Deloitte Access Economics

# Australian Energy Regulator

## Gas demand forecast - Jemena Gas Network NSW

15 May 2015

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# Glossary

| | |
|---|---|
| AER | Australian Energy Regulator |
| E TO G | Electricity to Gas |
| GJ | Gigajoules |
| GSP | Gross State Product |
| I&C | Industrial and Commercial |
| JGN | Jemena Gas Networks (NSW) Ltd |
| SFD | State Final Demand |
| TJ | Terajoules |
| WPI | Wage price index |

# Executive Summary

Deloitte Access Economics Pty Ltd (Deloitte) has been engaged by the AER to review the forecast of gas usage in Jemena Gas Network's (JGN's) NSW gas network. To the extent that we did not consider JGN's forecast to be reasonable, we were asked to develop an alternative forecast.

This report has had regards to comments and changes made by JGN and its advisors in response to the AER's draft decision[1] and Deloitte's earlier report to the AER on this matter ('our 2014 report').[2]

## Approaches to gas demand forecasting

There is no single accepted approach to forecasting gas usage in Australia. However, there have been two broad approaches adopted in recent years – a linear trend approach (as adopted by the Core Energy Group (Core), who prepared JGN's forecasts) and an econometric approach. When the expected drivers of gas consumption (such as prices and economic conditions) are likely to follow a similar path as that experienced in recent history, the trend approach provides a simple, parsimonious approximation of future consumption. However, when trends are not expected to be maintained over the forecast period (due to, for example, a change in economic conditions) then the trend approach will not produce accurate forecasts. In this instance, an approach which incorporates forecasts of the expected drivers of gas consumption is preferred (i.e. an econometric regression).

In our view Core's use of a linear trend approach to forecasting future gas consumption has resulted in forecasts that are low and do not take into account all of the factors influencing gas usage. In particular Core's forecasts do not reflect the forecast improvement in the NSW economy in its per customer usage figures, although higher connections numbers caused by the recent housing boom are incorporated.

Further, the post-model adjustments introduced by Core (which adjust for the impact of changes in the price of gas and electricity) appear to overstate the likely impact of these factors on demand.

We recognise that econometric analyses are subject to the weaknesses imposed by limited degrees of freedom, and where no statistically robust measure of the relationship between gas demand and its drivers can be found a trend approach may be the next best alternative. However, the justification for adopting this approach should be documented in regulatory submissions (including details on the regressions performed and the reasons rejecting an econometric approach) and the impact of modelling simplification (through use of a trend) should be discussed.

[1] AER, *Draft decision Jemena Gas Networks (NSW) Ltd Access Arrangement 2015–20*, November 2014

[2] Deloitte Access Economics, *Gas demand forecast for Jemena's NSW network*, 24 November 2014

## Our review

We have made a number of adjustments to Core's forecasts to reflect areas of the forecast which we do not consider to be reasonable. These are summarised below. There are also a number of other elements of the forecast where we have not made adjustments because either:

- Sufficiently reliable data does not exist to do so – for example in the case of adjustments to the small business and I&C forecast to reflect economic conditions, or
- Although the approach, assumptions and parameter values adopted by Core are not necessarily those that we would use, they are nevertheless within – although usually towards the lower end – of a reasonable range.

We therefore consider the adjusted forecasts presented here to be the 'bottom end' of a reasonable range of forecasts.

## Connections

As Table i to Table iii highlight, the only adjustments we made to connection forecasts were for small business connections – namely a moderation in the strength of the increasing trend.

We are also of the view that the Core forecast of the percentage of new residential connections that are located in new estates (as distinct from medium to high density dwellings), at 48.8%, is high. We have adjusted the Core forecasts to reflect a new estates percentage of 45% although because this does not change the total number of connections Table ii does not show any change to the Core forecast.

**Table i: Tariff V Residential – revised connection forecast**

| | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|
| Actual | 1,103,184 | 1,136,607 | 1,172,432 | | | | | | |
| Deloitte forecast | | | | 1,208,251 | 1,242,767 | 1,274,694 | 1,304,049 | 1,330,847 | 1,355,105 |
| Core forecast | | | | 1,208,251 | 1,242,767 | 1,274,694 | 1,304,049 | 1,330,847 | 1,355,105 |
| *Difference (%)* | | | | *0%* | *0%* | *0%* | *0%* | *0%* | *0%* |

Source: Deloitte Access Economics

**Table ii: Tariff V Small Business – revised connection forecast**

| | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|
| Actual | 20,941 | 21,581 | 22,125 | | | | | | |
| Deloitte forecast | | | | 22,683 | 23,257 | 23,848 | 24,457 | 25,083 | 25,727 |
| Core forecast | | | | 22,710 | 23,343 | 24,025 | 24,762 | 25,556 | 26,413 |
| *Difference (%)* | | | | *-0.1%* | *-0.4%* | *-0.7%* | *-1.2%* | *-1.9%* | *-2.60%* |

Source: Deloitte Access Economics

**Table iii: Tariff V I&C – revised connection forecast**

| | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|
| Actual | 15,188 | 15,933 | 16,827 | | | | | | |
| Deloitte forecast | | | | 17,183 | 17,498 | 17,871 | 18,259 | 18,662 | 19,080 |
| Core forecast | | | | 17,183 | 17,498 | 17,871 | 18,259 | 18,662 | 19,080 |
| *Difference (%)* | | | | *0%* | *0%* | *0%* | *0%* | *0%* | *0%* |

Source: Deloitte Access Economics

## Consumption per customer

The forecast of **residential consumption per customer** has been revised by Core as a result of the addition of 2014 actual data, which lengthened the historical series and slightly modified the full historical series as a result of the weather normalisation process. With the addition of the 2014 data point the regression equation used as the basis of our forecasts in our 2014 report is no longer significant.

However, we remain concerned that the Core forecast does not adequately reflect the impact of economic conditions. Taking into consideration the expectation by ourselves, ACIL Allen and JGN's reviewers that it would be *household income* that drives residential consumption – rather than GSP and SFD which we previously utilised as proxies for household income – we re-ran the model with household disposable income as the explanatory variable. We found this to be a statistically significant driver of residential gas consumption per customer.

Due to the composition of the household disposable income series, forecasts for household disposable income are not generally produced as this would require assumptions about future income, fiscal policy and monetary policy. Consequently, we have adopted Core's approach of making post-model adjustments for known drivers of consumption which, due to the lack of statistical relationship, cannot be explicitly included in the baseline forecasts. A proxy for household disposable income was identified on the basis of correlation and theoretical justification – namely the NSW wage price index (WPI). The forecast of household disposable income was therefore derived using the linear relationship between household disposable income and the WPI, and Deloitte Access Economics' forecasts for WPI over the 5 year Regulatory Review period.

With the addition of the 2014 data point, no statistically significant relationship between **small business consumption per customer** and economic activity could be ascertained. Similarly, the regression used as the basis of our **I&C consumption per customer** forecasts for the 2014 report were no longer statistically robust. Our previous I&C model was based on GSP which, in 2014, increased when I&C consumption per connection decreased. With limited data points available, our regression analysis was not able to explain the 2014 data point (or ignore it as an outlier). As such, we have not made any changes to Core's trend forecasts of small business and I&C consumption per customer (other than to correct a small error in relation to the small business trend), although we remain concerned that the Core forecasts for these customer groups do not reflect economic conditions. Further, as discussed below, we have made adjustments to consumption per customer for all customer groups, to reflect our views about the impact of price changes on usage.

## The impact of price

A significant driver of the reduction in per customer usage forecast by Core is changes in the absolute and relative levels of gas and electricity prices. The impact of prices has been reflected by Core in a series of post-trend elasticity adjustments.

**Elasticity values**

In relation to own-price elasticity, Core has used a figure of -0.3 for residential and -0.35 for non-residential demand. These figures are consistent with those included in other Access Arrangements, notably for Envestra's South Australian and Victorian networks. Although elasticity estimates are not automatically transferable across different customer groups, these estimates are within a reasonable range and have previously been accepted by the AER.

The most significant price impact on demand occurs through the cross-price elasticity assumption. Core has adopted a cross-price elasticity of 0.1. While Core noted that no previous gas forecasts have incorporated cross price elasticity, it considers that the material forecast change in gas prices relative to electricity warrants inclusion in this case.

The adopted value of 0.1 reflects a range of US studies cited by Core, noting that there is no available Australian data on this subject.

As we outlined in our 2014 report, our concern with using a material cross-price elasticity estimate is the lack of relevant Australian evidence to support it. All the studies cited by Core are US based, some are quite old, and all are based around gas markets which are quite different to those in NSW.

We therefore have concerns about the applicability of the results of these studies to the NSW context. Given the significant effect the cross-price elasticity has on forecast volumes and hence prices – under Core's assumptions it results in a 14% reduction in average use across the outlook period – we consider that the supporting evidence for the elasticity value would need to be compelling to justify such an impact. We do not believe this evidence exists.

Furthermore, we note that the forecasts developed recently by the NSW electricity distribution businesses as part of their price review process have not included an assessment of cross price elasticity (with gas) and, therefore, this demand is essentially being 'lost' from a regulatory perspective.

On balance, our view is that it is reasonable to include an estimate of cross-price elasticity in the forecasts. Given the uncertainties regarding the level of the elasticity, and the potential impact on usage, we consider that using a conservative value of 0.05 is more reasonable than the 0.1 proposed by Core. We accept that this is a somewhat arbitrary figure, but we believe there is insufficient evidence at this time to justify an impact of the magnitude sought by Core.

**Approach to applying elasticity**

In Core's 2014 report on JGN's demand (the '2014 Core report')[3], the impact of elasticity on demand was calculated by multiplying the elasticity estimate by the price change, and multiplying this figure by average usage.

In its response to the AER's Draft Decision Core has adopted a different and more complex approach, which results in a much larger impact on demand. The new approach identifies that there is an elasticity impact in the historic (trend) usage figures which needs to be removed from the forward forecasts. Core's approach "applied the price differential between the forecast price impact and the historical price impact of price, to the forecast of demand per connection".

For reasons set out in section 4.3 we do not consider Core's new application of the elasticity estimates is reasonable, largely on the basis that it results in outcomes which are beyond a reasonable range. We have therefore adopted Core's original methodology to calculate the effect of electricity prices on demand.

**Price of electricity**

Core's 2015 report has updated the forecast price of electricity (for both retail and business customers) using forecasts of residential electricity prices issued by the AEMC. The AEMC's forecast reflects the draft decision issued by the AER for NSW distribution electricity prices. It calculates a reduction in overall residential electricity prices in 2014-15 and 2015-16 of 13% and 12% respectively (in real terms).

We consider that the residential price changes adopted by Core are reasonable.

However, reductions in the non-residential price of electricity are unlikely to be as substantial as for residential customers. This is because network charges, which are falling, make up a relatively smaller proportion of bills for non-residential customers, and particularly for I&C customers. Given the large impact of electricity prices on gas demand we believe it is important to use estimates of non-residential price changes that are as accurate as possible.

We have therefore made a number of assumptions to estimate the change in non-residential electricity prices, with the results as set out below:

**Table iv: Real change in electricity prices**

| | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|
| Residential (Core estimate) | -12.59% | -11.58% | -0.42% | 0.00% | 0.00% | 0.00% |
| Non-residential (Deloitte estimate) | -8.22% | -9.66% | 0.47% | 0.00% | 0.00% | 0.00% |

[3] Core Energy Group, *JGN Demand and Customer Forecast*, April 2014, as contained in Appendix 5.1 to JGN's *2015-2020 Access Arrangement Information*, 30 June 2014.

Table v to Table vii presents our revised forecasts for consumption per customer.

**Table v: Tariff V Residential – revised consumption per customer forecast (GJ)**

| | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|
| Actual | 21.04 | 20.47 | 20.08 | | | | | | |
| Deloitte forecast | | | | 19.21 | 18.53 | 18.29 | 18.19 | 18.32 | 18.40 |
| Core forecast | | | | 19.18 | 18.47 | 18.03 | 17.57 | 17.19 | 16.85 |
| *Difference (%)* | | | | *0.1%* | *0.3%* | *1.5%* | *3.6%* | *6.6%* | *9.2%* |

Source: Deloitte Access Economics

**Table vi: Tariff V Small Business – revised consumption per customer forecast (GJ)**

| | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|
| Actual | 246.64 | 243.84 | 246.36 | | | | | | |
| Deloitte forecast | | | | 206.99 | 197.94 | 191.49 | 183.82 | 175.60 | 169.32 |
| Core forecast | | | | 204.53 | 193.50 | 186.24 | 177.85 | 168.87 | 161.73 |
| *Difference (%)* | | | | *1.2%* | *2.3%* | *2.8%* | *3.4%* | *4.0%* | *4.7%* |

Source: Deloitte Access Economics

**Table vii: Tariff V I&C – revised consumption per customer forecast (GJ)**

| | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|
| Actual | 522.59 | 491.53 | 455.88 | | | | | | |
| Deloitte forecast | | | | 470.87 | 419.41 | 412.05 | 401.49 | 389.17 | 381.05 |
| Core forecast | | | | 466.65 | 411.75 | 403.49 | 392.08 | 378.69 | 369.15 |
| *Difference (%)* | | | | *0.9%* | *1.9%* | *2.1%* | *2.4%* | *2.8%* | *3.2%* |

Source: Deloitte Access Economics

## Total consumption

The tables below show our revised forecasts of total consumption following the changes discussed above.

**Table viii: Tariff V Residential – revised total consumption forecast (GJ)**

| | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|
| Actual | 23,216,478 | 23,262,669 | 23,540,485 | | | | | | |
| Deloitte forecast | | | | 23,205,155 | 23,026,920 | 23,318,188 | 23,724,241 | 24,375,586 | 24,929,420 |
| Core forecast | | | | 23,173,501 | 22,948,822 | 22,980,146 | 22,905,968 | 22,876,170 | 22,836,669 |
| *Difference (%)* | | | | *0.1%* | *0.3%* | *1.5%* | *3.6%* | *6.6%* | *9.2%* |

Source: Deloitte Access Economics

### Table ix: Tariff V Small Business – revised total consumption forecast (GJ)

| | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|
| Actual | 5,164,826 | 5,262,348 | 5,450,558 | | | | | | |
| Deloitte forecast | | | | 4,695,105 | 4,603,562 | 4,566,708 | 4,495,584 | 4,404,411 | 4,356,137 |
| Core forecast | | | | 4,644,979 | 4,516,814 | 4,474,594 | 4,403,912 | 4,315,646 | 4,271,818 |
| *Difference (%)* | | | | *1.1%* | *1.9%* | *2.1%* | *2.1%* | *2.1%* | *2.0%* |

Source: Deloitte Access Economics

### Table x: Tariff V I&C – revised total consumption forecast (GJ)

| | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|
| Actual | 7,937,111 | 7,831,619 | 7,671,044 | | | | | | |
| Deloitte forecast | | | | 8,090,781 | 7,338,827 | 7,363,856 | 7,330,755 | 7,262,578 | 7,270,459 |
| Core forecast | | | | 8,018,319 | 7,204,775 | 7,210,884 | 7,159,007 | 7,066,912 | 7,043,476 |
| *Difference (%)* | | | | *0.9%* | *1.9%* | *2.1%* | *2.4%* | *2.8%* | *3.2%* |

Source: Deloitte Access Economics

### Table xi: Total Tariff V consumption forecast (GJ)

| | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|
| Actual | 36,318,41 | 36,356,637 | 36,662,086 | | | | | | |
| Deloitte forecast | | | | 35,991,040 | 34,969,309 | 35,248,752 | 35,550,580 | 36,042,576 | 36,556,016 |
| Core forecast | | | | 35,836,800 | 34,670,411 | 34,665,624 | 34,468,887 | 34,258,728 | 34,151,962 |
| *Difference (%)* | | | | *0.4%* | *0.9%* | *1.7%* | *3.1%* | *5.2%* | *7.0%* |

# 1 Introduction

*This report presents revised consumption forecasts for the Tariff V customer group for JGN's NSW gas distribution network. The revised forecasts build on a November 2014 report by Deloitte Access Economics (Deloitte), the Australian Energy Regulator's (AER) Draft Decision, Jemena Gas Network's (JGN) response to that decision and the Deloitte report (including work prepared by consultants commissioned by JGN) and further analysis by Deloitte.*

## 1.1 Background

### 1.1.1 The Deloitte Report

In August 2014 Deloitte was engaged by the AER to perform a high level review of JGN's gas demand forecast. JGN's forecast was largely prepared by the Core Energy Group (Core) (and is referred to in this report as the '2014 Core report').

In undertaking this work Deloitte:

- Undertook a desktop review of the information provided to us. This included the following confidential information:
    - JGN's 2015-20 Access Arrangement Information, Appendix 5.1; and
    - A number of Excel models including weather normalisation calculations.
- Provided a number of questions which we discussed with JGN and Core.

The AER subsequently asked Deloitte to prepare an alternative gas forecast (referred to in this report as the '2014 Deloitte report'). To do so we used the same general framework as Core, and indeed used the Excel model provided by Core to calculate the alternative forecast. However we made a number of important modifications to assumptions and inputs, resulting in a different forecast.

- In relation to customer numbers we:
    - Amended the relative split between the connection of new estates and medium density dwellings by decreasing the former.
    - Reduced the number of forecast residential disconnections by having regard to a more recent time series than that adopted by Core.
    - Reduced the forecast number of new business connections.
- In relation to average use per connection we considered that the forecast reductions in per customer use were high, in part due to a failure to reflect the impact of economic conditions. We:
    - Applied an econometric approach to estimating residential and I&C per customer usage.
    - Adjusted the assumed cross price elasticity value from 0.1 to 0.05.

We also recommended that Core's forecast be updated for 2013-14 actual connection numbers and usage.

### 1.1.2 JGN's response

The AER adopted the recommendations set out in our 2014 report in its draft decision on JGN's Access Arrangement.

In response to the AER's draft decision JGN provided two expert reports on the demand forecasts which had been commissioned by its lawyers, Gilbert + Tobin.

The first was a report by Mr Adrian Kemp of HoustonKemp which was included as Appendix 3.5 of JGN's response. This report contested Deloitte's econometric modelling and argued that Deloitte's results did not support a conclusion that Core's forecasts understate residential consumption per connection.

The second report was prepared by Frontier Economics and included as Appendix 3.4 of JGN's response. It similarly challenged Deloitte's econometric modelling for residential customers and argued that the trend analysis approach adopted by Core was appropriate in the circumstances.

In Appendix 3.1 of its response JGN also disagreed with the other changes recommended by Deloitte and maintained its original position in respect of cross elasticity of demand, split between medium/high density and new estates, residential disconnections and small business connections.

Core also made a number of changes to its forecast (referred to in this report as the '2015 Core forecast') in order to reflect:

- The inclusion of 2013-14 actual data on consumption per customer and tariff V connection numbers
- Updates to the forecast of retail gas prices to account for the repeal of the *Clean Energy Act 2011*
- Updates to IPART's forecast of retail electricity prices to reflect more recent estimates published by the AEMC
- Updates to the forecasts of new connections and the split of new estate and medium/high density dwellings to reflect revised data from independent data sources
- Changes to the way in which it has applied the elasticity estimates to the forecast.

The impact of these changes has been to increase the number of new connections and decrease average use per connection. The additional new connections outweigh the impact of the reduced average use per connection so that forecast total usage rises.

### 1.1.3 This report

In light of JGN's response to the draft decision, the AER has asked Deloitte to review JGN's response and if necessary produce a revised set of forecasts. Any alternative demand forecasts are to reflect:

- the material produced by Deloitte prior to the AER's draft decision; and
- JGN's response to the initial Deloitte report, including reports prepared by HoustonKemp, Frontier Economics and the 2015 forecast prepared by Core.

### 1.1.4 Limitations

In preparing this report we have assumed that the information provided to us in the course of this assignment is accurate and complete.

Further, we have used the Excel model provided by Core as the basis for our re-forecast. We have not undertaken an 'audit' or any other assurance review of the information provided, including in relation to the integrity of the Excel model.

### 1.1.5 Structure of this report

This report presents our review of the JGN response and additional material, and our alternative methodology and alternative forecasts. The remainder of this report is structured as follows:

- Chapter 2 provides an overview of Core's modelling approach and a discussion of methods for forecasting demand;
- Chapter 3 presents the alternative customer number forecasts;
- Chapter 4 presents the alternative consumption per customer forecasts; and
- Chapter 5 presents the alternative total consumption forecasts.

In general this report focuses on the major assumptions and approaches used by Core, as well as those areas where we believe an alternative approach has merit. As a result it does not dwell on all aspects of the forecast, including areas where we are satisfied with the approach adopted. These include the weather normalisation undertaken (both in terms of historic normalisation and the future weather forecast) and the Tariff D forecast.

# 2 Approach to forecasting

*This Chapter first summarises the approach used by Core to prepare its forecast of usage. It then provides an overview of the alternative methodology utilised to develop the revised forecasts of gas consumption. In particular, it presents the revised modelling assumptions – specifically around price and customer numbers – and the modified econometric approach used to construct the forecasts.*

## 2.1 The Core forecasting approach

Core's approach to forecasting gas usage by Tariff V customers is summarised below:

- The tariff V market was segmented into residential, small business and Industrial and Commercial (I&C) groups, and the residential market was further segmented into existing, new estates, medium density/high rise and electricity to gas customers.
- Historic demand was normalised to remove the impact of weather and to derive a per customer forecast based on historic trends (i.e. where demand is primarily a function of demand in the previous year plus a trend factor). Consistent with elsewhere in Australia, per connection usage has been falling in recent years. Core has estimated this reduction to be 0.9% per annum for residential usage and 3.1% and 1.4% for small business and I&C respectively.
- This historic trend was then adjusted to reflect:
    - Forecast changes in the price of gas, using an estimate of own-price elasticity.
    - Forecast changes in the price of electricity, using an estimate of cross-price elasticity.

The impact of the price changes on per connection usage is significant, being larger than the trend effect for both residential and I&C customer groups. In the case of residential usage it is roughly double the trend.

Other key assumptions/outputs that characterise Core's Tariff V forecast are:

- Increased connection of new dwellings compared to recent history, but lower electricity to gas (E to G) conversions.
- A higher proportion of medium and high density connections compared to recent history.
- An increase in new non-residential connections.
- A small increase in residential disconnections.
- A reduction (in addition to the trend reduction) in per customer demand due both to higher gas prices (own-price elasticity) and (relatively) lower electricity prices (cross-price elasticity).

In preparing the JGN forecasts Core did not include a measure of economic activity (such as Gross State Product (GSP)) as an explanatory variable, noting that although it is possible some statistical correlation may exist between usage and GSP in the current period, many other factors – the decline of manufacturing, changing energy policies, more efficient

houses, the installation of solar panels, etc. – were likely to have a more material impact. Thus in Core's view any GSP impact was likely to be swamped by these other factors.

For Tariff D customers Core's forecast uses 2013 Chargeable Demand (CD) as a baseline then adjusts for:

- Net known new customers and disconnections and associated loads as advised by JGN (including based on a survey of the top 20 customers)
- Reallocations of demand between Tariff D and Tariff V as advised by JGN.

## 2.2 Approaches to demand forecasting

There is no single accepted approach to forecasting gas usage in Australia. However, there have been two broad approaches adopted in recent years – a linear trend approach (as adopted by Core) and an econometric approach. When the expected drivers of gas consumption (such as prices and economic conditions) are likely to follow a similar path as that experienced in recent history, then the trend approach provides a simple, parsimonious approximation of future consumption. However, when these trends are not expected to be maintained over the forecast period (due to, for example, a revival in economic conditions) then the trend approach will not produce accurate forecasts. In this instance, an approach which incorporates forecasts of the expected drivers of gas consumption is preferred (i.e. an econometric regression).[4]

In June 2014 ACIL Allen Consulting (ACIL Allen) prepared a report for the Australian Energy Market Operator (AEMO) proposing a methodology for forecasting gas consumption in eastern and south eastern Australia.[5] The methodology proposes using an econometric approach to forecast consumption by residential, business and small industrial consumers, and use of a survey approach for large industrial consumers. While the forecasting methodology is designed for a specific purpose – the preparation of the inaugural National Gas Forecast Report – we believe it is also largely appropriate for the purpose of preparing demand forecasts for Access Arrangements.

Specifically, ACIL Allen notes that an econometric approach to forecast consumption should involve the following steps.

- Identify the likely drivers of gas consumption and obtain forecasts of these drivers (split by customer numbers and usage per customer). These variables should be selected on the basis of the theoretical relationships with gas consumption, such as gas price, economic activity and population.
- Develop regression models to explain historical consumption using the identified drivers. The final specification of variables, lags and functional forms should be chosen empirically.
- Utilising the results of the regression analysis, produce a set of baseline forecasts based on the forecasts of the drivers of consumption. However, this assumes that the relationship between gas consumption and its drivers will be consistent with what was observed over the historical period.

[4] We note that Core did include price effects as a post-model adjustment and while this is not the preferred approach, it is preferable over a pure trend approach.

[5] ACIL Allen Report to AEMO, *Gas Consumption Forecasting – A Methodology*, 24 June 2014.

- Make post-model adjustments (as appropriate) to incorporate the impact of known changes in consumption that were not present in history. Two key candidates for post-model adjustment are the shift from gas to electricity for space heating, and increases in the price of gas, in particular relative to the price of electricity, although in both cases ACIL Allen cautions that post-modelling amendments may not be the theoretically best way to approach the task.

ACIL Allen also notes that a price elasticity of demand of -0.3 was accepted by the AER in 2012 (and has been proposed for residential customers by Core) but there is some possibility that in using this value could double count the impact of price increases.

## 2.3 Conclusion on modelling approach and subsequent revised assumptions

In our view Core's use of a simplistic linear trend approach to forecasting future gas consumption has resulted in forecasts that are low and do not take into account all of the factors influencing gas usage. In particular, Core's forecasts do not reflect the forecast improvement in the NSW economy in its per customer usage forecasts, although higher connections numbers caused by the recent housing boom are incorporated.

The starting point for forecasting future gas consumption should be to undertake an econometric modelling exercise to identify the exogenous factors that have influenced historical gas consumption. We accept that there can be data issues with econometrics which, in some cases, may warrant reverting to a simplistic trend based forecast (on the basis of the principle of parsimony). However, the justification for this approach should be documented (including details on the regressions run and reasons for rejection) and the impact of this simplification should be discussed.

We recognise that in reality many of the factors impacting gas consumption are relatively fixed over short periods – such as building efficiency and the number of gas appliances installed in a home – and are therefore likely to be adequately captured by a trend. However, there are two other key exogenous influences that are expected to impact gas demand but are subject to short term fluctuations not picked up through a trend – namely price and economic conditions. We accept Core's incorporation of price impacts as a post-model adjustment as the price elasticity of gas demand has proved difficult to ascertain statistically (although the use of quarterly consumption data could go some way to rectifying this). However, we do not consider that Core has adequately addressed the impact of economic conditions on consumption – stating that it was not found to be statistically significant (when included in a model with a trend term) is not sufficient justification for no further discussion of the potential for changed economic conditions over the forecast period to impact gas consumption.

These issues are explained in more detail below.

### 2.3.1 Econometric analysis

As discussed above, Core's approach to developing the forecasts is based on a simple trend model, with future consumption driven by trends over the last decade, adjusted (off-model)

for prices. Due to the influence of historical trends, Core found that measures of economic conditions did not add value to the trend model. As explained above, by developing the forecasts using this approach, we are concerned that Core has not adequately controlled for the expected changes in the drivers of gas consumption over the forecast period.

In particular, during the historical period used to support the trend analysis (2002 to 2013), NSW gas consumption was subject to the considerable economic changes brought on by the global financial crisis; going forward, however, NSW's economy is expected to strengthen and return to trend growth (see box 1 below). By not explicitly accounting for the effect of improving economic conditions on gas demand, Core's trend model has likely under-forecast consumption over the Review period.[6]

In contrast, the econometric analysis adopted by Deloitte (in 2014) to develop a revised set of forecasts was based on a structural model of consumption, with prices and economic conditions included within the econometric model, with the preferred model selected empirically. Given the expected changes to gas prices over the next five years, as well as the considerable economic changes that have occurred since 2008, the structural approach was deemed more appropriate for developing gas consumption forecasts over the Review Period. The modelling was applied to consumption per customer for each customer type and model selection was based on the in-sample forecast accuracy of each regression[7] as well as the standard model-fit tests of coefficient t-statistics, R-squared, and F-statistics.

The outputs of any modelling method – be it econometric or trend – should be subjected to a test against expectations. Are the results reasonable, consistent with economic theory and do not produce biased forecasts? Furthermore, the arguments used for justification of one assumption must be consistent with assumptions elsewhere in the modelling – for example, Core has argued that lower electricity prices (relative to gas prices) will depress gas usage, but there is no mention of the impact of lower electricity prices on gas connections (which are forecast to grow strongly).

We recognise that with the limited degrees of freedom available for the regression analysis – due to the use of annual data by Core – the resultant models were subject to limitations such as sensitivity of the coefficients to the years included in the analysis. However, where the statistical significance of a coefficient remained stable and the magnitude of the coefficient did not change greatly, we considered that the additional explanatory capability afforded by the regression modelling (based on economic conditions) was preferable to a simple trend model with no consideration of economic conditions.

Going forward, the limitations imposed by the length of the historical series can be overcome with the use of quarterly data, as suggested by JGN's reviewers and agreed to by Deloitte. The use of annual data by Core reduced the number of data points available by a

[6] By basing the forecasts on years where economic conditions were considerably weaker than usual, the forecasts will not account for the expected pick-up in economic activity over the Review period.

[7] That is, the regressions were conducted on 2002 to 2010 data, with the model coefficients used to 'forecast' 2011-2013 consumption. This in-sample forecast period was then compared against actual consumption in 2011-2013. Such an approach is preferable to conducting the regression analysis on the full dataset and claiming the regression model provides a good forecast – the model has been fitted to the actual data and will, therefore, naturally be a good predictor of the full dataset. The true test, however, is how the regression model performs on data *outside of the regression dataset.* We note that due to the limited number of data points available for this analysis there is a trade-off between good econometric practice and degrees of freedom.

factor of four. Arguably, annual data does not adequately capture the impact of changing drivers on gas consumption – for example, it would be expected that the impact of rising prices would change short term consumption behaviours within 6 months (allowing for billing cycle lags). The use of annual data reduces these relationships to medium to long terms trends. Given the five year forecast period for Access Arrangements, short term impacts should be considered.

### 2.3.1 Economic conditions as a driver of gas demand

In its 2012 gas demand forecast prepared for Envestra's Victorian and Albury networks[8] Core included a GSP-driven parameter in its forecasts and, as noted above, ACIL Allen has identified that GSP is one of the two most relevant drivers of gas consumption (the other being price). Core also took this view in its March 2012 gas demand forecast for Envestra in Victoria where it explicitly included GSP in the forecasts, noting that *Core has identified GSP as being a primary driver of future commercial and industrial gas demand. As such projections of GSP are used as a basis for projected demand per connection.*[9]

In its 2015 report, Core argued that due to the dissimilar gas penetration rates of the Victorian and NSW gas markets it was reasonable to use GSP in the analysis for one market and not the other – specifically, the lower cost of gas in the consumption bundle of NSW consumers relative to Victorian consumers makes them less price sensitive and therefore less likely to reduce consumption as income falls. This assertion, however, is not consistent with Core's adoption of a static price elasticity of demand; rather, if Core considers this to be the case then the price elasticity of demand for the NSW network should be lower than the Victorian network. Further, it could be argued that due to the relatively lower gas penetration rate in NSW gas consumption is more discretionary than in Victoria (where gas comprises a significant proportion of heating) – if this is the case then NSW consumption would be more sensitive to changing incomes, not less.

The risk is that by not including economic activity the forecasts of usage may be understated as forecasts of NSW GSP growth are generally healthier than recent outcomes, particularly as the historical trend included the impact of the global financial crisis. Deloitte forecasts an average GSP growth of 2.4% annually across the 5 year outlook period, compared with an average of 1.9% in the last 6 years (see the box below for the forecasts of GSP and state final demand relative to history).

The models we adopted for the 2014 forecasts for the residential and I&C customer groups explicitly included state final demand as a parameter.[10] While JGN's reviewers argued that state final demand does not have a theoretical relationship with gas consumption, we contend that state final demand is a reasonable proxy for economic activity. With limited data points available it is reasonable to select the measure of economic activity with the

[8] Core Energy, *Demand, Energy and Customer Forecasts, Envestra Limited – Gas Access Arrangement Review Victoria and Albury Networks (2013 to 2017)*, March 2012

[9] Ibid., p. 33.

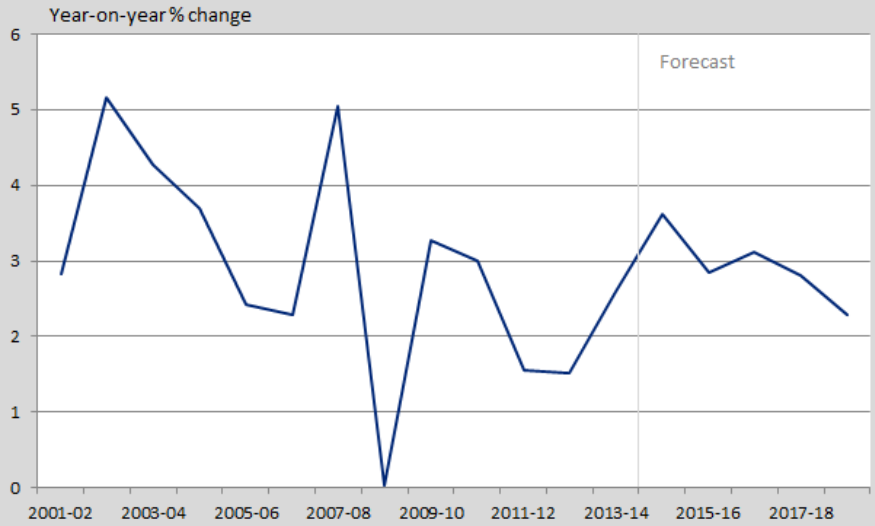
[10] The model underlying the small business consumption per customer forecasts was not changed from that adopted by Core – the strength of the downward trend over the historical period was larger than the effect of any potential explanatory variables (including price and economic conditions). Without accurately addressing the drivers of this trend (such as the closure of small scale manufacturers), the econometric regression for this customer group did not produce reliable results

strongest relationship with consumption. Indeed ACIL Allen recommended adopting GSP as a reasonable proxy for household income on the same basis.[11]

**Box 1: Economic forecasts**

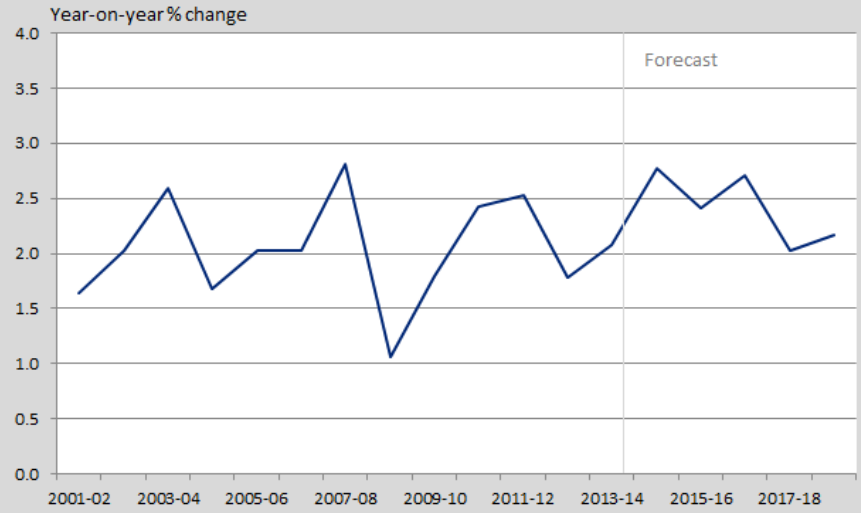
With the introduction of economic variables to the forecasting model it was necessary to also produce forecasts for both NSW Gross State Product (GSP) and State Final Demand (SFD). As the charts below illustrate, Deloitte expects both GSP and SFD to be generally higher over the Review Period than has been seen over the last five years (albeit with some volatility), in line with expectations regarding a return to more solid economic conditions in NSW.

**Chart 2.1: NSW State Final Demand**




Source: Australia Bureau of Statistics and Deloitte Access Economics

**Chart 2.2: NSW Gross State Product**




Source: Australia Bureau of Statistics and Deloitte Access Economics

[11] ACIL Allen Report to AEMO, *Gas Consumption Forecasting – A Methodology*, 24 June 2014 (page 28).

## 2.4 Inclusion of 2014 data

Since our 2014 forecast report Core and JGN has submitted a revised proposal based on an historical data series which has actual consumption and connection numbers for 2013-14 financial year (rather than a forecast). This has materially affected the forecasts presented in our 2014 report.

While the influence of the 2014 data point is discussed in more detail throughout the remainder of this report, two points warrant highlighting:

- Actual new connections and disconnections for 2013-14 were much higher than predicted by Core (and ourselves)
- The strength of the downward trend in 2014 residential and I&C consumption per connection was stronger than prevailing economic conditions would have forecast. As a consequence, the relationships we found to be statistically significant in our previous forecasts are no longer statistically significant. We have revised the modelling approach for residential consumption per customer but have been unable to find a robust alternative for I&C consumption per customer.

# 3 Customer numbers

*This chapter sets out Core's assumptions regarding customer connections and disconnections and the approach we have adopted in preparing our alternative forecast.*

## 3.1 Tariff V residential

### 3.1.1 Core approach and forecast

Consistent with standard practice, Core's forecasts of Tariff V residential connections are built up from base year 2013-14 customer numbers and simply add new connections and subtract disconnections. New connections have been separated into three categories:

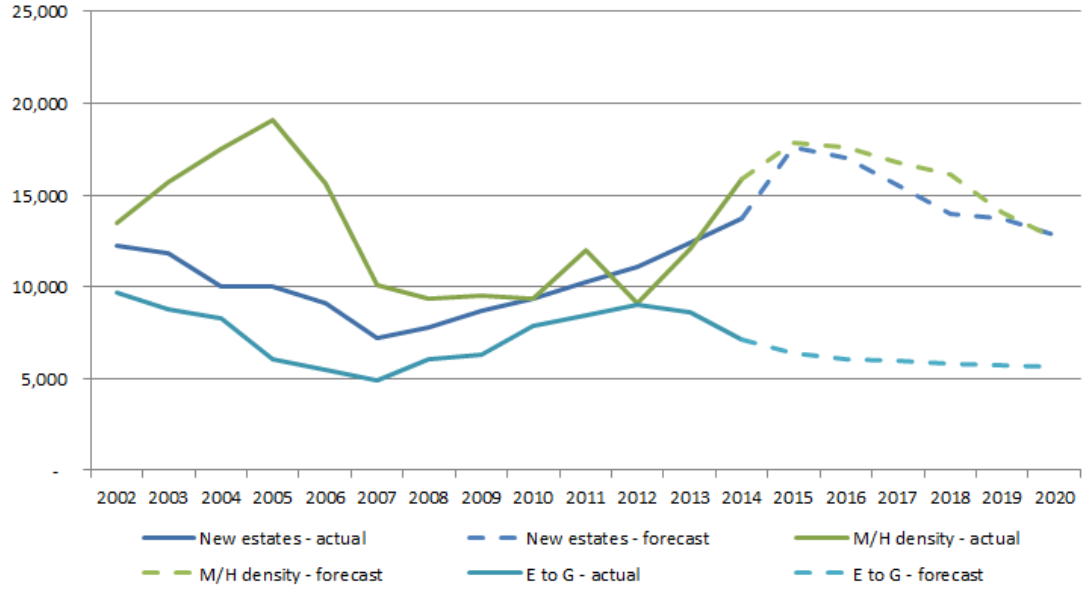
- Customers switching from a pure electricity household to one which is also connected to gas ('E to G' customers). Core considers that the impact of JGN's marketing activities is the key influence on new E to Gs. The forecast of new E to Gs is predicted to decline from 2012-13 levels as relatively higher gas prices mean the impact of marketing activities is lower.
- New dwellings – new estates.
- New dwellings – medium/high density.

Forecasts of new dwellings connections are based on both demand and supply side factors, with a 'catch-up' assumed to meet the existing dwelling stock deficiency in NSW.

Core has forecast that on average 52% of these new dwellings will be medium/high density while 48% will be in new estates.

Core's forecasts generate higher new estate and medium density connections compared to the current regulatory period, and lower E to G connections. Core increased the forecast of new residential connections in its 2015 forecast compared to its 2014 forecast, citing new information on dwelling forecasts.

**Chart 3.1 New residential connections – Core forecast**




### 3.1.2 Total new connections

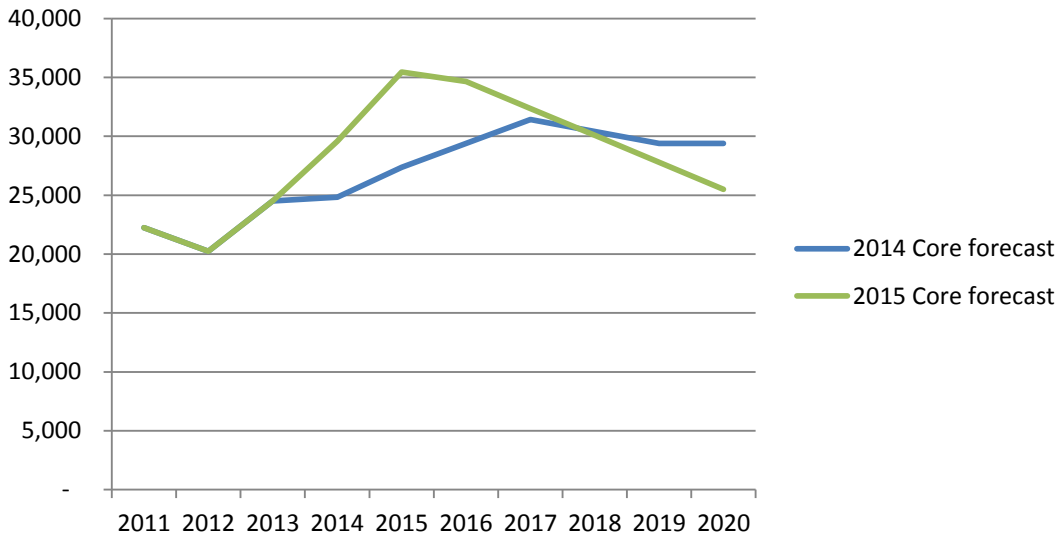
The approach of combining both supply side and demand side factors to arrive at estimates of new dwelling connections is somewhat novel. A more orthodox approach would simply be to use forecasts of new dwellings as the basis for the forecast.

Having said this, it is clear new dwelling completions in NSW are likely to be higher in the short to medium term than historic levels. Deloitte's own dwelling expenditure forecasts shows this and forecasts from industry commentators such as the Housing Industry Association (HIA) also confirm this point.

Core's forecast of new dwellings connections in its 2015 forecast are generally higher than its 2014 forecast as shown below, although lower in the latter years of the upcoming regulatory period. This reflects increases in new dwelling forecasts by independent commentators as well as connections in 2013-14 that were 4,741 (19%) higher than expected. Specifically, Core has attributed the increase to "updated third party forecasts by BIS Shrapnel, December 2014 data, as well as HIA housing forecasts up until November 2014 by type. This resulted in increased new dwellings residential connections of over 15,000 between 2016 and 2020."[12]

[12] Core, *Response to AER Draft Decision*, p. 37.

**Chart 3.2 New residential connections – Core 2014 v Core 2015**




In our 2014 report we suggested that the new connections figures appeared slightly low over the early part of the Access Arrangement period, and slightly high at the end of the regulatory period. We note that under the 2015 Core forecast the 'shape' of the new connections forecast is now more consistent with forecasts of new dwelling commencements/ completions.

Since we prepared our 2014 report the boom in the NSW housing and construction market has continued apace. Interest rates remain low and are more likely to decline than increase in the foreseeable future. Forecasts of new dwelling construction have increased recently and we note that the most recent Housing Industry Association (HIA) figures from February 2015 predict slightly higher levels of new dwelling commencements in 2014-15 and 2015-16 compared to those it was forecasting late in 2014 when we prepared our 2014 report (and that Core used for its 2015 report).

**Table 3.1: HIA new dwelling commencements in NSW ('000)**

| FY ending | 2010 Act. | 2011 Act. | 2012 Act. | 2013 Act. | 2014 Act. | 2015 | 2016 | 2017 | 2018 |
|---|---|---|---|---|---|---|---|---|---|
| 2014 forecast | **35.22** | **32.50** | **30.69** | **40.20** | **48.54** | **50.48** | **48.6** | **45.44** | **46.07** |
| Feb 2015 forecast | 35.02 | 32.49 | 30.75 | 40.22 | 46.26 | 51.62 | 49.71 | 45.44 | 46.07 |
| **Change** | | | | | | **+1.14** | **+1.11** | | |

We have compared the Core forecasts with the historic relationship between new connections and dwelling commencements (using HIA data, and both with and without a 1 year lag), as well as the historic relationship between new connections and dwelling completions (using BIS Shrapnel data). The Core forecasts seem slightly high when compared to HIA data, but low when using BIS Shrapnel data. Given this we are satisfied that the aggregate forecasts of total new residential connections is reasonable.

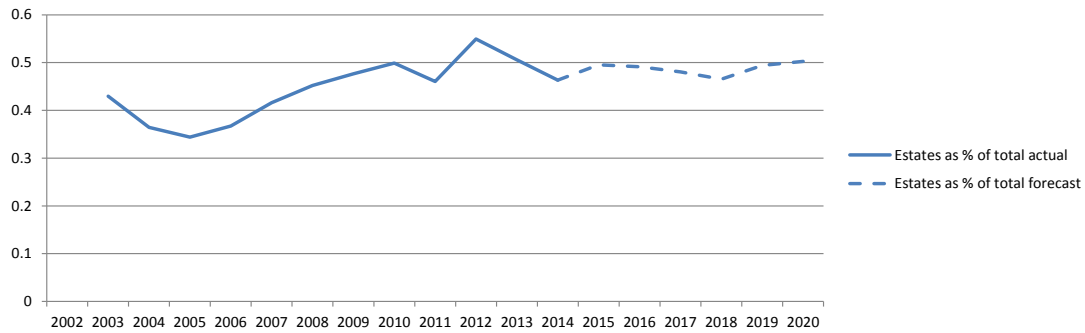
### 3.1.3 Proportion of new estates versus medium density

In our 2014 report we agreed with JGN that an increasing proportion of new connections are likely to be in medium density developments. However, we formed the view that the JGN forecasts overstated the proportion of new connections that will be in new estates, as at the time the HIA forecasts suggested that an average of 44% of new housing starts would be in new estates. Noting the high historic correlation between the HIA housing starts breakup between new estates and medium/high density dwellings, our alternative forecast adopted an assumption of 44% of new estates compared to Core's forecast at the time of 48%.

In response to our 2014 report Core declined to adjust its forecast, citing a range of third party research reports it had relied on to estimate the split between new estates and medium/high dwellings.

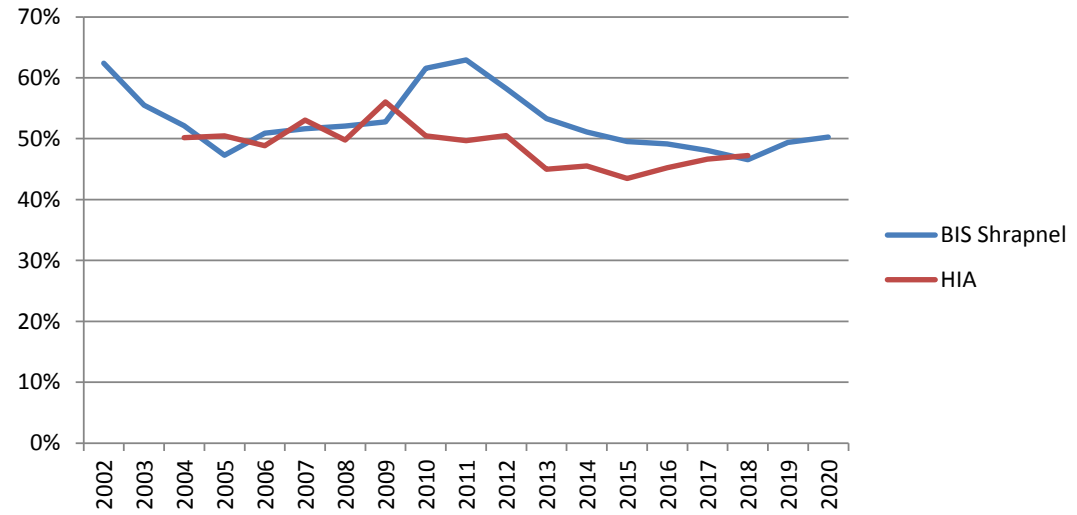
Core's 2015 forecast provides that, on average 48.8% of connections from 2014-15 to 2019-20 will be in new estates with 51.2% being medium/high density. This is a slight reduction from historical levels where an average of 49.3% of JGN's connections have been in new estates over the past 5 years, although the level in 2013-14 was only 46.3%. There has been a steady decline since 2011-12.

**Chart 3.3: New estates as a % of total connections**



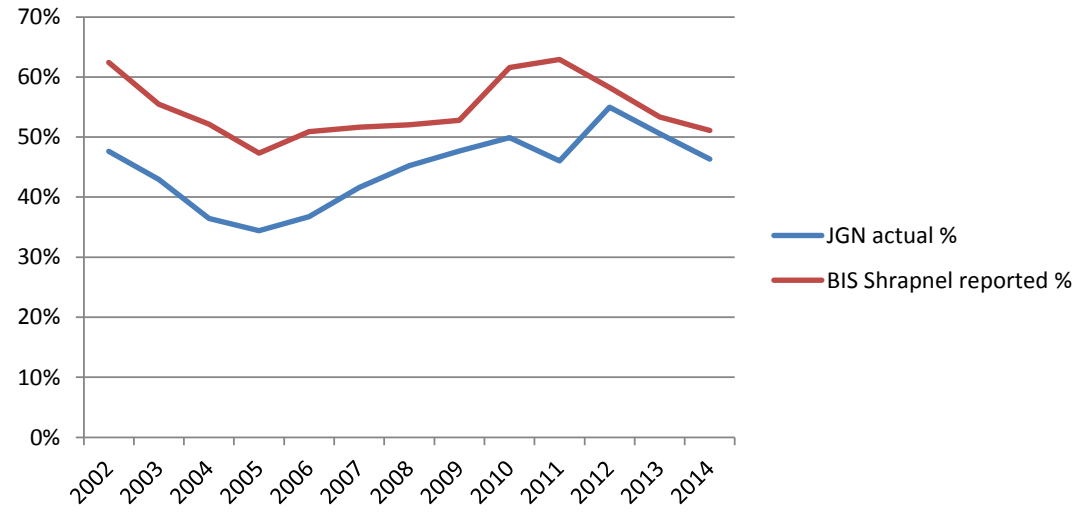

Both BIS Shrapnel and the HIA forecast that the percentage of new estates will decline in the short term before increasing. The HIA predicts the turnaround point for dwelling commencements will be in 2015-16, with BIS Shrapnel considering the turnaround point for dwelling completions will be in 2017-18.

**Chart 3.4: BIS Shrapnel and HIA forecasts of estate %**




It is also worth noting that while Core has cited a range of sources and evidence to support its forecast, the percentage split it has adopted is simply the same as forecast by BIS Shrapnel. This approach is flawed to the extent that Core's actual estate percentage has been lower in every year than the BIS Shrapnel actual estate completions, and sometime materially so. It is therefore not appropriate simply to adopt the BIS Shrapnel split for forecasting purposes as this will overstate the percentage of new estates.

**Chart 3.5: New estates as a % of total connections**

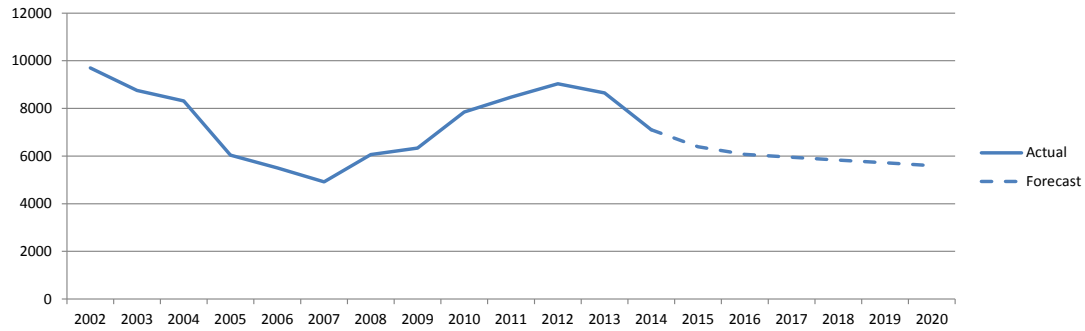



We remain of the view that the Core forecast of the percentage of new connections in estates, at 48.8%, is high. Data, including in particular the 'gap' between the BIS Shrapnel figures and JGN's actual connections, suggests that it is likely to be at least 3-5% less than this. We have therefore adjusted the Core forecasts to reflect a new estates percentage of 45%.

### 3.1.4 E to G

E to G conversions steadily increased from 2006-07 to 2011-12, but have since declined. The reduction was 18% in 2013-14. Core's forecast suggests that E to G conversions will continue to decline over the forecast period, although at a reducing rate.

**Chart 3.6: E to G conversions**




The reduction is based on an assumed reduction in marketing impact (expenditure is assumed to be constant in real terms) as "the relative price outlook of gas vs electricity moves in favour of electricity".[13]

**Table 3.2: Core forecast impact of marketing on number of E to G connections**

| 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|
| -5% | -10% | -5% | -2% | -2% | -2% | -2% |

We agree with Core that the price competitiveness of gas will decline over the Access Arrangement period. It seems reasonable, as Core has argued, that the relative gas versus electricity price is a key determinant of E to G conversions (along with the price of appliances), although our review of the literature was unable to identify any firm data on this in the Australian context.

In our original report we expressed some concern about the, in our view, relatively arbitrary reduction in E to G connections proposed by Core. In response Core disagreed that the adjustments were arbitrary, and suggested they were the result of 'careful consideration' by Core and JGN, although no additional data or quantitative information was provided to support this assertion.

It is therefore difficult to determine whether Core's forecasts of reductions in E to G transfers are reasonable, and if not, what a reasonable forecast might be. However, having regard to the 18% reduction in E to G conversions reported in 2013-14, the Core forecasts do not appear unreasonable and we have not made any adjustment to the forecast.

[13] Appendix 5.1, p. 55

## 3.2 Tariff V business customers

### 3.2.1 Approach and forecast

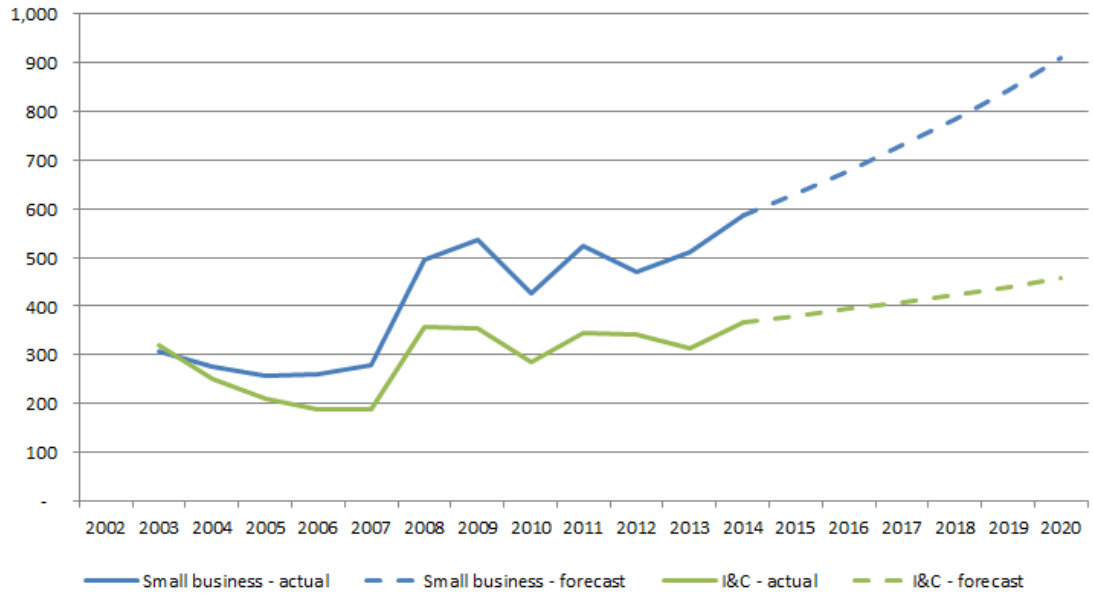
Core has indicated that its approach to forecasting new connections for small business and I&C customers was to:[14]

- Estimate new connections based on the historical trend (the cumulative average growth rate (CAGR) since 2003); and
- Adjust for expected movements between Tariff V and Tariff D.

Actual and forecast new connection numbers for the small business and I&C categories are shown below. In both cases the actual new connections show a pattern of:

- Falling or stable annual new connection numbers (in the range of 200-300) until 2006-07;
- A sharp increase in 2007-08, with new connections showing limited discernible trend until 2012-13; and
- Historically high levels of new connections in 2013-14, particularly for small business connections.

**Chart 3.7: New non-residential connections – Core forecast**




In our 2014 report (prepared prior to actual 2013-14 new connections being known) we suggested that Core's approach of using the cumulative average growth rate in new connections since 2003 may overstate the forecasts of new small business connections and hence is not reasonable. This was because using a longer term CAGR appears to ignore the 'step change' in new connections that occurred around 2008. While the economic outlook for NSW is strong, in our view it was unreasonable to expect the number of new small business connections to be approaching double that of 2012-13 in 2019-20.

[14] Appendix 5.1, p. 38

Further, it seemed inconsistent to argue on the one hand that gas will become relatively less competitive but on the other that new small business connections will increase to historically high levels.

In response to our 2014 report Core suggested that our analysis was flawed because it

- Ignored that a material number of connection movements are accounted for within the disconnections and balancing/unreconciled items classification
- Did not demonstrate statistical evidence of a structural change in new connections.

In relation to the first issue raised by Core, we believe it is not unreasonable not to have regard to the 'balancing/unreconciled items'. This 'error term' has not been taken into account in any of the Core forecasts and in any case it is not clear how such data should be used.

In regard to statistical evidence of a structural change in new connections, we have undertaken statistical tests to identify whether this exists, however ultimately the number of data points does not enable a structural change to be found.

At the core of this forecast is the tension between the sensitivity of business to economic cycles (relatively strong growth in connections is likely given strong future economic conditions) and the future impact of higher gas and lower electricity prices (which would imply lower growth in connections). Neither of these factors is captured in Core's trend.

The inclusion of the 2013-14 new connection number tends to support the Core forecast. At the same the forecast for new connections, particularly for small business, is still high compared to historic levels. New small business connections are forecast to rise approximately 50% between 2013-14 and 2019-20, with an average annual growth rate of 8%. This is high, and largely reflects the large increase in new customers in 2007-08.

Given the declining competitiveness of gas due to upcoming price changes, our view is that the Core forecast of new small business connections is high. We have therefore applied the actual growth rate of 2.9% between 2008-09 and 2013-14 to establish a forecast of new small business connections.

## 3.3 Tariff D

### 3.3.1 Approach and forecast

Tariff D customer numbers are based on JGN's knowledge of new customer connections and closures, as well as net known movements between Tariff D and V. This results in a large decrease in 2014 with a number of customers forecast to shut down as well as some customers moving from Tariff D to Tariff V. In 2016, a number of customers are assumed to join as a result of switching from Tariff V to Tariff D.

In its 2015 report Core has updated its tariff D consumption forecast based on actual 2013-14 usage information. We have not reviewed the forecasts in any detail but note that usage forecasts have all increased since Core's 2014 report.

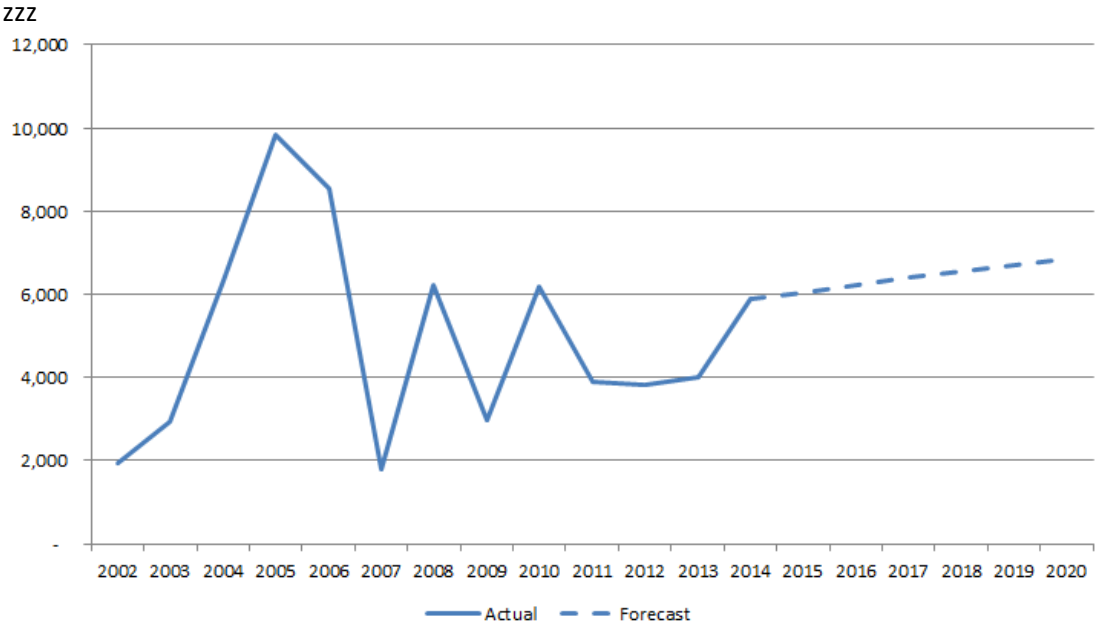
## 3.4 Disconnections

Core has forecast increasing numbers of disconnections over the next regulatory period, at levels generally higher than in the current regulatory period.

In its forecast Core notes that:

- For residential classes, the long-term historical average disconnection rate (2002 to 2014) was used as the basis of future disconnections.[15]
- For small business and I&C classes longer term historical disconnections were unreliable due to a large number of dormant supply points which caused a high disconnection rate prior to 2010. Hence disconnections after this time were used as the basis for forecasts. [16]

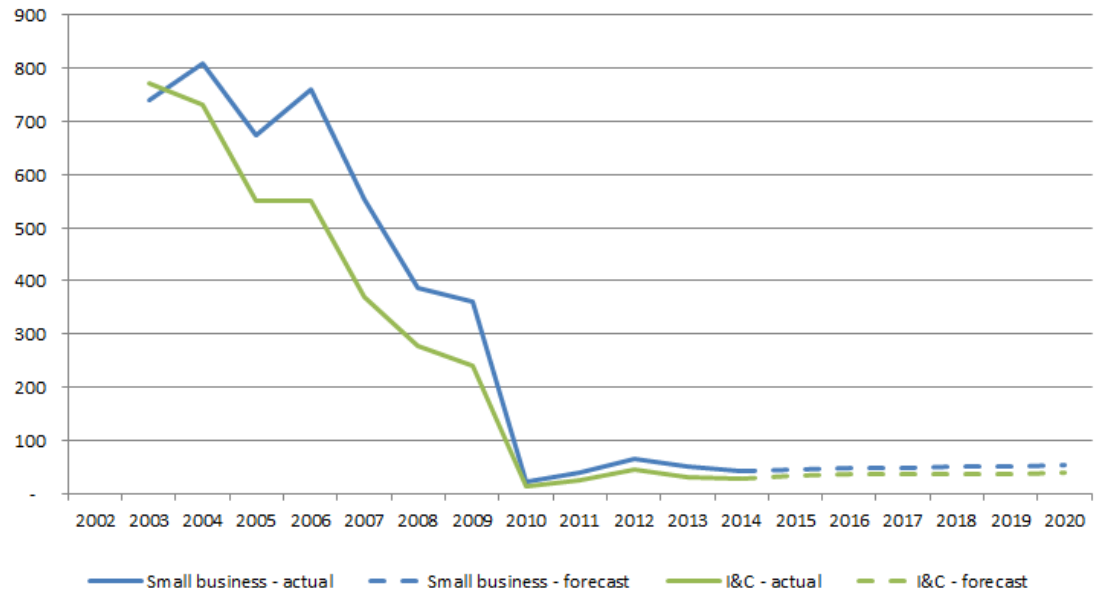
**Chart 3.8: Residential disconnections – Core forecast**




[15] Appendix 5.1, p. 32

[16] Appendix 5.1, p. 38

**Chart 3.9: Small business and I&C disconnections – Core forecast**




In our 2014 report we expressed concern that forecasts of residential disconnections seemed high. However, given the new 2013-14 data point they now appear more reasonable.

We have therefore not made any adjustment to the disconnection forecasts.

## 3.5 Summary of adjustments

The following tables present the revised customer number forecasts. In aggregate we have only adjusted the small business connection forecast, although we have changed the mix of new residential connections.

We are also of the view that the Core forecast of the percentage of new residential connections that are located in new estates (as distinct from medium to high density dwellings), at 48.8%, is high. We have adjusted the Core forecasts to reflect a new estates percentage of 45%.

**Table 3.3: Tariff V Residential – revised connection forecast**

| | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|
| Actual | 1,103,184 | 1,136,607 | 1,172,432 | | | | | | |
| Deloitte forecast | | | | 1,208,251 | 1,242,767 | 1,274,694 | 1,304,049 | 1,330,847 | 1,355,105 |
| Core forecast | | | | 1,208,251 | 1,242,767 | 1,274,694 | 1,304,049 | 1,330,847 | 1,355,105 |
| *Difference (%)* | | | | *0%* | *0%* | *0%* | *0%* | *0%* | *0%* |

Source: Deloitte Access Economics

### Table 3.4: Tariff V Small Business – revised connection forecast

| | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|
| Actual | 20,941 | 21,581 | 22,125 | | | | | | |
| Deloitte forecast | | | | 22,683 | 23,257 | 23,848 | 24,457 | 25,083 | 25,727 |
| Core forecast | | | | 22,710 | 23,343 | 24,025 | 24,762 | 25,556 | 26,413 |
| *Difference (%)* | | | | *-0.1%* | *-0.4%* | *-0.7%* | *-1.2%* | *-1.9%* | *-2.60%* |

Source: Deloitte Access Economics

### Table 3.5: Tariff V I&C – revised connection forecast

| | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|
| Actual | 15,188 | 15,933 | 16,827 | | | | | | |
| Deloitte forecast | | | | 17,183 | 17,498 | 17,871 | 18,259 | 18,662 | 19,080 |
| Core forecast | | | | 17,183 | 17,498 | 17,871 | 18,259 | 18,662 | 19,080 |
| *Difference (%)* | | | | *0%* | *0%* | *0%* | *0%* | *0%* | *0%* |

Source: Deloitte Access Economics

# 4 Revised consumption per customer forecasts

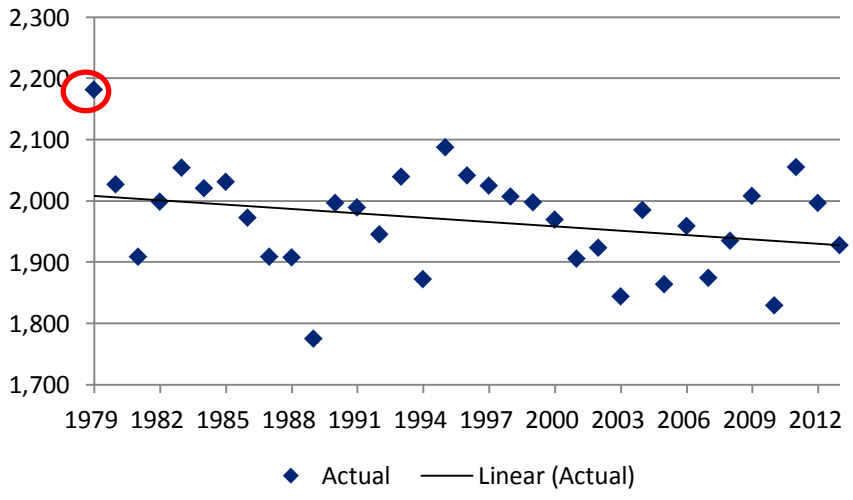
*This chapter reviews Core's approach to establishing per customer usage forecasts and sets out the methodology we have used to calculate our alternative forecast.*

## 4.1 Weather normalisation

'Normalising' historic usage to take into account weather is an important step in forecasting per customer usage. Core has used the Effective Degree Day (EDD) method for determining actual and forecast weather. The EDD concept has been used in Victoria for some time and is a measure of coldness (which is directly related to gas demand for space heating) The EDD is a composite index which incorporates the effect of temperature, windchill, insolation and season. Although we note that gas use for space heating is less widespread in NSW compared to Victoria, we consider it is still reasonable to use this measure in this case.

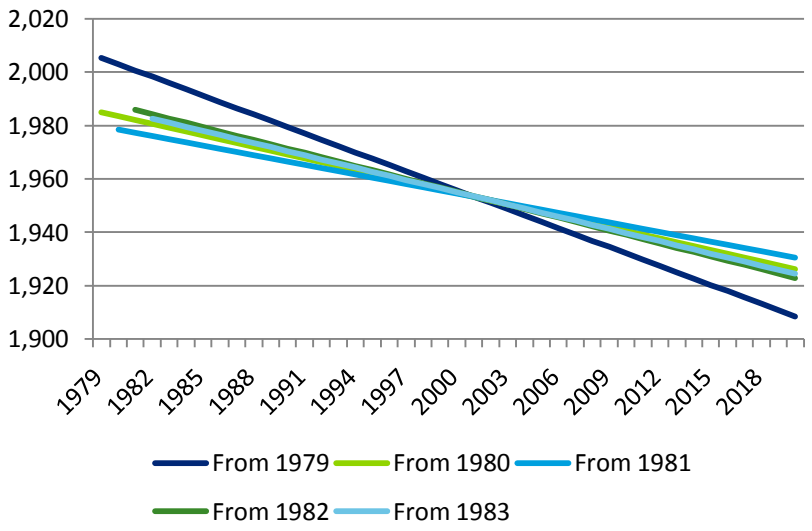
Core has calculated the linear trend in historical EDD based on annual data from 1979 to 2013, however we note the first year is a clear outlier in the data.

**Chart 4.1: EDD – trend beginning from 1979**




The chart below presents the linear trend in EDD when the starting year is varied between 1979 and 1983. The starting point bias of 1979 is clearly evident – where the other years following a broadly similar trend, 1979 has a much stronger downward trend.

**Chart 4.2: EDD trend with different starting years**




The table and charts below demonstrate the impact of the starting point on the slope and intercept coefficients used to develop normalised EDD.

**Table 4.1: Starting point bias - impact on EDD trend**

| | From 1979 | From 1980 | From 1981 | From 1982 | From 1983 | From 1984 |
|---|---|---|---|---|---|---|
| Observations | 35 | 34 | 33 | 32 | 31 | 30 |
| X-variable coefficient | -2.36 | -1.43 | -1.19 | -1.61 | -1.53 | -1.04 |
| Intercept coefficient | 2012.45 | 1989.21 | 1983.14 | 1993.91 | 1991.77 | 1978.87 |

**Chart 4.3: Impact of starting point of intercept coefficient**

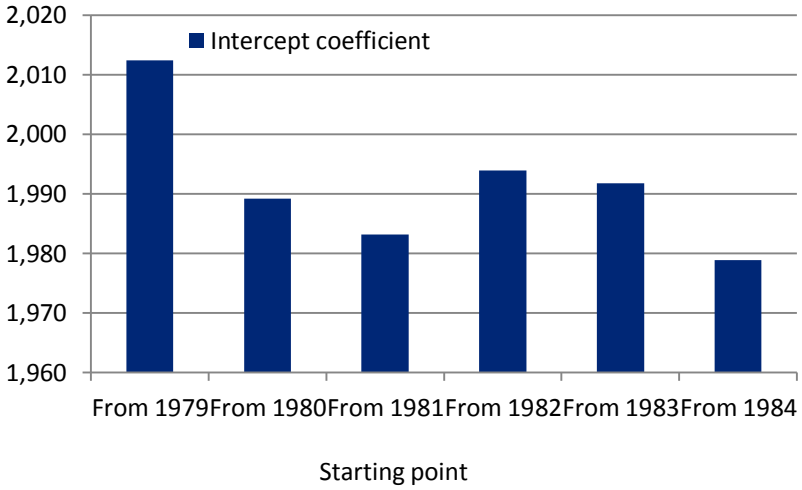
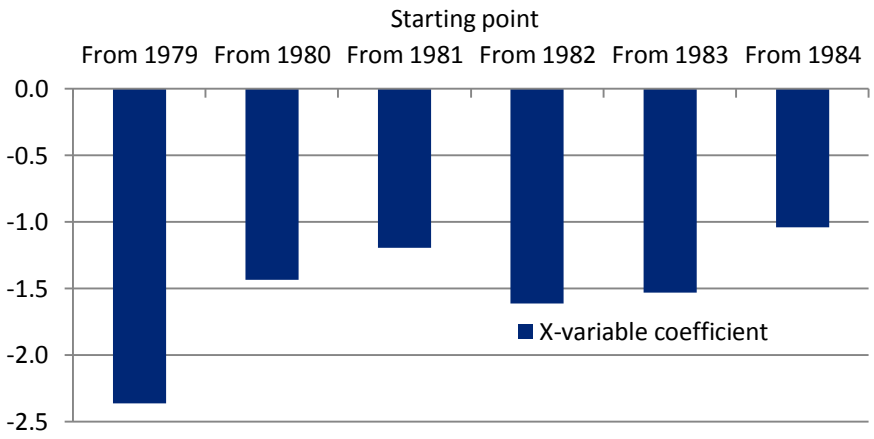


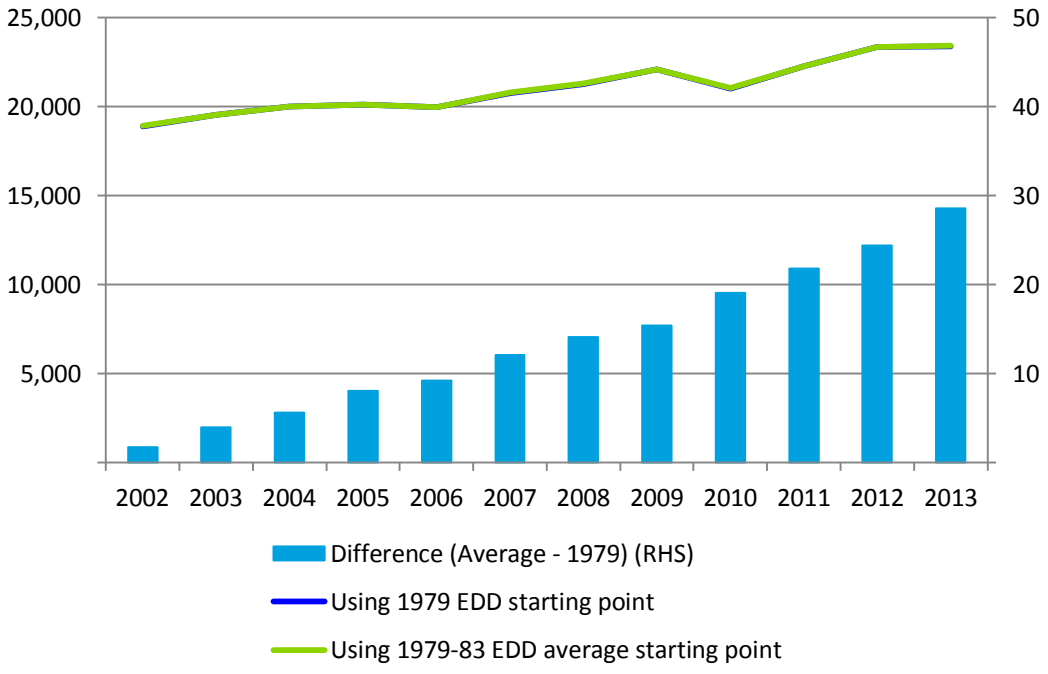
**Chart 4.4: Impact of starting point on X-variable coefficient**




The linear trend in historical EDD is used to develop normalised EDD. The difference between historical EDD and normalised EDD is multiplied by an annual 'sensitivity factor' (simple linear regression of EDD on consumption per connection) and the total number of connections. This gives 'residential abnormal demand'. 'Residential normalised demand' is 'residential actual demand' minus abnormal demand.

The chart below presents the difference in residential normalised demand between i) using 1979 as the starting point for EDD historical demand, and ii) using an average of 1979 to 1983 starting points as historical EDD.

**Chart 4.5: Residential normalised demand (TJ) under different EDD starting point assumptions**



While the starting point of 1979 has been shown to impact on estimated normalised residential demand, the magnitude of the impact in relation to total residential demand is small. This is worth noting; however it is not expected to have a material effect on the forecasts. We therefore consider the approach used to be reasonable.

We note that the addition of the 2014 actual residential consumption figure in the historical series (rather than a forecast for 2014) revised the underlying EDD calculations and therefore the resultant weather normalised consumption series.

## 4.2 Revised approach to forecasting consumption per customer

As explained elsewhere in this report, there is a strong argument for the requirements that forecasts of gas consumption take into account the impact of changes in future economic conditions on gas consumption. With economic activity in NSW expected to improve in comparison to the last five years (which comprises a large component of Core's historical series) (see box 1), it is even more important to ensure that the gas consumption forecasts allow for economic conditions, rather than being based on simplistic linear trends.

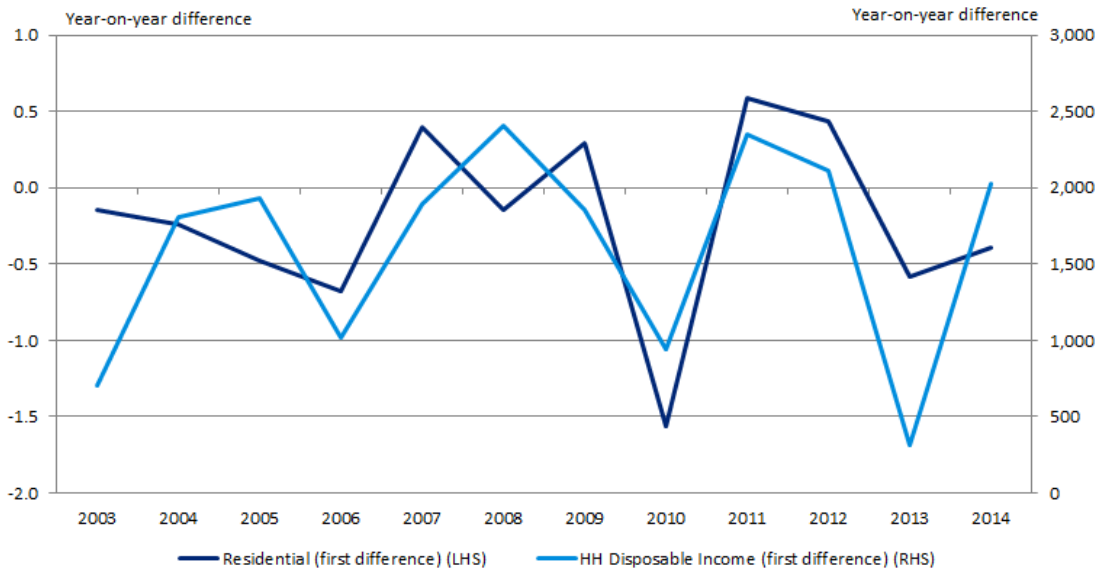
While our first preference would be to base the gas consumption forecasts on a structural econometric model which includes all of the expected drivers of gas consumption, the limited number of data points available has decreased the power of econometrics to accurately capture these relationships. Indeed, with the addition of 2014 actuals (rather than 2014 forecasts as was included in our previous analysis), the model we adopted previously was no longer found to be statistically significant.

However, taking into consideration the expectation by ourselves, ACIL Allen and JGN's reviewers that it would be *household income* that drives residential consumption – rather than GSP and SFD which we previously utilised as proxies for household income – we re-ran the model with household disposable income as the explanatory variable.

As Chart 4.6 illustrates, the first difference of household disposable income and residential consumption per customer have obvious similarities over the historical period.[17] Indeed the regression of the first difference of household disposable income on the first difference of residential consumption per customer was found to have a statistically significant coefficient and a statistically significant model overall (as shown by the F-statistic) (see Table 4.2). While our preference would have been to develop a model which included both price and economic activity, the price variable was not found to be statistically significant.

[17] The first difference has been used to remove the effect of non-stationarity from the analysis. Both household disposable income and residential consumption per customer are first difference stationary.

**Chart 4.6: Household disposable income and residential consumption per customer (first differences)**




Source: Core's Excel model and ABS State Accounts (5220.0) released 21/11/2014

**Table 4.2: Tariff V Residential – econometric regression results**

| Variable | Coefficient | p-value |
|---|---|---|
| Constant | -1.0496 | 0.022** |
| Household disposable income | 0.000522 | 0.0411** |
| R-squared | 0.3545 | |
| F-statistic (p-value) | 0.0411** | |

*Denotes statistical significance at the 10% level of confidence; ** Denotes statistical significance at the 5% level of confidence.
Source: Deloitte Access Economics

However, the reason household disposable income is not typically included in regression analyses is that this series is difficult to forecast. According to the ABS, household disposable income comprises "gross household income less income tax payable, other current taxes on income, wealth etc., consumer debt interest, interest payable by unincorporated enterprises and dwellings owned by persons, net non-life insurance premiums and other current transfers payable by households."[18] As such, forecasting this series would require assumptions about not only future income, but changes in fiscal policy (affecting taxes and welfare payments) and monetary policy (affecting mortgage payments and other debt interest).

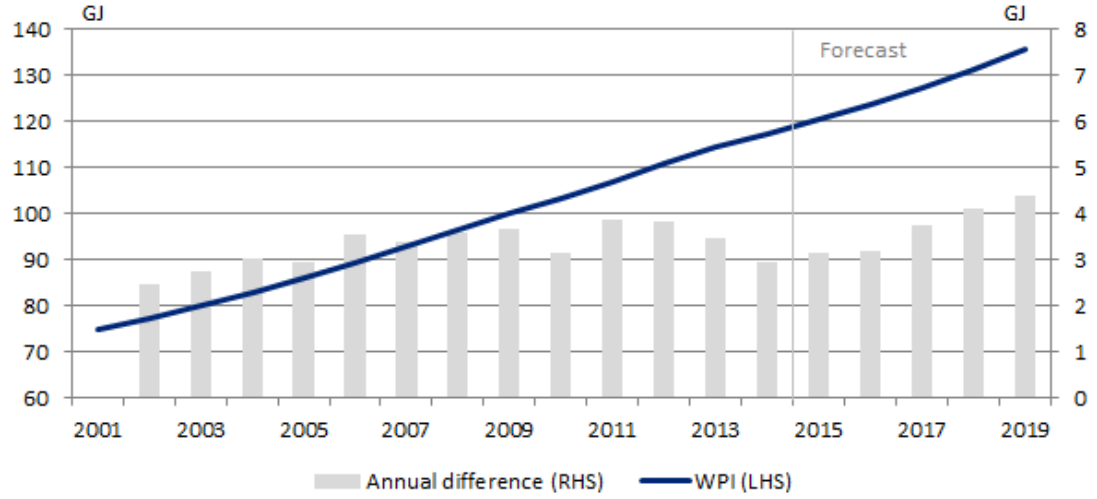
Consequently, we have adopted Core's approach of making post-model adjustments for known drivers of consumption which, due to the lack of statistical relationship, cannot be explicitly included in the baseline forecasts. We examined a number of alternative series to be used as a proxy for household disposable income, including GSP, SFD, average weekly earnings, private consumption, private housing investment, retail turnover, employment and the wage price index (WPI). While each variable has its strengths and weaknesses, the

[18] http://www.abs.gov.au/AUSSTATS/abs@.nsf/Lookup/5216.0Glossary12014?OpenDocument

WPI was found to have the strongest correlation with household disposable income (in first differences to remove the impact of strong linear upward trends) and, as a primary driver of income, has a theoretical link with household disposable income.

The forecast of household disposable income was therefore derived using the linear relationship between household disposable income and the WPI, and Deloitte Access Economics' forecasts for WPI over the 5 year Regulatory Review period. Chart 4.7 illustrates our forecast for NSW WPI between 2015 and 2019.

**Chart 4.7: NSW Wage Price Index**




Source: ABS State Accounts (5220.0) released 21/11/2014 and Deloitte Access Economics

The table below compares the 'trend' used by Core with that adopted by Deloitte, which reflects changes in economic conditions.

**Table 4.3: Tariff V Residential – change in consumption per customer forecast (before price impacts)**

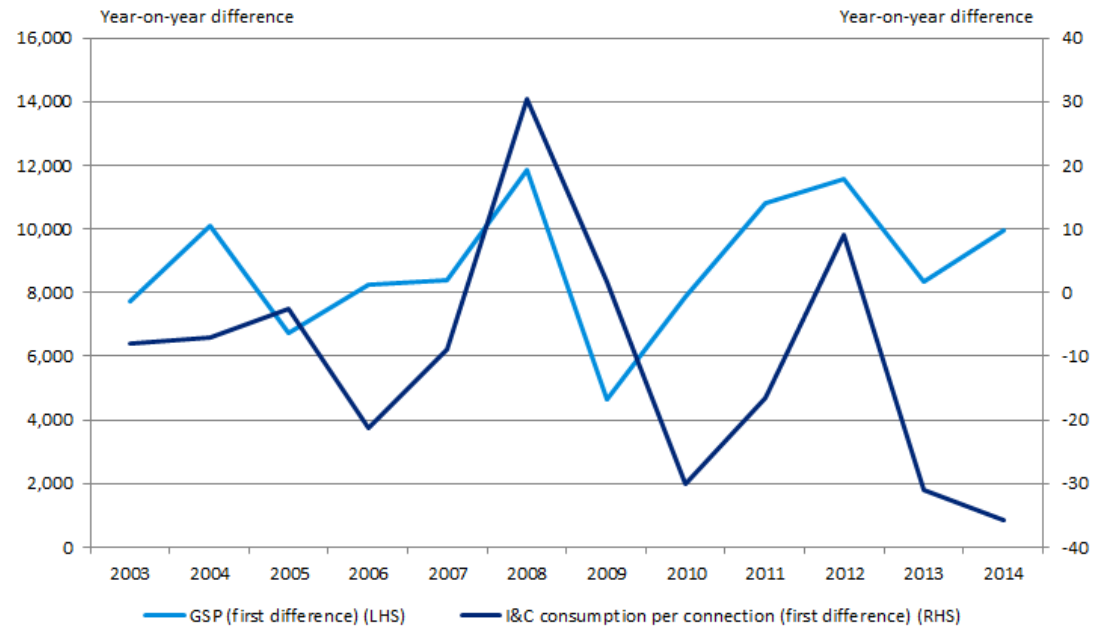
| | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|
| Deloitte trend | -1.6% | -1.6% | -0.2% | 0.7% | 1.4% | 0.9% |
| Core trend | -0.9% | -0.9% | -0.9% | -0.9% | -0.9% | -0.9% |

Source: Deloitte Access Economics

### 4.2.2 Tariff V I&C

As mentioned above, with the introduction of the 2014 data point the explanatory power of the regression model used in our 2014 report was diminished, and this was particularly the case for I&C consumption per connection. Our previous model was based on GSP and as Chart 4.8 illustrates in 2014 GSP and I&C consumption per connection went in different directions. With limited data points available the regression analysis was not able to explain the 2014 data point (or ignore it as an outlier).

**Chart 4.8: Tariff V I&C consumption per connection and NSW GSP**




Source: Core's Excel model and ABS State Accounts (5220.0) released 21/11/2014

Due to the lack of statistically robust measures of the relationship between I&C consumption per connection and GSP we concluded that there is insufficient information to claim Core's trend based approach is unreasonable. We therefore been unable to produce any alternative forecasts for I&C consumption per connection, other than for the adjustments caused by the elasticity effects discussed below.

### 4.2.3 Tariff V Small Business

Our 2014 report did not find a statistically significant relationship between economic conditions and small business consumption per connection due to the strength of the downward trend over the historical period (which was larger than the effect of any potential explanatory variables). Without accurately addressing the drivers of this trend (such as the closure of small scale manufacturers), the econometric regression did not produce reliable and robust results. As such, we maintained Core's modelling approach, namely the use of a simple linear trend.

However, where Core adopted a -3.2% downward trend (based on average annual growth between 2002 and 2013), the revised forecasts in our 2014 report were based on a -2.5% average annual growth (based on trends between 2008 and 2013). This was due to what appeared to be a change in the underlying trend in small business consumption per customer after 2008.

The introduction of the 2014 data point has changed this conclusion. We note, however, that Core's justification for no structural change (in their 2015 report) was incorrectly based on a comparison of the trend between 2003 and 2013, and 2008 and 2013. By including the full time period in the first trend calculation (2003 to 2013) Core did not accurately distinguish between the two periods. A more appropriate test of whether there was a

difference in trends before and after 2008 should have compared the trend between 2003 and 2008, and 2008 and 2013.

As Table 4.4 highlights, before the introduction of the 2014 data point there was a clear difference in the trend before and after 2008. Using Core's approach of averaging the annual percent change across time (rather than compound annual growth), between 2003 and 2008 small business consumption per customer declined at an average annual rate of 3.5%; in contrast, between 2008 and 2013 small business consumption per customer declined at an average annual rate of 2.7% (or a 0.8 percentage point difference). However, with the 2014 data point included, the post-2008 trend is now the same as the pre-2008 trend.

**Table 4.4: Comparison of small business consumption per customer before and after 2008**

| | 2003-2008 | 2008-2013 | 2008-2014 |
|---|---|---|---|
| Average annual % | -3.5% | -2.7% | -3.7% |
| CAGR | -3.8% | -2.5% | -3.8% |

We have not made any adjustments to Core's forecasts for small business consumption per connection other than:

- To correct a small error where the trend calculation[19] was incorrectly referencing 11 years of data when it should have been 12. This changes the trend from -3.1% to -2.9%
- To adjust for the elasticity effects discussed below.

## 4.3 Prices, elasticities and demand for gas

Core predicts an impact on volumes arising from higher gas prices (own price elasticity). It also predicts an impact on volumes arising from electricity prices falling in absolute terms and relative to gas prices (cross-price elasticity). These impacts are shown in Table 4.5. Together they result in a 9% and 11% reduction in average use per customer across the outlook period for residential and non-residential customers respectively.

**Table 4.5: Price elasticity impacts – Core[20]**

| | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|
| **Residential** | | | | | | |
| Own price | -0.25% | 0.74% | 1.06% | 0.90% | 1.41% | 1.68% |
| Cross price | -2.98% | -3.00% | -2.01% | -2.10% | -2.23% | -2.35% |
| Total | **-3.23%** | **-2.26%** | **-0.96%** | **-1.20%** | **-0.82%** | **-0.67%** |
| **Small Business and I&C** | | | | | | |
| Own price | -0.78% | 0.75% | 1.41% | 0.74% | 0.32% | 1.27% |
| Cross price | -2.98% | -3.00% | -2.01% | -2.10% | -2.23% | -2.35% |
| **Total** | **-3.76%** | **-2.25%** | **-0.61%** | **-1.36%** | **-1.91%** | **-1.08%** |

[19] In the case of small business Core's trend calculation is actually a cumulative average growth rate calculation rather than a trend (a trend has been used in the case of I&C and residential).

[20] Appendix 5.1, p. 87

### 4.3.2 Own price elasticity estimate

Core has adopted (long run) own price elasticity estimates of -0.30 for residential gas usage and -0.35 for non-residential gas usage. These elasticity estimates were accepted as reasonable by the AER in its review of Envestra's Victorian gas demand forecasts, based on previous studies and analysis of data.

Core's own modelling did not produce statistically significant estimates of own price elasticity in the NSW gas market. However, the estimates that were generated were broadly consistent with the estimates used in the Envestra forecast.

The elasticity of demand for gas will vary across jurisdictions according factors including:

- The cost and availability of alternative energy sources
- Total usage and total bills
- The 'culture' of gas use

Thus it is not automatically the case that the elasticity of demand for gas will be the same in NSW as Victoria. Nevertheless, given that the markets are broadly similar and in the absence of information to the contrary, we do not consider it unreasonable to apply the Victorian elasticities.

### 4.3.3 Cross price elasticity estimate

The most significant price impact on demand occurs through the cross-price elasticity assumption. Core has adopted a cross-price elasticity of 0.1. While Core noted that no previous gas forecasts have incorporated cross price elasticity, it considers that the material forecast change in gas prices relative to electricity warrants inclusion in this case.

The adopted value of 0.1 reflects four US studies cited by Core, which have found cross-price elasticity of gas demand, with respect to changes in electricity prices, ranging up to 0.15.

In its report to AEMO ACIL Allen noted that CiE was unable to quantity cross-elasticity of demand in its 2012 work for SP AusNet.[21] ACIL Allen concluded more generally that cross-elasticity had not, to its knowledge, previously been found to be significant in gas forecasting models, at least partly due to data issues. ACIL Allen noted that it was a factor that AEMO may wish to examine more closely in future, but effectively ruled out including it in its gas forecasting methodology in the short term.

Further, the forecasts developed recently by the NSW electricity distribution businesses as part of their price review process have not included an assessment of cross price elasticity (with gas) and, therefore, this demand is essentially being 'lost' from a regulatory perspective.

In response to our 2014 report, which suggested a preference for a cross price elasticity of 0.05, Core noted that:

[21] ACIL Allen Report to AEMO, *Gas Consumption Forecasting – A Methodology*, 24 June 2014, p. 41

- The elasticity estimate adopted is conservative when considered against the full range of international studies
- It was not possible to adopt a statistical analysis to analyse the relationship between movements in gas and electricity prices in NSW as there has not been a material deviation between gas and electricity prices in recent history in NSW
- Core has adopted the lower end of a range of 0.1 to 0.15
- Deloitte has provided no evidence or rationale to use a cross price elasticity factor of 0.05.

As we outlined in our 2014 report, our concern with using a material cross-price elasticity estimate is the lack of relevant Australian evidence to support it. All the studies cited by Core are US based, some are quite old, and all are based around gas markets which are quite different to NSW. Specifically:

- The Bernstein & Griffith paper is a US national level data set from 1977 to 2014. The cross-price elasticity value in the paper (of 0.146) is a lagged elasticity – the Core forecast does not use a lag.
- The Payne, Loomis & Wilson paper uses data from 1970 to 2007 for Illinois, a state with a cold winter climate and 81% of homes with natural gas heating
- The Herbert & Barber paper uses a data set from 1960-83 in Northeastern USA – again an area with cold winters. The report investigates three comparable models that include estimated parameters for cross-price elasticity. These values are 0.10, 0.19, and 0.32. Core reported only the first value, which came from the only model that did not include the price of oil (PO) as an explanatory variable. However the authors point out that "the consequence of excluding the PO variable, assuming the true value could be measured, is that there is some bias in the estimated coefficients for INC, PE [cross-price elasticity], WHDD, and PG due to linear connection between these variables and the true PO variable."
- The Alberini et. al. paper uses a data set from 1997 to 2007 for the 50 largest metropolitan areas in the US. Alberini et al reports that reports that current cross-price elasticity is 0.15 for a single model specification. Alberini et. al. indicate that "*the cross-price elasticity is positive (0.15) and indicates the gas and electricity are substitutes in the model with city-specific effects, but turns insignificant when we use dwelling-specific effects, and negative and insignificant in the model with dwelling-family effects."*

We therefore have concerns about the transferability of the results of these studies to the NSW context. Given the significant effect that the cross-price elasticity has on forecast volumes and hence prices– we consider that the supporting evidence for the elasticity value would need to be compelling to justify such an impact. We do not believe this is the case.

We also note that an Australian study by Akmal and Stern in 2001, cited by SP AusNet in a submission to the AER for its 2013-17 Access Arrangement Review, found that the cross-price elasticities between electricity and gas were negative using national data and positive but not significant using state data. SP AusNet concluded that "evidence suggests that the most appropriate assumption for forecasting for residential gas use is to allow for no relationship between electricity prices and gas consumption". SP AusNet surmised that "It is plausible that households react to 'energy' prices with lower consumption of electricity

and gas, rather than switching between electricity and gas." If SP AusNet is correct this suggests there is no cross-elasticity impact.

On balance, our view is that it is not unreasonable to include an estimate of cross-price elasticity in the forecasts, but that given the paucity of Australian evidence regarding the level of the elasticity, and the potential impact on usage, using a value of 0.1 is not reasonable. Our recommendation is to use a non-zero but lower figure of 0.05. We look forward to future studies providing better estimates of cross price elasticity in the Australian context.

### Price of electricity

Core's 2015 report has updated the forecast price of electricity (for both retail and business customers) using forecasts of residential electricity prices issued by the AEMC. The AEMC's forecast reflects the draft decision issued by the AER for NSW distribution electricity prices. It calculates a reduction in overall residential electricity prices in 2014-15 and 2015-16 of 13% and 12% respectively (in real terms).

We consider that the residential price changes adopted by Core are reasonable.

However, reductions in the non-residential price of electricity are unlikely to be as substantial as for residential customers. This is because network charges, which are falling, make up a relatively smaller proportion of bills for non-residential customers, and particularly for I&C customers.

We asked JGN about the use of the residential price change when calculating demand from non-residential customers. In response JGN advised that 'Core has adopted a simple approach to forecasting electricity prices that is considered reasonable in the circumstances. We note that Deloitte also applied the same electricity price movements for residential and non-residential customers in their alternative demand forecasts and previous advice to the AER.'[22]

We note JGN's response but believe that given the large impact of electricity prices on gas demand under Core's forecasting approach we believe it is important to use the most accurate estimates of non-residential price changes as possible.

There are no 'official' forecasts of changes in non-residential electricity prices in NSW. Indeed there is a paucity of information available on the contribution of the various elements of the electricity price to the overall bill. We have therefore made a number of simple assumptions to estimate the change in non-residential electricity prices, with the results as set out below:

[22] JGN Response to AER Information Request 050, p. 1.

**Table 4.6: Real change in electricity prices**

| | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|
| Residential (Core estimate) | -12.59% | -11.58% | -0.42% | 0.00% | 0.00% | 0.00% |
| Non-residential (Deloitte estimate) | -8.22% | -9.66% | 0.47% | 0.00% | 0.00% | 0.00% |

### 4.3.4 Application of the elasticity estimates

In the 2014 Core Report, the impact of elasticity on demand was calculated by multiplying the elasticity estimate by the price change, and multiplying this figure by average usage.

In its response to the AER's Draft Decision Core has adopted a different and more complex approach, which results in a much larger impact on demand. The new approach identifies that there is an elasticity impact in the historic (trend) usage figures which needs to be removed from the forward forecasts. Our understanding is that Core has adopted the following approach (using cross-price elasticity as an example).

- Core has forecast a 'trend' of future electricity price changes based on historic price changes.
- Each year's 'trend' price change for 2015-2020 has been multiplied by the assumed elasticity factor of 0.1, in order to establish an elasticity impact 'implicit' in the Core trend (to give a figure X%)
- Core has then multiplied the assumed cross price elasticity of 0.1 by the actual forecast price change for each year 2015 to 2020 (to give a figure Y%).
- The difference between X and Y is then the percentage change applied to per customer demand attributable due to cross price elasticity. Because X is a positive number (historically electricity prices have been increasing) and Y is a negative number (in the future electricity prices are forecast to fall) the difference is a large positive number.

Under the approach adopted in its 2014 report Core simply applied Y% to the per customer demand.

A similar approach has been applied in respect of own-price elasticity.

The way in which these post-model elasticity adjustments have been implemented raise a number of concerns, including:

- As discussed above, we consider that of itself the cross-price elasticity estimate of 0.1 is high
- The resultant impact on per customer demand is large – averaging about -2.5% per annum for residential cross-price elasticity alone – particularly in view of the limited Australian evidence of any cross-price elasticity demand effects between electricity and gas
- We have some concerns with the use of a 'trend' forecast of electricity prices which suggests that historic changes in electricity prices are following a defined trend, when in reality they are exogenously determined. We appreciate that Core is attempting to remove an 'implied' trend in prices from the overall trend forecast, but this highlights the issues and complexities that arise when post-model adjustments are made rather than incorporating a price variable in an econometric equation.

- This approach is somewhat unique, theoretical, and has not, to our knowledge, been adopted in gas forecasting to date in Australia.
- The calculations appear unduly complex given the range of other factors that have not been adjusted for post-model and might reasonably also have a material impact on usage.

In its work for AEMO ACIL Allen noted that "post-model adjustments are forecasts in their own right and, as such, should be made transparently and based on robust methodologies. They should reflect actual practice and experience to the maximum extent possible." We are not persuaded that the approach to applying the elasticity estimates by Core meets these criteria, with our main concern being that regardless of any theoretical merits, the resultant impact on demand, particularly from cross-price elasticity, is unduly high.

We also note that alternative approaches to adjusting for cross price elasticity could be adopted. For example, one option would be to retain Core's original approach to the application of price elasticity but re-calculate the forward trend forecast to directly remove the price effects from the historical trend. We understand Core has proposed this approach in Western Australia. We also note that applying this approach in relation to JGN would result in higher per customer usage forecasts than the adjustments we have made.

In summary we consider that the elasticity adjustments are not reasonable due to their magnitude and have adjusted the elasticity impacts to reflect Core's original approach – a simple multiplication of the price elasticity factor by the change in price.

## 4.4 Summary of adjustments

Table 4.7 provides an overview of the revised price assumptions adopted for the updated forecasts.

**Table 4.7: Revised price assumptions**

| Assumption | Detail |
|---|---|
| Cross price elasticity | Moderated to 0.05 |
| Price of non-residential electricity | Price reductions for non-residential have been reduced compared to those adopted by Core |
| Approach to elasticity impact | Adjusted back to original Core approach |

Source: Deloitte Access Economics

## 4.5 Revised consumption per customer forecasts

The following tables present the revised consumption per customer forecasts for JGN's NSW gas distribution network, based on the discussion set out above. Note that these are based on Core's weather normalised series.

**Table 4.8: Tariff V Residential – revised consumption per customer forecast (GJ)**

| | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|
| Actual | 21.04 | 20.47 | 20.08 | | | | | | |
| Deloitte forecast | | | | 19.21 | 18.53 | 18.29 | 18.19 | 18.32 | 18.40 |
| Core forecast | | | | 19.18 | 18.47 | 18.03 | 17.57 | 17.19 | 16.85 |
| *Difference (%)* | | | | *0.1%* | *0.3%* | *1.5%* | *3.6%* | *6.6%* | *9.2%* |

Source: Deloitte Access Economics

**Table 4.9: Tariff V Small Business – revised consumption per customer forecast (GJ)**

| | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|
| Actual | 246.64 | 243.84 | 246.36 | | | | | | |
| Deloitte forecast | | | | 206.99 | 197.94 | 191.49 | 183.82 | 175.60 | 169.32 |
| Core forecast | | | | 204.53 | 193.50 | 186.24 | 177.85 | 168.87 | 161.73 |
| *Difference (%)* | | | | *1.2%* | *2.3%* | *2.8%* | *3.4%* | *4.0%* | *4.7%* |

Source: Deloitte Access Economics

**Table 4.10: Tariff V I&C – revised consumption per customer forecast (GJ)**

| | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|
| Actual | 522.59 | 491.53 | 455.88 | | | | | | |
| Deloitte forecast | | | | 470.87 | 419.41 | 412.05 | 401.49 | 389.17 | 381.05 |
| Core forecast | | | | 466.65 | 411.75 | 403.49 | 392.08 | 378.69 | 369.15 |
| *Difference (%)* | | | | *0.9%* | *1.9%* | *2.1%* | *2.4%* | *2.8%* | *3.2%* |

Source: Deloitte Access Economics

# 5 Revised consumption forecasts

Based on the forecasts of customers and consumption per customer presented chapters 3 and 4, the tables below summarise our alternative forecasts for total consumption.

**Table 5.1: Tariff V Residential – revised total consumption forecast (GJ)**

| | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|
| Actual | 23,216,478 | 23,262,669 | 23,540,485 | | | | | | |
| Deloitte forecast | | | | 23,205,155 | 23,026,920 | 23,318,188 | 23,724,241 | 24,375,586 | 24,929,420 |
| Core forecast | | | | 23,173,501 | 22,948,822 | 22,980,146 | 22,905,968 | 22,876,170 | 22,836,669 |
| *Difference (%)* | | | | *0.1%* | *0.3%* | *1.5%* | *3.6%* | *6.6%* | *9.2%* |

Source: Deloitte Access Economics

**Table 5.2: Tariff V Small Business – revised total consumption forecast (GJ)**

| | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|
| Actual | 5,164,826 | 5,262,348 | 5,450,558 | | | | | | |
| Deloitte forecast | | | | 4,695,105 | 4,603,562 | 4,566,708 | 4,495,584 | 4,404,411 | 4,356,137 |
| Core forecast | | | | 4,644,979 | 4,516,814 | 4,474,594 | 4,403,912 | 4,315,646 | 4,271,818 |
| *Difference (%)* | | | | *1.1%* | *1.9%* | *2.1%* | *2.1%* | *2.1%* | *2.0%* |

Source: Deloitte Access Economics

**Table 5.3: Tariff V I&C – revised total consumption forecast (GJ)**

| | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|
| Actual | 7,937,111 | 7,831,619 | 7,671,044 | | | | | | |
| Deloitte forecast | | | | 8,090,781 | 7,338,827 | 7,363,856 | 7,330,755 | 7,262,578 | 7,270,459 |
| Core forecast | | | | 8,018,319 | 7,204,775 | 7,210,884 | 7,159,007 | 7,066,912 | 7,043,476 |
| *Difference (%)* | | | | *0.9%* | *1.9%* | *2.1%* | *2.4%* | *2.8%* | *3.2%* |

Source: Deloitte Access Economics

**Table 5.4: Total Tariff V consumption forecast (GJ)**

| | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|
| Actual | 36,318,41 | 36,356,637 | 36,662,086 | | | | | | |
| Deloitte forecast | | | | 35,972,639 | 34,943,207 | 35,218,958 | 35,520,920 | 36,013,181 | 36,526,603 |
| Core forecast | | | | 35,836,800 | 34,670,411 | 34,665,624 | 34,468,887 | 34,258,728 | 34,151,962 |
| *Difference (%)* | | | | *0.4%* | *0.8%* | *1.6%* | *3.1%* | *5.1%* | *7.0%* |

# Limitation of our work

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## Contact us

Deloitte Access Economics
ACN: 149 633 116

Level 1
9 Sydney Avenue
Barton ACT 2600
PO Box 6334
Kingston ACT 2604 Australia

Tel: +61 2 6175 2000
Fax: +61 2 6175 2001

www.deloitteaccesseconomics.com.au

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