CORE ENERGY & RESOURCES

# Jemena Gas Networks (NSW) Gas Access Arrangement

# July 2025 to 30 June 2030

## Gas Demand and Connections Forecast

17 April 2024

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# Glossary

| | |
|---|---|
| AA or GAA | Access Arrangement; Gas Access Arrangement |
| ABS | Australian Bureau of Statistics |
| ACQ | Annual Consumption Quantity |
| ADQ | Average Daily Quantity (ACQ/365) |
| AEMC | Australian Energy Market Commission |
| AEMO | Australian Energy Market Operator |
| AER | Australian Energy Regulator |
| CORE | Core Energy and Resources |
| D/C | Demand per connection |
| EDD | Effective Degree Day |
| GJ | Gigajoule |
| GSP | Gross State Product |
| JGN | Jemena Gas Networks (NSW) Ltd |
| MDQ | Maximum Daily Quantity |
| NCC | National Construction Code |
| NGR | National Gas Rules |
| NSW | New South Wales |
| PJ | Petajoule |
| R-C; RC | Reverse Cycle (Air-conditioning) |
| Review Period | The Access Arrangement Period: 1st July 2025 to 30 June 2030 |
| TJ | Terajoule |

# 1. Executive Summary

## 1.1. Introduction

This report has been prepared by Core Energy and Resources Pty. Ltd. (**CORE**) for the purpose of providing Jemena Gas Network (NSW) Ltd (**JGN**) with an independent forecast of gas customers and gas demand for the company's natural gas distribution networks in New South Wales ("NSW"), for the five-year Access Arrangement (**AA**) Review Period from 1 July 2025 to 30 June 2030 (**Review Period**).

## 1.2. Methodology

CORE has used a methodology which is consistent with the 1 July 2020 to 30 June 2025 AA, with adjustments to reflect AER comments on that AA, changes in circumstances, including the impact of COVID, and changing Government policy stance as it relates to greenhouse gas – (GHG) emissions including future gas use. Although the methodology is consistent, the development of JGN's gas demand forecasts for the Review Period has required a far greater degree of research, analysis, and modelling of expected changes in circumstances which are expected during the Review Period, which results in materially lower levels of growth in connections, demand per connection and demand than compared with the current 2020-25 period.

CORE's methodology has considered AA Proposals and Decisions by the AER, and forecasting techniques and methodologies adopted by leading energy forecasting organisations, both throughout Australia and internationally. This ensures that CORE's approach meets the specific requirements of the NGR.

## 1.3. Demand Forecast

CORE's demand forecast for JGN over the 1 July 2025 to 30 June 2030 period is summarised as follows:

Table 1.1 CORE JGN Demand Forecast (Financial Year ended 30 June)

| Forecast Element | 2026 | 2027 | 2028 | 2029 | 2030 | Average % Change 2026-2030[1] |
|---|---|---|---|---|---|---|
| Residential Demand \| GJ | 27,950,597 | 27,757,484 | 27,308,683 | 26,661,912 | 25,665,813 | -1.70% |
| Commercial Demand \| GJ | 12,560,188 | 12,217,736 | 11,794,816 | 11,295,550 | 10,646,065 | -3.63% |
| Industrial ACQ Demand \| GJ | 45,468,176 | 46,109,915 | 44,328,131 | 42,106,612 | 41,709,173 | -2.12% |
| Industrial MDQ Demand \| GJ | **238,101** | **240,094** | **223,824** | **214,353** | **213,143** | -1.85% |
| Industrial MDQ 9th highest Demand \| GJ | **215,012** | **218,061** | **202,905** | **194,042** | **194,209** | -1.55% |

Source: CORE JGN Demand Model

The following paragraphs provide an overview of CORE's demand forecast for each customer segment.

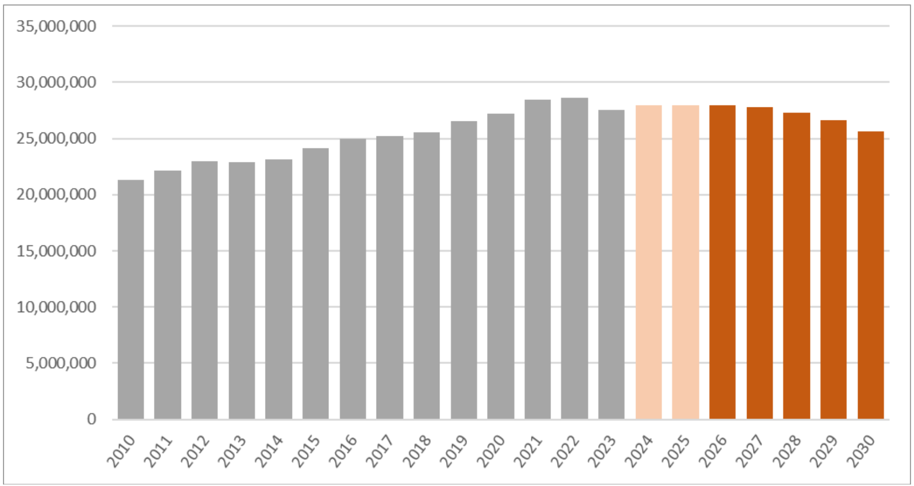
[1] The change is an average annual change based on the % movement between the closing value from the end of FY 2025 to FY 2030

### 1.3.2. Residential

#### 1.3.2.1 Demand

Residential demand is forecast to fall by an average annual rate of 1.7 % between FY2026 and FY2030 due to a low rate of growth in net connections and a reduction in average demand per connected customer.

Figure 1.1 Residential Demand – history and forecast (normalised GJ)




Source: CORE JGN Demand Model

#### 1.3.2.2 Connections

Residential connections are forecast to decline from historical levels due to:

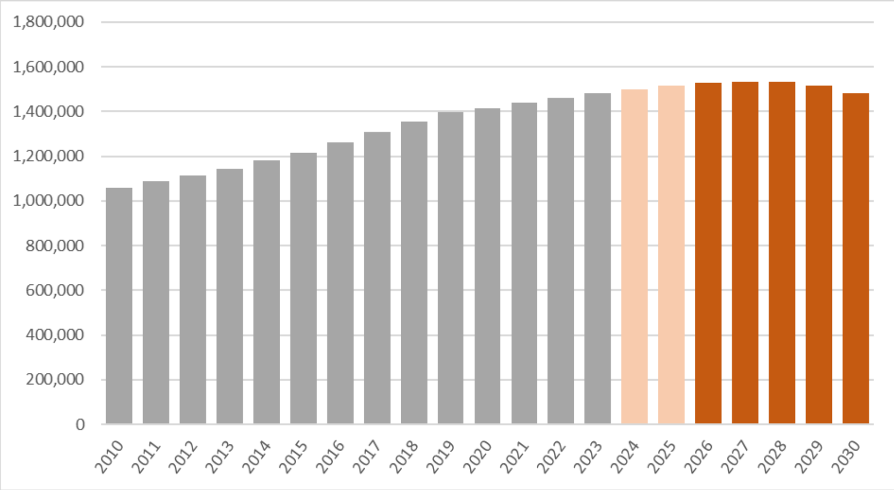
New Customers:

- lower levels of new dwelling construction activity.
- significant NSW dwelling growth outside the JGN network area
- increase in all electric dwellings, leveraging solar and electric heat pump technologies and influenced by new National Construction Code (NCC) standards and government policy which is focused on leveraging renewable energy to meet emission reduction targets.

Existing Customers:

- higher level of "Disconnections" – particularly when appliances require replacement or are replaced during renovation.
- higher level of "Abolishments".
- increased trend toward electrification – particularly when appliances require replacement or during renovation
- increased awareness of cost effectiveness and sustainability of renewable sourced electricity and energy efficiency of heat pump technology – water and space heating.

Figure 1.2 Residential closing connections – history and forecast (No. of connections).



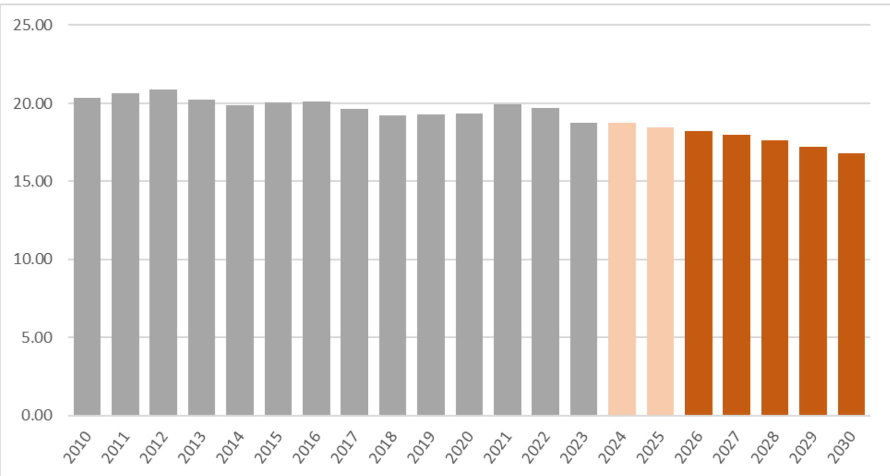

Source: CORE JGN Demand Model

### 1.3.2.3 Demand per Connection

Residential demand per connection is expected to fall at a faster rate than recent historical rates for the following primary reasons:

- increasing solar and battery storage penetration within the "Existing customer" grouping, which substitutes gas use.
- growing trend toward replacement of gas heating with electric R-C air-conditioning when appliances are due to be replaced or during renovation.
- growing trend in use of alternative water heating technologies, including solar and electric heat pumps.
- advances in dwelling construction standards which favour alternative energy sources, including 7 star standards introduced by updates to the NCC, which favour solar and electric appliances.
- increased level of new higher density dwellings with lower levels of gas connection over time and those connected to gas using lower levels of gas due to advances in building and appliance efficiency and lower levels of appliance penetration (lower water and/or space heating penetration).

Figure 1.3 Residential Demand per Connection – history and forecast. (normalised GJ)



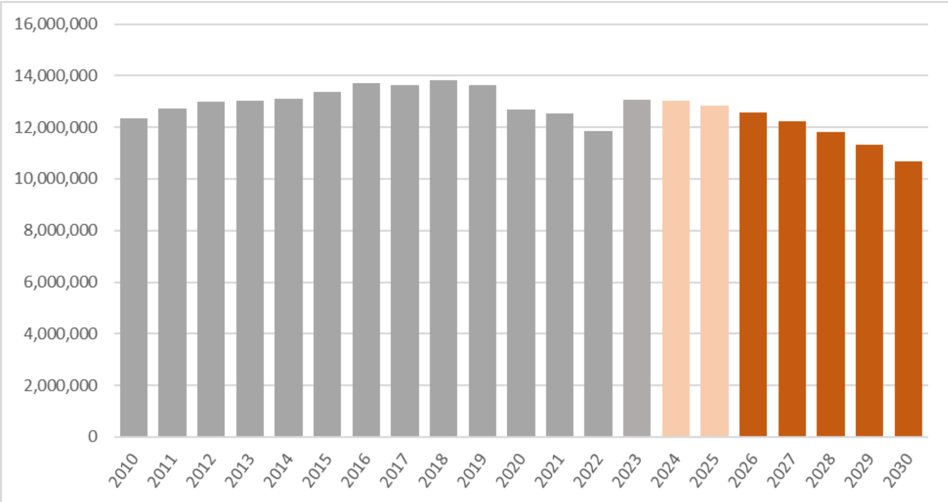

Source: CORE JGN Demand Model

### 1.3.3. Small Business ("SB")

#### 1.3.3.1 Demand

SB demand is forecast to fall by an average annual rate of 3.63% between the Review Period due to a fall in both connections, and average demand per connected customer.

Figure 1.4 SB Demand – history and forecast (normalised GJ).




Source: CORE JGN Demand Model

#### 1.3.3.2 Connections

SB connection growth is forecast to decline from historical levels due to:

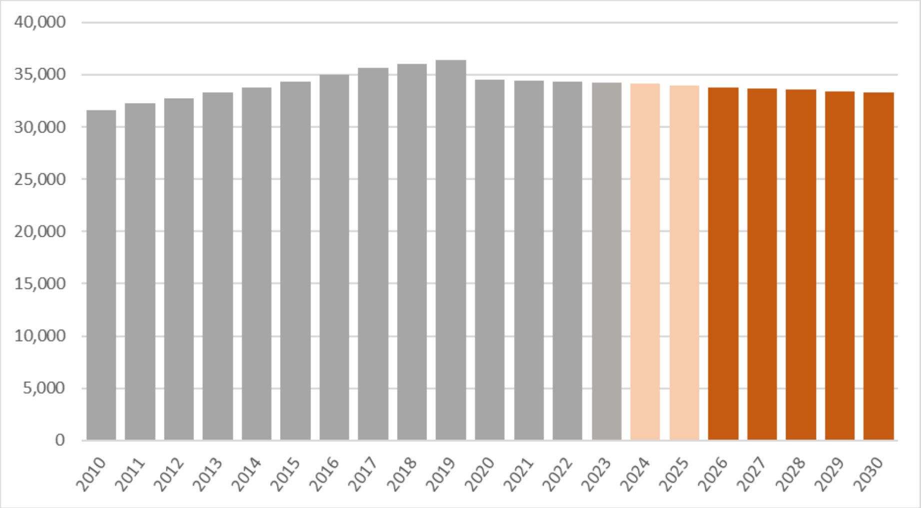
New Customers:

- lower level of forecast new SB developments within the JGN network area.
- increase in all electric buildings, leveraging solar and electric heat pump technologies.
- advances in construction standards which favour other energy sources.

Existing Customers:

- higher level of disconnection – particularly when appliances require replacement.
- increased awareness of cost effectiveness and sustainability of renewable sourced electricity and energy efficiency of heat pump technology – water and space heating.

Figure 1.5 SB Connections – history and forecast (Number of closing connections).



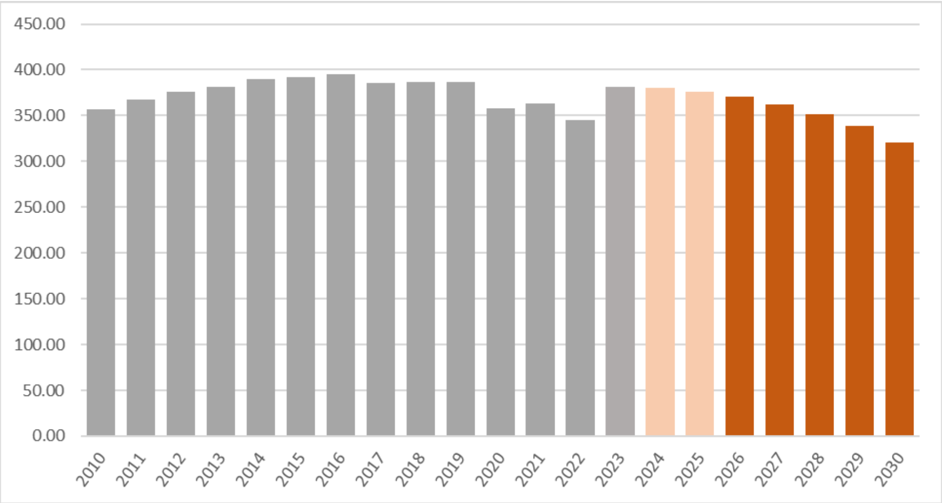

Source: CORE JGN Demand Model

#### 1.3.3.3 Demand per Connection

SB demand per connection is expected to fall at a faster rate than recent historical rates for the following primary reasons:

- increasing solar and battery storage penetration within Existing customer category, which substitutes gas – although to a lower extent than residential.
- continuing advances in energy efficiency.
- growing trend in use of alternative water heating technologies.

Figure 1.6 SB Demand per Connection – history and forecast (normalised GJ).




Source: CORE JGN Demand Model

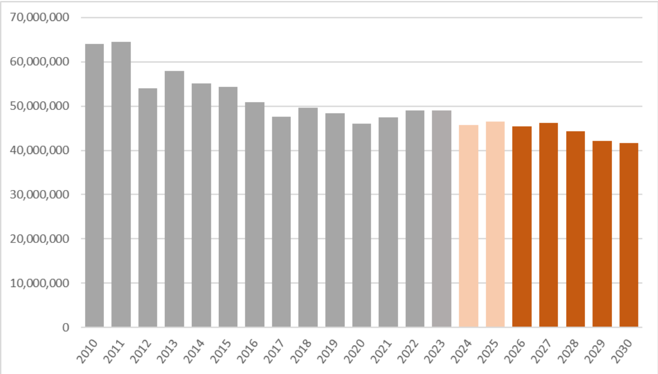
### 1.3.4. Industrial

Industrial demand is forecast to fall between FY 2025 and FY 2030 by an average annual rate of:

- -2.12% for ACQ/ADQ
- -1.85% for MDQ and
- -1.55% for 9th highest MDQ.

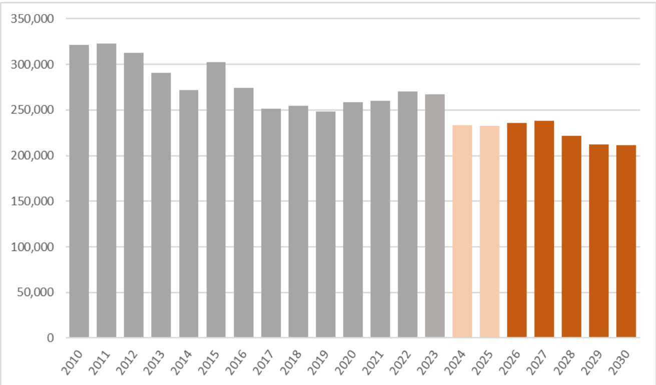
These reductions are due to expected material changes in the ways industrial customers source and use energy, to enhance profitability and meet sustainability standards.

Figure 1.7 Figure 1.7 Industrial ACQ Demand – history and forecast. (GJ)



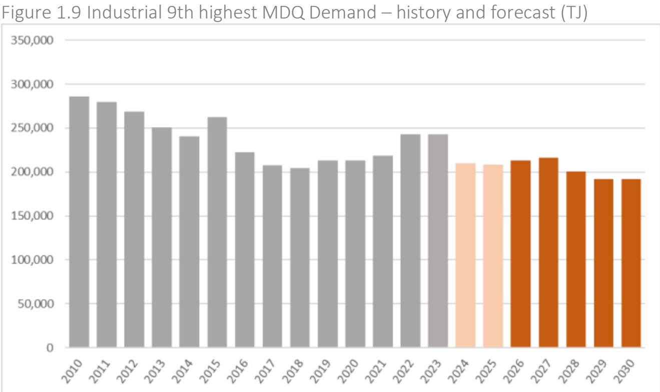

Source: CORE JGN Demand Model

Figure 1.8 Figure 2.8 Industrial MDQ Demand – history and forecast (TJ)




Source: CORE JGN Demand Model

Figure 1.9 Industrial 9th highest MDQ Demand – history and forecast (TJ)




Source: CORE JGN Demand Mode

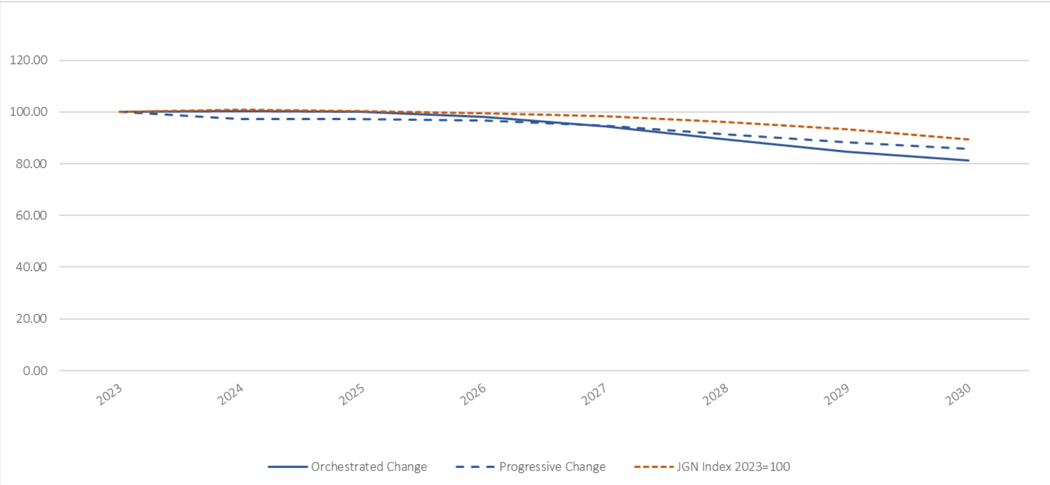
Major changes which are forecast to impact industrial demand include:

- use of new, more energy efficient heating and processing technologies
- greater use of alternative energy sources including solar, hydrogen and waste resources and 'behind the meter' solutions
- changes in market competitiveness across certain sectors.

## 1.4. Validation

As a significant element of a broader validation process, CORE has compared of its forecast against the Progressive and Orchestrated Step Change forecasts presented by AEMO within its 2023 Gas Statement of Opportunities (GSOO) as summarised in the following figures.

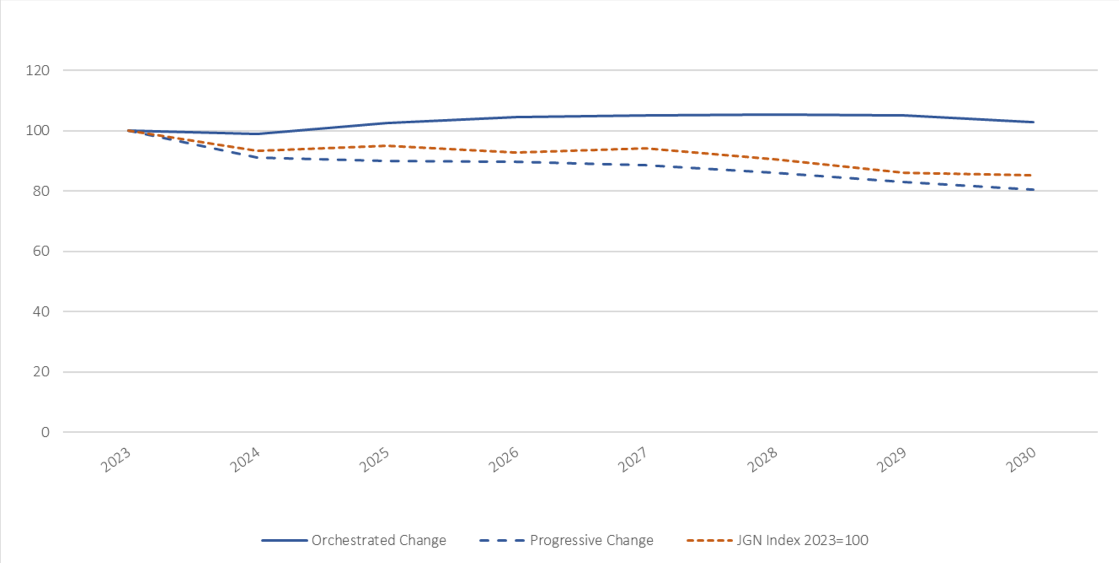
Figure 1.10 JGN R&C forecast and AEMO 2023 GSOO scenarios on an index basis with 2022=100




Source: CORE based on AEMO data and JGN Demand Model; R&C – residential and SB

Figure 2.10 compares Residential and SB (R&C) customers together as AEMO does not present a separate forecast for each segment. Further, the AEMO forecast is for NSW as a whole whereas the JGN forecast is for the network alone (noting that JGN demand represents the vast majority of NSW demand in 2023 (close to 85% based on AEMO data) but NSW demand also includes consumers in other smaller networks including but not limited to the ACT, Albury and Wagga). Figure 2.10 also shows that the JGN forecast is broadly consistent with the two AEMO scenarios which CORE considers most relevant for this purpose, with JGN actual and forecast demand being consistently above the AEMO scenarios and exhibiting a lower rate of decline than the AEMO scenarios.

Figure 1.11 JGN Industrial forecast and AEMO 2023 GSOO scenarios on an index basis with 2022=100




Source: CORE based on AEMO data and JGN Demand Model

Figure 2.11 compares industrial  actual and forecast demand for Industrial customers , again noting that AEMO data is for NSW as a whole. Based on 2023 actual data JGN was close to 90% of NSW demand (based on AEMO data). The JGN forecast is between the AEMO Progressive and Orchestrated Change scenarios.

CORE considers that this analysis provides a strong validation of the CORE forecast. CORE notes that the fit with AEMO is reasonable under the circumstances and CORE has used latest available data, including submissions from Industrial customers, that is, data which is more current than the data relied upon by AEMO prior to its 2023 GSOO release.

# 2. Introduction

## 2.1. Report Scope

This report has been prepared by Core Energy and Resources Pty. Ltd. (**CORE**) for the purpose of providing Jemena Gas Networks (NSW) Ltd (**JGN**) with an independent forecast of gas customers and gas demand for the company's natural gas distribution network in New South Wales (**NSW**), for the five-year Review Period from 1 July 2025 to 30 June 2030 (**Review Period**).

This report and related forecast models will form part of JGN's Revision Access Arrangement (**AA**) submission to the Australian Energy Regulator (**AER**).

CORE has taken all reasonable steps to ensure this report, and the approach to deriving the forecasts referred to within the report comply with Part 9, Division 2 of the National Gas Rules (**NGR**). This division outlines "access arrangement information relevant to price and revenue regulation", including ss 74; 75:

> 74. Forecasts and estimates
>
> (1) Information in the nature of a forecast or estimate must be supported by a statement of the basis of the forecast or estimate.
>
> (2) A forecast or estimate:
>
> (a) must be arrived at on a reasonable basis; and
>
> (b) must represent the best forecast or estimate possible in the circumstances.
>
> 75. Inferred or derivative information
>
> Information in the nature of an extrapolation or inference must be supported by the primary information on which the extrapolation or inference is based.

In addition to this report, CORE attaches the following confidential models to this report:

- JGN EDD Model
- JGN Weather Normalised Demand Model
- JGN Demand Forecast Model

## 2.2. Report Structure

All years refer to financial years (**FY**) unless stated otherwise.

The report comprises the following main elements, supported by certain Annexures:

1. Introduction
2. Executive Summary
3. Methodology
4. Weather Normalisation
5. Residential Demand and Connection - History and Forecast
6. SB Demand and Connections – History and Forecast
7. Industrial Demand and Connections – History and Forecast
8. Allocation of Residential and SB Demand by Customer segments.

## 2.3. Overview of JGN Network

Extending across approximately 25,000 km, JGN distributes natural gas to approximately 1.5 million residential business and industrial sites in Sydney, Newcastle, the Central Coast and Wollongong, as well to customers in more than 20 regional centres, including the Central West, Central Tablelands, South-West, Southern Tablelands, Riverina, and Southern Highlands regions.

Figure 2.1 Map Showing JGN Distribution Network


Source: JGN

JGN offers Transportation services with different tariffs applied to defined tariff classes:

i. **Demand Tariff:** A Delivery Point can be assigned a Demand Tariff customer group where the quantity of gas withdrawn at that Delivery Point is reasonably expected to be equal to or greater than 10 TJ of Gas per annum.

ii. **Volume Tariff:** A Delivery Point can be assigned a volume tariff customer group where the quantity of gas withdrawn at that Delivery Point is reasonably expected to be equal to or less than 10 TJ of Gas per annum.

JGN also provides Ancillary Services including:

- Hourly charge – non-standard User initiated requests and queries
- Abolishment
- Special meter reads
- Expedited reconnection

# 3. Methodology

## 3.1. Overview

The methodology adopted by CORE to derive the demand and connections forecast for the JGN, involves four primary elements – each consistent with the approach adopted for the 2020-25 Review Period.

1. An approach to normalising historical demand to remove the impact of abnormal weather (Section 3.2)
2. An approach to deriving a forecast of Residential demand (Section 3.3)
3. An approach to deriving a forecast of Commercial demand (Section 3.4)
4. An approach to deriving a forecast of Industrial demand (Section 3.5)

The methodology adopted by CORE takes into consideration AER prior draft and final decisions relating to recent AA demand forecast proposals, which together with consideration of approaches adopted by leading national and international organisations engaged in energy forecasting, including AEMO, results in a best-practice approach to gas connection and demand forecasting.

The methodology favours a highly transparent approach, including a demand forecast model that examines material factors that are considered likely to, or have the potential to, impact normalised demand and future connections.

This report sets out material underlying facts and assumptions relied upon to develop forecast gas demand, including actual connections and demand data provided by JGN for the period 1 July 2008 to 30 June 2023.

CORE considers this process to be compliant with s 74(2) of the NGR - Forecasts are constructed on a reasonable basis whilst representing the best forecasts possible in the circumstances.

Further detail relating to major elements of CORE's approach is set out below.

## 3.2. Weather Normalised Demand

Gas consumption by residential and SB customers is materially influenced by weather, including during seasonal winter heating season. Accordingly, the weather impact on historical residential and SB consumption is analysed and modelled to remove the impact of abnormal weather conditions, to provide an appropriate, 'normalised' historical trend in demand per connection for consideration for demand forecasting purposes.

Whilst there is some evidence of industrial sectors being influenced by weather, CORE considers it is not statistically significant to to separate weather from the many other influences on demand across the wide range of ANZSIC industrial classes which are represented within the JGN. Further, the impact of COVID on demand during the FY2020-2022 period and customer recovery phase response in 2023 makes this data unsuitable as an indicator of long-term demand trends. Therefore, Industrial forecasts are based on analysis of historical actual demand, specific customer surveys and factors which are considered to impact future demand which were not necessarily observable in the historic trend.

This approach is consistent with the approach adopted by energy market operator AEMO who excluded price impact from its forecast of gas demand for the Industrial customer class – as observable from AEMOs Electricity and Gas Forecast portal.

Consistent with the 2020-2025 AA, CORE's weather normalisation methodology for residential and SB customers is based on AEMO's EDD forecasting guidelines, as the EDD methodology, based on these guidelines has been demonstrated to provide a more rigorous and accurate approach to normalisation. This approach involves the derivation of an EDD Index and the application of that index to historical actual demand per connection to arrive at normalised historical demand per connection.

### 3.2.1. EDD Index

The weather index used for weather normalisation purposes is based on AEMO's $EDD_{312}$ methodology which has been accepted by the AER in previous AAs including JGN's 2020-25 AA. The calculation method and resulting parameters are outlined below:

EDD Calculation:

1. Access historical actual weather data sourced from the Bureau of Meteorology (BoM)
2. Develop an EDD Index Model. The EDD model is included as a supporting confidential document to this report.
3. Use the EDD Model to derive EDD Index coefficients by regressing daily gas demand on climate data, ranging from 2008 to 2023 (Residential and SB only).
4. Calculate EDD by using the weather normalised demand model and EDD index coefficients. The weather normalisation model is included as a supporting confidential document to this report.
5. Compare new results against prior AA results and ensure all material movements are understood and considered reasonable.

Below is a summary of the model structure and coefficients of CORE's $EDD_{312}$ Index, with weather data sourced from the BoM:

Daily demand per connection = $b_0 + b_1$*EDD + $b_2$*Friday + $b_3$*Saturday +$b_4$*Sunday.

| | | |
|---|---|---|
| EDD = | Degree Day ("DD312") | temperature effect |
| | + 0.01 * MAX (21.04 - Temperature, 0) * Wind speed | wind chill factor. |
| | - 0.05 * sunshine hours | warming effect of sunshine |
| | + Max (3.95 *2* Cos $\left(\frac{2\pi(\text{day}-190)}{365}\right)$ ) | seasonality factor |

Where $DD_{312}$ is the degree day as calculated by the following table:

| | | |
|---|---|---|
| $DD_{312}$ = | $T_2 - T_1$ if $T_1 < T_2$ | Daily temperature above threshold temperature |
| | 0 if $T_1 > T_2$ | Daily temperature below threshold temperature |

- $T_1$ is the average of 8 three-hourly temperature readings (in degrees Celsius).
- $T_2$ represents the estimated threshold temperature for gas heating.
- Average wind speed is the average of the 8 three-hourly wind observations.
- Sunshine hours are the number of hours of sunshine above a standard intensity. CORE notes that the associated coefficient was estimated to be 0 across the sample period. This is not uncommon for gas networks in temperate regions of Australia where maximum temperature statistically captures most of the sunshine impact.
- The seasonality factor models variability in consumer response to different weather. It indicates that residential and SB consumers more readily turn on, adjust heaters higher or leave heaters on longer in winter than in the shoulder seasons given the same weather or change in weather conditions. For example, central heaters are often programmed once cold weather sets in resulting in more regular use and consumers are potentially in the habit of using heating appliances once the middle of winter is reached. This change in consumer behaviour is captured in the Cosine term in the EDD formula, which implies that for the same weather conditions heating demand is higher in winter than in the shoulder seasons or in summer.[2]

### 3.2.2. Weather Normalised Demand – Residential and Small Business

CORE has developed a model to facilitate weather normalisation analysis which has been used for Residential and Small Business segments. The model is materially consistent with the one used for JGN's 2020-2025 AA.

The $EDD_{312}$ Weather Index was then used for regression analysis on JGN's residential and small business consumption data.

| | |
|---|---|
| 1. | Residential and Commercial data was regressed on historical EDD data, monthly. |
| 2. | The statistical relationship between customer gas demand and weather fluctuations was determined. |
| 3. | The regressions were performed with the two main data sets:<br>▪ Monthly sum of EDDs (calculated from the daily EDD series obtained from the first stage)<br>▪ Monthly sum of gas demand and gas demand per connection (JGN demand data) |

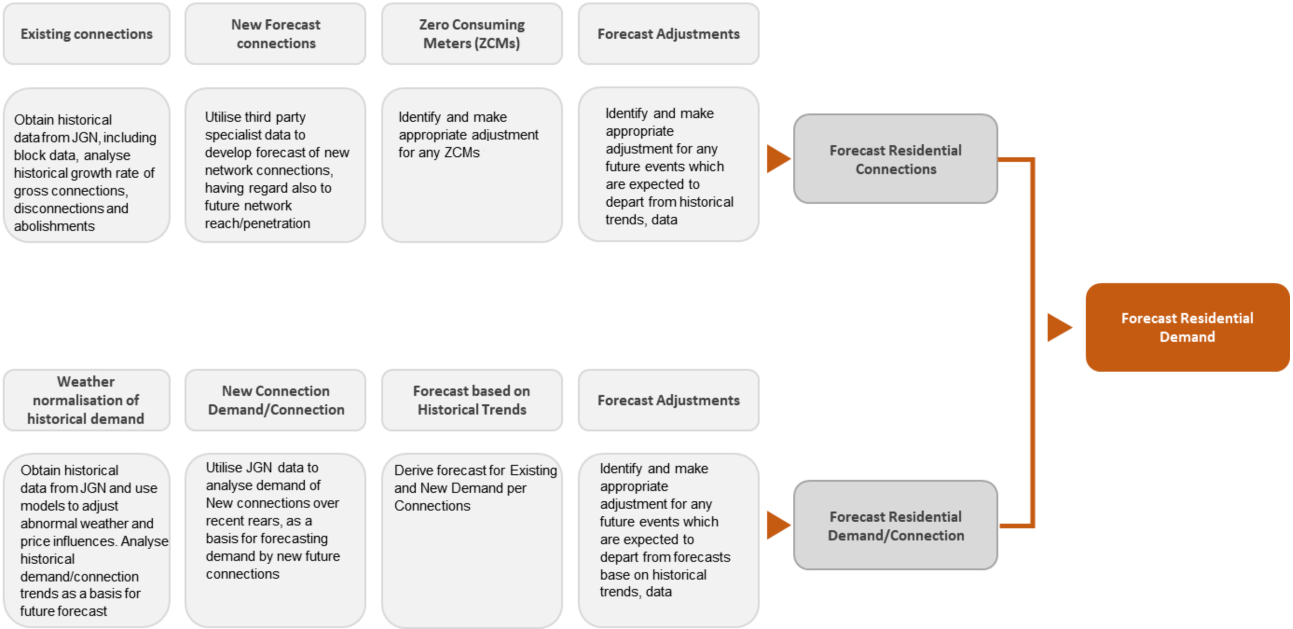
CORE considers this process to be compliant with s 74(2) of the NGR. Forecasts are constructed on a reasonable basis whilst representing the best forecasts possible in the circumstances.

[2] As described in; AEMO, *Victorian EDD Weather Standards – EDD312 (2012)*

## 3.3. Residential Customer segment

The methodology adopted by CORE for Residential demand forecasting purposes, is outlined in the figure below. This figure shows that residential demand is the product of forecast residential connections and demand per connection.

Figure 3.1 Tariff B3 Demand Forecast Methodology




Source: CORE

### 3.3.1. Connections

A combination of inhouse data and third-party specialist forecasts is an important element in this approach. This includes:

- analysis of historical trends based on JGN data.
- HIA residential commencement forecasts as a basis for forecasting NSW completions.
- ABS data to support analysis of energy and gas use trends and economic factors.

This approach is consistent with the approach adopted in JGN's 2020-25 AA.

#### 3.3.1.1 Existing Connections

- Residential connection numbers for 2010 to 2023 were compiled by CORE based on data provided by JGN.
- historical temporary disconnection and abolishment data was compiled by CORE based on data sourced from JGN.
- the closing 2023 connections are defined as existing connections for the forecast. The forecast of existing connections for a given year is derived by removing forecast disconnections from forecast opening connections. Forecast disconnections are based on the historical average of disconnections as a percentage of the year-opening number of connections, and adjusting for any factors which vary between the forecast and historical periods.
- the forecast of disconnections and abolishments also considers zero consuming meters – i.e. a Meter Identification Reference Number (MIRN) within the JGN system which has no recorded usage for a defined period.

#### 3.3.1.2 New Connections

CORE has derived an estimate of new dwelling connections in the 2024 to 2030 period via a four-step process:

1. *estimate new dwellings in NSW:* CORE has undertaken an extensive literature search and statistical analysis to derive a forecast of NSW dwelling completions. CORE has relied upon independent studies completed by HIA .
2. *estimate number of new dwellings in NSW that will be developed within the JGN area:* CORE has analysed dwelling completions within the LGA's served by the JGN network (Coastal and Country) relative to NSW as a whole, having regard to third party population and dwelling forecasts, including NSW Government and ABS.
3. *forecast the number of dwellings expected to be connected to the JGN network annually.* CORE analysed the historical JGN network penetration rate and determined adjustments based on forecast demographic and other trends, including decisions or pending decisions by a number of local governments to ban new gas connections, based on data sourced from HIA, NSW Government, ABS and local governments.
4. *determine the apportionment of forecast connections between dwelling types:* to enable analysis of the difference in demand per connection between the dwelling types. CORE analysed the historical average increase of houses vs medium and higher density dwellings, based on third party analysis including NSW Government, and forecast dwelling commencements by dwelling type which is sourced from HIA.

### 3.3.2. Demand per Connection

CORE has considered the alternative methodologies that could reasonably be used to forecast residential demand per connection. CORE considers that the most accurate estimate involves analysis of the historical annual average growth and then adjusting for the impact of each material factor influencing that growth. Regression analysis was completed for a range of other macroeconomic variables such as household income. Ultimately, no statistical trend fitted to the data set was significant, meaning that weather and price-normalised historical average growth rates were a more reliable alternative. In carrying out this approach, CORE ensured that all analysis was rigorous, data of a suitable quality was utilised, the forecast was set out in a transparent fashion and any assumptions, inputs, calculations, and results were displayed.

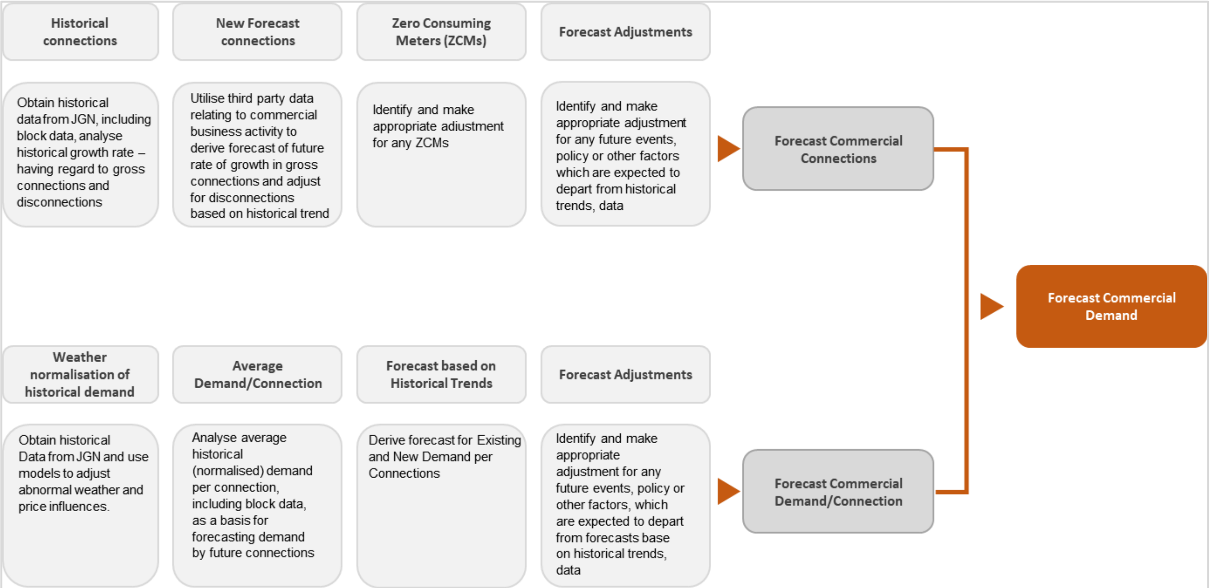
Therefore, the steps taken to arrive at a forecast of demand per connection were as follows:

- normalise demand per connection for the effects of weather using the process outlined in Section 4.
- derive the historical annual average growth in demand per connection based on normalised demand per connection between FY 2010 and 2023 using data provided by JGN.
- derive a forecast of demand per connection, having regard to major factors which are expected to influence demand per connection including economic activity, government policy, appliance switching and building and appliance efficiency trends.

## 3.4. SB Segment

The methodology adopted to derive a forecast of SB demand is similar to the approach used for Residential demand, although different drivers of demand are relied upon. The figure and paragraphs below provide relevant detail of the approach to deriving both SB Connections and Demand per Connection which form the basis of the Demand forecast.

Figure 3.2 SB Tariff Demand Forecast Methodology




Source: CORE

### 3.4.2. Connections

The following steps were taken to derive a forecast of SB connections.

- collate connections data from the FY 2009 to 2023 period based on inputs provided by JGN, which is used to derive annual growth rates for the 2010=2023 period.
- undertake analysis to arrive at the most appropriate drivers to use as a basis for forecasting future connections.
- use the selected driver/s to forecast connections for the 'bridging years' of 1 July 2024 to 30 June 2025 and the forecast for 1 July 2025 to 30 June 2030 .

### 3.4.3. Demand per Connection

The approach used in the residential demand forecast was also adopted for the SB sector.

- normalise historical demand per connection for the effects of weather using the process outlined in Section 4.
- determine the historical annual average growth in demand per connection based on demand per connection between 2010 (based on 2009-2010 movement) and 2023, for both existing and new connections based on inputs provided by JGN.
- determine the forecast of demand per connection, having regard to the normalised historical annual average growth and the movement in factors that are expected to impact future demand per connection. These factors include policy change, efficiency, decarbonisation and appliance mix trends.

## 3.5. Industrial Segment

Industrial demand (ACQ, MDQ and 9th highest MDQ) has been forecast via the following steps:

1. analysis of individual customer data, and customer cluster data based on ANZSIC classes, including historical demand trends, using data provided by JGN.
2. analysis of customer responses to a survey.
3. consideration of any known closures and load changes advised by JGN or identified via CORE research.
4. research and analysis of third-party data to assess factors that are expected to impact ACQ demand of individual customers and customer clusters data based on ANZSIC classes.
5. analysis of the historical relationships between MDQ with ADQ (ACQ/365).

# 4. Weather Normalised Historical Demand

## 4.1. Introduction

CORE's analysis of historical demand is based on weather normalised data to remove the influence of abnormal fluctuations on historical demand across the residential and SB customer segments, utilising proprietary EDD Index and Weather Normalisation models.

CORE's proprietary EDD index model and weather normalised demand model should be referred to in conjunction with this report. These models have been submitted to JGN to *form a confidential attachment to JGN's Access Arrangement Information*.

## 4.2. EDD Index

The EDD Index model is used to analyse relationships between movement in historical weather factors and movement in demand per connection, using widely accepted statistical regression techniques. The result is a series of coefficients which are used as inputs to the weather normalisation model.

Due to the impact of COVID on demand between 2020 and 2022 and customer behaviour in recovery in 2022-23, data used for the period to end 2023 resulted in statistically inferior results. Therefore, data used for EDD index purposes focused on the ten period between 2009 and 2019.

The EDD Index coefficients presented below have been used to normalise Residential and SB demand. As part of this process, both EDD and a linearised trend in historical EDD (due to warming trends) are calculated. Actual EDD greater than the EDD linearised trend, implies that weather in the year was colder than normal (and vice versa). Colder weather induces higher demand per connection, as more gas is required for heating (and vice versa).

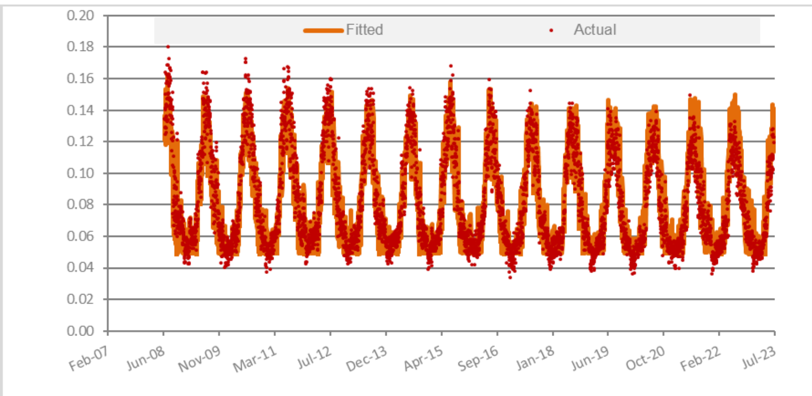
Table 4.1 EDD Index Coefficients

| | | |
|---|---|---|
| Degree Day Threshold | °C | 21.0786 |
| Wind Chill Coefficient | No. | 0.0111 |
| Insolation Coefficient | No. | -0.0500 |
| Seasonality Factor | No. | 197.07082 |
| Seasonality Coefficient | No. | 4.0019 |

Source: CORE based on EDD model

A chart showing the fit between actual demand and fitted demand is presented in the following figure.

Figure 4.1 Actual and Fitted Demand per Connection – Residential and SB demand per connection.




Source: CORE based on EDD model

## 4.3. Weather Normalisation

CORE's weather normalisation model is used to normalise actual JGN demand data for the FY 2009 to FY 2023 period.

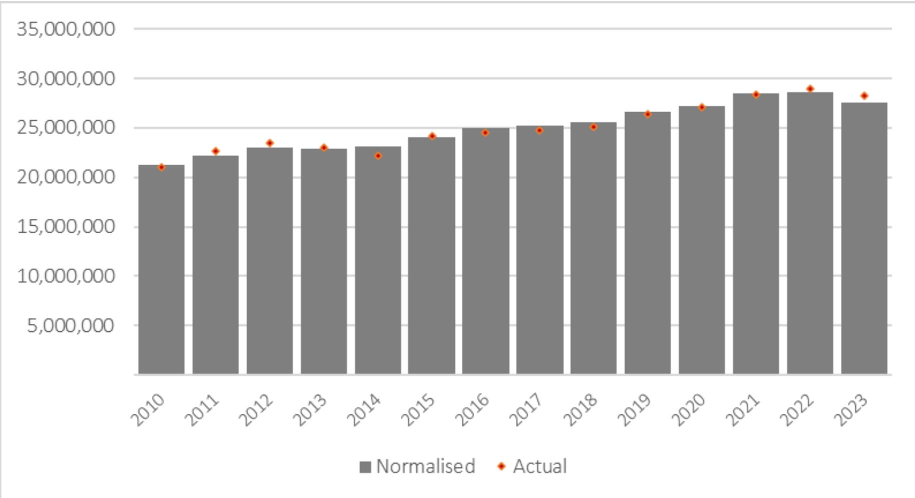
The model utilises coefficients from the EDD index model and applies a regression technique to derive separate coefficients to derive normalised demand per connection for both residential and SB segments.

### 4.3.1. Weather Normalised Demand Results

#### 4.3.1.1 Residential

Normalised Residential demand increased moderately between 2009 and 2014, with increased growth rates through to 2022, noting that COVID influences on demand in the 2020-2022 period. Demand returned toward a pre COVID decline trend in 2023.

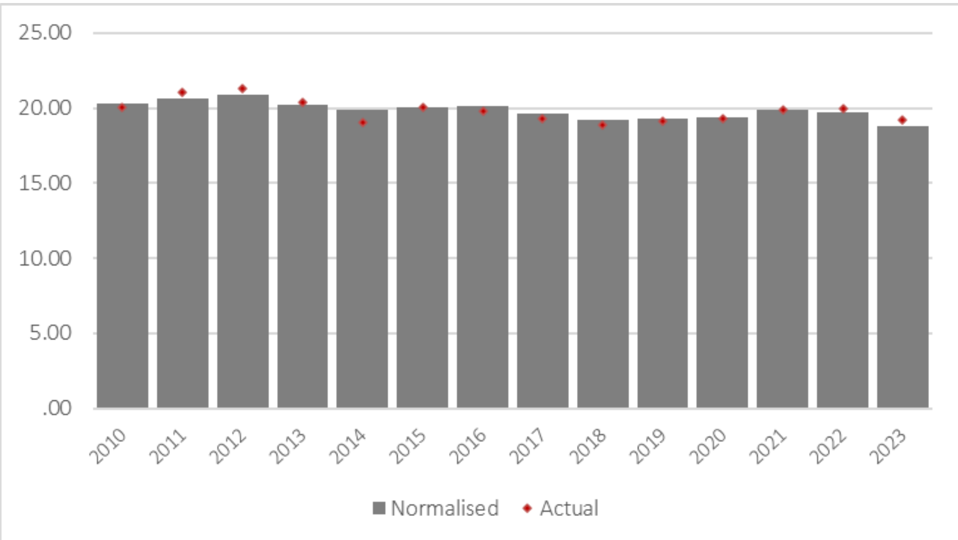
Figure 4.2 Residential Demand | GJ




Source: CORE based on weather normalisation model

Normalised Residential demand per connection has trended downward from FY 2012 to 2018, with increases thereafter to 2022, influenced by COVID followed by a fall in 2023.

Figure 4.3 Residential Demand per Connection | GJ

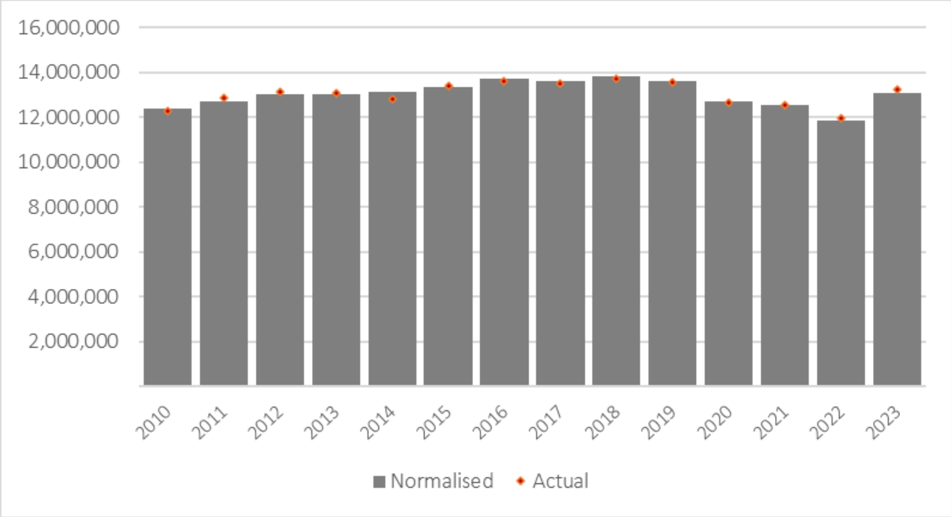



Source: CORE based on weather normalisation mode

#### 4.3.1.2 SB

Normalised historical demand has followed a moderate upward trend between 2011 and 2018 before flattening out through to 2019 and falling materially between FY 2020 and FY 2022 (due in part to COVID influences) and increasing in 2023 following lifting of COVID restrictions.

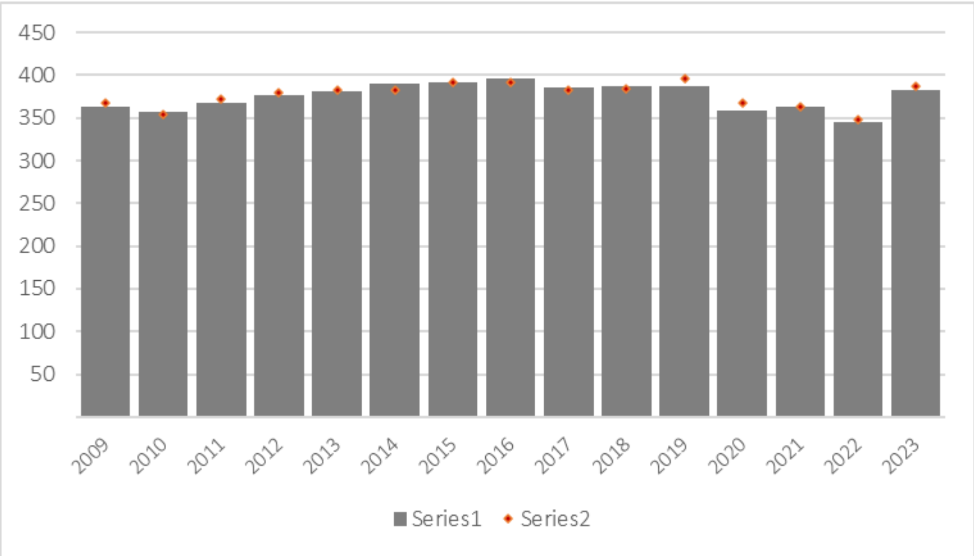
Figure 4.4 SB Demand | GJ




Source: CORE based on weather normalisation model

Normalised demand per connection has followed a trend which is close to that of SB demand above.

Figure 4.5 SB Demand per Connection | GJ




Source: CORE based on weather normalisation model

Table 4.2 Summary of EDD, Historical actual demand and weather normalised demand and demand per connection

| Year | | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Linearised EDD | (°C) | | 2,322 | 2,318 | 2,314 | 2,317 | 2,306 | 2,302 | 2,298 | 2,301 | 2,291 | 2,287 | 2,283 | 2,285 | 2,275 | 2,271 | 2,267 |
| EDD | (°C) | | 2,448 | 2,218 | 2,466 | 2,455 | 2,355 | 2,020 | 2,307 | 2,191 | 2,176 | 2,178 | 2,235 | 2,255 | 2,268 | 2,358 | 2,432 |
| Difference | (°C) | | 126 | (100) | 152 | 138 | 49 | (283) | 8 | (110) | (114) | (108) | (48) | (30) | (7) | 87 | 165 |
| Residential \| Normalisation | | | | | | | | | | | | | | | | | |
| Residential normalised demand | (GJ) | | 21,586,037 | 21,287,364 | 22,178,946 | 22,974,604 | 22,860,176 | 23,112,247 | 24,102,663 | 24,991,946 | 25,251,847 | 25,584,298 | 26,572,365 | 27,246,328 | 28,437,909 | 28,608,732 | 27,582,541 |
| Residential actual demand | (GJ) | | 21,946,959 | 20,970,182 | 22,643,235 | 23,408,624 | 23,006,111 | 22,134,027 | 24,108,808 | 24,567,597 | 24,797,288 | 25,144,448 | 26,355,391 | 27,108,230 | 28,396,125 | 28,962,933 | 28,285,546 |
| Difference | (GJ) | | 360,922 | (317,182) | 464,290 | 434,021 | 145,935 | (978,220) | 6,146 | (424,350) | (454,559) | (439,850) | (216,973) | (138,099) | (41,784) | 354,201 | 703,005 |
| Residential normalised demand per cc | (GJ/no.) | | 21.07 | 20.33 | 20.66 | 20.88 | 20.24 | 19.85 | 20.07 | 20.14 | 19.65 | 19.21 | 19.30 | 19.37 | 19.92 | 19.73 | 18.76 |
| Residential actual demand per connec | (GJ/no.) | | 21.42 | 20.03 | 21.09 | 21.27 | 20.36 | 19.01 | 20.07 | 19.80 | 19.29 | 18.88 | 19.14 | 19.27 | 19.89 | 19.97 | 19.24 |
| Difference | (GJ) | | 0.35 | -0.30 | 0.43 | 0.39 | 0.13 | -0.84 | 0.01 | -0.34 | -0.35 | -0.33 | -0.16 | -0.10 | -0.03 | 0.24 | 0.48 |
| Commercial \| Normalisation | | | | | | | | | | | | | | | | | |
| Commercial normalised demand | (GJ) | | 12,463,626 | 12,364,187 | 12,714,949 | 13,008,436 | 13,041,264 | 13,111,351 | 13,365,824 | 13,705,497 | 13,622,159 | 13,838,968 | 13,618,597 | 12,696,555 | 12,533,102 | 11,853,880 | 13,080,056 |
| Commercial actual demand | (GJ) | | 12,591,046 | 12,261,749 | 12,869,140 | 13,144,538 | 13,091,783 | 12,829,299 | 13,370,470 | 13,589,634 | 13,499,580 | 13,725,744 | 13,570,461 | 12,665,392 | 12,525,258 | 11,937,687 | 13,248,081 |
| Difference | (GJ) | | 127,420 | (102,437) | 154,191 | 136,101 | 50,519 | (282,052) | 4,645 | (115,863) | (122,578) | (113,224) | (48,136) | (31,163) | (7,844) | 83,807 | 168,026 |
| Commercial normalised demand per c | (GJ/no.) | | 363 | 357 | 368 | 376 | 381 | 390 | 392 | 395 | 386 | 387 | 387 | 358 | 364 | 345 | 382 |
| Commercial actual demand per conne | (GJ/no.) | | 367 | 354 | 372 | 380 | 382 | 382 | 392 | 392 | 382 | 384 | 396 | 367 | 363 | 347 | 387 |
| Difference | (GJ) | | 3.7 | (3.0) | 4.5 | 3.9 | 1.5 | (8.4) | .1 | (3.3) | (3.5) | (3.2) | (.4) | (.3) | (.2) | 2.4 | 4.9 |
| Connections | | | | | | | | | | | | | | | | | |
| Residential Opening Connections | | 956,699 | 1,009,764 | 1,034,658 | 1,058,256 | 1,086,637 | 1,114,561 | 1,144,132 | 1,180,138 | 1,215,749 | 1,261,217 | 1,308,745 | 1,355,179 | 1,398,851 | 1,414,617 | 1,440,248 | 1,460,152 |
| Residential Closing Connections | | 1,009,764 | 1,034,658 | 1,058,256 | 1,086,637 | 1,114,561 | 1,144,132 | 1,180,138 | 1,215,749 | 1,261,217 | 1,308,745 | 1,355,179 | 1,398,851 | 1,414,617 | 1,440,248 | 1,460,152 | 1,480,276 |
| Residential Net Movement | | 53,065 | 24,894 | 23,598 | 28,381 | 27,924 | 29,571 | 36,006 | 35,611 | 45,468 | 47,528 | 46,434 | 22,672 | 36,766 | 25,631 | 19,904 | 20,124 |
| Commercial Opening Connections | | 28,551 | 30,503 | 31,075 | 31,592 | 32,243 | 32,767 | 33,264 | 33,775 | 34,332 | 34,949 | 35,608 | 36,060 | 36,362 | 34,556 | 34,384 | 34,337 |
| Commercial Closing Connections | | 30,503 | 34,465 | 31,592 | 32,243 | 32,767 | 33,264 | 33,775 | 34,332 | 34,949 | 35,608 | 36,060 | 36,362 | 34,556 | 34,384 | 34,337 | 34,186 |
| Commercial Net Movement | | | 3,962 | 517 | 651 | 524 | 497 | 511 | 557 | 617 | 659 | 452 | 302 | 91 | (172) | (47) | (151) |

Source: CORE based on EDD and weather normalisation models

# 5. Residential Demand and Connections - History and Forecast

## 5.1. Introduction

This section of the report presents detail of CORE's approach to derivation of the Residential demand forecast, on a weather normalised basis.

Residential demand is derived using a bottom-up approach: the product of forecast connections and demand per connection.

CORE's approach takes into consideration historical trends as well as expectations of future drivers of demand which are not present in the historic data/trends – both macro and micro in nature, utilising a proprietary demand forecasting model. This report should be read in conjunction with the relevant tabs of CORE's JGN Demand model *which is a confidential attachment to JGN's Access Arrangement Information*.

## 5.2. Historical Trend Overview

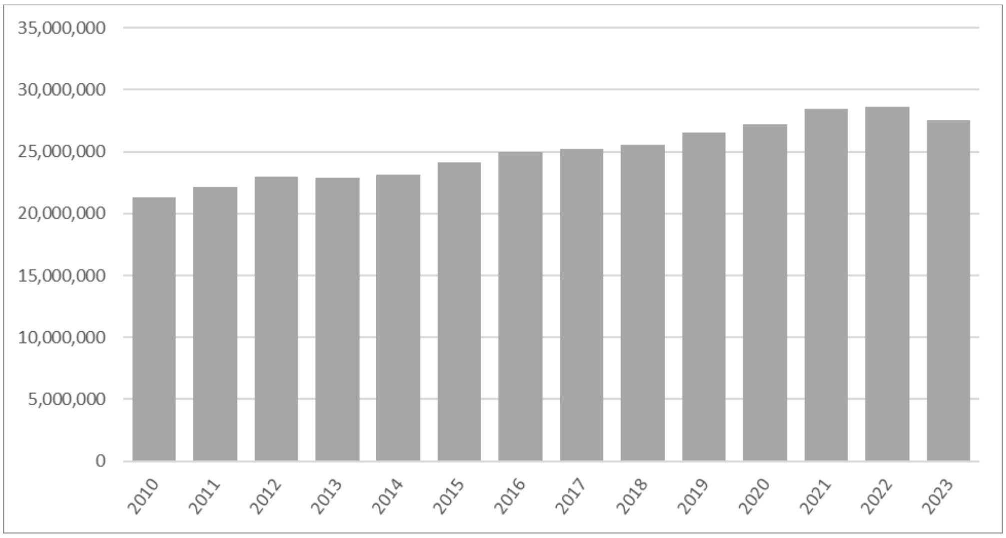
The approach to deriving a forecast of Residential demand commences with analysis of historical movements in demand and underlying movements in connections and demand per connection.

### 5.2.1. Historical Residential Demand Analysis

Due to the material impact of COVID on demand during 2020-2022, CORE has focused its analysis on the period to end of 2019 while considering any other facts of relevance during the period to FY 2023.

Residential normalised demand increased by an average annual rate of approximately 2.12% between 1 July 2009 and 30 June 2019, due to a growth in connections (2.91%), offset partially by a fall in average consumption per connection (-1.06%) as addressed below.

Figure 5.1 Residential weather normalised demand | GJ




Source: CORE based on weather normalisation model

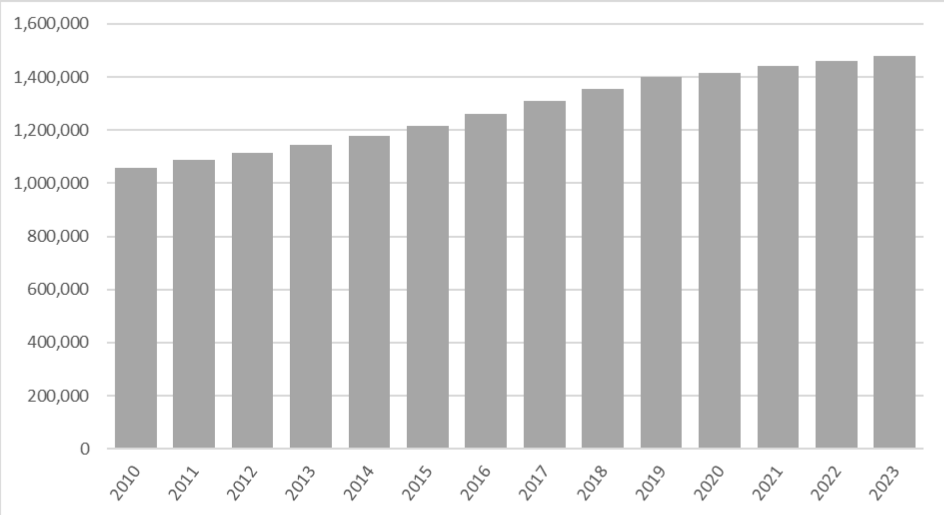
### 5.2.2. Historical Residential Connection Analysis

Residential closing connections increased by an average annual rate of 2.91% between 1 July 2009 and 30 June 2019, as shown n figure 5.2 below.

The net growth includes several elements which are analysed in later paragraphs:

- "Gross connections" - the net growth in residential dwelling completions in NSW
- "Penetration rate" – the % of NSW new dwellings which connect to the JGN based on gas appliance installation.
- "Temporary Disconnections" – the % of JGN connected customers which subsequently disconnect during the period.
- "Abolishments".

Figure 5.2 Residential Connections | No.




Source: CORE based on weather normalisation model

### 5.2.3. Historical Residential Demand per Connection (D/C) Analysis

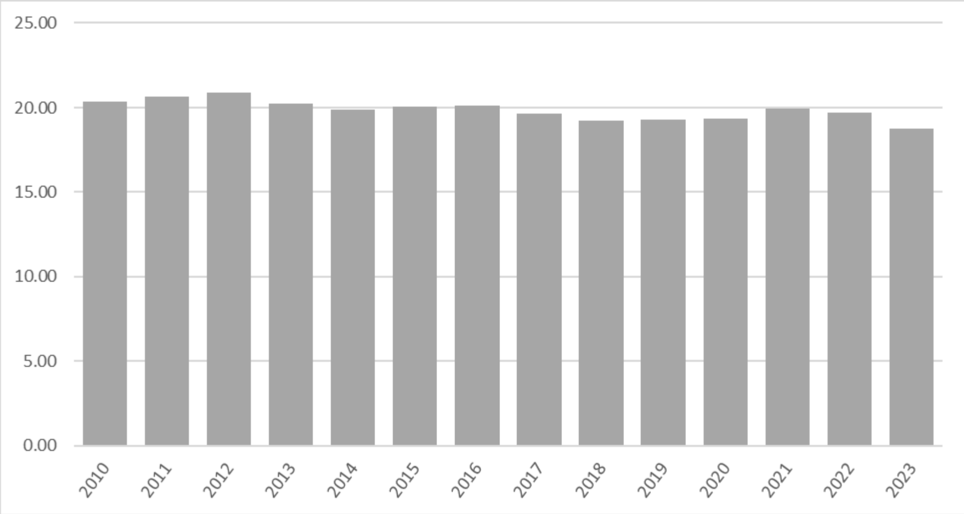
Residential D/C fell at an average annual rate of -1.06% between 1 July 2009 and 30 June 2019.

The net movement includes several elements which are analysed in later paragraphs:

- Existing connection D/C – average consumption per connection for customers existing at the commencement of a defined period.
- New connection D/C – average consumption per connection for new customers which connect to the JGN network.
  - "New Dwellings" with one or more gas appliances
  - "E to G" – customers previously using only electricity which acquire a gas appliance and connect to the network.
  - "High rise" dwellings and medium density dwellings with one or more gas appliances

These elements are analysed separately due to differences in D/C for each element.

Figure 5.3 Residential Demand/Connection | GJ.




Source: CORE based on weather normalisation model

## 5.3. Forecast Residential Demand and Connections

The methodology adopted by CORE to derive a forecast of JGN Residential demand, and connections is outlined in Section 3. CORE considers that this methodology delivers outcomes which are consistent with the NGR – the best forecast or estimate possible in the circumstances.

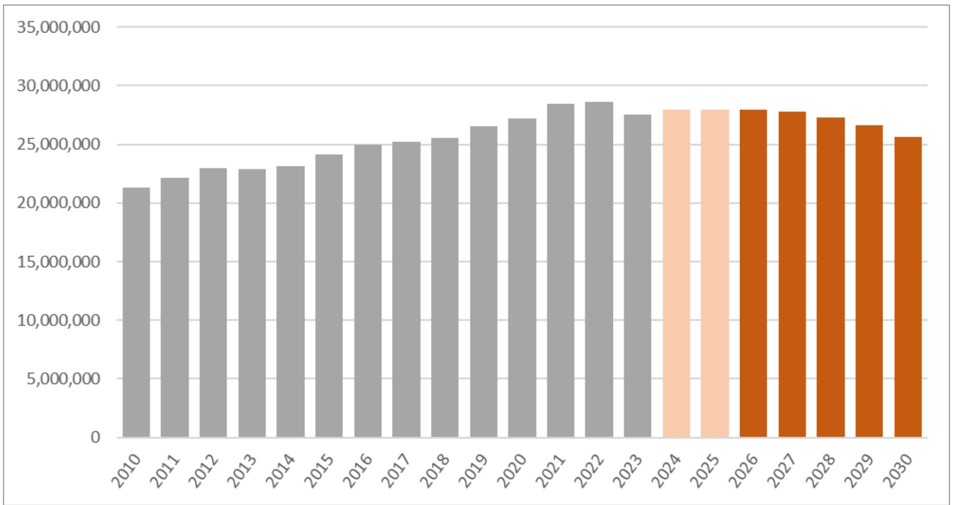
CORE's approach commences with a forecast of connections, followed by demand per connection, with the product of these elements being forecast demand.

CORE's demand forecast is summarised below and is followed by an analysis of underlying drivers.

### 5.3.1. Forecast Residential Demand

CORE forecasts modest growth in demand during the 2024-2025 period, relative to the pre COVID years, before plateauing in 2026 and declining thereafter. The forecast average annual decline during the Review Period is -1.7%, due to forecast declines in both connections and demand/connection as addressed below.

Figure 5.4 Residential Demand | GJ.




Source: CORE based on JGN Demand Model

### 5.3.2. Forecast Residential Connections

CORE's forecast of connections involves five primary elements:

- NSW dwelling completions - the growth in residential dwelling completions in NSW
- JGN Penetration rate – the % of NSW new dwellings which connect to the JGN network based on gas appliance installation.
- Disconnections – the % of JGN connected customers which subsequently temporarily disconnect during the period.
- Reconnection – temporary disconnections which subsequently reconnect to the network.
- Abolishments.

At the same time CORE collects additional data to support analysis of forecast demand per connection, focused on:

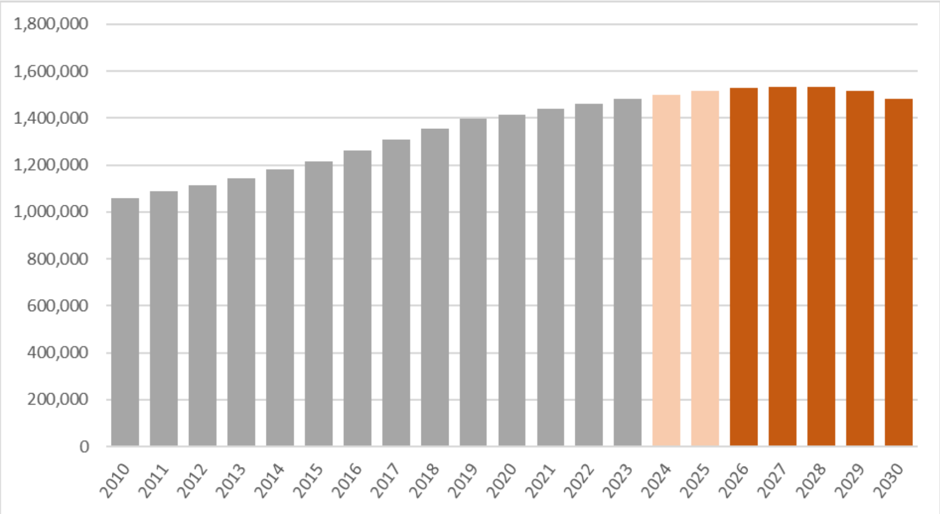
- JGN Penetration rate per dwelling type
- Dwelling connect type – E2G, estate/home, multi-story (high and medium density development).

### 5.3.3. Overview of Connection History and Forecast

The following figure summarises historical actual connections and CORE's forecast of connections for the two bridging years of 2024-2025 and the five-year Review Period ending in FY 2030.

This chart is characterised by a relatively consistent growth in connections until 2018 before tapering during the period to 2023, including COVID impacts. Growth rates are forecast to progressively flatten from 2024 and plateauing/falling from 2027, with an average growth rate for the 2026-2030 period of -0.49%.

Figure 5.5 Historical and Forecast Residential connections | No.



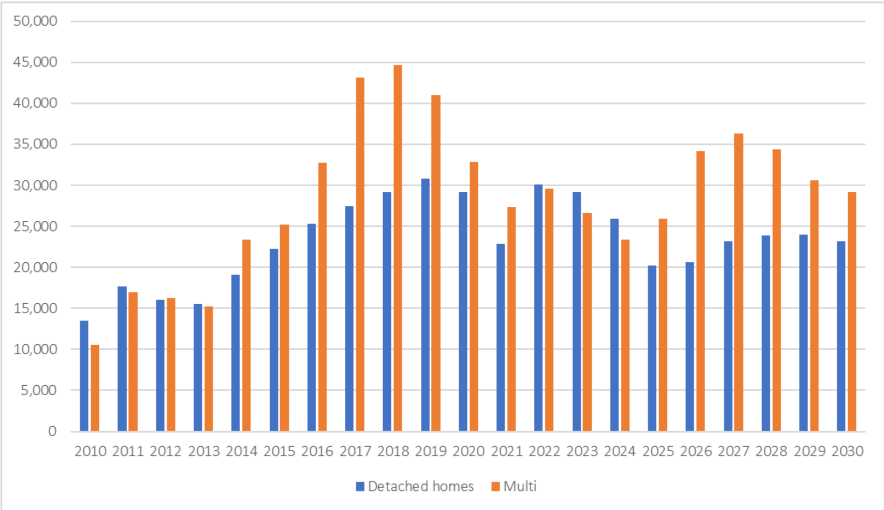

Source: CORE based on JGN Gas Demand Model

### 5.3.4. Analysis of factors Influencing CORE's Connections Forecast

*5.3.4.1 Reduced NSW dwelling completions*

CORE has derived an estimate of future NSW dwelling completions utilising latest available data sourced from HIA. CORE has applied a 1-year lag to HIA commencement data as a starting point to estimate housing completions, as summarised in the following figure (the lag is adjusted later as referenced below).

Figure 5.6 Historical and Forecast Residential dwelling commencement, lagged one year | No.




Source: CORE based on HIA data

This chart shows a material difference in dwelling commencement and completion activity between 2016-2021 and activity forecast in subsequent years – with a fall during many years of >25% from the recent high. Further, the figure shows changing trend in the share of multi vs single detached house dwelling developments.

This data is used as an input to CORE's demand model. A JGN network penetration rate is then derived to forecast JGN connections. At the same time the penetration rate is applied CORE has applied a further lag factor to multi dwelling developments (completed in 18 months) following commencement due to observations of delays in the NSW market associated with flow on impact of COVID over the shorter term and broader, structural resourcing constraints.

*5.3.4.2 Continuing decline in JGN penetration rate*

CORE has derived a weighted average penetration rate for JGN residential customers, having regard to the forecast weighting of multi dwelling and detached house developments.

CORE's analysis highlights a decline in penetration rate of over 41% from 2010-2015 average levels by 2023.

Figure 5.7 Historical and Forecast Residential dwelling average penetration rate | % of NSW dwellings.


| | 2010-15 | 2015-18 | 2019-23 | 2024-30 |
|---|---|---|---|---|
| Penetration rate | 74% | 65% | 46% | 32% |
| Rate of decline | 0 | -12.2% | -29.2% | -30.4% |

Source: CORE based JGN Gas Demand Forecast Model

CORE forecasts a 30% decline in penetration between 2024-2030, which is below average levels of actual movement observed historically between 2010-15 and 2023 of 41%.

CORE has considered an extensive list of influences on the JGN residential connection penetration rate and has placed most weight on the following interrelated – factors:

- continuation of a declining trend observable over the past 12 years.
- material growth in dwelling activity in areas outside the JGN network area.
- a high share of multi dwelling development activity which has a materially lower penetration rate than detached homes.
- forecast increase in full electrification of new dwellings – as observed through disclosures by developers, builders, and certain Councils.

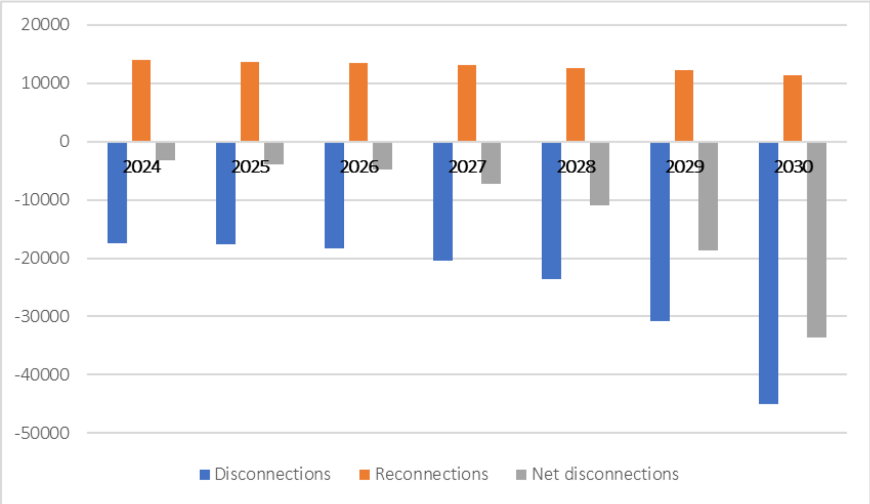
#### *5.3.4.4 Forecast of Temporary Net Disconnections and Abolishments*

*Net Disconnections*

CORE has developed a forecast of customers which are expected to temporarily disconnect from JGN's network and those expected to reconnect which combine to derive an expected level of net annual connections.

The result of this analysis is summarised in the following figure.

Figure 5.8 Forecast Residential temporary disconnections, reconnections and net connections.




Source: CORE based JGN Gas Demand Forecast Model

*Temporary Disconnections*

CORE has forecast a moderate progressive increase in disconnections until FY 2027, after which point a material increase is considered most likely as summarised in the figure 5.9.

The following factors have weighed most heavily on this forecast of disconnections:

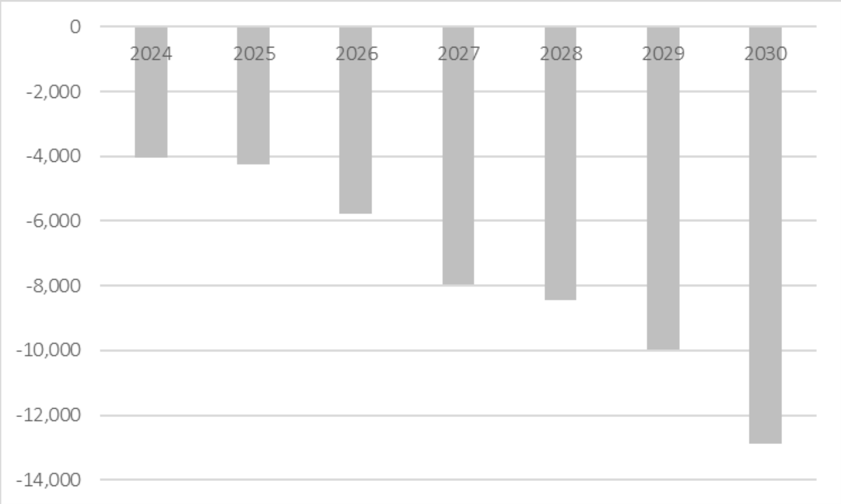
- the fact that zero consuming/dormant customer numbers are over 31,000 at end June 2023 and growing (material number of new customers are moving to zero or low levels in 2019-2022 – a significant portion of which are reasonably expected to disconnect before or during the Review Period.
- the fact that approximately 80,000 of JGN's residential customers face a major gas appliance replacement decision each year during a period where preferences are balancing in favour of electricity, including solar, over gas and a % of these customers are expected to move to fully electric.
- the fact that NSW no longer has access to lower cost gas due to international LNG price influences and the decline of supply from Cooper and Gippsland basins and lack of new competitive supply sources, other than the possible Narrabri project which has been stalled. NSW has also recently announced a ban on offshore oil and gas activity.
- perceptions by customers (driven by Government and other influential parties), that electricity prices will be lower in the mid to longer term due to lower cost of renewable technologies.
- greater customer understanding of the energy efficiency of heat pump technology - water and space heating over gas.
- increased consumer 'social conscience' pressures as the State and Commonwealth increases focus on achieving 2030 GHG reduction targets.

*Abolishments*

CORE has undertaken an analysis of the historical rate of abolishment as a % of Existing connections to derive a baseline forecast of future abolishments. The baseline has then been adjusted over time having regard to consideration of factors which are expected to influence future customer abolishment decisions including but not limited to renovation which favours meter removal once gas appliance use has been discontinued, economics – cost of disconnection vs abolishment and customer behaviour/preferences.

The existing rate of abolishments in 2022-23 is close to 4,000 and this level is expected to grow progressively through to 2030, with the majority of the increase in the latter years of the Review Period as illustrate in the following figure.

Figure 5.9 Historic and forecast abolishments.

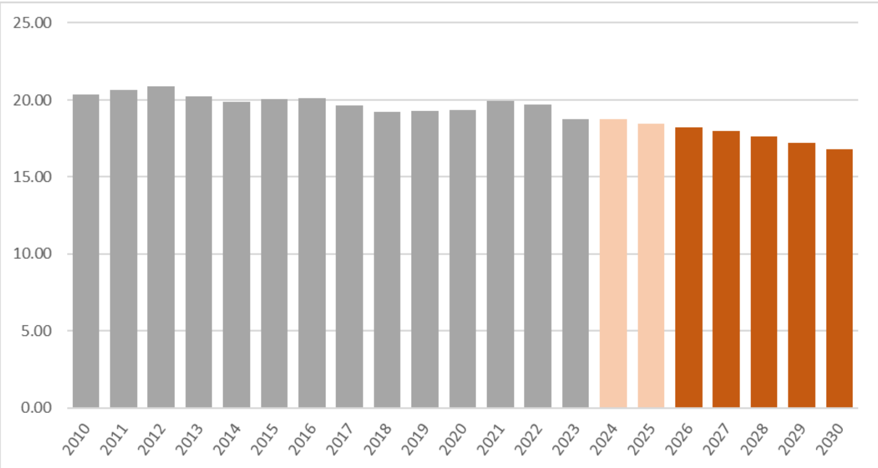



### 5.3.5. Forecast Decline in Residential Demand per Connection (D/C)

The following chart summarises historical normalised D/C and CORE's forecast of D/C for the two bridging years of FY 2024-2025 and the five-year Review Period ending in FY 2030.

This chart is characterised by a decline in D/C from FY 2012 until FY 2019 before increasing due to COVID impact during 2020-22and falling consistent with pre COVID years, in 2023. Growth rates are forecast to fall continuously from FY 2026 to FY 2030, with an average annual decline of 1.56% during the Review Period. Whilst this compares with an average decline in D/C of under 1% during the FY 2010 to FY 2019 period, it is noteworthy that multiple years experienced reductions of >2% and an average decrease of 2.56% in 2022 and 2023, recognising that this is influenced by recovery from the  COVID impacted period.

Figure 5.10 Historical and Forecast Residential D/C | GJ per connection.




Source: CORE based JGN Gas Demand Forecast Model

Following extensive research, analysis and modelling, the following factors weighed most heavily on CORE's forecast:

- forecast use of replacement appliances with higher efficiency star ratings as appliances are replaced and renovations take place, to mee the requirements of National Construction Code (NCC) 2022, BASIX et al.

- electrification trends.
- price elasticity.
- new dwelling developments with higher building efficiency standards under NCC/Nather/BASIX guidelines.
- high proportion of new multi-story dwelling connections which are demonstrated to have a lower D/C – due to smaller footprint, lower dwelling density and lower use of gas heating, in favour of R-C air-conditioning.

Further analysis of factors which are expected to impact future residential demand are included as Attachments A4, A5 and A6.

# 6. SB Demand and Connections – History and Forecast

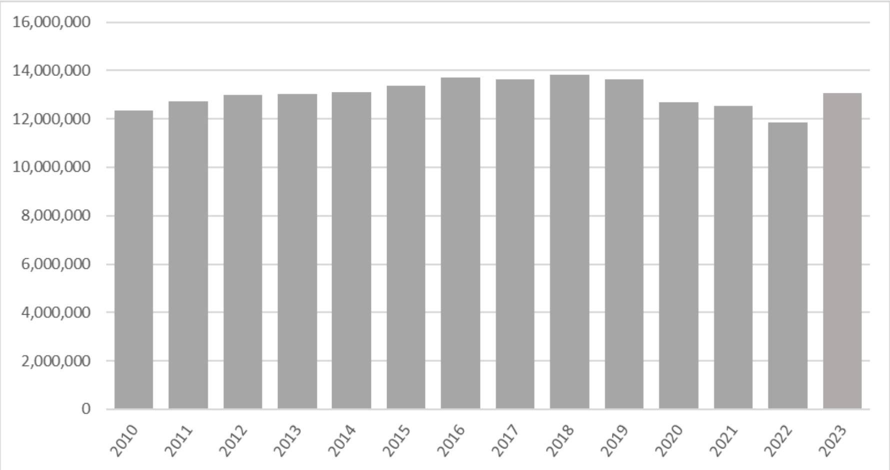
## 6.1. History

### 6.1.1. Demand

SB demand exhibited a consistent growth between FY 2011 and 2016 before flattening and commencing a decline during 2019, with the decline rate extending during COVID impacted years between 2020-2022, due to falling D/C beginning to offset the growth rate in connections, before an increase in 2019, but below 2019 (pre COVID) levels.

The average annual rate of growth between FY 2009 and 2019 was 0.9%.

Figure 6.1 Historical SB demand (GJ).



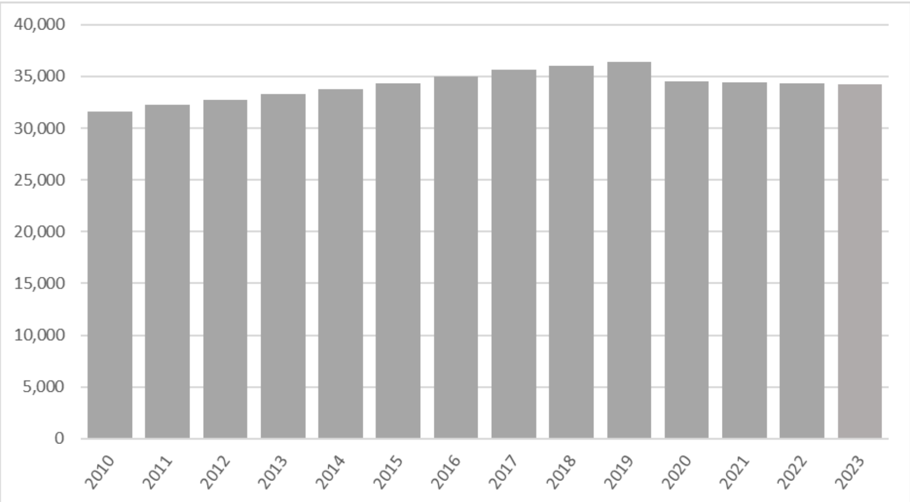

Source: CORE Weather Normalisation Model

### 6.1.2. Connections

SB connections have grown continually between FY 2009 and 2018 before commencing a decline in 2019 and beyond.

The average annual rate of growth between FY 2009 and 2019 was 0.06%.

Figure 6.2 Historical SB closing connections (No.).



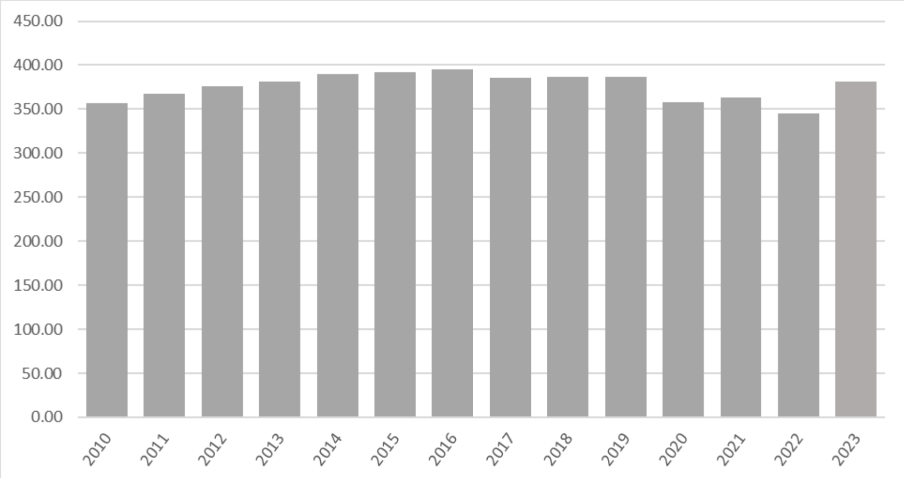

Source: CORE Weather Normalisation Model

### 6.1.3. Demand per Connection (D/C)

SB D/C transitioned in 2017 from a historical moderate growth trend to a flat to declining trend through to end COVID in 2022. The 2023 year was above 2022 Covid impacted D/C but below the 2019 pre COVID level.

The average growth in D/C between FY 2009 and 2019 was 0.91%.

Figure 6.3 Historical SB demand/connection (GJ).




Source: CORE Weather Normalisation Model

## 6.2. Forecast

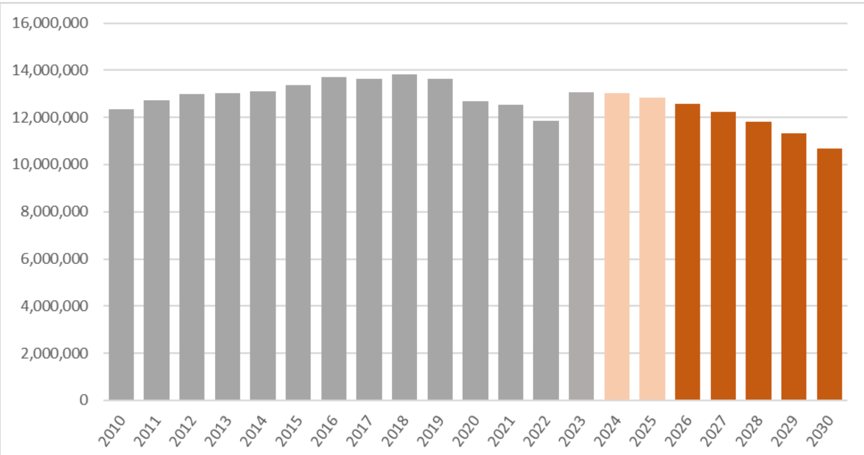
### 6.2.1. Demand

CORE's SB demand forecast opening value for FY 2023 is based on an estimated return in demand per connection toward 2019 levels (year before COVID impacted period).

Demand is forecast to remain relatively flat between FY 2024 and 2025 before commencing a more material downward trend due to a combination of falling connections and lower demand per connection as set out below.

Demand is forecast to fall in the FY 2026-2030 period by an average rate of -3.63%.

Figure 6.4 Historical and forecast SB demand (GJ).




Source: CORE JGN Gas Demand Forecast Model

### 6.2.2. Connections

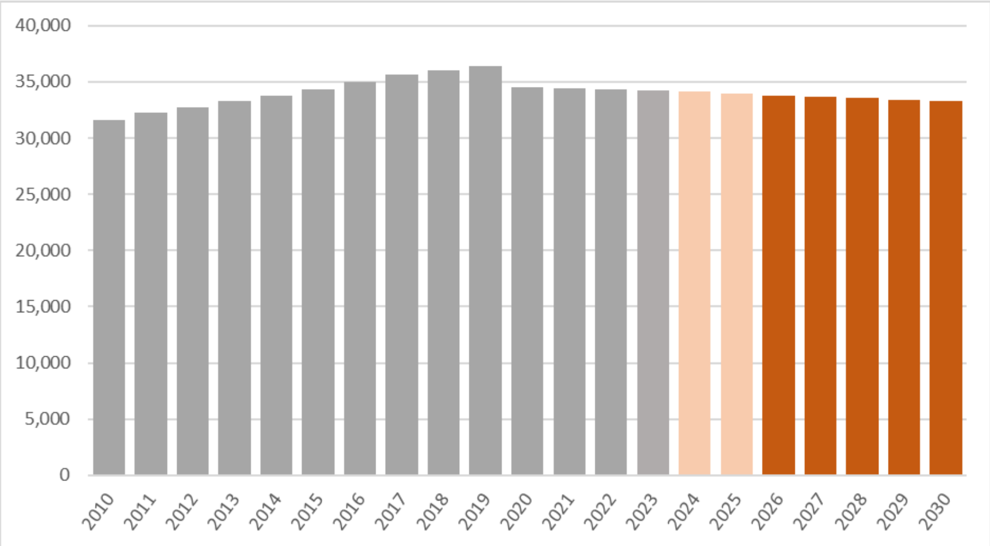
Connections are forecast to fall modestly between 2024 and 2030, continuing a decline which is observable since 2018.

The forecast average annual decline in SB connections for the FY 2026 to 2030 period is -0.50%.

The factors considered by CORE which have weighed most heavily on CORE's forecast include:

- an average annual appliance replacement rate of over 2,000 connections, assuming a 14-year replacement cycle
- a slower rate of growth in SB activity due to a lower rate of economic growth for several years which impact the forecast for the Review Period (including the bridging years of FY 2024-2025 which influence the opening base in the Review Period)
- a trend toward substitution of gas appliances in favour of electrical alternatives, including growth in solar and battery use.
- consumer response to assumed increase in gas cost relative to electricity, combined with national and state support/requirements to improve energy efficiency.

Figure 6.5 Historical and forecast SB closing connections (No.)




Source: CORE JGN Gas Demand Forecast Model

### 6.2.3. Demand per Connection

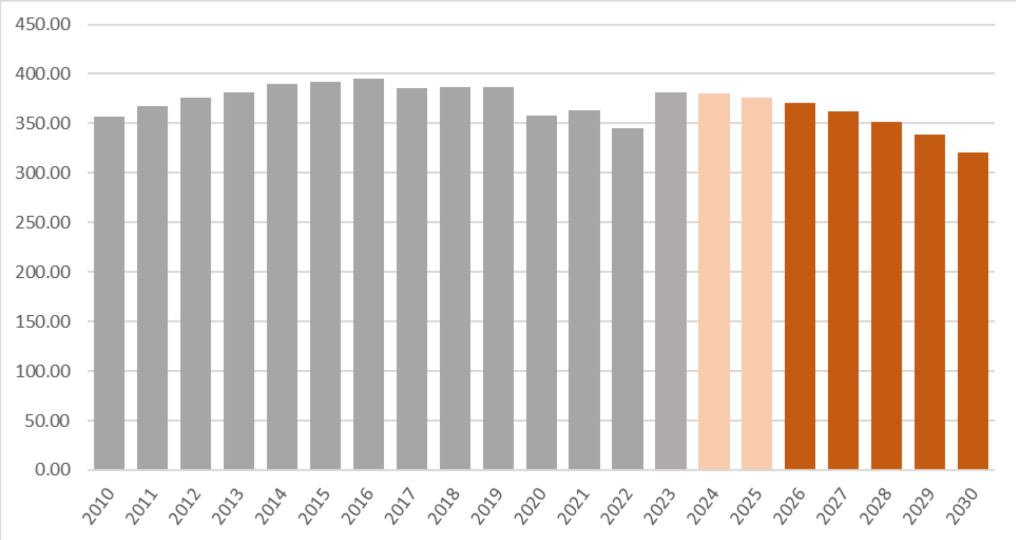
D/C is forecast to fall modestly during the FY 2024-2025 period before commencing a more significant decline.

The forecast average annual decline in SB D/C for the FY 2006 to 2030 period is -3.15%.

The factors considered by CORE which have weighed most heavily on CORE's forecast include:

- improvements in energy efficiency.
- reduced gas use due to substitution of one or more appliance categories.
- a trend toward electrification more broadly.

Figure 6.6 Historical and forecast SB demand/connection (GJ).



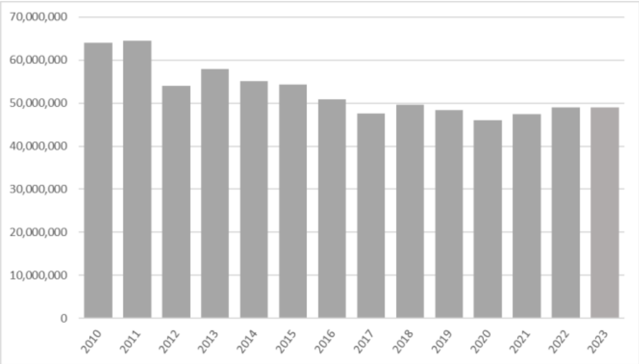

Source: CORE JGN Gas Demand Forecast Model

# 7. Industrial Demand - History and Forecast

## 7.1. Historical Demand

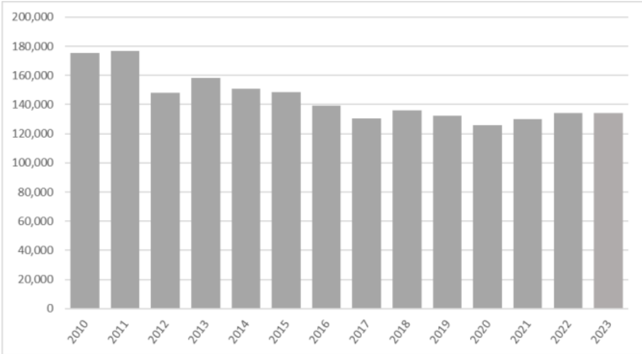
Historical Industrial ACQ and ADQ, MDQ and 9th highest MDQ have shown a general decline trend to 2019, before increasing modestly during 2020-2022 due to the impact changing consumption by a few large customers, and not a systematic trend across industrial customers more broadly.

Figure 7.1 Historical ACQ (GJ).



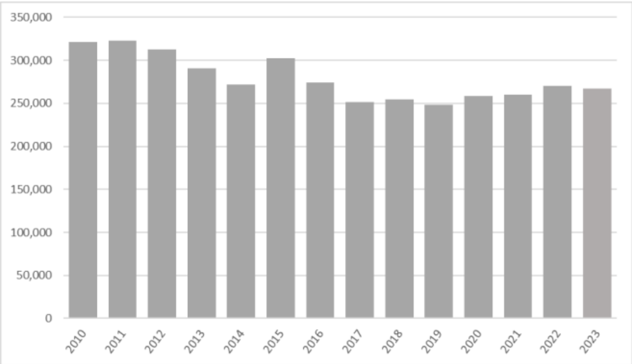

Source: CORE JGN Weather Normalisation Model

Figure 7.2 Historical ADQ (GJ).



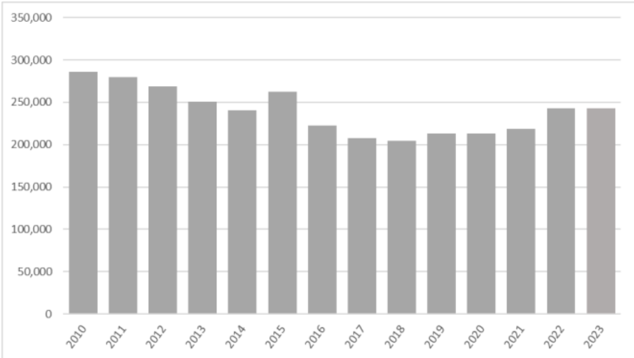

Source: CORE JGN Weather Normalisation Model

Figure 7.3 Historical MDQ (GJ).




Source: CORE JGN Weather Normalisation Model

Figure 7.4 Historical 9th highest MDQ (GJ).




Source: CORE JGN Weather Normalisation Model

During the 2009 to 2019 period Industrial demand has declined on an average annual basis as follows:

- ACQ: -2.81%
- MDQ: -2.58%
- 9th highest MDQ: -2.24%

## 7.2. Forecast Demand

### 7.2.1. ACQ

Base ACQ has been forecast in two parts:

- "Survey customers": Responses from top 20 customers surveyed.
- "Customers not surveyed": used 2023 actual ACQ as a base and adjust it annually by applying a factor representing CORE's forecast for each industrial sector and any changes known to JGN and advised to CORE.

The results are summarised as follows:

Figure 7.5 Base ACQ (GJ).

| | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 |
|---|---|---|---|---|---|---|---|
| Survey % | 59% | 60% | 61% | 62% | 62% | 60% | 62% |
| Survey No. | 27,216,027 | 28,482,511 | 28,666,205 | 30,346,161 | 29,999,957 | 28,593,137 | 29,962,018 |
| % Not surveyed | 41% | 40% | 39% | 38% | 38% | 40% | 38% |
| Not surveyed No. | 19,025,436 | 19,020,104 | 18,696,479 | 18,706,940 | 18,712,275 | 18,717,663 | 18,706,796 |
| Total No. | **46,241,463** | **47,502,615** | **47,362,684** | **49,053,101** | **48,712,232** | **47,310,800** | **48,668,814** |

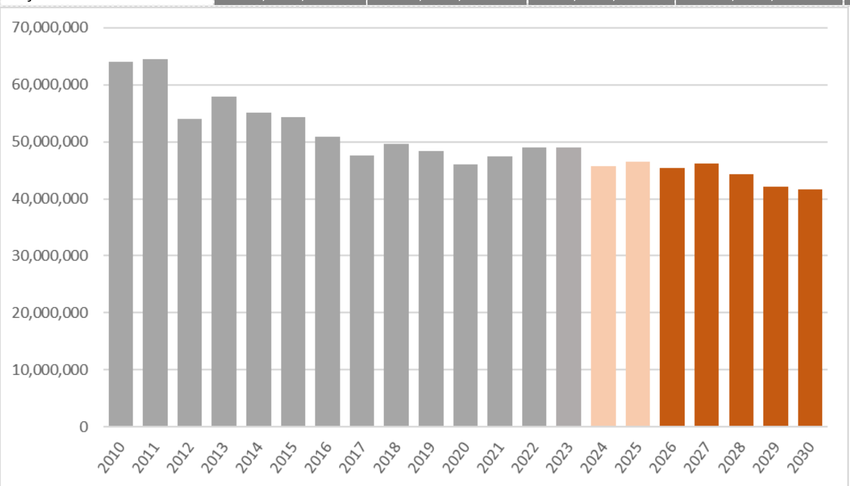
Source: CORE JGN Gas Demand Forecast Model

Base ACQ has then been analysed by CORE to determine most likely movements in gas demand (ACQ) due to new initiatives by industrial customers to meet emission targets and to realise economic benefits associated with productivity improvements and changes in energy sources, away from gas.

The following table summarises the reductions in ACQ demand determined by CORE together with the resultant adjusted forecast of ACQ.

Figure 7.6 Impact of new initiatives and resulting adjusted ACQ (GJ).

| | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 |
|---|---|---|---|---|---|---|---|
| New inititatives impact | 462,415 | 950,052 | 1,894,507 | 2,943,186 | 4,384,101 | 5,204,188 | 6,959,640 |
| Adjusted ACQ | 45,779,048 | 46,552,562 | 45,468,176 | 46,109,915 | 44,328,131 | 42,106,612 | 41,709,173 |




Source: CORE JGN Gas Demand Forecast Model

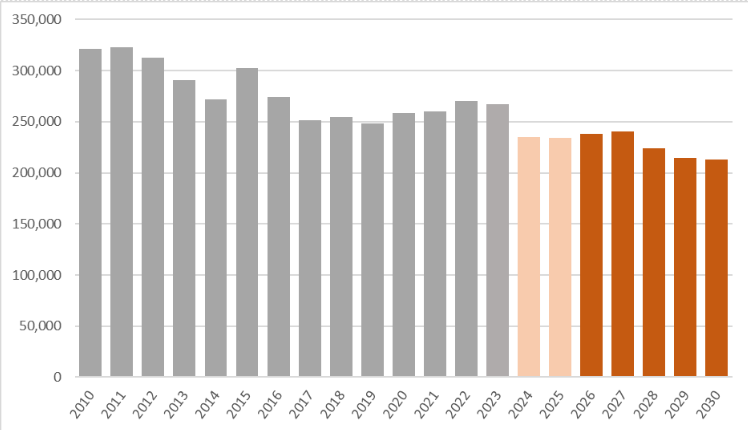
### 7.2.2. MDQ

MDQ has been forecast using the results of the survey to date and for non-surveyed customers the forecast is based on the relationship between ACQ and MDQ observed historically.

The results are summarised as follows:

Figure 7.7 MDQ (GJ).

| | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 |
|---|---|---|---|---|---|---|---|
| Base forecast, including survey responses | 237,751 | 239,310 | 247,967 | 255,421 | 246,655 | 241,455 | 249,387 |
| Less structural change per (ACQ/365) x historical average of MDQ/AD | 2,408 | 4,948 | 9,866 | 15,327 | 22,831 | 27,102 | 36,244 |
| | | | | | | | |
| Forecast MDQ | 235,342 | 234,363 | 238,101 | 240,094 | 223,824 | 214,353 | 213,143 |




Source: CORE JGN Gas Demand Forecast Model

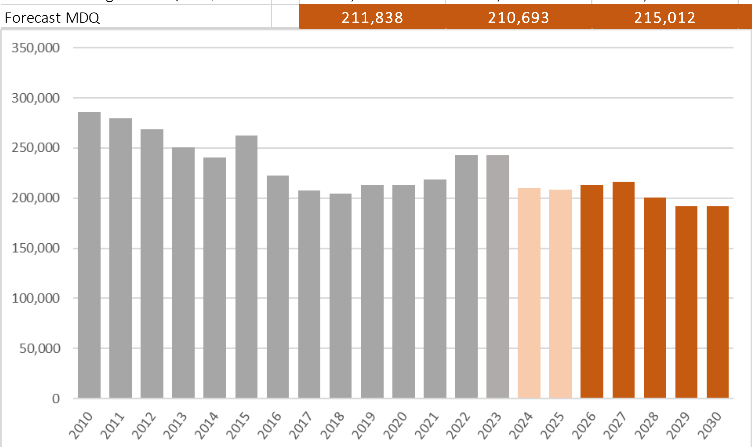
### 7.2.3. 9th highest MDQ

9th highest MDQ has been forecast by applying a consistent factor for each industrial customer (based on 2023 actual relationship between MDQ and 9th highest MDQ) for each year during the forecast period).

The results are summarised as follows:

Figure 7.8 9th highest MDQ (GJ).

| | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 |
|---|---|---|---|---|---|---|---|
| Base forecast | 213,887.70 | 214,904.81 | 223,410.47 | 231,107.82 | 222,339.01 | 217,111.45 | 225,060.31 |
| Less structural change per (ACQ/365) x historical average of MDQ/ADQ | 2,049.85 | 4,211.51 | 8,398.22 | 13,046.93 | 19,434.41 | 23,069.79 | 30,851.59 |
| Forecast MDQ | 211,838 | 210,693 | 215,012 | 218,061 | 202,905 | 194,042 | 194,209 |




Source: CORE JGN Gas Demand Forecast Model

# 8. Validation

CORE has undertaken research and analysis relating to an extensive range of studies and reports which address the outlook/forecast for NSW gas demand. CORE considers that the AEMO GSOO to be the preferred forecast for validation purposes.

The AEMO electricity and gas forecasting portal enables users to access GSOO data for each eastern Australia State. The data is presented for each State as a whole and for NSW the data is aggregated with ACT. (and the other regional gas networks in NSW including Wagga and Albury). Therefore, there are differences between the total AEMO NSW (and ACT) forecast and the CORE forecast for JGN. However, because JGN accounts for approximately 80% of CORE considers is reasonable to rely upon the comparison.

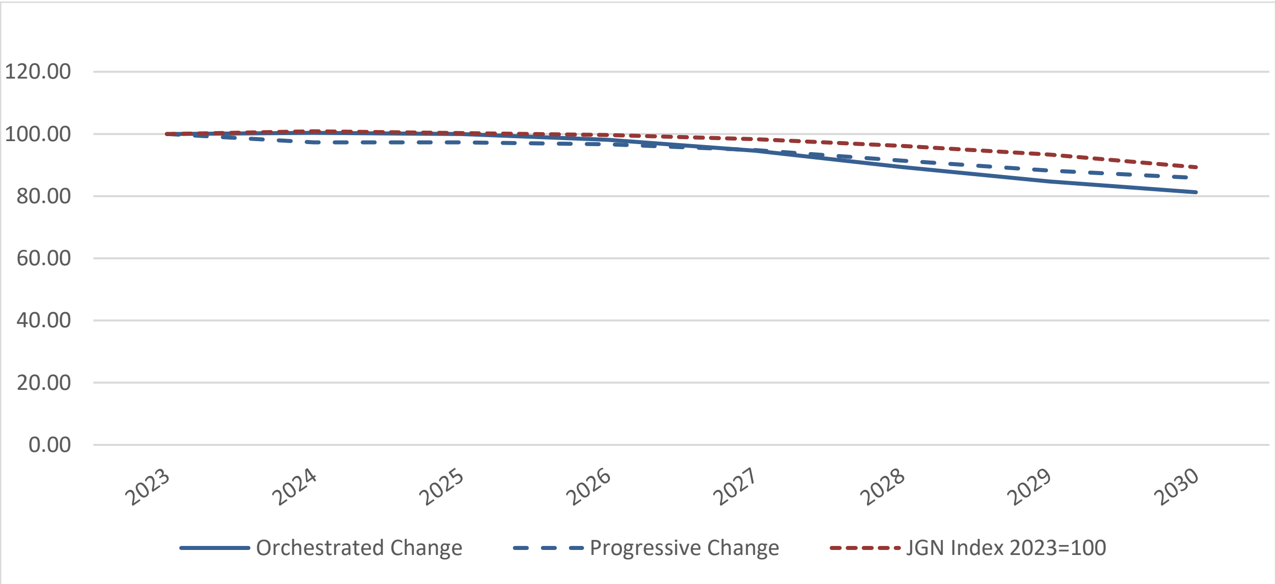
The AEMO GSOO forecast for NSW is presented on a Calendar Year (CY) basis, whereas the JGN forecast is presented on a Financial Year (FY) basis. For validation purposes CORE has developed an estimated GSOO FY forecast by averaging CY data – for example FY 2024 is half of CY 2023 and half of CY 2024.

The following Figure and paragraphs provide a summary of a comparison between the AEMO 2023 GSOO and the forecasts derived by CORE for the JGN network . The comparison is undertaken on an index basis with 2023=100 as the base year.

## 8.1. Residential and Commercial Segments (Tariff V).

CORE considers that the comparison summarised in figure 8.1 provides strong validation of the CORE forecast.

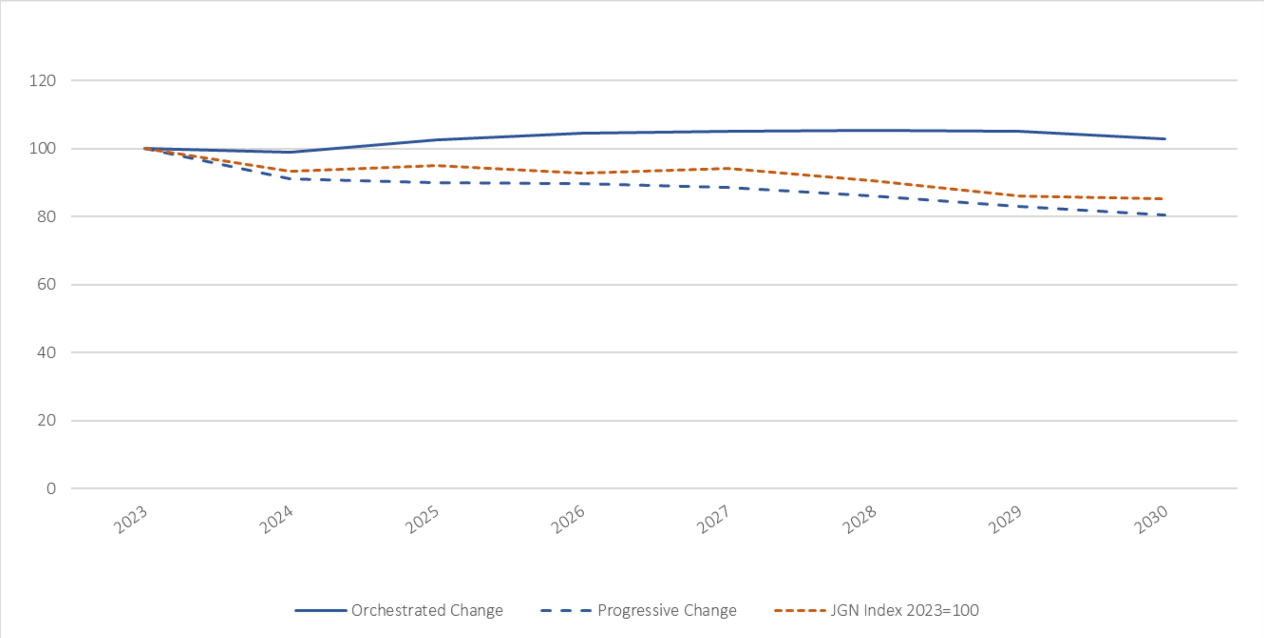
Figure 8.1 Comparison of AEMO GSOO and CORE forecast for combined R&C segments (Tariff V) 2023=100.




## 8.2. Industrial Segment (Tariff D).

CORE considers that the comparison summarised in figure 8.2 provides strong validation of the CORE forecast.

Figure 8.2 Comparison of AEMO GSOO and CORE forecast for combined Industrial segment (Tariff D) 2023=100.



# A1. Terms of Reference

Scope and Context

CORE has been engaged by JGN to deliver a gas demand forecast for JGN FY 2026-2030 AA pursuant to the terms contained herein.

- the forecast will address the level of demand arising from the residential, SB, and industrial sectors as well as forecasting customer numbers for these sectors and allocating demand by agreed customer classifications.
- the methodology will review the leading approaches to forecasting demonstrated by previous AAs and other experts in the field. The opinions formed will be based on quality statistical and other quantitative analysis, economic theory, appropriate qualitative analysis, and industry experience.
- the methodology and output comply with the NGR.

Relevant Considerations

Consideration and analysis of elements listed below. The relevant time frame for the forecast includes the period leading up to the Review Period as well as all years contained within the period.

- annual gas demand for new and existing residential and SB customers within the JGN distribution network.
- quantity and capacity-based demand for industrial users within the network.
- the historical trends in gas demand and customer numbers and relevance thereof.
- the various drivers and variables that create movements in average gas usage.
- the suitability and reliability of each statistical method used for the forecast.
- appliance trends and policies driving appliance efficiency changes.
- macroeconomic analysis such as population growth, GSP.

Output

The following deliverables:

- EDD Model.
- Weather normalisation model.
- 2025-30 Forecast Demand model.
- 2025-30 Forecast Report.

Collectively the deliverables will clearly evidence compliance with the NGR:

- The methodology used must be clearly explained and support must be provided to demonstrate that it is an appropriate basis for deriving forecasts which are best available in the circumstance.
- Modelling inputs, calculations and assumptions must be presented clearly, referencing the source of data, facts, or evidence.

## A2. Reference Documents

CORE has referred to the following extensive list of documents for the purpose of:

- refining CORE's forecasting methodology.
- identifying issues of significance addressed in recent gas access arrangements addressed by the AER.
- accessing specific data used as a modelling input for forecasting purposes, including historical trend analysis.
- accessing evidence to support derivation of forecasts presented within this report.
- validation/cross-check.

| Document | Source, location |
|---|---|
| ABS<br><br>4602.0.55.001 – Environmental Issues: Energy Use and Conservation. | Link |
| 5220.0 Australian National Accounts; State Accounts. | Link |
| 5609.0 Housing Finance. | Link |
| 3218.0 Regional Population Growth. | Link |
| 8731.0 Building Approvals. | Link |
| AEMO<br><br>Forecasting Methodology Information Paper. | Link |
| Gas Statement of Opportunities 2022 and 2023. | Link |
| Integrated System Plans (ISPs). | Link |
| Forecasting portal. | Link |
| **AEMC** Residential Electricity Price Trends. | Review of 2022 and prior – AEMC will release next report in late 2024, no 2023 release. |
| **AER** Access Arrangements – all gas network access arrangements. | Link |
| **AGL** public statement on 6 start energy rating. | Link |
| Arena<br><br>The Incredible ULCS: ultra-low cost solar. | Link |
| **Australian Building Codes Board.** | Link |
| **BASIX, NSW** | Link |
| **Bureau of Meteorology,** Weather Station Data – Sydney Airport. | JGN EDD and Weather Normalisation Models input data |
| **Clean Energy Council,** NSW gas demand analysis | Link |
| **COAG Energy Council**, National Energy Productivity Plan 2015-2030. | Link |

| Document | Source, location |
|---|---|
| **HIA** Housing Forecasts | Summarised within Residential forecast tab of JGN Demand Model |
| **NABERS**, NABERS for Apartment Buildings. | Link |
| **NatHERS,** Nationwide House Energy Rating Scheme (NatHERS). | Link |
| **NCC,** National Construction Code – 2022 | Link |

# A3. NSW Economic Outlook

## National Outlook – Context

The outlook for the global economy remains subdued. According to the International Monetary Fund (IMF), economic growth in advanced economies is expected to slow to 1.5 per cent and 1.4 per cent in 2023 and 2024 respectively, from 2.6 per cent in 2022. Meanwhile, the IMF has revised its forecast for growth in China to 5.0 per cent in 2023 (from 5.2 per cent) and 4.2 per cent in 2024 (from 4.5 per cent).

Inflation is slowing globally but remains elevated relative to the targets of central banks. The IMF expects this will remain the case until 2025, which suggests that central bank interest rates may need to remain higher for longer.

Figure A3.1 Australia Percentage change over year shown (%)

| | Year-ended | | | | | |
|---|---|---|---|---|---|---|
| | Dec 2023 | June 2024 | Dec 2024 | June 2025 | Dec 2025 | June 2026 |
| GDP growth | 1.5 | 1.3 | 1.8 | 2.1 | 2.3 | 2.4 |
| (previous) | (1.6) | (1.8) | (2.0) | (2.2) | (2.4) | – |
| Unemployment rate(b) | 3.8 | 4.2 | 4.3 | 4.4 | 4.4 | 4.4 |
| (previous) | (3.8) | (4.0) | (4.2) | (4.3) | (4.3) | – |
| CPI inflation | 4.1 | 3.3 | 3.2 | 3.1 | 2.8 | 2.6 |
| (previous) | (4.5) | (3.9) | (3.5) | (3.3) | (2.9) | – |
| Trimmed mean inflation | 4.2 | 3.6 | 3.1 | 3.0 | 2.8 | 2.6 |
| (previous) | (4.5) | (3.9) | (3.3) | (3.0) | (2.9) | – |
| | Year-average | | | | | |
| | 2023 | 2023/24 | 2024 | 2024/25 | 2025 | 2025/26 |
| GDP growth | 2.0 | 1.6 | 1.5 | 1.9 | 2.2 | 2.3 |
| (previous) | (2.0) | (1.7) | (1.8) | (2.0) | (2.2) | – |

(a) Forecasts finalised 31 January. The forecasts are conditioned on a path for the cash rate broadly in line with expectations derived from surveys of professional economists and financial market pricing; the cash rate is assumed to remain around its current level of 4.35 per cent until the middle of 2024 before declining to around 3.2 per cent by the middle of 2026. Other forecast assumptions (assumptions as of November Statement in parenthesis): TWI at 62 (61); A$ at US$0.66 (US$0.64); Brent crude oil price at US$80bbl (US$84bbl). The rate of population growth is assumed to have peaked in the September quarter at 2.5 per cent. After which it is expected to decline back to its pre-pandemic average of around 1.4 per cent. Shading indicates historical data.

(b) Average rate in the quarter.

SOURCE: Reserve Bank of Australia, February 2024

## New South Wales Outlook

Direct extracts from the NSW Treasury site on 21 March 2024 follow:

- although inflation is slowing, underlying inflation remains high, driven increasingly by services. Since the Budget, the Reserve Bank of Australia (RBA) has raised the cash rate, noting its increasing intolerance to upside inflation risks.
- economic growth is expected to remain lower than its historical average over the four years to 2026-27 as elevated interest rates continue to constrain demand. However, growth forecasts have been revised slightly higher since the Budget owing to stronger population growth and higher dwellings prices. Real GSP growth is forecast to be below trend in 2023-24 at 1½ per cent, revised up from 1¼ per cent growth forecast in the Budget. Similarly, real GSP growth is forecast to average 1.8 per cent per annum over the four years to 2026-27, slightly higher than the 1.7 per cent per annum forecast in the Budget. Accounting for the impact of higher population, real GSP per capita is expected to be broadly flat over the next two years before returning to growth from 2025-26.

- the recent easing in the labour market is expected to continue, which should gradually see inflation return to around 3 per cent by late 2024-25. This will allow economic growth to return to long-run levels in the latter part of the forecast period.

The following table presents a short to mid-term outlook for economic metrics, presented by the NSW Government.

Figure A3.2 NSW Economic indicators

| | 2022-23 | 2023-24 | 2024-25 | 2025-26 | 2026-27 |
|---|---|---|---|---|---|
| | Outcome | Forecast | Forecast | Forecast | Forecast |
| Real state final demand | 4.1 | 1½ (1¼) | 1½ | 2 (2¼) | 2¾ |
| Real gross state product | 3.7 | 1½ (1¼) | 1¼ | 2 | 2½ (2¼) |
| Employment | 5.8 | 1½ (1¾) | ½ (¼) | 1 | 1½ |
| Unemployment rate(b) | 3.1 | 3¾ | 4½ (4¾) | 4½ | 4¼ |
| Sydney consumer price index | 7.1 | 4½ (4¾) | 3¼ (3) | 2¾ | 2½ |
| Wage price index | 3.3 | 4 | 3¾ | 3¼ | 3¼ |
| Nominal gross state product | 10.0 | 3¾ (3½) | 3 (3½ ) | 4 (4½) | 5¼ (4¾) |
| Population(c) | 2.0 | 1.7 (1.4) | 1.3 | 1.3 (1.2) | 1.2 |

(a) Forecasts are rounded to the nearest quarter point and are annual average per cent change, unless otherwise indicated. 2023-24 Budget forecasts in parenthesis where different.

(b) June quarter, per cent.

(c) Per cent change through the year to 30 June. 2022-23 figure remains a NSW Treasury forecast and is rounded to the nearest 0.1 percentage point. The assumption for net overseas migration takes into account partial data to the September quarter 2023 and thereafter is assumed to increase in line with assumptions in the 2023-24 Australian Government Budget.

Source: NSW Government Treasury

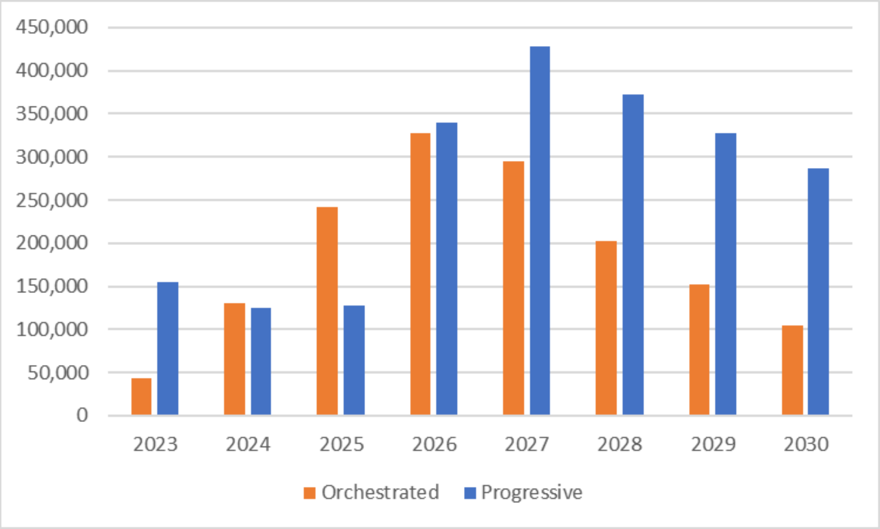
## A4. NSW Energy Price Elasticity Analysis.

As part of its 2023 GSOO and modelling, AEMO presented future scenarios of the impact of gas and electricity price movements on future gas demand. The following figure summarises the resulting forecast reduction in gas demand for the Orchestrated Change and Progressive Change scenarios.

The AEMO analysis is based on an assumed variance between gas and electricity price of approximately 10% in 2026 and 15% in 2027 under the Orchestrated Change scenario.

AEMOs forecasts have been reviewed by CORE and CORE has determined that the AEMO forecast fits within an acceptable range given the uncertainty relating to future prices in gas and electricity.

Figure A4.1 AEMO forecast of price impact on demand (reduction) – Tariff V (GJ)




Source: AEMO GSOO

## A5. Factors expected to reduce future gas consumption by Tariff V and D customers.

| Factor and Description | Expected impact | Increased electrification /reduced gas use | Increased energy efficiency /reduced gas use |
|---|---|---|---|
| NSW energy saving scheme.<br>Eligible NSW households can receive a discount on installing an energy-efficient air conditioning system or replacing an old air conditioning system with a more energy-efficient model.[3] | Increased use of air conditioners for room heating vs gas during the 2025-29 timeframe. | | |
| BASIX NSW<br>The NSW BASIX standards increased on 1 October 2023. The sustainability standards for new residential buildings include:<br>▪ increasing the thermal performance standard from an average of 5.5–6 stars to 7 stars on the Nationwide House Energy Rating Scheme (NatHERS)<br>▪ reducing greenhouse gas emissions by 7-11% (depending on location and type of residential development proposed).[4] | BASIX, and NCC are expected to operate in a complementary manner to reduce gas consumption in new house and multi developments between the 2025-29 timeframe.<br>▪ BASIX transition arrangements are expected to result in increased impact from 2025 onward.<br>▪ appliance substitution in favour of electric heat pump technologies – for water and room heating<br>▪ one of a range of factors influencing certain builders to favour all electric house developments.<br>▪ less incentive to use gas as will require complementary solar investment which in aggregate will be unattractive to a significant number of new home owners | | |

[3] https://www.energy.nsw.gov.au/households/rebates-grants-and-schemes/household-energy-saving-upgrades/upgrade-your-air-conditioning

[4] https://www.planning.nsw.gov.au/policy-and-legislation/buildings/sustainable-buildings-sepp/sustainability-standards-residential-development-basix

| | | | |
|---|---|---|---|
| National Construction Code – NSW application<br>NCC 2022 changes broadly commenced 1 May 2023.<br>▪ New increased BASIX energy efficiency requirements will apply to contracts signed for new homes from 1 October 2023.<br>▪ The BASIX thermal stringency target will move from 5.5-stars to 7-stars and the whole-of-home energy usage target from BASIX 50 to BASIX 70.<br>▪ Builders must disclose embodied emissions of major building materials used in the home. | | | |
| All electric energy Innovation<br>▪ Flexible demand and other innovations are being pursued to reduce energy consumption, which will favour all electrification, including solar. One example is a 200 building program involving a CSIRO led consortium. [5] | ▪ increased new all electric residential and SB developments | | |
| Local Government bans of new gas connections.<br>A number of local governments have moved to ban new gas connections and a number of reviews are pending. | ▪ Increased all electric developments. | | |
| Changing Builder preferences<br>▪ NSW builders are increasingly announcing strategic decisions to favour all electric developments vs gas and electricity for sustainability, regulatory and economic reasons.[6] | ▪ more all electric developments which will reduce new gas connections in the 2025-29 timeframe. | | |

[5] https://www.csiro.au/en/news/all/news/2023/august/smart-buildings-project-to-cut-emissions-and-electricity-costs-in-nsw

[6] https://arena.gov.au/blog/all-electric-self-sustaining-homes-for-suburban-sydney/;

## A6. Specific Impact of Energy Efficiency on NSW Gas Demand.

CORE has undertaken extensive research, analysis and modelling of the impact of energy efficiency – focused on water heating and space heating.

CORE's research identified extensive facts/analysis by third parties which are assessed to be suitably qualified to provide evidence which meets the requirements of the NGR. Examples include:

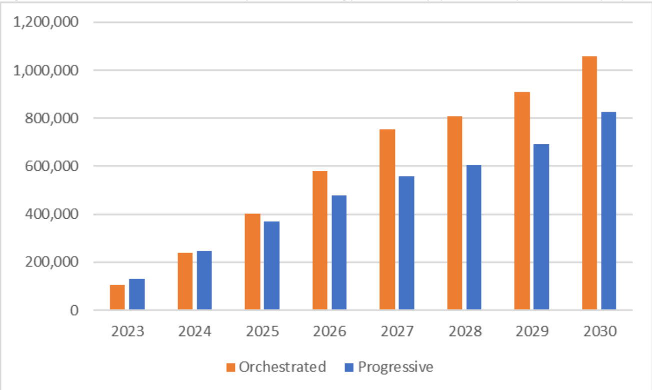
- AGL (largest NSW retailer of energy): a 6-star rating achieves a higher level of thermal energy efficiency than a 5-star rated house… a 6-star rated house is likely to use 24% less energy through heating and cooling than a 5-star rated house.
- CSIRO (Commonwealth research agency): An average 7-star home uses around 25% less energy than a 6-star home for heating or cooling (Climate Council, 2022), which can reduce household CO2 emissions by around 2.3 tonnes per year.
- Choice (leading consumer advocacy group in Australia): Heating appliances have a life expectancy up to 12-15 years.

Based on the independent facts and analysis considered, CORE has undertaken an assessment of the impact of energy efficiency gains in the space heating area. This assessment reveals that in the order of 100,000 JGN tariff V customers are expected to instal new generation appliances as part of new dwelling developments or existing customer replacements. Assuming a gas heating load of 15 GJ p.a. and an improvement in average efficiency of 20% – this is expected to result in a reduction in gas use of 300,000 GJ p.a. If the average star rating is 3-4 star and replaced by 6-7 star this percentage could be closer to 40% or >600,000 GJ p.a.

Validation

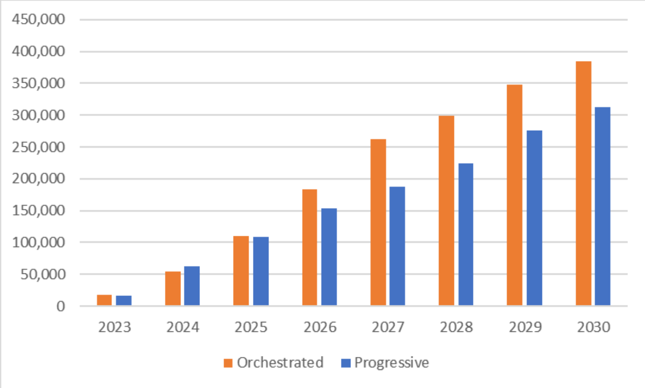
- AEMO: analysis undertaken as part of GSOO 2023 process derived the following forecast of the impact of energy efficiency on both Tariff V and D customers.

Figure A6.1 AEMO forecast of impact on energy efficiency (reduction) – Tariff V (GJ)




Source: AEMO GSOO supporting data book

Figure A6.2 AEMO forecast of impact on energy efficiency (reduction) – Tariff D (GJ)




Source: AEMO GSOO supporting data book.