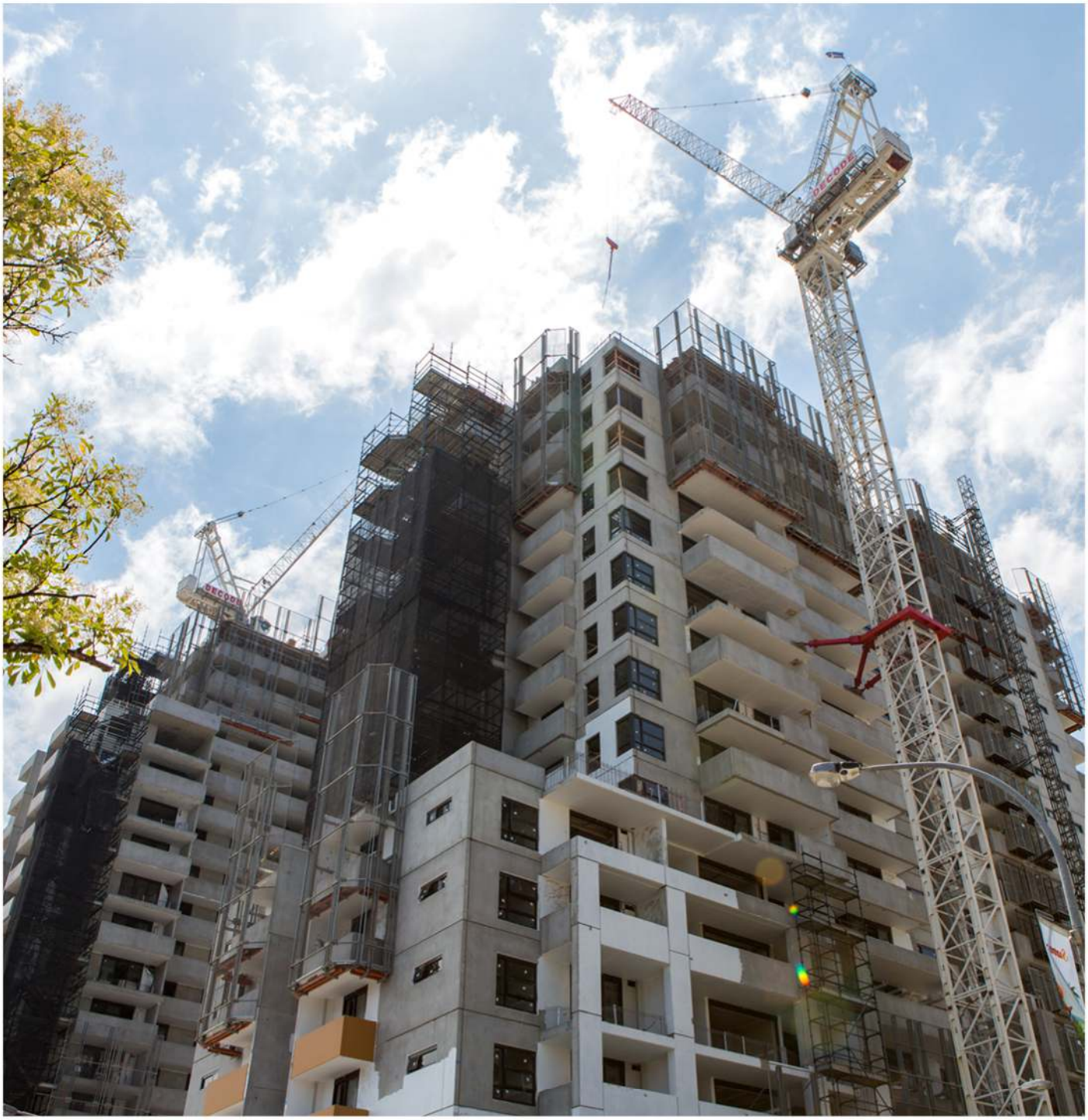


Jemena Gas Networks (NSW) Ltd

Revised 2020-25 Access Arrangement Proposal

Attachment 8.8

Response to the AER's draft decision - Running on empty: How to keep NSW fuelled for the future

Jemena
bringing energy to life

NSW Business Chamber

RUNNING ON EMPTY:

How to keep NSW fuelled for the future.

A report prepared by EnergyQuest for NSW Business Chamber

Thinking Business

CONTENTS

FOREWORD BY THE NSW BUSINESS CHAMBER

Over 1.3 million homes in NSW use gas for cooking and heating. Gas underpins around 250,000 jobs in the NSW manufacturing sector. Thousands of small businesses, from commercial laundries to bakeries, depend on gas.

In less than six years, NSW is projected to face serious gas shortages. If additional gas supply is not sourced, NSW will face crippling price rises, forced business closures and job losses right across the state. Costs that gas-using businesses incur from gas price rises will be passed on to their customers or erode their profitability.

Inaction on gas and energy security are now holding the future of businesses in NSW to ransom, threatening employment losses and reduced investment. Poor planning and a lack of action to develop significant gas resources in NSW have resulted in NSW having the most expensive gas in mainland Australia and the least certainty in respect to gas supply security. NSW has proven reserves equivalent to just 35 days' demand — the majority of our supply is reliant on other states and territories.

NSW is endowed with significant gas resources and has historically licenced operators to explore and produce from its gas fields. However, recent years have seen gas activities all but cease. An unofficial moratorium on coal seam gas has thwarted development at Narrabri, the most viable of NSW's gas fields, and deterred exploration everywhere else. It will take around four years to get production to levels to meet demand, so there is little time remaining if Narrabri is to meet demand in the projected shortfall year of 2025.

Now is not a time for further reviews but a time for action to ensure NSW has energy security to power our homes, our businesses and our future.

Improving confidence in future gas availability and at a a competitive price is necessary to support further investment in renewable electricity. Gas-fired power generation will support other energy storage options to supply firmer power during periods when renewables are not available. However, for gas-fired power generation to be able to play this role new gas power stations will need to be built. Without greater confidence in the future of the gas supply picture in NSW, it is unlikely that investors will be attracted to build these power stations.

NSW must address gas shortages. Sitting on abundant reserves and importing 98 per cent of our gas requirements within a constrained national gas market will see further price rises for every household and business in NSW. Natural gas is a bridge to a cleaner energy future for NSW and it is an essential commodity for households and business. NSW must take immediate action to ensure reliable, sustainable and affordable energy is available, or else we risk our gas market running on empty.

Stephen Cartwright
Chief Executive Officer
NSW Business Chamber

INTRODUCTION

NSW imports practically all of its natural gas from other states. Yet gas is an important part of NSW's energy mix, with approximately one third of non-transport[1] energy moving through NSW's gas pipelines.

Gas supply to NSW, and the east coast of Australia, is forecast to fall short of demand as soon as 2025 — in less than six years.

NSW must take several necessary steps to address this situation. NSW has viable gas resources and extensive infrastructure which makes it a strong candidate for gas exploration and development, as well as LNG gas imports. However, while those resources remain in the ground, and import and infrastructure facilities sit waiting for approvals, business confidence in the future status of the NSW gas market is waning.

This report examines the current state of play for the gas industry in NSW, analyses the consequences of 'business as usual' and the need for change, and makes recommendations with a 'NSW gas road map' to achieve a better outcome of supply security and more affordable gas.

[1] Non-transport energy does not include energy in road, rail, marine and aviation fuels.

SUMMARY

NSW faces an imminent shortfall in gas supply. The Australian Energy Market Operator (AEMO) has recently warned that gas supply in NSW will not meet demand in the winter of 2025. Gas prices have already risen in response to the tight supply, presenting a serious challenge to manufacturers and other users of gas. Sydney gas prices have almost doubled in four years, as traditional gas supplies decline and alternate high value markets for producers (such as LNG) became available. After Hobart, Sydney is forecast to have the highest wholesale Residential and Commercial gas prices on the east coast.

Commercial and Industrial gas users are reported to be postponing pay increases, reducing headcount, and deferring investments or expansions. Some have closed altogether, blaming high gas prices. These effects are not limited to the biggest users. A typical commercial bakery in Sydney will pay an extra $26,400 per year for gas compared to a bakery in Brisbane. A galvanising plant in NSW would pay $66,000 per year more than a Queensland competitor.

NSW imports practically all of its gas from other states, despite the fact that NSW sits on abundant natural gas resources. In 2011, NSW contingent resources (i.e. gas which has been discovered, but not yet appraised for commerciality) were 20,159[2] PJ. This would be enough gas for 174 years at current NSW usage rates[3] — if it proves to be economic and is developed. This abundant supply in the ground contrasts with decreasing rates of production and lack of progress in developing new fields. NSW's proven reserves — those which are economic and ready to be produced — would now supply the state for only 35 days at 2018 consumption rates. Downgrades of reserves, due to the loss of access/permits, difficult geology and uncertain permitting for Narrabri, have been the equivalent to losing 25 years of NSW gas supply.

[2] Including part of the Clarence Moreton basin which extends into Queensland.
[3] In 2018 NSW consumed 116 PJ.

The Narrabri area has the NSW gas field closest to being ready for new production. It has the potential to supply up to 19 years of NSW gas demand. The field has been explored by Santos, which submitted its Environmental Impact Statement back in February 2017. The development is still pending government approval and permits. Santos has said that any production from Narrabri will go to the domestic market.

Recommendation 1: Approve development of the Narrabri gas field by 2020

Due to the time needed to bring the field fully online, for Narrabri to be producing by the time of the expected supply shortfalls in 2025, approval to proceed needs to be given by 2020. The NSW Government should increase its focus on the Narrabri project, and accelerate the review and approval processes.

As a result of the poor progress in developing NSW's gas resources, the state relies almost completely on imports via pipelines from South Australia, Queensland and Victoria to meet demand. Recent trends mean Victoria is decreasing in significance while Queensland is expanding as a source of imports into NSW. As more gas flows from Queensland and the NT to meet southern demand, capacity of the pipeline infrastructure will be reached, becoming an obstacle to additional supply. The additional cost of piping gas to NSW gas users is likely to more than double by 2025, as interstate gas travels longer distances to NSW. NSW business users will be at a competitive disadvantage compared to users closer to the locations of production.

Recommendation 2: Begin a program of pipeline and infrastructure upgrades to expand capacity by 2021

Gas pipeline infrastructure needs to reflect the new balance of supply sources. A review of gas pipeline infrastructure should be carried out, to identify constraints and viable capacity upgrades for links between NSW and northern producers. Pipeline capacity may also need to be expanded between proposed LNG import facilities and the major demand markets within NSW.

LNG imports offer an alternative supply option to in-state production and to inter-state imports via pipeline. There are several advantages to enabling NSW to import LNG. It would:

- Increase flexibility to add supply on high demand days or in response to unexpected events or shortfalls.
- Provide long-term contracting certainty for major users.
- 'Cap' NSW spot prices at those prevailing on international markets, limiting how far prices could rise.
- Avoid pipeline infrastructure constraints and add competitive alternatives to long distance pipelines.

Recommendation 3: Facilitate LNG import terminal construction for NSW to begin by 2022.

The NSW Government should support LNG imports into NSW, and ensure that permits and applications for expansion are prioritised. To be able to contribute to improved security at the time of the projected 2025 shortfalls, LNG facility developers should be in a position to start construction by the end of 2022.

Prospective developers of gas in NSW have faced protracted timetables for government approvals. The NSW Government designated the Narrabri Gas Project as a 'Strategic Energy Project', and signed a Memorandum of Understanding (MOU) with Santos to streamline the assessment process for Narrabri five years ago, yet Narrabri remains unapproved. In Queensland, where gas projects have been brought online successfully, the state government empowered a Coordinator-General to advance critical projects through the approval processes and ensure that government resources and priorities are properly applied. The expected level of gas project activity, should Narrabri proceed, would be unprecedented in recent times in NSW, and so relevant departments will need to 'skill up' with staff who have experience of natural gas projects.

Recommendation 4: Appoint a Coordinator to lead work on critical gas projects by 2020

The NSW government should appoint a Coordinator to progress critical gas projects through the approval processes and ensure that government resources and priorities are properly applied. It should make certain that the Coordinator has access to people experienced in natural gas developments, to ensure that the specific technical issues raised in natural gas projects can be given appropriate scrutiny.

The NSW Chief Scientist and Engineer concluded in 2014, that the technical challenges and risks posed by the coal seam gas (CSG) industry can in general be managed. High standards of engineering, sensible selection of land, and high-quality monitoring can ensure that gas development can take place safely and in an environmentally-responsible manner.

Between now and 2037, NSW is forecast to triple its gas-fired power generation (GPG) as it replaces aging coal-fired power generators, and supports increasing renewable power generation. When it displaces coal-fired generation, GPG lowers greenhouse gas emissions by 31% to 50%[4]. GPG supports the transition to renewables by providing reliable dispatchable power when wind or solar are unavailable. Yet if potential investors in GPG are unsure that reliable gas supplies will be available into the 2030s, those power stations may not be brought forward. This in turn risks putting the brakes on the state's ability to incorporate higher levels of renewable generation into its electricity mix.

In NSW, an estimated 300,000 jobs rely on gas supply. Gas supplies around 1.3 million households and 33,000 businesses. NSW's manufacturing sector, which is approximately 84% of the state's Industrial gas load, employs 253,000 people in 26,127 businesses, adding $33 billion in industry value.[5] Without addressing NSW's looming gas shortfall these could be at risk.

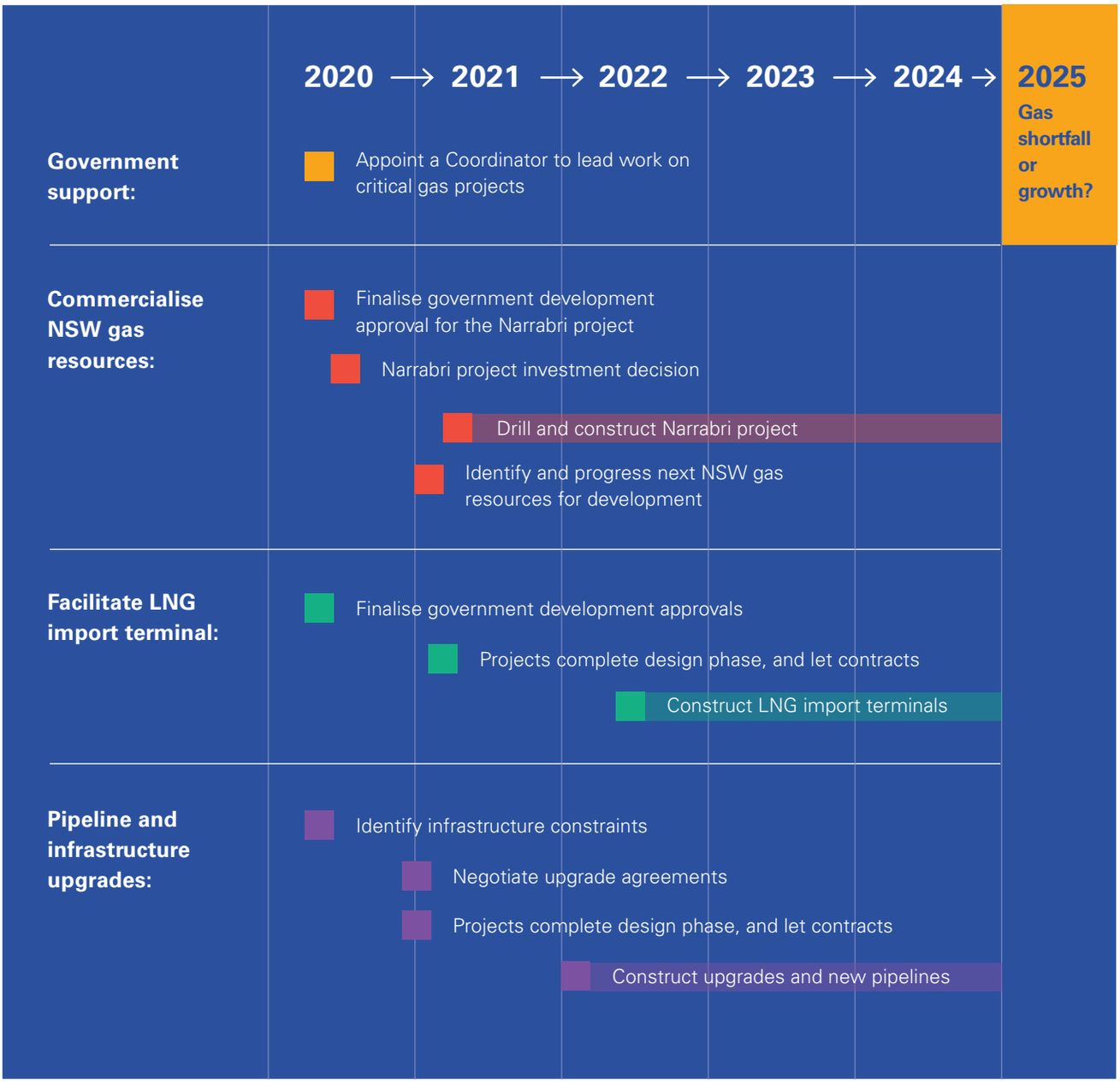
Development of Narrabri alone would bring in over $233 million in royalties, in addition to the corporate and payroll taxes and GST that an $11.9 billion investment will generate. This will also lead to more than 500 jobs in regional NSW, mostly in skilled and well-paid professions.

[4] Open cycle gas turbines (OCGTs) and combined cycle gas turbines (CCGTs) respectively

[5] NSW Government, "Economic Value and Sector Overview", 2019; https://www.industry.nsw.gov.au/development/industry-opportunities/advanced-manufacturing/economic-value-sector-overview

NSW gas road map

NSW needs to acknowledge the approaching gas shortage and its potentially devastating impact on NSW businesses and the economy. Work must begin immediately on an integrated gas road map to mitigate these impacts.



Source: EnergyQuest analysis

WHERE ARE WE?
AN INDUSTRY OVERVIEW

1. NSW gas supply: Relying on the neighbours

Where does NSW gas come from?

NSW imports practically all of its natural gas from other states. This means it has to pay more in transport costs, and leaves it exposed to pipeline constraints.

To meet NSW demand, gas is supplied by pipelines connecting gas fields in South Australia, Queensland and Victoria (Figure 1):

- Moomba to Sydney pipeline (MSP) has a nameplate capacity of 446 TJ/d, and charges a tariff of $1.12/GJ.
- Eastern Gas Pipeline (EGP) from Longford, Victoria to Sydney has a nameplate capacity of 258 TJ/d and charges a tariff of $1.30/GJ.
- Victoria to NSW Interconnector at Culcairn (VNI) has a nameplate capacity of 223 TJ/d. It charges a tariff which depends on prices in the Victorian transmission system, but which is generally competitive with the EGP in moving gas to Sydney

Figure 1 Gas pipelines supplying NSW

Source: EnergyQuest

NATURAL GAS PIPELINES AND STORAGES

LEGEND:

- **Gas pipeline**
- **Natural gas storage facility**

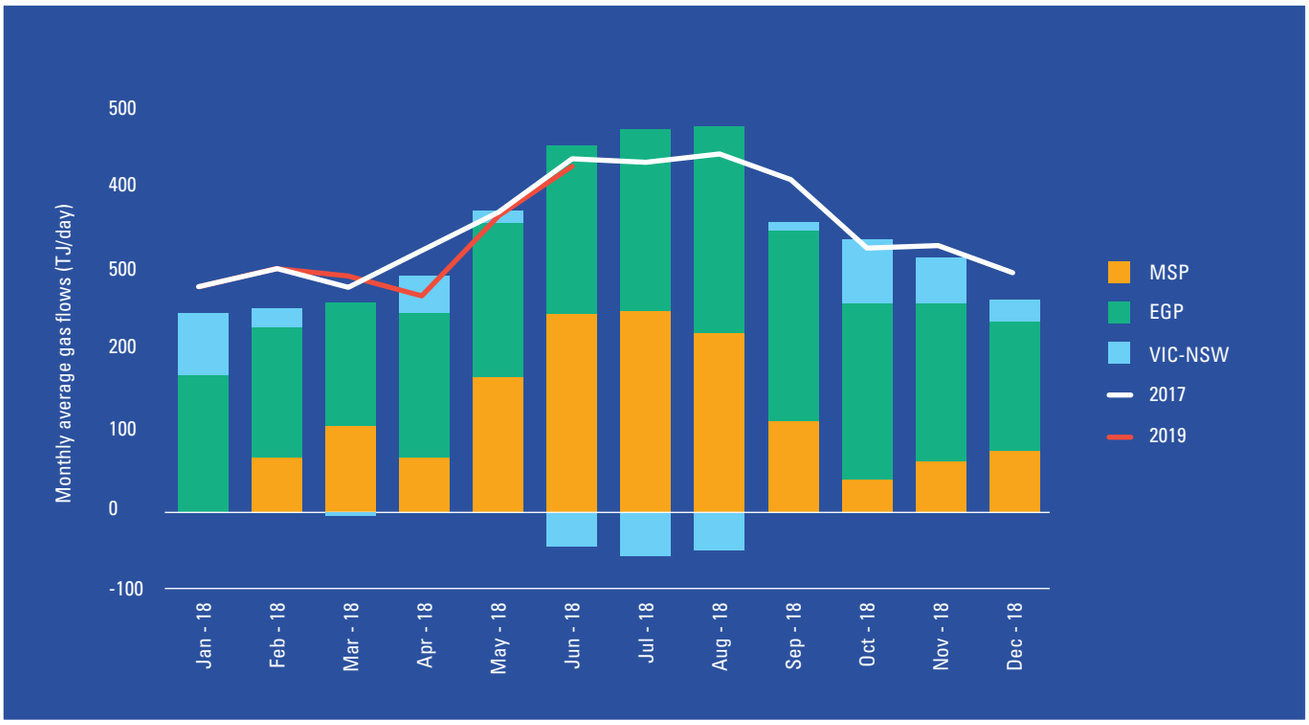
Monthly data from January 2018 for these three pipelines supplying gas to NSW is shown in Figure 2. In addition, the aggregate gas flows to NSW are also shown for 2017 and January to June for 2019.

Flows into NSW totalled 128 PJ (350 TJ/d average) in 2017 and 119 PJ (326 TJ/d average) in 2018. The flows north from Victoria for the same period decreased 38% from 125 PJ (342 TJ/d average) in 2017 to 77 PJ (210 TJ/d average) in 2018.

In contrast, flows in the MSP from South Australia and Queensland increased from 3 PJ (8 TJ/d average) in 2017, to 43 PJ (118 TJ/d average) in 2018. This trend is a result of ongoing decline in production from the Victorian offshore fields in the Gippsland and Otway basins, and the increasing importance of gas supplied from Queensland.

The seasonal variation highlights the supply peaks over winter (June–August) which totals over 30% of the annual flow. Note that the VNI flows south into Victoria over winter (4.5 PJ or 49 TJ/d), while the southbound flows into NSW are higher — averaging 238 TJ/d and 229 TJ/d on the MSP and EGP respectively. This creates additional strain on NSW pipeline infrastructure.

Figure 2 NSW gas pipeline flows by pipeline



Source: AEMO Gas Bulletin Board

NSW gas production

There are only six production licences active in NSW, producing a modest 5 PJ per year from Camden gas field, to the southwest of Sydney[7]. AGL is scaling back production at Camden, to shut down in 2023.

Yet, while current production is low, NSW has significant gas resources in the ground. The challenge is to convert these contingent resources into economic reserves, but first it must be understood that not all gas resources are economic reserves[8].

Not all gas resources are reserves

The Society of Petroleum Engineers publishes the Petroleum Resources Management System[7] (PMRS), which is the industry standard for defining gas resources and reserves.

Reserves are those quantities of petroleum anticipated to be commercially recoverable by application of development projects to known accumulations. A common reserves estimate is Proven and Probable (referred to as '2P') reserve volumes. 2P volumes have at least a 50% probability that the actual quantities recovered will equal or exceed the 2P volume estimate.

Contingent Resources are those quantities of petroleum estimated to be potentially recoverable from known accumulations, by the application of development project(s) not currently considered to be commercial owing to one or more contingencies. The best estimate for contingent resources is referred to as 2C.

Prospective Resources are those quantities of petroleum estimated, as of a given date, to be potentially recoverable from undiscovered accumulations by application of future development projects.

By these industry definitions, only gas reserves are considered to be economic and thus able to be contracted to meet firm demand.

[7] AGL Website, "Camden Gas Project"; https://www.agl.com.au/about-agl/how-we-source-energy/camden-gas-project

[8] Society of Petroleum Engineers, "Petroleum Resources Management System 2018", June 2018; https://www.spe.org/industry/reserves.php

Converting gas resources to economic reserves

In NSW (and other Australian states) the state owns the gas resources, and licences operators to identify prospective resources, explore and find contingent resources, and appraise the resources for development.

The recent history of NSW's reserves and contingent resources classification, comparing 2011 with 2019, is shown in Table 1.

This dramatic reduction in 2P reserves from 2,885 PJ in 2011 to only 11 PJ in 2019, is the equivalent of losing enough gas to supply NSW for 25 years. This was the result of the loss of access/ permits in the Clarence-Moreton, Hunter and Gloucester fields, to difficult geology, and uncertain permitting for Narrabri.

In 2011, NSW (and the Queensland part of the Clarence Moreton basin) contingent resources were 20,159 PJ, or enough to supply NSW at current usage rates for 174 years if developed.

While the potential development costs of the 2C resources are unknown and permits are still to be obtained, the initial focus of policy should be on facilitating development at Narrabri. With the most favourable conditions and the most advanced development of the key gas fields, it is likely that any new gas production in NSW would start at Narrabri. Further development of the wider resources could then potentially build off Narrabri gas processing and pipeline infrastructure, and local industry experience to expand gas production.

Potential alternative gas supply

A number of potential alternative gas supplies are under consideration or preliminary development. Two supply options which are being advanced are biogas and hydrogen.

Biogas is a renewable gas energy source generated from the fermentation of organic matter — mostly from water treatment facilities, agricultural waste, and landfill sites. There are 242 biogas plants operating in Australia[10]. The actual amount of gas generated by these plants is difficult to calculate as statistics are not consistent, but 10 PJ per year may be a reasonable order of magnitude estimate. This is approximately 1% of Australia's domestic demand. Estimates of the potential for biogas can be as high as 371 PJ per year, based on Germany's biogas production. However, realising this potential requires building up to 90,000 biogas units, at an estimated $5 to $50 million each.

Hydrogen is also a gas based proposal to decarbonise gas networks. Hydrogen has had considerable attention from the Commonwealth Government, which is developing a 'National Hydrogen Strategy' to explore its potential. Existing natural gas pipelines can accept relatively low concentrations of hydrogen of 5% to 15%, depending on the specifications of the transporting pipelines. Higher concentrations would require upgrading, or at least detailed engineering analysis of the pipeline infrastructure. The first trial[11] of adding hydrogen to gas networks in Australia has been proposed for Adelaide. First gas production is scheduled for mid-2020, with a vision to completely decarbonise gas pipelines by 2050.

While biogas and hydrogen are intriguing possibilities for the future, it is unlikely that they can be developed quickly enough to make a material contribution to NSW's gas supply before the forecast gas shortfalls emerge.

the initial focus of policy should be on facilitating development at Narrabri

Table 1 NSW gas reserves and resources

PJ	Reserves (2P)		Cont. Reserves (2C)	
Basin	**2011**	**2019**	**2011**	**2019**
Clarence - Moreton (NSW - QLD)	445	-	13,529	-
Gloucester	669	-	176	-
Gunnedah/Narrabri	1,426	-	4,564	2,254
Sydney/Camden	345	11	1,890	-
Total	**2,885**	**11**	**20,159**	**2,254**

Source: NSW Parliamentary Research Service[9]; Company reports; EnergyQuest analysis

Note:
- Includes part of the Clarence-Moreton basin which extends into Queensland from NSW.
- 2019 Narrabri 2C is Santos share.

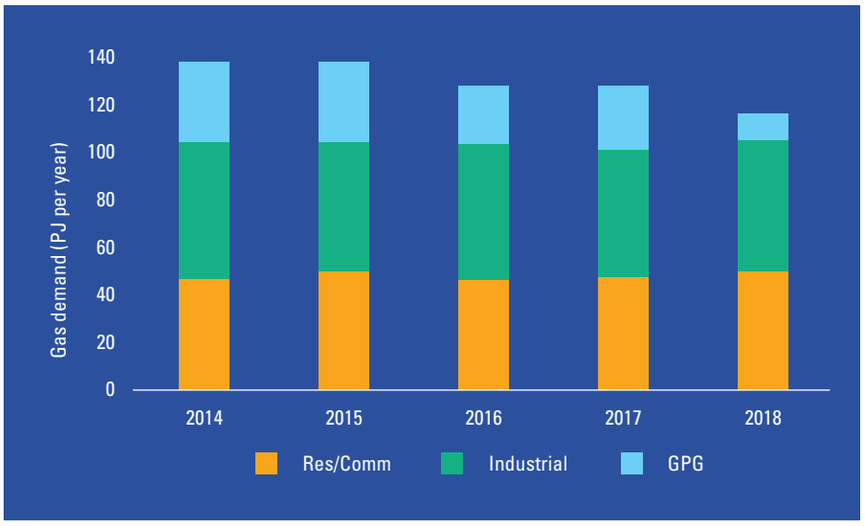
2. Demand: Falling now, but a growth outlook

NSW market demand: Historical

Over the past five years, NSW gas demand has fallen 15%. In 2018, Residential/Commercial (Res/Comm) and Industrial demand were 42% and 48% respectively of NSW demand. In 2014, GPG demand was 33 PJ, or 24% of total NSW demand. This has fallen to 9.5% of total NSW gas demand as renewable sources have eaten into its market share, and coal-fired generators increased their volume of electricity generated by 5% for the same period.

NSW gas demand by sector for 2014 to 2018 is shown in Figure 3.

Figure 3 NSW gas demand by sector



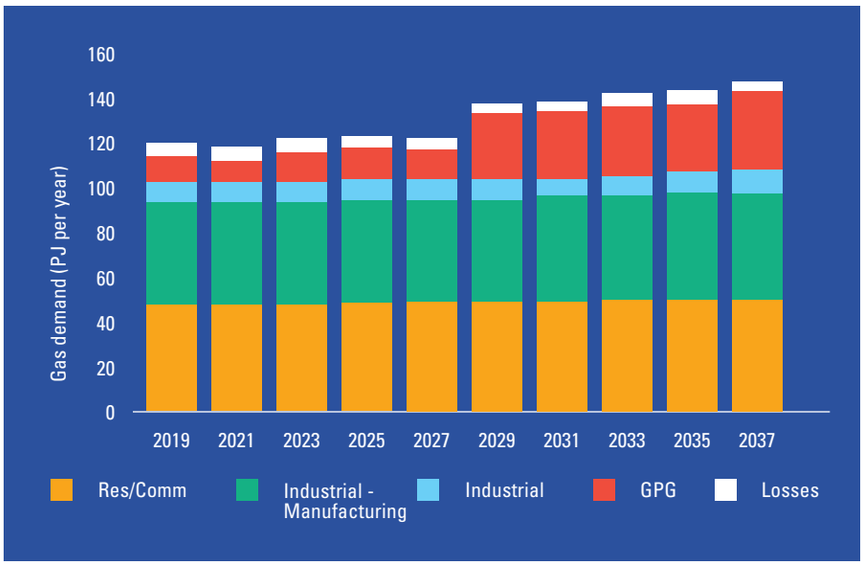
Source: AEMO, "2019 GSOO"[12]

NSW market demand: Forecast

AEMO forecasts that the Residential/ Commercial and Industrial sectors in NSW will see little change in their demand patterns out to 2037. Forecast gas demand by sector from 2019 to 2037 is shown in Figure 4. The Industrial sector is reported as 'Industrial – Manufacturing' and 'Other business' (non-manufacturing uses, e.g. financial services, transport, and services businesses such education, health care and telecommunications).

All sectors, other than GPG, have little or no growth over the forecast period. However, GPG is projected to triple from 11 PJ in 2019 to 35 PJ in 2037, as coal power stations close and gas increasingly provides support to renewables.

Figure 4 Forecast NSW gas demand by sector



Source: AEMO, "2019 GSOO"

[9] NSW Parliamentary Research Service, "Gas resources, industry structure and domestic reservation policies" Briefing Paper 12/2013 Table 13; https://www.parliament.nsw.gov.au/researchpapers/Documents/gas-resources-industry-structure-and-domestic-re/Gas%20-%20resources,%20industry%20structure%20and%20domestic%20reservation%20policies.pdf

[10] Bioenergy Australia and enea consulting, "Biogas opportunities for Australia, March 2019; https://s3-ap-southeast-2.amazonaws.com/piano.revolutionise.com.au/cups/bioenergy/files/2za1rgxbisjqxcme.pdf

[11] Australian Gas Networks Media release 21 Feb 2018: https://www.australiangasnetworks.com.au/our-business/about-us/media-releases/australian-first-hydrogen-pilot-plant-to-be-built-in-adelaide

[12] AEMO, "2019 Gas Statement of Opportunities" (2019 GSOO); https://www.aemo.com.au/Gas/National-planning-and-forecasting/Gas-Statement-of-Opportunities

Peak demand issues

NSW's daily winter peak gas demand is around 200 TJ/d higher than that for summer. This is largely due to the significant increase of around 160 TJ/d in peak demand over winter for the Residential/Commercial sector.

When the last four years are considered (Figure 5), two trends in gas supply to NSW become evident:

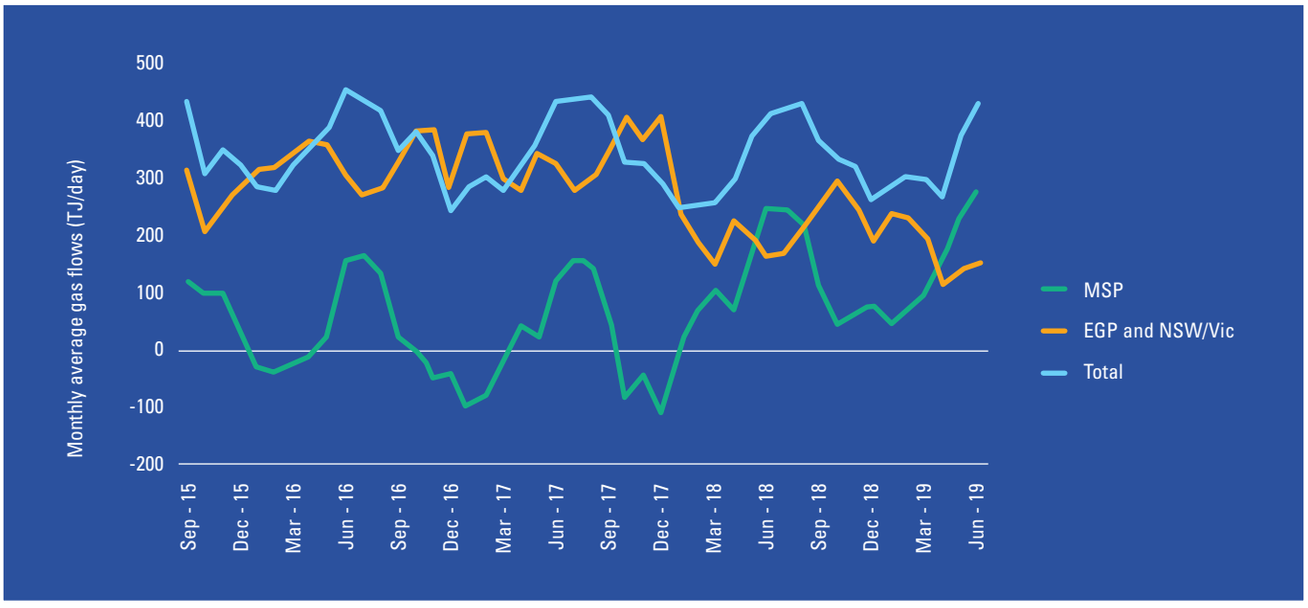
1. Increasing reliance on gas from Queensland, as supply from Victoria decreases.

Over the last four years, there have been increased flows to NSW on the Moomba to Sydney Pipeline (MSP) south, and lower flows north from Victoria on both the Eastern Gas Pipeline (EGP) and Victoria-NSW interconnector (VNI), particularly for the critical winter peak.

2. Increasing seasonal swings on the Moomba to Sydney Pipeline (MSP) which will eventually reach pipeline capacity.

For June 2019, MSP flows reached new highs averaging 276 TJ/day, considerably more than the combined average flows from Victoria of 151 TJ/day.

Figure 5 Flows into NSW/ACT by pipeline



Source: AEMO Bulletin Board; EnergyQuest analysis

[13] APGA Website, "The role of natural gas in Australia"; https://www.apga.org.au/gas-facts-and-figures

East coast market demand: Historical

The gas market in east coast states has seen a significant shift in recent years. Until the early 2000s, Victoria was the dominant producer, but that crown has shifted to Queensland which is now by far the biggest producer, helped by the dual developments of LNG exports and CSG production. This change has significant consequences for gas users up and down the coast, including in NSW.

Demand for east coast gas grew by 162% from 2014 to 2018. LNG exports from Curtis Island in Queensland beginning in December 2014 increased LNG gas feedstock demand from 5 PJ in 2014 to 1,237 PJ in 2018. LNG exports now account for 68% of total demand for east coast gas.

The development of CSG not only provides feedstock for the LNG projects, it now supplies around 30% of the east coast domestic gas market[13]. Maintaining CSG production for LNG and domestic gas demand requires the drilling of two to three gas wells per day. With the associated water handling, pipelines and gas processing facilities, this represents an ongoing investment of around $2 billion each year. This supports an ongoing industry which provides regional economic benefits, infrastructure opportunities (e.g. power grids for renewables) and critical mass for a vibrant gas development industry, which also supports domestic gas supply.

The historical demand for east coast gas by sector for 2014 to 2018 is shown in Figure 6.

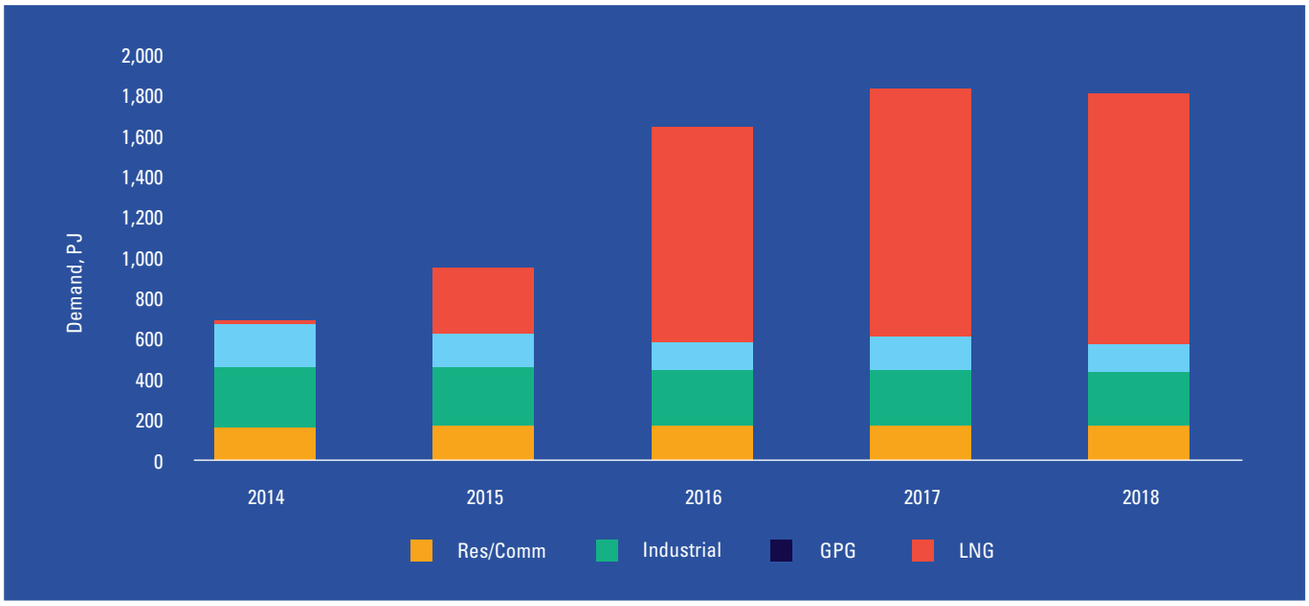
Res/Comm and Industrial demand have remained relatively flat over this period with demand growth of 2.0% per year and -3.3% per year respectively.

Overall demand growth has been dominated by LNG. Since 2014, three LNG projects on Curtis Island (on Gladstone Harbour, Queensland) have added six LNG processing trains[14] with a total capacity of around 24 million tonnes per annum (Mtpa) of LNG — all exported.

Santos' GLNG project with a capacity of 7.8 Mtpa plans to produce at approximately 6.0 Mtpa by year end 2019 due to gas supply constraints[16]. This represents an unsupplied demand of 1.8 Mtpa or 108 PJ per year, which is equivalent to 86% of NSW's total annual demand.

In 2014, NSW gas demand was 19.8% of total east coast demand. By 2018, this share of gas demand had declined to 6.4%, making NSW less important to east coast gas producers when considered in the total market context.

Figure 6 East coast (excluding NT) gas demand by sector



Source: Australian Energy Market Operator (AEMO), Gas Statement of Opportunities 2019 (GSOO 2019)

[14] AEMO, "Gas Statement of Opportunities 2019" (GSOO 2019) 2019; https://www.aemo.com.au/Gas/National-planning-and-forecasting/Gas-Statement-of-Opportunities

[15] An LNG 'train' is a single integrated gas processing and refrigeration unit. For the Curtis Island LNG projects, one train processes around 4 million tonnes of LNG per year. Each of the three LNG projects operates two LNG trains.

[16] Santos, "Santos Media Release", 26 Sept 2018; https://www.santos.com/media/4526/180926-santos-targets-production-of-more-than-100-mmboe-by-2025.pdf

East coast market demand: Forecast

AEMO forecast that across the entire east coast, Residential/Commercial and Industrial sectors have total demand of 451 PJ to 462 PJ per year over the forecast period to 2037, a growth rate of only 0.1% per year. This mirrors the flat growth trajectory projected for NSW.

Again matching the trend in NSW, forecast GPG demand along the east coast increases from 91 PJ in 2019 to 227 PJ in 2037, a growth rate of 4.7% per year, as coal-fired power generators are retired and GPG is used to replace coal and support higher renewable power generation.

LNG demand growth is forecast at just 0.4% per year, as no additional export facilities are expected, while those already operating maintain steady export volumes fulfilling long-term contracts. Forecast gas demand by sector from 2019 to 2037 is shown in Figure 7[17].

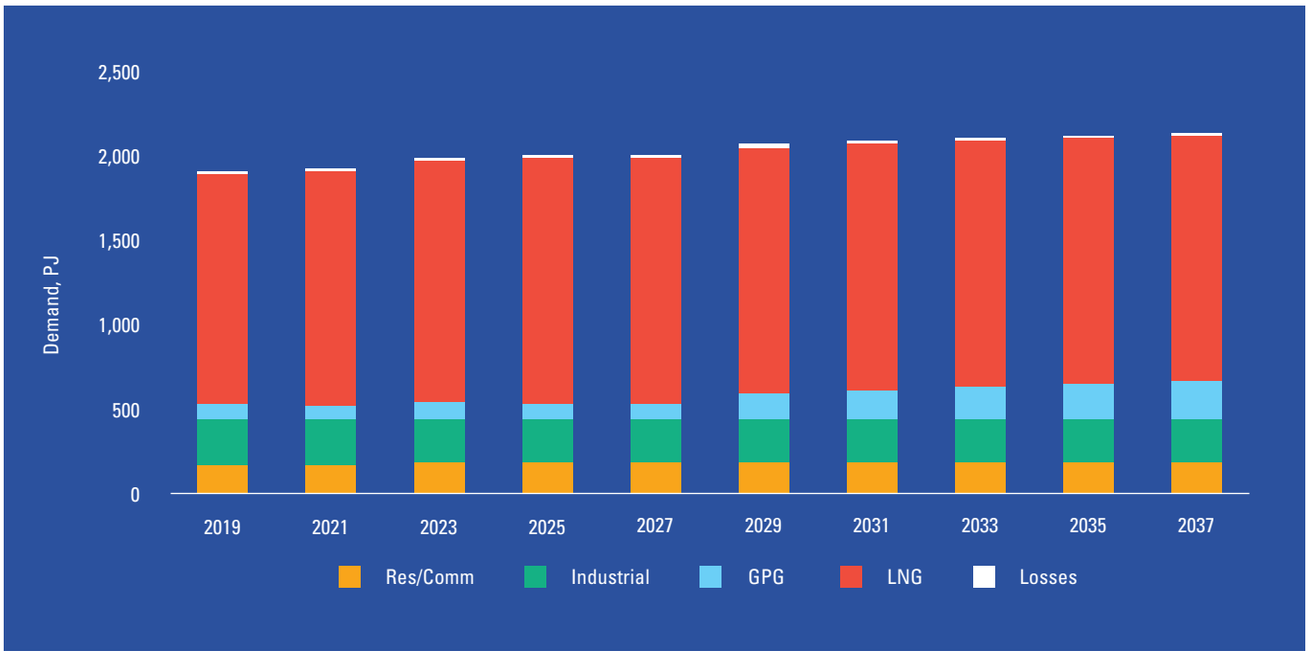
Gas demand reduction measures

The majority of Commercial and Industrial (C&I) gas users surveyed by the Australian Competition and Consumer Commission (ACCC) have implemented gas-reduction strategies, including energy efficiency improvements and fuel switching, and continue to explore further opportunities to cut gas use[18].

For example, Australian Paper is moving forward with an energy-from-waste plant after successful completion of a $7.5 million feasibility study. Another C&I gas user has converted one boiler from gas to coal and another from gas to woodchips.

Some C&I gas users have developed sophisticated arrangements for sourcing gas — switching from being supplied by a retailer to organising their own gas supply and transportation. One user, Incitec Pivot, has moved into the gas production business, developing a gas tenement in a joint venture with Central Petroleum.

Figure 7 Forecast east coast market demand by sector



Source: AEMO, "GSOO 2019"

[17] 'Losses' include 'fugitive gas' lost from pipelines, as well as gas used to run compressor engines along the pipeline network

[18] ACCC, "Gas Inquiry 2017–20", July 2019, p74

3. Gas prices: Putting industry at risk

Rising gas prices have become an increasingly high profile burden for business on the east coast, and for NSW in particular.

Gas price trends

Sydney gas prices have risen in recent years as traditional supply declines and alternate markets such as LNG offer higher value compared to domestic gas prices. The increase from 2014/15 average Sydney spot market (i.e. the daily wholesale price paid for uncontracted gas at the Sydney city 'gas gate' at Wilton) prices of $3.43/GJ to 2018/19 average prices of $9.93/GJ was nearly a tripling of gas prices in just four years (Figure 8).

Wallumbilla gas supply hub is a key east coast gas trading hub. It is based in the largest gas producing basin (Surat/Bowen), and the largest uncommitted 2P gas reserves on the east coast. Its pipeline connection to Moomba means prices at Wallumbilla influence gas volumes which move through the Moomba to Sydney gas pipeline — which was most recently the largest source of gas to NSW (as can be seen in Figure 5).

Despite Wallumbilla being the closest gas trading hub to the major demand of the LNG exporters, it generally trades at a discount to Sydney prices.

The last LNG production train on Curtis Island was commissioned in October 2016. Allowing six months for stabilisation of gas demand, Figure 9 shows the price premium that the Sydney spot market has traded at since 1 April 2017, compared to the Wallumbilla price.

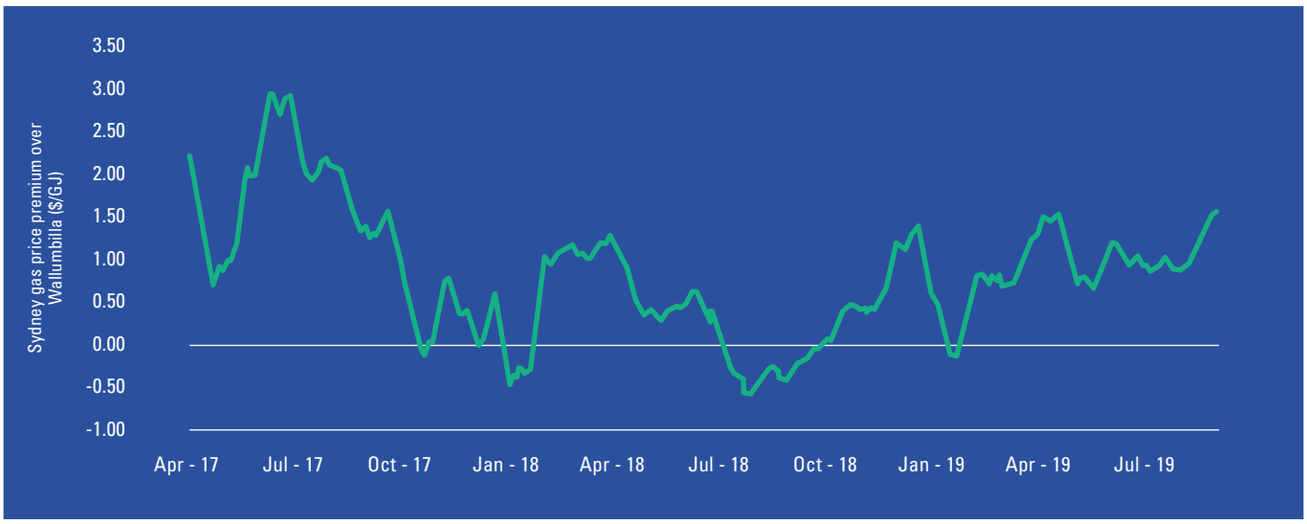
While there are occasions when the price difference is in Sydney's benefit at approximately -$0.50/GJ, the average price premium from 1 April 2017 to 31 August 2019 was $0.83/GJ, for a total cost to gas users in NSW of approximately $250 million over this period. Unless this price premium is addressed with more local gas supply, cheaper pipeline tariffs, and gas supply alternatives like LNG imports, the ongoing or 'business as usual' cost to NSW gas users is around $96 million per year.

Figure 8 Sydney gas spot market prices

Source: AEMO Gas Bulletin Board

[19] ACCC, "Gas Inquiry 2017–20", July 2019, p50

Figure 9 Sydney gas price premium compared to Wallumbilla gas supply hub



Source: AEMO Gas Bulletin Board

LNG netback

Now that the east coast has LNG export facilities on Curtis Island, the international market for LNG has begun to have an impact on gas prices offered to domestic gas users. Gas producers have an alternative buyer to the domestic market, and customers of LNG in Asia commonly pay higher prices than seen in eastern Australia.

The ACCC calculated[19] an average LNG net back price for the east coast. LNG net back is the price that an LNG exporter would need to receive to be indifferent between selling the gas to a domestic buyer over the entirety of 2020, and selling cargoes on the Asian LNG spot market (such as Platt's JKM — Japan Korea Marker) in 2020.

The forecast LNG netback prices for gas delivered in 2020 are shown in Figure 10.

Figure 10 Expected LNG netback prices at Wallumbilla on forward contracts for 2020 delivery

Source: ACCC, "Gas Inquiry 2017–20", July 2019, p52

Figure 10 shows how buyers' expectations of the state of the market in 2020 have changed over the past three years. Expected LNG netback prices at Wallumbilla for 2020 have varied significantly since the end of September 2017, rising from less than $7/GJ to almost $11/GJ by October 2018. Expectations around average 2020 LNG netback prices have since softened, falling to just over $8/GJ by mid-June 2019, as global LNG supply and inventories increased for the northern summer.

These changes in expectations of Asian LNG spot prices over a relatively short period show the degree of price volatility in the Asian LNG market. This may also be an arbitrage opportunity (discussed further in Section 9) to exploit low LNG prices if the market can access the gas volumes either through import terminals or agreements with an LNG exporter.

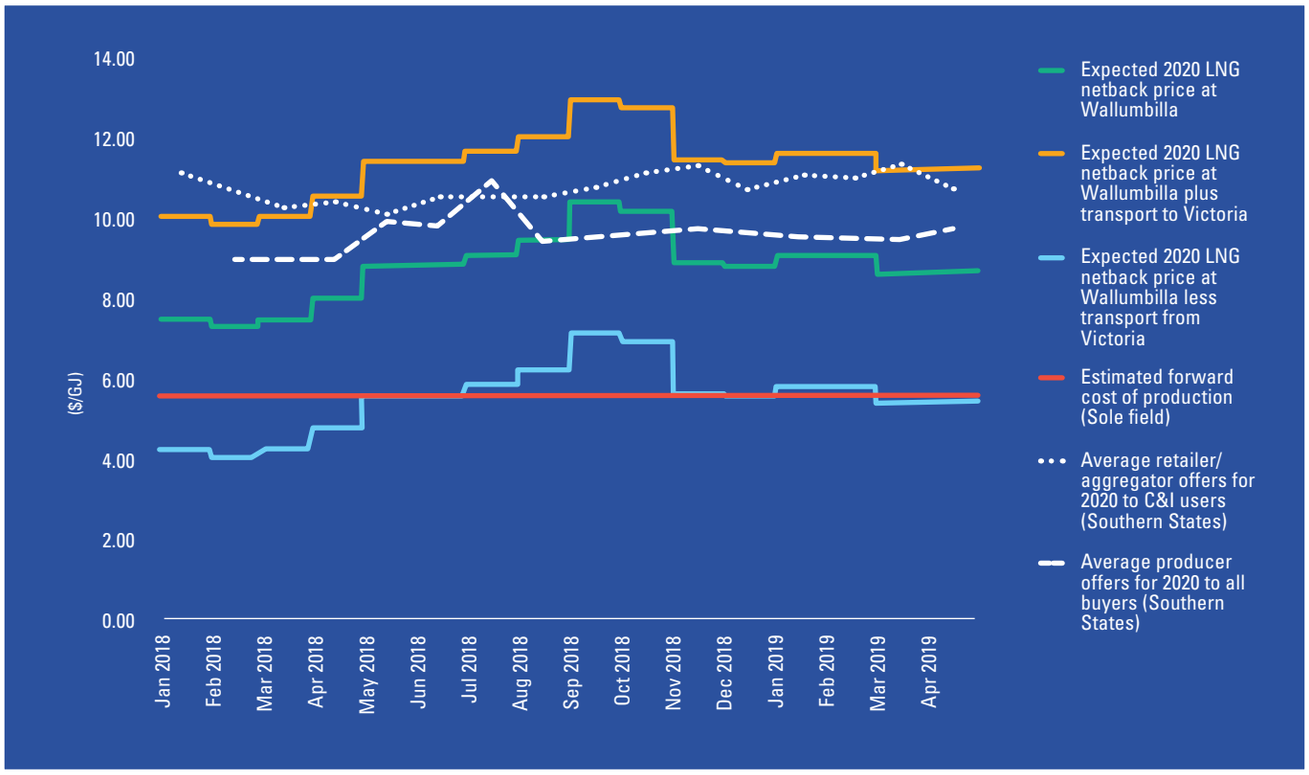
When considering the cost of transportation between the southern states and Queensland, the ACCC developed a range of possible pricing outcomes[19] in gas supply negotiations in NSW and other the southern states, which would usually be expected to fall between:

- the buyer alternative (representing a ceiling in negotiations): the LNG net back price at Wallumbilla plus the cost of transporting gas from Wallumbilla to the user's location; and,
- the seller alternative (representing a floor in negotiations): the LNG net back price at Wallumbilla less the cost of transporting gas to Wallumbilla or the cost of production (whichever is higher).

This proposition was tested in the ACCC's "Gas Inquiry 2017–20" report (Figure 11).

The analysis determines that the "buyer alternative", i.e. LNG net back pricing, results in higher prices for gas customers in NSW and southern states, whether gas is supplied by producers ($1/GJ higher) or retailers ($1.75/GJ higher).

Figure 11 Gas contract price offers for 2020 supply against 2020 LNG netback prices



Source: ACCC, "Gas Inquiry 2017–20", July 2019, Chart 2.4, p57

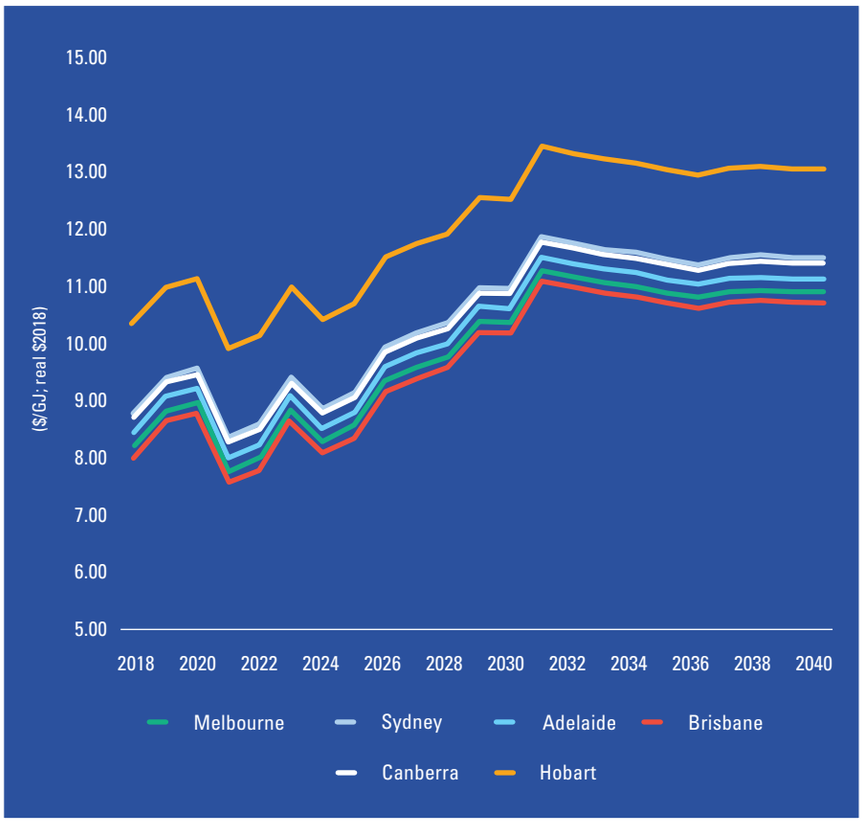
Residential and Commercial delivered wholesale price forecast

AEMO developed analysis of the delivered wholesale gas price forecasts for the east coast Residential/ Commercial markets (Res/Com) (i.e. at the distribution network inlet point) to 2040 for its "2019 GSOO" (Figure 12).

After Hobart, Sydney is forecast to have the highest wholesale gas prices on the east coast. Sydney based gas users are paying an additional cost of up to $0.75/GJ more than competitors in other capital cities (excluding Hobart).

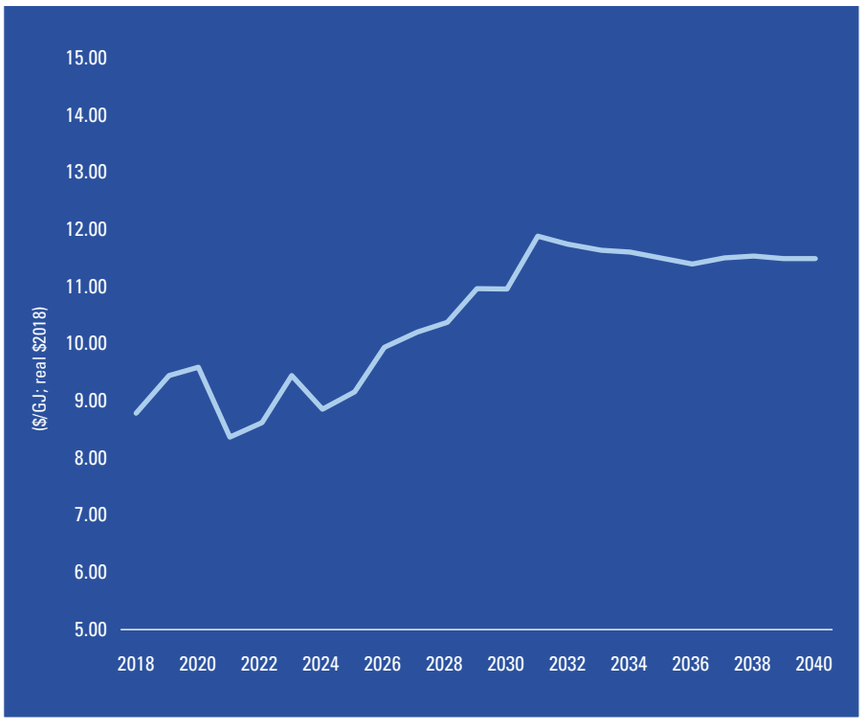
Sydney prices (real $2018) are forecast to increase from $8.78/GJ in 2018 to $11.84/GJ in 2031, then reducing steadily to $11.47/GJ in 2040. For clarity, the forecast prices for Sydney from Figure 12 are shown in Figure 13.

Figure 12 East coast wholesale Res/Com price forecast



Source: AEMO, "Delivered Wholesale Gas Prices Outlook 2019–2040", January 2019; https://www.aemo.com.au/-/media/Files/Gas/National_Planning_and_Forecasting/GSOO/2019/CORE-Eastern-Australia-Gas-Price-Projections-Report-16-January-2019.pdf

Figure 13 Sydney delivered wholesale Res/Com prices



Source: AEMO, "Delivered Wholesale Gas Prices Outlook 2019–2040", January 2019; EnergyQuest analysis

WHY IS THIS A PROBLEM?

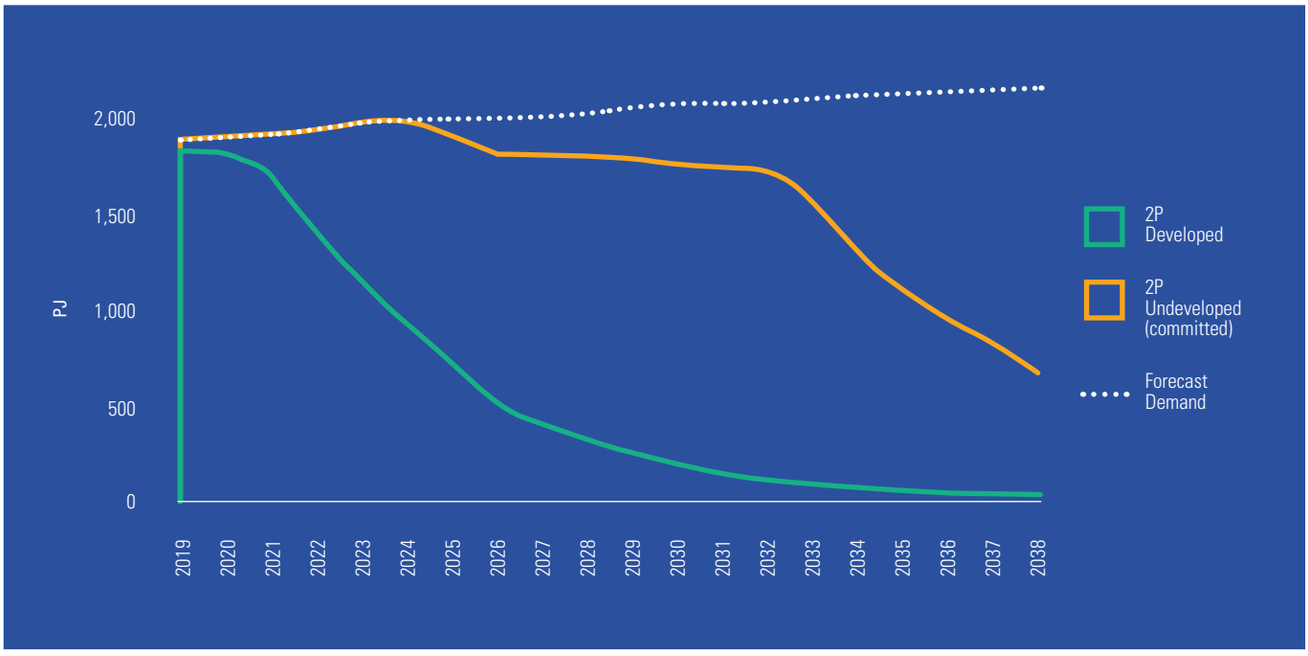
4. Supply shortfall expected by 2025

AEMO forecasts a rapid decline in production from existing reserves. As yet undeveloped reserves are able to fill the breach until around 2025, but after that additional gas supply, either from LNG imports or developing currently unproven '2C' contingent resources, will be needed to meet demand, as shown in Figure 14.

The winter peak is when demand is highest. Even with the growth in CSG production, extensive pipeline systems connecting distant gas fields, storage facilities and more sophisticated trading markets, AEMO's analysis[20] shows that gas supply will not meet demand in the winter of 2025.

AEMO's analysis shows that gas supply will not meet demand in the winter of 2025.

Figure 14: Eastern Australia (excl. NT) supply/demand forecast



Source: AEMO, "GSOO 2019", p41

[20] AEMO, "GSOO 2019", p42

5. Business-as-usual will quickly run into major issues

As shown in Figure 14, the gas market is currently balanced, but tightens from 2021 to 2024, with shortfalls hitting in 2025.

Gas prices already present a serious challenge to users, particularly manufacturers.

Rod Sims, chair of the ACCC recently said:[21]

> **"Manufacturers will go out of business if gas pricing stays where it is. Even if gas makes up 5% of their cost base, the doubling or trebling of prices effectively eats their margins."**

Stephen Bell, CEO of Qenos stated:[22]

> **"As the only manufacturer of polyethylene in Australia, our future depends upon the reliable supply of gas at an affordable price. Qenos is a strong supporter of projects such as Narrabri in New South Wales and onshore gas exploration in Victoria that would increase gas supply to the market."**

US Studies Centre has also noted:[23]

> **"With abundant physical reserves, Australia needs to consider policies that will unlock its gas resources, producing similar outcomes to those seen in the US: cheaper energy, a manufacturing and industrial revival, job creation and economic growth, with a smaller emissions footprint."**

Lindsay Partridge, CEO of Brickworks, said[24] the company would consider not replacing assets in certain states, such as NSW, unless the gas supply situation was resolved. Mr Partridge said their soaring gas bills — which have risen from $4/GJ to $14/GJ — were now costing $25 million a year, or one-third of earnings before interest and tax.

> **"Why would we replace an asset where there is no guarantee we will have gas in 10 to 20 years' time? We are already bringing in bricks from around the world out of sheer desperation. Unless the situation improves, we'll let the assets run down here and invest elsewhere."**

C&I gas users continue to report difficult circumstances with the primary concern being gas prices and their impact. The price of gas was one of the top three concerns of all gas users surveyed by the ACCC. Lack of competition among gas suppliers and long-term uncertainty were the second and third most reported concerns.

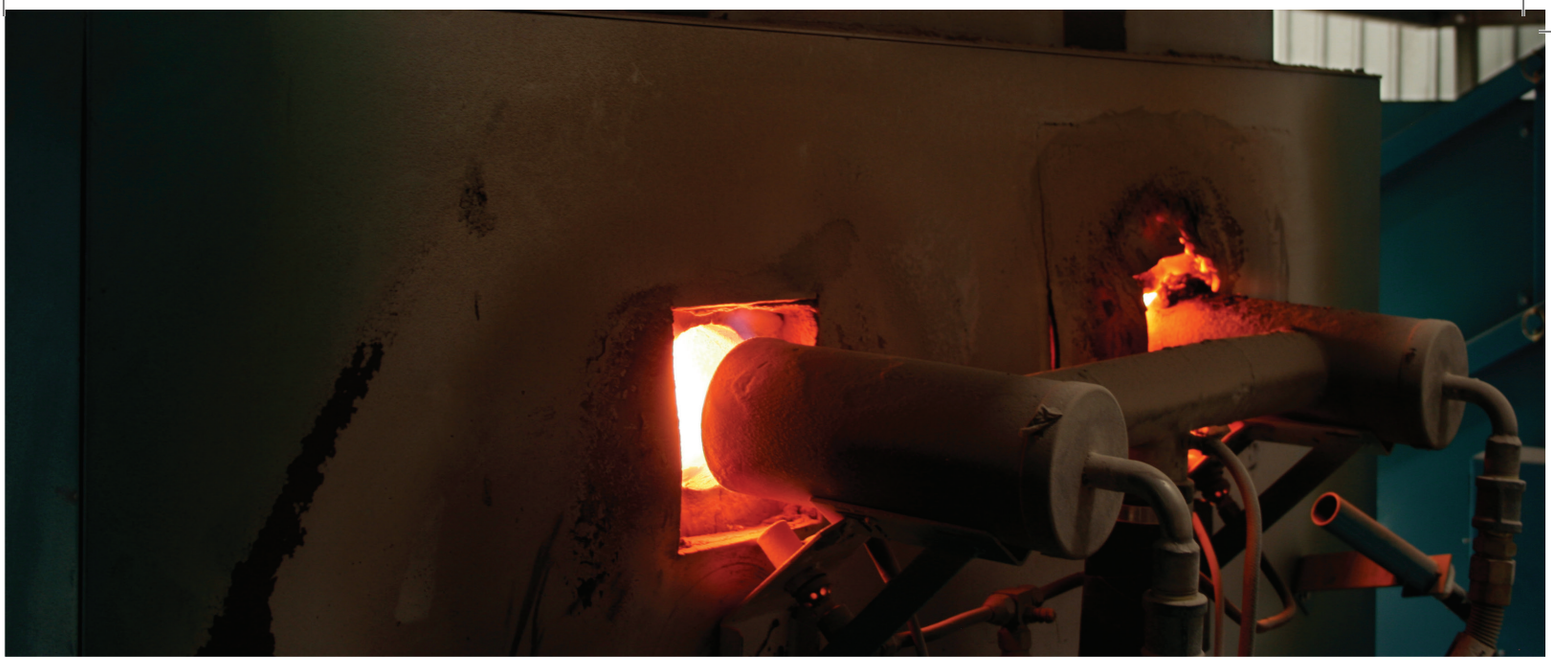
A number of C&I gas users have advised the ACCC that their business operations are unsustainable in the long-term. As a result, some are postponing capital expenditure, reducing headcount, scaling back pay increases and deferring investments or expansions.

[21] Australian Financial Review, 23 August 2019, p32

[22] Chemistry Australia, press release, 13 August 2019; https://chemistryaustralia.org.au/news-events/chemisty_industry_launches_new_report

[23] The Australian, "Energy costs 'threaten industry'", 11 December 2018; https://www.theaustralian.com.au/business/mining-energy/energy-costs-threaten-industry/news-story/9eee962b472faf27da96d68510f00f91

[24] Australian Financial Review, "Decade of inaction leaves gas users on 'cusp' of collapse", 4 June 2019; https://www.afr.com/companies/energy/decade-of-inaction-leaves-gas-users-on-cusp-of-collapse-20190603-p51tw6



A number of C&I gas users have expanded operations overseas instead of increasing development in Australia, citing significantly lower gas prices overseas—particularly in the USA.

Some have gone a step further. In May 2019, Dow Chemicals announced plans to shut its manufacturing plant in Melbourne, citing rising gas prices as one of the main reasons for its decision. This follows the closure of RemaPak[25], a Sydney-based producer of polystyrene coffee cups, and Claypave, a Queensland-based brick and paving manufacturer, in the first quarter of 2019[26].

Senator Canavan, Federal Resources Minister[27], said:

> **"Thousands of jobs in manufacturing across eastern Australia depended on breaking down the barriers to gas production and red tape generally in the resource sector."**

Jeanne Johns, Managing Director & CEO of Incitec Pivot Limited commented on Chemistry Australia's recent report[28]:

> **"Australia's chemical industry supports more than 1,600 full time equivalent jobs for every petajoule of gas it uses, 80 times higher than LNG and 150 times more than the gas-fired electricity. The chemical industry contribution to the local economic activity per petajoule of gas used is also greater than that provided by either the LNG or gas-fired electricity industries."**

Incitec Pivot[29] recently built a $1.08 billion 'world scale' ammonia plant in the USA, after considering and not proceeding with a similar plant in NSW.

As difficult as this period is, when gas supply shortfalls arrive business conditions will become even more difficult.

As difficult as this period is, when gas supply shortfalls arrive business conditions will become even more difficult.

[25] Australian Financial Review, 6 September 2019, p23. Article notes they were unable to trade out of Administration since January and will now be liquidated and shut down

[26] ACCC, "Gas Inquiry 2017–20", July 2019, p74

[27] Australian Financial Review, 6 September 2019, p23.

[28] Chemistry Australia, Press release, 13 August 2019; https://chemistryaustralia.org.au/news-events/chemisty_industry_launches_new_report

[29] Australian Financial Review, "Why Incitec Pivot built a factory in the US, not Australia" 4 Sept 2017; https://www.afr.com/opinion/james-fazzino-why-incitec-pivot-built-a-factory-in-the-us-not-australia-20170831-gy7s9s

6. NSW is not well positioned to meet gas-user needs

Gas pipeline costs

As NSW's traditional gas supply basins (Gippsland and Cooper Basin) decline, and interstate gas travels longer distances to NSW, the amount NSW gas users have to pay for transporting gas will increase. Today NSW gas users pay $0.83/GJ more for gas compared to a user based at the Wallumbilla gas supply hub. This amounts to an annual business-as-usual cost of $96 million. By 2025, when gas will be coming to NSW from further away, this is likely to more than double to an average of $2.04/GJ (Table 2), raising this cumulative annual cost to NSW users to $236 million.

This is a substantial additional cost for NSW gas users when compared to gas users in the other states: a business in Sydney will pay $1.32/GJ more for transporting gas than a competitor in Brisbane.

For some small businesses this can be a substantial cost (Table 3).

As a result of the cost of moving gas long distances to NSW, gas users closer to the source of gas supply will be at a competitive advantage to users at the end of the pipeline. The further the gas has to travel, the more the end user will ultimately pay for it. As supply dynamics shift, this will tend to favour locating gas-intensive businesses in Queensland or the NT over NSW. Production within NSW can help moderate transport cost impacts.

This transmission pipeline cost impost is in addition to any risks of cost increases in gas itself, and the local pipeline distribution (from the transmission pipeline to the gas-user) network.

Table 3 Typical small business gas consumption and NSW cost impost

	Gas Demand TJ/y	Cost impost $/y
Dry Cleaner	0.5	**660**
Bakery	20	**26,400**
Galvanising plant	50	**66,000**
Tomato processor	280	**369,600**

Note: Additional cost for a Sydney based business compared to an equivalent business in Brisbane at $1.32/GJ

Source: Grattan Institute, "Gas at the crossroads", 2014; Deloitte, "Australian Gas Market Transformations", July 2014; EnergyQuest analysis

Table 2 Gas reserves and pipeline tariffs to Sydney by basin

PJ	Basin	Reserves (2P)	%	Pipeline Tariff
NSW	Sydney	11	0.09%	0.00
South Australia	Cooper	502	4.1%	1.12
Victoria	Gippsland	2,596	21.1%	1.30
Victoria/Tasmania	Bass	175	1.4%	1.67
Victoria	Otway	667	5.4%	1.70
Queensland	Surat/S. Bowen	7,383	59.9%	2.00
NT	Amadeus	242	2.0%	5.04
NT	Blacktip	747	6.1%	5.04
		12,323	**100.00%**	**2.04**

Source: Government data; Pipeline company published tariffs; EnergyQuest analysis

Note:
- 2P reserves only; does not include contingent resources of Beetaloo or Narrabri.
- AEMO LNG forecast volumes to 2038 subtracted from Queensland
- Santos contract volume with GLNG of 538 PJ subtracted from Cooper Basin

Infrastructure constraints

As more gas flows from Queensland and the NT to meet southern demand, capacity of the pipeline infrastructure will be reached, becoming an obstacle to additional supply.

The MSP, which is the key pipeline for northern gas to NSW, can carry 446 TJ of gas per day[30]. A current peak usage day in NSW sees the state consume 480 TJ of gas — a number that is forecast to rise to 517 TJ by 2037. At present the MSP alone cannot cover NSW's demand at peak — and that is without factoring in that some of the gas that the MSP carries will be destined for Victoria rather than NSW[31].

Another impending constraint is the south-west Queensland pipeline from Wallumbilla to Moomba, which has an east to west capacity of 384 TJ/d, or 86% of the MSP capacity. This means that supplies from South Australia's Cooper Basin are still required to supplement the Queensland peak day gas flows — a situation which cannot continue with the Cooper Basin in decline.

Pipeline infrastructure will need to be upgraded and updated to match the new patterns of supply and demand across Eastern Australia. Section 8 describes how this can be done.

As a result of the cost of moving gas long distances to NSW, this will tend to favour locating gas intensive businesses in Queensland or the NT over NSW.

[30]APA Website, n.d: https://www.apa.com.au/globalassets/documents/info/schematic/msp-diagram.pdf

[31]In May 2019, 74 TJ/d was shipped to Victoria through the MSP via the VNI.

WHAT NEEDS TO BE DONE?

Regulators, politicians, and expert groups have described the need for action to address the impending gas shortfalls in NSW.

In its 2019 "Gas Statement of Opportunities", AEMO concluded:

"… based on existing, committed, and anticipated production … domestic gas demand, particularly in the southern states, will be difficult to meet in its entirety over the next 10 years without either:

- Exploration and development of new southern resources, or
- New gas supplies delivered via LNG import terminal(s), or
- Major pipeline infrastructure expansions to deliver Queensland and Northern Territory gas southwards, or
- A combination of all three

Given development timeframes, progress on these developments will need to commence shortly."

Based on the analysis in the previous sections of this report, EnergyQuest strongly agrees with AEMO's assessment and recommendations.

Development of NSW resources is essential to improving the gas supply position in the state. This development should be complemented with actions to expand pipeline capacity and enable LNG imports into the state.

The following sections develop these recommendations in the NSW context.

7. Recommendation: Approve development of the Narrabri gas field by 2020.

There are several known gas basins in NSW, namely:

- Clarence-Moreton
- Gloucester
- Gunnedah/Narrabri
- Hunter
- Sydney/Camden

However, since around 2011, 2P gas reserves have been reduced to near zero reflecting the lack of development progress.

For example, Metgasco in their 2012 Annual Report declared 2P reserves of 428 PJ, proven, probable and possible (3P) reserves of 2,542 PJ, and 2C contingent resources of 2,512 PJ. Three years later, reserves were reduced to zero and 2C increased to 4,428 PJ.

In 2019, NSW has 2,254 PJ of contingent resources — all in the Narrabri area. This has the potential to supply up to 19 years of NSW gas demand.

Narrabri gas project

There has been interest in NSW CSG for at least 16 years, when Eastern Star Gas[32] acquired NSW gas exploration acreage around 2003.

Santos increased its interests in NSW over time, finally buying Eastern Star Gas in 2011. An Environmental Impact Statement for CSG production at Narrabri was submitted in February 2017. Development is still awaiting government approval and permits.

During this period, CSG development has been reported to be subject to an unofficial (and un-legislated) 'moratorium'. In June 2019 the Australian Financial Review reported[33] that:

> **"State and federal government sources have told The Australian Financial Review that the $3 billion [Santos' Narrabri] project, which has been subject to an unofficial state moratorium on coal seam gas for several years, should get the green light by Christmas".**

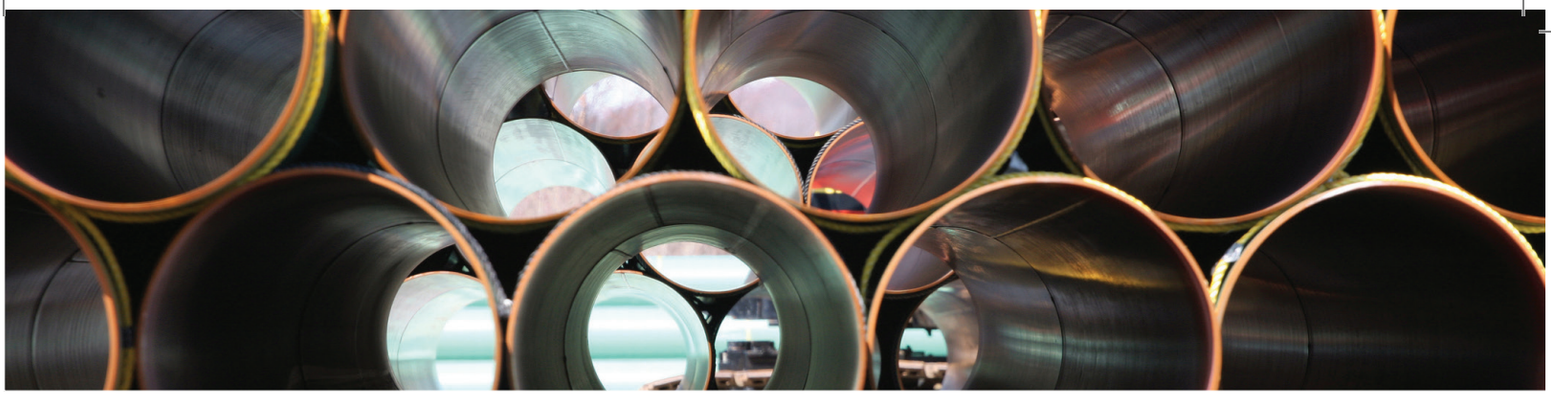
However, the NSW Planning and Public Spaces Minister Rob Stokes has downplayed speculation of the project's imminent approval, telling the Sydney Morning Herald[34] that there are "robust and thorough processes for major projects which have significant implications for the state, its people and its resources".

Santos has recently signed MOUs to supply Narrabri gas to C&I users Brickworks and Perdaman Group, as well as gas wholesaler Weston Energy. Subject to the project's approval, Santos would supply Brickworks with up to 3 PJ per year of Narrabri gas for seven years, and Weston with 10 PJ per year for ten years[35].

"We have committed 100 percent of Narrabri gas to the domestic market, enough to supply up to half of NSW's needs and help support about 300,000 jobs in NSW that rely on natural gas"

[32] Eastern Star Gas Website, "Eastern Star Gas: Company History; http://sore.net.au/wp-content/uploads/2010/12/Eastern-Star-Gas_-Company-History.pdf

[33] Sydney Morning Herald, "Santos coal seam gas plan still has hurdles to clear: NSW government", 22 June 2019; https://www.smh.com.au/business/markets/santos-coal-seam-gas-plan-still-has-hurdles-to-clear-nsw-government-20190621-p5202c.html



Santos CEO, Kevin Gallagher stated[34]:

> **"We have committed 100 percent of Narrabri gas to the domestic market, enough to supply up to half of NSW's needs and help support about 300,000 jobs in NSW that rely on natural gas…**
>
> **Gas from Narrabri will always be cheaper than gas imported from other states or from overseas. Santos has spent more than $500 million on the Narrabri Gas Project since acquiring Eastern Star in 2011. We've applied the best science to our environmental impact assessment and the NSW Government has put strong environmental regulation in place.**
>
> **We have a proven record of developing coal seam gas resources safely and without harm to the environment or water resources, and a development consent decision is now a matter for the NSW Independent Planning Commission."**

NSW's Deputy Premier, John Barilaro, in late April 2019 said a final decision would be made on it later this year[36].

> **"Coal seam gas is a form of gas, [that] in its extraction … does make gas a little bit more expensive, so there are other arguments - not only the impacts it will have on aquifers. The reality here today is we want to see gas here in the New South Wales market, be it CSG, be it liquified natural gas [or gas] that comes through pipelines from the Bass Strait."**

This statement highlights the need for political support to ensure the Narrabri gas project is expedited. To get from initial permit approvals to stable full production levels takes around four years. In that time, in addition to engineering works at the site, contracts will need to be firmed up with potential buyers The NSW Government must increase its focus on the project, and accelerate review and approval processes to ensure completion by the end of 2019. This will be necessary to ensure the field reaches stable production levels by 2025.

Santos has estimated production from Narrabri would reach up to 70 PJ per year (or around 50% of NSW demand). At that rate, additional 2P reserves would be required to extend the field life beyond 10 years, meaning that further exploration and investigative work will need to be carried out alongside drilling for production.

Other NSW fields are further behind on the track to possible production. NSW's potentially large undeveloped 2C gas contingent resources are not yet considered by producers to be commercially viable, and it is unlikely that these quantities will become economic and be developed by 2025.

[34] Santos Media release, "Santos signs MOUs with Brickworks and Weston Energy for Narrabri", 9 May 2019; https://www.santos.com/media-centre/announcements/santos-signs-mous-with-brickworks-and-weston-energy-for-narrabri-gas/

[35] ABC News, "LNG import terminal - an Australian first - a sign of hope for NSW manufacturing", 29 April 2019; https://www.abc.net.au/news/2019-04-29/australian-first-lng-import-terminal-at-port-kembla-green-light/11054028

[36] ABC News, "LNG import terminal - an Australian first - a sign of hope for NSW manufacturing", 29 April 2019; https://www.abc.net.au/news/2019-04-29/australian-first-lng-import-terminal-at-port-kembla-green-light/11054028

8. Recommendation: Begin a program of pipeline and infrastructure upgrades to expand capacity by 2021.

The balance of NSW's gas supply has shifted from Victoria to Queensland. Pipeline infrastructure needs to reflect this change. Existing pipeline bottlenecks need to be identified and upgraded to ensure reliable gas supply to gas users.

However, on their own actions to improve pipeline capacity only have a limited effect on the supply position, at best deferring the projected shortage from 2025 to 2027.

> **AEMO notes in its "2019 GSOO" that "if all infrastructure limitations were alleviated from 2024, there is forecast to be sufficient excess northern supply to help meet all demand in both the northern and southern regions [including NSW] until 2027".**

Pipeline infrastructure which should receive attention include:

- For the proposed LNG import terminals
  - The pipeline capacity from Australian Industrial Energy's (AIE) Port Kembla regasification facility to Sydney. A new pipeline from Port Kembla to the Sydney gas hub at Wilton, as proposed[37] by APA would need to transit populated and environmentally sensitive areas which may slow the construction timeframe.
  - The pipeline capacity from EPIK's Newcastle regasification facility to Sydney.
- For gas shipped from Moomba and northern Australia, review
  - The proposed pipeline from Narrabri to the MSP, including peak day modelling and compression requirements for despatch into the MSP.
  - The MSP pipeline capacity and utilisation.
  - The Moomba hub pipeline connections and compression limitations, on the south-west Queensland pipeline to Moomba and the MSP.
  - The utilisation of Moomba underground storage to support NSW peak days and supply constraints.
  - The potential for large scale pipelines from the NT to the east coast. Connecting the NT pipelines to Moomba would be to NSW's advantage.

There should also be further consideration of what would attract the required infrastructure investments for NSW. The usual long term (40 plus year) timeframes for new pipelines, storage or pipeline capacity expansions may need to be revisited for a carbon constrained world, with policy and regulatory uncertainties, and new disruptive technologies such as hydrogen or LNG imports at new points in the gas grid. Investors must understand and manage the risks, and be able to capture profits commensurate with the risk profile.

[37] APA Website, "Port Kembla to Wilton pipeline"; https://www.apa.com.au/about-apa/our-projects/port-kembla-to-wilton-pipeline/

9. Recommendation: Facilitate LNG import terminal construction for NSW to begin by 2022.

There are five proposals to build LNG import terminals on the east coast of Australia. While this may seem at odds with Australia's LNG exports, some countries already export and import LNG, including USA, Malaysia, U.A.E. and Egypt. LNG is a method to transport gas, and once distances exceed a few thousand kilometres, then it is a viable commercial alternative to pipelines for the right volumes and flexibility requirements.

LNG regasification can be either with an onshore regas facility, or a floating storage and regasification unit (FSRU; Figure 15) which is typically an LNG ship with an added regasification unit enabling it to import or load LNG directly from another LNG ship, regas the LNG and pump it ashore for direct use in the pipeline network. Most FSRUs stay moored and LNG comes on another ship which offloads into the FSRUs storage tanks. Some FSRUs load the LNG and make the trip to the regas berth without a second vessel involved.

Figure 15 FSRU docked at Teeside terminal, UK

Source: AGL, "Fact sheet Floating Storage and Regassification Units" October 2017; https://www.agl.com.au/-/media/aglmedia/documents/about-agl/how-we-source-energy/crib-point/fsru_factsheet_a4_v2.pdf?la=en&hash=DDC9AFB2F8757001EBCAEBDE8387420D. Photo - Excelerate Energy.

There are two NSW FSRU proposals: the Australian Industrial Energy (AIE) project at Port Kembla, and the EPIK project at Newcastle.

AIE: Port Kembla

The New South Wales Government has granted the necessary planning approval to AIE's Port Kembla LNG import terminal project[38]. While AIE has yet to announce a final investment decision, it has signed a deal for EnergyAustralia to take 15 PJ of imported gas per year for five years starting in 2021, subject to the project's approval.

AIE has flagged it would take between 12 and 14 months to install its regas facility. AIE plans to lease a regasification and storage vessel from global LNG shipping giant, Hoegh of Norway. The Hoegh Galleon floating storage and regasification vessel was launched from the Samsung shipyards in July 2019.

Recent reports suggest AIE has submitted new documents to the NSW Government for approval for a larger facility design because customers have offered firm indications that peak demand over the medium term could top 500 TJ/d[39]. This increased capacity would be needed for the 850 MW gas-fired generator being considered in an AIE joint venture feasibility study.

It is unclear how the extended approvals process will impact on the original timetable to supply gas from January 2021.

[38] AIE Website, 2019; https://ausindenergy.com

[39] Australian Financial Review, "Forrest's gas import plan delayed by growing pains", 19 August 2019; https://www.afr.com/companies/energy/forrest-s-gas-import-plan-delayed-by-growing-pains-20190818-p52ibf

EPIK: Newcastle

EPIK[40] is an LNG project development company focused on originating and developing FSRU projects, including its flagship Newcastle GasDock LNG project at the Port of Newcastle.

Subject to further engineering design, regulatory planning and environmental assessments, Newcastle GasDock will incorporate a 170,000m^3 class FSRU, a dockside jetty, and a pipeline lateral connecting the FSRU terminal to an interconnection point on Jemena's Newcastle to Sydney pipeline.

EPIK has chosen the Port of Newcastle as its location to tap into Australia's south-east gas market. Located at the end of an existing gas pipeline, an import facility at the Port of Newcastle aims to provide natural gas not only to industrial, commercial and residential users in the Newcastle region, but to the broader NSW market.

In April 2019, EPIK announced it had executed an agreement with Watpac, an Australian engineering firm, for the exclusive provision of design, engineering and construction services for the onshore infrastructure components of the project. In addition, EPIK has a strategic partnership with Hyundai LNG Shipping and environmental and planning support from Arup.

On 14 August 2019, the Government of NSW declared[41] EPIK's Newcastle GasDock LNG import terminal project to be Critical State Significant Infrastructure. The media release noted that "The Newcastle GasDock terminal will be capable of supplying more than 80% of NSW's current gas demand, with the potential to increase throughput as demand requires."

The Newcastle-Sydney pipeline would require expansion to allow for significant gas flows south to Sydney.

EPIK estimates the onshore development at the port alone will be $250 million. The total estimated project value will come to $589 million, including the FSRU, which Hoegh will supply[42]. Further capital commitments may be required if the pipeline from Newcastle to Sydney needs expansion.

Key points in support of importing LNG into NSW

1. Peak gas supply

In a tight gas market, supply disruptions are most likely on peak demand days. As already discussed, current forecasts indicate that there will be insufficient gas to meet winter peak demand in 2025.

In addition to conventional gas storage at Iona, Victoria, there are another two LNG based storage facilities which can also provide peak supply. One is AGL's facility[43] at Newcastle, and the second is APA's facility[44] at Dandenong, Victoria. These facilities use stored LNG to provide very fast gas supply for peak demand. An FSRU uses a similar process, but on a larger scale.

The ability to source and process additional LNG shipments, up to the capacity of the regasification and pipeline infrastructure, is an additional flexibility for adding gas supply volume to NSW, especially for the peak winter season.

2. Long term gas contract certainty

With decreasing gas reserves, producers become more averse to agreeing to long-term contracts which may extend beyond their reserves portfolio, or lock out higher price opportunities. The trend is to write shorter contracts to minimise these risks.

However, for large gas users this can be a problem as they may require long-term gas supply certainty to underpin multi-million dollar investments. An LNG import terminal has access to the global gas supply market, and so it is not limited by local production trends. There will still be issues regarding the cost of the imported gas, but there are normally options to link it to oil prices, US Henry Hub or other international benchmarks to mitigate some risk.

---

[40] EPIK, "Newcastle GasDock: Bringing New Energy to New South Wales", 2019; https://www.epiklng.com/ngdc.html

[41] NSW Government, Ministerial Media Release "Newcastle gas terminal given critical status", 14 August 2019; https://www.planning.nsw.gov.au/News/2019/Newcastle-gas-terminal-given-critical-status

[42] Energy New Bulletin, "Newcastle ING import terminal given critical project status", 14 August 2019; https://www.energynewsbulletin.net/development/news/1369433/newcastle-lng-import-terminal-given-critical-project-status#.XVPtROvH4J0.twitter

[43] AGL, "Newcastle Gas Storage Facility", 2019; https://www.agl.com.au/about-agl/how-we-source-energy/newcastle-gas-storage-facility

[44] APA, "Dandenong ING Gas Storage Facility", 2019: https://www.apa.com.au/our-services/gas-transmission/gas-storage/dandenong-lng-gas-storage-facility/

3. Arbitrage opportunities

Within the competitive gas industry of the east coast, prices are influenced by gas production for the domestic market, and LNG net back gas, i.e. gas that could otherwise have been exported, but is redirected into the domestic market.

With the introduction of LNG import terminals, the ability to deal with large volumes of LNG traded on the LNG spot market delivered directly into NSW, would be available.

There is the added advantage that the winter peak in NSW corresponds to the lower demand northern summer period, when LNG spot prices are generally at their lowest.

As an illustration, over the 2019 winter peak period of June to August, the off-peak northern summer spot (JKM) LNG prices fell to US$4.88/MMBtu. Allowing for transport from north Asia to NSW and regasification, this would provide peak gas supply at around A$9.12/GJ ex-regas plant in NSW (Table 4), which is comparable to the Sydney spot prices of A$8.76/GJ for the same period, especially when additional pipeline charges (around $0.45/GJ) are added to bring Sydney STTM gas to regional areas such as Port Kembla.

4. Infrastructure alternatives

NSW relies on three long distance pipelines from other states for its gas supply. The increasing requirement for additional gas from Queensland, especially for peak days, will be constrained in the future. LNG regasification in NSW would provide high volume gas supply which does not rely on the interstate pipelines.

Moreover, regasification would be a competitive alternative to incumbent pipeline assets creating market alternatives for gas buyers and limiting the prices pipeline owners are able to charge.

5. Meets expected supply shortfall timeframes

FSRUs can be commissioned in relatively short time frames[45]. New build FSRUs typically take 27 to 36 months, but converting an LNG carrier would typically require just 18 to 24 months. If the projects are sanctioned soon, they have sufficient time to meet expected supply shortfalls in NSW.

However, the time required to achieve final investment decision should not be underestimated. Aggregating sufficient demand from multiple customers to underpin the required investment can be a complex process. Factors which may need to be considered by gas buyers are commitments to existing gas supply contracts as they come to an end, and assessment of the risks in committing to buying LNG with global pricing and supply exposure.

The NSW Government should support LNG imports into NSW, and ensure that permits and applications for expansion are prioritised.

Table 4 Spot LNG regasification in NSW - Illustrative example

June - August 2019	Unit	Cost/Price	Conversion
SpotLNG (JKM) Price	US$/MMBtu	4.88	
Ship to NSW	US$/MMBtu	0.75	
Victoria	US$/MMBtu	5.63	
	US$/A$		0.70
	GJ/MMBtu		1.055
LNG ex-ship NSW	A$/GJ	7.62	
Regasification	A$/GJ	1.50	
Ex-regas plant NSW	A$/GJ	9.12	
Sydney STTM	A$/GJ	8.76	

Source: AEMO Bulletin Board; Platts JKM; EnergyQuest analysis

10. Recommendation: Appoint a Coordinator to lead work on critical gas projects by 2020.

Chief Scientist's Independent Review of Coal Seam Gas Activities in NSW

An independent review of CSG activities in NSW was commissioned on 21 February 2013 by the NSW Premier, in a climate of community unease about CSG production. The NSW Chief Scientist and Engineer reviewed CSG activities in NSW, including the potential environmental, human health and social impacts of CSG production, and the legislative and regulatory framework within which CSG operations occur in NSW.

The report[46] concluded that:

"the technical challenges and risks posed by the CSG industry can in general be managed through:

- careful designation of areas appropriate in geological and land-use terms for CSG extraction;
- high standards of engineering and professionalism in CSG companies;
- creation of a State Whole-of-Environment Data Repository so that data from CSG industry operations can be interrogated as needed and in the context of the wider environment;
- comprehensive monitoring of CSG operations with ongoing automatic scrutiny of the resulting data;
- a well-trained and certified workforce; and,
- application of new technological developments as they become available.

All of this needs to take place within a clear, revised, legislative framework which is supported by an effective and transparent reporting and compliance regime and by drawing on appropriate expert advice."

In other words, there is nothing about CSG production that presents an unmanageable risk. High standards of engineering, sensible selection of land, and high-quality monitoring can ensure that gas development can take place safely and in an environmentally-responsible manner.

The scientific review of the CSG in NSW has been supplemented by multiple studies by the CSIRO, including:

- "CSG-induced groundwater impacts in the Pilliga region: prediction uncertainty, data-worth and optimal monitoring strategies"[47]
- "Social Baseline Assessment: Narrabri project – Final Report"[48]
- "Regional Methane Emissions in NSW CSG Basins – Final"[49]

As part of the government response in 2014, the NSW Government[50] noted that:

> **"efforts have also been made to streamline and coordinate processes across regulators, including through a Memorandum of Understanding (MOU) and the establishment of a cross-agency working group on CSG. In addition, several agencies have taken steps to improve regulatory capability and capacity through recruiting staff, purchasing additional instrumentation and developing materials to improve officers' knowledge of the CSG industry".**

Development of large and complex projects, especially in unfamiliar (for the state) sectors such as CSG at Narrabri requires a coordinated and supportive role for government. The appointment of the NSW Environmental Protection Agency (EPA)[51] as the lead regulator of gas activities in NSW partly addressed this need. The EPA has taken on responsibility for compliance with, and enforcement of, all conditions of gas activities — including conditions issued by other agencies (excluding work health and safety conditions). The Division of Resources and Energy and the Department of Planning and Environment are responsible for determining gas applications and issuing conditions of consent.

[46] NSW Government Chief Scientist and Engineer, "Final Report of the Independent Review of Coal Seam Gas Activities in NSW", September 2014, page iv; https://www.chiefscientist.nsw.gov.au/__data/assets/pdf_file/0005/56912/140930-CSG-Final-Report.pdf

[47] https://publications.csiro.au/rpr/pub?pid=csiro:EP182556

[48] https://gisera.csiro.au/project/social-baseline-assessment-narrabri-region-nsw-relation-csg-development/

[49] https://gisera.csiro.au/project/regional-methane-emissions-in-nsw-csg-basins/

[50] Ibid, p6

"The Queensland Government's Coordinator General in the Department of State Development, Manufacturing, Infrastructure and Planning has special powers and oversight to coordinate government approvals and progress projects. This was critical during the early establishment and expansion of the gas industry in Queensland. If the NSW government is serious about nurturing gas production in the state, a body with similar powers and responsibilities would be a valuable enabler."

Despite the NSW Government designating the Santos Narrabri Gas Project as a Strategic Energy Project, and signing an MOU with Santos to streamline the assessment process for the Narrabri Gas Project, after five years the Narrabri Project is not yet approved.

Three different government departments regulate and apply conditions to gas development proposals, but no single department has the responsibility of facilitating the project's progress through the government processes and bureaucracy, as is practiced in other jurisdictions. For example, for designated major projects (i.e. 'coordinated projects' or those in 'State Development Areas') in Queensland, the Queensland Government's Coordinator General in the Department of State Development, Manufacturing, Infrastructure and Planning has special powers and oversight to coordinate government approvals and progress projects. This was critical during the early establishment and expansion of the gas industry in Queensland. If the NSW government is serious about nurturing gas production in the state, a body with similar powers and responsibilities would be a valuable enabler.

In addition to the establishment of a Coordinator accountable for the progress of gas critical projects, existing departments should be properly resourced with the right skills for the Narrabri Project development. The Narrabri Project Environmental Impact Statement indicates that up to 850 wells on 425 sites will be drilled. Assuming a four year period to production plateau, this may require up to 212 wells to be drilled each year. While this is approximately half of Santos' drilling activity rate in Queensland, it will be an unprecedented level of activity in NSW, for which key departments need to be properly resourced. Many of the skills required will be quite technical, so an appropriate lead time to add these to the departments must be allowed for.

Other government options such as state gas reservation or Federal Government intervention are likely to have limited effect at best, or even make the situation worse.

Three different government departments regulate and apply conditions to gas development proposals, but no single department has the responsibility of facilitating the project's progress through the government processes and bureaucracy

[51] NSW EPA Website, "Gas regulation in NSW"; https://www.epa.nsw.gov.au/licensing-and-regulation/gas-industry/gas-industry-in-nsw/faqs

[52] Narrabri Project Website, "The Narrabri Gas Project Environmental Impact Statement", February 2017; https://narrabrigasproject.com.au/uploads/2018/02/FACT-SHEET-EIS-Website.pdf

Gas reservation

With no gas to reserve, the issue of state gas reservation does not seem relevant to NSW. Santos has already stated[53] that "one hundred per cent of Narrabri gas would go into the domestic market, potentially supplying up to half of NSW natural gas demand" should it be allowed to produce.

While NSW has not imposed any reservation policy (nor, given Santos's commitments, should it need to), over the past two years the Queensland Government has issued tenements with domestic supply conditions to six gas producers:

- Senex Energy
- Chi Oil and Gas
- Armour Energy
- Central Petroleum
- a joint venture between Santos and Shell
- a joint venture between APLNG and Armour Energy

Gas produced from the relevant tenements must be sold domestically, and gas from the APLNG/Armour Energy tenement has an additional requirement that it must be sold to a manufacturer.

South Australia went one step further, with a condition[54] for its Plan for Accelerating Exploration (PACE) gas program such that "gas users (firstly electricity generators, followed by industry and then retail consumers in South Australia) will be provided with a first right to agree commercial terms to contract gas resulting from successful grant-supported projects". This condition favours state gas users over interstate ones such as NSW.

Were other states to adopt gas reservation policies along the lines of South Australia's, it could reduce supply to NSW further. Moreover, as the gas market tightens, the pressure for each state government to look after its own gas users (ahead of NSW) will increase.

Federal Government intervention

Each state and territory in Australia manages its own resources within its jurisdiction. The Australian Federal Government manages offshore resources beyond the three nautical mile limit of the states and territories. It also has power under the constitution to control exports.

Without any direct powers to control how each state and territory develops its gas resources, the Federal Government developed the Australian Domestic Gas Security Mechanism[55] (ADGSM) which gives it powers to limit LNG exports under certain circumstances.

The ADGSM aims to ensure there is a sufficient supply of gas to meet the forecast needs of energy users within Australia. If LNG projects' use of domestic gas results in a supply shortfall in the domestic market, those projects may be required to limit their exports or find new gas sources.

The powers of the ADGSM have not been triggered to date, but a Heads of Agreement between the Federal Government and Queensland LNG producers was signed in September 2018, and applies to gas supply for both 2019 and 2020. The agreement aims to "maintain a secure supply of gas to the east coast domestic market". Under the agreement, the LNG producers have committed to offer uncontracted gas to the domestic market in 2019 and 2020 to meet any expected supply shortfalls. The LNG producers have agreed to offer this uncontracted gas on reasonable terms and before offering it overseas.

However, as the southern (Victoria, Tasmania, NSW and South Australia) fields further decline in the future and if no more southern resources are developed, pipeline constraints (particularly in the pipelines from Moomba) may limit the amount of gas that can be sent from northern gas fields to assist in meeting southern demand as required by the ADGSM.

The Federal Government has announced that a review of the ADGSM will be completed by the end of September 2019[56]:

> **"Past approvals of large gas export projects have not adequately considered the impact on the domestic gas market and that has contributed to some of the pressures we have seen in recent years. We cannot afford to repeat these past mistakes.**
>
> **The review will assess if the ADGSM is still fit for purpose to deliver a functional domestic gas market with the lowest possible prices for consumers while ensuring strong investment in new gas production. It will specifically investigate the ongoing appropriateness of the ADGSM's Total Market Security Obligation arrangements.**
>
> **Second, the Government will consider options to establish a prospective national gas reservation scheme.**
>
> **In considering the establishment of a gas reservation scheme, the Government will work cooperatively with the States and Territories. The establishment of any such a scheme should coincide with State and Territory governments removing unwarranted restrictions on gas developments. The Government will seek to conclude its consideration of options by February 2021."**

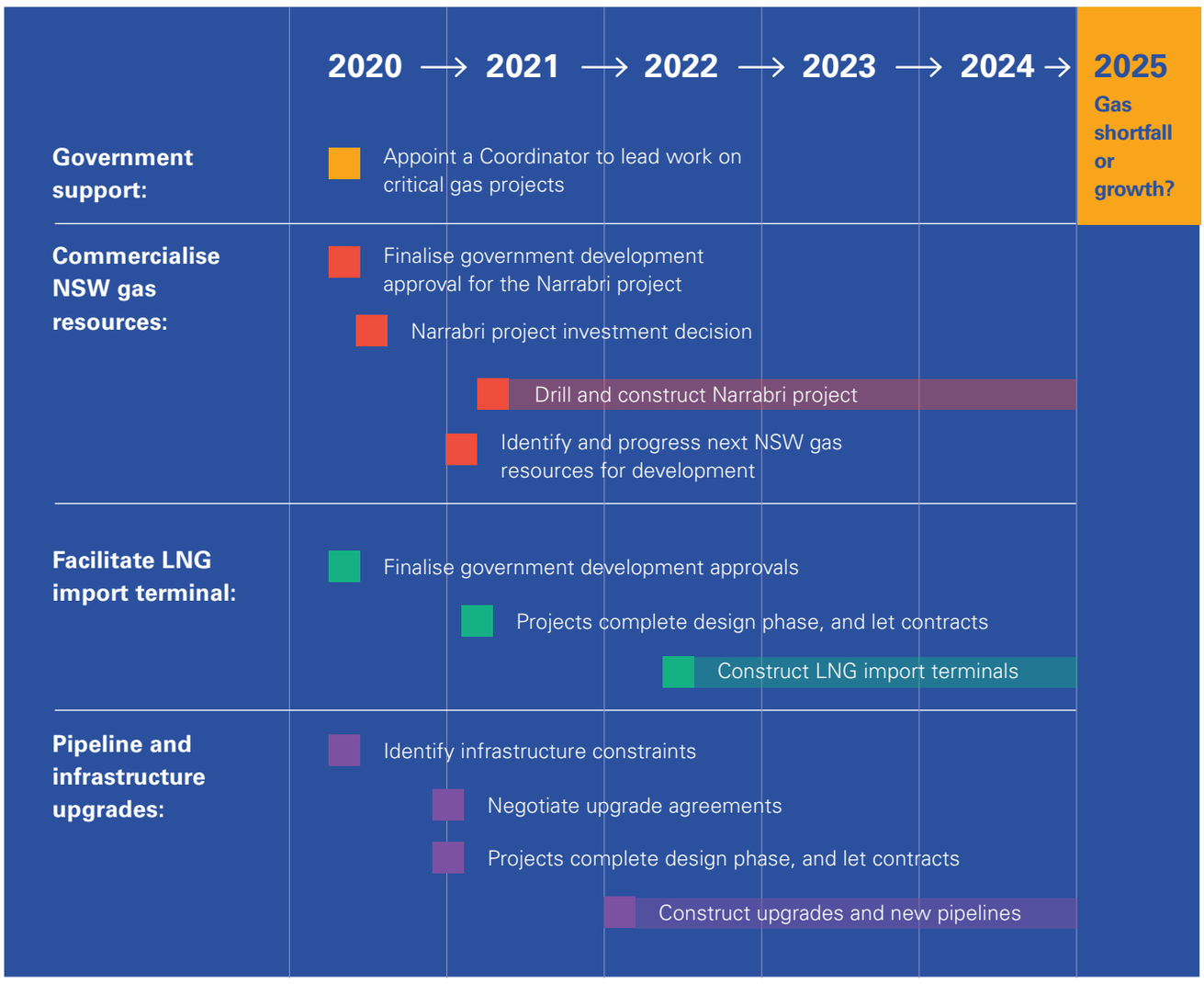
The Queensland LNG operators have large, long-term LNG supply contracts with overseas buyers, which are material to the receiving countries. For example, China is Australia's largest trading partner, and Queensland LNG supplies about 28% of China's LNG requirements.

An aggressive use of the ADGSM which caused a shortfall to important trading partners could have unintended consequences, suggesting that some caution in its use will be exercised. Also the ADGSM is a relatively short-term horizon of a few years, and large gas buyers are seeking more certainty for a longer period. Tempting as export restrictions might initially seem, there is also a significant risk that they deter further investment, both in new CSG fields and in those which are already operational (given the large operating costs of CSG production in comparison to conventional gas wells). Curtailing exports will not help domestic consumers if it ends up curtailing production as well.

NSW cannot rely on Federal intervention to block Queensland gas exports as the 'solution' to its approaching gas shortage.

To avoid the approaching gas shortage potentially devastating impact on NSW businesses and the economy, NSW instead needs to lift the unofficial blocks on in-state production and approve the Narrabri development. Work must begin immediately on an integrated gas road map, as outlined in Sections 7-10 and Figure 16 to mitigate these impacts.

Figure 16 NSW gas road map



Source: EnergyQuest analysis

[53] Santos, "Narrabri natural gas set to power more homes and businesses in northwwst NSW ", media release, 14 January 2019; https://www.santos.com/media-centre/announcements/narrabri-natural-gas-set-to-power-more-homes-and-businesses-in-northwest-nsw/

[54] South Australian Government, "PACE Gas"; http://www.energymining.sa.gov.au/petroleum/latest_updates/pace_gas

[55] Federal Register of Legislation, 2017; https://www.legislation.gov.au/Details/F2017N00050

[56] Federal Government, Media Release, "Government acts to deliver affordable, reliable gas", 6 August 2019; https://www.minister.industry.gov.au/ministers/canavan/media-releases/government-acts-deliver-affordable-reliable-gas

11. Benefits: What does a gas industry offer NSW?

NSW economic impact

An estimated 300,000 jobs rely on gas supply. Gas supplies around 1.3 million households and 33,000 businesses[57].

The Industrial sector accounts for 45% (56 PJ) of total gas demand in NSW. NSW's manufacturing sector, which is approximately 84% of the state's Industrial load, is important to the NSW and Australia's economy[58] employing 253,000 people in 26,127 businesses, adding $33 billion in value, and exporting $2.4 billion in value.

Access to a secure, competitive gas supply underpins the contribution to the economy from these manufacturing firms.

Regional development

Locally sourced gas puts downward pressure on gas prices by increasing supply alternatives and minimising pipeline related costs. It also enhances energy security by increasing diversity of supply.

A local gas project, such as Santos' Narrabri project, provides economic benefits, including:

- investment: capital investment of $3.6 billion and operating expenditure of $5.5 billion over its 25 year life[59]
- job creation: both for field development (construction of wells and associated infrastructure with 1,300 jobs) and later operations. Over the project life of 25 years a total of 512 direct and indirect jobs in NSW are forecast as follows:
  - 127 jobs in the Narrabri local government area
  - 161 jobs in adjacent regions
  - 224 jobs in the rest of NSW
- infrastructure development: a new pipeline connecting to the MSP, and GPG
- regional development: flow on impacts to other businesses supplying goods and services to Narrabri project
- Santos estimates an economic output for the project of $11.9 billion for the economies of Narrabri, the region and NSW[60]

Tax revenue

Development of NSW resources has a tax benefit from petroleum royalties and payroll taxes, not only from the gas project but also other businesses supplying indirect jobs in adjacent regions and elsewhere in NSW.

As a general indication, assuming Narrabri gas production of 777 PJ (which was the last gas reserves number for Santos' share of Narrabri), a 'well-head net value' of $3/GJ[61], and a royalty rate of 10%, the Narrabri project may provide a minimum of $233 million in NSW petroleum royalties in addition to the corporate and payroll taxes and GST that an $11.9 billion investment will generate.

[57] Santos, "Executive Summary of Narrabri EIS", 2016, pES5; https://majorprojects.accelo.com/public/599b13c8378739ff1fd1451067c2ab38/00c%20Executive%20summary.pdf

[58] NSW Government, "Economic Value and Sector Overview", 2019; https://www.industry.nsw.gov.au/development/industry-opportunities/advanced-manufacturing/economic-value-sector-overview

[59] Ibid, pES9

[60] Ibid, pES9

[61] EnergyQuest analysis based on Queensland Government 2019 Budget for royalties (p153), and estimated gas production; https://budget.qld.gov.au/files/4.%20Revenue%20Measures.pdf

Feedstock to the chemicals industry

While heating and cooking can technically be substituted by electricity (albeit at a cost that is often substantial), this is not the case when gas is used as a feedstock. The chemicals industry is unique among Australian industrial sectors in needing gas for this purpose. It is used as a source of carbon and hydrogen, transformed into value added products.

APPEA notes[62]:

> **"Natural gas is also a raw material (feedstock) for creating products such as fertilisers, explosives, paper, plastics and chemicals. In most cases, there is no substitute for gas.**
>
> **Gas is used to produce ammonia, which is an important feedstock for several industries.**
>
> - **The most commonly used fertiliser in the world is urea, which is produced from ammonia. Producing each tonne of urea requires 21 GJ of natural gas — the same amount of gas that the average NSW household uses in a year. Australian industries use 1.6 million tonnes of urea each year**
> - **Ammonia is also used to make explosives and cleaning products, and in fermentation, brewing and winemaking."**

Chemistry Australia, who represents the chemistry industry which relies on gas as a feedstock, commissioned the "Chemical Sector Economic Contribution Analysis" report[63].

The report analysed the importance of gas to its industry, and the economic impact:

- The chemistry sector drives more than $286 million of local economic activity for every PJ of gas it consumes.
- The sector also supports more than 1,600 full time equivalent jobs for every PJ of gas it uses.
- The chemistry industry underpins more than 212,000 full time equivalent jobs across the economy.
- 80% of the chemistry sector is located in Victoria, NSW and Queensland.
- The chemistry sector directly employs more than 19,000 people in full time equivalent jobs in NSW.
- In 2017–18, the chemistry sector contributed $11.2 billion to NSW's Gross State Product.

[62] APPEA, "Manufacturing with gas", 2019; https://www.appea.com.au/oil-gas-explained/benefits/gas-and-manufacturing/

[63] ACIL Allen consulting, "Chemical Sector Economic Contribution Analysis", 2 August 2019; http://www.chemistryaustralia.org.au/docs_mgr/ACILAllenChemistry2017-2018%20FINAL.pdf. The report estimates the direct and indirect economic value of the output of the Australian chemical industry during the financial year 2017–2018.

12. Environmental benefits

Emission reductions

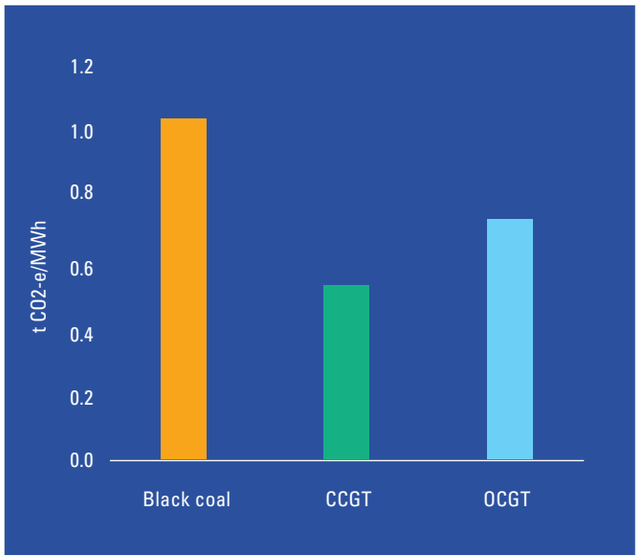
GPG of electricity is expected to increase from 2029 in response to the retirement of aging coal-fired plants and potential support of renewables by offering "firmer" power. Where gas-fired generation replaces coal, it will lower emissions.

A recent CSIRO report[65] concluded:

> **"A comparison of [greenhouse gas] GHG emissions from electricity production in Australia from Queensland thermal coal or natural gas derived from Surat Basin CSG showed a reduction in emissions of 31% (open cycle gas turbine; OCGT) and 50% (closed cycle gas turbine; CCGT)".**

The total emissions from electricity generation from coal and GPG (OCGT and CCGT) are shown in Figure 17.

Figure 17 Emissions for electricity generation by fuel type



Source: CSIRO, July 2019, p28

Gas supports renewables

Gas-fired generation supports the transition to a renewables-based electricity future by providing firmer, dispatchable power. A power sector largely based on renewables will require energy storage (industrial scale batteries and pumped storage such as Snowy 2.0) and GPG. During this transition, GPG will support other energy storage options to supply firmer power during periods when renewables output is low.

For NSW, GPG is forecast to more than triple from 11 PJ per year today to 35 PJ per year in 2037 as coal-fired power generators close, and gas fills the gaps in renewable output.

GPG in NSW also provides grid support which improves network stability and lowers transmission losses, particularly for NSW's long distance networks. Without these remote GPG power stations, network upgrades would be required to supply remote load centres. Further, the fast-start capability of gas turbines allows for rapid response to changes in daily demand and provides the flexibility needed to supply the load required. They provide services which are difficult or expensive for renewables to provide, letting network operators maintain frequency and voltage at desired levels.

However, for gas-powered generation to be able to play this role, new gas power stations will need to be built. Without greater confidence in the future of the gas supply picture in NSW, it is unlikely that investors will be attracted to build these power stations. There is a risk, as a result, that the problems in the gas market in the mid 2020s could have consequences that spill over to affect the electricity market by the end of the decade.

[64] AEMO, "2019 GSOO"

[65] CSIRO, "Whole of Life Greenhouse Gas Emissions Assessment of a Coal Seam Gas to Liquefied Natural Gas Project in the Surat Basin, Queensland, Australia", July 2019, p28; https://gisera.csiro.au/wp-content/uploads/2019/07/GISERA_G2_Final_Report-whole-of-life-GHG-assessment.pdf

Abbreviations

2P - proved and probable reserves

2P - proved and probable reserves

2C - best estimate contingent resources

ACCC - Australian Competition and Consumer Commission

ADGSM - Australian Domestic Gas Security Mechanism

AEMO - Australian Energy Market Operator

APLNG - Australia Pacific LNG

APPEA - Australian Petroleum Production and Exploration Association

ATP - Authority to prospect

C&I - Commercial and Industrial

CCGT - combined cycle gas turbine

CO2 - carbon dioxide

CO2-e - carbon dioxide equivalent

CSG - coal seam gas

DNRME - Queensland Department of Natural Resources, Mines and Energy

EGP - Eastern gas pipeline

EPA - Environmental Protection Agency

FSRU - floating storage and regasification unit

GHG - greenhouse gas

GPG - gas-fired power generation

GJ - gigajoule (1 billion joules or 109)

GLNG - Gladstone LNG

GSOO - Gas Statement of Opportunities

HOA - heads of agreement

JKM - Platt's Japan Korea Marker

LNG - liquefied natural gas

MOU - memorandum of understanding

MSP - Moomba to Sydney pipeline

Mt - million tonnes

Mtpa - million tonnes a year

MW - megawatt

MWh - megawatt hour

OCGT - open cycle gas turbine

PACE - Plan for Accelerating Exploration

PJ - petajoule (one thousand terajoules)

PJ per year - petajoules a year

PRMS - Petroleum resources management system (Society of Petroleum Engineers)

Res/Com - Residential and Commercial

STTM - Short term trading market

TJ - terajoule (one thousand gigajoules)

TJ/d - terajoules per day

VNI - Victoria – New South Wales Interconnect

Conversion factors

EnergyQuest converts the measures used by different companies to a consistent basis. In line with Australian industry conventions, we use joules for domestic gas, barrels for oil and condensate and tonnes for LPG and LNG. Where available we use individual company conversion ratios.

Otherwise we use:

crude oil 1 barrel (bbl) = 1 barrel oil-equivalent (boe)
sales gas 1 petajoule (PJ) = 171,937 boe
sales gas 1 billion cubic feet (Bcf) = 1.06 PJ
LPG 1 tonne (t) = 8.458 boe
LNG 1 million tonnes (Mt) = 55.43 PJ
LNG 1 million tonnes (Mt) = 9531 Kboe
LNG 1 cubic meter = 0.4157 tonnes
condensate 1 barrel = 0.935 boe
ethane 1000 tonnes = 0.05181 PJ
ethane 1 PJ = 15.1 MMcm
oil/condensate 1000 barrels = 158.97 kilolitres
LPG 1000 tonnes = 1.88 ML
sales gas 1 petajoule (PJ) = 26.71 MMcm
British thermal units 1 million (MMBtu) = 1.055 GJ = 1Mcf = 10 therms
British thermal units 1 billion Btu = 1.055 TJ = 1 MMcf
British thermal units 1 trillion Btu = 1.055 PJ = 1 Bcf

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a. we will not be liable in any way for such losses (either to you or to any third party); and

b. you will indemnify us for any claim made by that third party against us in connection with the unauthorised use of EnergyQuest's IP.

7. Subject to our prior written consent, any use of EnergyQuest's IP by you or your related entities (by way of reference, citation, quotation or in any other way or in any form) must be clearly and directly attributed to us in an accurate manner and in the context in which it is intended. We accept no responsibility for any cost, expense or liability incurred by you or any other person as an indirect or direct consequence of any such use of EnergyQuest's IP in a manner which is inconsistent with the purposes of the Consultancy. You hereby release us, to the fullest extent permitted by law, in respect of any such claims, losses or expenses.

8. We observe the National Privacy Principles in the Privacy Act 1988. In dealing with you, we may collect certain information such as your name, contact details, personal and business information. Information collected about you is used only:

a. for the purpose of the Consultancy; and

b. in a manner which you would reasonably expect us to use or disclose it for that purpose.

9. If you do not accept these Terms or if you breach these Terms, we can terminate the Consultancy.

10. These Terms:

a. may be amended by us at any time by posting amended terms and conditions on our website, but otherwise cannot be varied without our written consent; and

b. are governed by and construed in accordance with the laws of South Australia, Australia. You irrevocably and unconditionally submit to the non-exclusive jurisdiction of the courts of South Australia.

11. If you breach any of these Terms:

a. we reserve the right to suspend or terminate the Consultancy;

b. we reserve the right to suspend or terminate your subscription to EnergyQuarterly;

c. we may take action against you in respect of any loss or damage that we suffer because of your breach; and

d. those restrictions imposed on you by these Terms (including those relating to EnergyQuest's IP) will continue to apply, even after the termination of the Consultancy.

12. For the purposes of these Terms:

a. "you" and "your" refers to:

in the case of a subscription to EnergyQuarterly for a limited-user licence, the subscriber and/or the holder(s) of that limited-user licence;

in the case of a corporate subscription to EnergyQuarterly, the subscriber and each of those of the subscriber's authorised employees to whom EnergyQuarterly is distributed; and

in all other cases the person who has engaged EnergyQuest,

b. "us", "we" and "our" refers to EnergyQuest Pty Ltd.

NSW Business Chamber

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