East Coast Gas: Resource potential at different gas price scenarios

Part 2: Commercialisation of unconventional gas resources
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Quantifying the potential of Eastern Australian unconventional plays

At what gas price does it make sense to exploit Eastern Australian unconventional gas potential?

Part 1: Quantification of unconventional gas resource potential

Common Recovery Segment Mapping

Part 2: Commercialisation of unconventional gas resources

Eastern Australia gas market model
Australia’s east coast gas market

East Coast Gas Consumption by Sector and Gas Price

- Industrial Consumption
- Residential Consumption
- Gas Power Generation
- LNG
- Avg Wholesale Gas Price

When insanity makes sense: Australia’s best option is LNG imports

By Clyde Russell
March 7, 2019 – 12:00pm

Australia has painted itself into a corner with its natural gas industry and faces the stark reality that there are no easy choices to alleviate the dual problem of a looming supply crunch and the associated higher prices.

Vic ban could open LNG imports door: RISC
Thursday 1, September 2016

VICTORIA locking the gate to gas exploration could strengthen the case for LNG imports into eastern Australia, RISC Advisory has told Energy News.

Though it may conjure up images of ‘carrying coal to Newcastle’ or ‘selling ice to eskimos’, the idea of importing LNG into the eastern states may not be as crazy as it sounds given recent decisions in the eastern states and political moves further north.
Have we seen this story before?

- "The US is destined to become a key LNG import market" (BG)
- "North America emerges as a major importer of LNG" (EIA, IEEJ & others)
- "Natural Gas prices will remain high in the US for the foreseeable future" (EIA)

Source: EIA
Quantifying Unconventional Resources

Breakeven Gas Price Mapping

- **Break-even Gas Price (AUD/GJ)**
- **Drill Depth**
- **Distance to Pipeline**
- **EUR per Cell**
- **Number of Potential Layers**
- **EUR per Layer**
- **Common Recovery Segment Map**

Low, Best and High Deterministic Bookend Horizontal Frac Typecurves

<table>
<thead>
<tr>
<th>Wellbookend</th>
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<th>Low Bookend</th>
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Max-Min and Min-Min Book ends

| DQIP SRV | 30 Day QI | EUR 12 & 15* Years | QI/EUR Ratio
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IP 30 days
Visualising East Coast gas potential

PATCHAWARRA ESTIMATED ULTIMATE RECOVERY POTENTIAL

Estimated resource: 146 Tcf *

* Mid-case type curve EUR with full development (Well count: 24,628)
Visualising East Coast gas potential

PATCHAWARRA ESTIMATED ULTIMATE RECOVERY POTENTIAL

Calculated EUR per section (Bscf)

- <2
- 2 - 10
- 10 - 20
- 20 - 30
- 30 - 40
- 40 - 50
- 50 - 60
- 60 - 70
- 70 - 80
- 80 - 90
- 90 - 100
- 100 - 110
- 110 - 120
- 120 - 130
- 130 - 140
- 140 - 150

Estimated resource: 280 Tcf *

* Mid-case type curve EUR with full development (Well count: 53,503)
Visualising East Coast gas potential

PATCHAWARRA ESTIMATED ULTIMATE RECOVERY POTENTIAL

Estimated resource: 345 Tcf *

* Mid-case type curve EUR with full development (Well count: 71,615)
Visualising East Coast gas potential

PATCHAWARRA ESTIMATED ULTIMATE RECOVERY POTENTIAL

Calculated EUR per section (Bscf)
- <2
- 2 - 10
- 10 - 20
- 20 - 30
- 30 - 40
- 40 - 50
- 50 - 60
- 60 - 70
- 70 - 80
- 80 - 90
- 90 - 100
- 100 - 110
- 110 - 120
- 120 - 130
- 130 - 140
- 140 - 150

Estimated resource: 363 Tcf *

* Mid-case type curve EUR with full development (Well count: 77,763)
Unconventional gas potential

USA Shale Gas Production

- Permian (TX & NM)
- Marcellus (PA, WV, OH & NY)
- Utica (OH, PA & WV)

Australian CSG Production
Total eastern Australia Unconventional Potential

- At $6/GJ
- At $9/GJ
- At $11/GJ
East Coast Gas Market Model

Market model built on gas supply network with supply aggregated at the basin level and demand aggregated at pipeline termination points.
East Coast Gas Market Model

Market model built on gas supply network with supply aggregated at the basin level and demand aggregated at pipeline termination points.
Southern States Supply Gap Range

- **Low Domgas Supply Case**
- **High Domgas Supply Case**
- **Marginal Gas Supply Price (RHS)**

**Annual Shortfall exceeds SWQP capacity**

- LNG Imports begin to meet peak demand shortfall

East Coast Gas Market Model

- **Annual Shortfall** exceeds **SWQP capacity**
- LNG Imports begin to meet peak demand shortfall
Market Supply Scenario Analysis

PATCHAWARRA ESTIMATED ULTIMATE RECOVERY POTENTIAL

Estimated resource: 0 Tcf *

Market supply volume at A$6/GJ

Recent Santos drilling activity

Estimated resource: 146 Tcf *

Market supply volume at A$9/GJ
Market Supply Scenario Analysis

PATCHAWARRA ESTIMATED ULTIMATE RECOVERY POTENTIAL

- Estimated resource: 0 Tcf *

Recent Santos drilling activity

MARKET SUPPLY VOLUME AT A$6/GJ

- 2019 costs
- 20% costs
- 40% costs
- 60% costs

MARKET SUPPLY VOLUME AT A$9/GJ

- 2019 costs
- 20% costs
- 40% costs
- 60% costs

QUEENSLAND

SOUTH AUSTRALIA

South Australia

Recent Santos drilling activity

Estimated resource: 146 Tcf *
Development Cost Optimisation – 20% Reduction in Development Costs

Estimated resource: 0 Tcf *

PATCHAWARRA ESTIMATED ULTIMATE RECOVERY POTENTIAL

Recent Santos drilling activity

Estimated resource: 261 Tcf *

PATCHAWARRA ESTIMATED ULTIMATE RECOVERY POTENTIAL

Market supply volume at A$6/GJ

- 2019 costs
- 20% costs
- 40% costs
- 60% costs

Market supply volume at A$9/GJ

- 2019 costs
- 20% costs
- 40% costs
- 60% costs

100km
Development Cost Optimisation – 40% Reduction in Development Costs

Estimated resource: 5.9 Tcf *

PATCHAWARRA ESTIMATED ULTIMATE RECOVERY POTENTIAL

Market supply volume at A$6/GJ

Recent Santos drilling activity

Estimated resource: 343 Tcf *

PATCHAWARRA ESTIMATED ULTIMATE RECOVERY POTENTIAL

Market supply volume at A$9/GJ
Development Cost Optimisation – 60% Reduction in Development Costs

**PATCHAWARRA ESTIMATED ULTIMATE RECOVERY POTENTIAL**

Estimated resource: 251 Tcf *

**Recent Santos drilling activity**

**MARKET SUPPLY VOLUME AT A$9/GJ**

- 2019 costs
- 20% costs
- 40% costs
- 60% costs

**MARKET SUPPLY VOLUME AT A$6/GJ**

- 2019 costs
- 20% costs
- 40% costs
- 60% costs

**SOUTH AUSTRALIA**

Estimated resource: 386 Tcf *

**QUEENSLAND**

Market supply volume at A$9/GJ
East Coast Gas Market Model Forecasts

East Coast 2P + LNG Import Supply Forecast

LNG Imports

2P + LNG Import Average New Supply Gas Prices


A$/GJ

Wallumbilla  Brisbane  Sydney  Melbourne  Adelaide

East Coast 2P + Unconventional Supply Forecast

Unconventional Supply

2P + Unconventional Average New Supply Gas Prices


A$/GJ

Wallumbilla  Brisbane  Sydney  Melbourne  Adelaide
### Eastern Australian unconventional plays of interest

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Permian basins: Cooper-Bowen-Galilee-Gunnedah-Sydney

Great Artesian basins: Eromanga-Surat
Some closing thoughts

• LNG imports are likely to be required into the east coast market from as early as 2022 to meet peak demand requirements resulting in further upward pressure on gas pricing.

• If no new sources of supply are developed LNG imports could be supplying >20% of the southern states demand from 2029.

• Unconventional supplies can be competitive in the east coast market from 2022 onwards as an alternative to the diversion of significant CSG supply from LNG producers or large scale LNG imports.

• If unconventional gas can be developed on a large scale there is potential to add new supply from a number of basins as costs fall leading to the possibility of new supply for LNG projects and downward impact on domestic prices by the second half of the 2020’s.
RISC Eastern States gas market study and unconventional play atlas

Start

Resource development break-even analysis

The gas price slider bar provides interactive break even development maps for all of the recognised unconventional plays in Eastern Australia.

A quantitative analysis of the unconventional gas potential of Eastern Australian basins has been undertaken using a spatial analysis methodology of play fairway sweet-spot mapping. Play components considered important for the presence and recovery of unconventional gas were mapped across the plays of interest. Modelled horizontal well type curves and development plans from North American analogues for unconventional gas production have been used to quantify the sweet-spot mapping using a methodology RISC has developed called common recovery segment mapping.

Eastern Australia gas market supply forecast

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Deliverables

The Eastern Australia unconventional play atlas is provided in both hyperlinked and interactive pdf report and as an optional ArcGIS project.

The Eastern Australia gas market study is provided as a pdf and an optional excel model.