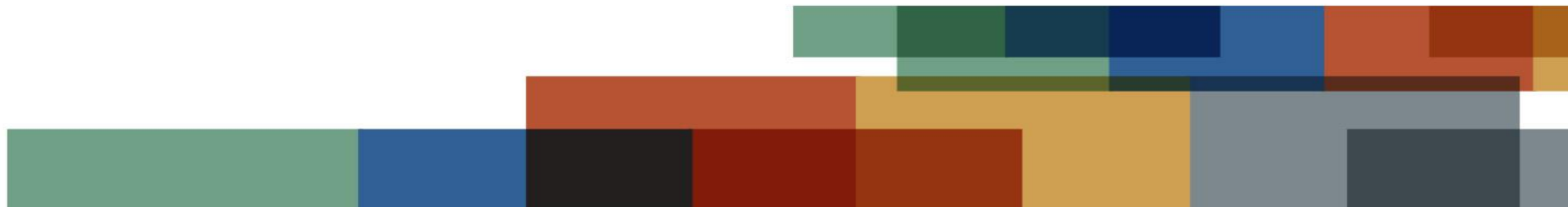


East Coast Gas: Resource potential at different gas price scenarios

Part 2: Commercialisation of unconventional gas resources



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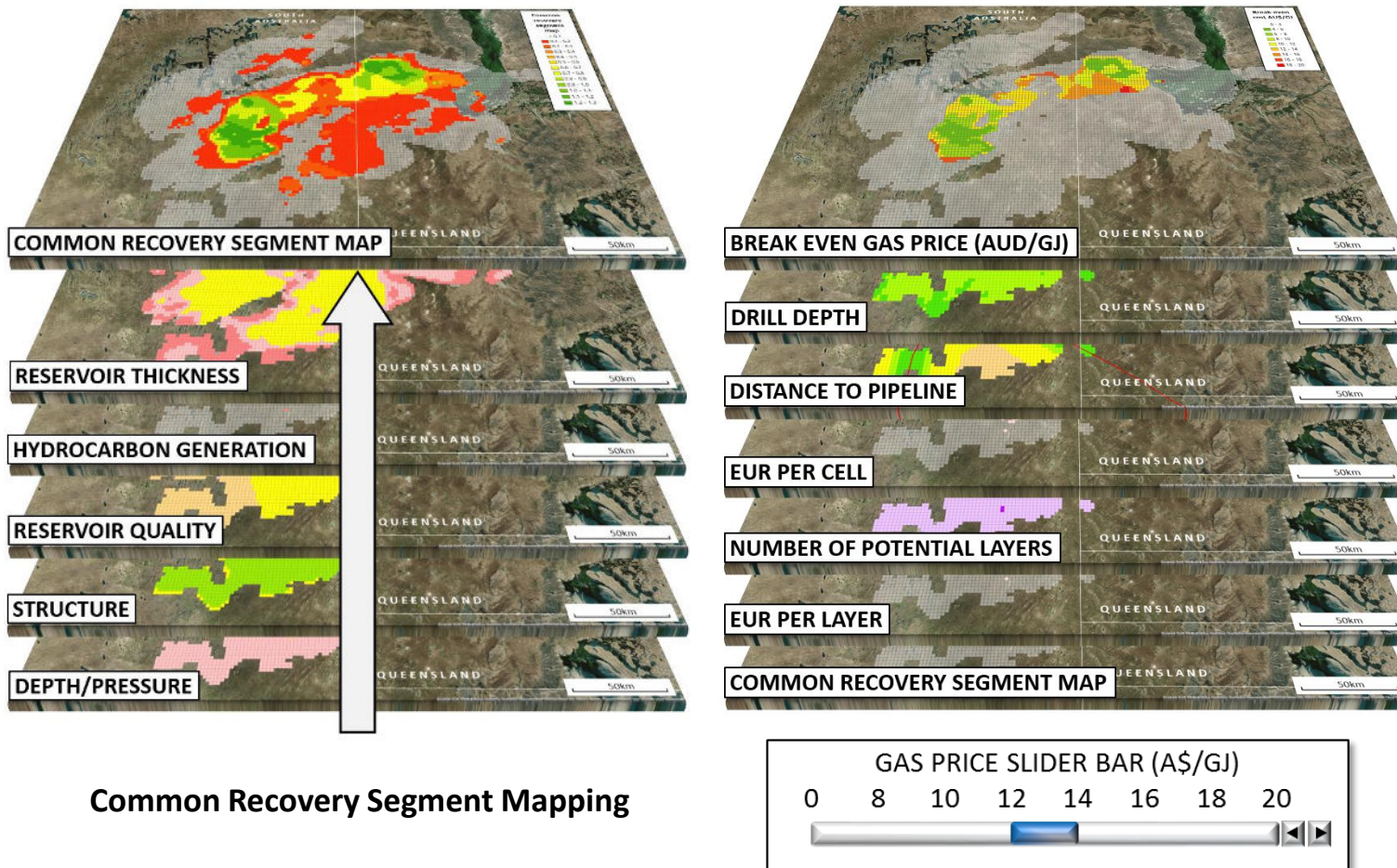
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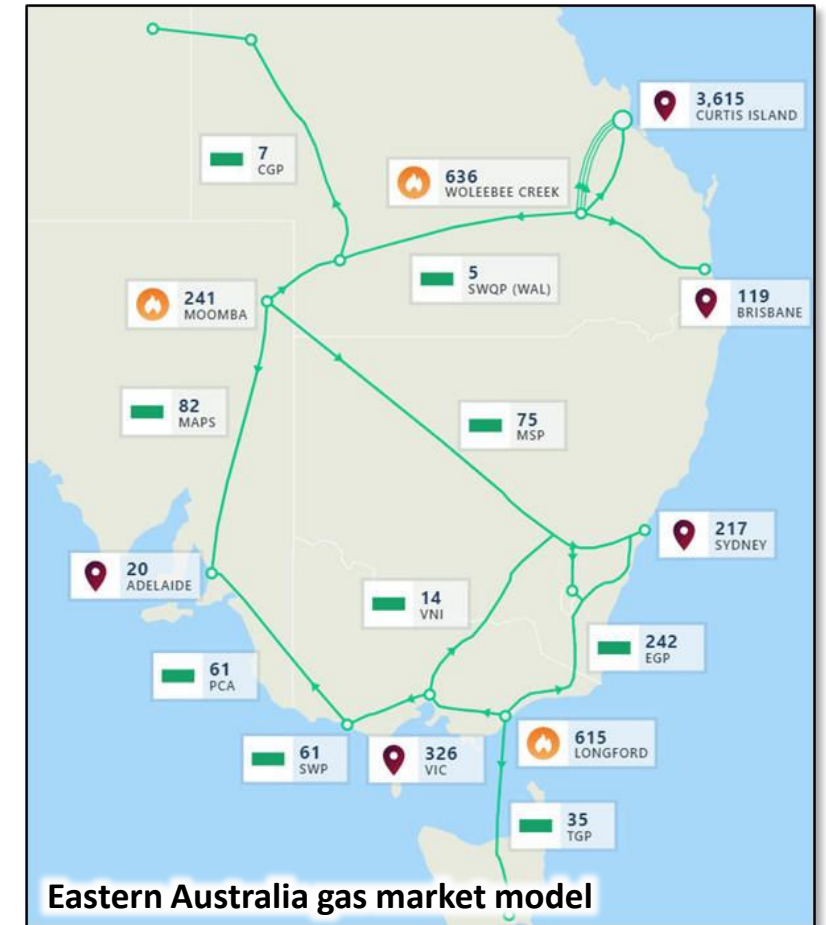
Quantifying the potential of Eastern Australian unconventional plays

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

Part 1: Quantification of unconventional gas resource potential



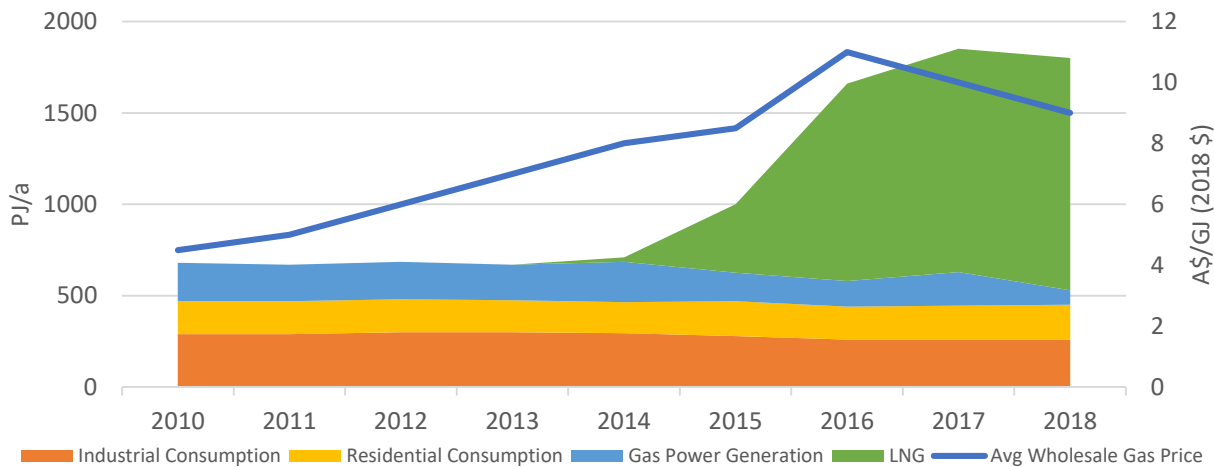
Part 2: Commercialisation of unconventional gas resources



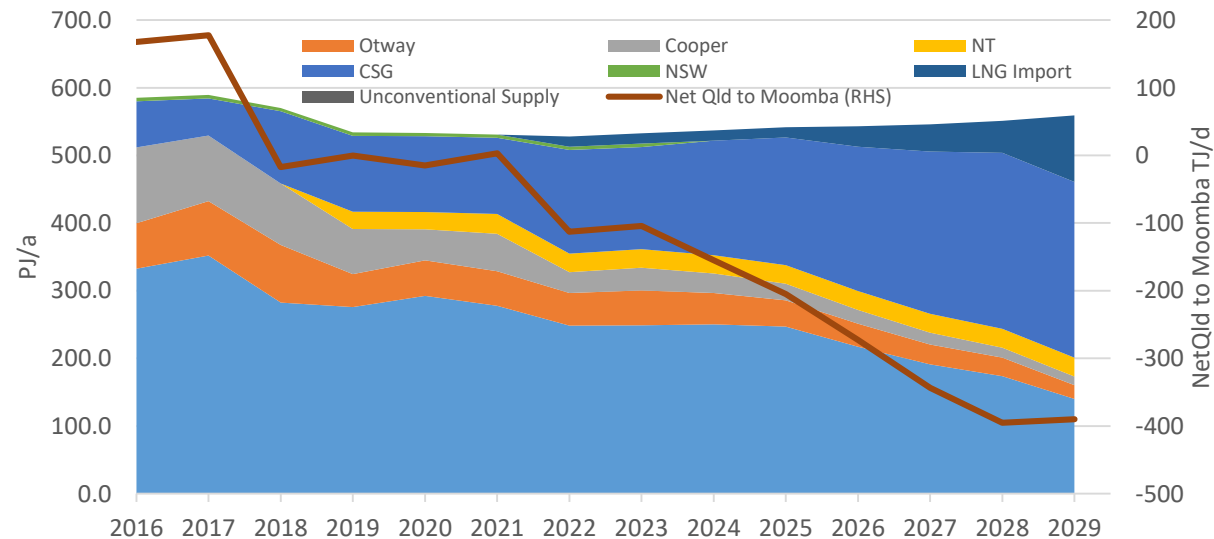
Australia's east coast gas market



East Coast Gas Consumption by Sector and Gas Price



East Coast Domestic Gas 2P + LNG Import Supply Forecast



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.

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

By Clyde Russell

March 7, 2019 – 12:06pm

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.

Print Email Facebook Twitter More

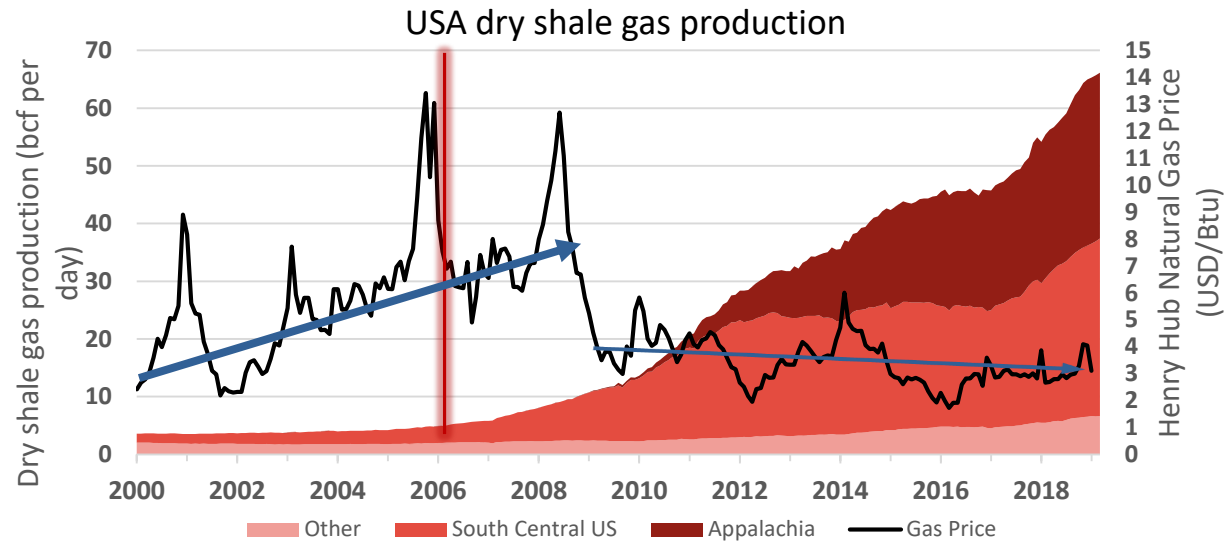
LNG import terminal approval — an Australian first — a sign of hope for NSW manufacturing

ABC Illawarra By Kelly Fuller and Gavin Coote

FROM ABC ILLAWARRA

- Why Tania Daykin is putting old chickens before the eggs
- Art and alcohol bringing out creative flair in expanding entertainment landscape
- Liberal candidate angry over 'go back to where you came from' remark

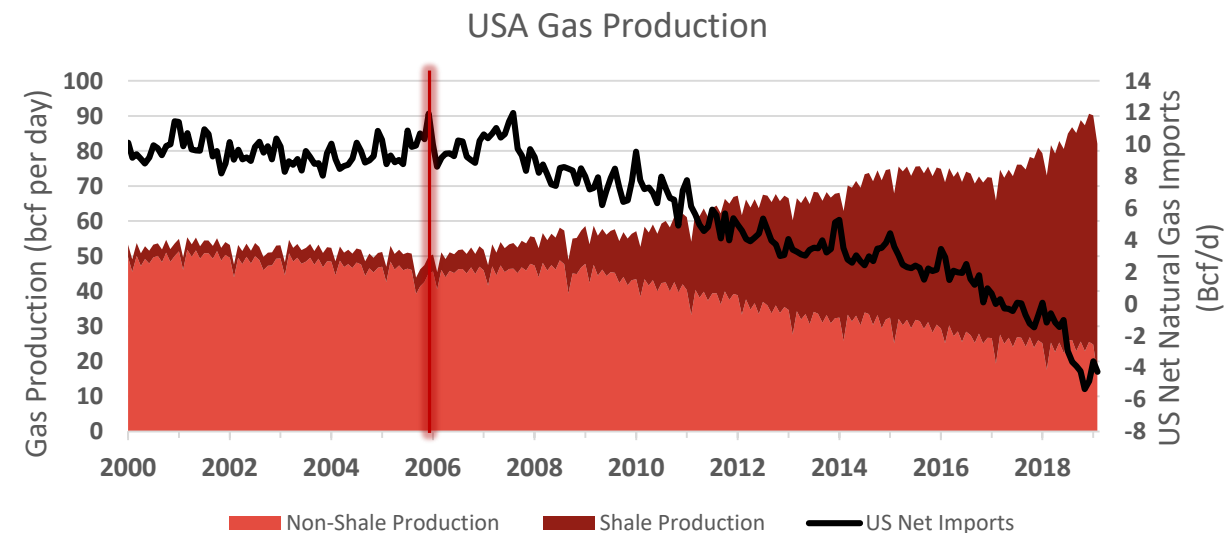
Have we seen this story before?



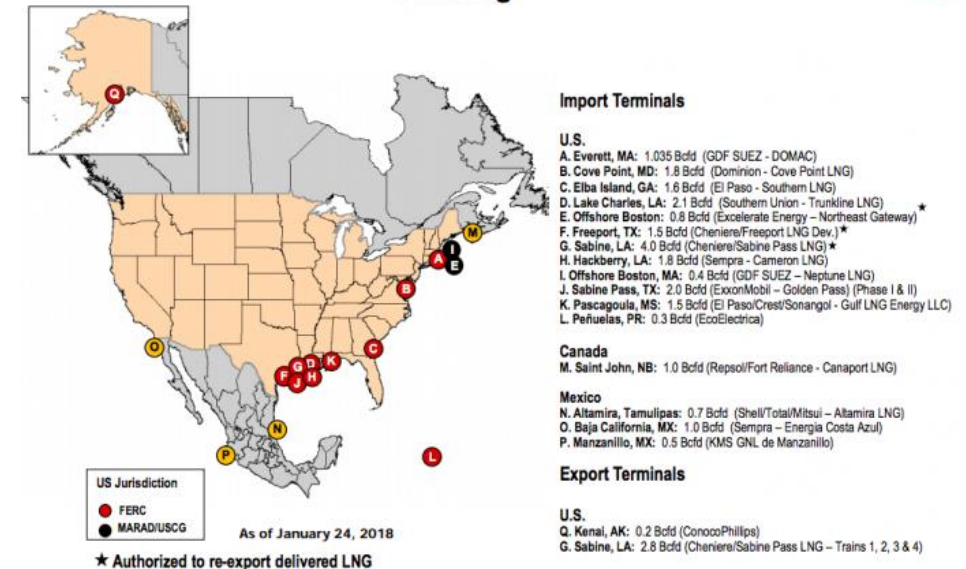
"The US is destined to become a key LNG import market" (BG)

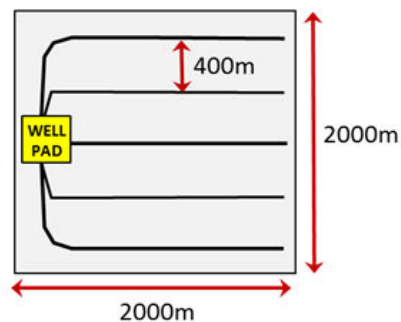
"North America emerges as a major importer of LNG" (EIA, IEEJ & others)

"Natural Gas prices will remain high in the US for the foreseeable future" (EIA)



North American LNG Import/Export Terminals Existing

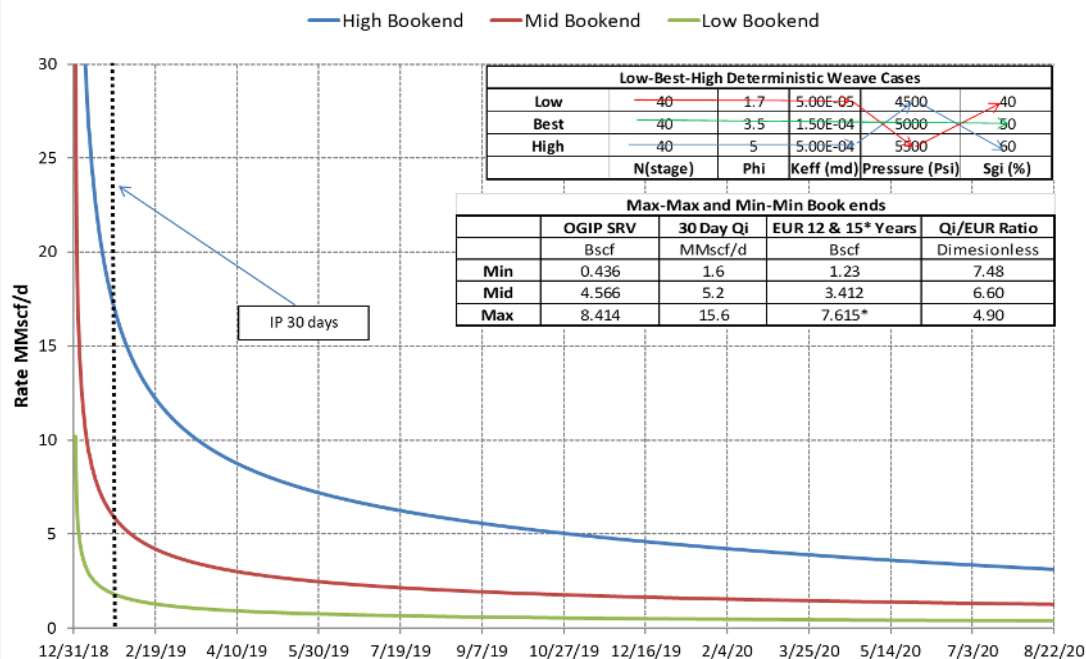




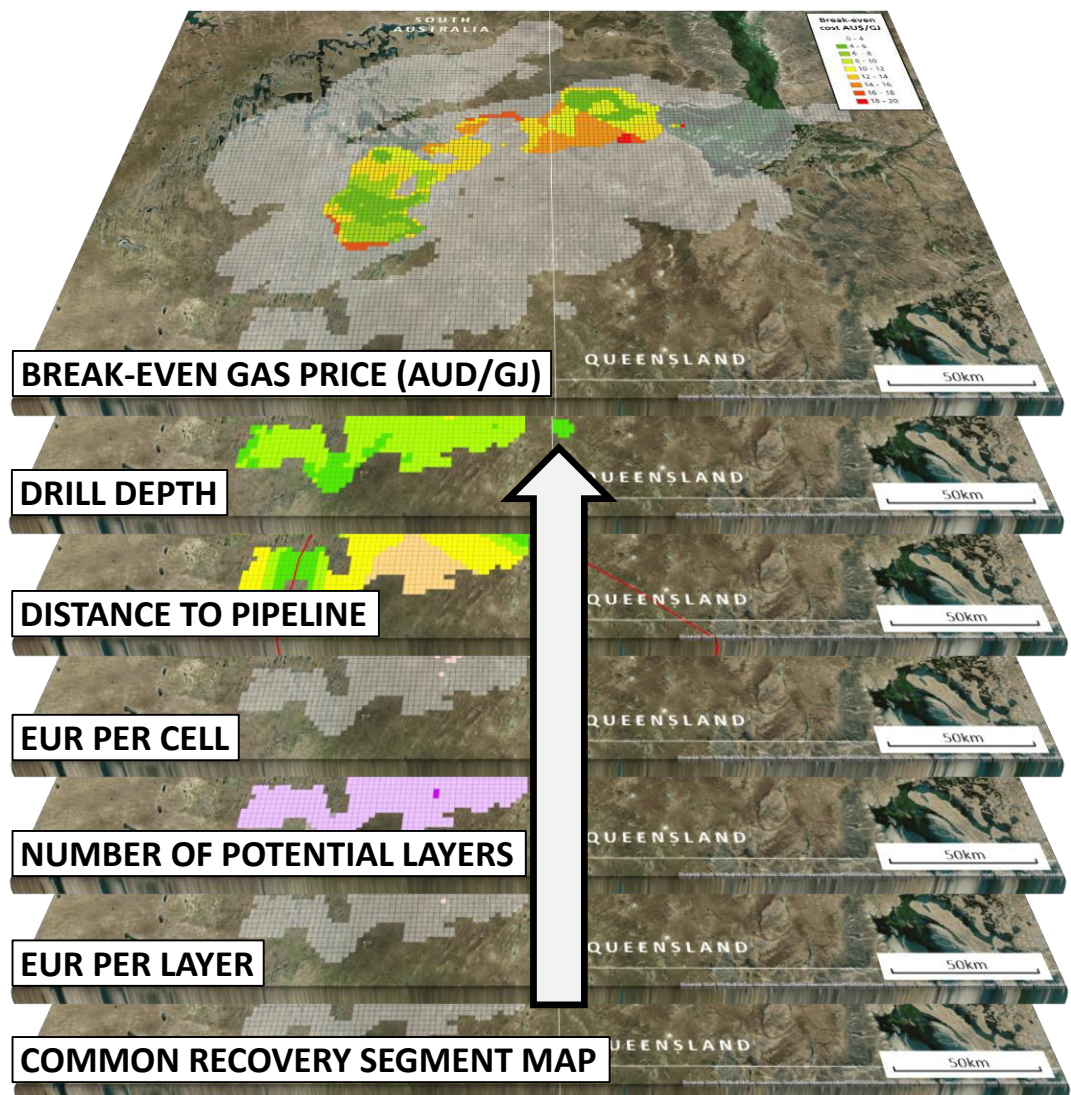
5 wells per 2km x 2km cell

X

Low, Best and High Deterministic Bookend Horizontal Frac Typecurves

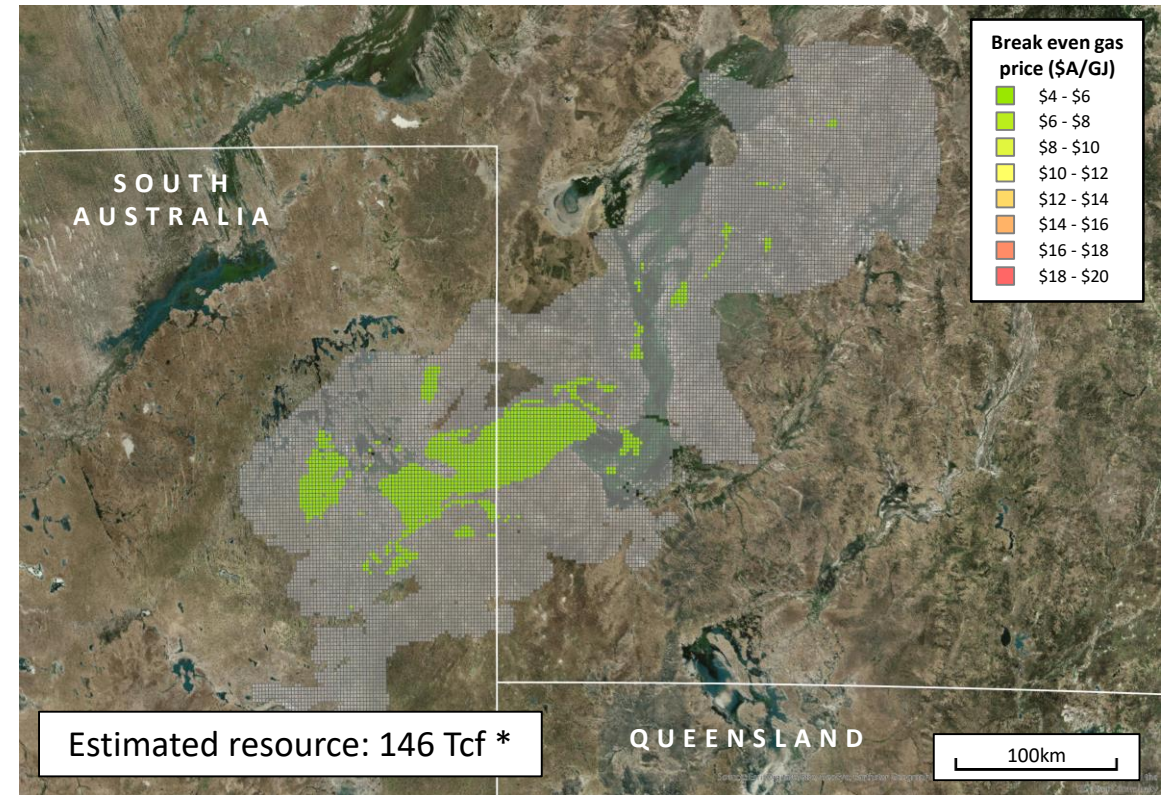
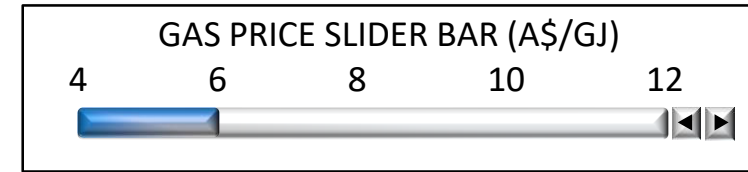
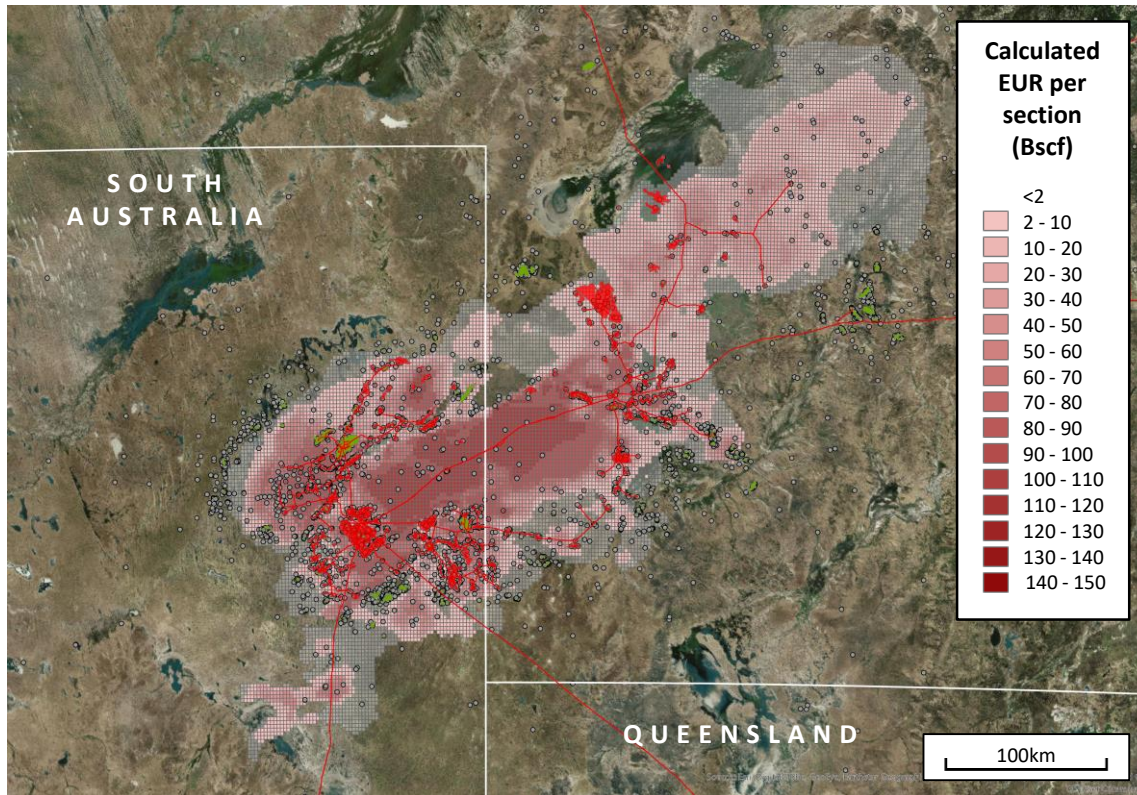


Breakeven Gas Price Mapping



Visualising East Coast gas potential

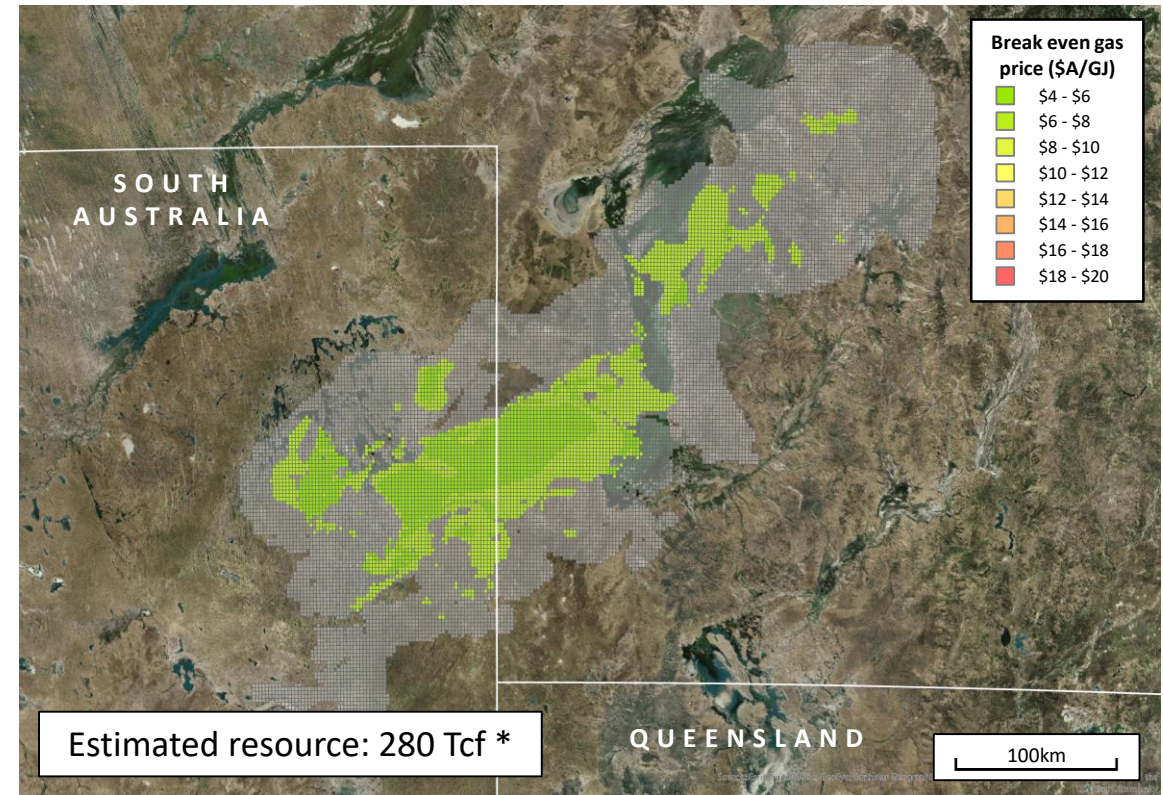
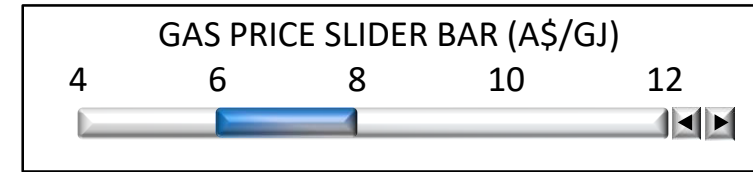
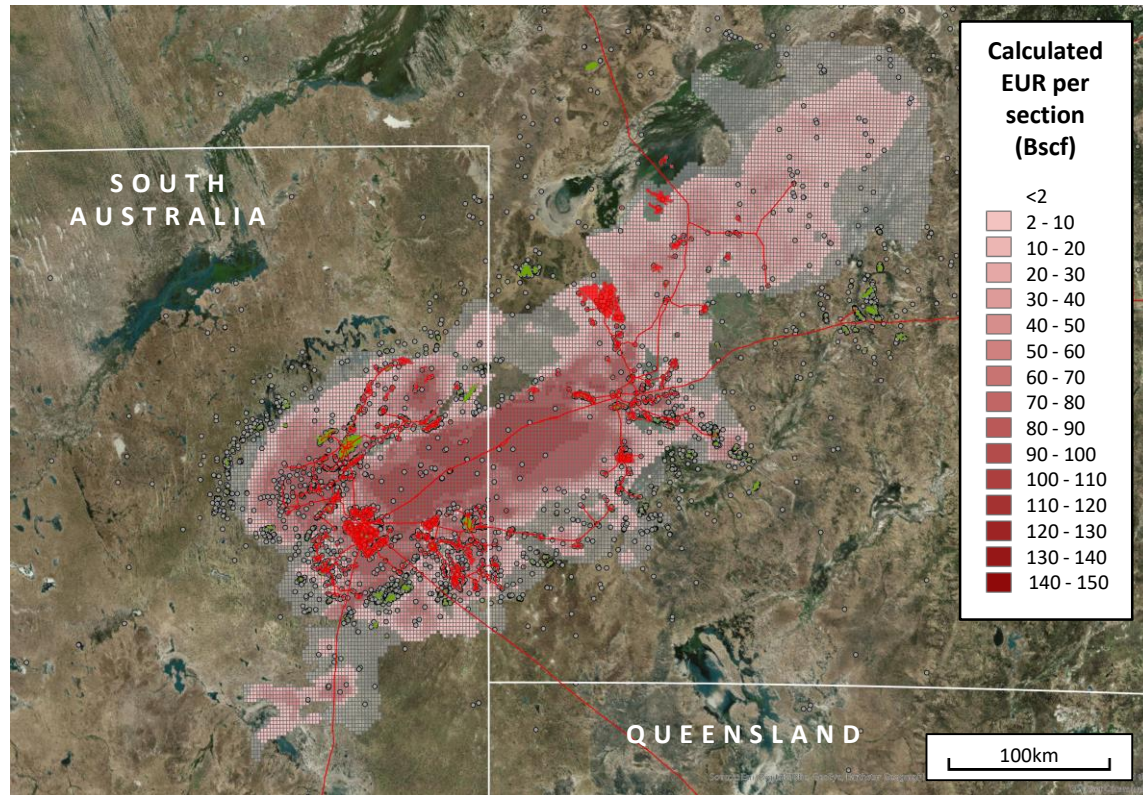
PATCHAWARRA ESTIMATED ULTIMATE RECOVERY POTENTIAL



* Mid-case type curve EUR with full development (Well count: **24,628**)

Visualising East Coast gas potential

PATCHAWARRA ESTIMATED ULTIMATE RECOVERY POTENTIAL

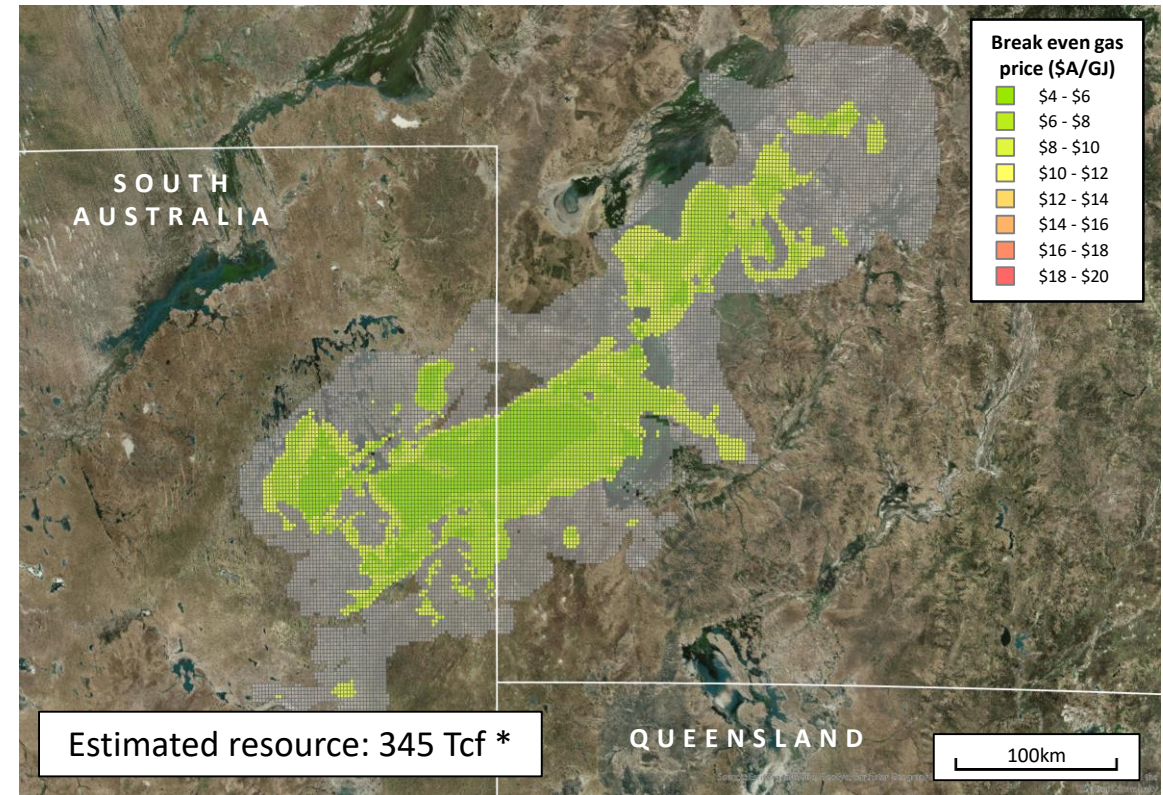
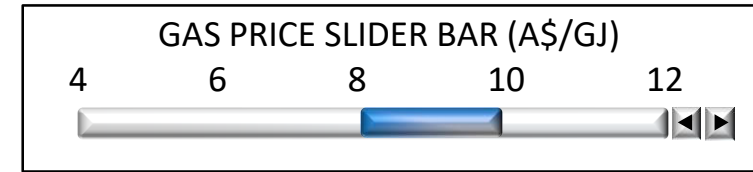
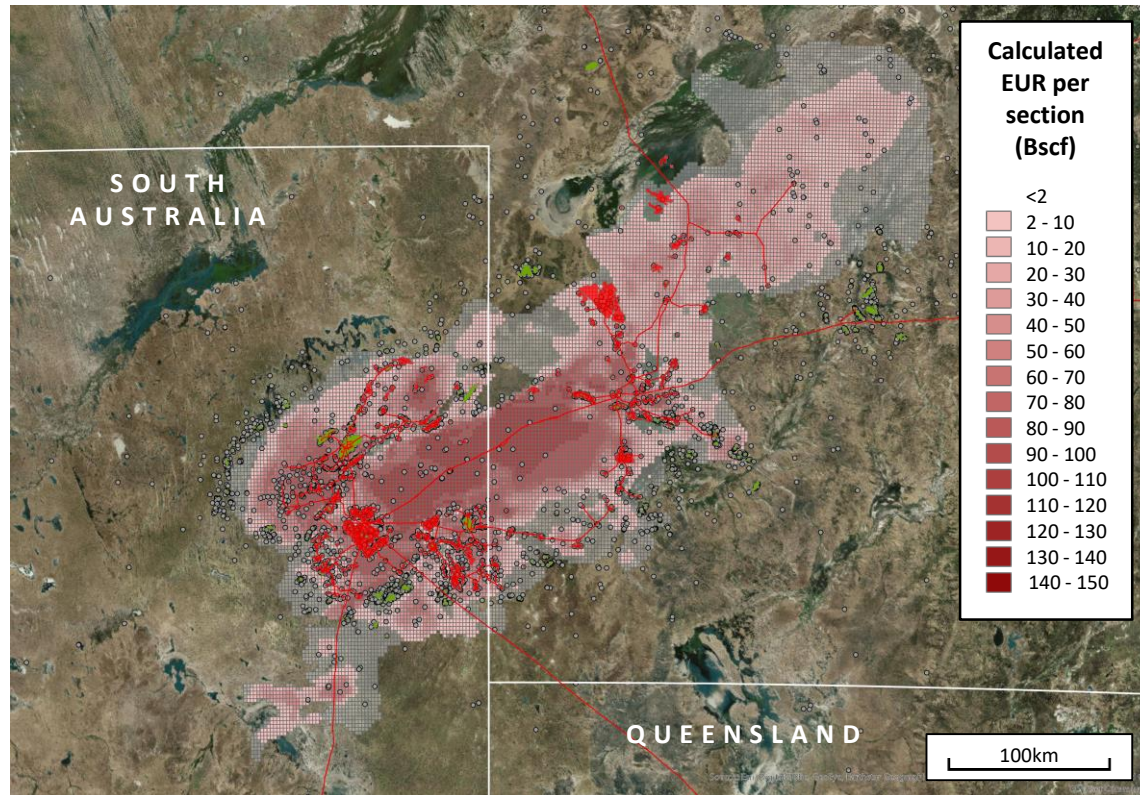


* Mid-case type curve EUR with full development (Well count: **53,503**)

Visualising East Coast gas potential



PATCHAWARRA ESTIMATED ULTIMATE RECOVERY POTENTIAL

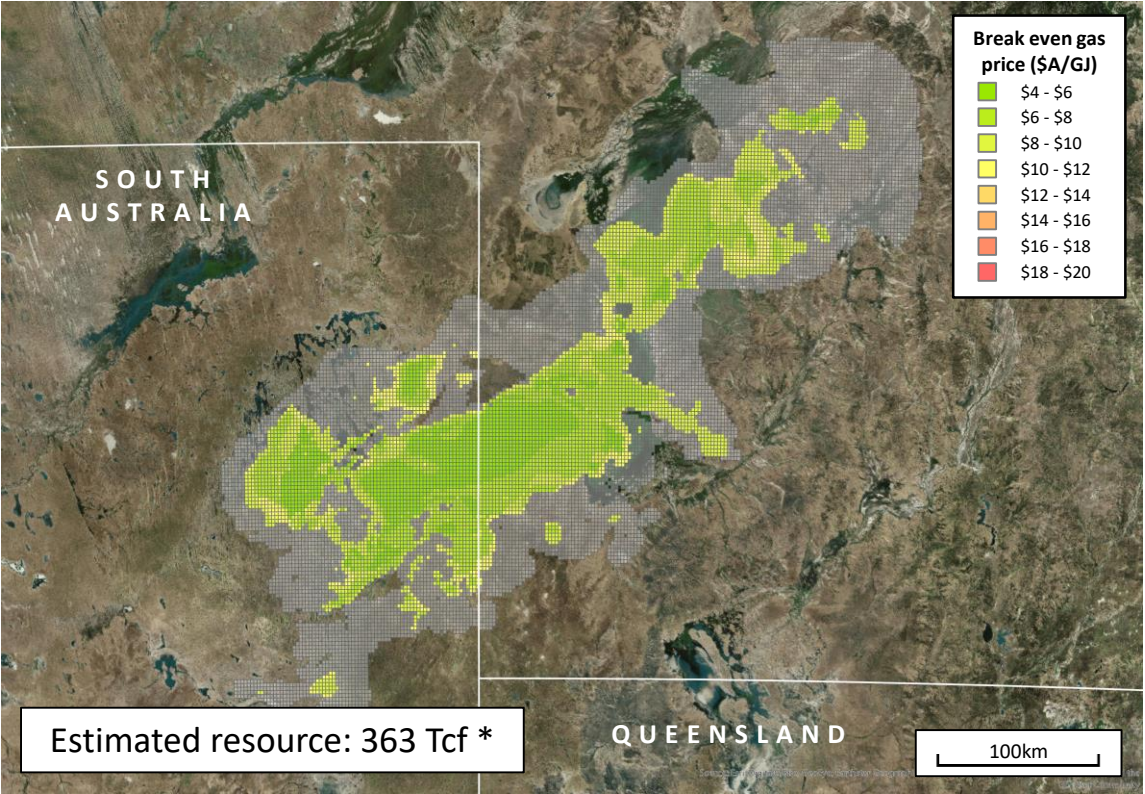
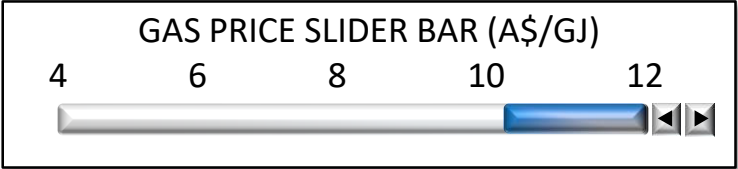
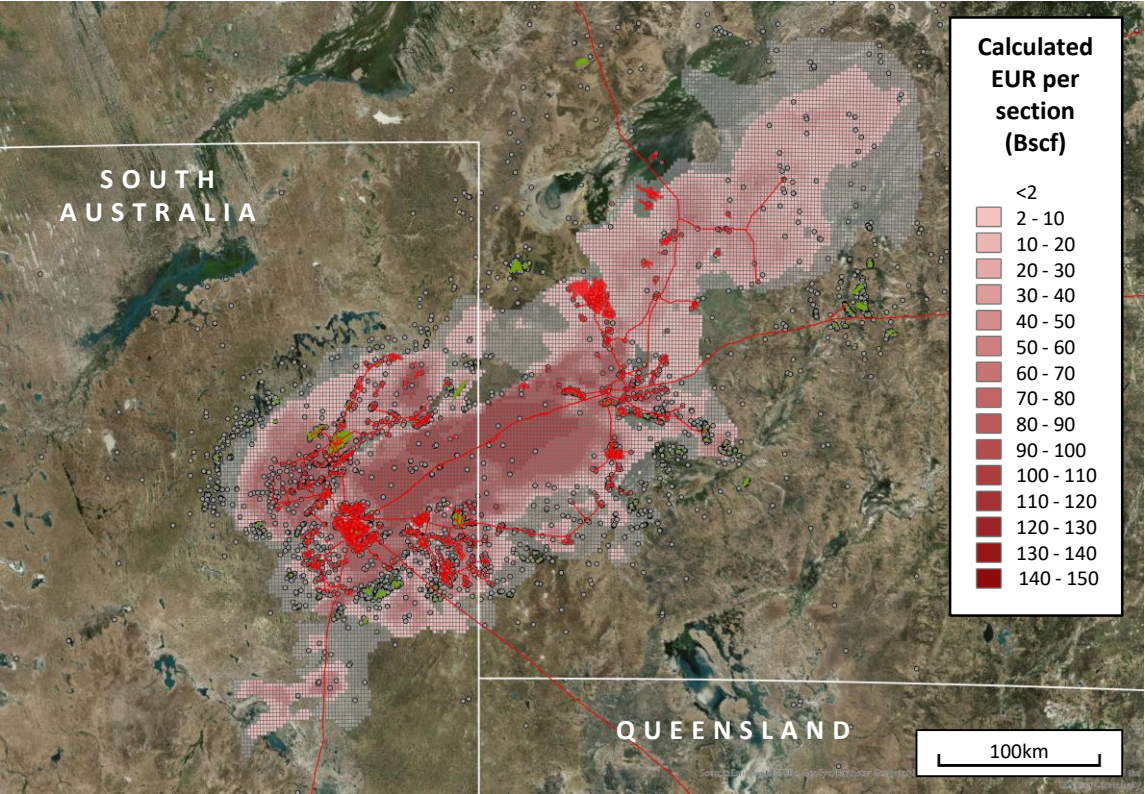


* Mid-case type curve EUR with full development (Well count: **71,615**)

Visualising East Coast gas potential

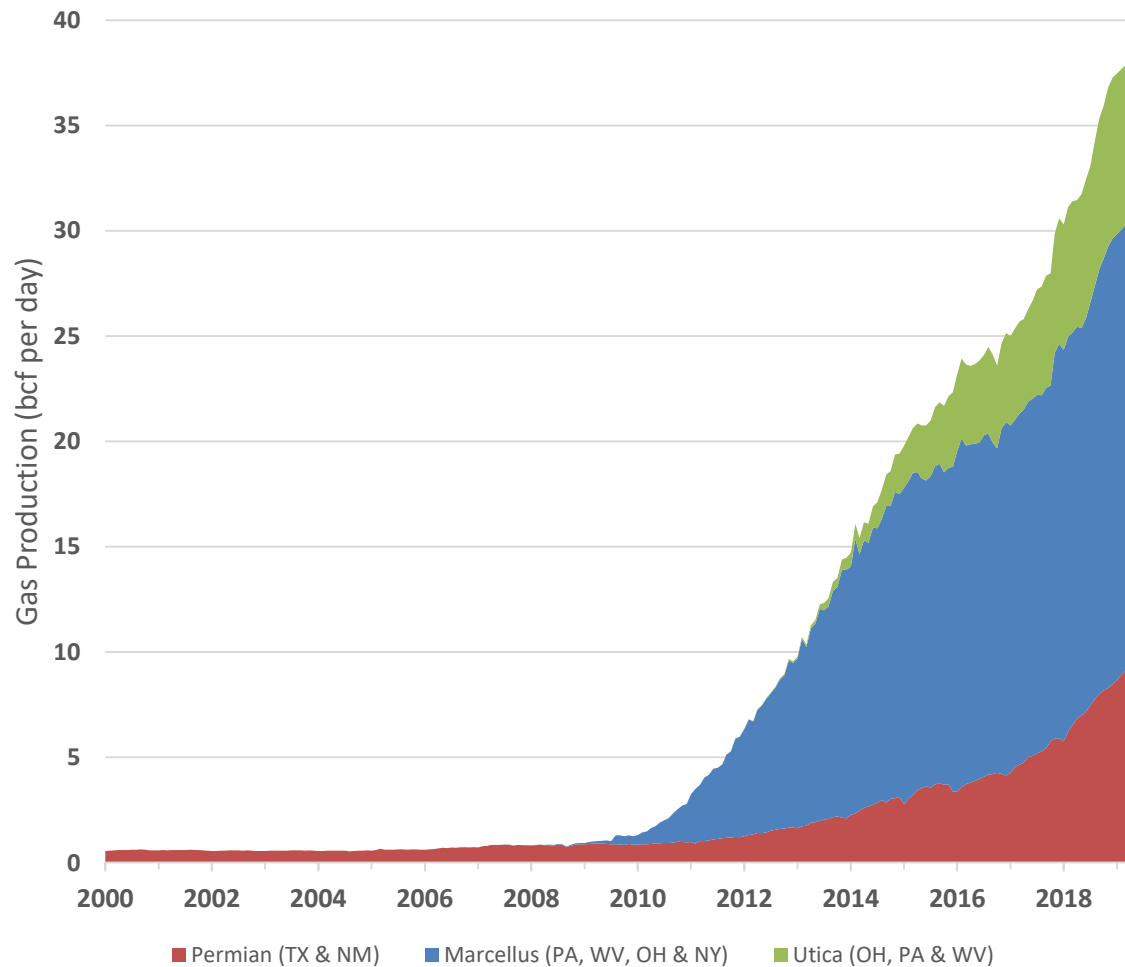


PATCHAWARRA ESTIMATED ULTIMATE RECOVERY POTENTIAL

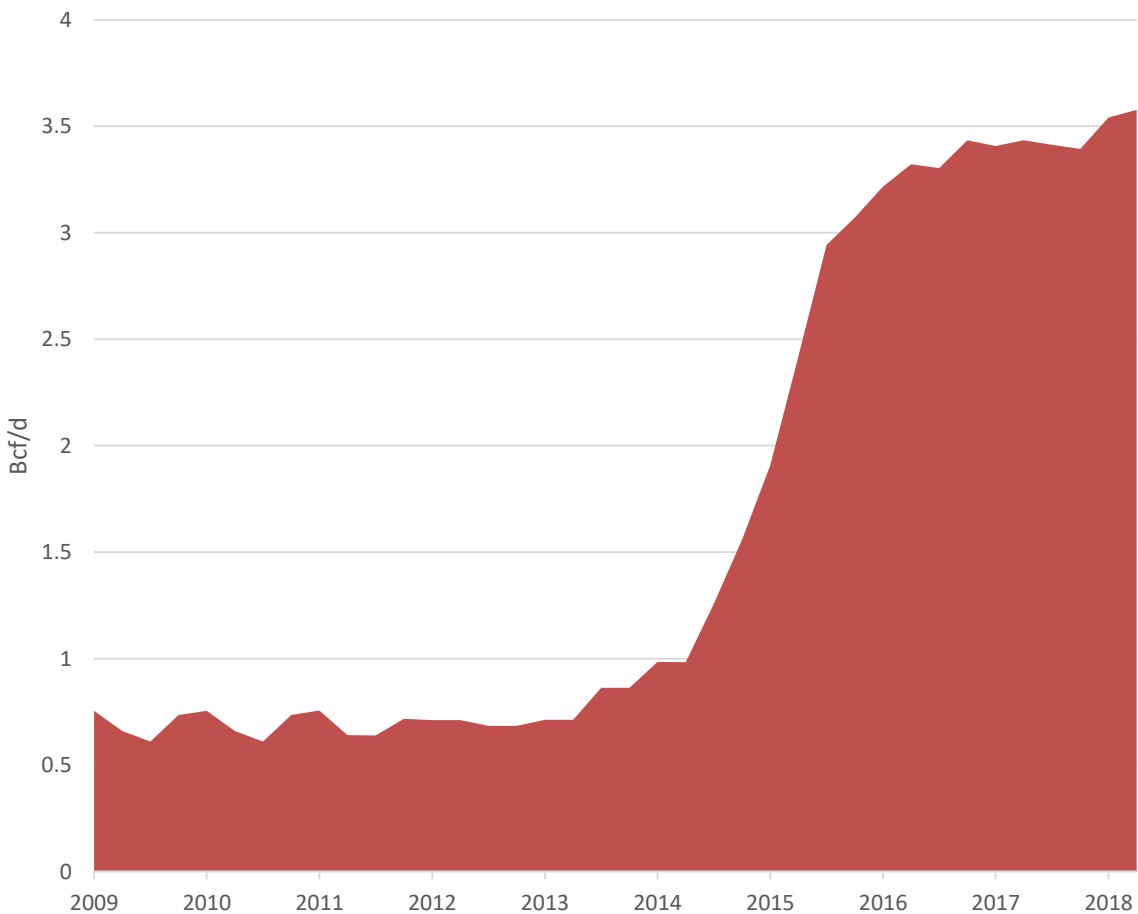


* Mid-case type curve EUR with full development (Well count: **77,763**)

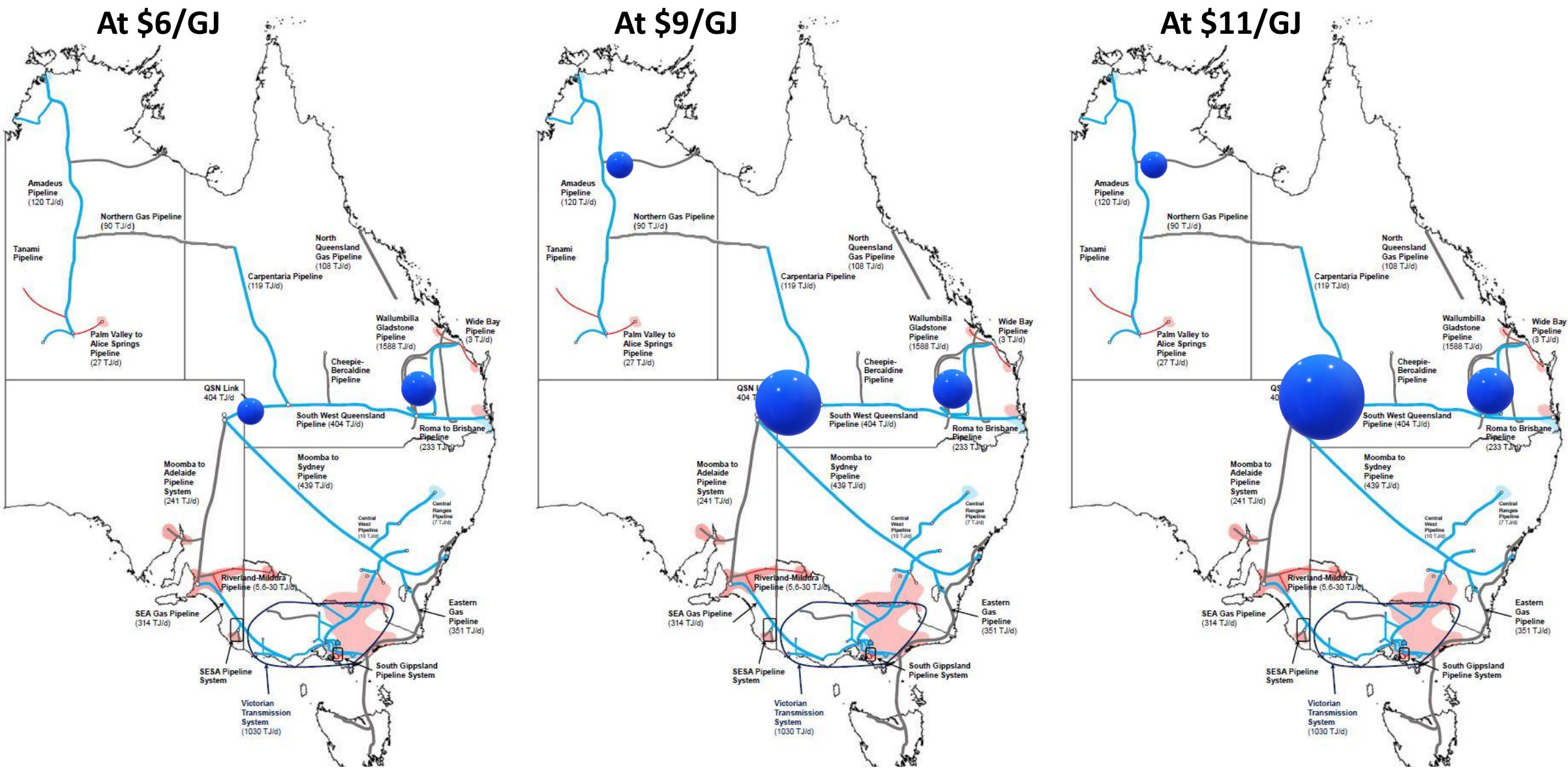
USA Shale Gas Production



Australian CSG Production



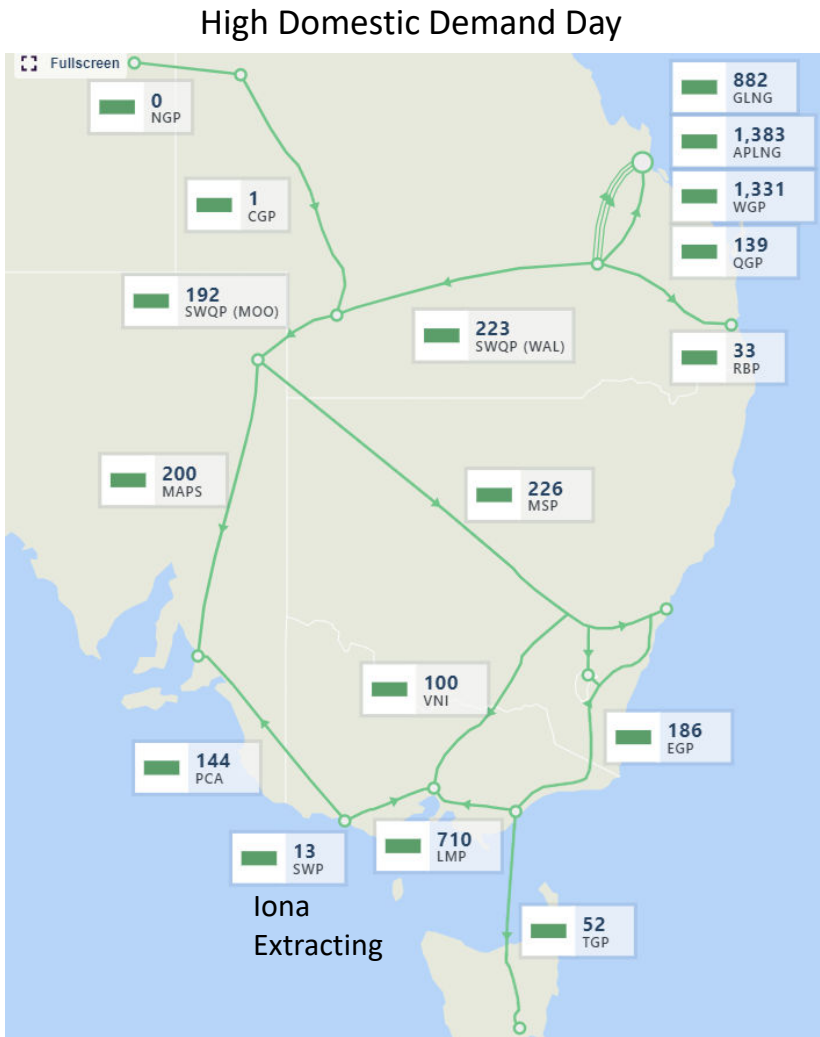
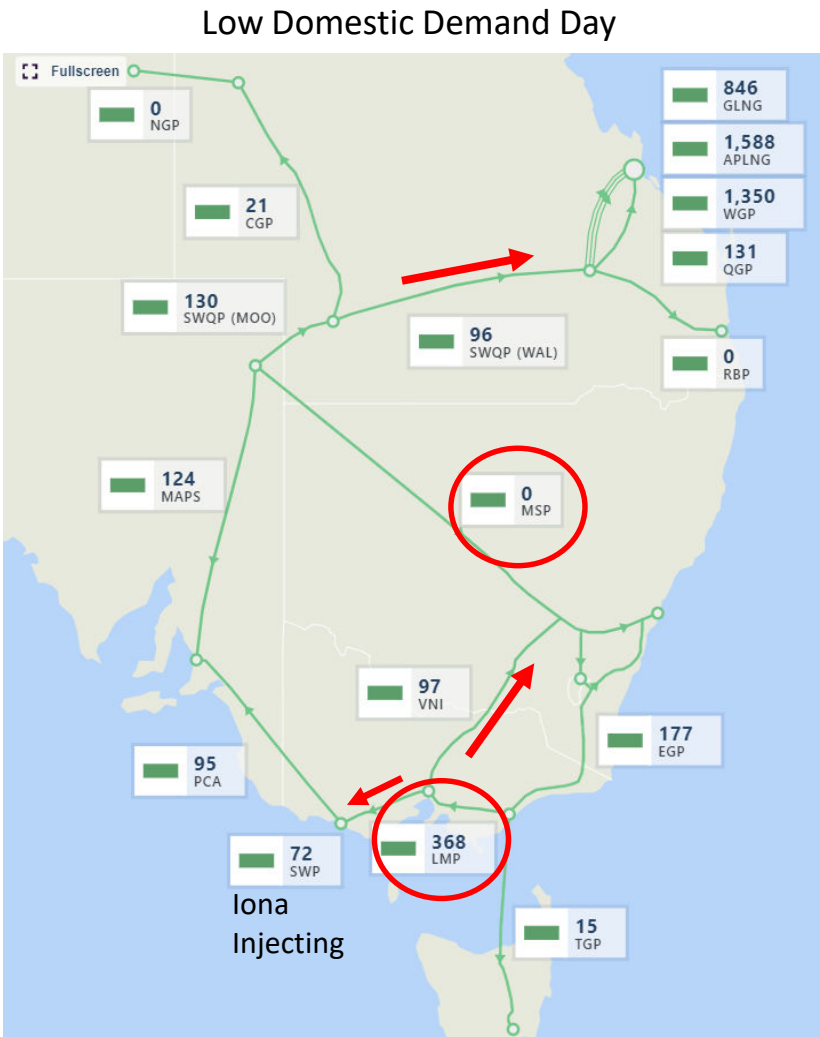
Total eastern Australia Unconventional Potential



East Coast Gas Market Model



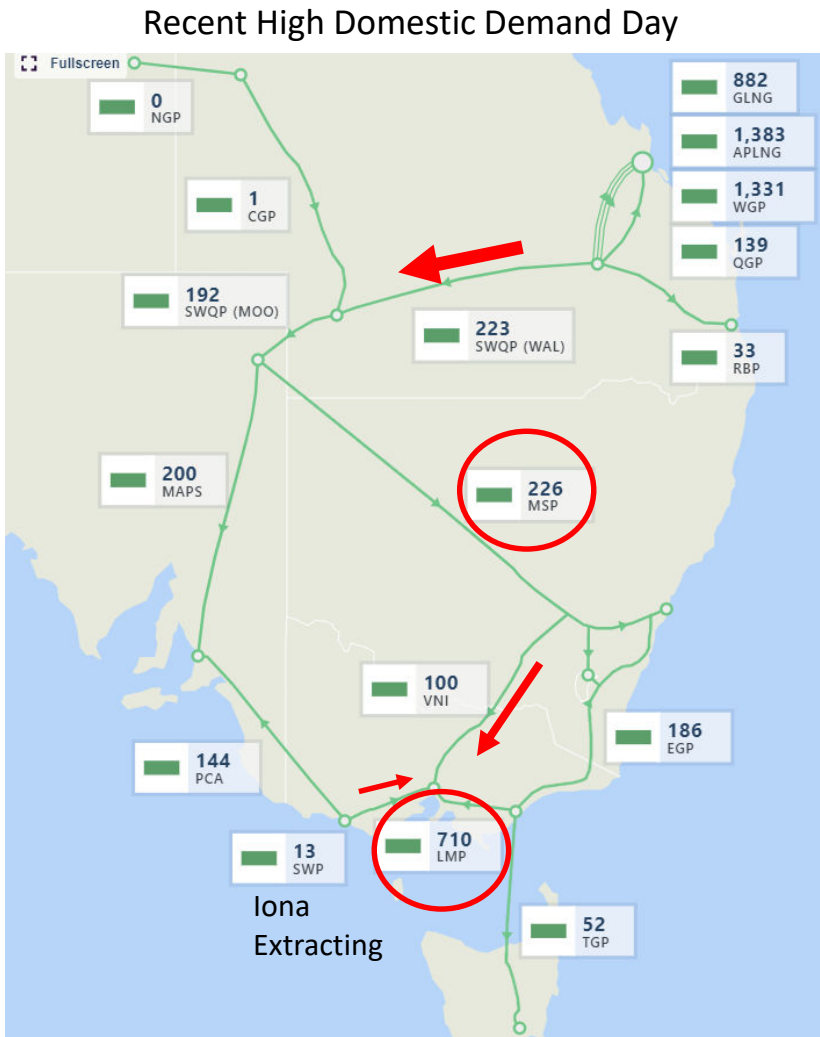
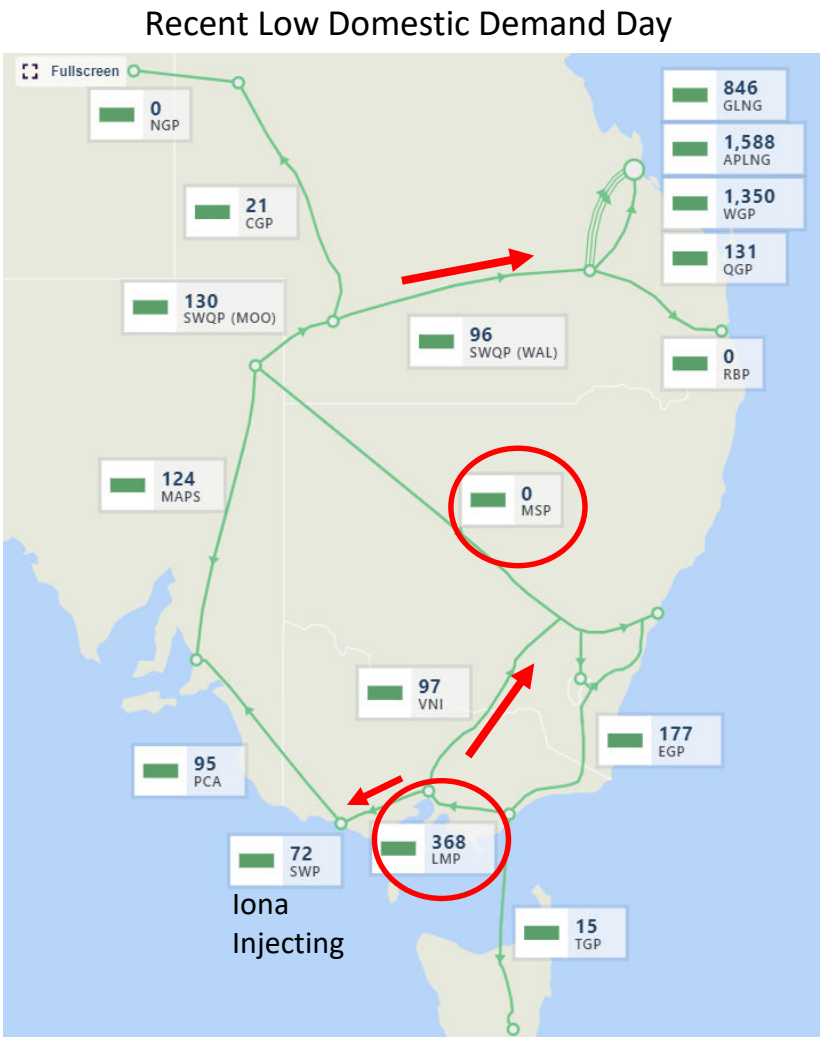
Market model built on gas supply network with supply aggregated at the basin level and demand aggregated at pipeline termination points



East Coast Gas Market Model



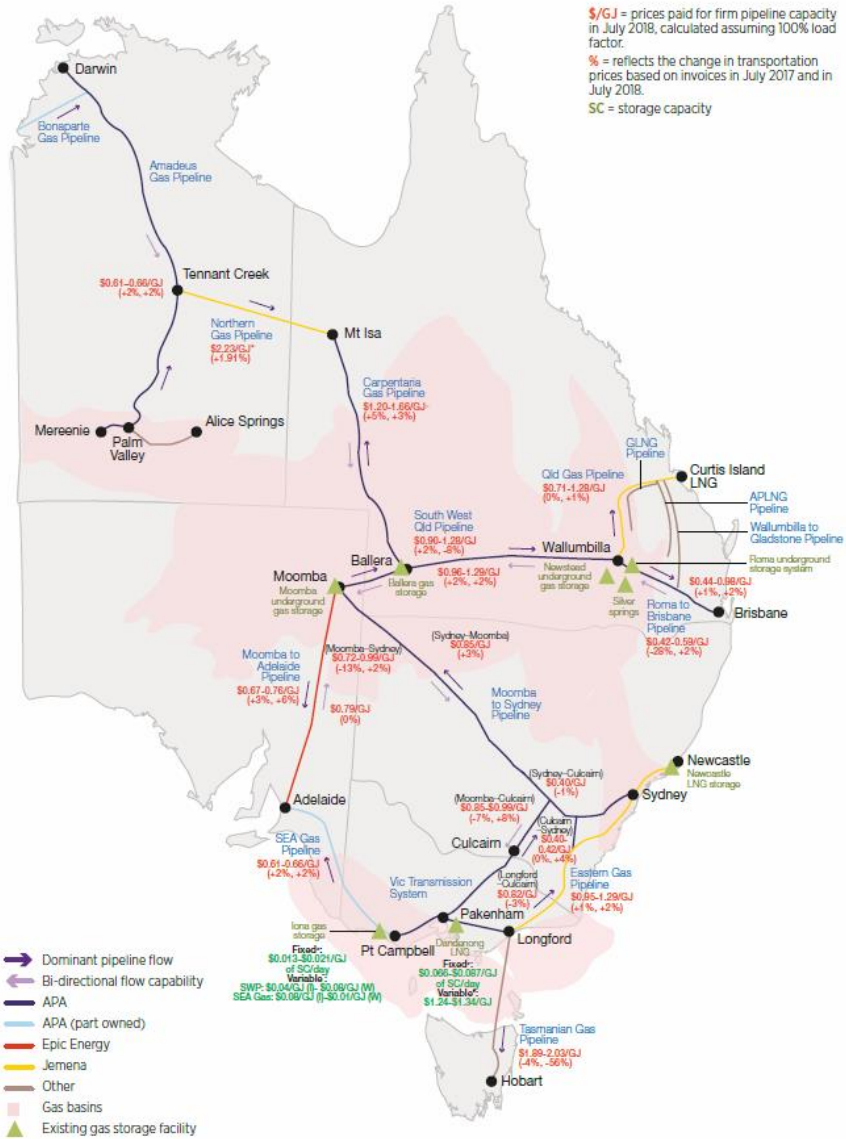
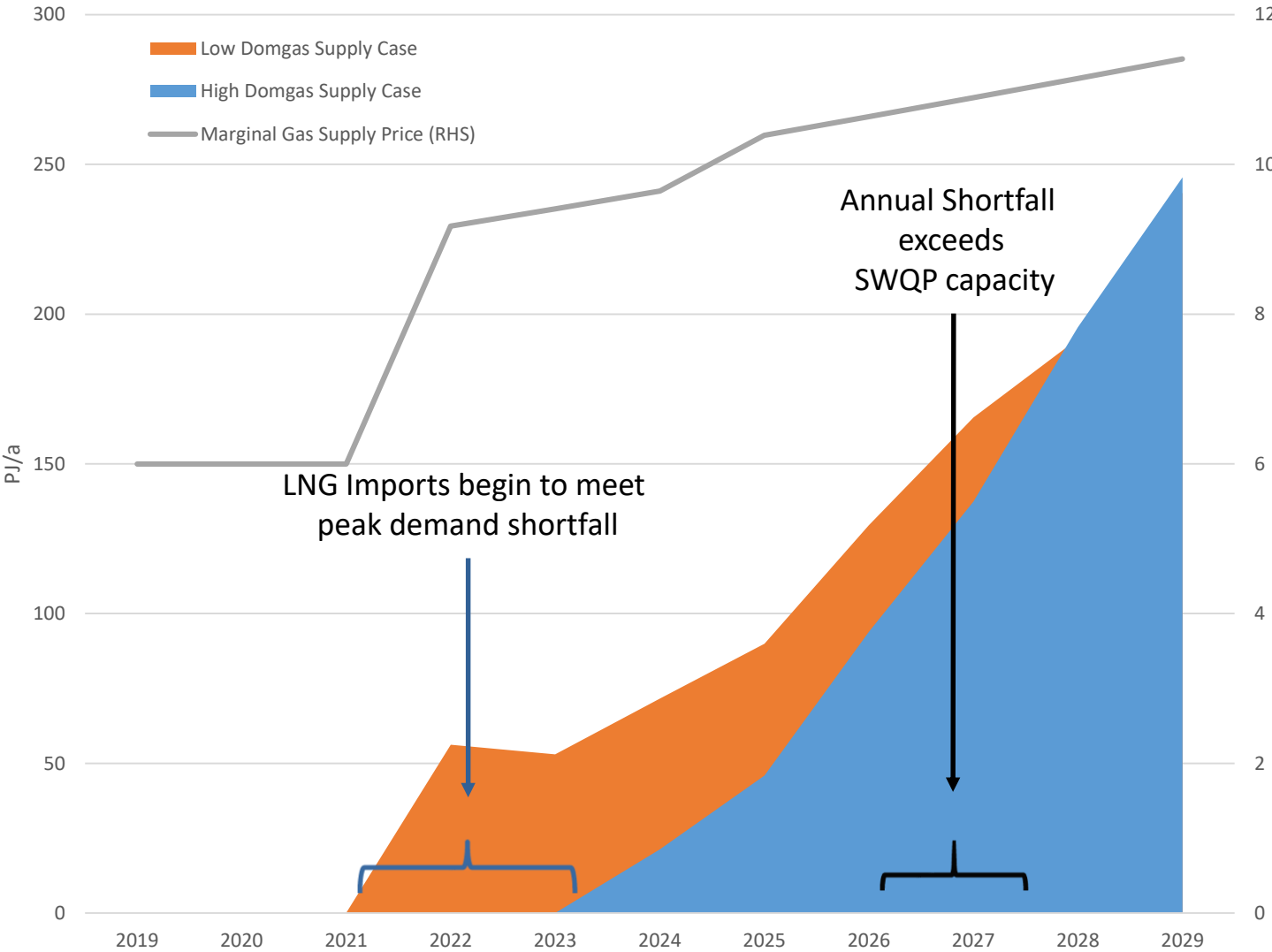
Market model built on gas supply network with supply aggregated at the basin level and demand aggregated at pipeline termination points



East Coast Gas Market Model



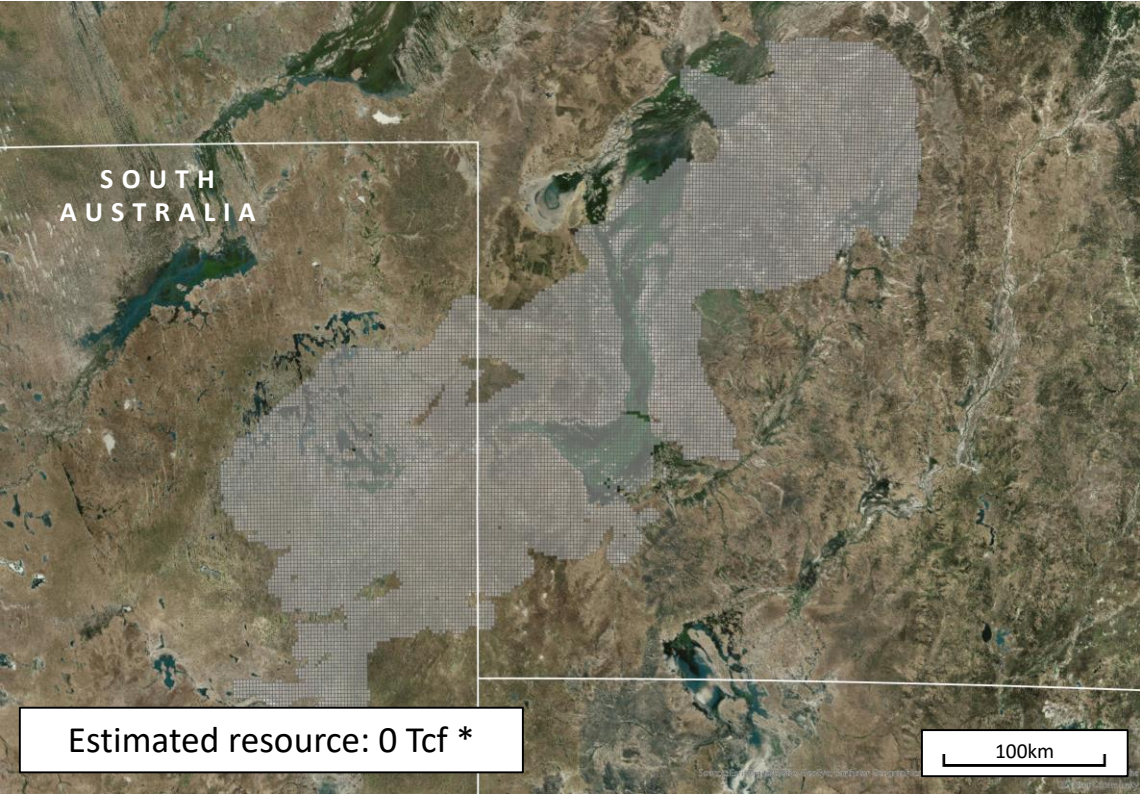
Southern States Supply Gap Range



Market Supply Scenario Analysis

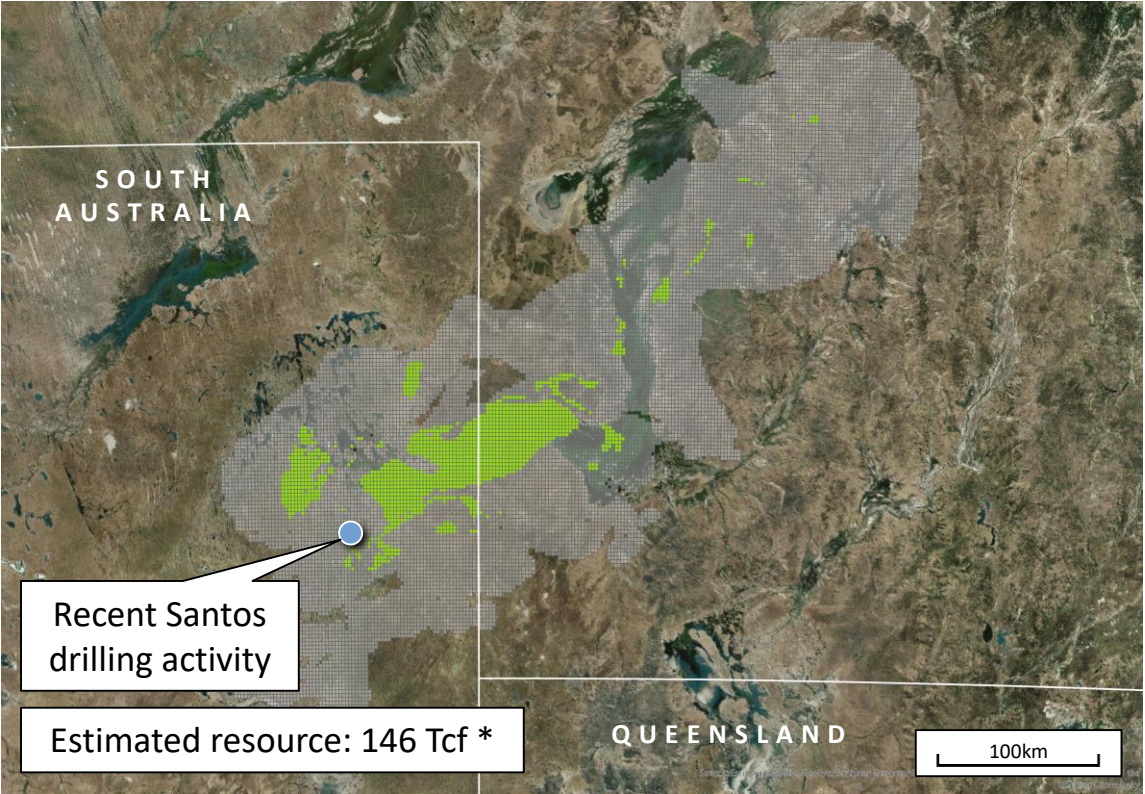


Market supply volume at A\$6/GJ



PATCHAWARRA ESTIMATED ULTIMATE RECOVERY POTENTIAL

Market supply volume at A\$9/GJ



PATCHAWARRA ESTIMATED ULTIMATE RECOVERY POTENTIAL

Market Supply Scenario Analysis

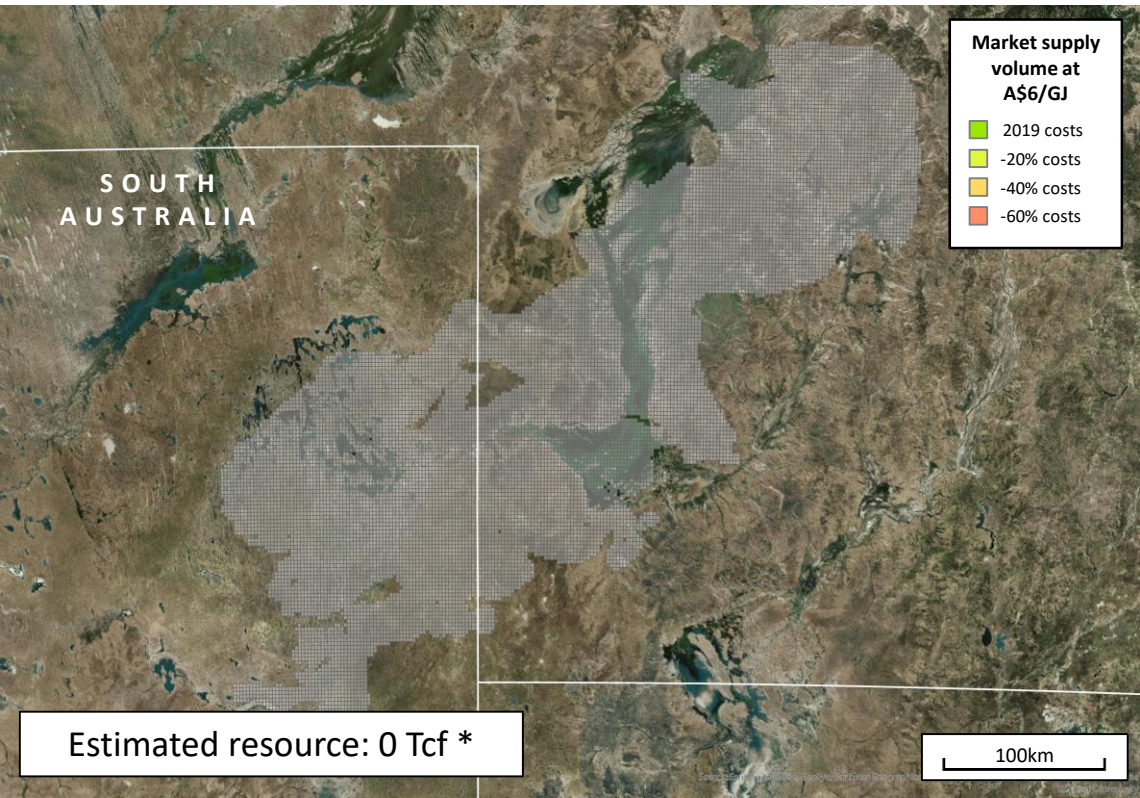


DEVELOPMENT COST SLIDER BAR (%)

0% -20% -40% -60%

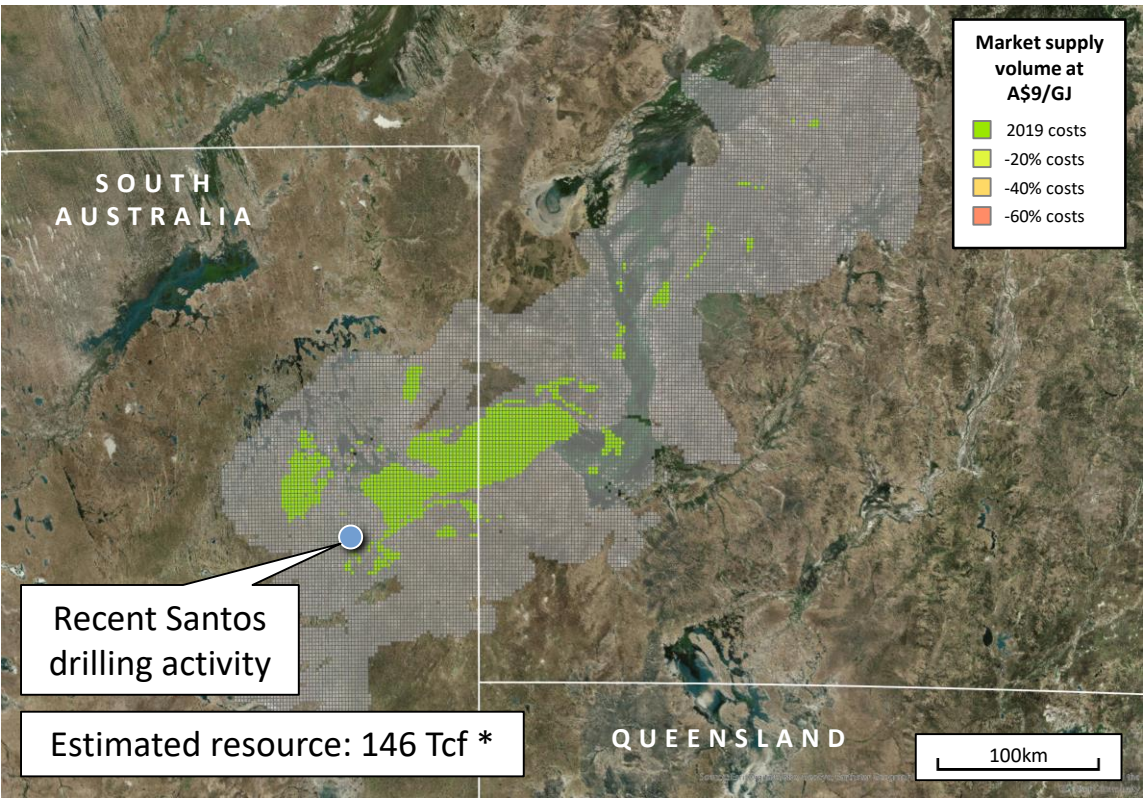


Market supply volume at A\$6/GJ



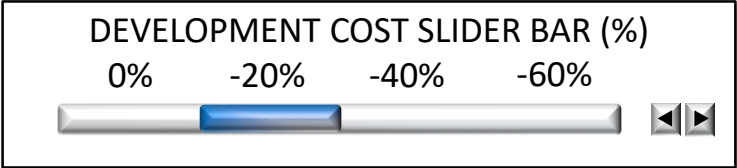
PATCHAWARRA ESTIMATED ULTIMATE RECOVERY POTENTIAL

Market supply volume at A\$9/GJ

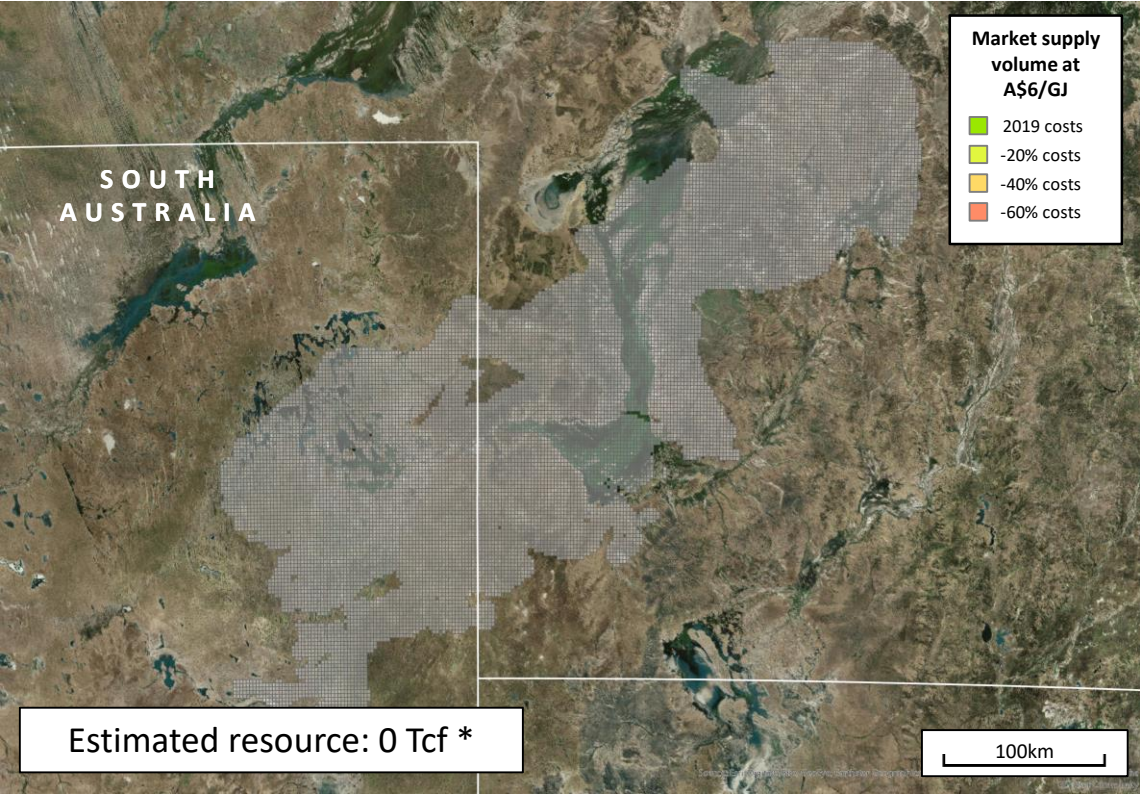


PATCHAWARRA ESTIMATED ULTIMATE RECOVERY POTENTIAL

Development Cost Optimisation – 20% Reduction in Development Costs

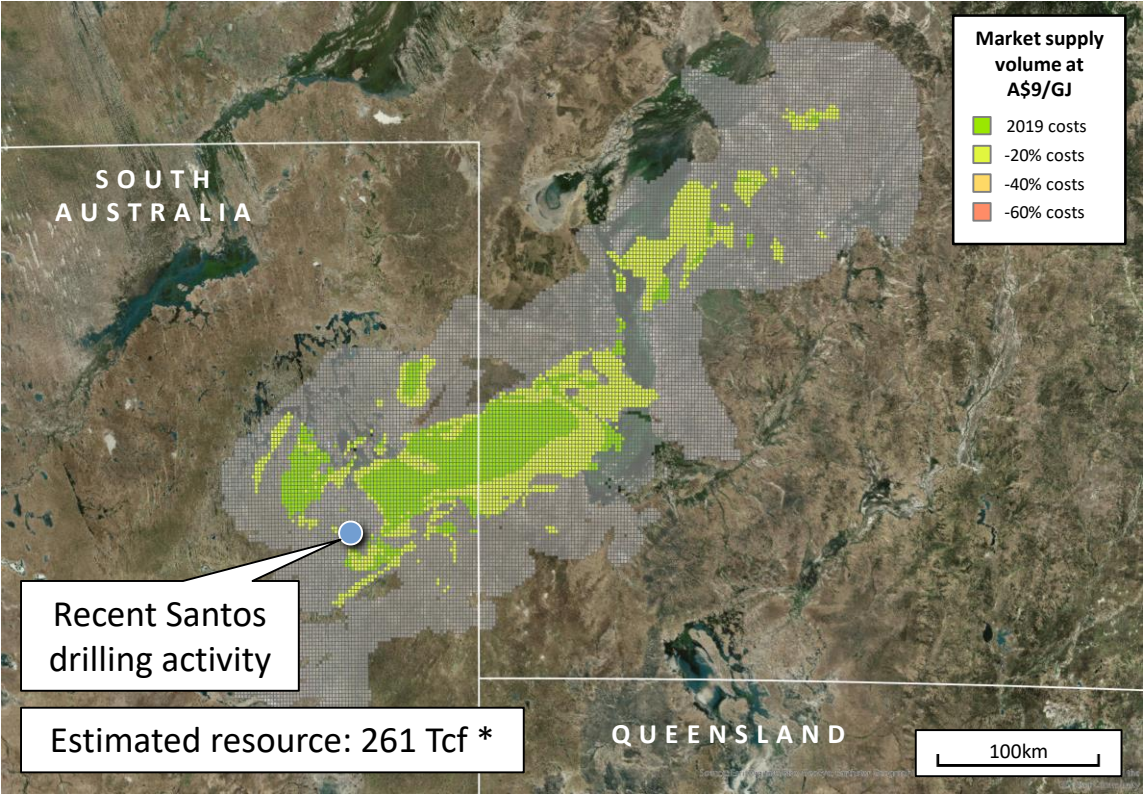


Market supply volume at A\$6/GJ



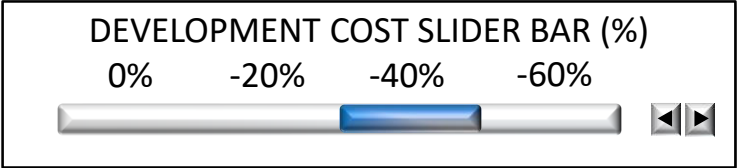
PATCHAWARRA ESTIMATED ULTIMATE RECOVERY POTENTIAL

Market supply volume at A\$9/GJ

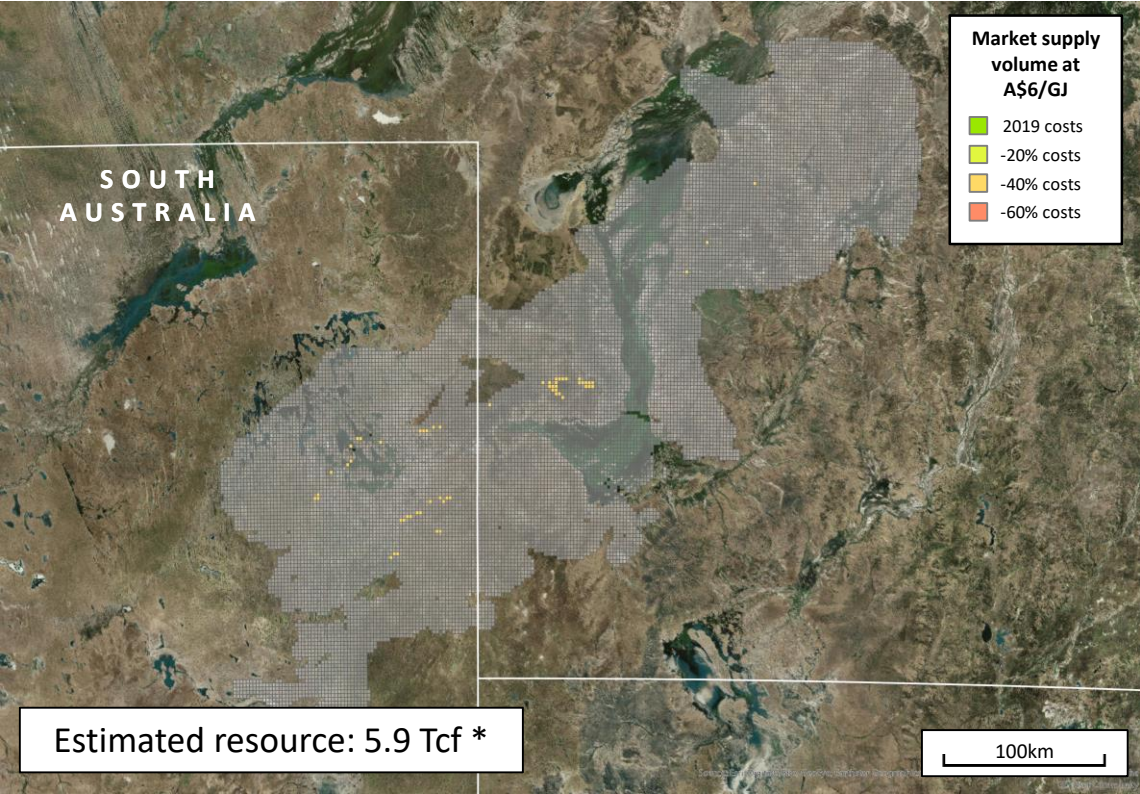


PATCHAWARRA ESTIMATED ULTIMATE RECOVERY POTENTIAL

Development Cost Optimisation – 40% Reduction in Development Costs

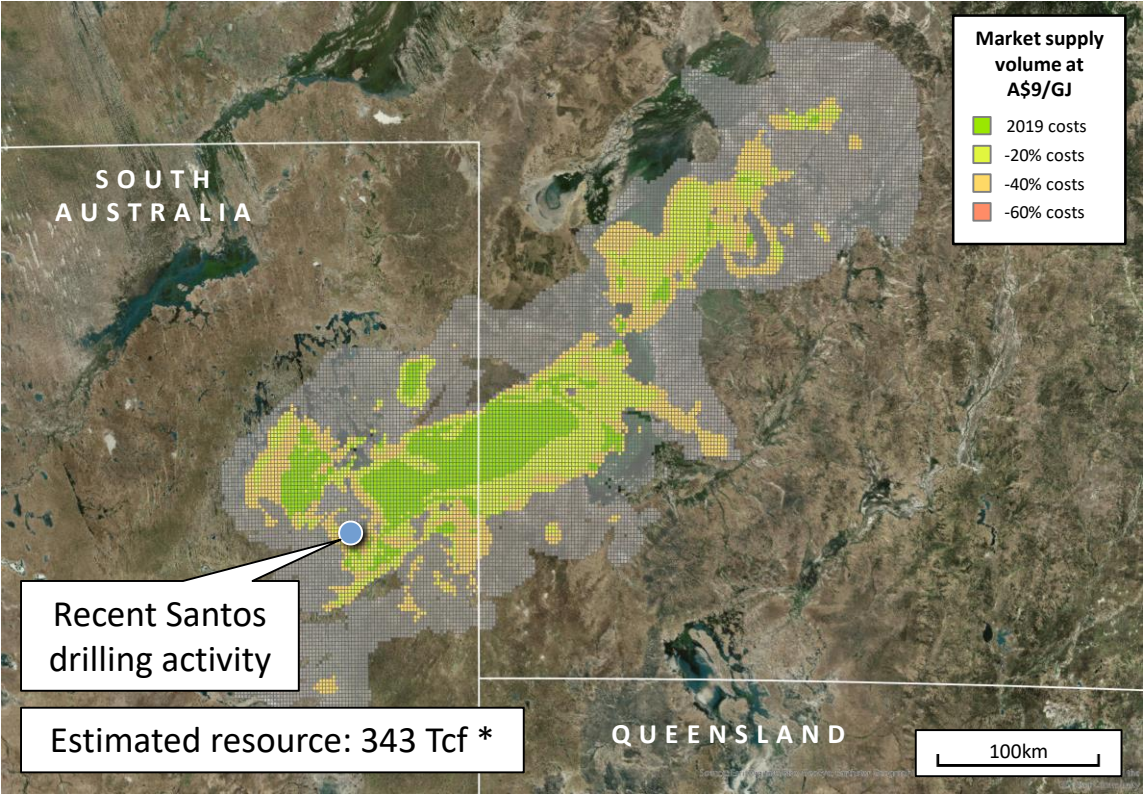


Market supply volume at A\$6/GJ



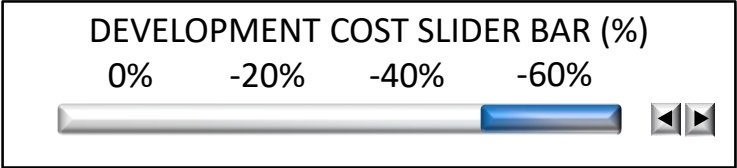
PATCHAWARRA ESTIMATED ULTIMATE RECOVERY POTENTIAL

Market supply volume at A\$9/GJ

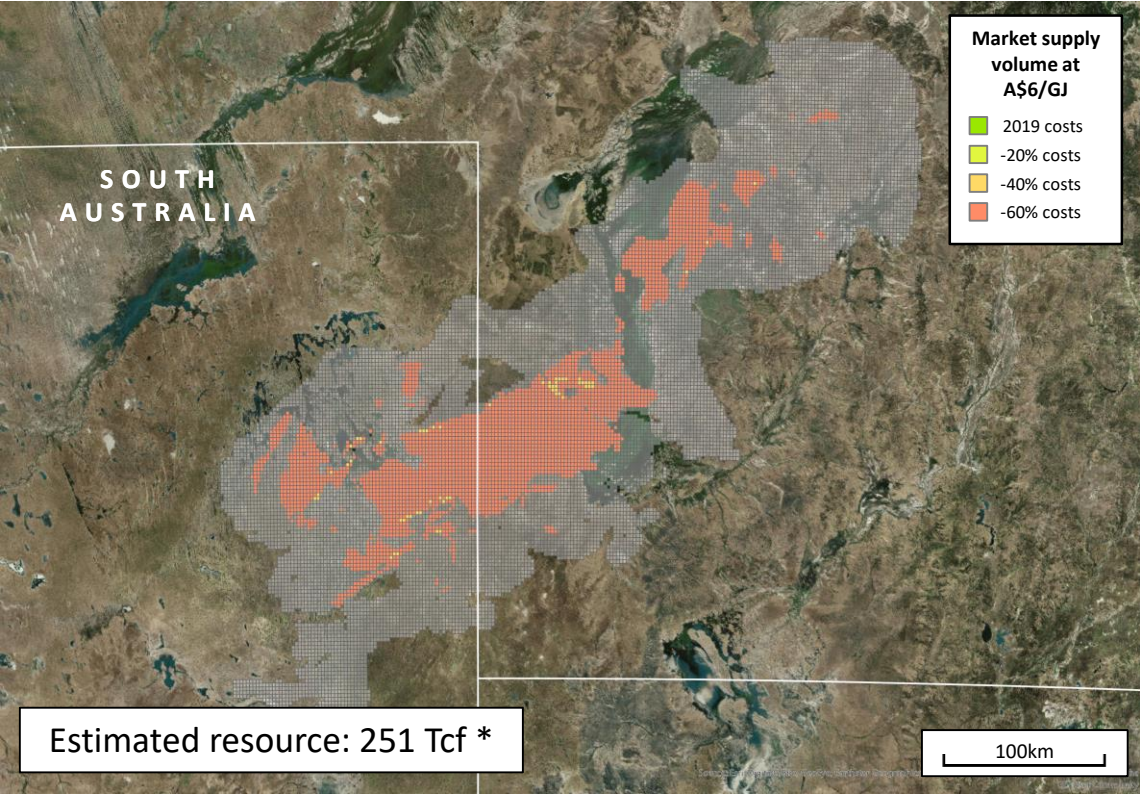


PATCHAWARRA ESTIMATED ULTIMATE RECOVERY POTENTIAL

Development Cost Optimisation – 60% Reduction in Development Costs

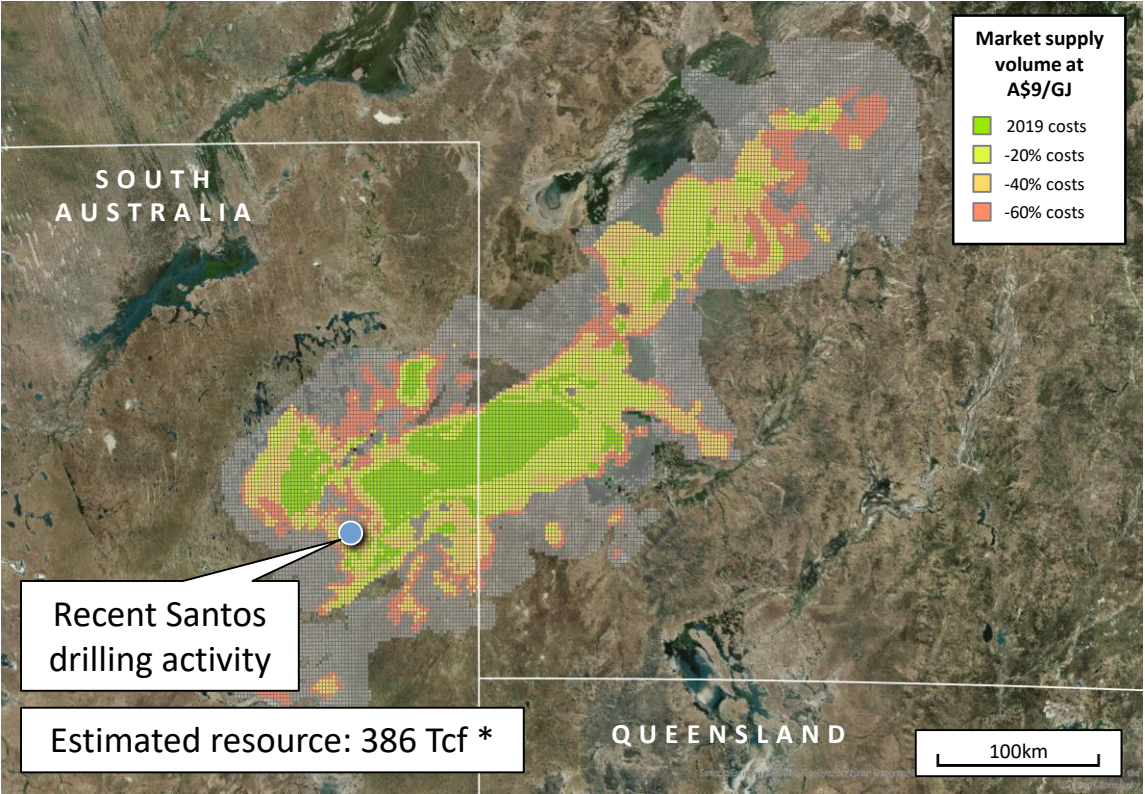


Market supply volume at A\$6/GJ



PATCHAWARRA ESTIMATED ULTIMATE RECOVERY POTENTIAL

Market supply volume at A\$9/GJ

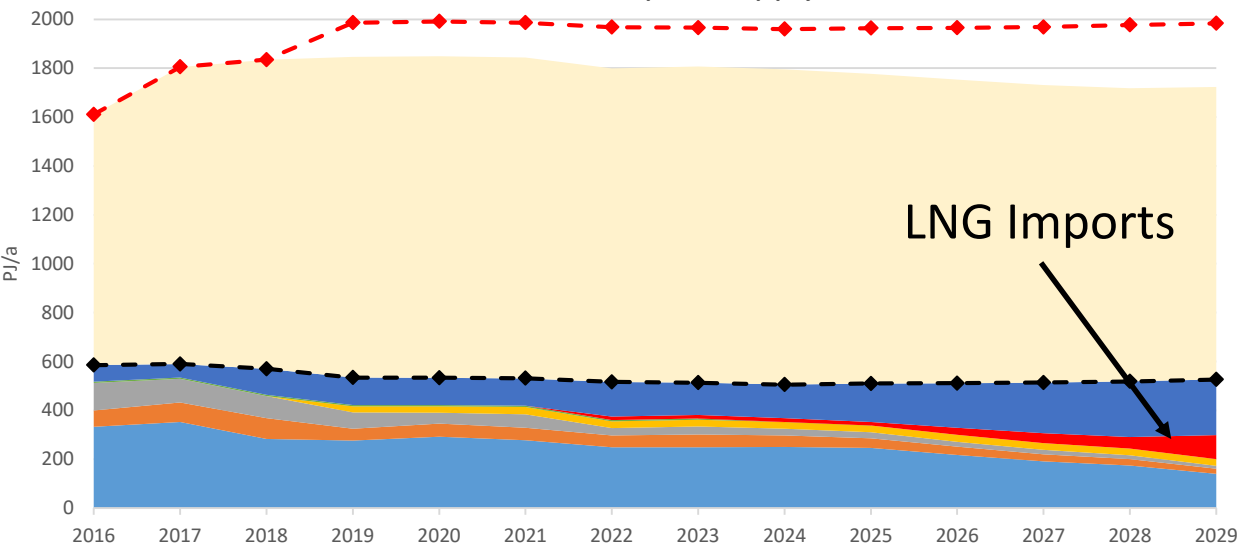


PATCHAWARRA ESTIMATED ULTIMATE RECOVERY POTENTIAL

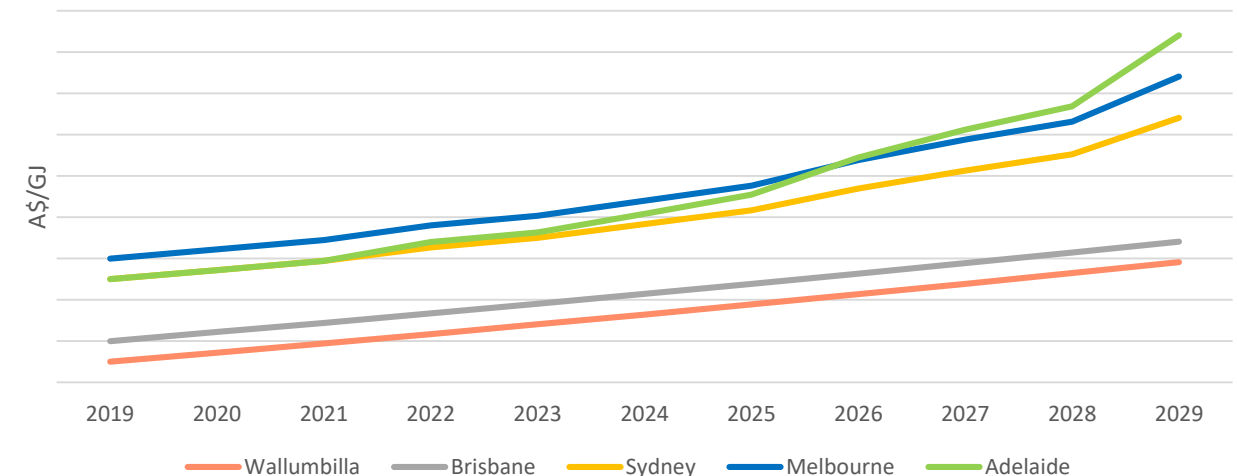
East Coast Gas Market Model Forecasts



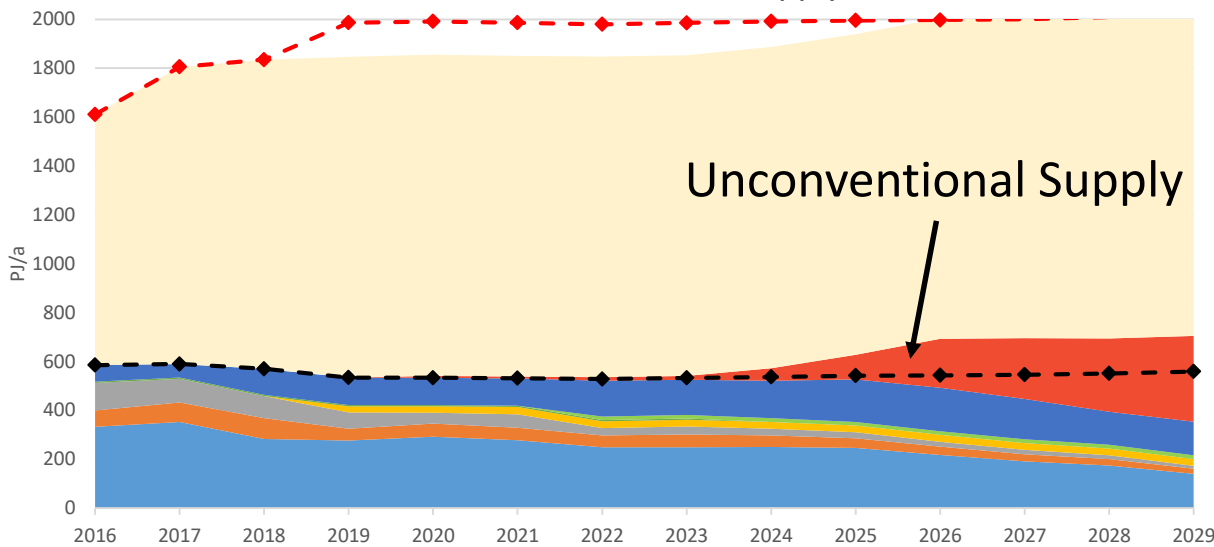
East Coast 2P + LNG Import Supply Forecast



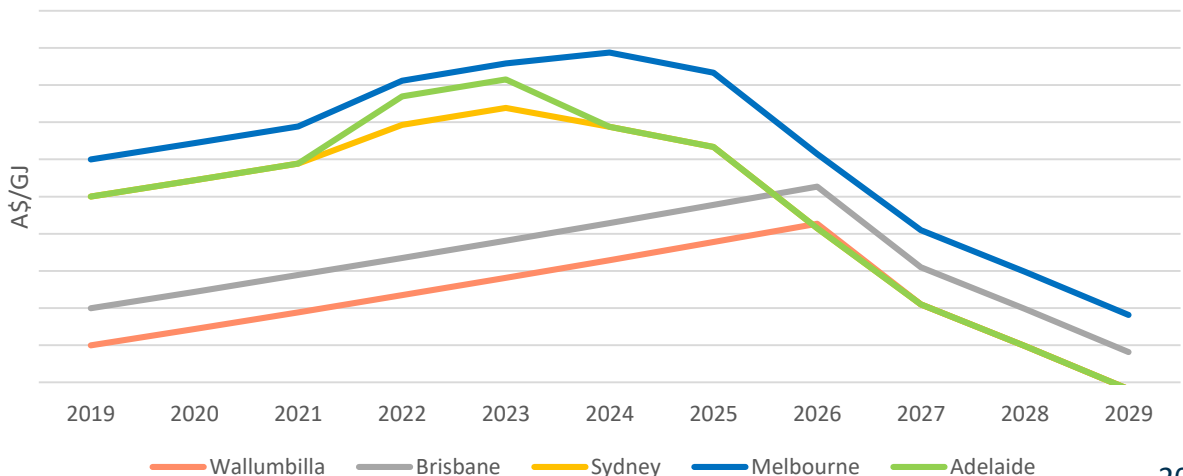
2P + LNG Import Average New Supply Gas Prices



East Coast 2P + Unconventional Supply Forecast

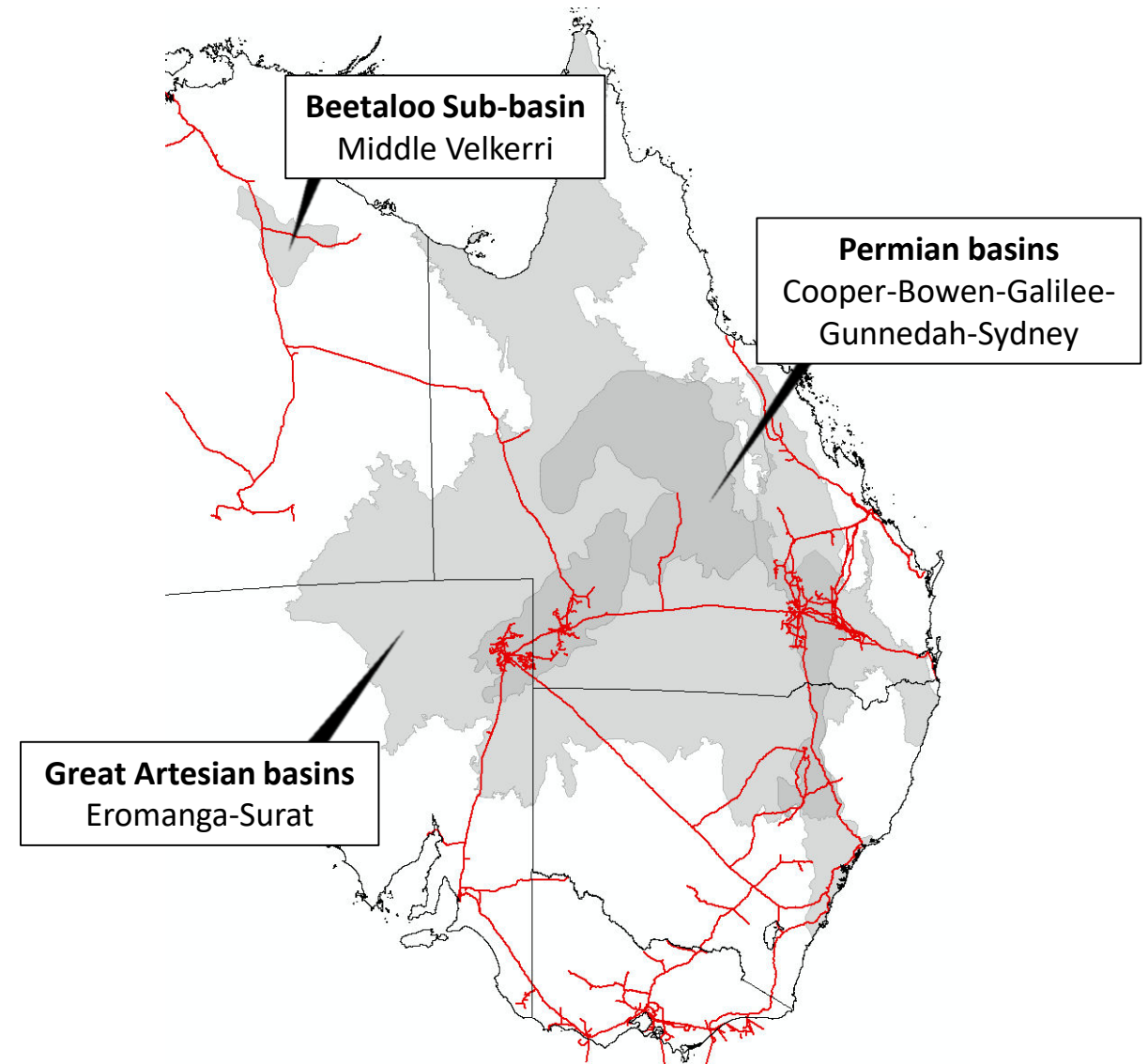


2P + Unconventional Average New Supply Gas Prices



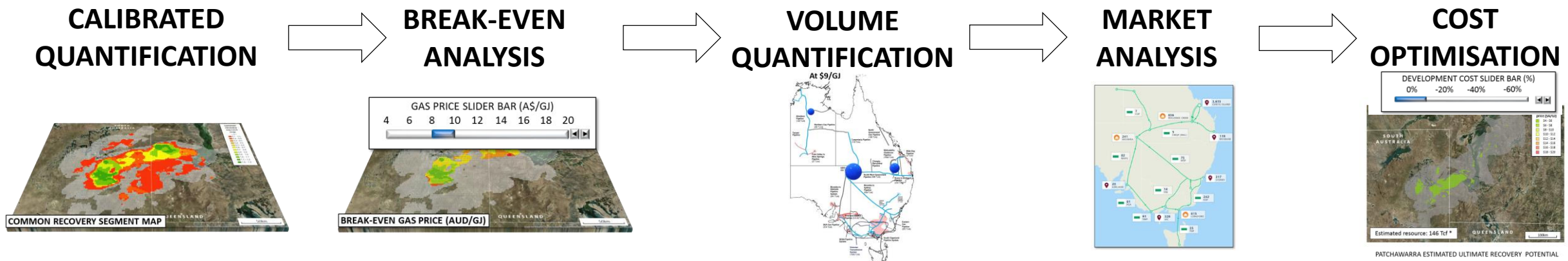
Eastern Australian unconventional plays of interest

BASIN	PLAY / RESERVOIR	PLAY TYPE
COOPER	TOOLACHEE	SHALE GAS
COOPER	DARALINGIE	TIGHT GAS
COOPER	ROSENEATH	SHALE GAS
COOPER	EPSILON	TIGHT GAS
COOPER	MURTEREE	SHALE GAS
COOPER	PATCHAWARRA	TIGHT GAS
EROMANGA	WINTON	TIGHT GAS
BOWEN	BANDANNA-BARALABA	COAL SEAM GAS
BOWEN	TINWON	TIGHT GAS
BOWEN	REIDS DOME BEDS	TIGHT GAS
SURAT	WALLOON	COAL SEAM GAS
SURAT	PRECIPICE	TIGHT GAS
SURAT	SPRINGBOK	TIGHT GAS
GALILEE	ARAMAC	COAL SEAM GAS
BEETALOO	VELKERRI	SHALE GAS



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



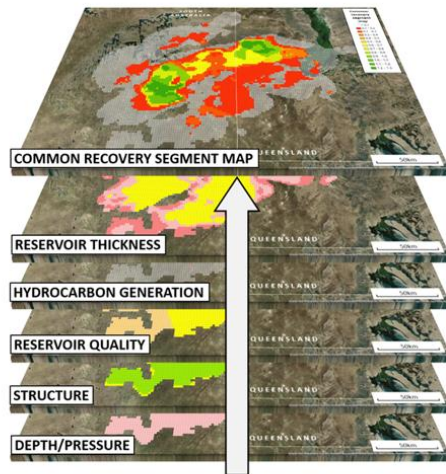
decisions with confidence

Australian Eastern States gas market study and unconventional play atlas

RISC has developed a comprehensive Australian Eastern States gas market study. The study is based on the 2P reserves positions for domestic gas producers paired with a range of gas demand forecasts to identify probable supply gaps on the East Coast over the next 10 years. A market response to the high gas pricing on the East Coast in the form of new developments is already underway.

At what gas price does it make sense to start developing unconventional resources in the Eastern states?

Resource play quantification for all of the Eastern States recognised potential unconventional plays

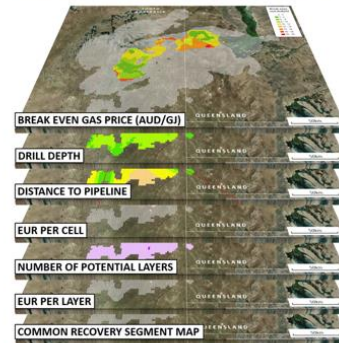


The study has analysed all of the potential sources of unconventional gas to fill the East Coast market gap and determines likely gas supply rates, development schedules and breakeven supply costs for each of the major demand centres.

The study illustrates the required gas prices to drive unconventional gas development in Eastern Australia, the subsequent scale of new unconventional gas supplies to the forecast gaps in the market and describes how those developments can reverse the trend of rising prices over time.

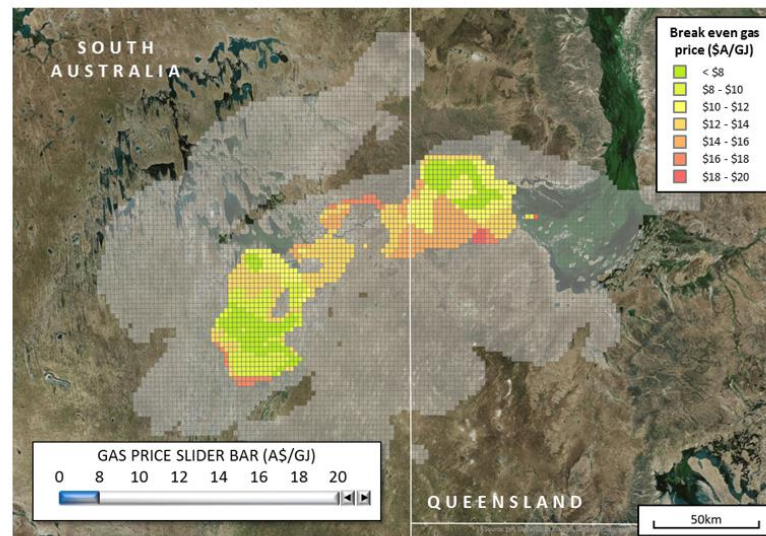


Resource development break-even analysis



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.

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

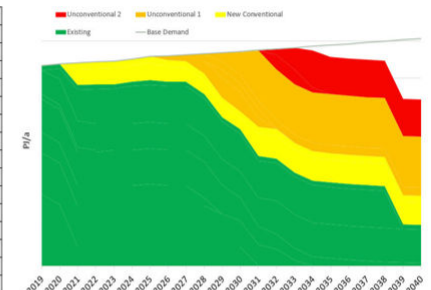


decisions with confidence

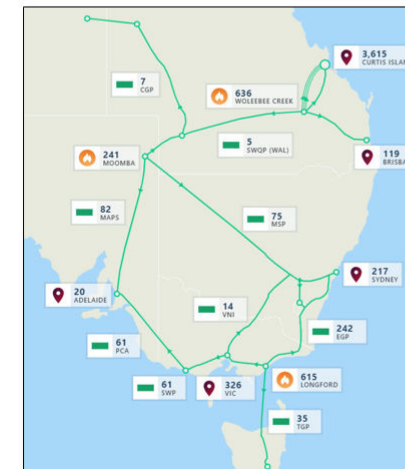
All major gas resource plays identified in Eastern Australia have been quantified

BASIN	PLAY / RESERVOIR	PLAY TYPE
COOPER	TOOLACHEE	SHAPE GAS
COOPER	DARALINGIE	TIGHT GAS
COOPER	ROSENATH	SHAPE GAS
COOPER	EPSILON	TIGHT GAS
COOPER	MURTEREE	SHAPE GAS
COOPER	PATCHAWARRA	TIGHT GAS
EROMANGA	WINTON	TIGHT GAS
BOWEN	BANDANNA-BARALABA	COAL SEAM GAS
BOWEN	TINWON	TIGHT GAS
BOWEN	REIDS DOME BEDS	TIGHT GAS
SURAT	WALDON	COAL SEAM GAS
SURAT	PRECIPICE	TIGHT GAS
SURAT	SPRINGBOK	TIGHT GAS
GALILEE	ARAMAC	COAL SEAM GAS
BEETALOO	VELKERRI	SHAPE GAS

Eastern Australia gas supply forecast



Eastern Australia gas market model



A quantitative understanding of unconventional resource potential at different gas price scenarios allows us to understand how potential unconventional resource developments could contribute towards the Eastern Australia energy supply mix

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

Contact

 Ian Cockerill
Head of Geoscience
ian.cockerill@riscadvisory.com

 Joe Collins
Principal Development Engineer
joe.collins@riscadvisory.com

Contact

 Ian Cockerill
Head of Geoscience
ian.cockerill@riscadvisory.com

 Joe Collins
Principal Development Engineer
joe.collins@riscadvisory.com