AGENDA – Forecasting Reference Group (FRG)

MEETING: #4

DATE: Tuesday 27 February 2018

TIME: 2.30 pm – 4.30 pm AEDT

LOCATION: AEMO Melbourne Boardroom, AEMO Sydney Boardroom;
AEMO Fraser Room; AEMO Coonawarra Room, AEMO Ningaloo Room

TELECONFERENCE: Dial: 1800 055 132 Meeting ID: 36722934

CONTACT: Energy.forecasting@aemo.com.au

ITEM	TIME	TOPIC	PAPERS	RESPONSIBLE	ACTION
1.	2:30pm – 2:35pm	Welcome and Introductions	None	Tania McIntyre (Chair)	Note
2.	2:35pm – 2:45pm	Previous Minutes and Action Items	FPRG Minutes: 30 January 2018	Chair	Agree/ Discuss
3.	2:45pm – 3:00pm	Demand Forecast Updates • Publication timings	None	Nicola Falcon (AEMO)	Discuss
4..	3:00pm – 3:20pm	March Electricity Forecast Updates • CSG • Large Industrial Load • Electric Vehicle	Presentation 1	Greg Staib (AEMO)	Discuss
5.	3:20pm – 3:50pm	Status of Current Work and Next Steps on: • Maximum Demand • Heatwaves and Climate Change	Presentation 2	Daniel Guppy (AEMO)	Discuss
6.	3:50pm – 4:20pm	Demand Side Participation Forecast Update, approach and results	Presentation 3	Magnus Hindsberger (AEMO)	Discuss

7.	4:20pm – 4:25pm	Other Business	None	All	Discuss
8.	4:25pm – 4:30pm	Meeting Close	Next meeting scheduled: Tuesday 27 March 2018	Chair	Note

DRAFT MINUTES – Forecasting and Planning Reference Group (FPRG)

MEETING: # 3

DATE: Tuesday 30 January 2018

CONTACT: Energy.Forecasting@aemo.com.au

ATTENDEES:

NAME	ORGANISATION	LOCATION
Craig Oakeshott	AER	Adelaide
Eli Pack	AEMO	Brisbane
Shane Brunker	Energy Queensland	Brisbane
Craig Price	AEMO	Melbourne
Jo Dean (Secretariat)	AEMO	Melbourne
Matthew Marston	AEMO	Melbourne
Nick Culpitt	AEMO	Melbourne
Nicola Falcon	AEMO	Melbourne
Rachael Shaw	AEMO	Melbourne
Tania McIntyre (Chair)	AEMO	Melbourne
Teresa Rinaldi	AEMO	Melbourne
Michael Pierce	AGL	Melbourne
Steve Leopardi	AGL	Melbourne
Ben Skinner	Australian Energy Council	Melbourne
Chris Streets	Energy Australia	Melbourne
Richard Paprzycki	Energy Australia	Melbourne
Neil Gascoigne	Powercor Australia	Melbourne
Panos Priftakis	Snowy Hydro	Melbourne
Peter Wormald	Delta Electricity	Sydney
James Googan	Origin	Sydney
David Moore	Planning NSW	Sydney
John Sligar	Sligar and Associates	Sydney
Elizabeth Bowron	AEMC	Teleconference
Damian Dwyer	APPEA	Teleconference
Don Prentis	APA Group	Teleconference
Jackie Bridge	AusNet Services	Teleconference
Will Schivell	Australian Gas Infrastructure	Teleconference
David Whitelaw	Dept. of Environment and Energy	Teleconference
Hugo Klingenberg	Electranet	Teleconference
David Hock	Engie	Teleconference
Maya Muthuswamy	Engie	Teleconference
Geoff Bongers	Gamma Energy Technology	Teleconference
David Headberry	Major Energy Users	Teleconference
Erin McSweeney	NSW Dept. of Planning Transport	Teleconference
Tadipatri Prasad	NSW Government	Teleconference
Ian McGill	NSW University	Teleconference
Cameron McLean	Powerlink	Teleconference
Keith Rulan	Powerlink	Teleconference
Craig Memery	Public Interest Advocacy Centre	Teleconference
Jennifer Brownie	QLD Electricity Users Network	Teleconference
James Bennett	SA Power Networks	Teleconference
Ewan Sherman	TasNetworks	Teleconference
Arindam Sen	TransGrid	Teleconference

1. Welcome and Introductions

Tania McIntyre (AEMO) welcomed the FPRG to the first meeting of 2018.

Tania thanked the FPRG stakeholders for their participation in the 2017 forums and continued input into the post forum surveys.

Tania acknowledged the IT issues highlighted within the feedback (specifically regarding the video conferencing and teleconference facilities) noting that a solution is currently being sought.

2. Previous minutes and action items

Tania McIntyre (AEMO) ran through the Action Items from the November 2017 meeting. The meeting minutes were accepted and noted as final.

Updates on outstanding Action Items have been appended below.

3. Gas Statement of Opportunities (GSOO)

Rachael Saw (AEMO) informed the FPRG that AEMO is proposing to delay publication of the GSOO, including gas demand forecasts, from 31 March 2018 to mid-June 2018 to align with data timeframes for the Australian Domestic Gas Security Mechanism (ADGSM) and to reduce administrative burden on participants.

Members of the FPRG commented that they were supportive of the change for this year, but would want extensive consultation before setting this date in subsequent years as the ADGSM may not be a long term requirement. One member commented that, in the interest of winter planning, the sooner the release the better, but followed up with a correction later to advise that they were comfortable with a June publication date.

Any further queries or comments on this, please contact:
energy.forecasting@aemo.com.au

4. Generator Information

Matthew Marston (AEMO) presented on AEMO's data collection and future publication of information with the following highlights from the presentation:

- The new data portal creates a 'one-stop-shop' and has been created to be as easy to use as possible.
- Data is being collected in a new way, asking new questions which will assist in forecasting reliability and energy constraints.
- AEMO aims to roll this out by July 2018. Prior to this, AEMO will host participant trials/feedback and training sessions.

A query was raised on projects by non-market participants and how these would be captured and how AEMO plans to get visibility of these. Nicola Falcon (AEMO) responded that the current strategy was based on stakeholder consultation and getting people to voluntarily submit information. Another question on demand side

response and the commitment criteria capability was raised and AEMO agreed they would need to start thinking about this.

It was suggested that Transmission Network Service Provider's (TNSP's) and jurisdictional bodies could assist in providing lists of new or potential participants coming on board.

ACTION 4.1.1: Matthew Marston (AEMO) to provide a sample of the questions table for the portal to FPRG prior to March 2018. Questions will also be discussed at targeted data portal workshops in next couple of months.

ACTION 4.1.2 Tadipatri Prasad (NSW Govt.) will contact Nicola Falcon (AEMO) to provide a list of upcoming projects offline.

Stakeholders queried how AEMO identifies current projects, stating that information coming from the AEMO website is unreliable as it leaves room for incorrect information and is missing new projects that have been publicly announced. Nicola reiterated that AEMO rely on information on new projects to come to AEMO through Registrations, conversations with Network Service Providers, AEMO's Generator Information Survey etc.

Stakeholders were encouraged to send information on any new projects to generation.information@aemo.com

5. Integrated System Plan (ISP) Update

Craig Price (AEMO) provided an update on the ISP informing the FPRG that the consultation paper for the ISP has been released, with submissions addressing the approach and scenario due Friday 2 February 2018.

Once submissions have been received the remaining input is due by end of February 2018.

The first ISP is due for release in June 2018 and will capture the diversity in half hour traces of difference areas. The data will be released through the data portal.

The context, focus and purpose of first Integrated System Plan (ISP):

- The merits of strategies based on scale size renewable zones (Finkel 5.1) relative to strategies reliant on market led investment in distributed resources (both embedded and transmission).
- The approach to re-engineer the power systems as existing thermal fleet reaches end of life and is replaced with generation in different parts of the power system and other alternatives (such as demand management).
- The technical requirements needed to manage future power systems.
- The need for any large scale investment in long-life long-lead time generation and transmission, under a low regret approach that balances risks of inefficient investment and stranding against timely investment to maintain reliability.
- The value created by networks to enable diversity of supply and storage and thereby improve reliability and reduce costs.

ACTION 5.1.1 Craig Price (AEMO) to engage with Craig Oakeshott (AER) in discussions on network frameworks and current renewable zones in greater detail offline.

Nicola Falcon (AEMO) requested that stakeholders with any information or details to share on storage to contact her to provide any insights on types of storage options, range of costs, the resilience of power system security, new technology and the range of services offered.

The ISP will deliver plans under three core scenarios, these plans will look at renewable energy zones and what generations might connect under difference scenarios.

In 2019 AEMO will be working with the AEMC to look at how governments might support specific renewable energy zones.

Further queries or statements on this, please email energy.forecasting@aemo.com.au.

6. Trends and Generator Reliability

Nick Culpitt (AEMO) presented on generator summer capabilities informing the FPRG of the following:

- This will focus on the capability of the fleet in the summer peaks.
- The modelling is based on summer capacities provided by participants and information on historical outages.
- Nine main station types are being used in the recent GHD study for AEMO, modelling temperature rises and impact on NEM unit output.

This will be covered in more detail in the Generator Performance Data Information Workshop on 13 February.

Stakeholders were encouraged to submit ideas, trends, comments or questions to energy.forecasting@aemo.com.au or Tania McIntyre directly.

7. Medium Term Projected Assessment of System Adequacy (MT PASA)

Nicola Falcon (AEMO) provided an update on the Medium Term Projected Assessment of System Adequacy (MT PASA) informing the FPRG that the redeveloped MT PASA previously due to go live on the 15 February 2018 has been delayed.

The complexity of the project and challenges repeatedly running the system reliably on the cloud environment have contributed to this delay. AEMO has a commitment that this will be delivered by the end Q2 2018, although earlier go-live is anticipated by the end of April 2018.

The participant trial will commence at the end of February 2018. The dates will be available by the end of this week with email notifications sent out to provide more information. Any questions or queries can be directed to energy.forecasting@aemo.com.au or jo.dean@aemo.com.au

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9. Meeting Close

The next Forecasting Reference Group meeting is scheduled for Tuesday 27 February 2018.

The next Planning Reference Group is scheduled for Tuesday 13 February 2018.

Forecasting Reference Group (FRG) Actions Items

Item	Date Raised	Topic	Action required	Responsible	By	Status
4.1.1	30 Jan 2018	Generator Information	Sample of the 'questions table' in new portal to be distributed to FPRG.	Matt Marston (AEMO)	March 2018	Open
4.1.2	30 Jan 2018	Generator Information	Tadipatri Prasad to discuss upcoming projects off line	Tadipatri Prasad (NSW Govt.) Nicola Falcon (AEMO)		Open
5.1.1	30 Jan 2018	Integrated System Update	Discussion of ISP details to be held offline.	Nicola Falcon, Craig Price (AEMO) Craig Oakeshott (AER)	10 February 2018	Open
1.4.1	19-Sep-17	Summer Analytics Program	Chat with Ausnet Services regarding the ARENA project with Solcast. GS Update – Spoke with Luke at Solcast – insights to be released in future. Commitment from Siro for 1 resource. *20/11 Update* – Yet to commence program. *30/01 Update* – Vivian Mai, Price and Consumer demand behaviour and Song Li, Climate/Heatwaves will present on in the coming months.	Greg Staib (AEMO)	24-Oct-17	In progress

1.4.2	19-Sep-17	Summer Analytics Program	Discuss consumer behaviour around tariffs with Craig Memery (PIAC) *20/11Update* - relates to analytics program – comment taken on board. *30/01 Update* – Craig to discuss with Tania off line	Scott Maves (AEMO) Greg Staib (AEMO)	24-Oct-17	Completed
1.5.1	19-Sep-17	Electric vehicles	Confirm penetration of EVs is for a strong, neutral and weak scenarios.	Greg Staib (AEMO)	24-Oct-17	Completed

UPDATED ELECTRICITY DEMAND FORECAST UPDATE FROM 2017 ESOO

February 2018

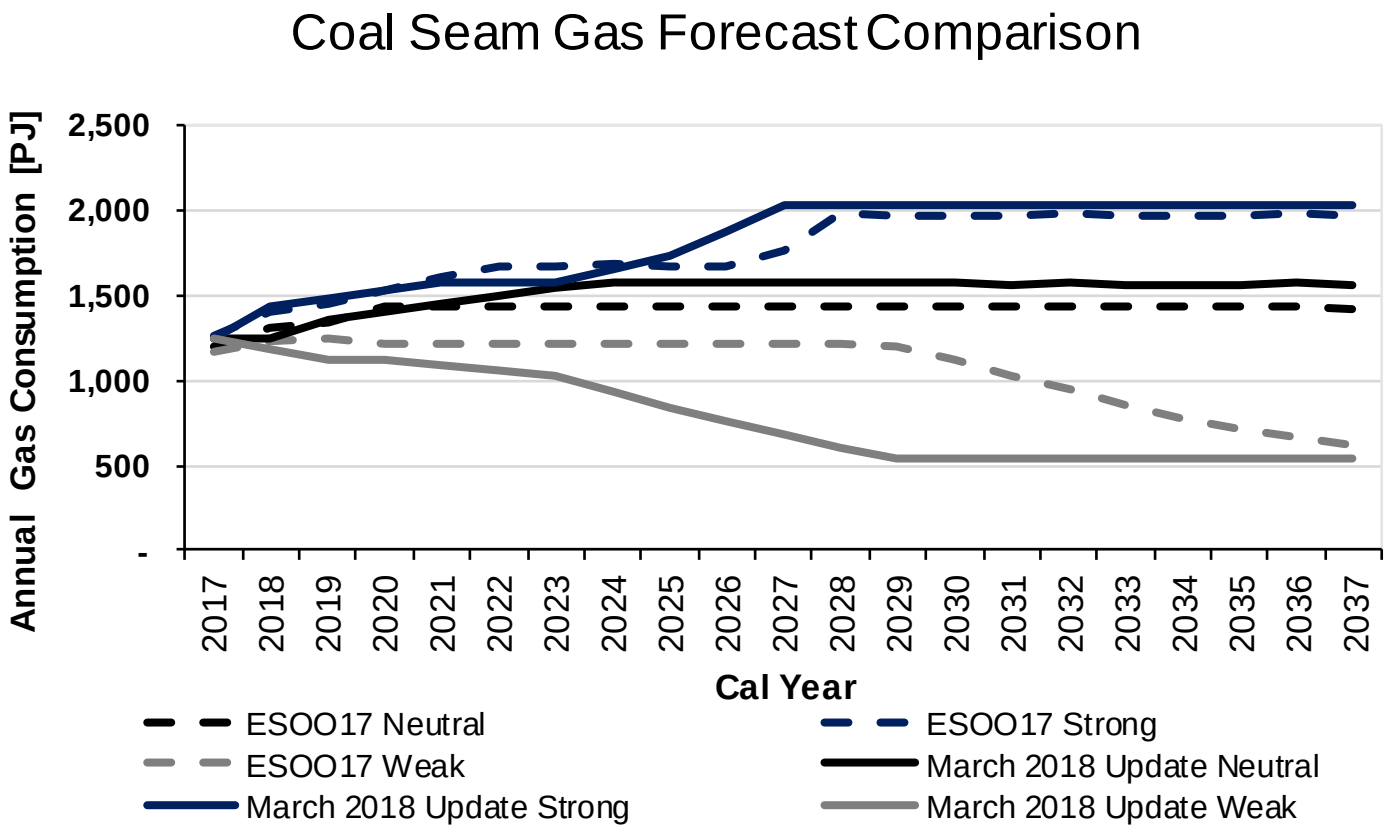
PRESENTED BY RELIABILITY FORECASTING

AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

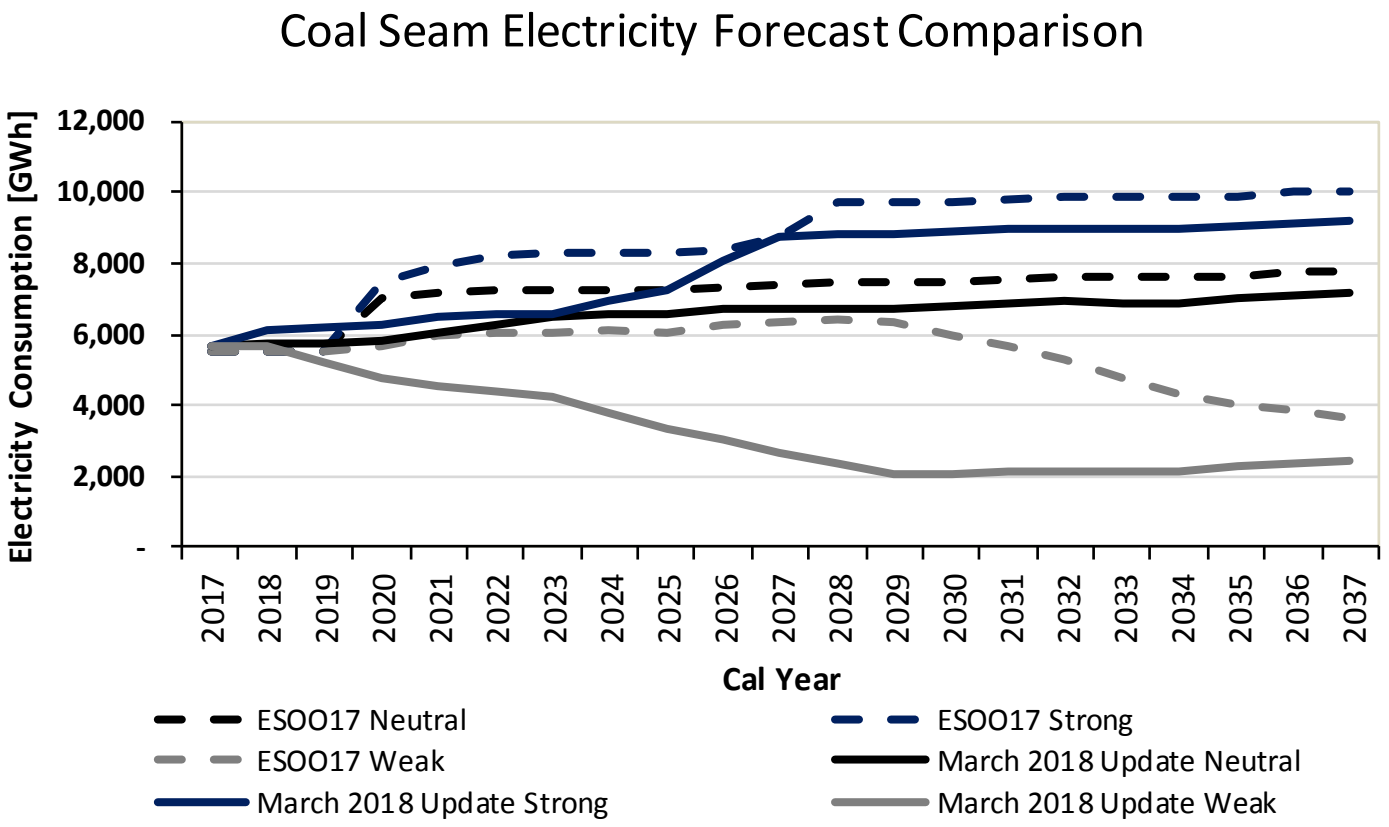
PURPOSE

- Present updated forecast reflecting changes in the NEM that have occurred since the publication of the ESOO17 forecast
- The changes include:
  - Revised LNG/CSG forecasts (as discussed at September FRG)
  - Updated Electric Vehicle forecasts (as discussed at September FRG)
  - Large Industrial Load assumptions
  - New calculations for historical auxiliary demands

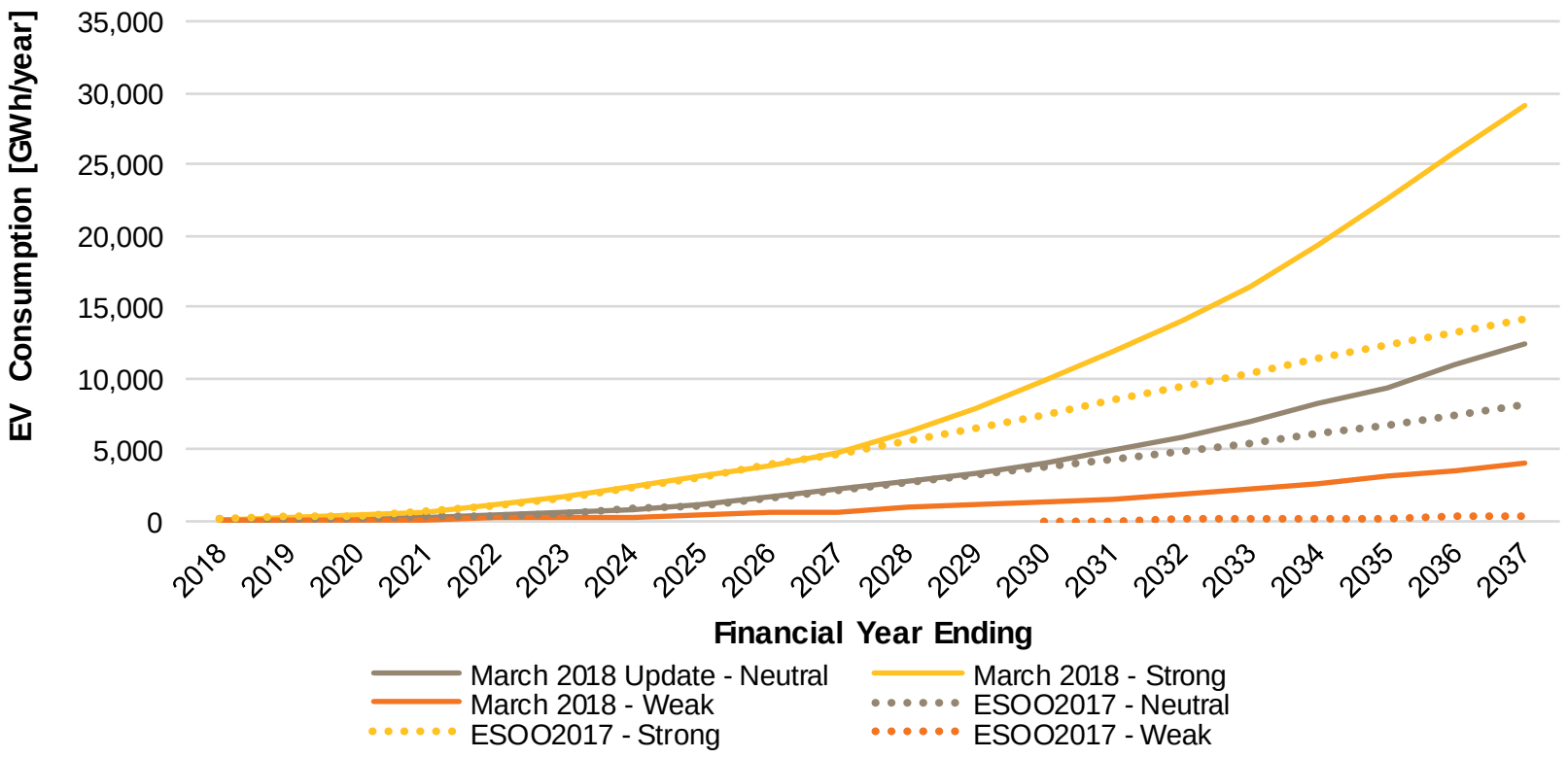
COAL SEAM GAS FORECAST UPDATE



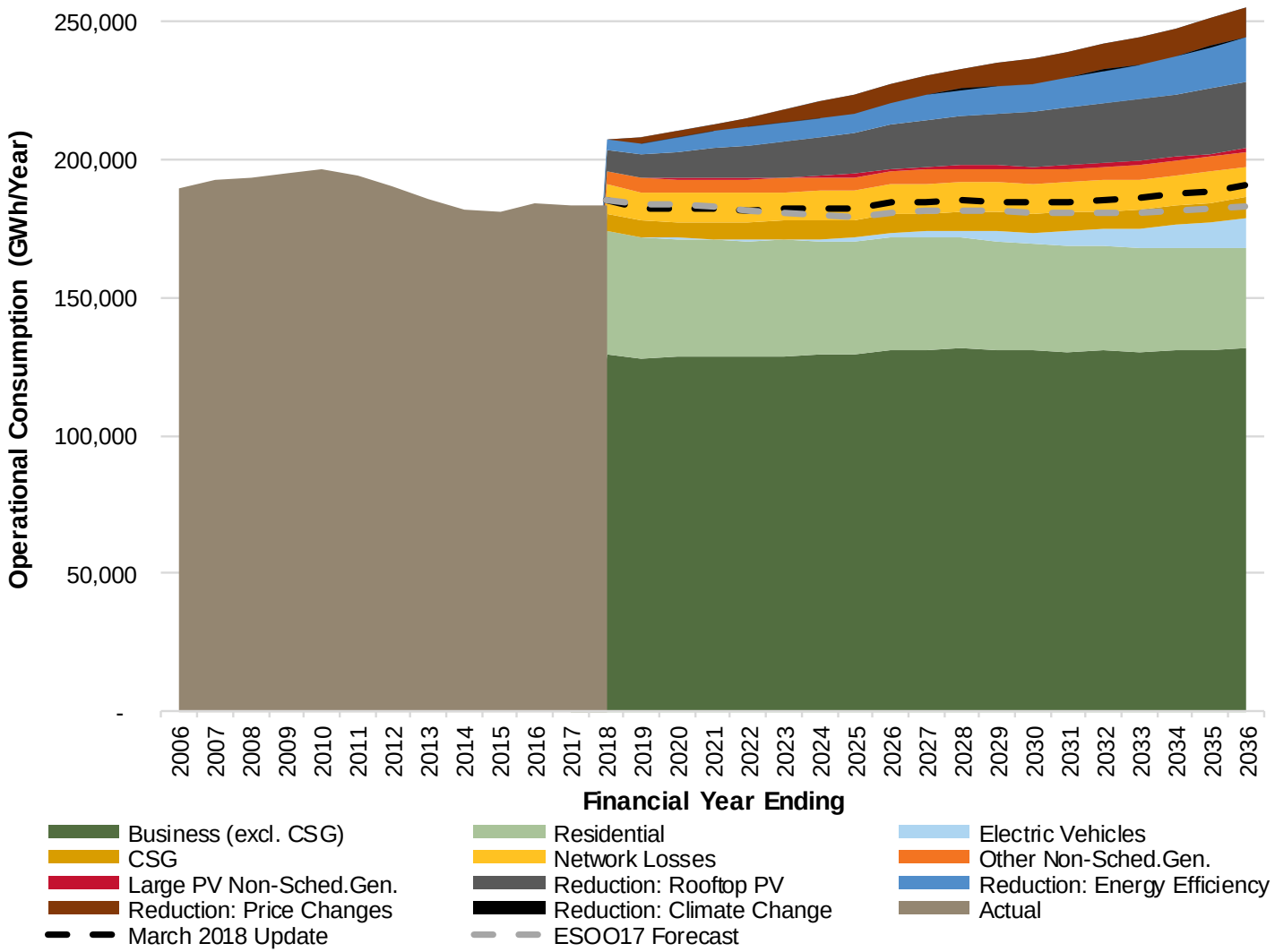
COAL SEAM GAS FORECAST UPDATE



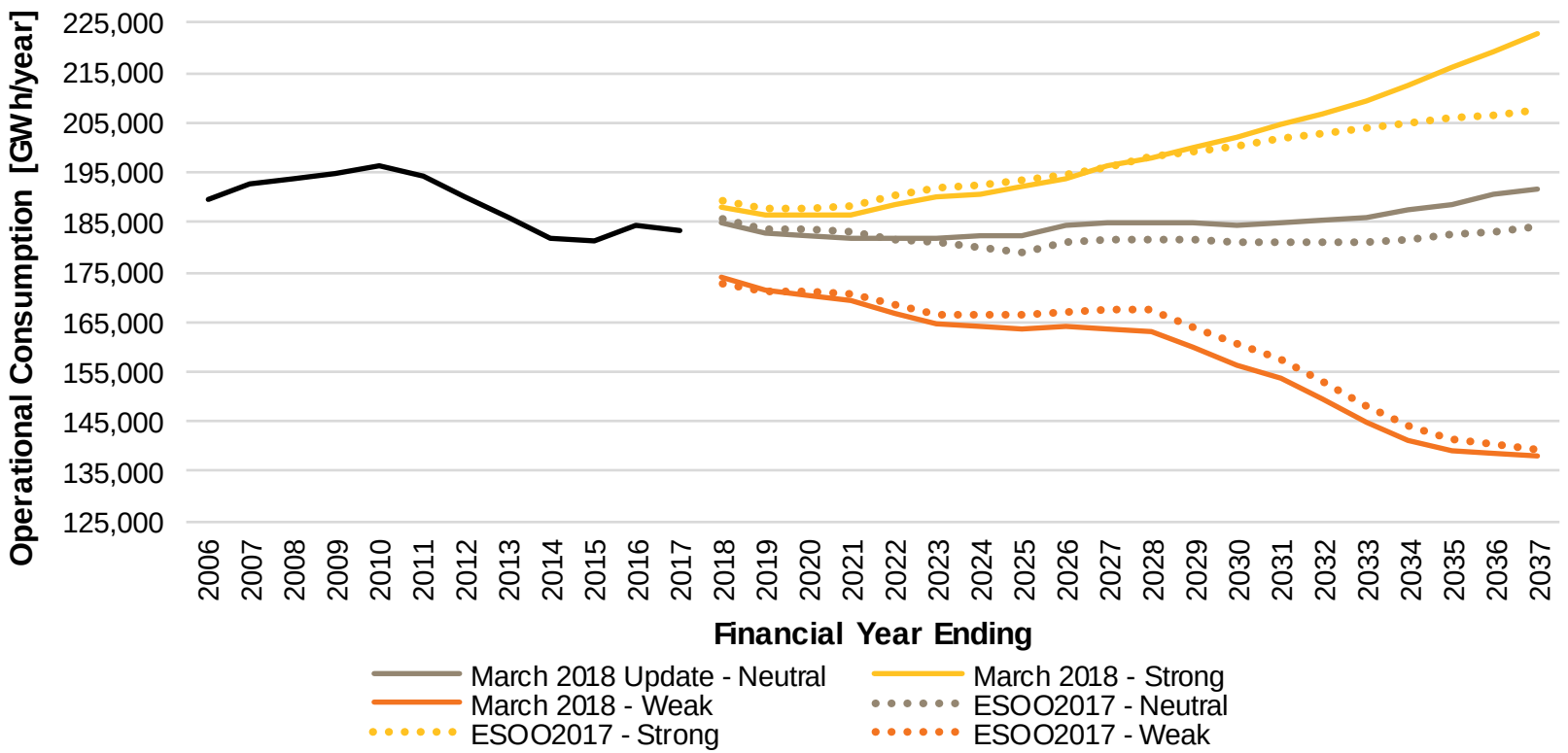
ELECTRIC VEHICLE FORECAST UPDATE



MARCH 2018 NEM FORECAST



NEM FORECAST: SCENARIOS



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AUSTRALIAN ENERGY MARKET OPERATOR

Maximum Demand Forecasting
Heatwaves and Climate Change

February 2018

Agenda

1. Purpose
2. 2017 Maximum Demand Methodology
3. Case Study of NSW 10-Feb-2017
4. Summer Research Into Heatwaves Driving Demand
5. Summer Research Into Climate Change

Purpose

- Explain the current Maximum Demand methodology and how it captures heatwaves.
- Present AEMO's results from the Summer Research Project into how heatwaves impact demand
- Discuss upcoming work to better represent climate change in our demand forecasts

NEFR 2017 MD Methodology

NEFR 2017 MD Methodology

2017 Maximum Demand Methodology:

- Used a half-hourly underlying demand model
  - Underlying demand is the demand at the power point
- Trained on 2.25 years of data to capture consumers' current response to weather and calendar effects
  - Including instantaneous temperatures and heatwaves
- Simulated and forecast demand:
  - Bootstrapped 17 climate change adjusted historical weather years to capture half-hourly solar and temperature variability
  - Simulated "random shocks" assuming Gaussian distribution
  - Forecast future consumer behaviours including; appliance uptake, PV + battery uptake, large industrial load etc.
- Translated underlying demand to operational demand (as sent out) and found the maximum and the percentile

Summer Research Into Heatwaves

Summer Research Into Heatwaves

AEMO is currently experimenting with a number of variables to improve our understanding of demand in the presence of heatwaves

These variables include:

- Daily rolling average (1 days to 3 days)
- The Excess Heat Factor (EHF)
  - $EHIsig = (Ti + Ti\text{-}1 + Ti\text{-}2)/3 - T95$
  - $EHIaccl = (Ti + Ti\text{-}1 + Ti\text{-}2)/3 - (Ti-3 + \ldots + Ti-32)/30$
  - $EHF = EHIsig \times \max(1, EHIaccl)$
  - Where Ti is the daily average temperature and T95 is the 95th percentile of daily average temperatures from 1960.
- Heatwave dummy variables
- EHF x Heatwave dummy
- Heatwave ordinal variables
  - We dismissed this variable as there were not enough extreme heatwaves in the dataset

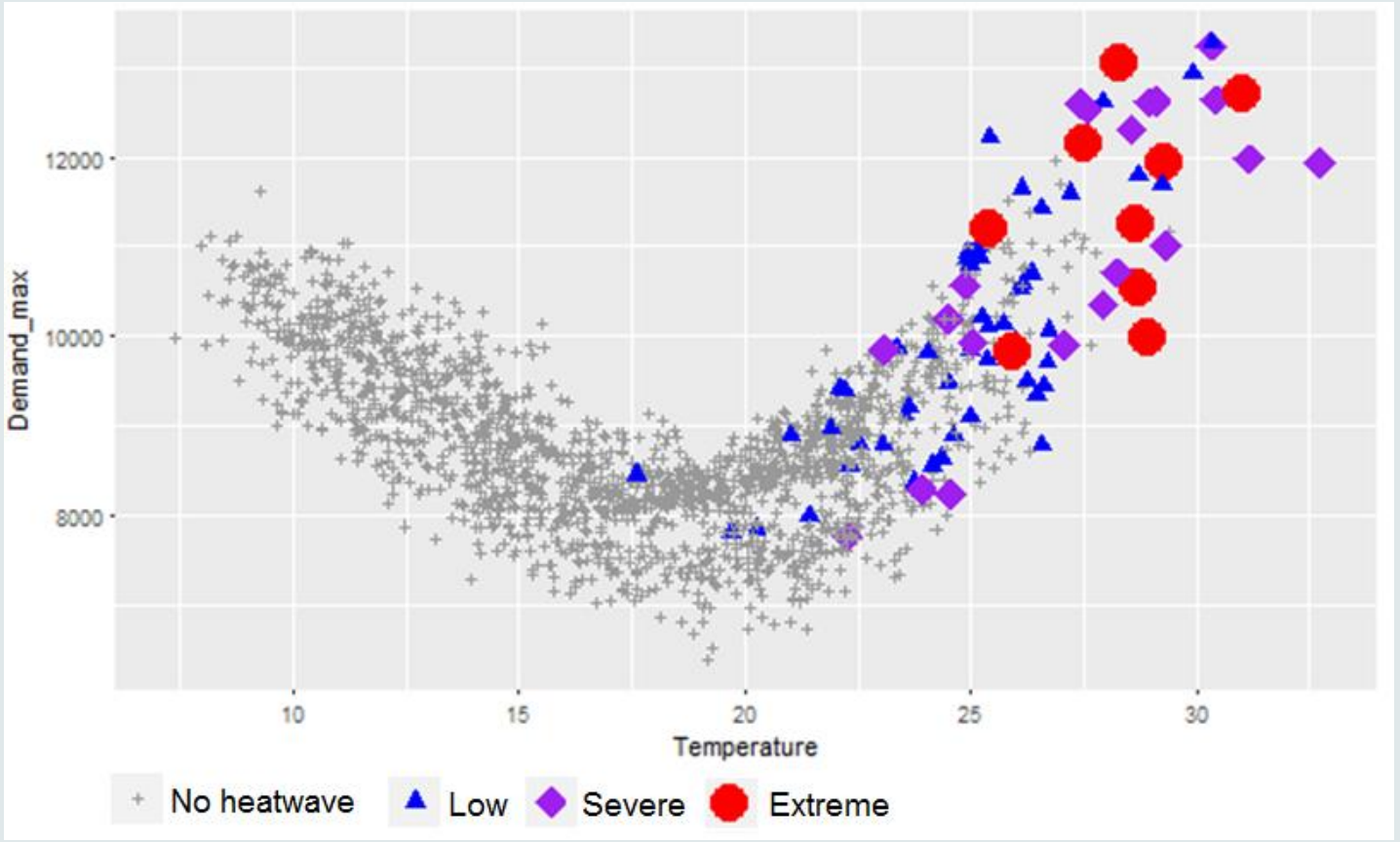
Summer Research Into Heatwaves

	Model 1	Model 2	Model 3	Model 4	Model 5
New Variable	Naïve	CD_3DAYLAG	EHF	HW_dummy	EHF x HW_dummy
R^2	0.7880	0.8000	0.7980	0.8030	0.7980
Adj. R^2	0.7870	0.7990	0.7980	0.8030	0.7980
SE	463	450	452	446	452
Res_min	-1961	-1942	-1926	-1898	-1927
Res_max	2550	2199.7	1944.3	2171	1953.3
AIC	113919	113493	113542	113355	113546
BIC	114037	113618	113667	113480	113671
Out-of-sample accuracy (of top 1% demand values)					
MSE	830	768	749	714	830

Key points

- The inclusion of a heatwave variables performs as well or better than the naive model in forecasting demand
- Model 2 (3 day lag) was used in the NEFR 2017
- The forecast accuracy of model 3 and model 4 performs better than the NEFR 2017 approach

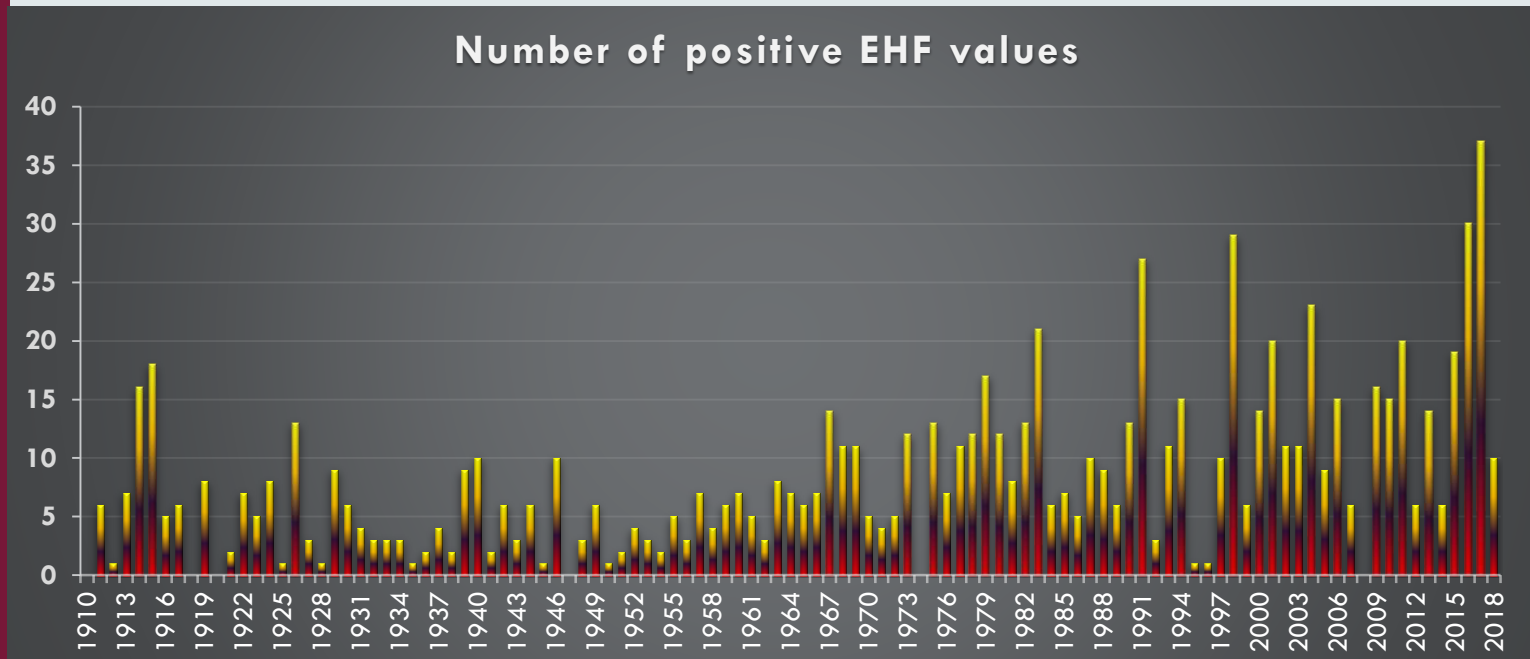
Summer Research Into Heatwaves

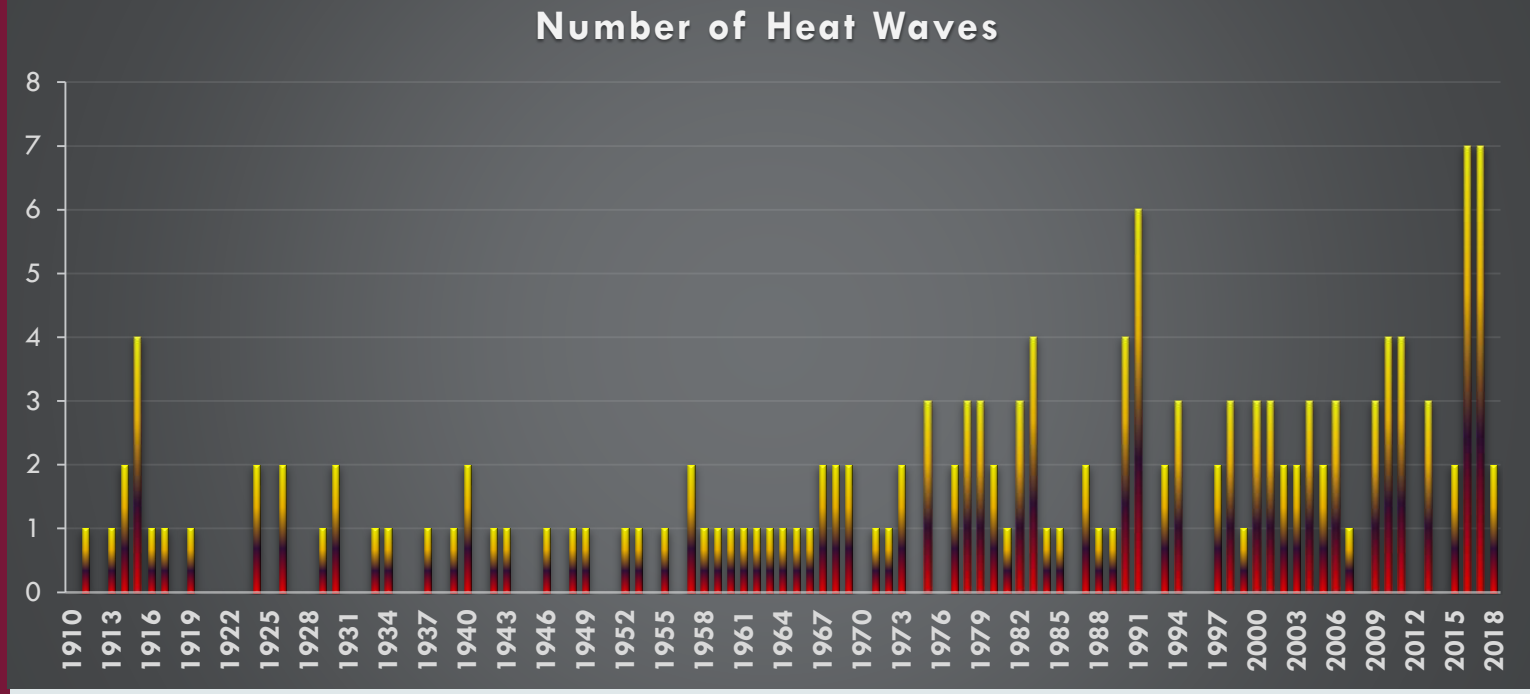


- Low – Between 0 and the 65 percentile of EHF (EHF65% = 4.1)
- Severe – Between the 65 percentile and 3 times the 65 percentile of EHF
- Extreme – Greater than 3 times the 65 percentile of EHF

Summer Research Into Climate Change

Summer Research Into Climate Change





Summer Research Into Climate Change

- As discussed, simulating weather conditions is important for probabilistic demand forecasting
- The 17 climate change adjusted historical weather years are designed to represent 17 possibilities of this year.
- In simulating we adjusted historical weather data up to 1-July-2017 levels assuming the 4.5 Representative Concentration Pathway (RCP)
  - The models suggest that following a 4.5 emissions pathway would result in CO2 concentration reaching 540 ppm by 2100 leading to an average 2^0c increase by 2100 relative to 1960
  - We have extrapolated this out to imply a 0.5^0c temperature increase over the next 20 years
  - In effect, we increased historical temperatures by 0.5^0c per 20 years

Summer Research Into Climate Change

- Our Summer Research Project is currently researching how climate change will:
  - Impact the maximum temperatures and the over night temperatures
  - Change the frequency, length and intensity of heatwave
- AEMO are looking at how to better lift and stretch historical weather data to reflect the weather patterns in 20 years under a RCP of 4.5 or 8.5

2018 DSP forecast: Methodology and draft results

February 2018

Purpose

- Present draft 2018 DSP forecast update and method used for calculation
- Obtain feedback about the appropriateness of the included components for assessing system reliability
- Get understanding of industry use of the DSP forecast

Agenda

- DSP definitions
- 2018 DSP forecast results
- Understanding changes
  - Data and methodology updates
- Price vs reliability response
- Uses of the DSP forecast
- Next steps

What is DSP?

Regular (daily)	Semi-regular (frequent)	Occasional (rare)

• Tariff driven or timer based:
  • Hot-water
  • Pool pumps
  • Battery
	• Price driven
	  • Back-up generators
	  • Industrial loads
		• Reliability driven
		  • Critical peak pricing
		  • Peak smart A/C

Embedded into max demand forecast

Part of DSP forecast
Price bands + Reliability response

Where is the most growth in DSP expected to happen?

Draft 2018 DSP forecast

Draft 2018 DSP forecast (in MW) – Summer (2018-19)

	NSW	QLD	SA	TAS	VIC
$300/MWh	77.7	32.5	1.2	5.6	28.4
$500/MWh	78.0	32.8	2.1	18.8	31.4
$1000/MWh	78.0	33.9	2.1	19.3	33.0
$2500/MWh	91.5	40.3	2.1	21.5	33.0
$5000/MWh	97.2	40.3	5.4	21.5	33.0
$7500/MWh	105.0	40.3	6.4	21.5	33.7
Reliability	105.0	66.4	6.4	23.2	77.2

- Excludes any RERT/ARENA DSP.

For comparison:

Estimated DSP for 2017–18 Summer

Price trigger	NSW	QLD	SA	TAS	VIC
$300/MWh	42.1	21.5	8.3	2.5	16.1
$500/MWh	50.3	22.2	9.1	3.9	18.3
$1000/MWh	50.3	24.3	9.1	3.9	20.9
$7500/MWh	69.8	45.0	48.7	15.0	87.7
Reliability response*	193.1	108.6	80.1	42.3	87.7

* Reliability response refers to situations where a Lack of Reserves notice (LOR2 or LOR3) is issued (see National Electricity Rules, rule 4.8.4 for definitions).

See: https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/Electricity-Forecasting-Insights/Key-component-consumption-forecasts/Demand-side-participation

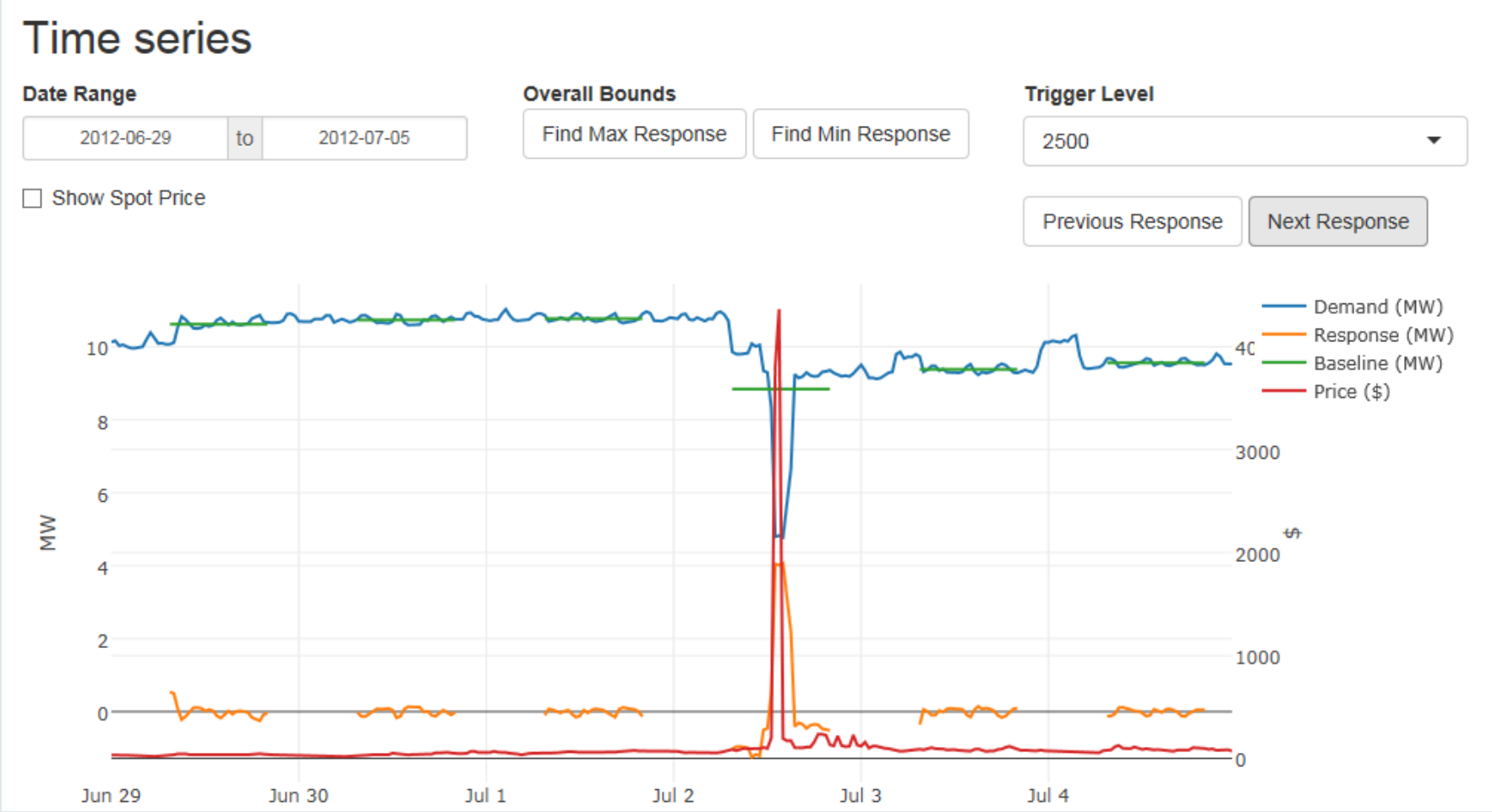
What has changed?

- 2013-2017 DSP forecasts based on:
  - Industrial load response at different price levels (meter data analysis)
  - Survey of retailers/aggregators/NSPs
  - Small non-scheduled generators (mostly removed from 2017 and now including in non-scheduled generation forecast)

- 2018 DSP update:
  - Updated survey data (test of 2018 DSP data collection).
  - Revised method that uses the meter data analysis method for all DSP loads, not just industrial loads.
  - In the tool, each DSP NMI is classified into types:
    - Industrial load (flat)
    - Daily load shape
    - Irregular loads

    } Baseline methodology varies between types
  - Response calculated by wholesale price levels or Lack-Of-Reserve (LOR) conditions.

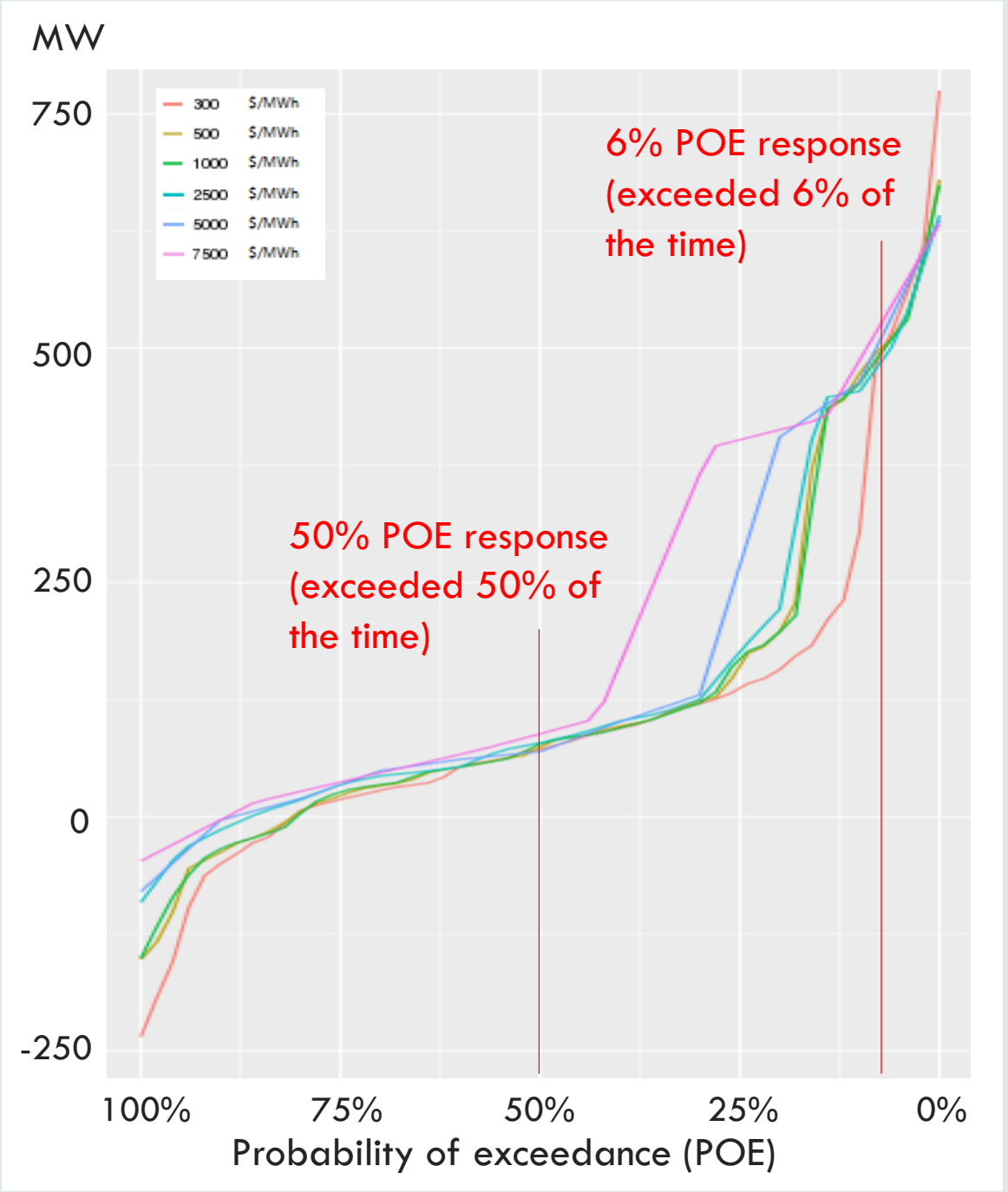
DSP tool – example response vs baseline (by price trigger)



DSP tool – example results

Response distribution curve calculated based on 5 years of historical response to different price triggers

Shows DSP is a probabilistic resource from a system level



Price vs. reliability response

Draft 2018 DSP forecast (in MW) - Summer

	NSW	QLD	SA	TAS	VIC
$300/MWh	77.7	32.5	1.2	5.6	28.4
$500/MWh	78.0	32.8	2.1	18.8	31.4
$1000/MWh	78.0	33.9	2.1	19.3	33.0
$2500/MWh	91.5	40.3	2.1	21.5	33.0
$5000/MWh	97.2	40.3	5.4	21.5	33.0
$7500/MWh	105.0	40.3	6.4	21.5	33.7
Reliability	105.0	66.4	6.4	23.2	77.2

- Includes 50% POE price response only in price bands.
- Network DSP is available for reliability response only.
- Excludes any RERT/ARENA DSP.

For comparison:

Historical POE50 response (MW) during actual LOR

	NSW	QLD	SA	TAS	VIC
No LOR	-1.8	-0.4	0.0	-1.4	-1.0
LOR 2	277.2	37.9	-0.8	62.9	-8.1
LOR 3	NA	NA	NA	34.4	90.9

Very few data points, so values highly uncertain

Use of the DSP forecast

For this use, is it appropriate to include 50% POE price response?

Should network response be included too?

DSP forecast used by AEMO in:

- MT-PASA, EAAP, ESOO, NTNDP/ISP

(forecast reliability assuming response is there)

Excluded in short term processes:

- ST-PASA / PD-PASA

(forecast reliability assuming response is **not** there, to signal the need for DSP response)

Any industry use?

Next steps

- This forecast update to be published end of March 2018 (minor update).
- Next major update:
  - AEMO to get updated DSP information in April 2018 as part of the DSP information guidelines process.
    - Workshop for participants 6 March 2018.
  - DSP forecast to be updated based on new tool.
  - To be published with next major electricity forecast update.