



Remodel, reinvent

How technology and changing business models are impacting the future of LNG

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Introduction

Over the last decade, the global natural gas supply industry has begun to move away from its traditional integrated model where major producers developed large, often stranded gas fields, built large liquefied natural gas (LNG) facilities and sold the cargoes to mainly large utilities.

Today, a number of newer business models have emerged due to the rapidly changing dynamics that are impacting the market, including increasing resource availability (e.g., US shale gas), new technologies (e.g., floating liquefaction – floating liquefied natural gas (FLNG), and floating storage regasification units (FSRUs)) and new sources of demand (e.g., China and India). While long-term contracts still make up the bulk of current trade,¹ portfolio companies, tolling liquefiers, and networks of smaller buyers and sellers have grown substantially. We analyzed these new business models in our 2016 report, [Work in progress: How can business models adapt to evolving LNG markets](#). In this report we expand on that framework to address the impact of new technologies, new business models and changing supply and demand conditions.

To assess this impact, we conducted a survey of LNG market executives from around the world and across the value chain, including major producers, traders and buyers along with interviews with industry thought leaders. This report includes an overview of the LNG landscape with a focus on current supply and demand, and an analysis of how the industry's business models have changed in the last few years and how they could continue to evolve. The report then highlights several major technologies driving the evolution including small-scale LNG, floating liquefaction and regasification, new gas-on-gas trading hubs, digitization (e.g., blockchain, data analytics and the Internet of Things) and more flexible financing. Lastly, the report outlines how different business models and new technologies could shape the LNG market of tomorrow – one that is likely to be more flexible, liquid and accessible.

Sources of near-term LNG supply and demand growth

While there are a number of high profile LNG projects in Asia, Europe, the Middle East and Africa, survey respondents expect more rapid supply growth from the Americas (figure 1). This is likely driven by the number of high profile projects currently under construction in

the US, combined with the LNG Canada project sanction (survey responses collected before the final investment decision (FID) was announced).² East Africa, Qatar and Russia were also top of mind for respondents (figure 2).

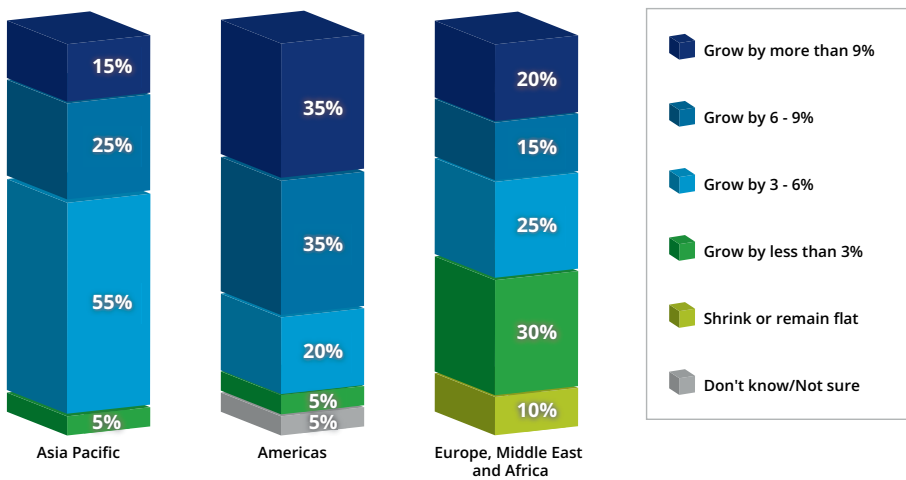


Figure 1: Modest supply growth expected in Asia Pacific, but more than half of the respondents expect nine percent plus growth in capacity in the Americas, Europe, Middle East, and North Africa

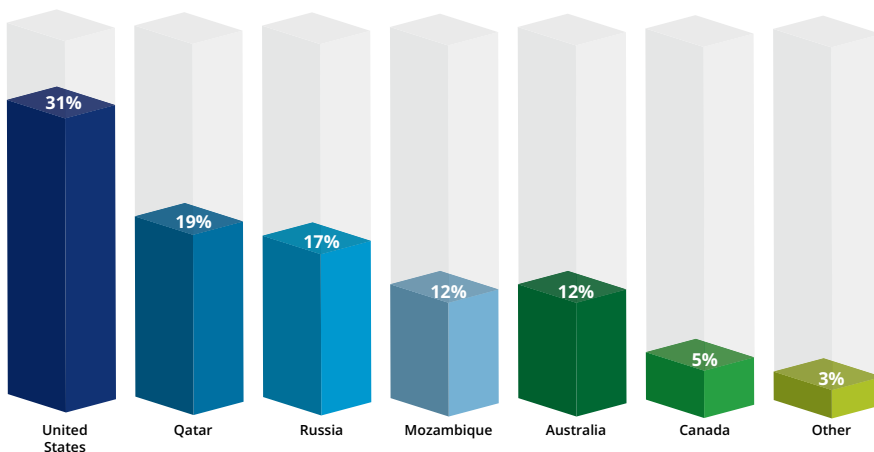


Figure 2: Overwhelmingly, respondents see most of the new liquefaction capacity being built in the United States, followed by Qatar, Russia and Mozambique over the next five years

In contrast to supply, respondents see the most rapid demand growth in the Asia Pacific region over the next five years, with split expectations for other parts of the world (figure 3). This appears to be driven by both demographic and economic growth as several countries including China, India and Pakistan were

cited as the greatest sources of new demand over the next five years (figure 4). China's push to reduce environmental emissions and dependence on coal seems to have led to a recent increase in natural gas imports, including LNG.³ Other countries heavily reliant on coal, such as India, might pursue a similar strategy.

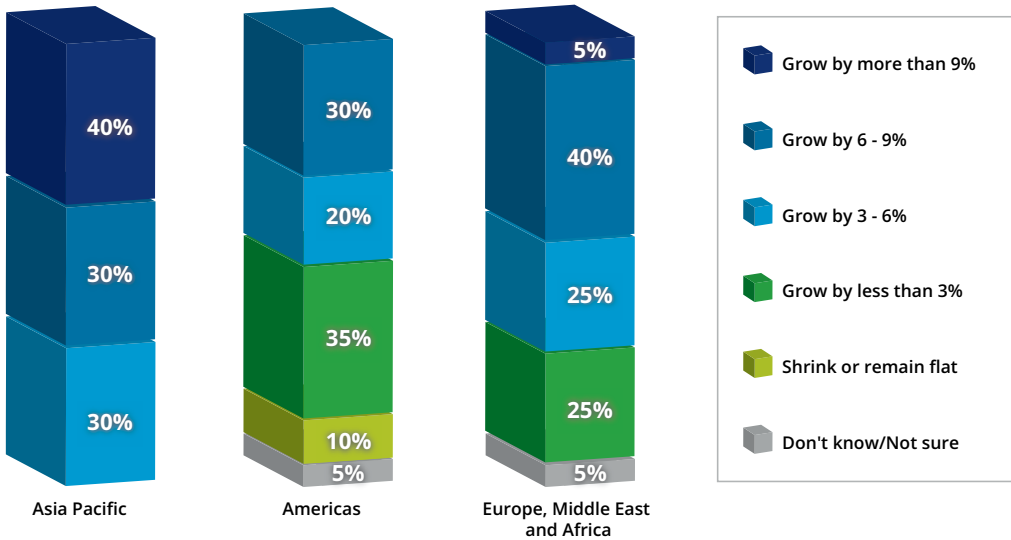


Figure 3: Asia Pacific will likely drive demand growth in the next five years, with modest to flat growth elsewhere

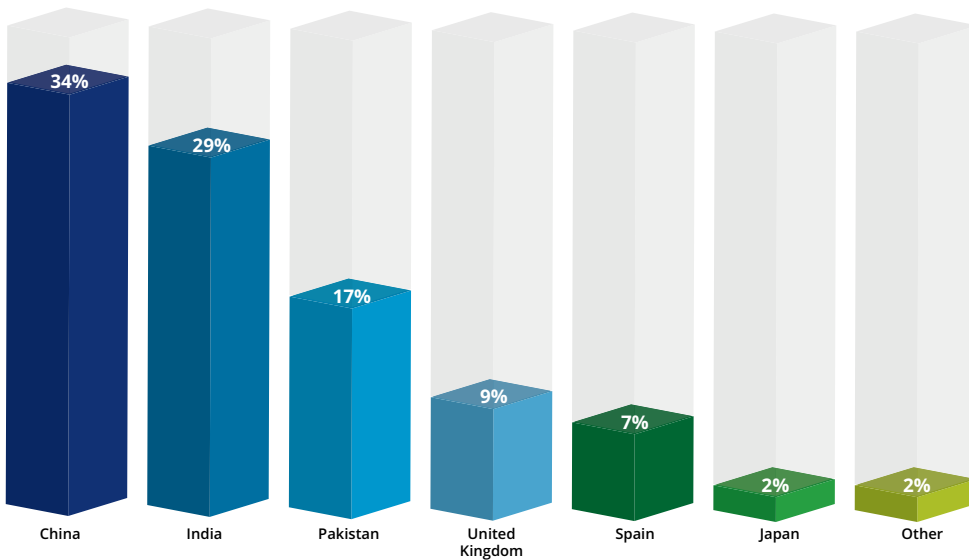


Figure 4: China, India and Pakistan are expected to be the greatest sources of demand growth over the next five years

Short-term contracts, tolling models and technology – three takeaways from the survey

The LNG market is evolving and becoming increasingly dynamic and diverse. Recent demand trends support the responses from the survey, suggesting countries like China, India and Pakistan will play an outsized role in LNG demand growth compared to historically important buyers in Japan and South Korea. Moreover, as the number of buyers increase, new buyers may have more challenging credit ratings than traditional buyers, resulting in greater counter-party credit risk. This means small-scale, modular and floating technology will likely become increasingly important to offset new commercial risks not seen with larger, more traditional buyers. To that end, we asked respondents for their views across a range of technological, financial and market questions. Three key findings stood out:

1. Between 2008 and 2017, spot and short-term LNG offtake contracts grew from 20 percent to 30 percent of volumes exported.⁴ Seventy six percent of respondents believe that these contracts will grow faster than overall LNG trade. This trend has important implications:
 - It could become more difficult to build new capacity as companies will not be able to rely on traditional long-term contracts to collateralize projects.
 - Buyers could see sales opportunities for trading houses, portfolio players and liquefiers with spare capacity as more attractive than LNG from yet-to-be sanctioned projects.
 - Brownfield and smaller or modular projects might become more appealing. Absent new financial products (e.g., a long-term, liquid LNG-focused futures market), our respondents also suggested that producers and financiers might need to be willing to accept higher market risk.
2. In all cases, shorter contracts could mean slower supply of new capacity despite expectations. We could see the number of new, project-debt driven developments reaching FID decline as investment becomes more challenging. A pivot towards equity-based financing may only partially offset that decline, as seen with the recently sanctioned LNG Canada project.⁵ Equity financing however, is limited to those larger players who have access to sufficient capital to support these types of projects.
3. US natural gas production has grown dramatically, from roughly 55 billion cubic feet per day (Bcfd) a decade ago to more than 80 Bcfd in 2018, and continued growth is projected.⁶ That has facilitated significant LNG export growth; from essentially zero a few years ago to 3 Bcfd in 2018. Based on current projects, exports could grow to more than 10 bcf in the next five years.⁷ Combined with the emergence of accessible natural gas supply with transparent pricing (e.g., Henry Hub), a new business model that relies on tolling agreements rather than traditional oil-linked offtake contracts, has in part driven the growth of US LNG exports. These agreements rely on liquefaction as a service with specific per volume costs, rather than the all-in free on board or ex-ship LNG prices seen in other projects. This style of contract tends to provide flexibility to the buyer allowing them to procure their own natural gas and decouple LNG prices from liquids pricing (e.g., Brent or Japanese customs-cleared crude).

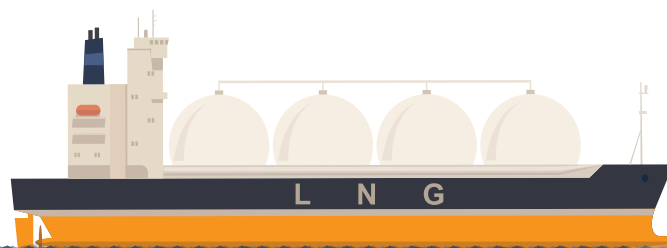
Despite this, less than 20 percent of respondents think that companies could develop US-style tolling projects elsewhere. They cite a range of reasons including regulatory, market and project

scale challenges. In particular, other countries face challenges in developing the large, liquid domestic natural gas markets to provide the security of supply needed for these types of contractual arrangements. However, these doubts may be short sighted - Canada has a large resource base driven by unconventional, which could underpin tolling-style agreements for future projects. Similarly, Woodside and the Northwest Shelf LNG partners, several who are involved in the Browse project, are considering the use of tolling agreements in Australia.⁸ However, the business model is expected to remain challenging for those attempting to monetize stranded natural gas fields.

The industry appears to be unsure about how to best adapt and deploy new technologies. Approximately 60 percent of respondents say that digitization through big data analytics, machine learning and blockchain applications could have an impact on the LNG industry, with a particular interest in deploying blockchain to facilitate trade. A considered approach to execution will be critical due to both technical complexity and the difficulty in building consensus around a single system. When effectively implemented however, these types of systems could increase transaction price and volume

transparency and reduce the time required to settle trades.⁹ The international consortium, VAKT supported by a number of producers, traders, and banks have been developing a digital ecosystem using blockchain to enable secure and transparent post trade transacting.¹⁰ However, with limited blockchain deployments to date, mainly in small-scale renewable power markets, application to the LNG markets seems far off.¹¹

This space continues to evolve as market participants' needs are evaluated and technologies are developed. Based on Deloitte's [2018 Oil, gas and chemicals executive survey](#) and [The Industry 4.0 paradox report](#), blockchain appears to be a longer-term aspiration. Blockchain could provide integrated digital trading infrastructure that allows cargo to be traded and tracked more easily. This would enable the use of smart contracts to simplify the trading process, which could deliver significant value to the industry. However, in the shorter-term, big data analytics seem to be a high priority which provides the opportunity to optimize the timing of LNG shipping and reducing energy usage in the liquefaction and regasification process. This, unlike blockchain, will likely be a series of smaller incremental projects rather than an industry-wide disruptor.



A combination of opportunities and threats face the LNG market in the near term

In our 2016 report [LNG at the crossroads: Identifying key drivers and questions for an industry in flux](#), we outlined seven factors that could shape the LNG market. Some factors, such as the cost of shipping, are cyclical, while

others, such as economic growth, appear to be secular (table 1). Two years on, several of these factors still affect the industry and are contributing to rising demand.

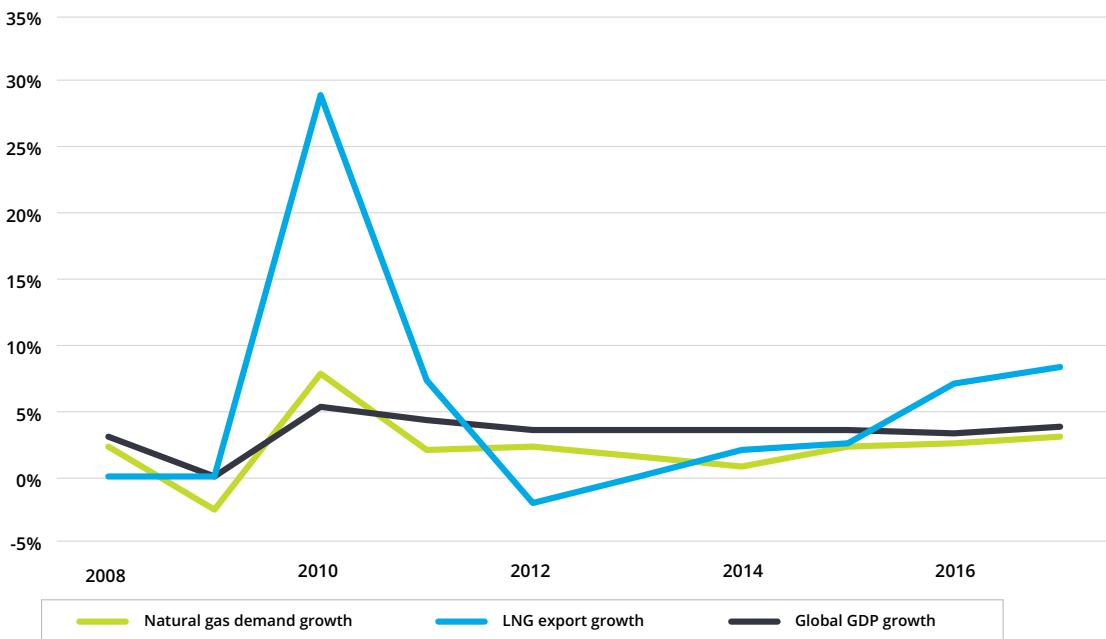
Table 1: Seven trends impacting LNG and their impact

Trend	Current and near-term impact
Economic growth	Economic challenges remain, including emerging market currency concerns, but growth has proven resilient in key markets like China, providing cyclical headwinds for the LNG industry.
Increased energy efficiency	Energy efficiency will likely continue to reduce the rate of energy demand growth, but this has been offset by economic and population growth.
Excess LNG capacity	LNG markets have tightened over the last year as indicated by Japanese import prices, but with significant US liquefaction capacity coming online in the next few years, the sellers are expected to face cyclical pressure.
Lower transport costs	LNG shipping fleets were well in excess of demand, but the spread has tightened as trading continues to grow.
Access to new markets	This secular trend remains important as new LNG volumes are exported to an increasing number of countries, this is expected to continue.
New types of end users	While some applications, like LNG bunkering, have become increasingly available, the longer-term impacts remain to be seen. New International Maritime Organization (IMO) regulations on sulfur limits from 2020 may increase LNG for marine applications and similarly, there is increased use of LNG in trucking, especially in China. Floating import terminals offer flexibility and access to smaller markets (e.g., Egypt, Jordan, Pakistan and potentially Australia).
Increasing market liquidity	An increase in tradeable volumes has led to increased short-term trading and liquidity, but the lack of available storage and other barriers mean that its impact remains on the horizon for now. However, indexes like the Platts Japan Korea Marker (JKM) benchmark and new digital trading platforms could support the continued evolution of price transparency and commoditization of the LNG industry.

Source: Deloitte analysis

Our survey respondents agreed that these trends matter, with 70 percent of survey takers expecting that Asia Pacific LNG demand will rise by more than six percent over the next five years, with 50 percent saying the same for Europe, the Middle East, and Africa. This is driven by several factors including global growth, which has been robust and is projected to continue at almost four percent per year for the next five years, barring a recession or similar (figure 5). The sharp rise in 2010 is due to increased capacity that came onstream due to newly-commissioned liquefaction trains in 2010 as well as from the ramp-up in output from trains commissioned in 2009¹². Due to the discreteness of LNG supply as well as project size and timing, the relationship between LNG and the macro-economy is not quite as clear.

LNG demand and economic growth are not well correlated. Secondly, more than 35 countries import LNG today, compared to roughly 20 only a decade ago.¹³ Thirdly, new markets like LNG as a transport fuel are growing, adding new sources of demand alongside more traditional applications.¹⁴ Environmental concerns are also driving these trends. For example, China's demand for natural gas is due not only to the need to provide energy, but also to displace higher polluting energy sources like coal by increasing the share of gas in the primary energy mix to 10 percent by 2020 (up from six percent today). Similarly, LNG bunkering provides an alternative to high sulfur fuel oil that will not meet new IMO 2020 regulations.¹⁵



Source: Deloitte analysis^{16, 17, 18}

Figure 5: LNG and natural gas demand is tied to global economic growth

To meet rising demand in the next five years, global liquefaction capacity will likely need to continue to grow as well. Our respondents agree, expecting capacity to continue growing rapidly – potentially in excess of six percent per year in some regions. That could, however, be a tall order as project financing may be difficult if contract durations continue to shorten as they have in recent years.¹⁹ Believing a third of new capacity is to be built in the US, respondents expect finance constraints to be mitigated by the tolling agreements popular in the region, and the flexibility in pricing and delivery

they afford. Similarly, brownfield projects in the US or elsewhere like Qatar may get the green light even with shorter-term agreements. However, large-scale, onshore greenfield plants, be it in Mozambique or Alaska, face an uphill battle for project sanction. To meet our respondent's expectations for supply growth, companies will likely need to rethink their business models and risk management strategies. One example mentioned previously is LNG Canada, which will be funded via equity financing, rather than by project-level debt.

Looking beyond the survey: Adapting existing business models to a new global LNG market

In our report, [Work in progress: How can business models adapt to evolving LNG markets?](#), we identified six major LNG market participants: large scale integrated producers, portfolio companies, tolling or contract liquefiers, traders, large utility buyers and consortiums,

and small-scale utilities (table 2). These companies span the global gas value chain: drilling wells, operating producing fields, gathering systems and pipelines as well as liquefaction, trading, transport and natural gas consumption.

Table 2: Opportunities and challenges facing LNG buyers, seller and traders in an evolving market

Business model	Comparative advantages	Opportunities	Challenges
Integrated producers	Economies of scale, access to large resources, extensive industry experience, ability to bear risk.	Potential to increase market share with integrated upstream, midstream and trading organizations leveraging increased liquidity.	Traditional project scope and financing could be difficult in a more transient market.
Portfolio companies *	Overlapping skillset with integrated companies, but with enhanced marketing flexibility and optionality.	Integrated operations combined with existing portfolio structure seem well-suited to more flexible markets.	Like traditional operators, developing conventional greenfield projects could prove problematic.
Tolling and contract liquefiers	Potentially lower cost base, competitive pricing and outsized capacity to grow.	Limited investment in upstream and midstream infrastructure with access to US gas markets could provide lower-cost opportunities to ramp-up sales volumes.	Existing projects limited to the Atlantic Basin as operators have not succeeded in developing tolling/contract liquefaction projects outside of the United States. This may be due to concerns around availability of gas supply given the de-linking of upstream and liquefaction processes.
Traders and financiers	Highly flexible as providers of capital and liquidity with limited long-term market exposure.	Large amounts of uncontracted new capacity entering the market in the next five years combined with rapid Asian economic growth could create opportunity for traders to help buyers and sellers optimize their portfolios and offset risk.	Limited long-term capacity contracts or means of production could expose these companies to more market risk than other LNG company types.
Large utilities and consortiums	Extensive industry experience with deep, long-term ties to major producers.	Significant volumes under construction and awaiting sanction offers access to LNG cargoes on favorable terms.	Higher volatility and shorter contracts could increase price and volume risks for companies required to meet high percentage of domestic market demand.
Small-scale utilities	Potential opportunistic buyers with limited contractual liabilities.	Companies that have small or intermittent demand could have wider access to global LNG markets due to higher volumes available combined with technologies like Floating Storage and Regasification Units (FSRUs).	Higher volatility and shorter contracts could lead to loss of access if the markets tighten due to potential capacity growth slowdown.

Source: Deloitte analysis

* Portfolio companies are companies that market and sell LNG from several assets, potentially across multiple regions, as opposed to selling gas from a single liquefaction plant.

These six company types are well represented in our survey's respondents. They believe that short-term trading will play an increasingly significant role in LNG. Additionally, they do not see companies developing US-style tolling projects in other countries (with the potential exception of Canada) and the potential benefits from digitization remain uncertain. These trends could potentially slow capacity growth and delay the construction of new greenfield plants as markets rely on shorter-term, more flexible and potentially more volatile contracts.

The challenge could be to square the circle, with LNG buyers seeking flexible, shorter-term contracts while potential sellers are typically looking to develop conventional liquefaction projects. If LNG producers are exposed to increased market risk in both the short and long term, then producers have an incentive to reshape how these projects are designed, financed and executed. Traders and buyers may have less incentive in the short term, but the benefits of a more efficient, transparent market could be worthwhile pursuing. Reshaping the markets would present different business models with alternative risks and rewards. While respondents may not be sure how the LNG market will evolve, it is clear there are opportunities for business model transformation.

Companies with historic ties to the industry including integrated producers, portfolio players and large-scale utilities will need to adapt as the market becomes more flexible. If larger buyers are unwilling to sign multi-decadal, fixed-term sale and purchase agreements, operators of major liquefaction projects may be exposed to increased market risk. As mentioned previously, this could reduce access to limited-recourse financing. If project level debt is less accessible than in the past, these companies seem to have two options: corporate-level debt or project equity financing. Neither the idea of using corporate debt to fund large project nor cargo buyers investing equity in a liquefaction project is new, but could be a challenge.

Looking further into the future, there is an opportunity to push LNG industry financing further. An offtake agreement, like a contract, guarantees certain payments in exchange for either tangible goods (e.g., LNG cargoes) or intangible rights (e.g., access to capacity) with an array of caveats and conditions. While not widely discussed within the industry today, there is an opportunity to separate certain parts of sales and purchase agreements from the corporate entities that are part of a transaction. Although not necessarily common in oil and gas outside of overriding royalty agreements or perhaps petroleum service contracts, other industries have made similar shifts. For example, commercial or residential property can be sectioned into economic interests (e.g., real estate investment trusts or mortgage-backed securities), facility management contracts and tenant leases (or sublease in the case of shared workspace companies). This way multiple parties can share various costs, benefits and obligations of using property, while not necessarily being responsible for all aspects.

In the case of LNG, a project could be structured with an operator who develops the project but has limited or no equity in the project and is compensated through an ongoing management fee. Using that structure, it would be possible for small increments of offtake capacity from one project, or a portfolio of projects without destination restrictions, to be sold through either an auction-type system or direct negotiation. These shares would entitle the holder to a certain number of cargoes per year in exchange for an ongoing payment, similar to an option premium, thus mimicking features of a take-or-pay clause in a traditional contract. By securitizing LNG capacity, projects could be financed by those who may only have short-to-medium term interest in the project, because they could later re-sell their shares while assuming market risk due to shifts in value of the underlying asset.

Undoubtedly, new (or even existing but atypical) financial structuring will likely face challenges during adoption.

However, even if these companies are not currently interested in corporate debt or equity financing for LNG projects, they may not have much of a choice going forward, unless the market tightens significantly and contract durations begin to lengthen. Otherwise, greenfield facilities could have trouble securing capital to reach the final investment decision. There is an incentive to innovate if the alternatives are unavailable.

If larger companies tend to lack flexibility, smaller market participants could lack access. For a regional utility providing natural gas to a city or a power utility that derives the bulk of their energy from intermittent or variable sources like hydro, wind or solar, LNG could provide an appealing alternative to cope with the intermittency issues. However, with a typical large offtake contract running 20 years and sometimes requiring the purchase of two million tonnes per annum²⁰ (roughly 260 million cubic feet per day) under take-or-pay terms, would likely prove too onerous to be feasible. Thanks to FSRUs, a cyclically soft market over the last few years and increased activity from trading houses, smaller, shorter and spot contracts have been available to non-traditional buyers, though credit-worthiness could remain an issue.

However, if markets tighten, and there are signs that they have already,²¹ these smaller buyers could face challenges procuring spot or short-term contracts at affordable prices. Trading organizations could provide liquidity (for a price) and a futures market could provide some price-risk mitigation. However, respondents were split on the timing of future markets, unsure whether

we would see a major futures hub develop in the next couple of years, over the next six years or beyond. More specifically, half of respondents thought that if a hub develops it would likely be in the Asia Pacific region in countries like China, Japan or Singapore. For a power company in Brazil, Asian LNG futures may prove a poor hedge for market risks in the Atlantic basin as gas prices have diverged in the past.²²

Like larger companies, smaller ones could also benefit from securitization. If a buyer is not a creditworthy counterparty, they could struggle to secure capacity via a traditional contract, particularly if they are seeking to purchase relatively small volumes. A tradable equity share in a project, however, could provide the flexibility of a shorter-term contract with an asset that could be used as collateral for debt financing. There would be some equity-type risk associated with project ownership, but trading houses could be willing to assume asset and LNG price volatility risk in exchange for either payment or a portion of offtake volumes. These structures would have to evolve in line with both market needs and as companies better understand their own energy needs and appetite for financial risk.

If companies look to novel financing structures and more flexible terms to transform their business models, the existing physical assets will not change. In the future, however, the physical and digital process used to transport, liquefy and market natural gas in the form of LNG may need to change to better match the changing industry, perhaps by deploying relatively new technology.

Technology as a catalyst for business model transformation

What opportunities are there for technology to bridge the gap between buyers and sellers as LNG markets evolve? It typically comes down to flexibility, transparency and efficiency. While respondents were unsure how exactly technology could be used, three key points came to the forefront: modular projects, blockchain and big data.

Whether it is trading spot contracts or the execution of a LNG-backed equity agreement, the LNG market is likely to become increasingly flexible. FLNG and FSRUs should play a role as companies can deploy them more quickly and at smaller scales than traditional facilities.²³ Similarly, small and microscale LNG appear to make sense in a world where demand is increasingly fragmented, whether due to demand from shipping or to supplying a number of intermittent buyers. In both cases, reducing unit costs might be the biggest challenge as they may be a good fit for where the market is heading. Our survey respondents expect smaller-scale LNG to grow faster than the overall market. The next few years may prove that to be correct.

Blockchain could pose more of a challenge, which organizations like the digital trading platform VAKT are working on. Respondents said that it could be used to improve transparency and optimized LNG trading, but other studies looking more broadly at oil and gas technology deployment, have found that blockchain is often viewed as longer-term opportunity. That being

said, as LNG becomes increasingly securitized and the number of cargoes traded increase, there could be a need for increased transparency and access to a global transactions platform. Particularly in the case of multi-party LNG project-backed equity structuring, smart contracts could provide a means to simplify execution. Moreover, the lack of legacy systems could mean greater opportunities for novel solutions. While the specific technology used to underpin the system could be up for debate, greater collaboration around the financing and financial structure of the LNG market will likely be needed.

Big data is a buzzword that applies to a range of projects crossing multiple industries including oil and gas, broadly including the use of large data sets (potentially sourced from IoT-type sensors) and high-powered analytics to generate novel insights and drive innovation. The potential benefits seen elsewhere in the industry apply in part to LNG as well. There are opportunities to cut energy and materials waste, increase operational uptime with predictive maintenance and improve the design of supply chains.²⁴ In the case of the latter, it would need to be considered on a case-by-case basis. Many projects still include significant volumes exported under long-term contracts with fixed destinations. Optimizing routing and procurement processes may therefore be limited. Spot volumes, portfolio players and trading houses, however, might find new analytical tools useful in executing trades in an efficient manner.

Remodel, reinvent: What's next for LNG?

Population growth, increasing economic prosperity in developing nations, government regulation and actions focused on improving air quality will drive demand for lower-carbon energy globally. As a result, LNG will command an increasing share of the global fuel mix given its lower-carbon footprint and its ability to flexibly supply increasingly diverse markets, customers and applications - ranging from power generation to marine and land transportation. Based on our survey, respondents expect consumption to increase in the Asia Pacific region over the next five years, most notably in China, India and Pakistan, with the bulk of new supply coming from the US among others. However, with respondents expecting spot and short-term contracts to grow (along with small-scale and floating LNG), the market could become increasingly fragmented and difficult to finance.

Why is that? Many recent projects have been financed by project-level debt that required long-term sales and

purchase agreements. We have seen some equity-financed projects announced (e.g., LNG Canada), but it remains to be seen if that will be replicated elsewhere. Additionally, US export growth has been driven by tolling-style agreements that may not be readily adaptable to other countries. Now is the time for companies to evolve and adapt to keep pace with market changes. Moreover, new technologies ranging from big data to blockchain could be used to reduce costs, improve logistics and simplify transactions.

The next five years will be a challenging and dynamic period for LNG producers, traders and buyers as they navigate a rapidly evolving market and adapt new technologies and business models.

One thing is certain, the global LNG industry will continuously remodel and reinvent itself in order to deliver energy to a rapidly growing and changing world.

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Thomas is a manager for the Deloitte Energy, Resources & Industrials research and insights team, analyzing trends in the global energy industry with a focus on LNG, upstream exploration, and development, as well as global energy demand. Prior to joining Deloitte, he worked as a market researcher covering deepwater and frontier oil and gas projects in North America. Thomas started his career as a field engineer for a leading oilfield services company in the Gulf of Mexico.

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