

# Electricity Demand Forecast Post NZIER Report Model Review

## Background

The Electricity Commission undertook an analysis of alternative approaches for forecasting demand for electricity in New Zealand. The resulting models and background material were reviewed by the NZIER with a view to:

- critiquing the methodology used to evaluate and select alternative models;
- assessing how reasonable the models are, and the validity of the inputs; and
- if required, suggesting alternative models or approaches.

This paper outlines the analysis and review processes carried out by the Commission subsequent to the NZIER review.

## NZIER review findings

The NZIER review made a number of recommendations with respect to additional tests that could be usefully documented as part of the model assessment. The following sections outline the various actions taken by the Commission as a result of both the review and the discussions that were subsequently held with the NZIER reviewers.

### Commonality of model types

One of the points made by the NZIER was that comprehension of the models would be assisted if each sector had a similar model structure. The assessment process had not sought to restrict the selection of the models in this way, however we acknowledge that it would certainly make explaining the models easier if they were of a similar type. Unfortunately, in the initial rounds of analysis we found that the model types that performed well for the residential sector performed badly when applied to the commercial and light industrial sector. We believe that, in this case, the adoption of the differing model structures is necessary to ensure better modelling results.

### Non-stationarity of the model variables

Most of the key variables used in the models are non-stationary – i.e. they have a trend. Generally both the explanatory and dependent series increase over time (GDP, population, residences and electricity demand). As the NZIER note, this may cause spurious regression results, and is a problem for the commercial and light industrial model in particular.

A common approach in such a situation is to base the models on first differences (i.e. the annual change in each series rather than their absolute values). A number of models using first differences were tested for each sector in the early phases of

the model assessment. We reviewed these models in more detail following the NZIER review but confirmed that the results we obtained using these models were less robust than the final models selected using the original base series.

### **Parameter stability**

Model results may vary depending on the time periods the models are estimated across. In some cases there may be a clear change in the relationship between the explanatory and dependent variables over the period being considered. In other cases, the estimated model coefficients may prove to be unstable with changes in the period modelled.

The initial narrowing down of the models carried out in the first phase of assessment attempted to eliminate problems associated with changing relationships between the variables by assessing step changes in the underlying drivers and demand. Following the NZIER review, we carried out formal Chow tests on the models to check for the possibility of changes that we had not picked up through the earlier process. The approach we used was to re-estimate the model results for all the possible combinations of start and end dates for each model (with a minimum of 10 years modelled) and then run multiple Chow tests within each re-estimated model (with a minimum of 5 years on either side of the Chow test split).

This process provided useful information for narrowing down the final models adopted. It did show that in some cases models that performed well by other measures were very unstable when the modelling period was changed slightly (see below under the Lagged Dependent Variable section).

### **Explanatory variable suitability**

NZIER noted that better targeted explanatory series may improve the model results and suggested a number of series that would be worth considering. One of the main factors constraining the range of alternative models that were assessed during this process was the lack of reliable historical and forecast data series. The Commission fully agrees that more targeted series would be useful and plans to work with the appropriate organisations and agencies during the ongoing forecast development process.

The Commission also carried out a number of additional tests on the various models to confirm that the variables included within the models were appropriate.

### **Lagged dependent variables and the use of a smoothed series**

The light industrial and commercial model proposed by the Commission and reviewed by NZIER initially smoothes historical demand and then uses it as a lagged explanatory variable in the regression model. The smoothing process is intended to remove year to year variation caused by factors that are impractical to model. This

process is somewhat arbitrary though and NZIER suggested that simply using a lagged variable without smoothing may give reasonable results.

The Commission constructed a lagged variable model. The initial test results were slightly better than the proposed model for the light industrial and commercial sector, and the resulting forecasts very similar. However, in the process of testing the stability of the coefficients to changes in the modelling period it became apparent that this model was very unstable. Dropping the final year of the sample period off caused the model coefficients and the resulting demand forecasts to swing significantly. The proposed model did not suffer from the same instability. Therefore while the lagged model was simpler and performed better at face value, the risk of an additional year's data causing a swing in the forecasts is sufficiently concerning to remain with the originally proposed model.

### **Forecast uncertainty**

Although not identified explicitly in the NZIER review, a number of minor changes were made to the distributions used to model future forecast uncertainty. Additional information was obtained from the NZIER relating to historical labour productivity improvements. This was used to improve the GDP uncertainty modelling. Additional analysis was also carried out on the distribution of the various population scenarios to give a more appropriate spread for drivers affected by the population forecasts.

### **Summary**

The Commission will continue to review and update the modelling as new information becomes available. NZIER made a number of general recommendations around model improvement which we intend to incorporate into the ongoing forecast development and review process.

Once more targeted data series have been developed and can be used as explanatory variables it is possible that one of the alternative models may prove to be a better option. However at this stage, given the data available to us, we believe that the proposed models are the most appropriate of those assessed.