



Gas Production and Transmission Costs Eastern and South Eastern Australia

February 2015



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Definitions

Unless otherwise stated, the definitions detailed in the following table apply throughout this report.

Term	Definition
1P Reserves	Defined by the internationally-recognised Petroleum Resources Management System as proven reserves (both proved developed reserves and proved undeveloped reserves).
2P reserves	Defined by the internationally-recognised Petroleum Resources Management System as 1P (proven reserves) plus probable reserves.
3P reserves	Defined by the internationally-recognised Petroleum Resources Management System as 2P (proven reserves plus probable reserves) plus possible reserves.
2C reserves	Defined by the internationally-recognised Petroleum Resources Management System as the best estimate of contingent resources.
Coal seam gas ("CSG")	Natural gas contained in coal deposits. Generally high proportion of methane but may be produced with variable amounts of inert or non-inert gases.
Contingent resources	Defined by the internationally-recognised Petroleum Resources Management System as those quantities of petroleum which are estimated, on a given date, to be potentially recoverable from known accumulations, but which are not currently considered to be commercially recoverable.
Conventional gas	Natural gas that is extracted from conventional underground reservoirs using conventional exploration and production methods.
Production cost	Breakeven price of gas (expressed as AUD/GJ) required to cover the net present value of full lifecycle costs of producing reserves for a defined supply area and to resource owner with a 10% real return on capital.
Prospective resources ("PR")	As defined by the internationally-recognised Petroleum Resources Management System. Prospective Resources are those quantities of petroleum which are estimated, on a given date, to be potentially recoverable from undiscovered accumulations.
Reserves	Defined by the internationally-recognised Petroleum Resources Management System as those quantities of petroleum which are anticipated to be commercially recovered from known accumulations from a given date forward.
Transmission cost	Breakeven transmission tariff (expressed as AUD/GJ) required to cover the net present value of full lifecycle costs of a transmission pipeline and to provide the pipeline owner with a 7% real return on capital.
Other unconventional gas	Natural gas that is found in unconventional reservoirs including shale and tight gas but excluding coal seam gas.

Acronyms

Acronym	Definition
AEMO	Australian Energy Market Operator
APLNG	Australia Pacific LNG
ASX	Australian Securities Exchange
AUD	Australian dollar
Core	Core Energy Group
CSG	Coal seam gas
GLNG	Gladstone LNG
GSOO	Gas Statement of Opportunities
LNG	Liquefied natural gas
MWh	Megawatt hour
NSW	New South Wales
PJ	Petajoule
QCLNG	Queensland Curtis LNG
Qld	Queensland
R/P ratio	Reserves-to-production ratio
SA	South Australia
SPE	Society of Petroleum Engineers
Tas	Tasmania
Vic	Victoria

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1. INTRODUCTION & BACKGROUND

1.1 Introduction

Core has been engaged by AEMO to provide projected gas production and transmission costs for eastern and south eastern Australia (EA) as an input into its Gas Statement of Opportunities process for the 2015 year.

Specifically this report addresses:

- Core's best estimate of production costs in AUD 2014 real terms
- Core's best estimate of transmission costs in AUD 2014 real terms
- Discussion of the sensitivity of changes in projected costs to a change in key assumptions.

This report should be read in conjunction with an Excel data book titled "AEMO_GSOO_Costing Data book_ Public".

1.2 Background

The EA gas sector has entered a period which is characterised by a significant upward trend in cost structure, attributable mainly to increased labour, service and capital costs, lower well productivity, and a downward trend in gas liquid yield. Accordingly, it is considered timely to develop scenario-based estimates of the cost of extracting gas resources over the period 2015 to 2034 (in net present value terms).

2. METHODOLOGY

2.1 Methodology

Core has developed scenarios of future production and transmission costs, utilising a discounted cash flow methodology to derive a break-even gas price per GJ (for gas production) and a regulated return based tariff per GJ (for gas transmission) by applying real discount rate against projected real cash flows.

These resultant cost estimates were submitted to asset operators in draft form for review purposes. The revised estimates (where provided) are incorporated below.

2.2 Production Costs

2.2.1 Supply Areas

Core has defined the following supply areas as a basis for estimating the cost of supply/production. The location of these supply areas is summarised in Attachment 2. These supply areas have been defined on the basis of varying technical features, including geology and development type.

Table 2.1 Supply Areas for Cost Analysis Purposes

Basin/ area
Conventional
Bass
Cooper
Gippsland
Otway
CSG
Bowen - Fairview
Bowen - Moranbah/ATP 1003
Bowen - Spring Gully
Gloucester
Gunnedah
Surat - Eastern Walloons
Surat - IronBark
Surat - Middle Walloons
Surat - Undulla Nose
Surat - Western Walloons
Sydney - Camden Gas Project
Other Unconventional
Cooper - Napamerri
Cooper - Unconventional

Source: Core Energy Group

2.2.2 Major Assumptions

Core has developed a range of production cost related assumptions for each supply area, utilising proprietary models and publicly available information including ASX releases, annual reports, investor presentations, and third-party data and analysis.

Major assumptions used to develop total supply cost include:

- Exploration and acquisition cost
- Reserves and forecast production — volume and timing
- Development, drilling and completion type and cost
- Gas processing capacity and cost
- Gas gathering cost
- Water handling capacity and cost
- Operating cost
- Taxes and royalties.

2.2.3 Scenario Analysis

Three scenarios have been defined to guide the development of a cost range:

- Low Productivity — where geological conditions and application of engineering technology is expected to result in a low rate of production and/or low estimated ultimate recovery (“EUR”) per well, and thus a higher cost of production.
- Reference Scenario — most likely geological conditions and application of engineering technology resulting in an expected rate of production and/or EUR per well, and thus an expected cost of production.
- High Productivity Scenario — superior geological environment and cost effective and efficient application of engineering technology, resulting in a high rate of production and/or EUR per well, and thus a lower cost of production.

Core’s costing scenarios have been constructed to be consistent with AEMO’s Low, Medium and High energy consumption scenario drivers, as set out in AEMO 2014 Planning & Forecasting Scenarios¹.

2.2.4 Derivation of the Breakeven Price of Gas and Transmission Tariff

In arriving at the breakeven price of gas for each of the gas supply areas, Core applied a discounted cash flow (“DCF”) methodology, involving:

- Projecting future production and cash flows
- Discounting after tax cash flows to a present value using a 10% real discount rate
- Determining the price of gas at which the net present value of projected cash flows is equal to zero (i.e. break-even).

To arrive at the break-even tariff for a notional pipeline, Core assumed a real discount rate of 10%.

2.2.5 Impact of Liquids Production on Project Economics

A number of the supply areas, which are currently in production, generate a material level of oil and gas liquids. Core has estimated the level of oil and gas liquids in order to arrive at gas netback costs for these fields by apportioning costs between oil and gas liquids, and deducting a portion of the gas liquids value from the gas supply cost. This contribution has averaged below AUD1/GJ.

2.3 Transmission Costs

Core has developed an estimate of transmission costs for existing transmission pipelines, and also developed an estimate of the cost of developing new transmission pipeline capacity.

An estimate of existing tariffs is based on publicly available data retained within a Core database. An estimate of the cost of developing a new pipeline is based on Core modelling using public information. The results have been reviewed by a major pipeline operator and any revisions have been incorporated.

Major costs considered include:

- Line pipe
- Construction costs
- Coating cost
- Operating cost
- Contingency.

¹ AEMO, 2014 Planning & Forecasting Scenarios, February 2014 < [8 |](https://www.google.com.au/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0CB0QFjAA&url=http%3A%2F%2Fwww.aemo.com.au%2FElectricity%2FPlanning%2F~%2Fmedia%2Ffiles%2FOther%2Fforecasting%2F2014_Planning_and_Forecasting_Scenarios.ashx&ei=0yLdVJLXLY778QXPmoDQCA&usg=AFQjCNETS68E16mEGhVTZuw8cjnOckY_A&sig2=AXSwk1PJYt43LaL_qr20g></p>
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3. PRODUCTION COSTS

3.1 Summary

A summary of Core's estimates of supply costs are provided in Table 3.1 below.

Table 3.1 Summary of supply costs | AUD/GJ

Basin	Low	Reference	High
Conventional			
Bass	4.46	4.05	3.65
Cooper	5.83	5.30	4.77
Gippsland	4.95	4.50	4.05
Otway	4.07	3.70	3.33
CSG			
Bowen - Fairview	4.95	4.50	4.05
Bowen - Moranbah/ATP 1003	7.70	7.00	6.30
Bowen - Spring Gully	3.90	3.55	3.19
Gloucester	5.45	4.95	4.46
Gunnedah	7.98	7.25	6.53
Surat - Eastern Walloons	6.70	6.00	5.70
Surat - IronBark	5.34	4.85	4.37
Surat - Middle Walloons	6.00	5.70	5.65
Surat - Undulla Nose	5.00	3.90	3.60
Surat - Western Walloons	9.35	8.50	7.65
Sydney - Camden Gas Project	4.46	4.05	3.65
Other Unconventional			
Cooper - Napamerri	8.65	7.75	6.80
Cooper - CBJV Unconventional	5.83	5.30	4.77

Source: Core Energy Group with Operator input for a number of areas.

4. TRANSMISSION COSTS

4.1 Summary of Existing Transmission Tariffs

A summary of Core's estimate of transmission tariffs are provided in Table 4.1 below and the location of these pipelines is presented in Figure 4.1.

Table 4.1 Summary of transmission costs – major existing pipelines | AUD/GJ

Basin	Low	Ref	High
Carpentaria Gas Pipeline	1.82	1.48	1.48
Eastern Gas Pipeline	1.33	1.21	1.09
Longford to Melbourne Gas Pipeline	0.29	0.25	0.25
Moomba to Adelaide Pipeline System	0.73	0.67	0.60
Moomba to Sydney Pipeline System	0.99	0.90	0.85
Queensland Gas Pipeline	1.03	0.94	0.94
Roma - Brisbane Pipeline	0.63	0.57	0.57
South East Australia Gas Pipeline	0.88	0.80	0.80
South West Pipeline	0.30	0.28	0.28
South West Queensland Pipeline	1.08	0.98	0.89
Tasmania Gas Pipeline	2.55	2.05	2.05

Source: Core Energy Group with Operator input for a number of areas.

4.2 Summary of Cost of New Transmission Capacity

A summary of Core's estimates of transmission costs are provided in Table 4.2 below and the location of these pipelines is presented in Figure 4.1.

Table 4.2 Summary of transmission costs – new pipeline | AUD

Cost Element	Core Estimate
Cost of steel line pipe	2,500/tonne
Coating cost	45.00/ square metre
Construction cost	30,000/ inch kilometre
Other (insurance, engineering, legal etc)	15%
Contingencies	10%

Source: Core Energy Group with Operator input for a number of areas.

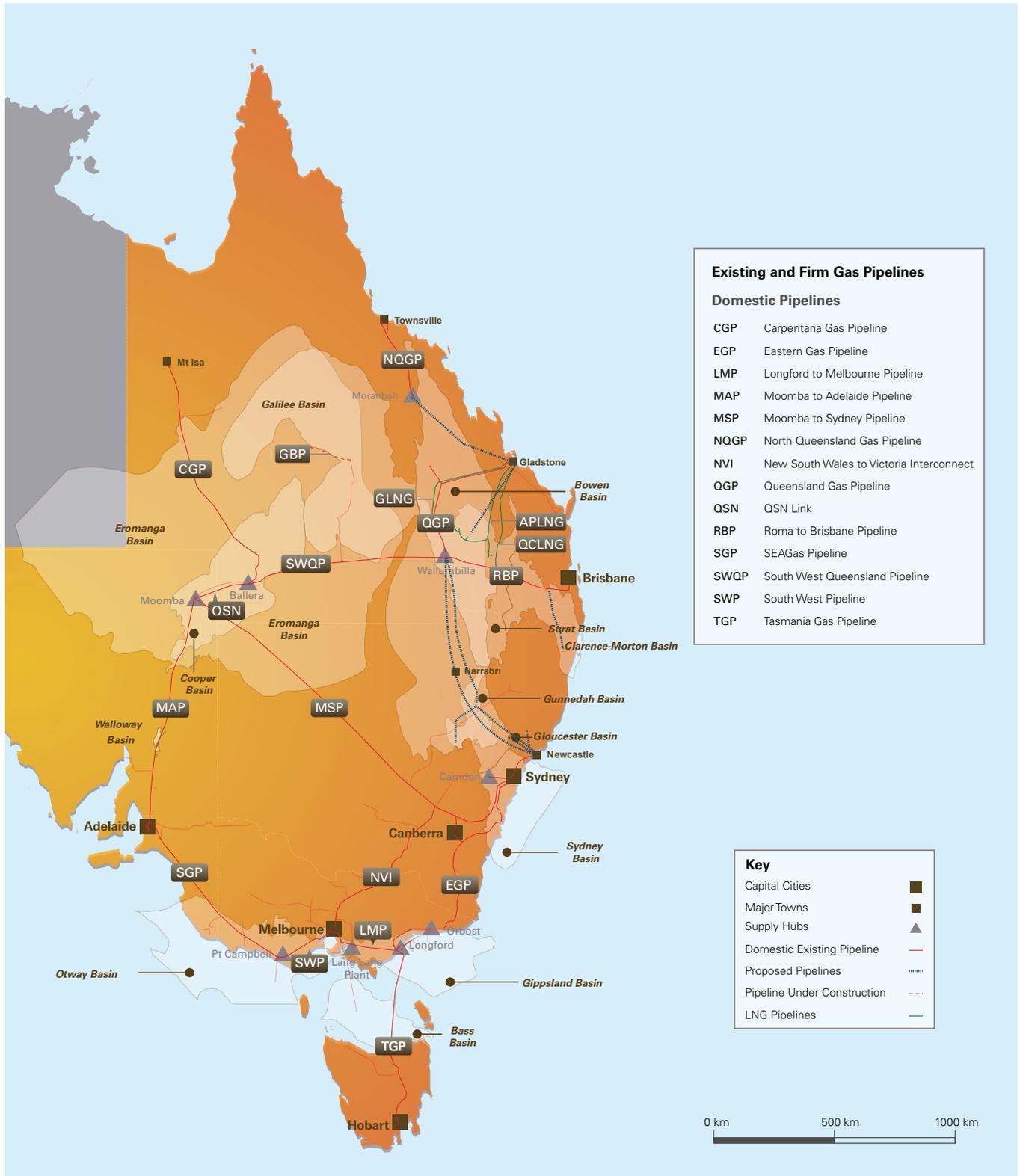
The following table provides a Low to High range of capital costs for pipelines of varying configuration for a 100km length, together with an indicative tariff based on a real rate of return of 7%.

Table 4.3 Summary

Pipeline configuration	Low AUD Million	Ref. AUD Million	High AUD Million	Ref. Tariff
8 inch Class 600, 5.6mm wall thickness	28.4	31.5	34.7	AUD0.11/GJ
14 inch Class 600, 9.1 mm wall thickness	55.9	62.1	68.3	AUD0.10/GJ

Source: Core Energy Group with Operator input for a number of areas.

Figure 4.1 Location of Major Existing Transmission Pipelines



Source: Core Energy Group

- AGL Energy; Website, Reports, Releases, Presentations.
- APA; Website, Reports, Releases, Presentations.
- APLNG Website, Reports, Releases, Presentations.
- APPEA; Website, Reports, Releases, Presentations.
- Arrow Energy Limited; Website, Reports, Releases, Presentations.
- AWE Limited; Website, Reports, Releases, Presentations.
- Bass Strait Oil; Website, Reports, Releases, Presentations.
- Beach Energy; Website, Reports, Releases, Presentations.
- BG Group; Website, Reports, Releases, Presentations.
- BHP Billiton Limited; Website, Reports, Releases, Presentations.
- Cooper Energy; Website, Reports, Releases, Presentations.
- Core Energy Group; Databases, Reports and Intelligence.
- Drillsearch Limited; Website, Reports, Releases, Presentations.
- Esso Australia; Website, Reports, Releases, Presentations.
- Exoma Energy Limited; Website, Reports, Releases, Presentations.
- GLNG Reports, Releases, Presentations.
- GPA; Website, Reports, Releases, Presentations.
- Lakes Oil; Website, Reports, Releases, Presentations.
- Metgasco Limited; Website, Reports, Releases, Presentations.
- Molopo Limited; Website, Reports, Releases, Presentations.
- Nexus Limited; Website, Reports, Releases, Presentations.
- Origin Energy; Website, Reports, Releases, Presentations.
- QCLNG Website, Reports, Releases, Presentations.
- Queensland Department of Mines and Energy; Gas Reserves and Production
- S.A. Department of State Development; Website, Reports, Releases, Presentations.
- Santos Energy Limited; Website, Reports, Releases, Presentations.
- Senex Limited; Website, Reports, Releases, Presentations.
- Society of Petroleum Engineers; Website, Reports, Releases, Presentations.
- Somerton Energy; Website, Reports, Releases, Presentations.
- Strike Energy Limited; Website, Reports, Releases, Presentations.
- WestSide Corporation; Website, Reports, Releases, Presentations.

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Attachment 1 | Consultancy Scope

Description of Consultancy Services and Deliverables

Consultancy Services are for the delivery of:

1. Projections of gas production and gas transmission costs under three scenarios — high, expected, low.

Attachment 2 | Supply Areas for Cost Analysis Purposes

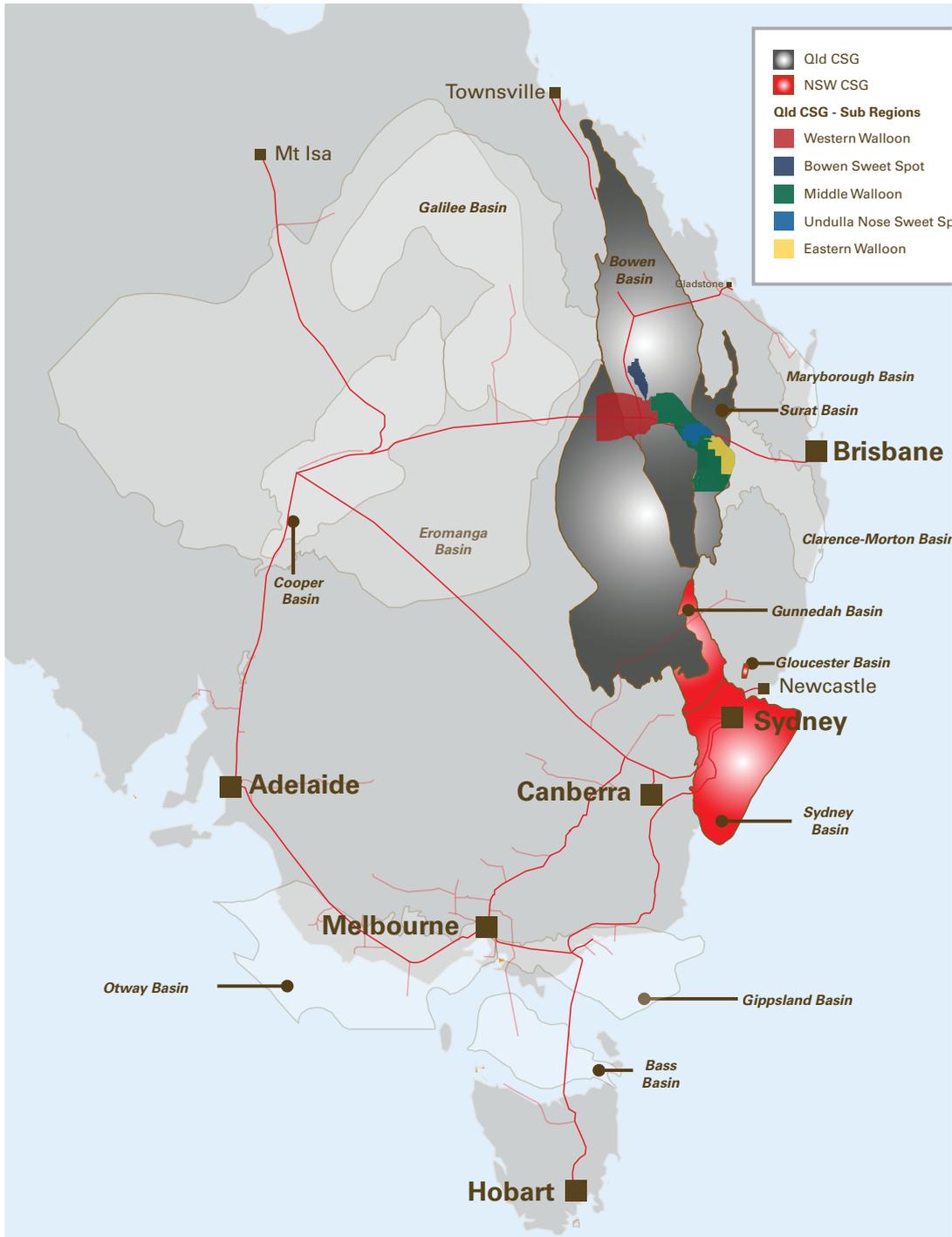
Supply Areas | Conventional Gas



Source: Core Energy Group

Attachment 2 | Supply Areas for Cost Analysis Purposes cont.

Supply Areas | CSG



Source: Core Energy Group

Attachment 2 | Supply Areas for Cost Analysis Purposes cont.

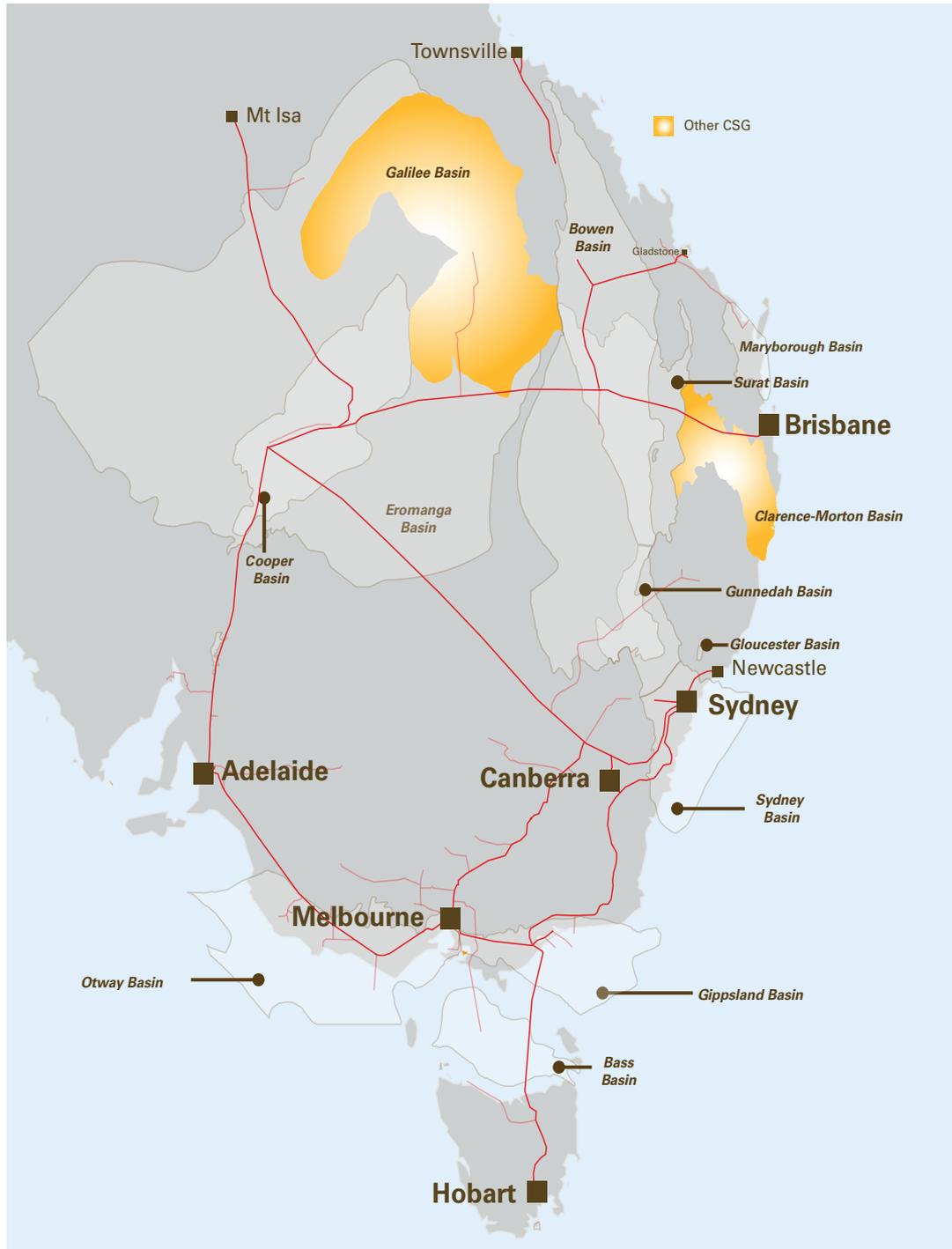
Supply Areas | Other Unconventional



Source: Core Energy Group

Attachment 2 | Supply Areas for Cost Analysis Purposes cont.

Supply Areas | Other CSG



Source: Core Energy Group



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