



# **INQUIRY INTO FLOATING LNG**

## **SHELL SUBMISSION**



Economics and Industry Standing Committee  
Parliament of Western Australia



# Contents

Executive Summary .....	1
Shell in Australia .....	3
Australian LNG in the international LNG Market .....	4
The international LNG Market (Supply & Demand) .....	4
Australian LNG projects .....	5
Innovation and Prelude FLNG .....	6
Prelude FLNG.....	7
The case for FLNG.....	8
Where is FLNG being considered for use? .....	10
FLNG in context; economic opportunities and impacts ...	10
National Economic Benefit.....	11
Opportunities for local business .....	11
Employment .....	11
WA as a global hub for LNG and FLNG .....	12
A Case Study: Norway .....	12
Economic benefits to Western Australia from multiple FLNG developments .....	13
Domestic gas supply and the (F)LNG sector .....	14
Recommendations .....	16

# Executive Summary

Shell in Australia has played a foundational role in the Australian oil and gas sector. In the early 1980s, Shell brought key technology, capability, people and funding to the North West Shelf Joint Venture, Australia's first LNG project. Since then Shell has continued its deep and broad participation in Australian LNG, with around \$30 billion in capital currently being invested over a five year period through our participation in projects such as Prelude Floating LNG (FLNG), Gorgon and Wheatstone.

FLNG is a relatively recent innovation in the global LNG business. FLNG may represent the best technical and economic development option for gas reserves, depending on the challenges and opportunities each project presents. With real cost and schedule advantages, Shell believes that FLNG enables the development of gas resources ranging from smaller, more remote fields to potentially larger fields (via multiple facilities). In Australia, FLNG is a direct response to market conditions, allowing the Australian LNG sector to remain cost-competitive and capture Asia-Pacific LNG market opportunities. The same is true in a number of other LNG supply countries globally, where FLNG is also being actively considered.

Shell FLNG has a mature design basis, with more than 2 million man-hours invested in research, detailed design, development and integration of existing LNG technologies. Shell's standardised FLNG design focuses on safety, robustness and high availability to enable continuous, stable LNG production. The design has gone through extensive testing programs and simulations to ensure its safety throughout all weather conditions. Safety and reliability is on a par with modern offshore oil and gas facilities. The smaller footprint of FLNG developments results in significant cost and schedule advantages and greatly reduces the environmental impacts compared to onshore LNG projects.

FLNG will have significant long term economic benefits for Western Australia, bringing an opportunity for WA to consolidate its position as a hub for the global LNG sector. While Australian firms are involved in the construction phase, the main economic opportunities for local business

participation will come over the decades of the operations phase, where we expect FLNG will exhibit similar local content outcomes to onshore LNG developments. Shell expects that Prelude FLNG will:

- have a local content component of around 70% in the operations phase;
- create 350 direct and 650 indirect skilled jobs for a period of 25 years;
- add more than \$45 billion to Australia's GDP; and
- spend \$12 billion on Australian goods and services..

Western Australia, in partnership with the Federal Government and industry, can and should look to position itself as a key knowledge centre in the emerging global FLNG sector. Shell is committed to working with the Federal and WA State Governments, industry and the communities we operate in to help mature Western Australia into a global hub for FLNG, and to building skills and capabilities in Western Australia.

In order to better understand the potential long term benefits of FLNG developments for the national and State economy, Shell has undertaken preliminary analysis to examine the potential economic impacts of multiple FLNG developments, including employment and revenue outcomes. This work indicates that three FLNG facilities operating off the Western Australian coast could generate:

- 1000 – 1500 direct jobs;
- 3500 – 4700 indirect jobs; and
- Up to A\$90 billion in Federal Government revenues with an estimated A\$10 billion in revenues to the WA Government over project lifetime.

This submission will cover the international context in which the Australian LNG sector operates, the role of FLNG in the LNG sector, the development of the Prelude FLNG project and the expected and potential economic benefits that FLNG can, and will, bring to Western Australia and Australia.





# Shell in Australia

Shell has had a presence in Australia since 1901, when it became the first company to import bulk kerosene into the Australian market – changing how the dominant energy source of the era was transported. Over the last 113 years, Shell's footprint in Australia has changed significantly as the business has adapted to meet the needs of its customers.

Today Shell has large and diversified interests in Australia including oil refining; the production of specialist petroleum products; retailing fuels and lubricants; and the production of oil and natural gas (including LNG) for both domestic and export markets. Among international oil companies, Shell is the world's largest producer of liquefied natural gas (LNG).

In Australia Shell employs around 2500 people, split between our upstream (exploration, development and production) and downstream (refining, marketing and retail) businesses. Perth is the base for the upstream business, which is growing rapidly and employs over 500 people. Shell has recently signed as the foundation tenant for Leighton's Kings Square development, within the WA Government's CityLink Project. Kings Square will be the corporate headquarters for Shell in Australia, and also the corporate support centre for Prelude FLNG.

Australia is key to Shell's LNG growth aspirations globally. Shell sees natural gas as a major part of the energy mix needed to meet the world's growing energy demand. Shell is in the midst of a five year, \$30 billion investment program in Australian LNG projects alone, making Shell one of Australia's largest foreign investors. Shell is a major investor in key Australian LNG projects, including our operated Prelude FLNG project (67.5% equity), the Gorgon Joint Venture (25% equity), the Wheatstone Joint Venture (6.4%), the North West Shelf Venture (16.6% equity), the Browse Joint Venture (c27%), the Sunrise Joint Venture (26%) and Arrow Energy (50%).

In addition Shell Australia maintains an active exploration portfolio, with operated and non-operated joint venture interests in the Browse, offshore Canning, Bonaparte and Carnarvon basins, with over A\$1 billion dollars of future exploration activity currently in planning.



## AUSTRALIAN LNG IN THE INTERNATIONAL LNG MARKET

To understand why FLNG can in certain circumstances represent the best development option for investors and governments, it is important to consider emerging dynamics in the international LNG market and the impact that cost trends are having on current and future developments in the Australian LNG sector. Whether FLNG is considered by LNG project proponents will rest on a range of factors, including the size and composition of the gas resource, the distance to existing infrastructure, water depth, prevailing metocean conditions and project economics.

## THE INTERNATIONAL LNG MARKET (SUPPLY & DEMAND)

Global LNG demand is forecast to grow from around 220 Mtpa<sup>1</sup> in 2010<sup>2</sup> to approximately 450 Mtpa in 2030, which will see it far outpace oil demand growth for the same period. To meet this demand forecast, between now and 2030 at least 200 Mtpa of additional global LNG supply capacity will be required<sup>3</sup>. Much of LNG's historical growth has been driven by the established LNG markets in Japan and Korea - the world's largest and second largest LNG importers and core customers for Australian LNG. Some 50% of the future demand growth is expected to come from Asia-Pacific countries including new demand from rapidly developing economies such as China, India and South East Asian countries, which are searching for a cheaper alternative to oil fired generation and a more environmentally friendly energy source than coal.

At the same time, a multitude of new, lower-cost supply sources, including North America and Africa, are expected to drive a more competitive LNG landscape for Australian projects.

### GLOBALLY THERE ARE MORE PROJECTS UNDER CONSIDERATION THAN WILL BE NEEDED TO MEET DEMAND

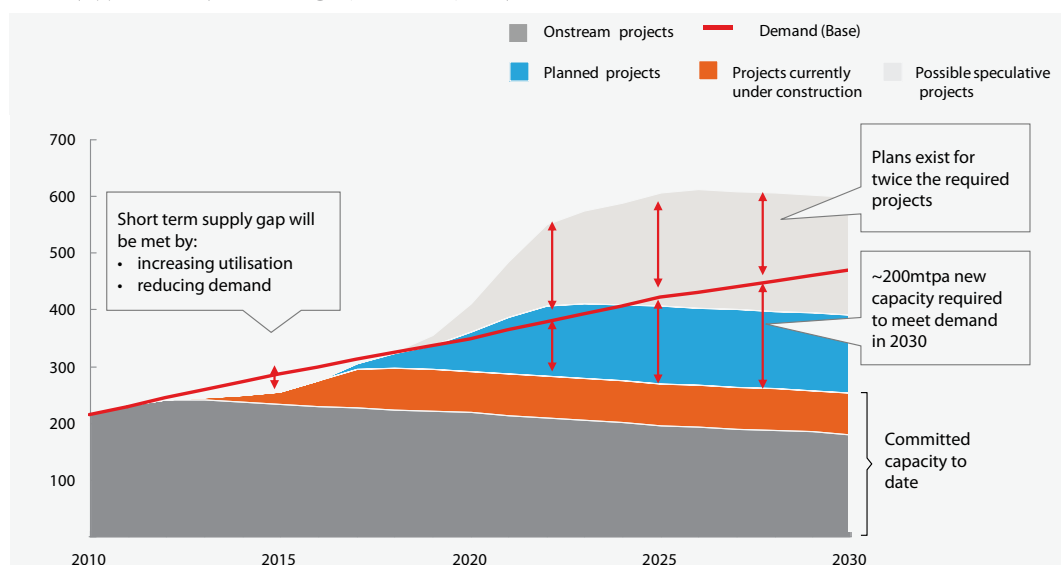


FIGURE 1: GLOBAL LNG SUPPLY—DEMAND PROJECTION<sup>4</sup>

<sup>1</sup> Million tonnes per annum of Liquefied Natural Gas

<sup>2</sup> WoodMackenzie LNG Demand Outlook 2012

<sup>3</sup> McKinsey and Co. "Extending the LNG Boom; Improving Australia's Productivity and Competitiveness" 2013

<sup>4</sup> McKinsey Energy Insights November 2012

More than 60 projects currently under consideration in 22 countries, could add more than 350 Mtpa of additional capacity by 2030. North America, with an abundant supply of low-cost Shale and Tight gas, could account for more than 100 Mtpa of that growth, with Africa (including the major new gas finds in East Africa) close to 100 Mtpa and Russia some 50 Mtpa. A range of other supply countries could represent a further 100 Mtpa. Australia has the potential to develop a further 40-50 Mtpa of new LNG supply capacity. In short, by 2030, supply could outstrip demand growth by as much as a factor of two, and LNG customers will continue to seek diversity in their supply portfolios. In light of these projections, Australian LNG projects will have to move quickly to capture a share of demand growth against tough competition. FLNG represents an opportunity for Australian projects to continue to be developed in this competitive environment and secure new long term LNG supply contracts.

## AUSTRALIAN LNG PROJECTS

Australia's proximity to North Asia, the world's largest LNG market, combined with an abundance of natural gas resources, has underpinned Australia's standing as a stable and reliable supplier of LNG. Australia currently has three operational LNG projects; North West Shelf LNG, Pluto LNG and Darwin LNG, representing 7

producing LNG "trains" supplying in the order of 24 Mtpa.

These three producing projects have been followed by a wave of seven LNG projects in construction, representing an additional 14 LNG "trains", which are expected to see Australia's annual LNG production exceed 80 Mtpa by 2020. Of the 21 Australian LNG trains in production by 2020, just one (Prelude) will be an FLNG development. The unprecedented scale of recent investment in LNG projects has stretched the capacity of the Australian economy in key areas, occurring as it did simultaneously with large investments in the minerals sector, and has had cost and schedule impacts on almost all large resource projects.

The relative cost performance (per unit of LNG capacity) of Australian LNG projects is illustrated by Figure 2. The cost of Australian LNG projects has increased significantly since Darwin LNG, far in excess of the global rate of cost growth for LNG developments. Australian LNG projects are now amongst the highest cost developments worldwide. The proposed onshore LNG Browse project in the Kimberley, would have had a \$/Mtpa ratio that exceeded all the other Australian projects shown in figure 2, would not have met generally accepted return rates for the very large sums of capital required and would have, in all likelihood, destroyed value for shareholders.

LNG DEVELOPMENT COST (US\$ PER MTPA CAPACITY)

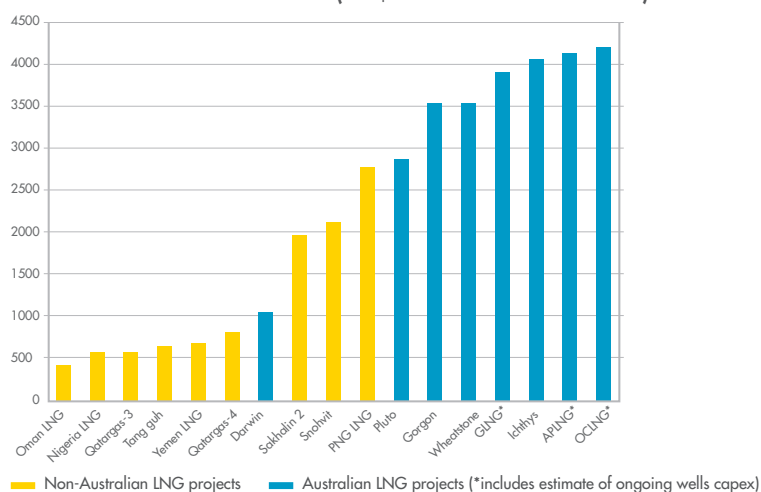


FIGURE 2: GLOBAL LNG DEVELOPMENT COSTS COMPARISON<sup>5</sup>

<sup>5</sup> Source: Wood Mackenzie 2013 and Shell analysis

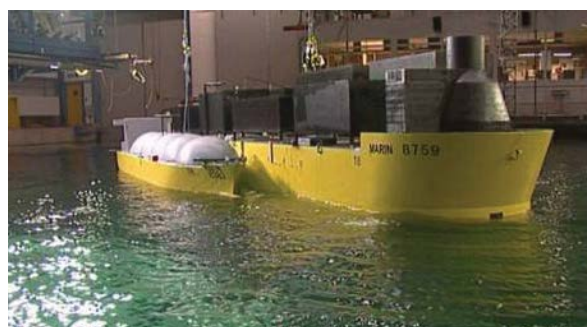
The cost disadvantages that Australian LNG projects have experienced in this investment peak have been exacerbated by multi-factor productivity issues intrinsic to Australia, including remote locations and limited existing infrastructure, along with significantly higher labour costs than those of other LNG exporting countries. At the same time Australia's complex and overlapping regulatory systems multiply project risks and complexities, increasing costs for large scale projects without improving regulatory outcomes. The Australian Petroleum Production and Exploration Association (APPEA) in a 2013 study found that Australia's complicated, overlapping regulatory approval processes could significantly increase project capital expenditure costs and add to schedule delays. For example, APPEA found that in the case of large offshore LNG projects, project delays could decrease revenue to Federal and State Governments by as much as 12%.<sup>6</sup> Together these (cost and schedule) factors make Australian landed LNG 20-30% more expensive than competing suppliers, particularly North American and East African suppliers, according to a recent McKinsey study<sup>7</sup>. The reality is, that even addressing those factors that can be changed by policy or industry response, Australia's intrinsic factors see us at a comparative cost disadvantage when compared to economies such as North America. In future, Australian LNG projects will have to be even more competitive to deal with disadvantages such as remote locations, poor infrastructure and/or expensive to monetise hydrocarbons.

## INNOVATION AND PRELUDE FLNG

Shell has a strong record of innovation in the oil and gas sector, designing the world's first LNG plant, the first LNG tanker and the world's first FPSO<sup>8</sup>. FLNG enables natural gas to be extracted, treated, liquefied, stored and loaded for export, on a single facility at sea. FLNG represents a new phase in innovation, applying similar design and operating approaches to those already widely used in FPSOs, which are commonly used to produce oil off Western Australia.

In designing FLNG, Shell's objectives were that it be safe, robust, cost efficient, and with a high availability to enable continuous and stable LNG supply. Safety was the primary

focus, with multiple quantitative risk assessments at various stages of the design confirming that the FLNG facility would be at least equally as safe as modern FPSOs and offshore production facilities currently in operation. The FLNG design includes a number of key safety features including the layout (and separation) of hydrocarbon processes from accommodation modules, enlarged safety gaps between process modules, fire-proof protective coatings and specially designed product loading arms. The FLNG facility is designed for 1 in 10,000 year weather events which means waves in excess of 28m and wind gusting at more than 300km/hr. At all times, including during a cyclone, the facility remains on-location, with personnel remaining on board. Its size and sheer mass (600,000 tonnes fully ballasted) is a significant help in this regard. Maintenance is also carried out on-location, removing the need to transit to a dry dock, such as Singapore. Remaining on-station for continual production and maintenance improves its overall availability compared to FPSOs (as it eliminates the lost time needed to disconnect and reconnect) and also avoids the safety risk associated with transporting large numbers of people by helicopter. Shell's FLNG system is designed to have a total system availability similar to that of conventional onshore LNG projects.



<sup>6</sup> APPEA "Cutting Green Tape" 2013

<sup>7</sup> McKinsey and Co. "Extending the LNG Boom; Improving Australia's Productivity and Competitiveness" 2013

<sup>8</sup> FPSO: Floating, Production and Storage Offtake vessel



## PRELUDE FLNG

The Prelude FLNG project in Australia will be Shell's first deployment of its FLNG technology and is likely to be the first FLNG facility in the world. Prelude will be located in the Browse Basin, approximately 475km north-north east of Broome and over 200 km from the nearest point on the coast of the remote Kimberley region, in Western Australia. The Prelude natural gas field was discovered by Shell in 2007 with an additional field, Concerto, discovered nearby in 2009. A Final Investment decision (FID) was taken by Shell in May 2011 to commence the construction of the FLNG facility. The application of Shell's FLNG technology to Prelude has made it possible that the field will be brought into LNG production just ten years after discovery. Prelude FLNG will produce 3.6 Mtpa of LNG, 1.3 Mtpa of condensate and 0.4 Mtpa of LPG, and operate for about 25 years.

In 2012, new participants joined the Prelude FLNG project under separate agreements; namely INPEX (17.5%), Kogas (10%) and CPC (5%). The participation of other upstream players and long term LNG customers in the Prelude FLNG venture demonstrates market confidence in Shell's FLNG technology. Shell retains 67.5% equity and is Operator.

Once complete, the FLNG facility will be towed from South Korea to the Prelude location for commissioning and start-up. In Prelude's case the FLNG facility will process gas that is fed to it from seven production wells via a flexible riser through the turret. The processed hydrocarbons will be stored within the double skinned hull in insulated membrane tanks. The LNG and LPG will be loaded into product tankers that berth alongside, using specifically developed loading arms suitable for the marine environment. The condensate will be loaded via a standard floating hose to a tanker astern of the FLNG facility (as is the practice for FPSOs). At least two tugs will assist the safe berthing of all product vessels and also act as emergency response vessels.

As with all Australian LNG projects currently under construction, Prelude FLNG will draw on global supply chains in the capital investment phase, with construction taking place where a range of factors including capability, safety and cost can be satisfied. The main structure and



topsides are being manufactured and assembled in the Samsung Heavy Industries yard in Geoje, South Korea, globally one of the few shipyards of suitable scale and capability. The turret system, which secures the FLNG to the seabed and around which the facility 'weathervanes', is under construction in Dubai. The subsea systems are currently being manufactured in Malaysia and will be installed in 2015.

There are opportunities for Australian firms to participate in Prelude via the approved Australian Industry Plan, in place since 2009. A significant amount of local expenditure will derive from the Prelude wells drilling campaign, commencing in 2013 with Broome as the key supply point. In addition, a number of contracts for subsea scope have been awarded to Australian firms.

During the expected 25 year operations phase, aviation and drilling support will be based in Broome, while facility support will come from a supply base currently under construction in Darwin. Approximately 120 – 140 personnel will be based on the facility at any one time, with accommodation for up to 340 individuals on the facility to allow for ongoing maintenance activities.

## THE CASE FOR FLNG

The cost and schedule benefits of FLNG will enhance the LNG industry's ability to continue to develop Australia's gas resources. Australia is now one of the highest cost countries for the construction and operation of LNG projects. This reality reflects relatively high input costs such as the price of skilled labour and materials, but also the fact that Australia's gas resources are often in very remote locations, far from existing infrastructure. Over the last decade the Australian LNG sector has had to continually respond to competition in the international LNG market and to growing cost and schedule pressures. To do so, the current generation of land-based LNG projects are employing increasing levels of modularisation in fabrication and construction (up to levels of 80%), representing a step-change from the technologies employed for the construction of the original trains on the NWS project.

As has been the case in North West Australia, large, conventional near-shore gas resources are often developed first, as they are usually easier and more economic to

develop than the smaller or more remote fields. As gas basins mature, exploration naturally moves out into more remote locations, further offshore, and into deeper water depths. More remote gas fields face a much higher cost of development, making land-based LNG solutions far more difficult – both technically and economically. FLNG has become widely recognised as a viable (or possibly the only viable) development option for smaller and/or more remote gas resources, as is the case for Prelude. In many cases, the choice is to develop a gas field with FLNG technology or not develop at all.

The LNG industry has now also recognised the broader potential that FLNG technology has to address cost competitiveness. In Australia, significant cost pressures have seen material increases in announced capital expenditures for major onshore LNG projects. In some cases, cost overruns have been up to 50%, in aggregate resulting in more than US\$30 billion additional capital spend to that envisaged at the time of the final investment decisions. The FLNG concept simplifies and reduces construction scope substantially since it does not require separate offshore processing platforms, long pipelines to shore, near-shore works (dredging of shipping channels or jetty construction) or the civil works associated with the development of an onshore LNG site. FLNG developments require less than 1/10th of the materials (steel, concrete and rock) required for onshore LNG developments. The smaller footprint of FLNG developments results in a significant cost advantage over onshore LNG developments. The reduced scope and lack of near-shore works greatly reduces the environmental impacts of FLNG compared to conventional greenfield onshore LNG projects.

FLNG will not always be the best or preferred solution for new LNG projects. It does however represent an important technological development for the global LNG industry - particularly in the case of more remote or economically challenged gas fields – with the potential to significantly reduce LNG development project costs and minimize both the construction and environmental footprint. Through experience in application and further research and development, it is reasonable to expect that FLNG will continue to evolve for use, for example, on leaner/dryer gas fields or in deeper water and/or differing metocean conditions.





## WHERE IS FLNG BEING CONSIDERED FOR USE?

Offshore Australia is just one of a number of locations in the world where FLNG can improve the economically competitive development of gas resources. FLNG is also under consideration by operators in Indonesia, Malaysia, South and Central America, the Persian Gulf, East and West Africa and in the East Mediterranean. In each case, investors and resource holders are considering economic and technical factors, including international LNG market considerations, in looking at FLNG as a timely, effective and economic option to monetise gas resources. Given the advantages FLNG can have over 'traditional' land-based LNG developments in certain environments, it is reasonable to expect that FLNG will continue to be selected as a competitive development option by various developers and governments in numerous countries globally.

## FLNG IN CONTEXT; ECONOMIC OPPORTUNITIES AND IMPACTS

The LNG industry in Australia dates back to the 1980s when the North West Shelf Project commenced deliveries of liquefied natural gas (LNG) to buyers in North Asia. Since then, the LNG sector has seen considerable growth helping to diversify Australia's exports from traditional sources such as Iron Ore and contributing A\$68 billion in taxes and royalties. Western Australia has been at the heart of the Australian LNG revolution with the state now accounting for 64% of Australia's natural gas production and LNG exports contributing A\$11.3 billion to the WA economy in 2012, of a total A\$97 billion from the resource sector, second only to iron ore<sup>9</sup>.

Australia's position as a pre-eminent LNG supplier is evidenced by the more than A\$200 billion in LNG projects currently under construction as well as the additional A\$180 billion in capital expenditure flagged for future LNG projects. Should all these projects come to fruition, the LNG sector will create an additional 150,000 jobs, increase GDP by 1.5% and could see Australia overtake Qatar as the world's largest LNG supplier.<sup>10</sup>

PROJECT	LOCATION	SIZE (MTPA)	STATUS	OPERATOR
Prelude	Australia	3.6	Construction	Shell
Kanowit	Malaysia	1.2	Construction	PETRONAS
Rotan	Malaysia	1.5	Design phase	PETRONAS
Abadi	Indonesia,	2.5	Design phase	INPEX
Sunrise	Timor Sea	4.0	Concept	Woodside
Bonaparte FLNG	Australia	2.5	Design phase	GDF Suez
Santos Basin	Brazil	2.5	Design phase	PETROBRAS
Scarborough	Australia	6.0	Design phase	Exxon
Browse	Australia	3 x 4.0	Design phase	Woodside
Tamar	Israel	3	Design phase	Pangea
Lavaca bay	US	4.4	Design phase	Excellerate
Corpus Christi	US	8	Design phase	Pangea
Greater Poseidon	Australia	> 3	Design phase	Conoco
Cash/Maple	Australia	3	Concept	Hoegh
Area 4	Mozambique	> 3	Concept	eni
La Creciente	Columbia	3	Design phase	EXMAR

TABLE 1 - FLNG IS BEING CONSIDERED IN MULTIPLE LOCATIONS GLOBALLY<sup>11</sup>

<sup>9</sup> McKinsey and Co. "Extending the LNG Boom; Improving Australia's Productivity and Competitiveness" 2013

<sup>10</sup> McKinsey & Co. "Extending the Resources Boom" 2013

<sup>11</sup> Shell.



Prelude FLNG, like conventional LNG onshore developments, will deliver long term, high value opportunities for both Australia and Western Australia through direct and indirect employment, increased government revenue, spend on local goods and services, training, higher education investment, knowledge transfer and capability development.

### National Economic Benefit

An independent study by ACIL TASMAN estimated the national economic benefit of Prelude FLNG over the 25 year project life to be:

- 350 direct and 650 skilled indirect jobs;
- A\$12 billion in taxes over the project life;
- A\$12 billion in local goods and services;
- An improvement in the balance of trade by A\$18 billion; and
- A\$45 billion uplift to Australia's GDP

### Opportunities for local business

In line with the Australian Industry Participation National Framework principles and the Shell Australia Local Content Policy, the Prelude FLNG project has worked to provide full, fair and reasonable opportunity for Australian owned companies to participate in the project. The Prelude FLNG Australian Participation Plan was approved by AusIndustry and ICNWA<sup>12</sup> in 2009. Under the plan, Shell has worked, and continues to work, with Project Connect, and both ICN WA and ICN NT, to ensure local business have access to compete for Prelude contracts. Shell has established a Prelude Local Content Roundtable with the relevant State and Federal agencies.

Using these tools, Shell and its major contractors were able to engage a number of Australian firms for the Prelude construction phase, despite a majority of the construction occurring overseas. For example, Australian firms have been awarded contracts for the supply base, topside cranes, and for some subsea infrastructure. Significant local spend has already been achieved through preparations for drilling and the associated logistics, subsea installation and the onshore supply base. By Prelude FLNG startup, capital expenditure on drilling, subsea, logistics and onshore activities, is estimated to include approximately

40% local content, representing some \$470 million on Australian goods and services.

Shell's global experience shows that for the operations phase, developing local support and relationships improves equipment availability in the long term and should ultimately deliver more cost effective and efficient outcomes. After establishing safety, integrity, asset performance and quality as givens, Australian content is a key consideration for the Prelude FLNG Project.

Shell Australia will require around 200 contracts to support the Prelude facility during the operations and maintenance period of 25 years. These contracts will be predominantly awarded to Australian businesses, and we estimate that at least \$200 million per annum, or approximately 70% of the annual operating cost, will be Australian content. Over time, this will grow further. Of that amount, it is expected around 70% could go to Western Australian enterprises. Shell recently posted an Expression of Interest notice on Project Connect for the Prelude FLNG and maintenance phase, and the EOI is intended to provide a shortlist of Australian businesses to qualify for tender.

One of the differentiators of FLNG is that the maintenance work profile will be smoother than an onshore plant, providing more and continuous employment opportunities. Rather than relying on major shutdowns for maintenance, the FLNG philosophy of continued maintenance minimises the scope of major shutdowns by increased routine maintenance effort during normal operations, whilst on-location. This provides a more sustainable and stable basis for support industries to offer long term employment. Corporate support for the Prelude FLNG project will also involve significant spend with local companies, especially in Western Australia.

### Employment

Shell Australia is committed to employing Australians to work on Prelude FLNG. In the operations phase, Shell's expectation is that Prelude FLNG will see similar employment benefits to a one train onshore LNG facility, offering long-term, highly skilled positions for a project life of 25 years.

By 2017 there will be 350 people working on Prelude with a further 650 in support roles, across Broome, Darwin and with a majority based in the Perth office.

<sup>12</sup> ICN refers to Industry Capability Network

Shell Australia has elected to prioritise Australian talent for Prelude FLNG, and has started early with a strategy of hiring more experienced staff first to support the project delivery, followed by a series of recruitment waves until the start of operations in 3 years' time.

There are currently 60 Australians already working in the Prelude FLNG operations organisation. Most new employees will spend approximately two years working in the construction yard in South Korea, before returning to Perth for start-up and operations. Some employees will also be posted to other Shell projects around the world to gather vital operations experience prior to start-up.

### **WA as a global hub for LNG and FLNG**

The industry is also collaborating through various initiatives, including the proposed Oil and Gas Innovation Partnership, to foster local knowledge and enterprise capacity in key resource related technologies, including FLNG. Shell is a core participant in the partnership, and believes that with industry and government support, it will be an effective vehicle to develop local enterprises and enhance the position of Western Australia as an internationally competitive export hub for the LNG sector. Using the partnership Shell intends to work with governments and industry to position WA as a global hub for FLNG, as multiple FLNG developments mature in our offshore waters.

Australia is likely to be the first country with an operating FLNG project. Gaining international recognition as a technical and operations knowledge base has long term benefits, evident in overseas locations such as those in the UK, Norway and USA. The success of these locations has stemmed from a very deliberate collaboration between industry and government to maximise opportunities and to capture first mover advantage now is the right time to plan and invest in the future FLNG sector in Australia.

### **A Case Study: Norway**

Norway presents an impressive example of a country that has used its natural resources to not only create wealth for its people but also develop world class technical expertise that is in high demand in the global oil and gas industry. The offshore oilfield services industry in Norway has a

total annual revenue of \$61 billion (> 10% of Norway's GDP) and employs approximately 100,000 people. For a country where its first major hydrocarbon field (Ekofisk) was discovered as late as 1969, it is quite remarkable that over 1/3rd (35 out of 108) of all FPSOs installed globally are owned by Norwegian companies.

Norwegian companies today are involved in some of the most complex oil and gas operations around the world. Carefully crafted government policies incentivise foreign companies to develop technology in Norway and to transfer skills to Norwegian companies. Additionally, indirect measures such as support for training in oil-related expertise and creation of state research institutions to support Norwegian companies also accelerated the capability build-up in the Norwegian oil field services industry.

It is notable that the key success factors for hub development include significant government and industry co-ordination, critical mass, and competitive advantage. In Australia Shell has been working with partners including government, the tertiary and vocational training sector to build training and workforce capacity for Prelude FLNG. Shell, in preparation for Prelude FLNG, has developed a number of initiatives aimed at building local capacity to support the project. The FLNG Training Consortium is a partnership between Challenger Institute and Curtin University, established with financial support from Shell. This partnership will see the creation of the first FLNG training facility at the Australian Centre for Energy and Process Training (ACEPT) in Henderson, and will train all operators for Prelude FLNG.

Through a partnership with the University of Western Australia's Energy and Minerals institute, Shell has established the Shell EMI Chair in Offshore Engineering to increase offshore research and education in WA. Professor David White took on the role as chair in January 2013 and he will be supported by two Shell funded Associate Professors and three sponsored PhD scholarships.

Shell, collaboratively with three other operators, has developed Australia's first pre-planned Oil Spill Operational and Scientific Monitoring Program (OSMP) as part of our



environmental licence conditions and together with the Ichthys Project is engaging the West Australian Marine Science Institute, the Australian Institute of Marine Science and the CSIRO to deliver environmental baseline studies and the capability to conduct the OSMP in case of an oil spill.

A clear factor in the successful precedent hubs around the globe, is the extent and quality of collaboration between industry, government and tertiary education institutions. This is an opportunity for WA, in the field of LNG and FLNG, that has yet to captured.

### **Economic benefits to Western Australia from multiple FLNG developments**

While Prelude is the only FLNG project currently in execution in Australia, Shell has worked to understand the economic benefits to the State and Federal Governments from the deployment of multiple FLNG facilities in Australia. In undertaking this analysis, Shell has drawn on lessons and knowledge from the Prelude FLNG project and has modelled a range of outcomes in conjunction with third party advisers, to develop a picture of the long term benefits to the State from multiple FLNG developments. Although this work is indicative only, it illustrates that multiple FLNG developments will, by the time they reach the operations phase, contribute to Western Australia's economy to a similar or greater extent than existing onshore LNG plants.

The table below describes the potential long term economic benefits to Western Australia from multiple FLNG facility developments.

In terms of direct employment, three operating FLNG units will create up to 1500 skilled jobs for the long-term (25 years or more), the majority of which will be based in WA. The number of indirect (onshore support) jobs is greater and by the time six FLNG units are operational, up to 9,400 long-term skilled jobs will have been created in Australia, with the majority in WA. In addition to these jobs, the increased revenues and economic activity stimulated by the FLNG industry could generate in excess of 10,000 induced jobs, created by the additional activity associated with the Direct and Indirect jobs. Induced impacts are the 'spill-over' benefits throughout the economy, triggered by the additional incomes of businesses and individuals.

Given the cost-competitive nature of FLNG developments, contribution to government revenues (including all taxes and royalties) could be significant. For example, three FLNG units would generate around \$90 billion of government revenues over project life, including \$10 billion revenue to the State of WA. These figures double, to \$180 billion and \$20 billion, in the case of six operating FLNG units. In the case of contribution to the Australian economy, over a 40 year period, six operating FLNG units could generate in excess of \$230 billion in GDP.

		<b>3 FLNG UNITS</b>	<b>6 FLNG UNITS</b>
Direct jobs created (number)	Australia Total	1000 – 1500	2000 – 3000
	of which, WA	750 – 1150	1500 – 2200
Indirect jobs created (number)	Australia Total	3500 – 4700	7000 – 9400
	of which, WA	1900 – 2500	3800 – 5000
Government Revenues (A\$ billions, nominal)	Australia Total	88 – 94	176 – 188
	of which, WA	9 – 10	18 – 20
GDP impact (A\$ billions, nominal)	Australia Total	119 – 161	238 – 322

TABLE 2 – STATE AND NATIONAL BENEFITS FROM POTENTIAL FUTURE FLNG DEVELOPMENTS <sup>13</sup>

<sup>13</sup> Shell Study

## Domestic gas supply and the (F)LNG sector

In recent years rising international prices for energy have generated public debate about the appropriate settings for domestic gas markets and how strengthening linkages to international markets should be managed. Shell acknowledges that the WA State Government will always have an interest in ensuring access to safe and affordable domestic energy. Shell supports market-based policy approaches as the most resilient and robust mechanisms to ensure that consumers benefit from affordable, sustainable energy.

The recent findings of the WA Government's Independent Market Operator (IMO) in July 2013, indicate that further market intervention in the form of the domgas reservation policy is not warranted, as illustrated by Figure 3 below. In the IMO's initial Gas Statement of Opportunity, published in July 2013, the report summarises "there is expected to be adequate gas supply to meet forecast demand in the domestic market", and further: "existing gas reserves are forecast to be sufficient to continue to meet 2022 domestic and LNG demand levels for a very considerable period beyond 2022".

In the case of proposed FLNG developments, there would be no economically viable physical means of providing gas molecules from the fields - generally hundreds of kilometres from the coast and even more distant from existing onshore domestic gas infrastructure. While the concept of FLNG providing domestic gas through some sort of "offset" arrangement has been mooted, this concept has commercial and technical difficulties which may challenge its feasibility. These complexities arise from the numerous entities involved (various gas joint ventures, domestic gas customers, LNG customers, infrastructure owners, LNG terminal and ship owners etc) and the difficulties from aligning confidential terms in commercial contracts across the value chain.

Investment in domestic gas supply from LNG projects should be premised on a clear understanding as to the need and timing for the gas (the supply-demand balance), access to available infrastructure and the commercial viability of the investment. Shell supports a case-by-case approach to the issue of domestic gas supply from (F) LNG projects, so in a dialogue with LNG proponents the State can build an understanding, of the commercial and technical complexity inherent in supplying domgas from specific (F)LNG developments.

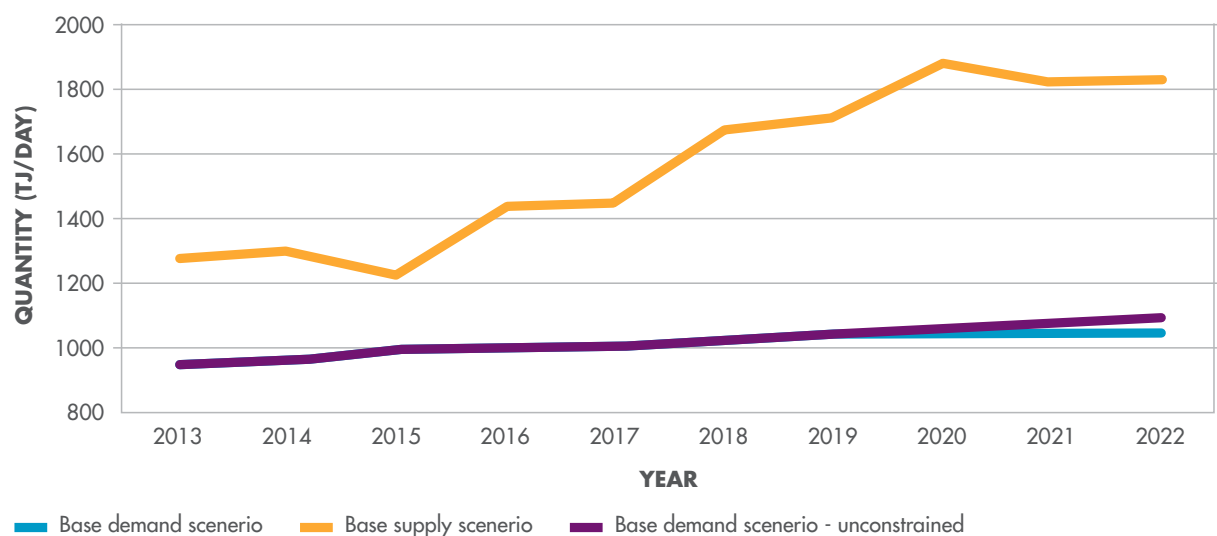


FIGURE 3: WA DOMGAS SUPPLY-DEMAND BALANCE 2013-2022 [SOURCE: NEIR FORECASTS 2013-2022]





# Recommendations

- The Federal and State Governments should ensure proponents are enabled to select the best technical, commercial and sustainable development option for LNG projects, to ensure the efficient and timely development of Federal and State petroleum resources.
- The State Government should conduct a rigorous and robust economic assessment of the domestic gas reservation policy in 2013-14, with a view to discontinuing the policy as a barrier to the effective and timely development of petroleum resources.
- The State should continue to and increase its support for the proposed Oil and Gas Innovation Partnership, as a vehicle to develop the suite of enterprise capabilities to support the further development of Western Australia as an international hub for the petroleum sector and for the FLNG industry.
- The State should review the existing port, land and supply chain infrastructure necessary to support multiple FLNG developments off the Western Australian and North West Coast of Australia, and should request Federal Government support in developing appropriate port and land based infrastructure.
- The State Government should work with the Federal Government to coordinate and integrate the suite of tertiary training opportunities that have been developed by the oil and gas sector, working to ensure that existing and future research and development capacity focused on the oil and gas sector in Western Australia retains international scale and continues to enhance competitiveness.
- The State should work with the Federal Government and industry to ensure WA is an attractive environment for the ongoing development of the onshore and FLNG sectors, with a view to identifying and removing barriers that reduce the international competitiveness of Western Australia and to attract technology investment which can be leveraged globally.
- The State Government should work with the Federal Government to cut duplication and overlap in regulatory approval regimes, working co-operatively to establish a “one-stop shop” arrangement, where overlap occurs or where both governments have jurisdiction.

