UPDATE TO GAS STATEMENT OF OPPORTUNITIES

UPDATING INFORMATION PROVIDED IN:

- THE 2017 GAS STATEMENT OF OPPORTUNITIES FOR EASTERN AND SOUTH-EASTERN AUSTRALIA, AND
- THE 2016 GAS STATEMENT OF OPPORTUNITIES FOR WESTERN AUSTRALIA

Published: **September 2017**

AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

IMPORTANT NOTICE

Purpose

This document provides an update to:

- The March 2017 Gas Statement of Opportunities and the updated gas outlook in the June 2017 Energy Supply Outlook for eastern and south-eastern Australia, in accordance with the National Gas Law and Part 15D of the National Gas Rules.
- The December 2016 Gas Statement of Opportunities for Western Australia, in accordance with the *Gas Services Information Act 2012* (WA) and Part 6 of the Gas Services Information Rules.

This update is based on information available to AEMO as at 1 August 2017, and includes an update from one producer on 15 September 2017. In the analysis of the National Electricity Market, it does not consider recent announcements by the Queensland government on its renewable energy plan.

Disclaimer

The forecasts in this report use information provided by third parties. AEMO has made every effort to ensure the quality of the information in this document but cannot guarantee that information, forecasts and assumptions are accurate, complete or appropriate for your circumstances. This publication does not include all of the information that an investor, participant or potential participant in natural gas markets might require and does not amount to a recommendation of any investment.

Anyone proposing to use the information in this publication (including information from third parties) should independently verify and check its accuracy, completeness and suitability for purpose, and obtain independent and specific advice from appropriate experts.

Accordingly, to the maximum extent permitted by law, AEMO and its officers, employees and consultants involved in the preparation of this document:

- make no representation or warranty, express or implied, as to the currency, accuracy, reliability or completeness of the information in this document; and
- are not liable (whether by reason of negligence or otherwise) for any statements or representations in this document, or any omissions from it, or for any use or reliance on the information in it.

Version control

Version	Release date	Changes
1	September 2017	Initial release

EXECUTIVE SUMMARY

Based on the most recent developments in the gas industry, data, discussions with industry participants, and its latest modelling, AEMO forecasts that:

- In eastern and south-eastern Australia, there is potential for an annual energy shortfall in the domestic gas market of 54 petajoules (PJ) in 2018 and 48 PJ in 2019.
- In Western Australia, all export and domestic gas demand will be met in 2018 and 2019.

While there is operational flexibility month to month in gas and liquefied natural gas (LNG) production, AEMO's current forecasts suggest the aggregate gas supply available to the domestic market in eastern and south-eastern Australia may not be sufficient to meet the total annual energy requirements of domestic gas users in these regions in 2018 and 2019.

The shortfall could be higher than expected, in a variety of plausible circumstances that could increase demand for gas by household and business consumers, and for gas-powered generation of electricity (GPG) in the National Electricity Market (NEM). AEMO's reasonable estimate, considering these uncertainties, is that the shortfall could be as high as 107 PJ in 2018 and 102 PJ in 2019.

Projections of aggregated gas production and LNG gas demand vary, based on market conditions and contracting, indicating a dynamic situation that can change rapidly. As such, AEMO considers that the risks in the overall energy balance for eastern and south-eastern Australia warrant continued close attention and monitoring.

In this analysis, AEMO has considered the overall annual energy to be supplied by gas in the 2018 and 2019 calendar years.

East coast producers provided AEMO with projections of annual production.[1] LNG consortia provided AEMO with projections of annual quantities of gas required for LNG exports. AEMO forecast domestic annual energy requirements for electricity and gas by businesses and households, and in GPG.

In eastern and south-eastern Australia:

- The aggregated projection of annual gas production, provided by gas producers, is 1,891 PJ in 2018 and 1,886 PJ in 2019.
- The aggregated projection of annual demand for gas for LNG exports, provided by LNG consortia, is 1,303 PJ in 2018, and 1,336 PJ in 2019.
- After subtracting projections of LNG gas demand from projections of production, the forecast available supply of gas for domestic use is 588 PJ in 2018 and 550 PJ in 2019.
- AEMO forecasts a domestic gas energy requirement of 642 PJ in 2018 and 598 PJ in 2019.

AEMO's forecasts of domestic gas requirements consider the range of gas potentially demanded by household and business gas sectors, accounting for a range of risks and uncertainties that can cause variability in energy consumption and use. The forecasts also include a range of electricity supply and demand requirements under various scenarios that could affect demand for gas by GPG in the NEM:

- The aggregated demand for gas by the household, commercial, and industrial sectors is forecast to be 466 PJ in 2018 and 463 PJ in 2019.
- The annual gas requirement by GPG is projected to be 176 PJ in 2018 and 135 PJ in 2019.

Table 1 summarises AEMO's adequacy outlook for the eastern and south-eastern Australia gas market for the next two years.

[1] These supply forecasts comprise aggregated total throughput by processing facility, and represent producers' operational projections of annual production in the next two years, regardless of their contracted positions.

Table 1 Gas supply adequacy assessment (PJ)

	2018		2019	
Aggregate gas production	1,891		1,886	
Aggregate LNG export gas demand	1,303		1,336	
Gas supply available to domestic market	**588**		**550**	
	Expected	Uncertainty	Expected	Uncertainty
Residential, commercial, and industrial	466	492	463	495
GPG	176	203	135	157
Total domestic gas demand	**642**	**695**	**598**	**652**
Surplus / Deficit	**-54**	**-107**	**-48**	**-102**

This table includes uncertainty factors for domestic gas demand to cover feasible conditions that could increase gas demand and the size of the shortfall above expected levels. These uncertainty factors, for each demand sector, are explained in Table 2.

Table 2 Factors affecting uncertainty of demand forecasts

Demand segment	Notes on methodology and expected forecasts	Uncertainty factors increasing demand beyond expected forecasts
Residential and commercial	AEMO examines a range of factors when forecasting residential and commercial gas use. These include historical demand, prices, population growth, appliance preferences, energy efficiency, dwelling construction trends, and other economic factors. AEMO models these inputs as part of a forecasting process that includes extensive industry consultation, and where valuable, benchmarking advice from consultants, which together are used to quality check and validate assumptions and outputs. The overall expected forecast in the short term, as it was in AEMO's 2016 *National Gas Forecasting Report* (NGFR), is for demand across these sectors to decline slightly.	Key uncertainties that could increase residential and commercial demand beyond expected levels include: • Weather variance (such as colder winter). • Population variance. • Response to changing energy prices and bills, including energy efficiency. • Economic assumptions affecting commercial demand for gas. • Gas to electric appliance switching. • Annualised estimates of long-term uncertainty regarding policy, technology, consumer preferences, and structural and behavioural change.
Industrial	Forecasts for industrial gas use include factors used for residential and commercial sectors, as well as economic, business, and commercial conditions relevant to the largest gas users across the outlook period. This is achieved via a mix of analytics, modelling, and direct consultation with industrial businesses to understand projected gas consumption. AEMO also reviews historical data. Projections are now higher than in the 2016 NGFR, due to expected production shifts advised by some large users. In some cases, production levels are returning to historical levels after a period of low or interrupted output. The forecasts include expansions, such as Century Mine in Queensland announced in February 2017. A small decline is, however, forecast to continue. Despite neutral economic conditions, many large industrial gas users remain challenged by the international trading environment and by cost factors in Australia, including gas and electricity prices. A key example is the continuing decline of the Australian automotive manufacturing sector.	The key uncertainty factor that could increase industrial demand beyond expected levels is the potential for large production shifts in the output of gas users, recognising that the size of these shifts can create step-changes in annual gas use by region.

Demand segment	Notes on methodology and expected forecasts	Uncertainty factors increasing demand beyond expected forecasts
GPG	The annual requirement for GPG gas demand will directly depend on: • The level of electricity consumption in the NEM. • The dynamics of the NEM and supporting contracts and commercial arrangements of participants, which will influence the operation of GPG relative to coal-fired generation, hydro generation, and renewable sources such as wind and solar. AEMO considered the underlying competitive dynamics between electricity generation fuels, generation portfolios, and renewable generation. The GPG forecast includes the effect of potential expansion of renewable generation considered in its 2017 *Electricity Statement of Opportunities* (ESOO) for the NEM.[2] Based on an assessment of current generator strategies and underlying fuel costs, AEMO modelled a range of potential outcomes, providing insight into the uncertainty factors affecting GPG. This included expected additional gas demand for returning mothballed GPG that have been announced in the NEM, and the impacts of retirements of NEM generators. The expected demand for GPG in 2018 is higher than previously forecast, reflecting the 2017 reversal of a declining trend due to factors (increased security requirement in South Australia, retirement of Hazelwood Power Station, and response to electricity prices) which are expected to continue next year. The forecast in 2019 is lower than in 2018 due to projected increases in renewable generation and consumer energy efficiency.	A number of factors could result in higher electricity consumption which would impact GPG (such as a hotter summer). AEMO's analysis used a risk and uncertainty-bounded forecast for residential and business electricity use, similar to that described above for gas (including the same factors driving higher energy use), to determine the GPG uncertainty quantity. AEMO also examined a number of other scenarios potentially affecting NEM dynamics and increasing GPG demand above expected levels: • Reduced rainfall impacting hydro generation. • Reduced average wind speeds impacting wind farm output. • Delays in the installation of new renewable generation. • The extended (three months) unavailability of a coal-fired generator. The GPG uncertainty quantity is sufficient to cater for a number of these scenarios provided the expected electricity consumption occurs.

The uncertainty values in Table 1 provide for a number of the drivers noted in Table 2 coinciding; for example, higher household and business demand for gas, as well as increased electricity consumption in the NEM that would increase GPG demand.

In some circumstances, domestic demand could exceed the uncertainty values in Table 1; for example, if higher gas demand from households and businesses coincided with multiple NEM contingency events increasing GPG demand. AEMO, however, considers this additional level of coincidence of higher demand factors to be a very low risk.

As shown in Table 1, forecasts for each of the next two years indicate additional annual gas production could be needed for contracting to supply the annual energy needs of the domestic gas market:

- This risk is not driven by deliverability, as there is sufficient infrastructure capacity in place for production of gas and transport to domestic users.
- If additional gas production capacity existed, negotiation of bilateral contracts and/or alternative market-based solutions (such as provisioning of quantities for sale via AEMO's Gas Supply Hub) would be needed before this production would be made available.

From this assessment, AEMO projects that the annual gas energy balance situation in eastern and south-eastern Australia will remain tight. AEMO also notes that projections of aggregated gas production and LNG gas demand vary based on market conditions and contracting. These dynamic circumstances and risks in the overall energy balance for eastern and south-eastern Australia warrant continued close attention and monitoring.

[2] AEMO. *Electricity Statement of Opportunities*, September 2017. Available at: https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/NEM-Electricity-Statement-of-Opportunities.

CONTENTS

TABLES

FIGURES

CHAPTER 1. PURPOSE AND SCOPE

This Update to the *Gas Statement of Opportunities* (GSOO) assesses the forecast adequacy of the east coast gas market and Western Australia gas market to meet forecast annual gas requirements for calendar years 2018 and 2019.

This assessment is based on information available at 1 August 2017, and includes an update from one producer on 15 September 2017. In the analysis of the National Electricity Market (NEM), it does not consider recent announcements since 7 July, including the Queensland government's announced renewable energy plan.

Gas demand forecasts include demand from domestic residential, commercial, and industrial customers, for gas-powered generation (GPG) supplying Australia's electricity markets, and for liquefied natural gas (LNG) export operations.

AEMO has produced this outlook under the National Gas Law and Part 15D of the National Gas Rules (for eastern and south-eastern Australia) and the *Gas Services Information Act 2012* (WA) and Part 6 of the Gas Services Information Rules (in Western Australia), to inform markets, policy-makers, and other stakeholders about the projected gas supply-demand balance. There is no equivalent power for AEMO to assess gas supply and demand in the Northern Territory.

The gas markets in Western Australia and the Northern Territory are not connected with the eastern and south-eastern Australian gas markets, and have different supply and demand drivers. The construction of a pipeline to Northern Territory has the potential to link the Northern Territory and eastern and south-eastern gas markets in the future. At this time, the domestic gas supply from each gas area operates independently.

AEMO anticipates that the assessment for the 2018 calendar year will, along with a range of other information and contributions from other parties, inform the Federal Minister for Resources, who requested information from AEMO on 24 July 2017 under clause 9(6) of the Customs (Prohibited Exports) (Operation of the Australian Domestic Gas Security Mechanism) Guidelines 2017 (ADGSM).

The ADGSM provides for the Minister to consult with a number of parties, including market bodies, government agencies, LNG projects, the Prime Minister, and Ministers, on the potential for a domestic gas shortfall in any calendar year and, following consultation, to determine whether LNG export restrictions should be imposed to avoid such a shortfall.

It is important to note that, as in any forecast, supply and demand projections are subject to change due to changed circumstances during the calendar year, and that these projections, and the 2019 forecast in particular, are AEMO's expectations based on available information at this time.

CHAPTER 2. EASTERN AND SOUTH-EASTERN AUSTRALIA

2.1 Approach

This GSOO Update assesses the forecast adequacy of the east coast gas market to meet forecast annual gas demand from domestic residential, commercial, and industrial customers, for GPG supplying the NEM, and for LNG export operations.

It provides an adequacy forecast for calendar years 2018 and 2019. All yearly volumes are expressed in calendar year terms unless otherwise stated.

In this analysis, AEMO has considered the overall annual energy balance and requirements for energy to be supplied by gas. Analysis deriving from AEMO's 2017 GSOO for eastern and south-eastern Australia[3] determined that capacities for existing plant and pipeline infrastructure were sufficient to 2029 to process and deliver maximum daily demand and annual consumption. Therefore, for the purposes of this report, maximum daily demand was not considered in assessing annual supply adequacy, nor were potential disruptions to key gas processing and pipeline infrastructure assets.

AEMO has updated its domestic demand projections for GPG and the residential, commercial, and industrial sectors, and used information provided by gas producers and LNG consortia. AEMO used a number of scenarios to test a range of risks and uncertainties, discussed further in Section 2.4.

2.2 Gas production outlook

This report uses projections of production for calendar years 2018 and 2019 provided by eastern and south-eastern gas producers. To protect the confidentiality[4] of individual submissions, production forecasts have been aggregated in this report.

These supply forecasts comprise aggregated total throughput by processing facility, and represent producers' operational projections of annual production in the next two years, regardless of their contracted positions.

Producers have provided AEMO with lower supply projections in both years compared to AEMO's forecasts that it used in its March 2017 GSOO, and to projections provided by gas producers that AEMO used in its June 2017 *Energy Supply Outlook* (ESO). These forecasts are outlined in Table 3.

Table 3 Comparison of eastern and south-eastern Australia production forecasts (petajoules (PJ))

	March 2017 GSOO		June 2017 ESO		September 2017 GSOO Update	
	2018 (PJ)	2019 (PJ)	2018 (PJ)	2019 (PJ)	2018 (PJ)	2019 (PJ)
Total eastern and south-eastern Australia forecast production	1,949	1,949	1,938	1,950	1,891	1,886

The decreased forecast production in both years in the latest projections relates to an approximately 4% revision downwards of forecast production from existing projects (that is, fields already producing). Producers have not specified delays to projects not yet online.

East coast producers have indicated to AEMO that they constantly revise production forecasts, and that changes to supply forecasts should be expected.

[3] AEMO. *GSOO Methodology*, March 2017. Available at: http://www.aemo.com.au/Gas/National-planning-and-forecasting/Gas-Statement-of-Opportunities.

[4] Given the commerciality of the information, AEMO has been provided information under strict confidentiality requirements.

Factors which could lead to production being higher than projected include:

- Greater flow rates from wells than expected.
- Additional contracting for gas. Existing production could be reallocated to domestic supply needs, or additional production capacity could potentially be made available from coal seam gas (CSG) fields for increased domestic supply, in response to market conditions. For example, recent public announcements by Santos of 15 petajoules (PJ) supply[5] of gas for Pelican Point Power Station in 2018, and an additional 30 PJ[6] for domestic contracting over 2018 and 2019, illustrate the highly dynamic nature of the upstream gas market.
- Higher prices leading to greater cash flow and an increase in capital budget spend. This may lead to the acceleration of projects not yet online or the expansion of gas projects already producing in the longer term, but is not expected to materially alter outcomes within the next 12 months.
- A change in various state government policies to remove restrictions on exploration and development of gas reserves and resources. Similarly, this is not currently expected to materially alter outcomes within the next 12 months.

2.3 LNG export gas demand outlook

This report uses operational projections, provided by LNG consortia, of gas required for LNG export for the calendar years of 2018 and 2019.

LNG is the single largest point of consumption of gas, representing approximately 70% of supply. Consequently, any change in LNG demand will have a material effect on the overall supply adequacy assessment.

AEMO is not privy to the contractual arrangements of the LNG consortia or their gas supply arrangements, although the consortia have suggested to AEMO that there is reasonable flex in the operation of LNG facilities. They also have advised that any increased demand for export LNG is not expected to impact total east coast supply adequacy, as the increased demand is contingent on, and would be supported through, additional equity supply.[7]

There is potential for changes in LNG demand in response to international LNG spot markets, although AEMO does not have information to forecast such movements.

Continuing flexibility in gas demand for LNG exports will be important for management of unexpected events in the gas supply chain, or new increases in gas demand by GPG to maintain NEM power system security and reliability.

The latest projections of annual gas requirements for LNG export from Curtis Island LNG consortia are approximately 2% lower than the combination of AEMO's and LNG consortia's projections used in AEMO's June 2017 ESO, and lower than the forecasts used in the March 2017 GSOO, as outlined in Table 4.

Table 4 Comparison of Curtis Island export LNG demand forecasts (PJ)

	March 2017 GSOO		June 2017 ESO		September 2017 GSOO Update	
	2018 (PJ)	2019 (PJ)	2018 (PJ)	2019 (PJ)	2018 (PJ)	2019 (PJ)
Total export LNG forecast demand	1,376	1,428	1,344	1,374	1,303	1,336

[5] Santos. Media release, "Santos to redirect gas to South Australia economy", 14 August 2017. Available at: https://www.santos.com/media-centre/announcements/santos-to-redirect-gas-to-south-australian-economy/.
[6] Santos. Media release, "GLNG gas to be supplied into the East Coast domestic market", 7 September 2017. Available at: https://www.santos.com/media-centre/announcements/glng-gas-to-be-supplied-into-the-east-coast-domestic-market/.
[7] Supply derived from producers' own operations or their share of joint venture operations operated by others. This does not include gas purchased from third parties.

The LNG consortia have advised AEMO that their production forecasts, included in the total production outlook in Section 2.2, are consistent with these forecasts of gas required for LNG exports.

They also provided information on a range of scenario forecasts of potential gas requirements, which reflect the following drivers (or combination of drivers):

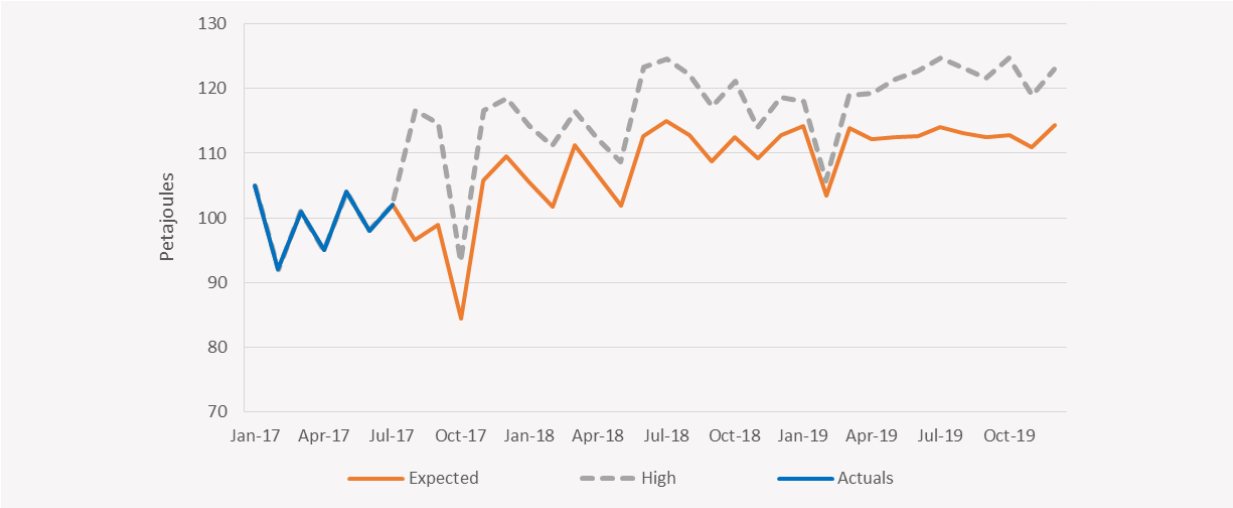
- Greater/lower flow rates than forecast.
- Lower/higher rates of planned and unplanned maintenance.
- Market conditions, including the arbitrage between the domestic and export LNG markets

Figure 1 below shows:

- Actual demand for LNG exports to 31 July 2017.
- Forecast scenarios from August 2017 until the end of 2019.

Demand for export LNG from Curtis Island may increase during 2018 and 2019, as all six LNG trains have completed their commissioning phase and are able to operate at higher capacity than previously.

Figure 1 Indicative monthly quantities of gas required for LNG exports (ex-Curtis Island), actual January–July 2017 and forecast (scenarios) August 2017 – December 2019



Based on a combination of profiled annual quantities and monthly profiles provided by LNG consortia, along with data from the Gas Bulletin Board.

2.4 Domestic market gas demand outlook

AEMO examines a range of factors when determining its forecasts for domestic gas use:

- For the residential and commercial sectors, these factors include historical demand, prices, population growth, appliance preferences, energy efficiency, dwelling construction trends, and other economic factors.
- For the industrial sector, in addition to the above, AEMO considers the economic, business, and commercial conditions relevant to the largest gas users across the outlook period. This is achieved via a mix of analytics, modelling, and direct consultation with industrial businesses to understand projected gas consumption and risks to this consumption.
- AEMO also reviews historical data to understand the likelihood of large production shifts in the output of gas users, recognising that the size of these shifts can create step-changes in annual gas use by region.

AEMO models these inputs as part of a forecasting process that includes extensive industry consultation, and where valuable, benchmark advice from consultants, governments, and regulators. These inputs are used together to quality check and validate projections and insights.

Given that the focus of this outlook is the next two years, a time in which a tight supply-demand balance is expected for both gas and electricity, AEMO has also assessed short-term uncertainties and risks in its demand projections for each sector.

2.4.1 Residential, commercial, and industrial gas demand outlook

AEMO forecasts aggregated demand for gas by residential, commercial, and industrial customers to be 466 PJ in 2018 and 463 PJ in 2019.

This represents a minor increase in forecast gas demand in the next two years, compared to previous forecasts used in the March 2017 GSOO and June 2017 ESO, as outlined in Table 5.

Table 5 Comparison of residential, commercial, and industrial demand forecasts (PJ)

	March 2017 GSOO		June 2017 ESO		September 2017 GSOO Update			
	2018 (PJ)	2019 (PJ)	2018 (PJ)	2019 (PJ)	2018 (PJ)		2019 (PJ)	
					Expected	Uncertainty	Expected	Uncertainty
Total residential, commercial and industrial forecast demand	458	444	458	444	466	492	463	495

Forecasts of residential and commercial sector gas consumption are similar to previous forecasts. The small increase is predominantly due to revised expectations of industrial demand (slightly increased by approximately 8 PJ in 2018 and 19 PJ in 2019), based on recent interviews with the largest industrial gas users in all regions.

AEMO conducted these interviews to update its understanding of the large industrial sector outlook for gas use, general business conditions, and risks relating to gas supply and pricing.

In these interviews, industrial gas users advised AEMO:

- They expect production shifts over the next two years. In some cases, production levels are returning to historic levels after a period of low or interrupted output. The projections also include expansions, such as the announced expansion of Century Mine in Queensland, announced in February 2017.
- The current attention on gas supply by industry and government has alleviated some pessimism over future gas availability, including in respect of Queensland's pilot release of land for gas exploration in the Surat Basin. This has deferred some anticipated reductions in manufacturing output that were previously advised due to gas availability concerns.

Figure 2 shows historical gas demands from 2012, and a forecast band of demand for the period 2018 and 2019.

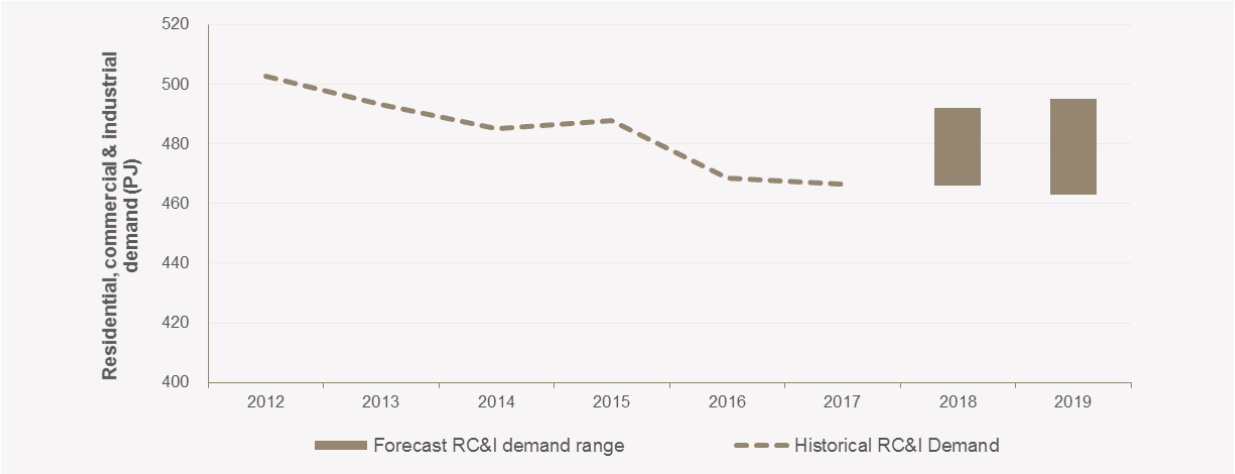
The lower limit of the forecast band reflects AEMO's expected outlook for gas consumption. This shows a continuance of the trend decline in gas consumption evident in the historic gas demand data. The major factors driving the declining trend in long-term gas consumption are:

- Improvements in the energy efficiency of buildings and appliances.
- An increasing preference for electric instead of gas appliances.
- An increasing preference for all electric multi-unit dwellings, such as apartments.
- A continuing structural shift in the Australian economy away from gas-intensive manufacturing and heavy industry.

The upper limit of the forecast band includes a measure of error above this expected demand to account for plausible risks and uncertainties which could increase domestic residential and business

gas demand compared to the expected forecast in the two-year outlook period. An example of this risk or uncertainty is the possibility of an exceptionally cold winter, causing additional demand for gas heating.

Figure 2 Residential, commercial, and industrial demand, actual 2012–16 and forecast from January 2017



AEMO has considered it prudent to include an allowance for risk and uncertainty given the expected tight supply-demand balance over the next few years, affecting both the gas and electricity sectors.[8] This uncertainty factor has been applied to both gas and electricity projections, where the latter is used to estimate gas demand for GPG.

Examples of measured risks and uncertainties that are accommodated in this allowance include:

- More extreme weather, which could result in the demand for gas exceeding the expected projection by 11 PJ in 2018 and 11 PJ in 2019.[9]
- Less demand response to gas price changes, which could result in demand for gas exceeding the expected projection by 7 PJ in 2018 and 11 PJ in 2019.[10]
- Other forecast uncertainties above the expected projection (8 PJ in 2018 and 9 PJ in 2019) that account for possibilities such as structural and behavioural changes to gas demand. AEMO has included an allowance for variations from forecast of factors such as the uptake of energy efficiency, gas to electric appliance switching, and production changes of major industrial loads.[11]

2.4.2 GPG gas demand outlook

This annual requirement for GPG gas demand will primarily depend on the level of electricity consumption in the NEM, as forecast in AEMO's 2017 *Electricity Statement of Opportunities* (ESOO) for the NEM.[12]

[8] AEMO has consulted with industry and large energy users to support a review of risks and uncertainties pertinent to forecasts of residential and business energy use over the next two years. This review has informed the setting of this allowance for risk and uncertainty.

[9] AEMO has modelled annual weather variability, representing the probable impact on gas consumption of a range of annual temperature outcomes between the warmest year (5th percentile) and coolest year (95th percentile) when measured on a 20-year probabilistic basis. This addresses normal variability in demand for heating by fitting a confidence band around the median climate assumption assumed in AEMO's long-run forecasts.

[10] There is uncertainty about energy supply agreements, competition, pricing, and business priorities, as these relate to energy consumption. AEMO does not have visibility of these commercial dynamics, and considers that this uncertainty is material in a short-term two-year assessment in which gas supply is expected to be tight.

[11] AEMO reviewed all forecast drivers to account for a range of identified risks and uncertainties affecting its forecast models over the short and long term. This included analysis of structural changes in energy use over the last 20 years, which informed an annualised estimate of forecast variance that indicates AEMO's assessment of confidence in its expected projection.

[12] AEMO. *Electricity Statement of Opportunities*, September 2017. Available at: https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/NEM-Electricity-Statement-of-Opportunities.

GPG demand is highly dependent on the behaviour of coal-fired generation and other electricity generators that use fuels other than natural gas. With an increasing mix of renewable energy to supplement the significant fleet of coal generators in the NEM, and with gas generators typically providing mid-merit electricity generation (which adjusts during the day as demand changes), the demand for gas for GPG is likely to be increasingly variable.

To forecast gas demand for GPG, AEMO has assessed the possible expansion of renewable generation driven by national targets that deliver a geographic spread of renewable generation across the NEM. This mix of generation (including the existing fleet of coal, gas, hydro, and renewable generators, complemented by additional capacity of renewable generation and battery storage) has been modelled in the 2017 NEM ESOO to determine the adequacy of electricity supply.

Table 6 shows AEMO's latest GPG forecasts compared to those published earlier in 2017.

The return to service of mothballed GPG (including Pelican Point and Swanbank E, and the deferral of the intention to mothball two units at Torrens Island) was included in this GSOO Update assessment, further increasing overall gas demand for GPG, compared to earlier forecasts.

Table 6 Comparison of GPG demand forecasts (PJ)

	March 2017 GSOO		June 2017 ESO		September 2017 GSOO Update			
	2018 (PJ)	2019 (PJ)	2018 (PJ)	2019 (PJ)	2018 (PJ)		2019 (PJ)	
					Expected	Uncertainty	Expected	Uncertainty
Total GPG forecast demand	115	115	138	136	176	203	135	157

Following the 2017 retirement of Hazelwood Power Station, approximately 10 terawatt hours (TWh) of electricity production must be supplied in the NEM by other generators, including GPG. As such, AEMO's forecast GPG demand in 2018 is greater than the total GPG gas consumed in 2016 (but lower than actual outcomes observed from 2012 to 2015, due to renewable energy contributions in 2018 and 2019 that were not present from 2012 to 2015).

Figure 3 below shows the relativity of the 2018 and 2019 forecasts of gas demanded by GPG, compared to historical actual gas consumed by GPG. The figure shows that the expected forecast, including an uncertainty factor, for GPG in 2018 is within the historical range of operational requirements, with the expected projection below the projected gas consumption by GPG for 2017.

In recent years, increasing penetration of renewable energy (including both large-scale wind and solar installations and rooftop photovoltaic (PV) systems) has combined with declining electricity consumption to lower overall GPG needs. Increases in gas fuel costs have also contributed to the reduction in gas generation, as the reduction of 'ramp gas' (gas that was available at lower prices from the Queensland LNG consortia as they increased production in the lead up to their first LNG cargoes) and the commencement of LNG exports has placed upward pressure on gas prices. Gas fuel costs have particularly impacted those generators coming off long-lived gas contracts and being exposed to higher prices.

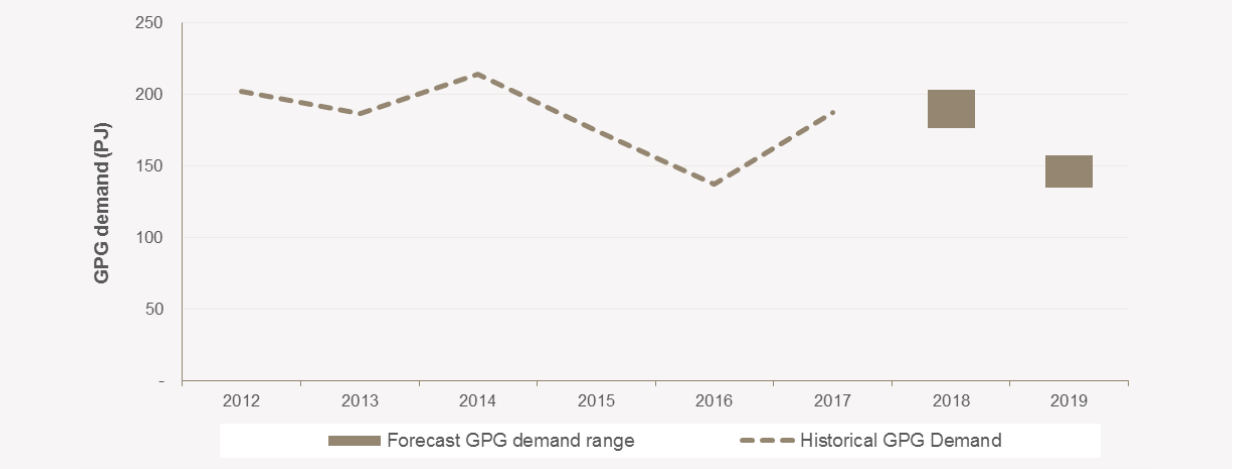
In 2017[13], the declining trend in GPG consumption has reversed, due to:

- An increased operational requirement to operate GPG in South Australia to support security of supply.
- The retirement of Hazelwood Power Station reducing the amount of available coal energy in the NEM, resulting in increased operation of GPG.
- Higher wholesale electricity market prices, which have affected GPG operations because gas is the most price-responsive generation fuel.

[13] AEMO's forecast 2017 historical GPG demand includes a combination of actual GPG demand (year to date) and forecast.

AEMO's forecast GPG gas demand for 2018 is similar to 2017. The forecast drop in GPG gas consumption in 2019 is predominantly due to increasing connection of renewable generators in the NEM and increased consumer energy efficiency.

Figure 3 GPG demand, actual since 2012 and forecast



2017 corresponds to actual observations up to 31 July 2017, with forecast generation for August to December combined with these actuals.

The uncertainty factor above the expected forecast GPG demand in 2018 and 2019 provides a reasonable tolerance for demand variability, as a margin to cover forecasting uncertainty due to changes in primary drivers of electricity consumption.

GPG demand could vary according to a range of factors:

- Higher electricity consumption impacting GPG, for example due to a hotter summer.
- Operational contingencies in electricity generation, affecting the NEM supply mix and market share for GPG, and outlined in more detail under 'risk assessments' below:
  - Reduced rainfall impacting hydro generation.
  - Reduced average wind speeds impacting wind farm output.
  - Delays in the installation of new renewable generation.
  - The extended (three months) unavailability of a coal-fired generator.

AEMO's supply adequacy assessment (Section 2.5) consolidates the risks posed by these uncertainties. The GPG demand uncertainty factor allows for higher GPG demand due to higher electricity consumption impacting GPG. This additional volume of gas would also be sufficient to cater for multiple other contingencies, if electricity consumption is at the expected level. The likelihood of all coincident contingencies occurring simultaneously within a year, or higher electricity consumption with one or more contingencies within a year, is considered to be a very low risk.

Risk assessments

AEMO has modelled market outcomes[14] calibrated to behaviours observed in recent history, with a particular focus on the period since the retirement of the Hazelwood Power Station in March 2017.

AEMO has assessed the sensitivity of GPG demand to competitive forces affecting market supply, in particular the availability of renewable resources, the timing of new developments, and the availability of coal. These outcomes, shown in Table 7, provide insights into how individual drivers can affect forecasts of GPG gas demand.

[14] The market modelling used a combination of Nash-Cournot bidding for portfolio generators, bid-price uplifts and contract levels of retail electricity contracts, coal supply contracts, and gas contracts for GPG portfolios.

Table 7 Impacts of considered risks and uncertainties on GPG demand (PJ)

Drivers of additional GPG demand	2018 (PJ)	2019 (PJ)
Impact of lower rainfall resulting in lower hydro production	12	11
Impact of lower wind speeds resulting in lower overall wind production	6	5
Impact of renewable investment deferrals	13	39
Impact of extended unavailability of coal for 3 months (single unit)	9 to 12	6 to 13

The impacts of these risks are described in greater detail below:

- **Less rainfall and contribution from hydro.**

  AEMO has projected electricity production from hydro-electric generation using the latest available long-range projections of weather and water inflows. These projections are dependent on actual weather over the next two years. Projections of expected energy production from hydro over the next two years therefore have some inherent uncertainty, although medium-term and long-term storages across the large hydro networks can assist in managing short-term issues affecting rainfall and storage inflows.

  Reduced electricity production from major hydro-electric generators could reasonably lead to additional GPG gas demand.

  – If water inflows are down, so is water inventory, resulting in decreased hydro generation. With reduced hydro inflows, hydro generators can be expected to reduce electricity generation, conserving water resources where possible for peak demand periods. This reduced generation at other times will likely lead to increased GPG demand.

  – In determining this contingency, AEMO has considered a reduction of approximately 12% in production from the two major hydro facilities (Snowy Hydro and Hydro Tasmania) only, or approximately 1,600 gigawatt hours (GWh). With such a reduction in available generation, GPG is expected to increase generation to compensate, resulting in increased gas demand of approximately 12 PJ in 2018 and 11 PJ in 2019. In three of the last seven calendar years (2010 to 2016), hydro generation was at or marginally below the targeted production in this sensitivity.

- **Less wind and contribution from wind.**

  Wind generation is inherently dependent on prevailing weather conditions. Historically, wind resources have varied each year, with total production estimated to be capable of a 11% swing depending on wind conditions.

  In AEMO's modelling, with the existing level of wind capacity, wind resources may lead to a variation of wind generation up to 1,500 GWh per annum.[15] AEMO's assessment of wind resources showed a swing of -4% to +7% around the average wind year.

  Lower wind production could reasonably lead to additional demand for gas by GPG of approximately 6 PJ in 2018 and 5 PJ in 2019. By 2019, the capability of coal-fired generation to absorb variations in renewable generation increases, due to slight reduced utilisation factors. This can act to offset lower renewable generation in years of low wind and solar, despite projected increasing penetration of renewable energy.

  In two of the last seven years, renewable resources have been approximately as low as the downside risk identified in this contingency analysis.

[15] AEMO's models have captured this range by modelling the reference simulation years that coincide with the highest and lowest annual wind production to quantify the GPG effect. The central estimate represents the average production observed across the historical reference years.

- **Stalled renewable investment.**

  The Clean Energy Council reviewed the progress of the Renewable Energy Target (RET) in June 2016[16], concluding that the pace of investment needs to increase on developments to date. To address risks associated with renewable energy developments, AEMO has modelled two alternative generation expansion scenarios for 2018 and 2019. Renewable investment continues to be incentivised through federal and state renewable energy policies (such as the federal Large-scale Renewable Energy Target (LRET)), although, while capacity is not committed, there is a risk that development might not eventuate, or may be delayed.

  AEMO quantified the potential impact of renewable investments on GPG by modelling an expanded renewable energy outlook, as well as a development path reflecting only developments currently considered committed according to AEMO's commitment criteria.[17] Using these two outlooks, AEMO projects that GPG demand may need to be up to 13 PJ higher in 2018 and 39 PJ higher in 2019 if no additional renewable investments are installed (beyond current commitments). Even a delay to renewable developments, particularly those as yet uncommitted, could lead to increased GPG (depending on the extent of the delay).

- **Extended coal-fired power station outage.**

  Recent examples of extended coal-fired generation outages in the NEM include the Yallourn mine flood (2012), Hazelwood fire (2014), and Eraring outage (2016).

  With an aging coal fleet, there is potential for a more serious failure to occur than is typically addressed by normal preventative maintenance. AEMO has modelled the impact of a sustained outage of a coal generating unit to quantify the risk to GPG demand. Should an unplanned extended outage of a coal-fired unit occur (say for three months), additional gas would be required to supply the requirements of GPG to rebalance electricity supply in the NEM.

  An outage of a single large coal-fired generating unit, assumed as 600 MW, could require additional gas for GPG of between 9 PJ and 12 PJ in 2018, and between 6 PJ and 13 PJ in 2019. However, there may be capacity across the coal fleet to offset the loss of production from the failure, given portfolios tend to allow for generator failures in constructing their contract books, to manage the financial exposure of such a failure. As such, while the direct effect of an outage could lead to increased GPG demand, the specific region, generation portfolio, and unit affected may impact the actual sensitivity of GPG demand to the outage.

Gas Supply Guarantee

Gas producers and pipeline operators made a commitment to the Commonwealth Government to make gas supply available to electricity generators during peak NEM periods. The Gas Supply Guarantee mechanism has been developed by industry to facilitate the delivery of these commitments.

While the ADGSM is intended to provide means to manage the risks to the annual domestic energy balance, the Gas Supply Guarantee mechanism is directed to short-term deliverability and supply issues for GPG, and as such is most appropriate to address operational risks or major unplanned events, such as an unplanned outage of a major coal-powered unit.

2.5 East coast gas supply adequacy outlook

This outlook is based on information available at 1 August 2017, and includes an update from one producer on 15 September 2017.

[16] Clean Energy Council, Progress and Status of the Renewable Energy Target, available at: https://www.cleanenergycouncil.org.au/news/2016/June/renewable-energy-target-progress-status-momentum.html.

[17] AEMO's commitment criteria are defined in each NEM region spreadsheet on AEMO's Generation Information web page, accessible at: http://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/Generation-information.

AEMO has used projections of production for calendar years 2018 and 2019 provided by eastern and south-eastern gas producers, and projections provided by LNG consortia of gas required for LNG export for the calendar years of 2018 and 2019.

AEMO understands from discussions with facilities that there is scope for additional operational flexibility and that production and LNG demand could vary from the projections provided for this assessment.

Domestic gas demand has been forecast by AEMO, with GPG demand based on projections of coal-fired, hydro, and renewable generation as explained in previous sections. The aggregate domestic gas demand projections represent AEMO's projections of the gas requirements for domestic use, both for supply of gas and electricity.

The prospect of risks in gas supply over the next two years has required AEMO to assess the potential extent of risk in all sectors of the domestic gas forecasts.

An additional annual quantity of gas production over the next two years could be needed for contracting by the domestic gas market under a range of potential outcomes, considering reasonable risks. These include, for example, more extreme weather than forecast, less structural changes than anticipated, or operational contingencies that affect the demand for gas by GPG.

This additional annual quantity has been determined by assessing the market deficit in both 'expected' and 'uncertainty' forecasts across 2018 and 2019, and is summarised in Table 8.

The uncertainty factor provides for a number of drivers coinciding, for example, higher household and business demand for gas as well as increased electricity consumption in the NEM that would increase GPG demand.

In some circumstances, domestic demand could exceed the levels indicated as 'uncertainty' in Table 8, for example, if higher gas demand from households and businesses coincided with multiple NEM contingencies increasing GPG demand. AEMO, however, considers this additional level of coincidence of higher demand factors to be a very low risk.

If additional gas production capacity existed, negotiation of bilateral contracts and/or alternative market-based solutions (such as provisioning of quantities for sale via AEMO's Gas Supply Hub) would be needed before this production would be made available.

Table 8 summarises AEMO's adequacy outlook of the eastern and south-eastern Australia gas market.

Table 8 Gas supply adequacy assessment (PJ)

	2018		2019	
Aggregate gas production	1,891		1,886	
Aggregate LNG export gas demand	1,303		1,336	
Gas supply available to domestic market	**588**		**550**	
	Expected	**Uncertainty**	**Expected**	**Uncertainty**
Residential, commercial, and industrial	466	492	463	495
GPG	176	203	135	157
Total domestic gas demand	**642**	**695**	**598**	**652**
Surplus / Deficit	**-54**	**-107**	**-48**	**-102**

Current forecasts suggest there is the risk of a shortfall in the total annual quantity of gas available to supply the annual energy needs of the domestic gas market. This risk is not driven by deliverability, with sufficient infrastructure capacity in place for production of gas and transport to domestic users.

AEMO notes, however:

- The net balance is strongly influenced by the difference between total gas production and total LNG gas demand, in which small variations of 5% or less would significantly alter the outlook.
- Projections of aggregated gas production and LNG gas demand vary based on market conditions and contracting, indicating a dynamic situation that could change rapidly.
- Actual quantities of gas required domestically in eastern and south-eastern Australia will strongly depend on conditions experienced in the NEM over the next two years, and the role of GPG in maintaining reliability in a rapidly evolving NEM.
- As outlined in Section 2.4.2, there are other potential events that could further add to domestic gas demand.

From this assessment, AEMO concludes that the annual gas energy balance situation in eastern and south-eastern Australia is expected to remain tight.

As such, AEMO considers that the risks in the overall energy balance for eastern and south-eastern Australia warrant continued close attention and monitoring.

CHAPTER 3. WESTERN AUSTRALIA GAS ADEQUACY

3.1 Approach

For gas supply adequacy modelling, AEMO used the methodology from the 2016 *WA Gas Statement of Opportunities* (WA GSOO).[18] Revised forecasts will be presented in the 2017 WA GSOO in December 2017. AEMO is not expecting any material changes to the forecasts presented in the 2016 WA GSOO which are relevant for this 2018 outlook.

The Western Australia domestic gas market is adequately supplied until 2021. At present, total gas production capacity (1,616 terajoules a day (TJ/day)) exceeds total annual and peak gas demand for Western Australia (1,150 TJ/day). The quantity of recoverable gas reserves is estimated to last until 2022.

For the 2016 WA GSOO, AEMO engaged the National Institute of Economic and Industry Research (NIEIR) to develop domestic gas demand forecasts for the outlook period. NIEIR prepared three forecast scenarios for domestic gas demand, as shown in Table 9.

Table 9 Domestic gas demand scenarios

Scenario	Economic scenario	Projects	Prospective demand*
Low	Low	Projects that are certain to operate over the outlook period, including established loads and projects that have achieved a favourable final investment decision.	Not included
Base	Base		Not included
High	High		Included

* Prospective demand includes gas consumed by potential projects which may be developed over the outlook period, or may switch from diesel to gas over the outlook period.

3.2 Gas reservation policy

In Western Australia, the availability of domestic gas is not directly affected by gas demand from LNG projects. All Western Australia-based LNG projects (Gorgon, North West Shelf, Pluto, and Wheatstone) acquire gas reserves for LNG production from joint venture (JV) offshore petroleum fields associated with each LNG project, and do not compete directly with domestic-only gas producers for gas reserves.

In line with the Western Australia domestic gas reservation policy, these LNG projects reserve a quantity of gas to supply to the state's domestic gas market. Three of the four Western Australia LNG projects have domestic gas production facilities committed to supplying the domestic gas market, and the remaining LNG project, Pluto LNG, is yet to announce plans for supplying the domestic gas market.

3.3 Western Australian gas supply adequacy outlook

AEMO estimates:

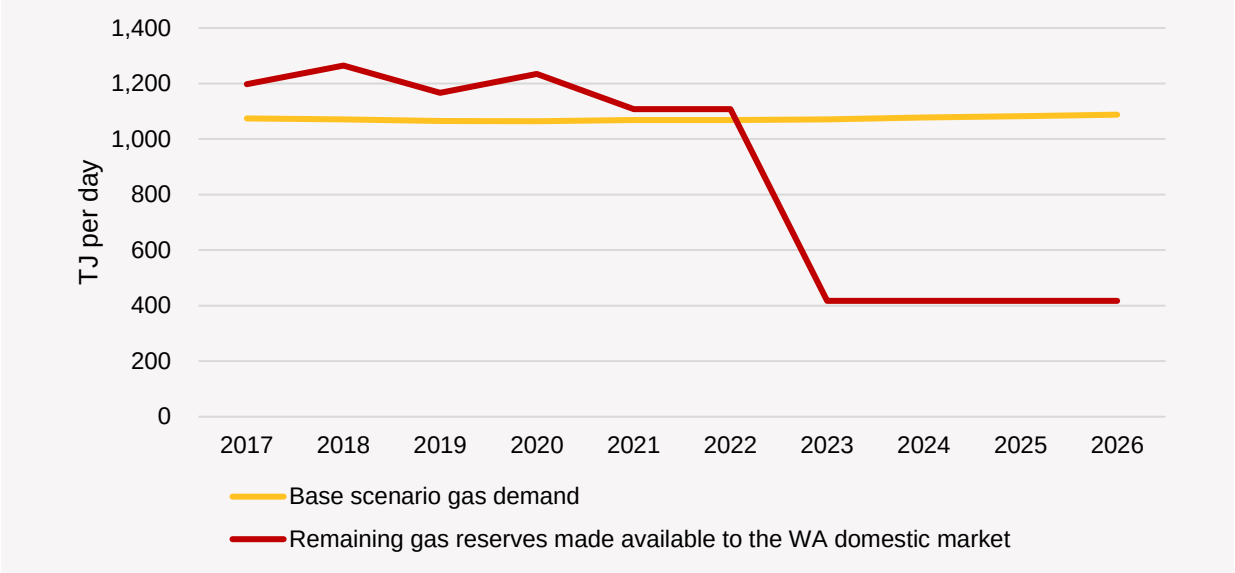
- All Western Australia-based LNG projects have access to sufficient gas reserves from their associated petroleum fields to meet all existing LNG contractual obligations and domestic gas requirements for the 2018 and 2019 calendar years.
- All Western Australia domestic-only gas producers also have sufficient gas reserves to meet forecast domestic gas demand over the same horizon.

In the 2016 WA GSOO, forecast gas demand was compared against the availability of economically recoverable Western Australia gas reserves for AEMO's base scenario over the 2017 to 2026 outlook

[18] AEMO. 2016 *WA Gas Statement of Opportunities*, December 2016. Available at: http://aemo.com.au/Gas/National-planning-and-forecasting/WA-Gas-Statement-of-Opportunities.

period. As Figure 4 shows, AEMO estimates that there are sufficient gas reserves available to supply domestic gas demand in Western Australia until the end of 2022.

Figure 4 Western Australia gas market balance, 2017 to 2026



It is important to note that the quantity of economically recoverable remaining gas reserves to the Western Australia domestic gas market for the 2017 to 2026 outlook period accounts for the total quantity of gas reserves available from the state's domestic-only gas producers.

Uncontracted quantities of gas reserves held by Western Australia-based LNG projects, beyond the quantities of gas reserves that have been set aside for the domestic gas market under the Western Australia gas reservation policy, may be made available to the Western Australia domestic gas market. The LNG-linked domestic production facilities are connected to the same petroleum fields as the LNG production facilities.

However, additional quantities of domestic gas, and the availability of additional uncontracted gas reserves to the Western Australia domestic market, are subject to future expected market prices of domestic gas and LNG.

CHAPTER 4. LINKS TO RELATED INFORMATION

The tables below provide links to additional resources, or related AEMO planning information.

Table 10 Links to supporting information – eastern and south-eastern Australia

Information source	Website address
Energy Supply Outlook, June 2017	https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/NEM-Electricity-Statement-of-Opportunities
Gas Statement of Opportunities	https://www.aemo.com.au/Gas/National-planning-and-forecasting/Gas-Statement-of-Opportunities
Gas Statement of Opportunities Methodology	https://www.aemo.com.au/Gas/National-planning-and-forecasting/Gas-Statement-of-Opportunities
National Gas Forecasting Report	https://www.aemo.com.au/Gas/National-planning-and-forecasting/National-Gas-Forecasting-Report
National Gas Forecasting Report Methodology	https://www.aemo.com.au/Gas/National-planning-and-forecasting/National-Gas-Forecasting-Report
Victorian Gas Planning Report	https://www.aemo.com.au/Gas/National-planning-and-forecasting/Victorian-Gas-Planning-Report
Energy Adequacy Assessment Projection Update	https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/Energy-Adequacy-Assessment-Projection
NEM Electricity Statement of Opportunities	http://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/NEM-Electricity-Statement-of-Opportunities
NEM Electricity Statement of Opportunities Methodology	http://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/NEM-Electricity-Statement-of-Opportunities
AEMO Generation Information page	http://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/Generation-information
National Electricity Forecasting Report	https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/National-Electricity-Forecasting-Report
National Transmission Network Development Plan	http://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/National-Transmission-Network-Development-Plan

Table 11 Links to supporting information – Western Australia

Information source	Website address
WA Gas Statement of Opportunities	http://www.aemo.com.au/Gas/National-planning-and-forecasting/WA-Gas-Statement-of-Opportunities
WEM Electricity Statement of Opportunities	http://www.aemo.com.au/Electricity/Wholesale-Electricity-Market-WEM/Planning-and-forecasting/WEM-Electricity-Statement-of-Opportunities