Attachment 3: Demand, throughput and customer numbers

Access Arrangement Information for the 2016-21 ACT, Queanbeyan and Palerang Access Arrangement

Submission to the Australian Energy Regulator

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Key points

- Throughput for the volume customer group (known under the 2010-15 access arrangement as the 'tariff customer tariff class') is forecast to reduce by 1.59 per cent per annum on average over the 2016-21 access arrangement period. This decline in throughput is greater than the 0.51 per cent average annual decline in weather-normalised throughput observed over the past four years.
- The increased rate of decline reflects independent third-party projections of slowing growth in new housing starts and the economy in the Australian Capital Territory (ACT), which are expected to ease the growth in new gas connections from 3.7 per cent per annum over the past four years to 2.5 per cent in the 2016-21 period.
- The decline in throughput, despite growth in connections over the past four years, is a product of falling throughput per connection. Throughput per connection is forecast to continue to decline at a similar rate due to:
    - the greater availability and affordability of energy efficient appliances;
    - stronger competition from alternative energy sources;
    - the changing housing density mix; and,
    - changing customer preferences and incentives to adopt renewable energy.
- The demand customer group (known under the 2010-15 access arrangement as the 'contract customer tariff class') is expected to stabilise, with no new customer connections anticipated in the 2016-21 access arrangement period. Forecast growth rates in annual contract quantity and maximum daily demand are 0.52 per cent and 0.47 per cent per annum, respectively, over the 2016-21 period.

Consumer benefits

- Accurate and reasonable forecasts of connections, throughput and demand are in the long-term interests of consumers as they ensure that the average price path is set at the appropriate level—no higher or lower than necessary to allow ActewAGL Distribution to recover its efficient costs of providing the services that consumers want.

3.1 Overview

ActewAGL Distribution engaged Core Energy, an independent external consultant, to provide forecasts of gas throughput, maximum demand and customer numbers for the 2016-21 access arrangement period. These forecasts are used in setting the price control for ActewAGL Distribution's gas network tariffs. These forecasts therefore need to reflect a realistic expectation of demand so that prices are sufficient, but not more than necessary, to promote efficient investment in, and operation of, natural gas services for the long-term interests of consumers. Core Energy was selected to produce these forecasts as it has considerable expertise and experience in developing gas network forecasts and advising on gas forecasting methods. This experience includes, but is not limited to, developing the gas consumption forecasts for the Jemena Gas Networks (JGN) 2015-20 access arrangement, the Envestra (South Australia) 2011-2016 access arrangement, the Envestra (Victoria) 2013-17 access arrangement and the Envestra (Queensland) 2011-16 access arrangement.

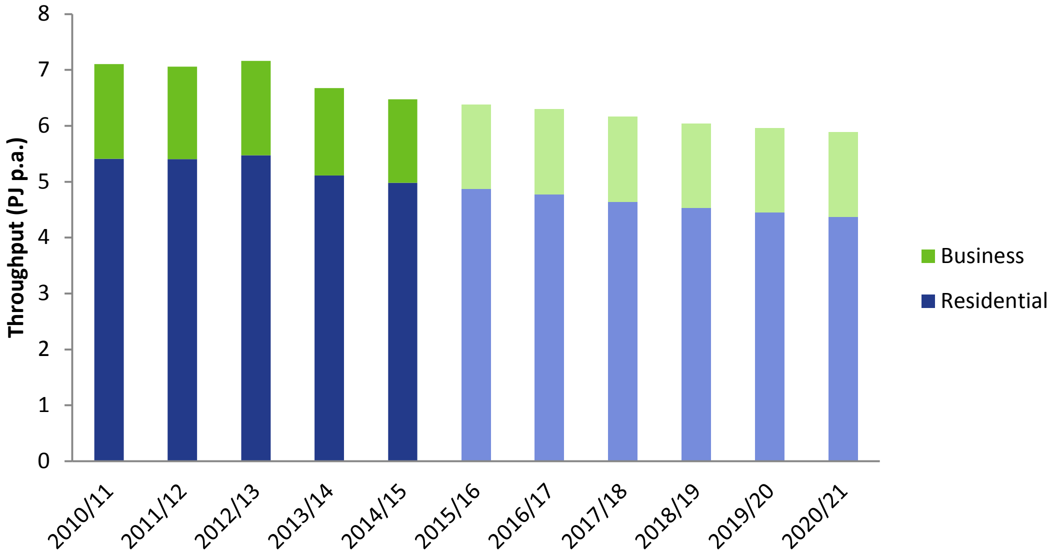
Forecasts were developed for two customer groups: the volume customer group (known under the 2010-15 access arrangement as the 'tariff customer tariff class') and the demand customer group (known under the 2010-15 access arrangement as the 'contract customer tariff class').[1] The volume customer group is further segmented into residential and business customers, and analysed by separating connection numbers and throughput per connection.

3.1.1 Forecasts for the volume customer group

Residential volume customer connections are forecast to grow, but at a rate lower than the historical rate, owing to differences in housing growth forecasts, relative to the past. The throughput per connection for this customer class is forecast to fall in line with increasing energy efficiency and other factors accounted for within the historical trend, in addition to the forecast increase in the real wholesale price of gas, both relative to CPI (increasing wholesale prices) and to the price of electricity (increased competitiveness of electricity prices). The rise in residential connections does not fully offset the fall in throughput per connection, resulting in falling total residential throughput.

[1] Volume customers are customers reasonably expected to consume less than 10 TJ of gas per annum, and demand customers are those customers reasonably expected to consumer greater than, or equal to, 10 TJ per annum.

Figure 3.1 Historical and forecast weather-normalised throughput for residential and business volume customers (2014/15 values are estimates)



The number of business volume customer connections is forecast to rise but at a rate slower than in the past, due to positive but lower economic activity in the ACT. Throughput per business volume customer is forecast to fall due to historical trends (including climatic trends, appliance trends, energy efficiency trends and policy), expected increases in gas prices and expected decreases in electricity prices. The influence of the forecast increase in business volume customer connections outweighs that of the forecast decrease in throughput per connection, resulting in an overall increase in throughput for this customer class.

For the volume customer group in total, including both residential and business customers, ActewAGL Distribution is forecasting a reduction in total throughput from 6,296 TJ in 2016/17 to 5,887 TJ in 2020/21 (Figure 3.1), with customer connections increasing from 144,998 in 2016/17 to 160,166 in 2020/21 (Table 3.1).

Table 3.1 Forecast throughput and connections for the volume customer group

	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21
Total volume customers						
Connections (no.)	141,528	144,998	148,739	152,463	156,476	160,166
Throughput (GJ)	6,378,363	6,296,219	6,160,131	6,039,643	5,956,158	5,886,757
Residential volume customers						
Connections (no.)	137,974	141,337	144,966	148,575	152,471	156,039
Throughput (GJ)	4,867,580	4,769,776	4,638,499	4,531,286	4,447,063	4,367,126
Business volume customers						
Connections (no.)	3,554	3,661	3,773	3,887	4,005	4,127
Throughput (GJ)	1,510,783	1,526,442	1,521,632	1,508,357	1,509,095	1,519,631

3.1.2 Forecasts for the demand customer group

The second customer class analysed is the demand customer group. The maximum daily quantity (MDQ) is forecast to fall in the first year of the 2016-21 access arrangement period due to [redacted] and then rise over the remaining years, with a major increase in 2018/19 due to [redacted] This same general pattern is expected for the annual contract quantity (ACQ). The number of demand customers is expected to remain steady at 40 as no new demand customers are expected within the forecast period. These results are shown in Table 3.2.

Table 3.2 MDQ, ACQ and connections for demand customers

	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21
MDQ (GJ)	8,025	7,951	7,956	8,201	8,206	8,211
ACQ (GJ)	1,201,836	1,185,399	1,185,769	1,231,356	1,231,764	1,232,191
Connections (no.)	40	40	40	40	40	40

The demand and connections forecasts drive key elements of the operating and maintenance expenditure (opex) and capital expenditure (capex) requirements (attachments 5 and 6), as well as the reference tariffs (attachment 12).

The remainder of this attachment describes the legal requirements for these forecasts (section 3.2), the historical performance of ActewAGL Distribution over the 2010-15 access arrangement (section 3.3), the process of generating these forecasts (section 3.4), and a discussion of the use of the forecasts (section 3.5).

3.2 Regulatory requirements

3.2.1 Rule 72

Rule 72(1)(a)(iii) of the National Gas Rules (the Rules) states that the access arrangement information must include:

> *… usage of the pipeline over the earlier access arrangement period showing:*
>
> *(A) for a distribution pipeline, minimum, maximum and average demand …*
>
> *(B) for a distribution pipeline, customer numbers in total and by tariff class.*

This requirement is addressed in section 3.3 below.

A second applicable section of Rule 72 is Rule 72(1)(d), which states that:

> *… to the extent that is practicable to forecast pipeline capacity and utilisation of pipeline capacity over the access arrangement period, a forecast of pipeline capacity and utilisation of pipeline capacity over that period and the basis on which the forecast has been derived.*

This part of Rule 72 is difficult to interpret in the context of a distribution network because a distribution network is made up of a meshed network of interconnected pipes. Due to a number of practical considerations, the calculation of utilisation is not straightforward and it is thus not practicable to provide forecasts of capacity and utilisation in this case.

3.2.2 Rule 74

Rule 74 of the Rules requires ActewAGL Distribution to satisfy the following requirements in regard to forecasting and estimation:

> *(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.*

Requirement (1) is satisfied by the information in this attachment. Requirement (2) is addressed by the explanation provided in this attachment (particularly section 1.4, discussing the forecasting methodology), the Core Energy report provided in appendix 3.01, and the Core Energy spreadsheet models provided in appendix 3.02, appendix 3.03 and appendix 3.04.

3.3 Historical performance

This section addresses the requirements of both parts of Rule 72(1)(a)(iii), and describes the key trends over the 2010/11 to 2014/15 period. In addition to these regulatory requirements, if there are significant differences between the Australian Energy Regulator (AER) approved values and the actuals, an explanation is given. Significance is assumed to be any deviation greater than five per cent.

3.3.1 Throughput

Table 3.3 shows the difference between the throughput forecast in the AER's final decision of March 2010 for both volume customers and demand customers, and the actual throughput over the 2010-15 access arrangement. Volume-customer throughput was significantly higher than forecast in the early years of the period and fell below the forecast in the later years of the period. There was a marked decrease in actual throughput between 2012/13 and 2013/14. The table also shows the weather-normalised actual throughput for volume customers derived from Core Energy's forecasting model. These figures show that some of the variance between forecast and actual throughput can be explained by the weather deviating from the historical average. Over the five years, volume-customer throughput is expected to be around 6.6 per cent higher than the forecast in the final decision, whereas weather-normalised throughput is only 4.5 per cent higher than the final decision.

For demand customers, throughput was below the forecast in the final decision for three of the regulatory years. Over the five years, demand-customer throughput is expected to be 0.2 per cent lower than the forecast.

Table 3.3 Historical total annual energy throughput (TJ) approved by the AER and actual

	2010/11	2011/12	2012/13	2013/14	2014/15
Volume customers					
AER final decision	6,545	6,525	6,565	6,642	6,736
Actual incurred	7,344	7,346	7,384	6,636	6,476[e]
Variance (%)	12.2	12.6	12.5	-0.1	-3.9
Weather-normalised actual[e]	7,105	7,060	7,165	6,677	6,476
Variance (%)	8.6	8.2	9.1	0.5	-3.9
Demand customers (ACQ)					
AER final decision	1,166	1,171	1,179	1,192	1,210
Actual incurred	1,139	1,224	1,166	1,155	1,224[e]
Variance (%)	-2.3	4.6	-1.1	-3.1	1.2
All customers					
AER final decision	7,711	7,696	7,744	7,834	7,946
Actual incurred	8,483	8,571	8,550	7,791	7,700[e]
Variance (%)	10.0	11.4	10.4	-0.6	-3.1

Source: ActewAGL Distribution Access Arrangement Information, 2009; Core Energy, 2015 (appendices 3.1 – 3.3).
[e] Estimate from Core Energy's model.

3.3.2 Maximum, minimum and average daily quantity

In accordance with Rule 72(1)(a)(iii)(A), Table 3.4 presents the maximum, minimum and average daily quantity for each year of the 2010-15 access arrangement period.

Table 3.4 Actual historical minimum, maximum and average daily demand (TJ)

	2010/11	2011/12	2012/13	2013/14	2014/15[e]
Minimum	61.73	65.75	59.62	62.34	62.94
Maximum	4.22	4.97	4.81	3.95	5.07
Average	23.66	23.80	22.93	21.26	22.51

[e] Estimate from Core Energy's model.

3.3.3 Customer numbers

In accordance with Rule 72(1)(a)(iii)(B), Table 3.5 presents the forecast and actual customer numbers over the 2010-15 access arrangement period, partitioned by volume and demand customers. Annual growth in customer numbers has been higher than forecast in the final decision. In 2010/11 and 2011/12 the actual was within one per cent of the forecast. However, in the remaining years of the access arrangement the deviation between actual and forecast customer numbers increased to around three per cent. The number of demand customers has been close to the forecast values.

Table 3.5 Forecast and actual customer numbers

	2010/11	2011/12	2012/13	2013/14	2014/15
Volume tariff customers					
Forecast	119,711	123,429	127,030	130,284	133,420
Actual	120,438	124,411	129,394	134,234	138,017[e]
Variance (%)	0.6	0.8	1.9	3.0	3.4
Contract customers					
Forecast	41	41	41	41	42
Actual	38	39	40	40	40[e]

Source: ActewAGL Distribution Access Arrangement Information, 2009; Core Energy, 2015 (appendices 3.1 – 3.3).
[e] Estimate from Core Energy's model.

3.4 Forecasting methodology

ActewAGL Distribution engaged Core Energy to generate forecasts of throughput, maximum demand and connections in accordance with the relevant sections of Rules 72 and 74 of the Rules. This section summarises Core Energy's methodology, with the report attached as appendix 3.01 and the spreadsheet models attached as appendix 3.02, appendix 3.03 and appendix 3.04. The purpose of this section of the attachment is to address Rule 74(2), to show that the forecasts have been arrived at on a reasonable basis, and to demonstrate that the forecasts provided in this attachment are the best forecasts available in the circumstances.

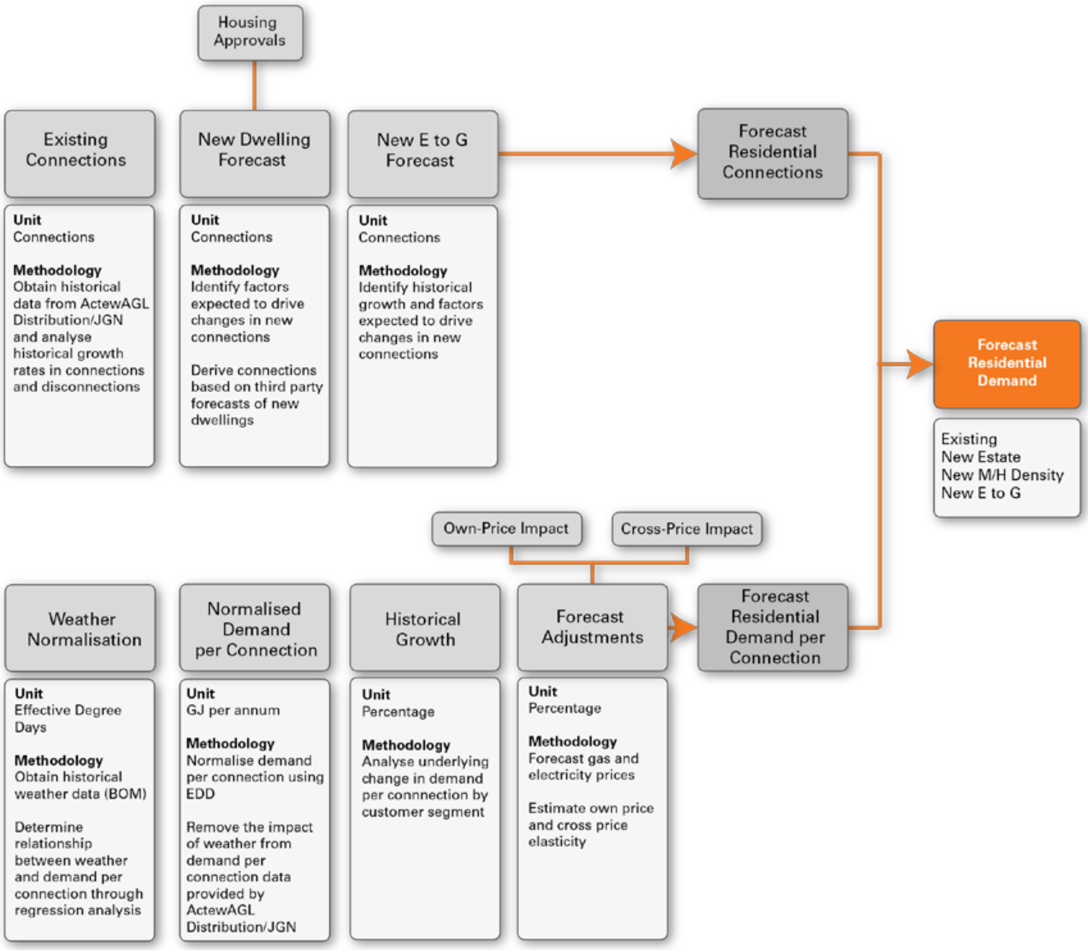
3.4.1 Methodology for the volume customer group

Broadly, the methodology adopted by Core Energy involves forecasting the number of connections and throughput per connection separately for each customer group, adjusting both components by factors expected to have a major impact in the future, and then combining these components to provide a forecast of total throughput for each customer group. Two volume customer classes were utilised: residential and business. There are many common elements in the methodologies applied to the two classes. Section 3.4.1.1 discusses the method applied to the residential volume customer class in detail, while section 3.4.1.2 discusses the differences in the methodology applied to the business volume customer class.

3.4.1.1 Residential volume customers

Figure 3.2 illustrates the method Core Energy used to forecast the number of connections and throughput per connection for residential volume customers.

Figure 3.2 Residential volume customers forecasting methodology



Residential volume connections

Core Energy forecast future connections using a bottom-up approach. This approach consisted of three main steps.

1. The existing connections in 2013/14 were used as a base from which the average rate of disconnections was removed, taking account of the 'Mr Fluffy' loose-fill asbestos buyback scheme. To this 'base' forecast, Core Energy appended a forecast of the number of new connections from two sources: new dwellings and new electricity-to-gas connections.
2. Using independent, third-party forecasts of housing starts to forecast new dwellings, Core Energy then considered the reach of the network and penetration rates before apportioning these new connections to estates and medium/high-density housing using Housing Industry Association (HIA) data for the 2016-21 access arrangement period.
3. The rate of electricity-to-gas conversions were forecast using historical trends.

Throughput per residential volume connection

Core Energy calculated throughput per connection using the following five steps:

1. normalise historical throughput for the effects of weather;
2. divide total residential throughput by the number of residential connections;
3. obtain the growth rate of weather-normalised throughput per residential connection;
4. remove the effects of historical changes in retail gas and electricity prices (based on estimates of own- and cross-price elasticity) on historical throughput growth rates; and
5. forecast throughput per connection taking into consideration factors such as forecast changes in retail gas and electricity prices, forecasts of economic activity, government policy and efficiency trends.

Each of these steps is described in further detail below.

Weather normalisation

Gas throughput is materially influenced by weather. This is especially true for the residential customer class. In order to develop a forecast of throughput under 'average weather conditions', it is important to understand how the historical data has been influenced by the weather. Core Energy has based its weather-normalisation approach on Australian Energy Market Operator (AEMO) guidelines.[2] Specifically, the approach employed uses a proxy variable for weather conditions affecting gas consumption called effective degree days (EDD). This is a variable which takes into account daily average temperature, sunshine hours, wind speed and time of the year by appropriately weighting temperature below a certain threshold, the interaction of temperature below that threshold with wind, the amount of sunshine and the time during the year. AEMO provides values of the weights and threshold for Victoria, but since the weather in the ACT differs from that in the main population centres in Victoria, these weights have been re-estimated by Core Energy using ACT data.

Core Energy has aggregated the fitted daily EDD values to produce fitted, monthly EDD values. Using this data, Core Energy has then considered a number of potential models for use in estimating the effect of weather on this data. Core Energy has used R^2 and the Akaike Information Criterion to select, from those potential models, a model of throughput which uses EDD in that month and the previous month's throughput as regressors:

$$throughput_t = \beta_0 + \beta_1 EDD_t + \beta_2 throughput_{t-1} + \varepsilon_t$$

Using historical daily EDD from 1978 to 2014, Core Energy fitted a linear regression of EDD over time and then individually aggregated both the actual daily EDD and fitted values to create two series of annualised data. Weather-normalised throughput for a given year is calculated as the actual throughput in that year minus the product of β_1 and the deviation of EDD in that year from the fitted value.

[2] AEMO, 2012, *2012 Review of the weather standards for gas forecasting*, April.

Core Energy uses this weather-normalised throughput series to calculate historical weather-normalised throughput per connection, as well as the historical trend of throughput per connection. From this historical trend, Core Energy removed the impact of historical changes in real retail gas and electricity prices (using estimates of own-price and cross-price elasticity) to arrive at a 'base' growth rate which is extrapolated into the future from 2013/14. Notionally, this 'base' growth rate accounts for a continuation in the trends of all of the variables that have affected past demand other than weather and the real retail prices of gas and electricity. Adjustments are made to this 'base' forecast for factors which have a material effect and which have not yet been captured in the historical trend.

The process Core Energy has used in weather normalisation differs from that used by ActewAGL Distribution in its 2010-15 access arrangement information. In the 2010-15 access arrangement information, ActewAGL Distribution used heating degree days (HDD),[3] a variable found to be inferior to EDD by AEMO.[4] The weather correction in that model consisted of multiplying the abnormal HDD—the difference between that year's observed HDD and the long-term average HDD—by a temperature sensitivity coefficient, estimated by regressing historical demand on historical HDD.[5] This process is similar to that used by Core Energy, with the key difference being that Core Energy has included a lag of demand in the model to estimate the coefficient.

Own-price elasticity

Core Energy has used a weighted five-year lag structure of own-price effects to capture the full, long-run impact of any change in real retail gas prices. The impact of future gas prices on throughput per residential connection has been estimated using forecast real gas price changes and the historical estimates of elasticities of lagged price changes. The estimated long-run (cumulative) price elasticity, reached over a period of five years, is -0.30 for residential volume customers and -0.35 for business volume customers. Both the approach and the values are consistent with the AER's final decision for Envestra (Victoria) 2013-17.[6] The resultant own-price elasticity effect is then added to the weather-normalised 'base' forecast.

Cross-price elasticity

Given that the main substitute for gas is electricity, Core Energy has incorporated the estimated effects of changes in retail electricity price on gas throughput. The reason for this inclusion, relative to previous access arrangements, is that gap between gas prices and electricity prices is expected to widen—a circumstance not observed in the recent past. Core Energy has calculated this effect as the product of the forecast changes in the gas-electricity price ratio and an estimate of cross-price elasticity of 0.1, which was derived from Core Energy's literature review. In its final

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[3] HDD is a variable similar to EDD in that it attempts to capture weather. HDD uses only a cut-off temperature, which contrasts with EDD which uses that same variable, but also wind chill, sunshine and time of year.

[4] AEMO, 2012, *2012 Review of the weather standards for gas forecasting*, April, p. 4.

[5] ActewAGL Distribution, 2009, *Access arrangement information for the ACT, Queanbeyan and Palerang gas distribution network*, June, p. 83.

[6] Acil Tasman, 2012, *Review of Demand Forecasts for Envestra Victoria*, August, p. 21; AER, 2013, *Access arrangement final decision Envestra Ltd 2013-17 Part 1*, March, p. 47.

decision on the JGN access arrangement for 2015-20, the AER accepted a forecast calculated using a cross-price elasticity value of 0.1.[7]

Other factors considered negligible

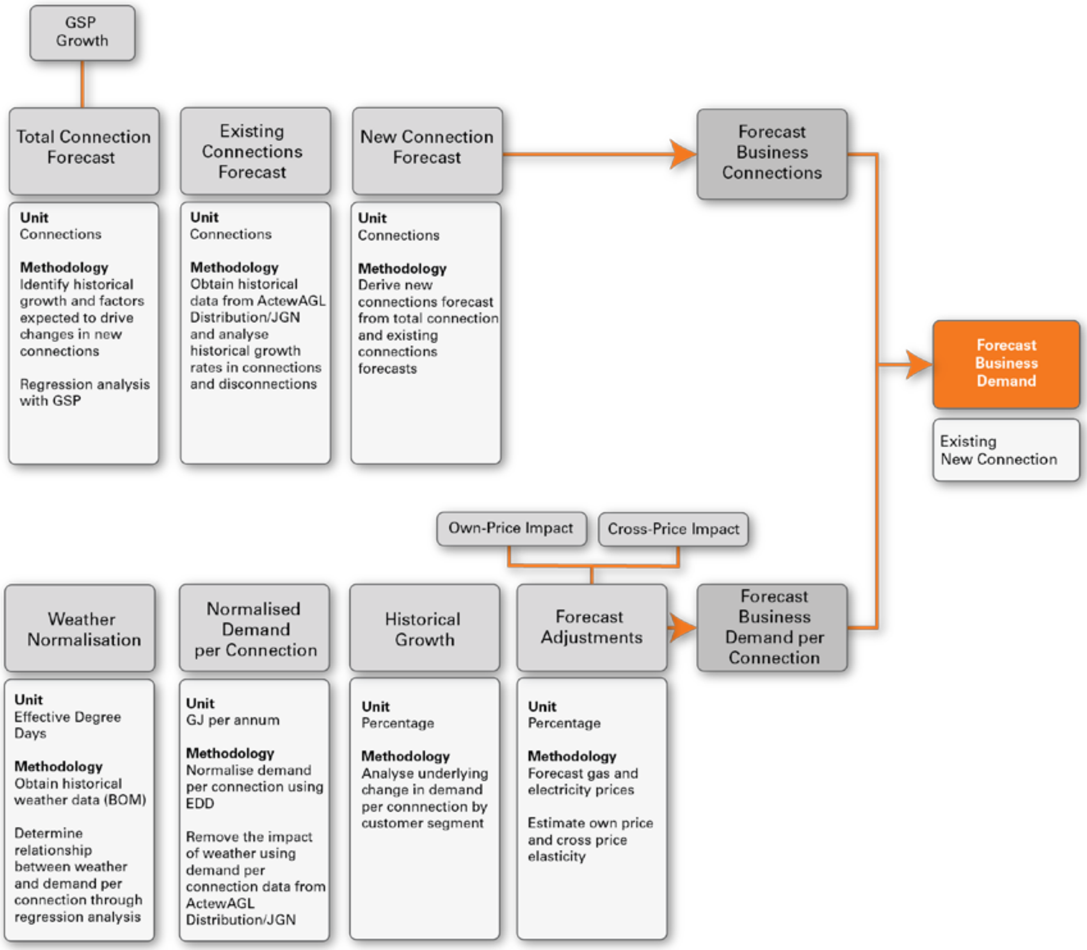
Core Energy identified other potential factors which have *ex ante* potential to influence residential throughput per customer. These include appliance trends, government policy, and economic growth. However, upon further analysis, Core Energy has found these factors are captured in the historical trend, and that these trends are likely to continue at a rate similar to the historical rate, and so are adequately captured in the model.

3.4.1.2 Business volume tariff customers

The approach taken by Core Energy in forecasting the business volume customer class is broadly the same as that for residential volume customers. This approach is shown in Figure 3.3, with differences relative to the approach used for the residential customer class described below.

[7] AER, 2015, *Final Decision Jemena Gas Networks (NSW) Ltd Access Arrangement 2015-20 Attachment 13 – Demand*, June, p. 13-12.

Figure 3.3 Business volume tariff customer class forecasting methodology



Business volume connections

Core Energy has forecast the number of existing business connections using a method similar to that for residential connections, with the exception of the 'Mr Fluffy' buyback scheme adjustment as no businesses are affected by this scheme. From these forecast values, the impact of gross state product (GSP) is removed to create a 'base' forecast.

Core Energy has used regression analysis to find a strong relationship between business connections and GSP, and has used independent, third-party forecasts of GSP to arrive at a forecast of the rate of growth of business connections. This rate is then appended to the 'base' forecast to arrive at a total number of business connections.

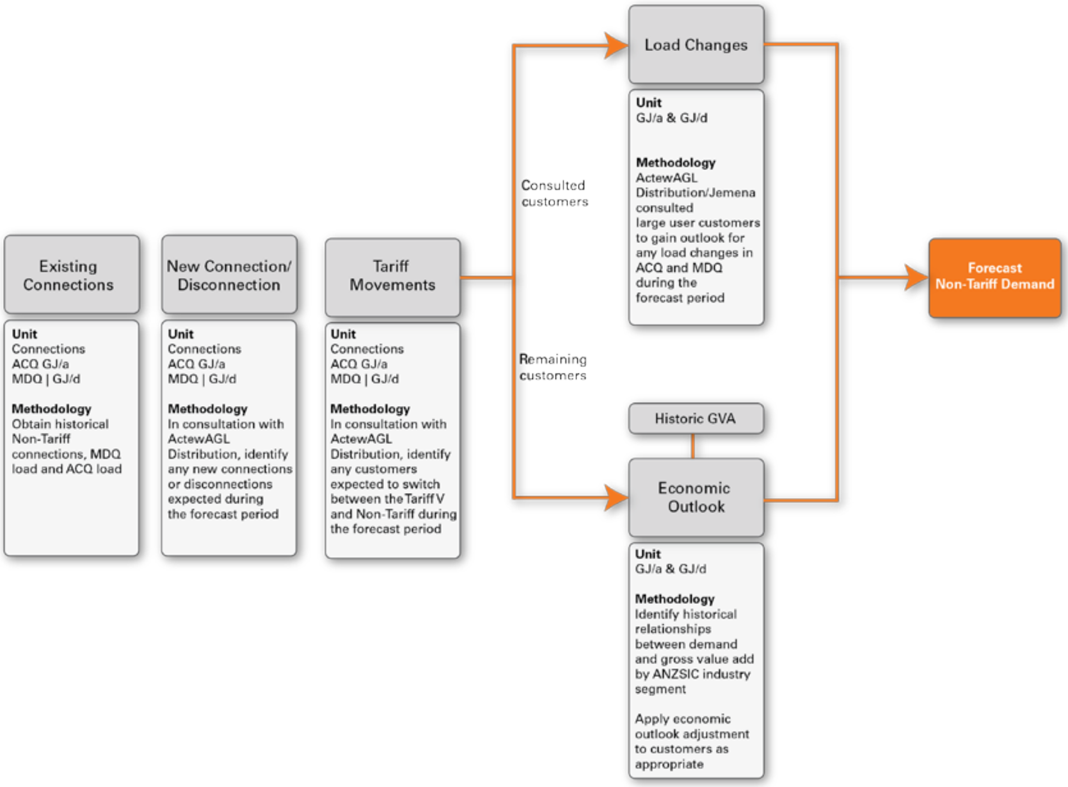
Throughput per business volume connection

The process to forecast energy throughput per business volume connection is the same as that used for the residential volume customer class, discussed in section 3.4.1.1.

3.4.1.3 Demand customer group

Customers within the demand customer group are engaged in contracts which provide for an MDQ. Core Energy has used the approach outlined in Figure 3.4 to forecast MDQ, which is elaborated below.

Figure 3.4 MDQ and ACQ forecasting methodology



Each customer in the demand customer group was allocated to their respective industry sector. These customers were then partitioned into two groups: those who have been surveyed and for which specific information is known; and those who have not been surveyed and for which minimal information is known.

Surveyed customers

The surveyed customers were directly asked whether they expected any changes in load for the forthcoming access arrangement period. Responses were directly incorporated into the forecasts for these individual customers. Given this information, Core Energy added (respectively, removed) any known connections (respectively, disconnections), accounted for any movement between the volume and demand customer groups, and accounted for material load changes.

Non-surveyed customers

The remaining customers (i.e. the non-surveyed customers) were assumed to grow at the rate of their respective industry segment. The gross value added of each of these industry segments was regressed against gas demand, with those regressions resulting in significant relationships being further assessed by Core Energy in respect of whether that relationship was likely to continue into the future. If the relationship was assessed as likely to continue into the future, the expected growth rate was applied to all customers within that segment. For those industry segments which did not show a significant relationship in the regression, Core Energy assumed the MDQ would remain unchanged.

3.4.2 Precedents for the methodology

ActewAGL Distribution notes that the AER has, in past regulatory determinations, accepted the general principles of the approach outlined above. The details of applying this methodology have differed between businesses, with the AER taking issue with some specific assumptions adopted by Envestra and JGN. For ActewAGL Distribution's report at appendix 3.01, Core Energy has taken every effort to address relevant issues raised by the AER in relation to the methods used to forecast demand for Envestra and JGN, where appropriate to do so. Specific instances of the use of the general methodology outlined above, the responses by the AER, and the consideration by ActewAGL Distribution are discussed below.

Jemena Gas Networks (2015)[8]

In its 2015 final decision on JGN’s access arrangement for 2015-20, the AER accepted the general methodology, but made the following adjustments relevant to ActewAGL Distribution.

- *The proportion of new dwellings categorised as medium/high-density did not reflect HIA data*

  Core Energy has used HIA data for ActewAGL Distribution's report, the details of which are discussed in section 3.4.3 below.

- *The use of residential retail prices in the cross-price elasticity calculation was not accepted, as non-residential prices are not expected to fall as substantially as residential prices.*

  Since the majority of gas usage in the ACT is by residential customers paying residential tariffs, the use of forecast residential retail prices is the most appropriate in the circumstances.

Envestra Victoria (2012)[9]

In its response to the demand forecasts submitted by Envestra in 2012, the AER accepted the methodology but took issue with the data. Specifically, *Envestra used projected EDD over a historical period rather than actuals; and the most current data available was not used.*

ActewAGL Distribution has used the most current, actual data available in arriving at its forecasts, as outlined in section 3.4.3 below.

3.4.3 Data

The data sources used in estimating the forecasting model are reliable and the best available.

[8] AER, 2014, *Draft Decision Jemena Gas Networks (NSW) Ltd Access arrangement 2015-2020 Attachment 13 – Demand,* November, pp. 10-11.

[9] AER, 2012, *Access arrangement draft decision Envestra Ltd 2013-17 Part 1*, September, p. 63.

Weather data
All weather data were sourced from the Bureau of Meteorology (BOM) at Station 70014 (Canberra Airport Comparison) for the period 1 July 2007 to 28 February 2010, and from station 70351 (Canberra Airport) from 1 March 2010 to 5 December 2012. These data included:

- temperature;
- wind; and
- sunshine hours, which had to be estimated for the period 5 December 2012 to 30 June 2014 as BOM stopped measuring sunshine hours but continued to measure solar exposure (Core Energy has used the historical relationship between sunshine hours and solar exposure to fit values for use as a proxy for the missing data).

Connections and throughput data
Connections and throughput data were sourced internally from ActewAGL Distribution/JGN.

Population data
A set of population data for the ACT was sourced from the Treasury and Economic Development Directorate of the ACT Government, and for the Queanbeyan and Palerang regions was sourced from the NSW Government, Department of Planning and Environment. Core Energy extrapolated the NSW data for the forecast period.

Housing data
New dwellings historical values and forecasts were sourced from the Housing Industry Association—a housing data source the AER has previously adopted.[10]

Price data
Gas (and other household fuels) and electricity price index data were obtained from the Australian Bureau of Statistics (Cat. No. 6401.08).

Economic activity data
A data set for historical gross state product was sourced from the Australian Bureau of Statistics (Cat. No.5220.0). Forecasts of gross state product were sourced from BIS Shrapnel.

Demand customer data
Data associated with demand customers were internally sourced from ActewAGL Distribution/JGN.

3.5 Forecasts

The Core Energy model was used to satisfy Rule 74 in reference to throughput, customer numbers and MDQ. Key trends in these variables are also discussed in this section. It is ActewAGL Distribution's view that these Core Energy forecasts are the best possible forecasts given the circumstances.

[10] AER, 2014, *Draft Decision Jemena Gas Networks (NSW) Ltd Access arrangement 2015-2020 Attachment 13 – Demand,* November, pp. 13-10, 13-16.

3.5.1 Volume customer group

Table 3.6 shows the forecasts for connections and throughput for the volume customer group.

Table 3.6 Throughput and connections for the volume customer group

	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21
Connections (no.)	141,528	144,998	148,739	152,463	156,476	160,166
Throughput (GJ)	6,378,363	6,296,219	6,160,131	6,039,643	5,956,158	5,886,757

Over the forecast period, there is sustained growth in connections with an average growth rate of 2.51 per cent per year. This growth rate is slower than the historical rate of 3.66 per cent per year. This difference is explained below in relation to each customer class. Total throughput is forecast to fall at an average rate of -1.59 per cent per year. This decline is faster than the historical trend of -0.51 per cent per year. The factors explaining this difference are discussed below.

Table 3.7 shows the residential volume customer class, disaggregated (at the highest level) into connection numbers and throughput per connection. The number of connections is driven by the construction of new dwellings and the conversion to gas in existing dwellings, with the former being the greater influence. These connection rates are lower than historical connection rates, consistent with the HIA prediction of a slowing in new housing starts.

Forecast throughput per connection is a weighted average of separate forecasts for existing connections, new estate connections, new medium/high-density connections and electricity-to-gas conversions. The forecast with the largest influence on the outcome is the forecast for existing connections, which is calculated by extrapolating the historical trend, adjusted for the estimated effects of changes in retail prices in gas and electricity over the historical and forecast periods. Throughput per residential connection is forecast to decline at a rate comparable, but slightly higher (-4.52 per cent per year), than the rate observed in the historical data (-3.98 per cent per year), due in part to consumer responses to relative prices, sustained uptake of energy efficient appliances, and customer and government preferences for clean energy, but primarily to changes in housing density mix towards medium/high density housing.

Overall, the forecast increase in connection numbers is more than offset by the forecast decrease in throughput per connection, resulting in a forecast decrease in total throughput for residential customers.

Table 3.7 Total throughput, connections and throughput per connection for residential customers

	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21
Throughput (GJ)	**4,867,580**	**4,769,776**	**4,638,499**	**4,531,286**	**4,447,063**	**4,367,126**
Connections (no.)	**137,974**	**141,337**	**144,966**	**148,575**	**152,471**	**156,039**
Existing connections (including disconnections)	129,355	128,288	127,202	126,097	125,278	124,437
Cumulative E-to-G	1,562	2,343	3,124	3,905	4,686	5,467
Cumulative new estate dwellings	3,586	5,692	7,772	9,853	11,933	13,810
Cumulative medium/high density dwellings	3,471	5,014	6,867	8,721	10,574	12,325
Throughput per connection (GJ)	**35.3**	**33.7**	**32.0**	**30.5**	**29.2**	**28.0**
Existing connections	*36.1*	*34.8*	*33.4*	*32.2*	*31.1*	*30.1*
Growth	-1.02	-0.99	-0.97	-0.94	-0.92	-0.89
Own-price elasticity	-0.16	-0.30	-0.48	-0.29	-0.19	-0.10
Cross-price elasticity	-0.23	0.07	0.00	0.00	0.00	0.00
New estate dwellings	*32.3*	*31.2*	*29.9*	*28.8*	*27.8*	*26.9*
Growth	-0.92	-0.89	-0.87	-0.84	-0.82	-0.80
Own-price elasticity	-0.14	-0.27	-0.43	-0.26	-0.17	-0.09
Cross-price elasticity	-0.21	0.06	0.00	0.00	0.00	0.00
New medium/high density dwellings	*13.8*	*13.4*	*12.8*	*12.3*	*11.9*	*11.5*
Growth	-0.39	-0.38	-0.37	-0.36	-0.35	-0.34
Own-price elasticity	-0.06	-0.11	-0.19	-0.11	-0.07	-0.04
Cross-price elasticity	-0.09	0.03	0.00	0.00	0.00	0.00
New E-to-G	*24.5*	*23.7*	*22.7*	*21.9*	*21.1*	*20.5*
Growth	-0.70	-0.68	-0.66	-0.64	-0.62	-0.61
Own-price elasticity	-0.11	-0.20	-0.33	-0.20	-0.13	-0.07
Cross-price elasticity	-0.16	0.04	0.00	0.00	0.00	0.00

Table 3.8 sets out the disaggregation of the forecasts for business volume customers. Similar to residential volume customers, the number of connections is forecast to increase and the throughput per connection forecast to decrease. The rate of increase in connection numbers is comparable, at 3.04 per cent per year, but slightly lower than the historical average growth rate of 3.66 per cent per year. This difference is primarily due to the effects of reduced forecast growth in GSP.

Throughput per connection for business volume customers is forecast to decline at a rate of 3.62 per cent per year (prior to any movements of customers between the volume and contract-customer classes) which is similar to the historical average decline of 4.16 per cent per year. This easing of the rate of decline is primarily driven by the own-price effects being less substantial than during the 2010-15 period, while the remaining rate of decline is accounted for by the continued influence of factors contained in the historical trend, and customer and government preferences for clean energy.

In contrast to the residential volume customer class, the forecast growth in connections outweighs the forecast decrease in throughput per connection, resulting in a forecast increase in business volume throughput.

Table 3.8 Total throughput, connections and throughput per connection for business volume customers

	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21
Throughput (GJ)	**1,510,783**	**1,526,442**	**1,521,632**	**1,508,357**	**1,509,095**	**1,519,631**
Connections (no.)	**3,554**	**3,661**	**3,773**	**3,887**	**4,005**	**4,127**
Existing connections (including disconnections)	3,381	3,364	3,347	3,330	3,312	3,295
Cumulative new connections	173	298	427	559	694	833
Movement: tariff to non-tariff	-4	-4	-4	-4	-4	-4
Movement: non-tariff to tariff	3	3	3	3	3	3
Throughput per connection (GJ)	**425.2**	**416.9**	**403.3**	**388.0**	**376.8**	**368.2**
Existing connections	*426.5*	*414.5*	*397.7*	*379.6*	*365.7*	*354.7*
Growth	-11.0	-10.7	-10.4	-10.2	-9.9	-9.7
Own-price elasticity	-1.5	-1.7	-6.4	-7.9	-3.9	-1.3
Cross-price elasticity	0.2	0.3	0.0	0.0	0.0	0.0
New connections	*543.2*	*527.9*	*506.5*	*483.4*	*465.8*	*451.8*
Growth	-13.9	-13.6	-13.3	-12.9	-12.6	-12.3
Own-price elasticity	-1.9	-2.1	-8.1	-10.1	-5.0	-1.6
Cross-price elasticity	0.3	0.4	0.0	0.0	0.0	0.0

The effect of declining throughput for the residential customer class outweighs the effect of increasing throughput for the business volume customer class, leading to an overall decrease in throughput for the volume customer group by 6.5 per cent between 2016/17 and 2020/21.

3.5.2 Demand customer group

The key forecast variables for the demand customer group are MDQ, ACQ and customer numbers. These three components are provided in Table 3.9 to show the major factors driving the forecasts.

Both MDQ and ACQ are forecast to decline early in the 2016-21 access arrangement period and then increase in the later part of the period. Over the five-year period, MDQ is forecast to grow at an average rate of 0.47 per cent per year, while ACQ is forecast to grow at an average rate of 0.52 per cent per year. These growth rates are substantially lower than those observed over the historical period of 6.10 and 2.17 per cent per year, respectively. The reason for this moderation is that no new demand customers are forecast to be connected over the 2016/17 to 2020/21 period, in contrast to the 2010-15 period, which saw the connection of a number of large demand customers. The number of demand customers is forecast to remain constant at 40 across the forecast period.

Table 3.9 MDQ, ACQ and connection numbers for the demand customer group

	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21
MDQ (GJ)	*8,024.8*	*7,951.3*	*7,956.1*	*8,200.9*	*8,205.9*	*8,211.0*
Historical MDQ baseline	8,242.0	8,242.0	8,242.0	8,242.0	8,242.0	8,242.0
Cumulative change in existing connections MDQ	-190.0	-268.2	-268.2	-28.2	-28.2	-28.2
Cumulative economic adjustments	9.0	13.7	18.4	23.3	28.2	33.3
Cumulative volume tariff to contract movement	193.8	193.8	193.8	193.8	193.8	193.8
Cumulative contract to volume tariff movement	-230.0	-230.0	-230.0	-230.0	-230.0	-230.0
ACQ (GJ)	*1,201,836*	*1,185,399*	*1,185,769*	*1,231,356*	*1,231,764*	*1,232,191*
Historical ACQ baseline	1,155,040	1,155,040	1,155,040	1,155,040	1,155,040	1,155,040
Cumulative change in existing connections ACQ	19,695	2,403	1,899	46,594	46,090	45,586
Cumulative economic adjustments	1,657	2,512	3,385	4,278	5,189	6,120
Cumulative volume tariff to contract movement	49,517	49,517	49,517	49,517	49,517	49,517
Cumulative contract to volume tariff movement	-24,073	-24,073	-24,073	-24,073	-24,073	-24,073
Connections (no.)	*40*	*40*	*40*	*40*	*40*	*40*
Existing connections	36	36	36	36	36	36
Volume tariff to contract movement	4	4	4	4	4	4

3.5.3 Use of the forecasts

The forecasts developed by Core Energy for ActewAGL Distribution are a critical input to calculating reference tariffs, as well as to the development of opex and capex forecasts.

3.5.3.1 Operating expenditure (opex)

The Core Energy forecasts outlined above have been used to forecast opex in four main areas.

1. Output growth forecast: forecast customer numbers are used to calculate the deviation of the number of customers from the base year. This value is then multiplied by an estimate of the incremental cost per customer to arrive at the additional opex required to serve this larger network.

2. Utilities Network Facilities Tax (UNFT): UNFT is charged on 'total services length'. ActewAGL Distribution has based its forecast of total services length on the forecast growth in customer numbers outlined in this attachment. Services length and customer numbers are correlated, since growth in customer numbers due to greenfields developments will result in growth in the total route length of the pipelines.
3. Unaccounted Gas (UAG): UAG is forecast as a fixed proportion of the forecast of total throughput outlined in this attachment.
4. Energy Industry Levy (EIL): EIL is based, in part, on the forecast throughput outlined in this attachment.

Further details are given in attachment 5 of this access arrangement information.

3.5.3.2 Capital expenditure (capex)

The Core Energy forecasts outlined above have been used to forecast capex in a single area: the cost of connection. In determining the total cost of connections, ActewAGL Distribution has multiplied the cost per connection by the forecast new customer connections outlined in this attachment. This calculation is discussed in more detail in attachment 6 of this access arrangement information.

Abbreviations used in this document

Abbreviation	Full term
ACQ	annual contract quantity
ACT	Australian Capital Territory
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
BOM	Bureau of Meteorology
capex	capital expenditure
EDD	effective degree days
EIL	Energy Industry Levy
E-to-G	electricity to gas conversions
GJ	gigajoule(s)
GSP	gross state product
GVA	gross value added
HDD	heating degree day
HIA	Housing Industry Association
JGN	Jemena Gas Networks (NSW) Ltd
MDQ	maximum daily quantity
NSW	New South Wales
opex	operating and maintenance expenditure
PJ	petajoule(s)
Rules, the	National Gas Rules
TJ	terajoule(s)
UAG	unaccounted-for gas
UNFT	Utilities Network Facilities Tax