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August 2024



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ON THIS MONTH'S COVER



The new STS Marine Solutions icon is based on the North star (Polaris) which has been giving direction to mariners for centuries. The five points of the star also represent the company's vision of being the customer's first choice provider, thus demonstrating direction and quality to the energy sector through a symbol.

The icon also points to the north east, which is where STS Marine Solutions Ltd head office is based in the UK, so there are many connotations to this new icon.

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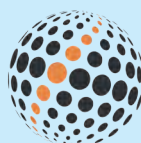
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JESSICA CASEY
EDITOR



COMMENT

It's that time in the sporting calendar again for one of the world's biggest events: The Summer Olympics.

Happening from 26 July – 11 August 2024, the Games will see an estimated 10 500 athletes (which will be split 50% men and 50% women for the first time ever) from 209 countries competing in 32 different sports and 339 events.¹

Taking place this year in Paris, there is an extra emphasis on sustainability. A few ways in which this is being achieved include: recovery of 94% of materials from deconstruction for the building of the Olympic Village, the use of 100% renewable energy sourced locally, the employment of electric, hybrid, and hydrogen-powered vehicles provided by Worldwide Olympic Partner, Toyota, and a 50% reduction in single-use plastics in catering.

On 26 July 2024, the Paris Olympics made history – it was the first time in the history of the Games that the Opening Ceremony took place outside of a stadium, with performances in open air and utilising the River Seine.

Athletes were paraded along the river on boats dedicated to the delegations. This provides another example of the Games' focus on sustainability, and offers an opportunity for France to accelerate its energy transition for boats navigating on the water. Paris 2024 has partnered with HAROPA PORT to support the electrification of Parisian port quays, with a total of 78 charging points available. The aim is to operate all sightseeing boats, carrying approximately 9.5 million tourists annually, with electric motors by 2037.²

This is not the only means of marine travel that has been decarbonised. Paris 2024 has worked with its official partner, CMA-CGM, and its subsidiary CEVA Logistics to roll out more environmentally-friendly logistics solutions, including the latest generation container ships powered by LNG biofuels for the transport of products such as furniture, sports equipment, medical and technological equipment.

As has been well documented, LNG as a fuel for the marine and road transport industry is becoming increasingly common

and popular. Dover Fueling Solutions' article, starting on p.34, considers LNG as an alternative fuel, and looks at its environmental, cost, and business impacts to determine if it could be the perfect solution for the fleet fuelling business.

Following this article, *LNG Industry* has provided an insight into other alternative fuels that are being considered, mainly for use in the marine transport industry, focusing on ammonia, methanol, and biofuels. Although these are less advanced, research and advice are being developed to help understand these fuels better and make them safer. For example, The American Bureau of Shipping (ABS) has released guidance focused on ammonia bunkering, the first such advisory for the industry. The *ABS Ammonia Bunkering: Technical and Operational Advisory* takes into account the aspects of bunkering ammonia as a fuel, providing the maritime industry with a better understanding of the challenges involved and how best to address them. Ammonia is widely considered as a leading alternative fuel due to its greenhouse gas emissions reduction potential, but it is quite toxic, so safe bunkering facilities (whether by truck, ship, or land storage terminal) will be crucial to enabling its adoption.³

Speaking of the marine industry, you can pick up a copy of the August issue of *LNG Industry* at SMM in Hamburg at the beginning of September. **LNG**

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GUEST COMMENT

JULIEN BOULLAND

**GLOBAL MARKET LEADER, SUSTAINABLE SHIPPING,
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As the maritime industry continues to adapt to more stringent regulatory frameworks aimed at curtailing shipping's carbon emissions, the need to adopt low-carbon fuel alternatives is becoming an even greater priority. However, many persisting barriers hamper the adoption of low-carbon fuels – barriers such as the limited availability of green fuels to meet the significant demand, not just within the maritime industry, but across all transportation modalities; the significant cost that is involved for both shipowners and operators compared to fossil fuel counterparts; and the challenges that arise when considering the complex dynamics of fuel supply across the entire value chain.

The current fragmentation of the green fuel supply chain is significant. To bring green fuels to the maritime market, we will need action on multiple fronts: increasing access to available feedstocks, accelerating sustainable fuel production, and developing transport links alongside bunkering infrastructure, all of which represent substantial challenges. However, low-carbon fuels are only one piece of the decarbonisation puzzle. As a result, it is vital that more immediate operational measures and energy efficiency technologies are leveraged.

A recent study by Bureau Veritas (BV), which modelled potential decarbonisation trajectories for shipping, highlights that embracing practical solutions such as reducing speed, voyage optimisation, and weather routing could have a cumulative impact on reducing shipping's carbon emissions.¹ The study suggested that under a 'central progressive' scenario, which would see moderate growth in maritime transport and a large uptake of bio and synthetic fuels, implementing measures such as reducing speed and waiting times could reduce total greenhouse gas (GHG) emitted in the atmosphere by 44% for the period between 2020 – 2050. Alongside these practical solutions, the study stated that the development of carbon insetting methodologies represented an

opportunity to help mitigate the cost of green fuel adoption, whilst connecting actors willing to pay a green premium across the global value chain.

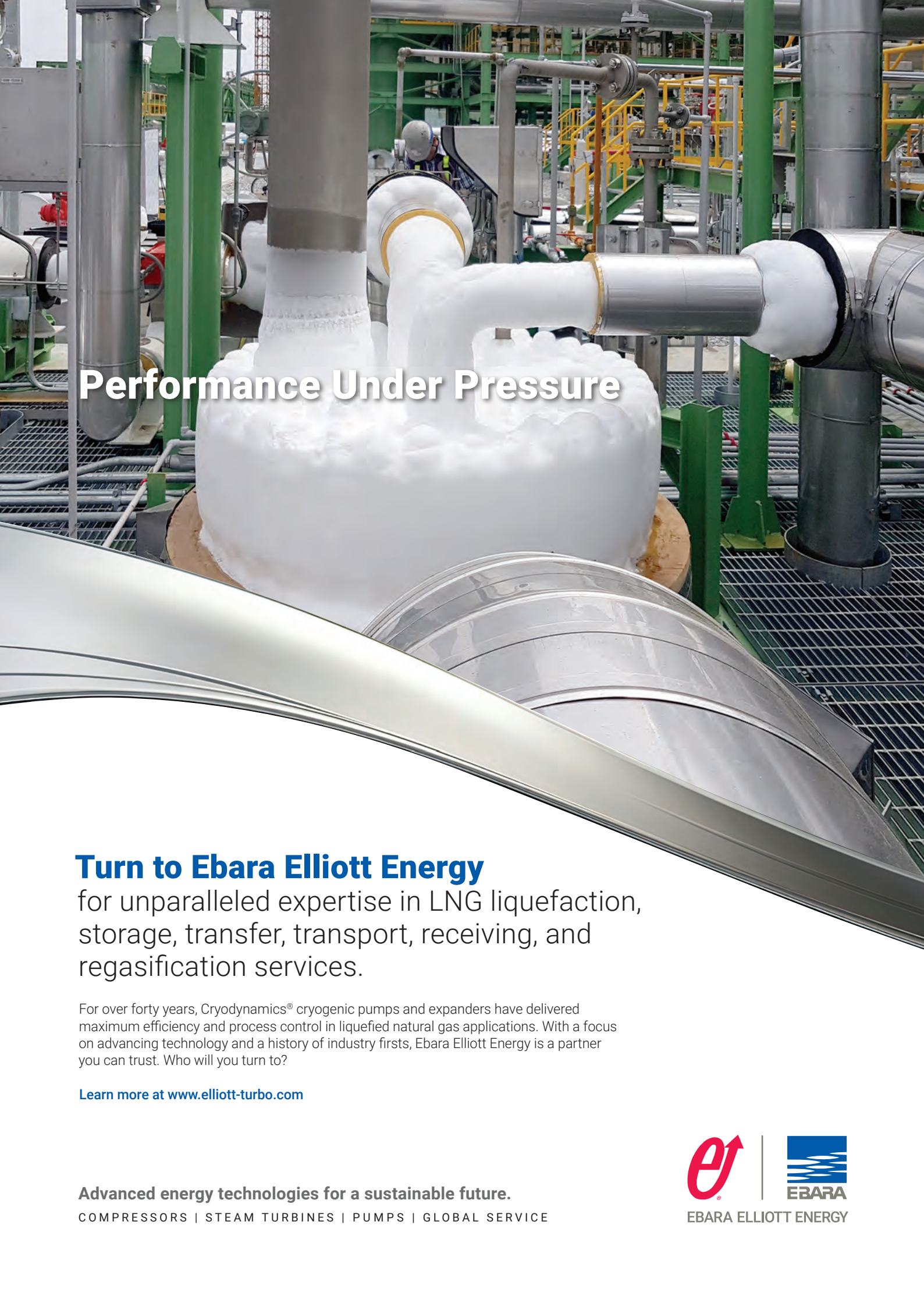
Carbon insets allow energy providers, owners, carriers, and forwarders to share the cost of carbon reduction projects with the end customer, the wider market, or subsidise their decarbonised transport through verified carbon claims. Based on reliable assurance verification, this flexible methodology allows for an acceleration of low-carbon initiatives, providing an opportunity for operators to share the cost of decarbonisation.

Moreover, the use of digital platforms to record and verify the validity of the inset certificates helps to address supply chain fragmentation, by connecting a variety of stakeholders, including fuel buyers and suppliers. This removes geographical barriers that arise from sourcing through physical supply chains, bringing the supply and demand actors of low-carbon fuel development together.

Carbon insetting is a solution that holds significant potential in developing a more unified supply chain that will ultimately accelerate the adoption of low-carbon fuels. However, the obstacles that the industry faces in achieving the IMO's greenhouse gas emissions targets are complex and multifaceted. That is why a decarbonised future will not be achieved without an unprecedented level of cooperation that extends beyond the maritime sector. To support this cross-industry collaboration, BV has established the Future Shipping Team (FST), which consolidates the expertise from the various sectors of the BV Group, to facilitate the sharing of knowledge and research. It is BV's hope that initiatives such as the FST will be replicated on a much broader scale in order to achieve the industry's decarbonisation ambitions. **LNG**

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LNG NEWS

Italy

Edison completes first LNG bunkering operation in the Adriatic Sea

Edison has completed the first LNG ship-to-ship bunkering operation to take place in the Adriatic Sea and the first to be carried out by Edison through the use of the LNG carrier, *Ravenna Knutsen*, which has been supplying the Ravenna LNG coastal depot (DIG) – forming part of the group's integrated logistics chain and contributing to the decarbonisation of road and maritime transport – since 2021.

The *Ravenna Knutsen* is a unique small LNG carrier with extreme operational flexibility, available to Edison under a contract with Norwegian shipowner, Knutsen OAS Shipping. It was built by Hyundai Heavy Industries at the Mipo shipyard in South Korea. The LNG carrier can transport up to 30 000 m³ of LNG via three high-nickel steel tanks that are suitably insulated to withstand cryogenic temperatures. The ship has a double set of cargo manifolds (both low and high), which grant it utmost operational versatility, making it capable of operating with storage facilities and vessels of different sizes.

The use of LNG ensures compliance with the limits imposed by the International Maritime Organization for the transit of vessels in sulfur emission control areas (SECA areas), which the Mediterranean is set to join on 1 May 2025. [LNG](#)

Norway

Gasum ceases all LNG purchases from Russia

In 24 June 2024, the Council of the EU approved the 14th sanctions package against Russia. The package includes a prohibition to purchase or import LNG originating from Russia through EU terminals that are not connected to the EU gas network.

The prohibition included in the sanctions package came into force on 26 July 2024. Gasum complies with all sanctions imposed by the EU and has accordingly ceased all purchases of Russian LNG.

Gasum has a long-term LNG supply contract with Russian gas company, Gazprom Export, which was concluded before 2022. The LNG supply contract is a so-called take-or-pay agreement, which means that Gasum has been obligated to pay for a certain amount of gas each year to Gazprom Export, whether it is collected or not.

The sanctions adopted by the EU do not allow Gasum to terminate its agreement with Gazprom Export but constitute a force majeure on the purchase or import of Russian LNG to off-grid terminals.

Gasum procures LNG from a number of different sources. Gasum has a long-term sourcing agreement with, for example, the Risavika liquefaction plant in Norway. In addition to Norway, Gasum procures LNG globally through terminals in Central Europe.

The majority of the LNG directly sourced by Gasum has already previously come from other sources than Russia, and does not pose any issues in terms of LNG availability to Gasum's customers. [LNG](#)

China

Wison New Energies signs strategic partnership with CIMC Changhong

Wison New Energies (WNE) and Zhoushan CIMC Changhong Shipyard Co., Ltd have signed a three-year strategic co-operation agreement in Shanghai on 23 July 2024. According to the agreement, WNE shall furnish its clientele with a full suite of EPCIC services pertaining to floating natural gas facilities and clean energy solutions. CIMC Changhong will align synergistically with WNE to mutually reinforce their competencies. Collaboratively, the two companies are poised to bolster Wison's pre-eminence within the sector of integrated clean energy solution.

CIMC Changhong is a large scale shipbuilding and offshore engineering company offering integrated services across the entire industry chain, including shipbuilding, repairs, conversions, and marine engineering projects. The company is equipped with six dry docks varying in dimensions from 240 – 510 m long and 40 – 120 m wide. It features a maximum single-lift capacity of 800 t, alongside extensive yard areas and diverse facilities and equipment, which together facilitate the capability of constructing and shipping modules of around 10 000 t. [LNG](#)

Mexico

New Fortress Energy achieves first LNG for Fast LNG asset

New Fortress Energy Inc. (NFE) has achieved first LNG for its initial Fast LNG asset located offshore Altamira, Mexico. With this, Fast LNG establishes itself as the fastest large scale LNG project ever developed.

NFE's proprietary Fast LNG design is the first of its kind, pairing the latest advancements in modular liquefaction technology with jack up rigs or similar offshore infrastructure to enable a faster deployment schedule than traditional liquefaction facilities.

With a production capacity of 1.4 million tpy, or approximately 70 trillion Btu, first LNG completes the vertical integration of NFE's LNG portfolio and will play a pivotal role in supplying low-cost, clean LNG to the company's downstream terminal customers. [LNG](#)

USA

Sempra Infrastructure announces EPC contract with Bechtel for Port Arthur LNG Phase 2

Sempra Infrastructure, a subsidiary of Sempra, has announced that Port Arthur LNG Phase 2 and Bechtel Energy have signed a fixed-price EPC contract for the Port Arthur LNG Phase 2 project under development in Port Arthur, Texas.

As part of the EPC contract, Bechtel will perform the detailed EPC, commissioning, start-up, performance testing, and operator training activities for the project. The scope of the agreement also includes the ability to conduct pre-final investment decision work to better assure project cost and schedule certainty.

The proposed Port Arthur LNG Phase 2 project is competitively positioned and is under active marketing and development. The project received authorisation from the Federal Energy Regulatory Commission in September 2023 and is expected to include two liquefaction trains capable of producing approximately 13 million tpy of LNG, which would increase the total liquefaction capacity of the facility from approximately 13 million tpy to up to 26 million tpy. [LNG](#)

USA

Tellurian to be acquired by Woodside

Tellurian Inc. has entered into a definitive agreement with subsidiaries of Woodside Energy Group Ltd pursuant to which Woodside will acquire all the outstanding shares of Tellurian for US\$1.00 per share in an all-cash transaction.

The acquisition price represents a 75% premium to Tellurian's closing price on 19 July 2024, and a 48% premium to Tellurian's 30-day volume weighted average price, which reflect Driftwood LNG's premier site, fully permitted status, advanced stage of pre-FID development and strong relationships with Bechtel, Baker Hughes, and Chart. The implied total enterprise value of the transaction, including net debt, is approximately US\$1.2 billion. The transaction, which was unanimously approved by both boards of directors, is expected to close in 4Q24, subject to customary closing conditions, including approval from Tellurian shareholders and the receipt of regulatory approvals.

Lazard is serving as financial advisor and Akin Gump Strauss Hauer & Feld LLP is serving as legal counsel to Tellurian. [LNG](#)

THE LNG ROUNDUP

- ▶ Crowley accepts delivery of largest US-flagged LNG bunker barge
- ▶ Monadelphous awarded construction contract for Woodside Pluto LNG facility
- ▶ Shell takes FID on Manatee project
- ▶ DEFSa to launch new small scale LNG station in Aspro Skydras

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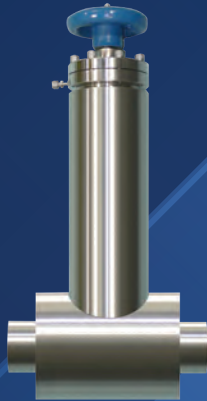




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Beijing, China

www.wgc2025.com/eng/home

Scotland

Wärtsilä and Seapeak renew lifecycle agreement

Wärtsilä has signed a 16-year lifecycle agreement with Seapeak Maritime (Glasgow) Ltd, one of the largest independent owner-operators of liquefied gas vessels. The contract covers 10 LNG carriers and is an extension of an earlier Wärtsilä lifecycle agreement for these vessels. The new order was booked by Wärtsilä in 1Q24.

The new agreement, which is based on 72 000 running hours, is designed to increase the engines' time between overhauls to 30 000 operating hours. The enhanced maintenance performance enabled by this agreement will result in a new level of support for the operator.

The scope of the agreement includes remote 24/7 operational support from Wärtsilä experts, Dynamic Maintenance planning, Wärtsilä's predictive maintenance service Expert Insight, scheduled spare parts, and field service for larger and more complex issues. Wärtsilä will also provide a full-time contract manager in Seapeak's Glasgow office. **LNG**

USA

ADCC pipeline begins commercial service

The ADCC pipeline entered commercial service on 1 July 2024, and is capable of providing approximately 1.7 billion ft³/d of natural gas transportation capacity to the Cheniere Corpus Christi liquefaction facility from markets on Whistler Pipeline's Agua Dulce Header in South Texas. The receipt points in Agua Dulce provide Cheniere direct access to Permian and Eagle Ford volumes, in addition to volumes sourced along the Gulf Coast.

The ADCC pipeline further enhances the natural gas infrastructure in Texas and creates an additional demand point for Permian gas. This infrastructure is expected to help reduce flared volumes in the Permian Basin and further support US LNG exports to global markets.

The ADCC pipeline is a joint venture owned 70% by Whistler Pipeline LLC, which is a joint venture between WhiteWater (50.6%), MPLX LP (30.4%), and Enbridge (19%), and 30% by a wholly-owned subsidiary of Cheniere Energy, Inc. **LNG**

the Netherlands

Uniper produces first bio-LNG at Gate terminal

At the Gate terminal in Rotterdam, Uniper has become the first shipper to start using the bio-LNG production capacity to convert biomethane into bio-LNG.

The bio-LNG produced at the Gate terminal is certified under the International Sustainability and Carbon Certification (ISCC) scheme.

The underlying commodity is biogas produced in one of the EU member states, upgraded to biomethane to remove substances, such as carbon dioxide and hydrogen sulfide and fed into the Dutch natural gas grid. At the Gate exit point, the LNG terminal takes over the biomethane and liquefies it using the terminal's existing infrastructure.

The capacity of the liquefier is about 100 000 tpy and can be used by the existing shippers. **LNG**



LNG NEWS

Oman

Government of Oman to develop new LNG train

The government of the Sultanate of Oman has announced its plan to develop an additional LNG train with a capacity of 3.8 million tpy at Qalhat Industrial Complex in South Sharqiyah Governorate.

The strategic expansion will boost Oman's production of LNG to 15.2 million tpy, optimising the utilisation of the country's available discovered volumes of natural gas resources, while enhancing its LNG export capabilities.

The government is now progressing with finalising the FEED study for this new LNG train project. This critical step is expected to pave the way for the project's final investment decision.

LNG trains allow the government to improve operational efficiency and maximise the use of existing infrastructure. The project is expected to be completed and operational by 2029, helping to meet the growing global demand for LNG.

LNG is considered to be a key contributor to the local economy, with Oman LNG and Qalhat LNG maintaining positive reputations in the global markets. [LNG](#)

UAE

Shell, TotalEnergies, bp, and Mitsui take stakes in ADNOC's Ruwais LNG project

Bp, Mitsui & Co., Shell, and TotalEnergies are to be awarded a 10% equity stake each in the Ruwais LNG project with ADNOC retaining a 60% majority stake. Separately, ADNOC has signed several new long-term LNG sales commitments with international partners, including for the delivery of 1 million tpy with Shell and 0.6 million tpy with Mitsui & Co., taking the committed Ruwais LNG production capacity to 70%.

The partnership reinforces Abu Dhabi's position as a trusted investment destination and builds on the final investment decision (FID) for the Ruwais LNG project, which was endorsed by Sheikh Khaled bin Mohamed bin Zayed Al Nahyan in his capacity as Chairman of the Executive Committee of the Board of Directors of ADNOC in June.

The agreement was signed by Dr Sultan Ahmed Al Jaber, ADNOC Managing Director and Group CEO; Murray Auchincloss, CEO of bp; Kenichi Hori, President and CEO of Mitsui & Co.; Wael Sawan, CEO of Shell; and Patrick Pouyanné, Chairman and CEO of TotalEnergies. [LNG](#)

Scotland

Crown LNG selects IKM Consulting as engineering design partner for Grangemouth LNG project

Crown LNG Holdings Ltd, a leading provider of LNG liquefaction and regasification terminal technologies for harsh weather locations, has selected IKM Engineering & Environmental Consultants, an award-winning civil and structural engineering and environmental consultancy, as its partner for the design and engineering of its planned 100% owned floating LNG import terminal in the Firth of Forth, Scotland. The appointment represents a critical milestone as Crown advances toward final investment decision (FID) for the Grangemouth project.

The Grangemouth project, located on the east coast of Scotland, seeks to support the UK's increasing drive for energy security post-Brexit and in the context of geopolitical impacts on energy markets. Currently, the UK

relies on just three facilities for all of the country's LNG imports, which increased 74% from 2021 – 2022.

IKM's mandate will include the pre-FEED and FEED phases, including project management and execution planning. Specific services to be provided include: consenting; overall process design; facility layout optimisation; detailed engineering; and procurement support.

A site study for location of the import facility and LNG vessel access has been completed, and Crown will progress immediately with the consenting process with the Scottish and UK governments. Existing power grid and gas grid access is available within 10 miles of the proposed site location. Crown will employ an FSRU technology for the project. [LNG](#)

亚洲
重新
点燃

ASIA REIGNITES





Emma Richards, Associate Director, Oil & Gas at BMI, a Fitch Solutions Company, examines how Asia has returned as a driving driving force of global LNG demand amid shifting energy dynamics.

After a troubling few years, Asia is re-emerging to regain its role as the engine of global LNG demand growth. Russia's invasion of Ukraine in 2022, and the subsequent steep decline in gas flows from Russia to Europe, radically altered global gas dynamics. Price-sensitive consumers in Asia were crowded out of the market as European buyers scrambled to sure up the security of their own supply, replacing piped gas with LNG. LNG imports into the EU and UK surged, sapping flows to the Pacific basin and, as a result, global LNG and European



gas hub prices spiralled, both catalysing and compounded by the broader energy crisis. Market conditions have since normalised, with the Asian spot LNG benchmark JKM receding from its 2022 highs of US\$70/million Btu to around US\$12/million Btu as of mid-June. Consequently, flows into Asia recovered in 2023, albeit somewhat moderated by weakening economic growth amongst several key importers (including China, India, and Japan), a mild winter and a robust increase in piped gas exports from Russia to China. Nevertheless, the region accounted for the lion's share of global LNG demand growth in 2023, and will make up over 75% of net global growth over the next 10 years.

Economic backdrop

While the long-run outlook for LNG demand in Asia is sanguine, the near-term economic backdrop is somewhat mixed. Most of the region's importers will see their real growth domestic product (GDP) growth accelerate over 2024 – 2025, but BMI forecasts growth to soften in China and India. LNG imports have risen healthily in both markets in the year-to-date, but could face some downward pressure going forward, exacerbated by perennial competition with domestic coal resources and, in China's case, imported pipeline gas. GDP growth in the northeast Asian markets is structurally lower than elsewhere in the region, but economic activity looks buoyant in south and southeast Asian countries including Bangladesh, the Philippines, Thailand, and Vietnam. Although these markets represent only a small share of the region's LNG imports (accounting for little more than 10% of the regional total this year), their economic and demographic fundamentals are strongly supportive of increased energy consumption and LNG demand growth over the coming decade. Thailand, Pakistan, and Bangladesh will rank among Asia's largest import growth markets in volume terms out to 2033, supplementing vast volume additions in India and China and offsetting lacklustre growth in South Korea and outright declines in Japan.

Natural gas and the energy transition

Asia is somewhat of a special case in the emphasis it places on natural gas as a bridging fuel in the ongoing energy transition. Governments across the region are actively pursuing a growing role for gas in their energy mixes, seeking to switch away from coal in the power sector, supplant oil in petrochemicals production, raise the use of gas amongst domestic industries and promote the proliferation of city gas markets. In this regard, the heavy election schedules in 2024 has bred some uncertainty. However, policy continuity has so far prevailed. In Bangladesh, India, Indonesia, Pakistan, South Korea, and Taiwan the incumbents have broadly maintained their hold on power, although some have lost their legislative majorities. This points to continued strong support for natural gas, translating into small but significant increases in its share of the energy mix and a large gain in the overall demand for LNG.

LNG demand growth will be strongest amongst emerging markets. A case in point is the power sector: total power generation will increase by 6344 TWh (51.1%) over the next 10 years for emerging markets in Asia, vs 157 TWh (7.1%) for developed markets. For natural gas-fired generation, the comparable figures are 706 TWh (89.0%) and 163 TWh (21.3%). The key 'known unknown' is, of course, renewables penetration. The expected increase in renewables output is one of the main reasons behind the anticipated decline in Japan's LNG imports,

coupled with nuclear capacity restarts and improved energy efficiency. The country now faces a growing LNG surplus as utilities cut LNG use for power generation. LNG importers are likely to seek market outlets for sales in other domestic industries or reexport their surpluses.

The broader shift in regional demand from emerging to developed markets raises some interesting questions which will be closely monitored over the coming years. Notably, emerging markets tend to have more uncertain demand outlooks, greater sensitivity to prices, less creditworthy buyers in comparison to the giant Japanese and South Korean utilities, and are generally more unable or unwilling to lock into large, long-term supply contracts. This feeds into a broader market trend towards increased spot and short-term trading, the rise of the portfolio player and growing contract disputes aimed at loosening contractual terms to smooth the flow of LNG. This is just part-and-parcel of the LNG market's gradual shift from rigid end-to-end trading to a fully commoditised, globalised, and liquid marketplace, more akin to European or North American gas hubs or crude oil and refined fuels.

While the increase in regional gas demand is critical to Asia's LNG outlook, import growth is also being fuelled by falling domestic production. In general, Asian markets have little or no access to piped gas supplies, with China being a notable exception. Amongst the region's LNG importers, only China, Vietnam and, to a much lesser degree, Thailand, are set to see domestic gas output rise. Several countries, including Bangladesh, Myanmar, Pakistan, and the Philippines are on track for a meaningful decline. In response, many countries in the region are rapidly building out their regasification capacity, although the recent uptake of floating regasification and storage units by buyers in Europe has put a dent in some of these plans. Nevertheless, the outlook is rosy, with emerging markets in Asia set to increase their LNG imports by 118 billion m³ (73%) over the coming decade, while developed market imports rise by 7 billion m³ (3.6%).

Upwards for LNG supply

Although the demand side tends to take the focus in Asia, the supply side should not be overlooked. LNG supply growth has happened in waves. In the decade following 2010, Asia – led by Australia – dominated global liquefaction capacity addition. Since then, the US has taken up the mantle, with growth fuelled by abundant domestic shale gas supplies, a diverse competitive landscape and an attractive investment climate, as well as extensive existing infrastructure to leverage. The Middle East and Africa will account for the lion's share of new supplies coming online up to 2033, led by Qatar and Mozambique, as both monetise large and low-cost discovered resources. Australia's mega-LNG projects were plagued by delays and cost overruns and there is little appetite to invest in ventures of this kind going forward. The dynamics of the market are shifting and smaller, phased and more flexible projects which offer lower lead times and shorter payback periods will likely be the preference, with large scale greenfield additions becoming more the exception than the rule.

However, Asia is due for somewhat of a revival. Australia itself is set to see exports expand by 18 billion m³ (18%) over the next 10 years, as various backfill projects are brought onstream. The only planned capacity expansion is the Pluto LNG expansion, but the implementation of pro-climate policies domestically should free up additional volumes of gas for export abroad via existing

LNG terminals. The next largest growth markets in the region are Malaysia and Indonesia. In Malaysia, growth is being driven by a combination of floating liquefaction capacity increases and increased production at the legacy Bintulu plant, which should raise exports by 16 billion m³ (49%) up to 2033. There are significant upside risks to feed gas supplies from three major gas projects slated to come online between 2024 – 2027. Petronas and Shell are currently developing Kasawari and Rosmari & Marjoram (R&M) gas projects, output from which is earmarked for LNG production at the Bintulu plant, while Lang Lebah – another sour gas project – is also intended to supply Bintulu.

Meanwhile, Indonesia is on track for a 15 billion m³ (89%) increase in its net exports over the same period. The ramp-up at Tangguh LNG Train 3 over 2023 – 2024 is a part of the story, as is Sengkang LNG, while the prospective Abadi LNG project offers upside risk to the outlook. As with Malaysia, the Indonesian government is pushing to raise output at the legacy Bontang plant, but rising demand could infringe on the availability of domestic feedstock in both markets.

The region also has two smaller producers – Brunei and Papua New Guinea. Papua New Guinea is set to see a moderate increase in its LNG exports (2.4 billion m³ [22.4%]) over the coming decade, buoyed by the development of the Elk-Antelope field and the start-up of two new LNG trains, a final investment decision on which is expected in 2025. In addition, ExxonMobil is progressing the Angore project, which will be used to backfill PNG LNG. There is upside risk to the current outlook stemming from a potential third train at PNG LNG, although these plans seem to have been shelved for the moment. Brunei is by far and away the laggard of the region. Its exports are relatively small,

standing at around 5 billion m³ in 2024, and are set to decline significantly over the next 10 years, falling by 2 billion m³ (41%). The market is struggling with dwindling domestic gas reserves and rising demand. Offshore exploration efforts are ongoing, but there seems little hope of a meaningful increase in feed gas production. Brunei LNG has reportedly sought supplies outside of the country to maintain its exports and profit from favourable arbitrage opportunities, but will unlikely be able to lock into new long-term supply contracts. This is a common thread across the region, with strong domestic demand significantly outpacing on the availability of local gas supplies and increasingly encroaching on export levels, dragging liquefaction plant utilisation increasingly below nameplate capacity.

Outlook

As Asia pivots towards a future where natural gas plays a pivotal role in its energy landscape, the delicate balance between domestic production, import capacity, and demand will shape the region's position in the global LNG market. The region's burgeoning economies and their push for cleaner energy sources underscore the importance of LNG as a transitional fuel, even as they grapple with the challenges of price sensitivity, supply contracts, and the integration of renewable energy sources. The evolution of Asia's energy policies, infrastructure development, and economic growth trajectories will undoubtedly influence global gas dynamics, with a ripple effect that extends globally. As these trends continue to be monitored, it is clear that Asia's energy choices will have profound implications for the worldwide LNG trade, underscoring the region's role as a key player in the global energy transition. **LNG**



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A terminal story

Ken Liu,
Project Manager of
CPC Third LNG Receiving
Terminal Tank Project, CTCI Corp.,
outlines how the company overcame a
series of triumphs during the development of
the CPC Guantang Third LNG Receiving
Terminal Tank Project in Taiwan.

As the Taiwanese government continues to promote the energy transition and promote green energy, coal-fired power generation is being gradually replaced with natural gas to reduce air pollution. Therefore, Taiwan's CPC Corp. plans to commence operations of the third Guantang LNG terminal project by the middle of 2025 to ensure the stability of power supply in Taiwan.

The LNG storage tanks of the Guantang project were constructed by CTCI Corp. and a consortium partner, Kawasaki Heavy Industries Co. (KHI). CTCI Corp. is in charge of tank civil design and construction work, while KHI is responsible for tank mechanical design.

Aside from the main task of constructing two LNG storage tanks – both with a capacity of 160 000 m³ within a working area of less than 3.5 ha. – the project team had to deal with numerous challenges including seasonal coastal strong winds, the COVID-19 pandemic, labour shortages, ecological conservation, and carbon emissions reductions during construction to successfully achieve mechanical completion of the project. As CPC's jetty and regasification facilities are still under construction, the two LNG tanks are currently sealed with nitrogen gas and are on standby for the arrival of the first LNG in early April 2025.

Site space constraint of LNG storage tanks construction

The Guantang project is located near the algae reef ecological conservation area.

The initial plan was to construct four storage tanks within a 12 ha. area. However, due to ecological conservation constraints, the plan was revised to build two tanks within a reduced area of 3.5 ha. A full containment double dome roof tank design for the LNG storage tanks was chosen for this project, considering that Taiwan is located in a seismically active area. This design of tank can seal LNG inside the inner tank when earthquake-induced displacement causes liquid fluctuation – a phenomenon called 'sloshing'. In order to avoid sloshing damage, full containment double dome roof tank design can reduce the tank height compared to

suspended deck design under the same storage tank volume. However, a reasonable site space for temporary material storage, fabrication, and installation is still required. As there were many interface contractors simultaneously working in the same area along with CTCI, space constraint thus emerged as the primary challenge of this project.

To tackle the problem of limited site space, CTCI used a 4D model to plan all schedules of construction activities, which enabled us to visualise information such as required material storage areas, spaces for operating construction equipment, lifting sequences, etc. in 3D alongside scheduled dates. This ensured early communication and coordination with other interface contractors regarding the required construction spaces.

Besides, extensive prefabrication and modularisation of tank roof structures were adopted in this project, significantly reducing site working space requirement. In total, 1700 t of tank roof structure were prefabricated and modularised to several roof blocks outside the site. CTCI had two shops for roof block prefabrication and modularisation, one was located near the sea port for easy receipt of raw materials and conducting prefabrication of tank roof structures, the other was located near the construction site to modularise roof blocks. The company then assembled roof blocks at the site within one week for each inner roof block and outer roof block, reducing the time and space occupied by roof blocks storage and large cranes on the construction site.



Figure 1. Guantang project is located near the algae reef ecological conservation area. Ecological protection measures must be implemented during construction.



Figure 2. Tank roof air raising for the first tank.

Seasonal coastal strong winds

The second challenge is seasonal coastal strong winds. During the autumn and winter season, peak ground wind speeds at the site can reach up to 30 m/sec. Once wind speeds exceed 10 m/sec., hoisting operations are prohibited to ensure construction safety, which means the construction time is constrained.

To address this, CTCI adopted the DOKA modular template to provide a stable and safety working platform during the outer concrete wall construction. This method ensures high stability during bad weather conditions and with low risk in scheduling control, surpassing the use of slipform method. The DOKA modular template offers six-level safe working platforms, including upper-level concrete pouring and lower-level wall surface treatment. Before the concrete pouring process, the reinforcing bars were prefabricated on the ground as modules, which were then installed in DOKA template to reduce the risk of letting site crew work on high places. In the meantime, with the prefabrication and modularisation of tank roof structures outside the site, it not only significantly saved time for hoisting, but reduced personal working hours on scaffolding.

Additionally, with the tank roof air raising technology, the 1700 t of tank roof structure were raised to a height of 30 m and was well-positioned in a single day, creating an inside-the-tank construction site unaffected by weather conditions for continuing inner tank shell welding. During the tank roof air raising process, all personnel needed to work together cohesively to constantly measure the raising rate, the inclination, and the rotation of tank roof so as to promptly make necessary adjustments. As a result of

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precision control capabilities, after being raised to a height of 30 m, the roof with a diameter of 76 m possess tolerances of less than 3 cm of inclination and 0.8 cm of rotation.

COVID-19 pandemic

During the construction period, the COVID-19 pandemic emerged as another challenge that lasted for two years. To prevent the cluster infection and subsequent work suspension or progress delays, all personnel were required to wear masks even during construction. Additionally, weekly rapid tests were performed and an isolation accommodation area was set up for confirmed COVID-19 cases. For employees who can work from home, a CTCI-developed application allowed easy communication between employees, and an e-platform was built for downloading, reviewing, and modifying design documents and for using other functions same as employees in office.



Figure 3. Isolation room with independent bathroom for mild COVID-19 cases at site.

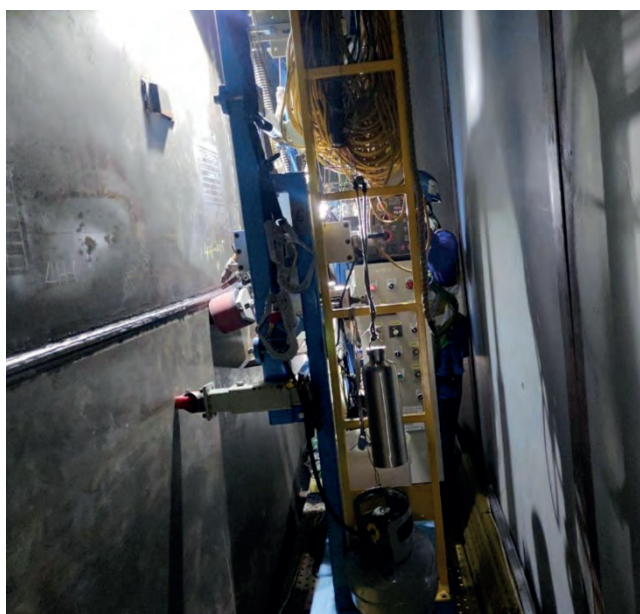


Figure 4. Self-developed semi-automated SAW welding machine was capable of moving within a 1 m-wide gap between the inner and outer shell.

Furthermore, to prevent cross-infection, the construction personnel for the first tank was separated from those for the second tank, with both having separate working areas, commuting routes, dining facilities and accommodations. These measures effectively prevented work suspension resulted from personnel cluster infection, contributing to successfully deliver the project during the COVID-19 pandemic.

Labour shortage

During the construction period of this project, Taiwan's labour market experienced a severe shortage in workers resulted from the numerous ongoing construction projects in Taiwan during the same period, especially for experienced welders. Even the wages for experienced welders doubled, it was still challenging to hire them.

In response to the labour shortage crisis, modularised roof block materials were prefabricated in the shop using semi-automated SAW welding machine to reduce the need for welders. Horizontal weld seams on the inner shell plates were welded using self-developed lightweight and mobile semi-automated SAW welding machine. These machines could adapt to the curvature of the inner shell plates and were suspended from the top of the shell plates using self-propelled rollers, moving within a 1 m gap between the inner and outer shell. This ensured stable and continuous welding while maintaining the quality and significantly reducing the need for on-site manpower, thus overcoming the challenge of labour shortage.

In addition, with KHI's design improvement on tank roof, CTCI used a temporary jig to fix the tank roof immediately when air-raising the tank roof to the correct position, replacing the traditional method that requires a lot of welding work to fix the tank roof and saving the need for a significant number of welders.

Ecological conservation

The protection of algae reef ecology is of paramount importance in this project. Several measures had been adopted including quarterly environment monitoring, and the process of collecting, sedimenting, and recycling surface runoff wastewater to site watering for dust control instead of discharging it into the sea. Through these efforts, coral community within the algae reef ecosystem had seen a gradual increase during the construction period.

Moreover, with the ESG visions in mind to reduce carbon emissions, high-efficiency LED lighting fixtures and high-efficiency elevator motors in design were adopted to save energy during plant operation. Fly ash and slag were also being used to adjust the mass concrete ratio of the two tanks with a volume of 27 700 m³, significantly reducing cement carbon emissions during the construction period.

On the other hand, as the LNG storage tank must be highly dry and in an anaerobic state before LNG injection, nitrogen gas was used to replace the air and dry the tank. The project employed nitrogen piston flow technology to precisely control the nitrogen temperature and flow rate via density difference between the hot nitrogen (light density) and the air (heavy density), so as to form a

nitrogen cloud which acted as a piston at the top of the tank, thus discharging air from the bottom valve of the tank efficiently. This method significantly reduced the use of liquid nitrogen that contributed to low carbon emissions during the production of liquid nitrogen.

Enhanced construction quality

Lastly, a systematic approach to enhancing construction quality was adopted by increasing the thickness of the tank bottom plate and reducing the weld seam width tolerance to prevent welding defects. After the tank bottom plate welding was completed, a liquid penetration test was conducted on the weld seams of the two tank bottom plates, which has a total length of approximately 3000 m. The inspection results were examined by using a magnifying glass, and only when the image appeared entirely white did it deem qualified. After the completion of the liquid penetration test on the weld seams of the tank bottom plate, a vacuum box negative pressure test was conducted in two different pressure stages. A highly-sensitive foam liquid was used for visual inspection, capable of detecting tiny holes in the weld seams as small as 0.01 mm, in order to ensure the construction quality.

Tank sealing with nitrogen gas

Since the CPC's jetty and regasification facilities are still under construction, storage tanks that have achieved mechanical completion must be sealed with nitrogen to maintain a dry and anaerobic environment to avoid corrosion. A dedicated tank maintenance team is set

up to measure dew point and oxygen concentration for both inner and outer tank regularly. Ensuring outer tank's nitrogen pressure within 0.000 – 0.005 kg/cm²G is important as well because the gauge pressure is sensitive to change of the atmospheric pressure. The maintenance team uses nitrogen breathing tank to adjust the outer tank pressure automatically, supplying/discharging nitrogen gas to/from the breathing tank once its buffer is insufficient.

Conclusion

In conclusion, as construction projects are subject to local site conditions, the contractor must give constructability a lot of thought in the design stage and make necessary adjustments to reduce risks during construction while taking ecological and environmental protection into consideration. For unforeseen major events such as the COVID-19 epidemic, it is necessary to follow the law and owner instructions to minimise its impact on the project. Only proactive management and flexible adaptability can effectively handle unforeseen circumstances. Overcoming numerous challenges during the construction period, the project team successfully achieved mechanical completion of tanks and continues to maintain the storage tanks well to ensure that LNG can be filled into tanks successfully in the near future. The project team was honoured with the Taiwan Public Construction Golden Quality Award in 2023, in recognition of the team's efforts to ensure construction quality, construction safety, environmental protection, and carbon emissions reduction. **LNG**





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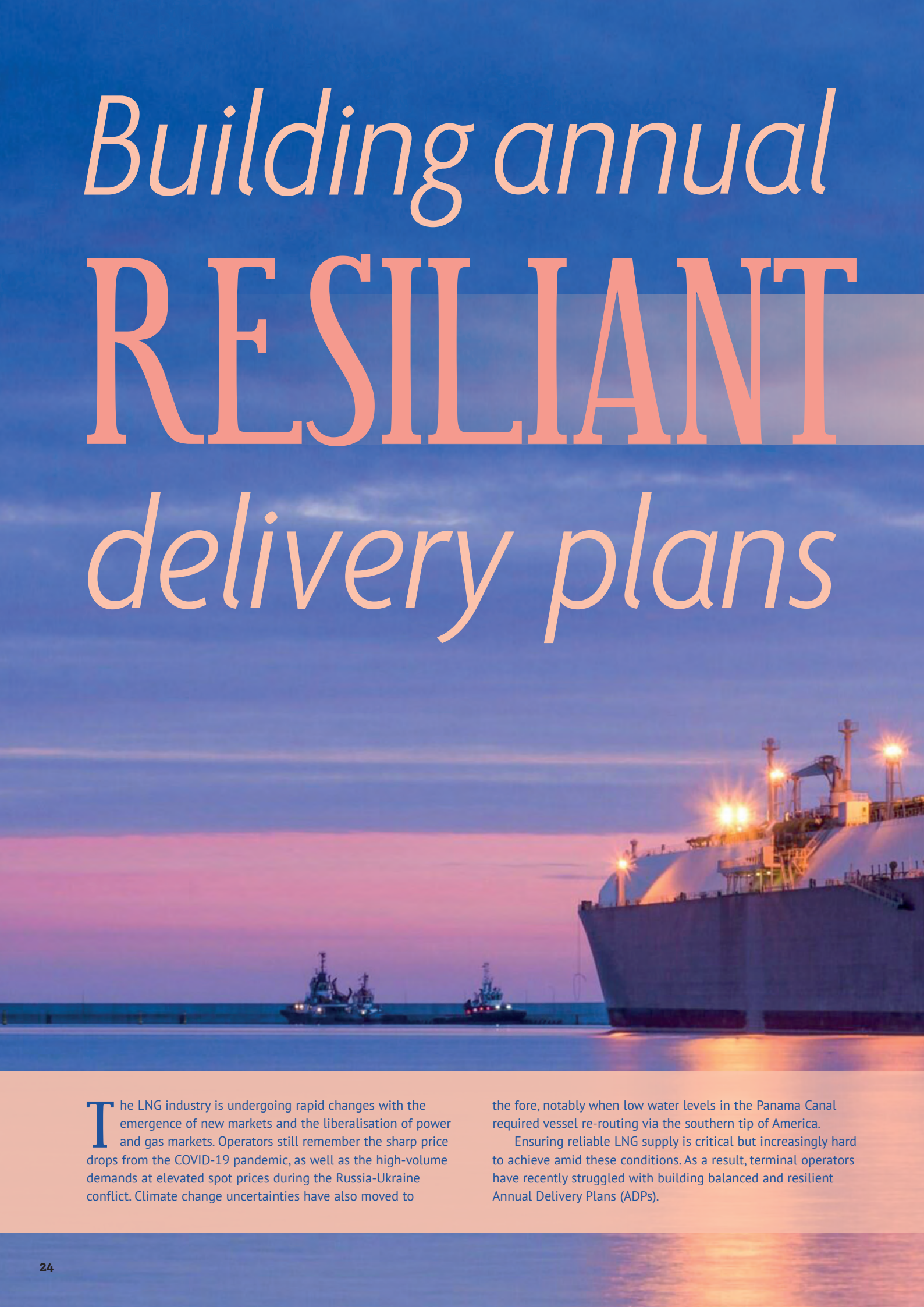


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The LNG industry is undergoing rapid changes with the emergence of new markets and the liberalisation of power and gas markets. Operators still remember the sharp price drops from the COVID-19 pandemic, as well as the high-volume demands at elevated spot prices during the Russia-Ukraine conflict. Climate change uncertainties have also moved to

the fore, notably when low water levels in the Panama Canal required vessel re-routing via the southern tip of America.

Ensuring reliable LNG supply is critical but increasingly hard to achieve amid these conditions. As a result, terminal operators have recently struggled with building balanced and resilient Annual Delivery Plans (ADPs).

Praveen Lawrence and Maulik Shah, Royal HaskoningDHV, UK, consider the importance of using dynamic simulation to balance flexibility and risks.



This article examines why ADP development has become so challenging using standard tools, and how end-to-end value chain logistics simulation software can identify potential operational risks and assist developing a resilient ADP. It also looks at case studies and deep-dive into how the right approach helps mitigate risks to ADP delivery.

Why ADP development has become more challenging

Although long-term contractual commitments and inflexible supply chains still drive many LNG shipments, commoditisation has introduced significant price and volume uncertainties. This has led to a rise in more complex contracts, with nearly 40% of LNG now sold through spot market or short-term contracts.

This means LNG operators must update their approach to contracts by considering flexibilities demanded along with its intrinsic value. These flexibility demands can take various forms, including around price, location, timing, and portfolio. Finding an optimal balance is crucial for both sellers and buyers.

Against this backdrop, developing an LNG terminal ADP is often a prolonged process. It starts with a low-data, uncertain environment. It involves iterations between internal and external stakeholders who can have conflicting interests. There is no single source of truth everyone can look to. And customer demands also evolve as negotiations progress.

Operators must still arrive at a viable ADP that offers contractual flexibilities attractive to customers – managing trade-offs to minimise delivery risks.

Why operators struggle to create resilient ADPs

Given the drive towards more demanding contracts, transition to LNG portfolio operations, higher levels of uncertainty and the increasing impact of climate change/geopolitical events, there is a greater need for more resilient and balanced ADPs. However, the commonly used tools cannot deliver this – they are often static, incomprehensive, or are empirical in nature.

Static calculations using tools like Microsoft Excel are still popular but managing these tools over time can be difficult. There are considerable risks from the lack of

appropriate version control and difficult-to-audit formulas. These tools do not account for process uncertainties or random disruptions like weather or unplanned events at the terminal.

In fact, any static model leaves operators vulnerable. Even rigorous static subsystem models that account for liquefaction plant performance under varying ambient conditions, fluid compositions, and cooling medium performances cannot capture full value chain dynamics. This means they do not account for knock-on effects for example, gas availability, or unplanned shutdown on the terminal's ability to load cargoes on schedule – and they cannot guide on mitigating logistical issues.

Even data-driven solutions leveraging AI have limitations. They require large data volumes to train and validate models, and missing datasets and data quality issues often limit accuracy and reliability. Although fully validated models may be useful for some data interpolation solutions, there can still be accuracy and reliability issues if solutions require extrapolation where there is no previous data.

Dynamic simulation accounts for unpredictability and flexibility

Given the increasingly unpredictable risks and demanding nature of LNG operations, ADP development requires dynamic simulation. Tools like Twinn Witness LNG Logistics Simulator accurately represent the end-to-end value chain from gas to liquefaction, export, shipping and regasification. They account for the complexity of operations, knock-on effects of supply/demand variations, channel traffic, unplanned maintenance across the chain and more. For context, Witness has a 20-year heritage in LNG and has played a role in the operation of nearly 40% of the world's LNG capacity, and is also increasingly applied to carbon dioxide and ammonia shipping development projects. It therefore has fully-validated models that can be relied on to predict future terminal performance, accounting for dynamic risks.

Dynamic simulation therefore gives stakeholders the ability to:

- Evaluate ADP performance as it evolves.
- Stress test ADP resilience.
- Identify where risks are high.
- Find optimal ways to mitigate risks, balancing the many trade-offs involved in operations.

To illustrate the importance of dynamic simulation, Figure 1 compares static and dynamic analysis of a terminal's inventory prediction over a year. The static analysis

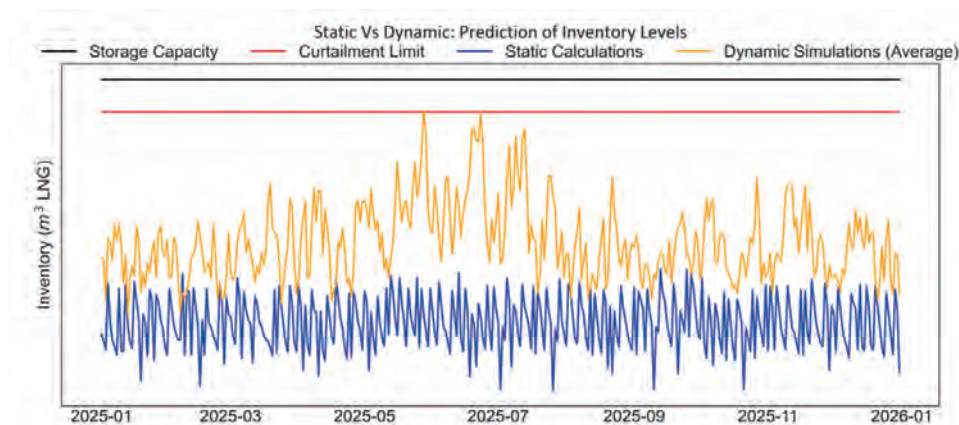


Figure 1. Static vs dynamic analysis of terminal inventory levels.



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shows relatively consistent operations, but the dynamic simulation shows that the reality of operations can lead to tank top situations that curtail production. Dynamic simulation can be used to plan and mitigate that risk; if the static analysis was relied upon, the terminal would have incurred substantial (and unnecessary) costs.

With the growing popularity of flexible contracts, dynamic simulation plays a critical role in stress testing ADPs to minimise commercial risks – as the following case studies show.

Introducing flexibility around different market mixes

The LNG operator in this case study deals with multiple customers, owns a fleet of carriers and delivers cargo on a DES/FOB basis. Customers were requesting more delivery flexibility, and the operator wanted to understand the risks involved in meeting the demands.

They used Twinn Witness LNG Logistics Simulator to develop and stress test four ADP scenarios:

- ADP 1 represented the base scenario, which involved scheduling 25% of LNG for Europe and 75% for Asia.
- ADP 2 sent a higher proportion of LNG to Europe and the rest to Asia, as per the delivery flexibility requested by customers.
- ADP 3 used the same destination mix as ADP 2 but involved one additional delivery vessel.

- ADP 4 used the same destination mix as ADP 2 but involved two additional delivery vessels.

The goal was to identify and quantify the risks associated with the varying flexibility levels – and determine whether the operator needed additional ships to mitigate those risks. The analysis focused on two key performance indicators (KPIs):

- Production losses at the terminal.
- Number of vessels loading outside their berthing window, which ties into demurrage costs.

Figure 2 summarises the Witness analysis of terminal performance under the four ADP scenarios.

For the production loss analysis, the variations stem from operational uncertainties like bad weather windows, unplanned maintenance and delays in vessel arrival time. ADP 2 had higher average losses and a wider range of losses than ADP 1. ADP 3 had considerably lower losses. However, ADP 4 did not lead to further improvements, suggesting that the bottleneck shifted away from the vessels.

The berthing window analysis showed that more vessels would load outside their windows as the allocation to European import terminals increased. Adding one vessel (ADP 3) mitigated this issue, but the variation remained high. Adding two vessels (ADP 4) marginally enhanced performance by reducing the average number of vessels outside their windows, but the variation was still high.

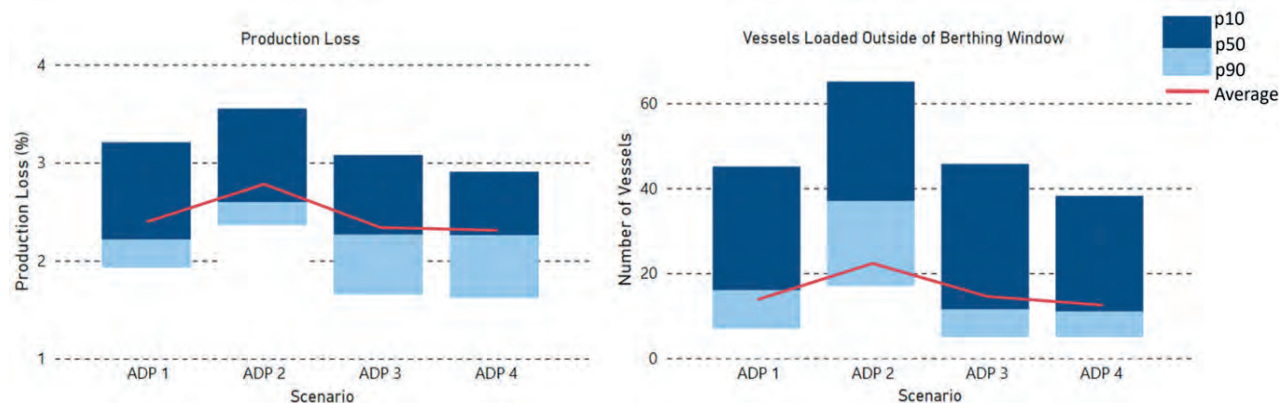


Figure 2. KPI analysis for four ADP scenarios.

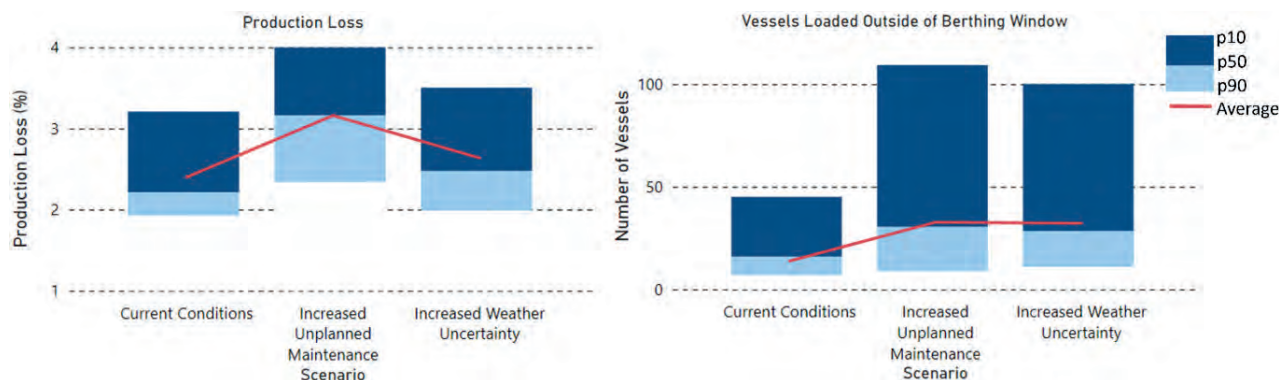


Figure 3. KPI analysis for three ADP scenarios.



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With the insight from this dynamic analysis, the LNG operator could quantify the trade-offs between flexibility and operational efficiency – and account for them in planning and contract negotiations.

Risk assessing an ADP in the face of extreme uncertainties

All ADPs developed require a thorough stress testing to verify if the plans can be met under extreme conditions and identify where investment/support is required to improve the resilience of the ADP.

In this second case study, the LNG operator wanted to assess its ADP's resilience in two scenarios: increasingly adverse weather and higher unplanned maintenance demands. Figure 3 summarises the Witness analysis of the impact on production losses and the number of vessels loading outside berthing windows.

The analysis showed that for the proposed ADP, the terminal performance was very sensitive to unplanned maintenance events with significantly higher production losses (approximately 50% more than the current conditions) and demurrage costs associated with this. In the case of adverse weather uncertainties, the production losses were marginally higher (approximately 10% more than the current conditions) but the demurrage costs were still high. The spread from p90 – p10 (i.e. the variation) increased further, thereby giving a measure of higher risks associated with these increased uncertainties.

This analysis helped the operator to prioritise where investments should be focussed on and what operational

mitigation strategies should be implemented to lower the impact of the identified risks to terminal performance.

How to analyse ADP resilience using dynamic simulation

Dynamic simulation tools like Twinn Witness LNG Logistics Simulator can be used to analyse an ADP's resilience. A deep dive into simulation data can help uncover the root cause for poor performance and address the underlying issues.

Figure 4 shows a Witness analysis of cargoes reaching berth outside their ADP arrival window. A 24 hour delay was considered acceptable, but longer delays warrant further scrutiny. The Witness analysis can then relate the delay to the reasons, which could be to pilot station queues, lack of berth availability, insufficient inventory, etc.²

On closer investigation, the operator recognised the reasons for the congestion, negotiated a modified delivery plan with the customer and ensured that the risks were mitigated. Figure 5 shows that rescheduling eliminates delays longer than 24 hours for the cargo, and that the associated ship queue spike due to berth unavailability had been addressed.

Working to build resilient ADPs

Optimising LNG terminal performance is critical in the current environment of high commoditisation, growing demand for contractual flexibility and higher levels of uncertainty. Static, Excel-based analyses and data-driven solutions do not give a complete picture of real-life terminal operations or supply chains, which are convoluted and significantly affected by uncertainties. Dynamic simulations

account for these uncertainties and model the end-to-end LNG value chain. They can therefore accurately quantify risks and thoroughly stress test ADPs – so operators can efficiently arrive at resilient delivery plans. **LNG**

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2. The reasons for delay are not necessarily limited to queues at pilot station, lack of berth availability and insufficient inventory. Other possible reasons for delay that are accounted in the model could be weather-related disruption in the channel/during voyages, daylight restrictions, channel traffic or unavailability of tugs.

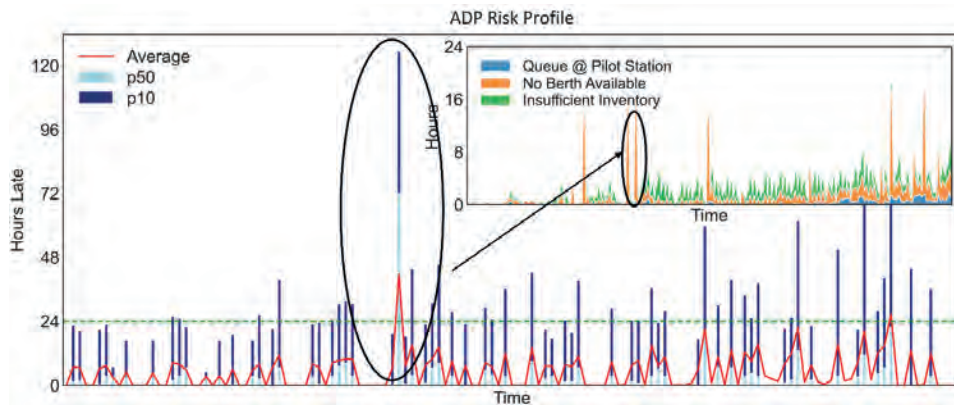


Figure 4. ADP showing cargo delays with reason for delay.

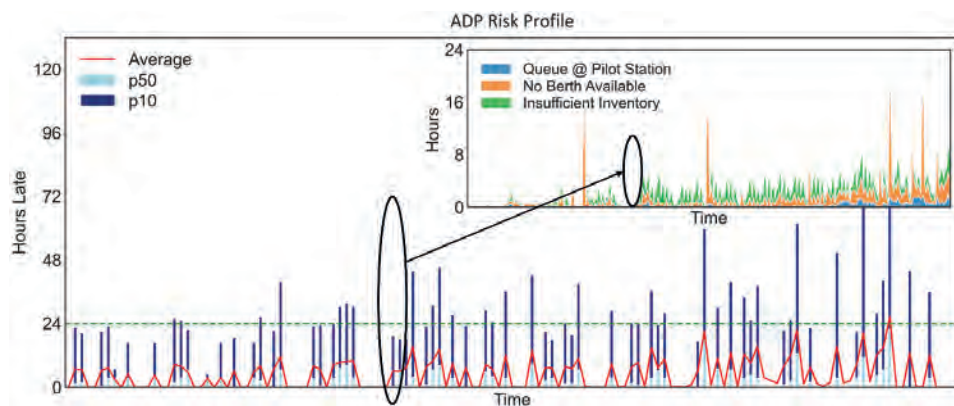


Figure 5. ADP performance after rescheduling.

REIMAGINING FLOW CONTROL



Valves are exposed to extremely challenging conditions when handling feed gas. **Fabrizio Delledonne, IMI, Italy,** explains how a novel quarter-turn ball valve design has transformed production.

It would be fair to assume plants now have flow control down to a fine art. After all, the LNG industry is well over 50 years old and has grown exponentially in the last two decades. This has emphasised the need for best practice when processing feed gas for liquefaction. But despite clear areas of progress, this has yet to emerge and many organisations still rely on older valve designs that introduce their own set of challenges.

This would not be a problem were it not for the wide range of different conditions found as gas enters transmission networks. Feed gas is often supplied from several sources, held by owners that use their own

pressures and flow rates. This puts pressure on valves close to the inlet, limiting rangeability and stable control. However, there have been considerable breakthroughs in this area, which now make it easier for LNG plants to process more efficiently and without the issues resulting from flow instabilities, shifting temperatures, and changes to flow velocity.

The noise problem

LNG trains often exceed accepted noise tolerances of 85 dB, with several sources contributing to the problem. Compressors, for example, increase the pressure of natural gas before it enters a liquefaction unit. These machines are working at high rotational speeds and, as the name suggests, make use of gas that is highly compressed. This on its own is loud enough, yet there are also pumps, heat exchangers, turbines, and vents that add to the overall noise levels on site. Some of this equipment can be housed to mitigate noise levels, though this is not always practical.



Figure 1. With more than 160 000 DRAG™ trims installed in severe service control applications worldwide and 14 000 isolation valves installed in applications where safety, integrity, and performance are critical, IMI's dBX Shield rotary control valve has a strong pedigree.

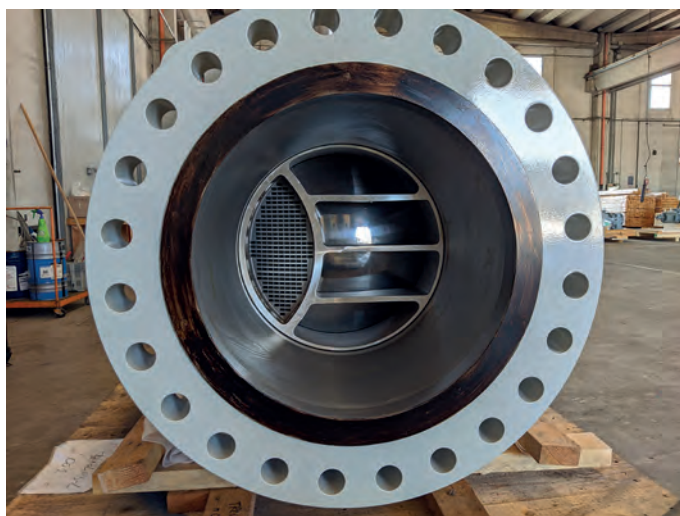


Figure 2. The dBX Shield's design delivers high rangeability in its class at 1000:1 full noise, velocity, and kinetic energy that fully meets ISO/IEC control valve sizing.

Valves present a more complex challenge for managing noise at LNG plants – mainly due to the complex physical changes taking place inside pipework when natural gas is transferred from one area to another. When a control valve opens or closes, gas rapidly changes its flow rate and direction, causing turbulence and fluctuations in pressure. These changes can cause major tremors and vibrations inside the valve and downstream through the pipework.

Until recently, noise has only been a significant problem for staff working at plants. However, urban sprawl and an increased demand for LNG has brought residences much closer to the source of potentially hazardous noise. In 2020, for instance, locals in the Welsh town of Milford Haven complained of a constant low droning, likened to a helicopter hovering nearby. The source of the noise was traced back to an LNG tanker berthed at a nearby terminal, which was preparing to offload its cargo. Cases like this are becoming increasingly common, particularly in coastal areas where LNG plants are located, restating the need for better mitigation techniques at source.

Reimagining flow control

Such techniques can be seen through the IMI's recent work with an LNG producer in the Caribbean. The company operates four liquefaction trains, with a total capacity of approximately 115 million tpy of LNG, making it among the largest in the world.

In the early 2000s, the customer approached IMI to address the criticality of its feed gas flow control valves. The feed gas line size was already sized at 24 in., while the flow control valve on the data sheet, specified as a linear motion globe valve, should have been 36 in. to accommodate check valve (Cv) requirements.

In response, the IMI team worked on a new valve design to improve safety and total gas output. To maximise the valve's Cv, a quarter-turn ball valve was proposed with an inherently higher flow capacity and the addition of a customised multi-stage trim design based on the company's DRAG™ technology – a solution developed by the company in 1960s to control high-pressure drops. The company called this valve dBX Shield, owing to its ability to manage and minimise flow control issues.

Modulating valves for feed gas applications foresee multi-stage trim, making them an ideal application for the introduction of DRAG. Adding it to a quarter-turn trunnion mounted ball valve was considered a new approach at the time of development, allowing for a consistent space and weight reduction compared to traditional solutions, as well as better sealing performance when closed.

Over the years, this valve design has gained momentum and been further improved with the introduction of new manufacturing techniques. The DRAG element, for instance, was optimised with the introduction of additive manufacturing, making it easier to make incremental design improvements without having to modify the overall valve design. The dBX Shield offers flow control, reducing noise in some settings to just 60 dB.

The LNG facility in question carries out regular inspections to identify and eliminate asset integrity issues

stemming from installed assets. This is what led the facility to move from its existing linear valves to a single dBX Shield, finding the move would improve plant efficiency, tackle on-site noise and secure higher yields.

There has been a marked improvement since the site upgraded its train two feed gas line valve to a dBX Shield 24 in. reduced bore. Further valve inspections have now resulted in a repeat order for the facility's third train feed gas line.

Additive advantages

The company has been working with additive manufacturing since 2010, investigating and testing it for the use in the production of standard production parts, including DRAG trim. The technology and recognition of the process has grown considerably as it has advanced over the past decade. Improvements to additive manufacturing machines have also had a large impact on the design and manufacture of complex components for a wide number of industries including aerospace, defence, medical, and automotive industries.

Within IMI, additive manufacturing is commonly used for the production of DRAG trim components. 3D printing offers several advantages for simplifying the manufacturing process, including reduced raw material usage, quicker delivery times and consistency of valve trim components.

The gas industry is seeing an increasing trend in the demand for fugitive emission control mandated by global standards such as ISO 15848, API 641, and API622. Fugitive emissions through any static or dynamic joints or seals within

valves by design have better sealing capabilities through their life, so as the LNG industry looks towards carbon reduction, valve selection will be crucial.

With more than 160 000 DRAG trims installed in severe service control applications worldwide and 14 000 isolation valves installed in applications where safety, integrity, and performance are critical, the dBX Shield rotary control valve has a strong pedigree.

Additive manufacturing is still a developing technology and machines have limitations in the production of component sizes. To work around this, a method was developed by IMI to produce a DRAG flow control element in a shape that could accommodate the use of 3D printing. Working this way also meant the product was not limited by the machine's capabilities.

Base material for the dBX Shield trim is Inconel 718, as this delivers optimal performance for both the printing and design requirements. This design also allows trims to be engineered specifically to meet customer process flow requirements. The ball valve retains all of its capabilities in terms of sealing, fire safe certification, and quarter-turn actuation with full modulating functionality.

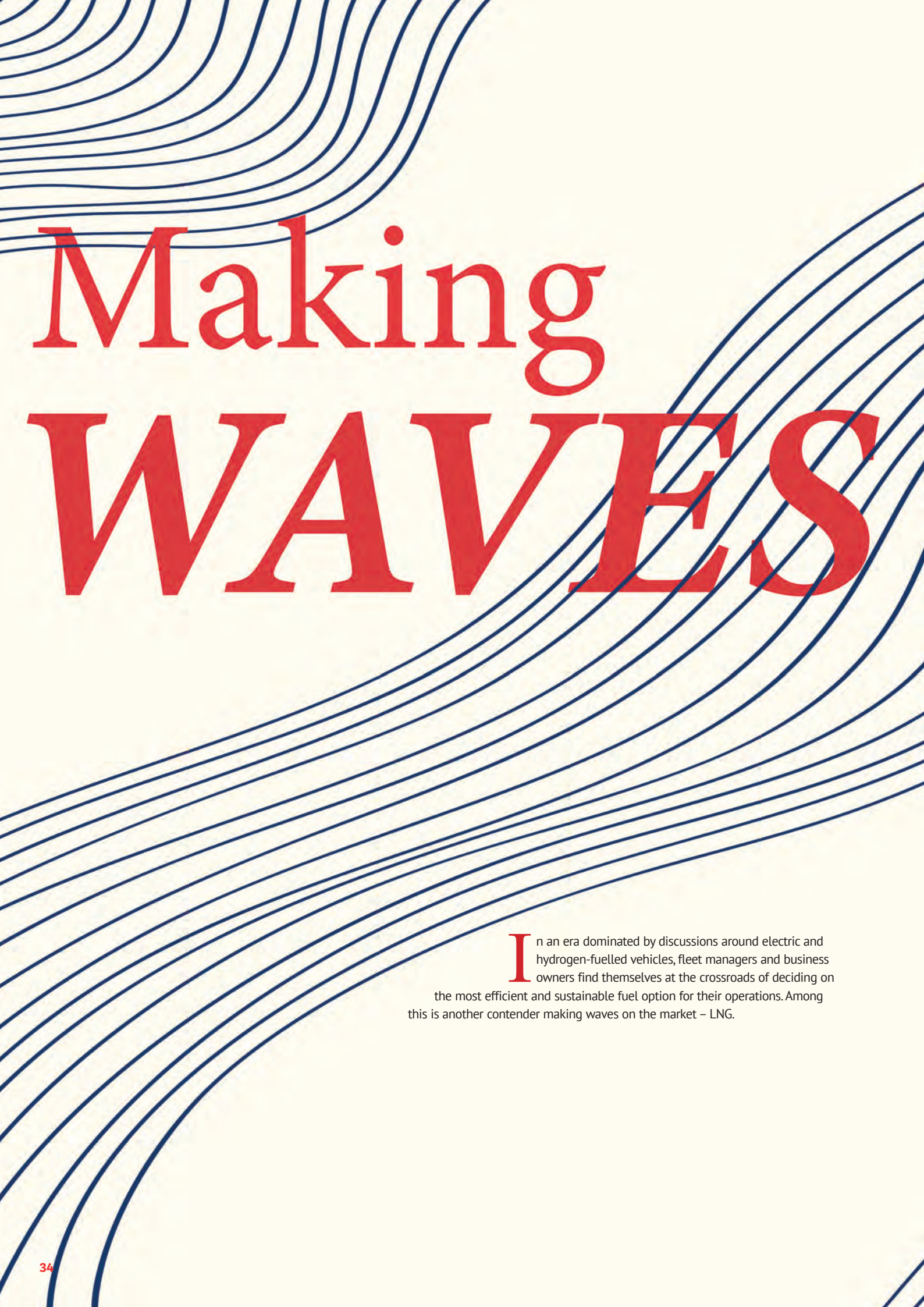
The design delivers the highest rangeability in its class at 1000:1 full noise, velocity, and kinetic energy that fully meets ISO/IEC control valve sizing. The use of this valve in LNG feed gas and gas pipelines significantly reduces infrastructure capital costs. As seen in the earlier example, it eliminates the need for multiple valves and offers weight savings when compared to a traditional globe control valve. [LNG](#)



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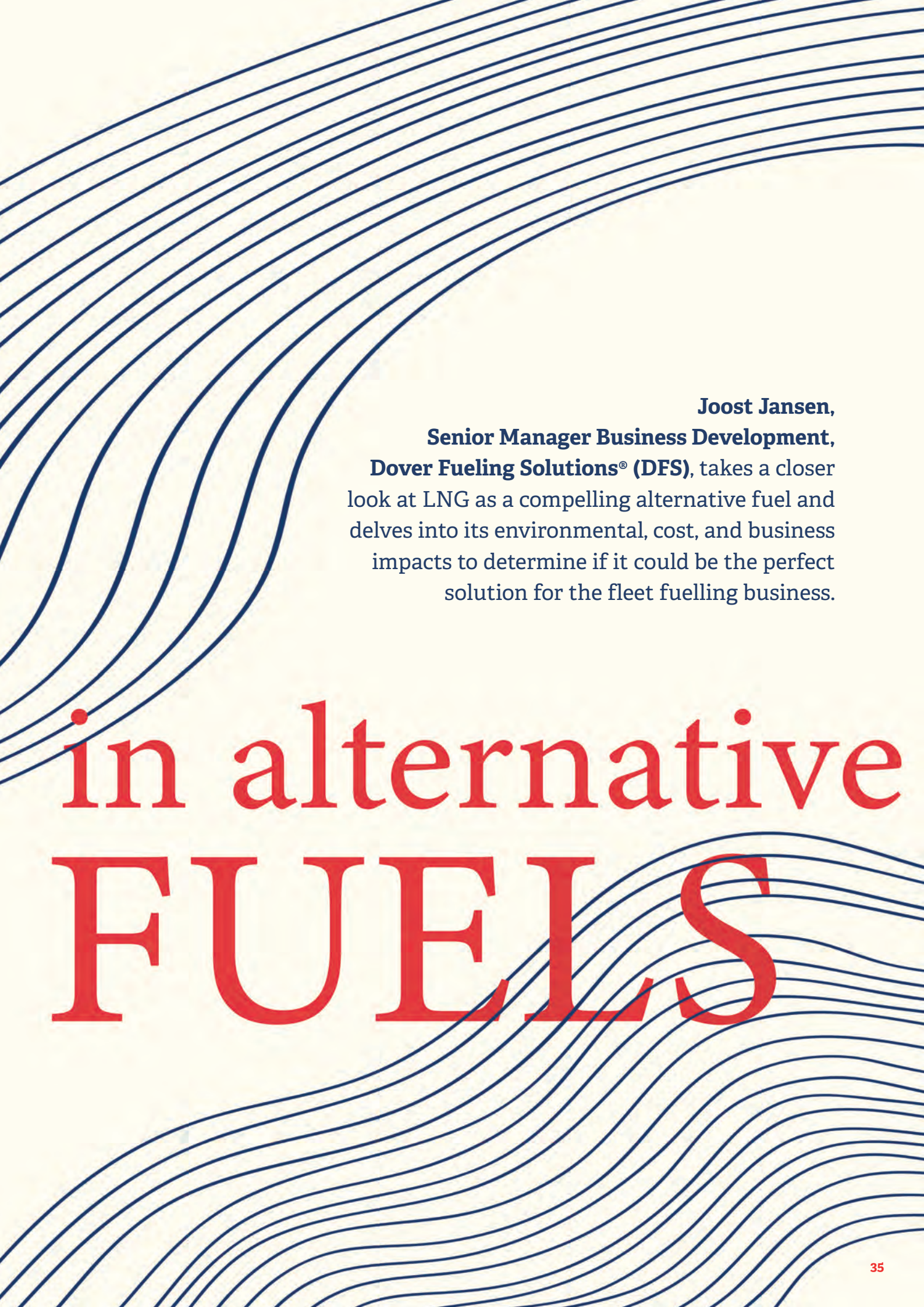
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Making *WAVES*

In an era dominated by discussions around electric and hydrogen-fuelled vehicles, fleet managers and business owners find themselves at the crossroads of deciding on the most efficient and sustainable fuel option for their operations. Among this is another contender making waves on the market – LNG.



Joost Jansen,
Senior Manager Business Development,
Dover Fueling Solutions® (DFS), takes a closer
look at LNG as a compelling alternative fuel and
delves into its environmental, cost, and business
impacts to determine if it could be the perfect
solution for the fleet fuelling business.

in alternative FUELS

Ultimately, consumers are looking for energy that is affordable, reliable, and environmentally friendly. LNG meets these criteria, and its competitive costs help make it a promising choice for commercial transportation.

Environmental impact

As the continent transitions towards net zero, buyers and governments are now refocusing their efforts on lowering carbon dioxide (CO₂) emissions in order to meet decarbonisation goals.

LNG is a natural gas that has been reduced to a liquid state through a process of cooling, and it is the cleanest fossil fuel, producing 40% less CO₂ than coal and 30% less than oil.¹

Methane is the primary component, making up 85% – 89% of the gas. This releases fewer pollutants during combustion, making it a sustainable choice that improves air quality.

Another key player on the market is bio-LNG, which emits 85% less CO₂ than diesel and is a key solution in

minimising emissions from the heavy goods vehicle (HGV) sector.

LNG fuel station operations face a challenge when managing boil-off gas (BOG). Continuously evaporated LNG causes BOG and rising pressure inside the storage tank. Venting BOG into atmosphere is costly and will become illegal as part of the Europe (Green) Deal.

In order to rectify this, LC3 Trasporti installed the LIQAL Boil-off Gas Treatment Unit (BTU) system via SGIG, at their station in Piacenza, Italy.

The tank pressure, in the station in Piacenza, is now under control and at low total cost of ownership (TCO), resulting in smooth and efficient truck refuelling operations on site. LC3 can now provide a unified refuelling experience at its LNG station. With the LIQAL BTU System, truck drivers can refuel their LNG vehicle smoothly and consistently. In addition, logistics are easier to manage as there is no need to arrange offloading to reduce tank pressure. The installation of the LIQAL BTU system also allows the site to operate with a lower minimum level of LNG within the tank and with LIQAL BTU system, LC3 is now able to deliver 100% bio-LNG to trucks.

“Rising temperatures due to climate change affect the entire Mediterranean region and Italy, where we operate. This year, we also experienced record heatwaves, especially during the summer months. With the LIQAL BTU solution, we can now avoid the consequences of BOG in our facility caused by excessive overheating, preventing the risk of any direct gas emissions into the atmosphere. We have had the new system in operation for months, even during hotter summer periods, and have not encountered any issues. In fact, we can completely eliminate the risk of overheating. Furthermore, we have conducted bio-LNG refuelling phases at 100% and can confirm that the system is functioning perfectly. We can be satisfied and proud of this partnership with LIQAL and DFS for what we are accomplishing today and for what we can achieve in the future, soon reaching 100% bio-LNG dispensing from our Piacenza facility thanks to this technology,” explained Michele Ambrogi, President of LC3 Trasporti.



Figure 1. LC3 Trasporti, Piacenza, Italy, featuring the LIQAL Boil-off Gas Treatment Unit.



Figure 2. Rolande Alkmaar, the Netherlands, featuring LIQAL LNG dispensers.

A cost-effective solution

Fuel poverty is a real problem, so providing affordable energy is critical. LNG emerges as a cost-efficient solution, thanks to the ample supply of natural gas resources and the steadiness of its prices, in contrast to the fluctuations observed in the oil market.

During 1H23, LNG imports in Europe were predominantly led by nations in

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LNG
INDUSTRY

East Asia and Europe.¹ China, Japan, and South Korea emerged as the top three global importers, followed by the UK, France, and Spain, where the majority of European regasification capacity is housed.

Access to a diversity of suppliers can not only reduce prices, but can also offer the flexibility to move to more reliable shippers or avoid geopolitically sensitive markets.

The affordability of vehicles powered by LNG is on the rise, supported by an expanding infrastructure catering to the specific fuelling requirements of fleets.

Furthermore, LNG engines typically incur lower maintenance costs, yielding long-term savings for businesses. Unlike electric vehicles (EVs), which often demand substantial upfront investments, LNG presents a more gradual transition without the necessity for a massive initial financial commitment.

A recent study has highlighted the effects of ongoing advancements in liquefaction and shipping technologies on the reduction in production, transportation, and regasification costs, fuelling the swift expansion of the global LNG industry.¹ The purification and liquefaction costs of natural gas have seen a decrease of 35% – 50%, while the transportation cost per unit of LNG has declined by 40%, making LNG a price-competitive solution for today and for the future.

Businesses have the opportunity to invest in LNG dispensers that provide truck drivers with an intuitive refuelling experience and exceptional uptime. When paired with a product to ensure consistent performance, such as the LIQAL BTU, businesses can upgrade their fuel sites with a low TCO while embracing the latest clean fuel technology.

Positive business impact

Transitioning to LNG can positively impact businesses in several ways. Firstly, LNG engines often boast a longer lifespan than traditional diesel engines, enhancing the overall durability of a fleet. The gas is also readily available, with a growing network of LNG refuelling stations worldwide, ensuring operations are less likely to face disruptions due to fuel shortages.

Although LNG infrastructure is still developing, it is growing fast. There are around 735 LNG stations in Europe, with the bulk concentrated in the west, and its

cost-competitive benefits means there is strong potential for commercial transport.

According to the latest statistics, the majority of LNG stations in Europe are in Germany (128), followed by Italy (125) and Spain (88).²

LNG is especially well-suited for long-distance road freight transport, given the limited availability of alternatives to diesel in this case. Moreover, its familiar refuelling method should appeal to drivers. With the emergence of reliable and convenient refuelling units, such as the compact LIQAL LNG Mobile Refueling Unit (MRU) that Gasrec incorporated at a site in the UK to suit numerous locations, it becomes easier for fuel retailers to implement clean energies with minimal work or additional costs – this can even be in addition to conventional fuel dispensers at larger service stations, to cover a multitude of drivers.

Increasing demand for LNG as a 'transitional fuel'

As the EU transitions towards its intermediate target of a 55% reduction of net-emissions by 2030, 'transitional fuels' will likely play a big part in everything from long haul transport to powering home deliveries.

A transitional fuel, in contrast to conventional fuels such as oil-derived petrol and diesel, are any types of fuels which contribute to FIT for 55 reduction targets. Natural gas is the cleanest burning of all transitional fuels and emits significantly less CO₂ than its traditional counterparts.

LNG, especially bio-LNG, is also a cost-effective solution, and has the ability to reduce emissions – something that is highly attractive to the heavy-duty transport industry and other adjacent carbon-intensive sectors.

According to the European Commission, LNG development into a global commodity can improve the security of energy supply in general by boosting the use of natural gas as fuel for transport.³ LNG provides a long-term solution, as The International Energy Agency predicts there are enough resources to last 230 years if consumption remains at current levels.

Conclusion

With its environmental advantages, cost-effectiveness, and positive business impacts, LNG is on the way to becoming one of the most in-demand fuels globally for heavy-duty transport. It can contribute to future energy security measures and facilitate the worldwide transition to decarbonise major carbon-emitting economies. **LNG**

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3. 'Alternative fuels', *European Commission*, <https://alternative-fuels-observatory.ec.europa.eu/general-information/alternative-fuels>



Figure 3. The Netherlands, LIQAL LNG dispenser.

A SPOTLIGHT ON ALTERNATIVE FUELS

LNG Industry

highlights some recent news stories showcasing the advancements in methanol, ammonia, and biofuel as alternative fuels.

Although perhaps the most advanced and readily-available alternative fuel available to the market today, LNG is not the option being considered as the world focuses on reaching climate targets. This feature will highlight some recent news stories on the use of ammonia, hydrogen, methanol, and biofuel as different pathways for helping achieve decarbonisation in the maritime industry.

BIOFUELS



India

Banle Group completes inaugural bunkering at Mundra Port

Banle International Ltd, the listing vehicle of Banle Group, has announced the successful completion of its inaugural bunkering service in India on 11 July 2024. This landmark operation was conducted at Mundra Port, Gujarat, one of India's largest and most strategically important ports. This achievement marks a significant step forward in Banle's expansion strategy and underscores its commitment to enhancing operational capabilities and market presence in key global regions. [LNG](#)

South Korea

Yang Ming's *YM Together* bunkers biofuel in South Korea

Starting in 2024, Yang Ming Marine Transport Corp. is beginning to fuel its fleet with sustainable biofuel. This initiative aims to implement the company's sustainable development strategy, achieve net-zero emissions by 2050, and provide low-carbon transportation services to customers. *YM Together*, an 11 000 TEU container ship, recently became the first foreign-flagged vessel in South Korea to bunker biofuel.

Currently serving the Trans-Pacific route PN3, *YM Together* bunkered B30 HSFO biofuel at Pusan Port, South Korea, on 26 June 2024, in collaboration with KPI OceanConnect, a leading global provider of marine energy solutions, and GS Caltex, a major refiner and a pioneer in biofuel delivery in South Korea. This type of biofuel is a blend comprising used cooking oil methyl esters (UCOME), which complies with ISO 8217 and meets International Sustainability & Carbon Certification (ISCC) standards. This biofuel also meets the green fuel standards of the FuelEU Maritime Initiative, reducing up to 25% of greenhouse gas (GHG) emissions than do conventional marine fuels. Apart from the biofuel, onboard facilities such as scrubbers and shore power systems (AMP) enable *YM Together* to effectively cut GHG emissions and offer customers with transport services that are sustainable and environmentally-friendly. The addition of Pusan port as a biofuel bunkering port in Asia increases flexibility in bunkering options for different routes, which in turn helps Yang Ming to expand the use of biofuel. [LNG](#)

Singapore

K-LINE and Gram Car Carriers co-operate on reducing vessel emissions

Gram Car Carriers ASA (GCC) has announced that Kawasaki Kisen Kaisha Ltd (K-LINE) will use biofuel on three vessels chartered from GCC from July 2024 to reduce emissions and support the energy transition.

The biofuel will be supplied to the sister vessels *Viking Ocean*, *Viking Diamond*, and *Viking Coral* while bunkering in Singapore, an Asian hub for marine biofuels. The use of biofuel is a key environmental initiative to reduce emissions across the entire value chain (well-to-exhaust) and an effective way of transitioning to low-carbon marine fuels amid globally tightening environmental regulations.

Biofuel emits carbon dioxide (CO₂) when it is burned as fuel, but the feedstocks have absorbed CO₂ from the atmosphere, so it is regarded as a sustainable fuel under international standards set by the Intergovernmental Panel on Climate Change (IPCC). [LNG](#)

CLEAN FUELS ROUNDUP

- ▶ Yanmar and Amogy to explore ammonia-to-hydrogen integration for decarbonised marine power
- ▶ Government of Canada invests in green shipping transition for marine industry
- ▶ MPA and NYK forge partnership to advance maritime sustainability, digitalisation, and development
- ▶ Mabanaft submits permit-related approval documents for planned construction of ammonia import terminal in Hamburg



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Source: NYK Line.

AMMONIA

Singapore

ITOCHU, Nihon Shipyard, ClassNK, and MPA sign MoU for joint study of ammonia-fuelled bulk carriers

ITOCHU Corp., ClassNK, Nihon Shipyard Co., Ltd, and Maritime and Port Authority of Singapore (MPA) have signed a memorandum of understanding (MoU) regarding a joint study for the design and safety specifications of ammonia-fuelled ships which are under development by ITOCHU and partners.

As one of parties of the MoU, MPA will review and provide their views to the designs of the ammonia-fuelled ships to ensure their safe operations.

This MoU is based on the premise that 200 000 DWT class bulk carriers will be built by Nihon Shipyard with an ammonia dual-fuelled engine by applying alternative design approval process in accordance with the 'Integrated project for development and social implementation of ammonia-fueled ships' which was adopted under the 'Green Innovation Fund Project/Development Project for Next-Generation Ships/Development of Ammonia-Fueled Ship', a project publicly offered by New Energy and Industrial Technology Development Organization in October 2021. The necessary clarifications of the specification for the ammonia-fuelled ship to carry out ammonia bunkering in Singapore will be conducted among parties of this MoU, for the commercialisation of ammonia-fuelled ships. [LNG](#)

Japan

ClassNK issues world's first AiP for bunkering boom of ammonia fuel

ClassNK has issued an Approval in Principle (AiP) for a design concept of the ammonia fuel bunkering boom, which is jointly developed by Nippon Yusen Kabushiki Kaisha (NYK Line) and TB Global Technologies Ltd. This is the world's first AiP certification for the design of a bunkering boom for ammonia fuel.

As ammonia fuel utilisation is expected in shipping for decarbonisation, bunkering vessels that supply fuel to ships and related equipment will play an essential role in the supply chain. On the other hand, due to the novelty, it can be difficult to confirm the safety of some equipment by applying existing rules.

Targeting such new technologies, ClassNK has issued the *Guidelines for Technology Qualification* that define a certification process to demonstrate that an acceptable level of safety, equivalent to that of technologies designed under existing rules and standards, has been verified. Through the guidelines, ClassNK is providing a risk-based approach to safety assessment for the implementation of new technology.

ClassNK carried out a drawing review of a basic design of the bunkering boom based on part N of its 'Rules and Guidance for the Survey and Construction of Steel Ships' for ships carrying liquefied gases in bulk, and conducted a review of documents required by the 'Guidelines for Technology Qualification'. Upon confirming they comply with the prescribed requirements, ClassNK issued the AiP. [LNG](#)

Japan

JERA and NYK complete world-first truck-to-ship bunkering of fuel ammonia

JERA Co., Inc. has conducted the world's first truck-to-ship bunkering of fuel ammonia, to an ammonia-fuelled tugboat (A-Tug) owned by NYK Line that is scheduled to be completed in late August 2024.

The bunkering of fuel ammonia took place at Yokohama Port's Honmoku Pier with the co-operation of the Yokohama City Port and Harbor Bureau and under the fuel supply agreement that JERA concluded with NYK on 27 May 2024. The bunkered fuel ammonia was produced by

Resonac Corp. at its Kawasaki Plant in part using waste plastic as a raw material, and the same fuel ammonia will also be used going forward for the A-Tug's sea trial. After the A-Tug is completed, JERA will supply fuel ammonia to its operator, Shin-Nippon Kaiyosha Corp.

The bunkering of fuel ammonia to ships is the company's first example of a decarbonisation solution that extends beyond the power generation sector to use in other industrial sectors (multi-purpose). [LNG](#)



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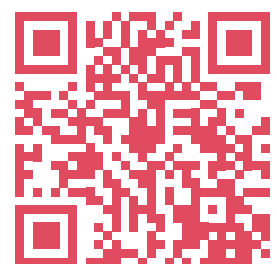
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Source: NYK Line.

METHANOL

China

Fratelli Cosulich cuts first steel for methanol dual-fuelled bunker tanker

Fratelli Cosulich has held the steel cutting ceremony at Taizhou Maple Leaf Shipbuilding for its methanol dual-fuelled bunker tanker.

The 7990 DWT IMO Type II chemical vessel has a capacity of over 8000 m³ and will be able to carry both green methanol and biofuels. It will be equipped with three MAN GenSets designed for running on methanol.

The four-stroke engines will be part of a diesel-electric propulsion system, while an on-board battery storage system will optimise fuel consumption and reduce greenhouse gas emissions.

The vessel is scheduled for delivery during 4Q25 and will be located at the Port of Singapore under a contract with global commodities trader Trafigura. [LNG](#)

China

TFG Marine signs agreement with Consort Bunkers for newbuild methanol bunker tankers

TFG Marine has announced the signing of a long-term time charter agreement with Consort Bunkers for four newbuild methanol carriage-ready bunker tankers. This marks TFG's latest move to prepare its logistics capabilities for the future demand for low-carbon marine fuels.

The 6500 DWT IMO type 2 tankers are being constructed by Merchants Jinling shipyard in Nanjing, China, and will be operated by Consort Bunkers for TFG Marine. Deliveries will commence in late 2024 and continue into 2025.

The vessels will be capable of carrying TFG Marine's current range of marine fuels, including HSFO, VLSFO, MGO, and biofuels up to B100, as well as any grade of liquid methanol in the future. [LNG](#)

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The rise of FSRUs as pivotal components of LNG supply chains looks set to continue. **Andrew Stafford, Technical Director at Trelleborg Marine and Infrastructure**, discusses why this shift needs to be supported by a more interconnected operational LNG ecosystem.

STANDARDISING LNG OPERATIONS



LNG trade has moved beyond its focus on long-term contracts characterised by predictability, and diversified to encompass shorter-term, more adaptable spot contracts, triggering a demand for increased flexibility, safety, and efficiency in LNG production procedures.

Looking ahead, demand for LNG remains robust – serving as a key transitional energy source and offering lower prices and greater availability compared to other alternatives. However, supply growth slowed in 2023, and is anticipated to be constrained again in 2024, despite a strong start to the year in the spot market. The International Energy Agency (IEA) expects demand to grow by 2.3% in 2024, primarily driven by industrial use and concentrated in fast-growing Asian markets.¹ Despite a marginal increase in gas-to-power demand, lower hydro availability in regions like China and India may boost

gas-fired power plant use. However, global LNG supply growth is limited to 3%, with potential downward risks from new plant delays, geopolitical tensions, feed gas issues, and shipping constraints. This limited supply could cap demand growth in key Asian and European markets.

As energy firms navigate these market patterns, LNG supply chains are being reassessed to adapt to this more dynamic environment and ensure infrastructure remains fit for purpose; with demand for increasingly sophisticated FSRUs, one clear new pattern is emerging. Another consequence of demand for more agile operations has been the adoption of ship-to-ship (STS) transfers, a tried and trusted process for oil-based products, but a relatively new process within LNG supply chains, highlighting the industry's shift away from traditional oil-based infrastructure.

FSRUs and ship-to-ship transfers

STS transfers involve the direct movement of LNG between two vessels at sea, bypassing the need for onshore infrastructure. This method offers greater flexibility and efficiency in LNG delivery, reducing costs, especially in regions with limited onshore terminal capacity or fluctuating demand patterns.

In an era where speed and operational flexibility are paramount, FSRUs have emerged as game-changers in LNG logistics, particularly in enabling STS transfers – receiving LNG from LNG carriers, storing it temporarily, and then transferring it to other vessels for distribution or regasification. The ability of FSRUs to accommodate STS transfers reflects a shift towards more agile and decentralised LNG operations.

Moreover, as this article will go on to explain, by embracing digitalisation, the LNG industry can tap into a future where interoperability and connectivity drive operational excellence.

Standardisation for efficiency and safety

Aligning with the momentum seen across the maritime and infrastructure industries, the LNG industry is undergoing a transformation driven by the quest for efficiency, safety, and operational agility. This is manifesting itself in a harmonisation of equipment and procedures to enhance operational efficiency and mitigate risks associated with LNG handling.

Improving STS connectivity is essential to address compatibility issues between ships' systems, especially legacy emergency shutdown (ESD) links. Many large scale LNG analogue fibre optic links, designed in the 1980s, originally adhered to technology standards of that era. In the 1990s, efforts were made to reverse-engineer these links for compatibility, but the absence of standardised design specifications led to complexity and inefficiency, resulting in unique legacy interface support challenges.

To ensure efficient performance and safety during STS LNG transfers, one vessel must essentially replicate shoreside operations effectively. Over the last 30 years, continuous development has enabled the re-engineering of STS systems, removing traditional hardware barriers that impeded efficient ship linking. Consequently, LNG carriers equipped with the latest ship-to-ship link (SSL) models can engage in STS transfer processes using any of their ESD links, notably the fibre optic system. This transformation enables

telecommunications more akin to traditional ship-to-shore connections, eliminating historical limitations associated with traditional safety links. This advancement is particularly advantageous for STS and FSRU installations, specifically those involving multiple LNG transfer processes.

As STS transfers become more prevalent, modernising and harmonising systems are crucial to mitigate risks and enhance operational efficiencies significantly. In a dynamic market where systems and processes may vary due to geographical or operational variances, the importance of uniformity cannot be overstated. Additionally, uniformity could become essential for business continuity if components in older systems become obsolete.

Going forward, FSRUs, being integral to the modern LNG infrastructure, will need to keep up with standardised practices to ensure compatibility and interoperability with other components of LNG supply chains. Standardisation not only streamlines operations but also facilitates regulatory compliance and risk management, crucial aspects in an industry characterised by stringent safety standards and environmental considerations.

Leveraging technology for enhanced connectivity

Advancements in technology play a pivotal role in enhancing STS connectivity and operational efficiency. FSRUs leverage cutting-edge digital systems and communications technologies to facilitate seamless transfers between LNG carriers and other vessels. Modernising STS connectivity involves transitioning from legacy analogue systems to digital platforms that support real-time monitoring, control, and data exchange.

The integration of standardised digital systems in FSRUs enables efficient management of STS transfers, reducing operational complexities and enhancing safety. By embracing digitalisation, the LNG industry is embracing a future where interoperability and connectivity drive operational excellence.

Despite the advantages offered by FSRUs, there are challenges that must be addressed to fully capitalise on their potential. Ensuring compatibility between FSRUs and LNG carriers, optimising transfer processes, and maintaining stringent safety protocols are ongoing priorities for industry stakeholders. Additionally, as FSRU technology continues to evolve, investments in research and development are essential to enhance performance and reliability.

The rise of FSRUs represents a transformative phase in LNG logistics, where flexibility and efficiency are redefining industry norms. These floating units not only enable STS transfers but also serve as hubs of innovation, driving the adoption of standardised practices and technology solutions across the LNG value chain.

The role of hose transfer systems

Integral to the efficiency and safety of STS operations involving FSRUs, LNG hose transfer systems (HTS) provide further opportunities to enhance standardisation and flexibility within the LNG supply chain.

HTS solutions are essential for accommodating new operational scenarios, such as connecting and transferring LNG from standard FSRUs to the largest LNG carriers, such as Q-Flex and Q-Max vessels. They also facilitate LNG reloading to small scale carriers or bunkering ships with minimal adjustments to existing hardware.



Figure 1. Rising popularity of FSRUs requires more interconnected operating systems.

This adaptability streamlines operations by enabling a single connection to manage both cargo transfer and communication, thereby reducing the need for multiple setups and allowing for faster, more efficient transfer initiations. Furthermore, integrating ESD functions from both sides of the transfer into a unified system significantly improves safety, enabling a single trigger point to halt operations instantly in emergencies, reducing response times and minimising potential hazards. Real-time data exchange within this integrated system can pre-emptively identify and address potential issues, ensuring smooth and safe operations.

A comprehensive HTS package that incorporates SSL communication is essential to a practical, efficient, and safety-enhanced approach to modern LNG logistics, enabling the advancement of reliability and efficiency of STS transfers.

The importance of industry collaboration

Creating standardised systems and procedures requires collaborative efforts across industry stakeholders. Organisations such as Society of International Gas Tanker and Terminal Operators (SIGTTO), Society for Gas as a Marine Fuel (SGMF), and Oil Companies International Marine Forum (OCIMF) play pivotal roles in developing guidelines and best practices for safe and efficient LNG operations.

Collaboration between energy companies, engineers, manufacturers, and technology developers is also essential

to address compatibility challenges and drive innovation in LNG logistics. By working together to establish common standards and frameworks, the industry can overcome operational barriers and unlock the full potential of FSRUs in advancing STS transfers.

Future outlook

Looking forward, it is likely that FSRUs are poised to assume an even more significant role in the LNG industry's evolution. With global LNG demand continuing to rise and trade dynamics shifting, investments in FSRU infrastructure that embraces digitalisation will be crucial in driving interoperability and connectivity for operational excellence. This includes the development and implementation of packages that combine modern HTS systems with SSL communication functionality, as well as addressing ESD link compatibility issues.

Standardising LNG operations through greater FSRU integration signifies a shift towards a more interconnected LNG ecosystem. By fully unlocking FSRU's potential, setting new benchmarks for operational excellence and reinforcing advancements of STS transfers and standardisation efforts, energy companies will be better positioned to enable agile and resilient LNG logistics at an unprecedented scale. **LNG**

References

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LNG INDUSTRY 15 FACTS

...ON ASIA

The region accounted for the majority of global LNG demand growth in 2023

Floating LNG capacity increases and increased production at LNG plants in Malaysia should raise exports by 16 billion m³ (49%) up to 2033

The Asian continent covers one-third of the Earth's surface



Thailand, Pakistan, and Bangladesh will rank among Asia's largest import growth markets in volume terms out to 2033

Indonesia is on track for a 15 billion m³ (89%) increase in its net exports between 2024 – 2027

Papua New Guinea is set to see a moderate increase in its LNG exports (2.4 billion m³ – 22.4%) over the coming decade

Emerging markets in Asia are set to increase their LNG imports by 118 billion m³ (73%) over the coming decade

The national sport of Pakistan is field hockey

Developed market imports are expected to rise by 7 billion m³ (3.6%) in the next 10 years

Asia will make up over 75% of net global growth over the next 10 years

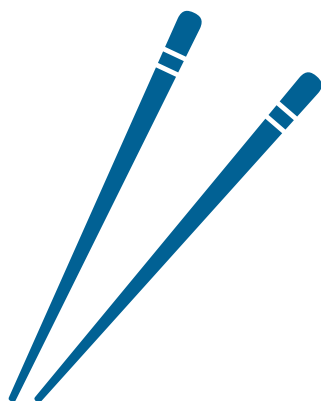
Indonesia was the first Southeast Asian country to qualify for the FIFA World Cup in 1938

Bangladesh has six seasons: grismo (summer), barsha (rainy season), sharat (autumn), hemanto (cool season), sheet (winter), and bashonto (spring)

Papua New Guinea is situated on the Pacific Ring of Fire

There are over 1600 temples in Kyoto, Japan

In Thai culture, each day of the week is associated with a particular colour. For example, Monday is yellow, Tuesday is pink, and Wednesday is green





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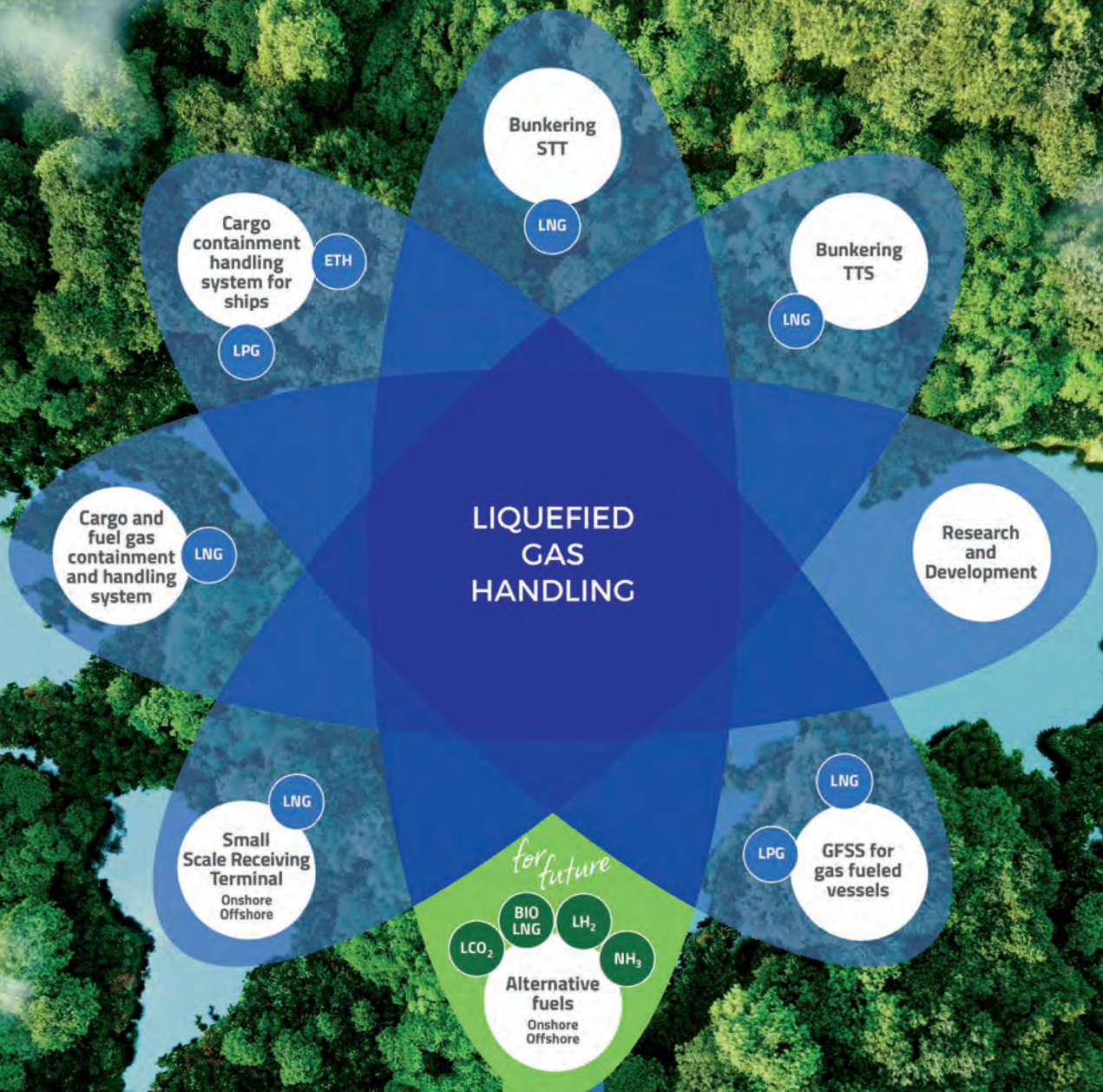
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