ACIL ALLEN CONSULTING

REPORT TO
ESSENTIAL SERVICES COMMISSION

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WHOLESALE ELECTRICITY SPOT PRICE

2015 AND 2016 PROJECTIONS

AN INPUT TO THE ESC'S CONSIDERATION OF THE VICTORIAN FEED-IN TARIFF

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Introduction

ACIL Allen Consulting (ACIL Allen) has been engaged by the Essential Services Commission (ESC) to provide projections for spot wholesale electricity prices for Victoria over the period 2015 to 2016. The projections were prepared using *PowerMark*, ACIL Allen's proprietary model of the National Electricity Market. The projections themselves were provided to the ESC in spreadsheets accompanying this report.

The purpose of this report is to provide an overview of the projections and to compare them against corresponding projections that ACIL Allen prepared for the ESC in February 2014.

Scenario basis

The projections cover calendar years 2015 and 2016 and are undertaken for a single scenario, which represents ACIL Allen's off-the-shelf Base Case at the time of writing. This scenario incorporates the current demand forecasts produced by AEMO in its 2014 National Electricity Forecasting Report (NEFR) and ACIL Allen's internal supply assumptions.

This case incorporates an assumed reduction in the Renewable Energy Target – specifically the Large-scale Renewable Energy Target (LRET) – to a level of 27,000 GWh by 2020. While we recognise political negotiations in respect of the LRET are ongoing, this level corresponds with the Government's stated preferred position on the policy. The assumed level of the LRET is important for longer-term modelling assignments however, given this engagement only involves modelling to the end of calendar year 2016, it is less critical. Variations to the LRET policy are likely to only have a minor impact on market outcomes during this period as construction lead times for wind farms are typically 12-18 months once projects reach a final investment decision.

Projection results

The projected time-weighted average spot prices for Victoria are:

- **Calendar year 2015: $33.41/MWh**
- **Calendar year 2016: $36.66/MWh**

Changes to input assumptions that have been made since February 2014 and that affect the calendar year 2015 and 2016 period include:

- reductions in forecast demand from AEMO from the 2014 NEFR
- revised wind build profile in accordance with a 'real 20%' RET (as described above these changes have little impact in the projection period)
- modification to a number of minimum generation day-time constraints on a number of gas-fired CCGT and cogeneration units reflecting the potential to on-sell gas entitlements upon start-up of the Queensland LNG plants
- mothballing of Swanbank E from October 2014 onwards
- closure of Energy Brix facility (Sept 2014); Redbank (Oct 2014)
- decreased output from hydro facilities in the next couple of years in light of low storages after carbon tax legislation was repealed
- included several wind farms as committed projects:
  - Bald Hills, VIC (106.6 MW); complete by May 2015

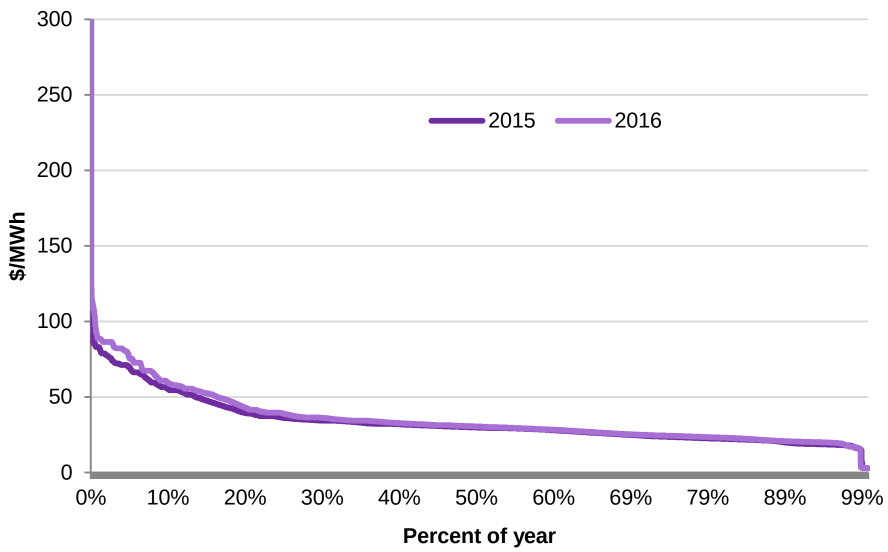
– Portland Stage 4, VIC (47.5 MW); complete by May 2015[1]

— updated MLFs and interconnector loss equations based on AEMO's report entitled "Regional Boundaries and Marginal Loss Factors for the 2014/15 Financial Year ".

These changes to the supply-side have varying impacts upon projected prices: some positive, some negative.

Figure 1 provides the projected load duration curves for the two years. Owing to the subdued market conditions, very little price volatility is expected, with very few instances when the spot price exceeds $300/MWh in the Base Case.

Figure 1 **Victorian spot price duration curves: 2015 and 2016**



Source: ACIL Allen PowerMark modelling

Comparison with February 2014 projections

ACIL Allen provided a wholesale spot price projection to the ESC in February 2014. These projections included results for calendar year 2014 and 2015. As such, the current projections provide an update for calendar year 2015. Price outcomes and demand inputs are compared against the current set of projections in Table 1.

The price we project now is less than was projected in February 2014 by approximately $11/MWh. Much of this reduction is attributable to the assumption of lower demand – both peak demand (699 MW lower) and annual energy (2,373 GWh lower).[2] The reduction in demand reflects the revised AEMO outlook in the 2014 National Electricity Forecasting Report which was released in late June 2014, adjusted based on ACIL Allen's methodology for subtracting off behind-the-meter solar PV output.

[1] Note that Portland Stage 4 is a non-scheduled generator and therefore is not explicitly modelled.

[2] We note that at the time of writing, peak demand in Victoria had already reached 8,563 MW in calendar year 2015.

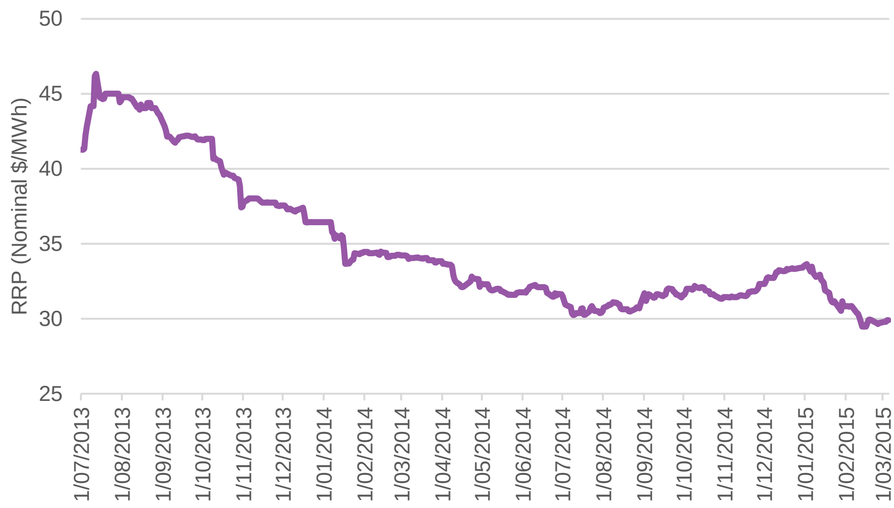
Table 1 **Comparison against previous results for Victoria for 2015**

	Units	Value
Results provided in February 2014		
Time-weighted average RRP	$/MWh	$44.50
Peak demand	MW	9,129
Annual energy	GWh	47,089
Current results		
Time-weighted average RRP	$/MWh	$33.41
Peak demand	MW	8,429
Annual energy	GWh	44,715
Change		
Time-weighted average RRP	$/MWh	-$11.09
Peak demand	MW	-699
Annual energy	GWh	-2,373

Note: Nominal dollars. Both demand and energy expressed on an 'as generated' basis
Source: ACIL Allen

The revision to the projected price for calendar year 2015 is material as it represents a 25% reduction. The previous iteration matched the futures market reasonably closely toward the end of calendar year 2013 (the input assumptions for this modelling were set as at November 2013), however since that time futures prices have declined significantly as shown in Figure 2. The current projected price for 2015 represents a 12% premium to the current futures price.

Figure 2 **Historic closing prices for Victoria base calendar year 2015 futures**



Source: ACIL Allen based on ASX Energy data

Stochastic analysis

The gross energy-only market of the NEM includes a high price ceiling which can at times result in significant price volatility throughout the year. Spot price outcomes can range from the market price floor (-$1,000/MWh) to the price ceiling ($13,500/MWh in 2014-15). This price volatility generally occurs during high demand periods, particularly when these coincide with generator forced outages. Owing to the fact that the NEM price ceiling is much higher than average price (whether measured in time weighted or load weighted terms), individual price spike events can have a significant effect on annual average price outcomes.

There are many factors that contribute to this variability.[3] Key among them is the inherent uncertainty of:

- generator unavailability due to unplanned (forced) outages
- timing of high demands and peak demand variability driven by extreme weather factors (consecutive hot days in summer and cold days in winter)
- intermittent generator output (particularly wind farms)

These factors are stochastic (random) by nature and cannot be forecast deterministically.

The Base Case presented above represent the outcomes from a single simulation. As such, it cannot characterise the full distribution of possible price outcomes. ACIL Allen does however condition the Base Case inputs so that it approximates a median (P50) outcome.

At the ESC's request, ACIL Allen applied Monte Carlo techniques to reveal an underlying price distribution of possible price outcomes for any given year.

The price distribution is naturally skewed to the right (high price). This reflects the fact that prices can spike to very high levels during times of generator outage coinciding with high demand periods, whereas low price events are generally bound by marginal generator costs.

The following sections describe the process and results from the stochastic simulations.

Demand traces

As it is the timing of high demand events and the shape of the upper end of the load duration curve (how many or how few high demand periods there are) that is important for price formation, ACIL Allen utilises historical weather patterns to develop a range of 'synthetic' demand traces.

These are derived from 41 years of historical weather data for each NEM region, sourced from the Bureau of Meteorology. These are 'mapped' to recent demand observations at the daily level by finding the best matching daily temperature profile (given the month and day type) across the NEM by searching for the closest least squares match between the temperature profile for that day and the temperature profile for a day in the three years 2009-10 to 2011-12 across all NEM regions simultaneously.

The produces a set of 44 'synthetic' demand traces which correspond to prevailing historical weather patterns. Each of these traces will have slight differences in terms of timing of peak events and also differences in the shape of the load duration curve. Importantly, the traces maintain the levels of correlation between NEM regions on a daily basis.

Intermittent profiles

In keeping with the 44 synthetic demand traces, ACIL Allen aligns intermittent wind generation profiles with these demand sets to preserve the correlation between wind output and demand events. For example, it is important to preserve the correlation between peak demand and the output of wind farms in South Australia and Victoria.

[3] Note that price variation caused by stochastic factors is different to structural factors (such as explicit carbon pricing), which tends to shift the whole price distribution. Structural factors can be examined through the examination of different scenarios.

Peak demands

The absolute level of peak demand in each region is another stochastic factor, reflected in the fact that AEMO produces peak demand forecasts on a probabilistic basis. To account for this, ACIL Allen grows each demand trace such that the peak demand aligns randomly with a point on AEMO's distribution.

The forecast P10, P50 and P90 peak demand levels from AEMO's 2013 NEFR document for each NEM region have been used to anchor the maximum and minimum peak demands from the synthetic demand traces for each year (the median is anchored to the P50). Whilst we recognise that the P10 and P90 points do not represent the absolute extremes expected – by definition 10% of occurrences occur above and 10% below these levels – we lack the necessary data points.

Forced outage sets

PowerMark requires as an input the availability of each generator unit for each half-hour of the year. Using binomial probability theory, ACIL Allen has simulated 12 sets of forced outages (the Base Case set plus 11 others) which are defined by inputs relating to the binary condition of outage (i.e. either an outage event or not an outage event) and the outage duration.

This process allows a range of outage outcomes to be produced. The most important factor in outages is coincidence – if a number of units are forced out at the same time, volatile prices usually result. The process used to simulate the outage sets allows these sorts of coincidences to be represented appropriately.

The outage scenarios are built using randomly selected sequences of events for each plant in the model which are consistent with the underlying performance unplanned outage rates determined for each plant.

Stochastic simulations

Once the required stochastic inputs have been generated, *PowerMark* is run for each of them independently. All structural inputs – for example fuel prices, new entrant timing, retirements etc. – are held constant across these simulations. Combining the 44 synthetic demand profiles with the 12 forced outage sets results in a total of 528 simulations for each year examined.

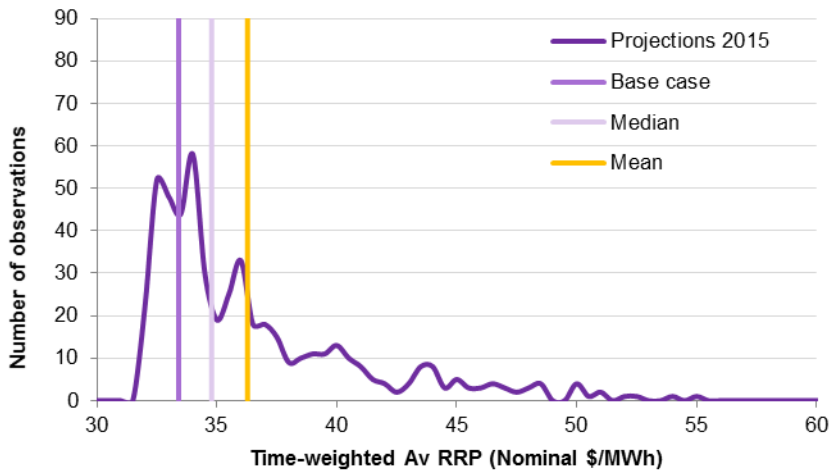
Results

Each of the 528 stochastic simulations yield the same outputs that are generated for a standard single case run. The results were supplied to the ESC. This section summarises the key outcomes for Victorian wholesale spot prices.

Figure 3 illustrates the potential variation in annual spot price outcomes modelled for Victoria for 2015 achieved from varying the stochastic factors alone. A similar chart for 2016 is presented in Figure 4. For these particular years, the Base Case outcome sits below the median of the distribution.

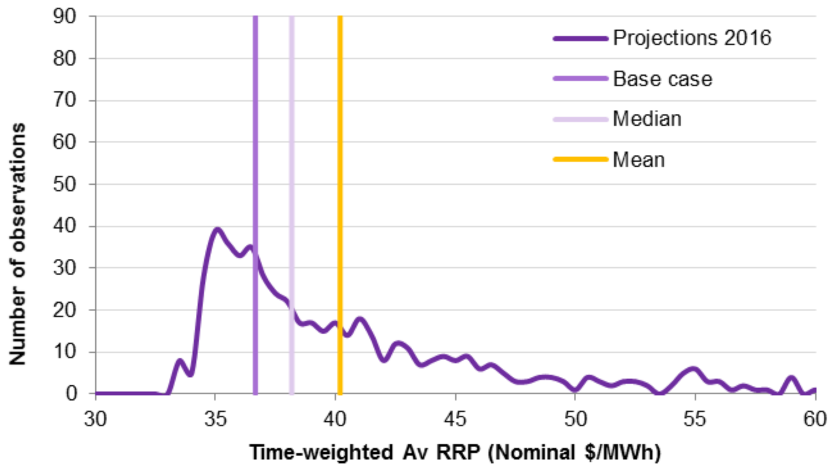
Table 2 provides some other summary statistics for the projection Victorian time-weighted annual RRP from the simulations, whilst Figure 5 and Figure 6 provide the average time-of-day outcomes.

Figure 3 **Stochastic simulation results for Victorian RRP: 2015**



Source: ACIL Allen PowerMark modelling

Figure 4 **Stochastic simulation results for Victorian RRP: 2016**



Source: ACIL Allen PowerMark modelling

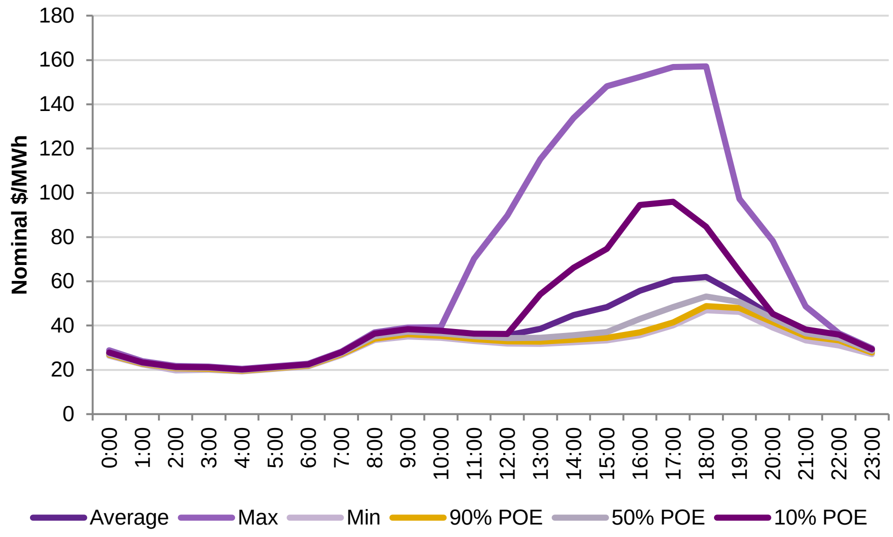
Table 2 **Summary of stochastic outcomes for Victoria time-weighted RRP**

	2015	2016
Base Case	33.41	36.66
90% POE	32.35	34.61
Median (50% POE)	34.79	38.18
10% POE	43.25	48.89
Mean	36.28	40.19
Max	54.86	66.68
Min	31.67	33.31

Note: Nominal $/MWh

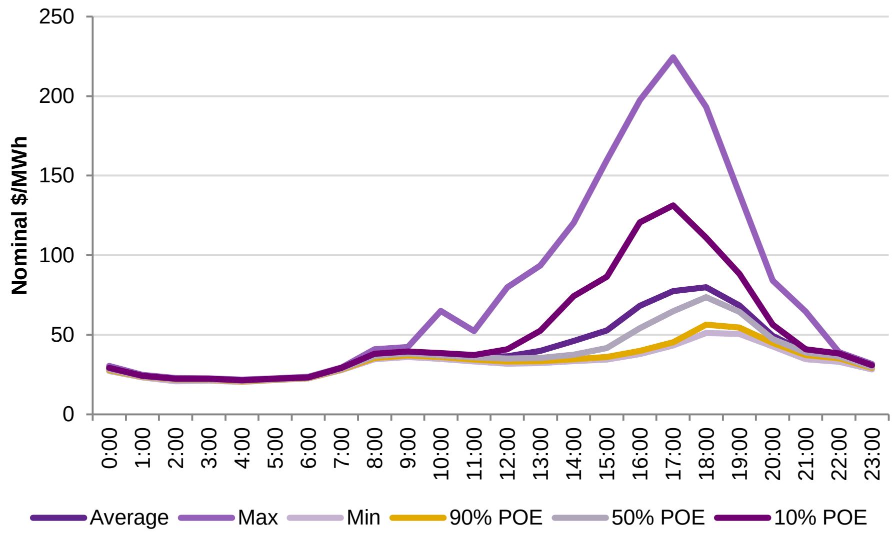
Source: ACIL Allen *PowerMark* modelling

Figure 5 **Time-of-day averages across the simulations for 2015**



Note: Average Victorian RRP by time-of-day
Source: ACIL Allen *PowerMark* modelling

Figure 6 **Time-of-day averages across the simulations for 2016**



Note: Average Victorian RRP by time-of-day
Source: ACIL Allen PowerMark modelling

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