Modeling the broader deployment of demand side management onto the Australian National Electricity Markets

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Overview

The growth in peak demand in the National Electricity Market (NEM), on the East coast of Australia, has significantly shifted the focus of investment in infrastructure and put pressure on delivered energy prices for consumers. One of the stratagies which have been considered by stakeholders to reduce the cost of peak demand growth is the implementation of strategies for promoting Demand Side Management (DSM). Allowing large users to bid competitively into the spot market to reduce their demand could reduce the incidence of VoLL and potentially the need to deploy an excessive number of peaking generation assets. DSM has yet to make any real impact on the NEM by comparison to other liberalised electricity markets.

With the impending introduction of the Australian Carbon Pollution Reduction Scheme (CPRS), and a greatly expanded Mandatory Renewable Energy Target (MRET), a low pollution future needs to be realised via significant cuts in emissions by stationary energy production. Deciding on the optimal mix of generation assets and DSM which can fulfil emission constraints and the desire for renewable generation will require long-term forecasts Furthermore, to understand the full economic benefit of the deployment of DSM, modelling must be performed at a market level to examine the behavioural consequences of such a wide spread deployment.

Methods

Establishing a framework for forcasting long-term electricity market behaviour and the effects of increasing use of demand side management requires the following suite of models to examine:

- Electricity market behaviour
- Costs of electricity generation (Levelised Cost of Energy and Short Run and Long Run Marginal Costs)
- Carbon price forward curve behaviour.

The simulation of market behaviour and the inevitable change in electricity production trends has been performed using a model of the National Electricity Market (NEM) that simulates operation and dispatch of power generation assets on a half-hourly basis over the medium- to long-term. The modelling software we use for this investigation (PLEXOS), developed by Energy Exemplar, provides an extensive database of all generating assets and transmission operations within the NEM. This model evaluates the dispatch of the optimal fuel type mix based on an order of merit determined by bidding behaviour of generators to recover short run and long run marginal costs (SRMC and LRMC). Marginal cost recovery for generating units is the primary driver for bidding behaviour within the NEM, while possible fuel mix changes due to increased demand will also change price behaviour. The modelling software we use for this investigation (PLEXOS), developed by Energy Exemplar, provides an extensive database of all generating assets and transmission operations within the NEM.

Initially we will establish a base case scenario to produce load forecasts and capacity factors which we shape to historical data obtained from the market operator's (AEMO) data server. We then use PLEXOS to establish a benchmark for greenhouse gas (GHG) emissions which provides an emissions profile for the NEM. Furthermore, the introduction of the emissions trading scheme in 2013 will also uplift wholesale spot prices across the NEM. The following scenarios were modelled for each year from 2012 out to 2050:

1. **Business-As-Usual (BAU) case with no significant DSM**
2. **5% of peak demand displaced via DSM**
3. **10% of peak demand displaced via DSM**

Results

Effects on Average Electricity Prices

The ability for large users to bid their demand displacement competitively into the NEM, will reduce electricity prices by reducing the incidence of prices above $1000/MWh. The frequency of high prices on the NEM has largely corresponded to insufficient investment in generation or inter-regional constraints highlighting the need to increase regional reverse plant margains. The roll out of DSM will have a significant impact on the average price of energy throughout the NEM. The drop in average prices for each of the DSM scenarios indicates that investment in new technology will lower the delivered energy cost across the NEM. Furthermore, by the development of strategies to enhance the deployment of DSM peak demand growth could also be slowed, there by deferring the need to invest in transmission infrastructure.

Conclusions

With the introduction of the CPRS, wholesale electricity prices are set to increase to meet the marginal cost increase imposed by a carbon price. Through the modelling of DSM, we hope to demonstrate the benefits of large users being able to bid to reduce demand on the NEM have been shown to significantly improve the long term reduction of electricity prices. The drop in average price and volatility with respect the DSM scenarios presents many opportunities for market participants to reduce their exposure and uncertainty to the wholesale electricity market.