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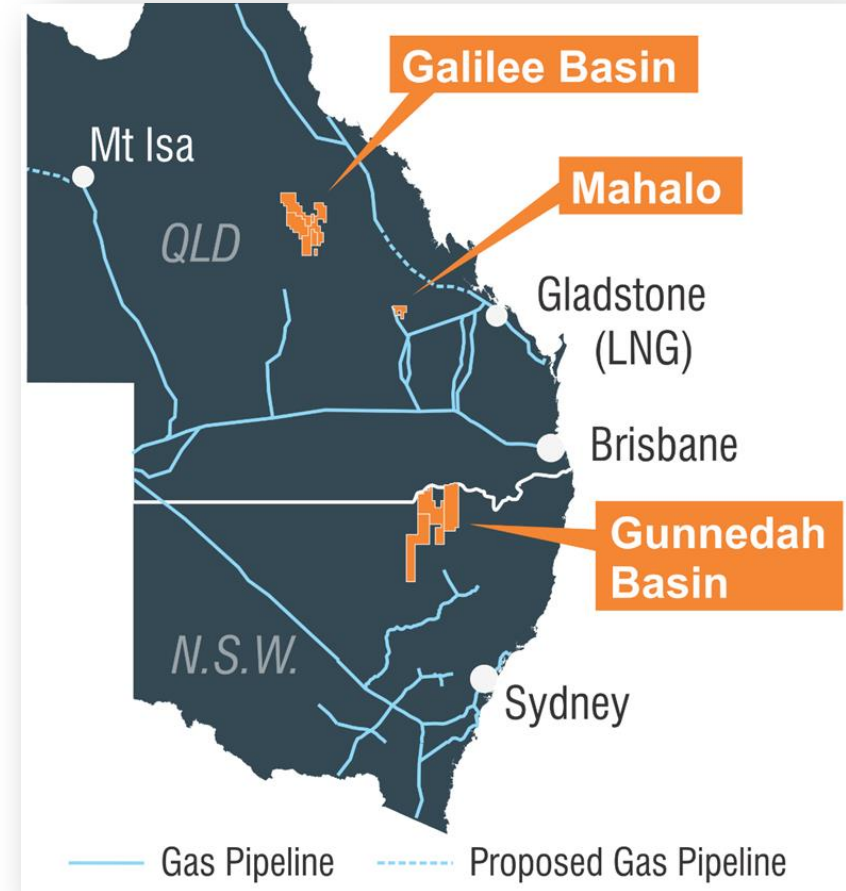
Unconventional Gas in East Australia – Where Next ?



Tor McCaul, Managing Director, Comet Ridge Limited
China-Australia Unconventional Natural Gas Forum, Beijing
7 November 2016

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- ASX listed - based in Brisbane
- Focus on natural gas in eastern Australia
- Multi-basin presence
 - ✓ Southern Bowen (Mahalo)
 - ✓ Galilee
 - ✓ Gunnedah
- Coal Seam Gas (CSG) Pilot schemes running at the Mahalo Gas Project with initial 2P and 3P reserves
- Significant resource base in the Galilee Basin northwest of Gladstone (over 2200 PJ 3C)¹
 - ✓ CSG
 - ✓ Sandstone Gas

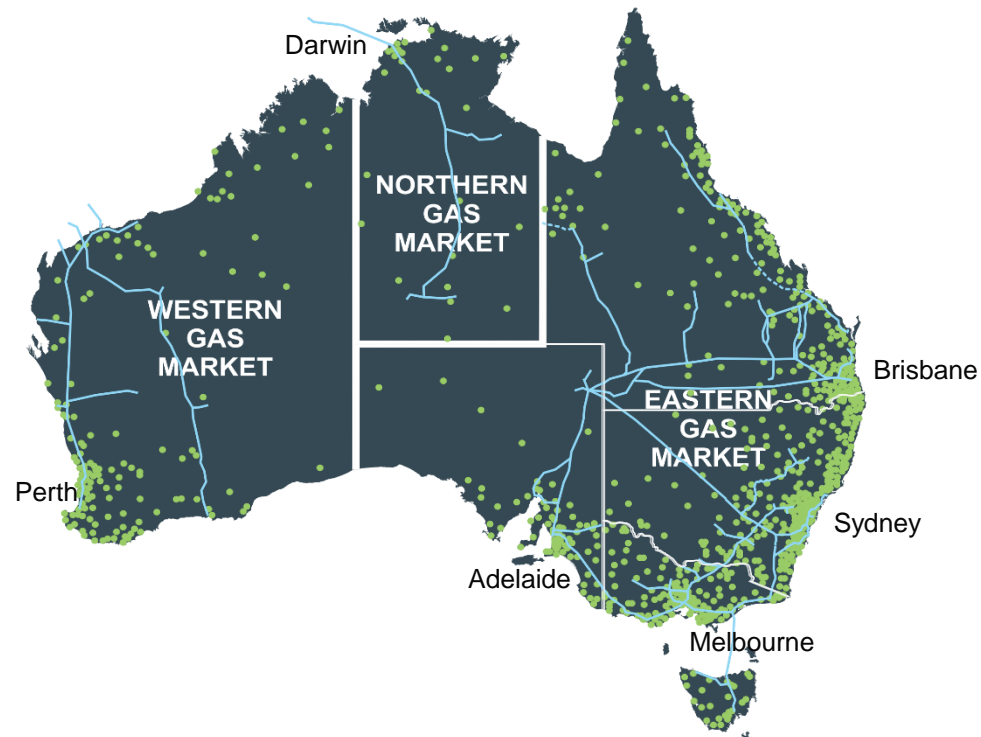


Australian Gas Market Background



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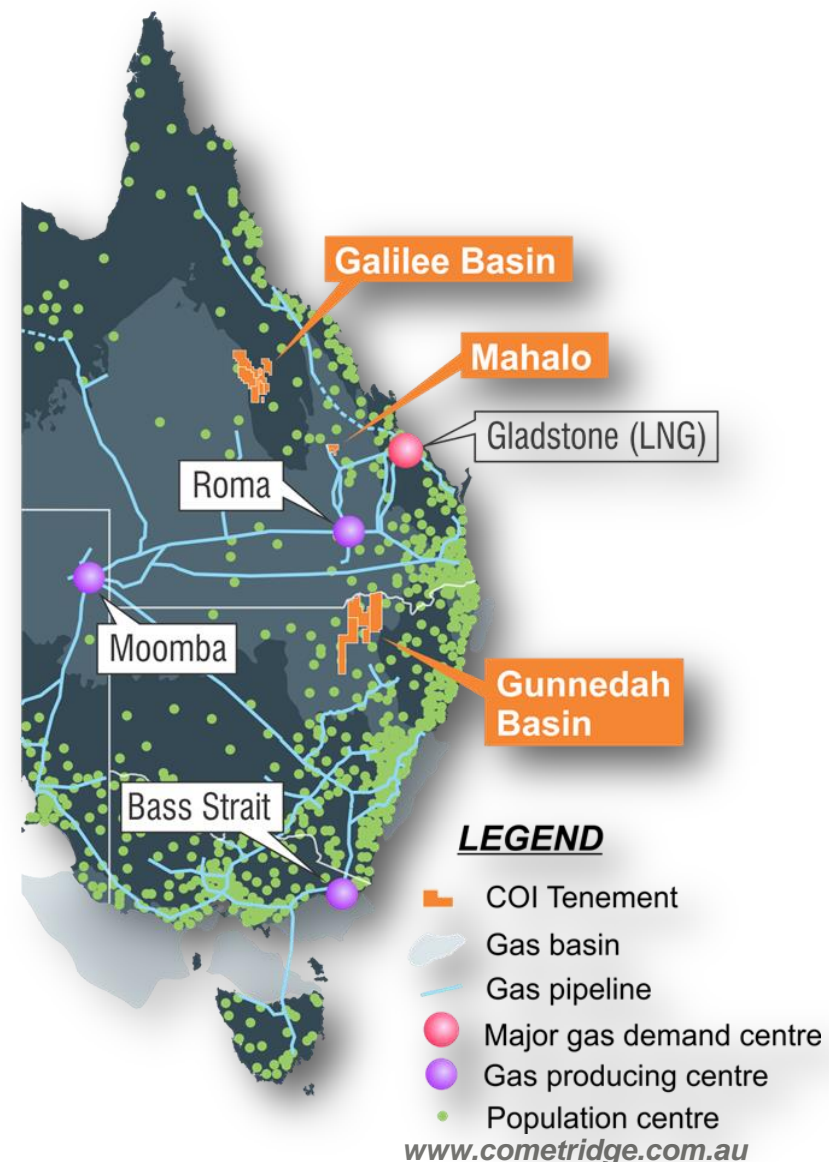
- Large continent
- Small population residing mostly around coast, particularly in southeast
- Historically small gas market relative to reserve base
- Subsequently historically low gas prices
- Gas resources are generally located at a distance from major population centers
- Gas pipeline transmission network is sparse (compared for example, to US national pipeline network)
- Three separate functioning gas markets developed independently; not yet interconnected



Source: Australian Energy Resource Assessment (GA), 2014

Eastern Australia Gas Market Development

- Late 1960s start of gas transmission and industrial and domestic use in the Eastern region
 - ✓ Bass Strait, Victoria (offshore)
 - ✓ Moomba, South Australia (onshore)
 - ✓ Roma, Queensland (onshore)
- Initial LNG exports commenced mid 1980s
 - ✓ Northwest Shelf online and LNG export initially to Japan
 - ✓ Expanded later to South Korea, China and India
- Further LNG development in west and north
- Since late 2014, three LNG projects in Gladstone in the east (25 MMTPa)
- Gas prices in eastern market are moving higher due to
 - ✓ Greater demand
 - ✓ Government constraints limiting supply

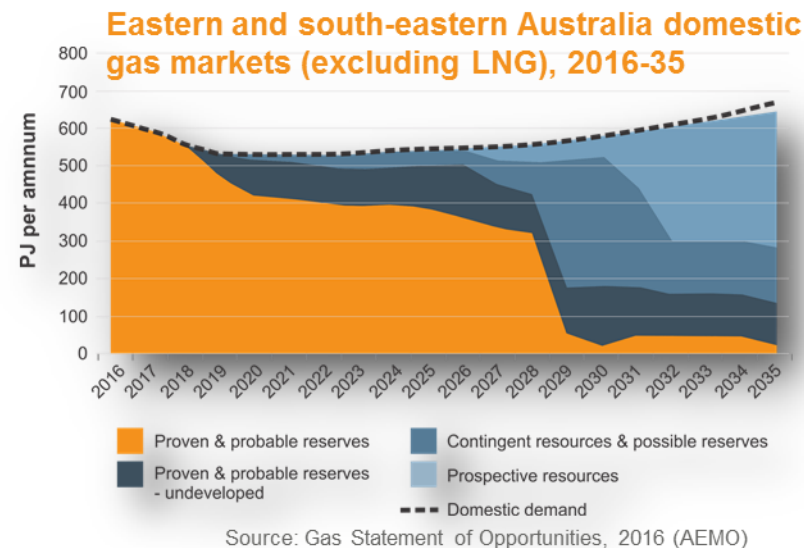
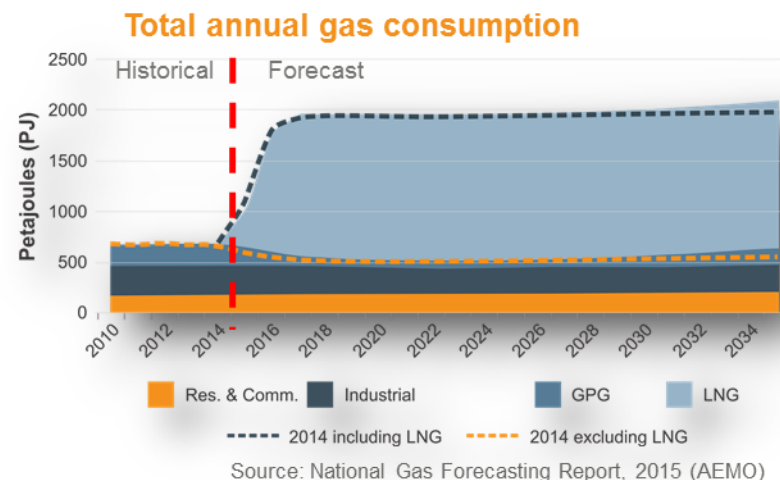


Eastern Australia Gas Market Currently



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- Massive increase in demand since 2014 due Gladstone LNG
- Recent price spikes to above \$25/GJ during high demand winter period
 - short term market only
 - long term industrial customers under pressure
- Shortfall in gas supply to meet domestic demand from 2018
- Development of contingent resources and reserves required to meet forecast domestic demand
- How will the price of oil and global LNG prices impact on gas allocation between LNG and domestic markets?



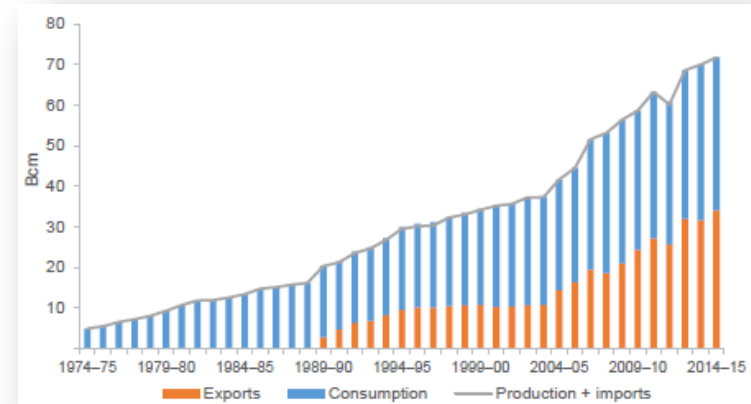
Historic Sources of Gas



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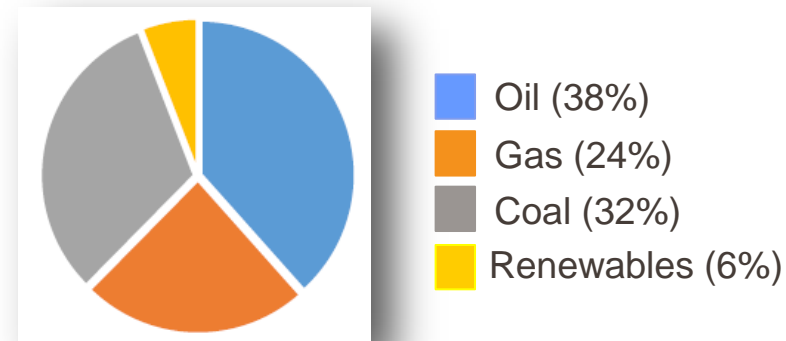
- Eastern Australia gas market supplied with conventional sandstone gas from 1960s – including associated gas (with oil production, particularly Bass Strait)
- Since late 1990s, CSG production grown substantially from Queensland
- Eastern Australia production from conventional reservoirs peaked and now declining
- Increasing requirement for production from unconventional resources
- Significant volume of gas in place which was economically uncommercial to develop at lower gas prices
- Move to tight gas reservoirs also aided by improvements to technology

Aus Natural Gas Production and Consumption



Source: Unconventional Gas in Australia , APPEA (2016)

Australian Final Energy Consumption: 2013-14



Source: Unconventional Gas in Australia , APPEA (2016)

Eastern Australia External Factors



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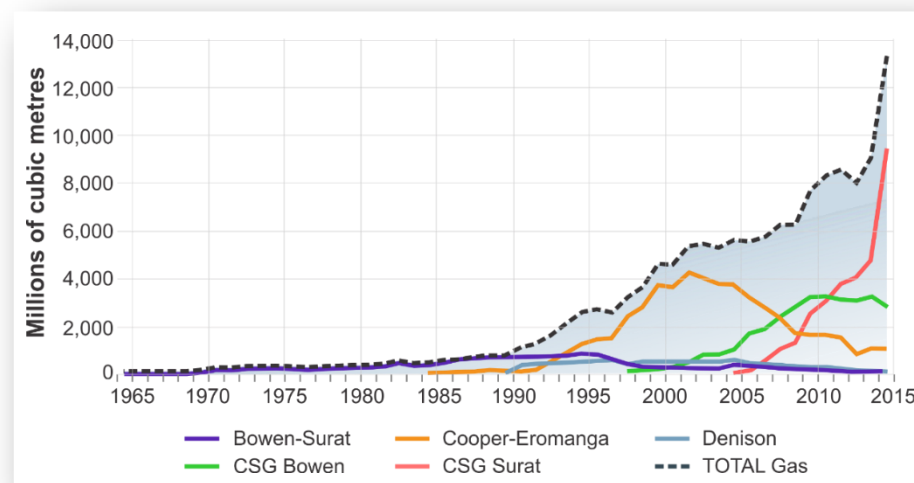
- Significant green activism and disruption applied to gas exploration and production across Australia despite the significant contribution gas can make to curbing emissions
- Moratoria on onshore gas exploration and development and other regulatory restrictions in several states and territories – LIMITING supply as demand INCREASES dramatically !
- Queensland and South Australia have been blessed with gas common sense over the past several years
- Increasing national awareness of need for gas power backup in an electricity network with growing renewables
- Tension building between East Coast LNG export and domestic and industrial use – who will suffer decreased supply?



Future Sources of Gas

New reserves will come from:

1. Poorer quality areas in existing CSG basins moving away from sweet-spots (i.e. Surat Basin)
 - ✓ Gladstone LNG projects likely to focus here
 - ✓ But can they get their costs down?
2. Untapped CSG in new basins further from market (i.e. Galilee Basin)
 - ✓ Smaller cap companies likely to focus here
 - ✓ Lighter touch with low overhead
3. Shale oil and gas
 - ✓ Current NT moratorium causing delay
 - ✓ High cost and long lead time?
4. Conventional gas moving into tighter sandstone reservoirs (i.e. Cooper and Galilee Basins)
 - ✓ LNG companies have tried very deep (high cost)
 - ✓ Smaller cap companies to try mid range depths (and lower cost)



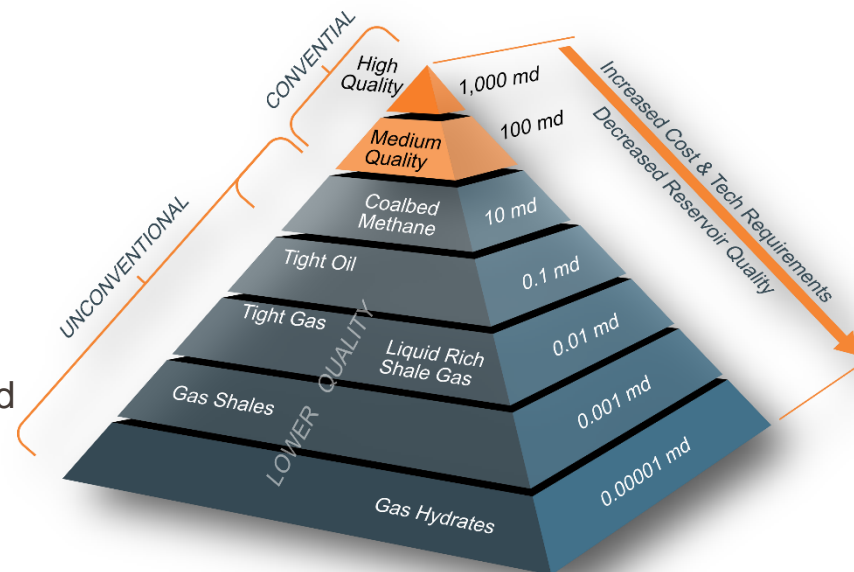
Source: Qld Department of Natural Resources and Mines (2016)

Production Challenges



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- Development of contingent resources and reserves will require a shift in focus away from high quality conventional reservoirs and CSG sweet-spots – and needs to be economic in a lower oil price environment!
- Leading to increased technical challenges
 - Decreased reservoir quality – more data required to understand reservoir
 - Decreased permeability = decreased flow per well
 - Increased technical requirements including innovative completion methodology
 - Increased number of wells required to develop resource
 - Connectivity between wellbore and reservoir will remain a key technical driver for economic success
 - Increased requirement for stimulation techniques (and horizontal wells)



Source: PSE Healthy Energy (2016)

Tighter Sandstone Reservoirs

- Had been some Queensland focus on tighter onshore sandstone reservoirs in 1980s and 1990s however this was somewhat taken over by focus on CSG reservoirs from late 1990s
- Tighter gas opportunities exist in eastern Australia
 - ✓ Expect to see more effort in the short to medium term
- Tighter sandstone reservoirs need to be approached much more carefully than conventional reservoirs. Considerations include:
 - ✓ Mud property selection / reservoir fluid sensitivity
 - ✓ Mud overbalance minimisation (balanced drilling?)
 - ✓ Drawdown minimisation avoiding fines mobilisation
 - ✓ Testing on penetration (not after logging)
 - ✓ Suitability of horizontal wells (and orientation)
 - ✓ Air / Nitrogen drilling
 - ✓ Identification and orientation of natural fractures (& stress regime)
 - ✓ Application of stimulation - hydraulic fracturing
 - ✓ Application of Short Radius Drilling (coiled tubing?)
 - ✓ Other methods, not yet identified



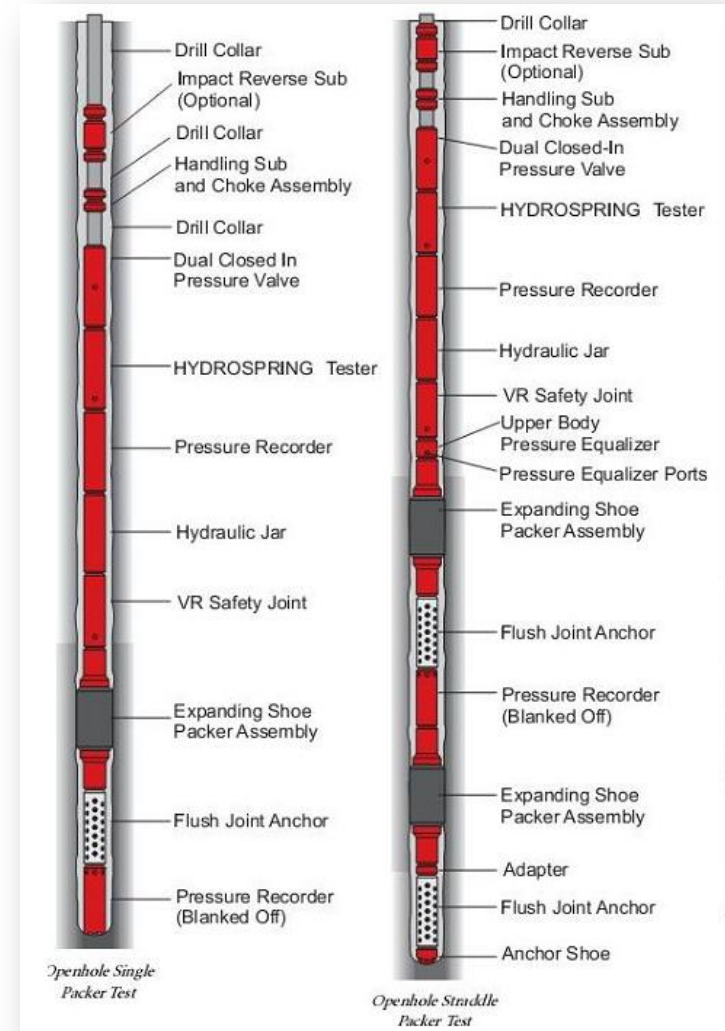
Tighter Sandstone Reservoirs



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Drill stem testing

- Reservoirs can be fluid sensitive and very susceptible to damage via mud overbalance and mud components
- Drilling to TD and obtaining logs can lead to unacceptably long delays before testing which can lead to poor DST flow results and negative assessment of potential reservoirs
- For tighter zones, Mudlog data can be used to pick packer seats and testing prior to logging in openhole
- Tests run immediately after penetration for least damage and best flow
- Onshore operators often have experience with this
- Tool strings consist of weight-set packers (either single or dual) to achieve zone isolation
- Numerous Queensland examples of tight reservoirs with poor flow results after testing delays and overbalance. Offset wells tested on penetration or air drilled and showed considerably better results
- Greater use now of electric line conveyed testing tools – eg MDT and FRT however time still a critical factor



Source: China Petroleum Technology & Development Corporation (CPTDC)

Tighter Sandstone Reservoirs

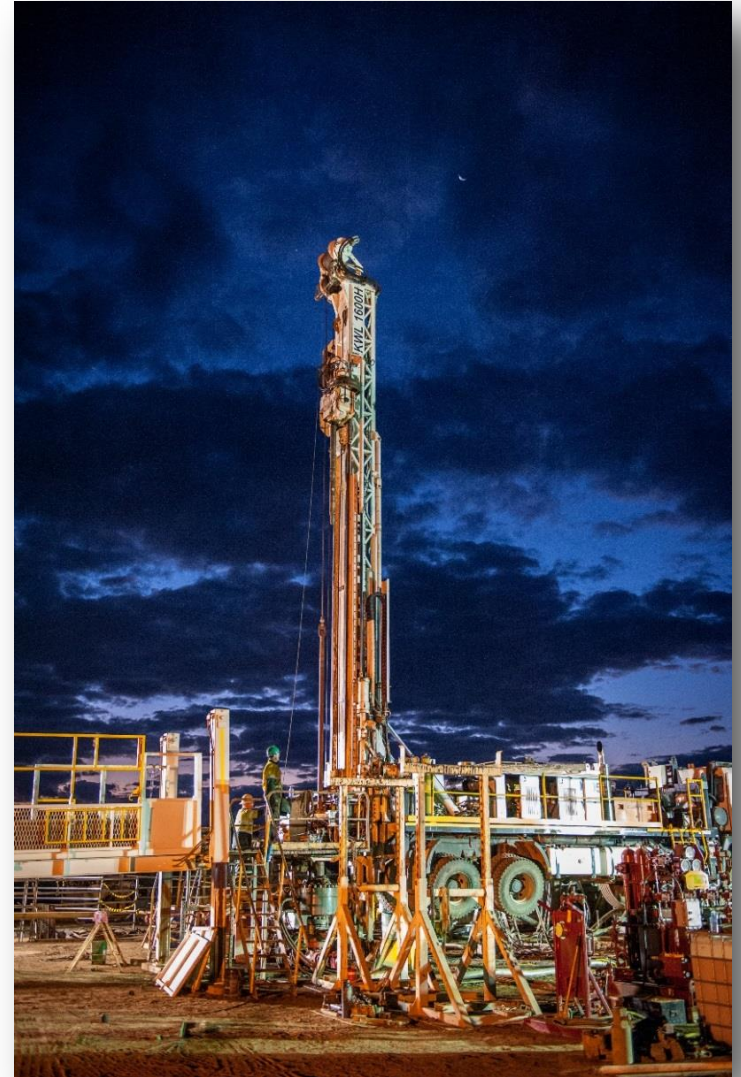
Air / Nitrogen Drilling

- High mud overbalance used during drilling of early exploration wells (1960s to 1990s) – resulted in non-commercial gas flows (field examples Rolleston, Yandina & others)
- Air / Nitrogen drilling enabled commercial gas rate in a number of applications
- Tighter reservoirs historically drilled with heavier mud weights may simply require drilling with Air / Nitrogen



Summary

- The Australian east coast gas market has grown and changed drastically in the past two years
- The steady growth in gas production has been focused largely around CSG for the past 15 years
- Shale gas may come in the medium to longer term however maintaining gas into the east coast market in the short term is likely to come from:
 - ✓ Movement into lower quality CSG around the edges of current basin sweet-spots
 - ✓ CSG from new basins, more proximal to demand centres
 - ✓ Tighter sandstones
- Research effort for unconventional gas at an academic level should also continue to support tighter sandstone gas production as well as CSG
 - ✓ Technical innovation remains critically important for lowered costs
- The quality of the connection between the wellbore and the reservoir is likely to remain one of the key economic drivers for success in both tighter gas and CSG



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Competent Person Statement and ASX Listing Rules Chapter 5 - Reporting on Oil and Gas Activities

The Contingent Resource for the Albany Structure referred to at page 2 of this presentation are taken from an independent report by Dr Bruce McConachie of SRK Consulting (Australasia) Pty Ltd, an independent petroleum reserve and resource evaluation company, originally released to the Market in the Company's announcement of 6 August 2015. The Contingent Resources information has been issued with the prior written consent of Dr McConachie in the form and context in which it appears. His qualifications and experience meet the requirements to act as a Competent Person to report petroleum reserves in accordance with the Society of Petroleum Engineers ("SPE") 2007 Petroleum Resource Management System ("PRMS") Guidelines as well as the 2011 Guidelines for Application.

COI confirms that it is not aware of any new information or data that materially affects the information included in the two announcements referred to above and that all of the material assumptions and technical parameters underpinning the estimates in the announcements continue to apply and have not materially changed.



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