ACIL ALLEN

Large customer demand forecast review

Briefing note for Jemena Electricity Networks (JEN)

14 October 2024

Introduction

When preparing its 2021–26 electricity distribution pricing proposal, Jemena Electricity Networks (JEN) commissioned ACIL Allen to prepare 10-year demand forecasts for the period 2019-2028. These forecasts were provided in ACIL Allen's report[1] dated 17 January 2020 and were submitted to the AER as attachment 5.03 to its January 2020 regulatory proposal. Since that time, a series of connection applications from major customers requiring a supply for maximum demand above 10 MW (predominantly data centres) that had not been forecasted has resulted in an increase in demand for network capacity over the 2021-2026 regulatory control period.

JEN have engaged ACIL Allen to comment on the forecasting methodology employed and to:

— reflect on major customer connection developments JEN has faced since that time

— provide an opinion on whether these developments could have reasonably been foreseen at the time of preparing those forecasts, and

— identify relevant major customer connection demand drivers that have transpired since those forecasts which explains why ACIL Allen did not foresee them at the time.

This briefing note represents ACIL Allen's deliverable under this engagement with JEN addressing the above.

In forming our opinion on the above, we have considered:

— our approach to forecasting major customer loads

— information that was available at the time the forecasts were prepared

— information being considered by others who were involved in producing or reviewing forecasts at that time such as the Australian Energy Market Operator (AEMO) as part of its Integrated System Plan (ISP), other Victorian distribution and transmission networks and the AER

— policy developments since that time that have affected major customer demand that did not exist at the time the demand forecasts were prepared.

[1] ACIL Allen, JEN demand forecasts 2019-2028 - customer number, annual electricity consumption and network maximum demand forecasts, 17 January 2020

ACIL Allen's demand forecasts for JEN

The forecasts in question were produced by ACIL Allen in the period between September 2019 and January 2020, with the final report published on 17 January 2020. The forecasts produced were:

- Customer numbers and annual electricity consumption forecasts from 2019 to 2028 for:
  - residential
  - small business
  - large business (Low Voltage)
  - large business (High Voltage)
  - large business (Sub Transmission)
- Network maximum demand covering:
  - Summer and Winter maximum demand forecasts (in kW) for the JEN area
  - Maximum demand forecasts were provided at the 10%, 50% and 90% probability of exceedance (POE) levels.

ACIL Allen adopted an econometric approach to modelling energy consumption as well as summer and winter maximum demand.

Specifically, regression models were estimated to quantify the relationship between consumption, customer numbers and maximum demand and their drivers. Those models were used with projections of the drivers to produce baseline forecasts.

The key drivers used were:

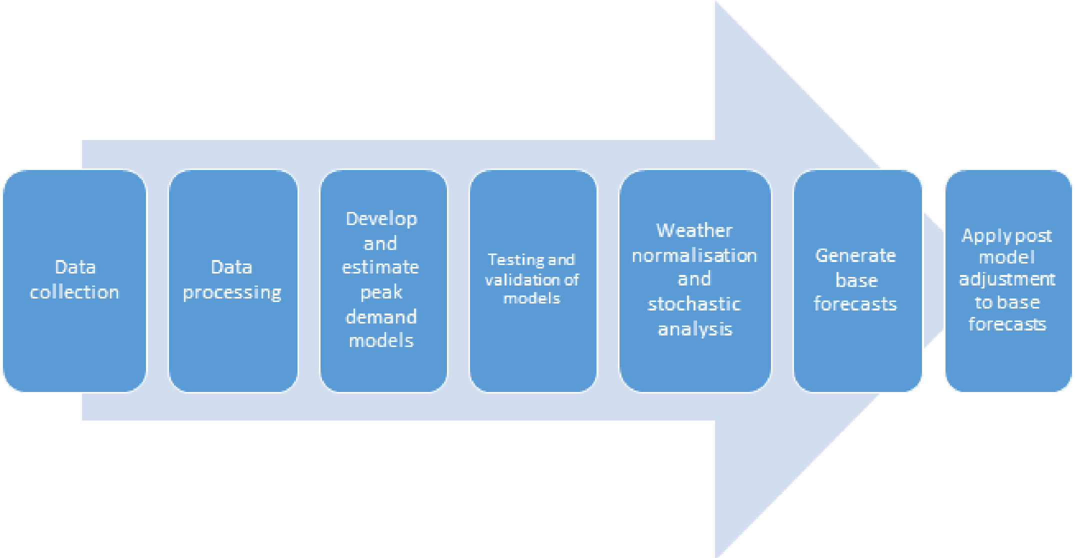
- Economic growth as measured by Gross State Product (GSP)
- Population growth within the Jemena network
- Weather as measured by Heating degree days (HDD) and Cooling degree days (CDD) within the energy models
- Daily maximum and minimum temperatures within the summer and winter maximum demand models
- Retail electricity prices.

In addition to the baseline forecasts, post model adjustments were made to the forecasts to account for the impact of ongoing take-up of rooftop PV systems, battery storage and electric vehicles. Those impacts were calculated separately from the baseline econometric models.

In the case of the summer and winter maximum demand forecasts, total system maximum demand was modelled econometrically as part of a single model. Maximum demand could not be disaggregated into residential, small business and large business. The diagram below shows the process involved in producing summer and winter maximum demand forecasts.

In the case of energy consumption, separate econometric models were developed and estimated for each customer class. For residential and small business customers, separate models were estimated for customer numbers and average consumption per customer. In the case of the Large business LV class of customers, an econometric model of total consumption was developed.

Figure 1 Process for producing summer and winter maximum demand forecasts



Source: ACIL Allen

Large business HV and sub-transmission forecasts forecasting approach

In the case of large customers, consumption and customer numbers were not modelled using regression in the large HV and sub-transmission customer classes. This is because the very small number of large and heterogeneous customers in these classes makes regression an unsuitable tool.

In the absence of a suitable time series relating consumption, customer numbers and their drivers, the most recent year's values were used as the starting point for the forecasts. No other adjustments were made.[2]

ACIL Allen's general approach to modelling major customer loads is as follows:

1. First, we include only those loads that have been identified by the DNSP as already committed or very likely to proceed. We do this because we cannot reasonably expect to have better information than the DNSP itself on potential new large loads.
2. Second, the new loads have to be considered large enough to cause a discrete shift in the historical time series or they must be unique in nature so that that type of large load has not occurred before in the past. Otherwise, these loads are likely to be already captured by the econometric models themselves. This avoids the likelihood of double counting the major load.
3. We only consider adding new large loads that are confirmed and committed. Potential projects that have not advanced beyond the enquiry stage are not given any weight.

This is a conservative approach that in our view has allowed us to avoid an upward bias to our forecasts and to minimise forecast errors. It is also an approach that served us well over the 15 years leading up to the pandemic. New large loads have historically tended to be smaller than the initial connection enquiry, they have tended to occur later than initially thought, and some have often not gone ahead at all. For this reason, a conservative approach has proven to be prudent.

Based on experience, we often find that a connection enquiry is associated with a project feasibility study. One input into a project's financial model when testing for financial viability would be the cost of grid supplied electricity and the transmission and distribution networks costs make up a key component of these costs. Making a connection enquiry to a DNSP is a means of 'firming up' a cost estimate. Inevitably, there are

[2] ACIL Allen, JEN demand forecasts 2019-2028 - customer number, annual electricity consumption and network maximum demand forecasts, 17 January 2020, p.38.

many projects which fail to meet financial hurdles or do not proceed for other reasons resulting in a lower level of actual new connections to a DNSP relative to connection enquiries.

At the time of undertaking the forecasts, there were five major loads that JEN were forecasting as part of their original proposal. These were:

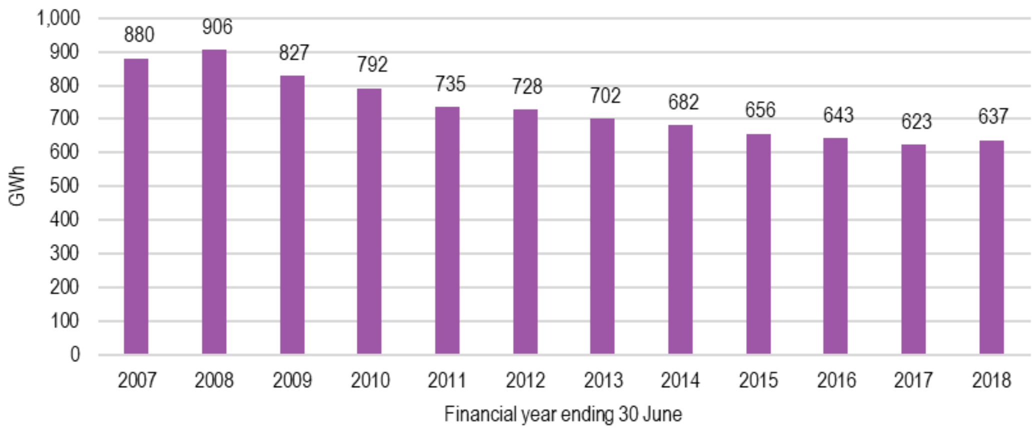
— a residential development at Yarra Bend (10.8 MVA)
— redevelopment of the Moonee Valley Racecourse (7.1 MVA)
— development of the Footscray Hospital (10 MVA)
— the North-East Link project to construct and operate three twin lane tunnels (30 MVA) and
— [redacted].

The first three large loads were deemed to be a captured by the underlying regression coefficients and so were not exclusively accounted for. The other two, were reflected in the Large HV customer number forecasts but no additional load was added to the system level forecasts because, while they were large enough to impact the forecasts at the level of the terminal station, they were small relative to the size of the system and were also not expected to come online quickly.

Moreover, the historical data did not indicate that there were many significant large loads coming online around this time. Between 2016 and 2020, JEN connected only 47 MVA of large loads from three customers. These were Melbourne Airport (30 MVA), Westgate Tunnel (12 MVA) and CSL (5 MVA). Despite this, consumption from this category had declined significantly over the preceding 10 years as shown below.

Consumption volumes had declined gradually since 2008, while remaining relatively stable between 2016 and 2018.

Figure 2 Historical Large HV customer consumption



Source: JEN

The advent of a series of large data centres was not foreseen in 2020 by either JEN or other official forecasting agencies such as AEMO[3]. In our view, it was therefore reasonable to not include the impact of data centres when constructing the forecasts.

[3] 2019 and 2020 Inputs, Assumptions and Scenarios report (IASR), AEMO

Events which have transpired since 2020

Unforeseen major customer connection requests

Since 2020, JEN has been seen a large increase in major customer connection requests, particularly data centres. In the period from June 2021, JEN has received requests (with a high likelihood of proceeding) for 1,708 MVA of capacity, of which 1,459 MVA was from data centres. This has now exceeded JEN's total zone substation capacity. Moreover, there have been additional data centre customer approaches and requests for feasibility studies for 2,200 MVA of capacity.

The table below shows the major data centre requests that JEN has received.

Table 1 JEN unforeseen data centre connection enquiries (with high likelihood of proceeding)

Data centre	Stage	Incremental Capacity (MVA)
[redacted]		

Source: JEN

In addition to the data centre requests, JEN has received requests from seven major infrastructure projects with a high likelihood of proceeding:

- [redacted]
- [redacted]
- [redacted]
- [redacted]
- [redacted]
- [redacted]
- [redacted].

Government policy initiatives

The COVID and post COVID response periods resulted in behavioural changes that could not be reliably predicted in the early stages of the pandemic. While people stayed and worked from home, the demand for residential energy consumption and demand increased. Working from home and the use of remote meeting software such as Teams and Zoom led to a rapid increase in data usage.

Moreover, a number of Government Policy initiatives at the Commonwealth and Victorian State Government levels relating to the digital economy were released during this period potentially affecting data usage and data centre demand (see **Table 2**).

At the time of preparing JEN's 2021-26 forecasts, data centres consumed about 1% of global electricity use[4]. However, this is now expected to increase significantly with the emergence of Artificial Intelligence (AI). It is reported that widespread adoption of AI will result in a dramatic increase in energy usage from the IT industry.[5] A key milestone for AI was the public release of ChatGPT (a generative artificial intelligence chatbot developed by OpenAI) in November 2022. This resulted in the start of a projected broad uptake in AI applications.

It is our view, that these factors accelerated and brought forward the demand for data centre capacity that has transpired in recent years.

Table 2 Government Policy Initiatives since 2020

Government	Initiative
Commonwealth Government Initiatives	Digital Economy Strategy 2030 (2021-22 Budget, 11 May 2021)
	Digital Economy Strategy 2030 Update (2022-23 Budget, 29 March 2022)
	National Reconstruction Fund (2022-23 Budget, 25 October 2022)
	Critical Technologies Support (2023-24 Budget, 9 May 2023)
	Security Legislation Amendment (Critical Infrastructure Protection) Bill 2022 (February 2022)
Victorian Government Initiatives	Cyber Strategy 2021 (September 2021)
	Victorian Digital Strategy 2021-26 (October 2021)

Was potential data centre demand identified by other relevant organisations in 2020?

As part of a desktop research exercise, ACIL Allen looked for evidence of data centre demand and energy forecasts of DNSPs, the AER and AEMO prior to January 2020.

We were unable to uncover evidence of data centre energy and maximum demand being incorporated into the demand and energy forecasts of DNSPs or AEMO at or around this time. We examined historical Distribution Planning reports (DAPRs) of the Victorian distribution businesses and were unable to detect any mention of data centre demand in any of their forecasting related documentation. Similarly, AEMO's Inputs, Assumptions and Scenarios report (IASR) makes no mention of data centres until its 2025 IASR consultation paper which was released in July 2024[6].

This in our view, indicates that the impact of data centres on electricity demand and energy consumption was not being considered by demand forecasters at the time.

[4] https://www.iea.org/commentaries/data-centres-and-energy-from-global-headlines-to-local-headaches
[5] https://www.scientificamerican.com/article/the-ai-boom-could-use-a-shocking-amount-of-electricity/
[6] https://aemo.com.au/consultations/current-and-closed-consultations/2025-iasr-scenarios-consultation

Were these events reasonably foreseen?

In our view, it was not reasonable to foresee the rapid rise in the demand for data centres or other major infrastructure projects for the following reasons:

— Data centre demand was not being projected by any of the major DNSPs or the Australian Energy Market Operator at this time. AEMO is the pre-eminent and official forecaster of peak demand and energy consumption for the NEM, yet it failed to identify the surge in data centre demand. Based on our view the demand trajectory has changed dramatically with changes to Government policy and the emergence of AI which has significant energy requirements.

— The historical data up to January 2020 failed to show any significant evidence that large loads in excess of 10 MWs had been connecting to JEN's network in the last few years. Connection enquiries since that time indicate a material shift in the underlying energy market trends.

— There had been only three requests by major customers for an aggregate of 47 MVA to connect to JEN's distribution network in the period between 2016 and 2020 that progressed to actual connection agreements.

— There was massive uncertainty at the time associated with the potential size of the centres, their possible locations and the timing of their construction. Under such uncertainty we could not reasonably make any attempt at forecasting their impact on peak demand and energy within the JEN network.

— ACIL Allen's conservative approach to forecasting maximum demand and energy consumption would not allow for forecasts for the demand for data centres to be included given all the reasons provided above.

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