Review of Demand Forecasts for SP AusNet

Victorian Gas Access Arrangement Review for the period 2013 – 2017

Prepared for the Australian Energy Regulator

Final Report – August 2012

ACIL Tasman

Economics Policy Strategy

Reliance and Disclaimer

ACIL Tasman Pty Ltd

ABN 68 102 652 148
Internet www.aciltasman.com.au

Melbourne (Head Office)
Level 4, 114 William Street
Melbourne VIC 3000

Telephone (+61 3) 9604 4400
Facsimile (+61 3) 9604 4455
Email melbourne@aciltasman.com.au

Brisbane
Level 15, 127 Creek Street
Brisbane QLD 4000
GPO Box 32
Brisbane QLD 4001

Telephone (+61 7) 3009 8700
Facsimile (+61 7) 3009 8799
Email brisbane@aciltasman.com.au

Canberra
Level 2, 33 Ainslie Place
Canberra City ACT 2600
GPO Box 1322
Canberra ACT 2601

Telephone (+61 2) 6103 8200
Facsimile (+61 2) 6103 8233
Email canberra@aciltasman.com.au

Perth
Centa Building C2, 118 Railway Street
West Perth WA 6005

Telephone (+61 8) 9449 9600
Facsimile (+61 8) 9322 3955
Email perth@aciltasman.com.au

Sydney
Level 20, Tower 2 Darling Park
201 Sussex Street
Sydney NSW 2000
GPO Box 4670
Sydney NSW 2001

Telephone (+61 2) 9389 7842
Facsimile (+61 2) 8080 8142
Email sydney@aciltasman.com.au

For information on this report

Please contact:

Paul Balfe
Telephone 07 3009 8700
Mobile 0404 822 317
Email p.balfe@aciltasman.com.au

Contributing team members

Jeremy Tustin
Leo Yanes
Joel Etchells

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1 Introduction

1.1 Background

The *National Gas Rules* (NGR), rule 72(1)(a)(iii) require the access arrangement information provided by the service provider to include usage of the pipeline over the earlier access arrangement period showing:

- minimum, maximum and average demand
- customer numbers in total and by tariff class.

In making a decision whether to approve or not to approve an access arrangement proposal, the Australian Energy Regulator (AER) is required under rule 74 of the NGR to be satisfied that forecasts required in setting reference tariff(s) are arrived at on a reasonable basis and represent the best forecast or estimate possible in the circumstances.

1.2 Scope and Approach

The AER has engaged ACIL Tasman to provide independent advice through written reports on the demand forecasts contained in the access arrangement proposals submitted by the Victorian transmission and distribution businesses to assist it in its decision about whether to approve the access arrangement proposals.[1]

The process followed by the AER for assessing proposed access arrangements and access arrangement revisions is set out in the Final Access Arrangement Guideline published in March 2009 (AER, 2009).

1.2.1 Requirements of the Terms of Reference

The Terms of Reference for the review of demand forecasts are set out in Appendix 7B. In summary, the Terms of Reference require ACIL Taman to provide advice on whether the demand forecasts for each business have been arrived at on a reasonable basis and represent the best forecasts for demand in the circumstances.

More specifically, the Terms of Reference require ACIL Tasman to:

1. undertake a desktop review of the demand forecasts
2. formulate questions on areas where further information or clarification is required

[1] Envestra Victoria, Envestra Albury, Multinet, SP AusNet and APA GasNet.

3. analyse all material provided and prepare separate reports for each service provider, including recommendations on whether the demand forecasts have been arrived at on a reasonable basis and represent the best forecasts for demand in the circumstances.
4. provide alternative forecasts if necessary (that is, if the review of the forecasts submitted by the service provider finds that they have not been arrived at on a reasonable basis and do not represent the best forecasts for demand in the circumstances).

1.2.2 Approach to the review

A key part of the information submitted by a service provider in support of a proposed access arrangement is a forecast of the level of demand for the reference services provided, over the course of the access arrangement period. This typically involves forecasting demand for services for a period of five years from the commencement date of the new access arrangement. It is important to ensure that the forecasts represent best estimates arrived at on a reasonable basis because:

- Demand forecasts may impact the forecast capital expenditure required to meet the new demand of prospective users or the increased demand of existing users and may therefore influence forecast revenue.
- Demand forecasts influence the tariffs set to meet forecast revenue in each year of the access arrangement period, and how this revenue is to be allocated between tariff classes for different reference services.

In undertaking this review, ACIL Tasman has considered the following issues:

1. the adequacy of the overall approach and methodology
2. the reasonableness of the assumptions
3. the currency and accuracy of the data used
4. the account taken of key drivers
5. whether the methodology has been properly applied.

The review has been undertaken as desktop analysis into the methodology, data and parameters, and assumptions used to develop the demand forecasts. ACIL Tasman has used its own knowledge of Australian gas markets to test assumptions.

1.2.3 Data sources

In preparing this review, ACIL Tasman has relied on the following data sources:

- The National Gas Rules
- The Access Arrangement Information submitted by SP AusNet (SP AusNet, 2012)

- The demand forecast prepared by the Centre for International Economics (CIE, 2012)
- Requests for additional information to SP AusNet
- Various specialist reports as detailed in the Bibliography

1.2.4 Structure of the report

The remainder of this report is structured as follows:

Chapter 2 sets out the key findings of the report. To the extent that the review takes issue with particular elements of the forecast, it describes the nature of those concerns and recommends action to be taken to address those concerns.

Chapter 3 describes the scope of the SP AusNet operations.

Chapter 4 describes the forecast methodology and assumptions.

In Chapter 5 we consider whether the application of the methodologies and assumptions described in Chapter 4 has produced forecast results for the SP AusNet network that are reasonable in light of historical patterns of demand as well as current and anticipated influences on retail gas demand in the distribution area. We consider separately the forecasts for the Volume and Demand sectors of the market.

Finally, in Chapter 6, we set out our conclusions regarding the acceptability of the forecasts, and the actions that the AER should require to address identified deficiencies in the forecasts as submitted.

2 Key Findings and Recommendations

2.1 The CIE forecasts

The demand forecasts contained in SP AusNet's Victorian Access Arrangement Information document (SP AusNet, 2012) are based on the forecast developed by the Centre for International Economics (CIE, 2012). The forecasts cover the period from 2011 to 2017 and are based on a combination of assumptions and econometric regression models.

The CIE forecasts address two components which make-up demand: usage per customer and number of customers. This applies to the three market segments served by the distribution business: residential customers (Tariff V – Residential), small commercial and industrial customers (Tariff V – Non-residential) and large industrial customers (Tariff D and Tariff M).

In preparing the SP AusNet demand forecasts, CIE has considered key drivers of gas demand, including:

1) Weather
2) Catchment area population growth
3) SP AusNet network expansion
4) Connection cohort
5) Type of dwelling
6) Government policies –
   a) policies related to construction standards and building design
   b) a variety of Federal and State-level policies impacting gas usage
7) Type of economic activity undertaken by commercial and industrial customers
8) Wholesale price of gas
9) Price of substitutes

CIE has tried to take a comprehensive and statistically rigorous approach to the development of the forecasts and the establishment of relationships between demand and its key drivers. CIE has been transparent in terms of its methods and assumptions. Nevertheless data issues and the complexity of the demand relationships have limited the explanatory power of the model, as acknowledged by CIE:

> "… the regressions do not capture a large share of variation as would be expected given the nature of the statistical exercise and the information available. This reflects that we have few variables to explain the variation across households or businesses in gas use and that use through time for a given household or business is subject to variation from many factors that are not accounted for in our model." (CIE, 2012b)

There are a number of methodological issues with the forecasting approach used by CIE to develop the SP AusNet demand forecasts (see section 4.1.3). These issues have the potential to introduce bias and distortions to the modelling results. The key question is whether further effort directed to improving the model (in terms of either the range of explanatory variables included or the estimation of demand coefficients) would be likely to produce a significantly better or more reliable forecast. Given the short time series of available data and the difficulties involved in reliably estimating the coefficients associated with each of the variables in a fully specified demand function, it is not clear that such effort would necessarily produce more reliable forecasts.

Accordingly, while recommending that consideration be given in future to the methodological issues identified, we consider that in the current circumstances the approach used by CIE to develop the SP AusNet demand forecasts is acceptable, and that the methodology employed is sufficiently rigorous overall to satisfy the requirement of rule 74 of the NGR that the forecasts are arrived at on a reasonable basis.

CIE has normalised historical demand data using annual effective degree days. As a cross-check, they have also checked system daily consumption against daily weather and tested the validity of the AEMO preferred effective degree day measure. For the residential demand forecasts, CIE adjusted 2010 per dwelling consumption for each Tariff Zone and each usage block to reflect 'typical' climatic conditions. Typical climatic conditions are modelled using annual effective degree day measures from CSIRO projected forward with a continued decline in EDDs (SP AusNet, 2012, p. 79). Similarly for the commercial demand forecasts, CIE adjusted 2011 consumption to reflect expected climatic conditions. AEMO has recently released a review of Victorian EDD as part of its weather standards for gas forecasting. (AEMO, 2012). That study concluded that, based on Melbourne EDD data for the period 1970 to 2011, the trend-projected annual EDD standard for calendar year 2012 is 1309 – some 31 EDD higher than the value based on the CSIRO UHI plus medium agw projection. We consider that it would be more appropriate for SP AusNet to weather normalise the historical data on the basis of the AEMO EDD standard. This is further discussed in section 4.3.

2.2 Assessment of the forecasts

Having examined the forecasts of Tariff V Residential customer numbers, we conclude that those forecasts do not appear to be unreasonable. However, it would be more appropriate for SP AusNet to use the most recent population growth rates published by the Victorian Department of Planning and Community Development (see section 5.2.1).

CIE's Tariff V Non-residential customer number forecasts fall well below the historical trend as a result of their method of estimation of the relationship between residential customer connections and commercial/industrial connections. CIE does not identify any specific policies which might explain the marked slow-down. The exclusion of the data for 2003 and 2004 appears to be arbitrary (see section 5.2.1).

ACIL Tasman considers that, unless convincing evidence can be provided of policy changes or other factors that would support the exclusion of this data, SP AusNet should be required to amend the commercial customer numbers forecast to take account of the full data series from 2003 to 2011.

The CIE projections for both growth rate and absolute levels of gas demand for Tariff V customers, both residential and non-residential, are well below historical trends. The total Tariff V demand forecasts show very significant breaks in trend, both in terms of aggregate demand and average demand per customer. In order to assess whether these are reasonable expectations in the light of recent market and policy developments, we have considered separately the residential and non-residential components of the forecast.

The forecast customer numbers for the Tariff V Residential customer group, while showing slower growth than in the past, do not appear to be unreasonable, subject to adjustment for use of the AEMO weather standard. The forecasts imply an accelerating rate of decline in average use which can be explained by policy changes—in particular the recent adoption of the 6-star building standard—and by expected increases in wholesale gas prices that have been factored into the forecasts.

For the Tariff V Non-residential customer group, a sharp break in trend appears to reflect a combination of low assumed growth in the number of commercial customers (relative to historical rates) and a largely unexplained reversal of trend in average gas use per customer. In combination, these factors result in a forecast of Non-residential Tariff V gas demand that is not intuitively reasonable and cannot be justified on the basis of recent policy changes.

The reversal of trend appears to be driven, at least in part, by the estimated value of price elasticity of demand used by CIE in preparing the forecasts which, at –0.77, is more than double the estimates of price elasticity that have been previously approved by the AER in the case of the South Australian gas distribution system). It is also much higher than other distribution businesses have proposed in the current Victorian gas access arrangement review, and is much higher than published estimates in the literature. The high elasticity estimate may lead to the forecast of gas consumption by the Tariff V Non-residential customer group being too low. On the other hand it can be argued that there is little direct evidence of own price elasticity of gas in the Victorian market and that the estimates made by CIE are the best available given that a statistically significant relationship has been demonstrated.

With regard to Tariff D customer numbers and Maximum Hourly Quantity (MHQ) forecasts, we conclude that the assumptions of stable customer numbers and MHQ throughout the forecast period to 2017 are conservative and may prove to be optimistic.

3 Scope of SP AusNet operations

The following description of the SP AusNet Victorian gas distribution operations is a summary of the information provided in the Access Arrangement Information (SP AusNet, 2012).

The SP AusNet natural gas transmission and distribution network extends throughout western metropolitan Melbourne and South-West and West regional Victoria. SP AusNet's gas distribution network serves three rapidly developing urban growth corridors to the west of Melbourne, at Hume, Melton and Wyndham. The network distributes natural gas from the principal gas transmission system to individual gas meters, which supply customers' appliances.

In total, SP AusNet delivers gas to approximately 605,000 customers across a geographically diverse region spanning some 60,000km^2. The gas transmission and distribution network includes mains, mainline valves, pressure regulating facilities (including city gates, field and district regulators), service pipes, meters and ancillary equipment.

The majority of the distribution system operates at high pressure with a minimum allowable pressure of 140kPa to a maximum of 515kPa. "City Gates" regulate supply from the transmission system (owned and operated by APA GasNet) to SP AusNet's distribution network. The medium pressure distribution systems operate between 15kPa to 140kPa, with Field Regulators controlling gas supply from SP AusNet's high pressure networks. The low pressure distribution systems operate up to 7kPa with District Regulators controlling gas supply from SP AusNet's high and medium pressure networks.

Pipeline corrosion is managed through the installation of corrosion protections units (CPUs) and sacrificial anode beds. Meter and regulator assemblies, which vary from large industrial or commercial units to small domestic units, supply gas to consumers. A meter and regulator setup is provided for each supply point (i.e. customer connection) from the distribution network.

SP AusNet uses a SCADA (Supervisory Control and Data Acquisition) system to monitor and control assets across the network from the transmission system to the network fringe. The SCADA system provides data on the real-time performance of the assets, and data for long-term evaluation of gas demand and network performance to identify potential system deficiencies.

The gas distribution network has been constructed over a period of more than 100 years and using a variety of pipeline materials with varying performance capabilities. Cast iron and steel were used predominantly until the introduction in the late 1970s of polyvinyl chloride (PVC) for low pressure pipeline replacement and polyethylene for high pressure networks.

Today, PVC is no longer installed in the network, leaving polyethylene as the dominant pipeline material. The type of material dictates the maximum operating pressure and affects the overall performance of the network. Since cast iron can only be operated at medium and low pressures compared to polyethylene, the continuing replacement of cast iron mains with polyethylene pipe enhances the capacity and integrity of the network, helping to offset some of the natural age-related deterioration. Polyethylene materials also deliver significant safety benefits over the aging cast iron assets.

Plans for asset renewal and augmentation will be informed by the need to replace cast iron and unprotected steel mains, which impose capacity constraints and performance risks in terms of leakage. Capacity will need to be expanded to meet demand for network services, given that three of Melbourne's major growth corridors are situated in SP AusNet's network.

3.1 Historical gas demand

The historical customer numbers for the SP AusNet distribution network are shown in Table 1.

Table 1 **SP AusNet gas networks—historical customer numbers, by class**

Year ended 30 June	2007	2008	2009	2010	2011
Residential	512,828	527,839	544,380	561,877	578,446
Small business	15,157	15,293	15,426	15,572	15,693
Volume Customer Total	**527,984**	**543,132**	**559,806**	**577,448**	**594,139**
Demand Customers	290	294	295	298	298
Total customers	**528,274**	**543,425**	**560,101**	**577,746**	**594,437**

Note: "Demand Customers" here include Tariff D and Tariff M customers; there are currently 9 Tariff M customers.
Data source: (SP AusNet, 2012b)

Historical gas demand, by customer class, is summarised in Table 2.

Table 2 **SP AusNet gas networks—historical customer demand (TJ), by class**

Year ended 30 June	2007	2008	2009	2010	2011
Residential	25,441	28,750,	28,624	30,109	28,854
Small business	5,413	5,813	5,454	5,851	5,769
Volume Customer Total	**30,855**	**34,564**	**34,079**	**35,960**	**34,623**

Data source: (SP AusNet, 2012b)

4 Forecast methodology and assumptions

The demand forecasts contained in SP AusNet's Victorian Access Arrangement Information document (SP AusNet, 2012) are based on the forecast developed by the Centre for International Economics (CIE, 2012).

The demand forecasts in the SP AusNet Access Arrangement Information document (SP AusNet, 2012) were developed using the methodology described below. The forecasts cover the period from 2011 to 2017 and are based on a combination of assumptions and econometric regression models.

The following describes the objectives of the demand modeling exercise undertaken by CIE on behalf of SP AusNet, as set out in the CIE report (CIE, 2012):

- To provide forecasts over the 2011-2017 period for
  - Customer numbers
  - Average use per customer
- The forecast needs to be specific to
  - Tariff Zones
  - Tariff Class (Residential, Commercial and Industrial)
- The forecast also needs to satisfy standard criteria:

1) National Gas Rules criteria, namely.-
   a) Information in the nature of a forecast or estimate must be supported by a statement of the basis of the forecast or estimate
   b) A forecast or estimate:
      i) must be arrived at on a reasonable basis
      ii) must represent the best forecast or estimate possible in the circumstances
2) Criteria earlier articulated by ACIL Tasman (ACIL Tasman, 2010):
   a) Be accurate and unbiased
   b) incorporate key drivers, including weather
   c) incorporate policy impacts
   d) be transparent and repeatable
   e) address model validation and testing

6. All inputs should be properly referenced to independent sources.

7. The next section describes the modelling process on which SP AusNet's forecasts are based.

4.1 Econometric modelling

This section reviews SP AusNet's data sources, as well as the econometric/modelling approach adopted by CIE. The section concludes with a detailed discussion of the issues that ACIL Tasman has identified with the demand forecast provided by SP AusNet.

4.1.1 Data sources

The following tables summarise sources for historical and forecast data, for residential, commercial and industrial customers, respectively.

Table 3 **Data Sources – Residential**

Historic – customer data	SP AusNet
Forecast – EDD	CSIRO
Forecast – wholesale gas prices	Australian Treasury Strong Growth, Low Pollution - Modelling a Carbon Price; July 2011; Chart B6: Domestic Australian gas prices
Forecast – wholesale gas price (Victoria)	CIE calculations are applied to Australian Treasury Gas Price forecasts
Forecast – Dwellings	Victoria Planning and Community Development
Forecast – Dwellings (New Towns)	CIE calculations applied to SP AusNet forecast generated in 2004, covering 2004-2025 period

Source: SP AusNet (2012)

Table 4 **Data Sources – Commercial**

Historic – customer data	SP AusNet
Forecast – output gap	GSP is from Victorian Treasury Budget Update 2011. CIE calculations are used to obtain the output gap
Forecast – EDD	CSIRO
Forecast – electricity price	Deloitte Access Economics 2011, Modelling the Clean Energy Future Policy, Victorian Department of Premier and Cabinet
Forecast – wholesale gas prices	Australian Treasury Strong Growth, Low Pollution - Modelling a Carbon Price; July 2011; Chart B6: Domestic Australian gas prices
Forecast – wholesale gas price (Victoria)	CIE calculations are applied to Australian Treasury Gas Price forecasts

Source: SP AusNet (2012)

Table 5 **Data Sources – Tariff D/M, Industrial**

Historic – customer data	SP AusNet
Forecast growth rates	AEMO (2010)

Source: SP AusNet (2012)

4.1.2 Forecasting approach

The CIE forecasts address two components which make-up demand: usage per customer and number of customers. This applies to the three market segments served by the distribution business: Residential customers, small commercial and industrial customers (Tariff V – Non-residential) and large industrial customers (Tariff D and Tariff M).

Table 6 provides a detailed breakdown of SP AusNet's tariff structure. Demand forecasts are constructed in order to match this structure.

Table 6 **Tariff Breakdown: SP AusNet**

Customer type	Time of year	Regions	Tariff types
Domestic	Peak Period – June to September Off-peak Period – October to May	West Central New towns West New towns Central	Supply charge per day connected Charges for usage based on blocks of: • 0-0.1 GJ/day • 0.1-0.2 GJ/day • 0.2-1.4 GJ/day • >1.4 GJ/day
Commercial	Peak Period – June to September Off-peak Period – October to May	West Central New towns West New towns Central	Supply charge per day connected Charges for usage based on blocks of: • 0-0.1 GJ/day • 0.1-0.2 GJ/day • 0.2-1.4 GJ/day • >1.4 GJ/day
Tariff M	All year	West Central New towns West New towns Central	Maximum hourly demand
Tariff D	All year	West Central New towns West New towns Central	Maximum hourly demand

Data source: (SP AusNet, 2012)

CIE forecasts the number of customers as well as usage per customer for the breakdown shown in Table 6. The forecasts are arrived at by means of a four step approach:

1. Identify fundamental drivers of demand and establish the strength of their effects on demand
    a. For customer numbers, this is done based on visual inspection of correlation between customer numbers and various drivers. For residential customer numbers, the key driver is the number of dwellings. The forecast of commercial customer numbers is also based on the number of dwellings, with an adjustment factor of 6 commercial customers per 1000 residential customers is applied
    b. For usage per customer, econometric regression models were estimated using SP AusNet's billing database
2. Having identified the drivers of demand, CIE then sources projections for these drivers, using publicly available estimates
3. Generate the demand forecasts by feeding the projections of the key drivers of demand (sourced in step 2) through the models constructed in step 1
4. Review forecasts using a top-down approach, by comparing forecasts against correlated variables, such as population and economic growth forecasts for the regions under consideration

In preparing the SP AusNet demand forecasts, CIE considers the following drivers for demand:

1) Weather – colder climate leads to greater gas demand
2) Catchment area population growth – more residents and businesses will results in more connections and hence customers
3) SP AusNet network expansion – as the network is expanded, more customers have the option of joining
4) Connection cohort – more recent connections tend to be more energy efficient, in part due to more stringent building standards, thereby lessening demand
5) Type of dwelling – units consume less gas than houses
6) Government policies –
    a) policies related to construction standards and building design are seen to have a significant impact on demand. As buildings become more energy efficient, their gas usage (if connected to the network) is lower
    b) a variety of Federal and State-level policies impacting gas usage
7) Type of economic activity undertaken by commercial and industrial customers – Whether customers are in expanding or contracting economic sectors will affect their gas demand
8) Wholesale price of gas – higher wholesale prices will curtail gas demand
9) Price of substitutes – such as electricity

The following subsections explain in more detail how the forecasts were constructed, in terms of both the number of customers and the average usage per customer.

Number of Customers

Residential Customer Numbers: Central and West Regions

The approach taken for residential customer numbers in the Central and West regions is to use the forecasted growth rate of new dwellings produced by the Victorian Department of Planning and Community Development (Victoria Department of Planning & Community Development, 2008) and apply these growth rates to the most recent number of residential customers for SP AusNet. The current round of forecasts is based on VDP (2009) dwelling growth forecasts and applies this to a recent estimate of numbers of SP AusNet residential customers. The CIE (2012) has noted that the Victorian Department of Planning and Community Development will issue an updated forecast by mid-2012, which can be used to update the forecasts in SP AusNet's AAI**. We note that DPCD has now issued this updated forecast[2], and accordingly we recommend that the AER require SP AusNet to update the residential customer number forecasts using this new information.** *We also note that there are minor discrepancies between the customer numbers shown in the Regulatory Information Notification (RIN) and those shown in the latest version of the CIE Report. This appears to be a result of the RIN drawing on an earlier version of the CIE report.*

Other drivers for residential customer numbers were considered but were deemed by CIE to be of lesser importance or to have insufficient information available to establish their impact. Hence, these were left out of the forecast:

1. Population growth - SP AusNet's customer base has grown at a faster rate than population, which leads to the conclusion that it is a poor indicator of growth in customer numbers (Chart 3.10 in (CIE, 2012))
2. Growth in household income- Measured by growth in average weekly earnings. Visual inspection (Chart 3.11 in (CIE, 2012)) suggests a weak relationship
3. Network Expansion Plans - SP AusNet has no specified network expansion plans for the forecast period

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[2] Victoria Department of Planning and Community Development, 2012: "Victoria in Future 2012" Data tables available at http://www.dpcd.vic.gov.au/home/publications-and-research/urban-and-regional-research/census-2011/victoria-in-future-2012/vif-2012-data-tables

4. New connections and disconnections - SP AusNet/CIE report that there is limited data to support analysis of the reasons why customers may choose to connect/disconnect in any given year

Commercial Customer Numbers: Central and West Regions

For commercial customers in the Central and West Regions, SP AusNet's forecast assumes that new commercial customers will be a proportion of new residential customers, at a rate of six new commercial customers per 1,000 new residential customers. This factor is applied to the residential customer numbers forecast obtained above to yield the forecast of commercial customer numbers. The ratio of 6/1000 is based on coefficients in a pooled regression analysis which distinguishes between Local Government Areas (LGA's) and across the 2004-2011 and 2005-2011 time periods (Table 4.6, (CIE, 2012)).

SP AusNet looked into other candidate drivers for commercial customer numbers. However, these were left out of the forecast since they were judged to be of lesser importance or to have insufficient information available to establish their impact:

1. Economic growth - As measured by per cent change in Gross State Product (GSP) for Victoria. The correlation between GSP and commercial customer numbers appears to be weak (Table 4.7 in (CIE, 2012))
2. Growth in household income - Measured by growth in average weekly earnings. As with economic growth, visual inspection (Chart 4.9 in (CIE, 2012)) suggests poor correlation
3. Network Expansion Plans - SP AusNet has no specified network expansion plans for the forecast period
4. New connections and disconnections - Data limitations are cited by SP AusNet/CIE as the main reason why it would be difficult to analyse connection/disconnection decisions by customers

Residential and Commercial Customer Numbers: Central and West New Towns

For the new towns, the approach is based on an SP AusNet forecast originally produced in 2004. The original 2004 forecast was reviewed and accepted at the time by the Essential Services Commission of Victoria and covers the period from 2004 to 2025. Customer growth in the "new town" areas is driven not by new dwellings (since these are established residential areas) but by the rate of uptake of customer connections following the network expansion into these areas, which was completed some years ago. In effect what has happened over the current access arrangement period is that the rate of connection uptake has been more rapid than initially anticipated. However, the number of potential customers (effectively at 100% penetration rate) remains essentially unchanged. SP AusNet's current forecast progressively reduces the gap between actual customer numbers and the original 2004 forecast. The gap between the original forecast and the actual customer numbers gradually reduces until the new forecast converges to the original forecast in 2025 (see Chart 3.18 in (CIE, 2012)). The same approach has been used for both commercial and residential customer numbers. In the circumstances we consider that the approach taken is reasonable and that requiring SP AusNet to reconsider the end point of the forecast in 2025 would be unlikely to result in material changes to the forecasts.

Usage per Customer

In terms of usage per customer, the approach taken by CIE is to estimate a number of regression equations to identify key drivers of gas demand, for both residential and commercial customers. The regressions use static panel data techniques, which allow the regressions to be run on data tracking individual customer usage over time. SP AusNet's preferred specification is a random effects characterization, which allows individual customer and time characteristics to be treated as part of the random error component of the regression.

Residential Customer Usage

The key regression equations for residential usage proposed by CIE (CIE, 2012) and reflected in SP AusNet's access arrangement information (SP AusNet, 2012) are of the following form:

$$Log\left(\frac{Demand}{Customer}_{it}\right) = \beta_0 + \beta_1\, Unit_i + \beta_2\, YearConnected_i + \mu_i + \gamma_1\, Year_t + \gamma_2\, Log(EDD_t) + \gamma_3\, Log(ElecPrice_t) + \delta_1\, Log(Price_{it}) + \delta_2\, Retailer_{it} + \varepsilon_{it} \quad (1)$$

Where:

- t subscripts represent the time period of a variable

- i subscripts identify individual customers

- Log is the Natural Logarithm of a variable

- Demand/Customer$_{it}$ is gas demand for customer i, in year t

- β_0 is an intercept term

- β_1 is the coefficient for a dummy (0,1) variable which specifies whether the customer is a single dwelling or a unit, labeled $Unit_i$

- β_2 is the coefficient on a variable establishing the year in which a customer was connected to the network, labeled $YearConnected_i$

- μ_i is a dwelling-specific random error term

- γ_1 is the coefficient on a time trend, labeled $Year_t$

- γ_2 is the coefficient on Effective Degree Days in year t, labeled EDD_t

- γ_3 is the coefficient on the price of electricity in year t, labeled $ElecPrice_t$

- δ_1 is the coefficient on the price of gas paid by customers in their region in year t, labeled $Price_{it}$. The price paid in a region is identical for all customers located in that region. It is an index based data published by the Essential Services Commission of Victoria, assuming consumption of 60 GJ.

- δ_2 is the coefficient on a dummy (0,1) variable which captures whether the customer has changed retailers (equal to zero before a customer changes retailers, and 1 after a change of retailers occurs)

- ε_{it} is a dwelling-specific random error term in year t

Where possible, variables are defined in logarithms. Hence the coefficients can be interpreted as the per cent change in the dependent variable associated with a one per cent change in the corresponding explanatory variable, that is, coefficients represent elasticities.

Equation (1) is a common functional form used to estimate demand functions. However, due to lack of data the regression analysis omits measures of customer income/production or household composition as explanatory variables, and so this effect will be captured by the variables that have been included.

Residential regression results are reported in (CIE, 2012), Table 5.5. All coefficients are statistically significantly different from zero. Key insights are:

1. Home units consume around 50 per cent less gas than houses.
2. The adoption of 5 star energy efficiency standards in 2006 led to a downward step in gas use from new buildings, by approximately 12 per cent.
3. Gas use trends down by 0.7 per cent per year across all residential customers.
4. Own price elasticity is estimated at -0.17 for residential customers: A one per cent increase in gas price leads to a decrease in usage of 0.17 per cent.
5. Customers who switch retailers are found to exhibit higher gas usage. This may be because they are able to obtain a lower price after switching, or

because their intrinsically higher gas usage means they face higher gas bills which create an incentive to "shop around" in an effort to minimize cost.

6. Effective Degree Days are found to increase gas usage, at a rate of 0.4 per cent for a variation of 10 Effective Degree Days.
7. The relationship between electricity prices and gas usage is inconclusive, with various studies (CIE, 2012), (Akmal, Residential energy demand in Australia: an application of dynamic OLS. , 2001a), (Akmal, 2001b) finding different and often contradictory results. The expected negative relationship between gas usage and electricity prices is therefore neither robust nor well established.
8. A number of statistical cross-checks are presented in (CIE, 2012): Tables 5.8, 5.9, 5.10 and 5.15, and this process generally supports the finding of robust statistical relationships. The exception is electricity prices, which as noted in point (7) above, is neither robust nor well established. As a consequence, it is dropped from the analysis.
9. Policy impacts are difficult to measure in the regression analysis, and to some extent are captured by the time trend coefficients. In addition to the time trends, CIE applies a 12 per cent reduction in gas usage for new homes in 2012, which is based on the estimated coefficients for the May 2011 implementation of the 6 star energy efficiency standards for new homes and units. This adjustment does not double count the effect of the time trend, since both effects were estimated concurrently in the base regression model. In consequence, each effect is additive to the other, given that they were estimated using partial regression analysis, that is, each effect was estimated whilst accounting for the other effect.

The next subsection details the approach used in forecasting commercial customer usage.

Commercial Customer Usage

The key regression equations for commercial usage proposed by CIE (CIE, 2012) and reflected in SP AusNet's access arrangement information (SP AusNet, 2012) are of the following form:

$$Log\left(\frac{Demand}{Customer}it\right) = \mu_i + \gamma_1\, Year_t + \gamma_2\, Log(EDD_t) + \gamma_3\, Log(VA_t) + \gamma_4\, Log(\,ElecPrice_t) + \delta_1\, Log(Price_t) + \varepsilon_{it} \qquad (2)$$

$$\mu_i = NewConnection_i + Region_i + \varepsilon_i$$

Where:

- t subscripts represent the time period of a variable

- i subscripts identify individual customers

- Log is the Natural Logarithm of a variable

- $Demand/Customer_{it}$ is gas demand for customer i, in year t

- μ_i is a customer-specific fixed effect (intercept), defined in the second line of equation (2) as the sum of dummy variables stating whether customer i is a new connection ($NewConnection_i$) and the corresponding region where the customer is located ($Region_i$). In the final analysis, only the $NewConnection_i$ variable is implemented

- γ_1 is the coefficient on a time trend, labeled $Year_t$

- γ_2 is the coefficient on Effective Degree Days in year t, labeled EDD_t

- γ_3 is the coefficient on measures of the output gap for Value Added in year t, labeled VA_t

- γ_4 is the coefficient on the price of electricity in year t, labeled $ElecPrice_t$

- δ_1 is the coefficient on the price of gas paid by customers in their region in year t, labeled $Price_t$. The price paid in a region is identical for all customers located within that region. It is data published by the Essential Services Commission of Victoria, assuming consumption of 500 GJ per year per business.

- ε_{it} is a customer-specific random error term in year t

Where possible, variables are defined in logarithms. Hence the coefficients can be interpreted as the per cent change in the dependent variable associated with a one per cent change in the corresponding explanatory variable, that is, coefficients represent elasticities.

Commercial regression results are report in (CIE, 2012) Table 6.5. The only coefficients which are statistically significantly different from zero are those for EDD (positive) and gas price (negative, with an elasticity of -0.77). The time trend, electricity prices and value added are not statistically significant. Nonetheless, the estimated coefficients are included when generating the forecasts, which use equation (2) as the basis of estimate.

Further statistical checks are presented in (CIE, 2012) Tables 6.6, 6.7, 6.8 and 6.9. This robustness analysis shows that weather (through EDD) has a stronger effect on smaller customers. The gas usage reduction attributable to the time trend is stronger for smaller customers, with top quartile customers exhibiting a positive time trend. Other cross-checks include using different measures of value added and electricity prices, with results from the base model remaining unchallenged. Breaking down the analysis by usage blocks (intensity of usage) shows that more intensive users are more responsive to electricity prices, value added, and gas price. During peak periods, these variables are statistically significant for customers with usage greater than 0.2 GJ/day.

Industrial Customer Usage

Demand from industrial customers is specified in terms of maximum hourly quantities (MHQ). Forecasts for the 2011 to 2017 period are based on annual gas system demand forecasts prepared by the Australian Energy Market Operator (AEMO, 2010). The forecast is based on growth rates for Tariff D volume forecasts assuming a medium economic growth scenario. More specifically, forecasted growth rates for Tariff D volumes are applied to total MHQ, by MHQ demand block and by region.

Having presented the context in terms of the methodology/approach and data sources used by CIE to forecast demand on the SP AusNet network, the next section discusses the main issues ACIL Tasman has identified in relation to the forecasts.

4.1.3 Methodological issues

This section presents the main issues identified by ACIL Tasman as related to the forecasting methodology.

Issue 1 – Absence of Dynamics in Estimation

The regressions in equations (1) and (2) omit a treatment of dynamic aspects of demand. In the presence of dynamic behaviour, it is often the case that the dependent variable (for the case under consideration, gas demand) is a function of past values of itself[3]. This can arise because the dependent variable may exhibit a sluggish adjustment process; hence past values will continue to affect values in the present.

To account for this, it is customary to introduce a lagged dependent variable among explanatory variables. In this specification equation (1) would take the following form:

$$Log\left(\frac{Demand}{Customer}it\right) = \beta_0 + \beta_1\ Unit_i + \beta_2\ YearConnected_i + \mu_i + \gamma_1\ Year_t + \gamma_2\ Log(EDD_t) + \gamma_3\ Log(ElecPrice_t) + \delta_1\ Log(Price_{it}) + \delta_2\ Retailer_{it} + \delta_3\ Log\left(\frac{Demand}{Customer}it - q\right) + \varepsilon_{it} \qquad (3)$$

Similarly, equation (2) would now include a lagged dependent variable. Variables and coefficients in equation (3) are as defined previously and δ_3 is the

[3] In econometric terms, the time series for the dependent variable exhibits a certain degree of autocorrelation.

coefficient on the lagged dependent variable, which is lagged by *q* periods (the number of lags, *q*, needs to be estimated). Estimation of a regression such as equation (3) allows the definition of short-run and long-run elasticities of demand. In particular, the coefficient δ_1 represents the short-run own-price elasticity of demand. The long-run elasticity is calculated as $\delta_1/(1-\delta_3)$.

However, the regressions used by CIE, namely equations (1) and (2), omit lagged the dependent variable. Hence, the specification does not capture dynamic demand behaviour, which is necessary to estimate short and long run demand elasticities.

Impact

The absence of a long-run versus short-run elasticity estimates leads to a lack of understanding on how changes in the price of gas will affect customer usage over time, since it confuses the short and long run effects. In consequence, the effect of price changes on the trajectory of the forecast will not be well defined.

Resolution

The demand function should contain a lagged dependent variable, which would allow proper estimation of short and long run demand elasticities. In this case, estimation would need to use Dynamic Panel Data techniques (see for example the approaches in (Arellano M. &., 1991) and (Arellano M. &., 1995) which are readily available in the STATA econometric software used by CIE for their econometric estimation).

Issue 2 – Presence of Endogenous Variables Among Explanatory Variables

The inclusion of prices as explanatory variables in regression equations (1) and (2) means that endogenous variables (in this case, gas prices) are being treated as exogenous variables. This leads to econometric estimation problems resulting in statistically biased coefficients.

Impact

Estimated coefficients and the associated forecast will be statistically biased.

Resolution

Estimation should be conducted using Instrumental Variables techniques.

Issue 3 – Non-linearities in Demand

The regression equations that have been specified in equations (1) and (2) do not capture non-linear aspects of demand. In particular, as explanatory variables rise or fall, it does not necessarily follow that demand per customer will track these variables by a constant per cent change. At high/low levels for some of these variables, a given per cent change in the variable under consideration will not necessarily lead to the same per cent change in gas demand per customer. Consider the example of weather: businesses or households will not necessarily change their gas demand by the same percentage for a given percentage increase in EDD at different levels of EDD: There may be upper/lower thresholds in demand, above/below which the intensity of demand may taper off or increase.

The non-linearities discussed above can also be present in prices of gas as well as substitutes. There may be thresholds in gas and electricity prices above or below which a larger or smaller customer response is triggered. For example, if electricity prices rise beyond a certain level, then it may become optimal for customers to switch to gas heating, and given that the electricity price thresholds may be common to many customers, this could create an 'avalanche effect', which should be reflected in larger cross-substitution coefficients for high electricity price levels. Indeed, this may explain why the coefficient for electricity prices becomes statistically significant for more intensive users of gas. Similar logic applies to lower thresholds, as well as own price.

Impact

Not accounting for non-linearities in demand (particularly not accounting for the presence of upper/lower thresholds) can lead to over/under estimation of demand. It is difficult to ascertain *ex-ante* the magnitude or direction of any impact.

Resolution

This issue could be ameliorated by introducing non-linear terms into the regression equations. In particular, introducing higher powers of the relevant variables would capture non-linearities present in the data.

Issue 4 – Omitted Variable Bias

Although the regression models considered provide a reasonable approach to estimation of demand, it is likely that there may be omitted variables. This is particularly relevant in the light of the low coefficients of determination that have been reported, which tell us that most (over 90 per cent) of the variation in demand has been left unexplained.

Impact

Omitting explanatory variables leads to statistical bias in the estimated coefficients and the associated forecast. *Ex-ante*, it is unclear whether the coefficients might be upward or downward biased.

Resolution

The solution is to expand the set of explanatory variables until a better fit is achieved. The dataset contains a large number of observations, so expanding the number of explanatory variables should still leave more than sufficient degrees of freedom.

Other Issues Identified

Low Coefficient of Determination (R^2)

Reported coefficients of determination (R^2) appear to be unusually low for a dataset of the size used by CIE (see for example Tables 5.5, 5.8 and 5.9). The dataset is a panel containing over 3 million observations. In panel data, it is common to obtain very high coefficients of determination, and given the high statistical significance reported for coefficients, ACIL Tasman questioned the R^2 figures.

CIE responded as follows:

> "We have not drawn much attention to the R2 values, apart from to highlight that the regressions do not capture a large share of variation as would be expected given the nature of the statistical exercise and the information available. This reflects that we have few variables to explain the variation across households or businesses in gas use and that use through time for a given household or business is subject to variation from many factors that are not accounted for in our model." (CIE, 2012b)

The response sheds no light on why R^2 for a panel data model could/should be interpreted differently from any other model. CIE's response points to the omitted variable problem as the source of the low R^2. CIE relies on the statistical significance of individual parameters. However, omitted variables lead not only to biased coefficient estimates, but also to biased standard error estimates, making reliance on these results problematic.

Selection of Drivers for Customer Numbers Based on Visual Inspection

CIE's selection of key drivers for customer numbers is based on a visual inspection of correlation between customer numbers and the drivers being inspected. While a visual inspection may be a satisfactory test when the correlation is obviously nil or very low, there is a case for driver selection based on more rigorous tests. ACIL Tasman would prefer to see the selection process supplemented with some key tests, such as the actual correlation coefficient between the variables under consideration. Given a sufficient number of observations, multiple variable regression analysis could also be used to supplement/support the driver selection decision. This was the approach used in the usage per customer sections, which is more rigorous and robust than the approach used for customer numbers.

Central and West New Towns: 2004 Customer Number Forecast not Updated

The customer number forecast for the Central and West New Towns is based on a 2004 SP AusNet forecast covering the period from 2004 to 2025. This forecast was reviewed and accepted at the time by the Essential Services Commission of Victoria (ESCV). However, since 2004 the actual customer numbers have been significantly higher than those proposed in the 2004 forecast. The approach adopted by SP AusNet has been to maintain the end point of the 2004 forecast (in 2025), and to project starting from the current customer numbers so that the gap between the 2004 forecast and the actual figures is gradually extinguished by 2025, when the 2004 and the current forecast converge.

Notwithstanding acceptance by ESCV in 2004 it is arguable, in the light of the divergence between the 2004 forecast and the numbers that eventuated, that the forecast should have been regenerated from first principles. In particular, there is a question whether the end point of the 2004 forecast in 2025 is remains valid. However, the rationale for converging toward the previous 2025 forecast is that customer growth in the "new town" areas is driven not by new dwellings (since these are established residential areas) but by the rate of uptake of customer connections following the network expansion (CIE, 2012, p. 34). In effect what has happened over the current access arrangement period is that the rate of connection uptake has been more rapid than initially anticipated but the number of potential customers (effectively at 100% penetration rate) remains essentially unchanged. In the circumstances we consider that the approach taken is reasonable and that requiring SP AusNet to reconsider the end point of the forecast in 2025 would be unlikely to result in material changes to the forecasts.

Discrete Dependent Variable: Industrial Customers

When estimating the MHQ for SP AusNet's industrial customers, no attempt is made to account for the fact that these are large customers whose individual decisions have a significant impact on demand. By applying growth rates from the Tariff D volume forecast by AEMO (2010), the impact of individual entry, expansion, downsizing or exit decisions is not taken into account. A preferable approach would be to ascertain individual customer plans during the forecast period. If econometric methods are to be used, it is important to note that the industrial customer forecast will deal with lumpy decisions, resulting in discrete dependent variables. In particular, a model designed for count data would result in better estimates and demand forecasts for customer numbers[4]. Likewise, if econometric methods are used to forecast MHQ per customer, they will need to deal with the estimation of upper bounds.

4.2 Summary of Methodology Review

Section 4.1 lays out the key methodological issues identified by ACIL Tasman in the demand forecasts prepared by CIE for SP AusNet. From the discussion above ACIL Tasman concludes that notwithstanding the issues that have been identified, the proposed demand forecast methodology provides a reasonable approach.

ACIL Tasman has identified a number of issues that should be taken into consideration in subsequent forecasts. Issue 1 highlights the absence of dynamics in the estimation, with the consequence that the impact of price changes on the trajectory of demand is not well defined. Issue 2 establishes the presence of endogenous variables among explanatory variables, which may lead to statistical bias in coefficients and forecasts. Issue 3 discusses the absence of accounting for non-linearities in the forecasting methodology. This becomes important when there are large impacts to the explanatory variables. Whilst policy changes are on-going, ACIL Tasman does not envisage substantial and unaccounted for shocks to the drivers of demand. Hence not accounting for non-linearities in demand is not expected to be a fundamental cause for error in the forecast. Issue 4 highlights the potential for omission of variables affecting demand. The consequence of omitting relevant variables is that regression coefficient estimates will be biased, and it is unclear *ex-ante*, whether the bias would be up or down. It would be desirable to include a larger number of explanatory variables in the analysis.

Other identified issues include:

- the low coefficients of determination (R^2) which are reported. Given the robustness of the analysis and the statistical significance of the explanatory variables, ACIL Tasman would expect a much higher R^2.
- the lack of rigour in selection of drivers for customer numbers
- the re-use of an outdated forecast for new towns growth

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[4] As an example, the Poisson regression model is typically used for estimation when the dependent variable takes the form of count data (0,1,2,…). There are various estimation methods which are applicable, with Maximum Likelihood being the most common.

- the lack of attention paid to the potential impact of individual decisions by large industrial customers.

Despite these methodological issues it is not clear that further effort directed to improving the model (in terms of either the range of explanatory variables included or the estimation of demand coefficients) would be warranted or likely to produce a significantly better or more reliable forecast.

After consideration of the above issues, ACIL Tasman concludes that the proposed demand forecast methodology is (like any forecast) imperfect, but that it is sufficiently rigorous overall to satisfy the requirement of rule 74 of the NGR that the forecasts are arrived at on a reasonable basis.

4.3 Weather normalization of historical data

Weather has a significant impact on gas demand. The need to adjust historical data on gas consumption to take account of variations in weather has been noted, for example, by AEMO who in commenting on the Victorian gas distribution system noted that:

> "Understanding the factors that affect the consumption of gas is central in evaluating future energy demands. When temperatures are lower than normal, energy demand for residential heating increases. This strong relationship between gas demand and climate highlights the need to identify the weather conditions assumed when calculating forecast demand. In gas forecasts, the actual demand needs to be adjusted for weather before the underlying growth can be calculated. These weather adjustments can be simplified through the use of Effective Degree Day (EDD) variable." (AEMO, 2009, p. 55)

There are two basic approaches commonly used to adjust temperature data to take account of weather variations: Heating Degree Days (HDD) and EDD.

The HDD approach uses a single measure of weather, namely temperature. HDD is calculated from meteorological data as the sum, over a year, of the negative differences[5] between the average temperature on each day and 18^{o} Celsius.

The EDD approach preferred by AEMO is a multifactor method based on the concept of HDD but also taking into account measures of average wind velocity, sunshine hours and seasonal variations in consumer propensity to use heating. The EDD approach in effect seeks to extend the HDD method by taking into account other weather-related parameters that may affect consumer behavior in relation to gas consumption for space heating and water heating.

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[5] If the average temperature on a particular day is greater than or equal to 18^{o}C, then HDD for that day is zero.

4.3.1 Approach used

The approach to weather normalisation used by CIE is described in Appendix C of the CIE Report (CIE, 2012).

CIE has normalised data using annual effective degree days. As a cross-check, they have also checked system daily consumption against daily weather and tested the validity of the AEMO preferred effective degree day measure.

Based on ordinary least squares regression of consumption against effective degree days and not allowing for a time trend, CIE concludes that 1 EDD increases consumption by about 14TJ across all SP AusNet's customers, which is equivalent to 6.7 per cent of average daily consumption. The effect is strongest for small (Tariff V) customers, for which each 1EDD increases demand by 11.7%. CIE found a much weaker relationship between effective degree days and consumption for Tariff D customers, with each 1EDD increasing demand by 1.8%.

For the residential demand forecasts, CIE adjusted 2010 per dwelling consumption for each Tariff Zone and each usage block to reflect 'typical' climatic conditions. CIE notes in its report that typical climatic conditions are modelled using annual effective degree day measures from CSIRO projected forward with a continued decline in EDDs (SP AusNet, 2012, p. 79).

Similarly for the commercial demand forecasts, CIE adjusted 2011 consumption to reflect expected climatic conditions. Typical climatic conditions are modelled using annual effective degree day measures which include a projected continued decline in EDDs.(SP AusNet, 2012, p. 86).

The CSIRO analysis that underpins these trends is set out in Appendix 4B and Appendix 4C of the SP AusNet access arrangement submission (Suppiah & Whetton, 2012a),(Suppiah & Whetton, 2012b).

The key issue arising from this analysis is the assumption regarding 'normal' weather between 2005 and the present. This is discussed in the next section.

4.3.1 Normal weather – the choice of EDD inputs

The analysis conducted by CSIRO analysis shows that historical weather data for Victoria exhibits a warming trend (and a corresponding upward trend in the number of EDDs) over approximately the last 60 years. According to CSIRO this historical trend has been largely due to the Urban Heat Island (UHI) effect.[6]

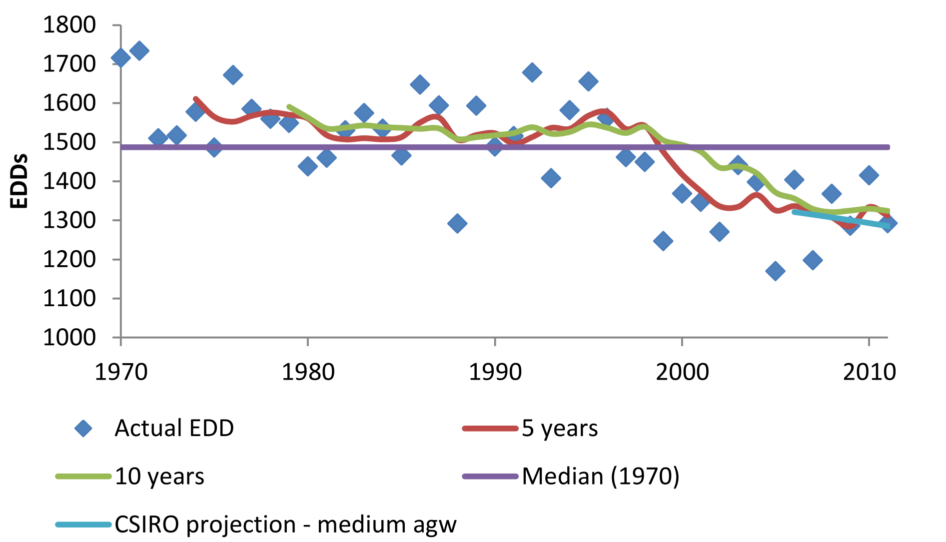
[6] In very simple terms the UHI effect is the result of increased 'urbanisation' and thus increased numbers of buildings and other man-made structures in urban areas. Those

SP AusNet and CIE have accounted for this trend by using CSIRO's medium anthropogenic global warming projection, which was prepared in 2007. In effect, they have assumed that this projection reflects "normal" or 50 per cent probability of exceedence weather conditions between 2005 and 2010.

In our experience it is unusual to use a projection as the basis for weather normalising historical data. It is not clear from CSIRO's report that CSIRO intended its projections to be used this way or that this is an appropriate use for them. A more usual approach would be to base an assumption about normal weather conditions on historical data.

AEMO has published actual EDD data for the period from 1 January 1970 to 31 December 2011. Those data are plotted in Figure 1 along with the median and five and ten year rolling averages. The CSIRO's medium agw projection is shown for comparison.

Figure 1 **EDDs in Victoria 2000 to 2011**



Data source: AEMO

Figure 1 shows that the number of EDDs observed each year has clearly declined over the period since 1970. It also suggests that weather conditions in the last decade were warmer than either of the decades beforehand (that is, fewer EDD's were observed). It is evident that average EDD declined sharply through the late 1990s to mid 2000s (a period during which severe drought conditions were experienced in south-eastern Australia). The moving averages suggest that the rate of EDD decline may have eased over the past five years.

structures themselves radiate heat thus preventing minimum temperatures from being as low as they may otherwise have been.

By using CSIRO's medium agw projection for weather normalisation we consider that SP AusNet may have understated the "normal" number of EDDs in recent history. To the extent that it has done this, it would have "over corrected" gas demand in a downward direction. As shown in Figure 2, the rate of decline of EDDs over the past decade appears to have been slower than CSIRO projected in 2007. In addition to CSIRO's medium agw projection, Figure 2 shows two linear regression lines projected through the historical EDD data and CSIRO's two more moderate projections.[7] The two regressions were estimated the same way, but differed in their starting year. One regression line is fitted to all EDD data since 1970, while the other is fitted to data since 2000.

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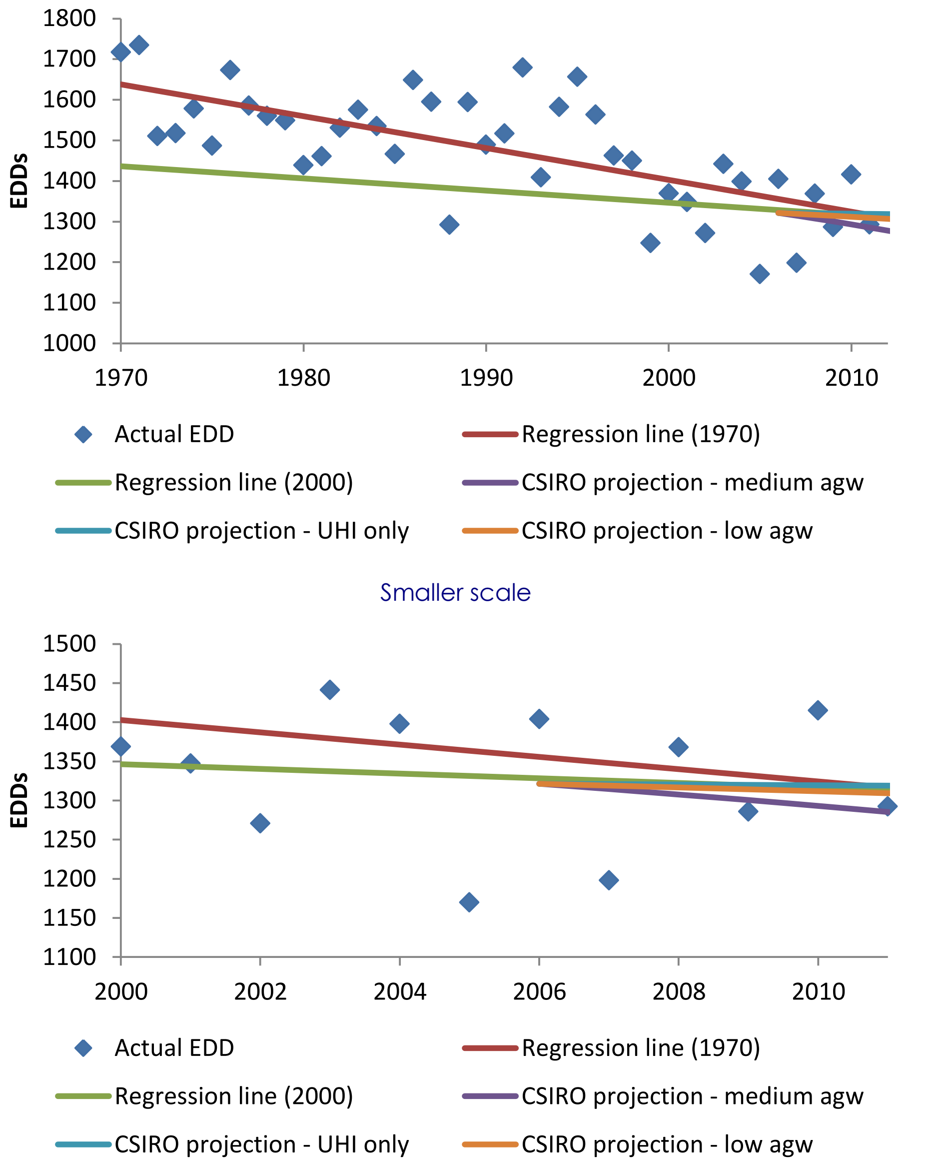
7 Given our view that the medium agw projection appears to understate the number of EDDs, CSIRO's high agw projection, which projects even fewer EDDs, is omitted.

Figure 2 **Alternate projections of EDDs in Victoria**



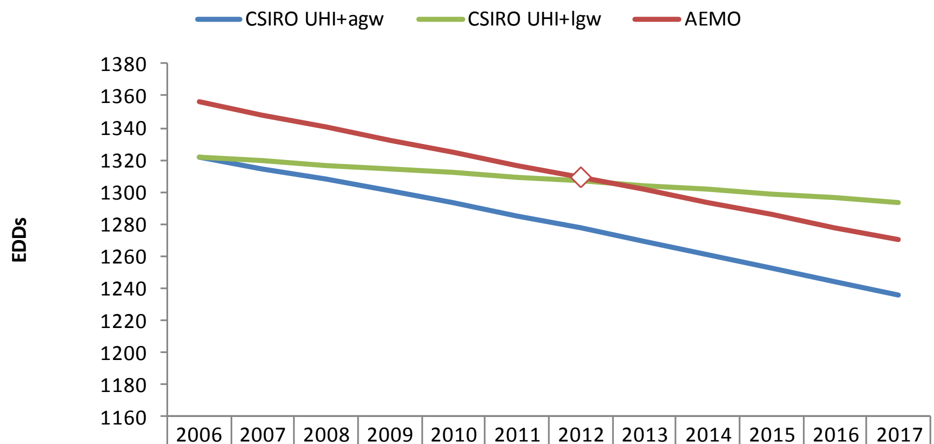
Data source: AEMO

The two panes of Figure 2 show the same data, with the lower pane showing higher resolution (data only from 2000 onwards).

Figure 2 suggests that the warming trend has not been as great in recent years as projected in CSIRO's medium agw projection. The regression line (2000) shown in Figure 2 lies close to CSIRO's low agw and UHI only projections which are close to one another.

AEMO has recently released a review of Victorian EDD as part of its weather standards for gas forecasting. (AEMO, 2012). That study concluded that, based on Melbourne EDD data for the period 1970 to 2011, the trend-projected annual EDD standard for calendar year 2012 is 1309 – some 31 EDD higher than the value based on the CSIRO UHI plus medium agw projection and similar to the current value based on the CSIRO UHI plus low agw projection (see Figure 3). The rate of decline in EDDs since 1970 observed by AEMO has been close to that in CSIRO's medium agw projection at around 7.8 EDD/year. The difference between the two lines is that CSIRO's projection appears to 'start from a lower base'.

Figure 3 **Comparison of CSIRO EDD projections with AEMO EDD trended values**



	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
CSIRO UHI+agw	1321	1315	1308	1301	1293	1285	1278	1270	1261	1253	1244	1235
CSIRO UHI+lgw	1321	1319	1317	1314	1312	1309	1307	1304	1302	1299	1296	1294
AEMO	1356	1348	1340	1332	1325	1317	1309	1301	1293	1286	1278	1270

Data source: (AEMO, 2012), (Suppiah & Whetton, 2012b)

The effect of using the lower EDD trend based on the CSIRO forecast is to make the demand forecasts lower, on average, for each year of the regulatory period than they would have been if the AEMO regression line was used as the basis of weather normalisation.

We consider that it would be more appropriate for SP AusNet to weather normalise the historical data on the basis of the AEMO EDD standard which is based on actual temperature outcomes for the period 1970 to 2011, rather than the CSIRO forecast which represents modelled temperature outcomes based on data for the period 1970 to 2005 (Suppiah & Whetton, 2012a, p. 23).

4.4 Gas price assumptions

CIE has estimated changes in the retail price of gas taking into account:

- changes in the wholesale gas price without a carbon tax, multiplied by the share of wholesale gas prices in retail prices
- changes in the retail price of gas attributable to the carbon tax

- changes in the price level for distribution tariffs multiplied by the share of distribution tariffs in retail prices.

Specifically, CIE has used estimates of Victorian wholesale gas prices based on spot prices in the Victorian market (data compiled by AEMO); changes wholesale gas prices, excluding carbon tax effects and impacts of carbon tax on gas prices, prepared by Australian Treasury ((Treasury, 2011) Chart B6 and Table 5.19 respectively). CIE has also included a gas price adjustment to reflect anticipated changes in distribution price from 2013. CIE further assumes that the wholesale price of gas comprises 23% of the final delivered price of gas to households, and 32% for businesses. Similarly, CIE assumes that gas distribution costs comprise 29% of the final price of gas for households and 13% for businesses.

In Appendix E, CIE sets out further analysis and commentary on current and future wholesale gas prices, noting that “there is the potential for much sharper rises in wholesale prices than factored into our forecasts”. This conclusion is based on the supposed potential for wholesale gas prices in Eastern Australia to move to levels reflecting LNG export parity, which in turn points to recent experience of high gas prices in Western Australia.

ACIL Tasman would argue that the high gas prices that have prevailed in Western Australia for the past five years or so are related to fundamental supply/demand considerations rather than any automatic “flow through” of LNG netback prices: low wholesale gas prices prevailed in Western Australia for some 20 years notwithstanding linkages to LNG markets. Nevertheless we would agree that the large export LNG projects in central Queensland have the potential to influence gas prices throughout Eastern Australia. Other factors will also come into play, including: the extent of gas supply from CSG and other unconventional sources (tight gas, shale gas) in Queensland, NSW and central Australia; exploration outcomes in conventional supply areas such as the Gippsland and Otway Basins; levels of supply side competition; and the level of gas demand for power generation which is being impacted by penetration of renewable generation sources.

CIE in Appendix E also, in our view quite properly, notes that there are a number of factors which may mitigate upward pressure on wholesale gas prices.

Clearly there are a range of factors that could affect future wholesale gas prices. In the context of this review, the question is whether the assumptions made by CIE with regard to wholesale gas prices for the purposes of modeling future gas demand are reasonable. Having reviewed the CIE assumptions and their sources, and based on our knowledge of Australian wholesale gas markets, ACIL Tasman considers that the assumptions adopted by CIE regarding changes in wholesale and retail gas prices are reasonable and that they are based on reputable independent sources.

We note that the CIE demand forecasts have been prepared taking into account these assumed increases in wholesale and retail gas price, as well as the assumptions regarding own-price elasticity of demand discussed in section 5.2.4.

5 Assessment of the forecasts

In this chapter we review the revised forecasts for SP AusNet, to consider whether the application of the methodologies and assumptions used by CIE has produced forecast results that are reasonable in light of historical patterns of demand as well as current and anticipated influences on retail gas demand in the distribution area. We consider separately the forecasts for the Volume and Demand sectors of the market.

5.1 Use of trend extrapolation for forecast verification

In the following analysis we have used historical trend analysis as a cross-check on the results generated using the CIE methodology. ACIL Tasman recognises that forecasting on the basis of extrapolation of historical trends involves a risk of overlooking changes in market drivers that could result in future trends differing from historical trends. The fact that a forecast diverges from the historical trend cannot in itself be taken as proof that the forecast is unreasonable. Rather, such divergence may prompt us to ask whether there are good reasons for the break in trend.

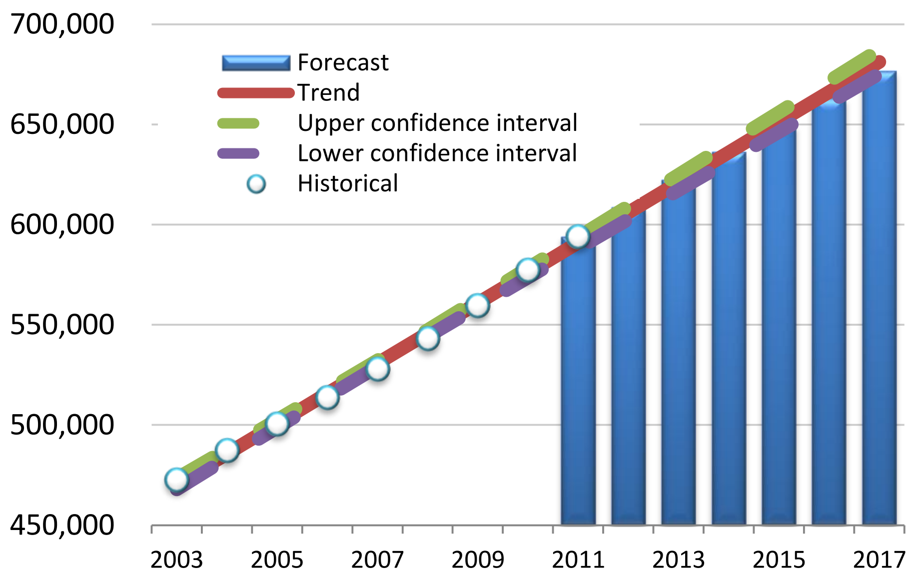
Note that the scale of the Y axis in the following charts has been chosen to allow the relationships between forecasts, historical trends and confidence intervals to be seen clearly. This has the effect of exaggerating the apparent extent of deviations from historical trends, when in fact the changes may be much less pronounced when viewed in absolute terms. Care should therefore be exercised in interpreting the charts.

5.2 Tariff V Customer forecasts

5.2.1 Tariff V customer numbers

The forecast of total customer numbers for the Tariff V customer sector is summarised and compared with historical actual customer numbers in Figure 4. Forecast growth in customer numbers is slightly lower than the historical trend rate, which was generated using an Ordinary Least Squares (OLS) regression on actual customer numbers from 2003 to 2011. By 2017 the forecast is around 4,000 or 0.06% lower than the historical trend.

Figure 4 **Historical and forecast customer numbers—Tariff V Total**



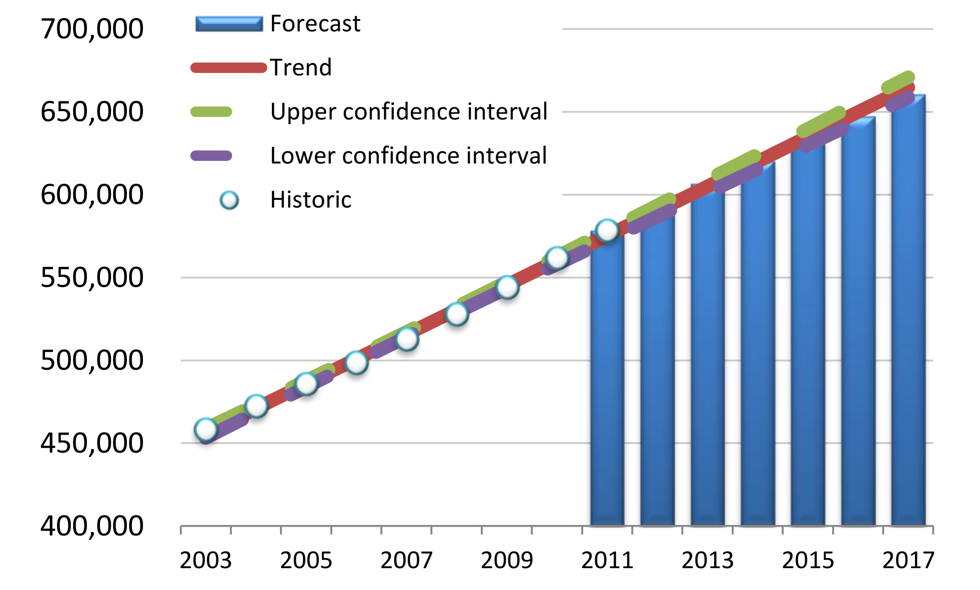
Data source: (NIEIR, 2007c), (CIE, 2012), ACIL Tasman analysis

Figure 5 shows the corresponding data and forecast trends for residential customer numbers as a subset of the Tariff V customer class. As might be expected given the high proportion of residential customers in the total Tariff V customer base, the residential customer forecast show a similar pattern to total Tariff V.

CIE notes that a greater than expected historical population growth rate in Victoria from 2006-2011 was responsible for the VDP's projections understating the number of new dwellings in recent years (CIE, 2012, pp. 95-96). Projected population growth rates have converged towards the realized rates in recent years. Taking into account the lagged impact of population on dwelling construction, CIE expects the VDP's projections to provide a sensible account of future dwelling constructions and thus, residential customer connections.

Looking at the results relative to the historic trend and noting the CIE's examination of the underlying components of the VDP's dwellings projections, the forecast customer numbers for residential Tariff V do not appear to be unreasonable.

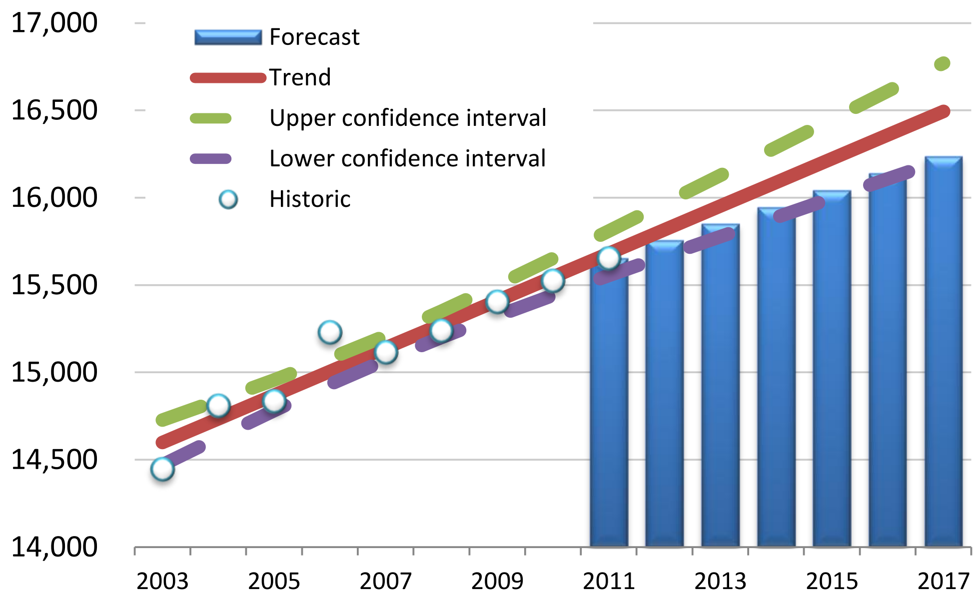
Figure 5 **Historical and forecast customer numbers— Tariff V residential**



Data source: (NIEIR, 2007c), (CIE, 2012), ACIL Tasman analysis

Figure 6 shows the corresponding results for the non-residential (commercial and industrial) Tariff V customers.

Figure 6 **Historical and forecast customer numbers—Commercial & Industrial Tariff V**



Data source: (NIEIR, 2007c), (CIE, 2012), ACIL Tasman analysis

CIE's forecast falls well below the historical trend as a result of their method of estimation of the relationship between residential customer connections and commercial/industrial connections. CIE notes an apparent decline in the ratio of new commercial customers to new residential customers in recent years, noting that:

> "The number of new commercial customers for an additional 1000 residential customers averages 11.4 for 2003 to 2011. For 2005 to 2011, each 1000 additional residential customer resulted in an additional 6.5 commercial customers. Given the potentially different policies that appear to have resulted in a higher growth rate in commercial customer numbers in earlier years, it is more appropriate to consider the relationship between residential and commercial numbers from 2005 to 2011." ((CIE, 2012, p. 40) as subsequently corrected in response to AER request for clarification)

CIE does not identify any specific policies which might explain the marked slow-down. The exclusion of the data for 2003 and 2004 appears to be arbitrary.

ACIL Tasman considers that, unless convincing evidence can be provided of policy changes or other factors that would support the exclusion of this data, SP AusNet should be required to amend the commercial customer numbers forecast to take account of the full data series from 2003 to 2011.

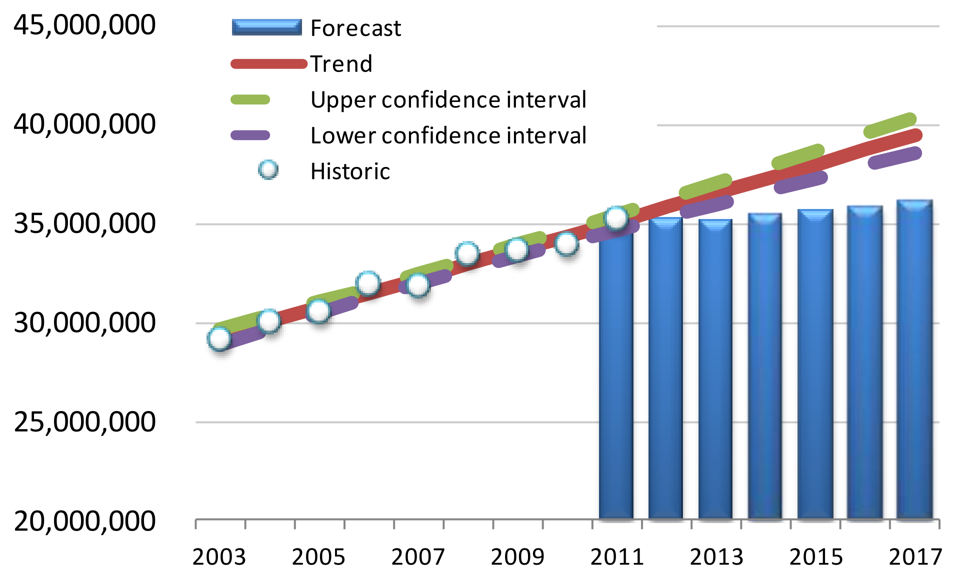
5.2.2 Tariff V gas demand

The forecast of gas demand for the Tariff V Customer sector in total is summarised and compared with weather normalised historical data in Figure 7. The corresponding comparisons for the Tariff V Residential and Tariff V Business (Commercial and Industrial) customer groups are shown in Figure 8 and Figure 9 respectively.

The CIE projections for both growth rate and absolute levels of gas demand for Tariff V customers, both residential and non-residential, are well below historical trends.

Total projected Tariff V demand is approximately 3.5 PJ or 9.0% below the historical trend by 2017, and around 2.6 PJ or 6.6% below the level of demand implied by the estimated lower confidence interval of the historical trend. The compound annual growth rate (CAGR) of the CIE forecast is approximately 0.4%, while the CAGR of the estimated trend for the forecast period is approximately 1.9%.

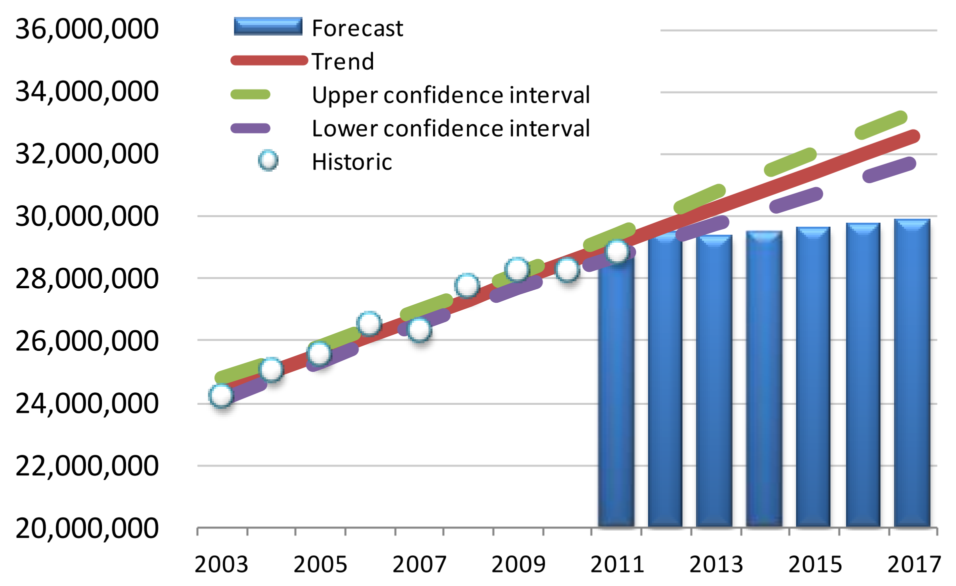
Figure 7 **Forecast consumption compared to weather-adjusted historical trend—Tariff V TOTAL (consumption in GJ)**



Data source: (NIEIR, 2007c), (CIE, 2012), ACIL Tasman analysis

Figure 8 shows the corresponding data and forecast trends for residential customer demand as a subset of the Tariff V customer class.

Figure 8 **Forecast consumption compared to weather-adjusted historical trend—Tariff V Residential customers (consumption in GJ)**



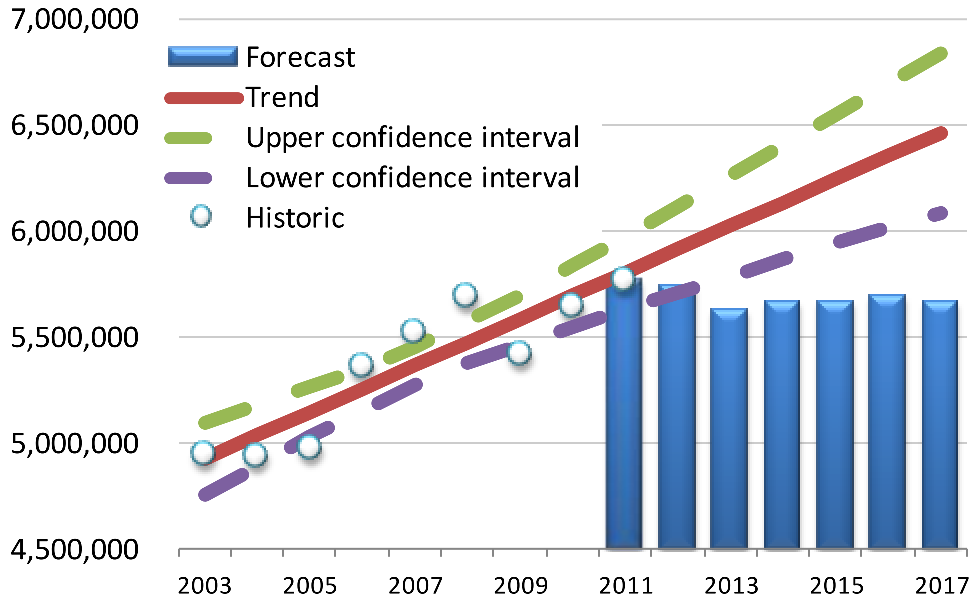
Data source: (NIEIR, 2007c), (CIE, 2012), ACIL Tasman analysis

Projected Tariff V Residential demand is approximately 2.7 PJ or 9.0% below the historical trend by 2017, and around 1.9 PJ or 6.3% below the level of demand implied by the estimated lower confidence interval of the historical trend. The compound annual growth rate (CAGR) of the CIE forecast for residential demand is approximately 0.6%, while the CAGR of the estimated trend for the forecast period is approximately 1.9%.

Figure 9 shows the corresponding data and forecast trends for non-residential (commercial) customer demand as a subset of the Tariff V customer class.

Projected Tariff V Non-residential demand is approximately 0.8 PJ or 14.1% below the historical trend by 2017, and around 0.4 PJ or 7.5% below the level of demand implied by the estimated lower confidence interval of the historical trend. CIE is forecasting commercial demand to contract at compound annual growth rate (CAGR) of **minus 0.3%** over the forecast period, while the CAGR of the estimated trend for the forecast period is approximately 1.8%.

Figure 9 **Forecast consumption compared to weather-adjusted historical trend—Tariff V Non-residential (commercial) customers (consumption in GJ)**



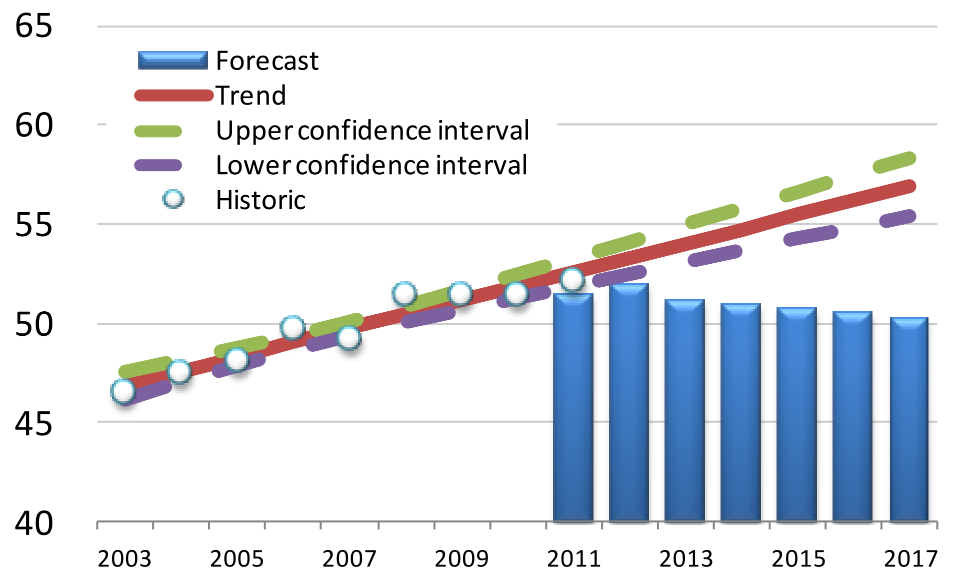
Data source: (NIEIR, 2007c), (CIE, 2012), ACIL Tasman analysis

5.2.3 Tariff V forecast average consumption

Assumptions regarding average gas consumption per customer for the Tariff V sector are critically important to the overall demand forecasts because the process of generating the usage forecasts involves applying average gas consumption rates to the projected customer numbers in each demand segment. In this analysis we have calculated the implied average gas consumption per customer in the Tariff V sector by dividing historical and forecast gas usage (weather normalised) by the number of customers in the relevant class.

The gas use per customer for the Tariff V group as a whole (that is residential AND commercial/small industrial customers) is shown in Figure 10.

Figure 10 **Actual vs forecast average gas consumption per customer, after weather normalisation—Tariff V TOTAL (consumption in GJ)**

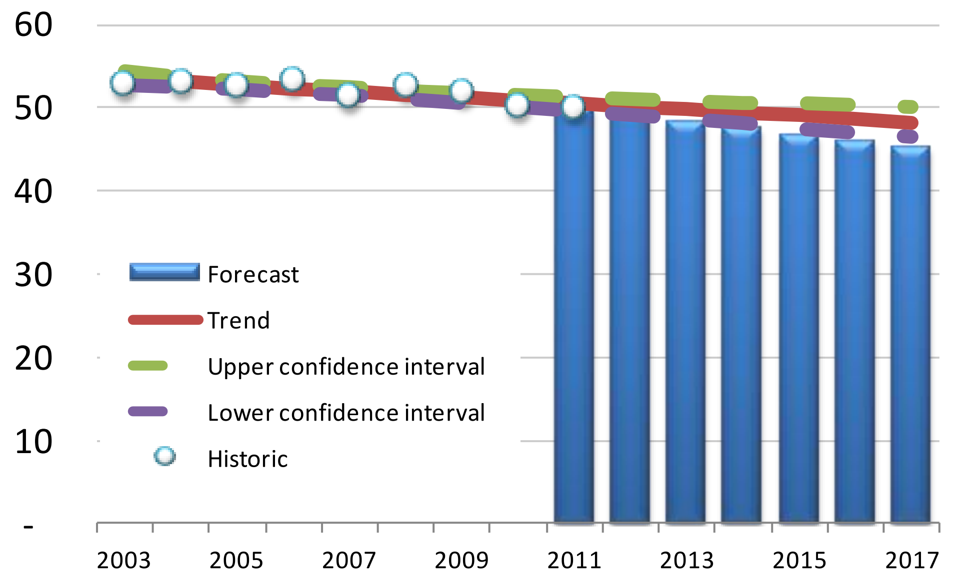


Data source: (NIEIR, 2007c), (CIE, 2012), ACIL Tasman analysis

The forecast shows a very clear break in trend, with average use per customer rising at a compound average rate of 1.45% over the period 2003 to 2011, but forecast to fall at an average rate of –0.39% over the forthcoming access arrangement period.

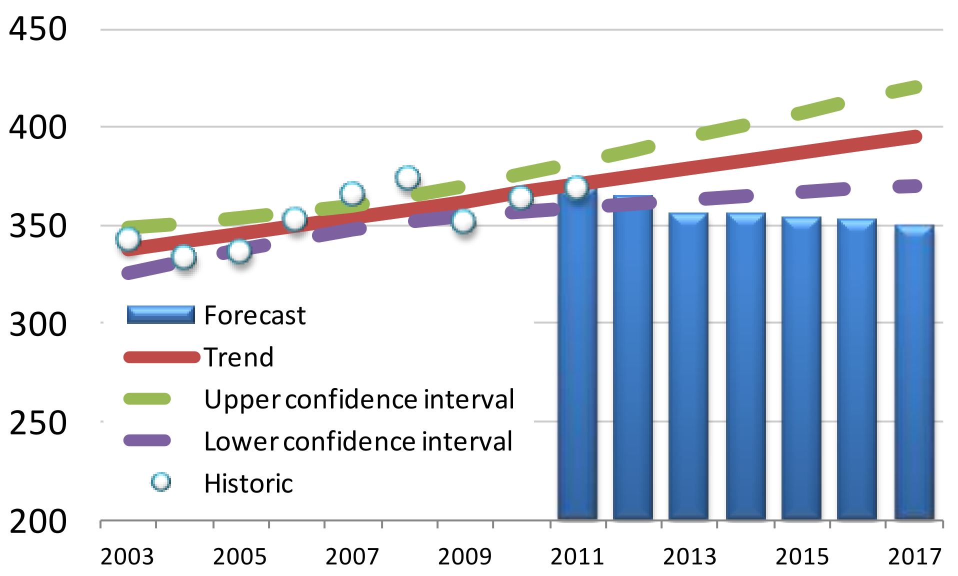
In order to assess the reasonableness of this forecast, it is necessary to examine separately the corresponding trends for average consumption in the residential and non-residential customer groups. The corresponding comparisons for the Tariff V Residential and Tariff V Non-residential customer groups are shown in Figure 11 and Figure 12 respectively.

Figure 11 **Actual vs forecast average gas consumption per customer, after weather normalisation—Tariff V Residential (consumption in GJ)**



Data source: (NIEIR, 2007c), (CIE, 2012), ACIL Tasman analysis

Figure 12 **Actual vs forecast average gas consumption per customer, after weather normalisation—Tariff V Commercial (consumption in GJ)**



Data source: (NIEIR, 2007c), (CIE, 2012), ACIL Tasman analysis

The weather adjusted historical data confirms that average use per customer in the residential customer group has been declining fairly steadily over the period 2003 to 2011, from around 53 GJ/a/customer to about 50 GJ/a/customer, a compound average decline rate of –0.7%. The forecast would see the average use per residential customer decline from 50 GJ/a/customer to 45 GJ/a/customer, a compound average decline rate of –1.6%.

On the other hand, the historical data shows that average use per customer in the non-residential (commercial) customer group has risen (somewhat irregularly) over the period 2003 to 2011, from around 340 GJ/a/customer to about 370 GJ/a/customer, a compound average growth rate of about 1.8%. However, the forecast would see a reversal of that trend, with the average use per non-residential customer declining from 370 GJ/a/customer to less than 350 GJ/a/customer, a compound average decline rate of –0.9%.

5.2.4 Assessment of the Tariff V demand forecasts

The total Tariff V demand forecasts show very significant breaks in trend, both in terms of aggregate demand and average demand per customer. In order to assess whether these are reasonable expectations in the light of recent market and policy developments, it is necessary to consider separately the residential and non-residential components of the forecast.

As noted in section 5.2.1, the forecast customer numbers for the Tariff V Residential customer group, while showing slower growth than in the past, do not appear to be unreasonable. The forecasts imply an increase in the rate of decline of average consumption per residential customer from around –0.7% per year historically (over the period 2003 to 2011) to –1.6% per year over the forecast period. This accelerating rate of decline in average use can be explained by policy changes—in particular the recent adoption of the 6-star building standard which will significantly reduce energy consumption in new dwellings—and by expected increases in wholesale gas prices resulting from a combination of carbon price pass through, increased gas demand for electricity generation, and impacts of large-scale LNG exports. CIE and SP AusNet have explicitly included these price effects in the demand forecasts (see section 4.1.2). We therefore consider that, notwithstanding the shift below historical trend illustrated in Figure 8, the gas demand forecast for Tariff V Residential customers is not unreasonable, subject to adjustment to reflect the AEMO EDD standard as discussed in section 4.3.1.

For the Tariff V Non-residential customer group, we have already noted in section 5.2.1 that the forecast of customer number is likely to be depressed as a result of using an assumed relationship between the numbers of residential and non-residential customers that arbitrarily excludes some historical data from the trend analysis. The sharp break in trend for Non-residential Tariff V consumption shown in Figure 9 appears to reflect a combination of low assumed growth in the number of commercial customers (relative to historical rates) and a reversal of trend in average gas use per customer as shown in Figure 12.

In combination, these factors result in a forecast of Non-residential Tariff V gas demand that is not intuitively reasonable and does not appear to be justified on the basis of recent policy changes.

The reversal of trend appears to be driven, at least in part, by the estimated value of price elasticity of demand used by CIE in preparing the forecasts. For commercial customers, CIE has estimated a price elasticity of demand of –0.77. This is more than double the estimates of price elasticity that have been previously approved by the AER (-0.30 for Residential and -0.35 for Commercial/Industrial demands in the case of the South Australian gas distribution system); it is much higher than other distribution businesses have proposed in the current Victorian gas access arrangement review[8], and it is much higher than published estimates in the literature, a selection of which are shown in Table 7.

Table 7 **Comparison of price elasticity of demand for gas and electricity**

	Estimated price elasticity of demand	
Study	Gas	Electricity
Dale et al (2009)	-0.111	-0.285
Bernstein and Griffin(2006)[a]	-0.12	-0.24
Bohi and Zimmerman (1984)	-0.2	-0.25
Alberini et al (2010)	-0.566 to -0.693	-0.667 to -0.860

a This paper includes estimates of price elasticity of demand for both short and long run and for different levels of geographic aggregation. These are the short run residential elasticity estimates for the national level (USA).

The high elasticity estimate may lead to the forecast of gas consumption by the Tariff V Non-residential customer group being too low. On the other hand it can be argued that there is little direct evidence of own price elasticity of gas in the Victorian market and that the estimates made by CIE are the best available given that a statistically significant relationship has been demonstrated.

5.3 Tariff D customer forecasts

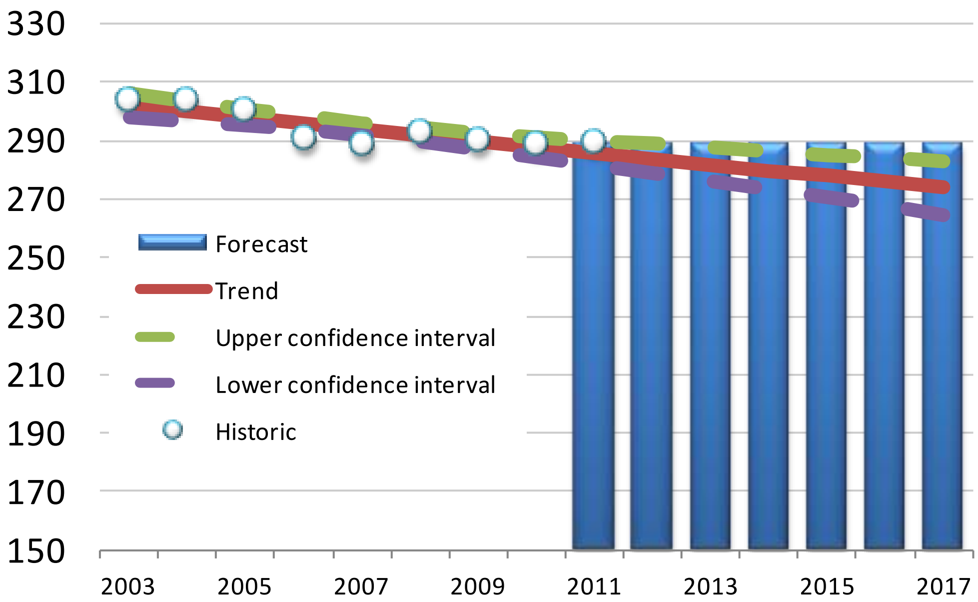
5.3.1 Tariff D customer numbers

The Tariff D customer class represents large gas users (>10TJ/year), and includes both commercial and industrial gas users.

Figure 13 shows the actual and forecast customer numbers for the Tariff D Commercial customer class for the SP AusNet network.

8 CORE Energy estimated an own-price elasticity of demand of –0.27 but adopted a value of 0.30, in line with the decision in (AER, 2011). Multinet adopted an own-price elasticity of –0.28

Figure 13 **Actual and forecast Tariff D customer numbers**



Data source: (NIEIR, 2007c), (CIE, 2012), (SP AusNet, 2012b), ACIL Tasman analysis

SP AusNet has forecast that the number of Tariff D customers will remain steady at 289 throughout the forecast period. As shown in Figure 13, Tariff D customer numbers have declined from 304 in 2003 to 289 in 2011. In light of the historical trend, the assumption of stable customer numbers throughout the forecast period to 2017 is conservative and may prove to be optimistic.

5.3.2 MHQ forecasts for Tariff D customers

Relationship between MHQ and gas demand

While it is important to consider the volume forecasts for Tariff D customers, it is the forecasts of Maximum Hourly Quantity (MHQ) bookings that are critical in terms of implications for tariff setting. This is because the charges for Demand Customers are calculated on the basis of the system capacity (MHQ) used, rather than the physical quantity of gas delivered.

The relationship between gas demand and MHQ is complex. The ratio of average daily throughput to peak daily throughput (that is, the "load factor") varies widely from customer to customer. MHQ is directly related to peak daily requirements, rather than average daily requirements.

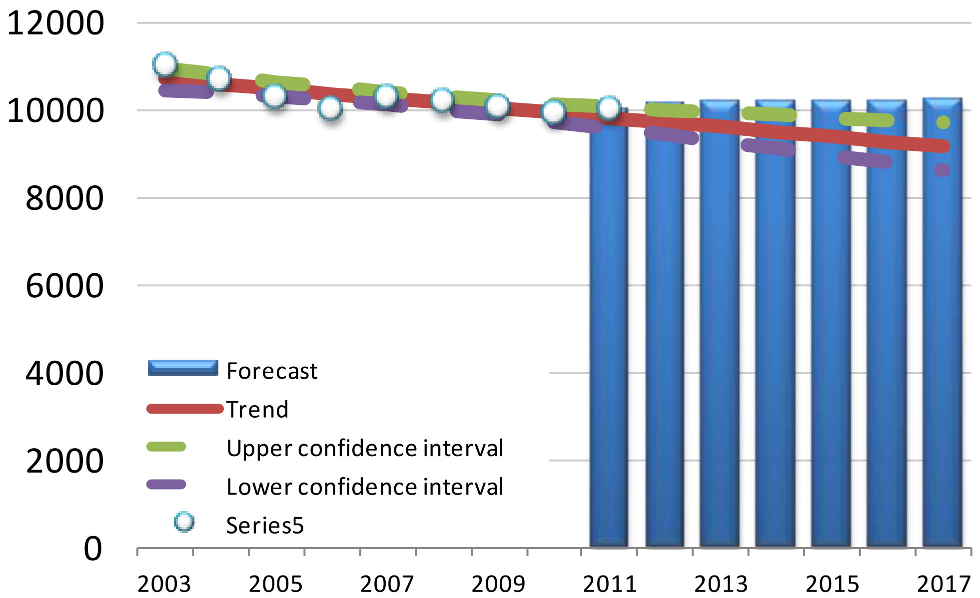
Hence the loss or gain of a demand customer has an impact on aggregate system MHQ requirements that is not necessarily proportional to the corresponding impact on total gas demand. A very low load factor customer such as a peaking electricity generator may have a large MHQ requirement, but may consume only a small quantity of gas over the course of a year.

The impact of changes in MHQ is further complicated by the fact that capacity is not uniform throughout the pipeline network. Hence the cost impact of adding or subtracting a customer with a given MHQ requirement may vary depending on where that requirement is located within the system.

MHQ history and forecast

Historical and forecast MHQ for the Tariff D customer group is shown in Figure 14.

Figure 14 **Tariff D Customer Maximum Hourly Quantity (MHQ) in GJ/hour**



Data source: (NIEIR, 2007c), (CIE, 2012), (SP AusNet, 2012b), ACIL Tasman analysis

SP AusNet has forecast that Tariff D MHQ will remain relatively steady at around 10,200 GJ/hr throughout the forecast period. As shown in Figure 14, Tariff D MHQ has declined from about11,000 GJ/hour in 2003 to about 10,000 GJ/hour in 2011. In light of the historical trend, the assumption of stable MHQ throughout the forecast period to 2017 is conservative and may prove to be optimistic.

6 Conclusions

Having examined the forecasts of Tariff V Residential customer numbers, we conclude that those forecasts do not appear to be unreasonable, although there is a need to take into account updated estimates by DPCD of population growth rates relevant to the SP AusNet distribution area.

CIE's Tariff V Non-residential customer number forecasts fall well below the historical trend as a result of their method of estimation of the relationship between residential customer connections and commercial/industrial connections. CIE does not identify any specific policies which might explain the marked slow-down. The exclusion of the data for 2003 and 2004 appears to be arbitrary.

ACIL Tasman considers that, unless convincing evidence can be provided of policy changes or other factors that would support the exclusion of this data, SP AusNet should be required to amend the commercial customer numbers forecast to take account of the full data series from 2003 to 2011.

The CIE projections for both growth rate and absolute levels of gas demand for Tariff V customers, both residential and non-residential, are well below historical trends. The total Tariff V demand forecasts show very significant breaks in trend, both in terms of aggregate demand and average demand per customer. In order to assess whether these are reasonable expectations in the light of recent market and policy developments, we have considered separately the residential and non-residential components of the forecast.

The forecast customer numbers for the Tariff V Residential customer group, while showing slower growth than in the past, do not appear to be unreasonable, subject to adjustment for use of the AEMO weather standard. The forecasts imply an accelerating rate of decline in average use which can be explained by policy changes—in particular the recent adoption of the 6-star building standard—and by expected increases in wholesale gas prices.

For the Tariff V Non-residential customer group, a sharp break in trend appears to reflect a combination of low assumed growth in the number of commercial customers (relative to historical rates) and a largely unexplained reversal of trend in average gas use per customer. In combination, these factors result in a forecast of Non-residential Tariff V gas demand that is not intuitively reasonable and cannot be justified on the basis of recent policy changes.

The reversal of trend appears to be driven, at least in part, by the estimated value of price elasticity of demand used by CIE in preparing the forecasts which, at –0.77, is more than double the estimates of price elasticity that have been previously approved by the AER in the case of the South Australian gas distribution system). It is also much higher than other distribution businesses have proposed in the current Victorian gas access arrangement review, and is much higher than published estimates in the literature. The high elasticity estimate may lead to the forecast of gas consumption by the Tariff V Non-residential customer group being too low. On the other hand it can be argued that there is little direct evidence of own price elasticity of gas in the Victorian market and that the estimates made by CIE are the best available given that a statistically significant relationship has been demonstrated.

With regard to Tariff D customer numbers and Maximum Hourly Quantity (MHQ) forecasts, we conclude that the assumptions of stable customer numbers and MHQ throughout the forecast period to 2017 are conservative and may prove to be optimistic.

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A Curriculums Vitae

Following are brief curriculums vitae for the consulting team involved in the preparation of this report

Paul Balfe

Paul Balfe is an Executive Director of ACIL Tasman and has overall responsibility for ACIL Tasman's gas business. Paul has more than 30 years experience in the energy and resources sectors. Previously he held a number of senior executive positions in the Queensland Department of Minerals and Energy. He has a Masters in Business Administration and a degree in Science.

Paul is responsible for the development and commercialisation of ACIL Tasman's *GasMark* model and its application to strategic and policy analysis throughout Australia, New Zealand and in South East Asia. He provides a range of analytical and advisory services to companies, government agencies and industry associations, particularly in the gas, electricity and resources sector. He has expertise in gas, electricity, resources, mining, economic impact analysis and in the analysis of CIE risk management, safety and health.

He has advised government and corporate sector clients on matters relating to the coal, oil and gas industries, coal seam gas, oil shale, mining safety and health, environmental management and alternative and renewable energies. With qualifications in geology and business administration, his experience ranges across both technical and commercial aspects of project evaluation and development.

Paul has worked extensively on gas industry matters, particularly gas policy reform issues; gas market analysis; gas pipeline developments, acquisitions and disposals; and gas project commercial analysis. He has worked extensively in the Queensland coal seam gas industry as an adviser to both government and corporate sector clients on regulatory, technical, economic and commercial aspects of CSG development.

Joel Etchells

Joel Etchells is a Consultant in ACIL Tasman's Brisbane office. Prior to joining ACIL Tasman Joel was employed by the Federal Treasury as a member of the International and Model Development Unit, within the Macroeconomic Modelling Division. In this role he was required to produce and analyse economic modelling results, including results from a variety of models. Joel used CGE models to forecast the impact of alternative climate change mitigation policies on the Australian economy and its major trading partners.

This involved examining the broad macroeconomic impacts of proposed polices, through to sector specific analysis within a CGE framework.

Since joining ACIL Tasman, Joel has used CGE modelling techniques to analyse the economic impact of variety of infrastructure/capital investments and economic policies; ranging from large natural resource development projects, through to an analysis of the impact of geospatial information for the Tasmanian economy. This work involved formulating and subsequently simulating economic shocks associated with a particular scenario as well as the qualitative analysis of the model output. He has also worked on gas access regulation in Victoria.

Joel has an Honours degree in economics from the University of Queensland and is currently completing a Bachelor of Applied Mathematics at the Queensland University of Technology. His honours year encompassed 12 months of postgraduate coursework and research with a major in econometrics, equipping him with the requisite skills to undertake a wide range of economic analysis.

Jeremy Tustin

Jeremy Tustin is a senior consultant in ACIL Tasman's Melbourne office. He has a degree in Economics from the University of Adelaide. His background is in economic regulation, in particular in the energy and water sectors, and competition and consumer protection.

Jeremy's energy background includes significant experience in greenhouse and renewable policy. He represented South Australia on the National Emissions Trading Taskforce, which was the joint taskforce of Australian States and Territories that was first to propose a cap and trade emissions trading system for Australia. In this area, Jeremy and his team developed and interpreted models of the impact an emissions trading scheme would have on South Australia and in developing a mechanism for offsets. Jeremy was also closely involved with the development of South Australia's solar feed-in law.

In relation to energy efficiency, Jeremy developed a reporting methodology for the South Australian Government's target to improve the energy efficiency of its buildings. He also coordinated interdepartmental activity in relation to that target, developed strategies to achieve it and prepared public reports on progress.

In his role with the Department of Treasury and Finance (SA), Jeremy advised the Treasurer on water policy, both rural and urban. He worked with the Office for Water Security to prepare Water for Good, South Australia's water security plan. In particular, Jeremy worked on the early stages of the design of the future economic regulatory regime for the South Australian urban water sector. This included the decision to assign the regulator's role to the Commission. He also worked on a cost benefit analysis of a number of possible means of meeting South Australia's urban water demand.

Jeremy recently conducted (with others) the following projects:

- A review of the electricity sales, customer numbers and maximum demand forecasts submitted by the five Victorian electricity distribution businesses to the AER for the upcoming regulatory period (2011 to 2016).
- A review of the demand forecasts submitted to the Essential Services Commission of South Australia by SA Water
- A review of certain principles underpinning the Essential Services Commission of South Australia's upcoming determination of the standing contract price for gas in South Australia

Dr Leo Yanes

Leo Yanes is a Senior Consultant in ACIL Tasman's Brisbane Office. Dr Yanes has a strong background in quantitative economics, with an emphasis on econometrics, planning, valuation (discounted cash flows, cost-benefit analysis), quantitative risk analysis (Monte Carlo simulation, real options), and general equilibrium analysis.

Dr Yanes' modelling expertise encompasses supply chain modelling (including consolidated valuation using discounted cash flows, tax modelling and quantitative risk analysis), partial and general equilibrium models, input-output analysis and cost-benefit analysis.

Dr Yanes' regulatory and policy experience includes the following economic impact studies:

- Oil & gas sector expansion in Venezuela (PDVSA, Venezuela, 1994-1997)
- Santos GLNG project (Santos/Petronas/Total/KoGas, QLD, 2008)
- Australia-Pacific LNG project (Origin/ConocoPhillips, QLD, 2009)
- Impact to 2070 of the educational aspects of the National Reform Agenda, encompassing early childhood, schools and tertiary (Department of Education, Employment and Workplace Relations, ACT, 2010)

Dr Yanes has several years of econometrics training, most of it received at the London School of Economics (U.K.), were he completed the M.Sc. and Ph.D. in economics. His econometrics expertise includes non-parametric methods (Data Envelopment Analysis or D.E.A.), time series, cross-section and panel data studies, using classical econometrics. His experience in this field includes:

- Forecasting private mining exploration expenditure and mining production for NSW to 2025. These forecasts were based on time series and dynamic panel data econometrics, and required forecasting the Reserve Bank of Australia's Commodity Price Index (for the NSW Geological Survey, 2010)

- A time series (co-integration) analysis of oil sector linkages in Venezuela, spanning 1950-1995 (for PDVSA, the National oil company of Venezuela, 1995)
- Forecasts for the Eastern Australia gas market to 2100. These forecasts were based on market growth projections (for Santos, 2009)

Dr Yanes' commercial/business planning experience includes project appraisal using discounted cash flow and long and short-run forecasting. He has built cash flow models for various oil & gas projects at Santos and PDVSA (the Venezuelan national oil company). Among these, Dr Yanes contributed to the construction of an integrated supply chain model for the Santos GLNG project, which encompasses all aspects of the production process, from a module forecasting gas and water flows through to LNG delivery.

As a lecturer at the School of Economics, University of Queensland (2002-2008), Dr Yanes taught and carried out research in industrial economics (monopoly, oligopoly & antitrust), mathematical economics, game theory, international trade, economic growth and firm structure. His research concentrated on analysing the impact of oligopolies on economic growth and international trade (in dynamic general equilibrium).

B Terms of Reference

The AER is seeking independent advice through written reports on the demand forecasts contained in the access arrangement proposals submitted by the Victorian transmission and distribution businesses to assist it in its decision about whether to approve the access arrangement proposals.

The consultant will be required to provide advice on whether the demand forecasts for each business have been arrived at on a reasonable basis and represent the best forecast for demand in the circumstances.

The review will require the consultant to undertake the following:

(i) a desktop review of demand forecasts and any relevant materials contained in the access arrangement proposals submitted by service providers

(ii) formulate a series of detailed questions on areas where it is considered that further information or clarification is required from the service providers to substantiate the demand forecasts

(iii) analyse all material provided and prepare separate reports for each service provider containing a list of issues identified from the review, and recommendations on whether the demand forecasts for each service provider have been arrived at on a reasonable basis and represent the best forecast for demand in the circumstances.

(iv) provide alternative forecasts of demand for the service providers if the consultant finds that the proposed demand forecasts have not been arrived on a reasonable basis and do not represent the best forecast for demand in the circumstances.

If requested by the AER the consultant will also:

(v) provide further advice on the revised access arrangement proposals from service providers scheduled to be submitted after the release of the AER's draft decisions.

The AER's decisions are subject to merits review by the Australian Competition Tribunal and judicial review by the Federal Court. The consultant's analysis and reports must be produced to a standard that is commensurate with scrutiny at that level. The consultant must describe in its written report the qualitative and/or quantitative methodologies applied in any calculation or formulae, the input values used or assumed, the rationale for any substituted values used or assumptions made and the conclusions reached in sufficient detail to support the AER in meeting its obligations under the relevant clauses of Part 9 of the NGR.

In addition to the draft and final reports, the consultant must provide supporting spreadsheets and analysis to ensure the AER can meet the requirements set out in Rules 59 and 62 of the NGR for the making and publication of decisions.

The consultant will be required to liaise with service providers and AER staff during the course of the access arrangement review. These consultations may include e-mail and telephone communications with AER staff and service providers.

C Establishment of Confidence Intervals around historical trend lines

The following explanation of the construction of confidence intervals is based on information provided in the manual for the Statistica software package.

> The confidence intervals for specific statistics (for example, means or regression lines) provide a range of values around the statistic where the "true" (population) statistic can be expected to be located (with a given level of certainty).
>
> The confidence intervals for the mean give us a range of values around the mean where we expect the "true" (population) mean is located (with a given level of certainty). Confidence intervals can be calculated for any p-level; for example, if the mean in a sample is 23, and the lower and upper limits of the p=.05 confidence interval are 19 and 27 respectively, then we can conclude that there is a 95 per cent probability that the population mean is greater than 19 and lower than 27. If the p-level is reduced to a smaller value, then the interval would become wider thereby increasing the "certainty" of the estimate, and vice versa. The width of the confidence interval depends on the sample size and on the variation of data values. The calculation of confidence intervals is based on the assumption that the variable is normally distributed in the population. This estimate may not be valid if this assumption is not met, unless the sample size is large, say n = 100 or more.

Confidence Intervals (CI's) have the form:

$$Est \ \pm t_{1-\frac{\alpha}{2},(n-2)} SE_{est}$$

For the CI around the y-estimate in the linear regression equation, the CI is given by:

$$CI = Est_y \ \pm t_{1-\frac{\alpha}{2},(n-2)} SE_{est}$$

Where $t_{1-\frac{\alpha}{2},(n-2)}$ is the inverse of the Student's t-distribution for confidence level α given that n is the number of data points (so that n-2 is the number of degrees of freedom in the distribution)

and

$$SE_{est} = SE_y \times \sqrt{\frac{1}{n} + \frac{(x_i - \bar{x})^2}{\sum(x_i - \bar{x})^2}}$$