



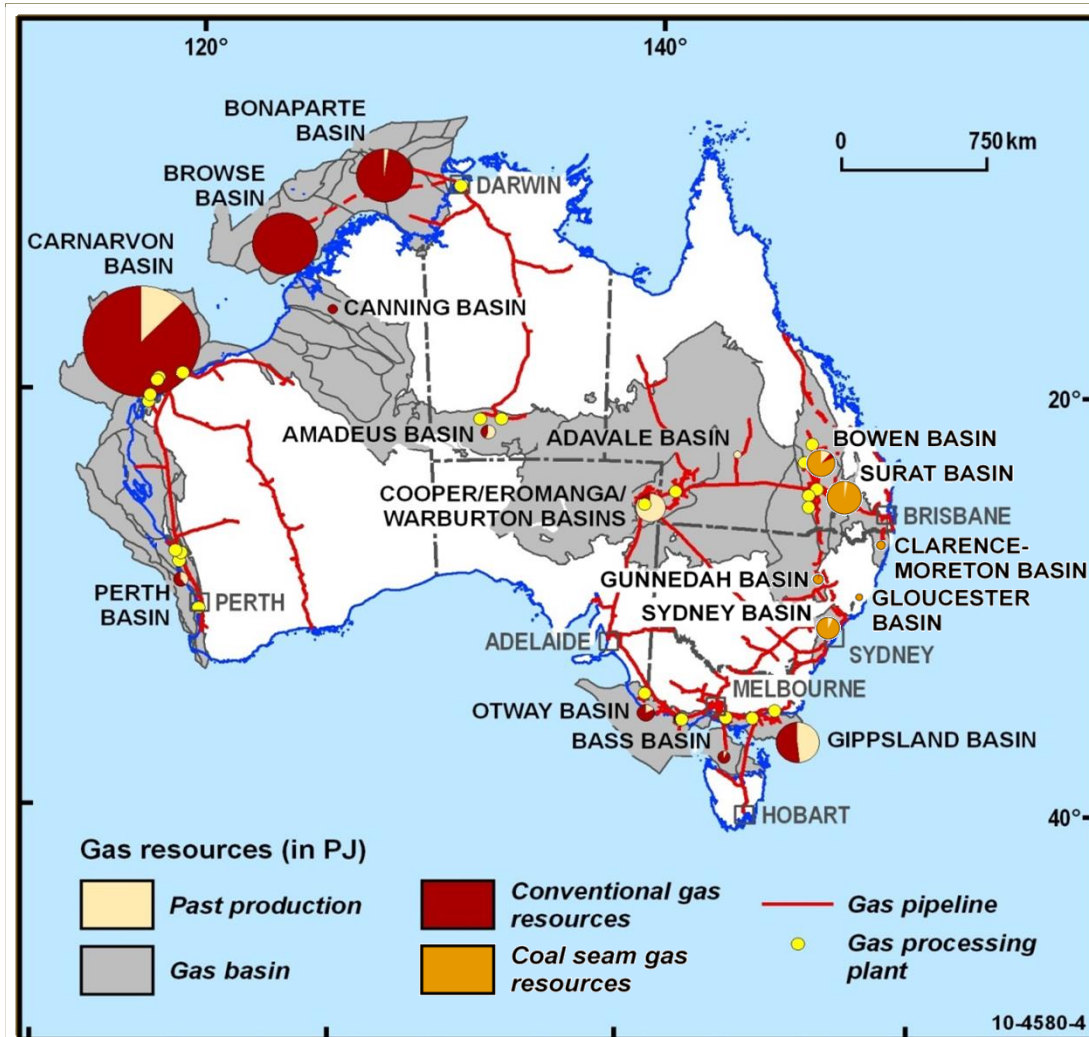
Pathway to shale gas development in APEC: Australian shale gas

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Gas resources, infrastructure and commerciality



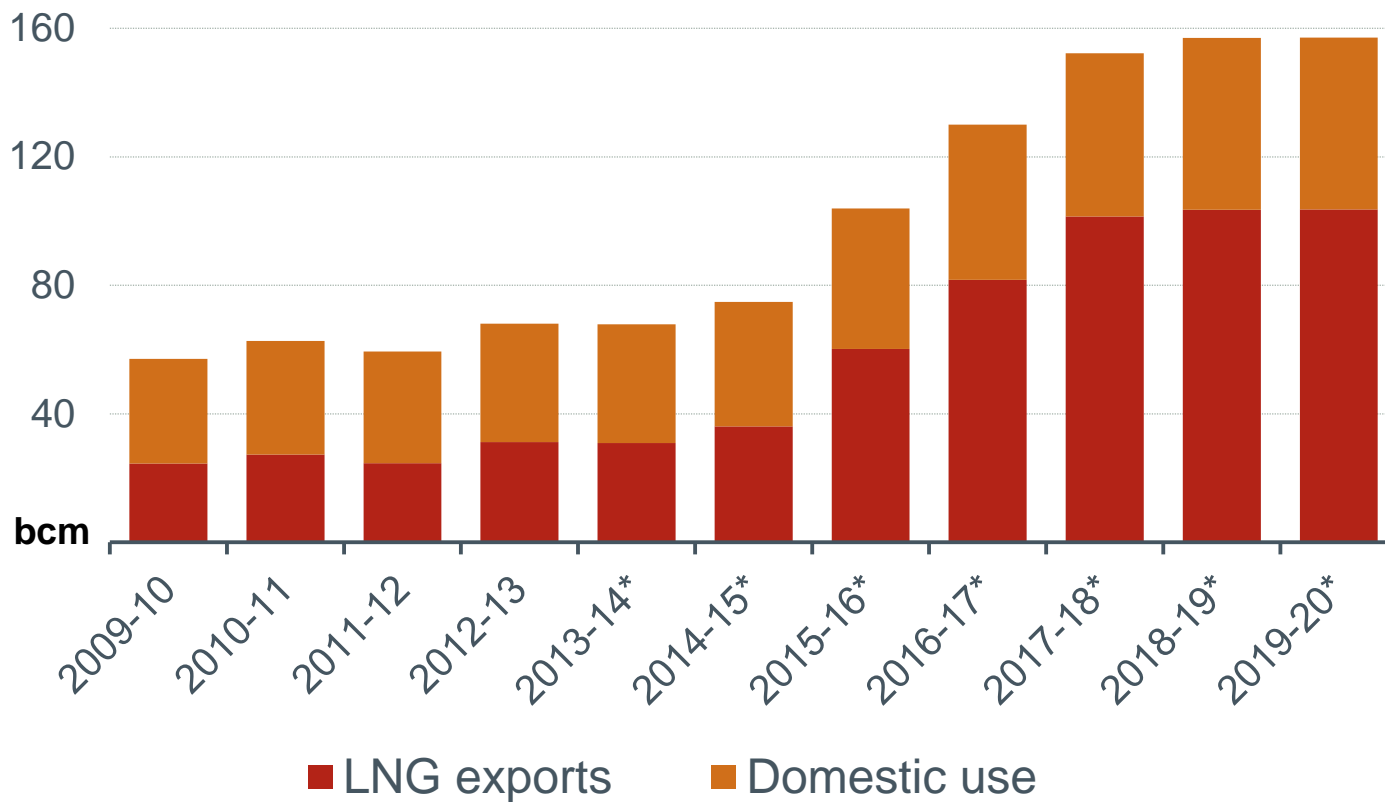
- Gas is an important resource
- A range of conventional and unconventional gas resources
- In-place infrastructure is a key factor for commercialisation (United States experience)
- The most prospective basins are tied to markets by existing pipelines

Australia's gas potential

Resource Category	Conventional gas		Coal seam gas		Tight gas		Shale gas		Total gas	
	PJ	tcf	PJ	tcf	PJ	tcf	PJ	tcf	PJ	tcf
EDR	113 400	103	35 905	33	-	-	~3	-	149 305	136
SDR	59 600	54	65 529	60	-	-	2200	2	127 329	116
Inferred	~11 000	~10	122 020	111	22 052	20	-	-	155 072	141
All identified resources	184 000	167	223 454	203	22 052	20	2200	2	431 706	392
Estimates of total resources - identified, potential and undiscovered	249 700	227	258 888	235	Unknown	Unknown	480 700	437	989 288	899

Source: Geoscience Australia 2012 ; Energy Information Administration estimates 2013

Gas demand being driven by LNG exports

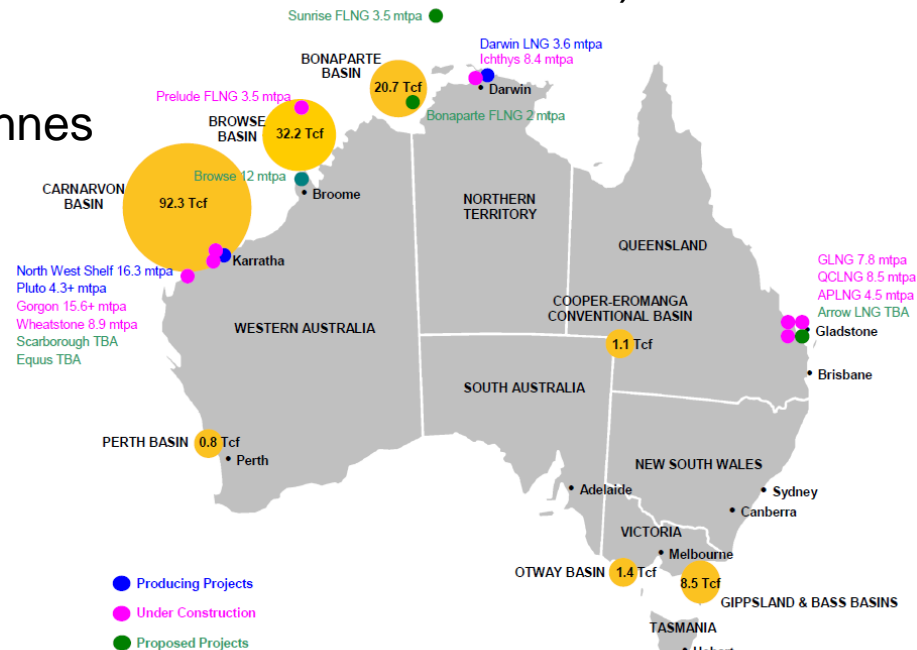


* Denotes forecast and projection

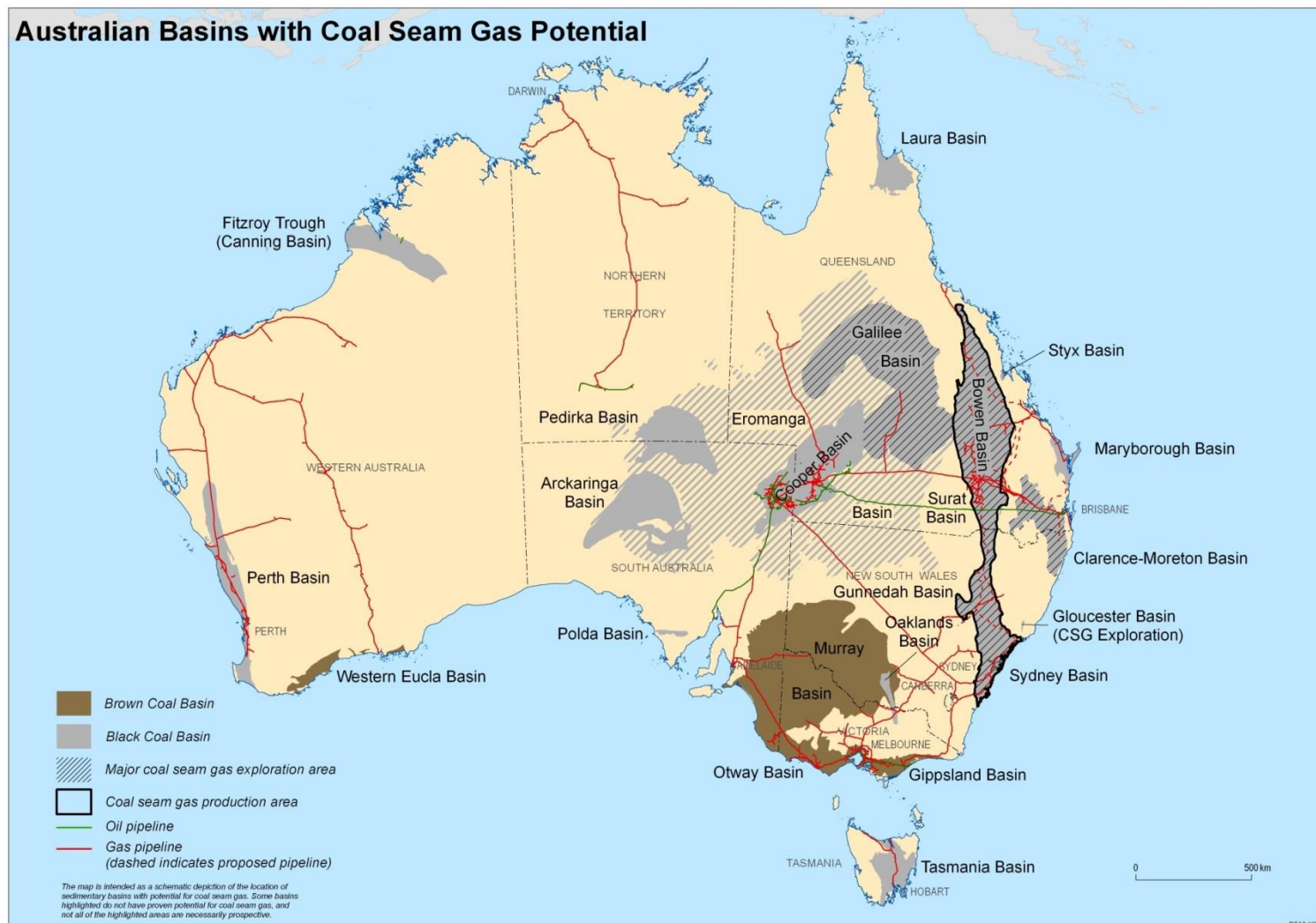
Australian LNG projects

Unprecedented Expansion

- Three operating projects - NWS, Pluto and Darwin LNG with combined capacity 24.2 million tonnes from seven LNG trains
- Seven projects in construction - combined capacity 61.7 million tonnes from 14 LNG trains (Total \$180 billion investment)
- World's largest Floating LNG (Shell's Prelude in construction in Korea)
- Three CSG LNG Projects – Gladstone
 - ▶ Combined capacity - 25.3 million tonnes
 - ▶ QCLNG (BG Group, CNOOC & Tokyo Gas)
 - ▶ GLNG (Santos, Total, KOGAS & Petronas)
 - ▶ APLNG (Origin, ConocoPhillips & Sinopec)
 - ▶ Arrow (Shell and Petrochina – in planning)

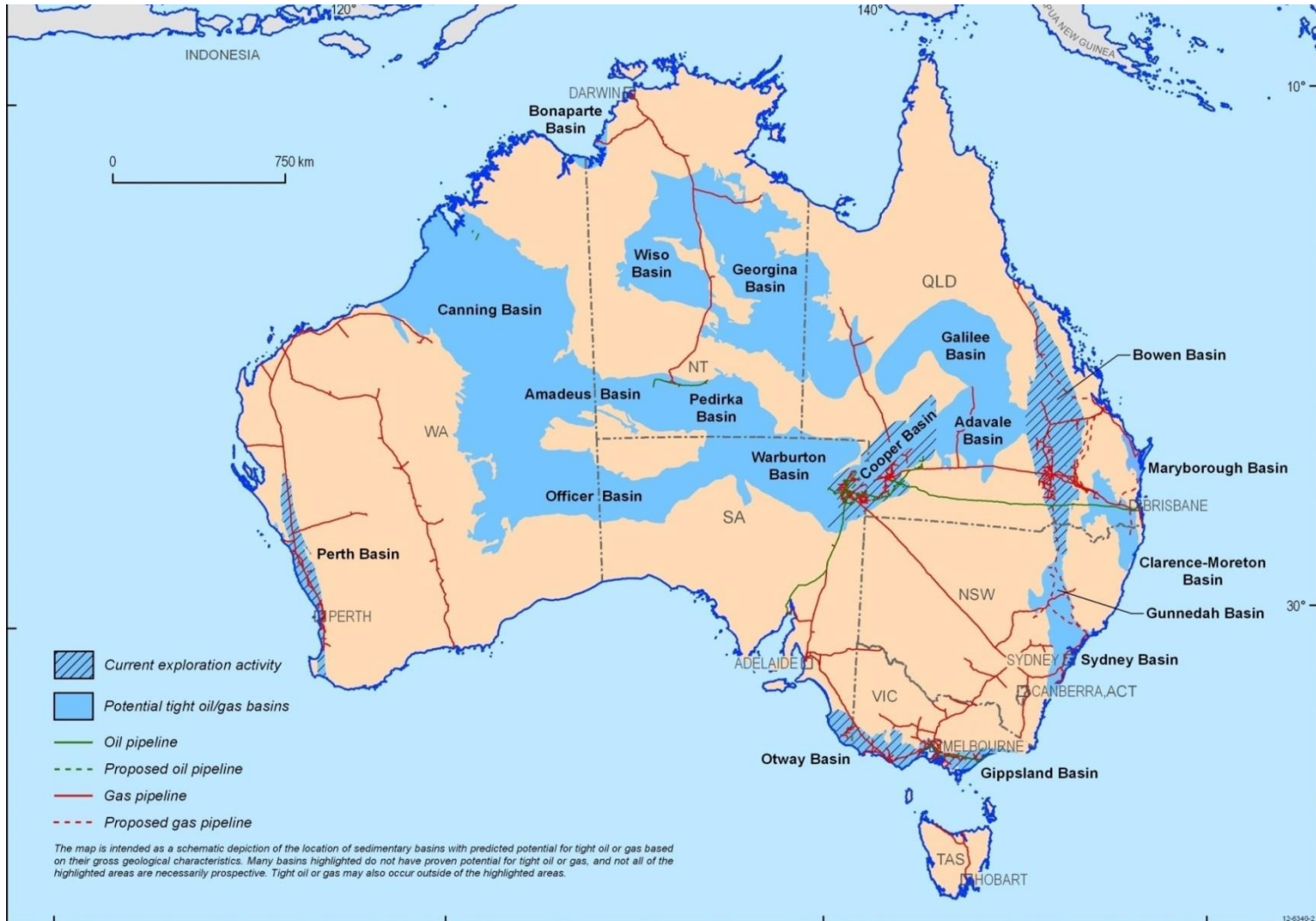


Coal seam gas potential

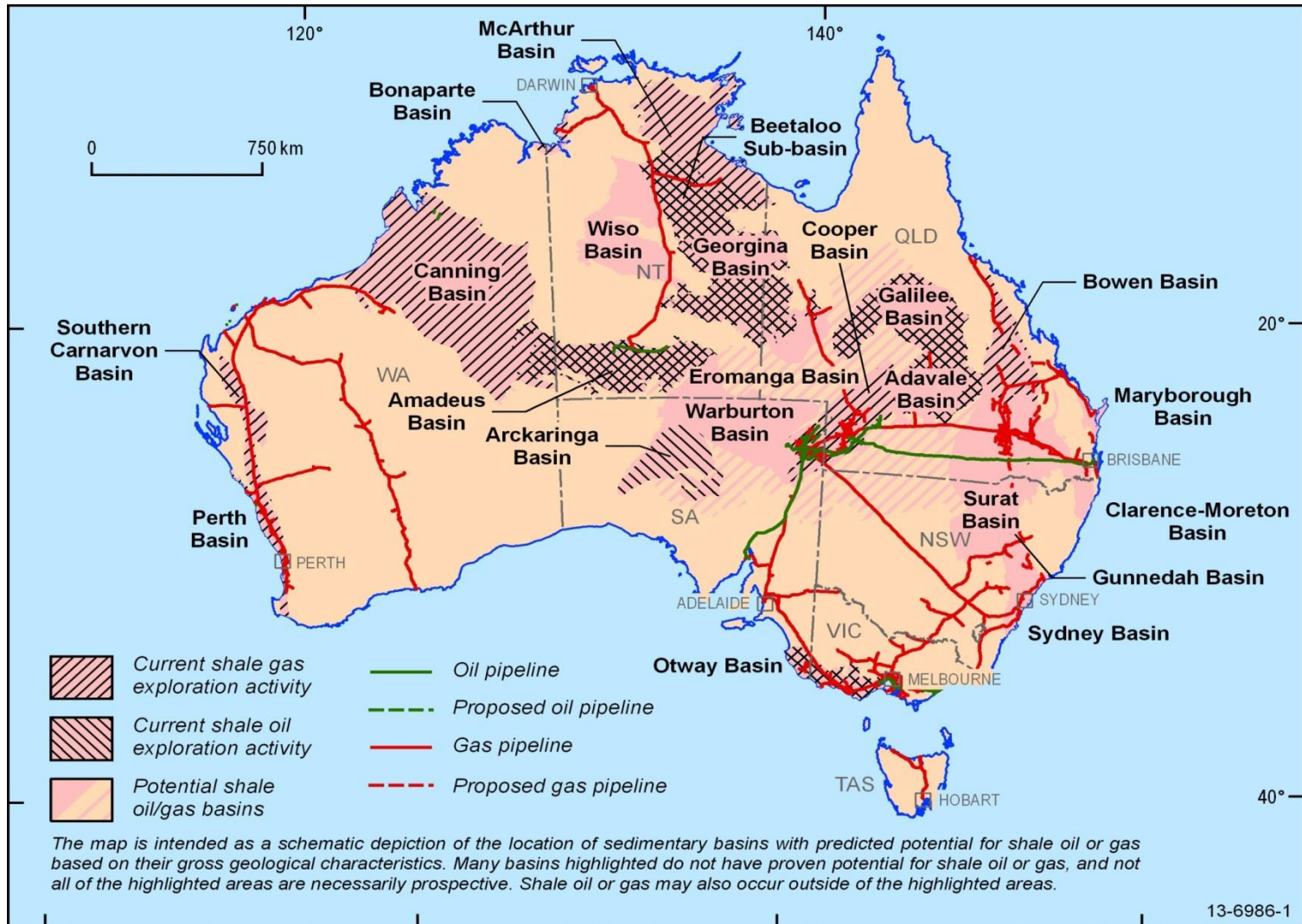


Source: Geoscience Australia

Tight gas potential



Shale gas and shale oil potential



Australian unconventional gas production

Coal Seam Gas

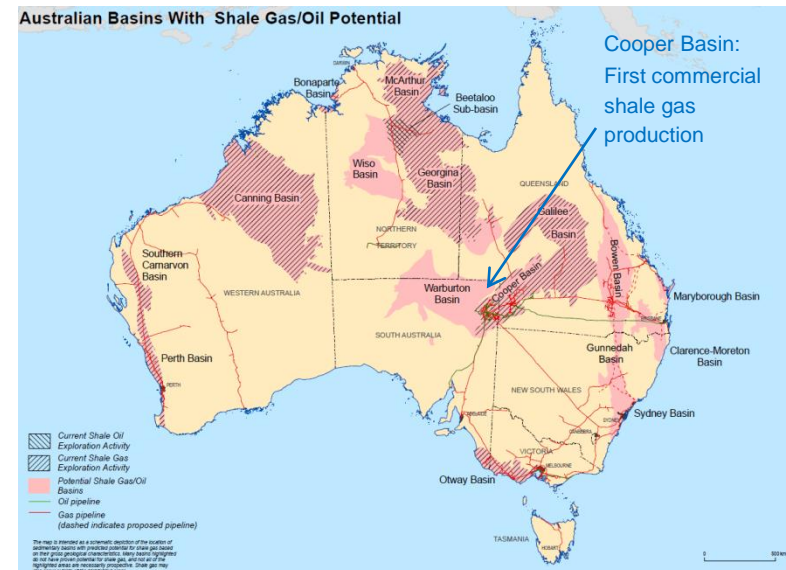
- Extensive exploration and production in Queensland
- 264 PJ in 2012-13 from Bowen and Surat Basins
- ~ 6 PJ from New South Wales

Tight gas / Liquids potential

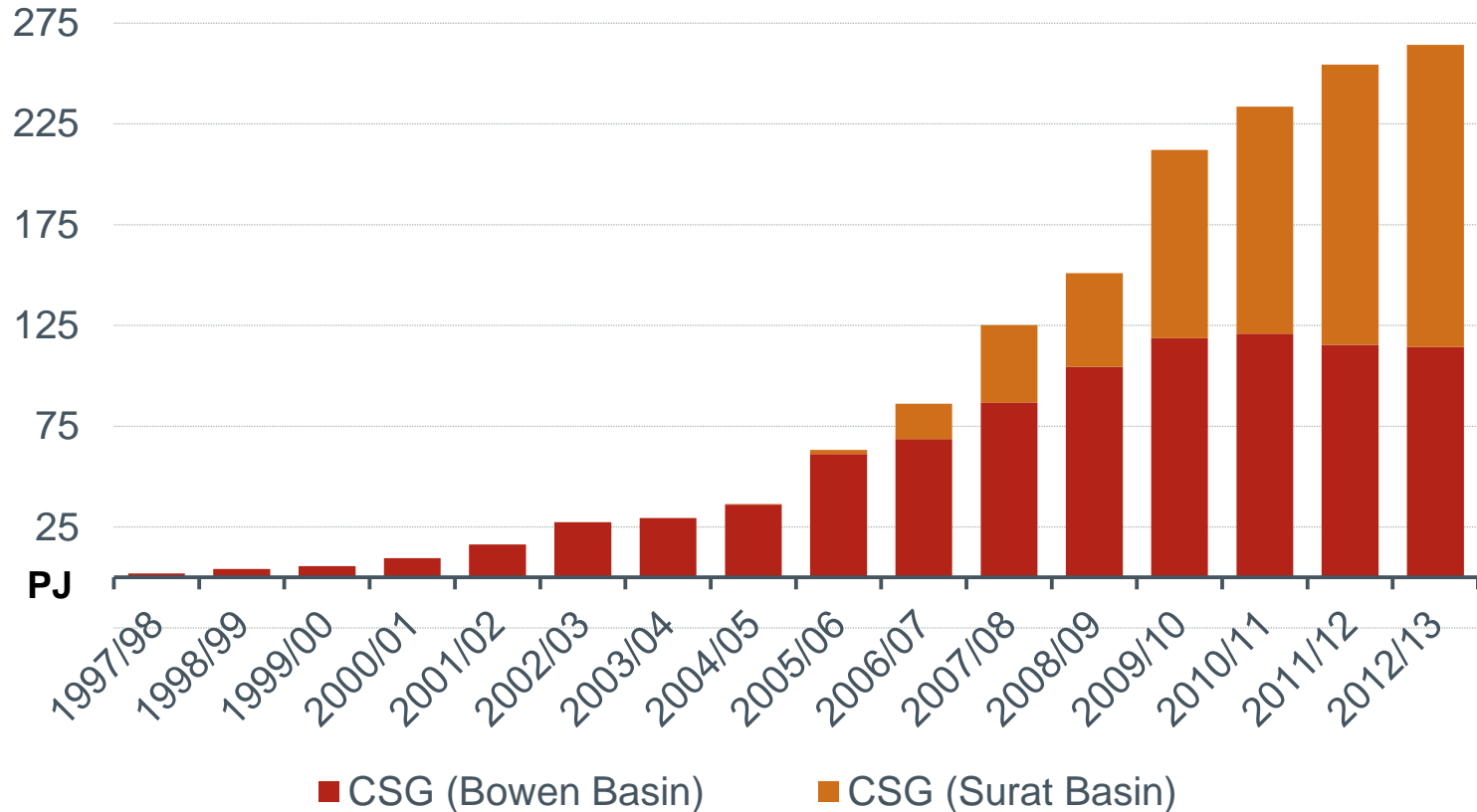
- No known commercial production

Shale Gas

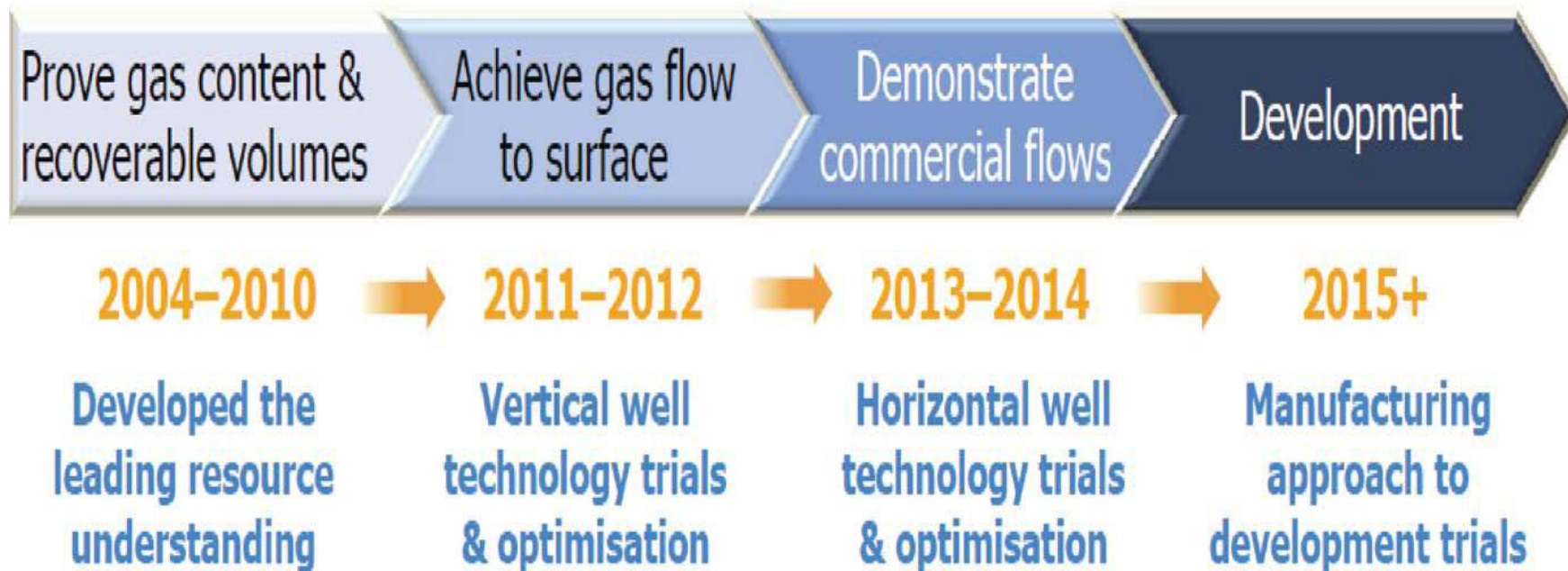
- Exploration and development at an early stage
- First production - 2012 Cooper Basin (Santos) ~ 2 mmscf/day – uncertainty about play classification
- No other commercial production, but recent entry of multinationals



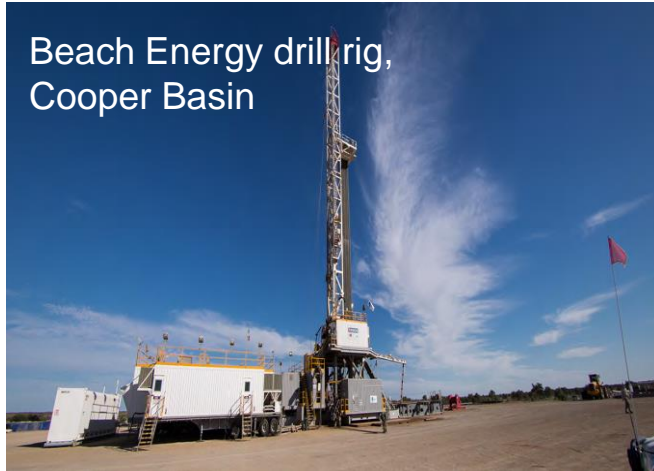
Queensland coal seam gas production



Cooper basin shale gas development timeline



Drivers of Australian shale gas development



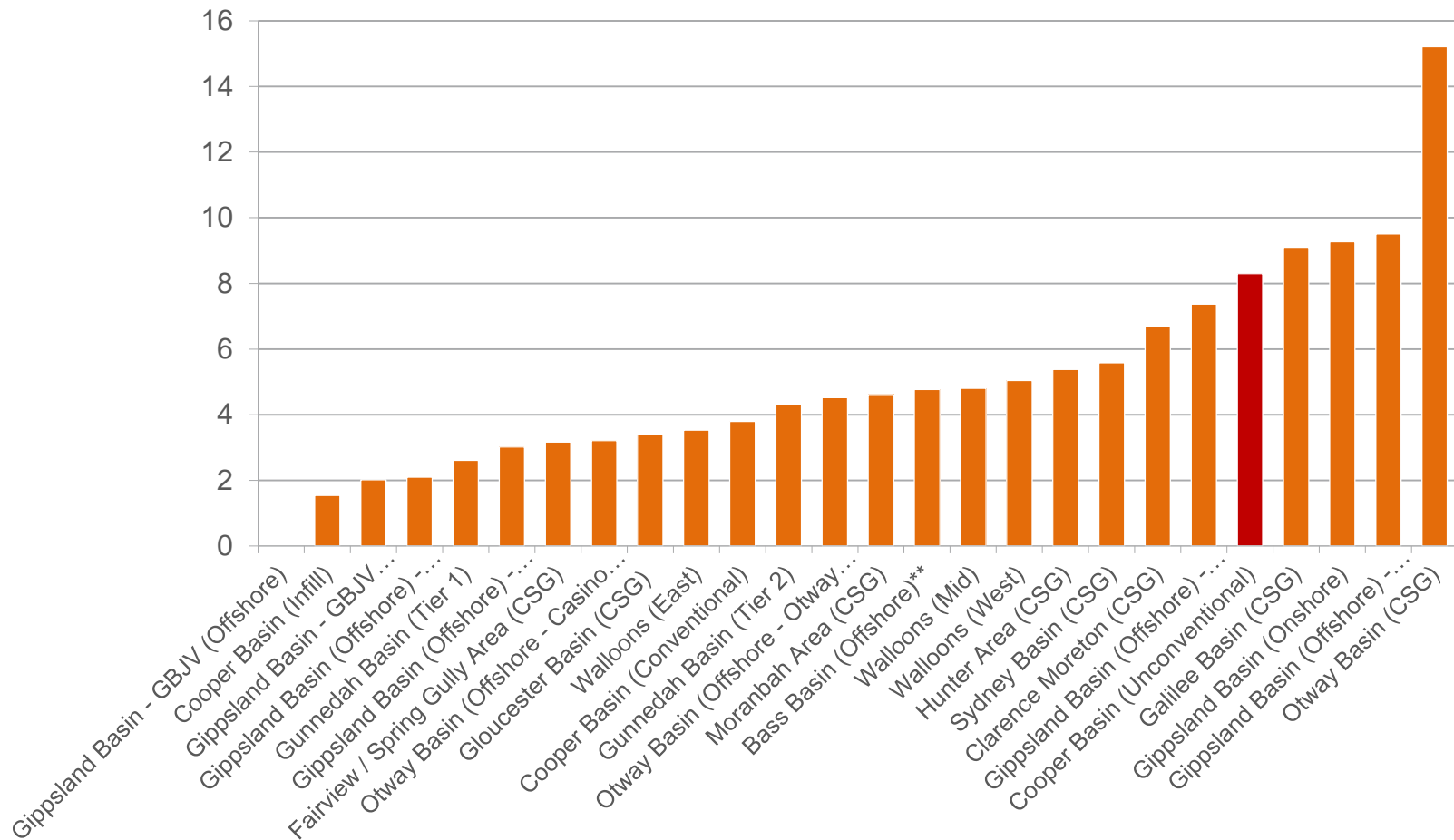
Beach Energy drill rig,
Cooper Basin



Santos' Moomba gas
processing plant, Cooper
Basin

- Large resource base ~ 481,000 PJ (427 tcf)
- Politically stable and open economy have underpinned a responsive gas sector
- Well placed to learn from US shale commercialisation
- A major supplier of LNG to Asia-Pacific region
- Tight conditions in both domestic and LNG markets
- Proximity of prospective shale gas areas to existing LNG facilities and major domestic demand centres
- Most CSG reserves are committed to LNG

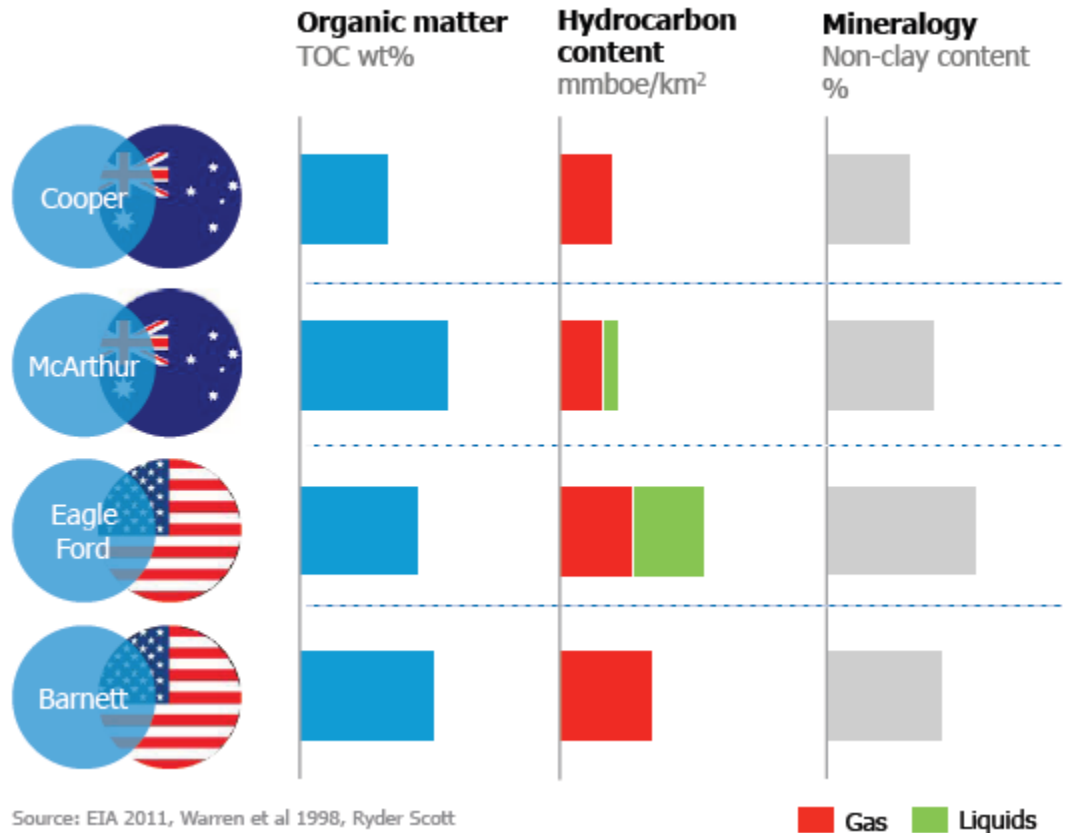
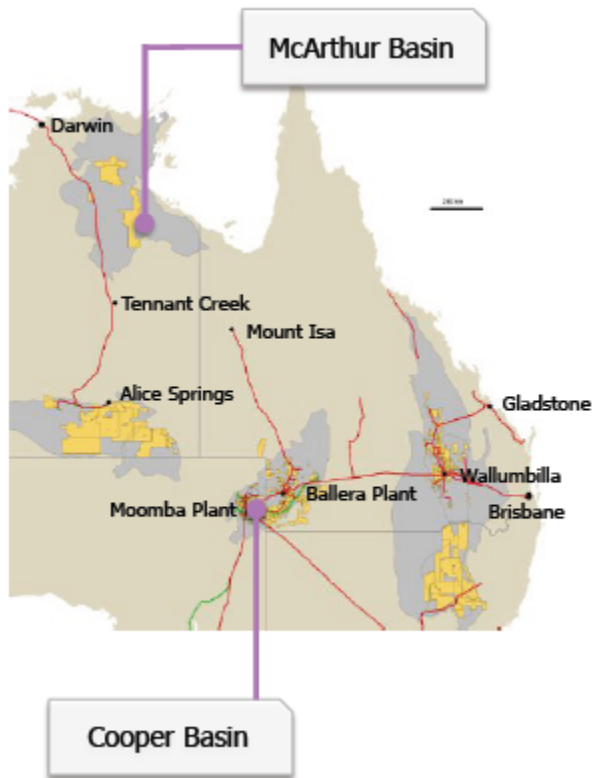
Cost of production in eastern gas basins and areas (AUD/GJ) - 2012



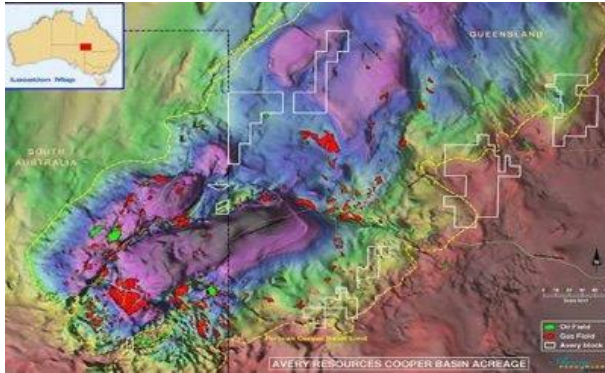
Cost of production in eastern gas basins

Resource	Basin	Cost Range \$AU/GJ
Conventional (new and existing)	Gippsland	\$2.02 - \$9.51
CSG (existing)	Surat/Bowen	\$3.50 - \$5.04
CSG (new)	Galilee	\$9.10
CSG (new)	Gunnedah/Sydney	\$2.61 - \$5.58
Shale (new)	Cooper	\$8.30
Shale (Santos)	Cooper	\$6.00 - \$9.00
Well Costs	Basin	Cost \$AU per well
CSG (new)	Surat/Bowen	\$2.3 - \$3.5 m
Shale (Existing - Santos)	Cooper (Moomba 191-Vertical)	\$10.0 m
Shale (AEMO)	Cooper	\$10.5 m

A comparison of Australian and US shale basins



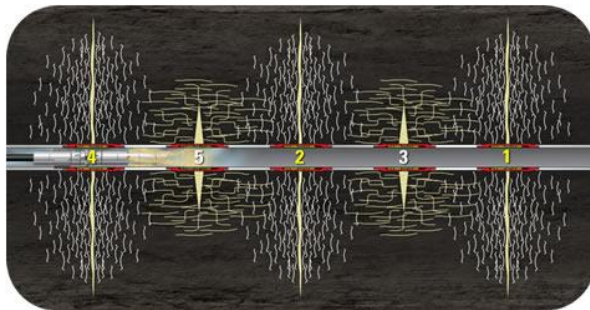
Benefiting from the US shale gas experience



Multi-well pad drilling,
Cowralli, Cooper Basin



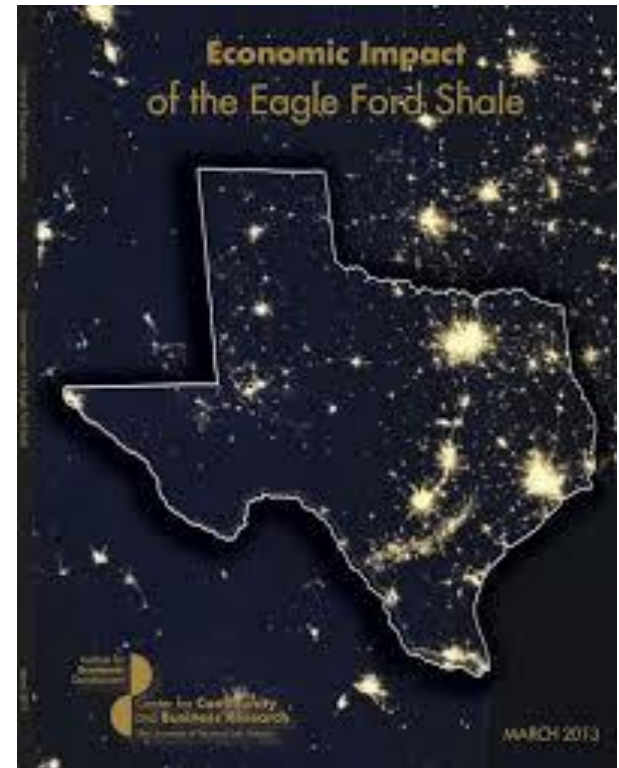
- Massive expansion in US gas exploration and development over recent years driven by technology and innovation
- Australia is benefiting through:
 - Geological modelling - to determine gas volume, stress regimes, brittleness, recovery factors and plan well trajectories
 - Drilling techniques - to reduce well costs through design, repeatability and scale
 - Multi-stage fracture stimulation - to maximise stimulated rock volume and ultimate recovery per well



Broader lessons from the US shale gas experience

- Expect large well-to-well performance variability
- Development costs are uncertain, but are likely to be higher in Australia than United States
- Rigorous regulation combined with management and mitigation of environmental risks is required

(Francis O'Sullivan, MIT)



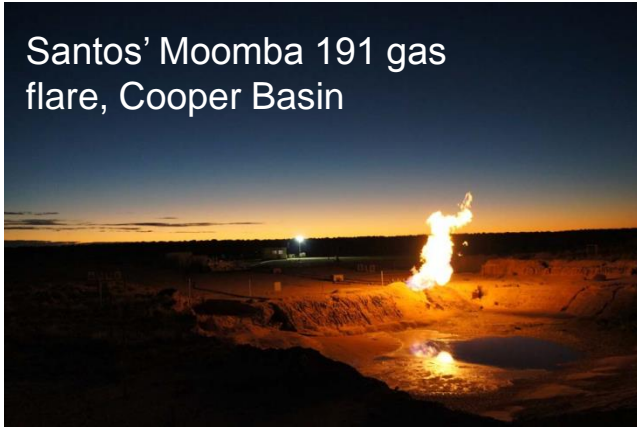
The policy challenges presented by shale gas

- Potential impacts on the environment and communities
- Ensuring a transparent, adaptive and effective regulatory system
- Eastern Australian Domestic Gas Market Study – provided options for government consideration to improve the market in the areas of:
 - Gas market reform
 - Gas supply competition
 - Commercial and regulatory environment for infrastructure
 - Market data and transparency
 - Gas market governance
- Energy White Paper – second half 2014



Outlook for shale gas in Australia

Santos' Moomba 191 gas flare, Cooper Basin



- Potentially significant economic benefits from shale gas development
- Must have a “social licence” to operate
- Not a cheap source of gas, but early estimates suggest it may be competitive with new CSG and conventional
- Still large shale gas resources to be discovered
- Several issues to address:
 - ▶ Impact on the environment
 - ▶ Skill shortages
 - ▶ Lack of equipment and infrastructure

Thank you