Fulcrum3D: Wind Forecasting for the NEM

LESSONS LEARNT REPORT 2

Project Details

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This Project received funding from ARENA as part of ARENA's Advancing Renewables Program - Short Term Forecasting funding round.

EXECUTIVE SUMMARY

- Our forecasting model continues to be more accurate than AWEFS such that it has passed AEMO's accuracy requirements with respect to RMSE and MAE on 5-minute power production.
- MP5F API status for the three Pacific Hydro wind farms involved in this project:
  - Clements Gap - submitting unsuppressed forecasts
  - Taralga - submitting unsuppressed forecasts in the assessment phase
  - Crowlands – registered.
- Sodars have been installed at the prevailing upstream locations at all three wind farms and have demonstrated forecast windows of 30mins at site mean wind speeds.
- The MP5F API is increasingly robust. Further streamlining of the API connection process is an area for improvement.
- Overall forecast refinement is ongoing.
- Remote SCADA access is streamlining the forecast system (discussed further below).
- Pacific Hydro continue to be excellent project partners, we would like to acknowledge their invaluable contribution.
- There is currently minimal value in using forecasts for FCAS participation or export control but further increases in FCAS costs may strengthen the case for using forecasting for these services.
- Other completed activities:
  - Accuracy assessment on forecasts to date
  - Cost-benefit analysis for Clements Gap forecasts
  - Explored factors affecting accuracy
  - Explored viability of other forecasts
- The project is on track to meet its outcomes.

KEY LEARNINGS

1. Category: PROJECT STRUCTURE

1.1. Objective: Demonstrate the potential commercial benefits of wind and solar farms investing in short-term, self-forecasting solutions

Lesson Learnt No. 1.1.1: The project team is key.
Details: Working with Pacific Hydro and AEMO has been collaborative and productive. Pacific Hydro are excellent partners and we would like to acknowledge their invaluable contribution.

2. Category: TECHNICAL

2.1. Objective: Demonstrate the ability to submit five-minute ahead self-forecasts via AEMO's web based MP5F API

Lesson Learnt No. 2.1.1: The MP5F API is increasingly robust and reliable.
Details:

- The MP5F API registration process continues to change as AEMO continues to refine the API processes.
- The regular expiration of API passwords is problematic. A secure automated (or semi-automated) system for resetting passwords is critical to operational efficiency. We understand AEMO is working on a better system for this.
- A published API connection process with worked examples would be helpful.

2.2. Objective: Demonstrate the five-minute ahead self-forecasts are more accurate than the AWEFS and ASEFS

Lesson Learnt No. 2.2.1: Self-forecasts can be more accurate than AWEFS.
Details: Our forecasting models continue to be more accurate than AWEFS such that they have passed AEMO's accuracy requirements with respect to RMSE and MAE on 5-minute power production.

Lesson Learnt No. 2.2.2: Remote SCADA access streamlines forecasting.
Details:

- Pacific Hydro have developed a SCADA remote access system (the GOS or Global Operating System). We are now using the GOS at Clements Gap and Taralga to query the wind farm SCADA from our servers in Sydney. This is an exciting development as it is removing the need for onsite loggers and will potentially streamline SCADA access on other wind farms where a GOS (or similar) is available.
- This solution is faster, simpler, lower cost and there are less points of failure.

Lesson Learnt No. 2.2.3: Upstream Sodars detect upstream wind changes in useful timeframes.
Details: The Clements Gap upstream sodar is detecting wind changes that affect wind farm generation at useful time frames (30 minutes at site mean wind speed).

Lesson Learnt No. 2.2.4: Sodar enhancements have improved accuracy.
Details: We have improved sodar data availability at lower and higher heights to increase the robustness of forecasting. Baffle testing at Taralga validated improved availability at all heights with a significant boost at the lower heights due to reduction of ground clutter, while using 20-meter range bins is improving higher height availability to the order of 80% availability at 200m.

Fulcrum3D are working on other developments to future proof the technology for the next generation of wind turbines.

A future workstream may be to explore the effectiveness of cheaper/other upstream sensors in detecting wind front changes e.g. pressure sensors.

3. Category: COMMERCIAL

3.1. Objective: Demonstrate the potential commercial benefits of wind and solar farms investing in short-term, self-forecasting solutions.

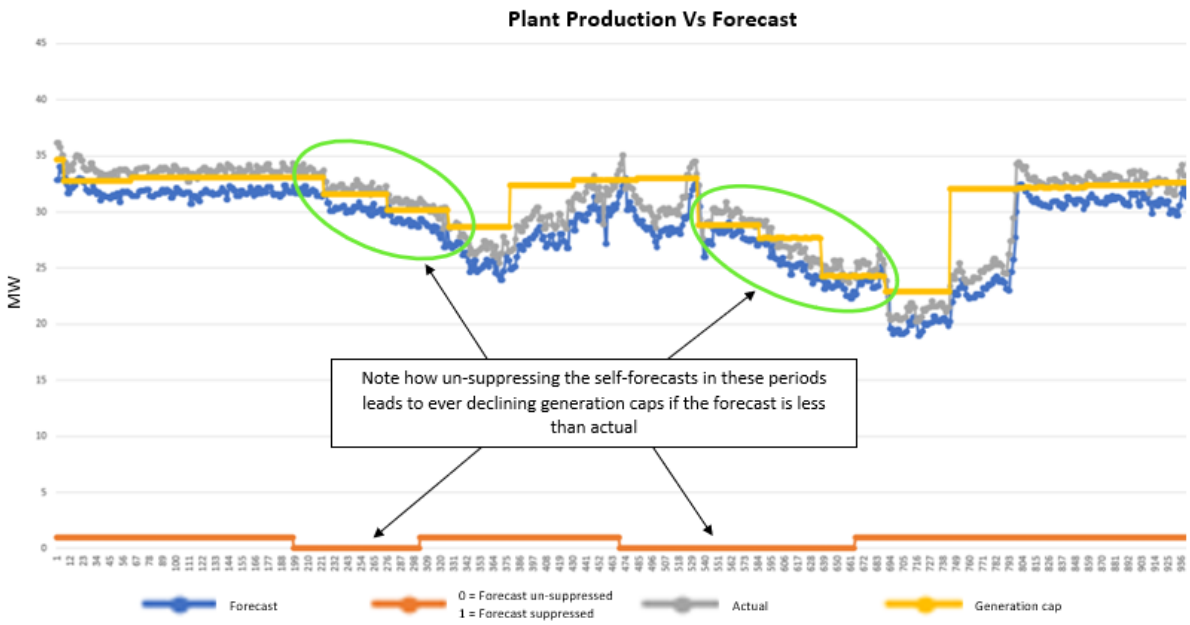
Lesson Learnt No. 3.1.1: AEMO's Causer Pays calculation can be replicated.
Details: We have developed a model that replicates AEMO's calculation of causer pays charges using publicly available NEMWeb data. This will allow the commercial benefits of self-forecasting to be assessed.

Lesson Learnt No. 3.1.2: The NEM Dispatch Engine zeros negative self-forecasts.
Details: The NEM dispatch engine sets a zero floor for the dispatch target but the FCAS calculation uses negative numbers when generation is negative (i.e. the plant is a net consumer). So when plants are not generating power but consuming from the grid they incur FCAS costs that cannot be managed by self-forecasting because MP5F and subsequent pipelines within AEMO's dispatch engine do not allow negative dispatch targets. Operational forecasting meeting notes from 2018 said MP5F would allow negative submissions but this is not the case. AEMO have been able to validate our internal analysis that this effect can contribute 10-20% to a generator's MPF. It is worth noting that of all the semi-scheduled generators on the NEM, only four solar farms show negative generation, but there are 25 wind farms that do.

Lesson Learnt No. 3.1.3: Self-forecasting can be challenging during periods with generation caps.

Details: We have observed the risk of ever declining forecasts on South Australian wind farms during periods of generation caps as shown in the plot below.

This is in line with AEMO's comments in the initial press release for this self-forecasting trial "Wind and solar farms […] can be required to curtail their generation to match an overly conservative forecast." [1].



Self-forecasting during periods with generation caps. *Source: Fulcrum3D*

It is currently prudent to suppress self-forecasts during generation caps because small errors in forecasts or the plant control system can start a continuous exponential decline in output as shown above.

Methods to negate control system issues (such as slightly overestimating actual production), can result in significant causer pays charges. There is potential to overcome this if more information can be shared between the generator and AEMO about dispatch intervals with dispatch caps.

Lesson Learnt No. 3.1.4: The business case for using self-forecasts for FCAS participation/export control is not strong.

Details: The spot price for energy is generally significantly higher than the spot price for FCAS services so a generator is better off selling into the energy market. The terms of some PPA contracts may mean this is not the case for some solar farms (e.g. Take Or Pay contracts).

Further increases in FCAS costs may strengthen the case for FCAS participation. It should be noted that FCAS participation capability (technical and regulatory) would

[1] ARENA, $9 million funding to enhance short term forecasting of wind and solar farms (18 March 2019)

have been valuable to wind and solar farms during the recent South Australian islanding event.

- The Hornsdale wind farms are the only operational renewable generation FCAS providers in South Australia and so were the only renewable generators able to capitalise on the FCAS windfall that occurred during this event. All other wind and solar farms collectively paid more for their FCAS than the market value of the energy during that period.
- Allan O'Neil notes in his recent WattClarity article that *"generators who don't fully understand their exposure to FCAS, and have not developed mitigation strategies – even partially, perhaps through developing capabilities to become FCAS providers like the Hornsdale wind farms – can leave themselves open to very nasty surprises."* [2].
- The business case for FCAS participation is likely to strengthen if there are similar events in the future.

[2] O'Neil, Allan. Don't Forget About FCAS! *WattClarity* (17 February 2020)