FORECAST ACCURACY REPORT 2016

FOR THE NATIONAL ELECTRICITY FORECASTING REPORT

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AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

IMPORTANT NOTICE

Purpose

The purpose of this publication is to report on the accuracy of the consumption and maximum demand forecasts in the *2015 National Electricity Forecasting Report* (NEFR). It is prepared to satisfy the requirements of rule 3.13.3(q) of the National Electricity Rules (Rules), and to report on any improvements made by AEMO or other relevant parties to the forecasting process.

Rule 3.13.3(u) of the Rules requires AEMO to undertake an assessment of the accuracy of consumption and maximum demand forecasts in the *Electricity Statement of Opportunities* (ESOO). However, AEMO publishes the relevant forecast used in the ESOO in a standalone *National Electricity Forecasting Report* (NEFR).

AEMO has published this *Forecast Accuracy Report* in accordance with rule 3.13.3(u) of the Rules. It is based on information available to AEMO as at September 2016.

Disclaimer

Version control

Version	Release date	Changes
1	17/11/2016	

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CHAPTER 1. INTRODUCTION

The Australian Energy Market Operator (AEMO) produces this *Forecast Accuracy Report* for the Reliability Panel each year. The report assesses the accuracy of the operational consumption and maximum operational demand (MD) forecasts in AEMO's *2015 National Electricity Forecasting Report* (NEFR), for each region in the National Electricity Market (NEM).[1]

It does this by comparing forecast operational consumption and MD in the 2015 NEFR against actual operational consumption and MD for 2015–16.

The NEFR provides AEMO's independent electricity consumption forecasts for each region.[2] AEMO publishes the NEFR each year along with a range of supplementary documents, including the *Forecasting Methodology Information Paper*.[3]

The accuracy of AEMO's operational consumption and MD forecasts depends on AEMO's forecast models, which in turn rely on forecast input data, including economic forecasts.

Terms used in this report are defined in the glossary.

[1] AEMO. *National Electricity Forecasting Report*, June 2015. Available at: http://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/National-Electricity-Forecasting-Report.

[2] Queensland, New South Wales, Victoria, South Australia, and Tasmania.

[3] AEMO. *Forecasting Methodology Information Paper: 2015 National Electricity Forecasting Report*, July 2015. Available at: http://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/National-Electricity-Forecasting-Report.

CHAPTER 2. FORECAST ACCURACY

2.1 Methodology

Based on industry feedback, AEMO has adopted a simplified measure of forecast performance in this report, compared with previous annual publications.

In this report, AEMO assessed forecast accuracy by measuring the percentage difference between actual and forecast components of the published forecasts, and comparing actual MD with:

- Published forecasts (POE10, POE50, and POE90)
- Major forecast drivers, including weather, measured by heating degree days and cooling degree days (HDD and CDD[4]).

The accuracy metric is percentage difference, calculated using the formula below:

$$percentage\ difference = \frac{forecast_{FY16} - actual_{FY16}}{actual_{FY16}} \times 100$$

[4] For a detailed description on how HDD and CDD is derived, see page 55 of the 2016 NEFR *Forecasting Methodology Information Paper*, available at: http://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/National-Electricity-Forecasting-Report.

2.2 Queensland

Table 1 Forecast accuracy of Queensland 2015 NEFR forecasts for 2015–16

	NEFR 2015 Forecast	Actual	Difference	Difference (%)	
Native Consumption (GWh)	57,343	55,915	1,428	2.6%	
SNSG (GWh)	1,612	1,654	-42	-2.5%	
Operational Consumption As Generated (GWh)	55,731	54,261	1,470	2.7%	
Residential & Commercial (excluding PV impact) (GWh)	31,435	31,388	48	0.2%	
Large Industrial (excluding LNG) (GWh)	14,237	14,220	17	0.1%	
Large Industrial LNG (GWh)	4,631	3,569	1,062	29.8%	
Auxiliary Load (GWh)	3,860	3,608	252	7.0%	
PV Production (GWh)	2,311	2,285	26	1.1%	
Energy efficiency (GWh)	255	255			
Transmission Losses (GWh)	1,567	1,477	90	6.1%	
Weather					
HDD	244	159	85	53.7%	
CDD	1,182	1,271	-89	-7.0%	
	Actual	**POE10**	**POE50**	**POE90**	**Actual POE**
Maximum Demand (MW)	8,672	9,691	9,231	8,834	0.96
Weather					
Temperature (°C)	31.4	36.0	33.7	31.3	0.89

- The 2015 NEFR prediction of residential and commercial consumption was within 0.2% of actual consumption.
- PV output was over forecast by 1%, due to either increased installed PV capacity or increased solar radiation.
- Forecast consumption of the LNG projects was higher than actual consumption in Queensland, due to a slower ramp-up of the LNG projects.
- Actual MD was a POE 96, whereas the corresponding temperature at the time of MD was a POE 89.

2.3 New South Wales

Table 2 Forecast accuracy of New South Wales 2015 NEFR forecasts for 2015–16

	NEFR 2015 Forecast	Actual	Difference	Difference (%)	
Native Consumption (GWh)	71,706	72,457	-751	-1.0%	
SNSG (GWh)	1,422	1,458	-36	-2.5%	
Operational Consumption As Generated (GWh)	70,284	70,999	-716	-1.0%	
Residential & Commercial (excluding PV impact) (GWh)	50,512	51,356	-845	-1.6%	
Large Industrial (GWh)	15,096	15,271	-175	-1.1%	
Auxiliary Load (GWh)	3,128	3,069	59	1.9%	
PV Production (GWh)	1,462	1,489	-27	-1.8%	
Energy efficiency (GWh)	836	836			
Transmission Losses (GWh)	1,548	1,303	245	18.8%	
Weather					
HDD	1,011	923	89	9.6%	
CDD	501	547	-46	-8.5%	
	Actual	**POE10**	**POE50**	**POE90**	**Actual POE**
Maximum Demand (MW)	13,047	13,794	12,531	11,555	0.30
Weather					
Temperature (°C)	38.8	43.3	37.5	33.0	0.39

- All the forecast consumption components were within 2–3% of actual consumption, with the exception of transmission losses, which were lower than expected.
- There were more cooling degree days in New South Wales, which could have been offset by fewer heating degree days with respect to residential consumption.
- Large industrial consumption was higher than forecast, due to increased consumption by some major industrial consumers.
- Actual MD was a POE 30, whereas the corresponding temperature at the time of MD was a POE 39.

2.4 South Australia

Table 3 Forecast accuracy of South Australia 2015 NEFR forecasts for 2015–16

	NEFR 2015 Forecast	Actual	Difference	Difference (%)	
Native Consumption (GWh)	13,376	13,466	-90	-0.7%	
SNSG (GWh)	67	55	12	22.1%	
Operational Consumption As Generated (GWh)	13,309	13,411	-102	-0.8%	
Residential & Commercial (excluding PV impact) (GWh)	9,627	9,841	-214	-2.2%	
Large Industrial (GWh)	2,800	2,745	55	2.0%	
Auxiliary Load (GWh)	580	445	136	30.5%	
PV Production (GWh)	994	1,021	-27	-2.7%	
Transmission Losses (GWh)	301	380	-79	-20.8%	
Weather					
HDD	1,012	971	41	4.2%	
CDD	718	736	-18	-2.4%	
	Actual	**POE10**	**POE50**	**POE90**	**Actual POE**
Maximum Demand (MW)	2,895	3,232	2,926	2,615	0.55
Weather					
Temperature (°C)	40.3	42.2	38.5	33.8	0.26

- Residential and commercial consumption was under forecast by 2.2%.
- Large industrial consumption was slightly lower than forecast, due to a fall in consumption by some major industrial consumers.
- Auxiliary loads were lower than forecast, reflecting a downward trend in auxiliary loads in South Australia as more renewable energy is introduced.
- Actual MD was a POE 55, whereas the corresponding temperature at the time of MD was a POE 26.

2.5 Victoria

Table 4 Forecast accuracy of Victoria 2015 NEFR forecasts for 2015–16

	NEFR 2015 Forecast	Actual	Difference	Difference (%)	
Native Consumption (GWh)	48,359	47,777	582	1.2%	
SNSG (GWh)	780	673	107	15.8%	
Operational Consumption As Generated (GWh)	47,580	47,104	476	1.0%	
Residential & Commercial (excluding PV impact) (GWh)	35,793	36,152	-359	-1.0%	
Large Industrial (GWh)	6,252	5,855	397	6.8%	
Auxiliary Load (GWh)	4,318	3,745	574	15.3%	
PV Production (GWh)	1,200	1,178	22	1.9%	
Transmission Losses (GWh)	1,217	1,352	-136	-10.0%	
Weather					
HDD	1,163	1,171	-8	-0.7%	
CDD	457	470	-13	-2.8%	
	Actual	**POE10**	**POE50**	**POE90**	**Actual POE**
Maximum Demand (MW)	9,029	9,783	8,517	7,792	0.30
Weather					
Temperature (°C)	33.4	42.0	38.7	32.9	0.88

- Residential and commercial consumption was under forecast by 1%, due to higher than expected heating degree days in winter and cooling degree days in summer.
- PV output was slightly over forecast, further explaining the slight under forecast in residential consumption.
- Large industrial consumption was lower than expected, due to lower consumption by some major industrial consumers.
- Auxiliary loads were lower than forecast, reflecting a downward trend in auxiliary loads in Victoria as more renewable energy is introduced.
- Actual MD was a POE 30, whereas the corresponding temperature at the time of MD was a POE 88.

2.6 Tasmania

Table 5 Forecast accuracy of Tasmania 2015 NEFR forecasts for 2015–16

	NEFR 2015 Forecast	Actual	Difference	Difference (%)	
Native Consumption (GWh)	11,026	10,467	559	5.3%	
SNSG (GWh)	479	396	83	21.1%	
Operational Consumption As Generated (GWh)	10,547	10,071	476	4.7%	
Residential & Commercial (excluding PV impact) (GWh)	3,658	3,681	-23	-0.6%	
Large Industrial (GWh)	6,340	6,025	315	5.2%	
Auxiliary Load (GWh)	221	103	118	114.5%	
PV Production (GWh)	133	121	12	9.6%	
Transmission Losses (GWh)	328	262	66	25.2%	
Weather					
HDD	2,318	2,193	124	5.7%	
CDD	40	50	-11	-21.2%	
	Actual	**POE10**	**POE50**	**POE90**	**Actual POE**
Maximum Demand (MW)	1,660	1,766	1,685	1,618	0.68
Weather					
Temperature (°C)	4.70	6.90	5.50	3.50	0.70

- Forecast residential and commercial consumption was within 0.6% of actual consumption
- Industry consumption was lower than forecast, due a fall in consumption by some major industrial consumers.
- Auxiliary load and transmission losses were significantly over forecast in Tasmania, most likely due to the Basslink cable being down, as Tasmania is a net exporter of electricity.
- Actual MD was a POE 55, whereas the corresponding temperature at the time of MD was a POE 70.

CHAPTER 3. IMPROVEMENTS TO THE FORECASTING PROCESS

Since the publication of the 2015 NEFR, AEMO has changed its forecasting methods to improve accuracy and the quality of forecasting insights.

3.1 2016 NEFR improvements

AEMO enhanced its NEFR 2016 forecasting methodology by delivering more detailed 'bottom-up' models that embrace a mix of economic and technical methods to better capture the continuing transformation of the energy supply and demand system.

The electricity market has undergone a rapid transformation since the mid-late 2000s, driven by changes in technologies that:

- Sit between the consumer and the grid, such as rooftop PV, energy-efficient appliances, and technologies that enable greater control of appliance operation and energy usage.
- Have become increasingly affordable to typical residential and business consumers.
- Are increasingly being adopted, in part as a possible solution to energy bill inflation.

Further, a transition away from energy-intensive industries affected business consumption, which is largely driven by the Australian economy, with the global financial crisis, mining boom, and subsequent commodity price collapse.

While much of the change has been occurring beyond the bulk transmission grid, it has major implications for the operation and development of the grid, and therefore for AEMO's forecasting and planning reports.

In the past, AEMO used bulk transmission data as the primary source of data for forecasting. However, this data:

- Is highly aggregated (so does not provide fine detail).
- Is historic (so may not be indicative of a changing future).
- Does not reveal dynamics that originate beyond the grid.

AEMO found that this approach made it more difficult in the changing energy environment to quickly detect and understand key trends. In response, AEMO adopted new data streams from beyond the grid in the 2016 NEFR, such as:

- Consumer energy meter data.
- Complementary data from other agencies and sources – such as national account data from the Australian Bureau of Statistics – to support greater understanding of structural change in the economy.

By integrating detailed data from beyond the grid, AEMO has shifted to finely segmented 'bottom-up' forecasting approaches that embrace forward-looking economic and structural methods, and rely less on historic data that may not be indicative of Australia's economy and consumer behaviours.

Using these new data streams, AEMO introduced a new simulation process for forecasting demand, enabling the use of long-range weather data and more dynamic forecast drivers to prepare 20-year projections of maximum and minimum energy demand.

3.2 2017 NEFR improvements

The 2017 NEFR will continue a program of forecast development to achieve further improvements:

- Climate change normalisation of weather input data, and long-range climate forecasts. AEMO is working closely with the Bureau of Meteorology to understand how best to apply climate change projections in long-range energy forecasts.
- Improving weather models for forecasting heating and cooling load. AEMO is leading a process, with the industry's Forecasting Reference Group, to review, improve, and consolidate weather models used in AEMO's long-range forecasts.
- Forecasting future price and tariff structures. AEMO is adapting its forecasting methods to accommodate the price and tariff structures of the future energy system to better capture changing consumer behaviour. This will more accurately represent the changing consumer behaviour in response to the evolving energy system.
- Co-optimised forecasts. For the 2016 *National Gas Forecasting Report* (NGFR), AEMO has piloted a new co-optimised forecasting process that has enabled a better capture of important change dynamics across the energy system. The 2017 NEFR will adopt this approach to integrate the feedback between gas and electricity, supply and demand, and international and domestic drivers of change. This approach has demonstrated improvements in capturing a range of more complex interactions, including:
  - Gas to electric appliance-switching.
  - Climate and emissions policy.
  - Gas supply scarcity and impacts on wholesale market pricing.
  - The international oil and gas market, with impacts on Queensland's LNG sector.

3.3 New forecast performance assessment framework and forecasting dashboard

The energy market is changing rapidly, and AEMO intends to move to a framework to account for and reflect the rapidly changing environment. In the short term (three to five years), there are a number of rapid changes in the market happening beyond the grid. In addition, the increase in large industrial closures is making demand peaks difficult to model. In the long term (20 years), there are more uncertainties with climate change and disruptive technologies such as battery technology, solar PV, and energy efficiency.

AEMO is developing a new forecast performance assessment framework with industry, and proposes to:

- Replace the forecast accuracy report, as required under Clause 3.13.3(u), with forecast accuracy measures available on an online forecast performance dashboard.
- Expand the scope of performance assessment to include most of AEMO's gas and electricity forecasts.

The dashboard would allow AEMO to remain agile in responding to available information and will allow AEMO to make data available to stakeholders more frequently. The dashboard could be updated as often as month or weekly. Furthermore, the dashboard could be interactive, allowing the user to view the data in different ways.

AEMO is in the process of scoping and designing the updated portal to ensure that relevant forecasting information and performance measures is available to its stakeholders. AEMO will consult with industry and stakeholders on the energy forecasting dashboard layout and content via the Forecasting Reference Group.

GLOSSARY

This document uses many terms that have meanings defined in the National Electricity Rules (NER). The NER meanings are adopted unless otherwise specified.

Term	Definition
auxiliary load	The load from equipment used by a generating system for ongoing operation. Auxiliary loads are located on the generating system's side of the connection point, and include loads to operate generating systems co-located at coal mines.
cooling degree days (CDD)	A sum of the number of degrees that the ambient temperature is above the threshold temperature for each day of the year.
heating degree days (HDD)	A sum of the number of degrees that the ambient temperature is below the threshold temperature for each day of the year.
installed capacity	The generating capacity (in megawatts (MW)) of the following (for example): • A single generating unit. • A number of generating units of a particular type or in a particular area. • All of the generating units in a region. Rooftop PV installed capacity is the total amount of cumulative rooftop PV capacity installed at any given time.
large industrial load	There are a small number of large industrial loads – typically transmission-connected customers – that account for a large proportion of annual energy in each National Electricity Market (NEM) region. They generally maintain consistent levels of annual energy and maximum demand in the short term, and are weather insensitive. Significant changes in large industrial load occur when plants open, expand, close, or partially close.
maximum demand (MD)	The highest amount of electrical power delivered, or forecast to be delivered, over a defined period (day, week, month, season, or year) either at a connection point, or simultaneously at a defined set of connection points.
native electricity consumption	The electrical energy supplied by scheduled, semi-scheduled, significant non-scheduled, and small non-scheduled generating units.
operational electricity consumption	The electrical energy supplied by scheduled, semi-scheduled, and significant non-scheduled generating units, less the electrical energy supplied by small non-scheduled generation.
probability of exceedance (POE) maximum demand	The probability, as a percentage, that a maximum demand level will be met or exceeded (for example, due to weather conditions) in a particular period of time. For example, a POE10 maximum demand for any given season is expected to be met or exceeded, on average, one year in 10 – in other words, there is a 10% probability that the projected maximum demand will be met or exceeded.
rooftop photovoltaic (PV)	A system comprising one or more photovoltaic panels, installed on a residential or commercial building rooftop to convert sunlight into electricity. The 2015 NEFR forecasts considered only rooftop systems (systems installed to generate electricity primarily for self-consumption by residential or commercial consumers, including projects above 100 kW as well as smaller systems). It did not consider PV installations like solar farms or community projects which are designed to sell electricity into the market.
SNSG	Small non-scheduled generation
transmission losses	Electrical energy losses incurred in transporting electrical energy through a transmission network.