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Mr Andrew Turley
Manager, Integrated Energy Systems
Forecasting Division
Australian Energy Market Operator
GPO Box 200
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Dear Mr Turley

RE: NEM Demand Forecast Methodology Issues Paper Consultation

ERM Power Limited (ERM Power) welcomes the opportunity to respond to the Australian Energy Market Operator's (AEMO's) National Electricity Market (NEM) Demand Forecast Methodology Issues Paper (the Paper) issued 7 November 2018.

About ERM Power

ERM Power is an Australian energy company operating electricity sales, generation and energy solutions businesses. The Company has grown to become the second largest electricity provider to commercial businesses and industrials in Australia by load[1], with operations in every state and the Australian Capital Territory. A growing range of energy solutions products and services are being delivered, including lighting and energy efficiency software and data analytics, to the Company's existing and new customer base. The Company operates 662 megawatts of low emission, gas-fired peaking power stations in Western Australia and Queensland. www.ermpower.com.au

General comments

ERM Power supports AEMO decision to release its NEM Demand Forecast Methodology Information Paper Version 1 dated 26 September 2018 and accompanying consultation Issues Paper for review and comment. We believe this is a first and important step by AEMO to assist participants, market observers, jurisdictions and other NEM regulatory bodies to understand the methodology by which AEMO formulates NEM medium and long term regional consumption and demand forecasts used in critical planning areas such as the Medium Term Projected Assessment of System Adequacy (MT PASA), the Energy Adequacy Assessment Projection (EAAP) and the Electricity Statement of Opportunities (ESOO). All these planning documents are used to assess the future reliability of the NEM to meet future consumer demand. Achieving a reasonable level of accuracy, particularly in maximum demand forecasts used in these documents, is paramount in achieving these objectives.

To date, significant concerns have been raised on a number of occasions by participants, market observers and market regulatory bodies with regards to the conservative nature (over forecasting) of AEMO's medium and long term forecasts. The recent Australian Energy Markets Commission's (AEMC) Reliability Frameworks Review found that "*In the MTPASA timeframe (between 2-years and 7-days ahead of dispatch), forecast demand has been consistently higher than actual demand across all NEM regions over the past six years.*

[1] Based on ERM Power analysis of latest published financial information.

The historical differences between forecast and actual demand are relatively large compared to average and maximum regional demand. The differences are often of a similar magnitude across the six year analysis period, showing there have not been material changes over the period analysed."[2]

We support the Commission's findings and agree that whilst there has been no observable deterioration with regards to these large differences, there has also been no observable improvement. We are of the strong belief that work needs to be undertaken by AEMO to achieve real improvements in the accuracy of their medium and long term forecasts. This is further highlighted by the fact that the market operator's 10% Possibility of Exceedance (POE) for Victoria has never been achieved, despite several extreme and prolonged weather events occurring during several summers. Conversely, it is also worth noting that actual demand has been lower than the 90% POE forecasts in 5 out of the last 19 years. In SA, actual demand in 6 of the last 19 years was less than the 90% POE forecast.

The summer of 2017/18 was acknowledged by the Bureau of Meteorology as being;[3]

- *Australia's third-warmest year on record, with the annual national mean temperature 0.95 °C above average*
- *Maximum and minimum temperatures warmer than average; particularly maxima, which were the second-warmest on record (1.27 °C above average)*

Temperature outcomes over the summer of 2017/18 in Melbourne (AEMO's proxy for Victoria) exceeded the 90th percentile of historical temperature outcomes during all 3 summer months and the 95th percentile in December and January on working weekdays and outside the AEMO-designated holiday period in December/January, notwithstanding, actual demand failed to achieve the 2017 National Electricity Forecasting Insights (NEFI)/ESOO 50% POE forecast. Despite this outcome, AEMO increased its forecast 10% and 90% POE maximum demands for Victoria for the 2018-19 summer by more than 400 MW compared to the 2017 National Electricity Forecasting Insights (NEFI). This is one of the reasons for the high USE forecast for Victoria for the 2018/19 summer. It is these concerning conservative forecasting outcomes arising from AEMO's current forecasting methodology that AEMO must seek to improve.

Whilst we offer further comment on information set out in the Demand Forecast Methodology Information Paper, this should be read in the context of comments solely on the Information Paper and should not be considered as supportive of forecasting outcomes issued by AEMO as part of the 2018 ESOO. We remained concerned that for most regions the forecasts remain highly conservative in nature.

Transparency, accessibility and consistency of forecasts

ERM Power believes there are three significant areas for improvement to AEMO's demand forecasts, being transparency, accessibility and consistency. Historically, the normal convention used in the electricity industry both prior to the NEM and up until the 2015 National Electricity Forecasting Report (NEFR) /ESOO was that forecast and actual consumption was reported on a "sent out" basis and maximum demand was reported on an "as generated" basis. Forecasting report data was relatively easy to access and consistent with other real time data, however, from the 2016 NEFR/ESOO this changed, with data more difficult to access and requiring post retrieval manipulation to achieve data consistency. We propose a number of recommendations below to improve this.

It has also been observed that historical operational demand data derived from earlier AEMO forecasting reports have altered without explanation as subsequent NEFR/NEFI/ESOO reports are released.

[2] Section 3 page 48 AEMC Reliability Frameworks Review – Directions Paper
[3] BOM Annual Climate Statement 2017

The NEFR/NEFI/ESOO reports contain no comparison of actual historical data with the most recent forecasts immediately prior to the applicable summer or winter period. Further adding confusion to the process, the naming of demand forecasting reports has varied with reports titled as the SOO, ESOO, NEFR and NEFI. The central planning forecast over different reporting years has been referred to as the "medium", "planning" and "neutral" scenarios. Overall, we believe the current methodology to obtain useful and consistently based actual and forecasting data is poor, confusing and requires immediate attention.

We suggest that in future all annual demand forecasting reports be released as the National Electricity Forecasting Report – NEFR. The clear tittle of this report explains its purpose.

We also suggest the NEFR:

- must contain a central clearly labelled "planning" forecast scenario with data in this scenario used for all AEMO's medium and long-term planning documents such as the MT PASA, ESOO and EAAP, to determine the future supply vs demand reliability assessment.
- should contain clear and consistent reporting of forecasts and actual energy consumption based on a "sent out" basis and maximum operational demand based on an "as generated' basis, restoring the historical norm and consistency with AEMO's real time data publication of actual operational demand.
- should contain historical data for a minimum of 10 years and report both the actual and historically contemporaneous "planning" forecast for 10, 50 and 90% for those years to allow interested parties to easily compare actual to "planning" forecast outcomes.
- data should be easy to retrieve via a dedicated link on AEMO's website included in each successive NEFR as it is released and also via AEMO's Forecasting Demand Data Portal.
- and additional data to show the full breakdown of how the forecasts are derived would remain available as per the current CSV format download selection template on the Forecasting Demand Data Portal.

These improvements are important to ensure historical and forecast data is transparent, consistent and easily accessible, as currently this is not the case.

Business annual consumption

The Information Paper reasonably sets out the data inputs used to calculate the annual consumption forecasts for a range of medium to large scale businesses. However, there are many questions relating to the selection of sub categories in the 'Other Business' category which we believe should be considered.

Could the inclusion of other sub-categories such as energy usage for rail services, schools, hospitals or data centres, etc, which have specific consumption shapes improve the accuracy of the forecasts?

As additional large scale batteries or pumped storage hydro units are installed in the grid, how will the consumption associated with charging of these batteries and water pumping be captured and reported on?

How will the expected increases in demand response due to current rule change proposals be captured?

With regards to the forecasts for electric vehicle charging, it is unclear from the Information Paper what breakdown of electric vehicle charging will be captured under business consumption. Would this include all large scale multi vehicle charging stations, or only charging stations at business premises?

Whilst there are other questions associated with business consumption, these are also relevant to the residential consumptions and maximum demand forecasting sections and will be captured in these areas of this submission.

Residential annual consumption

The Information Paper reasonably sets out the data inputs into calculating the annual consumption forecasts for residential consumption. Notwithstanding, we have concerns with the actual input assumptions to the modelling, and as indicated above, these concerns apply to both the consumption forecasts for business as well as residential consumption, and for the calculation of residential connection point and temperature sensitive business connection points half hourly demands.

Selection of weather stations used in calculations

We note that in Table 14 – Appendix A2 of the Information Paper, AEMO sets out 6 weather stations in 5 capital cities, which excludes Canberra, (though a large demand centre in itself), which are used as the proxy for the calculation of temperature sensitive demand across the entire region. We are concerned that the use of so few data points will fail to adequately capture the operational spread of weather outcomes across the NEM as a whole and note that other AEMO documents indicate that up to 20 weather stations are used for forecasting purposes. This limited input of weather stations has the potential to impact accuracy of a number of calculations in the forecasting process. Given the range of operational data available from "bulk supply points" in the transmission system and individual connection point meter data which covers the geographical spread of the NEM, we would be interested to understand why AEMO has chosen not to utilise an expanded selection of weather stations to model consumption and demand variability across a region and the NEM in the calculation methodology.

Use of heating and cooling degree days

We note that AEMO has not used widely accepted industry standard values for the selection of critical temperatures for the calculation of cooling and heating degree days in modelling temperature sensitive load variations, but instead preferring to determine its own set of critical temperatures on a region by region basis[4]. We request that AEMO provide justification for this departure from the use of the industry standards. In considering the use of non-standard values, we would be interested to understand if AEMO considered a "time of day" variable and solar radiation values in their decision process. The impact of solar radiation for cooling degree days can be significant, and we submit that not all dwelling or business cooling requirements are derived solely from ambient temperature outcomes, and demand outcomes will vary for the same temperature outcomes due to variance in solar radiation. The inclusion of worked examples of the calculation in the applicable appendix to the Information Paper would be of value.

Calculation and use of an "average" consumption and half hourly demand per residential connection point

The Information Paper indicates that an average "base" and "temperature sensitive" consumption and half hourly demand is calculated based on the total residential consumption divided by the number of residential connections in the region on a region basis. These "base" and "temperature sensitive" load outcomes are then applied to all existing and future residential connection points for the applicable region. It is unclear from the Information Paper if these connection points were further disaggregated to account for variables in the type of connection, i.e. detached house, semi-detached house or unit, or the use type of the connection, i.e. owner occupied, rental or holiday accommodation.

These attributes would allow for greater accuracy as it would consider the more likely consumption and demand patterns pertaining to the different types and use at the connection point and be more reflective of the natural mix of residential connection points. We also believe that AEMO should consider the potential for usage diversification, where residences may be unoccupied during working hours or holiday periods and therefore will not be temperature sensitive during these time periods.

[4] Table 13 – Appendix A2 NEM Demand Forecast Methodology Information Paper

Similar concerns would apply to connection points currently allocated to the business category where averaging of consumption and half hourly demand is used in the calculation process.

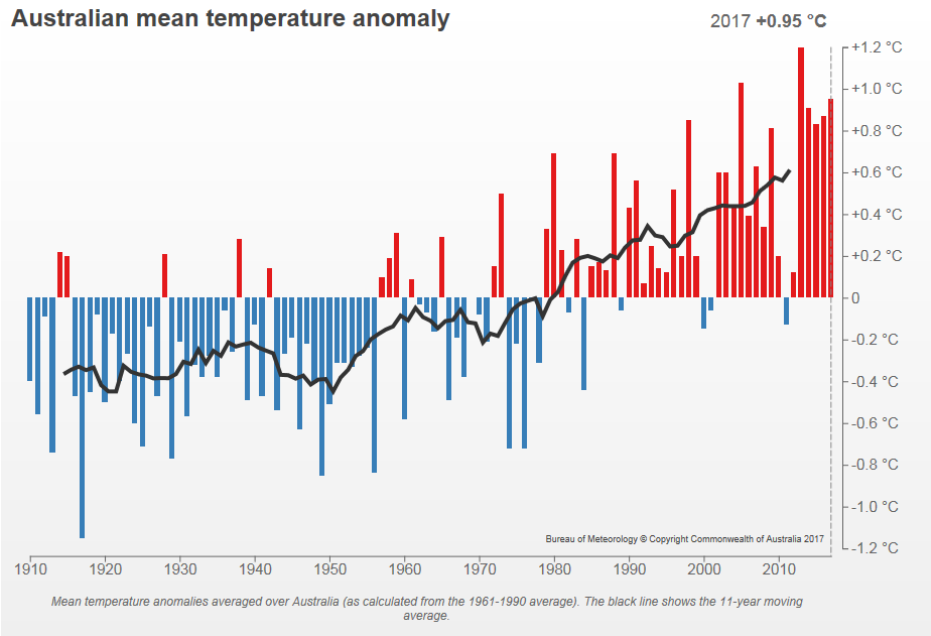
We believe the Information Paper would benefit from the inclusion of regionally based data for temperature sensitive load, for both consumer and business load. The data could be supplied in tabular or graphical form and would be set out on the basis of an increase in demand (KW) per one degree deviation from the critical temperature(s).

We also note that the Information Paper includes adjustment factors to incorporate AEMO's view that electrical appliances will be bigger than those currently or historically installed and thus increase overall consumption and half hourly demand. We add caution in this regard and request AEMO to consider that replacement of older electrical appliances with newer more efficient models may actually lead to consumption and demand reductions. It is our view that AEMO should access independent data to validate their current assumption.

Calculation and use of factors for the impact of climate change

The Information Paper indicates that AEMO has included a climate change adjustment in the forecast of temperature sensitive load. We understand that this adjustment factor acts to increase the number of cooling degree day values and potentially to decrease the heating degree day values. This climate change adjustment factor is applicable for both residential and some sectors of the business consumption category. The factor is also applicable for the calculation of maximum demand forecasts across residential and business demand.

The inclusion of this factor is based on AEMO's view that both the mean of daily temperatures and the maxima of monthly and seasonal temperatures are increasing at a known trend. In addition, we note that whilst the Information Paper is not clear with regards to the selection of a "base year" from which this factor is calculated, the Information Paper indicates the selection of Calendar Year 2000 as the "base year" in a number of other calculations. Data available from the Bureau of Meteorology partially supports AEMO's view that the mean of the daily temperatures are increasing, however it is less clear that the maxima of monthly and seasonal temperatures are increasing and at the same trend. It is also less clear that a statistically significant trend post calendar year 1990 has emerged in mean daily temperature outcomes. The graph below has been copied from the Bureau of Meteorology 2017 Annual Climate Station.



As no data is provided in the Information Paper with regards to the calculated adjustment factors which are to be applied on a yearly basis to the forecast period, or the forecast temperature trend that this is based on, we reserve support for their inclusion. Further, we recommend that these yearly adjustment factors and the temperature trend utilised also be included in the next revision of the Information Paper. We also request that data be presented to support AEMO's view that the maxima of monthly and seasonal temperatures are increasing at a known trend and at a higher rate than the increase in the mean of the daily temperatures.

Calculation of the impact of rooftop solar PV

As jurisdictions such as Victoria commit to a large roll out of rooftop solar PV, accuracy in rooftop solar PV load outputs will be more and more important. Based on the graphs presented in Figure 12 - Appendix A3, it could be assumed that AEMO's rooftop solar PV output is based on the panel installation value as opposed to a combination of installed panel and inverter capacity. It is reasonably common practice for an installation to include panel capacity of 15 to 25% higher than inverter capacity in rooftop solar PV. Simply calculating solar PV output based on panel capacity may overestimate the contribution of solar PV in the Native Demand consumption calculation. It may also underestimate the contribution of solar PV to the summer afternoon peak demand periods, as the inverters will continue to contribute later and at higher output levels into the afternoon periods than that modelled by AEMO.

Also, the information paper indicates that in calculating the contribution of solar PV to the summer afternoon peak demands, AEMO have assumed that all solar panels are currently installed facing due north, noting that over time panel installations may shift towards a more westerly rooftop panel orientation, reaching 10% of the forecast effective capacity after 20 years. Whilst these assumptions may be correct, there is no supporting data to indicate that existing installation have been installed primarily facing northwards. We recommend that AEMO consider funding a survey to more accurately determine the orientation of panels and also the relationship of panel to inverter capacity.

Whilst it is acknowledged that due to the installation of rooftop solar PV the timing of operational maximum demand in summer months is moving back to later in the day, the actual magnitude of this new summer peak demand may be lower than that which occurred with the historical timing of maximum summer demand in the 15:30 to16:30 period due to the impact of rooftop solar PV. With maximum grid supplied demand during summer months occurring later in the day, 16:30 to 17:30, the contribution of some segments of the business category would also be lower, i.e. schools and factories which have closed by this time.

We also note that AEMO has included a "solar rebound effect" factor where residential connection points are assumed to increase consumption and possibly half hour demand by 20% due to lower electricity bills following the installation of rooftop solar PV. We believe AEMO should provide further details of the basis for this assumption and the base level from which the adjustment is calculated.

Forecast of the impact of residential electric vehicle charging

We support AEMO's decision to engage external consults (CSIRO) to consider and assist with developing potential electric vehicle charging profiles. We note that the Information Paper indicates that 40% of electric vehicle charging is assumed to occur from the time the vehicle is garaged from its return journey to the primary residence. We are concerned that this may not fully consider the impact that technology such as the use of smart meters and retail tariff incentives will play in consumer's choice to adjust electric vehicle charging times outside higher demand periods.

With regards to the forecast of timing of overall conversion of the existing transport fleet to electric vehicles, the impact of electric vehicles on the power system is far from certain, and multiple electric vehicle futures are equally likely.

We believe consideration should also be given to other alternative low emission transportation options, i.e. hydrogen, either directly injected into an advanced combustion engine or used in fuel cell powered electric vehicles. Whilst a move to lower emission transportation alternatives is inevitable, it should not be assumed that electric vehicles will be the only or primary choice. We believe the Information Paper would benefit from further assessment in this area.

Energy Efficiency Savings

The Information Paper indicates that the National Energy Productivity Plan for a 40% improvement in energy productivity by 2030 has been assessed by AEMO and included on the basis that only 60% (24% improvement in total) of this target will be achieved in practice. AEMO's assessment is based on AEMO's view that a 40% consumption rebound effect will occur. We believe the Information Paper should set out in greater detail the input assumptions and calculations for this consumption rebound effect and where possible be based on supporting independent analysis which sets out clear arguments for its conclusions.

Calculation of Maximum demand forecasts

The forecasting of the range (10, 50 and 90% POE) of maximum regional demand is in ERM Power's view the most critical area of forecasting undertaken by AEMO with regards to the determination of future reliability of supply to consumers. It is these forecasts which determine the level of future supply and demand management investment required in the NEM and the need for and level of procurement of any Reliability and Emergency Reserve Trader (RERT) contracts.

Given this, this area of forecasting should demand a "best endeavours" outcome by AEMO with regards to accuracy. In ERM Power's view, supported by independent analysis undertaken by the AEMC during the recently completed Reliability Frameworks Review and the National Generators Forum in the analysis provided in its submission dated 31 March 2010 to the AEMC's 2010 Review of the Effectiveness of NEM Security and Reliability Arrangements in light of Extreme Weather Events, it is possible a highly conservative approach has been taken by both AEMO and its predecessor to the forecasting of potential maximum regional demand outcomes.

Historically, maximum demand forecasts have been provided on a simple summer and winter seasonal basis and we question if this level of forecasting remains sufficient in the rapidly transforming NEM. In our view it is time to reconsider this outcome with a view to publishing monthly maximum demand forecasts which will facilitate the better planning of supply side outages, demand management activity and improve the accuracy of reliability assessments. Where currently historical demand traces used in AEMO's modelling are adjusted to meet the seasonal maximum demand forecast across multiple months, we believe these historical demand traces would more accurate if adjusted from monthly based forecasting set points.

We understand from the Information Paper that 1,000 years of possible half hourly demand traces are derived from 1,000 years of simulated weather (temperature) outcomes, however little overall detail is provided regarding the process to derive, or the actual outcomes for these 1,000 years of simulated weather outcomes. We believe a simple way for interested parties to have greater confidence in the reasonability of these simulated weather outcomes would be for AEMO to publish in tabular form the 10, 50 and 90% POE of daily maximum temperature outcomes from AEMO's model for the initial forecast year on a monthly timescale. These derived values could then be compared to the historical Bureau of Meteorology data for the reference weather stations by referencing to the percentile of historical weather (temperature) outcomes. This would provide a reasonable historical benchmark for the simulated values to be easily compared to actual outcomes. In addition, we consider that the calculated yearly climate change adjustment values on a monthly basis for each reference weather station should also be published.

We note that the Information Paper indicates AEMO also applies an Excess Heating Factor (EHF) to modify forecast outcomes where daily maximum temperatures in simulated weather outcomes exceed the 95th percentile value for 3 consecutive days.

No details were provided with regards to the 95th percentile value for the applicable weather stations or the value of the EHF modification factor or how it is applied to the underlying demand forecast. We believe the Information Paper should provide additional details regarding the 95th percentile temperatures and the regional EHF modification values and how they are applied.

Whilst the above check would provide a level of comparison for the simulated temperature outcomes, as indicated in the residential annual consumption section of this submission, significant work is required by AEMO to further explain input assumptions and calculated outcomes for a number of areas which also relate to maximum demand forecasts. These areas include the use of heating and cooling degree days, the calculation of average "base" and "temperature sensitive" demand, the calculation of the impact of rooftop solar PV and the level of forecast energy use reduction associated with the various energy efficiency schemes.

Half Hourly Demand Traces

The Information Paper describes in overview the process for scaling of historical half hour demand traces to match the 10 and 50% POE forecasts for use in AEMO's key planning and forecasting reports. Notwithstanding, we believe this area requires additional clarification with regards to the selection of the number of days which are scaled on a yearly or seasonal basis to match the 10 and 50% POE forecasts. If only one day, (a primary day) per year or season is scaled, (which we believe would be the more acceptable input assumption), we question how many other days are then correlated to maintain a predetermined relationship with the primary scaled day and the methodology used to derive and maintain this correlation.

Conclusion

We thank AEMO for the opportunity to provide input to the current consultation process. We fully support AEMO in the publication of this initial NEM Demand Forecast Methodology Information Paper and believe this is a positive outcome to improve transparency in this area of AEMO's internal processes. In our submission we have set out areas of concern or where we have questions with regards to AEMO's published methodology.

As indicated in our submission, due to the changing nature of the NEM, achieving a reasonable level of accuracy in the range of maximum demand outcomes, and not simply on a seasonal basis, but moving towards publication of monthly maximum demand forecasts is a critical step to ensuring the reasonable accuracy of any future reliability assessment and the provision of signals to the market for supply side outage planning, and additional supply side or demand management investment.

Currently, ERM Power remains concerned that maximum demand forecasts remain overly conservative and may be leading to a view that NEM reliability is less than is actually the case if maximum demand forecasting accuracy was improved and thus more aligned with the true range of potential actual outcomes. This concern with regards to the accuracy of the market operators demand forecasts is not new and has been acknowledged in numerous submissions as early as 2010 to AEMC's reviews. We refer AEMO to analysis and commentary as submitted by the National Generators Forums submission dated 31 March 2010 to the Second Interim Report – AEMC's Review of the Effectiveness of NEM Security and Reliability Arrangements in light of Extreme Weather.

We also believe that improvements to AEMO forecasts in the areas of transparency, accessibility and consistency are required, and should be implemented as soon as reasonably achievable.

Please contact me if you would like to discuss this submission further.

Yours sincerely,

[signed]

David Guiver

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