Stage 2 report to

Essential Services Commission of South Australia

Demand forecasts for the Envestra gas distribution network in South Australia

21 March 2006

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

EXECUTIVE SUMMARY

Introduction

The Essential Services Commission of South Australia (the Commission) regulates third party access to the South Australian gas distribution networks through approval of Access Arrangements. Envestra, the natural gas distributor for Adelaide and other regions of South Australia, has submitted proposed Access Arrangement revisions covering the period 1 July 2006 to 30 June 2011.

The revisions include forecasts of gas demand for three Reference Tariffs: Domestic Haulage for residential customers; Commercial Haulage for small business customers consuming less than 10 TJ pa; and Demand Haulage for customers consuming more than 10 TJ pa. Demand forecasts are important in setting reference tariffs. The Commission has engaged McLennan Magasanik Associates (MMA) to evaluate whether the forecasts proposed by Envestra meet the required criterion of the Gas Code, to be considered "best estimates arrived at on a reasonable basis[1]".

In its Stage 1 report MMA reviewed the approach, methodology and assumptions used by Envestra in preparing its forecasts and concluded that the Envestra forecasts did not meet the above criterion. MMA recommended to the Commission that the Envestra forecasts be considered to not meet the requirement. The Stage 1 report set out the reasoning behind this conclusion in each of the Domestic, Commercial and Demand markets and provided specific recommendations on how the Envestra forecasts could be amended in order to be considered by MMA to meet the Code requirements.

Envestra was provided with a copy of the Stage 1 report and made a detailed response to it. After taking into account the response made by Envestra, MMA was still of the opinion that the forecasts prepared by Envestra did not meet the Code requirements. MMA was then asked by the Commission to prepare forecasts for the Envestra network which MMA considered did meet the Code requirements.

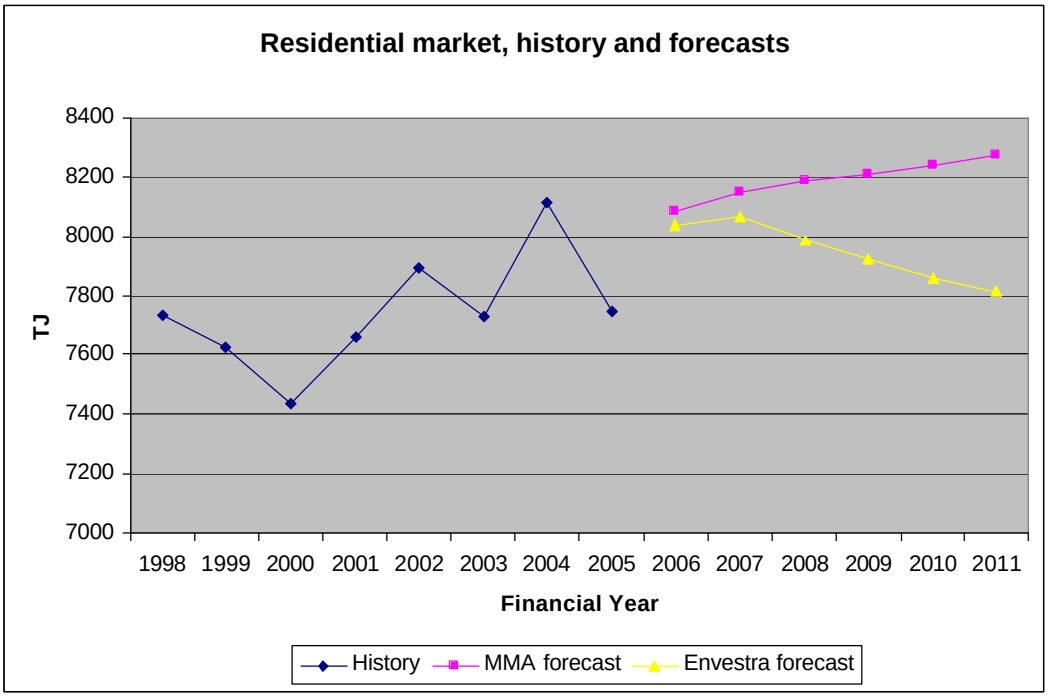
This Stage 2 report sets out MMA forecasts for the Domestic, Commercial and Demand Haulage reference tariffs. The MMA forecasts are derived largely from the assessments, conclusions and recommendations made in the Stage 1 report and take into account comments and information provided by Envestra in its response to that report and also subsequent responses and debate. The Executive Summary describes only the forecasts. Some references to the Envestra responses are made in the main text of the report.

1 This is referred to as the Code requirement.

Residential market

The history of the residential market and the MMA and Envestra forecasts are provided in Exec Figure 1. Historical data have not been weather normalised, however, forecasts assume normal weather. Note that consumption in new town reticulations is included in both forecasts.

Exec Figure 1 Residential market, consumption history and MMA and Envestra forecasts, TJ



The winter weather in 2005 was very warm resulting in residential usage being less than expected. Both MMA and Envestra have forecast significant increases for the year 2006 because of the assumption of normal weather going forward. However, beyond this point the two forecasts diverge. While MMA is forecasting that the residential market as a whole will grow, Envestra is forecasting that it will fall after 2006/07.

As the assumptions about customer number growth are essentially the same, about 1.9% pa, the difference between the two forecasts is almost entirely due to different assumptions about average usage, for both established homes and new homes. Weather normalised average usage has been declining at about 0.8% pa. Both MMA and Envestra are forecasting that the average usage will decline due to a number of factors including government initiatives. The difference is in the extent. MMA is forecasting that from 2006 average usage will decline at 1.4% pa, which, with a customer number growth rate of 1.9% pa results in overall growth of 0.5% pa. The reasoning behind the MMA forecast

changes in average usage is provided in the body of the report. Envestra has forecast that the average usage will, from 2006, decline at about 2.5% pa, which, with customer number growth of 1.9% pa results in a net residential market decline of 0.6% pa.

The MMA consumption, average usage and customer number forecasts for the residential market are provided in Exec Table 1 together with the forecast of new residential customer connections

Exec Table 1 MMA forecasts of residential market consumption, TJ, average usage per customer, GJ and customer numbers

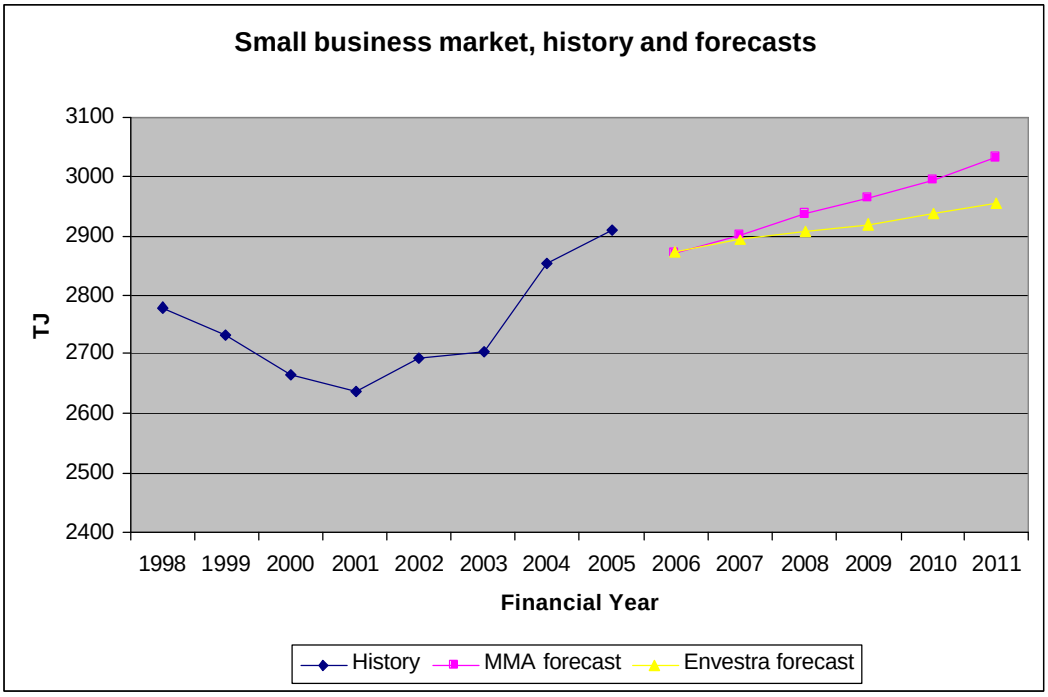
	2005*	2006	2007	2008	2009	2010	2011
Consumption, TJ	7745	8085	8147	8188	8210	8241	8274
Average usage per customer, GJ	22.2	22.8	22.5	22.2	21.9	21.6	21.2
Residential customers	348844	355005	361742	368843	375265	382348	389618
New connections		7816	8392	8756	8077	8738	8925

* Actual consumption, not weather normalised, and customer numbers in 2005. Forecasts include new town reticulations.

Small business market

The history of the small business market from 1998 to 2005 and the MMA and Envestra forecasts for the market are provided in Exec Figure 2. Again, the historical data has not been weather-normalised.

Exec Figure 2 Small business market, history and MMA and Envestra forecasts, TJ



As can be seen from the Figure, there appears to have been a turn-around in the market about half-way through the period 1998 to 2005, with falls in consumption from 1998 to 2001 followed by increases from 2001 to 2005. The reasons behind this are not clear, but could be due in part to movements between the Commercial and Demand Haulage categories. MMA has forecast the small business market as a whole using the drivers of weather and Gross State Product (GSP). Despite the possibility of a change in key drivers being the cause of the upturn since 2001, MMA has forecast based on the trend over the period 1998 to 2005 and has added to this Envestra's assumptions about the relatively minor growth from reticulation in new townships. Envestra has used a methodology detailed in the Stage 1 report.

Despite the expected return to normal weather in 2006 both MMA and Envestra have forecast a reduction in usage by the market in that year as consumption returns to trend values. Beyond 2006 MMA has forecast growth of an average of 1.1% pa, while Envestra has forecast that growth will be only half this amount. MMA has forecast customer number growth based on historical growth seen over the period 1998 to 2005.

The MMA consumption and customer number forecasts for the small business market are provided in Exec Table 2 together with the forecast of new small business connections.

Exec Table 2 MMA forecasts of small business market consumption, TJ and customer numbers

	2005*	2006	2007	2008	2009	2010	2011
Consumption, TJ	2911	2870	2903	2935	2961	2995	3031
Small business customers	8,509	8,616	8,724	8,843	8,958	9,091	9,204
New connections		306	306	318	314	331	312

* Actual consumption in 2005, not weather normalised. Forecasts include new town reticulations.

Demand market

MMA has forecast the contracted maximum daily quantity (MDQ) for demand customers on a regional and zonal basis by:

- Surveying eighteen of Envestra's largest customers
- Assuming that growth of the remaining small customers will be in line with that seen in recent (limited) MDQ growth history but taking into account the possibility that some of this may have been due to a move from algorithm to telemetry (i.e. measurement) based contracting. This has been further moderated in the Southern Zone because of the relatively small number of smaller Demand customers on which to base growth estimates and uncertainty about prospects there.
- Factoring in closures and curtailments seen over the past year or expected in this year.
- Adding Envestra's forecast growth in new township reticulations in the Southern Zone (McLaren Vale), Riverland Region (Tanunda) and Monarto.

MMA's forecasts, by region and zone, are provided in Exec Table 3.

Exec Table 3 MMA forecasts of contracted MDQ for the Demand market by region and zone, GJ MDQ

	2005*	2006	2007	2008	2009	2010	2011
Adelaide							
Central	11,067	10,494	10,393	10,366	10,312	10,273	10,236
Northern	33,295	32,880	32,844	35,333	35,509	35,701	35,902
Southern	5,410	4,210	4,210	4,310	4,410	4,510	4,610
North Western	17,852	17,800	17,800	17,800	17,800	17,800	17,800
Regions							

	2005*	2006	2007	2008	2009	2010	2011
Peterborough	62	62	62	62	62	62	62
Port Pirie	3597	3596	3596	3596	3596	3596	3596
Riverland	750	750	750	750	750	850	850
South East	930	888	917	948	981	1016	1053
Whyalla	57	57	57	57	57	57	57
Monarto	0	0	0	0	283	378	472
Total	73,020	70,737	70,629	73,222	73,760	74,243	74,639

* Actual MDQ in 2005.

MMA forecasts that there will be growth in MDQ of about 0.4% pa over the period 2005 to 2011. However, this is made up of an initial loss of about 3% in 2006, due to the closures and curtailments at two customers, followed by growth at about 1.1% pa between 2006 and 2011.

Growth is expected to be strongest in the Northern Zone [confidential] the Southern Zone (because of new customers in McLaren Vale) and the South East.

The key difference between the MMA forecasts and the Envestra forecasts are in the Northern Zone [confidential]. The MMA and Envestra forecasts are similar in the Central and North Western Zones and the other regions.

1 INTRODUCTION

1.1 Background

The Essential Services Commission of South Australia (the Commission) regulates third party access to the South Australian gas distribution networks, essentially under the National Third Party Access Code for Natural Gas Pipeline Systems (the Code). Third party access to the Envestra gas distribution network is currently available under an Access Arrangement (AA) approved by SAIPAR, which remains in force until 30 June 2006. Envestra has submitted its proposed AA revisions for the new regulatory period commencing on 1 July 2006. The revised AA must be approved by the Commission according to procedures and criteria set down in the Code.

The tariffs included in the proposed Envestra AA revisions are predicated, in part, on forecasts of demand. Under the Code, demand forecasts are required to be "…best estimates arrived at on a reasonable basis". The Commission has engaged McLennan Magasanik Associates (MMA) to review the demand forecasts provided by Envestra and comment on whether it considers they meet the above criterion.

1.2 Stage 1 report

In the Stage 1 report to the Commission dated 14 November 2005, MMA recommended to the Commission that the Envestra forecasts be considered to not meet the requirements of the Code. The MMA Stage 1 report highlighted MMA's assessment of the areas of deficiency in the Envestra forecasts and made detailed recommendations as to how these deficiencies could be addressed. These recommendations are reproduced below.

MMA recommendations to the Commission:

Forecasts related to the Domestic Haulage Reference Tariff

Recommendation 1: MMA recommends that the Envestra forecasts for the Domestic Haulage Reference Tariff as provided in the Access Arrangement be considered to not meet the Code requirement of "best estimates arrived at on a reasonable basis".

Recommendation 2: New township numbers would need to be included in Envestra's customer number and volume forecasts, both residential and small business.

Recommendation 3: Forecast disconnection numbers would need to be confirmed by Envestra and an acceptable basis for these forecasts provided.

Recommendation 4: If Envestra seeks to separately forecast average usage for established dwellings and new dwellings, the forecast for average usage by established dwellings would need further substantiation and linkage to reference material, in particular the derivation of assumed appliance or household efficiency trends and the income elasticity.

Recommendation 5: In order to allow the proper calculation of average usage for established dwellings over the past few years, the impact of below average usage in new dwellings needs to be taken into account by Envestra.

Recommendation 6: The reduction of average usage by established homes going forward should be the same as that over the recent past, except to the extent that acceptable justification is provided.

Recommendation 7: Forecasts for average usage by new dwellings clearly require considerable further substantiation and linkage to reference material.

Recommendation 8: In the absence of acceptable substantiation by Envestra it is recommended that the only changes to average usage of new homes be the move to 5-star thermal rating, a limited move to solar-gas hot water systems and the assumption that AAA showerheads will be required in plans for new homes from 1 July 2006 (with appropriate implementation time).

Recommendation 9: In the absence of information from Envestra allowing average usage by established and new homes to be properly understood and disaggregated, it is recommended that the existing trend for all homes (i.e. 0.7% to 0.8% pa) be continued with additional reductions for the move to 5-star thermal rating, a limited move to solar-gas hot water and AAA showerheads.

Forecasts related to the Commercial Haulage Reference Tariff

Recommendation 10: MMA recommends that the Envestra forecasts for the Commercial Haulage Reference Tariff as provided in the Access Arrangement be considered to not meet the Code requirement of "best estimates arrived at on a reasonable basis".

Recommendation 11: Envestra should analyse and forecast the small business market as a whole, not divide it into commercial and small industrial.

Recommendation 12: Envestra should either weather normalise the small business market and carry out its analysis on the weather normalised market as a whole or carry out further analysis to demonstrate that this should not be the case. In either case further analysis of the extent of weather sensitivity of the small business market is required.

Recommendation 13: Envestra should select a forecasting methodology which it can demonstrate balances the recent history with changes to key drivers. MMA considers that a time or economic based trend, based on weather normalised historical data, would be appropriate.

Recommendation 14: Envestra should confirm the validity and consistency of the data provided, especially for the years 1998, 1999 and 2005.

Recommendation 15: If Envestra elects to forecast using commercial and/or industrial outputs as a key driver it should derive appropriate elasticities from available data rather than assume them.

Recommendation 16: Average usage for the small business market as a whole has remained reasonably constant over the past several years. Envestra should assume that the average usage will stay constant in deriving its net customer numbers.

Forecasts related to the Demand Haulage Reference Tariff

Recommendation 17: MMA recommends that the Envestra forecasts for the Demand Haulage Reference Tariff as provided in the Access Arrangement be considered to not meet the Code requirement of "best estimates arrived at on a reasonable basis".

Recommendation 18: Envestra should be asked to prepare consistent historic consumption information for the period 1998 to 2005. Envestra should also be asked to attempt to get MDQ data, going back to 1998 as well.

Recommendation 19: Envestra should hold discussions with its largest 10 to 20 customers, or the retailer to these, to ascertain gas consumption and MDQ expectations and likelihood of expansions, closures and relocations over the next 5 – 6 years. Envestra should document the outcomes of these discussions and also prepare a

summary spreadsheet of the expectations for both consumption and MDQ.

Recommendation 20: Envestra should prepare a summary of consumption by all other customers from 1998 to 2005 and attempt to relate these to either time or economic parameters. Forecasts of consumption can then be prepared.

Recommendation 21: Any changes in the load factors of these other customers should be taken into account in preparing MDQ forecasts.

1.3 Response by Envestra

The MMA Stage 1 report was provided to Envestra for comment. Envestra responded to the MMA report, and in particular to each of the recommendations, on 25 November 2005.

The comments received from Envestra included the provision of some further information and analysis, corrected some information included in its Access Arrangement Information (AAI) and made reference to a separate study being undertaken by the National Institute of Economic and Industry Research (NIEIR), which became available in December. MMA has not prepared a detailed review of the NIEIR report.

Upon reviewing the comments received from Envestra, MMA was still of the opinion that the forecasts provided by Envestra did not meet the requirements of the Code.

The Commission has asked MMA to prepare a Stage 2 report including independent forecasts, which MMA considers do meet the requirements of the Code.

1.4 Stage 2 report containing MMA forecasts

This report provides the MMA forecasts for the Envestra distribution networks. It should be read in conjunction with the Stage 1 report previously provided to the Commission, which sets out historical demand for each of the Reference Tariffs and MMA's views on key drivers, methodology and assumptions.

The Stage 2 report is laid out as follows,

Chapter 2 provides MMA forecasts for the Domestic Haulage market.

Chapter 3 provides MMA forecasts for the Commercial Haulage market.

Chapter 4 provides MMA forecasts for the Demand Haulage market.

The Stage 2 report takes into account comment provided by the Commission and information and comment provided by Envestra in its responses to the Stage 1 report and subsequently to MMA's Stage 2 report dated 23 December 2005. Where appropriate this is referred to in the individual chapters.

Concurrently with MMA's preparation of independent forecasts for the Commission, Envestra requested the National Institute of Economic and Industry Research (NIEIR) to prepare customer and sales forecasts for the South Australian gas distribution networks. Envestra made the NIEIR report[1] available to the Commission and to MMA on 6 December 2005. MMA has not undertaken a detailed review of the NIEIR forecasts, as it is not within the scope of this project to comment on whether the NIEIR forecasts are consistent with the requirements of the Code. Nevertheless, MMA has considered the NIEIR report to ensure that any new material or information was taken into account in the MMA forecasts.

1.5 Conventions followed and reliance

As in the Stage 1 report all the analysis has been carried out using financial year data. Unless otherwise specified all results and tables refer to financial years. The convention followed in the report has been to refer to the financial year as either both the years covered or as the year which contains the 30th June. Thus, the financial year commencing 1 July 2003 and concluding on 30 June 2004 is referred to in the text as either 2003/04 or 2004.

We have in some cases derived relationships which use logarithmic functions. Generally we use the natural logarithm (ln) for these relationships but sometimes refer to them as log.

[*Confidential Information removed*]

Tables and percentages may not appear to completely reconcile in some cases. This could be for a number of reasons including rounding and use of trend estimates. Actual results for 2005, generally not weather normalised, are often included in Tables with forecasts which are weather normalised.

We have generally relied on the accuracy of the historical data provided by Envestra. While we have reviewed the forecasts we have generally not reviewed the historical data and have commented only where data appears anomalous.

[1] Natural gas forecasts for the Envestra distribution region to 2015. A report for Envestra. NIEIR, November 2005

2 DOMESTIC HAULAGE MARKET

2.1 MMA Stage 1 Conclusions

In its Stage 1 report MMA concluded that the methodology used by Envestra for the domestic haulage market could, in most cases, be considered reasonable, but that the assumptions used in modelling average usage per customer were not considered to be "best estimates".

As has been the case for the Envestra forecasts and the MMA analysis in Stage 1, the customer number and average usage components of the Domestic Haulage market have been forecast separately.

2.2 Customer numbers

2.2.1 Reticulated areas

In the Stage 1 report it was noted that residential customer numbers had grown at about 1.8% pa over the period 1998 to 2005 and that Envestra had forecast that they would continue to grow at about the same rate.

MMA has assessed Envestra's forecast residential customer number growth rate, of about 1.8% pa excluding customer growth in newly reticulated areas (new townships), to be reasonable (MMA Stage 1 report Section 4.3). Despite a minor slow-down expected in new home dwelling growth, overall customer numbers were expected to continue to grow at about the same level as over the current regulatory period because of high penetration of new dwellings and potentially increased levels of "electric to gas" conversions because of Government policy related to hot water installations.

2.2.2 New townships

Envestra proposes to reticulate three new townships, Tanunda, Monarto and McLaren Vale, during the next regulatory period. In the Stage 1 report it was noted that the Envestra customer number forecasts provided in the Access Arrangement Information (AAI) did not include the customer numbers forecast to connect in these townships and a recommendation made that these be included.

Recommendation 2: **New township numbers would need to be included in Envestra's customer number and volume forecasts, both residential and small business.**

Envestra has stated that while its New Township customer number forecasts were included in the revenue model provided to the Commission on 20 October 2005, they were inadvertently omitted from the Attachment to the AAI.

MMA has included the Envestra forecasts for new township customer numbers within its forecasts.

2.2.3 MMA forecasts of residential customer numbers

The MMA forecasts of residential customer numbers are provided in Table 2-1. They are the same as the Envestra forecasts including new townships.

Table 2-1 Residential customer number forecast, financial years

	2005*	2006	2007	2008	2009	2010	2011
Reticulated areas	348844	355005	361742	368678	374974	381841	388924
New townships				165	291	507	694
Total	348844	355005	361742	368843	375265	382348	389618

* Actual numbers for 2005.

Residential customer numbers are forecast to grow at about 1.9% pa over the period 2005 to 2011.

2.2.4 New residential customer connections

For the purpose of forecasting both capital expenditure and average usage a forecast of new customer connections is required. This is derived from a combination of net customer growth (given in Table 2-1) together with an estimate of disconnections.

Envestra has assumed in its modelling that residential disconnection numbers will be 1650 customers per year. This appeared inconsistent with some of the information provided in the AAI. As a result MMA made the following recommendation in its Stage 1 report.

Recommendation 3**: Forecast disconnection numbers would need to be confirmed by Envestra and an acceptable basis for these forecasts provided.**

In its response Envestra has stated that it has assumed in its modelling that the residential disconnection numbers will be 1650 pa and commercial and small industrial will be 238 pa, based on history.

Envestra has provided the history of disconnection numbers for residential, commercial and small industrial customers from 1999 to 2005 (residential) and from 2001 to 2005 (small business). While the basis on which Envestra has chosen the disconnection numbers it has assumed is unclear, for the residential market the 1650 chosen is similar to the 1655 average disconnections over the period 2001 to 2005. MMA considers it reasonable to use the 5-year average disconnection number for residential customers.

Table 2-2 New residential customer connections, 2006 to 2011

	2006	2007	2008	2009	2010	2011
Gain in net residential customers	6161	6737	7101	6422	7083	7270
Disconnections	1655	1655	1655	1655	1655	1655
New customer connections	7816	8392	8756	8077	8738	8925

MMA also considers it reasonable to use a similar approach for small business customers and has used the 5-year average of 199 disconnections for this market (see Section 3.3).

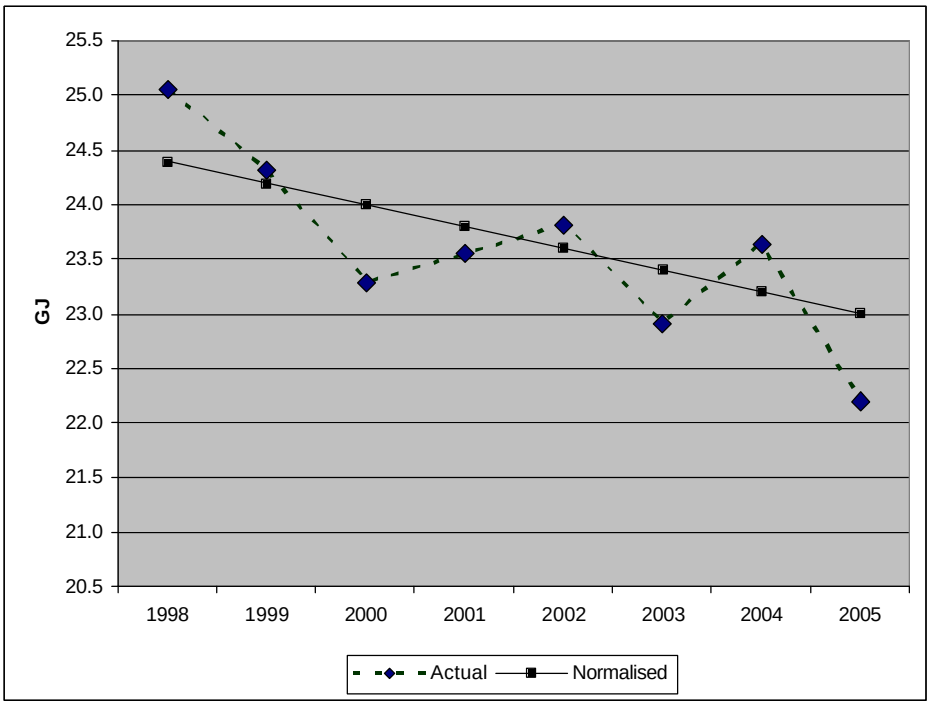
2.3 Average usage

2.3.1 Weather trend and normalisation

MMA's analysis of weather trends and derivation of weather normalisation models are presented in APPENDIX A . A warming trend of 2.86 HDDs /year or 0.3%/year has been used to derive both weather normalised historical and forecast average usage.

Actual and trend weather normalised[2] annual average usage over the period 1998 to 2005 are shown in Figure 2-1.

Figure 2-1 Actual and weather normalised residential average usage (GJ)



2 MMA's weather normalisation methodology simultaneously normalises and estimates a trend. Non-trended normalisations can be constructed using weather sensitivity coefficients but are not presented in this report.

Normalised usage exhibits a downward trend at a rate of 0.8% pa, considerably less than the downward trend of 1.7% pa evident in actuals before accounting for weather variation. The trend normalised usage in 2005 is estimated to be 23.02 GJ pa.

2.3.2 Forecast methodology

Envestra has prepared separate forecasts for three residential market sub-sectors: established dwellings, new dwellings and new townships. Established dwellings includes only customers already connected in 2004/05, adjusted for disconnections, and new dwellings is comprised of new homes and new connections to existing dwellings. The number of customers anticipated in new townships is low, less than 2% of total new connections.

MMA has adopted the same market disaggregation. Envestra has forecast average usage for new townships to be significantly higher than that for existing users. MMA cannot understand the rationale for this assumption and has instead used the average for the network as a whole for new townships.

2.4 Average usage - new dwellings

2.4.1 MMA Stage 1 recommendations and the Envestra response

MMA made the following recommendations in its Stage 1 Report.

Recommendation 7: Forecasts for average usage by new dwellings clearly require considerable further substantiation and linkage to reference material.

Recommendation 8: In the absence of acceptable substantiation by Envestra it is recommended that the only changes to average usage of new homes be the move to 5-star thermal rating, a limited move to solar-gas hot water systems and the assumption that AAA showerheads will be required in plans for new homes from 1 July 2006 (with appropriate implementation time).

Recommendation 9: In the absence of information from Envestra allowing average usage by established and new homes to be properly understood and disaggregated, it is recommended that the existing trend for all homes (i.e. 0.7% to 0.8% pa) be continued with additional reductions for the move to 5-star thermal rating, a limited move to solar-gas hot water and AAA showerheads.

In its responses Envestra has provided further information and references in relation to the above, which have been considered in deriving the MMA forecast. MMA's new dwellings average usage forecast is based upon considerations similar to Envestra's new dwellings forecast. The key input assumptions have been derived through the following process:

- Determining current/historical new dwellings usage
- Assessing influences on the future usage trend including:

- Gas appliance penetration
- Higher thermal efficiency of dwellings
- Appliance efficiency and minimum efficiency performance standards
- Policy initiatives favouring solar hot water and encouraging water conservation
- Potential socio-economic impacts.

2.4.2 Current/historical usage

Envestra has provided two sets of estimates of gas usage in new dwellings over the past three years (Table 2-3):

- In its "Detailed Response to MMA Stage 1 Review of Demand Forecasts", usage by a sample of new dwellings whose first full year of consumption was 2002/03, called the 2001 sample. It is understood that the figures are weather normalised.
- In the workbook "SA average consumption 2002-03 to 2004-05", usage by new dwellings whose first full years of consumption were 2003/04 and 2004/05 respectively. The weather normalised values in the table are MMA estimates as Envestra's workbook incorrectly multiplies the normalised values by 0.96.

Table 2-3 Weather normalised new dwellings gas usage, GJ

First connected	Average usage in full year			
	2002/03	2003/04	2004/05	Average since connected
2001/02	19.8	21.2	n/a*	20.5
2002/03	n/a	18.9	19.6	19.3
2003/04	n/a	n/a	18.9	18.9

* Data not provided

Two factors are apparent: new dwellings usage is lower than the average across all dwellings; and there is potentially a downward trend paralleling the year of connection. For forecasting purposes the three estimates in the right-hand column have been used to calibrate MMA's new dwellings usage model, as described in section 2.4.7.

2.4.3 Gas appliance penetration in South Australia

Some appliance penetration data from the ABS was provided in MMA's Stage 1 report to help objectively assess claims of significant movements away from natural gas appliances. Since the Stage 1 report was prepared, updated ABS data have become available through the release on 30 November 2005 of the ABS 4602.0 publication using

survey data from March 2005. [3] This allows the conclusions from that section of the report to be updated.

The ABS 4602.0 publication now compares data from similar surveys in 2005, 2002, 1999 and, for some questions, 1994. Some of the information of interest is provided in Table 2-4 and Table 2-5.

Table 2-4 Information about appliance penetration in South Australia, %

South Australia	Jun-94	Mar-99	Mar-02	Mar-05
Gas as a source of energy in dwellings*			64.4%	68.1%
Gas as main source of energy used in cooking* ^		47.6%	49.7%	46.8% - 52.4%^
Gas as source of energy used in heating water*#	47.7%	47.0%	49.2%	50.8%
Gas as main source of energy used in space heating*	33.3%	32.3%	32.7%	33.3%
Proportion with Reverse cycle / heat pump	52.9%	35.4%	50.5%	53.4%

Source ABS 4602.0, March 2005. * Note that for the first time in 2005 LPG is separated from mains gas. In order to allow comparison we have combined the two where appropriate. ^ Note that for the first time in 2005 the main source of energy used in cooking has allowed a choice of electricity and gas combined. 5.6% of respondents chose this option. # Note that solar was a separate item in this question so presumably gas-boosted solar units are counted separately.

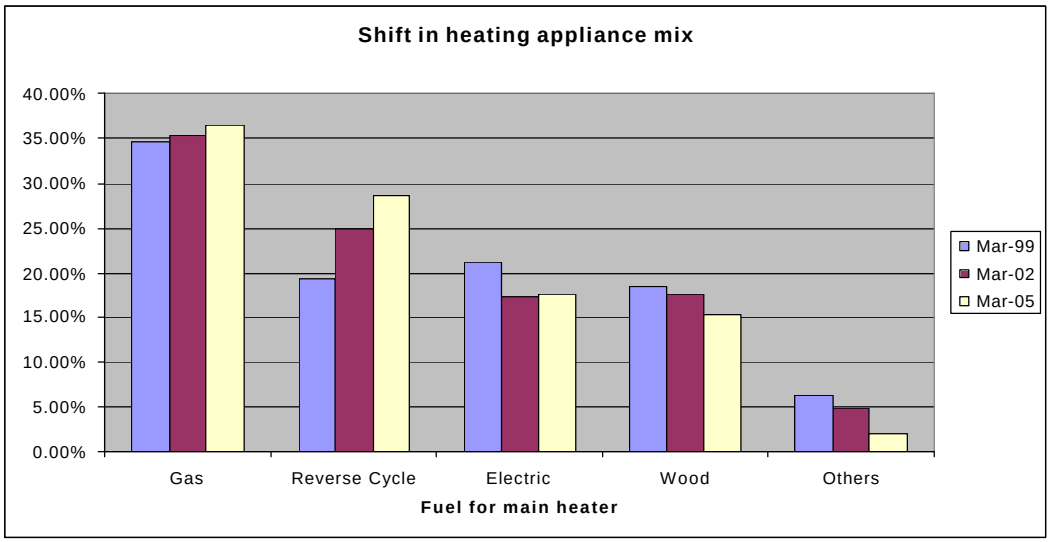
Although these statistics do not all show obvious trends[4] they do show that over the period 1999 to 2005 the proportion of households which used gas as a main source of energy in cooking, heating water and space heating at least held steady for the state as a whole.

This statistic is especially interesting for the heating market where reverse cycle air conditioning penetration has certainly increased over the period 1999 to 2005. However, as can be seen from Figure 2-2 this appears to have taken market share away from electricity, wood and other fuels rather than from gas.

3 Australian Bureau of Statistics, publication 4602.0, "Environmental issues, people's views and practices" March 2005, released on 30 November 2005.

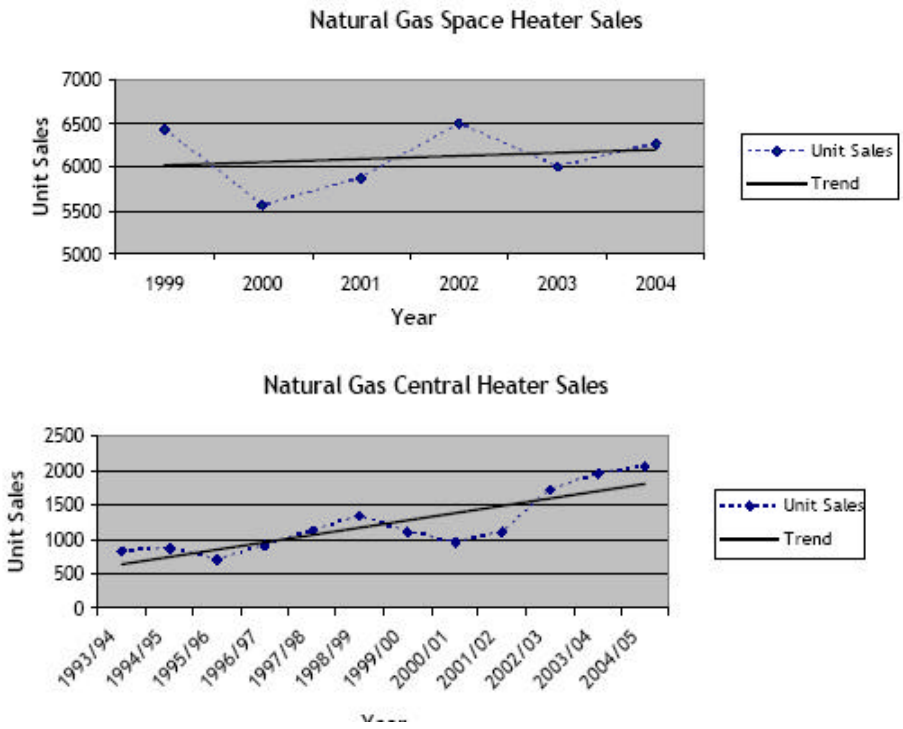
4 For example LPG has been likely to be included with mains natural gas until 2005 and there has been no compensation for changes to gas penetration of residential homes over time.

Figure 2-2 Shift in heating appliance mix, %



Source ABS 4602.0, March 2002

Indeed, two graphs provided by Envestra as evidence that heating sales are stagnant (reproduced below) actually suggest that gas heater sales in combination, over the period 1999 to 2004 have increased at a rate faster than the rate of customer growth.



Source Envestra Average residential gas consumption in South Australia, page 11.

Although such statistics are by no means conclusive they indicate that care must be taken in forecasting significant shifts in penetration without providing supporting analysis. The appliance ownership trends are indicative of steady levels of preference for gas for cooking, heating and water heating. It would be expected that, absent government policy initiatives favouring other energy sources, these preferences would translate into maintenance of new dwellings gas appliance penetration. The impact of solar hot water initiatives is discussed below.

2.4.4 Higher thermal efficiency of dwellings

New dwellings in South Australia have been required to meet the four-star rating for thermal efficiency since 1 January 2003 and this would have had its first impact on gas usage on dwellings connected during 2004/05. From 1 July 2006 the five-star rating will be mandated – its first full year impact on gas usage will be 2007/08.

The impact of these higher standards can be estimated assuming that prior to 2003 the average new home was of a two-star rating. For a two-star home Envestra estimates average consumptions of 13.5 GJ pa for a space heater and 42 GJ pa for a central heater (Table 5 in "Average Residential Gas Consumption in South Australia" (Attachment 2 to Envestra's Network Development Paper)). Combined with new dwellings penetrations of 28% for space heaters and 5% for central heaters, these result in heating use per new home connection of 5.9 GJ pa MMA has no information that suggests these figures are incorrect.

The reduction in gas heating usage with the move from two- to four- to five-stars should be proportional to the changes in Adelaide heating/cooling usage settings (expressed in MJ/m2) for star-ratings in NatHERS v 2.32 (Nationwide Home Energy Rating Scheme). The settings and MMA estimates of the corresponding gas heating usage are presented in Table 2-5. The move from two-star to five-star is estimated to reduce average usage in new dwellings by 2.4 GJ pa

Table 2-5 New dwellings gas heating usage

Home rating	NatHERS setting (MJ/m2)	Estimated gas heating usage per new home connection (GJ pa)
Two-star	350	5.9
Four-Star	250	4.2
Five-Star	210	3.5

2.4.5 Appliance efficiency and minimum efficiency performance standards

Increases in gas appliance efficiency have the potential to reduce gas usage over time. The greater efficiency of new appliances relative to the stock in existing dwellings is partly responsible for new dwelling usage being lower than existing dwelling usage.

The future trend in gas appliance efficiencies will be influenced by proposed changes in Minimum Efficiency Performance Standards (MEPS). The current gas MEPS were set in 1983 and for water heating required a minimum overall efficiency (burner + losses) of 47.6%[5]. The new gas water heater MEPS proposed[6] for introduction during or after 2006 is likely to increase the minimum efficiency requirement to between 55% and 57% (an increase of 15% to 19%) for typical storage water heaters and to 62% (an increase of 31%) for instantaneous water heaters.

These increases in MEPS are unlikely to lead to significant, immediate increases in average appliance efficiencies however, because the majority of appliances already meet the new standard. Data presented by Mark Ellis et al[7] show that the average efficiencies of storage and instantaneous water heaters available in 2002 were 59% and 65% respectively (Table 2-6).

Table 2-6 Water heater efficiencies, 2002

Star rating	Efficiency band	Number of storage HWs	Number of instant HWs
1-star	47.6% - 51.1%	1	0
2-star	51.2% - 55.3%	8	2
3-star	55.4% - 60.2%	26	10
4-star	60.3% - 66.0%	4	19
5-star	66.1% - 73.1%	7	35
6-star	73.2% - 100%	0	0
Ave stars		3.2	4.3
Ave Efficiency		59.0%	65.4%

The impact of the proposed new MEPS would be to remove the 1-, 2- and 3- star instantaneous water heaters, the 1- and 2-star storage and possibly some 3- star storage water heaters. The MEPS impact would therefore be to increase the average efficiency of storage water heaters to between 61% and 67% and to increase the average efficiency of instantaneous water heaters to 67%. The overall increase in average water heater efficiency would therefore be 2.8% to 6.2% rather than 15% to 19% and for forecast purposes MMA has adopted a halfway value of 4.5%, which is assumed to take effect in 2007/08. It is noted that a number of commentators, including those referenced by Envestra, appear not to distinguish between increases in MEPS and increases in appliance efficiency.

The real impact of the new MEPS will be in the longer term. Under current MEPS appliances are clustered at the top end of the star rating scale, giving manufacturers and

5 Energy Labelling and Minimum Energy Performance Standards for Domestic Gas Appliances. Report to SEAV prepared by Mark Ellis and Associates, EES and George Wilkenfeld and Associates, November 2002.

6 The final form and implementation timing of the new gas MEPS has yet to be decided

7 Energy Labelling and Minimum Energy Performance Standards for Domestic Gas Appliances. Report to SEAV prepared by Mark Ellis and Associates, EES and George Wilkenfeld and Associates, November 2002.

importers limited incentives to introduce higher efficiency appliances. This is particularly acute for instantaneous water heaters, which dominate the new dwellings market. The new MEPs and associated star-ratings will provide significantly greater marketing incentives for the introduction of higher efficiency appliances.

For forecasting purposes we have adopted AGO[8] projections of increases in appliance efficiency ratings prior to and after 2007/08 with the MEPS increase in 2007/08. In its high efficiency scenario projections AGO suggests that new heater efficiency ratings will improve at 1.2% pa and new water heater efficiency ratings will improve at 0.5% pa (burner only, applicable to instantaneous water heaters) over the medium term. It is noted that AGO does not provide significant substantiation of these projections and that its other scenarios show lower increases. Nevertheless, as noted above, the new MEPS will provide incentives for increases in appliance efficiency.

2.4.6 Policy initiatives favouring solar hot water and encouraging water conservation

Solar hot water

The South Australian Government has provided rebates of $500 or $700 (depending upon the size of the collector area) for the installation of solar hot water systems in new and existing homes. The energy/GHG efficiency of gas hot water systems is recognised in the fact that the rebates are not available for electric boosted or heat pump systems that replace existing gas systems or in a new home that has access to reticulated gas. It is therefore unlikely that gas water heating will lose significant market share to electric boosted solar and the key issue for gas is the penetration of gas boosted solar at the expense of conventional gas systems.

Table 2-7 details the solar rebate approved applications since 2001/02, showing that: existing homes account for more than 75% of applications and electric boosted account for more than 90%. The inevitable conclusion is that the majority of applications are for electric boosted solar to replace existing electric water heaters or in new homes in areas without gas reticulation.

For 2004/05 the split of gas boosted was 149 to new dwellings and 43 to existing dwellings. The penetration of gas boosted solar in new gas homes is therefore very low, 149 out of more than 6,000 new home gas connections, i.e. 2.5%.

The rate of replacement of gas by gas boosted solar is even lower - MMA estimates that there are approximately 300,000 gas water heaters in South Australia, which are replaced on average every 15 years, generating a replacement market of 20,000 per year, of which solar-gas captured 43 or 0.2%.

8 Australian Residential Building Sector Greehouse Gas Emissions 1990-2010. AGO 1999.

Table 2-7 Solar rebate applications

	2001/02	2002/03	2003/04	2004/05	2005/06*
Total	957	2,365	2,526	2,730	1,347
New homes	132	359	468	636	323
Existing homes	825	2,006	2,058	2,094	1,024
Electric boosted	910	2,288	2,402	2,523	1,191
Gas boosted	28	71	112	192	149
Other	19	6	12	15	7

* Information only available for the half year.

Envestra claims that in 2004/05 approximately 10% of gas connection orders for new homes specified a gas-boosted solar unit, which is clearly inconsistent with the reported rebate applications. It seems unlikely that new home owners would not avail themselves of the rebate, as it would be promoted by government, retailers and builders. The recently obtained data for the first half year of 2005/06 included in the above Table shows the annualised number of rebates for 2005/06 likely to be about 300 gas-solar, which is less than 4% of the 7,800 new gas connections expected in that year. While there is a possibility that the number of rebates does not fully capture all the solar-gas systems installed, we do not expect the discrepancy to be great.

Envestra also reports that a number of land developments have mandated solar water heating and will use gas-boosted units to ensure that the developments are reticulated with gas. Unfortunately it is not clear that this is the case[9] and also the scale of the developments relative to total new homes development is not specified.

On the basis of the available information, we have projected the gas-boosted solar share of all new gas connections, both separate houses and units/apartments, to grow from 2.5% in 2004/05 to 7.5% in 2005/06 and then by 2.5 percentage points each year to 20% in 2010/11. As gas usage by a gas-boosted solar unit is approximately 40% that of a conventional unit's usage, this change will contribute a further 1.3 GJ pa reduction in average usage in new dwellings.

AAA showerheads

MMA considers that there is a good possibility that AAA showerheads will within the next few years be mandated in new homes in South Australia, as they have in Queensland and Victoria[10]. For the purpose of this forecast, it is assumed that AA

9 For example, Envestra cited the Mawson Lakes developers as mandating gas-solar appliances. However, we understand that few of the Mawson Lakes houses developed so far actually have installed solar-gas hot water.

10 And, are likely to be included within cost-effective ways to meet the Basix requirements for new dwellings in NSW.

showerheads are mandated from 1 July 2007, one year after the five-star rating, and have a first full-year impact on consumption in 2008/09.

MMA estimates that each AAA showerhead reduces household hot water requirements by approximately 17%. The current penetration of AAA showerheads in South Australia is variously estimated at 36.9% (ABS 4618.4, Oct 2004, Table 2.15) and 49.1% (ABS 4602.0, Mar 2004, Table 3.37). It is expected that new dwellings would have a higher penetration, which we have assumed to be 50%. At 100% penetration AAA showerheads would therefore reduce water heating requirements by a further 8.5% or approximately 1.2 GJ per new dwelling.

2.4.7 Appliance based projection

The above factors have been combined to produce an appliance based projection of new dwelling average usage excluding economic and pricing impacts. Table 2-8 illustrates the calculation of heating usage and Table 2-9 illustrates the calculation of water heating usage. Cooking usage is estimated at 2.4 GJ per dwelling throughout the forecast period. Total usage has been calibrated by adjusting water heating usage to fit totals of 20.5 GJ pa in 2002/03, 19.3 GJ pa in 2003/04 and 18.9 GJ pa in 2004/05 (refer to section 2.4.2) by minimising the least squares error across the three years. The modelled historical and forecast usage is provided in Table 2-10.

Table 2-8 New dwelling heating usage

Year of dwelling construction	First year of full usage	Home star rating	Underlying usage (GJ pa)	Appliance Efficiency	Actual usage (GJ pa)
2001 / 02	2002 / 03	2	5.9	56.9%	**6.0**
2002 / 03	2003 / 04	2	5.9	58.3%	**5.9**
2003 / 04	2004 / 05	4	4.2	59.6%	**4.1**
2004 / 05	2005 / 06	4	4.2	61.0%	**4.0**
2005 / 06	2006 / 07	4	4.2	62.4%	**3.9**
2006 / 07	2007 / 08	5	3.5	65.2%	**3.2**
2007 / 08	2008 / 09	5	3.5	66.4%	**3.1**
2008 / 09	2009 / 10	5	3.5	67.6%	**3.0**
2009 / 10	2010 / 11	5	3.5	68.8%	**3.0**

Table 2-9 New dwelling water heating usage

Year of dwelling construction	First year of full usage	% Gas boosted solar	% AAA showers	Underlying usage (GJ pa)	Appliance Efficiency	Actual usage (GJ pa)
2001 / 02	2002 / 03	1%	50%	12.1	65.9%	**12.0**
2002 / 03	2003 / 04	2%	50%	12.1	66.4%	**11.9**
2003 / 04	2004 / 05	2.5%	50%	12.0	66.9%	**11.7**
2004 / 05	2005 / 06	7.5%	50%	11.8	67.4%	**11.5**
2005 / 06	2006 / 07	10.0%	50%	11.4	67.9%	**11.0**
2006 / 07	2007 / 08	12.5%	50%	11.3	71.0%	**10.4**
2007 / 08	2008 / 09	15.0%	100%	10.0	71.5%	**9.2**
2008 / 09	2009 / 10	17.5%	100%	9.9	72.0%	**9.0**
2009 / 10	2010 / 11	20.0%	100%	9.7	72.5%	**8.8**

Table 2-10 New dwelling average usage, appliance based projection (GJ pa)

Year	Heating	Water heating	Cooking	Total	Envestra forecast
2002 / 03	6.0	12.0	2.4	20.4	
2003 / 04	5.9	11.9	2.4	20.1	
2004 / 05	4.1	11.7	2.4	18.2	
2005 / 06	4.0	11.5	2.4	17.8	17.4
2006 / 07	3.9	11.0	2.4	17.3	17.1
2007 / 08	3.2	10.4	2.4	15.9	14.5
2008 / 09	3.1	9.2	2.4	14.6	14.2
2009 / 10	3.0	9.0	2.4	14.4	14.0
2010 / 11	3.0	8.8	2.4	14.1	13.7

2.4.8 Potential socio-economic impacts

In addition to the technical factors of home and appliance efficiency taken into account above, new dwelling gas usage will also be impacted by changes in household size,

dwelling size, household income and household behaviour. Of these the small downward movement in household size and upward trends in dwelling size and household income are unlikely to have an impact that is material relative to the technical factors built into the forecast.

Household behavioural changes are most likely be responses to the greater comfort levels and lower prices afforded by more efficient gas use. For example, households may increase their comfort levels by increasing winter thermostat levels, because the cost of heating in four- and five-star homes is lower than they are used to. While these effects, known as "rebound", would generally lead to higher usage, there is no sound basis for estimating the net effect and their potential impact is therefore omitted from MMA's new dwelling forecast.

2.5 Average usage - established dwellings

2.5.1 MMA Stage 1 recommendations

MMA made the following recommendations in its Stage 1 Report.

Recommendation 4: If Envestra seeks to separately forecast average usage for established dwellings and new dwellings, the forecast for average usage by established dwellings would need further substantiation and linkage to reference material, in particular the derivation of assumed appliance or household efficiency trends and the income elasticity.

Recommendation 5: In order to allow the proper calculation of average usage for established dwellings over the past few years, the impact of below average usage in new dwellings needs to be taken into account by Envestra.

Recommendation 6: The reduction of average usage by established homes going forward should be the same as that over the recent past, except to the extent that acceptable justification is provided.

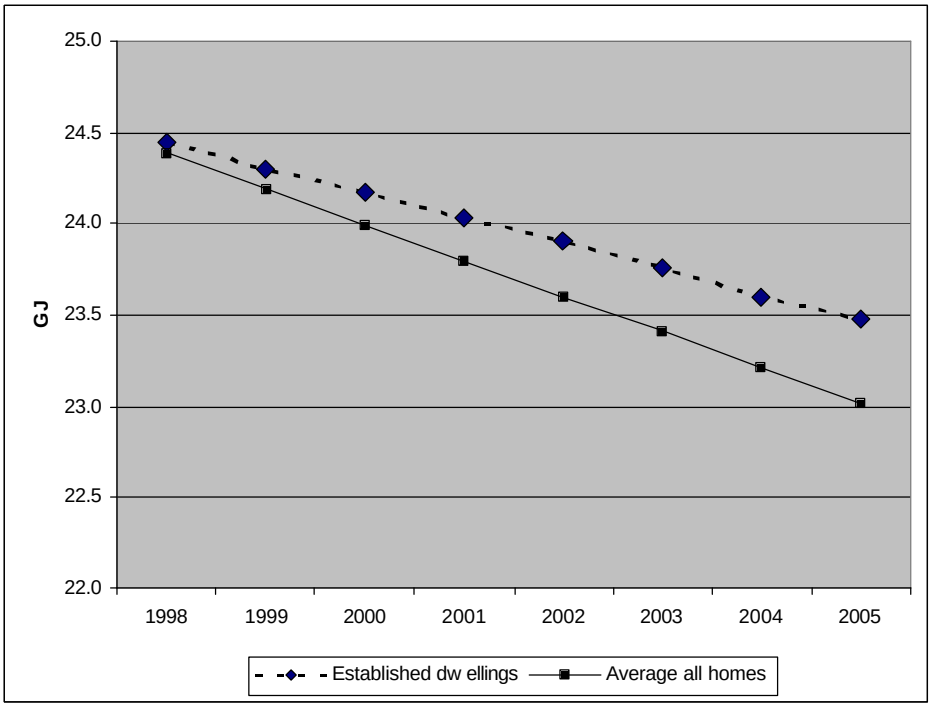
In its responses Envestra has provided further information and references in relation to the above, which have been considered in deriving the MMA forecast.

2.5.2 Historical trend

The below average usage in new dwellings contributes significantly to the downward trend in average usage exhibited in Figure 2-1. The historical trend in average usage in dwellings already established by 1998 has been determined by estimating new dwellings usage over the period 1998 to 2005 using the material presented in section 2.4 and subtracting it from total usage. As expected, the established dwellings average usage trend declines at a lower rate (0.57% pa) than the average trend (0.83% pa).

The 1 GJ fall in usage in established dwellings from 1998 to 2005 is consistent with information provided by Envestra, which shows a 1 GJ fall in average usage from 1998 to 2004 in a sample of dwellings that were already connected in 1997[11] (the 1997 sample).

Figure 2-3 Established dwellings average usage historical trend, GJ per customer



2.5.3 Forecast

The established dwelling trend is driven by a range of factors, including: the weather trend; gas appliance penetration; appliance efficiency trends; and economic factors. It is not considered feasible to determine precise relationships for all these factors, given the limited period of the data (8 years) and the lack of precise historical values for factors such as appliance penetration and efficiency trends. The forecast is therefore based on the expectation that the future trend in usage in dwellings established by 2005 would be very similar to the historical trend in established dwellings, unless one or more drivers are expected to undergo significant change over the forecast period. The potential changes in the major drivers are assessed below.

2.5.3.1 Weather trend

The forecast weather trend is the same as the historical trend.

[11] Envestra, Detailed Response to MMA Stage 1 Review of Demand Forecasts

2.5.3.2 Gas appliance penetration

The broad appliance ownership trends discussed in Section 2.4.3 are indicative of steady levels of preference for gas for cooking, heating and water heating. There are no government policy initiatives that impact on the replacement of gas appliances in established homes with new gas appliances and it is therefore expected that gas appliance penetration will be maintained.

The impact of solar hot water initiatives in the established homes sector has been minimal, with gas-boosted solar having captured 0.2% of the estimated gas water heater replacement market (refer to Section 2.4).

2.5.3.3 Appliance efficiency

Increases in new appliance efficiency due to new MEPS are discussed in section 2.4. MEPS is expected to result in a modest increase in water heater efficiency, above the recent trend increases embodied in the AGO projections.

MMA has incorporated changes in new appliance efficiencies due to MEPS into its projection of existing homes average usage using a model that is benchmarked against the historical trend decline in average usage. The model recalculates average appliance efficiencies each year using the formula:

$$E_{t+1} = E_t + (N_{t+1} - O_{t+1}) / L$$

E, N and O respectively denote the efficiencies of the appliance population as a whole, efficiencies of new appliances and of old appliances being replaced, in year t , t+1 etc. L is the average appliance lifetime. The formula is applied to each appliance category and the initial values of E and O in 2005 are calculated assuming that the AGO efficiency gains (refer to section 2.4.5) have applied over the past L years, so that:

$$E_{2005} = N_{2005} - AGO*L / 2$$

$$O_{2005} = N_{2005} - AGO*L$$

In these formulae AGO refers to the annual efficiency gains assumed to underlie recent usage trends, 0.5% for water heaters and 1.2% for heaters. Using the AGO efficiency gains over the period 2006 to 2011 (i.e. ignoring MEPS), the model yields the following average usage projection:

Table 2-11 Existing dwellings usage model, pre-calibration output, GJ

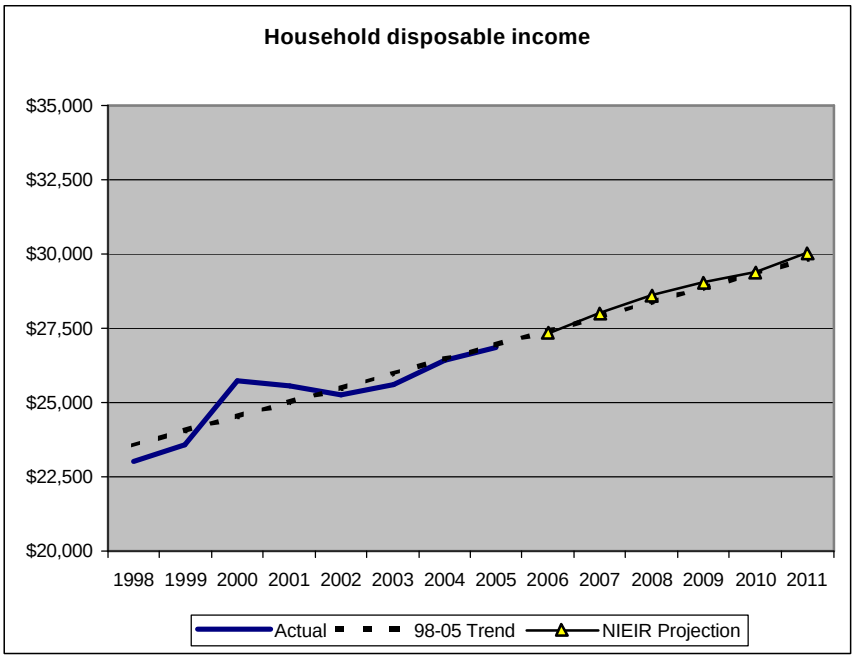
2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	Growth Rate
23.02	22.81	22.60	22.41	22.21	22.03	21.84	-0.87%

Since these are the underlying trend efficiencies and no other factors have been changed, the growth rate should be the recent trend growth rate of -0.57%, hence the model results are increased by an average of 0.30% p.a. to achieve the correct calibration.

2.5.3.4 Economic factors

The major economic factor likely to affect average usage in established dwellings is household disposable income. As can be seen in Figure 2-4, the NIEIR projections used by Envestra are almost identical to an extension of the trend established between 1998 and 2005.

Figure 2-4 Household disposable income, historical and NIEIR projection



2.5.3.5 Existing homes forecast

It is apparent that the trends in all key drivers of average usage in established homes with the exception of appliance efficiency are most likely to continue over the forecast period. Consequently, average usage in established homes is projected to decline from its 2005 value of 23.02 GJ at the same trend rate as over the period 1998 to 2005, adjusted for the impact of MEPS using the model described above. Over the period 2005 to 2011 average usage by established homes is forecast to decline by an average of 0.71% pa from 23.02 GJ to 22.06 GJ pa (Table 2-12).

Table 2-12 Existing dwellings usage forecast, GJ

2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	Growth Rate
23.02	22.88	22.75	22.58	22.40	22.23	22.06	-0.71%

2.6 Forecasts for the residential market

The consumption forecasts for the residential market have been derived by multiplying customer numbers for established homes, new connections and new townships and multiplying these by the average usage in each year. The MMA forecasts for the market are provided in Table 2-13.

Table 2-13 MMA forecasts for the residential market, TJ

	2005*	2006	2007	2008	2009	2010	2011
Established dwellings	7745	7945	7862	7763	7666	7570	7475
New connections		139	285	421	537	660	783
New townships		0	0	4	7	11	15
Total	7745	8085	8147	8188	8210	8241	8274

* Actual 2005 consumption, not weather-normalised.

The forecasts can be divided into two steps. In the initial step, for 2006, the market increases by over 4% due largely to the assumption of normal weather for that year after a very warm 2005. Following this, from 2006 to 2011, MMA forecasts that market growth will be about 0.5% pa, made up of a growth in customer numbers of 1.9% pa and a reduction in average usage of 1.4% pa.

2.7 Comparison with Envestra residential forecasts

The Envestra forecasts for the residential market (after including Envestra's new township forecasts) are provided in Table 2-14.

Table 2-14 Envestra forecasts for the residential market, TJ

	2005*	2006	2007	2008	2009	2010	2011
Established dwellings	7745	7,929	7,844	7,661	7,502	7,334	7,184
New connections		108	224	325	416	512	610
New townships		-	-	3	8	14	20
Total	7745	8,037	8,068	7,990	7,926	7,860	7,813

* Actual 2005 consumption, not weather-normalised.

After an initial increase in 2005 due to the assumption of normal weather, Envestra is forecasting that the residential market will reduce at an average rate of 0.6% pa. The estimated customer number increase of 1.9% pa is more than overcome by an average usage decline of about 2.5% pa.

As can be seen from a comparison of Table 2-13 and Table 2-14, there is a substantial difference between the MMA and Envestra forecasts. This is due almost entirely to the very different assumptions about average usage for mainly existing but also new homes.

Concurrently with MMA's preparation of independent forecasts for the Commission, Envestra requested the National Institute of Economic and Industry Research (NIEIR) to prepare customer and sales forecasts for the South Australian gas distribution networks. Envestra made the NIEIR report[12] available to the Commission and to MMA on 6 December 2005.

NIEIR consumption forecasts for the residential market commence in 2006 at a level lower than that forecast by either MMA or Envestra and then decline over the period 2006 to 2011 at a rate of 0.16% pa, which is intermediate between the growth rate of 0.5% pa forecast by MMA and the decline of 0.6% pa forecast by Envestra[13]. The NIEIR report appears to be based essentially upon the same information provided by Envestra that has been made available to MMA and does not introduce any new information that MMA considers needs to be incorporated into the MMA forecasts. It is clear from the residential market outcomes that NIEIR has made different average usage assumptions than MMA, however, there is no information or arguments presented that dissuade us from the assumptions used in the MMA forecasts.

12 Natural gas forecasts for the Envestra distribution region to 2015. A report for Envestra. NIEIR, November 2005

13 It should be noted that the MMA and Envestra forecasts both include consumption in the new township reticulations, whereas it is not clear that this is the case for NIEIR.

3 COMMERCIAL HAULAGE OR SMALL BUSINESS MARKET

3.1 MMA Stage 1 conclusions

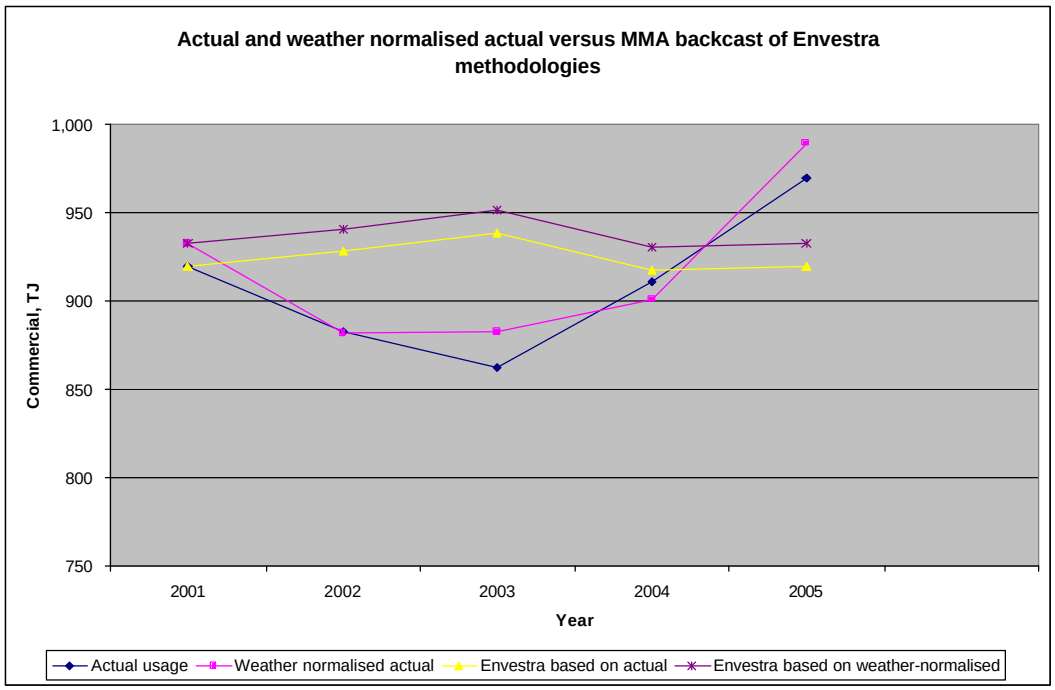
In MMA's Stage 1 report it was concluded that the Envestra forecasts for the small business market (Commercial Haulage) could not be considered "best estimates arrived at on a reasonable basis". MMA raised fundamental concerns about both the methodology used and the assumptions incorporated in the Envestra forecasts.

- The division of the market for forecasting purposes into commercial (defined as <1 TJ) and small industrial (defined as 1 to 10 TJ) was considered inappropriate. It implies a commercial or small industrial nature to enterprises which does not necessarily exist. More importantly, the division means that there is an impact of movements between classes, which is artificial and can be avoided by combining the two.

- The assumption that the small industrial market is not weather-sensitive is unwarranted without further testing of the assumption. MMA analysis, provided in the Stage 1 report, suggests that the small business market as a whole is significantly more weather sensitive than assumed by Envestra.

- Envestra has forecast the commercial category using a complicated formula which has been explained in MMA's Stage 1 report (Stage 1 Section 5.2). Envestra has linked change to two key drivers, the trend of weather normalised average usage and change in commercial output multiplied by an elasticity. MMA considers the linking of commercial sector sales to an average user driver to be unwarranted. As described in the Stage 1 report (Figure 5.1), the coefficient of determination ($r^{2)}$ between average usage and time, the basis for such a driver, is not good ($r^2 = 0.46$) and the forecast that average usage for these customers will continue to fall at a rate of around 3% pa over the forecast period when it has been stable or growing over the past two to three years suggests this to not be a reliable key driver. The changes in average usage may be more a function of weather and movements into and out of the category, or data anomalies, rather than real movements. MMA backcasting of the Envestra methodology from 2001 (from when NIEIR output data have been provided by Envestra) to 2005 suggests that the forecasting methodology used would not have been a reliable forecaster of commercial usage over this period as seen in Figure 3-1.

Figure 3-1 Comparison of MMA backcast of commercial load in TJ versus actual and weather normalised actuals, Adelaide only.



- MMA also considers that Envestra should have used the weather normalised actual result as the starting point for its forecasts, rather than the actual usage. This increases the results by about 2% in each year. It also partly helps explain why Envestra has forecast a drop of about 5.7% between weather normalised usage for the commercial market in 2005 (1059 TJ) and its forecast usage in 2006 (999 TJ).

- Envestra has not used a similar trend average-usage approach for the small industrial market. The reason for the approach taken not being uniform across both commercial and small industrial sectors is unclear.

- There is uncertainty about some of the data, especially the values from the earlier years and the apparently anomalously high customer number growth in the year 2004 / 05.

- According to Envestra its estimation of elasticities for the commercial and small industrial sectors is subjective. Based on the limited data available, MMA has assessed the elasticity of commercial consumption to a change in commercial output to be about 0.3 (with a very low r^2) while the elasticity of the small industrial sector to a change in industrial output is estimated to be 1.3 with a good r^2. Conversely, Envestra has estimated the commercial elasticity to be 0.8 and the small industrial elasticity to be only 0.13.

3.2 Envestra's response

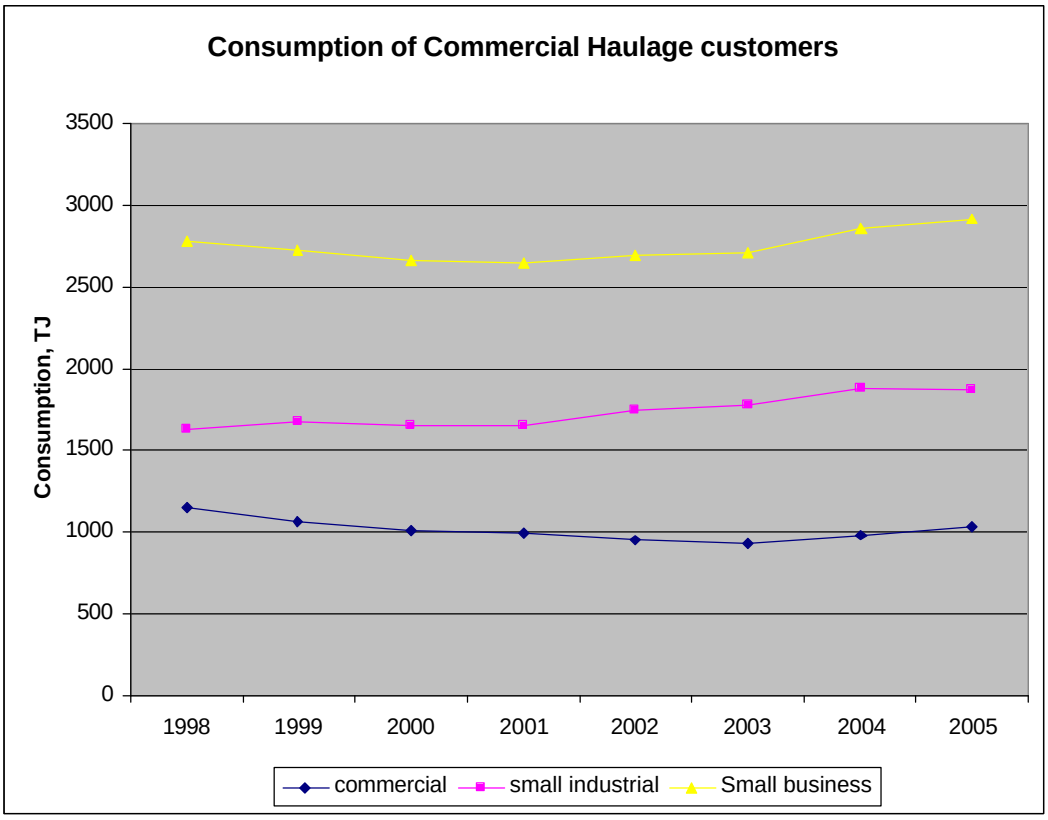
Envestra has responded to each of MMA's specific recommendations.

Recommendation 11: Envestra should analyse and forecast the small business market as a whole, not divide it into commercial and small industrial.

Envestra has responded that it forecasts the commercial and small industrial segments separately due to variability in average consumption between the two and the differences in weather correlation between the two markets. Envestra considers that the movement between classes will be captured in the historical trends and that the separation will allow more reliable forecasting.

MMA is generally of the view that where customer classes can be consistently classified, their key drivers identified and reasonable correlations established, forecasting should be for that market separately. However, MMA does not consider this to have been the case for the commercial class. As explained elsewhere, there is some uncertainty about the data, the possibility of significant levels of switching between the categories because of definitions (see Figure 3-2) and the level of correlation between the consumption and the forecast drivers in the commercial market is poor. In such a case MMA considers it prudent to consider the market in combination. MMA has forecast the small business market as a whole.

Figure 3-2 History of the commercial, small industrial and small business markets



Recommendation 12: Envestra should either weather normalise the small business market and carry out its analysis on the weather normalised market as a whole or carry out further analysis to demonstrate that this should not be the case. In either case further analysis of the extent of weather sensitivity of the small business market is required.

Envestra claims that the commercial market is weather sensitive while the small industrial market is not. According to Envestra this is because of the absence of space heating in most cases and the process based usage of gas by small industrial customers.

However, it is far from clear that this is the case. For example, even in the demand class some one third of customers are commercial users, such as hotels, offices, hospitals and the like. Such users are likely to have a significant heating load. This implies that a significant proportion of the 1 to 10 TJ customer class is also commercial, with many likely to be weather sensitive.

As stated in the Stage 1 report, MMA considers it reasonable to assume a level of weather sensitivity in the entire small business market unless demonstrated otherwise. Envestra has asserted that there is no weather sensitivity for the small industrial market but has not demonstrated this. In other jurisdictions which are influenced by weather the whole small business market has generally been weather normalised (for example in the case of AGL Gas Networks in NSW, regulated by IPART, and the ActewAGL network in the ACT regulated by the ICRC).

MMA has forecast the small business market using a methodology which weather normalises consumption for the market as a whole. The difficulty in splitting out the weather sensitivity between commercial and small industrial customers is another reason to forecast for the class as a whole.

Recommendation 13**: Envestra should select a forecasting methodology which it can demonstrate balances the recent history with changes to key drivers. MMA considers that a time or economic based trend, based on weather normalised historical data, would be appropriate.**

Envestra has argued that its forecasting in this area is reasonable because there are a number of ways of forecasting, it represents its view on how best to forecast and is used by Envestra for its internal network planning. Envestra also claims that it is consistent with the approach accepted by other regulators as being reasonable under the Code.

MMA accepts that there are a number of ways of forecasting which depend on data availability and assessments of key drivers. Envestra forecasting for network planning may also be based on the forecast model, although the methodology does appear convoluted and subjective.

MMA cannot comment on whether other regulators have accepted as reasonable the Envestra approach. MMA could not find any public evidence of acceptance of some aspects of the Envestra methodology, for example, forecasting by class which allows

movements within one reference tariffs and weather normalising only one component of the small business market without providing evidence that the other component does not also need weather normalising. Similarly, MMA does not consider the use of a methodology which relies, in part, on subjective assessments of parameters to be reasonable. Overall, MMA does not consider the Envestra methodology for the small business market to be reasonable.

Recommendation 14: Envestra should confirm the validity and consistency of the data provided, especially for the years 1998, 1999 and 2005.

Envestra has confirmed that the data provided is the best available, captured consistently and accurately reflects outcomes in the applicable year. Although this does not explain some apparent anomalies MMA has accepted and used this data.

Recommendation 15: If Envestra elects to forecast using commercial and/or industrial outputs as a key driver it should derive appropriate elasticities from available data rather than assume them.

Envestra has used the following formula to forecast the commercial and small industrial markets:

Previous years volume x trend average usage forecast for this year / trend average usage in previous year x (change in output x elasticity).

For the commercial sector the elasticity used by Envestra has been 0.8 while for the small industrial it has used 0.13. MMA questioned the derivation of the elasticities.

In its response, Envestra has provided some analysis undertaken by NIEIR and further information. The NIEIR analysis appears to show an elasticity of around 0.8 for the small industrial market and -1.3 for the commercial market[14]. In other words, a 1% increase of state GSP would see gas usage for the small industrial sector gas usage increasing by about 0.8% and gas usage in the commercial sector reducing by about 1.3%. As pointed out in the MMA Stage 1 report, this is quite different to the elasticities used by Envestra. Similarly, elsewhere, commercial elasticities have been reported as lower than industrial elasticities.

MMA cannot see any evidence for the Envestra statement in its response that "Envestra has used an elasticity of 0.8 for the commercial sector and 0.13 for small industrial customers, which closely relates to the actual elasticity observed in the historic data." The converse would appear to be the case.

The overall Envestra methodology (assuming a reducing average usage) results in the commercial sector reducing from Envestra's weather-normalised value of 1059 TJ in 2004/05 to 1014 TJ in 2010/11. However, for the small industrial sector this is not the

[14] Ignoring the fact that Envestra has used regional commercial and manufacturing output while the NIEIR analysis is for state GSP as a whole. It is also not clear what weather normalisation has been carried out.

case, with the elasticity of 0.13 being directly related to the gas forecast thus underestimating growth in this sector.

The last paragraph of the Envestra response to this recommendation is reproduced below.

"The overall elasticity of 0.4 for commercial and small industrial Tariff V is half way between the published elasticities of around 0.8 and the implied elasticities of zero to 0.16 from the actual historical data. NIEIR put the view to Envestra that this was a reasonable position to adopt in forecasting gas demand for this segment."

It is not clear to MMA whether this is a suggestion for a different methodology and elasticity or whether it is intended to justify the methodology and elasticities used in the Envestra forecasts. If the latter then MMA does not consider the argument compelling.

Recommendation 16: Average usage for the small business market as a whole has remained reasonably constant over the past several years. Envestra should assume that the average usage will stay constant in deriving its net customer numbers.

Envestra's methodology has resulted in apparently anomalous growth in commercial and small industrial customer numbers, as described in Sections 2.3.2 and 3.12 of the Stage 1 report.

MMA has previously recommended that the small business market be treated as a whole and in this recommendation that the average usage (after weather normalisation) be considered to be flat. This was on the basis of MMA's analysis of weather normalised sales in the (dominant) Adelaide region for the market as a whole being approximately flat over the period 1998 to 2005[15].

Envestra has responded that it has seen a fall in average usage in the commercial sector and that this needs to be accounted for.

Instead of assuming flat average usage MMA has instead assumed that the increase in customer numbers over the forecast period will be the average of that seen over the period 1998 to 2005.

3.3 MMA Forecasts of small business usage

MMA has weather normalised small business or C&I usage using the parameters set out in APPENDIX A . MMA considers that the whole small business market has some weather sensitivity and MMA has used its best estimates of the sensitivity based on the information available.

MMA has then assessed various small business usage forecasting methodologies (section A.3). The analysis is made difficult by the two different trends apparent in the data, a

[15] In fact MMA's assessment was that the weather normalised average usage trended up by 0.1% pa.

reduction in usage in the first part of the period followed by growth in the second part. There is no apparent reason for the shift.

Although there is an argument that the period from 2001, being the more recent, is likely to best capture the current trends, MMA has decided to use the period 1998 to 2005 for its analysis as there is no clear evidence of a change in drivers within the period.

MMA has assessed the relationship of 1998 to 2005 small business sales against both a time trend (that is a constant increase in consumption every year) and actual GSP trend (the increase in small business sales depends on state GSP). Analyses that incorporate weather normalisation have also been assessed. The small business usage forecast is based on a model that includes both GSP and Heating Degree Days (HDDs – see Stage 1 Report section 3.4 and Appendix A) using NIEIR GSP projections and the HDD trend determined in section A.2.

To the outcome of this model MMA has added the Envestra forecast of small business consumption in the Tanunda, Monarto and McLaren Vale new reticulations.

The MMA forecasts of the small business market including new township growth (same as assumed by Envestra) are provided in Table 3-1. They show a forecast reduction in usage in 2006 by about 1.4%, due to an assumed return to trend growth, and then growth from 2006 at an average of 1.1% pa.

Table 3-1 MMA forecast of small business consumption, TJ

	2005*	2006	2007	2008	2009	2010	2011
Existing areas	2911	2870	2903	2932	2952	2967	2997
New reticulations		0	0	3	9	28	33
Total	2911	2870	2903	2935	2961	2995	3031

* Actual 2005 consumption, not weather-normalised.

The MMA forecast of customer number growth and new connections is provided in Table 3-2.

Table 3-2 MMA forecast of small business customer numbers and new connections

	2005*	2006	2007	2008	2009	2010	2011
Existing areas	8,509	8,616	8,724	8,831	8,938	9,046	9,153
New townships		0	0	12	20	45	51
Small business customers	8,509	8,616	8,724	8,843	8,958	9,091	9,204
New connections		306	306	318	314	331	312

* Actual 2005 customer numbers.

MMA has assumed that the growth in customer numbers in currently reticulated areas will be 107, the average over the period 1998 to 2005 and has added to this average disconnections of 199 (see Section 2.2.4) and the assumed number of new connections in new townships to calculate new connections.

3.4 Comparison with Envestra forecasts

The Envestra small business forecasts and customer numbers are provided in Table 3-3. The forecasts include those in both currently reticulated areas and new townships.

Table 3-3 Envestra forecast of small business consumption, TJ, and customer numbers

	2005*	2006	2007	2008	2009	2010	2011
Consumption	2911	2874	2895	2909	2918	2937	2955
Customers	8509	8590	8829	8985	9126	9262	9472

* Actual 2005 consumption, not weather-normalised, and customer numbers.

The Envestra consumption forecasts are some 75 TJ or 2.5% lower than the MMA forecasts by 2011 while the Envestra customer number forecasts are some 200 customers higher. The difference is likely to be due almost entirely to the different forecasting methodologies.

In the NIEIR report[16] the consumption forecasts for the small business market commence in 2006 at a level some 1.6% higher than that forecast by either MMA or Envestra and then increase over the period 2006 to 2011 at a rate of 0.3% pa, which is lower than the growth rate forecast by Envestra (0.6% pa) and MMA (1.1% pa)[17]. NIEIR has forecast separately for the commercial and small industrial sectors and has not weather normalised the small industrial sector. The NIEIR report appears to be based essentially upon the same information provided by Envestra that has been made available to MMA and does not introduce any new information that MMA considers needs to be incorporated into the MMA forecasts.

16 Natural gas forecasts for the Envestra distribution region to 2015. A report for Envestra. NIEIR, November 2005 made available to the Commission and MMA on 6 December 2005.

17 As for the residential market it should be noted that the MMA and Envestra forecasts both include consumption in the new township reticulations, whereas it is not clear that this is the case for NIEIR.

4 DEMAND MARKET

4.1 MMA Stage 1 report

In MMA's Stage 1 report it was concluded that the Envestra forecasts for the Demand Haulage market could not be considered "best estimates arrived at on a reasonable basis". MMA was of the opinion that the methodology adopted was not reasonable and made recommendations as to how it could be improved.

4.2 Envestra's response

Envestra has responded to each of MMA's specific recommendations.

Recommendation 18: Envestra should be asked to prepare consistent historic consumption information for the period 1998 to 2005. Envestra should also be asked to attempt to get MDQ data, going back to 1998 as well.

Envestra has responded that it does not have the pre-2003 information required as, until July 2002 it did not bill customers separately. The information required belonged to the incumbent retailer, Origin Energy.

Given that Envestra has not been able to provide information prior to 2002/03, MMA has had to rely on the information from 2002/03 to 2004/05.

Envestra has further cast doubt on the relevance of some of the data provided from 2002/03 to 2004/05. According to Envestra, the contracted MDQ data for most of the customers was derived from an algorithm. Only after telemetry was installed or upgraded, by mid 2004, and properly checked, was Envestra confident that the MDQ data could be relied upon. Envestra suspects that the use of the algorithm systematically understated MDQ.

In essence, Envestra is saying that it can only fully rely on the MDQ data from 2004/05 and that changes between 2002/03 and 2004/05 may be due to the movement from use of the algorithm to telemetry, rather than real changes to MDQ.

MMA has taken some account of this uncertainty in its forecasting.

Recommendation 19: Envestra should hold discussions with its largest 10 to 20 customers, or the retailer to these, to ascertain gas consumption and MDQ expectations and likelihood of expansions, closures and relocations over the next 5 – 6 years. Envestra should document the outcomes of these discussions and also prepare a summary spreadsheet of the expectations for both consumption and MDQ.

Envestra has responded that it does not have a direct relationship with end-users and has raised some concerns about the reliability of end-user customer surveys.

While MMA accepts that customer surveys are not perfect it still considers them important in understanding likely intentions, especially when the alternative is to make the assumption that MDQ will stay the same apart from announced changes.

MMA has surveyed a number of the largest Envestra customers.

Recommendation 20: Envestra should prepare a summary of consumption by all other customers from 1998 to 2005 and attempt to relate these to either time or economic parameters. Forecasts of consumption can then be prepared.

As discussed above, Envestra has stated that it does not have access to consumption prior to 2002/03 and that even its MDQ data until 2004/05 is suspect.

MMA has forecast based on the limited data available.

Recommendation 21: Any changes in the load factors of these other customers should be taken into account in preparing MDQ forecasts.

As discussed above, Envestra has responded to this recommendation by saying that the MDQ changes between 2002/03 are not clear as they may have been due to a change from use of an algorithm to telemetry.

While MMA understands the concern, it is of the opinion that some account must be taken of growth in contracted MDQ between 2003 and 2005. The MMA methodology to do this is described in step 2 below.

4.3 MMA forecasts

4.3.1 Forecasting methodology

MMA has forecast on a regional and zonal basis in the following way.

1. MMA has surveyed eighteen of Envestra's largest customers to discuss expectations of gas usage and contracted MDQ going forward. Based on these discussions the customer or MMA has forecast ACQ and/or MDQ over the forecast period. MMA has used these MDQ forecasts as its large customer forecasts.
2. Annual growth in MDQ of remaining "smaller" demand customers has been estimated from the growth seen for that zone or region between the years 2003 and 2005, the years for which individual customer information has been provided by Envestra. Recognising the potential for error caused by the movement from algorithm to telemetry, MMA has for each small customer in the larger zones also re-calculated the growth rate taking into account individual customers whose MDQ has increased for no apparent reason (i.e. it was not accompanied by an increase in consumption). Smaller customers who either started or ceased usage over the period were taken into account in both calculations. MMA has then weighted the growth rate 75% to the amended growth rate and 25% to the initial growth rate to take into account Envestra's expectation (which seems to be borne out by the data available) that the change to telemetry may have overstated actual MDQ changes. Given the relatively small number of "smaller" demand

customers in the Southern Zone, after discussions with Envestra MMA has considered it prudent to assume that there is no net growth by such customers over the forecast period.

3. MMA has factored in a reduction in MDQ [*confidential information removed*] to one customer in the Central Zone and a loss of [*confidential information removed*] in the Northern Zone due to [*confidential information removed*] in that zone. This is in accordance with the Envestra expectations and may change if MMA manages to hold discussions with that customer. MMA is also uncertain about

[*Confidential Information removed]*

4. MMA has also added Envestra's forecast additional MDQ in McLaren Vale to the Southern Zone, Tanunda to the Riverland Region and Monarto separately.

[*Confidential Information removed]*

4.3.2 MMA forecasts

The MMA forecasts for each of the zones and regions are provided in Table 4-1.

Table 4-1 MMA MDQ forecasts by region and zone, GJ contracted MDQ

	2005*	2006	2007	2008	2009	2010	2011
Adelaide							
Central	11,067	10,494	10,393	10,366	10,312	10,273	10,236
Northern	33,295	32,880	32,844	35,333	35,509	35,701	35,902
Southern	5,410	4,210	4,210	4,310	4,410	4,510	4,610
North Western	17,852	17,800	17,800	17,800	17,800	17,800	17,800
Regions							
Peterborough	62	62	62	62	62	62	62
Port Pirie	3597	3596	3596	3596	3596	3596	3596

	2005*	2006	2007	2008	2009	2010	2011
Riverland	750	750	750	750	750	850	850
South East	930	888	917	948	981	1016	1053
Whyalla	57	57	57	57	57	57	57
Monarto	0	0	0	0	283	378	472
Total	73,020	70,737	70,629	73,222	73,760	74,243	74,639

* Actual 2005 MDQ.

MMA forecasts that there will be growth in MDQ of about 0.4% pa over the period 2005 to 2011. However, this is made up of an initial loss of about 3% in 2006, due to the closures and curtailments at two customers, followed by growth at about 1.1% pa between 2006 and 2011.

Growth is expected to be strongest in the Northern Zone [*confidential information removed*] and the South East.

4.4 Comparison with Envestra forecasts

The Envestra forecasts are provided in Table 4-2.

Table 4-2 Envestra MDQ forecasts by region and zone, GJ contracted MDQ

	2005*	2006	2007	2008	2009	2010	2011
Adelaide							
Central	11,067	10,738	10,319	10,319	10,319	10,319	10,319
Northern	33,295	32,994	32,475	32,475	32,475	32,475	32,475
Southern	5,410	5,480	3,580	3,580	3,580	3,580	3,580
North Western	17,852	17,852	17,852	17,852	17,852	17,852	17,852
Regions							
Peterborough	62	62	62	62	62	62	62
Port Pirie	3,597	3,597	3,597	3,597	3,597	3,597	3,597
Riverland	750	750	750	750	750	750	750
South East	930	1,108	1,108	1,108	1,108	1,108	1,108
Whyalla	57	57	57	57	57	57	57
Total	73,020	72,638	69,800	69,800	69,800	69,800	69,800

* Actual 2005 MDQ.

The key differences between the MMA forecasts and the Envestra forecasts are in the Northern Zone [confidential]. MMA has included the Envestra forecasts for new town reticulations In the Southern Zone and the Riverland Region and for Monarto while these are not included in the Envestra forecasts. The Envestra forecasts in the South East are greater than the MMA forecasts largely because Envestra's starting number is higher. The reason for this is unclear. The MMA and Envestra forecasts are similar in the Central and North Western Zones and the other regions.

In its report to Envestra dated November 2005[18], NIEIR has forecast consumption for the demand market to reduce by 1.7% in 2006 and then to grow thereafter at about 1.8% pa[19]. Although MDQ forecasts are referred to as being within the scope of the NIEIR work, MMA could not find such forecasts within the report. Both MMA and Envestra have forecast MDQ to reduce in 2006. MMA has then forecast overall growth in MDQ of about 1.2% pa overall, while Envestra has forecast no change apart from growth in new townships[20]. The NIEIR report does not introduce any new information that MMA considers needs to be incorporated into the MMA forecasts.

18 Natural gas forecasts for the Envestra distribution region to 2015. A report for Envestra. NIEIR, November 2005

19 Although NIEIR has subseqently stated at a meeting that it now expects Demand consumption growth to be less than this.

20 As for the other markets it should be noted that the MMA and Envestra forecasts both include consumption in the new township reticulations, whereas it is not clear that this is the case for NIEIR.

APPENDIX A WEATHER NORMALISATION

A.1 Weather normalisation

Gas demand in the residential and small commercial/industrial customer segments is strongly influenced by weather conditions from day-to-day and from year-to-year. In view of the impossibility of accurately forecasting future weather conditions, in preparing gas forecasts the industry standard procedure is to:

1. Weather normalise historical actual gas demand, so that underlying non-weather related trends can be identified.
2. Prepare forecasts assuming that normal (average or trend) weather conditions will prevail, so that actual future demand variations due to weather variations from normal will have an equal probability of being positive or negative.

Envestra has used the heating degree day index (HDD) to weather normalise actuals and forecasts. Daily HDDs are defined by:

HDD = 18-T if T<18 and HDD = 0 if T=18, where T is the average daily temperature[21] in degrees Celsius.

HDDs as defined assume that gas demand is not influenced by temperatures above 18 C and that the variation below 18 C is linear, with no saturation effects. These assumptions approximate a more complex reality that other organisations have sought to capture by using other weather factors, such as sunshine and wind[22]. In spite of these limitations weather normalisation models using HDDs have considerable explanatory power, reflected in high adjusted R-squared values (refer to section A.3) and HDDs are therefore widely used for weather normalisation.

Envestra used annual HDDs equal to the sum of daily HDDs through the year. It is noted that this definition is not consistent with the use of billings based consumption however, since some of the consumption billed in first quarter of each year was actually consumed in the last quarter of the previous year and was therefore affected by the weather in that quarter[23]. The appropriate annual HDD value is therefore the sum of the daily values through the first three quarters of that year plus weighted values of daily HDDs in the last quarter of that year and (differently) weighted values of daily HDDs in the last quarter of the previous year.

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21 The average is typically defined as the average of the daily maximum and minimum.

22 Effective degree days (EDDs) incorporating these factors have been developed by Vencorp for Victoria and by NIEIR for South Australia.

23 This applies to quarterly billed customers. For monthly billed customers the final quarter in the previous year becomes the previous June.

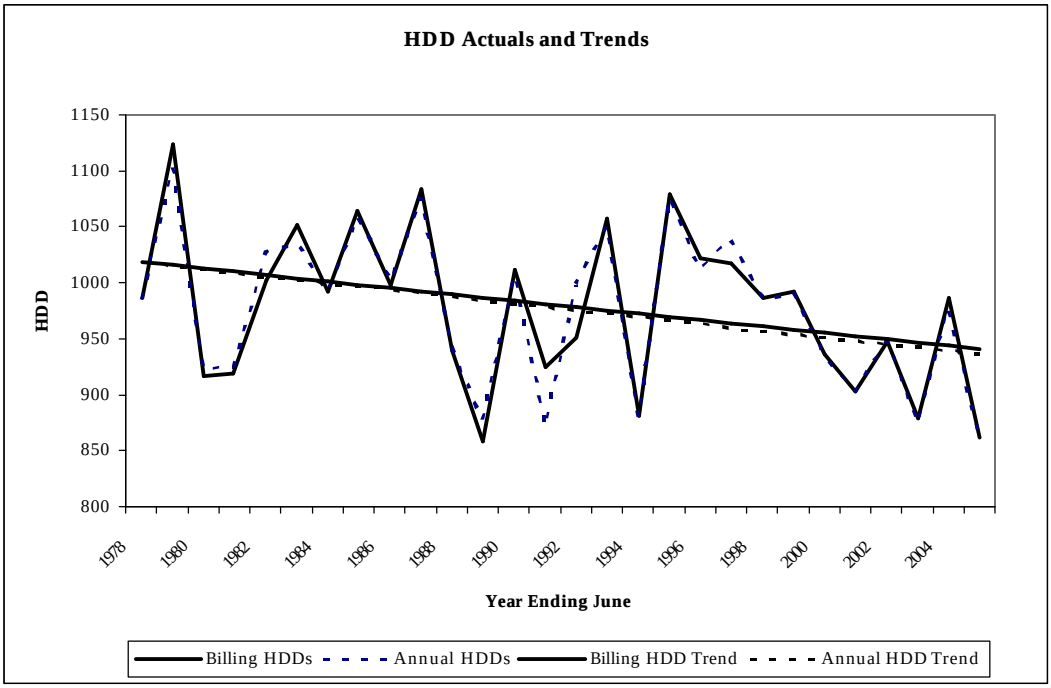
In the Stage 1 Report MMA used the simple annual HDDs, to maintain consistency with Envestra's analysis. For the purpose of constructing the forecast however MMA has derived and used billings related annual HDD values, referred to as Billings HDDs.

A.2 Weather trend

Billing HDDs for the Kent Town (Adelaide) weather station from 1978 to 2005 are compared with simple annual HDDs in Figure A-1. A downward trend is evident in both statistics – 2.86 HDDs per year for Billing HDDs compared to 3.05 HDDs per year for simple annual HDDs. The trends are marginally significant in statistical terms, with T-statistics of 2.0. The Billing HDD trend value in 2005 is 941.2 HDDs, which will decline to 924.1 HDDs by the end of the regulatory period in 2011. These trend values are the normal weather conditions that are used in the forecasts.

Note: Billing HDDs applicable to monthly billed customers have also been derived but have not been used in the forecast for reasons that are explained below.

Figure A-1 HDD Actuals and trends



A.3 Weather normalisation

MMA has weather normalised average gas usage using both annual and daily usage data sets and models. Neither type of data set / model is ideal because annual data sets are small and daily data is an aggregation of residential, commercial and industrial load excluding a number of sub-networks. MMA therefore uses both data sets to test their consistency.

A further model of small business total usage has also been derived for forecasting small business usage.

A.3.1 Annual data

This analysis utilises annual average usage data to estimate the coefficients in a model of the form:

$$\text{Average usage}_t = A + B \times \text{Year}_t + C \times \text{HDD}_t + D \times \text{HDD}_t \times \text{Year}_t$$

In this model A represents base load usage in year 0 (1998), B represents the annual trend in base load usage, C represents the weather sensitivity in year 0 and D represents the annual trend in weather sensitivity. HDDs are Billing HDDs.

The model is structured to directly normalise both base- and weather-sensitive load. Weather only normalisations can be derived using the weather coefficients. As there are only eight data points it is unlikely that all four coefficients will be statistically significant - statistically significant estimates of A and C are essential for a model that can be used to weather normalise the data.

Residential

For the residential sector, models with coefficients A and C and at most one of B and D passed the significance test, i.e. the data is sufficient to estimate base load and weather sensitivity coefficients and the annual trends in either one of these but not both. The models with three coefficients have higher adjusted R-squared (Adj R-Sq) statistics than the two-coefficient model and are preferred for that reason. A valid four-coefficient model has been formed by averaging the coefficients of the three coefficient models. The coefficients and derived parameters are reported in Table A-1 and Table A-2.

Table A-1 MMA residential weather normalisation model coefficients

	Coefficients			
Adj R-Sq	**A**	**B**	**C**	**D**
0.92	12.62	-0.0815	0.0122	-0.000085

Table A-2 MMA residential model derived values, 2005

Normalised load/customer (GJ)			Per HDD (TJ)
Base load	**Weather sensitive**	**Average usage**	**Weather sensitivity**
12.05	10.97	23.02	4.06

The negative values of coefficients B and D imply that both base load and weather sensitive load per customer, and consequently normalised residential average usage, are declining. The estimated HDD sensitivity of residential load in 2005 is 4.1 TJ. The annual decline in usage due to the declining trend in HDDs is 0.14% [(2.86 / 941.2)*(10.97 / 23.02)].

Small business

Analysis of average usage in the commercial sector by itself did not yield any statistically significant models. However for the combined commercial and small industrial sector a two coefficient model was estimated satisfactorily, albeit with a relatively low R-squared value (Table A-3 and Table A-4). This analysis was performed using Billing HDDs for monthly and quarterly billed customers – the quarterly values resulted in higher adjusted R-squared coefficients and are reported below.

Table A-3 MMA small business weather normalisation model coefficients

	Coefficients			
Adj R-Sq	**A**	**B**	**C**	**D**
0.42	197.6	0	0.15	0

Table A-4 MMA small business model derived values, 2005

Normalised load/customer (GJ)			Per HDD (TJ)
Base load	**Weather sensitive**	**Average usage**	**Weather sensitivity**
197.6	144.3	341.9	1.30

The estimated HDD sensitivity of small business load in 2005 is 1.3 TJ. The estimated HDD sensitivity of combined residential and small business load in 2005 is 5.4 TJ, compared to Envestra's estimate of 4.9 TJ (Envestra Forecasts of Demand Table 3.1). MMA's estimate of the residential / small business split is 76:24 compared to Envestra's 90:10.

A.3.2 Daily data

This approach has been used to corroborate the annual analyses above. The analysis replicates Envestra's analysis of Adelaide daily gas demand (gate station volumes less daily metered customers), with a number of changes. The basic model used is:

$$\text{Average usage}_d = A + B \times HDD_d + C \times \text{Friday}_d + D \times \text{Saturday}_d \; E \times \text{Sunday}_d$$

In this model Friday, Saturday and Sunday are dummy variables that account for changes in base load on those days (Monday was found to be the same as other weekdays) and A-E are coefficients. Also included were annual trend variables for each of the principle variables above, enabling a single equation to be fitted to all eight years of data.

The estimated HDD sensitivity of the combined residential and small business load in 2005 using this model is 5.2 TJ, which is consistent with the MMA estimates based on annual analyses and Envestra's estimate using daily data. The adjusted R-Squared value is 0.85 and all T statistics in the model used are significant.

A.3.3 Small business usage model

To forecast small business total usage it is necessary to use simple trends or to relate usage to an economic driver such as GSP using a model of the form:

$$\text{Usage}_t = A + B \times GSP_t$$

The weather induced variation in usage tends to obscure both time trends and the GSP relationship, hence it is useful also to weather normalise usage simultaneously using a trend model as in section A.3.1 or a GSP model of the form:

$$\text{Usage}_t = A(1 + B \times GSP_t)(1 + C \times HDD_t)$$

$$= a + b \times GSP_t + c \times HDD_t + d \times GSP_t \times HDD_t \;, \quad d = bc/a$$

A summary of the analysis of small business usage from 1998 to 2005 is shown in Table A-5.

Table A-5 Small business usage models

Variables included	Adj R-Sq	Trend Growth (TJ pa)	GSP Elasticity	HDD Sensitivity (TJ/HDD)
Time	0.15	20		
GSP	0.21		0.3	
Time, HDDs	0.24	30		1.1
GSP, HDDs	0.25		0.4	0.9

Model accuracy is limited by the overall shape of actual usage, declining up to 2001 and increasing sharply after 2001, which is not reflected in HDD or GSP variations (Figure A-1). It is noted that the HDD sensitivities are consistent with but slightly lower than those estimated from average usage.

Although the model accuracies are the same, the GSP, HDD model is preferred to the Time, HDD model for forecasting purposes because it captures economic influences on small business usage.

Figure A-1 Small business usage models