Attachment 3: Energy, customer numbers and peak demand forecasts

Revised regulatory proposal for the ACT electricity distribution network 2019–24

November 2018

evoenergy

Table of contents

List of figures

List of tables

1 Introduction

One of the *expenditure objectives* that the Australian Energy Regulator (AER) must consider when assessing Evoenergy's regulatory proposal and making its constituent decisions in relation to forecast capital expenditure (capex) and forecast operating expenditure (opex) under clauses 6.12.1(3) and 6.12.1(4) of the Rules,[1] is the need to meet and manage expected demand for Standard Control Services.

The Rules require the AER to accept the capex and opex forecasts for the regulatory period if it is satisfied that they reasonably reflect the capex and opex criteria, which include, among other things, 'a realistic expectation of the demand forecast and cost inputs required to achieve the [capex/opex] objectives'.[2]

The regulatory proposal for the 2019–24 regulatory period is supported by three forecasts which are discussed in this attachment:

- energy sales—an input into the Tariff Structure Statement, including formulating the indicative pricing schedule;
- customer numbers—an input into forecasting connections related capex; and
- peak demand—an input into forecasting augmentation expenditure.

These forecasts are referenced in various parts of the regulatory proposal including proposed capex, opex and pricing.

Evoenergy notes that the AER's *Framework and Approach* binding decision on the control mechanism[3] for the ACT was to apply a revenue cap control to the services which are classified as Standard Control Services. Consequently, the revenue allowance for the next regulatory period will be decoupled from the volume of energy transported.

2 Energy sales

2.1 Background

Evoenergy engaged consultants Jacobs to identify key factors influencing electricity sales in the ACT and to prepare an independent sales forecast for the ACT electricity distribution network for the 2019–24 regulatory control period. Jacobs has expertise in developing energy sales forecasts and advising on energy forecasting methods. This attachment provides a summary of the forecast and the approach used to derive it. Further detail on the method, processes and assumptions used to determine the forecast was provided in appendix 3.1 to Evoenergy's January 2018 regulatory proposal.

There is considerable uncertainty associated with forecasting electricity sales over a five-year horizon, notwithstanding the utilisation of expert external advice to develop the best possible forecast. In the ACT, annual electricity sales grew almost continuously until the late 2000s, but have since remained relatively stable. Sales forecasts now need to

[1] National Electricity Rules, clauses 6.5.6(a)(1) and 6.5.7(a)(1).

[2] National Electricity Rules, clauses 6.5.6(c)(3) and 6.5.7(c)(3).

[3] AER July 2017, Framework and Approach for ActewAGL, p. 33.

contemplate not only the potential magnitude of growth, but also the possibility of a decline.

In commissioning expert advice, Evoenergy's main objective was to ensure that the methodology and the proposed forecast account appropriately for the current trends in energy consumption as well as economic, environmental and operational factors.

These factors include:

- increasing installation of microgeneration, such as solar photovoltaics (PV);
- increasing impact of new technologies as distributed energy resources;
- confirmation of the treatment of energy efficiencies;
- new and emerging network tariff structures; and
- retail price trends.

2.2 Methodology

Evoenergy is satisfied that the methodology applied appropriately accounts for the existing sales trends and factors impacting these trends. Jacobs developed an econometric seasonal (quarterly) model using the Eviews statistical package,[4] which used the variables outlined in Table 2.1 to forecast energy sales.

Development of the model to forecast energy sales involved the following steps:

- inspection of historic data;
- specification of models;
- residual analysis;
- tests for multicollinearity;
- selection of best performing model;
- development of a system-level model (for verification);
- development of solar PV generation forecast; and
- post-modelling adjustments.

A more detailed description of the methodology is provided in appendix 3.1 of the January 2018 regulatory proposal.

[4] Eviews is a statistical package mainly used for time series oriented econometric analysis.

Table 2.1 Independent variables used to forecast electricity sales

Class	Independent variable
Seasonal	Heating degree days – historic and simulations
Seasonal	Cooling degree days – historic and simulations
Seasonal	Quarterly instrumental variables (Dummies for Q1, Q2, Q3 and Q4)
Economic	Australian real GDP – historic and projected
Economic	ACT state final demand – historic and projected
Economic	ACT unemployment rate – historic and projected
Price	Residential retail prices – historic and projected – strong, neutral and weak scenarios forecast
Price	Commercial retail prices – historic and projected – strong, neutral and weak scenarios forecast
Efficiency	Total Residential energy efficiency – historic and projections – strong, neutral and weak scenarios forecast
Efficiency	Total Commercial energy efficiency – historic and projections – strong, neutral and weak scenarios forecast
Daylight	Sunshine hours ACT – long-term average

Source: Jacobs

2.3 Forecasts

Total energy sales are forecast to be 2.4 per cent higher by the end of the next regulatory period (in 2023/24) compared to 2017/18, which is the most recent full financial year of data (Table 2.2 and Figure 2.1). This primarily reflects growth in energy sales to Low Voltage (LV) Commercial customers more than offsetting a decline to Residential and Unmetered customers.

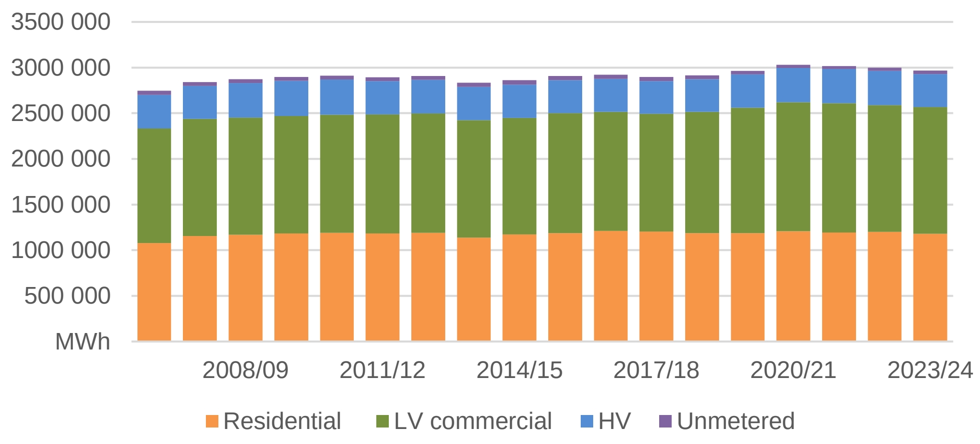
Table 2.2 Actual energy sales in 2016/17 and 2017/18 and forecast energy sales 2018/19 – 2023/24

GWh	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24
Residential*	1,213	1,205	1,187	1,187	1,209	1,194	1,200	1,179
LV Comm.	1,303	1,291	1,329	1,375	1,413	1,415	1,390	1,389
HV	362	356	356	365	375	375	373	362
Unmetered	44	45	44	38	34	33	35	36
Total	**2,921**	**2,897**	**2,917**	**2,965**	**3,030**	**3,017**	**2,999**	**2,966**

Source: Jacobs

* Includes gross PV generation

Figure 2.1 Forecast energy sales for the ACT electricity network

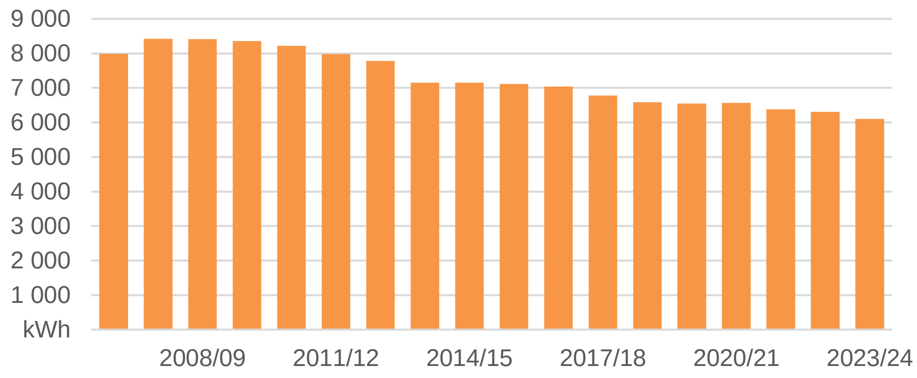


Source - Jacobs

The 2.4 per cent forecast increase in energy sales by 2023/24 relative to 2016/17 is largely driven by a forecast increase in customer numbers (section 3), rather than an underlying increase in demand for energy by individual consumers. A feature of the Jacobs forecasts is a reduction in per customer energy sales for all four customer classes by the end of the next regulatory period compared to 2017/18.

The volume of energy consumed per residential customer is forecast to be 10 per cent lower by the end of the next regulatory period (2023/24) than in 2017/18 (Figure 2.2). One factor contributing to this decline is an assumed increase in the installation of solar PV by existing customers in established suburbs, as well by new customers in new subdivisions. In the ACT there are some new residential developments which have mandated solar PV and battery storage, and customers in these areas are expected to use considerably less energy than customers in older suburbs. In addition, the closure of the gross metered solar scheme will result in an increase in net metered solar generation. Because of the significantly lower retail tariffs for solar, it is expected that customers coming off gross metered tariffs will increase their proportion of self-usage behind the meter.

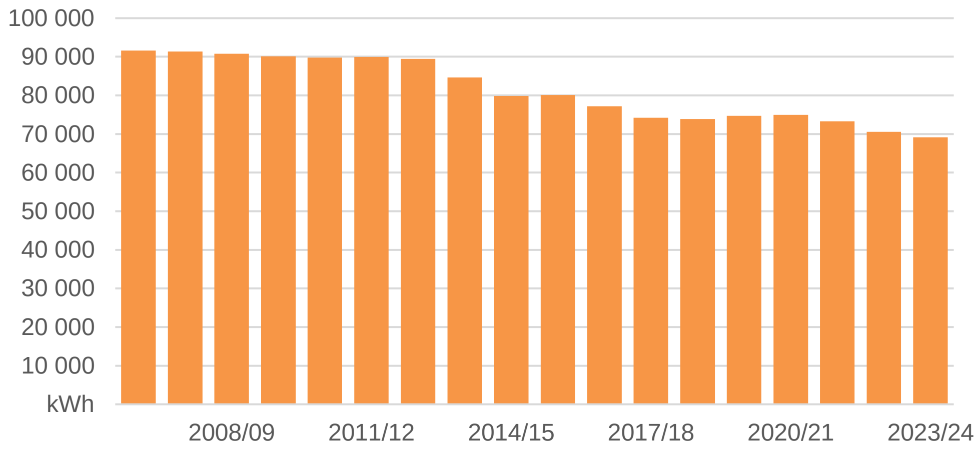
Figure 2.2 Gross energy volumes per Residential customer



Source - Jacobs

The amount of energy consumed per LV Commercial customer is forecast to be 7 per cent lower by the end of the next regulatory period (2023/24) than in 2017/18 (Figure 2.3). This reflects the effects of assumed growth in retail prices and ongoing increases in energy efficiency. The effect of the considerable increase in retail prices in 2017/18 is reflected in reduced per customer volumes more quickly than for Residential customers where there is assumed to be a lag of around one year.

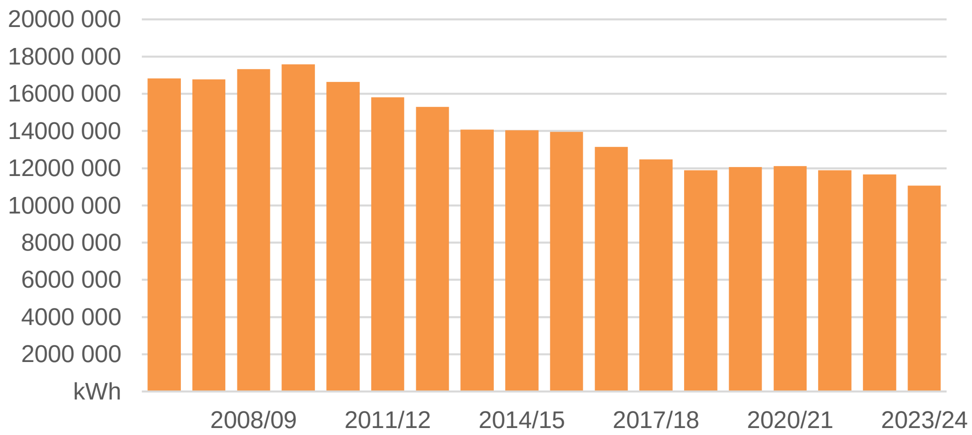
Figure 2.3 Gross energy volumes per LV Commercial customer



Source – Jacobs

The amount of energy consumed per HV customer is forecast to be 11 per cent lower by the end of the next regulatory period (2023/24) than in 2017/18 (Figure 2.4). Jacobs found that energy efficiency was a significant contributing variable to the reduction in per customer energy volumes for HV customers.

Figure 2.4 Gross energy volumes per HV customer

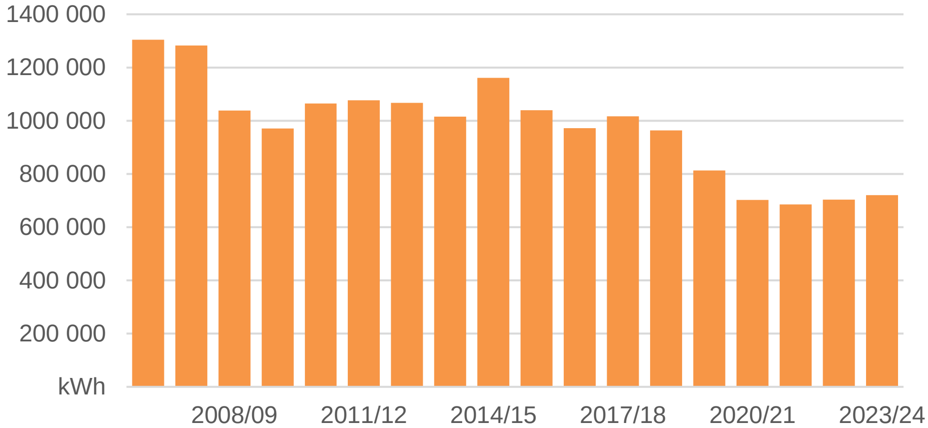


Source – Jacobs

The amount of energy consumed per Unmetered customer is forecast to be 29 per cent lower by the end of the next regulatory period (2023/24) than in 2017/18 (Figure 2.5). This is the largest reduction in per customer usage of the four customer classes. This forecast reflects a post-modelling adjustment by Jacobs to account for the ACT

Government's plan, announced in late 2017, to upgrade a significant proportion of the ACT's streetlights from incandescent to LED bulbs. The ACT Government has stated that this action will contribute towards improving energy and carbon efficiency by 20 per cent by 2020.[5]

Figure 2.5 Gross energy volumes per Unmetered customer



Source – Jacobs

3 Customer numbers

Evoenergy engaged Jacobs to also prepare an independent forecast of the number of customers connected to the ACT electricity network for the 2019–24 regulatory control period. Jacobs disaggregated the customer base into four categories: Residential, LV Commercial, HV and Unmetered. This section provides a summary of the forecasts and the approach used to derive them. Further detail on the method, processes and assumptions used to determine the forecasts are provided in appendix 3.1 of the January 2018 regulatory proposal.

3.1 Methodology

Evoenergy is satisfied that the methodology applied by Jacobs appropriately accounts for the existing trend in customer numbers and factors impacting these trends when forecasting future customer numbers. Jacobs developed an econometric seasonal (quarterly) model in Eviews, which used the economic and demographic variables outlined in Table 3.1 to forecast customer numbers. Jacobs found that projected ACT population was the dominant variable when forecasting customer numbers.

[5] https://www.cmtedd.act.gov.au/open_government/inform/act_government_media_releases/meegan-fitzharris-mla-media-releases/2017/a-brighter-future-for-canberras-streetlight-network

Table 3.1 Independent variables used to forecast customer numbers

Class	Independent variable
Economic	Australian real GDP – historic and projected
Economic	ACT state final demand – historic and projected
Economic	ACT unemployment rate – historic and projected
Demographic	ACT population – historic and projected

Source - Jacobs

Development of the model to forecast energy sales involved the following steps:

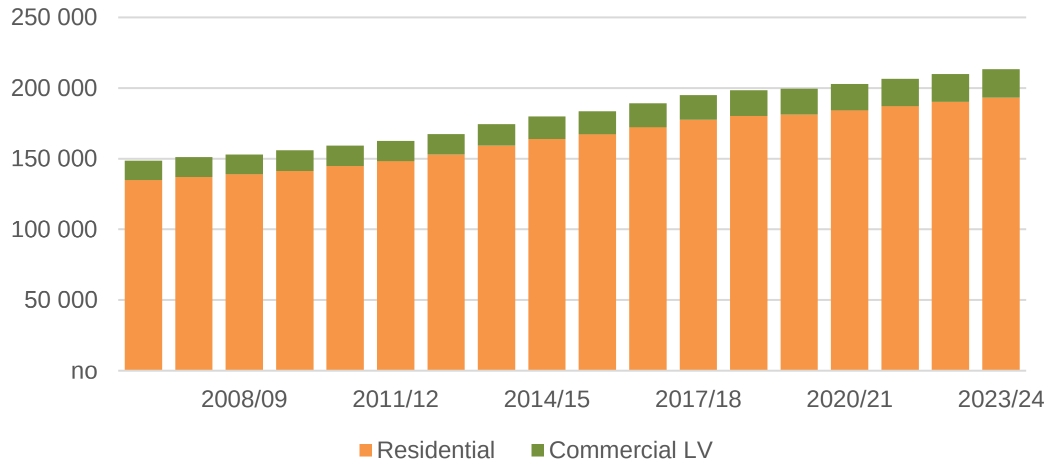
- inspection of historic data;
- specification of models;
- residual analysis;
- tests for multicollinearity;
- selection of best performing model;
- development of a system-level model (for verification);
- development of solar PV generation forecast; and
- post-modelling adjustments.

A more detailed description of the methodology is provided in appendix 3.1 of Evoenergy's January 2018 regulatory proposal.

3.2 Forecasts

The total number of customers connected to the ACT electricity network is forecast to be 9 per cent higher by the end of the next regulatory period in 2023/24 compared to 2017/18, which is the most recent full financial year of customer number data (Figure 3.1 and Table 3.2). The largest percentage increase is attributable to the LV Commercial customer class, which is forecast to grow by 16 per cent over this period. The number of Residential, HV and Unmetered customers is forecast to increase by 15 per cent, 12 per cent and 9 per cent, respectively.

Figure 3.1 Forecast number of Residential and LV Commercial customers



Source: Jacobs

The number of Residential customers is forecast to increase to 193 000 by 2023/24, 9 per cent higher than 2017/18. This primarily reflects projected growth in the ACT population, and by extension the number of households. This level of growth implies an average annual growth rate in customer connections of around 1.5 per cent. Over the 10 years to 2017/18, the number of Residential customer connections grew by an average 2.6 per cent a year.

The main observable trend to come from Jacobs' modelling on Residential customer numbers is that the number of customers is correlated to the population in the ACT. The output from Jacobs' Eviews model is depicted in Table 4 of the modelling appendix. This output shows that when forecasting the number of Residential customers, the strongest contributing variable is population growth. The output also shows an R squared above 99 per cent and that the model is well specified.

Table 3.2 Forecast customer numbers

	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24
Residential	177,640	180,382	181,181	184,142	187,182	190,226	193,243
LV Commercial	17,391	17,974	18,414	18,856	19,299	19,699	20,088
HV	29	30	30	31	32	32	33
Unmetered	45	46	47	48	49	49	50

Source: Jacobs

The number of LV Commercial customers is forecast to increase to 20,088 by 2023/24, 16 per cent higher than 2017/18. This primarily reflects relatively strong projected economic growth for the ACT during the forecast period. This level of growth implies an average annual growth rate in customer connections of 2.5 per cent, which is comparable with historical growth rates. Over the 10 years to 2017/18, the number of LV Commercial customer connections grew by an average 2.2 per cent a year.

An observable trend to come from Jacobs' modelling on LV customer numbers is that the number of customers is correlated to state final demand. The model was initially tested using population data but the results were poor. When population was substituted for state final demand (lagged by one year), the quality of the results improved. The output from Jacobs' model is depicted in the modelling appendix.

4 Peak demand

This section provides a summary of Evoenergy's forecasts of maximum demand and the methodology used to derive the forecasts. A more detailed description of the methodology used to develop the forecasts, as well as the results, is in appendix 3.2.

4.1 Independent verification of forecasts

The forecasts presented in this section have been independently verified by Jacobs, who have expertise in developing and undertaking verification of demand forecasts.

4.2 Methodology

Evoenergy is continually reviewing and refining its demand forecast methodology to ensure it is using the most up-to-date analytical models and techniques. Load demand forecasting is critical because load is one of the main drivers of capex. Within the planning drivers, network load demand forecasting is one of the most complex because of its probabilistic and unpredictable nature. It is difficult to predict because of its dependence on many factors, including customer choices, ambient temperatures, weather patterns, and in particular, load growth patterns.

Ten-year forecasts of maximum summer and winter load demands at all of Evoenergy's zone substations have been developed. Load growth varies from year to year and is not uniform across the network. The forecast reflects the spatial distribution of development in Canberra which is largely driven by uneven residential and commercial development across the ACT: demand at some zone substations is increasing considerably year on year, whereas demand at other zone substations is largely unchanged year on year. Proximity to renewable generation facilities also affects the demand at a zone substation. It is not unusual to find parts of the network that grow at three or four times the average network growth rate, while other parts of the network experience negative growth.

Evoenergy has improved the way it forecasts peak demand since it last submitted a regulatory proposal to the AER (Table 4.1). Evoenergy used a multiple linear regression model for the 2014–19 proposal, but for this proposal it used bottom-up and top-down demand forecasts and then reconciled them to derive the definitive demand forecast. Forecasts for each zone substation were developed using a bottom up forecast. The Monash Electricity Forecasting Model was used to determine the underlying trend and base load. Known proposed new customer block loads are added to the zone substation forecasts. The development of the system demand forecast was done using a top-down model which included various econometric and demographic variables. The purpose of the top-down forecast is to provide a comparison and check that the reconciled bottom-up forecast is consistent with overall expectations for the ACT.

A more detailed explanation of the methodology used to forecast peak demand is provided in appendix 3.2.[6]

Table 4.1 Difference between the current and previous peak demand forecast methodologies

Model features	Old methodology (2014–19 regulatory submission)	Current forecast methodology
Type of model	Multiple linear regressions	Semi-parametric demand model with solar and battery storage simulation
Drivers	Temperature-related variables, demographic and economic factors	Temperature-related variables, demographic and economic factors, retail electricity prices, and energy efficiency
Number of sub-models	None	Total of 49 models = 48 half-hourly models + 1 seasonal average demand model
Normalisation	None	Raw demands normalised for HH model
Simulation	No, temperature forecast based on percentile calculation of historical data	Yes, temperature, solar generation and battery discharging and charging simulations
Model selection	Stepwise regression	HH model: Cross validation procedure based on MSE Seasonal average demand model: by minimum AICc
Model evaluation	None	Evaluation of forecasting model by comparing actual demand with ex ante forecasts and ex post forecasts
Forecast bias	Potential positive bias	Risk of bias tested by model evaluation process
Rooftop PV forecast model	None	Integrated as part of demand simulation
Battery storage model	None	Integrated as part of demand simulation
Electric vehicle adjustment	None	Seasonal average demand post-model adjustment

4.3 Forecasts

Evoenergy's forecasts of peak demand for summer and winter are presented in Table 4.2 and Table 4.3, and Figure 4.1 and Figure 4.2.

Evoenergy's demand forecasts reveal that during the next regulatory control period, peak demand during summer is likely to be slightly below the level of peak summer demand during the current regulatory period. There is a 50 per cent likelihood that underlying demand on the network will be around 2 per cent lower by the end of the 2019–24 regulatory period than at the start.

[6] Evoenergy Peak Demand Forecast for Period: 2018–27.

One of the reasons summer peak demand is not forecast to grow during the next regulatory period is because of an assumed increase in the rate of installation of solar PV. Peak energy production from solar PV in summer usually coincides with peak network demand brought about by air conditioning load. As a result, some of the growth in summer peak demand over the next regulatory period is likely to be supplied by behind-the-meter PV installations.

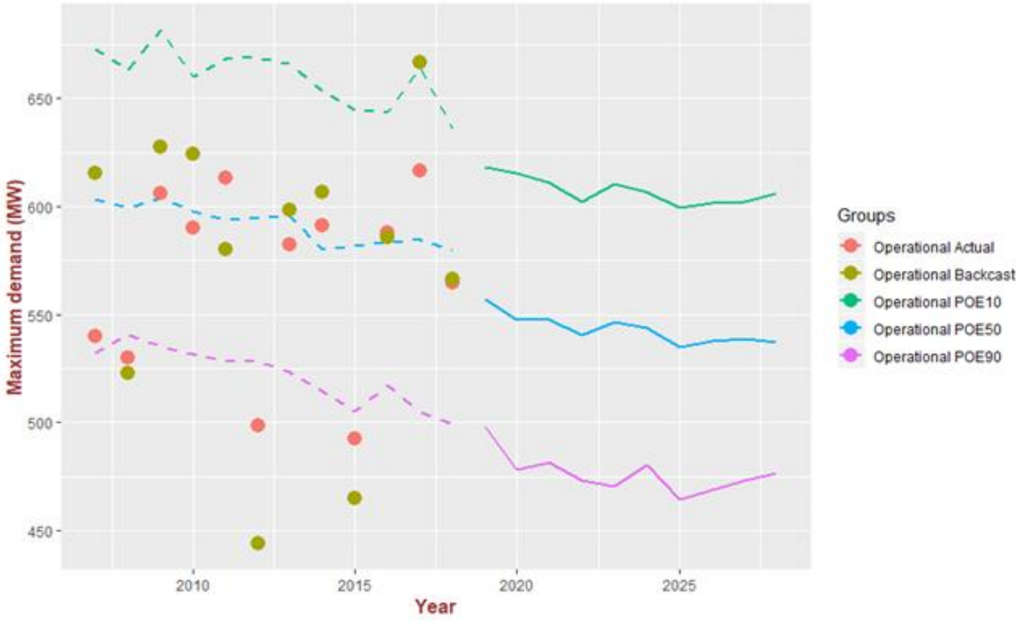
Table 4.2 10-year summer peak demand forecast, total system, MW

Year	TransGrid Import less EV		Plus EV (TG import)		Plus large solar & bio generation (Operational demand)		Plus battery		Plus rooftop PV		Plus energy efficiency	
	POE50	POE10	POE50	POE10	POE50	POE10	POE50	POE10	POE50	POE10	POE50	POE10
2019	539	600	539	600	557	618	557	619	595	657	597	660
2020	530	598	530	598	547	615	548	615	593	664	599	671
2021	528	592	529	593	548	611	548	611	596	660	607	673
2022	523	585	524	585	540	602	540	603	589	655	606	674
2023	528	590	529	591	546	610	546	610	593	664	613	686
2024	525	584	526	586	544	607	544	606	592	658	615	683
2025	517	582	519	584	535	600	534	599	586	655	610	682
2026	518	580	521	584	537	602	536	599	590	655	616	685
2027	518	581	522	586	539	602	536	599	588	661	616	693
2028	516	581	523	589	537	606	532	600	586	652	615	685

Source: Evoenergy

Evoenergy's peak demand forecasts reveal that during the next regulatory control period, peak demand during winter is likely to fall slightly. There is a 50 per cent likelihood that underlying demand on the network will peak at 612 MW in 2024 compared to 616 MW in 2018.

Figure 4.1 Evoenergy system ZSS 10-year Summer demand forecast



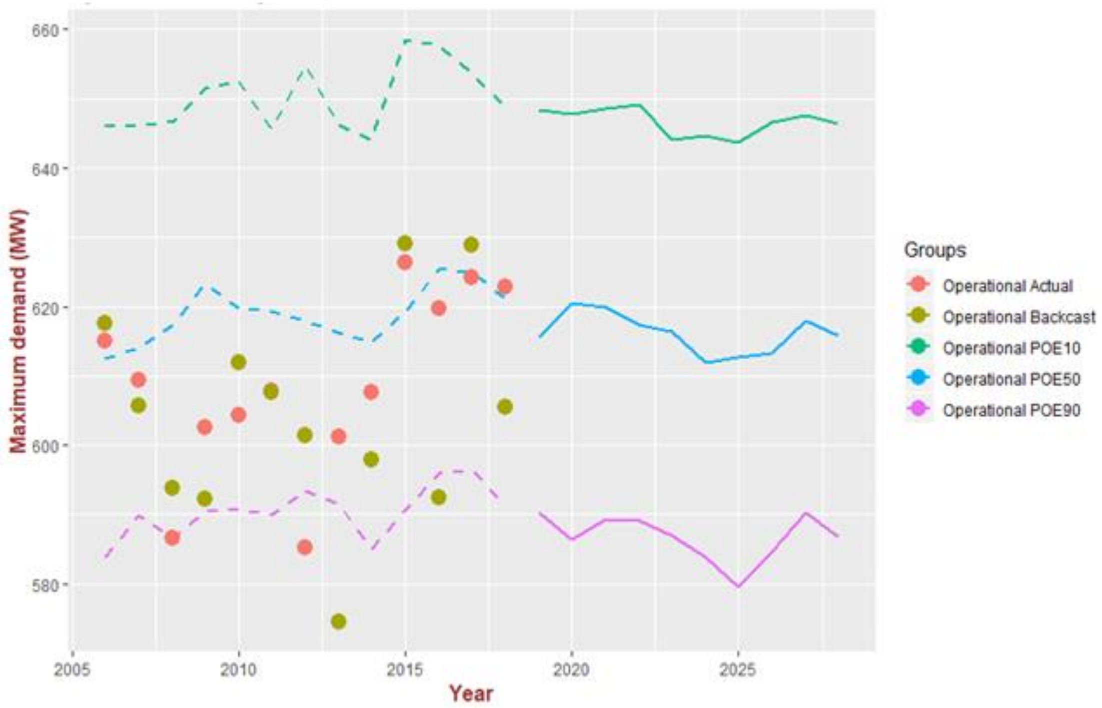
Source - Evoenergy

Table 4.3 10-year winter peak demand forecast, total system, MW

Year	TransGrid Import less EV		Plus EV (TG import)		Plus large solar & bio generation (Operational demand)		Plus battery		Plus rooftop PV		Plus energy efficiency	
	POE50	POE10	POE50	POE10	POE50	POE10	POE50	POE10	POE50	POE10	POE50	POE10
2019	610	643	610	643	616	648	617	649	621	655	628	661
2020	615	644	616	644	620	648	623	651	627	656	639	668
2021	615	643	615	644	620	649	622	651	627	657	645	676
2022	612	643	613	644	617	649	620	651	625	656	646	678
2023	611	638	612	639	616	644	619	646	624	653	647	678
2024	605	635	607	637	612	645	614	645	618	651	644	678
2025	605	635	608	638	613	644	615	645	620	648	647	677
2026	604	636	609	641	613	647	614	647	620	650	650	681
2027	606	636	613	643	618	648	617	646	623	651	655	684
2028	601	628	611	638	616	646	612	639	616	644	649	679

Source: Evoenergy

Figure 4.2 Evoenergy 10-year winter peak demand forecast



Source - Evoenergy

Further details on Evoenergy's peak demand forecasts can be found in the modelling appendix. This appendix includes peak demand forecasts out to 2028 for each of our zone substations. Evoenergy considers that the forecast supports the revised capex program outlined in part four of the Revised Regulatory Proposal.

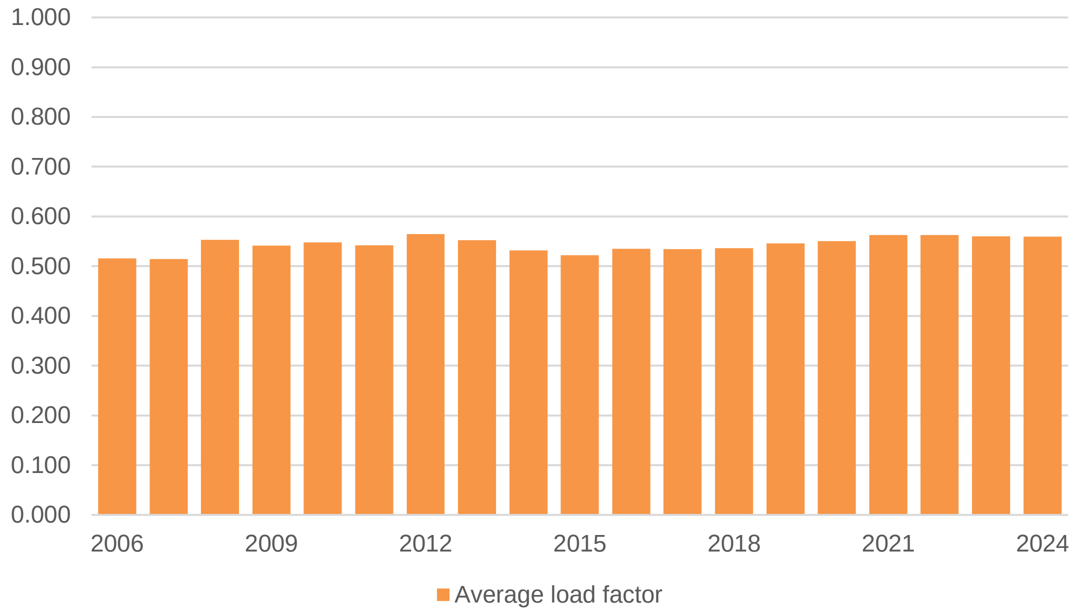
5 Consistency of energy sales and demand forecast

To prove consistency between the energy sales and peak demand forecasts, Evoenergy compared historical and forecast (POE 50) system annual average load factors. The system annual average load factor is approximately a scalar multiple of the ratio of energy sales and maximum demand:

$$\text{System annual average load factor} = \frac{\text{Energy delivered during year}}{\text{System maximum demand} \times \text{Number of half hour periods in a year}}$$

Figure 5.1 shows the actual system annual average load factor for 2006 to 2017 and forecasts for the forthcoming regulatory period based on the system maximum demand and energy sales forecasts discussed above. There is a consistent trend across the historical and forecast load factors, which indicates that the forecasts have been grounded upon similar assumptions about growth patterns and energy consumption trends, even though the two forecasts were independently produced.

Figure 5.1 System annual average load factor—actual and forecast



Source: Evoenergy