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LNG again influences wholesale prices as Asia-Pacific region tops the league

Wholesale Gas Price Survey from IGU charts gradual evolution and modernization of sector

The highest wholesale natural gas prices were again found in the main LNG importing countries in the Asia-Pacific region, South Korea, Taiwan and Japan as well as Singapore and China.

Not far behind were many European countries, with Gas-on-Gas (GOG) pricing, as spot prices rose during 2018.

Prices were much lower in the United States, where they were even below those in Egypt, Nigeria, Indonesia and Malaysia and some Middle East countries.

Russia

Prices in Russia have fallen well below other countries, which, in previous years, had been above, as a consequence of the large rouble depreciation.

At the bottom of the wholesale gas prices chart are generally countries where the market is subjected to some form of regulation and often below the cost of production and transportation such as in Turkmenistan, Algeria and Venezuela.

The latest Wholesale Gas Price survey noted that the effects of global LNG imports and rapidly growing US domestic consumption more than offset declining pipeline imports in Europe and rising pipeline imports by China.

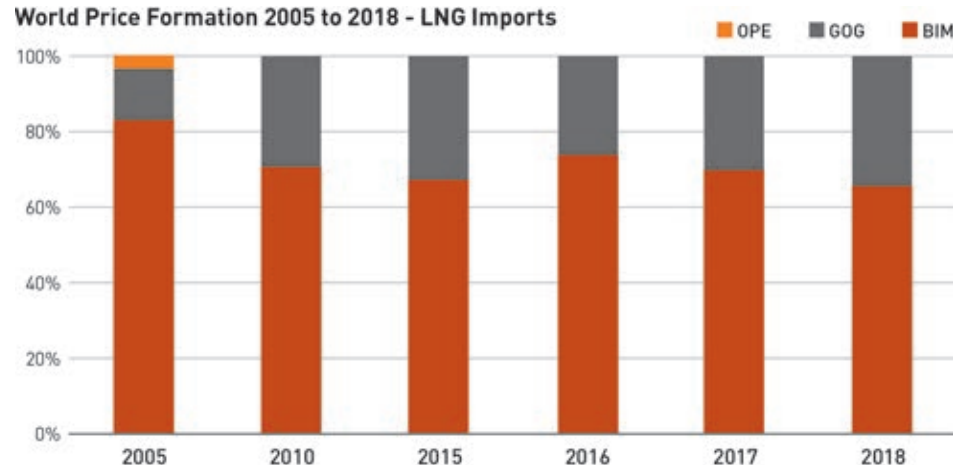
The survey published in May 2019 comes from the International Gas Union and is the 11th to be undertaken in a series that began in 2006.

The IGU stated that the share of gas-on-gas competition rose by half a percentage point between the 2017 and 2018 surveys to 47 percent and largely reflected the increasing share of spot LNG cargoes in the sector.

China position

"The oil price escalation share declined by a quarter of a percentage point to 19 percent, with the loss in LNG imports

World Price Formation 2005 to 2018 - LNG Imports



Total imports are the sum of pipeline imports and LNG have only comprised three categories Oil Price Escalation (OPE), Gas-on-Gas (GOG) and Bilateral Monopoly (BIM) in all IGU surveys from 2005 to 2018

being partly offset by gains in pipeline imports and domestic production in China," stated the IGU report.

It explained that the regulated cost of service and regulated social and political costs were largely unchanged overall, at 10 percent and 14 percent respectively, though the latter declined by almost half a percentage point, reflecting slower consumption growth in countries with "regulated social and political" pricing.

The gas-on-gas competition as defined by the IGU is the price determined by the interplay of supply and demand and relates to trades over a variety of different periods, daily, monthly and annually.

Trading takes place at physical hubs (e.g. Henry Hub) or notional hubs (e.g. NBP in the UK).

There are likely to be developed futures markets (New York Mercantile Exchange or InterContinental Exchange). Not all gas is bought and sold on a short-term fixed price basis and there will be longer term contracts but these will use gas price indices to determine the monthly price, for example, rather than competing fuel indices.

Also included in this category are any spot LNG cargoes, any pricing which is linked to hub or spot prices and also bilateral agreements in markets where there are multiple buyers and sellers.

Overall over the 2005 to 2018 period, the share of gas-on-gas competition has risen by almost 16 percentage points, while oil price escalation has declined by 5 percentage points.

Linkage

The Bilateral Monopoly (BIM) pricing sector has declined by 2.5 percentage points, while in the regulated categories regulation cost of service has risen by 9 percentage points, "regulation social and political" has risen by nearly 3 percentage points and "regulation below cost" has declined by almost 20 percentage points.

Oil Price Escalation (OPE) is also a large part of the survey and means the price is linked, usually through a base price and an escalation clause, to competing fuels, typically crude oil, gas oil and/or fuel oil. In some cases, coal prices can be used as can electricity prices.

In Europe gas-on-gas competition has risen to almost 76 percent of total consumption, with oil price escalation a third of this level.

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"The major overall changes, in the 2005 to 2018 period, have been the continuous move away from formal oil price escalation to gas-on-gas competition in Europe, and also in Russia as the independents and Gazprom competed for sales to large eligible customers such as power plants," said the IGU.

Unusual

"This is clearly a different kind of gas-on-gas competition from the liquid trading markets in North America and Europe but reflects the fact that there are multiple buyers and sellers, distinguishing it from the bilateral monopoly category, where there would be a single dominant buyer and/or seller," added the report.

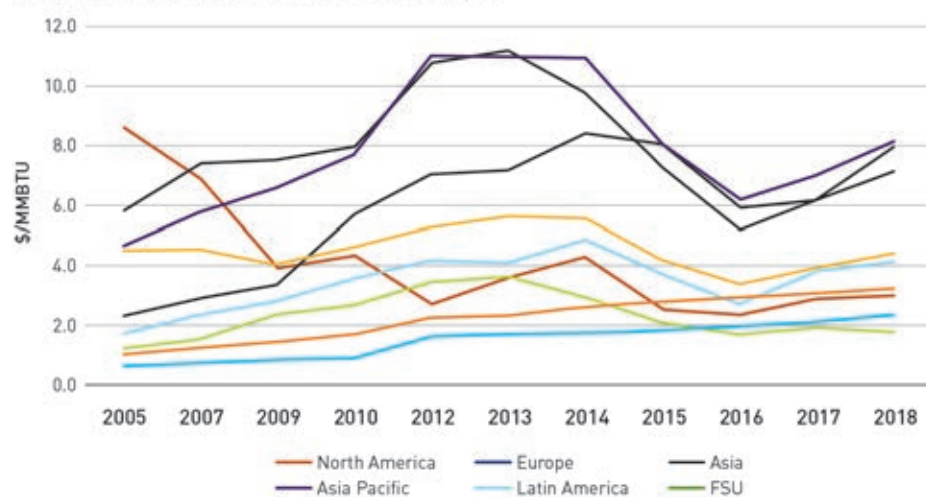
In Europe the move from formal oil price escalation to gas-on-gas competition, has seen the latter's share increasing from 15 percent in 2005 - when oil price escalation was 78 percent - to 76 percent in 2018 - when oil price escalation had declined to 24 percent.

"The changes have reflected a number of factors over the years; switching of domestic gas produced and consumed in a number of countries - Netherlands, Germany, UK and Italy especially - away from oil price escalation, and a decline in the volume of gas imported under the traditional oil-indexed contracts," said the report.

These were replaced by imports of spot gas

and increasing volumes traded at hubs, followed by the ending of contracts or the renegotiation of the terms to include a proportion of hub-spot price indexation in the pricing terms, or even a move to 100

Wholesale Price Levels 2005 to 2018 by Region



The rise in prices in the Asia Pacific and North Asia has been driven by changes to regulated prices and the start of LNG imports in China and India

percent hub price indexation, and in some cases, a reduction in the take-or-pay levels.

"The renegotiations have also seen the introduction of hybrid pricing formulas where oil indexation is partly maintained but within a price corridor set by hub prices," said the IGU survey.

"The respondents to the survey allocate the hybrid contracts in part to gas-on-gas competition and in part to oil price escalation, depending on how narrow or wide the price corridor is," it explained.

Mechanisms

The change in price formation mechanisms in Europe was not universal across the region.

"Northwest Europe has seen the most dramatic change in price

seen significant changes. Oil price escalation has declined from 85 percent in 2005 to 22 percent in 2018, while gas-on-gas competition has increased from almost zero in 2005 to 75 percent in 2018.

This is principally reflecting increased imports of spot gas, some re-exported from Germany, and contract renegotiations.

There has been less change in other areas of Europe such as the Mediterranean region, where oil price escalation has declined from 100 percent in 2005 to around 56 percent in 2018 with gas-on-gas competition rising from nothing to 44 percent, largely reflecting spot LNG imports with significant changes in pipeline imports into Italy in the last couple of years.

In Southeast Europe, there is now around 62 percent gas-on-gas competition, from nothing in 2012, as Romania completed its liberalization of domestic production prices.

Oil link in Asia

However, in Asia oil price escalation has gained ground while it has lost the share of the market in Europe.

Oil price use has made large gains in market share in Asia with a rise from 35 percent in 2005 to 67 percent in 2016, initially as China began importing more LNG as well as pipeline gas from Turkmenistan, but largely reflecting the domestic pricing reform, initially in two Chinese provinces, followed by rolling these changes out to the whole of China for most sectors.

"In the Asia Pacific there has been a steady increase in oil price escalation up to 2017, reaching some 66 percent, largely at the expense of regulated pricing, principally in Malaysia and Indonesia," said the report.

The share of oil price escalation

In Europe the move from formal oil price escalation to gas-on-gas competition, has seen the latter's share increasing from 15 percent in 2005 to 76 percent in 2018

formation mechanisms, with a complete reversal from 72 percent oil price

gas-on-gas competition in 2005 to 6 percent oil price escalation and 94 percent gas-on-gas competition in 2018, as a result of increased hub trading and contract renegotiations," said the report.

Central Europe has also, more recently,

declined in 2018 as spot LNG imports surged. The report noted that regulated pricing continues to move away from subsidies in many regions.

“Apart from the changes concerning gas-on-gas competition and oil price escalation in Europe, Asia and Asia Pacific, there have also been significant changes in the regulated pricing categories,” said the report.

“The increases in regulated pricing and policy changes in Russia not only saw a switch towards gas on gas competition, but also a switch from the subsidised regulation below cost in 2009 to regulation cost of service as Gazprom finally stopped losing money on their domestic gas sales, although with the freeze in regulated prices in 2014, there was a partial switch back to regulation social and political,” it explained.

Reforms

“There were also significant changes in China as pricing reforms, again around the 2009 period, saw domestic production prices being more formally regulated and the price formation mechanism changing

from regulation social and political to regulation cost of service, before the significant move to oil price escalation,” it added.

“Similarly, in Iran prices were raised significantly with the category changing from regulation below cost to regulation social and political in 2012, and a similar change in Nigeria in 2014, as prices increased, and gas-on-gas competition was introduced,” stated the report.

Pipeline trade has seen a continuous shift to gas on gas competition, and in LNG trade it appears that oil price escalation started to lose ground in 2018.

In pipeline imports there has been a largely continuous rise in gas-on-gas competition at the expense of oil price escalation, rising from 23 percent in 2005 to 61 percent in 2018, as oil price escalation declined from 57 percent to 31 percent.

“However, the decline in oil price escalation has been partly offset by a switch from bilateral monopoly in intra-FSU trade in 2009, and more recently the imports of pipeline gas from Turkmenistan to China, and in 2016, the

change in one of the gas contracts from Russia to Turkey,” said the report.

LNG surge

In contrast, oil price escalation largely held its share in the LNG market from 2007 to 2017, averaging 72 percent, compared to 28 percent for gas-on-gas competition. However, in 2018, there was a large surge in spot LNG imports.

“The respective shares fluctuated over the years between 2007 and 2017 as the LNG market grew, sometimes with more oil indexed contracts and sometimes with more gas-on-gas competition,” said the report.

“The gas-on-gas competition share can be divided into LNG going into traded markets such as the USA, in the early years, and European markets such as the UK, Belgium and Netherlands, and then spot LNG cargoes into the traditional LNG markets where oil indexed contracts dominate,” it added.

“The share of LNG trade going into traded markets has largely been in decline since 2010, while spot LNG gas has been on the increase,” stated the

report. “The traded markets share has declined as less LNG went to the USA and then as Northwest Europe has taken less LNG,” it said.

The increase in the gas-on-gas competition share in 2017 reflected the sharp rise in spot LNG more than offsetting the decline in LNG into Northwest Europe’s traded markets.

Gas-on-gas competition accounted for more than 50 percent of LNG imports into Europe in 2018, compared to 33 percent in 2017, while the gas-on-gas sector in Asia rose from 24 percent to 30.5 percent and in Asia Pacific from 18 percent to 24 percent.

“Despite the growth in LNG imports between 2017 and 2018 of some 22 billion cubic metres, or 5.5 percent, the actual volume of oil price escalation imports declined for the first time ever,” said the report.

“The share of spot LNG imports reached just over 30 percent of total LNG imports in 2018 amounting to some 126 Bcm - an increase of 65 Bcm since 2016 or 10.5 percentage points,” it stated. ■



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From US to Asia natural gas market set for \$600Bln boost to spending on infrastructure

Samuel Phillips of Barclays Commodities forecasts surge in new liquefaction and regasification capacity

LNG is the fastest-growing segment of the global natural gas market, with LNG demand growth of about 12 percent year-on-year in 2018, outpacing global consumption gains by a factor of four.

Moreover, as governments in Asia and elsewhere increasingly turn towards the cleaner-burning hydrocarbon while North American producers look internationally to find homes for their supply, LNG is set to play an increasingly important role in balancing the global gas market over the coming decade.

Liquefaction leads

This expansion is supported by about \$600 billion of investment through 2025 in proposed new liquefaction and regasification capacity across the globe.

Liquefaction plants account for the bulk of the potential investment. Globally, we are tracking approximately 70 projects in various stages of development which, if developed, would nearly double current annual liquefaction capacity to upwards of 800 million tonnes, or 37 trillion cubic feet.

While not all of these projects are likely to move forward to final investment decision (FID), the expansion of global LNG capacity represents a \$450-\$500Bln opportunity, assuming a fairly conservative \$1,000/ton cost for newbuild liquefaction.

This

Projects that have reached FID account for only about 20 percent of total proposed spending, suggesting the largest investment sums are yet to come.

liquefaction

Figure 1. Global LNG liquefaction capacity could nearly double by 2025

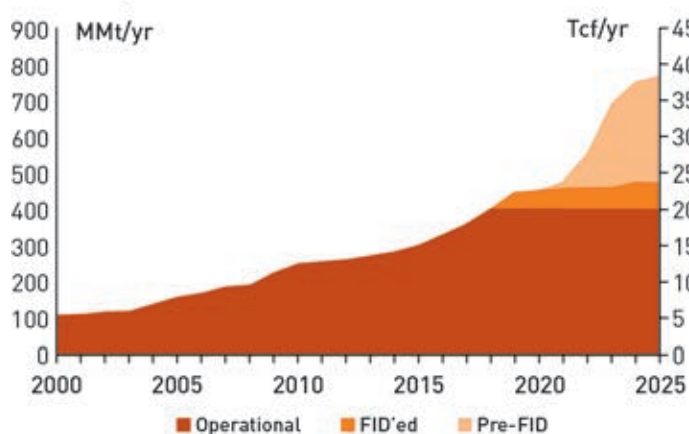
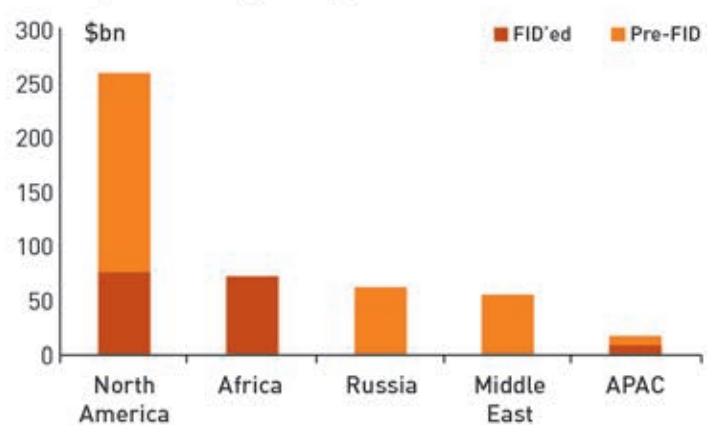


Figure 2. North America leads the way in potential LNG liquefaction spending



Worldwide export capacity to set for another surge along with spending on infrastructure in expanding plants and build-outs in US Gulf Coast and emerging basins in west and eastern Africa

spending would be spread across industries such as construction, engineering, midstream, and steel.

Projects that have reached FID account for only about 20 percent of total proposed spending, suggesting the largest investment sums are yet to come.

More than half of this proposed liquefaction capacity and related investment is slated for North America, where surging shale production has propelled the US into the third-largest LNG exporter in the world.

Canada

Canada is also set to enter the LNG export market with the Shell-led LNG

Canada project scheduled to come online in 2024 at a cost of upwards of \$40Bln.

New liquefaction projects in Africa, the Middle East, and Russia also present

investment opportunities, each worth in excess of \$50Bln.

Spending on new regasification facilities to

handle growing imports of LNG is also rising in stride with liquefaction spending.

With more than 160 regas facilities either under construction or proposed, global regas capacity is set to expand by 50 percent to be able to handle more than 1,100 tonnes per annum (or 54 Tcf per annum) by 2025, if all the projects move forward.

Nearly 60 percent of this proposed capacity is in Asia, where governments have championed the fuel as a cleaner-burning alternative to coal.

For example, we forecast Chinese LNG imports and regas capacity alone could rise as much as 50 percent by 2020, following a quintupling of regas capacity from 2010 to 2018.

Europe volumes

Europe is another fast-growing market, with nearly 120MT per year of regas capacity in the works.

This global investment in regas capacity represents a roughly \$125Bln opportunity through 2025, assuming a cost of \$300/ton.

While traditional onshore LNG import terminals are the majority of proposed capacity, floating storage and regas (FSRUs) projects represent a large and growing share, accounting for more than 40 percent of the total.

This share has the potential to increase as well, particularly in the Americas and Asia, as FSRUs allow smaller markets access to LNG imports that once had been cost-prohibitive.

Turning to China, a separate report by the bank said that the steep ramp-up in LNG exports anticipated ahead of next winter should exacerbate volatility from tighter balances.

Outsized role

We examine the Chinese gas market and the outsized role it will likely play in the US market over the next two years.

We forecast Chinese LNG imports will rise by about 50 percent, or about 3.5 billion cubic feet per day (Bcf/d) by 2020, driving as much as three-quarters of global LNG demand growth.

Chinese gas demand is forecast to rise 18 percent and, while domestic production is increasing at a rapid clip and new import pipelines are in the works, the onus will fall on imported LNG to balance the market

The Beijing Government's support and infrastructure investment are behind much of the expected demand gains.

This should make our LNG import forecast more resilient to both price and economic changes. However, if the current economic slowdown persists, LNG imports could underperform our forecast by 40 percent.

US impact

With the US accounting for more than 80 percent of global new export capacity expected online through 2020, US gas prices will become progressively more influenced by the strength of the Chinese economy.



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It is believed that Shell and Total are best positioned to benefit from higher Chinese LNG imports.

In the US, the UK-headquartered bank said that with five LNG export plants coming on stream over the next year or so, it expects exports to nearly double to roughly 10 Bcf per day and this increased connectivity with the global gas market adds risks to forecasting.

Barclays joined others in noting the potential impact of tight storage and rising LNG exports on domestic prices.

Several banks indicated there was increased upside price risk on core summer 2019 and winter 2019-20 contracts.

Henry Hub forecasts

A hot summer could easily support stronger power generation levels than assumed in the firm's base case, and put storage on a trajectory comparable to the low last year.

However, their analysts viewed LNG exports as the biggest downside price risk.

The global gas market is moving into a

period of oversupply, and with the United States playing the role of marginal supplier, there is risk for reduced utilization of US export facilities.

It is assuming an average 90 percent utilization of LNG export facilities through 2020. If utilization were to fall to average even 75 percent, it would lower its 2019 price outlook slightly.

Between 2010 to 2018, the summer trading range of the prompt New York Mercantile Exchange contract "tightened by nearly 65 percent as production growth dampened volatility".

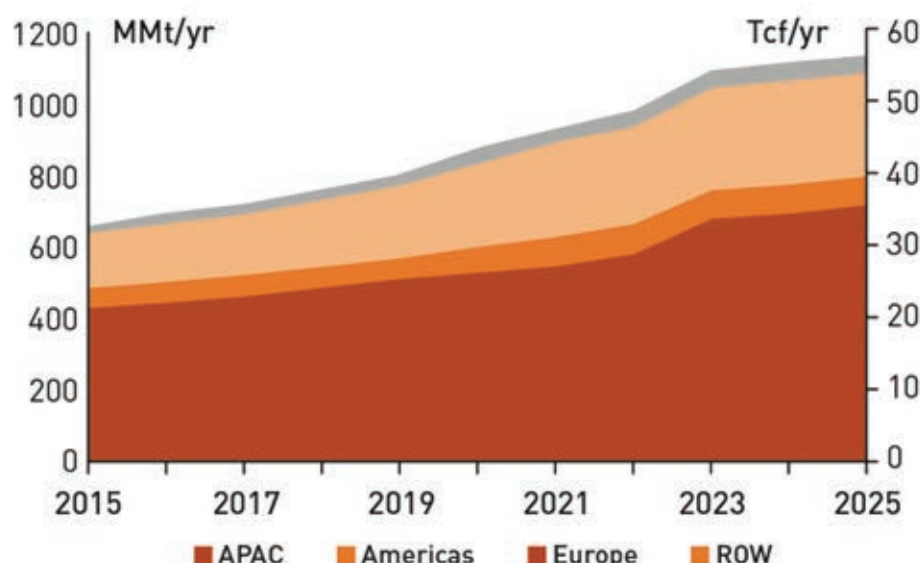
If this year is a case of 'pay now or pay later,' we think the market will pick the latter.

Meanwhile, the lower storage baseline also reduced the bank's expectations for end-October to 3.3 Tcf, which would rival last year's 13-year low of 3.2 Tcf.

Unlike last year, however, production growth next winter should not provide as much of a counter-balance to low inventories.

It is forecasting year-on-year gains of around 3.5 Bcf/d next winter, less

Figure 3. Global regas capacity could grow 50% by 2025



Regasification facilities will be increasing as part of new wave of output

than half the record-setting 8 Bcf/d-plus increases seen during the past five months. Appalachian producers appear to be tightening the reins on growth this year, while Kinder Morgan Inc.'s Gulf Coast Express could fill up quickly, constraining Permian Basin gas production yet again.

This combination of lower storage and

slowed production growth has increased our conviction that higher volatility and prices await next winter.

Cumulatively, the firm has raised its Henry Hub price forecast through the first quarter of 2020 by an average of 10 cents, with the bulk of its price increase occurring in fourth quarter of 2019, which it raised 20 cents.

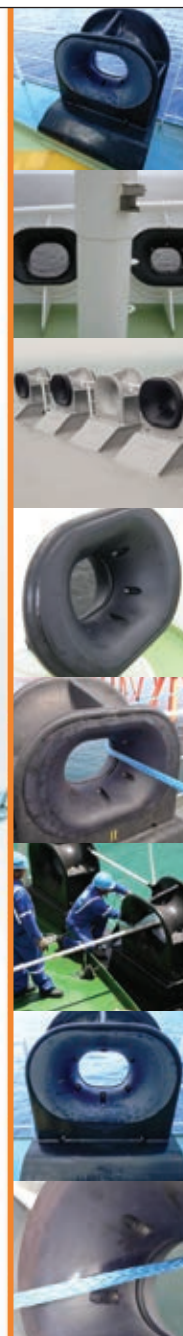


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For the Record

AIR PRODUCTS, the leading US liquefied natural gas equipment-maker and industrial gases company, reported an increase in income from operations at it pursued its role in LNG worldwide and in industrial gases projects in Saudi Arabia and China. The Lehigh Valley, Pennsylvania-based company, said fiscal second-quarter profits amounted to \$421 million compared with \$416.4M in the same three months a year ago, a rise of just over 1 percent. Fiscal second-quarter sales came in at \$2.2 billion an increase of 1 percent over the prior year. Among its most recent LNG contracts, Air Products was chosen in February 2019 to provide its technology and equipment and a related process licence for the Golden Pass export plant being developed in Texas by Qatar Petroleum and ExxonMobil. The equipment includes the main cryogenic heat exchangers to be installed at the heart of the proprietary propane pre-cooled mixed refrigerant liquefaction process for the three-Train facility. “This strong performance was roughly offset by a 4 percent unfavorable currency move and 2 percent from a contract modification to a tolling agreement in India, which impacted sales but not profits,” said Air Products in its earnings statement. “Excluding the Jazan (Saudi Arabia) project, volumes grew 5 percent due to positive base business volumes and additional new plant on streams, including the Lu’An gasification facility in China,” said Air Products. “Pricing improved in all three regions and across merchant product lines,” stated the US company.

Air Products reported gross earnings of \$825 million, an increase of 12 percent over the same three months of 2018. “The committed and motivated team at Air Products continues to generate superior performance, delivering our 20th consecutive quarter of adjusted earnings-per-share growth despite unfavourable currency,” said Seifi Ghasemi, Chairman, President and Chief Executive. “We have a differentiated position of financial strength and technology that enables us to continue deploying capital into strategic, high-return, value-creating projects while also continuing to return

cash to shareholders through our dividend,” stated Ghasemi. In its industrial gases divisions, the Americas sales amounted to \$992 million, an increase of 9 percent on the same quarter of 2018. Europe and Middle east sales came in at \$494M, a drop of 12 percent from 2018 quarter. Air Products reported sales of \$625M, a rise of 12 percent over the prior year. Volumes increased 12 percent, driven primarily by new projects including the Chinese Lu’An industrial gases venture. “We are forging a new path for growth through successful execution of world-scale projects,” said Ghasemi. “As a result, we remain confident that we will continue to deliver on our commitments,” he added.

ANNOVA, the US company planning an LNG export project for the south bank of the Brownsville Ship Channel in Texas and whose owners include Chicago-based power company Exelon Corp., is expected to be given the go-ahead after receiving a final environmental impact statement from regulators. The Annova project is expected to ship around 6.95 million tonnes per annum from its proposed liquefaction and export plant. The joint venture proposes the construction of six small-scale liquefaction Trains as well as an interconnected pipeline and marine export facilities. The Federal Energy Regulatory Commission said that with suitable mitigation measures the environmental impacts from the export venture could be reduced or contained. “We determined that the construction and operation of the project would result in adverse environmental impacts. Most impacts on the environment from the proposed project would be reduced to less than significant levels with the implementation of Annova’s proposed impact avoidance, minimization, and mitigation measures and the additional measures recommended by FERC staff,” said the FERC. However, the FERC statement noted that there was scope for additional short-term environmental impacts from the cumulative noise from several LNG projects being developed in the area of the Brownsville Ship Channel. The FERC stated that the project, combined with others in the “geographic scope, including the Rio Grande LNG and Texas LNG projects”, would result in significant cumulative impacts from construction noise from pile-driving and shoreline erosions within the Brownsville Ship Channel during vessel transits.

It recommended that the Annova venture has “appropriate consultations” with the National Marine Fisheries Service and the US Fish and Wildlife Service to discuss mitigation measures before construction is allowed to begin. The FERC also recommended that Annova file all outstanding cultural resource reports and agency comments for its review before a construction permit is issued. Annova has already modified its project layout to create a 185-acre environmental conservation corridor and avoid impacting over 100 acres of wetlands. Its environmental plans would also restore tidal exchange and estuarine habitats lost when the Brownsville Ship Channel and State Highway 48 were constructed. The joint venture’s equity owners in addition to Exelon are US engineering, processing and equipment company Black & Veatch of Kansas and construction firm Kiewit Corp., based in Omaha, Nebraska. The company said it was in the process of securing one billion cubic feet per day of firm natural gas transportation from Agua Dulce Hub in south Texas to the project site.

AUSTRALIAN Industrial Energy and two Japanese partners have advanced with plans for the first Australian liquefied natural gas import terminal at Port Kembla to bring in shipments of LNG for the state of New South Wales by 2020. AIE, part of the Mindereroo investment and mining group, has joined with Japanese companies Marubeni Corp. and JERA Co. Inc. to develop an LNG import facility near Sydney to make up domestic natural gas shortfalls during peak demand periods on the southeast Coast. The NSW Government has given planning approval for the AIE-led venture comprising a floating storage and regasification unit (FSRU), a wharf infrastructure and a pipeline to connect to the existing NSW East Coast gas network. “Once operational, the terminal could supply 70 percent of the state’s annual gas demand and help to ease the cost of energy bills for the 33,000 businesses and a million households in NSW that depend on natural gas,” said a statement. Port Kembla is an existing industrial cargo port with man-made breakwaters about 100 kilometres south of Sydney in the Illawarra region. The Port Kembla terminal will initially handle around 2 million tonnes per annum of LNG. “Before approving the terminal, the NSW Government assessed the environmental, social

and economic impacts identified by community, government and independent stakeholders,” added the NSW government.

The NSW state Minister for Energy and Environment, Matt Kean, said the Port Kembla gas terminal would be a “game-changer” for improving energy security and helping to ease energy costs. “It could support gas-fired electricity generation in NSW and help make sure we have reliable electricity,” stated Kean. The project is led by the Mindereroo group, controlled by Australian billionaire Andrew Forrest. Marubeni, a long-standing global LNG market participant, is also taking part along with JERA, now the largest Japanese utility company after being formed as part of a merger between many assets owned by Tokyo Electric Power Co. and Chubu Electric. The choice of Port Kembla was the result of a joint feasibility study launched in February 2018 when the joint venture was first established. The LNG terminal is regarded as a lower-cost alternative to a proposed Australian inter-state pipeline from West to East at a cost of around A\$5 billion. At least two other regasification ventures are moving forward in NSW and in the southeast state of Victoria. AIE has said that its Japanese partner JERA would supply the LNG while Marubeni is expected to provide infrastructure financing as well as the FSRU. AIE has also signed preliminary agreements with some industrial customers for the supply of regasified LNG, including a large-scale gas-fired power station in the state. For the second stage of the development, AIE has said it was considering the construction of a new 750-megawatts, gas-fired power plant or expanding an existing facility.

BAHRAIN, the Gulf kingdom set to start LNG imports soon, has signed an exploration and production sharing agreement with Eni, the Italian energy company with a recent record of huge natural gas discoveries offshore Egypt and Mozambique. Eni has signed its exploration and production sharing agreement with the National Oil and Gas Authority of Bahrain (NOGA) for offshore Block 1. The Italian company said that under the terms of the agreement, Eni will pursue exploration activities in an offshore area in the Gulf of over 2,800 square kilometres in the northern territorial waters of in water depths ranging from 10 metres up to 70 metres. The signing was attended by Mohamed

Bin Khalifa Al Khalifa, Minister of Oil of Bahrain and Chairman of the board of NOGA and Claudio Descalzi, Chief Executive Officer of Eni. “Thanks to this agreement, Eni strengthens its presence in Bahrain, in line with its strategy aimed at diversifying its exploration portfolio across basins with liquid hydrocarbon potential, as those present in this Middle East region,” said Eni. The signing comes as Bahrain's first LNG import terminal, near Khalifa Bin Salman Port, is set for its commercial start-up. The LNG facility comprises a floating storage unit (FSU) and a regasification platform. Bahrain has already taken over the charter of the FSU called “Bahrain Spirit” on a 20-year deal from shipping company Teekay LNG, a shareholder in the project. The Bahrain LNG ownership consortium comprises four companies, owning between 30 percent and 20 percent of the shares, including the Gulf state’s National Oil & Gas Authority (Noga), Teekay LNG, South Korea’s Samsung C&T and the Gulf Investment Corporation.

Until now, Bahrain has not been a natural gas importer and has met all its own needs from domestic sources and these are now expected to increase. The exploration accord with Eni is similar to one signed with Egypt that led to a huge offshore natural gas discovery in 2015 by the Italian company. The find was the Zohr field in the East Mediterranean and it enabled the Egyptians to meet all their domestic gas needs and halt LNG imports. Natural gas currently fuels all of Bahrain’s power plants. The country’s power sector consumes around 50 percent and the industrial sector about 33 percent of total natural gas supplies. At the same time, Bahrain has already made new oil and natural gas discoveries, though these are still being assessed in the Khalij al-Bahrain offshore basin, south of where Eni will commence its E&P operations. The existing Bahrain resources are estimated to comprise more than 80 billion barrels of tight oil and between 10 and 20 trillion cubic feet of tight gas.

BAKER HUGHES-GE, the energy services company and LNG equipment supplier, reported sluggish first-quarter earnings even as it logged two important turbomachinery contracts for projects in West Africa and the US Gulf Coast. BH-GE returned to an operating profit of \$176M from a loss of \$41M in the first quarter of 2018, though earnings were 54 percent lower than the previous fourth-

quarter of 2018 when earnings were \$382M. The company’s revenues for the first quarter rose by 4 percent to \$5.61 billion from \$5.39Bln in the year-ago quarter. However, revenues were down compared with the previous quarter when \$6.26Bln was posted. “BH-GE delivered a solid first quarter against a backdrop of stabilizing global oil and gas markets. US rig count dropped slightly less than expected, and international activity remained steady,” said Lorenzo Simonelli, BH-GE Chairman and Chief Executive. “The LNG market is very active. While the speed of the recovery varies across these markets, we see our company positioned to benefit from multiple growth drivers,” added Simonelli. “Our Turbomachinery & Process Solutions (TPS) segment saw continued activity in the LNG market, with further progress on several major projects. In the first quarter, we secured contract awards to provide turbomachinery equipment for the Golden Pass LNG export facility and BP’s Tortue Floating LNG project,” stated the CEO.

He was referring to the venture in Texas being pursued by Qatar Petroleum and ExxonMobil and another offshore Senegal and Mauritania being developed by BP and Dallas-based Kosmos Energy. BH-GE's turbomachinery and process division orders still fell 12 percent year-on-year and equipment orders were down 14 percent. The turbomachinery division’s revenue of \$1.30Bln was 11 percent lower compared with the \$1.46Bln registered in the same three months of 2018. BH-GE remains optimistic about more LNG orders in the pipeline. “We remain at the forefront of technology and solutions for the LNG market and are well positioned as new projects are sanctioned,” added the CEO. “In summary, we have a positive outlook across a number of end markets. Strengthening international markets will have the largest positive impact on our business, while operators in North America will continually re-evaluate their spending plans,” he said. “The next wave of LNG projects will be positive for us, and we continue to see encouraging signs in the offshore market,” concluded Simonelli.

BANGLADESH has started up its second liquefied natural gas import facility deployment offshore the port of Cox’s Bazar and the floating storage and regasification unit, the “Summit LNG”, has already sent gas into the Asian nation’s network. The FSRU is part of a

project involving Singapore-based Summit Power International and Excelerate Energy of the US, owner and operator of the FSRU. The “Summit LNG” vessel is capable of regasifying 500 million cubic feet a day and has been chartered from Excelerate for a period of 15 years. The ship loaded its commissioning cargo at Ras Laffan in Qatar before heading for Bangladesh and Summit Power said it had now started supplying gas to the grid. “This significant milestone was achieved approximately one month ahead of schedule, saving resources for the government, and will be the source of supply to many of the homes and industries waiting for much-needed gas,” said Summit Power, whose Chairman and founder is Muhammed Aziz Khan. “Investors in Bangladesh require to believe that energy, gas and power will be available to their industries,” stated Khan. “Our ‘Summit LNG’ and its 500 million cubic feet per day capability will help to strengthen that trust,” added Khan.

The Summit Power Chairman also called on the government and the Bangladesh Energy and Regulatory Commission to make sure fair natural gas prices were set. “Only a fair price can ensure uninterrupted gas and power supply,” said Khan. “We are grateful for the opportunity given to us by the Ministry of Power, Energy and Mineral Resources, as well as PetroBangla and Rupantarita Prakritik Gas Co Ltd,” he added. The Summit FSRU can handle around 3.75 million tonnes per annum of LNG and doubles the country’s import capacity after a first FSRU, the “Excellence”, was commissioned at Moheshkhali Island in August 2018 as the first Bangladesh import facility. The Moheshkhali Island venture was co-developed by PetroBangla, the International Finance Corporation, part of World Bank Group, and Excelerate provided the FSRU. The latest FSRU is a 138,000 cubic metres capacity vessel that was refitted at dry dock by the N-KOM shipyard in Ras Laffan in Qatar. Summit Power operates 20 plants in Bangladesh with an installed capacity of 1,941 megawatts, comprising 20 percent of Bangladesh's total capacity in the private sector. The power company is also developing the 583 MW gas-fired plant in the Bangladesh town of Meghnaghat, located about 20km south of the capital Dhaka and which will be the nation’s largest when it comes on line in March 2022.

BROWNVILLE Ship Channel is making progress in its development as one of the major liquefied natural gas export waterways with the owner of the Rio Grande LNG project financing a key improvement plan set to start in 2020 and using some design features from the expanded Panama Canal. NextDecade Corp., developer of the Rio Grande and Galveston Bay export projects in Texas, has recently signed an agreement to provide all the finance for the Brazos Island Harbor Channel Improvement Project to make the Brownsville Ship Channel navigation safer and more efficient. The Brazos Island Harbor project involves the deepening of the ship channel from the Gulf of Mexico to the western boundary of the proposed Rio Grande LNG export plant. NextDecade will also fund the widening of the bend close to the entrance of the Brownsville Ship Channel to improve navigational safety. The Port of Brownsville is governed by the Brownsville Navigation District, a political subdivision of the State of Texas. The district is guided by an elected Board of Commissioners who serve four-year terms. Brownsville Navigation District Chairman John Reed recently signed the ship channel improvement agreement with NextDecade Chief Executive Matt Schatzman. “A wider, deeper channel not only benefits existing and future port customers, it also benefits our LNG partners,” said Reed. “When complete, the deeper channel will make us among the deepest ports on the Gulf of Mexico, enhancing our competitiveness by closely matching the design features of the expanded Panama Canal,” explained Reed. The Port of Brownsville is located at the southernmost tip of Texas at the westernmost terminus of a 17-mile channel that flows into the Gulf of Mexico at the Brazos Santiago Pass. The City of Brownsville is two miles to the southwest and is adjacent to the Rio Grande River, providing a convenient gateway via three international bridges to Mexico and beyond. The current Brownsville Ship Channel has an authorized depth of 42 feet. The turning basin has a depth of 36 feet and a width of 1,200 feet.

Planning to deepen the ship channel from 42 feet began in 2007 with a project feasibility study. The US Army Corps of Engineers (USACE) completed the feasibility study in 2014, recommending deepening the channel to 52 feet. Estimates for the deepening project may

be up to \$350 million, with about 50 percent of the actual total paid for by NextDecade. The US Congress has authorized the channel deepening project, making the Brazos Island Harbor project eligible to receive federal funding. “With the new partnership, the Brownsville Navigation District expects to pay for the project with a combination of public-private partnership dollars, port funds and federal funds,” said Chairman Reed. “The project is expected to start in the first half of 2020, with completion in 2023,” he added. NextDecade plans to construct and operate the Rio Grande LNG project on a 984-acre site on the ship channel. The proposed LNG project could result in significant investment in Cameron County, creating nearly 6,000 direct jobs during construction. NextDecade received the Final Environmental Impact Statement from the Federal Energy Regulatory Commission for the Rio Grande project and its affiliated Rio Bravo Pipeline. With the FEIS issuance, the FERC has established a 90-day federal authorization decision deadline of July 25, 2019. The Rio Grande plant is expected to produce around 27 million tonnes per annum of LNG when fully developed. NextDecade has said it anticipates making a positive final investment decision on up to three of the six Trains at the Rio Grande facility by the end of the third quarter of 2019. The Houston-based company has a second Texan export venture under development called Galveston Bay LNG. The Galveston Bay project will include a 97-mile affiliated pipeline to move 3 billion cubic feet of natural gas per day from the Katy Hub in Waller County, while the liquefaction plant is proposed for a 550-acre site along the Texas City Ship Channel.

CHART INDUSTRIES, the US LNG and industrial gases equipment provider, has agreed to acquire Harsco Corp.’s Industrial Air-X-Changers business for \$592 million in cash as it makes its fourth acquisition in two years to broaden its sector offerings. Chart, based in the outskirts of Atlanta, Georgia, said the acquisition was expected to be completed in the second quarter of 2019, subject to the satisfaction of certain customary closing conditions and regulatory requirement. The Harsco Industrial Air-X-Changers unit specializes in gas compression coolers. The Chart acquisition 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. Jill Evanko, President and CEO of Chart, said she was delighted with the latest acquisition of Harsco’s Industrial Air-X-Changers unit.

“This is a perfect match of two companies with complementary strengths,” stated Evanko. “This strategic acquisition will enable us to build on the strong foundation Harsco has constructed for its Air-X-Changers business,” added the CEO. “We look forward to integrating the strong management team and very talented team members into the Chart family,” stated the CEO. Harsco said the proceeds from the transaction to sell its gas compression equipment subsidiary would be used to pay debts and provide the parent company with additional financial flexibility to continue investing in other growth opportunities. Harsco also announced, in a separate deal, that it had entered into an agreement to acquire Clean Earth Inc., a specialty waste company, further accelerating its transformation into an environmental solutions operator. “The sale of our Air-X-Changers business marks a significant step for Harsco as we focus on delivering superior performance across market cycles and scaling the differentiated and value-added environmental solutions that are becoming important growth drivers for the Company,” said Chairman and Chief Executive Nick Grasberger. “This transaction is a great outcome for Harsco and the Air-X-Changers business. Under Chart’s ownership, Air-X-Changers will become part of a company that is a leading supplier of mission critical equipment to the energy and chemicals industries, and one that is committed to growing the business for the benefit of its customers and employees,” added Grasberger.

CHART INDUSTRIES announced the release of the updated version of its liquefied natural gas processing technology. Chart said its IPSMR®+ process moves on from its current technology for the liquefaction of natural gas. “The additional features of IPSMR®+ will further lower power consumption, reduce plant emissions and lower plant cost per ton,” said the company whose headquarters are on the outskirts of Atlanta. “Chart’s IPSMR®+ delivers industry leading project economics by producing more LNG while reducing plant capital cost,” it added. The company explained that in the new age of LNG modular midscale solutions, Chart’s existing IPSMR® process has already been adopted by engineering, procurement and construction companies and validated by both state-owned and international oil and gas companies. “Specifically, IPSMR®, along with our industry-proven brazed aluminum heat-exchangers, Core-in-Kettle® heat-exchangers and our Hudson air cooled heat-exchangers, will be utilized on multiple mid-scale export terminal projects,” stated Chart. The new version, IPSMR®+, builds on our single mixed-refrigerant design and adds a pre-cooling step. Chart noted that its IPSMR®+ process provides as much as 8 percent increased efficiency over IPSMR®.

Chart’s less complicated method for pre-cooling IPSMR® requires approximately 25 percent less plot space than conventional pre-cooled liquefaction technologies, independent of which rotating equipment is utilized. In addition to broadening its mid-scale offering, with the additional efficiency, capacity and cost benefits, the IPSMR®+ process fits with LNG plant projects using multiple identical liquefaction Trains. “At our customers’ requests to continue developing innovative technology solutions using industry standard and proven equipment, Chart is pleased to be offering IPSMR®+ which is an enhancement of our successful IPSMR® process technology,” said Jill Evanko, Chart’s Chief Executive. The CEO stated that IPSMR®+ had been evaluated by two international oil companies who have compared it with other technologies and determined it continued to be the most efficient. “We are proud of our equipment and processes which serve a broad set of applications and can be customized to what works best for the operator and our partners in each project,” added Evanko.

CHINESE liquefied natural gas imports rose 25 percent in March compared with the same month a year ago and the nation has also begun to improve its natural gas storage facilities to help meet peak demand. The LNG imports amounted to 4.06 million tonnes in March compared with 3.25MT in March 2018, according to data from the General Administration of Customs. However, the statistics showed that the level of shipments were down from the 4.35MT imported in February 2019 and much lower than the 6.58MT received in January at the height of the Northern Hemisphere winter season. For the January-March period, China imported a total of 14.95MT of LNG, 20.7 percent higher than in the first three months of 2018. Among the main suppliers of shipments to China in March 2019 were nations such as Qatar, Australia, Indonesia and Nigeria. China’s National Development and Reform Commission has been working to encourage companies to expand the gas pipeline network, improve gas storage and is now seeing results in enabling the system to meet peak demand when required. China generally uses depleted or abandoned gas fields and reservoirs to build underground storage as they are more effective and economical compared with spherical tanks above ground. The state-owned major, China Petroleum & Chemical Corp., also known as Sinopec, has now started sending natural gas imported at its Tianjin LNG terminal east of Beijing, to the newly-built Wen 23 underground gas storage facility at Puyang in northern Henan province.

The Wen gas storage was part of the China’s 13th Five-Year Plan to benefit Hebei and Henan provinces and was rebuilt from an exhausted gas field and put into operation in mid-March 2019. Sinopec said that the storage is connected to its own Ordos-Anping-Cangzhou gas pipeline, which is 700 kilometres long and includes one trunk line and two branch lines linking eight cities and 23 counties. The pipeline has been in commercial operation since November 2018. The gas storage is also linked to Sinopec’s Yulin-Jinan and Puyang-Kaifeng gas pipelines in northern China. The Wen storage facility has capacity of 10.4 billion cubic metres and it is now the largest in the northern and eastern regions. The underground storage gives Sinopec’s gas supply optionality and flexibility during peak

demand in northeast China. The Wen project is the first of several major underground gas storage facilities scheduled to start up in the next couple of years to meet growing Chinese demand. Sinopec's onshore Tianjin LNG terminal, which started commercial operations in April 2018, has an annual transfer capacity of 3MT.

CHIYODA Corp., one of the leading Japanese LNG engineering companies, has named Kazushi Okawa as its new Chairman and Chief Executive to lead turnaround efforts after it suffered large losses on contracts and a plunge in its shares. Okawa, aged 62, previously headed Mitsubishi Corp.'s infrastructure project and plant engineering departments. The current Chiyoda President and CEO Masaji Santo is expected to assume the figure head role of President when the appointments are confirmed at the annual meeting of shareholders to be held on June 25. Analysts noted that Mitsubishi is Chiyoda's biggest shareholder with a 33.5 percent stake and has put its man in place to lead the company overhaul and the return to profitability. Chiyoda is also expected to receive a capital injection of at least \$1.4 billion to help it recover from project setbacks and to secure some of the liquefaction plant work in a new wave of forthcoming contracts. Mitsubishi and the largest Japanese bank, Mitsubishi UFJ Financial Group, have given financial help twice previously to Chiyoda.

Mitsubishi itself is likely to lead this time with an injection of capital via a private placement of new preferred shares, backed up by other loans. Chiyoda is one of the top four global companies for building LNG production plants, along with Japanese peer JGC Corp, Bechtel of the US and Franco-US company TechnipFMC. Chiyoda is trying to stabilize its finances for a future wave of LNG export projects that are approaching final investment decisions. It is already part of a consortium comprising McDermott and Zachry Group of the US contracted to build the Golden Pass liquefaction and export plant in Texas for Qatar Petroleum and ExxonMobil. The company's shares plunged to a 10-year low at the end of 2018 when losses began to emerge in its earnings forecasts for the Cameron project and other ventures, including the Tangguh LNG plant expansion in Indonesia.

DELEK GROUP of Israel, the company with stakes in the giant Leviathan field in the Eastern Mediterranean set to come on stream in 2020, said it was one of the bidders for UK North Sea oil and natural gas assets being sold by Chevron Corp. of the US. Chevron is selling its central North Sea assets, including the Alba, Alder, Captain and Erskine fields as well as the Britannia, Elgin-Franklin and Jade non-operated projects. Analysts said the US major's pending transaction is all the more urgent as it plans to spend more than \$33 billion on acquiring Anadarko Petroleum, the US shale and Mozambique LNG developer. "Delek confirms that as part of its strategy to expand its activities in the international energy markets and capture additional operational and financial synergies, its wholly-owned subsidiary Ithaca Energy submitted a bid in relation to the Chevron sales process and is in discussions with Chevron in relation to its bid," said the Israeli company. "The sales process relates to Chevron's interests in the oil and gas fields Alba, Alder, Britannia (and its satellites), Captain, Elgin-Franklin, Erskine and Jade located in the UK North Sea," explained Delek. "To the extent that any transaction is concluded between the parties it is anticipated that closing would follow in 2019 and would be funded inter alia through a combination of conventional non-recourse debt finance and existing resources," stated the Israeli company.

Also in the running for the Chevron North Sea fields, valued at more than \$2Bln, are UK chemicals company Ineos, Premier Oil of the UK and Oman's Petrogas. Delek is expanding its international presence after acquiring Ithaca Energy in February 2017. Delek's East Med operations include plans to supply natural gas to Jordan, Israel, Egypt and the Palestinian Authority as well as possible feed-gas volumes for LNG production. Delek acquired Ithaca for US\$525 million and said that the purchase was part of Delek's strategy to focus on exploration and production and expansion beyond its East Med operations offshore Israel and Cyprus. The Israeli group's subsidiaries are stakeholders in the Leviathan gas field with reserves of 22 trillion cubic feet and in the established Tamar field in Israeli waters as well as the Aphrodite field offshore Cyprus. The Israeli company's main partner in the East Med operations is Houston, Texas-based Noble Energy.

ENAGAS, the Spanish gas network owner and LNG terminal operator, posted a more than 7 percent drop in first-quarter revenues as it reported progress on the Trans Adriatic Pipeline connecting Turkey with Italy via Greece and Albania and reflected on a US acquisition. Enagas said its quarterly highlight was the purchase of 10.93 percent of US pipeline company Tallgrass Energy for \$590 million in alliance with US equity fund Blackstone Infrastructure and GIC, the sovereign wealth fund of Singapore. "This operation strengthens the company's strategy for growth and sustainable dividends in the medium and long term," explained Enagas. The Spanish utility also reported that the Trans Adriatic Pipeline was now 85.7 percent complete. "Enagas has a 16 percent stake in this infrastructure project that is key to guaranteeing the security of Europe's energy supply," it said. Enagas added that its revenues for first-quarter fell 7.4 percent to 278.2 million euros (\$312M) from 300.5M euros in the first three months of 2018. Net profits increased 0.2 percent to 103.9M euros. Enagas has four domestic LNG import terminals around Spain at Barcelona in the northeast, Cartagena in the southeast, Huelva in the southwest and Gijon in the northwest. It also owns a 50 percent stake in the facility serving the northwest city of Bilbao.

Other European investments held by Enagas, in addition to the Trans Adriatic Pipeline, include a stake in Greek natural gas transmission operator DESFA. The company said that its net debt at the end of March 2019 was 4.40 billion euros (\$4.93Bln), higher than the 4.27Bln euros in the previous quarter because of the inclusion of the debts of the Chilean LNG terminal company, GNL Quintero. The figure additionally includes debts from the acquisition of its stake in Tallgrass Energy. In its market overview, Enagas said domestic-commercial demand for natural gas in Spain at the end of the first quarter was 2.4 percent higher than the same period of 2018 and amounted to 104.0 terawatt hours. There was also a 4.9 percent increase in industrial demand compared with the first quarter of 2018 as new customers were added amid the "positive performance" of the Spanish economy. The demand for natural gas for power generation increased by 31.4 percent due to lower hydropower generation in the first three months of 2019.

EXXONMOBIL, the US major has signed a sales and purchase agreement with Zhejiang Provincial Energy Group to provide liquefied natural gas supplies over a period of 20 years. Under the agreement, Zhejiang Energy is expected to receive 1 million tonnes per annum at its regasification facilities in China. "This sales and purchase agreement represents an important milestone and provides a solid foundation for our strategic partnership with Zhejiang Energy," said Peter Clarke, senior vice president of LNG at ExxonMobil. "ExxonMobil shares Zhejiang Energy's vision in developing a major LNG gateway in the Ningbo-Zhoushan region," added Clarke. The US company, whose headquarters are in Irving, Texas, is a global exploration and production partner of Qatar Petroleum whose Qatargas subsidiary is one of the world's largest LNG producers at Ras Laffan. "We look forward to continuing our support for Zhejiang Energy during the construction, commissioning and operation of its Wenzhou LNG receiving terminal," stated the ExxonMobil executive.

China is now the second-largest LNG importer and in 2018 saw shipments jump by 38 percent to 53.81MT compared with just over 39MT in 2017. China is also in the midst of increasing regasification and storage capacity at existing terminals as well as constructing new facilities. Zhejiang Energy, in partnership with China Petroleum & Chemical Corp., is developing its Wenzhou gas hub to boost supplies in the eastern Chinese provinces. The Wenzhou project includes four 200,000 cubic metres capacity storage tanks, a berth to dock tankers of 30,000 cubic metres to 266,000 cubic metres capacity, as well as a 26-kilometres pipeline. The first phase of the terminal is expected to start operations at the end of 2021. "With a long-term commitment to China, ExxonMobil expects to help meet China's energy needs through its products, technologies, partnerships and investments," said the US company.

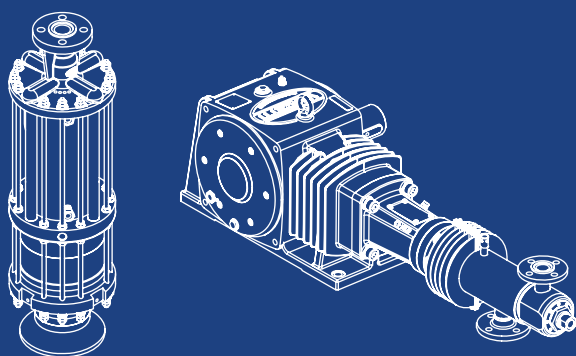
FLEX LNG, the growing LNG shipping company with four vessels operating and nine others on order and whose largest shareholder is a trust firm controlled by Norwegian magnate John Fredriksen, has formally filed with the US Securities and Exchange Commission to be listed on the New York Stock Exchange. Flex said it had publicly filed a registration statement with the SEC



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after saying in April that a filing was imminent. “No new securities will be issued in connection with the listing, which is expected to commence after the SEC completes its review process,” said Flex. “Following the listing, the company’s ordinary shares will be listed for trading on both the NYSE and the Oslo Stock Exchange under the ticker FLNG,” added Flex. Fredriksen has several other companies listed on the NYSE, including Frontline Ltd., one of the world’s largest oil tanker companies with around 60 vessels. Frontline is based in Hamilton, Bermuda, and Fredriksen is Chairman of the board and President of the company. Flex is currently a small operation by comparison with Frontline. Flex had reported latest quarterly profits of \$15.2 million compared with \$1.3M of profits in the same three months of 2017.

Flex has said it expected the coming growth of LNG production and the expected rise in demand for natural gas to continue tightening the shipping market. “We believe that our state-of-the-art LNG carriers will command a premium in the market and be the preferred vessels for longer term charters,” said Flex. The Fredriksen-owned company, Gevevan Trading, is Flex’s largest shareholder and following a recent private placement of shares holds a 44.6 percent stake in Flex. Flex said on April 30 that it signed a sale-charterback transaction with Hyundai Glovis Co. of South Korea, a logistics company that normally specializes in car-shipping vessels, for the LNG carriers “Flex Endeavour” and “Flex Enterprise”. Under that agreement, Flex will sell the vessels to Hyundai Glovis for a combined gross sum of \$420m. Flex explained that both carriers would then be chartered back for a period of 10 years. Flex will have options to acquire the vessels during the term of the time-charters.

FLUXYS LNG, the operator of the Zeebrugge import terminal in Belgium, has opened a subscription window from April 30 to May 24 for unloading slots and additional storage services at the facility. Fluxys said Zeebrugge offered its customers optimum destination flexibility, including direct access to the markets of Belgium, fully interconnected with the gas systems of all surrounding markets such as those in France, the Netherlands and the UK and take-away capacity from the terminal is readily

available. “The subscription window is a highly attractive opportunity for companies to secure LNG terminalling capacity with an experienced provider at a key strategic location providing optimum destination flexibility,” said Fluxys. “Fluxys LNG will allocate the requested services to the subscription window participants by 20 November 2019 at the latest,” it added. The Zeebrugge facility has operated since 1987 and its tariffs are regarded as among the most competitive in Northwest Europe. It is also one of the terminals that perform occasional transshipments of LNG cargoes from the Russian Yamal liquefaction and export plant in Northern Siberia. Fluxys is currently building a fifth LNG storage tank with a capacity of 180,000 cubic metres and additional process installations.

The construction is expected to be completed by mid-2019 and will further support its operations. “Capacity at the Zeebrugge terminal is highly attractive because gas import needs in Northwest Europe are set to rise significantly,” said Fluxys. “While gas production in The Netherlands and the North Sea is declining, gas demand for power generation will increase to accommodate the phase-out of sizeable coal, lignite and nuclear power generation capacity in the region,” it added. “The Zeebrugge terminal ticks all the boxes for LNG companies who are keen to close the forthcoming supply-demand gap in Northwest Europe,” stated the Belgian company. Fluxys noted that Zeebrugge was recognized as a versatile facility, able to handle LNG ships of any type and size for loading or unloading. The terminal also serves as a hub for small-scale vessels as well as LNG truck-loading. Fluxys has invested in a second truck-loading station, doubling the capacity from 4,000 to 8,000 truck-loadings per annum in 2019. Access to subscription registration is via the Web site of www.fluxys.com

GASUM, the Finnish natural gas company, an LNG supplier and infrastructure operator in Finland, Sweden and Norway reported lower profits and volumes ahead of the opening up of Finland’s gas market in 2020. The company’s operating profits in the first quarter fell 16.1 percent to 61 million euros (\$68.1M) from 72.8M euros in the same three months a year ago. Quarterly revenue rose 1.5 percent to 396.6M euros

from 390.5M euros in the year-ago period. The Skangas LNG business is now fully under the Gasum banner and during the quarter the bunkering vessel “Coralus” performed its 100th ship-to-ship bunkering. The vessel’s main operating areas are the North Sea, the Baltic Sea and the Skagerrak area and Gasum said the use of LNG for shipping fuel was growing. The Manga LNG import terminal at the Port of Tornio, Finland’s second import facility, has progressed to commissioning. The other import terminal is at Pori. “The world’s first LNG-fueled icebreaker, ‘Polaris’, received LNG fuel from the Pori import terminal in February,” said Gasum. The company added that its preparations are gathering pace ahead of the opening up of the Finnish gas market at the start of 2020, which is when the transmission business will be unbundled into a separate company. “Work related to the opening up of the gas market will continue strongly throughout the year,” said Johanna Lamminen, Gasum Chief Executive.

The gas transmission business will be unbundled from Gasum into a separate company by the beginning of 2020. In relation to the transmission business, Gasum owns the Finnish natural gas transmission pipeline network and the gas inter-connector pipeline project constructed between Finland and Estonia (Baltic Connector) and is responsible for gas transmission to customers. Until the end of 2019, Gasum will act as the Transmission System Operator (TSO) with system responsibility, and the new Gas TSO with its ownership unbundled from Gasum will begin operations on January 1, 2020. The CEO also noted that the size of the Nordic heavy-duty vehicle filling station network will become many times bigger in the next few years as more vehicles switch to gas in heavy-duty transport. “This year will see us open gas filling stations serving lighter vehicles in conjunction with the IKEA stores in Raisio, Kuopio and Tampere, Finland,” said Lamminen. “Gas as a fuel is also attracting interest among public transport and particularly heavy-duty transport operators. The City of Lappeenranta will introduce low-emission gas buses and several transport companies have taken gas-fueled heavy-duty vehicles and biogas-fueled delivery vehicles into service,” she added. The sales volumes of natural gas decreased year on year in the quarter while

LNG consumption rose. Natural gas consumption totaled 8.3 terawatt hours versus 9.3 TWh in the 2018 quarter and LNG consumption was up at 1.63 TWh compared with 1.55 TWh in the year-ago period.

GIBRALTAR has formally opened its liquified natural gas import terminal as the British overseas territory switches from diesel power to gas-fired electricity and promotes cleaner fuel for shipping visiting the port. The newly commissioned import and regasification facilities were recently completed by Royal Dutch Shell and its subsidiary Gasnor adjacent to a converted 80-megawatts gas-fired power plant. Shell said LNG would be delivered to the terminal by ship twice a month and at night, minimising disruption to the neighbouring port and airport. The LNG will be stored in five double-walled stainless-steel tanks, each able to hold 1,000 cubic metres. Gibraltar is an example of small-scale LNG in action in terms of deliveries and use. Similar facilities are being studied by other project developers around the world to provide cleaner power and fuel. The opening ceremony was attended by Gibraltar’s Chief Minister Fabian Picardo and Shell executives, including Steve Hill, Executive Vice President for Gas and Energy Marketing.

“I am immensely proud that, under this government, we have made the crucial switch to cleaner power generation,” said Picardo. “Instead of using old technology we can now look forward to clean, safe, gas-fired power generation from the port,” he added. “I am delighted that the issues as to reliability of Gibraltar’s power supply and what we pump into the air by the supply of that power are now resolved for generations,” he said. Shell executive Hill congratulated the Gibraltar Government for taking the decision to adopt LNG for power supply back in 2011. “Obviously the future of energy is probably a much more widely debated discussion around the world today than it was at that time,” added Hill. “Some people think we should get rid of all our fossil fuels immediately and that is hard to understand because fossil fuels still represent 80 percent of energy supply today,” stated the Shell executive.

INDIAN liquefied natural gas imports rose 2.6 percent for the fiscal year to almost 20 million tonnes, though dropped

for the month of March with cargoes arriving at a slower pace from main suppliers in Qatar, West Africa and Australia. The shipments were received at India's four operating import terminals at Dahej, Hazira and Dabhol near the West Coast port of Mumbai and at the new East Coast terminal at Kamarajar, 25 kilometres north of Chennai Port in Tamil Nadu. The imports dropped in March by 14.4 percent to 1.63 million tonnes (2.20 billion cubic metres) from 1.90MT (2.47 Bcm) in March 2018. The Asian nation's shipments were also down in February 2019 and had amounted to 1.41MT compared with 1.56MT in February 2018. However, the volumes for the full fiscal year to date at the end of March rose 2.6 percent to 19.98MT (27.01 Bcm) from 19.47MT in the previous fiscal year. LNG was procured during the month by Petronet LNG, Gas Authority of India, Gujarat State Petroleum Corp., Reliance Industries, Bharat Petroleum Corp., Torrent Power and Indian Oil Corp., according to data from the Indian Ministry of Petroleum and Natural Gas. Domestic natural gas output during March 2019 rose by 1.2 percent to 2.81 Bcm compared with 2.78 Bcm in the same month the previous year. The cumulative production of natural gas for the 12 months of the fiscal year was up 0.7 percent to 32.87 Bcm compared with 32.64 Bcm in the previous fiscal year.

The Ministry said that LNG imports were regasified to make up 52 percent of the nation's natural gas consumption during March as overall monthly gas usage totalled 4.57 Bcm. The major natural gas consuming sectors for the combined LNG and domestic gas output were the fertilizer industry (29 percent), gas-fired power (21 percent), city-gas distribution (17 percent), refineries (13 percent) and petrochemicals (7 percent). Among the LNG cargoes that were received at the Dahej terminal in March, there was one carried by the 172,000 cubic metres capacity carrier "Beidou Star". The vessel unloaded a shipment on March 19 from the Gorgon plant on Barrow Island in Western Australia. African cargoes unloaded at Dahej included one carried on the 160,500 cubic metres capacity vessel "Sonangol Sambizanga" from Angola in southwest Africa. Among the Qatari cargoes, the 210,100 cubic metres capacity Q-Flex carrier "Al Ghariya" unloaded a shipment at Dahej on March 23 from Ras Laffan in Qatar.

JGC CORP. of Japan, one of the leading global LNG engineering companies, has been praised by the influential Japanese Ministry of Economy, Trade and Industry for its use of digital technology in liquefaction plant construction and for onstream operations. JGC, whose most recent projects include Ichthys LNG in Australia and the Russian Yamal project and with a backlog including the LNG Canada plant in British Columbia, said the award reflected its high-tech focus underpinned by its "Grand Plan 2030" strategy. "The selection was based on JGC's advanced efforts in the utilization of digital technology, such as improving plant construction productivity using wireless sensors and 3D data, and establishing a system to support the yield improvement of LNG plants," said JGC. The mention by the Ministry came as Yokohama-based JGC posted just modest recent earnings, though its performance has been better than that of Japanese peer Chiyoda Corp., which suffered losses from contract hold-ups and some wayward project estimates. While JGC posted lower sales and income in the third quarter of its fiscal year, it was anticipating its LNG Canada work over the next four years. JGC was awarded that contract with Fluor Corp. of the US. The Canadian plant will be located at a brownfield site near the town of Kitimat in BC.

Experienced player JGC, is also working on the Coral floating LNG venture offshore Mozambique for Italian energy company Eni and partners after being a contractor on the world's first FLNG project for Petronas offshore Malaysia. JGC said its two main IT aids for liquefaction plant construction and operations are "Field Opt" and "Airlize LNG". "At overseas plant construction sites, where thousands to tens of thousands of workers are engaged, improving labor productivity, automation, and labor-saving are key issues," said the company. "JGC has developed and is promoting the use of Field Opt, a support system for construction productivity improvement that combines real-time positioning of workers and construction equipment using wireless sensors (RFID: radio frequency identification) and detailed control of construction sequences using 3D CAD data," it added. JGC said that its "Airlize LNG" technology helped in building some LNG plants, where the yield rate depended on weather issues

such as temperature and wind direction, which can cause problems in operations. "JGC has developed 'Airlize LNG' to increase production through simulating operation optimization by utilizing technology related to computational fluid dynamics (CFD) and meteorological data-sensing as part of company efforts to improve the productivity of LNG plants," stated the JGC.

KINDER MORGAN, the US pipeline and infrastructure company, has encountered minor issues relating to the commissioning of equipment at the facility near Savannah in the state of Georgia vying to enter the start-up phase ahead of the Cameron LNG plant in Louisiana. Elba Island is an existing import terminal that has been transformed into an export plant to produce an initial 2.5 million tonnes per annum of LNG from 10 small liquefaction Trains. Kinder had previously expected the first liquefaction Train to come on stream in April and the remaining Trains following in sequence. However, the project has been hit by minor construction delays. The start-up had previously been expected by the end of 2018. According to the Federal Energy Regulatory Commission, the mini liquefaction Trains 1-6 at Elba Island are expected to start entering service at one-month intervals. Elba Island's Trains 7-10 are then scheduled to come on stream in the third quarter of 2019. The 10 units being installed at Elba mark the first time this specific technology is being deployed in the US. The Elba plant is using Royal Dutch Shell's Movable Modular Liquefaction System.

These small-scale liquefaction Trains are mostly pre-assembled then brought to the site. "Since this is the first project using this specific configuration of liquefaction technology, we have experienced some minor issues that are being resolved as part of the process," said Kinder. The Georgia project is supported by a 20-year supply contract with Shell and is the smallest of the three US plants being completed in 2019. Shell was a stakeholder in the Elba Island plant when it operated as an import terminal. Start-ups for Elba Island, Sempra Energy's Cameron LNG in Louisiana and the Freeport plant in Texas will double the number of US LNG export terminals in operation. The Cameron facility is also set for production, ahead of Freeport, though both have suffered various holds ups and

problems in construction. Kinder and several equity fund partners are also developing the Gulf LNG export project proposed at the site of the existing import terminal at Pascagoula in Mississippi.

KOSMOS Energy's Greater Tortue-Ahmeyim project, the floating liquefied natural gas development offshore the maritime boundaries of Mauritania and Senegal, is making advances as shareholder Kosmos Energy prepares to sell some of its stake. "In the wider Mauritania-Senegal basin, Kosmos has commenced a formal process to sell down its interest to around 10 percent," said the Dallas, Texas-based company in its first-quarter earnings. Kosmos agreed to sell BP around 60 percent of the Senegal and Mauritania 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 early May, 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 (FPSO) unit. The latest contract was awarded in April 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.

"These next phases are expected to expand capacity of this hub to almost 10 million tonnes per annum of LNG for export," said Kosmos. 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. Kosmos posted a first-quarter net loss of \$53 million and revenues were \$297M on sales of 5.1 million barrels of oil equivalent. "Kosmos has made a strong start to 2019 with progress across all business units and first-quarter results in line with guidance," said Andrew G. Inglis, Chairman and Chief Executive officer. "Our intention to sell down our position in Mauritania and Senegal to around 10 percent has generated significant industry interest and we have commenced a formal process, with bids expected by the end of summer," added Inglis. "On the finance side, we successfully completed a \$650M bond offering during the quarter meaning Kosmos now has no debt maturities until 2022. We also paid our inaugural quarterly dividend in the first quarter," stated the CEO.

mitsubishi corp. of Japan is planning to refinance the Japanese energy and LNG engineering company Chiyoda Corp. with a capital injection of at least \$1.4 billion to help it recover from project setbacks and to secure some of the liquefaction plant work in a new wave of forthcoming contracts. Chiyoda, one of the world's leading builders of LNG liquefaction plants, has struggled with losses from the Cameron LNG project in Louisiana being developed by Semptra Energy and in other projects. The Cameron venture has been a loss-maker for Chiyoda as it went behind schedule because of bad weather on the Gulf Coast, a shortage of skilled workers and had additional costing issues. Mitsubishi and the largest Japanese bank, Mitsubishi UFJ Financial Group, have given financial help twice previously to Chiyoda. Mitsubishi itself has a 33.5 percent stake in the engineering company and the injection of capital is expected via a private placement of new preferred shares and loans, according to a report by Japan's Nikkei financial news platform. Chiyoda is one of the top four global companies for building LNG production plants, along with Japanese peer JGC Corp, Bechtel of the US and Franco-US company TechnipFMC.

Chiyoda is trying to stabilize its finances for a future wave of LNG export projects that are approaching final investment decisions. It is already part of a consortium comprising McDermott and Zachry Group of the US contracted to build the Golden Pass liquefaction and export plant in Texas for Qatar Petroleum and ExxonMobil. Chiyoda is currently implementing counter-measures to reduce overall costs in its operations, obtaining change orders and reviewing settlement conditions from ongoing ventures while also finalizing its recovery strategy. The company's shares plunged to a 10-year low at the end of 2018 when losses began to emerge in its earnings forecasts for the Cameron project and other ventures, including the Tangguh LNG plant expansion in Indonesia. Chiyoda has also been involved in recently completed global projects such as Ichthys LNG in Australia for Inpex Corp. and French major Total and the Yamal LNG venture in Russia for Novatek, Total and Chinese stakeholders.

Naturgy Energy Group, the Spanish utility with major US and Russian liquefied natural gas supply contracts as

well as gas and power businesses in six Latin American countries, reported lower sales and margins in the short-term LNG market offset by strong long-term sales growth. Naturgy is one of the companies that have signed 20-year agreements for US cargoes from Cheniere Energy's Sabine Pass and Corpus Christi plants and is also a main contract holder for cargoes from the Yamal LNG plant in Arctic Russia operated by natural gas company Novatek. Naturgy reported a 6.7 percent rise in overall first-quarter net income from gas and power, infrastructure and LNG to 340 million euros (\$381 million) from 320M euros in the year-ago quarter. The company posted a 6.3 percent rise in quarterly gross earnings to 1.12 billion euros (\$1.25Bln) from 1.05Bln euros in the same three months of 2018. Naturgy's net sales came to 6.35Bln euros (\$7.12Bln) in the quarter. "The beginning of 2019 has been marked by the solid performance of the Infrastructure businesses and the stability in Gas & Power despite a more challenging energy scenario compared to the previous year," said Naturgy. Because of Naturgy's access to ample US LNG volumes and Yamal shipments from Siberia, the company said its international LNG unit had already secured around 90 percent of its needs, while in power supply, it has continued to reduce its portfolio of fixed-price sales contracts. This has included the sale of the gas distribution and supply business in Italy, the sale of a minority stake in the gas distribution business in Spain and the disposal of its remaining 42 percent stake in the gas distribution business in the South American nation of Colombia. The overhaul of assets comes as Naturgy is also set to start receiving 1.5 million tonnes per annum of LNG from the second liquefaction Train at Cheniere's LNG export facility at Corpus Christi in Texas.

The Spanish energy group already has a contract for almost 3.7 MTPA from Cheniere's Sabine Pass plant. Its diverse LNG supply portfolio also includes shipments from Algeria, Qatar and Nigeria. The company additionally owns a small fleet of LNG vessels. Still, Naturgy explained that its international LNG sales business posted earnings of just 105M euros in the quarter, down 29.5 percent from 40,974 gigawatt hours in the 2018 quarter to 29,068 gigawatt hours in the first three months of 2019. "This was as a result of lower volumes and smaller margins in short-term sales,"

said Naturgy. "As mentioned in the past, market conditions in the first quarter of 2018, and during the year 2018 as a whole, were extraordinary and should not be extrapolated for year 2019," stated the company. While Naturgy suffered in the spot and short-term LNG market, things were better as far as long-term deliveries were concerned. "Long-term sales continue to show a healthy growth (up 64 percent) supported by the commercial efforts intended to reduce margin volatility through the lengthening of the average maturity of our contracts," said the company. In its Latin American and South American businesses, Naturgy posted a rise of 14.8 percent to 195M euros in its quarterly gas and power infrastructure earnings because of tariff updates and efficiencies. This part of the natural gas division involves regulated gas distribution and infrastructure in Argentina gas and power, Brazil gas, Chile gas and power and Peru gas. In Chile, it also includes a gas supply business. Earnings in the North of Latin America from Mexican gas and Panama electricity amounted to 101 million euros, up 68.3 percent on the back of positive regulatory measures. Naturgy said its net debts amounted to 15Bln euros (\$16.8Bln), a 1 percent drop from the previous quarter, due to strong cash flow and despite 560M euros in dividend payments and a 135M euros share buyback during the quarter.

Noble Energy, the US exploration and production company, has reported that its liquefied natural gas feed-gas plans for offshore Israel and Equatorial Guinea were on track. Noble said its Leviathan natural gas project in the East Mediterranean offshore Israel was more than 80 percent complete amid sales proposals from various parties for pipeline deliveries and LNG liquefaction. The Houston-based company confirmed in its first-quarter earnings that first gas sales deliveries from the Leviathan field are expected by the end of 2019. "The company also sanctioned the Alen gas monetization project in Equatorial Guinea with initial sales planned for the first half of 2021," added Noble, in reference to the sending of feed-gas to the Bioko Island liquefaction plant in West Africa. Noble said that during the quarter it delivered total sales volumes of 337,000 barrels of oil equivalent per day, with US onshore volumes coming to 253,000 barrels of oil equivalent per day. Quarterly net sales volumes from the

company's assets in Israel, the operating Tamar gas field, totaled 235 million cubic feet of natural gas equivalent per day. "Production on a gross basis exceeded one billion cubic feet of natural gas equivalent per day, above expectation as a result of higher domestic natural gas demand," said Noble. "The Leviathan project highlights during the first quarter include jacket and pile installation, production manifold installation and completion of pipeline installation," explained Noble, whose offshore Israel partners include subsidiaries of the Israeli Delek Group. Options for the Leviathan production include sending feed-gas to existing liquefaction capacity in Egypt or to the Egyptian domestic market. "The next major (Leviathan) milestone will be the loading and shipping of the platform topsides expected by the end of the second quarter.

The project remains on budget and on schedule for first production by the end of 2019," stated Noble. At the end of the quarter, Noble announced the sanctioning of the Alen gas monetization project offshore Equatorial Guinea. At start-up, incremental sales from the Alen field are anticipated to be between 200 and 300 MMcf/d, gross. The company reported a first-quarter net loss of \$313 million compared with a net profit of \$574M in the same quarter of 2018 because of lower overall revenues. Total quarterly sales revenues came to \$1.05 billion compared with \$1.28Bln in the same three months a year ago, while operating expenses jumped to \$1.14Bln from \$528M in the 2018 quarter. "Our onshore US accomplishments in 2019 include lower well costs in each of our basins, reduced cycle times and strong production," said David L. Stover, Noble's Chairman and Chief Executive. "Offshore, we are uniquely positioned with world-class international projects that have minimal to no decline, and by the end of the year, Leviathan is expected to be generating significant new cash flow for our company," added Stover. Noble's US assets include production in the Denver-Julesburg Basin, known as the D-J Basin, in eastern Colorado, in the Delaware Basin in West Texas and southern New Mexico and in the Eagle Ford Shale in southern Texas. Total sales volumes across the company's US onshore assets averaged 253,000 barrels of oil equivalent per day. "First-quarter volumes reflect another quarterly production record for the company's DJ Basin assets," said Noble. The DJ Basin averaged 144

MBoe/d, an increase of 5 percent sequentially and 21 percent from the first quarter 2018. Sales volumes from the Delaware Basin assets totaled 59,000 Boe/d, up 30 percent from the first quarter of 2018.

NOVATEK, the Russian operator of the Yamal LNG plant in Siberia, said a subsidiary of the Yamal LNG stakeholder, China National Petroleum Corp., has decided to become a shareholder in Novatek's second liquefaction joint venture, Arctic LNG II. The CNPC subsidiary that will hold the Arctic LNG II project shares is called China National Oil and Gas Exploration and Development Co. (CNODC). The binding agreement was signed in Beijing in front of Leonid Mikhelson, Chairman of Novatek, and Wang Yilin, Chairman of CNPC, and gives CNODC a 10 percent stake in the venture. "The agreement is a continuation of our successful cooperation with CNPC," said Mikhelson. "We successfully launched the Yamal LNG project on budget and ahead of initial schedule as partners, which is a unique achievement in the global gas industry," he added. "The accumulated experience of working together is a solid basis for the successful implementation of our new LNG project," stated the Novatek Chairman. Feed-gas for Arctic II will come from the Utrenneye natural gas field where reserves are estimated at 1,138 billion cubic metres.

Novatek is making fast progress with its second project by signing equipment and engineering contracts for the liquefaction plant that will be sited in Russia's Gydan Peninsula. Contracts have been signed with turbo-machinery provider Siemens of Germany and the oil and gas engineering firm, Saipem of Italy. The Arctic II project's final investment decision is expected to be taken in the second half of 2019, with plans to start up the first liquefaction Train in 2023. The venture will have three Trains, each with a capacity to produce around 6.6 million tonnes per annum. The Trains will be installed on Gravity Based Structures made of concrete and including LNG storage facilities totaling 687,000 cubic metres capacity. Another Arctic II shareholder is French energy major Total, also a partner in Yamal LNG. Total has acquired a direct 10 percent stake in the venture. Total already owns a 19.4 percent stake in the Novatek company so its 10 percent direct stake gives it 21.6 percent of the Arctic II project.

ORIGIN Energy, a shareholder in the Australia Pacific LNG plant in Queensland with Sinopec of China and ConocoPhillips, reported record revenue from its share of 33 cargoes shipped in the first quarter at an average price of US\$10.84 per million British thermal units. Origin said the selling price for first-quarter cargoes was 2 percent higher than the US\$10.59 per MMBtu price in the fourth quarter of 2018 and 34 percent up on the average price of US\$8.10 per MMBtu fetched in the first three months of 2018. "JCC (long-term contract) prices softened in the early part of the quarter, as economic growth concerns and US sanction waivers for Iran helped ease oil market tightness. Prices have since recovered, driven by OPEC output cuts and further supply outages in Venezuela," explained Origin in its quarterly activities report. The APLNG cargoes shipped in the first quarter were only three more than the 30 that departed in the same three months of 2018. The plant produces almost 9 million tonnes per annum from two Trains and 7.6MTPA is contracted to Sinopec, whose formal name is China Petroleum & Chemical Corporation. Sydney-based Origin said its share of production from the APLNG plant at Curtis Island was 834,100 tonnes in the first quarter, a 3 percent rise on the 772,800 tonnes taken in the year-ago quarter. Origin said its one-third share of APLNG sales brought in record revenue of A\$763.9 million (US\$540), a 53 percent increase compared with the A\$499.9M earned in the same quarter of 2018.

Origin runs two divisions, Integrated Gas, including upstream coal-seam gas for LNG, and Energy Markets, its gas and electricity retail and wholesale business. Domestic natural gas sales brought in A\$75M in the quarter, down 17 percent from the previous quarter's A\$90M, though also lower than the year-ago period's A\$82.7M. "Natural gas sales decreased 10 percent on the prior quarter, reflecting seasonal demand and the ending of short-term wholesale contracts in Queensland. This decline in sales was partly offset by more gas utilised in generation," said Origin. Origin Chief Executive Frank Calabria said the APLNG plant continued to deliver strong earnings. "This result was driven by continued reliable operational performance and higher realised commodity prices," explained Calabria. "In the Energy Markets business, our power stations performed solidly over

the summer and were ready and available during heatwave conditions which occurred across much of the country in January and again in March," he added. "While gas sales to wholesale customers declined in the quarter, we directed additional gas to generation where it helped to meet peak summer demand in the electricity market," stated the CEO.

PAVILION ENERGY, the Singaporean company owned by the city-state wealth fund Temasek, has performed the first commercial ship-to-ship liquefied natural gas bunkering operation in the Port of Singapore as part of efforts to create an Asian LNG Hub. The operation comprised a reload of 2,000 cubic metres capacity of fuel onto a small-scale tanker at the newly-modified second jetty at the Singapore LNG (SLNG) import terminal at Jurong Island, followed by a ship-to-ship transfer to the receiving heavy-lift commercial vessel. "Pavilion Energy's first commercial ship-to-ship LNG bunkering operations in Singapore demonstrates our strong commitment and capability to deliver a comprehensive suite of LNG bunker supply solutions to Singapore and the region," said Mr. Frédéric H. Barnaud, Group Chief Executive of Pavilion Energy. "We are very pleased to have achieved this shared milestone in close collaboration with the Maritime and Port Authority (MPA) and SLNG Corporation, and with the support from various stakeholders, partners and customers," added Barnaud. Ms Quah Ley Hoon, CEO of the Port Authority, said that as the world's largest bunkering port, Singapore is committed to provide a range of fuels to meet the future energy needs of the global shipping industry. "We congratulate Pavilion Gas for completing this ship-to-ship LNG bunkering operation in the Port of Singapore safely and look forward to more of such activities taking place in our Port," she added.

Through its wholly-owned subsidiary, Pavilion Gas, a licensed LNG bunker supplier in the Port, Pavilion said it continued to be at the forefront of change for cleaner and more responsible solutions with LNG bunkering. Pavilion Energy demonstrated its truck-to-ship bunkering capabilities in 2017, and further expanded its bunker logistics with the charter of its first LNG bunker vessel newbuild in February 2019. The 12,000 cubic metres capacity re-fueling vessel with Mark III Flex membrane LNG

storage tanks from French company GTT is set for delivery by 2021. "We strongly believe that LNG will become the worldwide fuel of choice for bunkering in the long term, and SLNG is well-positioned to facilitate this development," said Tan Soo Koong, CEO of terminal owner SLNG. "We are keen to work with all stakeholders and invest in infrastructure as necessary, to help grow LNG bunkering here," he added.

PETROCHINA reported a slight rise in first-quarter 2019 net profits as oil and gas revenues increased and losses were narrowed from imported LNG and pipeline natural gas because domestic gas prices were higher than last year. The Hong Kong Stock Exchange-listed unit of state-controlled China National Petroleum Corp, said first-quarter net profits were up 1 percent to 10.25 billion yuan (\$1.52 billion) compared with 10.15Bln yuan in the same three months a year ago. Total revenues grew 8.9 percent during the three months to 591 billion yuan (\$87.7Bln) compared with 512.65Bln yuan in the 2018 quarter. "In respect of natural gas and pipeline gas, the Group coordinated the utilisation of various resources such as domestically produced gas, imported gas and LNG and optimised the transportation and sales plans for gas," explained PetroChina. The company said that as a result of the rise in the price and sales of natural gas, the profit from overall operations in the gas and pipeline segment amounted to 12.58Bln yuan (\$1.9Bln), representing an increase of 12.5 percent versus 11.18Bln yuan in the 2018 quarter. PetroChina said it managed to cut its losses from imported LNG and pipeline natural gas amid high winter demand in January as the nation's anti-pollution policies led to gas being favoured over coal. "The Group made great efforts to take effective actions to control the loss incurred from sales of imported gas and LNG in the natural gas and pipeline segment," said the company. The LNG and pipeline gas net loss amounted to 3.28Bln yuan (\$488M) with an increase in sales volumes helping to reduce the losses by the amount of 2.53Bln yuan (\$376.5M) from the net losses of 5.82Bln yuan (\$865.1M) reported in the year-ago quarter. PetroChina is a growing LNG market participant and parent CNPC has a share in the Yamal joint venture in Arctic Russia. CNPC is also a stakeholder in the Arctic II LNG project. The Asian major is additionally part of

Shell’s LNG Canada project under its own name PetroChina and has a stake in the Area 4 reserves in the Rovuma Basin offshore Mozambique with Italian company Eni and ExxonMobil of the US that will underpin their Rovuma LNG project.

As regards LNG imports to China, PetroChina operates three of its own import terminals and has access to several others. “Crude oil output of the Group in the quarter was 223.4 million barrels, representing an increase of 4.6 percent as compared with the same period of last year,” said PetroChina. “Marketable natural gas output amounted to 999.9 billion cubic feet, representing an increase of 8.9 percent compared with the same period of last year,” it added. “The oil and gas equivalent output was 390.1 million barrels, representing an increase of 6.4 percent from last year, of which the domestic oil and gas equivalent output was 337.5 million barrels, representing an increase of 5.0 percent,” stated the company. PetroChina said that in exploration and production, the Group continued to optimise its deployments, consolidate its resource base and maintain stability in oil production and increasing gas output. “Overseas oil and gas equivalent output was 52.6 million barrels, representing an increase of 16.0 percent as compared with the same period of last year,” it said. PetroChina, led by Chairman Wang Yilin, said in its business review that the world economy grew at a slower pace with a greater downward pressure and risks of uncertainty. “The economy of China continued to operate within a reasonable range and maintained its tendency to be generally steady with certain progress,” added the company. “While the growth of domestic refined oil consumption slowed down, the supply remained abundant,” noted PetroChina. “The Group grasped the favourable opportunities offered by the upward movement of international oil price and the relatively fast growth of demand in the natural gas market to intensify the production and operation of its two business chains of oil and gas,” stated the Chinese major.

QATAR PETROLEUM has issued an invitation to tender for the reservation of ship construction capacity mainly in South Korea for an initial 60 new LNG carriers to transport its volumes from the expansion of its Ras Laffan liquefaction plant in Middle East and its Golden Pass facility in the US Gulf Coast. The company said the tender also included options for replacement requirements for Qatar’s existing LNG fleet. Qatar Petroleum’s North Field Expansion (NFE) project will increase the Arab Gulf nation’s LNG production capacity from 77 million tonnes per annum to 110 MTPA starting in 2024. In addition to addressing shipping requirements for the North Field Expansion Project, the tender covers shipping requirements for the LNG volumes that will be purchased and marketed by Ocean LNG, a joint venture between Qatar Petroleum and ExxonMobil from the Golden Pass facility currently under construction for start-up in 2014. The Golden Pass plant was originally designed as an import facility located on the Sabine-Neches Waterway in Texas before the shale-gas revolution. It is now being reconfigured at a cost of more than \$10 billion to export up to 15.6 MTPA of LNG from an initial three Trains with the Ocean LNG venture trading the cargoes worldwide. “With this significant step, Qatar Petroleum embarks on another major LNG shipbuilding campaign expected to initially deliver 60 LNG carriers in support of the planned production expansion, with a potential to exceed 100 new LNG carriers over the next decade,” said Saad Sherida Al-Kaabi, the President and Chief Executive of Qatar Petroleum.

“This important initiative reinforces Qatar Petroleum’s commitment to its global reputation as a safe and reliable LNG producer at all times and under all circumstances,” added Al-Kaabi. Korean shipyard executives were previously sounded out by Qatar Petroleum executives on freeing up berths over the next 12 months for a wave of Qatari LNG newbuilds. Samsung Heavy Industry, Hyundai Heavy Industries and Daewoo Shipbuilding & Marine Engineering are

set to receive orders, even as Hyundai and Daewoo may eventually merge under a Korean shipyard consolidation plan. The Korean yards specialize in constructing the Qatari Q-Flex and Q-Max tanker with between 210,000 cubic metres and 266,000 cubic metres capacity. A South Korean government spokesman said that the Qataris had outlined their LNG carrier building plans at the start of 2019 during a bilateral summit in Seoul. Between 2004 and 2007, Qatar ordered 45 LNG carriers from the Korean yards when Daewoo built 19 Qatari carriers, Samsung constructed 18 vessels and Hyundai received orders for eight ships. The scope of the expansion at the Ras Laffan production complex involves an additional four liquefaction Trains, each with nameplate capacity of 7.8 MTPA. Qatar Petroleum said it had entrusted its subsidiary Qatargas to execute this LNG ship building program on its behalf. “This tender, along with the recently released Engineering, Procurement and Construction tender for four new mega-Trains planned as part of the North Field expansion, constitute two monumental and historical milestones as we make major strides in our commitment towards the further development of the world’s largest non-associated gas field,” stated Al-Kaabi. Qatar’s new onshore facilities will receive about 4.6 billion standard cubic feet per day of feed gas from the southern sector of Qatar’s North Field gas reserves in the Gulf. Qatar has the southern portion of the North Field and the other part is under the jurisdiction of Gulf neighbour Iran.

SHELL reported 6 percent lower liquefied natural gas volume sales in the first quarter, though profits jumped 17 percent in the Integrated Gas Division because of higher prices and earnings from trading. Shell has three divisions, Integrated Gas, including LNG, and Upstream and Downstream. First-quarter earnings for Integrated Gas came to \$2.79 billion compared with \$2.39Bln in the same three months of 2018. Overall earnings in the quarter were up 2 percent at \$6.00Bln versus \$5.89Bln in the year-ago period. Shell said first-quarter LNG

sales were down to 17.51 million tonnes compared with 18.58MT in the same three months of 2018. The Anglo-Dutch company’s total LNG production was 12 percent lower compared with the first quarter a year ago, mainly due to divestments and the transfer of the Salym gas assets from the Sakahlin LNG plant in the Russian Far East into Shell’s Upstream segment. Shell added that its LNG liquefaction volumes also decreased, by 2 percent, compared with the first quarter of 2018, mainly due to higher maintenance activities and divestments, partly offset by increased feed-gas availability.

However, the Anglo Dutch company stated that its Integrated Gas earnings increased due to higher realised LNG and gas prices, bigger contributions from LNG trading, though these rises were partly offset by the impact of lower production and a fall in LNG sales. Natural gas production available for sale in the first quarter fell 6 percent to 4,143 million standard cubic feet per day from 4,407 million scf/d. “Shell has made a strong start to 2019, with the first-quarter financial performance demonstrating the strength of our strategy and the quality of our portfolio of assets,” said Chief Executive Ben van Beurden. “The power of our brand, serving millions of customers every day, continues to be a differentiator,” he added. “Our integrated value chain enabled our Downstream business to deliver robust results despite challenging market conditions” stated the CEO.

SPANISH supplies of liquefied natural gas as a maritime fuel for vessels passing the Strait of Gibraltar and the development of infrastructure were considered at a European Union-backed meeting at the Spanish port of Algeciras. The main speakers at the meeting were Salvador de la Encina, the President of the Spanish Ports Authority, Gerardo Landaluze, President of the Port of Algeciras Bay, and Claudio Rodriguez, Gas Assets General Manager of the utility and LNG import terminals operator Enagas. The discussions covered the specific developments to take place in Algeciras to further the implementation of LNG as a fuel. “The main progress made has been the adaptation and construction of infrastructure and the application of LNG to multimodal transport to enable small-scale and bunkering services with LNG to be provided in the Iberian Peninsula,” said a statement. The aim of the project partly

Diary of events

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

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

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

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financed by the EU's executive arm, the European Commission, is to promote the supply of LNG as a fuel in the transport sector, particularly for shipping. There are 42 partners from Spain and Portugal supporting the Iberia-wide project, including 13 port authorities, 21 industrial partners as well as LNG operators, shipbuilders and import terminals.

"Algeciras, through the efforts currently being made, aims to consolidate its position in the future as a regional leader in the use of LNG in the maritime sector," stated Gerardo Landaluze, President of the Port of Algeciras Bay. "Algeciras produced the first supply of LNG as a maritime fuel in the country in 2012 and it can currently supply LNG to ships by means of tanker trucks," added Landaluze. Claudio Rodriguez, the Enagas executive, said the EU project would allow Spain to lead Europe through the process of energy transition in the maritime sector. "This is based on the 50-year history of LNG in our country and ratified by the development of innovative, competitive and sustainable logistics that will be able to fulfil European directives regarding availability of capacity to serve demand from the sector five years ahead of schedule," said Rodriguez. On behalf of the European Commission, Jose Fernandez-Garcia, Policy Officer for Ports and Inland Waterways, explained to the meeting how Spanish ports could take advantage of the Connecting Europe Facility to obtain more infrastructure financing.

TECHNIPFMC, the energy and liquefied natural gas engineering company, reported a plunge in first-quarter profits and revenues also fell as it finished off the Yamal LNG project in Russia and was at the start of other ventures such as floating LNG work offshore West Africa. The Franco-US company said first-quarter net profits were down 78 percent to \$20.1 million compared with \$95.1M in the same three months of 2018. Revenues were 6.8 percent lower in the first three months at \$2.91 billion versus \$3.25Bln in the year-ago quarter. "Onshore-Offshore division reported first-quarter revenue of \$1.33Bln, a fall of 15.1 percent from the prior-year quarter as we moved closer to completion on major projects, primarily Yamal LNG," said TechnipFMC. "Projects awarded in recent quarters are in early stages of completion and will contribute more significantly in subsequent quarters

as the projects progress," explained the company. Onshore-Offshore operating profit was down 23.3 percent to \$155.7M compared with \$202.9M in the same quarter of 2018. Among the TechnipFMC projects is BP's FLNG development in the Tortue Ahmeyim gas fields offshore Mauritania and Senegal. The African project saw the launch of the engineering, procurement and Construction phase offshore. TechnipFMC also noted its finishing work on the Shell Prelude FLNG hull offshore northwest Australia. "In Onshore-Offshore, we continue to execute well and achieved notable project milestones during the period," said TechnipFMC Chief Executive Doug Pferdehirt. "Orders of \$3.1Bln were more than double our revenues in the quarter, driven by major downstream and offshore projects," added the CEO. "Additionally, we are prioritizing five LNG projects that are most strategic to TechnipFMC and offer the highest probability of successful execution," he stated.

In addition to ongoing contracts, TechnipFMC said it was continuing to strengthen its process technology business unit with important new partnerships, including in mid-scale, modular LNG solutions. "We have developed a number of standardized, modular mid-scale LNG train designs with capacities ranging from 1 to 3 million tons per annum using the Air Products AP-SMR and AP-DMR processes," said the company. "Delivered by engineering, procurement and fabrication models, these designs offer more certainty around cost and schedule. We have received contracts in China and North America," said TechnipFMC. The Subsea division reported first-quarter revenue of \$1.18Bln, largely unchanged from the 2018 quarter. "Modest growth in services offset the decline in project revenues reflected in the lower level of vessel utilization," said TechnipFMC. CEO Pferdehirt said overall quarterly orders of \$6.2Bln were our highest since the fourth quarter of 2014 and backlog grew 22 percent from the previous quarter to \$17.8Bln. "This reflects the strength of our integrated subsea model, our demonstrated capabilities in downstream and gas monetization, and continued growth in international surface markets," he said.

TELLURIAN, the developer of the Driftwood LNG export plant near Lake Charles in Louisiana, is proceeding with its plans that now may include a fourth

pipeline as it posted a larger quarterly net loss and gave more details of its costings and partnership plans. The company said its first-quarter net loss widened to \$34.12 million compared with \$25.18M in the same three months of 2018. Revenues was reported as \$4.95M versus \$6.80M in the same three months a year ago as Tellurian ended its first quarter with around \$88.3M of cash and cash equivalents and about \$57.3M of debts. "Tellurian has a strong balance sheet consisting of approximately \$384M in assets," noted the company. Tellurian estimates that its Driftwood LNG export plant proposed for 1,000-acre in Calcasieu Parish in Louisiana will cost around \$28 billion, including construction costs, transaction expenses and contingencies, though excluding interest costs. It intends to produce 27.6 million tonnes per annum at the Driftwood plant from 2023. The facility will include up to 20 small-scale liquefaction Trains, three LNG storage tanks and three marine berths. "We have entered into four lump-sum, turnkey engineering, procurement and construction agreements totaling \$15.2Bln with Bechtel Oil, Gas and Chemicals Inc. for construction of the Driftwood terminal," said the company. Tellurian included in its quarterly highlights the signing of a heads of agreement with a subsidiary of French major Total for a \$500 million equity investment in the project. The French company also signed up for the right to purchase 1 MTPA of LNG and for a 15-year sales and purchase agreement to acquire an additional 1.5 MTPA at Japan Korea Marker (JKM) prices. The company additionally furthered the sale of LNG and Driftwood partnership interests by completing preliminary agreements with other potential partners, including Petronet LNG of India.

"Tellurian is now permitted to construct, operate, and export LNG from the Driftwood project and has a fully articulated EPC plan in place with Bechtel," said Chief Executive Meg Gentle. "Our primary focus for the next quarter is finalizing the Driftwood partnership financing. Total has committed as the first partner of Driftwood and we expect to execute final agreements with them by mid-June," added the CEO. "We remain on schedule to produce LNG in 2023 and generate \$8.00 of cash flow per share after ramp up," stated Gentle. Tellurian's proposed pipelines are expected to consist of three projects, the Driftwood pipeline, the

Haynesville Global Access Pipeline and the Permian Global Access Pipeline. "We are also considering the potential development of a fourth pipeline, the Delhi Connector Pipeline, which would run approximately 180 miles from the Perryville-Delhi Hub in northeast Louisiana to Lake Charles," explained Tellurian. The Driftwood pipeline will be a 96-mile large diameter pipeline that will interconnect with 14 existing interstate pipelines throughout southwest Louisiana to secure adequate natural gas feedstock. Tellurian estimates that the construction costs for the Driftwood pipeline will be \$2.3Bln before other expenses. The Haynesville Global Access Pipeline is expected to run for 200 miles from northern to southwest Louisiana. The Permian Global Access Pipeline is expected to be 625 miles long and to run from West Texas to southwest Louisiana. Each of these pipelines is expected to have a diameter of 42 inches and be capable of delivering approximately 2 Bcf/d of natural gas. "We currently estimate that construction costs will be approximately \$1.4Bln for the Haynesville Global Access Pipeline and \$3.7Bln for the Permian Global Access Pipeline," added Tellurian.

TELLURIAN received the US Department of Energy long-term authorization for its Driftwood LNG project to export domestically-produced liquefied natural gas from its proposed export facility near Lake Charles to non-free trade agreement countries. "I am pleased to announce the order signed today authorizing Driftwood, owned by Tellurian Inc., to export up to 3.88 billion cubic feet per day of natural gas as LNG, to any country that does not have a free trade agreement with the US," said US Energy Secretary Rick Perry. "The US is now in its third consecutive year as a net exporter of natural gas, now exporting domestic LNG to 35 countries," added Perry. "I applaud the American private sector for continuing to reach new milestones and look forward to continued growth in this sector," he stated. Tellurian President and Chief Executive Meg Gentle said she thanked the US Administration, Secretary Perry and the DOE staff for their diligence in authorizing the order that she viewed as crucial to global LNG trade.

"The US will become a top three LNG exporter and Tellurian intends to do our part in creating US jobs while delivering a cleaner energy supply source to the

world,” added Gentle. Tellurian received a Federal Energy Regulatory Commission order in April 2019 granting authorization for the Driftwood LNG project, a proposed liquefaction and export facility to produce 27.6 million tonnes per annum and for its associated 96-mile pipeline. The Driftwood project schedule includes a final investment decision in 2019, a start to construction activities shortly afterwards and the beginning of commercial operations by 2023.

THAILAND national energy company PTT Exploration and Production (PTTEP), whose LNG assets include a stake in the Mozambique LNG export project in Area 1 of the Rovuma Basin, reported a 23 percent jump in first-quarter net income as it secured more exploration acreage and a floating LNG stake in Malaysia. PTTEP posted 12.47 billion Thai baht (\$374 million) of net profits in the first three months of 2019

compared with 5.57Bln Thai baht (\$304M) in the same period of 2018. The Thai company’s first-quarter revenues came to the equivalent of \$1.42 billion, an increase of 15 percent from \$1.24Bln in the same three months of 2018. “This was primarily driven by improved average sales volume to 319,230 barrel of oil equivalent per day (boed), compared with 293,099 boed in the first quarter of 2018 as a result of the acquisition of additional participating interests of the Bongkot gas project, coupled with the higher average selling price rising from \$44.01 per barrel of oil equivalent to \$46.21 per boe,” said the company. PTTEP has an 8.5 percent interest in the licence held by Anadarko Petroleum of the US and most recently the partners entered into sale and purchase agreements with Pertamina, the state-owned energy company of Indonesia, for 1 million tonnes per annum (MTPA) for a term of 20 years.

Another LNG deal was signed with

Bharat Gas Resources of India for 1 MTPA for a term of 15 years. “PTTEP is moving forward with the new ‘Expand & Execute’, strategy which we’ve actively implemented since earlier this year and have successfully achieved several major milestones,” said Phongsthorn Thavisin, PTTEP President and Chief Executive. “We marked our move in the Middle East by being awarded two offshore exploration blocks, along with our global strategic partners, in one of the world’s highly petroleum potential locations, the United Arab Emirates,” he explained. “We also extended our footprint in Southeast Asia by acquiring Murphy Oil Corporation’s business in Malaysia,” stated the CEO, in reference to assets including a stake in the Rotan Floating LNG project in Block H offshore Sabah. “This will help boost sales volume and sales revenue immediately,” added Phongsthorn. “PTTEP was awarded an additional two offshore exploration blocks

in Malaysia as well. The aforementioned investments will help PTTEP grow in both the short term and long term,” stated the CEO.

UK LNG import terminal owner National Grid said its Isle of Grain facility on the Medway River southeast of London was planning to offer the market 8 million tonnes per annum of capacity through 100 berthing slots as well as additional storage. National Grid will offer the capacity and slots along with 390,000 cubic metres of associated storage from 2025. “The capacity on offer is a combination of newbuild and existing capacity which comes out of contract in 2025,” said Grain LNG. “The expansion will increase the size of the Grain terminal in Kent to approximately 1.2 million cubic metres,” added the company. The offer comes as Grain LNG and the UK’s other two terminals at Milford Haven in Wales saw a considerable

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increase in utilisation in the winter season. This was because new global supplies had to be shipped to Britain and elsewhere in Europe as Atlantic-to-Pacific basin arbitrage was uneconomic because North Asian prices were lower than in the previous year. Nicola Duffin, Commercial Manager for Grain LNG, said the Kent terminal already has the largest storage tanks in Europe, which offer customers flexibility to store LNG and to optimise send-out in response to market prices.

“With the expansion of Grain we will further optimise our existing assets, which means we’ll be able to be more competitive than typical newbuild capacity,” added Duffin.

“We’re also ideally located in the South East of the UK, so tariffs to the National Balancing Point (NBP) are very favourable,” she explained. “Our customers benefit from the short-haul tariff to the IUK and BBL interconnectors, allowing them to easily move gas to other European price hubs such as the Dutch TTF,” added Duffin. “We have two entry points to the NBP, a high-pressure entry point and a low-pressure entry point that offers our customers further savings on entry costs and a much lower minimum send-out requirement compared to competitors,” she stated. Grain could also benefit from proposed changes to the gas specification rules in the UK, which would significantly reduce variable costs for LNG shippers. The UK’s Wobbe Limits currently require some sources of LNG to be blended with nitrogen to meet UK gas specifications. Plans are underway to increase these limits, which could come into force by April 2020 as part of the Gas Safety Management Regulations. Proposals call for the Wobbe Index, an indicator of the interchangeability of fuel gases to be changed to 52.85 MJ/m³ - a limit that would allow all but rich LNG to enter the grid without blending. “LNG would be subject to lower processing and variable costs,” said Duffin. “Lower costs will make the UK a more attractive destination for LNG, which ultimately benefits UK energy consumers,” she added. The Grain terminal also offers small-scale solutions to the market and additional services including reloads, trans-shipments and a multi-bay facility for reloading road tankers, and ISO containers. A marine breakbulk facility is planned to be completed by 2022 whereby standard cargoes can be broken up into smaller parcels for small-scale users.

VENTURE GLOBAL, the US LNG project developer with two export plants proposed for Louisiana, has filed with regulators to permit its construction of a third plant in the Gulf Coast state. The Arlington, Virginia-based company filed with the Federal Energy Regulatory Commission for a venture called Delta LNG and its associated Delta Express pipeline. The company’s first and most advanced plant is at Calcasieu Pass in Louisiana with current nameplate export volumes of 12 million tonnes per annum and is expected to come on stream in 2022, along with associated facilities, including the TransCameron Pipeline. Venture Global, owned by former investment banker Michael Sabel and lawyer Robert Pender who act as joint chief executives, is also constructing a second plant at Plaquemines near river mile-marker 55 on the west side of the Mississippi River, 30 miles south of New Orleans. The Mississippi River project has current output targets of 20 MTPA of LNG and was set to include small-scale liquefaction Trains, four LNG storage tanks and three marine loading berths. The Delta LNG plant is also proposed for Plaquemines Parish and would have peak capacity to process 24 MTPA. The filing made on April 17 also requested the start of a permit process for a 287-mile pipeline called Delta Express between Perryville in Louisiana, crossing into the neighbouring state of Mississippi, and then back into Louisiana to connect to the LNG plant. According to a preliminary schedule the third Venture Global project could see construction start in late 2021 and the plant shipping its first cargo by November 2024.

Venture Global had in March 2019 that it planned to expand the scope of its LNG development business on the US Gulf Coast to 60 MTPA of production based on customer demand, almost doubling current plans for 32 MTPA of output. Co-CEOs Pender and Sabel said that having fully contracted Calcasieu Pass and anticipating completion of Plaquemines LNG an expansion was being studied to meet additional customer demand. “We believe our model of mid-scale modular liquefaction is the future of low-cost LNG production,” they said. Venture Global noted that the Calcasieu Pass project with its planned 10 MTPA of output had received all federal authorizations. The project’s engineering contractor, Kiewit Energy of Omaha, Nebraska, is now carrying out site preparation in advance of

construction. The Calcasieu Pass plant has signed binding 20-year sale and purchase agreements with companies such as Royal Dutch Shell, BP of the UK, Italian utility Edison, Portugal’s Galp Energia, Repsol of Spain and Poland’s national oil and gas company. The Plaquemines project is expected to receive its final regulatory authorization in August and commence construction later in 2019.

WINTERSHALL HOLDING and Deutsche Erdoel AG (DEA), the German energy companies have completed their merger and the newly titled Wintershall Dea is now the leading independent gas and oil company in Europe with an initial public offering (IPO) of shares planned for 2020. The new Wintershall Dea company is notable in that it will be one of the few global players to have no liquefied natural gas interests. Indeed, Wintershall Dea will be a firm competitor of LNG because of its extensive interests in the European natural gas network supporting Russian pipeline imports and future projects. “Our roots are in Germany, our home is Europe and our work is global,” stated Chairman and Chief Executive Mario Mehren. The merger followed regulatory approvals allowing the main shareholders of DEA and Wintershall, the chemicals and energy group BASF and Russian-controlled LetterOne, to complete their deal. The merger had been first agreed in September 2018 and the completion gives Europe’s largest economy a company with widespread exploration and production assets. “The upstream activities of the company are supplemented by investments in natural gas infrastructure and midstream services,” added CEO Mehren.

Together with its partners, Wintershall Dea operates a natural gas pipeline network in Germany of around 2,400 kilometres and is also a shareholder in the Nord Stream network that brings Russian gas to Western Europe and in the Nord Stream II project that is currently being delayed by the European Union on the issue of energy policy. Oil and gas production of Wintershall and DEA together was 215 million barrels of oil equivalent (BOE) at the end of last year, equivalent to around 590,000 BOE per day. Proven reserves stood at 2.4 billion BOE, which leads to a reserve to production ratio of 11 years. “As a result of the merger, Wintershall Dea has a regionally balanced footprint with superior growth opportunities in its core

regions,” said the company. “Based on existing exploration and production projects, the company is on track to reach daily production of 750,000 to 800,000 BOE between 2021 and 2023,” it added.

WORLEYPARSONS, the Australian energy and LNG engineering group with international assets, is changing its name to Worley following the successful completion of the A\$4.5 billion (US\$3.2Bln) acquisition of the Energy, Chemicals and Resources division of Jacobs Engineering of the US. WorleyParsons entered into a binding agreement in October 2018 to acquire the Jacobs assets to improve its offerings in the energy, chemicals & resources division. The transaction has expanded the Worley presence in the refining and petrochemicals sectors to match its subsea and LNG contracts presence, especially in Australia. Worley subsidiary Intecsea was awarded a contract by Woodside for its Scarborough gas and Pluto LNG expansion project in Western Australia. The Worley unit has also recently been awarded a third contract by Santos for the subsea infrastructure in the Barossa-Caldita gas field offshore northwest Australia to expand the lifespan of the Darwin LNG plant, operated by ConocoPhillips. Worley said its new merged business of WorleyParsons and the Jacobs ECR division will now seek more energy contracts with a global workforce of 57,600 people.

“In Europe, the acquisition brings together a highly skilled workforce servicing the hydrocarbons sector in The Hague and Aberdeen, the chemicals sector in Belgium and Germany and the minerals sector in the United Kingdom,” said Worley. The company explained that Worley’s expansion in other strategic markets including the Middle East, North America, Canada, and India means it will have greater global reach, with leading market positions in the sectors. Worley Chief Executive Andrew Wood said the acquisition was about more than capacity and capability, it was also about opportunity. “Our new brand reflects our place at the forefront of the energy, chemicals and resources markets and our ability to support our customers through the global energy transition,” added the Worley CEO. “We plan to embrace the heritage of both WorleyParsons and Jacobs ECR while looking firmly ahead to, what promises to be an exciting future as one entity,” stated Wood. ■



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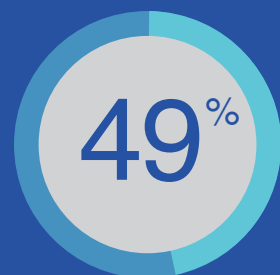
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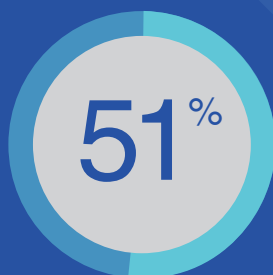
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US and European oil and gas industries point out benefits for EU of American LNG imports

The American Petroleum Institute and the International Association of Oil and Gas Producers issue LNG proposals

TransAtlantic LNG trading was at the centre of the first European Union-US Energy Council energy forum in Brussels with the main participants being members of the American Petroleum Institute and the International Association of Oil and Gas Producers.

“We’re experiencing a pivotal moment in US energy leadership as the No. 1 producer and exporter of natural gas and crude oil,” said the API.

Relationships

“It is a critical time in terms of collaborating and building our Trans-Atlantic LNG relationship, as we have an ability to not only continue to elevate the quality of life in America, but globally as well,” said the US energy industry body.

“American natural gas has reduced carbon-dioxide emissions in the US to the lowest levels we’ve seen in a generation, as well as provided substantial economic benefits to communities across the US,” it added.

The IOGP, whose headquarters are in London and which represents the upstream oil and gas industry said that if Europe seeks to reach climate-change objectives, policymakers have to acknowledge the value and role of natural gas in any long-term transition.

“The US, the UK, and others around the world have shown what an impact shifting from coal to gas makes from a carbon-dioxide emission reduction and air quality perspective,” said the IOGP.

Combination

“By making a smart use of Europe’s own gas resources and the LNG supplied by partners such as the US, we can bring about a system combining renewables and gas which provides a secure supply of affordable and clean energy to Europeans,” it added.

The joint policy recommendations from the US side include having the Federal Energy Regulatory Commission and US Department of Energy continue enhancing their established review and permitting processes while maintaining transparent and consistent approval schedules for projects.

From the European perspective, the recommendations include the EU sending consistent signals expressing confidence in the medium-term and long-term role of natural gas in the energy mix.

Summary of recommendations for the US:

- The Federal Energy Regulatory Commission (FERC) and the Department of Energy (DOE) should continue to improve their established review and permitting processes for US LNG export projects and maintain transparent and consistent approval timelines.
- Executive branch agencies should expand their efforts to promote US LNG to include EU countries, especially for those EU nations looking to diversify gas supply sources.
- Executive branch agencies should highlight existing US industry standards and promote streamlined approval processes to ensure the US can build critical energy infrastructure in an efficient and timely manner.

Summary of recommendations for the European Union:

- The European Commission should send consistent signals expressing confidence in the medium and long-term role of natural gas (including its decarbonized form) in the EU energy mix.
- The European Commission should work further with Member States to



The latest US export plant, Cameron LNG at Hackberry in Louisiana, was visited by President Donald Trump in May 2019 then cargoes were shipped

increase interconnectivity, remove barriers to cross-border trade and support the development of liquid gas hubs within Europe.

- The European Commission should encourage public entities and businesses to use LNG and CNG in road and maritime transportation to reduce CO2 emissions and substantially improve air quality in urban and port areas.
- The European Commission should avoid setting unduly restrictive gas quality specifications that could create unnecessary barriers for LNG to enter the EU.

Detailed suggestions for US

The Federal Energy Regulatory Commission (FERC) and the Department of Energy (DOE) should continue to improve their established review and permitting processes for US LNG export projects and maintain transparent and consistent approval timelines.

- For US LNG export projects to be approved for construction, they must first complete a lengthy (three year) and costly (\$50 million-\$100 million) FERC review process as required by the National Environmental Protection Act (NEPA). We recommend that FERC and cooperating executive branch agencies continue to enhance their review capabilities and look for opportunities to expedite the permitting process. Notably, we believe the FERC has considerable authority to do so without requiring Congressional approval.

- We encourage the FERC to consider multiple options, including expanding

reliance on third-party contractors, increasing staffing levels and opening regional offices (e.g., on the Gulf Coast). Other more systemic improvements could be gleaned from the results of the NEPA review currently being undertaken by the White House Council on Environmental Quality (CEQ).

- Beyond FERC, DOE grants export approvals to countries without a free trade agreement (i.e., non-FTA countries, including all EU countries) only after an extensive adjudication process that can be duplicative and result in orders that are hundreds of pages long. We recommend DOE continue to move swiftly and ensure these permits are issued on a transparent basis with a predictable timeline.

- Impact on US LNG Flows to the EU: These efforts will expedite the development of US LNG export projects by reducing overall permitting time. Perhaps more critically, it will enhance regulatory certainty, which in turn encourages European LNG buyers to sign long-term offtake agreements with US LNG developers.

Expand promotion of US LNG by US governmental agencies: The US federal government has several agencies focused on expanding trade opportunities for US companies and products.

In the past few years, many have been increasingly focused on opportunities in the natural gas and LNG sector, including the US Trade & Development Agency (USTDA), the Commerce Department, the Export-Import Bank and Overseas Private Investment Corp. (OPIC). We



recommend the US government redouble efforts and expand the focus to include members (or future members) of the EU.

- The efforts could include, among others, hosting reverse trade missions and technical workshops, offering business-to-business relationship building events and cooperating on project-specific pre-feasibility studies.

- The Impact on US LNG flows to the EU: The US has already established successful cooperative efforts with China and India, among other nations, that are focused on natural gas and LNG. We believe similar programs focused on EU members - especially those whose current gas supply options are limited - would be a strong step toward expanding and enhancing the Trans-Atlantic energy relationship. Greater engagement on behalf of the US could also bolster the EU efforts to implement the energy policy objectives referenced below.

Highlight existing US industry standards and promote streamlined regulatory processes to ensure the US can build critical energy infrastructure in a timely and efficient manner.

- The US oil and gas industry has developed some of the strictest operational standards in the world, covering the full range of the energy value chain. Executive branch agencies should continue to work with the industry to ensure much needed infrastructure projects can be permitted and constructed on a sensible timeline while still emphasizing safety and operational performance.

- Impact on US LNG flows to the EU: By facilitating the greater buildout of domestic pipeline infrastructure, natural gas from the US can be delivered to demand centers more efficiently and at a lower cost, while also reducing volatility. This in turn will encourage greater flows of US gas to other markets, including LNG to the EU.

Detailed suggestions for the EU

Express confidence in the future role of natural gas in the EU energy mix.

- Natural gas investments are more likely to happen if the policy framework for natural gas is positive. The role of natural gas as a flexible source of energy that can

meet demand when required should be better recognized by EU policymakers: significantly improving air quality, replacing coal to reduce power generation emissions today, and using hydrogen from natural gas with CCUS for further emission reductions tomorrow. Increase market interconnectivity, remove barriers to cross-border trade and support the development of liquid gas hubs within the EU.

- Effective implementation of the Third Energy Package and the associated gas network codes can help promote cross-border trade and efficient use of existing interconnections. Better access to the EU's most liquid gas hubs, in the north west of the EU, would provide EU Member States with access to diverse sources of gas. Well-connected and scaled-up markets in the EU create more attractive supply opportunities for LNG exporters, including from the US.

- Regulated gas retail prices distort gas market competition in the EU Member States, negatively impacting the commercial opportunities in the wholesale market. Such price regulation needs to be lifted and EU gas markets

moved to market-based mechanisms in line with competition principles.

Support

- Encourage public entities and businesses to use LNG and CNG in road and maritime transport to improve air quality, as well as actively support LNG as a bunkering fuel in European ports.

- The transport sector is the second biggest contributor to CO₂ emissions in the EU3 - natural gas could significantly contribute to EU's efforts in enabling cleaner transport. Gas can also help the shipping industry meet more stringent emissions targets. Using LNG as a marine transport fuel complies with the IMO's

2020 regulations and puts us on the right track to meet its 2050 objectives by reducing SO_x and PM emissions by close to 100 percent, NO_x by 80-90 percent and CO₂ emissions by up to 21 percent.

- Unduly restrictive gas quality standards could exclude certain LNG imports. We believe that quality standards across the EU should not create unnecessary barriers for gas to enter the EU.

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All development challenges are unravelled in floating solutions for LNG-to-power projects

Joseph McGladdery of Watson Farley & Williams of London analyses key LNG offshore projects

There are currently some 30 floating storage and regasification units (FSRUs) in operation, of which approximately 24 are operating as FSRUs and the other six trading as LNG carriers.

However, of those operating as FSRUs, only between three and four are currently employed in LNG-to-power projects.

Development challenges are unravelled in floating solutions in LNG-to-power projects

Solution

In this article, we review the role FSRUs have taken in providing regasified LNG as a feedstock for power generation, why there have been relatively few LNG-to-power projects utilising a floating solution, and how these complicated projects may be structured to give them the best chance of success.

Despite the relatively low numbers of FSRUs being utilised in LNG-to-power projects, it is fair to say that in recent years various factors - whether political, commercial or technical - have combined to enhance the conditions for LNG-to-power generation using floating solutions.

Ever growing environmental concerns have meant that economies such as China have changed their domestic policies to favour gas over less environmentally friendly traditional fuels for their power supply.

We are also now witnessing the “glut” in LNG supply that has been widely anticipated for some time resulting in it becoming competitively priced when compared to other fuels.

And with increased levels of technical innovation through the separation of the storage, regasification and even power generation elements, we have seen the development of small and mid-scale floating infrastructure with lower capital costs.

There is also no question that the speed with which an FSRU can be deployed not only assists in a project’s flexibility but also its feasibility - as it enables a developer to import LNG in the short term whilst either it or the host state plans for the longer term construction of an onshore based facility to exploit domestic gas supply.

Furthermore, as there are still only a handful of specialist operators of FSRUs, the units themselves tend to be leased by the FSRU provider to the project developer so that it is the former that incurs the initial capital cost rather than the latter.

However, despite these perceived advantages as compared to land based projects, a number of recent LNG-to-gas projects using FSRUs have failed - either before, or in some cases after, the final investment decision (FID) has been made, with the unfortunate legal fall-out that this implies.

And whilst of course there are numerous reasons why any project might fail, we believe there are lessons to be learned from projects to date:

State Policy: We have seen a number of LNG-to-power projects contemplated within particular jurisdictions suggesting a clear governmental policy to import LNG - but due to underlying legislation and regulation, developers have simply not been able to get their proposed projects over the line.

Ghana

An example of this is Ghana, where the government has looked to LNG imports to bridge the gap before the country’s domestic gas reserves can be utilised, but the absence of adequate local legislation has been one of the factors why none of the proposed projects have yet been successful.

Conflicting Interests: The flexibility that FSRUs can provide in bridging the gap between imports to domestic production can lead to conflicting interests, with LNG import projects competing with those based on domestic or pipeline gas for power generation. Again, this indicates a lack of policy co-ordination at state level, and leads to FSRU providers (and other contractors) spending additional time and resource attempting to determine which projects have the most realistic chance of success.

Risks

So why have a number of LNG-to-power projects in developing nations been successful while others have failed?

In our experience the successful



Using a floating LNG terminal is a fast-track route to becoming an importer

projects have been those that have been, to the greatest extent possible, “de-risked” from the outset.

To facilitate this we have seen international institutions (such as the International Finance Corporation, a World Bank member) providing a level of initial equity to projects, enabling the project developer and the host state to develop the requisite legislation and regulatory framework that has been necessary to support the project.

The legislation has been implemented to determine the technical, commercial and legal parameters under which the developer and state are obliged to operate under - and has enabled the developer to present these parameters to bidding contractors through a robust tender process.

In setting out the required parameters from the outset, it has allowed potential contractors (including the FSRU providers) to assess the project’s risks more efficiently and to structure their proposals according to the defined terms on which they are being asked to bid.

Complexity

Arguably this initial “de-risking” has led to less contractual complexity and lower transactional costs - and has ultimately afforded these projects a greater chance of success.

However, not only does the developer need to address the regulatory and legislative regimes, it is also needs to ensure that it structures the project to be both commercially viable and financeable.

This requires a contractual alignment across the LNG value chain - from the LNG sale and purchase contracts to the

shipping arrangements, the receiving and transmission structure (including the FSRU) and the offtake arrangements with end-users.

Each element needs to be reviewed by the developer in the context of “project-on-project” risk - and the consequences to the project of a failure in any one or more of these elements needs to be analysed and mitigated against to the greatest extent possible.

The provision of the FSRU is an integral part of any LNG-to-power project, and there is always a question as to whether it should be financed separately or as part of the overall project.

Project structures

The majority of FSRUs utilised within LNG-to-power projects are financed on the basis of a “non-integrated” structure, where the FSRU is financed independently of the power plant.

In these cases the FSRU is employed by the developer under a form of lease or services agreement where the provider generally receives a specified daily income linked to the unit’s warranted throughput.

On the other hand under an “integrated” project a single group of lenders provides financing for both the FSRU and the power plant, with the interests of the financiers being largely aligned so that as a group they retain the benefit of the security granted over both assets.

An example of this type of structure is the Sergipe project in Brazil, where Golar (as provider) has taken a shareholding in the project developer.

However, integrated projects tend to conflict with an FSRU provider's understandable wish to retain control of its FSRU - because by retaining control the provider is able to remove its asset should there be a problem with the project and redeploy it elsewhere.

As a result we think adopting an integrated approach for a developing nation's first LNG-to-power project may prove challenging if only because the knowledge and skillset required to manage such a project are often being acquired in line with the development of the project itself.

Commercial factors

The commercial factors to be determined are also extensive and flow through the length of the value chain: from the cost of the LNG feedstock at one end, to the price at which the developer can sell electricity to end users at the other - where the creditworthiness of the latter will also be a significant issue.

In addition, careful consideration needs to be given to currency exchange issues as the developer will be required to purchase the LNG in US dollars (or possibly euros) under the sale and purchase contracts, but will almost certainly receive local currency for the sale of electricity in the project's domestic market.

In terms of demand, we mentioned earlier that one of the benefits of a floating solution is that the infrastructure can be scaled down by segregating the storage and regasification elements to match demand. However demand can also be scaled up to match the project.

A newbuilding 170,000 cbm FSRU can send out regasified LNG at a rate of nearly 1,000 mmscf/day.

This equates to approximately 8 million tonnes per annum of LNG - which is significantly more than the amount (say two million tonnes) required to feed one 1,000 MW power station.

But this discrepancy also potentially provides a source of supply for more than one user. Sociedad Portuaria El Cayao (SPEC) has adopted a multi-user model for its project in Cartagena, Colombia where the project developer stands between the FSRU provider (in this case Höegh) and its three foundation customers as off-takers.

This provides the provider with a credit and performance interface, preventing it having to deal with numerous counterparts and separate offtake arrangements.

Without over stressing the point the price at which the electricity is sold to the end user point under any LNG or gas-to-power project is intensely price sensitive.

Costs

Consequently, developers need to exploit any opportunity available to them to develop additional markets that will reduce the overall cost of the project - whether that is the sale of electricity to additional customers as mentioned above, or re-selling the LNG to third parties (i.e.

to industrial users or by way of bunker fuel). Affordability (of electricity) is key!

Ultimately for any LNG-to-power project to succeed, all its moving parts must be pulled together in a workable suite of contracts.

There is no doubt that these projects are complicated.

Not only do they require the appropriate level of initial funding, they also need sophisticated planning from the outset.

Each party needs to fully understand

the level of risk it is being required to undertake - and this can only really be achieved through extensive due diligence.

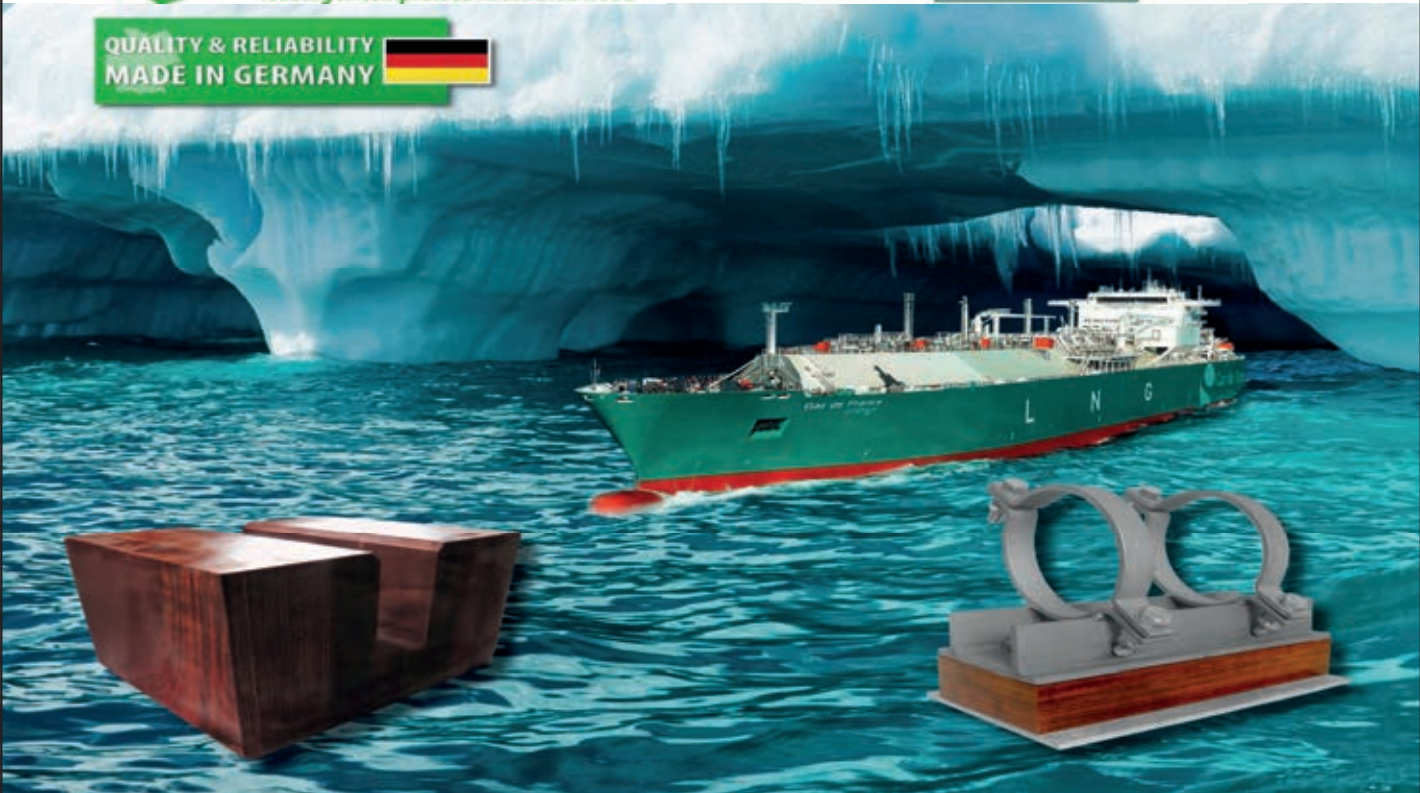
But whilst such LNG-to-power projects using floating solutions are complicated, they are also possible.

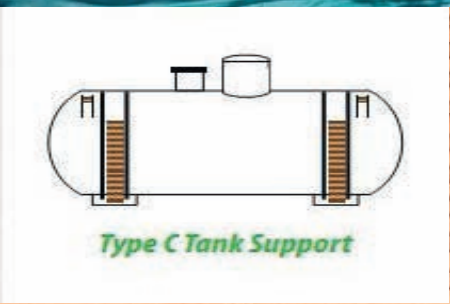
As we have seen from the projects that have been successful delivered, a developer that is able to develop a workable structure (ideally with the backing of a strong state sponsor) is at least giving itself a fighting chance of achieving FID. ■



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Sea-LNG and SGMF study endorses life-cycle superiority of LNG as a maritime fuel of choice

Advantages outlined in report involving leading consultants, academics and the energy majors

The most comprehensive study ever undertaken to assess the advantages of liquefied natural gas as a marine fuel, involving leading consultants, academics, the oil and gas majors and the leading global engine-makers, has given LNG a massive endorsement.

The study was commissioned by the main representative bodies of the LNG shipping industry and has found that using LNG as a maritime fuel reduces greenhouse-gas emissions by up to 21 percent and would be a major contributor to meeting International Maritime Organization emission targets through 2050.

Funded

The study was funded by the Sea-LNG industry group and the Society for Gas as a Marine Fuel (SGMF) and covered the entire life-cycle of the vessels and their fuel.

Sea-LNG and the SGMF also noted that the report they were handed confirmed that emissions of other pollutants such as sulphur oxides, nitrogen oxides and particulate matter are close to zero when using LNG compared with current conventional oil-based marine fuels.

The report was written by the leading consultancy “thinkstep” and was reviewed by a panel of independent academic experts and is now regarded as the definitive study into GHG emissions from current marine engines.

“The life-cycle GHG emission study is a long-awaited piece of the LNG-as-a-marine-fuel puzzle,” said Sea-LNG Chairman Peter Keller.

“It not only confirms what we already knew in terms of LNG’s immediate impact on air quality, human health and its cleanliness, but clearly highlights the genuine, substantiated GHG benefits of using today’s marine engines capable

of burning natural gas,” he explained. “Moving from current Heavy Fuel Oil to LNG does reduce GHG emissions. LNG does contribute to the IMO GHG reduction targets. And it is clear that LNG is the most environmentally-friendly marine fuel that is readily available and safe, both today and in the foreseeable future,” stated Keller.

Technology

The report said that on an engine technology basis, the absolute life-cycle emissions reduction benefits for LNG-fueled engines compared with HFO fueled ships today are between 14 percent to 21 percent for 2-stroke slow-speed engines and between 7 percent to 15 percent for 4-stroke medium-speed engines.

In the current bunkering market, around 72 percent of marine fuel is consumed by 2-stroke engines with a further 18 percent used by 4-stroke medium-speed engines.

“LNG is safe to use, fully compliant and readily available as a marine transport fuel,” said Chad Verret, the Chairman of the SGMF Board.

“Standards, guidelines and operational protocols are all in place to ensure that the safe way is the only way when using gas as a marine fuel,” added Verret.

“LNG meets and exceeds all current and 2020 marine fuel compliance requirements for content and emissions, local and GHG,” he explained.

Main goals

“With the world LNG bunker vessel fleet doubling in the next 18 months and those vessels being deployed at major bunkering hubs, LNG as a ship fuel is rapidly becoming readily available,” stated the SGMF Chairman.

Dr Oliver Schuller was team leader of the consultants and said the main goal was to provide an accurate report of the

g/kWh	Oil-based fuels		Gas-based fuel	
	HFO _{2.5}	MGO _{0.1}	LNG	LNG
2-stroke slow speed	Diesel		Diesel-DF	Otto-DF
Main fuel consumption	184.8	174.0	141.3	145.1
Pilot fuel consumption	-	-	6.4	1.5
Urea solution consumption	20.7	20.7	-	-
Methane Slip	-	-	0.1%	1.5%

Technical parameters provided by engine manufacturers and are used for the calculation of the Well-to-Wake GHG emissions of the 2-stroke slow speed

life-cycle GHG emissions from LNG as a marine fuel compared with conventional marine fuels.

“This is a comprehensive report using the latest primary data to assess all major types of marine engines and global sources of supply with quality data provided by Original Equipment Manufacturers including Caterpillar MaK, Caterpillar Solar Turbines, GE, MAN Energy Solutions, Rolls Royce, Wartsila, and Winterthur Gas & Diesel, as well as from ExxonMobil, Shell, and Total from the supply side,” said Schuller.

“It is quality assured in assessing the supply and use of LNG as a marine fuel according to ISO standards and objectives, having been peer-reviewed by leading academics from key institutions in France, Germany, Japan and the USA,” stated Schuller.

The context of the study was that the international shipping industry, as other industry sectors, are under pressure to reduce emissions.

The International Maritime Organization (IMO) has announced the ambition to reduce the GHG emissions from international shipping by at least 50 percent by 2050 compared with 2008.

More stringent air-quality regulations, such as the IMO 2020 global sulphur cap, are also approaching.

Specifications

In the light of the IMO 2020 global sulphur cap, conventional oil-based

residual marine fuels will need to either change in their specification or be replaced by alternative fuels like LNG.

While the environmental benefits of LNG as the most promising alternative marine fuel are clear in relation to local pollutants such as sulphur oxides (SOX), nitrogen oxide (NOX), and particulate matter (PM), various studies have demonstrated different GHG impacts from the use of LNG.

These differences have resulted from the studies using different assumptions, methodologies and data. Most important, the studies have used different data and assumptions about methane emissions in the LNG supply chain, and methane slip in ship engines.

Key findings

The end result is that there are divergent opinions about the GHG benefits of LNG as marine fuel which in turn influence views on whether LNG is a viable option to address GHG emissions.

Life cycle analysis of GHG emissions of LNG and oil-based marine fuels and their use is a complex topic due to different engine technologies in operation, the different fuels bunkered and their geographically specific supply chains.

The conclusions of the Sea-LNG-SGMF study are:

- The use of LNG as marine fuel shows GHG reduction of up to 21 percent compared with current oil-based marine fuels over the entire life cycle from

g/kWh	Oil-based fuels		Gas-based fuel	
	HFO _{2.5}	MGO _{0.1}	LNG	LNG
4-stroke slow speed	Diesel		Otto-SI	Otto-DF
Main fuel consumption	197.5	184.7	155.8	156.5
Pilot fuel consumption	-	-	6.4	2.8
Urea solution consumption	15.7	15.7	-	-
Methane Slip	-	-	1.3%	2.5%

Results for the 4-stroke engine. It should be noted that all energy related numbers in this study are referring to the lower heating value (LHV)

g CO ₂ -eq/kWh	Oil-based fuels		Gas-based fuel	
	HFO _{2.5}	MGO _{0.1}	LNG	LNG
2-stroke slow speed	Diesel		Diesel-DF	Otto-DF
Total WtW GHG emissions	697	686	549	598
- of which methane	23	24	37	96
- supply	23	24	33	33
- combustion	-	-	4	63

Data of the 2-stroke slow speed Otto cycle engine shows that methane slip accounts for 63 g CO₂-eq/kWh, equal to 11 percent of the total WtW GHG emissions.

g CO ₂ -eq/kWh	Oil-based fuels		Gas-based fuel	
	HFO _{2.5}	MGO _{0.1}	LNG	LNG
2-stroke slow speed	Diesel		Diesel-DF	Otto-DF
Total WtW GHG emissions	741	724	629	692
- of which methane	24	25	96	151
- supply	24	25	36	36
- combustion	-	-	60	115

The same characteristics apply for 4-stroke medium speed engines with the two engine technologies investigated using an Otto combustion cycle

Well-to-Wake (WtW). The benefit is highly dependent on the engine technology installed and, to a certain extent, on the type of reference fuel (distillate or residual).

- On an engine technology basis, the WtW GHG emission reduction for gas fuelled engines compared with HFO fuelled engines are between 14 to 21 percent for 2-stroke slow speed engines, and between 7 to 15 percent for 4-stroke medium speed engines.

- On a Tank-to-Wake (TtW) basis, the combustion process for LNG as a marine fuel shows GHG benefits of up to 28 percent compared with current oil-based marine fuels. On an engine technology basis, the TtW emissions reduction benefits for gas fuelled engines compared with HFO fuelled engines are between 18 to 28 percent for 2-stroke slow speed engines and between 12 to 22 percent for 4-stroke medium speed engines.

- Local pollutants, such as sulphur oxides (SOX), nitrogen oxides (NOX) and particulate matter (PM), are reduced when using LNG compared with current conventional marine fuels. Due to the negligible amount of sulphur in the LNG fuel, SOX emissions are reduced close to zero. NOX emissions are reduced by up to 95 percent to meet the IMO Tier III limits without NOX reduction technologies when using Otto cycle engines (a typical spark ignition piston engine). Limited data on PM emissions is available, however reductions of up to 99 percent are normal compared with heavy fuel oil (HFO).

- For post-2020 oil-based marine fuels (low sulphur fuel oil (LSFO) or the use of HFO in combination with an exhaust gas cleaning system) there is no significant difference in the WtW GHG emissions compared with current oil-based fuels. Post-2020 gas fuelled 2-stroke engines have advantages in the order of 14 percent to 22 percent (current: 14-21 percent), and 4-stroke engines between 6 percent to 16 percent (current: 7-15 percent) compared with HFO fuelled engines.

- As a direct comparison if the global marine transport fleet for 2015 was to completely switch to LNG then there would be a GHG emission reduction of 15 percent marine GHG emissions based upon engine technology alone.

- GHG reductions are reduced depending upon the degree of methane slip incurred during the combustion process. High pressure 2-stroke Diesel cycle engines and marine gas turbine

propulsion units incur methane slip less than 1 percent of the overall WtW GHG emissions. Low pressure 2-stroke and 4-stroke Otto cycle reciprocating engines are sensitive to methane slip with 10-17 percent of the WtW GHG emissions resulting from unburned methane in the combustion process.

Status

This study presents the current status of the industry. Ongoing optimisation in supply chain and engine technology developments will further enhance the benefits of LNG as a marine fuel.

Methane slip reduction at combustion in the engines and methane emission reduction in the supply chain as well as further improving energy efficiency in combination with other measures such as enhanced operational methods and

speed optimisation will make a major contribution to meeting the IMO's GHG emissions reduction target 2050 for shipping.

An indicative analysis showed that bioLNG and synthetic LNG can provide an additional significant (up to 90 percent) benefit in terms of WtW GHG intensity.

The study noted that GHG emissions of fuel supply chains differ from region to region due to a large number of variables. Therefore, specific supply chain analyses as applied in this study have been key in order to get to a global average GHG intensity. ■

This article is based on extracts from a report sponsored by SEA-LNG Limited and the Society for Gas as a Marine Fuel Limited (SGMF) entitled: "Life Cycle GHG Emission Study on the Use of LNG as Marine Fuel".



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



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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	172,000	Dynagas	Daewoo	Oct-17	Cyprus	DFDE	GTT	4	Various
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

CARRIER FLEET



Energy Advance	145,000	Tokyo LNG Tankers	Kawasaki Sakaide	Mar-05	Japan	S	Moss	4	Darwin
Energy Atlantic	159,924	Alpha	STX Jinhae	Sep-15	Malta	DFDE	GTT	4	Various
Energy Confidence	155,000	Tokyo LNG Tankers	Kawasaki	Apr-09	Panama	S	Moss	4	Various
Energy Frontier	147,600	Tokyo LNG Tankers	Kawasaki Sakaide	Sep-03	Japan	S	Moss	4	Darwin
Energy Glory	165,000	Tokyo LNG Tankers	JMU	Sept-18	Japan	S	Moss	4	Various
Energy Horizon	177,000	Tokyo LNG Tankers	Kawasaki	Jul-11	Japan	S	Moss	4	Pluto LNG
Energy Liberty	165 000	MOL	JMU Tsu	Oct-18	Japan	TFDE	IHI-SPB	4	Various
Energy Navigator	147,000	Tokyo LNG Tankers	Kawasaki Sakaide	May-08	Japan	S	Moss	4	Various
Energy Progress	145,000	MOL	Kawasaki	Nov-06	Japan	S	Moss	4	Bayu Undan LNG
Enshu Maru	165,257	K Line	Kawasaki	June-18	Japan	S	Moss	4	Various
Esshu Maru	162,000	K Line-Transpacific	Kawasaki Sakaide	Dec-14	Panama	S	Moss	4	Australia-Japan
Excalibur	138,200	Exmar/ Excelerate	Daewoo	Oct-02	Belgium	S	GTT	4	Various
Excel	138,106	Exmar/ MOL	Daewoo	Sep-03	Belgium	S	GTT	4	Various
Excelerate	138,000	Exmar/Excelerate	Daewoo	Oct-06	Belgium	S	GTT	4	Various
Excellence	138,000	GKFF Ltd.	Daewoo	May-05	Belgium	S	GTT	4	Excelerate Energy
Excelsior	138,000	Exmar	Daewoo	Jan-05	Belgium	S	GTT	4	Various
Exemplar	150,900	Excelerate	Daewoo	Jun-10	Belgium	S	GTT	4	Various
Expedient	151,000	Excelerate	Daewoo	Nov-09	Belgium	S	GTT	4	Various
Experience RV	174,000	Exmar/Excelerate	Daewoo	Jul-14	Marshall Is.	DFDE	GTT		Various
Explorer	150,900	Exmar/Excelerate	Daewoo	Mar-08	Belgium	S	GTT	4	Excelerate
Express	151,000	Exmar/Excelerate	Daewoo	May-09	Belgium	S	GTT	4	Various
Exquisite	150,900	Excelerate	Daewoo	Sep-09	Belgium	S	GTT	4	Various
Fedor Litke	172,636	Dynagas	Daewoo	Nov-17	Cyprus	DFDE	GTT	4	Various
Flex Endeavour	173,400	Flex LNG	Daewoo	Jan-18	Marshall Is.	MEGI-DF	GTT	4	Various
Flex Enterprise	173,400	Flex LNG	Daewoo	Jan-18	Marshall Is.	MEGI-DF	GTT	4	Various
Flex Rainbow	174,000	Flex LNG	Samsung	July-18	Marshall Is.	MEGI-DF	GTT	4	Various
Flex Ranger	174,000	Flex LNG	Samsung	April-18	Marshall Is.	MEGI-DF	GTT	4	Various
Fraiha	210,100	J5 Consortium	Daewoo	Sep-08	Marshall Is.	DRL	GTT	4	Qatargas
FSRU Independence	170,000	Hoegh	Hyundai	Feb-14	NIS	DFDE	GTT	4	Various
FSRU Lampung	170,000	Hoegh	Hyundai	May-14	Indonesia	DFDE	GTT	4	Various
Fuji LNG	147,895	TMSC Gas	Kawasaki	Jun-04	Malta	S	Moss	4	Various
Fuwairit	138,000	Peninsular LNG	Samsung	Jan-04	Bahamas	S	GTT	4	RasGas II
Galea	134,425	Shell Shipping	Mitsubishi Nagasaki	Oct-02	Singapore	S	Moss	5	Shell
Galia 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



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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
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

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LNG Leo	126,400	MOL/LNG Japan	GD Quincy	Dec-78	Marshall Is.	S	Moss	5	Pertamina
LNG Lerici	65,000	Exmar	Italcantieri Sestri	Mar-98	Italy	S	GTT	4	Sonatrach
LNG Libra	126,400	Hoegh LNG	GD Quincy	Apr-79	Marshall Is.	S	Moss	5	Various
LNG Lokoja	148,300	BW Gas	Daewoo	Dec-06	Bermuda	S	GTT	4	Nigeria LNG
LNG Mars	155,000	MOL/Osaka Gas	Mitsubishi	Oct-16	Marshall Is.	S	Moss	5	Various
LNG Ogun	148,300	NYK Line	Samsung	Aug-07	Japan	S	GTT	4	Nigeria LNG
LNG Ondo	148,300	BW Gas	Daewoo	Sep-07	Bermuda	S	GTT	4	Nigeria LNG
LNG Oyo	140,500	BW Gas	Daewoo	Dec-05	Bermuda	S	GTT	4	Nigeria LNG
LNG Pioneer	138,000	MOL	Daewoo	Jul-05	Bahamas	S	GTT	4	Idku
LNG Port Harcourt	175,000	Bonny Gas	Samsung	Oct-15	Bermuda	DFDE	GTT	4	Nigeria LNG
LNG Portovenere	65,000	Exmar	Italcantieri Sestri	Jun-96	Italy	S	GTT	4	Sonatrach
LNG River Niger	141,000	Bonny Gas Transport	Hyundai	May-06	Bermuda	S	Moss	4	Various
LNG River Orashi	145,910	BW Gas	Daewoo	Nov-04	Bermuda	S	GTT	4	Nigeria LNG
LNG Rivers	137,231	Bonny Gas Transport	Hyundai	Jun-02	Bermuda	S	Moss	4	Nigeria LNG
LNG 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



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Milaha Qatar	145,000	Milaha	Samsung	Apr-06	Denmark	S	GTT	4	Qatar
Milaha Ras Laffan	138,270	Milaha	Samsung	Mar-04	Denmark	S	GTT	4	RasGas II
Min Lu	147,000	China Ships	Hudong	Aug-09	China	S	GTT	4	Various
Min Rong	147,000	China LNG Ships	Hudong	Feb-09	Hong Kong	S	GTT	4	Australia-China
Mourad Didouche	126,130	Hyproc Shipping	Atlantique	Jul-80	Algeria	S	GTT	5	Sonatrach
Mozah	266,000	QGTC	Samsung	Aug-08	Qatar	DRL	GTT	5	Qatargas II
Mraweh	137,000	National Gas Shipping	Kvaerner-Masa	Jun-96	Liberia	S	Moss	4	ADGAS
Mubaraz	137,000	National Gas Shipping	Kvaerner-Masa	Jan-96	Liberia	S	Moss	4	Various
Muraq	210,100	J5-K Line	Daewoo	May-08	Marshall Is.	DRL	GTT	4	Qatar-Atlantic Basin
Murex	173,400	Teekay	Daewoo	Oct-17	Bahamas	DFDE	GTT	4	Various
Murwab	210,100	J5 Consortium	Daewoo	May-08	Marshall Is.	DRL	GTT	4	Qatargas
Muscat LNG	149,170	Oman Gas/MOL	Kawasaki Sakaide	Mar-04	Japan	S	Moss	4	Oman Gas
Myrina	173,000	Teekay	Daewoo	Sept-18	Bahamas	MEGI-DF	GTT	4	Various
Neo Energy	149,700	Tsakos	Hyundai	Feb-07	Liberia	S	GTT	4	Various
Neptune	145,000	Hoegh LNG/MOL	Samsung	Dec-09	Liberia	DFDE	GTT	4	Various
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 Euris	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

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Seri Bakti	152,300	MISC	Mitsubishi	Mar-07	Malaysia	S	GTT	4	Petronas
Seri Balhaf	152,000	MISC	Mitsubishi	Sep-08	Malaysia	S	GTT	4	Various
Seri Balquis	152,000	MISC	Mitsubishi	Dec-08	Malaysia	S	GTT	4	Various
Seri Begawan	152,300	MISC	Mitsubishi	Dec-07	Malaysia	S	GTT	4	Various
Seri Bijaksana	152,300	MISC	Mitsubishi	Feb-08	Malaysia	S	GTT	4	Petronas
Seri Camar	150,200	MISC	Hyundai	Feb-18	Malaysia	S	Moss	4	Petronas
Seri Camellia	150,000	MISC	Hyundai	Nov-16	Malaysia	S	Moss	4	Petronas
Seri Cemara	150,200	MISC	Hyundai	Apr-18	Malaysia	S	Moss	4	Petronas
Seri Cempak	150,200	MISC	Hyundai	Feb-18	Malaysia	S	Moss	4	Petronas
Seri Cenderawasih	150,000	MISC	Hyundai	Jan-17	Malaysia	S	Moss	4	Petronas
Sestao Knutsen	138,000	Knutsen	IZAR Sestao	Jan-07	Spain	S	GTT	4	Atlantic LNG
Sevilla Knutsen	173,400	Knutsen	Daewoo	Jun-10	N.I.S.	DFDE	GTT	4	Various
Shahamah	135,500	National Gas Shipping	Kawasaki Sakaide	Oct-94	Liberia	S	Moss	5	ADGAS
Shangra	266,000	QGTC	Samsung	Nov-09	Liberia	DRL	GTT	5	Qatargas IV
Shen Hai	147,100	China LNG	Hudong Zhonghua	Sep-12	China	AB/CC Steam	GTT	4	Various
Simaisma	147,700	Maran Gas Maritime	Daewoo	Jul-06	Greece	S	GTT	4	Qatar
SK Audace	180,000	SK-Marubeni	Samsung	Jul-17	Panama	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
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
Korea	Soma Fukushima	Japan Petroleum Exploration	2017	1	225,000
	Boryyeong	GS Energy, SK E&S	2017	3	200,000
	Incheon	Kogas	1996	20	2,880,000
	Kwangyang	POSCO	2005	4	530,000
	Pyeong-Taek	Kogas	1986	23	3,360,000
	Samcheok	Kogas	2014	3	600,000
	Tong-Yeong	Kogas	2002	17	2,620,000
Malaysia	Pengerang Johor	Petronas Gas	2017	2	400,000
Mexico	Altamira	Vopak, Enagas	2006	2	300,000
	Energia Costa Azul	Sempra LNG	2008	2	320,000
	Manzanillo	Samsung, Kogas, Mitsui	2012	2	300,000
Netherlands	Gate LNG	Gasunie, Royal Vopak	2011	3	540,000
Panama	Costa Norte	AES	2018	1	130,000
Phillipines	Pagbilao LNG	Energy World Corp.	2017	1	130,000
Poland	Swinoujscie	Baltic Gaz System	2015	2	320,000
Portugal	Sines	REN Atlantico	2004	3	390,000
Puerto Rico	Penuelas	EcoElectrica	2000	1	160,000
Singapore	Singapore	Singapore Energy Authority	2013	3	540,000
Spain	Barcelona	Enagas	1969	8	840,000
	Huelva	Enagas	1988	5	610,000
	Cartagena	Enagas	1989	5	587,000
	Bilbao	Enagas, EVE	2003	3	450,000
	Sagunto	GNF, Osaka Gas, Oman Oil	2006	4	600,000
	Mugardos, El Ferrol	Reganosa, Sonatrach, Sojitz Corp.	2006	2	300,000
	El Musel, Gijón,	Enagas	2013	2	300,000
Taiwan	Yung-An	CPC	1990	6	690,000
	Tai-Chung	CPC	2009	5	800,000
Thailand	Map Ta Phut	PTT LNG	2011	2	320,000
Turkey	Marmara Ereglisi	Botas	1994	3	255,000
	Izmir	EgeGaz	2006	2	280,000
USA	Everett	Suez LNG NA	1971	2	155,000
	Lake Charles	Shell, ETE	1982	4	425,000
	Freeport	Freeport LNG Development	2008	2	320,000
	Golden Pass, TX	Qatar Petroleum, ExxonMobil	2010	5	775,000
	Pascagoula, MS	Gulf LNG, Kinder	2012	2	320,000
UK	Isle of Grain	National Grid	2005	8	1,000,000
	South Hook	ExxonMobil, Qatar Petroleum, Total	2009	5	775,000
	Dragon LNG, Milford Haven	Shell, Petronas	2009	2	310,000

LNG Import Terminal Projects

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

LNG FSRU Import Facilities

Country	Location (Project)	Owners	Start up
Argentina	Bahia Blanca GasPort	Excelerate/YPF Repsol	2008
	Escobar GasPort	Excelerate/Enarsa	2011
Bangladesh	Moheshkhali	Excelerate, PetroBangla	2018
Brazil	Pecem, FSRU	Petrobras	2009
	Guanabara Bay FSRU	Petrobras	2009
	Salvador, Bahia FSRU	Petrobras	2013
China	Tianjin FSRU	CNOOC, Hoegh, various	2013
Colombia	Cartagena FSRU	Promigas, Sociedad Portuaria El Cayao	2016
Egypt	Ain Sokhna, Suez	EGAS, Hoegh	2015
	Ain Sokhna, Suez	EGAS, BW Gas	2015
Indonesia	Lampung	Hoegh LNG, PGN LNG	2014
	Nusantara (Jakarta Bay)	Golar LNG, Pertamina	2012
Italy	Livorno	OLT Offshore LNG Toscana	2013
Jordan	Aqaba, Jordan	Golar LNG	2015
Kuwait	Mina Al-Ahmadi	KPC	2009
Lithuania	Klaipeda	Klaipedos Nafta Hoegh LNG	2014
Malaysia	Malacca FSRU	Petronas	2012
Malta	FSU Armada Mediterrana	ElectroGas	2016
Pakistan	Port Qasim	Excelerate, Engro Corp	2015
	Port Qasim	BW-Mitsui, PGP Consortium	2017
Turkey	Aliaga FSRU, Neptune	Etiki LNG	2016
	Dortyol FSRU Challenger	Botas	2018
UAE	Ruwais, Abu Dhabi	Gasco (UAE)	2016
	Jebel Ali Port, Dubai	DSA (UAE)	2010
UK	Teesside GasPort	Excelerate	2007

LNG Export Projects

Country	Location/Project	Project Developers	Planned Start Up	Number of Trains	Capacity In MTPA
AUSTRALIA	Pluto LNG expansion	Woodside	2021+	2	10.0
CANADA	Bear Head LNG, Nova Scotia	LNG Ltd.	2024	4	8.0
	Goldboro LNG, Nova Scotia	Pieridae Energy	2024	2	10.0
	Kitimat LNG, BC	Woodside, Chevron	2024	2	10.0
	LNG Canada, BC	Shell, Mitsubishi, Kogas, PetroChina, Petronas	2024	2	12.0
	Kwispaa FLNG, Vancouver	Steelhead LNG	2024	4	12.0
	Vancouver Tilbury	WesPac Midstream	2021	1	3.25
	Woodfibre LNG, Squamish	Pacific Oil & Gas Co	2020	2	2.1
EQ.GUINEA	Equatorial Guinea Fortuna FLNG	Ophir, Golar LNG, GEPetrol	2020+	1	2.0
INDONESIA	Sengkang LNG	Energy World Corp.	2019	4	2.0
MALAYSIA	Rotan FLNG (Sabah)	Petronas, Murphy Oil	2021	1	1.5
MOZAMBIQUE	Area 1 Onshore	Anadarko Petroleum and partners	2023+	2	10.0
	Area 4 Onshore	Eni and partners	2023+	2	10.0
	Area 4 FLNG	Eni and partners	2020	1	2.5
NIGERIA	NLNG Train 7	NNPC, Shell, Eni, Total	2022+	1	7.0
PAPUA NEW GUINEA	Elk-Antelope LNG	Total, ExxonMobil Oil Search, Petromin	Studies		
RUSSIA	Sakhalin II expansion	Gazprom, Shell, Mitsui, Mitsubishi	2021	studies	
	Vladisvostok LNG	Gazprom, Itochu, various	2023+	2	10.0
	Arctic LNG II Siberia	Novatek, Total	2023	3	19.8
USA	Alaska LNG Nikiski	Alaska Gasline Development Corp.	2023+	3	20.0
	Annova LNG, Brownsville	Exelon Corp.	2023+	6	6.0
	Commonwealth LNG, Louisiana	Commonwealth LNG LLP	2022	8	9.0
	Corpus Christi Liquefaction, Texas	Cheniere	2019	2	9.0
	Delfin LNG, Louisiana	Delfin, Hoegh	2021	3	9.0
	Driftwood LNG, Louisiana	Tellurian Investments	2022	6	26.0
	Freeport LNG, Texas	Freeport LNG	2019	4	20.4
	Galveston Bay LNG	NextDecade	2023+	6	27.0
	Golden Pass, Texas	Qatar Petroleum, ExxonMobil	2021	3	15.6
	Jordan Cove, Coos Bay	Pembina Corp.	2024	2	7.8
	Lake Charles, Louisiana	Shell, ETE	2024	3	15.0
	Magnolia LNG	Louisiana LNG Ltd.	2023+	4	8.0
	Port Arthur LNG	Sempra	2023+	2	10.0
	Rio Grande LNG	NextDecade	2023+	6	27.0
	Sabine Pass LNG, Louisiana	Cheniere	2018-19	2	9.0
	Texas LNG Brownsville	Chandra, Meyer, Samsung, others	2023+	2	4.0
	VG LNG (Cameron Parish)	Venture Global	2021	5	10.0
	VG LNG (Plaquemines)	Venture Global	2021	10	20.0

LNG Exporters

Country	Location/Project	Shareholders	Start up	Liquefaction		Storage	
				Trains	capacity (nominal) mtpa	No. of tanks	Total capacity m³
ABU DHABI (UAE)	Das Island (Adgas)	ADNOC, Mitsui, BP, Total	1977	2	3.2	3	240,000
ALGERIA	Arzew	Sonatrach GL4Z	1994	1	2.5		
	Arzew	Sonatrach GL1Z	1964	3	1.1	3	35,000
	Arzew	Sonatrach GL2Z	1978	6	7.8	3	300,000
	Arzew	Sonatrach	1980	6	8.0	3	300,000
	Skikda	Sonatrach GL1K II	2014	1	4.7		
	Skikda	Sonatrach (rebuild)	1980	3	3.0	5	308,000
			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 (BP, Chevron (Mitsubishi/Mitsui)	1989	2	5.0	4	260,000
		NWS partners	1992	1	2.5	1	130,000
		Darwin (Bayu Undan) ConocoPhillips, Santos, Eni, Inpex, TEPCO, Tokyo Gas	2004	1	4.4	1	130,000
			2008	1	4.4	1	130,000
			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 Mitsubishi, Mitsui, Partex and Itochu	2000	2	7.1	2	240,000
		Oman Govt., Oman LNG Union Fenosa, Osaka Gas, & Itochu	2006	1	3.7	2	240,000
PAPUA NEW GUINEA	PNG LNG	ExxonMobil, Oil Search, Santos, JX Nippon Oil	2014	2	6.9	2	320,000
PERU	Peru LNG	Hunt Oil, Shell, Marubeni, SK Group	2010	1	4.4	2	260,000
QATAR	Qatargas 1-T1&2	QP, ExxonMobil, Total, Marubeni, Mitsui	1997	2	6.4	4	340,000
	Qatargas 1-T3	QP, ExxonMobil, Total, Marubeni, Mitsui	1999	1	3.1		
	Qatargas II-T1	QP, ExxonMobil	2009	1	7.8		
	Qatargas II-T2	QP, ExxonMobil, Total	2009	1	7.8	8	1,160,000
	Qatargas III-T1	QP, ConocoPhillips, Mitsui	2010	1	7.8		
	Qatargas IV-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	1	4.5	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
YEMEN	Bal-Haf	Yemen LNG, Total, Yemen Gas, Hunt Oil, SK Group, Hyundai	2009	2	6.7	2	320,000

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