Intermittent Generation Forum

Session 1 – Trends and updates

30 November 2020

Welcome and Introduction

Michael Gatt

Chief Operations Officer

AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

Our facilitators

AEMO

Michael Gatt

Alicia Webb

Rob Selbie

Jack Fox

Anthony Hill

Petar Pantic

Mike Davidson

ARENA

Carl Tidemann

Agenda

Time (ADST)	Duration (min)	Item	Presenter
9.30 am – 9.35 am	5	Welcome and Introduction	Michael Gatt
9.35 am – 9.45 am	10	Synopsis – Variable Renewable Energy (VRE) trends	Anthony Hill
9.45 am – 10.20 am	35	AWEFS/ASEFS and self-forecasting updates since previous forum (Mar 2020)	Petar Pantic Rob Selbie Jack Fox
10.20am – 10.40 am	20	Other business	Anthony Hill Jack Fox
10.40am – 11.10 am	30	ARENA self-forecasting update	Carl Tidemann
11.10am – 11.25 am	15	Questions and discussion	

Forum objectives for Session 1

- Inform stakeholders on:
  - AWEFS/ASEFS and self-forecasting enhancements since last forum in March 2020.
  - Planned updates to wind and solar energy processes.

- Seek stakeholders' feedback on prospective system enhancements.

Synopsis – Variable Renewable Energy (VRE) trends

Anthony Hill – Operational Forecasting

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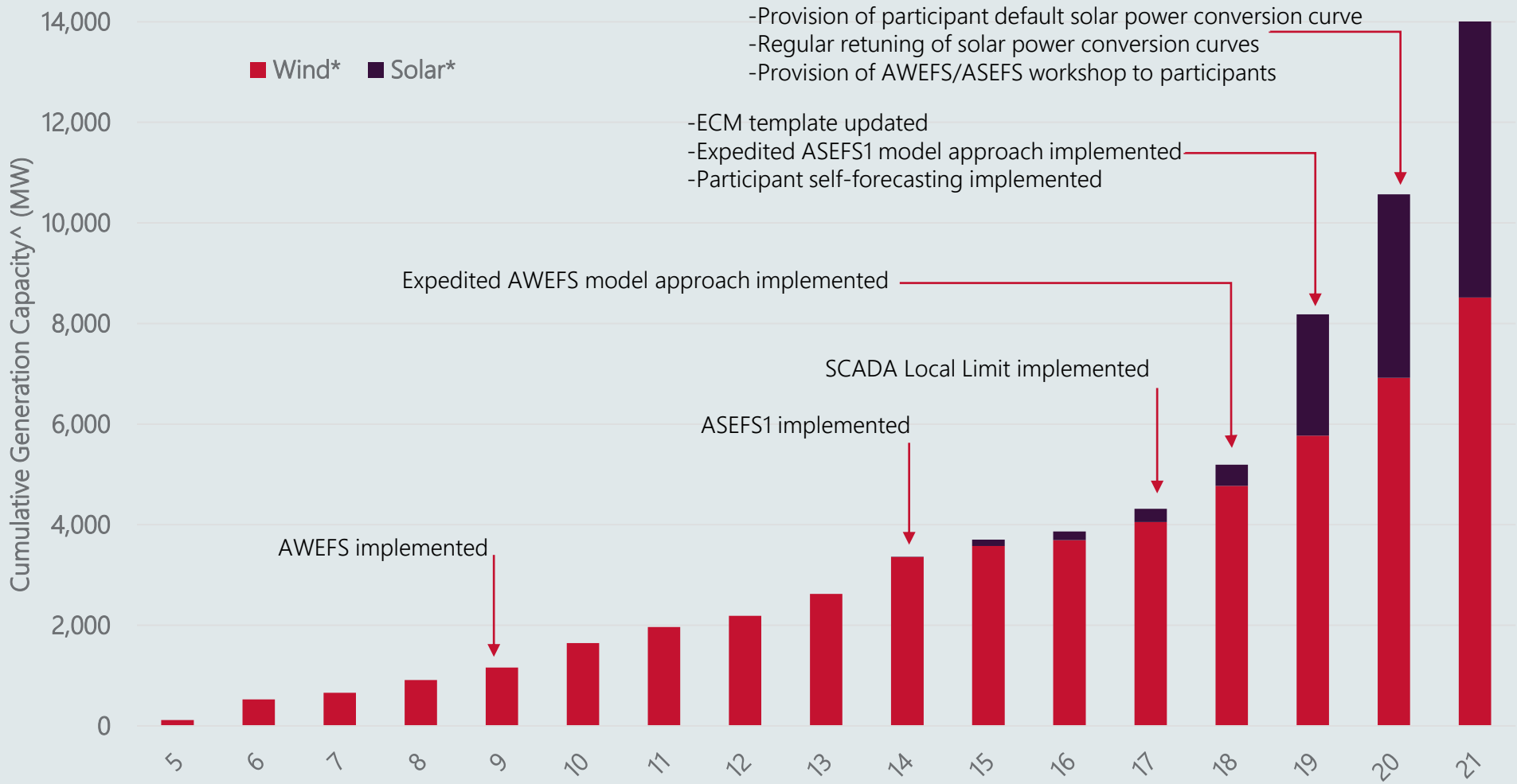
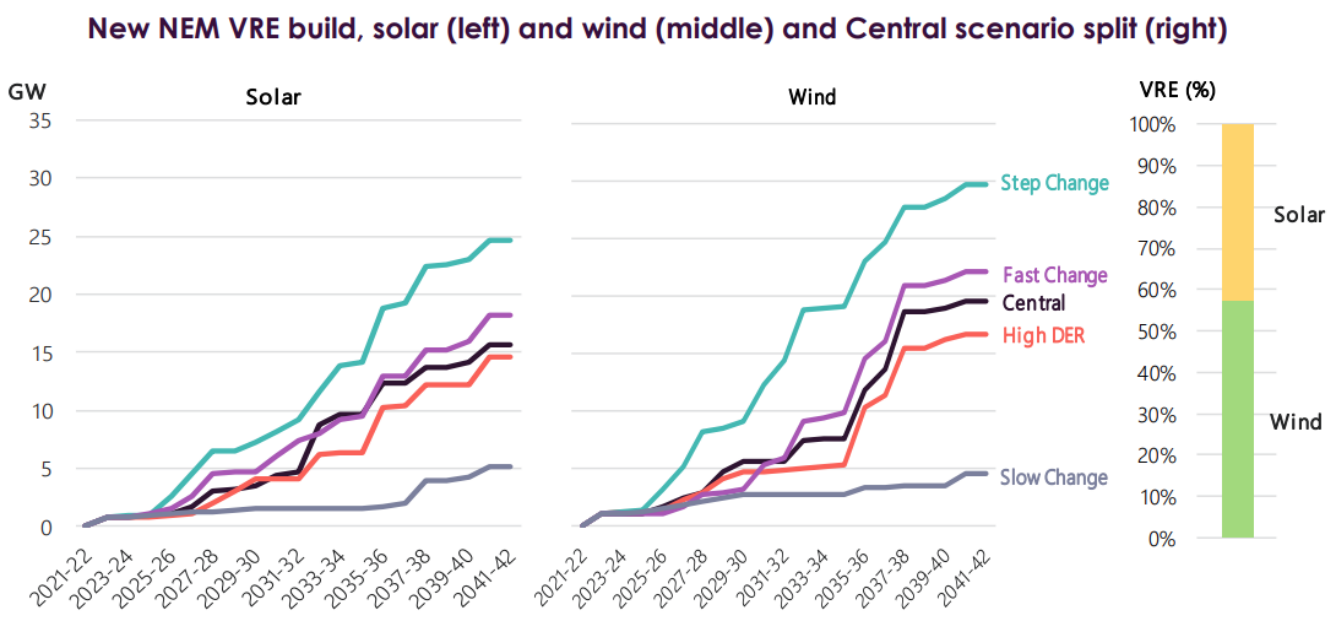
Background – Growth and successes



*Semi-scheduled + non-scheduled wind and solar generators.
^As of 25 Nov 2020.

Current status and challenges

- The NEM currently has ~13GW of wind and solar capacity – this is comprised of 75 wind farms and 61 solar farms.

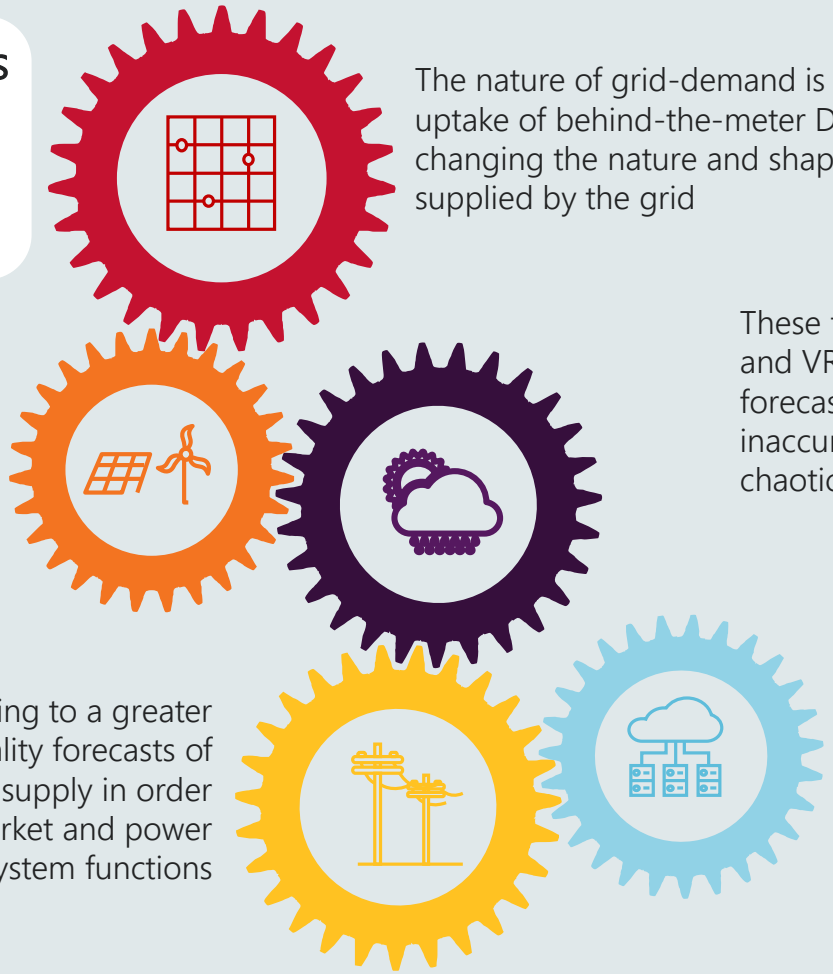


Reference: AEMO 2020 Integrated System Plan

- To facilitate more variable renewable energy in the grid, current and emerging challenges will need to be overcome.

The changing conditions that challenge Operational Forecasting

Forecasting errors and uncertainties need to be kept to the absolute minimum possible given these changing conditions



The nature of grid-demand is rapidly changing due to the uptake of behind-the-meter DER (rooftop PV, batteries, EV etc) changing the nature and shape of demand that must be supplied by the grid

These forecasts (both demand and VRE) are reliant on weather forecasts which are subject to inaccuracies due to the inherent chaotic nature of the weather

The share of VRE generation where the fuel source is the weather continues to increase rapidly, compounded by the closure of scheduled generators

This is leading to a greater reliance on quality forecasts of demand and VRE supply in order to perform market and power system functions

The increasingly complex and rapidly changing energy system means preparation needs to be made for imposed and disruptive change. Operational Forecasting must be enabled to transform processes, tools and systems to rapidly evolve our existing forecast solutions and create new types of forecasts to meet new demands

Current status and challenges

- Current challenges facing the industry are:
  - Forecasting generation during infrequent events such as storms causing extreme wind speeds, dust storms or extreme ambient temperature conditions.
  - Managing the cumulative deviations of output during critical events such as low-demand periods, separation events, low reserve periods.
  - Managing the effects of large non-scheduled wind generation.
  - Ensuring generators can be contacted 24/7 by the AEMO Control Room and immediately implement instructions.
  - Managing the impact of bushfires on network availability and reduced solar generation (large scale and rooftop PV)

Emerging and future

- Hybrid sites with co-optimisation

- Active participation and forward looking
  - Understanding the external factors influencing plant capability and actively managing its output.
  - Self-forecasting in longer-term timeframes.
  - Auto-bidding.

- Primary Frequency Response
  - Mandatory requirement for all scheduled and semi-scheduled generators.
  - Supports the secure operation of the power system by responding automatically to changes in power system frequency.

AWEFS/ASEFS and self-forecasting updates since previous forum (March 2020)

Petar Pantic
Rob Selbie
Jack Fox

Operational Forecasting

Removal of Pre-dispatch UIGF blending in the Dispatch UIGF

- The AWEFS/ASEFS Dispatch forecast model was originally designed to incorporate a minor blending component of the Pre-dispatch UIGF (~7%).
- This blending was originally intended to improve the accuracy of the Dispatch UIGF by providing a leading indicator of farm output.
- The Pre-dispatch UIGF is calculated using Numerical Weather Prediction (NWP) data in conjunction with intermittent generation availability entered in the EMMS Portal.

Removal of Pre-dispatch UIGF blending in the Dispatch UIGF

- AEMO reviewed the effectiveness of this blending and concluded the blending feature is ineffective due to a number of issues which were not originally foreseen. These include:
  - dispatch constraints limiting the number of Inverters/Turbines connected which are not reflected in EMMS Portal availability.
  - network runback schemes not modelled in constraints, leading to differences in actual farm availability and EMMS Portal availability.
  - differences in NWP wind speeds and actual site wind speed, particularly at low wind speeds, leading to a >0MW Pre-dispatch forecast whilst generation is 0MW.
  - A greater number of semi-scheduled generators not reflecting actual availability in the EMMS Portal.
- Increased frequency of the above instances results in the Pre-dispatch UIGF differing from actual generation output.
- AEMO removed this blending feature in mid-August 2020 which has improved the accuracy of the dispatch UIGF.

Update of Inclined Irradiance input

- During constrained intervals (eg. semi-dispatch cap), ASEFS produces a weather-based forecast using irradiance and inverter availability as the primary inputs, along with the solar power conversion curve.

- For solar farms with more than one cluster, the inclined irradiance measurement from Cluster 1 was used as the irradiance input.

- If the Cluster 1 Inclined Irradiance signal was out of service, had a stuck value, or marked as bad quality, ASEFS would ignore the signal potentially impacting forecast accuracy.

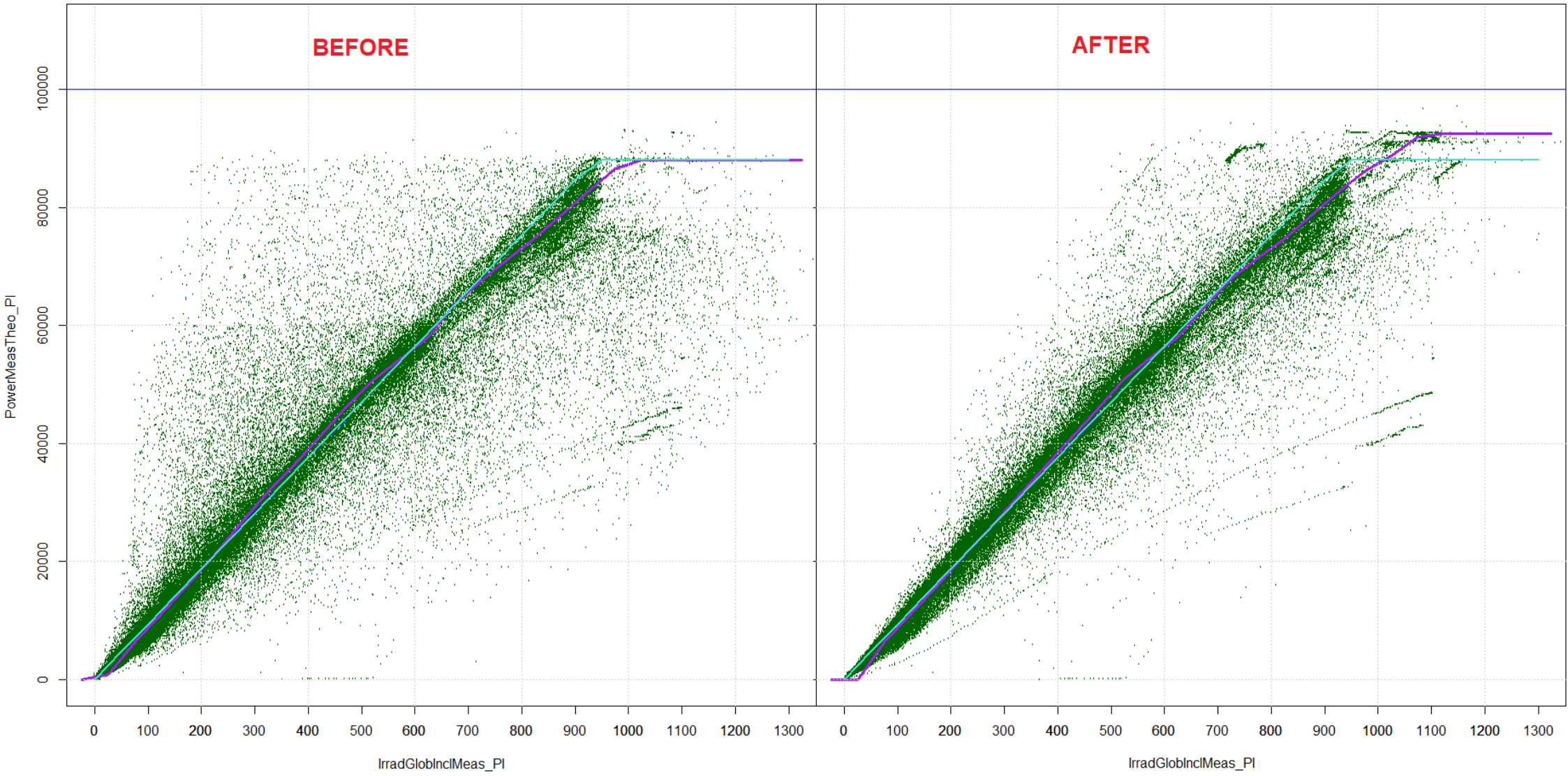
Update of Inclined Irradiance input

- In July 2020, AEMO updated the irradiance input to ASEFS to be an average of all cluster inclined irradiance measurements, and retrained all solar power conversion curves with historically calculated average data.

- The averaging filters bad irradiance readings, provides redundancy and is now consistent with the AWEFS wind speed input.

- The update resulted in tighter-fitting solar power curves and has increased the dispatch forecast accuracy during constrained intervals.

Update of Inclined Irradiance input – before and after



Update of wind speed input in Pre-dispatch/ST PASA models

- The AWEFS Pre-dispatch/ST PASA models use several Numerical Weather Prediction (NWP) input variables to produce the forecast in these timeframes.

- The main NWP input variables are wind speed and wind direction, and the best choice of parameters for wind power forecasts when implementing AWEFS was using model level wind parameters.

- AEMO's NWP provider introduced a new variable for wind forecasts at a 100m height above ground level, which was provisioned specifically for wind power prediction purposes.

Update of wind speed input Pre-dispatch/ST PASA models

- AEMO's AWEFS/ASEFS vendor completed a study comparing the forecast accuracy of model-level vs 100m height wind parameters over a 12-month period.

- The study showed an improvement in forecast accuracy across all timeframes for the majority of wind farms. The average relative improvement across all farms in N-RMSE was between 1.7% and 3.0%, and in N-MAE between 1.5% and 2.4%.

- AEMO has scheduled to update the wind speed and direction parameter to the 100m height variable and will be implemented imminently.

Wind and solar handbook

- AEMO is currently developing a handbook for semi-scheduled and some non-scheduled intermittent generators.

- The purpose of the handbook is to provide guidance to semi-scheduled generators, and non-scheduled generators with semi-scheduled obligations, on successfully registering and participating in the NEM from an operational forecasting and bidding perspective.

- The handbook has been developed following positive feedback from participants attending AWEFS/ASEFS information sessions, and increased queries from participants regarding model requirements and how to meet information obligations.

Wind and solar handbook

- The handbook specifically outlines the requirements and actions from an Operational Forecasting perspective to:
  - Achieve registration.
  - Facilitate the development and implementation of the AWEFS/ASEFS forecasting model.
  - Ensure inputs to AWEF/ASEFS models reflect actual site availability and site conditions.
  - Register and participate in participant self-forecasting.

- The handbook is expected to be published on the AEMO website in early 2021.

- AEMO will notify participants via email when the handbook has been published.

Start-up dispatch forecast prior to AWEFS/ASEFS

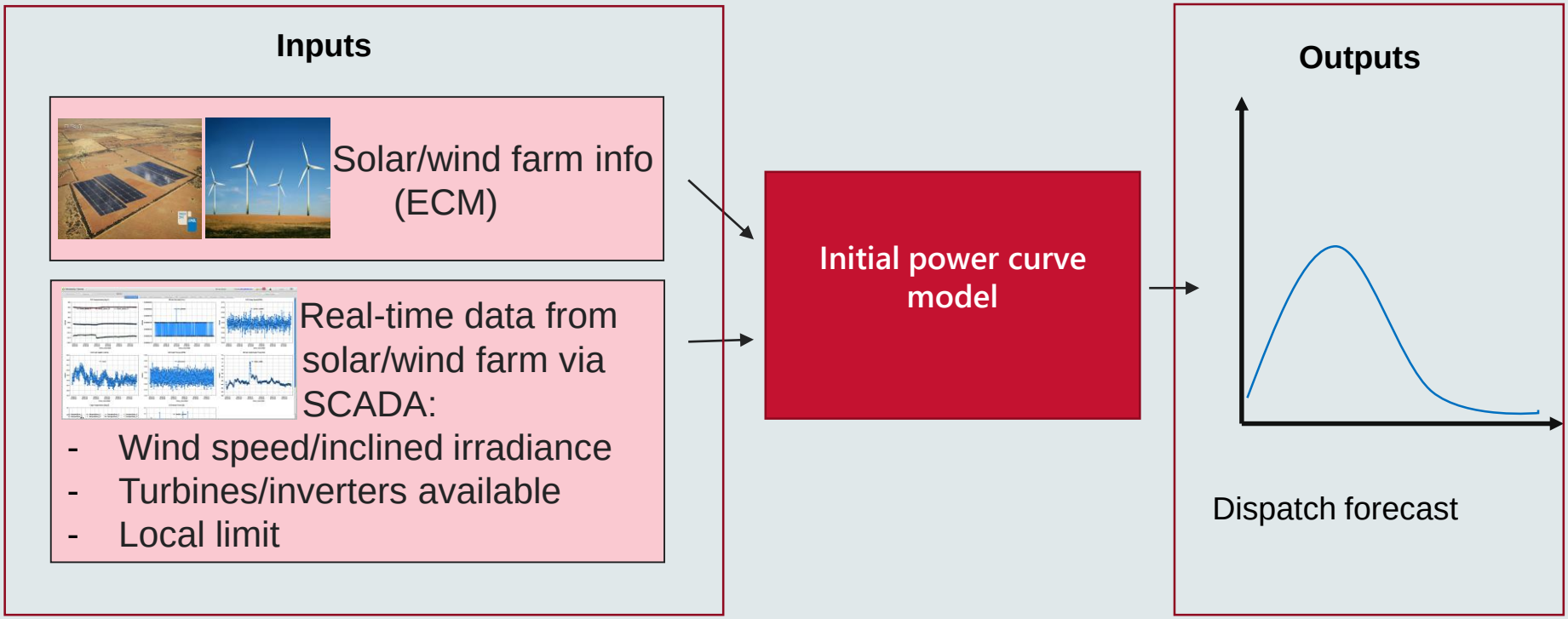
- For new wind and solar farms, implementing the AWEFS/ASEFS forecast model typically occurs 3-7 weeks following farm registration.

- In the interim, the default dispatch forecast is the farm's output i.e. Active Power (initialMW) = Dispatch UIGF (availability). If consecutive semi-dispatch cap intervals apply, this can lead to the dispatch target and output eroding to 0MW.

- This can reduce participants' revenue and can cause delays in the commissioning program.

Start-up dispatch forecast prior to AWEFS/ASEFS

- AEMO has developed a simple dispatch forecast model that can be implemented from the date of registration for the wind/solar farm.



- It will appear as 'FCST' in the MMS Data Model and target implementation date is January 2021.

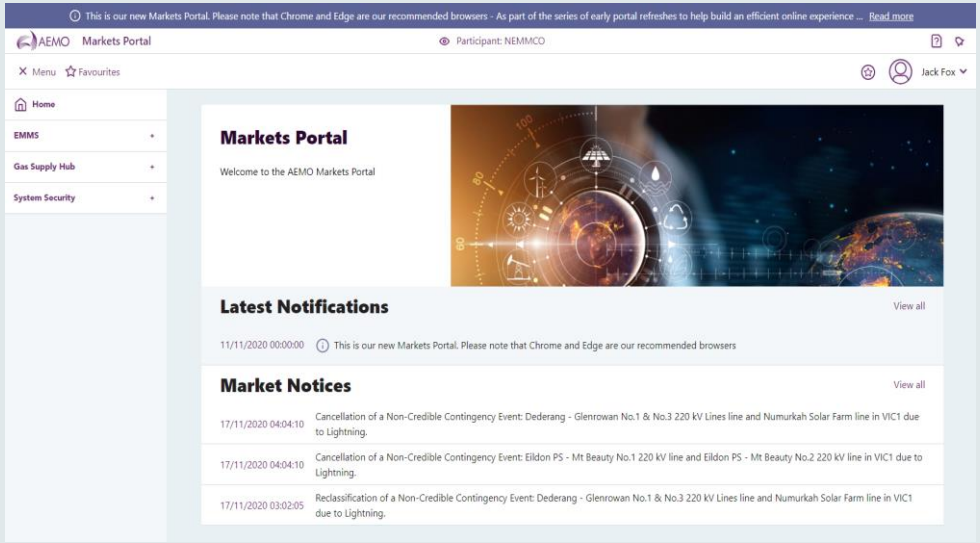
Publishing of plant availability next-day

- To improve market transparency, AEMO has continued receiving requests to publish the *plant availability* entries (Upper MW Limit, Turbines/Inverters Unavailable) submitted by semi-scheduled and non-scheduled generators on a next-day public basis.

- The *plant availability* submitted under NER 3.7B(b) is used as an input to produce the AWEFS/ASEFS Pre-dispatch and ST PASA forecasts.

- AEMO has scheduled the next-day publication of plant availability in the MMS Data Model for Nov 2020 in Pre-Production, and May 2021 in Production.

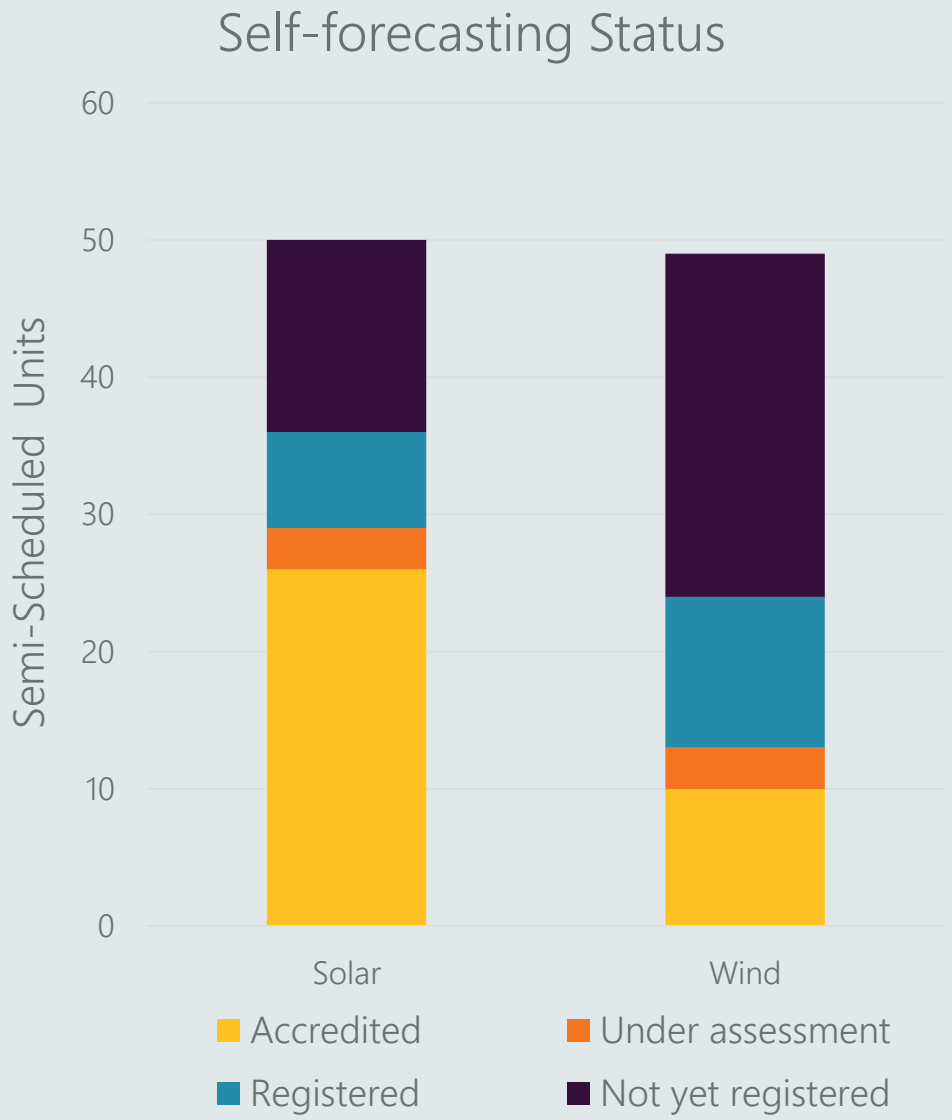
Updates to the web portal screens



- AEMO is in the process of upgrading the web portal screens to improve the usability, look-and-feel and provide a consistent interface for participants.
- The first set of updates rolled out to the landing page and NEMWeb in November 2020.
- Improvements to the usability of the intermittent generator screens are being scoped and prioritised for implementation in 2021.
- AEMO will provide an update to stakeholders when prioritisation and scheduling is complete in Q1 2021.

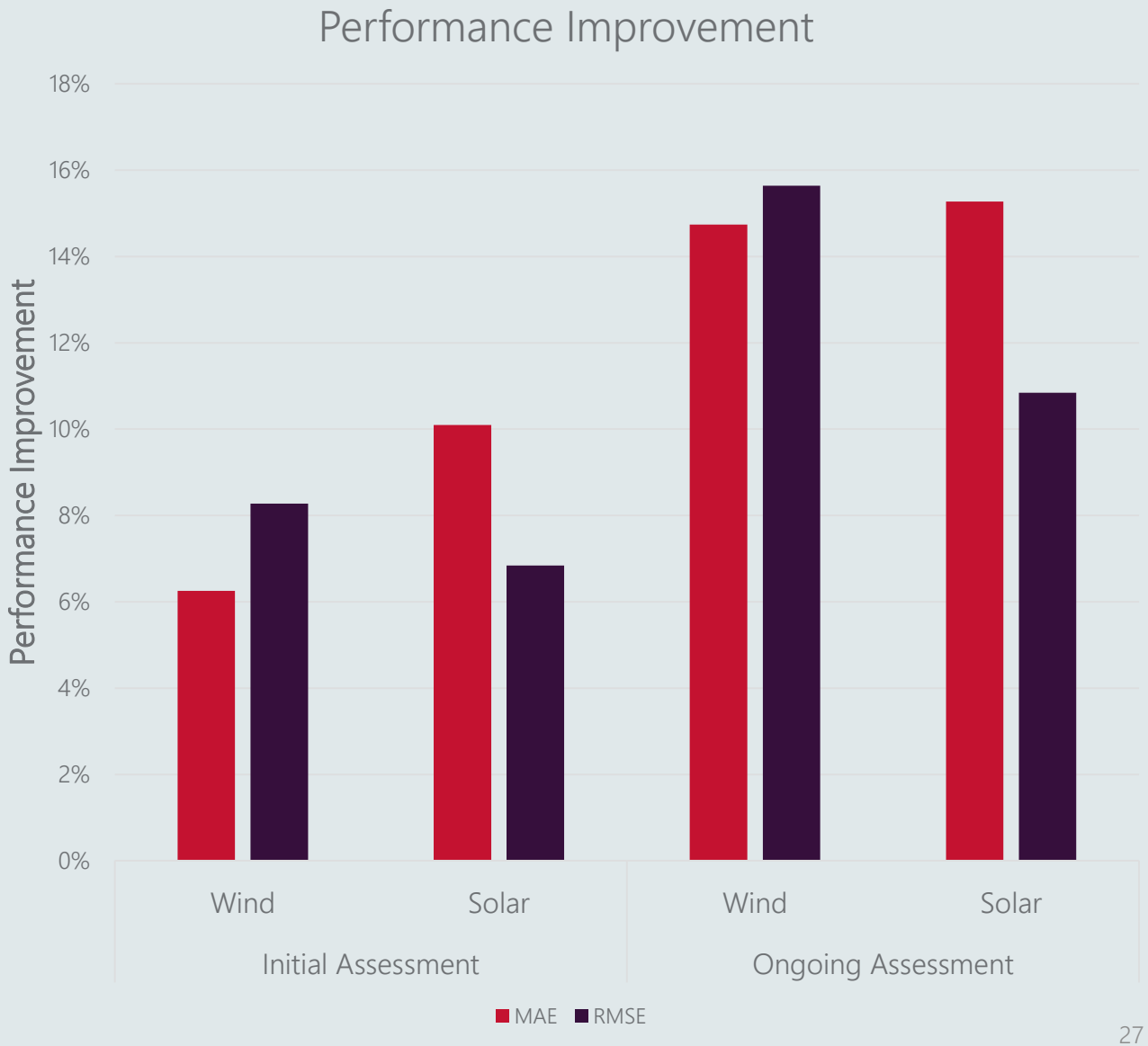
Self-forecast Status

- There are currently 99 semi-scheduled units registered in the NEM, with the majority implementing self-forecasting.
- Solar farms have shown the greatest interest, and 26 have already been successfully accredited.
- 30 distinct forecast models are being used across the fleet, supplied by 15 forecast providers, many of whom are third-parties that supply multiple participants (118 unique forecast models across all farms).

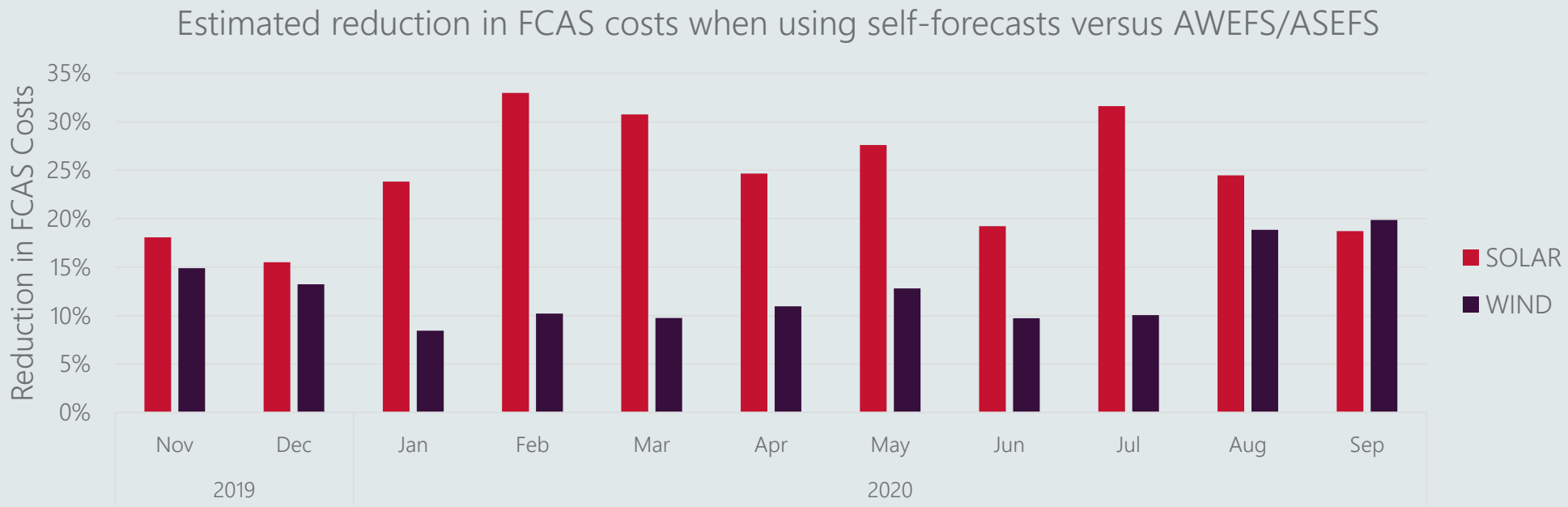


Self-forecast Performance

- Over initial assessment, self-forecasts performed **9%** better on average than AWEFS/ASEFS.
- This improved to **15%** better performance on average once accreditation was passed.
- Self-forecast models are improving over time with more data and experience.



Self-forecast Benefits



- Improved self-forecast performance puts downward pressure on the procurement of FCAS, which is beneficial for the whole market as VRE penetration continues to increase.

- This result highlights that AEMO and participants working together have delivered a positive outcome for the industry.

Self-forecast API improvements

- Improved API documentation portal.
- API access now granted within a week of a new self-forecast application.
- New ChangePassword API available for refreshing MSATS URM passwords outside of MarketNet.
- Improved API responses, such as when two self-forecasts with the same forecast priorities are submitted in the same second.

Other business

Anthony Hill
Jack Fox

AEMO Operational Forecasting

Non-scheduled wind generators with semi-scheduled obligations

- AEMO is currently reviewing the impacts of large non-scheduled generation on system operation and power system security.
- In this review AEMO has prioritised non-scheduled wind farms that it has previously directed, or may be required to direct in accordance with its operating procedures, in order to maintain power system security in abnormal circumstances.
- Response time is critical during challenging power system events, and minimising interactions and decisions during these complex events is necessary for adequate system operation and the maintenance of power system security.
- The AEMO control room estimates that a direction cannot be completed in less than ten minutes, which means the power system is at a heightened risk and may result in the power system being insecure for more than 30 minutes if multiple directions must be issued following a power system event, leading to a breach of NER 4.2.6(b)(1).
- AEMO will contact affected participants upon completion of its review.

Publishing real-time availability

- AEMO is seeking feedback on the publishing of actual plant availability (as measured via SCADA signals) on a next-day public basis.
  - Please provide any feedback to op.forecasting@aemo.com.au by Mon 14 December.

AEMO has identified the following details for discussion:

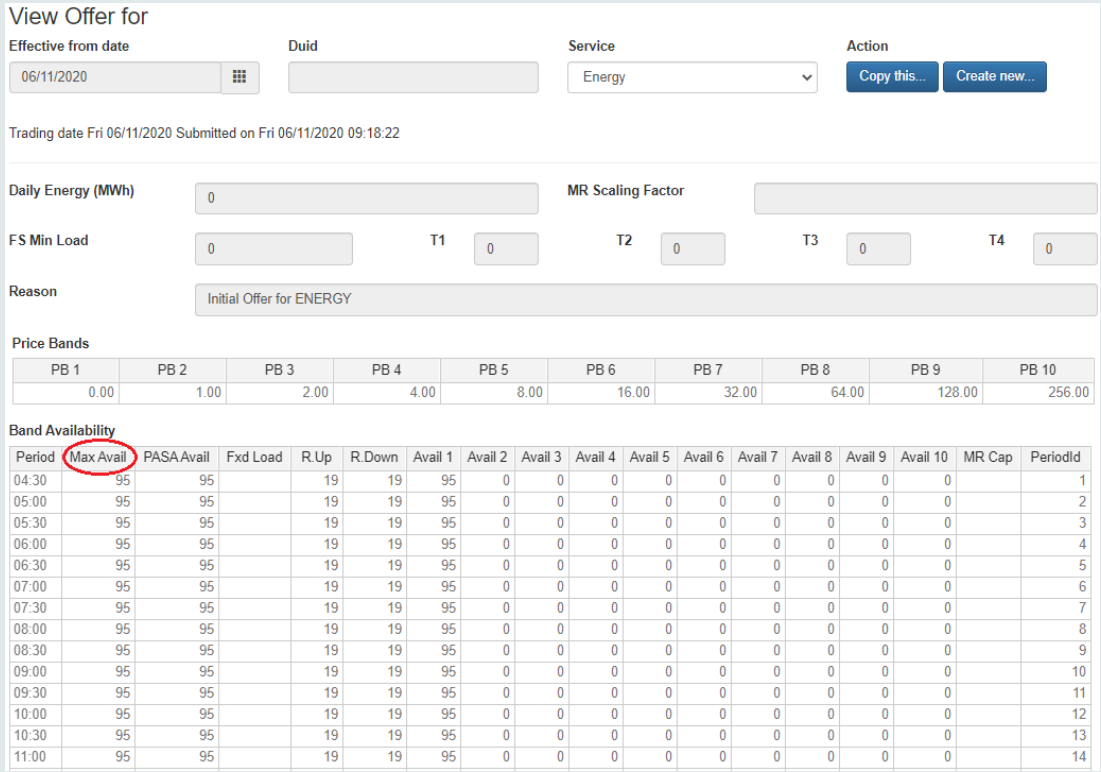
- The AWEFS/ASEFS dispatch forecast uses SCADA signals (Turbines/Inverters Available, and Local Limit) to determine *plant availability* however, tracing of the values of these signals as used to produce the dispatch forecast is not currently exposed out of AWEFS/ASEFS. Is the publication of tracking information required?

- The Participant self forecasting API does not ingest availability signal inputs used to produce the dispatch self forecast. How should plant availability be published for participant self forecasts?

- The implementation of Turbines/Inverters Available and the Local Limit SCADA signals differs across OEMs and SCADA control systems. Will differences in implementation cause a material impact to the usability of the plant availability data?

Enabling 'Max Avail' function for semi-scheduled generators

- AEMO is seeking feedback on the level of support in pursuing changes to enabling the 'Max Avail' function for semi-scheduled generators.
  - Please provide any feedback to op.forecasting@aemo.com.au by Mon 14 December.



View Offer for

Effective from date: 06/11/2020 | Duid: | Service: Energy | Action: Copy this... Create new...

Trading date Fri 06/11/2020 Submitted on Fri 06/11/2020 09:18:22

Daily Energy (MWh): 0 | MR Scaling Factor:

FS Min Load: 0 | T1: 0 | T2: 0 | T3: 0 | T4: 0

Reason: Initial Offer for ENERGY

Price Bands

PB 1	PB 2	PB 3	PB 4	PB 5	PB 6	PB 7	PB 8	PB 9	PB 10
0.00	1.00	2.00	4.00	8.00	16.00	32.00	64.00	128.00	256.00

Band Availability

Period	Max Avail	PASA Avail	Fxd Load	R.Up	R.Down	Avail 1	Avail 2	Avail 3	Avail 4	Avail 5	Avail 6	Avail 7	Avail 8	Avail 9	Avail 10	MR Cap	PeriodId
04:30	95	95		19	19	95	0	0	0	0	0	0	0	0	0		1
05:00	95	95		19	19	95	0	0	0	0	0	0	0	0	0		2
05:30	95	95		19	19	95	0	0	0	0	0	0	0	0	0		3
06:00	95	95		19	19	95	0	0	0	0	0	0	0	0	0		4
06:30	95	95		19	19	95	0	0	0	0	0	0	0	0	0		5
07:00	95	95		19	19	95	0	0	0	0	0	0	0	0	0		6
07:30	95	95		19	19	95	0	0	0	0	0	0	0	0	0		7
08:00	95	95		19	19	95	0	0	0	0	0	0	0	0	0		8
08:30	95	95		19	19	95	0	0	0	0	0	0	0	0	0		9
09:00	95	95		19	19	95	0	0	0	0	0	0	0	0	0		10
09:30	95	95		19	19	95	0	0	0	0	0	0	0	0	0		11
10:00	95	95		19	19	95	0	0	0	0	0	0	0	0	0		12
10:30	95	95		19	19	95	0	0	0	0	0	0	0	0	0		13
11:00	95	95		19	19	95	0	0	0	0	0	0	0	0	0		14

- The 'Max Avail' function in the energy offer table is the maximum planned availability in MW for the matching period, and is currently ignored for semi-scheduled units and replaced with the AWEFS/ASEFS dispatch UIGF.

Enabling ‘Max Avail’ function for semi-scheduled generators

- Enabling the ‘Max Avail’ function would support participants’ bidding teams updating unit availability for farms that do not have the SCADA Local Limit configured or during instances where it is not possible to update the signal to cap the dispatch UIGF and hence, cap the dispatch target.

- The ‘Max Avail’ function could be used to reflect runback limits, network outages or any other limits not reflected in SCADA Local Limit or AEMO constraints.

ARENA – Self-forecasting update

Carl Tidemann

Questions and Discussion

Further information

AEMO Standard for Power System Data Communications – Sets out the standards with which Data Communication Providers must comply when transmitting data (SCADA) to and from AEMO.

https://www.aemo.com.au/-/media/Files/Electricity/NEM/Network_Connections/Transmission-and-Distribution/AEMO-Standard-for-Power-System-Data-Communications.pdf

Ancillary Services Causer Pays Contribution Factors – Causer pays factors and supporting data.

https://aemo.com.au/en/energy-systems/electricity/national-electricity-market-nem/system-operations/ancillary-services/ancillary-services-causer-pays-contribution-factors

Dispatch – Dispatch procedure providing instructions and guidelines covering market operations in relation to the operation of the power system.

https://www.aemo.com.au/-/media/Files/Electricity/NEM/Security_and_Reliability/Power_System_Ops/Procedures/SO_OP_3705---Dispatch.pdf

Energy Conversion Model (ECM) Guidelines – Current AWEFS and ASEFS ECM Guidelines.

https://www.aemo.com.au/energy-systems/electricity/national-electricity-market-nem/system-operations/dispatch-information/policy-and-process-documentation#forecasting

Further information

Guide to Data Requirements for AWEFS and ASEFS - Supplementary Wind and Solar ECM material.

https://aemo.com.au/-/media/files/electricity/nem/security_and_reliability/dispatch/policy_and_process/guide-to-data-requirements-for-awefs-and-asefs.pdf

Guide to Intermittent Generation - Information regarding submitting intermittent generation availability to AEMO.

https://aemo.com.au/-/media/files/electricity/nem/it-systems-and-change/guide-to-intermittent-generation.pdf

Participant Self-forecasting - Information and registration of semi-scheduled generators providing their own (self) dispatch forecast.

https://www.aemo.com.au/energy-systems/electricity/national-electricity-market-nem/nem-forecasting-and-planning/operational-forecasting/solar-and-wind-energy-forecasting/participant-forecasting

Primary Frequency Response (PFR) – Information about the PFR requirement for scheduled and semi-scheduled generators.

https://aemo.com.au/en/initiatives/major-programs/primary-frequency-response

Contact information

- AEMO Operational Forecasting

op.forecasting@aemo.com.au

- AEMO Support Hub

https://aemo.com.au/en/contact-us