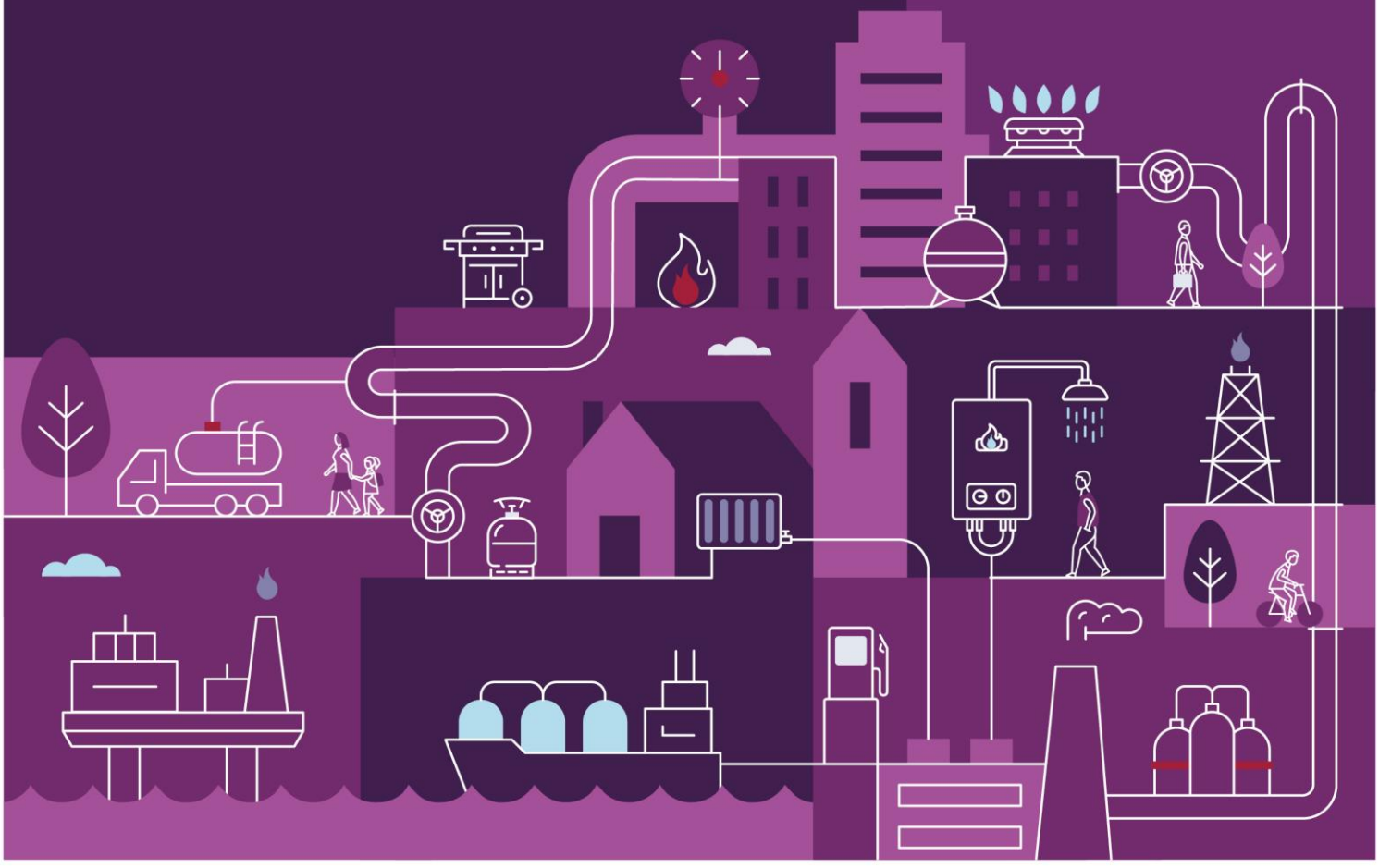
# 2023 Western Australia Gas Statement of Opportunities

**December 2023**

AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

## Market outlook to 2033

A report for the natural gas industry in Western Australia



# Important notice

## Purpose

The purpose of this publication is to provide information about the natural gas industry in Western Australia.

AEMO publishes this Gas Statement of Opportunities in accordance with rule 103 of the Gas Services Information Rules. This publication is generally based on information available to AEMO as at December 2023 unless otherwise indicated.

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## Acknowledgement

AEMO acknowledges the support, co-operation and contribution of all participants and project proponents in providing data and information used in this publication.

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# Executive summary

The 2023 Western Australia (WA) Gas Statement of Opportunities (GSOO) presents AEMO's assessment of WA's domestic gas market for the 10-year outlook period 2024 to 2033. The WA GSOO presents forecasts of WA's domestic gas demand and potential gas supply for Low, Expected and High scenarios, and an overview of gas infrastructure and emerging issues that affect Gas Market Participants and other stakeholders.

The state's gas supply relies on a small number of large projects, several of which are in decline. AEMO has identified the need for new gas supply to meet forecasted gas demand under all scenarios. The timing and scale of new supply sources introduces significant uncertainty into AEMO's projection of supply adequacy.

## Key findings

AEMO's 2022 WA GSOO identified a tight supply-demand balance for WA's domestic gas market. AEMO's 2023 forecasts for gas demand and supply look even tighter, increasing the opportunities for investment in new gas supply into the WA domestic market.

The WA domestic gas market is projected to be in deficit between 2024 and 2029, with potential supply from committed and expected projects up to 11% below forecast demand. There are options available to alleviate some of this shortfall, such as utilisation of gas in storage and the potential redirection of uncontracted liquefied natural gas (LNG). From 2030 onwards, further gas supplies are forecast to be required to meet increasing demand.

The outlook has three distinct phases:

- **Potential gas supply is forecast to be 105 PJ short of domestic demand up to 2026**. Additionally, flexibility is minimal – gas supply facilities are running close to, or at, capacity. This means that there is a risk of shortages in the event of supply outages or peaks in demand without corresponding responses from suppliers and consumers.
- **Between 2027 and 2029, supply is forecast to grow as Scarborough, South Erregulla, Lockyer Deep, and Waitsia are expected to enter the domestic market.** Demand continues to decline (due to decarbonisation) until 2027, but then steps up in 2028 as the Perdaman Karratha Urea project begins production. The market is 31 PJ short in this period.
- **From 2030 onwards, the gas market is forecast to move into an increasing deficit**, with deficits of over 100 TJ/day from 2031 (over 10% of demand each year). This is driven by coal generation retirements increasing the need for gas generation and a decline in production from existing gas fields, partially offset by increased renewable power generation and decarbonisation across the economy.

AEMO's updated forecasts, reflecting the latest developments in the gas industry, reaffirms the critical role of gas in supplying WA's energy needs, including to support the transition to net zero. Given the dynamic nature of the energy transition, there is also relatively high uncertainty in the forecasts of both supply and demand due to factors such as the timing of major supply or demand projects, the pace of industry decarbonisation and the availability of other sources of electricity generation.

The 2023 WA GSOO is released during a critical phase of Western Australia's energy transition. The trends presented in the 2023 Wholesale Electricity Market (WEM) Electricity Statement of Opportunities (ESOO)[1] show strong growth in electricity demand, driven by electrification, electric vehicle uptake, and new energy-intensive industries including green hydrogen production.

Several of these trends lead to reduced gas consumption. However, increases in expected electricity consumption, coupled with the phased closure of state-owned coal power stations[2] has a corresponding impact on modelled use of gas-powered generation to support the transition to a majority-renewables power system. Strong growth in new industries also partially offsets the decarbonisation of existing industries.

## WA domestic gas market outlook

The WA gas market is expected to remain in deficit throughout the majority of the forecast period. There are significant demand-side risks, including timing of commercial operation for new gas-consuming facilities such as Perdaman's Karratha Urea Project and Woodside's H2Perth hydrogen project. Pressures associated with future coal supply and the planned retirements of coal-fired generation, are expected increase the reliance on SWIS gas powered generation (GPG) fleet, and GPG is expected to play an important role, along with new renewables, storage and supporting transmission infrastructure, in ensuring reliability in the SWIS as the energy transition continues. However, an expected increase in the rate of industrial decarbonisation and domestic electrification has a mitigating effect on gas demand.

Until new supply from Woodside's Scarborough gas project and the Perth Basin comes online in significant quantities – likely from around 2027, gas supply will continue to decline. AEMO has included South Erregulla (2026), Scarborough (2027), Lockyer Deep (2028) and Waitsia (2029) in its Expected scenario forecast. There are risks for all these projects, such as legal risks to the Scarborough project over development milestones, geological risks of drilling in the Perth Basin (highlighted by the Waitsia project drilling a rare dry development well), and development risk at Lockyer Deep and South Erregulla as they are pre-final investment decision (FID).

[1] Available at: https://aemo.com.au/-/media/files/electricity/wem/planning_and_forecasting/esoo/2023/2023-wholesale-electricity-market-electricity-statement-of-opportunities-wem-esoo.pdf.

[2] WA Government, State-owned coal power stations to be retired by 2030 with move towards renewable energy, 2022, at: https://www.wa.gov.au/government/media-statements/McGowan-Labor-Government/State-owned-coal-power-stations-to-be-retired-by-2030-20220614.

**Figure 1 Expected scenario WA gas market balance, 2023 to 2033 (TJ/day)**

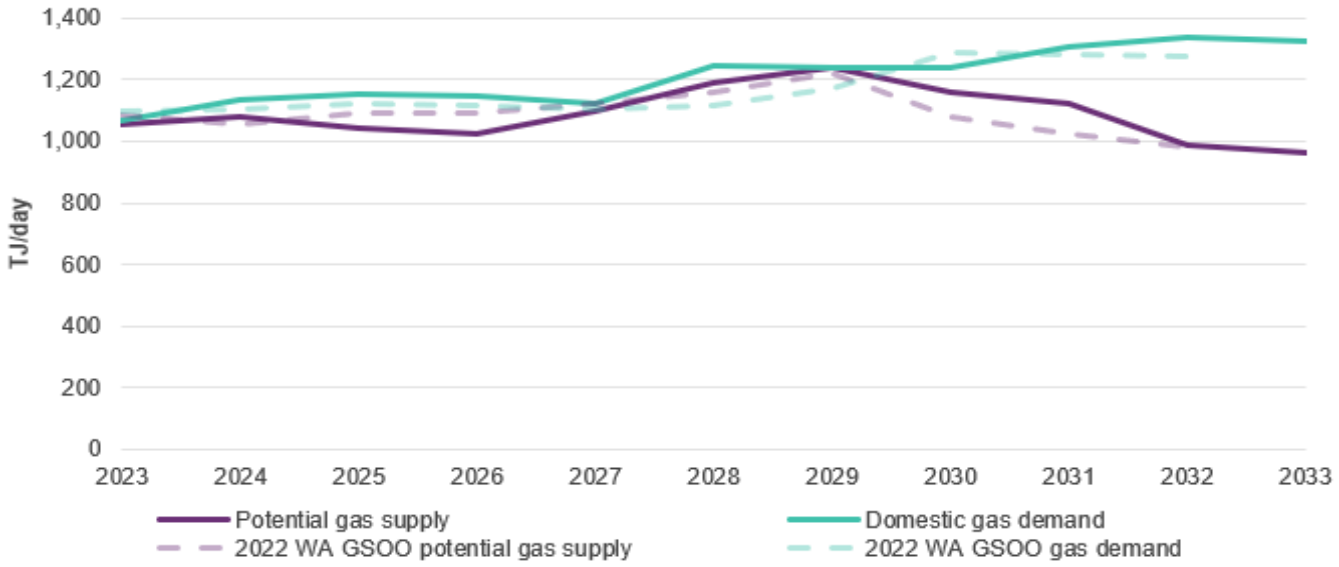


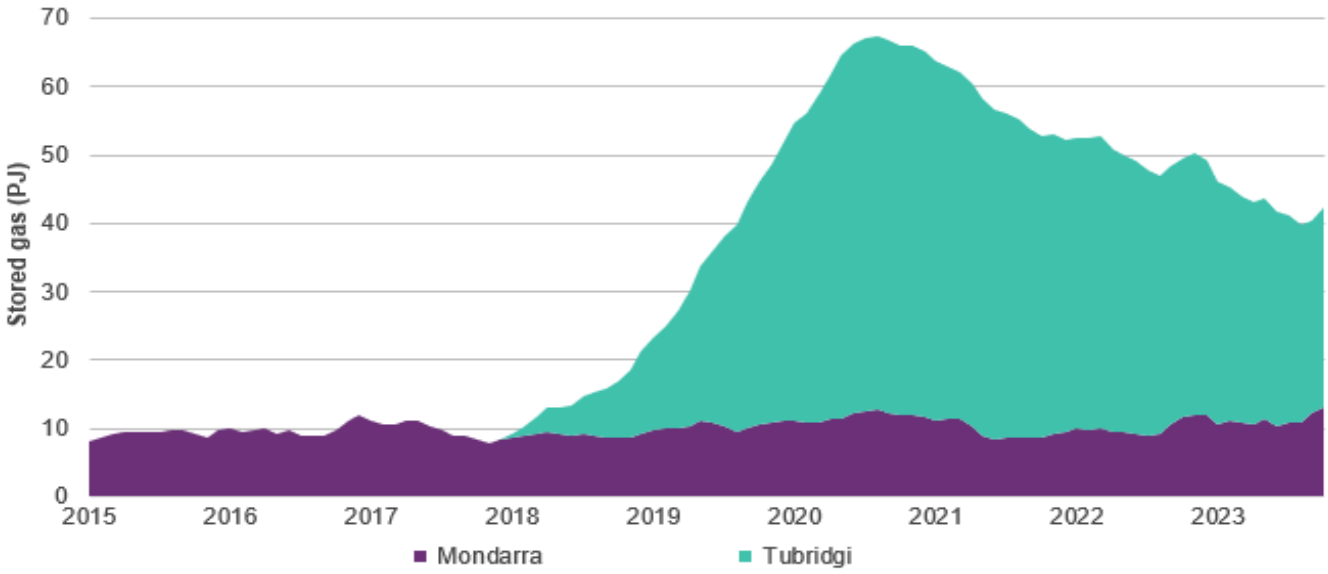

**Table 1 Potential gas supply and domestic demand forecasts (TJ/day), 2023 to 2033**

| | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 10-year annual average growth rate |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Potential gas supply** | 1,053 | 1,077 | 1,044 | 1,023 | 1,098 | 1,191 | 1,241 | 1,160 | 1,122 | 985 | 963 | -0.9% |
| **Domestic gas demand** | 1,066 | 1,133 | 1,153 | 1,147 | 1,124 | 1,249 | 1,241 | 1,237 | 1,310 | 1,340 | 1,325 | 2.2% |
| **Difference** | -13 | -56 | -109 | -125 | -26 | -58 | 0 | -77 | -188 | -354 | -362 | - |
| **Difference as % of demand** | -1.2% | -5% | -9% | -11% | -2% | -5% | 0% | -6% | -14% | -26% | -27% | - |

Two key indicators suggest that gas demand has exceeded supply from production facilities in the WA market since late 2020.

Firstly, the volume of gas in long-term storage at Tubridgi peaked in September 2020, shown in Figure 2. Since then, gas has been withdrawn at an average rate of 8 PJ per annum (22 TJ/day), supplementing supply from WA's gas production facilities. At this rate of extraction, the Tubridgi long term storage will be depleted by the end of 2026.

**Figure 2 Cumulative stored gas, 2015 to 2023 (PJ)**




Source: Western Australia Gas Bulletin Board (WA GBB).
Note: The figure presents cumulative stored gas data up to 31 October 2023.

Secondly, the peak in storage coincided with the low point for spot gas traded in WA ($2.13/GJ in May 2020). Since then, the spot price has increased to around $10/GJ[3], which further indicates tight supply conditions.

For the period between 2024 and 2026, AEMO is not aware of any new domestic gas supply projects under construction that could address these shortfalls. This indicates that the tight conditions in the WA domestic gas market will need to be alleviated by responses from suppliers and consumers, which may include:

- Withdrawals from storage. WA has around 42 PJ of gas in storage[4], which can deliver gas at up to 210 TJ/day[5]. Withdrawals from storage have been augmenting supply at around 8 PJ per annum since late 2020.
- Uncontracted LNG (LNG spot cargoes) could be diverted from the export market into the domestic market. This could have an impact throughout the forecast period.

In the medium term, the supply/demand balance could be impacted by:

- Development of gas fields that are not currently included in the gas supply forecasts, such as West Erregulla or further expansion of Beharra Springs. Discoveries made in 2023 in the Perth Basin could also be developed within the timeframe of this forecast.
- Large gas users transitioning more rapidly to lower emissions electricity sources.
- Large industrial gas users potentially closing facilities and reducing consumption.

From 2028, the WA domestic gas market could see the entry of Perth Basin gas on a larger scale. Because a number of prospective supply projects in both the Perth and Carnarvon basins are at early stages of appraisal, the scale of the resources and the volumes they could deliver remain uncertain.

[3] See: https://www.gastrading.com.au/spot-market.

[4] Estimated using data from the WA GBB, October 2023.

[5] Tubridgi and Mondarra have a combined storage capacity of 78 PJ and can deliver an equivalent of 210 TJ/day for a maximum of four months. This assumes that both storage facilities are full and accounts for Mondarra's higher withdrawal rate and lower capacity compared to Tubridgi.

Over the longer-term, new sources of gas supply may include:

- Backfill projects at existing facilities, such as Corvus or Dorado being developed through Varanus Island.
- Expansion of existing facilities, including the domestic gas plants attached to LNG projects.
- Undeveloped fields such as West Erregulla or Beharra Springs Deep in the Perth Basin.
- New discoveries, such as Trigg Northwest, North Erregulla, Tarantula or Gynatrix in the Perth Basin.

Longer-term demand responses are highly dependent on the pace of decarbonisation of industry to low emissions electricity sources. Increased decarbonisation of the electricity system, underpinned by an acceleration of the transition to firmed renewables, offers a further pathway to reduce demand for gas in the domestic market.

## Potential gas supply

The assumptions for new gas supply sources underpinning AEMO's potential gas supply forecasts are summarised in Table 2.

**Table 2 Assumptions for new gas supply sources in the Expected scenario**

| Project | Operator | Volume (TJ/day) | Available from | Notes |
|---|---|---|---|---|
| **South Erregulla** | Strike Energy | 40 | Mid-2026 | Currently under appraisal, with FID anticipated in 2024. |
| **Scarborough** | Woodside Energy | 180 | Mid-2027 | Being developed as an LNG supply source to Pluto Train 2. Domestic gas plant will have capacity of 225 TJ/day. |
| **Lockyer Deep** | Mineral Resources | 50 | 2028 | Currently under appraisal, with FID anticipated in the first half of 2024. |
| **Waitsia stage two** | Mitsui E&P Australia | 100 | Jan 2029 | Being developed for LNG export via the Karratha Gas Plant, then to supply the domestic gas market at an assumed initial rate of 100 TJ/day. |

## Previous outlook

The 2022 WA GSOO projected the WA domestic gas market to be tightly balanced through to 2029. Between 2023 and 2026, demand was expected to exceed supply by a total of 45 PJ. The forecast commencement of Scarborough (180 TJ/day) in mid-2027 was projected to be sufficient to return the market to surplus until 2029 (although demand from the Perdaman Karratha Urea Project was not included in the Expected case). From 2030, the increase in gas required for power generation following Synergy's coal retirements was projected to result in a deficit of up to 296 TJ/day by 2032.

## A lot has changed in the gas supply sector since the 2022 WA GSOO

Several supply-side events have had an impact on the potential gas supply forecasts. AEMO has adjusted its supply view as follows:

- In December 2022, Strike Energy announced the delay of West Erregulla, which was forecast to supply 87 TJ/day of gas from 2025. AEMO forecasts this field has been delayed until 2027 and is now considered only in the High case in this GSOO.

- In January 2023, Beach Energy announced an 11% (ca. 130 PJ) downgrade of reserves at Waitsia[6]. In this WA GSOO, Waitsia Stage 2 is assumed to deliver 100 TJ/day from 2029 (AEMO modelled 125 TJ/day from 2029 in the 2022 WA GSOO). However, Waitsia's production rate falls rapidly as its lower reserves are depleted faster.
- Through 2023, Woodside has faced increasing legal challenges to its Scarborough project. These have come from both environmental groups and traditional owners and may impact the supply of domestic gas from Scarborough. AEMO continues to assume Scarborough comes online in mid-2027, but is monitoring the situation.
- In August 2023, the nameplate capacity of Wheatstone was upgraded from 205 TJ/day to 215 TJ/day[7]. This followed a series of higher-flow tests carried out by the operator. AEMO has adjusted its production forecast accordingly.
- Forecasts for Pluto have been downgraded following the publication of LNG trucking data on the WA Gas Bulletin Board from late 2022. AEMO now models 3 TJ/day for LNG trucking (compared to 15 TJ/day in the 2022 WA GSOO).
- Based on historical production data, assumptions for Gorgon and Wheatstone have been adjusted to reflect actual operating patterns of around 90% of nameplate capacity (AEMO modelled 85% in the 2022 WA GSOO). Gorgon is modelled at 270 TJ/day (compared to 255 TJ/day in the 2022 WA GSOO), while Wheatstone is modelled at 194 TJ/day (compared to 174 TJ/day in the 2022 WA GSOO).
- Perth Basin exploration drilling has seen discoveries at Trigg Northwest, North Erregulla, Tarantula Deep and Gynatrix. These projects are not included in AEMO's forecast but will continue to be monitored for inclusion in future WA GSOOs.

AEMO notes that there is also a large volume of offshore undeveloped gas that could supply the WA domestic market during the outlook period, but these resources are currently too speculative to include in the potential supply forecasts. These resources include, but are not limited to, Corvus, Dorado, Chandon, Equus area, Geryon, Orthrus, Maenad, Spar Deep and Clio-Acme. AEMO will continue to monitor these and other projects for potential inclusion in future WA GSOOs.

## Domestic gas demand expected to grow

Global commodity markets are the key driver for WA's main exports like iron ore and base metals. Although prices have decreased during 2023[8], AEMO expects demand growth to recover in the medium term[9]. The mining and gas generation sectors, plus new-build hydrogen/urea facilities are expected to be the main contributors to domestic demand growth over the outlook period.

Overall domestic demand is forecast to grow at 2.2% per annum, from 1,133 TJ/day in 2024 to 1,325 TJ/day in 2033. Gas demand shows a number of events and underlying trends:

[6] See: https://yourir.info/resources/0c5a441cf54ff229/announcements/bpt.asx/2A1427801/BPT_FY23_Second_Quarter_Activities_Report.pdf.

[7] See: https://australia.chevron.com/news/2023/wheatstone-project-boosts-wa-domgas-supply.

[8] The iron ore price decreased slightly (US$122/tonne in January 2023 to US$121/tonne in September 2023), while the prices of copper, zinc, and nickel decreased by 8%, 25%, and 30% respectively between January 2023 and September 2023. See: https://www.worldbank.org/en/research/commodity-markets.

[9] See: *Critical minerals and other commodity forecasts for WA to 2033*, authored by the National Institute of Economic and Industry Research (NIEIR) and published as part of this GSOO.

- Perdaman taking FID on its Karratha Urea Project. This facility is contracted to take 130 TJ/day of gas from 2026 or 2027[10] (note that AEMO currently models start-up in 2028 in the Expected scenario), supplied from Woodside's Scarborough project.
- Eleven resources projects are expected to add a net 23 TJ/day to gas demand by 2026. Three of these are demand reduction projects.
  - Six are mining projects, including gold and lithium, and account for a net 12 TJ/day of increased demand.
  - Four projects are minerals processing – two lithium and two rare earths, totalling 10 TJ/day of additional demand.
  - One further project, the details of which are confidential.

Gas demand for gas generation of electricity in the SWIS is forecast to grow at an average annual rate of 5.8%, from 201 TJ/day in 2024 to a peak of 315 TJ/day in 2032.

## Decarbonisation forecast has increased since the 2022 WA GSOO

Counterbalancing the growth in resource projects are the growing moves towards decarbonisation. This trend is expected across the mining, industrial, small commercial and residential sectors:

- Electrification across the economy is forecast to lead to a 47 TJ/day drop in gas consumption by 2033.
- In the mining sector, AEMO has identified twenty separate decarbonisation projects. Most of these projects aim to reduce emissions from remote power generation through offsetting gas consumption using renewables and storage.
- Decarbonisation targets in the iron ore sector are particularly ambitious[11]. Although total gas use in iron ore mining is expected to remain flat through the outlook period at around 175 TJ/day, annual iron ore production over the same period is forecast to increase from 952 Mt to 1173 Mt[12]. This implies a reduction in gas-intensity from 0.184 TJ/Mt to 0.150 TJ/Mt, or a drop of around 18%.

## The role of gas powered generation in future gas needs

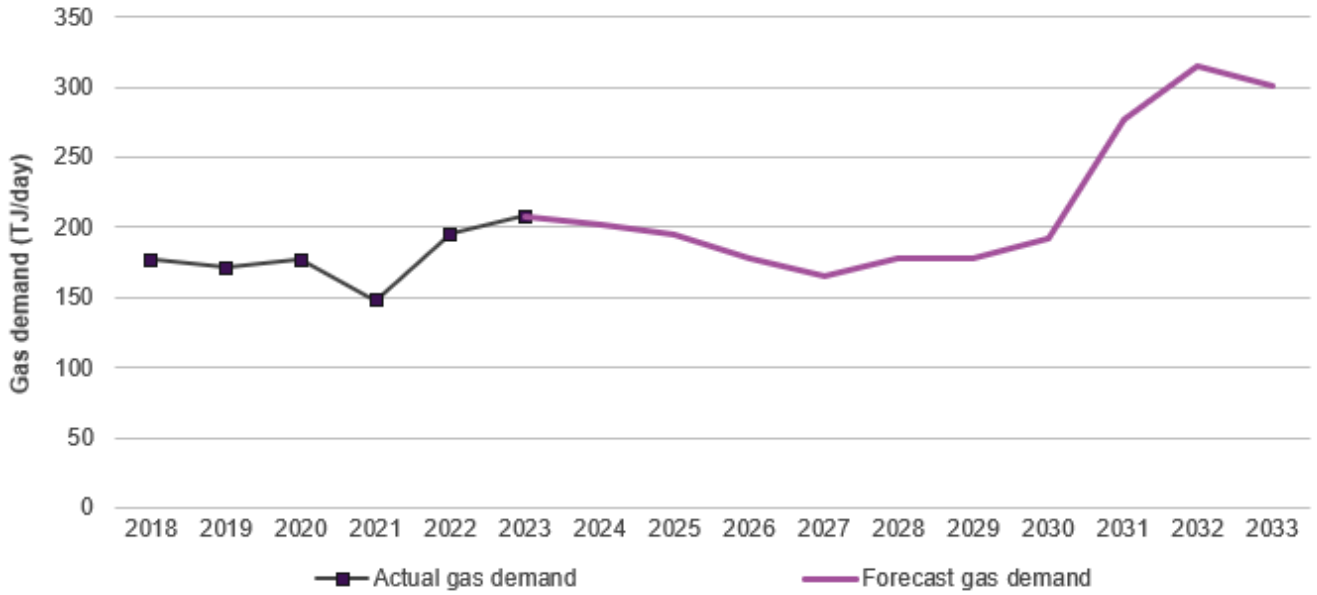
The SWIS GPG forecast shows that gas generation will continue to play a critical role in supporting reliability in the SWIS through the energy transition. The modelling has been aligned with the WEM ESOO as closely as possible and shows that as total electricity demand continues to increase, and coal generation is retired, additional GPG is needed. The SWIS GPG requirement is forecast to enter a decline late in the outlook period as new renewable generation, specifically wind combined with batteries, is expected to become available to materially replace the loss of coal capacity.

[10] See: https://www.woodside.com/docs/default-source/media-releases/long-term-domestic-gas-sale-between-woodside-and-perdaman-becomes-unconditional.pdf.

[11] See: https://www.riotinto.com/news/releases/2021/Rio-Tinto-to-strengthen-performance-decarbonise-and-grow and https://www.fmgl.com.au/in-the-news/media-releases/2022/09/20/fortescue-announces-execution-plan-for-industry-leading-decarbonisation.

[12] See: *Critical minerals and other commodity forecasts for WA to 2033*, authored by the National Institute of Economic and Industry Research (NIEIR) and published as part of this GSOO.

**Figure 3 Gas demand from SWIS GPG – Expected scenario, 2018 to 2033 (TJ/day)**




Consistent with the WA Government's SWIS Demand Assessment released in May 2023[13], the forecasts developed for this WA GSOO indicate that an economic build-out of renewables alongside high-efficiency gas generators will meet both WA Government targets and an increasing proportion of demand, reducing the impact of state-owned coal exiting the system. GPG is expected to play an important role, along with new renewables, storage and supporting transmission infrastructure, in ensuring reliability in the SWIS as the energy transition continues.

## Supply-demand balance risks

Between 2024 and 2029, the domestic gas market could easily move into surplus or deficit with any delays to demand or supply projects respectively. Key risks to the supply-demand balance include:

- **Market flexibility.** There is limited supply flexibility in the market, with gas production facilities operating at close to maximum capacity. If one of the larger gas plants went offline unexpectedly, there could be a short-term supply shortfall. Linepacking[14] of the 1,500 km Dampier to Bunbury Natural Gas Pipeline (DBNGP), plus the Mondarra and Tubridgi storage facilities, can provide some additional flexibility.
- **Coal supply.** The domestic gas market could be pushed into deficit if coal supply is restricted, leading to an increase in demand for gas generation. AEMO is closely monitoring the coal supply situation in WA.
- **Renewables supply.** Demand for domestic gas could also increase as a result of delays to new renewable electricity projects or lower than expected renewable generation output due to variable weather conditions or other factors.
- **Changing pattern of gas usage.** As gas is increasingly used for firming renewable power generation, the needs of gas generation in the WEM are changing rapidly. Close alignment with the WEM ESOO will help ensure that this report continues to reflect the changing pattern of gas consumption for generation, with short-term demand peaks in periods of low wind and solar resources and during peak demand events. These

[13] See: https://www.wa.gov.au/system/files/2023-05/swisda_report.pdf.

[14] Linepacking is using gas pipelines to store gas, by increasing pressure to increase the quantity of gas within a pipeline.

changing patterns of consumption are likely to increase operational impacts on gas infrastructure to meet shorter and sharper consumption needs.

- **New gas supply projects.** New gas supply projects could be delayed, potentially pushing the market further into deficit. Additionally, reserves risks remain at Perth Basin projects, where the geology is proving complex. AEMO will continue to engage closely with the operators of new and prospective gas supply projects to ensure its information is up to date.
- **Demand reduction or destruction.** Gas price-sensitive industries could choose to cease operations or take steps to reduce gas demand if gas is not available at competitive prices. Responses to AEMO's formal information request for this GSOO indicate that demand destruction could happen from $9.50/GJ, although the median price at which demand destruction occurs is $12.00/GJ[15].

## Ongoing improvements to the WA GSOO

In 2023 AEMO, in accordance with the Gas Services Information (GSI) Rules, conducted a five-year review[16] of the WA GSOO information. Following extensive consultation with industry, AEMO published the five-year review, addressing recommendations from industry, including:

- **Renewable energy and industrial decarbonisation**: Stakeholders asked AEMO to include more information on the rates at which industry will decarbonise and large-scale renewable energy supplies will grow, with consequent changes in gas use. Stakeholders requested that WA GSOO forecasts should include the impact of these trends on both overall gas demand and gas demand patterns.
- **Future gas supply**: WA has multiple gas supply projects either proposed or under development. Stakeholders asked AEMO to consider providing more clarity on future gas supply projects, especially Perth Basin supply and LNG-linked Domestic Market Obligation supplies.
- **Gas supply reliability**: Recent outages have highlighted a lack of flexibility in WA gas supply, with most gas plants producing at or close to capacity. Stakeholders asked AEMO to include a reliability outlook in its gas supply forecast.

Where possible, recommendations from the review have been incorporated into this WA GSOO, and AEMO will seek to make further improvements in future reports.

[15] The average spot gas price on 1 September 2023 was $9.64/gigajoule (GJ), although the spot market is very small (15 TJ/day in September, about 1% of the gas market) and this price should be viewed only as indicative. See: https://www.gastrading.com.au/spot-market/historical-prices-and-volume/monthly-volume-history.

[16] Available at: https://aemo.com.au/energy-systems/gas/gas-forecasting-and-planning/wa-gas-statement-of-opportunities-wa-gsoo/5-yearly-review-of-wa-gas-statement-of-opportunities.

# Contents

## Notes

- All data in this report is presented in calendar years unless otherwise stated.
- All references to $ in this report refer to Australian dollars.
- The compound annual growth rate was used to calculate the average annual growth rate. AEMO refined the calculation by using the first outlook year (year 1) minus one year (year 0) as the base year instead of year 1 to calculate the 10-year average annual growth rate. 2023 and 2028 were used as year 0 to calculate the five-year average annual growth rates for the first half and second half of the outlook period, respectively.

# 1 Year in review

This chapter provides a snapshot of events and initiatives that have been announced or occurred since publication of the 2022 Western Australia (WA) Gas Statement of Opportunities (GSOO)[17].

## 1.1 Gas supply and demand in 2023

In 2023 gas production has averaged 1,067 terajoules per day (TJ/day), slightly down from the 1,089 TJ/day seen in 2022 and 6% below the 2019 peak of 1,139 TJ/day[18]. Gas supply was interrupted in January 2023 when concurrent shutdowns reduced production by over 500 TJ/day. The WA Coordinator of Energy triggered the Emergency Management Facility on the Western Australia Gas Bulletin Board (WA GBB) to facilitate coordination across the sector and ensure adequate gas deliveries for customers[19].

Demand in 2023 has been driven by higher usage for electricity generation, as coal supplies were reduced through the summer of 2022/23. Gas usage by gas powered generation (GPG) in the South West Interconnected System (SWIS) has increased to 208 TJ/day in 2023 from 195 TJ/day in 2022, an increase of 6%. The sanctioning of Perdaman's Burrup Urea Project in April 2023 will create new demand of up to 130 TJ/day in the late 2020s.

Figure 4 compares the average gas production market share by company[20]. Over the 2022-23 financial year, Santos was the largest producer (30%), followed by Chevron (25%) and Woodside (19%). Santos's market share was lower than its average in the previous financial year and has been generally lower in 2023 than 2022, with its lowest at 19% in January 2023. This followed supply disruptions at the John Brookes and Reindeer gas fields as described later in this section. Woodside's merger with BHP Petroleum, effective 1 June 2022[21], resulting in Woodside increasing its market share from 17% in July 2022 to 22% in January 2023.

[17] Full references for this chapter are provided in Appendix A2.

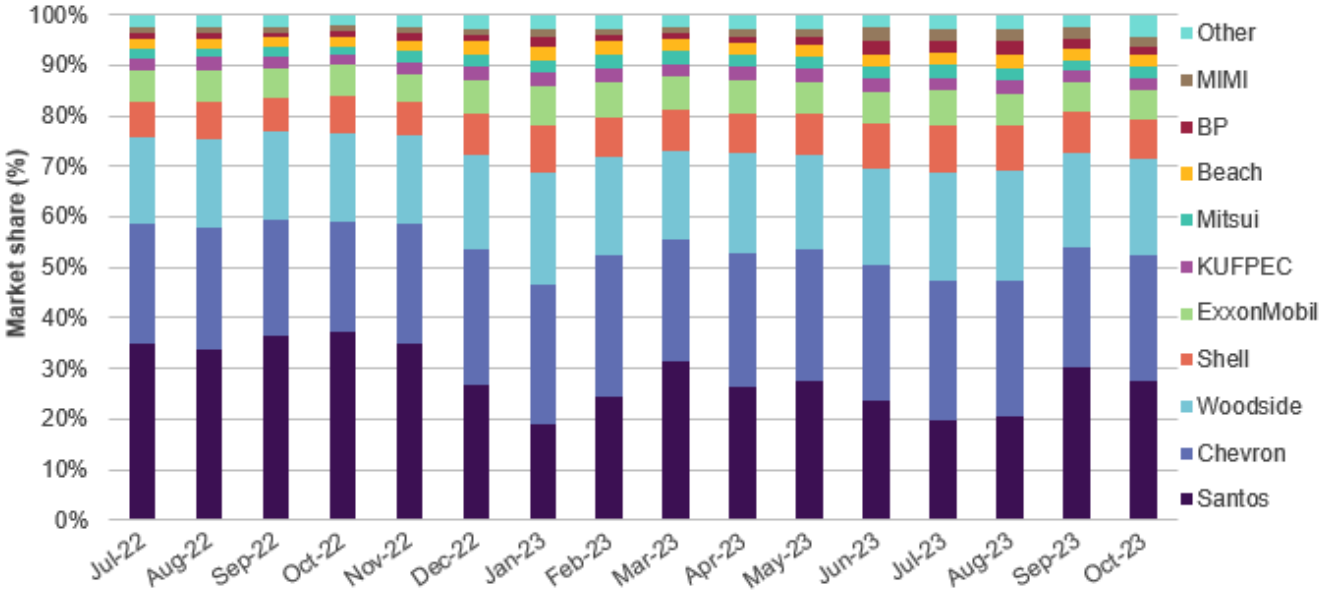
[18] Source: WA Gas Bulletin Board - https://gbbwa.aemo.com.au/#home.

[19] The January 2023 supply disruption incident is described fully in Section 1.2.3.

[20] The comparison was completed as per the market share on 31 October 2023, AEMO assumes that each company's production is in proportion to its equity share in each project.

[21] See: https://www.bhp.com/about/our-businesses/woodside-bhp-merger.

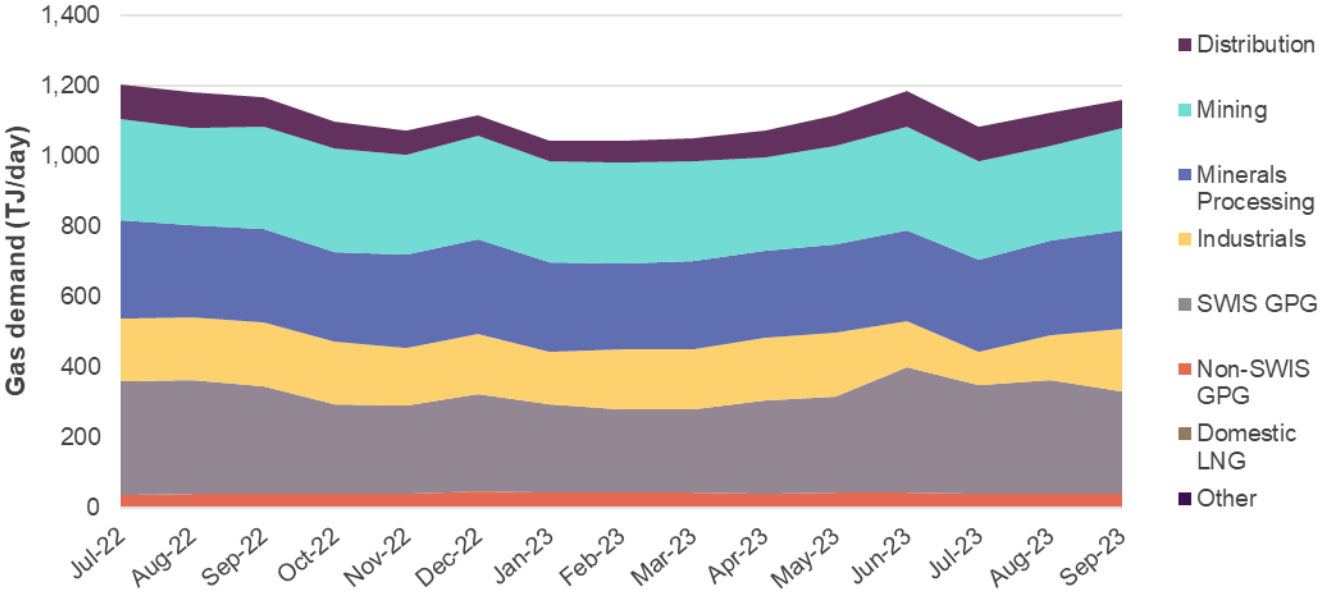
**Figure 4 Gas production market share by company[22], July 2022 to October 2023**




Source: WA GBB and company reports.

Figure 5 shows gas demand in WA since July 2022. The largest sectors are mining and SWIS GPG, both averaging 26%. The third large sector is minerals processing, averaging 24% through this period. SWIS GPG shows notable peaks in the winter months, reaching a peak of 30% of demand in June 2023 and exceeding 28% from June to August 2023. At the same time, the Industrial sector reduced its consumption, mainly due to Yara's Pilbara liquid ammonia plant reducing consumption over this period.

**Figure 5 Gas demand by sector, July 2022 to September 2023 (TJ/day)**




Source: WA GBB.
Note: Average gas demand data is up to 30 September 2023.

[22] AEMO assumes that each company's production is in proportion to its equity share in each project.

## 1.2 Supply projects – announced or updated

Since the publication of the 2022 WA GSOO, the WA market has seen two new gas supply projects brought onstream, one project delayed and the announcement of a closure date for another. Four new gas discoveries in the Perth Basin were also announced.

### 1.2.1 The following gas supply projects were announced or had progress updates:

- In December 2022, Strike Energy announced the termination of its agreements with Warrego and the Australian Gas Infrastructure Group (AGIG) to develop the West Erregulla gas project. The final investment decision (FID) on West Erregulla had been due in late 2023/early 2024.
- In December 2022, the contractor for Mitsui's Waitsia project (Clough) entered administration. Although construction has since recommenced, completion is not expected until mid-2024. Upon completion, the plant is expected to sell 250 TJ/day to the North West Shelf (NWS) Joint Venture. Also, in February 2023, Beach Energy downgraded the Waitsia net 2P[23] reserves by 11% (around 62 PJ) following the Stage 2 drilling campaign. Beach Energy's ability to supply 3.75 million tonnes (Mt) of liquefied natural gas (LNG) and meet its 20 TJ/day domestic gas obligation (DMO) remains unchanged.
- In August 2023, Chevron announced a 5% increase in the nameplate capacity of Wheatstone's domestic gas plant, from 205 TJ/day to 215 TJ/day, following technical enhancements and plant modifications.
- A Federal Court ruling in September 2023 has put Woodside's 2026 completion date target for Scarborough at risk. The court found that the regulator had wrongly provided seismic testing approval before the company had adequately consulted a traditional custodian. AEMO models Scarborough delivering 180 TJ/day into the domestic market from mid-2027.
- In October 2023, Santos announced that the Reindeer offshore gas field (Devil Creek gas plant) is expected to cease production in early 2024. Reindeer produced 45 PJ in 2022 and 14 PJ in 2023.
- In October 2023, Buru announced the award of a pre-Front End Engineering Design (FEED) study for its Rafael gas condensate discovery in the Canning Basin. Any gas from Rafael is not expected to enter the WA pipeline network but could be used locally, such as for (non-SWIS) power generation.
- Exploration and development drilling projects were progressed in the Carnarvon and Perth Basins. A number of exploration wells have discovered new gas resources, which have the potential to increase gas supply over the outlook period, including:
  - In January 2023, Mitsui's Gynatrix-1 intersected six metres of net gas pay across a 37-metre gross section in the target Kingia formation. Production testing is planned.
  - In June 2023, Mineral Resources announced a "significant" gas discovery at North Erregulla Deep-1. An oil zone was also identified in the Dongara Sandstone. Pressure data suggests that North Erregulla Deep is a discrete gas field. Testing achieved a peak flow rate of 99 million cubic feet per day (mmcfd), with 3% $CO_2$.
  - In August 2023, Beach Energy announced a gas discovery at Trigg Northwest-1. The well is expected to be cased and completed to facilitate future testing.

[23] Proved and probable (2P) reserves are considered the best estimate of commercially recoverable reserves. See Section 4.1.1 for more on category definitions.

- In October 2023, Beach Energy announced a gas discovery at Tarantula Deep in the Perth Basin. The result was in line with pre-drill estimates and the well was suspended for future development.

### 1.2.2 The following projects commenced production:

- In the second quarter of 2023, Santos' Spartan development achieved first gas. Gas from Spartan is processed at Varanus Island.
- In September 2023, Strike Energy produced first gas from its 33 TJ/day Walyering gas project in the Perth Basin. Walyering supplies gas into the Parmelia Gas Pipeline (PGP).

### 1.2.3 Gas supply outage in January 2023

A significant gas supply disruption event occurred during the period 6-13 January 2023, requiring the Coordinator of Energy to request that AEMO activate the Emergency Management Facility (EMF)[24] to support an industry response. The event was triggered by simultaneous outages and production reductions at three gas production facilities:

- On 29 November 2022, Santos announced a temporary shutdown of the John Brookes platform, due to a leak in the export trunkline connecting the platform to Varanus Island[25]. This reduced gas supply from Varanus Island to less than 50 TJ/day, from nearly 250 TJ/day prior to the shutdown[26]. Gas supply from John Brookes was restored on 9 February 2023[27].
- In December 2022, post 2022 WA GSOO, average production from Devil Creek was 203 TJ/day. However, it dropped to 60 TJ/day on 6 January 2023[28] as the Reindeer field watered out. This reduction had previously been flagged by the operator in a reserves downgrade in February 2021[29].
- On 5 January 2023, production from Wheatstone (which had been running at 205 TJ/day) was halted due to an equipment failure[30]. Production from Wheatstone was restored on 13 January 2023.

This gas supply reduction of over 500 TJ/day (approximately 200 TJ/day from Varanus Island, 140 TJ/day from Devil Creek and 205 TJ/day from Wheatstone) caused the linepack[31] levels on the Dampier to Bunbury Natural Gas Pipeline (DBNGP) to approach critical levels.

A coordinated response, led by the WA Coordinator of Energy, mitigated further deterioration of the situation, and included both increased production and decreased consumption by market participants[3].

[24] This is an online information service which is part of the WA GBB, activated by AEMO at the direction of the Coordinator of Energy in the event of an emergency or gas supply disruption and accessible only by certain parties. The EMF places additional obligations to provide alternative fuel information or ad hoc information such as gas in storage, as well as regular submissions.

[25] See: https://www.santos.com/news/temporary-shutdown-of-john-brookes-platform.

[26] See: https://gbbwa.aemo.com.au/#reports/actualFlow.

[27] See: https://www.santos.com/news/john-brookes-resumes-production.

[28] See: https://gbbwa.aemo.com.au/#reports/actualFlow.

[29] See: https://www.santos.com/news/annual-reserves-resource-statement-and-expected-impairment.

[30] See: https://gbbwa.aemo.com.au/#reports/actualFlow.

[31] "Linepack" is the total volume of gas physically stored in a pipeline and must remain within a tolerance determined by the pipeline operator. Reduced linepack can disrupt supplies to customers. Linepack levels are managed by monitoring and controlling supply and withdrawals.

### 1.2.4 Transactions and commercial agreements that may impact future gas supply:

- In December 2022, Western Gas signed a non-binding Term Sheet with the NWS project participants and a non-binding Heads of Agreement with Pluto in respect of key principles for producing 2 to 3 million tonnes per annum (Mtpa) of LNG from Equus gas from 2027. If this progresses, a DMO is likely to be applied to Equus.
- In February 2023, Hancock Energy acquired Warrego Energy and its 50% stake in the West Erregulla project.
- In June 2023, Mineral Resources finalised the acquisition of Norwest Energy, its joint venture partner in the Lockyer Deep discovery in the Perth Basin.
- In August 2023, Strike Energy presented a final offer to acquire Talon Energy, which was endorsed by the Talon Board.

## 1.3 Infrastructure developments

In July 2023, the Northern Goldfields Interconnect 579 km pipeline, extending from the Rosewick connection on the DBNGP to the Wildara connection on the Goldfields Gas Pipeline (GGP), became fully operational.

## 1.4 Demand projects – announced or updated

Numerous projects that may impact gas use have been announced since the publication of the 2022 WA GSOO, including gas generation, renewables, and minerals processing projects. The majority of those that could increase gas use are power generation in the mining sector.

All hydrogen projects that may affect demand for gas are included in Section 1.4.

### 1.4.1 Projects that commenced or ceased operations

- On 31 March 2023, the supply of reticulated gas in Esperance ceased. Horizon Power supported approximately 400 customers in Esperance to transition from gas to an alternative renewable energy source, with 90% of customers choosing a full or partial electrification solution.
- In May 2023, Fortescue Metals Group began production of magnetite at Iron Bridge. Iron Bridge is powered via a solar-gas hybrid power station and associated battery storage.
- In the first half of 2023, Mineral Resources and Albemarle recommissioned Train 3 at the Wodgina lithium mine, commenced second stage development and announced plans to study Train 4.
- During the third quarter of 2023, South32 completed the conversion of the first coal-fired boiler at Worsley to natural gas. The second boiler conversion is on track to be completed in the second quarter of 2024.

### 1.4.2 Project announcements

- In May 2023, Albemarle announced its decision to build two additional processing trains at the Kemerton lithium hydroxide plant, doubling capacity to 100,000 tonnes per annum (tpa) of lithium hydroxide at full capacity.
- In May 2023, Zenith Energy announced plans to build, own, and operate an 88 megawatts (MW) hybrid power station at the Bellevue Gold Project for an initial term of 15 years. The hybrid power station will consist of wind,

solar and gas generation and battery energy storage. The system has been designed to run 'engine-off' for extended periods.

- In August 2023, Kalium Lakes entered voluntary receivership. Its Beyondie Lakes Sulphate of Potash mine continues to operate while the administration process is underway.

### 1.4.3 Upcoming projects that made progress

- In April 2023, Perdaman closed financing and commenced construction on its 2.3 Mtpa urea project on the Burrup Peninsula. The project will utilise feedstock gas from Woodside's Scarborough project under a 20-year, 130 TJ/day, agreement.
- In June 2023, Lynas Rare Earths began final stage commissioning of its Kalgoorlie Rare Earths Processing Facility. The facility will use trucked LNG.
- In September 2023, Liontown Resources announced that $1.1 billion in financing had been secured to complete development of its Kathleen Valley Lithium Project. First production is expected in mid-2024.

### 1.4.4 Renewable projects expected to reduce gas demand that were announced or progressed

- In May 2023, Rio Tinto announced its Pilbara Renewables project, which intends to establish an integrated network of solar and wind power to develop 1,000 MW of power at its Pilbara operations, coupled to a large-scale Battery Energy Storage System (BESS). The first step in this is a 34 MW solar plant at the Gudai-Darri mine, to come online in late 2023, followed by a BESS at Tom Price.
- In May 2023, Alinta announced the battery and solar installation contracts for the Port Hedland Solar Battery Hybrid project, which is expected to power 100% of BHP's daytime port facilities from late 2024. Remaining power requirements are to be met via the battery and existing gas-fired power station.
- In June 2023, early-stage commissioning of the Northern Goldfields Solar Project by TransAlta and BHP Nickel West began, with energisation due for practical completion by the end of 2023. The solar and battery energy system will help power Nickel West's Mt Keith and Leinster operations, reducing their gas usage.
- In July 2023, the West Australian Department of Minerals, Industry, Regulation and Safety (DMIRS) awarded six geothermal exploration permits across the state (two south of Perth, two between Perth and Geraldton and two south of Broome).
- In August 2023, Fortescue reported progress on the Pilbara Energy Connect Project, which includes energy transmission line infrastructure, solar gas hybrid generation and associated battery storage. As part of this project, construction of a 100 MW solar plant at North Star junction is underway, with commissioning expected in 2024. Once complete, this project is forecast to deliver 25% of Fortescue's stationary energy requirements from solar power.

### 1.4.5 Transactions that may lead to future operational changes

AEMO has also noted asset and company sales in the mining and natural gas industries, most of which do not appear to result in operational changes at this point in time, but may lead to future operational changes, including demand for gas:

- In July 2023, there were multiple adjustments to the MARBL Joint Venture (JV) Agreement between Mineral Resources and Albemarle Corporation:
  - Albemarle will take full ownership of the Kemerton lithium hydroxide plant, which it currently operates.
  - The MARBL JV changed to 50/50, with Mineral Resources to continue managing operations at the Wodgina mine. Completion of arrangements is expected in December 2023, pending Foreign Investment Review Board (FIRB) approval.
- In July 2023, it was reported that St Barbara's Leonora assets had been acquired by Genesis.
- In August 2023, Alinta Energy sold 100% of its Pilbara assets (local energy network, generation and storage assets and an 11.8% stake in the Goldfields Gas Pipeline) to the APA Group. The deal was completed on 1 November 2023.
- In September 2023, Enel closed the sale to INPEX Corporation of a 50% stake in the entity that owns the Flatrocks Wind Farm. The project remains on track for completion in 2023, to be fully operational in 2024. BHP Nickel West has a Power Purchase Agreement (PPA) for 100% of the energy produced, beginning in January 2024. Upon completion, the facility is predicted to have operational capacity of 76 MW and energy production of approximately 315 GWh/year.

## 1.5 Hydrogen

The WA Government released its initial WA Renewable Hydrogen Strategy in 2019, indicating its commitment to develop the hydrogen industry in WA, and is currently seeking consultation to refresh the strategy[32]. This support, along with the progress of industry-led hydrogen initiatives, has made it increasingly important to consider the potential impact of hydrogen on the WA gas market.

The hydrogen industry in WA is still emerging as a viable energy source, and most proposed projects remain focused on producing hydrogen for the transport, mining, and export sectors. The Wholesale Electricity Market (WEM) *Electricity Statement of Opportunities* (ESOO) forecast that Hydrogen could require 1.5 TWh of electricity generation by 2033. This has been included in the GPG modelling.

AEMO has assessed that there will be limited direct impact on the WA domestic gas market over the outlook period, with potential domestic supply of only 8 TJ/day by 2033[33]. Given that the industry is still at a nascent stage, and the sectors being targeted have limited impact on the WA domestic gas market, AEMO has not incorporated hydrogen into the 2023 WA GSOO supply forecast presented in Chapter 4.

AEMO will continue to monitor the progress of hydrogen initiatives in WA and will report on new developments in future GSOOs and at relevant industry forums.

### 1.5.1 Hydrogen initiatives announced in 2023

In July 2023, the WA Government announced an Investment Attraction Fund Grant of $15 million for the Kwinana Energy Transformational Hub project (KETH), operated by Luth Eolas Pty Ltd, a subsidiary of the Future Energy

[32] See: https://www.wa.gov.au/government/publications/renewable-hydrogen-strategy-refresh-consultation.

[33] This is in line with the input assumptions for hydrogen projects considered in the 2023 WEM ESOO Expected scenario.

Exports Co-operative Research Centre. FID is expected in 2023. Upon completion (scheduled for 2025), KETH is planned to have daily production of 800 kg of hydrogen and 10 tonnes of LNG.

In October 2023, the Australian Government opened expressions of interest for the Hydrogen HeadStart program, which will invest $2 billion in providing revenue support to large-scale (more than 50 MW) renewable hydrogen projects through competitive hydrogen production contracts. Successful projects will receive funding as a production credit that will cover the current commercial gap between the cost of hydrogen produced from renewables and its market price.

### 1.5.2 Hydrogen projects announced or progressed since the 2022 WA GSOO

In May 2023,

- Horizon's renewable-hydrogen-powered microgrid in Denham completed construction, testing and commissioning.
- Woodside submitted environmental approval application documents for the development of a domestic and export-scale hydrogen and ammonia production facility (H2Perth) within the Rockingham Industry Zone.

In July 2023,

- Hexagon completed the pre-feasibility study for the WAH2 Blue Hydrogen project, with pre-FEED starting in Q3 2023. Commercial discussions with gas suppliers are in progress, to supply 55 TJ/day in Phase 1.
- ATCO Australia cancelled its plans to build a 10 MW electrolyser to produce 4.3 tpa of green hydrogen at the Warradarge Wind Farm after determining it is no longer commercially viable.

In August 2023,

- BP completed its concept development phase study into the Kwinana Energy Hub. The study identified two potential base-case green hydrogen production scenarios, with the hub producing either 44 tonnes/day or 143 tonnes/day.
- The WA Government commenced an exclusive negotiation period with a South Korean renewable energy consortium to establish a green ammonia plant near Geraldton at Development WA's Narngulu Industrial Estate. The facility is expected to produce up to 1 Mtpa of green ammonia using renewable hydrogen.

## 1.6 Regulatory update

- In December 2022, the Economic Regulation Authority (ERA) approved an annual reference tariff variation for the ATCO Gas Australia Mid-West and South-West Gas Distribution Systems (GDS) to apply from 1 January 2023. The approved haulage reference tariffs increased by around 7.3% as a result of higher-than-forecast inflation and cost pass-through events.
- In June 2023, the Economics and Industry Standing Committee announced it will inquire into matters relating to the WA Domestic Gas Policy, with the tabling date for the Committee's interim report scheduled for 22 December 2023. The inquiry is considering:
    1. The adequacy of mechanisms to ensure:
        a. Timely delivery of gas into the domestic market.
        b. Transparency of supply and prices of gas available to the domestic market.

2. The state government's role in ensuring adequate availability of domestic gas into the future, particularly over the short to medium term.

3. The findings and recommendations of the 2011 Inquiry into Domestic Gas Prices, prepared by the previous Economics and Industry Standing Committee (2008–2013), to the extent that they are relevant to the current inquiry's terms of reference 1 and 2.

- In August 2023:
  - Australian Energy Ministers approved an update to the national energy objectives, which embeds emissions reduction as part of the long-term interests of energy consumers. This has now been legislated into the national energy laws.
  - The Australian Energy Market Commission (AEMC) has also published a targets statement, which is a list of jurisdictional targets to be considered by the three market bodies (AEMC, AEMO, and AER), and others, when applying the national energy objectives.
  - The WA State government moved to include emissions as part of the State Electricity Objective, with the Electricity Industry Amendment (Distributed Energy Resources) Bill 2023.
  - The WA Government updated the WA Domestic Gas Policy for the Perth and Canning Basin. Of note:
    - The WA Government will not consider exemptions from the WA Domestic Gas Policy for onshore gas developments on the existing pipeline network to export LNG, including those in the Perth Basin. Gas from the existing pipeline is to be for Western Australian industry and consumers only.
    - For the Canning Basin, these gas resources are not connected to the existing pipeline network and, as such, a normal application of the WA Domestic Gas Policy applies, which requires gas project developers to make available 15% of exports for the domestic market.
- In September 2023,
  - ATCO Gas Australia submitted its proposed access arrangement for the Mid-West and South-West GDS for the sixth access arrangement period (AA6) to the ERA. ATCO's sixth access arrangement period will commence on 1 January 2025, running until 2029, and is now subject to the regulated review process.

## 1.7 GSOO Five-yearly review

In 2023 AEMO, in accordance with the Gas Services Information (GSI) Rules, conducted a five-year review[34] of the WA GSOO information. AEMO surveyed WA gas stakeholders in March, receiving 21 responses from a broad spectrum of stakeholders, including gas buyers, gas sellers, advocacy groups and government. This feedback has been critical in planning the development of the WA GSOO and we thank stakeholders for their submissions.

The three most submitted suggestions for improvements to future WA GSOOs were:

- **Renewable energy and industrial decarbonisation**: Stakeholders asked AEMO to include more information on the rates at which industry will decarbonise and large-scale renewable energy supplies will grow, with consequent changes in gas use. Stakeholders requested that WA GSOO forecasts should include the impact of these trends on both overall gas demand and gas demand patterns.

[34] Available at: https://aemo.com.au/en/energy-systems/gas/gas-forecasting-and-planning/wa-gas-statement-of-opportunities-wa-gsoo/5-yearly-review-of-wa-gas-statement-of-opportunities%5d.

- **Future gas supply**: WA has multiple gas supply projects either proposed or under development. Stakeholders asked AEMO to consider providing more clarity on future gas supply projects, especially Perth Basin supply and LNG-linked Domestic Market Obligation supplies.
- **Gas supply reliability**: Recent outages have highlighted a lack of flexibility in WA gas supply, with most gas plants producing at or close to capacity. Stakeholders asked AEMO to include a reliability outlook in its gas supply forecast.

While AEMO has not incorporated all recommendations in this 2023 WA GSOO, we have sought to uplift these areas in developing this report. We intend to further develop the WA GSOO in the future, particularly in addressing the resiliency of supply during outage events, and the role of pipeline and storage capacity in light of changing consumption patterns.

# 2 Supply-demand balance

Domestic gas demand is forecast to exceed potential gas supply throughout the outlook period in both the Expected and High scenarios. In the Low scenario, the market is forecast to be more balanced.

The impact of new supply from 2026 is crucial to the outlook, any delays or downgrades could be critical to the gas supply-demand balance in WA. Likewise, the assumptions around build-out rates of renewables are a key part of mitigating gas demand growth in the longer term. This chapter outlines risks to the forecasts and provides options to alleviate the projected shortfalls.

## 2.1 Expected scenario

As shown in Table 3 and Figure 6, the WA domestic gas market is expected to be undersupplied through to 2030. Between 2024 and 2028, demand is expected to exceed supply by a total of 136 petajoules (PJ), with shortfalls forecast to increase from 5% of demand in 2024 to a peak of 11% in 2026.

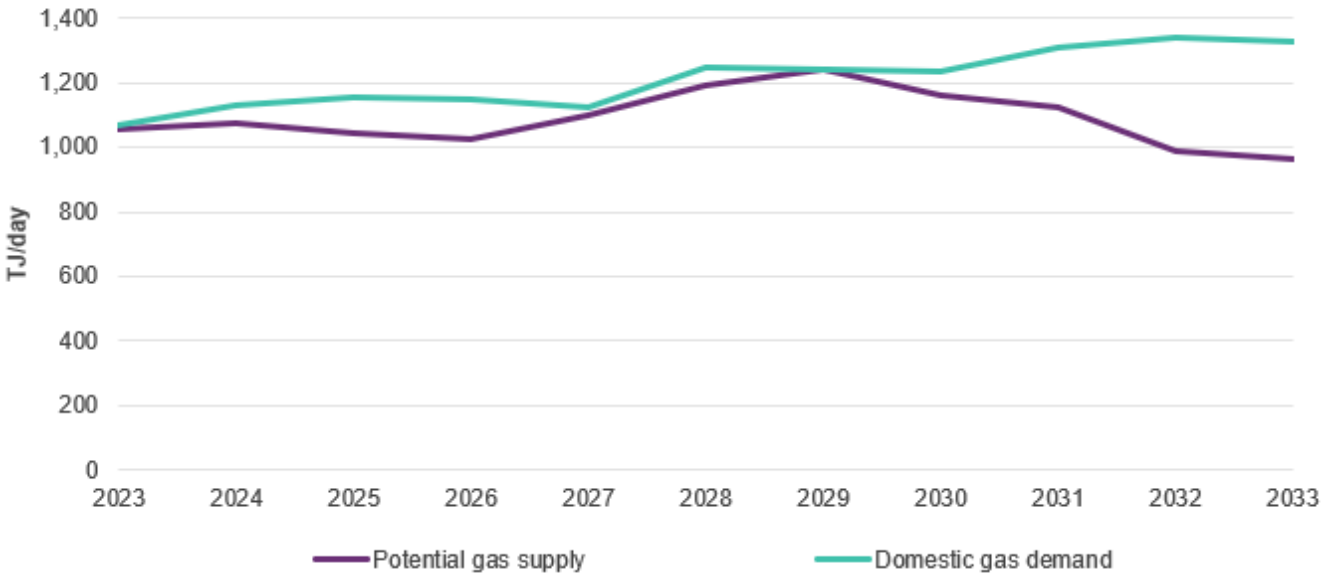
The expected start-up of South Erregulla (2026), Scarborough in mid-2027, Lockyer Deep (2028) and Waitsia Stage 2 from 2029 is projected to be sufficient to return the market to balance in 2029. However, from 2030, the increase in gas required for GPG[35] following coal retirements is projected to result in deficits of up to 362 TJ/day by 2033.

**Table 3 Potential domestic gas supply and demand forecasts, Expected scenario (TJ/day), 2023 to 2033**

| | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 5-year annual average growth rate | 10-year annual average growth rate |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Potential gas supply** | 1,053 | 1,077 | 1,044 | 1,023 | 1,098 | 1,191 | 1,241 | 1,160 | 1,122 | 985 | 963 | 2.5% | -0.9% |
| **Domestic gas demand** | 1,066 | 1,133 | 1,153 | 1,147 | 1,124 | 1,249 | 1,241 | 1,237 | 1,310 | 1,340 | 1,325 | 3.2% | 2.2% |
| **Difference** | -13 | -56 | -109 | -125 | -26 | -58 | 0 | -77 | -188 | -354 | -362 | - | - |
| **Difference as % of demand** | -1.2% | -5% | -9% | -11% | -2% | -5% | 0% | -6% | -14% | -26% | -27% | - | - |

[35] RBP. *Gas powered generation forecast modelling – 2023, December* 2023, prepared for AEMO and published alongside the WA GSOO.

**Figure 6 Expected scenario supply-demand balance, 2023 to 2033 (TJ/day)**



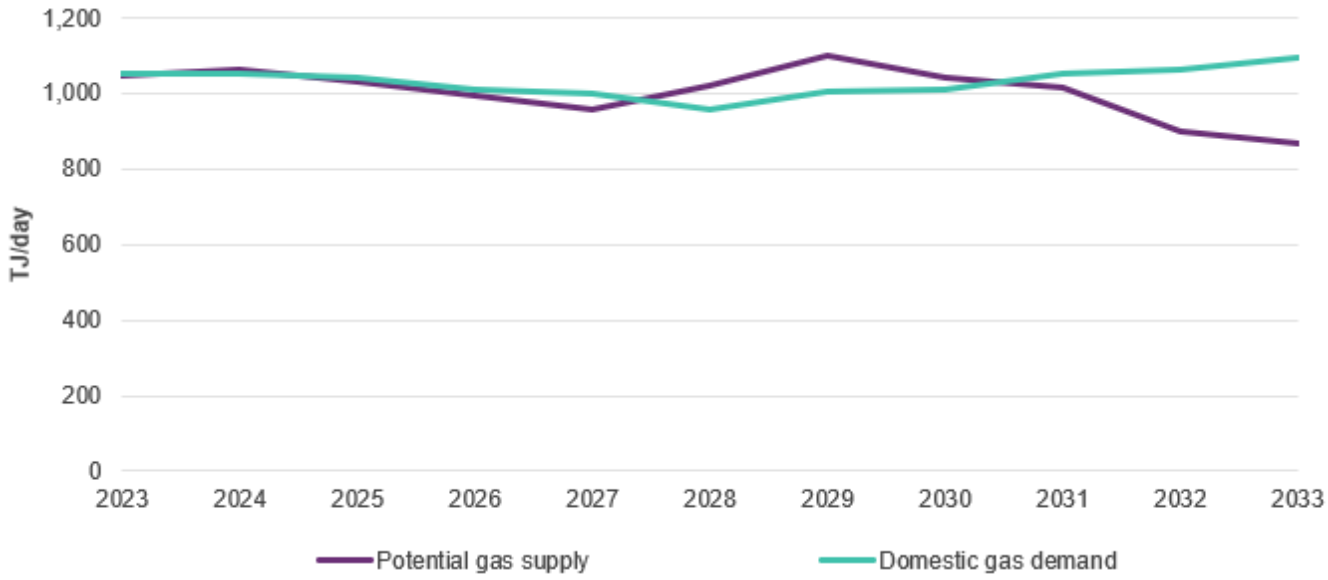

## 2.2 Low scenario

The Low scenario includes only existing gas supply and demand sources and therefore represents a conservative forecast. Both supply and demand forecasts are lower than the Expected scenario. Potential gas supply is forecast to decline at an average annual rate of 1.9% over the outlook period, in line with reserve depletion at existing production facilities (see Table 4 and Figure 7). However, gas demand is also expected to be lower than the Expected scenario, as economic growth is lower under this scenario. This produces a more balanced market than the Expected scenario, although a growing shortfall is forecast to emerge from 2031 as SWIS coal retirements increase the requirement for GPG.

**Table 4 Potential domestic gas supply and demand forecasts, Low scenario (TJ/day), 2023 to 2033**

| | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 5-year annual average growth rate | 10-year annual average growth rate |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Potential gas supply** | 1,046 | 1,062 | 1,032 | 993 | 959 | 1,021 | 1,101 | 1,042 | 1,018 | 899 | 868 | -0.5% | -1.9% |
| **Domestic gas demand** | 1,055 | 1,051 | 1,041 | 1,010 | 1,002 | 958 | 1,006 | 1,008 | 1,053 | 1,062 | 1,092 | -1.9% | 0.4% |
| **Difference** | -8 | 11 | -9 | -17 | -43 | 63 | 95 | 34 | -34 | -163 | -224 | - | - |
| **Difference as % of demand** | -0.8% | 1% | -1% | -2% | -4% | 7% | 9% | 3% | -3% | -15% | -21% | - | - |

**Figure 7 Low scenario supply demand balance, 2023 to 2033 (TJ/day)**




## 2.3 High scenario

The High scenario includes all projects in the Expected scenario, and adds prospective supply and demand sources, including backfill for existing production facilities. Under the High scenario, AEMO assumes that Bluewaters power station closes in late 2026[36], leading to higher medium-term gas demand from SWIS GPG in this scenario. In the longer term, additional renewable power is brought online and demand for gas begins to decrease slowly after 2030.

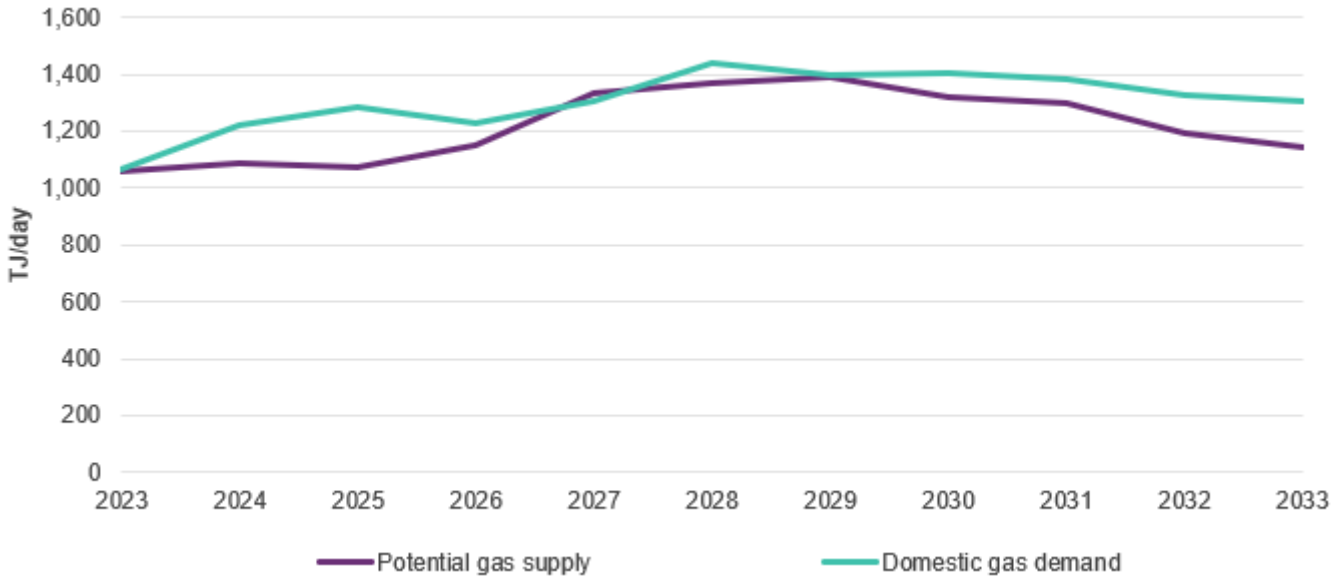
Demand is forecast to exceed supply for every year in the outlook period (except 2027 when Scarborough is brought onstream) under the High scenario (see Table 5 and Figure 8). The scale of the shortfall is much greater than in the Expected scenario, totalling 344 PJ.

**Table 5 Potential domestic gas supply and demand forecasts, High scenario (TJ/day), 2023 to 2033**

| | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 5-year annual average growth rate | 10-year annual average growth rate |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Potential gas supply** | 1,058 | 1,087 | 1,074 | 1,153 | 1,334 | 1,367 | 1,387 | 1,317 | 1,300 | 1,190 | 1,140 | 5.3% | 0.7% |
| **Domestic gas demand** | 1,068 | 1,223 | 1,285 | 1,225 | 1,304 | 1,438 | 1,399 | 1,403 | 1,386 | 1,324 | 1,304 | 6.1% | 2.0% |
| **Difference** | -10 | -136 | -211 | -72 | 30 | -71 | -12 | -86 | -86 | -134 | -164 | - | - |
| **Difference as % of demand** | -0.9% | -11% | -16% | -6% | 2% | -5% | -1% | -6% | -6% | -10% | -13% | - | - |

[36] Which is one year later than forecast in the 2023 WEM ESOO High scenario to reflect the assignment of Capacity Credits for the 2025-26 Capacity Year.

**Figure 8 High scenario supply demand balance, 2023 to 2033 (TJ/day)**




## 2.4 Risks to the forecasts

Between 2024 and 2029, the WA domestic gas market could easily move into surplus or deficit with any delays to demand or supply projects respectively. Key risks to the forecast supply-demand balance include:

- **Market flexibility** – there is limited supply flexibility in the market, with gas production facilities operating at close to maximum capacity. If one of the larger gas plants was to go offline unexpectedly, there could be an immediate but short-term supply shortfall. Linepacking of the 1,500 km Dampier Bunbury Natural Gas Pipeline (DBNGP), plus the Mondarra and Tubridgi storage facilities, may provide limited additional flexibility. However, as seen in January 2023[37], the lack of supply-side flexibility means that the demand side may have to undertake the majority of the response to any shortfall.
- **Coal supply.** The domestic gas market could be pushed further into deficit if coal supply is restricted, leading to an increase in demand for gas generation. AEMO is closely monitoring the coal supply situation in WA.
- **Renewables supply.** Demand for domestic gas could also increase as a result of delays to new renewable electricity projects or lower than expected renewable generation output due to variable weather conditions or other factors.
- **Changing pattern of gas usage.** As gas is increasingly used for firming renewable power generation, the delivery WEM requirements are changing. Close alignment with the WEM ESOO will help ensure that this report continues to reflect the changing pattern of gas consumption, with short-term demand peaks in periods of low wind and solar resources and during peak demand events. These changing patterns of consumption are likely to increase operational impacts on gas infrastructure to meet shorter and sharper consumption needs.
- **Additional gas demand.** Woodside has proposed H2Perth, a hydrogen project located in Kwinana which is expected to require gas in its first phase, and Strike Energy has proposed the Haber Urea project in the

[37] See Section 3.1.3 for full details of the January 2023 incident.

Mid-West, which would be supplied from the company's Perth Basin gas resources. Either of these projects going ahead would put further pressure on gas demand, potentially increasing the market shortfall.

- **New gas supply projects.** New gas supply projects could be delayed, exacerbating supply shortfalls. Conversely, if lead times shorten, new supply projects may commence earlier than forecast, alleviating supply shortfalls. Additionally, reserves risks remain at Perth Basin projects, where the geology is proving complex. AEMO will continue to engage closely with the operators of new and prospective gas supply projects to ensure its information is up to date.
- **Demand reduction or destruction.** Gas-price sensitive industries could choose to cease operations or take steps to reduce gas demand if gas is not available at competitive prices. Responses to AEMO's formal information request (FIR) process indicate that demand destruction[38] could happen from $9.50/GJ, although the median price at which demand destruction occurs is $12.00/GJ[39].
- **Gas substitution.** There are several projects under construction or proposed that could reduce gas consumption. BHP has signed a PPA with Flat Rocks windfarm[40] to provide power to its Nickel West operations, while the company is also undertaking the Northern Goldfields Solar project, to complement gas generation at its Leinster Nickel operations with renewable power from two solar farms, backed up with batteries[41]. In addition, Fortescue Metals Group (FMG) has set a target of zero emissions by 2030 from its operations[42], which may affect its iron ore mines in WA, and aims to replace its gas and diesel generation with a combination of renewables, batteries and hydrogen.

## 2.5 Options that could reduce or eliminate the potential supply shortfalls

The forecast supply shortfalls in this WA GSOO could be alleviated by options including the following:

- In the short term, gas could be made available from storage at up to 210 TJ/day, subject to the quantity of gas in storage at the time[43] and the duration of the requirement.
- Uncontracted liquefied natural gas (LNG spot cargoes) could be diverted from the export market into the domestic market. This could have an impact throughout the forecast period.

In the medium term, the supply/demand balance could be impacted by:

- Development of gas fields that are not currently included in the gas supply forecasts, such as West Erregulla or further expansion of Beharra Springs. Discoveries made in 2023 in the Perth Basin could also be developed within the timeframe of this forecast.
- Large gas users transitioning more rapidly to lower emissions electricity sources.
- Large industrial gas users potentially closing facilities and reducing consumption.

[38] Demand destruction is the permanent or sustained decline in the demand for a certain good in response to high prices or limited supply.

[39] See Section 5.4 for more details.

[40] See: https://www.bhp.com/news/articles/2023/10/bhp-nickel-west-wind-farm-powering-ahead.

[41] See: https://www.bhp.com/news/articles/2022/07/solar-panels-begin-installation-in-northern-goldfields.

[42] See: https://www.fmgl.com.au/in-the-news/media-releases/2022/09/20/fortescue-announces-execution-plan-for-industry-leading-decarbonisation.

[43] There was 42 PJ of gas in storage in October 2023 based on data from AEMO's WA Gas Bulletin Board.

From 2028, the WA domestic gas market could see the entry of Perth Basin gas on a larger scale. Because a number of prospective supply projects in both the Perth and Carnarvon basins are at early stages of appraisal, the scale of the resources and the volumes they could deliver remain uncertain.

Over the longer-term, new sources of gas supply may include:

- Backfill projects at existing facilities, such as Corvus, Dorado or Spar Deep being developed through Varanus Island.
- Expansion of existing facilities, including the domestic gas plants attached to LNG projects.
- Undeveloped fields such as West Erregulla or Beharra Springs Deep in the Perth Basin.
- New discoveries, such as Trigg Northwest, Tarantula or Gynatrix in the Perth Basin being developed as greenfield projects.
- Further successful exploration in the Perth Basin, leading to new development opportunities.

Longer-term demand-side responses could include:

- Build-out rates of renewable energy and energy storage could be accelerated, leading to lower gas demand from GPG in the SWIS in the longer term.
- Industrial decarbonisation could be accelerated, decreasing gas demand in the medium to long term.

# 3 Gas demand

In the Expected scenario, WA domestic gas demand is forecast to increase from 1,066 TJ/day in 2023 to 1,325 TJ/day in 2033 at an average annual rate of 2.2%.

Demand from GPG in the SWIS is forecast to grow from 208 TJ/day in 2023 to a peak of 315 TJ/day in 2032, as anticipated coal powered generation retirements increase the reliance on GPG, underscoring the role of gas in supporting the transition to net zero. Additionally, committed new resources projects, most notably Perdaman's Karratha Urea Project, are expected to contribute to a net increase of 132 TJ/day to gas demand by 2033.

## 3.1 Historical WA domestic gas demand by usage category

WA Gas Bulletin Board (GBB)[44] data classifies WA's gas demand by the following major usage categories:

- Minerals processing.
- Mining.
- Electricity generation (SWIS[45] and non-SWIS).
- Industrial (major users such as manufacture of ammonia and fertiliser).
- Retail distribution network.
- Others (Large User), including liquefied petroleum gas (LPG) and domestic LNG producers[46].
- Others[47].

Figure 9 shows the domestic gas demand by usage category from 2018 to 2023. The domestic gas demand remains at similar level at ~1,000 TJ/day between 2018 and 2023. There is a notable increase in electricity generation for 2022 and 2023, of ~15-19% compared to 2021, which is attributable to the unusually high electricity demand during the winter months. This is offset by slight decreases in most of the other sectors, resulting in negligible overall change.

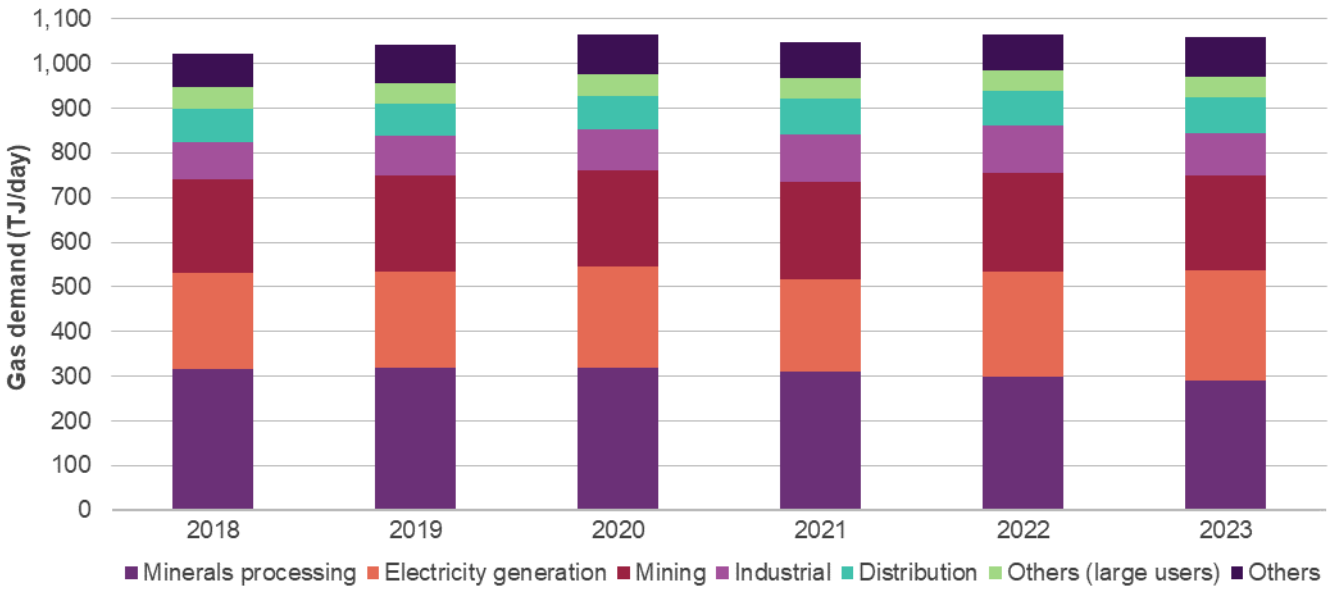
[44] See: https://gbbwa.aemo.com.au. WA GBB data excludes gas consumed by petroleum and LNG processing, which is not reported to the GBB.

[45] The SWIS comprises the electricity transmission and distribution networks in the south-west area of Western Australia and extends from Albany in the south to Kalbarri in the north and to Kalgoorlie in the east. The non-SWIS area includes all towns and mine sites outside of the SWIS (see Appendix A3 for further information).

[46] There are three LNG facilities in WA that liquefy pipeline gas and supply LNG to customers not on the pipeline network: EVOL LNG, Clean Energy Fuels Australia and EDL Energy.

[47] Others correspond to users that are not obligated to register in the WA GBB as their demands do not exceed 10 TJ per day for at least one day in the past 12 months.

**Figure 9 Domestic gas demand by usage category, 2018 to 2023 (TJ/day)[A, B, C]**




Source: WA GBB

A. Annual average of gas demand for 2023 is based on WA GBB data until 9 November 2023.
B. Others correspond to users that are not obligated to register in the WA GBB as their demand does not exceed 10 TJ per day for at least one day in the past 12 months. They include LPG production and domestic LNG production.
C. Others (large users) are large users that are not classified under other categories for large users (i.e. minerals processing, electricity generation, mining, and industrial).
D. Post-adjustment made to GBB data to account for ~50% of the gas consumption from Pinjarra Cogeneration (under electricity generation) going towards steam production for Alcoa Pinjarra (captured under minerals processing). In addition, Port Hedland which is classified as mining in GBB is adjusted to electricity generation. The purpose of these adjustments is to improve alignment with forecasts classification.

Most large customers[48] are supplied directly through the transmission network (such as the DBNGP and the Goldfields Gas Pipeline [GGP]). Customers supplied through the retail distribution network accounted for only 7.7% of total domestic gas demand in 2023[49]. Of the sectors, minerals processing (27.4%), electricity generation (23.2%), and mining (20.2%) have the largest shares, while industrial (8.9%), other large users (4.3%), and others (8.3%) make up the remainder.

## 3.2 WA domestic gas demand forecasts

### 3.2.1 Forecasting scenarios

AEMO has developed WA domestic gas demand forecasts for the outlook period for three scenarios – Low, Expected, and High. These scenarios reflect variations in the economic outlook, commodity production, gas prices, population growth, technological innovations, climate policy commitments of the Federal Government and WA Government, as well as new gas project development (including gas demand reduction due to a transition to

[48] Gas consumers using 10 TJ/day or more are classified as large customers. The categories considered to be large customers include minerals processing, mining, gas generation (SWIS and non-SWIS), industrial, and other Large Users.

[49] Based on WA GBB data until 9 November 2023.

renewables). These scenarios are largely aligned with those in the 2023 WEM ESOO[50], which are mapped from AEMO's 2023 Inputs Assumptions and Scenarios Report (IASR)[51].

The scenarios from the 2023 WEM ESOO are[52]:

- **Low scenario** (*Progressive Change*) – this scenario explores the task of achieving Australia's Paris Agreement commitment of a 43% emissions reduction compared to 2005 levels by 2030 in a more challenging economic environment. While ongoing energy sector investments are required by national and state policies, the Low scenario reflects reduced demand for commodities. The slower pace of economic progress in this scenario is primarily due to higher technology costs and supply chain challenges compared to other scenarios. Nonetheless, substantial investments in decarbonisation are still anticipated, and as a result, the transition in this scenario is expected to be faster than in the Low scenario presented in the 2022 WA GSOO. The slower technology advancement assumptions may support longer use of gas prior to a transition to renewables.
- **Expected scenario** (*Step Change*) – this scenario is centred around achieving a scale of energy transformation that supports Australia's contribution to limiting global temperature rise to below 2°C compared to pre-industrial levels (and may be compatible with 1.5°C pathways for the NEM as well, depending on actions taken by other sectors of Australia's economy). It features a high level of active consumer participation and significant investments in consumer energy resources (CER) to drive the decarbonisation of Australia's economy. This scenario forecasts growth in electrification across both the business and residential sectors, which have been incorporated in this 2023 WA GSOO as part of improvements to modelling to better align with the WEM ESOO (see Section 2.2.2).
- **High scenario** (*Green Energy Exports*) – this scenario reflects very strong decarbonisation efforts both domestically and globally to limit temperature increase to 1.5°C. This leads to a rapid transformation of Australia's energy sectors and a strong emphasis on electrification. With increased domestic and international economic growth, there is a global demand for green energy. Enhanced settings for technological development, supply chain management, social license, and domestic and international cooperation enable substantial growth in green energy exports, including the export of green hydrogen through ammonia and energy-intensive manufacturing utilising hydrogen, such as green steel production. The strong decarbonisation assumptions may suggest less use of gas and more renewable sources to meet the increase in energy demand and to displace the loss of coal electricity generation.

A complete description of the scenarios, including narratives and key parameters is presented in the 2023 IASR.

## Model improvements

Several key improvements have been incorporated into the 2023 WA GSOO forecasts:

- Improved split-out of demand reduction projects, which have increased significantly. These comprise decarbonisation-focused projects which may include on-site generation (typically renewables) or efficiency upgrades that are expected to reduce gas consumption. While the High scenario includes more speculative

[50] See: https://aemo.com.au/en/energy-systems/electricity/wholesale-electricity-market-wem/wem-forecasting-and-planning/wem-electricity-statement-of-opportunities-wem-esoo.

[51] See: https://aemo.com.au/-/media/files/major-publications/isp/2023/2023-inputs-assumptions-and-scenarios-report.pdf.

[52] The corresponding scenarios from the 2023 IASR are noted in italics.

demand reduction projects, only committed projects[53] are included in the Expected and Low scenarios in the 2023 WA GSOO.

- Adoption of multi-sector modelling[54] to consider the potential for gas to electricity fuel switching, for Residential and Commercial (Tariff V) and Industrial (Tariff D) customers. This is consistent with the 2023 WEM ESOO.
- Identification of potential for alternative gases such as hydrogen and biomethane to add to the supply mix, although these are not considered in the supply-demand balance and not presented in this chapter as the quantity of forecast hydrogen and biomethane is relatively small. For more details, refer to Appendix A4.

Further information relating to the methodology and assumptions underpinning the gas-powered generation and gas demand scenarios is provided in Appendix A4 alongside the supporting reports:

- *Commodity Forecasts for Western* Australian *to 2033* report prepared by the National Institute of Economic and Industry Research[55].
- *Gas Powered Generation forecast Modelling 2023 – Final Report* prepared by Robinson Bowmaker Paul[56].
- *Multi-sector energy modelling 2022: Methodology and results Final* report prepared by CSIRO and Climateworks Centre (CWC)[57].

## Committed new projects

Twelve[58] committed mining, minerals processing, and industrial projects, three of which are associated with demand reduction, are forecast to contribute an additional net 131 TJ/day to demand by 2028[59]. All projects have the same start date among the three scenarios unless otherwise stated.

- Lynas's Mount Weld Mine capacity expansion is expected to be complete by 2024[60].
- Mineral Resources' restart of the Wodgina spodumene mine is expected to have a third train from 2024[61].
- Gas demand reduction is expected at Northern Star's Jundee mine due to the installation of new renewable generation from wind, solar, and battery technology starting from 2024[62].
- First production from the Liontown Resources' Kathleen Valley Lithium Project is expected in the second half of 2024[63].
- Lynas' Kalgoorlie Rare Earths Processing Facility is expected to be operational in the second half of 2024[64].

[53] AEMO assesses project development likelihood based on whether it has achieved Final Investment Decision, progress of environmental approvals and any relevant market releases.

[54] AEMO engaged consultants CSIRO and CWC for multi-sector modelling as outlined in the 2023 IASR.

[55] Available at https://aemo.com.au/energy-systems/gas/gas-forecasting-and-planning/wa-gas-statement-of-opportunities-wa-gsoo.

[56] Available at https://aemo.com.au/energy-systems/gas/gas-forecasting-and-planning/wa-gas-statement-of-opportunities-wa-gsoo.

[57] See: https://aemo.com.au/-/media/files/stakeholder_consultation/consultations/nem-consultations/2022/2023-inputs-assumptions-and-scenarios-consultation/supporting-materials-for-2023/csiro-climateworks-centre-2022-multisector-modelling-report.pdf?la=en

[58] The 2022 WA GSOO included six committed projects.

[59] This list only includes committed projects that have yet to establish a connection point. Projects that have not yet reached capacity but already have established a connection point are considered as existing.

[60] See: https://wcsecure.weblink.com.au/pdf/LYC/02703894.pdf.

[61] See: https://clients3.weblink.com.au/pdf/MIN/02703550.pdf.

[62] See: https://www.nsrltd.com/investor-and-media/asx-announcements/2023/june/nst-adds-ounces-and-commits-to-renewable-energy-at.

[63] See: https://www.ltresources.com.au/wp-content/uploads/2023/10/61175048.pdf.

[64] See: https://wcsecure.weblink.com.au/pdf/LYC/02724575.pdf.

- Liontown Resources' Kathleen Valley Lithium is expecting to reduce gas demand by constructing a hybrid power station consisting of 30 MW of wind capacity, a 16 MW solar PV, 17 MW battery energy storage system (BESS), and a thermal power component comprised of 27 MW of gas generation, and 5 MW of diesel standby generation[65].
- Covalent Lithium's Kwinana lithium hydroxide refinery is expected to commence operations in the first half of 2025[66].
- Iluka's Rare Earths Refinery is expected to commence operations in the first half of 2025[67].
- Bellevue Gold Project is planning to reduce gas demand by establishing a hybrid power station, consisting of wind and solar generation, thermal generation, and battery storage by 2025[68].
- Perdaman's Karratha Urea Project is expected to be operational in the first half of 2029, 2028, and 2027 under the Low, Expected, and High scenarios, respectively[69].
- Northern Star's Kalgoorlie Consolidated Gold Mines Mill (KCGM) Expansion is expected to increase KCGM's processing capacity by the second half of 2026.
- One project identified through the confidential 2023 FIR process is expected to start gas consumption starting from the first half of 2025.

### Gas-powered generation (GPG) demand

Scenario assumptions specific to GPG in the SWIS are based on the electricity demand forecasts presented in the 2023 WEM ESOO.

In all scenarios, non-SWIS GPG (including towns serviced by Horizon Power but excluding GPG used for mining) represents roughly 16% of total GPG (3.8% of total domestic gas demand) at the start of the forecast period. Non-SWIS GPG demand is expected to be stable as limited growth in GPG is expected for the non-SWIS area. Further discussion on the projected outlook for individual gas use sectors is provided in Section 3.2.4 and on SWIS GPG forecasts in Section 3.2.6.

## 3.2.2 Domestic gas demand forecasts by scenario

Figure 10 presents the domestic gas demand forecasts[70] under the Low, Expected, and High scenarios from the 2022 and 2023 WA GSOOs, with actuals from 2018 to 2023.

In summary, over the outlook period:

- In the **Low scenario**, domestic gas demand is forecast to decline in the first half of the outlook period, followed by an increase in the second half. The initial decline is largely attributed to a decline in GPG forecasts. The

[65] See: https://zenithenergy.com.au/liontown-resources-signs-power-purchase-agreement-ppa-with-zenith-energy-for-the-largest-off-grid-renewable-energy-hybrid-power-station-in-australia/.

[66] See: https://www.wesfarmers.com.au/docs/default-source/reports/2023-annual-report.pdf?Status=Master&sfvrsn=42fae1bb_3.

[67] See: https://iluka.com/media/su1bifv5/eneabba-community-news-update.pdf.

[68] See: https://zenithenergy.com.au/bellevue-gold-and-zenith-energy-partner-to-establish-innovative-hybrid-power-station-for-bellevue-gold-project/.

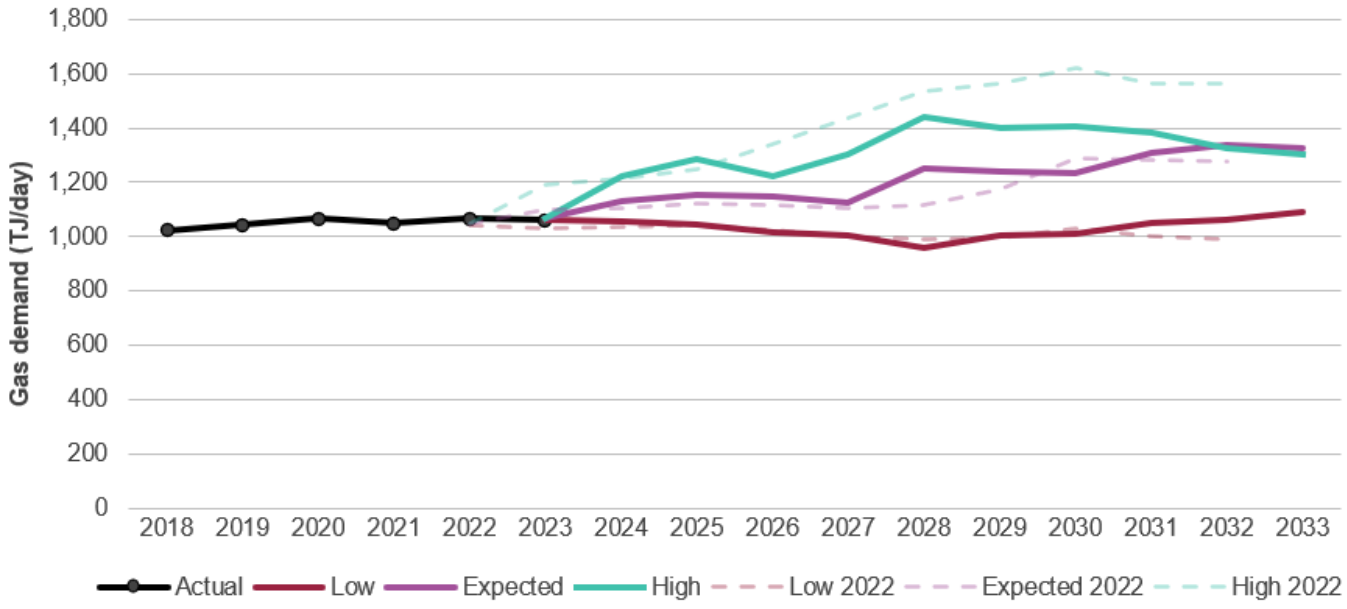
[69] See: https://perdaman.com.au/2023/04/20/perdaman-urea-project-closes-financing/#:~:text=Perdaman%20is%20pleased%20to%20announce,north%20of%20Karratha%2C%20Western%20Australia.

[70] The impact of electrification is accounted for in the domestic gas demand forecasts.

trend is reversed in the later years as Perdaman's Karratha Urea Project is assumed to come online in 2029. The net result is a slight overall increase at an average annual rate of 0.3%.

- In the **Expected scenario**, domestic gas demand is forecast to grow at an average annual rate of 2.2%, driven largely by growth in the industrial sector (5.4%), including Perdaman's Karratha Urea Project (starting 2028) and by an increase in GPG (3.3%). Forecast growth in the minerals processing and mining sectors is limited to less than 2%. Fuel switching from gas-to-electricity for distribution customers is projected to lead to a small decrease in gas demand – see Appendix A4 for further information.
- In the **High scenario**, domestic gas demand is forecast to grow at an average annual rate of 2.0%. Increase in gas demand is largely driven by Perdaman's Karratha Urea Project, which is assumed to start in 2027. Growth in the High scenario is lower than the 2022 forecast due to decarbonisation efforts offsetting gas usage, as well as lower GPG forecasts after 2027 due to higher expected build-out of renewables. The High scenario includes a total of 35 new and prospective projects, of which 18 are associated with demand reduction. This results in a projected maximum net gain of 213 TJ/day in 2028, after which demand is forecast to decline as demand reduction projects are implemented.

**Figure 10 Domestic gas demand – actual data and forecasts under three scenarios from 2022 and 2023 WA GSOOs, 2018 to 2033 (TJ/day)**



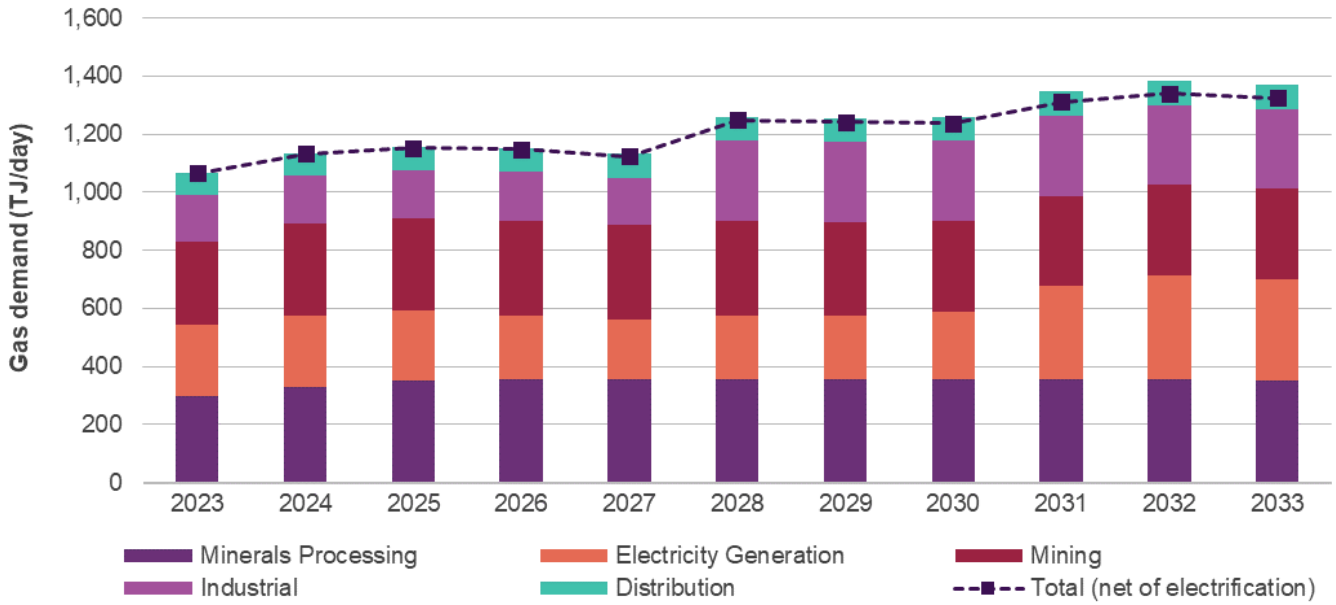

### 3.2.3 Domestic gas demand forecasts by usage category

WA domestic gas demand has been split into five usage categories[71] in accordance with the GBB and as outlined in Section 3.1. To assist with modelling, projects in the "Others (Large Users)" have been classified as industrial while projects in the "Others" category have been allocated into the five usage categories shown in Figure 11.

[71] Usage categories are defined in this way because each category is affected by different external and internal influences. Appendix A5 has a complete breakdown of how gas consumers were categorised. The mining and minerals processing sectors include gas generation located at remote mine sites or minerals processing facilities.

For the 2023 WA GSOO, electrification forecasts[72] adopted from multi-sectoral modelling was incorporated into the gas demand forecasts for the first time. The electrification forecasts are broadly modelled to Tariff D and Tariff V consumers. The electrification forecasts for Tariff D are only available as a total and is not available for individual demand categories (such as mining). The total domestic gas demand, which includes the reductions from electrification, is shown as the black dashed line in Figure 11. Note that the average annual rate by sector quoted in this section excludes the consideration of electrification unless otherwise specified.

**Figure 11 Domestic gas demand forecasts by usage cateogory, Expected scenario, 2023 to 2033 (TJ/day)**




Drivers of trends in the different sectors are:

- Gas demand for **electricity generation** is forecast to grow at an average annual rate of 3.3%[73] across the outlook period. This is slightly lower than an average annual rate of 4.0%[74] forecast in the 2022 WA GSOO. This slower increase in the GPG demand is due to forecast stronger growth in renewable generation. For more information on SWIS GPG forecasts, refer to Section 3.2.6.
- In the **mineral processing** sector, gas demand is forecast to increase at an average annual rate of 1.8% across the outlook period. This is lower than the average annual rate of 2.8% forecast in the 2022 WA GSOO, due to downward revisions of production estimates by the operators of alumina refineries[75].
- In the **mining** sector, gas demand is projected to increase at an average annual rate of 1.0% over the outlook period. This contrasts with the downtrend forecast in the 2022 WA GSOO (-0.7%), with the change driven by a

[72] Electrification in this context refers to fuel switching from gas to electricity drawn from the grid. This differs from the numerous decarbonisation projects captured in the 2023 FIR process. These projects reduce natural gas demand by transitioning from on-site gas power generation to behind-the-meter renewable energy source such as wind power and solar farms.

[73] Note that this is gas demand growth for the whole of WA. Gas demand from electricity generation in the SWIS is forecast to grow at an average annual rate of 3.8%.

[74] The growth rates for the 2022 WA GSOO have been recalculated following the adjustment of the base year to its calculation.

[75] See: https://company-announcements.afr.com/asx/awc/67a1e146-6e07-11ee-9a5a-6217ad01baef.pdf.

reclassification of a number of prospective renewables projects[76] into the High scenario in the 2023 WA GSOO.

- Gas demand in the **industrial** sector is forecast to increase at an average annual rate of 5.4% across the outlook period. This is significantly higher than the 0.1% forecast in 2022 WA GSOO, attributed to Perdaman's Karratha Urea Project.
- Residential and small business **distribution** is forecast to increase at an average annual rate of 1.2%. If electrification is included in the 2023 WA GSOO forecasts, the result shows an average annual decline rate of 1.5%, which contrast with the increases forecast in the 2022 WA GSOO (0.7%)[77].
- The electricity generation, mining, and minerals processing sector currently dominate the total domestic gas demand at similar proportions (23.3%, 26.6%, and 27.8%, respectively). Electricity generation is forecast to increase its share slightly to 25.1%, while a minor decrease is projected for mining and minerals processing (22.8% and 25.7%, respectively) by 2033. Distribution currently has the smallest contribution of 7.2%, which is forecast to shrink to 6.3% by 2033. The contribution of the industrial sector is currently about 15.2%, but is forecast to increase to 20.0% by 2033.
- The 2023 WA GSOO has incorporated electrification in the gas demand modelling, resulting in a slight reduction in the total domestic forecasts (up to 47 TJ/day for 2033).

### 3.2.4 Domestic gas demand forecasts by region

WA domestic gas forecasts have been spilt into three demand regions:

- East (includes the GBB Zones of Goldfields and Kalgoorlie).
- North (includes the GBB Zones of Karratha, Dampier, Pilbara, and Telfer)
- Metro/South West (includes the GBB Zones of Mid-West, Parmelia, Metro, and South West).

Figure 12 presents the domestic gas demand forecasts by region for the Expected scenario.

Of the three regions, the North is forecast to have the highest growth rate at an average annual rate of 4.1%. This is largely attributed to the inclusion of Perdaman's Karratha Urea Project in the Expected scenario starting in 2028.

In the Metro/South West region, average annual gas demand growth of 1.6% is forecast over the outlook period with growth notably higher in the later years. This results from an expected increase in SWIS GPG, partially offset by a reduction from electrification.

Growth in gas demand in the East region is expected to be supported by gold mining projects, but largely offset by development of on-site renewables. As a result, gas demand in this region is expected to grow at an average annual rate of only 0.3% over the outlook period.

[76] This is related to the improved split-out of the demand reduction projects for 2023 WA GSOO. For 2022 WA GSOO, the status of each renewables (demand reduction) project followed the classification of the core project it is associated with. For 2023 WA GSOO, only the demand reduction projects considered as committed are considered in the Expected scenario.

[77] Electrification is introduced for the first time in 2023 WA GSOO. Thus, this growth rate does not include electrification.

**Figure 12 Domestic gas demand forecasts by region, Expected scenario, 2023 to 2033 (TJ/day)**


### 3.2.5 SWIS GPG forecasts

Figure 13 shows the SWIS GPG demand forecasts for the Low, Expected, and High scenarios. In summary:

- In the **Low** and **Expected** scenarios, SWIS GPG demand is forecast to initially decline, followed by an increase, resulting in average annual growth rates of 1.4% and 3.8%, respectively. The forecast increase in SWIS GPG demand[78] is reflective of increasing demand and decline in coal generation, with gas providing firm generation alongside renewables and storage.
- In the **High** scenario, SWIS GPG demand forecasts show more fluctuations throughout the outlook period, but with an overall annual rate of growth of 2.1%. A notable difference between the High scenario and the other two scenarios is a lower peak demand to annual electricity consumption ratio[79]. This results in the model favouring renewables and storage build-out, reducing reliance on gas. This is evident in the forecasts for 2032 and 2033, in which SWIS GPG demand is lower in the High scenario than for the Expected scenario.

As the energy transition in WA continues to progress, gas use in electricity generation is increasingly impacted by a broader range of variables, including but not limited to demand growth, generation facility outages and fuel availability and new buildout of renewables and storage capacity. It is therefore likely, in a given year, that gas consumption may deviate significantly from the modelled outcomes.

Overall, the SWIS GPG demand forecast in the 2023 WA GSOO is higher than that for the 2022 WA GSOO in the near term but lower in the long term. In the early years, with the limited number of new-build renewables projects in the pipeline, more SWIS GPG is expected to be required to support the transition away from coal generation as well as to meet the forecast increases in electricity demand. The SWIS GPG demand requirement is forecast to

[78] Despite the upward trend, the SWIS GPG forecasts show that WA is meeting the Federal Government's commitment to achieve an 82% share of renewable generation by 2030.

[79] The lower peak demand to annual electricity consumption ratio can be attributed to the high responsiveness of large loads (particularly for emerging industries such as hydrogen) to reduce demand during peak demand period considered in the forecasts.

decline in the later years as new renewable generation – specifically wind combined with batteries – is projected to become available to materially replace the loss of coal capacity.

The SWIS GPG demand forecasts[80] were developed using key 2023 WEM ESOO assumptions including those relating to forecast demand, existing and committed fleet composition and Essential System Services. Assumptions relating to this modelling are outlined in Appendix A4.

While input assumptions have been aligned with the ESOO, fundamental differences exist in terms of the objectives of the ESOO and GSOO, with the former identifying opportunities for electricity, quantified in projections of unserved energy. The GSOO instead forecasts the appropriate generation mix that will most efficiently meet the forecast electricity demand to ensure reliability.

For the SWIS GPG assessment, the modelling forecasts that an economic build-out of renewables and storage alongside high efficiency gas generators will meet both renewable energy commitments and an increasing proportion of demand, including as the state-owned coal exiting the system. It is clear from the results that GPG is forecast to continue playing a critical role in supporting reliability in the SWIS through this energy transition.

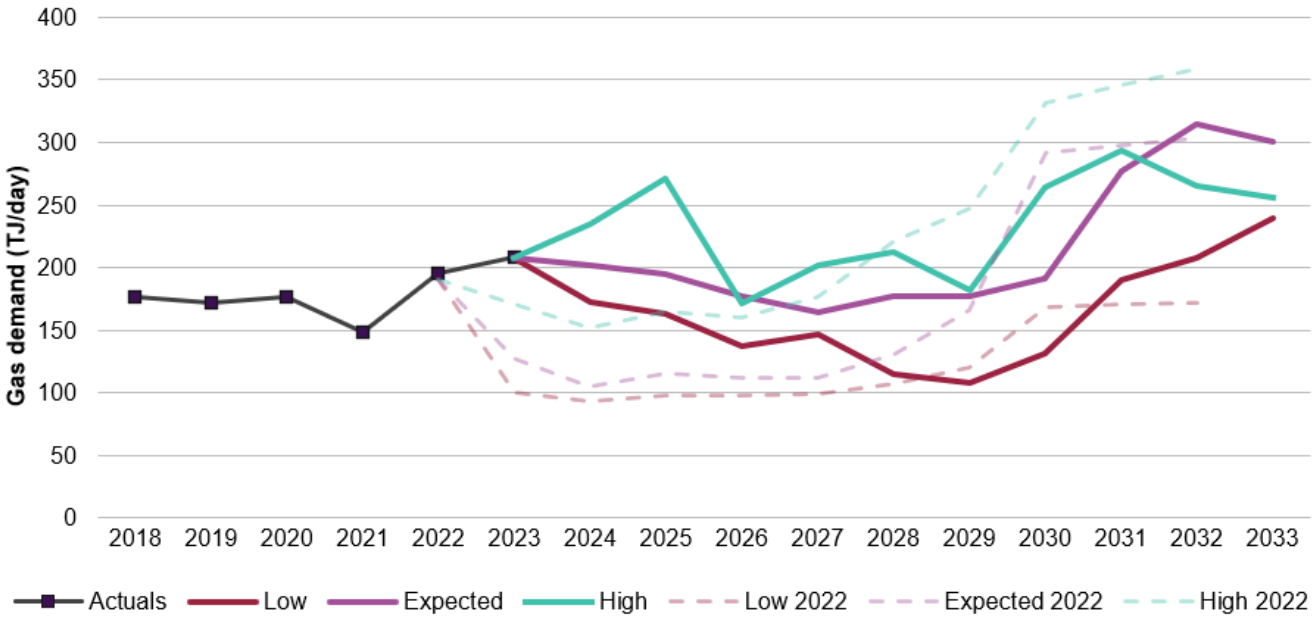
The rapid development of new renewable generation projects, alongside enabling technologies such as storage and transmission infrastructure will be critical to enabling the reduction of GPG required to support the system. This is particularly evident in the High scenario, which sees lower gas demand than the Expected scenario in the early 2030s despite the earlier forecast retirement of Bluewaters Power Station in 2026 and elevated demand forecasts across the outlook period.

Over the longer-term, even with strong investment in renewables and storage, gas is expected to continue to support reliability in the SWIS well beyond the outlook period of this GSOO. The role of gas through decarbonisation of the SWIS was similarly highlighted in the 2023 SWIS Demand Assessment, which identified up to 3.9 GW of new flexible gas generation capacity would be required in the SWIS by 2042[81].

[80] Available at https://aemo.com.au/energy-systems/gas/gas-forecasting-and-planning/wa-gas-statement-of-opportunities-wa-gsoo.

[81] Available at: https://www.wa.gov.au/system/files/2023-05/swisda_report.pdf.

**Figure 13 SWIS GPG demand under three scenarios from 2022 and 2023 WA GSOOs, 2018 to 2033 (TJ/day)**




## 3.3 Total gas demand forecasts

Total gas demand is based on the assumptions outlined in Appendix A4 and is the aggregate of forecasts for domestic gas demand[82], LNG export feedstock, and gas used in LNG processing.

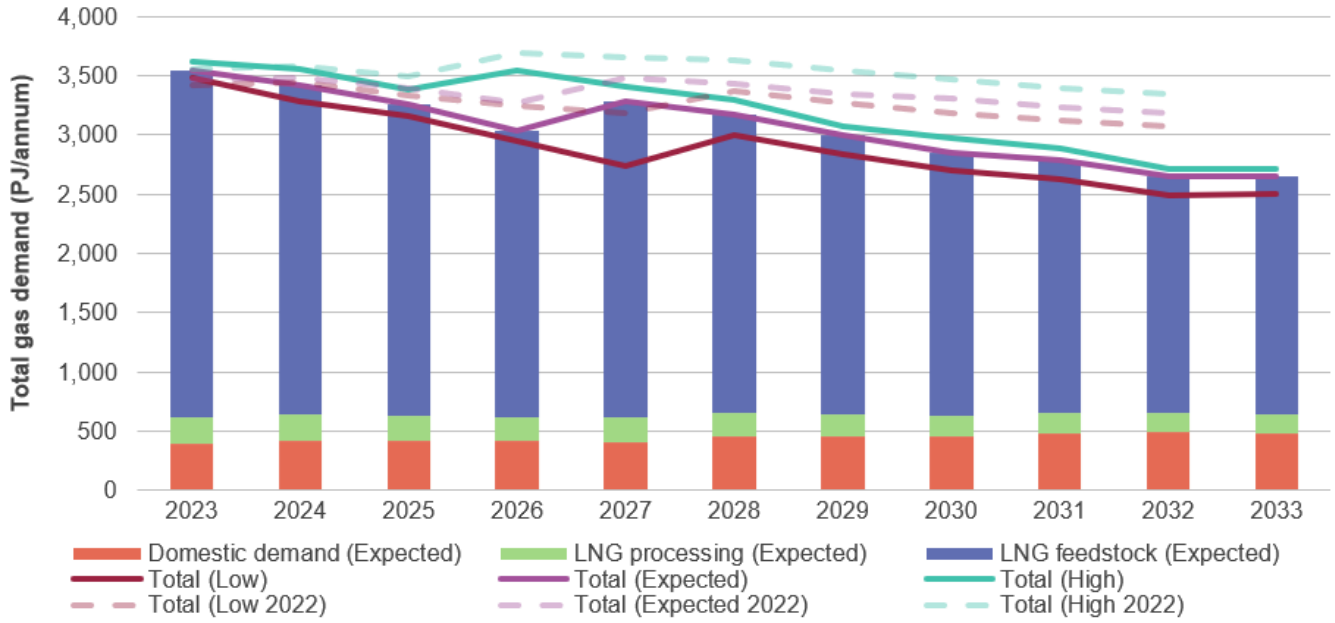
Figure 14 shows the total gas demand forecasts for the Low, Expected, and High scenarios from the 2022 and 2023 WA GSOOs. In summary:

- In the **Low scenario**, total gas demand is projected to decline at an average annual rate of 3.3% over the outlook period. This scenario assumes that Scarborough is brought onstream later than expected (2028) and that Waitsia backfills the KGP from 2025. The Low scenario assumes below-nameplate production from existing LNG plants and Pluto Train 2 achieving production of 4.5 Mtpa.
- In the **Expected scenario**, total gas demand is projected to decline moderately at an average annual rate of 2.9% over the outlook period. This scenario assumes that South Erregulla is brought onstream in 2026, Scarborough in 2027, Lockyer Deep in 2028 and that Waitsia backfills the KGP from 2024. The Expected scenario assumes that existing LNG plants achieve nameplate production rates and that Pluto Train 2 achieves 5 Mtpa.
- In the **High scenario**, total gas demand is projected to decline moderately at an average annual rate of 2.8% over the outlook period. This scenario assumes that South Erregulla is brought onstream in 2025, Scarborough in 2026, Lockyer Deep in 2027 and that Waitsia backfills the KGP from 2024. The High scenario assumes that existing LNG plants achieve nameplate production rates, and that Pluto Train 2 achieves 5 Mtpa.

[82] Domestic gas forecasts include all sectors for domestic gas consumption as discussed under section 3.2.4.

Overall, the 2023 WA GSOO total gas demand forecasts are lower than the 2022 WA GSOO forecasts for all three scenarios. This is largely due to lower than expected LNG production particularly from KGP and Prelude. Another important driver for the lower total demand forecasts under the High scenario is lower total domestic gas demand forecasts.

**Figure 14 Total gas demand forecasts under the Low, Expected, and High scenarios, 2023 to 2033 (PJ/annum)**




A further breakdown for total gas demand forecasts into domestic gas demand, LNG feedstock, and LNG processing for the Low, Expected, and High scenarios is in Appendix A4.

For the Expected scenario, LNG feedstock and LNG processing are forecast to account for an average of around 79.0% and 6.3% of the total gas demand, respectively, throughout the outlook period, with domestic gas demand accounting for 14.7% of total gas demand.

## 3.4 WA domestic gas demand forecasts compared to 2022 WA GSOO

The Expected scenario gas demand forecasts developed for the 2022 and 2023 WA GSOO are compared in Figure 15.

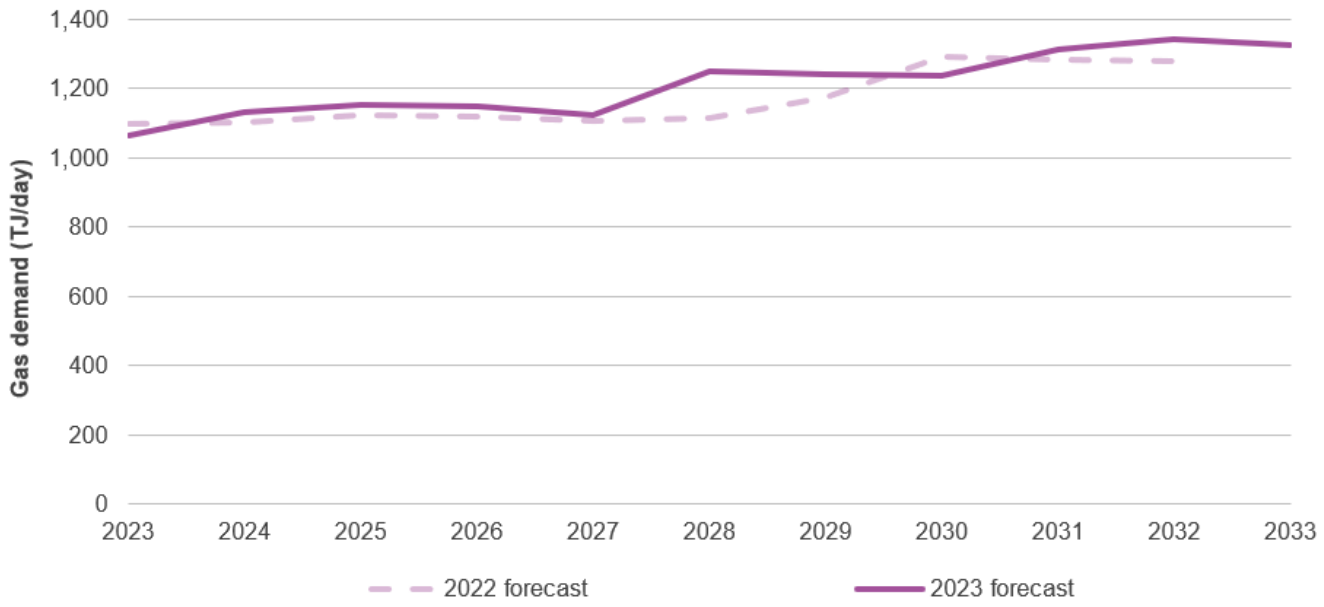
The WA domestic gas demand forecasts presented in this 2023 WA GSOO report are generally slightly higher than the 2022 WA GSOO for the entire outlook period. This is attributed to:

- Fewer demand reduction projects[83].
- Higher GPG forecast in the earlier years.
- From 2028, the inclusion of Perdaman's Karratha Urea Project.

These increases are partially offset by the incorporation of electrification for the first time.

[83] Only projects that are considered as committed are included in the Expected scenario as part of the modelling improvement of the split out of the demand reduction projects.

**Figure 15 Comparison of 2022 and 2023 WA domestic gas demand forecasts, Expected scenario, 2023 to 2033 (TJ/day)**




## 3.5 Reconciliation of previous WA GSOO domestic gas demand forecasts

Table 6 reconciles WA GSOO domestic gas demand forecasts from the last five years against actual gas demand data sourced from the WA GBB. Forecasting methodology improvements, changes in assumptions, access to FIR data and improved data availability from the GBB have contributed to the accuracy of the forecasts over time.

The reconciliation of actual gas demand against previous WA GSOO domestic gas demand forecasts indicates that:

- Across the five years of forecasts considered, the percentage difference between the forecasts and actual gas demand varies between -1.9% to 6.3%, with a tendency to over-forecast.
- The greatest variances from 2023 actuals are forecasts from the 2021 and 2019 WA GSOOs (6.3% and 6.2%, respectively).

**Table 6 Reconciliation of previous WA GSOO domestic gas demand forecasts (% deviance of forecast from actual)[A], 2019 to 2022**

| | 2019 | 2020 | 2021 | 2022 | 2023[B] | Average absolute % deviance |
|---|---|---|---|---|---|---|
| **December 2018 GSOO forecast deviance (%)** | 2.5 | 1.0 | 3.4 | 2.1 | 3.1 | 2.4 |
| **December 2019 GSOO forecast deviance (%)** | | -1.9 | 1.7 | 3.0 | 6.2 | 3.2 |
| **December 2020 GSOO forecast deviance (%)** | | | 1.9 | 1.3 | 2.1 | 1.8 |
| **December 2021 GSOO forecast deviance (%)** | | | | 0.5 | 6.3 | 3.4 |
| **December 2022 GSOO forecast deviance (%)** | | | | | 3.8 | 3.8 |

A. Percentage difference is calculated as (forecast demand – actual demand)/actual demand. A negative figure denotes an under-forecast while a positive figure denotes an over-forecast.
B. Using data from 1 January 2023 to 9 November 2023.
C. Discrepancies between the percentage deviance of forecast from 2021 actuals with figures reported in 2022 WA GSOO is due to corrections made to GBB actual data, which affected data from 1 July 2021 and onwards.

# 4 Gas supply

Potential gas supply is projected to decrease at an average annual rate of 0.9% over the outlook period. This forecast decrease is driven by natural reserves depletion, along with the expected cessation of production from the Reindeer gas field (Devil Creek gas plant). The decline is projected to be partially offset by the development of the Scarborough, Waitsia, South Erregulla and Lockyer Deep gas fields.

AEMO forecasts the potential availability of gas supply to the WA domestic market, or "potential gas supply". Potential gas supply is defined as supply that could be made available to the domestic gas market, given forecast prices, production costs and domestic market obligations (DMOs), subject to processing capacity and gas reserves.

## 4.1 Profile of upstream gas production

### 4.1.1 Reserves and resources

Gas has been categorised into either reserves or resources, based on the level of commercial and technical uncertainties associated with extraction[84]. These terms are broadly defined below:

- Reserves are quantities of gas that are anticipated to be commercially recoverable from known accumulations. Proved and probable (2P) reserves are considered the best estimate of commercially recoverable reserves[85].
- Contingent (2C) resources are considered less commercially viable than reserves. These can be considered roughly the equivalent of reserves with one or more commercial or technical uncertainties impacting the likelihood of development. 2C resources are considered the best estimate of sub-commercial resources[86].

Third-party estimates of WA total conventional gas resources[87] are summarised in Table 7.

**Table 7 WA conventional gas resources and reserves (PJ), August 2023[88]**

| Type | 2022 | 2023 |
|---|---|---|
| **Conventional 2P gas reserves** | 72,532 | 71,201 |
| **Conventional 2C gas resources** | 61,910 | 59,220 |

[84] These uncertainties could include securing finance, obtaining government approvals, negotiating contracts, or overcoming geological challenges.

[85] The 2P reserves categorisation indicates there is a reasonable probability that 50% or more of the gas is recoverable and economically profitable. 2P is a generally accepted industry standard and has been used as the best estimate. Proved reserves (1P) indicate that this probability is higher than 90%. For detailed definitions, see the Society of Petroleum Engineers, at https://www.spe.org/en/industry/petroleum-resources-classification-system-definitions/.

[86] The resources are estimated to exist in prospective areas but are not currently commercially viable.

[87] 'Conventional' refers to formations that are relatively straightforward to extract, and 'unconventional' refers to formations that are much more difficult to extract, in some cases requiring specialised techniques. Both conventional and unconventional gas formations may contribute to reserves and resources, depending on the economic viability of extraction. For more details, refer to Appendix A4.3.

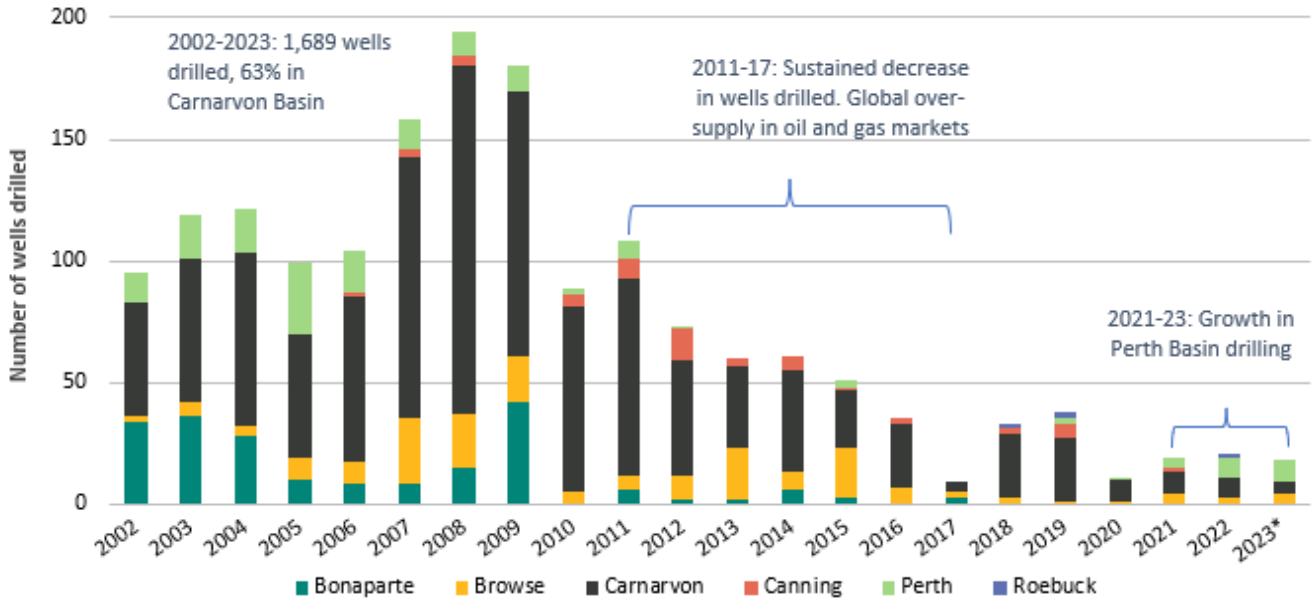
[88] Department of Jobs, Tourism, Science and Innovation, WA, 2023, at https://www.wa.gov.au/government/publications/western-australias-economy-and-international-trade.

In addition to conventional gas, WA has unconventional gas resources (basin centred, shale, and tight gas) mostly located in the Canning Basin. Geoscience Australia has estimated 2,429 PJ of unconventional 2C gas that could ultimately be recoverable from the Canning Basin[89]. There has been no commercial production of unconventional gas in WA to date.

### 4.1.2 Exploration

Gas supply to the WA domestic market relies on the ongoing development of gas discoveries. The number of exploration and development wells drilled in WA remains subdued, with only 18 wells drilled so far in 2023 compared to 194 at the peak in 2008. The Perth Basin has seen renewed interest in recent years, with 23 wells drilled between 2021 and 2023. The Perth Basin overtook the Carnarvon Basin during 2022 and 2023 in terms of wells drilled for the first time since at least 1990. Location of drilling by year is shown in Figure 16.

**Figure 16 Exploration and development wells drilled, 2002 to 2023**




Source: WAPIMS, NOPIMS, and AEMO.
Note: Data until 31 October 2023, sourced from https://nopims.dmp.wa.gov.au/Nopims/Wells and https://wapims.dmp.wa.gov.au/WAPIMS/Wells.

Domestic gas supply via the pipeline network is not expected from the Bonaparte, Browse, Canning or Roebuck basins during the outlook period.

### 4.1.3 Domestic gas supply

There are currently 10 gas production facilities supplying the WA domestic gas market, with a total nameplate capacity of about 1,821 TJ/day[90,91]. The Karratha Gas Plant (KGP) maintains the largest nameplate capacity at 630 TJ/day.

[89] See: https://www.ga.gov.au/digital-publication/aecr2023/gas.

[90] Nameplate capacity as of 31 October 2023.

[91] The Dongara gas production facility has not operated since Q3 2017 and has therefore been excluded. The nameplate capacity values, along with gas production facility average production and capacity utilisations are shown in Appendix A4.3.

Several key events have impacted WA domestic gas supply since the 2022 WA GSOO. The gas supply disruption in early January 2023 is discussed in detail in Chapter 1. The other key events, including production start-up at Spartan (via Varanus Island) and Walyering (in the Perth Basin), that impacted domestic gas supply in WA are detailed below.

## Other key events since the 2022 WA GSOO[92]

- The nameplate capacity of Devil Creek was reduced by more than 70% in early 2023 from its capacity in 2022, primarily due to water breakthrough at the Reindeer field. The Reindeer gas field is expected to cease production completely in early 2024[93].
- The Spartan development was brought onstream in Q2 2023[19]. This is a backfill to the Varanus Island infrastructure and is a domestic-only gas supply.
- The Northern Goldfields Interconnect pipeline was commissioned in July 2023, connecting the DBNGP to the Goldfields Gas pipeline[94]. This provides an alternative gas supply route for consumers in the southern goldfields region, which includes Kalgoorlie.
- The nameplate capacity of the Wheatstone domestic gas facility was increased by 5% in August 2023[95], taking capacity up to 215 TJ/day from 205 TJ/day. This followed a period of testing higher flow rates and should lead to an increased supply into the domestic market.
- The Walyering production facility in the Perth Basin was brought onstream in September 2023[96], with production capacity of 33 TJ/day.
- There are slight increase in nameplate capacities of the Beharra Springs and Xyris production facilities in March 2023, reaching 25 TJ/day and 30 TJ/day respectively.

Figure 17 presents the historical gas supply in the WA domestic market over the last decade.

[92] Year to date is to 31 October 2023. For detail on nameplate capacities see: https://gbbwa.aemo.com.au/#reports/mediumTermCapacity.

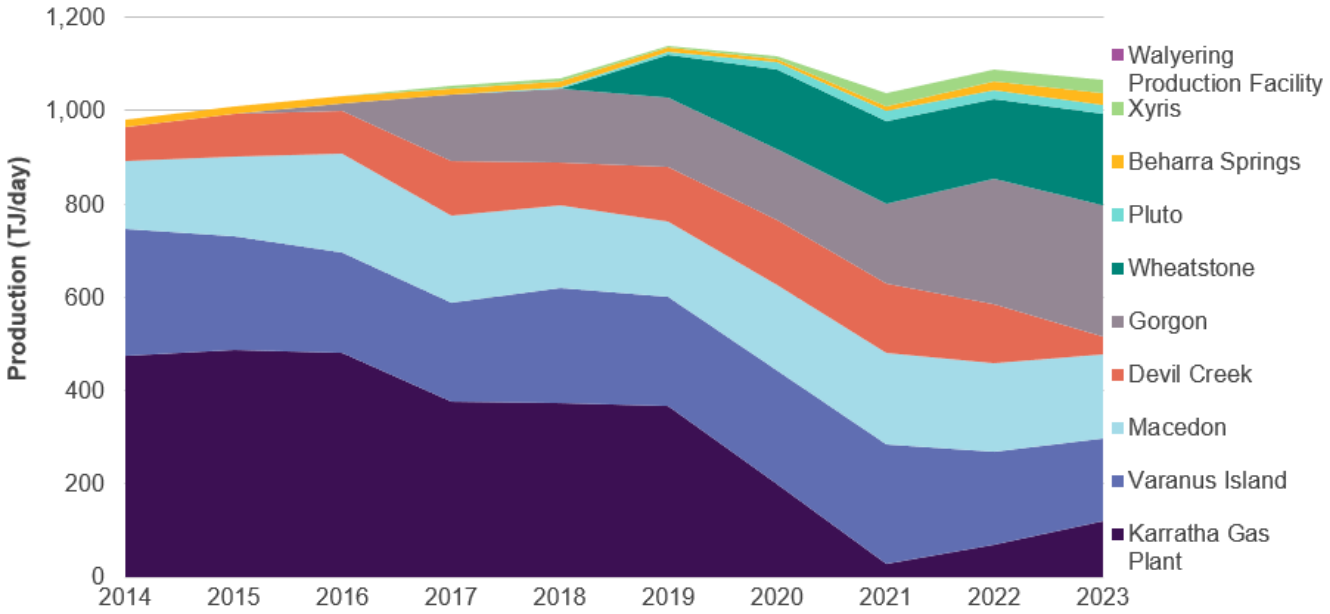
[93] See: https://www.santos.com/wp-content/uploads/2023/10/2023_Third_Quarter_Report.pdf.

[94] See: https://www.wa.gov.au/government/media-statements/Cook-Labor-Government/Boost-to-energy-security-as-WA's-newest-gas-pipeline-opens---20230728.

[95] See: https://australia.chevron.com/news/2023/wheatstone-project-boosts-wa-domgas-supply.

[96] See: https://company-announcements.afr.com/asx/stx/.pdf.

**Figure 17 Average annual gas production by facility, 2014 to 2023 (TJ/day)**




Source: WA GBB.

Note: Figure presents average annual domestic gas supply data until 31 October 2023.

Key observations are:

- Since 2014, gas supply sources in WA have become more diversified.
- Domestic market obligation quantities from Gorgon (2016[97]), Pluto (2018[98]), Wheatstone (2019[99]), and Waitsia (2020)[100,101] started supplying the domestic gas market.
- The Pluto/KGP interconnector was brought onstream in 2022, allowing Pluto gas to be processed at the KGP and delivered into the domestic market via the KGP connection point[102].
- The Beharra Springs Deep gas field was connected to the existing Beharra Springs gas production facility in early 2021[103], which increased the facility's production from 6 TJ/day in 2020 to 20 TJ/day in 2022[104].
- Xyris Production Facility's capacity was expanded to 20 TJ/day in mid-2020[105] and to 30 TJ/day in 2021[106].
- In January 2022, Gorgon started supplying its second tranche of gas, taking its total capacity to 300 TJ/day[107].

[97] See: https://gbbwa.aemo.com.au/#reports/actualFlow.

[98] See: https://www.wa.gov.au/government/publications/implementation-of-the-wa-domestic-gas-policy.

[99] See: https://gbbwa.aemo.com.au/#reports/actualFlow.

[100] See: https://yourir.info/resources/0c5a441cf54ff229/announcements/bpt.asx/2A1272234/BPT_Waitsia_Gas_Project_Stage_2_Reaches_FID.pdf.

[101] Note that Waitsia was already supplying the domestic market, but this supply became a DMO following the LNG export agreement.

[102] See: https://www.woodside.com/what-we-do/operations/pluto-lng/pluto-KPG-interconnector.

[103] See: https://yourir.info/resources/0c5a441cf54ff229/announcements/bpt.asx/2A1310912/BPT_Quarterly_report_for_the_period_ended_30_June_2021.pdf.

[104] See: https://gbbwa.aemo.com.au/#reports/actualFlow.

[105] See: https://yourir.info/resources/0c5a441cf54ff229/announcements/bpt.asx/2A1258293/BPT_Quarterly_report_for_the_period_ended_30_September_2020.pdf.

[106] See: https://gbbwa.aemo.com.au/#reports/actualFlow.

[107] See: https://gbbwa.aemo.com.au/#capacities.

## 4.2 Potential gas supply model assumptions

AEMO's supply model does not project how much gas *will* be produced, but how much *could* be produced. It distinguishes between existing, committed[108], and prospective projects[109] by including prospective projects when the forecast price (WA domestic gas price or Asian LNG price) exceeds production costs.

For more information about the methodology and features of the model, see Appendix A4.3.

### 4.2.1 Forecasting scenarios

AEMO developed potential gas supply forecasts for the Low, Expected, and High scenarios for the outlook period using the following input assumptions:

- Domestic gas demand forecasts, domestic gas price forecasts, and Asian LNG netback[110] forecasts for the Low, Expected, and High scenarios were matched to the relevant gas supply scenario.
- Production costs, DMO volumes, and gas reserves were the same for all three scenarios.
- AEMO sourced forecasts for domestic gas prices, Asian LNG netback, and production cost estimates from EnergyQuest. Gas reserves and contracted volumes were sourced from the 2023 WA GSOO FIR process. Existing DMO volumes were sourced from the WA Department of Jobs, Tourism, Science and Innovation (DJTSI[111]). Market intelligence was gathered via informal and formal gas stakeholder interviews, and publicly available information in relation to projects.
- AEMO assessed the potential domestic gas supply sourced from Hydrogen sector by considering the developments of announced hydrogen projects. Growth in the Hydrogen sector is expected to come from the production of low-carbon hydrogen (blue and green[112]) towards the end of the outlook period in line with following assumptions:
  - In the industrial sector, hydrogen may be used in fuel cells to power fixed and mobile plant, combusted for heat generation, and as a feedstock for fertiliser/ammonia production. Hydrogen may also be used as a fuel in the transport sector for heavy mining vehicles and passenger vehicles.
  - Another application currently being explored in Western Australia is blending hydrogen (up to 10% volume) directly into the gas transportation network for use in the residential and commercial sector or in the power generation sector. A pre-feasibility study on converting the Parmelia gas pipeline to 100% hydrogen carriage is currently underway[113].

AEMO has projected that hydrogen will have only a minimal impact on potential domestic supply towards the end of this outlook period[114]. This forecast is driven by the lack of hydrogen committed for domestic usage (most projects are focussing on exports), along with uncertainty around the progress of hydrogen projects. AEMO will

[108] Expansions to production capacity that have achieved FID.

[109] New projects that have not yet achieved FID and have not been excluded from the modelling for one of the reasons listed in Appendix A4.3.

[110] Netback price is the export parity price for a domestic producer. It is calculated as the LNG destination sale price less the liquefaction and transport costs.

[111] See: https://www.wa.gov.au/government/publications/implementation-of-the-wa-domestic-gas-policy#.

[112] "Blue" hydrogen is produced from natural gas, with emissions sequestered using carbon capture and storage. "Green" hydrogen is produced from renewable energy. For more information on hydrogen projects, see https://research.csiro.au/hyresource/parmelia-green-hydrogen-project/.

[113] See: https://research.csiro.au/hyresource/parmelia-green-hydrogen-project/.

[114] This is in line with the input assumptions for hydrogen projects considered in the 2023 WEM ESOO Expected scenario.

continue to assess the possible impact of hydrogen on potential domestic gas supply, with a view to including hydrogen supply in future WA GSOOs.

### 4.2.2 Key modelling assumptions

WA has a Domestic Gas Policy[115] that aims to secure the state's long-term energy needs by ensuring that LNG export project developers make gas available to the WA domestic market. The policy seeks to reserve the equivalent of 15% of LNG exports for WA consumers. In August 2023, the WA Government strengthened this domestic gas policy to clarify that it would not consider any further exemptions to gas exports through the WA pipeline network (including those in the Perth Basin), and that supply of gas to Australia's east coast would be treated as an export for the purposes of the policy[116].

AEMO has adjusted the daily delivery rates[117] associated with the LNG-linked supply sources that are operating at capacity (Gorgon and Wheatstone). Following analysis of historical production, 90% of the full DMO was assumed to be available to the WA domestic gas market on an annual basis. The modelling also assumed the maximum potential gas supply from domestic-gas only projects is available to the market, subject to remaining gas reserves.

AEMO's modelling assumptions can be summarised as follows:

- The **Low** scenario included only existing and committed gas production capacity.
- The **Expected** scenario included all projects in the low scenario, plus prospective supply sources that are expected to commence operation in the outlook period based on forecast prices and production costs.
- The **High** scenario included all projects in the Expected scenario, plus additional prospective projects that AEMO considers may proceed over the outlook period.

Full details of AEMO's scenario assumptions are shown in Table 8 and Table 9.

[115] See: https://www.wa.gov.au/government/publications/wa-domestic-gas-policy.

[116] This update follows from the WA Domestic Gas Policy in 2020 that clarified that gas exports through the WA pipeline network would not be agreed, and Waitsia was granted an exemption. See: https://www.wa.gov.au/government/publications/implementation-of-the-wa-domestic-gas-policy.

[117] Full details of the domestic market obligations in force, including gas produced and outstanding commitments, are available on DJTSI's website. See: https://www.wa.gov.au/government/publications/implementation-of-the-wa-domestic-gas-policy.

**Table 8 Potential gas supply modelling assumptions for existing projects**

| Production facility | Category | Assumption in all three scenarios |
|---|---|---|
| **Beharra Springs** | Existing domestic gas only | 28 TJ/day throughout the outlook period[A] |
| **Devil Creek** | Existing domestic gas only | Ceases production end of Q1 2024[B] |
| **Gorgon** | Existing LNG-linked with DMO | 270 TJ/day throughout the outlook period |
| **Karratha Gas Plant** | Existing LNG-linked with DMO | 90 TJ/day throughout the outlook period[C] |
| **Macedon** | Existing domestic gas only | 167 TJ/day in 2024, with declining production limited by remaining reserves for the rest of the outlook period |
| **Pluto** | Existing LNG-linked with DMO | 28 TJ/day: 3 TJ/day via LNG truck-loading[D] and 25 TJ/day via pipeline |
| **Pluto acceleration** | Existing LNG-linked with DMO | 18 TJ/day between 2024 and 2025, with an additional 25 TJ/day from 2025 (Pluto gas to be delivered via the KGP) |
| **Spartan** | Existing domestic gas only | 55 TJ/day in 2024, reducing through the outlook period, delivered through Varanus Island |
| **Varanus Island (John Brookes and Spar-Halyard)** | Existing domestic gas only | 177 TJ/day from 2024 with declining production limited by remaining reserves for rest of the outlook period |
| **Waitsia** | Existing LNG-linked | At least 20 TJ/day from 2024[E] delivered via Xyris |
| **Walyering** | Existing domestic gas only | 25 TJ/day from late-2023 |
| **Wheatstone** | Existing LNG-linked with DMO | 194 TJ/day throughout the outlook period[F] |

A. The nameplate capacity increased from 18.5 TJ/day to 24 TJ/day in November 2022, and 25 TJ/day in March 2023. See: https://gbbwa.aemo.com.au/#capacities.
B. The capacity of Devil Creek was decreased from 220 TJ/day to 50 TJ/day in March 2023, primarily due to water breakthrough at the Reindeer field. The field is expected to cease completely in early 2024.
C. This gas delivery from the KGP is assumed to include 18 TJ/day of Pluto acceleration DMO until mid-2025, and then 25 TJ/day of Pluto additional domestic gas commitment between 2025 and 2029.
D. AEMO has included "Non-connection-point demand", i.e. off-grid gas demand, that is equal to the Pluto LNG truck loading production.
E. See: https://www.beachenergy.com.au/wp-content/uploads/BPT_FY23_Third_Quarter_Activities_Report.pdf.
F. The capacity of Wheatstone was increased from 205 TJ/day to 215 TJ/day in August 2023, see: https://australia.chevron.com/news/2023/wheatstone-project-boosts-wa-domgas-supply.

**Table 9 Potential gas supply modelling assumptions for new projects**

| Gas field | Category | Low | Expected | High |
|---|---|---|---|---|
| **Corvus** | New domestic gas only | Not developed | Not developed | 50 TJ/day from mid-2031 |
| **Gynatrix** | New domestic gas only | Not developed | Not developed | 15 TJ/day from 2027 |
| **Lockyer Deep** | New domestic gas only | Not developed | 50 TJ/day from mid-2028 | 50 TJ/day from mid-2027 |
| **Scarborough[A]** | New LNG-linked with DMO | 180 TJ/day from mid-2028 | 180 TJ/day from mid-2027 | 180 TJ/day from mid-2026 |
| **South Erregulla** | New domestic gas only | Not developed | 40 TJ/day from mid-2026 | 40 TJ/day from mid-2025 |
| **Trigg Northwest** | New domestic gas only | Not developed | Not developed | 15 TJ/day from 2027 |
| **Waitsia Stage 2[B]** | New domestic gas only | 20 TJ/day between 2024 and 2028. An additional 50 TJ/day from 2029 | 20 TJ/day between 2024 and 2028. An additional 100 TJ/day from 2029 | 30 TJ/day between 2024 and 2028. An additional 100 TJ/day from 2029 |
| **West Erregulla** | New domestic gas only | Not developed | Not developed | 80 TJ/day from mid-2027 |

A. Scarborough is being developed as an LNG supply source to Pluto Train 2 and a domestic gas facility with a nameplate capacity of 225 TJ/day.
B. Developed as an LNG supply source through NWS up until 2028 and then to supply domestic market from 2029 onwards.

### 4.2.3 Prospective supply sources

AEMO has included two undeveloped fields, Lockyer Deep and South Erregulla, in its Expected scenario.

There are an additional four undeveloped fields in the High scenario supply forecast: Corvus, Gynatrix, Trigg Northwest, and West Erregulla (see Appendix A4.3 for further information about the selection criteria for these

projects). These prospective domestic gas-only projects have been included in the High scenario only. AEMO will monitor development of these projects for potential inclusion in the Expected scenario in future WA GSOOs.

### Lockyer Deep

Lockyer Deep 1 was discovered in September 2021[118]. It lies 10 km north of the West Erregulla project and 15 km east of the Waitsia project. The field is owned by Energy Resources Limited (subsidiary of Mineral Resources Limited, 80% and operator), and Norwest Energy NL (20%). The Lockyer Deep 2 appraisal well, drilled in March 2023, came in dry[119]. A further appraisal well, Lockyer Deep 3 (net pay 13m, 12% porosity), was drilled in July 2023 and is scheduled for completion in 2024[120].

In the Expected scenario, AEMO has assumed that Lockyer Deep will take FID in 2024 as a domestic gas supply project and will be available from 2028.

### South Erregulla

Strike Energy (100%) reported a discovery at South Erregulla in February 2022[121]. Progress of this project includes 128 PJ (2P) of gas reserves certified at South Erregulla[122] and a production licence granted in September 2023[123,124]. A successful appraisal well, South Erregulla 2, was drilled in October 2023[125], with net gas pay of 16 metres. Two gas sales agreements, totalling 42 PJ, were announced on 17 November 2023[126].

AEMO has modelled South Erregulla in the Expected scenario as a prospective domestic gas project available from 2026.

### Corvus

The Corvus gas field[127] is located offshore in the Carnarvon Basin, approximately 90 km northwest of Dampier in Commonwealth waters. The field is 100% owned and operated by Santos. AEMO previously modelled Corvus as backfill for Devil Creek from 2028. However, the Reindeer gas field and Devil Creek sites have progressed to be converted to a carbon capture and storage (CCS) hub by 2028[128]. AEMO assumed any development of Corvus will be via Varanus Island.

### Gynatrix

Gynatrix is located to the south of the Waitsia gas field (Mitsui E&P operated permits), 250 km north of Perth[129]. Mitsui E&P (50%, operator) and Beach Energy (50%) announced the discovery of Gynatrix in early 2023, with

[118] See: https://clients3.weblink.com.au/pdf/MIN/02419018.pdf.
[119] See: https://clients3.weblink.com.au/pdf/MIN/12 April 2023.pdf.
[120] See: https://clients3.weblink.com.au/pdf/MIN/02729518.pdf.
[121] See: https://app.sharelinktechnologies.com/announcement/asx/c6a07525393901c5ab390c7d499c6c3f.
[122] See: https://app.sharelinktechnologies.com/announcement/asx/eb3571f5817c22a0de8c5db1e2f0fc2a.
[123] See: https://app.sharelinktechnologies.com/announcement/asx/13 September 2023.
[124] See: https://app.sharelinktechnologies.com/announcement/asx/15 June 2023.
[125] See: https://app.sharelinktechnologies.com/announcement/asx/5 October 2023.
[126] See: https://app.sharelinktechnologies.com/announcement/asx/249a4909e34fdab7605a077db2110979.
[127] See: https://www.santos.com/wp-content/uploads/2020/02/190416-b-successful-corvus-2-appraisal-well-discovers-significant-offshore-resource.pdf.
[128] See: https://www.santos.com/wp-content/uploads/2023/02/Climate-Change-Report-2023.pdf.
[129] See: MEPAU-EXA-COR-00003-Information-Sheet-Elegans-and-Gynatrix-Exploration.pdf.

6 metres of net gas pay across a 37-metre gross section in the Kingia reservoir[130]. Completion and well testing planning is underway[131].

### Trigg Northwest

Trigg Norwest was discovered in August 2023[132]. It lies within the locality of Arrowsmith, approximately 20 km south of Dongara and 270 km north of Perth. As per Beach Energy's (100%, operator) announcement in October 2023, logging while drilling showed net gas pay of 6 metres across a 49-metre gross section in the Kinga sandstone reservoir[133]. The well will be subject to further testing for productivity, connected volumes and commerciality.

### West Erregulla

The West Erregulla field was discovered in 2019 and is located onshore in the Perth Basin, approximately 230 km north of Perth. The field is owned by Strike Energy (50%, operator) and Warrego Energy (50%, now part of Hancock Energy)[134].

The 2P reserve estimate is 422 PJ[135] and the operator is progressing environmental approvals to develop the West Erregulla gas field[136]. Two further wells, Erregulla Deep -1 and Southwest Erregulla -1, are expected to be drilled in mid-2024 and late-2025 respectively[137].

## 4.2.4 Multi-user gas storage facilities

Gas storage can provide an alternative supply source of gas. WA has two multi-user gas storage facilities in operation, as shown in Table 10.

**Table 10 WA multi-user gas storage facilities, 2023**

| Facility | Operator | Commenced operation | Gas storage capacity (PJ) | Injection/withdrawal capacity (TJ/day) |
|---|---|---|---|---|
| **Mondarra** | APA Group | 2013 | 18 | 70/150 |
| **Tubridgi** | Australian Gas Infrastructure Group | 2017 | 60 | 90/60 |
| **Total** | | | 78 | 160/210 |

Source: WA GBB.

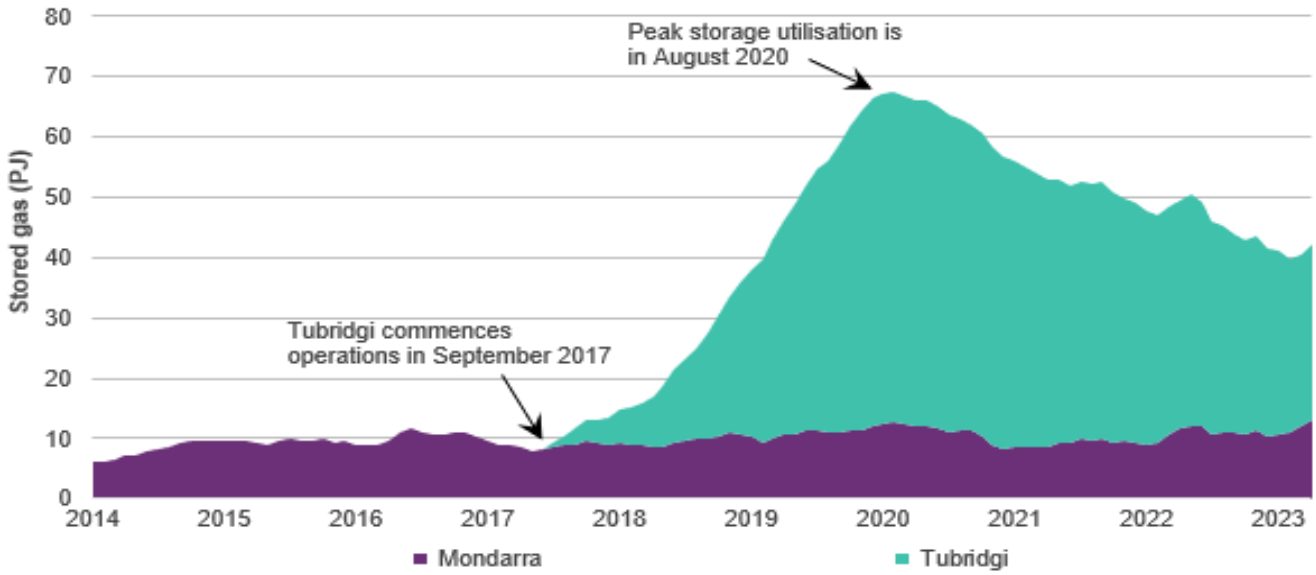
Tubridgi typically provides long-term storage, as it has low injection/withdrawal capacity relative to its storage capacity. It is also located remotely from the major gas markets of the southwest.

Mondarra is much closer to the Perth Metropolitan area and is connected to both the DBNGP and Parmelia pipelines. It has high injection/withdrawal capacity relative to its storage capacity and is typically used for short-term storage and daily balancing.

[130] See: https://www.beachenergy.com.au/wp-content/uploads/BPT_FY23_Second_Quarter_Activities_Report.pdf.
[131] See: https://www.mepau.com.au/schedule-of-activities/.
[132] See: https://yourir.info/resources/0c5a441cf54ff229/announcements/bpt.asx/2A1467495/BPT_Trigg_Northwest_1_gas_discovery.pdf.
[133] See: https://yourir.info/resources/0c5a441cf54ff229/announcements/bpt.asx/BPT_FY24_First_Quarter_Activities_Report.pdf.
[134] See: https://app.sharelinktechnologies.com/announcement/asx/c133b54227a195cb83d8276049426106.
[135] See: https://app.sharelinktechnologies.com/announcement/asx/27 July 2022.
[136] See: https://www.epa.wa.gov.au/proposals/west-erregulla-field-development-program/9 October 2023.
[137] See: https://app.sharelinktechnologies.com/announcement/asx/25 October 2023.

The amount of gas estimated to be stored in Mondarra and Tubridgi is shown in Figure 18. AEMO estimates that the facilities contained approximately 42 PJ of stored gas in October 2023[138], down from 49 PJ in October 2022[139]. This resulted in a capacity utilisation rate of 54.2%.

**Figure 18 Cumulative stored gas, July 2014 to October 2023 (PJ)**




Source: WA GBB.
Note: The cumulative stored gas data is up to 31 October 2023.

Stored gas peaked in August 2020 and declined between September 2020 and October 2023 as withdrawals outpaced injections. Declines in stored gas since 2020 have coincided with increasing prices in the domestic gas spot market[140] and are likely to be indicative of tight market conditions for gas supply across this period.

## 4.3 Potential gas supply forecasts

Depending on the various input assumptions for the Low, Expected, and High scenarios (see Appendix 4.3), prospective supply sources and backfill for existing production facilities were assumed to commence if:

- Forecast WA domestic gas prices exceed the cost of production, for domestic gas projects.
- Forecast Asian LNG prices exceed the cost of production, for LNG-linked projects. If the project commences, AEMO assumed that an associated DMO will be offered to the domestic gas market.

AEMO assessed various prospective gas supply sources that could be included based on the criteria above. While there is a large volume of undeveloped gas that could supply the WA domestic market during the outlook period, these resources are currently too speculative to be included in the potential supply forecasts. These resources include, but are not limited to, North Erregulla Deep, Tarantula Deep, Dorado, North Erregulla,

[138] Calculated as net injections less withdrawals over the period August 2013 to 31 October 2023 and excluding cushion gas.

[139] See: https://aemo.com.au/-/media/files/gas/national_planning_and_forecasting/wa_gsoo/2022/2022-wa-gas-statement-of-opportunities.pdf.

[140] See: https://www.gastrading.com.au/spot-market/historical-prices-and-volume/forecast-vs-actual.

Maitland, Julimar Brunello Phase 3, Equus, Zola, Bianchi and Browse. AEMO will continue to monitor these projects for potential inclusion in future WA GSOOs.

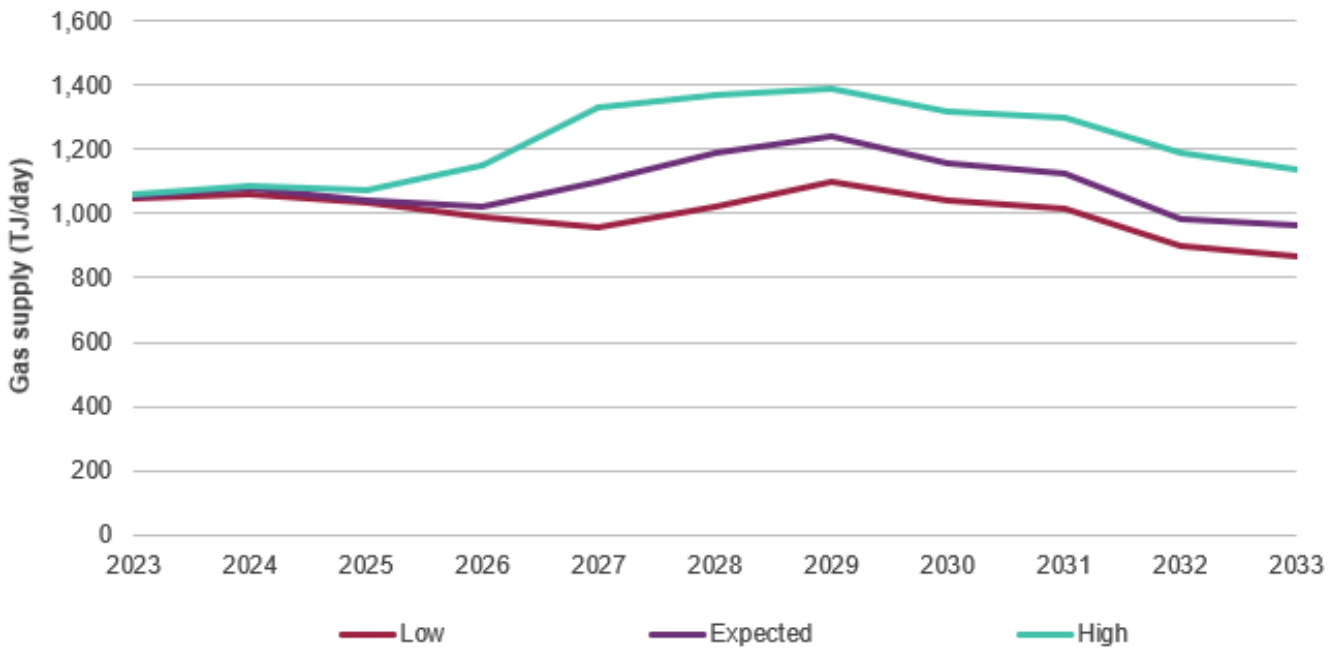
AEMO's potential gas supply forecasts for the three scenarios are shown in Table 11 and Figure 19. Potential gas supply forecasts in all three scenarios are lower than the total installed nameplate production capacity over the outlook period.

**Table 11 Potential gas supply forecasts in three scenarios (TJ/day), 2023 to 2033**

| Scenario | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 5-year annual average growth rate | 10-year annual average growth rate |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Low** | 1,046 | 1,062 | 1,032 | 993 | 959 | 1,021 | 1,101 | 1,042 | 1,018 | 899 | 868 | -0.5% | -1.9% |
| **Expected** | 1,053 | 1,077 | 1,044 | 1,023 | 1,098 | 1,191 | 1,241 | 1,160 | 1,122 | 985 | 963 | 2.5% | -0.9% |
| **High** | 1,058 | 1,087 | 1,074 | 1,153 | 1,334 | 1,367 | 1,387 | 1,317 | 1,300 | 1,190 | 1,140 | 5.3% | 0.7% |

Note: 2023 captures actual production between 1 January to 31 October 2023 and estimated production between 1 November to 31 December 2023. For the average annual growth rate calculations, 2023 is the base year (year 0) and 2033 is the final year (year 10).

**Figure 19 2023 WA GSOO potential gas supply forecasts in three scenarios, 2023 to 2033 (TJ/day)**




Across the three scenarios, potential supply increases are due to Scarborough being brought onstream (from 2026 – High scenario, 2027 – Expected scenario, and 2028 – Low scenario) and additional domestic supplies from Waitsia from 2029 (all scenarios). In summary, between 2024 and 2033 potential gas supply is projected to:

- Decrease at an average annual rate of 1.9% in the Low scenario. This is due to:
  - The Reindeer gas field, which supplies the Devil Creek production facility, ceasing production in early 2024.
  - Production from Varanus Island and Macedon decreasing gradually.

  - LNG-linked supplies from Gorgon, North West Shelf, Wheatstone and Pluto continue to produce 90% of their DMO.

- Decrease at an average annual rate of 0.9% in the Expected scenario. This is due to the following additional supply in this scenario compared to the Low scenario:
  - South Erregulla from 2026.
  - Lockyer Deep from 2028.
- Increase at an average annual rate of 0.7% in the High scenario. This is due to the following additional and accelerated gas supply included in this scenario compared to the Expected scenario:
  - South Erregulla from 2025.
  - Lockyer Deep from 2027.
  - West Erregulla from 2027.
  - Gynatrix from 2027.
  - Trigg Northwest from 2027.
  - Corvus from 2031.

### 4.3.1 Pipeline capacity to deliver additional gas to meet peak demand

As the penetration of renewable power generation increases[141], the role of gas power generation is changing. To meet baseload and peaking requirements, the need to firm renewable generation is growing. This results in larger gas demand requirements in the mornings and evenings.

The main pipeline supplying gas to the SWIS generators is the DBNGP. AEMO continues to liaise with the pipeline operator to analyse the future demands that will be placed on the DBNGP.

Demand for pipeline services on the DBNGP are underpinned by long term contracts and the operator is confident that the DBNGP can meet current contractual commitments to Shippers. Further, there has not been a curtailment of pipeline services since February 2007, which occurred during an upgrade of the pipeline.

The DBNGP has a nameplate capacity of 845 TJ/day, based on firm full haul T1 capacity[142], although instantaneous intraday flows can be higher. For example, on 23 November 2023, the DBNGP recorded the equivalent of 920 TJ/day[143] instantaneous flow into the Perth metro area. This occurred as SWIS operational demand hit a record high of 4,041 MW[144]. This flow rate demonstrated the DBNGP's capability to meet the growing GPG demands of the energy transition. AEMO will continue to review the potential for GPG dispatch outcomes which may place additional requirements on the DBNGP.

[141] AEMO, 2023, Wholesale Electricity Market *Electricity Statement of Opportunities*, at https://aemo.com.au/-/media/files/electricity/wem/planning_and_forecasting/esoo/2023/2023-wholesale-electricity-market-electricity-statement-of-opportunities-wem-esoo.pdf.

[142] See: https://www.agig.com.au/customer-access.

[143] Source: Australia Gas Infrastructure Group (AGIG).

[144] Source: AEMO.

## 4.4 Comparison of 2022 and 2023 WA GSOO potential gas supply forecasts

The Expected scenario potential gas supply forecasts developed for the 2022[145] and 2023 WA GSOOs are compared in Figure 20. For the 2023 WA GSOO, compared to the 2022 WA GSOO, AEMO:

- Added the South Erregulla (40 TJ/day from mid-2026), owned and operated by Strike Energy. The field was awarded a production licence in September 2023 and was awarded primary environmental approval by the EPA and achieved gas sales agreements in November 2023[146,147].
- Added Mineral Resources' Lockyer Deep (50 TJ/day from mid-2028) field. The operator drilled two appraisal wells in 2023 and expects to take FID in late 2023 or 2024.
- Removed the West Erregulla gas field (87 TJ/day from 2023 was included in 2022 WA GSOO), a joint venture between Strike Energy and Hancock Prospecting[148]. Near-field exploration drilling is expected from 2024, while the operator continues to seek environmental approval.
- Updated its DMO production assumptions for Gorgon and Wheatstone, based on the domestic gas agreements and historical production, which increased the supply forecast by around 34 TJ/day (see Table 22 in Appendix 4.3.2).
- Updated its assumptions about reserve depletion rates, based on responses from the 2023 FIR that indicated stronger production from domestic-only supply sources, which has increased the supply forecast by around 42 TJ/day.
- Updated its forecasts for gas reserves and resources, production costs, domestic gas prices and Asian LNG prices.

These changes account for most of the differences between the 2022 and 2023 WA GSOO potential gas supply forecasts in the Expected scenario.

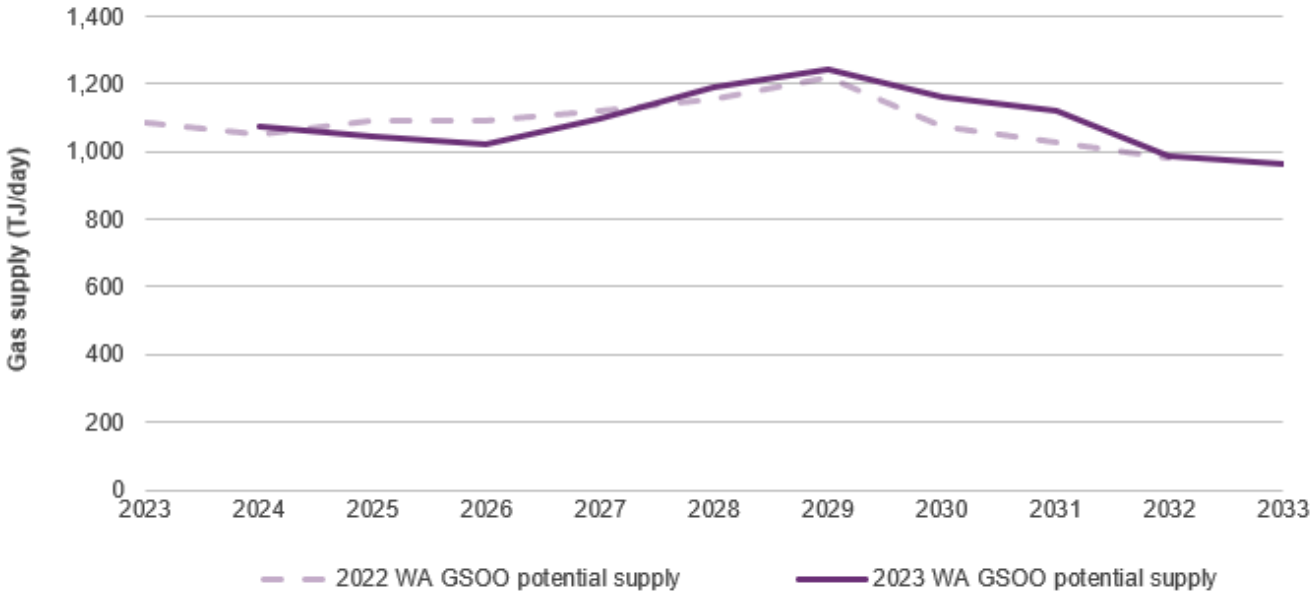
[145] The potential gas supply forecasts in the 2022 WA GSOO covered the period 2023 to 2032.

[146] See: https://www.marketindex.com.au/asx/stx/announcements/south-erregulla-update-14 Nov 2023.

[147] See: https://strikeenergy.au/wp-content/uploads/2023/09/2023-Strike-Annual-Report.pdf.

[148] See: https://strikeenergy.au/west-erregulla-2/.

**Figure 20 Potential gas supply forecasts from 2022 and 2023 WA GSOOs, Expected scenario, 2023 to 2033 (TJ/day)**



# A1. Formal information request data analysis

This section presents aggregate data submitted by GMPs and non-GMPs through the 2023 FIR process and provides a comparison with data previously received in FIRs for the 2020, 2021 and 2022 WA GSOOs.

In line with the Gas Services Information (GSI) Rules, AEMO has conducted a confidential FIR process annually since 2017 to collect data and information from GMPs[149] for the purposes of the WA GSOO. While some non-GMPs provide information voluntarily, GMPs are required to respond in accordance with the GSI Rules[150].
The data presented in this section includes:

- Gas demand and supply estimates.
- Contracted volumes.
- Gas reserves.
- Domestic gas prices that may cause gas consumers to reduce or increase gas demand.

Data has been aggregated to protect confidentiality of the individual respondents. Some information submitted as part of the FIR process has not been presented[151].

AEMO has used the FIR data as an input into developing the gas demand and potential gas supply forecasts for the 2023 WA GSOO.

AEMO has taken all due care to reconcile the information received but accepts no liability for any errors it may contain. The data reported is from the 2023 FIR process, unless otherwise specified. All data presented is the latest available as of 31 October 2023 and should be considered indicative only. It is important to note the data does not represent AEMO's forecasts.

## A1.1 Gas market participant profile

Of the 70 surveyed participants, 60 responded to the 2023 FIR. Compared to the 2022 FIR, the response rate from GMPs decreased by five percentage points (see Table 12). Fewer non-GSI participants were issued with FIRs in 2023 compared to 2022, with 69% responding.

[149] Under rule 106 of the GSI Rules, AEMO may require GMPs to provide information for the WA GSOO. This does not cover all participants in the WA domestic gas market.

[150] Under rule 21 of the GSI Rules, GMPs include Registered Facility Operators and Registered Shippers, although some exemptions are available. For example, some facilities that consume gas are not responsible for the shipping of this gas and are thus not required to be registered. The GSI Register for GMPs and facilities is maintained and updated regularly by AEMO. Both are available at https://www.aemo.com.au/energy-systems/gas/wa-gas-bulletin-board-wa-gbb/participate-in-the-wa-gbb/participants-and-facilities-registered-for-the-wa-gbb.

[151] Including gas consuming facility names, their capacities and development status, and consumption by pipeline and storage facilities.

**Table 12 FIR response rate overview, 2022 to 2023**

| Year | 2022 | | | 2023 | | |
|---|---|---|---|---|---|---|
| | Number of requests issued | Number of responses received | Response rate | Number of requests issued | Number of responses received | Response rate |
| **Gas market participants** | 55 | 53 | 96% | 54 | 49 | 91% |
| **Non-GSI participants (optional)** | 22 | 17 | 77% | 16 | 11 | 69% |
| **Total** | 77 | 70 | 91% | 70 | 60 | 86% |

For the purposes of analysis, respondents were categorised as either consumer[152], supplier[153], or infrastructure operator (includes pipelines and storage facilities), with responses as presented in Table 13. Gas consumers were further broken down into sectors (including mining, minerals processing, gas generation, and domestic LNG).

**Table 13 Distribution of responses, 2023**

| | Consumers | Suppliers | Infrastructure | Total |
|---|---|---|---|---|
| **Gas market participants** | 39 | 7 | 3 | 49 |
| **Non-GSI participants (optional)** | 4 | 7 | 0 | 11 |
| **Total** | 43 | 14 | 3 | 60 |

## A1.2 Gas demand and supply data

For the outlook period, AEMO requested GMPs to provide the following data for each facility:

- For gas consumers – total gas consumption and maximum contracted gas demand estimates.
- For gas suppliers – total nameplate capacity[154] and committed gas supply estimates.

The following sections provide indicative insights of the WA gas market over the next 10 years.

### A1.2.1 Gas demand

Expected gas demand[155] is lower throughout the forecast period compared to both the 2022 and 2021 FIR data (see Figure 21).

Expected gas demand is anticipated to increase slightly between 2023 and 2026, with new gold, lithium and iron ore mining projects commencing operations and industrial gas use increasing. Growth from new projects is expected to decline in the second half of the outlook period. Overall, GMPs expectations of gas demand equates to an average annual decline of 2.4% between 2024 and 2033, from 912 TJ/day to 730 TJ/day. Some gas-consuming facilities are anticipated to reach the end of their lives during the outlook period, while others are expected to transition to renewable energy resources, reducing demand for gas especially in the middle of the

[152] Includes gas consuming facility names, their capacities and development status, and consumption by pipeline and storage facilities.

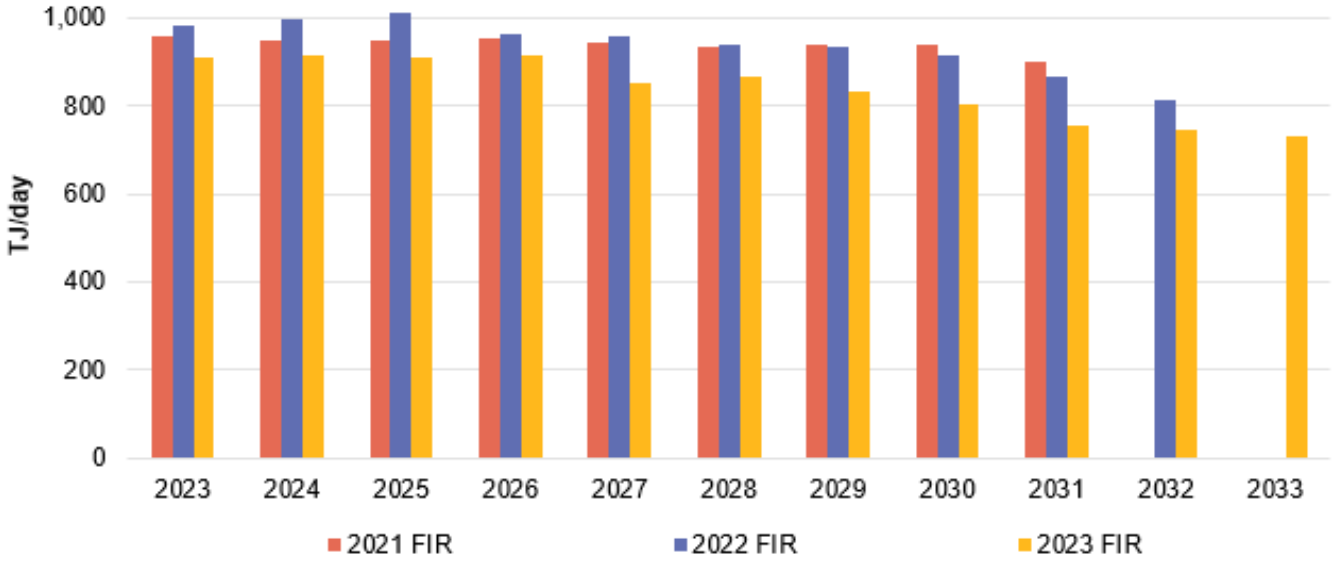
[153] Excludes gas resellers and facilities with gas demand less than 10 TJ/day.

[154] The FIR requested "Total known nameplate capacity (in TJ/day) that is available to the WA domestic gas market".

[155] Expected gas demand includes all committed projects that have attained FID and are expected to commence during the outlook period.

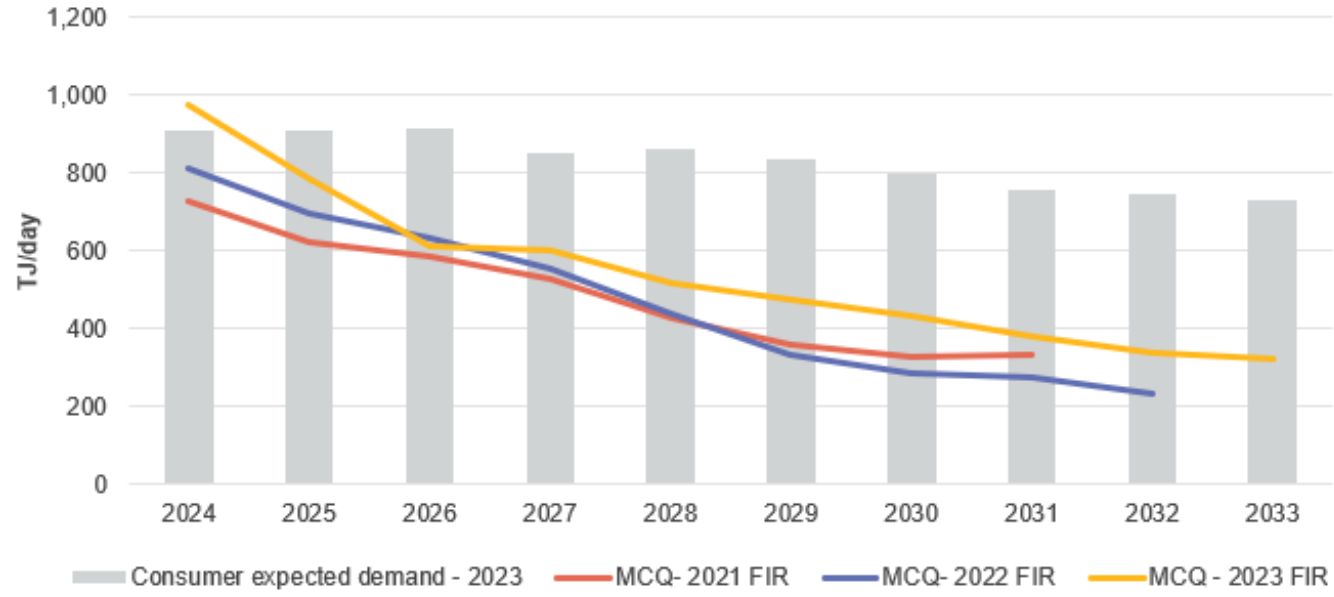
decade. This is expected to be offset by expansions to other facilities that have achieved FID and conversion of coal-consuming facilities to gas.

**Figure 21 Comparison of consumer expected demand, 2021 to 2023 FIRs (TJ/day)**




Consumer maximum contracted quantity (MCQ) is lower than expected demand over the whole outlook period (see Figure 22). This indicates that consumers have not fully contracted their gas demand beyond 2024, even though the contracted position looks stronger than previous years (the proportion of gas contracted is higher relative to total expected demand).

**Figure 22 Comparison of consumer maximum contracted levels (MCQ), 2021 to 2023 FIRs (TJ/day)**



The 2023 FIR responses show a larger range of contract durations than the 2022 and 2021 responses. Additionally, the responses show a reduction in long-term contracts (longer than five years).

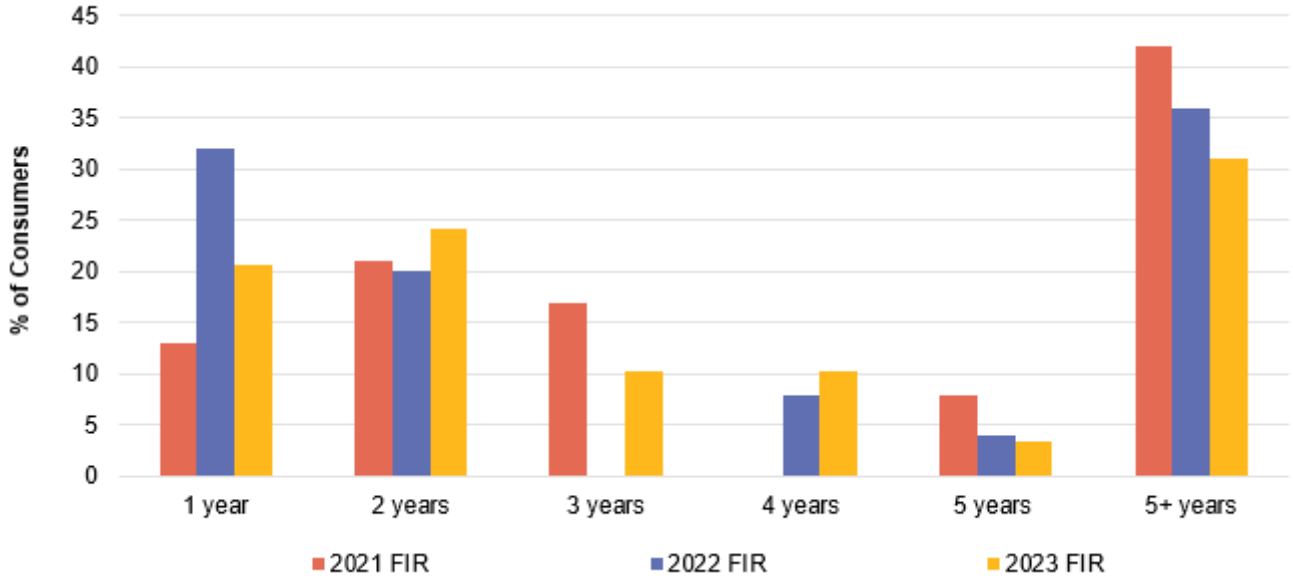
Compared to the 2022 FIR, the number of consumers with single-year contracts is much lower in the 2023 FIR. However, the increase in two-, three- and four-year contracts is likely to leave fewer gas buyers needing to recontract in the short term.

Around 45% of consumers have contracted their gas demand for two years or less. Some are planning to meet any additional energy requirements through spot gas supplies or fuel switching from gas to renewables.

Most long-term contracted positions are for diminishing volumes over time, so these consumers are likely to have to recontract at least part of their requirements through the outlook period.

The price sensitivity of market participants is illustrated in Appendix A1.4.

**Figure 23 Comparison of consumer maximum contract duration, 2021 to 2023 FIRs**



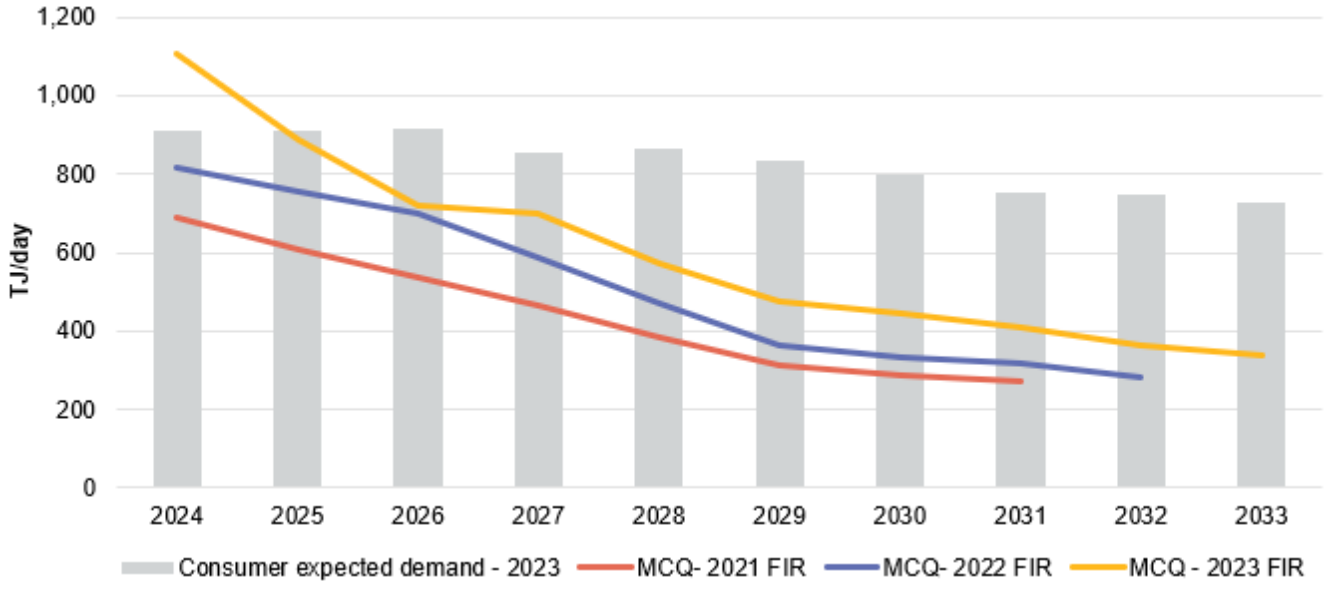

## A1.2.2 Gas supply

Supplier MCQ has increased by an average of 118 TJ/day compared with the 2022 FIR (see Figure 24). While the total MCQ is higher than the 2022 FIR, the rate of decline in quantities (13% annually[156]) is similar to the 2022 FIR (14% annually), suggesting that suppliers' contracting strategies in 2023 are similar to those in 2022.

The supplier contracted quantities are generally higher than consumer contracted quantities throughout the outlook period as the 2023 FIR responses covered a larger proportion of suppliers than consumers in the market.

[156] Measured 2024 to 2032, when the two forecasts overlap.

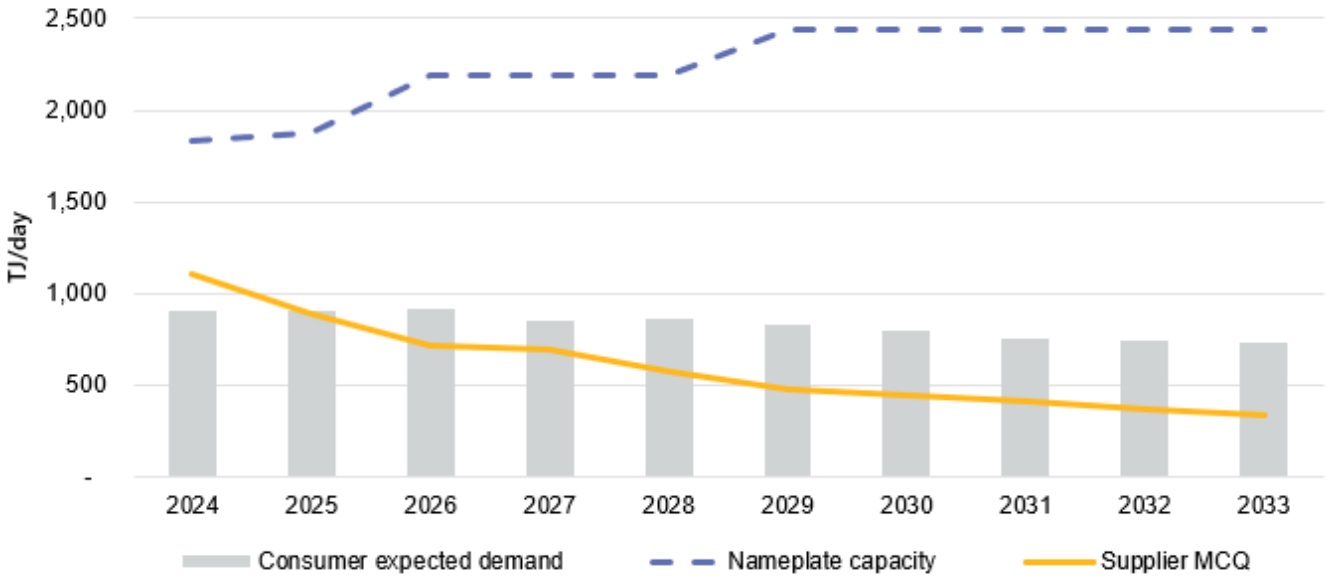
**Figure 24 Comparison of supplier contracted levels (MCQ), 2021 to 2023 FIRs (TJ/day)**




### A1.2.3 Gas demand and supply balance

Based on the reported MCQ, supply utilisation is expected to be 61% of the supply facilities' nameplate capacity in 2024, dropping to 14% by 2033 (see Figure 25).

**Figure 25 Consumer expected gas demand compared to supplier contracted levels (MCQ) and nameplate capacity, 2024 to 2033 (TJ/day)**



## A1.3 Gas reserves

Domestic gas production facility operators and joint venture partners reported the volumes of 2P gas reserves associated with all their WA petroleum production licences, as well as 2P gas reserves physically connected to each existing domestic gas production facility. This data is an input into AEMO's potential gas supply model.

Table 14 compares the 2P gas reserves connected to domestic gas production facilities with the figures received as part of previous FIRs[157]. Connected 2P reserves (developed and undeveloped) have decreased relative to the 2022 WA GSOO estimates by 5,174 PJ (13%).

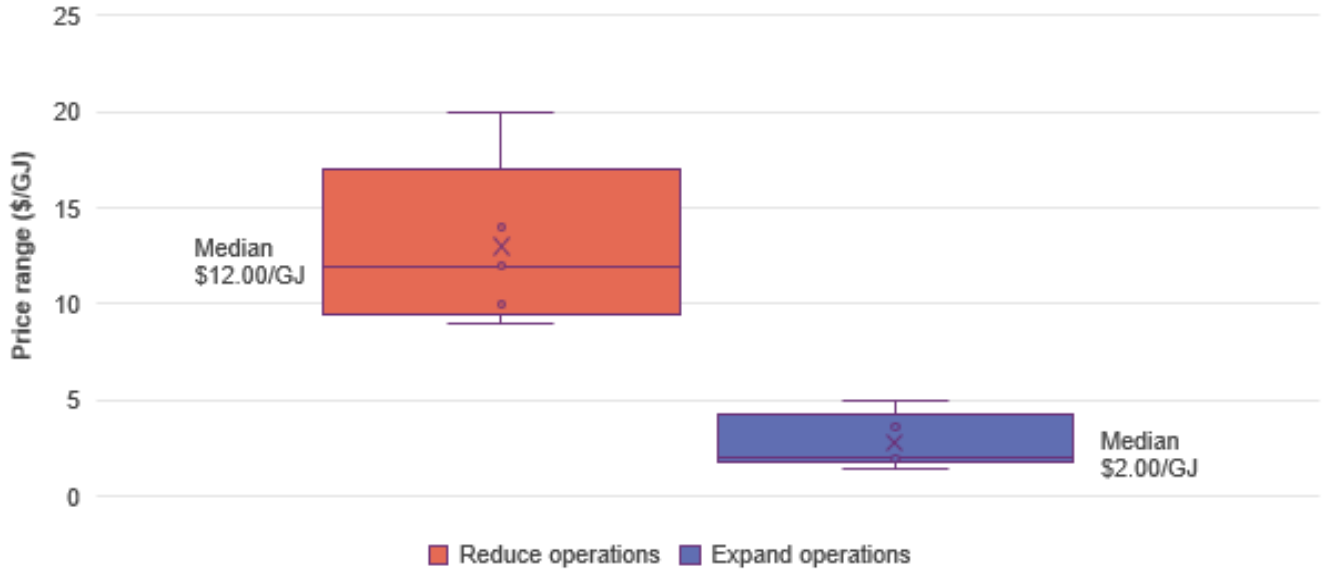
**Table 14 Total 2P gas reserves (PJ), 2019 to 2023 FIRs**

| Gas reserves and resources | 2019 | 2020 | 2021 | 2022 | 2023 |
|---|---|---|---|---|---|
| **Total 2P reserves connected to domestic gas production facilities** | 43,131 | 47,337 | 42,607 | 39,813 | 34,639 |

## A1.4 Domestic gas prices that would influence consumption

Consumers representing around one-fifth of WA gas consumption provided WA domestic gas prices that could influence their behaviour over the outlook period. They submitted gas prices that would either encourage expansion (new or existing facilities) or encourage reduction of their gas demand (closure or curtailment)[158]. The gas price at which the median of respondents would reduce operations is $12.00/GJ, while they may expand operations if it falls to $2.00/GJ. For a full description of historical domestic gas prices in WA, see Appendix A3.

**Figure 26 Median gas price estimates that could result in changes in gas consumption ($/GJ)**




Consumers noted that, in addition to gas prices other factors such as availability of alternative fuel, commodity prices, transportation cost and approval of project proposals would impact the scale of their operations.

[157] Volumes reported at standard conditions (60°C and 1 atmosphere [101.325 kilopascal (kPa)] pressure).

[158] These prices have not been used in the potential gas supply modelling, which requires domestic gas price forecasts.

# A2. Year in review sources

## A2.1 Supply projects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# A3. Gas market characteristics, historical domestic prices and cost of production

## A3.1 WA gas market characteristics

WA's unique combination of geographic isolation and very large gas resources has led to a history of large LNG developments in the region. WA Government policy promoted the development of gas fields in the NWS area during the 1980s. Subsequently, the former State Energy Commission of WA signed a large gas supply contract with the NWS partners in 1980 and completed construction of the DBNGP in 1984.

The WA domestic gas market has several key characteristics:

- Large, typically offshore, gas reserves, with a significant proportion of these developed primarily to supply the global LNG market.
- A limited number of large suppliers and consumers.
- Bilateral, commercial, and long-term take-or-pay gas sales contracts, with small volumes of short-term and spot gas sales.
- Limited information about supply that is available to be contracted, potential buyers, and gas contract pricing.
- A small number of pipelines and interconnectors, with limited surplus pipeline capacity.
- Total gas storage capacity of 78 PJ, which can receive up to 150 TJ/day and supply up to 210 TJ/day.

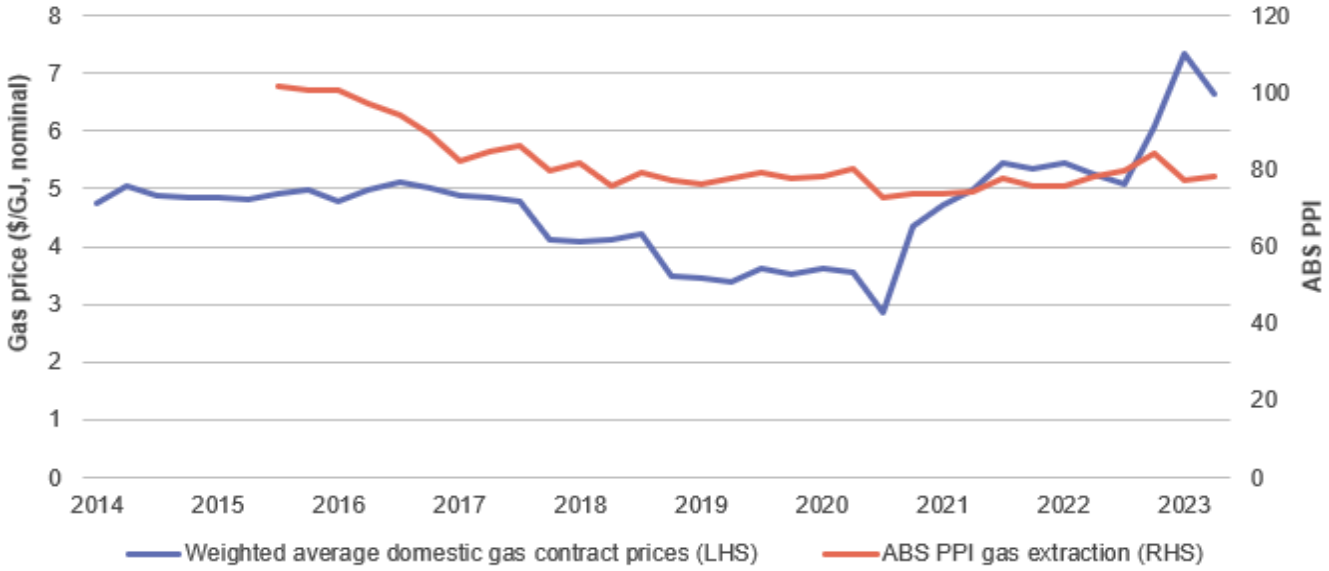
## A3.2 Historical domestic gas prices

The quarterly historical domestic gas contract price[159] is compared with the Australian Bureau of Statistics (ABS) producer price index (PPI)[160] for gas extraction in Figure 27.

[159] Prior to 2016, the average domestic gas price was derived from all domestic gas sales into WA. However, beginning with the March quarter 2016, the average domestic gas price has been derived only from domestic gas sales reported to the State Government in relation to the administration of royalties. Therefore, the domestic gas price represents only a subset of all domestic gas sales. For more details, see: http://www.dmp.wa.gov.au/About-Us-Careers/Latest-Statistics-Release-4081.aspx.

[160] The base for the index is the 2015-16 financial year. See: .https://www.abs.gov.au/statistics/economy/price-indexes-and-inflation/producer-price-indexes-australia/latest-release.

**Figure 27 Historical domestic gas contract prices and ABS PPI – WA (gas extraction, index), Q1 2014 to Q2 2023 ($/GJ)**




Source: ABS and Department of Energy, Mines, Industry, Regulation and Safety.

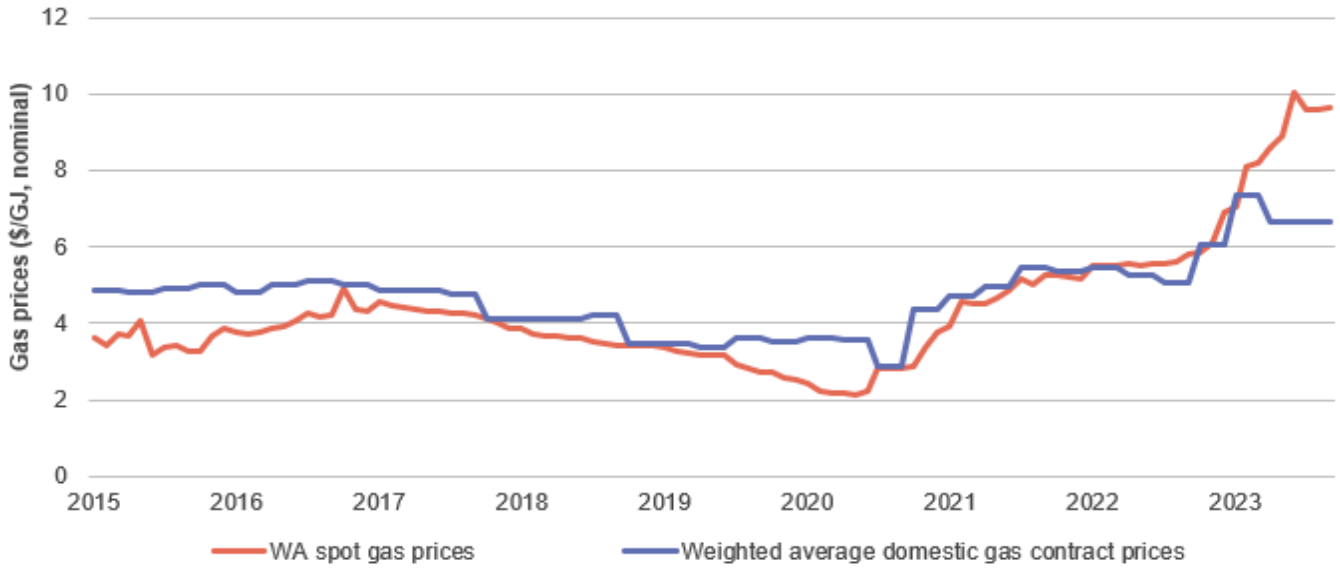
The average gas contract price fell back to $6.65/GJ in Q2 2023 after peaking at $7.35/GJ in Q1 2023. The price is 132% above its low point of $2.87/GJ, recorded in Q3 2020. The ABS PPI (gas extraction) also shows an upward trajectory since its low in Q3 2020, although it has subsequently fallen back to an index of 78.30 in Q2 2023.

Figure 28 shows average monthly nominal spot prices (for gas traded via Gas Trading Australia Pty Ltd [gasTrading][161]) since early 2015. Spot prices have generally trended upwards over the past three years, rising from $2.13/GJ in May 2020 to $9.64 in September 2023. A notable peak of $10.02 was reached in Jun 2023, followed by a small decline. The current spot price of $9.42/GJ in October 2023 is nearly 4.5 times higher than the lowest price in May 2020. Spot prices are more volatile than the weighted average domestic gas contract prices[162].

[161] See: http://www.gastrading.com.au/spot-market/historical-prices-and-volume/13-historical-prices-and-volume/27-price-history-table.

[162] See: http://www.dmp.wa.gov.au/About-Us-Careers/Latest-Statistics-Release-4081.aspx.

**Figure 28 WA spot gas prices from gasTrading, January 2015 to September 2023 ($/GJ)**




Source: Gas Trading Australia Pty Ltd – gasTrading Spot Market™ and Department of Energy, Mines, Industry Regulation and Safety.

## A3.3 Production costs for the WA domestic gas market

AEMO has estimated the weighted average cost of gas production for each year in the 10-year outlook period. These costs range from $2.90/GJ in 2023 to $3.02 /GJ in 2033. These production costs have been used to develop the forecast domestic gas prices applied in the potential gas supply model (see Appendix A4.3).

**Table 15 Production costs ($/GJ), 2023 to 2033**

| | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Weighted average costs of production ($/GJ, $ real, 2023)** | 2.90 | 2.62 | 2.64 | 2.68 | 2.79 | 2.88 | 2.94 | 2.94 | 2.96 | 3.02 | 3.02 |

Weighted average production costs have been calculated using the following assumptions:

- The short-run marginal cost (SRMC) has been used for onstream projects.
- Whole of project costs have been used for under-development and prospective projects.
- New projects were introduced to the market according to assumptions based on the timeframes publicly announced by project operators (see Appendix A4.3 for further information about these dates).
- A 10% discount rate has been used.

Costs were weighted by gas production by field and the cost (either SRMC or whole of project costs) of that field, for both existing facilities and prospective supply sources[163]

[163] For existing facilities, AEMO used the nameplate production capacity. For prospective supply sources, the DMO quantity or the expected production capacity were used as applicable. See Chapter 4 – Gas supply for further details of production capacity.

# A4. Input assumptions and methodologies

This appendix provides details of input assumptions and methodologies used to forecast potential gas supply, domestic gas demand, and total gas demand.

## A4.1 Economic and commodity forecasts

This section provides an overview of the WA economic and commodity forecasts used as inputs in AEMO's potential gas supply and gas demand models as described in Appendix A4.

WA's domestic gas demand has primarily been driven by the economic environment. Historically, gas demand has been influenced by:

- Commodities in the mining and minerals processing sectors. Strong growth in commodity prices generally stimulates investment in new mining operations and minerals processing facilities, which has historically driven gas demand in regional and remote WA.
- The productivity of commercial and industrial users on the gas distribution networks, whose gas demand may increase or decrease in line with changes in the level of economic activity in the South West region of WA.

More recently, decarbonisation has become an increasingly large driver of gas demand reduction projections. Renewables contribution in power generation is playing an important role in reducing demand for gas used for GPG. Increasing fuel switching is also being observed, as large users of gas consider alternative sources of energy through electrification. Fuel switching has a complex relationship with gas demand as the additional electricity demand impact on gas is strongly linked to the level of decarbonisation in the power system. These impacts are occurring both within the SWIS, and in remote areas with independent grids. For the 2023 WA gas demand forecasts and information on the drivers of demand over the outlook horizon, see Chapter 3.

### A4.1.1 Economic outlook

To maintain consistency between long-term electricity and gas forecasting, AEMO utilises economic forecasts prepared by Oxford Economics Australia[164] which serves as input for both the 2023 WEM ESOO and the development of the WA domestic gas demand forecasts for this WA GSOO.

Table 16 shows Oxford Economics Australia's Low, Expected, and High[165] projections for gross state product (GSP), which were used as inputs into the gas demand forecasts.

[164] See Oxford Economics Australia, Microeconomic Projects Report, 2022, at https://aemo.com.au/-/media/files/stakeholder_consultation/consultations/nem-consultations/2022/2023-inputs-assumptions-and-scenarios-consultation/supporting-materials-for-2023/bis-oxford-economics-2022-macroeconomic-outlook-report.pdf

[165] Low, Expected, and High scenarios correspond to Progressive Change, Step Change and Hydrogen Export scenarios, as defined in Oxford Economics Australia's report.

**Table 16 WA GSP (%) annual growth forecasts for different economic growth scenarios, 2023-24 to 2033-34 financial years**

| Scenario | 2023-24 | 2024-25 | 2025-26 | 2026-27 | 2027-28 | 2028-29 | 2029-30 | 2030-31 | 2031-32 | 2032-33 | 2033-34 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Low** | 0.5 | 1.3 | 3.4 | 3.0 | 3.3 | 3.2 | 3.1 | 2.7 | 2.7 | 2.6 | 2.5 |
| **Expected** | 3.5 | 3.0 | 3.4 | 3.7 | 3.4 | 2.9 | 2.9 | 2.8 | 2.6 | 2.5 | 2.5 |
| **High** | 4.4 | 4.2 | 3.8 | 3.5 | 3.4 | 3.2 | 3.1 | 3.0 | 3.0 | 2.9 | 2.8 |

Source: Oxford Economics Australia

WA's GSP is forecast to grow at 3.1% on average over the 10 years to 2033-34 in the Expected scenario. This growth reflects an expectation of renewed mining investment in WA. These investments also drive growth in the construction sector and lead to increased economic activity, and population growth.

The Low scenario is characterised by lower population growth, slower pace of technological progress, and weaker investment growth (particularly in mining) compared to the Expected scenario.

The High scenario is characterised by strong decarbonisation objectives and greater economic and population growth relative to the Expected scenario.

See Oxford Economics Australia's report[166] for more information on the methodology and assumptions for the WA GSP forecasts.

### A4.1.2 Commodity outlook

AEMO engaged the National Institute of Economic and Industry Research (NIEIR) to provide commodity forecasts[167] as inputs for the development of the WA domestic gas demand forecasts. To develop the commodity production forecasts, NIEIR combined information on new projects as well as existing projects' expansions and closures for each commodity type with consensus price forecasts.

Mining activity in WA remains strong as Australia's economic recovery from the pandemic is now well entrenched. WA's commodity production was valued at $254 billion in 2022-23[168].

In summary, NIEIR's projections for key WA commodities are as follows:

- Iron ore – the outlook beyond 2023 remains strong for iron ore production with a number of new projects expected to come online. Examples include Mineral Resources' Onslow Iron and Atlas Iron/Hancock Prospecting's Hardey and Sanjiv Ridge (Stage 2) projects. However, a decline is anticipated in 2025, followed by a strong resurgence.
- Gold – production is expected to continue to grow until 2024, followed by a decline in 2025 and 2026 attributed to an expected drop in prices. From 2027 onward gold prices is expected to grow steadily. The high gold prices over 2021 and into 2023 have stimulated a large number of new, committed and prospective projects.
- Lithium – Lithium production has experienced a significant increase since 2020, driven by strong demand from the lithium-ion battery market and increased lithium prices. Forecasts for the outlook period indicates a continued upward trajectory with annual growth rate of 7.1%, aligning with global commitment to emission

[166] See: https://aemo.com.au/-/media/files/stakeholder_consultation/consultations/nem-consultations/2022/2023-inputs-assumptions-and-scenarios-consultation/supporting-materials-for-2023/bis-oxford-economics-2022-macroeconomic-outlook-report.pdf.

[167] NIEIR prepared forecasts for the following commodities – iron ore, alumina, gold, nickel, zinc, copper, lithium, lead, cobalt, and mineral sands.

[168] See: https://www.dmp.wa.gov.au/About-Us-Careers/Latest-Statistics-Release-4081.aspx.

reduction and consequent increase in demand for consumer electronics and electric vehicles (EVs). Notably, significant expansions at major mines in WA are expected over the 2024 to 2028 period.

- Copper – The outlook indicates and upward trend in copper production. Demand for Copper is primarily driven by decarbonisation of electricity sector as it is an essential material for manufacture of wind turbines and solar modules, as well as expansion of transmission and distribution networks. Copper production is expected to decline in 2023 due to closure of De Grussa mining operations in 2022. However, by 2025 the expected commissioning of the West Musgrave project is projected to contribute to recovery of copper production volumes.
- Cobalt – Cobalt is projected to undergo strong annual growth at rate of 13.6% until 2033, representing a stronger expansion compared to 2022 WA GSOO. The growth is driven by elevated prices and is further supported by growth in energy storage sector. The rate of development of new mines and resources partly depends on uptake of EVs. An accelerated uptake of EV and residential battery storage is expected to positively impact the cobalt outlook post 2025, aligning with decreased battery prices conducive to mass-market adoption.
- Lead – Lead production, which has experienced a steady decline until 2022, is expected to grow strongly until 2024, following which production is expected to steadily increase over the remaining outlook period. This upturn in 2023 is attributed to commissioning of the Abra lead-silver mine which is projected to reach steady-state production of approximately 95kt of lead by 2024.
- Mineral sands – Following a reduction in 2022, Mineral sand production is expected to steadily increase with commencement of Strandline Resources' Coburn operation in late 2022.

Further information about the commodity forecasts can be found in NIEIR's report[169].

## A4.2 Gas demand forecast methodology

AEMO presents WA domestic and total gas demand forecasts, defined as:

- Domestic gas demand forecasts – includes all major mining and minerals processing, industrial, commercial, GPG demand in the SWIS and non-SWIS areas, and small-use customers connected to WA's gas distribution networks.
- Total gas demand forecasts – includes domestic gas demand plus an estimate of the total quantity of gas required for LNG exports, reflecting an overall assessment of WA gas demand.

For the 2023 WA GSOO, AEMO has incorporated several improvements to the domestic gas demand forecasts:

- Improved split-out of demand reduction projects which are decarbonisation-focused and expected to reduce gas consumption.
- Incorporation of electrification forecasts, derived from multi-sector modelling, for Residential and Commercial (Tariff V) customers and large users (Tariff D).
- Forecasts of alternative gases such as hydrogen and biomethane to identify potential to add to the supply mix.

The methodology for preparing these forecasts is summarised in Appendix A4.2.

[169] NIEIR. *Economic and Commodity forecasts for Western Australia to 2033*, September 2023, prepared for AEMO and published alongside the WA GSOO.

### A4.2.1 Domestic gas demand

AEMO forecasts domestic gas demand by separately modelling each of the following sectors:

- Tariff V – volumetrically tariffed customers, which includes residential and commercial distribution network customers. These consumers typically use less than 10 TJ/year. Distribution networks include the Mid-West and South-West, along with Kalgoorlie and Leonora, but exclude Albany, which distributes liquefied petroleum gas.
- Tariff D – demand tariffed customers that typically use more than 10 TJ/year. This includes industrial customers that are located within the distribution network, and the following transmission-connected consumers:
  - Minerals processing – secondary processing of raw materials.
  - Mining – primary extraction.
  - Industrial – including LPG and LNG producers.
  - Other industrial customers that are located within the distribution network.
  - GPG (including SWIS[170] and non-SWIS).

The methodology applied in forecasting each sector is summarised in the following sections:

#### Residential and commercial distribution customers (Tariff V)

The distribution network includes the low-pressure pipelines used to supply small-use residential and non-residential retail customers. These customers account for approximately 8% of WA's domestic gas demand. AEMO projected Tariff V total consumption by applying different assumptions based on the customer type (residential or non-residential), and the consumption per connection.

The average per-connection Tariff V consumption is estimated, consisting of heating[171] and baseload components. This is used as the base for forecasting Tariff V annual consumption, with growth driven by the following factors:

- Connection numbers.
- Energy efficiency.
- Weather and climate change effects.
- Gas price impacts.

Further information about the WA Tariff V forecasting methodology can be found in Chapter 5 of AEMO's *Gas Demand Forecasting Methodology Information Paper*[172].

#### Large users (Tariff D)

Tariff D consumers account for approximately 84% of WA's total domestic gas demand, and include:

- Mining consumers such as:

[170] Forecasts of SWIS GPG gas demand were prepared by Robinson Bowmaker Paul and are published alongside the WA GSOO. See: https://aemo.com.au/en/energy-systems/gas/gas-forecasting-and-planning/wa-gas-statement-of-opportunities-wa-gsoo.

[171] Heating load is largely dependent on future weather projections, specifically the frequency and severity of cold days. This is referred to as HDDs (heating degree days).

[172] See: https://aemo.com.au/-/media/files/gas/national_planning_and_forecasting/gsoo/2023/2023-gas-statement-of-opportunities-methodology---demand-forecasting.pdf

  - Iron ore producers – BHP, CITIC Pacific, Fortescue Metals Group, and Rio Tinto.
  - Gold producers – AngloGold Ashanti, Blackham Resources, and Newcrest.
  - Nickel producers – BHP NickelWest and Glencore.
  - Lithium producers – Mineral Resources Limited.
  - Base metals producers – Cyprium Metals.
- Minerals processing consumers such as Alcoa, Albemarle, Tianqi Lithium Energy Australia, BHP, and South32.
- Industrial consumers such as CSBP, Yara Pilbara, Perdaman.
- Construction materials producers such as Midland Brick and Cockburn Cement.
- Domestic LNG producers such as EDL and Wesfarmers.
- Other industrial customers that are connected to the distribution network.

Tariff D gas consumers are associated with natural gas intensive processes, such as minerals processing calcination facilities, equipment used to mine specific minerals, and specific finished products. The growth or decline in future gas consumption has been linked to the quantity of minerals processed, mined, or produced. AEMO used NIEIR's commodity forecasts as an input into the Tariff D demand forecasts. The mining, minerals processing, and industrial forecasts are largely driven by:

- Projected mining activity.
- Commodity prices.
- Expected mine production and outages.
- Production costs.
- Exchange rate forecasts.

AEMO has used information received from gas consumers as part of the 2023 FIR for developing the gas demand forecasts for these sectors. Where FIR information was unavailable, AEMO has applied NIEIR's commodity production forecasts.

### Minerals processing, mining, and industrial sectors

AEMO's forecasts of the mining, minerals processing, and industrial sectors are based on data gathered using the following sequence:

1. Tier 1 (preferred method) – obtain forecast data from the facility operator, usually through the FIR, with data quality checks performed against historical consumption along with any public announcements about the facility's operations.
2. Tier 2 (if no site-specific forecast was available) – use secondary information such as commodity forecasts. Historical usage data was analysed to calculate either a regression-based energy coefficient (commodity-specific) or an energy intensity factor.
3. Tier 3 (where data for the first two approaches was unavailable) – historical pattern matching across multiple years of consumption data (sourced from the WA GBB) determined whether the forecast was based on a trend or a median level of usage.

## Tariff D – distribution consumption

AEMO receives daily metered consumption data for distribution-connected industrial customers from CGI Logica.

To forecast gas demand, the Tariff D customers were split into two components: aggregate and large individual users. An econometric model was applied to forecast the aggregate component, which considered the impact of annual gross state product growth, climate-adjusted weather, and weekdays. The large individual user component was forecast using information provided by the distribution network service provider.

## SWIS GPG

The most variable component of gas demand, electricity generation from SWIS GPG[173], is estimated to account for approximately 19.5% of domestic gas demand in 2023. In the 2023-24 Capacity Year, 2,876 megawatts (MW) of Capacity Credits were assigned to gas or dual fuel gas-and-diesel generators, of which about two-thirds are peaking or mid-merit[174].

Forecasts of SWIS GPG gas demand were prepared by Robinson Bowmaker Paul (RBP) and were added to AEMO's forecasts. The scenarios used by RBP for the GPG modelling are shown in Table 17.

RBP undertook the assessment using its dispatch optimisation tool, WEMSIM, to co-optimise energy dispatch and Essential System Services to determine the quantity of gas used for electricity generation, based on the following input assumptions:

- Generator technical data, including capacity, outage rates, ramp rates, heat rates, minimum stable levels, utility-scale intermittent profiles, and cost information.
- Information about network transfer limits and constraints.
- Details of generation entry and retirements, including:
  - Expected staged retirement of coal generators.
  - Committed[175] and prospective[176] new generation builds.
  - Generic new capacities to meet the Reserve Capacity Target, with the economic viability of these facilities assessed based on the capital costs and operating parameters published in the GenCost 2022-23 report published by CSIRO[177].
- Requirements for Contingency Reserve Raise, Contingency Reserve Lower, Regulation Raise, and Regulation Lower.

[173] Some GPG that participate in the Wholesale Electricity Market (for example, Alcoa Wagerup power station) serves large behind-the-fence loads in the minerals processing, mining, or industrial sectors and is excluded from SWIS GPG gas demand in the WA GSOO. For a full description of how AEMO classifies facilities, see Appendix A7.

[174] Peaking capacity operates less than 10% of the time, and mid-merit capacity operates between 10% and 70% of the time. See: https://www.aemo.com.au/-/media/files/electricity/wem/planning_and_forecasting/esoo/2023/2023-wholesale-electricity-market-electricity-statement-of-opportunities-wem-esoo.pdf.

[175] Committed new builds include Facilities that that were assigned Capacity Credits for 2025-26 Capacity Year, contracted for NCESS – Reliability Services 2024-26(WA), or scored 80% or higher in the new project status evaluation implemented for 2023 WEM ESOO. See: https://aemo.com.au/consultations/tenders/tenders-and-expressions-of-interest-for-ncess-reliability-services-wa and https://aemo.com.au/-/media/files/electricity/wem/reserve_capacity_mechanism/assignment/2023/capacity-credits-assigned-for-the-2025-2026-capacity-year.pdf.

[176] Prospective new builds include Facilities that are candidates for registration and have submitted a valid Expression of Interest for the 2023 Reserve Capacity Cycle (2023 EOI) or scored between 50% and 80% in the new project status evaluation implemented for 2023 WEM ESOO.

[177] See: https://www.csiro.au/en/research/technology-space/energy/energy-data-modelling/gencost.

- Operational demand profiles used in the 2023 WEM ESOO reliability forecast[178].
- Intermittent generation profiles for utility-scale renewable generation.
- Fuel prices, including pipeline domestic gas, coal, and diesel price assumptions.
- Benchmarking coal generation against historical coal generation levels.

**Table 17 Scenario mapping for GPG modelling**

| Scenario | Low | Expected | High |
|---|---|---|---|
| **Operational consumption**[A] | Low | Expected | High |
| **Peak demand**[A] | Low case 10% probability of exceedance (POE) | Expected case 10% POE | High case 10% POE |
| **Gas price**[B] | Low | Expected | High |
| **distributed energy resources (DER)**[A] | Low | Expected | High |
| **Generation retirements** | • BW1_BLUEWATERS_G2 and BW2_BLUEWATERS_G1 retire 1 October 2030. | BW1_BLUEWATERS_G2 and BW2_BLUEWATERS_G1 retire 1 October 2030. | BW1_BLUEWATERS_G2 and BW2_BLUEWATERS_G1 retire 1 October 2026. |
| | • MUJA_G6 retires 1 April 2025.<br>• COLLIE_G1 retires 1 October 2027.<br>• MUJA_G7 retires 1 October 2029.<br>• MUJA_G8 retires 1 October 2029. | | |
| **Generation new builds/upgrades** | • ERRRF_WTE_G1 (28.9 MW)<br>• PHOENIX_KWINANA_WTE_G1 (36 MW)<br>• FLATROCKS_WF1 (74 MW)<br>• SBSOLAR_CUNDERDIN_PV1 Solar (100 MW)<br>• SBSOLAR_CUNDERDIN_PV1 ESR (55 MW / 220 MWh)<br>• COLLIE_ESR1 (200 MW / 4h) | | |
| | • Others[C]:<br>Storage (255 MW)<br>Gas (20 MW)<br>Solar (2 MW)<br>Landfill gas (4.2 MW) | • Others[C]:<br>Storage (255 MW)<br>Gas (20 MW)<br>Solar (2 MW)<br>Landfill gas (4.2 MW) | • Others[C]:<br>Storage (1359 MW)<br>Gas (207 MW)<br>Solar (358 MW)<br>Wind (370 MW)<br>Landfill gas (4.2 MW) |

[A] Sourced from the 2023 WEM ESOO.
[B] Sourced from EnergyQuest.
[C] Other Facilities refers to new build or upgraded generation that are either less than 10 MW or identified based on information from 2023 Expressions of Interest for Reserve Capacity, 2023 WEM ESOO FIR or procured under AEMO's 2022 NCESS for Reliability, projects are not listed here individually due to confidentiality but are presented as an aggregate capacity by technology type.

## Non-SWIS GPG

Non-SWIS GPG includes the electricity distribution networks operated by Horizon Power and accounts for approximately 3.8% of total domestic gas demand. To forecast non-SWIS GPG gas consumption, AEMO has used

[178] The SWIS GPG forecasts were developed based on operational demand profiles derived from reference years 2019, 2020 and 2021. The demand forecasts only applied GPG results based on the operational demand profiles associated with the reference year 2021. For SWIS GPG forecasts for all reference years, see RBP. *Gas powered generation forecast modelling – 2023, December* 2023, prepared for AEMO and published alongside the WA GSOO.

information received from gas consumers as part of the 2023 FIR. Where FIR information was unavailable, AEMO applies a linear trend model consistent with the *Gas Demand Forecasting Methodology Information Paper*[179].

## Committed new project demand

Committed new project demand is defined as projects that have a direct impact on WA gas consumption (either by increasing or decreasing consumption) and have taken a final investment decision (FID) or are under construction.

These projects include approved upcoming projects that will use natural gas as an input feedstock, for power generation, or renewable energy projects which will offset existing gas demand. Committed new project demand includes expansions to existing minerals processing, mining, and industrial operations.

Gas consumption for each project under this category has been estimated individually, based on publicly available information, consultation with the project proponent, or from gas consumption information provided to AEMO as part of the 2023 FIR process. The estimated quantities and start dates for individual projects may differ among the three gas demand scenarios (see Section 3.2 for further details about these projects).

## Prospective gas demand in the High scenario

While gas demand forecasts for all three scenarios include committed projects, the High gas demand scenario includes prospective projects that may impact consumption of gas over the outlook period ("prospective demand").

Projects included in the prospective demand forecasts were required to meet **at least two** of the following criteria:

- The project is located within 20 kilometres of a gas transmission pipeline that is under construction, has spare shipping capacity, or is a new pipeline that has attained FID.
- The project proponent has submitted a request for environmental approval to the WA or Australian Government.
- The project proponent has a commercial arrangement with a gas pipeline or gas storage company to expand and/or connect physical infrastructure to withdraw gas.
- The project may consume gas from existing domestic gas or LNG facilities.
- The project proponent has received Capacity Credits.
- The project proponent has publicly announced its intention to build a renewable energy generation project or any other projects that specifically offset the use of gas as an input or energy source.

The shortlisted projects were assessed to determine the likelihood that they would consume gas over the outlook period. The finalised list included projects submitted by GMPs and some non-GMPs as part of the 2023 FIR process.

## Demand reduction projects

Demand reduction projects are those associated with decarbonisation and are expected to reduce gas consumption. Examples include on-site renewable generation or efficiency upgrades. For the 2023 WA GSOO, AEMO has improved how the demand reduction projects are modelled by considering them independently from

[179] See: https://aemo.com.au/-/media/files/gas/national_planning_and_forecasting/gsoo/2023/2023-gas-statement-of-opportunities-methodology---demand-forecasting.pdf.

their core projects. In this process, only committed demand reduction projects[180] are included in the Expected and Low scenarios, while more speculative demand reduction projects are only included in the High scenario.

### Electrification

AEMO, for the first time in a WA GSOO, has applied the outcomes of multi-sector modelling related to electrification, consistent with the methodology employed in the 2023 WEM ESOO. The electrification forecasts are developed for both Tariff D and Tariff V consumers, electrification for Tariff D consumers is then further disaggregated to demand categories (such as mining).

### Hydrogen and Biomethane forecasts

AEMO has identified the potential for hydrogen and biomethane to offset future natural gas consumption, based on the outcomes of multi-sector modelling. However, these forecasts are not incorporated into the supply-demand balance for the 2023 WA GSOO[181].

For more details on the multi-sector energy modelling, refer to *Multi-sector energy modelling 2022: Methodology and results* final report prepared by CSIRO and Climateworks Centre (CWC)[182]. For more details on the methodology to forecast gas reduction from electrification as well as hydrogen and biomethane supply, refer to the *Gas Demand Forecasting Methodology Information Paper*[183]

## A4.2.2 Total gas demand

To develop WA total gas demand forecasts, AEMO estimated the amount of gas required for WA's LNG industry and added it to the domestic gas demand forecasts, as shown in Figure 29. The total gas demand forecasts are shown in Appendix A6.

**Figure 29 Total gas demand equation**


AEMO developed three scenarios (Low, Expected, and High) for total gas demand.

LNG forecasts were developed using historical production utilisation data for existing LNG facilities, and publicly available information on the proposed production capacity and commencement dates of new LNG facilities.

The assumptions applied in each total gas demand scenario are summarised in Table 18.

[180] AEMO assesses project development likelihood based on whether it has achieved Final Investment Decision, progress of environmental approvals and any relevant market releases.

[181] While the hydrogen and biomethane forecasts are not incorporated in the supply-demand balance, natural gas consumed by the GPG required to manufacture hydrogen for export or use in industries such as transport is considered in the demand forecasts.

[182] See: https://aemo.com.au/-/media/files/stakeholder_consultation/consultations/nem-consultations/2022/2023-inputs-assumptions-and-scenarios-consultation/supporting-materials-for-2023/csiro-climateworks-centre-2022-multisector-modelling-report.pdf.

[183] See: https://aemo.com.au/-/media/files/gas/national_planning_and_forecasting/gsoo/2023/2023-gas-statement-of-opportunities-methodology---demand-forecasting.pdf.

**Table 18 LNG export assumptions by scenario**

| Scenario | | Low | Expected | High |
|---|---|---|---|---|
| **Gas feedstock for LNG exports** | **Project** | **Quantity of LNG** | | |
| | North West Shelf (Karratha Gas Plant - KGP) | 14.9 Mtpa (million tonnes per annum) in 2023, decreasing at approximately 20% per annum from 2024. | | |
| | NWS production maintained via backfill from Waitsia | 1.5 Mtpa from early 2025 to 2028 | 1.5 Mtpa from mid-2024 to 2028 | 1.5 Mtpa from early 2024 to 2028 |
| | Gorgon LNG | 14.0 Mtpa | 14.3 Mtpa | 15.0 Mtpa |
| | Pluto LNG | 4.5 Mtpa, decreasing at approximately 20% per annum from 2025 | | |
| | Wheatstone LNG | 8.9 Mtpa, decreasing at approximately 15% per annum from mid 2026 | | |
| | Prelude FLNG | 1.8 Mtpa | 2.2 Mtpa | 2.7 Mtpa |
| | Ichthys LNG | 8.5 Mtpa | | |
| | NWS production maintained via backfill through the interconnector from Pluto | N/A | 0.5 Mtpa from 2022 to 2025 | |
| | Pluto train one supported by backfill from Scarborough | 3.0 Mtpa from 2028 | 3.0 Mtpa from 2027 | 3.0 Mtpa from 2026 |
| | Pluto train two expansion from Scarborough gas | 4.5 Mtpa, commences 2028 | 5.0 Mtpa, commences early 2026 | |
| **Gas used for processing LNG[A]** | | 8% | | |

A. Processing estimates were taken from processing companies' reports and presentations.

## A4.3 Gas supply forecasting model

### A4.3.1 Reserves and resources

AEMO uses estimates made under the Society of Petroleum Engineers (SPE) system of reserves classification[184], which is a standard metric across the gas industry. Gas accumulations are categorised into either reserves or resources, based on the level of commercial and technical uncertainty associated with extraction[185].

A summary of the terms has been provided in Table 19.

[184] See: https://www.spe.org/en/industry/reserves/.

[185] These uncertainties could include securing finance, obtaining government approvals, negotiating contracts, or overcoming geological challenges. The terms resources and reserves are not interchangeable: reserves constitute a subset of resources.

**Table 19 Classification of reserves and resources**

| Classification | Definition |
|---|---|
| **1P** | A measure of gas reserves that includes proven (developed and undeveloped) reserves with a reasonable certainty (normally at least 90% confidence) of being recoverable. |
| **2P** | A measure of gas reserves that includes proven (1P) and probable reserves (normally at least 50% confidence of being recoverable). |
| **2C** | A measure of gas resources that are considered less commercially viable than reserves. 2C resources are considered the best estimate of sub-commercial resources. |

Source: SPE

Over time, gas reserves and resources are developed, depleted, or reassessed (particularly against commercial benchmarks), so the forecasts of gas reserves and resources change.

### A4.3.2 Potential gas supply forecast methodology

Instead of forecasting how much gas is expected to be supplied over the outlook period, AEMO's forecasts of potential gas supply reflect how much gas could be produced if there was market demand for it at the forecast price. This approach is useful to assess supply adequacy and identify potential supply gaps[186].

To determine these potential gas supply sources, AEMO sources information on prospective gas supply from external consultants, DJTSI, interviews with stakeholders and information in the public domain. AEMO uses both physical and commercial characteristics sourced from Energy Quest when assessing prospective supply sources, as summarised in Table 20.

**Table 20 Criteria for assessing prospective gas supply sources**

| **Physical Characteristics** |
|---|
| • Location of reserves,<br>• Water depth,<br>• Volume of reserves,<br>• Reservoir characteristic,<br>• DMO for sources that are primarily being developed to supply the global LNG market. |
| **Commercial Characteristics** |
| • Ownership structure (joint venture or sole owner),<br>• Proponent or operator experience,<br>• Primary development driver (global LNG market or domestic gas market),<br>• Likely development path (for example, tie-back to an existing facility, or new production facility),<br>• Estimated development costs, based on the likely development path,<br>• Commercial arrangements (for example, any tolling requirements),<br>• Gas sales contracts,<br>• Environmental approvals,<br>• Infrastructure access. |

[186] Transmission pipeline capacity constraints are not considered in the model.

AEMO's potential gas supply model was redeveloped by ACIL Allen in 2018 following the recommendations of the 2018 five-yearly WA GSOO review[187]. The model tracks the gas reserves remaining for each domestic-only production facility on an annual basis by incorporating assumptions about the following inputs:

- Initial gas reserves and resources.
- Modelled annual gas sales (contracted and uncontracted).
- Fuel gas requirements.
- Incremental reserves additions and backfill.
- Where possible, AEMO sourced model input data from GMPs and non-GMPs through the 2023 FIR and made assumptions based on publicly available information where FIR data was unavailable. For the 2023 WA GSOO, AEMO updated the input assumptions used in the model.

AEMO assessed several new supply sources. Some of these candidates for supply or backfill/infill of existing gas production facilities were excluded for at least one of the following reasons:

- Insufficient appraisal of the field had been completed to evaluate the size and characteristics of the resource.
- The development timeframe was likely to extend beyond the end of the outlook period.
- Developing the resource was considered to be uneconomic under current and expected near-term LNG and domestic market conditions.
- The project proponent or operator had not selected a preferred development option.

AEMO will continue to monitor these fields as potential future supply sources.

Based on the existing and new gas supply sources that have been included in the gas supply model, Table 21 summarises the selection criteria and basis of assessment.

187 See: https://www.aemo.com.au/-/media/files/gas/national_planning_and_forecasting/wa_gsoo/2018/five-yearly-review-of-the-wa-gsoo.pdf.

**Table 21 Potential gas supply model operation**

| | Existing/committed domestic-only | Existing/committed LNG-linked | Prospective domestic-only | Prospective LNG-linked |
|---|---|---|---|---|
| **Model logic** | Potential gas supply equals the minimum of:<br>• Production capacity<br>• The decline rate advised by the GMP as part of the 2023 FIR, where reserves are insufficient to maintain gas production at nameplate capacity throughout the entire outlook period. | Either<br>• Domestic Market Obligation (DMO), where the DMO is less than the nameplate plant capacity,<br>Or<br>• Nameplate capacity less 10%[A] based on historical availability to account for plant maintenance, where the plant capacity is equal to the DMO. | Developed when the domestic gas price forecast exceeds the estimated cost of production.<br>Potential gas supply equals the minimum of:<br>• Production capacity<br>• Decline rate based on similar fields in the same basin. | Developed when the forecast Asian LNG net back price exceeds the estimated cost of production.<br>Once developed, potential gas supply equals the DMO. |
| **Projects included in the model** | • Beharra Springs[B]<br>• Devil Creek[B]<br>• Lockyer Deep[C]<br>• Macedon[B]<br>• South Erregulla[C]<br>• Varanus Island[B]<br>• Walyering[B]<br>• Xyris[B] | • Gorgon[B]<br>• KGP[B]<br>• Pluto[B]<br>• Scarborough[B]<br>• Waitsia (Stage two) [B]<br>• Wheatstone[B] | • Corvus[D]<br>• Gynatrix[D]<br>• Trigg Northwest[D]<br>• West Erregulla[D] | • None |

A. Analysis of Wheatstone and Gorgon domestic gas production rates (sourced from WA GBB) from the first full year of production has shown that historical availability is around 90% over a calendar year.
B. Included in the Low, Expected, and High scenarios.
C. Included in the Expected and High scenarios.
D. Included in the High scenario.

Table 22 summarises the key changes to assumptions for potential gas supply sources between the 2022 WA GSOO and the 2023 WA GSOO.

**Table 22 Key assumptions of potential gas supply model, 2022 and 2023 WA GSOOs**

| Project | Operator | 2023 Scenario | Assumption in 2022 WA GSOO | Assumption in 2023 WA GSOO |
|---|---|---|---|---|
| **Beharra Springs expansion** | Beach Energy | Expected | FID was reliant on increasing capacity and undertaking a debottlenecking project and was therefore not included. | Following FID, available at 28 TJ/day between 2024 and 2033. |
| **Corvus** | Santos | High | Available at 150 TJ/day from mid-2028 (High scenario only) | Available at 50 TJ/day from mid-2031, reflecting available reserves |
| **Devil Creek** | Santos | Expected | Intermittent production as reserves deplete, complete cessation of the Reindeer gas field and Devil Creek production facility in 2027. | Cessation of the Reindeer gas field and Devil Creek production facility occurs from the start of the outlook period (Q1 2024). |
| **Gorgon** | Chevron | Expected | Available at 255 TJ/day | Available at 270 TJ/day |
| **Gynatrix** | Mitsui E&P | High | Not included | Available with limited reserves from 2027 |
| **KGP** | Woodside | Expected | Available at 70 TJ/day | Available at 90 TJ/day, reflecting increased historical supply, revised DMO and remaining reserves. |
| **Lockyer Deep** | Mineral Resources | Expected | 50 TJ/day production from 2027 in the High scenario. | Available at 50 TJ/day from 2028. |
| **South Erregulla** | Strike Energy | Expected | Available from mid-2026 at 30 TJ/day in the High scenario. | Available at 40 TJ/day from mid-2026. |
| **Trigg Northwest** | Beach Energy | High | Not included | Availability with limited reserves from 2027 |
| **Varanus Island** | Santos | Expected | Declining supply with reserve depletion, Spartan was expected to come online in 2023. | Limited supply to reflect reserves downgrades at Spar Halyard. |
| **Waitsia (Stage one and two)** | Mitsui E&P | Expected | Waitsia stage one available at 24 TJ/day, with LNG supply of 250 TJ/day from Stage two available between 2024 and 2028. Domestic supply of 125 TJ/day from 2029. | Waitsia stage one available at 20 TJ/day from 2024, with LNG supply of 250 TJ/day from stage two available between mid-2024 and 2028. Domestic supply of 100 TJ/day from 2029. |
| **Walyering production facility** | Strike Energy | Expected | Limited availability from mid-2023 with facility being underdeveloped, production peaks in 2026 at 25 TJ/day. | Available at 25 TJ/day from 2024 after being online from late 2023. |
| **West Erregulla** | Strike Energy | None | Available at an average 87 TJ/day from mid-2025. | Moved to High scenario following delay, development plan change and partner change. Available at 80 TJ/day from mid-2027. |
| **Wheatstone** | Chevron | Expected | Available at 174 TJ/day | Available at 194TJ/day reflecting historical supply and increase in nameplate capacity to 215 TJ/day in August 2023. |

### A4.3.3 Historical gas production

There are nine gas production facilities supplying the WA domestic market during the financial year 2022-23, with a total nameplate capacity (WA GBB) of about 1,821 TJ/day[188]. The KGP retains the largest nameplate capacity at 630 TJ/day. Table 23 shows the average capacity utilisation over the 2022-23 financial year.

**Table 23 Domestic gas production facility average production and capacity utilisation, 2022-23 financial year**

| Facility | Nameplate capacity[A] (TJ/day) | Average production (TJ/day) | | | | | Average capacity utilisation[B] | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 Jul – 30 Sept 2022 (Q1) | 1 Oct - 31 Dec 2022 (Q2) | 1 Jan- 31 Mar 2023 (Q3) | 1 Apr - 30 Jun 2023 (Q4) | 2022-23 financial year | 1 Jul - 30 Sept 2022 (Q1) | 1 Oct - 31 Dec 2022 (Q2) | 1 Jan- 31 Mar 2023 (Q3) | 1 Apr - 30 Jun 2023 (Q4) | 2022-23 financial year |
| Beharra Springs[C] | 25[189] | 21 | 22 | 24 | 25 | 23 | 105% | 102% | 101% | 98% | 102% |
| Devil Creek[D] | 220[190] | 144 | 183 | 56 | 29 | 103 | 65% | 83% | 25% | 58% | 58% |
| Gorgon | 300[191] | 279 | 278 | 285 | 279 | 280 | 93% | 93% | 95% | 93% | 93% |
| KGP | 630[192] | 80 | 79 | 80 | 123 | 91 | 13% | 13% | 13% | 20% | 14% |
| Macedon | 170[193] | 192 | 185 | 185 | 179 | 185 | 90% | 87% | 87% | 84% | 87% |
| Pluto[E] | 40[194] | 14 | 20 | 13 | 15 | 15 | 57% | 80% | 52% | 59% | 62% |
| Varanus Island | 390[195] | 212 | 136 | 139 | 202 | 172 | 61% | 39% | 40% | 67% | 52% |
| Wheatstone | 215[196] | 205 | 196 | 180 | 216 | 199 | 95% | 91% | 84% | 100% | 93% |
| Xyris[F] | 30[197] | 24 | 26 | 28 | 27 | 26 | 84% | 95% | 101% | 91% | 93% |
| **Total** | **2,040** | **1,171** | **1,127** | **988** | **1,094** | **1,096** | **59%** | **56%** | **49%** | **61%** | **57%** |

A. The nameplate capacity values have been taken from company websites and public announcements.
B. Utilisation was calculated using WA GBB capacity (which may differ from nameplate capacity).
C. Beharra Springs nameplate capacity was revised from 20 TJ/day in March 2022 to 22 TJ/day in August 2022, to 24 TJ/day in November 2022, to 25 TJ/day in March 2023.
D. Devil Creek nameplate capacity was 220 TJ/day from 1 July 2022 to 29 March 2023 and then reduced to 50 TJ/day from 30 March 2023.
E. The Pluto LNG facilities have a nameplate capacity of 40 TJ/day (a 25 TJ/day pipeline gas facility and a 15 TJ/day LNG truck loading facility).
F. Xyris capacity was revised from 20 TJ/day in November 2020 to 25 TJ/day in March 2021, to 28 TJ/day in June 2021, and to 30 TJ/day in March 2023.

The following trends were observed during the 2022-23 financial year:

- The highest production was from Gorgon (280 TJ/day annual average), followed by Wheatstone (199 TJ/day annual average) and Macedon (185 TJ/day annual average). Pluto had the lowest production (15 TJ/day).

[188] Dongara has not operated since Q3 2017 and has therefore been excluded. Walyering production facility was brought online on 25 September 2023, with a nameplate capacity of 33 TJ/day, and is therefore outside the reporting period (FY22-23) in Table 23.

[189] See: https://www.mepau.com.au/project/beharra-springs-project/.

[190] See: Nameplate capacity of the plant was reduced from 220 TJ/day to 50 TJ/day on 30 March 2023 with expected cessation in early 2024. For detail see: https://www.santos.com/wp-content/uploads/2023/10/2023_Third_Quarter_Report.pdf and https://www.santos.com/wp-content/uploads/2023/11/Santos-Investor-Day-2023.pdf.

[191] See: https://australia.chevron.com/our-businesses/gorgon-project.

[192] See: https://www.bp.com/en/global/corporate/news-and-insights/reimagining-energy/gas-and-the-north-west-shelf-in-bp-upstream-portfolio-australia.

[193] See: https://www.woodside.com/docs/default-source/sustainability-documents/transparency-documents/2023-government-submissions-reports/submission-woodside_inquiry-into-the-wa-domgas-policy.pdf.

[194] See: https://www.woodside.com/docs/default-source/sustainability-documents/transparency-documents/2023-government-submissions-reports/submission-woodside_inquiry-into-the-wa-domgas-policy.pdf.

[195] See: https://www.santos.com/wp-content/uploads/2023/11/Santos-Investor-Day-2023.pdf.

[196] See: https://australia.chevron.com/news/2023/wheatstone-project-boosts-wa-domgas-supply.

[197] See: https://www.mepau.com.au/project/waitsia-gas-project/.

- Production from the KGP has increased in the second half of the financial year. This has been due to the completion of scheduled turnaround and maintenance activities, processing of Pluto gas through the Pluto-KGP interconnector and revised DMO at the plant[198].
- Production from Beharra Springs slightly increased, with revised nameplate capacity after Beharra Springs Deep gas field was tied in during April 2021[199].
- Production from Devil Creek and Varanus Island has been decreasing due to natural depletion of reserves. Production from Devil Creek was further impacted by the disruption of Reindeer gas field, while that for Varanus Island was triggered by the temporary shutdown of John Brooks platform, as detailed in Chapter 1. Production for both plants returned to higher rates in the last quarter with intermittent production from Devil Creek and commencement of Spartan (via Varanus Island)[200].
- The Beharra Springs, Gorgon, Wheatstone, and Xyris facilities had the highest capacity utilisation over the financial year, all operating at over 90%, while the KGP facility had the lowest capacity utilisation at 14%. The remaining facilities have been operating at capacity utilisations ranging from 52% to 87%.
- Overall, the weighted average capacity utilisation was 57% over this financial year with the highest utilisation in the last quarter when production from Devil Creek and Varanus Island increased.

[198] See: https://www.woodside.com/docs/default-source/asx-announcements/2023-asx/third-quarter-2023-report.pdf and https://www.woodside.com/docs/default-source/asx-announcements/2023-asx/investor-briefing-day-2023-transcript.pdf.

[199] See: https://yourir.info/resources/0c5a441cf54ff229/announcements/bpt.asx/6A1104415/BPT_2022_Beach_Energy_Ltd_Annual_Report.pdf.

[200] See: https://www.santos.com/wp-content/uploads/2023/10/2023_Third_Quarter_Report.pdf.

# A5. Domestic gas demand forecasts by region

**Table 24 Domestic gas demand forecasts by region (TJ/day), Expected scenario, 2024 to 2033**

| Year / Region | Metro/South West | North | East |
|---|---|---|---|
| **2024** | 684.1 | 313.6 | 134.9 |
| **2025** | 699.0 | 317.6 | 136.5 |
| **2026** | 682.5 | 321.3 | 143.5 |
| **2027** | 668.5 | 316.6 | 138.5 |
| **2028** | 678.6 | 431.9 | 138.3 |
| **2029** | 679.3 | 428.6 | 132.6 |
| **2030** | 683.6 | 428.6 | 124.4 |
| **2031** | 756.2 | 428.6 | 125.1 |
| **2032** | 787.5 | 426.5 | 125.6 |
| **2033** | 771.9 | 426.7 | 126.1 |

# A6. Total gas demand forecasts

**Table 25 Domestic gas demand forecasts (PJ/annum), 2024 to 2033**

| Year | Low | Expected | High |
|---|---|---|---|
| **2024** | 385.9 | 413.4 | 446.5 |
| **2025** | 382.1 | 420.9 | 469.1 |
| **2026** | 371.1 | 418.8 | 447.2 |
| **2027** | 365.7 | 410.2 | 476.1 |
| **2028** | 349.6 | 455.8 | 524.8 |
| **2029** | 367.2 | 452.8 | 510.7 |
| **2030** | 368.0 | 451.4 | 512.2 |
| **2031** | 384.2 | 478.1 | 505.8 |
| **2032** | 387.7 | 489.0 | 483.4 |
| **2033** | 398.8 | 483.5 | 475.8 |

**Table 26 LNG feedstock forecasts (PJ/annum), 2024 to 2033**

| Year | Low | Expected | High |
|---|---|---|---|
| **2024** | 2681.1 | 2782.7 | 2883.7 |
| **2025** | 2569.1 | 2631.2 | 2692.7 |
| **2026** | 2382.1 | 2417.9 | 2868.0 |
| **2027** | 2199.3 | 2656.3 | 2717.8 |
| **2028** | 2447.7 | 2509.8 | 2571.3 |
| **2029** | 2290.4 | 2352.4 | 2374.5 |
| **2030** | 2156.0 | 2218.1 | 2279.6 |
| **2031** | 2079.4 | 2141.5 | 2203.0 |
| **2032** | 1943.7 | 2005.7 | 2067.3 |
| **2033** | 1943.7 | 2005.7 | 2067.3 |

**Table 27 LNG processing forecasts (8% of feedstock) (PJ/annum), 2024 to 2033**

| Year | Low | Expected | High |
|---|---|---|---|
| **2024** | 214.5 | 222.6 | 230.7 |
| **2025** | 205.5 | 210.5 | 215.4 |
| **2026** | 190.6 | 193.4 | 229.4 |
| **2027** | 175.9 | 212.5 | 217.4 |
| **2028** | 195.8 | 200.8 | 205.7 |
| **2029** | 183.2 | 188.2 | 190.0 |
| **2030** | 172.5 | 177.4 | 182.4 |
| **2031** | 166.4 | 171.3 | 176.2 |
| **2032** | 155.5 | 160.5 | 165.4 |
| **2033** | 155.5 | 160.5 | 165.4 |

**Table 28 Total gas demand forecasts (PJ/annum), 2024 to 2033**

| Year | Low | Expected | High |
|---|---|---|---|
| **2024** | 3281.6 | 3418.7 | 3560.9 |
| **2025** | 3156.7 | 3262.6 | 3377.2 |
| **2026** | 2943.8 | 3030.1 | 3544.6 |
| **2027** | 2741.0 | 3279.0 | 3411.4 |
| **2028** | 2993.1 | 3166.4 | 3301.8 |
| **2029** | 2840.8 | 2993.4 | 3075.2 |
| **2030** | 2696.5 | 2846.9 | 2974.2 |
| **2031** | 2630.0 | 2790.9 | 2885.1 |
| **2032** | 2486.8 | 2655.2 | 2716.1 |
| **2033** | 2497.9 | 2649.7 | 2708.5 |

# A7. Sector classifications

**Table 29 Classification of gas consumers into sectors (GBB delivery points)**

| Sector | Gas consumers | | |
|---|---|---|---|
| **Minerals processing** | • Alcoa Kwinana<br>• Alcoa Pinjarra[A]<br>• Alcoa Wagerup<br>• BHP Kwinana nickel refinery<br>• BP Refinery | • Hismelt Kwinana<br>• Kemerton Lithium Hydroxide Facility and Utility Systems<br>• Tianqi Lithium Hydroxide Facility | • Tiwest Chandala<br>• Tiwest Kwinana<br>• Worsley alumina[B] |
| **Mining** | • Agnew<br>• Bellevue gold<br>• Birla Nifty<br>• Boonamichi Well<br>• Chichester (Diesel to gas)<br>• Cosmos<br>• Eliwana Mine and Rail Project<br>• Granny Smith goldmine<br>• Gruyere goldmine<br>• Gudai Darri<br>• Gwalia<br>• Hill 60[C]<br>• Iron Bridge magnetite project<br>• Jaguar | • Karlawinda mine<br>• Leinster<br>• Mount Keith power station<br>• Mt Morgans<br>• Murrin<br>• Newman power station<br>• Paraburdoo power station<br>• Parkeston power station<br>• Pinga Creek Meter Station<br>• Plutonic<br>• Robe River<br>• Saracen<br>• Savory Creek<br>• Sino Iron project power station | • Solomon power station<br>• Southern System Power Station<br>• Sunrise Dam<br>• Tarmoola Meter<br>• Telfer gold mine<br>• Tropicana<br>• Wellesley MS<br>• Wiluna Gold<br>• Wiluna Jundee<br>• Windimarra<br>• Wodgina<br>• Yamarna<br>• Yarnima power station<br>• Yurrali Maya power station |
| **Industrial** | • Australian Gold Reagents<br>• Boodarie<br>• Beyondie<br>• Cockburn Cement<br>• CSBP ammonia<br>• Esperance<br>• Fero industries | • Hazer Biogas<br>• Maitland LNG Plant<br>• Midland Brick<br>• Mid-west LNG hub<br>• ROC Oil<br>• Rocla | • Tip Top Canning Vale<br>• Wesfarmers[D]<br>• Whiteman Brick<br>• Yara fertilisers |
| **SWIS GPG** | • Kemerton power station<br>• Kwinana power station<br>• Mungarra power station | • NewGen Kwinana & Cockburn power station<br>• NewGen Neerabup power station<br>• Perth Energy Kwinana | • Pinjar power station<br>• Pinjarra power station<br>• Wagerup power station<br>• Tiwest cogeneration |
| **Non-SWIS GPG** | • Carnarvon power station<br>• Exmouth power station | • Karratha power station<br>• Onslow power station | • Port Hedland power station<br>• South Hedland power station |

A. Includes one delivery point on the DBP and one on the Parmelia pipeline.
B. Includes two delivery points on the DBP.
C. Includes the mine site and power station (two delivery points).
D. Including Wesfarmers gas and LNG facilities.

# A8. WA gas infrastructure

WA gas infrastructure includes multi-user gas storage facilities, domestic gas transmission pipelines, spot and short-term trading mechanisms and LNG export production facilities. Information on domestic gas production facilities is provided in Appendix A4.3.

## A8.1 Gas transmission pipelines

WA's gas transmission network is shown in Figure 30.

**Figure 30 Gas transmission pipelines in WA**


Source: WA GBB and AEMC.

## A8.2 Spot and short-term trading

AEMO does not operate a spot or short-term trading market in WA. Instead, most short-term demand is met by confidential contracts settled between parties. Short-term gas may also be procured through two independent and non-aligned mechanisms:

- gasTrading operates a spot market where sellers advise the operator of any surplus gas for the coming month, which is broadcast to the market and subsequently allocated depending on the ranking of the purchasers' offers and availability. The exact volumes available are confirmed by the seller one day ahead. Trade data is published on gasTrading's website at the end of each month.
- Energy Access Services Pty Ltd operates a real-time energy trading platform where members enter gas trade agreements with a focus on supply durations of up to 90 days. Trades can encompass firm and interruptible gas arrangements, as well as imbalances, and trade data is published monthly on the Energy Access website.

AEMO estimates that approximately 1-2%[201] of total gas consumption in WA is traded on a short-term basis. Information in the public domain regarding the quantity and associated prices of spot or short-term gas is provided by gasTrading and Energy Access Services.

## A8.3 LNG export production facilities

WA's LNG nameplate production capacity totals 46.3 Mtpa and consists of four production facilities:

- NWS (KGP) – 16.9 Mtpa[202].
- Pluto – 4.9 Mtpa[203].
- Gorgon – 15.6 Mtpa[204].
- Wheatstone – 8.9 Mtpa[205].

All the LNG projects in WA have historically used only equity gas – that is where the ownership of gas does not change from wellhead to export. However, in March 2022, third-party use of the NWS liquefaction facility commenced.

On 31 March 2022, Woodside announced that the Pluto joint venture had begun piping gas into the KGP, via the Pluto-KGP Interconnector[206]. Approximately 2.5 million tonnes of LNG will be produced from Pluto gas piped into the KGP facilities between 2022 and 2025. Around 20.5 PJ of Pluto gas will also be supplied into the domestic market via the KGP in the same period, which commenced in April 2022[207].

[201] Calculated using WA Gas Spot Market data and WA GBB. See: https://www.gastrading.com.au/spot-market/historical-prices-and-volume/daily-volume-history and https://gbbwa.aemo.com.au/.

[202] See: https://www.woodside.com/what-we-do/operations/north-west-shelf.

[203] See: https://www.woodside.com/what-we-do/australian-operations/pluto-lng.

[204] See: https://australia.chevron.com/our-businesses/gorgon-project.

[205] See: https://www.woodside.com/what-we-do/australian-operations/wheatstone-project.

[206] See: https://www.woodside.com/docs/default-source/asx-announcements/2022/processing-of-pluto-gas-starts-at-north-west-shelf.pdf.

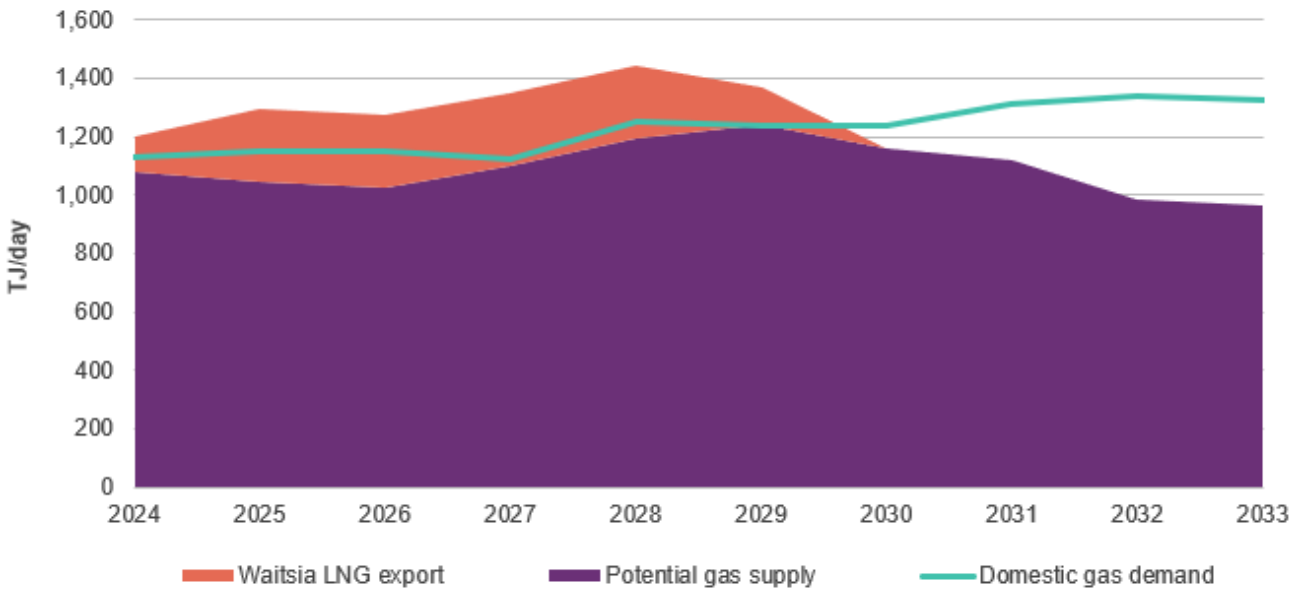
[207] See: https://www.wa.gov.au/government/publications/implementation-of-the-wa-domestic-gas-policy.

On 6 June 2023, Gorgon joint venture partners announced the start-up of production from Gorgon Stage two, connecting 11 additional wells in the Gorgon and Jansz-lo fields, accompanying offshore production pipelines and subsea infrastructure to support gas processing facilities on Barrow Island[208].

Additionally, the Waitsia joint venture has been given permission to export 7.5 million tonnes of LNG (416 PJ) from its stage two reserves via the NWS infrastructure[209]. This export deal will be the first time onshore gas has been exported as LNG, and the first time gas will be supplied into the southern end of the DBNGP, but where the customer is at the northern end. The forecast additional supply and demand created by Waitsia LNG export is shown in Figure 31.

AEMO has excluded the Waitsia export volumes from the supply/demand balance, as it is considered available for true domestic demand. However, the produced gas will be recorded on the GBB and will flow through WA infrastructure.

**Figure 31 Domestic gas prospective supply and demand plus Waitsia-to-KGP LNG export gas, 2024 to 2033 (TJ/day)**




Two additional facilities source gas from Commonwealth waters off the northwest coast of WA, but the liquefaction either occurs offshore or in the Northern Territory and, therefore, they do not contribute to WA's overall LNG production capacity:

- Prelude Floating Liquefied Natural Gas (FLNG) – a 3.6 Mtpa[210] floating LNG facility operated by Shell, which exports directly from the offshore facility.

[208] See: https://australia.chevron.com/news/2023/gorgon-stage-two-starts-production-supporting-long-term-energy-supply.

[209] See: https://www.mediastatements.wa.gov.au/Pages/McGowan/2020/12/WA-Government-reaches-agreement-on-job-creating-domestic-gas-project.aspx.

[210] See: https://www.shell.com.au/media/2019-media-releases/first-lng-cargo-shipped-from-prelude-flng.html.

- Ichthys LNG – a 8.9 Mtpa[211] LNG project operated by INPEX Corporation, which has an onshore liquefaction plant located in Darwin.

[211] See: https://www.inpex.com.au/projects/ichthys-lng/.

# A9. Conversion factors, units, and abbreviations

The following conversion factors have been applied in preparing figures for all this 2022 WA GSOO.

## Conversion factors

| | To | | | | | | |
|---|---|---|---|---|---|---|---|
| **From** | **Billion cubic metres NG** | **Billion cubic feet NG** | **Million tonnes of oil equivalent** | **Million tonnes LNG** | **Trillion British thermal units** | **Million barrels of oil equivalent** | **Petajoule** |
| | **Multiply by** | | | | | | |
| Billion cubic metres NG | 1 | 35.3 | 0.9 | 0.74 | 35.7 | 6.6 | 37.45 |
| Billion cubic feet NG | 0.028 | 1 | 0.025 | 0.0216 | 1.01 | 0.19 | 1.06 |
| Million tonnes of oil equivalent | 1.11 | 39.2 | 1 | 0.82 | 39.7 | 7.33 | - |
| Million tonnes LNG | 1.36 | 48 | 1.22 | 1 | 48.6 | 8.97 | 55.43 |
| Trillion British thermal units | 0.028 | 0.99 | 0.025 | 0.021 | 1 | 0.18 | 1.06 |
| Million barrels of oil equivalent | 0.15 | 5.35 | 0.14 | 0.11 | 5.41 | 1 | 5.82 |
| Petajoule | 0.027 | 0.943 | - | 0.018 | 0.943 | 0.172 | 1 |

## Units of measure

| Abbreviation | Unit of measure |
|---|---|
| GJ | Gigajoule |
| Mtpa | Million tonnes per annum |
| MW | Megawatt |
| MWh | Megawatt hour |
| PJ | Petajoule |
| Q | Quarter |
| tcf | Trillion cubic feet |
| TJ | Terajoule |
| **TJ/day** | Terajoule per day |

## Abbreviations

| Abbreviation | Expanded name |
|---|---|
| 1P | Proved reserves |
| 2C | Contingent resources |
| 2P | Proved and probable reserves |
| ABS | Australian Bureau of Statistics |
| ACCC | Australian Competition and Consumer Commission |
| AEMC | Australian Energy Market Commission |
| AEMO | Australian Energy Market Operator |
| CDD | Cooling degree days |
| CEFA | Clean Energy Fuels Australia |
| CSBP | Cuming Smith British Petroleum and Farmers Limited |
| DBP | DBNGP (WA) Transmission Pty Ltd |
| DBNGP | Dampier to Bunbury Natural Gas Pipeline |
| DER | Distributed energy resources |
| DJTSI | WA Department of Jobs, Tourism, Science, and Innovation |
| DEMIRS | WA Department of Energy, Mines, Industry, Regulation, and Safety |
| DMO | Domestic market obligation |
| EDL | Energy Developments Limited |
| EPA | Environmental Protection Agency |
| ERA | Economic Regulation Authority |
| ESOO | Electricity Statement of Opportunities |
| FID | Final investment decision |
| FIR | Formal information request |
| FMG | Fortescue Metals Group |
| GBB | Gas Bulletin Board |
| GMP | Gas Market Participant |
| GPG | Gas powered generation |
| GSA | Gas Sale Agreement |
| GSI Rules | Gas Services Information Rules |
| GSOO | Gas Statement of Opportunities |
| HDD | Heating degree days |
| KGP | Karratha Gas Plant |
| LNG | Liquefied natural gas |
| LPG | Liquified petroleum gas |
| MCQ | Maximum contracted quantity |
| NIEIR | National Institute of Economic and Industry Research |
| NWIS | North West Interconnected System |
| NWS | North West Shelf |
| PPA | Power Purchase Agreement |
| PPI | Purchasing Power Index |
| PV | Photovoltaics |
| SOP | Sulphate of potash |
| SPE | Society of Petroleum Engineers |
| SWIS | South West Interconnected System |
| WA | Western Australia |
| WA GBB | Western Australia Gas Bulletin Board |
| WEM | Wholesale Electricity Market |

# A10. Glossary

This document uses terms that have meanings defined in the GSI Rules. The GSI meanings are adopted unless otherwise specified. Additional terms used in this document have the following meanings:

| Term | Definition |
|---|---|
| **1P** | A measure of gas reserves that includes proven (developed and undeveloped) reserves. |
| **2C** | A measure of gas resources that are considered less commercially viable than reserves. 2C resources are considered the best estimate of sub-commercial reserves. |
| **2P** | A measure of gas reserves that includes proven (developed and undeveloped) and probable reserves. |
| **Backfill** | Connecting additional gas fields or reserves to an existing domestic gas production facility, instead of building new processing infrastructure (sometimes referred to as a tie-back). |
| **Committed projects** | Gas supply or demand projects that are existing, under construction or have taken a positive FID. |
| **Distribution network** | The low-pressure networks operated by ATCO and used to supply residential and non-residential customers in the Perth metropolitan area and regional centres of Albany, Bunbury, Geraldton, and Kalgoorlie. |
| **Domestic gas demand** | Includes all major industrial and commercial loads, electricity generators, and small-use customers connected to WA's gas transmission and distribution networks. |
| **Large customers** | Gas customers using 10 TJ/day or more (GBB Large Users). |
| **Linepack** | The pressurised volume of gas stored in the pipeline system. Linepack is essential for gas transportation through the pipeline network each day, and as a buffer for within-day balancing. |
| **LNG feedstock** | Natural gas that enters an LNG production train for removal of impurities and liquefaction. |
| **Potential gas supply** | Instead of forecasting how much gas is expected to be supplied over the outlook period, AEMO's forecasts of potential gas supply reflect how much gas could be produced if there was market demand for it at the forecast price. This approach is useful in assessing supply adequacy and identifying potential supply shortfalls. |
| **Prospective projects** | Prospective gas supply sources include all gas field developments which have been publicly announced that would make supply available to the WA domestic gas market, including LNG projects. Selected prospective supply sources have been included in the potential gas supply model.<br>Prospective gas demand projects are only included in the High scenario and must meet set criteria (described in Appendix A3.2.1). These include projects that may switch from diesel to gas electricity generation. |
| **Ramping requirements** | The difference between minimum and peak demand in the SWIS is widening with increasing uptake of behind the meter PV and large-scale solar. This, combined with increased intermittent wind generation, requires generation (usually using gas) that is capable of rapidly increasing output ("ramping") over a short period of time to meet evening peak demand. |
| **Total gas demand** | Domestic gas demand plus an estimate of the gas required to produce LNG for export, reflecting an overall assessment of the demand for natural gas in WA. |
| **Transmission network** | The high-pressure pipelines used to transport large volumes of gas from the production facilities to customers. Large customers can connect directly to the transmission network, while smaller customers are supplied through the distribution network connected to the transmission network. |
| **Western Australian Gas Bulletin Board (WA GBB)** | A public website (gbb.aemo.com.au), formally established in 2013 under Western Australia's Gas Services Information (GSI) Rules and managed by AEMO, that provides information of forecast and historical data on the domestic production, transmission, storage and usage of natural gas in Western Australia. |

# A11. List of tables and figures

## Tables

# Figures