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Australia gives Asia-Pacific view of North Asian LNG developments

LNG production in the US adds to Australian and Qatari output for North Asian demand surge

The combined nameplate capacity of US LNG projects is on track to triple to around 70 million tonnes per annum in 2020 and six plants are expected to be operational by the end of 2019, while production will continue to ramp up through 2021.

An Australian government report said that the expansion in infrastructure is expected to make the US the world's third-largest LNG exporter, behind Australia, where nameplate capacity will soon reach 88 MTPA and Qatar, where output is expected to remain at 77 MTPA for the next few years.

Russia's LNG export capacity will reach 27 MTPA by the end of 2019 through Yamal LNG and the country's first export plant on Sakhalin Island.

Output

"In 2021, growth in global supply capacity is expected to slow down to its lowest level since 2013, with the only additions to capacity likely to be from new Trains at existing projects in the US and Indonesia," said the latest Australian Resources & Energy report.

Qatar's exports have ranged from 72 MTPA to 77 MTPA per annum since 2011, although other sources put the peak of Qatar's exports at around 80 MTPA.

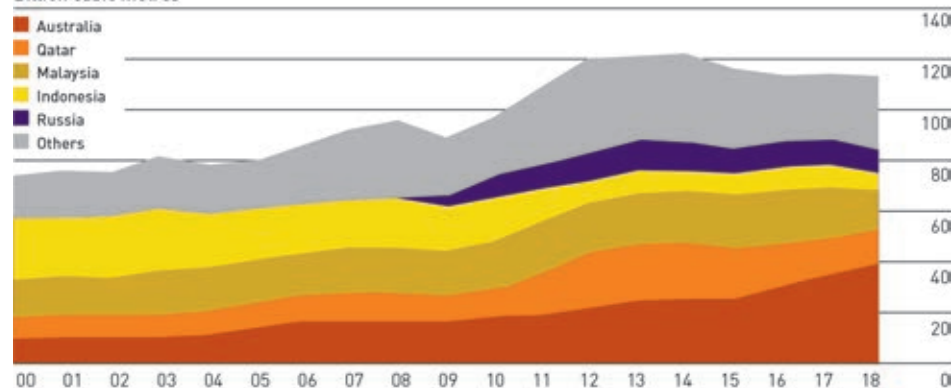
Qatar's LNG exports are forecast to remain around 76MT through to 2021.

However, the Qataris have plans to increase LNG production capacity by 43 percent to 110MT in 2024.

While LNG trade has recently been caught up in trade tensions between China and the US, the forward picture is regarded as positive in the Asia-Pacific region.

"The effect of tariffs on short-term LNG prices appears to have been minimal, or has been swamped by other

LNG imports by source: Japan
Billion cubic metres



Australia is increasing its LNG shipments to Japan as others falter

factors, such as rapidly increasing supply capacity in LNG markets," stated the report.

Australia has accounted for the majority of the increase in China's imports since China imposed tariffs on US LNG in September 2018.

That said, the Australians say that it is difficult to attribute this increase directly to the effect of tariffs, given China's rapidly growing LNG demand and the ramp up of new Australian projects such as Wheatstone in Western Australia and Ichthys in the North Territory over the same period.

Other countries, such as Malaysia and Indonesia, have also increased LNG exports to China.

The impact of China lifting tariffs on US LNG to 25 percent from June 2019 will become clearer in coming months, as data for the second half of 2019 comes in.

"It is possible that trade flows continue to reorganise around increased tariffs, with few apparent effects on the market," said the report.

"It may also become increasingly costly for China to bring in more LNG from non-US sources. Chinese LNG requirements are growing rapidly and the ramp up in low-cost US LNG would have been a

natural source of new supply for China," explained the report.

"If non US-origin LNG is more costly for China to import, then tariffs could potentially have the effect of reducing China's LNG purchases," it added.

In other North Asian market developments, Japan's LNG imports are forecast to fall to 77MT in 2021 as overall energy demand in Japan is expected to decline slightly. At the same time, LNG is expected to face increasing competition in the electricity generation sector from both nuclear and renewable power generation.

The restart of several reactors over 2018 is expected to reduce Japan's annual LNG imports from 2019 onwards. Currently nine of Japan's 42 nuclear reactors had gained approval to restart and were in operation.

"Further nuclear restarts appear likely over the next five years while 18 reactors have applications to restart with the Nuclear Regulation Authority, and at least three reactors are likely to restart before end 2021," explained the report.

It cautions that several eventualities complicate the outlook for nuclear energy in Japan, and could see Japan import more LNG than forecast.

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Japan's Nuclear Regulation Authority stated recently that it would order the shutdown of any nuclear reactors that have not met deadlines to implement counter-terrorism measures.

"In addition, ongoing public opposition to nuclear energy in Japan could delay the restart of more nuclear power reactors," said the report.

China was the second-largest LNG buyer in the world in 2018, importing 54MT of LNG (73 billion cubic metres). And shipments to its growing network of 20 terminals continued to increase rapidly in the first half of 2019 and were up more than 19 percent cent on the same period a year earlier, on the back of surging gas demand.

"Strong demand also made room for increased pipeline gas imports and domestic gas production," said the Australians.

"Growth in China's gas consumption is expected to continue over the outlook period, driven by China's efforts to reduce air pollution and 'turn China's skies blue again' soon," it added.

"China is aiming to raise the share of gas in the overall energy mix from 7 percent in 2017 to a target range of 8.3 percent to 10 percent in 2020, and to 15 percent in 2030," said the report.

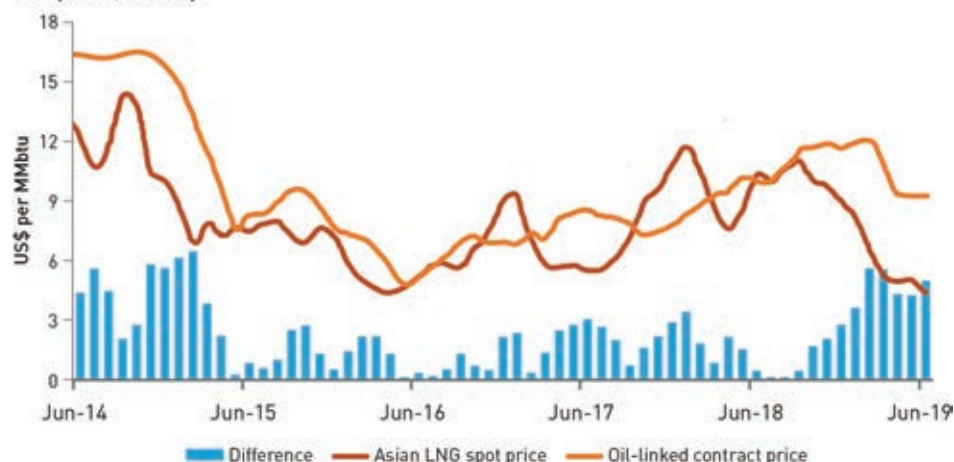
In 2021, China's gas consumption is forecast to reach 364 Bcm, up from around 280 Bcm in

2018.

"LNG is expected to play a major role in servicing rising Chinese gas demand and China's LNG imports are forecast to reach 72MT (98 Bcm) in 2021," said the report.

"While both domestic production and pipeline imports

LNG prices, monthly



Differential between oil-linked contract prices and spot LNG cargoes

are forecast to grow, they are not expected to keep pace with rising domestic demand," it added.

China is targeting domestic gas production of 207 Bcm in 2020, up 30 percent from around 159 Bcm in 2018.

The Asia giant is still facing challenges in lifting domestic output, including difficult geology, and it could easily fall short of its 2020 production target.

China's pipeline gas imports are also expected to increase over the next few years.

There are plans to expand the capacity of the Central Asia-China Gas Pipeline system from 55 Bcm to 65 Bcm by the end of 2019.

The "Power of Siberia" pipeline from Russia to

northern-eastern

China is also scheduled for completion at the end of 2019.

"China is expected to import around 5 billion cubic metres of gas from Russia in the first full year of the pipeline's operation in 2020, but it will take until around 2025 for the imports

to reach the pipeline's full capacity of 38 Bcm," added the report.

South Korea

The world's third-largest buyer of LNG in 2018 was south Korea with imports reaching an all-time high of 45MT.

"The rise was due to a sharp fall in nuclear power generation with reactors offline for both regular maintenance and unexpected downtime," said the report.

"South Korea's LNG imports fell by 15 percent in the first four months of 2019, with demand constrained by a mild winter and the return of nuclear generation capacity to operation, and the return of nuclear generation capacity is expected to drive a short-term fall in South Korea's imports to 41MT in 2019," it added.

The outlook expects that by 2020 LNG imports are expected to begin increasing again, reaching 46MT in 2021.

South Korea's long-term plan is to shift its energy mix towards renewables and gas, and away from nuclear and coal.

Against this backdrop, South Korea plans to close several more ageing coal-fired power stations before 2022, and has lowered taxes on LNG imports and raised taxes on thermal coal imports.

The Australian report noted that there was also significant scope for increased LNG demand in other emerging Asian economies, such as Pakistan, Bangladesh, Indonesia, Malaysia and Thailand.

Pakistan is already a significant LNG buyer, with imports reaching an estimated 8MT in 2018, after the country experienced a domestic gas shortage.

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

"LNG is expected to play a major role in servicing rising Chinese gas demand and China's LNG imports are forecast to reach 72MT (98 Bcm) in 2021"



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LNG industry leads way as transitional fuel and main developer of energy and affiliated sectors

Spot and futures trading and more infrastructure will enhance economic and environmental benefits

Within the natural gas industry, the fastest growing source of supply will be LNG, which is anticipated to grow at approximately 4 percent annually, providing a flexible energy solution to meet the needs of many countries.

At the same time, the LNG industry is being reshaped by a range of factors, including the new sources of supply emerging from the US and Africa.

Fleet

Shipping expansion is also taking place and the building of more floating storage and regasification units is increasing the penetration of LNG into emerging markets and meeting the needs of buyers such as China and India.

Buyers in mature markets are reconsidering the balance between long-term and shorter-term contracts, with the spot market growing year-by-year.

An increasing share of contracts are linked to hub-based pricing. As a reflection of these driving forces in the industry, new business models are emerging as well, with new players entering various points in the LNG supply chain.

There has been rapid growth in the number of countries supplying LNG, almost doubling between the start of the century and 2018. This has significantly increased the flexibility and security of gas supply options for importing countries.

Building

For example, in 2018 China imported natural gas from more than 20 countries, via a combination of both pipelines and as LNG.

In 2018, delivered volumes of global LNG reached 319 million tonnes, nearly doubling in the last 10 years.

Once all current construction is finished by 2020, the liquefaction capacity will have doubled from its 2015 level.

Liquefaction capacity additions picked up in 2018 and brought 37MT into the market.

LNG supply is expected to grow by 35 MT and 29 MT in 2019 and 2020

respectively and 60 percent of this supply growth is going to come from US projects alone through 2020.

However, capacity additions are expected to slow down rapidly as the 30 percent of the remaining projects under construction come on stream over the next three years.

At the same time, the number of countries importing LNG has quadrupled, with LNG trade increasing from 100MT in 2000 to 319MT in 2018.

China alone represented 60 percent of the global growth in the LNG market in 2018, primarily driven by a coal-to-gas switching programme in the industrial, commercial and residential sectors.

Strong

Despite the strength of the Chinese market, the LNG trade has proven to be both flexible and resilient, able to adapt quickly to shifting trade patterns, market factors and policy changes.

For example, South Korea hit its record high LNG imports of 44MT in 2018 due both to a record-breaking heat wave during summer months, low nuclear utilization and policy-driven constraints on coal-fired generation to improve air quality.

Demand strength will continue as gas import and transmission infrastructure continues to pick up pace.

China's regasification capacity is expected to continue to increase, from the current 70MT to more than double in five years.

Currently, India has four regas terminals in operation with effective capacity of more than 30 MTPA operating at relatively high levels of utilization of about 75-80 percent.

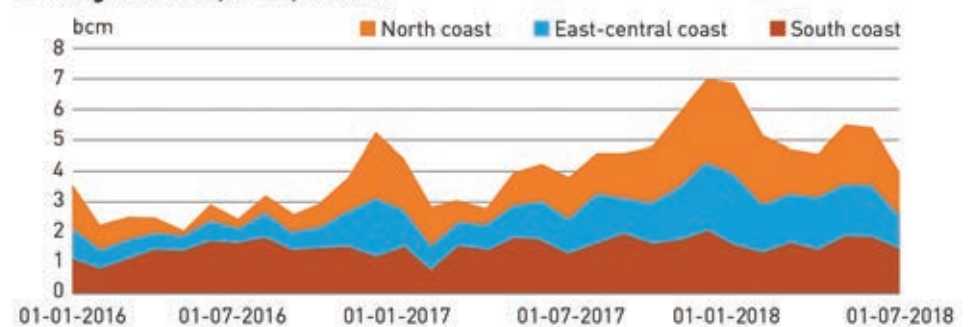
With five projects under construction currently, the regas capacity is expected to double in three years' time.

Capacities

This expansion in import capacity will be matched by significant increases in gas transportation and distribution within India in the coming decade.

Currently there are around 4,000

LNG regasification, China, 2016-18



Chinese regasification and import capacities have recently been expanding

kilometres of pipelines under construction, while the government licensed 86 new areas for city-gas distribution in 2018 alone in areas which have historically had no access to natural gas.

Floating storage and regasification units (FSRUs), which present a fast, flexible and economically competitive option for countries looking to import LNG, have made a significant impact on accessing new markets.

FSRUs also offer benefits to countries looking to replace or complement existing gas supplies, or to balance seasonal variations in hydropower.

Currently, there are over 20 FSU terminals in operation worldwide and many more under construction, according to the International Gas Union.

Time horizon

The current wave of investment that underpinned today's 70 percent expansion in LNG capacity across the global market is expected to support the demand growth over the next few years.

However, robust demand growth across time horizon requires continued investments in the new projects now to meet this growing demand by the middle of next decade.

The global market continues to develop its flexibility and responsiveness to the needs of buyers.

Historically, around half of all spot supplies go into North Asia, where one cargo a day is traded.

But the regional diversity of spot buying is growing, with Europe emerging as the largest buyer. It is expected that

the European market will play a pivotal role for spot market development, growth and depth in the coming years.

The growth of the spot market has also supported the emergence of alternative pricing benchmarks, most notably the Japan Korea Market (JKM) LNG benchmark price assessment for spot cargoes.

Increased spot trade in Asia enables confidence in the use of JKM as a benchmark.

More physical spot trading will likely be followed by a financial market to management risk. Activity in the JKM swaps futures market increased its percentage versus the physical market, getting to just over 10 percent last year.

This compares to 2017 when the LNG derivatives market only covered 3 percent of the physical market.

Liquidity in the financial Asian LNG spot markets continues to reflect a rising number of participants in the physical and financial markets but also the increasing confidence to transact on an index that tracks the supply and demand fundamentals.

Component

Natural gas will be a critical component of this energy transition – to generate electricity, provide heat for essential industrial processes, heat or cool homes, and transport people and goods over long distances.

LNG will play a prominent role in this transition, enhancing global energy security by connecting remote sources of supply with demand centres in a flexible, secure manner.

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Switching from coal to cleaner-burning natural gas is significantly reducing greenhouse gas emissions and air pollution.

The flexibility of natural gas will continue to support the integration of variable renewable electricity, cost-effectively responding to increases in demand and drops in supply from solar, wind and hydro.

Natural gas will also be vital in parts of the economy that are more difficult to electrify, including industrial processes and freight transport.

Electricity generation is expected to increase from a fifth of energy use to 50 percent by 2050.

Support for renewables

As the share of renewable electricity increases, the flexibility of natural gas will make it increasingly competitive with other thermal power generation.

Natural gas will also be vital in parts of the economy that are more difficult to electrify, including industrial processes and freight transport.

Economics, government policies, market regulation and an evolving industry structure will shape the future role of LNG in the energy industry.

The economics will become more competitive as government policies consider not only the cost of purchasing and using fuel, but also the anticipated costs associated with the impacts on the environment.

Conclusion

Economics, government policies and relative environmental benefits will shape the future role of natural gas.

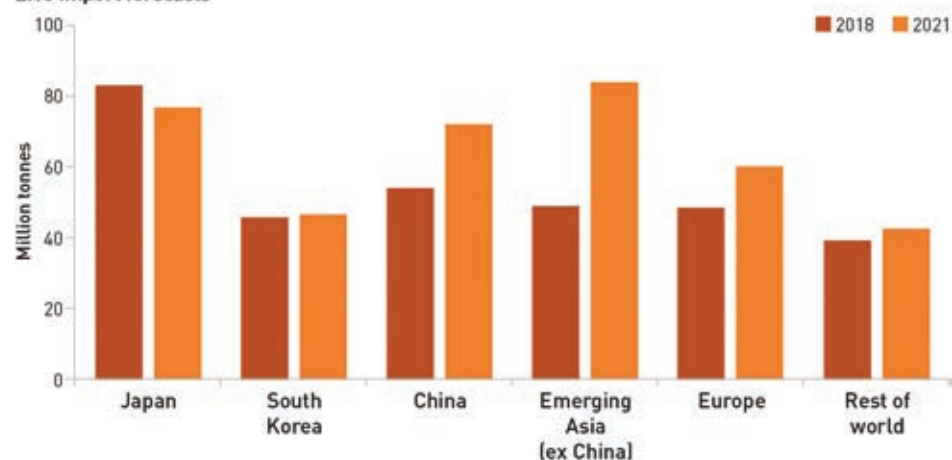
Government policies that put a price on carbon emissions can help reduce emissions and encourage investment in cleaner energy sources. Likewise, government-led emissions standards can drive investment and accelerate emissions reductions.

The rapid growth of LNG is playing an important role in increasing energy supply, security, diversity and flexibility.

LNG is available during gas market uncertainties (supply and demand).

Some examples where LNG provides

LNG import forecasts



How shipments are expected to change on a regional basis

energy security are: declining domestic production, pipeline disruptions, falling nuclear utilisation and reliability, hydroelectric seasonality, renewable intermittency and weather disruptions.

Strategic trends will continue to reshape the structure of the LNG industry.

The opening up of new markets through the use of FLNG technology, the increased scale of the traded spot market for LNG and the growing linkage to

hub-based pricing will allow for new business models to emerge and a more flexible and robust LNG market to continue to grow. ■

This article is partly based on extracts from a conference paper called "LNG: Powering Progress and Evolving Industry" by Jefferson Edwards, Shell Energy, Royal Dutch Shell



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LNG shipbuilding expands for various global export projects and growing marine fuel needs

Spot and futures trading and more infrastructure will enhance economic and environmental benefits

The liquefied natural gas shipping market is being affected by the changes that have occurred in LNG trading in recent years, with increasing demand for flexibility in supply and contracts of shorter duration.

The customer base for LNG will also change because of cleaner fuel for shipping demanded in emission control areas in various regions of the world and stricter regulations being brought in by bodies such as the International Maritime Organization.

Sales

These moves are encouraging a build-out of LNG bunkering infrastructure and small-scale re-fuelling vessels.

The development of spot LNG carrier (LNGC) chartering emerged in the

conventional carrier market in the aftermath of the Fukushima nuclear accident and tsunami in Japan in 2011 as demand for spot cargoes surged.

Spot LNGC charter rates reached their lowest levels in 2016-2017 at below \$30,000 per day, driven by an excess of shipping capacity. The increasing LNG imports into China - especially for the winter months - led to the development of seasonal price patterns for spot charter rates, with a first cycle during the winter of 2017-2018, followed by a much stronger cycle at the end of 2018.

Spot charter rates rose up to \$190,000 per day in November 2018 as market operators used LNGCs as floating storage ahead of an expected tight supply market in Asia - which did not materialise because of warmer-than-average temperatures.

This led in turn to a sharp drop in spot rates, which returned to their pre-2018 levels of \$35,000 per day at the end of the first quarter of 2019.

Such high prices and strong volatility prompted a series of newbuild orders for LNGCs in 2018, with a total of 100 new LNGCs on order as of the end of the first quarter of 2019, accounting for an increase of 20 percent in total shipping capacity (or 6 million cubic metres of LNG).

"According to an average construction time of two to three years, most of this additional shipping capacity will be commissioned by the end of 2021," said a natural gas industry report from the International Energy Agency.

"This forecasts that the current order book would provide a sufficient shipping capacity increment to maintain a fleet

utilisation rate of about 95 percent (the equivalent of 2018), but will require additional vessels beyond 2021 to maintain a balanced market, though one with limited spare capacity," added the IEA.

"The equivalent of at least 70 new vessels (assuming a constant fleet size without retirements) would be required between 2022 and 2024 to maintain an average fleet utilisation rate of 95 percent," it stated.

Trade flows

LNG trade in the Pacific Basin and Middle East accounted for 78 percent of total LNG flows in 2018 at a volume of 337 billion cubic metres, increasing from 301 Bcm in 2017.

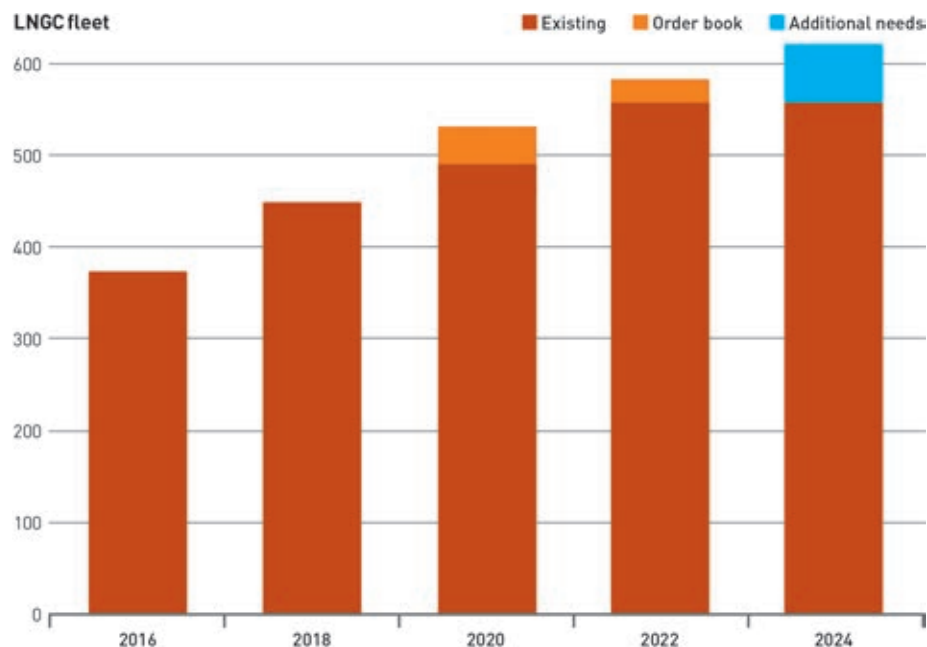
"This results mainly from the growth in imports into China (up 21 Bcm per year),

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Spot LNG carrier charter market is growing with the global fleet

Korea (up 8.5 Bcm) and Pakistan and India (up 3.5 Bcm each), while Japanese imports were almost stable (down 1 Bcm) and those into the Middle East declined (2.6 Bcm)," explained the IEA.

"In the Atlantic Basin, imports increased marginally from 94 to 96 Bcm/y between 2017 and 2018 as a whole, but with some compensating effects between a 10 percent increase in Europe (up 6 Bcm/y), some stability in both North and South America (down 0.5 Bcm), and a steep decline in Egyptian imports (down 5 Bcm) as the country saw its own production increase sharply," added the report.

The IEA stated that by 2024 LNG flows in the Pacific Basin and Middle East are expected to reach 436 Bcm per annum, or a 30 percent increase from 2018, thus accounting for 80 percent of total LNG trade.

"Growth in export volumes from US, Australian, African and Russian projects currently under development account for most of the additional trade East of the Suez Canal," it stated.

Atlantic Basin

Atlantic Basin flows are seen growing by 14 percent to 110 Bcm a year by the end of the forecast period, with US LNG providing the bulk of additional volumes.

Exports from Qatar are expected to shift further to the East, as the Pacific Basin's share of its trade increases from 76 percent in 2018 to 83 percent by 2024.

US LNG flows were almost balanced in 2018 (59 percent to the Pacific Basin) with Korea becoming its largest destination, after its first two years of exports were slightly dominated by Atlantic Basin destinations.

Chile and then Mexico were the largest destinations for US volume in 2016 and 2017.

"Exports to the Pacific Basin are expected to increase strongly to reach a share of 75 percent of US LNG flows by 2024, while Europe becomes the main destination on the Atlantic Basin," said the IEA.

Russian cargoes

The report noted there would be additional Russian LNG flows from the Yamal peninsula which are expected to be almost equally balanced between basins.

The global LNG supply outlook has evolved substantially since the last issue of the IEA report, with a total of 63 Bcm per annum of new projects taking final investment decisions or starting construction since mid-2018, and a significant number of additional greenfield and expansion projects scheduled for FID during 2019.

A large share of this additional capacity (44 Bcm/y) is scheduled to be commissioned during the forecast period.

Outside of LNG carriers, the use of LNG as a fuel for maritime transport is currently a niche market, mainly concentrated in Europe.

As of early 2019 there are about 155 LNG-fuelled vessels in operation (excluding LNG carriers), of which a large majority are small ships used for short to medium-distance journeys - such as ferries, tugboats, car and small container vessels.

Propulsion

However, the fleet of LNG-powered vessels is growing fast and is expected to double by 2024 with about 150 ships on order, and with additional potential from another 140 "LNG-ready" ships, equipped with the technology to use LNG as an alternative on a dual-fuel propulsion basis.

This growing interest of the shipping industry in LNG as a bunker fuel is driven by the implementation of a 0.5 percent global sulphur cap on maritime fuels by the IMO from 1 January 2020, which will dramatically impact a market that consumed 3.4 million barrels per day (mb/d) of high-sulphur fuel oil in 2018.

"LNG has several advantages as a marine fuel compared to more conventional options for complying with 2020 fuel specifications - it is a proven technology already extensively used by LNG carriers, it has a stable and standardised quality, and has a lower environmental footprint than oil-based fuels," said the IEA.

"It also has little sulphur and LNG does not emit particulates, while reducing nitrogen oxides and carbon dioxide emissions by up to 85 percent and 20 percent respectively," added the report.

It would therefore also contribute to the IMO's greenhouse-gas emission strategy, which aims to reduce the sector's total GHG emissions by at least 50 percent by 2050 compared with 2008.

Moreover, LNG as a fuel has become increasingly competitive with oil-based marine fuels as gas prices have decreased strongly since the end of 2018.

However, switching to LNG also has additional costs and requirements.

"It is unlikely to compete with conventional fuels for the existing fleet, as the cost of installing exhaust-gas cleaning systems (also known as scrubbers) is cheaper than conversion to a new propulsion system, with payback times up to three times faster than LNG," said the IEA.

Even for new-build vessels, there is an additional cost to choosing the LNG option over scrubbers, estimated by European ship brokerages at \$20 million

for a 15 000 twenty-foot equivalent unit (TEU) container vessel.

In operational terms, it takes additional tank space (and therefore can have an impact on cargo capacity, especially for small vessels), requires special training of crew members and bunkering operations take longer than for oil-based products.

Emissions

From the emissions perspective, potential methane losses can be an issue, especially for low-pressure engines.

"As regards bunkering infrastructure, the number of facilities is currently limited but expanding," said the IEA.

"As of early 2019 six bunkering vessels are active (mainly in northwest Europe) and nine are under construction, of which five are to be delivered in 2019," it added.

"Alternative bunkering services by truck to ship are also available, enabled by the large number of LNG regasification terminals equipped with truck-loading facilities," explained the report.

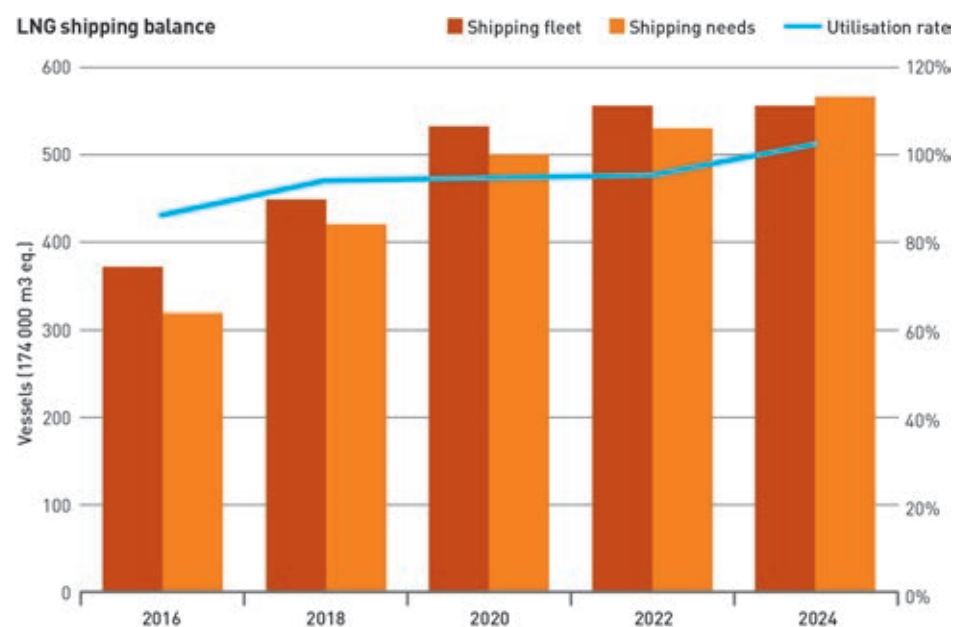
"The current lack of standardisation and consistency in the licensing and

control of LNG bunkering between countries remains a barrier to its development, although the harmonisation of standards and operations across different markets is progressing," it said.

LNG as a bunker fuel remains a market in an early stage of development.

"Its medium-term growth is expected to be supported by two main segments: container ships and cruise liners," stated the IEA.

"They are considered the most suitable because they operate largely fixed shipping lines, which minimises logistical issues as bunkering infrastructure remains under development," it added. ■



Market balancing seen for the LNG carriers market through 2024

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For the Record

ABS, the American Bureau of Shipping, and Japanese shipping company Mitsui OSK Lines have signed an accord to collaborate on up to 14 new gas carriers expected to transport cargoes from the US to North Asia as well as other global markets. The agreement covers seven newbuild LNG carriers and seven Very Large Ethane Carriers (VLECs). MOL has an LNG fleet in operation numbering almost 100 vessels as well as a growing fleet of VLECs. Six of MOL's jointly-owned VLECs were delivered in 2016 and 2017 and have been engaged in the transportation of liquefied ethane from Houston to the facilities of Reliance Industries in India. In addition to its LNG fleet and VLECs, MOL's other ships include large crude oil carriers, liquefied petroleum gas carriers, containerships, bulk carriers and car carriers.

MOL is now shipping more LNG cargoes from the US to Japan, including from the Cameron liquefaction plant of Semptra Energy in the state of Louisiana, as more export facilities come on stream on the Gulf Coast. "ABS is a world leader in gas and the classification of gas carriers, with a track record of supporting some of the most innovative and technically demanding projects in the world," said Tony Nassif, ABS Executive Vice President and Chief Operating Officer. "It is outstanding to have that expertise recognized by an innovator such as MOL," added Nassif. "ABS is proud to be able to use our extensive experience to support these projects and advance the safe handling, storage and transportation of gas," he stated. ABS, whose headquarters are in Houston, will provide reviews, surveys, inspection and other classification services for machinery and equipment as well as assist with managing the requirements for foreign-flag carriers calling at US terminals. "We have accumulated experience and knowledge as one of the world's leading LNG carrier owners and management companies and

the largest VLEC operator in the world," said Tatsuro Watanabe, MOL General Manager of Energy Business Strategy in the transport unit. "ABS's extensive experience, demonstrates that MOL is committed to offering safe, high-quality and efficient gas transport service to customers," added Watanabe.

The Japanese shipping line is also using ice-breaking carriers for the first time to ship LNG cargoes from the Russian Yamal plant in the Arctic region. MOL has developed an expertise in floating LNG terminals as the owner of the world's largest floating storage and regasification unit now in operation in Turkey. The "MOL FSRU Challenger" has 263,000 cubic metres of capacity and is set to be transferred after 2020 to Hong Kong for a gas-to-power project. ABS said its services provide the natural gas industry with information and guidance for a range of vessels, including FRSUs, structures, gas-fuel systems and equipment. It also offers specification reviews, risk and hazard assessments, bunkering suitability reviews, project management for new construction and feasibility studies.

ALGERIA, the North African liquefied natural gas producer, has agreed a renewed deal with Tunisia and Italian energy company Eni for the pipeline transportation of more natural gas to southern Europe as the Algerians also prepared to direct new gas finds into industry rather than LNG exports. Algerian LNG exports have been falling and last year they dropped by 18.2 percent to 10.10 million tonnes compared with 12.34MT the previous year at its two liquefaction plants at Skikda and Arzew on the Mediterranean Coast. Tunisian Industry Minister Slim Feriani and Eni Chief Executive Claudio Descalzi signed the new agreement to transport Algerian natural gas by pipeline through Tunisia. The agreement follows another reached with Algerian state energy company Sonatrach in May in relation to the purchase of gas and transport across the Strait of Sicily and completes the contractual framework that allows Eni to import Algerian gas into Italy. With this agreement, Eni said it was undertaking to operate the Algeria-Tunisia-Italy pipeline for the next 10 years, through its subsidiary Trans-Tunisian Pipeline Company (TTPC),



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ensuring the necessary reinvestment for modernising infrastructure and taking advantage of the exclusive rights to the entire transport capacity. Built in the early 1980s and strengthened subsequently over several phases, the trans-Tunisian pipeline consists of two lines, 48 inches wide and around 370km long, from the Algerian-Tunisian border near Oued Saf to the Cap Bon headland. It also has five compression stations. “With a transport capacity of approximately 34 billion cubic metres per annum, it plays a key role in Italian and Tunisian energy supply and will continue to do so,” stated Eni.

The Italians added that the pipeline contributed to the diversification of sources and to the energy transition in the Italian market. “The agreement represents a further confirmation of Eni’s long-standing commitment to North African countries, not only in hydrocarbon exploration and production, but also in managing transport infrastructure,” added Eni. Sonatrach Chief Executive Rachid Hachichi also met with Eni counterpart Descalzi to review progress on boosting natural gas output in the North African nation. Sonatrach reported in early 2019 that several petrochemical joint ventures were under negotiation to monetise its natural gas through channels other than pipeline and LNG exports. Industry is therefore expected to remain the main driver of natural gas consumption growth in Algeria in the near future. Residential and commercial demand is set to remain stable, with limited consumption growth owing to gas already having high market penetration in Algeria. Sonatrach and Eni confirmed the intention to accelerate the development of new oil and gas projects in the North Berkine basin in the Algerian desert that will lead to a significant increase in national production. The project is composed of two phases. The first is related to oil development and has started up. The second one, a natural gas project, is scheduled to come on stream by the end of September 2019 with a 180-kilometres pipeline being completed.

ANCALA PARTNERS, a London-based private equity fund, has acquired a 50 percent stake in the UK Dragon LNG import terminal in Milford Haven in Wales from Malaysian energy company Petronas. The Petronas stake was sold for an undisclosed amount and Ancala’s partner in the LNG terminal will be Royal Dutch Shell. Petronas was an original investor in the Dragon LNG facility with BG Group of the UK. The Dragon facility came on line in 2009 alongside the existing South Hook

LNG terminal, owned by Qatar Petroleum and ExxonMobil. Shell then became a stakeholder in the terminal when it acquired BG in 2016. The Dragon terminal is one of three LNG regasification facilities in the UK, the third being the Isle of Grain facility southeast of London, owned by National Grid. The terminal has a gas send-out rate to the National Transmission System of up to 9 billion cubic metres of natural gas, or around 6.5 million tonnes of

LNG. Facilities at the terminal were recently enhanced through commissioning of a small-scale reliquification plant.

Petronas will continue to be a customer of the Dragon terminal as a counterparty to a long-term throughput agreement. “Dragon LNG is well placed to benefit from reducing UK gas storage capacity and maturing North Sea gas production,” said Lee Mellor, a partner at Ancala. “With revenues underpinned by a long-term

availability-based throughput agreement with Shell and Petronas, the transaction represents an attractive addition to our portfolio and expands our midstream infrastructure activities,” added Mellor. UK-based international law firm Dentons said it advised Petronas on the transaction. The Dentons team was led by UK Energy partner Humphrey Douglas and supported by Energy senior associate Daniel Saville and associate Michael Walton. Dentons



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added that PwC UK Corporate Finance acted as the financial advisor on the deal, led by Jon Shelley and Tom Copeland, and supported by David Isaacs.

ASIA'S shipbuilding industry is heading for even tighter competition for orders to build vessels such as LNG carriers, oil tankers and container ships as two of the largest Chinese shipbuilding companies are examining a merger plan at the same time as two of the biggest South Korean shipyard operators are also advancing with a merger proposal. South Korean companies Hyundai Heavy Industries and Daewoo Shipbuilding & Marine Engineering, are still moving slowly forward with their merger plans first revealed in February 2019. Now China State Shipbuilding Corp. (CSSC) and China Shipbuilding Industry Corp. (CSIC), the country's two biggest state-backed shipbuilders by production capacity, are discussing a merger to compete against regional rivals. The two Chinese listed companies announced in stock exchange filings on July 2 that they were planning a strategic restructuring, though their plans have still to be approved by the relevant authorities in Beijing. Both CSSC and CSIC have said they believe they could compete better as a single company in seeking orders for LNG carriers, military vessels and cruise liners. "It's time for capable Chinese shipyards to make complex, high value-added vessels to reach buyers in new segments through asset restructuring, international collaboration and research and development activities," said a supporting statement from the China Association of the National Shipbuilding Industry. If the merger goes through, the two Chinese shipbuilding groups will have more sales volume than their South Korean competitors, as well as other shipbuilders around the world. South Korean shipbuilders, Hyundai Heavy and Daewoo Shipbuilding as well as Samsung Heavy Industries gained 85 percent of the world's total orders for LNG carriers in 2018. The merger would give the Chinese companies the scale to match Hyundai's proposed acquisition of Daewoo Shipbuilding.

CSIC's major shipyards are located in Dalian, Qingdao and Wuchang, along with a large number of associated suppliers and research facilities. Its sales revenue amounted to 305 billion yuan (\$44.3 billion) in 2018, with profit of 6.9 billion yuan (\$1Bln). It currently manages five listed companies. CSSC's core assets include Shanghai Waigaoqiao Shipbuilding, Jiangnan Shipyard Group and Hudong-

Zhonghua Shipbuilding as well as the Longxue shipbuilding facilities in Guangzhou, the port city in southeast China. CSSC had annual sales of 114.4 billion yuan (\$16.6Bln) in 2018, with 2.4 billion yuan in profit. The group to date has three listed companies. Both CSSC and CSIC have already begun to deploy more financial resources in developing ships such as mega-container vessels, LNG carriers and dual-fuel vessels able to be powered by LNG or diesel fuel. In March 2019, Hyundai signed a deal worth an estimated 2 trillion won (US\$1.6 billion), with the state-run Korea Development Bank to buy Daewoo Shipbuilding. The bank is the largest shareholder in Daewoo Shipbuilding, with a controlling 55.7 percent stake in the company. As part of the deal, Hyundai has split into two entities. This was voted through at a Hyundai meeting of shareholders on May 31 against a background of hostility from Korean labor unions. Hyundai swung back to profit in the first quarter of 2019 following a large loss in the year-ago quarter. If the Korean takeover is finally completed in the months ahead, the Hyundai Heavy Industries Group will have control of four shipbuilders, Hyundai Heavy, Hyundai Samho Heavy Industries, Hyundai Mipo Dockyard and Daewoo Shipbuilding.

BELGIUM through its Federal Commission for Electricity and Gas Regulation has approved the tariff and liquefied natural gas services agreement proposals for unloading slots and additional storage services at the Zeebrugge LNG import terminal. The regulatory approval clears the way for Fluxys LNG to finalise new long-term contracts for the facility up to 2044. "The approval allows us to turn binding interest from the market into new long-term contracts worth roughly 1 billion euros," said Pascal De Buck, Chief Executive and Chairman of Fluxys Belgium, the transmission network operator. The director of the regulatory Commission, Laurent Jacquet, said the tariffs have decreased for all terminal users who unload and store LNG, and inject natural gas into the transmission system. "Through the new tariffs, the Commission has established a solid and stable framework for regulatory supervision in the future," explained Jacquet. "These favourable conditions consolidate Zeebrugge's position as an access point for LNG deliveries to Europe," he added. Fluxys said that the current long-term contracts for unloading at the Zeebrugge terminal expire in 2028. During a

subscription window held from 30 April until May 24 unloading slots and additional storage services at the Zeebrugge facility were offered over subsequent periods up to 2044. "The subscription window proved highly successful and revealed binding interest from the market for the entire unloading capacity at the facility up to 2044," stated Fluxys.

Fluxys and the regulator noted that the positive outcome of the subscription window process was the result of a combination of factors. "Gas import needs in Northwest Europe are set to rise significantly," they said. "Gas production in The Netherlands and the North Sea is declining, while gas demand for power generation will increase to accommodate the phase-out of sizeable coal, lignite and nuclear power generation capacity in the region," they added. Fluxys stated that the subscription window offered an attractive tariff proposition together with optimum destination flexibility throughout Northwest Europe from a strategically positioned LNG terminal. Zeebrugge is directly linked into the Belgian market (ZTP) and is fully interconnected with the gas systems of all surrounding markets. These include the Dutch Title Transfer Facility (TTF) the German Gaspool, the Trading Region France (TRF) market and the UK National Balancing Point (NBP) and take-away capacity from the terminal is readily available.

BHP, the Australian commodities and energy company whose assets include a stake in the North West shelf liquefied natural gas export plant in Western Australia, has issued the world's first bulk carrier tender for LNG-fueled transport for up to 27 million tonnes of its iron ore. "Through this tender, we are seeking potential partners who share our ambition of lowering emissions to the maritime supply chain," said BHP. The company said the tender was open to a select group of industry leaders, from ship owners, banks and LNG fuel network providers. The apparent aim of the tender is to find a partner for an LNG-powered newbuild iron-ore carrier, or a shipping company willing to order one with a pre-booked charter from BHP. BHP said that introducing LNG-fueled ships into its iron ore maritime supply chain would eliminate nitrogen oxide and sulphur oxide emissions and significantly reduce carbon-dioxide emissions along the busiest bulk transport route globally from Western Australia to North Asia.

As well as LNG-fueled transport for up to 10 percent of its iron ore, the tender

seeks other innovative solutions that can lower greenhouse gas emissions and increase productivity from BHP's freight requirements. "We are fully supportive of the International Maritime Organisation's (IMO) decision to impose lower limits on sulphur levels in marine fuels," said Rashpal Bhatti, Vice President, Maritime and Supply Chain. "While LNG may not be the sustainable homogenous fuel of choice for a zero carbon future, we are not prepared to wait for a 100 percent compliant solution if we know that, together with our partners, we can make significant progress now," added Bhatti.

"This new tender adds to the work BHP is doing with customers, suppliers and parties along our value chain to influence emissions reductions from the transport and use of our products," stated the BHP executive. "We recognize we have a stewardship role, working with our customers, suppliers and others to influence emissions reductions across the full life cycle of our products," he explained. BHP, whose main offices are in Melbourne, London and Singapore said that as well as making investments in emerging technologies, it sets GHG emissions reduction targets for its operations and works across sectors to strengthen its global policy.

CHART INDUSTRIES, the US LNG and industrial gases equipment provider, completed its takeover of Harsco Corp.'s Air-X-Changers business, boosting its offering of air-cooled heat exchangers and industrial fans. The Harsco AXC business specializes in gas compression coolers and was purchased for almost \$600 million, with funding raised from loans and a share offering. The new Air-X-Changers products will be part of the Chart Energy & Chemicals FinFans division, offering a broad product range with varied air-cooled capabilities. The growing Chart division will be comprised of the previously acquired Hudson Products business, the Air-X-Changers unit and Chart's own Cooler Services. "I am excited to complete the Air-X-Changers acquisition on schedule, which provides strong backlog for the second half of 2019, immediate margin accretion to us and a strong team," said Chart Chief Executive Jill Evanko. "Eric Clower, who has demonstrated consistent profitable growth as the General Manager for Air-X-Changers over the past eight years, will continue to build our E&C FinFans business as the segment President, effective immediately," added Evanko.

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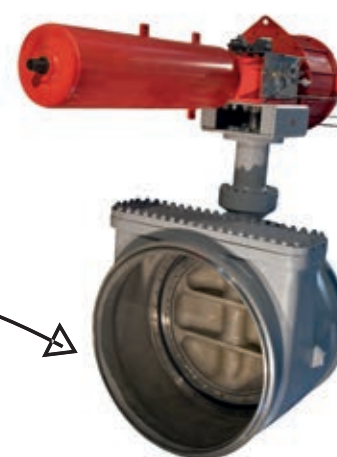
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FinFans, supporting Eric with her 22 years of experience in the business. We welcome all of the Harsco AXC team to the Chart family,” stated the CEO. The Chart acquisition of Air-X-Changers is the fourth in the past two years after other takeovers in the US and Europe. Chart first expanded its business in 2017 by acquiring German company VCT Vogel, a servicer of cryogenic and mobile gas tank equipment and trucks and a European leader in truck-mounted drive and control systems. The takeover of the German company followed its \$410M cash purchase of smaller US sector rival Hudson Products for its range of air-cooled heat exchangers and axial flow cooling fans for the refining, petrochemical and natural gas markets. Then in September 2018, Chart agreed to acquire Italian company VRV S.p.a., an engineer and designer of cryogenic equipment whose offerings complement Chart’s products. Chart, based in the outskirts of Atlanta, Georgia, first agreed in May 2019 to take over the Harsco unit.

CHEVRON CORP. is continuing to progress with its revived Canadian

Kitimat liquefied natural gas export project originally proposed with Apache Corp. for Bish Cove in British Columbia. Chevron has just had a project amendment request accepted by provincial regulators for a redesigned project and an increase in export capacity to 18 million tonnes per annum. Chevron, the operator of two LNG export plants in Western Australia, now has Australian company Woodside Petroleum as its partner after Woodside purchased assets from Apache in 2014, including stakes in Wheatstone LNG in Australia and the Kitimat venture in BC. The companies have also submitted a new detailed project plan to the provincial regulators with proposals for a plant design with an initial three LNG processing Trains instead of two. The British Columbia BC Environmental Assessment Office (EAO) said on July 11 2019 that it has just formally accepted an amendment request from the Kitimat LNG operating general partnership for an amendment to the Environmental Assessment Certificate for the project.

The EAO said that it was also aware that these proposed project changes may

also require a federal assessment under the Canadian Environmental Assessment Act. “On July 10, 2019, the EAO requested substitution to the Canadian Environmental Assessment Agency in the event that the Project is subject to review,” it said. Chevron first presented the revised Kitimat LNG facility plans using a compact design to the Haisla Nation Council back in October 2017. “Since that time, engagement with the Haisla Nation has been centred on clarifying the changes to the design, reasoning behind the changes, the potential positive and negative impacts, and identifying potential environmental mitigation,” Chevron told the EAO. Chevron provided the Haisla Nation with a Project Update Document on March 1, 2019, which was submitted to the Canadian Environmental Assessment (CEA) on March 28.

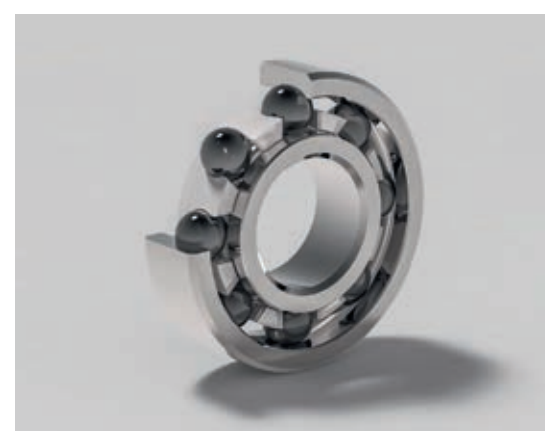
In late June 2019, Chevron said it provided legal counsel for the Haisla Nation with early drafts of chapters on the environmental effects and proposals for “Proponent Engagement and Consultation with Indigenous Groups”. Then on July 3, 2019, Chevron said it gave a draft project

description to the Haisla First Nation for review and possible comment. Chevron is proposing a number of changes to the revised Kitimat project concept that enhances the cost, schedule, execution and operating and environmental performance relative to the prior design. The 2019 Kitimat LNG Expansion Project comprises two phases: 1. An optimization of the two LNG Train configuration to use a compact, all-electric drive design with a combined output capacity of 12 MPTA, an optimized marine terminal and reduced LNG storage capacity (the Compact E-drive Design), and 2. A potential expansion (Third LNG Train Expansion) that includes an additional LNG processing Train, an LNG storage tank and an additional LNG loading berth on the Kitimat foundation project site.

In addition, the development concept includes an all-electric plant powered by clean, renewable hydroelectricity from the provincial utility BC Hydro, and Chevron said it would set the global standard for the lowest emissions intensity of any large-scale LNG facility. Feed-gas for Chevron’s Kitimat plant will come from the large upstream shale-gas resources in the

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322,000 net acres it has in the Horn River and Liard Basins of northeast BC. Chevron will then transport the gas on the proposed Pacific Trail Pipeline to the site at Bish Cove. The US major noted that its Kitimat LNG project was the most mature of the proposed Canadian LNG ventures and it also has an established partnership with the Haisla First Nation who live in the Kitimat area. The re-launching of the Bish Cove project follows a final investment decision made in October 2018 by the Royal Dutch Shell-led LNG Canada joint venture. Both plant sites are almost adjacent and are located about 650 kilometres north of the province's largest city, Vancouver. Shell and its Asian partners, including PetroChina, Petronas of Malaysia, Japan's Mitsubishi and Korea Gas corp. have started work at the brownfield site, also near Kitimat, and which had been an energy products terminal before being acquired by Shell in 2011 when the Chevron project was already progressing nearby.

CHINA NATIONAL Petroleum Corp., the largest Chinese oil and gas company, said it planned to ramp up production of domestic natural gas to meet more than 50 percent of its primary energy output by 2020 to support the clean-air policies that have also boosted the need for LNG and pipeline imports. "Domestic natural gas output is expected to reach 55 percent of domestic output by 2025," said a CNPC statement. The company, whose Hong Kong-listed subsidiary is PetroChina, said its natural gas production reached 138.02 billion cubic metres last year, of which 109.37 Bcm was produced in China, a year-on-year increase of 5.9 percent. CNPC said it had also increased imports of overseas pipeline natural gas and LNG, while striving to further improve its own production capacity in the coming years. The National Development and Reform Commission in May 2019 released new oil and gas liberalization measures to require facility operators to open up access to their oil and gas infrastructure to free up the flow of natural gas. The new measures follow the government's announcement earlier in 2019 that it plans to establish a national pipeline company as part of China's move to accelerate the opening up of its domestic oil and gas markets and to extend the gas network to provide a nationwide alternative to coal. These measures are all part of the clean-air policy that will strive to replace coal use with natural gas in the domestic market. This energy reform comes as the start of

Russian supplies from the "Power of Siberia" natural gas pipeline is scheduled to start in December 2019.

CNPC and Russian company Gazprom have signed a 30-year agreement for Russian gas to be supplied via the eastern route, the "Power of Siberia" gas pipeline, and would amount in volumes of 38 Bcm per annum. CNPC's pipeline contract with Gazprom is in addition to its stake in the latest Russian LNG export project, the Yamal plant on the Arctic coast of Siberia. Yamal is operated by the second-largest Russian natural gas company, Novatek. The "Power of Siberia" pipeline is around 97 percent complete with more than 2,000 kilometres now installed and connected in the section running from Chayandinskoye, the gas fields centre in the Russian Far East, to the Chinese border in the Amur Region. CNPC also said that its shale-gas production in the southwest province of Sichuan reached 4.27 Bcm in 2018, up 40 percent compared with the previous year and it will be further developed for purposes of national energy security. The daily shale-gas output in southern Sichuan has reached 20.11 million cubic metres, a year-on-year increase of 119.3 percent. The CNPC statement cited CNPC Chairman Wang Yilin as also saying the emissions from energy output and use had declined. He said emissions of ammonia nitrogen, sulfur dioxide and nitrogen oxides decreased by 7 percent, 7.6 percent and 7.2 percent respectively year-on-year in 2018. The company said it would invest another 31.9 billion yuan (\$4.6 billion) in the 2019-2020 period to strengthen pollution prevention and boost the nation's transformation to lower carbon emissions.

COMMONWEALTH LNG in the US, a liquefaction and exports plant proposed for the west side of the Calcasieu Ship Channel near Johnson Bayou in Louisiana, has signed a preliminary supply deal with Singapore-based commodities trading firm Gunvor. Commonwealth said it signed a heads of agreement with Gunvor Singapore outlining the principal details of a future firm accord for the supply of 1.5 million tonnes per annum of LNG for a term of 15 years. The project has a schedule to make a final investment decision in 2020 and to start commercial operations by 2024. Its plant will have a total liquefaction capacity of 8.4 MTPA and LNG storage capacity volumes of 240,000 cubic metres and has chosen a modular construction format, according to filings with the Federal Energy Regulatory Commission. A total of eight liquefaction Trains are planned with each having

production capacity of just over 1 MTPA. There would additionally be six LNG storage tanks, each with a capacity of 40,000 cubic metres. An adjacent electric plant would be powered by an 80-megawatt gas turbine and there would be boil-off gas handling systems, utilities, and communications system. A 3.7-mile natural gas receiving pipeline for feed-gas is also proposed, extending from existing pipelines operated by Kinetica Partners and Bridgeline Holdings.

The marine berth would have the size to accommodate LNG carriers with capacity up to 215,000 cubic metres. "The agreement with Commonwealth LNG is a significant step in executing Gunvor's overall strategy of uncovering and securing low-cost resources and seamlessly delivering them to high value markets," said Kalpesh Patel, Gunvor Co-Head of LNG Trading. "We look forward to working with the Commonwealth team as they continue to progress their project," added Patel. Paul Varello, Commonwealth's President and Chief Executive, said he was delighted at securing the first step towards a firm supply deal. "We are proud to be entering into an agreement for a portion of our LNG offtake with the Gunvor Group, one of the world's premier commodities trading houses," explained Varello. "Our mantra is to develop LNG solutions for the next generation and in Gunvor we have found a commercial partner who not only shares that vision, but through its creativity and innovation exemplifies it," stated the CEO.

CYPRUS extended a tender deadline to September for the supply of cargoes for a floating liquefied natural gas import terminal and associated facilities currently under development. The original deadline had been set for the end of March and has now been moved to September 6. The Cypriot Natural Gas Public Company (DEFA) has invited expressions of interest for the supply of LNG for the facilities to be sited near the town of Vasilikos, where energy storage units already exist. The tender for the supply of the LNG is the second part of the gas-to-power project. The project was broken up into two separate tenders, one for the infrastructure, including the FSRU and associated facilities including gas storage and pipelines and one for the purchase of LNG. The first tender concerning the infrastructures is currently under consideration by the Government, though no announcement date has been given. "Prospective LNG suppliers who respond must fulfil several pre-qualification

requirements in order to be added to DEFA's list of pre-qualified LNG suppliers," said DEFA. The statement added that DEFA intends to procure its LNG through a combination of medium and long-term supply via one or more LNG sales and purchase agreements. The utility will also require supplemental cargoes via master sales agreements.

Following the completion of a feasibility study in 2016, Cyprus decided to proceed with the development of the import terminal based on a floating storage and regasification unit. The government expects the FSRU to be in place and the infrastructure be completed by the end of 2020. Cyprus will charter an FSRU with at least 125,000 cubic metres of storage capacity to unload LNG from carriers up to 217,000 cubic metres capacity. The Cyprus project will be linked to a gas-fired power plant through the conversion of an existing oil-fired facility. European Union funding of the project would amount to 40 percent of its cost. Another Mediterranean island nation, Malta, brought its floating storage unit on line in January 2017 in Marsaxlokk Bay to supply the nearby Delimara power station with LNG imports. The UK overseas territory of Gibraltar has also switched in 2019 to using gas from small-scale LNG imports for power generation. The first Cypriot tender also requires construction of offshore infrastructure for the permanent berthing of the FSRU and onshore natural gas infrastructure for gas delivery to the Vasilikos power station and potentially other gas consumers. Cyprus also has substantial offshore acreage in the Levant Basin of the East Mediterranean, estimated to contain sizeable recoverable resources. US company Noble Energy discovered the Aphrodite gas field in Cyprus's offshore waters in 2011 with estimated reserves of 5 trillion cubic feet.

ENGIE, the French energy company and utility with LNG interests and with growing renewable assets in Europe, said it would become a retail natural gas supplier for three markets in the northeast US state of Massachusetts after last year selling its LNG import terminal near Boston. Engie said it would offer fixed and index-plus pricing, as well as firm delivery services to commercial and industrial customers in the three service territories of Boston Gas, Colonial Gas and Essex Gas and retains gas interests in seven states. While the French utility has sold many of its LNG assets to energy major Total, it retains three LNG import terminals in France. Its European LNG subsidiary Elengy is a unit

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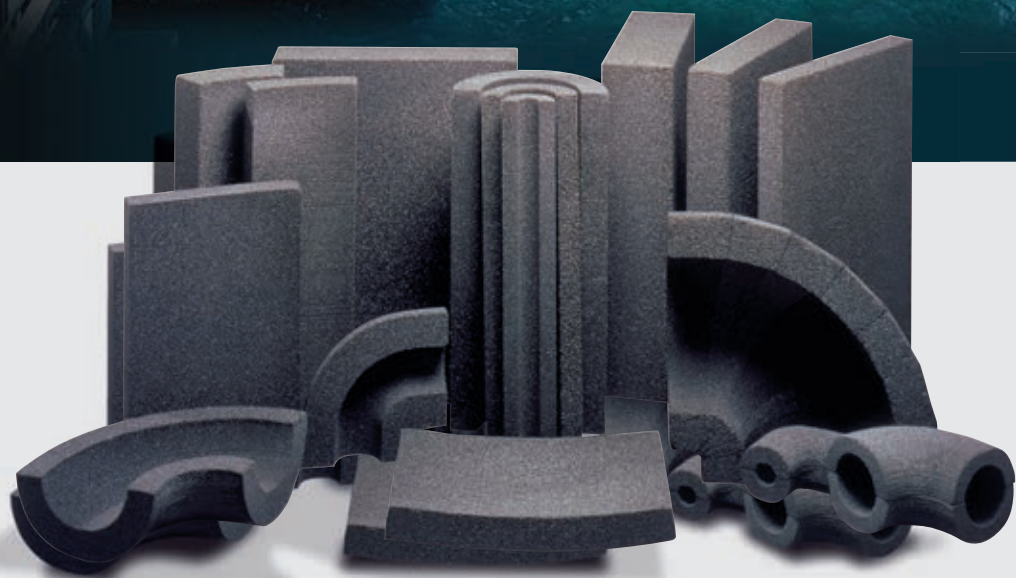


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of France's network operator GRTgaz, though within the Engie Group. Engie's three French terminals are Montoir-de-Bretagne on the Atlantic coast, as well as Fos Tonkin and Fos Cavaou near Marseilles on the Mediterranean coast. Engie North America said its new Massachusetts offer includes a standard contract and payment terms and a choice of dual electricity and gas supplies. The French utility already serves the retail electricity needs of more than 1,600 commercial and industrial customers in Massachusetts.

"Engie has a rich history in Massachusetts, which includes serving as the official energy supplier to the Boston Red Sox baseball team," said Engie. "The state is a \$7 billion natural gas market and one of the top five markets in the US for natural gas consumption," noted the French utility. "We believe we have a competitive, transparent commodity offer backed by financial strength and a global ambition to lead the transition to a zero-carbon future," said Tim Hughes, Regional Vice President at Engie Resources. Engie now offers natural gas service in seven states, including Ohio, Illinois, New York

and Pennsylvania. Engie sold the Boston Everett LNG import terminal in 2018 to Chicago-based Exelon Generation. The terminal was the longest-operating LNG import facility in the US when it changed hands. The facility started importing LNG in 1971.

EVOL LNG, the provider of liquified natural gas as a fuel for remote power stations and marine bunkering and a subsidiary of the Australian Wesfarmers Chemicals, Energy & Fertilisers group, has signed up a Western Australian gold mine to use LNG for power instead of diesel. "Kirkalocka Gold Mine will soon be powered by a cleaner alternative, thanks to a new agreement between Evol LNG and Adaman Resources," said Evol. The company said the long-term arrangement has Evol supplying LNG to the Adaman Resources gold mine located about 70 kilometres south of Mt Magnet in the mid-West region of Western Australia. The Kirkalocka Gold Mine is set to restart operations after more than a decade, with the mine's new owners refurbishing the processing plant and increasing its

capacity to more than 2.2 million tonnes per annum. The mine will use Evol LNG to fuel Zenith Energy's 14.5 megawatt power station with supply commencing from September 2019. Evol said the use of LNG as an alternative to diesel will help minimise the mine's carbon emissions.

"LNG produces 25 percent less carbon-dioxide emissions than diesel, and during the initial six years of operation, the mine will avoid 50,000 tonnes of greenhouse gas emissions by fuelling its power station with LNG instead of diesel," said Evol Wholesale Manager Nick Rea. "This is the equivalent of keeping around 3,000 cars off the road," added Rea. Evol said it would build, own, operate and maintain the on-site LNG storage and vaporisation facility at the mine. The facility will use Evol's modular design which allows for fast installation and expandability to suit the mine's growing energy requirements. "Utilising LNG as an alternative to diesel-fired generation will significantly reduce our energy costs and exposure to volatile diesel prices," said Adaman Resources Chief Executive Craig Bradshaw. "Evol's LNG will provide environmental, financial and

economic benefits for the company," added Bradshaw. "Based on the current diesel price, we estimate our energy costs will be reduced by more than A\$13 million (US\$9M) during the first six years of operation," he stated. The Kirkalocka Gold Mine deal was Evol's third major contract in the mid-West of Australia in recent years and the company said it saw huge potential for growth in this region. "The scarcity of gas pipelines and absence of grid power would otherwise force off-grid mines to use diesel for power generation, but we are able to provide a much better solution with LNG," stated Rea.

EXXONMOBIL and Qatar Petroleum are proceeding with a long-term upstream development in Argentina's Vaca Muerta shale play with plans for 90 wells with a central production facility and pipelines. The project in the Bajo del Choique-La Invernada block in Neuquen province is expected to produce up to 55,000 oil-equivalent barrels per day within five years. The Neuquen provincial government granted ExxonMobil a 35-year concession in Vaca Muerta for Bajo del Choique-La

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Invernada in 2015. ExxonMobil said it then began an exploration pilot program the following year and now has three producing wells and three additional wells moving into production. “A production facility, gas pipeline and oil terminal have been in operation since 2017 and were recently connected to the Pacific Gas pipeline by a another 16-inch pipeline,” said ExxonMobil. The Bajo del Choique-La Invernada block comprises 99,000 acres, located about 114 miles northwest of Neuquen city, a region in northwest Argentina.

ExxonMobil’s Argentine unit is the operator and holds 90 percent interest in partnership with Gas y Petroleo del Neuquen, which owns a 10 percent interest while the Qataris are also involved. The ExxonMobil unit is leading its unconventional operations in the Vaca Muerta shale play under a joint venture agreement with Qatar Petroleum, which has a 30 percent interest in ExxonMobil’s upstream affiliates in Argentina. “We are encouraged by the excellent results of our Neuquen pilot project and look forward to increased production through this significant expansion,” said Staale Gjervik, senior vice president of unconventional resources at ExxonMobil. “The reforms implemented by the federal and provincial governments have been critically important to enabling the development of the Vaca Muerta basin as one of the country’s main energy resources,” added Gjervik.

GENERAL ELECTRIC, the US power systems provider, said it was chosen to provide key equipment for the proposed increase in liquefied natural gas production at the Sultanate of Oman liquefaction plant in the Arabian Peninsula. GE said it would provide the full Variable Speed Drive System with the 18-megawatt (MW) two-pole motor to replace the existing 7.5-MW motor. “With similar weight and footprint, GE’s drive system can be easily integrated into the existing plant layout with faster execution time,” said the US power provider. The Omani facilities export to Japan, South Korea and the spot market and comprise the amalgamated three liquefaction Trains of Oman LNG and Qalhat LNG, now producing more than 10 million tonnes per annum. The Sultanate has revitalised its LNG production after the Khazzan natural gas discovery by BP and the plants near the port of Sur have been at near nameplate capacity since 2017. GE won a tender for the equipment as part of the Oman’s debottlenecking project as the nation moves to monetize its recent natural gas finds with more LNG exports. After

identifying specific areas in the plant that further enhance efficiency and create additional value from surplus gas in the grid, Oman LNG has decided to embark on debottlenecking various systems and optimizing existing compressor train performance. Ultimately, the debottlenecking project will increase the plant’s overall production at project completion across three liquefaction Trains.

The three Trains had previously suffered from a lack of feed-gas as supplies were diverted to fill domestic gas shortages. The Omani government allocates Oman LNG feed-gas supplies from various gas fields and the new Khazzan field production has ended all resource concerns for the near future. “The oil and gas landscape is shifting as such that companies are turning attention to the more environmentally-friendly LNG sources to meet the energy demand. And we are right here to help,” said Ed Torres, Chief Executive of Marine and Oil & Gas at GE’s Power Conversion business. “We have a track record to deliver some of the world’s landmark LNG projects,” he added. “Leveraging on our multiyear experience, world-class technology and execution capability, we are the partner of choice for providing electrical solutions for the LNG application,” stated the GE executive. KBR, the US energy and LNG engineering company, was awarded the front-end engineering and design contract by Oman in May 2019 for the debottlenecking project. Houston, Texas-based KBR explained that it would act as an extension to Oman LNG’s project team and help manage the overall execution of the debottlenecking efforts, whereby better output can be achieved by fixing all the inefficiencies, both technical and operational.

GERMAN LNG TERMINAL, the joint venture company developing the European nation’s first regasification facility at Brunsbuettel on the Elbe River near the port of Hamburg, said it has started the engineering, procurement and construction pre-qualification tender process. The company said potential EPC contractors who make known their interest in bidding for the project on or before 1st July 2019 will receive a pre-qualification package. Binding lump-sum offers will have to be prepared and submitted by pre-qualified bidders between August and October 2019. The winning bidder will be announced during the first quarter of 2020, followed by the release of an early or limited notice to proceed to commence

scheduled early activities. The Brunsbuettel project is a joint venture involving two Dutch companies, natural gas operator Gasunie, global storage company Vopak as well as German energy firm Oiltanking GmbH, a subsidiary of the Marquard & Bahls AG of Hamburg. RWE, one of Europe’s leading energy companies and utilities based in the German city of Essen, has already booked “a considerable part” of the capacity from the planned terminal. Germany is the only major European Union nation without LNG import facilities and has come under political pressure from partners in Brussels and other allies to accept North American LNG in competition to Russian pipeline gas as part of the EU bloc’s energy security policy. The joint venture plans to build, own and independently operate a combined import and distribution LNG terminal in Brunsbuettel. “The terminal’s business model is characterised by the provision of multi-purpose services as well as open access to terminal capacity,” explained the developers.

They pointed out that Brunsbuettel benefits from several advantages: a) Its location near the North Sea along the Elbe river, and close to the Kiel Canal and therefore its easy access to markets in North-West Europe, Scandinavia and the Baltics; b) The close proximity to the port of Hamburg with according LNG bunker potential; c) The location is within the ChemCoast Park that includes industrial customers with high energy needs; and d) There is strong support of both local and regional government. In addition, the German federal government supports an LNG terminal as it contributes to gas supply diversification and provides efficient supply chains for LNG as an alternative fuel. “The market’s reaction to the Brunsbuettel terminal project has been positive with interest from future customers reflected in the execution of several Heads of Agreements,” said the German LNG Terminal company. The application for exemption from regulated third-party access and the permit application are based on terminal capacity of 8 billion cubic metres per annum. The developers said that it was envisaged that up to four EPC Contractor entities will be pre-qualified to enter the competitive tender process. “Experience in design and construction of similar projects and awareness of German codes and practices will be essential attributes to pre-qualify, besides financial strength and safety track record,” said the German LNG Terminal company. Uniper, the

German energy company and utility, launched an open season in May 2019 to test interest in another German LNG import terminal project planned for the North Sea port of Wilhelmshaven. Uniper said it would test the interest of natural gas companies in using its planned facility and was looking for a partner to be the operator. Dusseldorf-based Uniper said the proposed terminal would use a floating storage and regasification unit to handle around 7.5 million tonnes per annum of LNG and customers had until July 19 to express an interest.

GLX, the Australian-owned liquefied natural gas trading platform, said buyers, sellers and traders can now access GLX spot LNG cargo dealing in Europe. GLX Managing Director for LNG Market Development Marc Howson said the growing liquidity and current market conditions were the catalysts for the European launch, adding to its Australian and Singapore-based market dealings. “Given fast-growing LNG deliveries and counterparties in Europe, participants are looking for real-time market sentiment established directly between buyers and sellers of LNG cargos,” said Howson. GLX’s new digital bid-offer system has now been introduced into the region after it has slowly branched out from Perth in Western Australia and Singapore. GLX said European demand for LNG continues to grow, with US and Russian cargoes being

Diary of events

September

Japan LNG Producer-Consumer

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

October

North American Gas Forum

21 - 23 October 2019
The Westin Washington, City Center Washington, D.C., United States
<https://energy-dialogues.com/nagf/>

Singapore International Energy Week

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

November

EAGC – European Annual Gas Conference 2019

5 - 7 November 2019
Intercontinental Paris Le Grand 2 Rue Scribe, 75009 Paris, France
<https://www.theeagc.com>

December

The CWC 20th Annual World LNG Summit & Awards

3 - 6 December 2019
Rome Cavalieri, Rome, Italy
<https://world.cwclng.com>



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increasingly traded at UK National Balancing Point and Dutch Title Transfer Facility prices. “The platform and its digital bid-offer system allow tradeable bids and offers to take place with tailored levels of transparency,” stated GLX.

One of the trading outfit’s investors include Woodside Petroleum, the Western Australian-based LNG plant operator of the Pluto and Northwest Shelf LNG plants. GLX was launched in Perth 2016 by former Australian energy industry executives and its LNG trading platform became operational in 2017. Woodside has now become an equity investor to further support GLX as it seeks to deepen its trading relationships in the LNG sector. GLX said its platform enhances conventional LNG trading by accepting direct bids, offers and trades by industry participants in real-time, significantly reducing time and de-risking the potential of data entry errors. “The major difference is that trading is conducted without time delays, working in real-time, and allows all parties to have pricing transparency and absolute control over their trading,” explained MD Howson. “As counterparties

increase, trading venues need greater flexibility to manage the strategic objectives of each participant,” he added.

HUNGARY opened its first filling station for liquefied natural gas at Szigetszentmiklos, south of the capital Budapest, as part of the European Union-backed clean fuel network stretching from eastern Poland to Spain. With the opening of the LNG filling station, Hungary now joins the Trans-European Transport Network (TEN-T) with corridors extending along major motorway routes between the EU countries. Hungarian truck transport companies are also now able to buy LNG-fueled vehicles for domestic freight transport. The construction of the Szigetszentmiklos filling station was carried out as part of the Connecting Europe Facility (CEF) for the transport sector. The Hungarian LNG stations will form part of a pan-European network already being built in Belgium, France, Germany the Netherlands, Poland and Spain. It will eventually join the 27 EU states. The stations will be located approximately every 400 kilometres along

core road network corridors from Spain to eastern Poland. The Hungarian fuel station is located on Budapest’s orbital ring-road motorway at the southwest edge of the city. The primary objective of the project was to deploy the infrastructure necessary for the development of LNG-fueled transport in Hungary and to implement the first filling points and ensure their supply.

The total costs of the project amounts to 1.2 million euros (\$1.36M), 85 percent of which came from EU finance. A European joint venture to promote LNG fuel for road transport, including companies such as Royal Dutch Shell and truck-makers Scania and Iveco, is also backing the EU plans. “The primary goal of the project is preparing the construction of an infrastructure network that supports LNG-based transportation in Hungary,” said an EU statement. The station was built by Pannon Fuel Co. and the testing phase started in May and lasted for about five weeks. The Hungarian station and others in the EU offer premium-quality BioLNG and compressed natural gas (CNG) aimed at the trucking market. Within the framework of the EU project,

work has also begun on a small-scale Hungarian LNG-production plant to supply fuel to the station, the first of several planned in the country.

INPEX CORP. of Japan and Royal Dutch Shell have received Indonesian approval for their new Plan of Development for the onshore liquefied natural gas project using feed-gas from the Abadi gas field in the Masela Block in the Arafura Sea of Indonesia. The project is expected to be operational by around 2026 with Inpex already completing preliminary front-end engineering design for an LNG plant with an annual initial capacity of 9.5 million tonnes. The submission of the revised plan to the Indonesian government followed the signing in Japan on June 16 of a preliminary accord. “The notice of approval was delivered to Inpex, as the operator of the project on behalf of Inpex Masela and Shell Upstream Overseas by Ignasius Jonan, Minister for Energy and Mineral Resources of the Republic of Indonesia, in the presence of Joko Widodo, President of Indonesia,” said the Japanese company.



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However, no firm onshore location has been given by any of the parties for the Abadi liquefaction plant. The Indonesians had earlier proposed that a 370-mile pipeline should be built to connect the Abadi gas field resources to a liquefaction plant on Indonesia's Aru Island, while Inpex had preferred a location in the southeast Asian nation's Tanimbar Islands chain. The original Inpex plan for the Abadi project with partner Shell was to produce LNG from a floating production hull, similar to the Prelude FLNG project offshore northwest Australia that shipped its first LNG cargo in June 2019. In addition to the revised development plan, the Indonesians also approved the application for a seven-year additional time allocation and a 20-year extension to the Production Sharing Contract (PSC) for the Masela Block, extending the term of the PSC until 2055.

"While the project's development concept has been changed from a floating LNG scheme to an onshore LNG scheme, I am confident that the economics of the project based on the revised plan are now sufficiently strong for Inpex and Shell given the PSC term until 2055 and the financial conditions secured," said Takayuki Ueda, President and Chief Executive of Inpex. "Inpex aims to make this project competitive and will continue to work towards the production start-up scheduled in the latter half of the 2020s," added Ueda. Inpex said it would continue to work closely with its partner Shell to begin the necessary preparations to commence front-end engineering and design. The company added that a final investment decision is subject to a series of subsequent evaluations including FEED work.

"Obtaining approval for the Plan of Development is an important achievement and Shell appreciates the constructive partnership of the authorities that has enabled progress," said Clare Harris, Shell's Executive Vice President for Venture Development. "As the joint venture moves to the next phase of the Abadi project, we look forward to continuing our close collaboration with Inpex in delivering a globally competitive onshore LNG development that will benefit the country for decades to come," added Harris. Abadi LNG will be the first large-scale integrated LNG development project operated by Inpex in Indonesia and follows on from the Inpex-operated Ichthys LNG plant in Australia's Northern Territory.

JAPAN, the world's largest liquefied natural gas importer, still managed to

purchase more than 210 million short tons of coal on foreign markets in 2018, making it the world's third-largest coal importer after India and China as the Japanese switch to using more LNG and renewables has slowed markedly since 2011. Japan continues to use steam coal to fuel one-third of its electricity generation and metallurgical coal for raw steel production. The continued high proportion of Japanese coal use was highlighted in a report just published by the US Energy Information Administration. Japan imports almost 99 percent of the coal it consumes. Australia is Japan's primary coal supplier, exporting 128 MMst, or 61 percent, of Japan's demand in 2018. Indonesia (32 MMst), Russia (21 MMst), the United States (13 MMst) and Canada (9.6 MMst) accounted for another 35 percent of total Japanese coal imports. Japanese LNG imports from the US are set to increase in 2019 as the Asian nation has purchased volumes and tolling capacity at the growing build-out of American liquefaction and export plants. US LNG appeals to Japanese utilities because of its lower costs and will replace cargoes from other regions as long-term contracts expire. However, US thermal coal exports to Japan have grown even faster than LNG with a 20 percent rise in Japan's coal imports from the US logged in 2018, while 2019 exports as of March were already 38 percent higher than in all of 2018. Japanese LNG imports through its network of 35 regasification terminals have stalled over the past four years after reaching a peak of 85.04 million tonnes in 2015. They then edged lower or were little changed at 83.34MT in 2016, 83.63MT in 2017 and 82.85MT in 2018. While Japanese LNG imports rose by 0.3 percent in April 2019, they had previously dropped for five straight months and 2019 is likely to see little LNG import growth from Japan. Indeed, many analysts expect China to overtake Japan as the world's largest LNG importer within about seven years.

Coal now accounts for about one-third of Japan's electricity generation. "In 2018, Japan's utilities produced an estimated 317 billion kilowatt hours of electricity at more than 90 coal-fired power plants," said the US report. "Coal's share of electricity generation in Japan was higher in 2018 than it was before the 2011 Fukushima nuclear accident," stated the EIA. "In 2010, coal accounted for 25 percent of Japan's electricity generation, and nuclear generation accounted for 29 percent," said the EIA. The US report noted that prior to 2011, Japan's Ministry of Economy, Trade

and Industry (METI) had planned to reduce coal's generation share by more than half by 2030, intending for nuclear power to offset coal plant retirements. The plan included increasing the nuclear generation share in Japan's electricity mix to 50 percent by 2030. "However, as a result of the Fukushima accident and subsequent suspension of Japan's nuclear fleet, METI now projects a future energy mix of 20 percent to 22 percent nuclear, 22 percent to 24 percent renewables, 26 percent coal, and 27 percent natural gas through 2030," said the EIA. Japan's utilities plan to construct 20 gigawatts of coal-fired electric power generation capacity in the next decade. "The scope of development will depend on how many suspended nuclear reactors resume operation. Increased competition in Japan's electricity market may also have an effect as new non-coal entrants compete for market share," explained the US report. "New coal plant development also depends on whether the Japanese government will grant environmental approvals to planned coal-fired power projects, given the country's intention to reduce carbon-dioxide emission levels by 26 percent by 2030," added the EIA.

JGC CORP. of Japan has been awarded an engineering contract in the Sultanate of Oman by French major Total for what will be the world's first liquefied natural gas production plant built specially to supply the shipping fuel market on the Arabian Peninsula. JGC, based in Yokohama, said its front-end engineering and design work will be part of a competition, also including McDermott of the US, in a tender for the LNG maritime fuel plant proposed by Total for the Port of Sohar in Oman in partnership with the Oman Oil Company. This project consists of FEED services to construct a new medium-scale LNG plant with an annual production capacity of 1 million tonnes per annum in Sohar, one of the largest industrial zones in the Middle East and well sited for shipping passing through the Gulf of Oman. Total and Oman have already signed an accord for the development of the onshore natural gas block that will provide feed-gas for the plant.

JGC noted that it has been responsible for constructing LNG plants that account for around 30 percent of global production. "Currently JGC is executing a total of three LNG plant construction projects, including a large-scale plant in Canada, as well as floating LNG plants off the coast of Malaysia and off the coast of Mozambique," said the Japanese company. Total will

provide the feed-gas for the Sohar LNG production for bunkering under a deal signed between Ministry of Oil and Gas of Oman and Total linked to the award of the exploration licence for onshore Block 12 where there are "significant prospective" gas resources. Total is now in the development phase of its Omani regional hub for LNG bunkering as more regulations are imposed for cleaner marine fuel and the International Maritime Organization's sulfur cap comes into force from 2020. Oman is a major anchorage and stop-over point for tankers and other vessels on trade routes between the Middle East, Asia and Europe.

The LNG bunkering plant would be supplied with feed-gas from the Greater Barik block in central Oman and would comprise a processing Train offering the flexibility for expansion as the global bunkering market develops. The French company is already a 7.5-percent shareholder in the large-scale Oman LNG project at Sur in the south of the country. The Omani facilities export to Japan, South Korea and the spot market and comprise the amalgamated three liquefaction Trains of Oman LNG and Qalhat LNG, now producing more than 11 million tonnes per annum. The Omani liquefaction Trains are also set to undergo de-bottlenecking to boost production under a contract awarded to KBR of the US.

KOSMOS ENERGY, the main shareholder with BP of the UK in floating liquefied natural gas projects offshore Mauritania and Senegal in West Africa, said the latest well drilling in the Greater Tortue-Ahmeyim field may lead to an expansion of resource potential and estimates and to more LNG production. Kosmos, based in Dallas, Texas, said its latest drilling in the Greater Tortue Ahmeyim-1 well (GTA-1), encountered approximately 30 metres of net gas pay in the high-quality Albion reservoir. The Greater Tortue-Ahmeyim LNG project is on track to deliver first gas by mid-2022 and the well, which has been designed as a future producer, will be used to further optimize the development drilling plans for the BP-operated project. "The GTA-1 well confirms our expectation that the gas resource at Greater Tortue-Ahmeyim will continue to grow over time and could lead to further expansion of this world-scale LNG project with 10 million tonnes per annum of production," said Kosmos Chairman and Chief Executive Andrew G. Inglis. "In addition, Kosmos's process to sell down its interest to 10 percent has



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received considerable interest from the industry, with initial bids expected over the summer, and a transaction conclusion anticipated by year-end,” added Inglis. Kosmos was the original successful explorer of the Senegal-Mauritania reserves and agreed to sell BP around 60 percent of the licences in 2016 with the UK major taking over operatorship.

The US company retained around 30 percent of the Senegal fields and licence and about 28 percent of the project’s Mauritania holdings. Kosmos added that as of May 2019, all major contracts have been awarded for phase one of the project and construction activity has commenced with work on the floating production storage and offloading unit. The latest contract was awarded in April 2019 to US engineering company KBR for the pre-front-end engineering and design services work for Phases 2 and 3 of the Greater Tortue-Ahmeyim venture. The first gas from the Kosmos-BP FLNG Train 1 is scheduled for 2021 and the start of the second FLNG Train is set for 2023. The GTA-1 well is located offshore Senegal and was drilled in 2,500 metres of water,

about 10 kilometres from the Guembeul-1A and Tortue-1 wells, to a total depth of 4,884 metres. Kosmos said that the “Ensco DS-12” rig, working on behalf of operator BP, will now drill the Yakaar-2 appraisal well in Senegal in the coming weeks, before drilling the Orca-1 exploration well in Mauritania late in the third quarter. The other partners of BP and Kosmos in the cross-border Greater Tortue-Ahmeyim project include the national oil and gas companies of both countries.

KEANE GROUP Inc. and C&J Energy Services, two Houston-based oil and gas services companies, agreed to combine their completions and production services operations such as hydraulic fracturing in shale basins and workover rigs in an all-stock merger valued at about \$1.8 billion. The merger, expected to be completed by the end of 2019, includes 50 fracture fleets, 158 wireline trucks, 81 pump down units, 28 coiled tubing units, 139 cementing units and 364 workover rigs for a total of 2.3 million hydraulic horsepower of assets. The transaction provides “greater scale and scope with meaningful

positions” in the most active US energy basins. The combined oilfield services footprint across the Lower 48 States will extend into every major producing region including the Permian and Appalachian Basins, the Eagle Ford Shale, Midcontinent, the Rockies-Bakken formations and into California. Their complementary customers bases include around 30 blue-chip players in American energy such as Chevron Corp., Marathon Oil, Noble Energy, Shell, BP, Hess, Apache Corp., Encana and many others. Under the agreed merger terms, Keane and C&J shareholders each would own 50 percent of the equity of the combined company. “The merger of equals unites two great companies, resulting in a broader portfolio of well completion services across an even greater footprint in the US, benefiting our combined employees, shareholders, customers, suppliers and the communities in which we operate,” stated Keane Chief Executive Robert Drummond, who will serve as the combined company’s CEO and President. “With two strong teams, enhanced and diversified operations, a strong balance sheet, ample liquidity,

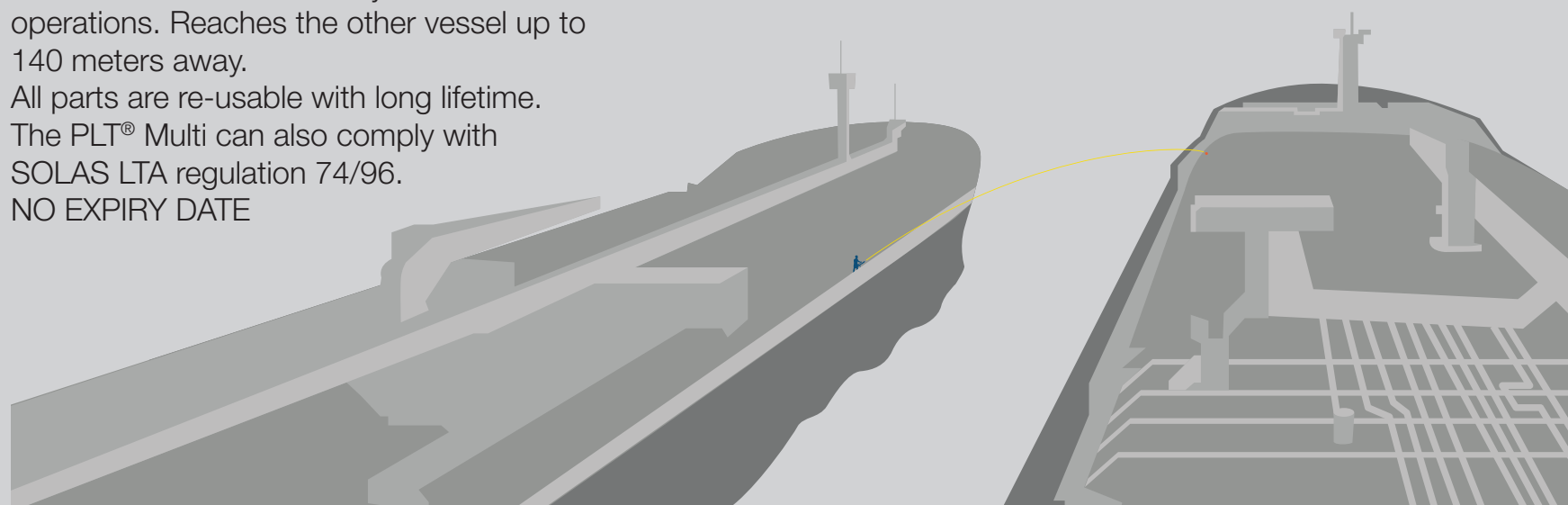
attractive free cash flow and a legacy of successful research and development, the combined company will be well positioned to further invest in technology and innovation,” added Drummond.

Under terms of the agreement, which has been unanimously approved by each board, C&J shareholders would trade each share for 1.6149 shares of Keane. C&J also would be allowed to pay a cash dividend of \$1.00 per share before the deal is completed. On a pro-forma basis as of the end of March, the combined company would have about \$4.2 billion in net revenue with \$686 million in operating cash flow. Within a year of closing, annualized run-rate cost synergies are estimated at \$100 million. “This agreement to merge C&J and Keane underscores the highly complementary nature of our two platforms and cultures,” said C&J CEO Don Gawick. “We are excited by the many strategic and financial benefits of this combination, including the opportunities for our employees from the greater scale and enhanced capabilities of the combined company,” added Gawick. C&J Chairman Patrick Murray is to serve

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as the new company's board Chairman. C&J Chief Financial Officer Jan Kees van Gaalen would remain CFO, while Keane CFO Gregory Powell has been named Chief Integration Officer. The combined 12-member board would be split equally with six each from the C&J and Keane boards. The corporate name and new ticker symbol on the New York Stock Exchange is to be announced before the transaction is completed and the headquarters would remain in Houston.

LLOYD'S Register, the UK maritime classification society, has awarded South Korean shipbuilder Samsung Heavy Industries, with approval in principle for a very large crude carrier (VLCC) powered by liquefied natural gas. The Samsung design is for an oil tanker with a two-stroke, dual-fuel LNG and diesel engine capability. The VLCC would also be equipped with a 6,000 cubic metres LNG fuel storage tank. Lloyd's Register and Samsung have also assessed the technical feasibility of the LNG fuel supply system and energy-saving technologies. The approval means that the South Korean company can begin sales and marketing for the new ship. Under rules from the International Maritime Organization being introduced from 2020, ships have to use marine fuel with sulfur content of no more than 0.5 percent compared with the current limit of 3.5 percent. The joint venture project called "VLCC 2020" is for an LNG-fueled VLCC designed to emit about 25 percent less carbon-dioxide and 99 percent less sulphur oxides compared with a conventional VLCC.

"This is a significant milestone for SHI and demonstrates our commitment to taking a step forward to help meet the challenge of reducing greenhouse gas emissions through a technically and commercially viable design," said Samsung. "We will actively target the shipbuilding market with our new eco-friendly ship that can also greatly cut operational costs," added the company. "We will raise our competitiveness in bids by cutting down on production costs and localizing parts," it added. Thomas Aschert, the Lloyd's Register area manager for North European marine and offshore activities, said he was pleased to be working with Samsung on the project. "We are proud to work with SHI on such a future-focused LNG-fuelled VLCC design and this AiP demonstrates SHI's commitment to supporting the shipping industry to reduce GHG emissions," added Aschert.

PETROBRAS, the Brazilian state-run oil and natural gas company, has announced its largest natural gas discoveries in more than a decade in six deepwater wells in the Sergipe Basin offshore northeast Brazil. The finds come as the new Petrobras Chief Executive Roberto Castello Branco appointed in January 2019 continues to overhaul the company after four years of financial and bribery scandals. The deepwater oil and gas producer is in the midst of a divestment programme that has helped raise cash and streamline its operations. Petrobras said it is now looking at drawing up a budget plan to finance production from the Sergipe Basin wells. The natural gas finds were described by the Brazilian government as the largest since the sub-salt discoveries in 2006, and that Petrobras could extract up to 20 million cubic metres of natural gas per day, equivalent to one third of total Brazilian production. The gas discoveries also coincide with efforts by Economy Minister Paulo Guedes to try and reduce the cost of natural gas by up to 50 percent to "reindustrialize" the country. An LNG project is also operating in the small northeast Brazilian state of Sergipe. Golar LNG said its power venture subsidiary Golar Power and Stonepeak Infrastructure Partners are progressing with the project involving a power plant and an LNG import facility. Golar managed in April 2019 to deliver a commissioning cargo to the venture. This Golar-Stonepeak integrated gas-to-power project is still scheduled to come on stream in early 2020.

Analysts said that the Golar venture was well positioned in delivering LNG to Brazil where the gas industry still lags others in the Americas and where very few cities are connected to pipeline gas. The Golar Power subsidiary has signed agreements for the venture to charter the "Golar Nanook", a newbuild 170,000 cubic metres capacity floating storage and regasification unit for a term of 26 years. This is Brazil's first private-sector LNG-to-power project. The country's two operating regasification terminals at Pecem in Ceara state and Salvador in Bahia state are owned by Petrobras rather than private companies. The annual earnings contribution for Golar Power is currently projected to be around \$41 million and with upside potential for Golar to use the remaining two-thirds of FSRU capacity not utilized by the project. The LNG FSRU is deployed at a strategic entry point in northern Brazil, within 20 kilometres of the main gas distribution network, and has the potential to unlock future LNG

distribution opportunities in the country. Centrais Eletricas de Sergipe is the joint venture company operating the project, also involving a 1.5-gigawatts power plant, and 50 percent owned by Golar Power. Petrobras also in May announced the conclusion of the sale of the gas pipeline company Transportadora Associada de Gas (TAG), operator of natural gas pipelines in Brazil's north and northeast. The TAG pipeline system was sold to a group led by French utility Engie and a Canadian investment fund based in Quebec, the Caisse De Depot Et Placement Du Quebec (CDPQ). According to a stock exchange filing, Petrobras said it received a total of 33.5 billion Brazilian reais (US\$8.69 billion) from the buyers for the 90 percent stake it held in TAG. The announcement follows a decision by Brazil's Supreme Court to clear the deal. The Petrobras transaction will help cut the national energy company's debts currently estimated at \$88 billion, the biggest among global oil and gas majors. The Petrobras decision to sell TAG is part of a plan to prioritize exploration and production, which is considered the most important value-generating activity for the company.

PIERIDAE ENERGY, the developer of the Goldboro LNG project in the Canadian Atlantic province of Nova Scotia, said it had negotiated extensions of the key deadlines under its 20-year supply agreement with German utility Uniper. These include expected commercial deliveries of shipments to Uniper to start between November 30, 2024 and May 31, 2025. The Calgary-based company is seeking to build a liquefaction plant with an initial two Trains northeast of the Nova Scotia capital, Halifax. Pieridae added that it had also extended to September 30, 2020, its deadline for making a financial investment decision (FID) for the Goldboro plant. The FID had previously been expected by mid-2020. The 20-year agreement with Uniper is for 5 million tonnes per annum of LNG, half of the plant's expected first phase capacity. "These extensions allow us to complete the work needed to make a final investment decision for the Goldboro project," said Pieridae Chief Executive Alfred Sorensen. The company said it had most of the necessary Canadian federal and provincial regulatory permits to proceed.

Pieridae awarded a contract in April 2019 to US energy engineering company KBR to perform a review of an amended version of a previously prepared front-end engineering and design study of the

Goldboro plant. KBR will also conduct an "open-book estimate" necessary for an engineering, procurement, construction, and commissioning agreement with the intention of entering into an EPC contract by the time of the FID on Goldboro. "We continue to have ongoing discussions with KBR that will ultimately lead to finalized designs and fixed costs for the project. We expect the vast majority of that work to be completed near the end of 2019, which will move us closer to FID," explained Sorensen. Pieridae additionally signed an agreement in June 2019 with Shell Canada Energy to acquire all of Shell's midstream and upstream assets in the southern foothills of Alberta province to boost its LNG feed-gas reserves. The purchase price of the Shell Alberta assets is C\$190 million (US\$145M), including C\$175M in cash to be raised by Pieridae through the issuance of debt and equity. The balance will be in the form of the issuance of Pieridae common shares to Shell with an aggregate value of C\$15M. Its shares are on the venture list of the Toronto Stock Exchange for small commodities companies. The whole deal is expected to be finalized in the third quarter of 2019.

"Our recent announcement that we will be acquiring key Shell assets in the Alberta Foothills helps us secure much of the remaining conventional natural gas supply needed for the first Train at Goldboro," said Sorensen. "This is Eastern Canada's only LNG facility with the majority of its permits, a pipeline route and an anchor customer. Goldboro LNG will create thousands of Canadian jobs and establish a solid global market for Canadian energy for years to come," stated the CEO. Shell has helped Goldboro LNG move forward as its own LNG Canada project in British Columbia survives as the only large-scale venture in BC from a dozen previously proposed. Shell's plans will cost C\$40 billion (US\$30.2Bln) to implement compared with the C\$10Bln projected cost of the Nova Scotia plant. The conventional natural gas assets Pieridae controls are expected to allow the company to access up to US\$1.5 billion in credit support from the German government to develop these upstream assets as part of the Goldboro project.

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 US port as a member and its second in North America after Vancouver in Canada. Sea-LNG said the Port of Virginia is the first in

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the US to join the multi-sector industry group and the fifth worldwide. The Port of Virginia is an international hub port on the Atlantic Coast adjacent to the Norfolk naval base with connections to over 45 countries worldwide, and an extensive rail network across the United States. The Vancouver Fraser Port Authority, the federal agency of the Port of Vancouver in the Pacific Coast province of British Columbia, was signed up in March 2019 as 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. “We’re very pleased to welcome the Port of Virginia as our first US port member,” said Peter Keller, Chairman of Sea-LNG. “The US has vastly increased its LNG export capacity since the industry really took flight in early 2016, inspiring development in LNG bunkering capabilities on the East and West Coasts,” added Keller. “The addition of the Port of Virginia to the coalition marks the climbing interest in LNG as a commercially viable, environmentally sustainable fuel for US

domestic and international shipping,” stated the Chairman. Sea-LNG now has 36 members who also comprise shipping companies, classification societies, major LNG suppliers, LNG bunkering companies, infrastructure providers and equipment manufacturers. The Port of Virginia is just south of the LNG export plant at Cove Point on Chesapeake Bay in Maryland which supplies Asian nations and others with the fuel.

As part of its pledge to deliver operational excellence and sustainable growth, the Port of Virginia is currently undertaking a \$700 million expansion project to increase overall container capacity by 40 percent, as well as increasing lifting and docking capabilities across its six terminals. In March 2019, the port also established a working group to examine the benefit and scalability of LNG bunkers for maritime trade. “The Port of Virginia has always been at the center of maritime innovation,” said John F. Reinhart, Chief Executive of the Virginia Port Authority. “Our industry is evolving and the issues of alternative marine fuels and ports reducing their

carbon footprints are growing in their importance,” he added. “LNG bunkering would represent a complimentary capability to our land and waterside assets and investments. Sea-LNG is a major player in leading the conversation about using LNG as a viable and sustainable marine fuel,” said Reinhart. Sea-LNG said it unites key players from across the LNG marine value chain to address the barriers to the adoption of LNG ahead of emissions regulations such as the international Maritime Organization sulfur cap in fuel being introduced from 2020. LNG continues to provide a major advantage in terms of improving air quality and human health in coastal areas. “It can achieve up to 28 percent tank-to-wake reductions for two-stroke engines, compared with conventional oil-based fuels, which is also a major step forward in terms of greenhouse gas,” explained Sea-LNG. “Further, LNG in combination with efficiency measures being developed for new ships in response to the IMO’s Energy Efficiency Design Index, will provide a way of meeting the IMO’s target of a 40 percent decrease in GHG by

2030 for international shipping,” it added.

SEMPRA ENERGY, the California-based utility and operator of the Cameron LNG export plant in Louisiana, filed a request to expand its Port Arthur project in Texas where the liquefaction Trains will be the largest in the US. The Sempra processing Trains at Port Arthur would be the largest built in the US, each with capacity of 6.73 million tonnes per annum, though smaller than the world’s largest Trains of 7.8 MTPA of capacity operating at the Ras Laffan plant in Qatar. Sempra has asked the Federal Energy Regulatory Commission to initiate a pre-filing environmental review to its original plan for two Trains, each with 7.73 MTPA of output, by adding two more Trains of the same capacity at the facility in Jefferson County in Texas. The addition of Train 3 and Train 4 would double the facility’s output from the current 13.46 MTPA to a total of almost 27 MTPA. The company plans to build the plant on a site along the west side of the Sabine-Neches Ship Channel, about five miles south of the city of Port Arthur. The expansion will utilize



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 - Additional delivery capacity

Our advantages:

Access to NBP:

- One of the most liquid gas markets in Europe
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Europe via interconnectors:

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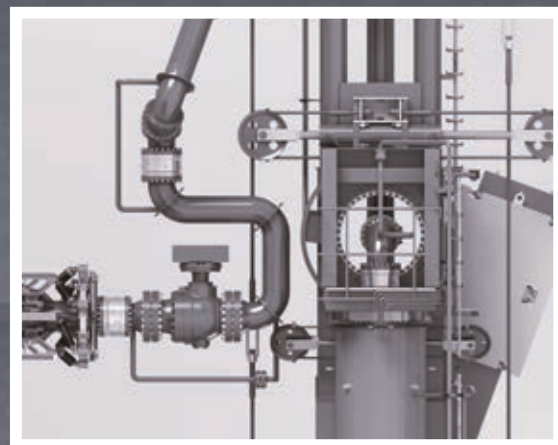
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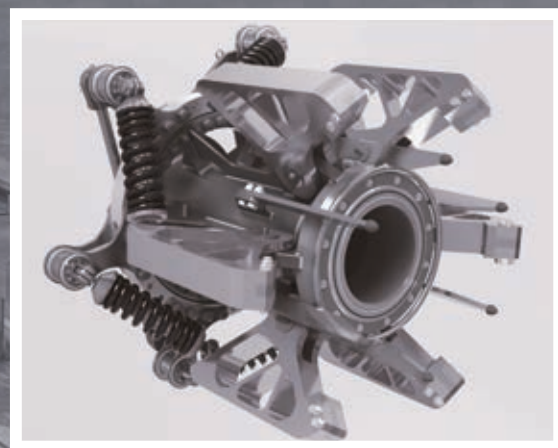
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the same liquefaction Train design as that put forward for the initial plant so that much of the initial engineering design is already complete. Bechtel designed the original two-Train plant and has been retained as the project engineer.

Sempra said that it proposes to file its formal application for the expansion in January 2020. "In that application, Sempra will request that the Commission issues authorization for the siting, construction, and operation of the expansion project by no later than January 2021," the company explained. "Sempra anticipates requesting authorization to begin construction in March 2022," it added in its FERC request. Sempra first received its environmental impact statement from regulators in October 2018 for the Port Arthur project. The previous FERC review addressed the potential environmental effects of the construction and operation of the various proposed facilities, as well as the Texas Connector and Louisiana Connector pipelines. The original filing covered two liquefaction Trains, three LNG storage tanks, each with a capacity of 160,000 cubic metres, a new marine terminal with two LNG vessel berths, an area for support vessels, an LNG transfer system and a truck-loading area.

TC ENERGY Corp., the Canada-based North American pipeline and infrastructure company, has agreed to sell US shale basin midstream assets held by its subsidiary Columbia Midstream Group for US\$1.27 billion to UGI Energy Services of the US. TC Energy, which recently changed its name from TransCanada Corp., said the transaction was expected to close in the third quarter of 2019 subject to customary regulatory approvals. Columbia Midstream, which operates in the Appalachian Basin, owns four natural gas gathering systems and an interest in a company with gathering, processing and liquids assets. These assets connect production to markets throughout western Pennsylvania, eastern Ohio and northern West Virginia. This sale does not include any interest in Columbia Energy Ventures Company (CEVCO), which is TC Energy's minerals business in the Appalachian Basin. TC Energy emphasized it would continue to own and operate its significant network of interstate pipelines in the Appalachia with its Columbia Gas Transmission system, which transports low-cost natural gas supplies from the shale production region to markets in the US, including LNG export facilities. In addition to owning interstate pipelines

supplying US LNG export plants and natural gas markets, the Calgary, Alberta-based TC Energy is also tasked with building the pipeline to the LNG Canada plant being developed near Kitimat in the province of British Columbia.

"The sale of Columbia Midstream Group advances our ongoing efforts to prudently fund our industry-leading portfolio of high-quality natural gas pipelines, liquids pipelines and power generation projects, while maximizing value for our shareholders," said Russ Girling, TC Energy President and Chief Executive. "Along with the sale of Coolidge and partial monetization of Northern Courier we now expect to realize approximately C\$3.4Bln (US\$2.6Bln) of proceeds from announced portfolio management activities in 2019," added Girling. "When combined with our significant and growing cash flow, access to capital markets and potential additional portfolio management activities, we are well-positioned to fund our \$30 billion secured capital program," stated the CEO. Wells Fargo Securities acted as exclusive financial advisor to TC Energy on the transaction.

TECHNIPFMC, the Franco-US energy engineering company, said it was awarded a significant subsea contract by Reliance Industries of India for the development of a large natural gas field in the Krishna Godavari basin of the Bay of Bengal offshore Andhra Pradesh. The MJ1 field is located in deep water of the basin which covers an area of 15,000 square kilometres onshore and 25,000 square kilometres offshore. TechnipFMC said the contracts cover the fabrication and installation of flexible risers, rigid and flexible flowlines and umbilicals. The project is in 700-1,100 metres water depth with a well depth of 4,200 metres below the mean sea-level in a high-temperature and pressure environment. It comprises of wells connected to a subsea production, with tie-back to a Floating Production Storage and Offloading vessel to process and separate liquids, and gas which will be exported to the onshore terminal through one of the existing 24-inch trunk pipelines. The project is expected to begin production in mid-2022. The East Coast of India is lacking natural gas supplies and this is holding back industrial development. While there are five LNG import terminals on India's West Coast, there is only one on the East Coast at Kamarajar Port in Tamil Nadu which was commissioned in 2019. India consumes more than 5 billion cubic feet a day of natural gas and aspires to double gas consumption by 2022.

Reliance and its partner, BP of the UK, have said natural gas production from the KG D6 integrated development is expected to help reduce India's dependence on LNG imports and would amount to over 10 percent of the country's projected gas demand in 2022. Reliance and BP only sanctioned the MJ project, the third-phase of the KG D6 development, on June 11 2019. The MJ project is the third of three new ventures in the Block KG D6 integrated development plan and its approval follows those taken over the last two years for the "R-Series" deep-water gas field and the "Satellites" cluster. Together the three projects are expected to develop a total of about 3 trillion cubic feet of discovered gas resources with a total investment of around 35,000 crore rupees (US\$5 billion). "We are very honored to be associated with this prestigious natural gas project leading to further value creation," said Arnaud Pieton, President of Subsea at TechnipFMC. "These awards confirm the trust we have built over the long term with Reliance along the oil and gas value chain, reflecting both our commitment to the Indian market and our leadership in the energy transition domain, through subsea gas projects," added Pieton. Reliance said these three projects when fully developed will bring about 1 billion cubic feet a day of new domestic gas onstream, phased over 2020-2022.

TECHNIPFMC was awarded a number of subsea contracts by Anadarko Petroleum, the licence holder of the Area 1 Rovuma Basin feed-gas resources for the Mozambique onshore LNG project. The TechnipFMC contracts focus on the development of reserves in the Golfinho-Atum fields offshore the southeast African nation. TechnipFMC was awarded a major contract for the engineering, procurement, construction and installation (EPCI) of the subsea hardware system through its wholly owned United Arab Emirates-incorporated subsidiary, Technip Middle East FZCO. The company gave no specifics on the value of the Mozambique contract save to say it was worth more than \$1 billion. The onshore Mozambique project will have phase one output of almost 12.9 million tonnes per annum of LNG from two liquefaction Trains, as well as all necessary associated infrastructure, storage tanks and export jetty facilities. Anadarko is proceeding with its Mozambique LNG commitments after agreeing earlier in 2019 to be taken over by US peer Occidental Petroleum, while its LNG assets will be sold to French major Total.

The TechnipFMC award followed the granting in May 2019 of the onshore engineering, procurement and construction contract valued at around \$6 billion to a consortium comprising Saipem of Italy and its main partner McDermott International of the US, while Chiyoda Corp. of Japan will fill an advisory role. The TechnipFMC subsea work will be carried out in cooperation with offshore vessel and platform owner and consortium partner Van Oord of the Netherlands and its Mideast subsidiary in cooperation with another European-based subcontractor, Allseas. In support of these awards, TechnipFMC is increasing its presence in Mozambique and has had a new office in the capital Maputo since February 2019. TechnipFMC has also been awarded separate contracts under its wholly owned US incorporated subsidiary, FMC Technologies Inc., to provide subsea hardware in support of well construction. "We are extremely pleased to have been selected for the majority of the Mozambique LNG subsea scope," said Arnaud Pieton, President of the Subsea division at TechnipFMC. "TechnipFMC will highlight our industry leading subsea capabilities to help maximize Anadarko's overall project value," added Pieton. "This award is a testament of our 25-year partnership with Anadarko and will further expand our presence in Mozambique," he said. Anadarko is still operator of the Mozambique project until the Occidental deal is completed and has a 26.5 percent stake and operatorship of the Area 1 reserves that underpin the LNG venture. Other shareholders in the Area 1 licence and LNG project include the Japanese trading house Mitsui & Co. and three Indian companies, Bharat Petro Resources, ONGC Videsh and Oil India Ltd., as well as Thailand's national energy company PTTEP and the Mozambique state-owned oil and gas firm ENH.

TITAN LNG, a Dutch supplier to the marine and industrial market with a pontoon system for the delivery of LNG to river barges and sea-going ships in the ports of Amsterdam, Rotterdam and Antwerp, has carried out its first barge-based operation in Rotterdam. Titan's LNG bunkering pontoon is called the Titan LNG Flex-Fueler. Long-term customer Nor Lines received the LNG cargo in the Dutch Port of Rotterdam from an inland waterways barge. According to a statement, this makes Titan LNG the first accredited bunker supplier of the fuel able to deliver by inland barge. Titan's LNG

bunker permit for Rotterdam and the overall LNG bunkering accreditation were granted in May 2019. The “FlexFueller001” is just one in a series of vessels, with the “FlexFueller002” currently under construction and scheduled for completion by mid-2020 in the Port of Antwerp. Titan LNG said that the construction of a third barge will be announced in the coming months to complete ARA barge-based fueling activities. Ronald van Selm, Chief Operating Officer at Titan LNG, said his company was proud that the “FlexFueller001” was operating after successfully completing her trials. “We can now offer safe, reliable and efficient bunkering that resembles conventional bunkering and are ready to serve more LNG-powered vessels in the ports of Amsterdam, Rotterdam and Antwerp,” stated Van Selm. Samskip, operator of the LNG-powered Nor Lines vessels, the “Kvitnos” and the “Kvitbjorn”, has a weekly service into Rotterdam and requires a high reliability of LNG supply.

“We focus on economical, efficient, reliable and environmentally friendly transport,” said Paul Wielaars, Trade Manager for Nor Lines for West Coast Norway. These flexible ships will sail in 14-day loops, connecting Rotterdam and Eemshaven in the Netherlands with Norwegian ports from Hammerfest in the far north, and taking in calls including Sandnes-Tananger, Bergen, Trondheim, Alesund, Bodo and Tromso. In Rotterdam, the Nor Lines vessels arrive at the logistics terminal, whose lay-out, equipment and experience focus on multipurpose vessels, RoRo, break-bulk and containers can be handled in one place which is regarded as essential. “That’s why we are happy with our partner Titan LNG. We’re excited to bunker LNG alongside the terminal. This saves us time as we are no longer dependent on truck-to-ship operations,” explained Wielaars. “Bunkering at the same time as cargo operations take place, can save us up to eight hours,” he added.

TRAFIGURA, the international commodities group, reported an almost doubling of six-month profits as its LNG, crude oil and gasoline trading desks were the stand-out contributors. Trafigura posted a sharp increase in profits for the first half with margins on oil trading showing an especially strong recovery. Trafigura said profit for the period rose 92 percent to \$426 million from \$222 million in the same six months of 2018, principally due to a strong performance in oil and petroleum products trading. “Our

performance was also enhanced by our market-leading position in strategic commodity flows, notably the increase in exports of crude oil and liquefied natural gas from the US,” said Trafigura. Among the LNG volumes it receives are cargoes from Cheniere Energy’s Sabine Pass plant in Louisiana where Trafigura has a 15-year supply agreement. “In commodity markets that remained fiercely competitive, Trafigura prioritised profitable business over further volume growth and maintained a very robust financial position with ample access to liquidity,” said Christophe Salmon, Chief Financial Officer. Gross profit in Oil and Petroleum Products trading was \$1.03 billion, nearly three and a half times higher than in the first half of 2018.

“Whilst all of the division’s books performed well during the period, the crude oil, gasoline, LNG and wet freight desks were the stand-out contributors,” stated Trafigura. “Gross profit in Metals and Minerals trading fell by a third compared with last year to \$437M, reflecting a slow start for the non-ferrous concentrates and refined metal books,” it added. However, group revenues were flat compared to the same period a year ago, reflecting trading volumes that remained largely stable and average commodity price levels broadly in line with last year. Overall revenue was slightly down at \$86.29Bln versus \$86.93Bln in the same six months of 2018. Trafigura said that the first half was again particularly marked by the global oil market remaining in a state of backwardation during the period, meaning that spot prices were higher than forward prices. “By having repositioned our oil trading book a year ago in response to the change of the term structure, we were able to benefit from increased price volatility resulting from geopolitical events during this period,” said the company. In subsequent events, Trafigura said that in May 2019 it raised its latest tranche of 540 million Chinese yuan (\$78M) in Chinese “Panda” bonds as part of a \$2.35 billion yuan (\$340M) financing programme in China’s mainland debt market.

US Federal Energy Regulatory Commission staff issued the draft environmental impact statement on the Alaska LNG project proposed by the Alaska Gasline Development Corp. and concluded that it would have significant impacts on the state offset by many economic benefits. The project was launched nine years ago and LNG would be produced and exported by 2025 after engineering, construction and

production costs estimated at around \$43 billion. The FERC conclusions were that the venture’s significant environmental impacts would also bring an economic boost from export revenues in commercializing the natural gas resources of Alaska’s North Slope. Alaska’s project would comprise several pipelines, including a 807-mile main line of 42-inches in diameter and with associated above-ground facilities. These include eight compressor stations and a liquefaction facility with output of 20 million tonnes per annum at Nikiski on the eastern shore of Cook Inlet on the Kenai Peninsula. The main pipeline would deliver peak capacity of 3.9 billion standard cubic feet per day of natural gas from companies such as US major ExxonMobil and BP of the UK. The publication of the three-volume FERC report marks a key step in the state’s efforts to secure a permit leading to construction. A public comment period has now started as part of the permit process and would last until October 3. The FERC draft report said that the project would have significant environmental impacts if it goes ahead, though most impacts could be minimized with mitigation measures. “However, some of the adverse impacts would be significant even after the implementation of mitigation measures,” stated the regulator. The President of the state-owned AGDC, Joe Dubler, said the FERC report represented substantial progress for the Alaska LNG project. “Alaska LNG holds the potential for significant energy, economic and employment benefits for Alaskans,” said Dubler. “We will now begin to thoroughly examine this comprehensive document to understand the Commission’s recommendations,” he added. “The ongoing permitting process incorporates 150,000 pages of data and should give Alaskans confidence that the project’s merits and impacts are being rigorously scrutinized,” he explained.

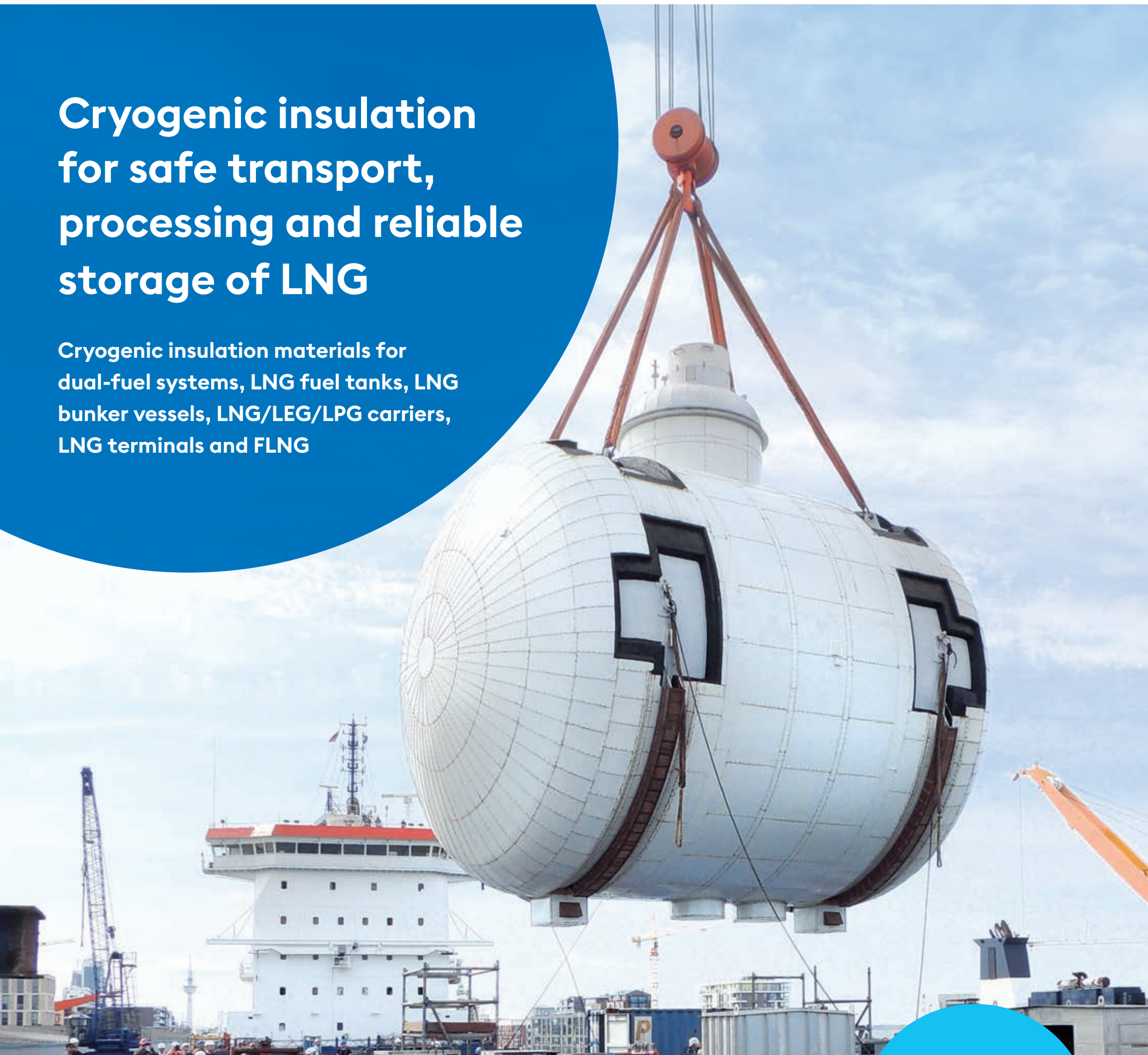
The gas treatment facilities comprising a main plant at Prudhoe Bay and the Point Thomson gas transmission line would be on state land designated for oil and natural gas development within the North Slope Borough. “We conclude that project construction and operation would result in temporary, long-term, and permanent impacts on the environment,” said the FERC report. “Most impacts would not be significant or would be reduced to less than significant levels with the implementation of proposed or recommended avoidance, minimization and mitigation measures, but some impacts would be adverse and significant,” explained the regulator. “We

conclude that constructing the project would have significant impacts on permafrost due to granular fill placement, particularly for the Mainline Pipeline facilities,” it said. “The project would have significant adverse impacts on wetlands from granular fill placement resulting in substantial conversions of wetlands to uplands,” added the report. “Significant adverse impacts on forest would result from permanent losses or conversions from installation of above-ground facilities, granular fill placement and vegetation maintenance in the Mainline Pipeline right-of-way,” it stated. The FERC also gave details of impacts on wildlife in the state. “For caribou, the impacts on the Central Arctic Herds would likely be significant due to the timing of impacts during sensitive periods, permanent impacts on sensitive habitats, and the project location at the center of the herds’ range,” said the FERC. “During the years of simultaneous construction, start-up, and operational activities at the liquefaction facilities, as well as during flaring events, impacts on air quality could be significant,” said the FERC. “Operational noise associated with the liquefaction facilities at the two nearest noise sensitive areas would likely double due to facility operation, which would be considered a significant increase,” the report added. However, it also stated that the project would result in positive impacts on the state and local economies, though adverse impacts on housing, population, and public services could occur in some areas.

VENTURE GLOBAL, the US liquefied natural gas developer pursuing three projects in the state of Louisiana, has now raised a total of \$2.8 billion in financing and much more will be needed as it presses ahead with plans to produce 56 million tonnes per annum of LNG for export. Venture Global said it had just raised \$675 million of additional capital from “world-class institutional investors” to be used primarily for the further development of its proposed Plaquemines export project in Louisiana with 20 MTPA of output. Analysts say that the cost of bringing one large-scale LNG liquefaction and export plant on stream with associated facilities and around 27 MTPA of production is estimated at over \$25 billion. “In addition to \$855M of capital previously raised by Venture Global and the \$1.3Bln project-level equity commitment from Stonepeak Infrastructure Partners, Venture Global has now raised total committed capital of more than \$2.8Bln to support the development of its facilities,”

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said the company. The Arlington, Virginia-based company's Plaquemines venture is sited near river mile-marker 55 on the west side of the Mississippi River, 30 miles south of New Orleans. The project will include multiple small-scale liquefaction Trains, four LNG storage tanks and three marine loading berths.

The company's most advanced plant in terms of development is at Calcasieu Pass in Louisiana with current nameplate export volumes of 12 MTPA. Calcasieu Pass is expected to come on stream in 2022, along with associated facilities, including the TransCameron Pipeline. Venture Global is owned by former investment banker Michael Sabel and lawyer Robert Pender, who act as joint chief executives. The third project is the Delta plant with a site also on the Mississippi River. The Delta project and its associated Delta Express pipeline would have output capacity of 24 MTPA. The proposed Delta and Plaquemines plants are stand-alone projects with no shared facilities and are under different development schedules. The Delta export terminal will be on land owned by the Port of Plaquemines and the Delta Express Pipeline would extend northwesterly for 281 miles, crossing private land in 14 parishes.

WOODFIBRE LNG, the small-scale Canadian export project planned for near Squamish in British Columbia, was granted a permit by the provincial authorities to proceed with construction. The Woodfibre liquefaction plant will be located on the site of a former pulp mill about 7 kilometres from Squamish and 70km north of Vancouver. It will comprise a facility with output of 2.1 million tonnes per annum and LNG storage tanks with 250,000 cubic metres of capacity. Woodfibre is a Canadian subsidiary of Pacific Oil & Gas, a unit of the Royal Golden Eagle group of Indonesian businessman Sukanto Tanoto and whose headquarters are in Singapore. "Following a rigorous process, Woodfibre LNG is pleased to have received our Facility Permit issued from the BC Oil and Gas Commission, one of the key permits required for construction and operation of the project," said Woodfibre LNG President David Keane. "This is a positive step forward as we work to build the cleanest LNG export facility in the world," added Keane. "This permit specifies requirements the project must comply with for design, construction and operation of the Woodfibre LNG Project, with a focus on public and environmental safety," he explained.

"Previous to this permit, Woodfibre

LNG is proud to have received three major environmental assessment approvals," stated Keane. He noted that the company had also undertaken an environmental assessment process in cooperation with the native North American Squamish First Nation. "The progress we have made would not be possible without the contributions and feedback made by our First Nation partners and the Squamish community," said Keane. "We are dedicated to bringing benefits to British Columbia through jobs and economic development, and ultimately a project that will have

significant positive impact," he added. "This permit is a large piece of our puzzle, and with it in place, we are working towards a final decision to proceed with this project this summer," said the Woodfibre President. Woodfibre said in June that it had signed up a subsidiary of BP of the UK as its first firm customer. The company has agreed to deliver 750,000 tonnes of LNG for a 15-year period from around 2023. The Woodfibre LNG project is one of the few moving forward on the Canadian West Coast where more than a dozen were previously planned. Woodfibre

owner PO&G also has LNG import assets in China. It holds a 35 percent stake in the Rudong LNG import terminal in China's eastern Jiangsu Province, with 55 percent held by Kunlun Energy, a Hong Kong-listed subsidiary of PetroChina. PetroChina itself is an investor in the largest LNG export project moving forward in BC, the LNG Canada joint venture in Kitimat with 20 MTPA of initial output. It is led by Royal Dutch Shell and with other stakeholders including Mitsubishi Corp. of Japan, Petronas of Malaysia and Korea Gas Corp. ■

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RINA's technical expertise provides vital support for Eni's ground-breaking Coral South FLNG plant

Mozambican floating venture is on track using a multitude of equipment and talents

The Coral South Floating LNG export project, whose development offshore Mozambique is led by Italian energy company Eni, begins production in 2022.

When the African FLNG plant comes on stream it will feature a raft of innovative technologies, both topside and subsea that have not been used in an LNG venture to date.

Validation

For the facility to perform as designed these technologies need to be validated before commissioning, and that role has fallen to Registro Italiano Navale (RINA), the Italian maritime classification society, founded in the port of Genoa in 1861.

Driven by growing demand in Asia, the race is on to develop the rich gas reserves off Africa's East Coast, primarily in Mozambique and Tanzania.

To date three LNG projects are planned to deliver more than 30 million tonnes per annum from a combined \$50 billion in capital expenditure - the Rovuma LNG project, the Mozambique LNG project and the Coral South FLNG venture.

These projects are all expected to come on stream between 2022 and 2025.

Discovered in May 2012, the Coral South gas field is estimated to hold 16 trillion cubic feet (Tcf) of recoverable gas.

Eni's Coral FLNG hull will be deployed in the southern part of the Area 4 licence block operated by Eni in the Rovuma Basin.

Water depths

It will be operating in water depths in excess of 2,000 metres and will produce 3.4 million tonnes of LNG per annum over its 25-year lifespan.

Eni awarded a consortium of TechnipFMC, JGC Corp. and Samsung Heavy Industries, the engineering, procurement, construction, installation, commissioning and start-up (EPCIC) contracts in 2017 for the FLNG facility.

The work also includes the associated risers and subsea flowlines system, as well as the installation of the umbilical's and subsea equipment.

At the same time Eni awarded a contract to supply the production systems and ancillary equipment, including the subsea wellheads, production trees,

manifolds and a complete topside control system for the Coral South FLNG project to GE Oil and Gas, now part of Baker Hughes-GE.

Aker Solutions of Norway is supplying three steel tube umbilical's totalling 19 kilometres in length.

"With a host of innovation planned, it is vital for that project's success that the technology is validated prior to installation," said Stefano Filippi, Head of Mozambique and Angola Energy for RINA.

"RINA has been selected as the certification authority for the fabrication and design of the subsea structures and equipment for the Coral South FLNG project as well as to provide technological validation services," he noted.

Subsea

"RINA entered in Coral South FLNG project for third-party certification from 2017, during the project engineering phase, and will be involved up to the procurement conclusion, in 2022," stated Filippi.

The project comprises six subsea wells tied-back using three cluster manifolds to a permanently anchored FLNG vessel that is capable of producing and offloading 3-plus MT of LNG as well as 480,000 tons of gas condensate a year.

The 439m-long, 65m-wide and 38.5m-tall, 210,000t FLNG vessel is being constructed by Samsung Heavy Industries' (SHI) on Geoje Shipyard in South Korea.

TechnipFMC and JGC will be responsible mainly for the engineering and procurement work for the vessel's topsides and the management of the overall project.

Samsung will be responsible for EPC work on the hull and fabrication of the topsides.

BP offtake

Under a 20-year contract, UK major BP has already agreed to an offtake deal for all the LNG.

The facility will be permanently moored in the Rovuma Basin with a large-diameter internal turret to withstand cyclonic weather and oceanic waves.

LNG production will be by four turbo-compression Trains equipped with aero derivative gas turbines.

Market	Developer	Project	MTPA	cm	Start-Up
Malaysia	Petronas	PFNLG Satu, Kanowit Field	1.2	354,000	2017
Australia	Shell	Prelude	3.6	437,500	2018
Cameroon	SNH/Perenco/Golar LNG	Kribi (Golar Hill)	1.2	125,000	2018
Equatorial Guinea ¹	Ophir	Fortuna (Golar Gandria)	2.2	125,000	2019
Malaysia	Petronas	PFLNG2, Rotan Field	1.5	177,000	2020
Mozambique	ENI	Coral South	3.4	230,000	2020
Argentina ²	Exmar	Tango FLNG	0.5	16,500	2019
Senegal	BP	Greater Tortue	2.4	125,000	

Coral FLNG is advancing for Mozambique while other projects are stalled

Power and refrigeration will be supplied by four turbo-generation units also driven by aero derivative gas turbines.

RINA's role is also to perform an independent review of the sub-sea equipment, in particular the subsea completion system, subsea manifold system, tie-in system, top side control system, subsea control system, wellhead and umbilicals.

"Our work started as soon as our client Coral S.A. submitted the first order to contractors and will be completed at the end of the procurement phase," said RINA.

Review team

Engineers, mainly from RINA's Fano office on Italy's Adriatic Coast, are involved in the review of around 10,000 documents, while inspectors are witnessing and monitoring the main construction phase, mainly in Italy, Norway, the UK and the US.

In addition to design reviews, RINA is involved in the process of technology validation.

CORAL SA, has identified technologies which will be implemented for the first time in an Eni Group project and has tasked RINA with performing a strict monitoring and overview on all the engineering documents and construction at the manufacturer.

Examples of innovative subsea technology are the horizontal production tree complete with subsea control module (SCM) and chemical inject metering valves (CIMV) along with the flow control module that includes the wet gas flow meters (WGFM).

The SCM is an independently retrievable unit that provides well control functions during the production phase. The manifold is a 10-inch dual header

system with two-slot, multi-bore infield production manifold complete with SCM, CIMV and SRM.

RINA's experience qualifying new technologies made them the perfect choice for this project.

Methodology

"The technology qualification process is the methodology through which a novel technology may be certified with respect to its fitness for service, which includes safety, availability and performance," added Filippi.

"It may be related to a simple component, as well as to complex systems that relate to each other. Of course, the more complex the system, the more involved is the technology qualification process," he said.

"RINA developed a special procedure for the technology qualification process and produced its own 'Guide for Technology Qualification Processes'. This includes the subdivision of the technology into manageable elements (subsystems and components, processes or operations, manufacturing and installation), the assessment of the new technology elements, identification of the main challenges and uncertainties related to the novel technology," he explained.

"RINA's project team is mainly based in Italy and coordinated by the head office but, at the same time, we are developing facilities and presence in Mozambique to be able to support the client throughout the project," he said.

"Our local team is deeply involved in the LNG projects that are starting in the country and being trained through our network, in order to develop the technology and in country know-how," concluded the RINA executive. ■

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US LNG cargoes for India will help boost food production as well as clean-up air pollution

Asian demand is growing with India among the leading buyers as it also tries to build more gas infrastructure

India began importing liquefied natural gas in 2004 and since then a lack of connectivity for the LNG receiving terminal infrastructure has led to supply limitations in the country standing by to increase its US LNG shipments, especially from the Cove Point plant in Maryland

There were five LNG receiving terminals in operation in India at the start of the year, at Dahej, Hazira, Dabhol and Kochi on the West Coast and at Kamarajar Portin Tamil Nadu on the East Coast.

Regas growth

In addition, there is a sixth terminal at Mundra on the West Coast which has been mechanically completed but has yet to start regular operations.

The lack of inland pipeline connectivity to the downstream market especially limits the use of the Kochi terminal in the southwest state of Kerala.

As a result, the country's total receiving capacity remains at only 20-30 billion cubic metres per annum despite a nameplate capacity of over 50 Bcm.

The government has long planned to build new terminals, though technical and financial issues have pushed back the development of new regasification terminals since 2013.

The country's fifth LNG terminal and India's first East Coast regasification facility at Kamarajar started operations in March 2019. The terminal is designed to receive more than 6 Bcm per annum to be used mainly as feedstock in the fertiliser industry as a substitute for naphtha.

Concentration

As four more import terminals are planned to start operations in the next few years, the bottlenecks in receiving and transporting LNG supply need to be resolved for better distribution within the country and for the development of the city-gas market.

The Indian Hiranandani group said a floating storage and regasification import project at Jaigarh port, south of the West Coast city of Mumbai, is on scheduled to start commercial operations by the fourth quarter of 2019, a year behind schedule.

This would take the number of completed regas terminals to seven. When operational, the Jaigarh terminal will supply customers through the pipeline

connected to national gas grids at Dabhol. However, there will still be only one LNG terminal for the whole East Coast of India at the start of 2020 even though about half-a-dozen others are planned.

Indian Prime Minister Narendra Modi inaugurated the Kamarajar LNG terminal as it was so important as the East Coast plays economic catch-up with the West Coast.

The Kamarajar facility is owned by Indian Oil Corp., the refining and fuel marketing company, and has 5 MTPA of import capacity and two tanks each with storage of 180,000 cubic metres.

Kamarajar is formerly one of India's main coal ports and was previously called Ennore. It 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.

With Gas Authority of India and the and the Adani Group, Indian Oil is also developing the Dhamra LNG terminal in the East Coast state of Odisha.

The Dhamra terminal when completed would serve city-gas and power projects as well as industrial customers.

Growth

Before it became an LNG nation, India had relied on its domestic production of associated gas from oilfields to meet the country's requirement for both power generation and industrial uses.

However, the country's strong economic and population growth led to further acceleration in natural gas demand, led by industrial uses.

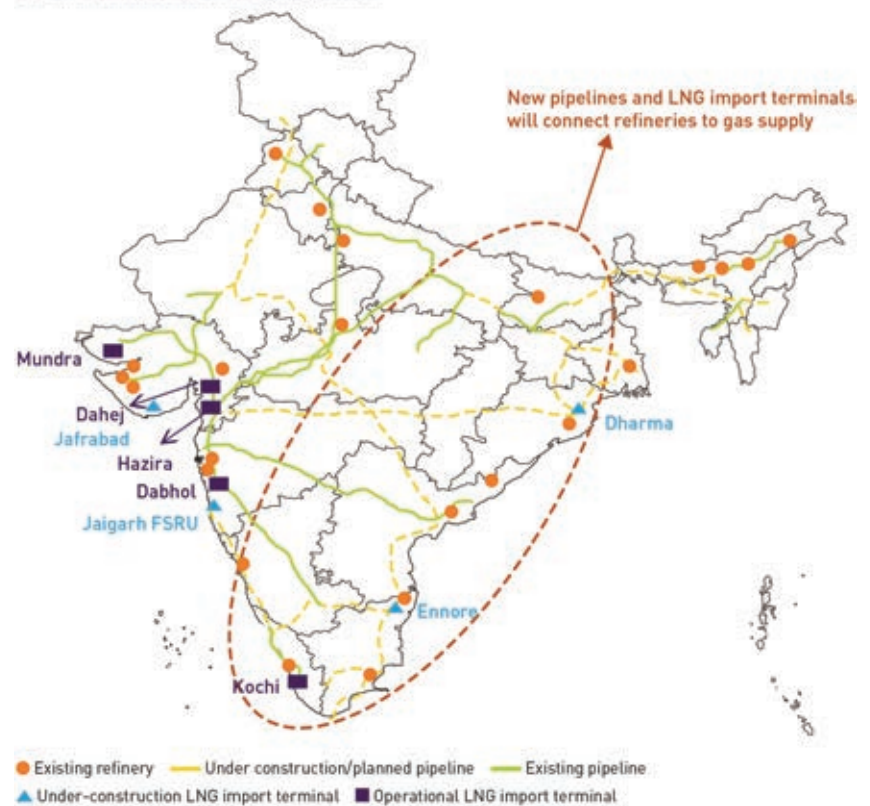
The government's strategy of expanding the role of natural gas in India, together with the development of the domestic pipeline network and the market and pricing, are expected to enable further growth in natural gas consumption.

Industry

One of the main users of natural gas is the crucial Indian fertilisers industry that supports domestic agriculture's needs and food production.

As the use of fertilisers remains lower in India than in most developed and emerging countries, it is considered that

Gas infrastructure and refinery map of India



Existing and planned LNG import terminals, refineries and pipelines nationwide as East Coast plays catch-up with West Coast

the fertiliser industry has strong potential for growth, up to an average of 10 percent per year during the period 2018-24.

Based on this strong policy support in favour of industrial development, and the fertiliser sector in particular, this forecast expects an average 7 percent per year increase in natural gas consumption for industrial uses until 2024.

The expected growth of natural gas in the transport sector by deployment of compress natural gas (CNG) and LNG will be another driver of India's future gas demand.

One of the government's recent initiatives is to set up an additional 10,000 CNG distribution stations by 2030, to reduce the use of diesel and gasoline and improve urban air quality.

In the longer term, the government is considering an affordable and efficient fleet of electric vehicles, including buses, rickshaws and smaller vehicles.

Clean fuel

That said the promotion of CNG-powered and LNG-fuelled automobiles and buses is continuing. Initiatives such as these are expected to encourage removal of the current infrastructure hurdles, leading to improvements in the LNG importing capability of the country.

The decline of domestic natural gas production from 2011, combined with stagnating LNG imports until 2015 due to high price levels and slower development of relevant infrastructure, hampered the development of natural gas in power generation in India.

Power generation from gas-fired power plants fell and was replaced by economically competitive coal-fired power plants.

This trend continued during fiscal year 2016-2017 when natural gas accounted for only 7 percent of installed generating capacity (or 25 GW), and less than 3 percent of electricity generation.

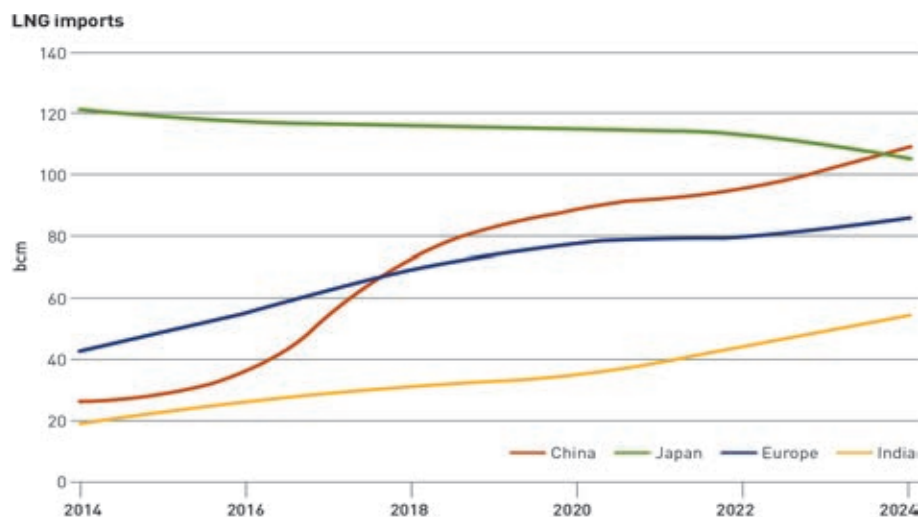
Concerns over air pollution issues in major cities in India have raised awareness of the need to develop cleaner sources of energy in the mix.

Renewables

Since renewable power sources, mainly hydro followed by wind, solar and biomass, already account for 35 percent of the country's capacity, the government of India aims to increase the use of natural gas in the power mix.

It is setting an ambitious target of doubling the share of natural gas in India's primary energy mix from the current 7 percent to 15 percent by 2030.

In order to increase the use of natural



Indian LNG import forecasts compared with other nations and regions

gas, the government is planning to expand the domestic pipeline network and import capacity, to ensure the connection of fertiliser factories and stalled power generation plants in the eastern regions and the expansion of the city-gas distribution network.

The 10th City Gas Distribution Bidding Round, which concluded in March 2019, was subject to strong competition with some 225 bids submitted.

It led to the distribution of letters of intent to 12 consortia for city-gas network development in 50 Geographical Areas.

As per the commitment made by the bidders, over 6 million new connections and 1,500 CNG fuel stations should be installed by end of March 2023.

Network

The first phase of the 2 655 kilometres-long Jagdishpur–Haldia and Bokaro–Dhamra gas pipeline project have been completed.

A 585 km-long section connecting to the eastern Indian states will also be further extended by 729 km in the next phase.

The pipeline connection has especially been a crucial step in reviving the

fertiliser industry in the eastern region of India, where most of the natural gas-fired power and fertiliser plants have been mothballed since 2013 with the decline of domestic production, namely from the KG D6 offshore basin.

The pipeline is also expected to supply natural gas to refineries, steel plants and other industries in the region.

GAIL, the country's main natural gas infrastructure operator, is currently developing several pipeline expansion projects, which total over 4 200km.

The fertiliser industry in India accounts for almost 30 percent per annum of India's natural gas consumption and was supplied by LNG imports (55 percent) and domestic production (45 percent).

It is extremely important industry supporting food production in the agricultural-based economic outside of key sectors.

Double role

So LNG exports to India from the US Gulf Coast and Maryland will also help to feed the nation as well as clean-up air pollution.

Fertilisers are subsidised to ensure

sufficient and affordable supply for the country's agricultural sector.

Urea is the main component of the fertiliser subsidy budget, accounting for above two-thirds of the total envelope over the recent fiscal years.

The budgeted fertiliser subsidy amounts to the equivalent of more than \$10 billion for fiscal year 2018-2019.

The Indian government reformed its fertiliser subsidies in 2015 by introducing natural gas price pooling to have a single reference price for feedstock from different sources of supply, domestic production or LNG imports.

The share of (cheaper) domestic gas production in overall supply to the fertiliser industry declined from 75 percent in 2013 to 45 percent in 2018, partly due to the gradual shutdown of the KG-D6 offshore gas field.

This caused an increase in the subsidy budget to guarantee a fixed price for buyers, although the budget has stabilised in recent years.

Developing domestic natural gas production would help to alleviate the subsidy burden.

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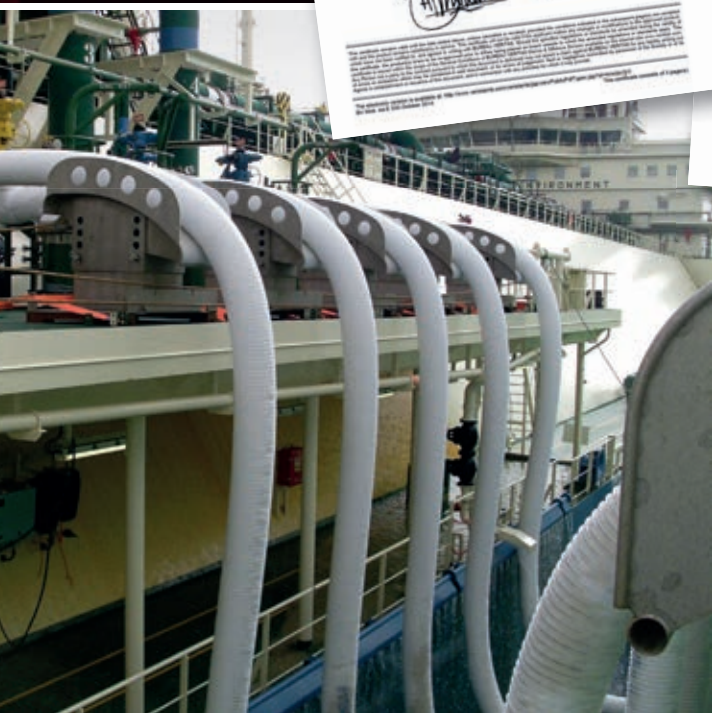
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Using radar-based level measurement improves efficiency and safety at LNG import terminals

Håkan Jubel, business development manager for cryogenic storage at Emerson

The cryogenic full-containment tanks used for storing LNG are large, complex structures with a typical capacity of between 30,000 and 200,000 cubic metres.

These vessels include an inner liquid containment steel tank, an outer concrete (or steel) tank for secondary containment control, and thermal insulation between the two to avoid liquid boil-off during storage.

Investment

Because these vessels are so technically advanced, their design and construction requires significant investment from tank farm operators, and payback times can be lengthy.

It is therefore important to implement accurate and reliable tank gauging systems that will help in maximising storage capacity and throughput, as well as minimising maintenance costs, thereby ensuring a faster return on investment, according to the US Emerson company, whose headquarters are in St. Louis, Missouri.

Level and temperature measurement

technology forms a key part of an LNG tank gauging system.

The ability to accurately and reliably measure the level of the liquid inside each tank is essential for inventory management and custody transfer purposes, and therefore in helping to maximise profitability.

Level and temperature are also measured as part of an overfill prevention system (OPS).

Filling a tank above its capacity can cause an overspill, which presents a safety hazard.

In addition, monitoring level is an important means of ensuring that tanks are not leaking, thereby helping to prevent product loss and potential safety incidents.

Preventing overspills and having the ability to detect leaks early is also vital in helping to comply with environmental regulations.

Challenges

Measuring level and temperature in full containment storage tanks presents several challenges. The required measurement range in these tall structures can often be 40 metres (131 feet) or more, which makes it difficult to achieve high levels of accuracy.

Also, such tanks are not opened during operation, which adds complexity when it becomes necessary to access instrumentation for maintenance. Equipment reliability is therefore a major consideration when selecting measurement technology for these applications.

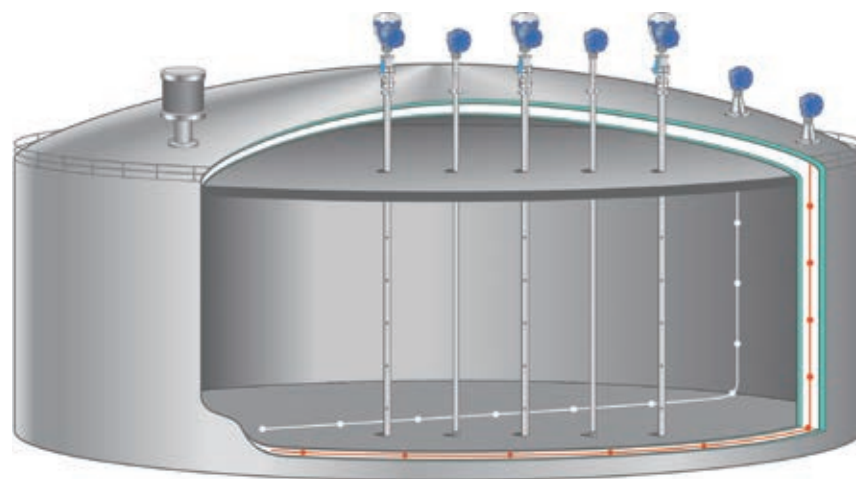
A further challenge is presented by the inner structure of these tanks. Standard storage tanks have only one vapour space, but in full containment tanks there are two - one outside the tank's fixed suspended deck and another inside it.

These two large spaces have different temperatures and for inventory purposes this needs to be considered when calculating the liquid equivalent within the spaces.

Methods

Level measurement in these tanks has traditionally been performed using either a float and tape method or servo technology.

In the former, a large float inside the tank is connected to a spring motor and



Model of a storage tank with Emerson measuring equipment technology in place

mechanical numeric indicator at the lower end of the outside of the tank through a pulley system.

For remote monitoring, the float gauge may be equipped with a transmitter, which provides tank level values to the control room.

When adopting the servo method, the float is replaced by a small displacer, which has buoyancy, but does not float on the liquid.

The displacer needs to be suspended by a thin wire, which is connected to the servo gauge on top of the tank.

Tension

A weighing system in the servo gauge senses the tension in the wire. Signals from the weighing mechanism control an electric motor in the servo unit and make the displacer follow the liquid level movements. A transmitter sends the level information to the control room using digital communications.

Although widely used, these methods have major shortcomings.

For example, the accuracy of a float gauge is often poor, with multiple error sources including buoyancy differences, dead-band, backlash and hysteresis in the mechanisms.

The float gauge is a relatively simple device, but has many moving parts that will require regular maintenance over its lifespan.

Servo gauges generally perform better than float gauges, but also have many moving parts.

Because the displacer and the wire are in contact with the liquid, servo gauges may require more attention for calibration and maintenance.

The modern approach involves using

top-down non-contacting radar level gauges to provide accurate and reliable level measurement.

This has become the world's fastest growing tank gauging technology in cryogenic applications.

The measurement of liquid level by non-contacting radar gauges is based on microwave signals emitted towards the surface and reflected back to the transmitter.

To reliably measure the level in a full containment tank, a radar gauge needs a sufficiently strong reflected signal, known as an echo, from the LNG surface.

Radar gauges based on two-wire frequency modulated continuous wave (FMCW) technology transmit a radar signal with increasing frequency over time to create a signal sweep.

The signal echo reflected from the surface is picked up by the antenna. Because the frequency of the transmitted signal constantly varies, the echo frequency always differs slightly to the transmitted signal at any given moment.

The difference between these frequencies is directly proportional to the echo delay - i.e., the distance from the transmitter to the surface - which enables accurate measurement of the level.

Sensitivity

The sensitivity of transmitters based on FMCW technology is more than 30 times higher than those based on pulse radar technology.

This maximises their signal strength and enables them to deliver greater measurement accuracy and reliability.

In LNG applications, a four-inch still-pipe guides the radar signal, resulting in a strong, undisturbed echo from the surface of the liquid.



The Emerson Rosemount 5900S Radar Level Gauge with LNG antenna

Typically, the radar sweep is controlled by a crystal oscillator to achieve instrument accuracy of 0.5 millimetres (0.020 inches).

Non-contacting radar level gauges are suitable for use in LNG storage tanks because their electronics are housed within the transmitter head, located outside the tank.

These devices can measure the LNG level in the tank without any physical contact with the surface, and without the need for inside-tank components that would require maintenance.

Antenna

A specific antenna option can be employed to enable a device to function in such an extreme environment.

These devices have minimal maintenance requirements, as they have no moving parts and do not touch the liquid, and they can boast impressive reliability, with mean time between failures for critical parts measured in decades.

The long measuring range required in these tall tanks can be challenging for non-contacting radar level gauges.

However, the latest devices can provide highly accurate measurements at distances of over 55 metres (180 feet), and furthermore, the measurements can be verified while the tank is in operation.

This is achieved through comparing measured level values to the known distance of a reference pin mounted in the still-pipe along with a deflection plate at the end of the pipe.

Temperature

The high-performance LNG automatic tank gauging systems into which non-contacting radar level gauges are integrated also include Level Temperature Density (LTD) devices to monitor tank temperature and density profiles, to detect stratification.

Stratification occurs when two separate layers of LNG are formed within a tank and this can potentially lead to a dangerous release of boil-off vapour called a roll-over.

Separation

The accurate multiple spot temperature sensors used for inventory measurements

also provide an online temperature profile as a back-up to the LTD instruments.

Additional temperature measurements are made by multiple spot temperature sensors to monitor the cool-down process and to add leak detection. Both functions are achieved by using several single spot temperature sensor elements which are fully integrated in the tank gauging system.

These are distributed along the inner tank wall and at the tank bottom (for cool-down supervision) and within the insulation space between the inner and outer tank walls (for leak detection).

Three level gauges are typically installed on an LNG storage tank – one supporting the basic process control system (BPCS), a secondary and redundant gauge for inventory, and a third providing information for the OPS.

In compliance with the International Electrotechnical Commission's 61511-2 standard, the same technology can be used for all three gauges.

Compared with using different technologies, this 'identical separation' method provides the advantage of

reducing complexity and the likelihood of human error during installation and maintenance.

Proof-testing

Level gauges used in a safety instrumented system must be periodically proof-tested to ensure that they will function properly when a safety demand occurs.

These tests have traditionally been carried out by technicians in the field and verified by a worker in the control room. This time-consuming and labour-intensive method can involve workers having to climb tanks to access the instruments, putting their safety at risk.

However, new technology within the latest radar level gauges now enables operators to undertake proof-testing remotely by inputting a straightforward sequence of settings and commands from their interface in the control room.

This eliminates the need for workers to climb tanks and/or be exposed to tank contents, and thereby provides significant benefits in terms of reducing risk, saving time and improving efficiency. ■

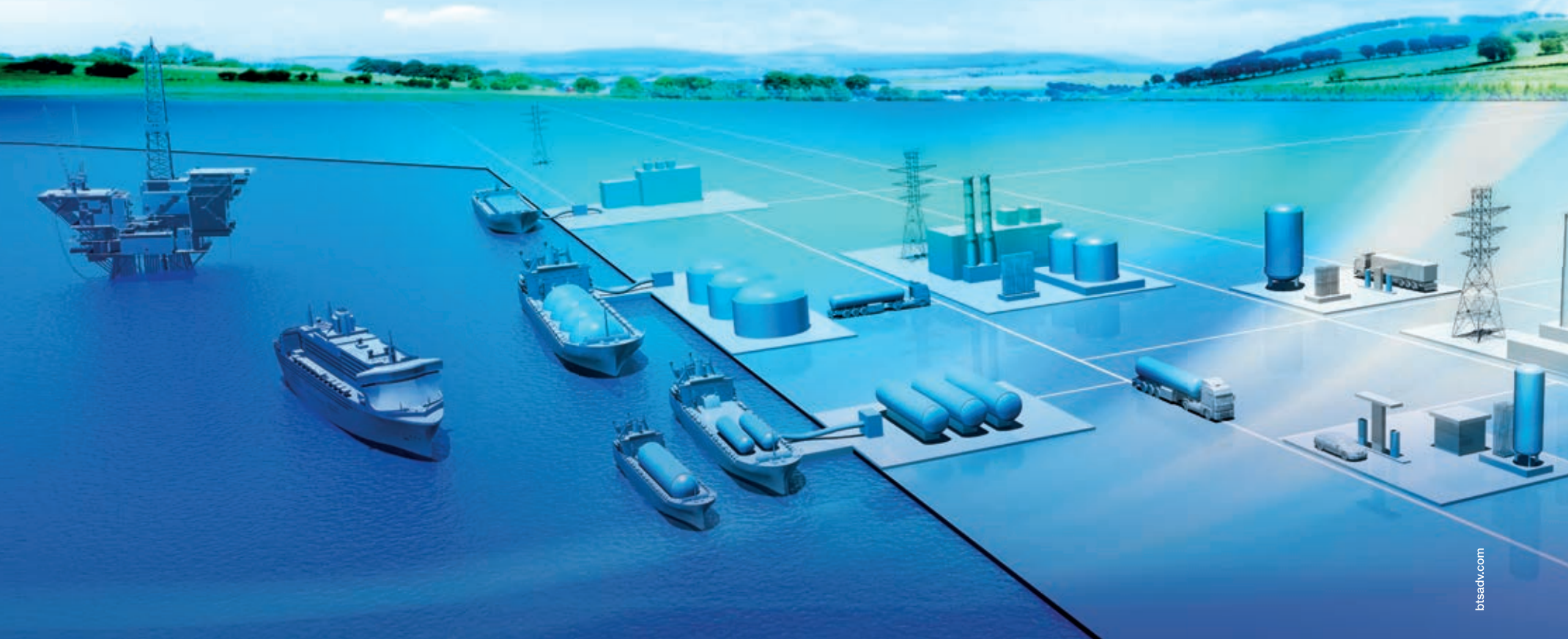
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Nakilat of Qatar forecasts positive shipping outlook for increasing global fleet delivery schedules

Gulf state fulfils key role with annual shipments to over 90 import terminals

The world demands better commitment and greater responsibility towards sustainability and environmental protection globally. This has created a huge demand for cleaner energy such as liquefied natural gas, which has significantly lower nitrogen oxide and carbon emissions, as compared to coal and oil.

Clean energy is vital for present and future developments, creating a sustainable future for the next generations.

Prospering

In this prospering LNG market, the most critical link in the supply chain is the transportation - the vessel.

Without gas tankers, LNG as a commodity cannot reach end users worldwide.

With one of the largest LNG shipping fleets in the world, Nakilat fulfils this global demand for clean energy by transporting LNG to over 90 terminals across 26 countries.

Since its establishment in 2004, the company has followed through its long-term business strategy to establish itself at the forefront of the energy transportation and maritime sector from thereon.

The new liquefaction plants and an increase in global LNG demand will likely maintain the strong fundamentals of the LNG shipping market.

Hence as the world's largest LNG shipping company which accounts for 11.5 percent LNG shipping capacity,

Nakilat is well placed to take advantage of this.

Balanced

Recognizing Qatar's abundant natural gas resources, Nakilat has capitalized on the opportunity to grow into a fully-fledged shipping company by adding ship management capabilities. Carrying more than two-thirds of Qatar's LNG exports, Nakilat is determined to sustainably grow its fleet size and market share.

Nakilat has been diligently focused on expanding its international business portfolio in terms of strategically balanced growth and diversification. The strong fundamentals of the LNG market especially in recent years, create an attractive investment environment, enabling LNG shipping players to capture new business opportunities and profitable assets.

Strategic alliance with renowned partners has been fundamental to the company's success, and Nakilat always look for opportunities to grow its international presence and maximize returns for shareholders.

Leader

Nakilat has enjoyed increased earnings given the full impact of its fleet expansion last year, with the inclusion of two additional LNG vessels and a Floating Storage Regasification Unit (FSRU) in 2018.

Earlier in 2019, Nakilat expanded its LNG fleet with four additional newbuild LNG carriers which will be fitted with the



Qatar has an amazing reach around the world with its mostly contracted cargoes

latest technology system, through the establishment of a new joint venture with Maran of Greece.

The new vessels will be commercially and technically managed by Nakilat with the delivery time between 2020 and 2021.

The expansion exercises effectively increase Nakilat's fleet size to 74 vessels comprising of the world's largest LNG fleet of 69 LNG carriers, as well as four large LPG carriers and one Floating Storage Regasification Unit (FSRU).

Its in-house shipping management subsidiary Nakilat Shipping Qatar Limited (NSQL) currently operates 18 vessels, comprising of 14 LNG carriers and four LPG carriers.

Nakilat aspires not only to be the largest LNG shipowner but also recognized as a safe, reliable and efficient ship operator.

Safety enhancement, vessel reliability and cost optimization continue to be Nakilat's main drivers for operational excellence in managing its vessels.

High standards

Nakilat enhanced its safety initiatives, leveraged operational opportunities and implemented efficiency measures to reduce costs that were beneficial to the company during this challenging period facing the shipping industry.

Nakilat continuously seek ways to enhance safety performance through setting stringent targets and higher standards than the benchmarked industry average.

As such, the company takes pride in

receiving honorary prestigious accolades for excellence in the areas of health and safety, sustainability development and business resilience.

This is reflected through its second consecutive "Five-Star" grading of the comprehensive Occupational Health and Safety Audit, as well as the "Sword of Honour" award for reaching "the pinnacle of excellence" in managing the company's health, safety, and environmental risks by British Safety Council (BSC).

All of Nakilat's LNG vessels have received the "Green Award" status and operate in accordance with best practices as defined within the program.

In addition, regular monitoring of ambient air quality and marine water and innovative measures to reduce electricity consumption have been introduced at its shipyard to improve efficiency.

Nakilat's main operational focus between late-2017 up to 2019 has been to safely and successfully complete all its vessels' second special survey dry dockings, which is a requirement when vessels approach 10 years of age.

Sustainability

Delivering energy responsibly means being mindful of integrating environmental considerations across all operations.

The landscape governing ocean transport is changing. With environmental agenda being a high priority in today's shipping industry, LNG as a fuel solution is growing momentum



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with shipowners across the world, Nakilat included.

Driven by its sustainability focus in the aspect of environmental management, it is worth noting that Nakilat pursued a pilot project for the world's first M-Type Electronically Controlled - Gas Injection (ME-GI) systems onboard LNG carrier Q-Max "Rasheeda".

The 266,000 cubic metres capacity ship was built in 2010, one of the 45 Q-Max and Q-Flex types and owned by Nakilat.

The company's excellent safety track record and the availability of LNG supply onboard greatly facilitated the incorporation of such a system on the vessel.

The ME-GI system offers a robust environmentally resilient combustion solution with among the highest fuel efficiency available in the market. Aimed to give full control on choice of fuel type, the Q-Max "Rasheeda" became a pivotal case study for ships of its scale.

Thus far, the GI engine has been providing an optimal fuel flexibility, greater control for operational efficiencies for Nakilat, and comes with enormous environmental advantages.

The Q-Max "Rasheeda" showcased promising results with significant running hours on gas since project roll-out to date.

Besides other substantial commercial benefits, the company has also observed around 95 percent reduction of Sulphur Oxides (SOX) when burning gas.

There is no doubt that learnings from this pilot project will pave way for greater enhancement for greener shipping system designs.

Capabilities

Nakilat believes that its success has been and shall continue to be internally generated through a high calibre workforce that forms its most valuable asset.

Aligned with its long-term growth strategic objective, Nakilat will be expanding its in-house crew administration to have greater autonomy in its operations and closer management of its seafarers.

This will in turn support the company's efforts in strengthening in-house capabilities, technical know-how, development of a sustainable workforce as well as optimizing operational costs.

The company is consolidating its capabilities by means of modernizing systems, enhancing human capital

capacity, developing competencies, and acquiring technical know-how not only in preparation for the next phase of LNG vessels expansion but also in FSRUs.

The next round of vessel management transitions from Shell International Trading and Shipping Company Ltd. (STASCO) to NSQL is scheduled to commence in 2020.

Nakilat also intends to take full ship management responsibility of its FSRU "Exquisite" from the current operator in 2020.

This will require NSQL to complement its skill base with additional knowledge and competencies to strengthen the company's positioning in this fast-developing, niche segment of the LNG industry.

Synergy

With an integrated maritime portfolio comprising ship repair and conversion, towage, agency and logistics, Nakilat is strategically equipped to capture business across the LNG value chain.

The company's world-class shipyard, the Erhama Bin Jaber Al Jalahma Shipyard has already completed over 1,000 ship repairs, offshore maintenance, ship building and fabrication projects, with LNG vessel repairs making up roughly 20 percent of this figure.

Nakilat strives to meet the growing energy transportation needs in a responsible manner, by balancing the economic, environmental and social needs aspects of sustainability, steered by excellence in safety and health, solid governance and ethical business practices.

The driving forces behind Nakilat's continued success have always been its skilled professionals, coupled with a keen focus on high standards safety management, operational efficiency, sound business diversification strategies and synergetic alliances with established industry partners. Nakilat continues to focus on long-term growth and development strategies.

Qatar's plans to increase LNG exports to 110 million tonnes (MT) per annum over the next few years will provide an excellent, large-scale opportunity for further growth in Nakilat's fleet.

The company is continuously looking to expand its international portfolio on the basis of long-term contracts as well as exploring multiple market sectors such as LNG ships, FSRUs, LPG ships and also small-scale LNG to cements its position as a global leader in energy transportation. ■



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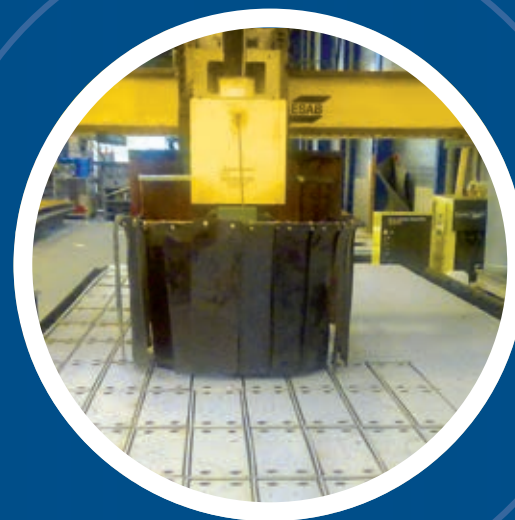
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Bunkering unit designs are now tailored to the needs of the expanding market for LNG fuel

Angeles Lopez Castejon, LNG Project Manager, SENER Marine, Spain

The liquefied natural gas supply market is a constant challenge for designers of floating LNG facilities, due to its ever changing requirements and needs.

With an annual R&D investment of 21.2 million euros (\$23.6M), and in our role as technology specialists, at SENER we are in the continuous process of developing flexible and innovative projects, adapting the designs of LNG supply facilities to the needs of our customers.

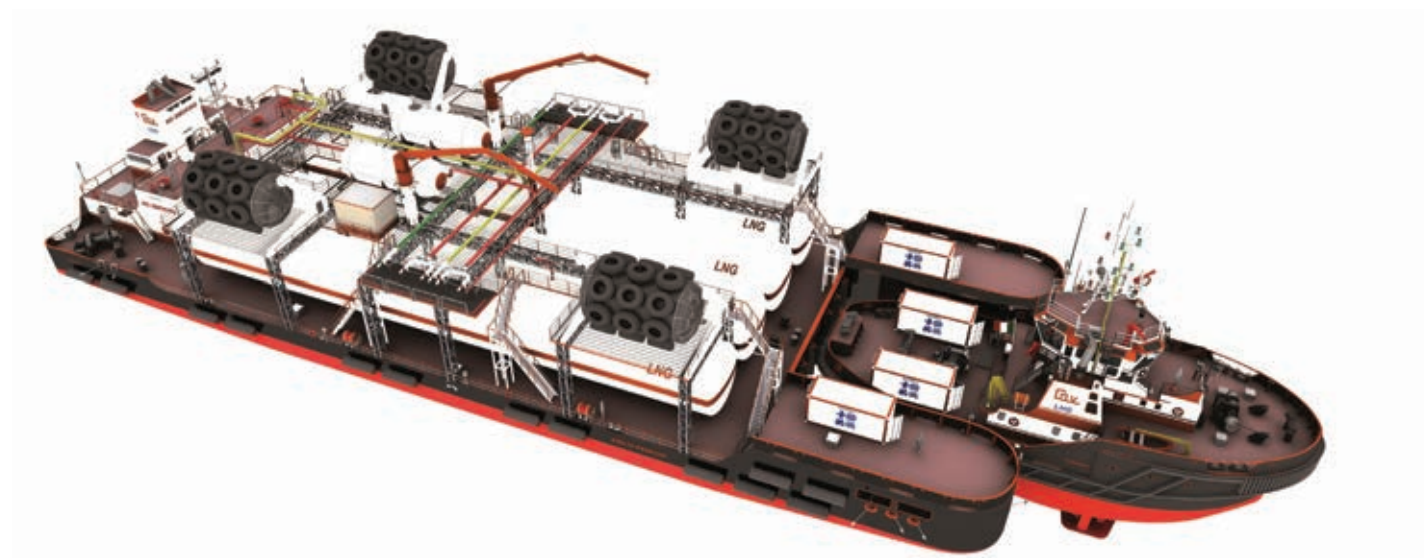
Potential

Demand forecasts for different locations around the world with the potential to expand the LNG market are coming true, and the agents in the LNG chain - gas companies, shipowners and operators - are taking the next step in acquisitions and/or chartering, which is enhancing the LNG bunkering sector.

Similarly, the cruise and container ship sectors are starting to invest in liquefied natural gas propulsion for their new constructions, employing dual engines, which increases the need to build the bunkering vessels that will refuel them.

In 2018, SENER began designing the first combined floating LNG bunkering unit, the only one of its kind anywhere by virtue of being the first puller combined unit in the world, with a pull of 65 tons.

The unit consists of a power unit driven by Voith and dual marine diesel oil (MDO) and LNG engines, the first Voith



The gas system has been changed to C-type tanks with vacuum insulation, which reduces the boil-off gas

tugboat powered by dual engines in the world.

And there is a cargo unit, able to carry 1000 cubic metres of MDO in structural tanks and 4000 cubic metres of LNG in two type-C pressurized tanks, with perlite insulation.

Construction is currently underway on what will be the first combined LNG supply unit to carry out bunkering operations for cruise ships entering the Venice lagoon.

After a months-long search involving Spanish, Turkish and Italian shipyards, the shipowner decided to build the vessel in an Italian shipyard.

This design has unrestricted navigation, it can sail through all types of waters.

Advantages

As a result, it offers high operational flexibility to the shipowner, who can

operate it beyond the Adriatic, as initially planned.

In addition, during months of low LNG supply activity, it can provide towing services by uncoupling the cargo unit.

The main challenges faced by SENER in this work were:

- Integrating the Voith propellers into the dual-engine design, which was a constructive experience as designers, and a challenge in a smaller tugboat, as it is the first Voith tugboat with LNG designed in the world.
- The position of the power unit (tugboat) at the fore part of the cargo unit (barge), and the fact that the power unit pulls on the barge, required a careful design to ensure the hazardous areas were properly separated and to comply with the safety standards required by the

International Maritime Organization (IMO).

- A unique and essential communication system designed exclusively to meet the shipowner's requirements: the unit is electrically coupled by an umbilical electrical cord, and mechanically by way of the pin between the tugboat and barge. This way, all the electrical power of the combined unit is generated in the tugboat and sent to the barge via the umbilical.
- The limited amount of space on the tugboat posed one of the greatest difficulties in designing the unit. The position of the on-board LNG tank and its cold box had to be tailor-made to fit into a very small space. Furthermore, since the tugboat has to be Tier III, it required installing SCRs in the exhausts of both engines.

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Due to the small size available on board to install these units, 3D designs had to be made in the initial stages.

Canal test

Finally, the low wake generated by the combined unit, a requirement to operate in Venice, made it necessary to conduct numerous canal tests and computational fluid dynamics (CFDs) calculations.

The various canal tests were used to find the ideal position for the pin joining the tug and the barge, to reduce drag, improve maneuverability, improve seakeeping and reduce the generated wake.

The tugboat and barge were tested individually in the canal, as were the two units combined.

Tug and barge

These tests were carried out in close collaboration with the shipowner, the canal in Vienna and the suppliers of the propellers.

As a result of these tests, the shapes of the skids on the barge had to be

reworked to keep the waves generated by the tugboat and barge from reinforcing each other.

The shape of the end of the stern skid was also improved to optimize the underway stability of the combined unit.

The position of the pin connecting between the tugboat and barge changed during the design phase.

It was initially located at the center of the tugboat, but after a series of tests in the canal, conditioned also by the owner's requirements not to position the pin at the bow, the pin was eventually positioned at the stern of the tugboat.

This change reduced the pitch and also lowered the accelerations in the tugboat, thus improving crew comfort.

The hazard identification studies (HAZID) and risk analyses conducted prior to the design detected key points that simplified the design, making it more flexible.

The hazardous areas and all the services involving the liquefied natural gas were studied from a safety-oriented

design approach in order to anticipate risks.

These studies have yielded a safe vessel, one that conforms to the requirements of the Italian registration authority and the RINA classification society.

Evolution

The flexibility of the design served as a source of inspiration this year for other floating unit projects.

The new designs are adapted to regasification requirements for on-shore gas supply, to the need for different liquefied natural gas storage capacities, to different operations in locations required to withstand tsunamis, to different tugs by adapting the shapes of the barge and tugboat for the connection pin, and to other situations.

These new designs have the pin positioned at the bow to further reduce accelerations and pitch. The shapes of the barge have been improved based on the navigation route.

And on other occasions, the gas system has been changed to C-type

tanks with vacuum insulation, which reduces the boil-off gas (BOG), and therefore the BOG processing equipment.

This unique design has been made possible thanks to SENER bringing together different types of engineering. In Energy, SENER develops projects in all the fields that make up the LNG value chain (liquefaction, storage, regasification, distribution and power generation); in addition, the company is also an expert in other key aspects for this type of project, such as marine engineering and marine civil works.

Moreover, SENER, as a technology specialist, has developed its own solutions, including the boil-off gas recombiner or reliquifier, it has designed a cryogenic storage tank, as well as a wide range of floating solutions for LNG storage, regasification and power generation.

In this context, the innovative combined floating LNG supply unit has been very well received by the LNG supply market, which is always in continuous development. ■



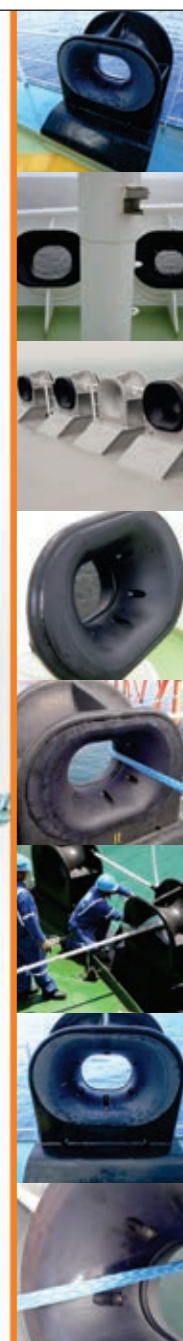
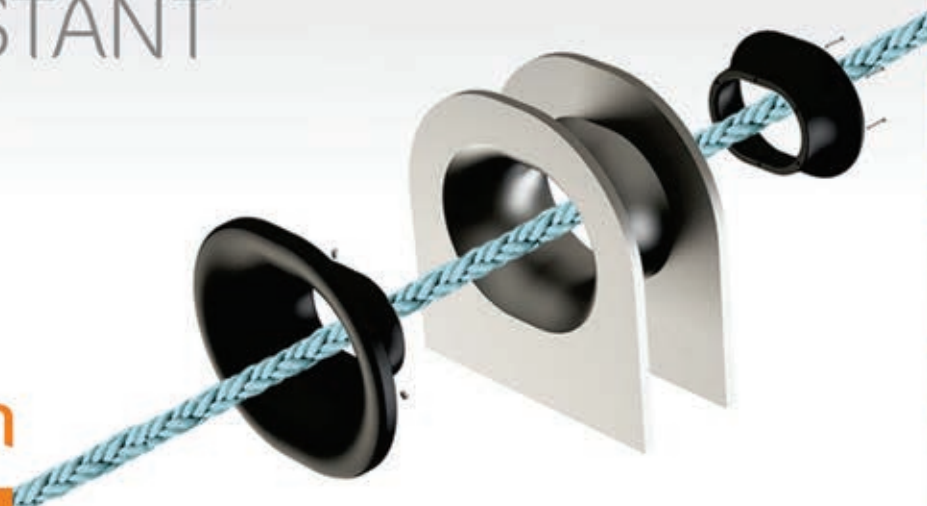
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Floating LNG hulls enable natural gas to rise to prominence as ideal global power solution

Javid Talib, Vice President of Black & Veatch Oil & Gas unit and director of FLNG Technology

A confluence of factors, both domestic and international, are driving optimism in the natural gas market.

Growing global demand for power generation - particularly in Asia - combined with aggressive renewable energy targets, the continuing low cost of natural gas and surging capabilities in infrastructure support the case for growing investment.

Transition

Even assuming an aggressive penetration of renewable energy, natural gas is expected to play a key role in paving the path to a low-carbon future by providing reliable, cost-effective baseload power and flexibility to integrate more renewables.

A recent report from the foundation, the Interstate Natural Gas Association of America, reaffirmed the importance of natural gas in the coming decades amid a surge of renewables, and detailed future opportunities for natural gas to play a role in supporting a more sustainable future.

The Role of Natural Gas in the Transition to a Lower-Carbon Economy concluded that natural gas will retain its important role in the US power sector for at least the next two decades, even as renewable energy grabs a bigger share of the nation's electricity market.

Globally, the gas demand will be met largely by importing LNG, for which prices have fallen significantly, making the fuel a more competitive proposition.

Infrastructure that enables LNG export facilities will play a vital role in serving global markets.

Maturing

Expect to see growing investment in FLNG capabilities, which have improved to offer a viable, flexible and economical solution to supply LNG to off-takers around the world.

About a decade ago, the introduction of FLNG was heralded as a way to monetize offshore stranded gas reserves. Today, FLNG production and shipping technologies are proven, along with its ability to move supply to end users much faster than traditional onshore facilities.

This makes FLNG an increasingly attractive and important element in the



Exmar's 'Tango FLNG' arrives at Bahia Blanca port in Argentina. The Black & Veatch liquefaction process was installed during construction and when it was originally bound for off the Caribbean coast of Colombia

current price environment, and the current trend is to use FLNG to monetize onshore or nearshore gas reserves.

These successes are backed by recent milestones achieved by Golar LNG's "Hilli Episyo" FLNG production vessel conversion, which began full commercial operations offshore Cameroon in April 2018.

Earlier this year, Black & Veatch received full notice to proceed on converting Golar LNG's "Gimi" into an FLNG vessel to support BP's work offshore Mauritania and Senegal.

In June, Black & Veatch's patented PRICO© technology was put to commercial operation, after successfully completing its Guaranteed Performance Test aboard Exmar's "Tango FLNG", at port Bahia Blanca in Argentina, the world's first barge-based FLNG and Argentina's first LNG export facility.

These examples serve as fresh evidence of FLNG's market viability in quickly moving supply to demand-heavy markets.

But these are more than just major milestones; they've opened the doors to what's possible when serving a world that relies heavily on a diversified portfolio of power solutions.

Financing success

The proliferation of FLNG projects hinges on the ability of investors to see them as viable capital investments.

Five years ago, the technical aspect of FLNG presented a complex series of roadblocks; how could producers ever

hope to efficiently perform liquefaction on board of a floating vessel?

Today, the technical side of it is no longer the issue; it's the financial element that creates the most daunting barrier.

When developers aren't in a position to satisfy the guarantee demands of lenders, particularly on large projects that reach into the billions of dollars (FLNG development costs can carry a price tag of \$1 billion to \$2 billion), it can be incredibly difficult to source funding and make progress. This applies to both large FLNG and land-based facilities.

It's no surprise that economics are the driving force behind FLNG investment.

Returns

According to Black & Veatch's 2019 Strategic Directions: Natural Gas Report, which integrates survey data from across the natural gas industry, the majority of respondents said return on investment (ROI) is the primary driver when it comes to making FLNG investment decisions, followed by lower Capex/Opex and offtake commitments.

Although major international oil companies like BP and Shell have the means to fund these projects internally, most of the players today are small developers, without big balance sheet to support investment.

But developer entry into the market is a strong indication that the successes of small- to mid-scale FLNG facilities are putting investors at ease.

FLNG facilities are proving to be a

lower-risk opportunity for investors for three big reasons:

- They offer a quicker speed to market.
- They are not fixed to one location.
- They offer greater operational flexibility.

In today's low-priced environment, it's critical that investors start seeing ROI as quickly as possible.

Streamlined

FLNG ship-based facilities are smaller and more streamlined than their land-based rivals and offer the ability to ensure consistent high quality in a controlled environment.

The benefits of not having to wait for local permitting processes to break ground while of a ship yard cannot be overstated.

For example, constructing the large land-based storage tanks necessary for onshore LNG facilities can involve a permitting and construction lengthy process; but an FLNG vessel serves as its own containment system, reducing the need to construct additional tanks.

Considerations such as these speeds up every aspect of project development, from permitting to construction to commissioning.

As a result, the FLNG timeline from final investment decision to commercial operation is a three- to four-year process.

Fast track

Onshore facilities, on the other hand, can take upwards of four to five years to come online.

Allowing the product to get to market a full year earlier allows LNG producers to monetize their revenue streams faster and investors to see ROI arrive more quickly, a win-win for everyone involved.

Because large land-based LNG facilities are fixed in one location, they are vulnerable to logistical issues depending on where the plant is located.

For example, fluctuations in labor availability and productivity inject a higher level of risk on production schedule and cost.

Due to their massive size and complex nature, these facilities cannot scale up or down easily to match varying offtaker demands.

FLNG projects have a smaller footprint and therefore carry a lower Capex burden. They can also be developed in bite-sized “blocks,” rather than one megaproject that requires intense investment.

This approach also makes the solution easier to manage and finance and allows discrete sales commitment volumes.

FLNG operations also allow for far

more operational flexibility. While onshore LNG facilities rely on one massive train, FLNG uses multiple smaller trains that can aggregate production up to 6 million-ton capacity.

Smaller

Small and medium scales fly in the face of the idea that bigger is better, or even more economical.

Running an operation with multiple smaller trains allows the project to be more flexible in production, offering

several benefits while removing an element of risk.

Running multiple smaller trains offers flexibility when meeting the needs of offtakers.

Gone are the days of long contracts and securing buyers to offload the entire supply of large train. Instead, producers can run multiple smaller trains, which allows them a more manageable, scalable offtake capacity that can serve single or multiple sales contracts.

Removing the need for large volumes and long contracts makes it easier to secure buyers and helps instil confidence in investors.

Multiple smaller trains are also more efficient in that they allow producers to more easily turn up or down the production, rather than run a single large train at lower capacity, which is not an efficient allocation of resources.

And when it comes to operations and maintenance, running one large train is extremely taxing on the equipment, increasing the risk of malfunction.

Running multiple smaller trains helps to maintain uptime.

Plus, if a facility's one large train goes offline for any reason, production halts altogether, versus having two smaller trains, where one can go offline while one continues to function.

Reducing the risk of production loss helps overcome the economies of scale.

Future

With the forecast for energy demand looking bright - BP's Energy Outlook predicts a 1.2 percent year-over-year increase - paired with a positive lender position, it's understandable why the industry is excited about the future of FLNG.

LNG is a clean fuel without the intermittency issues that renewables face today, and as developers enter the market amid a strengthening confidence in the economics, expect to see FLNG projects spring up across the globe.

FLNG is now considered a reality on the open market, backed by its reputation as a viable, flexible and economical solution for monetizing and exporting both nearshore gas reserves and land-based pipeline networks. So, what's next?

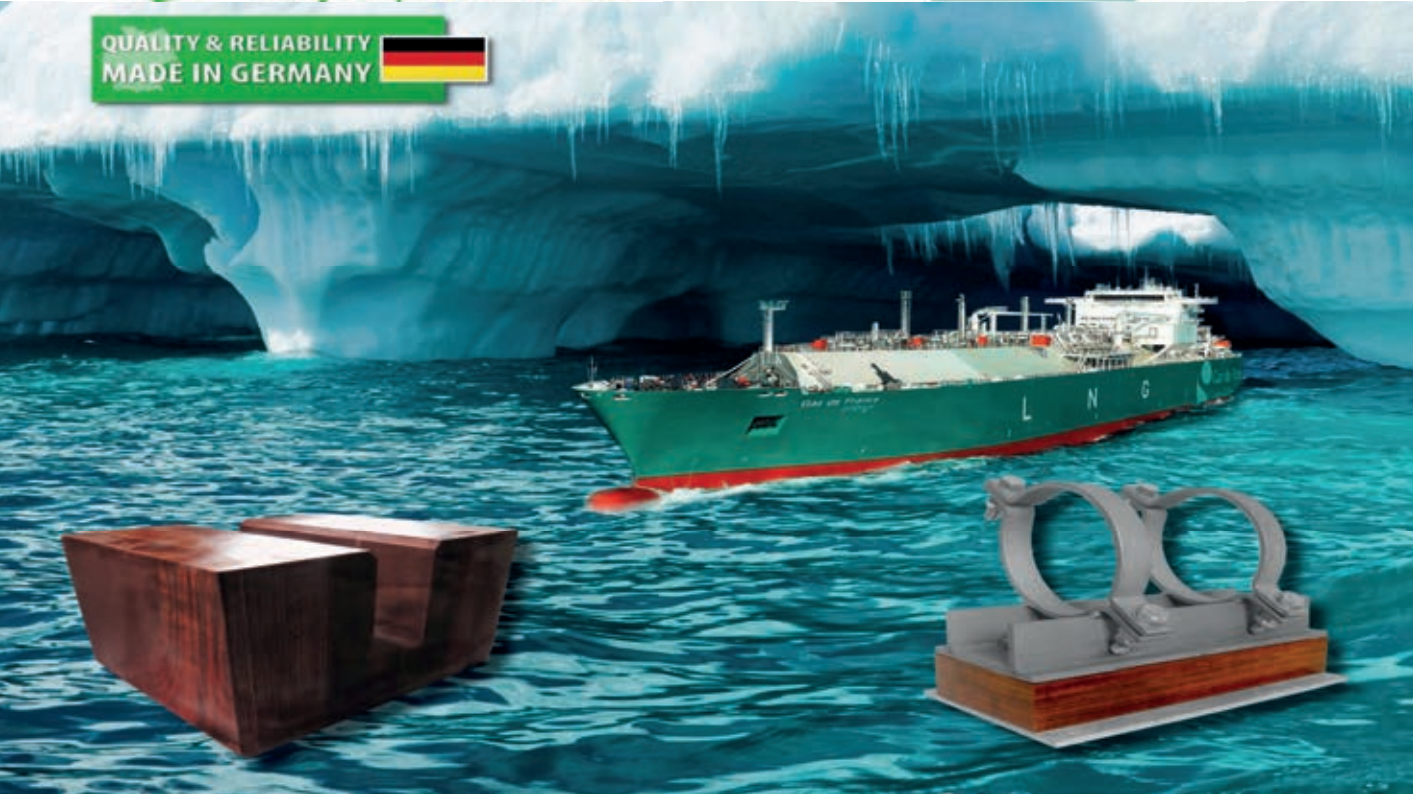
FLNG will continue to grow in capability and reach as the demand for cleaner low-carbon energy continues to rise.

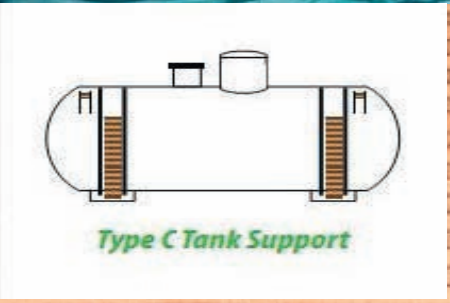
The financial and operational flexibilities of FLNG are on record, and investors are giving careful consideration to FLNG's promise of moving supply faster at lower financial risk. ■



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- **GL** Germanischer Lloyd
- **BV** Bureau Veritas
- **DNV** Det Norske Veritas
- **LR** Lloyd's Register
- **GTT** Gaztransport, Technigaz
- **DIN ISO 9001 : 2008**
- **ABS** American Bureau of Shipping

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- High compressive strength
- Water resistant
- Low thermal conductivity
- Low coefficient of friction
- Temperature stability
- Low coefficient of linear expansion

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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	GTT	5	Qatargas IV
Abadi	135,000	Brunei Gas Carriers	Mitsubishi Nagasaki	Jun-02	Brunei	S	Moss	5	Brunei LNG
Abalamabie	174,900	Bonny Gas	Samsung	June-16	Bermuda	DFDE	GTT	4	Nigeria LNG
Adam LNG	162,000	Oman LNG	Hyundai	Dec-14	Marshall Is.	DFDE	GTT	4	Oman LNG
Al Aamriya	210,100	J5 Consortium	Daewoo	Feb-08	Marshall Is.	DRL	GTT	4	Qatargas
Al Areesh	151,700	Teekay LNG	Daewoo	Jan-07	Qatar	S	GTT	4	Ras Gas II
Al Bahiya	210,185	QGTC	Samsung	Oct-09	Liberia	DRL	GTT	5	Qatar-Atlantic
Al Biddah	135,275	J4 Consortium	Kawasaki Sakaide	Nov-99	Japan	S	Moss	5	Qatargas
Al Daayen	151,700	Teekay LNG	Daewoo	Apr-07	Qatar	S	GTT	4	RasGas II
Al Dafna	266,000	QGTC	Samsung	Oct-09	Marshall Is.	LR DRL	GTT	4	Qatar-Atlantic
Al Deebel	145,000	Peninsular LNG	Samsung	Dec-05	Bahamas	S	GTT	4	Qatargas
Al Gattara	216,200	OSG/Nakilat	Hyundai	Oct-07	Marshall Is.	DRL	GTT	4	Qatargas II
Al Ghariya	210,100	ProNav	Daewoo	Feb-08	Bahamas	DRL	GTT	4	Qatargas
Al Gharaffa	216,200	OSG/Nakilat	Hyundai	Jan-08	Marshall Is.	DRL	GTT	4	Various
Al Ghashamiya	216,000	QGTC	Samsung	Mar-09	Liberia	DRL	GTT	4	Qatar-Atlantic Basin
Al Ghuwairiya	261,700	QGTC	Daewoo	Aug-08	Marshall Is.	DRL	GTT	5	Qatar-Atl'c Basin
Al Hamla	216,000	OSG	Samsung	Feb-08	Marshall Is.	DRL	GTT	4	QatarGas
Al Hamra	137,000	National Gas Shipping	Kvaerner-Masa	Jan-97	Liberia	S	Moss	4	ADGAS
Al Huwaila	217,000	Teekay	Samsung	May-08	Bahamas	DRL	GTT	4	RasGas III
Al Jasra	137,100	J4 Consortium	Mitsubishi Nagasaki	Jul-00	Japan	S	Moss	5	Qatargas
Al Jassasiya	145,700	Maran-Nakilat	Daewoo	May-07	Greece	S	GTT	4	RasGas
Al Kharaitiyat	216,200	QGTC	Hyundai	May-09	Liberia	DRL	GTT	4	Qatargas III
Al Kharaana	210,000	QGTC	Daewoo	Oct-09	Marshall Is.	DRL	GTT	4	Qatargas IV
Al Kharsaah	217,000	Teekay	Samsung	May-08	Bahamas	DRL	GTT	4	RasGas III
Al Khattiya	210,000	QGTC	DSME	Oct-09	Marshall Is.	DRL	GTT	4	Qatargas IV
Al Khaznah	135,500	National Gas Shipping	Mitsui Chiba	Jun-94	Liberia	S	Moss	5	ADGAS
Al Khor	137,350	J4 Consortium	Mitsubishi Nagasaki	Dec-96	Japan	S	Moss	5	Qatargas
Al Khuwair	217,000	Teekay LNG	Samsung	Jul-08	Korea	DRL	GTT	4	RasGas
Al Mafyar	266,000	OSG/Nakilat	Hyundai	Oct-07	Marshall Is.	DRL	GTT	4	Qatargas II
Al Marrouna	151,700	Teekay	Daewoo	Nov-07	Bahamas	S	GTT		Ras Gas I
Al Mayeda	266,000	QGTC	Samsung	Jan-09	Liberia	DRL	GTT	5	Qatar-US/Var.
Al Nuaman	210,000	QGTC	DSME	Dec-09	Marshall Is.	DRL	GTT	4	Qatargas IV
Al Oraiq	210,000	J5 Consortium	Daewoo	Apr-08	Marshall Is.	DRL	GTT	4	Various
Al Rayyan	135,360	J4 Consortium	Kawasaki Sakaide	Mar-97	Japan	S	Moss	5	Qatargas
Al Rekayyat	216,200	QGTC	Hyundai	Jun-09	Bahamas	DRL	GTT	4	Qatar-Atlantic
Al Ruwais	210,100	ProNav	Daewoo	Nov-07	Germany	DRL	GTT	4	Qatargas II
Al Sadd	210,100	QGTC	Daewoo	Mar-09	Liberia	DRL	GTT	4	Qatar-Atlantic Basin
Al Safliya	210,100	ProNav	Daewoo	Dec-07	Bahamas	DRL	GTT	4	Qatargas II
Al Sahla	216,200	J5	Hyundai	Jun-08	Japan	DRL	GTT	4	Ras Gas III
Al Samriya	261,700	QGTC	Daewoo	Sep-08	Marshall Is.	DRL	GTT	5	Qatargas II
Al Sheehaniya	210,100	QGTC	Daewoo	Feb-09	Liberia	DRL	GTT	4	Qatar-Atlantic Basin
Al Shamal	217,000	Teekay LNG	Samsung	Jun-08	Qatar	DRL	GTT	4	RasGas
Al Thakhira	145,000	Peninsular LNG	Samsung	Sep-05	Bahamas	S	GTT	4	Qatargas
Al Thumama	216,000	J5 Consortium	Hyundai	Apr-08	Japan	DRL	GTT	4	Rasgas
Al Utouriya	215,000	J5	Hyundai	Sep-08	Panama	DRL	GTT	4	RasGas
Al Utourma	215,000	J5	Hyundai	Sep-08	Panama	DRL	GTT	4	Ras Gas III
Al Wajbah	137,350	J4 Consortium	Mitsubishi Nagasaki	Jun-97	Japan	S	Moss	5	Qatargas
Al Wakrah	135,360	J4 Consortium	Kawasaki Sakaide	Dec-98	Japan	S	Moss	5	Qatargas
Al Zhubarah	137,570	J4 Consortium	Mitsui Chiba	Dec-96	Japan	S	Moss	5	Qatargas
Alto Acrux	147,000	LNG Marine Transport	Mitsubishi	Mar-08	Bahamas	S	Moss	4	Various
Amali	148,000	Brunei-Shell	DSME	Jul-11	Brunei	DFDE	GTT	4	Brunei LNG
Amanl	154,800	Brunei-Shell	Hyundai	Nov-14	Brunei	DFDE	GTT	4	Brunei LNG
Aman Bintulu	18,928	Perbadanan / NYK Line	NKK Tsu	Oct-93	Malaysia	S	GTT	3	Petronas
Aman Hakata	18,800	Perbadanan / NYK Line	NKK Tsu	Nov-98	Malaysia	S	GTT	3	Petronas
Aman Sendai	18,928	Perbadanan / NYK Line	NKK Tsu	May-97	Malaysia	S	GTT	3	Petronas
Arctic Aurora	160,000	Dynagas	Hyundai	Jul-13	Marshall Is.	DFDE	GTT	4	Various
Arctic Discoverer	140,000	K Line	Mitsui Chiba	Jan-06	Bahamas	S	Moss	4	Various
Arctic Lady	147,200	MOL/Hoegh LNG	Mitsubishi Nagasaki	Apr-86	Norway	S	Moss	4	Various
Arctic Princess	147,200	MOL/Hoegh LNG	Mitsubishi Nagasaki	Jan-06	Norway	S	Moss	4	Various
Arctic Sun	89,880	Arctic LNG Shipping	IHI Chita	Dec-93	Liberia	S	IHI SPB	4	ConocoPhillips/Marathon
Arctic Voyager	140,000	K Line	Kawasaki	Jul-06	Bahamas	S	Moss	4	Statoil
Arkat	148,000	Brunei-Shell	DSME	Feb-11	Brunei	DFDE	GTT	4	Brunei LNG
Arwa Spirit	165,000	Teekay LNG	Samsung	Sep-08	Marshall Is.	DFDE	GTT	4	Various
Aseem	154,850	K Line-Petronet	Samsung	Nov-09	Malta	S	GTT	4	Qatar-India
Asia Endeavour	160,000	Chevron	Samsung	Dec-14	Bahamas	DFDE	GTT	4	Various
Asia Energy	160,000	Chevron	Samsung	Sept-14	Bahamas	DFDE	GTT	4	Various
Asia Excellence	160,000	Chevron	Samsung	Sept-13	Bahamas	DFDE	GTT	4	Various
Asia Venture	160,000	Chevron	Samsung	Sept-17	Bahamas	DFDE	GTT	4	Various

CARRIER FLEET



Asia Vision	160,000	Chevron	Samsung	June-14	Bahamas	DFDE	GTT	4	Various
Bahrain Spirit	173,000	Teekay	Daewoo	Sept-18	Bahamas	DFDE	GTT	4	Various
Barcelona Knutsen	173,400	Knutsen	Daewoo	May-10	N.I.S.	DFDE	GTT	4	Various
Bebatic	75,060	Brunei Shell Tankers	Atlantique	Oct-72	Brunei	S	GTT	6	Brunei LNG
Beidou Star	172,000	MOL	Hudong	Oct-15	Hong Kong	DRL	GTT	4	Various
Berge Arzew	138,088	BW Gas	Daewoo	Jul-04	Norway	S	GTT	4	Sonatrach
Boris Vilkitsky	172,600	Dynagas	Daewoo	Jan-17	Cyprus	DFDE	GTT	4	Yamal LNG
BW GDF-Suez Boston	138,059	BW Gas	Daewoo	Jan-03	Norway	S	GTT	4	Suez LN
BW GDF Suez Everett	138,028	BW Gas	Daewoo	Jun-03	Norway	S	GTT	4	Suez LNG
BW Integrity	170,000	BW Gas	Samsung	May-17	Singapore	DFDE	GTT	4	FSRU
BW Pavilion Leeara	161,880	BW Gas	Hyundai	Feb-15	Singapore	DFDE	GTT	4	Various
BW Pavilion Vanda	161,880	BW Gas	Hyundai	Feb-15	Singapore	DFDE	GTT	4	Various
BW Singapore	170,000	BW Gas	Samsung	May-15	Singapore	DFDE	GTT	4	FSRU
BW Suez Paris	162,400	BW Gas	Daewoo	May-09	N.I.S.	DFDE	GTT	4	Yemen-Atlantic
Bilbao Knutsen	138,000	Knutsen / Marpetrol	IZAR Sestao	Jan-04	Spain	S	GTT	4	Atlantic LNG
Bilis	77,730	Brunei Shell Tankers	La Seyne	Mar-75	Brunei	S	GTT	5	Brunei LNG
Bishu Maru	162,000	K Line-Transpacific	Kawasaki Sakaide	Dec-15	Panama	S	Moss	4	Australia-Japan
Boris Davydov	172,600	Dynagas	Daewoo	Sept-18	Cyprus	DFDE	GTT	4	Yamal LNG
British Achiever	173,644	BP Shipping	Daewoo	June-18	IOM	MEGI-DF	GTT	4	Various
British Contributor	173,644	BP Shipping	Daewoo	Oct-18	IOM	MEGI-DF	GTT	4	Various
British Diamond	155,000	BP Shipping	Hyundai	Sep-08	IOM	DFDE	GTT	4	Indonesia-Various
British Emerald	155,000	BP Shipping	Hyundai	Jun-07	UK	DFDE	GTT	4	Tangguh LNG
British Innovator	138,200	BP Shipping	Samsung	Jul-03	Isle of Man	S	GTT	4	Various
British Merchant	138,000	BP Shipping	Samsung	Apr-03	Isle of Man	S	GTT	4	Various
British Partner	173,644	BP Shipping	Daewoo	Mar-18	IOM	MEGI-DF	GTT	4	Various
British Ruby	155,000	BP Shipping	Hyundai	Jan-08	U.K.	DFDE	GTT	4	Various
British Sapphire	155,000	BP Shipping	Hyundai	Sep-08	IOM	DFDE	GTT	4	Tangguh
British Trader	138,000	BP Shipping	Samsung	Dec-02	Isle of Man	S	GTT	4	Engas
Broog	135,466	J4 Consortium	Mitsui Chiba	May-98	Japan	S	Moss	5	Qatargas
Bu Samara	266,000	QGTC	Samsung	Dec-08	Qatar	DRL	GTT	5	Qatargas
BW Suez Paris	162,400	BW Gas	Daewoo	May-09	N.I.S.	DFDE	GTT	4	Yemen-Atlantic
BW Suez Brussels	162,400	BW Gas	Daewoo	May-09	N.I.S.	DFDE	GTT	4	Yemen-Atlantic
Cadiz Knutsen	138,826	Knutsen / Marpetrol	IZAR Puerto Real	Jun-04	Spain	S	GTT	4	Engas
Cape Ann	145,000	Hoegh LNG/MOL	Samsung	May-10	Liberia	DFDE	GTT	4	Various
Castillo de Santisteban	173,600	Elcano	STX	Aug-10	Malta	S	GTT		Various
Castillo de Villalba	138,000	Elcano	IZAR	Nov-03	Spain	S	GTT	4	Sonatrach
Catalunya Spirit	138,000	Teekay LNG Partners	IZAR Sestao	Mar-03	Liberia	S	GTT	4	Atlantic LNG
Celestine River	145,000	KLNG	Kawasaki	Dec-07	Bahamas	S	Moss		Various
Cesi Beihai	174,100	MOL-China LNG	Hudong	June-17	Hong Kong	S	GTT	4	Australia-China
Cesi Gladstone	174,100	MOL-China LNG	Hudong	Oct-16	Hong Kong	S	GTT	4	Australia-China
Cesi Lianyungang	174,100	MOL-China LNG	Hudong	June-18	Hong Kong	S	GTT	4	Australia-China
Cesi Qingdao	174,100	MOL-China LNG	Hudong	Nov-16	Hong Kong	S	GTT	4	Australia-China
Cesi Tianjin	174,100	MOL-China LNG	Hudong	Sept-17	Hong Kong	S	GTT	4	Australia-China
Challenger FSRU	263,000	MOL LNG	Daewoo	Oct-17	St Kitts	DFDE	GTT	4	Various
Cheikh Bouamama	75,500	Skikda LNG Transport	USC	Jul-08	Bahamas	S	GTT	4	Sonatrach
Cheikh El Mokrani	75,500	Med LNG Corp	USC	Jun-07	Bahamas	S	GTT	4	Sonatrach
Christophe de Margerie	172,600	SCF	Daewoo	Nov-16	Cyprus	DFDE	GTT	4	Various
Clean Energy	150,000	Dynagas	Hyundai	Mar-07	Marshall Is.	S	GTT	4	Various
Clean Force	150,000	Dynagas	Hyundai	Jan-08	Marshall Is.	S	GTT	4	Various
Clean Ocean	155,900	Dynagas	Hyundai	Mar-14	Marshall Is.	DFDE	GTT	4	Various
Clean Planet	155,900	Dynagas	Hyundai	Mar-14	Marshall Is.	DFDE	GTT	4	Various
Clean Vision	160,000	Dynagas	Hyundai	Jun-15	Marshall Is.	DFDE	GTT	4	Various
Cool Explorer	160,000	Thenamaris	Samsung	Oct-13	Bermuda	DFDE	GTT	4	Various
Cool Runner	160,000	Thenamaris	Samsung	May-14	Bermuda	DFDE	GTT	4	Various
Cool Voyager	160,000	Thenamaris	Samsung	Oct-13	Bermuda	DFDE	GTT	4	Various
Corcovado LNG	160,106	TMSC Gas	Daewoo	Jun-14	Malta	TFDE	GTT	4	Various
Creole Spirit	174,000	Teekay	Daewoo	Jan-16	Bahamas	MEGI-DF	GTT	4	Cheniere
Cubal	160,400	Mitsui/NYK/Teekay	Samsung	Jan-12	Bahamas	DFDE	GTT	4	Various
Cygnus Passage	145,400	Cygnus LNG	Mitsubishi	Feb-09	Panama	S	Moss	4	Various
Dapeng Moon	147,000	China Ships	Hudong	Jul-09	China	S	GTT	4	Various
Dapeng Star	147,000	China Ships	Hudong	Nov-09	China	S	GTT	4	Various
Dapeng Sun	147,000	China Ships	Hudong	Jul-07	China	S	GTT	4	Woodside Energy
Diamond Gas Orchid	165,000	MOL-Jera	MHI-Nagasaki	Aug-18	Japan	S-gas	Moss	4	US-Japan
Diamond Gas Rose	165,000	MOL-Jera	MHI-Nagasaki	Aug-18	Japan	S-gas	Moss	4	US-Japan
Disha	136,000	Petronet LNG Ltd.	Daewoo	Jan-04	Malta	S	GTT	4	Qatargas
Doha	137,350	J4 Consortium	Mitsubishi Nagasaki	Jun-99	Japan	S	Moss	5	Qatargas
Duhail	210,100	ProNav	Daewoo	Jan-08	Germany	DRL	GTT	4	Various
Dukhan	135,000	J4 Consortium	Mitsui Chiba	Oct-04	Japan	S	Moss	4	Qatargas
Dwiputra	127,385	Humpuss Consortium	Mitsubishi Nagasaki	Mar-94	Bahamas	S	Moss	4	Pertamina
Ebisu	147,547	Golar LNG	Kawasaki	Sep-08	Bahamas	S	Moss	4	Various
Eduard Toll	172,000	Teekay-CLNG	Daewoo	Dec-17	Bahamas	MEGI-DF	GTT	4	Various
Ejnan	145,000	4J	Samsung	Jan-07	Bahamas	S	GTT		RasGas
Ekaputra	136,400	Humpuss Consortium	Mitsubishi Nagasaki	Jan-90	Liberia	S	Moss	5	Pertamina
Energy Advance	145,000	Tokyo LNG Tankers	Kawasaki Sakaide	Mar-05	Japan	S	Moss	4	Darwin



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Energy Atlantic	159,924	Alpha	STX Jinhae	Sep-15	Malta	DFDE	GTT	4	Various
Energy Confidence	155,000	Tokyo LNG Tankers	Kawasaki	Apr-09	Panama	S	Moss	4	Various
Energy Frontier	147,600	Tokyo LNG Tankers	Kawasaki Sakaide	Sep-03	Japan	S	Moss	4	Darwin
Energy Glory	165,000	Tokyo LNG Tankers	JMU	Sept-18	Japan	S	Moss	4	Various
Energy Horizon	177,000	Tokyo LNG Tankers	Kawasaki	Jul-11	Japan	S	Moss	4	Pluto LNG
Energy Liberty	165 000	MOL	JMU Tsu	Oct-18	Japan	TFDE	IHI-SPB	4	Various
Energy Navigator	147,000	Tokyo LNG Tankers	Kawasaki Sakaide	May-08	Japan	S	Moss	4	Various
Energy Progress	145,000	MOL	Kawasaki	Nov-06	Japan	S	Moss	4	Bayu Undan LNG
Enshu Maru	165,257	K Line	Kawasaki	June-18	Japan	S	Moss	4	Various
Esshu Maru	162,000	K Line-Transpacific	Kawasaki Sakaide	Dec-14	Panama	S	Moss	4	Australia-Japan
Excalibur	138,200	Exmar/ Excelerate	Daewoo	Oct-02	Belgium	S	GTT	4	Various
Excel	138,106	Exmar/ MOL	Daewoo	Sep-03	Belgium	S	GTT	4	Various
Excelerate	138,000	Exmar/Excelerate	Daewoo	Oct-06	Belgium	S	GTT	4	Various
Excellence	138,000	GKFF Ltd.	Daewoo	May-05	Belgium	S	GTT	4	Excelerate Energy
Excelsior	138,000	Exmar	Daewoo	Jan-05	Belgium	S	GTT	4	Various
Exemplar	150,900	Excelerate	Daewoo	Jun-10	Belgium	S	GTT	4	Various
Expedient	151,000	Excelerate	Daewoo	Nov-09	Belgium	S	GTT	4	Various
Experience RV	174,000	Exmar/Excelerate	Daewoo	Jul-14	Marshall Is.	DFDE	GTT		Various
Explorer	150,900	Exmar/Excelerate	Daewoo	Mar-08	Belgium	S	GTT	4	Excelerate
Express	151,000	Exmar/Excelerate	Daewoo	May-09	Belgium	S	GTT	4	Various
Exquisite	150,900	Excelerate	Daewoo	Sep-09	Belgium	S	GTT	4	Various
Fedor Litke	172,636	Dynagas	Daewoo	Nov-17	Cyprus	DFDE	GTT	4	Various
Flex Endeavour	173,400	Flex LNG	Daewoo	Jan-18	Marshall Is.	MEGI-DF	GTT	4	Various
Flex Enterprise	173,400	Flex LNG	Daewoo	Jan-18	Marshall Is.	MEGI-DF	GTT	4	Various
Flex Rainbow	174,000	Flex LNG	Samsung	July-18	Marshall Is.	MEGI-DF	GTT	4	Various
Flex Ranger	174,000	Flex LNG	Samsung	April-18	Marshall Is.	MEGI-DF	GTT	4	Various
Fraiha	210,100	J5 Consortium	Daewoo	Sep-08	Marshall Is.	DRL	GTT	4	Qatargas
FSRU Independence	170,000	Hoegh	Hyundai	Feb-14	NIS	DFDE	GTT	4	Various
FSRU Lampung	170,000	Hoegh	Hyundai	May-14	Indonesia	DFDE	GTT	4	Various
Fuji LNG	147,895	TMSC Gas	Kawasaki	Jun-04	Malta	S	Moss	4	Various
Fuwairit	138,000	Peninsular LNG	Samsung	Jan-04	Bahamas	S	GTT	4	RasGas II
Galea	134,425	Shell Shipping	Mitsubishi Nagasaki	Oct-02	Singapore	S	Moss	5	Shell
Galicia Spirit	140,620	Teekay LNG Partners	Daewoo	Jul-04	Liberia	S	GTT	4	Engas
Gaselys	153,500	GdF/NYK	Atlantique	Mar-07	France	DFDE	CS 1	4	Engas
Gallina	134,425	Shell Shipping	Mitsubishi Nagasaki	Oct-02	Singapore	S	Moss	5	Shell
GasLog Chelsea	153,000	GasLog	Hanjin Korea	Dec-09	Panama	TFDE	GTT	4	Various
Gaslog Geneva	174,000	GasLog	Samsung	Sept-16	Bermuda	TFDE	GTT	4	Shell charter
Gaslog Genoa	174,000	GasLog	Samsung	June-18	Bermuda	TFDE	GTT	4	Various
Gaslog Gibraltar	174,000	GasLog	Samsung	Oct-16	Bermuda	TFDE	GTT	4	Shell charter
Gaslog Glasgow	174,000	GasLog	Samsung	Jun-16	Bermuda	TFDE	GTT	4	Shell charter
Gaslog Greece	174,000	GasLog	Samsung	Mar-16	Bermuda	TFDE	GTT	4	Shell charter
GasLog Hongkong	174,000	GasLog	Hyundai	June-18	Bermuda	TFDE	GTT	4	Various
GasLog Houston	174,000	GasLog	Hyundai	Jan-18	Bermuda	TFDE	GTT	4	Various
GasLog Salem	165,000	GasLog	Samsung	Apr-15	Liberia	TFDE	GTT	4	Various
GasLog Santiago	155,000	GasLog	Samsung	Mar-13	Liberia	TFDE	GTT	4	Various
GasLog Saratoga	155,000	GasLog	Samsung	Dec-14	Bermuda	TFDE	GTT	4	Various
Gaslog Savannah	155,000	GasLog	Samsung	May-10	Bermuda	DFDE	GTT	4	Various
GasLog Seattle	155,000	GasLog	Samsung	Oct-13	Bermuda	TFDE	GTT	4	Various
GasLog Shanghai	155,000	GasLog	Samsung	Jan-13	Liberia	TFDE	GTT	4	Various
Gaslog Singapore	155,000	GasLog	Samsung	Jul-10	Bermuda	DFDE	GTT	4	Various
Gaslog Skagen	155,000	GasLog	Samsung	Oct-13	Bermuda	DFDE	GTT	4	Various
Gaslog Sydney	155,000	GasLog	Samsung	May-13	Bermuda	DFDE	GTT	4	Various
GDF-Suez Global Energy	74,000	Gaz de France	Chantiers	Dec-06	France	DFDE	CS1	4	Sonatrach
GDF-Suez Point Fortin	154,200	LNG Japan	Imabari/Koyo	Feb-10	Panama	DFDE	GTT	4	Various
Gemmata	138,100	Shell Shipping	Mitsubishi Nagasaki	Mar-04	Singapore	S	Moss	5	Shell
Georgiy Brusilov	172,000	Dynagas	Daewoo	June-18	Cyprus	DFDE	GTT	4	Yamal LNG
Ghasha	137,510	National Gas Shipping	Mitsui	Jun-95	Liberia	S	Moss	5	ADGAS
Gigira Laitebo	177,000	MOL-Itochu	Hyundai	Feb-09	Panama	DFDE	GTT	4	Various
Golar Arctic	140,645	Golar LNG	Daewoo	Dec-03	Marshall Is.	S	GTT	4	Shell Spot
Golar Bear	160,000	Golar	Samsung	Mar-14	Bermuda	DFDE	GTT	4	Various
Golar Celsius	160,000	Golar LNG	Samsung	Sep-13	Bermuda	DFDE	GTT	4	Various
Golar Crystal	160,000	Golar LNG	Samsung	Oct-13	Bermuda	DFDE	GTT	4	Various
Golar Eskimo (FSRU)	160,000	Golar LNG	Samsung	Jan-15	Bermuda	DFDE	GTT	4	Various
Golar Freeze	125,850	Golar LNG	HDW	Feb-77	UK	S	Moss	5	Various
Golar Glacier	162,000	Golar LNG	Hyundai	Sep-14	Marshall Is.	DFDE	GTT	4	Various
Golar Grand	145,880	Golar LNG	Daewoo	2006	IoM		GTT	4	Various
Golar Ice	160,000	Golar LNG	Samsung	Feb-15	Bermuda	DFDE	GTT	4	Various
Golar Igloo (FSRU)	160,000	Golar LNG	Samsung	Oct-13	Bermuda	DFDE	GTT	4	Various
Golar Kelvin	160,000	Golar LNG	Samsung	Jan-15	Bermuda	DFDE	GTT	4	Various
Golar Maria	145,950	Golar LNG	Daewoo	2006	Marshall Is.		GTT	4	Various
Golar Mazo	135,225	Golar LNG/CPP	Mitsubishi	Jan-00	Liberia	S	Moss	5	Pertamina
Golar Penguin	160,000	Golar LNG	Samsung	Mar-14	Marshall Is.	DFDE	GTT	4	Various
Golar Seal	160,000	Golar LNG	Samsung	Aug-13	Bermuda	DFDE	GTT	4	Various
Golar Singapore (FSRU)	160,000	Golar LNG	Samsung	June-15	Bermuda	DFDE	GTT	4	Various



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Anadarko Mozambique Area 1



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Senior Advisor to the CEO, **Tellurian Inc.**



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Golar Snow	160,000	Golar LNG	Samsung	Jan-15	Bermuda	DFDE	GTT	4	Various
Golar Tundra (FSRU)	160,000	Golar LNG	Samsung	Dec-15	Bermuda	DFDE	GTT	4	Various
Golar Viking	140,000	Golar LNG	Hyundai	Jan-05	Marshall Is.	S	Moss	4	Various
Golar Winter	138,250	Golar LNG	Daewoo	Apr-04	Marshall Is.	S	GTT	4	Petrobras
Grace Acacia	150,000	Algaet Shipping	Hyundai	Jan-07	Japan	S	GTT	4	Various
Grace Barleria	150,000	Swallowtail Ship	Hyundai	Oct-07	Japan	S	GTT	4	Various
Grace Cosmos	150,000	AGH Shipping	Hyundai	Mar-08	Japan	S	GTT	4	Various
Grace Dahlia	177,000	Tokyo Gas	Kawasaki	Oct-13	Japan	S	Moss	4	Various
Gracilis	138,830	Golar LNG	Hyundai	Jan-05	Marshall Is.	S	GTT	4	Shell BG
Granatina	140,645	Shell Shipping	Daewoo	Dec-03	Singapore	S	GTT	4	Shell
Grand Aniva	147,200	Sovcomflot/NYK	Mitsubishi	Jan-08	Japan	S	Moss	4	Various
Grand Elena	147,200	Sovcomflot/NYK	Mitsubishi	Oct-07	Japan	S	Moss	4	Various
Grand Mereya	147,200	Primorsk/MOL/K Line	Chiba	May-08	Japan	S	Moss	4	Sakhalin II
Hanjin Muscat	138,200	Hanjin Shipping	Hanjin	Jul-99	Panama	S	GTT	4	Oman Gas
Hanjin Pyeong Taek	130,600	Hanjin Shipping	Hanjin	Sep-95	Panama	S	GTT	4	Pertamina
Hanjin Ras Laffan	138,214	Hanjin Shipping	Hanjin	Jul-00	Panama	S	GTT	4	QatarGas
Hanjin Sur	138,333	Hanjin Shipping	Hanjin	Jan-00	Panama	S	GTT	4	Oman Gas
Hispania Spirit	140,500	Teekay LNG Partners	Daewoo	Sep-02	Spain	S	GTT	4	Atlantic LNG
Hoegh Esperanza FSRU	170,000	Hoegh	Hyundai	April-18	Norway	DFDE	GTT	4	Various
Hoegh Gallant FSRU	170,050	Hoegh LNG	Hyundai	May-14	Marshall Is.	DFDE	GTT	4	chartered
Hoegh Giant FSRU	170,050	Hoegh LNG	Hyundai	Jan-18	Marshall Is.	DFDE	GTT	4	various
Hoegh Grace FSRU	170,050	Hoegh LNG	Hyundai	May-15	Marshall Is.	DFDE	GTT	4	various
Hyundai Aquapia	135,000	Hyundai MM	Hyundai	Mar-00	Panama	S	Moss	4	Oman Gas
Hyundai	135,000	Hyundai MM	Hyundai	Jan-00	Panama	S	Moss	4	RasGas
Hyundai Ecopia	145,000	Hyundai	Hyundai	Nov-08	Panama	S	GTT	4	Various
Hyundai Greenpia	125,000	Hyundai MM	Hyundai	Nov-96	Panama	S	Moss	4	Pertamina
Hyundai Oceanpia	135,000	Hyundai MM	Hyundai	Jul-00	Panama	S	Moss	4	Oman Gas
Hyundai Technopia	135,000	Hyundai MM	Hyundai	Jul-00	Panama	S	Moss	4	RasGas
Hyundai Utopia	125,182	Hyundai MM	Hyundai	Jun-94	Panama	S	Moss	4	Pertamina
Iberica Knutsen	138,000	Knutsen OAS	Daewoo	Aug-06	Norway	S	GT 96	4	Gas Natural
Ibra LNG	147,100	Oman Gas	Samsung	Jun-06	Panama	S	GTT	4	Oman LNG
Ibri LNG	145,000	Oman Gas	Mitsubishi	Jul-06	Panama	S	GTT	4	Oman LNG
Ish	137,540	National Gas Shipping	Mitsubishi Nagasaki	Nov-95	Liberia	S	Moss	5	ADGAS
K Acacia	138,017	Korea Line	Daewoo	Jan-00	Panama	S	GTT	4	Oman Gas
K Freesia	135,256	Korea Line	Daewoo	Jun-00	Panama	S	GTT	4	RasGas
Kinisis	173,400	K-Line	Daewoo	Jan-18	Liberia	MEGI-DF	GTT	4	Various
K Jasmine	145,700	Korea Line	Daewoo	Mar-08	Panama	S	GTT	4	Kogas offtake
K Mugungwha	152,000	K Line	Daewoo	Nov-08	Panama	S	GTT	4	Various
Kita LNG	160,106	TMSC Gas	Daewoo	Jun-14	Malta	TFDE	GTT	4	Various
Kotawaka Maru	125,200	J3 Consortium	Kawasaki Sakaide	Jan-84	Japan	S	Moss	5	Darwin
Kumul	172,000	MOL	Hudong	May-16	Hong Kong	DRL	GTT	4	PNG-Asia
Lalla Fatma N'Soumer	145,000	Algeria Nippon Gas	Kawasaki Sakaide	Dec-04	Bahamas	S	Moss	4	Various
Lijmilya	261,700	QGTC	Daewoo	Sep-08	Marshall Is.	DRL	GTT	5	Various
LNG Abalamabie	174,900	Bonny Gas	Samsung	Nov-16	Bermuda	DFDE	GTT	4	Nigeria LNG
LNG Abuja	126,530	Bonny Gas Transport	GD Quincy	Sep-80	Bahamas	S	Moss	5	Nigeria LNG
LNG Abuja II	174,900	Bonny Gas	Samsung	Oct 16	Bermuda	DFDE	GTT	4	Nigeria LNG
LNG Adamawa	141,000	Bonny Gas Transport	Hyundai	Jun-05	Bermuda	S	Moss	4	Various
LNG Akwa Ibom	141,000	Bonny Gas Transport	Hyundai	Nov-04	Bermuda	S	Moss	4	Various
LNG Aquarius	126,300	MOL/LNG Japan	GD Quincy	Jun-77	Marshall Is.	S	Moss	5	Various
LNG Barka	153,000	NYK	Kawasaki	Jan-09	Bahamas	S	Moss	4	Various
LNG Bayelsa	137,500	Bonny Gas Transport	Hyundai	Feb-03	Bermuda	S	Moss	4	Nigeria LNG
LNG Benue	145,700	BW Gas	Daewoo	Mar-06	Bermuda	S	GTT	4	Nigeria LNG
LNG Bonny	177,000	Bonny Gas Transport	Hyundai	Oct-15	Bermuda	DFDE	GTT	4	Nigeria LNG
LNG Borno	149,600	NYK Line	Samsung	Aug-07	Japan	S	GTT	4	Nigeria LNG
LNG Capricorn	126,300	MOL/LNG Japan	GD Quincy	Jun-78	Marshall Is.	S	Moss	5	Pertamina
LNG Cross River	141,000	Bonny Gas Transport	Hyundai	Sep-05	Bermuda	S	Moss	4	Various
LNG Dream	145,000	Osaka Gas	Kawasaki	Sep-06	Japan	S	Moss	4	Woodside Energy
LNG Ebisu	147,500	MOL	Kawasaki	Sep-08	Bahamas	S	Moss	4	Various
LNG Edo	126,530	Bonny Gas Transport	GD Quincy	May-80	Bahamas	S	Moss	5	Nigeria LNG
LNG Enugu	145,000	BW Gas	Daewoo	Oct-05	Bermuda	S	GTT	4	Nigeria LNG
LNG Fimina	175,000	Bonny Gas Transport	Samsung	Oct-15	Bermuda	DFDE	GTT	4	Nigeria LNG
LNG Flora	127,700	J3 Consortium	Kawasaki Sakaide	Mar-93	Japan	S	Moss	4	Pertamina
LNG Fukurokuju	165,000	MOL	Kawasaki	June-15	Japan	S	Moss	4	Various
LNG Gemini	126,300	MOL/LNG Japan	GD Quincy	Sep-78	Marshall Is.	S	Moss	5	Pertamina
LNG Imo	148,300	BW Gas	Daewoo	Jun-08	Bermuda	S	GTT	4	Nigeria LNG
LNG Jamal	135,330	Osaka Gas/J3 Consortium	Mitsubishi Nagasaki	Oct-00	Japan	S	Moss	5	Oman Gas
LNG Juno	177,300	MOL-Osaka	Mitsubishi	Oct-18	Marshall Is.	DFDE	Moss	4	Freeport LNG/Various
LNG Jupiter	145,000	NYK Line	Kawasaki	Jul-09	Bahamas	S	Moss	4	Various
LNG Jurojin	155,300	MOL	MHI Nagasaki	Nov-15	Japan	S	KM	4	Various
LNG Kano	148,471	BW Gas	Daewoo	Jan-07	Bermuda	S	GTT	4	NLNG
LNG Lagos	177,000	Bonny Gas	Hyundai	Oct-15	Bermuda	DFDE	GTT	4	Nigeria LNG
LNG Leo	126,400	MOL/LNG Japan	GD Quincy	Dec-78	Marshall Is.	S	Moss	5	Pertamina
LNG Lerici	65,000	Exmar	Italcantieri Sestri	Mar-98	Italy	S	GTT	4	Sonatrach
LNG Libra	126,400	Hoegh LNG	GD Quincy	Apr-79	Marshall Is.	S	Moss	5	Various

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LNG Lokoja	148,300	BW Gas	Daewoo	Dec-06	Bermuda	S	GTT	4	Nigeria LNG
LNG Mars	155,000	MOL/Osaka Gas	Mitsubishi	Oct-16	Marshall Is.	S	Moss	5	Various
LNG Ogun	148,300	NYK Line	Samsung	Aug-07	Japan	S	GTT	4	Nigeria LNG
LNG Ondo	148,300	BW Gas	Daewoo	Sep-07	Bermuda	S	GTT	4	Nigeria LNG
LNG Oyo	140,500	BW Gas	Daewoo	Dec-05	Bermuda	S	GTT	4	Nigeria LNG
LNG Pioneer	138,000	MOL	Daewoo	Jul-05	Bahamas	S	GTT	4	Idku
LNG Port Harcourt	175,000	Bonny Gas	Samsung	Oct-15	Bermuda	DFDE	GTT	4	Nigeria LNG
LNG Portovenere	65,000	Exmar	Italcantieri Sestri	Jun-96	Italy	S	GTT	4	Sonatrach
LNG River Niger	141,000	Bonny Gas Transport	Hyundai	May-06	Bermuda	S	Moss	4	Various
LNG River Orashi	145,910	BW Gas	Daewoo	Nov-04	Bermuda	S	GTT	4	Nigeria LNG
LNG Rivers	137,231	Bonny Gas Transport	Hyundai	Jun-02	Bermuda	S	Moss	4	Nigeria LNG
LNG 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	GTT	4	Various
Lusail	138,000	Peninsular LNG	Samsung	May-05	Bahamas	S	GTT	4	Qatar
Macoma	173,400	Teekay	Daewoo	Oct-17	Bahamas	DFDE	GTT	4	Various
Madrid Spirit	138,000	Teekay LNG Partners	IZAR Puerto Real	Jan-05	Spain	S	GTT	4	Engas
Magdala	173,400	Teekay	Daewoo	Feb-18	Bahamas	DFDE	GTT	4	Various
Magellan Spirit	165,500	Teekay LNG Partners	Samsung	Sep-08	Denmark	DFDE	GTT	4	Various
Malanje	160,400	Mitsui/NYK/Teekay	Samsung	Jul-11	Bahamas	DFDE	GTT	4	Various
Maran Gas Achilles	174,000	Maran	Hyundai Samho	Feb-16	Greece	DFDE	GTT	4	Various
Maran Gas Agamemnon	174,000	Maran	Hyundai Samho	May-16	Greece	DFDE	GTT	4	Various
Maran Gas Alexandria	161,870	Maran	Hyundai Samho	Sep-15	Greece	DFDE	GTT	4	Various
Maran Gas Amphipolis	173,400	Maran	Daewoo	Aug-16	Greece	DFDE	GTT	4	Various
Maran Gas Apollonia	161,870	Maran	Daewoo	Jan-14	Greece	DFDE	GTT	4	Various
Maran Gas Asclepius	145,000	Kristen Navigation	Daewoo	Jul-05	Bermuda	S	GTT	4	Qatar
Maran Gas Coronis	145,700	Maran	Daewoo	Sep-07	Greece	S	GTT	4	Rasgas II
Maran Gas Delphi	159,800	Maran	Daewoo	Feb-14	Greece	DFDE	GTT	4	Various
Maran Gas Efessos	159,800	Maran	Daewoo	Jun-14	Greece	DFDE	GTT	4	Various
Maran Gas Hector	174,000	Maran	Hyundai Samho	Nov-16	Greece	DFDE	GTT	4	Various
Maran Gas Lindos	159,800	Maran	Daewoo	Jun-15	Greece	DFDE	GTT	4	Various
Maran Gas Mystras	155,900	Maran Gas	Daewoo	May-15	Greece	DFDE	GTT	4	Various
Maran Gas Olympias	174,500	Maran	DSME	Feb-17	Greece	DFDE	GTT	4	Various
Maran Gas Pericles	174,000	Maran	Hyundai Samho	June-16	Greece	DFDE	GTT	4	Various
Maran Gas Posidonia	161,870	Maran	Daewoo	May-14	Greece	DFDE	GTT	4	Various
Maran Gas Roxana	173,400	Maran	Daewoo	Jan-17	Greece	DFDE	GTT	4	Various
Maran Gas Sparta	161,870	Maran	Hyundai Samho	April-15	Greece	DFDE	GTT	4	Various
Maran Gas Spetses	174,000	Maran	Daewoo	Feb-18	Greece	DFDE	GTT	4	Various
Maran Gas Troy	155,900	Maran Gas	Daewoo	May-15	Greece	DFDE	GTT	4	various
Maran Gas Ulysses	174,000	Maran	Hyundai Samho	Jan-17	Greece	DFDE	GTT	4	Various
Maria Energy	174,000	Tsakos	Hyundai	Mar-15	Marshall Is.	TFDE	GTT	4	Various
Marib Spirit	165,000	Teekay LNG	Samsung	May-08	Marshall Is.	DFDE	GTT	4	Various
Marvel Crane	177,000	NYK-Mitsui	Mitsubishi	Mar-19	Singapore	S	Moss	4	US/Various
Marvel Eagle	155,000	MOL-Osaka	Kawasaki	Sept-18	Marshall Is.	S	Moss	4	Cameron LNG/Various
Marvel Falcon	174,000	NYK-Mitsui	Samsung	Nov-18	Singapore	DF	GTT	4	Cameron LNG/Various
Marvel Hawk	174,000	NYK-Mitsui	Samsung	Dec-18	Singapore	DF	GTT	4	Cameron LNG/Various
Matthew	126,540	Suez LNG Shiping	Newport News	Jun-79	Bahamas	S	GTT	6	Atlantic LNG
Megara	173,000	Teekay	Daewoo	Oct-18	Bahama	MEGI-DF	GTT	4	Various
Mekaines	266,000	Naklilat	Samsung	Mar-09	Liberia	DRL	GTT	4	Qatar-Atlantic Basin
Meridian Spirit	165,500	Teekay LNG	Samsung	Jan-10	Denmark	DFDE	GTT	4	Various
Mesaimeer	210,100	Naklilat	Hyundai	Mar-09	Liberia	DRL	GTT	4	Qatar-Atlantic Basin
Methane Alison Victoria	145,000	GasLog	Samsung	Aug-07	Bermuda	S	GTT	4	Eq.Guinea LNG
Methane Becki Anne	170,000	GasLog	Samsung	Sep-10	Bermuda	TFDE	GTT	4	Various
Methane Heather Sally	145,000	GasLog	Samsung	Jul-07	Bermuda	S	GTT	4	Eq.Guinea LNG
Methane Jane Elizabeth	145,000	GasLog	Samsung	Jun-06	Bermuda	TFDE	GTT	4	Engas
Methane Julia Louise	170,000	GasLog	Samsung	Dec-09	Bermuda	TFDE	GTT	4	Various
Methane Kari Elin	138,200	Shell	Samsung	Jun-04	Bermuda	S	GTT	4	Various
Methane Lake Charles	145,000	Shell	Samsung	Feb-07	Bermuda	S	GTT	4	Marathon Oil
Methane Lydon Volney	145,000	Shell	Samsung	Aug-06	Bermuda	S	GTT	4	Engas
Methane Mickie Harper	170,000	Shell-GasLog	Samsung	Nov-10	Bermuda	TFDE	GTT	4	Various
Methane Nile Eagle	145,000	Shell-GasLog	Samsung	Dec-07	Bermuda	S	GTT	4	Engas
Methane Patricia Camila	170,000	Shell-GasLog	Samsung	Oct-10	Bermuda	TFDE	GTT	4	Various
Methane Princess	138,159	Golar LNG	Daewoo	2003	UK	S	GTT	4	Spot BG
Methane Rita Andre	145,000	GasLog	Samsung	Mar-06	Bermuda	S	GTT	4	Engas
Methane Shirley Elizabeth	145,000	GasLog	Samsung	Apr-07	Bermuda	S	GTT	4	Marathon Oil
Methane Sprit	165,000	Teekay LNG	Samsung	Mar-08	Singapore	DFDE	GTT	4	Various
Milaha Qatar	145,000	Milaha	Samsung	Apr-06	Denmark	S	GTT	4	Qatar
Milaha Ras Laffan	138,270	Milaha	Samsung	Mar-04	Denmark	S	GTT	4	RasGas II
Min Lu	147,000	China Ships	Hudong	Aug-09	China	S	GTT	4	Various
Min Rong	147,000	China LNG Ships	Hudong	Feb-09	Hong Kong	S	GTT	4	Australia-China



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Mourad Didouche	126,130	Hyproc Shipping	Atlantique	Jul-80	Algeria	S	GTT	5	Sonatrach
Mozah	266,000	QGTC	Samsung	Aug-08	Qatar	DRL	GTT	5	Qatargas II
Mraweh	137,000	National Gas Shipping	Kvaerner-Masa	Jun-96	Liberia	S	Moss	4	ADGAS
Mubaraz	137,000	National Gas Shipping	Kvaerner-Masa	Jan-96	Liberia	S	Moss	4	Various
Muraq	210,100	J5-K Line	Daewoo	May-08	Marshall Is.	DRL	GTT	4	Qatar-Atlantic Basin
Murex	173,400	Teekay	Daewoo	Oct-17	Bahamas	DFDE	GTT	4	Various
Murwab	210,100	J5 Consortium	Daewoo	May-08	Marshall Is.	DRL	GTT	4	Qatargas
Muscat LNG	149,170	Oman Gas/MOL	Kawasaki Sakaide	Mar-04	Japan	S	Moss	4	Oman Gas
Myrina	173,000	Teekay	Daewoo	Sept-18	Bahamas	MEGI-DF	GTT	4	Various
Neo Energy	149,700	Tsakos	Hyundai	Feb-07	Liberia	S	GTT	4	Various
Neptune	145,000	Hoegh LNG/MOL	Samsung	Dec-09	Liberia	DFDE	GTT	4	Various
Nikolay Yevgenov	172,600	Teekay	Daewoo	Oct-18	Bahamas	MEGI-DF	GTT	4	Various
Nikolay Zubkov	172,600	Dynagas	Daewoo	Nov-18	Cyprus	DFDE	GTT	4	Yamal LNG
Nizwah LNG	145,000	Oryx LNG Carriers	Kawasaki Sakaide	Dec-05	Japan	S	Moss	4	Oman Gas
Northwest Sanderling	127,525	Australia LNG	Mitsubishi Nagasaki	Jun-89	Australia	S	Moss	4	NWS
Northwest Sandpiper	127,500	Australia LNG	Mitsui Chiba	Feb-93	Australia	S	Moss	4	NWS
Northwest Seaeagle	127,450	Australia LNG	Mitsubishi Nagasaki	Nov-92	Bermuda	S	Moss	4	NWS
Northwest Shearwater	127,500	Australia LNG	Kawasaki Sakaide	Sep-91	Bermuda	S	Moss	4	NWS
Northwest Snipe	127,747	Australia LNG	Mitsui Chiba	Sep-90	Australia	S	Moss	4	NWS
Northwest Stormpetrel	127,600	Australia LNG	Mitsubishi Nagasaki	Dec-94	Australia	S	Moss	4	NWS
Northwest Swallow	127,708	J3 Consortium	Mitsui Chiba	Nov-89	Japan	S	Moss	4	NWS
Northwest Swan	138,000	Australia LNG	Daewoo	Mar-04	Australia	S	GTT	4	NWS
Northwest Swift	127,590	J3 Consortium	Mitsubishi Nagasaki	Sep-89	Japan	S	Moss	4	NWS
Noshu Maru	180,000	MOL-Jera	MHI-Nagasaki	Feb-19	Japan	S-gas	Moss	4	US-Japan
Oak Spirit	173,400	Teekay	Daewoo	Jan-16	Bahamas	MEGI-DF	GTT	4	Cheniere
Ob River	150,000	Lance Shipping	Hyundai	Oct-07	Marshall Is.	S	GTT	4	Various
Oceanic Breeze	155,300	K-Line	Mitsubishi-Nagasaki	June-18	Japan	S	Moss	4	Darwin-Japan
Onaiza	210,100	Nakilat	Daewoo	Apr-09	Liberia	DRL	GTT	4	Qatar-Atlantic Basin
Ougarta	171,866	Hyproc Shipping	Hyundai	Mar-17	Algeria	DFDE	GTT	4	Sonatrach
Pacific Arcadia	147,200	NYK Line	MHI	Oct-14	Bahamas	S	KM	4	Various
Pacific Breeze	182,000	K Line	Kawasaki	Mar-18	Marshall Is.	DFDE	Moss	4	Ichthys LNG
Pacific Enlighten	145,000	LNG MT	Mitsubishi	Mar-09	Japan	S	Moss	4	Various
Pacific Eurus	137,000	LNG Marine Transport	Mitsubishi Nagasaki	Mar-06	Bahamas	S	Moss	4	Darwin
Pacific Mimosa	155,300	NYK Line	MHI	Nov-17	Bahamas	S	Moss	4	Australia-Japan
Pacific Notus	137,006	Pacific LNG Shipping	Mitsubishi Nagasaki	Sep-03	Bahamas	S	Moss	5	Darwin
Palu LNG	160,106	TMSC Gas	Daewoo	Jun-14	Malta	TFDE	GTT	4	Various
Pan Americas	174,000	Teekay	Hudong	Mar-18	Hong Kong	TFDE	GTT	4	US-Asia
Pan Asia	174,000	Teekay	Hudong-Zhonghua	July-17	Bahamas	TFDE	GTT	4	Cheniere
Pan Europe	174,000	Teekay	Hudong	Sept-18	Hong Kong	TFDE	GTT	4	US-global
Papua	171,800	MOL-China	Hudong	Jan-15	Hong Kong	DFDE	SSD	4	PNG LNG
Patris	173,400	K-Line	Daewoo	Feb-18	Liberia	MEGI-DF	GTT	4	Various
Polar Eagle	89,880	Polar LNG	IHI Chita	Jun-93	Liberia	S	IHI SPB	4	ConocoPhillips/Marathon
Prachi	173,000	NYK-SCI	Hyundai	Nov-16	Singapore	TFDE	GTT	4	Petronet
Provalys	153,500	Gaz de France	Chantiers	Nov-06	France	DFDE	CS1	4	ELNG
Pskov	170,200	SovComFlot	STX	Mar-14	Liberia	DFDE	GTT	4	Various
Puteri Delima	130,400	MISC	Atlantique	Jan-95	Malaysia	S	GTT	4	Petronas
Puteri Delima Satu	137,100	MISC	Mitsui Chiba	Apr-02	Malaysia	S	GTT	4	Petronas
Puteri Firuz	130,400	MISC	Atlantique	May-97	Malaysia	S	GTT	4	Petronas
Puteri Firuz Satu	137,100	MISC	Mitsubishi Nagasaki	Sep-04	Malaysia	S	GTT	4	Petronas
Puteri Intan	130,400	MISC	Atlantique	Aug-94	Malaysia	S	GTT	4	Petronas
Puteri Intan Satu	137,100	MISC	Mitsubishi Nagasaki	Dec-01	Malaysia	S	GTT	4	Petronas
Puteri Mutiera Satu	137,100	MISC	Mitsui Chiba	Apr-05	Malaysia	S	GTT	4	Petronas
Puteri Nilam	130,400	MISC	Atlantique	Jun-95	Malaysia	S	GTT	4	Petronas
Puteri Nilam Satu	137,100	MISC	Mitsubishi Nagasaki	Sep-03	Malaysia	S	GTT	4	Petronas
Puteri Zamrud	130,400	MISC	Atlantique	May-96	Malaysia	S	GTT	4	Petronas
Puteri Zamrud Satu	137,100	MISC	Mitsui Chiba	Apr-87	Malaysia	S	GTT	4	Atlantic LNG
Raahi	136,000	Petronet LNG Ltd	Daewoo	Dec-04	Malta	S	GTT	4	Qatargas
Ramdane Abane	126,130	Hyproc Shipping	Atlantique	Jul-81	Algeria	S	GTT	5	Sonatrach
Rasheeda	266,000	QGTC	Samsung	Jun-10	Liberia	DRL	GTT		Various
Ribera del Duero Knutsen	173,400	Knutsen	Daewoo	Nov-10	Nor-NIS	DFDE	GTT	4	Various
Rioja Knutsen	176,300	Knutsen	Daewoo	Dec-16	Nor-NIS	DFDE	GTT	4	Various
Rudolf Samoylovich	172,652	Teekay-CLNG	Daewoo	Oct-18	Bahamas	MEGI-DF	GTT	4	Various
Salalah LNG	147,000	Oman Gas/MOL	Samsung	Dec-05	Japan	S	GTT	4	Oman
SCF Polar	71,500	Sovcomflot	Kockums	Aug-69	Liberia	S	GTT	6	Sonatrach
Sean Spirit	174,000	Teekay	Hyundai Samho	Feb-19	Bahama	MEGI-DF	GTT	4	Various
Seishu Maru	162,000	K Line-Transpacific	Kawasaki Sakaide	Jan-15	Panama	S	Moss	4	Australia-Japan
Seri Alam	138,000	MISC	Samsung	Oct-05	Malaysia	S	GTT	4	Yemen LNG
Seri Amanah	145,000	MISC	Samsung	Mar-06	Malaysia	S	GTT	4	Yemen LNG
Seri Anggun	145,000	MISC	Samsung	Nov-06	Malaysia	S	GTT	4	Yemen LNG
Seri Angkasa	145,000	MISC	Samsung	Feb-07	Malaysia	S	GTT	4	Petronas
Seri Ayu	145,000	MISC	Samsung	Oct-07	Malaysia	S	GTT	4	Various
Seri Bakti	152,300	MISC	Mitsubishi	Mar-07	Malaysia	S	GTT	4	Petronas
Seri Balhaf	152,000	MISC	Mitsubishi	Sep-08	Malaysia	S	GTT	4	Various
Seri Balquis	152,000	MISC	Mitsubishi	Dec-08	Malaysia	S	GTT	4	Various

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Seri Begawan	152,300	MISC	Mitsubishi	Dec-07	Malaysia	S	GTT	4	Various
Seri Bijaksana	152,300	MISC	Mitsubishi	Feb-08	Malaysia	S	GTT	4	Petronas
Seri Camar	150,200	MISC	Hyundai	Feb-18	Malaysia	S	Moss	4	Petronas
Seri Camellia	150,000	MISC	Hyundai	Nov-16	Malaysia	S	Moss	4	Petronas
Seri Cemara	150,200	MISC	Hyundai	Apr-18	Malaysia	S	Moss	4	Petronas
Seri Cempak	150,200	MISC	Hyundai	Feb-18	Malaysia	S	Moss	4	Petronas
Seri Cenderawasih	150,000	MISC	Hyundai	Jan-17	Malaysia	S	Moss	4	Petronas
Sestao Knutsen	138,000	Knutsen	IZAR Sestao	Jan-07	Spain	S	GTT	4	Atlantic LNG
Sevilla Knutsen	173,400	Knutsen	Daewoo	Jun-10	N.I.S.	DFDE	GTT	4	Various
Shahamah	135,500	National Gas Shipping	Kawasaki Sakaide	Oct-94	Liberia	S	Moss	5	ADGAS
Shangra	266,000	QGTC	Samsung	Nov-09	Liberia	DRL	GTT	5	Qatargas IV
Shen Hai	147,100	China LNG	Hudong Zhonghua	Sep-12	China	AB/CC Steam	GTT	4	Various
Simaisma	147,700	Maran Gas Maritime	Daewoo	Jul-06	Greece	S	GTT	4	Qatar
SK Audace	180,000	SK-Marubeni	Samsung	Jul-17	Panama	DFDE	GTT	4	Various
SK Splendor	138,375	SK Shipping	Samsung	Mar-00	Panama	S	GTT	4	Oman Gas
SK Stellar	138,375	SK Shipping	Samsung	Dec-00	Panama	S	GTT	4	RasGas
SK Summit	138,000	SK Shipping	Daewoo	Aug-99	Panama	S	GTT	4	RasGas
SK Sunrise	138,306	I. S. Carriers	Samsung	Sep-03	Panama	S	GTT	4	RasGas
SK Supreme	138,200	SK Shipping	Samsung	Jan-00	Panama	S	GTT	4	RasGas
Sohar LNG	137,250	Oman Gas/ MOL	Mitsubishi Nagasaki	Oct-01	Malta	S	Moss	5	Oman Gas
Solaris	155,000	GasLog	Samsung	Jul-14	Bermuda	TFDE	GTT	4	Various
Sonangol Benguela	160,500	Sonangol	Daewoo	Sep-11	Bahamas	S	GTT	4	Angola LNG
Sonangol Etosha	160,500	Sonangol	Daewoo	Sep-11	Bahamas	S	GTT	4	Angola LNG
Sonangol Sambizanga	160,500	Sonangol	Daewoo	Sep-11	Bahamas	S	GTT	4	Angola LNG
Southern Cross	172,000	MOL	Hudong	May-15	Hong Kong	DRL	GTT	4	Various
Soyo	160,400	Mitsui/NYK/Teekay	Samsung	May-11	Bahamas	DFDE	GTT	4	Various
Spirit of Hela	177,000	MOL	Hyundai	Oct-09	Panama	DFDE	GTT	4	Various
Stena Blue Sky	145,700	Stena	Daewoo	Jan-06	Panama	S	GTT	4	Various
Stena Clear Sky	171,800	Stena	Daewoo	Sep-10	Panama	DFDE	GTT	4	Various
Stena Crystal Sky	171,800	Stena	Daewoo	Jul-10	Panama	DFDE	GTT	4	Various
STX Kolt	145,700	STX Panocean	Korea Hanjin	Nov-08	Panama	DFDE	GTT	4	Various
Suez Point Fortin	154,200	Trinity LNG	Koyo Japan	Nov-09	Panama	S	GTT	4	Yemen LNG
Taitar No. 1	145,000	NYK Line	Mitsubishi	Oct-09	Liberia	S	Moss	4	Various
Taitar No. 3	145,000	NYK Line	Mitsubishi	Jan-10	Liberia	S	Moss	4	Various
Taitar No. 4	145,000	NYK	Mitsubishi	Jan-10	Liberia	S	Moss	4	Various
Tangguh Batur	145,700	Sovcomflot/NYK	Daewoo	Dec-08	Cyprus	S	GTT		Tangguh
Tangguh Foja	155,000	K Line	Samsung	Jul-08	Panama	DFDE	GTT	4	Tangguh LNG
Tangguh Hiri	155,000	Teekay LNG	Hyundai	Nov-08	IOM	DFDE	GTT	4	Tangguh
Tangguh Jaya	145,700	K Line	Samsung	Nov-08	Panama	DFDE	GTT	4	Tangguh
Tangguh Palung	155,000	K Line	Samsung	Mar-09	Panama	DFDE	GTT	4	Tangguh
Tangguh Sago	155,000	Teekay LNG	Hyundai	Mar-09	IOM	DFDE	GTT	4	Tangguh LNG
Tangguh Towuti	145,700	Sovcomflot/NYK	Daewoo	Oct-08	Cyprus	S	GTT	4	Tangguh
Tembek	216,200	OSG/Nakilat	Samsung	Sep-07	Marshall Is.	DRL	GTT	4	Qatargas II
Tenaga Satu	130,000	MISC	Dunkerque	Sep-82	Malaysia	S	GTT	5	Petronas
Tessala	171,866	Hyproc Shipping	Hyundai	Dec-16	Algeria	DFDE	GTT	4	Sonatrach
Torben Spirit	173,000	Teekay	Daewoo	Feb-17	Bahama	MEGI-DF	GTT	4	Various
Trinity Arrow	154,900	K Line	Imabari Shipbuilding	Mar-08	Panama	S	GTT	4	Various
Umm Al Amad	210,100	J5	Daewoo	Aug-08	Marshall Is.	DRL	GTT	4	Ras Gas III
Umm Al Ashtan	137,000	National Gas Shipping	Kvaerner- Masa	May-97	Liberia	S	Moss	4	ADGAS
Umm Bab	145,000	Kristen Navigation	Daewoo	Nov-05	Bermuda	S	GTT	4	Qatargas
Umm Slaal	266,000	QGTC	Samsung	Nov-08	Qatar	DRL	GTT	5	Qatargas
Valencia Knutsen	173,400	Knutsen	Daewoo	Sep-10	Nor-NIS	DFDE	GTT	4	Various
Velikiy Novgorod	170,200	SovComFlot	STX	Feb-14	Liberia	DFDE	GTT	4	Various
Vladimir Rusanov	172,000	MOL-China Shipping	Daewoo	Mar-18	Hong Kong	DFDE	GTT	4	Yamal
Vladimir Viz	172,000	MOL-China Shipping	Daewoo	Sept-18	Hong Kong	DFDE	GTT	4	Yamal
Vladimir Voronin	172,600	Teekay	Daewoo	Jun-19	Bahamas	MEGI-DF	GTT	4	Various
Wakaba Maru	125,000	J3 Consortium	Mitsui Chiba	Apr-85	Japan	S	Moss	5	Pertamina
WilForce	156,000	Teekay LNG	Daewoo	Aug-13	NIS	DFDE	GTT	4	Various
WilPride	156,000	Teekay	Daewoo	June-13	NIS	DFDE	GTT	4	Various
Woodside Cheney	174,000	Maran	Hyundai Samho	Mar-16	Greece	DFDE	GTT	4	Various
Woodside Donaldson	165,500	Teekay LNG	Samsung	Dec-09	Singapore	DFDE	GTT	4	Various
Woodside Goode	159,800	Maran	Daewoo	Jul-14	Greece	DFDE	GTT	4	Various
Woodside Reeswithers	173,400	Maran	Daewoo	Nov-16	Greece	DFDE	GTT	4	Various
Woodside Rogers	155,900	Maran Gas	DSME	Jul-13	Greece	DFDE	GTT	4	Various
Yamal Spirit	174,000	Teekay	Hyundai Samho	Jan-19	Bahama	MEGI-DF	GTT	4	Various
Yari LNG	159,983	TMSC Gas	Daewoo	Jun-14	Malta	TFDE	GTT	4	Various
Yenisei River	155,000	Dynagas	Hyundai	Jul-13	Marshall Is.	DFDE	GTT	4	Various
YK Sovereign	127,125	SK Shipping	Hyundai	Dec-94	Panama	S	Moss	4	Pertamina
Zarga	266,000	QGTC	Samsung	Dec-09	Liberia	DRL	GTT	5	Qatar-Atlantic
Zekreet	135,420	J4 Consortium	Mitsui Chiba	Dec-98	Japan	S	Moss	5	Qatargas

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

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	3	480,000
	Dapeng ND Guangdong	CNOOC	2018	4	640,000
	Dongguan, Guangdong	Jovo Group	2013	2	160 000
	Fujian LNG (Xiuyu)	CNOOC, Fujian I&D Corp.	2008	2	640,000
	Guangdong	CNOOC,BP	2006	3	480,000
	Haikou, Hainan LNG	CNOOC	2014	3	480,000
	Ningbo, Zhejiang	CNOOC, Zhejiang Energy	2012	3	480,000
	Qidong, Jiangsu	Guanghui Energy	2018	1	60,000
	Qingdao, Shandong	Sinopec	2014	3	480,000
	Rudong	PetroChina	2011	3	530,000
	Shanghai	CNOOC, Shenergy Group	2009	3	495,000
	Shanghai, Mengtougou	Shanghai Gas	2008	3	120 000
	Shenzen, Diefu	CNOOC	2016	2	320,000
	Tangshan, Hebei	PetroChina	2013	3	480,000
	Tianjin North	Sinopec	2017	2	320,000
	Yuedong, Guangdong	CNOOC	2016	2	320,000
	Zhoushan Zhejiang	Enn Group	2018	2	320,000
	Zhuhai, Gaolan	CNOOC	2013	3	480,000
Dominican Republic	Punta Caucedo	AES Andres	2003	1	160 000
Finland	Pori	Gasum Skangas	2016	1	30,000
	Tornio	Gasum Skangas	2018	1	30,000
France	Fos Tonkin	Elengy	1972	3	150,000
	Montoir-de-Bretagne	Elengy	1980	3	360,000
	Fos Cavaou	Engie, Total	2010	3	330,000
	Dunkirk LNG	EDF, Fluxys, Total	2016	3	570,000
Gibraltar	Gasnor	Shell	2018	1	5,000
Greece	Revithoussa	DEPA	2000	3	225,000
India	Dabhol	GAIL, NTPC (Ratnagiri Gas & Power)	2009	3	480,000
	Dahej	Petronet LNG	2004	4	592,000
	Hazira	Shell India, Total	2005	2	320,000
	Kochi, Kerala	Petronet LNG	2013	2	320,000
	Mundra	Gujarat State Petroleum, Adani Group	2018	2	320,000
	Kamarajar (Ennore), Tamil Nadu	Indian Oil, DFC, ICICI Bank	2019	2	360,000
Indonesia	Arun	Pertamina	2015	5	507,000
Italy	Panigaglia	Snam	1969	2	100,000
	Porto Levante (offshore GBS)	ExxonMobil, Qatar Petroleum, Edison Gas	2009	2	250,000
Japan	Negishi	Tokyo Gas	1969	14	1,180,000
	Sodegaura	Tokyo Gas	1973	35	2,660,000
	Ohgishima	Tokyo Gas	1998	4	850,000
	Higashi-Ohgishima	Tokyo Electric	1984	9	540,000
	Futtsu	Tokyo Electric	1985	10	1,110,000
	Yokkaichi LNG	Chubu Electric	1988	4	320,000
	Kawagoe	Chubu Electric	1997	6	840,000
	Yokkaichi Works	Toho Gas	1991	2	160,000
	Chita LNG Joint	Toho Gas, Chubu Electric	1978	4	300,000
	Chita LNG	Toho Gas, Chubu Electric	1983	7	640,000
	Chita - Midorihama	Toho Gas	2001	3	600,000
	Senboku I	Osaka Gas	1972	4	180,000
	Senboku II	Osaka Gas	1977	18	1,585,000
	Himeji	Osaka Gas	1984	8	740,000
	Himeji LNG	Kansai Electric	1979	7	520,000
	Yanai	Chugoku Electric	1990	6	480,000
	Niigata	Nihonkai LNG, Tohoku Electric	1984	8	720,000
	Oita	Oita Gas, Kyushu Electric	1990	5	460,000
	Tobata	Kitakyushu LNG	1977	8	480,000
	Fukuoka	Saibu Gas	1993	2	70,000
	Sodeshi	Shizuoka Gas	1996	3	337,200
	Hatsukaichi	Hiroshima Gas	1996	2	170,000
	Kagoshima	Nippon Gas	1996	2	136,000
	Shin-Minato	Sendai City Gas	1997	1	80,000
	Nagasaki	Saibu Gas	2003	1	36,000
	Sakai	Kansai Electric, Cosmo Oil	2006	3	420,000

LNG Import Terminals (continued)

Country	Location (Project)	Owners	Start up	Storage	
				Tanks	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	Chubu	2011	3	540,000
	Hachinohe LNG	Nippon Oil	2015	2	280,000
	Hitachi LNG	Tokyo Gas	2015	1	230,000
	Soma Fukushima	Japan Petroleum Exploration	2017	1	225,000
Korea	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
	Mugardos, El Ferrol	Reganosa, Sonatrach, Sojitz Corp.	2006	2	300,000
	El Musel, Gijón,	Enagas	2013	2	300,000
Taiwan	Yung-An	CPC	1990	6	690,000
	Tai-Chung	CPC	2009	5	800,000
Thailand	Map Ta Phut	PTT LNG	2011	2	320,000
Turkey	Marmara Ereglisi	Botas	1994	3	255,000
	Izmir	EgeGaz	2006	2	280,000
USA	Everett	Suez LNG NA	1971	2	155,000
	Lake Charles	Shell, ETE	1982	4	425,000
	Freeport	Freeport LNG Development	2008	2	320,000
	Golden Pass, TX	Qatar Petroleum, ExxonMobil	2010	5	775,000
	Pascagoula, MS	Gulf LNG, Kinder	2012	2	320,000
UK	Isle of Grain	National Grid	2005	8	1,000,000
	South Hook	ExxonMobil, Qatar Petroleum, Total	2009	5	775,000
	Dragon LNG, Milford Haven	Shell, Petronas	2009	2	310,000

LNG Import Terminal Projects

Country	Location/Project	Owners/Project Developers	Start up	Storage	
				Tanks	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	Dhamra Odisha	Indian Oil, Adani, GAIL	2020	2	320,000
	Jaigarh	Hiranandani Group	2019	2	320,000
	Kodinar	Hindustan Petroleum Corp.	2022	1	160,000

LNG FSRU Import Facilities

Country	Location (Project)	Owners	Start up
Argentina	Bahia Blanca GasPort	Excelerate/YPF Repsol	2008
	Escobar GasPort	Excelerate/Enarsa	2011
Bangladesh	Moheshkhali	Excelerate, PetroBangla	2018
	Cox's Bazar	Summit Power International, Excelerate Energy	2019
Brazil	Pecem, FSRU	Petrobras	2009
	Guanabara Bay FSRU	Petrobras	2009
	Salvador, Bahia FSRU	Petrobras	2013
China	Tianjin FSRU	CNOOC, Hoegh, various	2013
Colombia	Cartagena FSRU	Promigas, Sociedad Portuaria El Cayao	2016
Egypt	Ain Sokhna, Suez	EGAS, Hoegh	2015
	Ain Sokhna, Suez	EGAS, BW Gas	2015
Indonesia	Lampung	Hoegh LNG, PGN LNG	2014
	Nusantara (Jakarta Bay)	Golar LNG, 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 Mediterranea	ElectroGas	2016
Pakistan	Port Qasim	Excelerate, Engro Corp	2015
	Port Qasim	BW-Mitsui, PGP Consortium	2017
Turkey	Aliaga FSRU, Turquoise FLNG	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	2022	1	3.4
NIGERIA	NLNG Train 7	NNPC, Shell, Eni, Total	2022+	1	7.0
PAPUA NEW GUINEA	Elk-Antelope LNG	Total, ExxonMobil Oil Search, Petromin	Studies		
RUSSIA	Sakhalin II expansion	Gazprom, Shell, Mitsui, Mitsubishi	2021	studies	
	Vladisvostok LNG	Gazprom, Itochu, various	2023+	2	10.0
	Arctic LNG II Siberia	Novatek, Total	2023	3	19.8
USA	Alaska LNG Nikiski	Alaska Gasline Development Corp.	2023+	3	20.0
	Annova LNG, Brownsville	Exelon Corp.	2023+	6	6.0
	Commonwealth LNG, Louisiana	Commonwealth LNG LLP	2023+	8	9.0
	Corpus Christi Liquefaction, Texas	Cheniere	2019	2	9.0
	Delfin LNG, Louisiana	Delfin	2023+	3	9.0
	Driftwood LNG, Louisiana	Tellurian, Total and others	2023	6	27.6
	Freeport LNG, Texas	Freeport LNG	2019	3	15.3
	Galveston Bay LNG	NextDecade	2023+	6	27.0
	Golden Pass, Texas	Qatar Petroleum, ExxonMobil	2021	3	15.6
	Jordan Cove, Coos Bay	Pembina Corp.	2024	2	7.8
	Lake Charles, Louisiana	Shell, ETE	2024	3	15.0
	Magnolia LNG	Louisiana LNG Ltd.	2023+	4	8.0
	Port Arthur LNG	Sempra	2023+	2	10.0
	Rio Grande LNG	NextDecade	2023+	6	27.0
	Sabine Pass LNG, Louisiana	Cheniere	2016-19	1	4.5
	Texas LNG Brownsville	Chandra, Meyer, Samsung, others	2023+	2	4.0
	VG LNG (Cameron Parish)	Venture Global	2022	5	10.0
	VG LNG (Plaquemines)	Venture Global	2022	10	20.0
	VG LNG (Delta-Plaquemines)	Venture Global	2024		24.0

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
ARGENTINA	FLNG Tango	Bahia Blanca	2019	1	0.5	1	16,100
AUSTRALIA	Karratha	NWS Woodside, Shell, BHP	1989	2	5.0	4	260,000
		(BP, Chevron	1992	1	2.5	1	130,000
		(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					
PAPUA NEW GUINEA	PNG LNG	Oman Govt., Oman LNG Union Fenosa, Osaka Gas, & Itochu	2006	1	3.7	2	240,000
		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-T1	QP, Shell	2010	1	7.8		
	RasGas I- T1&2	QP, ExxonMobil, Kogas, Itochu, LNG Japan	1999	2	6.6		
	RasGas II- T3	QP, ExxonMobil	2004	1	4.7		
	RasGas II- T4	QP, ExxonMobil	2005	1	4.7	6	840,000
	RasGas II- T5	QP, ExxonMobil	2007	1	4.7		
	Rasgas III – T6	QP, ExxonMobil	2009	1	7.8		
	Rasgas III – T7	QP, ExxonMobil	2010	1	7.8		
RUSSIA	Sakhalin Island	(Sakhalin Energy) Gazprom, Shell, Mitsui, Mitsubishi	2009	2	9.6	2	200,000
	Yamal LNG Siberia	Novatek, Total, CNPC, Silk Fund	2017	3	16.5	4	640,000
TRINIDAD & TOBAGO	Point Fortin Train 1	BP, Shell, CIC, NGC	1999	1	3.0	2	204,000
	Train 2	BP, Shell	2002	1	3.3	1	160,000
	Train 3	BP, Shell	2003	1	3.3	1	160,000
	Train 4	BP, Shell, NGC	2005	1	5.2	1	160,000
USA	Cheniere Sabine Pass	Cheniere Energy	2016	5	22.5	5	800,000
	Cove Point LNG	Dominion Energy	2017	1	5.3	7	695,000
	Cheniere Corpus Christi	Texas Cheniere	2018	2	9.0	3	480,000
	Cameron Hackberry	Sempra, Total, Mitsui, Mitsubishi	2019	1	4.9	3	480,000
	Elba Island Georgia	Kinder Morgan, EIG Energy	2019	10	2.5	5	535,000
	Freeport LNG, Texas	Freeport LNG	2019	1	5.1	3	483,000
YEMEN	Bal-Haf	Yemen LNG, Total, Yemen Gas, Hunt Oil, SK Group, Hyundai	2009	2	6.7	2	320,000

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