Deploying Electricity Load Forecasts on MATLAB Production Server.
Executive Summary

- This presentation will show how Alinta Energy used the MATLAB product suite to improve the accuracy of its W.A. electricity load forecasts.

- The Neural Networks methodology was adopted to segment its customer base and to predict each segment’s load shape.

- MATLAB Production Server integrated with the Data Warehouse allowed forecasts to be updated on a daily basis so that the Trading and Wholesale teams always have the most up to date forecast.

- Analysts can now spend time focusing on improving the accuracy of the forecast rather than administering and reconciling outputs.
Alinta Energy: Who are we?

We supply natural gas and electricity to 800,000 residential and commercial & industrial customers throughout Australia. We’ve been retailing gas in Western Australia since 1995 and more recently are a new energy retailer in Victoria and South Australia.

We employ 780 people in 14 locations across Australia and New Zealand.

Alinta Energy’s power generation and energy infrastructure portfolio includes a number of power stations, transmission lines and natural gas pipelines in Australia and a power station in New Zealand. The combined installed capacity of the power stations represents approximately 2,500MW of base load, intermediate and peaking power generation.
Electricity Load Forecasting Background

- Alinta Energy is major supplier of electricity to business customers in the W.A energy market. Regulation prevents Alinta from selling electricity to residential customers in W.A.

- These customers range from small business consuming 50 MWh p.a. up to large industrial and mine sites consuming in excess of 100 GWh p.a.

- Although large by the volume of electricity consumed, Alinta has a relatively small yet rapidly growing customer base (approx. 2,000\(^{(a)}\) as at June 2014).

- This diverse customer base is not only differentiated by size but also by the time of day and the seasonality of when they consume energy.

- Accurate load forecasts are required so that the Wholesale team can procure energy to match supply and demand while the traders can optimise short term trading benefits.

\(^{(a)}\) ERA 2014 Annual Performance Report: Energy Retailers
Problem # 1

A rapidly changing customer base in W.A. means forecasting load in aggregate derived from historic values produced inaccurate results.

The trading models would routinely underestimate peak load (particularly during the summer) as the acquired customers quite often had different load shapes to the customer base from 12 months prior.

Solution

Create load forecasts by customer segment using the Neural Network Toolbox and then aggregated to create a total Alinta load forecast.
Alinta’s MATLAB Product Suite

MATLAB
Neural Network Toolbox
Statistics and Machine Learning Toolbox
Database Toolbox
MATLAB Compiler
MATLAB Production Server
Load Forecasting Process

**Group Customers**
Customers with similar load shapes (based on historic data) are grouped into 100 buckets using MATLAB Neural Networks pattern recognition.

**Create Neural Networks**
The 100 grouped Historic loads are analysed by MATLAB against a number of weather & calendar variables to create a load predictor neural network for each group.

**Predict Load**
Future date and expected weather variables are fed into each of the 100 networks to predict future load by group. Each group is then weighted by their expected load relative to total load to create the total load forecast.
Clustering: Self Organising Maps

Customer Classification based on:
- Seasonal Profile
- Monthly peak / off-peak Percentage
Clustering: Example Load Shapes

C3: Light Manufacturing

C34: Restaurants

C100: Mining
Neural Networks Load Forecast Input / Output

Weather Variables
• Temperature
• Humidity
• Wet Bulb
• Wind Speed

Calendar Variables
• Day of Week
• Month
• Interval (half hour)
• Public Holidays
• School Holidays

The load forecast for all 100 clusters are weighted by volume.

Then aggregated to create a total load forecast.
Need for faster and more frequent updates of forecasts with “one version of the truth” for users located throughout Australia.

The previous electricity load forecasts were updated on a quarterly basis as part of the regular budgeting timetable. These loads become out of date very quickly as customers churn in and out and temperature forecast change.

Solution

MATLAB Production Server integrated with the Data Warehouse will allow forecasts to be updated on a daily basis so that the Trading and Wholesale teams always have the most up to date forecast.
What is MATLAB Production Server?

MATLAB Production Server™ lets you run MATLAB® programs within your production systems, enabling you to incorporate custom analytics in enterprise applications. Web, database, desktop, and enterprise applications request MATLAB analytics running on MATLAB Production Server via a lightweight client library. A server-based deployment ensures that users access the latest version of your analytics automatically, with client connections that can be protected with SSL encryption.

You use MATLAB Compiler™ SDK to package programs and deploy them directly to MATLAB Production Server without recoding or creating custom infrastructure. MATLAB Production Server runs on multiprocessor and multicore servers, providing low-latency processing of concurrent work requests.

Source: http://au.mathworks.com/products/matlab-production-server/
Load Forecasting System Environment

- WA Retail Analytics to maintain customer lists and load shape classification in MATLAB Production Server (MPS).
- 3rd Party Weather Forecaster provides daily weather forecasts and actual observations.

**Perth**
- WA Retail Analytics

**Adelaide**
- Weather and date variables passed from the data warehouse to MATLAB
- Half Hourly Load generated by Neural Network Models written back to DWH
- Interface:
  - Input variables are passed from the web form to MPS
  - Users will be able to receive load forecasts through Data Warehouse reporting tools

**Sydney**
- Wholesale Trading
- Risk

**WA Wholesale Analytics**
Web Based User Interface

Analysts access the models through a web based front end.

\[ f(x) \] Input variables are passed from the web form to the neural network models deployed on MATLAB Production Server.

Once the load forecast is calculated, the results are written back to the Data Warehouse.
Users in multiple locations can now access a single source of the truth from reports written against the Data Warehouse.

Note: The load displayed on this page is fictitious and not based on actuals.
Realised Benefits of MATLAB Production Server

Faster and more frequent updates of forecasts

- Allows Wholesale to optimise short term trading benefits.
- Time spent focusing on improving accuracy of forecasts rather than administering and reconciling outputs.

Centralised location supported by I.T.

- Single version of the code deployed (single source of truth).
- Analysts can concentrate on writing code rather than administering IT systems.

Other MATLAB code can be deployed

- The actual time spent calculating the load is now less than one minute per day. This allows huge capacity to run other advanced calculation models on MPS across East & West and Wholesale & Retail.
Questions?