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3 September 2013

The Chairman
Economics & Industry Standing Committee
Parliament House
Perth
WA 6000

ATT: Dr Brian Gordon, Principal Research Officer

Dear Dr Gordon

INQUIRY INTO THE ECONOMIC IMPACTS OF FLOATING LIQUEFIED NATURAL GAS OPERATIONS

Please find enclosed Woodside's submission to the Economics and Industry Standing Committee inquiry into the economic implications of floating liquefied natural gas operations (FLNG).

Should you require any further information regarding this submission, please do not hesitate to contact Paula Hickey, Senior Corporate Affairs Adviser, on (08) 9348 3579.

Yours Sincerely



Roger Martin
Vice President Corporate Affairs

Attached: Woodside submission to the Inquiry into the Economic Implications of Floating Liquefied Natural Gas

Copy:



Woodside submission to the Inquiry into the Economic Implications of Floating Liquefied Natural Gas Operations

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1. Terms of Reference

Western Australian Legislative Assembly Economics and Industry Standing Committee - Inquiry into the Economic Implications of Floating Liquefied Natural Gas Operations

The Committee will identify the manner in which the use of floating liquefied natural gas operations will impact upon the following sectors of the Western Australian economy:

- Engineering and design;
- Fabrication and manufacturing;
- Construction and ancillary services; and
- Domestic gas supply and industrial gas users.

The Committee will also identify the extent to which the use of floating liquefied natural gas operations will impact upon state revenue in Western Australia.

2. Key Points

Floating LNG (FLNG) technology has the ability to become an important part of the suite of development options available to the Australian and international LNG industry. It has the potential to unlock new energy resources around the globe and serve as a complementary development option to traditional onshore LNG facilities.

Woodside has confidence in FLNG technology and views it as a feasible development option for future LNG developments. Once it has been fully established in the marketplace FLNG technology has substantial growth potential and may keep Australia, and in particular Western Australia, at the forefront of the global oil and gas industry.

FLNG comprises long-standing and proven technology on a floating facility. FLNG carries strong economic appeal and allows companies to phase capital expenditure on large developments.

Woodside believes the adoption of new technologies provides opportunities for additional private or public investment in the development of complementary strategically located infrastructure (i.e. LNG receiving terminals, marine and supply base facilities and injection points) that facilitates both state and national economic growth.

Woodside believes the public conversation should focus now on how Australia embraces this new FLNG technology, the benefits that flow from this new technology, and ensure policy settings permit the LNG industry to remain competitive and sustainable.

A Browse FLNG development has the potential to make a significant contribution to Western Australia and the broader Australian economy and would provide enduring local content and employment opportunities.

FLNG technology has substantial growth potential. For this opportunity to be realised, it is critical that industry, Government and educational institutions work together to set the priorities and policies with regards to FLNG technology. If effective, Western Australia could be positioned as an industrial, operational and technology hub for FLNG through an Oil and Gas Industry Innovation Partnership.

Woodside recognises the importance of energy security in Australia and governments' objectives to ensure security of supply and support projects to reach commercialisation. WA's Independent Market Operator identifies there is an adequate supply of domestic gas in the WA market and current developments are expected to broaden the sources of supply for the domestic market.

3. Introduction

Woodside welcomes the opportunity to make this submission to the Western Australian Legislative Assembly Economics and Industry Standing Committee's *Inquiry into the Economic Implications of Floating Liquefied Natural Gas Operations*.

The dynamic nature of the domestic and international LNG industry means that governments (both State and Commonwealth) and industry must consistently review approaches to resource development and policy settings that facilitate the timely development of petroleum resources for the benefit of the Australian and Western Australian economy.

Woodside considers that FLNG provides an innovative option for Australia's LNG industry to commercialise offshore fields in what is an increasingly competitive global environment. Innovations, like FLNG, provide an opportunity for a number of offshore fields to reach commercialisation and this technology has the ability to become an important part of the suite of development options available to the Australian and international LNG industry.

This submission provides general comment on FLNG technology, based on Shell's FLNG technology and Woodside's offshore development expertise referencing the proposed Browse LNG Development as a case study.

Browse LNG Development – Background

Woodside is the major equity holder and operator of the Browse Joint Venture¹, which aims to commercialise the Venture's three gas and condensate fields in the Browse Basin which lies in the Indian Ocean, 425 km north of Broome in Western Australia.

The Browse Joint Venture is currently considering the potential for the Browse gas fields to be commercialised utilising Shell's FLNG technology and Woodside's offshore development expertise.

The Browse fields, which were discovered between 1971 and 2000, contain a combined contingent resource of about 15.9 trillion cubic feet of dry gas and 436 million barrels of condensate.

Covering the Brecknock, Calliance and Torosa gas fields, the Browse JV holds seven petroleum retention leases under the *Offshore Petroleum and Greenhouse Gas Storage Act 2006* (Cth) (OPGGSA), the *Petroleum (Submerged Lands) Act 1982* (WA) and the *Petroleum and Geothermal Energy Resources Act 1967* (WA).

Five of the leases (WA-28-R, WA-29-R, WA-30-R, WA-31-R, WA-32-R) sit in Commonwealth waters. Two leases (TR/5 and R2) covering part of the Torosa field are governed by the State.

Woodside, as Operator of the Browse Joint Venture, undertook a material work program which included undertaking Basis of Design (BOD) in 2010 and Front End Engineering and Design (FEED) in 2011/12. In April 2012, the Browse Joint Venture was granted a variation to the conditions of the retention leases which required it to be in a position to take a final investment decision in 1H 2013.

By March 2013, the Browse Joint Venture completed the technical and commercial evaluation of the James Price Point development concept. Following this evaluation Woodside announced that the James Price Point development concept did not meet the company's commercial requirements for a positive Final Investment Decision (FID).

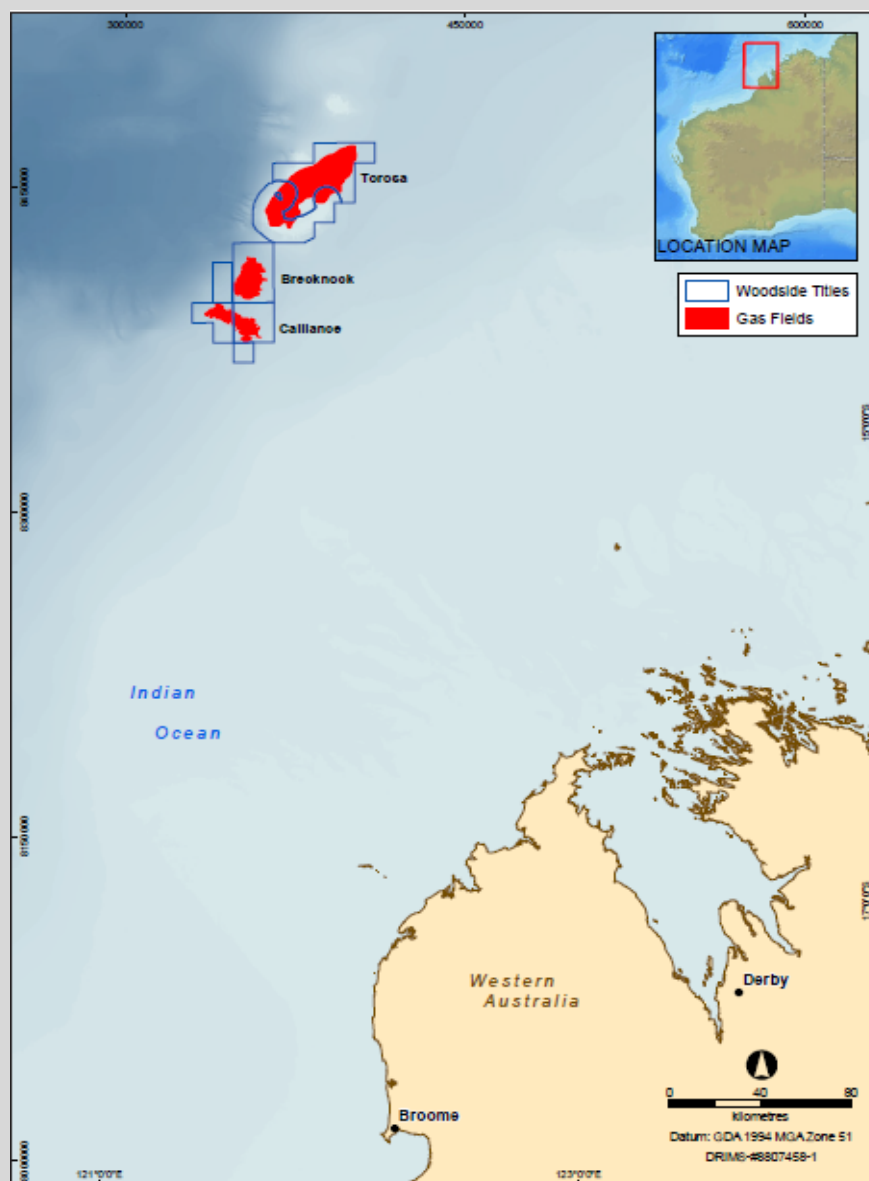
¹ Joint Venture Partners include: Woodside (operator); Shell Development (Australia) Pty Ltd; BP Developments Australia Pty Ltd; Japan Australia LNG (MIMI Browse) Pty Ltd; PetroChina International Investment (Australia) Pty Ltd

Woodside subsequently announced in April 2013 that it had entered into an agreement with Shell that set out the key principles that would apply in the event the Browse resources were developed using Shell's floating LNG technology. The agreement provided a framework that would enable the Browse Joint Venture to progress FLNG as a development concept, with Woodside remaining as Operator, and subject to the approval of the Browse Joint Venture.

On 20 August 2013, Woodside announced to the Australian Stock Exchange that Woodside Energy Limited, as operator of the Browse Joint Venture, was recommending the Browse Joint Venture use floating LNG technology as the development concept to commercialise the three Browse gas fields.

This concept would involve using Shell's FLNG technology and Woodside's offshore development expertise. Given the combined size of the three Browse fields, Woodside is proposing a phased development involving three FLNG facilities. On 2 September 2013, the Browse Joint Venture selected FLNG as the development concept to progress through to the Basis of Design phase.

Figure 1: Browse Joint Venture - Browse Basin Gas Fields



Source: Woodside website

4. About Woodside

Woodside is Australia's largest independent oil and gas company with a proud history of safe and reliable operations spanning many decades.

As the largest operator of oil and gas in Australia, Woodside produces around 900,000 barrels of oil equivalent each day, predominantly from a portfolio of facilities which we operate on behalf of some of the world's major oil and gas companies.

We have been operating our landmark Australian project, the North West Shelf Project, for 29 years, and it remains one of the world's premier liquefied natural gas (LNG) facilities. During this time the NWS Project has also maintained a reliable supply of domestic gas for Western Australia and continues to supply approximately 55% of the State's domestic gas supplies.

With the successful start-up of the Pluto LNG Plant in 2012, Woodside now operates six of the seven operating LNG processing trains in Australia, helping to meet the demand for cleaner energy from our pipeline customers in Australia and LNG customers in the Asia Pacific region and beyond.

Woodside also operates four floating production storage and offloading (FPSO) vessels for oil projects in the Exmouth Basin, North West Shelf and Timor Sea.

In regard to Woodside's LNG growth projects, Woodside has recommended the Browse Joint Venture progress to the Basis of Design phase using floating LNG technology (FLNG) as the development concept to commercialise the Browse resource. Engagement also continues with both the Australian and Timor-Leste governments on the Sunrise LNG development located 150 km south-east of Timor Leste.

Woodside's international assets also include deepwater production facilities in the Gulf of Mexico plus acreage in the USA, Brazil, Peru, Republic of Korea and the Canary Islands.

In 2012 Woodside expanded its international presence through conditional agreements to take equity in the Leviathan gas field in offshore Israel and exploration acreage in offshore Myanmar. In 2013, Woodside also had two separate offers accepted to farm-in to offshore blocks located in the prospective Porcupine Basin off Ireland.

5. State of the LNG Industry

Introduction

Participants in the global LNG industry operate in a highly competitive and dynamic environment. This challenging environment reinforces the imperative for the Australian industry to focus on technological advances, cost management, growing its reputation as a reliable supplier and developing human capacity. Without constant focus on keeping at the forefront of the global industry, Australia runs the risk of ceasing to be competitive.

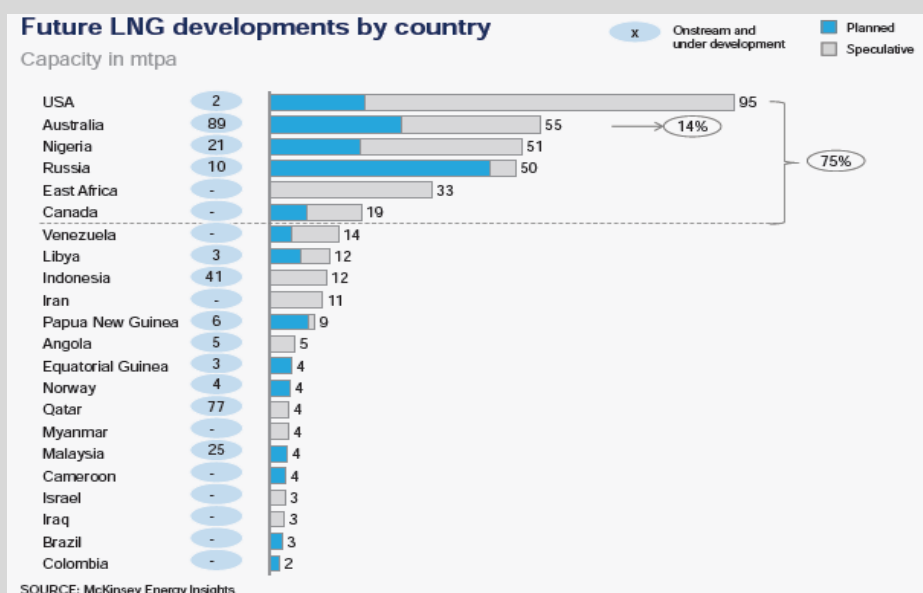
The global LNG industry

Currently there are 38 operating LNG projects in the world, with twelve projects under construction (seven in Australia).² The projects currently under construction include two FLNG projects, Prelude and a smaller Malaysian development; the first conversion of a re-gasification terminal in the Gulf of Mexico that will be supplied by U.S. pipeline gas; and three projects on Curtis Island in Gladstone, Queensland, which will be supplied by coal seam methane (CSM).

Beyond the currently sanctioned projects, there are many new projects in development, not all of which will proceed. New and emerging supply regions are expected to play an increasingly important role in global supply. The list of proposed projects includes further U.S and potentially Canadian developments underpinned by North American shale gas, as well as projects in East Africa based on offshore gas discoveries. This will potentially provide customers in the Asia Pacific region with access to an increasingly diverse range of LNG sources, adding to the competitive environment already faced by Australian LNG suppliers.

The following table illustrates the number of operating, planned and speculative LNG projects around the globe.

Figure 2: Future LNG Developments



Source: McKinsey & Co, *Extending the LNG Boom*

² Wood MacKenzie

In this constantly changing environment, the importance of maintaining a competitive edge in the Australian oil and gas industry cannot be underestimated. Woodside believes that FLNG offers such an opportunity.

Australian LNG industry

The Australian LNG industry is undergoing a period of rapid transformation with seven greenfield LNG projects under construction on the west, north and east coasts. These projects are expected to commence production over the coming six years, adding an estimated 60 million tonnes per annum (Mtpa) to the 24 Mtpa currently being produced. This will potentially mean by 2020 Australia will overtake Qatar as the largest global supplier of LNG. This is a significant achievement and one that will provide sustainable, long-term operational employment and contribute significantly to the broader Australian economy (further information on the potential benefits of LNG developments in the context of FLNG refer to section 7).

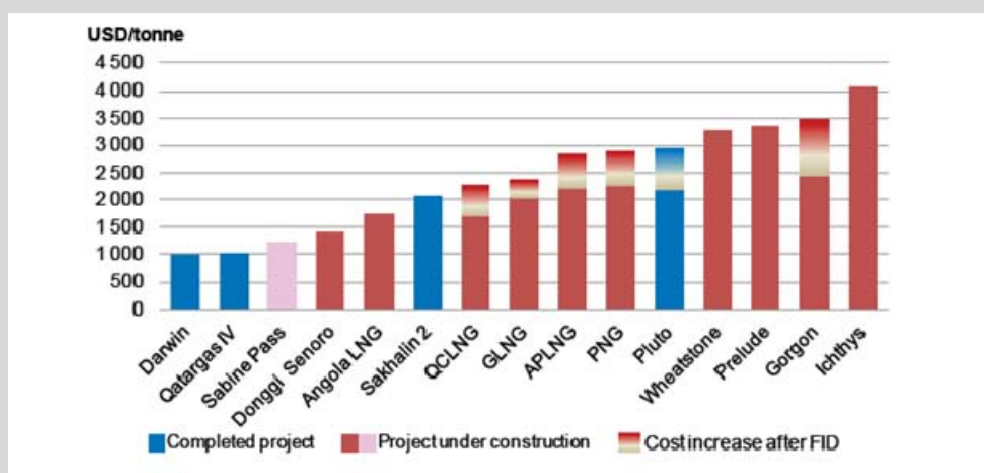
With seven greenfield LNG projects under construction, the industry is currently faced with high construction costs and a tight labour market. It is estimated that one third of these greenfield projects will face budget overruns of at least 50% and experience associated schedule delays.³

Combined with pressure from the global expansion of the industry Australia has become one of most expensive countries in the world for constructing LNG projects. A recent study by McKinsey and Company suggests that Australian developments are around 30% more expensive than comparable overseas projects⁴.

In a globally competitive environment managing the cost of supply to customers is of critical importance to ensuring the ongoing growth of the industry in Australia.

To illustrate the difference in costs between projects the table below illustrates construction costs for a range of LNG projects around the globe.

Figure 3: Construction costs (US\$ / tonne LNG) of LNG Projects



Source: International Energy Agency, Gas Medium-Term Market Report 2013⁵

³ Chatham House, *What Next for the Oil and Gas Industry?* 2012

⁴ McKinsey and Company – *Extending the LNG Boom: Improving Australian LNG* ProMay 2013

⁵ International Energy Agency, *Gas Medium-Term Market Report 2013, Market Trends and Projections 2018*. (NOTE: This table excludes operating costs.)

The previous table illustrates that capital costs of Australian projects sit at the higher end of the cost spectrum. This cost picture again emphasises the need for current and future Australian LNG projects to take advantage of opportunities for cost savings, productivity gains, and technological developments in order to remain competitive and viable.

The need to remain competitive is also forcing a thorough analysis of current and future construction methods, productivity drivers, project management methods, financing and technological options (including increased modularisation and offshore module assembly, and floating LNG technologies). This change could see brownfield expansion and FLNG forming the next growth phase of new LNG supply from Australia.

Western Australian Gas Industry

The energy industry has played and continues to play a major role in driving economic development in Western Australia.

The five train Woodside operated North West Shelf Project produces 16.3 Mtpa and the one train Pluto LNG project produces 4.3 Mtpa. The Chevron operated Gorgon project (expected to commence in 2015) will add 15.6 Mtpa via three trains and the Chevron operated Wheatstone project (expected to commence in 2016) will add 8.9 Mtpa from two trains. Combined, these projects will supply a total of 45.1 Mtpa of LNG and deliver significant benefits to Western Australia and the broader Australian economy.

As outlined by the Independent Market Operator (IMO) Gas Statement of Opportunities (GSOO), Western Australia has thirteen gas processing facilities, seven of which are operational and service the Western Australian gas market. Four of the seven operational facilities process gas from the Carnarvon Basin and the remaining three from the Perth Basin.

There are three existing major domestic gas processing facilities that service the Western Australian market including:

- The Woodside-operated North West Shelf Gas at Burrup Peninsula;
- Apache-operated Varanus Island facility located offshore from Karratha; and
- Apache-operated onshore Devil Creek facility located in the Pilbara.

For 29 years Woodside as operator of the NWS Project has supplied Western Australia with a reliable supply of domestic gas and Woodside is currently the largest supplier in the market. The majority of domestic gas is used to service the mining, manufacturing and electricity generation industries.⁶

There are three other gas processing facilities currently under construction that will support the states domestic gas market;

- BHP-Billiton operated Macedon gas development project near Onslow (first production is expected during calendar year 2013);
- Chevron-operated Gorgon project on Barrow island (first LNG cargo is due to be loaded in the first quarter 2015, with domestic gas due to be delivered to the market in 2015); and
- Chevron-operated Wheatstone project located near Onslow (first LNG expected in 2016).

This will result in Western Australia having six domestic gas producers.

⁶ The Office of Energy 2031 Strategic Energy Initiative Directions Paper, March 2011
[http://www.parliament.wa.gov.au/publications/tables/papers.nsf/displaypaper/3813100cb1e5bc616f7914cc48257855000f71a1/\\$file/3100-15.03.11.pdf](http://www.parliament.wa.gov.au/publications/tables/papers.nsf/displaypaper/3813100cb1e5bc616f7914cc48257855000f71a1/$file/3100-15.03.11.pdf)

There are two major gas transmission pipelines. These are the Dampier to Bunbury Natural Gas Pipeline (which is understood to be fully contracted⁷) and the Goldfields Gas Pipeline, linking the northern gas processing plants to southern markets.

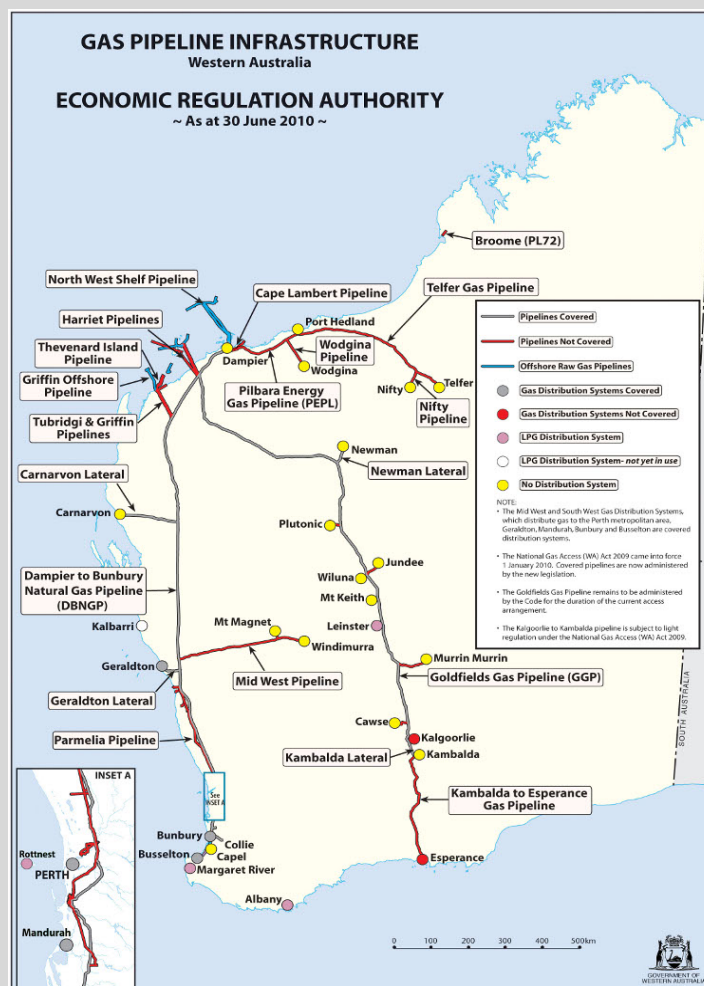
Smaller gas transmission pipelines include the Parmelia, Mid West, Pilbara, Telfer and Kambalda-Esperance pipelines. Natural gas distribution networks serving small-use customers also exist in the Geraldton area, the Perth, Peel, Busselton corridor, Kalgoorlie and Esperance, with Albany and Margaret River being serviced by distribution networks reticulating liquefied petroleum gas (LPG).

The Dampier to Bunbury Natural Gas Pipeline, the Goldfields Gas Pipeline and the Western Australia Gas Networks Distribution System are governed by the National Gas Law and access is regulated by the Economic Regulation Authority. Western Australia's entire existing gas network infrastructure is privately owned.

There is one gas storage facility in Western Australia, the Mondarra underground gas storage facility near Dongara (connects with both the Parmelia Gas Pipeline and the Dampier to Bunbury Natural Gas Pipeline). There are no LNG receiving terminals in Western Australia.

The following diagram depicts Western Australia's gas pipeline infrastructure.

Figure 4: Gas Pipeline Infrastructure – Western Australia



⁷ Dampier to Bunbury Natural Gas Pipeline website: <http://www.dbp.net.au/about-dbp/dbngp-reg-framework.aspx>

6. Government Policies

Western Australian Government

Strategic Energy Initiative

The *Strategic Energy Initiative Energy 2031 – Building the Pathways for Western Australia's Energy Future* is a policy designed to develop a 20 year vision for energy in Western Australia that provides for a safe, secure, competitive and cleaner supply of energy that supports WA's population and economic growth.

The predominant energy source for the Western Australia economy is natural gas sourced from the state's North West coast. The State's primary fuel use is natural gas which powers over 60 per cent of electricity generated in Western Australia.⁸

The policy recognises that *"...the community's expectations about the reliability, affordability and sustainability of the State's energy supplies are increasing and the public expects the State Government and industry to work together toward meeting those expectations"*.⁹

The Western Australia Gas Reservation Policy requires state-based LNG producers to make available the equivalent of 15 percent of production from LNG projects for domestic use.¹⁰ [The majority of projects¹¹ offshore of Western Australia currently considering the use of FLNG are located in Commonwealth waters, under the jurisdiction of the Australian Government].

The Strategic Energy Initiative provides for a flexible approach to the domestic gas commitment on LNG producers whereby gas may be provided from other LNG projects or by providing the equivalent energy from an alternate source. The issue of commercial viability is also considered whereby the State Government may assess an LNG producer's domestic gas obligation on a case-by-case basis against commerciality criteria.

The Western Australia Gas Reservation Policy, which has maintained a level of bipartisan support from the state's major parties since its introduction, is expected to be reviewed in 2014-15.

Woodside supports the future review of the state's Gas Reservation Policy and remains committed to working with the WA government on these matters.

Independent Market Operator (IMO) – WA Gas Statement of Opportunities (GSOO)

The IMO's recently released GSOO Report indicates that in the next few years the Western Australia domestic gas market can expect to see an expansion of existing domestic gas processing facilities, the completion of new domestic gas processing facilities and LNG export facilities¹². These developments are expected to broaden the sources of supply for the domestic market in Western Australia,¹³ and there is an adequate supply in the WA market.

⁸ The Office of Energy 2031 *Strategic Energy Initiative Energy 2031 – Building the Pathways for Western Australia's Energy Future*
http://www.finance.wa.gov.au/cms/uploadedFiles/Public_Utility_Office/WAs_Energy_Future/Strategic_Energy_Initiative_Energy2031_Final_Paper.pdf

⁹ Ibid

¹⁰ Ibid

¹¹ Browse LNG project includes seven retention leases, five in commonwealth waters and two state waters

¹² Independent Market Operator – WA Gas Statement of Opportunities

http://www.imowa.com.au/f7753,4223481/GSOO_1_Report_FINAL.pdf

¹³ Ibid

The IMO's GSOO indicates that the sources of supply will diversify and there will be an oversupply of gas in the near term for the Western Australia domestic market. The key findings for the period 2013 - 2022 are as follows:

- "...there is expected to be adequate gas supply to meet forecast demand in the domestic market;
- The forecast average annual growth for WA domestic gas supply is expected to be 3.7% per annum, compared to a forecast average annual growth for domestic gas demand of 1.1% per annum;
- The gas processing capacity in the domestic market is anticipated to be double the forecast level of domestic gas demand by the end of 2022;
- 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;
- Gas demand forecasts suggest demand growth will be higher for areas located outside the South West Interconnected System (SWIS);
- Total gas demand in WA, including both LNG production (feedstock and processing) and domestic demand, is forecast to grow 8% per annum until 2022; and
- There are several medium to long-term growth challenges confronting the WA LNG market, although these are not expected to impact on the domestic natural gas sector in the forecast period, but may have an impact into the future".¹⁴

Australian Government

Many of the decisions and policies directly affecting the development of gas resources in Commonwealth waters offshore of Western Australia fall under the jurisdiction of the Australian Government.

Energy White Paper

The *Energy White Paper* (EWP) sets out the policy framework to guide the future development of Australia's energy and energy resource sectors. The policy broadly commits to deliver Australia's energy needs through competitive and well-regulated markets that operate in the long-term interests of consumers and the nation.¹⁵

Woodside supports an approach that allows open and transparent markets to operate, and which facilitates economic growth and benefits across the Australian economy on commercial terms.

The EWP recognises that Australia is a high-cost producer compared to many other potential energy suppliers and that specifically there is a requirement for further investment in domestic infrastructure to enable energy growth.¹⁶

¹⁴ Ibid

¹⁵ *Energy White Paper 2012* http://www.ret.gov.au/energy/facts/white_paper/Pages/energy_white_paper.aspx

¹⁶ Ibid

The Commonwealth and the State have both identified the importance of appropriate energy infrastructure in Western Australia in support of energy security. The EWP suggests that further development of the Western Australia gas market would benefit from, amongst other things, improved infrastructure to facilitate market development

“To increase competition, the government notes the importance of building customer numbers, increasing the liquidity of the market, improving transparency and mechanisms for trading gas, particularly on short term arrangements and adding alternative injection points and storage facilities”.

Notwithstanding the supply scenario in WA, Woodside is cognisant of the Commonwealth government’s commitment to energy security policy and the government’s objective to support projects to reach commercialisation.

FLNG – Domestic Gas Infrastructure

With the respective Commonwealth and State energy security and domestic gas policy objectives in mind, Woodside believes the public conversation should focus now on how Australia embraces this new FLNG technology, the benefits that flow from this new technology, and ensure policy settings permit the LNG industry to remain competitive and sustainable.

While there are no capabilities on the proposed FLNG facilities to process and export domestic gas for supply to existing domestic gas infrastructure, Woodside believes the adoption of new technologies provides opportunities for additional private or public investment in the development of complementary strategically located infrastructure.

For example, there is the potential for public and/or private development of LNG receiving terminals, and injection points to service the growth of FLNG developments and facilitate both state and national economic growth.

Case Study: Strategic Energy Infrastructure

Depending on the country and market, there is a wide variety of energy infrastructure in use and a variety of business models utilised to contribute to energy supply and security.

For example in Japan there are 31 LNG regasification terminals that supply gas to a range of buyers. While the terminals are generally owned and used by separate companies, a number of these terminals are now utilised by a variety of users.

In Singapore the Government supported the development of LNG import facilities to diversify supply and increase competition on the domestic gas market. The terminal may also serve to develop Singapore as an LNG trading hub.

While these markets are very different to the Western Australia context, investigating them can be useful in broadening our understanding of how other countries manage their energy supply and security.

7. Floating LNG

Over the past 18 months, Woodside has identified the cost challenges associated with operating in Australia and has renewed its focus on technology to deliver improvements and competitive advantage (a *Browse LNG Development a case study for FLNG* is included in section 7). FLNG is one such model that Woodside has been examining due to the associated benefits of utilising this technology.

There are a range of companies across the globe that are also currently considering or progressing FLNG developments, these include¹⁷:

- Shell's Prelude FLNG facility in Australia;
- Exxon operated Scarborough project in Australia;
- GDF Suez operated Bonaparte project in Australia;
- PETRONAS' project in Malaysia;
- Abadi project in Indonesia; and
- Hoegh LNG, DSME and Petromin project in Papua New Guinea.

FLNG Technology

This section includes comment on Shell's FLNG technology as well as Woodside's offshore development expertise in the context of an agreement executed in April 2013 between Woodside and Shell Developments.¹⁸

Shell's generic FLNG technology is based on their 'design one, build many' premise, where the same technology may be deployed to different locations across the globe.

Shell's Prelude FLNG Project is likely to be the world's first FLNG facility deployed in the world. The FLNG facility will be 488m long and 74m wide, weigh around 600,000 tonnes (when fully loaded), stay moored at location for 25 years and is expected to produce at least 3.6 million tonnes of LNG per year as well as liquid petroleum gas and condensate for export. The project is expected to contribute to the Western Australian and Australian economies through the creation of tax revenue, jobs and opportunities for Australian businesses.¹⁹

FLNG technology involves the placement of conventional gas liquefaction facilities or 'topsides' on a large floating structure which is then permanently moored over a gas field.

Offloading of the produced LNG is carried out in the field via side by side loading to LNG carriers, while condensate is offloaded by a traditional tandem arrangement. Ongoing operations are maintained by a crew of 130-150 technically trained operators and 250-270 ongoing maintenance personnel who are periodically complemented by a larger workforce during periods of maintenance.

¹⁷ Wood Mackenzie

¹⁸ Key Principles Agreement, April 2013

¹⁹ Shell website: <http://www.shell.com.au/aboutshell/who-we-are/shell-au/operations/upstream/prelude.html>

The application of this technology can be seen as a natural evolution in the industry, similar to the development of Floating Production Storage and Offtake (FPSO) facilities for offshore oil fields in the 1980's.

While FLNG is new to the industry, its advantage lies in the way it integrates established practices, processes and equipment on a floating facility.

FLNG draws significantly on existing technology. This includes:

- technology to store and offload products as found in the LNG shipping industry,
- technology to treat and liquefy natural gas as found in onshore plants, and
- offshore production experience, including using standardised methodologies for drilling and completions, subsea and pipelines.

Figure 5: Image of Shell's FLNG concept



Copyright of Royal Dutch Shell

Safety and Reliability

Shell has matured the health and safety aspects of FLNG over 12 years. This knowledge and approach will be initially applied to the Prelude development and then to other developments that follow.

Shells' generic FLNG technology is designed to minimise risks to the health and safety of personnel on board or working near the facility to a level comparable to other offshore oil and gas facilities.

FLNG facilities are designed to 1 in 10,000 year weather cyclones. This ensures integrity beyond the conditions of cyclones.

The FLNG design life is 50 years with a scheduled dry dock after 25 years, allowing the facilities to remain on station for the life of the project even during Category 5 cyclones.

Shell has undertaken significant consultation with regulators and associated stakeholders since 2008 and environmental approvals and a Design Safety Case are in place for the FLNG technology.

The design objectives of FLNG technology are standardised, robust, cost efficient and have a focus on high availability to enable continuous and stable LNG supply. Shell included the following approach to the FLNG design:

- General Layout – Accommodation is located at the back of the facility and the flare is at the front which provides the lowest overall risk. Quantitative Risk Assessments were repeatedly conducted at successive design stages to validate this arrangement;
- The type of equipment chosen and its placement on the trains effectively increases the safety of the facility e.g. utility modules provide around 100m separation between the accommodation and the first hydrocarbon processing modules.
- The effect of motion, both of the FLNG and LNG carrier were repeatedly tested through all design phases. Testing used actual metocean conditions in basin model tests and a full-scale rig was used to test new coupling features being the only additions on an otherwise conventional loading arm design.

Offshore development

Consideration of an LNG development using floating technology has been supported by Woodside's experience in offshore development.

Woodside has extensive expertise in subsea development as well as within floating production of our oil assets. This expertise will be utilised in the future consideration of LNG developments that utilise floating technology.

Woodside operates an extensive network of subsea and pipeline infrastructure in Australian waters. Woodside has installed more than 1000 km of pipelines, designed to withstand extreme conditions including cyclonic waves and currents. Woodside also installed 134 km of flexible flowlines and 30 flexible risers attached to our floating production storage and offloading (FPSO) vessels. Woodside currently operates four FPSO vessels and has a track record of efficiently and safely producing from our fields, delivering infill opportunities and pursuing exploration and development opportunities.

Permanent mooring

As outlined earlier Shell has designed the FLNG facility and its mooring to withstand a 1 in 10,000 year weather event, and to remain on-station during the biggest cyclone events.

Generally the turret will consist of 4 bundles of 6 mooring lines anchored to the seafloor. Combined, these mooring lines will weigh approximately 24,000 tonnes. The system allows the facility to weather vane, or turn in the wind while remaining on station over the gas field.

This innovative mooring technology saves valuable production days that would otherwise be lost on disconnecting the facility and moving it off the field.

Production reliability

The design of the generic FLNG facility allows reliability to be enhanced by the close proximity of the facility to the subsea wells. Production reliability is maximised through the facility permanently staying on station, even during heavy weather.

Product offloading

Safe and efficient product offloading of both condensate and LNG is a critical part of generic FLNG facility operations to ensure products are supplied on time to customers, and that facility uptime is maximised.

A combination of in-field support vessels (ISVs) and FLNG facility thrusters are required to orientate the facility to allow the LNG carriers to come alongside and connect for offloading.

The side-by-side rigid loading arms are proven technology for the onshore oil and gas industry however as with other elements of a FLNG facility this is a new application in an offshore environment.

For new FLNG developments, and in line with Prelude, the side-by-side offloading arrangement will be subjected to extensive new technology qualification including, but not limited to:

- Scaled model testing;
- Analyses to simulate motions of FLNG facility and LNG carrier in various environmental conditions;
- Failure analysis (e.g. clash, load, fatigue) of loading arms;
- Offloading monitoring system (weather, metocean) and governing procedures for offloading activities; and
- Emergency Release Couplings (ERC) on the loading arms which release at a predetermined tension preventing significant damage to offloading arms / hose.

8. Opportunities from FLNG

Employment

An FLNG facility will require approximately 350 personnel in steady state operations (across two shifts on a rotating basis). This is comparable to a traditional onshore LNG plant in its operational phase.

During periods of major maintenance up to an additional 250-270 will be required per facility. Noting that maintenance for an FLNG facility is more regular when compared to a traditional LNG plant, this approach will generate ongoing employment throughout the life of the field.

Personnel on board during normal operations will consist of highly trained LNG operators and maintainers, engineers, management, as well as facility maintenance personnel (cleaners, cooks etc).

Through FLNG developments, Australia has a unique opportunity to generate sustainable, long-term employment on a technologically advanced facility. In order to maximise this opportunity, collaboration between governments and industry is required to ensure that government policy and project planning is aligned and the appropriate training and education structures are in place.

Woodside believes the debate that has surfaced in the media about “lost” jobs on the Browse FLNG project is somewhat misleading. There are no jobs if a project is unable to be commercialised. Potentially, Browse FLNG provides many hundreds of jobs over a long period for WA, and tens of billions of dollars of revenue for state and federal governments.

Australian Venture Consultants in a recent study on the economic benefits of oil and gas projects, indicated that “the focus should be on the very significant benefits that accrue over the life of the projects which is between 25-50 years at a minimum and likely longer as the projects expand”, and focus ought not only be on the benefits during the construction phase, which is a significantly shorter time frame, usually several years.²⁰

Woodside’s approach to local content

Woodside has a strong track record of providing full and fair opportunity to Australian suppliers. Woodside will continue to work closely with Government through the Industry Capability Network Western Australia on each of our projects, to identify contract packages that match local industry for the different phases of our developments.

An example of our approach to local content can be demonstrated by Woodside Pluto LNG Plant, where about 80% of all operational expenditure is sourced in Australia. This involves gas extraction and processing services, as well as transport and marine loading and servicing for offshore infrastructure.

With respect to FLNG, and based on the proposed Prelude FLNG development, approximately \$12 billion is expected to be spent on Australian goods and services.²¹ This represents a significant footprint and benefits for both the Western Australian and the broader Australian economy.

Woodside also continues to participate in State and Commonwealth Government initiatives that aim to strengthen participation by Australian businesses in the construction and operations phases of resource projects (e.g. Australian Industry Participation Plans).

²⁰ Australian Venture Consultants, “*The Economic Benefits of Oil & Gas in WA - a selection of case studies*”, p11

²¹ IBID p.40

Onshore Infrastructure

FLNG facilities require onshore infrastructure and logistics support during both installation and operations phases, which will lead to ongoing employment and contracting opportunities.

An offshore FLNG facility will require significant onshore supply facilities to maintain safe and efficient production.

Supply base requirements will include:

- Access to marine support and materials supply base;
- Access to helicopter aviation base for crew transfers and other aviation requirements;
- Some onshore accommodation to support FLNG crew rotations and transfers; and
- Logistics support vessels to transfer goods and materials to the facility(s).
- Dedicated infield support and supply vessels for operations including:
 - Permanent standby vessels at the FLNG facility(s); and
 - Vessels for supply and removal of materials, equipment and consumables.

Developing Competitive Advantage for Western Australia

In any new technology, early operational knowhow is extremely valuable and FLNG is no exception.

Once it has been fully established in the marketplace FLNG technology has substantial growth potential. For this opportunity to be realised, it is critical that industry, Government and educational institutions work together to set the priorities and policies with regards to FLNG technology. If effective, Western Australia could be positioned as an industrial, operational and technology hub for FLNG.

Industry Innovation Partnership

Woodside has led a proposal on behalf of industry to create an Oil and Gas Industry Innovation Partnership (OGIIP) under the Commonwealth Government's industry program²². The OGIIP will receive \$16 million to establish the partnership, with a further \$4 million per annum for ongoing operations. The OGIIP will be headquartered in Perth with several interstate node offices, and governed by a six member board, equally represented by industry, subject matter experts and universities.

The OGIIP currently has 45 Core Partners and over 250 small to medium enterprises and research organisations have expressed their support to date. Core Partners will participate in Precinct activities and make a technology, local content or supply chain liaison available. In addition to the funding support announced by the Commonwealth, the Innovation Precinct enjoys in principle support of the WA government, through the Minister for Commerce (Attachment 1).

²² *A Plan for Australian Jobs*

The Precinct will initially focus on seven areas where wide collaboration creates a dividend:

- **Improve Construction Productivity** – Lower costs and risks by streamlining the supply chain, improving work practices and utilising the latest technologies to eliminate waste.
- **Gas Developments** – Design, maintenance and operations capabilities around floating LNG technology to capture advantage for Australia in this new technology area. Develop data and expertise in coal seam gas, shale gas and other unconventional gas that could be double the offshore resource. Build expertise and assess competitiveness for gas-to-liquids.
- **Computational Geosciences** – Leverage the Pawsey Supercomputing centre and advanced computing methods to improve the acquisition and processing of geo-data.
- **Subsea Production Technologies** – Create a skill base and infrastructure for Subsea Technologies to be developed on local projects and exploited for growth across the globe.
- **Remote Plant Operation** – Build capability and technologies for remote plant operation. Work together with ACEPT to create highly skilled and information centric jobs in a Western Australian global operations hub.
- **Cooperative Business and Safety Practices** – Standardise contracts, pre-qualifications, safety and environmental systems. Lay the groundwork for shared infrastructure on remote projects. Collaborate on process safety, human and organisational factors and reliability engineering to prevent major accidents.
- **Social Impact of Oil and Gas** – Understand the social impact of the industry. Utilise advanced analytics and communications technologies to improve industry reach. Develop geosequestration as a mechanism to improve environmental sustainability.

The following case study provides an example from the oil and gas sector in Norway. The case study describes how the organisations assisted the sector, improved local employment and content, leveraged and created innovation and reduced transaction costs.

Case Study: National Centre of Excellence Subsea (NCE) Norway

Innovation Norway set up NCE in 2006 to build capability in subsea maintenance, modification and operation. It was established in Bergen, the home of a cluster of subsea companies. By 2008 it had 100 members from business, education and research organizations. NCE Subsea builds the sector's presence in international markets, promotes R&D projects, facilitates education and training, and encourages cooperation. It is funded by Innovation Norway, Research Council of Norway and the Industrial Development Corp. of Norway (Siva). Employment in member companies rose from 2,500 in 2004 to 4,600 in 2008 and aggregate turnover increased by 255% in the same period. NCE Subsea facilitated 50 joint industry projects (JIP) and raised \$80 million in its first two years of operation for JIP and R&D activities. Demand for research projects is mostly from the industry. As an example, ClampOn is developing a subsea corrosion/erosion monitor as a joint project with BP and Innovation Norway.²³

²³ Terdre, N. (2008), Bergen – Norway's center of advanced subsea engineering, Offshore Magazine, Volume 70, Issue 8

Community development and social investment

Woodside recognises that long-term and meaningful relationships with the communities in which Woodside operates are fundamental to maintaining the company's licence to operate. The focus of Woodside's community engagement and social investment program is to create strong partnerships that make a real contribution to the vitality, capacity and capability of communities.

Woodside works with Indigenous communities to create a sustainable future through employment, business participation and social investment initiatives. This work is guided by our Reconciliation Action Plan.

Since 1984, Woodside as operator of the North West Shelf Project, along with the North West Shelf Project participants, has made significant investments of over \$300 million in roads, housing, health services, and education in the Pilbara region. Over the last five years the North West Shelf and Pluto LNG Projects have invested \$14 million in community infrastructure projects in Karratha.

Since 2006, Woodside and the Browse Joint Venture invested more than \$2.9 million in communities in the West Kimberley through its social investment program. Under the new development concept proposed for the Browse development, social investment programs will continue be part of the Browse FLNG proposal.

Case Study: Browse LNG Development – Case study for FLNG

A Browse FLNG Development has the potential to make a significant contribution to Western Australia and the broader Australian economy and would provide enduring local content and employment opportunities.

FLNG Technology

On 2 September 2013, the Browse Joint Venturers selected the use of floating LNG (FLNG) technology as the development concept to commercialise the three Browse gas fields. This concept involves using Shell's FLNG technology and Woodside's offshore development expertise for the Browse LNG Development.

The Basis of Design (BOD) phase will determine the major design parameters for the front end engineering and design (FEED) of the subsea, FLNG and associated infrastructure, based on the phased construction of three floating facilities at the Brecknock, Calliance and Torosa gas fields.

The BOD phase will be executed by Woodside, as Operator of the Browse Joint Venture, with support from Shell as the FLNG technology provider.

The facilities will be based on Shell's Prelude FLNG facility design, with changes only made to accommodate field specific conditions, consistent with the Shell FLNG "*Design One Build Many*" philosophy. Each facility will comprise of a large ship-shaped hull approximately 488 metres long, 74 metres wide and 44 metres deep.

Local Content and Employment

Woodside is committed to providing full, fair and reasonable opportunities for local industry to contribute to its activities and to maximise local industry participation where it is capable and competitive on the basis of health, safety, environment, quality, cost and delivery.

Local industry capability will ultimately determine the level of local content on the Browse FLNG Development.

During the BOD of the Browse LNG Development, Woodside intends to undertake the necessary scoping activities to assess the logistics services and supply chain opportunities that will be created by the development and how they can best be delivered. These opportunities will be in the operations phase of the development and may include:

- Technical services
- Facility repair and maintenance
- Marine support services
- Aviation services
- Domestic services

Woodside, as Operator, will submit an Australian Industry Participation Plan for the development to the Federal Government in accordance with the requirements of the requirements of the Australian Jobs Act (2013).

An FLNG facility will require approximately 350 personnel in steady state operations (across two shifts on a rotating basis). This is comparable to a traditional onshore LNG plant in its operational phase. Based on a three facility scenario for the Browse FLNG Development, this equates to approximately 1050 personnel directly employed on these facilities.

Additional personnel will be employed in onshore roles providing supply base, logistics, marine and aviation support services.

During periods of major maintenance up to an additional 250-270 will be required per facility. Noting that maintenance for an FLNG facility is more regular when compared to a traditional LNG plant, this approach will generate ongoing employment throughout the life of the field.

Economic Impact and Multiplier Effect

The Browse FLNG Development has the potential to deliver a positive economic impact and enable a multiplier effect of benefits to flow-on to Western Australia and the broader Australian economy.

An economic assessment undertaken by ACIL Allen Consultants for Woodside estimates real income²⁴ benefits for Western Australia from the proposed Browse FLNG Development could amount to about A\$22 billion over the life of the project.²⁵

ACIL Allen also estimates the Browse FLNG Development could increase Australia's Gross Domestic Product (GDP) by approximately A\$82 billion (in present value terms) over the life of the project.

Significant revenue from the project would flow to both State and Commonwealth governments during the operations of the Browse FLNG Development.

ACIL Allen estimates that State revenue from payroll tax, royalties and WA originated GST will amount to approximately A\$1.6 billion over the life of the project. Commonwealth revenue is estimated to be approximately A\$102 billion which includes PRRT, company and other taxes.

²⁴ Real income provides an indication of changes in economic welfare of the state's economy. It measures the income available to the state for final consumption and saving. Real income equals GDP:

- plus the trading gain or loss resulting from changes in terms of trade;
- plus real primary incomes receivable from abroad; minus real primary incomes payable abroad;
- plus real current transfers receivable from abroad; minus real current transfers payable abroad.

²⁵ Life of project assumption = approximately 40 years

9. Attachments



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ATTORNEY GENERAL; MINISTER FOR COMMERCE

Our Ref: 44-05610

Senator the Hon Kim Carr
Minister for Industry, Science, Innovation and Research
PO Box 6022
House of Representatives
Parliament House
CANBERRA ACT 2600

Dear Minister

WESTERN AUSTRALIAN PARTICIPATION IN THE INDUSTRY INNOVATION PRECINCT PROGRAM

I would like to inform you that Woodside Energy, with its headquarters in Western Australia, is leading an industry consortium which includes Chevron, Shell and other industry and research partners, in submitting an application for an Oil and Gas Industry Innovation Precinct, under the Australian Government's Industry Innovation Precinct program.

Woodside has advised me that the Precinct's Perth hub would leverage a national network that focuses collaborative efforts on an industry-wide strategic agenda, to improve productivity and competitiveness. Building on Western Australia's position as Australia's primary Liquefied Natural Gas (LNG) and crude oil producer, the Precinct would drive a national growth strategy that should triple the number of jobs, and potentially increase export earnings in the five-year term of the program, from \$12 billion in 2012 to \$61 billion by 2018.

The Oil and Gas Precinct would initially focus on the following areas where wide collaboration creates a dividend:

- Improve Construction Productivity – Lower costs and risks by streamlining the supply chain, improving work practices and utilising the latest technologies to eliminate waste.
- Gas Developments – Create design, maintenance and operations capabilities around floating LNG technology to capture advantage for Australia in this new technology area.
- Computational Geosciences – Capitalise on Western Australia's high performance computing facilities (Pawsey Centre) and advanced computing methods to improve the acquisition and processing of geo-data.
- Subsea Production Technologies – Create a skill base and infrastructure for Subsea Technologies to be developed on local projects and exploited for growth across the globe.
- Remote Plant Operation – Build capability and technologies for remote plant operation. Create highly skilled and information centric jobs in an Australian central operations hub.

.../2

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- Cooperative Business Practices – Develop local supply chains. Standardise contracts, pre-qualifications, safety and environmental systems. Lay the groundwork for shared infrastructure on remote projects. Collaborate on safety, human and organisational factors and reliability engineering to prevent major accidents.
- Sustainability – Enable mutually beneficial co-existence. Understand socioeconomic and environmental impacts. Utilise advanced analytics and communications technologies to improve outreach to industry. Develop geosequestration to improve environmental sustainability.

The State Government's infrastructure and capability would also contribute to and support the Precinct activity, including the Australian Marine Complex (AMC), the Pawsey High Performance Computing Centre and the Innovation Centre of WA.

We are already seeing strong support by industry for the proposed Precinct's focus areas which, if continued, will ensure it has the maximum opportunity to succeed and achieve long term sustainability. I encourage you to consider the benefits that this proposed Precinct can realise for this significant aspect of the economy.

Your sincerely



Hon. Michael Mischin MLC
ATTORNEY GENERAL; MINISTER FOR COMMERCE

cc: Mr John Grills, Chairman - National Precinct Selection Board, Department of Industry, Innovation, Climate Change, Science, Research and Tertiary Education ✓

23 JUL 2013



ASX Announcement

Tuesday, 20 August 2013

Woodside Petroleum Ltd.
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WOODSIDE RECOMMENDS FLOATING LNG FOR BROWSE

Woodside has resolved to recommend the Browse Joint Venture participants use floating LNG (FLNG) technology as the development concept to commercialise the three Browse gas fields.

This concept would involve using Shell's FLNG technology and Woodside's offshore development expertise for the Browse LNG Development.

The selection of FLNG as the development concept requires the approval of the Browse Joint Venture participants before progressing through to the Basis of Design phase.

Woodside's decision follows the evaluation of alternative development concepts for Browse after the announcement in April this year not to proceed with the onshore development at James Price Point.

Other development concepts considered included a pipeline to existing facilities in the Pilbara and a modified option in the Kimberley.

Woodside CEO Peter Coleman said it was pleasing that Woodside had been able to complete the evaluation of alternative development concepts quickly.

"Through this review, a compelling case has emerged for floating LNG as the best option for early commercialisation of the world-class Browse resource," Mr Coleman said.

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ASX Announcement

Monday, 2 September 2013

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BROWSE JOINT VENTURE SELECTS FLOATING LNG AS BASIS OF DESIGN

Further to Woodside's announcement on 20 August 2013, the company advises that the Browse Joint Venture participants have selected the use of floating LNG (FLNG) technology as the development concept to commercialise the three Browse gas fields.

This concept involves using Shell's FLNG technology and Woodside's offshore development expertise for the Browse LNG Development. The Browse Joint Venture participants have agreed to progress Basis of Design (BOD) work in relation to the selected development concept.

The BOD phase will determine the major design parameters for Front End Engineering and Design (FEED) of the proposed subsea and FLNG facilities and associated infrastructure.

The BOD phase will be executed by Woodside as operator of the Browse Joint Venture, with support from Shell as the FLNG technology provider, to enable the optimal development of the Browse resources.

Work will commence immediately to undertake all of the necessary studies and work required to place the Browse Joint Venture participants in a position to consider the commencement of FEED for the selected development concept in 2014.

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