AUSTRALIAN WIND ENERGY FORECASTING SYSTEM (AWEFS)

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AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

IMPORTANT NOTICE

Purpose

AEMO has prepared this document to provide information about the Australian Wind Energy Forecasting System (AWEFS), as at the date of publication.

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Glossary

a) In this document, a word or phrase *in this style* has the same meaning as given to that term in the National Electricity Rules.

b) In this document, capitalised words or phrases or acronyms have the meaning set out opposite those words, phrases, or acronyms in the table below.

c) Unless the context otherwise requires, this document will be interpreted in accordance with Schedule 2 of the *National Electricity Law*.

Table 1: Glossary

Term	Meaning
5MPD	5 minute Pre-dispatch
AWEFS	Australian Wind Energy Forecasting System
ECM	*Energy conversion model*
EMMS	Electricity Market Management Systems
ESOO	Electricity Statement of Opportunities
MT*PASA*	Medium-term Projected Assessment of System Adequacy
MW	Megawatts
NEM	National Electricity Market
NEMDE	NEM Dispatch Engine
NER	National Electricity Rules
PASA	Projected Assessment of System Adequacy
POE	Probability of Exceedance
SCADA	Supervisory Control and Data Acquisition
SDC	Semi-dispatch Cap
STPASA	*Short term* Projected Assessment of System Adequacy
UIGF	*Unconstrained Intermittent Generation Forecast*

1 INTRODUCTION

The purpose of this document is to provide a high level overview of the Australian Wind Energy Forecasting System (AWEFS) design, detailing the inputs, outputs and their usage. The document also provides information about the linkage between wind generator Supervisory Control and Data Acquisition (SCADA), Australian Wind Energy Forecasting System (AWEFS) and NEM Dispatch Engine (NEMDE), and how NEMDE generates *dispatch instruction*s (*dispatch level* and semi-dispatch cap) for semi-scheduled generators using AWEFS forecasts.

The intended audience for this document is anyone interested in gaining an understanding of the Australian Wind Energy Forecasting System (AWEFS).

2 OVERVIEW

Under National Electricity Rules (NER) Clause 3.7B, *AEMO* is required to prepare forecasts of the *available capacity* of semi-scheduled generators, in order to schedule sufficient generation in the Dispatch process. *AEMO* is also required to prepare *Unconstrained Intermittent Generation Forecasts* (UIGF)[1] to be used in Projected Assessment of System Adequacy (*PASA*) processes (NER Rule Clause 3.7.1 (c) (2)) for *reserve* assessment purposes. In order to meet these requirements, the Australian Wind Energy Forecasting System (AWEFS) produces wind generation forecasts for all semi-scheduled and non-scheduled wind generators in the *NEM*.

3 TYPES OF FORECASTS

AWEFS generates forecasts for the Dispatch, 5MPD, *Pre-Dispatch*, *Short term PASA* and Medium Term *PASA* processes. The horizon (period up to which forecasts are generated), frequency (how often forecasts are generated) and resolution (period for which the forecast applies) of the forecasts for each process are provided in Table 2: Forecast Horizons, Frequency of Updates and Resolution below:

Table 2: Forecast Horizons, Frequency of Updates and Resolution

	Horizon	Frequency of updates	Resolution
Dispatch	5 min	5 min	5 min
5MPD	2 hours	5 min	5 min
Pre-dispatch	Up to 40 hours	30 min	30 min
Short term PASA	8 days	30 min	30 min
Medium term *PASA*	2 years	Daily	Daily

4 INPUTS

There are two sets of inputs that are used for generating forecasts in AWEFS.

1. A set of static data related to the technical specifications of the wind generator, in order to develop the forecasting models for different types of wind generators.
2. A set of dynamic data, consisting of real-time measurements (through SCADA) and numerical weather predictions, are used in the forecasting models to generate the forecasts for the different timeframes.

4.1 Static Data - *Energy conversion model*

New wind generators *connecting* to the *NEM*, are required to submit an *Energy conversion model* consisting of the wind generator details, historical meteorological measurements as well as attributes of the individual clusters. Due to the

[1] *Unconstrained Intermittent Generation Forecasts* (UIGF) is the forecast generation output of wind generators without considering network limitations, economical decisions or the dispatch optimisation process.

different locational parameters and wind turbine technologies associated with different wind generators, it is necessary to develop forecasting models specific to each wind generator. The static data and historical measurements provided as part of the *Energy conversion model* assists in choosing and developing the forecasting models for each wind generator. The *Energy conversion model* template and some of the key static data items contained in it are provided in Appendix A – *Energy conversion model* template and some key static data items.

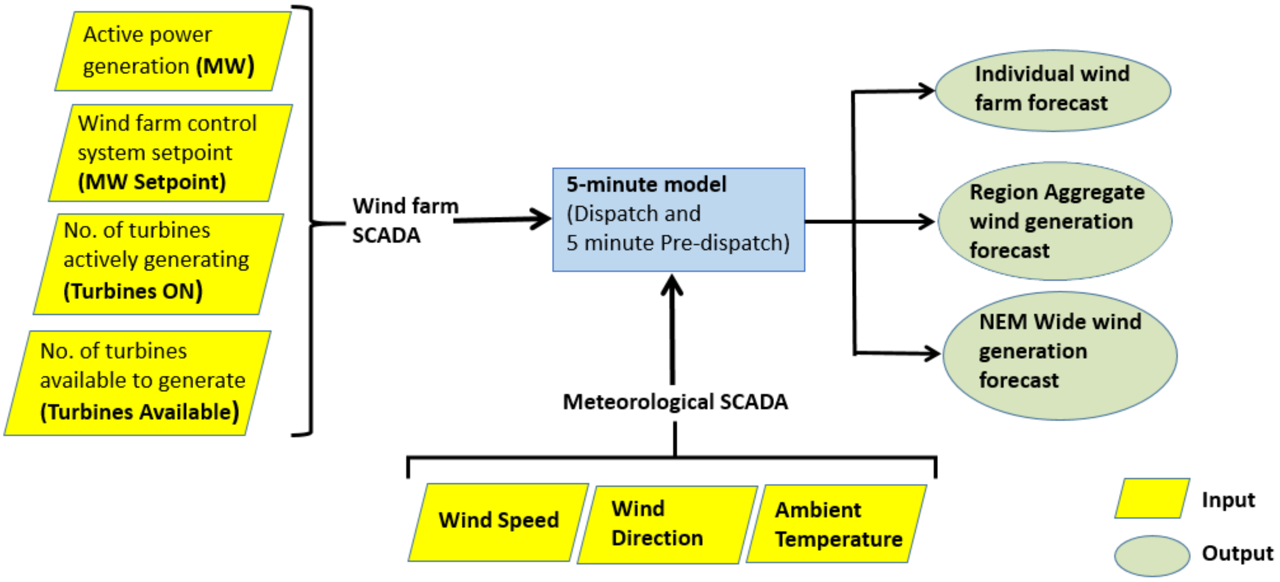
4.2 Dynamic Data

The dynamic data that are used in generating the forecasts vary based on the processes (or timeframes). The inputs for each process are listed below.

4.2.1 Dispatch and 5 minute pre-dispatch (5MPD)

The forecasts in the Dispatch and 5 minute Pre-dispatch processes (5MPD) depend on real-time measurements (SCADA). Figure 1: Inputs and Outputs for Dispatch, 5MPD processes below summarise the various SCADA inputs that are needed to generate the forecasts in the Dispatch and 5 minute Pre-dispatch processes (5MPD).

Figure 1: Inputs and Outputs for Dispatch, 5MPD processes



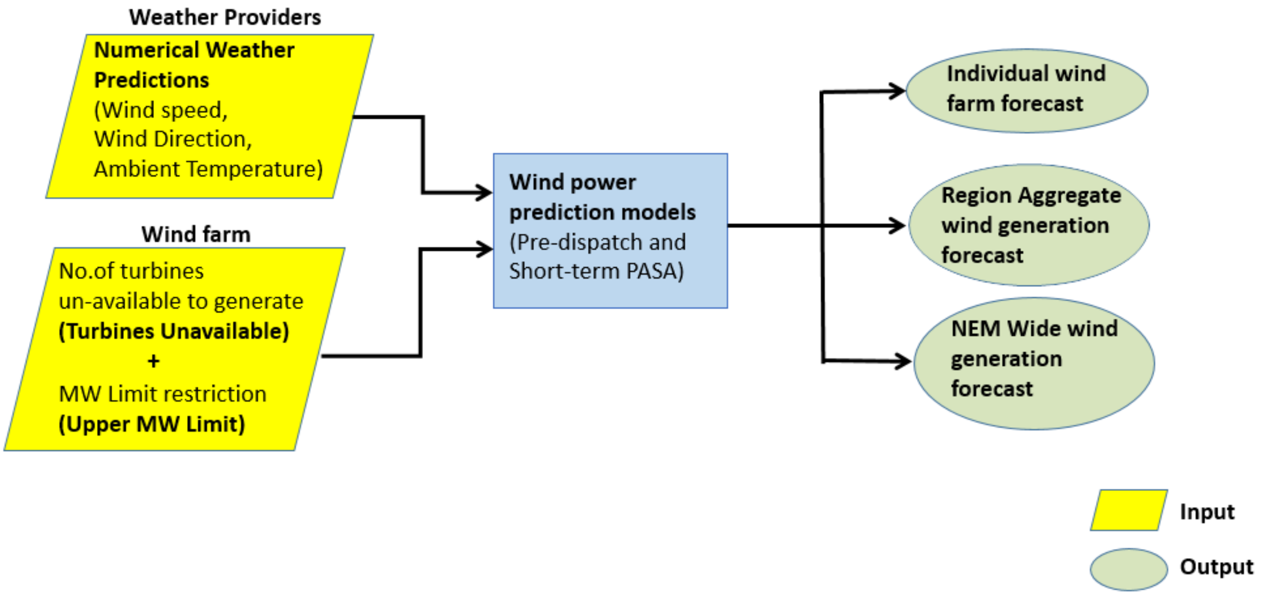
During normal operation or periods when a wind generator is not *constrained off*, the UIGF forecasts are based on the active power generation (MW) SCADA from the wind generator, which is more reliable than a weather model-based forecast. That is, a wind generator's forecast for the next five minutes will be close to the wind generator's actual output in the previous five minutes. However at times when a wind generator is *constrained off,* the UIGF forecasts produced by the AWEFS system is based only on the wind speed, number of turbines available to generate and MW setpoint SCADA.

Appendix B – SCADA input used in Dispatch, 5MPD processes provides a description of each SCADA input used in the Dispatch and 5MPD processes.

4.2.2 *Pre-dispatch* and *Short term PASA*

Figure 2: Inputs and Outputs for *Pre-dispatch* and *Short term PASA* forecasts below summarise the inputs required to generate the *Pre-dispatch* and *Short term PASA* forecasts.

Figure 2: Inputs and Outputs for *Pre-dispatch* and *Short term PASA* forecasts



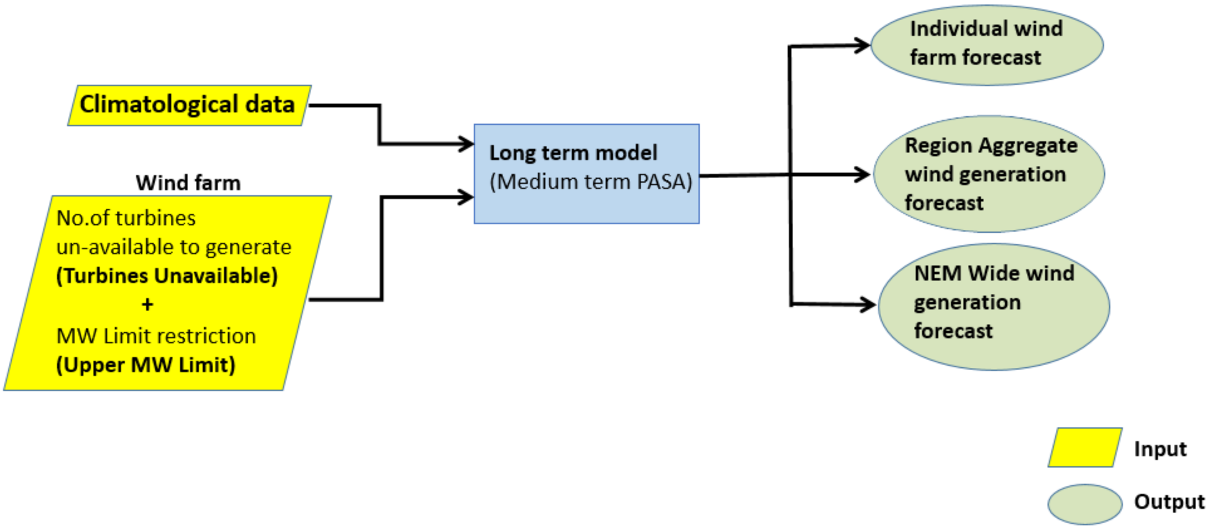
The forecasts in the *Pre-dispatch* and *Short term PASA* timeframes are dependent on:

- Numerical Weather Predictions: *AEMO* has contracted with two commercial weather forecast providers, to provide weather predictions that are used to generate the *Pre-dispatch* and ST*PASA* wind generation forecasts. The weather prediction that has the most impact on these forecasts is Wind speed.
- No. of turbines unavailable to generate (Turbines Unavailable): All wind generators are required to provide information regarding the number of turbines unavailable for generation in each cluster. This includes turbines that are under maintenance/repair and turbines that are being manufactured/installed. This information is used by AWEFS to determine the generation capability of the wind generator. The information is entered by wind generator operators via *AEMO*'s EMMS Participant Web Portal.
- MW Limit restriction (Upper MW Limit): All wind generators are also required to provide information regarding generation (MW) restrictions affecting the wind generator. These restrictions could be imposed on the wind generator by AEMO or the relevant NSP due to network limitations. The restrictions could also be limitations within the wind generator itself, which may prevent the wind generator from generating above a certain limit. This information is used by AWEFS to determine the generation capability of the wind generator. The information is entered by wind generator operators via *AEMO*'s EMMS Participant Web Portal.

4.2.3 Medium Term *PASA*

Figure 3: Inputs and Outputs for Medium-term PASA forecasts below summarise the inputs required to generate the Medium term forecasts.

Figure 3: Inputs and Outputs for Medium-term PASA forecasts



The forecasts in the medium term timeframe are dependent on the following inputs.

- Climatological data: Medium term forecasts are based on long term weather behaviour, at the wind generator site or region. Medium term forecasts are not dependent on real-time measurements or numerical weather predictions since their accuracy is very limited for timeframes exceeding 10 days.
- No.of turbines unavailable to generate (Turbines Unavailable): Same as *Pre-dispatch* and *Short term PASA*
- MW Limit restriction (Upper MW Limit): Same as *Pre-dispatch* and *Short term PASA*.

5 OUTPUTS

5.1 Types of forecasts generated

The AWEFS system generates four different types of UIGF forecasts:

- Individual wind generator forecasts: It generates wind generation forecasts for all semi-scheduled and non-scheduled wind generators (of registered capacity greater than 30 MW) individually.
- *NEM* Wide forecast: It generates a *NEM* Wide wind generation forecast comprising of generation due to semi-scheduled and non-scheduled wind generators across the *NEM*.
- Region forecasts: It generates forecasts on a regional basis for New South Wales (NSW), Queensland (QLD), Victoria (VIC), South Australia (SA) and Tasmania (TAS). Similar to the *NEM* Wide wind generation forecast, the regional forecasts include semi-scheduled and non-scheduled wind generation within each region.
- Uncertainty forecasts: In *Pre-dispatch*, *Short term PASA* and Medium Term *PASA* timeframes, AWEFS generates 10% Probability of Exceedance (POE) and 90% POE forecasts for the three types of forecasts listed above.

6 USAGE

This section details how UIGF forecasts are used in the different processes.

6.1 Semi-scheduled wind generation forecasts

- In Dispatch, 5MPD and *Pre-dispatch* processes, the UIGF forecasts for individual semi-scheduled wind generators are used as *available capacity*. *Available capacity* refers to the generation capability of a wind generator that is available for Dispatch (without consideration of network limitations, price bids etc.). For conventional generators, the *available capacity* for each unit is submitted by the generators. However, for semi-scheduled and non-scheduled wind generators the *available capacity* is the same as their UIGF forecasts produced by AWEFS.

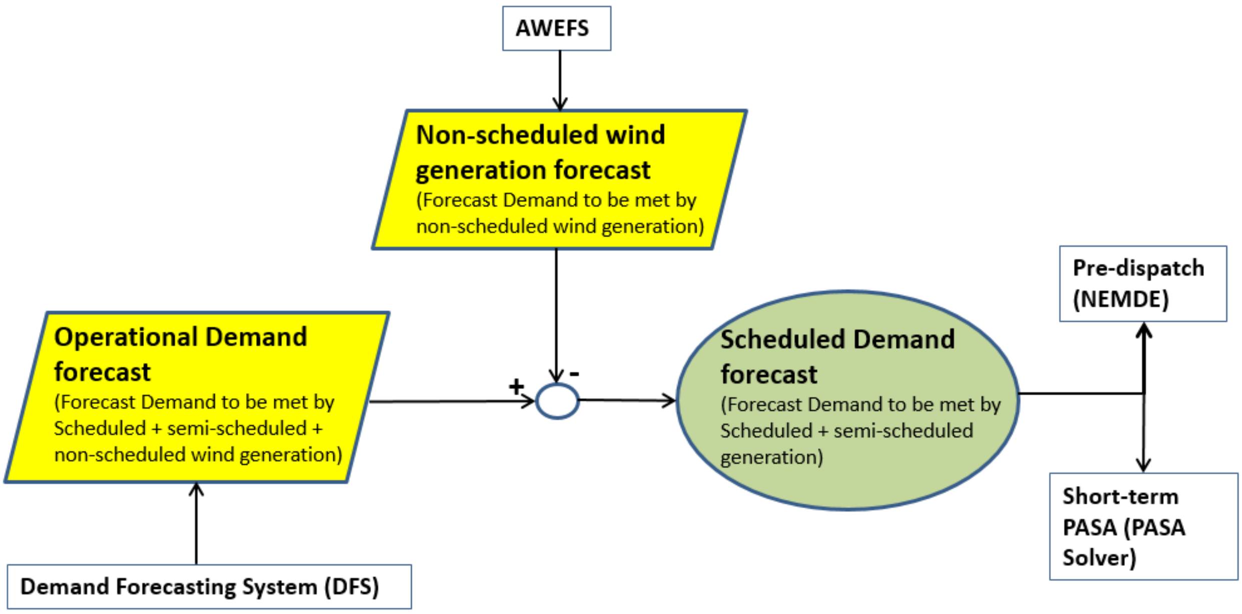
- In *Short term PASA* and Medium-term *PASA* processes, the UIGF forecasts for individual semi-scheduled wind generators are used as *PASA Availability*. Similar to *available capacity* in the Dispatch, 5MPD and *Pre-dispatch* processes, *PASA Availability* in the *Short term PASA* and Medium-term *PASA* timeframes indicate the generation capability of the wind generator without consideration of network limitations, price bids etc.

6.2 Non-scheduled wind generation forecasts

- In *Pre-dispatch* and *Short term PASA* processes, non-scheduled wind generation forecasts are used in deriving the Scheduled Demand[2] used for *reserve* assessment. The individual non-scheduled wind generation forecasts in each region are deducted from the Operational Demand[3] forecast generated by *AEMO*'s Demand Forecasting System for the respective regions. The Scheduled Demand value thus produced is used in assessing generation and *reserve* availability in *Pre-dispatch* and *Short term PASA* processes. The Scheduled Demand value is also published to the market.

  Figure 4: Usage of non-scheduled wind generation forecast in determining Scheduled Demand for *Pre-dispatch* and STPASA below provides a summary of the above process.

Figure 4: Usage of non-scheduled wind generation forecast in determining Scheduled Demand for *Pre-dispatch* and STPASA



- In the Medium-term *PASA* process, non-scheduled wind generation forecasts are deducted from the ESOO Native Demand[4] to determine the Scheduled Demand used for *reserve* assessment.

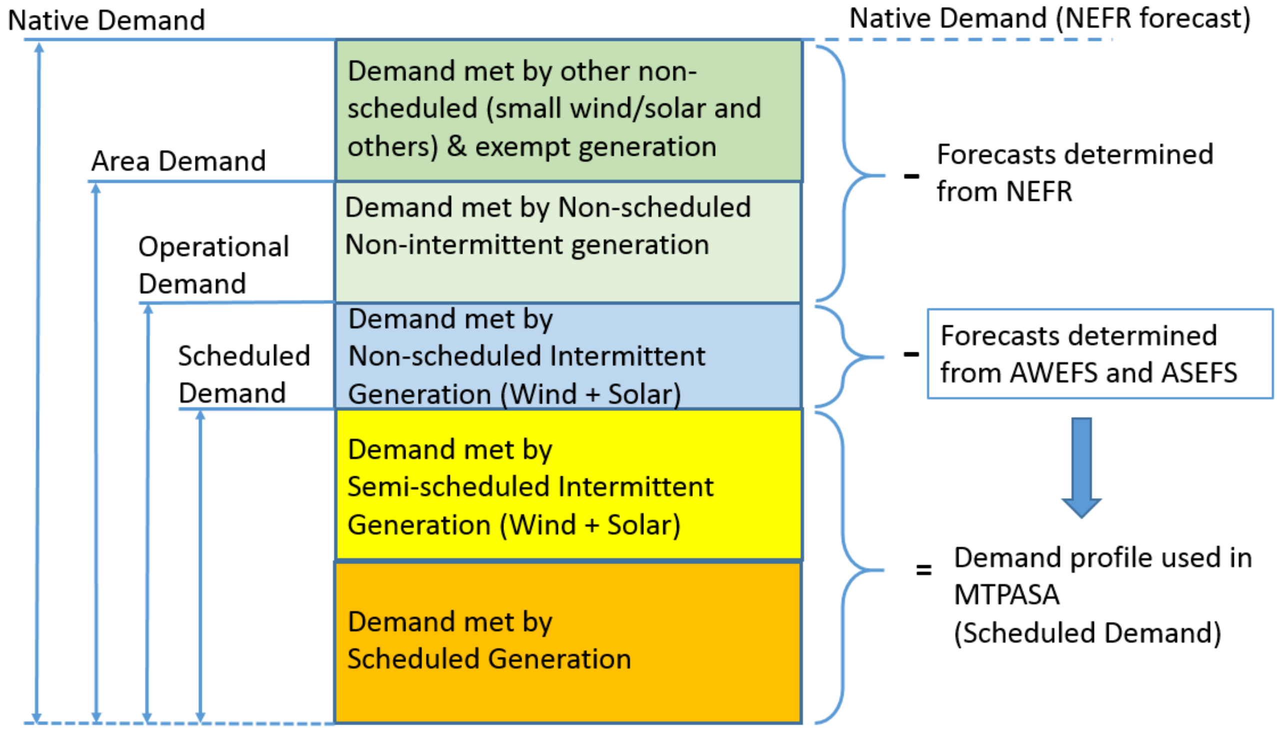
  Figure 5: Usage of non-scheduled wind generation forecast in determining Scheduled Demand for MTPASA below shows the different components of the NEFR Native Demand and how Scheduled Demand used in the Medium-term *PASA* process is derived by deducting the non-scheduled components.

[2] **Scheduled Demand** in a region is demand that is met by local scheduled and semi-scheduled generation and by generation imports to the region. **Scheduled Demand** differs from the other key demands in that it excludes the demand met by all non-scheduled (wind and non-wind) generation and exempt generation, and includes the demand of local scheduled loads.

[3] **Operational Demand** in a region is demand that is met by local scheduled generation, semi-scheduled generation and non-scheduled wind generation of aggregate capacity ≥ 30 MW. This also includes generation imports to the region but excludes the demand of local scheduled loads.

[4] **Native Demand** in a region is demand that is met by local scheduled, semi-scheduled, non-scheduled and exempt generation and by generation imports to the region, excluding the demand of local scheduled loads.

Figure 5: Usage of non-scheduled wind generation forecast in determining Scheduled Demand for MTPASA

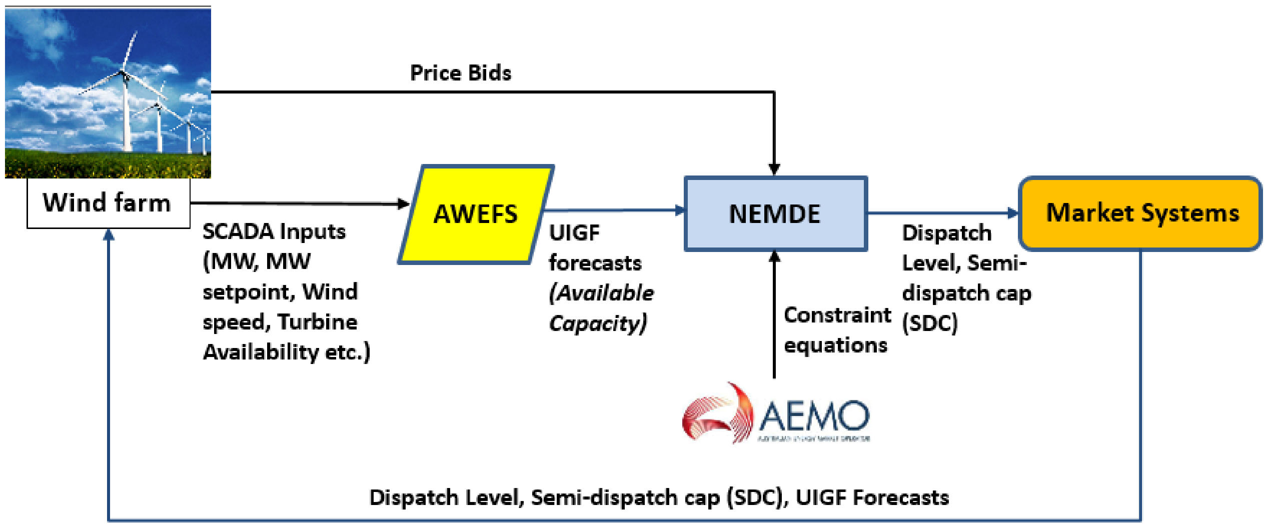


7 LINKAGE BETWEEN WIND GENERATOR SCADA, AWEFS AND NEMDE

7.1 Dispatch and 5 minute Pre-dispatch (5MPD)

The linkage between Wind generator SCADA, AWEFS and NEMDE in Dispatch and 5MPD is summarised in Figure 6: Linkage between Wind generator SCADA, AWEFS and NEMDE in Dispatch and 5MPD below.

Figure 6: Linkage between Wind generator SCADA, AWEFS and NEMDE in Dispatch and 5MPD

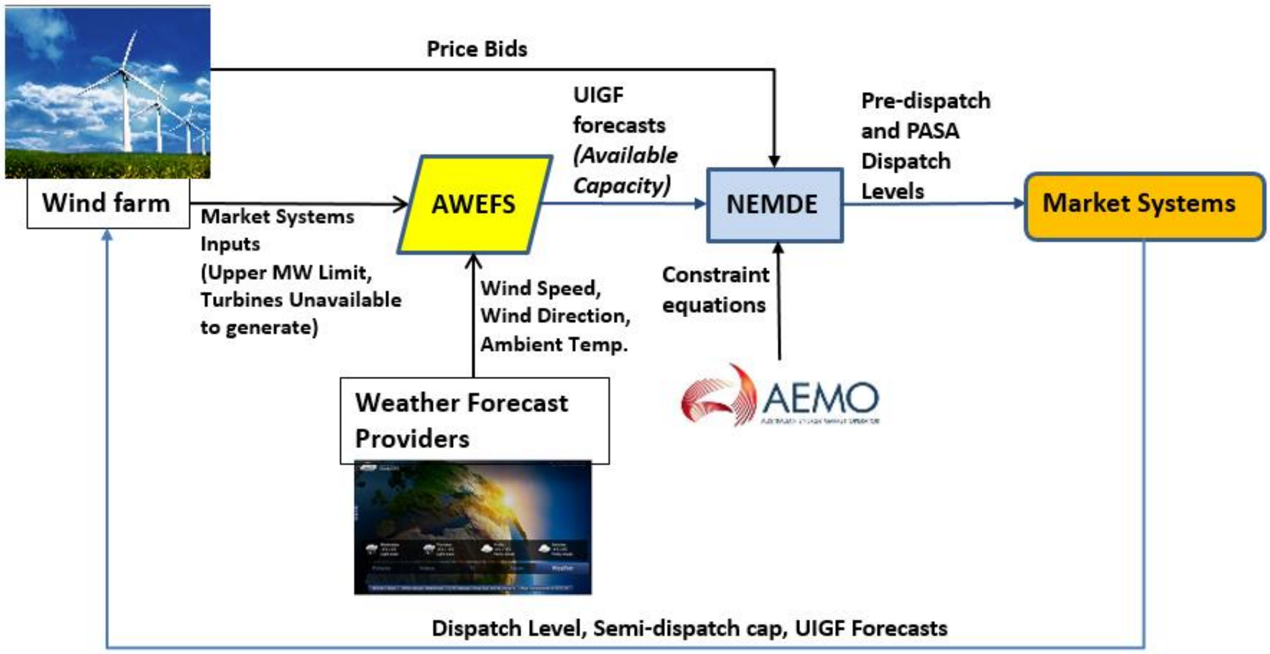


The SCADA inputs from each wind generator feed into the AWEFS system, to generate *Unconstrained Intermittent Generation Forecasts* (UIGF) for the Dispatch or 5MPD . UIGF represents the *available capacity* of the wind generator during the 5 minute Dispatch interval. The forecasts are then used in NEMDE, where network constraints and price bids submitted by each wind generator are taken into consideration, for determining *dispatch level*s and semi-dispatch cap (SDC) for the Dispatch Interval. Wind generators receive the *dispatch instruction* (comprising the *dispatch level* (in MW) and semi-dispatch cap (0/1)) and UIGF forecasts via AEMO's Market Systems Interface and respond to the *dispatch instruction* by capping their output at the *dispatch level* when the semi-dispatch cap (= 1) is applied.

7.2 *Pre-dispatch* and *PASA* processes

The linkage between Wind generator market systems inputs, Weather predictions from weather forecast providers, AWEFS and NEMDE in *Pre-dispatch* and *PASA* is shown in Figure 7: Linkage between Wind generator market systems inputs, Weather forecasts, AWEFS and NEMDE in *Pre-dispatch* and PASA processes below.

Figure 7: Linkage between Wind generator market systems inputs, Weather forecasts, AWEFS and NEMDE in *Pre-dispatch* and PASA processes



The market systems inputs (Upper MW Limit, Turbines unavailable to generate) submitted by each wind generator via the EMMS Participant Web Portal feed into the AWEFS system, to generate *Unconstrained Intermittent Generation Forecast*s (UIGF) for the *Pre-dispatch*, *Short term PASA* and Medium term *PASA* processes. The UIGF forecasts are then used in NEMDE, where network constraints and price bids submitted by each wind generator are taken into consideration, for determining the *dispatch level*s for the *Pre-dispatch*, *Short term PASA* and Medium term *PASA* processes.

8 *DISPATCH LEVEL* AND SEMI-DISPATCH CAP

This section provides an overview of how NEMDE determines *dispatch level*s for semi-scheduled wind generators in the Dispatch, 5MPD and *Pre-dispatch* processes, based on the *Unconstrained Intermittent Generation Forecast*s (UIGF) produced by AWEFS.

8.1 NEMDE and Wind generator *Dispatch level*s

NEMDE uses price bids, *available capacity* information and constraint equations (represent limitations on network) to determine *dispatch level*s for generators. Conventional generators submit both price bids and *available capacity* information to NEMDE. However, wind generators only submit price bid information since *available capacity* is determined by AWEFS. The price bids (submitted by the wind generator), *available capacity* (determined by AWEFS) and constraint equations (formulated by AEMO) feed into NEMDE, where wind generators are treated similar to conventional generators. Based on the inputs, NEMDE generates *dispatch level*s for semi-scheduled wind generators in Dispatch, 5MPD and *Pre-dispatch* processes. Semi-scheduled wind generators are only required to follow the *dispatch level*s when the semi-dispatch cap (SDC) is applied (on).

Similarly, in the *Short term* and Medium-term *PASA* processes, the *PASA availability* for semi-scheduled wind generators is determined by AWEFS and is equivalent to the *Unconstrained Intermittent Generation Forecast*s (UIGF). *PASA* solver determines targets (after consideration of network limitations) for semi-scheduled wind generators based on the *PASA availability* information (determined by AWEFS).

8.2 Semi-dispatch cap (SDC) and conditions for trigger

In the Dispatch process, semi-scheduled wind generators are required to follow the *dispatch level*s generated by NEMDE only when the semi-dispatch cap (SDC) is applied (on). When the semi-dispatch cap applies for a particular DI, wind generators are required to generate at or below the *dispatch level* generated for that DI. At times when the semi-dispatch cap is not applied, wind generators are free to generate to any level.

The conditions that trigger NEMDE to apply a semi-dispatch cap are listed below:

1. If the *dispatch level* determined by NEMDE is lesser than the *available capacity* (determined by AWEFS), then semi-dispatch cap is set to 1 (normally 0). This could occur when there are:
    - network limitations that require the wind generator to generate lesser than its capability
    - inter-regional limitations
    - Price bid or market-related limitations including ramp rate, fixed loading level, non-dispatch of uneconomic price bands or marginal dispatch of economic price bands.

   OR

2. If the *dispatch level* determined by NEMDE is equal to the *available capacity* (determined by AWEFS), but a generic constraint would be violated if the wind generator's generation were to exceed the *dispatch level* for that DI, then semi-dispatch cap is set to 1.

Appendix C – AWEFS forecasts during abnormal conditions details how AWEFS generates forecasts during abnormal conditions such as periods when:

- Bad/failed quality SCADA is input from the wind generator.
- High wind speed conditions exceed the cut-out speed of wind turbines.
- Wind generators are *constrained off*; and
- Overrides are applied by AEMO.

APPENDIX A – *ENERGY CONVERSION MODEL* TEMPLATE AND SOME KEY STATIC DATA ITEMS

The *Energy conversion model* template can be found at: http://www.aemo.com.au/Electricity/Market-Operations/Dispatch/Energy-Conversion-Model-for-Wind-Forecasting

Some of the key static data items contained in the *Energy conversion model* are provided below.

Table 3: Key Static Data items contained in the *Energy conversion model.*

Wind generator Parameters	Description
Proposed DUID	DUID of the wind generator to be used in *AEMO*'s Market Systems. The DUID in the *Energy conversion model* should be the same as the DUID in the Registration Application.
Cluster ID	IDs for each cluster of wind turbines, to be used in *AEMO*'s Market Systems.
Expected Date of energisation /connection to grid	Expected Date when the wind generator is to commence generation or commissioning tests.
Expected Date of commercial operation	Expected Date when the wind generator would have completed commissioning tests and begin commercial operation.
Registered Capacity	Installed capacity of the wind generator.
Wind generator geographical co-ordinates	Geographical co-ordinates of a representative location of the wind generator
Wind generator altitude	Representative value for the wind generator altitude (average of the ground altitude of turbine locations)
Wind generator geometry	Wind generator map with wind turbine locations marked on it.
Met Mast measuring height	The height of the meteorological mast that measures the real-time meteorological data.
Met Mast geographical co-ordinates	The geographical co-ordinates of the meteorological mast.
Orography	Map of wind generator area in numerical format (dimensions of land surface)
Roughness	Map of terrain roughness in numerical format.
Individual Cluster Details	**Description**
No. of wind turbines in the Cluster	To determine the capacity of each cluster, the number of turbines in each cluster needs to be provided.
Type of Turbines	Manufacturer type and model of turbines in the cluster.
Hub Height of the turbines	Height from the turbine platform to the rotor of an installed wind turbine
Rotor Diameter	Diameter of the rotor blades
Turbine Power vs. Speed curve	Manufacturer supplied power curve that shows correlation between power output from the turbine vs. wind speed.
Nominal power of turbines	Nominal capacity of the wind turbine
Cut-out and restart after Cut-out wind speeds	Wind speed above which the turbines would cut-out to avoid damage to blades, and restart after Cut-out wind speed refers to speed below which the turbine can generate again, after the cut-out.
Cut-out and restart after cut-	Temperatures above which the turbines would stop operating to avoid

out temperatures	damage, and restart after cut-out temperatures refer to the temperature below which the turbine gets back in operation after a cut-out due to high temperature.
Control Schemes in operation	Details about any Network Service Provider imposed control schemes which could limit the output from the wind generator to avoid overloads etc.
Historical Measurements	**Description**
Historical SCADA measurements since operation of wind generator	This is only required if an existing wind generator had to be modelled into AWEFS.
Historical wind measurements from the site	All new wind generators would need to provide historical wind speed and wind direction measurements for a period of atleast one year, with at least hourly resolution.

APPENDIX B – SCADA INPUT USED IN DISPATCH, 5MPD PROCESSES

Table 4: SCADA Inputs used in Dispatch, 5MPD processes

Wind generator SCADA parameters	Description
Wind generator generation (MW)	The power output from the wind generator as measured at the connection point.
Wind generator control system setpoint (MW Setpoint)	MW set-point applied in the wind generator's control system to limit (down regulate) its output to at or below the level required by *AEMO* or the Network Service Provider.
No. of Turbines On	The number of turbines (within the entire wind generator) actively generating.
No. of Turbines Available	The number of turbines (within the entire wind generator) that are available to generate, including turbines actively generating, turbines that are cut-off due to high ambient windspeed/temperature conditions as well as turbines that are paused due to down regulation. It excludes turbines that are under maintenance/repair and turbines that are being manufactured/installed.
Meteorological SCADA parameters	**Description**
Wind speed	Wind speed as measured from the meteorological mast/turbine nacelle.
Wind Direction	Wind direction as measured from the meteorological mast/turbine nacelle.
Ambient Temperature	Ambient Temperature as measured from the meteorological mast/turbine nacelle.

APPENDIX C – AWEFS FORECASTS DURING ABNORMAL CONDITIONS

The purpose of this section is to provide an understanding on how AWEFS generates forecasts during certain abnormal conditions.

C.1 Bad or Failed Quality SCADA

During periods of bad or failed quality active power generation (MW) SCADA from wind generators, the AWEFS system will rely on information from numerical weather predictions (from weather forecast providers) and number of turbines available to generate, to determine the UIGF forecasts.

However, the quality of the UIGF forecasts will deteriorate over time since there is no real-time information about the wind generator's MW output.

C.2 High wind speed cut-out

During periods when the wind speed increases above the cut-out speed[5] (as specified by the wind generator in the *Energy conversion model*), the forecasts generated by AWEFS are designed to reflect the reduced generation due to turbine cut-out (turbines that are automatically stopped or cut-out from generating). The forecasts generated under such conditions are primarily dependent on the wind speed and number of turbines available to generate.

C.3 Periods when AWEFS UIGF forecasts are turned off

There are certain instances when AEMO turns off the UIGF forecasts that are generated by AWEFS. These include:

- Early stages of commissioning for a new wind generator: For newly commissioning wind generators, the forecasting modules in the AWEFS system require tuning and development, for which sufficient amount of active power generation (MW) and wind speed data needs to be accumulated. To allow sufficient time to build enough history, AEMO has the functionality to turn off the UIGF forecasts generated by the AWEFS system during this period. Once the forecasts are turned off, they are replaced with the active power generation (MW) SCADA from the wind generator, in NEMDE, to generate the *dispatch level* for the next DI.

  The UIGF forecasts from AWEFS are turned on, prior to the wind generator's date of completion for commissioning, and at a stage when AEMO has sufficient confidence in the quality of the forecasts that are generated by the AWEFS system.

- Periods when forecasts are seen to be unreliable: If the forecasts generated by the AWEFS system is seen to be unreliable or interfering with market outcomes, AEMO will turn off the UIGF forecasts generated by AWEFS. Unreliable forecasts can be generated as a result of incorrect SCADA inputs from the wind generator or inaccurate weather forecasts. AEMO will turn on the UIGF forecasts from AWEFS only at a stage when there is sufficient confidence in the quality of the forecasts.

C.4 Periods when a wind generator is *constrained off* in Dispatch

During periods when a wind generator output is restricted or *constrained off* due to network limitations or local wind generator restrictions, the forecasts generated by AWEFS do not reflect the wind generator output resulting from the limitations. The forecasts during such periods reflect the generation capability of the wind generator in the absence of the external limitations. This is because NER Rule Clause 3.7B requires AEMO to prepare 'Unconstrained' forecasts at all times. The unconstrained forecasts, generated during periods when a wind generator is *constrained off*, are dependent on the wind speed, number of turbines available to generate and the wind generator control system setpoint (MW Setpoint) SCADA inputs.

[5] Minimum speed at which turbines are stopped to avoid damage to the rotor blades.

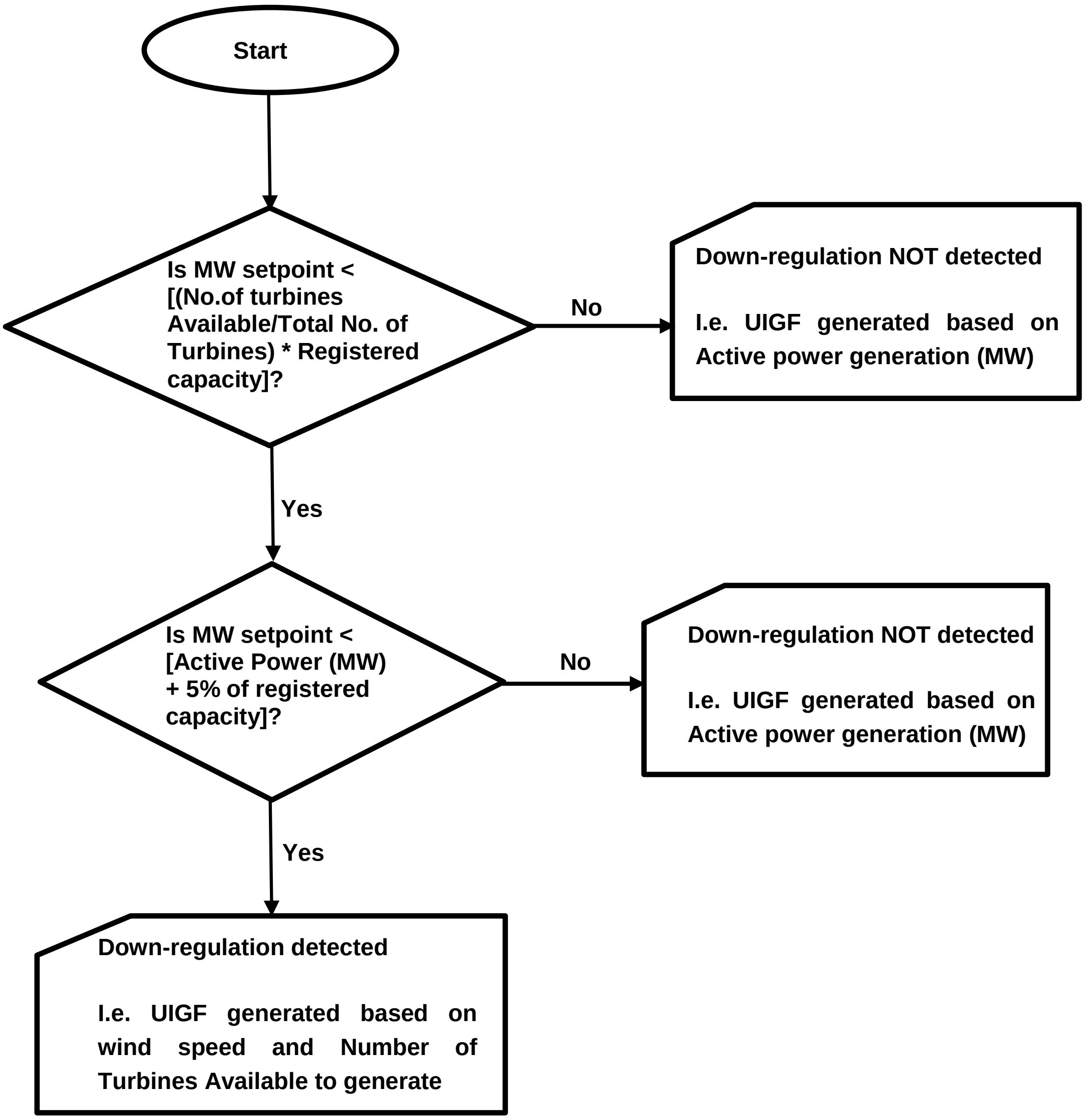
C.4.1 Mode of Operation for Wind generator control system setpoint (MW Setpoint) SCADA

The wind generator control system setpoint (MW Setpoint) SCADA provides AWEFS with an indication on whether a reduced wind generator output is due to operator action resulting from external limitations or due to a reduction in wind speed. The MW setpoint SCADA should operate as listed below:

- During periods of normal operation (when wind generator output is not *constrained off*), the MW setpoint should reflect a value above the wind generator's registered capacity (but below 250% of it).
- During periods when the wind generator is *constrained off*, the MW Setpoint should reflect the set-point applied in the wind generator's control system to limit (down regulate) its output to at or below the level required by AEMO. During such periods, the MW set-point could be the same as the *dispatch level* generated by NEMDE (if the wind generator intends to generate at the level required by AEMO) or wind generator's own set-point values (if the wind generator intends to generate at a level lesser than the level required by NEMDE). It is important that during such periods, the wind generator's active power generation (MW) profile closely reflects the wind generator's control system setpoint (MW setpoint) profile.

C.4.2 How does AWEFS detect if a wind generator is *constrained off*?

AWEFS performs certain validation checks to determine if a wind generator is *constrained off*. These checks are summarised in the flowchart below:



AWEFS checks if the wind generator's control system setpoint is below the nominal capacity of the wind generator (determined as No.of turbines Available/Total No.of Turbines * Registered Capacity). If yes, AWEFS checks further to see if the wind generator's active power generation (MW) is close to the MW setpoint (allowing for a margin equal to 5% of registered capacity). If both conditions are met, AWEFS sets the wind generator output "down-regulation detected" flag and uses the current wind speed from SCADA to calculate UIGF, provided it is of good quality. If either one of the conditions are not met, AWEFS will not detect down-regulation and generates a forecast based on active power generation (MW). An example of how a wind generator's control system setpoint (MW Setpoint) SCADA should operate during periods of down-regulation is shown in Figure 8: Example of MW Setpoint functionality during down-regulation below.

Figure 8: Example of MW Setpoint functionality during down-regulation