Revised Proposal

Attachment 5.07

2018 Electricity Demand Forecasts Report

January 2019

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Contents

2018 Electricity Demand Forecasts Report

Ausgrid serves 1.7 million customers across 22,000 square kilometres of 'poles and wires' that stretch from Sydney, through the Central Coast and up to the Hunter Valley. Ausgrid's electricity network includes 181 zone substations and 33 sub-transmission substations; with separate summer and winter demand forecasts produced for each substation.

The electricity demand forecasts are a key input into the annual network planning process and are important in the development of Ausgrid's capital expenditure forecasts. For details on Ausgrid's capital expenditure requirements, please refer to the capex chapter of the revised revenue proposal or Ausgrid's 2018 Distribution and Transmission Annual Planning Report.

The forecasts are produced for 50% Probability of Exceedance (50 POE), 90% Probability of Exceedance (90 POE) and 10% Probability of Exceedance (10 POE) levels. The central forecasts used as part of the assessment of options for an identified need are the 50 POE forecasts. The 10 POE forecasts and 90 POE forecasts are used as part of an assessment of 'reasonable' scenarios which are designed to test alternate sets of key assumptions and whether they affect identification of the preferred option. Within this update, we have presented the results of the 50 POE forecasts.

As a core business function, the annual production of maximum electricity demand forecasts consolidates the input of external forecasting and subject matter experts with Ausgrid's expertise and detailed customer energy demand and connection data.

2018 Forecasts Results

Peak demand is a key driver of growth capex requirements. We have revised our revised peak demand forecasts to take account of the most recent information available following the submission of our Initial Proposal. Updated information includes economic data and revised customer connection information.

The latest capex forecast is based on 2018 spatial demand forecast which projects system demand to increase by about 0.8% pa over the 2019-24 period. The 2018 revised system forecast is lower than the 2017 forecast of 1.5% per annum used in the initial proposal. The peak demand forecast used for 2019-24 capex planning was based on 2017 data which has been updated for the latest 2018 information.

Ausgrid's coincident total summer and winter maximum demand forecast is shown in Figure 1 in the next page.

The change in demand growth is due principally to updates to the forecasts incorporating newer electricity price outlooks, economic and population growth. This has resulted in short term increases in summer load growth, primarily due to price response.

In the longer term, we expect the growth trajectory to be flatter than previously forecasts, due to the impact of energy efficiency, rooftop PV and battery storage countering higher demand. We are also expecting lower economic growth in NSW to suppress energy demand in our area.

Further, we sought to address matters raised by the AER and customers about our approach to forecasting.

Key updates to our peak demand forecasts include:

- New modeling commissioned by Ausgrid to project the impact of rooftop PV, battery storage and energy efficiency. Modeling resulted in flatter demand growth in the longer term compared to the 2017 forecast;
- Refinements to the assessment of new large customer connections; and
- Application of the most recent economic data on economic growth, population growth and impact of electricity prices.

We discuss these matters in more detail below.

The Ausgrid 2018 electricity demand forecasts for zone substations and sub-transmission substations are broadly similar to the 2017 forecasts for the near term (5 year) period at a network whole of system level. In comparison with the 2017 forecast, a significant change is that the downward impact of higher retail electricity prices has moderated in 2018 following an update to the AEMO supplied forecast for retail residential and non-residential electricity prices.

In the long term, the 2018 forecast shows a moderation in demand, principally due to updates to forecasts for the impacts from emerging technologies. Over the long term period, the average growth is 0.4% pa in the five year period from 2023 to 2028.

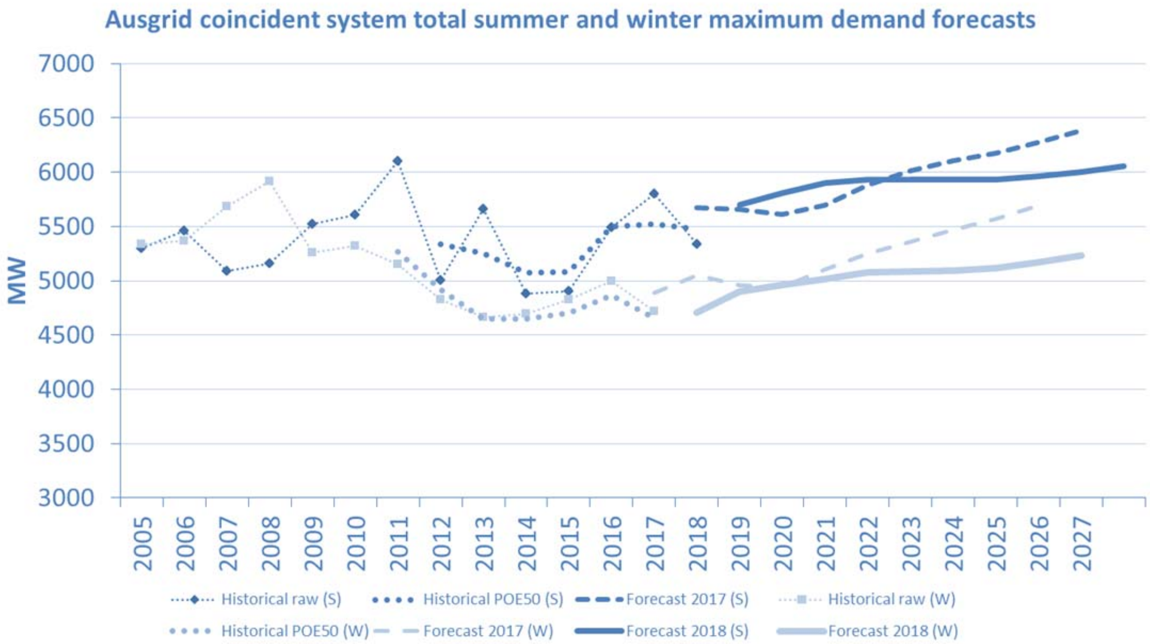

Figure 1

At the spatial level, around 54% of zones in summer and 43% of zones in winter are expected to experience growth in maximum demand over the next 7 years (based on compound annual growth). This is down from 62% of zones in summer and 60% of zones in winter expected to experience growth over the next 7 years in the 2017 forecast. A comparison of the growth rates for Ausgrid's zone substations in the 2017 and 2018 forecasts is shown below.

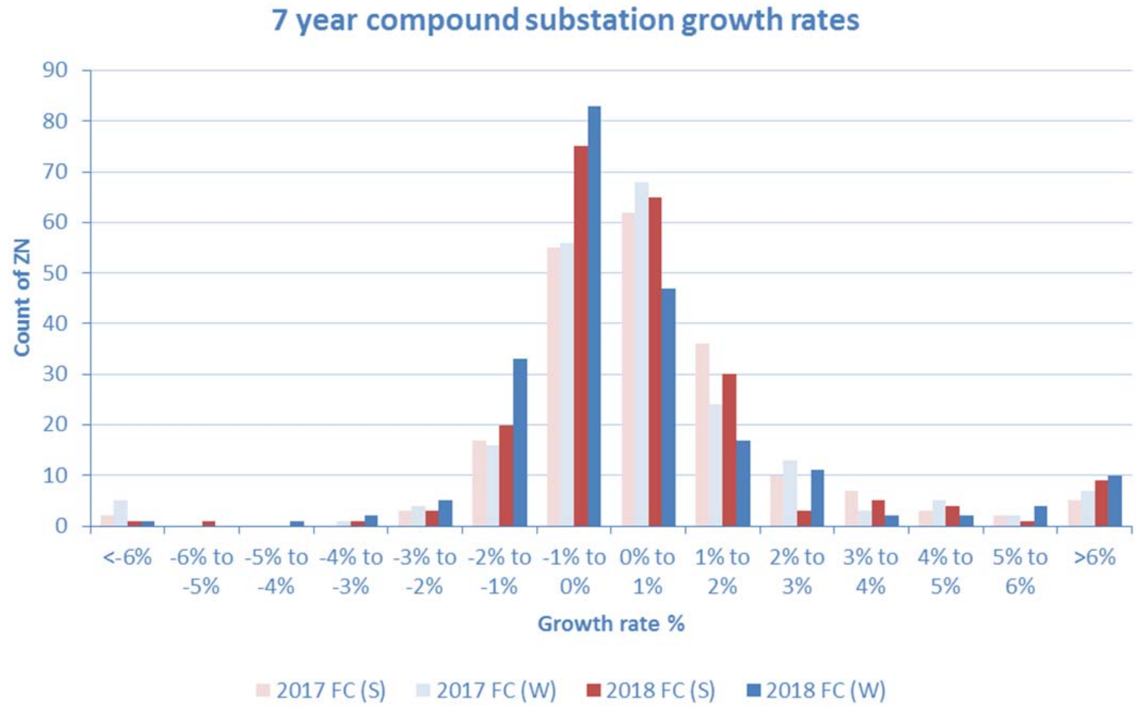

Figure 2

The low rates of growth result in a relatively modest increase in substation utilisation across the period from 2018 to 2030 with 5% of zone substations forecast to exceed the substation rating in 2024 and 6% in 2030. Forecast substation utilisation for the dominant peak season is displayed for 2018, 2024 and 2030 in the following chart.

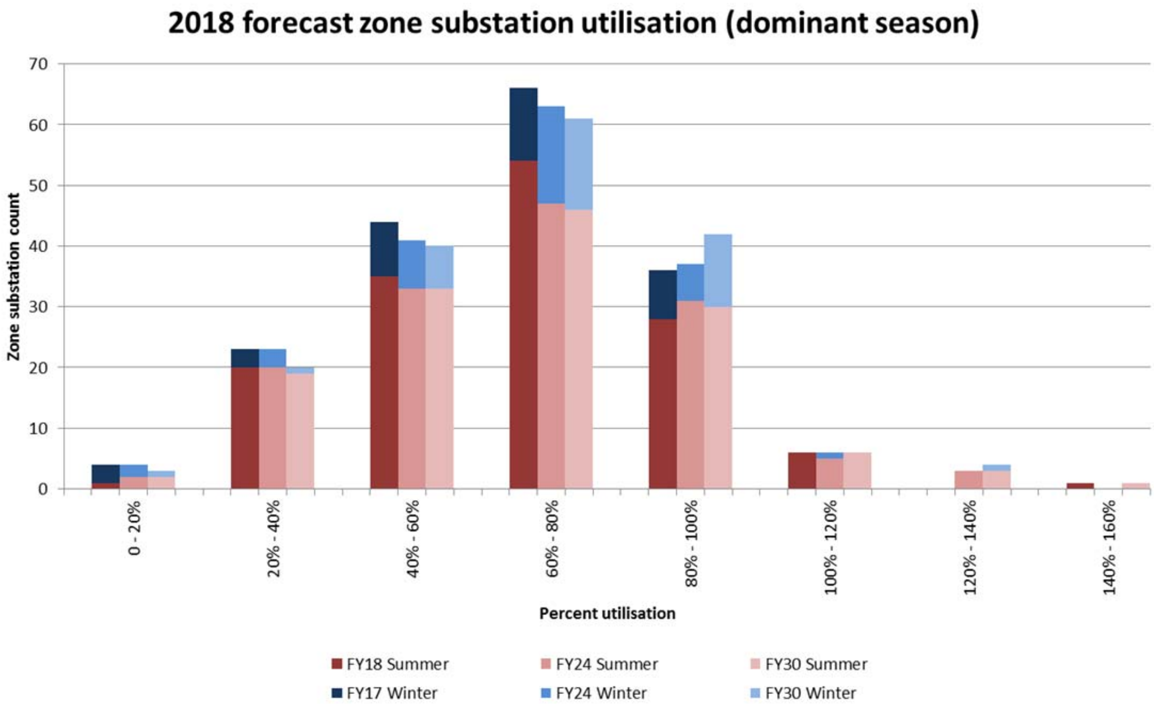

Figure 3

A total of 7 of the 181 zone substations and 5 of 34 sub transmission substations have a 7 year average growth rate greater than +3.0%. These substations, listed in the tables below, typically have a high number of new large customer connections (block loads) in the initial forecast years. While comprising only 6% of substations and 12.5% of total system demand in 2024, 36% of all new forecast load from large 11kV customer connections is situated in these areas.

Rank	Zone Location	ROG
1	Macquarie Park 132_11kV	9.4%
2	Camperdown 33_11kV	6.5%
3	Crows Nest 132_11kV	4.5%
4	Arncliffe 33_11kV	4.4%
5	Mayfield West 132_11kV	3.8%
6	Lidcombe 33_11kV	3.7%
7	Mascot 33_11kV	3.1%

Rank	Sub transmission Location	ROG
1	Rozelle 132_33kV	17.4%
2	Alexandria 132_33kV	12.6%
3	Pyrmont 132_33kV	6.5%
4	Willoughby 132_33kV	5.3%
5	Homebush 132_33kV	4.3%

This spatial variation in forecast demand can be seen in the regional breakdown of growth rates with a greater number of zone substations in the Sydney South region experiencing higher rates of annual growth. See below histogram charts summarising the summer 50 POE forecast growth rates for each of Ausgrid's regional areas. Rates shown are the 7 year compound annual growth rate (CAGR).

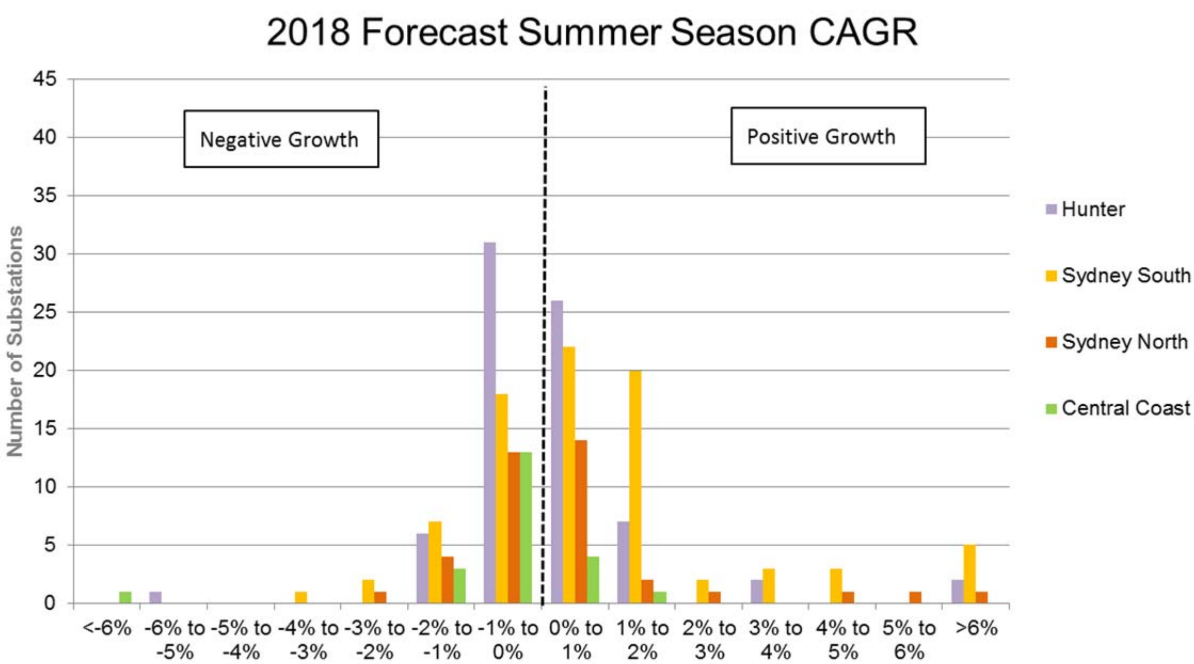

Figure 4

AER draft decision

The AER considered Ausgrid's approach to forecasting demand to be reasonable, but identified a number of issues that they considered should be addressed in future forecasts and our revised proposal.

The AER raised four principal issues:

- Differences in forecast outcomes with the Australian Energy Market Operator's (AEMO) forecast;
- Differences in forecast outcomes between AEMO and Ausgrid for solar PV, batteries and electric vehicles;
- Ausgrid's forecast methodology for block loads (large new customer connections); and
- Ausgrid's treatment of new block loads for road tunnels, rail and data centres

We address each of these issues below.

AEMO comparison

With regard to AEMO's forecast, the AER in its draft decision stated:

> *"Ausgrid forecasts its summer system peak demand to grow at a higher rate than the AEMO forecasts."* [1]

And in particular, the AER noted:

> *"from 2017–18 until 2023–24, Ausgrid forecasts an average annual growth of 1.2 per cent compared with 0.1 per cent from AEMO."* [2]

Following updates to forecast methodologies by both Ausgrid and AEMO, the forecasts are now significantly more closely aligned with 7 year compound annual growth rates of 1.1% and 1.4% respectively.

The increased similarity in forecast outcomes is largely due to greater alignment in the forecast components for key forecasting methodology elements. While, at this stage, AEMO does not publish sufficient detail to enable Ausgrid to definitively identify the contribution from individual forecast elements, discussions with AEMO indicate that the differences are principally due to minor variations in methodologies for weather correction, trending and treatment of block loads in the short term forecast horizon, and econometric modeling and post model adjustments in the longer term forecast horizon. A comparison of the forecast coincident summer maximum demand is shown in Figure 5 in the next page.

[1] AER Draft Decision (2018) Ausgrid 2019-24 Attachment 5 – Capital Expenditure, pg 5-130

[2] Ibid, pg 5-131

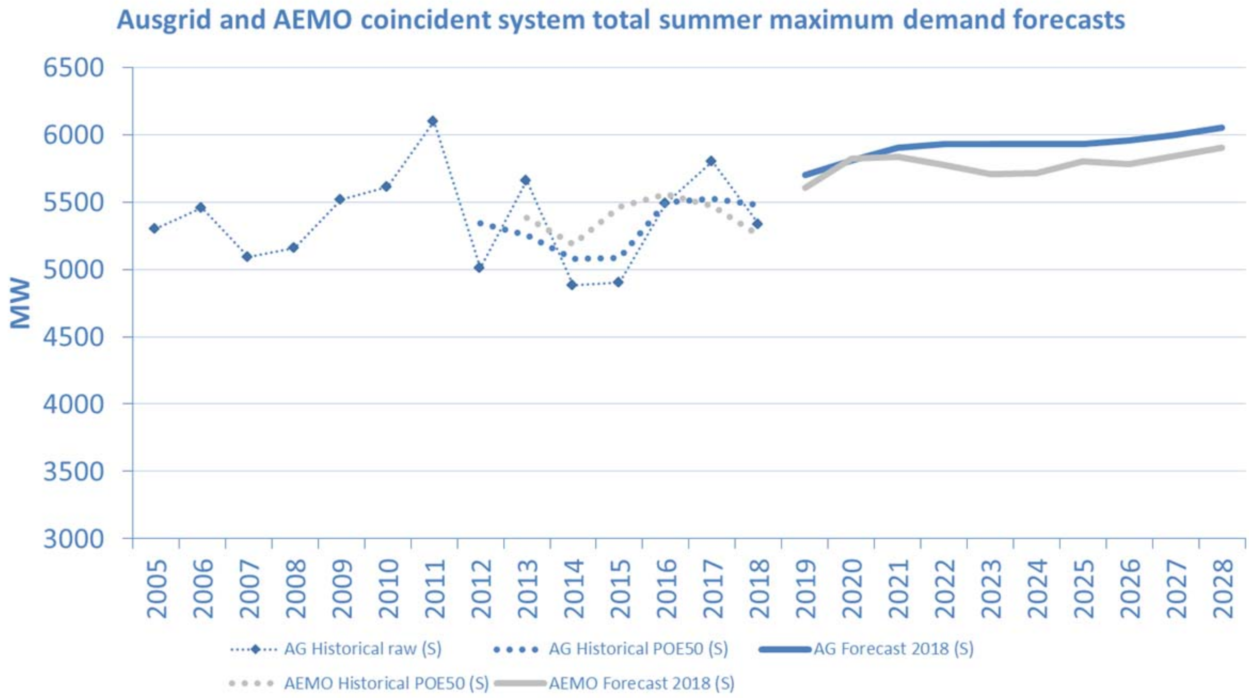

Figure 5

Emerging technologies

With regard to solar and batteries, the AER in its draft decision stated:

> *"Ausgrid considered that the penetration of solar and batteries in its network area is modest compared with other networks in Australia. It argued that many apartments and commercial sites in the Sydney region within its network are not suitable for installing solar technology."* [3]

And:

> *''Unlike AEMO, Ausgrid assumes no uptake of non-residential battery energy storage"* [4]

Stakeholders voiced similar views that Ausgrid's forecast impact from distributed energy resources (DER) was too low and that this led to higher long term growth rates.

To address these concerns, Ausgrid engaged external expertise to develop and deliver DER forecasts for the 2018 spatial demand forecast. The updated DER forecasts use an agent based model to simulate customer bill savings to forecast future uptake of solar and battery technology.

There are 6 agents, or representative customers; 3 residential and 3 non residential customers which represent the mix of customer types in the Ausgrid network.

For each agent, the model calculates annual electricity bills savings based on a projection of electricity prices, Solar PV and battery installation costs, including how costs will decline over time. Electricity bill savings are calculated from actual half-hourly PV generation data and customer interval demand data over a 12 month period. For DER configurations involving batteries, a charge/discharge algorithm is overlaid that aims to avoid daily peak period energy charges by storing and consuming energy behind-the-meter.

[3] AER Draft Decision (2018) Ausgrid 2019-24 Attachment 5 – Capital Expenditure, pg 5-133

[4] Ibid, pg 5-133

The model derives the return on investment (ROI) for various combinations of PV and battery sizes including for standalone PV, standalone batteries and combined PV plus battery configurations. Based on the range of calculated ROIs, the optimal DER configuration is identified for each agent for each year.

DER uptake is determined from the ROI, variable by agent and by year, which drives an incremental uptake in DER for those customers who don't already have DER. The higher the calculated ROI, the higher the incremental uptake in DER. Spatial distribution of the solar and battery storage systems are based on the share of each agent type using ABS census information.

The resultant demand impact from solar and storage for the 2018 forecast is a 270 MW reduction in maximum demand by 2024 and 508 MW by 2030. This increase in the forecast adoption of DER results in a reduction in future annual growth rates to about 0.3-0.4% by 2025. From that point growth is expected to being to increase again due to increasing growth in electric vehicles.

With respect to electric vehicles, the AER in its draft decision stated:

> *"Unlike AEMO, Ausgrid assumes … 0.3kW per vehicle peak demand effect for electric vehicles."* [5]

As noted in Section 5.4 of Attachment 5.07 - 2017 electricity demand forecasts report of our initial proposal, Ausgrid adopts AEMO's forecast of electric vehicle numbers, but did not adopt AEMO's past assumptions of no peak demand impact. Australian6 and international studies7 have shown that there would be a maximum demand impact on a working weekday of between 0.3 kW and 0.4 kW per vehicle during the peak periods (2pm to 8pm). For our 2018 forecasts, we have retained both our use of the latest AEMO vehicle quantity forecasts and 0.30 kW per vehicle maximum demand impact. This maximum demand impact assumes a level of customer take-up of cost reflective tariffs consistent with international jurisdictions with a more developed electric vehicle market.

For their 2018 forecast, and based upon advice from the CSIRO, AEMO have adopted three different demand charging profiles which result in a varying maximum demand impact ranging from 0.5-1.4 kW per vehicle during the 2pm-8pm period when Ausgrid's zone and sub-transmission substations reach maximum demand. Following this change, AEMO's forecast includes a larger increase in maximum demand due to electric vehicles in comparison with the Ausgrid forecast.

Due to the uncertainty associated with the peak demand impacts from electric vehicles, Ausgrid is collaborating with industry, AEMO and the NSW government in the ARENA funded project Charge Together led by EVenergi to better understand the future take up of electric vehicles and the associated impacts of electric vehicle charging on the electricity distribution network.

Outcomes from the project will help manage the impacts of electric vehicle charging on the distribution network by providing guidance on:

- the forecast spatial distribution of the take-up of electric vehicles;
- customer charging preferences;
- customer tariff preferences; and
- customer preferences to demand response programs or other smart charging initiatives.

Outcomes from the project are likely to provide guidance for forecasts and tariff design beginning in mid to late 2019.

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[5] Ibid, pg 5-133

[6] Ausgrid, Smart Grid Smart City: Electric Vehicle Technical Compendium,2014

[7] Idaho National Laboratory, EV Project Electric Vehicle Charging Infrastructure Report,2013

Block loads

With regard to block loads, the AER in its draft decision stated:

> *"Ausgrid's approach to forecasting block loads departs substantially from the approach taken by AEMO and contributes to Ausgrid's higher growth rates."* [8]

Noting that:

> *''These forecast new connections are much higher than those observed in the historical data and are not included in AEMO block load adjustments due to the size threshold difference."* [9]

And making reference to a footnote that states:

> *''AEMO has applied a 5 per cent threshold to screen out block loads, resulting in thresholds of over 200MW and 50MW for the Sydney region and the Hunter region respectively. The block load size thresholds adopted by Ausgrid are relatively small at 50 amps for 11kV connections and all connections at 33kV and above. The 50 amp threshold is equivalent to load of less than 1MW or about 3 per cent of the load on a zone substation with a load of 30MW (the average Ausgrid zone substation load)."* [10]

Ausgrid considers that the comparison between the threshold of 200MW used by AEMO for their Sydney Transmission Connection Point forecasting region with the 1MW threshold used by Ausgrid for our zone substation forecasts fails to consider reference spatial load. AEMO are forecasting for the Sydney and Central Coast region as a whole representing 4000MW of customer load. Ausgrid are forecasting at a spatial level for 180 separate zone substations with an approximate average maximum demand of about 30MW. When the threshold is represented as a percentage, the AEMO threshold is 5% and the Ausgrid threshold is 3-3.5%. Representing the thresholds as a percentage of the base forecast load is a fairer comparision then representation in MW.

The use of a 5% threshold by AEMO and others is derived from typical past industry practice and recommended by ACIL Allen in their report commissioned by AEMO to guide connection point forecasting. On block loads, this report stated that:

> *"Block loads cause demand data to 'step' either up or down depending on the circumstances. In either case they can obscure the underlying growth pattern in the data."* [11]

recommending that

> *"adjustments should be made to remove the impact of block loads from the historical data"* [12]

and that

> *"in principle, block load and organic growth should be dealt with separately"* [13]

Ausgrid supports this industry best practice approach from ACIL Allen and consequently has incorporated this approach to addressing block loads separately in our forecasting methodology. As noted in Section 5.7 of Attachment 5.07 - 2017 electricity demand forecasts report of our initial proposal, Ausgrid adopts a comprehensive assessment process of all large customer connections to

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[8] AER Draft Decision (2018) Ausgrid 2019-24 Attachment 5 – Capital Expenditure, pg 5-130

[9] Ibid, pg 5-133

[10] Ibid, pg 5-133

[11] ACIL Allen, Connection point forecasting, A nationally consistent methodology for forecasting maximum demand, pg xi

[12] Ibid

[13] Ibid, pg 6

more accurately assess the probable impact on local zone substation demand. This involves the tracking and analysis of several thousand customer connection applications for seven years of historical data and four forecast years so as to forecast block loads and organic growth independently.

Essentially, this means that historic block loads are removed from the historic trend so that the underlying organic growth pattern in the data is discovered. Forecast block loads are then added to the calculated underlying trend in the same way the historic block loads are derived. This includes the application of scaling factors derived from the analysis of historical block loads. It is Ausgrid's view that this approach more accurately forecasts local substation demand.

In a period when new large customer connections are increasing, this does lead to higher block load demand than that observed in the historical block load data. During the current significant customer activity, this is to be expected. If, in future, the rate of new large customer connections decline, Ausgrid's approach will result in a lower and more correct forecast demand than if we were to derive the trend from data that includes the cyclical development activity we are currently experiencing.

The following graph shows an independent construction index produced by RLB mapped against the count of 11kV block load activity included in Ausgrid's historical trend and forecast. The RLB index uses crane activity as an indicator of current activity in the construction industry in the Sydney region (RLB index produced for Australian capital cities).

Crane activity is a likely leading indicator of completed new customer connections and mapping the RLB index lagged by two years shows that Ausgrisd's underlying block load data corresponds closely with the index. If the slight downturn in crane activity continues to decline, then the Ausgrid method of handling block loads when trending growth rates and forecasting demand will result in lower substation forecasts in the future.

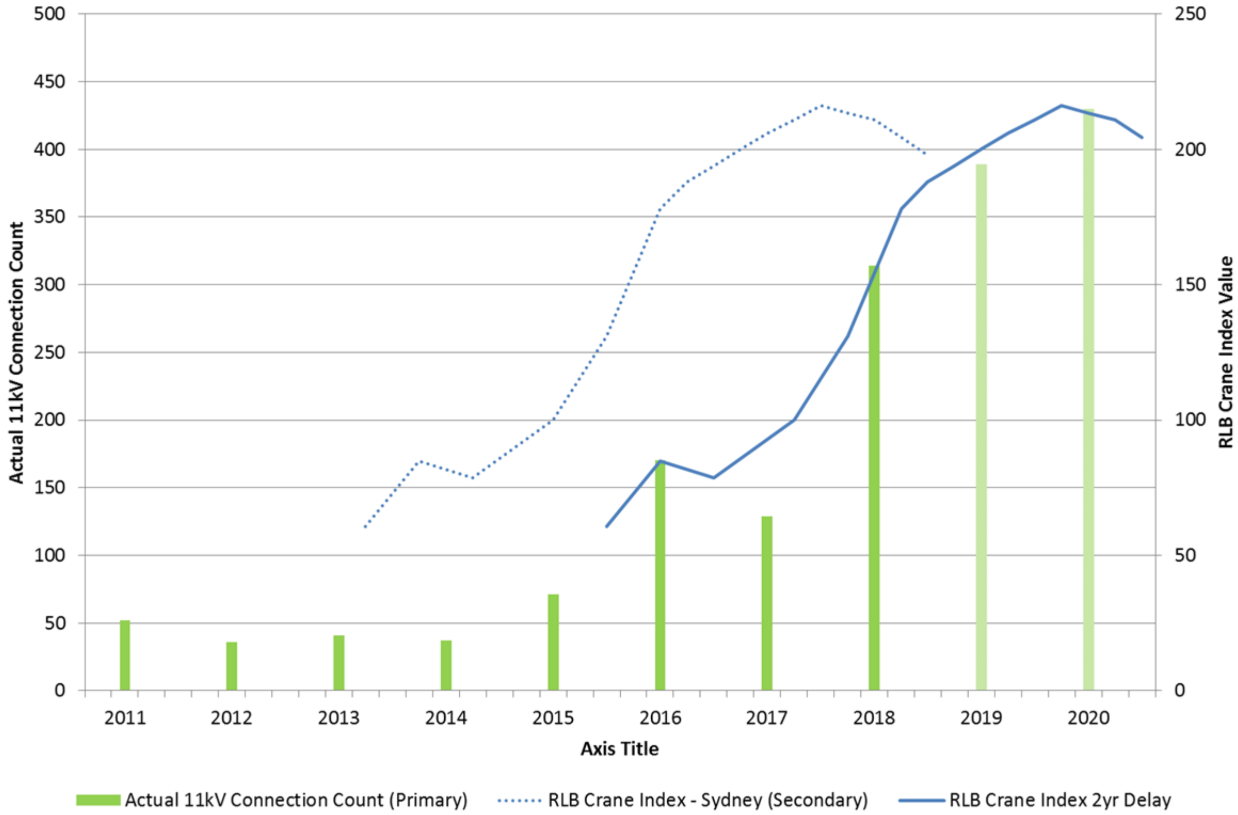

Figure 6

See also the following chart which shows the zone substation growth rates with and without the impact of block loads and the decline in the number of zones with positive growth when block loads are excluded.

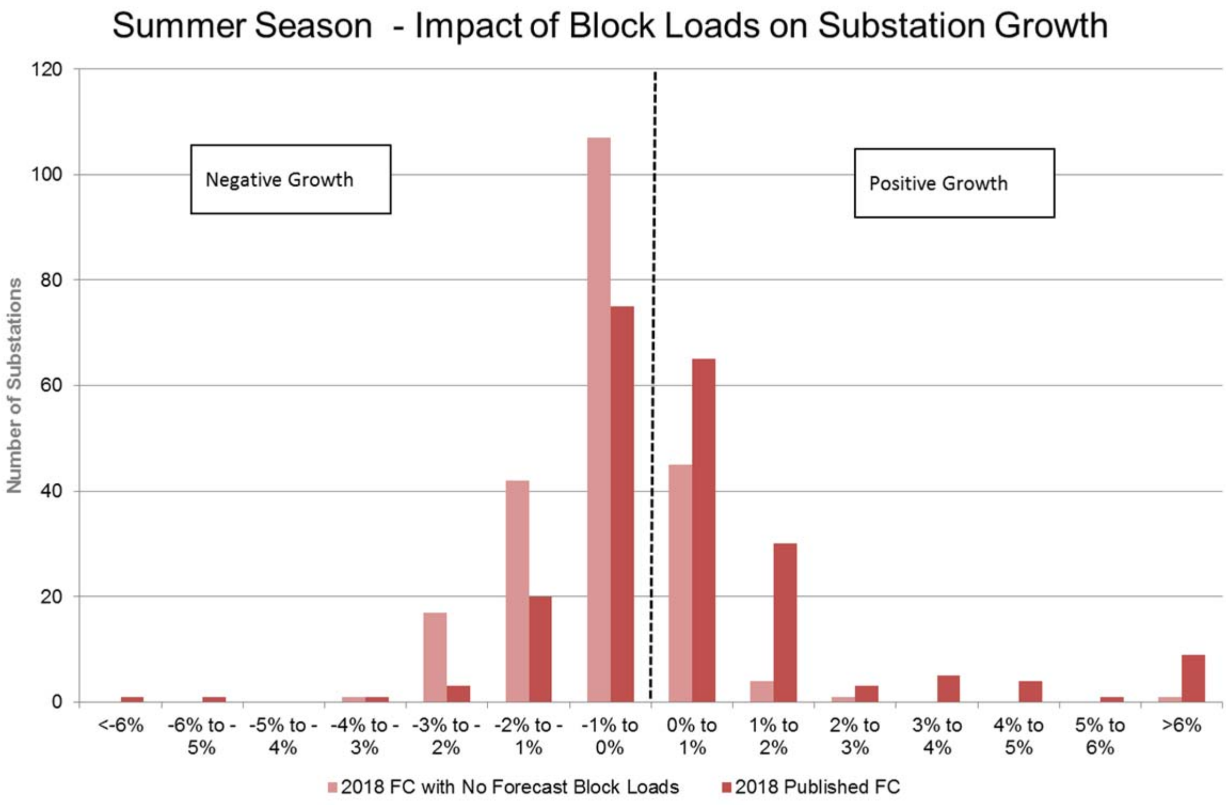

Figure 7

Note that it is our understanding that AEMO have adopted modified processes to manage the large new customer connections currently underway in the Sydney transmission connection point region.

Road tunnels, rail and data centres

With regard to block loads for road tunnels, rail and data centres, the AER in its draft decision expressed concern that our forecast did not adequately test customer connection requests to determine the resultant maximum demand impact. The AER provided a detailed review of the specific customer connections associated with these block load categories in a confidential Appendix G. We commend the AER for what is a considered assessment of these new customer loads in confidential Appendix G.

As noted by the AER in the public attachment 5, Capital expenditure:

> *"Ausgrid has already indicated some of our concerns have been rectified in its 2018 maximum demand forecast."* [14]

As per the AER's comment, Ausgrid has updated the forecasts for these large new customer loads using latest available information from customers which we consider has addressed the AER's concerns.

For new road tunnel connections, Ausgrid's 2017 forecast were based upon preliminary design information from the customer. The 2018 forecast includes a more thorough review of the more advanced design by the customer, with a key change in our estimates the result of a better understanding of the emergency and standard operating requirements.

[14] AER Draft Decision (2018) Ausgrid 2019-24 Attachment 5 – Capital Expenditure, pg 5-134

The updated assessment has resulted in a 49% reduction in the scaling factor applied to new road tunnels from 0.57 to 0.28, such that even though the 2018 forecasts includes two further road tunnels resulting in a 32% increase in total requested road tunnel capacity, the forecast demand is lower in the 2018 forecast. The new revised 2018 demand forecast for road tunnels is 33% lower than Ausgrid's 2017 forecast and 33% lower than the AER's comparison forecast in Appendix G.

Note that the AER's assessment in Appendix G appears to have misinterpreted elements of the information provided such that Ausgrid's actual 2017 forecast demand for road tunnels was 44% lower than that stated in Appendix G.

For new rail connections, Ausgrid's 2017 forecast was similarly based upon preliminary design information from the customer. The 2018 forecast includes a more thorough review of the more advanced design by the customer, with the updated assessment resulting in an 11% cut in the scaling factor applied to new rail connections.

In contrast to road tunnels, the customer requested capacity has reduced by 29% as the more advanced design status allows more accurate capacity estimates. In combination with the reduction in the scaling factor applied, there has been a 36% reduction in the forecast new rail demand in the 2018 forecast compared with the 2017 forecast. The new revised demand forecast is 46% lower than the AER's comparison forecast in Appendix G.

Note that the AER's assessment in Appendix G appears to have misinterpreted elements of the information provided such that Ausgrid's actual 2017 forecast demand for rail was 38% lower than that stated in Appendix G.

With respect to new data centre connections, the AER noted:

> *"there are data centre projects of substantial size that are not covered in the 2017 demand forecast."* [15]

Customer connection requests in this industry category continue to be a major source of new customer demand, with an 81% increase in requested capacity from the 2017 to the 2018 forecast. Forecast treatment of the requested capacity has also been updated, resulting in a reduction of 12% in the applied scaling factors. The combination of the modified scaling factors and increased customer connection requests has resulted in a 59% increase in the forecast new data centre demand in the 2018 forecast.

Note that all large new customers are required to directly pay for connection of their premises to Ausgrid's network. And as these prospective customers are expected to utilise a large percentage of any shared assets, specific tariff arrangements are established to recover the majority of the cost of the augmentation from the beneficiaries (i.e. the new customers), taking into account their share in the capacity added to the network. In effect, these customers will be charged a cost reflective network price, determined specifically from this network augmentation investment, plus allocated costs from the use of the upstream system - i.e. through 'Distribution Use of System (DUOS) tariffs.

[15] AER Draft Decision (2018) Ausgrid 2019-24 Attachment 5 – Capital Expenditure, pg 5-134