AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

27 March 2014

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Mr Neville Henderson
Chairman
Reliability Panel
Australian Energy Markets Commission
PO Box A2449
Sydney South, NSW 1235

Dear Mr Henderson

2013 Forecast Accuracy Report

Please find attached a copy of AEMO's 2013 Forecast Accuracy Report. The report was published on the AEMO web site as part of the 2013 National Electricity Forecast Report (NEFR) package.

This report was independently reviewed by Woodhall Investment Research, Monash University and Frontier Economics. Both Woodhall Investment Research and Monash University have been involved in developing suitable assessment techniques for the 2014 NEFR forecasts. In particular, AEMO has committed to decompose forecasting errors into driver projection errors and model errors as part of its public Action Plan for the 2014 NEFR.

AEMO would be pleased to receive any comments on the attached report.

As discussed with the Reliability Panel, AEMO will provide a draft of the 2014 Forecast Accuracy Report for the Reliability Panel's review by 1 November 2014. The report will not be published on AEMO's website until the Reliability Panel's comments have been addressed.

Please contact Margarida Pimentel, Senior Manager Energy Forecasting on 03 9609 8370 of margarida.pimentel@aemo.com.au for any questions relating to the attached report.

Yours sincerely

Margarida Pimentel
Senior Manager Energy Forecasting

cc: Charles Hoang, Australian Energy Market Commission
Murray Chapman, Australian Energy Market Operator

Attachments: 2013 Forecast Accuracy Report

FORECAST ACCURACY REPORT

National Electricity Forecasting Report

2013

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Acknowledgements

AEMO acknowledges the support, co-operation and contribution of all participants in providing the data and information used in this publication.

Published by

AEMO
Australian Energy Market Operator
ABN 94 072 010 327

EXECUTIVE SUMMARY

In examining the accuracy of AEMO's models and forecasts, an analysis of energy model performance for the 2012 National Electricity Forecasting Report (NEFR) models was undertaken. Generally, year-to-date variances for annual energy were between 0.7 and 2.7%. Operational energy variances were between 0.4 and 2.1%, with the exception of Queensland at 4.2%. Queensland, New South Wales and Victoria forecasts show some over-forecasting, mainly due to lower-than-expected commercial and residential consumption. South Australia and Tasmania forecasts have shown some under-forecasting; this was mainly due to higher-than-expected consumption from the residential and commercial sector.

This report discusses the improvements to the 2013 energy models, with the analysis indicating that the 2013 models produced superior results compared to the 2012 NEFR models. The 2013 NEFR models generally appear to provide better in-sample forecasts, indicating that the models are more suitable for forecasting energy consumption, given the data that is available. Biases observed in the 2012 models have been addressed in the 2013 models.

In addition, notable energy modelling improvements were included in the 2013 NEFR models. These are enhancements of short-term forecasts and more reliable model coefficients, due to specific development of the short-run components of the models and the use of more appropriate model types. This is expected to translate into more accurate forecast outcomes in both the short and long term.

The historical probability of exceedence (POE) distributions for maximum demand in each region were analysed and found to be generally acceptable. The one exception is Victoria, where the model does not appear to fit the older data (pre 2007-08) as well as the more recent data. Improvements to this model will be pursued for the next round of model development. However, given that the model tends to fit recent maximum demands relatively well, the 2013 forecasts are not considered to be biased.

The 10% POE maximum demand forecasts have shown variances between 1.0 and 2.7%, except for Tasmania at 5.0%. The 10% POE operational demand has shown variances between 0.9 and 3.6%, except for Tasmania at 5.0%. The models for Queensland, Victoria and Tasmania show some over-forecasting mainly due to lower-than-expected residential and commercial demand and lower-than-expected large industrial demand.

For New South Wales and South Australia, the results indicate some under-forecasting, mainly due to higher-than-expected residential and commercial demand. For New South Wales and Tasmania, the comparison of forecasts and actuals for both annual energy and maximum demand shows an under-forecast in one and over-forecast in the other. This indicates that the ratio of peak to average demand was under-forecast in New South Wales and over-forecast in Tasmania.

As a result of reviews of the 2013 forecast models, some key areas of improvement have been flagged for the 2014 NEFR models.

These include: Investigating better ways to incorporate energy efficiency estimates in the modelling; constructing measures of economic activity that will be better at capturing structural changes in the economy affecting energy and maximum demand; enhancing the maximum demand models to eliminate the need for adjustments; using temperature corrected demand inputs into the maximum demand modelling; undertaking an in-depth review of maximum demand price elasticity; and developing a 'whole-year' annual maximum demand forecast across seasons, in addition to maximum demand forecasts by season.

These improvements should reduce the potential risks of forecasting bias.

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CHAPTER 1 - INTRODUCTION

This report provides an assessment of the forecasts provided in the 2012 National Electricity Forecast Report (NEFR) and highlights key improvements to the forecasting process for the 2013 NEFR.

Prior to 2012, annual energy and maximum demand forecasts were prepared by AEMO together with transmission network service providers (TNSPs). For the first time in 2012, AEMO independently developed all annual energy and maximum demand forecasts. This report focuses on the results of AEMO's 2012 NEFR and implemented improvements of the 2013 NEFR forecast models.

All forecasts have been compared using the medium (or planning) scenario. This report will also examine forecast accuracy of operational demand[1] forecasts for energy and maximum demand to provide additional transparency.

In addition to the dependency on forecast models, the accuracy of energy and maximum demand forecasts will also be dependent on forecast input data, including economic forecasts.

As a result of both internal and external reviews of the 2013 forecast models, some key areas of improvement have been flagged for the 2014 NEFR models and are discussed in Chapter 8.

[1] AEMO's derivation of operational energy/demand forecasts is determined by subtracting forecasts of small non-scheduled generation from the annual energy and maximum demand forecasts.

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CHAPTER 2 - METHODOLOGY

2.1 Annual energy

2.1.1 Back assessment

To provide some evaluation of the 2012 NEFR forecasts, the annual energy (sent out) and operational energy forecast variances have been presented in this report for each National Electricity Market (NEM) region. The back assessment will compare the one-year-ahead forecasts prepared in the 2012 NEFR with the year-to-date outcomes[1]; it will also examine these variances in the context of previous one-year-ahead forecasts prior to the 2012 NEFR (annual energy only).

To assess the 2012 NEFR forecasts for 2012-13, the actual financial year-to-date (YTD) annual energy used was as of the end of May 2013. This was the most up-to-date estimate available at the time of preparation of this report, and differs from the estimate of 2012-13 annual energy in the 2013 NEFR. The actual YTD annual energy was compared against the 2012 NEFR YTD forecast, which was determined by using the monthly historical weightings of annual energy for the last five years to adjust the 2012 NEFR forecast for 2012-13 to a YTD figure.

2.1.2 Back cast

Back casting is used to evaluate the performance of AEMO's 2012 NEFR models and 2013 NEFR models. In-sample dynamic[2] forecasts for the period 2001-02 to 2011-12 were produced to assess how well the models were able to forecast against actual demand. These are essentially what the forecast outcomes would have been if they had started from 2001-02, with the actual economic and weather drivers known.

Variances here use the actual energy consumption as the base[3], this differs from other variances in this report, where forecasts are used as the base. This enables better comparison of 2012 and 2013 model outcomes.

2.1.3 Improvements since the 2012 NEFR

Improvements to the 2012 NEFR energy models were identified and have been implemented in the 2013 NEFR. One of the major improvements is the estimation of the long-run relationship between electricity demand and key drivers based on the Dynamic Ordinary Least Squares (DOLS) regression methodology.

The models used in the 2012 NEFR do not produce the most robust long-run estimates, as they generally relied on estimation methods not suited to small sample data sets. In addition, these models may have been affected by issues of endogeneity. Endogeneity issues arise when the model cannot account for the fact that a variable, such as price, may affect energy consumption; and energy consumption may also affect price. The model will only allow for price to affect energy consumption. This makes it difficult to determine the relationship of energy consumption with each individual variable and to understand the individual effects each one has on energy consumption.

The DOLS model has been shown to alleviate problems of small sample bias and endogeneity, and AEMO has therefore applied the DOLS methodology to estimate long-run relationships between energy consumption and several demand drivers.

For further information regarding the specific models developed, please see the Forecast Methodology Information Paper.

[1] For year-to-date forecast calculations, monthly weightings are used to disaggregate annual forecasts. These weightings are based on historical energy data and have been used to separate the annual energy and operational energy forecasts from the 2012 NEFR into monthly forecasts for the 2012-13 year.

[2] In-sample indicates that the data used for model assessment was also used to determine the model coefficients. Forecasts are dynamic in nature in that any forecast errors in earlier years will influence the forecasts in later years, thereby capturing the evolution of the relationship between forecasting variables over the ten year period.

[3] Variance % (actual base) = 100% x (Forecast – Actual) / Actual; Variance % (forecast base) = 100% x (Forecast – Actual) / Forecast

2.1.4 Further improvements to 2013 NEFR energy models

Initially, AEMO developed preliminary forecast models that relate demand with price, income and temperature, using the DOLS methodology. Diagnostic tests found that these preliminary models fitted the data reasonably well. However, issues arose in interpreting the short-run forecasts.

These preliminary models were tested using impulse response functions[4], isolating the effects of changes to income and electricity price on energy consumption. The response in energy consumption was implausible and difficult to explain, with oscillating short-run responses in the short term. Furthermore, the impulse response analysis did not show a significant long-run response in energy consumption, as might be expected after a step change in price or income.

It was found that the short-run component of the models was dominated by seasonal patterns, and this made estimating accurate short-run coefficients difficult. Additionally, the preliminary models may have been over-specified with too many coefficients in the models, relative to the small sample size. Based on this, additional work was undertaken to address the issue of seasonality and improve the forecast models so that they provided sensible short-run and long-run forecasts.

The final 2013 NEFR models have a simpler specification and have more effective short-run components. The results were shown to be more stable and plausible both in the long-run and short-run forecasts.

2.2 Maximum demand definitions

2.2.1 2013 model assessment

This section provides some assessment of the robustness of the maximum demand forecast models used in the 2013 NEFR. For conciseness, only the peaking season for each region is assessed. With the exception of Tasmania, this is summer.

The concept of Probability of Exceedence (POE) is used extensively in examining the maximum demand forecast models. In this context, probability of exceedence refers to how likely a maximum demand is in a given summer/winter; for example, a 10% POE represents a one-in-ten year summer/winter event.

It is also important to note that the concept of fully probabilistic POE is not the same as a POE developed with weather correction methodology. While weather conditions play an important part in determining the maximum demand probability distribution, other factors may also significantly affect this. Therefore, POE estimates using a weather correction methodology cannot be compared directly with the fully probabilistic POE estimates used by AEMO.

In previous reports, assessing maximum demand forecast accuracy, emphasis has been placed on hind casting (in-sample point forecast) and evaluating the model forecast against actual or maximum demand for all historical maximum demands. However, for a model that produces probability distributions (as opposed to point forecasts) a different assessment method is required.

2.2.2 2012–13 summer maximum demand Forecast

An examination of where the maximum demand points sit on the maximum demand distribution[5] fitted by the model will provide some detail on the validity of the maximum demand model. It would be expected, given a large sample size, that half of the points will lie below the 50% POE and half of the points will lie above this line. Additionally, it would be expected that 10% of points will lie above the 10% POE line and 90% of points will lie above the 90% POE line. However, given that the sample size is small, this exact outcome cannot be expected, but a general adherence to this is expected.Assessment of 2012 NEFR forecasts

[4] Impulse response functions track sensitivity of a dependent variable in a dynamic model in response to a given change to one of the explanatory variables; in this case, the sensitivity or the likely response in energy consumption given changes to price or income.

[5] In analysing the historical POE distribution, analysis is confined to non-large-industrial consumption, that is, maximum demand less large industrial demand, plus an estimate of contribution from rooftop PV.

Using the estimated historical 10% POE from the 2013 forecasting models, an estimate of the 10% POE for that summer/winter can be obtained. This is compared to the forecast 10% POE from the 2012 NEFR to determine the relative accuracy of the 2012 NEFR forecasts for one season ahead. Note that 10% POE is particularly relevant for planning purposes and accuracy of this forecast is important. In addition, the maximum demand forecast models have been tuned to these particular conditions.

This assessment using the 2013 maximum demand model as the POE level for the 2012-13 summer or 2012 winter is not necessarily an absolute POE, rather it is produced by the maximum demand model, using the historical data for the 2012-13 summer and 2013 winter, and therefore can be viewed as an indication of the forecast accuracy, rather than an exact measurement. It should be noted that the historical maximum demand distribution is based on the non-industrial maximum demand POE distribution (produced by the model) and the actual large industrial demand at the time of maximum demand.

Analysis will be provided for both maximum demand (as generated) and operational demand at the time of maximum demand, including the underlying reasons causing the variance.

It should be noted that potential sources of forecast variance exist outside of the maximum demand model and these include the following:

- Large Industrial load forecasts.
- Photovoltaic (PV) contribution forecast, including forecast installed capacity and contribution factor.
- Energy efficiency offset forecast.
- Energy forecasts.
- Economic forecasts.

2.2.3 Key improvements to the 2013 maximum demand forecast methodology

For the 2013 maximum demand forecasting models AEMO, together with Monash University, implemented some key improvements to enhance the forecasting models. Specifically these are as follows:

- Allowing for specific price response observed at peak times. Using peak price elasticity in the maximum demand model, based on research undertaken by Monash University.
- Allowing for changes in the load factor over time. Based on research undertaken by Monash University, the maximum demand forecast model now adjusts over time to allow a superior model fit.
- Incorporating simulated heating and cooling degree days in the maximum demand distribution to allow for the effect of consistently warm or cold summers or winters in the maximum demand probability distribution.
- Incorporating a half-hourly PV generation trace. This trace is added to the non-industrial demand, enabling a more complete view of non-industrial demand at peak times. Additionally, a broader sample set was used in determining the PV contribution factor at peak times for all regions, enabling a more accurate forecast for future rooftop PV contribution at times of maximum demand.

Please see the Forecast Methodology Information Paper and Rooftop PV Information paper for more information regarding the maximum demand forecast modelling improvements and rooftop PV.

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CHAPTER 3 - QUEENSLAND

This section provides an assessment of the forecast accuracy for Queensland annual energy and maximum demand forecasts.

Some key improvements to the energy model are discussed.

A financial year-to-date (YTD) assessment of the one-year-ahead forecast from the 2012 NEFR is examined. Some over-forecasting for the 2012-13 year is observed, with the majority of variance in the residential and commercial sector.

The forecast 2012-13 summer maximum demands were higher than the actual maximum demand; this was mainly due to lower-than-expected residential and commercial demand, lower-than-expected large industrial demand and higher-than-expected installed rooftop PV capacity.

3.1 Annual energy

3.1.1 Annual energy forecasts

Table 3-1 — 2012 NEFR forecast of Queensland annual energy for 2012-13

	YTD Annual Energy (sent out)	YTD Operational Energy
Forecast (GWh)	45,986	48,679
Actual (GWh)	44,819	46,642
Variance (GWh)	1,167	2,037
Variance (%)	2.54%	4.18%

Comparing the YTD forecasts with actual outcomes, the 2012 NEFR annual energy forecasts for the 2012-13 year are shown to have been over-forecast for both annual energy and operational energy, with variances of 2.54% and 4.18%, respectively. Key reasons for this variance are:

Lower–than-expected residential and commercial consumption; this is particularly evident from February onward, with flooding in late January 2013 and milder than expected weather conditions in the state reducing energy consumption.

Higher-than-expected small non-scheduled generation, contributing to lower-than-expected operational energy.

Table 3-2 presents the one-year-ahead forecasts from 2000-01 to 2012-13 YTD for annual energy.

Table 3-2 — One year ahead annual energy forecast variance for Queensland

FYE	1-year ahead annual energy forecast (GWh)	Actual annual energy (GWh)	Variance %	Source
2001/02	41,236	42,146	-2.21%	Powerlink
2002/03	43,207	42,851	0.82%	Powerlink
2003/04	45,225	44,700	1.16%	Powerlink
2004/05	46,667	45,903	1.64%	Powerlink
2005/06	48,487	47,480	2.08%	Powerlink
2006/07	49,665	48,029	3.29%	Powerlink
2007/08	51,593	48,311	6.36%	Powerlink
2008/09	53,248	49,768	6.54%	Powerlink
2009/10	51,503	50,647	1.66%	Powerlink
2010/11	53,487	48,871	8.63%	Powerlink
2011/12	52,802	48,900	7.39%	Powerlink
2012-13 YTD	**45,986**	**44,819**	**2.54%**	**AEMO**

Figure 3-1 — One-year-ahead annual energy forecast variance for Queensland

3.1.2 Back cast

Table 3-3 presents the dynamic in-sample forecast results from the 2012 and 2013 NEFR models

Table 3-3 — 2012 NEFR and 2013 NEFR dynamic in-sample annual energy forecasts for Queensland

FYE	Actual annual energy (GWh)	2012 NEFR in-sample forecast (GWh)	Variance %	2013 NEFR in-sample forecast (GWh)	Variance %
2001/02	42,146	41,783	-0.90%	42,044	-0.20%
2002/03	42,851	42,448	-0.90%	43,003	0.40%
2003/04	44,700	44,396	-0.70%	44,841	0.30%
2004/05	45,903	45,267	-1.40%	45,713	-0.40%
2005/06	47,480	46,901	-1.20%	47,341	-0.30%
2006/07	48,029	47,725	-0.60%	48,052	0.00%
2007/08	48,311	48,500	0.40%	48,709	0.80%
2008/09	49,768	49,642	-0.30%	49,547	-0.40%
2009/10	50,647	50,475	-0.30%	50,146	-1.00%
2010/11	48,871	48,771	-0.20%	49,107	0.50%
2011/12	48,900	49,535	1.30%	49,134	0.50%

Comparison of the 2012 and 2013 NEFR show that both models fit the data relatively well. The in-sample forecasts from both models tracked the actuals relatively well and overall the two models produced comparable in-sample forecasts in terms of accuracy. The 2012 NEFR model does show smaller variances than the 2013 NEFR model from 2007-08 onwards; however, variances overall are small. While this does not demonstrate a clear improvement, generally the 2013 NEFR models have been demonstrated to be generally more appropriate and less prone to small sample bias.

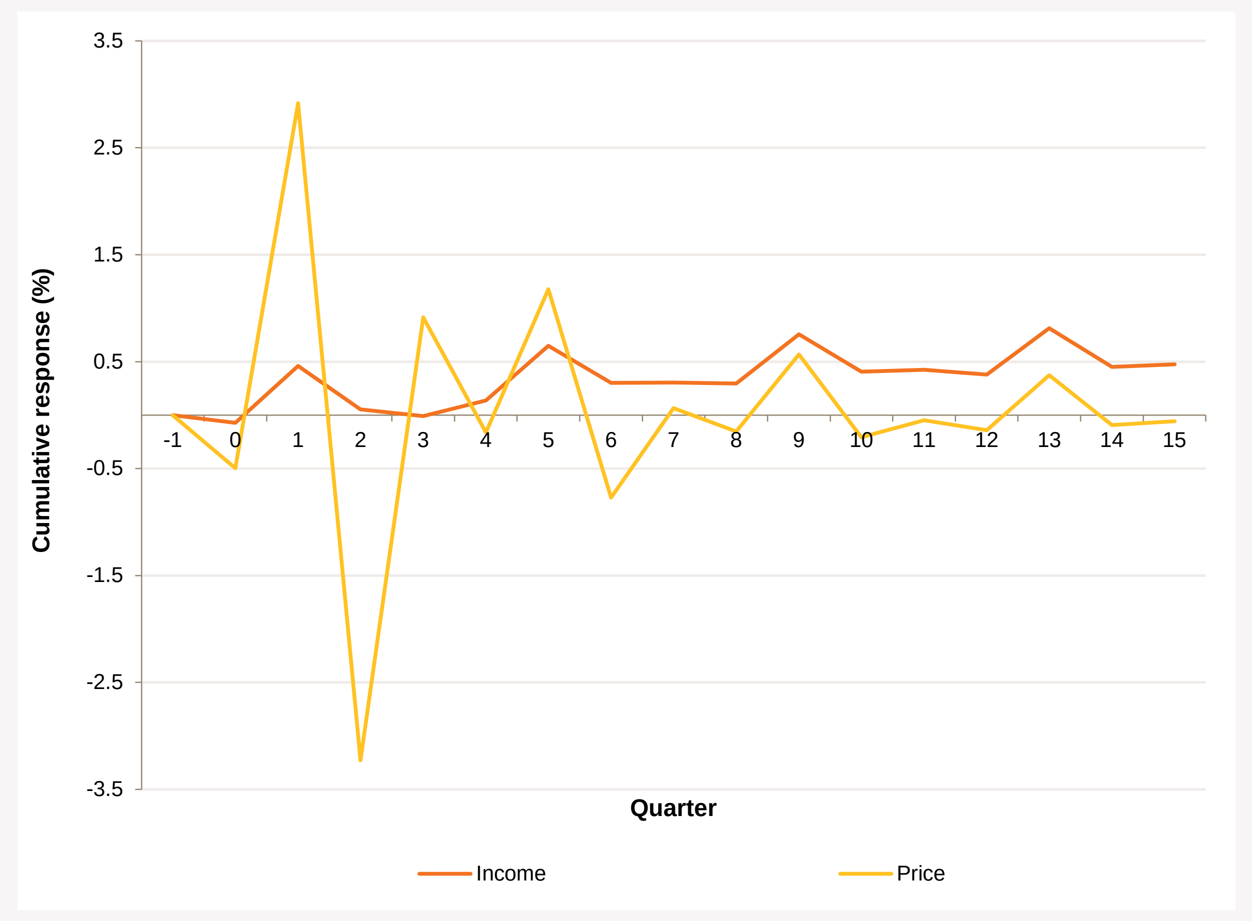
3.1.3 2013 energy model improvements

The following section provides an analysis comparing the stability of the preliminary models that were initially developed and the 2013 NEFR models for Queensland. Scenario analysis has been undertaken to assess the response in energy consumption and demand forecast by comparing the effects of a change in income and electricity prices for Queensland. Note that both models are based on DOLS estimators to obtain long-run estimates. The results highlight improvements made in the 2013 NEFR models and the rationale for rejecting the preliminary models.

Preliminary models

Figure 3-2 shows the response in energy consumption from the preliminary models given a step increase in income and electricity price.

Figure 3-2 — Impulse response for Queensland annual energy preliminary model



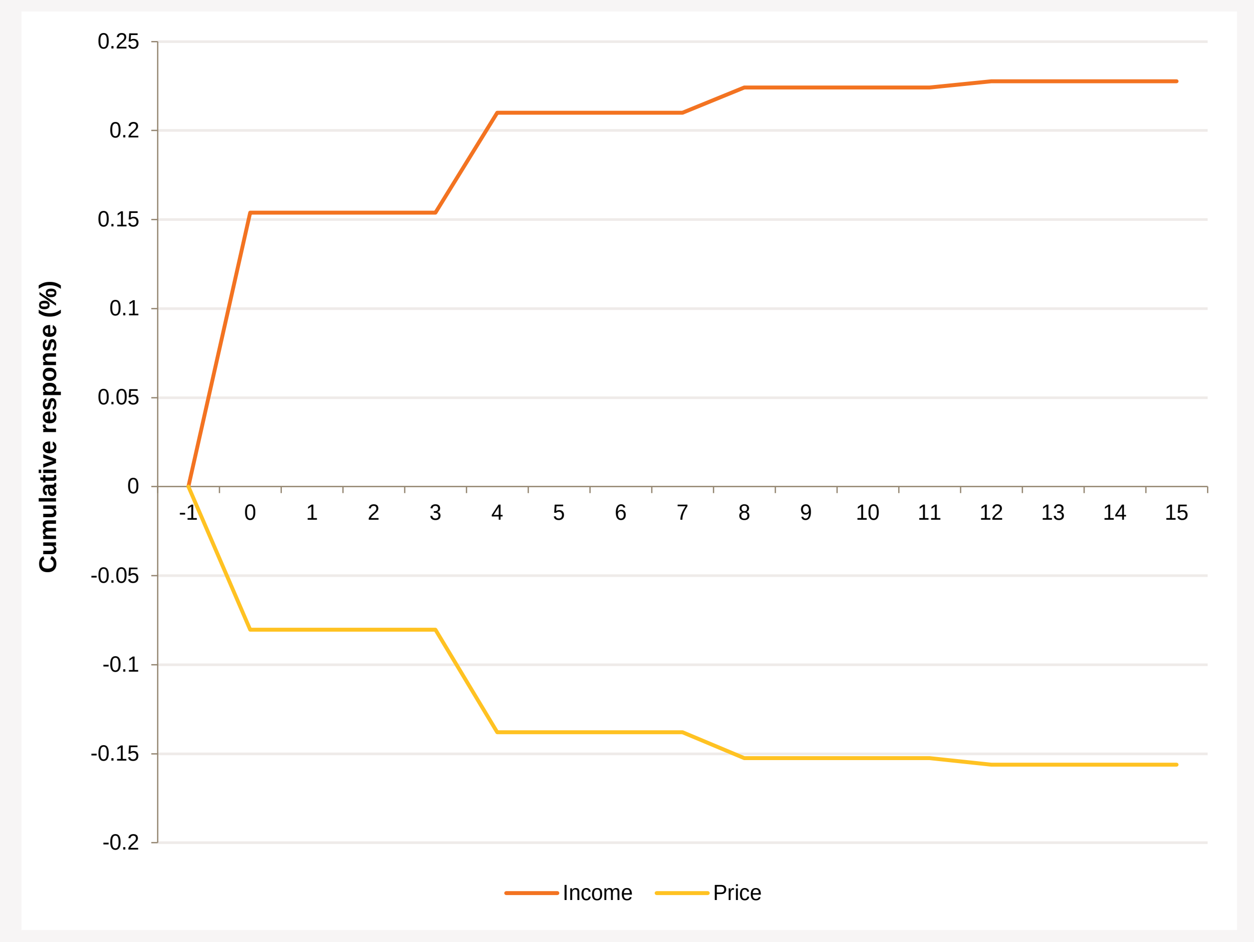
The response in energy consumption should generally show a smooth transition towards a new long-run equilibrium. As the graph shows, the short-run response from the preliminary model produces a highly fluctuating response in energy consumption.

This seems implausible, especially for a price effect where the short-run response oscillates between positive and negative; this indicates that the response to an increase in prices will be to actually increase demand, which is unlikely. While the income effect shows relatively stable and expected forecasts, the quarterly changes in response seem unreasonable and are caused by seasonal patterns in the data.

2013 NEFR models

Figure 3-3 shows much more plausible responses in energy consumption given a 1% increase in income and prices based on the 2013 NEFR models.

Figure 3-3 — Impulse response for 2013 NEFR Queensland annual energy model



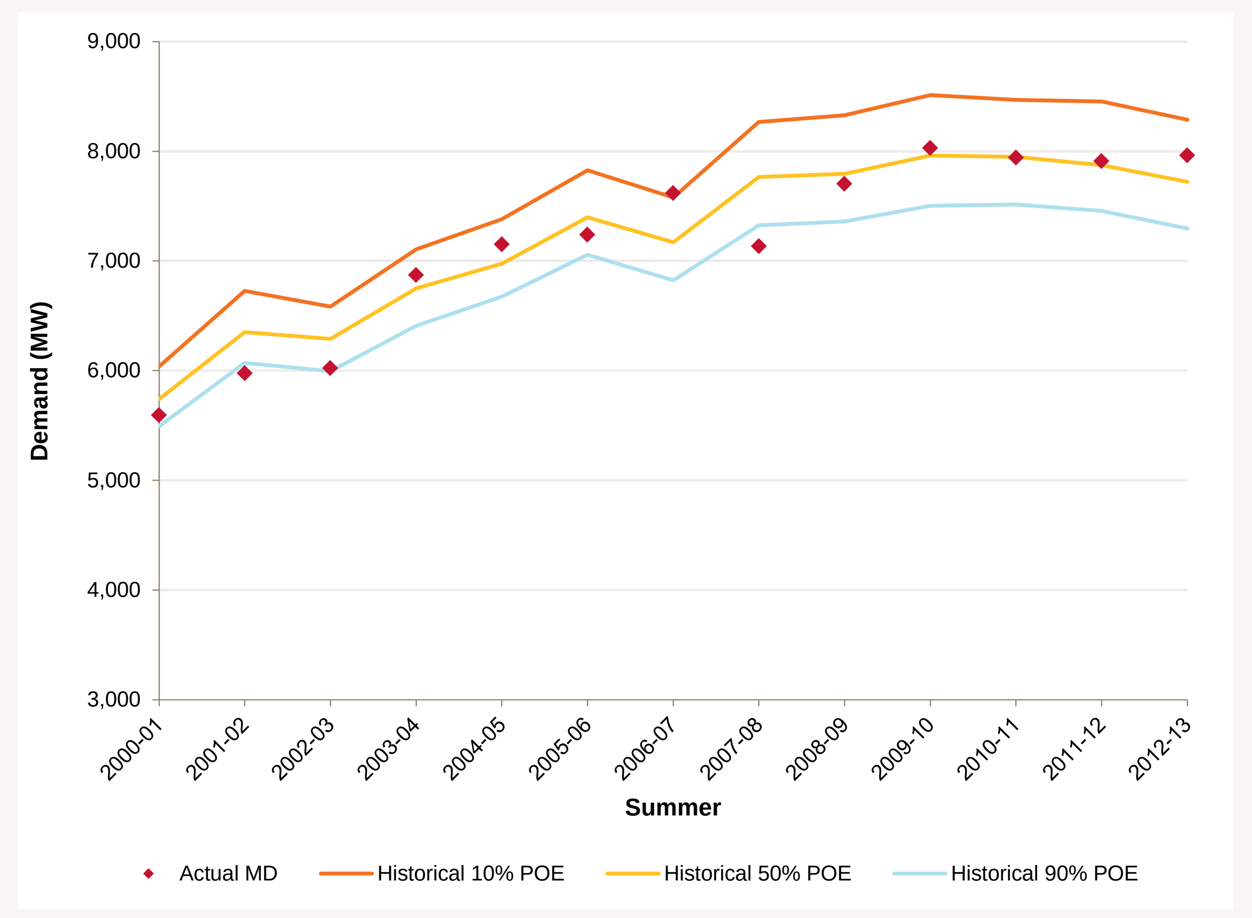
The responses do not exhibit the quarterly fluctuations that were affecting the preliminary models. The 2013 NEFR models show that the response in energy consumption to an increase in price or income will gradually move towards a new equilibrium that is consistent with the long-run estimates. This shows that the seasonal problems have been corrected in the 2013 NEFR models. The results clearly show that the 2013 NEFR models are much more stable and are capable of producing more accurate forecasts.

3.2 Maximum demand

3.2.1 2013 model assessment

The following assessment shows two different methods for examining the appropriateness of the maximum demand forecast distribution. Both tests focus on where maximum demand points sit on the maximum demand distribution.

Figure 3-4 — 2013 NEFR Queensland historical POEs for non-industrial component of maximum demand



As Figure 3-4 shows, the historical distribution produced by the 2013 maximum demand model for non-industrial demand shows a relatively uniform distribution in relation to the actual maximum demand points, with approximately half of the points below the 50% POE historical POE and approximately half the points above. Table 3-4 summarises these results:

Table 3-4 — Proportion of actual MDs exceeding 2013 NEFR Queensland historical POEs for non-industrial demand

	Historical Points	Percentage
Above 10% POE	1	8%
Above 50% POE	6	46%
Above 90% POE	11	85%

3.2.2 2012–13 summer maximum demand forecast

The estimated 10% POE maximum demand from the 2013 NEFR maximum demand model has been compared against the 10% POE forecast from the 2012 NEFR for the 2012-13 summer as a measure of forecast accuracy for maximum demand and operational demand. This is shown in Table 3-5 below

Table 3-5 — Comparison of 2012-13 10% POE from 2012 NEFR forecast and 2013 NEFR estimate for Queensland

10% POE	Maximum Demand	Operational Demand
Forecast (MW)	9,299	9,135
Estimate (MW)	9,045	8,804
Variance (MW)	254	331
Variance (%)	2.73%	3.63%

Contributing to this variance are the following:

- Lower-than-expected residential and commercial demand.
- Higher-than-expected rooftop PV capacity.
- Lower-than-expected large industrial demand.
- Lower-than-expected auxiliary loads.

Operational demand variance is also partly caused by:

Higher-than-expected small non-scheduled generation contribution at the time of maximum demand.

CHAPTER 4 - NEW SOUTH WALES (INCLUDING THE AUSTRALIAN CAPITAL TERRITORY)

This section provides an assessment of the forecast accuracy for Queensland annual energy and maximum demand forecasts.

Some key improvements to the energy model are discussed.

A financial year-to-date (YTD) assessment of the one-year-ahead forecast from the 2012 NEFR is examined. Some minor over-forecasting for the 2012-13 year is observed, with the majority of variance caused by lower-than-expected residential and commercial consumption and lower-than-expected large industrial consumption.

The forecast 2012-13 summer maximum demand shows some small under-forecasting due to higher-than-expected residential and commercial load.

4.1 Annual energy

4.1.1 Annual energy forecasts

Table 4-1 — 2012 NEFR forecast of NSW annual energy for 2012-13

	YTD Annual Energy (sent out)	YTD Operational Energy
Forecast (GWh)	63,702	66,573
Actual (GWh)	62,218	65,300
Variance (GWh)	1,484	1,273
Variance (%)	2.33%	1.91%

The forecasts have generally exceeded actual outcomes. The 2012 NEFR annual energy forecasts for the 2012-13 year are shown to have over-forecast for both annual energy and operational energy, with variances of 2.33% and 1.91% respectively. Key reasons for this variance are as follows:

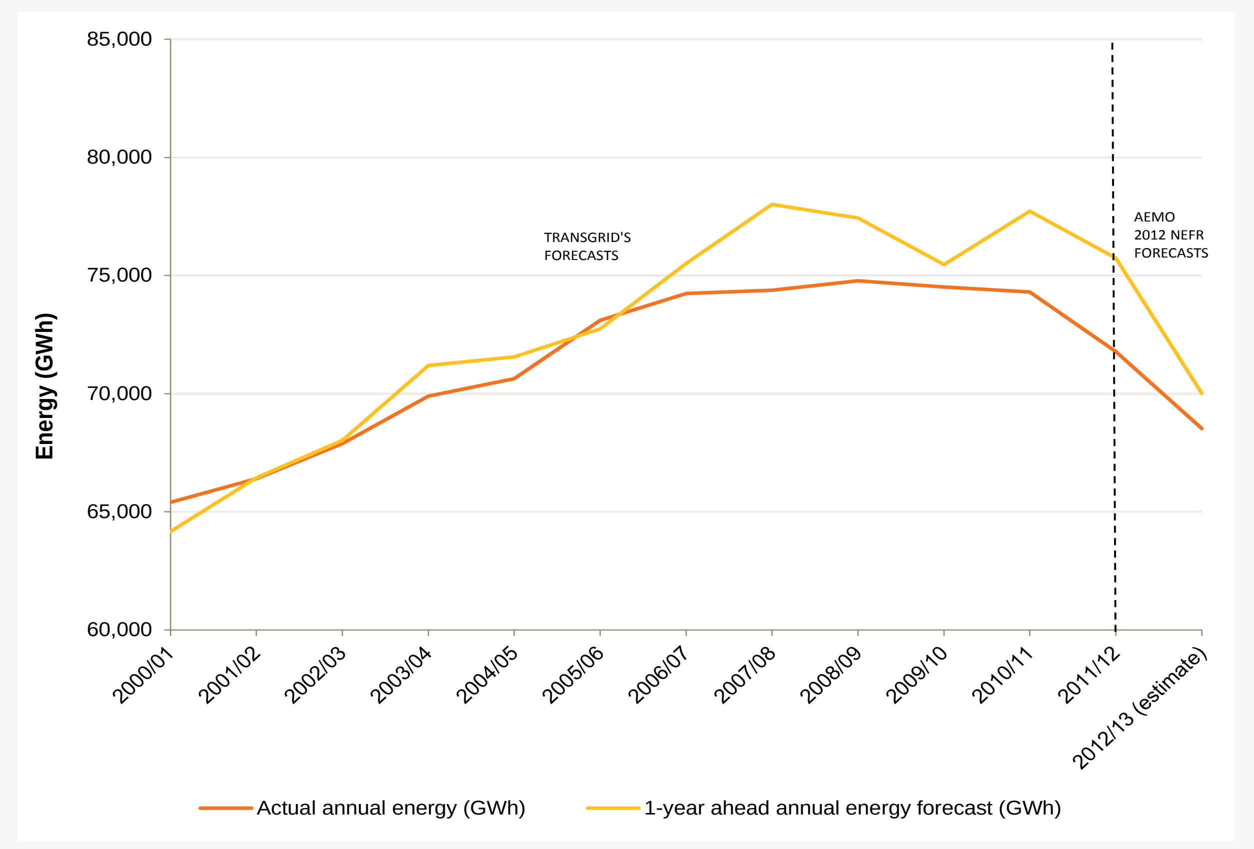
- Lower-than-expected residential and commercial consumption.
- Lower-than-expected large industrial consumption.
- Lower-than-expected transmission losses and auxiliary loads.

Table 4-2 presents the one-year-ahead forecasts from 2000-01 to 2012-13 YTD for annual energy.

Table 4-2 — One year ahead annual energy forecast variance for NSW

FYE	1-year ahead annual energy forecast (GWh)	Actual annual energy (GWh)	Variance %	Source
2001/02	66,445	66,406	0.06%	TransGrid
2002/03	68,020	67,887	0.20%	TransGrid
2003/04	71,190	69,899	1.81%	TransGrid
2004/05	71,560	70,638	1.29%	TransGrid
2005/06	72,740	73,100	-0.50%	TransGrid
2006/07	75,510	74,246	1.67%	TransGrid
2007/08	78,010	74,378	4.66%	TransGrid
2008/09	77,440	74,781	3.43%	TransGrid
2009/10	75,470	74,522	1.26%	TransGrid
2010/11	77,720	74,308	4.39%	TransGrid
2011/12	75,735	71,782	5.22%	TransGrid
2012-13 YTD	**63,702**	**62,218**	**2.33%**	**AEMO**

Figure 4-1 — One-year-ahead annual energy forecast variance for NSW



4.1.2 Back cast

Table 4-3 presents the dynamic in-sample forecast results from the 2012 and 2013 NEFR models.

Table 4-3 — 2012 NEFR dynamic in-sample annual energy forecasts for NSW

FYE	Actual annual energy (GWh)	2012 NEFR in-sample forecast (GWh)	Variance %	2013 NEFR in-sample forecast (GWh)	Variance %
2001/02	66,406	68,876	3.7%	66,081	-0.5%
2002/03	67,887	70,666	4.1%	67,704	-0.3%
2003/04	69,899	73,573	5.3%	70,308	0.6%
2004/05	70,638	74,493	5.5%	70,745	0.2%
2005/06	73,100	76,302	4.4%	72,615	-0.7%
2006/07	74,246	78,218	5.3%	74,006	-0.3%
2007/08	74,378	79,209	6.5%	74,633	0.3%
2008/09	74,781	79,649	6.5%	74,893	0.1%
2009/10	74,522	78,704	5.6%	73,990	-0.7%
2010/11	74,308	77,810	4.7%	74,073	-0.3%
2011/12	71,782	75,146	4.7%	71,951	0.2%

The results clearly show that the 2013 models produce superior in-sample forecasts. The 2012 NEFR models do not appear to fit the data very well and there is a tendency of the 2012 NEFR models to over forecast when compared against actual outcomes, possibly indicating a biased model.

In comparison, the 2013 NEFR models fit the data very well and the in-sample forecasts do not show any tendency to under or over forecast, indicating that the 2013 NEFR models are well-specified.

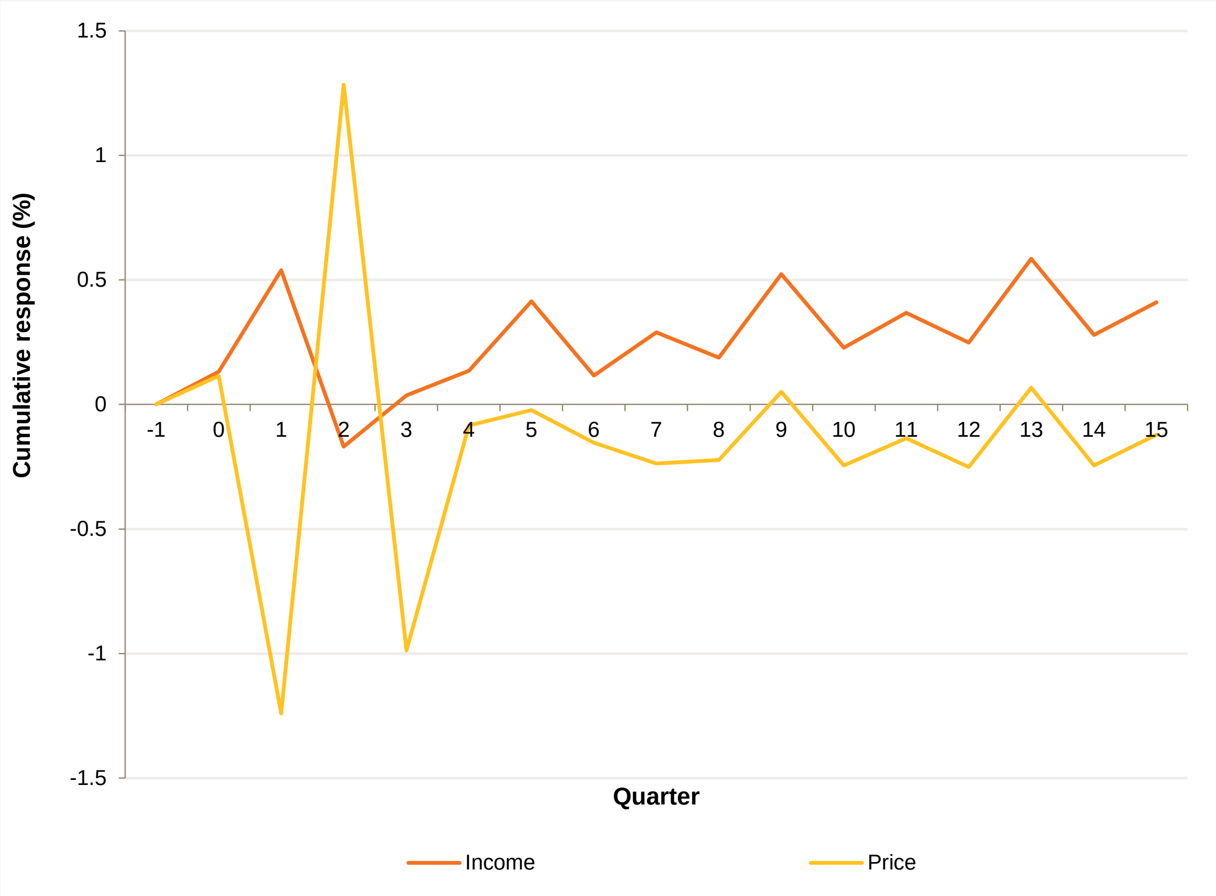
4.1.3 2013 energy model improvements

Chapter 3 - The following section provides an analysis comparing the stability of the preliminary models and the 2013 NEFR models for New South Wales. Scenario analysis has been undertaken to assess the response in energy consumption and demand forecast by comparing the effects of a change in income and electricity prices for New South Wales. Note that both models are based on DOLS estimators to obtain long-run estimates. The results highlight improvements made in the 2013 NEFR models and the rationale for rejecting the preliminary models.

Preliminary models

Figure 4-2 shows the response in energy consumption from the preliminary models given a permanent increase in income and electricity price.

Figure 4-2 — Impulse response for NSW annual energy preliminary model



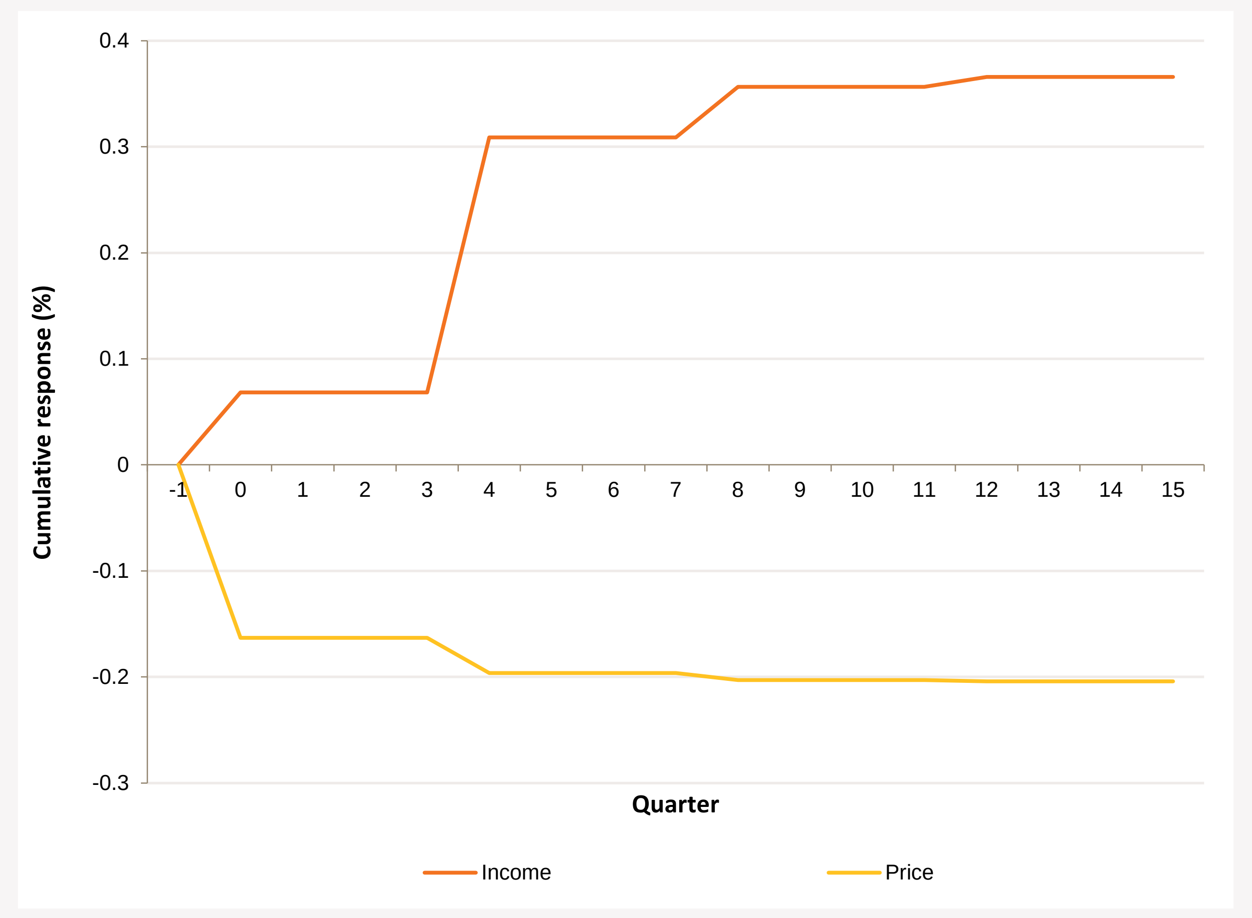
The response in energy consumption fluctuates, and is particularly prominent when prices increase. Furthermore, energy consumption increases dramatically for one quarter in response to an increase in price, which is neither intuitive nor plausible.

The response in energy consumption for income effects is also not intuitive, as the response in energy consumption shows that energy consumption will decrease despite an increase in income. The quarterly fluctuations do not seem sensible and are most likely the result of seasonal patterns in the data.

2013 NEFR models

Figure 4-3 shows the response in energy consumption form the 2013 NEFR models given a permanent increase in income and electricity price.

Figure 4-3 — Impulse response for 2013 NEFR NSW annual energy model

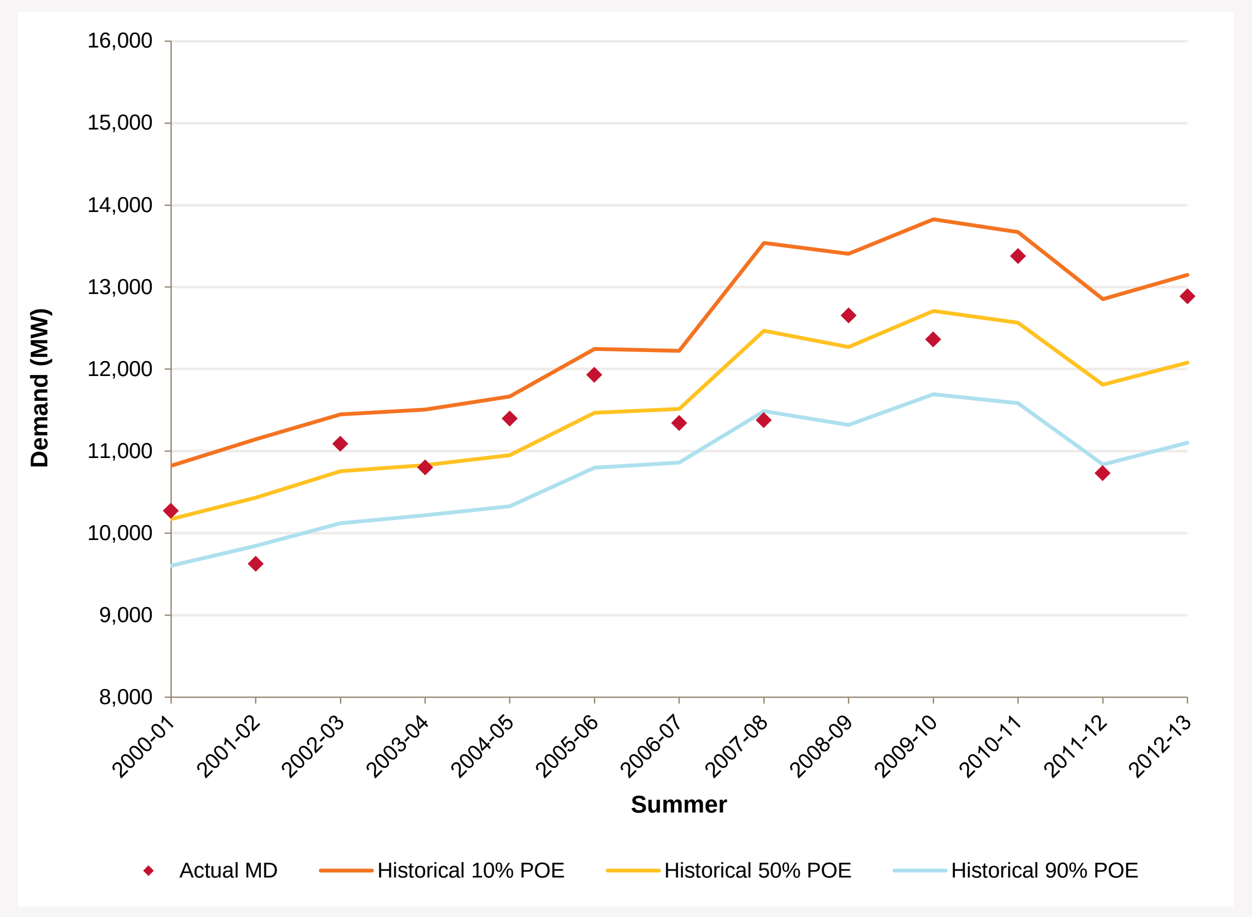


Importantly, this graph shows that the response in energy consumption does not exhibit the quarterly fluctuations that were affecting the preliminary models. This shows that the seasonal problems that affected the preliminary models have been corrected in the 2013 NEFR models. The 2013 NEFR models show that in the absence of further change to income and prices, the response in energy consumption will gradually move towards a new equilibrium that is consistent with long-run estimates.

4.2 Maximum demand

4.2.1 2013 model assessment

Figure 4-4 — 2013 NEFR NSW historical POEs for non-industrial of maximum demand



As figure 4-4 above shows, the historical distribution produced by the 2013 maximum demand model for non-industrial demand shows a relatively uniform distribution in relation to the actual maximum demand points, with approximately half of the points below the historical 50% POE and approximately half the points above. The following table summarises these results:

Table 4-4 — Proportion of actual MDs exceeding 2013 NEFR NSW historical POEs for non-industrial demand

	Historical Points	Percentage
Above 10% POE	0	0%
Above 50% POE	7	54%
Above 90% POE	10	77%

4.2.2 2012-13 summer maximum demand forecast

Comparing the estimated 10% POE maximum demand from the 2013 NEFR maximum demand model against the 10% POE forecast from the 2012 NEFR for the 2012-13 summer, forecast accuracy for maximum demand and operational demand are shown in table 4-5 below:

Table 4-5 — Comparison of 2012-13 10% POE from 2012 NEFR forecast and 2013 NEFR estimate for NSW

10% POE	Maximum Demand	Operational Demand
Forecast (MW)	14,065	13,947
Estimate (MW)	14,206	14,152
Variance (MW)	-141	-206
Variance %	-1.01%	-1.48%

Contributing to this variance is higher-than-expected residential and commercial demand.

Operational demand variance is also partly caused by lower-than-expected small non-scheduled generation contribution at the time of maximum demand

CHAPTER 5 - SOUTH AUSTRALIA

This section provides an assessment of the forecast accuracy for South Australia annual energy and maximum demand forecasts.

Key improvements to the energy model are discussed.

A financial year-to-date (YTD) assessment of the one-year-ahead forecast from the 2012 NEFR is examined. Some under-forecasting for the 2012-13 year is observed, with the majority of variance caused by higher-than-expected residential and commercial consumption. This may be partly due to warmer-than-expected summer conditions for the region.

The forecast 2012-13 summer maximum demand shows some under-forecasting due to higher-than-expected commercial and residential loads, large industrial loads and auxiliary loads.

5.1 Annual energy

5.1.1 2012 NEFR forecasts

Table 5-1 — 2012 NEFR forecast of South Australia annual energy for 2012-13

	YTD Annual Energy (sent out)	YTD Operational energy
Forecast (GWh)	11,884	12,458
Actual (GWh)	12,207	12,719
Variance (GWh)	-323	-261
Variance %	-2.72%	-2.10%

2012 NEFR annual energy forecasts for the 2012-13 year are shown to have under-forecast for both annual energy and operational energy, with variances of -2.72% and -2.10%, respectively. Key reasons for this variance are as follows:

- Higher-than-expected residential and commercial consumption.
- Lower-than-expected auxiliary loads.
- Higher-than-expected consumption over the summer period (and March) due to warmer-than-expected conditions, resulting in higher-than-expected cooling loads.

Table 5-2 presents the one-year-ahead forecasts from 2000-01 to 2012-13 YTD for annual energy.

Table 5-2 — One-year-ahead annual energy forecast variance for South Australia

	1-year ahead annual energy forecast (GWh)	Actual annual energy (GWh)	Variance %	Source
2001/02	12,600	11,948	5.17%	AEMO
2002/03	12,766	12,479	2.25%	AEMO
2003/04	12,899	12,321	4.48%	AEMO
2004/05	12,263	12,364	-0.82%	AEMO
2005/06	11,628	12,802	-10.10%	AEMO
2006/07	13,743	13,451	2.13%	AEMO
2007/08	13,684	13,431	1.85%	AEMO
2008/09	14,278	13,686	4.14%	AEMO
2009/10	14,145	13,621	3.70%	AEMO
2010/11	14,307	13,729	4.04%	AEMO
2011/12	14,543	13,372	8.05%	AEMO
2012/13 YTD	**11,884**	**12,207**	**-2.72%**	**AEMO**

Figure 5-1 — Annual energy forecasts for South Australia

5.1.2 Back cast

Table 5-3 presents the dynamic in-sample forecast results from the 2012 and 2013 NEFR models.

Table 5-3 — 2012 NEFR and 2013 NEFR dynamic in-sample annual energy forecasts for South Australia

FYE	Actual annual energy (GWh)	2012 NEFR in-sample forecast (GWh)	Variance %	2013 NEFR in-sample forecast (GWh)	Variance %
2001/02	11,948	11,146	-6.7%	11,880	-0.6%
2002/03	12,479	11,614	-6.9%	12,446	-0.3%
2003/04	12,321	11,347	-7.9%	12,366	0.4%
2004/05	12,364	11,636	-5.9%	12,442	0.6%
2005/06	12,802	12,061	-5.8%	12,871	0.5%
2006/07	13,451	12,644	-6.0%	13,396	-0.4%
2007/08	13,431	12,626	-6.0%	13,340	-0.7%
2008/09	13,686	12,884	-5.9%	13,659	-0.2%
2009/10	13,621	12,994	-4.6%	13,718	0.7%
2010/11	13,729	13,184	-4.0%	13,889	1.2%
2011/12	13,372	12,611	-5.7%	13,383	0.1%

Comparison of the 2012 and 2013 NEFR models clearly indicate that the 2013 NEFR models produce superior in-sample forecasts. The 2012 NEFR models do not appear to fit the data very well. There is a tendency for the 2012 NEFR models to under-forecast against actuals, possibly indicating a biased model.

The 2013 NEFR models fit the data very well and the in-sample forecast do not show any tendency to under or over-forecast indicating that the 2013 NEFR models are well-specified.

5.1.3 2013 energy model improvements

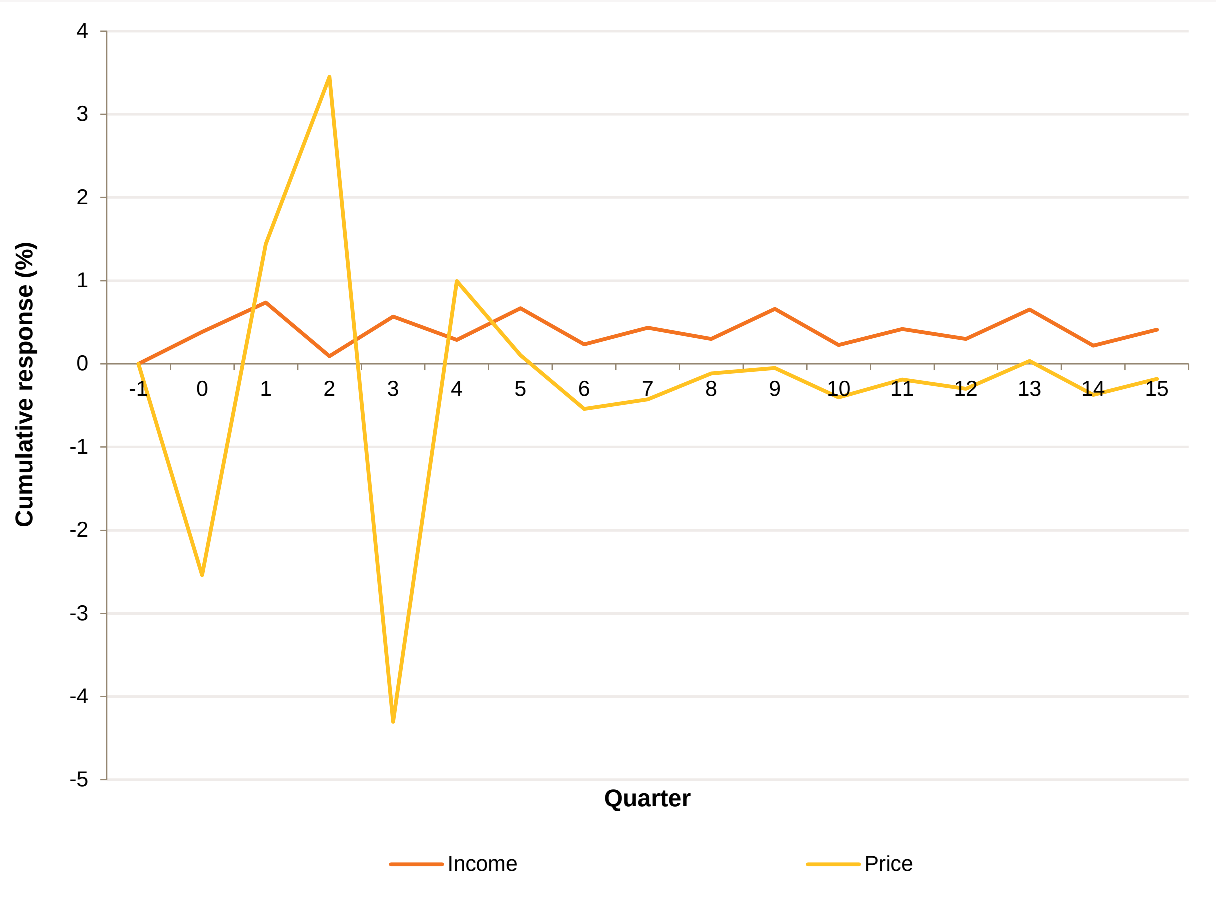
The following section provides an analysis comparing the stability of the preliminary models and the 2013 NEFR models for South Australia. Scenario analysis has been undertaken to assess the response in energy consumption and demand forecast by comparing the effects of a change in income and electricity prices for South Australia.

Note that both models are based on DOLS estimators to obtain long-run estimates. The results highlight the improvements in the 2013 NEFR models and the rationale for rejecting the preliminary models.

Preliminary models

Figure 5-2 shows the impulse response of energy consumption given a 1% permanent increase in income and electricity prices.

Figure 5-2 — Impulse response for South Australia annual preliminary model



The consumption response to a price increase oscillates from negative to positive, indicating that energy consumption may increase in some quarters despite a price rise; this is not intuitive. The response for income seems more plausible and is relatively stable with minor fluctuations; however, the swings between each quarter do not seem plausible and are likely to be the result of seasonality.

2013 NEFR models

Figure 5-3 shows the response in energy consumption from the 2013 NEFR models given a permanent increase in income and electricity price.

Figure 5-3 — Impulse response for 2013 NEFR South Australia energy model

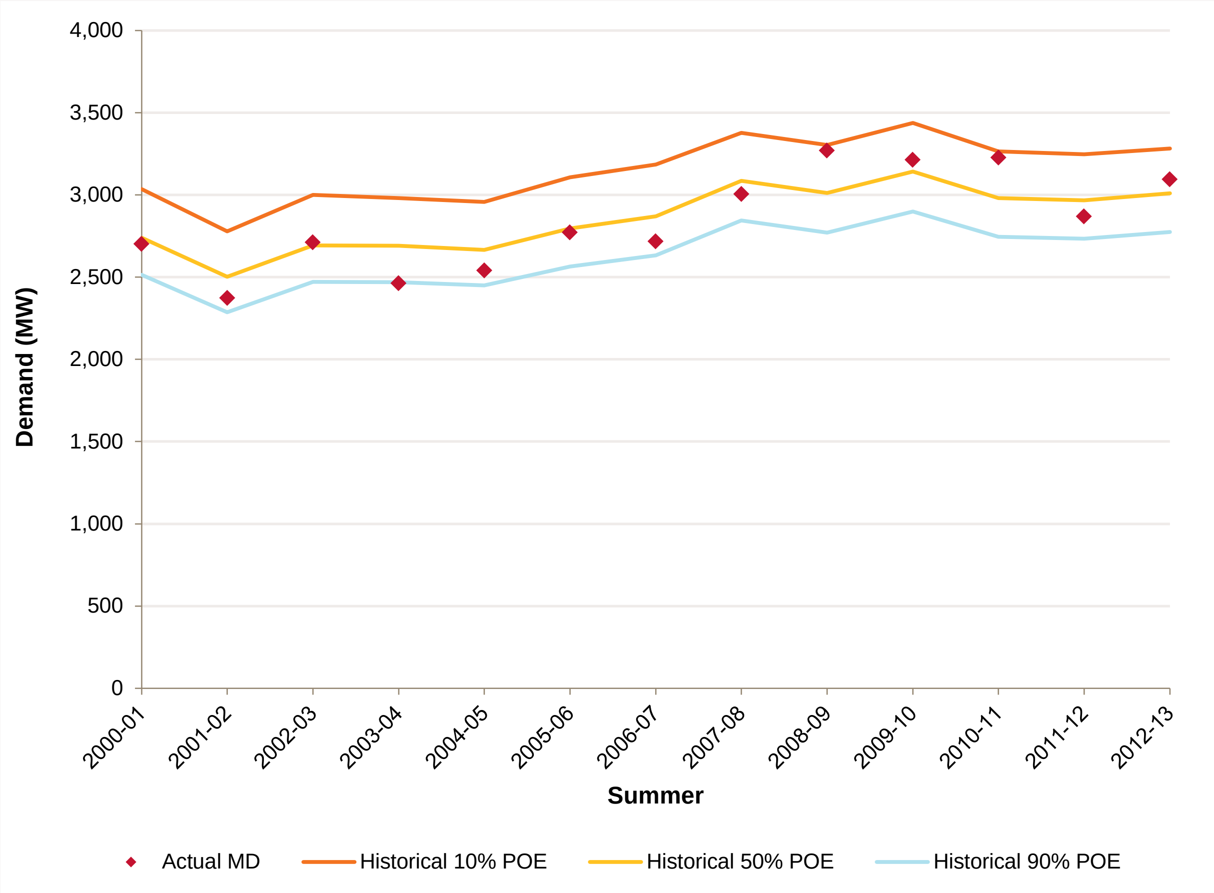
Figure 5-3 shows a much more sensible response in energy consumption from the 2013 NEFR models. The short-run response is much more plausible and does not oscillate between quarters. In the absence of further price or income changes, response in energy consumption is expected to gradually move over four quarters towards a new long-run equilibrium that is consistent with the long-run estimates. The figure shows there is some 'over-adjustment' to changes in income in the short-run and this is corrected in the long-run, where energy consumption is initially higher, but then moderates slightly.

This shows that the seasonal problems that affected the preliminary models have been corrected in the 2013 NEFR models, which will produce much more stable and plausible forecasts.

5.2 Maximum demand

5.2.1 2013 model assessment

Figure 5-4 — 2013 NEFR South Australia historical POEs for non-industrial component of maximum demand



As the above chart shows, the historical distribution produced by the 2013 maximum demand model for non-industrial demand shows a relatively uniform distribution in relation to the actual maximum demand points, with approximately half of the points below the historical 50% POE and approximately half the points above. It is not an exact fit and this cannot be expected due to the small sample size. But the fit appear better for the more recent years indicating the model is unbiased. The following table summarises these results:

Table 5-4 — Proportion of actual MDs exceeding 2013 NEFR South Australia historical POEs for non-industrial demand

	Historical Points	Percentage
Above 10% POE	0	0%
Above 50% POE	5	38%
Above 90% POE	12	92%

5.2.2 2012-13 summer maximum demand forecast

Comparing the estimated 10% POE maximum demand from the 2013 NEFR maximum demand model against the 10% POE forecast from the 2012 NEFR for the 2012-13 summer, forecast accuracy for maximum demand and operational demand are shown below:

Table 5-5 — Comparison of 2012-13 10% POE from 2012 NEFR forecast and 2013 NEFR estimate for South Australia

10% POE	Maximum Demand	Operational Demand
Forecast (MW)	3,271	3,249
Estimate (MW)	3,345	3,277
Variance (MW)	-74	-28
Variance %	-2.25%	-0.86%

Contributions to this variance are the following:

- Higher-than-expected residential and commercial loads.
- Higher-than-expected auxiliary loads.

CHAPTER 6 - VICTORIA

This section provides an assessment of the forecast accuracy for Victoria annual energy and maximum demand forecasts.

Key improvements to the energy model are discussed.

A financial year-to-date (YTD) assessment of the one-year-ahead forecast from the 2012 NEFR is examined. Some over-forecasting for the 2012-13 year is observed, with the majority of variance caused by lower-than-expected residential and commercial consumption.

The forecast 2012-13 summer maximum demand shows some under-forecasting due to higher-than-expected commercial and residential loads and higher-than-expected large industrial loads

6.1 Annual energy

6.1.1 2012 NEFR forecasts

Table 6-1 — 2012 NEFR forecast of Victoria annual energy for 2012-13

	YTD Annual Energy (sent out)	YTD Operational Energy
Forecast (GWh)	43,318	46,987
Actual (GWh)	42,848	46,422
Variance (GWh)	470	565
Variance (%)	1.08%	1.20%

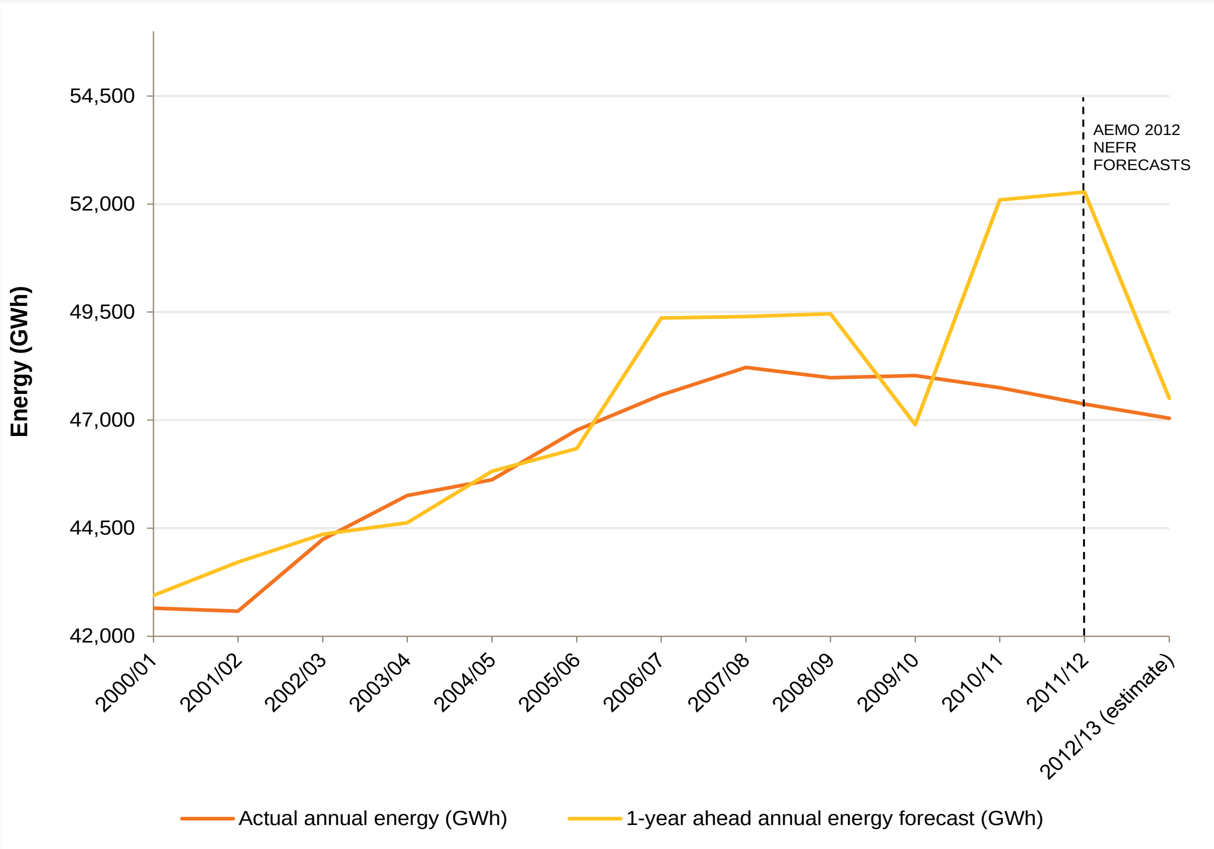
The 2012 NEFR annual energy forecasts for the 2012-13 year are shown to have over-forecast for both annual energy and operational energy, with variances of 1.08% and 1.20% respectively. The key reason for this variance is lower-than-expected residential and commercial consumption.

Table 6-2 presents the one-year-ahead forecasts from 2000-01 to 2012-13 YTD for annual energy.

Table 6-2 — One-year-ahead annual energy forecast variance for Victoria

FYE	1-year ahead annual energy forecast (GWh)	Actual annual energy (GWh)	Variance %	Source
2001/02	43,715	42,583	2.59%	AEMO
2002/03	44,364	44,244	0.27%	AEMO
2003/04	44,626	45,261	-1.42%	AEMO
2004/05	45,820	45,624	0.43%	AEMO
2005/06	46,342	46,768	-0.92%	AEMO
2006/07	49,367	47,584	3.61%	AEMO
2007/08	49,401	48,223	2.38%	AEMO
2008/09	49,459	47,984	2.98%	AEMO
2009/10	46,895	48,033	-2.43%	AEMO
2010/11	52,092	47,754	8.33%	AEMO
2011/12	52,276	47,375	9.38%	AEMO
2012-13 YTD	**43,318**	**42,848**	1.08%	**AEMO**

Figure 6-1 — One-year-ahead annual energy forecast variance for Victoria



6.1.2 Back cast

Table 6-3 presents the dynamic in-sample forecast results from the 2012 and 2013 NEFR models.

Table 6-3 — 2012 NEFR and 2013 NEFR dynamic in-sample annual energy forecasts for Victoria

FYE	Actual annual energy (GWh)	2012 NEFR		2013 NEFR	
		in-sample forecast (GWh)	Variance %	in-sample forecast (GWh)	Variance %
2001/02	42,583	44,311	4.1%	42,732	0.4%
2002/03	44,244	45,350	2.5%	44,280	0.1%
2003/04	45,261	46,618	3.0%	45,504	0.5%
2004/05	45,624	46,978	3.0%	45,695	0.2%
2005/06	46,768	47,932	2.5%	46,626	-0.3%
2006/07	47,584	48,997	3.0%	47,566	0.0%
2007/08	48,223	49,499	2.6%	47,921	-0.6%
2008/09	47,984	49,511	3.2%	47,936	-0.1%
2009/10	48,033	49,487	3.0%	47,825	-0.4%
2010/11	47,754	49,283	3.2%	47,574	-0.4%
2011/12	47,375	49,296	4.1%	47,361	0.0%

The results clearly indicate that the 2013 models produce superior in-sample forecasts. The 2012 NEFR models do not appear to fit the data as well. There is a tendency of the 2012 NEFR models to over forecast when compared against actual outcomes, possibly indicating a biased model.

In comparison, the 2013 NEFR models fit the data very well and the in-sample forecasts do not show any tendency to under- or over forecast indicating that the 2013 NEFR models are well-specified.

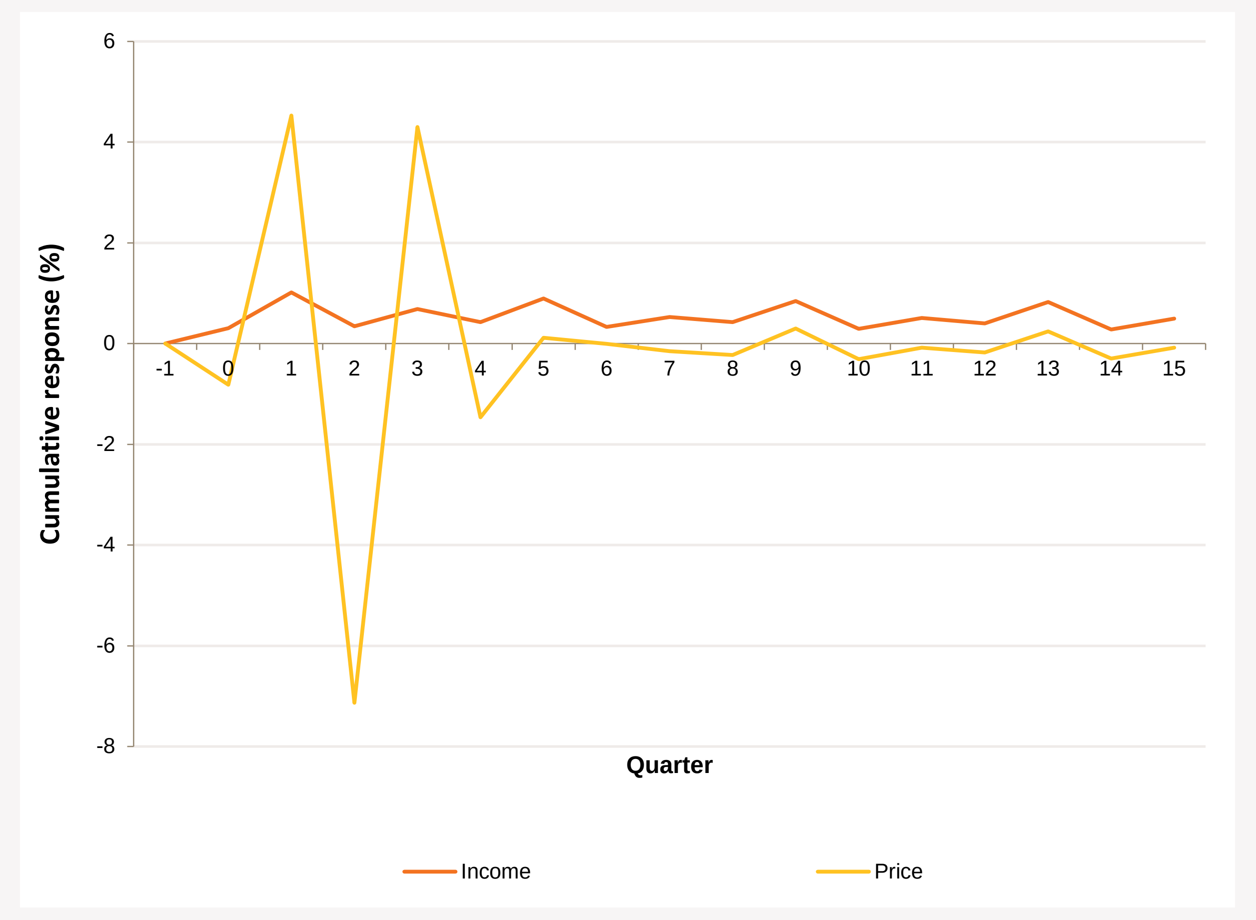
6.1.3 2013 energy model improvements

The following section provides an analysis comparing the stability of the preliminary models and the 2013 NEFR models for Victoria. Scenario analysis has been undertaken to assess the response in energy consumption and demand forecast by comparing the effects of a change in income and electricity prices for Victoria. Note that both models are based on DOLS estimators to obtain long-run estimates. The results highlight the improvements in the 2013 NEFR models and the rationale for rejecting the preliminary models.

Preliminary model

Figure 6-2 shows the response in energy consumption given a 1% increase in income and electricity price.

Figure 6-2 — Impulse response for Victoria annual energy preliminary model



In response to a 1% increase in price, energy consumption oscillates suggesting that the response will be an increase in energy consumption, which is unrealistic. While the response to an increase in income appears intuitive, the quarterly fluctuations do not seem reasonable and are likely to be due to seasonality in the data.

2013 NEFR model

Figure 6-3 shows the response in energy consumption from the 2013 NEFR models given a permanent increase in income and electricity price.

Figure 6-3 — Impulse response for 2013 NEFR Victoria annual energy model

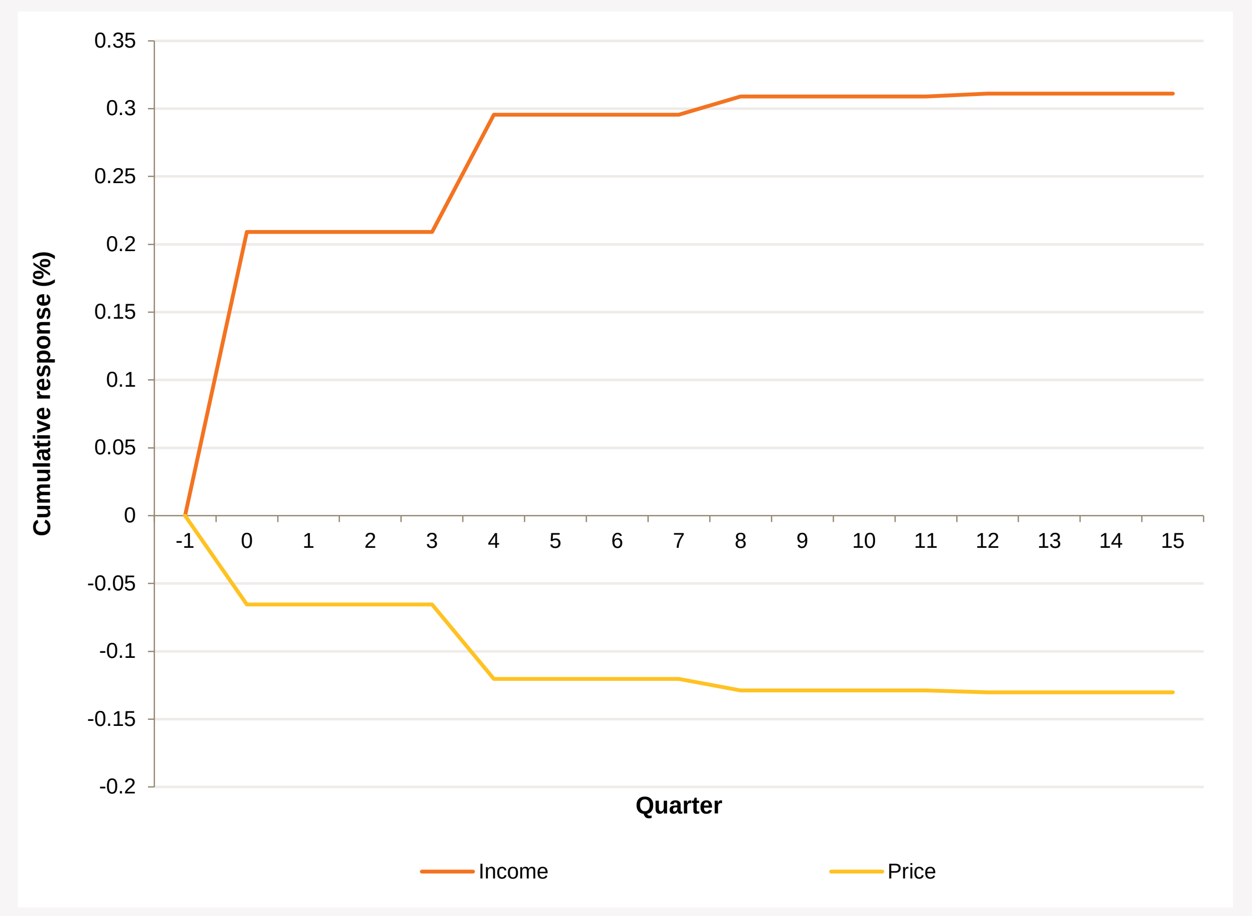
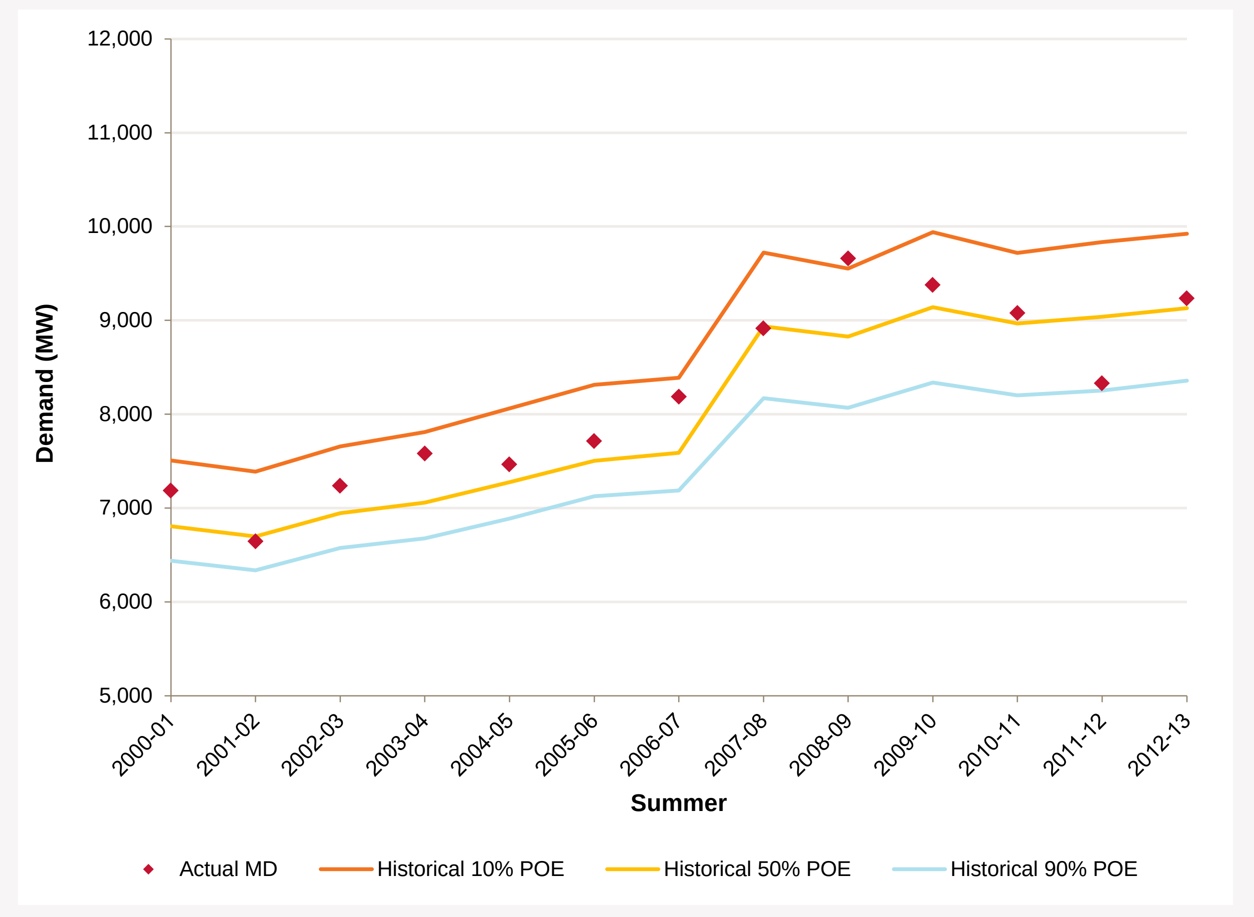


Figure 6-3 shows a much more plausible response in energy consumption. The short-run responses do not fluctuate and gradually move towards a new long-run equilibrium that is consistent with the long-run estimates. This shows that the seasonal problems that affected the preliminary models have been corrected in the 2013 NEFR models which will produce much more stable and plausible forecasts.

6.2 Maximum demand

6.2.1 2013 model assessment

Figure 6-4 — 2013 NEFR Victoria historical POEs for non-industrial component of maximum demand



As figure 6-4 shows, the historical distribution produced by the 2013 maximum demand model for non-industrial demand shows a relatively uniform distribution in relation to the actual maximum demand points, with approximately half of the points below the historical 50% POE and approximately half the points above. The following table summarises these results:

Table 6-4 — Proportion of actual MDs exceeding 2013 NEFR Victoria historical POEs for non-industrial demand

	Historical Points	Percentage
Above 10% POE	1	8%
Above 50% POE	10	77%
Above 90% POE	13	100%

The results suggest that the 50% POE is possibly too low, with 77% of points above the 50% POE line and 100% of points above the 90% POE line. However, these statistics do not necessarily indicate a forecast distribution that is too low, as it is quite plausible to obtain these statistics by chance with a small sample of data even if the forecast distribution is correct. Improvements to this will be considered in future forecast models.

6.2.2 2012-13 summer maximum demand forecast

Table 6-5 — Comparison of 2012-13 10% POE from 2012 NEFR forecast and 2013 NEFR estimate for Victoria

10% POE	Maximum demand	Operational demand
Forecast (MW)	10,624	10,608
Estimate (MW)	10,483	10,464
Variance (MW)	141	144
Variance %	1.33%	1.36%

Contributing to this variance is lower-than-expected large industrial loads.

CHAPTER 8 - IMPROVEMENT AREAS FOR 2014

Subsequent to an independent peer review of all forecasting models by Frontier Economics, the following areas have been flagged for improvement for the 2014 NEFR.

Annual energy

Investigate modelling the demand for energy services (rather than energy demand) and make historical estimations of energy efficiency.

Currently, AEMO's annual energy models try to capture the effects of historical energy efficiency effects through the economic drivers. Additional energy savings for the forecast period (over and above the existing savings) are then applied as a post model adjustment to offset forecast energy consumption.

Although estimating historical energy efficiency savings over the historical data period will pose technical difficulties, AEMO will investigate incorporating energy efficiency in the energy models historically, allowing the economic and temperature variables to drive an 'energy services' model which may be closer to actual consumption patterns and may yield more accurate estimations of elasticises.

Investigate constructing a measure of economic activity that will better explain energy consumption

Currently, AEMO's annual energy models use either State Final Demand or Gross State Product as 'income drivers'. These variables may not capture structural changes occurring in the Australian economy that may affect energy consumption. Additionally, if these income variables are correlated with the price variables used in the models, and these correlations change over time, there is a risk of biasing forecasts.

The construction of a composite economic variable that will be more closely correlated to energy consumption and that is relatively uncorrelated to price will be investigated for the 2014 NEFR. This may alleviate risks of potential forecast bias.

Maximum demand

Investigate alternative specifications of half-hourly demand models

The half-hourly demand models used to produce maximum demand forecasts, attempt to relate demand to temperature. There may be potential improvements in re-fitting these models for times of extreme temperatures. Although there are numerous half-hourly models used in the overall maximum demand forecast model, AEMO together with Monash University will investigate if there is scope for improvement in fitting these 'demand-temperature curves', particularly for extreme weather conditions. This may alleviate any need for modelling adjustments necessary in the models.

Use of temperature correct historical average demand

The half-hourly maximum demand models currently use the average seasonal demand in MW as a base value for each summer/winter. Temperature correcting historical average demand's will provide more accurate base values, allowing the maximum demand models to separate temperature sensitive demands more accurately and potentially estimate the demand-temperature relationships more accurately.

Undertake an in-depth review of methodology used to make peak price elasticity adjustments

Maximum demand forecasts utilise different price elasticities, or responses to price increase, than the annual energy forecasts. Currently these elasticities require a more rigorous examination in determining more accurately what price elasticity is likely to be at maximum demand and at different conditions. AEMO will work with Monash University to review this methodology.

Develop whole-year annual maximum demand forecasts, in addition to seasonal maximum demand forecasts

Currently maximum demand forecasts are provided for either summer or winter, however it may be beneficial to provide annual maximum demand distributional forecasts, particularly for regions such as NSW, where the summer and winter maximum demand forecast distributions can overlap, or where the region can be either summer or winter peaking

CHAPTER 7 - TASMANIA

This section provides an assessment of the forecast accuracy for Tasmania annual energy and maximum demand forecasts.

Key improvements to the energy model are discussed.

A financial year-to-date (YTD) assessment of the one-year-ahead forecast from the 2012 NEFR is examined. Some under forecasting for the 2012-13 year is observed, with the majority of variance caused by higher-than-expected residential and commercial consumption.

The forecast 2012-13 winter maximum demand shows some over-forecasting due to lower-than-expected commercial and residential, and large industrial loads.

7.1 Annual energy

7.1.1 Annual energy forecast

Table 7-1 — 2012 NEFR forecast of Tasmania annual energy for 2012-13

	YTD Annual Energy (sent out)	YTD Operational Energy
Forecast (GWh)	9,536	9,334
Actual (GWh)	9,601	9,295
Variance (GWh)	-65	39
Variance (%)	-0.68%	0.42%

2012 NEFR annual energy forecasts for the 2012-13 year are shown to have slightly under-forecast for annual energy and slightly over-forecast for operational energy, with variances of -0.68% and 0.42%, respectively. Key reasons for this variance are:

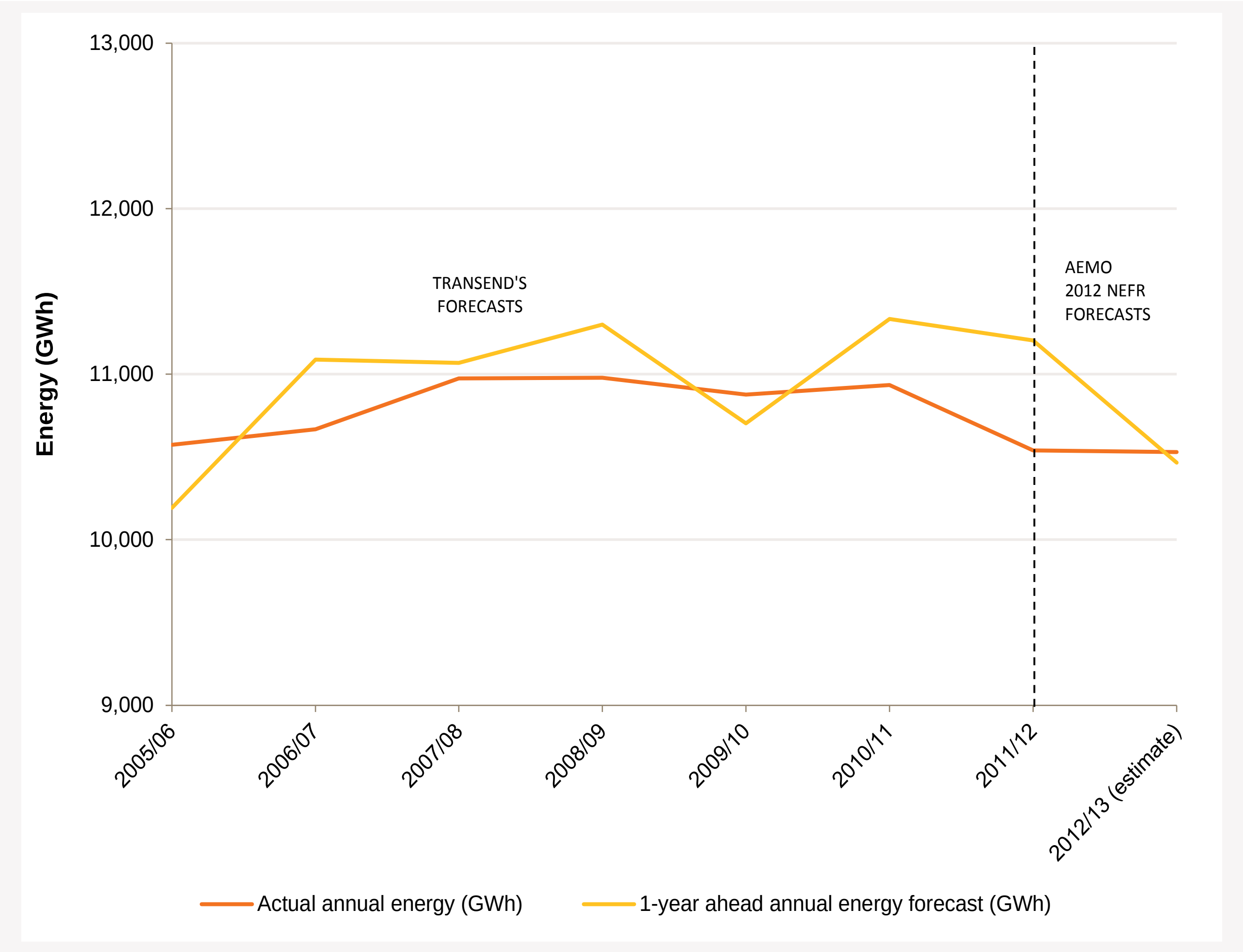
- Higher-than-expected residential and commercial consumption, causing under-forecasting of annual energy.
- Higher-than-expected small non-scheduled generation, causing over-forecasting of operational energy, contributing to lower-than-expected operational energy.

Table 7-2 presents the one-year-ahead forecasts from 2005-06 to 2012-13 YTD for annual energy.

Table 7-2 — One year ahead annual energy forecast for Tasmania

FYE	1-year ahead annual energy forecast (GWh)	Actual annual energy (GWh)	Variance %	Source
2005/06	10,193	10,574	-3.74%	Transend
2006/07	11,088	10,667	3.80%	Transend
2007/08	11,069	10,974	0.86%	Transend
2008/09	11,300	10,979	2.84%	Transend
2009/10	10,704	10,877	-1.62%	Transend
2010/11	11,334	10,934	3.53%	Transend
2011/12	11,204	10,540	5.93%	Transend
2012-13 YTD	**9,536**	**9,601**	**-0.68%**	**AEMO**

Figure 7-1 — One-year-ahead annual energy forecast variance for Tasmania



7.1.2 Back cast

Table 7-3 presents the dynamic in-sample forecast results from the 2012 and 2013 NEFR models.

Table 7-3 — 2012 NEFR and 2013 NEFR dynamic in-sample annual energy forecasts for Tasmania

	Actual annual energy (GWh)	2012 NEFR in-sample forecast (GWh)	Variance %	2013 NEFR in-sample forecast (GWh)	Variance %
2005/06	10,574	10,541	-0.3%	10,535	-0.4%
2006/07	10,667	10,700	0.3%	10,668	0.0%
2007/08	10,974	10,818	-1.4%	10,829	-1.3%
2008/09	10,979	10,889	-0.8%	10,886	-0.8%
2009/10	10,877	10,867	-0.1%	10,867	-0.1%
2010/11	10,934	11,175	2.2%	11,113	1.6%
2011/12	10,540	10,472	-0.6%	10,514	-0.2%

Comparison of the 2012 and 2013 NEFR show that both models fit the data relatively well. The in-sample forecasts from both models tracked the actuals relatively well and the two models produced comparable in-sample forecasts in terms of accuracy. Overall, the 2013 NEFR models appear to produce better in-sample forecasts.

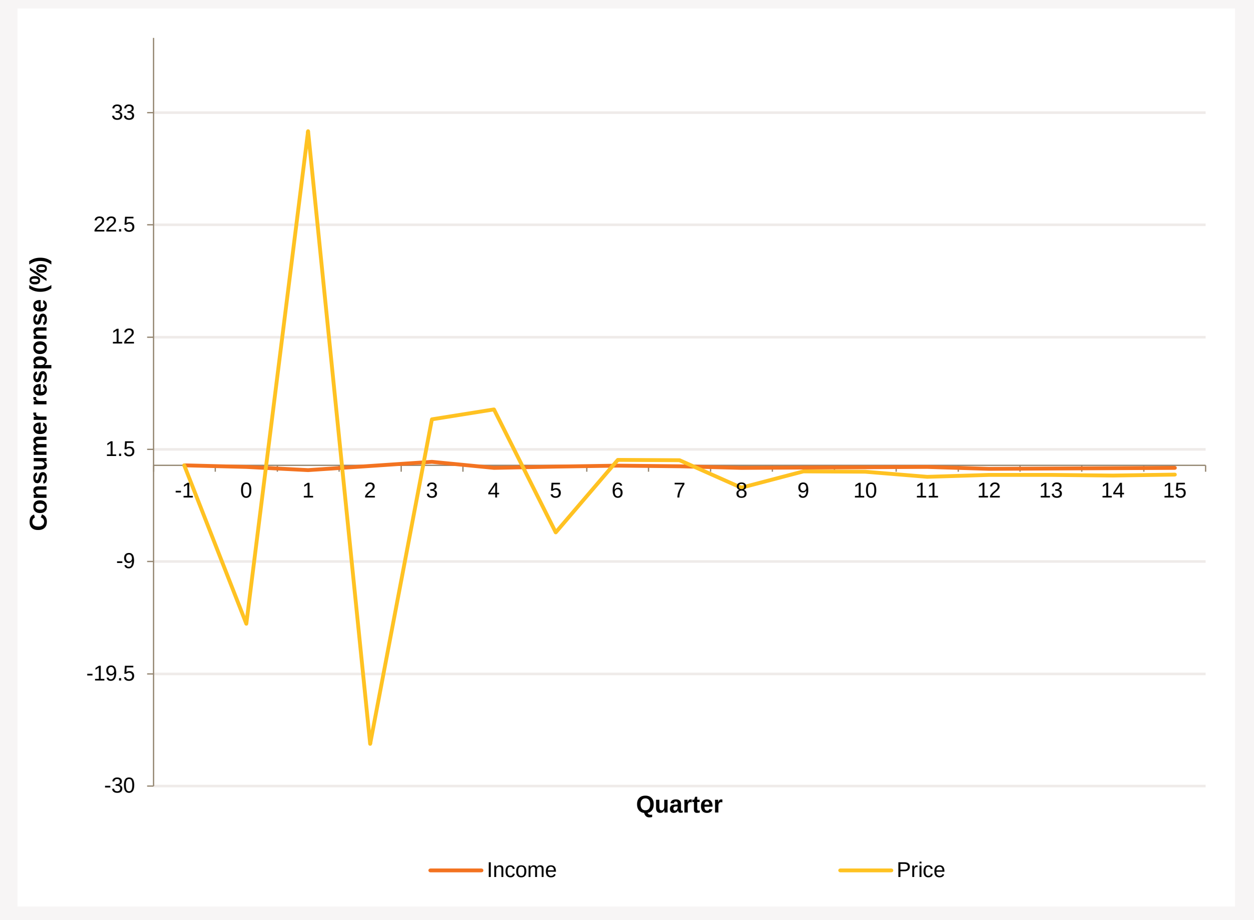
7.1.3 2013 energy model improvements

The following section provides an analysis comparing the stability of the preliminary models and the 2013 NEFR models for Tasmania. Scenario analysis has been undertaken to assess the response in energy consumption and demand forecast by comparing the effects of a change in income and electricity prices for Tasmania. Note that both models are based on DOLS estimators to obtain long-run estimates. The results highlight the improvements in the 2013 NEFR models and the rational for rejecting the preliminary models.

Preliminary models

Figure 7-2 shows the response in energy consumption for a 1% change in income and electricity prices from the preliminary models.

Figure 7-2 — Impulse response for Tasmania annual energy preliminary model

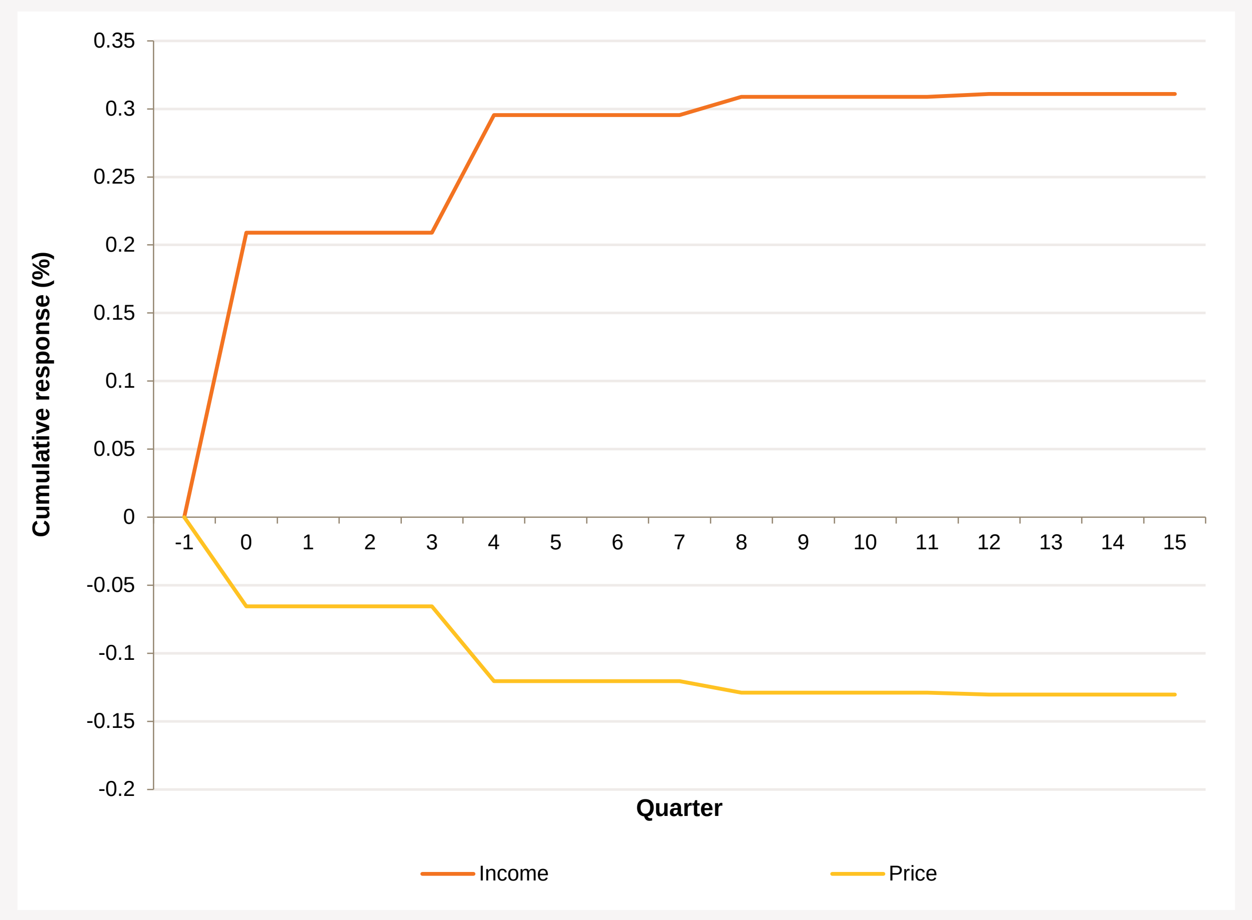


Like all other regions, response in energy consumption oscillates from negative to positive given an increase in prices, which does not seem plausible. The response in energy consumption to income changes highlight a significant problem with this model, as the model predicts income to have very little effect on energy consumption compared to changes in electricity prices. Importantly, quarterly fluctuations suggest that seasonality is dominating the response of energy consumption rather than changes to income and price.

2013 NEFR models

Figure 7-3 shows the consumption response to a one-off 1% permanent increase in income and prices from the 2013 NEFR models.

Figure 7-3 — Impulse response for 2013 NEFR Tasmania annual energy model

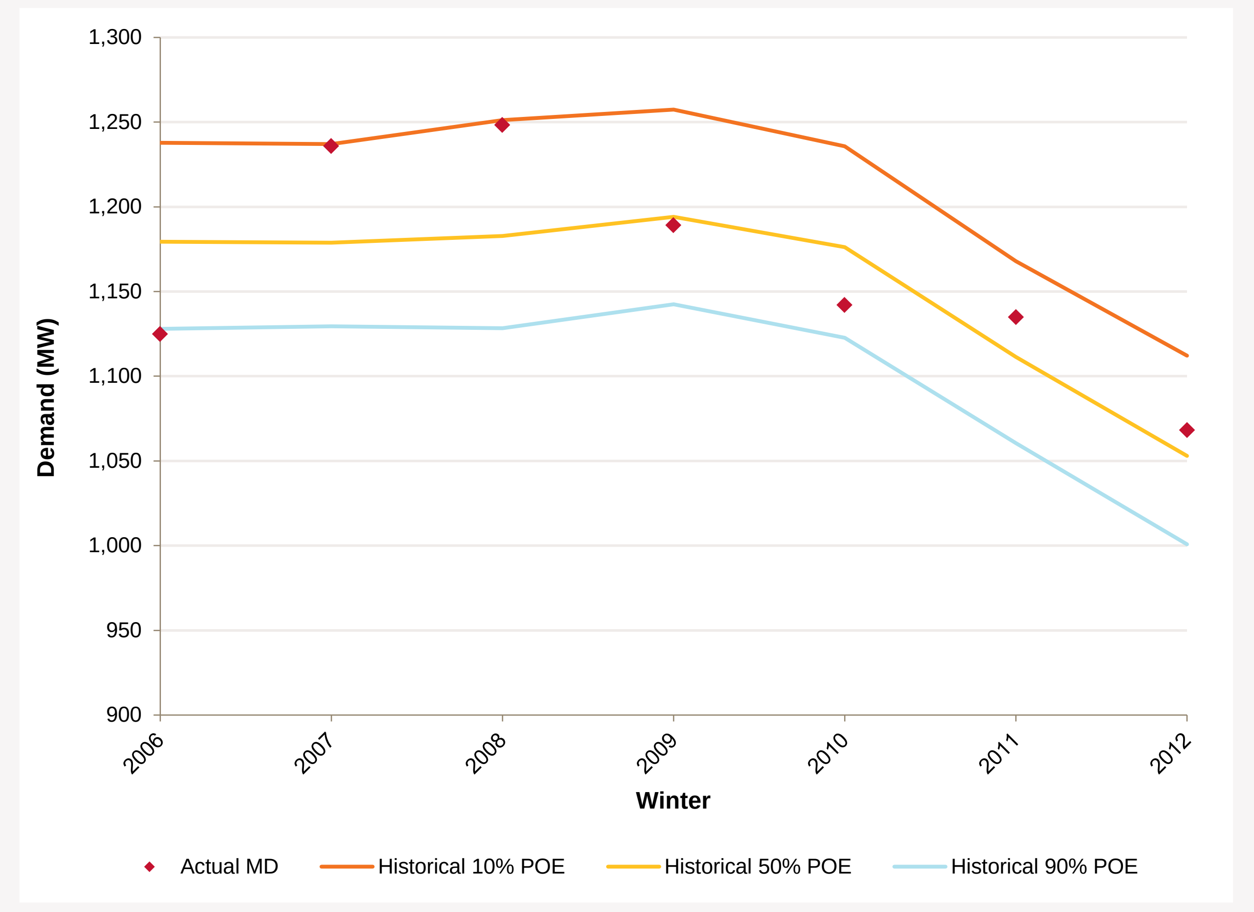


The graph shows that, given a change to income or price, the response in energy consumption will gradually move to a new long-run equilibrium if there are no further changes. Most importantly the results do not exhibit oscillating energy consumption as suggested in the preliminary models. This shows that the seasonal problems that affected the preliminary models have been corrected in the 2013 NEFR models which will produce much more stable and plausible forecasts.

7.2 Maximum demand

7.2.1 2013 model assessment

Figure 7-4 — 2013 NEFR Tasmania historical POEs for non-industrial component of maximum demand



As figure 7-4 above shows, the historical distribution produced by the 2013 maximum demand model for non-industrial demand shows a relatively uniform distribution in relation to the actual maximum demand points. Table 7-4 below shows these results:

Table 7-4 — Proportion of actual MDs exceeding 2013 NEFR Tasmania historical POEs for non-industrial demand

	Historical Points	Percentage
Above 10% POE	0	0%
Above 50% POE	4	57%
Above 90% POE	6	86%

7.2.2 2012 winter maximum demand forecast

Comparing the estimated 10% POE maximum demand from the 2013 NEFR maximum demand model against the 10% POE forecast from the 2012 NEFR for the 2012 winter, forecast accuracy for maximum demand and operational demand are shown below:

Table 7-5 — Comparison of 2012 10% POE from 2012 NEFR forecast and 2013 NEFR estimate for Tasmania

10% POE	Maximum Demand	Operational Demand
Forecast (MW)	1,822	1,732
Estimate (MW)	1,731	1,646
Variance (MW)	91	86
Variance %	4.99%	4.98%

Contributing to this variance are the following:

- Lower-than-expected large industrial loads.
- Lower-than-expected residential and commercial loads.

CHAPTER 9 - SUMMARY

Overall, year-to-date annual energy variances from the 2012 NEFR forecasts were relatively small, with the exception of Queensland. The variances were shown to be mainly caused by overforecasting of the residential and commercial consumption in Queensland, New South Wales and Victoria.

Some significant improvements have been demonstrated in the 2013 NEFR annual energy models.

Examination of historical maximum demand POE distributions showed generally acceptable results; however, some improvements to the Victorian model have been identified for the 2014 NEFR.

The 10% POE maximum demand forecast accuracy has shown relatively small variances with the exception of Tasmania. Again, variances are mainly caused by overforecasting of the residential and commercial sector demand.

Some key areas of improvement have been flagged for the 2014 NEFR models, including different treatment of energy efficiency in modelling, constructing better economic variables more suited to forecasting energy consumption, enhancing the maximum demand models in regards to fitting for extreme temperatures, using temperature correction, and undertaking an in-depth review of maximum demand price elasticity and developing ‘whole-year’ annual maximum demand forecasts.

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