Confidential

Review of Demand Forecasts for Envestra South Australia

For the Access Arrangement period commencing 1 July 2011

Prepared for the Australian Energy Regulator

Draft VF – 31 December 2010

ACIL Tasman

Economics Policy Strategy

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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 1, 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

Darwin
GPO Box 908
Darwin NT 0801

Email darwin@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
PO Box 1554
Double Bay NSW 1360

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:

Owen Kelp

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1 Background

The Australian Energy Regulator (AER) engaged ACIL Tasman to review the adequacy and appropriateness of the methodology used by Envestra Limited ("Envestra") to develop forecasts of demand in its South Australian gas distribution networks for the access arrangement period commencing 1 July 2011, as set out in the proposed access arrangement information submitted by Envestra.

The *National Gas Rules* (NGR 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 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.

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).

2 This report

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.

2.1 Approach to the review

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.

3 Scope of Envestra operations

The Envestra South Australian distribution business comprises around 39% of Envestra's total gas distribution business, and serves customers in Adelaide, Mount Gambier, Whyalla, Port Pirie, Barossa Valley, Murray Bridge and Berri.

The network, which has been constructed over a period of more than 100 years, consists of a variety of pipe materials. The older parts of the network (pre-1970s) is mainly cast iron and unprotected steel. In the new parts of the network, polyethylene (PE) has been used as the predominant pipe material, with polyethylene pipes up to 100mm diameter being commonly used. PE is now also being used in sizes above 100mm diameter and in higher pressure applications. The type of pipe material dictates the maximum operating pressure of the constituent parts of the network. Since cast iron can only be operated at relatively low pressures compared to polyethylene, the on-going replacement of cast iron pipe with polyethylene pipe means that the capacity of the network is improving with time in many areas.

As at 30 June 2010, the total network length was 7,645 km of which 56% was PE, 17% cast iron and 26% coated steel. In terms of geographical coverage, 93% of the network (by line length) is located within the Adelaide area, 2.6% in the southeastern area around Mount Gambier, 1.6% in Port Pirie, 1.3% in Whyalla and the remaining 1.3% in Murray Bridge, Nuriootpa, Berri and other regional towns.

The network currently serves around 396,000 customers of which some 385,000 (97.5%) are residential customers. Gas deliveries through the network currently total around 24 PJ/year of which 32% is to residential customers, 12% to small commercial and industrial customers, and 56% to large commercial and industrial customers.

3.1 Historical gas demand

The historical customer numbers for the Envestra South Australia distribution network are shown in Table 1.

Table 1 **Envestra South Australia gas networks—historical customer numbers, by class**

Year ended 30 June	2006	2007	2008	2009	2010
Residential	358,055	364,805	371,503	378,249	385,816
Small business	9,276	9,434	9,603	9,772	9,812
Volume Customer Total	**367,331**	**374,239**	**381,106**	**388,021**	**395,628**
Demand Customers	177	174	173	171	169
Total customers	**367,508**	**374,413**	**381,279**	**388,192**	**395,796**

Data source:(NIEIR, 2010), Table 6.2

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

Table 2 **Envestra South Australia gas networks—historical customer demand (TJ), by class**

Year ended 30 June	2006	2007	2008	2009	2010
Residential	7,875	7,682	7,425	7,777	7,544
Small business	2,939	2,889	3,001	3,047	2,977
Volume Customer Total	**10,814**	**10,571**	**10,426**	**10,824**	**10,521**
Demand Customers	15,448	15,175	14,750	13,890	13,320
Total customers	**26,262**	**25,747**	**25,176**	**24,714**	**23,841**

Data source: *(NIEIR, 2010)*, Table 6.1

4 Forecast methodology and assumptions

The demand forecasts contained in the revised access arrangement information (Envestra, 2010a) have been developed by the National Institute of Economic and Industry Research (NIEIR) and are detailed in a separate demand forecasts study (NIEIR, 2010) included as Attachment 13 – 1 to the access arrangement information.

4.1 Forecast methodology for the 2011–16 access arrangement period

The market forecasts in the NIEIR report (NIEIR, 2010) were developed using the methodology described below. The forecasts cover a period from 2011 to 2020 and are based on a combination of historical load data together with NIEIR's assessments of economic and government policy factors.

The scope of the NIEIR study, as defined by Envestra, was as follows:

- A description of factors affecting the demand for natural gas in South Australia for each of the customer classes.
- A description of the methodology used to forecast gas consumption for each market segment, and key assumptions used to prepare forecasts, including the source of base data used, and an overview of forecasting models used. NIEIR was asked to give particular consideration to the impact of substitute energy sources, government policy initiatives (e.g. rebate on solar water heaters) and global warming on gas consumption.
- An assessment of the expected industrial closures, manufacturing activity, investment levels and residential property prices in South Australia and the impacts they will have on demand for natural gas over the forecast period.
- Estimates of gas consumption for the financial years 2009-10 to 2019-20 for:
  - domestic customers for the Adelaide, Whyalla, Port Pirie, Peterborough, Riverland and South East regions;
  - commercial and small industrial Tariff V customers in the Adelaide, Whyalla, Port Pirie, Peterborough, Riverland and South East regions; and
  - MDQ and annual volume forecasts for customers using greater than 10 TJ per annum (Tariff D) for each of the above regions and the Northern Adelaide, Central Adelaide and Southern Adelaide zones.
- Relevant commentary on the forecasts to interpret trends and to demonstrate consistency with expected movements in key economic variables.
- A review of the current weather standard used by Envestra and development of alternative measures of the standard incorporating other climate variables such as wind and sunshine.

The NIEIR forecasts were prepared in September 2010. Envestra provided NIEIR with the following data:

- Tariff R volumes and customer numbers by district (Adelaide, Peterborough, Port Pirie, Riverland, South East and Whyalla) and by tariff blocks on an annual basis from 2005-06 to 2008-09;
- Tariff C volumes and customer numbers by district (Adelaide, Peterborough, Port Pirie, Riverland, South East and Whyalla) and by tariff blocks on an annual basis from 2005-06 to 2008-09;
- Tariff D MDQ and customer numbers by zone (Northern Adelaide, Central Adelaide, Southern Adelaide, Peterborough, Port Pirie, Riverland, South East and Whyalla) and by tariff blocks on an annual basis from 2005-06 to 2008-09;
- Daily inflow data from various South Australian gate stations for the period 2004-05 to 2008-09;

- Daily telemetry data on each Tariff D customer spanning the period 2004 to 2009;
- Historical billing records of all individual Tariff D customers spanning the period 2004 to 2009;
- Historical billing records of a sample of residential customers (the sample based on vintage of the meter); and
- Other information describing the South Australian gas network and background papers. (NIEIR, 2010, p. 23)

The methodology adopted by NIEIR consisted of a combination of:

- an econometric based approach for Tariff D and business Tariff V customers; and
- an end-use based approach for modelling residential sector sales.

NIEIR's South Australian gas model was used to forecast Tariff D sales, customers and MDQ. This is an industry based forecasting model based on estimated econometric equations.

An end-use model was developed by NIEIR to forecast residential sales. This model separated average residential gas usage into three components–hot water, space heating and cooking–reflecting the three main purposes for which natural gas is used by residential customers in the areas covered by Envestra's South Australian gas networks.

NIEIR states that the main strength of end-use modelling is that the specific Commonwealth and State policies that affect each of these end-uses can be factored directly into the forecast. The end-use forecast was also reconciled against an econometric based forecast of residential gas sales. As noted by NIEIR, this combination of econometric and end-use modelling has been widely used in gas access arrangement decisions, including for the most recent Victorian Gas Access Arrangement Review.

The forecasting methodology is described in detail, together with the forecast results, in section 4 of the NIEIR report (NIEIR, 2010, pp. 24-47).

4.1.1 Econometric modelling

The econometric component of the NIEIR forecast incorporates a cascading assessment of economic outlook, starting at a national level and moving progressively to state and regional economic projections. The forecasts of the Envestra natural gas (sales) volumes have therefore been developed within a regional economic model of the South Australian economy. This model utilises NIEIR's state forecast of gross state product (by industry) and disaggregates it to the Local Government Areas (LGAs) level. These forecasts have been mapped to Envestra's distribution regions classification. A concordance between the LGAs and Envestra's zones is presented as an appendix to the NIEIR report.

At a regional level, the NIEIR analysis takes into account projections of population, dwelling stock and industry growth by sector. The regional energy model then provides an assessment of natural gas and electricity consumption by industry sector, class and customer numbers.

National economic performance

NIEIR sets out is assumptions about major Australian economic aggregates in Table 2.2 of the demand report (NIEIR, 2010, p. 13). On the key indicator of GDP, NIEIR is forecasting the following growth rates:

- 2010 – 11 3.4%
- 2011 – 12 3.8%
- 2012 – 13 2.6%
- 2013 – 14 1.7%
- 2014 – 15 2.5%

By way of comparison, recent Treasury forecasts of Australian GDP are as follows (Australian Treasury, 2010):

- 2010 – 11 3.0 %
- 2011 – 12 3. 75 %
- 2012 – 13 3.0 %
- 2013 – 14 3.0 %

The NIEIR forecasts of national GDP are therefore broadly in line with current official forecasts.

Regional economic performance

The South Australian gas distribution network includes the following regions:

- Adelaide (incorporating the Barossa Valley)
- Peterborough
- Port Pirie
- Riverland
- South East/Mount Gambier
- Whyalla

The Adelaide district comprises three tariff zones: Central, Northern and Southern. The other districts each represent a single tariff zone.

Over the period to 2019–20, NIEIR is forecasting population growth averaging 0.9% per year in the Adelaide region; -0.3% per year for Peterborough; 0.2% per year for Port Pirie; 0.7% per year for Riverland; 0.8% per year for South East Region; and 0.3% per year for Whyalla, compared to a State-wide average of 0.9% per year.

In terms of dwelling stock, NIEIR is forecasting growth somewhat stronger than the rate of population growth over the same period. This is consistent with a long-term trend toward fewer persons per household. NIEIR has assumed average growth in dwelling stock of 1.3% per year in the Adelaide region; 0.9% per year for Peterborough; 0.8% per year for Port Pirie; 1.4% per year for Riverland; 1.6% per year for South East Region; and 0.6% per year for Whyalla, compared to a State-wide average of 1.3% per year.

In terms of gross regional product growth, NIEIR is forecasting moderate growth of 2.0% in the Adelaide region; very slow growth of 0.1% per year for Peterborough and Port Pirie; 1.0% per year for Riverland; 0.9% per year for South East Region; and 0.5% per year for Whyalla, compared to a State-wide average of 1.8% per year.

By way of comparison, the South Australian government in its 2010–11 Budget Overview (Department of Treasury and Finance South Australia, 2010) anticipates growth in South Australian Gross State Product of 2.75% in 2010–11, 3.5% in 2011–12 and 2.75% in 2012–13 and 2013–14.

The NIEIR forecast is also much lower than the historical growth in South Australian economy. Between 2000 and 2009 South Australian GSP grew at an average rate of 2.7% (ABS, 2009), whereas NIEIR is forecasting growth of only 1.67% over the period 2010 to 2016.

The NIEIR forecasts of South Australian GSP are compared to the 10-year historical average growth rate in the State, and with recent SA Treasury projections, in Figure 5.

Envestra was asked why it considers that such a low forecast for economic growth in South Australia is an appropriate basis for generating demand forecasts. Envestra replied as follows:

> "The GSP growth forecasts for South Australia reflect NIEIR's national and state economic outlook. These forecasts are used by NIEIR in respect of all government policy advice that it provides (and not just in respect of preparing advice on demand forecasts). The forecasts therefore reflect NIEIR's best estimate of likely economic conditions into the future.
>
> The NIEIR national outlook incorporates a slowdown in national economic growth by 2013 and 2014, which is reflected in the state profile for South Australia. A significant portion of Australian economic growth is supported by the

> resources/mining boom, which shifts growth away from states such as South Australia and New South Wales to Queensland and Western Australia.
>
> To this end, the main prospect for a major mining project in South Australia is the BHP Olympic Dam expansion, which is still undergoing environmental assessment and is yet to receive BHP Board approval. However, Envestra does not supply gas to Olympic Dam, and indeed to the resources sector and surrounding areas more generally.
>
> It is for this reason that NIEIR does not use the headline gross state product values referred to in the above question. Rather, NIEIR forecasts industry output growth at the single and two digit industry level, so that gas demand forecasts are specifically linked to the industries supplied by Envestra. Using aggregate South Australian economic forecasts that include aggressive resource projections can therefore overstate economic conditions in areas supplied by Envestra's networks".[1]

We do not find this explanation to be convincing. The discussion of South Australian economic performance in the NIEIR report (NIEIR, 2010, pp. 18-22) clearly presents historical and forecast values for headline Gross State Product—not "growth at the single and two digit industry level". The historical GSP data presented by NIEIR is completely consistent with that reported by ABS for Australian GSP. It is therefore inaccurate to say that "NIEIR does not use the headline gross state product values referred to in the above question"—it clearly does. We do not disagree that growth in the industry sectors primarily associated with gas consumption may differ from gross GSP growth rates, and acknowledge that it is appropriate to take this fact into account in formulating the demand forecasts. However, the starting point for any such adjustment must still be the forecast for GSP and the fact remains that the NIEIR forecast for South Australia is very low compared with both the long-run historical average performance of the South Australian economy and the current South Australian Treasury forecasts.

In order to understand the sensitivity of the demand forecasts to the GSP assumptions, we consider that would be reasonable to ask Envestra to advise the impact on forecast customer numbers, by class, of adopting an alternative South Australian GSP growth rate assumption that is consistent with current South Australian Treasury forecasts and with the long-run historical rate of growth in the South Australian economy as revealed in ABS data.

4.1.2 Volume Customers (Tariff V) forecasts

The forecasts for Tariff V by class (residential, commercial and industrial) were developed for the six distribution network areas.

[1] Envestra document file 101122-AER EN 09 Response to AT Questions.docx

Residential sector sales forecasts were developed initially using a regression model incorporating real household disposable income and real residential gas prices. The income and price elasticities for the residential model were based on NIEIR's South Australian gas model estimates. The gas volume data was then weather normalised to take account of the impact of weather on gas demand.

The residential forecasts derived from the econometric model were then adjusted to be consistent with a State-wide end-use model of residential gas usage. This model disaggregates average gas usage into existing and new customers and by end-use: hot water, space heating and cooking.

The end-use model made specific assumptions regarding appliance lives, appliance efficiencies and the changing penetration of conventional and new technologies in the hot water segment. NIEIR noted that the assumptions regarding market shares for gas, solar-electric and solar-gas were consistent with those adopted by ETSA Utilities in its recent Access Arrangement submission to the AER in South Australia. Key Commonwealth and State policy impacts were factored directly into the end-use model forecast.

Residential customer number forecasts were linked to NIEIR's forecasts of the dwelling stock for each of the distribution network areas.

Forecasts for Tariff V (small commercial and industrial) were linked to a general equation for gas sales, where sales are related to gas prices and total commercial and industrial output for the distribution network areas.

Forecasting of average residential use

An important element in the forecast prepared by NIEIR for Envestra was an analysis of average residential gas usage. This included a historical analysis and an assessment of the key factors that will influence future usage per customer.

NIEIR points out that the analysis of average consumption of gas by residential customers is complex and that consumption is shaped by a large number of inter-related factors including:

- gas appliance penetration rates and their efficiency;
- existing and future Federal and State Government energy and water policy initiatives;
- fuel substitution between gas, electricity and solar combinations for water and space heating;
- changes in dwelling characteristics including building shell;
- socio-demographic changes; and
- the impact of weather on average usage, or weather normalisation issues.

Tables 4.4 and 4.5 of the NIEIR report present data on historical average residential gas use. The data shows a downward trend in average residential consumption from 25.0 PJ/year in 1997-98 to 20.0 GJ/year in 2008–09. The data also points to an even more dramatic reduction in average consumption depending on year of installation. According to this data, customers connected in 2002–03 or earlier use an average of about 20 GJ/a, while customers connected in 2007–08 consume only about 15 GJ/a. NIEIR concluded that the rate of average consumption for new connections declined by 25% over this period.

This somewhat overstates the rate of decline, given that the starting point in 2002–03 represents the average consumption for all connections at that date, not only for new connections made in that year. Nevertheless, the data does demonstrate that average rates of residential consumption across all customers has been declining over the past decade, and that for new customers connecting to the system, average consumption is significantly below the average for older customer connections.

NIEIR provides high level commentary on:

a) market trends affecting the installation of existing gas appliances, including but not limited to, the impacts of installing alternative appliances such as reverse cycle air conditioning in lieu of gas heating, continuous flow gas systems in lieu of storage gas systems, solar or electrical systems, and the impacts of water conservation measures on the consumption of hot water;

b) government energy efficiency policies including the phasing out of conventional electric resistance waters heaters; federal rebates to replace electric resistance waters heaters with solar water heaters; the South Australian Residential Energy Efficiency Scheme (REES) which encourages replaced of electric water heaters with gas or solar (gas in gas areas); eligibility of solar hot water and heat pump installations for renewable energy certificates under the Renewable Energy Target; South Australian 5–Star building standards which require installation of solar water heaters; hot water management, particularly regulation and incentives for installation of low flow shower heads; and

c) implementation of the Government's Carbon Pollution Reduction Scheme (CPRS) including the impacts on fuel substitution, reduction in demand of increased cost of gas especially in the large industrial market, economics of small and large scale cogeneration and electricity production.

NIEIR has provided limited information to separately quantify the impacts of individual policy initiatives (for example, a 5% reduction in average residential gas consumption driven by policies aimed at water conservation; an assumed 1% per year efficiency improvement on average for new solar-gas hot water systems; a reduction of approximately 1.8% per year associated with improved efficiency of gas space heaters).

NIEIR notes that the lower usage in new connections reflects higher efficiencies in water heating units, solar hot water penetration and water usage efficiencies, which it attributes in part to the introduction of the 5–Star Energy Standard in South Australia in 2006. Based on Envestra's analysis of new connection requests by appliance types and combination being installed, and expected consumption per appliance in South Australia, NIEIR has assumed consumption of 3 GJ/year for a cooker, 14 GJ/year for a hot water service and 8 GJ/year for a space heater and 24 GJ/year for a ducted central heater.

Weather normalization

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 the Australian Energy Market Operator (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 Effective Degree Days (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[2] between the average temperature on each day and 18^{o} Celsius.

The EDD approach preferred by AEMO, and also used by NIEIR, is a multifactor method based on the concept of Heating Degree Days (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

[2] If the average temperature on a particular day is greater than or equal to 18oC, then HDD for that day is zero.

other weather-related parameters that may affect consumer behavior in relation to gas consumption for space heating and water heating.

In the 2006 review of Envestra South Australia distribution access arrangements, ESCOSA and its demand consultant McLennan Magasanik and Associates (MMA) were critical of the EDD methodology used by Envestra and NIEIR. ESCOSA in its final decision concluded that:

> "It is the Commission's view that the approach adopted by NIEIR does not produce "best estimates" arrived at on a reasonable basis. While the additional weather factors in the EDD parameter are able to explain the variation in net system gas load from day to day, the EDD parameter is not proven to provide accurate annual domestic weather normalisation. MMA argues that this formula is flawed in that the variables A and B are not defined anywhere in the NIEIR report and appear to be variables determined to maximise the explanatory power of the EDD parameter. NIEIR provides three different EDD formulas in three different reports, and it is not clear which formula has been used in NIEIR's forecast for Envestra. Further, different data at different time periods appears to have been used in the NIEIR reports … The Commission accepts that there are many different forecasting methods and models available. Forecasting customer numbers and gas usage is a subjective process based on the forecaster's assumptions and variables that are included in the model. However, the Commission can assess the reasonableness of each approach by testing the level of rigour that was involved in proving the methodology … NIEIR has not demonstrated or substantiated the many assumptions and variables it uses throughout its weather normalisation forecasts to the same extent as MMA. In the Commission's view, the level of rigour and checking that MMA adopted in order to determine and demonstrate its method confirms that the MMA forecasts are best estimates arrived at on a reasonable basis. Therefore, the Commission has decided to adopt the MMA weather normalisation approach." (ESCOSA, 2006, pp. 57-58)

The EDD model proposed by NIEIR and Envestra for the 2006 access arrangement review was based on, and similar to the EDD formula then used by VENCorp (referred to as EDD_{66} because it was based on three-hourly weather observations from 6am to 6am the following day. Under this system, a 50% weighting was given to the 6am observations).

In 2006 VENCorp conducted a detailed review of the EDD formula for the Victorian gas network. This review concluded that a modified EDD model, the EDD_{312} index, provides a better predictor of heating demand for gas days commencing at 6am (as in both the Victorian and South Australian markets). The EDD_{312} index differs from the EDD_{66} in that it is the average of the three-hourly Melbourne temperature readings (in degree Celsius) from 3am to 12am the following day inclusive as measured at the Bureau of Meteorology's Melbourne Station, with equal weighting applied to all observations (AEMO, 2009, p. 56)

Table 3 compares the parameters of the EDD formulae used by NIEIR in the 2006 and 2010 access arrangement reviews with those used by VenCorp and subsequently AEMO for the Victorian gas distribution system.

Table 3 **Comparison of EDD parameters**

	VENCorp pre-2006	NIEIR SA 2006	AEMO Vic 2009	NIEIR SA 2010
Temperature	DD_{66}	DD_{66}	DD_{312}	DD_{66}
Wind	$0.023*(DD_{66}*Wind_{66})$	$0.021*(DD_{66}*Wind_{66})^{0.5}$	$0.023*(DD_{312}*Wind_{312})$	$0.02*(DD_{66}*Wind_{66})$
Sunshine	- 0.18*SUN	- 0.035*SUN	- 0.18*SUN	- 0.00*SUN
Seasonality	2*COS(2π(Day-200)/365)	2*COS(π(Day-200)/182)	2*COS(2π(Day-200)/365)	2*COS(π(Day-200)/182)

Data source: *(NIEIR, 2005)*, *(NIEIR, 2010)*, *(AEMO, 2009)*

A number of questions arising from the comparison of EDD parameters were put to Envestra. These questions, and the responses provided by Envestra[3], are discussed below:

Question: NIEIR states that "the coefficients in the above EDD formula have been calibrated to the Adelaide weather and daily gas consumption". How was this calibration undertaken and why are the parameters proposed the most appropriate to use?

> Response: "NIEIR has applied the general form of the EDD equation used by AEMO in Victoria (i.e. the model specification and functional form used in South Australia was based on that used by AEMO for Victoria). The parameter coefficients were estimated based on regression analysis using South Australian data on wind, temperature, sunshine and a seasonal factor against daily energy data."

We consider this clarification to be satisfactory.

Has NIEIR considered the 2006 VENCorp review of the EDD formula that found that, for the Victorian gas network, EDD312 was a better predictor of demand responses to weather effects than EDD66, and if so why has NIEIR concluded that EDD66 remains the most appropriate basis for weather normalization in South Australia?

> Response: "NIEIR has continued to use the EDD66 formula for annual weather normalisation, as the difference between EDD312 and EDD66 is considered to be immaterial.
>
> AEMO (formerly Vencorp) uses an EDD index for (daily) gas network management purposes as well as for annual weather normalisation. In the context of gas network management, small variations in the time periods used to gauge weather conditions can be important to predicting immediate daily gas demand (and hence AEMO's preference for EDD312).

[3] Envestra document file 101122-AER EN 09 Response to AT Questions.docx

> For annual weather normalisation, the individual daily movements in weather are aggregated across the year. At this time scale, the small variations in the index's formulation will have only a very slight impact on the estimated number of annual EDDs.
>
> The 2009 Victorian Annual Planning Report (VAPR, pg. 57 of Appendix A2) indicates that, based on statistical measures, EDD66 is acceptable as a measure of EDD and only marginally inferior to EDD312. This supports the contention that using EDD312 would result in an immaterial change to the forecasts."

We consider this explanation to be satisfactory, and acknowledge that for purposes of annual weather normalisation the difference between the two methodologies is likely to be immaterial.

Why has NIEIR determined a coefficient of 0.00 for the Sunshine parameter in the current EDD formula? Prima facie, this will have the effect of significantly increasing the EDD result and therefore reducing the weather normalized consumption values.

> Response: "… the EDD formula for Adelaide was estimated against Adelaide weather data. In Adelaide's case the warming effect of sunshine was found to be insignificant. In large part this can be explained by the fact that Adelaide is relatively "sunnier" than Victoria. That is, there is a greater number of clear days per annum in Adelaide than in Melbourne [87.5 vs 48.6] and longer sunshine hours [7.6 vs 6.0]. (The relevant data can be found at: http://www.bom.gov.au/climate/data/weather-data.shtml).
>
> That aside, the absolute level of the EDD is not materially relevant to weather normalisation. It is the difference of each actual EDD compared to the standard EDD (and hence the EDD measure needs to be consistently measured over time). It therefore follows that by excluding sunshine, it does not necessarily imply higher/lower weather normalised consumption values. "

We consider this explanation to be satisfactory.

EDD trend and data adjustment methodology

Using the above EDD formula, NIEIR has analysed weather data for Adelaide from 1980 to 2009, and has concluded that there is a linear downward trend of three EDD per year, with a standard EDD of 1296.7 in 2008-09.

Historical annual gas volumes have been weather normalised using following formula:

> Weather normalised volumes = actual gas volumes – Gas-EDD sensitivity * (actual annual EDD – standard annual EDD)

where "gas-EDD sensitivity" is a factor that measures gas consumption sensitivity to marginal changes in the annual number of EDDs. This factor has been estimated by regressing daily gas volumes against the daily EDD index, a constant and a centred moving average trend of daily volumes (to capture any cyclical movements) and represents the estimated coefficient on the EDD index variable.

The residential and commercial components of Tariff V volumes have been weather normalised by pro-rating the gas-EDD sensitivity factors to the components' relative volume levels. NIEIR has assumed that small industrial volumes of Tariff V are not weather sensitive.

The NIEIR report then states that:

> "Further, given the very small volumes of consumption by Tariff V customers in four of the districts, it was decided that weather normalisation would not contribute significantly to the accuracy of the forecasts. The exception is South East, where a small adjustment was made to the actual usage." (NIEIR, 2010, p. 31)

Envestra was asked to explain clearly which data has been adjusted and which has not, and to confirm the basis for the "small adjustment" made to the data for the South East district. Its response was as follows:

> "The weather adjustment for the South East region was made on the basis of the Adelaide EDD index (and therefore assumes overall annual weather patterns in the South East region are similar to Adelaide). The EDD sensitivity estimate was implied based on the relative share of volumes in the South East to the Adelaide region (for each market segment excluding tariff D). The total EDD sensitivity (i.e. for domestic and commercial combined) for the South East region is only 0.09 TJ per EDD (compared to approximately 3.5 TJ per EDD for the Adelaide region).
>
> It is again important to note that it is the difference between the actual and standard EDD (and not the absolute EDD level by itself) which is critical in the weather normalisation process. While the South East district tends to experience relatively cooler conditions than the Adelaide district, the severity of abnormal (cool or warm) weather conditions in any particular year are likely to be comparable across the two districts.
>
> The following regions have not been adjusted for abnormal weather variations due to the immateriality of any such adjustment:
>
> - Peterborough – which accounted for 0.0% of 2008-09 total volumes (i.e. excluding Tariff D);
> - Port Pirie – which accounted for 0.9% of 2008-09 total volumes;
> - Riverland – which accounted for 0.2% of 2008-09 total volumes; and
> - Whyalla – which accounted for 0.7% of 2008-09 total volumes.
>
> In can therefore be seen that weather normalising such small volumes is unlikely to materially impact the demand forecasts (In contrast, the South East region accounts for 2.7% of 2008-09 total volumes)."

We consider the above response to be satisfactory and agree that the approach adopted is reasonable, taking into consideration issues of materiality.

4.1.3 Demand Customers (Tariff D) forecasts

Forecasts of gas (sales) volumes for Tariff D customers were developed at industry and regional levels. NIEIR assigned an industry classification to every Tariff D customer. The industry regression models relate Tariff D gas consumption to:

- the change in output for that industry within the zone; and
- the change in real gas prices for that industry (incorporating lags in real prices to proxy the long run price elasticity).

The output and price elasticities at the zone level were adjusted to reflect differences in the gas intensity between industries and regions.

The Tariff D forecasts by industry and zone were, therefore, determined by:

- the outlook for the industry growth in each of the zones; and
- the structural parameters and relationships embodied in NIEIR's industry based South Australian natural gas demand model.

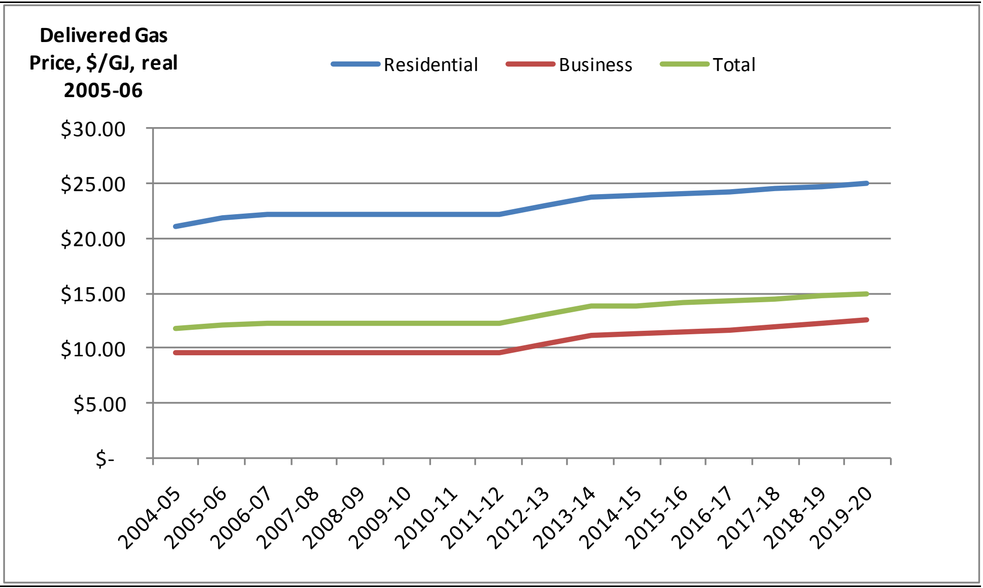
4.1.4 Other factors affecting the forecasts

Carbon pricing/emissions trading

NIEIR assumes that, despite the deferral of the Carbon Pollution Reduction Scheme (CPRS), some form of carbon pricing will be introduced leading to increases in electricity and gas prices. Carbon pricing is assumed to commence in 2014 with the price of carbon gradually increasing through to 2030. The resultant impact on delivered gas prices in South Australia is shown in Figure 1.

The gas prices projected by NIEIR show little change (in real terms) over the period 2004–05 to 2011-12. NIEIR forecasts that, under the influence of a delayed CPRS, gas prices in the residential sector will rise by some $1.90/GJ or 8.5 per cent between 2011-12 and 2015-16. The corresponding rise in the business sector is forecast to be $1.90/GJ or 19.8 per cent, with the average rise across all sectors being $1.90 or 15.6%.

Figure 1 **NIEIR projections for South Australian gas prices**



Data source: (NIEIR, 2010, pp. 40, Table 4.9)

ACIL Tasman considers that quantum and timing of the forecast gas price impacts are reasonable, bearing in mind the current uncertainty regarding the timing of introduction of carbon a carbon price mechanism, and the future carbon price trajectory. The fact that prices are forecast to begin rising before introduction of CPRS may reflect upward pressure on gas prices in anticipation of carbon pricing. This is reasonable, particularly for long term gas supply contracts that will span across the anticipated CPRS start date.

4.2 Conclusions regarding key forecast assumptions

In developing the demand forecasts, NIEIR has given consideration to the key drivers affecting future gas demand. Account has been taken of factors that might cause future gas demand growth to follow a different growth trajectory when compared to past experience. In terms of methodology we consider that the approach adopted by NIEIR is generally sound. However, main risks to forecast accuracy relate not to the methodology that has been followed, but to the assumptions regarding specific demand drivers and their impacts on demand. In this regard, the critical assumptions adopted by NIEIR include:

- the overall economic growth outlook in South Australia
- the impact of government policies and alternative technologies on gas demand and on average consumption per customer, particularly in the residential sector.
- The specific parameters chosen for weather normalization of the historical data on Tariff V residential and commercial customers.

With regard to the economic growth outlook, NIEIR has adopted forecasts that are significantly below recent South Australian government projections and very low compared with average growth in South Australia over the past decade as recorded by the Australian Bureau of Statistics. This has the potential to produce unreasonably low forecasts of gas demand, particularly in the Tariff V Business and Tariff D Commercial customer sectors.

The NIEIR report identifies a number of energy efficiency measures and policies on gas demand that have the potential to impact on gas demand. However, the bases for assumptions regarding the quantitative impacts attributed to particular interventions are generally not explained. As discussed in section 5.2.3 NIEIR is forecasting a much higher rate of reduction in average residential gas consumption than has been observed in the past.

The forecast of future delivered gas prices used by NIEIR incorporates the potential impact of carbon pricing, and is considered appropriate.

NIEIR has used an established method for weather normalisation of historical data on gas consumption in the Tariff V residential and commercial customer sectors. The EDD formula used by NIEIR is similar to that now used by AEMO for the Victorian gas distribution network. This method has been extensively researched by AEMO. Having received satisfactory responses to a number of questions about specific assumptions made by NIEIR with regard to EDD parameters, and about the application of the methodology, we consider the approach to weather normalisation to be appropriate.

In the following section we further examine the impacts of the assumptions used by NIEIR on the reasonableness of the forecasts, including statistical comparison of the forecasts with historical trends.

5 The forecasts

In this chapter we review the revised forecasts themselves, to consider whether the application of the methodologies and assumptions used by NIEIR and Envestra 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 South Australia. We consider separately the forecasts for the Volume and Demand sectors of the market.

5.1 Use of trend extrapolation for forecast verification

The NIEIR methodology looks to take into consideration the key drivers affecting future gas demand and factors that may cause future gas demand growth to follow a different trajectory from past experience. However a sound methodology alone does not ensure that the forecasts produced by application of that methodology are reasonable. The methodology needs to be supported by accurate data and appropriate assumptions in relation each of the input parameters.

In the following analysis we have used historical trend analysis as a cross-check on the results generated using the NIEIR 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.

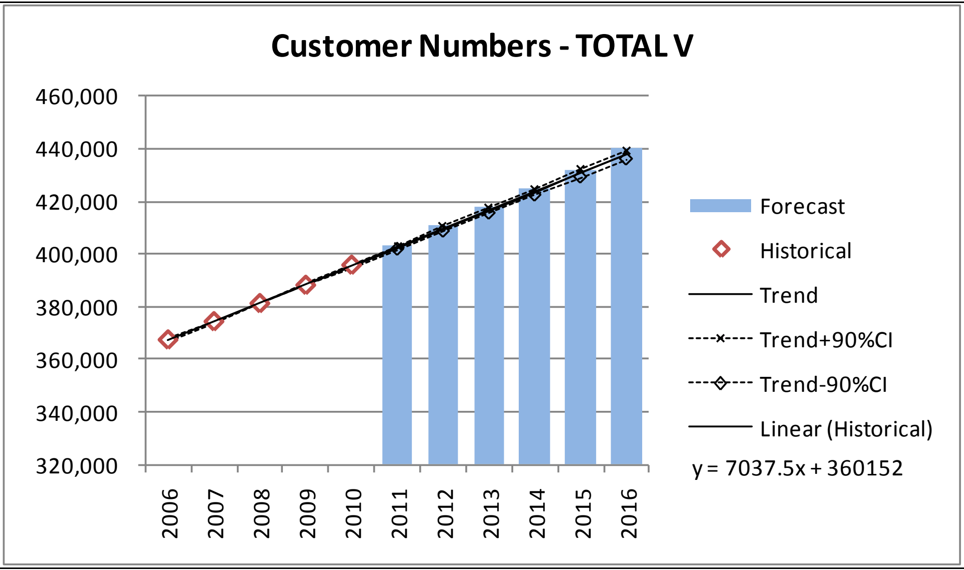
Envestra has confirmed that the 2009–10 data presented by NIEIR is a forecast rather than actual historical data. This is because actual data for the 2009–10 year will not be finalised until around February 2011 due to the process involved in replacing estimated data with actual data. Envestra has undertaken to provide this information in response to the AER Draft Decision (including by way of an updated demand forecast).

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 2. The historical data is tightly correlated. The forecast shows stronger growth in customer numbers than in the past, with total customers across the forecast period at or slightly above a 90 per cent confidence interval around the trend line[4]

Figure 2 **Historical and forecast customer numbers—Tariff V Total**

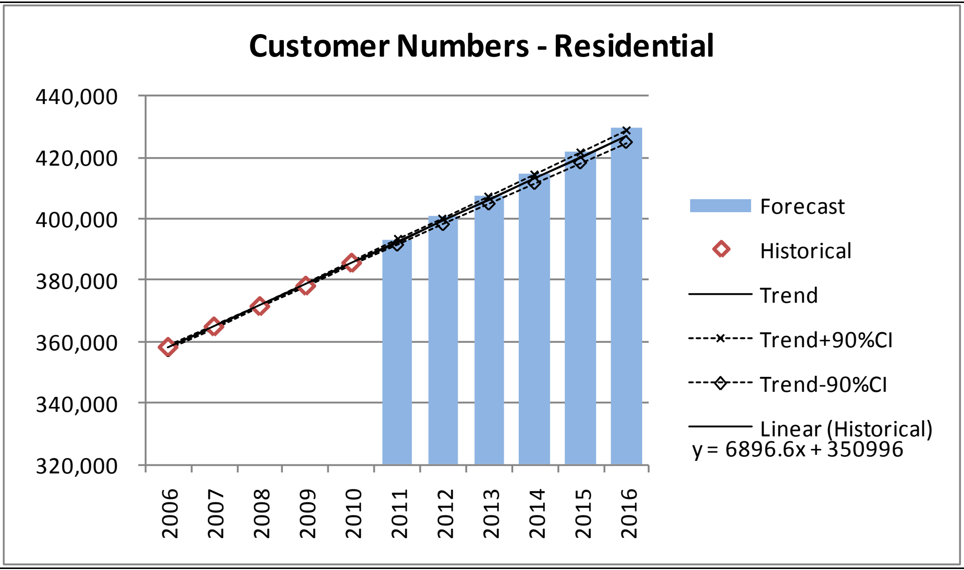


Data source: (Envestra, 2010a); (NIEIR, 2010); ACIL Tasman analysis

Figure 3 shows the corresponding data and forecast trends for residential customer numbers as a subset of the Tariff V customer class. The results are very close to those for the total Tariff V customer class—a wholly expected result given that residential customers account for more than 97 per cent of the Tariff V total customer numbers.

[4] See Appendix B for an explanation of the method of calculation of the 90 per cent confidence intervals.

Figure 3 **Historical and forecast customer numbers— Tariff V residential**



Data source: (Envestra, 2010a); (NIEIR, 2010); ACIL Tasman analysis

The NIEIR report identifies factors that could reasonably be expected to push growth in new residential customer connections to a higher rate:

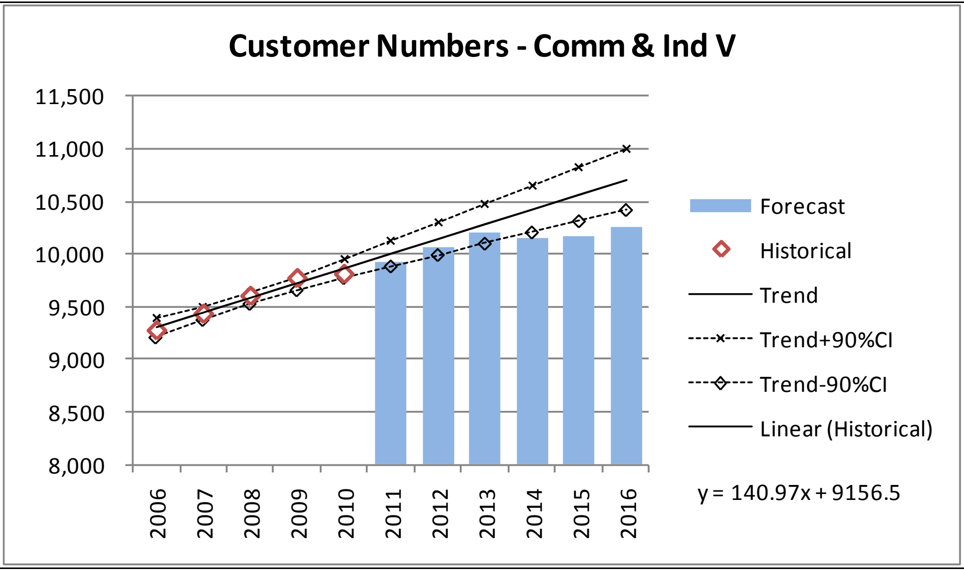
- Policies that tend to encourage installation of gas appliances rather than electric, but also tend to reduce average gas consumption by reducing the average energy use of new dwellings.
- The fact that under MEPS installation of new conventional electric resistance waters will be banned in all new and existing homes in gas reticulated areas from 2010, and in new flats and apartments in reticulated areas and established houses in non-gas reticulated areas from 2012.

Another factor that could be expected to increase the rate of growth for Tariff V customer is the gas marketing strategy to be undertaken by Envestra.

Overall the forecast rates of growth in customer numbers do not appear to be unreasonable.

Figure 4 shows the corresponding results for the Commercial and Industrial Tariff V customers.

Figure 4 **Historical and forecast customer numbers—Commercial & Industrial Tariff V**

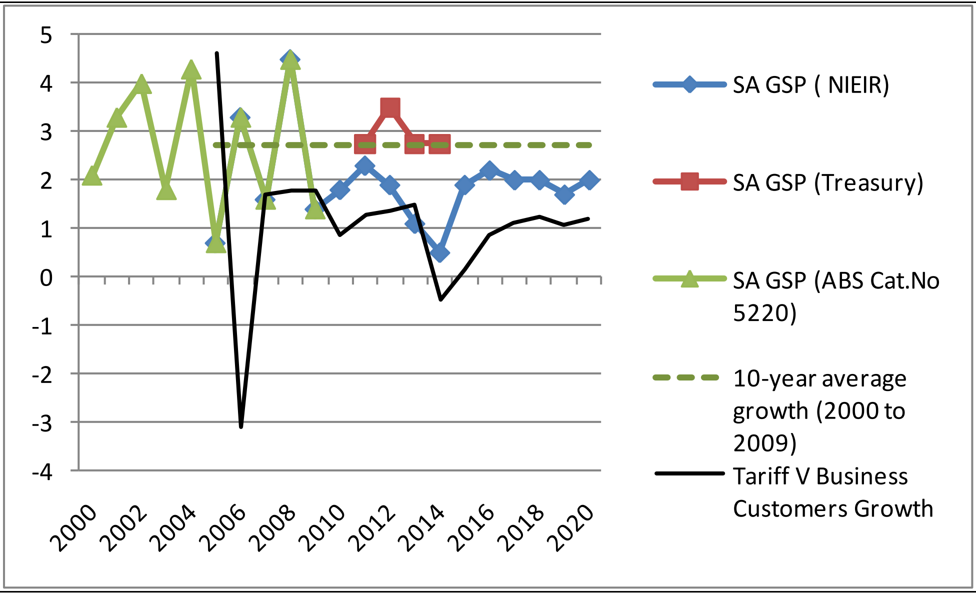


Data source: (Envestra, 2010a); (NIEIR, 2010); ACIL Tasman analysis

With a much smaller customer number set and greater sensitivity to economic cycles, the growth trend for small business customer numbers shows a weaker correlation and a correspondingly wider confidence interval around the extrapolated trend data. The forecast for small business Tariff V group, forecast customer numbers lie below the long-term trend and outside the lower bound of the 90 per cent confidence interval.

It might be expected that growth in small business customer numbers would reflect overall patterns of growth in the South Australian economy as reflected by changes in GSP. Indeed, as shown in Figure 5 there is a general correlation between the NIEIR forecasts of South Australian GSP and its forecasts of Tariff V Business customer numbers. The reason for the forecast business customer numbers falling significantly below the long-term trend therefore appears to be a very low forecast for GSP adopted by NIEIR, particularly in 2013 and 2014. As previously noted, and as illustrated in Figure 5, the NIEIR forecast of South Australia GSP is considerably below the corresponding forecast by the South Australian Department of Treasury and Finance. It is also much lower than the historical growth in South Australian economy. Between 2000 and 2009 South Australian GSP grew at an average rate of 2.7% (ABS, 2009), whereas NIEIR is forecasting growth of only 1.67% over the period 2010 to 2016.

Figure 5 **Comparison of Tariff V business customer growth with GSP history and forecasts**



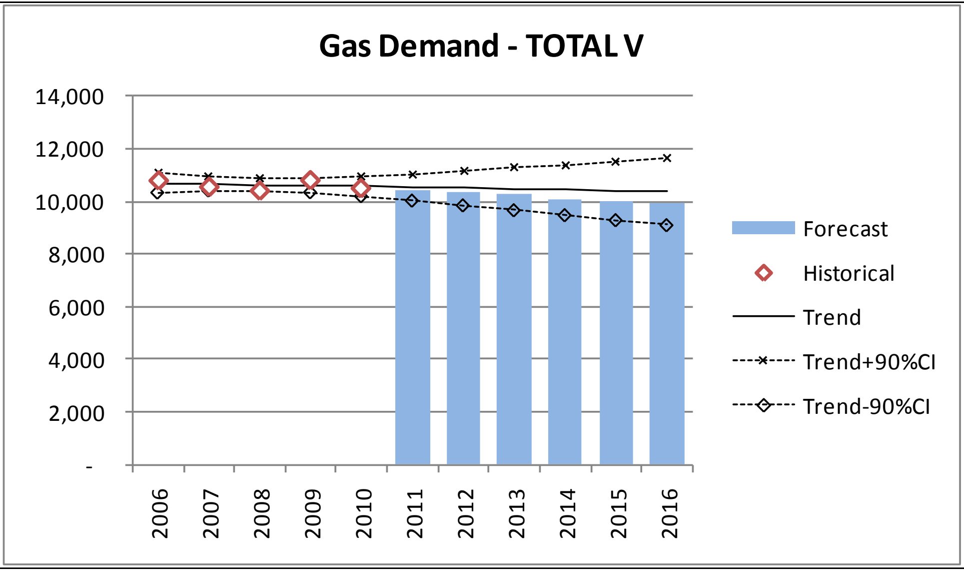
Data source: (NIEIR, 2010), Table 3.1, Table 6.2: *(Department of Treasury and Finance South Australia, 2010)*, *(ABS, 2009)*

We consider that, to the extent that the NIEIR is forecast of South Australian GSP is excessively pessimistic, the forecast for Tariff V Business customer numbers is likely to be understated.

5.2.2 Tariff V gas demand

The forecast of gas demand for the Tariff V Customer sector is summarised and compared with historical actual consumption in Figure 6. The forecast demand is here compared to raw historical trends (that is, without weather normalisation) based on linear extrapolation.

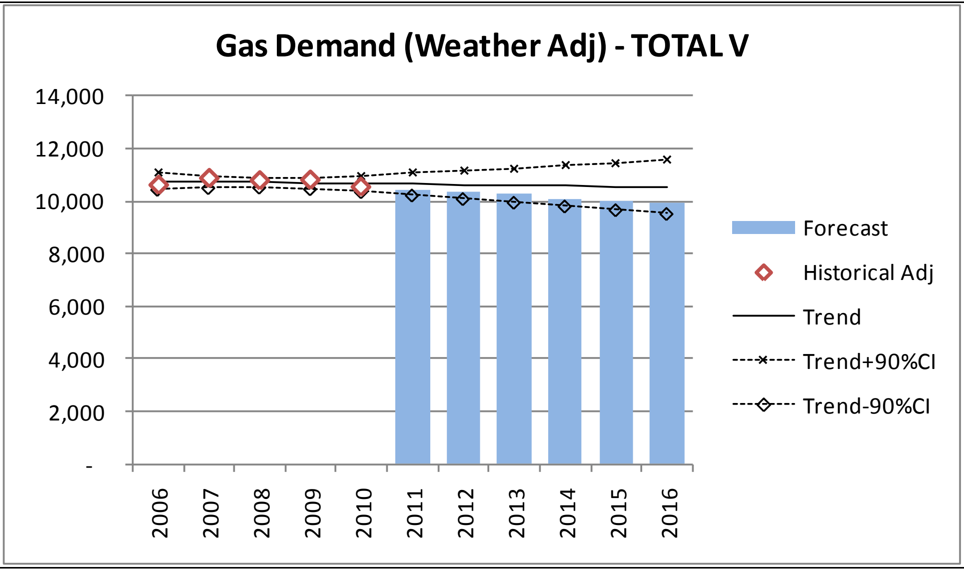
Figure 6 **Historical and forecast demand— Tariff V customers**



Data source: (Envestra, 2010a); (NIEIR, 2010); ACIL Tasman analysis

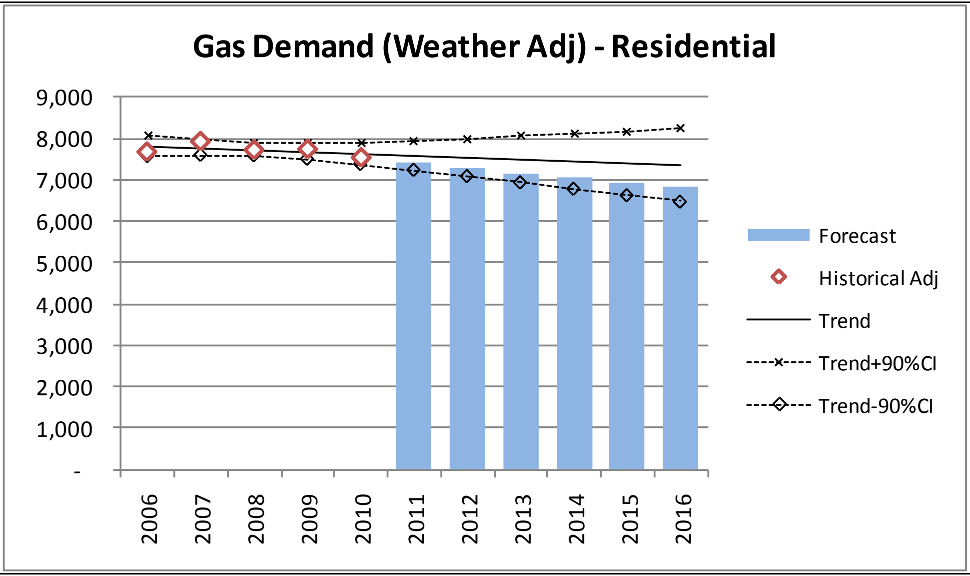
Figure 7 shows the comparison based on weather normalised historical data. The corresponding comparisons for the Tariff V Residential and Tariff V Business customer groups are shown in Figure 8 and Figure 9 respectively.

Figure 7 **Forecast consumption compared to weather-adjusted historical trend—Tariff V customer sector**



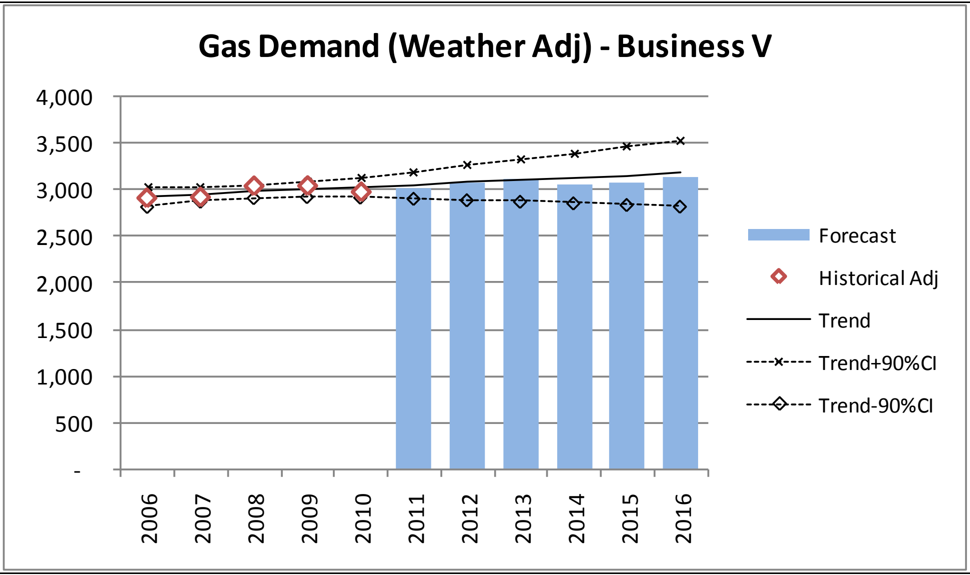
`*Data source: (Envestra, 2010a); (NIEIR, 2010);* ACIL Tasman analysis

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



Data source: (Envestra, 2010a); (NIEIR, 2010); ACIL Tasman analysis

Figure 9 **Forecast consumption compared to weather-adjusted historical trend—Tariff V Business customer**



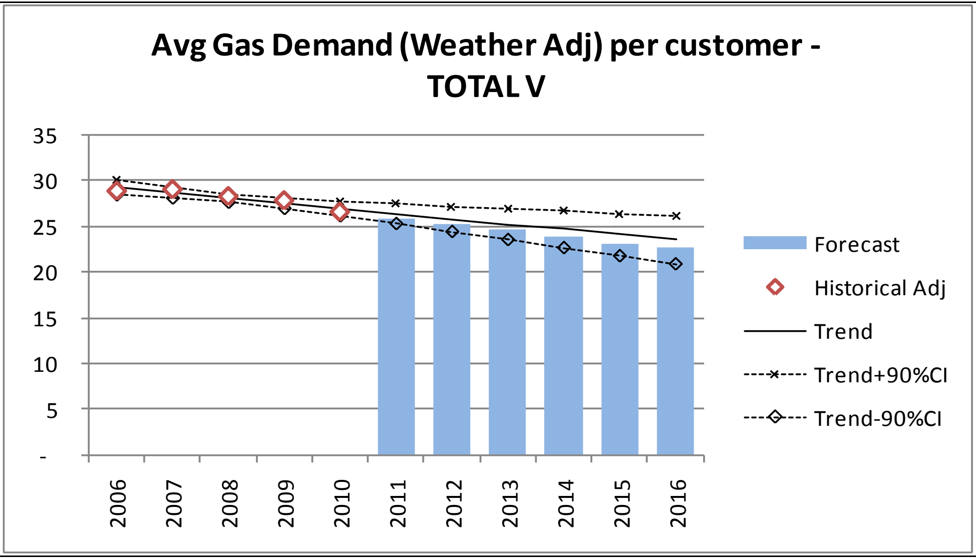
Data source: (Envestra, 2010a); (NIEIR, 2010); ACIL Tasman analysis

The forecast demand levels for residential customers and for the Tariff V customer group as a whole are below the historical trend line but remain within the 90 per cent confidence interval. The forecast demand for Tariff V Business customers is close to the historical trend. On this basis the difference between the forecasts and the linear trend projections based on recent data do not appear to be statistically significant.

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 forecasts are generated by applying average gas consumption rates to the projected customer numbers in each demand segment. The implied average gas consumption per Customer in the Tariff V sector as a whole (derived from Tariff V demand and customer numbers) is shown in Figure 10.

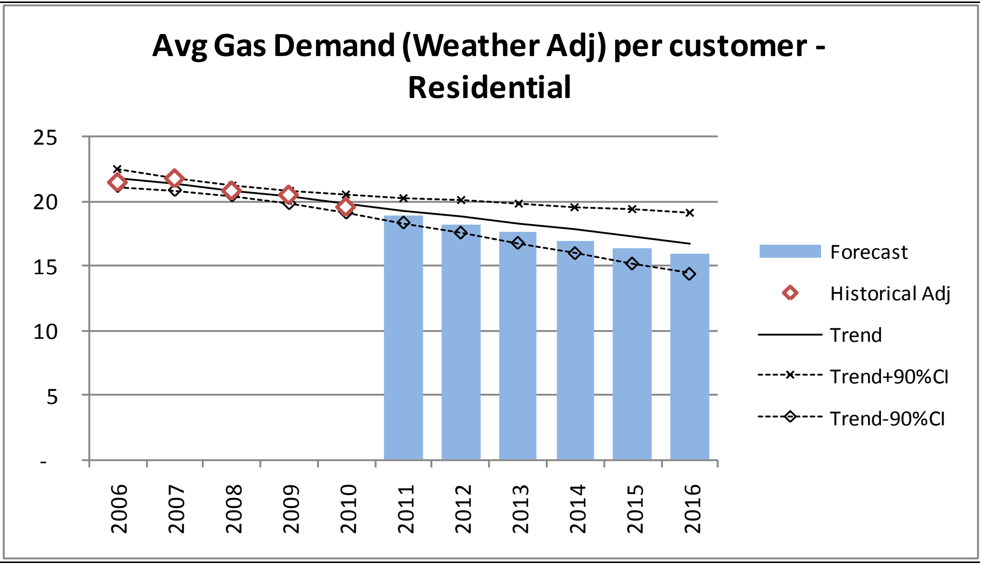
Figure 10 **Actual vs forecast average gas consumption per Volume Customer, after weather normalisation**



Data source: (Envestra, 2010a); *(NIEIR, 2010)*; ACIL Tasman analysis

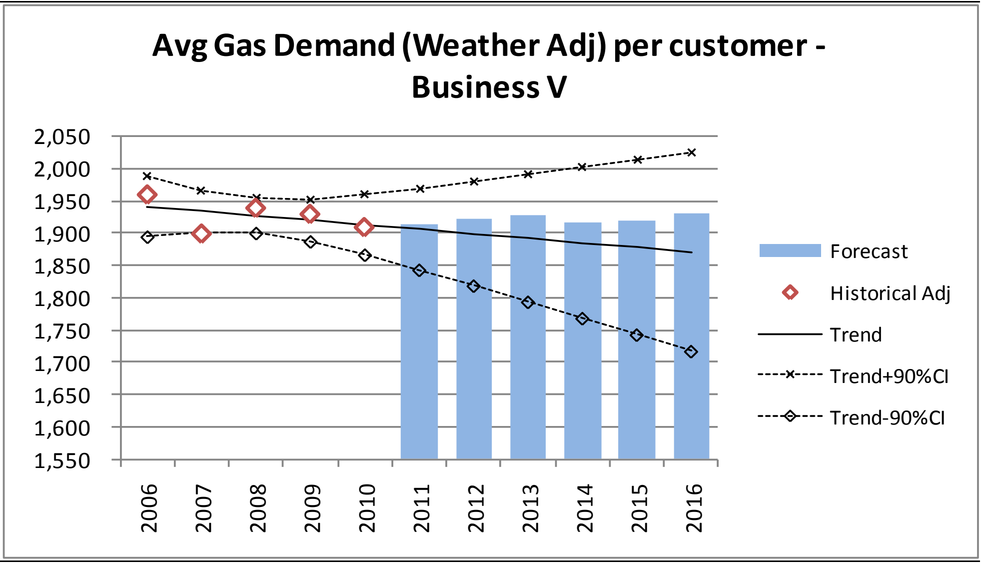
The corresponding comparisons for the Tariff V Residential and Tariff V Business customer groups are shown in Figure 11and Figure 12 respectively.

Figure 11 **Actual vs forecast average gas consumption per customer, after weather normalisation—Tariff V Residential customers**



Data source: (Envestra, 2010a); *(NIEIR, 2010)*; ACIL Tasman analysis

Figure 12 **Actual vs forecast average gas consumption per customer, after weather normalisation—Tariff V Business customer**



Data source: (Envestra, 2010a); *(NIEIR, 2010)*; ACIL Tasman analysis

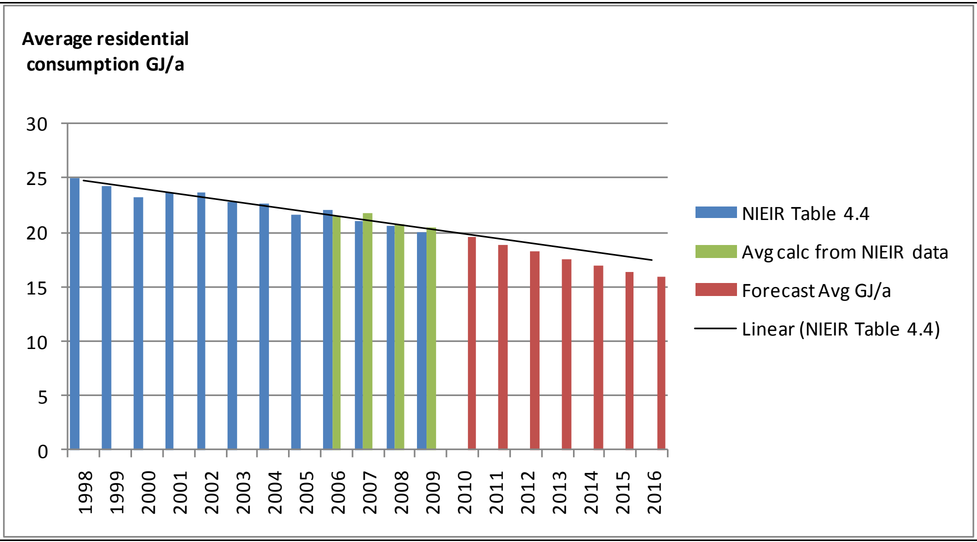
Again the forecast average demand levels for residential customers and for the Tariff V customer group as a whole are somewhat below the historical trend line but remain within the 90 per cent confidence interval.

The forecast demand for Tariff V Business customers is somewhat above the historical trend. On this basis the difference between the forecasts and the linear trend projections based on recent data do not appear to be statistically significant.

The forecast decline in the average rate of consumption for residential customers derives from NIEIR's estimation of the impacts of various government policies on gas demand. These were discussed in section 4.1.2. As noted there, while the NIEIR report identifies a number of energy efficiency measures and policies on gas demand that have the potential to impact on gas demand, the bases for assumptions regarding the quantitative impacts attributed to particular interventions are generally not explained.

A check on the reasonableness of the forecast assumptions can be made by comparing the historical rate of decrease in average consumption with the rate assumed in the forecast. This comparison is shown in Figure 13. Based on the data set out Table 4.4 of the NIEIR report, the average rate of gas consumption per residential customer fell by 2.0% per year between 1998 and 2009. Over the five-year period from 2005 to 2009 the rate of decline was also 2.0%. However, the average rate of reduction in gas consumption per residential customer forecast by NIEIR over the period 2010 to 2016 is 3.4%. While NIEIR discusses a number of factors contributing to the downward trend in average consumption, most of these have been apparent over the course of the current access arrangement period. NIEIR argues—with reasonable justification—that the historical trend toward lower average consumption levels will continue in the future. However, we do not consider that NIEIR has provided any rationale for the sharp *increase* in the rate of decline that they are forecasting over the next access arrangement period.

Figure 13 **Historical and forecast average gas consumption for residential customers**



Data source: (NIEIR, 2010) Table 4.4, 6.2, 6.3, 6.4

Envestra was asked to explain why it has assumed a sharp acceleration in the rate of decline of average residential gas consumption. Its response was as follows:

> "Envestra expects average consumption to decline at an accelerated rate in the 2010-16 period relative to the current access arrangement period. This reflects, to a large extent, the continually evolving policy framework that is aimed at lowering carbon emissions (including policies impacting on appliance choice and efficiency). Envestra holds the view that, particularly given the delay in the CPRS, such direct policy measures will most likely be strengthened going forward (as has occurred over the current period).
>
> What is clear is that average consumption has continued to decline over the past 10 years and that the rate of decline is increasing (as policy becomes increasingly focussed on lowering emissions). While the average decline over the 1998 to 2009 period has been 2% per year, since 2004 (mid way through this period) the decline has been 2.4% per year (as opposed to 1.7% per year up to 2004). Over the current access arrangement period, the reduction in average consumption has increased to 2.6% per year.
>
> NIEIR's forecast over the 2010 to 2016 is consistent with the observed accelerated decline in average consumption. This implies that, as has occurred in the past, policy/incentives aimed at lowering carbon emissions will continue to be strengthened over the next regulatory period (in addition to the other factors impacting gas demand such as the continual shift towards reverse cycle air-conditioning)."

We have significant concerns with regard to both the data on which these conclusions are based and the conclusions themselves.

First, with regard to the data, Table 4.4 of the NIEIR report purports to show average annual residential consumption based on weather normalised data. We have sought to replicate these averages using the customer numbers set out in Table 6.2 and the weather normalised consumption data set out in Table 6.3 of the NIEIR report. The calculated averages differ significantly from those quoted in Table 4.4. The comparison is shown in the following table:

Table 4 **Comparison of quoted and calculated average residential customer consumption rates**

	NIEIR Table 4.4 (GJ/a)	Calculated from NIEIR data (GJ/a)
2006	22.0	21.46
2007	21.1	21.75
2008	20.6	20.80
2009	20.0	20.49

Data source: NIEIR report, Tables 4.4, 6.2, 6.3

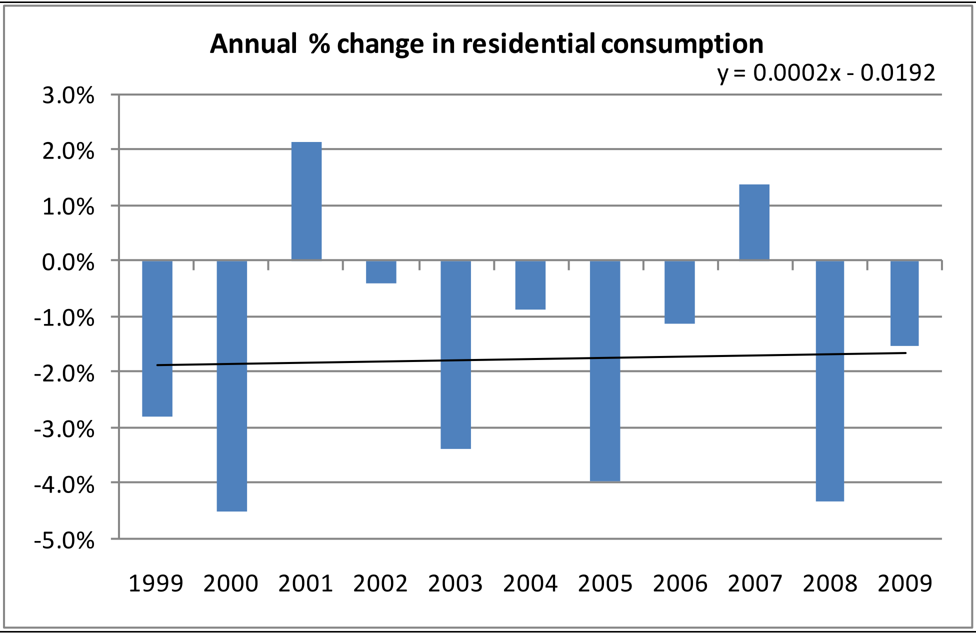
Note: ACIL Tasman does not have access to weather normalised consumption data prior to 2006, and so has not extended this analysis to earlier years.

Envestra appears to place considerable weight on the supposed increasing rate of decline of residential consumption, noting that: "While the average decline over the 1998 to 2009 period has been 2% per year, since 2004 (mid way through this period) the decline has been 2.4% per year (as opposed to 1.7%

per year up to 2004)". However if the averages calculated from the actual customer numbers and weather normalised consumption data tabulated by NIEIR are adopted, the assertion that the rate of decline is increasing cannot be supported. The rate of decline from 2004 (22.6 GJ/a) to 2009 (20.49 GJ/a) is then not 2.4% per year but 1.9%.

If the calculated average residential consumption rates for 2006 to 2009 are substituted for the corresponding values in Table 4.4 of the NIEIR report, and the year-on-year changes calculated, no acceleration of the rate of increase is apparent. This is illustrated in Figure 14.

Figure 14 **Annual changes in residential consumption 1999–2009**



Data source: NIEIR report, Tables 4.4, 6.2, 6.3

Note: Average consumption based on weather normalised data

Envestra argues that the rate of reduction in residential consumption will accelerate because "policy/incentives aimed at lowering carbon emissions will continue to be strengthened over the next regulatory period (in addition to the other factors impacting gas demand such as the continual shift towards reverse cycle air-conditioning)". The following are cited as examples of policies that will increase the rate of reduction in average residential consumption:

- increase in solar gas hot water heating
- shift to 6 Star building standards
- review of Minimum Energy Performance Standards
- carbon pricing.

ACIL Tasman agrees that such policies will continue to reduce average consumption levels for residential customers. However, we do not consider that any persuasive evidence has been presented to support a sharp increase in the rate of reduction from the historical average of 2.0% to the 3.4% implicit in the residential demand forecasts. Accordingly, we consider that the Tariff V Residential forecast should be adjusted to reflect the long run historical rate of decline which is around 2.0% per year (1.8% per year if the average of 20.49 GJ/a for 2008-09 is adopted).

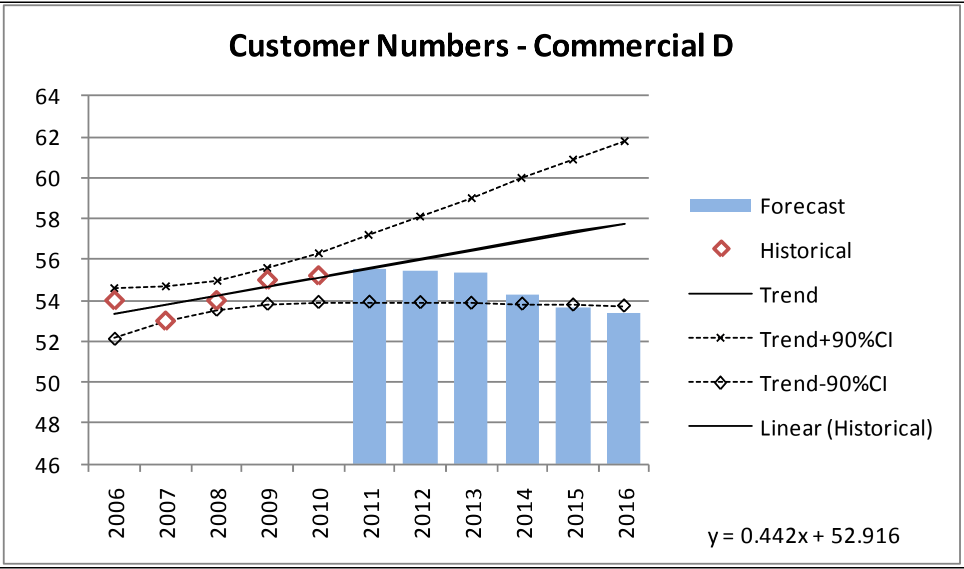
5.3 Tariff D customer forecasts

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 15 shows the actual and forecast customer numbers for the Tariff D Commercial customer class. The low customer numbers forecast in the second half of the next access arrangement period appear to reflect the very low South Australian economic growth forecasts adopted by NIEIR that were discussed in section 5.2.1. *Again, to the extent that the NIEIR is forecast of South Australian GSP is excessively pessimistic, the forecast for Tariff D commercial customer numbers is likely to be understated.*

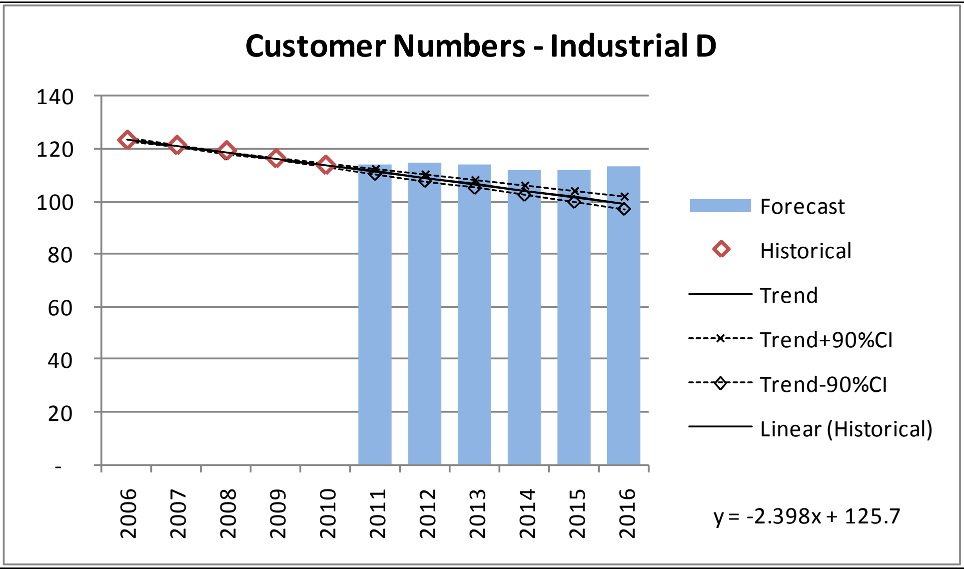
Figure 15 **Actual and forecast Tariff D Commercial customer numbers**



Data source: (Envestra, 2010a); (NIEIR, 2010); ACIL Tasman analysis

The corresponding actual forecast customer numbers for the Tariff D Industrial class are shown in Figure 16.

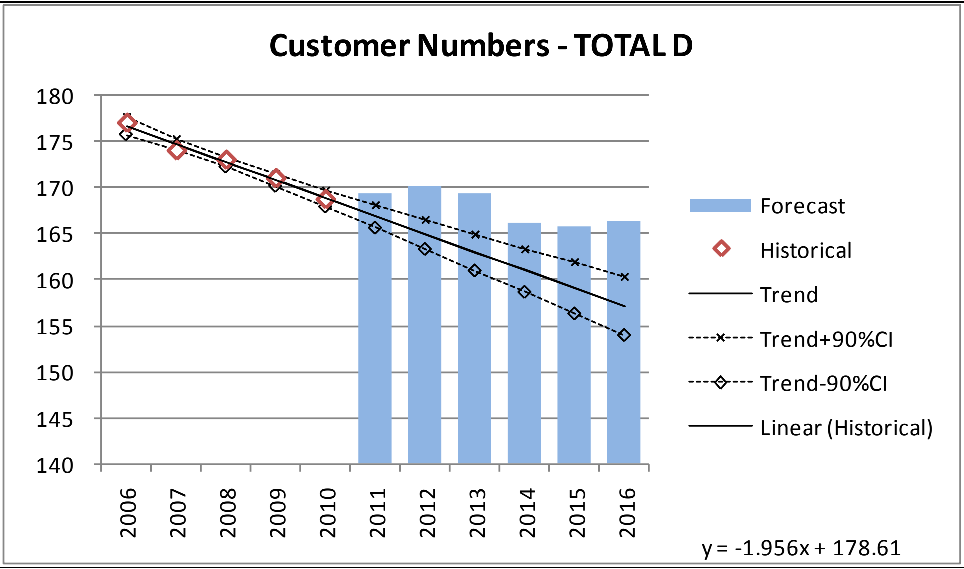
Figure 16 **Actual and forecast Tariff D Industrial customer numbers**



Data source: (Envestra, 2010a); (NIEIR, 2010); ACIL Tasman analysis

In this instance and despite the low economic growth forecast adopted by NIEIR, the forecast of customer numbers rises significantly above the long-term trend. In aggregate, the decline in customer numbers in the Tariff D Commercial class below the historical mild growth trend is offset by forecast stabilisation of customer numbers in the Industrial sector, so that the overall forecast of customer numbers in the Tariff D sector exceeds the historical trend (Figure 17).

Figure 17 **Actual and forecast Tariff D Aggregate customer numbers**



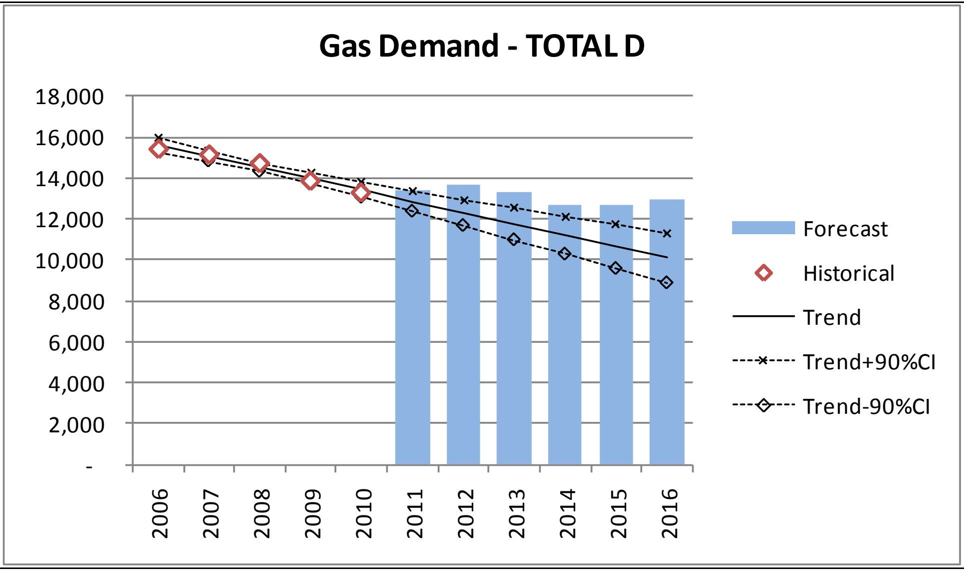
Data source: (Envestra, 2010a); (NIEIR, 2010); ACIL Tasman analysis

5.3.2 Tariff D gas demand

NIEIR has assumed that gas demand in the Tariff D sector is not significantly affected by weather and accordingly the demand forecasts for this sector are not weather normalised. Based on experience in other gas distribution networks, this is likely to be a reasonable assumption for most Tariff D customers, although some large commercial sites (for example, hospitals) may have a significant space heating load resulting in some degree of weather sensitivity.

The demand forecasts for the Tariff D customer group in aggregate are shown in Figure 18. The forecast anticipates a stabilisation of the clear downward trend in gas consumption commercial and industrial sector that has been apparent over the past five years. Accordingly, forecast consumption lies above the historical trend and outside the upper bound of the 90% confidence interval. This break in trend may be explained by Envestra's proposed gas marketing initiatives, as well as cyclical economic recovery.

Figure 18 **Tariff D aggregate demand forecast (Commercial and Industrial)**



Data source: (Envestra, 2010a); *(NIEIR, 2010)*; ACIL Tasman analysis

In light of these considerations we conclude that the Envestra forecast demand in the Tariff D sector is not unreasonable.

5.3.3 MDQ forecasts for Tariff D customers

Relationship between MDQ and gas demand

While it is important to consider the volume forecasts for Tariff D customers, it is the forecasts of Maximum Daily Quantity (MDQ) 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 (MDQ) used, rather than the physical quantity of gas delivered.

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

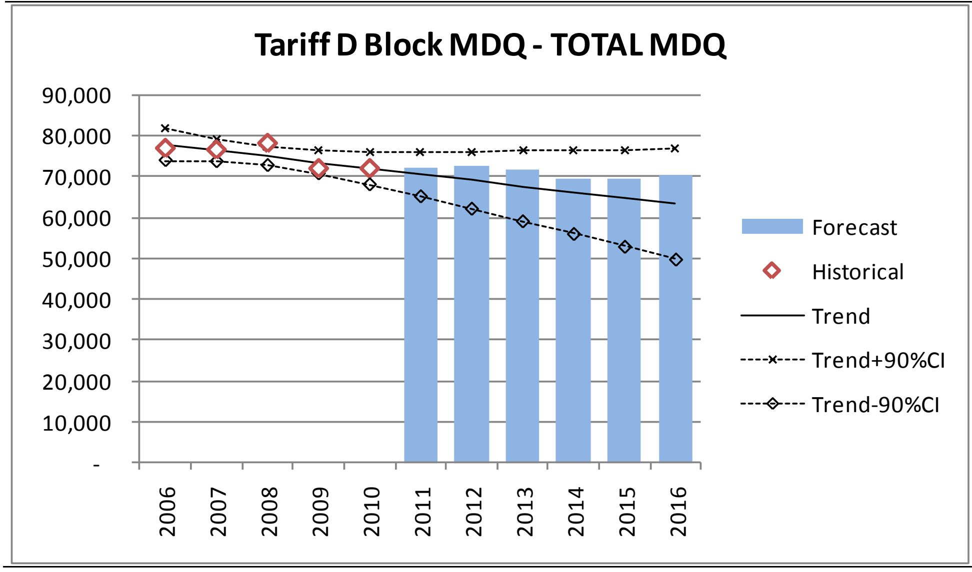
Hence the loss or gain of a demand customer has an impact on aggregate system MDQ requirements that is not necessarily proportional to the corresponding impact on total gas demand. A very low load factor customer such as a peaking electricity generator may have a large MDQ requirement, but may consume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

The impact of changes in MDQ 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 MDQ requirement may vary depending on where that requirement is located within the system.

MDQ history and forecast

Historical and forecast MDQ for the Tariff D customer group as a whole is shown in Figure 19. The forecast of MDQ lies slightly above the historical trend, well within the bounds of the 90% confidence interval.

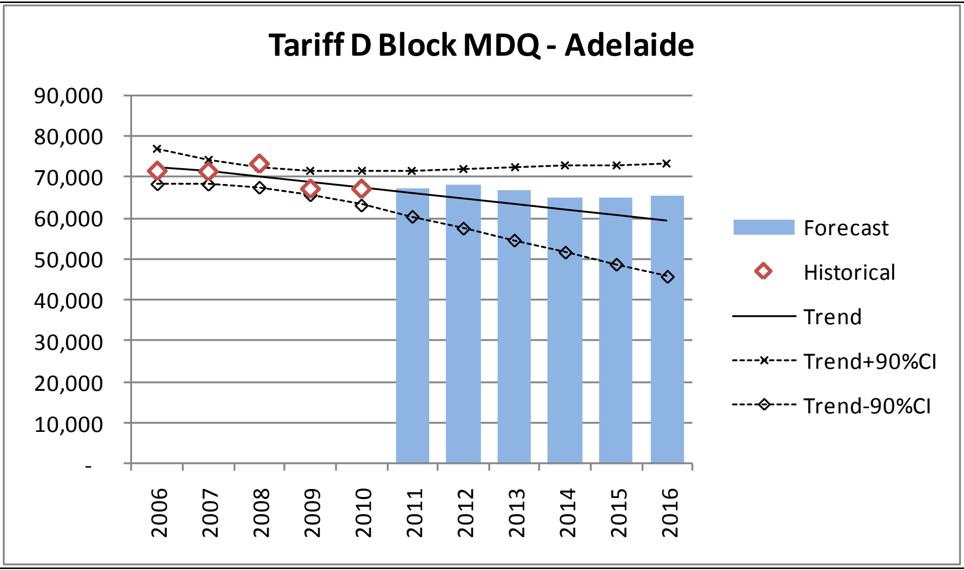
Figure 19 **Tariff D Customer Maximum Daily Quantity (MDQ)—TOTAL**



Data source: (Envestra, 2010a); (NIEIR, 2010); ACIL Tasman analysis

The historical data and forecasts for South Australia have in broken down into six regions: Adelaide, Petersborough, Port Pirie, Riverland, South East and Whyalla. The corresponding forecasts are illustrated in the following charts.

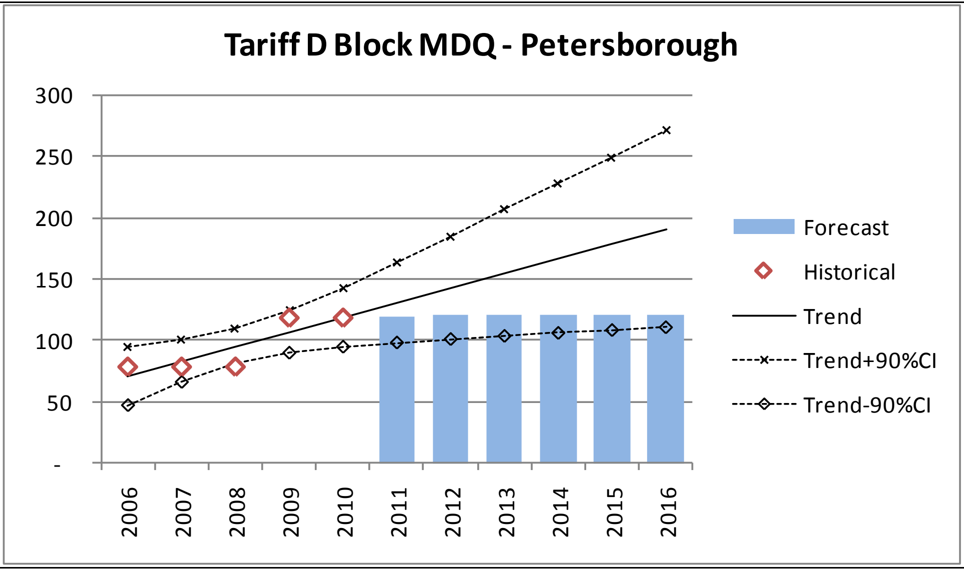
Figure 20 **Tariff D Maximum Daily Quantity (MDQ)—Adelaide**



Data source. (Envestra, 2010a); (NIEIR, 2010); ACIL Tasman analysis

In Adelaide, the MDQ forecast reflects some stabilisation of the mild downward trend that emerged over the current access arrangement period. The forecast MDQ use declines somewhat between 2014 and 2016 as a result of the low rate of economic growth assumed by NIEIR at this time. Nevertheless it remains somewhat above the recent historic trend line.

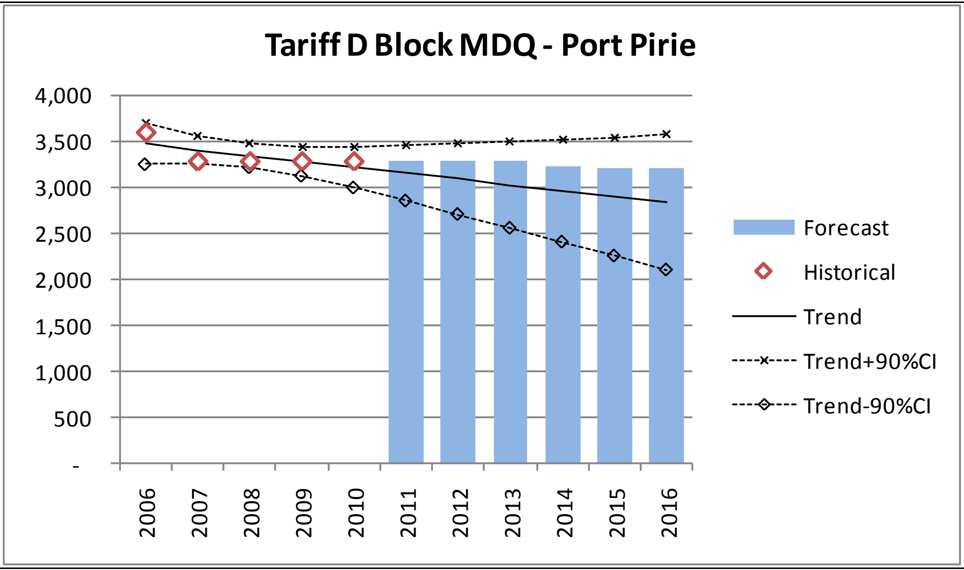
Figure 21 **Tariff D Maximum Daily Quantity (MDQ)—Petersborough**



Data source. (Envestra, 2010a); (NIEIR, 2010); ACIL Tasman analysis

In Petersborough there are a small number of Tariff D customers and a low MDQ requirement; the forecast for the Petersborough region therefore reflects a status quo expectation with stable MDQ requirements.

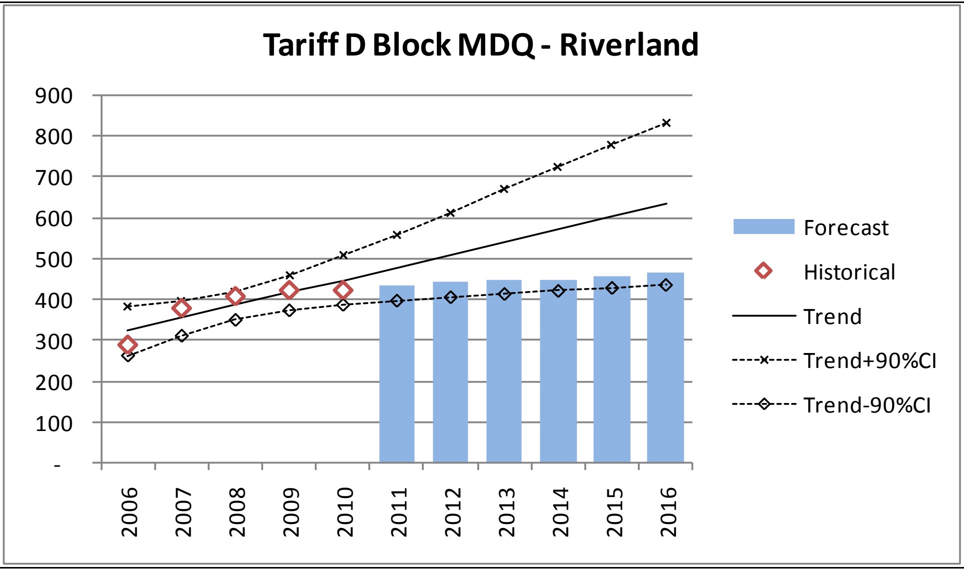
Figure 22 **Tariff D Maximum Daily Quantity (MDQ)—Port Pirie**



Data source. (Envestra, 2010a); (NIEIR, 2010); ACIL Tasman analysis

Port Pirie has a larger MDQ requirement, but again the forecast reflects a status quo expectation with virtually stable MDQ requirements.

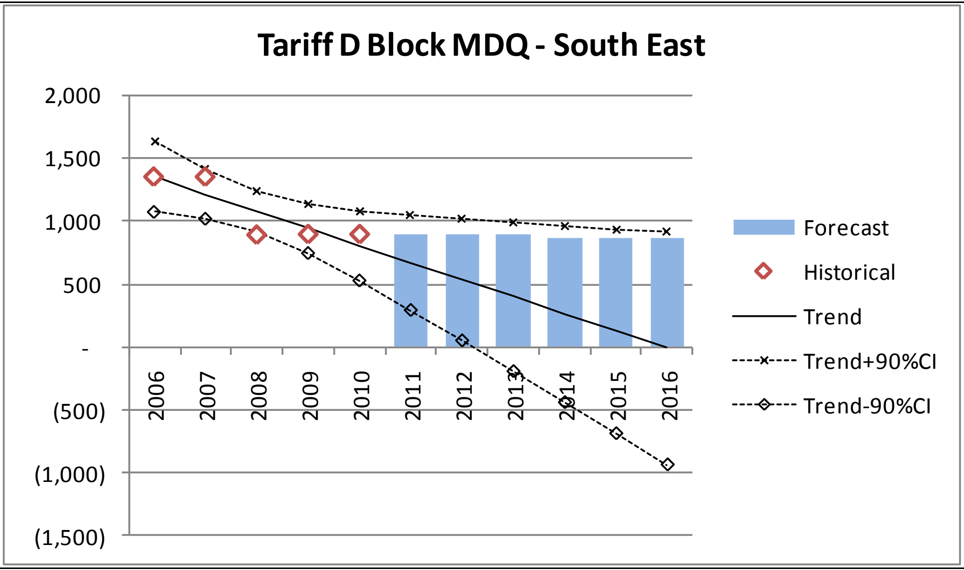
Figure 23 **Tariff D Maximum Daily Quantity (MDQ)—Riverland**



Data source. (Envestra, 2010a); (NIEIR, 2010); ACIL Tasman analysis

The Riverland region has a small MDQ requirement and the forecast reflects an expectation of marginal growth above current MDQ levels.

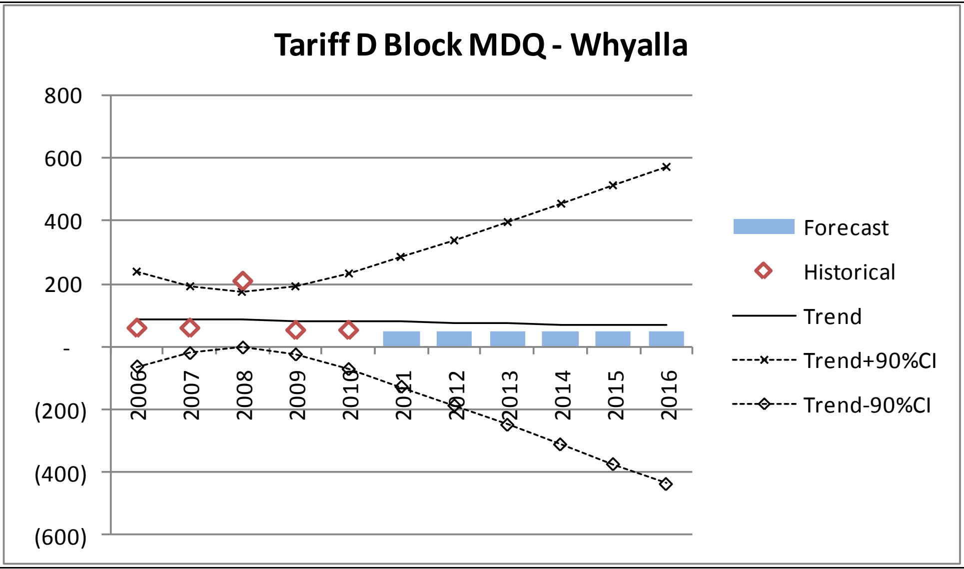
Figure 24 **Tariff D Maximum daily Quantity (MDQ)—South East**



Data source. (Envestra, 2010a); (NIEIR, 2010); ACIL Tasman analysis

In the South East region, the downward trend in the historic MDQ use appears to reflect the loss of one or more significant customers between 2007 and 2008. The forecast reflects an expectation of stable MDQ requirements at levels similar to those seen in 2008, 2009 and 2010. As a result, the forecast lies significantly above the historical trend.

Figure 25 **Tariff D Maximum daily Quantity (MDQ)—Whyalla**



Data source. (Envestra, 2010a); (NIEIR, 2010); ACIL Tasman analysis

Whyalla has only a small number of customers and a very low MDQ requirement; the forecast reflects an expectation of stable MDQ moving forward.

Based on consideration of the forecasts at regional level, we consider that the overall and regional forecasts of Tariff D Customer MDQ are not unreasonable.

6 Conclusions

The demand forecasts presented by Envestra are based on analysis undertaken by NIEIR as reported in Attachment 13.1 to the access arrangement information (NIEIR, 2010).

The forecasts in the NIEIR demand report have been prepared using a well-established and widely accepted methodology. In developing the demand forecasts, NIEIR has given consideration to the key drivers affecting future gas demand. Account has been taken of factors that might cause future gas demand growth to follow a different growth trajectory when compared to past experience. While we consider that the overall approach adopted by NIEIR is methodologically sound, the bases for assumptions regarding the quantitative impacts attributed to particular factors are generally not explained. The main risks to the forecast accuracy relate not to the methodology that has been followed, but to the assumptions regarding specific demand drivers and their impacts on demand. In this regard, the critical assumptions adopted by NIEIR include:

- the overall economic growth outlook in South Australia
- the impact of government policies and alternative technologies on gas demand and on average consumption per customer, particularly in the residential sector
- The specific parameters chose for weather normalization of the historical data on Tariff V residential and commercial customers.

With regard to the economic growth outlook, NIEIR has adopted forecasts that are significantly below recent South Australian government projections and very low compared with average growth in South Australia over the past decade as recorded by the Australian Bureau of Statistics. This has the potential to produce unreasonably low forecasts of gas demand, particularly in the Tariff V Business and Tariff D Commercial customer sectors.

The NIEIR report identifies a number of energy efficiency measures and policies on gas demand that have the potential to impact on gas demand. However, the bases for assumptions regarding the quantitative impacts attributed to particular policy interventions and other demand drivers are generally not explained.

The forecasts of future delivered gas prices used by NIEIR incorporate the potential impact of carbon pricing, and in our opinion are reasonable.

NIEIR has used an established method for weather normalisation of historical data on gas consumption in the Tariff V residential and commercial customer sectors. The EDD formula used by NIEIR is similar to that now used by AEMO for the Victorian gas distribution network. This method has been extensively researched by AEMO. Taking into account the responses to a number of questions about specific assumptions made by NIEIR with regard to EDD parameters, and about the application of the methodology, we consider that the approach that has been taken to weather normalisation to be reasonable.

The most problematic aspects of the forecasts relate to customer numbers in the Tariff V Business and Tariff D Commercial sectors and average gas consumption in the Residential sector.

The Tariff V Business and Tariff D Commercial customer number forecasts both lie well below the lower bound of the 90% confidence interval around the historical trend in the second half of the forecast period. This appears to be directly related to the low economic growth rates assumed by NIEIR.

While the forecast average gas consumption per customer in the Tariff V market as a whole is close to the historical trend, average consumption in the residential sector is projected to fall throughout the forthcoming access arrangement period from 18.89 GJ/year in 2010 to 15.89 GJ/year by 2016—a decline of 16%. The average rate of reduction in gas consumption per residential customer forecast by NIEIR over the period 2010 to 2016 is 3.4%. This compares to an average rate of reduction of 1.9% per year over the period 2004 to 2009, and 1.8% over the period 1998 to 2009[5].

We do not consider that any persuasive evidence has been presented to support an increase in the rate of reduction of residential consumption to 3.4% per year. Accordingly, we consider that the Tariff V Residential forecast should be adjusted to reflect the long run historical rate of decline of 1.8% to 2.0% per year.

In the Tariff D forecasts, low customer numbers in the second half of the next access arrangement period, particularly for the Tariff D Commercial customers, appear to reflect the very low South Australian economic growth assumptions adopted by NIEIR. When compared with both the long run historical GSP growth rates in South Australia and the current South Australian Government Department of Treasury and Finance forecasts, the NIEIR forecast of South Australian GSP appears to be excessively pessimistic.

5 Based on FY2009 residential customer numbers of 378,249 ((NIEIR, 2010), Table 6.2) and weather normalized residential customer consumption of 7,749 TJ ((NIEIR, 2010), Table 6.3) giving average residential consumption in FY 2009 of 20.49 GJ/a.

If this is accepted then it follows that the forecast for Tariff D commercial customer numbers are likely to be understated.

Subject to satisfactory resolution of these issues, we consider that the proposals by Envestra in relation to demand forecasts for the South Australian gas network business could be regarded as being reasonable.

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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 core 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.

Owen Kelp

Owen Kelp is a Consultant with ACIL Tasman specialising in electricity and gas markets. Owen has worked extensively on energy industry matters and across a broad range of assignments including upstream conventional and coal seam methane economics; market demand, supply and price forecasting studies; strategic reviews; transmission and distribution networks (project evaluation, throughput forecasts, asset sales and due diligence work); project evaluation (financial modelling, market studies and economic benefits);

regulatory and policy change impact studies. Over the last eight years Owen has managed more than 50 energy industry assignments.

He has extensive modelling capability using various software packages and programming languages as well as practical experience with operations research methods including linear programming and optimisation. He also has a good theoretical knowledge of financial markets and instruments. Owen has been principally responsible for the development and maintenance of a number of ACIL Tasman energy market models, in particular:

GasMark Global – ACIL Tasman's global model for gas trade for both LNG and pipeline gas

GasMark – ACIL Tasman's regional model of the interconnected Australian gas market

GasMark New Zealand – supply demand model for the New Zealand system

PowerMark – detailed model of the National Electricity Market used for price forecasting and asset due diligence

PowerMark WA – detailed model of the Western Australian electricity market.

Owen holds a Bachelor of Business (Economics and Finance) from Queensland University of Technology and a Graduate Diploma of Applied Finance and Investment from the Financial Services Institute of Australasia (FINSIA).

B 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

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