



cutting through complexity

KPMG GLOBAL ENERGY INSTITUTE

Floating LNG: Revolution *and* evolution for the global industry?

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Shell FLNG

LNG report series

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Overview

This report is intended to provide an overview of the developments that the liquefied natural gas (LNG) industry is facing during its unprecedented wave of expansion. Security of energy supply has always been one of the critical issues many countries face. Unlocking potential reserves economically and rapidly is essential to deliver energy security and can potentially affect trade flows profoundly. Floating LNG is an emerging technology for such fast and cost-effective development of new gas resources.

This is the second in a series of LNG reports that will provide deeper insights on specific elements of governance, jurisdiction, stakeholders and opportunity.

Hilda Mulock Houwer

Partner and Global Advisory Leader
Energy & Natural Resources
KPMG in Qatar



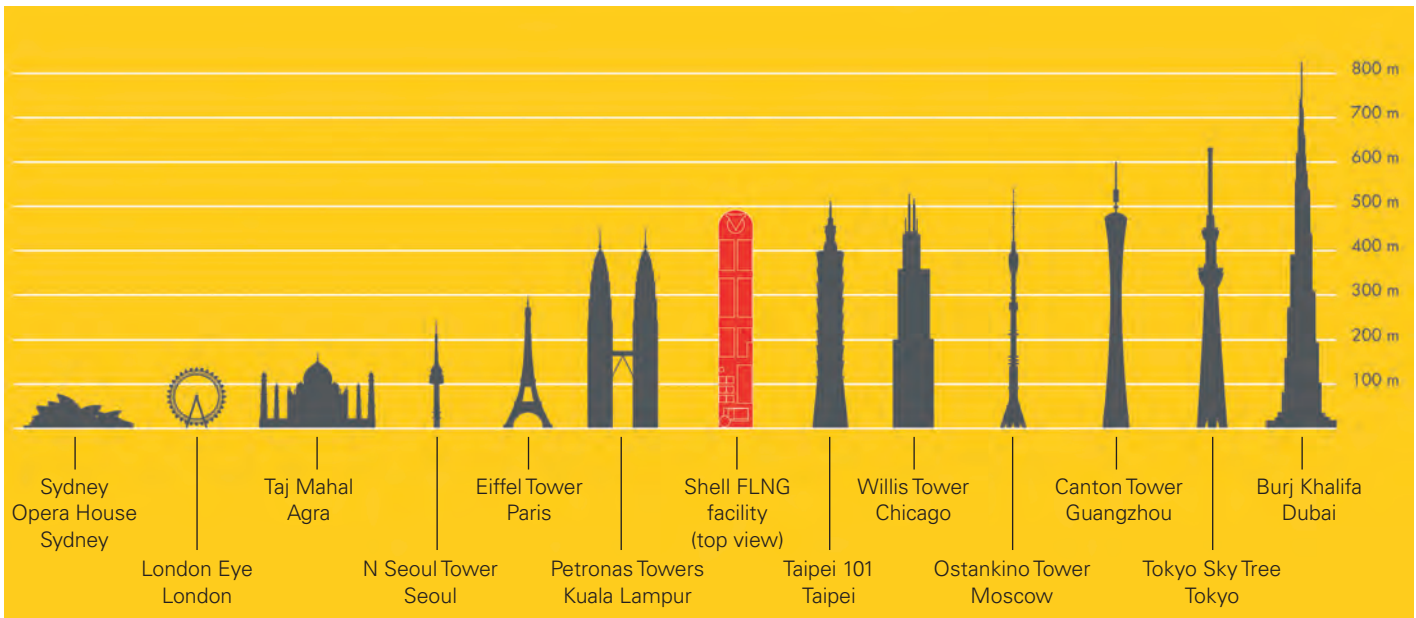
With 22 years of consulting and auditing experience in the oil and gas, energy and mining industries, Hilda Mulock Houwer has provided advisory services across the entire oil and gas value chain from strategy development to strategy implementation. Hilda has experience in operational excellence, process transformation, procurement, change management and financial process redesign.

Introduction

On 20 May 2011, Shell took final investment decision on the Prelude Floating LNG Project, to be installed off the north-west coast of Australia. Fast forward to 3 years later and Shell has laid the keel of the largest floating structure ever launched. The hull of this vessel, 488 meters long, would envelop the Statue of Liberty.

The impact of this new technology on the global LNG industry can be equally massive. If the front-runners in FLNG can meet a number of key technical, commercial and financial challenges, we predict it will emerge as a key pillar of a 2020s LNG business that looks quite different from that of today. But not all projects are suitable for floating solutions – and, with FLNG still in its very early stages, proponents are navigating a number of new risks and project management challenges.

Shell Prelude's floating liquefied natural gas facility stands tall



Photographic Services, Shell International Ltd.

The voyage to FLNG

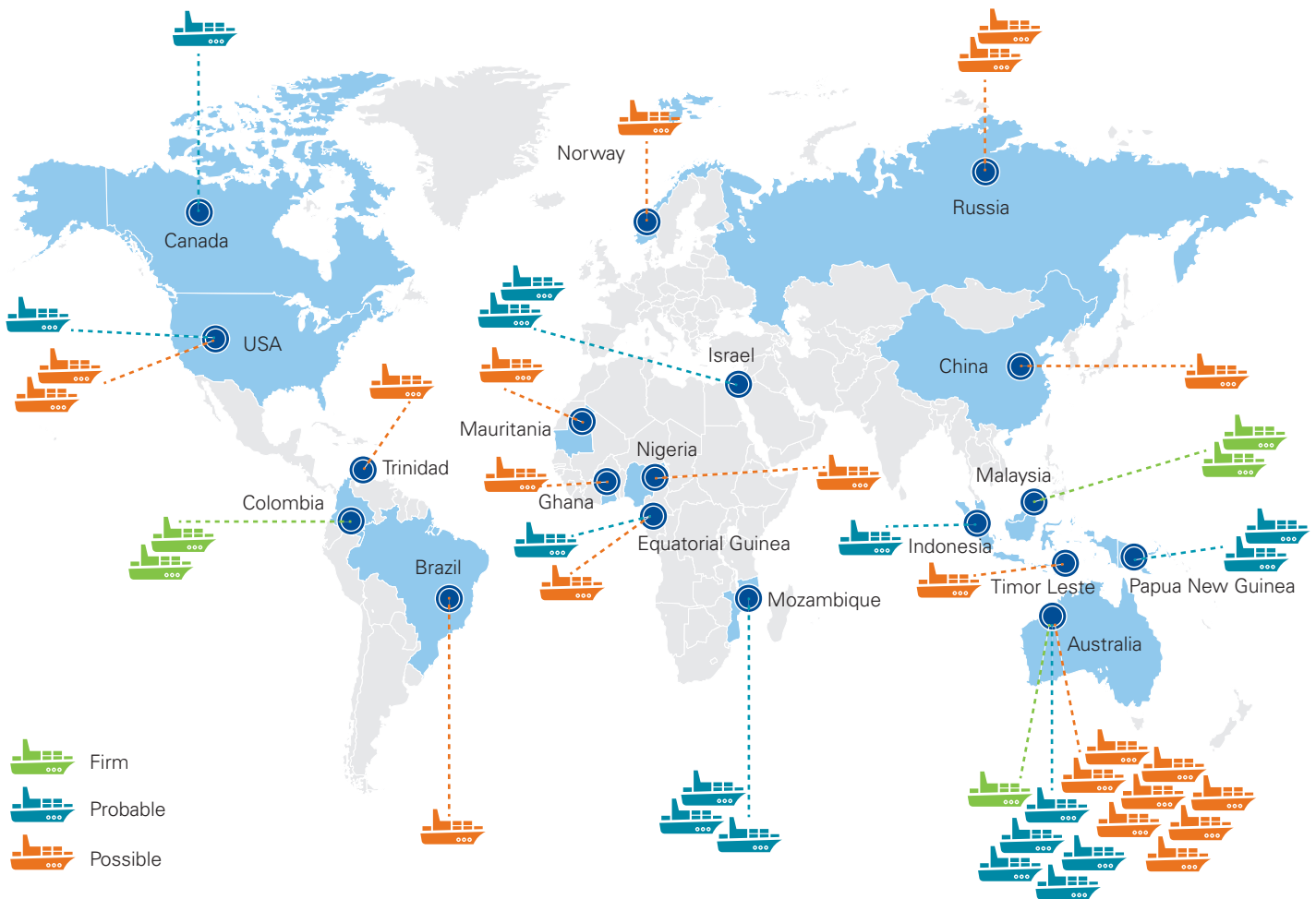
It has been a long voyage for FLNG. Research began in the 1970s. The initial detailed designs were made in the early 1990s with associated efforts to start an FLNG project around the turn of the millennium, but the emergence of Qatar as a dominant exporter and falling costs for giant onshore liquefaction trains halted progress. Today, growing demand, high prices, environmental and community challenges and steep costs for the infrastructure of land-based projects, have led several leading LNG

players – including Woodside, Shell, Petronas, ExxonMobil and Inpex – to take another look.

FLNG promises to unlock smaller, remote or environmentally-sensitive fields. Numerous projects in Southeast Asia, Australasia, Africa, the Eastern Mediterranean and Latin America may benefit. It is not just an offshore solution; developers in Western Canada and Papua New Guinea are considering it for onshore fields. Novel gas resources, such as Brazilian pre-salt

associated gas and North American shale gas have opened up new possibilities to use floating systems for export. FLNG can save costs and time – if executed well. As experience is gained, future projects may achieve first gas production quicker and more cheaply.

FLNG projects worldwide*



*KPMG International Inc., 2014; D. K. Jordan, (27 May 2014), 'Floating LNG', Clarkson Research Services Ltd. As of September 2014; may be subject to change.

FLNG emerges

Floating LNG and the development of new pricing methods and unconventional gas-to-LNG projects, may lead towards a faster-moving, more diverse – and more flexible global LNG industry.



Bruce Steenson

General Manager of Integrated Gas Programs and Innovation
Shell International Exploration and Production B.V.

Bruce has spent more than 30 years working for Shell on development projects in the Middle East, Central Asia, Europe, South America and Australia in roles spanning well engineering, production technology, process engineering and development project management. He is currently Managing Shell's LNG Programs and Innovation in their Integrated Gas business.

There are two scenarios for the future development of floating LNG. It may become a niche technology that is applied by a few companies to solve specific problems, with land-based configurations remaining the default. This could happen if the first FLNG plants encounter cost or operational difficulties or if land-based costs fall as the current construction boom ebbs. For smaller offshore gas fields, compressed natural gas or small-scale gas-to-liquids may become viable competitors.

However, in the second scenario, if the first few projects are successful, FLNG can emerge as a standard approach that eases the industry's problems with cost inflation and opens it up to a much wider range of fields and companies. The concurrent development of floating regasification giving access to a range of smaller markets, and the development of new pricing methods and unconventional gas-to-LNG projects, may lead towards a faster-moving, more diverse – and more flexible global LNG industry.

In a 2 September 2014 interview with Bruce Steenson, General Manager of Integrated Gas Programs and Innovation for Shell International Exploration and Production B.V., he compares the prospects for FLNG to floating production, storage and offloading vessels (FPSOs). "From the first oil FPSO in 1977, over a period of 1977 to 2000, 50 FPSOs were slowly installed. Between 2000 and 2010, came another 100."

Is FLNG, in short, a refinement or a transformation? Why should companies choose FLNG over a land-based plant? And, what is required to make an FLNG project successful?

Global context of floating LNG

The recent boom in global LNG construction could see global output almost doubling its 2012 level of 250 million tonnes per year by 2030. Sixty Million tons per annum (Mtpa) of this is in Australia.

However, developers of onshore projects have become increasingly frustrated with budget blow-outs and slow time to market. Rising labor costs, workforce activism, community opposition, complex environmental approvals, infrastructure challenges related to the difficulty of construction in remote locations and unfavorable exchange rate movements have all contributed to cost over-runs.

Construction costs, usually the largest single component, run at 30 percent of total project cost, but in Australian projects, this has risen to 50-60 percent. From 2000 to 2013, average capital costs of liquefaction plants rose from US \$300 per tonne per year to \$1200.¹

One example, Gorgon, is now estimated to cost AUS \$54 billion, up from the original AUS \$37 billion, and research firm Douglas Westwood estimated that Australia could miss out on AUS \$97 billion (US\$85 billion) of LNG investments if it were unable to get costs under control.

North America and East Africa are emerging as major potential LNG players, but proponents in new supply centers such as Western Canada and Mozambique worry about similar cost inflation, in an environment of flat or falling oil and LNG prices.

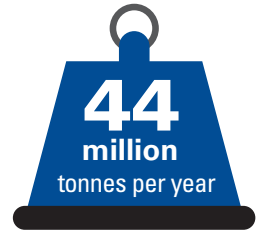
Cost savings and new confidence in FLNG

Expected cost savings and new confidence in floating designs are thus driving the first wave of project sanctions. Douglas Westwood estimates that US \$60 billion will be spent on floating LNG projects between 2014 and 2020. But this may be just the start. Pacific Rubiales' Colombia project and Petronas's PFLNG-1 should enter service in 2015, Shell's Prelude in 2017 and Murphy/Petronas's PFLNG-2 in 2018, with Excelerate's Port Lavaca in Texas intended for 2019. Perenco's just-sanctioned Kribi LNG in Cameroon is slated for 2017 start-up. ExxonMobil/BHP's Scarborough project in Western Australia would be the world's largest, at 6-7 million tonnes per year. Shipbroker Clarksons estimates that by 2019, likely global FLNG capacity will be 44 million tonnes per year, about 7.5 percent of the industry's total capacity. By 2022, there could be 22 FLNG vessels in place, with another 22 "possibles"²

Colombia and Port Lavaca are essentially inshore barge-mounted designs, not very different from a land-based facility. EXMAR's barge for Pacific Rubiales is being constructed in China at a very competitive reported cost of US\$700 per tonne. The Petronas and Shell projects are however, different – true open-water LNG FPSOs presenting higher costs and greater design challenges.

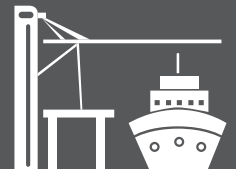
There are 10 reasons why a project developer may consider floating LNG. Proponents whose project features one or more of these have a strong impetus to consider floating solutions.

By 2019,
**Global
FLNG
capacity**



about

7.5%
of the industry's
total capacity



By
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there
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be **22** FLNG vessels
in place



... with another 22 **"possibles"**²

¹ B. Songhurst (February 2014) 'LNG Plant Cost Escalation', Oxford Institute for Energy Studies

² D.K. Jordan (27th May 2014) 'Floating LNG', Clarkson Research Services Ltd.

Ten reasons companies choose FLNG

1

Unlock smaller fields

Shell's 3.6 Mtpa Prelude is relatively small by Australian LNG standards; Petronas' 1.5 Mtpa FLNG-1 for the Kanowit field in Sarawak, Malaysia, and Pacific Rubiales' 0.5 Mtpa plant for La Creciente in Colombia are smaller still. These fields would unlikely be economic if developed through conventional land-based facilities. Large oil-fields producing significant quantities of associated gas, as in Brazil's pre-salt of the Santos Basin, are also candidates.

2

Access remote fields

Australian fields such as Browse are as much as 425 kilometers offshore, which would necessitate long and costly pipelines to onshore locations. In September 2013, the Browse joint venturers, Woodside, Shell, BP, PetroChina and Mitsubishi/Mitsui, decided on floating LNG, which may include three Prelude-type vessels.³ In September, BHP Billiton agreed with ExxonMobil that FLNG was the best approach for their Scarborough field, in 1000 meters of water and 200 kilometers off Western Australia. Arctic environments are a step further, given ice and rougher waters, but considered technically doable.

3

Avoid onshore 'no-go zones'

Large gas fields have been found in the Eastern Mediterranean, but the surrounding coastlines are heavily built-up with tourism and real estate. Onshore plant locations may face lengthy legal and permitting delays and community objections.

4

Reduce environmental footprint

Floating LNG plants do not require long seabed pipelines, dredging for jetties or onshore roads and construction. They save on fuel gas for compression to send gas to shore. After decommissioning, the vessel offers the potential to be relatively easily removed and re-deployed. "In Prelude's case," notes Steenson, "the option value is there in that the hull is designed for 50 years with the base case of stationing for 20 to 25 years. So with refurbishment, there is some possible additional value. One potential challenge to be taken into account regarding redeployability is the variance in gas composition by fields."

5

Deliver projects cheaper and faster

FLNG may offer reduced capital costs, particularly once shipyards have gained experience with construction and standardized solutions are employed. There could be substantial improvements in the process of integrating the hull and processing units. Modular components can be constructed at several locations. Onshore construction, marine works and the related high labor costs, in remote or hostile environments, can be minimized. For example, the dredging cost alone for the Wheatstone project in Western Australia – a 17 kilometer approach channel and 26 million cubic meters of dredged material – is estimated at AUS \$1.5 billion.⁴ Savings on such infrastructure, and a simpler supply chain, can mean FLNG projects make it to market faster.

6

Avoid the gold-rush

Simultaneous construction on numerous projects – 'gold-rush economics' - was blamed for escalating costs in Australian LNG and Canadian oil sands, and is also a worry for Western Canadian LNG developers currently. Mary Hemmingsen, Partner and National Sector Leader, LNG, Power and Utilities, KPMG in Canada, observes, "FLNG presents a configuration to mitigate labor and construction cost escalation such as faced in Australia and Canada by enabling construction to occur in lower cost areas with more labor depth such as Korean shipyards." Countries new to the LNG business, such as Mozambique and Tanzania, will find it difficult to supply sufficient skilled personnel. FLNG projects can also widen the circle of contractors beyond the seven world-scale LNG EPC companies. Shipyard construction also spreads the risk of currency appreciation, with 50 percent of project costs for onshore projects typically in local currency. Contrastingly, in areas with abundant skilled labor, such as the US Gulf Coast, this will be less of a driver for companies to choose floating options.

³ http://www.woodside.com.au/our-business/browse/documents/browse_flng_development_-_fact_sheet_-_April_2014.pdf

⁴ B. Songhurst (February 2014) 'LNG Plant Cost Escalation' Oxford Institute for Energy Studies

7

Put projects in a safe pair of hands

"If you look at LNG around the world, the logistics of getting a skilled workforce to the site and keeping them there can be hugely challenging and costly," notes Steenson. "You don't have that issue with a floating facility built in a yard. For example at Asian ship yards, 25,000 to 35,000 people are coming into the yard daily. So all of that logistics and infrastructure are already set up with productivity being more predictable and safety performance established." Several shipyards have related capabilities in constructing oil FPSOs and LNG tankers. The "design one, build many" philosophy may be applied by shipyards that can develop a high level of expertise in FLNG. The Prelude design is designed for rich gas, but features modules that could be added or removed to suit other gas compositions and increase liquefaction output. Other concepts than LNG FPSOs are also being considered – semi-submersibles and spars.

**Mary Hemmingsen**

Partner, National Sector Leader, LNG,
Power and Utilities
KPMG in Canada

Mary Hemmingsen brings over 20 years of experience as a North American energy business leader in asset management and related business development. This includes leadership in the development and delivery of policy, strategy and initiatives for energy, power, utilities and related infrastructure businesses in a range of capacities in both the public and private sector and for major utilities and global energy and asset managers.

8

Achieve peace of mind from security worries

Certain areas of LNG development, such as West Africa and the Eastern Mediterranean, have security concerns. Onshore fields and pipelines have frequently come under attack in parts of West Africa and the Middle East in recent years. Placing the facility offshore makes it less accessible to would-be attackers or saboteurs and can be supplemented with other defensive measures such as remote monitoring and barriers to make it difficult to scale the vessel. That said, piracy is a known risk and still requires safety precautions, including international cooperation in the case of the Eastern Mediterranean.

9

Mitigate political risk⁵

Onshore LNG plants represent a huge sunk investment, making the project developer vulnerable to a change of mind from the political authorities – which can include tax increases, nationalization or outright expropriation. In an extreme case, in which a host government seeks to expropriate an asset, or in which security conditions become intolerable, the FLNG plant can be sailed away, saving at least some of the project's value, and perhaps redeployed elsewhere. This option is unlikely ever to be used, but its existence does improve the owner's bargaining position.

10

Access other financing options

Financing of floating LNG projects is still in its infancy and will require greater experience from lending banks. With more corporations seeking to enter the LNG game, previously the near-exclusive preserve of the majors, innovative financing choices are becoming more important. Smaller companies, in particular, may benefit from other financing opportunities such as leasing the LNG vessel, taking advantage of tax incentives or accessing concessionary or export financing for shipping. The greater security offshore may make it easier to access financing for more risky host countries.

⁵ See, for instance, 'No paper chase: Transforming risk management at energy and natural resources companies', KPMG (2014)

Interview with Nobuo Tanaka, Global Associate for Energy Security and Sustainability, Institute of Energy Economics, Japan and former Executive Director of the International Energy Agency

Impact of floating LNG in delivering the IEA's 'Golden Age of Gas'

Can you put floating LNG in the context of today's global gas market?

LNG was limited to the East Asian countries, but now expanding to many parts of the world – gas is relatively cleaner, abundant. A global market is now appearing, but how well it will continue depends on many elements. How well the wave of exploration offshore goes is another interesting factor.

To help further diversification of sources, floating LNG is very interesting. Relatively smaller companies, smaller fields, make additional elements in the LNG market.

What impact might FLNG have on gas supply diversity and security?

It is going to be applied at certain gas fields and we will see how much it is commercially viable. Geopolitics in the Middle East and Ukraine is very fragile, so there is a chance the future market could be tighter. This technology may fill the gap, if it is coming at the proper speed. A success story is needed for this kind of innovation, but I think this technology has a very good chance of success.

This is a three-way competition with a new element – pipeline, LNG and now floating LNG.

How is FLNG relevant to Japan?

For Japan, our concern is if anything happens in the Strait of Hormuz, we will lose gas, so additional supply in some other area certainly helps. Asian economies are suffering with very high LNG prices. North American gas price competitiveness will not change, but FLNG adds further competition. As well as Shell and Petronas, Japan's Inpex are looking seriously at FLNG.

Japan has a very good shipbuilding industry. Japanese companies such as trading houses and utilities are getting more

interested in investing in exploration and development. The utilities need more gas and are willing to take risks. FLNG could be a very interesting target, combined with our technology for ship-building and our needs for gas resources. Some kind of innovative technology is required to regain competitiveness against the North American shale gas price.

Japanese power and gas market reform means the utilities need to find very competitive gas sources.

What are the FLNG risks?

For the environmental footprint, we have not seen problems with FLNG yet. In general, the IEA's 'Golden Rules' add only 7 percent to the cost of gas production. In some parts of the world, there are some geopolitical risks – will FLNG be impacted by wars, in some of the Mediterranean areas, in Africa close to Somalia? Of course, pipelines and fixed facilities have a more serious risk, but FLNG cannot solve these geopolitical risks itself.

How does FLNG relate to other gas market innovations?

Oil is too expensive relative to gas, thanks to the shale revolution. The Japanese government is pushing the utilities and trading houses to have more use of markets. Hub pricing discussion is happening everywhere. Singapore is a likely choice for the first hub, but then why not in Shanghai, in Seoul, if new technologies make for new supply? The soft infrastructure, social infrastructure of markets, abandoning the destination restrictions, as well as hardware through pipelines, floating regasification, are also necessary to make competition happen. All these elements are moving in the direction that gas is getting more important and satisfy the rules for the IEA's 'Golden Age of Gas'.



Nobuo Tanaka

Professor, GraSPP, the University of Tokyo
Global Associate for Energy Security and Sustainability
Institute of Energy Economics, Japan (IEEJ)

Nobuo Tanaka has extensive national government and international experience in the fields of energy, trade and innovation. As Executive Director of the International Energy Agency (IEA) from 2007-11, Mr. Tanaka led work on fossil fuel subsidy reform, energy efficiency policy recommendations (adopted by the G8), low-carbon energy technology roadmaps, gas and electricity security, energy poverty and carbon capture and storage, among others. With a strong background in international affairs, Mr. Tanaka has served as both Deputy Director and Director for Science, Technology and Industry (DSTI) of the Paris-based Organisation for Economic Co-operation and Development (OECD).

Key considerations and risks for FLNG developers

Proponents of floating projects have to consider what they need to get right, and which risks they have to manage. Most of the elements for a successful FLNG project are likely to be the same as for a conventional onshore LNG development. As the first FLNG projects are still in the construction phase, we are only at the early stages of identifying key success factors and lessons learned. It is vital to track initial

indications and determine analogies with other projects, such as FPSOs, to ensure the first wave of FLNG projects are delivered as effectively as possible. Failure in one of the early projects could deter new developers, worry financiers and host governments and set the technology back years.



Mina Sekiguchi

Managing Director, Head of Energy & Infrastructure, KPMG in Japan and Head of Energy & Natural Resources KPMG in Asia Pacific

As head of KPMG in Japan's Energy & Infrastructure sector and the Head of KPMG in Asia Pacific's Energy & Natural Resources sector, Mina Sekiguchi focuses on advising power and utilities, oil and gas, Japanese major trading companies and large power machinery manufacturers. With 7 years of corporate finance advisory experience, Mina provided M&A advisory services to major Japanese clients, including multiple cross-border M&A transactions.



The Japanese angle

As the world's largest LNG market, and one of the leading ship-builders, Japan has a particular interest in FLNG. Following the 2011 Fukushima Daiichi nuclear disaster and the shut-down of its nuclear fleet, LNG imports increased by 25 percent and "Japan is currently wasting USD \$40 billion a year for extra purchases of gas and oil for thermal power", as Nobuo Tanaka notes [KPMG – Nuclear Power: Its role in shaping energy policies in Asia Pacific].

Japan is acutely aware of its dependence on oil and LNG shipped through the Straits of Hormuz and Malacca, and on threats to global gas supplies from crises such as in the Ukraine. Additionally, its utilities are coming under increasing pressure to reduce the costs of electricity to their customers.

With nearly half of proposed FLNG projects in Asia-Pacific, including Japanese giant Inpex's Abadi in Indonesia, Japan is a likely major customer for FLNG. The country hopes that a more diverse supply, coming to market faster, will drive down prices and increase security. FLNG is one component of a broader strategy emphasizing the introduction of new price benchmarks based on US gas prices and traded Asian hubs, and accessing Russian pipeline gas and North American exports fed by shale gas.

Japanese companies are well-placed to develop FLNG alliances between upstream, utilities, shipbuilding and Engineering, Procurement and Construction (EPC) companies, a model that may apply to South Korea and China too.

Technology

Floating liquefaction is a relatively new technology, compared to floating regasification which has quickly established itself as a standard approach. Managing shipyard construction of FPSOs is now routine for oil and gas companies. Floating liquefaction should not present any excessive technical challenges.

However, it does require a specialized LNG containment system to prevent sloshing; topsides modules including gas pre-treatment and liquefaction; and safe systems for offloading cryogenic liquid in potentially difficult sea conditions, including the possible development of flexible hoses. New risk registers will need to be built and analyzed. Cyber security issues on a new type of offshore facility should be considered. Production processes have to be kept away from living quarters – sharing experiences from onshore LNG plants in confined sites such as British Columbia. Weather conditions will have to be factored into installation and operational schedules. Maintenance schedules are also different from onshore, due to the limited number of accommodation spaces on-board – Shell's plan for Prelude includes increased routine maintenance during normal operations.⁶

Cost and project management

Cost reduction is one of the key reasons to choose floating LNG.

Standardization is important as a way to save costs, but systems cannot be perfectly standard, which may limit the redeployment of vessels. For example, Australian facilities will have

to be cyclone-resistant. Prelude can withstand a category 5 cyclone – while this is not needed in East Africa.

Costs may fall significantly with experience. However, using floating systems is not a panacea. A recent study⁷ pointed out that companies were struggling to deliver FPSO vessels on time and budget: nine examples studied had on average 38 percent cost-overruns and were 16 months late. FLNG vessels will have to avoid such pitfalls.

Requirements for helping to mitigate such risks are:

- Allow sufficient time on front-end engineering; consider options and uncertainties carefully.
- Do not over-engineer the detailed design phase.
- Pursue standardization, not one-off designs.



⁶ J. Marshall and I. Grose (May 2014) 'Shell Australia – preparing to operate Prelude FLNG' Australian Petroleum Production & Exploration Association conference

⁷ M. Haney, M. Loffman and S. Robertson (5th February 2014) 'FPSO industry must re-think supply chain' Offshore Magazine, Volume 74, Issue 2.

- Issue tenders with achievable, realistic and action-based deadlines.
- Give careful consideration to integration of hull and topsides.
- If local content requirements require the use of inexperienced shipyards, then ensure this is accounted for in time and cost planning, and that attention is given to helping these shipyards improve their skills and quality control.
- Avoid conflicts of interest between different suppliers who may variously be seeking to reduce costs, keep on schedule or maximize scope and variation orders.
- Ensure sufficient construction slots at the shipyard are available and that the project is viewed by the shipyard as a top priority.
- Commission sufficient FLNG projects in a short period, for yards to generate and retain experience. If only a few projects are being built with gaps between, consider how knowledge from previous jobs can be retained.
- For operators, do not try to put too much of the financial and risk burden on contractors.

Supply chain management may be simpler than for onshore projects, but still requires integrating work from many different locations: for Prelude, the hull is built in South Korea, the turret in Dubai, subsea systems in Malaysia, control systems in Singapore and onshore bases in Broome and Darwin, Australia. KBR believes that, "Key factors for success will include proper front end loading and

successful interface management between traditional LNG and marine disciplines."⁸

Even if capital costs can be lower than traditional projects, Emma Wild, Head of Upstream Advisory Practice, KPMG in the UK, notes that "Operating costs may be higher and there may be increased operational challenges offshore, such as lower uptime. Floating projects may also miss out on synergies available where several projects share common utilities and marine works, as in Qatar, the US Gulf Coast import terminal conversions and possibly Mozambique." Floating projects will also miss out on the advantageous brownfield economics that expansions of land-based plants enjoy.



⁸ N. White (2nd July 2013) 'Drivers, Challenges and Solutions for FLNG' KBR presentation to IE Australia Perth Oil & Gas Facilities Group



Emma Wild

Head of Upstream Advisory Practice
KPMG in the UK

Emma Wild is an upstream specialist with a background and education in both chemical and reservoir engineering. With 20 years of international experience in the oil and gas sector and financial services, her primary focus is on transactions, corporate finance valuations, debt advisory and strategy. Prior to KPMG, she acted as Technical Advisor for a large UK financial services institution and holds various senior reservoir engineering and business development/new ventures roles globally.

Interview with Kimiho Sakurai, Section 5 Leader, Business Development Unit 2, Chiyoda Corporation

As an EPC contractor, what are some of the key issues for project management in FLNG?

Project management itself is essentially the same with other onshore projects, but we need to call in specialists for offshore, vessel construction, etc., and to evaluate metocean conditions (tides, waves, hurricanes) that impact design. Further, project execution plan after sail away of FLNG also needs to be considered in extra. LNG design, compared with onshore, would be basically the same, but since the space is limited on board, we need to achieve a cost effective compact design and safety for on board personnel at the same time.

For megaprojects, we form a consortium with shipyards and bring them to the first layer of contractors, to share risk and motivate them to be efficient. Some aspects are different from their traditional work, for example, the need for cryogenic pipes. We are already working with shipyards to solve these issues – they see FLNG as a big opportunity.

There are also many interfaces to manage. For an onshore project, Chiyoda can totally manage the EPC, but for FLNG,

turret suppliers, shipbuilders and subsea can be key players. Chiyoda has an alliance with Xodus, a specialist for offshore upstream and is now targeting FLNG subsea portion such as risers and offshore production, which are also a very significant amount of the project.

We have been successful in collaborating with clients and investors from the very initial stage of the projects and willing to continuously provide our LNG and project management professionalism in order to realize EPCI in the future with us. Since there is no FLNG in commercial operation yet, we form “one team” with the client to improve the development plan and design by mitigating risks of any kind and providing cost reduction at the same time. Our mission is to ensure the FLNG operates successfully and we always consider “what is the best for the project”. We wish to expand our Reliability No. 1 contractor to FLNG business, as well as we created for onshore LNG.



Kimiho Sakurai

Section 5 Leader, Business Development Unit 2
Chiyoda Corporation

Mr. Sakurai is responsible for Business Development of FLNG / Floater worldwide, hydrocarbon business development over the Middle East, Russia, CIS, Europe, Oceania, and Latin America regions. In previous roles, he was Director of Chiyoda International Indonesia, responsible for overall corporate activities of Chiyoda subsidiary in Indonesia, cum General Manager, Regional Business Development, South East Asia and responsible for business development activities across South East Asia.

With more than 500 large crude oil tankers, FPSOs and LNG tankers in service, construction of a few FLNG vessels should not tax shipyard capacity, but some may be expanded and retooled to specialize in such projects. LNG proponents, especially supermajors, may benefit from building a portfolio of FLNG projects. Alliances between E&P companies, EPC contractors and shipyards can develop the ship-builders' capabilities for these vessels and maximize the benefits from learning and standardization. E&P companies, however that have advocated FLNG for a long time, such as Shell and Petronas, will also need to protect their intellectual property and competitive edge. Shell has worked on Prelude with a consortium of Technip and Samsung as long-term technology partners.

Potential FLNG developers will be closely watching the first few projects. If these go smoothly, with no serious budget over-runs, delays or technical problems, other companies will gain confidence. This is particularly important for smaller companies, which could not absorb the costs and risks of an unsuccessful development.

Financing, legal, tax and regulation

Shell will own the Prelude facility, but other companies are looking at leasing, with Teekay, SBM Offshore and BW Offshore interested in constructing FLNG ships for lease, as with ordinary FPSOs. Leased ships may be smaller, 2-3 million tonnes per year rather than Prelude's 3.6 Mtpa, and use simpler liquefaction technology. This widens the circle of potential developers.

Project finance will also only be readily available once FLNG has proved its viability. As Jonathan Smith, Partner, Energy and Natural Resources and Oil and Gas Sector Leader, KPMG Australia notes however, "with Prelude costing an estimated AUS \$12 billion, FLNG projects will still largely be the domain of supermajors." Companies will need to work closely with finance providers to understand what they need to see to establish the technical reliability and bankability of their project and reduce the risk premium attached to project lending and EPC contracts.



Jonathan E. Smith

Partner, Energy and Natural Resources
Oil and Gas Sector Leader
KPMG Australia

Jonathan Smith brings over 25 years of experience in systems and process improvement. He specializes in assisting finance leaders in capital intensive industries on performance improvement of finance operations through CFO advisory, financial transformation and cost optimization/transparency. Jonathan has published on the role of the CFO in the development of corporate strategy, cost optimization and developing a cost culture in LNG/CSG projects.

Potential FLNG developers will be closely watching the first few projects. If these go smoothly, with no serious budget over-runs, delays or technical problems, other companies will gain confidence.



Roddy Adams

Partner

Head of ASPAC Infrastructure Markets
KPMG in Singapore

Including over 20 years of banking experience in the infrastructure sector, Roddy Adams was formerly the Global Head of Infrastructure & Energy and the Head of Equity & Projects at two major Australian financial institutions. A developer of power projects with a large hydro electric company, he has also closed multiple global project finance transactions as a sponsor, adviser, equity investor, lender and bond underwriter, bringing his significant knowledge and experience of debt and equity markets to his role.

Roddy Adams, Head of ASPAC Infrastructure Markets, KPMG in Singapore, points out that chartering arrangements for FLNG vessels, where the project owner chooses to lease rather than own, may draw on experience from floating regasification. "Issues include the commencement of hire, the compensation regime, force majeure, terms of mooring and specific marine law issues e.g. salvage and class of vessel. Vessels are often financed on a structured lease basis, while the overall project is often financed on a standard non-recourse basis. This can lead to a complicated intercreditor arrangement and a potential ranking of securities. On the face of it, these assets are re-deployable, but this is often heavily restricted by the rigid nature of ship financing models."

The status of FLNG plants may raise complicated questions for taxation, cost and price allocation and transfer pricing, particularly in a federal system such as Australia or Brazil. These issues would be even more complex for cross-border LNG projects such as those proposed between Israel and Cyprus or in West Africa.

As with FPSOs, floating LNG vessels may be classified either as ships or as production installations or even as both during different stages of the project. This means different regulations and standards will apply, making compliance more complicated. It will be important to engage early on – not only with the E&P regulator of the host country, but also with tax authorities, coastguard, shipping certification bodies, insurers and others to understand and agree how they will regard a floating LNG vessel.

Stakeholders

FLNG potentially offers advantages in managing stakeholders. By placing the bulk of the project offshore, it reduces the chance for conflict with local landowners and indigenous peoples and avoids the onshore environmental footprint. It may also make for easier labor and community relations by avoiding influxes of highly-paid workers into rural or remote areas. In addition, it makes the project less accessible to criminal or militant groups.



⁹ 'FLNG's Hard Sell' (25th September 2013), Petroleum Economist

Other stakeholders, however, may need careful engagement. National labor unions may object to perceived outsourcing of jobs to overseas shipyards: Brazil is one country with stringent local content requirements. Governments may seek onshore construction to generate employment.⁹ In the Sunrise project in the Joint Development Area between Timor Leste and Australia, Woodside argued that a floating plant would be US \$5 billion cheaper than an onshore plant in Timor Leste. But the Timorese government prefers a plant on land, believing that it would create more jobs and have a lower technical risk.¹⁰ As a result, the project has stalled.

Provincial or state-level governments may prefer onshore plants to gain a share of revenues that would otherwise go to the federal level and to attract related community projects such as schools and medical facilities. Like Western Australia, Israel and Mozambique, governments may have gas reservation policies that require

a proportion of gas be devoted to domestic consumers, requiring a pipeline to land even from floating plants.

To meet these concerns, companies are likely to have to place some infrastructure onshore – for example, supply bases, heliports and FLNG training centers – and possibly even do the ship-building in-country, requiring upskilling of local yards. Shell, for instance, has stressed that 70 percent of annual operating costs will be spent in Australia, with policies to encourage local and indigenous suppliers. Proponents will have to commit to local employment and education, especially in developing countries such as Mozambique and Tanzania which are trying to build a skilled workforce. They will have to articulate a clear case that lower costs – and indeed projects going ahead that would not otherwise be economically viable – mean higher tax revenues. And they will have to explain convincingly, the other advantages of FLNG such as reduced environmental impact.

It will be important to engage early on – not only with the E&P regulator of the host country, but also with tax authorities, coastguard, shipping certification bodies and others to understand and agree how they will regard a floating LNG vessel.



¹⁰ 'FLNG Gets Serious' (August 2010), Gas Today

Conclusion

“The Golden Age of Gas is leading to the Golden Age of LNG.”¹¹

The nascent FLNG industry is entering a critical period. With the world’s first four FLNG projects due to enter service between 2015 and 2018, the front-runners, as well as other likely proponents, will be watching closely. They will be keen to see whether these plants are delivered on-time and on-budget – and whether they perform well – with no serious design or operational flaws.

Proponents will weigh the 10 key reasons to consider floating LNG when making an investment decision. In some cases, onshore or floating solutions may both be viable. In others, the choice will be between a floating system or no project at all. As standardization and experience drive down costs, FLNG may widen its reach.

FLNG is not radically different from other projects the industry is familiar and comfortable with. It does, however, present some novel challenges – less on the technical side and more to do with the supply chain, project management, stakeholder engagement, financing, regulation and tax.

Floating plants can emerge as part of a more diverse, faster, cheaper and more agile global LNG industry. As Nobuo Tanaka observes, such continuing innovations are essential to deliver the IEA’s forecast ‘Golden Age of Gas’.

¹¹T. Regan, Tri-Zen International, ‘LNG 50’, 2014.

What are the key actions for FLNG proponents?

Consider how floating solutions may reshape the global LNG industry – to gauge the impact not just on FLNG ventures, but also on land-based LNG and other gas projects.

Understand the reasons for choosing a floating solution over a land-based plant. Not all factors are applicable to every project. Some projects may only be viable with a floating plant; others may present a real choice. Land-based, inshore and true blue-water FLNG plants also present different issues. Align with project partners and host governments early on regarding the criteria for concept selection.

Monitor the progress of the early FLNG projects and understand the challenges they meet and how they are overcome. Gather relevant data on cost and schedule to judge the economics of future projects and scope for improvement.

Consider what is different about FLNG projects – and what is common to all LNG investments. Understand the supply chain and the differences in project management. Learn from FPSO construction how to manage issues such as shipyard capacity and hull-topsides integration.

Begin building alliances with EPC companies, shipyards and potential local service providers.

Understand regulatory, legal, financing and tax issues well ahead of investment decisions. Engage with relevant stakeholders early and identify key risks and mitigation strategies.

KPMG Global LNG Competitive Advantage

For today's oil and gas companies, dealing with complexity has become a competitive challenge. Global competition, novel stakeholders and environmental concerns introduce new layers into business decisions.

A leading global provider of professional services to the LNG industry, KPMG member firms have successfully assisted clients in addressing business issues and major risks.

Business issues and risks	KPMG member firm advisory services
<ul style="list-style-type: none"> • Capital projects • Real-time assurance on capital expenditure management 	<p>Managing capital projects, contract processes and providing assurance are the focus of our Major Projects Advisory group.</p>
<ul style="list-style-type: none"> • Risk identification • Enterprise risk management • Outsource or insource? 	<p>Mitigating risks through tools and methodologies that address demand planning, supply and inventory management, strategic sourcing and contract management.</p>
<ul style="list-style-type: none"> • Business operations strategy • Demand side management 	<p>Organizational effectiveness, business readiness for LNG and operational excellence.</p>
<ul style="list-style-type: none"> • Issue recognition and strategy development • Business operations strategy • Capitalizing on different technology investments • Quality reporting 	<p>Designing or improving current business processes, including implementing technology focusing on logistic, supply chain and procurement management, are services that member firms' advisory teams have delivered successfully.</p>
<ul style="list-style-type: none"> • Talent transformation • Business operations strategy • IT projects implementation 	<p>Implementing appropriate size Human Resource strategies with the right enabling technologies is a key focus area to address labor-related risks.</p>
<ul style="list-style-type: none"> • Major project assurance • Enterprise risk management • Corporate governance improvements 	<p>Utilizing KPMG experts across our global network, advising businesses on implementing governance processes, risk management and ensuring compliance with legislation, including taxation.</p>
<ul style="list-style-type: none"> • Managing major capital expenditure projects and energy investment requirements • Major transaction management • Managing mergers, acquisitions, joint ventures and other third-party relationships 	<p>Project structuring, raising development phase equity, transaction advisory (financial modeling; development of country/project specific contractual frameworks), progressing these to support bankability, including advising in gas sales and purchase, and power purchase agreements. Advisory support can be provided during procurement and financing of capital projects.</p>
<ul style="list-style-type: none"> • Meeting increasing regulatory, government and multiple stakeholder demands • Managing major capital expenditure projects and energy investment requirements • Security of supply • Talent management 	<p>Managing relationships between IOCs and NOCs is critical to ensuring a balance between political and commercial objectives, such as royalty and taxation, security of supply, employment and infrastructure development. We assist IOCs and NOCs in creating a stable and attractive investment environment by developing policy and governance structures.</p>

Further LNG Insights

Webcasts: December 2014

Floating LNG: Revolution *and* evolution for the global industry?

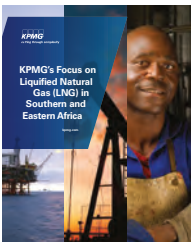


Major LNG projects: Navigating the new terrain

The LNG industry is approaching an unprecedented wave of expansion as new projects in Western Canada, the US Gulf Coast and East Africa pose technical challenges, but more importantly – non-technical challenges.

Webcast replay

Major LNG projects (or visit kpmg.com/energy)



KPMG's Focus on Liquefied Natural Gas (LNG) in Southern and Eastern Africa

Liquefied Natural Gas (LNG) is a key component of the global energy supply mix and it is a core strategic focus area for global oil and gas companies.



KPMG Global Energy Institute 4th Cocktail Reception: "Singapore – as an LNG hub"

The Global Energy Institute inaugural event in Tokyo presented the latest insights on Singapore as an LNG hub, including challenges and opportunities faced by the ASEAN regions.

For further publications, videos and other information on LNG, visit: kpmg.com/LNG

KPMG Global Energy Centers

KPMG member firms offer global connectivity. We have 18 dedicated Global Energy Centers in key locations around the world, working as part of our global network. The Centers are located in Beijing, Berlin, Budapest, Calgary, Dallas, Doha, Houston, Johannesburg, London, Melbourne, Moscow, Paris, Perth, Rio de Janeiro, São Paulo, Singapore, Stavanger and Tokyo.

These Centers enable KPMG professionals to transfer knowledge and information globally,

quickly and openly. With regular calls and effective communications tools, member firms share observations and insights, debate new emerging issues and discuss what is on member firms' clients' management agendas. The Centers also produce regular surveys and commentary on issues affecting the sector, business trends, changes in regulations and the commercial, risk and financial challenges of doing business.

KPMG member firms 18 Energy Centers



What sets KPMG apart

Our **business model** enables our network of **industry experts** to work side by side with **business leaders** to help develop and deliver strategies or solutions using highly **specialized teams** tailored to the specific **business needs** of member firm clients.

The KPMG Global Energy Institute (GEI):

Launched in 2007, the GEI is a worldwide knowledge-sharing forum on current and emerging industry issues. This vehicle for accessing thought leadership, events, webcasts and podcasts about key industry topics and trends provides a way for you to share your perspectives on the challenges and opportunities facing the energy industry – arming you with new tools to better navigate the changes in this dynamic arena.

Register today to become a member of the KPMG Global Energy Institute

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The KPMG Global Energy Conference

(GEC): The GEC is KPMG's premier event for executives in the energy industry. Presented by the KPMG Global Energy Institute, these conferences are held in both Houston and Singapore and bring together energy executives from around the world in a series of interactive discussions with industry luminaries. The goal of these conferences is to provide participants with new insights, tools and strategies to help them manage industry-related issues and challenges.



#KPMGGEC



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