

# ELECTRICITY FORECASTING INSIGHTS

FOR THE NATIONAL ELECTRICITY MARKET

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## IMPORTANT NOTICE

### Purpose

AEMO has prepared this document in connection with its national transmission planning and operational functions for the National Electricity Market. This report is based on information available as at 1 May 2017 unless otherwise specified.

This document, and associated data and documents, update information previously published annually by AEMO under the title *National Electricity Forecasting Report (NEFR)*.

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### Version control

Version	Release date	Changes
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## INTRODUCTION

This *2017 Electricity Forecasting Insights* provides independent electricity consumption, maximum demand, and minimum demand forecasts<sup>1</sup> for each National Electricity Market (NEM) region over a 20-year forecast period (2017–18 to 2036–37).

- Consumption met by grid-supplied electricity is forecast to remain flat for the next 20 years, despite projected 30% growth in population and assumed average growth in the Australian economy.
- Business demand is forecast to increase slightly, while net residential demand is projected to decline as growth in population and appliance usage is offset by increased generation from rooftop photovoltaic (PV) and by energy efficiency initiatives.
- Under a stronger economic growth forecast, consumption is projected to be 15% higher by 2036–37 than in the Neutral scenario, while weaker economic growth could result in forecast consumption 21% lower than the Neutral scenario at that time.
- Maximum demand is forecast to remain flat until the mid-2020s, and then start to increase as the time of maximum demand moves later in the day when rooftop PV output is small or zero.

Implications for business and household consumers:

- Energy consumers are expected to become more active in controlling their energy use, by improving energy efficiency and generating their own energy ‘behind the meter’. The recent spike in rooftop PV installations, and reported actions by large consumers, provide some evidence that many businesses and households are already acting, and this trend is forecast to continue, supported by projected falling costs for PV systems, battery storage, and energy-efficient appliances.

Implications for the energy sector:

- For the energy sector, there are opportunities to assist consumers through more targeted products and services, in particular in relation to managing energy use.
- Forecast growth in maximum demand in the medium to longer term may require investments in generation, network, or demand-side solutions to ensure reliability and security of supply.
- The wide uncertainty across the different scenarios poses challenges for investments.
- The energy system is going through a significant transition in how and when consumers use and are supplied energy. There is an important opportunity for new market and regulatory arrangements, improved system planning, and new market, network, and non-network solutions, to support an orderly transition and deliver consumers secure, reliable, and affordable energy to meet their demand.

AEMO’s forecasts explore a range of scenarios that represent a probable range of futures for Australia across Weak, Neutral, and Strong economic and consumer outlooks.<sup>2</sup>

<sup>1</sup> All references to consumption and demand forecasts in this report refers to operational consumption (sent out). This is the consumption to be supplied to the grid by scheduled, semi-scheduled, and significant non-scheduled generators (excluding their auxiliary loads, or electricity used by the generator). For further information about demand definitions, see: [http://www.aemo.com.au/-/media/Files/Electricity/NEM/Planning\\_and\\_Forecasting/NEFR/2016/Operational-Consumption-definition--2016-update.pdf](http://www.aemo.com.au/-/media/Files/Electricity/NEM/Planning_and_Forecasting/NEFR/2016/Operational-Consumption-definition--2016-update.pdf).

<sup>2</sup> The three sensitivities all assume Australia achieves its commitment at the 21<sup>st</sup> Conference of the Parties for the United Nations Framework Convention on Climate Change to reduce greenhouse gas emissions by between 26% and 28% below 2005 levels by 2030. For more information about scenarios, see: [https://www.aemo.com.au/-/media/Files/Electricity/NEM/Planning\\_and\\_Forecasting/NTNDP/2017/Draft-2017-Planning-and-Forecasting-scenarios.pdf](https://www.aemo.com.au/-/media/Files/Electricity/NEM/Planning_and_Forecasting/NTNDP/2017/Draft-2017-Planning-and-Forecasting-scenarios.pdf).

**Table 1 AEMO's 2017 forecasting and planning scenarios**

Driver	Weak scenario	Neutral scenario	Strong scenario
Population growth	Weak	Neutral	Strong
Economic growth	Weak	Neutral	Strong
Technology uptake (rooftop PV, energy efficiency, electric vehicles)	Slow - Hesitant consumer in a weak economy	Moderate - Neutral consumer in a neutral economy	Rapid - Confident consumer in a strong economy

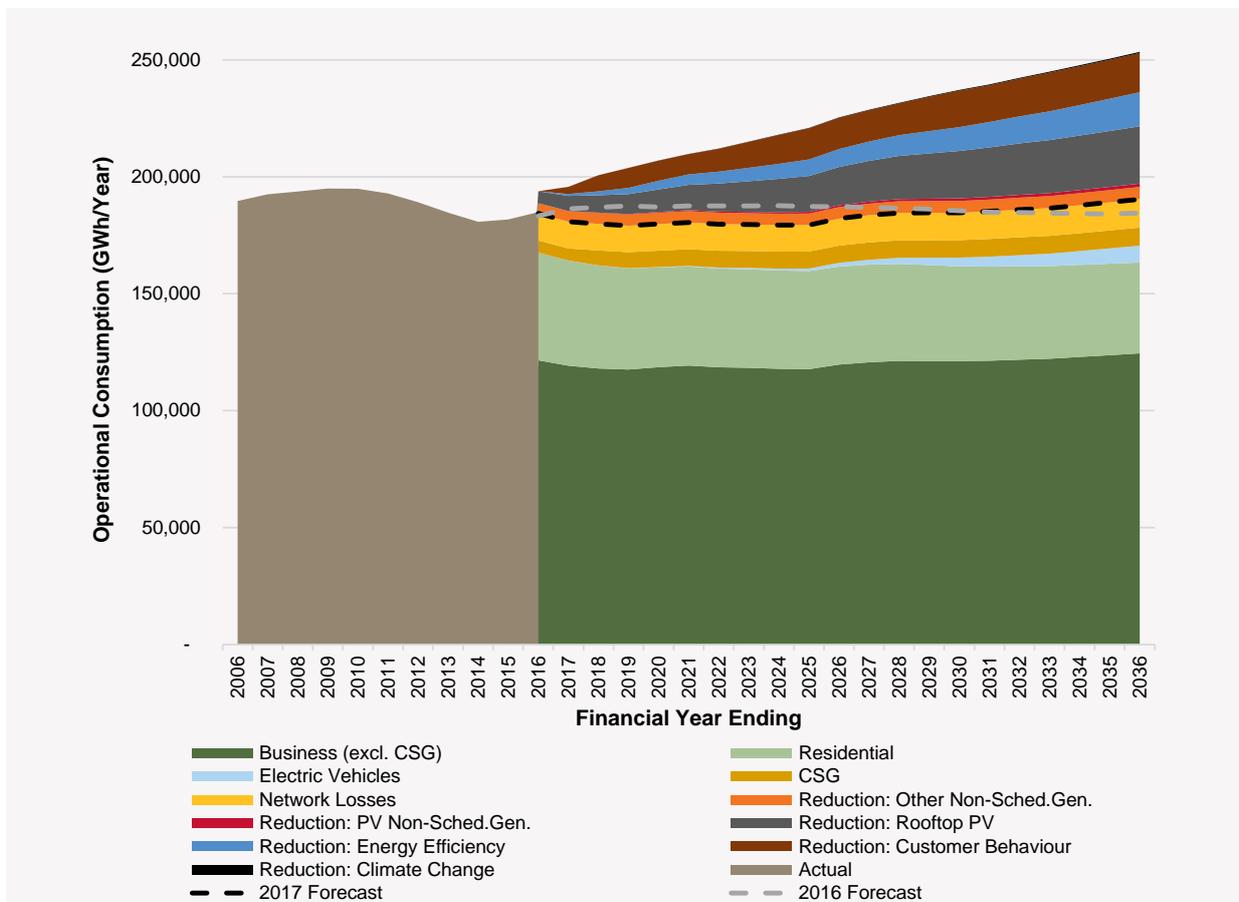
## ANNUAL CONSUMPTION

**Neutral scenario shows a flat 20-year outlook for the grid, as increased usage by business and household consumers is offset by self-generation and energy efficiency**

Over the forecast horizon, overall annual electricity consumption in the NEM is forecast to remain relatively flat, with reductions due to increased energy efficiency and rooftop PV offsetting recent consumption increases from Queensland's coal seam gas (CSG) sector, which has been the key driver behind NEM consumption growth in the last two years.

The Neutral scenario forecast for the NEM ends up at approximately the same level as in the 2016 *National Electricity Forecasting Report* (NEFR).

**Figure 1 Neutral scenario annual operational consumption forecast for the NEM**



Note: the liquefied natural gas (LNG) demand sector in the 2016 NEFR is now referred to as coal seam gas (CSG) and is covering electricity consumption associated with extraction and processing of CSG for both export and domestic markets.



Figure 1 highlights a forecast continuation of the trend presented in last year's NEFR, with total underlying consumption forecast to increase as population and the economy grow and business and household consumers use more electricity. Demand from the grid, however, is forecast to stay flat, as consumers increasingly control their own use and costs, reducing their demand for grid supply by:

- Generating their own electricity behind the meter (through rooftop PV, cogeneration, and other small-scale generation technologies on their own premises).
- Using more energy-efficient appliances, buildings, and machinery.
- Changing their behaviour to reduce electricity use where possible.

### Short to medium term – an opportunity to modernise

The energy system is going through a significant transition in how and when consumers use energy, requiring improved system planning and new market, network, and non-network solutions to achieve an orderly transition.

The short-term outlook is forecast to be heavily influenced by concerns about gas availability in the Eastern states and about increased energy prices. Based on information received and its own analysis, AEMO expects these responses:

- Businesses are increasingly expected to invest in self-generation (behind the meter) and energy efficiency, reducing demand from the transmission system (as shown in Figure 1).
- Most export-oriented businesses are expected to remain at current demand levels as the combination of input costs, exchange rates, and commodity prices is expected to remain relatively flat.
- Similarly, residential customers are expected to continue to reduce demand, predominantly by investing in rooftop PV, battery storage, and more energy-efficient appliances.

There is an important opportunity for new market and regulatory arrangements to be developed, to promote a smooth transition to a more efficient energy system that better meets the needs of consumers for reliable and affordable energy services.

### Longer term – a new outlook

AEMO's longer-term outlook is for an accelerating transition towards an actively engaged and flexible consumer demand:

- Investment in rooftop PV in March 2017 was at an all-time high. Forecast uptake is expected to remain strong till the late 2020s and then level off, resulting in almost 20,000 megawatts (MW) of installed rooftop PV by 2036–37. This is a substantial increase over current capacity (less than 5,000 MW). AEMO has assumed that it is technically feasible to integrate this amount of rooftop PV into the network over the forecast horizon, through a mix of market, network, and non-network (such as storage) solutions to address issues such as increasing variability in system demand, low daytime demand, and increased ramping at morning and afternoon electricity system peaks.
- Residential and commercial battery storage uptake is forecast to exceed 5,500 MW by 2036–37. This forecast has increased by 2,000 MW since last year, because the pace of reduction in costs of storage has accelerated. AEMO expects a proportion of new storage to be aggregated and used for price hedging by retailers and provision of ancillary services, further increasing the value streams from innovation and accelerating the rate of uptake.
- While EV sales are forecast to remain low overall in Australia (by comparison with traditional vehicles) in the short term, AEMO expects the rate of increase of uptake to rise from 2020 onward, based on latest technology price projections. The impact on overall consumption from the NEM is still expected to be relatively minor, as EVs' energy consumption is projected to remain much smaller than other energy services supplied by the NEM. Decarbonisation of other energy uses by electrification is an area that could add to demand in the future.

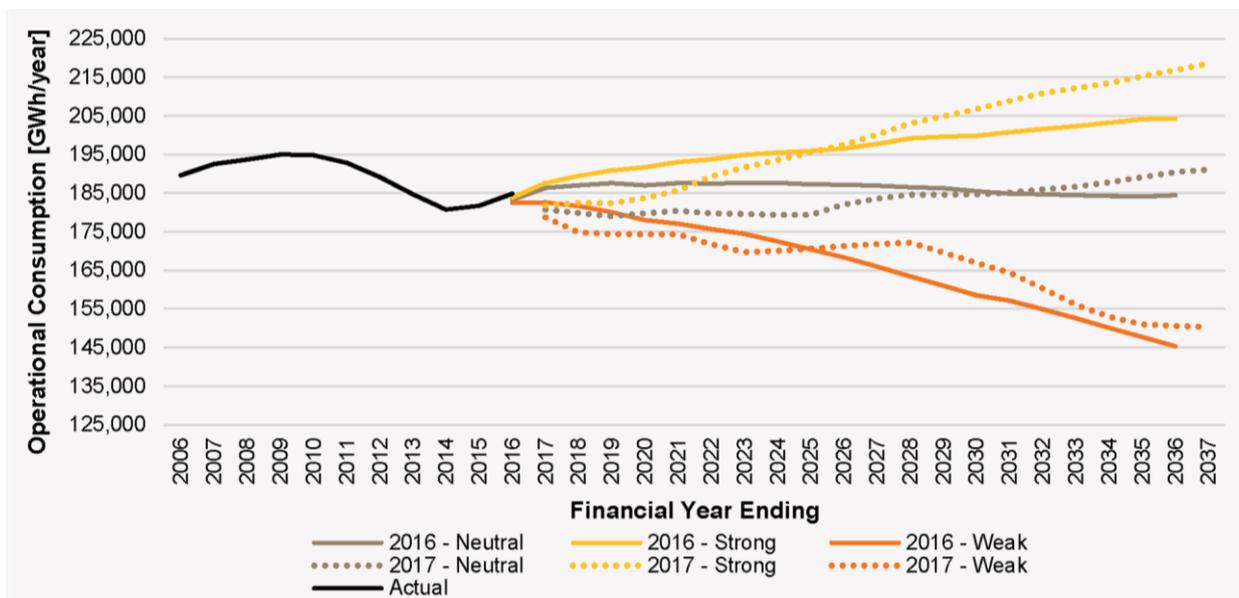
- Demand side participation<sup>3</sup> (DSP) by consumers is also expected to increase. This is projected to be driven initially by commercial/industrial consumers, with DSP controlled by retailers or specialist aggregators providing price hedging and potential ancillary services and reserves to the market. Longer term, as more households get smart meters and tariffs that reward changing consumption based on market conditions and new trading platforms such as peer-to-peer, residential DSP is also expected to increase. AEMO has a work program over the next 12 months to explore the possible extent and impact of the growth in residential DSP, the outcomes of which will guide the evolution of AEMO’s business capability to respond to the expected challenges.

Regional forecast data is available on AEMO’s forecasting data portal.<sup>4</sup>

**Outlook uncertainty – strong and weak scenarios**

Figure 2 compares forecast consumption under the Strong, Neutral, and Weak scenarios. The range of consumption projections toward the end of the forecast period, varying by almost 70,000 GWh across the three differing economic scenarios, highlight the uncertainty of the outlook for grid-supplied electricity.

**Figure 2 Comparison of Strong, Neutral, and Weak scenario forecasts**



The key reasons for the differences are:

- Varied assumptions about consumption by energy-intensive industry in Australia.
- Projected consumption from the CSG sector varies considerably across the three scenarios.

The wide span of possible outcomes makes it challenging for energy sector planners and investors to balance the risks of stranded assets against potential shortage of supply. This range is despite the three scenarios using the same environmental targets for the energy sector – adding uncertainty from changing environmental policies would further increase the risks faced by industry.

<sup>3</sup> Demand side participation means consumers responding to signals, including changes in price and system conditions, to manage their electricity consumption and costs.

<sup>4</sup> The forecasting data portal is at <http://forecasting.aemo.com.au/>.

The challenge can be mitigated through:

- Careful and improved system wide grid planning, accounting for the uncertain future.
- Considering projects that can be up-scaled or staged in development.
- Reducing political and regulatory uncertainty.

## MAXIMUM AND MINIMUM DEMAND

The key drivers of forecasts of regional maximum and minimum demands are similar to those for annual regional consumption. Demand growth is expected to be driven by growth in population, the economy, and appliance ownership, while increasing rooftop PV penetration and energy efficiency measures are projected to have a dampening effect.

The regional maximum demands are forecast to grow faster than annual consumption. As rooftop PV reduces grid consumption while the sun shines, increasing installation of PV is shifting the time of maximum demand to later in the day, resulting in maximum demand occurring at evening hours with little or no rooftop PV generation.

Increasing rooftop PV also affects the timing of minimum demand, moving it to the middle of the day when PV generation is at its highest, so grid demand is reduced.

The timing and extent of maximum and minimum demand is also affected by the forecast uptake of battery storage. Battery storage has been assumed to have a fixed charging/recharging schedule, charging up battery storage during the period of the day when rooftop PV generates the most electricity, and discharging them evenly during the evening period. This lifts minimum demand and lowers maximum demand projections accordingly at these times.

Overall:

- Maximum operational demand (10% probability of exceedance, or POE<sup>5</sup>) is driven by cooling loads and occurs in summer in all regions except Tasmania, where maximum demand is driven by heating needs and occurs in winter.
- Minimum operational demand (90% POE) occurs when there is neither heating nor cooling load. This generally happens in the shoulder months, in all regions except Tasmania. Tasmania's minimum demand occurs in summer.

Tables 2 and 3 show the maximum and minimum demand forecasts.

**Table 2 Forecast maximum operational demand (10% POE) by region – Neutral scenario [MW]**

	NSW		QLD		SA		TAS		VIC	
	Summer	Winter								
2016–17	14,111	13,071	9,355	8,314	3,116	2,732	1,417	1,769	9,493	7,797
2021–22	13,963	13,216	9,606	8,573	3,035	2,726	1,429	1,808	9,403	7,895
2026–27	14,678	14,103	10,074	9,104	3,048	2,825	1,459	1,863	9,395	8,028
2036–37	15,276	15,561	10,021	9,574	3,112	3,003	1,537	1,958	9,758	8,811

<sup>5</sup> Probability of Exceedance (POE) refers to the likelihood that a maximum demand forecast will be met or exceeded. A 10% POE maximum demand projection is expected to be exceeded, on average, one year in 10, while a 90% POE projection is expected to be exceeded, on average, nine years in 10. For minimum demand, a 90% POE means actual demand is expected to be below the projected minimum only one year in 10, making this the equivalent of a 10% POE maximum demand forecast in its level of expected reliability.

**Table 3 Forecast minimum operational demand (90% POE) by region – Neutral scenario [MW]**

	NSW		QLD		SA		TAS		VIC	
	Summer	Winter								
2016–17	4,858	5,546	4,204	3,944	462	693	806	904	2,308	2,805
2021–22	4,356	4,903	3,900	3,377	268	596	808	932	1,661	2,394
2026–27	3,583	4,364	3,684	3,208	31	444	827	957	908	1,911
2036–37	2,236	3,509	3,004	2,797	-421	150	879	1,020	427	1,659

The forecasts show:

- Maximum demand remaining relatively flat in the short to medium term, out to the mid-2020s.
- Maximum demand then starting to increase from the mid-2020s, in particular in Queensland and New South Wales (due to increasing cooling load). Additional increases in Queensland are forecast, due to projected growth in demand by the CSG sector.
- Increasing rooftop PV penetration will cause summer maximum demand to grow at a slower rate than winter maximum demand, because summer has more daylight hours than winter. This shift is also expected to cause New South Wales to become winter peaking from 2032–33.
- Minimum demand being relatively stable, until increasing rooftop PV uptake results in the time of minimum demand moving to the middle of the day. This is projected to happen by 2021–22 in Queensland and Victoria, and by 2026–27 in New South Wales. (South Australia is experiencing minimum demand in the middle of the day now, while Tasmania’s minimum demand has the highest probability of occurring in the early morning for the whole of the forecast period.)
- Once minimum demand has started to occur in the middle of the day, it is forecast to decrease rapidly, driven by continued growth in rooftop PV.
- Minimum demand in South Australia is expected to be negative by 2027–28, as rooftop PV generation is expected to exceed customer demand in some hours. South Australia could store this excess generation or export it to the rest of the NEM via the interconnectors, provided they were in service. This signals the important need for market and regulatory frameworks that support storage solutions and maximise the efficiency of shared electricity services for consumers.

This year’s forecasts include accounting for a projected impact of climate change on demand. The estimated impact is modest, compared to the other drivers, slightly increasing forecast demand in summer and reducing forecast demand in winter.

The maximum and minimum demand forecasts assume consumers do not change their consumption patterns in response to tariff changes, although projections for uptake of rooftop PV and battery storage do account for projected changes to tariffs. AEMO will, as part of its work program over the next 12 months, assess the extent to which consumer responses to tariff or price changes may affect daily consumption patterns and thus maximum and minimum demand levels.