

LNG North America

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FSRUs spring up as Arab Gulf buyers turn to spot LNG market

For several Arab states which border the Persian Gulf, deploying Floating Storage and Regasification Units (FSRU) to import LNG is a need, not an option. Benefitting from its geographic proximity of Qatar, and plentyfold new supply on global markets from United States and Australia, buyers in Kuwait, the UAE, Egypt, Jordan and increasingly also in Bahrain getting ready to absorb some of the surplus.



"The Middle East's dependence on LNG imports is bound to increase in the coming years, driven by growing gas demand in power sector and wider acceptance of floating technology," Priyank Srivastava, lead analyst at the Energy & Utility Advisory Protiviti told LNG Journal.

Increasing domestic demand and supply bottlenecks turned several Middle Eastern countries to become gas importers. For prospective buyers, importing liquefied natural gas via FSRUs is a cheap, fast-track and competitive solution," he said. Growing deploy-

ment of FSRUs is benefitting emerging importers in the Middle East without the need for expensive onshore import terminals."

"Over the past three years, the Middle East has grown into a recognized demand center at a time when demand from traditional LNG markets is somewhat stagnated," he said, pointing out LNG imports into the region have grown dramatically since 2015 after the arrival of additional FSRUs in Egypt and Jordan. Together, the two countries accounted for about 50% of the

total regional LNG imports in 2016. And on top of that, LNG volumes to traditional importers such as the UAE and Kuwait have been increasing gradually, growing by almost 60% over the past two years, up from 4.3 million tons (mt) to 6.9 mt in 2016.

Shifting supply-side patterns

Stark ripples in the supply/demand balance and a recalibration of global trade flows is boosting

competition between incumbent supplier Qatar, the world's leading LNG exporter, and the United States and succinctly, competition is heating up between Qatargas and Cheniere Energy, the frontrunner in US LNG exports.

Destination flexibility, provided via tolling structures, and greater liquidity in global LNG trade is promoting a gradual shift away from longterm, oil-linked contract pricing toward shorter term contracts and spot-based transactions.

Source: International Gas Union, Platts, Argus Media and Protiviti Calculation

America signs trade deal with China, promoting US LNG exports

The United States and China have reached a landmark agreement designed to reduce America's growing trade deficit and promote LNG shipment to China. US Commerce Secretary Wilbur Ross underlined the deal was part of a broader effort to remodel the relationship between the world's two largest economies.

President Donald Trump and his Chinese counterpart Xi Jinping evolved this latest agreement from a 100-day action plan that was announced when they met in April this year. The trade deal covers 10 key areas, including energy resources, agricultural trade and market access for financial service. Matters are, however far more concrete for US exports of beef than they are for US LNG:

As of July 15, American beef producers will be guaranteed fairly free access to the Chinese market in return for Washington allowing the import of cooked poultry from China.



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To stay on top of the game, Qatar has lifted its 12-year moratorium on further development of the world's largest gas field - North Dome and seeking to bring an extra 2 Bcf/d into production. "It's a signal that Qatar wants to recoup its market share, which has been falling as other regions have come up with new capacity," Srivastava said; and the strategy seems to have paid off: Competing on price and shipping costs, Qatar managed to quadruple the share of its overall exports to the Middle East from 3 percent in 2014 to nearly 12 percent in 2016.

Bearish spot markets make buyers think short-term

Middle Eastern buyers are focused on short- and mid-term contracts, taking advantage of the ample spot availability from different sourcing options. More than 90% of the LNG required by the Middle East importers is uncontracted.

"Regional new paradigm is to fulfill the demand mainly through short-term tenders, seeking cargoes for delivery no more than two years ahead. Any extra demand is met by spot tenders, usually awarded to traders, thereby increasing the trader-driven spot activity in the Middle East in

sourcing cargoes," Srivastava said.

Still, in recent months Middle Eastern gas demand remained muted because Egypt, the region's biggest buyer, "still intends to defer some of the cargoes further down the curve." But as the summer comes to the Middle East and temperatures soar, "LNG spot demand looks robust," he commented.

Emerging buyers embrace FSRUs

The introduction of Floating Storage and Regasification Units (FSRU) has granted a number of new countries access to the global LNG market, especially in the Middle East. "Low LNG prices and quick infrastructure offered by floating LNG terminals, make sense for these new entrants. Some of these FSRUs have played a phenomenal role in aligning the LNG demand-supply balance," he commented.

Going forward, FSRUs will continue to help open up market access for new importing countries.

"Prospects for FSRUs in the Middle East looks optimistic, but countries like Egypt and Kuwait are working towards becoming self-sufficient in gas production in the long term. This could hamper growth in the region's LNG imports in the long run," Srivastava cau-

Existing & Planned FRSUs in the Middle East Region

Country	FRSU	Import Capacity (mtpa)	Installation Year
UAE (Dubai)	Golar Freeze (replaced by Explorer)	3.58	2010
Kuwait	Golar Igloo	5.48	2014
UAE (Dubai)	Explorer	5.11	2015
Egypt	Hoegh Gallant	3.65	2015
Jordan	Golar Eskimo	5.48	2015
Egypt	BW Singapore	5.62	2015
UAE (Aby Dhabi)	Excelsior	5.11	2016
UAE (Sharjah)	Planned	3.77	2018
Lebanon	Planned (3 FRSUs)	-	2018-2020

floating concepts are in great demand hence the ratio of onshore vs. offshore terminals will continue to shift.

"Recent trends have indicated that the Middle East have preferred floating technology, as evident by the UAE, Kuwait, Egypt and Jordan, all joining the LNG importers' club using an FSRU in recent years," Srivastava said. "Likewise, while Sharjah is planning to moor one FSRU, Lebanon has a more ambitious plan to install three FSRUs at Tripoli, Selaata and Zahrani locations."

"Bahrain is also set to become an LNG importer using an FSU, with the LNG to be regasified onshore by 2018. The facility in Bahrain will initially import 3.25 mtpa but the capacity can be doubled if needed," he explained.

Moreover, energy-pricing reforms announced by Saudi Arabia in early 2016 and could make state-buyers consider LNG imports to reduce the country's dependence on oil for power generation.

Comparing the costs

Building a permanent land-based LNG import terminals can be expensive and time-consuming and can get delayed due to regulatory obstacles. An FSRU, on the other hand, can cost around \$300 million to build from scratch, or \$80 million if based on a converted LNG tanker.

"Several FSRU projects worldwide have already been started up with a very short lead time, which proves that the average facility of this kind can be up and running within 6-12 months," Srivastava said.

The driving force for the development of any particular FSRU project depends on various factors such as security of supply and se-

curing sufficient supply to seasonal meet demand.

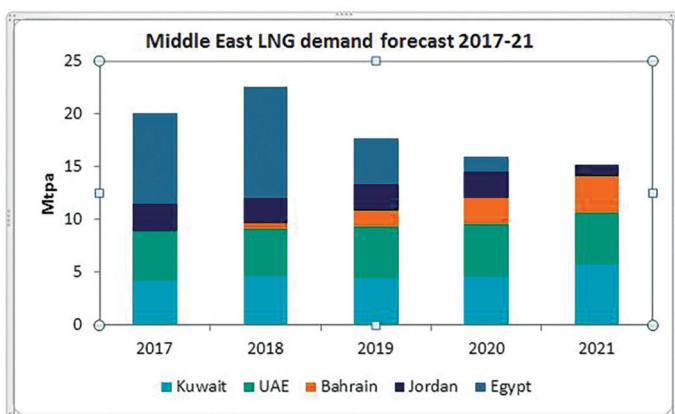
Overall, FSRUs offers more rapid fuel switching, as project can be operational faster than an onshore option, which can prove advantageous for emerging markets that focus on near-term demand requirements. FSRUs usually allow faster permitting processes, for the most cases floating regasification units are typically chartered from a third party.

"Without the need to construct significant onshore facilities, FSRUs often offer greater flexibility when challenged by either onshore space limitations or no suitable ports," he added. OPEX for an onshore terminal is around \$130,000 per day (4mtpa), while an FSRU is just \$280,000/day for the same regas capacity. Higher operating cost for an FSRU is mostly due to the leasing rate.

Terminal operability and expandability

Onshore terminals, however, do provide a number of benefits in comparison to floating solution, which become evident depending on target market requirements. Onshore terminals allow for the possibility of future expansions, both in terms of storage and regasification capacity. Furthermore, FSRUs comes with potential risks related to the terminal's operability.

Vessel performance, heavy seas or meteorological conditions and longer LNG deliverability downtime are some of the risks associated with unit operations, Srivastava said, suggesting "It makes more economic sense to use an onshore LNG terminal, if an FSRU is to be deployed for more than 15 years."



Source: Protiviti Calculation

tioned. "Still, looking beyond the Middle East, emerging buyers around the globe are that are considering FSRUs on their coastline."

Floating vs. onshore regas

Around 82% of today's existing worldwide regasification capacity is built onshore. Looking at vessel order books shows, however, that

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Wärtsilä's LNG-to-Power concept helps prop up 'wind chasers'

LNG-to-energy solutions, notably for distributed power, have made Wärtsilä one of the biggest supplier of gas- and liquid fuel-fired power stations in the 5 - 600 MW range. Such baseload and/or grid stability plants are used predominately as 'wind chasers' and 'sunset balancers', compensating for intermittent supply of renewable energy – soon also on the island of Aruba.

At Gastech, held in Tokyo in early April, Wärtsilä together with marine design consultancy Houlder and hose supplier Trelleborg showcased a system transferring LNG from the carrier vessel to shoreline terminals where no jetty exist. For island nations and other coastal communities around the globe, the transporting and bunkering of LNG is becoming increasingly important as a means to fuel distributed power stations.

Distributed power stations in off-grid locations tend to be often fuelled by LNG, which can be delivered to site via small, dedicated LNG vessels.

Case study Aruba

In Aruba, a Caribbean country situated just north of Venezuela, energy is needed for three main industries: tourism, aloë export, and petroleum refining. There is no LNG import terminal on the island and the government plans to step up the share of wind power and add some solar PV installation.

However, the steep rise in electricity demand for air conditioning, combined with switch to LNG-fuelled cruise ships has

prompted Wärtsilä to calculate Aruba's future demand as approximately 81.1 million cubic metres of gas or 62,400 tonnes per annum of LNG.

To import LNG to Aruba, one can as of October 2016 benefit from the AES Andres LNG terminal in the Dominican Republic which now offers reloads to small-scale LNG carriers. Alternatively, importers are counting on the the 138,500 m3 Golar Arctic - moored as a floating storage unit (FSU) offshore Jamaica - to be made available as a supply point for other small-scale LNG projects in the Caribbean.

Once LNG supply is in place in Aruba, flexible gas-fired power stations can be more easily run on the island.

Cooperation on small-scale LNG with Engie

Together with Engie of France, Wärtsilä is working on four work streams: LNG-to-Power solutions, LNG distribution in islands and remote areas, a LNG for ships, and small scale LNG and bio liquefaction.

The Finnish-French energy partnership was forged in November 2016, when senior executives

signed a memorandum to "co-develop technical solutions that would enable both Wärtsilä and Engie to expand their small scale LNG businesses."

Since then, the two companies are working on projects for a low-carbon economy: Wärtsilä is bringing to the table is its technical expertise and Engineering, Procurement and Construction (EPC) capabilities, while Engie's builds on its experience in natural gas distribution and commercialisation.

Pilot projects in Finland

Back in Finland, Wärtsilä's home market, the manufacturer works as EPC contractor for the onshore Manga LNG terminal, and has also delivered several small-scale power barges and a biogas liquefaction plant. The cooperation with Engie is meant to help replicate similar projects in Europe, the Americas and Asia.

Engie has pioneered the development of small-scale LNG to remote customers; its focus is on small liquefaction plants; LNG truck loading, bunkering and fuelling, and not least LNG for power applications.

Engie, AES jointly market LNG in Central America

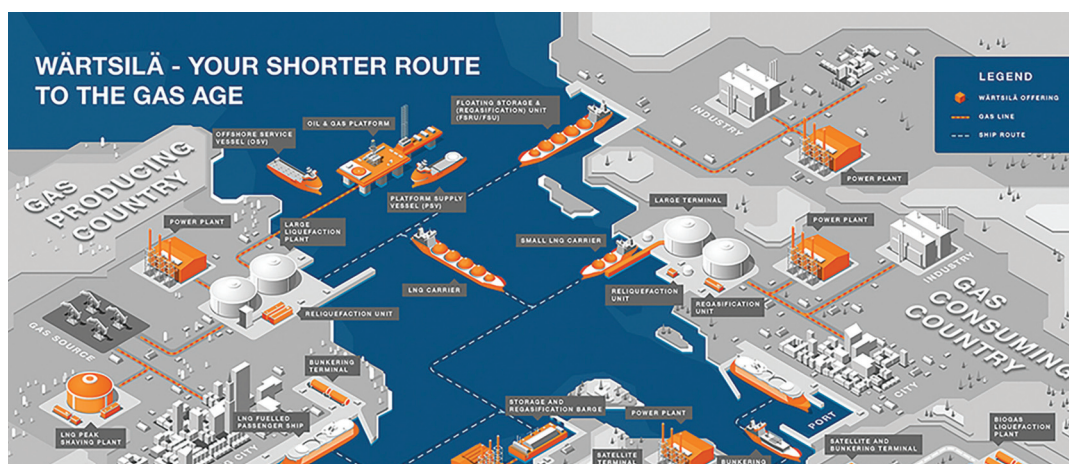
Engie of France and AES have entered into a joint venture to market and sell LNG to third parties in Central America. The JV will utilize the Costa Norte LNG regasification terminal, currently under construction with a capacity of 1.5 million tons per annum (mtpa).

Approximately 25% of the Costa Norte LNG regas capacity will supply fuel to a 380MW combined-cycle gas power plant in the city of Colón, Panama.

Costa Norte LNG, owned 50/50 by AES and Inversiones Bahía, is currently under construction in Colón; whereas AES owns the Colón CCGT that is being build nearby the regas facility. ENGIE committed to supply up to 0.4 mtpa of LNG to the gas power station starting from 2018.

The remaining capacity of the Costa Norte regas terminal is primarily available for the joint venture to market and sell to third parties. This includes up to 0.7 mtpa of LNG sourced from ENGIE mainly through the Cameron gas liquefaction project in the United States.

In a joint statement, Engie and AES said their joint venture would reinforce their joint marketing agreement signed in the autumn of 2016. Hereby both groups agreed to jointly market LNG in the Caribbean, from AES' Andres regasification facility in the Dominican Republic. The combined regasification capacity of Andres in the Dominican Republic and Costa Norte in Panamá is approximately 3 mtpa.



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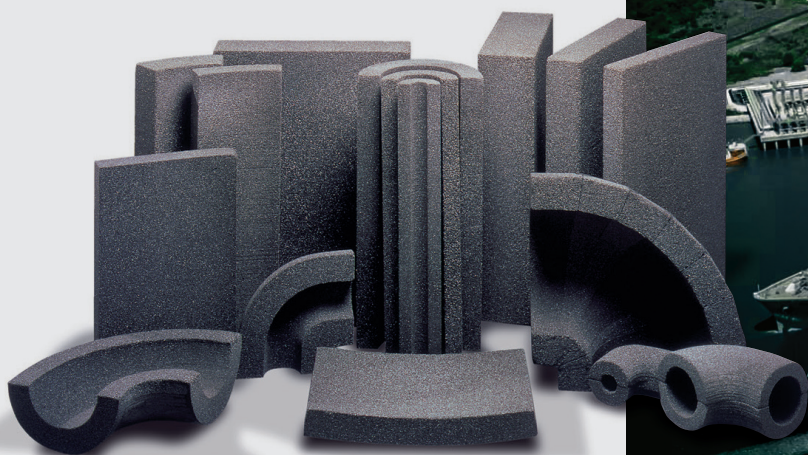
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Non-Technical Risk: “Social License – people can stop projects”

LNG development in British Columbia has created a paradox: people want investment in their communities, however, there is uncertainty associated with long-term environmental and social effects. These non-technical risks, if not managed, can stop a project in its tracks. To manage these uncertainties, Environmental Assessment (EA) processes are followed; these were developed to identify and predict both positive and negative effects of a project on the environment and society and are required for projects above a certain size and complexity.

However, moving forward with large projects is not just about an Environmental Assessment Certificate or even a tick in the Permits and Approvals box. Public awareness and social media can quickly cause irreparable damage to a project's image and reputation and can ultimately result in a project not getting off the ground. In addition to the legal requirements for consultation with Aboriginal and stakeholder groups within the EA process, there proponents of LNG projects should try to engage meaningfully with First Nations.

Hearing communities' views reduces risk

Early engagement and inclusivity with members of the Aboriginal and non-Aboriginal communities are paramount to the success of a project,” Dr. Mary Lou Lauria, VP Environment & Society Americas at Advisan told LNG Journal. “Showing that a community is heard, and that they have stake in the project allows them opportunities to input into the development of avoidance and mitigation measures early on in the project. This may result in fundamental changes such as the site or layout to avoid existing or traditional activities and sensitive or valued receptors.”

Research and history suggests that perceived poor social performance can result in millions of dollars of lost revenue and reputa-

tional damage and that social issues or “non-technical risks” are the primary cause of delay and/or cessation to major projects.

Goldman Sachs Investment Research completed an analysis of the top 190 oil and gas projects from around the world and found

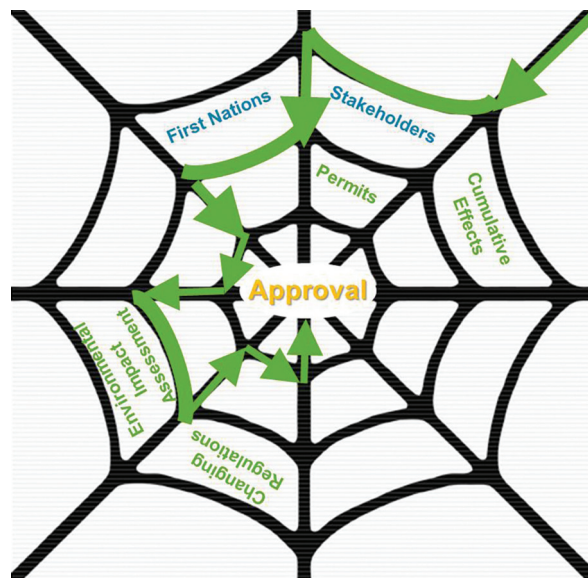
iversity of Queensland into the monetary costs of company-community conflict in the extractive industry has found that the costs of such conflict are mainly associated with project delays and lost productivity, but are also strongly associated with: Opportunity costs

ment, labour issues, consultation processes and environmental and community health issues.

“Core feelings of communities should be understood to be able to address the reaction,” Ms Lauria advises. Though First Nations may be excited about LNG project developers' investment in local communities and hope for employment and business opportunities - there is also anxiety surrounding change of local lifestyle, mistrust in any information provided by the industry and uncertainty about social and environmental impacts.

Creating shared value is advised as a means to overcome such concerns. “Shared value redefines the overall goal of companies from ‘making profit’ to creating shared value with the community. It takes away the concept of ‘sharing’ the value already created by firms, and instead talks about expanding the total pool of economic and social value,” she explained.

Making money has been the traditional approach to projects, whereby employment and income support for local communities often came second. Yet, Ms Lauria underlined that “the emerging view supports a different approach, one in which companies work on enhancing the competitiveness (and profitability) of the company, in order to advance socio-economic conditions simultaneously.” ■



The path to approval and social licence

that stakeholder and political risks are the main cause of delays. Similarly, in 2011, the U.S Chamber of Commerce analysed 351 stalled or cancelled projects and concluded that social activism was the leading contributor.

Common themes of poor social performance

More recently, a research project by the Harvard University and Uni-

- the inability for a company to pursue new projects; and, additional staff time needed to address conflicts - and this is from the CEO level down.

The most common root social causes of community tensions with major projects relate to competition for resources and prevention of traditional lifeways, consent and land access matters, distribution of benefits, such as employ-

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On natural gas, the agreement doesn't spell out how state-owned Chinese energy companies will import natural gas from the Lower US 48 States. It merely welcomed Chinese buyers to receive LNG shipments and offers the possibility to engage in long-term supply contracts with American suppliers. Long-term gas import is much preferred by

Chinese state energy companies over purchasing LNG cargoes on the spot market.

In a briefing at the White House, the Commerce Secretary Ross underlined that ramping up exports of natural gas from America is not believe to push up energy prices domestically that could harm the US energy-intensive industry.

“This will let China diversify, somewhat, their sources of supply and will provide a huge export market for American LNG producers,” Ross told reporters on Thursday. He added that a deal for coal exports to China was “not likely”, given the far shipping distances.

Expanding US LNG exports beyond 12 billion cubic feet per day (Bcf/d) is believed to benefit the

US economy while maintaining cheap gas prices at home that give the domestic industry a competitive edge, according to findings by the Center for Energy Studies at Rice University and Oxford Economics. Examining export scenarios of up to 20 Bcf/d, the study expands on the 6-12 Bcf/d scenarios studied in a previous DoE-commissioned report. ■

Gas use surges in the Americas, but LNG demand stays linked to weather patterns

South America's demand for natural gas is forecast to grow by some 50 Bcm to reach 191 Bcm by 2030, as overall energy demand increases and more gas-fired plants are being installed to balance renewable power supply. However, the region's potential to develop its LNG market remains largely uncertain, and is very much linked to local weather scenarios.

This is the gist of a report on "South America gas markets and the role of LNG" by Anouk Honore, published by the Oxford Institute for Energy Studies.

"As the region's economy and

dropower, but most new hydro will be run of the river or have small reservoirs," the report reads.

"As a result, generation will be even more significantly reduced in dry periods, thus needing more

ment and develop new resources in order to boost production", with geography, changing regulatory environment and fluctuations in oil prices all representing potential challenges to indigenous gas production.

there will be no region-wide pipeline integration, "but there is a possibility of sub-regional integration around LNG import terminals, as suggested by projects in Uruguay, Colombia or even LNG arriving in Chile and being sold to Argentina," it adds.

By 2030, most scenarios show a potential of 19.5 Bcm/year of potential LNG imports "under 'normal' weather conditions and if Bolivia's renew both its pipeline export contracts at levels allowing Argentina and Brazil to balance their demand."

LNG imports could rise to 30.5 Bcm/year (equals 22.4 mtpa) "in the case of no Bolivian exports, still under 'normal' weather conditions," the OIES forecasts.

On the other hand, cold winters in Argentina and dry weather across the region could have a significant impact on LNG intake. In Brazil alone, it could add up to 35 Bcm/year (or 25.7 mtpa) of LNG imports (on top of already needed imports) on a dry year by 2030.

In conclusion, the report points out "South America is not expected to be a major future LNG market unless there are extreme climatic conditions, which will not happen every year and will not last many years."

"LNG will remain necessary to supply much needed flexibility, additional volumes, security of supply and to reach new markets far from infrastructure. But there are also major uncertainties on volumes, prices, timeframe, location and even direction of the LNG flows as some importers could turn exporters at times of low demand toward the end of the timeframe." ■



Note: The list of "Planned/Proposed" LNG Regasification Terminals represented in this map is not exhaustive
 Source: IEA (2016a), p.VI.4 and Author's updates

population grows, energy demand is expected to continue to increase and become more reliant on natural gas, especially in electricity generation," Ms Honore writes. Despite weaker economic growth somewhat slowing down energy demand for the rest of this decade, "gas demand is still expected to increase."

"Meeting the needs for both additional generation and additional flexibility will be one of the greatest challenges" as "most new generation will be in the form of renewables, especially hy-

back-up capacity, especially gas plants" it argues, adding that "flexible supply will be increasingly needed in order to match the seasonal, and often volatile dispatch of gas-fired power plants". That would include both indigenous production and imports, particularly of LNG.

"South American countries will have to increase upstream invest-

Nevertheless, the report notes that "conflicting agendas add to the confusion on the future role of LNG, and even the direction of LNG trades", given that by 2016, three countries (Argentina, Brazil and Chile) were importing LNG while "in parallel, some countries harbour future ambitions to join Peru as LNG exporters when (or if) their national production permits."

In one scenario, the OIES expects the Americas to import as little as 7 Bcm/year of LNG in 2020 "under 'normal' weather conditions with Bolivian export commitments fulfilled and contracts prolonged." Brazil, Argentina and Chile will continue to import LNG and will be joined by Uruguay and Colombia, it forecasts, with Peru likely to remain the only exporter. Meanwhile,

Meeting the needs for both additional generation and additional flexibility will be one of the greatest challenges

- Anouk Honore, OIES report

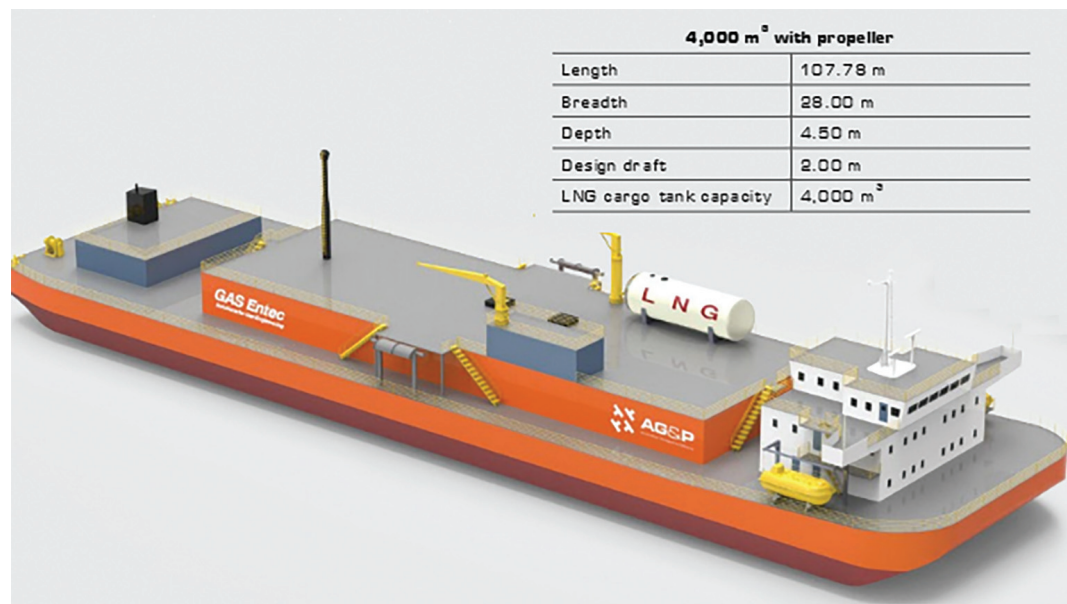
LNG supply, devised as a 'virtual pipeline'

Shell, Total and others are advancing small-scale LNG-to-power projects across Southeast Asia. An ultra-shallow draft LNG carrier by Philippines-based Atlantic, Gulf & Pacific Co. (AG&P) will be a key driver for executing such projects.

To meet versatile requirements, AG&P designed a small-scale LNG carrier (LNGC) - a workhorse to meet delivery challenges posed by shallow rivers and restricted harbours. To that end, the vessel is capable of both self-propulsion across open waters and the ability to de-ballast to two meters or less, whilst fully laden with its cargo of LNG.

Cargo capacity of the vessel is scalable from 4,000 cubic metres to 8,000 cbm, allowing access to restricted harbors so that the vessel can travel near shore or receive LNG cargo from FSU anchored offshore.

The ultra-shallow draft LNGC has a delivery time of approximately 14-16 months from order placement based on existing design specification.



Modularisation helps the Philippines-based company speed up delivery times. AG&P says it "builds the infrastructure in Lego-like pieces."

Product design and production

is carried out at AG&P's two manufacturing facilities, situated some 80km south of Manila. The production sites span 150 hectares of land where the company produce 125,000 tons of assembled

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GE's take on future energy systems

Electricity will make up about 25% of final energy consumption by 2040, as estimated by the International Energy Agency (IEA). Brushing climate concerns aside, Richard Zhang, technology executive at GE's Power Conversion business says electrification would not just help reduce emissions, but also offer significant cost and efficiency savings.

Decarbonisation is, so far, mostly an issue for the power generation sector, less so for end-consumers of electric gadgets. Yet, with new electric devices developed at a rapid rate, consumers and industries have been "quick to embrace the benefits of electrification."

"Through electrification, we can make energy production cleaner, more robust and sustainable. Electric machines are more efficient, more capable and re-

quire less maintenance," Zhang explained. "Future electrical machines will generate power with higher density, higher efficiency and allow for a higher degree of integration."

Cleaner system for LNG and marine applications

Drawing on over 100-years technical expertise on electrification, GE has, for example, developed electric-drive compression systems for LNG projects. The solu-

tion provides an alternative to mechanically driven devices, powered by gas itself or other fossil fuels.

"Electrified LNG infrastructure holds the key to transforming LNG production by making it cleaner and more efficient. It helps LNG production plants to meet the stringent environmental and carbon emission standards expected," suggested Zhang.

Looking to the marine industry for a further example, GE's Ma-

rine Solutions' power take off and power take in (PTO/PTI) technology harnesses the mechanical energy of the vessel's propulsion shaft to convert it into electrical energy.

"The shaft generator motor, installed between the engine and the propeller, can either contribute to propulsion power with onboard power generation or 'absorb' power from the rotation of the propeller shaft and redirect it to onboard systems," he explained; and therefore, "it diminishes the need to burn fuel to power onboard systems and resulting in significant fuel savings."

“**Electrified LNG infrastructure holds the key to transforming LNG production by making it cleaner ...**”

- Richard Zhang, technology executive, GE



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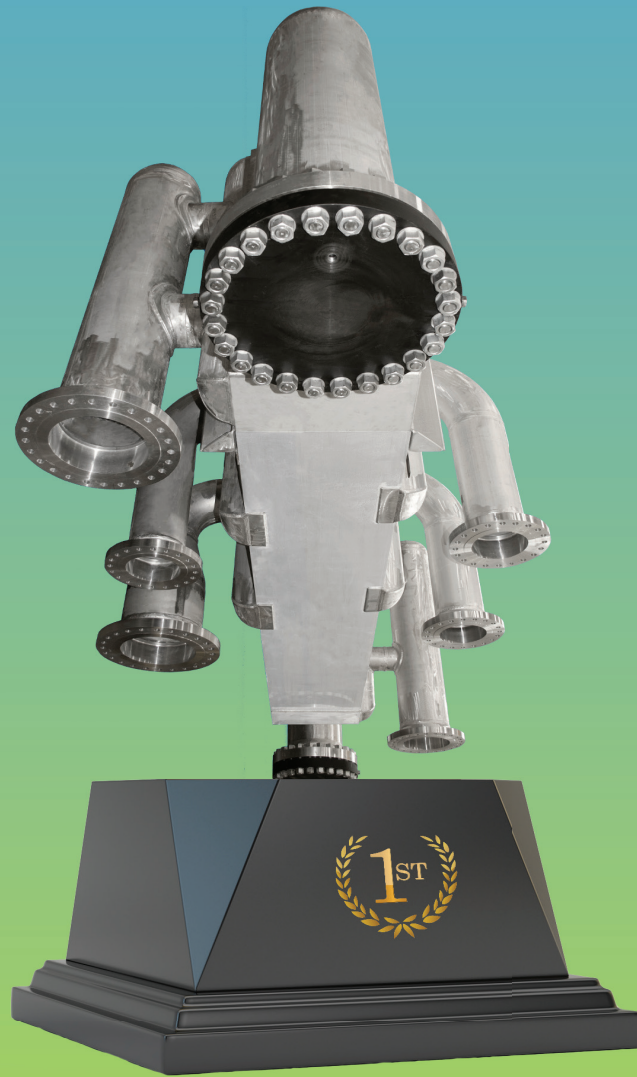
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