AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

Level 22
530 Collins Street
Melbourne VIC 3000

Postal Address:
GPO Box 2008
Melbourne VIC 3001

T 1300 858724
F 03 9609 8080

19 December 2012

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

Dear Mr Henderson,

2012 Electricity Demand Forecasting Accuracy Report

As required by Clause 3.13.3 (u) of the National Electricity Rules, I am pleased to provide the enclosed report, 2012 Electricity Demand Forecasting Accuracy, to the Reliability Panel.

For the purposes of this report, AEMO has focused its review to encompass a back-assessment and forecast POE comparisons to assess the forecasts for the 2011 ESOO and previous statement of opportunities reports only, which for most regions is based on the forecasts provided by TNSPs.

Based on the Reliability Panel's Comments (received in relation to the original version of the report provided on 1 November 2012), other key changes include:

- Provision of weather corrected historic maximum demand (50% POE) for meaningful comparison to forecasts.
- Clear delineation between previous Electricity Statement of Opportunity (ESOO) forecasts and 2012 National Electricity Forecasting Report (NEFR) forecasts.
- Commentary addressing why forecasts may have diverged from actual outcomes.
- Summery of AEMO's proposed improvements to the forecast models for the 2013 NEFR.

In its 2012 National Electricity Forecast Report (NEFR), AEMO published energy and maximum demand forecasts for all regions. As part of the 2013 NEFR, AEMO will assess its energy and maximum demand models, and report on the results of the back-assessment and POE comparisons. This will allow AEMO to identify and implement model improvements for the 2013 NEFR.

AEMO has also developed, and tested with industry, its plans for improving and aligning regional and connection point demand forecasts. We would be pleased to present this to the Reliability Panel.

Please contact Margarida Pimentel, Senior Manager Energy Forecasting, on 03 9609 8370 or margarida.pimentel@aemo.com.au for any questions relating to the attached report or if you would like a presentation on AEMO's energy forecasting plan.

Yours sincerely

Joe Spurio
Group Manager Network Development

Attachment: 2012 Electricity Demand Forecast Accuracy

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2012 ELECTRICITY FORECAST DEMAND ACCURACY

PREPARED BY: Operations

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FINAL

Contents

Executive summary

This report assesses the forecasts for the 2011 Electricity Statement of Opportunities (ESOO) and previous statement of opportunities reports.

It encompasses a back-assessment of the previous years' forecasts (for the years 2000-01 to 2010-12), comparing them against actual energy and maximum demand values to identify previous model errors and variations relating to economic outcomes, standard weather assumptions and post-model assumptions. All forecasts have been compared using the base (or planning) scenario.

This back-assessment demonstrates that the energy forecasts provided for the statement of opportunities reports:

- Are higher than actual outcomes, particularly in later years, in Queensland, New South Wales and South Australia.
- Anticipate a rebound in energy consumption in New South Whales, Victoria and Tasmania that did not occur.

It also demonstrates that the maximum demand forecasts provided for the statement of opportunities reports:

- Are higher than actual outcomes, particularly in later years, in Queensland and Tasmania.
- Remain relatively accurate in New South Wales, except for the 2011-12 year.
- Are relatively accurate in Victoria, although a downturn in actual demand from 2008-09 causes a divergence between forecast and actual demands which increases until 2011-12.
- Did not anticipate a sharp downturn in South Australian demand from 2010-11.

Causes for lower than forecast actual demands include:

- Structural changes occurring in the Australian economy, such as a slower than expected economic recovery from the global financial crisis and the contraction of the manufacturing sector, in part due to the high Australian dollar.
- Consumers' changing demand patterns, reflecting their response to electricity price increases.
- Significant uptake in rooftop photovoltaic (PV) systems, with homes supplementing their power needs with their own systems, reducing the demand seen in the National Electricity Market (NEM).

In addition, the accuracy of energy and maximum demand forecasts will also be dependent on external factors, including economic forecasts. For example, economic forecasts used in recent years have shown some divergence from actual outcomes, reflecting significant uncertainty in years following the Global Financial Crisis and this has affected the accuracy of energy and maximum demand forecasts.

In June 2012, AEMO developed independent energy and maximum demand forecasts for all NEM regions on a consistent basis for its 2012 National Electricity Forecasting Report (NEFR). AEMO engaged industry as part of this process in building market knowledge and collecting key data for all NEM regions.

AEMO will assess its energy and maximum demand models (as developed for the 2012 NEFR) and report on the results as part of its 2013 NEFR. This will provide relevant information regarding opportunities for improvement of the models, and enable AEMO to implement any material improvements to the forecast models.

1 Assessing the forecasts

NEM annual energy and maximum demand forecasts are reviewed to validate previous forecasts and/or identify any inaccuracies.

Previous reviews have included:

1. Back-assessment (energy); comparing previous forecasts and actual values on a one- and two-year-ahead basis to identify previous model errors and assumptions.
2. Forecast POE comparisons (maximum demand); comparing the 10%, 50% and 90% POE maximum demand forecasts for each year against the actual maximum demands and estimates of actual 50% POE.
3. Backcasts; used to test the demand forecasting model using a period of historical data that was not used in the original development of the model. The model is re-run assuming actual historical economic and weather conditions.

For the purposes of this report, AEMO has focused its review to encompass a back-assessment and forecast POE comparisons to assess the forecasts for the 2011 ESOO and previous statement of opportunities reports only, which for most regions is based on the forecasts provided by TNSPs.

For the first time, in its 2012 NEFR, AEMO developed independent energy and maximum demand forecasts for all NEM regions on a consistent basis. AEMO believes that an assessment of these energy and maximum demand models used for the 2012 NEFR would most usefully inform the improvement of future forecasts.

Rather than request the TNSPs to assess their individual models used for the 2011 ESOO, AEMO will assess its energy and maximum demand models and report on the results of the back-assessment and POE comparisons as part of its 2013 NEFR.

Annual Energy Forecasts

Annual energy forecasts are aimed at predicting energy consumption in Gigawatt Hours (GWh), on a sent out basis, by financial year. These forecasts are typically derived from econometric models, using drivers such as economic growth and electricity prices. These are point forecasts; that is, there is one estimate for each financial year.

Maximum Demand Forecasts

Maximum demand forecasts are aimed at predicting maximum demand in Megawatts (MW), on an as generated basis, by peaking season (summer/winter). AEMO's maximum demand forecasts are prepared using a probabilistic framework.

The Probability of Exceedence (POE) for maximum demand is the probability that a given maximum demand will be exceeded in a particular year. For example, a:

- 50% POE represents a maximum demand level that has a 50% chance that actual maximum demand will be above this level. This can be described as a one in-two year event.
- 10% POE represents a maximum demand level that has a 10% chance that maximum demand will be above this level in a given year. This can be described as a one in-ten year event.

Historically, we would expect that the actual maximum demands centre around the 50% POE level, with approximately one in ten being above 10% POE and approximately nine in ten being above 90% POE.

In the following sections, AEMO has estimated the 50% POE demand for previous years. The actual maximum demands should lie centred around this line. AEMO has developed historical estimates of 50% POE from its maximum demand forecasting model. AEMO's maximum demand model is based on simulating thousands of historical temperatures through a demand model and using the 50th percentile of the resulting probability distribution as the 50% POE[1].

Please note that the percentage POE estimates of actual maximum demands for historical maximum demands have previously been provided by the relevant TNSPs (except for Victoria and South Australia) and these were not assessed by AEMO in 2012.

[1] For more information on AEMO's maximum demand forecast model, see the 2012 Forecasting Methodology Information paper: http://www.aemo.com.au/Electricity/Planning/Forecasting/~/media/Files/Other/forecasting/Forecasting_Methodology_Information_Paper_v2.ashx

2 Review of the forecast accuracy by region

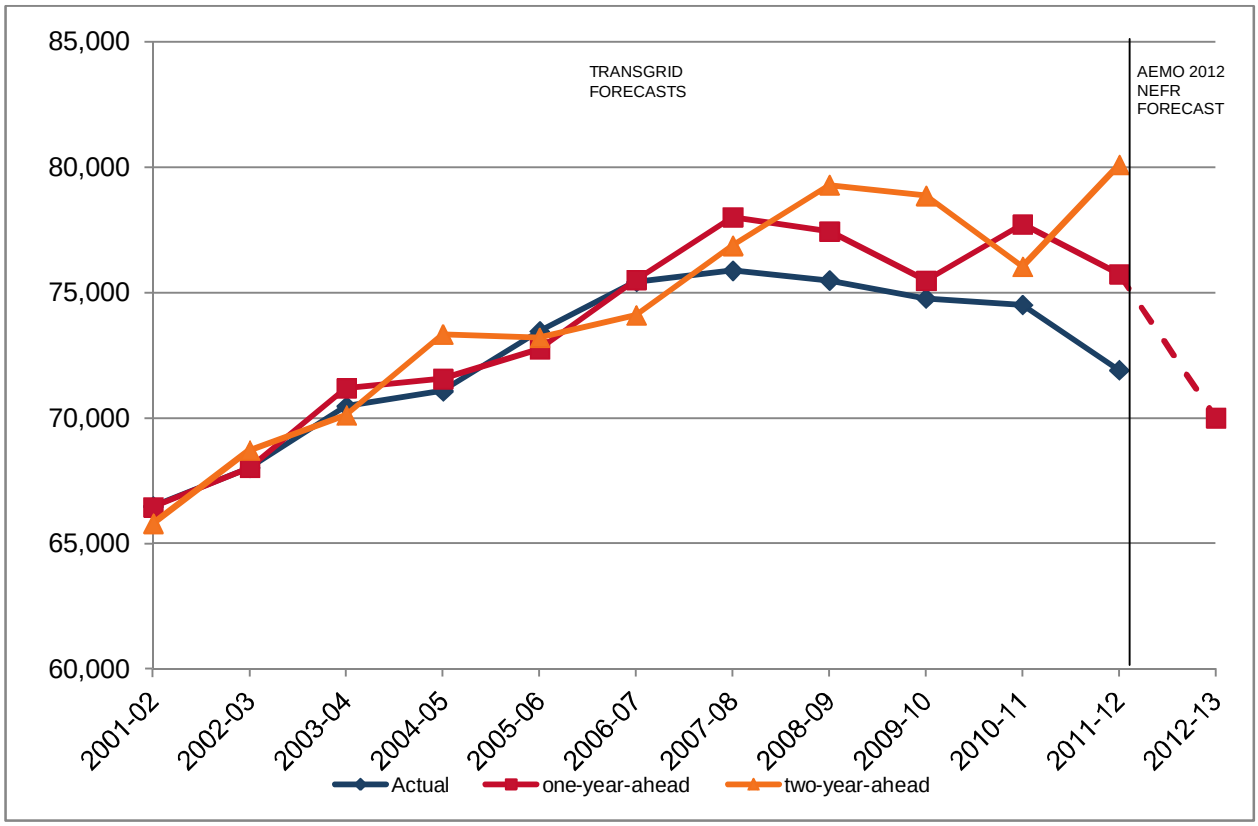
2.1 New South Wales (including the Australian Capital Territory)

Previous one- and two-year-ahead forecasts, compared with actual outcomes, have been relatively accurate, if slightly higher than actual outcomes. For example:

- The TransGrid energy forecast for 2011-12 published in the 2011 ESOO was 75,735 GWh; whereas the actual outcome was 71,911 GWh, a difference of 3,824 GWh or 5.3%.
- The TransGrid 90% POE maximum demand forecast for summer 2011-12 published in the 2011 ESOO was 13,827 MW; whereas the actual outcome was 12,141 MW, resulting in a difference between the actual and forecast 90% POE of 1,686 MW or 13.9%.

These results are shown in Figure 1, Figure 2 and Figure 3.

Figure 1 New South Wales one- and two-year-ahead energy forecasts



Generally, both one- and two-year-ahead energy forecasts track actual energy consumed closely until the 2007-08 year, where forecasts tend to be higher than actual outcomes after this time. Until 2007-08 actual energy growth is positive. Post 2007-08, actual annual energy declines, with a significant reduction in the 2011-12 year.

The decline in actual energy may be attributed to subdued economic growth from 2008-09 onwards and particularly steep electricity price increases in 2009-10 and 2011-12. Additionally, a slowdown in large industrial demand from the 2007-08 year onwards and significant uptake in PV in recent years could also have contributed to the decline in actual energy.

It should be noted that forecasts were revised down in the 2007-08 year (2008-09 one-year-ahead and 2009-10 two-year-ahead forecast) to adjust for the changes occurring in demand.

In the 2011-12 year, a combination of significant reductions in industrial demand (including the scale-back of the Kurri Kurri aluminium smelter), significant uptake in PV and slower than expected economic growth may have resulted in a sharp decline in actual energy.

Figure 2 New South Wales one-year-ahead summer maximum demand forecasts

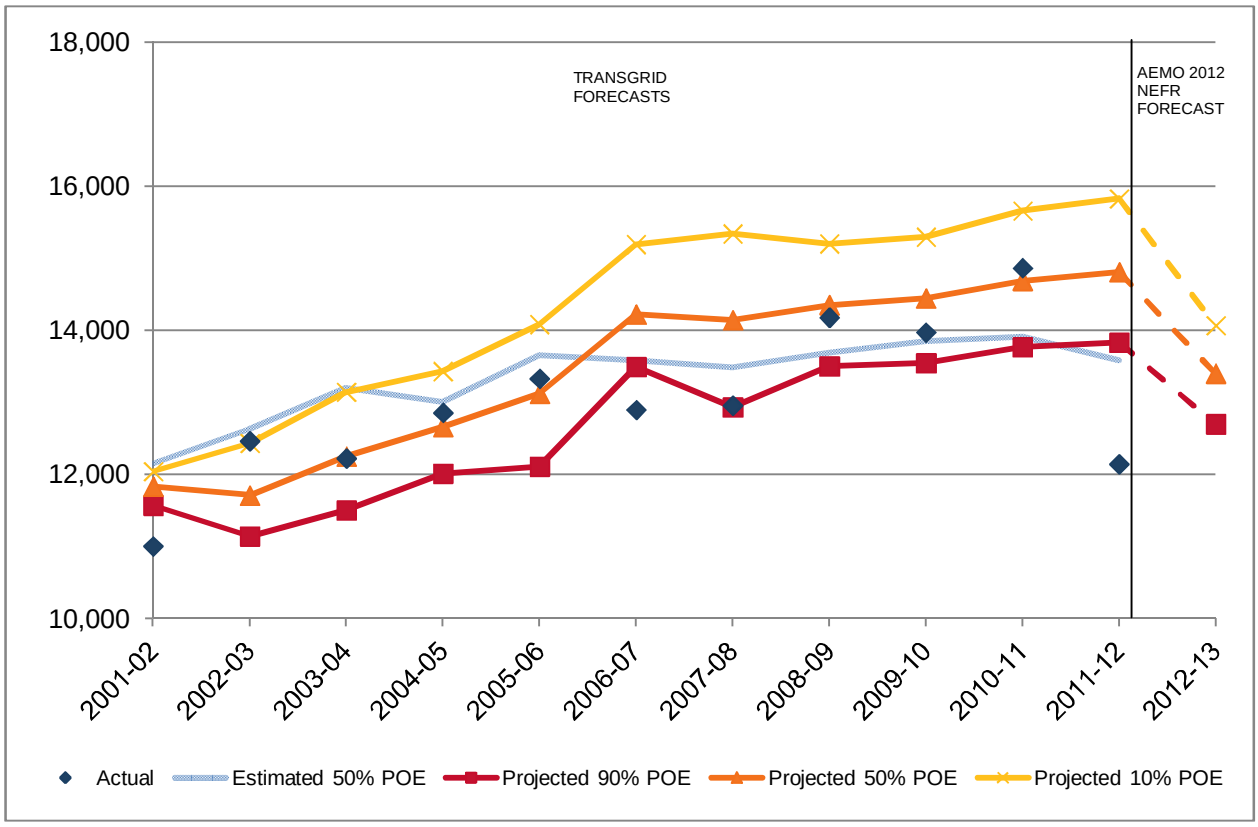
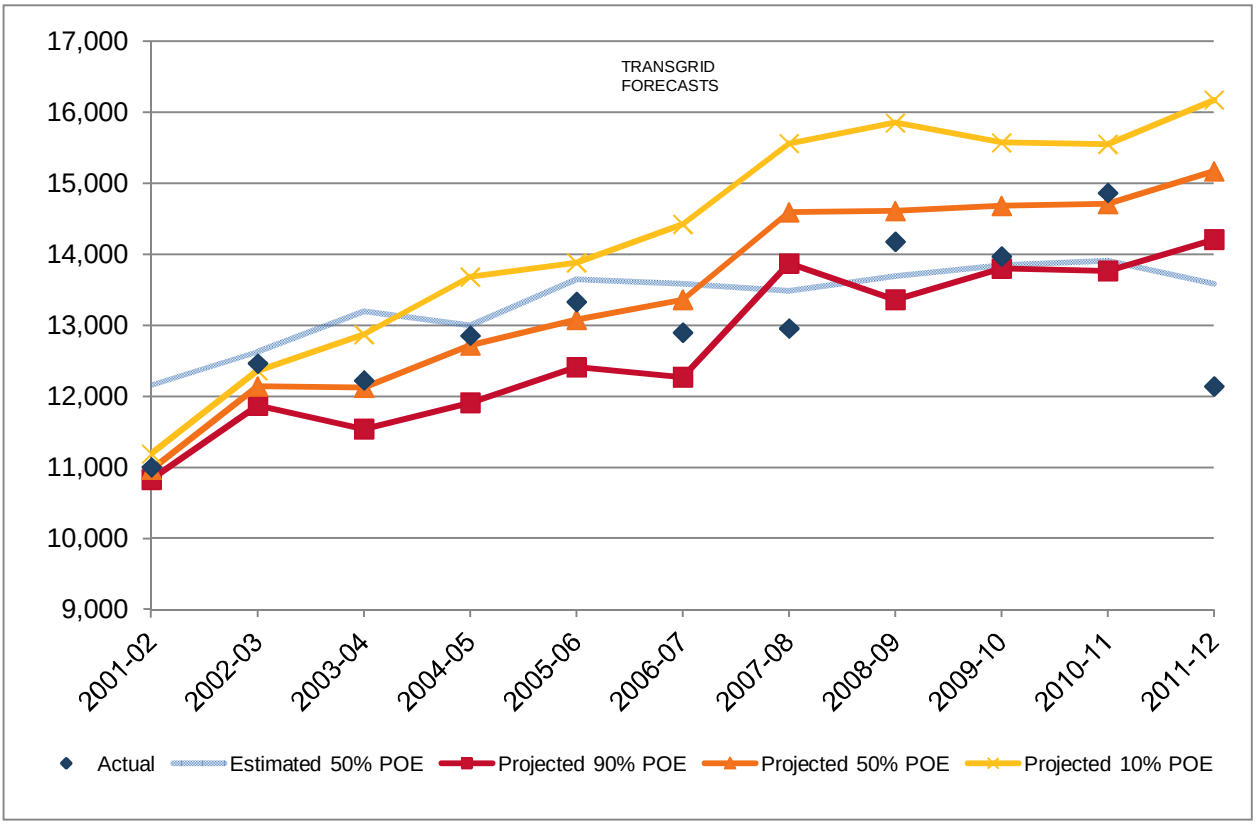


Figure 3 New South Wales two-year-ahead summer maximum demand forecasts



The one- and two-year-ahead maximum demand forecasts follow a similar pattern to the energy forecasts, with forecasts generally close to actual outcomes until the 2007-08 summer.

AEMO's 2012 NEFR forecasts are lower for the 2012-13 year and significantly lower for the energy forecast.

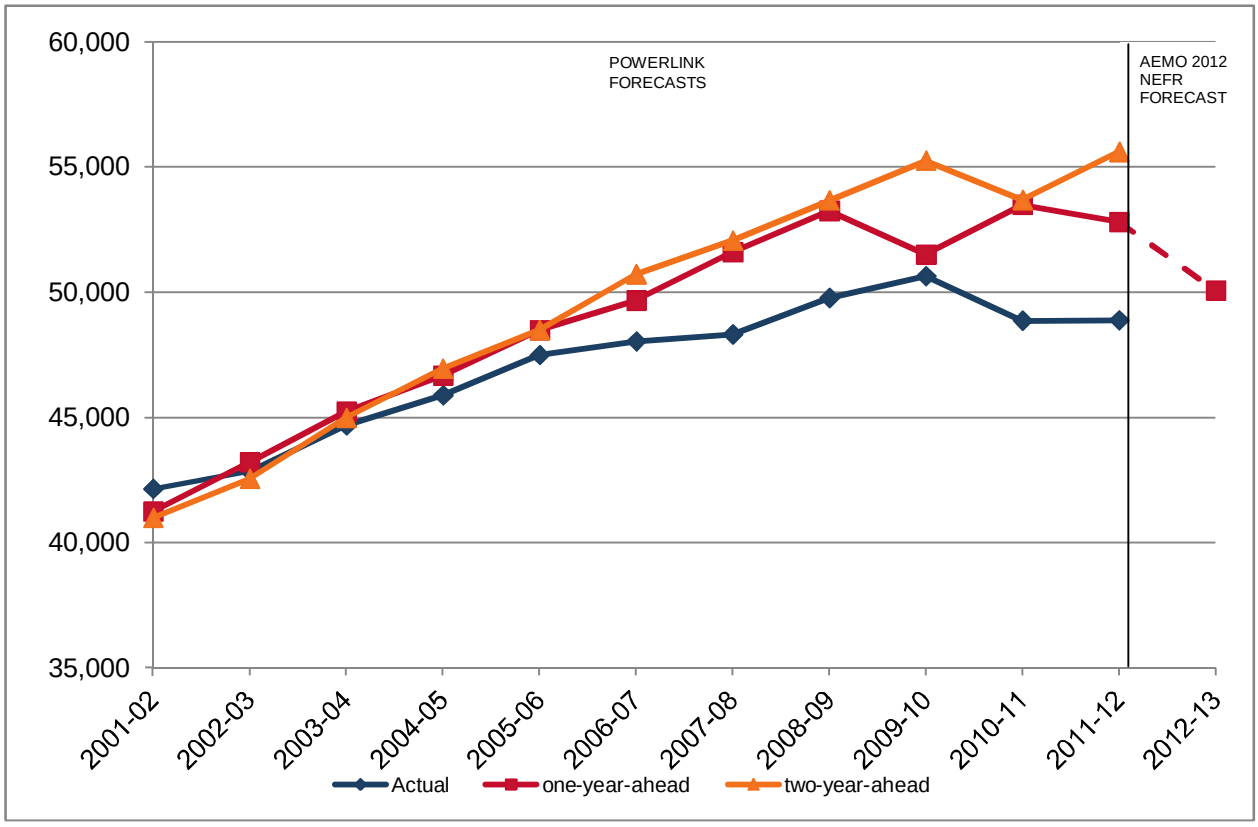
2.2 Queensland

Previous one- and two-year-ahead forecasts, compared with actual outcomes, reveal over-forecasting of summer maximum demand over several years. Looking at last year's forecasts:

- The Powelink energy forecast for 2011-12 published in the 2011 ESOO was 52,802 GWh; whereas the actual outcome was 48,880 GWh, a difference of 3,922 GWh or 8.0%.
- The Powerlink 50% POE maximum demand forecast for summer 2011-12 published in the 2011 ESOO was 10,103 MW; whereas the actual outcome was 8,806 MW, a difference of 1,297 MW or 14.7%.

These results are shown in Figure 4, Figure 5 and Figure 6.

Figure 4 Queensland one- and two-year-ahead energy forecasts



Generally, both one- and two-year-ahead energy forecasts exceed actual energy consumed and this becomes apparent from 2005-06 onwards. This is may be a result of aggressive electricity price increases from 2007-08 as well as particularly low economic growth from the 2008-09 year onward. Significant uptake in PV could also have contributed to lower actual energy consumption. The downward revision for the 2009-10 forecast (one-year-ahead) may have been concurrent with the global financial crisis, with significant uncertainty surrounding economic growth at that time.

Figure 5 Queensland one-year-ahead summer maximum demand forecasts

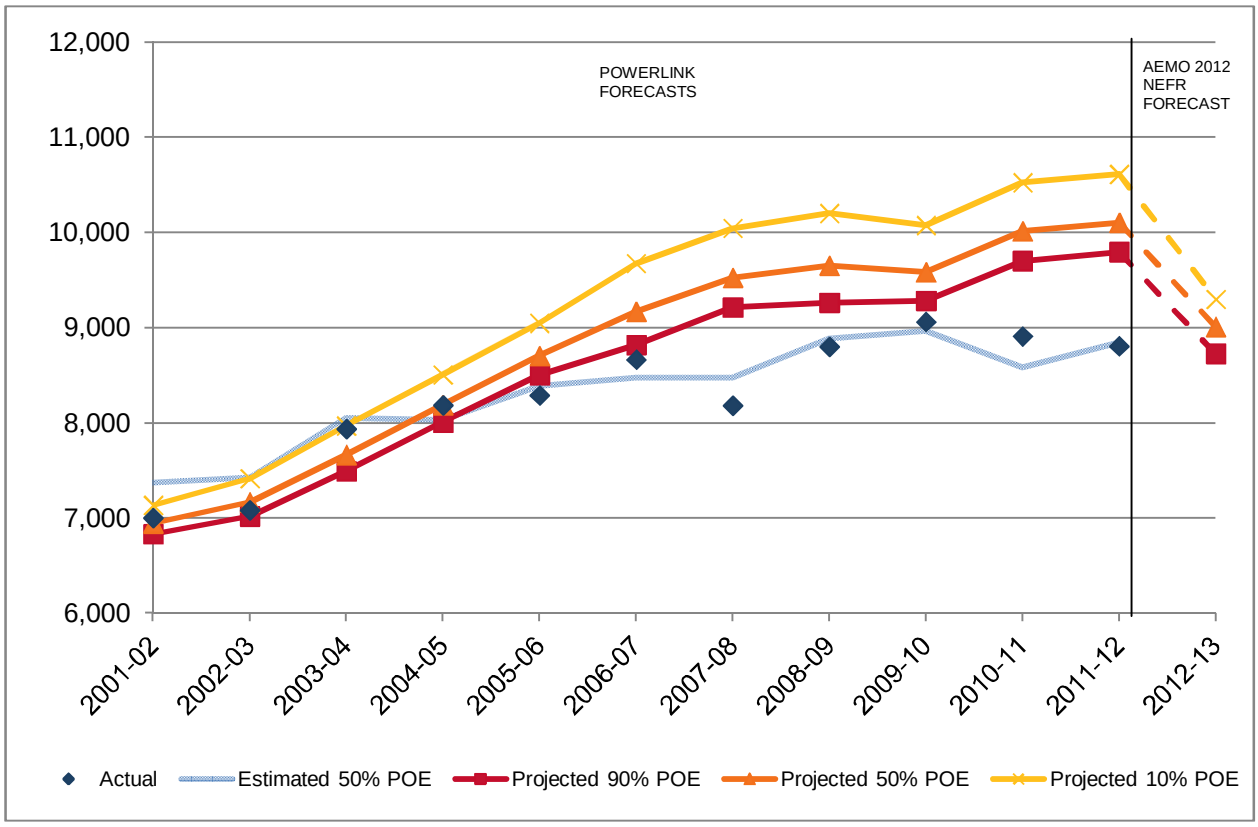
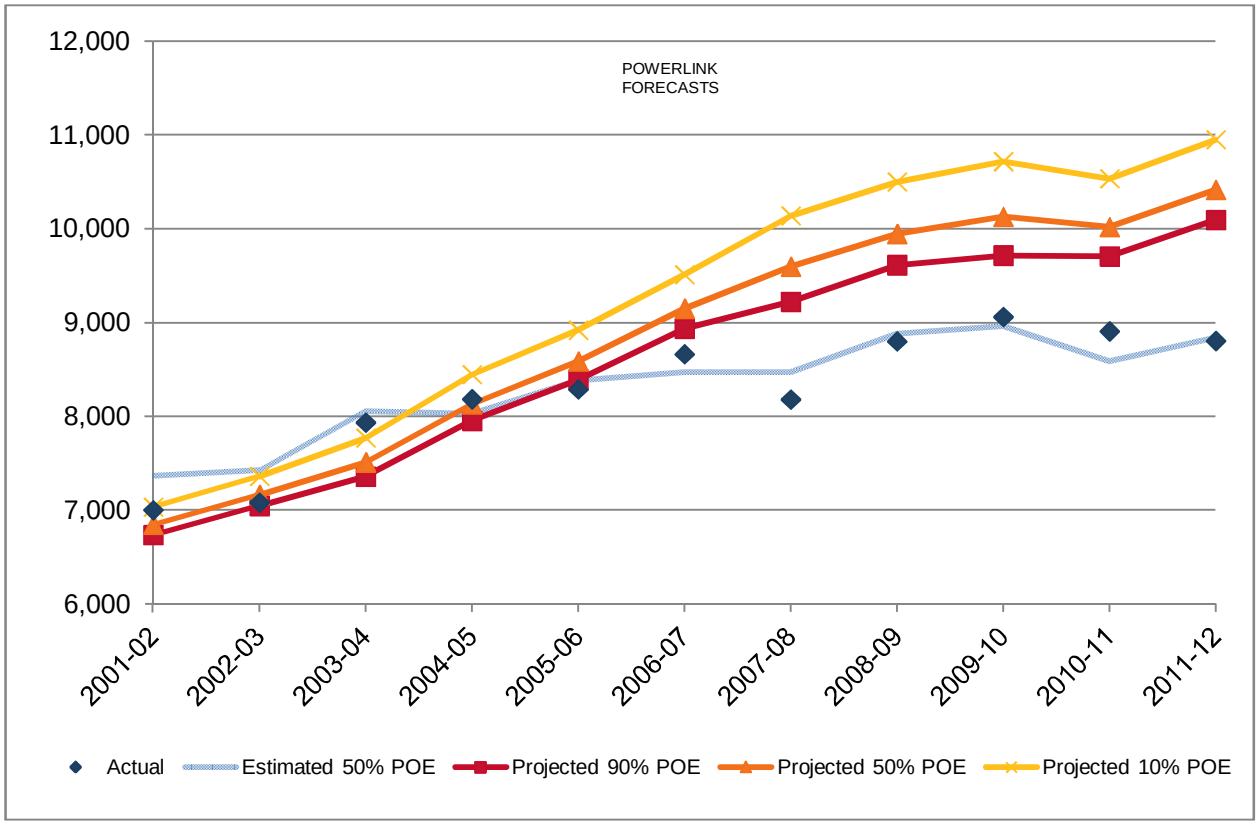


Figure 6 Queensland two-year-ahead summer maximum demand forecasts



The one- and two-year-ahead maximum demand forecasts follow a similar pattern to the energy forecast, with forecasts sitting well above actual maximum demand from the 2005-06 summer onwards and a pattern of increasing divergence over time.

AEMO's 2012 NEFR forecasts shown above are significantly lower for the 2012-13 year.

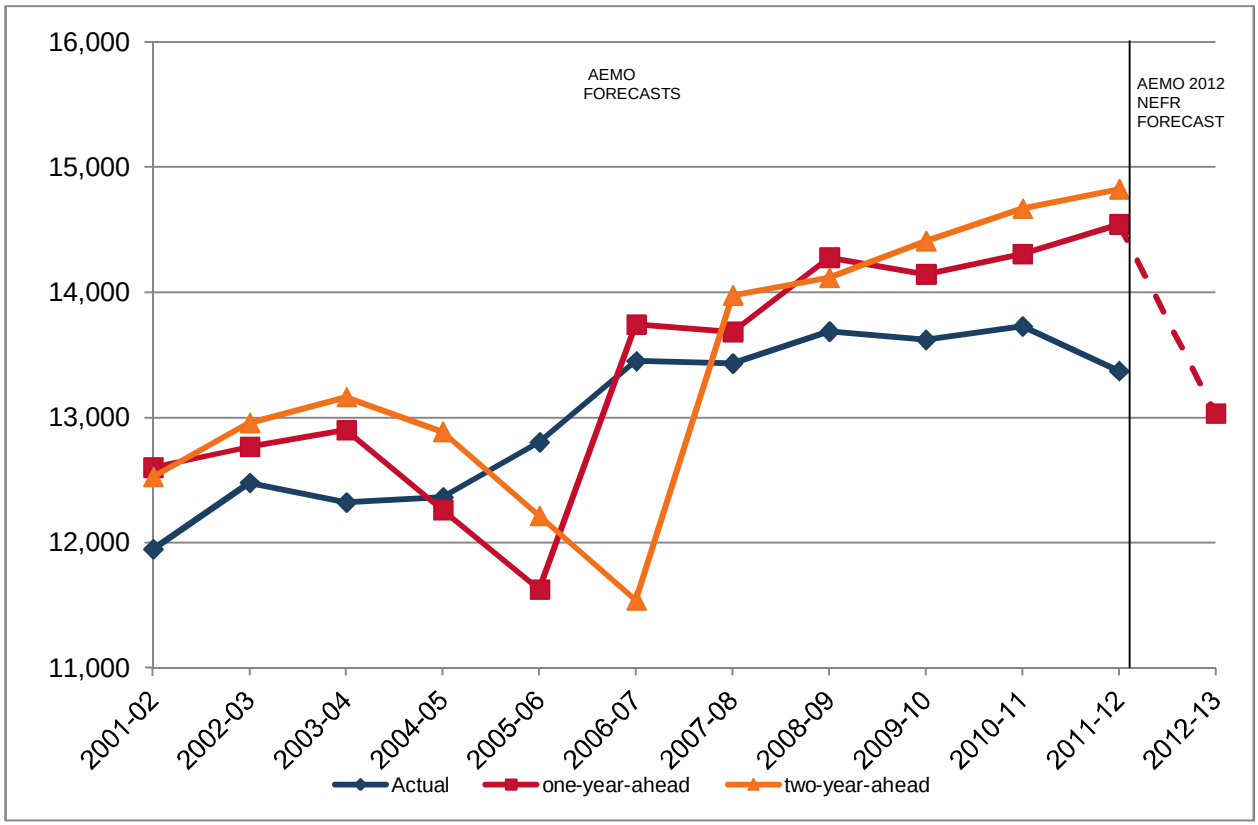
2.3 South Australia

Previous one- and two-year-ahead forecasts, compared with actual outcomes, reveal general over-forecasting in energy and a tendency to over forecast in maximum demand. For example:

- The AEMO energy forecast for 2011-12 published in the 2011 ESOO was 14,543 GWh; whereas the actual outcome was 13,372 GWh, a difference of 1,171 GWh or 8.8%.
- The AEMO 50% POE maximum demand forecast for summer 2011-12 published in the 2011 ESOO was 3,230 MW; whereas the actual outcome was 2,979 MW, a difference of 250 MW or 8.4%.

These results are shown in Figure 7, Figure 8 and Figure 9.

Figure 7 South Australian one- and two-year-ahead energy forecasts



Generally, both one- and two-year-ahead energy forecasts over-predict energy, except for the period between 2004-05 and 2007-08. After 2008-09 actual energy growth appears to level off and decline in the 2011-12 year.

Reasons for this over-forecasting may be unexpected significant price increases in 2002-03 and 2003-04 and through 2010-11 to 2011-12 and slow economic growth from 2008-09 onwards. Unexpected price reductions in 2005-06 resulted in higher than forecast energy consumption for 2005-06 (one-year-ahead) and 2006-07 (two-year-ahead).

For the 2011-12 year, lower than expected growth in large industrial demand, a rapid uptake in PV, slow economic growth and aggressive price increases have resulted in a sharp decline in actual energy consumption.

Figure 8 South Australian one-year-ahead summer maximum demand forecasts

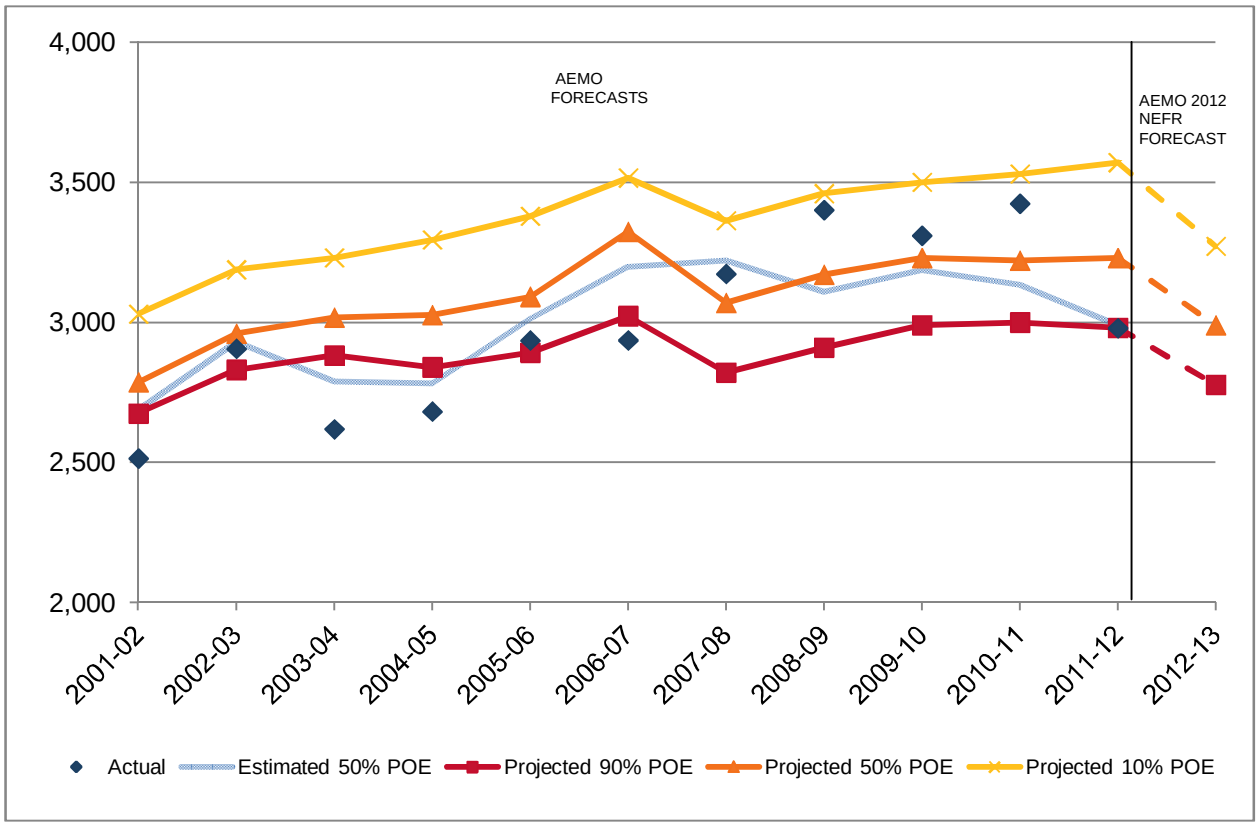
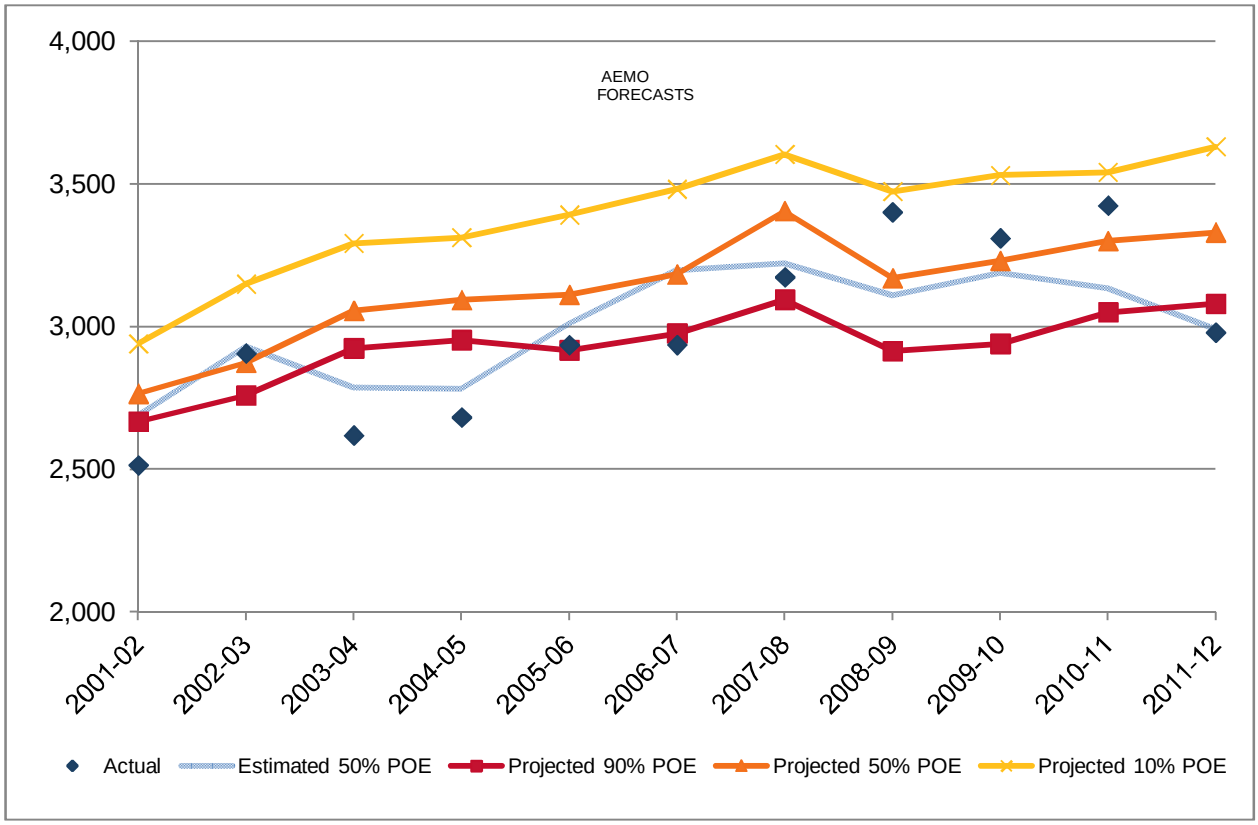


Figure 9 South Australian two-year-ahead summer maximum demand forecasts



The one- and two-year-ahead maximum demand forecasts are relatively accurate, with some over-forecasting in the early years (2003-04 and 2004-05). Maximum demand forecasts follow a similar pattern to energy forecasts for the 2011-12 summer, with some over-forecasting evident.

2012 NEFR forecasts are generally lower for the 2012-13 year than previous forecasts. AEMO's energy forecast is significantly lower.

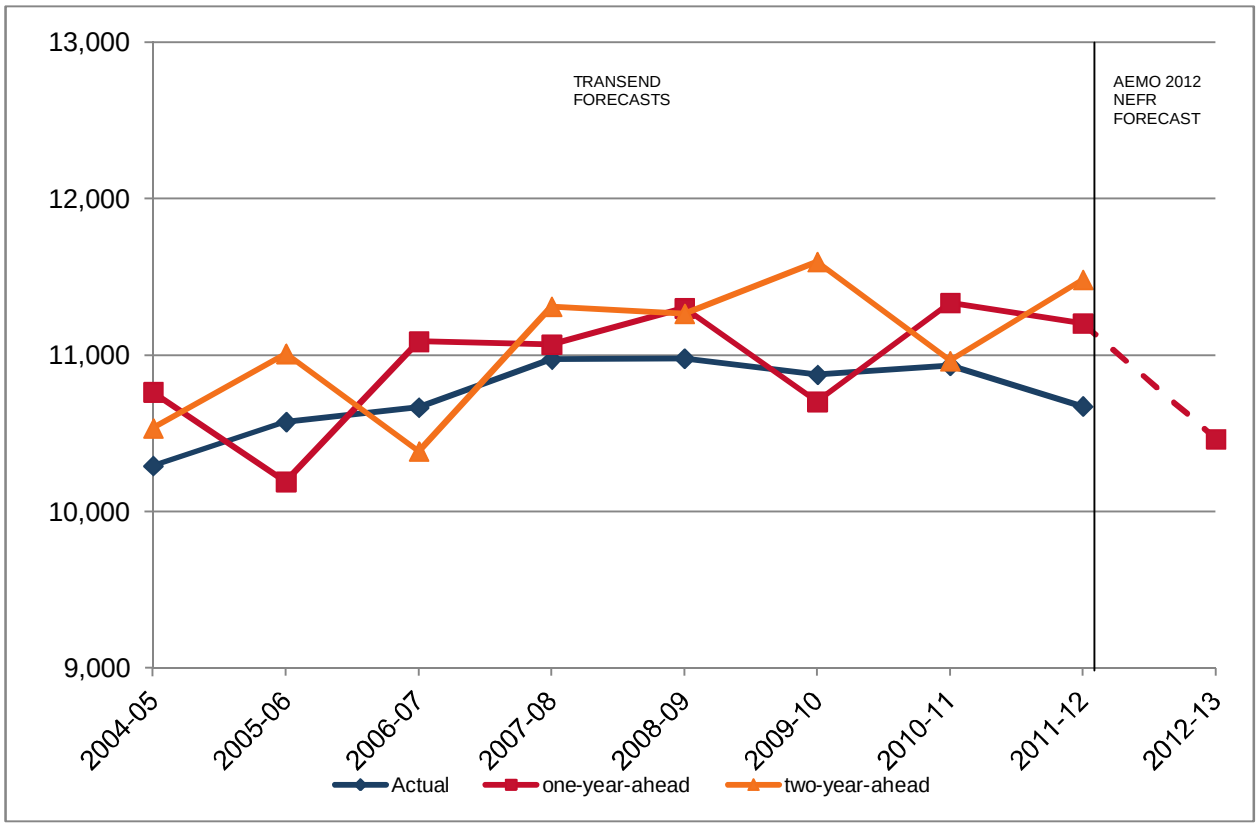
2.4 Tasmania

Previous one- and two-year-ahead forecasts, compared with actual outcomes, reveal over-forecasting of summer maximum demand over several years. Looking at last year's forecasts:

- The Transend energy forecast for 2011-12 published in the 2011 ESOO was 11,204 GWh; whereas the actual outcome was 10,674 GWh, a difference of 530 GWh or 5.0%.
- The Transend 90% POE maximum demand forecast for winter 2012 published in the 2011 ESOO was 1,889 MW; whereas the actual outcome was 1,684 MW, a difference of 205 MW or 12.2%.

These results are shown in Figure 10, Figure 11 and Figure 12.

Figure 10 Tasmanian one- and two-year-ahead energy forecasts



Generally, both one- and two-year-ahead energy forecasts centre on actual outcomes, with the exception of the 2011-12 year.

Uncertainty relating to industrial forecasts – since this typically represents half of Tasmania's energy consumption – is expected to have caused the variability between the one- and two-year-ahead forecasts and actual outcomes.

From the 2008-09 year onwards, unexpected significant increases in electricity prices, together with subdued economic growth may have caused some over-forecasting in more recent periods. It is also evident that some expectations of a rebound in energy consumption have not eventuated. Growth in alternative household fuel use may have had some dampening effect on energy consumption in recent years, contributing to the forecast variance.

In 2011-12, a contraction in large industrial demand (with the suspension of BHP's Temco Manganese smelter), continued slow economic growth and aggressive price increases may have resulted in a decline in actual energy.

Figure 11 Tasmanian one-year-ahead winter maximum demand forecasts

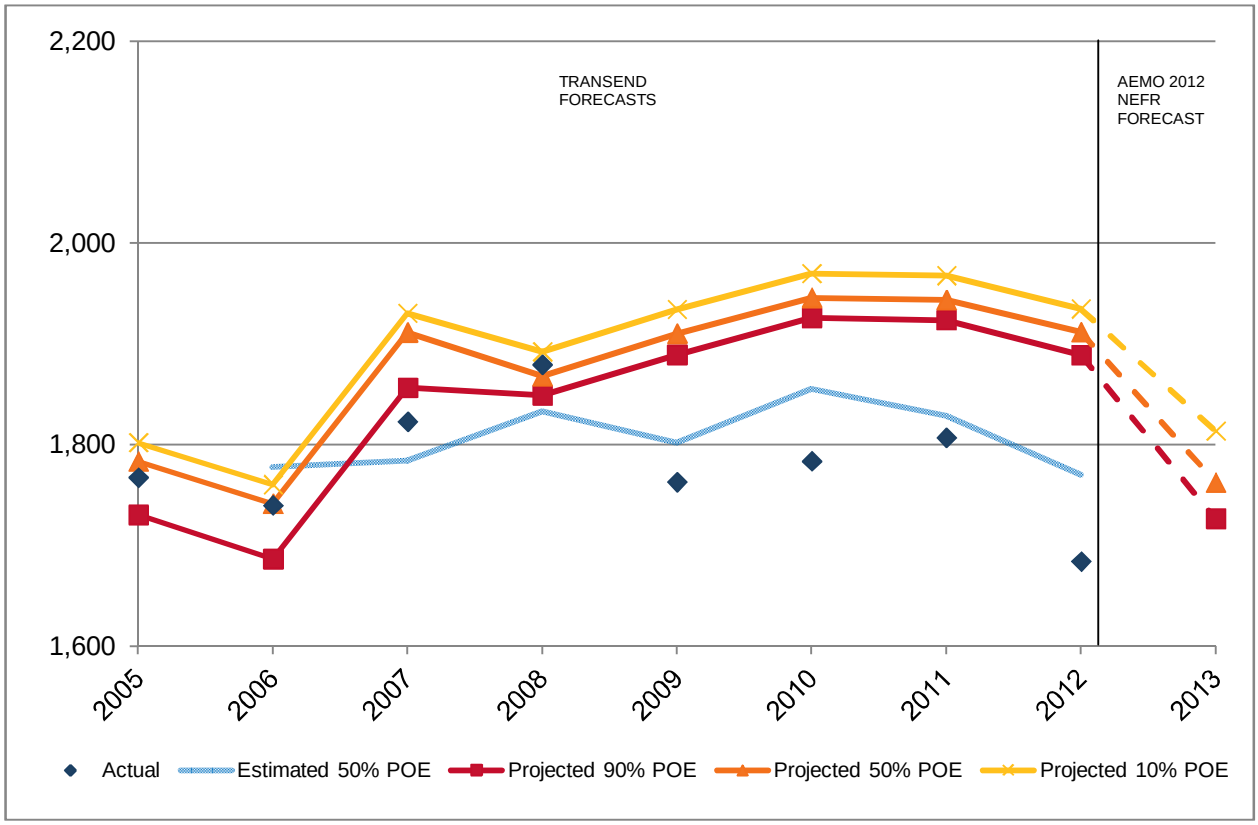
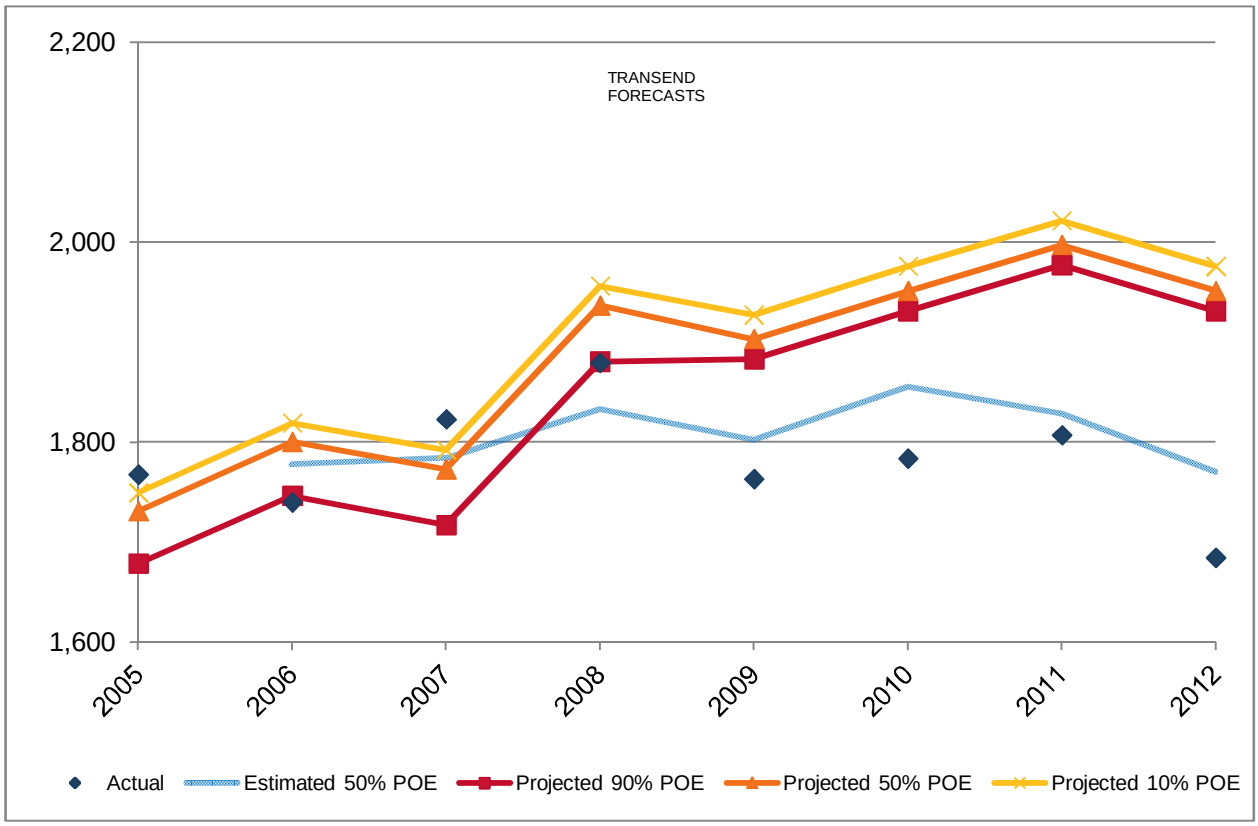


Figure 12 Tasmanian two-year-ahead winter maximum demand forecasts



The one- and two-year-ahead maximum demand forecasts have shown a tendency to over-forecast from winter 2008 onwards and a pattern of increasing divergence over time.

Over-forecasting in 2012 could be the result of lower than expected growth in industrial demand, unexpectedly slow economic growth and aggressive electricity price increases from 2008 onwards.

AEMO's 2012 NEFR forecasts are lower for the 2012-13 year and significantly lower for the maximum demand forecast.

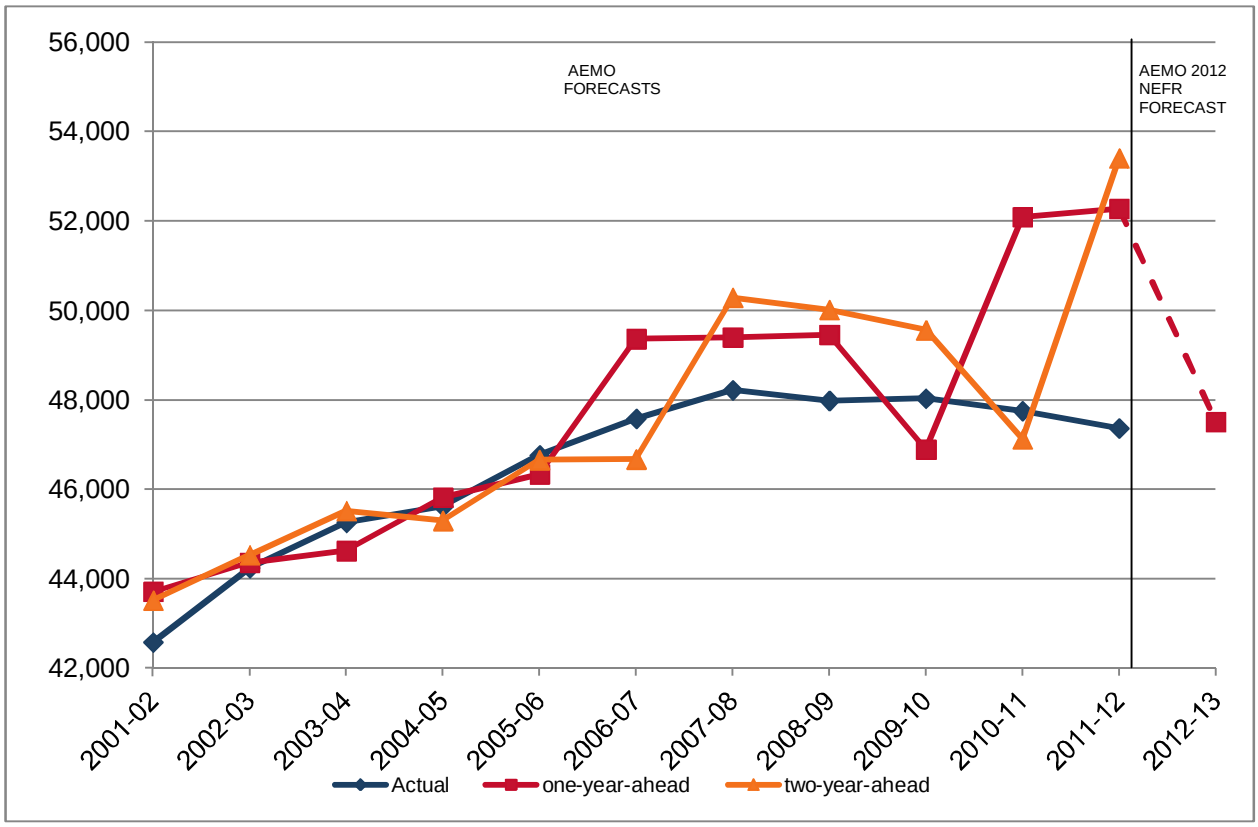
2.5 Victoria

Previous one- and two-year-ahead forecasts, compared with actual outcomes, reveal relatively accurate forecasts in early years, with some over-forecasting from 2007-08 onwards. For example:

- The AEMO energy forecast for 2011-12 published in the 2011 ESOO was 52,276 GWh; whereas the actual outcome was 47,367 GWh, a difference of 4,909 GWh or 10.4%.
- The AEMO 90% POE maximum demand forecast for summer 2011-12 published in the 2011 ESOO was 9,693 MW; whereas the actual outcome was 9,190 MW, a difference of 503 MW or 5.5%.

These results are shown in Figure 13, Figure 14 and Figure 15.

Figure 13 Victorian one- and two-year-ahead energy forecasts



Generally, both one- and two-year-ahead energy forecasts track actual energy consumed relatively closely until the 2007-08 financial year, where forecasts generally tend to be higher than actual outcomes. There are however some periods of under forecasting (2006-07 and 2010-11 for two-year-ahead forecasts and 2009-10 for one-year-ahead forecasts).

Until 2007-08 actual energy growth is positive. Post 2007-08, actual annual energy declines, with a significant reduction in the 2011-12 year.

The decline in actual energy may be attributed to subdued economic growth from 2008-09 to 2010-11 and electricity price increases from 2007-08 and 2009-10. Additionally, a general slowdown in large industrial demand from the 2007-08 year onwards and some uptake in PV in recent years could also have contributed to the decline in actual energy.

It should be noted that forecasts were revised downwards in the 2008-09 year (2009-10 one-year-ahead and 2010-11 two-year-ahead forecasts) to adjust for the changes occurring in demand.

For the 2011-12 year, significant uptake in PV and further reductions in industrial demand have resulted in a sharp decline in actual energy consumption.

Figure 14 Victorian one-year-ahead summer maximum demand forecasts

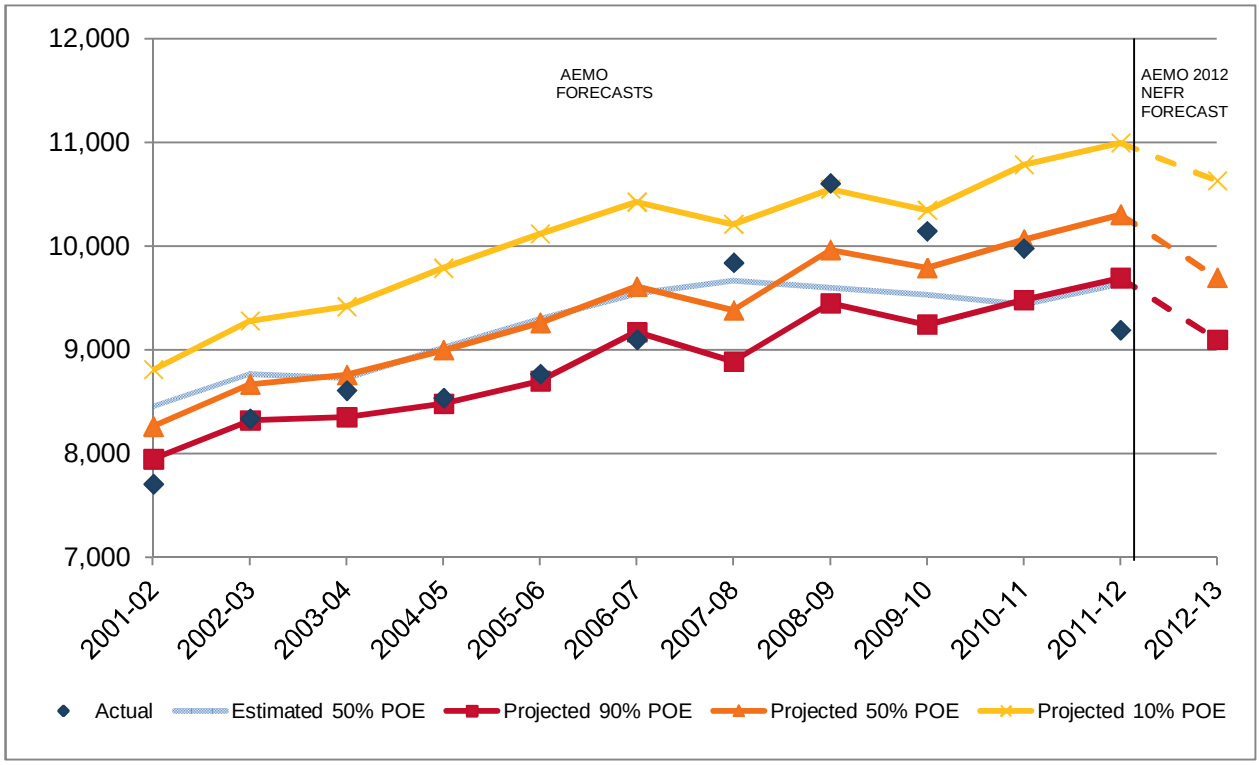
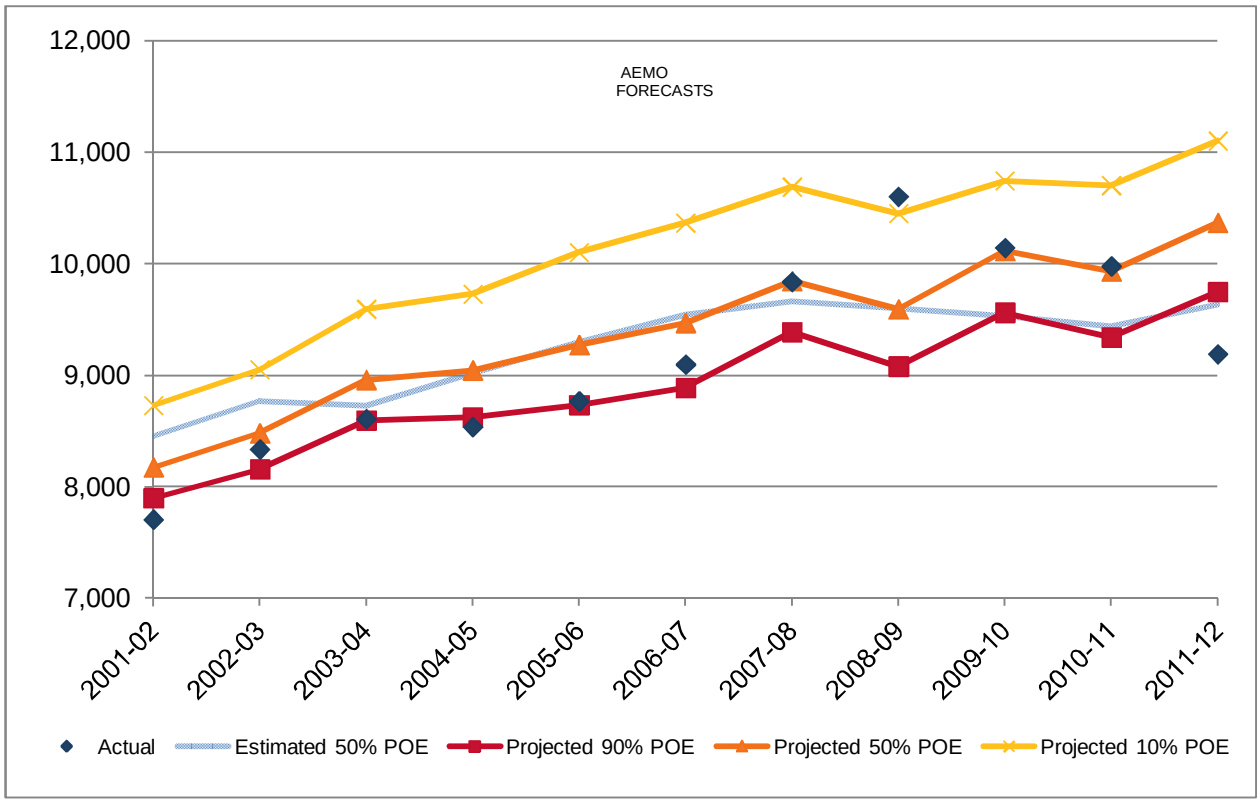


Figure 15 Victorian two-year-ahead summer maximum demand forecasts



The one- and two-year-ahead maximum demand forecasts are relatively accurate, yet with some over-forecasting in later years (2009-10 to 2011-12).

Overall, the energy and maximum demand forecasts tend to be relatively accurate, with some over-forecasting in recent years, including in 2011-12.

2012 NEFR forecasts are generally lower for the 2012-13 year and significantly lower than previously for the energy forecast.

3 Future Improvements

AEMO's 2012 NEFR represents significant changes to the forecasting approach for energy and maximum demand. With explicit recognition of the effects of rooftop PV, energy efficiency measures, an improved data repository and methodology, forecasts for NEM regions have generally been revised downwards, with more subdued growth rates than in previous forecasts examined in this report.

AEMO intends to further improve the forecasting process for the 2013 NEFR in the following areas:

- Refinements to the annual energy modelling process, with the use of alternative econometric model types such as Dynamic Ordinary Least Squares (DOLS) to allow for more consistent estimate long-term elasticity's. Additionally, the improvement of lag structures (lagged variables) in these econometric models will be implemented.
- Development of comprehensive model testing and acceptance criteria.
- Refinements to the Maximum Demand Modelling Process, including:
    - More accurate quantification of price elasticity at peak periods.
    - Allowance for changes in "peakiness" of demand, specifically allowing for different growth patterns in maximum demand to annual energy. The current modelling process does not allow for significant differences in trends of maximum demand and energy.
    - A greater focus on tuning maximum demand models to more recent summer periods and tuning for peak demand periods.
- The 2013 NEFR energy and maximum demand forecast model development will be supported by an external econometric modelling expert.
- A separate, independent peer review of the 2013 NEFR energy and maximum demand forecast models by an external consultant (different from modelling expert above) after the completion of forecast models. Results of this independent peer review will form part of an action plan for improvements in future forecast models.

The forecasting models and process will continue to evolve to meet the significant changes occurring in the electricity market. While it is important to provide accurate, independent and consistent forecasts for industry stakeholders, limitations on accuracy may arise through uncertainties related to:

- The economic outlook.
- Electricity prices.
- Structural changes in Australia's economy, with some sectors behaving very differently from others.
- Policy assumptions used in the forecasting process.