

Comments on the MMA report

**“Assessment of Envestra’s Response
to the Commission’s Draft Decision on
Envestra’s Access Arrangement and
the ESCOA Final Decision – Gas
Demand Forecasts”**

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1. NIEIR's response to ESCOSA Final Decision Gas Demand Forecasts

1.1 Overview

Envestra requested that NIEIR review the Commission's Final Decision on demand forecasts.

The Commission commences its Final Decision stating Section 8.2(e) of the code requires that the Commission must be satisfied that any forecasts required in setting Reference Tariffs represent best estimates arrived on a reasonable basis(pp 55).

The Commission has been presented with a number of forecasts. These include:

- forecasts by Envestra in its original submissions;
- forecasts by MMA, company appointed by the Commission that, amongst other things, prepares forecasts for State energy regulators; and
- forecasts by NIEIR, who prepares forecasts for various participants in the electricity and gas industry in Australia.

The Commission's criteria for assessing the Code requirement under 8.2 (e) of "best estimates arrived on a reasonable basis" is unclear to NIEIR. What criteria have the Commission and its consultants, MMA, used in assessing what is best and reasonable in the area of the gas demand forecasts.

NIEIR wrote to the Commission in April 2006 regarding weather normalisation and tabulated some key decision criteria in that letter relating to that issue. We were seeking to clarify this issue in a clear and transparent manner.

Key decision criteria for the gas demand forecasts we suggest should include:

- (i) acceptable and reasonable methodological approach;
- (ii) consistency with history as far as plausible and logical;
- (iii) consistency with other States;
- (iv) the methods/approaches highlight the uncertainties and sensitivities of the results derived;
- (v) the models have the best fit to the actual data and use as much historical information as possible; and
- (vi) adherence to statistical axioms and principles.

The term "best" in Section 8.2(e) of the Code may require the ranking of the decision criteria in a consistent and objective manner.

The process of preparing gas demand forecasts involves using econometric methods and statistics. Both MMA and NIEIR used econometrics and statistics in preparing their forecasts. The term “best” in econometrics has a specific meaning. It means the models developed have the best fit to the historical data. This is measured by the “coefficient of determination” or R^2 .¹

NIEIR have demonstrated (and MMA have conceded, refer to MMA “Response to Envestra comment following 22 Feb meeting.doc”) that the EDD approach to weather normalisation delivers significantly higher R^2 or fit to the South Australian daily gas data. The average fit or R^2 of the EDD method was 92% compared to only 86% for the HDD method.²

The Commission and its consultants, MMA, have not properly taken into consideration the term “best” (in Section 8.2(e)). This is a fundamental error of fact in NIEIR’s view. The EDD approach has a higher R^2 compared to the MMA HDD approach, therefore, the EDD approach better explains the impact of weather on SA gas demand.

MMA and the Commission have not revised their forecasts taking into account the EDD approach to weather normalisation between the draft and final decisions. This is a fundamental error in NIEIR’s view.

Irrespective of any mis-reportings or inconsistencies in the reports by both NIEIR and MMA on weather normalisation approaches, it is only the NIEIR EDD approach that has the “best” historical fit to the data (highest R^2). The EDD approach will more accurately predict future weather effects on gas demands and therefore is most consistent with Section 8.2(e) in this context.

1.2 The Commission in its final decision (paragraph 1750, page 58) has indicated that the reasonableness of each approach can be assessed by testing the level of rigour that was involved in proving the methodology.

MMA has used two methods to weather normalise the gas data. Method 1 is a method that uses 8 observations of annual sales and temperature data in a statistical regression. Method 2 uses daily gas usage data and daily temperature data but the daily gas data excludes temperature insensitive customers. Method 1, however, violates a number of the reasonableness criteria outlined in NIEIR’s April 2006 submission and therefore is not suitable for gas demand forecasting. These were documented in NIEIR’s letter to the Commission dated 20 April 2006 and in the report referred to in footnote 2 below.

The Method 2 approach has not been documented in any rigorous manner by MMA. MMA’s Stage 2 report (21 March 2006) reports average daily usage was regressed against daily HDDs with dummies for Friday, Saturday and Sunday. “Also included were annual trend variables for each of the principal variables”(MMA page 42).

¹ For example see Pindyck,R and Rubinfeld,D,” Econometric Models and Economic Forecasts”, McGraw-Hill,1976,pp57-60 or any introductory econometrics textbook.

² The average fit here is defined as the simple average of the individual R^2 from 1996-97 to 2003-04 from NIEIR’s April 2006 report, “Weather Normalisation of Envestra’s South Australian Gas sales The NIEIR and MMA approaches”.

The MMA daily equation is mis-reported in MMA's Stage 2 report (page 42, 21 March 2006) with the dependent variable reported as average usage. It is unclear what role the annual trend variables play as they are not reported in the equation itself either or defined in the report. No empirical results are reported other than a R^2 of 0.85 and a HDD sensitivity for 2005 of 5.2 TJ per HDD. No allowance for public holidays has been acknowledged by MMA, and there appears to be no allowance for economic cycles. Most importantly MMA fail to test the EDD approach to the daily data, which NIEIR found superior to the HDD approach.

NIEIR tested 3 different weather indexes, including HDD and EDD(refer to April 2006 NIEIR report, see footnote 2 below). The Commission's claim that MMA applied more rigour is simply not supported by the facts.

On the basis that:

- (i) MMA's Method 1 has been shown not to be credible by NIEIR;
- (ii) Method 2 by MMA is mis-reported in MMA's Stage 2 report and not correctly defined or documented and not tested using an EDD index; and
- (iii) NIEIR's EDD approach has been shown to have the "best" empirical fit to the South Australian gas data.

The Commission has not properly considered all of the information put before it in relation to weather normalization and cannot claim MMA have applied more rigour. Overall the MMA report attempts to cloud the issue regarding weather normalisation and the weather normalised historical growth in sales. Irrespective of what NIEIR did, or what MMA did, the fact remains MMA displayed a lack of rigour in not adequately testing or subsequently using the EDD index in weather normalization.

Therefore the EDD approach adopted by NIEIR is the approach that is most appropriate for use under Section 8.2(e) of the Code. The use of the HDD index by MMA, and not the EDD index, displays a lack of rigour in assessing the impact of weather on SA gas sales.

VENCorp, a independent Victorian participant in the electricity and gas industry, long abandoned the HDD index as a tool for weather normalisation as the linear relationship implied simply does not fit the data as well as the non-linear EDD index.

2. Comments on the MMA report “Assessment of Envestra’s Response to the Commission’s Draft Decision on Envestra’s Access Arrangement”

2.1 Introduction

The following section addresses some of the issues raised by MMA following Envestra’s response to the Draft Decision and submissions by NIEIR to the Commission.

Overall the MMA report attempts to cloud the issue regarding weather normalisation and the weather normalised historical growth in sales. Irrespective of what NIEIR did, or what MMA did, the fact remains MMA displayed a lack of rigour in not adequately testing or subsequently using the EDD index in weather normalization. This led to MMA underestimating the actual decline in average residential usage, and in their forecasts for established dwellings, the forecast decline in average usage to 2010-11 is lower than the actual historical decline. NIEIR does not believe this was the intention of MMA.

In gas demand forecasting, the first step is to weather normalise the gas data. For logical reasons, it is preferable to use daily data, as different weather patterns over a month or year can distort the true effects of weather on gas demand. Using annual or monthly data will distort the day to day effects of daily weather on daily gas demand.

NIEIR compared three alternative weather normalisation indices for the daily data and demonstrated that, like VENCORP discovered for Victoria, the EDD index is superior. The average fit or R^2 of the EDD method was 92% compared to only 86% for the HDD method (by simply averaging across all years modelled).

This unequivocally supports a conclusion that the use of an EDD approach results in best estimates. The rigor of testing alternate approaches by NIEIR was not addressed by the Commission in its Final Decision. Such analysis was not adequately undertaken by MMA, contradicting claims by the Commission that MMA was better able to verify outcomes and that MMA undertook a broader analysis than that of NIEIR.

MMA claimed to estimate a daily HDD model, although they have not documented their results as rigorously as NIEIR for their daily model, contrary. Indeed, the model is not correctly or completely specified in their Stage 2 report for the Commission.

MMA’s annual weather normalisation regression models, sometimes referred to as Method 1, have already been shown by NIEIR to suffer from a number of statistical errors as documented in NIEIR April 2006 submissions.

2.2 Specific responses

2.2.1 *“MMA has used two methods to assess weather sensitivity and normalisation. In addition to the method represented by Envestra as MMA’s sole methodology, MMA has used the method used by Envestra and NIEIR for corroboration.”* (MMA, page 2)

Response: There is no way that NIEIR can actually validate that MMA has actually performed correctly Method 2 as documentation of Method 2 in MMA’s Stage 2 report (page 42) is incorrect and insufficient.

2.2.2 *“The NIEIR derivation of EDDs is statistically unsound. It does not meet the criteria used by NIEIR to judge one of MMA’s approaches to weather normalisation. In addition there are three NIEIR reports, each of which appears to present a different EDD formula. Until EDDs are placed on a sound footing, HDDs are the preferred option.”* (MMA, page 2)

Response: NIEIR concedes that there were some minor discrepancies/inconsistencies in the documentation of the weather normalisation between the three reports. However, the focus should be on the method actually used, which has been articulated to all parties a number of times.

MMA’s focus is on these small errors, none of which have any material impact on the NIEIR results. MMA’s documentation also contains errors and mis-reporting. Statements like “placed on a sound footing” does not erase the fact that MMA failed to show due rigour and investigate the EDD index approach.

The claim that NIEIR’s derivation of the EDDs is statistically unsound is not correct. NIEIR has based its approach on the VENCORP methodology, but has calibrated the EDD data to the South Australian network (Adelaide). This is necessary since the responsiveness of gas demand to weather will be different in South Australia and Victoria. The EDD normalisation approach delivers the highest fit(highest R²), well above the inferior HDD approach.

2.2.3 *“Envestra’s and NIEIR’s method produces reliable estimates of weather sensitivity of net system load. In regard to normalisation of domestic load, the method suffers from use of invalidated assumptions and the trend is based on only eight data points.”* (MMA, page 2)

Response: This is a not an accurate representation of NIEIR’s approach and indicates an apparent misunderstanding of NIEIR’s methodology by MMA. The only trending using eight data points was by MMA under method 1, which NIEIR has already dis-credited. NIEIR did not establish a trend from eight data points, but built up its forecasts from a variety of information including:

- a segmentation of customers into new and established customers;
- an appliance model;
- an assessment of Commonwealth/State energy policies; and
- macro-economic indicators (e.g. GSP, dwelling growth, income).

2.2.4 “3. *The assertion that the commercial V market is weather sensitive while the industrial V market is weather insensitive.*

4. *The arbitrary pro-rating of weather normalisation between the domestic and commercial V markets.”* (MMA, page 31)

Response: We understood the industrial V market represented industrial customers and therefore would be relatively weather insensitive. Industrial implies that gas is used for industrial processes rather than space heating.

NIEIR’s assessment of the weather sensitivity of tariff V for South Australia was not arbitrary. NIEIR used the assessed sensitivities from VENCORP but pro-rated these to South Australian totals, taking into account the relative size of the non-domestic V markets in South Australia and Victoria.

This later criticism by MMA has been articulated a number of times and is simply incorrect.

2.2.5 *“In its Stage 2 report MMA used two methodologies for estimating the historical weather sensitivity and normalised usage of South Australian gas load. Both methods rely upon the statistical technique of regression analysis to establish the sensitivity of gas loads to weather variables such as heating degree days or effective degree days (HDDs and EDDs, defined in Section 2.2.6):*

Method 1: *regression analysis of annual domestic and small C&I loads (separately). This method simultaneously produces both sensitivity coefficients and normalised trend usage for the domestic and small C&I sectors.*

Method 2: *regression analysis of daily net system load (Adelaide gate station load less daily metered customers). This method produces only the sensitivity coefficients of the net system load. Normalised trend usage for the domestic and small C&I sectors is derived separately by disaggregating the sensitivity coefficient into domestic and small C&I components, weather normalising the respective annual loads and estimating trends.*

The two methodologies are compared in Table 2-1. Neither is perfect, which is why MMA used both and compared the results, unlike Envestra and NIEIR who relied solely upon Method 2.” (page 7)

Response: As noted above, Method 2 has not been adequately documented or reported by MMA. Method 1 has already been shown by NIEIR not to be statistically valid. Comparing a statistically invalid method (method 1) with another method is meaningless.

The assertion that NIEIR and Envestra relied solely on Method 2 is incorrect. MMA’s description of Method 2 in their Stage 2 report (page 42) is not consistent with either Envestra’s or NIEIR’s approach. MMA introduced some undefined and undocumented trend variables in their daily regression work. NIEIR also used the index with the best fit to the data, the EDD index.

MMA failed to undertake a full assessment of the EDD approach. If MMA had adopted the EDD approach in their own work, it would have shown a higher R^2 , and when incorporated into their forecasts, they would have been more consistent with the best requirement of Section 8.2(e) of the Code.

2.2.6 **Table 2-1 Comparison of weather sensitivity/normalisation methods**

	Method 1	Method 2
Based on variables being forecast?	Yes, uses separate domestic and small C&I data.	No, gate data is combined, Adelaide only and includes non-daily metered large users and UAPG.
Based on time intervals being forecast?	Yes, uses annual data.	No, uses daily data. Daily weather sensitivity not guaranteed to be the same as annual.
Directly establishes average usage trend?	Yes.	No, two stage process: weather normalisation; then simple trend based on 8 observations.
Allows for trends in temperature sensitivity?	Yes.	Yes.
Can be based on HDDs or EDDs?	Yes.	Yes.
Statistically robust sensitivities guaranteed?	No, only eight data points.	Yes, large number of data points.
Statistically robust normalised trends guaranteed?	No, only eight data points.	No, only eight data points.
Widely used?	No.	Yes.

(MMA, page 8)

Response: Table 2-1 compares Methods 1 and 2 on the basis of certain criteria. This table again misrepresents the NIEIR approach in a number of areas (see (3) and (4) above). Many of the criteria in relation to MMA's method 1, do not in anyway compensate for not complying with the central limit theorem or the multicollinearity problem. These issues were outlined in more detail in NIEIR's April 2006 report, "Weather Normalisation of Envestra's South Australian Gas sales The NIEIR and MMA approaches".

MMA concede that Method 1 is not to be statistically robust and not widely used. NIEIR has already addressed the deficiencies of Method 1 in considerable detail in the above report.

On balance, despite the table's mis-representation of Method 2, Table 2-1 suggests method 2 is the preferred approach, provided EDDs are used.

2.2.7 *"MMA naturally accepts NIEIR's general statements about the problems of using regression to estimate reliable coefficients from eight data points. The problems are well known to practitioners of statistical analysis and these potential problems are precisely the reason that MMA used Method 2 to verify the estimates from Method 1. However, since NIEIR has failed to properly replicate MMA's analysis, MMA does not accept NIEIR's detailed conclusions regarding the MMA model coefficients."* (MMA, page 9)

Response: This statement is misleading. NIEIR nearly perfectly replicated the MMA Method 1 equations. Whether MMA accepts or rejects NIEIR's observations regarding the Method 1 work is not relevant. Most, if not all, standard econometrics text books support NIEIR's conclusions in regard to MMA's Method 1 documented in the April 2006 report on weather normalization.

MMA were requested to provide Envestra and NIEIR with the equations and the data for the method 1 equations. The Commission and MMA refused to provide this information to Envestra and NIEIR.

The method 1 approach suffers from some serious statistical problems as documented in NIEIR's April 2006 submissions, which is supported in the econometrics literature. MMA admit to committing the specification error in econometrics by sequentially dropping explanatory variables in estimating the method 1 equation for the residential sector (MMA stage 2 report, page 40).

2.2.8 *"NIEIR's EDD derivation has two principle flaws:*

1. *Three apparently different formulas have been presented in three different reports and it is not clear which is best and why.*
2. *The methodology used is statistically unsound and does not meet the criteria used by NIEIR to judge weather normalisation Method 1." (MMA, page 12)*

Response: NIEIR agrees there were some minor discrepancies/inconsistencies in the formulas in NIEIR's reports and some typographical errors. These discrepancies have no material bearing on the forecasts.

The April 2005 report, prepared for the Commission measured wind in kilometres per hour, whilst subsequent reports measured wind in knots, consistent with VENCorp. This has no material impact on the level or the change in the index, and therefore the weather normalised numbers.

The exponent on the wind variable of 0.5 was a typo, as assessed by MMA. Again, this would not materially impact on the level or change in the index. We did not use the exponent on the wind variable at any stage in our analysis.

As already stated, the methodology used by NIEIR is not statistically unsound as it is used by VENCorp in Victoria and by companies such as Multinet and SP AusNet. The HDD methodological approach adopted by MMA was abandoned by VENCorp, since the EDD approach was shown to better fit daily gas demands. Assuming a linear relationship between heating load and temperature, as the HDD approach implies, produces inferior results in terms of model fit.

2.2.9 *"The regression model includes a constant, dummy variables representing weekends and public holidays, an economic activity variable and the EDD variable. MMA understands that the parameters A and B in the EDD formula are derived by manually varying them and repeating the regression analysis until the highest R-squared is obtained, which is the same method as used by VENCorp.*

This approach has the following defects:

1. *Only two parameters in the EDD formula are varied. VENCorp has also tested varying the temperature threshold (18C in the HDD term) and there is also no reason not to vary the coefficient of the cosine term (2) and the*

value 200 in the cosine term, both of which are arbitrary. Varying these parameters may yield even higher R-squared values.

2. *The statistical significance of the parameters A and B is not addressed, presumably because they are not directly part of the regression. This is a very significant omission, particularly as VENCORP has reported that:*

“All the components in the EDD formula are highly correlated with each other and this causes “Multicollinearity of the regressors” resulting in highly unstable regression coefficients. Inconsistent results can be generated depending on the order in which the variables are included in the analysis.” “ (MMA, pages 13-14)

Response: This quote is clearly inconsistent with VENCORP’s views given it currently uses the EDD approach. This quote has possibly been taken out of context.

A number of assertions and statements in Section 2.2.6.1.2 are incorrect. The parameters A and B in the EDD formula are estimated and no manual procedure was used to maximise the fit or R-squared.

The task for NIEIR was to find the best weather normalisation index for the South Australian data, consistent with industry standards. We found the EDD index, consistent with Victoria and VENCORP, superior than alternatives such as the HDD method adopted by MMA in terms of overall fit to the daily SA gas data.

The statistical significance was not reported by MMA for Method 1 and Method 2 either. MMA’s claim of a lack of statistical rigour in deriving EDDs is incorrect. EDDs are derived following the VENCORP methodology.

2.2.10 *“Base year new homes average usage” (MMA, page 15)*

NIEIR has not presented a plausible derivation of base year (2005-06) new homes average usage. It is stated that (page 35):

“The analysis in this section reports average gas usage by new dwellings in Adelaide in 2001 at around 19 GJ per annum. Given the introduction of 4-star standard in January 2003, the average usage by new customers in 2005-06 is assumed to be 17 GJ per connection.”

That section of the NIEIR forecast report actually reports average usage of new homes constructed in 2001 as 19.8 GJ in 2002-03 and 21.2 GJ in 2003-04, which averages 20.5 GJ, 7.5 per cent more than NIEIR claims. MMA, using this data together with that for new homes constructed in subsequent years and detailed calculations of the impact of 4-star homes and other factors, has estimated a 2005-06 new homes usage of 17.8 GJ per annum.

It is concluded that NIEIR has not used a best estimate of the base year new homes usage. Use of the NIEIR assumption would result in significantly lower gas demand forecasts compared to use of the best estimate.

Response: MMA claim that NIEIR has understated new home usage in 2005-06. MMA did not analyse the new customer data as NIEIR and Envestra did for this review. MMA relied upon Envestra’s and NIEIR’s work but failed to understand it. None of the 2001 meter data or the 1997 meter data was normalised. Given 2003-04 was well above a standard weather year, both estimates are overstated for that year. NIEIR advised MMA of this at our meeting

in February 2006, however, MMA have failed to revise their estimates. Their conclusion regarding both new homes and established homes are incorrect.

NIEIR used the 10 per cent trim mean estimates for assessing usage by 2001 meters giving average usage for 2001 meters of 18.7 GJ per meter. Normalising for weather for both years suggests new usage would 19.1 GJ per meter. MMA has used the sample mean which is higher and MMA have not normalised the data. This is clearly an error. Given the sample size of less than 600 new meters, the 10 per cent trim mean estimate is likely to be more accurate than the sample mean.

MMA new home usage for 2005-06 is 17.8 GJ per meter, some 2.7 GJ lower than the 20.5 they used as the 2001 estimate. Assuming MMA calculations re the impact of changes to building standards etc are correct the new customer usage should be around 16.5 GJ per meter, lower than the NIEIR estimate of 17 GJ per meter. The MMA estimate cannot be regarded as best.

2.2.11 "Existing homes forecast

A comparison of MMA, Envestra and NIEIR existing homes forecasts (Table 2-4) shows the impact of the key differences in MMA's and NIEIR's assumptions. The NIEIR forecast starts at a lower value (due to weather normalisation differences) and has a stronger declining trend (due to differences in historic trends and MEPS impacts). In all respects we consider the MMA estimates to be best estimates.

Table 2-4 Existing homes average usage forecast comparison (GJ per customer)			
	MMA Stage 2 Report	Envestra	NIEIR
2005-06	22.9	22.8	22.5
2006-07	22.8	22.5	22.3
2007-08	22.6	22.1	22.1
2008-09	22.4	21.6	21.7
2009-10	22.2	21.2	21.4
2010-11	22.1	20.8	21.1

Response: MMA report on the difference between the existing home forecasts. As MMA reports the NIEIR estimate starts at a lower value (due to weather normalisation) and has a stronger declining trend (due to weather normalisation and policy assumptions). Since the NIEIR weather normalisation approach is superior (see above), the MMA estimate starts incorrectly at a higher value, and declines at only 0.7 per cent per annum to 2010-11. In view of the fact that the MMA approach to weather normalisation is not "best", the MMA estimates of established usage cannot be regarded as best estimates, as MMA claim.