SECOND REPORT TO THE AER REVIEW OF ETSA UTILITIES SALES AND DEMAND FORECASTS

PREPARED BY: Transmission Services

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Executive Summary

The Australian Energy Regulator (AER) made its draft determination on the prices that will apply to ETSA Utilities regulated services over the next 5 financial years on 30 November 2009. ETSA Utilities provided a Revised Regulatory Proposal on 14 January 2010. The AER requested AEMO to review the revised proposal and its supporting information.

Upon review of the information, it became clear that there was more recent economic data that should be used in determining the forecast for ETSA Utilities sales. It was also determined that new models for business and residential sector forecasts would have to be developed because of the following factors:

- The more recent economic data released by ABS for the state accounts (Catalogue No. 5220) in December 2009 had revised the historic economic data as ABS had adopted new international standards;
- The variables for the model needed to be part of the forecast set provided in the more recent Access Economics, KPMG and NIEIR forecasts;
- The issue raised in ETSA Utilities' Frontier Economics paper about the dependent variables likely to be non-stationary and the possibility of spurious correlations between the variables was studied and it was determined that models would be developed which were based on first differences of the variables thereby removing any chance of non-stationary variables.

AEMO has also reviewed the post model adjustments based on the information provided by MMA in its report commissioned by ETSA Utilities. This has resulted in slightly larger reductions in these adjustments compared with our October 2009 report (of the order of 160 GWh).

The following table shows the differences in the sector sales growth rates making up the sales forecasts (except those where there is no difference between ETSA and AEMO):

		AEMO REPORT AVERAGE GROWTH RATE (%)	ETSA PROPOSAL AVERAGE GROWTH RATE (%)
Business sector	Initial 2009	3.5	-0.1
	Most recent	0.5	-0.7
Residential sector	Initial 2009	1.1	-2.5
	Most recent	-2.7	-2.5
Water heating	Initial 2009	-3.5	-10.8
	Most recent	-3.5	-9.3
Overall	Initial 2009	2.9	-0.7
	Most recent	-0.2	-1.1

The main differences between the sales forecasts in AEMO's October 2009 report and this report is the change in underlying economic forecasts:

- The average growth rate of SA manufacturing sector GVA has reduced from 2.8% to -0.1% which is the main driver behind the reduction in the business sector sales of around 1,000 GWh by 2014/15.
- The average growth rate of SA dwelling investment has reduced from 4.5% to 1.9% (for the replaced variable of dwelling ownership GVA) which is the main driver behind the reduction in the residential sector sales of around 500 GWh by 2014/15.

The overall result is that although AEMO developed new models for residential and business sector sales forecasts, the main reason for the large change between the October 2009 report (using the KPMG economic forecasts of March 2009) and this final report (using the January 2010 KPMG and October 2009 Access economic forecasts) is the underpinning economic forecast data. The final base sales forecast comparison between AEMO and ETSA utilities amended revised proposal is given in the following table:

BASE CASE PRICES	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	*ANN GTH %*
Business							
AEMO preferred	7,096	7,160	7,136	7,122	7,202	7,268	*0.5*
ETSA Utilities	6,814	6,830	6,803	6,714	6,654	6,571	*-0.7*
Residential							
AEMO preferred	3,735	3,682	3,597	3,453	3,331	3,253	*-2.7*
ETSA Utilities	3,502	3,460	3,404	3,297	3,183	3,079	*-2.5*
Water heating							
AEMO	637	614	592	572	553	534	*-3.5*
ETSA Utilities	645	594	643	493	444	395	*-9.3*
Public lighting							
AEMO	116	119	121	124	127	129	*2.2*
ETSA Utilities	114	117	120	123	126	129	*2.5*
Desalination plant							
AEMO	0	143	215	307	307	307	*na*
ETSA Utilities	0	143	215	307	307	307	*na*
Total							
AEMO preferred	11,583	11,717	11,661	11,577	11,518	11,491	*-0.2*
ETSA Utilities	11,075	11,144	11,185	10,934	10,714	10,481	*-1.1*

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1. Introduction

The Australian Energy Regulator (AER) is conducting a review to determine the prices that will apply to the regulated services provided by ETSA Utilities for the period 1 July 2010 to 30 June 2015.

AEMO provided a report to the AER in October 2009 reviewing the sales and demand forecasts submitted in ETSA Utilities' initial Regulatory Proposal. The AER subsequently adopted AEMO's sales forecasts in its November 2009 Draft Determination in place of the sales forecasts submitted by ETSA Utilities.

ETSA Utilities, responding to the Draft Determination, submitted a Revised Proposal on 14 January 2010. The Revised Proposal includes sales forecasts which are materially different from those developed by AEMO in October 2009 and adopted by the AER in the Draft Decision.

Supporting documents submitted by ETSA Utilities as part of its Revised Proposal provide a critique of AEMO's October 2009 report and argue that AEMO's sales forecasts were unreasonably high and based upon unreliable models and unreasonable assumptions, particularly in regard to post model adjustments for energy efficiency policies.

ETSA Utilities' revised sales forecasts also incorporate the effects of changes in the economic outlook subsequent to the development of ETSA Utilities' original Proposal and AEMO's October 2009 report.

The AER requested AEMO undertake a review of ETSA Utilities' revised energy sales forecasts and supporting information submitted as part of its Revised Proposal.

1.1 Scope of the review

The AER wrote to AEMO on 9 February 2009 requesting that AEMO:

- review and provide advice on the reasonableness of ETSA Utilities' input assumptions used in generating its revised energy sales forecast;
- review and provide advice on issues raised by ETSA Utilities in relation to AEMO's energy sales forecast methodology and forecasts;
- review and provide advice on the reasonableness of ETSA Utilities' post model adjustments to its baseline energy sales forecasts;
- determine whether any of ETSA Utilities' proposed changes should be incorporated into the existing energy sales forecast; and
- provide written advice to the AER, in a form which can be published with the AER's final decision, on the findings and conclusions of AEMO's review, including updated forecasts if necessary.

2. Review of ETSA Utilities' Input Assumptions

2.1 Economic assumptions

ETSA Utilities' Revised Proposal indicates that its revised sales forecasts are based on three independent economic outlooks developed by KPMG, Access Economics and NIEIR. Access Economics' forecasts are dated October 2009 and KPMG's and NIEIR's January 2010. These economic outlooks are different from one another and they also differ from the outlook developed by KPMG in 2009 and used in AEMO's 2009 report to the AER.

A further consideration in reviewing the economic assumptions is that the ABS released an updated set of State Accounts (Catalogue No. 5220) in December 2009. The new Catalogue provides an additional year of data (2008-09) upon which to base the development of forecasting models. The latest ABS release also adopts new international standards and definitions in regard to the presentation of National and State Accounts information, with the result that historic economic time series data has been revised significantly.

The following figures compare historic and forecast data for key measures of economic activity. The figures highlight revisions made by the ABS to historic data as well as differences between the economic scenario relied upon by AEMO in its 2009 report and the three new scenarios developed for ETSA Utilities' Revised Proposal. These comparisons are constrained by the level of information that is common across ETSA Utilities' three new economic scenarios. This information is essentially limited to GSP and sectoral Gross Value Added (GVA) forecasts and population projections. The ownership of dwellings GVA data reported below is conceptually related to the housing investment data used in AEMO's 2009 model, in that new investment adds to the total stock of housing, while the GVA data reflects the imputed return to owners of the housing stock.

Figure 1: South Australian GSP

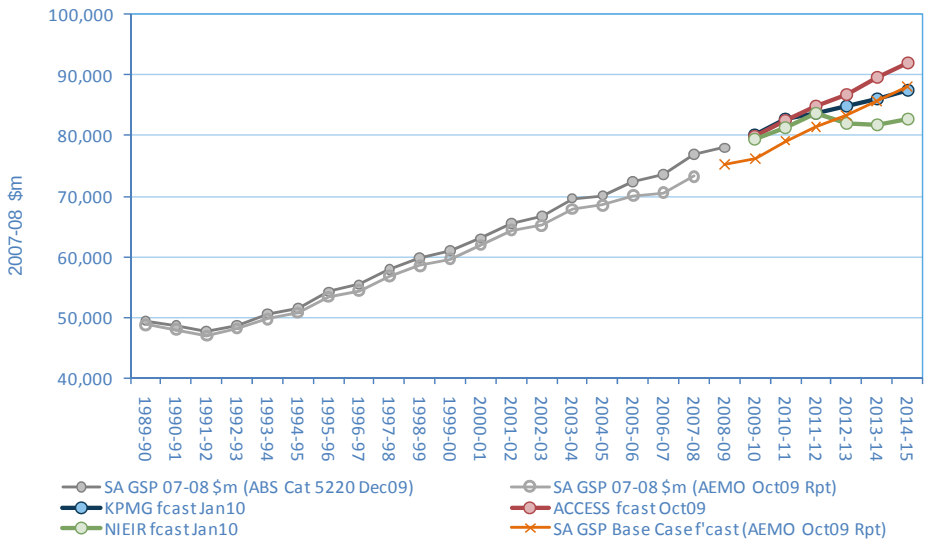


Figure 2: SA Ownership of Dwellings Gross Value Added

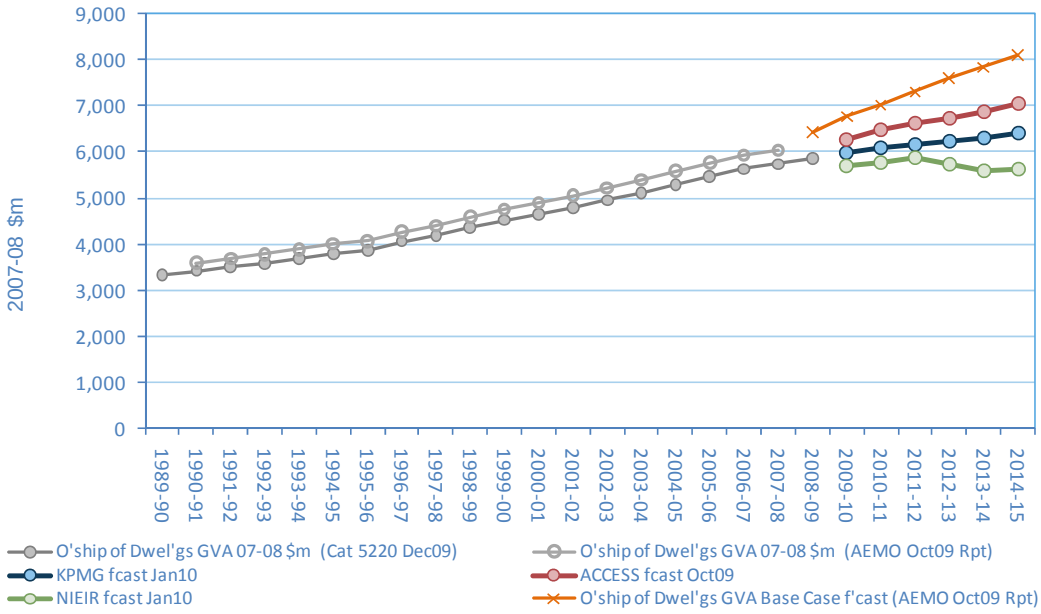


Figure 3: SA Manufacturing Sector Gross Value Added

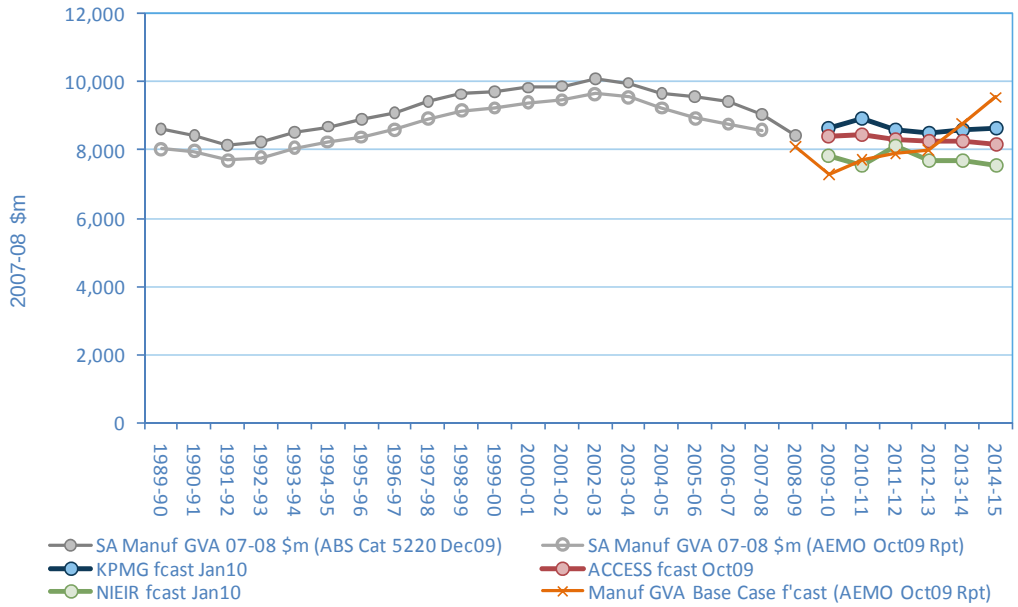
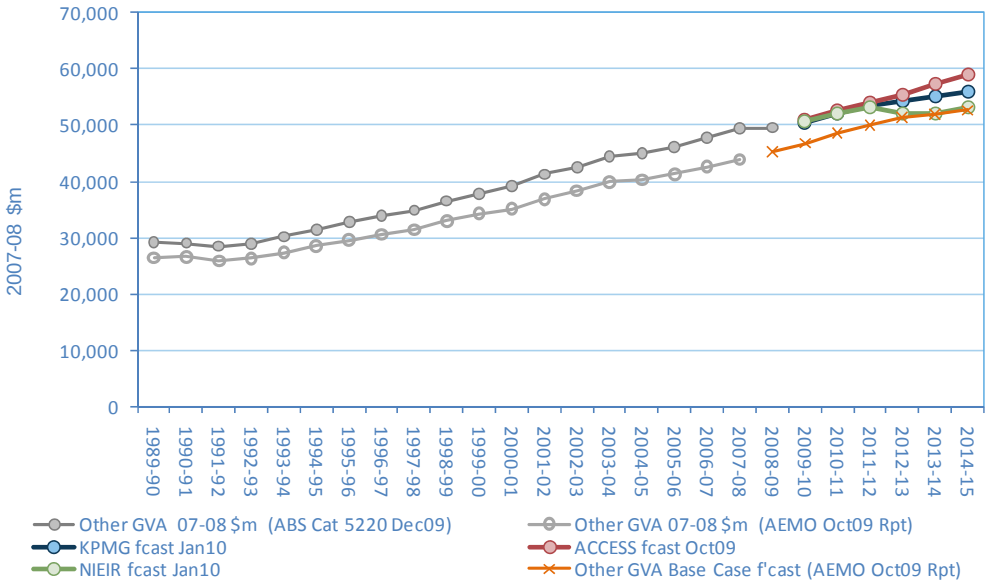
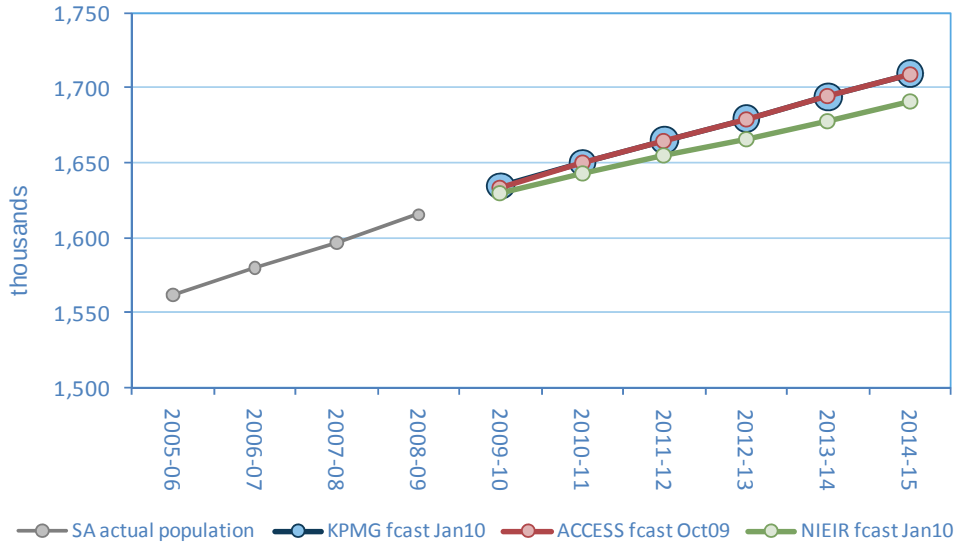


Figure 4: SA Other Sectors (ex Agric and Mining) Gross Value Added



AEMO has also reviewed the underlying population growth assumptions developed for ETSA Utilities by KPMG, Access Economics and NIEIR, as these assumptions are a key driver of the economic forecasts referred to in the preceding charts. As shown in the following figure, KPMG's and Access Economics' population forecasts are almost identical, while NIEIR's are materially lower. This difference in outlook for the population will underlie differences between the economic forecasts shown in the previous figures.

Figure 5: SA population



The following observations may be made in relation to the economic data:

- The significant revisions to the ABS's historic figures, together with an additional year of data, indicate that AEMO's October 2009 models are no longer likely to provide the best available sales forecasts. Furthermore, the overall level of economic activity, as reflected in the GSP data shown in Figure 1, was materially higher for the 2008-09 year than assumed in AEMO's earlier report to the AER. The outlook for different sectors of the economy, as reported in Figures 2 to 4, is also materially different from the forecasts relied upon by AEMO in its 2009 report. In light of these observations AEMO considers it important that it develop new electricity sales models and related forecasts for this report. In doing so, AEMO notes that the development of its new models is constrained by the range of common variables forecast by all three of ETSA Utilities' economic consultants.

- In developing its earlier report to the AER, AEMO adopted economic forecasts developed by KPMG for the 2009 Statement of Opportunities and benchmarked these against publicly available independent forecasts prepared by Access Economics around June 2009. AEMO's earlier report found that there was close agreement between KPMG's and Access Economics' forecasts. AEMO's earlier report also found that NIEIR's economic forecasts were consistently and materially lower than both KPMG's and Access Economics' forecasts.

- NIEIR's revised economic forecasts are again consistently lower than both KPMG's and Access Economics' revised forecasts, with the differences becoming increasingly pronounced as the forecast horizon is extended towards 2014-15. This is likely to reflect, in part at least, the large difference between NIEIR's population outlook and that provided by ETSA Utilities' other two consultants.

- KPMG's updated economic outlook has the overall size of the South Australian economy growing to around the same level by 2014-15 as it forecast last year for AEMO (refer Figure 1). KPMG's revised forecasts have had the effect of bringing forward economic growth at the expense of slower growth from 2010-11. This is not an unusual situation with the development of economic forecasts, as long term average growth rates tend to be driven by relatively stable fundamental characteristics such as demographics and resource endowments, with shorter term cycles in year-to-year growth reflecting more volatile effects associated with unexpected shocks such as the GFC and governments' evolving policy responses.

- Although KPMG's revised economic forecasts show the economy growing to around the same level as previously forecast for 2014-15, there have been material changes to KPMG's forecasts of the composition of expected growth on a sectoral level (refer Figures 2 to 4). In particular their forecast of manufacturing sector GVA shows a steady decline whereas the previous forecast had a strong rebound for the manufacturing sector (refer Figure 3). This will be reflected in AEMO's updated electricity sales forecasts.

AEMO is not an expert economic forecaster or commentator and cannot comment directly on the reliability or otherwise of the three economic scenarios relied upon by ETSA Utilities. However, AEMO notes that it is unusual to average different economic scenarios, particularly when the variables being averaged are sub-sets of overall economic activity. It is unclear that the resulting averages will "add up" to give a sensible overall picture of the economy. Instead, AEMO recommends an approach where different economic outlooks are treated as independent scenarios and, if required, the resulting sales forecasts averaged. In this report AEMO has therefore developed three sets of electricity sales forecasts, one for each of the updated economic outlooks provided by ETSA Utilities.

AEMO has already noted that NIEIR's forecasts are again materially lower than the forecasts provided by both KPMG and Access Economics, and that this may be due to NIEIR's much lower population growth assumptions for South Australia.

Given the relatively close agreement between KPMG's and Access Economics' forecasts, and the large differences between these forecasts and NIEIR's, AEMO recommends that the AER adopt an average of AEMO's sales forecasts based on KPMG's and Access Economics' outlooks.

2.2 Retail electricity price assumptions

ETSA Utilities' revised retail price assumptions assume that the Federal Government's CPRS-5 scenario will apply out to 2015. A similar assumption underlies KPMG's price forecasts that were adopted in AEMO's 2009 report to the AER. AEMO considers that this remains a reasonable assumption in the absence of a new policy statement by the Australian Government.

ETSA Utilities' price assumptions also allow for assumed network tariff price increases, whereas KPMG's 2009 forecasts did not. ETSA Utilities' assumed network tariff price impacts are consistent with its sales forecasts as submitted to the AER.

Actual price outcomes for the 2008-09 year are now known, and KPMG's latest economic outlook, as reported to ETSA Utilities in January 2010, is quite different from its earlier outlook used by AEMO during 2009. AEMO therefore concludes that KPMG's price forecasts developed in mid-2009 will no longer reflect its view of prices and are not the best assumptions that could adopted for this review. This leaves NIEIR's January 2010 forecasts, as submitted in the revised proposal, as the only candidate for an alternative price scenario.

NIEIR has provided a set of price forecasts which reflect assumed underlying prices (ie, price forecasts that only include the effects of the CPRS-5 and renewable energy policies), plus a set of adjustments which reflect ETSA Utilities' assumed network tariff effects on retail prices. The final price assumptions underlying ETSA Utilities' sales forecasts are a combination of the underlying price forecasts plus the network tariff adjustments.

NIEIR's underlying price scenario appears reasonable to AEMO. AEMO also considers that it is reasonable to include an allowance on top of NIEIR's underlying price forecasts for

network pricing effects. However, AEMO considers the extent of the allowances made by ETSA Utilities to be unreasonably high, as these adjustments are based on ETSA Utilities' sales forecasts which AEMO considers to be too low due to their other economic assumptions.

AEMO has therefore made its own adjustment to NIEIR's underlying price forecasts to reflect the AER's Draft Decision impact on network tariffs. In particular, AEMO has assumed that average retail prices would rise (above NIEIR's underlying forecasts) by 4.4% in real terms in 2010-11 and 1.6% each year thereafter. AEMO's sales forecasts also include a sensitivity analysis showing the effect of assuming that prices rise by 1% more or less than the price rises associated with the AER's Draft Decision.

The following figures compare ETSA Utilities' revised price assumptions with NIEIR's underlying price trajectories and the amended forecasts developed by AEMO for this report.

Figure 6: SA residential sector average retail prices

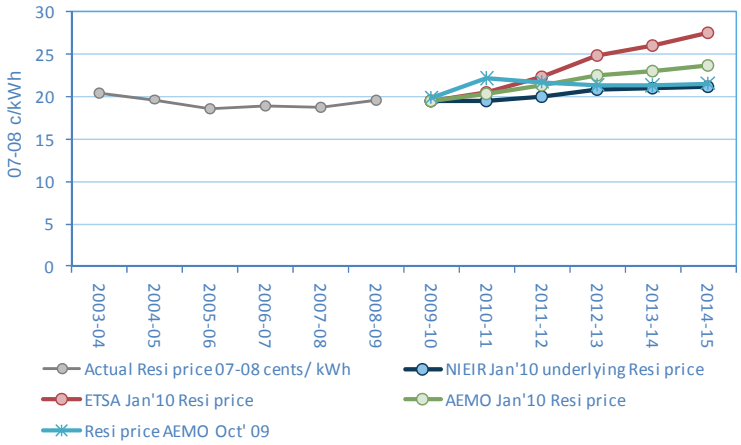
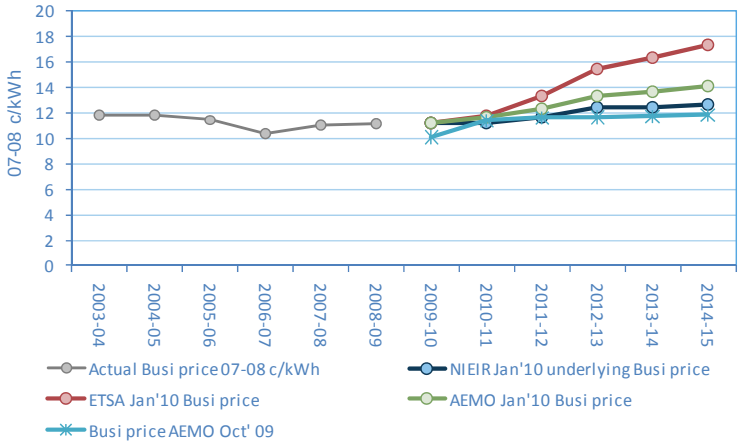


Figure 7: SA business sector average retail prices



Assumed real price increases between 2008-09 and 2014-15 for each set of price scenarios are tabulated below. AEMO's price trajectory assumes residential prices will rise by a total of 12.2% in real terms over the period due to network price decisions, whereas ETSA Utilities' has assumed a rise of 32.6%. Comparable increases for the business sector are 12.7% (AEMO) and 41.6% (ETSA Utilities). These network-driven real price increases are assumed to be in addition to NIEIR's underlying price forecasts which show real increases of 8.6% for the residential sector and 13.6% for the business sector over this period.

Table 1: Assumed real price increases, 2008-09 to 2014-15

	Residential price (real % inc)	Business price (real % inc)
NIEIR's underlying prices (excludes network price effects)	8.6	13.6
AEMO's price assumptions	20.8	26.3
ETSA Utilities revised price assumptions	41.2	55.2

AEMO acknowledges that the price trajectories it has developed for the purposes of this report are indicative estimates, and that actual price outcomes will depend on the AER's final network pricing decision and other policy effects. The prices associated with AEMO's different assumptions and revised sales forecasts are summarised below.

Table 2: AEMO's assumed retail price trajectories (2008-09 cents/kWh)

	Network pricing scenario								
	4.4% real increase in 2010-11 then 1.6% pa			5.4% real increase in 2010-11 then 2.6% pa			3.4% real increase in 2010-11 then 0.6% pa		
	SA Average price	SA Residential price	SA Business price	SA Average price	SA Residential price	SA Business price	SA Average price	SA Residential price	SA Business price
2009-10	13.35	19.52	11.15	13.35	19.52	11.15	13.35	19.52	11.15
2010-11	13.94	20.38	11.64	14.07	20.57	11.75	13.80	20.18	11.53
2011-12	14.66	21.26	12.33	14.95	21.68	12.57	14.38	20.85	12.09
2012-13	15.60	22.51	13.34	16.06	23.17	13.73	15.15	21.85	12.95
2013-14	16.06	22.98	13.66	16.70	23.89	14.20	15.44	22.09	13.13
2014-15	16.52	23.58	14.09	17.35	24.76	14.79	15.73	22.45	13.41
% chg 08-09 to 14-15	*23.8*	*20.8*	*26.3*	*30.0*	*26.8*	*32.6*	*17.8*	*15.0*	*20.3*

Note: prices shown in the table include assumed network-driven price rises and assumed rises in the underlying price.

3. Issues raised in relation to AEMO's forecasting models

ETSA Utilities commissioned Frontier Economics to prepare a report on the residential and business sector sales forecasting models used to develop AEMO's 2009 report to the AER. The report was submitted as attachment E1 to ETSA Utilities' revised proposal. ETSA Utilities has concluded that AEMO's models were not fit for the purpose of forecasting its sales levels. This section responds to the issues raised by Frontier Economics. It also responds to issues raised by ETSA Utilities in relation to AEMO's water heating sales forecasts.

3.1 Non-stationary dependent variables and the problem of spurious regressions

Frontier Economics reported that the dependent variables used in AEMO's residential and business sales forecasting models are likely to be non-stationary and, as a result, AEMO's models may be based on spurious correlations between the variables and will not produce reliable forecasts.

AEMO acknowledges the potential issues surrounding the use of non-stationary data and the problem of spurious regressions referred to by Frontier Economics. We have therefore reviewed the approach taken in-house and in consultation with Monash University, taking into account the well established Engle-Granger theorem that if non-stationary variables are I(1) (that is, integrated of order one) and it can be established that the variables are co-integrated with one another, then statistically valid long run relationships may be estimated in the manner adopted by AEMO.

Firstly, electricity consumption data and economic time series for the period 1989-90 to 2008-09 have been tested for stationarity. Two independent statistical tests were conducted on each data series. Where both tests supported the conclusion that the data are I(1), AEMO has interpreted this as strong evidence, and where only one test supported this conclusion, AEMO has interpreted this as weak evidence. The data series tested and results are set out in the table below.

Table 3: Results of tests for non-stationarity of data

DATA SERIES	EVIDENCE THAT DATA IS I(1)
Business sector electricity sales	strong
Residential sector electricity sales	strong
Per capita Residential sales	strong
Ave Business sector retail price of electricity	strong
Ave Residential sector retail price of electricity	strong
Ave South Australian retail price of electricity	weak

DATA SERIES	EVIDENCE THAT DATA IS I(1)
SA real gas price index	strong
SA Gross State Product	weak
SA Manufacturing sector GVA	strong
SA Ownership of dwellings GVA	strong
SA Other sectors GVA	strong
SA Manufacturing & Other sectors GVA combined	strong
SA Private dwellings Gross Fixed Capital Expenditure	strong
SA Household Final Consumption Expenditure	weak
Per capita SA H'hold Final Consumption Expenditure	weak

Secondly, AEMO has reviewed its October 2009 residential and business sales models and used the Engle-Granger test to determine if the data used in the models are co-integrated or not. Both sets of data were found to be co-integrated at the 10% p-level[1]. AEMO is therefore satisfied that its October 2009 forecasts were not based on spurious regression models, but represents statistically valid long run relationships between the data.

In developing the revised sales forecasts for this report, AEMO has elected to remove questions about the stationarity of data and co-integration as potential sources of debate and instead estimated new models using first differences of the economic variables and electricity consumption data, as recommended by ETSA Utilities and Frontier Economics. AEMO will be adopting this approach in future when developing regression models so that the issue of stationarity of data is beyond doubt.

3.2 AEMO's selection of independent driver variables and related issues

Frontier Economics also reported that AEMO appears to have had little regard to economic reasoning in the selection of driver variables and dynamic adjustments in developing its models, and instead relied upon identifying the best statistical models. Frontier Economics concluded that this approach leads to "unstable" models (ie, the development of different models with the passage of time), and that it is difficult to have confidence in models which are changed over time.

AEMO rejects these claims.

The purpose of the models which AEMO developed for the AER was specifically to forecast ETSA Utilities' electricity sales to 2014-15. Earlier models developed by the ESIPC were

[1] Tests for stationarity of the co-integrating relationship residuals may be conducted using the Dickey-Fuller approach described in basic econometric texts but different critical values must be adopted. These critical values may be calculated using tables in J.G. MacKinnon, *Critical Values for Cointegration Tests*, in R.F. Engle and C.W.J. Granger (eds) *Long-Run Economic Relationships: Readings in Cointegration*, Oxford University Press, 1991.

designed to forecast overall SA electricity sales, so it should not be surprising that different models have been developed. AEMO also notes that historic data is revised from time to time, including ABS and electricity sales data, and that new data become available with the passage of time. Both factors necessitate a reassessment of the performance of old models from time to time. AEMO promotes a culture of learning and continuous improvement and always strives to develop better forecasts. AEMO makes no apologies if this requires the development of new approaches and different models as time passes.

AEMO considered a wide range of potential economic variables and model structures in developing its sales forecasts for the AER, including the use of lagged price variables to reflect dynamic effects in consumers' responses. Considerable weight was placed on the out-of-sample forecasting performance of potential models, as this should be a reliable indicator of how well the forecasts can be expected to perform in the context of the AER's requirements. AEMO considers this to be a more important decision criterion than having a model satisfy preconceived theories about which driver variables should be included in a model and which should not. AEMO's preferred models performed exceptionally well in this regard, with a five-year-ahead out-of-sample forecast MAPE of 1.6% for business sales and 2.0% for residential sales. AEMO's approach to model development represents a transparent, objective and verifiable way in which to develop models and related forecasts.

AEMO does not consider the economic driver variables or model structures selected for its preferred models to be unusual or exceptional in any way.

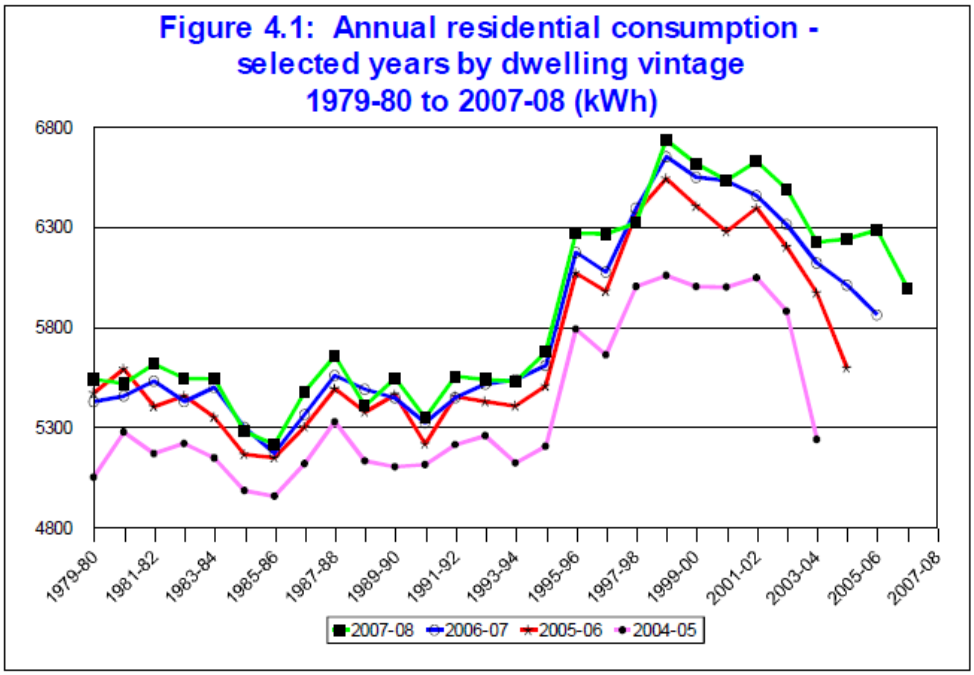
- It should not be surprising that business sales are found to respond to an electricity price variable and measures of activity in the manufacturing and "other" (ie, commercial and services) sectors. Any flow-through effects to these sectors arising due to changes in activity in the agriculture or mining sectors will be reflected in the economic forecasts for the manufacturing and other sectors. AEMO acknowledges that gas prices and weather conditions will also affect electricity sales to the business sector. However, AEMO's analysis of the data did not identify these effects as being significant. Estimated coefficients for these variables often had the wrong sign and the out-of-sample forecasting performance was typically poorer when these variables were included in potential models.
- Similarly, it should not be surprising that residential sales are found to respond to an electricity price variable, a weather variable and the level of dwelling investment. Dwelling investment[2] results in growth of the housing stock, which is where residential electricity consumption occurs. Dwelling investment also reflects changes in the household sectors' wealth and income, as well as growth of the population and

[2] The variable that provided the best fit for the model was ownership of dwellings GVA which ABS defines as "Ownership of dwellings consists of landlords and owner-occupiers of dwellings. Owner-occupiers are regarded as operating a business that generates a gross operating surplus. The imputation of a rent to owner-occupied dwellings enables the services provided by dwellings to their owner-occupiers to be treated consistently with the marketed services provided by rented dwellings to their tenants. Owner-occupiers are regarded as receiving rents (from themselves as consumers), paying expenses, and making a net contribution to the value of production which accrues to them as owners".

general economic conditions such as employment levels and interest rates. All of these factors influence residential electricity consumption, as do numerous other variables such as the type of new houses being constructed, household size, growth in the stock of air-conditioners and other appliances, and the price of substitute products such as gas and solar energy. However, it is clear that not all of these economic drivers can or should be included in a good forecasting model.

- Frontier Economics also commented on AEMO's residential sales model including a dummy variable from 1998-99 when the NEM started, stating that "*Although we are fairly confident that the effect ascribed by the model to the NEM is spurious, further analysis would be required to throw light on the reason for its being statistically significant*." AEMO's 2009 report suggested that this effect may also reflect a change in the way in which electricity sales data was compiled after the ETSA Corporation was split into separate businesses, or possibly an underlying behavioural change on the part of consumers. AEMO has considered this issue further with reference to data presented in NIEIR's January 2010 sales forecast report to ETSA Utilities (Attachment E.7 to the Revised Proposal). The following figure, reproduced from NIEIR's report, shows changes in average household electricity consumption in recent years for houses of different vintage. NIEIR has attributed large increases in average consumption to an increase in the floor space of new dwellings and increased penetration of air conditioning from the late 1990's. AEMO agrees that there appears to have been step changes in recorded average household electricity use over a very short period of time. The driver variables included in AEMO's residential sales forecasting model did not adequately capture these effects and a dummy variable was used instead. Use of a dummy variable to deal with unobserved variables or step changes in behaviour is common in econometric modelling. AEMO's analysis showed this effect to be important in the out-of-sample forecasting performance of its residential sales model.

Figure 8: NIEIR Chart – Average residential electricity consumption



3.3 Water heating sales forecasts

ETSA Utilities has made the following comments in regard to AEMO's sales forecasts for electricity used for water heating[3].

- "*The South Australian strategic plan was released on 1 January 2007. This set the direction for new residential building standards, which took effect on 1 July 2008. The standards effectively banned the installation (from July 2008) and replacement (from July 2009) of electric storage hot water services, except in very restricted circumstances.*
- *It is clear that the very significant effect of these recently introduced standards on the replacement of storage electric hot water services by more energy efficient appliances cannot be contained in the most recent five year trend in energy consumption. The AEMO assumption of an average life of 20 years for hot water appliances is significantly greater than the industry expectation of 7-10 years, which ETSA Utilities has confirmed by discussion with the appliance manufacturers. MMA also calculated from literature an average life of 9 years for hot water systems. ETSA Utilities has used a conservative life of 10 years*".

[3] ETSA Utilities Attachment E.3 to the Revised Proposal, Page 6.

AEMO's water heating sales forecasts do not rely on extrapolating trends observed over the past five years. Instead, AEMO's models and assumptions were shown to explain the actual level of sales over the past five years with a reasonable degree of accuracy.

AEMO's water heating sales forecasts for future years explicitly allow for changes associated with the new residential building standards banning the installation of new and replacement electric storage water heaters in residential premises except in certain defined circumstances. In particular, AEMO has assumed that all new water heaters installed in SA are gas, solar or heat pumps, and that only 5% of replacement installations are on a like-for-like basis. AEMO considers these assumptions to be reasonable, given that conventional electric storage water heaters may still be installed in the following circumstances:

- in non-dwellings, such as commercial premises, shops, schools, office buildings, sheds, garages or pools;
- in new and established multi storey flats and apartments (class 2 buildings);
- in dwellings owned by SA Housing Trust;
- in established homes without an SA Water supply;
- in established homes to service only one room of a house and not a shower and/or bathtub (eg a water heater solely for a kitchen or laundry);
- where water heaters are replaced under warranty;
- when installed in established homes in Remote areas;
- when replacing conventional electric water heaters in Regional areas; and
- when replacing internal conventional electric water heaters or outside conventional electric water heaters within 3 metres of a neighbour's windows or doors in Metropolitan and near Adelaide areas.

AEMO notes ETSA Utilities' comments and consultant advice regarding the life expectancy of water heating units and the important role this variable plays in forecasting future sales levels. However, AEMO believes that the life expectancy figures cited by ETSA Utilities refer to the average life across all types of water heaters. The key issue in relation to water heating sales forecasts is the life span of old-style electric storage water heaters with copper tanks which were the preferred choice in SA for many years and will therefore be common in many of Adelaide's older houses and non-residential premises. It is the replacement rate of these older-style units which will be an important driver of future sales levels due to the higher than average electricity use by these appliances.

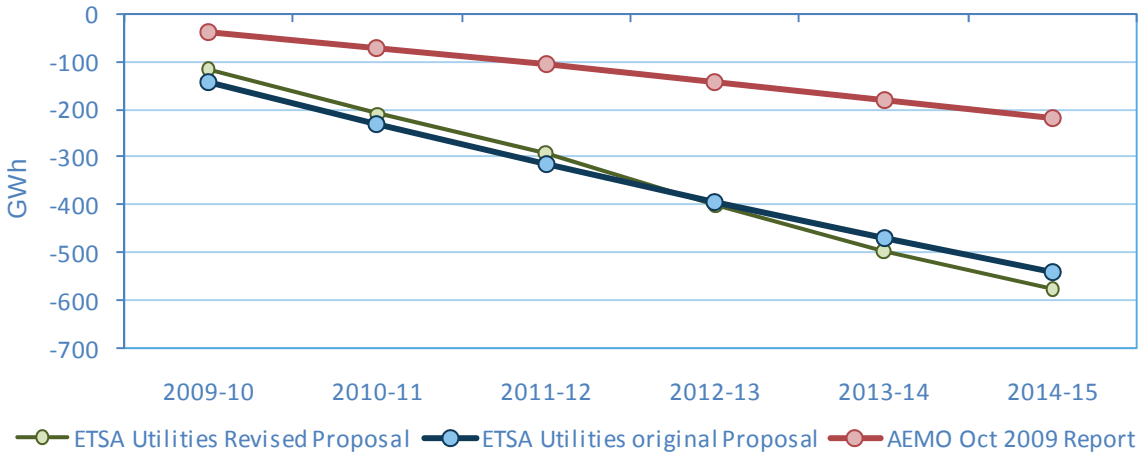
AEMO has discussed these issues with a major plumbing supplier in Adelaide and was advised that new water heating appliances typically have low cost vitreous enamel tanks with relatively short life spans, consistent with the figures cited by ETSA Utilities. However, the supplier also advised that it is not uncommon for older style, copper-tanked units to have a life span in excess of 20 years. AEMO is therefore satisfied that its water heating sales forecasts are reasonable and that ETSA Utilities' forecasts assume too short a life span for the existing stock of these appliances.

4. Review of post model adjustments

ETSA Utilities commissioned McLennan Magasanik Associates (MMA) to report on post model adjustments intended to capture the effects of energy efficiency policies that may not be reflected in business-as-usual sales forecasts. MMA's report was submitted as Attachment E.2 to ETSA Utilities' Revised Proposal.

As a result of the work undertaken by MMA, ETSA Utilities' Revised Proposal includes a slightly smaller overall level of post model adjustments in years to 2011-12 and slightly larger adjustments in later years. ETSA Utilities' revised level of adjustments remains much greater than proposed by AEMO in its 2009 report to the AER, as shown in the following figure.

Figure 9: ETSA Utilities original and revised post model adjustments



AEMO's 2009 report noted that the application of post model adjustments to modify baseline forecasts involves a degree of judgement, as opposed to being based on rigorous statistical tests. The report explained the basis for AEMO's judgements in each of the areas where an adjustment might potentially be considered.

In response to the AER's request, AEMO has reviewed the extensive amount of information presented in MMA's report in relation to energy efficiency programs and the development of post model adjustments. The full review is included as Appendix A to this report.

The key points to emerge from AEMO's review are as follows:

- AEMO's 2009 report proposed that no adjustments be made in respect of the REES scheme, air conditioning MEPS, and the federal insulation program. The review of information presented by MMA has resulted in AEMO agreeing that some adjustment

- AEMO's 2009 report proposed that no adjustments be made in respect of televisions, set-top boxes and standby power because efficiency improvements were assumed to be broadly offset by above-trend underlying growth in the use of these appliances. Information identified by MMA has facilitated a detailed assessment of the extent of expected efficiency gains in these areas and an assessment of the extent of above-trend growth of electricity use associated with these appliances. AEMO now proposes an adjustment totalling some 124.6 GWh by 2014-15.
- AEMO has proposed no change to the post model adjustments in respect of rooftop solar PV panels or lighting MEPS as the original ETSA Utilities proposal aligned well with AEMO's 2009 report and analysis. The ETSA Utilities revised proposal has increased the size of the post model adjustment which we do not endorse.
- Recent forecasting work undertaken by AEMO for the Australian Government's Energy White Paper examined the likely impact of phasing-in electric vehicles. This change is expected to affect ETSA Utilities' sales in coming years and appropriate adjustments have been added to the baseline forecast because this effect will not be reflected in past trends and relationships in the data. ETSA Utilities has not included an allowance for this effect in its revised sales forecast.

The following figure and table summarise AEMO's revised post model adjustments and compare them with the adjustments underlying ETSA Utilities' Revised Proposal.

Figure 10: Revised post model adjustments

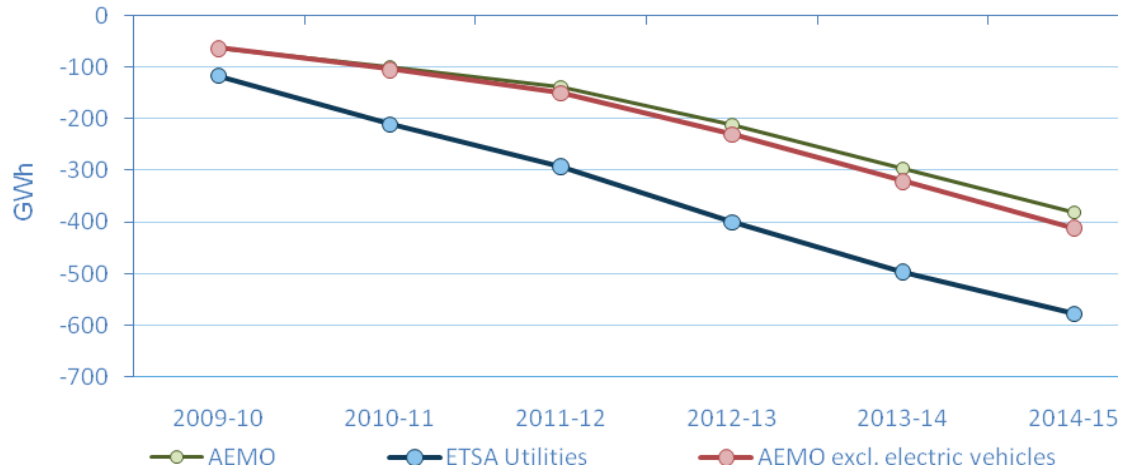


Table 4: Revised post model adjustments (GWh)

	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15
AEMO						
Electric vehicles	0.0	6.4	12.5	18.6	24.8	31.1
SA REES scheme	-4.4	-9.9	-15.6	-21.3	-27.1	-32.8
Federal insulation program	-15.9	-16.5	-17.2	-17.8	-17.8	-17.8
A/C MEPS	0.0	-3.2	-6.4	-9.6	-12.9	-16.2
Televisions and set-top boxes	12.2	27.5	41.0	20.2	-8.9	-36.6
Standby power	-14.9	-29.5	-44.2	-58.8	-73.4	-88.0
Solar PV panels	-11.3	-15.1	-18.9	-22.7	-26.4	-30.2
Lighting MEPS	-28.7	-58.2	-88.8	-120.1	-153.9	-189.7
Price and policy overlap	0.0	0.0	0.0	0.0	0.0	0.0
AEMO total	**-63.0**	**-98.5**	**-137.6**	**-211.6**	**-295.6**	**-380.2**
ETSA Utilities						
Electric vehicles	0.0	0.0	0.0	0.0	0.0	0.0
SA REES scheme	-7.0	-21.3	-38.7	-57.4	-78.8	-101.7
Federal insulation program	-13.8	-26.6	-36.0	-43.0	-45.3	-45.3
A/C MEPS	0.0	-4.5	-9.0	-13.5	-18.0	-22.5
Televisions and set-top boxes	-4.1	-2.5	-3.2	-36.1	-75.8	-111.6
Standby power	-14.8	-29.5	-44.2	-58.8	-73.4	-88.0
Solar PV panels	-9.9	-18.0	-24.7	-30.7	-35.4	-38.8
Lighting MEPS	-67.0	-108.0	-137.0	-163.0	-175.0	-179.0
Price and policy overlap	0.0	0.1	0.8	2.6	5.6	10.1
ETSA Utilities total	**-116.6**	**-210.3**	**-292.0**	**-399.9**	**-496.1**	**-576.8**

5. Proposed changes to ETSA Utilities forecasts

5.1 Summary of proposed changes

AEMO's review of information presented in ETSA Utilities' Revised Proposal and related documentation has identified the following factors which warrant a reassessment of the sales forecasts for the residential and business sectors adopted in the AER's Draft Decision.

- Revisions to historic ABS data, changes to the definitions of key components of the national accounting framework and the availability of an additional year of historic data all indicate that AEMO's October 2009 sales forecasting models are no longer the best available models.
- The revised economic scenarios provided by ETSA Utilities show material differences in the outlook for the overall economy and sector-specific gross valued added compared with the economic forecasts AEMO relied upon in developing its 2009 report. AEMO considers that this new information should be allowed for by the AER in its final decision.
- AEMO's review of the three new economic scenarios revealed reasonable agreement between KPMG's and Access Economics' forecasts. NIEIR's revised economic forecasts show materially slower growth than each of the other scenarios as the forecast horizon extends towards 2014-15. This discrepancy between KPMG's and Access's forecasts on the one hand, and NIEIR's on the other hand, is similar to the position with regard to the economic forecasts when AEMO developed its 2009 report. AEMO therefore considers that revised sales forecasts should be based on KPMG's and Access Economics' scenarios. However, rather than averaging economic scenarios as ETSA Utilities has done, AEMO recommends developing independent sales forecasts for KPMG's and Access Economics' scenarios and averaging the resulting sales forecasts.
- The revised economic scenarios have been developed so as to reflect the definitional changes adopted recently by the ABS. As such, AEMO's original sales forecasting models (which were based on different data definitions) cannot be used in conjunction with the revised economic forecasts. AEMO has therefore developed new sales forecasting models for the residential and business sectors so as to be able to utilise the updated economic outlooks. In doing so, AEMO has based its new models on first differences of the economic variables as suggested by ETSA Utilities.
- AEMO considers that it is reasonable to make some allowance in the retail electricity price assumptions to reflect likely network tariff price increases. AEMO recommends adjusting NIEIR's underlying price forecasts, which reflect assumed price impacts due to the ETS and other greenhouse gas abatement policies, to reflect the impact of

- AEMO's review of information presented in MMA's report on post modelling efficiency adjustments identified a number of areas where revised assumptions are warranted. These revised assumptions differ materially from AEMO's earlier report and the adjustments included in ETSA Utilities' Revised Proposal.

AEMO's review of ETSA Utilities' comments in relation to water heating sales forecasts found no basis for adjusting its October 2009 forecasts.

ETSA Utilities' sales forecasts for public lighting and Adelaide's new desalination plant are in reasonably close agreement with AEMO's 2009 forecasts. AEMO has not reviewed these forecasts and they remain unchanged from the earlier report.

5.2 AEMO's revised sales forecasting models

AEMO has developed new residential and business sector sales forecasting models for this report. The models are based on revised and extended data reported in the December 2009 release of ABS Catalogue No. 5220. Economic time series data used in the models has been tested for stationarity and found to be I(1) as reported earlier in this report. The forecasting models have been developed using first differences in the economic data.

AEMO considers that there are sound underlying theoretical reasons for including the particular variables used in its models. Each model includes an electricity price variable and at least one economic driver variable. The models also include weather variables where these were found to be significant. The residential model includes a dummy variable which takes the value of 1 from 1998-99. This variable captures the behavioural change in residential consumption associated with changes in the floor space of new dwellings and rapidly increasing penetration of air conditioners from around that time, as reported by NIEIR.

Business sector model

Historic economic data used to develop AEMO's business sales model are tabulated below.

Table 5: Historic data used in business sector sales model

	BUSINESS SALES GWH	GSP EXCLUDING MANUFACTURING GVA	MANUFACTURING SECTOR GVA	SA AVE PRICE 07-08 C/KWH
1989-90	4,476.4	40,837	8,626	15.88
1990-91	4,521.6	40,167	8,434	15.35
1991-92	4,475.1	39,517	8,141	15.74
1992-93	4,659.0	40,536	8,226	15.43
1993-94	4,834.1	42,140	8,522	14.63
1994-95	5,182.9	42,827	8,686	13.44

	BUSINESS SALES GWH	GSP EXCLUDING MANUFACTURING GVA	MANUFACTURING SECTOR GVA	SA AVE PRICE 07-08 C/KWH
1995-96	5,188.0	45,370	8,887	12.81
1996-97	5,125.8	46,359	9,090	13.21
1997-98	5,383.2	48,523	9,408	13.24
1998-99	5,632.9	50,116	9,638	13.18
1999-00	5,910.5	51,306	9,711	12.90
2000-01	6,077.5	53,208	9,832	13.93
2001-02	6,148.9	55,698	9,874	14.34
2002-03	6,321.3	56,697	10,073	14.61
2003-04	6,370.5	59,672	9,969	14.77
2004-05	6,449.9	60,481	9,646	14.40
2005-06	6,654.6	62,870	9,575	13.84
2006-07	6,906.9	64,191	9,434	13.29
2007-08	6,909.6	67,864	9,041	13.64
2008-09	6,945.7	69,569	8,422	13.35

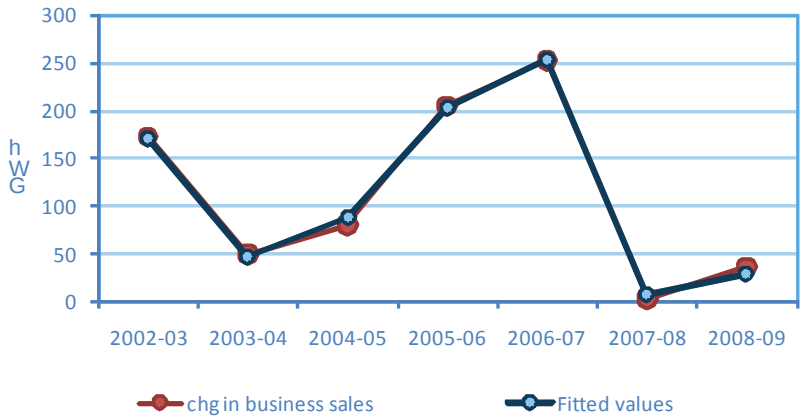
The business sales regression model has been fitted to changes in the sales and economic data for years 2002-03 to 2008-09. The best model obtained was based on the seven most recent years of observations which suggests that the underlying drivers of business sales growth have changed over the 20 years of historic data. The regression results are summarised in the following figure. The estimated coefficients are significant at the 5% p-level or better.

Figure 11: Business sales forecasting model

Regression Statistics				
Multiple R	1.00			
R Square	1.00			
Adjusted R Square	0.99			
Standard Error	8.76			
Observations	7.00			
ANOVA				
	df	*SS*	*MS*	*F*
Regression	4.00	54467.80	13616.95	177.63
Residual	2.00	153.32	76.66	
Total	6.00	54621.12		
	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	-63.01	24.05	-2.62	0.12
chg GSP ex Manuf	-0.03	0.00	-5.66	0.03
chg Manuf GVA	0.25	0.01	17.24	0.00
chg SA ave price 07-08 c/kWh	-138.06	11.15	-12.39	0.01
Ext summer CDD	0.46	0.05	9.63	0.01

Actual and fitted vales are shown in the figure below. The model provides a good fit to actual changes in annual business sales over the period.

Figure 12: Fitted values from Business sales model



Residential sector model

Historic data used to develop AEMO's residential sales model are tabulated below.

Table 6: Historic data used in residential sector sales model

	PER CAPITA RESI SALES (EX HOT WATER) KWH	PER CAPITA DWELL GVA $'000	RESI PRICE (REVISED) 07-08 CENTS/ KWH	EXT SUMMER CDD	EXT WINTER HDD
1989-90	1,649.6	2,326.3	15.83	533.1	999.4
1990-91	1,651.4	2,368.5	15.56	535.5	891.8
1991-92	1,595.6	2,406.0	16.02	416.8	984.7
1992-93	1,692.0	2,456.9	16.15	430.7	997.2
1993-94	1,629.4	2,520.4	16.14	371.4	856.7
1994-95	1,750.2	2,589.0	15.70	545.3	1,017.7
1995-96	1,749.7	2,622.1	15.22	419.6	955.9
1996-97	1,868.5	2,741.1	15.75	481.5	978.0
1997-98	1,913.5	2,810.6	16.03	476.5	1,029.8
1998-99	2,007.5	2,916.9	16.17	560.5	975.4
1999-00	2,068.0	3,006.1	16.10	588.0	917.3
2000-01	2,224.7	3,081.1	17.17	734.6	931.0
2001-02	2,026.6	3,155.5	17.07	241.6	855.8
2002-03	2,082.3	3,240.7	18.51	530.3	878.9
2003-04	2,095.7	3,330.6	20.44	511.0	955.2
2004-05	2,052.0	3,422.2	19.64	436.1	869.7
2005-06	2,196.1	3,496.5	18.50	582.0	1,015.1

	PER CAPITA RESI SALES (EX HOT WATER) KWH	PER CAPITA DWELL GVA $'000	RESI PRICE (REVISED) 07-08 CENTS/ KWH	EXT SUMMER CDD	EXT WINTER HDD
2006-07	2,233.5	3,562.3	18.85	671.3	854.8
2007-08	2,278.6	3,592.8	18.72	679.3	833.3
2008-09	2,262.9	3,624.4	19.52	546.2	975.6

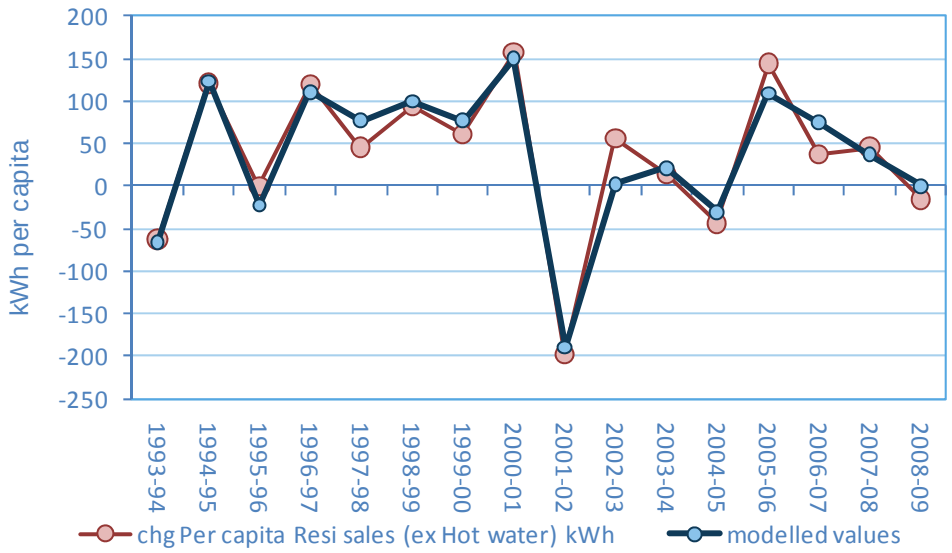
The residential sales model has been fitted to changes in per capita sales and the economic data for years 1993-94 to 2008-09. The best model obtained was based on the sixteen most recent years of observations. The regression results are summarised in the following figure. Coefficients are significant at the 5% level except on the price variable, which has nevertheless been retained in the model as numerous other studies have found this to be a significant driver variable of electricity sales.

Figure 13: Residential sales forecasting model

Regression Statistics				
Multiple R	0.97			
R Square	0.93			
Adjusted R Square	0.90			
Standard Error	28.34			
Observations	16.00			
ANOVA				
	df	*SS*	*MS*	*F*
Regression	5.00	112165.38	22433.08	27.93
Residual	10.00	8030.80	803.08	
Total	15.00	120196.18		
	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	-732.80	117.38	-6.24	0.00
chg per capita Dwell GVA	1.11	0.31	3.62	0.00
chg Resi price (revised) 07-08 cents/ kWh	-11.12	9.54	-1.17	0.27
Ext summer CDD	0.65	0.07	9.47	0.00
Ext winter HDD	0.41	0.13	3.21	0.01
DV	-51.44	18.83	-2.73	0.02

Actual and fitted values from the residential model are shown in the following figure. The model provides a good fit to past actual annual changes in per capita residential sales.

Figure 14: Actual and fitted values from the Residential sales model



5.3 Summary of economic assumptions

The economic forecasts and average electricity price assumptions used in developing AEMO's revised sales forecasts are summarised in the following tables.

Table 7: Summary of economic assumptions

	GVA OWNERSHIP OF DWELLINGS $M			POPULATION (000)		
	KPMG	**Access**	**NIEIR**	**KPMG**	**Access**	**NIEIR**
2009-10	5,993.3	6,284.0	5,710.2	1,634.2	1,632.9	1,629.7
2010-11	6,094.9	6,467.0	5,751.6	1,649.7	1,648.4	1,642.7
2011-12	6,172.5	6,613.6	5,872.5	1,664.5	1,663.2	1,654.2
2012-13	6,229.3	6,740.0	5,721.1	1,679.0	1,677.2	1,665.8
2013-14	6,297.7	6,877.1	5,600.6	1,693.7	1,690.7	1,677.5
2014-15	6,395.9	7,063.7	5,611.8	1,709.1	1,703.9	1,690.9

	GSP EXCL MANUFACTURING GVA $M			MANUFACTURING GVA $M		
	KPMG	**ACCESS**	**NIEIR**	**KPMG**	**ACCESS**	**NIEIR**
2009-10	71,408	71,469	71,576	8,638	8,418	7,812
2010-11	73,701	74,162	73,675	8,909	8,431	7,565
2011-12	75,184	76,434	75,617	8,610	8,322	8,103
2012-13	76,285	78,511	74,395	8,492	8,263	7,670
2013-14	77,459	81,290	74,064	8,600	8,253	7,667
2014-15	78,773	83,785	75,250	8,650	8,169	7,547

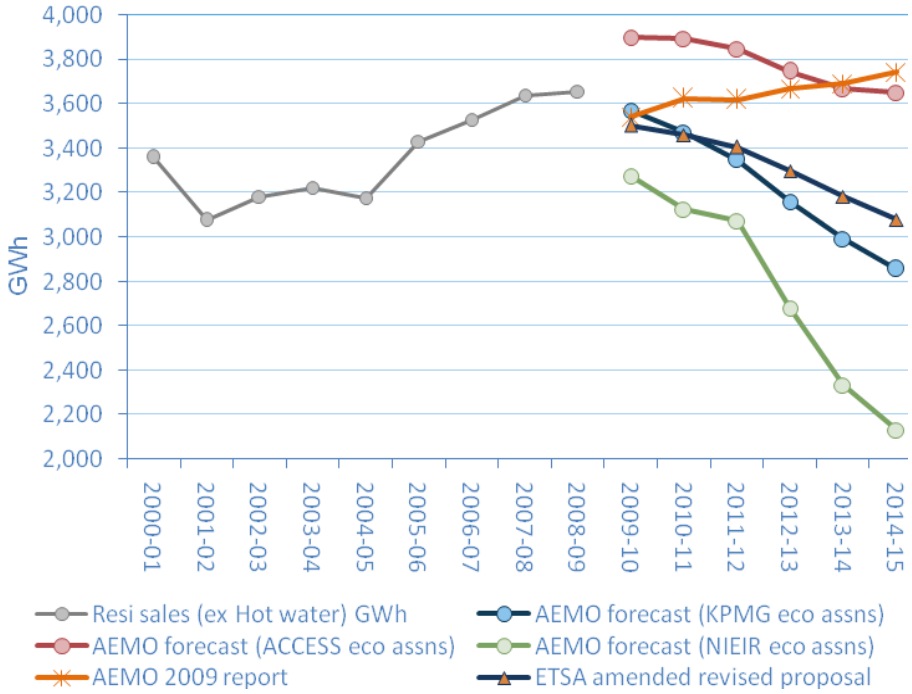
Table 8: Summary of electricity price assumptions

	AEMO BASE CASE			AEMO HIGH CASE			AEMO LOW CASE		
	SA Average 07-08 c/kWh	**Residential 07-08 c/kWh**	**Business 07-08 c/kWh**	**SA Average 07-08 c/kWh**	**Residential 07-08 c/kWh**	**Business 07-08 c/kWh**	**SA Average 07-08 c/kWh**	**Residential 07-08 c/kWh**	**Business 07-08 c/kWh**
2009-10	13.35	19.52	11.15	13.35	19.52	11.15	13.35	19.52	11.15
2010-11	13.94	20.38	11.64	14.07	20.57	11.75	13.80	20.18	11.53
2011-12	14.66	21.26	12.33	14.95	21.68	12.57	14.38	20.85	12.09
2012-13	15.60	22.51	13.34	16.06	23.17	13.73	15.15	21.85	12.95
2013-14	16.06	22.98	13.66	16.70	23.89	14.20	15.44	22.09	13.13
2014-15	16.52	23.58	14.09	17.35	24.76	14.79	15.73	22.45	13.41

5.4 Comparison of residential and business sales forecasts

The following figures compare AEMO's revised residential and business sector sales forecasts with its 2009 forecasts and those proposed by ETSA Utilities in its Revised Proposal.

Figure 15: Comparison of residential sector sales forecasts



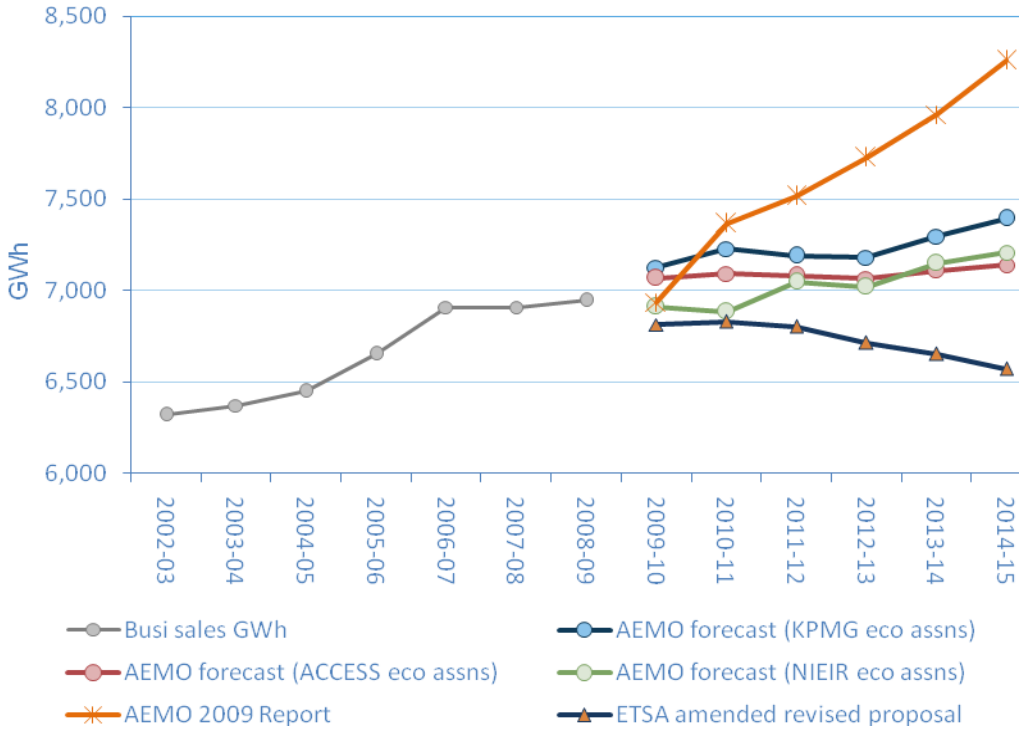
AEMO's residential sales forecasts based upon KPMG's economic outlook are quite close to ETSA Utilities' revised proposal (which is based on an average of NIEIR's and Access Economics' assumptions).

AEMO's forecasts based upon KPMG's economic assumptions are lower than the forecasts developed by AEMO in 2009 reflecting KPMG's revisions to its Dwelling Ownership GVA forecasts and the revised price assumptions adopted for this report. The forecasts developed using Access Economics' outlook are somewhat higher, reflecting Access's more favourable outlook for the South Australian economy.

The relatively large "jumps" in the forecasts for the first year (2009-10) based on Access's and NIEIR's assumptions reflect relatively large underlying differences in forecast growth of dwelling ownership GVA in that year. (KPMG has forecast growth of 2.4% for 2009-10, Access has forecast growth of 7.3% and NIEIR has forecast a fall of 2.5%.) Similar large "jumps" in the forecasts based on NIEIR's economic outlook are also apparent in 2012-13 and 2013-14, again reflecting relatively large underling GVA falls predicted for those years by NIEIR.

AEMO recommends adopting an average of the residential sales forecasts based on KPMG's and Access Economics' outlooks.

Figure 16: Comparison of business sector sales forecasts



AEMO's business sector sales forecasts are consistently above ETSA Utilities' revised forecasts, but are lower than the forecasts developed by AEMO in 2009, reflecting material

changes in KPMG's sector-specific outlook, particularly for the manufacturing sector, and AEMO's revised price assumptions.

AEMO recommends adopting an average of the business sales forecasts based on KPMG's and Access Economics' outlooks.

5.5 Overall Model Fit

The out-of-sample MAPE for the residential model is 1.25% and for the business model is 0.29%.

AEMO has concerns regarding presenting an overall MAPE for the sales models given that different models have been used to estimate each of the four sales' components. The estimated period that overlap for the four different models used is from 2005-06 to 2007-08. The value of MAPE for these years is 0.41%. The aggregation of the prediction across the different sectors in these three years shows that there was an underestimation of 95, 16 and 25 GWh respectively.

5.6 Summary tables

The following tables summarise AEMO's revised forecasts including the post model adjustments described in section 4 of this report. The information includes forecasts for the other sales categories in addition to residential and business sales, the impact of different retail price assumptions, and a summary of sales by tariff category. AEMO's preferred forecasts are derived as the average of the sales forecasts based on KPMG's and Access Economics' outlooks. Tables are also included at the end of the section showing sales forecasts based on NIEIR's underlying price trajectory in the absence of any network-driven price increases.

Table 9: Sales forecast summary – base case retail price assumptions (GWh)

BASE CASE PRICES	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	*ANN GTH %*
Business							
AEMO (KPMG)	7,124	7,226	7,189	7,180	7,296	7,395	*0.7*
AEMO (Access)	7,067	7,093	7,083	7,063	7,107	7,141	*0.2*
AEMO (NIEIR)	6,910	6,886	7,049	7,021	7,149	7,208	*0.8*
AEMO preferred	7,096	7,160	7,136	7,122	7,202	7,268	*0.5*
ETSA Utilities	6,814	6,830	6,803	6,714	6,654	6,571	*-0.7*
Residential							
AEMO (KPMG)	3,571	3,472	3,347	3,160	2,993	2,855	*-4.4*
AEMO (Access)	3,899	3,891	3,846	3,745	3,669	3,651	*-1.3*
AEMO (NIEIR)	3,274	3,125	3,071	2,679	2,332	2,129	*-8.2*
AEMO preferred	3,735	3,682	3,597	3,453	3,331	3,253	*-2.7*
ETSA Utilities	3,502	3,460	3,404	3,297	3,183	3,079	*-2.5*
Water heating							
AEMO	637	614	592	572	553	534	*-3.5*
ETSA Utilities	645	594	643	493	444	395	*-9.3*
Public lighting							
AEMO	116	119	121	124	127	129	*2.2*
ETSA Utilities	114	117	120	123	126	129	*2.5*
Desalination plant							
AEMO	0	143	215	307	307	307	*na*
ETSA Utilities	0	143	215	307	307	307	*na*
Total							
AEMO preferred	11,583	11,717	11,661	11,577	11,518	11,491	*-0.2*
ETSA Utilities	11,075	11,144	11,185	10,934	10,714	10,481	*-1.1*

Table 10: Sales forecast summary – low case retail price assumptions (GWh)

LOW CASE PRICES	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	*ANN GTH %*
Business							
AEMO (KPMG)	7,124	7,245	7,228	7,242	7,381	7,504	*1.0*
AEMO (Access)	7,067	7,111	7,122	7,126	7,193	7,250	*0.5*
AEMO (NIEIR)	6,910	6,905	7,088	7,084	7,234	7,317	*1.2*
AEMO preferred	7,096	7,178	7,175	7,184	7,287	7,377	*0.8*
ETSA Utilities	6,814	6,830	6,803	6,714	6,654	6,571	*-0.7*
Residential							
AEMO (KPMG)	3,571	3,475	3,354	3,172	3,009	2,876	*-4.2*
AEMO (Access)	3,899	3,895	3,854	3,757	3,685	3,672	*-1.2*
AEMO (NIEIR)	3,274	3,128	3,079	2,691	2,348	2,150	*-8.1*
AEMO preferred	3,735	3,685	3,604	3,465	3,347	3,274	*-2.6*
ETSA Utilities	3,502	3,460	3,404	3,297	3,183	3,079	*-2.5*
Water heating							
AEMO	637	614	592	572	553	534	*-3.5*
ETSA Utilities	645	594	643	493	444	395	*-9.3*
Public lighting							
AEMO	116	119	121	124	127	129	*2.2*
ETSA Utilities	114	117	120	123	126	129	*2.5*
Desalination plant							
AEMO	0	143	215	307	307	307	*na*
ETSA Utilities	0	143	215	307	307	307	*na*
Total							
AEMO preferred	11,583	11,739	11,708	11,652	11,620	11,622	*0.1*
ETSA Utilities	11,075	11,144	11,185	10,934	10,714	10,481	*-1.1*

Table 11: Sales forecast summary – high case retail price assumptions (GWh)

HIGH CASE PRICES	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	*ANN GTH %*
Business							
AEMO (KPMG)	7,124	7,208	7,150	7,116	7,208	7,281	*0.4*
AEMO (Access)	7,067	7,074	7,044	7,000	7,019	7,027	*-0.1*
AEMO (NIEIR)	6,910	6,868	7,010	6,958	7,061	7,094	*0.5*
AEMO preferred	7,096	7,141	7,097	7,058	7,114	7,154	*0.2*
ETSA Utilities	6,814	6,830	6,803	6,714	6,654	6,571	*-0.7*
Residential							
AEMO (KPMG)	3,571	3,468	3,339	3,148	2,976	2,833	*-4.5*
AEMO (Access)	3,899	3,888	3,839	3,733	3,652	3,629	*-1.4*
AEMO (NIEIR)	3,274	3,121	3,064	2,666	2,315	2,108	*-8.4*
AEMO preferred	3,735	3,678	3,589	3,440	3,314	3,231	*-2.9*
ETSA Utilities	3,502	3,460	3,404	3,297	3,183	3,079	*-2.5*
Water heating							
AEMO	637	614	592	572	553	534	*-3.5*
ETSA Utilities	645	594	643	493	444	395	*-9.3*
Public lighting							
AEMO	116	119	121	124	127	129	*2.2*
ETSA Utilities	114	117	120	123	126	129	*2.5*
Desalination plant							
AEMO	0	143	215	307	307	307	*na*
ETSA Utilities	0	143	215	307	307	307	*na*
Total							
AEMO preferred	11,583	11,695	11,614	11,501	11,413	11,355	*-0.4*
ETSA Utilities	11,075	11,144	11,185	10,934	10,714	10,481	*-1.1*

Table 12: AEMO preferred sales forecasts by tariff category (GWh)

	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15
Major Business	1,334	1,465	1,532	1,605	1,586	1,591
High Voltage Business	990	1,003	1,000	1,000	1,017	1,027
Low Voltage Business	4,887	4,954	4,941	4,948	5,032	5,086
Residential	3,735	3,682	3,597	3,453	3,331	3,253
Controlled Load	637	614	592	572	553	534
Total consumption	11,583	11,717	11,661	11,577	11,518	11,491

AEMO has also prepared the following sales forecasts based on NIEIR's underlying retail price trajectory in the absence of any additional network tariff-driven price rises.

Table 13: Sales forecast summary – using NIEIR underlying retail price assumptions (GWh)

NIEIR UNDERLYING PRICES	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	*ANN GTH %*
Business							
AEMO (KPMG)	7,124	7,307	7,305	7,335	7,488	7,625	*1.4*
AEMO (Access)	7,067	7,174	7,199	7,219	7,299	7,371	*0.8*
AEMO (NIEIR)	6,910	6,967	7,165	7,176	7,341	7,438	*1.5*
AEMO preferred	7,096	7,241	7,252	7,277	7,394	7,498	*1.1*
ETSA Utilities	6,814	6,830	6,803	6,714	6,654	6,571	*-0.7*
Residential							
AEMO (KPMG)	3,571	3,488	3,369	3,190	3,029	2,899	*-4.1*
AEMO (Access)	3,899	3,907	3,869	3,775	3,706	3,695	*-1.1*
AEMO (NIEIR)	3,274	3,140	3,094	2,708	2,368	2,174	*-7.9*
AEMO preferred	3,735	3,697	3,619	3,483	3,368	3,297	*-2.5*
ETSA Utilities	3,502	3,460	3,404	3,297	3,183	3,079	*-2.5*
Water heating							
AEMO	637	614	592	572	553	534	*-3.5*
ETSA Utilities	645	594	643	493	444	395	*-9.3*
Public lighting							
AEMO	116	119	121	124	127	129	*2.2*
ETSA Utilities	114	117	120	123	126	129	*2.5*
Desalination plant							
AEMO	0	143	215	307	307	307	*na*
ETSA Utilities	0	143	215	307	307	307	*na*
Total							
AEMO preferred	11,583	11,814	11,800	11,763	11,747	11,766	*0.3*
ETSA Utilities	11,075	11,144	11,185	10,934	10,714	10,481	*-1.1*

Table 14: NIEIR's underlying retail price assumptions

	SA AVERAGE RETAIL PRICE 07-08 C/KWH	RESIDENTIAL RETAIL PRICE 07-08 C/KWH	BUSINESS RETAIL PRICE 07-08 C/KWH
2009-10	13.35	19.52	11.15
2010-11	13.35	19.52	11.15
2011-12	13.82	20.04	11.62
2012-13	14.48	20.88	12.38
2013-14	14.67	20.99	12.47
2014-15	14.85	21.20	12.66

Appendix A: Review of Post Model Adjustments

1. Context

A significant difference between the ETSA Utilities and the AEMO demand forecasts is the extent of post-model adjustment for new energy efficiency measures that will lower future energy consumption below a historically-projected baseline. ETSA Utilities commissioned McLennan Magasanik Associates (MMA) to review the reasonableness of the logic on which the original ETSA forecast post-model adjustments were based. MMA recommended some changes which are now incorporated in ETSA Utilities revised demand forecast. Both the revised forecast and the MMA report are incorporated in the ETSA's revised pricing proposal[4].

This paper addresses the merits of MMA's arguments in relation to post-model adjustments. The paper does not cover adjustments made in respect of lighting MEPS or rooftop solar PV units.

2. Efficiency improvements, the baseline problem and the rebound effect

Policies to improve energy efficiency are generally based on two premises:

1. for monitoring purposes, that the impact of such policies, relative to business as usual, can be calculated; and
2. importantly, that improved energy efficiency will lead to lower energy consumption.

For forecasting purposes, the first premise is challenged by the difficultly in choosing the baseline that quantifies what would have happened in the absence of the policy. The second premise is challenged by the rebound effect, which describes the mechanism under which a lowering of the cost for a given energy service translates into heavier demand for that service or other energy services.

2.1 Choice of baseline

Engineering calculations of the economy-wide impacts of a particular energy efficiency programme may be undertaken based on the energy saved in each individual application and the number of expected applications. Calculations of this type may correctly determine the extent of energy savings 'caused' by the particular programme in question, but cannot reveal the degree to which the calculated savings are double-counting changes in behaviour that would have occurred anyway.

Energy efficiency improvements take place more or less constantly, due to a combination of technological change, market pressures and government policy changes. For forecasts that are generated using historical sales data, the modelling process will produce forecasts that include the average impact of historical energy efficiency improvements. An engineering

[4] ETSA Utilities (2010), *ETSA Utilities Revised Regulatory Proposal 2010-2015*, January, Chapter 5 and Appendix E http://www.aer.gov.au/content/index.phtml/itemId/733327 .

calculation of the impact of new efficiency improvements incorporated by way of post-model adjustment would therefore risk exaggerating the actual impact, as explained by AEMO' Supplementary Comments, which conclude:

"... the real question is whether the frequency and intensity of measures to be introduced in the future will be significantly different from the past."[5]

For the purpose of calculating a relative efficiency improvement resulting from a particular measure, the relevant baseline is the forward projection of that measure that is already included (implicitly or explicitly) in the overall sales projection.

2.2 Rebound effect

Engineering calculations of the energy savings resulting from a proposed policy do not account for offsetting energy increases arising from the effective cost reduction. For example, if a factory uses energy more efficiently, it becomes more profitable encouraging further investment and higher levels of output. This is termed the direct rebound effect. Even if the consumption of the energy service remains the same after an efficiency improvement, the money saved will increase demand for other services which in turn will increase energy demand throughout the economy. An example of this would be the introduction of more fuel-efficient cars, if the owners of the new cars spend the money saved from their fuel budget on other energy-consuming products, such as an overseas flight. In fact the savings may be spent on any product to contribute to increased production and consequently energy use throughout the economy. This is termed the indirect rebound effect[6].

The idea that energy efficiency improvements may lead to overall increased consumption implies a total rebound effect in excess of 100 per cent. This idea was first conceived by Jevons[7] who in 1865 cited the case of more economical use of coal in steam engines and in the production of cheap iron. This resulted in the widespread use of steam engines for a host of applications, while lower cost iron lowered the capital cost of steam engines and contributed to the development of railways, which in turn lowered the cost of transporting coal and iron thus further increasing the demand for both.

Not surprisingly the size of the rebound effect for less pervasive activities such as those pertaining to residential space conditioning and the use of household appliances is generally believed to be less than 100%. However, rebound effects, while difficult to measure, are likely to make a material difference to the outcome of many energy efficiency measures and should not be ignored.

A review of over 75 estimates of the rebound effect, undertaken by Greening at al. (2000), is summarised for relevant categories in Table 1.

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[5] AEMO (2009), *Supplementary Comments Regarding the Treatment of New Energy Efficiency Policies Expected to be Introduced in the Future*, October, unpublished letter to AER.
[6] These examples are taken from UKERC (2007), pp1-2.
[7] Referenced in UKERC (2007) as Jevons, W. S., (1865), "The Coal Question: Can Britain Survive?" in *The Coal Question: An Inquiry Concerning the Progress of the Nation, and the Probable Exhaustion of Our Coal-mines*, A.W. Flux ed, Augustus M. Kelley, New York.

Table 1: Empirical evidence for rebound effects

DEVICE	SIZE OF REBOUND	NUMBER OF STUDIES
Space heating	10-30%	26
Space cooling	0-50%	9
Water heating	10-40%	5
Residential lighting	5-12%	4
Home appliances (white goods)	0%	2
Commercial lighting	0-2%	4
Industrial processes	0-100% or more	A large number of studies with a variety of conclusions

3. Overlapping price effects and post-model adjustments

3.1 Price effects

3.1.1 MMA conclusion

AEMO pointed out that projected price impacts on electricity demand implicitly include consumers becoming more efficient in their use of electricity and that, at the micro level, this may correspond to consumers taking part in new energy efficiency measures. This raises the possibility of double-counting the effects of energy efficiency measures that have never been implemented previously. MMA's review concluded that there is likely to be a degree of correspondence, and recommended discounting the price effect by 7.5 per cent to account for the energy efficiency measures applied as post-model adjustments.

3.1.2 Comment

MMA provide evidence that policy makers intend energy efficiency measures to result in independent energy savings effects, over and above the impact predicted by price changes. MMA do not show any evidence that energy efficiency measures actually do result in independent energy savings effects. However, given the high upfront cost of most energy efficiency actions, measures that allow consumers to overcome the financial barriers are certainly likely to result in some additional energy saving.

If new efficiency measures are such that the total trend towards increasing energy efficiency in the future is accelerated relative to the past, then it is possible to represent this in a top-

down model as either a higher price elasticity than that estimated from historical data or as a post-model adjustment for the greater slope of the energy efficiency curve. MMA's recommended approach involves adjusting the estimated energy savings by the price effect to arrive at a discount amounting to 23.1 GWh out of a total of 378.8 GWh original reductions, or 6.1 per cent. However, this discount appears to be limited to removing the application of price elasticity to the post-model adjustment amount.

While this adjustment is theoretically justified it does not address the baseline issue, which in this context may be accounted for in one of 2 ways:

1. an accelerated trend in energy efficiency may be represented by an effective increase in price elasticity (a larger negative number); or
2. an accelerated trend in energy efficiency is represented by making post-model adjustments for impacts over and above the historical trend.

The strength of a top-down model of energy demand is that it represents historical efficiency trends and price effects. There is no empirical basis for estimating future price elasticity. Therefore efficiency improvements that can be quantified should be incorporated using explicit post-model adjustments. However these adjustments should only represent expected deviations from historical conditions.

3.1.3 Recommendation

MMA's recommended adjustment for the price effect is supported. Additional effects, if justified, should be made by way of post-model adjustments.

3.2 Residential Energy Efficiency Scheme

3.2.1 MMA conclusion

The Residential Energy Efficiency Scheme (REES) is specifically and carefully designed to be independent of other initiatives that would achieve energy savings and will apply in addition to effects emanating purely from price changes.

MMA noted that the REES:

- is designed to create energy savings over and above those resulting from other initiatives such as Minimum Energy Performance Standards (MEPS) for appliances and Residential Building Standards.
- provides for specific, enforceable greenhouse gas reduction targets.
- covers a wide range of activities; and
- is focused on low income households.

As such NIEIR[8] estimates of energy savings from the scheme are justified.

[8] Quoted by MMA (2009) as NIEIR (2009), *Electrical Energy projections for ETSA Utilities in South Australia to 2018-19*, pp38,45.

3.2.2 Comment

Table 2 shows a non-exhaustive list of efficiency activities that the Essential Services Commission of South Australia envisages may be implemented in order to achieve the specific REES greenhouse gas reduction targets. Retailers undertaking each activity can claim the attributed greenhouse gas reduction corresponding to that activity. While the actual activities undertaken depend on retailers and households preferences, the following seems clear from Table 2.

- There is a potential for REES to reinforce, bring forward in time or otherwise have a marginal efficiency impact on activities that would have occurred in the absence of the scheme.
- Energy efficiency improvements attributed to the scheme in most cases may be enjoyed by the householder partly as a cost saving and partly as increased comfort (for example higher winter temperatures).
- There may be some allowable activities that encourage higher energy consumption.
- As identified by MMA, there is some overlap of this scheme with the federal government's insulation scheme.
- While difficult to identify, there is likely to be an underlying historical level of growth in energy efficiency activities, due to the long run cost savings that are available to householders.

Table 2: Energy efficiency activities envisaged under REES[9]

DESCRIPTION OF ACTIVITY	ATTRIBUTED tCO_2-e	COMMENTS ON WHY THE ATTRIBUTED REDUCTION MAY NOT BE FULLY ACHIEVED
Install/exchange inefficient showerhead for efficient showerhead	1.6-1.8	Not applicable to showerheads in new dwellings. Electricity savings available only if electric water heating is present.
Ceiling insulation	0.2	Overlaps with federal insulation programme. Some of the benefit of fitting insulation is likely to be taken as increased comfort, rather than energy savings.
Draught proofing	0.0-3.4	Some of the benefit of draught proofing is likely to be taken as increased comfort, rather than energy savings.

[9] Further information is available from the Department of Transport Energy and Infrastructure, http://www.dtei.sa.gov.au/energy/government_programs/rees .

Retiring refrigerators and freezers manufactured before 1996	2.3-3.2	Likely to bring forward the inevitable retirement of old appliances. Most if not all will be replaced with more efficient new appliances, so the potential savings derive from the changeover difference in energy use.
Replace incandescent lamp with compact fluorescent lamp	0.1-1.0	Brings forward the inevitable replacement of old lamps due to failure. Incandescent replacements will not be available in future.
Install insulated ductwork to air-conditioning or gas central heating system	1.8-3.3	Expected to apply to new systems at the time of installation. Energy savings only available if non-insulated ductwork was originally proposed by the householder.
Replace ducted refrigerative air-conditioning unit with ducted evaporative cooler	6.6-9.6	In some cases a highly valued appliance may be replaced with a lower valued appliance. Even though the running costs are lower, the level of performance may be less satisfactory.
Replace existing air-conditioning or electric heating with efficient system	3.0-17.8	Efficiency benefits are likely to be enjoyed, at least in part, as increased comfort.
Install efficient air-conditioning unit or gas heater	0.5-9.0	Envisaged to apply to households that are considering installing a new system, therefore encouraging the choice of efficient heating or cooling systems.
Install or replace water heater	1.4-27.4	Applicable to a variety of circumstances, but mainly replaces older, conventional electric for heat pump or gas or electric boosted solar water heaters. Some overlap with REC incentive. Can be a completely new installation in some circumstances.

3.2.3 Recommendation

ETSA's approach, based on the assumption that the REES targets will be met, is supported. These targets are recalculated as GWh targets and shown in Table 3. The targets are based on the following assumptions:

- the tCO2-e targets for 2012 to 2015 are the same as the already announced 2011 target;
- an average greenhouse gas intensity factor of 980 tCO2-e/GWh;

- 88 per cent of the targets are achieved from attributed reductions in electricity consumption, 12 per cent from gas;
- activities have a 10-year life; and
- calendar year targets have been adjusted to financial years.

In terms of post-model adjustments, about half of the attributed reductions in energy consumption are likely to have occurred in the absence of the REES (including the overlap with the federal insulation programme) and a further quarter of the potential reduction is likely to be taken as improved comfort. The recommended post-model adjustments are therefore based on a quarter of the calculated targets. This is set out in Table 3, where annual sales reductions are a quarter of the calculated REES targets for each financial year.

Table 3: REES targets and recommended post-model adjustments

	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15
Calendar year savings targets (tCO_2-e)	235,000	255,000	255,000	255,000	255,000	255,000
Calendar year savings targets (GWh)	211.0	229.0	229.0	229.0	229.0	229.0
GWh targets spread over 10 years	21.1	22.9	22.9	22.9	22.9	22.9
GWh target adjusted to financial year	17.5	22.0	22.9	22.9	22.9	22.9
Annual sales reduction (GWh)	4.4	5.5	5.7	5.7	5.7	5.7
Cumulative sales reduction (GWh)	4.4	9.9	15.6	21.3	27.1	32.8

3.3 Federal insulation programme

3.3.1 MMA conclusion

Householders can receive up to $1,200 (originally $1,600) to install ceiling insulation as part of the federal government's Energy Efficient Homes Package which was first announced on 3 February 2009. The programme was cancelled on 19 February 2010 but will be replaced with the Renewable Energy Bonus Scheme which will run until the end of 2011 or until the allocated money runs out. This new scheme does not come into effect until 1 June 2010.

Since there are no previous programmes aimed at increasing the use of insulation in South Australian homes, MMA concluded that any effects of this programme on electricity use will not be reflected in historical data. However, the inclusion of these effects as a post-model adjustment should be tempered due to some overlap with activities likely to undertaken under the REES.

3.3.2 Comment

It is accepted that this is a new programme that will result in a higher level of home ceiling insulation than would otherwise have occurred. However the apparent impact on energy use will be tempered by:

- overlap with other incentives, particularly the REES;
- absorption of installations that would have occurred in any case, most probably with new or renovated homes; and
- the likelihood that the potential energy savings resulting from the installation of ceiling insulation will be enjoyed, at least in part, by increased levels of thermal comfort, rather than cost savings.

MMA have recognised only the first of these restrictions.

3.3.3 Recommendation

Following ETSA, the recommended post-model adjustment for the effects of REES in Table 3 includes recognition of the overlap between REES and the federal insulation programme.

The NIEIR work for ETSA Utilities uses 3,000kWh/year for average residential electricity use for heating however the MMA figure of 2,000kWh/year is a more reasonable estimate and is therefore used in our assessment.

The potential savings resulting from the federal insulation programme are recalculated and shown in Table 4 using the following assumptions:

- insulation saves 35 per cent of the energy required to achieve a given level of thermal comfort;
- at the start of the programme on 1 October 2009 there were 113,225 uninsulated South Australian homes;
- 51 per cent of dwellings use electricity for heating with an average consumption of 2,000 kWh/year for this purpose;
- 85 per cent of dwellings use electricity for cooling with an average consumption of 1,000 kWh/year for this purpose; and
- there is an eventual take-up rate the programme of 70 per cent, with 40 per cent completed during 2009/10.

Beyond this calculated potential savings, it is likely that all new homes (approximately 10,000 a year) will be insulated and that this is largely incorporated in the historical trend. Additionally, the estimated rebound effects shown in Table 1 imply that around 0.25 per cent of potential cooling savings and 0.20 per cent of potential heating savings will taken as increased comfort levels rather than cost savings. The results of these adjustments are also shown in Table 4.

Table 4: Federal insulation programme effects and recommended post-model adjustments

	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15
Incremental take-up rate	40%	10%	10%	10%	0%	0%
Remaining uninsulated homes	113,225	67,935	56,613	45,290	33,968	33,968
Take-up (no. of homes)	45,290	11,323	11,323	11,323	0	0
Potential cooling savings (GWh)	12.3	3.4	3.4	3.4	0.0	0.0
Potential heating savings (GWh)	14.8	4.1	4.1	4.1	0.0	0.0
Total potential savings (GWh)	27.1	7.4	7.4	7.4	0.0	0.0
Annual sales reduction (GWh)	15.9	0.6	0.6	0.6	0.0	0.0
Cumulative sales reduction (GWh)	15.9	16.5	17.2	17.8	17.8	17.8

3.4 Air-conditioner Minimum Energy Performance Standards

3.4.1 MMA conclusion

Enhanced Minimum Energy Performance Standards (MEPS) and labelling requirements for air-conditioners are scheduled to take effect from October 2009. MMA supports the use of a post-model adjustment to reflect increased efficiency in air-conditioner operation not reflected in the historical trend.

3.4.2 Comment

The potential savings effect of introducing more efficient air-conditioners may be calculated based on assumptions about the number of South Australian households, the current average air-conditioner energy use per air-conditioned household, current and future air-conditioner penetration rates, the average replacement rate and the assumed unit efficiency improvement. Each of these input values could prove to be different from its assumed value and so the calculated savings are subject to a wide band of uncertainty.

While potential savings calculation accepted by MMA is applied to a baseline that most likely reflects a projection of the recent historical trend in air-conditioner usage, no adjustment is proposed to allow for the rebound effect. As discussed in Section 3.2 and shown in Table 1,

some allowance is warranted for the division of potential energy savings between increased comfort and energy reduction.

3.4.3 Recommendation

The potential savings resulting from improved MEPS and the recommended post-model adjustments in terms of sales reductions are recalculated and shown in Table 5. It is noted that revised MEPS efficiency levels for relevant size units go from the existing 2.75 to 2.84, or a 3.3 per cent improvement, rather than 8.0 per cent as assumed by ETSA. However the higher improvement rate is accepted due to the effect of better choice facilitated by the new labelling requirements.

Assumptions underlying Table 5 are as follows:

- the number of South Australian households starts at 674,000 and grows by 1.2 per cent a year until 2014/15;
- 85 per cent of South Australian households have air-conditioning with an average electricity use of 1,000 kWh/year;
- the above penetration rate and average unit size remains the same over the forecast horizon;
- an 11 year replacement cycle; and
- an 8 per cent unit efficiency improvement due to MEPS.

The potential savings are adjusted assuming a 25 per cent rebound effect, due to higher efficiency enjoyed by householders partly as increased comfort and partly as cost savings.

Table 5: Air-conditioner MEPS effects and recommended post-model adjustments

	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15
Potential energy savings (GWh)	0.00	4.22	4.27	4.32	4.38	4.43
Annual sales reduction (GWh)	0.0	3.2	3.2	3.2	3.3	3.3
Cumulative sales reduction (GWh)	0.0	3.2	6.4	9.6	12.9	16.2

3.5 Television labelling and television and set-top box MEPS

3.5.1 MMA conclusion

Mandatory labelling and MEPS for televisions were first introduced in October 2009 and are expected to have an impact on electricity consumption. MEPS for set-top boxes were introduced in the previous year. However this is balanced against growth in television

numbers per household and technology and average size changes that favour increasing energy use.

MMA consider that energy consumption from televisions accelerated from around 2005; therefore any forecasting model that includes data more recent than this should implicitly account for energy growth from that source. Any post-model adjustment for increasing energy use by televisions would double-count the increase in energy already captured by historical data.

By contrast, a post-model adjustment for new energy efficiency measures is thought by MMA to be reasonable, given that these measures are not accounted for by historical data ending 2007/08.

However, MMA's Figure 7 shows accelerating projected energy use to 2015 for televisions and set-top boxes, after accounting for energy savings measures.

3.5.2 Comment

The projected growth in televisions that are larger and higher in energy use than previous models is very high. It is accepted that this growth began around 2005, however, this trend would not be fully captured by a general sales forecasting model based on even 10 years of historical data. Hence it is appropriate to try to ascertain the correct baseline from which to deduct potential savings.

Meanwhile the potential savings are also relatively large, so any calculated net savings (or growth offset) may be relatively small but subject to a very large band of error.

It is not appropriate in this case to consider a direct rebound effect, since householders are unlikely to alter their pattern of television use based on the energy efficiency of their television. The possibility of an indirect rebound (or income) effect is not ruled out, but is likely to be small enough to be disregarded.

3.5.3 Recommendation

MMA reproduce historical and projected energy consumption by televisions in Australia in their Figure 6[10]. This shows energy growth between 1986 and 2005 of around 8 per cent a year and growth from 2005 and into the future of 10 per cent a year. The growth from 1994 to 2009, which is the period on which the residential sales model is based on, goes from 7 PJ to 18 PJ. This is an average growth rate of 6.5% and would therefore be included in the model. The post model adjustment should therefore include a 3.5% growth in energy consumption by televisions.

Set-top boxes account for a small fraction (around one tenth) of the energy consumed by televisions, but the historical record is similarly from no growth to extremely high recent growth, as shown by MMA's Figure 8.

In contrast, the 2009 consultation regulatory impact statement (RIS) for the introduction of the new MEPS and labelling requirements projects that energy savings of 12 per cent a year on a business as usual projection will be achieved. This implies that there will be a long run

[10] MMA (2009), p39, from a report originally prepared by Energy Efficient Strategies for the Department of Environment Water Heritage and Arts –see: http://www.environment.gov.au/sustainability/energyefficiency/buildings/publications/energyuse.html .

reduction in energy growth from this source. However, if the projected energy savings are offset against projected growth in excess of the estimated trend of 6.5 per cent, then in the short run at least, new growth exceeds the projected savings. This is shown in Table 6, which shows some absolute annual savings emerging from 2013-14 onwards.

Table 6: Television labelling and television and set-top box MEPS effects and recommended post-model adjustments

	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15
Business as usual projection (GWh) ~10%	737.0	823.0	913.0	994.0	1087.0	1188.0
Proj. at hist. growth rate (GWh) ~ 6.5%	701.8	747.5	796.0	847.8	902.9	961.6
Growth additional to baseline (GWh)	35.2	75.5	117.0	146.2	184.1	226.4
Deemed savings from RIS (GWh)	23.0	48.0	76.0	126.0	193.0	263.0
Cumulative sales reduction (GWh)	-12.2	-27.5	-41.0	-20.2	8.9	36.6

3.6 Stand-by power target

3.6.1 MMA conclusion

A target of 1 watt maximum power use for all appliances in stand-by mode was agreed nationally in 2002. The target was to be initially reached by voluntary action and is being followed up with mandatory MEPS and labelling requirements across a number of different appliance types. MMA note similarities between various estimates of the potential energy savings of these measures.

Using reasoning similar to that for television energy consumption, MMA note that the acceleration in stand-by energy consumption started in the early to mid-1990s and therefore future energy savings should not be offset by above-trend future growth.

MMA note that no apparent progress has been made in arresting the acceleration in stand-by energy consumption despite the target being in place since 2002.

3.6.2 Comment

MMA, following ABARE[11], find that recent historical growth in stand-by energy was 15.0 per cent a year. As this growth rate has been largely consistent across the period for which the residential sales model was based i.e. 1993-94 to 2008-09, AEMO agrees that there is no need to account for any 'additional' growth outside the model (supported by MMA Figure

[11] Australian Bureau of Agricultural and Resource Economics (ABARE) (2009), *End use Intensity in the Australian Economy*, p45.

10[12]).The rebound effect is not significant in the case of stand-by power, for much the same reasons as in the case of televisions above.

3.6.3 Recommendation

Table 7 shows the calculated sales reductions recommended for changes in stand-by power which agrees with the MMA figures.

Table 7: Stand-by power target effects and post-model adjustments

	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15
Cumulative sales reduction (GWh)	14.9	29.5	44.2	58.8	73.4	88.0

4. Electric vehicles

AEMO's research suggests there could be almost 1 million electric vehicles on Australian roads by 2020 that will be charged from the electricity grid. Detailed modelling recently undertaken for the federal government indicated that 'smart charging' could add 0.3 per cent to annual South Australian energy consumption by 2014-15, above what would have been without electric vehicles, by filling in troughs in the daily load profile. It is assumed that the average daily charge per electric vehicle is 7 kWh.

Table 8 shows the estimated addition to South Australian residential electricity consumption that electric vehicles could make in this sector by 2014-15.

Table 8: AEMO estimates of the impacts of electric vehicles on residential electricity consumption in SA

	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15
Assumed electric vehicle numbers	0	2500	4900	7280	9700	12170
Average daily energy use (MWh)	0	17.5	34.3	51.0	67.9	85.2
Annual energy (GWh)	0.0	6.4	12.5	18.6	24.8	31.1

5. Conclusions

Table 9 summarises the recommended post model adjustments, where the cumulative total amounts to a reduction of 191.4 GWh by 2014/15, not including the effect of electric vehicle, or a reduction of 160.3 GWh including electric vehicles.

[12] Reproduced from Department of Environment Water Heritage and Arts (2008) op. cit.

Table 9: Summary of recommended sales reductions to be affected by post-model adjustments (GWh)

	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15
Electric vehicles	0.0	-6.4	-12.5	-18.6	-24.8	-31.1
REES	4.4	9.9	15.6	21.3	27.1	32.8
Insulation	15.9	16.5	17.2	17.8	17.8	17.8
Appliance MEPS	-12.2	-24.3	-34.6	-10.6	21.8	52.8
Stand-by power	14.9	29.5	44.2	58.8	73.4	88.0
Cumulative sales reduction not including electric vehicles	**23.0**	**31.6**	**42.4**	**87.4**	**140.1**	**191.4**
Cumulative sales reduction	**23.0**	**25.2**	**29.9**	**68.8**	**115.3**	**160.3**

6. References

Greening, LA, David Greene and Carmen Difiglio (2000), "Energy Efficiency and Consumption the Rebound Effect a Survey", Energy Policy, 28 389-401.

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