Forecasting Gas Price Trends & Impacts Across Australia in Uncertain Times

Australian Domestic Gas Outlook 2019
4 March 2019

INTRODUCTION

Introduction of presenters and experts

- Jim Snow, Executive Director Oakley Greenwood, Adjunct Professor University of Queensland (Energy Initiative)
  - Started in the energy industry in 1979 with AGL, involved ever since here and internationally: jsnow@oakleygreenwood.com.au
- Angus Rich, Principal Consultant Oakley Greenwood
  - Technical and commercial expert, 20+ years in the industry: arich@oakleygreenwood.com.au
- Robin Coombe, Gas Consultant, robin.coombe@energygassolutions.com
  - Detailed knowledge of LNG industry, gas production and large supply agreements
- Emily Alford, Principal Consultant Oakley Greenwood (WA Market Expert)
  - 25 years commercial experience in mining, trading, energy and utilities in the UK & Australia – WA resident works across the region: ealford@oakleygreenwood.com.au

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OGW Current and Recent Projects

- Gas Bulletin Board cost benefit study for more real time data – AEMO
- The Gas Price Trend Review 2017 across all of Australia
- (1st) Gas Transmission Arbitration – expert opinion and rebuttal
- Gas Market Reform Group (Vertigan) – (compulsory) capacity trading mechanisms and regulation
- New gas fired power stations for a number of major miners including significant renewables integration
- (Another) major demand and supply review looking forward including key interactions with electricity (using our modelling), energy security, emissions policies and "inertia" – as well as projects involving NEM and WEM forecasting
- Design of NT power market – which is all gas fired
- Due Diligence on gas assets
- Offshore LNG Generation assessment
- Efficiency of Gas prices for Small Customers in NSW – for IPART
- Review domestic gas price impacts on the small industrial and manufacturing market - QLD

Forecasting Gas Price Trends & Impacts Across Australia in Uncertain Times

- In this more in-depth learning session we will explore strategies for better predicting gas price trends.
- We will also examine the role gas may play in Australia and the impacts it may have considering the external environment and current and future drivers.
- We will seek to compare how these vary between east and west coast markets and how the “north east” may be the new energy zone.
- Consider business and residential gas price, consumption changes and the impacts on manufacturing.
- Look at the potential impacts of LNG supply/demand balance and forecasts and LNG regasification projects.
- Examine the potential role for gas in power generation as intermittent renewables bite – where is this most important market heading and why?
- Examine policy decisions – State and Federal as reforms are implemented – is there really an underlying inertia from policy that will play out – what about the gyrations in Canberra and what if we have a change of Government?

Todays Running Sheet

8.30 am to 9.00 am	Registration
9.00 am - 10.30 am	Session 1
10.30 am - 11.00 am	30 Minute Break
11.00 am - 12.30 pm	Session 2
12.30 pm - 1.30 pm	Lunch
1.30 pm - 3.00 pm	Session 3
3.00 pm - 3.30 pm	30 Minute Break
3.30 pm - 5.00 pm	Session 4

Today's Running Sheet

- Session 1 – Catch Up and Introduction (Jim and Angus)
  - We will go through what participants want to get out of the day and introductions
  - We will take a look at the most recent gas price data that is now starting to filter through – ACCC, (etc. – add more) - has much changed since the Gas price Trends review in 2017 across east and west coasts – did the drivers identified make an impact?
  - We will discuss regulatory developments for gas transmission and the gas market
- Session 2 – Gas Demand (Angus)
  - We will cover off the changes in demand that are occurring across Australia - we will take a look at the critical markets for gas use and discuss how these may impact or change?
  - We will drill down a bit into the interaction with the electricity markets and look at the potential for gas power generation – this is a critical discussion
- Session 3 – Gas Supply and all things LNG (Robin and Jim)
  - We will cover off the supply side with a focus on the east coast and a look at the west coast
  - This will include a timeline of notified and likely projects and discussion about reserves and their developments – this is also a critical session
- Session 4 – So what does this all mean (All led by Jim)
  - We will round out with a highly interactive session discussing the impact of future trends on prices - gas price scenarios, costs to produce gas, drilling moratoria and state based energy policy, etc.

Attendees and Objectives

Sectors?

- Consumers
- Investors and lenders to the market
- Transmission systems
- Distribution systems
- Retailers and Traders
- Consultants, Lawyers & Other Industry Professionals
- Support businesses to the industry
- Regulators and market operators
- Government/policy makers

Attendees Objectives?

GAS PRICES FOR NEW LOAD

Pricing Sources

- Gas Price Trends Review Report, 2017/18 – Oakley Greenwood – a recap
- ACCC LNG Netback Price Series, and
- ACCC Gas Inquiry Report(s)
- Wallumbilla Prices
- STTM Prices
- Victorian Prices and Futures
- ABS data

Gas Price Trends Review 2017/18 - key findings

- More very strong evidence that the gas markets in Australia follow typical economics of supply and demand when it comes to pricing, but
  - The market is "inefficient" mainly due to high use of bi-lateral contracts and lack of real price discovery,
  - Which remains fragmented and this is poor for investors, suppliers and buyers – subject in economic terms to significant potential deadweight loss (over or under consumption - supermarket example), and
  - For many buyers there was a significant lag effect between gas contracting – catch up major steps in pricing even though it had risen more linearly over time e.g. 2 and 3 year contracting – and contract timing was critical to outcomes
- The core problem was lack of supply (again) – often State policy driven, but
- Prices from Queensland are and will be capped by LNG netback due to Federal Government intervention, and
  - The base price for gas of cost to supply was escalating due to the costs of CSG supply increasing over time – the "book ends" of prices

Gas Price Trends Review 2017/18 - key findings

- The Government intervention also led to more gas from the north flowing or being offered into the east coast gas market
  - This had the impact of reversing prices along the east coast – cheaper in the north and more expensive in the south
- In the 2015 Gas Price Trends Report gas prices were lowest the further you were from Queensland (Melbourne was cheapest)
  - Pricing was Longford plus – costs to haul to Sydney mainly which is bereft of local supply, and
  - Similarly with lack of supply in Qld it was almost Longford plus a nominal value to haul to Queensland
- The injection of more gas from Queensland and pricing constraints in Queensland saw the prices at Longford start to look more like Queensland plus
  - Prices in Gladstone we much lower but Melbourne was $3/GJ higher than Gladstone?
  - Many in Victoria saw sudden leaps in the rices as they recontracted

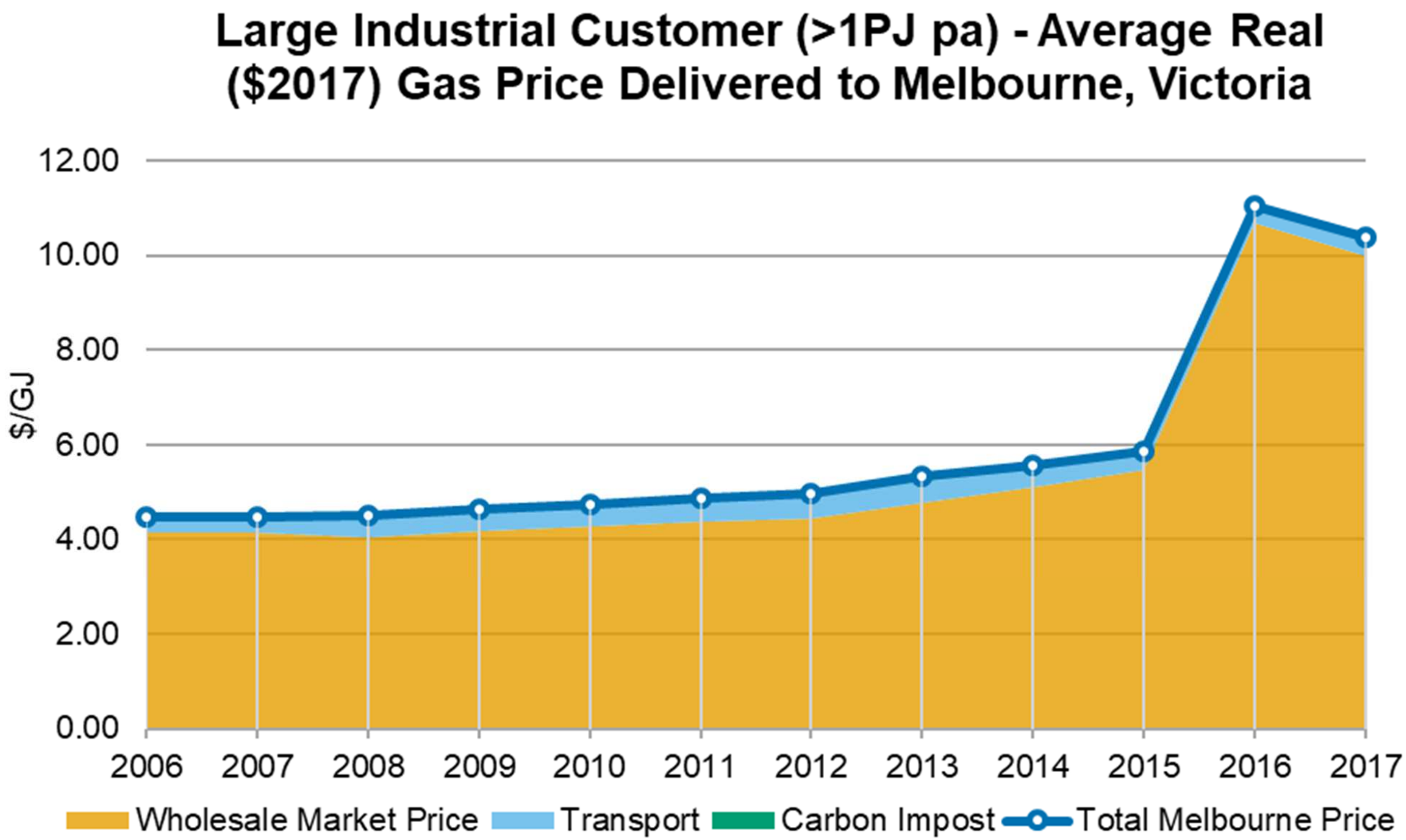
Gas Price Trends Review 2017/18 - key findings

- We note in both reports that Sydney is a clearing price for the market in many ways – large load centre serviced from north, west and south
  - Two of these reportedly depleting – Bass Strait and Moomba
- Pricing also peaked just before Government intervention
  - Outcomes for many were down to which month they contracted (July 2017)
- One other key finding was low liquidity and associated short term offers which was in stark contrast to the WA market developments
  - The key here is lack of price discovery – suppliers and buyers going short to manage around this issue – major gas market structural issue, and
- We were starting to see the inevitable other economic impact of price elasticity working on demand (and hopefully over time Supply)
  - Gas demand, like electricity demand, had dropped off in the domestic market even though the LNG plants had seen enormous growth in gas demand for export, in fact
  - We are seeing industrial and commercial market restructuring which we will come to later - and this was happening as electricity prices also reached a new high in the market

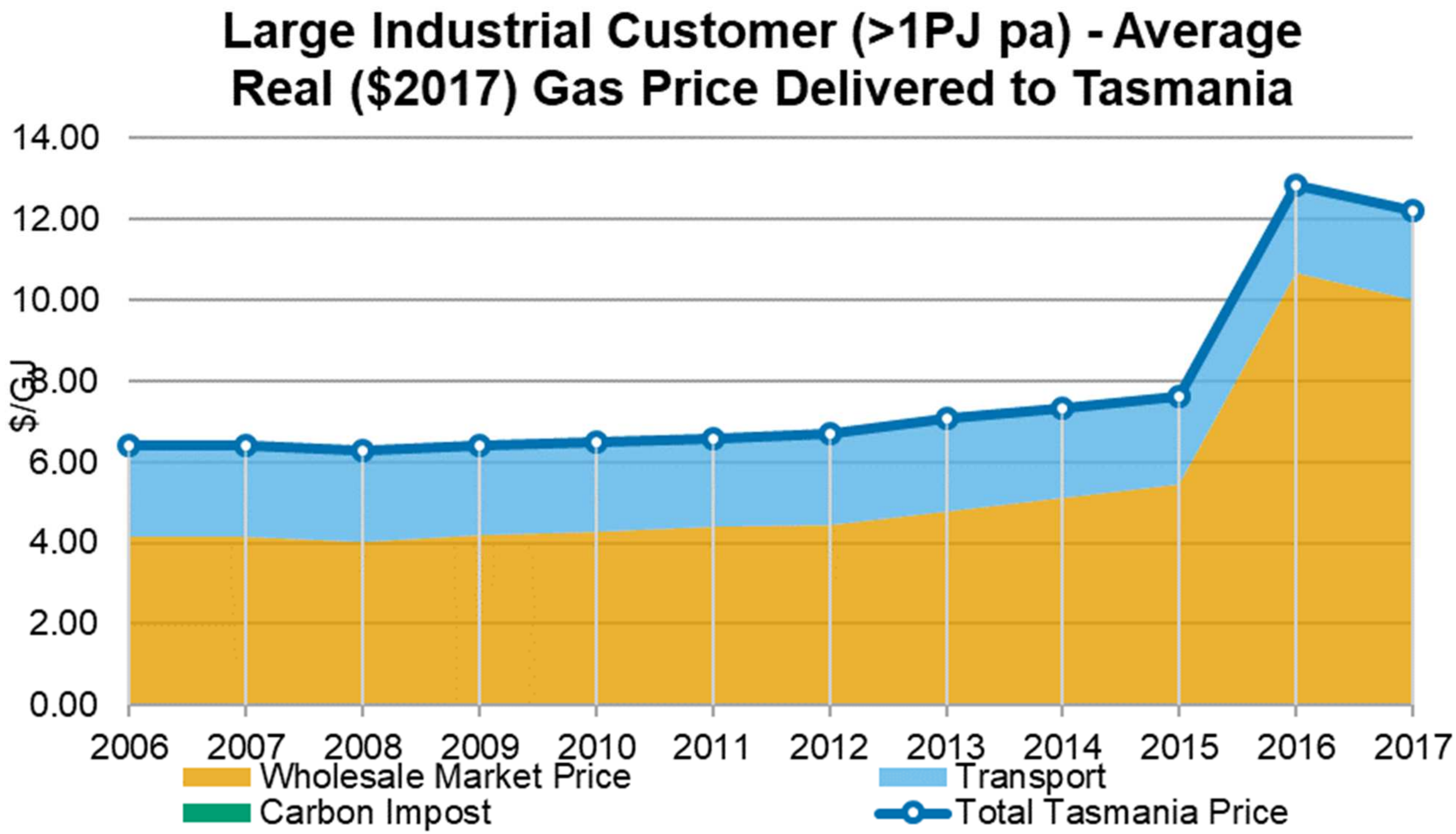
Gas Price Trends Review 2017/18 - key findings

- Customers have taken several classic approaches to demand reduction as they ration supply based on prices
  - Efficiency gains – using less to do more
  - Substitution – many moving to electricity where they can supplied more by renewables – solar PV has entered the commercial and industrial market now at scale
  - Rationalisation – some users are rationalising their plants and production across sites and states
  - Off-shoring – some are moving production offshore (especially in the food industry)
  - Industry restructuring – move to scale efficiencies, or simply shutting down under the weight of imports
- The potential inefficiencies of what is happening is alarming for the economy, and
  - Gas has become central to energy policy again
- Lets look at some price curves from then?

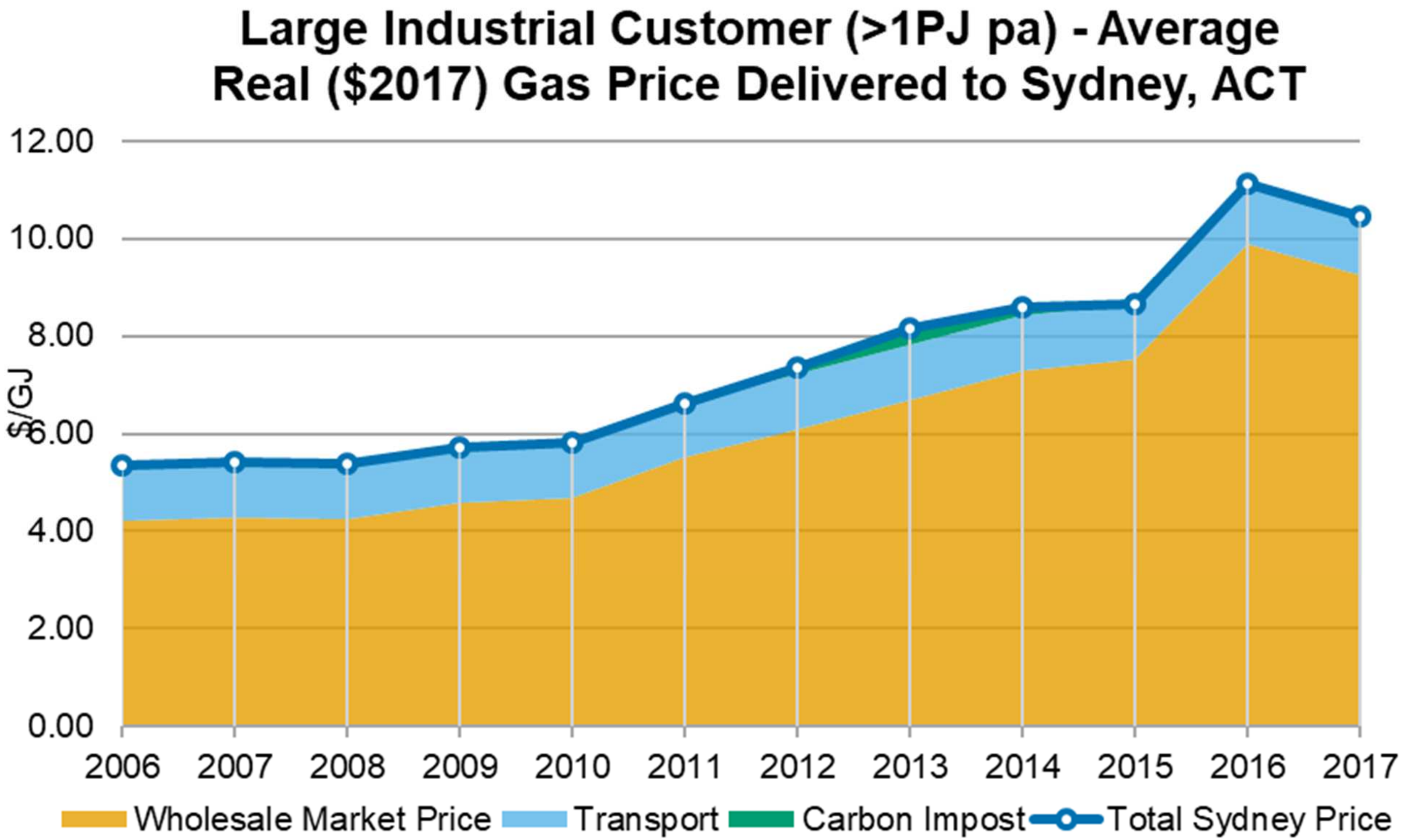
Victorian large Industrial customers - price components



Tasmanian large Industrial prices - components



NSW & ACT large Industrial gas prices - components



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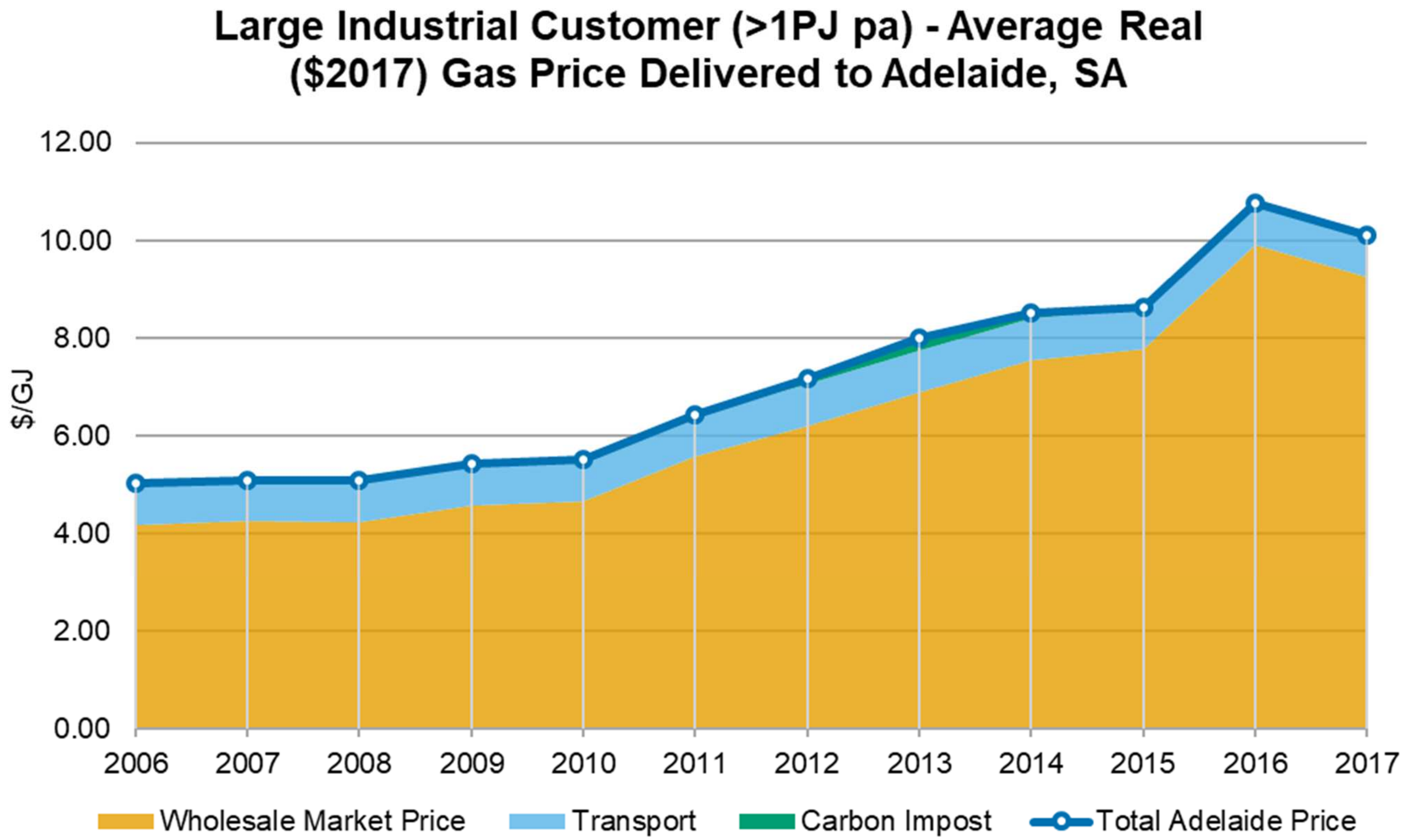
SA large Industrial gas prices – components



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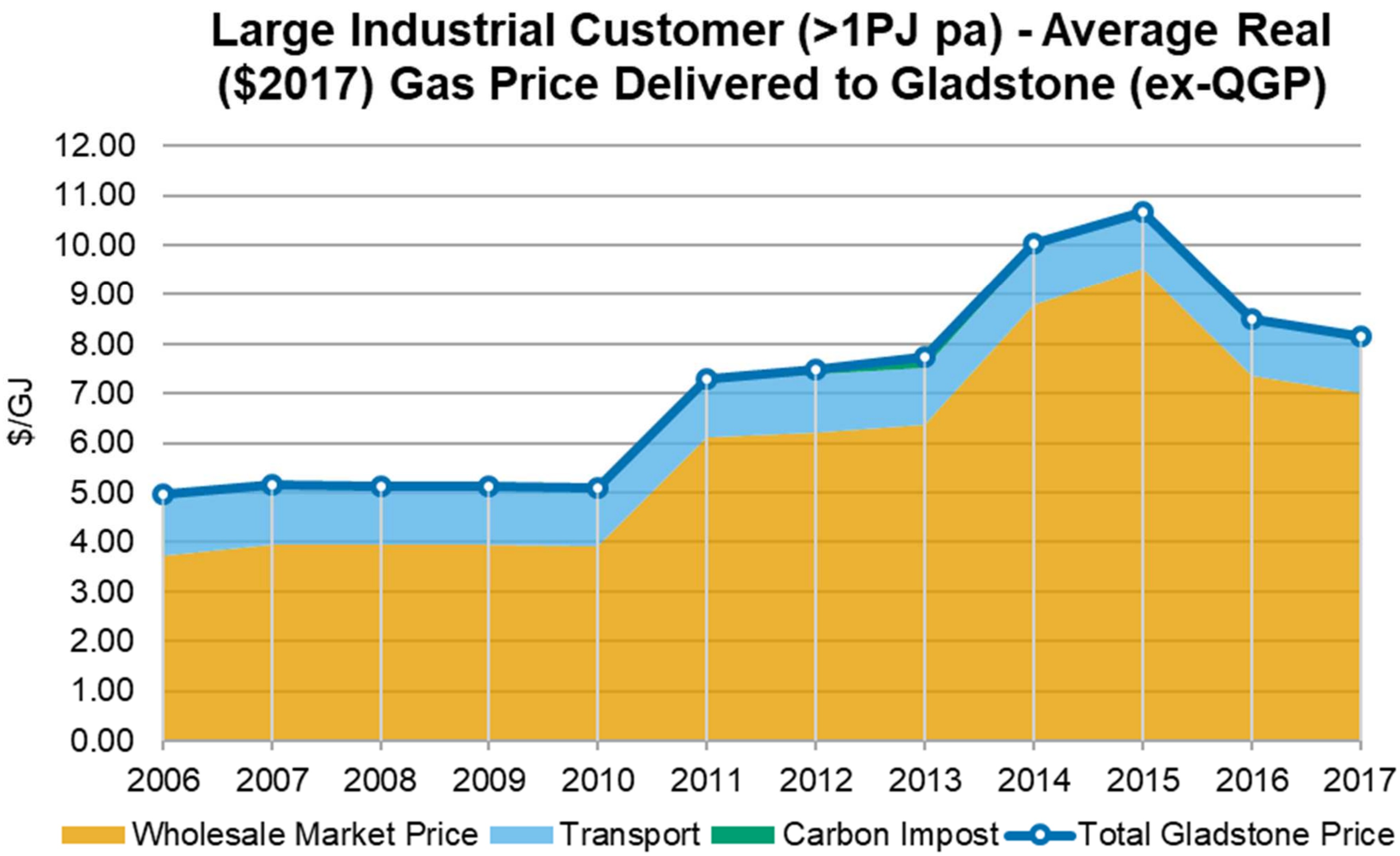
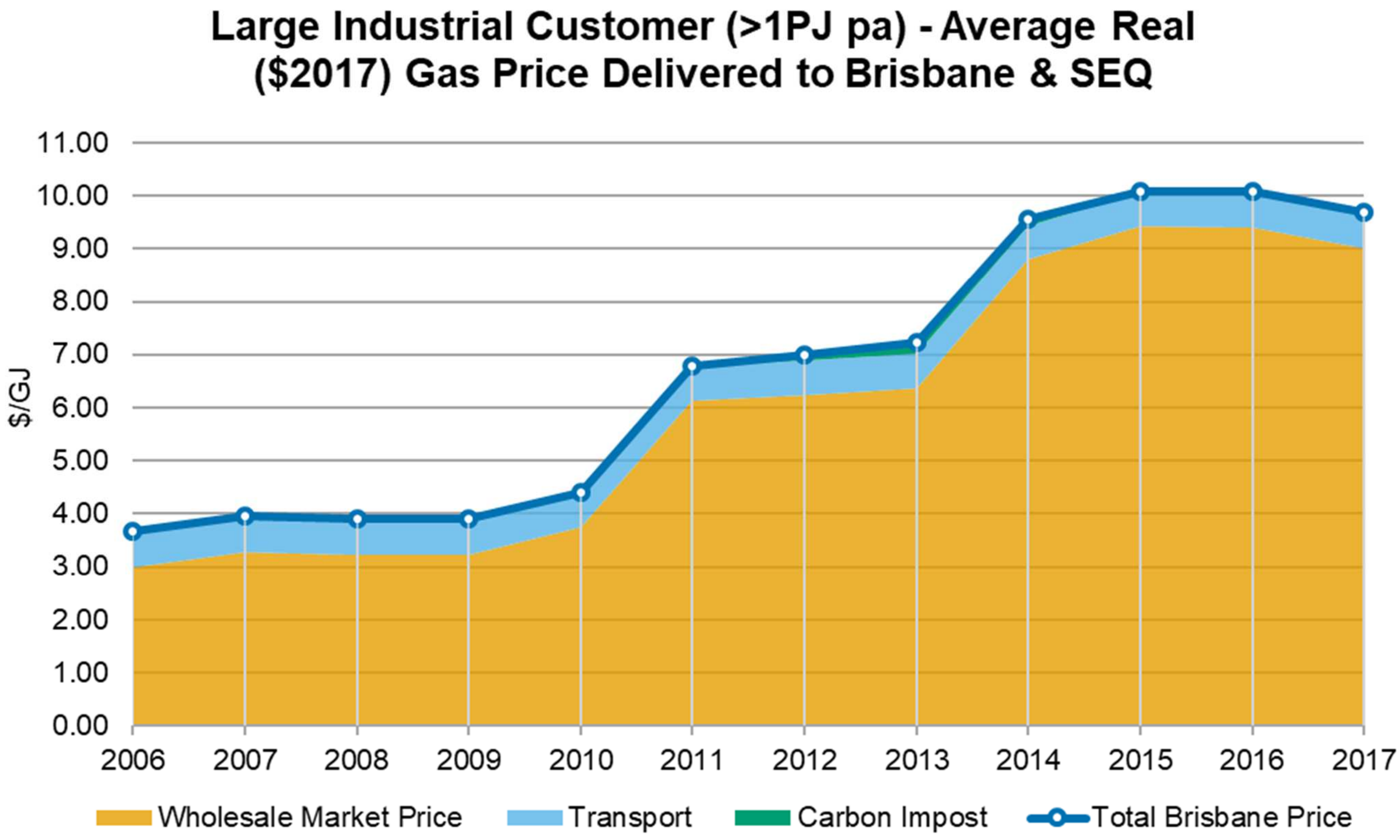
Gladstone large Industrial customer prices - components



Brisbane and South East Queensland - components



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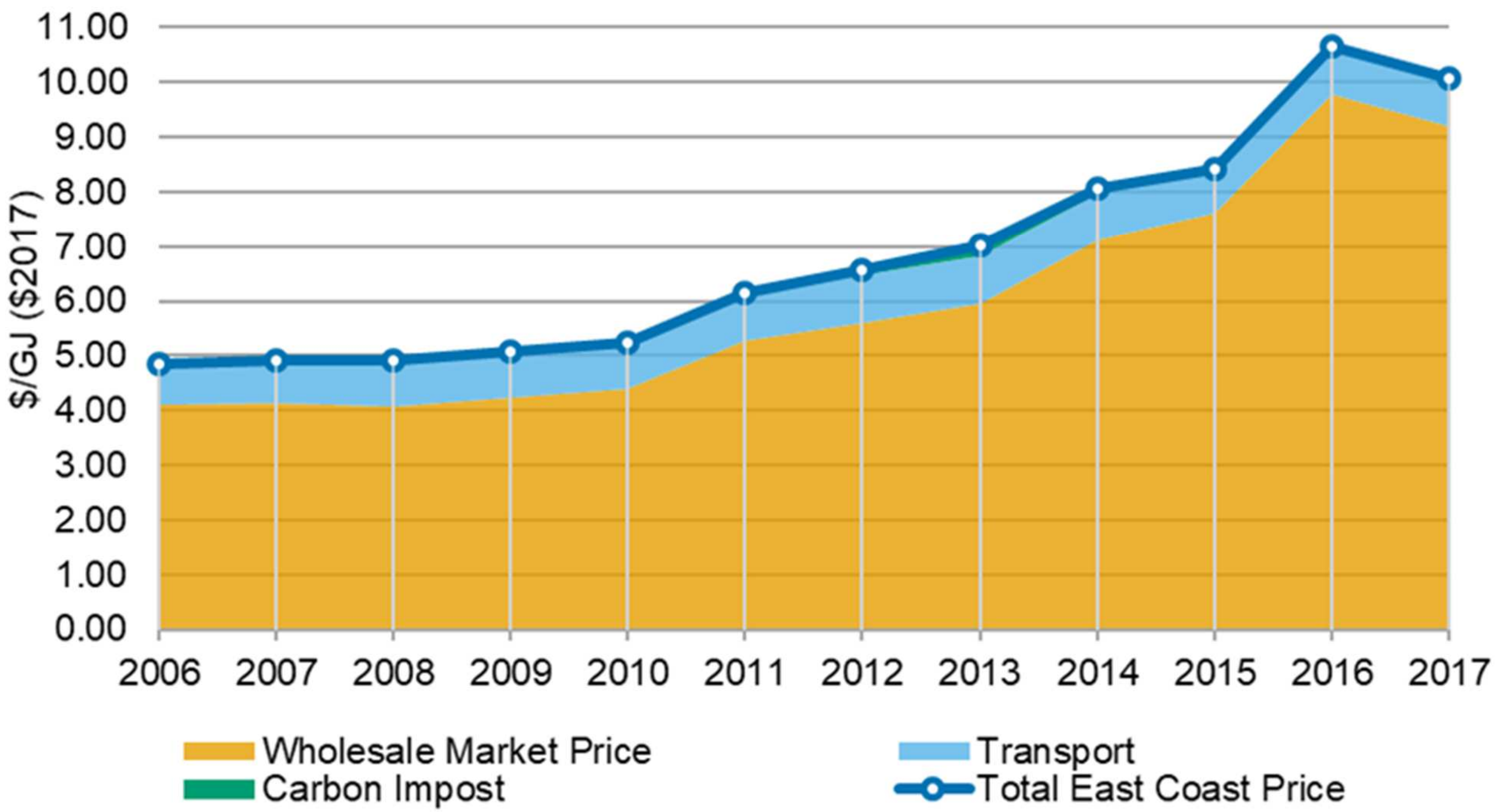
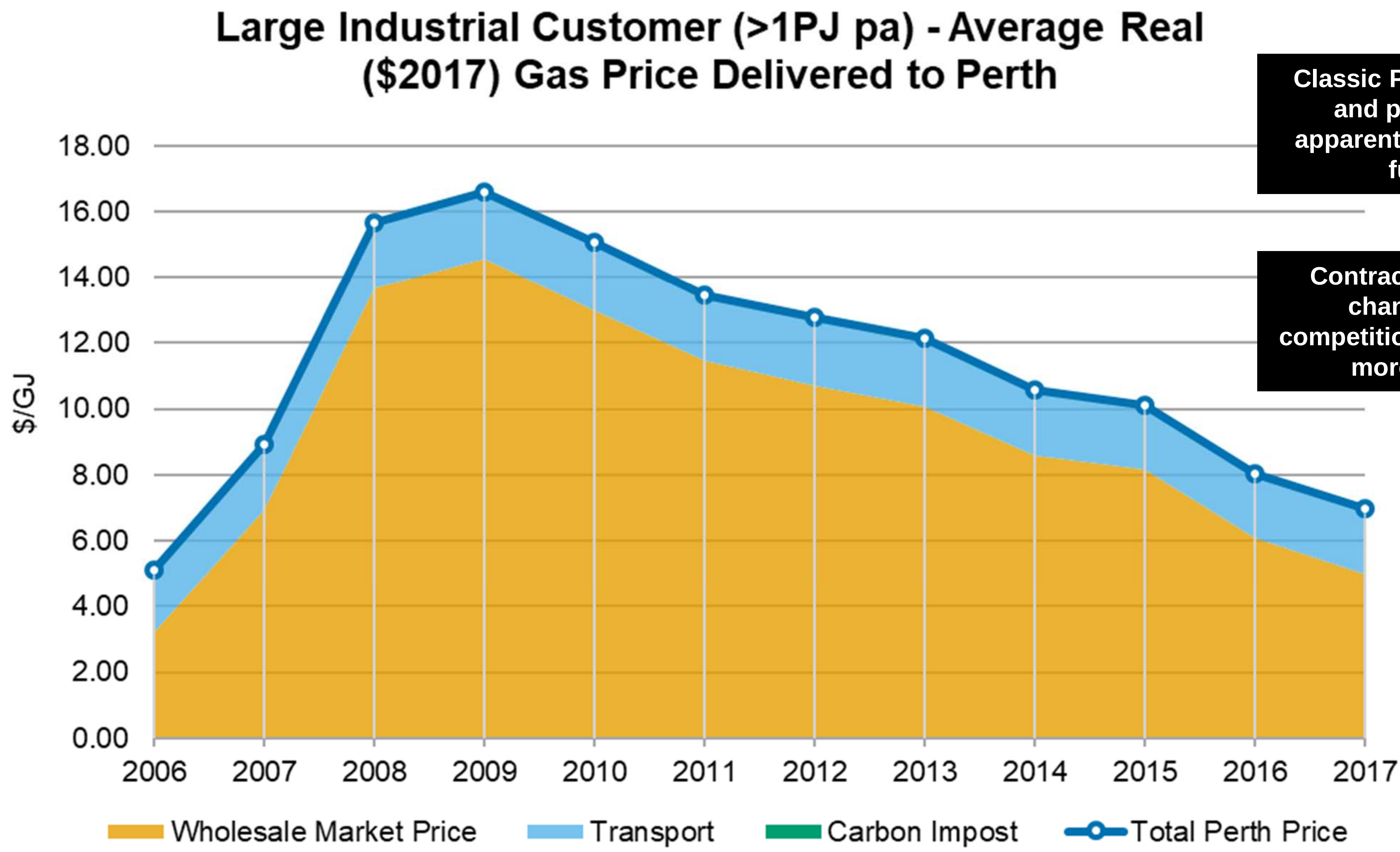
East coast weighted average large Industrial gas price - components



WA large Industrial gas prices (Perth) - components



Classic Price Bubble – and prices have apparently gone down further

Contract terms also changed with competition – longer and more flexible

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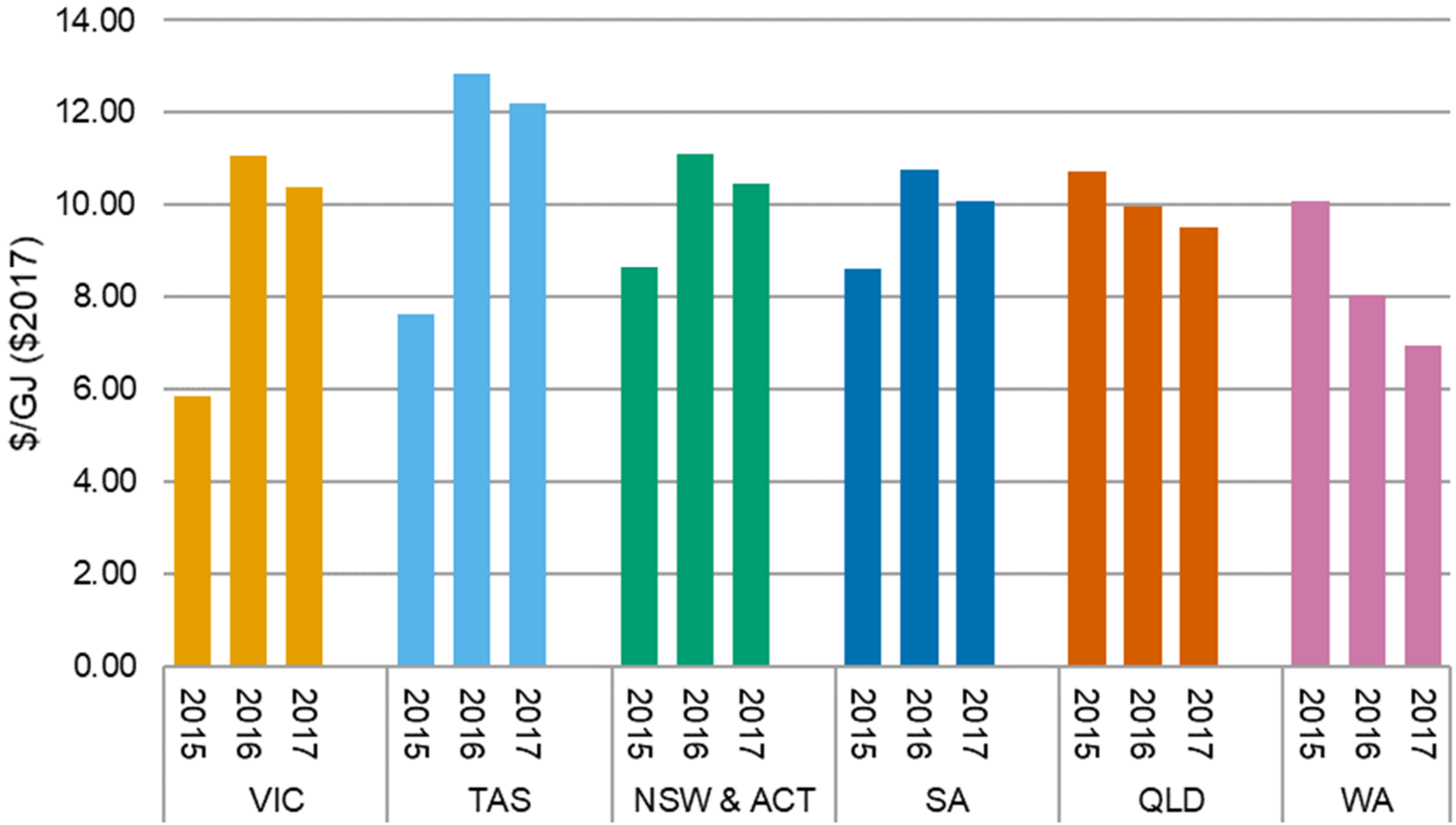
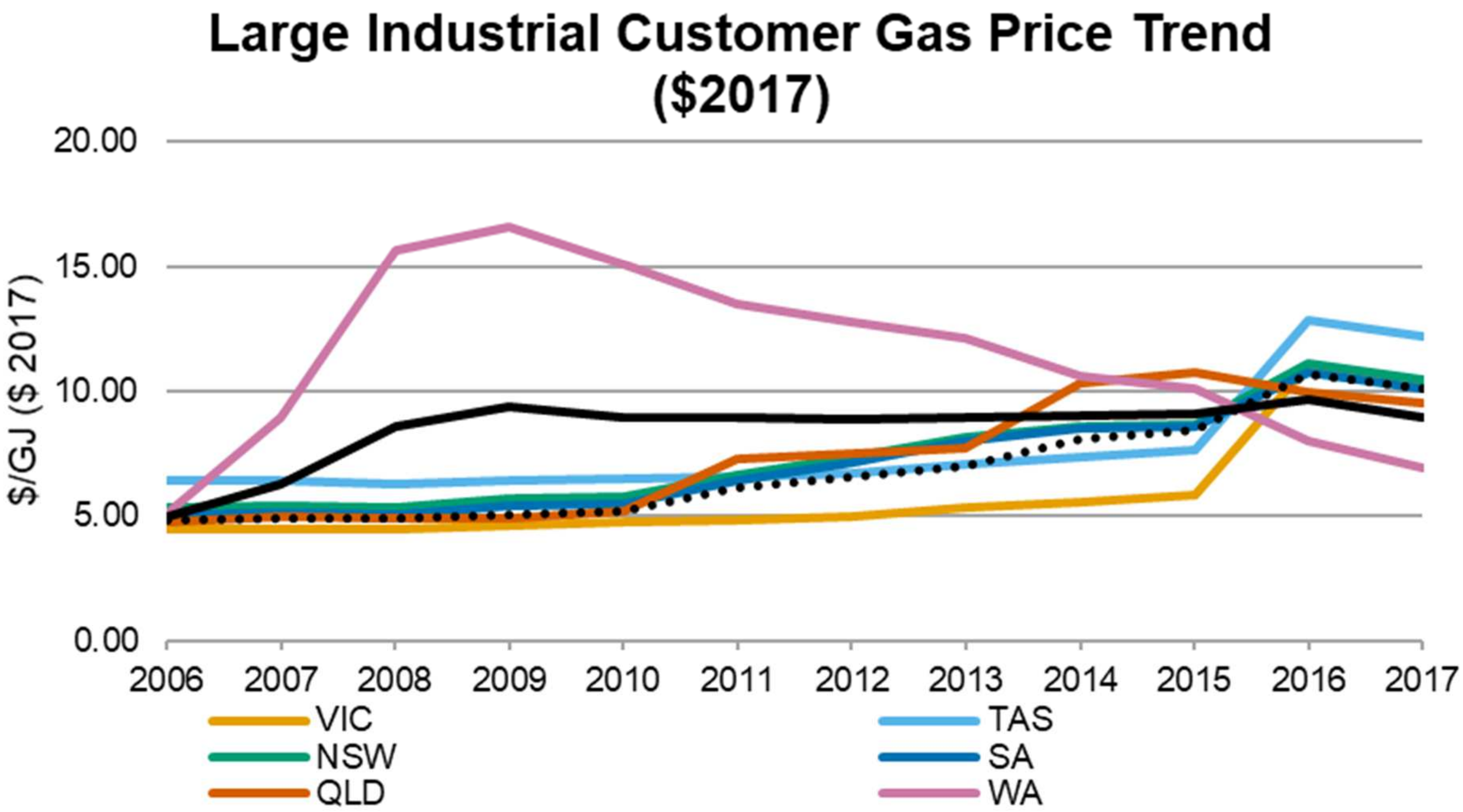
Wholesale Cost Changes 2015 to 2017 Report



Gas price trends for large industrial customers



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East Coast vs West Coast Statistics

Factor	East coast 2017	Western Australia 2017
Delivered average gas price	$10.08	$6.97 (Perth)
Wholesale gas component	$9.19	$5.00
Transport component	$0.89	$1.97 (Perth)
Total consumption 2015-16[1]	887 PJ	563 PJ
Total production 2015-16[2]	1,606 PJ	1,754 PJ
Major consumers	Mining 15% Manufacturing 28% Electrical 33% Residential 18% Others 7%	Mining 20% Manufacturing 29% Electrical 47% Residential 2% Others 2%
Gas source[3]	Conventional 41% Coal seam gas 59%	Conventional 100%
Policy settings	QLD Prospective Gas Production Land Reserve (PGPLR) NSW CSG exploration exclusion zones Victoria Resources Amendment Legislation (Fracking Ban) Act 2017	WA Gas Reservation Policy 15% WA onshore fracking moratorium
Spot markets	<0.1% through GSH	1%[4]
Bilateral markets	>99.9%	99%

Key drivers of future Industrial gas prices – 2017 view out 3 to 5 years

- The simple economic models of supply and demand balances and clearing prices is always at play in this market. Indicates it is still very much a commodity market
  - Needs more supply on the east coast, and demand will reduce to a new clearing market – still fraught with inefficiencies unless there is market based price transparency
- Critically, it has also seen the intervention by Government to force supply back into the domestic market from LNG producers to mitigate price and for energy security
  - Government intervention will be likely to be ongoing to cap prices to at least LNG netback – and maybe more mechanisms or orders to force in new supply on the east coast
- Market opaqueness and high transactional costs are very slowly being reformed but the market is still relatively inefficient in setting prices
  - This is likely to remain so and this will impact the underlying supply and demand balances at the macro level – and likely in an inefficient way (under and over consumption/supply), and
  - The market will continue to compensate through short contract terms and other mechanisms that avoid either seller or buyer being out of the money

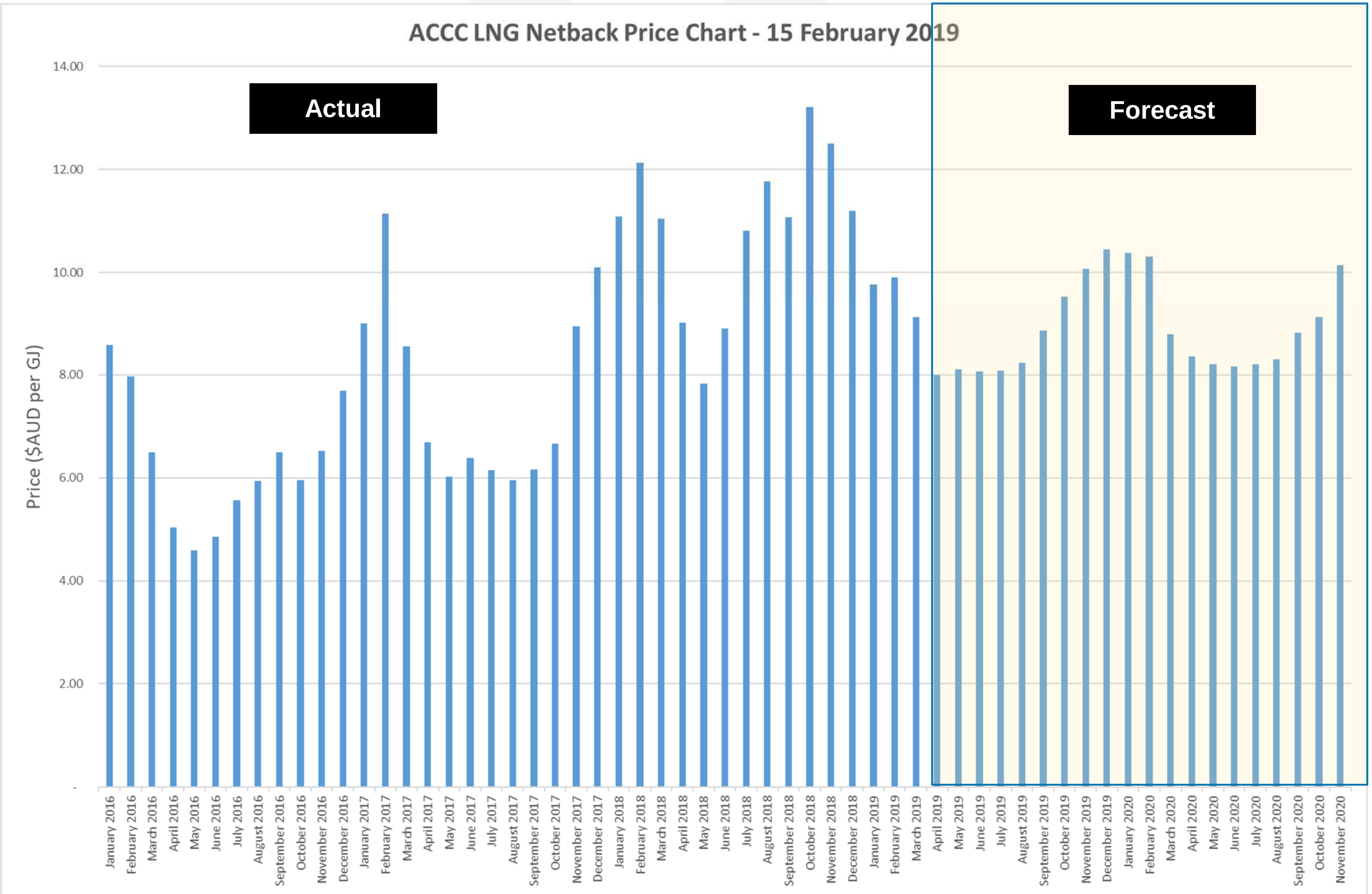
Key drivers of future Industrial gas prices – 2017 view out 3 to 5 years

- Prices will remain book ended with a higher production cost base and LNG netback capping at Gladstone – WA prices may remain low due to supply competition
  - Individual prices at nodes on the east coast may well exceed this netback pricing due to haulage costs (or arbitrage) and make Queensland attractive for both supply and price
  - But prices will remain high without new supply competition and it is not evident where that will come from unless it originates in Qld
  - Sydney will continue to be the clearing price for the east coast market (e.g. Longford plus, Moomba plus, Gladstone plus)
  - Costs of new gas supplies from CSG will be higher than conventional gas (e.g. WA gas) – and so the floor price will be higher no matter what level of supply competition and remain so even if cheaper supply becomes available (as it will not be sold cheaply in a supply constrained market)
- The outliers are a) cheap oil prices driving down LNG netback, or b) lots of new LNG developments from much higher LNG prices with those plants having to provide some level of domestic reserves/supply
  - Not likely over 5 years in terms of new supply but cheap oil prices are always on the cards
  - LNG imports may also consolidate the LNG netback price as the cap - but still most likely from Gladstone reference point (Gladstone plus)

ACCC LNG Netback Series

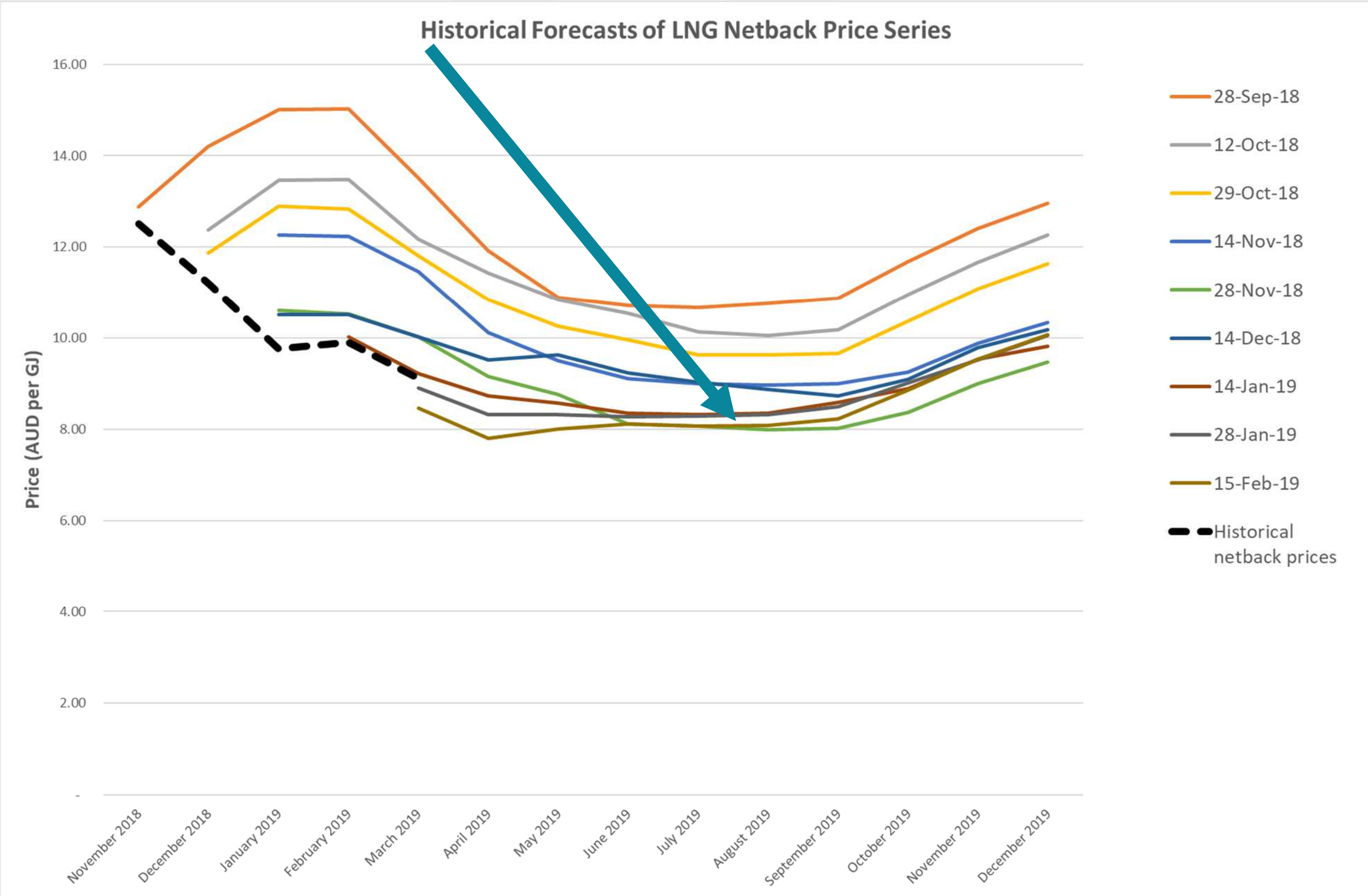
- The LNG netback price series includes:
  - Historical monthly LNG netback prices at the Wallumbilla Gas Supply Hub (Wallumbilla) in Queensland, dating back to January 2016 based on a measure of historical Asian LNG spot prices, and
  - Forward monthly LNG netback prices at Wallumbilla, extending to the end of the following calendar year, based on a measure of expectations of future Asian LNG spot prices.
- And this is a marginal cost exercise – assumes the domestic gas at Wallumbilla can either go marginal for LNG or domestically
  - An LNG netback price is a measure of an export parity price that a gas supplier can expect to receive for exporting its gas. It is calculated by taking the price that could be received for LNG and subtracting or 'netting back' the costs incurred by the supplier to convert the gas to LNG and ship it to the destination port.
  - LNG netback prices based on Asian LNG spot prices currently play an important role in influencing gas prices in the east coast gas market.

ACCC LNG Netback Series – 15 February 2019



- Platts/ICE JKM LMG futures data and Argus data on forward LNG haulage costs
- Exchange rate data (RBA) - uses actual at publish date as forecast
- Marginal plant efficiency data, marginal LNG Plant Opex costs, marginal costs of pipeline transport of gas to LNG facilities

The ACCC LNG netback price forecasts have dropped over the last 5 months



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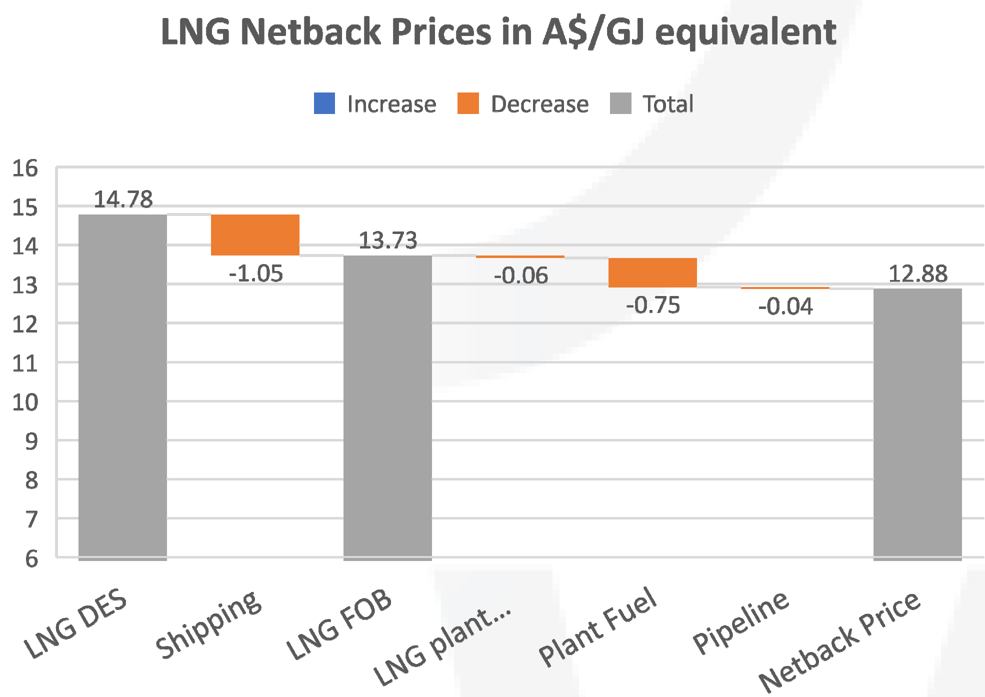
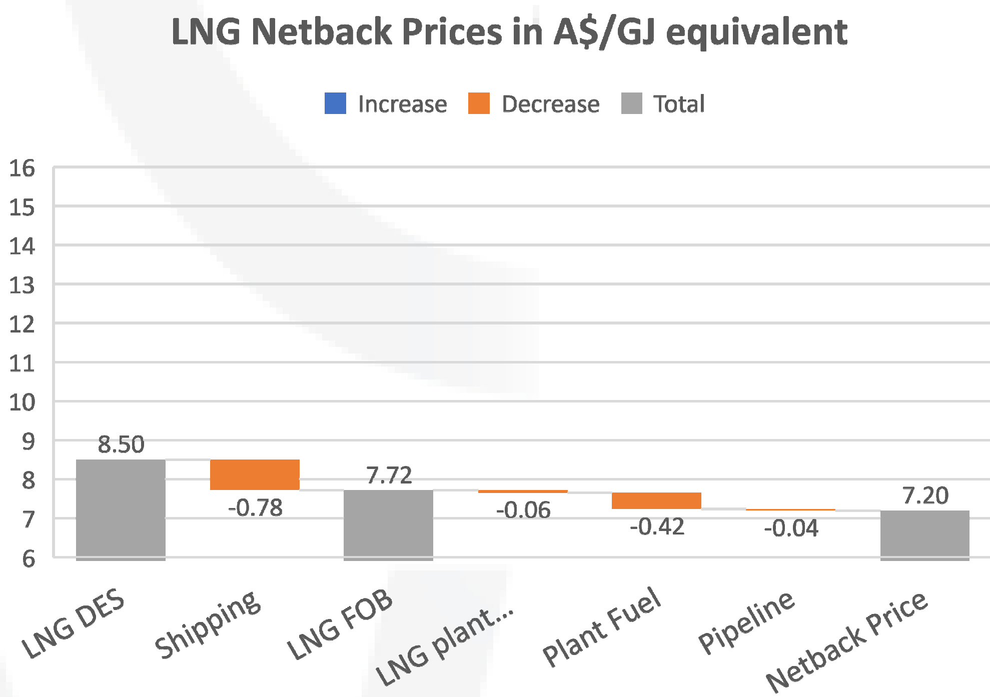
Nov 2018 vs Feb 2019 = 44% swing



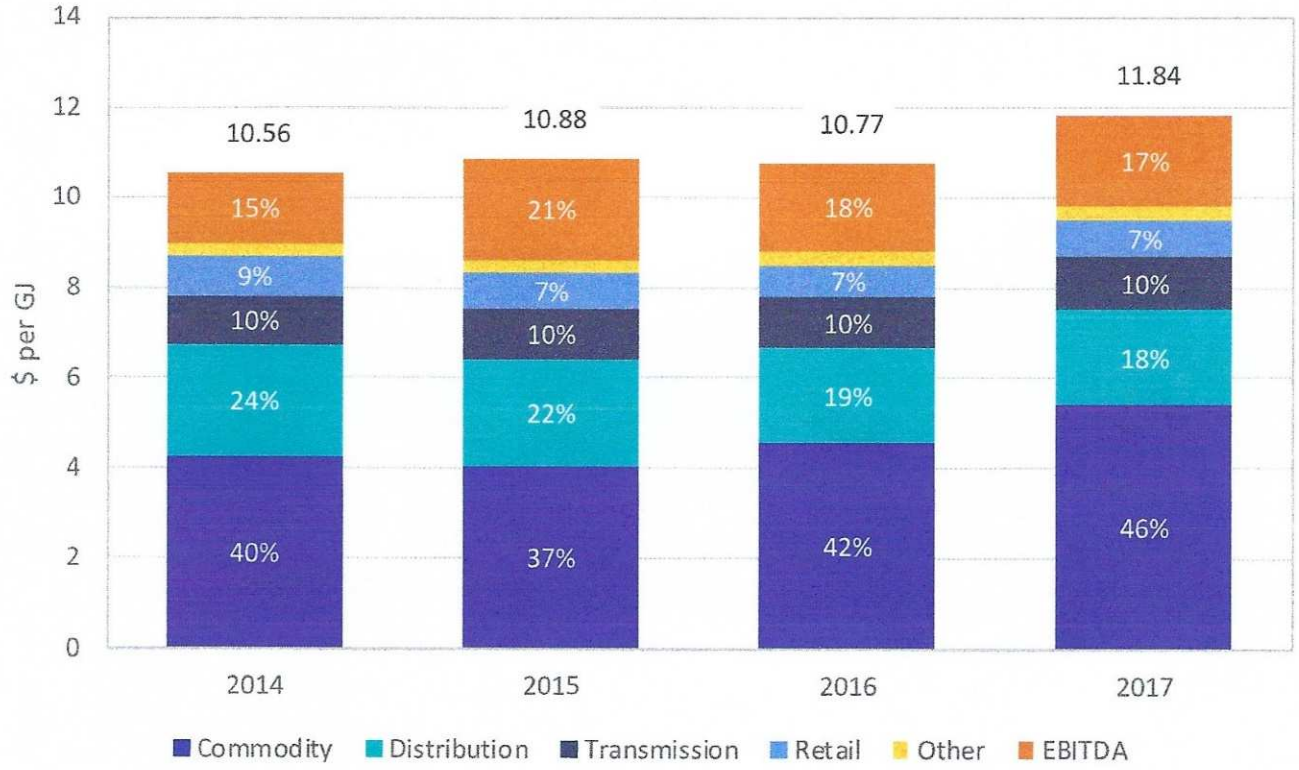


At US$11.30/mmBtu

- At US$6.50/mmBtu

ACCC retail margin initial analysis

Chart 3: The delivered price of gas[7] paid by the customers of AGL, EnergyAustralia and Origin, broken down by each cost component and the retailers' margin[8]



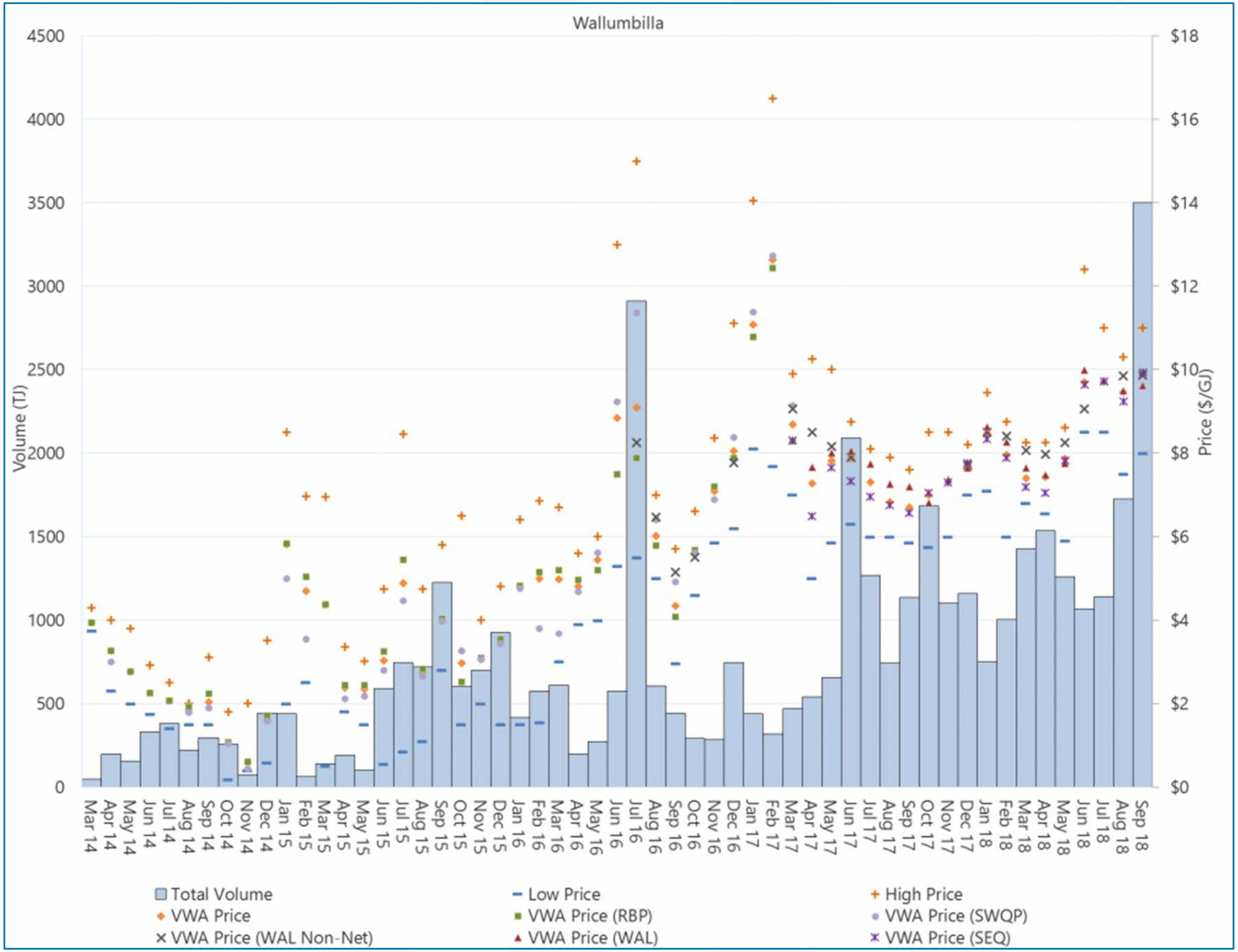
Source: ACCC analysis of information provided by retailers.

Note: In this chart, 'retail' costs refer to the retailers' operating costs, while 'other' costs include costs associated with storage and the costs of participating in AEMO-operated Wholesale Markets. Not all cost categories presented in this chart are applicable to all the customer segments – for example, retailers would not typically incur distribution costs in supplying wholesale customers.

ACCC LNG Netback Series

- Huge variance in forecasts and actuals over relatively short periods – really little correlation it seems
- Clearly a big difference between "futures" and clearing prices in this market over this period, and
- It is debatable what these granular spot prices mean relative to a domestic gas price as domestic gas contracts are a bit longer term
- Suspect that price spikes like the ACCC forecast late last year are taken as some form of signalling of short term demand and supply imbalances (as we did), but
- The longer term trends we are seeing now of $8.50 to $9.00/GJ at Wallumbilla out to end 2020 are more relevant in terms of domestic gas contracting and supply
- Lets see how this compares with Wallumbilla prices

Wallumbilla – volume weighted prices and volume history

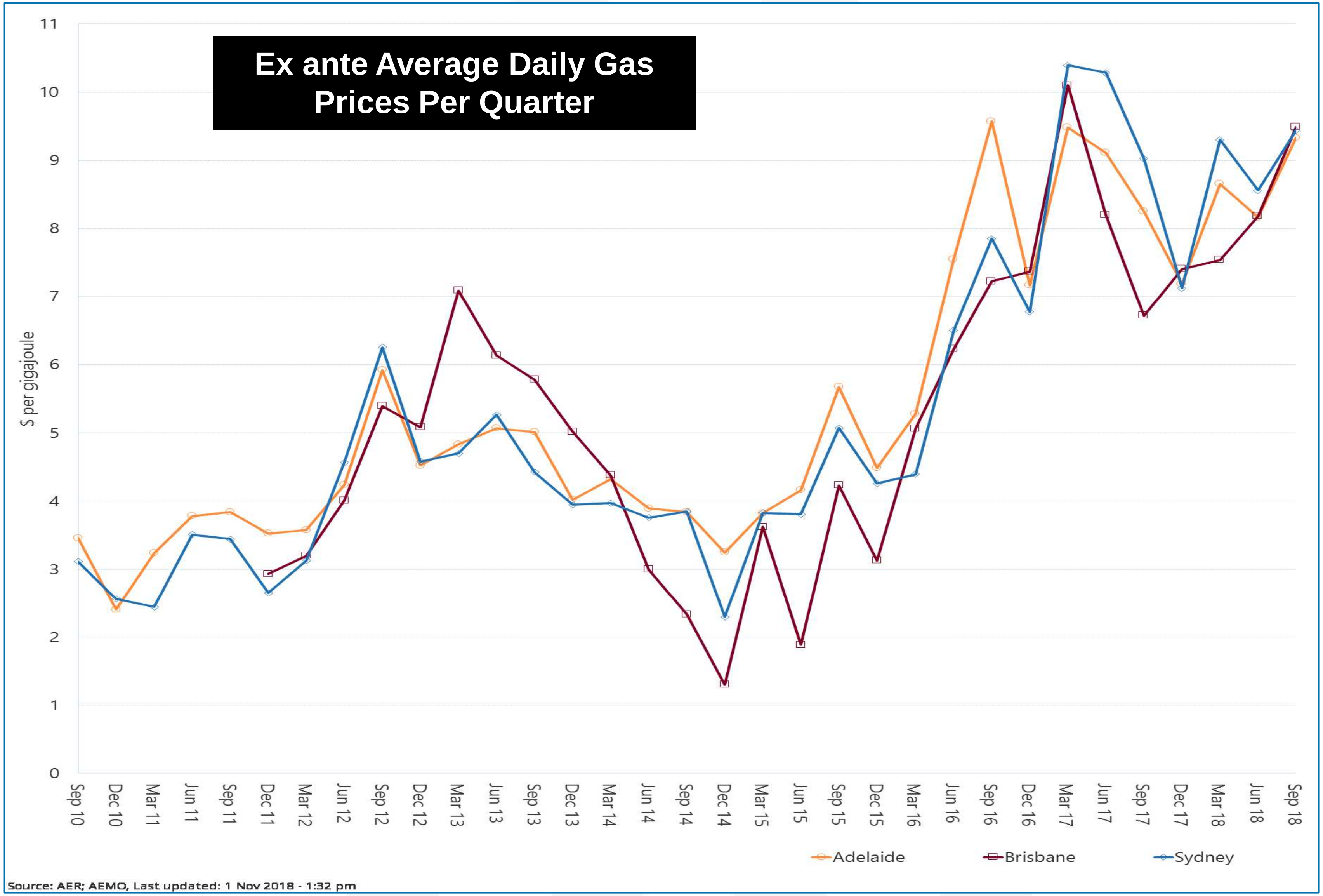


Wallumbilla – volume weighted prices and volume history

Wallumbilla – volume weighted prices and volume history

- We have seen both an escalating in prices and volumes traded
  - Volumes in 2016/2017 (September 2016 to 2017) were close to 9 PJ, and
  - In 2017/18 for the same period it was close to double that at 18 PJ
- The volumes changed markedly/step change occurred at roughly the same time as the Government intervention, as we started to see sales back into the southern states around June/July 2017 as we reported in 2017/18 Gas Price Trends Report
  - Went from 8.2 PJ/year (0.7 PJ/month), to
  - 15.5 PJ/year (1.26 PJ/month) and has stayed up there
- There is an argument that Wallumbilla prices are giving some level of price discovery now, but
- Again it is really indicative rather than actual market prices – some 11 sellers and 12 buyers in this hub
- Lets look at STTM prices?

STTM – volume weighted prices and volume history



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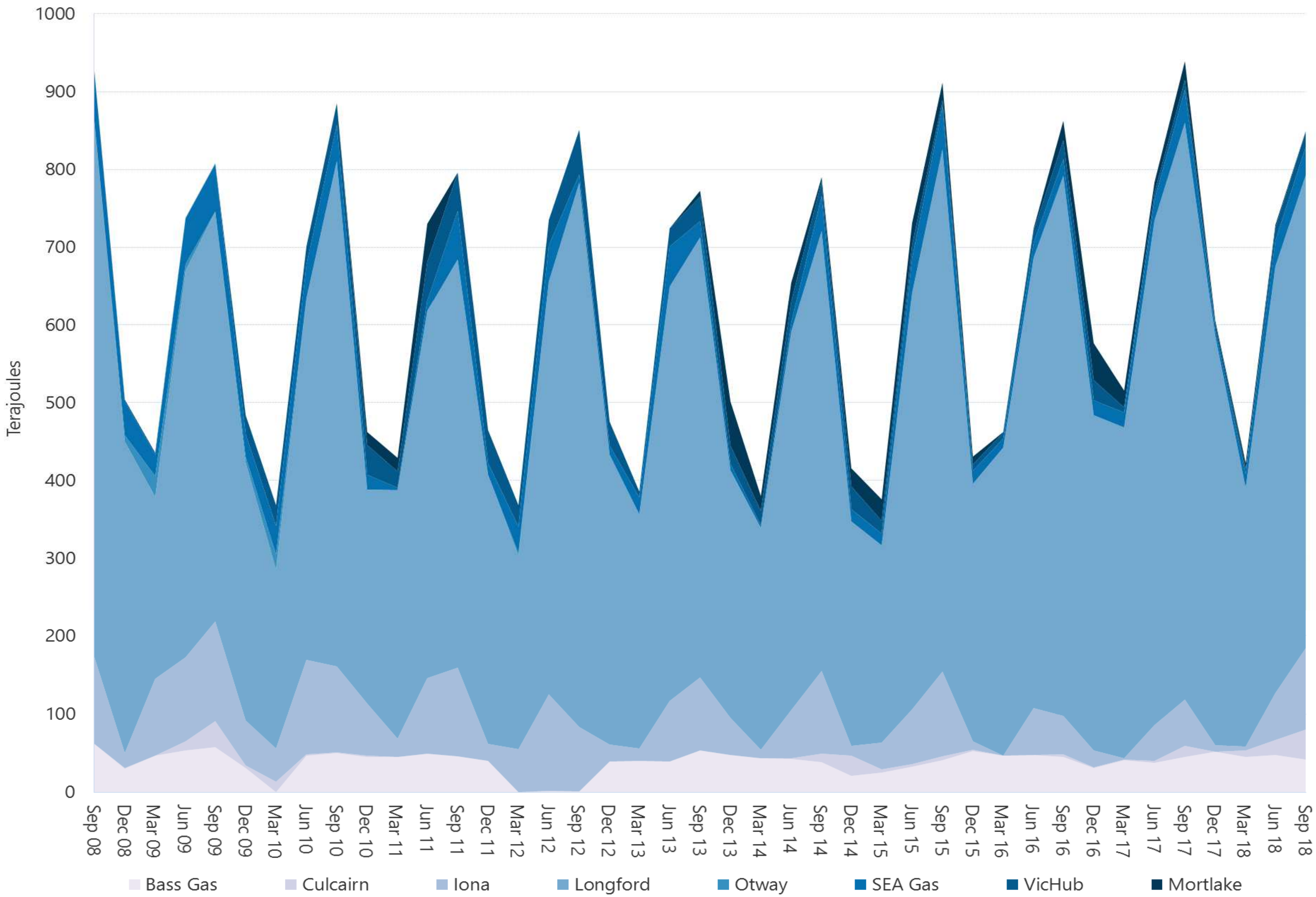
STTM Pricing

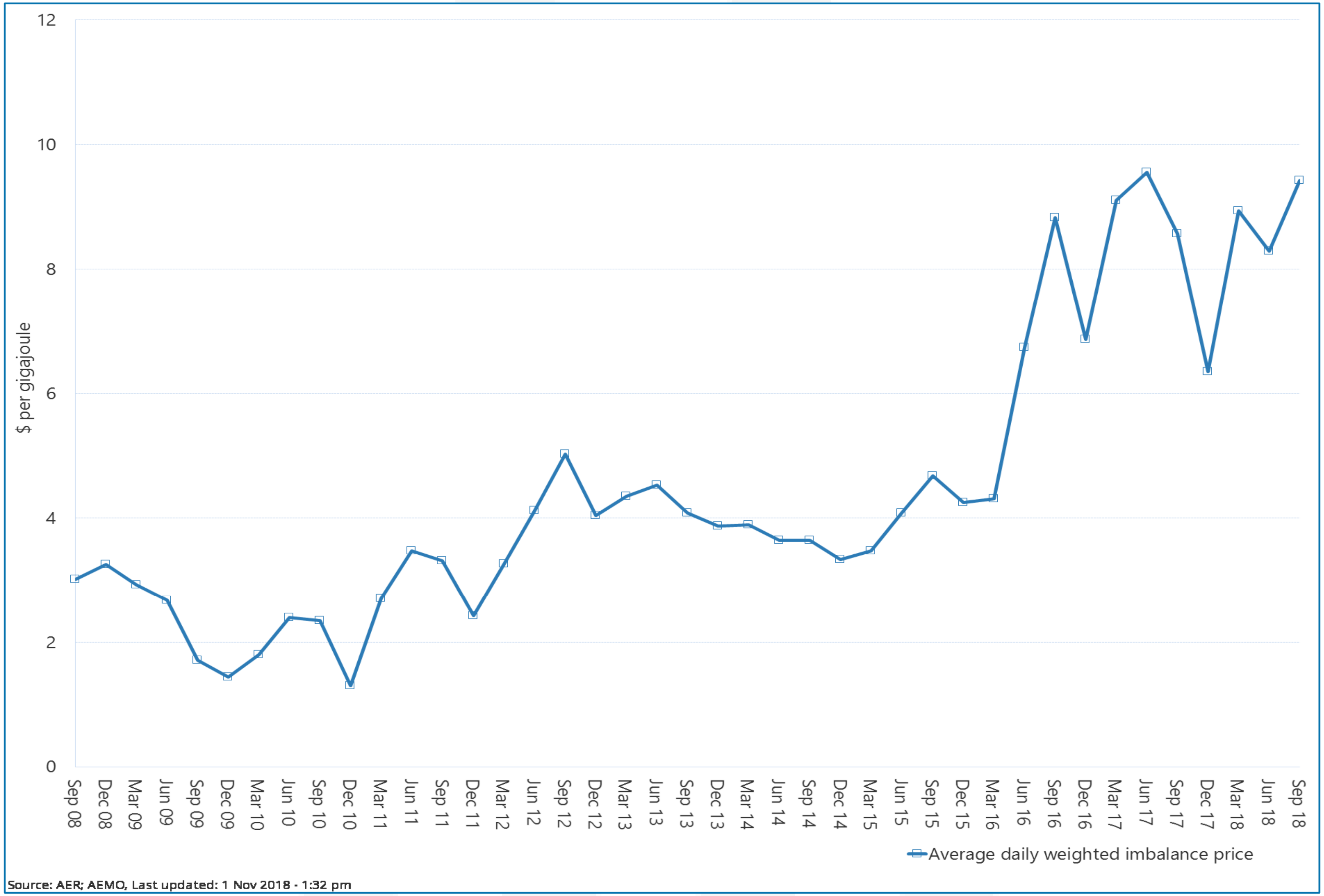
- Very small volumes traded daily for imbalances – 2.5 PJ for example at Sydney over 12 months (6 to 7 TJ/day), but
- There are a number of larger gas users (down to 5 TJ/year) buying gas direct from the Sydney hub via a retailer/trader
  - Weston Energy – Wholesale Hub Price Gas Contract – which now offers services to ACT, SA, Vic, Qld – pipelines paid at cost
  - Full volume flexibility – take market price risk – claimed to be delivering significantly lower average prices – classic risk/reward trade-offs
- Even so we can see the price escalations for these settlements over the last couple of years
- This is another price indicator based on small balancing volumes
- Lets look at the Victorian Declared Wholesale Gas Market (DWGM) and the associated Futures Prices for that market which has arisen (as it is a market carriage market)

Victorian DWGM Average Daily Volumes (Quarterly)



Source: AER; AEMO, Last updated: 1 Nov 2018 - 1:31 pm

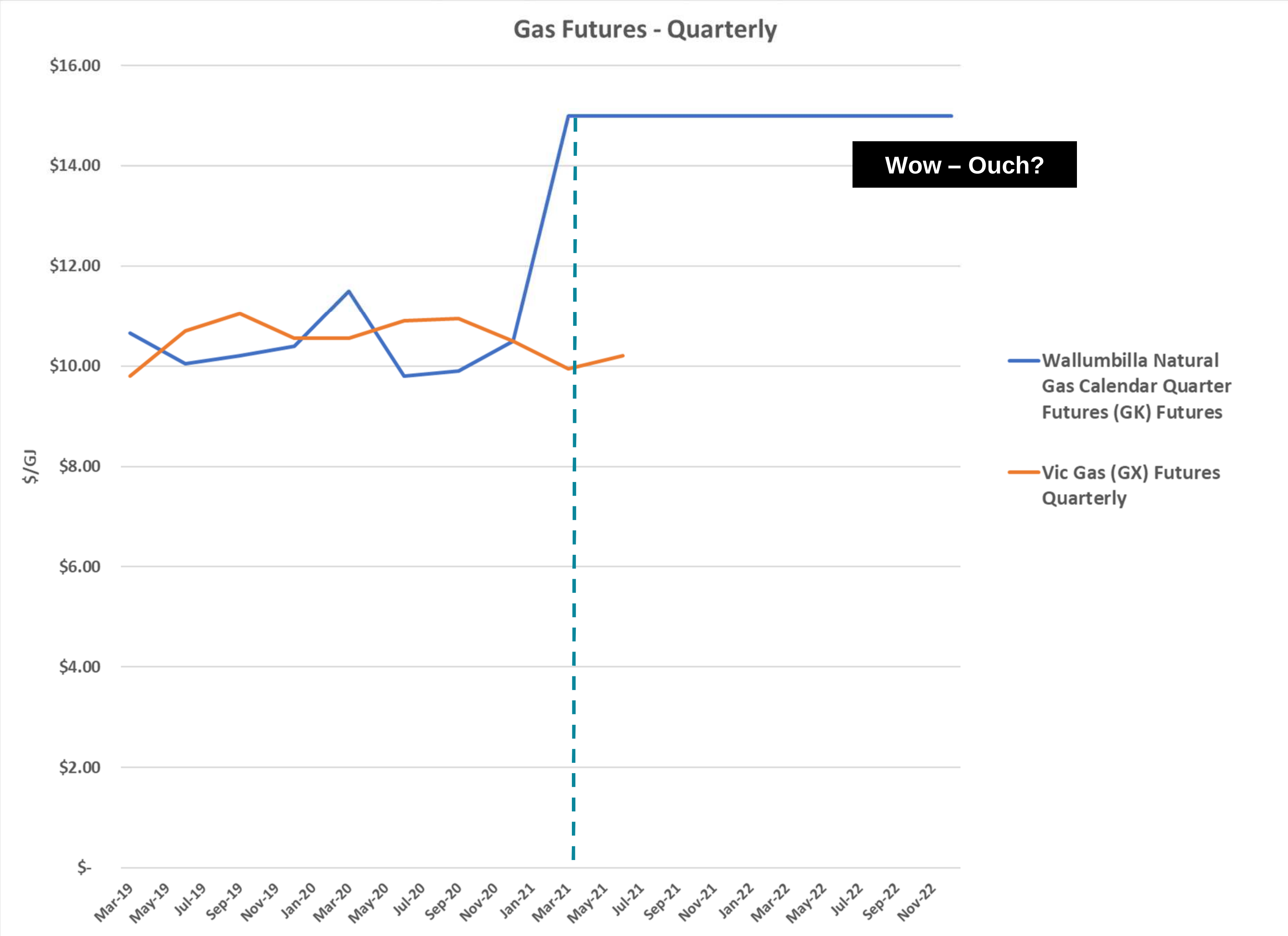
Victorian DWGM Average Daily Prices (Quarterly)



Victorian DWGM Pricing History

- Gee – what happened around June 2016…the price trend looks familiar, but
- Did Victoria benefit from intervention or was this going to happen anyway – beware unintended consequences?
- Lot more volume being traded in this market of course, and
- Evidence that some trading is direct gas sourcing
- This is another price indicator and adds well to the mix, and
- So lets now look at the ASX Natural Gas Futures
  - Have them for Victoria, and
  - Wallumbilla

Gas Futures - Quarterly



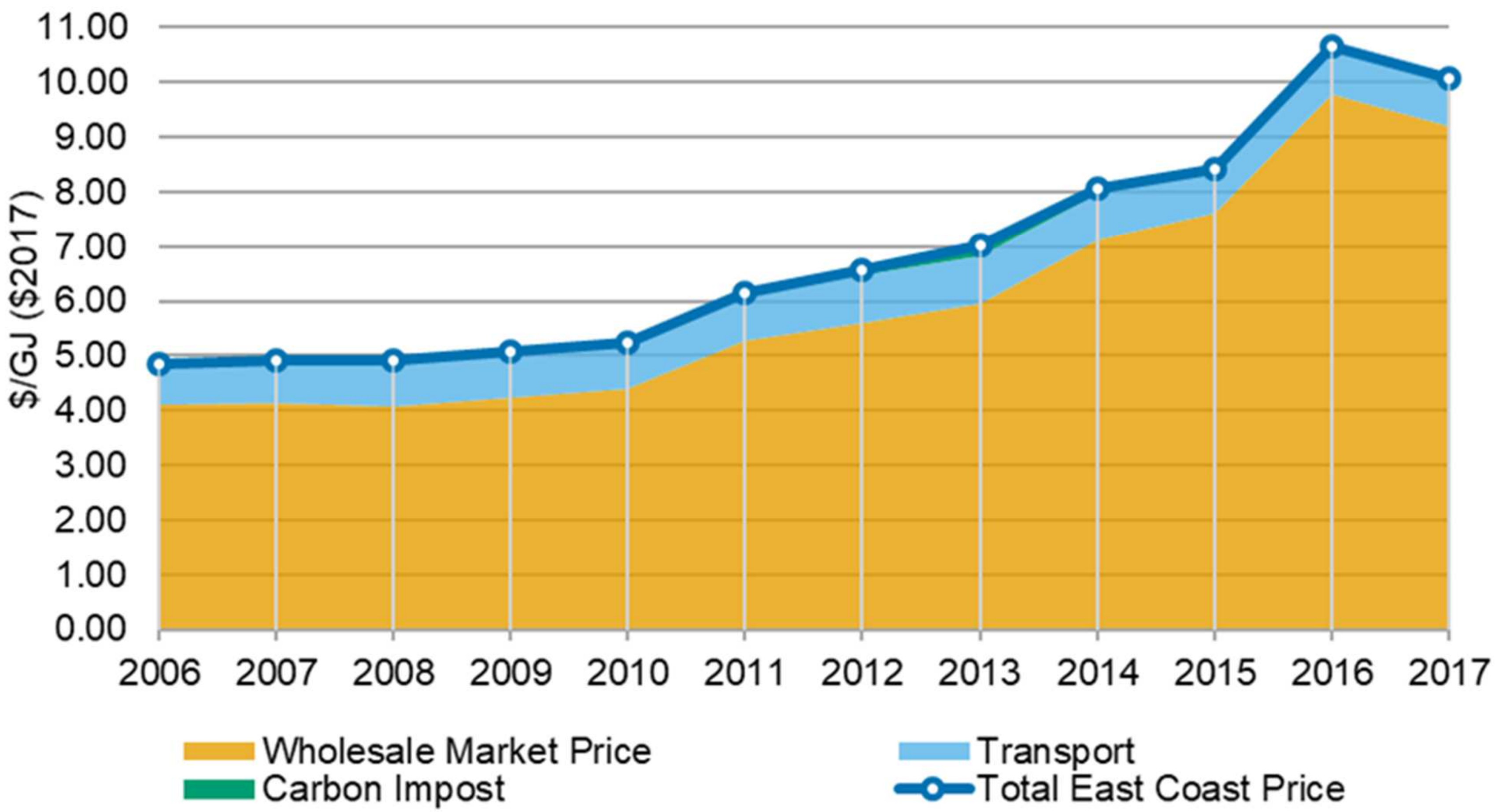
Gas Price Futures

- So what happens around 2021 – 50% escalation in price to $15/GJ at Wallumbilla?
- LNG Netback forecasts – don't extend that far but are distinctly rising by the end of this year?
- Maybe as we will see it could be more correlated with the major drop off in east coast supply being forecast from Longford at the same period?
- This is a really interesting first "sniff" at what might happen and it is clearly not pretty, but
- It does look to us like the market is pricing in the uncertainty that you will see later in supply – if you want a price 2 years out right now we are comfortable offering you $15/GJ – is

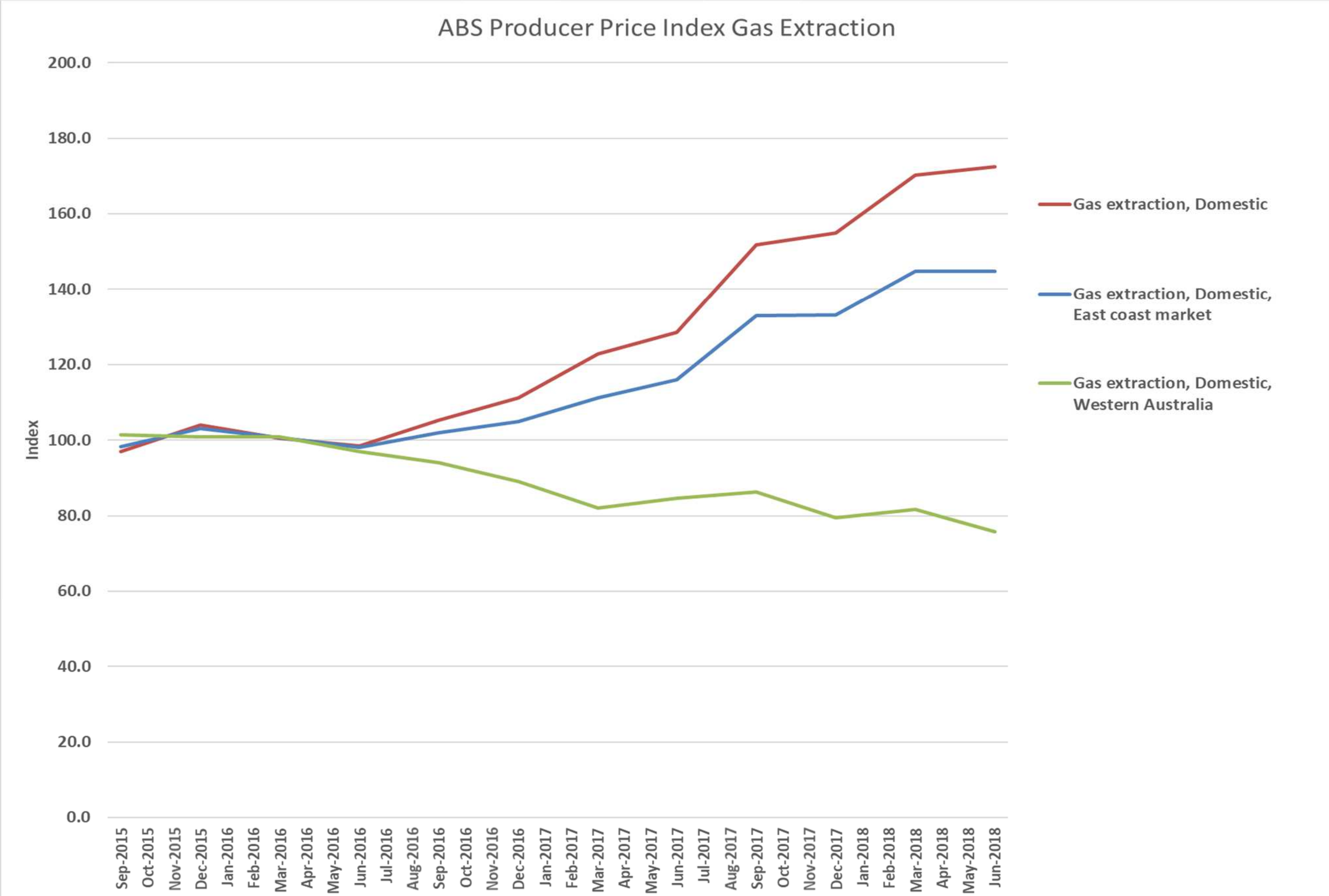
ABS Producer Price Index, Domestic Gas Extraction Series

- The ABS began investigating options to enhance the measurement of price change in the domestic natural gas industry in 2015.
- The development process included extensive engagement, initially with the Australian Energy Market Commission (AEMC), followed by consultation with other industry stakeholders.
- The outcome of this development work is the production of three new Producer Price Index (PPI) measures. The new series measure change in the prices received by producers of natural gas on the domestic market.
- The series are as follows:
  - Gas extraction, Domestic;
  - Gas extraction, Domestic, East coast market; and
  - Gas extraction, Domestic, Western Australia.
- East coats is showing a 72.5% increase in price to June 2018 in the series from September 2015, and
- In WA a 25% reduction – which fits with what we have been seeing

East coast weighted average large Industrial gas price - components



ABS Producer Price Index, Domestic Gas Extraction Series



ACCC Gas Inquiry Reports (East Coast Focused)

- This was commenced as a series in April 2017 – it is a 3 year inquiry into the supply and demand for wholesale gas in Australia – after the ACCC East Coast Gas Market Inquiry in 2015 - the fifth Interim Report was published in December 2018
- We will go through the supply and demand scenarios in our following sessions
- *While there have been some minor revisions of gas supply forecasts by producers, the risk of a gas supply shortfall in 2019 remains largely unchanged. Sufficient gas is expected to be produced in the East Coast Gas Market to meet expected export and domestic demand.*
- *Despite this, domestic gas commodity prices have continued to increase in line with export parity prices. By August 2018, most offers were priced at, or above, the mid-$10/GJ level. These prices are lower than those that were observed in 2017. However, following a significant upward shift in gas prices over the past few years, many C&I gas users are now facing very challenging long-term investment decisions. It appears increasingly likely that some C&I gas users will relocate from the east coast or close their operations.*

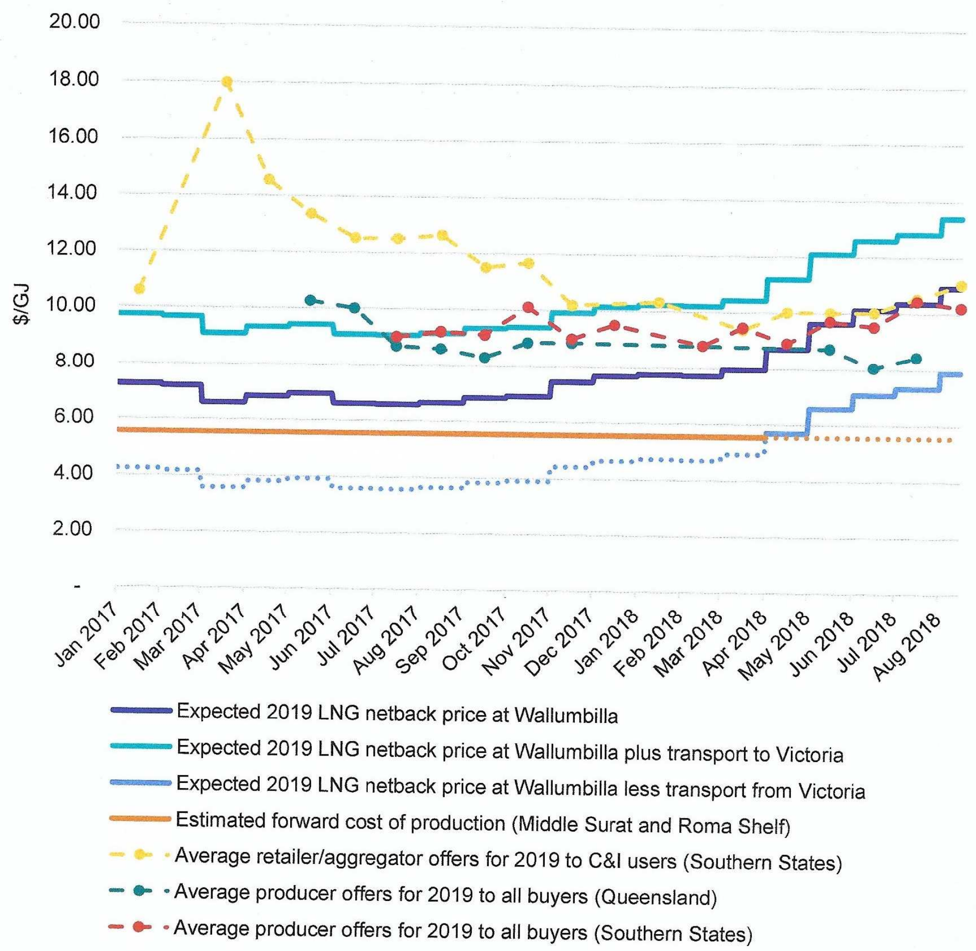
ACCC Gas Inquiry Reports (East Coast Focused)

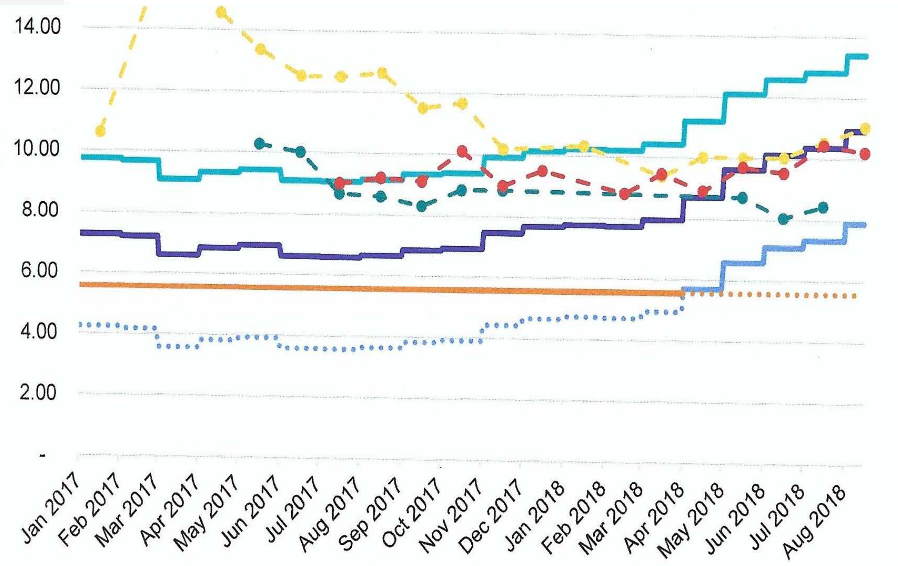
- *There are still constraints impeding the efficient flow of gas across the east coast. Current pipeline tariffs remain too high. Measures to address the monopoly pricing by pipeline operators have commenced, but are not yet in full effect. While it is too early to assess the impact of these measures on the market, evidence is beginning to emerge that these reforms are improving price discovery and putting downward pressure on prices for pipeline services. However, some further refinement of the information disclosure requirements, and greater scrutiny of the information published by pipeline operators pursuant to those requirements, may be necessary.*

- *The ACCC is currently conducting a review to examine how the costs and margins of the three largest gas retailers (AGL, EnergyAustralia and Origin) are affecting the delivered price of gas paid by their customers. Preliminary results indicate that the retailers have earned material margins on gas sales over 2014-2017. However, the ACCC emphasises that these are highly aggregated preliminary results, which require further examination. The ACCC will continue to conduct its review and will report on its findings in its 2019 interim reports.*

ACCC Gas Inquiry Reports (East Coast Focused)

Chart 2: Averages of monthly gas commodity prices offered for 2019 supply against contemporaneous expectations of 2019 LNG netback prices





Source: ICE, Argus, Core Energy, ACCC analysis of information provided by suppliers.

Notes: JKM futures prices quoted by ICE before June 2017 related to futures contracts for the first half of 2019 only. Prices are for gas commodity only. Actual prices paid by users may also include transport and retail cost components. Includes offers for gas supply of at least 12 months duration. Offers before 14 July 2017 are part of multi-year unfulfilled offers for annual quantities of at least 1 PJ. Any offers made prior to 14 July 2017 solely for gas supply in 2019 are not included (ACCC does not have this data). After 14 July 2017, all offers for quantities of at least 0.5 PJ are included.

ACCC Gas Inquiry Reports (East Coast Focused)

- *As the chart shows, expected LNG netback prices at Wallumbilla for 2019 increased from around $9/GJ towards the end of April 2018 to over $11.50/GJ by the end of August 2018.*
- *Over the same period, gas commodity prices offered by all suppliers in the domestic market for gas supply in 2019 ranged from $9/GJ to $12/GJ. By August 2018, most offers were at, or above, the mid-$10/GJ level, including several offers above $12/GJ.*
- *Gas commodity prices under gas supply agreements (GSAs) entered into by all the suppliers in the east coast over this period also ranged from $8.50/GJ to $11.95/GJ.*
- *Commodity gas prices charged by retailers/aggregators to C&I gas users remain, on average, higher than commodity gas prices charged by gas producers. However, this gap has narrowed compared to 2017. In the period April 2018 to August 2018, some retailers entered into GSAs with C&I gas users at lower prices than producers.*

ACCC Gas Inquiry Reports (East Coast Focused)

- *The expected LNG <u>netback prices at Wallumbilla for 2019 have also fallen significantly in recent months</u>. After reaching a peak of around $12.50/GJ in September 2018, expected*

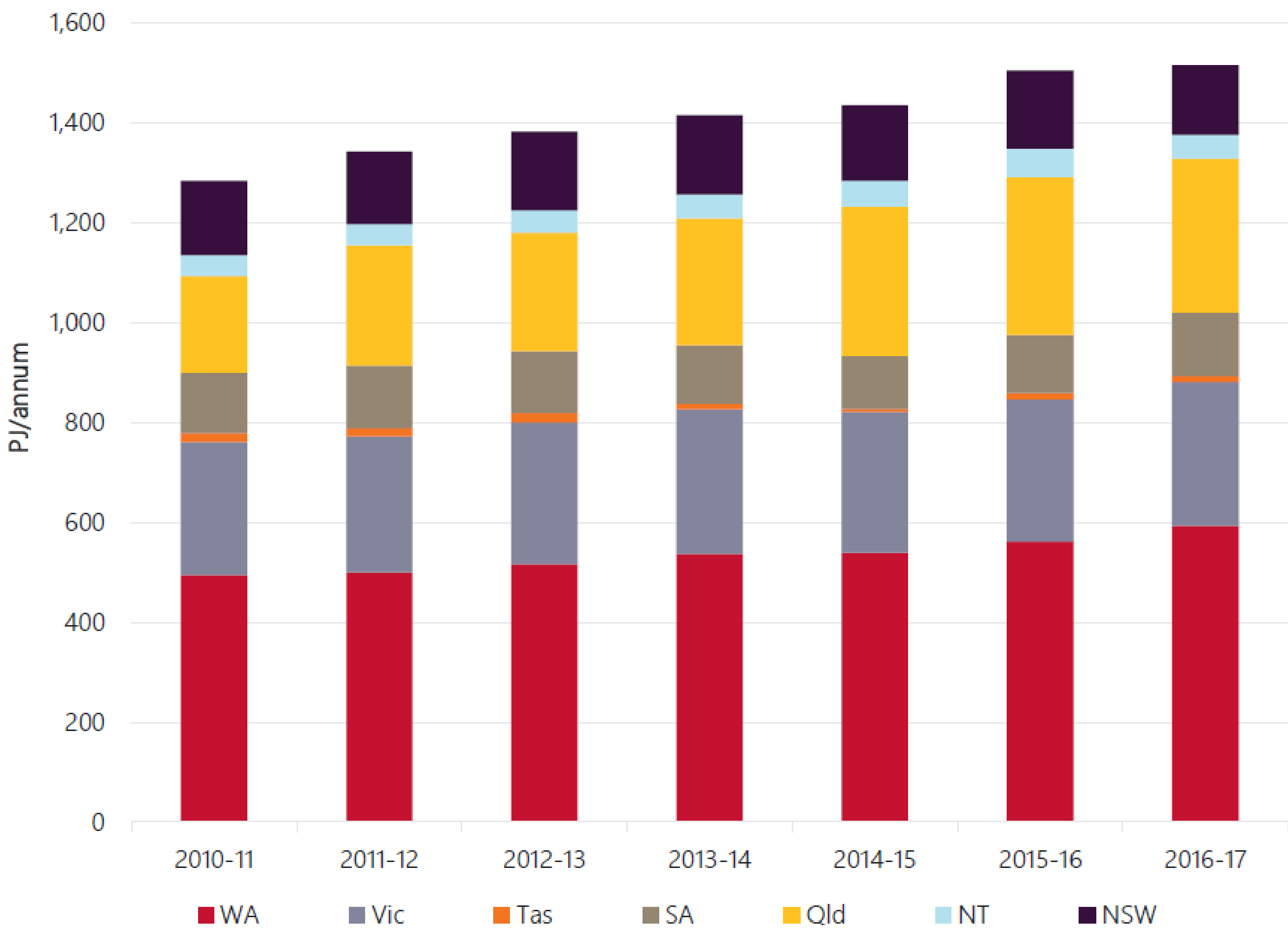
- *Some C&I gas users are increasingly re-contracting for shorter periods and much closer to the end of their existing GSAs, <u>hoping that domestic gas prices may ease</u>. Of those C&I gas users that are seeking longer-term GSAs, very few are receiving offers for terms that match their requested duration. Further, some C&I gas users are <u>not receiving many firm offers for supply from 2020 onwards</u>, with some suppliers not prepared to commit to supplying beyond 2019.*

- *"Prices are unsustainably high and unless resolved, represent a challenge to the <u>ongoing competitiveness and sustainability</u> of [our Australian] operations." - Large east coast gas user, October 2018*

- A good spot for a break and to move onto looking at gas demand…

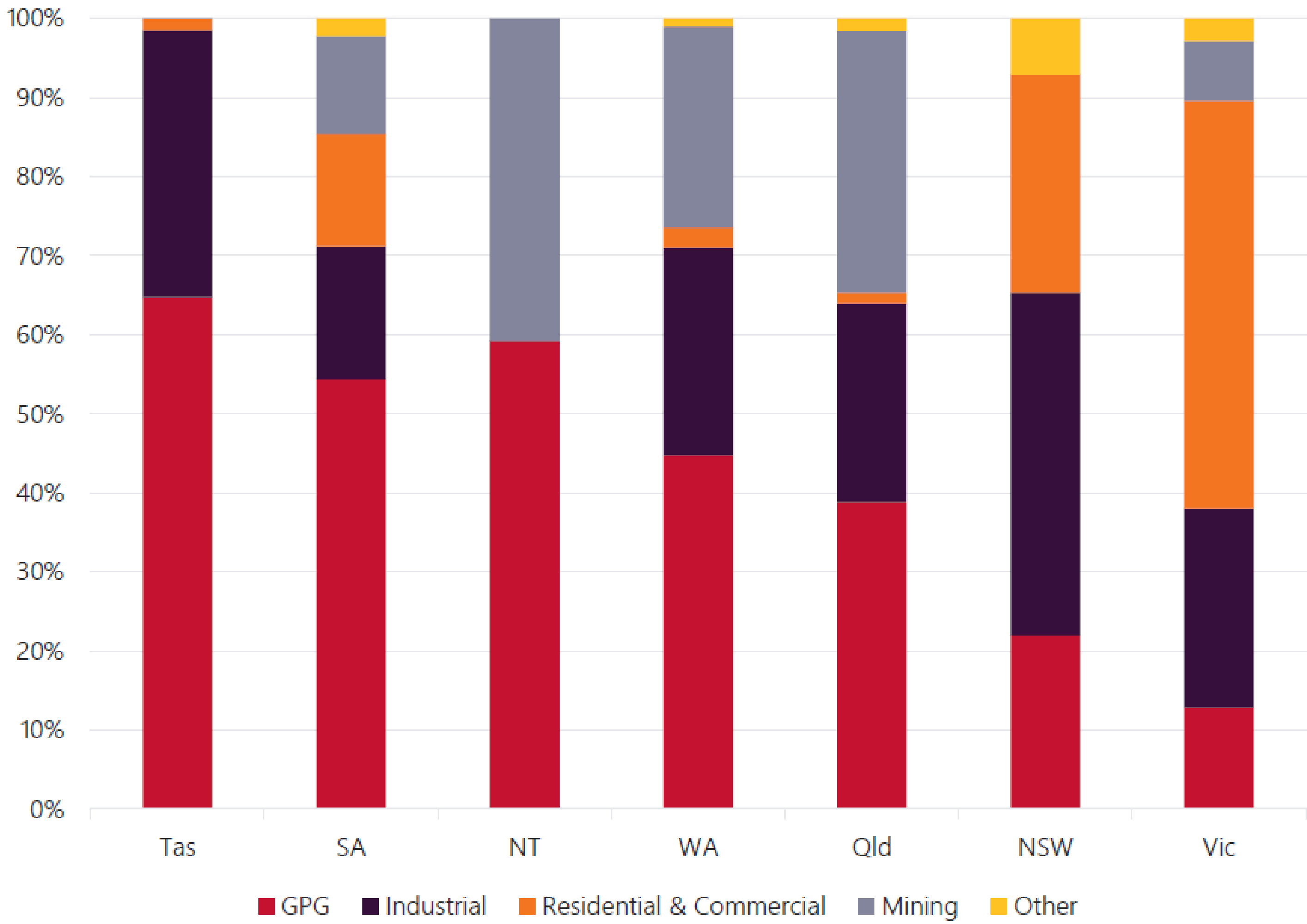
GAS DEMAND

Gas Demand by State - historical



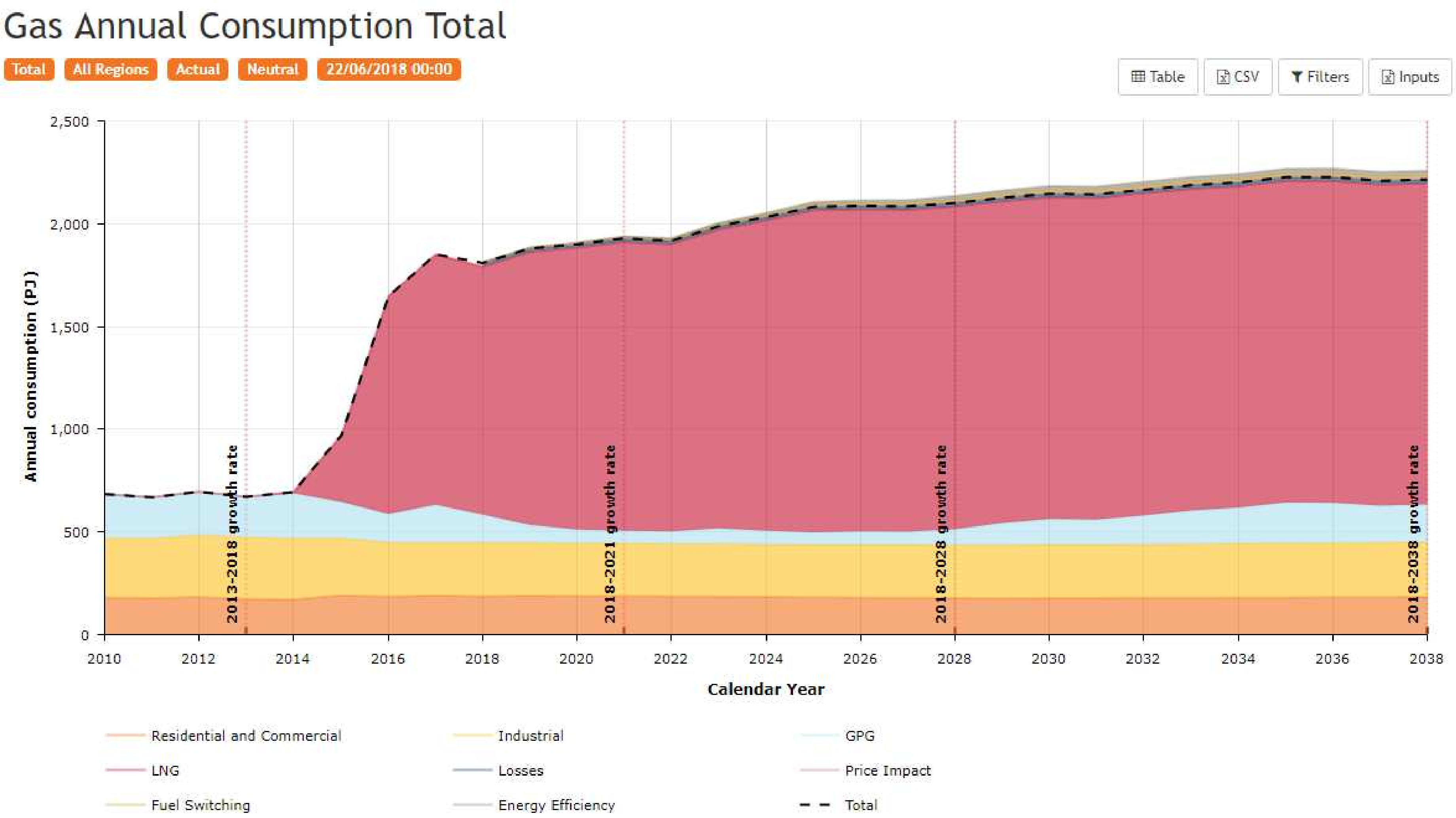
WA consumes more natural gas than any other state in Australia, despite its relatively small population. In 2016-17, WA's total gas consumption was 593.8 PJ, around 39% of Australia's total gas consumption

Gas Demand by State - diversity of demand



The Western and Central areas dominated by GPG and mining consumption with the South Eastern region dominated by industrial and residential/commercial consumption

East Australian Demand – forecast

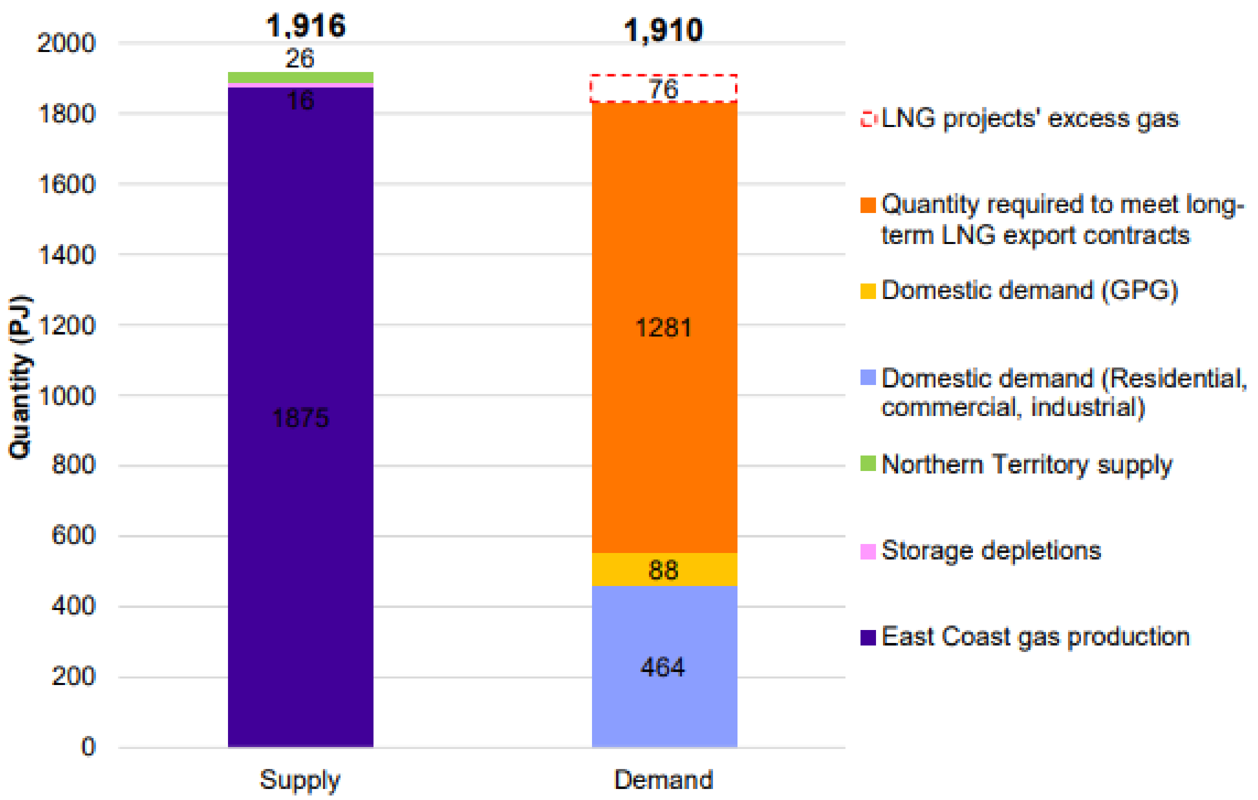


East Coast Domestic Demand breakdown Industrial (48%) and GPG (16%) and Res and Comm (35%) of 534 PJ in 2019.

East Australian Gas Supply/Demand - short term

- AEMO forecast of gas supply adequacy – GSOO June 2018
- No supply gaps are forecast before 2030 under expected market conditions. The risk of shortfalls previously projected for 2019 has been reduced due to changes in the energy markets, including:
    - Additional 8PJs available for Qld from LNG producers (reduction 1% in LNG demand)
    - Northern Gas Pipeline (NGP) online providing up to 33 PJ from the NT
    - Increased commitments of renewable generation projects forecast a reduction in GPG requirements.
    - Introduction and operation (July 2017) of the Australian Domestic Gas Security Mechanism (ADGSM) to incentivise the LNG producers to ensure adequate domestic supply – ~76 PJ of uncontracted gas. Used as a buffer if supply not met.
    - Minister for Resources and Northern Australia declared export restrictions not necessary for supply to meet demand in 2019.
    - Last Year: *“Current forecasts suggest there is the risk of a shortfall in the total annual quantity of gas available to supply the annual energy needs of the domestic gas market.” AEMO*

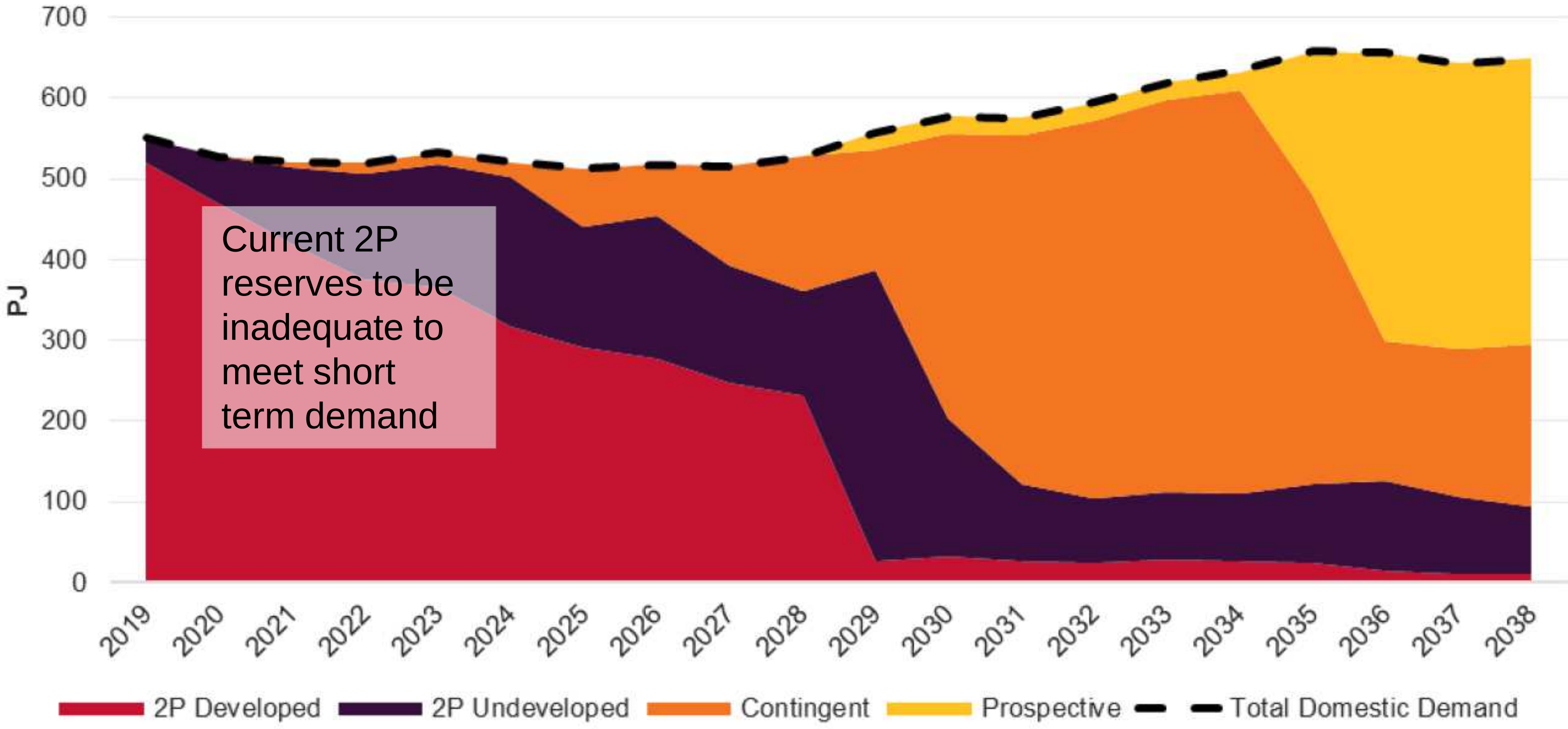
East Australian Gas Supply/Demand – short term



Forecast supply demand balance in the East Coast Gas Market for 2019.

East Australian Gas Supply/Demand - long term

- AEMO forecast of gas demand 2019-2038 – GSOO June 2018



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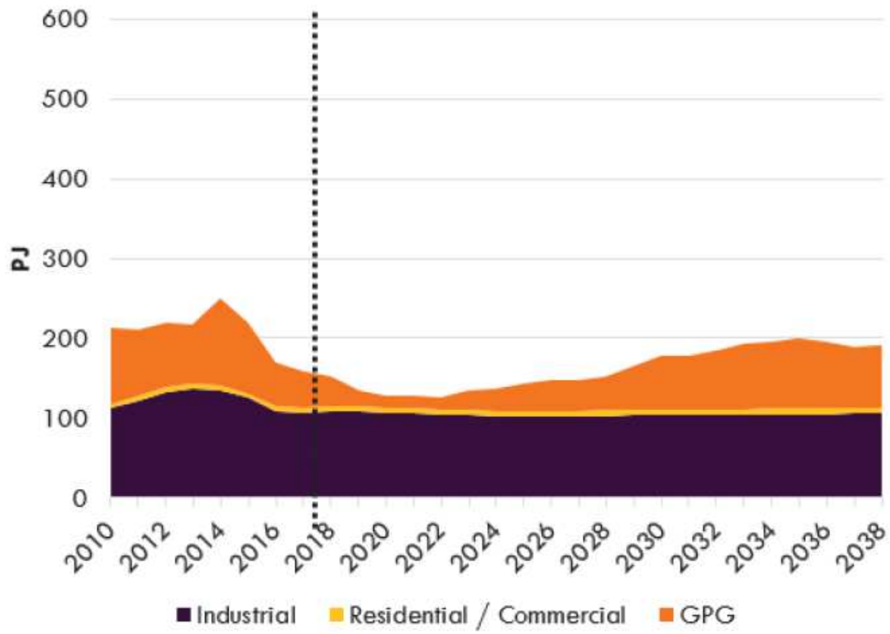
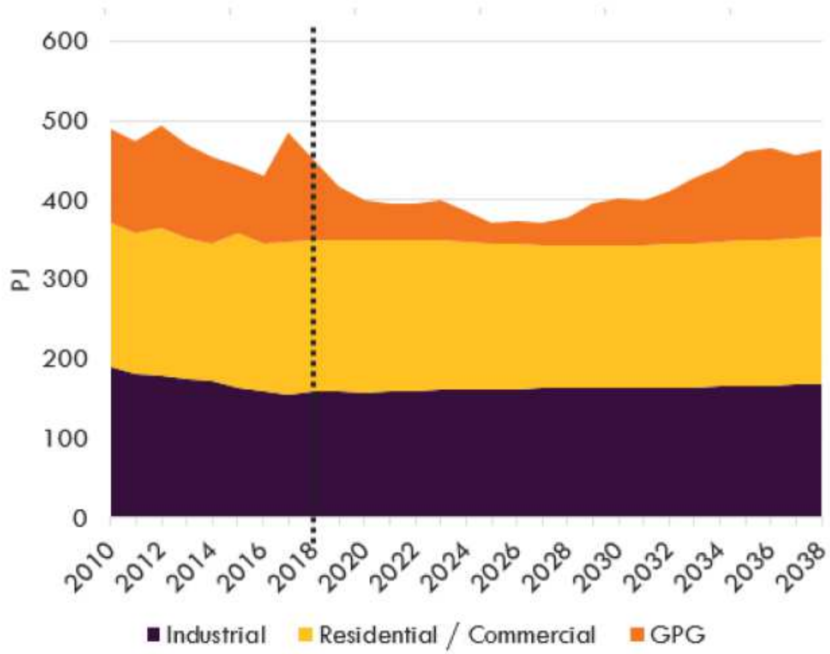
East Australian Gas Supply/Demand – long term

- Geographical diversity of demand
  - Largest demand in the Southern regions of Vic, SA and NSW



North



South

- Important considerations:
  - Likely long term domestic supply from the North (NT, Qld)
  - However, loads are in the South
  - Transport costs, infrastructure constraints

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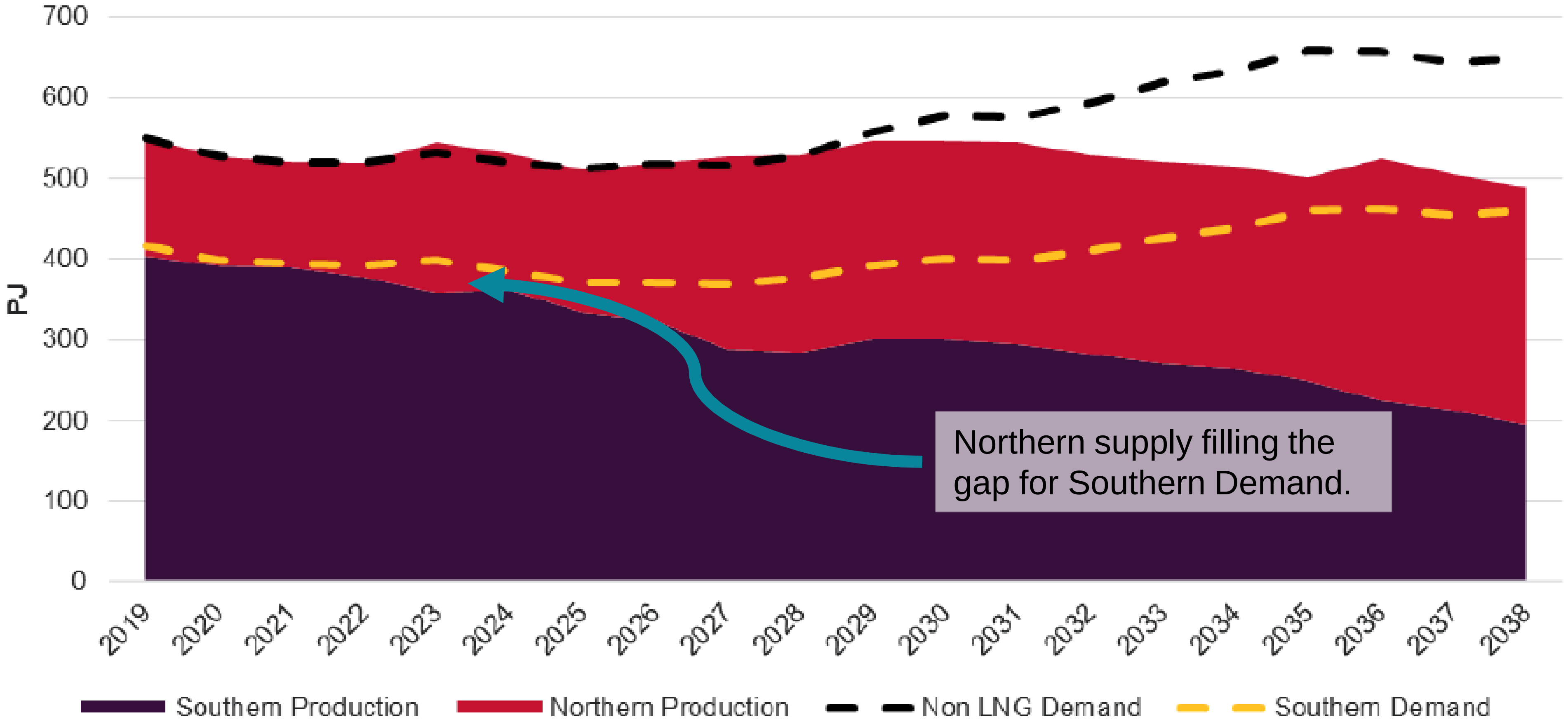
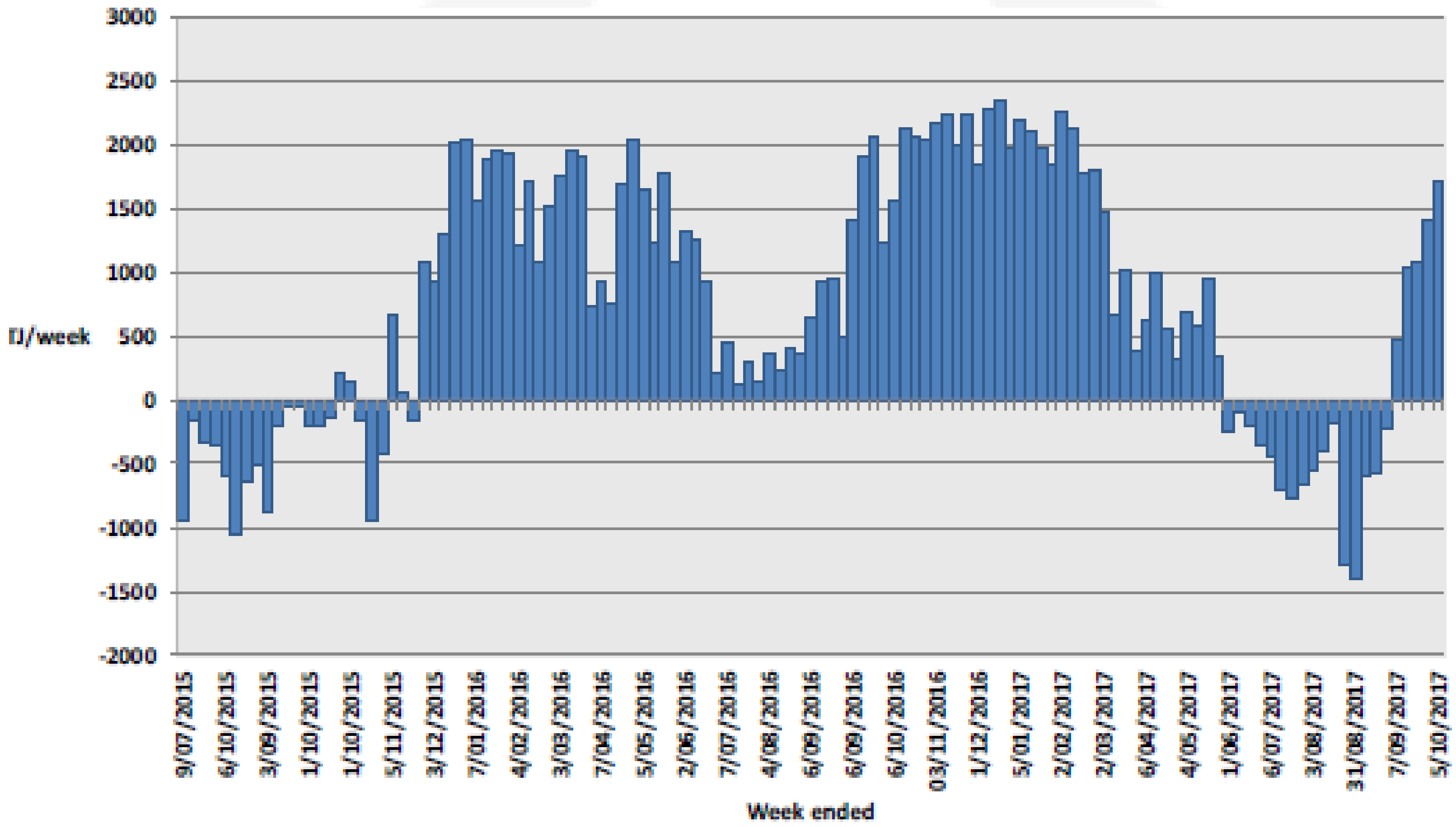
East Australian Gas Supply/Demand - long term



Gas flows between SE Australia and Queensland

- Weekly flows July 2015 to Oct 2017 (TJ/week) – Energy Quest Dec 2017
- Positive flows is gas flowing to Queensland from other states.
- Winter peak in SE Australia met from QLD.



  4 March 2019

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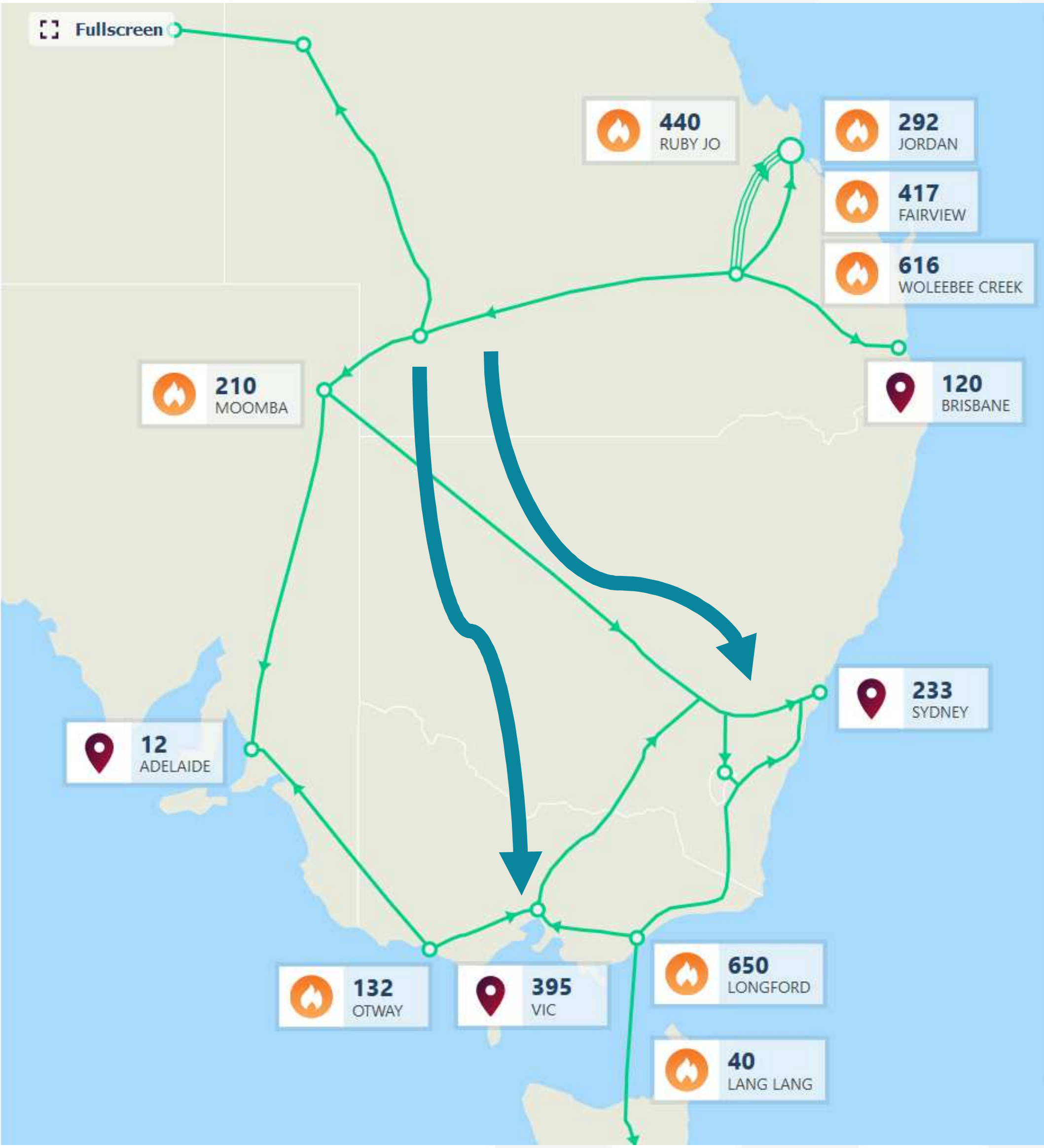
East Australian Gas Supply/Demand – long term



- Supply coming from Qld to NSW
- Supply coming from Qld to VIC for winter peaking
- This implies transport costs on gas that is LNG netback priced.

East Australian Gas Supply/Demand - disrupters

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HOME / BUSINESS / MINING

Fifth LNG import terminal planned as South Korean developer inks deal with Port of Newcastle

East coast LNG import proposals

	Longford, Vic	Crib Point, Vic	Port Kembla, NSW
Proponents	ExxonMobil, possibly BHP	AGL Energy	Andrew Forrest, JERA, Marubeni
Proposed start date	2022	2021-22	2020
Development cost	$100m*	$250m	$200m to $300m
Operating and lease cost per gigajoule	98¢*	$1.29*	$1.19*

*Macquarie Research estimates

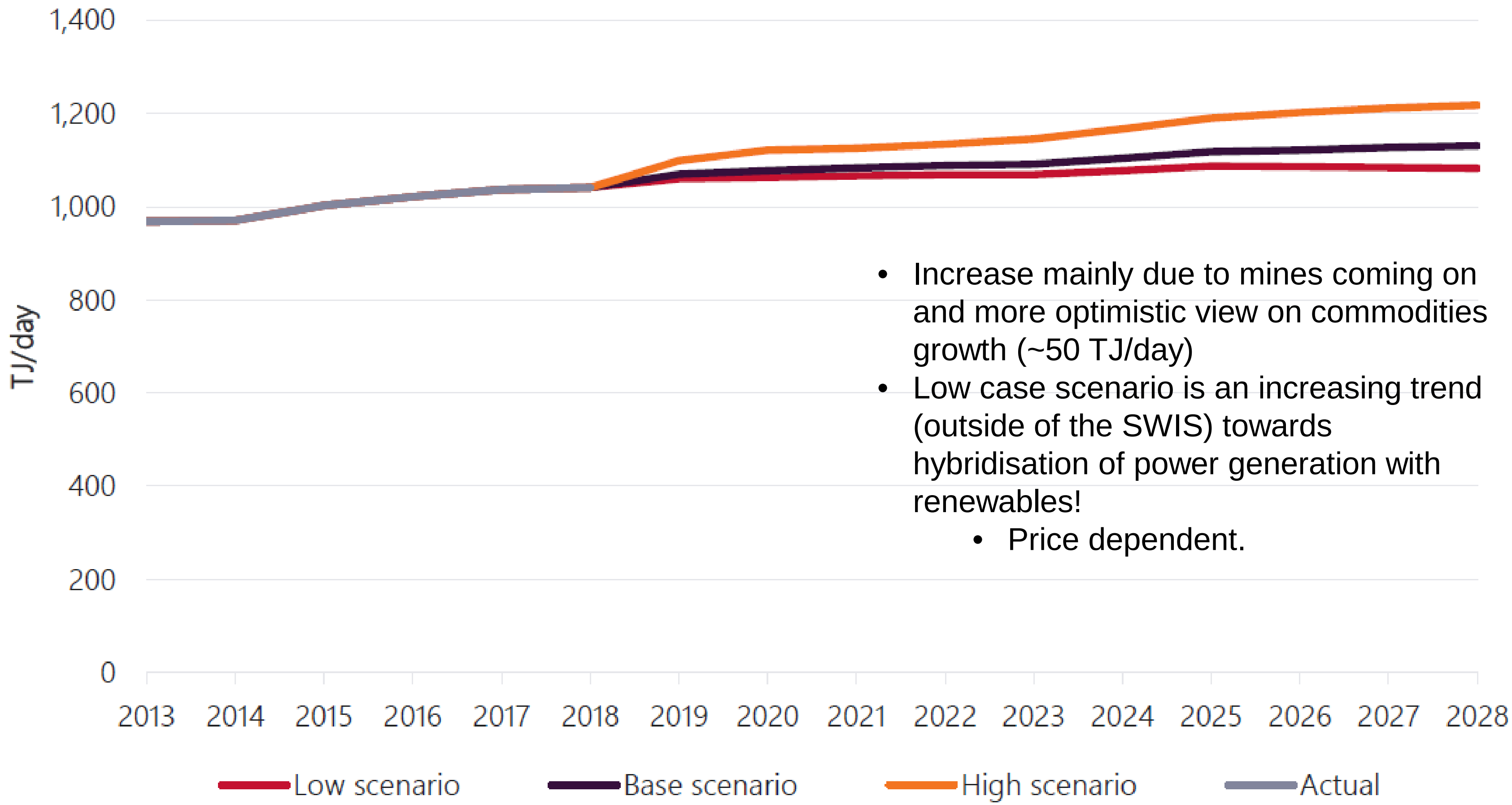
Source: ExxonMobil, AGL, Australian Industrial Energy

Is the timing right to build LNG import terminals?

- AGL - Cribb Point (Vic) 1H2020
- Australian Industry Energy (Tiggy) - Port Kembla (NSW) 1H2020
- ExxonMobil - Longford (Vic) 2022
  - Considered half cost due to use of existing infrastructure and replacement of declining Bass Strait fields.
- Venice Energy (Mitsubishi) - Pelican Point (SA) mid 2020
- EPIK - Newcastle (NSW)
  - Multipurpose powerstation, FSRU, bunker facilities.

West Australian Gas Demand

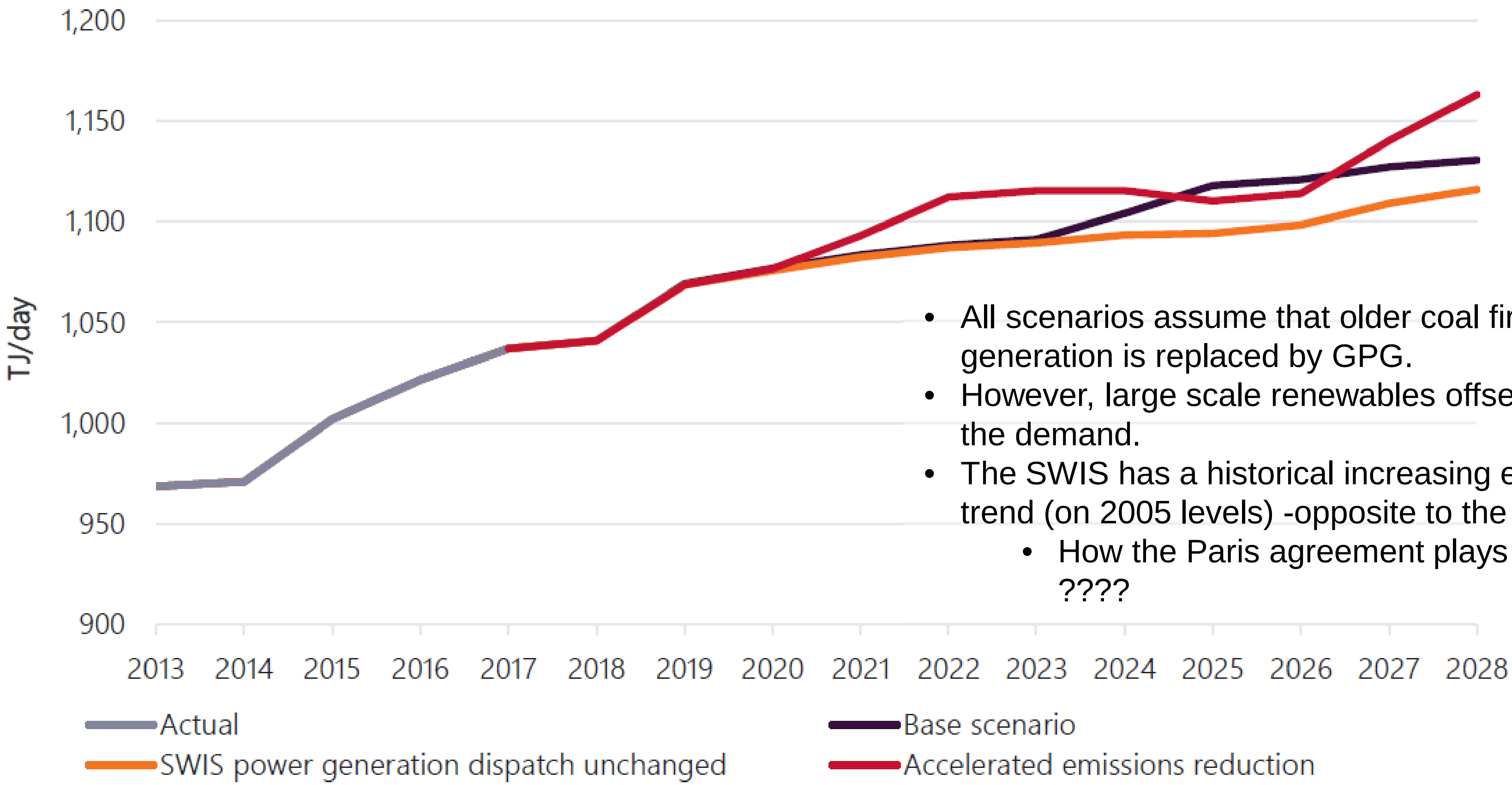
- AEMO forecast of gas demand 2018-2017 TJ/day – WA GSOO Dec 2017



- Increase mainly due to mines coming on and more optimistic view on commodities growth (~50 TJ/day)
- Low case scenario is an increasing trend (outside of the SWIS) towards hybridisation of power generation with renewables!
    - Price dependent.

West Australian Gas Demand

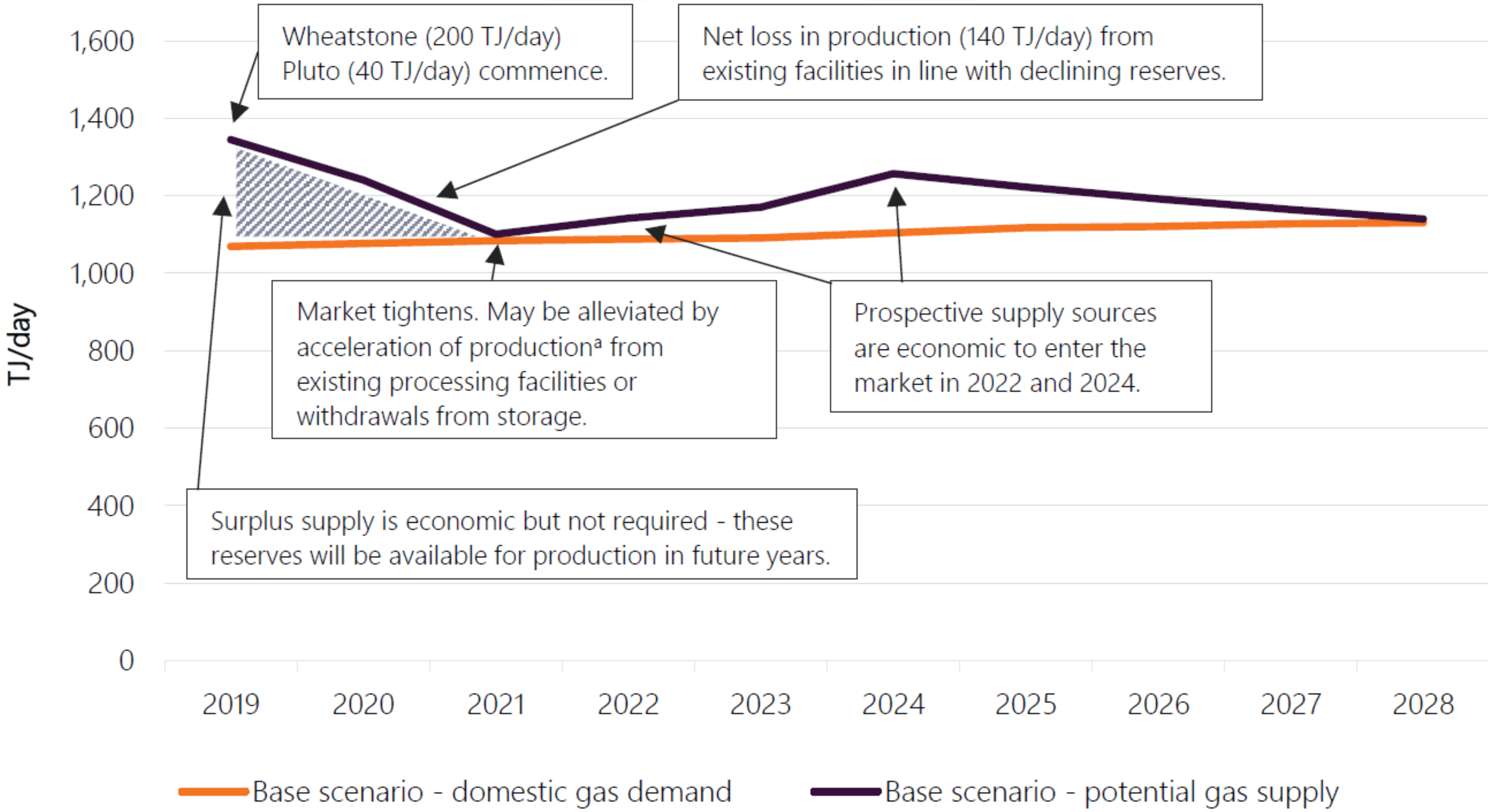
- AEMO forecast of gas demand 2018-2017 TJ/day – WA GSOO Dec 2017



- All scenarios assume that older coal fired generation is replaced by GPG.
- However, large scale renewables offset some of the demand.
- The SWIS has a historical increasing emissions trend (on 2005 levels) -opposite to the NEM.
    - How the Paris agreement plays out is still a ????

West Australian Potential Gas Supply

- AEMO forecast of potential gas supply 2019-2028 TJ/day – WA GSOO Dec 2018



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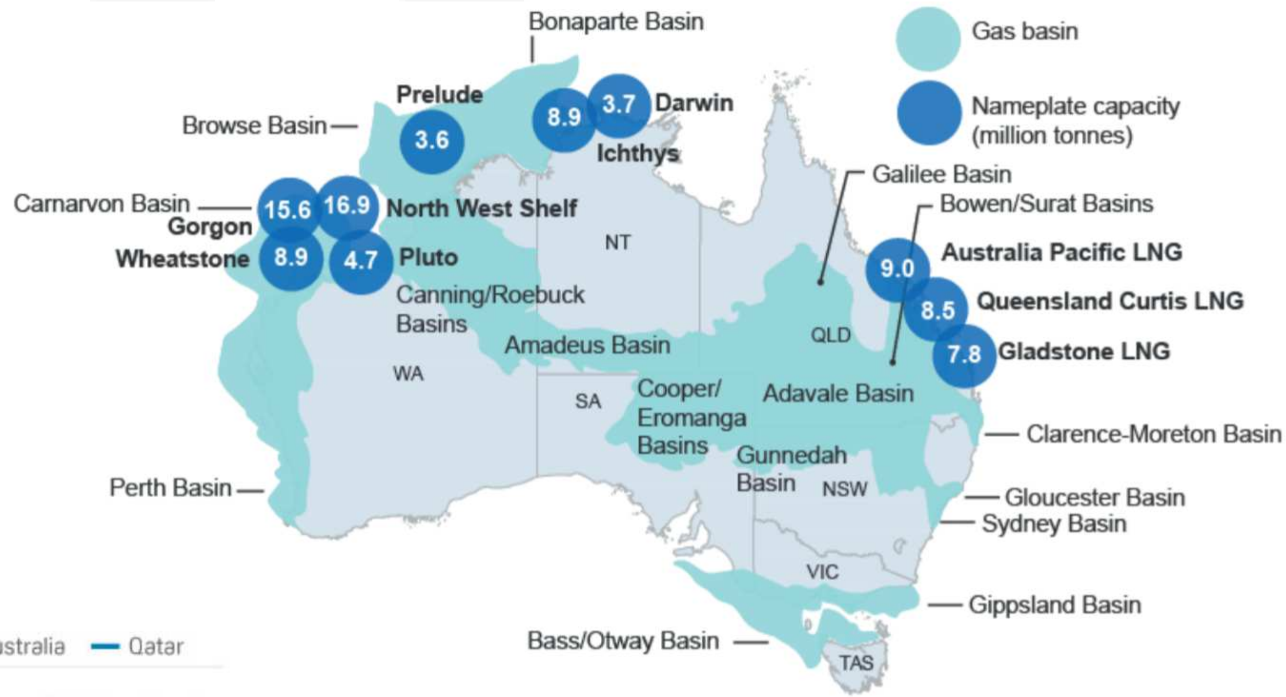
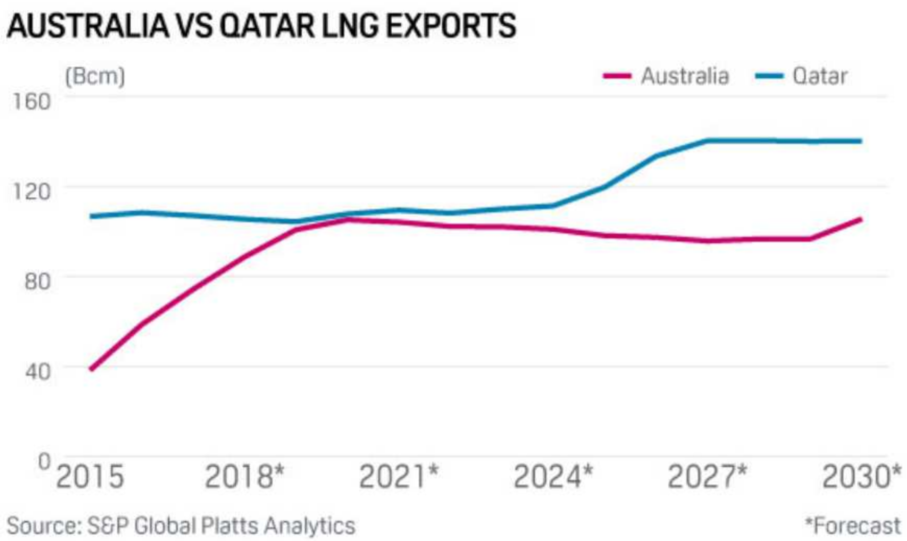
Australian LNG Demand - still growing but not as fast

Name plate capacity:

- WA 46.1 mtpa
- QLD 25 mtpa
- NT 12.6 mtpa





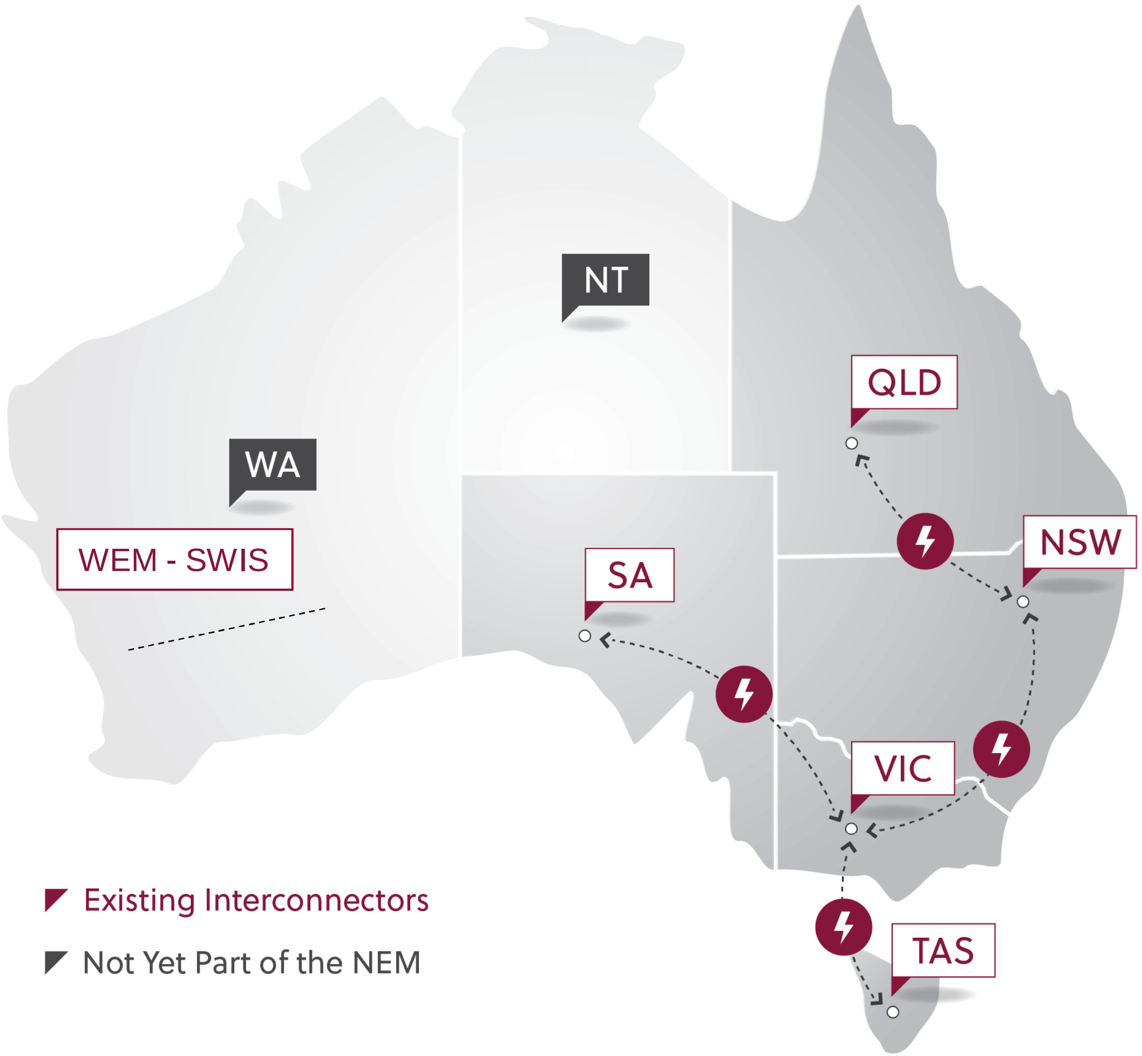
- Second largest global exporter in 2018 – 18% of global market
- Still growing but not as fast as predicted 12 months ago.
  - Gas shortages
  - Domestic supply commitments
  - Natural decline
  - Lack of energy policy

Mt = 57 PJ

GAS POWERED GENERATION

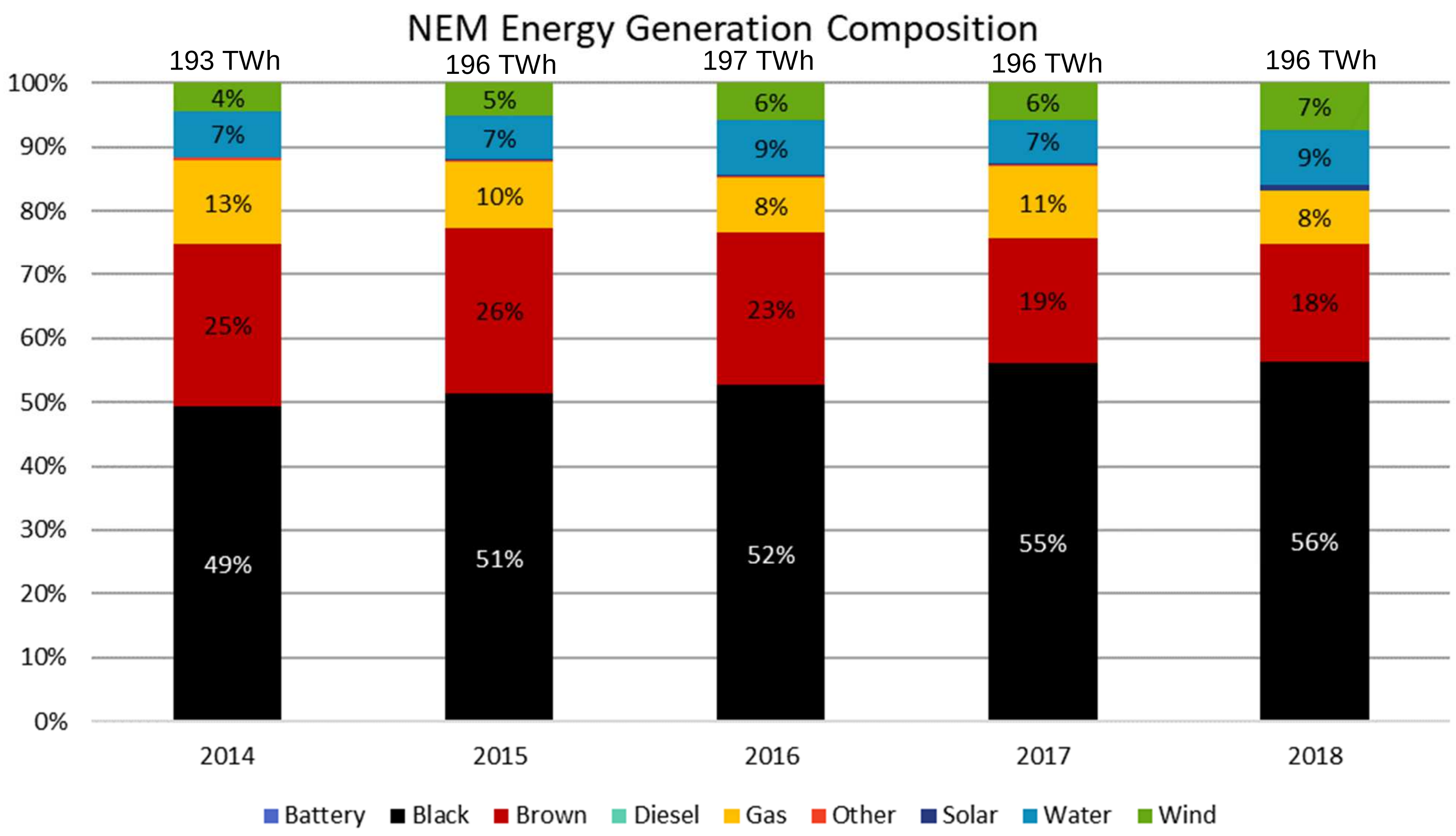
Gas Power Generation - Major Electricity Markets

GPG 45% Electricity
Production
70-75 PJ



GPG 7-8% of Electricity
Production
136 PJ

Gas Power Generation – Current State of Play



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Gas Power Generation - Technology Types

- OCGT Open Cycle Gas Turbine
  - lower capital cost
  - Fast ramping and fast to start
  - Lower efficiency/higher emissions (0.6-0.65 t/MWh)
  - Used for peaking/intermediate generation
  - Higher SRMC of gas price
- CCGT Combined Cycle Gas Turbine
  - Recovers approx. 50% of energy from exhaust by HRSG and steam turbine on tail
  - Higher capital cost/large amount of infrastructure
  - Slow to start and ramp
  - Very high efficiencies/low emissions (0.4 t/MWh)
  - Used for base load
- GTs can run dual fuels and often use liquids (diesel) as a back up (eg. WA)

Gas Power Generation - Marketing Strategies

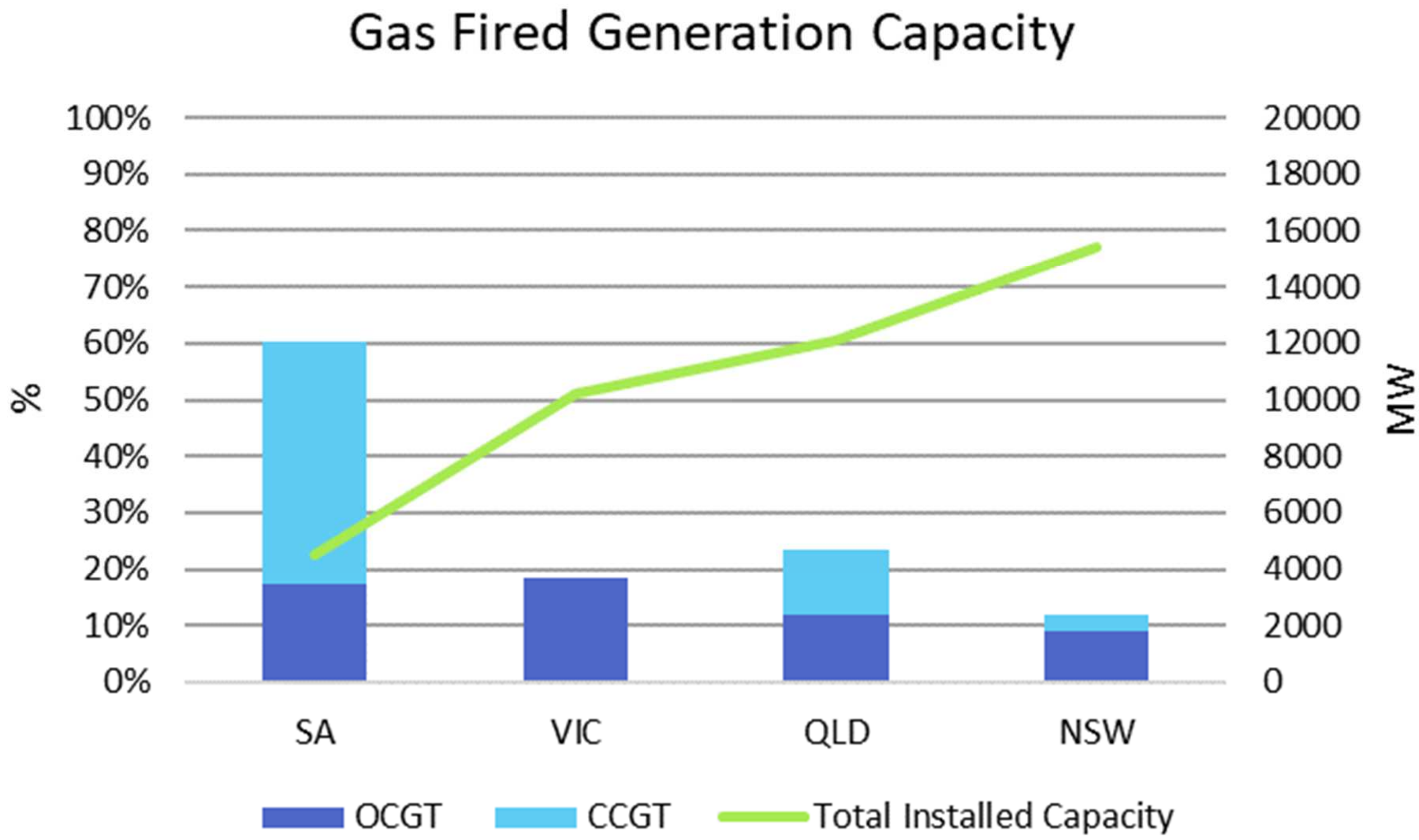
- vertically integrated, with ownership of gas resources and many combine gas generation with gas retailing activities, allowing them to take a portfolio view of gas flows and costs. These generators have more flexibility in how and when they run their gas plants.

- long-term GSAs that have electricity price hedges aligned with their GSAs. These operators are constrained less by prices, and more by their contracted gas supply quantities and their electricity supply commitments.

- source gas from upstream and downstream spot markets. These operators buy gas when the electricity price is likely to be high enough to cover the input gas costs, or the ‘spark spread’ between gas and electricity prices. These plants tend to run as peaking plants during high electricity demand periods.

- Generators with contracted electricity output can also operate in this manner by increasing output above contracted amounts at times to take advantage of the ‘spark spread’.

Gas Power Generation - Current Technology Make Up

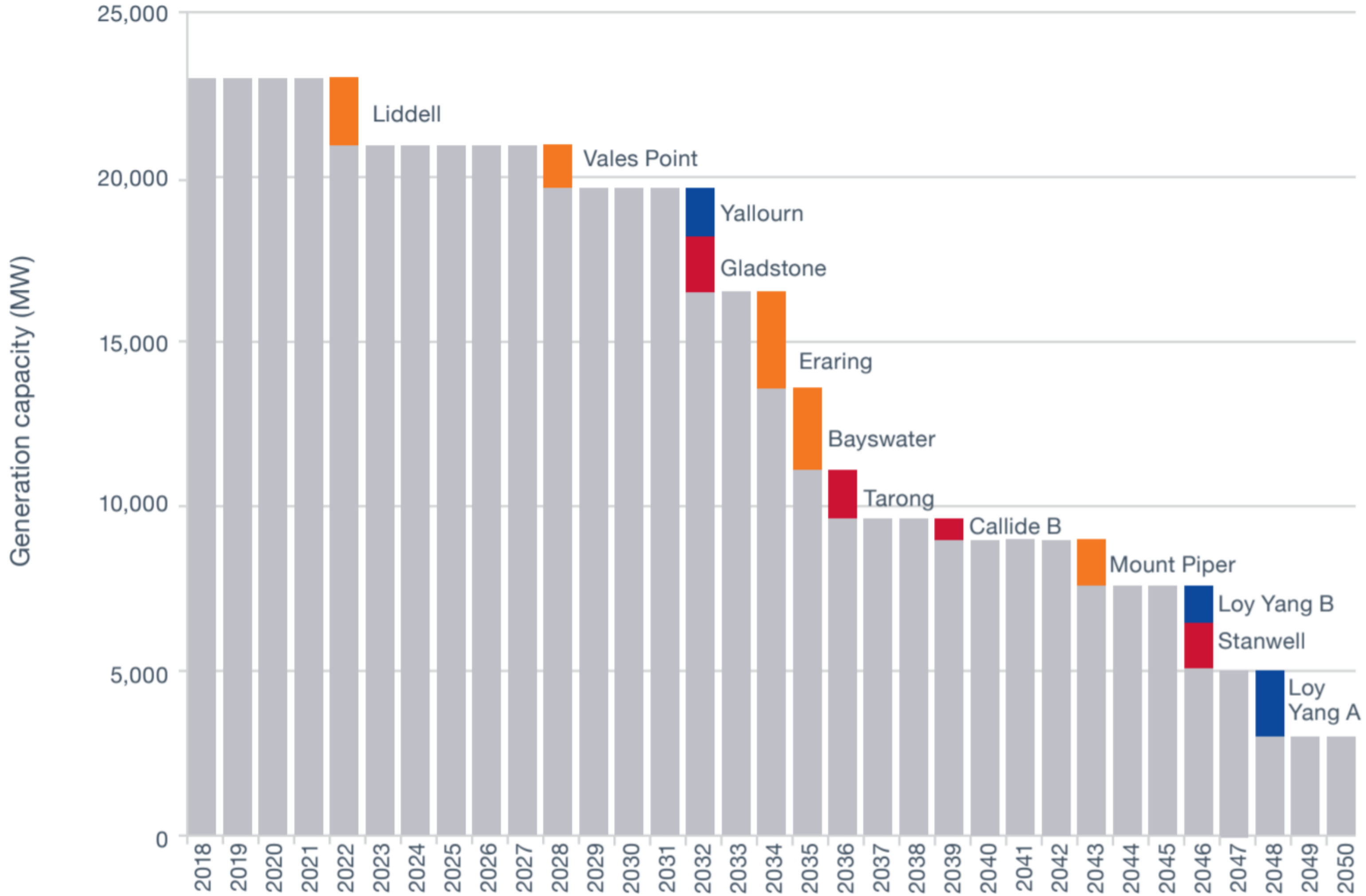


- Most markets dominated by OCGT for peaking and intermediate plant
  - Greater exposure to gas price due to lower efficiency but fast starting.
- QLD CCGT to support early CSG development policy

Gas Power Generation - Current Trends

- The level of GPG demand is more volatile relative to the demand forecasts for residential and industrial users, particularly over the short-term. This is because GPG demand is dependent on factors which are difficult to forecast accurately. For example, an increase in GPG demand could be caused by:
  - lower rainfall - reducing output from hydro generation
  - lower wind - reducing output from wind generation
  - deferrals of renewable generation investment
  - unexpected retirement of generation or unplanned outages.
- The role of GPG in the national electricity market (NEM) has changed significantly over the past 12 months. The retirement of the coal fired generator Hazelwood Power Station has removed 1600 MW of capacity from the market, which has increased the reliance on other forms of generation including GPG.
- GPG demand has historically been more variable than industrial and residential demand
- GPG is increasingly becoming the marginal cost of electricity.

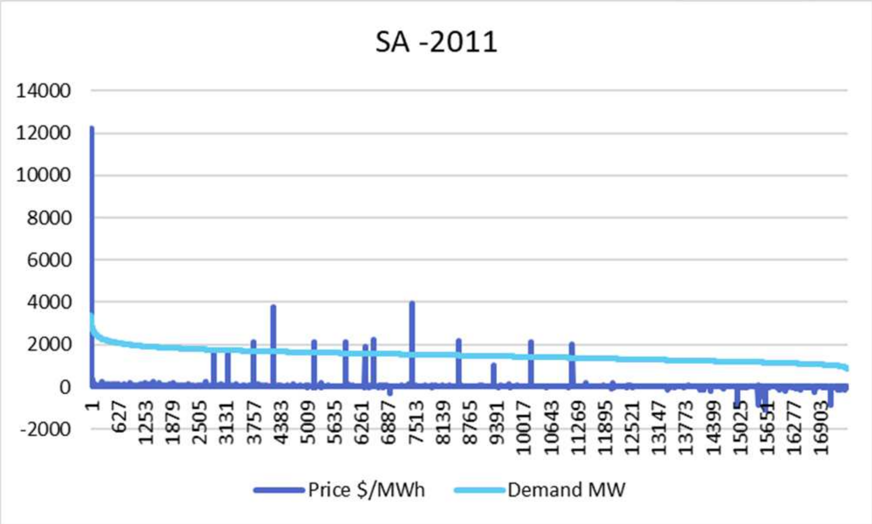
Gas Power Generation - Coal is around for a while



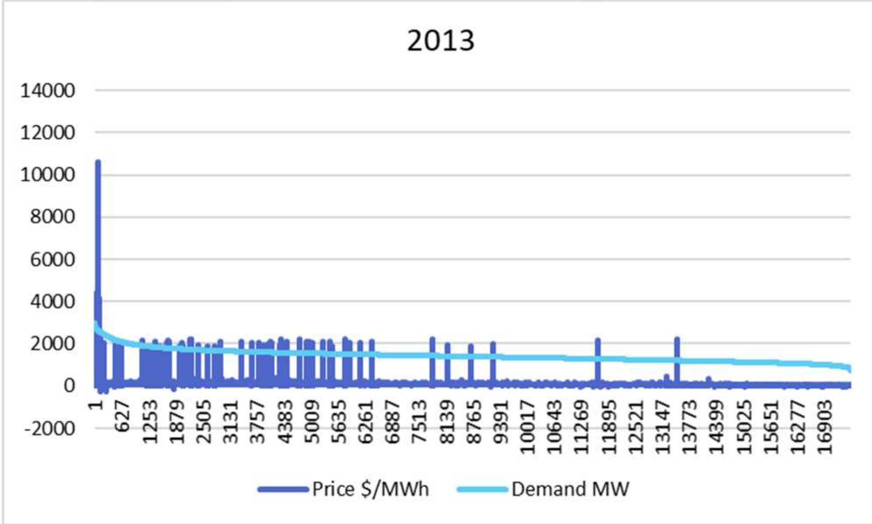
Kogan Creek (Q - 2057), Callide C (Q - 2051), Millmerran (Q - 2052), Tarong North (Q – 2052)

High percentage of renewables/intermittents - GPG Opportunities

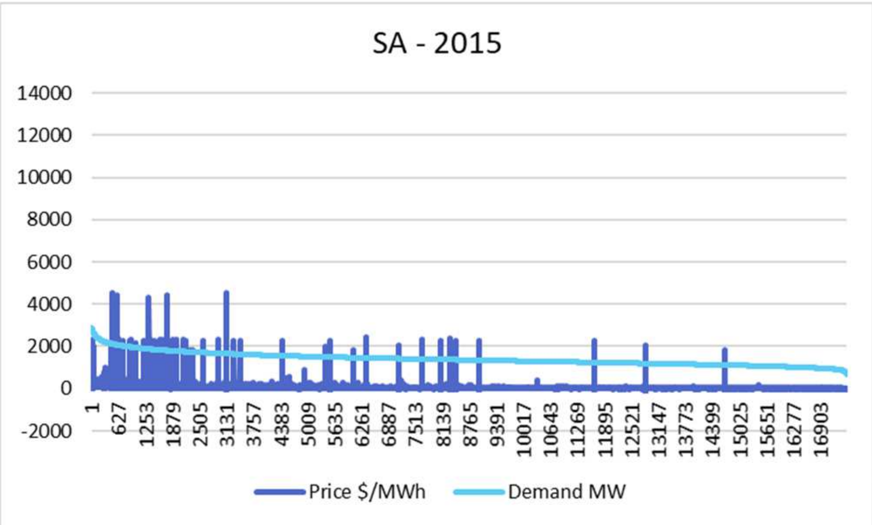
26% Intermittent Generation



32% Intermittent Generation



37% Intermittent Generation



- As the proportion of intermittent generation increases the correlation between peak demand (LDC) and spot price (generation reserve) decreases and becomes more correlated with weather/environmental conditions.
- Price spikes are more frequent and suitable for fast start/ramping gas fired generation.

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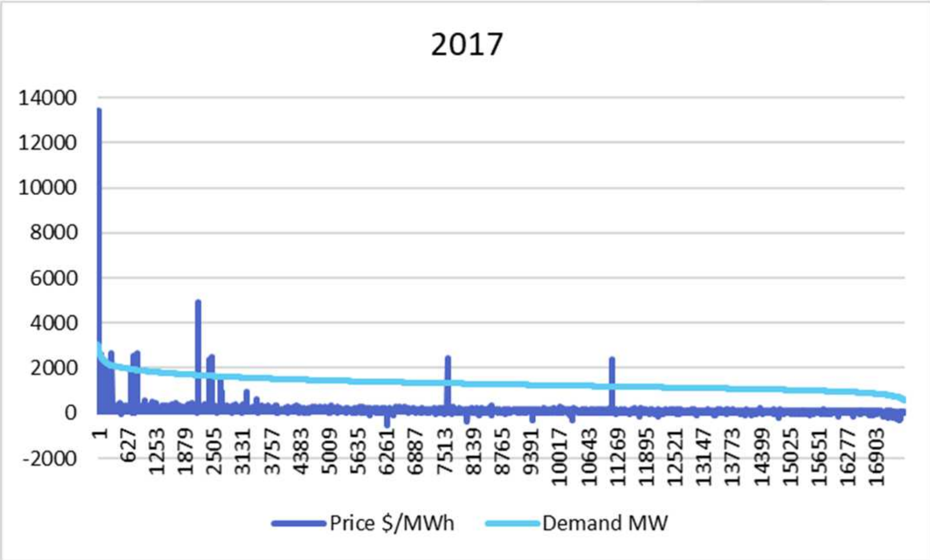
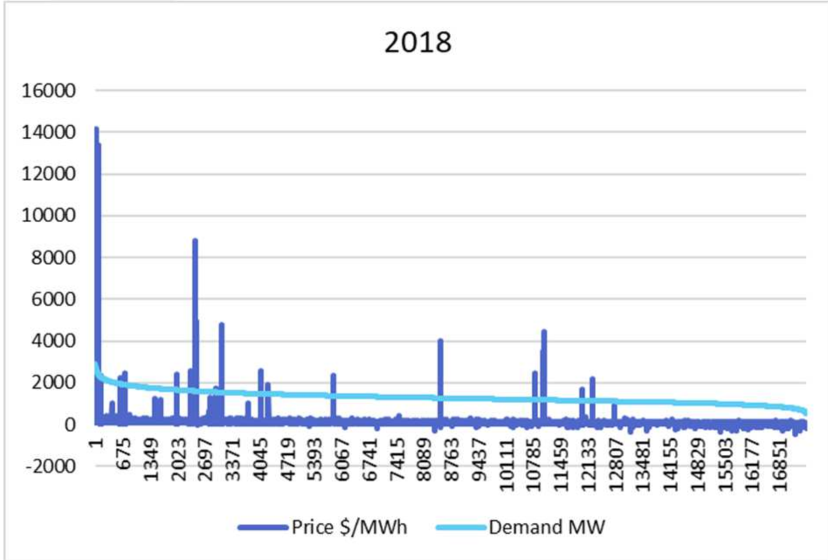
High percentage of renewables - GPG Opportunities

40% Intermittent Generation



46% Intermittent Generation



- 2017 different picture – dramatic changes
- Not as many price spikes
  - 60% gas generation (increased from 40% in 2015) increased to fill the retired coal generation.
  - Northern Power Station 520MW (brown coal) retired in 2016.
  - AEMO enforced interim security of supply by maintaining a minimum of two Torrens B units (200MW each) operational at all times. Connected inertia.
  - Pelican Point returned to full capacity 479MW, had been operating at ½ capacity due to oversupply in SA market from 2013.

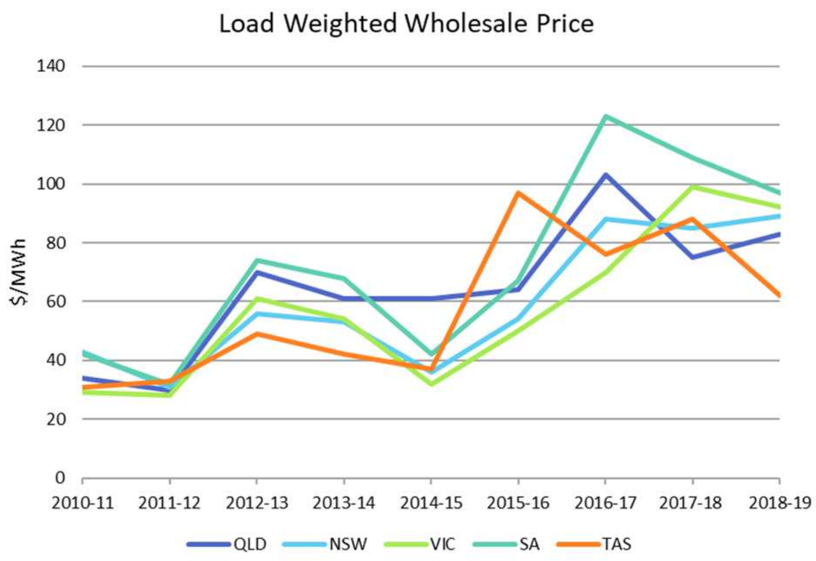
- 2018 – the year of the battery
  - Interim security still in place by AEMO
  - SA Government security comes online
  - Hornsdale power reserve operational – Tesla battery
  - Trend continues with decoupling of peak price and peak demand

The Rebels -VIC Market Analysis

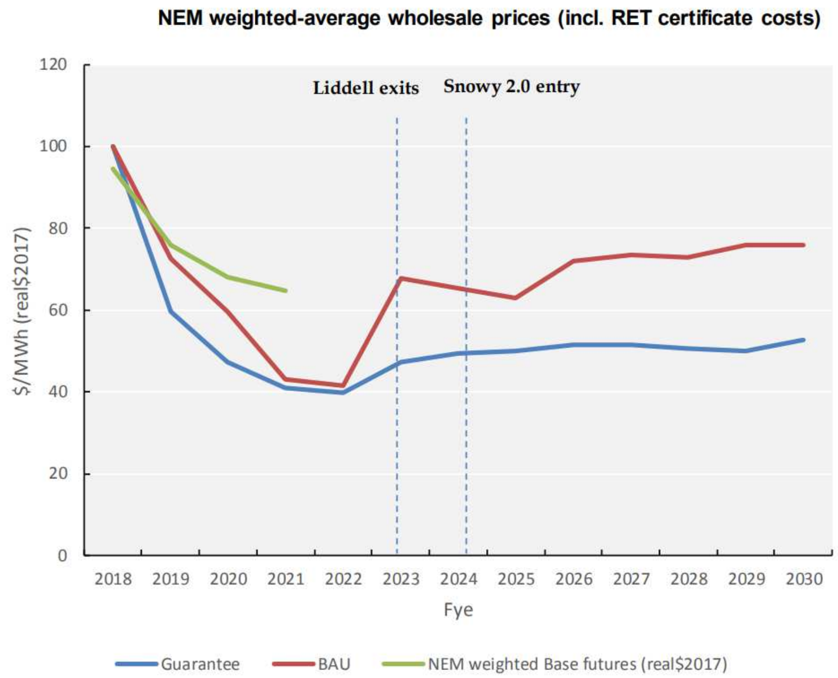
- Typical OCGT/peaking plants run 4%-6% of the time
- But not everyone
- In VIC for 2017
  - Mortlake capacity factor was 25%
  - Newport capacity factor was 27%
- Why the difference?
  - Mortlake - one of the cheapest gas generators in the NEM
  - Vertically integrated through Origin
    - owns the gas pipeline from the Port Campbell gas plant, so it doesn't need to pay third-party pipeline owners.
    - While it doesn't own the Iona gas plant at Port Campbell, it does have a majority share in two offshore gas wells.
    - it's strongly vertically integrated, and thus not subject to different financial pressures to other operators.

Gas Power Generation - What is the future?

Gas Power Generation - Future NEM Price Forecasts



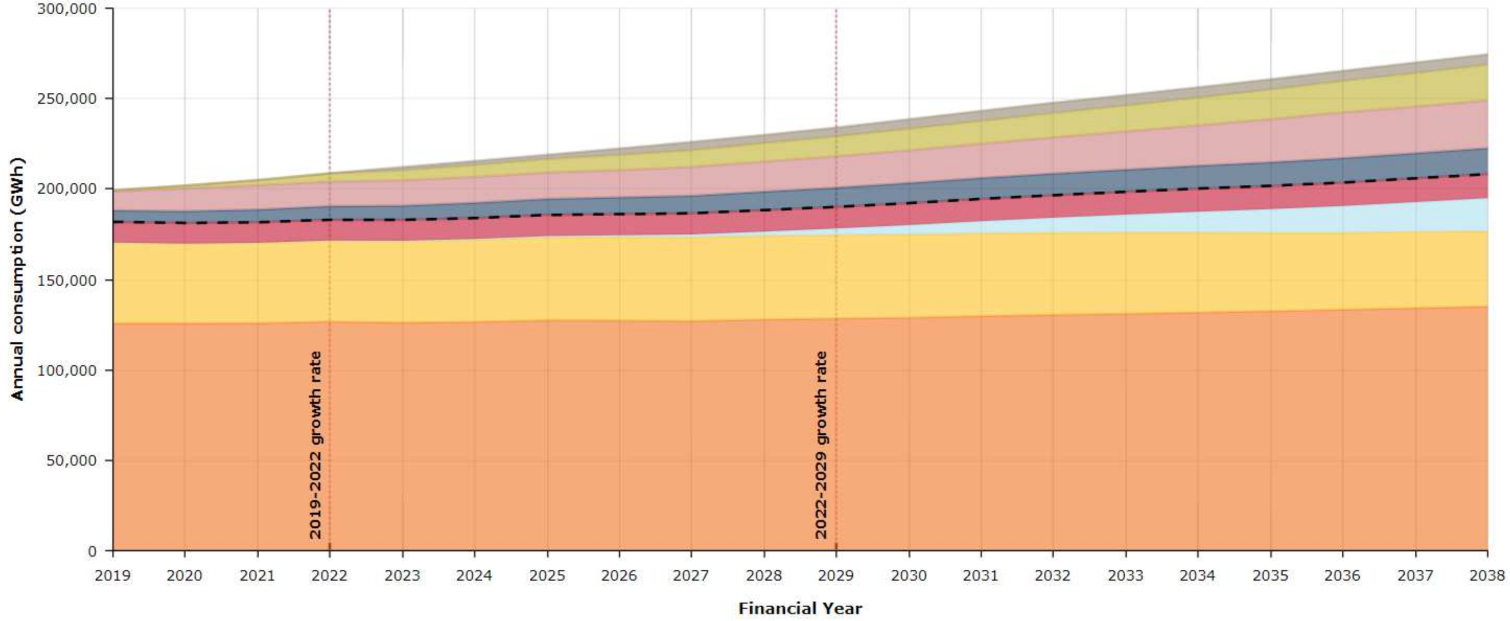
Source: AER Statistics

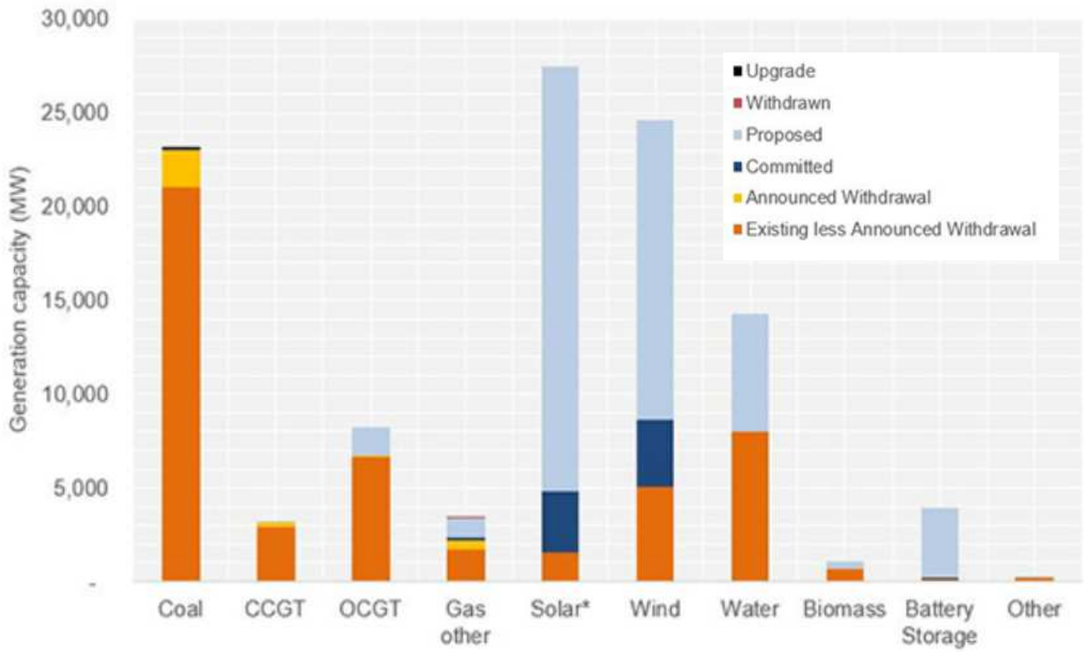


Source: COAG Energy Security Advice 20 Nov 2017

- Pricing has peaked in the 2016-17 due to coal retirements
- Expected to reduce as the LRET reaches capacity 2020
  - Other generation capacity entering due to State based schemes
  - Demand from the NEM is flat in the immediate future
- As the prices decrease to less than the SRMC of gas generation (given current gas prices), gas generation pushed to the peaking operation and gas demand decreases.

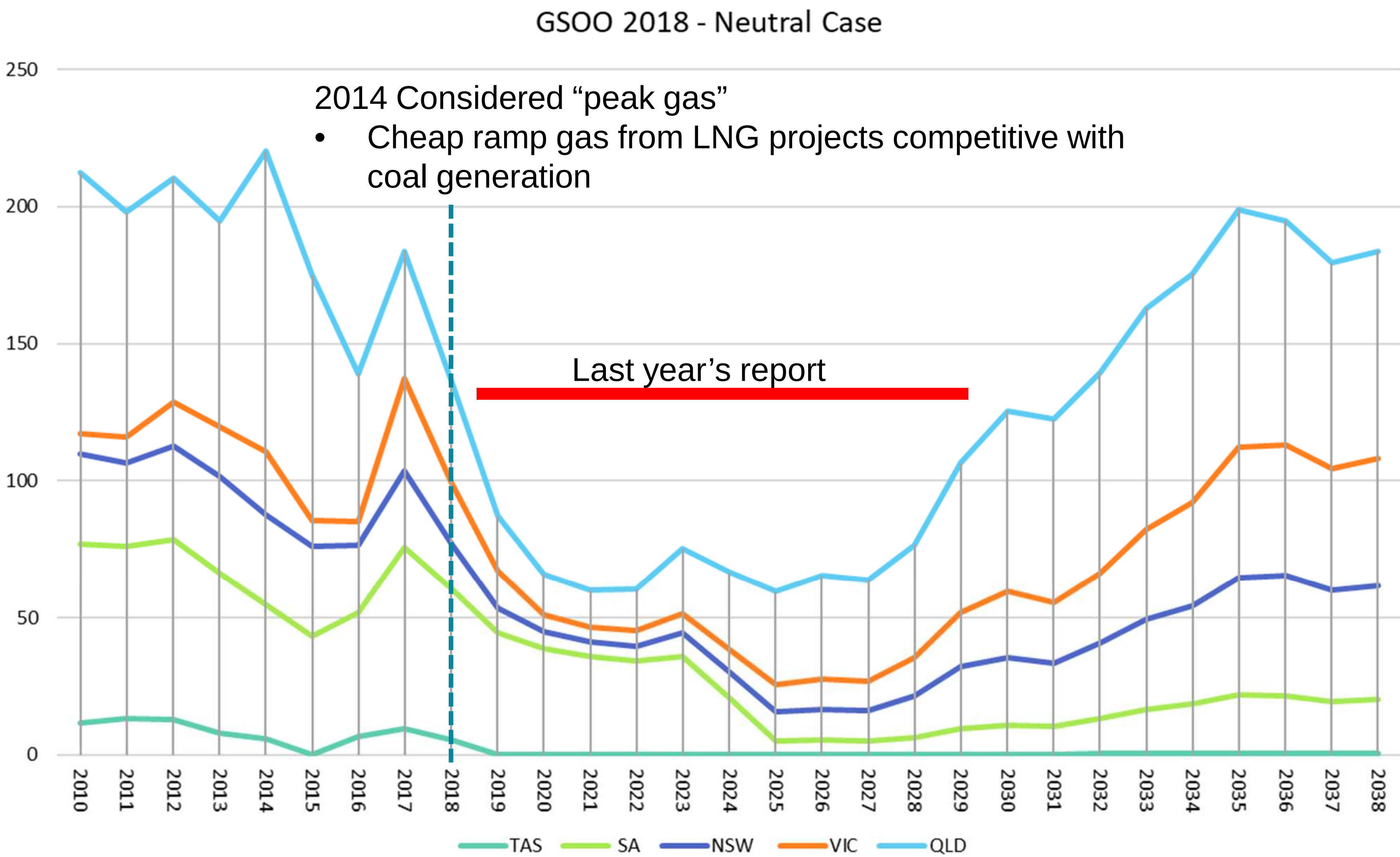
Gas Power Generation - Future NEM Installations





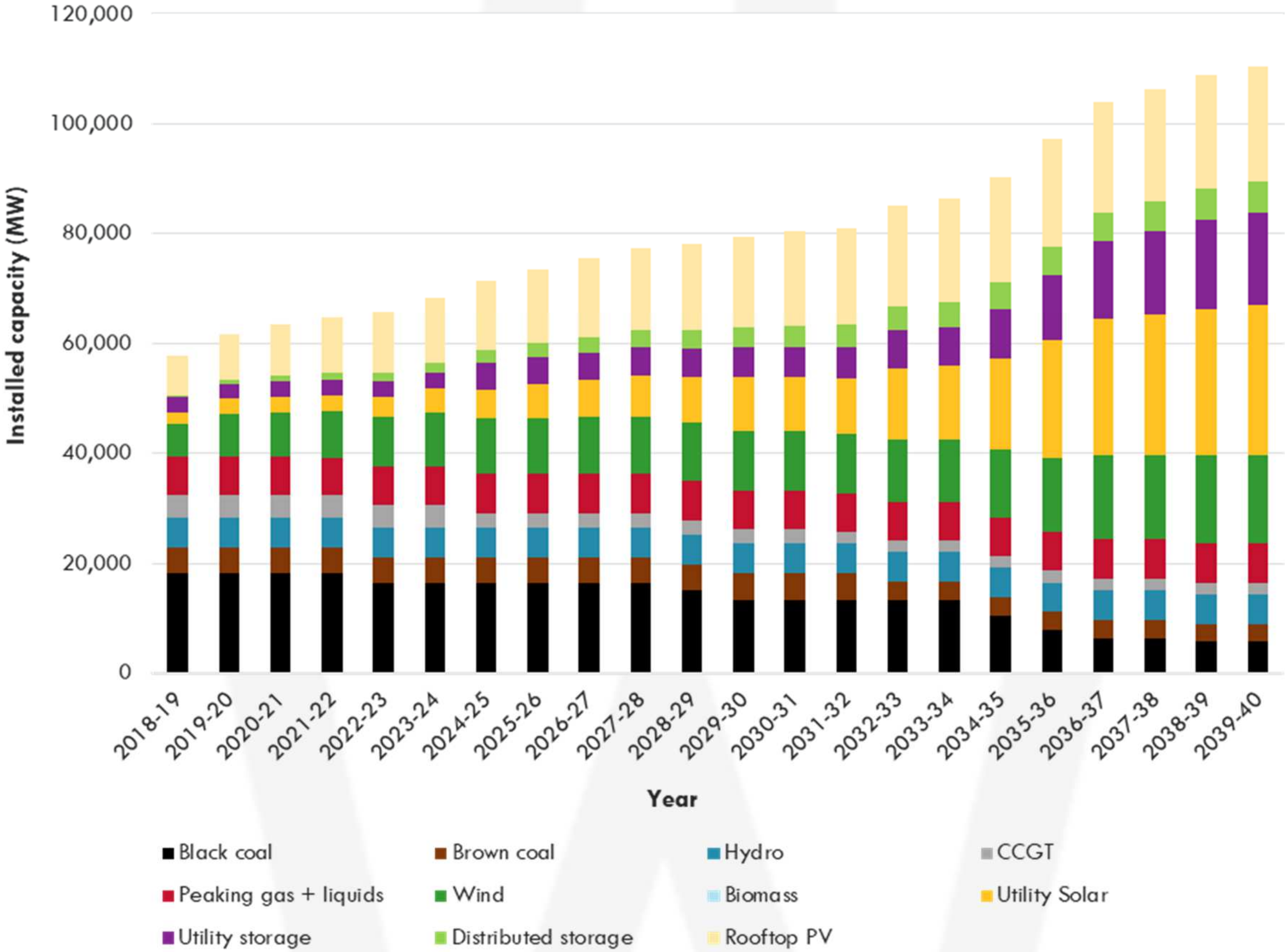
- Lots of capacity proposed or committed with flat central energy consumption to 2030. marginal increase afterwards.
- Mostly solar (25,916) and wind (19,602)
- CCGT (60) and OCGT (1,675)
- Needs retirement to make "space"

Gas Power Generation Forecasts - NEM



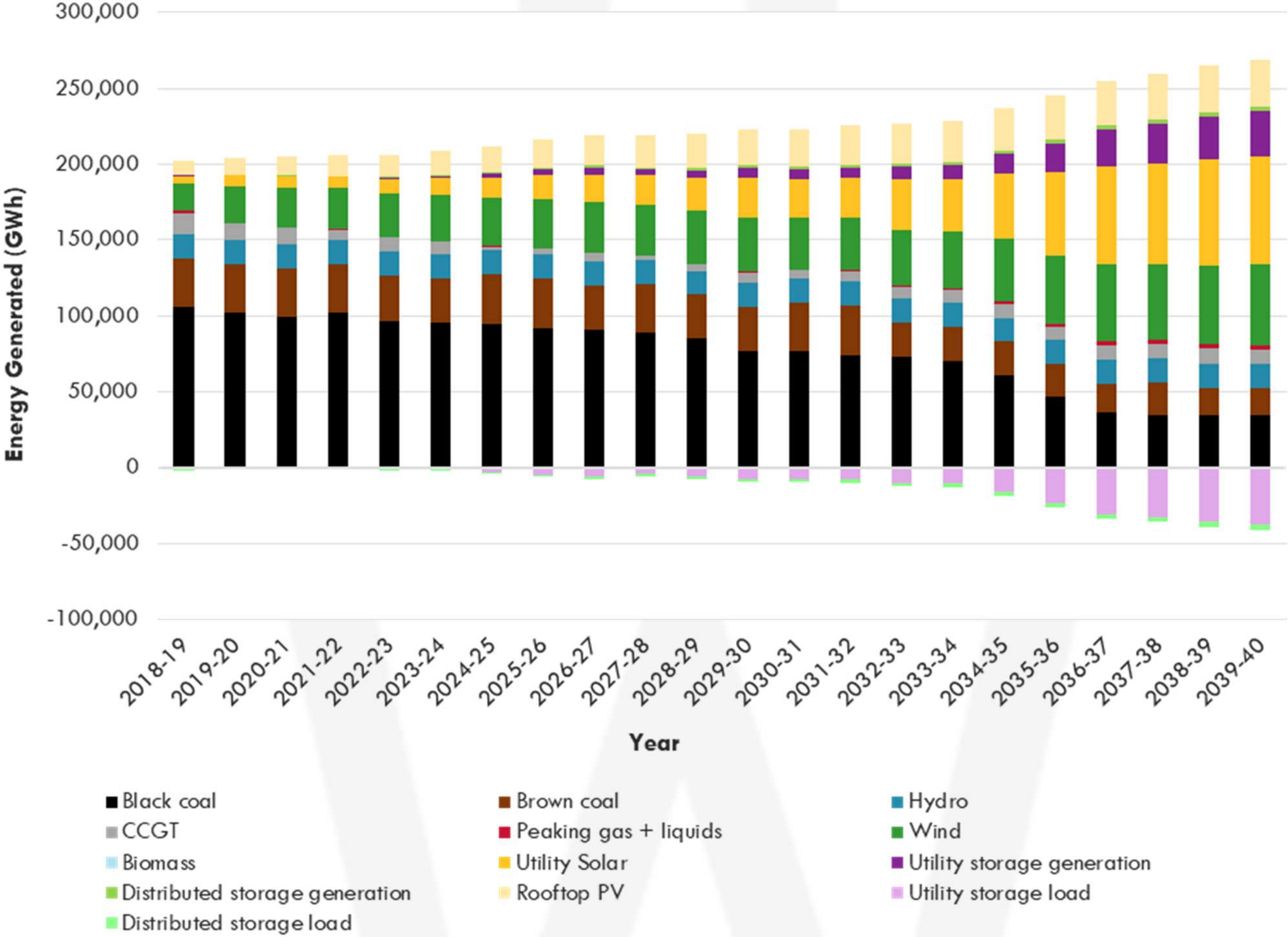
Source: http://forecasting.aemo.com.au/Gas/AnnualConsumption/Total

Gas Power Generation Long Term Forecasts - NEM



Source: AEMO 2018 Generation Outlook – Neutral with Storage Scenario

Gas Power Generation Forecasts - NEM



Source: AEMO NTNDP 2018 Generation Outlook – Neutral with Storage Scenario

Gas Power Generation - Influencing Factors in the NEM

- Complicated with a degree of uncertainty.
- Some uncertainty exists if the rapidly change electricity market
- *Wholesale price*
  - When NEM prices are low and gas prices increase GPG is pushed out from the intermediate market to peak market based on gas generation SRMC
  - Retirement of cheap large scale coal generators is likely to drive increase in wholesale pricing allowing gas generators to be more competitive in the intermediate to peak market, resulting in higher gas consumption
  - This may be limited by greater competitive tension in gas markets
- *Demand Side Technology Uptake*
  - Uncertainty with the growth of solar PV and storage translating to a uncertainty for GPG demand- volume and peak
- *Commonwealth and State Policies*
  - Many driving to zero emissions by 2050
  - Increase in intermittent generation will drive further opportunities for GPG over the longer horizon.
  - Retirement of coal generation will increase the use of gas generation for intermediate capacity

Gas Power Generation - Fed and State Policies

State	Target (energy)	Timing	Notes
Queensland	50% renewable generation 3GW rooftop PV (or one million installations) Zero Emissions	2030 2020 2050	Linear and ramped pathways considered. No requirement that qualifying generation projects must be located in QLD. No mandatory closure of coal plant. Targets are inclusive of rooftop PV.
South Australia	50% renewable generation Net zero emissions	2025 2050	Targets are inclusive of rooftop PV. Qualifying generation projects must be located within SA.
Victoria	25% renewable generation 40% renewable generation Net zero emissions	2020 2025 2050	Targets are inclusive of rooftop PV. Qualifying generation projects must be located within VIC
ACT	100% renewable generation Net zero emissions	2020	Targets are inclusive of rooftop PV. No requirement that qualifying generation projects must be located in the ACT.
WA	No explicit policy	2030	Current WEM emissions are increasing yearly - acceptable moving forward?
NSW	Net zero carbon emissions	2050	Targeting generation projects within State (no specific details).

Federal Policy

- Paris Agreement COP 21
- 26%-28% reduction on 2005 levels
- NEM 179Mtpa to 128 Mtpa in 2030

Gas Power Generation - Influencing Factors

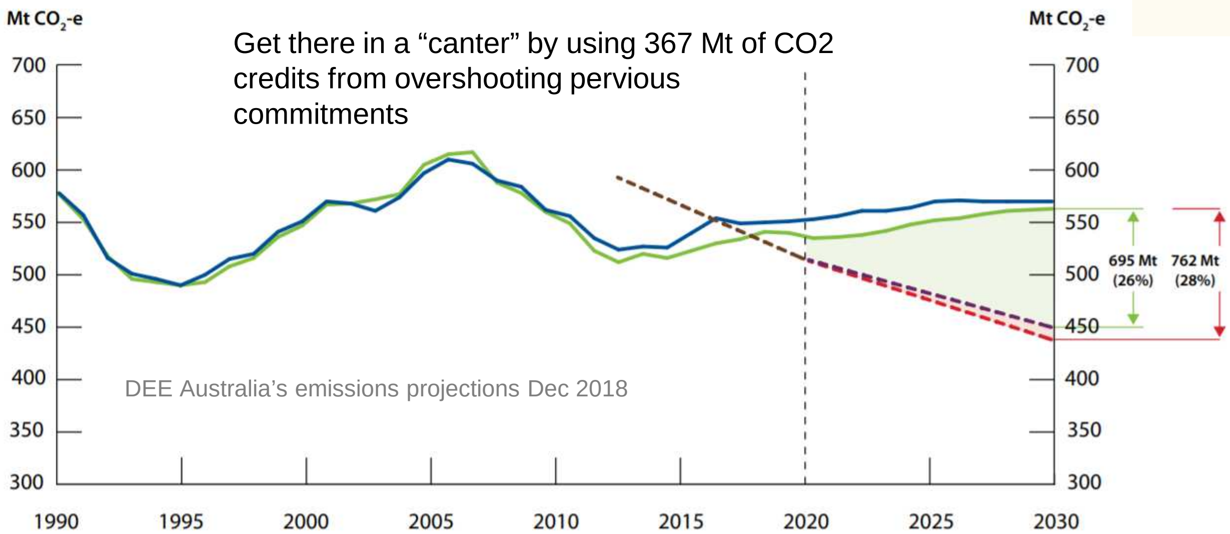
Last Year

Now

- “Fair dinkum power”
- Federal Government underwriting new power investments directly!
  - 70 proposals most in gas power (total 29000MW)

May elections

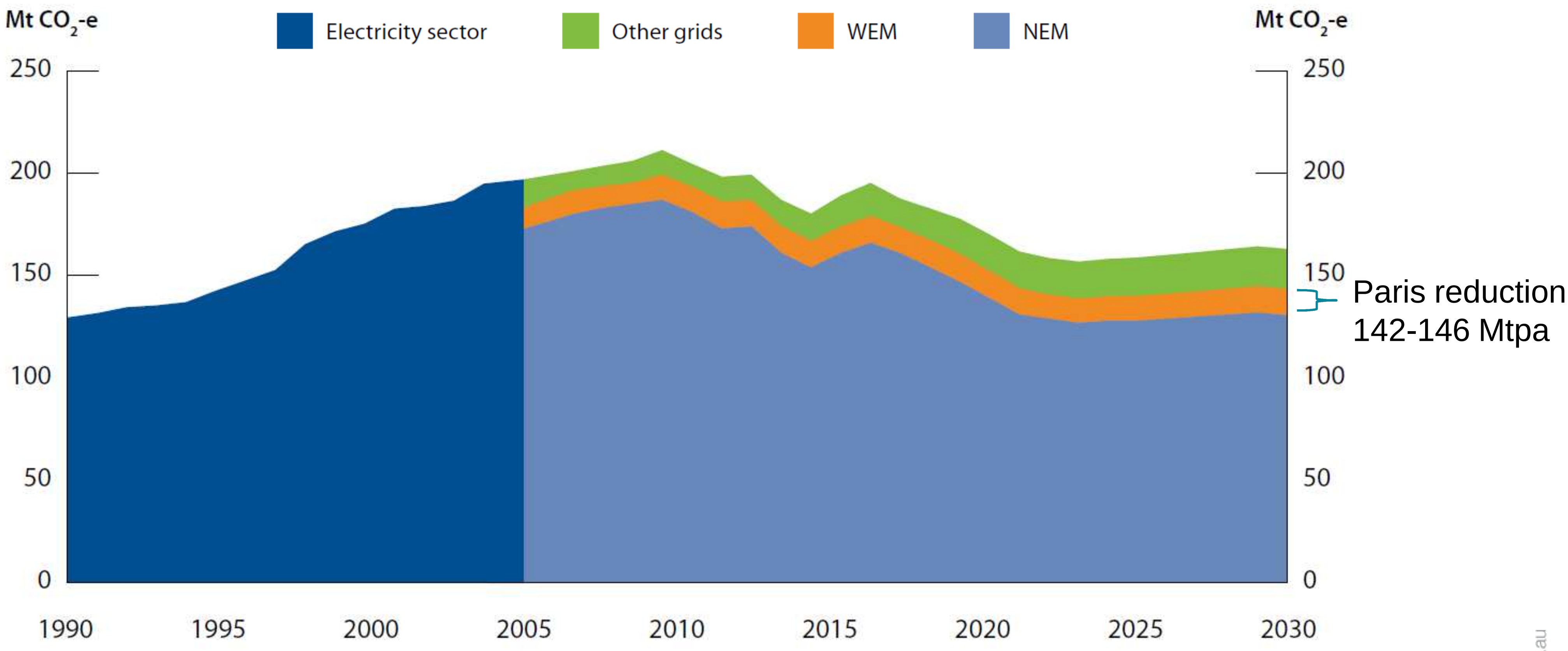
- Coalition $3.5B plan:
  - Snowy hydro 2.0, TAS battery of the nation
  - $2B for Climate Solutions Fund (old Direct Action)
- Opposition proposing a NEG 2.0
  - 45% reduction across all sectors



Emissions are increasing

- Projected to grow 4% on 2020 levels
- Due to:
  - LNG production
  - Increased transport
  - Declining forest sink
  - Growth in agriculture
- Offset mostly be renewables and lower electricity demand
- Fed Govt claim that we can use the 367 Mt credits from Kyoto.

Gas Power Generation - Influencing Factors in the NEM



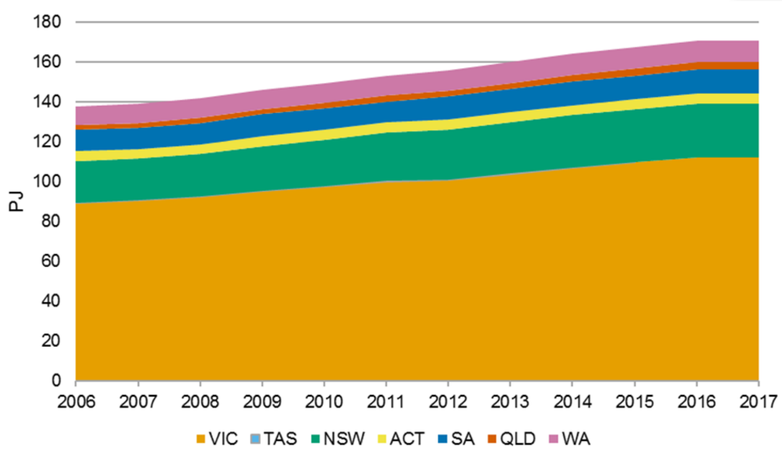
Gas Power Generation - Key Points

- Gas consumption, while enjoying an uplift at the moment is expected to be short lived and will decrease to the peaking capacity as prices in the electricity wholesale market roll off with new capacity in the form of wind and solar (which have low SRMC, no fuel costs and support through LGCs) and gas prices remain high.
- This is exacerbated due to a flat central energy consumption and greater up take of decentralised generation and storage.
- It is likely gas consumption will rise in the longer term horizon (post 2030) as further coal plant is retired due to age and further decreases in emission limits to 2050
- It is likely to end up stabilising as storage systems (solar thermal and PV/wind with storage) become the longer term solution towards 2045-2050 onwards.
- In the short to medium term, the NEM is likely to require higher levels of flexible GPG to maintain security and reliability. However, in the current environment there appear to be few incentives for investing in new GPG, with the exception of government-led investment as seen in South Australia and AGL, which has announced plans to replace its ageing generating units at its Torrens Island generator with newer more efficient generating units.
- Gas supply uncertainty and price volatility, lack of transparent market information, as well as barriers to efficient transportation and storage, may be impediments to future investment in GPG. As coal-fired generators retire, GPG is likely to set the marginal cost of generation within the NEM more often, which will flow through to consumers as higher retailer electricity prices. Under these circumstances, access to affordable gas supply will be critical.

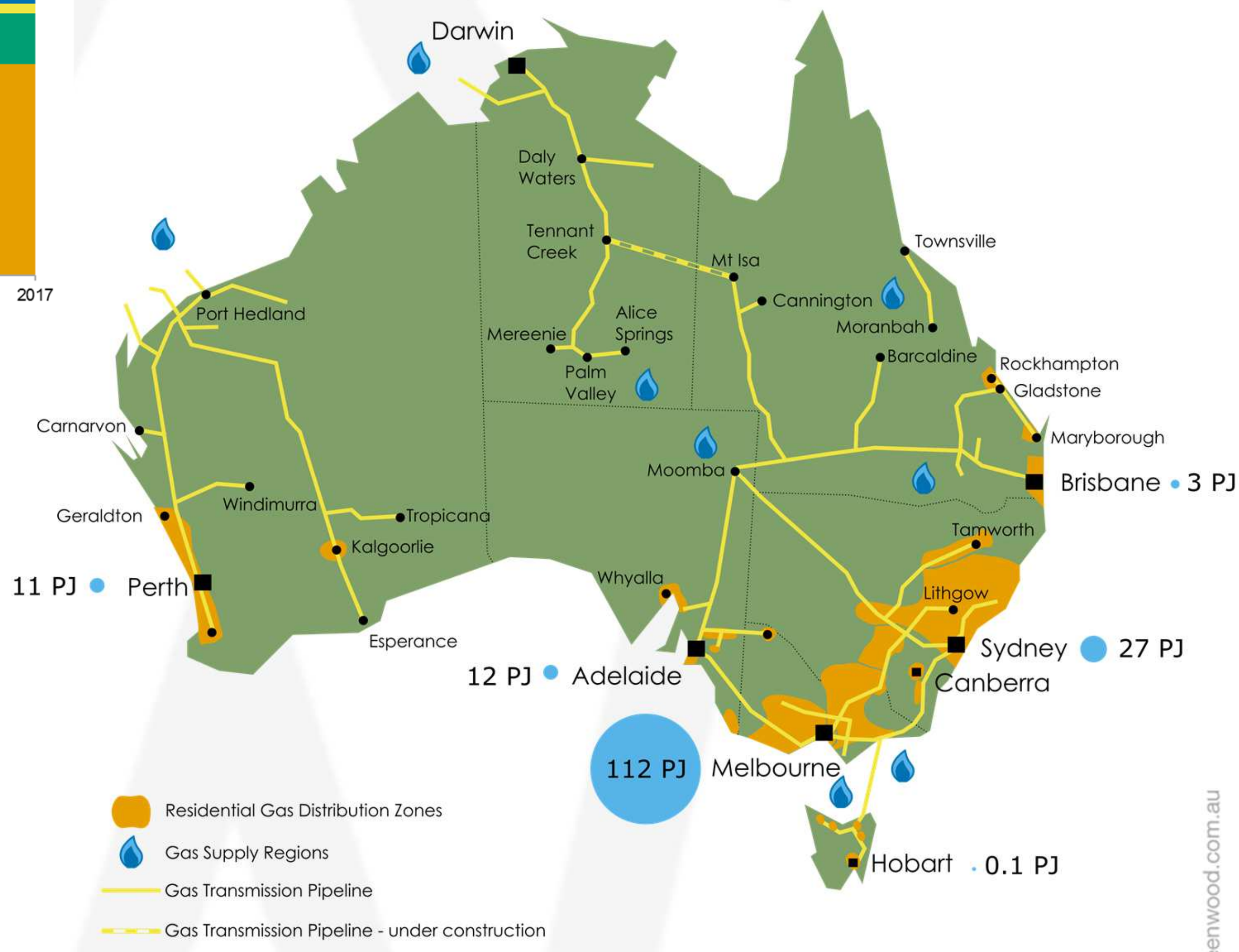
Residential gas trends

Residential gas trends

State consumption



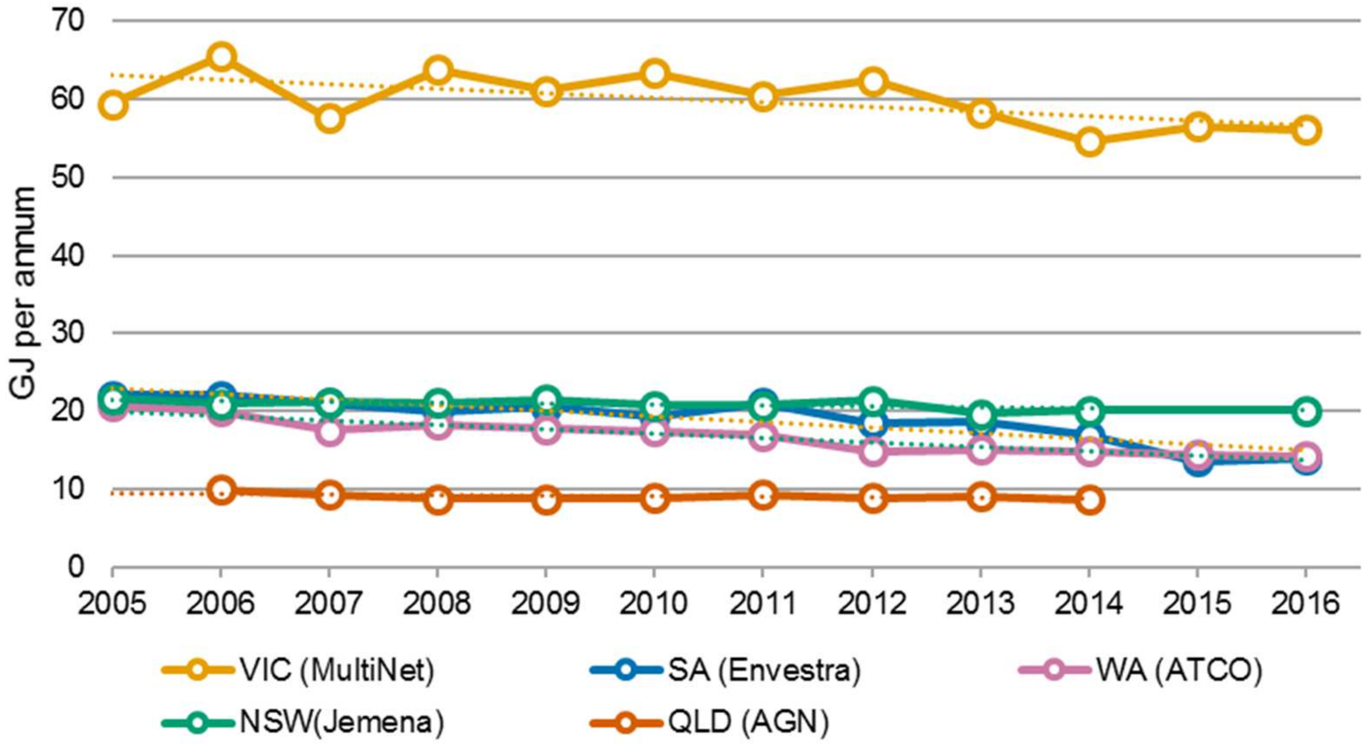
- Residential 171 PJ 2017
- 11% of total
- Overall residential gas consumption by state is increasing on year to year basis
- Victoria is still the largest consumer and forms 65% of Australian residential gas consumption.



4 March 2019

Residential gas trends

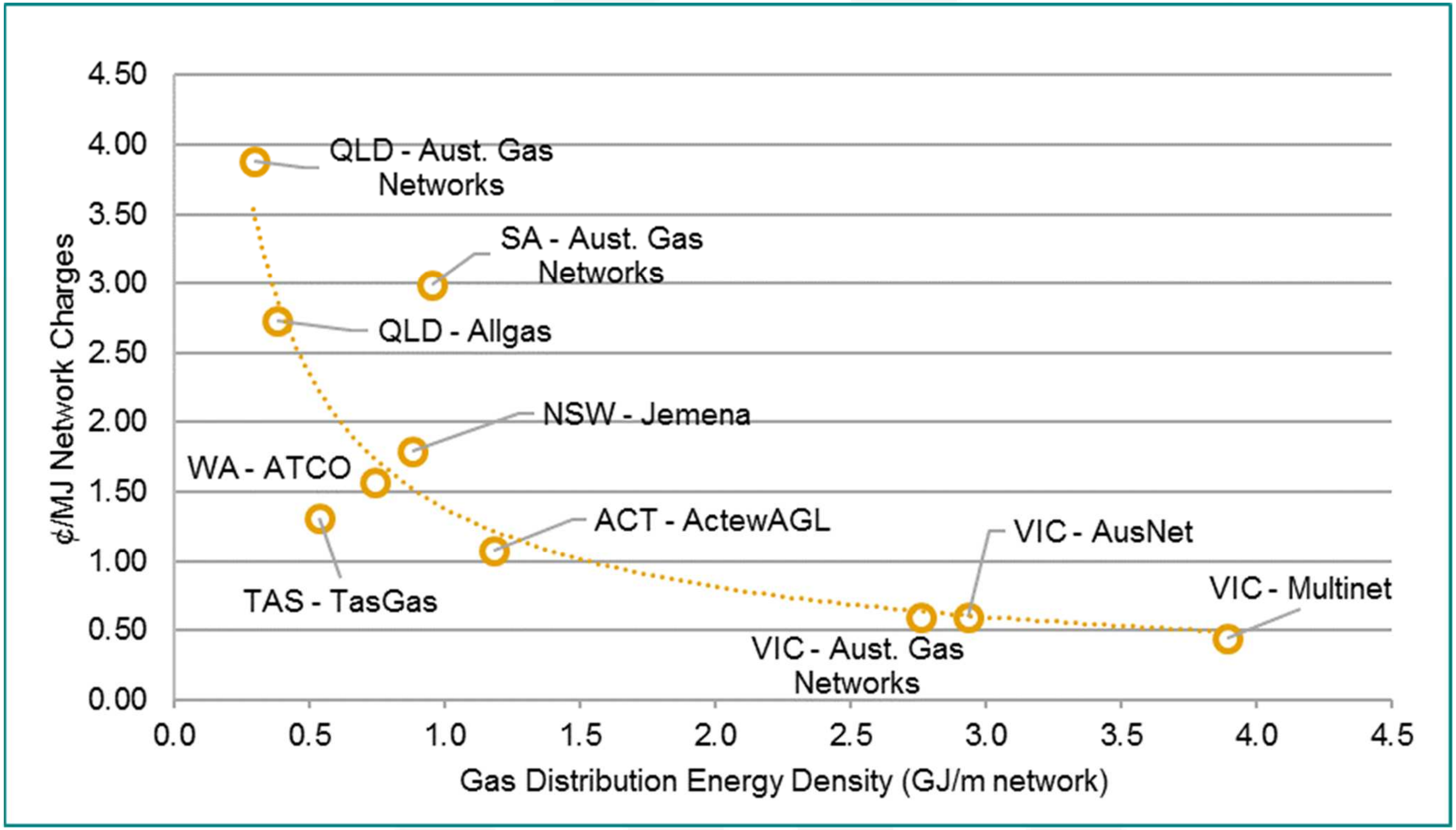
Household Consumption



- However, individual household consumption as general trend is still decreasing year on year due to better building construction, more efficient appliances, and use of electricity (reverse cycle air conditioners) – particularly for heating.

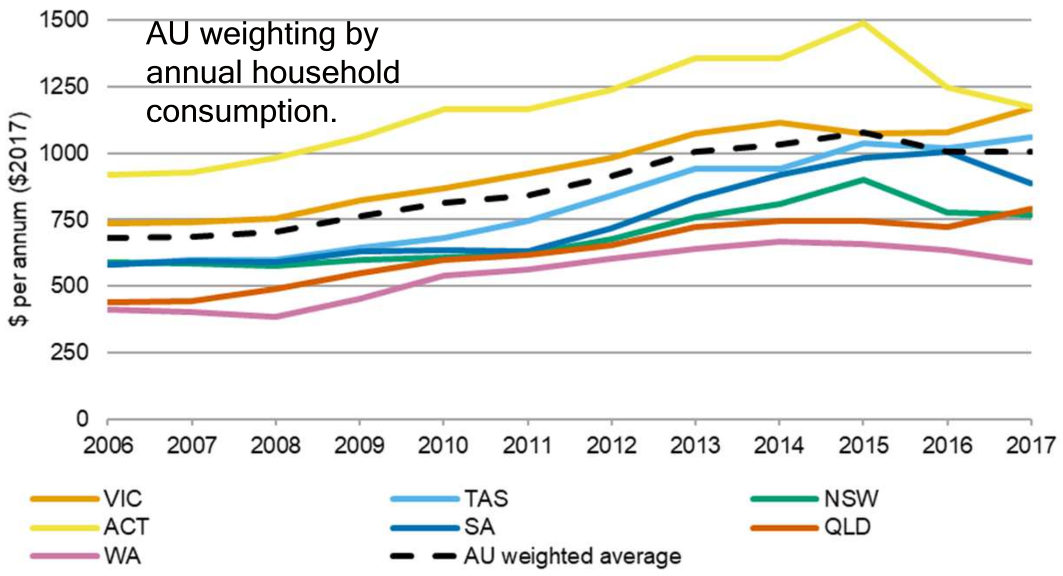
Residential gas trends

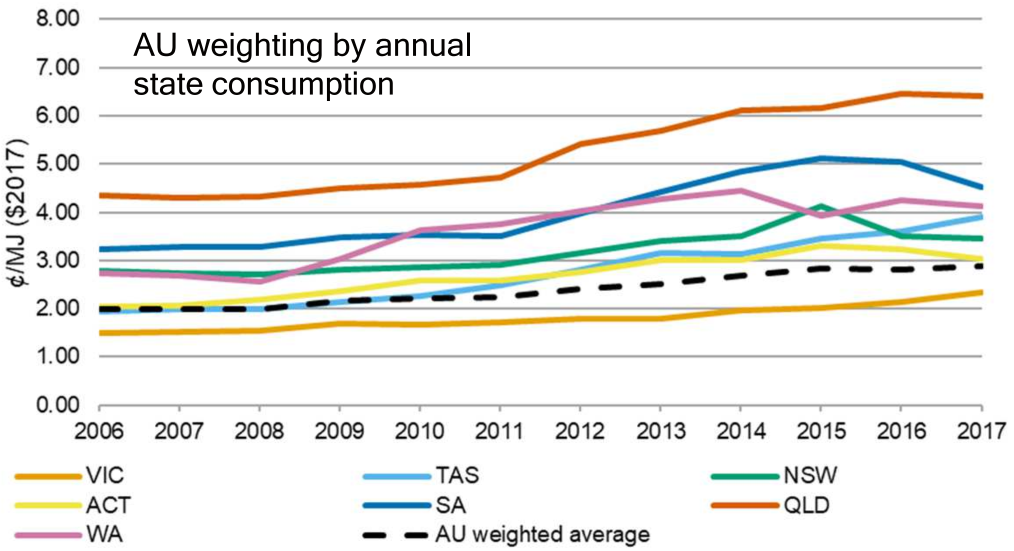
Benchmark network charges (¢/MJ) vs. distribution energy density (GJ/m network)



Residential gas price trends

Cost per household and c/MJ

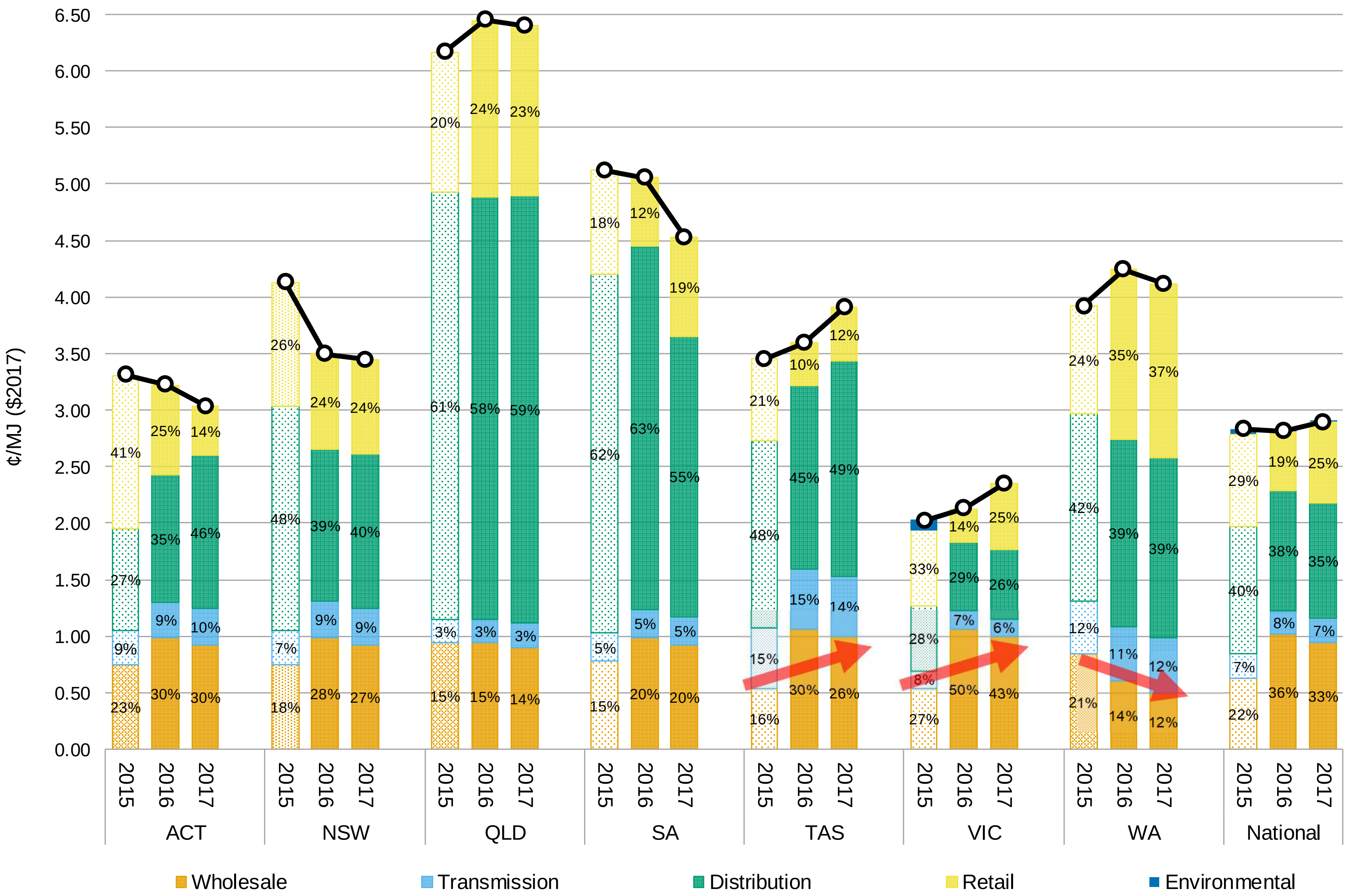




- The indicative total bill per household has shown a decline in most jurisdictions.
- Lowest gas cost on a ¢/MJ doesn't necessarily relate to the lowest bill. Eg. Victoria and Queensland.

Residential gas price trends

2015-2017 Component Breakdown



Residential gas price trends

- NSW wholesale gas price component has increased offset by a decrease in the distribution component (AER 2015 determination on Jemena gas access arrangements).
- SA follows a similar principle to NSW pricing except the AER decision on AGN's access arrangement was in 2016. Note the increase in wholesale gas price in 2016 and the reduced distribution component reflected in 2017 pricing).
- Victoria and Tasmania wholesale components have doubled. The increase is buffered somewhat by the retailer/s managing its portfolio. Tasmania distribution is unregulated so no transparency in pricing and only two retailers. Victoria's (Ausnet/AGN/Multinet) access arrangement decision released November 2017.
- ACT wholesale component has increased and is offset by the retail component more than halving over 2015 to 2017.
- WA wholesale component decreased and total prices have moderated somewhat. Competition (AGL/Origin) are entering the WA market putting pressure on incumbents. The regulated price cap puts a ceiling on the price but also allows for margin management in a low/decreasing wholesale gas price market.

Residential gas price trends

6 key points to take away

- Recent AER determinations make a difference e.g. NSW and SA
- Volume through infrastructure matters. Need to cover fixed costs e.g. QLD
- Higher penetration solar PV rooftop and fuel switching from gas to electricity (reverse cycle air conditioners) for space heating will exacerbate this issue
- Retailer gas contracting strategy can buffer their consumer base from escalating prices. e.g. VIC and TAS
- Price caps are good for consumers when wholesale gas prices go up. And also good for retailers when wholesale gas prices go down e.g. WA

GAS SUPPLY TRENDS

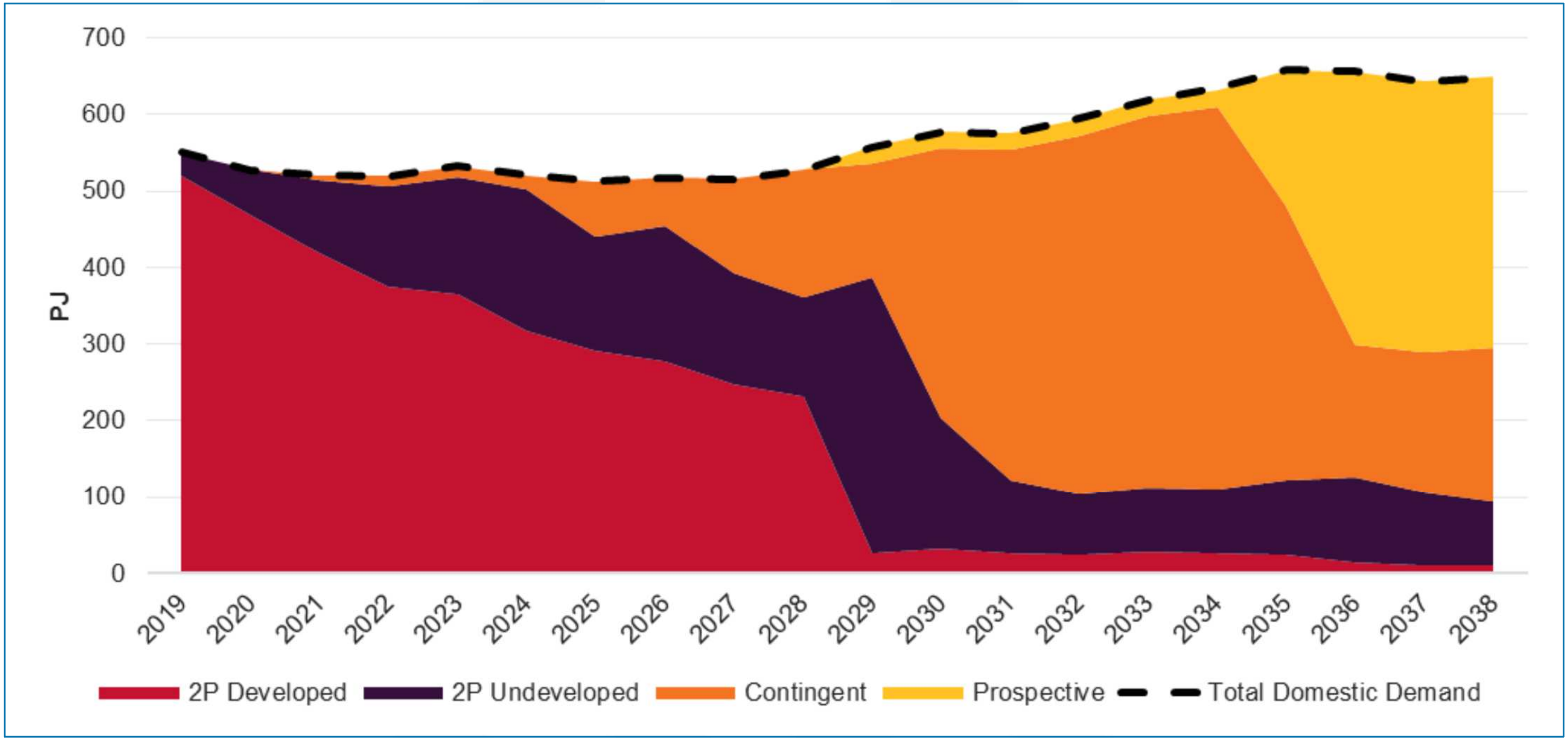
Gas Supply – let’s look at some recent data references and related information - are we in major strife or not?

- AEMO Gas Statement of Opportunities – GSOO, and
- Associated references to 2018 Victorian Gas Planning Report Update
- ACCC Gas Inquiry 2017-2020
- Public Reports and news items
- Session on LNG markets and LNG importation
- WA gas supply matters

AEMO GSOO 2018

Status of reserves and resources to meet domestic demand, 2019-38

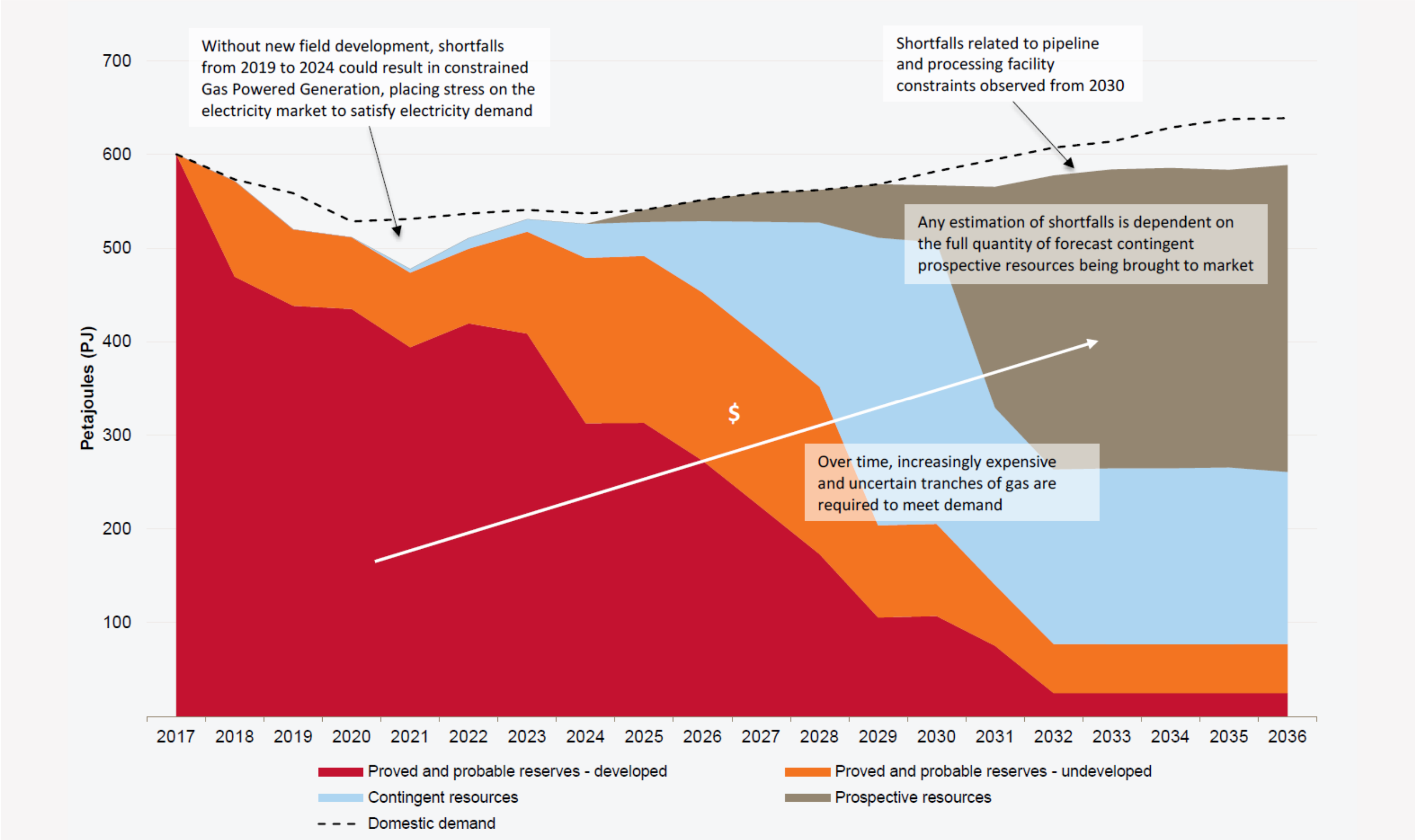
Over the next 10 years the domestic gas market would need 5,000 to 6,000 PJ of gas – without large uptakes for GPG load



Oakley Greenwood

Status of reserves and resources to meet domestic demand, 2017-36 - GSOO March 2017

Figure 1 Eastern and south-eastern Australia domestic gas production (excluding LNG), 2017−36[A]

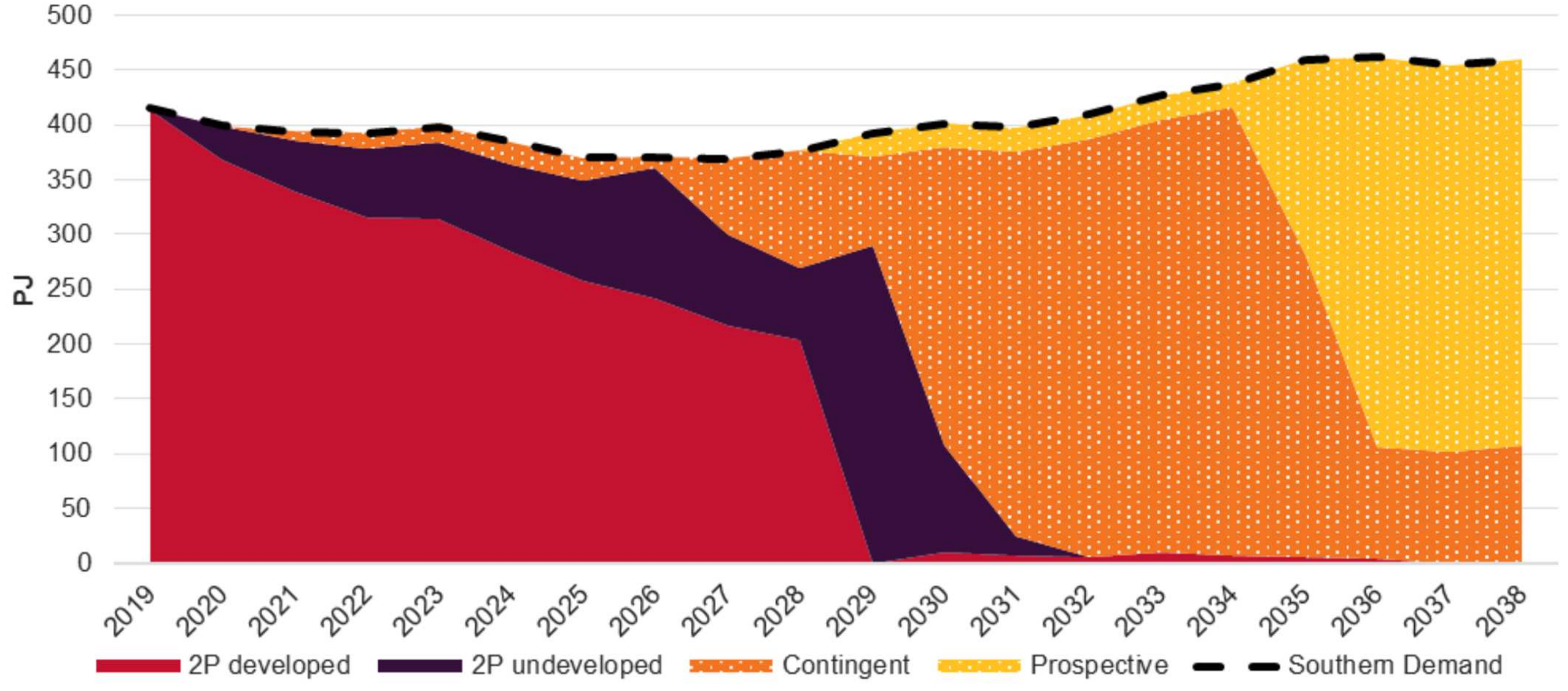


  4 March 2019

GSOO supply and infrastructure adequacy assessment

- *There are no gas supply gaps forecast in 2019, or in the short term, under expected conditions, although some field expansions are needed.*
- *Producers have indicated to AEMO that up to 42 PJ of undeveloped reserves are expected to come online by 2019 to meet demand, and first gas from contingent resources by 2021.*
- *Provided these as yet undeveloped reserves do come online, comparison of supply adequacy assessments for the Neutral and Strong scenarios indicates a level of resilience to unexpected variations in demand.*
- *In 2019, up to 37 PJ more gas supply is projected to be available, if needed, to accommodate weather- or event-driven variations in Neutral scenario consumption forecasts. However, to meet the full 112 PJ of additional LNG demand forecast in the Strong demand scenario, increased Queensland CSG production would be required.*
- *The rapid decline in production from 2P developed and undeveloped reserves clearly visible is mostly from fields located within the southern states.*

Status of southern reserves and resources required to meet southern demand, 2019-38



Oakley Greenwood

Producer forecasts 2018 - to AEMO

- Importantly this shows no apparent drop off in supply in the south over the period – all good, but
- This is clearly dependent on 2P undeveloped reserves – and some contingent reserves coming to production, and
- 2P (developed plus undeveloped) and 2C reserves have declined by 15% since 2017

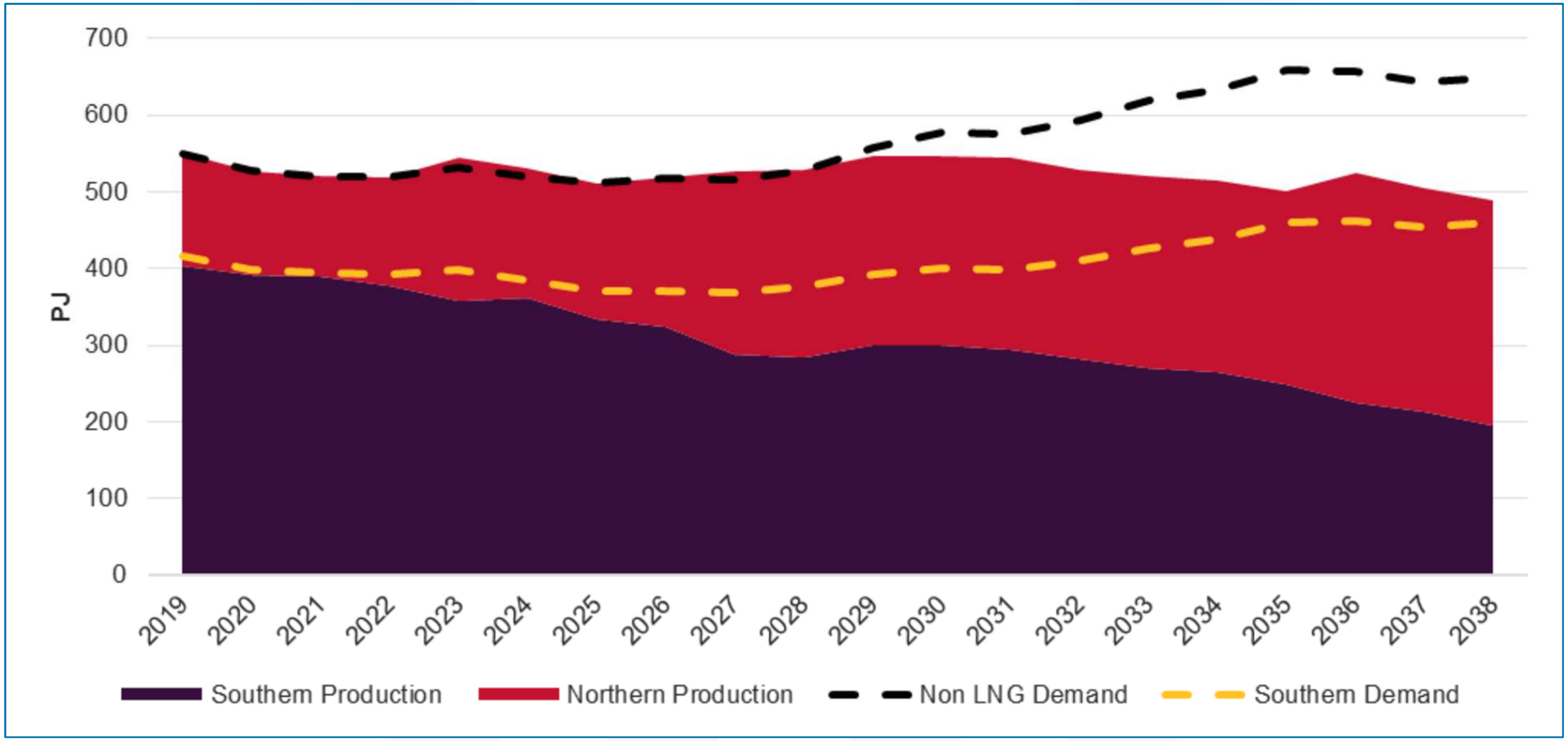
Table 6 Production forecasts to 2022 (PJ), as provided by gas producers

	2019	2020	2021	2022
VIC/NSW/SA[A]	452	483	463	479
QLD/NT[A]	1,486	1,561	1,636	1,603
Total production	1,938	2,044	2,099	2,082

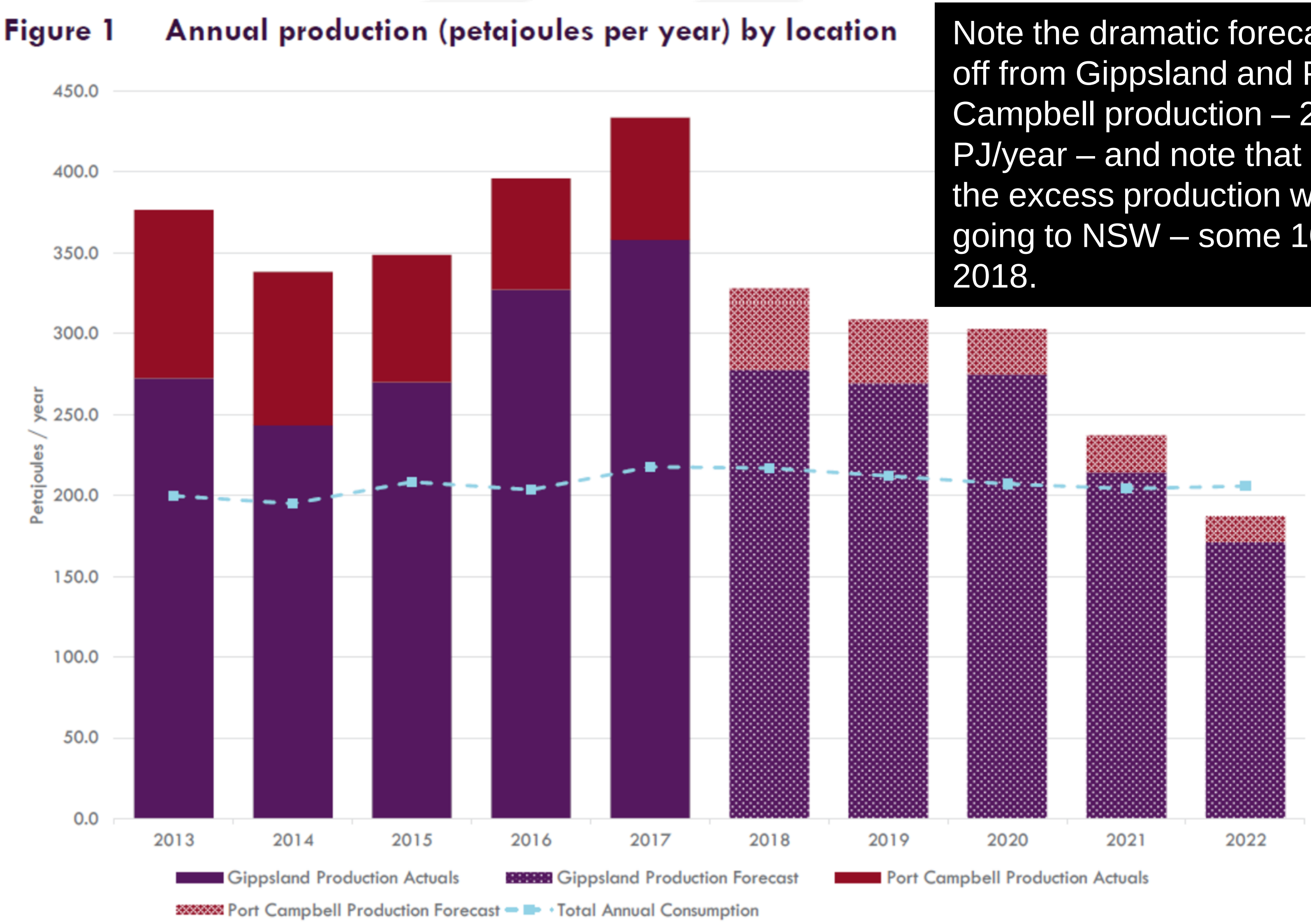
A. The Queensland component of the Cooper Eromanga basin appears in the SA category.

AEMO GSOO low southern resource case

- *The Low southern resource case explores a future where production from southern fields declines. In this case, **northern fields increase production to compensate for the decline in the south – including up to 178 PJ of gas otherwise destined for LNG** – although deliverability will become challenging. **Expansion of pipeline infrastructure to alleviate constraints** on SWQP and Moomba to Sydney Pipeline (MSP) would be required by 2030 to avoid domestic supply gaps. Without this expansion, **southern supply gaps of up to 160 PJ per year** are projected by 2038,*

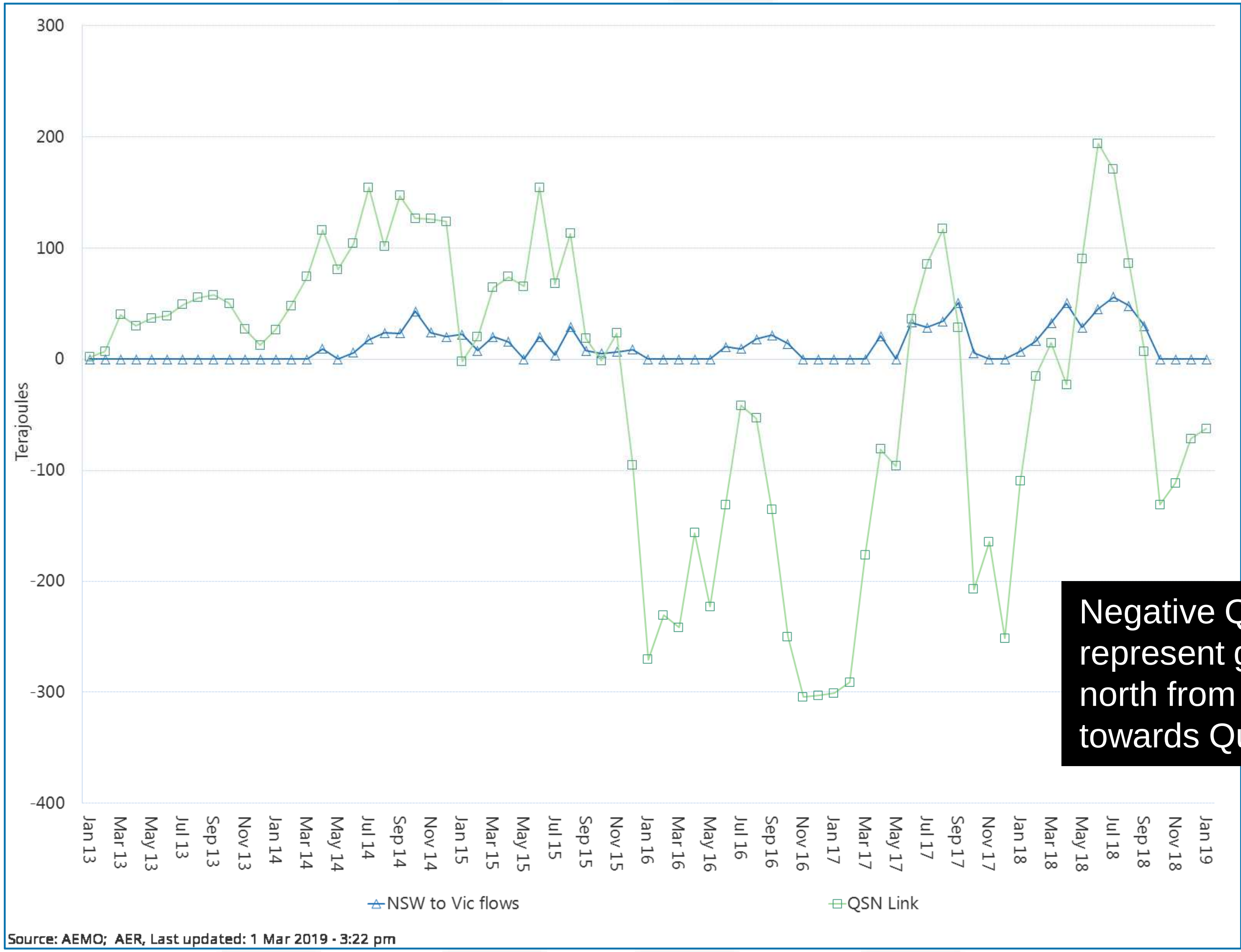


Victorian gas Planning Report Update – March 2018



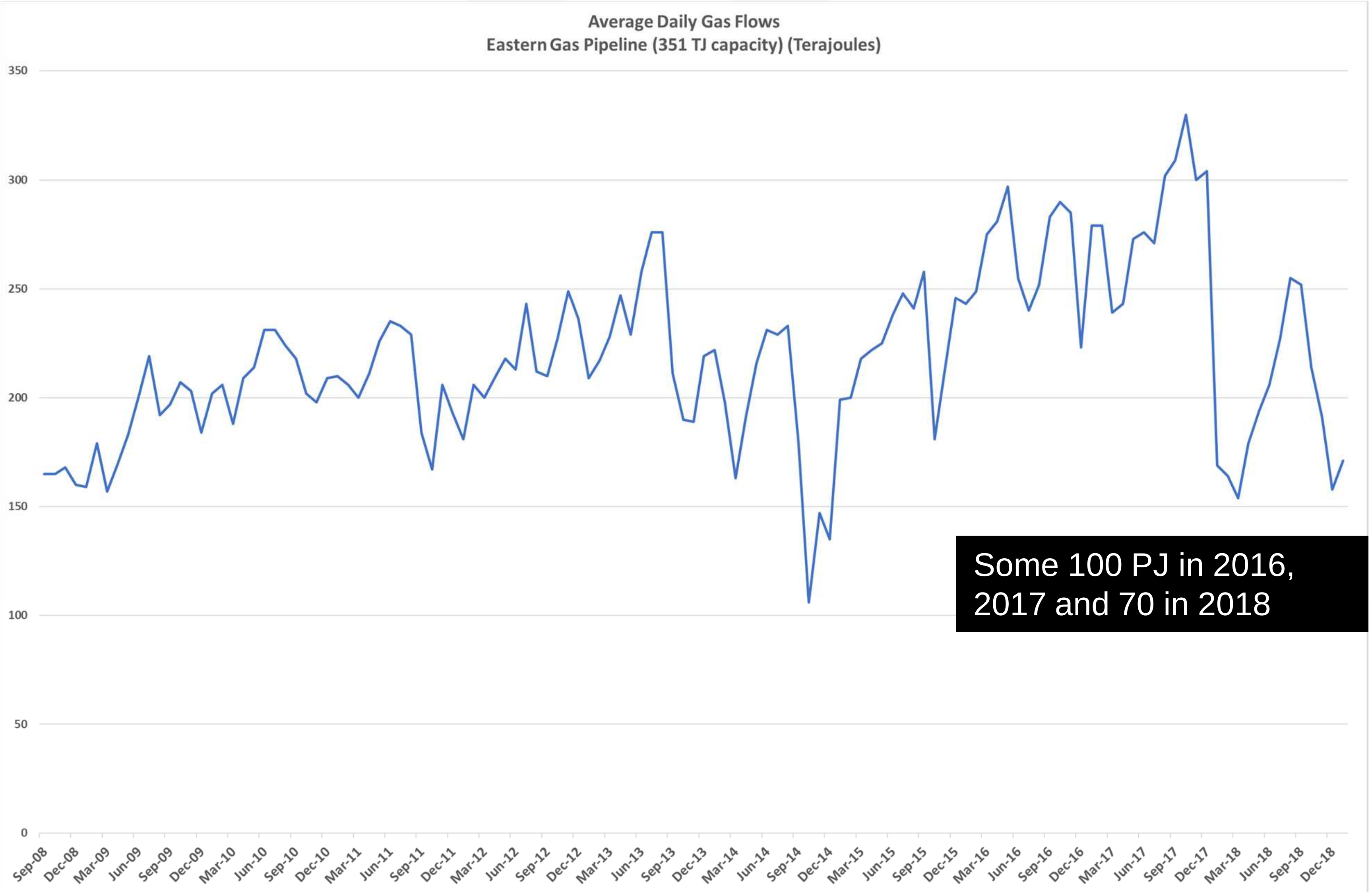
Note the dramatic forecast drop off from Gippsland and Port Campbell production – 200 PJ/year – and note that a lot of the excess production was going to NSW – some 100PJ in 2018.

Interstate flows – winter peaks being met from Queensland



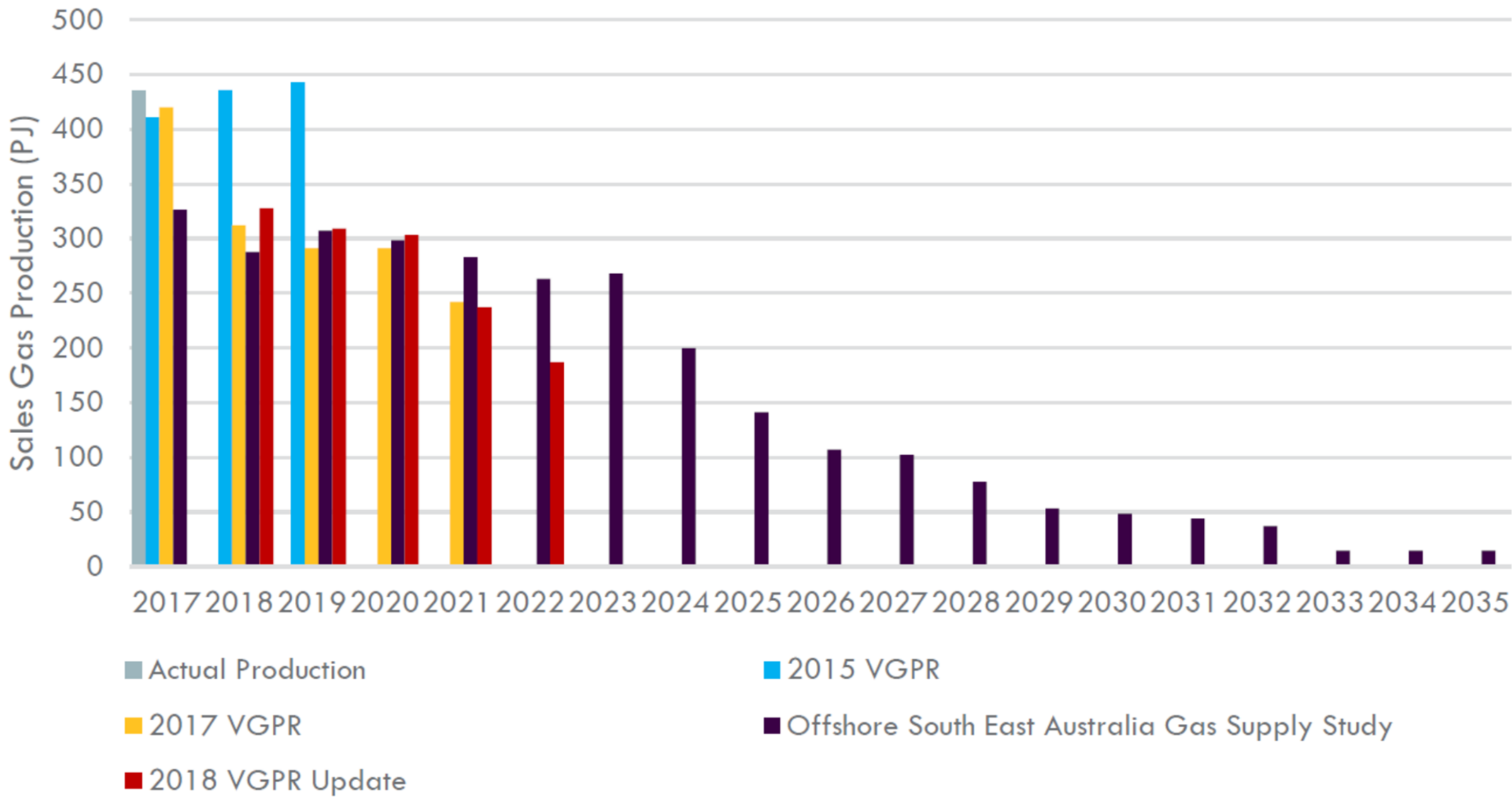
Negative QSN Link flows represent gas flowing north from Moomba towards Queensland

Interstate flows – Victoria to NSW



Other studies have show similar trends (from 2017)

Figure 2 Victorian production forecasts by year (PJ/a)



Victorian Gas Planning Report Update – March 2018

- Gas supply forecasts provided to AEMO by participants show that gas production, due to the depletion of offshore gas fields, is forecast to reduce further in 2022, following a projected decline to 2021
  - Without additional gas supply, there is a potential shortfall in meeting annual Victorian gas consumption from 2022. Without additional gas supply capacity, there is a potential shortfall in meeting Victorian winter peak day demand from 2021.
- Producers have advised AEMO that, by 2022:
  - Gippsland annual production is forecast to reduce to <u>38% below the 2018 production forecast. Maximum daily production capacity is forecast to reduce by 50% compared to the 2018 forecast</u>.
  - <u>Port Campbell annual production is forecast to reduce by 68%</u> from the 2018 forecast. <u>Maximum daily production capacity is forecast to reduce by 76%</u>.
- <u>Gas supply from Victoria to South Australia and New South Wales is expected to reduce</u>, due to the forecast decline in Victorian gas production.
  - Supply to these states is expected to reduce more during winter, due to inventory limitations on gas stored at the Iona Underground Gas Storage (UGS) facility.
- Additional gas supply from Queensland cannot address the forecast Victorian gas supply shortfall <u>unless additional pipelines are constructed</u>.
  - Expansion of the South West Queensland Pipeline and Moomba to Sydney Pipeline by constructing additional compression facilities could increase southbound capacity.

Bass Strait gas investment

- In December 2018 ExxonMobil announced they had made a final investment decision on its Bass Strait gas project – West Barracouta field off Victoria
  - They expect this gas to hit Victoria in 2021, and
  - The new project builds on more than A$5.5 billion invested by the Gippsland Basin Joint Venture in other recent projects in Victoria to supply Australian domestic gas demand, including the Kipper Tuna Turrum offshore project and the Longford Gas Conditioning Plant.
  - They also had great hopes for the Dory prospect in Bass Strait but after $120m in drilling it recently came up dry with no gas (November 2018)
- Graham Salmond, BHP's GM Petroleum in Australia, said the investment was a mark of the company's commitment to meeting east-coast gas demands at such a critical time.
  - "The West Barracouta project is an important investment, underpinned by strong economics and rates of return, that will unlock a high-quality new gas resource and will help offset Bass Strait production decline at a vital time for the east coast market," he said.
- Mr Salmond said West Barracouta was one of the largest undeveloped sweet gas reservoirs in the Bass Strait and would offset the decline from East Barracouta.
  - "We are also assessing other potential development opportunities in the Bass Strait to bring new supply to the domestic market," he said.

Bass Strait gas investment

- Mid last year ExxonMobil were also reported to be looking at an LNG import terminal to ease the forecast 2021 decline in production
- On 16th February this was reported as still being on the table: Exxon Australia Chairman Richard Owen
  - *"In the near-term I think the answer to this problem is that we need to find new sources of gas," Owen says. "That obviously includes more exploration in the Bass Strait but another part of that puzzle could be importing LNG into the marketplace. It could be an important part of the solution."*
- This would likely be cheaper than establishing a new site as it could be integrated into existing assets- circa $100m - Long Island point
- Exxon has started conducting initial engineering and design studies and started scoping potential suppliers – including gas from its own global portfolio – to a plant which could receive its first imports by 2022. A final investment decision could be struck in the next 12-18 months.
  - *Owen is watching the market closely and considering his options. "There are no overnight successes – these projects take five to seven years to bring to the market. But I'm quite hopeful we are going to find more gas in the Bass Strait."*

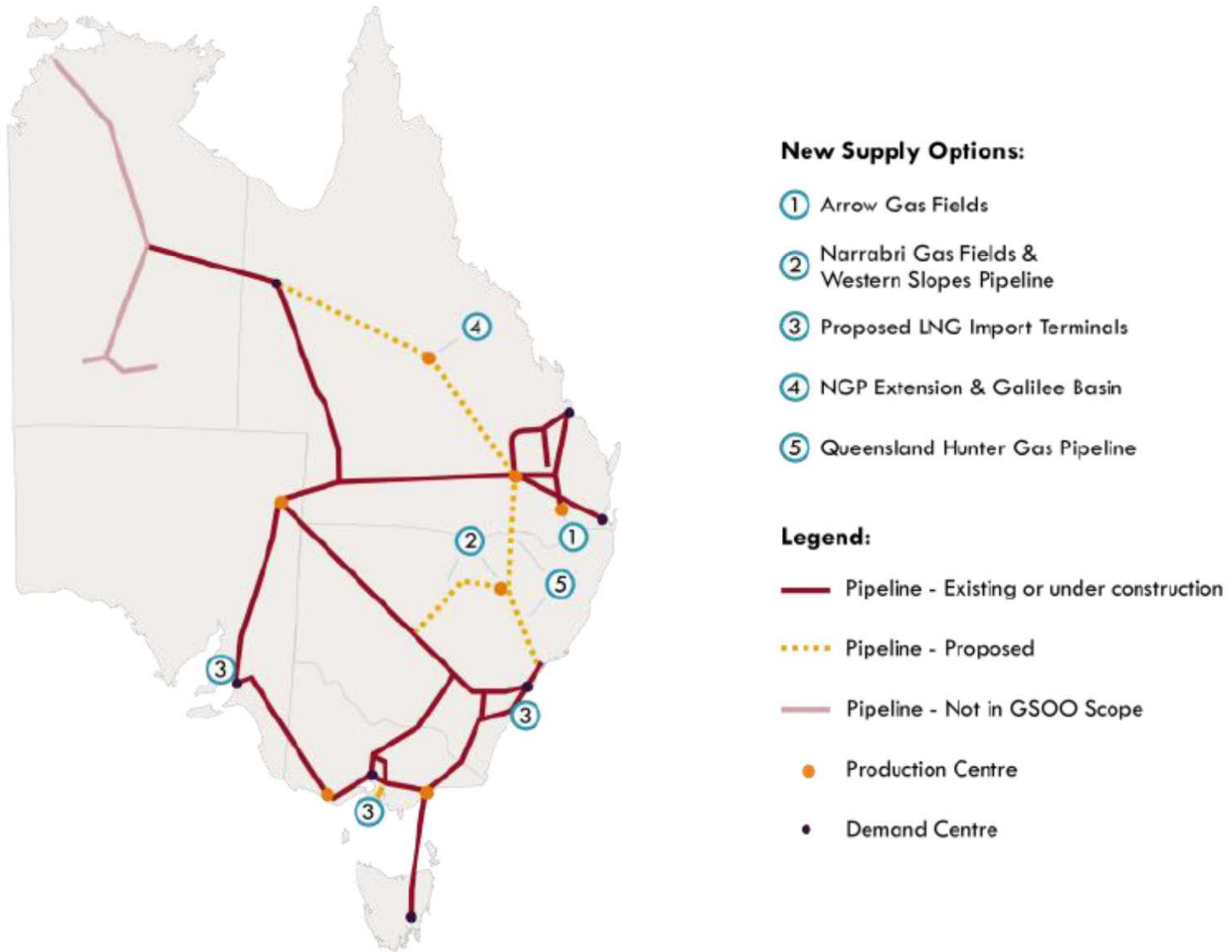
Potential (other) new supply options - AEMO GSOO 2018

Table 8 Summary of sensitivities examining new supply options

Supply option	Details	Estimated impact
Arrow gas field development	Arrow and Shell announced intentions to commercialise Arrow's gas fields in Surat Basin from 2021.	Could provide additional supply of approximately 655 TJ per day, or 240 PJ per annum.[44]
Narrabri gas field development	Narrabri gas fields would support southern production, providing up to 250 TJ per day at peak production. Santos is targeting first gas from 2021-22[45].	Would provide additional supply of 100 TJ per day initially (up to 35 PJ per annum), potentially ramping to 250 TJ per day (up to 90 PJ per annum). [46]
LNG import terminals	Import terminals where LNG volumes are regasified to be injected into the gas network of the importing region. Terminals have been under consideration at Melbourne (Crib Point), Sydney (Port Kembla) and Adelaide (Port Adelaide/Pelican Point).	Melbourne: Maximum of approximately 140 PJ per annum, depending on number of tanker deliveries.[47] Sydney: 100 PJ per annum targeted.[48] Adelaide: Details currently unknown.
NGP extension	The under-construction NGP is capable of extension from Mt Isa to connect to Wallumbilla. Such an extension may give rise to development within the Galilee Basin, increasing available gas supply from both Northern Territory resources and new resources in Queensland.	Up to 700 TJ/day (approximately 250 PJ/y) in additional pipeline capacity, enabling development of appropriate reserves in the Galilee Basin.[49]
Queensland Hunter Gas Pipeline	Additional transmission capacity between Wallumbilla to Newcastle, including access to the Narrabri gas fields.	Up to 450 TJ/day (approximately 160 PJ/y) in additional pipeline capacity, enabling delivery from Narrabri gas fields and greater north-south transfer capacity.[50] Alternatively, the Western Slopes Pipeline has also been proposed to deliver gas from Narrabri to southern demand centres.

Narrabri, Queensland and LNG Imports – maybe NT?

Figure 22 Potential new supply options



Arrow (Surat Basin) & Queensland domestic only leases

- Arrow gas - major development opportunity in Queensland – 5,000 PJ 2P/27 year flows - $10b investment – first gas was planned to be flowing in 2020
- Project fully approved by Queensland Government a couple of days ago
  - Yet though to go to FID
- Arrow is owned by Shell and PetroChina (50:50), and will supply Queensland Curtis LNG (QCLNG) which is also part owned by Shell (through QGC) as the majority shareholder (some holdings by CNOOC – 50% train 1, and Tokyo Gas – 2.5% train 2)
  - There had been concerns at a lack of gas supply for the QCLNG trains and that they may haver to shout one of the two processing units by 2015
  - In December 2017 Arrow announced a 27 year gas sales agreement with QCLNG, but
  - Reported still to be haggling over prices for the gas between Arrow and PetroChina – Shell on both sides of the bargaining in the back ground
  - Shell (QGC) reported that they had sold some 75 PJ into the domestic market – and they have been developing a domestic sales capability (11% of east coast demand)
- Arrow access deal on pipeline and gas processing (APLNG and QCLNG) will see a greater capability for them to push more gas into the east coast markets (5 November 2018)
- All this is seen as a major development for the east coast

Queensland domestic only leases

- Queensland has seen the opportunity to take pressure off the LNG plants for domestic gas and to grow the industry given regulatory market barriers in NSW, Victoria and SA (OGW has also been advising)
- The development of domestic gas only leases is now seen as a positive – Shell and Santos were reported in November 2018 to be backing "*Queensland gas reservation*" along with Woodside Petroleum – part of "*rebuilding trust*" - how times have changed…
- Shell and Santos are also now "*preferred bidders*" for one of several new exploration tenements released by Queensland Government on Thursday
- The first release was awarded to Senex Energy in 2017
- In early 2018 some 400 ha domestic only leases were awarded – Central Petroleum with off taker Incitec Pivot
- The releases have continued to escalate with some 6,00 square kilometres released for exploration in early 2018, and
- Since 2017 Qld has now released almost 25,000 square kilometres of land for gas exploration – 1/3 reserved for domestic market only supply
  - Start looking north – maybe a lot more to come

Santos – Narrabri

- A very plagued development but still going – even after massive write-downs by Santos (has zero book value now) – reported a domestic gas only supply focus – 36 to 90 PJ/y
- Reporting a lot of interest in gas sales in NSW, and
  - As of February 2019 they had signed a non-binding 20 year “deal” with Perdaman Group (WA Multinational)for supply of Narrabri gas to a proposed new ammonium nitrate plant (and integrated power station) to be built near Narrabri – using 14.5 PJ/year of appraisal and early development gas

Santos' Todd Dunn and Peter Mitchley at the Narrabri Gas Project

- Reported to be a $3.6b development – still being assessed by NSW Department of Planning for environmental approval with a decision expected in September 2019
  - However, also reported to be getting side lined politically by the LNG import terminals developments – environmentally Narrabri is under a lot of lobbying pressure (23,000 submissions) – NSW Labor has also pledged to block approvals – AWU not happy about that
  - Price will be interesting as this is complex extraction but Santos claim will deliver cheaper gas than LNG imports

NT Gas - NGP Pipeline - the "missing link"?

- Jemena pipelines - $800m, 662 km from tenant Creek to Mount Isa – first gas January 2019 – 90 TJ/day (30 plus PJ/year)
  - Reported to be 80% contracted (Incitec Pivot, Santos) – and Jemena looking to possibly expand the pipeline to take more NT gas to Qld – to 700 TJ/day (250 plus PJ/year) - $3b to $4b to undertake….
  - NT Resources Minister Ken Vowles said such developments meant the Territory was no longer the "backwater" of Australia. He said the NT was happy to do the heavy lifting and supply gas to the rest of the country, and could become the gas hub of Australia, but
- Dependent on new fields being developed (fracking moratorium has been lifted) – primarily the highly prospective Beetaloo basin, and
  - If that filed is developed it would likely be for LNG developments with domestic gas as a side stream – and may well go direct to Moomba with a new pipeline?
- Still has some opposition in the NT as well – long way to go here and probably not in next 3 to 5 years
  - Jemena does though have a Northern Growth Strategy and has been working with Senex on gas treatment and delivery - *"We know there is continued demand for gas across the east coast and that northern Australia will play a leading role in meeting this demand by bringing new gas to where it is most needed, via the most direct and economic route," said Mr Adams.*

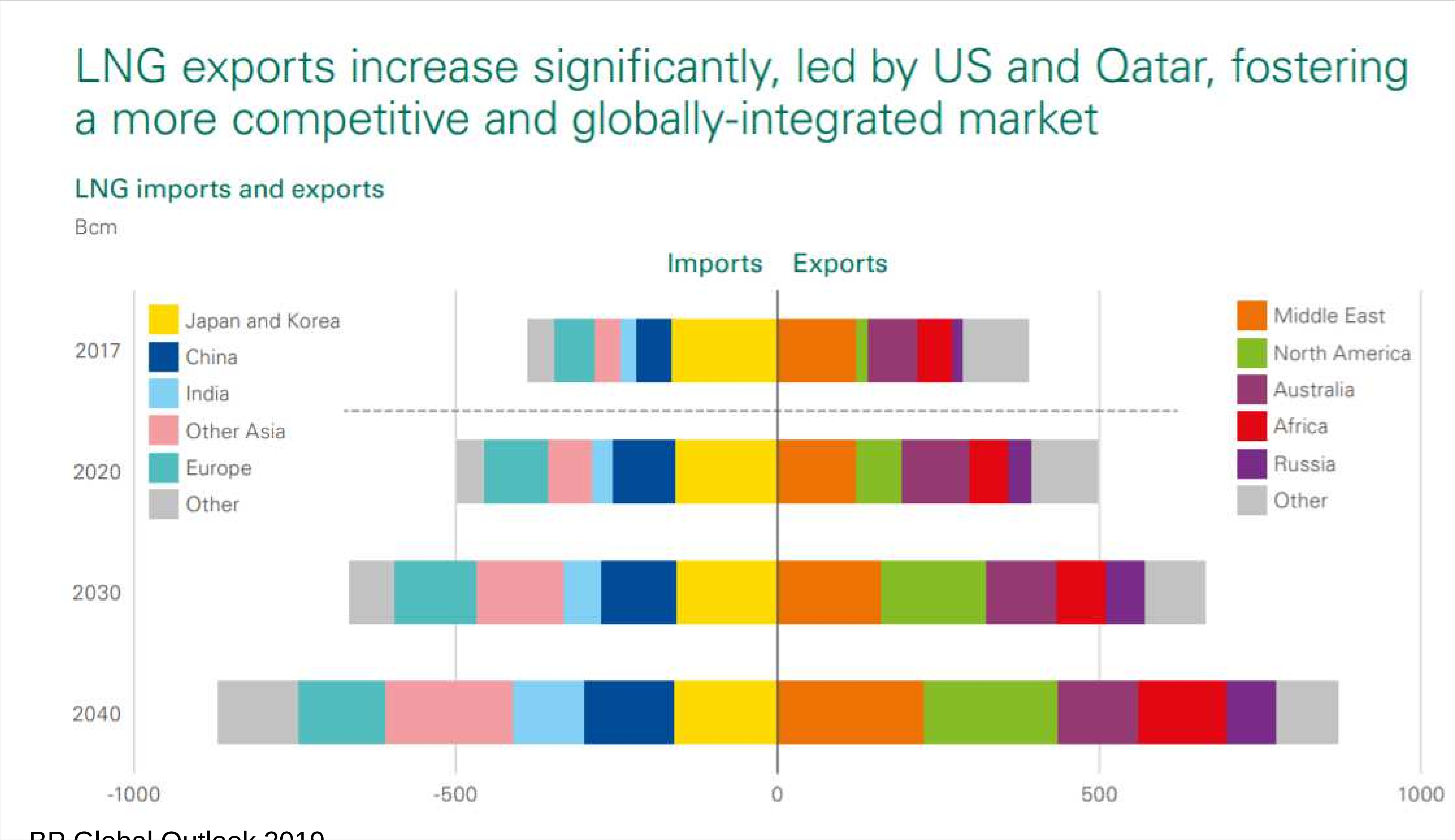
LNG AND LNG IMPORTS

International LNG & gas market

- 2019 will see a record number of LNG FIDs especially in the USA. Qatar, Russia and Mozambique also ramping up
- 2019 Global FID total likely to in excess of 60 MTPA of new committed capacity (Woodmac)
- Japan equivocating is it is dealing with the hollowing out of industry and gradual start-up of some nuclear plants
- Industrial demand for gas over the Outlook is largely driven by developing economies as they continue to industrialize, especially in regions with large gas resources (Middle East, Africa). Coal-to-gas (BP 2019 Global outlook)
- Demand for Gas, Renewables & Oil are all predicted to grow with China & India key players in growth in demand

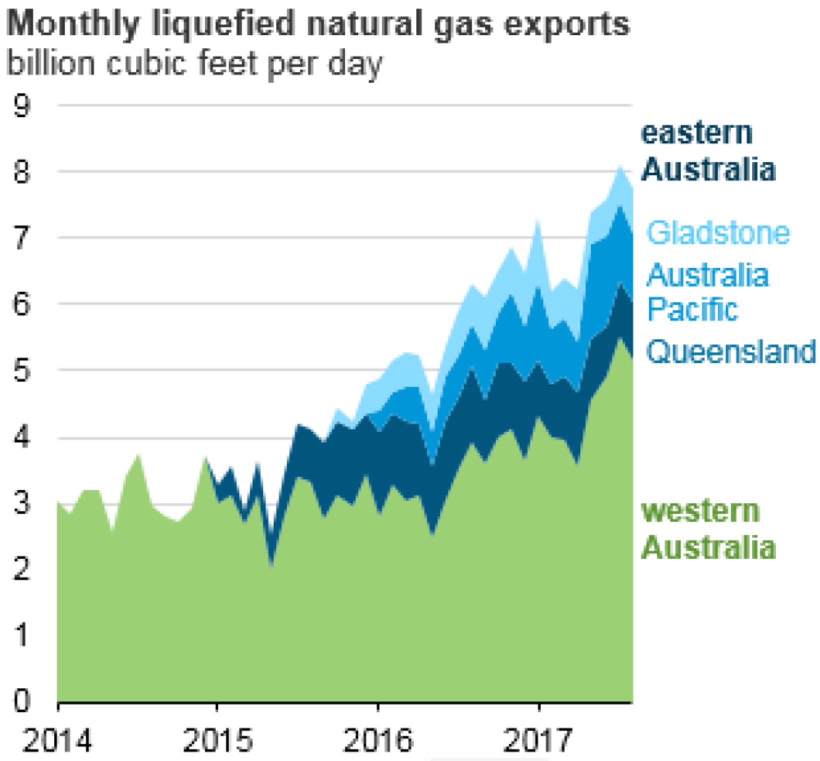
- Shale production from USA is having a massive effect on the World Oil & Gas market
- Gas still being flared in USA pending construction of pipelines and LNG facilities to take the excess gas
- Henry Hub prices sitting well below $3/mmBtu despite recent record cold snap
- USA supplying LNG to Europe & South America. Facilitating swaps to Asia
- Australia likely to be number 1 Global LNG producer in 2019 but will be overrun by Qatar soon after

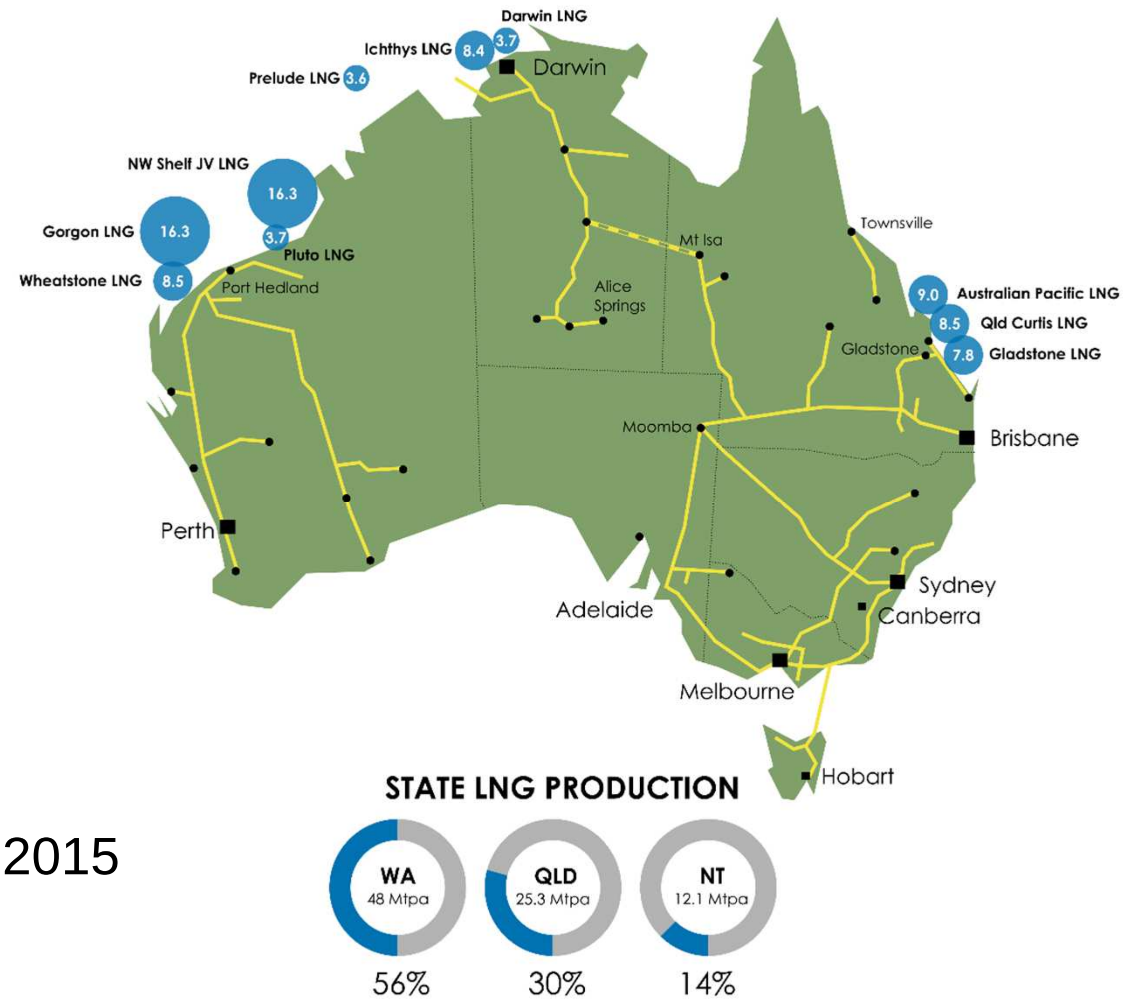
International LNG markets



BP Global Outlook 2019

Australian LNG –
Demand still growing – but Australia probably has now peaked

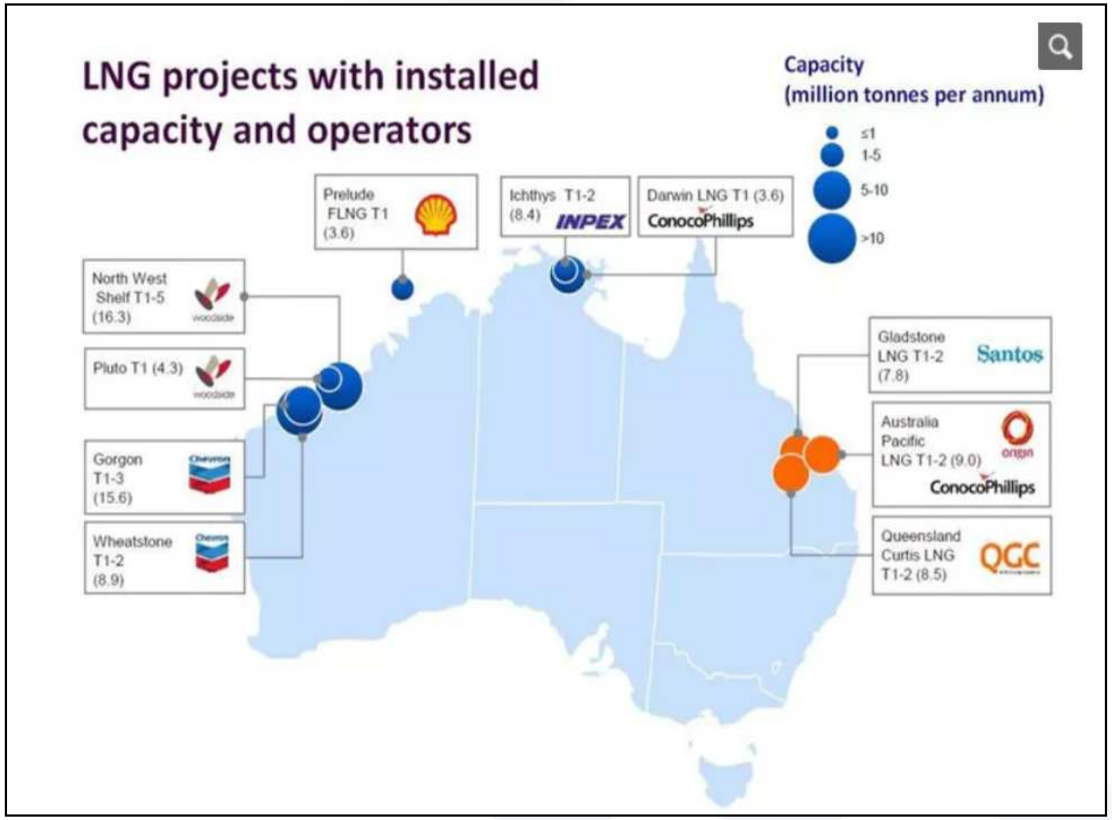




- Second largest global exporter in 2015
- Expect to take over Qatar in 2019

Australia's LNG Export Capacity

- The combined nameplate capacity of Australia's 10 LNG projects put together is 88 million mt/year
- Australia's projects consistently run up to 15% below capacity.
- Gladstone (east coast) plants exported 20.4 million mt of LNG in 2017 representing capacity utilization of 81%, with APLNG operating at 96% capacity, QCLNG at 78% and GLNG at 67% (EnergyQuest)
- Circa 1,300 PJ/A of Gas required for production of LNG from the East Coast of Australia



Scarborough – provides gas for Pluto T2 (WEL, BHP) FEED announcement soon

Browse field to backfill NWS (WEL, MIMI, BP, BHP, Shell & PetroChina)

Barossa field in **FEED**. Likely backfill for DLNG (COP, Santos & SK)

Crux backfill for Prelude (Shell, Seven Group & Osaka Gas)

Sunrise – locked politically

Oakley Greenwood

LNG Production outlook in Australia

- Production suspensions likely to be required:
  - 1 or 2 Gladstone LNG trains - serious supply constraints that are going to potentially be exacerbated by looming decline in production in the Bass strait
  - 1 or 2 NWS trains - prior to proposed Browse backfill gas commences (circa 2025).
  - Darwin LNG is facing (1 or 2 year) suspension prior to proposed Barossa Gas backfill commencing (circa 2024)
- On the growth side
  - Pluto Train 2 - likely to be sanctioned (Scarborough and Pluto train 2 likely to enter FEED 1Q 2019)
  - A regas terminal if installed in Victoria or NSW could save Gladstone plants from declaring FM on gas supplies - or the Arrow gas supply coming on stream
- Energy Quest sending a few shockwaves through the industry (next slide)

Qld projects in jeopardy - EnergyQuest?

- A (February) report from EnergyQuest has painted a bleak picture for the future of Queensland's LNG industry.
- According to the company, low CSG reserves and diversions to the domestic market could cause up to one third of the state's projects to partially shut down within the next six years.
- The consultancy's latest report detailed how the state's $84 billion LNG sector would be at risk in the next decade due to considerable doubt that sufficient CSG will be available for the three plants in Gladstone to ever achieve full-scale production.
- EnergyQuest said a clearer picture would emerge by 2025, with political pressures to divert gas away from exportation and back to the domestic market exacerbating the issue.

East Australian Gas Supply/Demand - disrupters

Is the timing right to build LNG import terminals?

- AIE - NSW
- AGL - Vic
- Exxon - Vic

Billionaire Miner, Japanese Plan Australia LNG Import Plant

By **Perry Williams**
February 26, 2018, 10:43 AM GMT+11 *Updated on* February 26, 2018, 6:19 PM GMT+11

Markets Data

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AGL Energy invites LNG bids for $250m Vic import terminal

WILL NEW LNG IMPORT TERMINALS CUT THE PRICE OF GAS?

EDITOR'S PICK, ENERGY / RESOURCES
June 27, 2018

Markets

LNG Import Boom Seen as No Relief for Australian Gas Prices

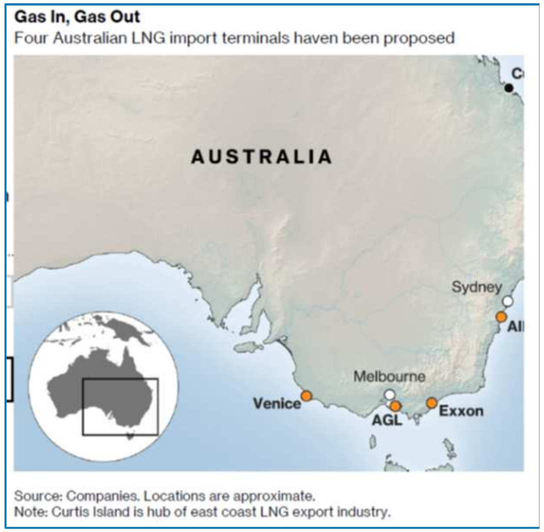
By James Thornhill
26 November 2018 4:00 AM *Updated on 26 November 2018 3:12 PM*

- Gas supply to east coast market set to tighten in years ahead
- State bans on exploration an obstacle to new domestic supply

LNG Importation on the east coast market

- Australian Industrial Energy Port Kembla LNG import terminal
  - Squadron Energy (Andrew Forrest), Marubeni (infrastructure financing) and JERA (worlds largest buyer of LNG – will supply the gas)
  - Could supply 75% (circa 100 PJ/year) of NSW total gas demand and "solve the gas shortage in NSW" – James Baulderstone CEO
  - 1.8 mt/year – focused on large gas users – $224m investment – targeting 2020 supply
  - Can also supply Victorian customers – via the EGP
  - Also looking at a 750 MW power station (or expansion of smaller ones nearby) 2020 to 2022- could become an electricity retailer as well as gas
- AGL Gas Import Jetty Project, Crib Point Victoria
  - Floating storage and regasification unit (FSRU) – jetty will be connected by pipeline at Pakenham circa 55 km long
  - Gas delivery circa 2020 in time to meet the winter peak
  - Makes a lot of sense for AGL as a large retailer – lots (and lots) of optionality for them

LNG Importation on the east coast market - 400 PJ plus of import capability?



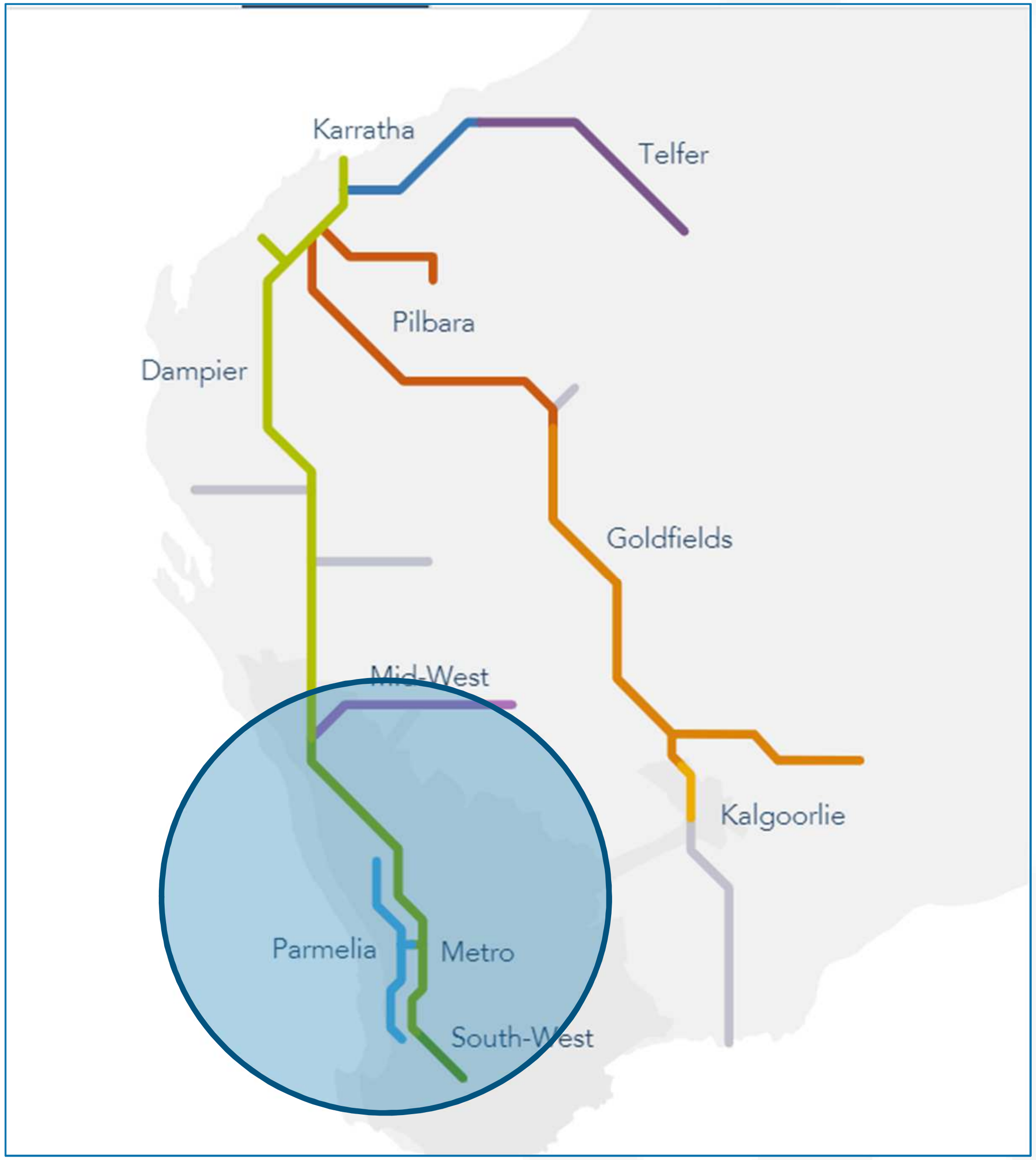
- AGL optionality
  - Retail book, power station fuel
  - Peak demand - gas and power generation
  - Arbitrage options if Qld setting gas prices in Sydney and Melbourne - pipeline costs bypass
  - Use to flatten load factors and buy base gas cheaper?
  - Low risk, high reward strategy for them
- Exxon Australia - we have discussed - embedded in their Gippsland assets - claim it would be cheaper to build and operate
- Venice Energy, SA (subsidiary of IG Partners)
  - Venice Energy aims to import LNG through Port Adelaide
  - Japan's Mitsubishi Corporation is backing the joint venture that is working to solve South Australia's future energy needs with a "virtual pipeline" project that would see liquid natural gas imports linked to a new firming capacity power station (540 MW) - Mitsubishi has invested $15 million to fully finance a feasibility study

LNG Importation on the east coast market

- The first stage of the project, with an estimated capital cost around AUD$200m, is being developed by Venice Energy in partnership with the Australian arm of Dutch project giant Arcadis and will include two new wharfs, a 170,000 m3 Floating Storage and Regasification Unit (FSRU), LNG shipping facilities, a nitrogen injection plant and cryogenic pipeline connections into the state's gas network.
- Venice Energy is finalising its development application and anticipates receiving all government and regulatory approvals before the end of 2019, with construction likely to commence in the first quarter of calendar year 2020 and commissioning by the end of that year.
- The terminal will be capable of delivering up to 120 Peta Joules (PJs) of gas into the local network on an annual basis and will allow foundation customers to reserve capacity and source their own LNG globally with the terminal operating as a tolling facility.
- The LNG terminal is part of an AUD$800m multi-stage project that will include a 500MW gas-fired power station utilising fast-start aero derivative engines that will provide system security and support to the state's renewable sector by offering firm, dispatchable power.
- Planning for that part of the project is already underway with approvals set for later next year and a fully operational facility expected to be completed by the end of 2022.

WA GAS SUPPLY?

WA gas pipeline network

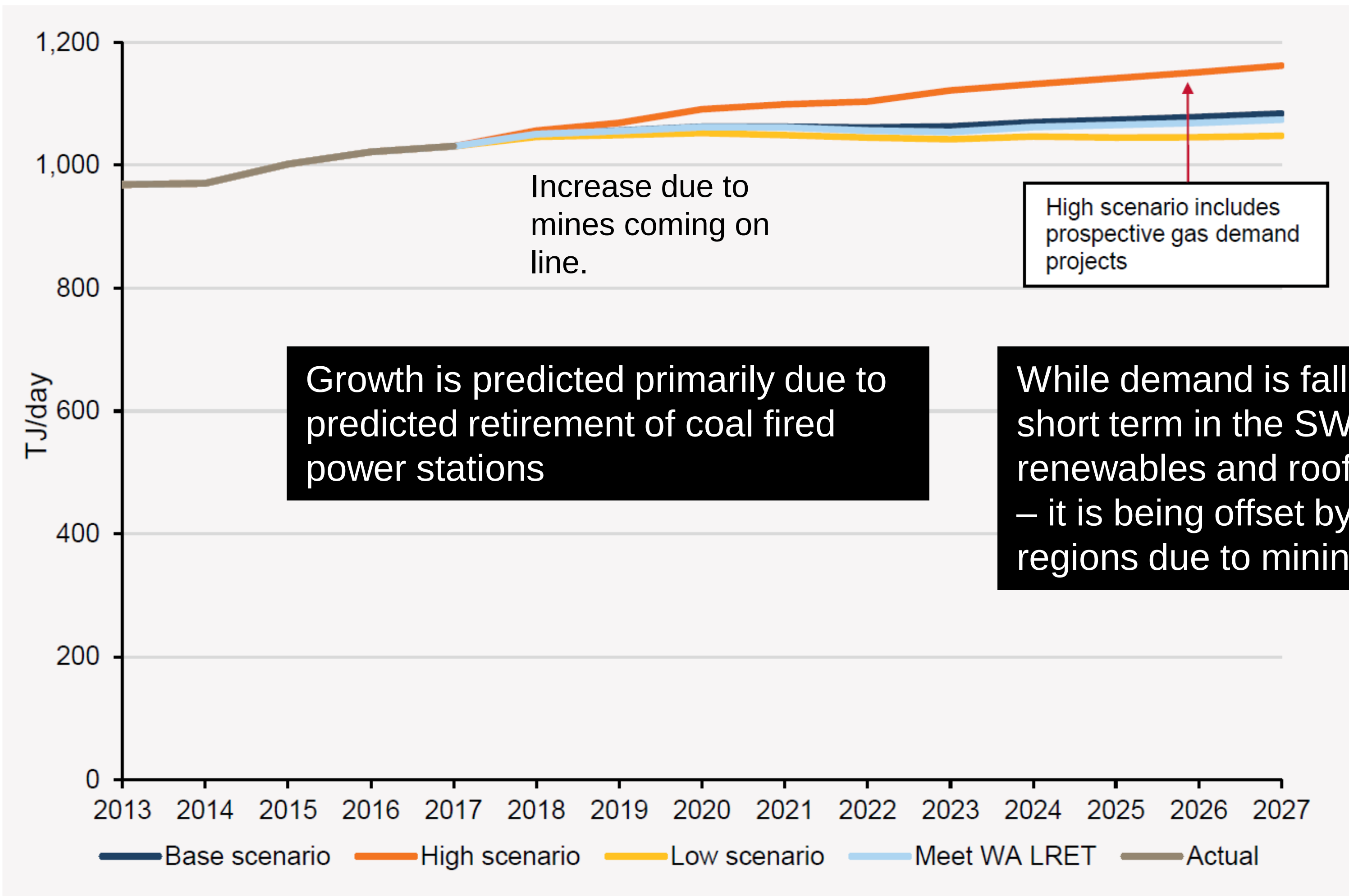


- Demand is dominated from the SWIS Area
- Majority of gas is piped down DBP (green)
- Pipelines have different owners including APA. Need separate agreements to ship gas to different locations
- Some pipelines like Telfer is a private pipeline

West Australian Gas Demand

- AEMO forecast of gas demand 2018-2017 TJ/day – WA GSOO Dec 2017

Figure 18 Domestic gas demand forecasts (TJ/day), 2018–2027



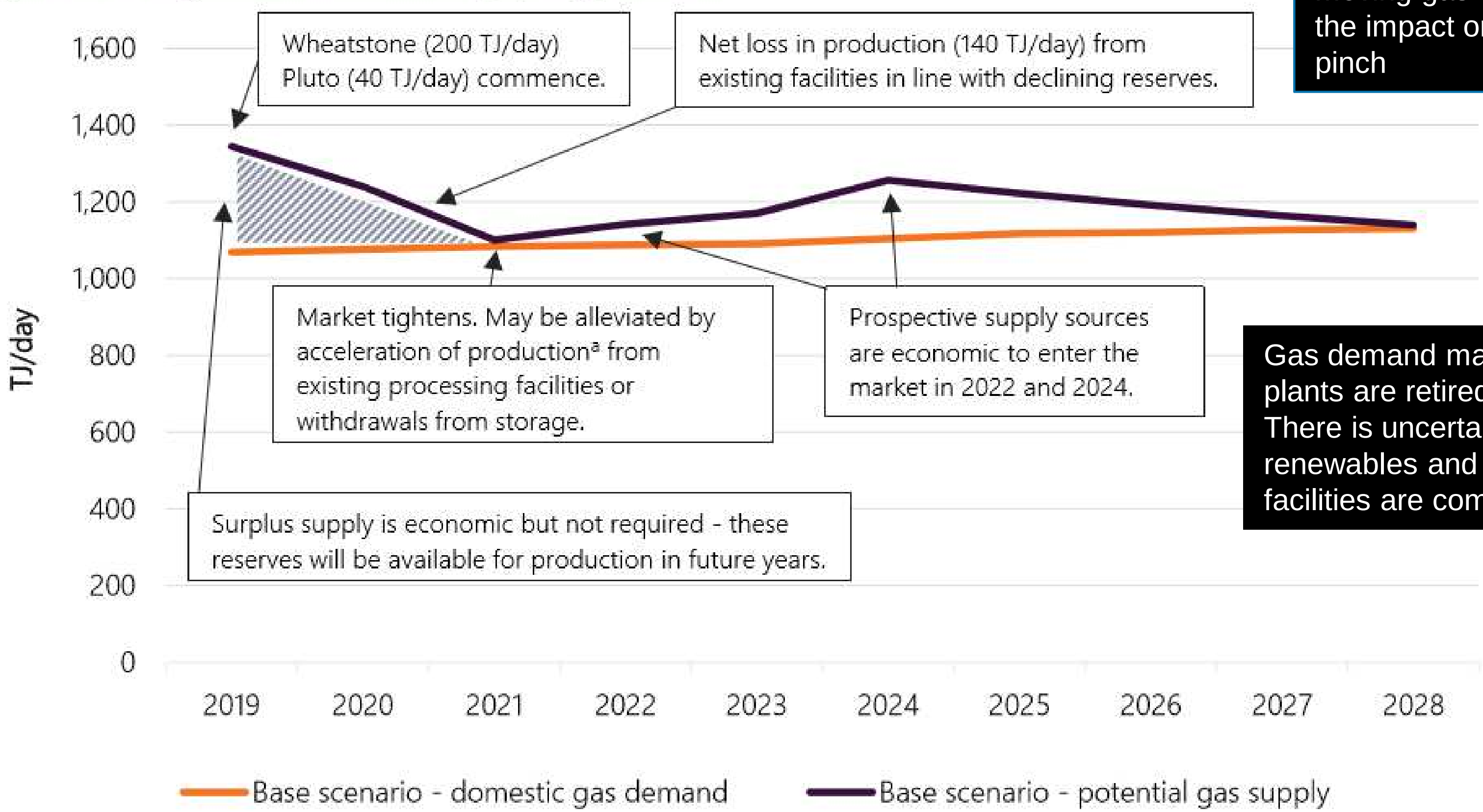
Growth is predicted primarily due to predicted retirement of coal fired power stations

While demand is falling/flat for GPG short term in the SWIS due to renewables and rooftop solar growth – it is being offset by growth in other regions due to mining

Source: MJA with AEMO.

West Australian potential gas supply

Figure 16 WA gas market balance (TJ/day), 2019-28



[a] Increasing the production rate from existing reserves, given the general underutilisation of existing processing capacity, thereby depleting these reserves at a faster rate than at present.
Source: AEMO and MJA.

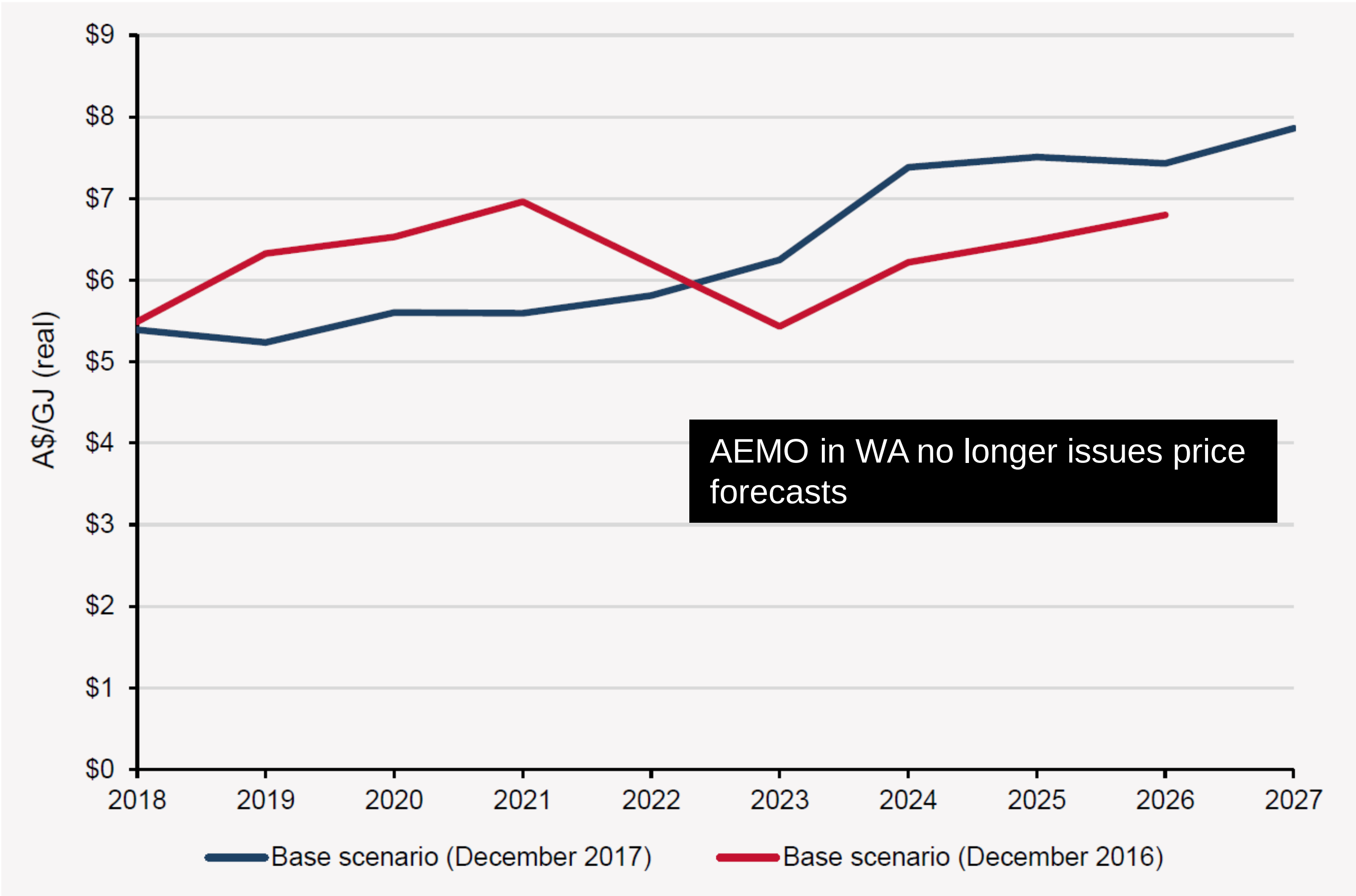
In the early 20s renewables and moving gas out of storage will reduce the impact or likelihood of any supply pinch

Gas demand may go up as coal fired plants are retired
There is uncertainty from the impact of renewables and whether any additional facilities are committed to in WA

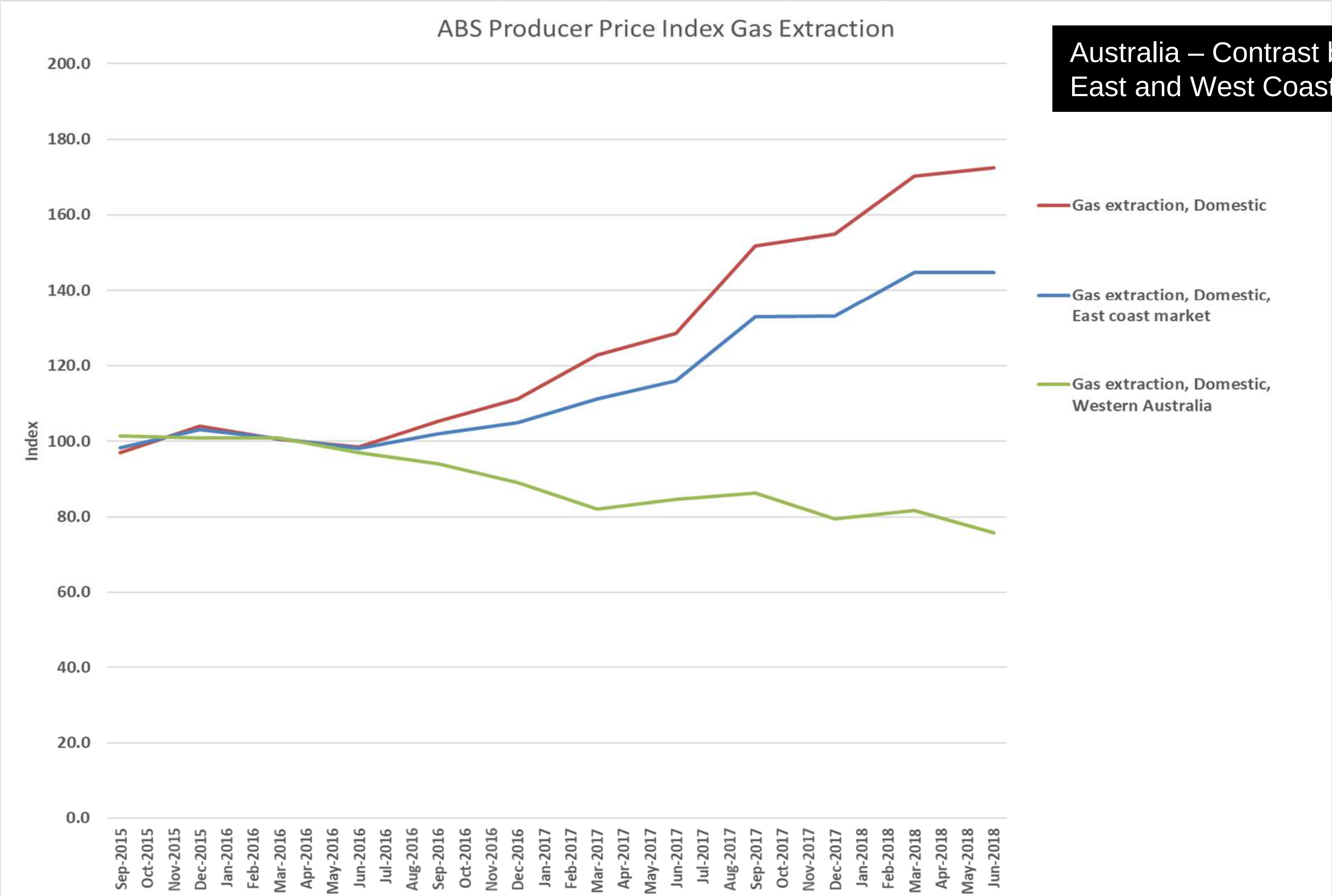
West Australian Potential Gas Supply/Demand

- AEMO forecast of wholesale gas price – WA GSOO Dec 2017

Figure 14 Comparison of the Base scenario medium- to long-term forecast contract prices ($/GJ real), 2016 WA GSOO and 2017 WA GSOO, 2018–27



West Australian prices have been dropping as outlined

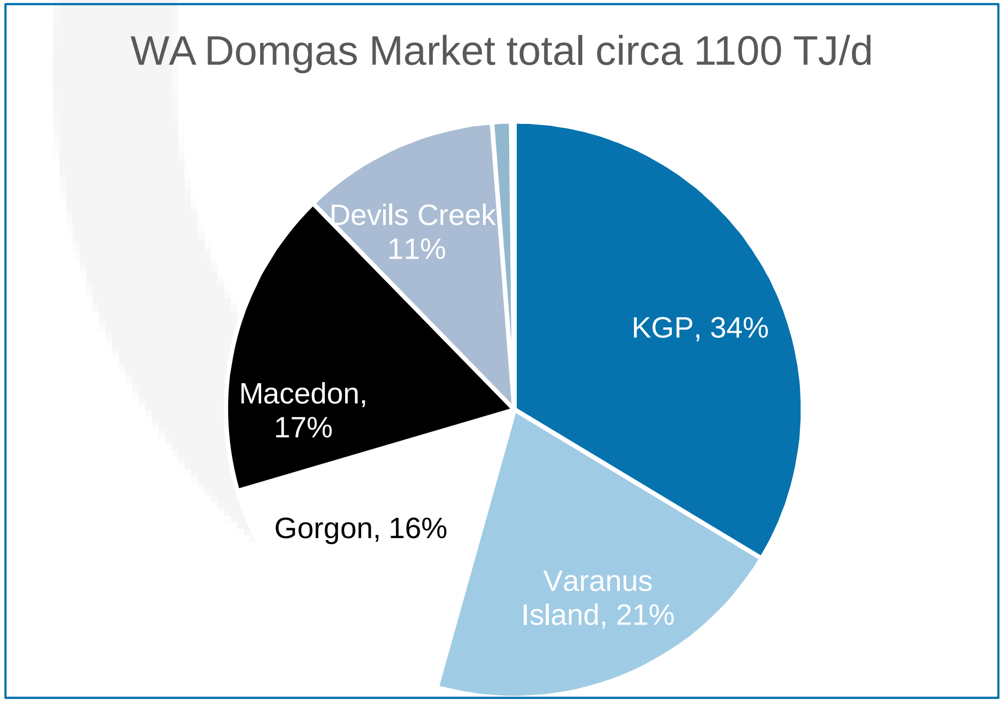


Australia – Contrast between the East and West Coast Gas Prices

WA Domestic Market

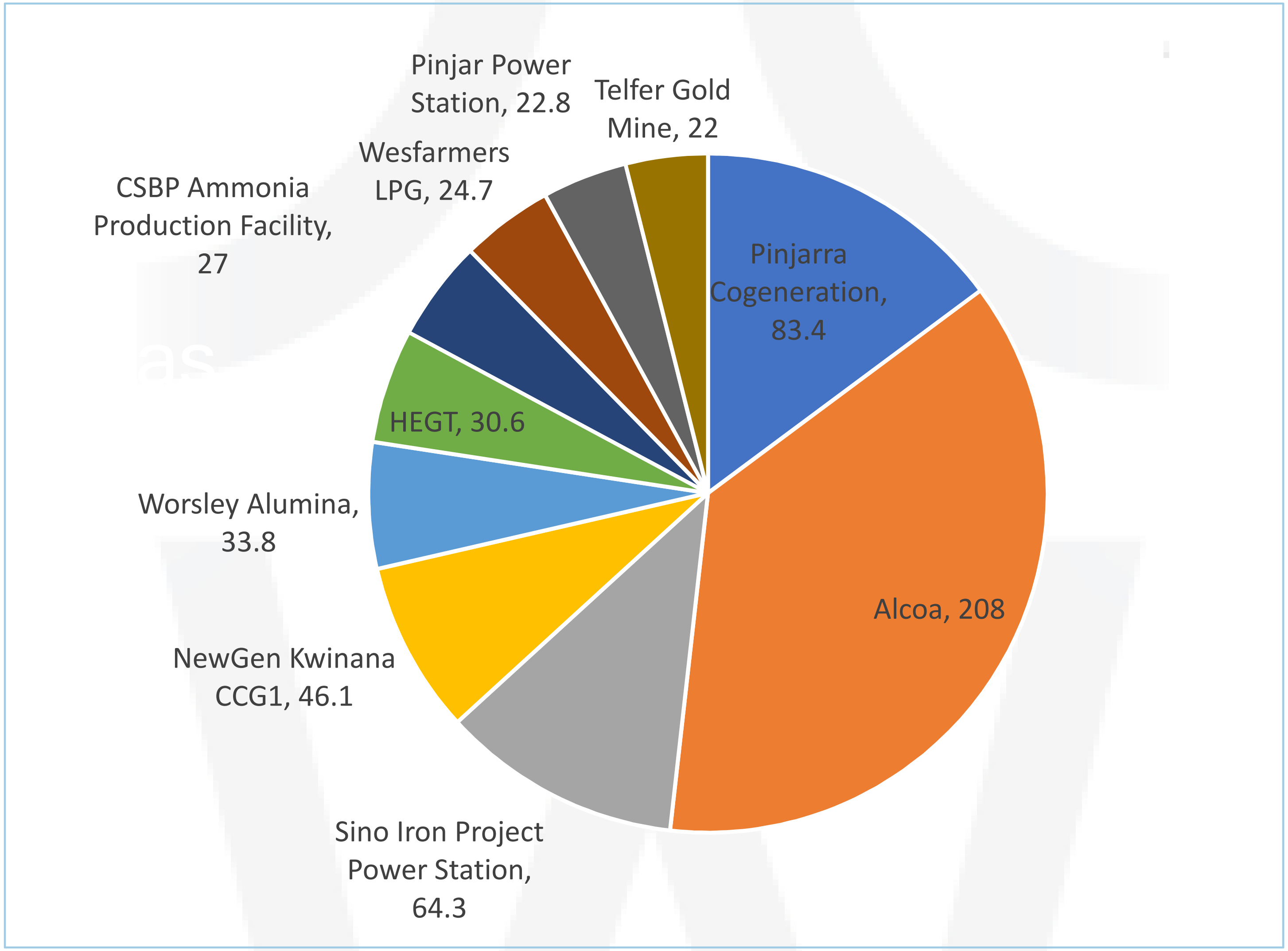
- In contrast to the East Coast market there is plenty of excess supply to meet short term outages
- AEMO cites the available capacity as being about 1600 TJ/d compared with demand circa 1100 TJ/d
- A key reason is Domestic Gas Reservation Policy (15% gas reserved for domestic use), PLUS
- An endowment of gas (proven plus probable) reserves relative to domestic demand
- Demand dominated by large industrial groups (mining, mineral processing & power) who have entered into long term agreements with producers

KGP is predicted to ramp down to circa 100 TJ/d and shortfall filled by Wheatstone, Pluto and Gorgon including Gorgon Tranche 2



- Large long-term contacts
- 24/7 ops
- Gas mostly supplied under a number of long-term agreements. Prices gone from circa \$7/GJ in 2013-14 to be about \$4/GJ and in some cases lower
- Bi-lateral nature of contracts makes price transparency difficult
- Much smaller spot market currently sub \$4/GJ indicative and illiquid

WA Domestic Market - major off takers



New Gas Supply in WA

- KGP expected to ramp-down to circa 100 TJ/d in early 20s. Shortfall replaced by Wheatstone (imminent), Gorgon Tranche 2 and Pluto
- From 2022, gas supply availability is expected to increase further if several prospective supply projects commence, including:
- Scarborough (domestic market obligation (DMO) of ~120 TJ/day) - Pluto Train 2 (FEED announcement is predicted in 1Q 2019).
- Waitsia Stage 2 field and production plant – Mitsui & Co (Australia) Ltd (Mitsui)'s acquisition of AWE Limited may give greater momentum to this proposed 100 TJ/day onshore facility, where field reserves were recently upgraded.
- Browse (DMO of ~270 TJ/day), which is expected to use existing processing infrastructure (North West Shelf).
- Equus – a new owner and development concept for these fields is currently proposed, that is, a stand-alone LNG project, although there are options to use emerging spare capacity at existing facilities. The expected DMO volume is 40 TJ/day.

Conclusions on WA Gas Market

- Supply looks stable for another ten years given that LNG developments were constructed with domestic gas production facilities based on the domestic gas reservation policy
- Some short term supply issues could emerge in 2021-22
- However, these issues can be ameliorated by
  - Additional contractual commitments by Buyers
  - Withdrawing gas from storage
- Gas demand likely to slowly grow but mostly because coal fired plants will be gradually retired
- Meanwhile gas fired power stations sometimes used intermittently due to uptake of renewables having an impact
- New projects will bring more gas to market. However, timing is uncertain.

Time for a break – then lets workshop some scenarios and discuss where this is all taking us

GAS PRICE SCENARIO WORKSHOP FOR NEXT 5 - 10 YEARS

Lets Build Up Some Scenarios Together

- This will be a highly interactive session led by OGW – to develop credible scenarios for gas supply and demand and prices – lets try and say develop three scenarios and then discuss these.
- What are the key drivers of demand - what sectors will drive demand and why?
- There is a circularity to gas demand – price dictates volumes at the margin – price elasticity effects?
- Supply and demand price balance has bookends – high and low prices – what are they and why?
- What major policies are impacting on gas and why?
- Credible scenario development.

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