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# *THE EFFECTIVENESS OF ENERGY STORAGE TO REDUCE PEAK DEMAND ON THE AUSTRALIAN NATIONAL ELECTRICITY MARKET*

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## Keywords

Renewable Energy, Storage; Peak Demand, Electricity Market, Smart Grids

## Overview

The energy sector has forecasted significant increases in demand over the next decade with the general belief that this will be serviced by increased renewable energy deployment within the grid. Most of this will be within distribution rather than transmission networks and as a result we will see rapid developments within smart grid technologies. Modelling undertaken has confirmed recent trends that much of the forecasted increased demand can be serviced through demand management rather than just increasing available supply through additional generation.

Whilst demand will continue to increase and through the introduction of renewable energy portfolio standards in many countries, much of this increase will be utilising renewable energy technologies, this will also force network providers to review the current grid operations and upgrade to provide for two-way energy flows. As much of the commercially available renewable technologies are intermittent by nature this will see the need for additional demand management controls and battery storage options to be included within the roll-out of new smart grids.

## Methods

Establishing a framework for forcasting long-term electricity market behaviour and the effects of increasing deployment of storage and consumer demand 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. 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. A 5% reductioln in emissions with respect to 2000 levels for Australia are assumed to be introduced given the current political environment. 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 2015, 2020 and 2025:

- **Business-As-Usual (BAU) case with no significant storage**
- **5% of peak demand displaced via Energy Storage**

- **10% of peak demand displaced via Energy Storage**

## Results

**Effects on Delivered Energy Prices**

The ability for system operators to control load and release storage available on the NEM will have a variety of effects on peak and average prices for electricity consumers. Firstly the tendency for peak growth to compound investment in infrastructure will be deferred to beyond the intial 3-5 year planning horizon. Given that transmission and distribution use of service charges have risen 13% on the most recent regulatory decision the opportunity to defer billions in capital expenditure will have a stabilising effect on retail pricing.

Furthermore, the ability for the Australian Energy Market Operator to use storage to further shave peak demand and to fill troughs in the demand cycle will also allow for more certaninty over investment signals for generators. With no new real investment in base load generation and the prospect of uncertainty over climate policy flattening the shape of demand will have a major effect on the prices on the wholesale spot market. The slowing in need for new expensive peaking generation assets (which typically bid at around $300 AUD/MWh) and the real incentives for gas fired intermedtiate operating plant prices should stabilise.

These two benefits will tend to stablise retail electricity prices for all segments in the demand structure, and provide for a more competitive and efficient electricity market.

## Conclusions

The demand management options are only considered part of the solution, but when coupled with storage the new smart grid is complete. Depending on the needs of the grid, storage can be used to shape demand or improve power system quality issues created through the deployment of intermittent technologies. Within Australia where electricity prices are expected to grow by 8-13% per annum over the next five years we are already seeing firms deploy demand management options, resulting in an overall decrease in electricity demand. This trend is not expected to continue, but further demand reductions can be obtained through deployment of storage and smart grid technologies creating energy savings.