Australian Natural Gas Developments in a Global Context

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Overview

- Australia currently has three geographically and economically separate natural gas markets: the Eastern, Western and Northern gas markets.

- The pipeline systems linking producing and consuming areas in the larger Eastern and Western gas markets are subject to access regimes.
  - The Eastern market is served by an electronic Bulletin Board system to facilitate trade in gas and capacity over the system.
  - Provision has been made to extend the National Bulletin Board system to the Northern and Western markets, with the Northern market likely to be linked in first.

- Between 1980 and 2010, Australia’s economic demonstrated resources (EDR) of conventional gas increased at an average rate of 9 per cent a year.

- Between 2000 and 2010, Australia’s EDR of CBM (called CSG in Australia) increased at an average annual rate of 56 per cent.

- Commercial production from shale commenced in the Cooper Basin in September, 2012.
  - Geoscience Australia estimates the shale gas resources in Australia ultimately will substantially exceed the CBM and conventional resources.

- Long run prospects for LNG exports are good, and large projects are under construction, but cost increases and market opportunities will constrain medium term development.
Australian natural gas resource potential

Western Australia estimated Resource Potential\(^1,2\)

Eastern Australia estimated Resource Potential\(^3\)

1 Source: BREE 2012 Gas Resource Assessment, 2012
2 Source: EIA World Shale Gas Resources, 2011
3 Source: AEMO 2012 GS00
Australian natural gas pipeline network

Source: Australian National Bulletin Board
Shale gas in the Cooper Basin

- The Cooper Basin resources have access to existing major domestic and, after completion of the Gladstone liquefaction terminals, international markets.
- Cooper shales are very similar to the Haynesville and Barnett shales in the US.
- There is an extensive subsurface data set as a result of more than 50 years of operation, including over 940 km$^2$ of 3D seismic.
- Almost 300 wells have been drilled through the Roseneath, Epsilon, and Murteree (REM) shales, resulting in more than 1,200 meters of cores.
- More than 700 wells have been fracture stimulated in the Cooper Basin to date.
- Rigs to drill horizontally are in place and working in the Basin.
- Although Cooper Creek passes through the basin, this is semi-desert country and the Cooper flows only in La Niña years; water is available from the Great Artesian Basin (see map), which is separated from the target zone by impermeable layers.
- Other land use in the Basin is non-competitive with oil & gas production, while companies already have working relationships with pastoral leaseholders and traditional land owners.
- Traditionally, gas flowed from Moomba to Wallumbilla, was reversed as CBM was developed for LNG export, and may reverse again to support Gladstone LNG export.
Australian Great Artesian Basin
More detail on Cooper shale resources

- REM thickness 350-400m
- REM, Toolachee, Daralingie, and Patchawarra are all gas saturated
- The shale formations are laterally continuous with thickness of individual shale units \(\approx 70\) m
- TOC ranges 2-4% in Roseneath, Murteree and up to 7% in Epsilon
- The central Napamerri Trough is over-pressured relative to depth and regional trend
- Potential for additional 600 m of gas saturation in the Patchawarra formation – Beach has best flows to date from this layer in the Moonta-1 well with 9 fracture stages
- Silica and siderite content make the shales brittle and they, and the tight sands, have been shown to respond to fracture stimulation – one vertical well up to 4.5 MMscf/d
Domestic demand for natural gas

- Domestic consumption 36 bcm in 2009-10, increasing at 6%pa over past 5 years
- Demand growth in power generation, but also in mining (including liquefaction)
- In 2010-11, natural gas was the energy source for 19% of Australia’s electricity generation (coal 68%, hydro 7%, wind 2%, other 3%)
- From October 2008-2011, 4.28 GW of gas-fired capacity added. In 2012, added:
  - A 550MW open cycle station in SW Vic partly to complement new wind farms
  - 200MW of additional high efficiency gas turbine capacity at Kwinana in WA
  - 120 MW of gas turbines at Weddell in the NT
- Projects at an advanced stage of development:
  - In 2013: 3rd turbine of 43MW at Weddell, and 53 MW gas plant at McArthur River, both in NT
  - In 2014: Diamantina 242MW CCGT at Mt Isa in Qld
  - In 2014: Yarnima 190MW CCGT in the Pilbara, WA
- Other gas-fired projects in planning include 12 in NSW, 7 in Qld, 2 in SA, 6 in Vic and 4 in WA, amounting to more than 15.2 GW of capacity. This compares to 14.7 GW of wind in planning, 3 GWs of coal and 1 GW of solar are also planned.
- Since 2010, over $3.8 billion in pipeline investment projects have been completed, are under construction or have been announced
Other domestic market issues

- As in North America, Australia has many small independent gas producers, many of which have been instrumental in developing CBM and lately shale gas resources.
- Major domestic consuming firms (electricity generators and LDCs) have increased their interest in the upstream gas industry.
- The AEMO is developing a market in pipeline capacity allowing industry participants to buy or sell gas and transmission capacity up to 4 weeks ahead of time.
- Wallumbilla in Qld is being developed as a liquid trading hub for Eastern Australia.
- The AEMO also issues a Gas Statement of Opportunities to facilitate planning and development of the Eastern Australia integrated gas market.
- In WA, the government has a domestic gas reservation policy whereby LNG project proponents must reserve up to 15% (amount subject to negotiation) of production for supply to the domestic market.
  - The obligation can be fulfilled by contracting with other smaller on-shore developers.
  - WA parliament has indicated in a bipartisan committee report that the government would abandon the policy if a more transparent wholesale gas market develops in WA.
BREE estimated Australian gas balance

Source: BREE Gas Market Report 2012
LNG projects: operating or in-construction

Source: BREE Resources and Energy Major Projects List, April 2013
Projects operating or under construction

- Projects in blue are in WA, those in yellow in the NT and those in green in Qld
- Comparing these projects with the Gas Market Report (GMR) export forecast:
  - GMR exports of around 1800 PJ in 2014–15 match capacity of 1800 in 2014
  - GMR exports in 2015–16 are 2800 PJ, while 2015 projected capacity is 3050 PJ
  - GMR exports in 2016–17 are 3100 PJ while 2016 projected capacity is 4068 PJ
  - GMR exports in 2018–19 are 3700 PJ while 2017-18 projected capacity is 5398 PJ suggesting further delays in project completion
- Major developers are:
  - BG (formerly QGC) for QCLNG
  - Chevron for Gorgon (with Shell, ExxonMobil) and Wheatstone (with Apache, TEPCO, KUFPEC)
  - Santos (with Petronas, Total, Kogas) for GLNG
  - Shell (with Inpex, Total) for Prelude FLNG
  - Origin/ConocoPhillips (with Sinopec) for APLNG
  - Inpex (with Total) for Ichthys
- Some of these firms have not had significant prior experience developing large LNG export projects, perhaps adding to delays and other cost over-runs
Cost over-runs

- All LNG projects currently under construction have experienced substantial cost over-runs.
- These have resulted predominantly from shortages of labor:
  - Almost half of recent project budgets are for labor, with wage increases and hiring expected in 2013.
  - *OilCareers* recently reported that construction workers in the Australian oil & gas industry expected on average almost 49% more than their US counterparts and 139% more than their UK counterparts.
- Other problems: tax and labor law changes, environmentalist opposition, “feel good” but practically worthless regulation, land policy, remoteness, lack of infrastructure, over-valuation of the $A.

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Publicly Announced versus October 2012 costs of Australian LNG projects

Source: BREE Resources and Energy Major Projects List, October 2012
Potential new technologies

- Developers are resorting to more off-shore fabrication of modules in SE Asia
  - The 4.3 mmtpa Pluto train has 264 units, of which 1/3 are core modules, but Woodside is planning future trains with only 5 self-contained modules that can be pre-commissioned before being towed to the site
- The FLNG concept, the ultimate version of this, is also new to the industry, and as such is likely to experience unforeseen difficulties
  - 488m long, 74m wide, weighing 600,000 tonnes fully loaded (≈ 6 aircraft carriers)
  - Allows more overseas construction and avoids on-shore facilities that are subject to oversight by state and local governments
- Other technologies being examined include subsea compression of the gas
- LNG Ltd has a patented “steam driven ammonia refrigeration process” for producing LNG that it claims is 30% more energy efficient and less capital intensive than other processes
  - It has proposed 2 relatively small capacity Gladstone plants, but perhaps is aiming to sell its processing technology to one of the other Gladstone project developers
  - Incidentally, the same company is planning a similar small modular facility for exporting LNG from the US Gulf Coast
- CNG is being examined as an alternative to LNG
## Other potential LNG projects

<table>
<thead>
<tr>
<th>Project</th>
<th>Major sponsor</th>
<th>Location</th>
<th>Project stage</th>
<th>Proposed start</th>
<th>Capacity PJ/yr</th>
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<tbody>
<tr>
<td>Arrow LNG 1&amp;2</td>
<td>Arrow</td>
<td>Gladstone Qld</td>
<td>Feasibility</td>
<td>2017+</td>
<td>443.4</td>
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<tr>
<td>Gorgon 4</td>
<td>Chevron</td>
<td>Barrow Is WA</td>
<td>Feasibility</td>
<td>2018+</td>
<td>288.2</td>
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<tr>
<td>Scarborough gas</td>
<td>ExxonMobil</td>
<td>FLNG</td>
<td>Feasibility</td>
<td>2018+</td>
<td>166.3</td>
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<tr>
<td>Bonaparte FLNG</td>
<td>GDF Suez</td>
<td>NT, FLNG</td>
<td>Feasibility</td>
<td>2018+</td>
<td>110.9</td>
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<tr>
<td>Tassie Shoal LNG</td>
<td>MEO Australia</td>
<td>Timor sea NT</td>
<td>Feasibility</td>
<td>2017+</td>
<td>166.3</td>
</tr>
<tr>
<td>Sunrise</td>
<td>Woodside</td>
<td>FLNG/JPDA</td>
<td>Announced</td>
<td>2017+</td>
<td>227.3</td>
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<td>Fisherman Landing 1</td>
<td>LNG Ltd</td>
<td>Gladstone Qld</td>
<td>Announced</td>
<td>2017</td>
<td>83.1</td>
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<td>Browse LNG</td>
<td>Woodside</td>
<td>FLNG</td>
<td>Announced</td>
<td>2018+</td>
<td>665.2</td>
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<tr>
<td>Cash Maple FLNG</td>
<td>PTTEP Australia</td>
<td>Timor sea NT</td>
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<td>2018+</td>
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<td>LNG Ltd</td>
<td>Gladstone Qld</td>
<td>Announced</td>
<td>2018+</td>
<td>83.1</td>
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<tr>
<td>Equus</td>
<td>Hess</td>
<td>Browse WA FPS</td>
<td>Announced</td>
<td>2018+</td>
<td>3rd party gas</td>
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<tr>
<td>Pluto 2&amp;3</td>
<td>Woodside</td>
<td>Karratha WA</td>
<td>Expansion</td>
<td>2020+</td>
<td>476.7</td>
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<tr>
<td>Arrow LNG 3&amp;4</td>
<td>Arrow</td>
<td>Gladstone Qld</td>
<td>Expansion</td>
<td>2020+</td>
<td>554.3</td>
</tr>
<tr>
<td>Wheatstone 3–5</td>
<td>Chevron</td>
<td>Onslow WA</td>
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<tr>
<td>QCLNG 3&amp;4</td>
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<td>Gladstone Qld</td>
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<td>ConocoPhillips</td>
<td>Gladstone Qld</td>
<td>Expansion</td>
<td>2020+</td>
<td>498.9</td>
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</table>

Source: BREE Resources and Energy Major Projects List, April 2013
General comments on potential LNG projects

- BREE categorizes projects in the “feasibility” stage to be further along than those in the “announced” stage.
- The expansions of pre-existing projects in the final five rows of the table have not been officially classified in the “announced” category.
  - Proponents of the original projects have previously stated the projects are designed to accommodate these expansions at some future date.
- Projects in the table would add more than 5000 PJ per year and more than double Australia’s LNG export capacity after all projects currently in construction are completed.
- Such a capacity expansion would not be consistent with BREE or RWGTM predictions.
  - This suggests that the projects are predicated on an infeasible projection of project completion costs and/or export netback prices.
Comments on particular projects

- Arrow (purchased by a Shell-PetroChina joint venture in 2010) was an original independent developer of CBM resources in Qld currently producing about 20% of Qld gas supply
  - Arrow is now negotiating supply to one or more of the three projects under construction in Gladstone
- Browse LNG was going to be processed onshore but Woodside has now abandoned onshore processing and will consider FLNG instead
- Long-term domestic supply contract negotiations are also tied up with negotiations over supplying natural gas to the Gladstone LNG projects
- CBM projects have encountered environmentalist opposition, especially in NSW
- Other FLNG proposals may depend on the outcome of the pioneering Shell project
- The developers of the Sunrise project want to use FLNG but the Timor Leste government wants an onshore processing facility on the island
Many projects compete for similar inputs

Source: BREE Resources and Energy Major Projects List, April 2013
Australia’s unprecedented investment boom

Concluding remarks

- Australia has a large resource endowment, not only in natural gas, but also coal and uranium (exports of which both substantially exceed natural gas exports by energy content), bauxite, iron ore, nickel, copper, gold, silver, lead, zinc and many other minerals that have recently been in high demand especially from China.

- Australia has a shortage of skilled labor and engineers, and a lack of infrastructure in remote regions.

- The $A is (still) over-valued from the huge inflow of investment funds, relatively high domestic interest rates and the perceived high correlation of Australia’s economic performance with that of China.

- Many poor government policies have exacerbated the problems, and while the current Federal government will likely lose office at the election due later this year reputations are easy to lose but hard to re-build.

- The investment boom has peaked and will need to be “digested” before the next boom starts again perhaps at the end of the 2020’s.