COMMERCIALISATION OF SHALE/TIGHT GAS IN AUSTRALIA

UBS AUSTRALIAN RESOURCES, ENERGY & UTILITIES CONFERENCE, SYDNEY

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DECISIONS WITH CONFIDENCE
DISCUSSION TOPICS

1. SHALE / TIGHT GAS POTENTIAL
2. COMMERCIALISATION CHALLENGES
3. SOME THOUGHTS ON AUSTRALIAN LNG
RISC Advisory

- RISC is an independent oil and gas advisory firm
- Offices in Perth, Brisbane, Dubai and London
- Highest level technical, commercial and strategic advice to clients around the world.
- Basin to Boardroom services

Mission
- Enable clients are able to make key decisions with confidence.

Disclosure
The statements and opinions in this presentation are given in good faith and in the belief that such statements are neither false nor misleading. RISC recommends that specific advice relating to your particular circumstances be obtained before implementing actions mentioned in this presentation.
SHALE/TIGHT/BCG GAS POTENTIAL

Shale/Tight/BCG Gas Prospective Resources
- 545 Tcf potential prospective resources (RISC 2010/2012 & EIA 2013)
- EIA 437 Tcf in 6 Basins (2013)
- 1300 Tcf ACOLA/AWT (2013)

Infrastructure
- Bowen, Cooper/Eromanga, Gippsland and Otway Basins close to well developed production infrastructure

Liquids
- Approx 40% gas considered to be liquids prone which is important for commercialisation
- Areas of Canning, Cooper, Perth and McArthur Basins stand out

Source: RISC Analysis
SHALE/TIGHT GAS ACTIVITY HIGHLIGHTS

Commercial Maturity Profile
- **Cooper, Perth and Amadeus Basin** have been producing tight gas for decades
- Focus now on ultra low permeability shale/basin centred gas prospects
- Strong JV’s with major players
- **Cooper** (Beach, Santos/Origin) most advanced 11 “shale/tight gas” vertical wells fracked and successfully tested, horizontal drilling underway. 1 Well hooked up and producing (Moomba 191)
- **Perth Basin** (AWE, Norwest, Transerv) 4 vertical “shale/tight gas” wells fracked and successfully flow tested
- **Canning Laurel** BCG (Buru) – 1 well fracted and tested gas/condensate, 5 wells drilled and ready for testing
- **Georgina** (Petrofrontier) 1 horizontal well fracked and tested did not produce
SHALE-TIGHT GAS CONTINUUM

**Shale vs. Silts vs Sandstone**

- **Tight gas, shales, and hybrids are all different petroleum systems:**
  - Petrophysics,
  - Completion,
  - Stimulation,
  - Economics,

- Each lithology exhibits high vertical and lateral variability (despite lateral continuity)
## SHALE GAS TECHNICAL SUCCESS FACTORS

<table>
<thead>
<tr>
<th>USGS Screening Criteria</th>
<th>Canning Basin Goldwyer Fm</th>
<th>Perth Basin IRCM Caringinia Kockatea</th>
<th>Cooper Basin REM</th>
<th>Amadeus Basin Horn Valley Siltstone</th>
<th>Beetaloo Basin Kyall Fm Velkerri Fm</th>
<th>Georgina Arthur Ck Fm</th>
<th>McArthur Barney Ck Fm</th>
<th>Otway Basin Eumerella Fm Casterton Fm</th>
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<td>Natural Fracture Potential</td>
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<td>High Lateral Continuity</td>
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# Basin Centre Gas (BCG)

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Canning Basin Laurel Fm</th>
<th>Cooper Basin Nappamerri BCG</th>
<th>Perth Basin IRCM Caringinina Kockatea</th>
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<td>Continuous Gas Saturation</td>
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<td>No Downdip Water Leg</td>
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DOMESTIC GAS +20 YEARS

Western Australia
- Circa 10 Tcf demand
- Circa 2 Tcf supply shortfall

Eastern Australia
- Circa 20 Tcf domestic demand
- Circa 10-15 Tcf supply shortfall

Opportunity
- 12-17 Tcf Domestic Gas
- Export required to monetise more than this

LIQUIDS CONTENT IMPACTS LNG REVENUE STREAMS

Moderate liquids content in produced gas can boost project revenue by more than 20%

Increase in Gross Revenue %

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<th>Condensate Gas Ratio bbl/MMscf</th>
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<tr>
<td>0%</td>
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<td>5%</td>
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<td>10%</td>
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<td>35%</td>
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<td>40%</td>
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Assumes LNG sold at energy value parity to condensate
Source: RISC Analysis
DISTANCE TO MARKET IS ALSO A FACTOR

Significant shipping differences for projects to reach key markets will influence cost comparison. This example shows one-way distances from producers to Japan.
Estimated transport costs to Japan

Shipping to market costs fall in the range of 10-20% of cargo value.

Notional costs include: BOG, fuel, ship charter.

Source: RISC Analysis
UNIT COST OF DELIVERED LNG TO JAPAN
CAN AUSTRALIAN UNCONVENTIONAL GAS COMPETE FOR REGIONAL LNG MARKETS?

Challenges

- Production infrastructure
- Services (rigs, frac spreads)
- Well Costs

- Australian well drilling, completion and stimulation costs currently 3-4 times higher than N America
- US Rig rates, drilling rates, frac costs all significantly better
- Well Cost a major driver in value

“Greenfield” shale gas example

- 6 bcf/well, 25 bbl/MMscf liquids
- 3000 m well with 2500 m lateral, 12 stage fracs
- US well cost $6-8 mill drilled and completed
- Aus well cost $12-14 mill (assumes learning curve)
**HOW CAN AUSTRALIAN SHALE GAS COMPETE?**

**“Business as Usual” Cost Reduction**
- 30% savings on current cost
- Campaign drilling
- Pad drilling
- Drilling learning curve
- Well will still cost 2X US equivalent

**Still not enough**
- Even with 30% savings, result is breakeven costs of supply 60% higher than US comparable
- Stretch target should be 50-60% savings on current costs to achieve even greater efficiencies

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**Diagram:**
- **30% savings expected “business as usual”**
- **50-60% savings “stretch target”**

**Bar Chart:**
- Relative Well Cost
- Components: Fracking, Site preparation, logging/testing fees, completion equipment/material costs, drilling material & services, site survey/positioning, basic rig hire, mob/demob

**Legend:**
- Aus Current Cost
- Aus Business as Usual
- US Current Cost
HOW CAN AUSTRALIAN OPERATORS DRIVE FURTHER IMPROVEMENT?

- Due to market/geographical issues, Aus costs unlikely to reach US benchmarks
- Remote locations, flooding and lack of infrastructure will all inevitably add to costs

“Technical Limit” Concept

- 50% improvements the norm
- Different business model required
  - Imperative from CEO down required
  - Different skill sets, continuous improvement systems and culture
  - Whole supply chain approach
  - Re-engineering of well construction, supply and development process: need campaigns
  - Integrated contract alignment with service providers essential
  - Manpower intensive compared to current operations, but good engineering is cheap

- Not a new idea, been around since the 80’s

Bond, D.F. et al.: “Step Change Improvement and High Rate Learning are Delivered by Targeting Technical Limits on Sub-Sea Wells,” SPE 35077 March 1996.
OUTLOOK FOR AUSTRALIAN SHALE GAS

- Vast resource potential 500+ Tcf
- Domestic market potential circa 15 Tcf over next 20 years
- Access to export market the key to unlocking the full scale potential
- Basins close to markets and Export infrastructure favoured
- Cost a major value driver making Australian shale gas 60% more costly than N American equivalents
- Scale, vision and a different business model is required to unlock the challenge