Jemena Gas Networks (NSW) Ltd

2020-25 Access Arrangement Proposal

Attachment 8.1

Overview of JGN's demand forecast

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Abbreviations

AA	Access Arrangement
ACQ	Annual Contract Quantity
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
Capex	Capital expenditure
CD	Chargeable Demand
Core	Core Energy & Resources
GJ	Gigajoule
GSP	Gross State Product
GVA	Gross Value Add
HIA	Housing Industry Association of Australia
IPART	Independent Pricing and Regulatory Tribunal
MDQ	Maximum Daily Quantity
NGR	National Gas Rules
Opex	Operating expenditure
TJ	Terajoule

Overview

Chapter 8 of our 2020 Plan provides an overview of our forecasts of new connections and gas demand over the 2020-25 period. This attachment explains how we have forecast gas demand, including customer numbers and consumption per connection, in each of our two key customer markets—the volume and demand markets—for our 2020 Plan.

Forecasts of gas demand and customer numbers are key inputs into determining our operating expenditure (**opex**) and capital expenditure (**capex**) requirements and our reference tariffs for the 2020-25 period.

This attachment is structured as follows:

- Section 1 describes the approach to forecasting gas demand including customer numbers and consumption per connection in each of our two key customer markets.[1]
- Section 2 reviews the forecasts of gas demand, including customer numbers and consumption per connection, for the 2015-20 period and, informed by this, describes some improvements and updates to the forecasting approach that have been made for the 2020-25 period to ensure we use the best forecast or estimate possible in the circumstances.
- Section 3 provides an overview of the forecasts of gas demand, including customer numbers and consumption per connection.
- Section 4 describes the use of the demand forecasts.
- Section 5 presents information on the usage of our network over the 2015-20 period.

List of demand attachments

Table OV–1: List of demand attachments

Attachments	Name	Author
8.1	Demand forecast	JGN
8.2	Demand forecast report	Core Energy & Resources (**Core**)
8.3	Demand forecast models	Core

[1] The Volume or 'Tariff V' market consists of residential and commercial customers who use less than 10TJ of gas per year and are generally charged on how much gas they consume (measured as MJ per billing period). Our 'Demand' market is for our largest customers who consume more than 10TJ a year. These customers are primarily charged on how much capacity they require (measured on a daily basis and charged as Chargeable Demand).

1. Approach to forecasting gas demand

We engaged an independent expert, Core Energy & Resources (**Core**), to forecast customer numbers and consumption per connection in each of our two key customer markets for the 2020-25 period. Core has described its methodology and assumptions, and provided the resulting forecasts in its report (included as Attachment 8.2 of our 2020 Plan).[2]

We previously engaged Core to forecast customer numbers and consumption in each of our two key customer markets for the 2015-20 period. Core is experienced in forecasting gas demand, having prepared forecasts for the Australian Energy Market Operator (**AEMO**) and other businesses[3] in the past. We selected Core as its methodology and forecasts have previously been reviewed, tested and accepted by the AER.

Key elements of Core's approach to forecasting gas demand, including those reviewed, tested and accepted by the AER, have remained consistent over time. Refinements to this approach have been made where necessary to reflect updated information, to ensure the forecasts represent the best forecasts or estimates possible in the circumstances. This includes consideration of other gas demand forecasts, including AER draft decisions and final decisions from all recent gas access arrangements.

The forecasting approach adopted by Core for the 2020-25 period is generally consistent with the methodology adopted by AEMO for forecasting gas demand.[4] Key areas of consistency include:

- Developing separate forecasts for different customer types.
- Forecasting residential connections based on forecasts of housing commencements.
- Weather normalising to account for the effect of weather on temperature-sensitive loads.
- Forecasting consumption per connection on the basis of statistical or econometric models that consider key drivers of gas consumption (including economic conditions and gas prices).
- Forecasting consumption for the largest industrial customers based on individual customer information.

1.1 Overview of approach to forecast gas demand

Core's approach involves separately forecasting gas demand, including customer numbers and consumption per connection, for each of our two key customer markets, and then combining these forecasts to provide total forecast demand. There are separate forecasts of gas demand for:

- Tariff V customer, residential customers and small business customers who consume less than 10 TJ of gas per annum. We refer to these customers as volume market customers.
- Tariff D customers, large industrial customers who consume more than 10 TJ of gas per annum. We refer to these customers as demand market customers

[2] Core Energy & Resources, *Gas Demand and Customer Forecasts, Jemena Gas Networks, NSW Gas Access Arrangement 2021-2025*, May 2019.

[3] Core have developed demand forecasts for gas access arrangements for our network, ATCO in Western Australia, AGN in Victoria and South Australia and Evoenergy in the ACT. Core have also developed demand forecasts for a number of major transmission systems. Core's experience is highlighted in section 1.2 of its report.

[4] AEMO, Demand Forecasting Methodology Information Paper, for the 2018 Gas Statement of Opportunities, June 2018.

1.1.1 Tariff V - Residential customers

Figure 1-1 summarises Core's approach to forecasting demand for residential customers. Key steps in methodology are as follows:

- Forecast the number of new connections based on independent forecasts of dwelling commencements in NSW (developed by the Housing Industry Association of Australia (**HIA**)), the average historical relationship between dwelling commencements in NSW and new connections, and number of disconnections based on the average historical rates.
- Allocate new connections to dwelling types (single, medium density and high-rise dwellings) based on dwelling information provided by the HIA.
- Remove the impact of weather[5] and of gas and electricity price changes on historical consumption per connection to identify the trend in forecast consumption per connection. Forecasts of consumption per connection are developed for each dwelling type, reflecting different average levels of consumption per connection.
- Adjust the forecast trend in consumption per connection for any new drivers or changes in existing drivers that are not included in this historical trend such as the effect of own-price elasticity[6] and cross-price elasticity.[7] These adjustments are based on elasticity estimates from the literature, which have been previously accepted by the AER.
- For new connections, ramping up consumption per connection over the first two years post-connection to a mature load level, consistent with what we see for new connections.
- Multiply consumption per connection by connection numbers to forecast total demand for each customer group.

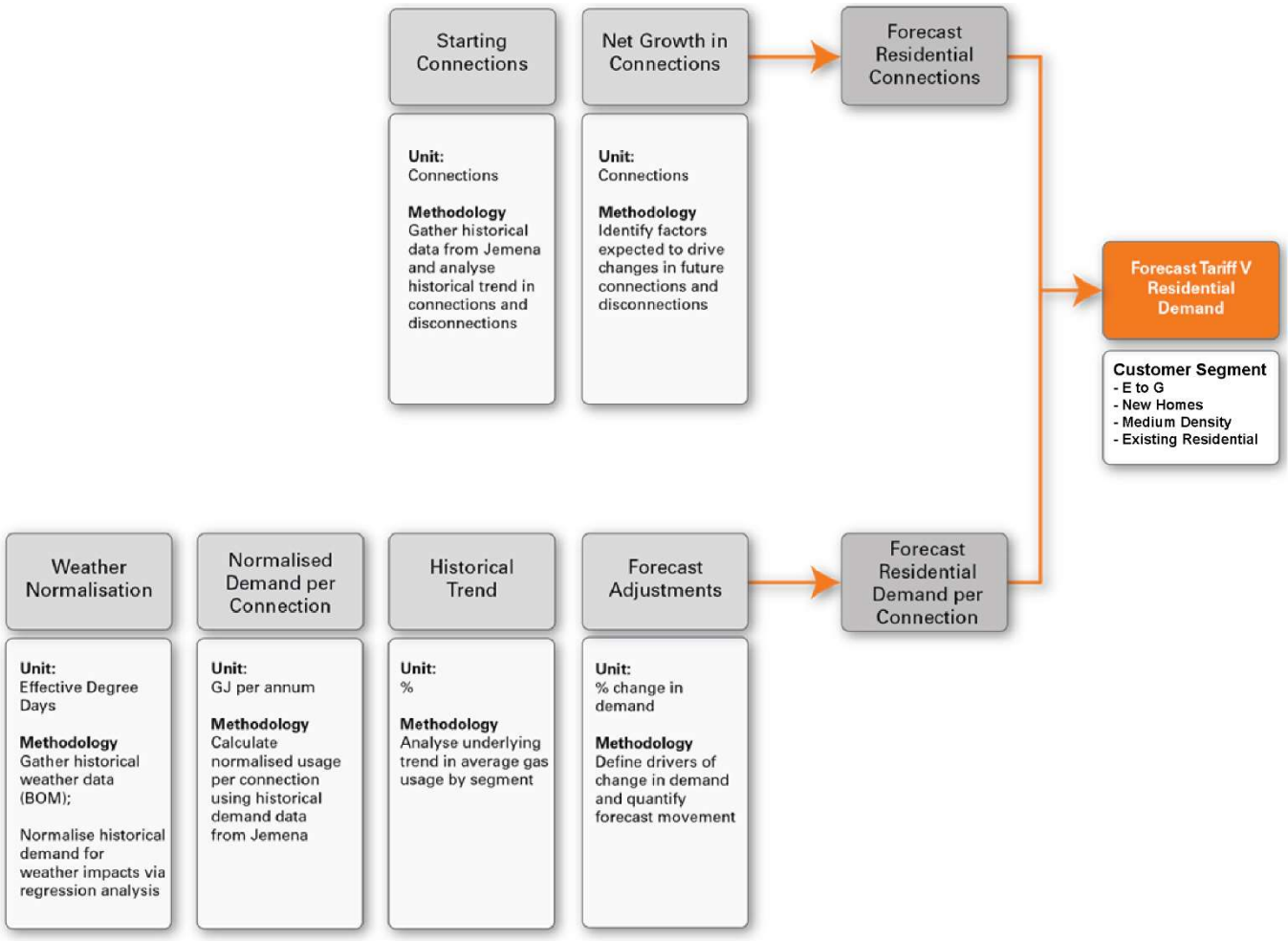
The main elements of this approach to forecasting gas demand (including those reviewed, tested and accepted by the AER) have remained consistent over time.

5 Gas demand for our residential and commercial customers is materially impacted by weather given our customers use relatively more gas when it is colder for space hearing and hot water production (and vice versa in times of warmer weather). It is therefore necessary to adjust the historical residential and commercial consumption per connection for weather to ensure the forecast starting point and historic trends relied upon to forecast gas demand are not unduly impacted by abnormal weather.

6 In this context, own price elasticity refers to the change in gas consumption as a result of a change in gas prices.

7 In this context, own price elasticity refers to the change in gas consumption as a result of a change in electricity prices.

Figure 1-1: Tariff V Residential Demand Forecast Methodology



Source: Core, Gas Demand and Customer Forecasts, Jemena Gas Networks, NSW Gas Access Arrangement 2021-2025, May 2019 (included as Attachment 8.2 of our 2020 Plan)

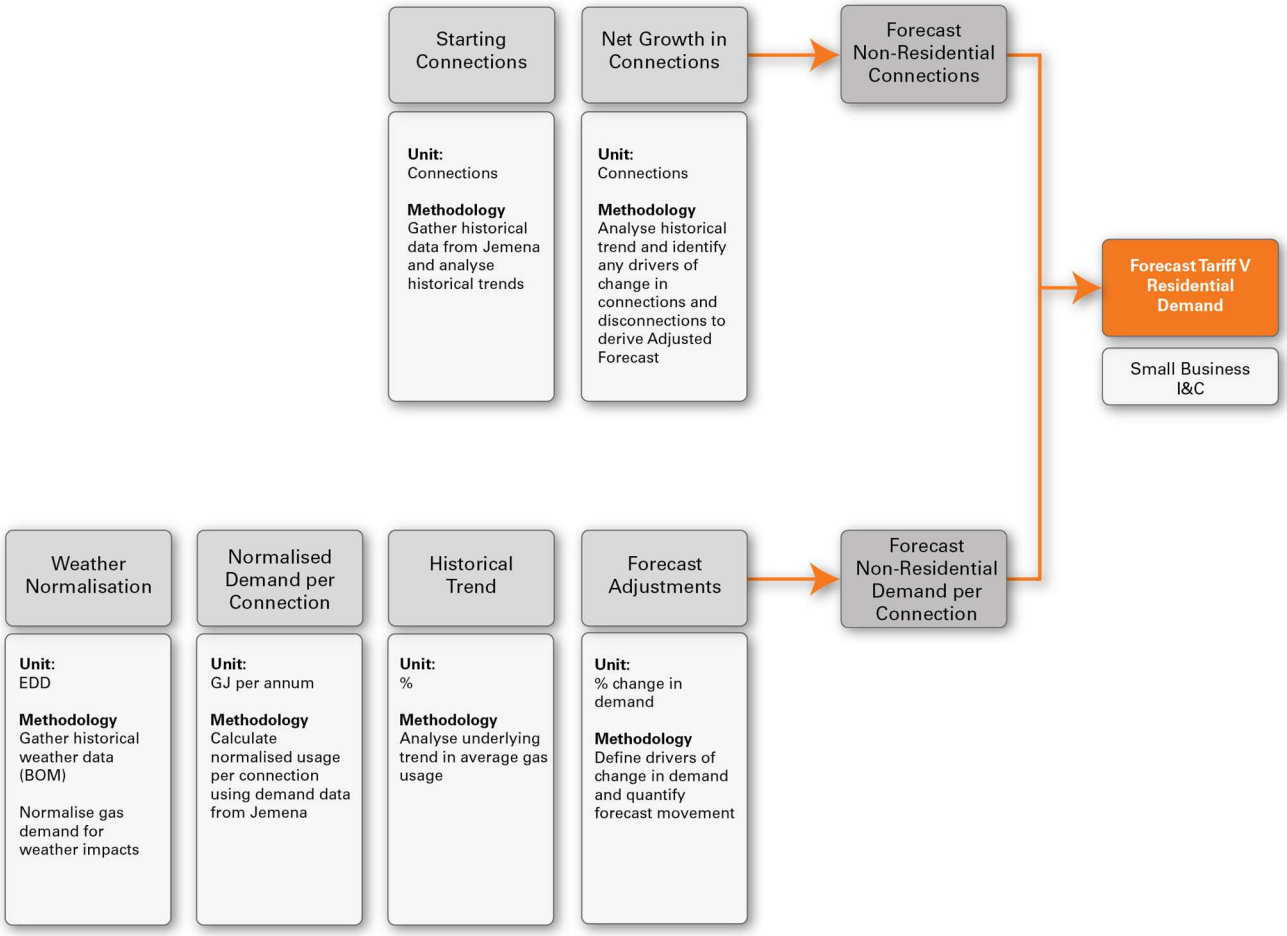
1.1.2 Tariff V - Small business customers

A similar approach to forecasting demand is used for small business customers. Figure 1-2 summarises Core's approach to forecasting demand for small business customers. Key steps in this methodology are as follows:

- Forecast the number of net new connections based on historical average new connections and disconnections.
- Remove the impact of weather and of gas and electricity prices on historical consumption per connection to establish forecasts of consumption per connection.
- Adjust the forecast trend in consumption per connection for any new drivers or changes in existing drivers that are not included in this historical trend such as the effect of own-price elasticity and cross-price elasticity. These adjustments are based on elasticity estimates from literature, which have been previously accepted by the AER.
- For new connections, ramping up consumption per connection over the first two years post-connection to a mature load level, consistent with what we see for new connections.
- Multiply consumption per connection by connection numbers to forecast total demand for each customer group.

Key elements of this approach to forecasting gas demand, including those reviewed, tested and accepted by the AER have remained consistent over time.

Figure 1-2: Tariff V Small Business Demand Forecast Methodology



Source: Core, Gas Demand and Customer Forecasts, Jemena Gas Networks, NSW Gas Access Arrangement 2021-2025, May 2019 (included as Attachment 8.2 of our 2020 Plan)

1.1.3 Tariff D - Industrial customers

Figure 1-3 summarises Core's approach to forecasting demand for industrial customers. Key features of this methodology are as follows:

- Forecasts of new connections and disconnections are based on the historical trend in new connections, after allowing for known closures, known new connections and customers expected to switch between Tariff D and Tariff V.
- Different approaches to forecasting Maximum Daily Quantity (**MDQ**) and Annual Contract Quantity (**ACQ**) are used for different industrial customers:
  - For the largest customers, forecasts are based on public domain review and our ongoing correspondence with customers.
  - For customers belonging to sectors that demonstrate a statistical relationship with Gross Value Add (**GVA**),[8] demand is forecast using a regression model of gas demand with GVA as an explanatory variable. GVA is forecast based on the historical relationship between GVA and Gross State Product (**GSP**), and NSW Treasury forecasts of GSP.
  - For customers belonging to sectors that exhibit clear temperature-sensitive loads, the approach used for small business customers is applied.

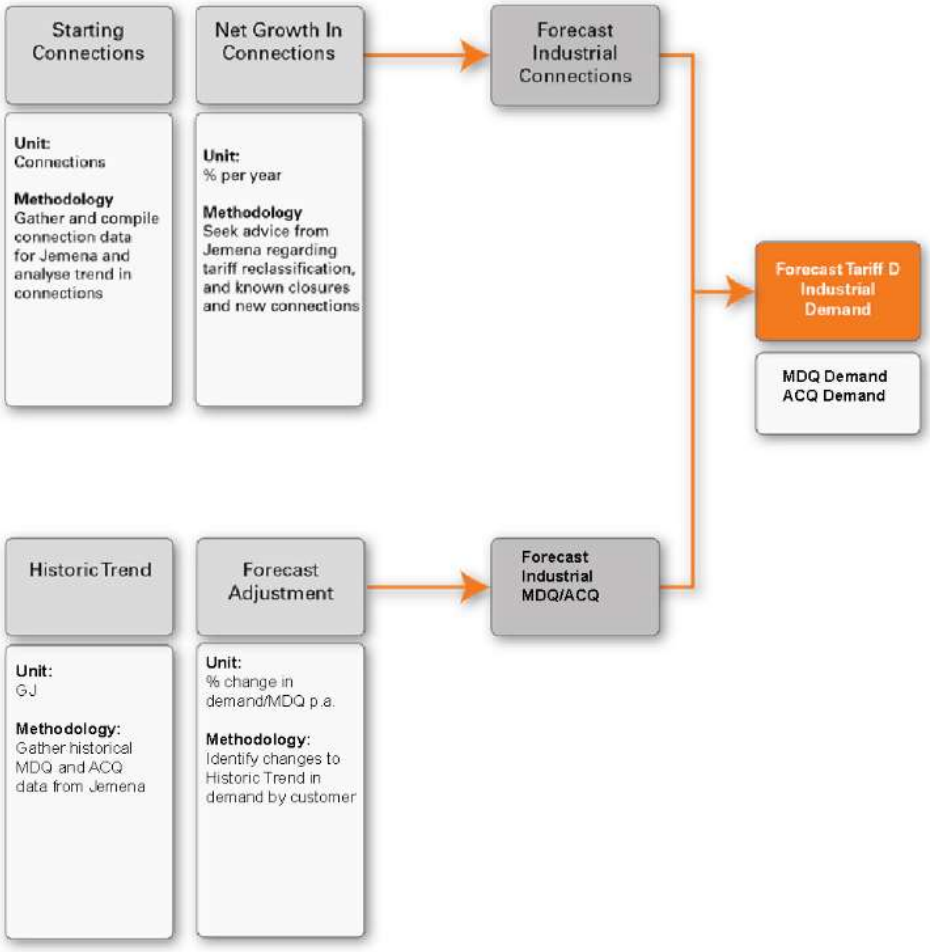
[8] Gross Value Add refers to the economic output of an economic sector. GVA is published by the Australian Bureau of Statistics (**ABS**).

- For all other customers, a historical trend is used.

- MDQ is forecast based on forecast ACQ, accounting for additional underlying movements in MDQ relative to ACQ. Chargeable Demand (**CD**) is forecast based on the historical relationship between MDQ and demand on the ninth highest demand day (which informs our calculation of CD).

Key elements of this approach to forecasting gas demand, including those reviewed, tested and accepted by the AER have remained consistent over time.

Figure 1-3: Tariff D Demand Forecast Methodology



Source: Core, Gas Demand and Customer Forecasts, Jemena Gas Networks, NSW Gas Access Arrangement 2021-2025, May 2019 (included as Attachment 8.2 of our 2020 Plan)

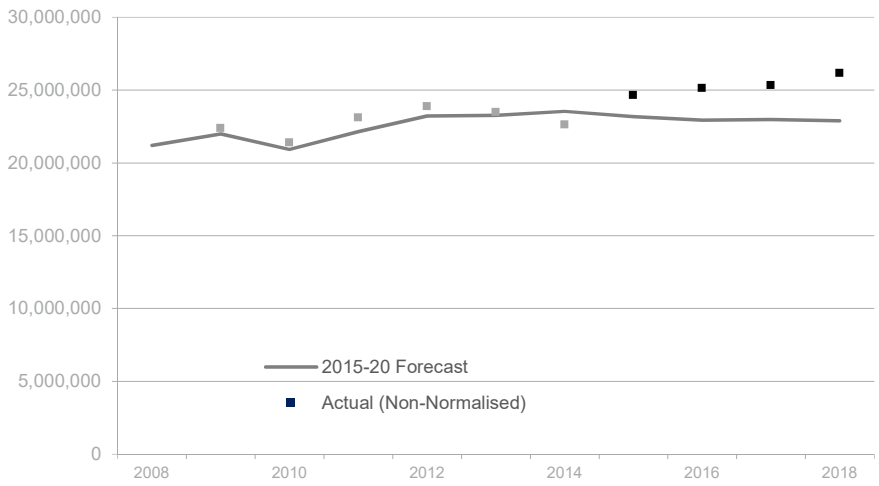
2. Review of forecasts for 2015-2020 AA period

As discussed, we have previously engaged Core to forecast gas demand, including customer numbers and consumption per connection, for each of our two key customer markets for the 2015-20 Access Arrangement (**AA**) period.

We asked Core to review its forecasts for the 2015-20 period in light of actual outcomes and potential changes in information availability. The purpose of this was to understand whether there are any refinements that could be made to ensure we use the best forecast or estimate possible in the circumstances.

Figure 2-1 compares actual residential demand with forecast residential demand for the 2015-20 period (indicated by the grey line). The grey dots show actual data available at the time the forecasts were developed, and the black dots show actual data that has since become available.

Figure 2-1: Residential total demand (GJ) – actual and 2015-20 forecast



Source: Core Energy & Resources, Gas Demand and Customer Forecasts, Jemena Gas Networks, NSW Gas Access Arrangement 2021-2025, May 2019 (included as Attachment 8.2 of our 2020 Plan)

At the time Core developed its gas demand forecast for the 2015-20 period, the most recent data showed a decline in total residential demand. Core forecast total residential demand to remain relatively flat as the reduction due to the decline in consumption per connection was expected to offset demand from new connections.

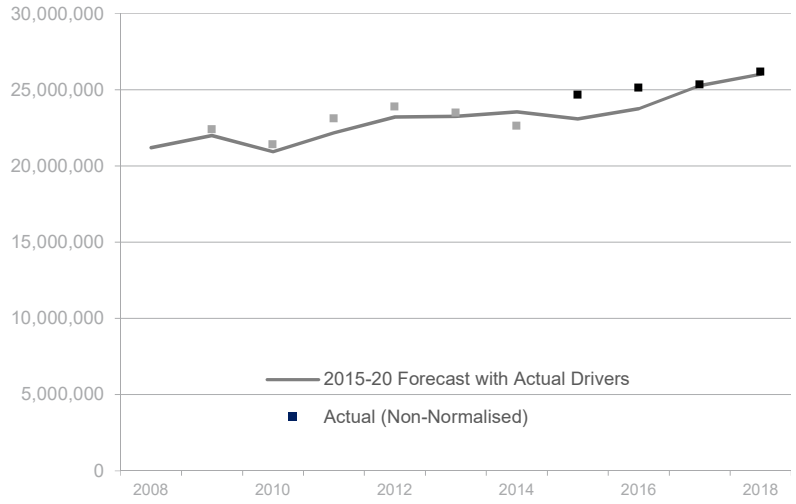
To date, Core's forecast has been lower than actual outcomes. Core has investigated the reasons for this and concluded that the differences between forecast and actual residential demand over the 2015 to 2018 period are explained by two factors:

1. Differences between forecast and outturn demand drivers (inputs into the Core model) – such as dwelling completions, gas prices and electricity prices.
2. Aspects of the modelling approach used for the 2015-20 period which have since been refined.

The effect of the differences between forecast and outturn demand drivers can be seen in Figure 2-2, which shows how accurate Core's 2015-20 forecast would have been if it had known at the time what actual dwelling completions, gas prices and electricity prices would be (i.e. if Core had perfect foresight).

It is clear from Figure 2-2 that the differences between forecast and outturn demand drivers account for a large part of the difference between the forecast and actual demand outcomes. Particularly in 2017 and 2018, the forecasts from the 2015-20 period with actual drivers are a very close match for actual outcomes.

Figure 2-2: Residential total demand (GJ) – actual and 2015-20 model with actual drivers



Source: Core Energy & Resources, Gas Demand and Customer Forecasts, Jemena Gas Networks, NSW Gas Access Arrangement 2021-2025, May 2019 (included as Attachment 8.2 of our 2020 Plan).

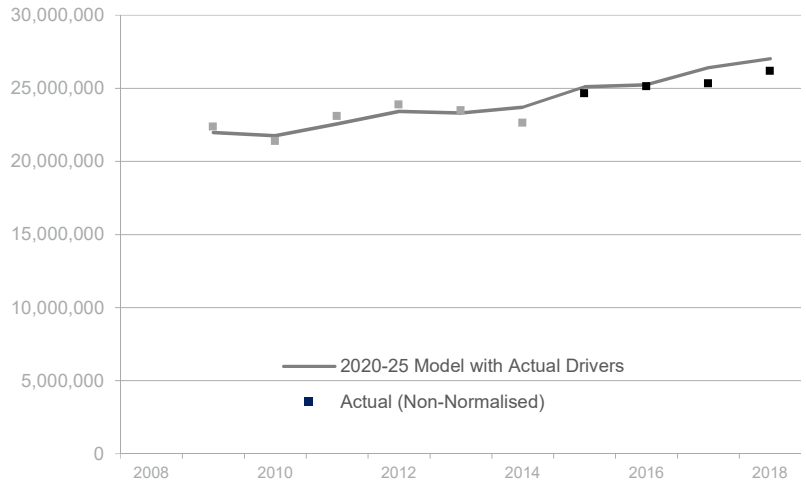
The key differences in forecasts of the drivers are the following:

- **Dwellings.** Core's modelling for the 2015-20 period made use of housing forecasts from BIS Shrapnel who, consistent with other forecast made at the time, underestimated housing growth during the NSW property boom. Core acknowledges there was considerable uncertainty of housing growth projections at the time of the previous forecast. Core's modelling for the 2020-25 period uses housing forecasts from the HIA as their forecast is split by dwelling types.
- **Gas prices.** Core's modelling for the 2015-20 period made use of gas price forecasts developed by Core, having regard to its views on market dynamics at the time and relevant third party analysis. While these price forecasts differed from actual outcomes, we consider that this is not unexpected when forecasting prices over a five year period. Core is well credentialled to provide gas price forecasts, as highlighted by the experience that Core includes in its report. For this reason, we think it is reasonable that Core has again forecast gas prices for the 2020-25 period, having regard to current and expected future market conditions.
- **Electricity prices**. Core's modelling for the 2015-20 period made use of electricity price forecasts from public sources, such as the Independent Pricing and Regulatory Tribunal's (**IPART's**) retail electricity pricing determination. IPART no longer determines retail electricity prices in NSW, so Core's modelling for the 2020-25 period makes use of price forecasts from the Australian Energy Market Commission (**AEMC**). We think this is a reasonable source for electricity price forecasts given that the AEMC takes into account expected wholesale electricity and network price movements.

Based on its ongoing gas demand forecasting work, Core has refined its forecasting approach since it developed the forecast for the 2015-20 period.

Figure 2-3 shows what Core would have forecast if it had used its current 2020-25 model (which incorporates the modelling refinements it has introduced), together with the outturn demand drivers. This forecast would have been very close to actuals for 2015 and 2016. For 2017 and 2018 the model would have produced demand estimates higher than actual outcomes. Overall, the forecasts would have been much closer than the forecasts that Core did develop for 2015-20 (as seen when comparing Figure 2-1 and Figure 2-3).

Figure 2-3: Residential total demand (GJ) – actual and 2020-2025 model with actual drivers



Source: Core, Gas Demand and Customer Forecasts, Jemena Gas Networks, NSW Gas Access Arrangement 2021-2025, May 2019 (included as Attachment 8.2 of our 2020 Plan)

The key modelling refinements made by Core include:

- The own-price elasticity method. The 2015-20 model sought to account for the own-price elasiticity in a way that reflected an own-price elasticity effect fitted to the historical data. Core has since refined its approach to use own-price elasiticity assumptions based on its extensive literature review.[9] This means Core's model now applies own-price elasticity estimates derived from academic literature rather than using its own estimates. This approach of forecasting own-price elasticity effects is consistent with the approach that Core has undertaken for other recent forecasting work, and consistent with the approach previously been reviewed, tested and accepted by the AER.[10]
- The cross-price elasticity method. As with own-price elasticity, the 2015-20 model sought to account for cross-price elasticity in a way that reflected an estimate fitted to historical data, but Core has since revisited its approach and now forecasts a cross-price elasticity effect based on a literature review of estimated cross-price elasticities.[11] This means Core's model now applies cross-price elasticity estimates derived from academic literature rather than using its own estimates.

9 See section A3 of Attachment 8.2, pp 73-76

10 Ibid.

11 Ibid.

- Assumptions about the ramp-up of gas consumption by new customers. Since the modelling for the 2015-20 period, Core has adjusted its model to reflect that new customers take several years to 'ramp up' to full consumption. This means that Core's model now takes into account that customers gas usage rises over time[12] plateauing at a mature load. Core previously assumed customers reached their mature load in the year they are connected.

Together, the divergence between forecast and outturn demand drivers combined with refinements to Core's modelling approach explain the majority of the difference between the forecast and actual demand over the 2015-20 period.

Core notes that for residential customers, the forecast decline in consumption per connection for JGN is more conservative (smaller) than the decline in consumption per connection that has been reviewed, tested and accepted by the AER for other gas access arrangements.[13]

[12] Customers tend to install gas appliances over time. Another factor is that customers will not be connected for 100% of the regulatory year they connect in. For instance, if a customer connects on 1 June 2020 we will only record 1 months consumption in the 2020 regulatory year.

[13] Ibid. p.16

3. Demand forecasts

3.1 Tariff V – Residential customers and small business customers

Table 3–1 sets out our forecast of connections at 30 June each year, demand per connection and total demand for residential customers for the 2020-25 period.

Table 3–2 sets out our forecasts of connections at 30 June each year, demand per connection and total demand for small business customers for the 2020-25 period.

Table 3–1: Tariff V – Residential forecasts

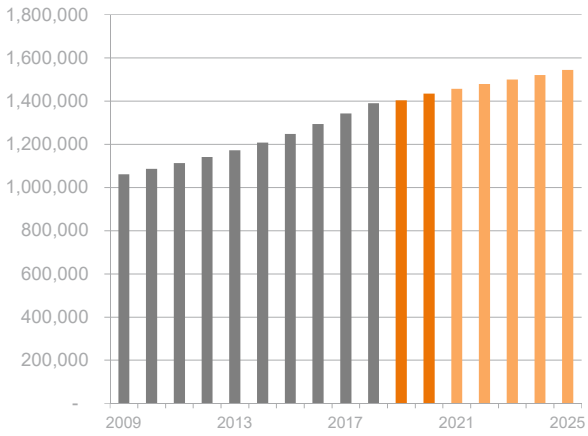
	2021	2022	2023	2024	2025
Residential connections (number)	1,419,534	1,440,478	1,460,831	1,481,644	1,503,736
Residential demand per connection (GJ/a)	18.7	18.7	18.6	18.4	18.3
Residential demand (GJ/a)	**26,585,541**	**26,886,480**	**27,112,545**	**27,332,636**	**27,550,788**

Table 3–2: Tariff V – Small business forecasts

	2021	2022	2023	2024	2025
Small business connections (number)	37,569	38,090	38,608	39,121	39,630
Small business demand per connection (GJ/a)	348.5	345.9	342.8	338.9	335.3
Small business demand (GJ/a)	**13,091,660**	**13,175,723**	**13,234,527**	**13,256,373**	**13,289,424**

Forecasts of total Tariff V connections and demand, historically and for the 2020-25 period, are shown in Figure 3-1 and Figure 3-3 respectively.[14]

Figure 3-1: Tariff V – total connections

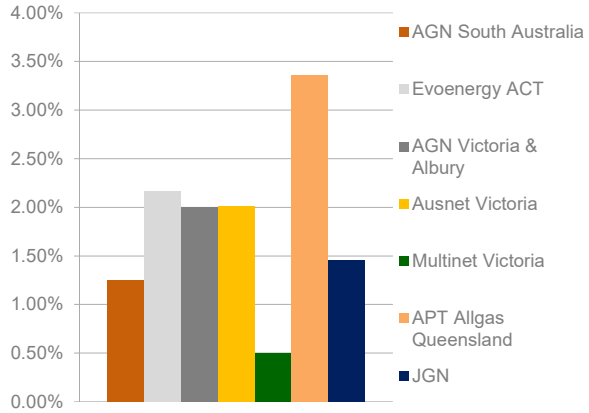


Source: Core Energy & Resources, Gas Demand and Customer Forecasts, Jemena Gas Networks, NSW Gas Access Arrangement 2021-2025, May 2019 (included as Attachment 8.2 of our 2020 Plan).

Figure 3-1 shows that total connections are forecast to continue to grow over the 2020-25 period, albeit at a slower rate than historically. While total connections are forecast to grow at a slower rate over the 2020-25 period, this rate is within the range of forecasts that have been reviewed, tested and accepted by the AER for other gas access arrangements, as seen in Figure 3-2 for residential customers (which account for the majority of Tariff V connections).

[14] Total demand is then allocated to individual tariff blocks based on the average split for the period 2016 – 2018 for VI tariffs. As the VB tariff was first introduced in 2016 we used the split from 2018.

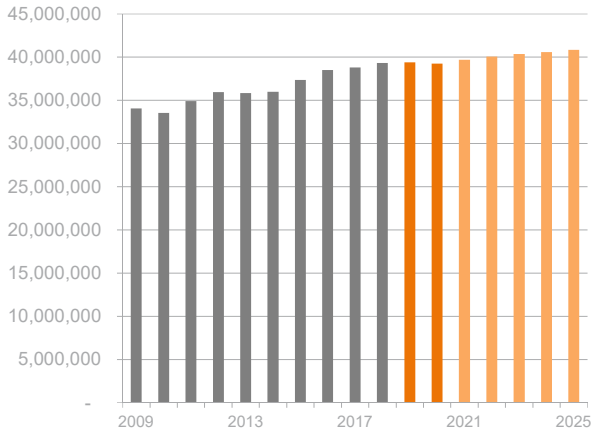
Figure 3-2: Forecast benchmarking – residential connection growth rates



Source: Core, Gas Demand and Customer Forecasts, Jemena Gas Networks, NSW Gas Access Arrangement 2021-2025, May 2019 (included as Attachment 8.2 of our 2020 Plan)

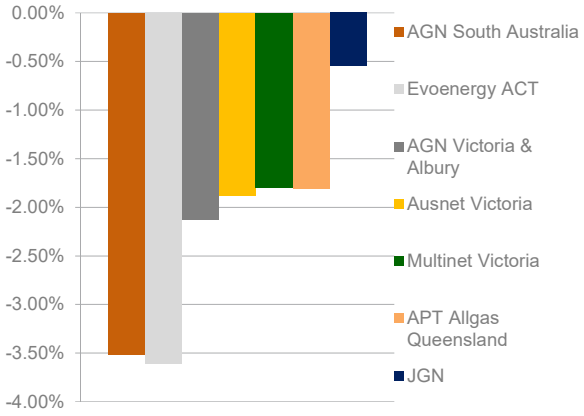
Figure 3-3 shows that total demand is also forecast to continue to grow over the 2020-25 period, albeit at a slower rate than historically. This is due in part to forecasts of declining demand per connection. As seen in Figure 3-4, the forecast rate of decline in demand per connection is much less than forecasts that have been reviewed, tested and accepted by the AER for other gas access arrangements.

Figure 3-3: Tariff V – total demand



Source: Core, Gas Demand and Customer Forecasts, Jemena Gas Networks, NSW Gas Access Arrangement 2021-2025, May 2019 (included as Attachment 8.2 of our 2020 Plan)

Figure 3-4: Forecast benchmarking – residential demand per connection growth rates



Source: Core, Gas Demand and Customer Forecasts, Jemena Gas Networks, NSW Gas Access Arrangement 2021-2025, May 2019 (included as Attachment 8.2 of our 2020 Plan)

3.2 Tariff D – Industrial customers

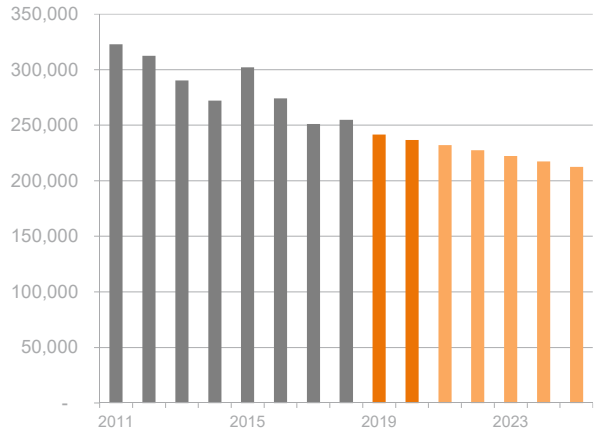
Table 3–3 sets out our forecasts of MDQ and ACQ for industrial customers for the 2020-25 period.

Table 3–3: Tariff D – Industrial forecasts

	2021	2022	2023	2024	2025
MDQ (GJ/d)	232,101	227,472	222,298	217,452	212,498
ACQ (GJ/a)	45,845,197	44,898,001	43,955,208	43,018,111	42,086,222

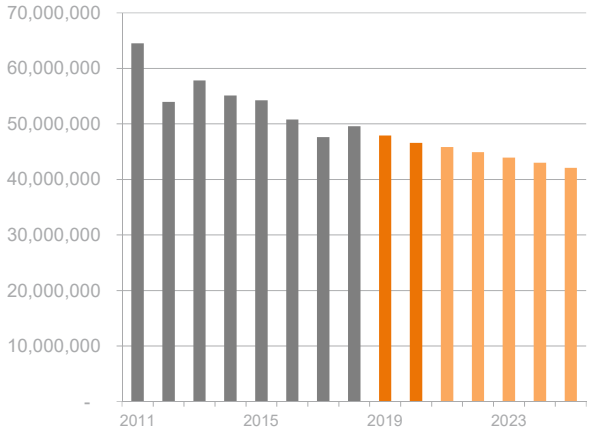
Forecasts of total Tariff D MDQ and ACQ, historically and for the 2020-25 AA period, are shown in Figure 3-5 and Figure 3-6 respectively. Figure 3-5 and Figure 3-6 show that both MDQ and ACQ are forecast to continue to decline over the 2020-25 AA period.

Figure 3-5: Tariff D - MDQ



Source: Core, Gas Demand and Customer Forecasts, Jemena Gas Networks, NSW Gas Access Arrangement 2021-2025, May 2019 (included as Attachment 8.2 of our 2020 Plan)

Figure 3-6: Tariff D - ACQ



Source: Core, Gas Demand and Customer Forecasts, Jemena Gas Networks, NSW Gas Access Arrangement 2021-2025, May 2019 (included as Attachment 8.2 of our 2020 Plan)

4. How the demand forecasts are used

There are several links between the demand forecast and other elements of our 2020 Plan. These include:

1. Prices – forecast sales volumes are used to determine our prices. More information on how we set our prices is provided in Attachment 4.1.
2. Capex – the number of new connections forecast is an input to our connection capex forecast. Our connections capex forecasting approach is outlined in Attachment 5.1.
3. Opex – the forecast gas throughput is used to forecast our unaccounted for gas costs, and customer numbers are an input to opex trend escalation. Further information on our opex forecast is provided in Attachment 6.1.

5. The 2015-20 period

Rule 72(1)(a)(iii) of the NGR requires that we show for the 2015-20 AA period the minimum, maximum and average demand for our network.

We generally do not use this kind of information to operate our network, nor do we forecast it, as localised demand rather than total demand is what drives our capex. More information on our how we plan and manage our network is provided in Attachment 5.1. Regardless, this information is presented in Table 5–1 for the years we have actual data.

Table 5–1: Minimum, maximum and average daily load 2016 to 2018 (TJ)

	2016	2017	2018
Minimum load	156.17	134.13	149.67
Maximum load	383.71	365.57	353.74
Average load	248.33	242.44	250.35

Rule 72(1)(d) of the NGR provides that the Access Arrangement Information must include to the extent practicable a forecast of pipeline capacity and utilisation over the next AA period and the basis upon which the forecast has been derived. Capacity and utilisation information for a distribution network is not available or relevantly meaningful. Our network is a geographically dispersed network made up of interconnected pipes and there are a number of practical considerations governing why the calculation of capacity and utilisation is not practicable.

The NGR also requires us to present customer numbers in total and by tariff class for the 2015-20 period. This information is also provided in our response to the AER's Regulatory Information Notice.

Table 5–2: Customer numbers by customer group

	2016	2017	2018	*2019 (Forecast)*	*2020 (Forecast)*
Residential	1,259,119	1,306,751	1,353,974	*1,366,847*	*1,396,854*
Small Business	34,858	35,506	35,937	*36,534*	*37,043*
Total Volume Tariff	***1,293,977***	***1,342,257***	***1,389,911***	***1,403,381***	***1,433,896***
Demand Tariff	***402***	***393***	***385***	***400***	***414***
Total	**1,294,379**	**1,342,6450**	**1,390,296**	***1,403,781***	***1,434,310***

(1) Customer numbers as at 30 June each year