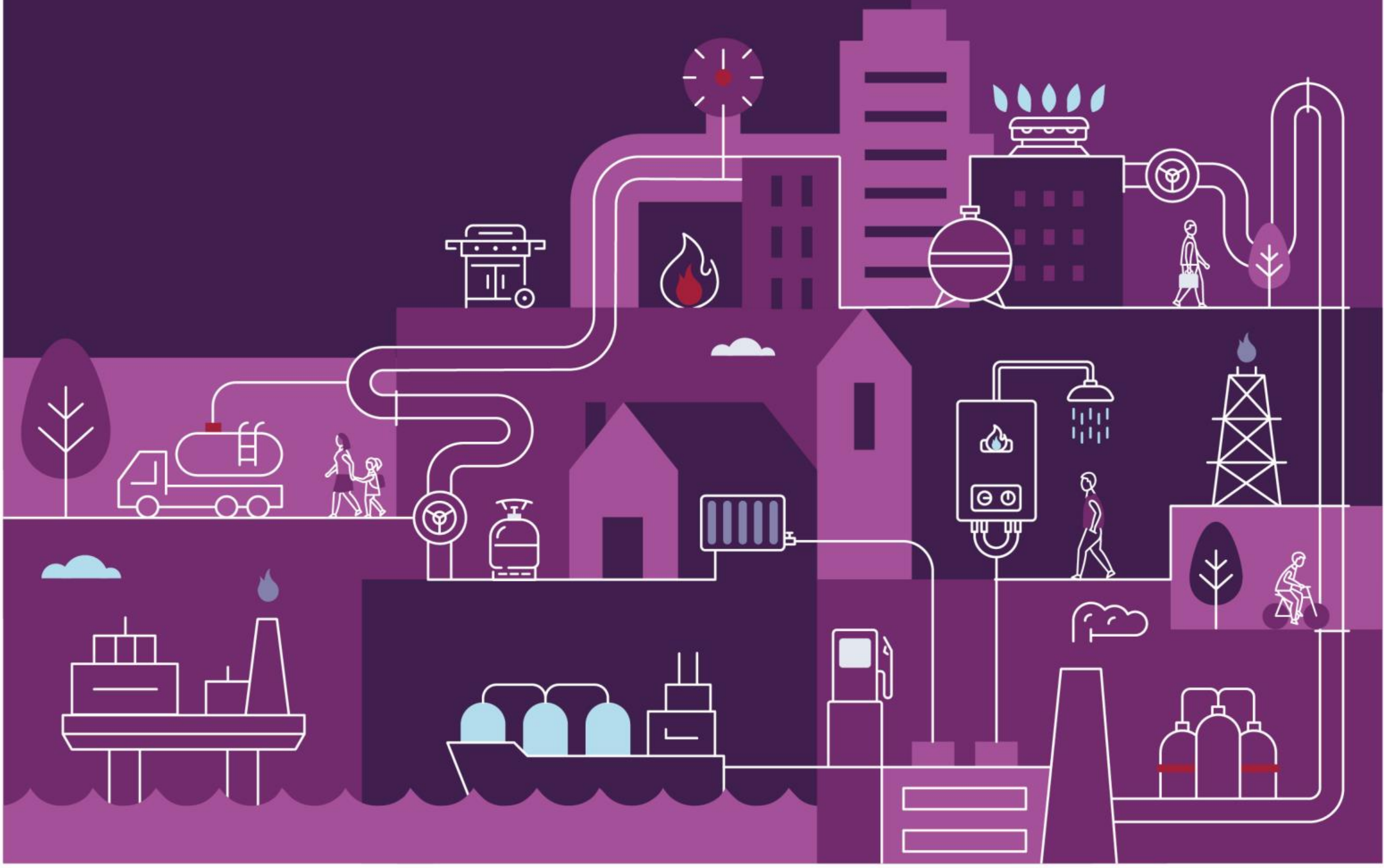
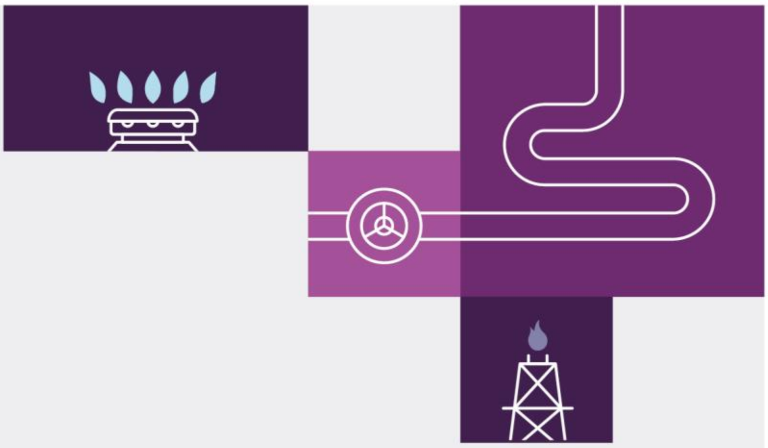
2022 Western Australia Gas Statement of Opportunities

December 2022

Market outlook to 2032

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 Western Australia 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 2022 unless otherwise indicated.

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Acknowledgement

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

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Executive summary

The 2022 Western Australia (WA) Gas Statement of Opportunities presents AEMO's assessment of WA's domestic gas market for the 10-year outlook period 2023 to 2032. The WA GSOO presents forecasts of WA's domestic gas demand and potential gas supply for Low, Base and High scenarios, and an overview of gas infrastructure and emerging issues that affect Gas Market Participants (GMPs) and other stakeholders.

Key findings

Potential gas supply is gas that could be economically made available to the domestic market, capped by the availability of processing capacity and gas reserves. It does not project how much gas *will be* produced, but how much *could be* produced.

Based on forecast demand and expected new and committed supply sources, the Western Australian (WA) domestic gas market is facing a tight supply demand balance between 2023 and 2029, with demand up to 5% higher than potential supply. The outlook has three distinct phases:

- In every year up to 2026, potential gas supply is forecast to be insufficient to meet domestic demand. However, the deficit is small – 45 petajoules (PJ) over four years peaking in 2024 at 49 terajoules (TJ)/day.
- Between 2027 and 2029, supply is forecast to slightly exceed demand as Scarborough is expected to be brought onstream at 180 TJ/day from mid-2027. The projected surplus is 38 PJ over three years at a maximum rate of 48 TJ/day, or from 1.3% of demand in 2027 up to 4.1% in 2029.
- From 2030 onwards, the gas market is forecast to move into a larger deficit, with shortfalls over 200 TJ/day between 2030 to 2032 (over 16% of demand each year). This is driven by planned coal retirements increasing the need for gas generation and a decline in production from existing gas fields.

The projected supply gaps could be alleviated by:

- Withdrawals from storage – WA has 78 PJ of storage capacity which can deliver gas at up to 210 TJ/day.
- Small quantities of short term additional supply from existing domestic gas production facilities.
- In the longer term, development of gas fields that are not currently included in the gas supply forecasts, such as Corvus, Lockyer Deep or South Erregulla.
- Large gas users transitioning more rapidly to lower emissions energy sources.

The WA Government's Domestic Gas Policy remains a cornerstone of WA's gas supply to the domestic market.

WA domestic gas demand is forecast to increase from 1,099 TJ/day in 2023 to 1,278 TJ/day in 2032, at an average annual rate of 1.7%, with contributions to growth from:

- Committed new resources projects, which are expected to add 43 TJ/day to gas demand by 2026.
- South West Interconnected System (SWIS) generation gas demand, which is forecast to grow from 127 TJ/day in 2023 to 304 TJ/day in 2032, as Synergy's scheduled coal retirements are only partially replaced by renewables.

Decarbonisation in iron ore mining is forecast to partially offset demand growth, with gas use in iron ore expected to drop from 157 TJ/day in 2023 to 107 TJ/day in 2032, despite forecast increasing production.

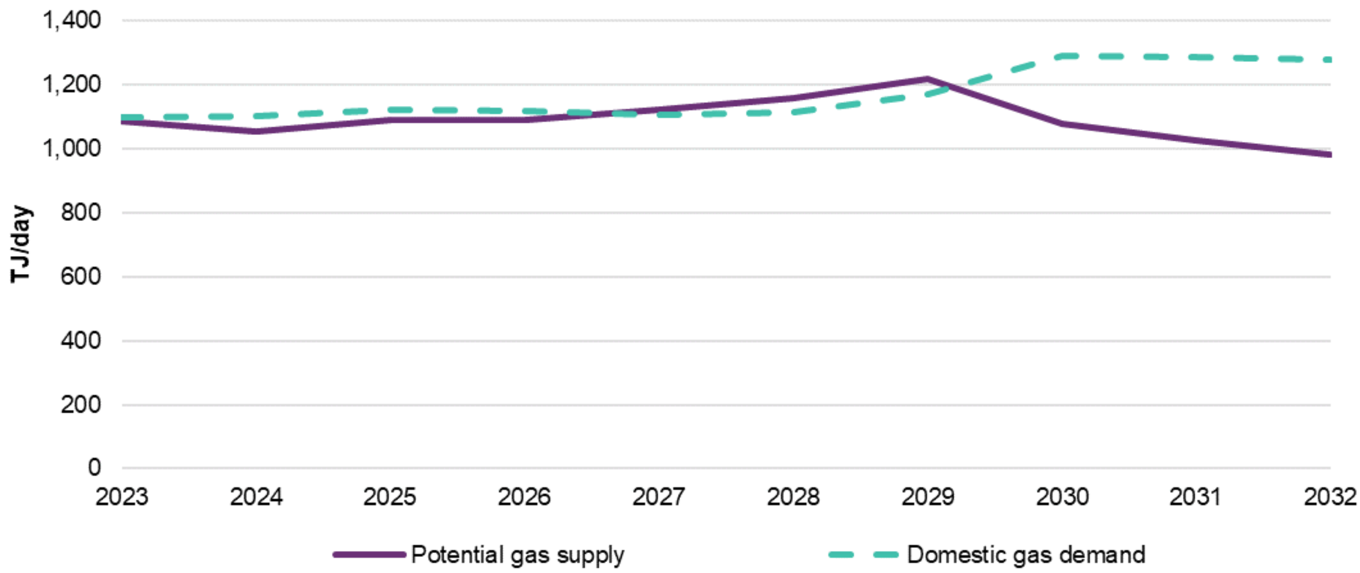
WA domestic gas market is expected to be tightly balanced

The WA domestic gas market is supplied by a combination of domestic-only and LNG-linked gas facilities. The LNG-linked facilities supply gas to the domestic market in accordance with Domestic Market Obligations (DMO), as part of the WA Government's Domestic Gas Policy[1]. Gas supplied under DMOs is expected to account for around 54% of WA's gas supply in 2023.

As shown in Figure 1 and Table 1, based on forecast demand and expected new and committed supply sources, the WA domestic gas market is expected to be tightly balanced through to 2029. Between 2023 and 2026, demand is expected to exceed supply by a total of 45 PJ, with the shortfall peaking in 2024 at 49 TJ/day. The commencement of Scarborough (180 TJ/day) in mid-2027 is projected to be sufficient to return the market to surplus until 2029. From 2030, the increase in gas required for power generation following Synergy's coal retirements is projected to result in a deficit of up to 296 TJ/day by 2032.

The 2021 WA GSOO, in comparison, projected supply gaps in 2025 (42 TJ/day), 2026 (85 TJ/day) and 2027 (13 TJ/day).

Figure 1 Base scenario WA gas market balance, 2023 to 2032



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

Table 1 Potential gas supply and domestic demand forecasts (TJ/day), 2023 to 2032

	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	5-year annual average growth rate	10-year annual average growth rate
Potential gas supply	1,084	1,053	1,090	1,091	1,121	1,158	1,219	1,077	1,025	982	1.3%	-1.1%
Domestic gas demand	1,099	1,103	1,123	1,117	1,107	1,115	1,171	1,290	1,284	1,278	0.3%	1.7%
Difference	-15	-49	-33	-26	14	42	48	-213	-258	-296	-	-
Difference as % of demand	-1.4%	-4.5%	-2.9%	-2.4%	1.3%	3.8%	4.1%	-16.5%	-20.1%	-23.1%	-	-

Between 2023 and 2029, the WA domestic gas market could easily move into surplus with any delays to demand projects, or deficit if any supply projects do not progress according to current expectations.

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

- In the short term, gas could be withdrawn from storage at up to 210 TJ/day, subject to the quantity of gas in storage[2] at the time and the duration of the requirement[3]. Existing gas production facilities may also be able to supply small additional quantities.
- Over the longer term, new sources of gas supply will be required to meet forecast demand, which may include:
  - Backfill projects at existing facilities, such as Corvus or Kultarr being developed through Varanus Island.
  - Expansion of existing facilities, such as Beharra Springs.
  - Undeveloped fields such as Lockyer Deep or South Erregulla in the Perth basin.

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 Base scenario

Project	Operator	Volume (TJ/day)	Available from	Notes
Scarborough	Woodside Energy	180	2027	Being developed as a liquefied natural gas (LNG) supply source to Pluto Train 2. Domestic gas plant will have capacity of 225 TJ/day.
Spartan	Santos	n/a	2023	Being developed as backfill to Varanus Island. No incremental production capacity will be added.
Waitsia Stage 2	Mitsui E&P Australia	125	2029	Being developed for LNG export via the Karratha Gas Plant (KGP), supplying the domestic market at an assumed initial rate of 125 TJ/day.
Walyering	Strike Energy	30	2023	Perth Basin new-build gas development. Achieved a final investment decision (FID) in August 2022.
West Erregulla	Strike Energy	87	2025	Perth Basin new-build gas development. Operator expects to take FID in early 2023.

[2] There was 49 PJ of gas in storage in October 2022 based on data from AEMO's WA Gas Bulletin Board.

[3] 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 both storage facilities are full and accounts for Mondarra's higher withdrawal rate and lower capacity compared to Tubridgi.

Two major events in 2022 have affected the potential gas supply forecasts:

- Strike Energy took FID on the Walyering project in the Perth basin. This will deliver up to 33 TJ/day (AEMO models the nameplate capacity of 30 TJ/day) into the Parmelia pipeline.
- In January 2022, Chevron's Gorgon project increased production capacity from 182 TJ/day to 300 TJ/day.

Since the 2021 WA GSOO, AEMO has updated its supply view of four domestic gas projects:

- Based on annualised historical data, assumptions for Gorgon and Wheatstone have been adjusted to reflect actual operating patterns of around 85% of nameplate capacity. Gorgon is modelled at 255 TJ/day (compared to 300 TJ/day in the 2021 WA GSOO), while Wheatstone is modelled at 174 TJ/day (compared to 205 TJ/day in the 2021 WA GSOO).
- Assumptions for Pluto now include acceleration gas (25 PJ at 18 TJ/day from May 2022) and additional commitment gas (45.6 PJ at 25 TJ/day from 2025).
- Waitsia Stage 2 is assumed to deliver 125 TJ/day from 2029 compared to 100 TJ/day in the 2021 WA GSOO. However, its delivery rate falls more rapidly as reserves are depleted faster at the higher production rate.

AEMO notes that there is a large volume of offshore and onshore 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, Chandon, Geryon, Orthrus, Maenad, Spar Deep and Clio-Acme. AEMO will continue to monitor these and other projects for potential inclusion in future WA GSOOs.

Growth in domestic gas demand

Global commodity demand is the key driver for WA's main exports like iron ore and base metals. Although prices have decreased during 2022[4], AEMO expects commodity demand to recover in the medium term[5].

Overall, domestic gas demand is forecast to grow at an annual rate of 1.7%, from 1,099 TJ/day in 2023 to 1,278 TJ/day in 2032. Forecast growth in domestic gas demand is underpinned by:

- Six committed resources projects that are expected to add a net 43 TJ/day to gas demand by 2026.
  - Four are mining projects, including gold, iron ore, lithium and nickel, and account for a net 38 TJ/day of increased demand[6].
  - Two are lithium processing projects, accounting for 5 TJ/day of demand.
- Gas demand for gas generation of electricity in the SWIS, which is forecast to grow at an average annual rate of 10%, from 127 TJ/day in 2023 to 304 TJ/day in 2032.
  - Renewables are projected to only partly replace coal plant retirements, and gas generation is forecast to be required for baseload power and system security.

[4] The iron ore price decreased from US$133/tonne in January 2022 to US$100/tonne in September 2022, while the prices of copper, zinc, and nickel decreased by 21%, 13%, and 2% respectively between January 2022 and September 2022. See https://www.worldbank.org/en/research/commodity-markets

[5] See: *Economic and commodity forecasts for WA to 2032*, authored by the National Institute of Economic and Industry Research (NIEIR) and published as part of this GSOO.

[6] One of the four projects (BHP's Nickel West) will reduce gas demand due to the installation of renewable energy.

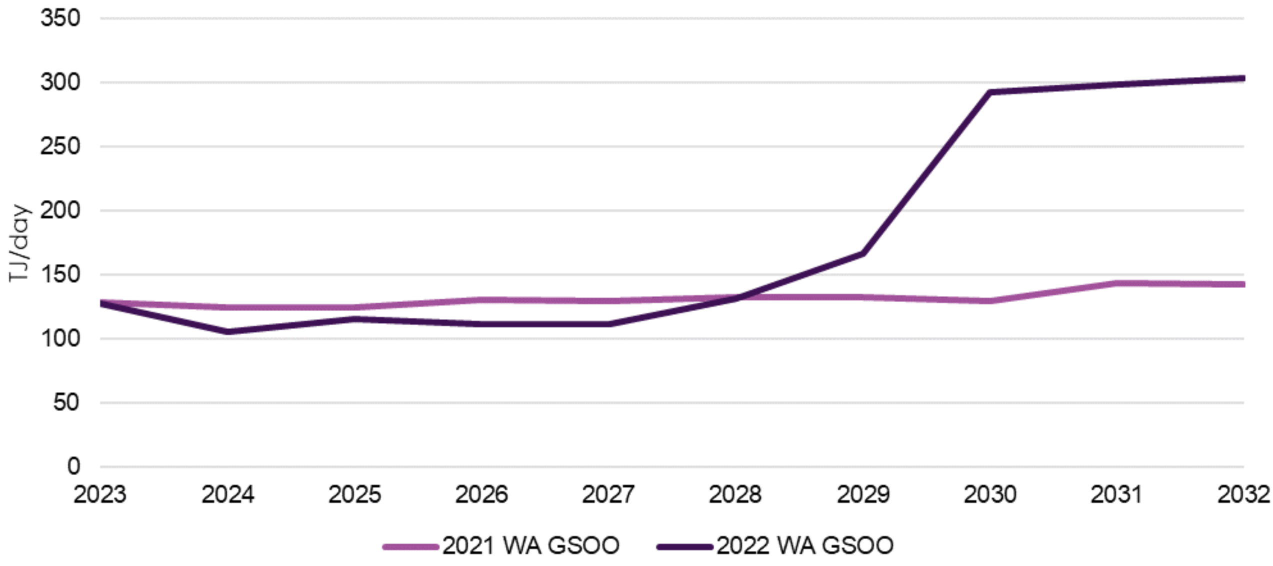
- Decarbonisation targets in the iron ore sector[7] (identified through the formal information request (FIR) process) are resulting in reduced forecast demand for gas. Gas use in iron ore mining is expected to drop from 157 TJ/day in 2023 to 107 TJ/day in 2032, despite forecast production growth, partly offsetting projected growth in overall demand for electricity.

Since the 2021 WA GSOO, the gas generation profile has changed markedly, due to Synergy's announcement of the scheduled closure of all its remaining coal-fired generators within the outlook period[8]. The gas generation forecast for 2023 is similar to last year's forecast, as higher gas prices (which reduce gas generation) are counteracted by a potential coal shortage (which increases gas generation). AEMO assumes there are no coal constraints after March 2023, leading to a slightly lower gas generation forecast from 2024 due to higher gas price assumptions.

From 2028, the impact of coal retirements starts dominating the forecast. AEMO's modelling projects that increasing renewables penetration will be insufficient to fully compensate for the loss of coal-fired baseload power and gas generation will have to increase to complement renewable generation.

Figure 2 shows a comparison of the 2021 and 2022 gas generation usage profiles.

Figure 2 Base scenario WA gas power generation gas demand forecast, 2023 to 2032



[7] See for example 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.

[8] Collie (2027), Muja unit 7and Muja unit 8 (2029). Muja unit 5 retired on 1 October 2022. Muja unit 6 is scheduled to retire on 1 October 2024.

Supply demand balance risks

Between 2023 and 2026, 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 experiences an unexpected interruption, there could be an immediate but short-term supply shortfall. Line packing[9] 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 further into deficit if coal supply continues to be restricted, leading to an increased demand for gas generation. AEMO is closely monitoring the coal supply situation in WA.
- **Additional gas demand** – the Perdaman urea project (125 TJ/day[10] of gas demand from 2026), currently in the High scenario forecast, could achieve FID in the next 12 months. This would increase gas demand, resulting in supply shortfalls from 2026 onward.
- **New gas supply projects** – new gas supply projects could be delayed, exacerbating forecast supply shortfalls. Conversely, if lead times shorten, new supply projects may commence earlier than forecast, alleviating forecast shortfalls. 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.

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

[10] See https://www.woodside.com/docs/default-source/media-releases/20-11-2018-woodside-signs-agreement-for-long-term-domestic-gas-supply.pdf.

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Tables

Figures

1 Year in review

This chapter provides a snapshot of events and initiatives that have been announced or progressed since the 2021 Western Australia (WA) Gas Statement of Opportunities (GSOO) and may facilitate future change in the WA gas market[11].

1.1 Supply projects – announced or updated

- Chevron Australia brought Gorgon domestic gas phase 2 online in January 2022. This increased the Gorgon joint venture's maximum domestic gas output to 300 terajoules (TJ)/day.
- On 1 June 2022, BHP merged its oil and gas business with Woodside Petroleum. The combined entity is now known as Woodside Energy and is the third largest supplier of domestic gas in Western Australia.
- In August 2022, Strike Energy sanctioned the Walyering project in the Perth Basin. The new-build gas facility is expected to deliver up to 33 TJ/day into the domestic market from 2023.
- Woodside Energy commenced development of Pluto train 2 and the associated Scarborough gas field in August 2022. The operator is targeting first liquefied natural gas (LNG) for 2026. For the forecasts in this GSOO, AEMO has assumed first domestic gas supply in 2027 (see Chapter 3 for further information).
- Exploration and development drilling projects were progressed in the Carnarvon and Perth Basins and the Bedout Sub-Basin. For the sake of brevity, AEMO has only included the wells targeting gas resources:
  - Strike Energy's South Erregulla gas discovery was announced in March 2022. The field is in the Perth Basin and the resource was independently certified in September 2022 at 128 petajoules (PJ).
  - Three production wells were drilled on the Waitsia gas field in the Perth Basin (Waitsia-5, 6 and 7). They are expected to become operational in the second half of 2023.
  - Woodside Energy drilled one production well on the Xena gas field in the Carnarvon Basin, which is part of the Pluto project.
  - Two appraisal wells were drilled at the Walyering discovery (Walyering-5 in November/December 2021 and Walyering-6 in May 2022). The resources were independently certified at 54 PJ in July and the field was sanctioned for development in August.
  - Further testing was carried out on West Erregulla-3 in June 2022. This led to the independent reserves estimate being increased from 300 PJ to 422 PJ.
  - Mineral Resources tested the Lockyer Deep well in the Perth Basin in March 2022. The well achieved a maximum sustained flow rate of 102 million standard cubic feet per day, with junior partner Norwest Energy stating that the resource estimate "significantly exceeds pre-drill expectations" of 1.1 trillion cubic feet (around 1,150 PJ). Appraisal drilling has not yet been undertaken.
  - In April 2022, Santos' offshore Apus well, targeting both oil and gas close to Dorado in the Bedout Sub-Basin, came in dry.

[11] Full references for this chapter are provided in Appendix A1.

   - Western Gas drilled the offshore Sasanof well in the Carnarvon Basin in June 2022, with no hydrocarbons found.
- Santos Limited signed a new five-year gas supply deal with Yara Pilbara Fertilisers to supply approximately 120 PJ of natural gas to Yara's liquid ammonia plant, starting from 2023.
- Woodside Energy received approval from the EPA to extend operations at the North West Shelf Project to 2070.

Further information on supply projects is detailed in Chapter 3.

1.2 Infrastructure developments

- In December 2021, Clean Energy Fuels Australia's (CEFA's) LNG facility at Mt Magnet was brought online. Gas is sourced from the Waitsia joint venture. This is the third small-scale LNG plant in WA supplying LNG to off-grid consumers.
- In March 2022, the Pluto-Karratha Gas Plant (KGP) interconnector linking Pluto LNG and the KGP commenced operation. This has enabled Pluto gas to be liquefied at the KGP and also facilitated additional domestic gas supply from the KGP.

1.3 Demand projects – announced or updated

Numerous projects that may impact gas use have been announced since the publication of the 2021 WA GSOO, including gas generation, renewables, and minerals processing projects. The majority of those that could increase gas use are gas generators in the mining sector.

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

The following projects commenced operations:

- In December 2021, the 60 megawatt (MW) Alinta Energy Chichester Solar Gas Hybrid Project was completed.
- In May 2022, Horizon Power and Pacific Energy completed the Esperance Power Project and opened the Shark Lake Renewables Hub in Esperance. This integrated power system includes renewable generation, a battery energy storage system (BESS) and a 22 MW high-efficiency gas power station. The hub is expected to generate around 46% of electricity in Esperance, replacing gas generation.
- In May 2022, Tianqi Lithium Energy Australia and IGO Limited started production of battery-grade lithium in their 24,000 tonnes a year Kwinana plant.
- Mineral Resources and Albemarle restarted operations at Wodgina Lithium Mine. The first spodumene concentrate from Train 1 was delivered in May 2022 while Train 2 was restarted in the third quarter of 2022.
- In the second quarter of 2022, Lynas Rare Earths began construction of the Kalgoorlie Rare Earths Processing Facility near Kalgoorlie that will use the existing gas and power supplies.
- In July 2022, Kalium Lakes Limited started production of Sulphate of Potash (SOP) from its Beyondie SOP Mine to CSBP Fertilisers. Production is expected to reach capacity by March 2023.
- In July 2022, Albemarle Corporation and Mineral Resources commissioned Train 1 of the Kemerton lithium refinery and expects to start production with Train 2 in the first half of 2023.

The following projects were announced:

- In April 2022, Iluka Resources took a final investment decision (FID) on the Eneabba rare earths refinery phase 3 project. It is expected to start production in 2025 with an annual capacity of 17,500 tonnes of rare earth oxide. Natural gas will be provided from the existing gas network pipeline connection.
- Rio Tinto and China Baowu Steel Group Co. announced the Western Range iron ore project in the Pilbara, with production capacity of 25 million tonnes per annum (mtpa) to sustain production of the Pilbara Blend from Paraburdoo mining hub. The mine is expected to begin construction in 2023 and production in 2025, with plans to upgrade using hydrogen gas and gas turbines.
- In June 2022, Kathleen Valley Lithium Project achieved FID with expected production start in 2024, initially with a capacity of 2.5 mtpa and a total annual capacity of approximately 500,000 tonnes of lithium oxide concentrate.
- Mineral Resources announced an expansion of Mt Marion mine in June 2022 to increase annual production capacity to 900,000 tonnes in 2023.

Upcoming projects that made progress include:

- Bellevue Gold is developing an underground gold mine at the Bellevue Gold Project with the first gold pour planned in 2023. The investment decision was secured in April 2022.
- Fortescue Metal Group anticipated first production of iron ore from its Iron Bridge mine in early 2023 with first ore feed into its processing plant in October 2022.

Renewable projects expected to reduce gas demand that were announced or progressed include:

- In April 2022, BHP signed a 12-year renewable power purchase agreement (PPA) with Enel Green Power to supply the total power requirements for Nickel West’s Kalgoorlie Nickel Smelter and Kambalda Nickel Concentrator from the Flat Rocks Wind Farm, with an annual capacity of 315 gigawatt hours. Power generation is expected to start in October 2023. This replaces electricity from gas generation.
- In April 2022, the State Government's Clean Energy Future Fund awarded an $11 million grant to seven regional renewable projects, supporting the transition to renewable energy sources for projects traditionally reliant on gas or diesel generation.
- Woodside Energy proposed a 500 MW solar facility with 400 megawatt hours (MWh) of battery storage to supply electricity to the Pluto LNG facility, the proposed Perdaman Urea Plant, and customers connected to the North West Interconnected System (NWIS). Electricity from the facility will replace gas used to generate power at both Pluto and in the NWIS.
- In June 2022, Nomadic Energy's pioneer project, the 5 MW re-deployable solar, was installed at Northern Star's Carosue Dam gold mine near Kalgoorlie, supplying energy for the mine and displacing diesel and natural gas use.
- In June 2022, BP became the operator of the, recently re-named Australian Renewable Energy Hub, with an updated plan of generating and converting 26 gigawatts (GW) of renewable electricity to approximately 1.6 million tonnes of hydrogen annually. Production is proposed to begin from 2025 with a plan to reserve 3 GW of the generated electricity for local use, displacing the current diesel, petrol, and gas usage as a primary resource for industry in the Pilbara region.

- In July 2022, BHP began installation of a 10.7 MW solar farm and 10.1 MW battery at BHP Nickel West's Northern Goldfields Solar Project that is expected to be operational by the end of 2022, swapping out diesel and gas power for solar and storage.
- In August 2022, the transition from reticulated gas to electricity started as part of Horizon Power's Esperance Energy Transition Plan, aiming to convert 379 reticulated gas customers to alternative energy by March 2023. The State Government committed $10.5 million in the 2022-23 State Budget to support impacted households and businesses.
- In the second quarter of 2022, Gruyere Mine Power Expansion came online, including a 13 MW solar farm and 4.4 MW BESS, supplementing the existing gas generation.
- In September 2022, Neoen announced the staged development of a South West Interconnected System (SWIS) connected BESS with a total capacity of 1,000 MW/4,000 MWh in Collie. This could replace gas generation during peak electricity demand periods.
- In November 2022, Rio Tinto announced the construction of two 100 MW solar power facilities and 200 MWh of on-grid battery storage in the Pilbara by 2026.

Further information on demand projects is provided in Chapter 3.

1.4 Hydrogen

The WA Government has indicated its commitment to develop the hydrogen industry since 2019, when it released the WA Renewable Hydrogen Strategy. 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 focus on producing hydrogen for the transport, mining, and export sectors. 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 2022 WA GSOO forecasts presented in Chapters 3 and 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.

Key initiatives announced in 2022 include:

- In January 2022, the WA Government opened a geothermal acreage release that covers more than 81,900 square kilometres of prospective areas including the Perth Basin, Canning Basin, South-West and Pilbara regions. This provides an opportunity for successful bidders to invest in geothermal exploration within the specified title for six years.
- In June 2022, the WA Government committed an additional $900 million to a Climate Action Fund, an Investment Attraction Plan and an Industrial Land fund to release strategic industrial sites and for investments in renewable energy and future climate related initiatives.
- In August 2022, the WA Government committed a grant of $10 million to Woodside Energy's proposed Hydrogen Refueller at its H2Perth project, with an initial daily production capacity of 235 kilograms of green hydrogen using a 2 MW electrolyser. The public refuelling stations are expected to commence operating in late 2024.
- In October 2022, an additional investment of the WA Government's $5.5 million grant was awarded to feasibility and planning works for the hydrogen hub in Geraldton, the Oakajee Strategic Industrial Area (SIA).

- In October 2022, the WA commenced consultation on the design of a Renewable Hydrogen Target, to require a percentage of electricity in the SWIS to be produced from renewable hydrogen.

Hydrogen projects that were announced or progressed since the 2021 WA GSOO include:

- In January 2022, the Australian Gas Infrastructure Group completed a feasibility study into preparing the DBNGP as critical support infrastructure for WA's emerging hydrogen industry, which determined that the pipeline could support up to 9% hydrogen blend.
- In January 2022, Arrowsmith Hydrogen Plant announced it will take FID in late 2022 for its production of up to 23 tonnes of green hydrogen using 65 MW of solar, 132 MW of wind, and 110 MW of battery storage, expected to come online in 2025.
- In March 2022, Infinite Green Energy acquired Northam solar farm to leverage the existing 11 MW solar farm with an additional 10 MW hydrogen electrolyser and battery storage for the green hydrogen MEG HP1 project. It is anticipated to be operational in the fourth quarter of 2023 with a daily production capacity of 4 tonnes of renewable hydrogen.
- In May 2022, a plan for the Murchison Hydrogen Renewables project was filed with WA's Environment Protection Authority to use 3.7 GW of wind and 1.5 GW of solar photovoltaics for producing renewable hydrogen. This will be used to manufacture approximately 2 million tonnes per annum of green ammonia for domestic and export markets. The project aims to produce hydrogen for transport fuels and for blending with natural gas in the DBNGP.
- ATCO progressed towards FID for its Clean Energy Innovation Park, which is co-located with the 180 MW Warradarge Wind Farm and planned to produce up to 4.3 tonnes per day of renewable hydrogen. The generated hydrogen will be used for industry, transport and blending into WA's gas distribution network.
- In June 2022, Hazer Group Limited signed an agreement with Water Corporation for construction and operation of a Hydrogen Commercial Demonstration Plant at its Woodman Point Wastewater Treatment Plant in Munster, which will produce low emissions hydrogen and synthetic graphite using biogas from methane feedstock.
- In August 2022, the Kwinana Energy Transformation Hub, with a daily production capacity of 800 kilograms of hydrogen and 10 tonnes of small-scale LNG, entered its Front-End Engineering and Design stage. The facility is expected to be operational by early 2025 with the aim of taking FID by the end of 2022.
- In September 2022, Yara Pilbara Fertiliser and ENGIE announced FID for the Yuri Project with an annual production capacity of 640 tonnes of renewable hydrogen.

1.5 Regulatory update

In July 2022, the Economic Regulation Authority (ERA) published an updated gas access arrangement guideline that covers the procedural matters related to access arrangements. This falls within the framework for the economic regulation of gas pipelines within WA and the role of the ERA in administering this regulatory scheme.

In September 2022, ATCO Australia submitted a reference service proposal for the Mid-West and South-West Gas Distribution Systems. As a regulated gas network, this required an approved access arrangement. The ERA is scheduled to publish the reference service proposal decision by 1 March 2023. This will set out the terms, conditions and prices under which third party users can access some pipeline services through the gas distribution system.

From 1 December 2022, the Gas Services Information (GSI) Rules require registered production facility operators to provide data to AEMO on the volume of LNG that is transported from their facilities by road tanker. AEMO will publish these gas volumes on the Gas Bulletin Board (GBB).

2 Supply demand balance

Domestic gas demand is forecast to exceed potential gas supply in all three scenarios. Both the Base and the Low scenarios forecast a brief return to surplus in the late 2020s, while the High scenario indicates a supply gap throughout the outlook period. This chapter outlines risks to the forecasts and provides options to alleviate the projected shortfalls.

2.1 Base scenario

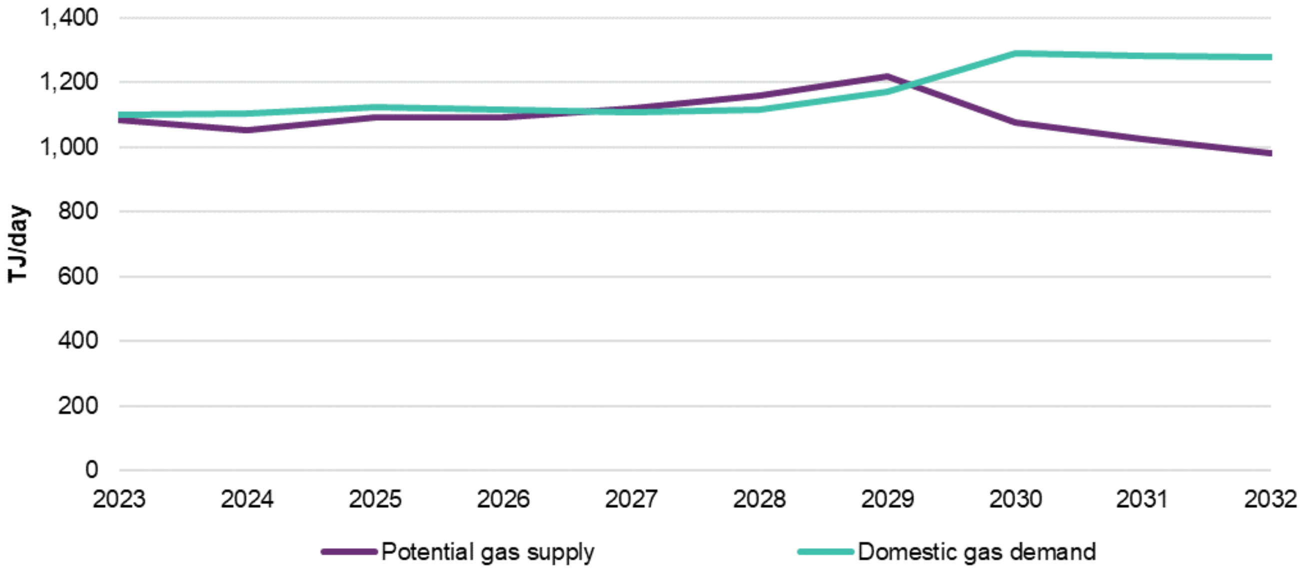
As shown in Figure 3 and Table 3, based on forecast demand and committed and expected new supply sources, the WA domestic gas market is expected to be tightly balanced through to 2029.

Between 2023 and 2026, demand is expected to exceed supply by a total of 45 PJ, with shortfalls forecast to peak at 4.5% of demand in 2024. The expected commencement of Scarborough (180 TJ/day) in mid-2027 is projected to be sufficient to return the market to surplus until 2029. From 2030, the increase in gas required for power generation following the expected retirements of coal-fired generation in the SWIS is projected to result in a deficit of up to 296 TJ/day by 2032.

Table 3 Potential domestic gas supply and demand forecasts, Base scenario (TJ/day), 2023 to 2032

	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	5-year annual average growth rate	10-year annual average growth rate
Potential gas supply	1,084	1,053	1,090	1,091	1,121	1,158	1,219	1,077	1,025	982	1.3%	-1.1%
Domestic gas demand	1,099	1,103	1,123	1,117	1,107	1,115	1,171	1,290	1,284	1,278	0.3%	1.7%
Difference	-15	-49	-33	-26	14	42	48	-213	-258	-296	-	-
Difference as % of demand	-1.4%	-4.5%	-2.9%	-2.4%	1.3%	3.8%	4.1%	-16.5%	-20.1%	-23.1%	-	-

Figure 3 Base scenario forecast supply demand balance, 2023 to 2032



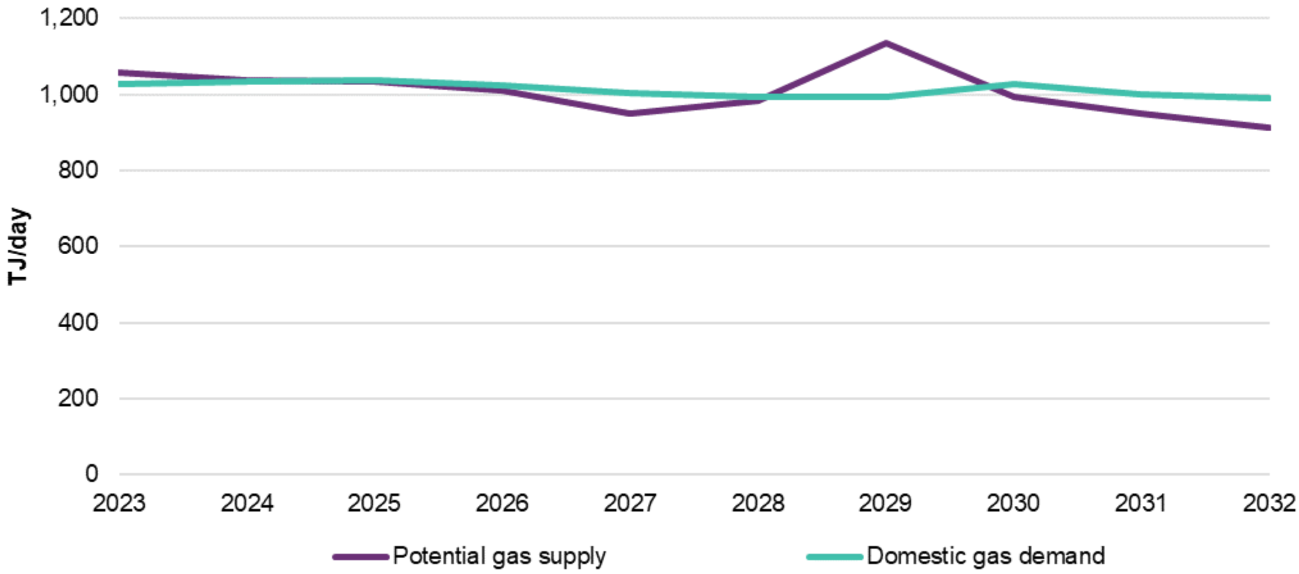
2.2 Low scenario

The Low scenario includes only existing and committed gas supply and demand sources and therefore represents a conservative forecast. Both supply and demand forecasts are lower than the Base scenario. Potential gas supply is forecast to decline at an average annual rate of 1.6% over the outlook period, in line with reserve depletion at existing production facilities (see Table 4 and Figure 4). This produces a potential supply gap from 2025 onward, with a brief period of oversupply in 2029 as Scarborough is brought online.

Table 4 Potential domestic gas supply and demand forecasts, Low scenario (TJ/day), 2023 to 2032

	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	5-year annual average growth rate	10-year annual average growth rate
Potential gas supply	1,059	1,038	1,035	1,012	951	983	1,134	992	949	913	-1.5%	-1.6%
Domestic gas demand	1,028	1,035	1,039	1,023	1,003	992	993	1,028	1,000	990	-0.7%	-0.4%
Difference	31	4	-4	-12	-51	-9	141	-36	-51	-77	-	-
Difference as % of demand	3.0%	0.4%	-0.4%	-1.2%	-5.1%	-0.9%	14.2%	-3.5%	-5.1%	-7.8%	-	-

Figure 4 Low scenario forecast supply demand balance, 2023 to 2032



2.3 High scenario

The High scenario includes all projects in the Base scenario, and adds prospective supply and demand sources, including backfill for existing production facilities. AEMO has included an assumption that the Bluewaters power station closes in mid-2023 due to coal supply issues. Should this happen, it will lead to higher gas demand from SWIS gas generation earlier in the outlook period in this scenario[12].

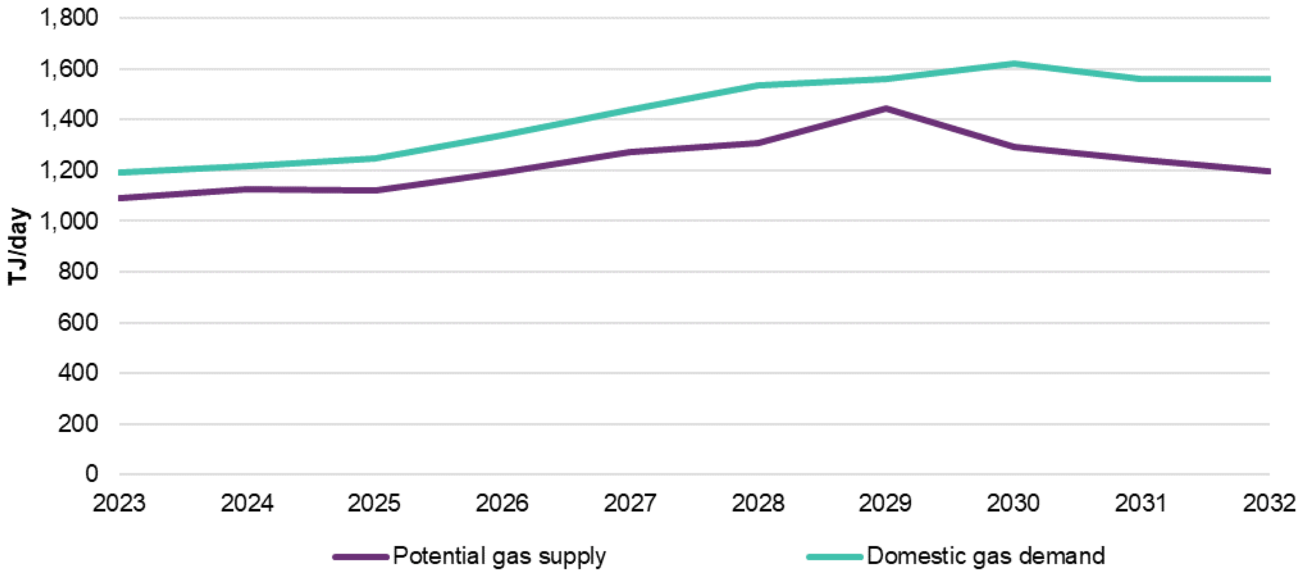
Demand exceeds supply for the entire outlook period under the High scenario (see Table 5 and Figure 5). The scale of the shortfall is much greater than in the Base scenario, totalling 728 PJ and exceeding 100 TJ/day in nine of the ten years.

Table 5 Potential domestic gas supply and demand forecasts, High scenario (TJ/day), 2023 to 2032

	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	5-year annual average growth rate	10-year annual average growth rate
Potential gas supply	1,089	1,126	1,119	1,193	1,273	1,307	1,444	1,293	1,242	1,195	3.7%	1.0%
Domestic gas demand	1,192	1,215	1,248	1,338	1,439	1,535	1,563	1,620	1,563	1,561	5.2%	3.0%
Difference	-103	-89	-129	-145	-166	-228	-120	-327	-321	-366	-	-
Difference as % of demand	-8.7%	-7.3%	-10.3%	-10.8%	-11.5%	-14.9%	-7.7%	-20.2%	-20.6%	-23.5%	-	-

[12] See: *Gas generation forecast modelling 2022*, authored by Robinson Bowmaker Paul and published as part of this GSOO.

Figure 5 High scenario forecast supply demand balance, 2023 to 2032



2.4 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 withdrawn from storage at up to 210 TJ/day, subject to the quantity of gas in storage at the time[13] and the duration of the requirement. Existing production facilities may also be able to supply small additional volumes of gas.
- In the longer term, additional supply could be sourced from:
  - Backfill projects at existing facilities, such as Corvus, Kultarr or Spar Deep being developed through the Varanus Island infrastructure.
  - Undeveloped gas fields such as Lockyer Deep and South Erregulla being developed as greenfield projects.
  - Successful exploration leading to additional backfill opportunities at existing production facilities.

2.5 Risks to the forecasts

Between 2023 and 2026, 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 was to experience an unexpected interruption, there could be an immediate but short-term supply shortfall. Line packing of the 1,500 km DBNGP, plus the Mondarra and Tubridgi storage facilities, may provide limited additional flexibility.

[13] There was 49 PJ of gas in storage in October 2022 based on data from AEMO's WA Gas Bulletin Board.

- **Coal supply** – the domestic gas market could be pushed further into deficit if coal supply continues to be restricted, leading to an increase in demand for gas generation. AEMO is closely monitoring the coal supply situation in WA.
- **Additional gas demand** – the Perdaman urea project (125 TJ/day of gas demand from 2026), which has been excluded from the Base scenario forecast, may take FID in the next 12 months. In addition, Woodside has proposed H2Perth[14], 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[15] near Dongara, which would be supplied from the proposed South Erregulla gas field development. Any of these (or other) projects going ahead would put further pressure on gas demand, potentially increasing the forecast shortfall.
- **New gas supply projects** – new gas supply projects could be delayed, exacerbating forecast supply shortfalls. Conversely, if lead times shorten, new supply projects may commence earlier than forecast, alleviating supply shortfalls. 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 destruction**[16] – gas price-sensitive industries could choose to cease operations if gas is not available at competitive prices.
- **Gas substitution** – there are several projects under construction or proposed that could reduce gas demand. For example, BHP is 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[17]. In addition, Fortescue Metals Group has set a target of zero emissions by 2030 from its operations[18], 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.

[14] See https://www.woodside.com/what-we-do/new-energy/hydrogen.

[15] See https://strikeenergy.com.au/project-haber/.

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

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

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

3 Gas demand

In the Base scenario, WA domestic gas demand is forecast to increase from 1,099 TJ/day in 2023 to 1,278 TJ/day in 2032 at an average annual rate of 1.7%, with contributions to growth from:

- SWIS electricity generation gas demand, which is forecast to grow from 127 TJ/day in 2023 to 304 TJ/day in 2032, as coal power station retirements are only partially replaced by renewables, creating more demand for gas.
- Committed new resources projects, which are expected to add 43 TJ/day to gas demand by 2026.

Decarbonisation plans show a marked increase from the 2021 WA GSOO, particularly in the mining sector. In iron ore mining, gas demand is forecast to decrease, with gas usage expected to drop from 157 TJ/day in 2023 to 107 TJ/day by 2032, despite forecast increasing production.

All data in this chapter is presented in calendar years unless otherwise stated.

3.1 Historical WA domestic gas demand

3.1.1 Overview

WA's unique combination of geographic isolation and very large gas resources provides a backdrop for remotely located LNG developments. WA Government policy promoted the development of gas fields in the North West Shelf (NWS)[19] area during the 1980s. The 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 is characterised by:

- Large gas reserves that are mostly located offshore and developed mainly 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.
- Residential, commercial, and small industrial consumers comprising around 15% of total demand.
- Small volumes of short-term and spot gas sales.
- A small number of pipelines and interconnectors, with limited surplus pipeline capacity.
- Limited information about supply that is available to be contracted, potential buyers, and gas contract pricing.

[19] The NWS as used in this GSOO refers to the group of gas fields tied back to the Karratha Gas Plant and includes, inter alia, the Goodwyn, North Rankin, Perseus and Angel fields.

- Total gas storage capacity of 78 PJ, which can receive up to 150 TJ/day and supply up to 210 TJ/day.

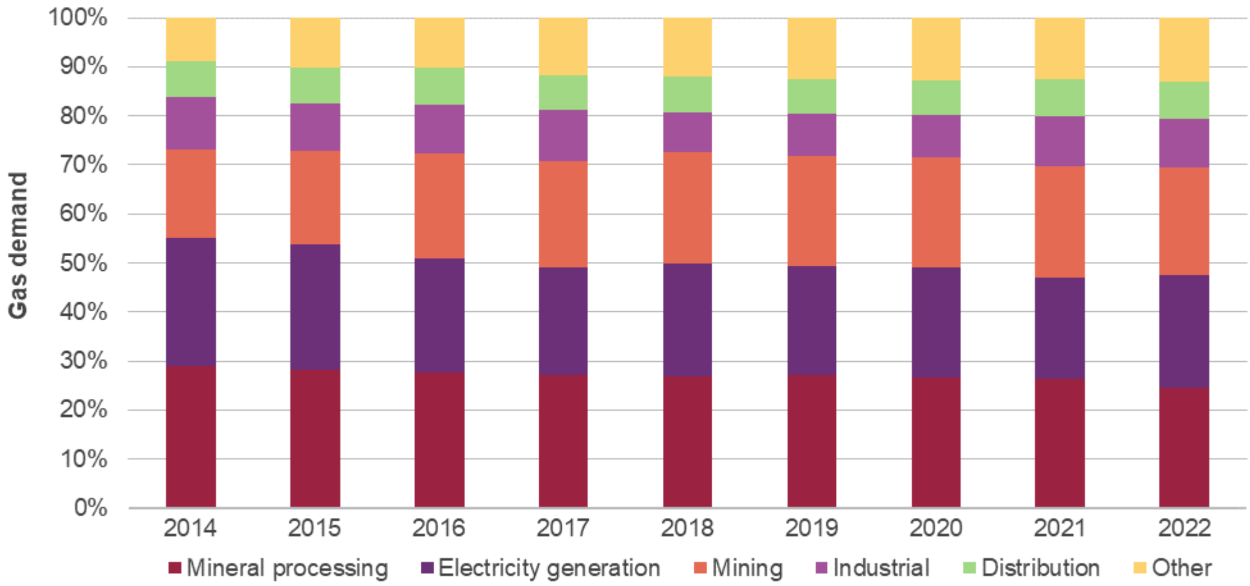
3.1.2 Historical domestic gas demand by usage category

WA Gas Bulletin Board (GBB)[20] data classifies WA's gas demand by the following major usage categories:

- Minerals processing.
- Mining.
- Electricity generation (SWIS[21] and non-SWIS).
- Industrial (major users such as ammonia and fertiliser manufacturers).
- Retail distribution network.
- Others[22].

Most large customers[23] are supplied directly through the transmission network (such as the DBNGP and the Goldfields Gas Pipeline [GGP]) and account for 84% of WA's total domestic gas demand (see Figure 6). Customers supplied through the retail distribution network accounted for only 7% of total gas demand in 2022[24]. Of the large customers, minerals processing (29%), electricity generation (27%), and mining (26%) have the largest shares, while industrial (12%) and other[25] (5%) make up the remainder.

Figure 6 Domestic gas demand by usage category, 2014 to 2022



Note: Annual average of gas demand for 2022 is based on data until 14 November 2022.

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

[21] 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).

[22] The Other category is related to all connection points that are not associated with production or storage facilities, large-users, or interconnecting pipelines, hence, they are not registered on the GBB.

[23] 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) and industrial.

[24] Based on WA GBB data until 11 November 2022.

[25] The majority of Other are mining and industrial.

Source: WA GBB

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, Base, and High. These scenarios reflect variations in the economic outlook, commodity production, gas prices, and population growth (see Appendix A3 for more information on scenario assumptions).

For the 2022 WA GSOO, AEMO continues to exclude hydrogen from the gas demand forecast. Hydrogen is not expected to impact the wholesale gas market during the outlook period, as most green hydrogen projects focus on transport (replacing diesel) and export markets. The WA Renewable Hydrogen Strategy[26] aims to have a 10% blend of hydrogen in the domestic gas distribution network by 2030. However, the distribution network accounts for less than 8% of gas use in WA and a 10% hydrogen blend would displace just 8 TJ/day.

Proposed hydrogen projects are all at an early planning stage, with none reaching the certainty threshold to be included in either the Base or High scenarios (see Appendix A3.2 for criteria).

Committed new projects

Six[27] committed mining and minerals processing projects are forecast to contribute an additional net 43 TJ/day to demand by 2026[28]:

- Bellevue Gold Project is expected to commence production in the second half of 2023[29].
- Covalent Lithium's Kwinana lithium hydroxide refinery is expected to commence operations in the second half of 2024[30].
- First production from Fortescue Metals Group's Iron Bridge (stage two) is expected in March 2023[31].
- First production from the Kathleen Valley Lithium Project is expected in the second quarter of 2024[32].
- Mineral Resources' restart of the Wodgina spodumene mine is expected to have a third train from mid-2023[33].
- BHP Nickel West's Northern Goldfields Solar Project, which will reduce gas demand at its northern Goldfields Nickel operations, is scheduled to be completed by the second quarter of 2023, consisting of a 27.4 MW solar farm at Mount Keith, and a 10.7 MW solar farm and 10.1 MW battery at Leinster[34].

[26] See https://www.wa.gov.au/government/publications/western-australian-renewable-hydrogen-strategy-and-roadmap.

[27] The 2021 WA GSOO included 15 committed projects.

[28] This list only includes committed projects that have yet to establish a connection point. Projects that already have not yet reach its capacity but already have estimated a connection point are considered as existing. Note that this definition introduced in the current GSOO.

[29] See https://wcsecure.weblink.com.au/pdf/BGL/02549015.pdf.

[30] See https://wesfarmers.gcs-web.com/static-files/6fb0ff83-6929-4068-97eb-2d752e4ccd4b/.

[31] See https://www.fmgl.com.au/about-fortescue/our-operations.

[32] See https://www.ltresources.com.au/projects/kathleen-valley.

[33] See https://clients3.weblink.com.au/pdf/MIN/02559896.pdf.

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

Gas generation demand

Scenario assumptions specific to gas generation in the SWIS are dependent on the electricity demand forecasts presented in the 2022 Wholesale Electricity Market (WEM) *Electricity Statement of Opportunities* (ESOO)[35], as well as the expected generation mix in the SWIS over the outlook period.

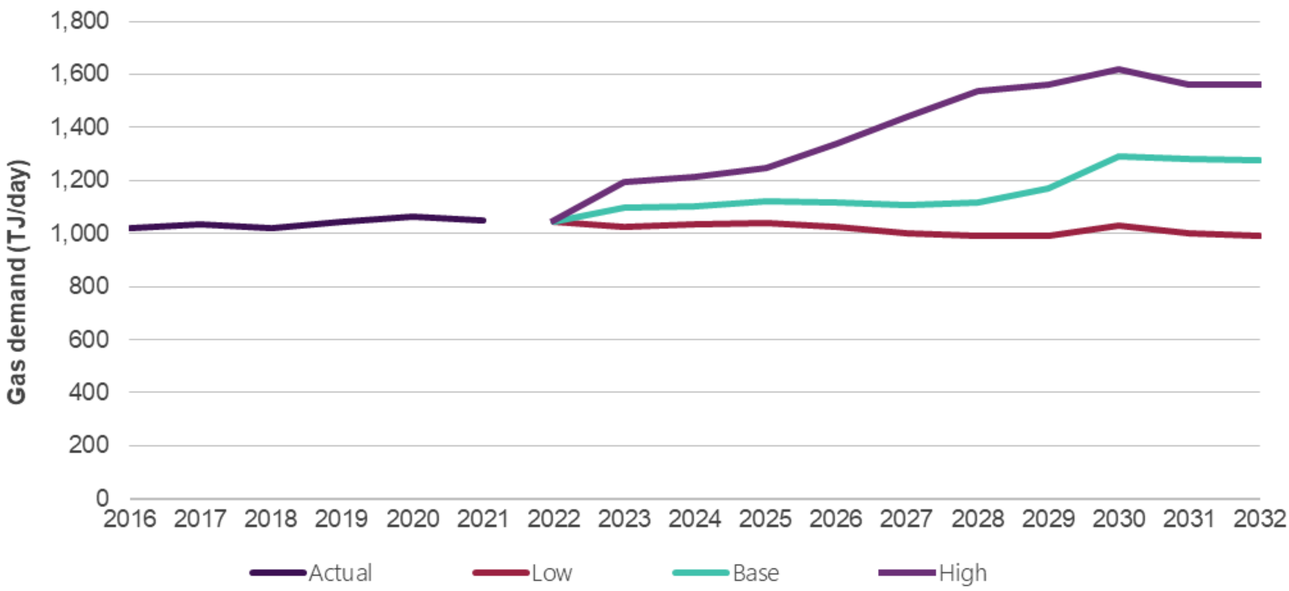
In all scenarios, non-SWIS gas generation (including towns serviced by Horizon Power, but excluding gas generation used for mining) represents roughly 27% of total gas generation (4.3% of total domestic gas demand) at the start of the forecast period. Non-SWIS gas generation demand is expected to be relatively stable as limited growth in the non-SWIS area is expected. Further discussion on the projected outlook for individual gas use sectors is provided in Section 3.3.3.

Further information relating to the methodology and assumptions underpinning the gas generation and gas demand scenarios is in Appendix A3 and in the supporting reports entitled *Commodity Forecasts for Western Australia to 2032* report prepared by the National Institute of Economic and Industry Research and the *Gas Powered Generation Forecast Modelling 2022 – Final Report* prepared by Robinson Bowmaker Paul[36].

3.2.2 Domestic gas demand forecasts by scenario

Figure 7 presents the domestic gas demand forecasts under the Low, Base, and High scenarios.

Figure 7 Domestic gas demand – actual data from 2016 to 2021 and forecast under three growth scenarios from 2022 to 2032



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

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

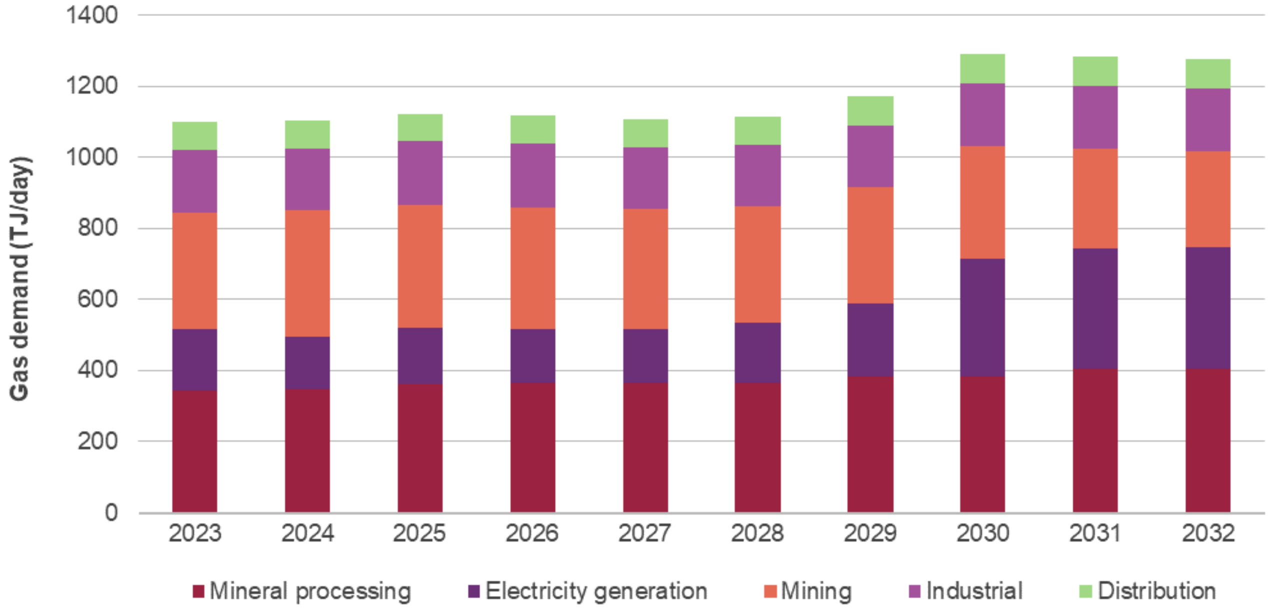
In summary, over the outlook period:

- In the Low scenario, domestic gas demand is forecast to decline at an average annual rate of 0.4%. Compared to the Base scenario, the Low scenario reflects a weaker commodity outlook which drives lower gas demand in both the mining and industrial sectors.
- In the Base scenario, total domestic gas demand is forecast to grow at an average annual rate of 1.7%, driven by growth in electricity generation (7.7%) and minerals processing (1.8%), partially offset by declining demand in the mining sector (-2.0%) – see Section 3.2.3 for further information.
- In the High scenario, domestic gas demand is forecast to grow at an average annual rate of 3.0%. Compared to the Base scenario, the High scenario includes seven prospective demand projects that could add up to 216 TJ/day by 2028.

3.2.3 Domestic gas demand forecasts by usage category

WA domestic gas demand has been split into five usage categories[37] in accordance with the GBB and as outlined in Section 3.1.2. To assist with modelling, projects in the "others" category have been allocated into five usage categories. The breakdown of the Base scenario into these five categories is shown in Figure 8.

Figure 8 Domestic gas demand forecasts by usage category, Base scenario, 2023 to 2032



[37] Usage categories are defined in this way because each category is affected by different external and internal influences. Appendix A6 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.

Drivers of trends in the different sectors are:

- Gas demand for electricity generation is forecast to grow at an average annual rate of 7.7%[38] across the outlook period. Since the 2021 WA GSOO, the gas generation profile has changed markedly, due to Synergy's announcement of the scheduled closure of all its remaining coal-fired generators within the outlook period[39]. Overall, the forecast for gas generation shows the following:
  - The forecast for 2023 is similar to the 2021 WA GSOO forecast, as high gas prices (reducing gas generation) are counteracted by a potential coal shortage (which increases gas generation). AEMO has assumed that the potential coal shortage will be resolved by the end of March 2023, leading to a slightly lower gas generation forecast from 2024 due to higher gas price assumptions.
- From 2028, the impact of coal generation retirements starts dominating the forecast. AEMO's modelling forecasts that increasing renewables penetration will be insufficient to fully compensate for the loss of coal-fired baseload power and gas generation is forecast to increase to complement the generation provided by renewables.
- In the mineral processing sector, gas demand is forecast to increase at an average annual rate of 1.9% across the outlook period. This is higher than an average annual rate of 0.7% stated in the 2021 WA GSOO, due to an increase in gas demand at existing refineries, including South32's Worsley, which is forecast to partially transition from coal to gas during the outlook period[40].
- In the mining sector, gas demand is projected to decline at an average annual rate of 2.0% over the outlook period, compared with an average annual increase of 1.7% in the 2021 WA GSOO. Decarbonisation targets in the iron ore sector (identified through the FIR process) will contribute most of this projected decrease[41]. Gas use in iron ore mining is expected to drop from 157 TJ/day in 2023 to 107 TJ/day in 2032, despite increasing production. This decarbonisation trend is also observed in other commodities such as gold and nickel (for example, BHP's Nickel West Northern Goldfields Solar Project) but to a lesser extent.
- Gas demand in the industrial sector is forecast to remain flat over the outlook period, compared to a modest (0.3%) decline in the 2021 WA GSOO.
- Residential and small business connections are forecast to grow at an average annual rate of 0.8%, similar to the forecast in the 2021 WA GSOO (0.7%).

[38] Growth for the whole of WA. In the SWIS, gas generation demand grows from 127 TJ/day in 2023 to 304 TJ/day in 2032.

[39] In June 2022, Synergy announced that its remaining coal generators would be retired by the end of 2029, with Collie closing in 2027 and Muja units 7 and 8 closing in 2029. AEMO has assumed that Bluewaters power station retires at the same time as the Muja units. See https://www.synergy.net.au/About-us/News-and-announcements/Media-releases/State-owned-coal-power-stations-to-be-retired-by-2030.

[40] See https://www.south32.net/docs/default-source/all-financial-results/2022-annual-reporting-suite/sustainable-development-report-2022.pdf.

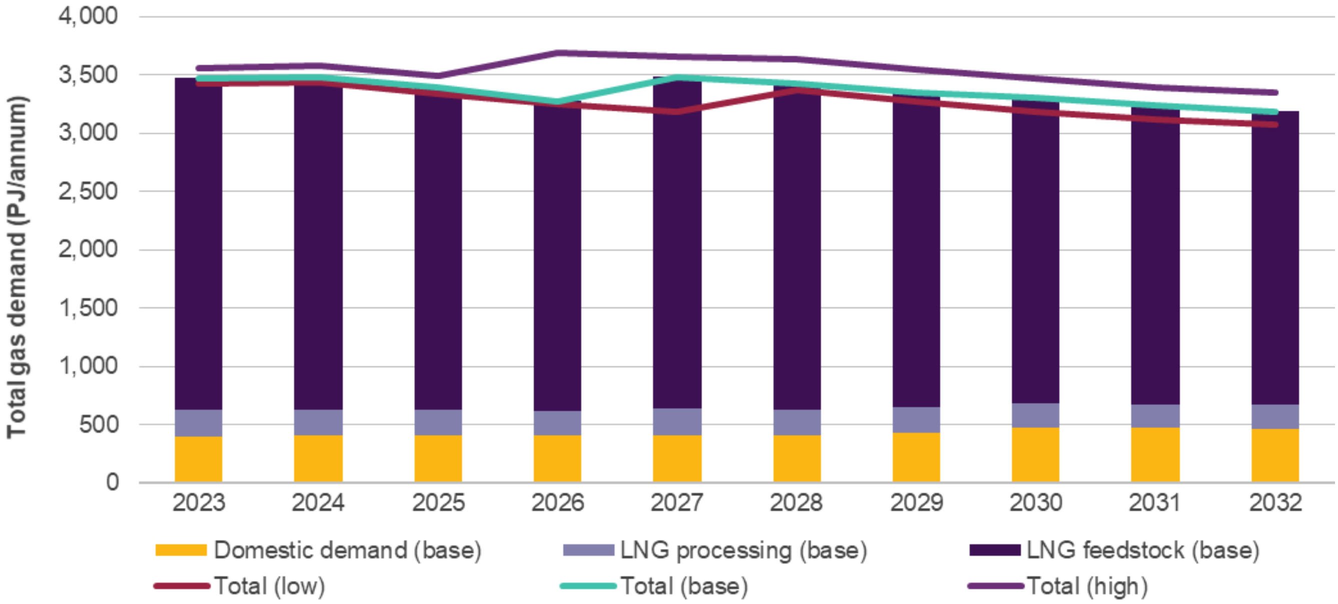
[41] See for example https://www.riotinto.com/news/releases/2021/Rio-Tinto-to-strengthen-performance-decarbonise-and-grow and https://www.fmgl.com.au/in-the-news/media-releases/2022/09/20/fortescue-announces-execution-plan-for-industry-leading-decarbonisation.

3.2.4 Total gas demand forecasts

Total gas demand is based on the assumptions outlined in Appendix A5 and is the aggregate of forecasts for domestic gas demand, LNG export feedstock, and gas used in LNG processing.

Figure 9 shows the total gas demand forecasts for the Low, Base, and High scenarios.

Figure 9 Total gas demand forecasts under the Low, Base, and High scenarios, 2023 to 2032



In summary:

- In the Low scenario, total gas demand is projected to decline at an average annual rate of 1.2% over the outlook period. This scenario assumes the KGP is backfilled by Waitsia Stage 2, with Scarborough added as an expansion of the Pluto LNG project from 2028. It illustrates a reduction in production for the KGP from 2022, as spare processing capacity emerges due to reserves depletion.
- In the Base scenario, total gas demand is projected to decline moderately at an average annual rate of 0.9% over the outlook period. Small projected increases in total gas demand starting from 2022, driven by backfill for the KGP from both Waitsia Stage 2 and expansion of Pluto, are insufficient to offset the depletion of reserves at the NWS fields. From 2027, despite additional gas from Scarborough, total gas demand falls as a result of further production decline at the NWS project.
- Compared to the Base scenario, the High scenario includes Gorgon producing at nameplate output (increasing from 14.7 mtpa to 15.6 mtpa), and earlier commencement of the Scarborough and Pluto train two projects (mid-2026 instead of mid-2027). This results in an average annual decline rate of 0.7% over the outlook period.

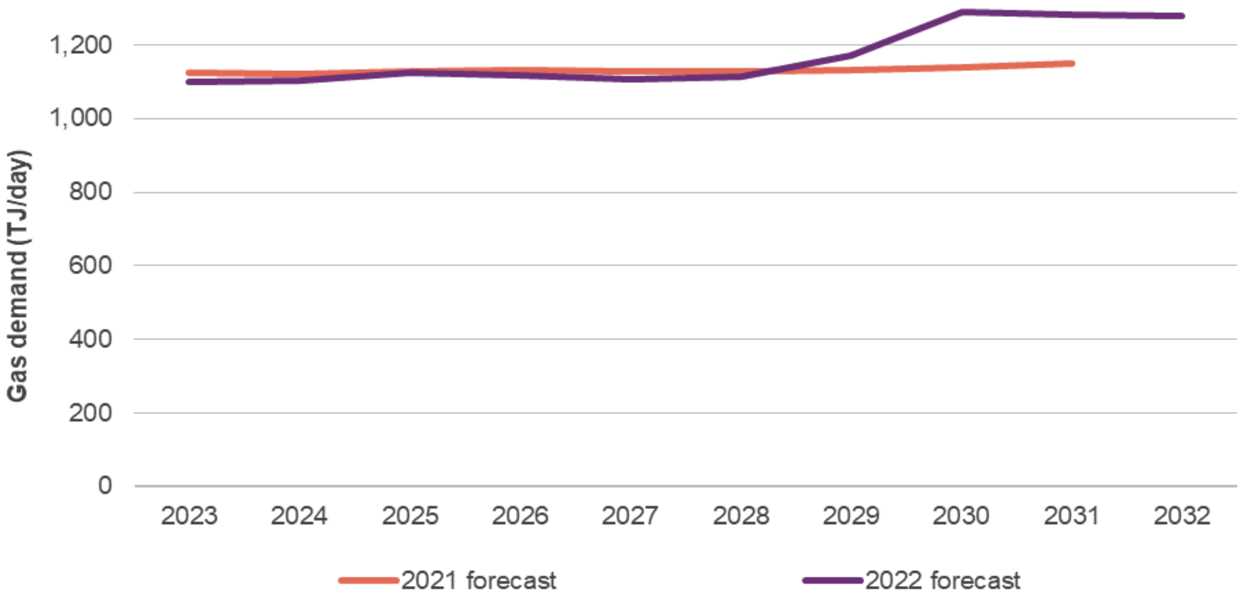
A further breakdown for total gas demand forecasts into domestic gas demand, LNG feedstock, and LNG processing for the Low, Base, and High scenarios is included in Appendix A3.

For the Base scenario, LNG feedstock and LNG processing are forecast to account for an average of around 81% and 6% of the total gas demand, respectively, throughout the outlook period, with domestic gas demand accounting for 13% of total gas demand.

3.3 WA domestic gas demand forecasts compared to 2021 WA GSOO

Figure 10 compares the Base scenario gas demand forecasts developed for the 2021 and 2022 WA GSOOs.

Figure 10 Comparison of 2021 and 2022 WA domestic gas demand forecasts, Base scenario, 2023 to 2032



The WA domestic gas demand forecasts presented in this 2022 WA GSOO are very similar to the 2021 WA GSOO up to 2028. However, from 2029 onward, the 2022 forecast for gas demand is significantly higher. The higher demand in the later years of the outlook period is largely due to additional gas generation being required to replace retiring coal-fired electricity generation (see Section 3.2.3).

3.4 Reconciliation of previous WA GSOO domestic gas demand forecasts

Reconciliation of previous WA GSOO domestic gas demand forecasts from the last five years against actual gas demand data sourced from the WA GBB is shown in Table 6. 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:

- Among the five years of forecasts considered, the percentage difference between the forecast and actual gas demand varies between -1.9% to 3.7%, with a tendency to over-forecast.
- Forecast accuracy has improved. The percentage difference between forecast and actual gas demand for the first forecast year shows an average absolute difference of less than 1.8% for 2020 and 2021, while it ranges between 1.2% and 2.4% for 2017, 2018, and 2019.

Table 6 Reconciliation of previous WA GSOO domestic gas demand forecasts (% deviance of forecast from actual)[A], 2018 to 2021

	2018 actual	2019 actual	2020 actual	2021 actual	2022 actual[B]	Average absolute % deviance
December 2017 GSOO forecast deviance (%)	2.8	1.3	-0.3	1.2	0.3	1.2
December 2018 GSOO forecast deviance (%)		2.5	1.0	3.2	2.8	2.4
December 2019 GSOO forecast deviance (%)			-1.9	1.4	3.7	2.3
December 2020 GSOO forecast deviance (%)				1.7	2.0	1.8
December 2021 GSOO forecast deviance (%)					1.2	1.2

A. Percentage difference is calculated as (forecast demand – actual demand)/actual demand. Negative means under-forecast while positive means over-forecast.
B. Using data from 1 January 2022 to 14 November 2022.

4 Gas supply

Potential gas supply is projected to decrease at an average annual rate of 1.1% over the outlook period. This decrease is driven by natural field depletion, plus the expected cessation of production from the Reindeer gas field (Devil Creek gas plant). This decline is partially offset by the development of the Spartan, Walyering, West Erregulla and Scarborough gas fields.

AEMO forecasts the potential availability of gas 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) under the WA Government's Domestic Gas policy, subject to processing capacity and gas reserves.

All data in this chapter is presented in calendar years unless otherwise stated.

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[42]. 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[43].
- 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[44].

Third-party estimates of WA total conventional gas resources[45] are summarised in Table 7. The increase in reserves is attributable to Woodside booking Scarborough as 2P reserves following the FID in November 2021.

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

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

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

[45] '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 A3.3.

Table 7 WA conventional and unconventional gas resources and reserves (PJ), August 2022[46]

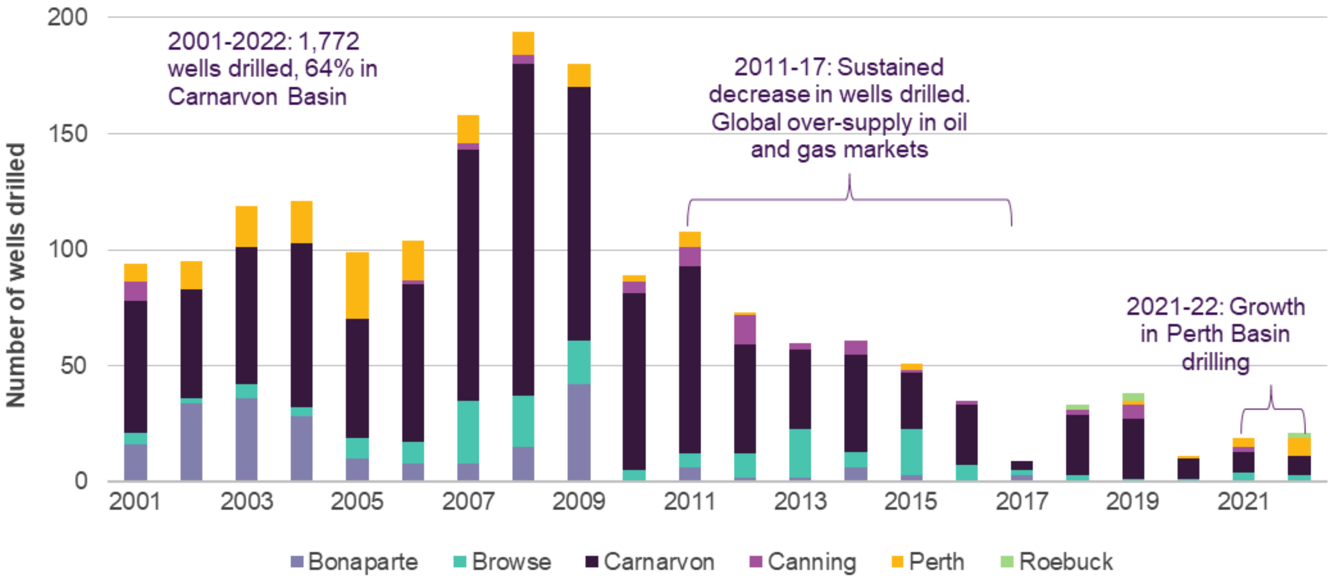
Type	2021	2022
Conventional 2P gas reserves	66,337	72,532
Conventional 2C gas resources	74,427	61,910

In addition to conventional gas, WA has unconventional gas resources (shale and tight gas), mostly located in the Canning and Perth Basins. Geoscience Australia has estimated that 438,599 PJ of shale gas could ultimately be recoverable from the Canning Basin[47]. 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 21 wells drilled so far in 2022 compared to 194 at the peak in 2008. The main area for development has been the Perth Basin, with 14 wells drilled over the last two years, as shown in Figure 11.

Figure 11 Exploration and development wells drilled, 2001 to 2022 (year to date)



Note: Data as at 21 November 2022. For source data, see http://www.ga.gov.au/nopims and https://wapims.dmp.wa.gov.au/WAPIMS/Search/Wells.

Domestic gas production is not expected from the Bonaparte, Browse, Canning or Roebuck Basins during the outlook period.

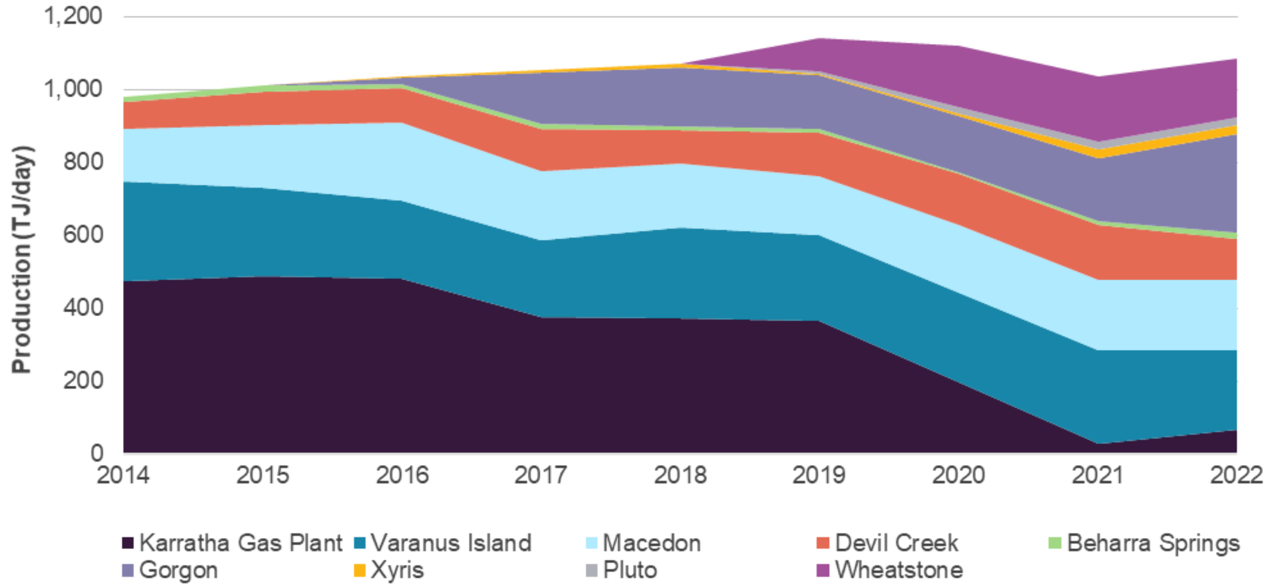
[46] See https://www.wa.gov.au/government/publications/western-australias-economy-and-international-trade.

[47] See https://www.ga.gov.au/digital-publication/aecr2021/gas.

4.1.3 Gas production

There are currently nine gas production facilities supplying the WA domestic gas market, with a total nameplate capacity of about 2,040 TJ/day[48]. The KGP maintains the largest nameplate capacity at 630 TJ/day.

Figure 12 Average annual gas production by facility, 2014 to 2022 (year to date, 31 October 2022)



Source: WA GBB

As shown in Figure 12, the following trends and events were observed between 2014[49] and 2022[50]:

- Since 2014, the gas supply sources in WA have become more diversified.
- DMO quantities[51] from Gorgon (2016), Pluto (2018) and Wheatstone (2019) started supplying the domestic gas market.
- Xyris Production Facility was expanded to 20 TJ/day in mid-2020[52] and 28 TJ/day in early 2021[53].
- In January 2022, Gorgon started supplying its second tranche of gas, taking its total capacity to 300 TJ/day[54].
- The KGP's market share declined from 48% in 2014 to 6% in 2022, although some production in 2022 has been sourced from the Pluto gas field via the Pluto-KGP interconnector.

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[48] The Dongara gas production facility has not operated since Q3 2017 and has therefore been excluded. The nameplate capacity values are shown in Appendix A3.3.3, along with gas production facility average production and capacity utilisations.

[49] 2014 is the first year for which a full year's set of GBB data is available for comparison.

[50] Year to date between 1 January 2022 and 31 October 2022.

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

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

[53] See https://yourir.info/resources/0c5a441cf54ff229/announcements/bpt.asx/2A1295285/BPT_Quarterly_report_for_the_period_ended_31_March_2021.pdf.

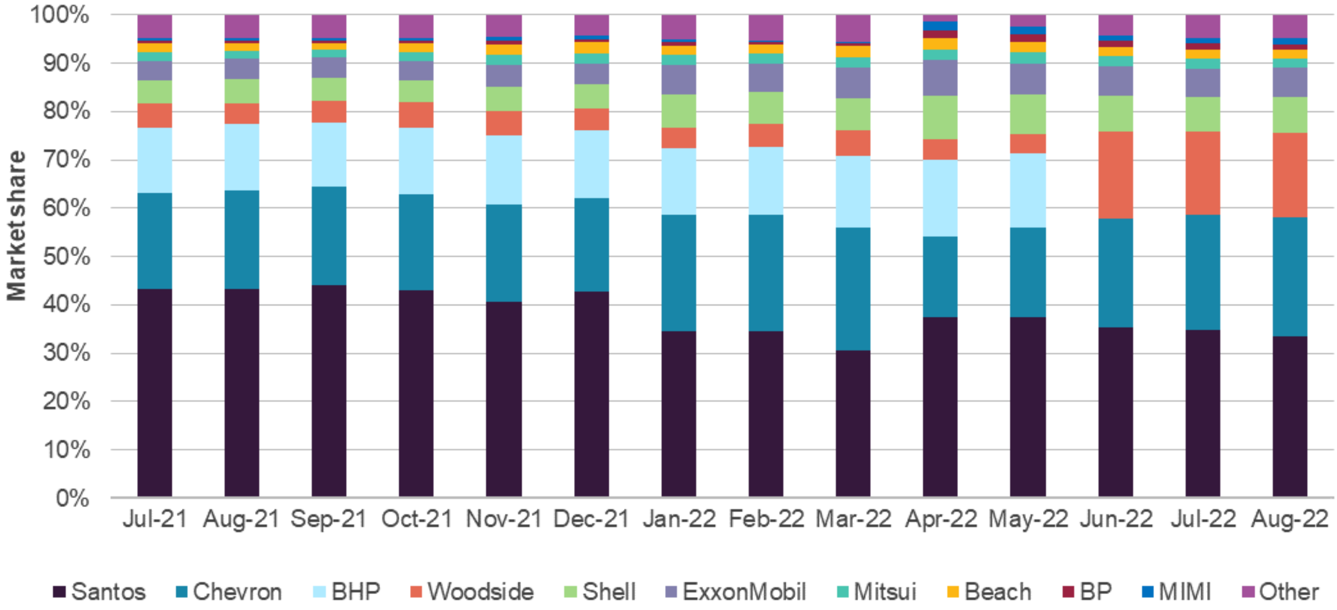
[54] See https://gbbwa.aemo.com.au/#capacities.

- The Beharra Springs Deep gas field was connected to the existing Beharra Springs gas production facility in early 2021[55], which has increased the facility's production from 6 TJ/day in 2020 to 20 TJ/day in 2022[56].

When comparing the average gas production market share by company (see Figure 13) for the 2021-22 financial year, Santos was the largest producer (39%), followed by Chevron (21%) and BHP (14%). In January 2022, stage 2 of the Gorgon project was brought online, resulting in Chevron, Shell and ExxonMobil increasing their market shares and Santos' market share declining from 43% in December 2021 to 34% in January 2022.

Woodside's merger with BHP Petroleum, effective 1 June 2022[57], increased Woodside's market share from 4% in May 2022 to 18% in June 2022.

Figure 13 Gas production market share by company, July 2021 to August 2022



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[58], and prospective projects[59] by including prospective projects when the forecast price (WA domestic gas price or Asian LNG price) exceeds production costs.

For further information about the methodology and features of the model, see Appendix A3.3.

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

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

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

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

[59] New projects that have not yet achieved FID and have not been excluded from the modelling for one of the reasons listed in Section 3.3.1.

4.2.1 Forecasting scenarios

AEMO developed potential gas supply forecasts for the Low, Base, and High scenarios for the outlook period. The input assumptions used in the three scenarios are:

- Domestic gas demand forecasts, domestic gas price forecasts, and Asian LNG netback[60] forecasts for the Low, Base, 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 Rystad Energy. Gas reserves and contracted volumes were sourced from the 2022 FIR process, and existing DMO volumes from the WA Department of Jobs, Tourism, Science and Innovation (DJTSI[61]). Market intelligence was gathered via informal and formal gas stakeholder interviews and publicly available information in relation to projects.

The hydrogen industry has the potential to expand significantly[62] with growth expected from low carbon hydrogen (blue[63] and green[64]) towards the end of the outlook period. Low carbon hydrogen can be used across multiple sectors. In the industrial sector, hydrogen can be used in fuel cells to power fixed and mobile plant, combusted for heat generation, and as a feedstock for fertiliser/ammonia production. Hydrogen can also be used as a fuel in the transport sector for heavy mining vehicles and passenger vehicles. Another application currently being explored in WA is blending hydrogen into the gas transportation network for use in the residential and commercial sector or in the power generation sector.

AEMO's current assessment is that there will likely be limited impact on the WA domestic gas market over the outlook period and therefore hydrogen has not been incorporated in the potential gas supply forecasts. As hydrogen becomes more commercially viable with supporting infrastructure, AEMO will monitor its potential for inclusion in future WA GSOOs.

4.2.2 Key modelling assumptions

WA has a Domestic Gas Policy[65] 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 gas equivalent to 15% of LNG exports for WA consumers. In August 2020, the WA Government clarified that it would not agree to gas exports through the WA pipeline network, and that supply of gas to Australia's east coast would be treated as an export for the purposes of the policy[66].

AEMO has adjusted the full DMO quantity[67] associated with the LNG-linked supply sources that are capacity constrained (Gorgon and Wheatstone). Following analysis of historical production, 85% of the full DMO is assumed to be available to the WA domestic gas market on an annual basis. The modelling also assumes the

[60] 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.

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

[62] Most hydrogen projects are still in the conceptual, early feasibility study stages and proponents have yet to make a final investment decision to commercialise these projects.

[63] "Blue" hydrogen is produced from natural gas, with emissions sequestered using carbon capture and storage.

[64] "Green" hydrogen is produced from renewable energy.

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

[66] Waitsia was granted an exemption to the WA Domestic Gas Policy. See https://www.mediastatements.wa.gov.au/Pages/McGowan/2020/08/Revised-policy-to-secure-domestic-gas-supply-and-create-jobs.aspx.

[67] 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.

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 includes only existing and committed gas production capacity.
- The **Base** scenario includes 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 includes all projects in the Base 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.

Table 8 Potential gas supply modelling assumptions for existing projects

Production facility	Category	Assumption in all three scenarios
Beharra Springs	Existing domestic gas only	22 TJ/day throughout the outlook period[A]
Devil Creek	Existing domestic gas only	Availability limited by remaining reserves
Gorgon[B]	Existing LNG-linked with DMO	255 TJ/day throughout the outlook period
Karratha Gas Plant	Existing LNG-linked with DMO	70 TJ/day throughout the outlook period[C]
Macedon	Existing domestic gas only	Availability limited by remaining reserves
Pluto	Existing LNG-linked with DMO	40 TJ/day from the existing truck-loading (15 TJ/day)[D] and pipeline injection capacity (25 TJ/day)
Pluto acceleration	Existing LNG-linked with DMO	18 TJ/day between 2023 and 2025, with additional 25 TJ/day from 2025 (Pluto gas to be delivered via the KGP)
Varanus Island (John Brookes and Spar-Halyard)	Existing domestic gas only	Availability limited by remaining reserves
Waitsia	Existing LNG-linked	At least 20 TJ/day between 2024 and 2028, delivered via Xyris, then 125 TJ/day available to the domestic market from 2029[E]
Wheatstone	Existing LNG-linked with DMO	174 TJ/day throughout the outlook period

A. The nameplate capacity increased from 18.5 TJ/day to 20 TJ/day in March 2022, and 22 TJ/day in August 2022. See https://gbbwa.aemo.com.au/#capacities.
B. Details of the LNG domestic supply assumptions are in Appendix 3.3.2.
C Average KGP production from 1 May 2022, when the Pluto acceleration obligation commenced, to 18 October 2022 was 82.5 TJ/day. Assuming the 18 TJ/day Pluto acceleration DMO has been met in full and delivered via the KGP, production from the North West Shelf (NWS) gas fields via the KGP would be 65 TJ/day. AEMO has assumed that the potential supply from the NWS, delivered via the KGP, will be 70 TJ/day over the outlook period.
D. AEMO has included "Non-connection-point demand", i.e. off-grid gas demand, that is equal to the Pluto truck loading production.
E. See https://mitsuiepmidwest.com.au/what-we-do/development/waitsia-stage-2/.

Table 9 Potential gas supply modelling assumptions for new projects

Gas project	Category	Low	Base	High
Scarborough	New LNG-linked with DMO	180 TJ/day from mid-2028	180 TJ/day[A] from mid-2027[B]	180 TJ/day from mid-2026
Spartan	New domestic gas only	30 TJ/day from 2024, delivered through Varanus Island	30 TJ/day from 2023, delivered through Varanus Island[C]	30 TJ/day from 2023, delivered through Varanus Island
Walyering	New domestic gas only	30 TJ/day from 2024	30 TJ/day from mid-2023[D]	30 TJ/day from early 2023
West Erregulla	New domestic gas only	Not developed	87 TJ/day from 2025	87 TJ/day from mid-2024
Corvus	New domestic gas only	Not developed	Not developed	150 TJ/day from 2028
Lockyer Deep	New domestic gas only	Not developed	Not developed	50 TJ/day from 2027
South Erregulla	New domestic gas only	Not developed	Not developed	30 TJ/day from 2026

A. See: https://www.bhp.com/news/media-centre/releases/2021/11/bhp-approves-phase-1-of-the-scarborough-project
B. See https://files.woodside/docs/default-source/asx-announcements/2021-asx/061.-scarborough-fid-teleconference-and-investor-presentation.pdf.
C. See https://www.santos.com/wp-content/uploads/2021/02/2020-Full-Year-Results-Announcement-and-Presentation.pdf.
D. See https://app.sharelinktechnologies.com/announcement/asx/4f83874c1f3a549332d2270957f0fe75.

4.2.3 Prospective supply sources

AEMO has included one undeveloped field, West Erregulla, in its Base scenario.

There are an additional three undeveloped gas fields in the High scenario supply forecast: Corvus, Lockyer Deep and South Erregulla (see Appendix A3.3.2 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 Base scenario in future WA GSOOs.

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%)[68].

Strike Energy has upgraded the 2P reserve estimate to 422 PJ[68] and has an application for environmental approval to develop the West Erregulla gas field[69] while AGI Operations has submitted an application to construct and operate the West Erregulla gas processing plant and pipeline[70]. An FID is expected once the environmental applications have been approved. Phase one of the project is expected to produce 87 TJ/day[71]. Strike Energy has gas sales agreements with CSBP (subsidiary of Wesfarmers)[72] and Perth Energy (AGL Limited),[73] while Warrego has a gas sales agreement with Alcoa of Australia[74].

[68] See https://app.sharelinktechnologies.com/announcement/asx/c133b54227a195cb83d8276049426106.

[69] See https://www.epa.wa.gov.au/proposals/west-erregulla-field-development-program.

[70] See https://www.epa.wa.gov.au/proposals/west-erregulla-processing-plant-and-pipeline.

[71] See https://strikeenergy.com.au/west-erregulla/.

[72] See https://asx.api.markitdigital.com/asx-research/1.0/file/2924-02274277-6A993558.

[73] See https://www.asx.com.au/asxpdf/20220406/pdf/457qxv2qlvnfn1.pdf.

[74] See http://asx.warregoenergy.com/site/PDF/842f238a-4ee7-4ce6-95bc-ddbb6ffdd25a/UpdatedWarregoandAlcoaSignLargeScaleLongTermGSA.

AEMO has modelled West Erregulla in the Base scenario as a prospective domestic gas project available from early 2025 at 87 TJ/day.

Corvus

The Corvus gas field[75] is located offshore in the Carnarvon Basin, approximately 90 km northwest of Dampier. 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 are likely to be converted to a carbon capture and storage (CCS) hub by 2028[76].

Lockyer Deep 1

Lockyer Deep 1 was discovered in September 2021[77]. 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 with 80%, operator), and Norwest Energy NL (20%). The gas reserves appear to be to be larger than initially expected[78]. Mineral Resources Limited has indicated that Lockyer Deep 1 is expected to be low-cost gas based on its proximity to infrastructure and reservoir deliverability, with first production targeted for mid-2024 pending an FID[79]. AEMO has assumed the project could come online by 2027, subject to the FID and obtaining environmental approvals.

South Erregulla

Strike Energy (100%) reported a discovery at South Erregulla in February 2022[80]. South Erregulla is located within Strike Energy's proposed Mid-West Low Carbon Manufacturing Precinct and has been earmarked as gas feedstock for Project Haber[81]. Gas reserves of 128 PJ (2P) have been certified at South Erregulla[82], with further drilling to be undertaken in 2023. If Strike can fast-track South Erregulla in a similar way to its Walyering Project, AEMO anticipates production could begin in 2026 subject to a successful FID in 2024[82].

4.3 Potential gas supply forecasts

Depending on the various input assumptions for the Low, Base, and High scenarios (see Appendix A3), prospective supply sources and backfill for existing production facilities are 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 assumes that an associated DMO quantity will be offered to the domestic gas market.

[75] See https://www.santos.com/wp-content/uploads/2020/02/190416-b-successful-corvus-2-appraisal-well-discovers-significant-offshore-resource.pdf.

[76] See https://www.santos.com/wp-content/uploads/2022/08/Santos-2022-Half-year-results-Final-2.pdf

[77] See https://clients3.weblink.com.au/pdf/MIN/02419018.pdf.

[78] See https://norwestenergy.com.au/wp-content/uploads/2022/06/2022-06-20-Huge-Lockyer-Deep-gas-discovery-bigger-than-expected.pdf and https://wcsecure.weblink.com.au/pdf/NWE/02544482.pdf.

[79] See https://clients3.weblink.com.au/pdf/MIN/02559896.pdf.

[80] See https://app.sharelinktechnologies.com/announcement/asx/c6a07525393901c5ab390c7d499c6c3f.

[81] See https://strikeenergy.com.au/project-haber/.

[82] See https://app.sharelinktechnologies.com/announcement/asx/eb3571f5817c22a0de8c5db1e2f0fc2a.

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, many of these resources are currently too speculative to be included in the potential supply forecasts. These resources include, but are not limited to, Kultarr, Spar Deep, Clio-Acme, Equus, Rafael 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 10 and Figure 14. Potential gas supply forecasts in all three scenarios are lower than the total installed nameplate production capacity over the outlook period.

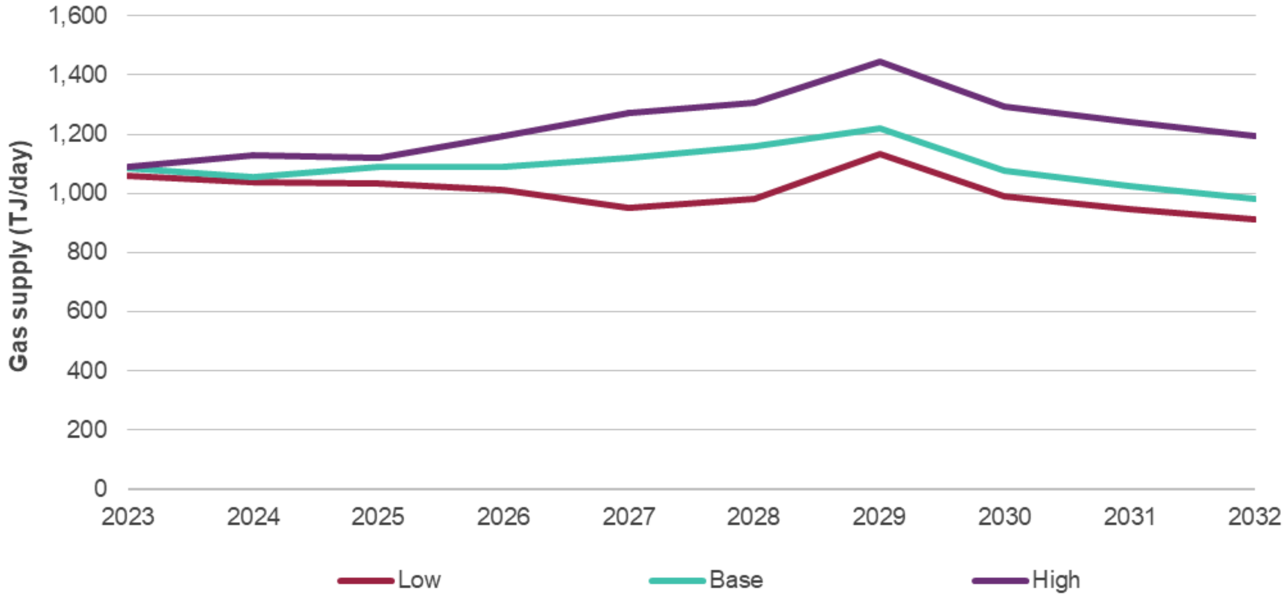
In summary:

- In the Base scenario, potential gas supplies are projected to decrease at an average annual rate of 1.1% between 2023 and 2032 due to:
  - Natural reserve depletion at the Reindeer gas field, which supplies the Devil Creek production facility, and the Macedon gas field. The Reindeer gas field and Devil Creek production facility is expected to be converted into a CCS hub in 2028.
  - The decline is partially offset by the development of the Scarborough, Spartan, West Erregulla and Walyering gas fields.
- In the High scenario, potential supply increases from 2026 as West Erregulla is accelerated and production from the Corvus, Lockyer Deep and South Erregulla gas fields is brought onstream.
- In all three scenarios, potential supply increases from 2026 (High scenario), 2027 (Base scenario) and 2028 (Low scenario) due to Scarborough coming online.

Table 10 Potential gas supply forecasts (TJ/day), 2023 to 2032

	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	5-year annual average growth rate	10-year annual average growth rate
Low	1,059	1,038	1,035	1,012	951	983	1,134	992	949	913	-1.5%	-1.6%
Base	1,084	1,053	1,090	1,091	1,121	1,158	1,219	1,077	1,025	982	1.3%	-1.1%
High	1,089	1,126	1,119	1,193	1,273	1,307	1,444	1,293	1,242	1,195	3.7%	1.0%

Figure 14 Potential gas supply forecasts, 2023 to 2032



4.4 Comparison of 2021 and 2022 WA GSOO potential gas supply forecasts

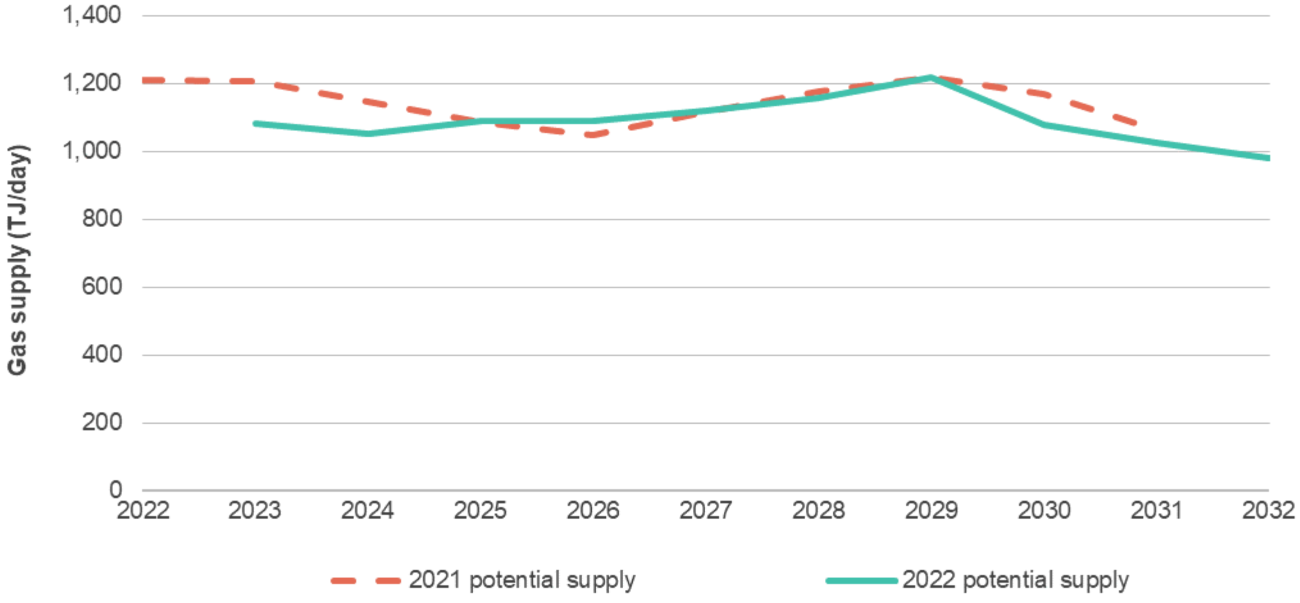
The Base scenario potential gas supply forecasts developed for the 2021[83] and 2022 WA GSOOs are compared in Figure 15. For the 2022 WA GSOO, AEMO updated the following:

- Development of Base scenario supply sources, most notably Walyering from 2023 (also see Appendix A3.3).
- List of prospective supply sources (see Section 4.2.2).
- Forecasts for gas reserves and resources, production costs, domestic gas prices and Asian LNG prices.
- Starting level of reserves for domestic-only gas production facilities.
- Assumptions about reserve depletion rates, based on responses from the 2022 FIR, which indicates stronger production from domestic-only supply sources.
- DMO volume assumptions, based on the domestic gas agreements and historical production, which has reduced the supply forecast by around 70 TJ/day (see Table 21 in Appendix 3.3).

These changes account for most of the differences between the 2021 and 2022 WA GSOO Base scenario gas supply forecasts.

[83] The potential gas supply forecasts in the 2021 WA GSOO covered the period 2022 to 2031.

Figure 15 Comparison of 2021 and 2022 Base scenario potential gas supply forecasts



5 Formal information request data analysis

This chapter presents aggregate data submitted by gas market participants (GMPs) and non-GMPs through the 2022 FIR process and provides a comparison with data previously received in FIRs for the 2020 and 2021 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[84] 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[85].

The data presented in this chapter includes:

- Gas demand and supply estimates.
- Contracted volumes.
- Gas reserves.

Data has been aggregated to protect confidentiality of the individual respondents. Some information submitted as part of the FIR process has not been presented[86].

AEMO has used the FIR data as an input into developing the gas demand and potential gas supply forecasts for the 2022 WA GSOO.

AEMO has taken due care to reconcile the information received but accepts no liability for any errors it may contain. The data reported is from the 2022 FIR process, unless otherwise specified. All data presented is the latest available as of November 2022 and should be considered indicative only. It is important to note the data does not represent AEMO's forecasts.

5.1 Gas market participant profile

Of the 77 surveyed participants, 70 responded to the 2022 FIR. Compared to the 2021 FIR, the response rate from GMPs increased by four percentage points (see Table 11). More non-GMP participants were issued with FIRs in 2022 compared to 2021, with 77% responding.

[84] GMPs are Gas Market Participants. 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.

[85] 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.

[86] Including gas consuming facility names, their capacities and development status, demand by pipeline and storage facilities and gas prices that may cause gas consumers to reduce or increase gas demand.

Table 11 FIR response rate overview, 2021 to 2022

Year	2021			2022		
	Number of requests issued	Number of responses received	Response rate	Number of requests issued	Number of responses received	Response rate
Gas market participants	53	46	92%	55	53	96%
Non-GSI participants (optional)	12	11	92%	22	17	77%
Total	65	60	92%	77	70	91%

For the purposes of analysis, respondents were categorised as either consumer, supplier[87], or infrastructure operator (includes pipelines and storage facilities), with responses as presented in Table 12. Gas consumers were further broken down into sectors (including mining, minerals processing, gas generation, and domestic LNG).

Table 12 Distribution of responses, 2022

	Consumers	Suppliers	Infrastructure	Total
Gas market participants	43	7	3	53
Non-GSI participants (optional)	7	10	0	17
Total	50	17	3	70

5.2 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 demand and maximum contracted gas demand estimates.
- For gas suppliers – total nameplate capacity[88] and committed gas supply estimates.

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

5.2.1 Gas demand

Expected gas demand[89] is higher in all years compared to the 2021 FIR data, except for 2029 and 2030 (see Figure 16).

Expected gas demand is anticipated to increase between 2022 and 2025 with new gold and nickel mining projects commencing operations and gas for electricity generation 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 0.6% between 2022 and 2030, from 960 TJ/day to 912 TJ/day. Some gas-consuming facilities are anticipated to reach the end of their lives during the outlook period, while others are expected to

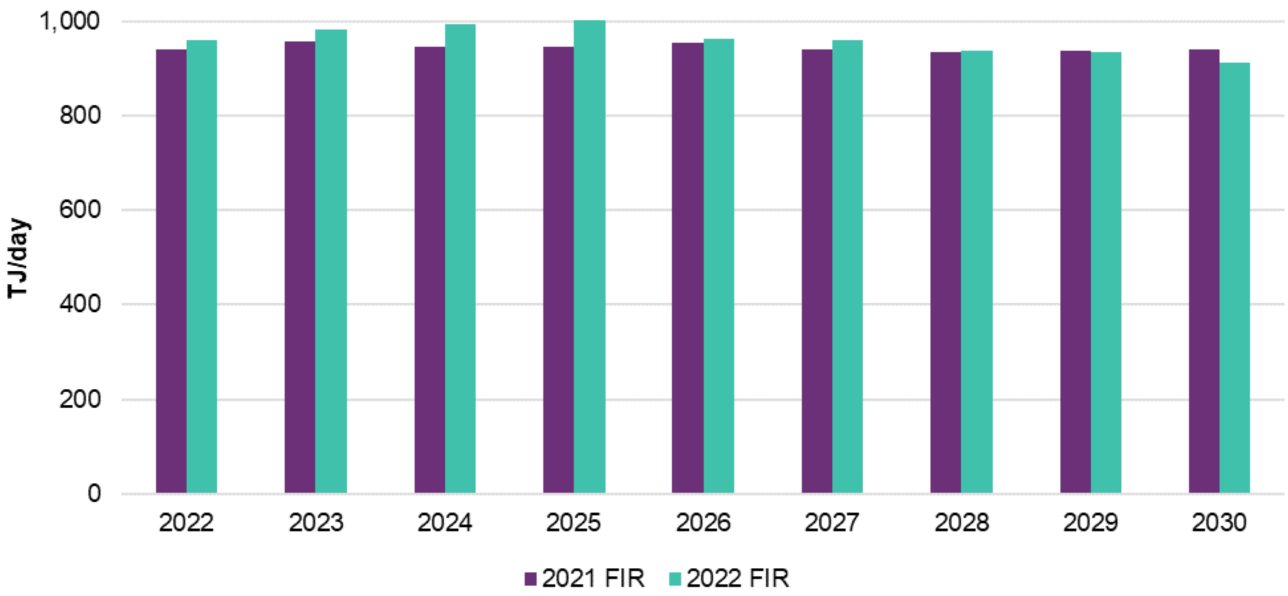
[87] Excludes gas resellers and facilities with gas demand less than 10 TJ/day.

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

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

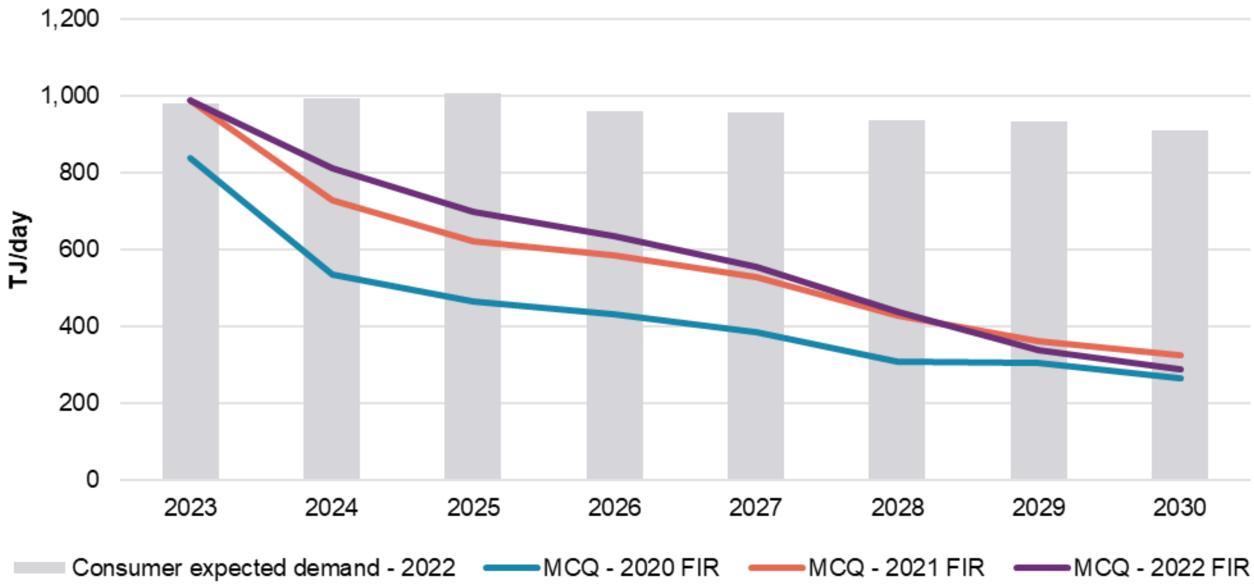
transition to more efficient generators and renewable energy resources, reducing demand for gas especially in the middle of the decade. This is expected to be offset by expansions to other facilities that have achieved FID.

Figure 16 Comparison of consumer expected demand, 2021 to 2022 FIRs



Consumer maximum contracted quantity (MCQ) is lower than expected demand over the whole outlook period except for 2023 (see Figure 17). This indicates that consumers have not fully contracted their gas demand beyond 2023, even though contracted quantities reported in the 2022 FIR are higher than the 2021 FIR for most of the outlook period.

Figure 17 Comparison of demand and consumer contracted levels (MCQ), 2020 to 2022 FIRs

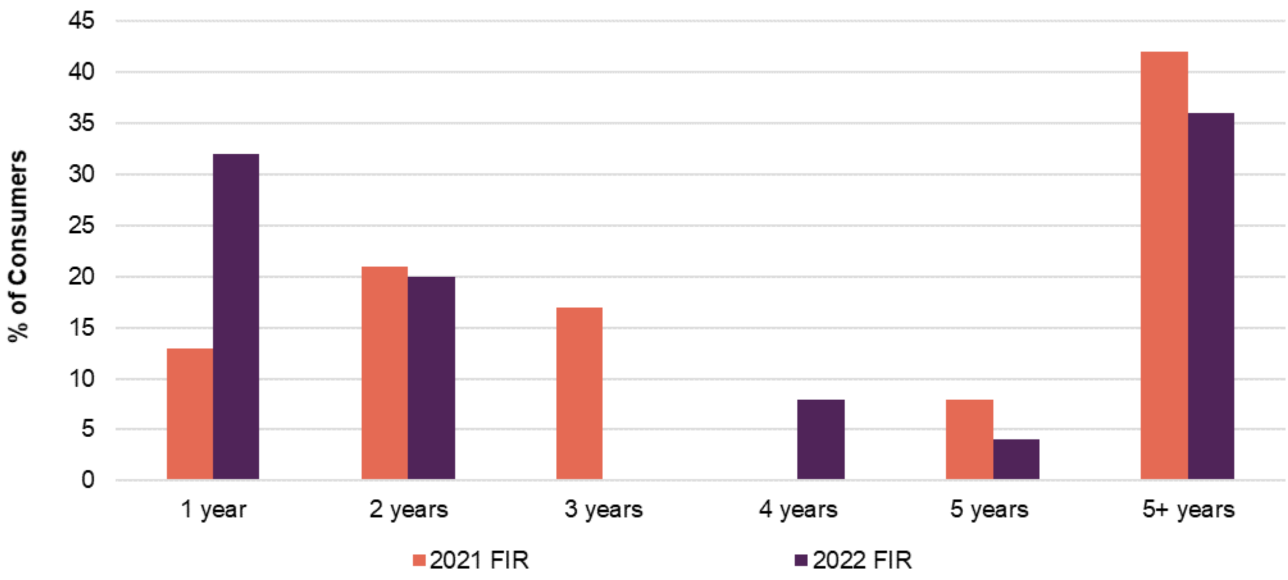


Almost 70% of consumers who have contracted with suppliers have either single-year or long-term (that exceed five years) contract portfolios (see Figure 18).

Compared to the 2021 FIR, the number of consumers with single-year contracts is much larger in the 2022 FIR. The increase in one-year contracts is likely to leave a greater number of gas buyers needing to recontract in the short term.

Over 50% 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.

Figure 18 Comparison of consumer maximum contract duration, 2021 to 2022 FIRs

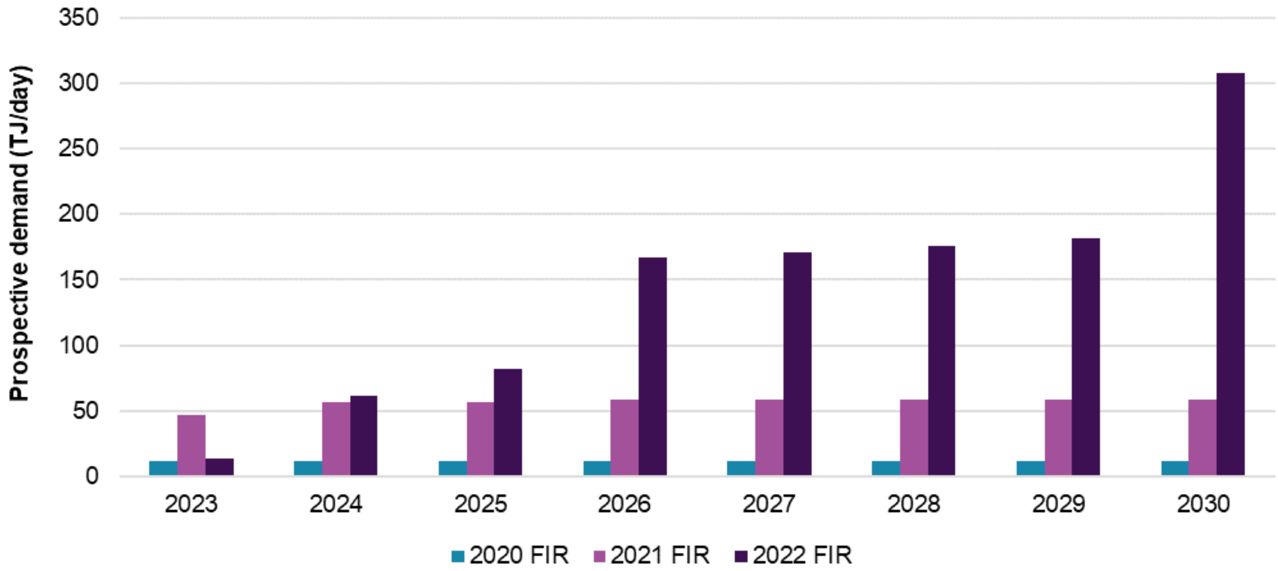


GMPs expect prospective demand[90] to increase from 13 TJ/day in 2023 to 308 TJ/day in 2030 (see Figure 19). Overall, the growth in prospective demand is significantly higher in the first half of the outlook period (90% a year) than the second half (15% a year).

Consumers provided estimates of incremental prospective demand either as a capacity change or as a fuel switch, especially in 2024, 2026 and 2030 in which the prospective demand increased significantly. Respondents to the 2022 FIR indicated this was due to expansions of existing projects and new projects compared to the 2021 FIR, resulting in higher expected gas demand from prospective projects. Fuel-switching (from diesel to gas or coal to gas) is expected to offset demand reductions due to changing from using gas to renewable energy for production.

[90] Projects were classified according to development stage – achieved FID, environmental approval, internal approval, or speculative. Prospective demand considers gas demand from proposed projects that have not yet achieved FID.

Figure 19 Comparison of prospective demand, 2020 to 2022 FIRs

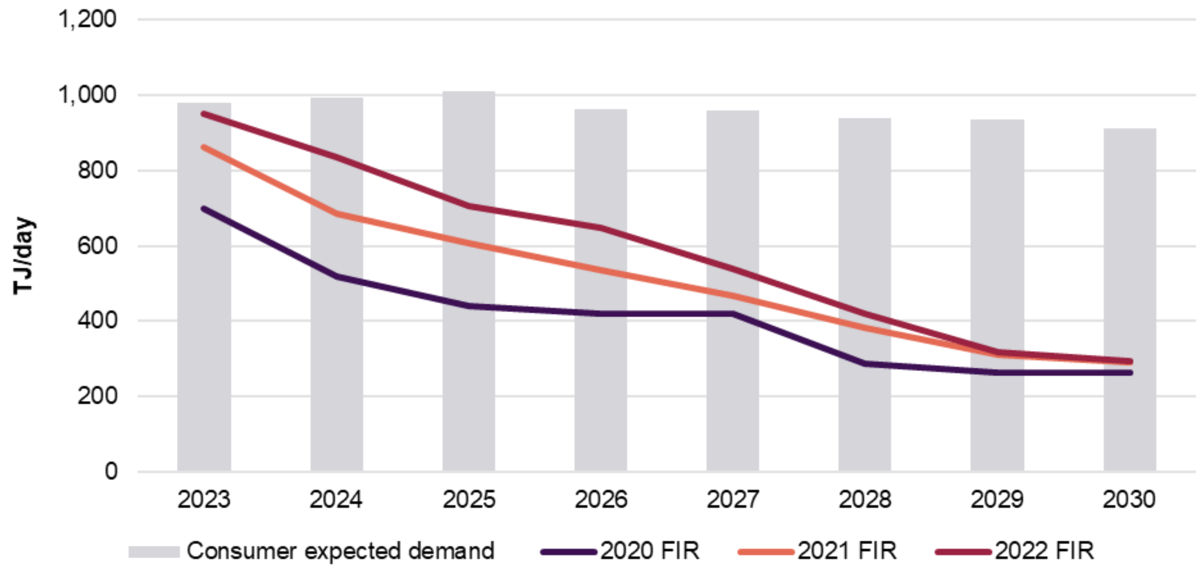


5.2.2 Gas supply

Suppliers expect nameplate capacity to grow at an average annual rate of 2.4%, from 2,137 TJ/day in 2023 to 2,636 TJ/day in 2032. The supplier MCQ has increased by an average of 82 TJ/day compared with the 2021 FIR (see Figure 20). While the total MCQ is higher than the 2021 FIR, the rate of decline in quantities (14% annually) is similar to the 2021 FIR, suggesting that contracting strategies in 2022 are similar to those in 2021.

The supplier contracted quantities are generally higher than consumer contracted quantities throughout the outlook period as the 2022 FIR responses covered larger proportion of suppliers than consumers in the market.

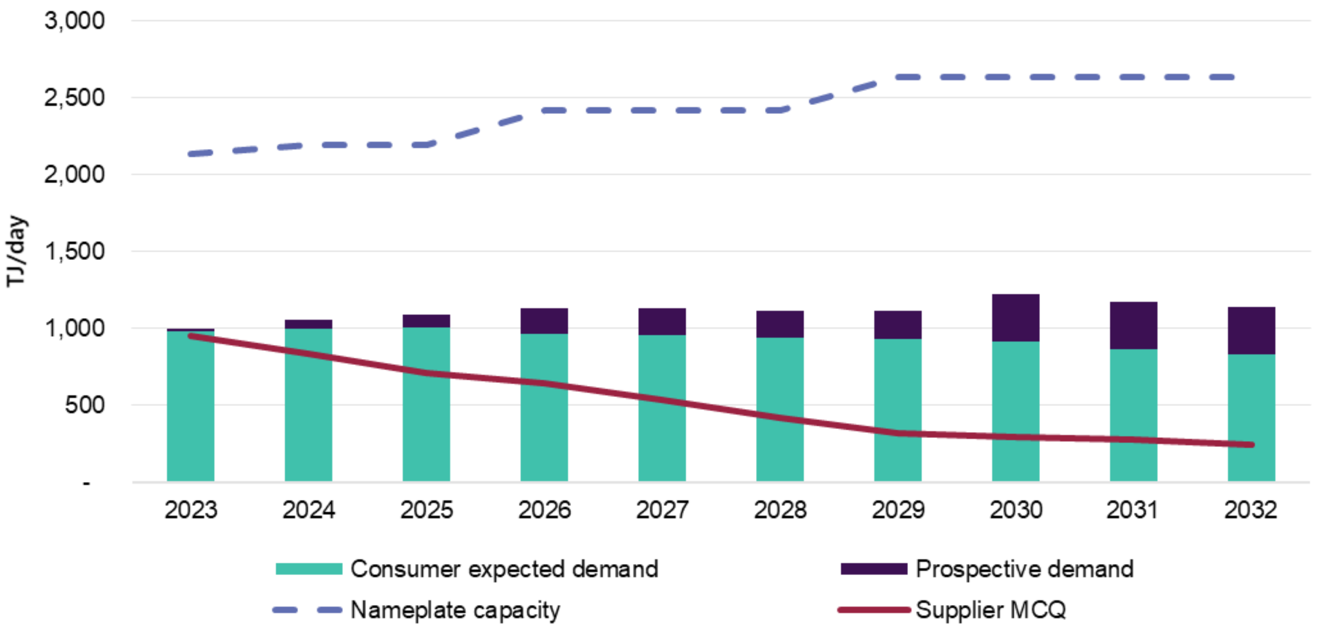
Figure 20 Comparison of supplier contracted levels (MCQ), 2020 to 2022 FIRs



5.2.3 Gas demand and supply balance

Supply utilisation is expected to be 46% of the nameplate capacity on average over the whole outlook period (see Figure 21). In 2023, the sum of expected and prospective demand is 994 TJ/day, which would use approximately 46.5% of suppliers' nameplate capacity. This utilisation is anticipated to fall over most of the outlook period (0.7% annually) with the lowest utilisation expected in 2029, at 42.3%, as new gas projects increased installed capacity more than the expected demand for gas.

Figure 21 Consumer expected gas demand compared to supplier contracted levels (MCQ) and nameplate capacity, 2023 to 2032



5.3 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 that are physically connected to each existing domestic gas production facility. This data is an input into AEMO's potential gas supply model.

Table 13 compares the 2P gas reserves connected to domestic gas production facilities with the figures received as part of previous FIRs[91]. Connected 2P reserves (developed and undeveloped) have decreased relative to the 2021 WA GSOO estimates by 2,794 PJ (6.6%).

Table 13 Total 2P gas reserves, 2018 to 2022 FIRs (PJ)

Gas reserves and resources	2018	2019	2020	2021	2022
Total 2P reserves connected to domestic gas production facilities	47,886	43,131	47,337	42,607	39,813

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

Appendices to 2022 Western Australia Gas Statement of Opportunities

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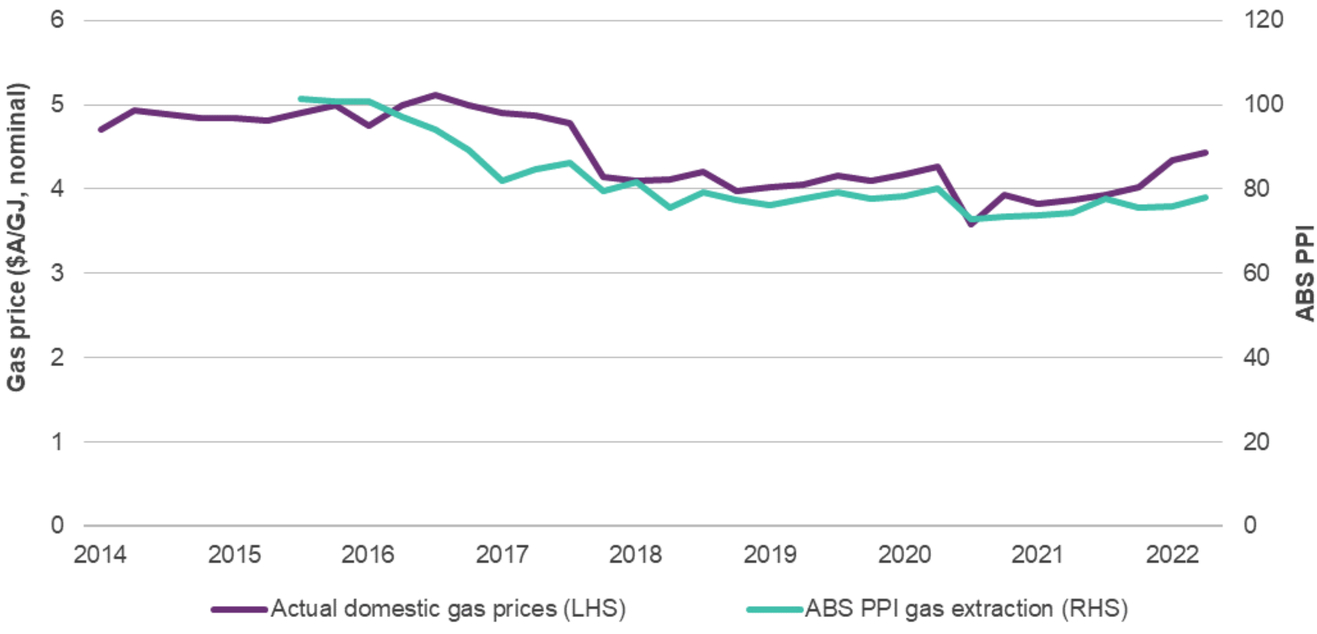
A2. Historical domestic gas prices and forward reference prices

All costs and prices in these appendices refer to 2022 Australian dollars unless otherwise specified.

A2.1 Historical domestic gas prices

The quarterly historical domestic gas contract price[92] is compared with the Australian Bureau of Statistics (ABS) producer price index (PPI)[93] for gas extraction in Figure 22

Figure 22 Historical domestic gas contract prices and ABS PPI – WA (gas extraction, index), Q1 2014 to Q2 2022



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

The average gas contract price in Q2 2022 was $4.43/GJ, a 14.2% increase from $3.87/GJ recorded in Q2 2021. The ABS PPI (gas extraction) shows a similar upward trend since the 2021 WA GSOO, but with a lower rate of increase at 5% from an index of 74.3 in Q2 2021 to 78 in Q2 2022.

Figure 23 shows average monthly nominal spot prices (for gas traded via gasTrading[94]) since early 2015. Spot prices have generally trended upwards over the past two years, from $2.13/GJ in May 2020 to $5.82 in September

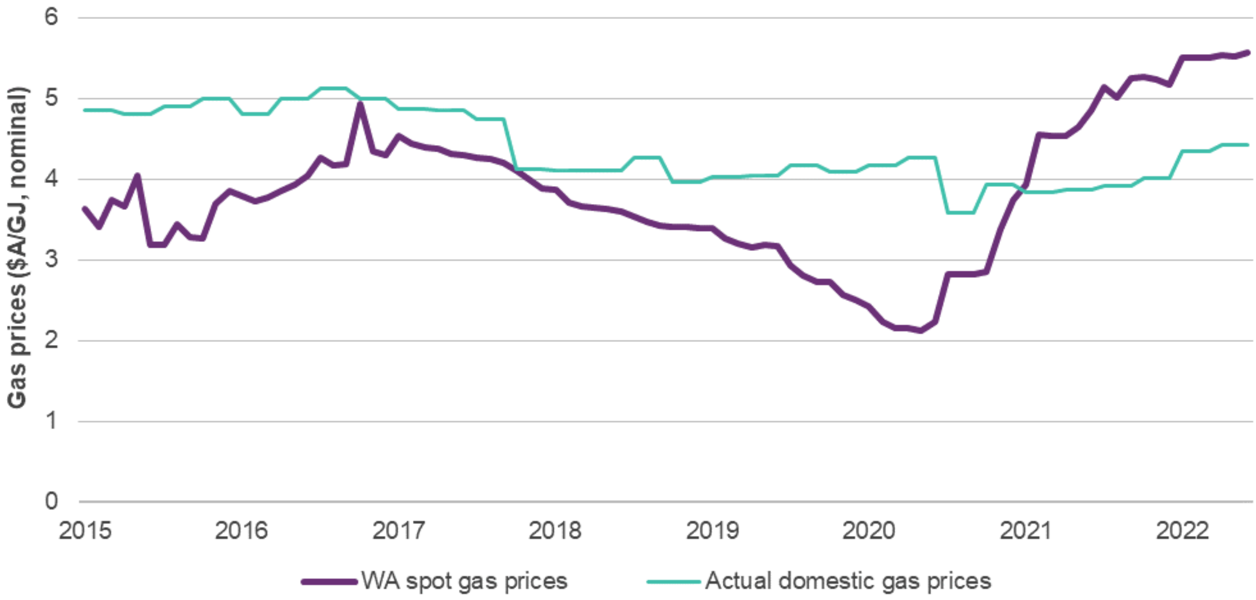
[92] Prior to 2016, the average domestic gas price was derived from all domestic gas sales into WA. However, beginning with the March quarter 2016, the average domestic gas price has been derived only from domestic gas sales reported to the State Government in relation to the administration of royalties. 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.

[93] 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.

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

2022. The current spot price in October 2022 is almost triple the lowest price in May 2020. Spot prices are more volatile than the actual domestic gas prices[95], which mainly reflect contract prices.

Figure 23 WA spot gas prices from gasTrading, January 2015 to September 2022



Source: gasTrading and ABS.

A2.2 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 $2.36/GJ in 2023 to $2.66/GJ in 2032. These production costs have been used to develop the forecast domestic gas prices applied in the potential gas supply model (see Appendix A3.3).

Table 14 Production costs, 2023 to 2032

	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Weighted average costs of production (A$/GJ, $ real, 2022)	2.36	2.33	2.33	2.28	2.28	2.48	2.67	2.63	2.64	2.66

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 the timeframes publicly announced by project operators (see Appendix A3.3 for further information about these dates).
- A 10% discount rate has been used.

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

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[96].

[96] 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.

A3. 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.

A3.1 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 Appendices A3.2 and A3.3.

WA's domestic gas demand is primarily 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, the impact of renewable penetration is impacting demand for gas used for power generation. For the 2022 WA gas demand forecasts and information on the drivers of demand over the outlook horizon, see Section 3.2.

Mining projects in WA are often located in remote areas, outside the South West Interconnected System (SWIS). Gas usage at these mines can include power generation for use at the mine site and adjoining towns. Gas generation at these sites is likely to be replaced by renewable generation in the future.

Hydrogen is expected to have a minimal impact on gas supply and demand over the 10-year outlook to 2032 because:

- It is not currently cost-competitive as a replacement for pipeline gas[97].
- While the WA Government is supportive of developing hydrogen technologies, the regulatory environment governing access to gas infrastructure currently precludes hydrogen[98].

A3.1.1 Economic outlook

To maintain consistency between long-term electricity and gas forecasting, AEMO used the economic forecasts that were prepared by BIS Oxford Economics[99] for the 2022 Wholesale Electricity Market (WEM) Electricity Statement of Opportunities (ESOO) as inputs into the development of the WA domestic gas demand forecasts.

[97] Several hydrogen feasibility studies are currently being undertaken across WA, including APA's study of the Parmelia Gas Pipeline capability to carry up to 100% hydrogen. See: https://www.apa.com.au/news/media-statements/2021/wa-government-supports-apas-world-leading-hydrogen-research/.

[98] See: https://aemo.com.au/-/media/files/stakeholder_consultation/consultations/gas_consultations/2021/hydrogen-blends-and-renewable-gases-procedures-review/consultation-paper.pdf.

[99] See: https://www.aemo.com.au/-/media/files/electricity/nem/planning_and_forecasting/inputs-assumptions-methodologies/2021/bis-oxford-economics-macroeconomic-projections.pdf.

Table 15 shows BIS Oxford Economics' low, base, and high projections for gross state product (GSP), which were used as inputs into the gas demand forecasts.

Table 15 WA GSP (%) annual growth forecasts for different economic growth scenarios, 2022-23 to 2032-33 financial years

Scenario	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30	2030-31	2031-32	2032-33
Low	0.4	1.9	3.3	3.7	3.5	3.4	3.0	2.7	2.7	2.7	2.6
Expected	3.2	3.4	3.5	3.3	3.1	3.0	3.0	2.9	2.8	2.6	2.6
High	2.6	3.3	2.7	3.3	3.4	3.4	3.2	2.8	2.8	2.8	2.8

Source: BIS Oxford Economics

WA's GSP is forecast to grow at 3.0% on average over the 10 years to 2032-33 in the Base scenario. This growth reflects anticipated renewed mining investment driving growth in the construction sector and investment spending, leading to increased economic activity, and population growth.

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

The high demand growth scenario is characterised by strong decarbonisation objectives and moderate economic and population growth relative to the expected demand growth scenario.

See BIS Oxford's report[100] for more information on the methodology and assumptions for the WA GSP forecasts.

[100] See: https://aemo.com.au/-/media/files/electricity/nem/planning_and_forecasting/inputs-assumptions-methodologies/2021/bis-oxford-economics-macroeconomic-projections.pdf.

A1.1.1 Commodity outlook

AEMO engaged the National Institute of Economic and Industry Research (NIEIR) to provide commodity forecasts[101] as inputs for the development of the WA domestic gas demand forecasts. To develop the commodity production forecasts, NIEIR combined information on new projects, expansions, and closures for each commodity type with consensus price forecasts.

Mining activity in WA remains strong despite the impact of COVID-19 on global commodity markets. WA's commodity production was valued at $231 billion in 2021-22[102].

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

- **Iron ore** – the outlook beyond 2022 remains strong for iron ore production with a number of new projects expected to come online. Examples include Fortescue Metals Group's Iron Bridge (stage two) and Rio Tinto's Gudai Darri projects.
- **Gold** – production is expected to continue to grow until 2024, following which, gold prices are expected to fall, leading to declining production. From 2027, gold production is expected to experience moderate growth.
- **Lithium** – strong average annual growth (11.2%) for lithium production is forecast over the outlook period. Global commitments to reducing emissions (leading to an increase in demand for consumer electronics and electric vehicle batteries) has led to a strengthened outlook for lithium since the 2021 WA GSOO. Renewed interest in lithium projects worldwide is likely to result in the development of new projects.
- **Copper** – the outlook shows minor fluctuations, but generally trends upwards. Demand for copper is largely driven by a global shift to renewable energy as it is an essential material for production of wind farms and solar panels.
- **Cobalt** – expected to grow at an average annual rate of 7.3% over the next 10 years to 2032, supported by strong prices resulting from both Russia's invasion of Ukraine in early 2022, as well as increasing incentives for investment in electric vehicles. However, it remains unlikely that WA's publicly announced projects will proceed until after 2025, when battery prices are expected to decline to a level that encourages mass-market uptake.
- **Lead** – forecast production at the Abra lead-silver mine shows strong growth in 2023, following which production is expected to steadily increase over the rest of the outlook period after prices recovered from a COVID-19 related 2020 low.
- **Mineral sands** – production is expected to increase following the commencement of Strandline Resources' Coburn operation in late 2022.

Further information about the commodity forecasts can be found in NIEIR's report[103].

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

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

[103] NIEIR. *Economic and Commodity forecasts for Western Australia to 2032*, August 2022, prepared for AEMO and published alongside the WA GSOO.

A3.2 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.

The methodology for preparing these forecasts is summarised in Sections A3.2.1 and A3.2.2.

A3.2.1 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 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.
- Other industrial customers that are located within the distribution network.
- GPG (including SWIS[104] 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 3.5% 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[105] 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.

[104] Forecasts of SWIS GPG gas demand were prepared by Robinson Bowmaker Paul and are published alongside the WA GSOO.

[105] 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).

- 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*[106].

Tariff D consumption

Tariff D consumers account for approximately 75% of WA's total domestic gas demand, and include:

- Mining consumers such as:
  - 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, TLEA, BHP, and South32.
- Industrial consumers such as CSBP and Yara Pilbara.
- 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.

From the list of industrial consumers, AEMO assumed that 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.

Due to these requirements, 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 (see Section A3.1.2 for further information). 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 2022 formal information request (FIR) for developing the gas demand forecasts for these sectors. Where FIR information was unavailable, AEMO has applied NIEIR's commodity production forecasts.

106 See https://aemo.com.au/-/media/files/gas/national_planning_and_forecasting/gsoo/2022/2022-gas-statement-of-opportunities-methodology-demand-forecasting.pdf

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 other causal 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 determined whether the forecast was based on a trend or a median level of usage.

Other Tariff D consumption

While gas consumption for the minerals processing, mining, and industrial sectors is available on the WA GBB, only aggregated data on distribution-connected industrial customers is readily available to AEMO.

To estimate gas demand, the segment was split into two components: aggregate and large 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 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[107], is estimated to account for approximately 17.5% of domestic gas demand in 2022. In the 2022-23 Capacity Year, 2,897 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[108]. Typically, the SWIS relies on GPG to supply peak load over the summer season and for the provision of Essential System Services (ESS)[109].

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 16.

[107] 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 A5.

[108] 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/2021/2021-wholesale-electricity-market-electricity-statement-of-opportunities.pdf.

[109] ESS is the power system security and reliability service whereby assigned generators automatically and constantly change their output to compensate for the differences between load and dispatched energy, as well as fluctuations caused by intermittent generation. Load following units will respond automatically to any over or under frequency events (including generator trips and load rejection events), thus regulating the system frequency.

RBP used 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[110].
- Details of generation entry and retirements, including:
  - Facilities that hold Capacity Credits via the Reserve Capacity Mechanism for the 2022-23 Capacity Year.
  - Expected staged retirement of coal generators.
  - Committed new generation builds, as well as prospective new builds obtained from the 2022 Expressions of Interest for Reserve Capacity[111].
- Operational consumption, peak demand, and Distributed Energy Resources (DER)[112] forecasts from the 2022 WEM ESOO.
- Previous Balancing Market bids and offers[113] (including negatively priced offers), to allow the model to replicate historical dispatch patterns.
- Fuel prices, including pipeline domestic gas, coal, and diesel price assumptions.
- The impact of current potential coal supply shortages on coal generators.

Table 16 Scenario mapping for GPG modelling

Scenario	Low	Base	High
Operational consumption[A]	Low	Expected	High
Peak demand[A]	Low case 90% probability of exceedance (POE)	Expected case 50% POE	High case 10% POE
Gas price[B]	Low	Expected	High
Behind the meter PV and battery storage[A]	Low	Expected	High
Coal supply situation	No shortage of coal supply	Coal shortages persist until the end of March 2023	Coal shortages persist until the end of June 2023
Generation retirements	• No retirement of BW1_BLUEWATERS_G2 and BW2_BLUEWATERS_G1	BW1_BLUEWATERS_G2 and BW2_BLUEWATERS_G1 retire 1 October 2029.	BW1_BLUEWATERS_G2 and BW2_BLUEWATERS_G1 retire 1 July 2023.
	• MUJA_G6 retires 1 October 2024. • COLLIE_G1 retires 1 October 2027. • MUJA_G7 retires 1 October 2029. • MUJA_G8 retires 1 October 2029.		
Generation new builds/upgrades	• ERRRF_WTE_G1 (28.9 MW) • PHOENIX_KWINANA_WTE_G1 (36 MW)		

[110] RBP incorporated constraints into the modelling from 1 October 2022, reflecting the WEM's expected move to security constrained economic dispatch on this date (which since has been delayed to 1 October 2023).

[111] See: https://aemo.com.au/en/energy-systems/electricity/wholesale-electricity-market-wem/wa-reserve-capacity-mechanism/expressions-of-interest.

[112] Including behind-the-meter solar PV, battery storage, and electric vehicles.

[113] By default, WEMSIM assumes capacity is offered for dispatch at short-run marginal cost.

Scenario	Low	Base	High
	• KWINANA_ESR1_ESR_01 commences 1 October 2023 (100 MW x 2 hr) • Other Facilities identified from 2022 Expressions of Interest for Reserve Capacity, aggregated and assigned to the high scenario based on AEMO's internal assessment (not listed here individually due to confidentiality)		

[A] Sourced from the 2022 WEM ESOO.
[B] Sourced from Rystad.

Non-SWIS GPG

Non-SWIS GPG includes the electricity distribution networks operated by Horizon Power and accounts for approximately 3.7% of domestic gas demand. To forecast non-SWIS GPG gas consumption, AEMO has used information received from gas consumers as part of the 2022 FIR. Where FIR information was unavailable, AEMO applies a linear trend model consistent with the *Gas Demand Forecasting Methodology Information Paper*[114].

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 where renewable energy projects 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 2022 FIR process. These estimates were added to all three 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 projects that may be developed and consume gas, projects that are likely to switch from consuming diesel to gas, and renewable energy projects that offset 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 an 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 as an electricity generator capable of operating on gas.
- Full project finance has been secured.

[114] See https://aemo.com.au/-/media/files/gas/national_planning_and_forecasting/gsoo/2022/2022-gas-statement-of-opportunities-methodology-demand-forecasting.pdf.

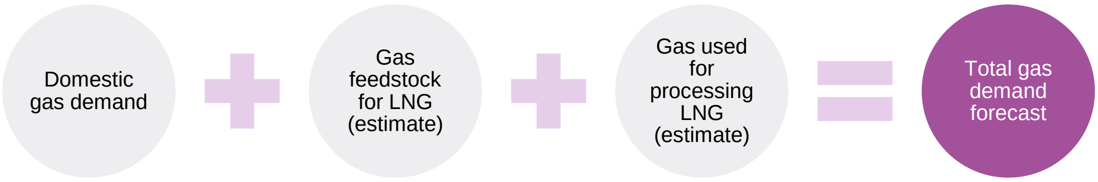
- The project proponent has publicly announced its intention to use gas.
- The project proponent has publicly announced its intention to build a renewable energy generation project or any other projects that specifically offset the use of gas as an input or energy source.

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 gas market participants (GMPs) and some non-GMPs as part of the 2022 FIR process.

A3.2.2 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 24. The total gas demand forecasts are shown in Appendix 5.

Figure 24 Total gas demand forecasts



AEMO developed three scenarios (Low, Base, 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 17.

Table 17 LNG export assumptions by scenario

<table>
<tr><th colspan="2">Scenario</th><th>Low</th><th>Base</th><th>High</th></tr>
<tr><td colspan="2"></td><td>Low</td><td>Base</td><td>High</td></tr>
<tr><td rowspan="11">Gas feedstock for LNG exports</td><td>Project</td><td colspan="3">Quantity of LNG</td></tr>
<tr><td>North West Shelf (Karratha Gas Plant - KGP)</td><td colspan="3">16.9 million tonnes per annum [mtpa] decreasing approximately at 15% per annum from 2023 to 2029 and 26% per annum from 2030 and onwards, supported by gas from Greater Western Flank 3 in 2022</td></tr>
<tr><td>NWS production maintained via backfill from Waitsia</td><td colspan="3">1.5 mtpa from 2024 to 2028</td></tr>
<tr><td>Gorgon LNG</td><td colspan="2">14.7 mtpa</td><td>15.6 mtpa</td></tr>
<tr><td>Pluto LNG</td><td colspan="3">4.5 mtpa</td></tr>
<tr><td>Wheatstone LNG</td><td colspan="3">8.9 mtpa</td></tr>
<tr><td>Prelude FLNG</td><td colspan="3">3.6 mtpa</td></tr>
<tr><td>Ichthys LNG</td><td colspan="3">8.9 mtpa</td></tr>
<tr><td>NWS production maintained via backfill through the interconnector from Pluto</td><td>NA</td><td colspan="2">0.5 mtpa from 2022 to 2025</td></tr>
<tr><td>Pluto train one supported by backfill from Scarborough</td><td>3.0 mtpa from 2028</td><td>3.0 mtpa from 2027</td><td>3.0 mtpa from 2026</td></tr>
<tr><td>Pluto train two expansion from Scarborough gas</td><td>4.5 mtpa, commences 2028</td><td>5.0 mtpa, commences 2027</td><td>5.0 mtpa, commences 2026</td></tr>
<tr><td colspan="2">Gas used for processing LNG[A]</td><td colspan="3">8%</td></tr>
</table>

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

A3.3 Gas supply model

A3.3.1 Reserves and resources

AEMO uses estimates made under the Society of Petroleum Engineers' system of reserves classification[115], which is standard 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[116].

A summary of the terms has been provided in Table 18.

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

[116] 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 18 Classification of reserves and resources

Classification	Definition
1P	Proved Reserves. Those quantities of gas that can be estimated with reasonable certainty to be commercially recoverable. If probabilistic methods are used, there should be a 90% probability that the quantities actually recovered will equal or exceed the estimate.
2P	Proved and Probable reserves. A measure of gas reserves that includes proved (1P) and probable reserves. It denotes the best estimate of reserves. If probabilistic methods are used, there should be at least a 50% probability that the quantities actually recovered will equal or exceed the best estimate.
2C	Contingent Resources. Those quantities of petroleum estimated, as of a given date, to be potentially recoverable from known accumulations, by the application of development projects not currently considered to be commercial owing to one or more contingencies. 2C resources are considered the best estimate of sub-commercial resources.

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

A3.3.2 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[117].

To determine these potential gas supply sources, AEMO sources information on prospective gas supply from external consultants, the WA Department of Jobs, Tourism, Science and Innovation (DJTSI), interviews with stakeholders and public information. AEMO uses both physical and commercial characteristics sourced from Rystad Energy when assessing prospective supply sources, as summarised in Table 19.

Table 19 Criteria for assessing prospective gas supply sources

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

[117] 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 five-yearly WA GSOO review[118]. 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 2022 FIR and made assumptions based on publicly available information, where FIR data was unavailable.

AEMO assessed several new supply sources. Some of these candidates for supply or backfill 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 20 summarises the selection criteria and basis of assessment.

[118] See: https://aemo.com.au/-/media/Files/Gas/National_Planning_and_Forecasting/WA_GSOO/2018/Five-Yearly-Review-of-the-WA-GSOO.pdf.

Table 20 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: • Production capacity, or • The decline rate advised by the GMP as part of the 2022 FIR, where reserves are insufficient to maintain gas production at nameplate capacity throughout the entire outlook period.	Either: • DMO, where the DMO is less than the nameplate plant capacity or • Nameplate capacity less 15%[A] where the plant capacity is equal to the DMO.	Developed when the domestic gas price forecast exceeds the estimated cost of production. Potential gas supply equals the minimum of: • Production capacity or • 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. Once developed, potential gas supply equals the DMO.
Projects included in the model	• Devil Creek[B] • Beharra Springs[B] • Macedon[B] • Varanus Island[B] • Xyris[B]	• Gorgon (tranches one and two)[B] • KGP[B] • Pluto[B] • Scarborough[B] • Wheatstone[B] • Waitsia[B]	• West Erregulla[C] • Lockyer Deep[D] • Corvus[D] • South 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 85% over a calendar year.
B. Included in the Low, Base and High scenarios.
C. Included in the Base and High scenario.
D. Included in the High scenario.

Table 21 summarises the key changes to assumptions for potential gas supply sources between the 2021 WA GSOO and the 2022 WA GSOO.

Table 21 Key changes in the supply model potential gas supply sources assumptions, 2021 WA GSOO compared to 2022 WA GSOO

Project	Operator	Scenario	2021 WA GSOO assumption	2022 WA GSOO assumption
Scarborough (LNG)	Woodside Energy	Base	Available at 210 TJ/day from mid-2027.	Available at 180 TJ/day from mid-2027.
KGP	Woodside Energy	Base	Available at 65 TJ/day.	Available at 70 TJ/day.
Waitsia Stage two (domestic-only)	Mitsui	Base	Supplies to the domestic market up to 100 TJ/day from 2029.	Supplies gas to the domestic market up to 125 TJ/day from 2029.
West Erregulla (domestic-only)	Strike Energy	Base	Available at 87 TJ/day from mid-2023	Available at 87 TJ/day from early 2025
Devil Creek	Santos	Base	Corvus was assumed to backfill Devil Creek in 2028	Production continues until 2023, then cessation of the Reindeer gas field and Devil Creek production facility occurs 2027.
Gorgon	Chevron	Base	Available at 300 TJ/day	Available at 255 TJ/day
Wheatstone	Chevron	Base	Available at 200 TJ/day	Available at 174 TJ/day
Beharra Springs expansion	Beach Energy	High	Increasing capacity from 18.5 TJ/day to 70 TJ/day by 2025	FID is reliant on increasing capacity and undertaking a debottlenecking project. Therefore, this project was removed.

A3.3.3 Historical gas production

There are nine gas production facilities supplying the WA domestic market, with a total nameplate capacity of about 2,040 TJ/day[119], as shown in Table 22. The KGP retains the largest nameplate capacity at 630 TJ/day.

Table 22 Domestic gas production facility average production and capacity utilisation, 2021-22 financial year

Facility	Nameplate capacity (TJ/day)	Average production (TJ/day)					Average capacity utilisation[A]				
		1 Jul – 30 Sept 2021 (Q1)	1 Oct - 31 Dec 2021 (Q2)	1 Jan- 31 Mar 2022 (Q3)	1 Apr - 30 Jun 2022 (Q4)	2021-22 financial year	1 Jul - 31 Aug 2021 (Q1)	1 Sept - 31 Dec 2021 (Q2)	1 Jan- 31 Mar 2022 (Q3)	1 Apr - 30 Jun 2022 (Q4)	2021-22 financial year
Beharra Springs	25[120]	8	16	17	20	15	46%	86%	92%	102%	81%
Devil Creek	220[121]	167	144	59	109	120	76%	65%	27%	50%	55%
Gorgon[B]	300[122]	180	176	250	277	221	99%	97%	83%	92%	93%
KGP	630[123]	32	41	33	91	49	5%	6%	5%	14%	8%
Macedon	220[124]	194	194	196	195	195	99%	99%	99%	92%	97%
Pluto[C]	25[125]	20	22	19	19	20	79%	89%	74%	77%	80%
Varanus Island	390[126]	238	236	223	216	228	69%	68%	65%	63%	66%
Wheatstone	200[127]	192	176	197	85	163	94%	86%	96%	41%	79%
Xyris[D]	30[128]	26	26	24	25	25	94%	93%	88%	98%	93%
Total	**2,040**	**1,058**	**1,031**	**1,018**	**1,038**	**1,036**	**-**	**-**	**-**	**-**	**-**

A. Utilisation was calculated using WA GBB capacity (which may differ from nameplate capacity).
B. Gorgon nameplate capacity was 182 TJ/day from 1 July to 31 December 2021.
C. 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).
D. 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.

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119 Dongara has not operated since Q3 2017 and has therefore been excluded. The nameplate capacity values have been taken from company websites.

120 See: https://www.beachenergy.com.au/perth-basin/.

121 See: https://www.santos.com/wp-content/uploads/2022/11/2022-Investor-Briefing-Day-ASX.pdf.

122 See: https://australia.chevron.com/our-businesses/gorgon-project.

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

124 See: https://www.santos.com/wp-content/uploads/2020/02/santos-wa-nt-site-visit-presentation-2019.pdf.

125 See: https://www.woodside.com/docs/default-source/media-releases/woodside-commisions-pluto-domestic-gas-pipeline.pdf.

126 See: https://www.santos.com/wp-content/uploads/2022/11/2022-Investor-Briefing-Day-ASX.pdf.

127 See: https://australia.chevron.com/our-businesses/wheatstone-project.

128 See: https://mitsuiepmidwest.com.au/what-we-do/production/waitsia-gas-field/.

The following trends (detailed in Table 22) were observed during the 2021-22 financial year:

- The highest production was from Varanus Island (228 TJ/day), closely followed by Gorgon (221 TJ/day on an annual basis) and Macedon (195 TJ/day). Beharra Springs had the lowest production (15 TJ/day).
- Production from the KGP has increased. This has been due to the opening of the Pluto-KGP interconnector in March 2022 and the processing of Pluto gas at the KGP[129].
- Production from Beharra Springs increased, as Beharra Springs Deep gas field was tied in during April 2021[130].
- Production increased at Gorgon from January 2022 as the second tranche of domestic gas production was brought onstream[131]. This took maximum production up to 300 TJ/day.
- Production from Devil Creek decreased due to natural decline at the Reindeer gas field.
- The Macedon, Xyris, Beharra Springs and Gorgon facilities had the highest capacity utilisation over the financial year, all operating at over 80%, while the KGP facility had the lowest capacity utilisation at 8%. The remaining facilities have been operating at capacity utilisations ranging from 55% to 80%.

[129] See: https://www.woodside.com/docs/default-source/asx-announcements/2022/first-quarter-2022-report.pdf.

[130] See: https://yourir.info/resources/0c5a441cf54ff229/announcements/bpt.asx/2A1295285/BPT_Quarterly_report_for_the_period_ended_31_March_2021.pdf.

[131] See: https://gbbwa.aemo.com.au/.

A4. Domestic gas demand forecasts by region

Table 23 Domestic gas demand forecasts by region (TJ/day), Base scenario, 2023 to 2032

Year / Region	Metro/South West	North	East
2023	627.7	334.2	137.0
2024	607.7	344.2	150.7
2025	637.2	334.0	151.9
2026	636.8	330.7	149.7
2027	637.2	325.2	144.4
2028	657.6	315.6	142.3
2029	716.2	315.5	139.8
2030	843.5	315.9	130.9
2031	872.2	284.3	127.1
2032	878.2	272.5	127.1

A5. Total gas demand forecasts

Table 24 Domestic gas demand forecasts (PJ/annum), 2023 to 2032

Year	Low	Base	High
2023	375.1	401.1	435.0
2024	378.7	403.6	444.8
2025	379.3	409.9	455.6
2026	373.5	407.8	488.3
2027	365.9	404.0	525.4
2028	363.1	408.3	562.0
2029	362.5	427.6	570.6
2030	375.3	470.9	591.3
2031	365.0	468.5	570.5
2032	362.5	467.6	571.3

Table 25 LNG feedstock forecasts (PJ/annum), 2023 to 2032

Year	Low	Base	High
2023	2817.1	2843.4	2890.8
2024	2829.0	2855.4	2902.8
2025	2736.2	2762.5	2809.9
2026	2657.0	2657.0	2967.7
2027	2590.7	2854.0	2901.4
2028	2770.3	2796.7	2844.1
2029	2679.5	2705.8	2753.2
2030	2596.0	2622.3	2669.7
2031	2538.3	2564.6	2612.0
2032	2495.7	2522.0	2569.4

Table 26 LNG processing forecasts (8% of feedstock) (PJ/annum), 2023 to 2032

Year	Low	Base	High
2023	225.4	227.5	231.3
2024	226.3	228.4	232.2
2025	218.9	221.0	224.8
2026	212.6	212.6	237.4
2027	207.3	228.3	232.1
2028	221.6	223.7	227.5
2029	214.4	216.5	220.3
2030	207.7	209.8	213.6
2031	203.1	205.2	209.0
2032	199.7	201.8	205.6

Table 27 Total gas demand forecasts (PJ/annum), 2023 to 2032

Year	Low	Base	High
2023	3417.5	3472.0	3557.1
2024	3434.0	3487.3	3579.8
2025	3334.4	3393.5	3490.3
2026	3243.1	3277.3	3693.4
2027	3163.9	3486.3	3658.9
2028	3355.0	3428.6	3633.5
2029	3256.4	3349.9	3544.1
2030	3179.0	3303.1	3474.6
2031	3106.4	3238.3	3391.5
2032	3057.8	3191.4	3346.2

A6. Sector classifications

Table 28 Classification of gas consumers into sectors (GBB delivery points)

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

A7. 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 A3.3.

A7.1 Gas transmission pipelines

A map of WA's gas transmission network is shown in Figure 25.

Figure 25 Gas transmission pipelines in WA

Source: WA GBB.

A7.2 Multi-user gas storage facilities

WA has two multi-user gas storage facilities in operation, as shown in Table 29.

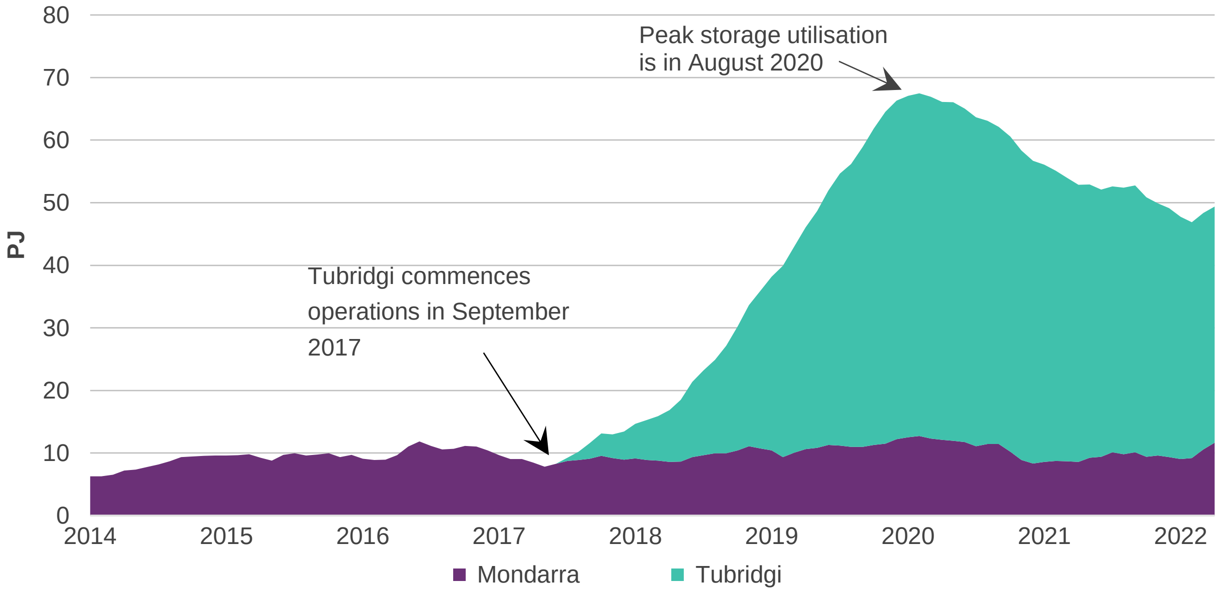
Table 29 WA multi-user gas storage facilities, 2022

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

The amount of gas currently stored in Mondarra and Tubridgi is shown in Figure 26. AEMO estimates that the facilities contained approximately 49 PJ of stored gas in October 2022[132].

Stored gas peaked in August 2020 and declined between September 2020 and October 2022 as withdrawals outpaced injections. Declines in stored gas since 2020 have coincided with increasing prices in the domestic gas spot market[133].

Figure 26 Cumulative stored gas, 2014 to October 2022



Source: WA GBB.

[132] Calculated as net injections less withdrawals over the period August 2013 to October 2022 and excluding cushion gas.

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

A7.3 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 Australia Pty Ltd 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%[134] 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 Australia Pty Ltd and Energy Access Services Pty Ltd.

A7.4 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[135].
- Pluto – 4.9 mtpa[136].
- Gorgon – 15.6 mtpa[137].
- Wheatstone – 8.9 mtpa[138].

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[139]. Approximately 2.5 million tonnes of LNG will be produced from Pluto gas piped into the KGP facilities between 2022 and 2025. Around 20 PJ of Pluto gas will also be supplied into the domestic market via the KGP in the same period.

[134] 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/

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

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

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

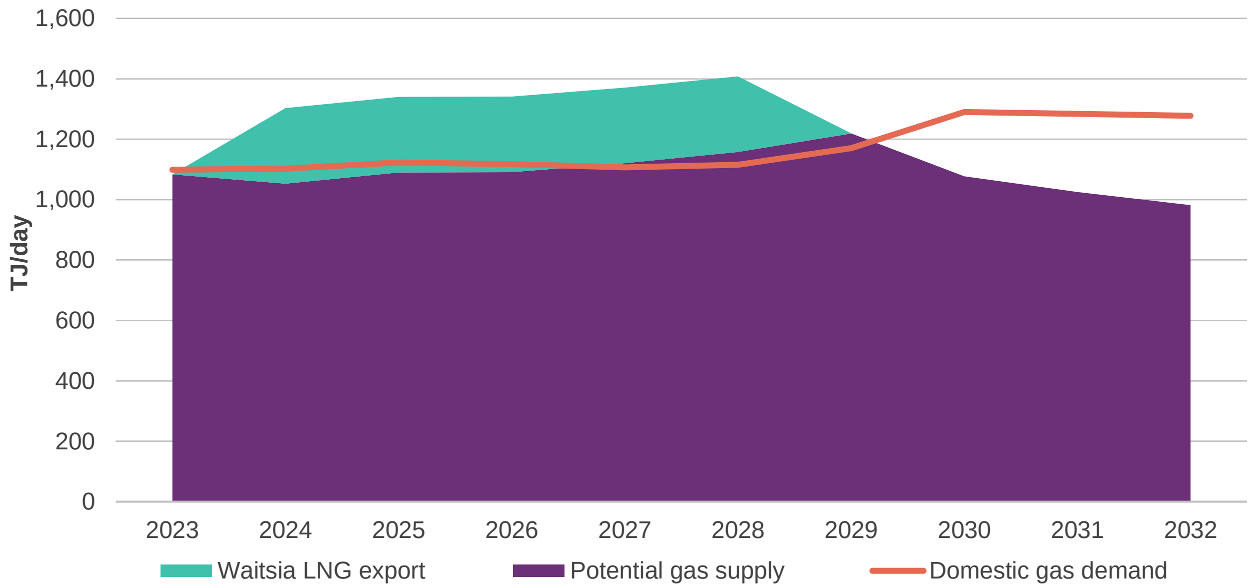
[138] See: https://www.woodside.com/what-we-do/australian-operations/wheatstone-project

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

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[140]. This export deal will be the first time onshore gas has been exported as LNG, and the first time gas been supplied at the southern end of the Dampier Bunbury Pipeline (DBP), but consumed at the northern end. The additional supply and demand created by Waitsia LNG export is shown in Figure 27.

AEMO has excluded the Waitsia export volumes from the supply/demand balance, as it is not true domestic demand. However, the produced gas will be recorded on the GBB and will flow through WA infrastructure.

Figure 27 Domestic gas prospective supply and demand plus Waitsia-to-KGP LNG export gas



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[141] floating LNG facility operated by Shell plc, which exports directly from the offshore facility.
- Ichthys LNG – a 8.9 mtpa[142] LNG project operated by Inpex Corporation, which has an onshore liquefaction plant located in Darwin.

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

[141] See: https://www.shell.com.au/about-us/projects-and-locations/prelude-flng-facility.html

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

A8. 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 meters 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 meters 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
A$	Australian dollar
GJ	Gigajoule
Mtpa	Million tonnes per annum
MW	Megawatt
MWh	Megawatt hour
PJ	Petajoule
Q	Quarter
tcf	Trillion cubic feet
TJ	Terajoule

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
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
DMIRS	WA Department of 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
SWIS	South West Interconnected System
WA	Western Australia
WEM	Wholesale Electricity Market

A9. 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).
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. 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.