama	S	GT NO 96	4	Pertamina
Hanjin Ras Laffan	138,214	Hanjin Shipping	Hanjin	Jul-00	Panama	S	GT NO 96	4	QatarGas
Hanjin Sur	138,333	Hanjin Shipping	Hanjin	Jan-00	Panama	S	GT NO 96	4	Oman Gas
Hispania Spirit	140,500	Teekay LNG Partners	Daewoo	Sep-02	Spain	S	GT NO 96	4	Atlantic LNG
Hoegh Esperanza FSRU	170,000	Hoegh	Hyundai	April-18	Norway	DFDE	GTT MIII	4	Various
Hoegh Gallant FSRU	170,050	Hoegh LNG	Hyundai	May-14	Marshall Is.	DFDE	TZ Mk. III	4	chartered
Hoegh Giant FSRU	170,050	Hoegh LNG	Hyundai	Jan-18	Marshall Is.	DFDE	TZ Mk. III	4	various
Hoegh Grace FSRU	170,050	Hoegh LNG	Hyundai	May-15	Marshall Is.	DFDE	TZ Mk. III	4	various
Hyundai Aquapia	135,000	Hyundai MM	Hyundai	Mar-00	Panama	S	Moss	4	Oman Gas
Hyundai	135,000	Hyundai MM	Hyundai	Jan-00	Panama	S	Moss	4	RasGas
Hyundai Ecopia	145,000	Hyundai	Hyundai	Nov-08	Panama	S	TZ Mk. III	4	Various
Hyundai Greenpia	125,000	Hyundai MM	Hyundai	Nov-96	Panama	S	Moss	4	Pertamina
Hyundai Oceanpia	135,000	Hyundai MM	Hyundai	Jul-00	Panama	S	Moss	4	Oman Gas
Hyundai Technopia	135,000	Hyundai MM	Hyundai	Jul-00	Panama	S	Moss	4	RasGas
Hyundai Utopia	125,182	Hyundai MM	Hyundai	Jun-94	Panama	S	Moss	4	Pertamina
Iberica Knutsen	138,000	Knutsen OAS	Daewoo	Aug-06	Norway	S	GT 96	4	Gas Natural
Ibra LNG	147,100	Oman Gas	Samsung	Jun-06	Panama	S	TK Mk. III	4	Oman LNG
Ibri LNG	145,000	Oman Gas	Mitsubishi	Jul-06	Panama	S	TK Mk. III	4	Oman LNG
Ish	137,540	National Gas Shipping	Mitsubishi Nagasaki	Nov-95	Liberia	S	Moss	5	ADGAS
K Acacia	138,017	Korea Line	Daewoo	Jan-00	Panama	S	GT NO 96	4	Oman Gas
K Freesia	135,256	Korea Line	Daewoo	Jun-00	Panama	S	GT NO 96	4	RasGas
K Jasmine	145,700	Korea Line	Daewoo	Mar-08	Panama	S	GT NO 96	4	Kogas offtake
K Mugungwha	152,000	K Line	Daewoo	Nov-08	Panama	S	GT NO 96	4	Various
Kita LNG	160,106	TMSC Gas	Daewoo	Jun-14	Malta	TFDE	GT No 96	4	Various
Kotawaka Maru	125,200	J3 Consortium	Kawasaki Sakaide	Jan-84	Japan	S	Moss	5	Darwin
Kumul	172,000	MOL	Hudong	May-16	Hong Kong	DRL	GT NO. 96	4	PNG-Asia
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	GT NO. 96	5	Various
LNG Abalamabie	174,900	Bonny Gas	Samsung	Nov-16	Bermuda	DFDE	TZ Mk III	4	Nigeria LNG
LNG Abuja	126,530	Bonny Gas Transport	GD Quincy	Sep-80	Bahamas	S	Moss	5	Nigeria LNG
LNG Abuja II	174,900	Bonny Gas	Samsung	Oct 16	Bermuda	DFDE	TZ Mk III	4	Nigeria LNG
LNG Adamawa	141,000	Bonny Gas Transport	Hyundai	Jun-05	Bermuda	S	Moss	4	Various
LNG Akwa Ibom	141,000	Bonny Gas Transport	Hyundai	Nov-04	Bermuda	S	Moss	4	Various
LNG Aquarius	126,300	MOL/LNG Japan	GD Quincy	Jun-77	Marshall Is.	S	Moss	5	Various
LNG Barka	153,000	NYK	Kawasaki	Jan-09	Bahamas	S	Moss	4	Various
LNG Bayelsa	137,500	Bonny Gas Transport	Hyundai	Feb-03	Bermuda	S	Moss	4	Nigeria LNG
LNG Benue	145,700	BW Gas	Daewoo	Mar-06	Bermuda	S	GT NO 96	4	Nigeria LNG
LNG Bonny	177,000	Bonny Gas Transport	Hyundai	Oct-15	Bermuda	DFDE	TZ Mk III	4	Nigeria LNG
LNG Borno	149,600	NYK Line	Samsung	Aug-07	Japan	S	TZ Mk. III	4	Nigeria LNG
LNG Capricorn	126,300	MOL/LNG Japan	GD Quincy	Jun-78	Marshall Is.	S	Moss	5	Pertamina
LNG Cross River	141,000	Bonny Gas Transport	Hyundai	Sep-05	Bermuda	S	Moss	4	Various
LNG Dream	145,000	Osaka Gas	Kawasaki	Sep-06	Japan	S	Moss	4	Woodside Energy
LNG Ebisu	147,500	MOL	Kawasaki	Sep-08	Bahamas	S	Moss	4	Various
LNG Edo	126,530	Bonny Gas Transport	GD Quincy	May-80	Bahamas	S	Moss	5	Nigeria LNG
LNG Enugu	145,000	BW Gas	Daewoo	Oct-05	Bermuda	S	GT NO 96	4	Nigeria LNG
LNG Fimina	175,000	Bonny Gas Transport	Samsung	Oct-15	Bermuda	DFDE	TZ Mk III	4	Nigeria LNG
LNG Flora	127,700	J3 Consortium	Kawasaki Sakaide	Mar-93	Japan	S	Moss	4	Pertamina
LNG Fukurokuju	165,000	MOL	Kawasaki	June-15	Japan	S	Moss	4	Various
LNG Gemini	126,300	MOL/LNG Japan	GD Quincy	Sep-78	Marshall Is.	S	Moss	5	Pertamina
LNG Imo	148,300	BW Gas	Daewoo	Jun-08	Bermuda	S	GT NO 96	4	Nigeria LNG
LNG Jamal Gas	135,330	Osaka Gas/J3 Consortium	Mitsubishi Nagasaki	Oct-00	Japan	S	Moss	5	Oman
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



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LNG Kano	148,471	BW Gas	Daewoo	Jan-07	Bermuda	S	GT No. 96	4	NLNG
LNG Lagos	177,000	Bonny Gas	Hyundai	Oct-15	Bermuda	DFDE	TZ Mk III	4	Nigeria LNG
LNG Leo	126,400	MOL/LNG Japan	GD Quincy	Dec-78	Marshall Is.	S	Moss	5	Pertamina
LNG Lerici	65,000	Exmar	Italcantieri Sestri	Mar-98	Italy	S	GT NO 96	4	Sonatrach
LNG Libra	126,400	Hoegh LNG	GD Quincy	Apr-79	Marshall Is.	S	Moss	5	Various
LNG Lokoja	148,300	BW Gas	Daewoo	Dec-06	Bermuda	S	GT No. 96	4	Nigeria LNG
LNG Mars	155,000	MOL/Osaka Gas	Mitsubishi	Oct-16	Marshall Is.	S	Moss	5	Various
LNG Ogun	148,300	NYK Line	Samsung	Aug-07	Japan	S	TZ Mk. III	4	Nigeria LNG
LNG Ondo	148,300	BW Gas	Daewoo	Sep-07	Bermuda	S	GT NO 96	4	Nigeria LNG
LNG Oyo	140,500	BW Gas	Daewoo	Dec-05	Bermuda	S	GT NO 96	4	Nigeria LNG
LNG Pioneer	138,000	MOL	Daewoo	Jul-05	Bahamas	S	GT No 96	4	Idku
LNG Port Harcourt	175,000	Bonny Gas	Samsung	Oct-15	Bermuda	DFDE	TZ Mk III	4	Nigeria LNG
LNG Portovenere	65,000	Exmar	Italcantieri Sestri	Jun-96	Italy	S	GT No 96	4	Sonatrach
LNG River Niger	141,000	Bonny Gas Transport	Hyundai	May-06	Bermuda	S	Moss	4	Various
LNG River Orashi	145,910	BW Gas	Daewoo	Nov-04	Bermuda	S	GT No 96	4	Nigeria LNG
LNG Rivers	137,231	Bonny Gas Transport	Hyundai	Jun-02	Bermuda	S	Moss	4	Nigeria LNG
LNG Saturn	153,000	MOL	MHI	Nov-15	Japan	S	Moss	4	Various
LNG Sokoto	137,231	Bonny Gas Transport	Hyundai	Aug-02	Bermuda	S	Moss	4	Nigeria LNG
LNG Taurus	126,300	MOL/LNG Japan	GD Quincy	Aug-79	Marshall Is.	S	Moss	5	Various
LNG Venus	155,000	Osaka/MOL	MHI	Oct-14	Japan	S	Moss	4	Various
LNG Vesta	127,547	Tokyo Gas Consortium	Mitsubishi Nagasaki	Jun-94	Japan	S	Moss	4	Pertamina
LNG Virgo	126,400	MOL/LNG Japan	GD Quincy	Dec-79	Marshall Is.	S	Moss	5	Pertamina
Lobito	160,400	Mitsui/NYK/Teekay	Samsung	Oct-11	Bahamas	DFDE	TZ Mk. III	4	Various
Lusail	138,000	Peninsular LNG	Samsung	May-05	Bahamas	S	TZ Mk. III	4	Qatar
Macoma	173,400	Teekay	Daewoo	Oct-17	Bahamas	DFDE	GT No. 96	4	Various
Madrid Spirit	138,000	Teekay LNG Partners	IZAR Puerto Real	Jan-05	Spain	S	GT No 96	4	Engas
Magdala	173,400	Teekay	Daewoo	Feb-18	Bahamas	DFDE	GT No 96	4	Various
Magellan Spirit	165,500	Teekay LNG Partners	Samsung	Sep-08	Denmark	DFDE	TZ Mk. III	4	Various
Malanje	160,400	Mitsui/NYK/Teekay	Samsung	Jul-11	Bahamas	DFDE	TZ Mk. III	4	Various
Maran Gas Achilles	174,000	Maran	Hyundai Samho	Feb-16	Greece	DFDE	GT No 96	4	Various
Maran Gas Agamemnon	174,000	Maran	Hyundai Samho	May-16	Greece	DFDE	GT No 96	4	Various
Maran Gas Alexandria	161,870	Maran	Hyundai Samho	Sep-15	Greece	DFDE	TZ Mk. III	4	Various
Maran Gas Amphipolis	173,400	Maran	Daewoo	Aug-16	Greece	DFDE	GT No 96	4	Various
Maran Gas Apollonia	161,870	Maran	Daewoo	Jan-14	Greece	DFDE	GT No 96	4	Various
Maran Gas Asclepius	145,000	Kristen Navigation	Daewoo	Jul-05	Bermuda	S	GT No 96	4	Qatar
Maran Gas Coronis	145,700	Maran	Daewoo	Sep-07	Greece	S	GT No 96	4	Rasgas II
Maran Gas Delphi	159,800	Maran	Daewoo	Feb-14	Greece	DFDE	GT No 96	4	Various
Maran Gas Efessos	159,800	Maran	Daewoo	Jun-14	Greece	DFDE	GT No 96	4	Various
Maran Gas Hector	174,000	Maran	Hyundai Samho	Nov-16	Greece	DFDE	GT No 96	4	Various
Maran Gas Lindos	159,800	Maran	Daewoo	Jun-15	Greece	DFDE	GT No. 96	4	Various
Maran Gas Mystras	155,900	Maran Gas	Daewoo	May-15	Greece	DFDE	GT No 96	4	Various
Maran Gas Olympias	174,500	Maran	DSME	Feb-17	Greece	DFDE	GT No 96	4	Various
Maran Gas Pericles	174,000	Maran	Hyundai Samho	June-16	Greece	DFDE	GT No 96	4	Various
Maran Gas Posidonia	161,870	Maran	Daewoo	May-14	Greece	DFDE	GT No 96	4	Various
Maran Gas Roxana	173,400	Maran	Daewoo	Jan-17	Greece	DFDE	GT No 96	4	Various
Maran Gas Sparta	161,870	Maran	Hyundai Samho	April-15	Greece	DFDE	G TZ Mk. III	4	Various
Maran Gas Spetses	174,000	Maran	Daewoo	Feb-18	Greece	DFDE	GT No 96	4	Various
Maran Gas Troy	155,900	Maran Gas	Daewoo	May-15	Greece	DFDE	GT No 96	4	various
Maran Gas Ulysses	174,000	Maran	Hyundai Samho	Jan-17	Greece	DFDE	GT No 96	4	Various
Maria Energy	174,000	Tsakos	Hyundai	Mar-15	Marshall Is.	TFDE	GTT Mk II	4	Various
Marib Spirit	165,000	Teekay LNG	Samsung	May-08	Marshall Is.	DFDE	TZ Mk. III	4	Various
Marvel Eagle	155,000	MOL-Osaka	Kawasaki	Sept-18	Marshall Is.	S	Moss	4	Cameron LNG/Various
Matthew	126,540	Suez LNG Shiping	Newport News	Jun-79	Bahamas	S	TZ Mk. I	6	Atlantic LNG
Megara	173,000	Teekay	Daewoo	Oct-18	Bahama	MEGI-DF	No 96	4	Various
Mekaines	266,000	Nakilat	Samsung	Mar-09	Liberia	DRL	GT No 96	4	Qatar-Atlantic Basin
Meridian Spirit	165,500	Teekay LNG	Samsung	Jan-10	Denmark	DFDE	TZ Mk. III	4	Various
Mesaimeer	210,100	Nakilat	Hyundai	Mar-09	Liberia	DRL	GT No 96	4	Qatar-Atlantic Basin
Methane Alison Victoria	145,000	GasLog	Samsung	Aug-07	Bermuda	S	TZ III	4	Eq.Guinea LNG
Methane Becki Anne	170,000	GasLog	Samsung	Sep-10	Bermuda	TFDE	TZ Mk. III	4	Various
Methane Heather Sally	145,000	GasLog	Samsung	Jul-07	Bermuda	S	Tz Mk. III	4	Eq.Guinea LNG
Methane Jane Elizabeth	145,000	GasLog	Samsung	Jun-06	Bermuda	TFDE	TZ Mk. III	4	Engas
Methane Julia Louise	170,000	GasLog	Samsung	Dec-09	Bermuda	TFDE	TZ Mk. III	4	Various
Methane Kari Elin	138,200	Shell	Samsung	Jun-04	Bermuda	S	TZ Mk. III	4	Various
Methane Lake Charles	145,000	Shell	Samsung	Feb-07	Bermuda	S	TZ Mk. III	4	Marathon Oil
Methane Lydon Volney	145,000	Shell	Samsung	Aug-06	Bermuda	S	TZ Mk. III	4	Engas
Methane Mickie Harper	170,000	Shell-GasLog	Samsung	Nov-10	Bermuda	TFDE	TZ Mk. III	4	Various
Methane Nile Eagle	145,000	Shell-GasLog	Samsung	Dec-07	Bermuda	S	TZ Mk. III	4	Engas
Methane Patricia Camila	170,000	Shell-GasLog	Samsung	Oct-10	Bermuda	TFDE	TZ Mk. III	4	Various
Methane Princess	138,159	Golar LNG	Daewoo	2003	UK	S	GT No 96	4	Spot BG
Methane Rita Andre	145,000	GasLog	Samsung	Mar-06	Bermuda	S	TZ Mk. III	4	Engas
Methane Shirley Elizabeth	145,000	GasLog	Samsung	Apr-07	Bermuda	S	TZ Mk. III	4	Marathon Oil
Methane Sprit	165,000	Teekay LNG	Samsung	Mar-08	Singapore	DFDE	TZ Mk. III	4	Various
Milaha Qatar	145,000	Milaha	Samsung	Apr-06	Denmark	S	TZ Mk. III	4	Qatar

CARRIER FLEET



Milaha Ras Laffan	138,270	Milaha	Samsung	Mar-04	Denmark	S	TZ Mk. III	4	RasGas II
Min Lu	147,000	China Ships	Hudong	Aug-09	China	S	GT No 96	4	Various
Min Rong	147,000	China LNG Ships	Hudong	Feb-09	Hong Kong	S	GT No 96	4	Australia-China
Mourad Didouche	126,130	Hyproc Shipping	Atlantique	Jul-80	Algeria	S	GT No 85	5	Sonatrach
Mozah	266,000	QGTC	Samsung	Aug-08	Qatar	DRL	TZ Mk III	5	Qatargas II
Mraweh	137,000	National Gas Shipping	Kvaerner-Masa	Jun-96	Liberia	S	Moss	4	ADGAS
Mubaraz	137,000	National Gas Shipping	Kvaerner-Masa	Jan-96	Liberia	S	Moss	4	Various
Muraq	210,100	J5-K Line	Daewoo	May-08	Marshall Is.	DRL	GT No 96	4	Qatar-Atlantic Basin
Murex	173,400	Teekay	Daewoo	Oct-17	Bahamas	DFDE	GT No 96	4	Various
Murwab	210,100	J5 Consortium	Daewoo	May-08	Marshall Is.	DRL	GT No. 96	4	Qatargas
Muscat LNG	149,170	Oman Gas/MOL	Kawasaki Sakaide	Mar-04	Japan	S	Moss	4	Oman Gas
Myrina	173,000	Teekay	Daewoo	Sept-18	Bahamas	MEGI-DF	No 96 GW	4	Various
Neo Energy	149,700	Tsakos	Hyundai	Feb-07	Liberia	S	GTT Mk II	4	Various
Neptune	145,000	Hoegh LNG/MOL	Samsung	Dec-09	Liberia	DFDE	TZ Mk. III	4	Various
Nizwah LNG	145,000	Oryx LNG Carriers	Kawasaki Sakaide	Dec-05	Japan	S	Moss	4	Oman Gas
Northwest Sanderling	127,525	Australia LNG	Mitsubishi Nagasaki	Jun-89	Australia	S	Moss	4	NWS
Northwest Sandpiper	127,500	Australia LNG	Mitsui Chiba	Feb-93	Australia	S	Moss	4	NWS
Northwest Seaeagle	127,450	Australia LNG	Mitsubishi Nagasaki	Nov-92	Bermuda	S	Moss	4	NWS
Northwest Shearwater	127,500	Australia LNG	Kawasaki Sakaide	Sep-91	Bermuda	S	Moss	4	NWS
Northwest Snipe	127,747	Australia LNG	Mitsui Chiba	Sep-90	Australia	S	Moss	4	NWS
Northwest Stormpetrel	127,600	Australia LNG	Mitsubishi Nagasaki	Dec-94	Australia	S	Moss	4	NWS
Northwest Swallow	127,708	J3 Consortium	Mitsui Chiba	Nov-89	Japan	S	Moss	4	NWS
Northwest Swan	138,000	Australia LNG	Daewoo	Mar-04	Australia	S	GT NO 96	4	NWS
Northwest Swift	127,590	J3 Consortium	Mitsubishi Nagasaki	Sep-89	Japan	S	Moss	4	NWS
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	NO. 96 GW	4	Cheniere
Ob River	150,000	Lance Shipping	Hyundai	Oct-07	Marshall Is.	S	TZ Mk. III	4	Various
Onaiza	210,100	Nakilat	Daewoo	Apr-09	Liberia	DRL	GT NO 96	4	Qatar-Atlantic Basin
Ougarta	171,866	Hyproc Shipping	Hyundai	Mar-17	Algeria	DFDE	GTT Mk III	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 Eurys	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	GT No 96	4	Various
Pan Americas	174,000	Teekay	Hudong	Mar-18	Hong Kong	TFDE	No. 96 GW	4	US-Asia
Pan Asia	174,000	Teekay	Hudong-Zhonghua	July-17	Bahamas	TFDE	NO. 96 GW	4	Cheniere
Pan Europe	174,000	Teekay	Hudong	Sept-18	Hong Kong	TFDE	No. 96 GW	4	US-global
Papua	171,800	MOL-China	Hudong	Jan-15	Hong Kong	DFDE	SSD	4	PNG LNG
Polar Eagle	89,880	Polar LNG	IHI Chita	Jun-93	Liberia	S	IHI SPB	4	ConocoPhillips/Marathon
Prachi	173,000	NYK-SCI	Hyundai	Nov-16	Singapore	TFDE	GT No 96	4	Petronet
Provalys	153,500	Gaz de France	Chantiers	Nov-06	France	DFDE	CS1	4	ELNG
Pskov	170,200	SovComFlot	STX	Mar-14	Liberia	DFDE	GT No. 96	4	Various
Puteri Delima	130,400	MISC	Atlantique	Jan-95	Malaysia	S	GT NO 96	4	Petronas
Puteri Delima Satu	137,100	MISC	Mitsui Chiba	Apr-02	Malaysia	S	GT NO 96	4	Petronas
Puteri Firuz	130,400	MISC	Atlantique	May-97	Malaysia	S	GT NO 96	4	Petronas
Puteri Firuz Satu	137,100	MISC	Mitsubishi Nagasaki	Sep-04	Malaysia	S	GT NO 96	4	Petronas
Puteri Intan	130,400	MISC	Atlantique	Aug-94	Malaysia	S	GT NO 96	4	Petronas
Puteri Intan Satu	137,100	MISC	Mitsubishi Nagasaki	Dec-01	Malaysia	S	GT NO 96	4	Petronas
Puteri Mutiera Satu	137,100	MISC	Mitsui Chiba	Apr-05	Malaysia	S	GT NO 96	4	Petronas
Puteri Nilam	130,400	MISC	Atlantique	Jun-95	Malaysia	S	GT NO 96	4	Petronas
Puteri Nilam Satu	137,100	MISC	Mitsubishi Nagasaki	Sep-03	Malaysia	S	GT NO 96	4	Petronas
Puteri Zamrud	130,400	MISC	Atlantique	May-96	Malaysia	S	GT NO 96	4	Petronas
Puteri Zamrud Satu	137,100	MISC	Mitsui Chiba	Apr-87	Malaysia	S	GT NO 96	4	Atlantic LNG
Raahi	136,000	Petronet LNG Ltd	Daewoo	Dec-04	Malta	S	GT NO 96	4	Qatargas
Ramdane Abane	126,130	Hyproc Shipping	Atlantique	Jul-81	Algeria	S	GT NO 85	5	Sonatrach
Rasheeda	266,000	QGTC	Samsung	Jun-10	Liberia	DRL	TZ Mk. III		Various
Ribera del Duero Knutsen	173,400	Knutsen	Daewoo	Nov-10	Nor-NIS	DFDE	GT NO. 96	4	Various
Rioja Knutsen	176,300	Knutsen	Daewoo	Dec-16	Nor-NIS	DFDE	TZ Mk III	4	Various
Rudolf Samoylovich	172,652	Teekay-CLNG	Daewoo	Oct-18	Bahamas	MEGI-DF	GT No 96	4	Various
Salalah LNG	147,000	Oman Gas/MOL	Samsung	Dec-05	Japan	S	TZ Mk. III	4	Oman
SCF Polar	71,500	Sovcomflot	Kockums	Aug-69	Liberia	S	GT NO 82	6	Sonatrach
Sean Spirit	174,000	Teekay	Hyundai Samho	Feb-19	Bahama	MEGI-DF	No 96	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	TZ Mk. III	4	Yemen LNG
Seri Amanah	145,000	MISC	Samsung	Mar-06	Malaysia	S	TZ Mk. III	4	Yemen LNG
Seri Anggun	145,000	MISC	Samsung	Nov-06	Malaysia	S	TZ Mk. III	4	Yemen LNG
Seri Angkasa	145,000	MISC	Samsung	Feb-07	Malaysia	S	TZ Mk. III	4	Petronas
Seri Ayu	145,000	MISC	Samsung	Oct-07	Malaysia	S	TZ Mk. III	4	Various
Seri Bakti	152,300	MISC	Mitsubishi	Mar-07	Malaysia	S	GT NO 96	4	Petronas
Seri Balhaf	152,000	MISC	Mitsubishi	Sep-08	Malaysia	S	GT NO 96	4	Various
Seri Balquis	152,000	MISC	Mitsubishi	Dec-08	Malaysia	S	GT NO 96	4	Various



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Seri Begawan	152,300	MISC	Mitsubishi	Dec-07	Malaysia	S	GT NO 96	4	Various
Seri Bijaksana	152,300	MISC	Mitsubishi	Feb-08	Malaysia	S	GT NO 96	4	Petronas
Seri 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	GT NO 96	4	Atlantic LNG
Sevilla Knutsen	173,400	Knutsen	Daewoo	Jun-10	N.I.S.	DFDE	GT NO 96	4	Various
Shahamah	135,500	National Gas Shipping	Kawasaki Sakaide	Oct-94	Liberia	S	Moss	5	ADGAS
Shangra	266,000	QGTC	Samsung	Nov-09	Liberia	DRL	TZ Mk. III	5	Qatargas IV
Shen Hai	147,100	China LNG	Hudong Zhonghua	Sep-12	China	AB/CC Steam	GT NO 96	4	Various
Simaisma	147,700	Maran Gas Maritime	Daewoo	Jul-06	Greece	S	GT No 96	4	Qatar
SK Audace	180,000	SK-Marubeni	Samsung	Jul-17	Panama	DFDE	TZ Mk. III	4	Various
SK Splendor	138,375	SK Shipping	Samsung	Mar-00	Panama	S	TZ Mk. III	4	Oman Gas
SK Stellar	138,375	SK Shipping	Samsung	Dec-00	Panama	S	TZ Mk. III	4	RasGas
SK Summit	138,000	SK Shipping	Daewoo	Aug-99	Panama	S	GT NO 96	4	RasGas
SK Sunrise	138,306	I. S. Carriers	Samsung	Sep-03	Panama	S	TZ Mk. III	4	RasGas
SK Supreme	138,200	SK Shipping	Samsung	Jan-00	Panama	S	TZ Mk. III	4	RasGas
Sohar LNG	137,250	Oman Gas/ MOL	Mitsubishi Nagasaki	Oct-01	Malta	S	Moss	5	Oman Gas
Solaris	155,000	GasLog	Samsung	Jul-14	Bermuda	TFDE	TZ Mk. III	4	Various
Sonangol Benguela	160,500	Sonangol	Daewoo	Sep-11	Bahamas	S	GT No. 96	4	Angola LNG
Sonangol Etosha	160,500	Sonangol	Daewoo	Sep-11	Bahamas	S	GT No. 96	4	Angola LNG
Sonangol Sambizanga	160,500	Sonangol	Daewoo	Sep-11	Bahamas	S	GT No. 96	4	Angola LNG
Southern Cross	172,000	MOL	Hudong	May-15	Hong Kong	DRL	GT NO. 96	4	Various
Soyo	160,400	Mitsui/NYK/Teekay	Samsung	May-11	Bahamas	DFDE	TZ Mk. III	4	Various
Spirit of Hela	177,000	MOL	Hyundai	Oct-09	Panama	DFDE	TZ Mk. III	4	Various
Stena Blue Sky	145,700	Stena	Daewoo	Jan-06	Panama	S	GT No 96	4	Various
Stena Clear Sky	171,800	Stena	Daewoo	Sep-10	Panama	DFDE	GT NO 96	4	Various
Stena Crystal Sky	171,800	Stena	Daewoo	Jul-10	Panama	DFDE	GT NO 96	4	Various
STX Kolt	145,700	STX Panocean	Korea Hanjin	Nov-08	Panama	DFDE	TZ Mk. III	4	Various
Suez Point Fortin	154,200	Trinity LNG	Koyo Japan	Nov-09	Panama	S	TZ Mk. III	4	Yemen LNG
Taitar No. 1	145,000	NYK Line	Mitsubishi	Oct-09	Liberia	S	Moss	4	Various
Taitar No. 3	145,000	NYK Line	Mitsubishi	Jan-10	Liberia	S	Moss	4	Various
Taitar No. 4	145,000	NYK	Mitsubishi	Jan-10	Liberia	S	Moss	4	Various
Tangguh Batur	145,700	Sovcomflot/NYK	Daewoo	Dec-08	Cyprus	S	GT NO 96		Tangguh
Tangguh Foja	155,000	K Line	Samsung	Jul-08	Panama	DFDE	TZ Mk. III	4	Tangguh LNG
Tangguh Hiri	155,000	Teekay LNG	Hyundai	Nov-08	IOM	DFDE	TZ Mk. III	4	Tangguh
Tangguh Jaya	145,700	K Line	Samsung	Nov-08	Panama	DFDE	TZ Mk. III	4	Tangguh
Tangguh Palung	155,000	K Line	Samsung	Mar-09	Panama	DFDE	TZ Mk. III	4	Tangguh
Tangguh Sago	155,000	Teekay LNG	Hyundai	Mar-09	IOM	DFDE	TZ Mk. III	4	Tangguh LNG
Tangguh Towuti	145,700	Sovcomflot/NYK	Daewoo	Oct-08	Cyprus	S	GT NO 96	4	Tangguh
Tembek	216,200	OSG/Nakilat	Samsung	Sep-07	Marshall Is.	DRL	TZ Mk. III	4	Qatargas II
Tenaga Satu	130,000	MISC	Dunkerque	Sep-82	Malaysia	S	GT NO 88	5	Petronas
Tessala	171,866	Hyproc Shipping	Hyundai	Dec-16	Algeria	DFDE	GTT Mk III	4	Sonatrach
Torben Spirit	173,000	Teekay	Daewoo	Feb-17	Bahama	MEGI-DF	No 96 GW	4	Various
Trinity Arrow	154,900	K Line	Imabari Shipbuilding	Mar-08	Panama	S	TZ Mk. III	4	Various
Umm Al Amad	210,100	J5	Daewoo	Aug-08	Marshall Is.	DRL	GT NO 96	4	Ras Gas III
Umm Al Ashtan	137,000	National Gas Shipping	Kvaerner- Masa	May-97	Liberia	S	Moss	4	ADGAS
Umm Bab	145,000	Kristen Navigation	Daewoo	Nov-05	Bermuda	S	GT NO 96	4	Qatargas
Umm Slaal	266,000	QGTC	Samsung	Nov-08	Qatar	DRL	TZ Mk. III	5	Qatargas
Valencia Knutsen	173,400	Knutsen	Daewoo	Sep-10	Nor-NIS	DFDE	GT NO. 96	4	Various
Velikiy Novgorod	170,200	SovComFlot	STX	Feb-14	Liberia	DFDE	GT No. 96	4	Various
Vladimir Rusanov	172,000	MOL-China Shipping	Daewoo	Mar-18	Hong Kong	DFDE	GT No 96	4	Yamal
Vladimir Viz	172,000	MOL-China Shipping	Daewoo	Sept-18	Hong Kong	DFDE	GT No 96	4	Yamal
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	GT NO 96	4	Various
WilPride	156,000	Teekay	Daewoo	June-13	NIS	DFDE	GT NO 96	4	Various
Woodside Cheney	174,000	Maran	Hyundai Samho	Mar-16	Greece	DFDE	GT No 96	4	Various
Woodside Donaldson	165,500	Teekay LNG	Samsung	Dec-09	Singapore	DFDE	TZ Mk. III	4	Various
Woodside Goode	159,800	Maran	Daewoo	Jul-14	Greece	DFDE	GT No. 96	4	Various
Woodside Reeswithers	173,400	Maran	Daewoo	Nov-16	Greece	DFDE	GT No 96	4	Various
Woodside Rogers	155,900	Maran Gas	DSME	Jul-13	Greece	DFDE	GT NO 96	4	Various
Yamal Spirit	174,000	Teekay	Hyundai Samho	Jan-19	Bahama	MEGI-DF	No 96	4	Various
Yari LNG	159,983	TMSC Gas	Daewoo	Jun-14	Malta	TFDE	GT No 96	4	Various
Yenisei River	155,000	Dynagas	Hyundai	Jul-13	Marshall Is.	DFDE	TZ Mk. III	4	Various
YK Sovereign	127,125	SK Shipping	Hyundai	Dec-94	Panama	S	Moss	4	Pertamina
Zarga	266,000	QGTC	Samsung	Dec-09	Liberia	DRL	TZ Mk. III	5	Qatar-Atlantic
Zekreet	135,420	J4 Consortium	Mitsui Chiba	Dec-98	Japan	S	Moss	5	Qatargas

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

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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	Tanks	Storage Capacity
Belgium	Zeebrugge	Fluxys	1987	4	380,000
Canada	Canaport Saint John	Irving Oil, Repsol	2009	3	480,000
Chile	Quintero	ENAP, Metrogas, Enagas	2009	3	334,000
	Mejillones	Engie, Codelco	2010	1	175,000
China	Beihai LNG, Guangxi	Sinopec	2015	4	640,000
	Dalian	PetroChina	2011	4	640,000
	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, Zhejiang	CNOOC, Zhejiang Energy	2012	3	480,000
	Qidong, Jiangsu	Guanghui Energy	2017	2	100,000
	Qingdao, Shandong	Sinopec	2014	3	640,000
	Rudong	PetroChina	2011	4	680,000
	Shanghai	CNOOC, Shenergy Group	2009	3	495,000
	Shanghai, Mengtougou	Shanghai Gas	2008	3	320 000
	Shenzen, Diefu	CNOOC	2016	2	320,000
	Tangshan, Hebei	PetroChina	2013	3	480,000
	Tianjin North	Sinopec	2017	4	640,000
	Yuedong, Guangdong	CNOOC	2016	4	480,000
	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	6	932,000
	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	2	320,000
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	JERA Co. Inc.	1984	9	540,000
	Futtsu	JERA Co. Inc.	1985	10	1,110,000
	Yokkaichi LNG	JERA Co. Inc.	1988	4	320,000
	Kawagoe	JERA Co. Inc.	1997	6	840,000
	Yokkaichi Works	Toho Gas	1991	2	160,000
	Chita LNG Joint	Toho Gas, JERA Co. Inc.	1978	4	300,000
	Chita LNG	Toho Gas, JERA Co. Inc.	1983	7	640,000
	Chita - Midorihama	Toho Gas	2001	3	600,000
	Senboku I	Osaka Gas	1972	2	275,000
	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	Capacity
Japan (continued)	Mizushima	Nippon Oil, Chugoku Electric	2006	2	320,000
	Sakaide	Shikoku Electric, Cosmo Oil	2011	1	180,000
	Ishikari LNG	Hokkaido Gas, Hokkaido Electric	2012	2	380,000
	Okinawa	Okinawa Electric Power	2012	2	280,000
	Naoetsu	Inpex	2013	2	360,000
	Joetsu	JERA Co. Inc.	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
	Shin-Sendai	Tohoku Electric	2015	2	320,000
Korea	Boryeong	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
	Reganosa, Ferrol	Galicia, Sonatrach, Tojeiro	2006	2	300,000
	El Musel, Gijón,	Enagas	2013	2	300,000
Taiwan	Yung-An	CPC	1990	6	690,000
	Tai-Chung	CPC	2009	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
	Elba Island	Kinder	2001	5	535,000
	Cove Point	Dominion	2003	5	530,000
	Freeport	Freeport LNG Development	2008	2	320,000
	Cameron	Sempra LNG	2009	3	480,000
	Golden Pass, TX	Qatar Petroleum, ExxonMobil	2010	5	775,000
	Pascagoula, MS	Gulf LNG, Kinder	2012	2	320,000
UK	Isle of Grain	National Grid	2005	8	1,000,000
	South Hook	ExxonMobil, Qatar Petroleum, Total	2009	5	775,000
	Dragon LNG, Milford Haven	Shell, Petronas	2009	2	310,000

LNG Import Terminal Projects

Country	Location/Project	Owners/Project Developers	Start up	Storage	
				Tanks	Capacity
China	Shenzhen	CNPC Yudean Power	2021	2	120,000
	Yangjiang	CNPC Yudean Power	2023	2	120,000
	Zhangzhou Fujian	CNOOC	2022	2	160,000
India	FSRU Andhra Pradesh	Andhra Pradesh Gas	2019	1	135,000
	Pipovav LNG (FSRU), Gujarat	Swan Energy	2019	2	320,000
	Andhra Pradesh	Hindustan LNG, Andhra Pradesh	studies	1	135,000

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
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, Pertamina	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, Neptune	Etiki 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	2020	1	2.5
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
	Cameron LNG, Louisiana	Sempra, Total, Mitsui, Mitsubishi	2019	3	14.95
	Commonwealth LNG, Louisiana	Commonwealth LNG LLP	2022	8	9.0
	Corpus Christi Liquefaction, Texas	Cheniere	2019	2	9.0
	Delfin LNG, Louisiana	Delfin, Hoegh	2021	3	9.0
	Driftwood LNG, Louisiana	Tellurian Investments	2022	6	26.0
	Elba Island, Georgia	Kinder Morgan, EIG Energy	2019	10	2.5
	Freeport LNG, Texas	Freeport LNG	2019	4	20.4
	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	2018-19	2	9.0
	Texas LNG Brownsville	Chandra, Meyer, Samsung, others	2023+	2	4.0
	VG LNG (Cameron Parish)	Venture Global	2021	5	10.0
	VG LNG (Plaquemines)	Venture Global	2021	10	20.0

LNG Exporters

Country	Location/Project	Shareholders	Start up	Liquefaction		Storage	
				Trains	capacity (nominal) mtpa	No. of tanks	Total capacity m³
ABU DHABI (UAE)	Das Island (Adgas)	ADNOC, Mitsui, BP, Total	1977 1994	2 1	3.2 2.5	3	240,000
ALGERIA	Arzew	Sonatrach GL4Z	1964	3	1.1	3	35,000
	Arzew	Sonatrach GL1Z	1978	6	7.8	3	300,000
	Arzew	Sonatrach GL2Z	1980	6	8.0	3	300,000
	Arzew	Sonatrach	2014	1	4.7		
	Skikda	Sonatrach GL1K II	1980	3	3.0	5	308,000
	Skikda	Sonatrach (rebuild)	2013	1	4.5		
ANGOLA	Soyo	Sonangol, Chevron, BP, ENI, Total	2012	1	5.2	2	370,000
AUSTRALIA	Karratha	NWS Woodside, Shell, BHP	1989	2	5.0	4	260,000
		(BP, Chevron	1992	1	2.5	1	130,000
		(Mitsubishi/Mitsui)	2004	1	4.4	1	130,000
		NWS partners	2008	1	4.4	1	130,000
		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	1	4.5	3	480,000
YEMEN	Bal-Haf	Yemen LNG, Total, Yemen Gas, Hunt Oil, SK Group, Hyundai	2009	2	6.7	2	320,000

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