Solcast nowcasting for solar farms and the Australian energy sector

LESSONS LEARNT REPORT No: 3

A sky-imager installed atop a weather station at a solar farm

PROJECT DETAILS

Recipient Name	Solcast
Primary Contact Name	Dr. Nick Engerer
Contact Email	nick@solcast.com
Reporting Period	April - September 2020

This Project received funding from ARENA as part of ARENA's Advancing Renewables Program - Short Term Forecasting funding round. The views expressed herein are not necessarily the views of the Australian Government, and the Australian Government does not accept responsibility for any information or advice contained herein.

EXECUTIVE SUMMARY

Solcast has deployed short-term forecasting solutions to eight Australian solar farms in this ARENA funded Project. The Project demonstrated sky-imager technology can improve forecast accuracy over the short-term, but that an ensemble forecasting approach considering multiple inputs other than solely a sky-imager is the preferred solution. An FCAS simulation tool was developed that can reproduce AEMOs published MPF data. Solcast forecasts resulted in MPF reductions when compared with ASEFS forecasting. Solcast has demonstrated the effectiveness of self-forecasting in the NEM to reduce individual participant and market-wide FCAS costs.

INTRODUCTION

Solcast is a global solar data services company specialising in satellite-based measurement and forecasting of solar irradiance and solar production, with offices in Sydney and Canberra. Our vision is a solar future - we're dedicated to developing the data and tools needed to plan, construct, operate and manage solar power systems across the world. The Solcast API is trusted by more than 8,000 users, with data for over 1,000,000 locations around the globe. In the NEM, Solcast provides short-term forecasting for over 50% of utility scale installed capacity.

In this ARENA funded project, Solcast is demonstrating and refining very short-term five-minute ahead solar power forecasts for eight solar farms in the Australian National Electricity Market (NEM). The forecasts are submitted on behalf of the solar farms to the Australian Energy Market Operator (AEMO) for use in dispatch.

Solcast's approach to five-minute ahead NEM self-forecasting is based upon three elements; 3rd generation weather satellite cloud nowcasting system, which identifies, characterises and models cloud cover in three-dimensions and predicts their future positions through fusion with weather forecasting model outputs; real-time data from solar farm supervisory control and data acquisition system (SCADA) used to reweight background satellite-derived ensemble forecast and to communicate inverter availability and/or active constraint; and one-minute forecasts derived from on-site sky-imagers. The five-minute forecast is generated in the cloud on centralised servers by blending the three forecast components and is exposed via a Solcast API (Application Programming Interface) endpoint for submission to the AEMO API.

Solcast is successfully submitting five-minute forecasts to the AEMO API for all eight solar farms. AEMO requires all forecasts to undergo an assessment to establish the accuracy and reliability of the new forecasting system. Key to this is demonstrating lower error than the Australian Solar Energy Forecasting System (ASEFS). Solcast has demonstrated reduced errors compared with ASEFS at all eight solar farms.

This Project will be releasing a comprehensive public report at the conclusion of the Project in December 2020. The report will expand on the three Lessons Learnt reports, pulling out key Project technical and commercial insights, and will provide an overview of forecast model performance in terms of both forecast accuracy, and MPF and regulation costs impacts.

KEY LEARNINGS

Lesson learnt No. 1: Forecast accuracy is not a suitable proxy to determine reduction in FCAS fees from a self-forecast

Category: Technical

Objective: Estimate the FCAS savings from a self-forecast solution

The Project developed a model to estimate the financial impact of improvement in forecast accuracy. The model can simulate a participant's causer pays factor and regulation cost given a specified forecast input. The Project has been able to match AEMOs published MPF data with the simulation tool. This allows the comparison of the Solcast forecast with the ASEFS forecast with respect to MPF.

It should be noted that a MW deviation can, at times, not impact the power system and may in fact be a positive, depending on power system frequency. This is a non-trivial outcome to model and means a participant cannot simply multiply the forecast accuracy improvement by regulation costs to estimate savings. Approaches that use forecast accuracy as a proxy for reductions in FCAS fees are therefore not robust and are not likely to produce accurate estimates of FCAS savings.

The larger the RNEF and LNEF values (in absolute terms), the higher a participant's causer pays settlement factors (CPF). Once the FCAS CPF is calculated for each participant, the relative cost difference between the ASEFS and Solcast forecasts can be determined. Although a strong correlation trend exists between deviations in RNEF/LNEF and CPF’s, there are still other variables that influence the total cost paid by participants in each settlement week, not the least being the actual market conditions that occurred in that settlement week.

Use of an inhouse FCAS simulation model allows for a faster forecast upgrade iteration cycle.

Generally, it would take 10+ weeks for a forecast algorithm change to be reflected in AMEO published MPF data, and longer still to establish a trend sufficient to confirm the forecasting change was desirable. We have reduced this cycle to a matter of minutes, allowing our modelling team to test many more forecast iterations than was possible previously.

Future projects in this space should not assume that forecast accuracy gain relative to ASEFS is a suitable proxy to determine FCAS savings. A deep understanding of the FCAS calculation methodology will aid in the development of an FCAS calculation tool, and in the interim testing of new forecast algorithms. Close consultation with AEMO is likely to be necessary to understand and deploy the required methodology.

Lesson learnt No. 2: AEMOs use of HTTP response codes

Category: Technical

Objective: Build an audit logging system to track system reliability

HTTP response codes provide standard protocols to allow systems to respond to the results of a HTTP request, and a convention has been built over time within the industry as to the correct use of the codes. The Project notes that AEMOs use of HTTP responses codes is not always consistent with industry convention, and this has an impact on monitoring and support services downstream from AEMO's API.

AEMO could make a clearer delineation between requests that fail due to client errors (4xx response codes) and requests that fail due to server errors (5xx response codes). The distinction has ramifications for how support teams react to the response codes, which if provided incorrectly, can have ramifications for how reliability metrics calculated by AEMO.

The AEMO API would also benefit from clearer delineation between a successful request (2xx response code) and a late request. At the time of writing, it appears that some request which are made to the AEMO API that receive a 200 HTTP response code, are later designated as a late submission in assessments provided to participants. A separate response type for a late request would allow participants to monitor, track late requests when made and improve our services to avoid late requests.

Future projects should keep audit logs of AEMO API response codes for each dispatch interval of each DUID. This is important to understand the reason why some forecasts are classified by AEMO as “DIS_EXCLUDED_MISSING_LATE_SF”. For asset owners, reasons for late submissions are not always caused by the submission system, and can occur through a fault of the AEMO API, or due to interruptions occurring in the network connection between a submission system and the AEMO API (which are neither the fault of AEMO or a participant, and are mostly unavoidable due to nature of the internet).

Lesson learnt No. 3: Monitoring of forecast system and forecast accuracy

Category: Technical

Objective: Detect and respond to operational issues affecting forecast accuracy and system stability

The Project has built numerous operational systems that monitor the health of the forecasting system and forecast accuracy with real-time, daily, and weekly reporting. Solcast runs a 24/7 support team that receives automated alerting in the event of abnormal system or forecast performance. The automation of monitoring is crucial for any future projects looking to scale a forecast system to multiple sites.

Automated forecast error reporting of MAE and RMSE can play an important role in detecting poor forecast performance. The Project has not had to supress a forecast due to poor forecast performance, but operational visibility of forecast accuracy statistics helps to focus on areas for improvement.

Future projects will absolutely need to develop robust monitoring systems to pick up and respond to abnormalities quickly. The ability to quickly suppress a forecast is also required, particularly in the case of spurious input data which requires intervention from external parties. Every possible issue cannot be considered, so here we share the most common operational issues we have detected and should be monitored in real-time;

1. Spurious SCADA data, including missing measurements, stuck measurements, old measurements, and inconsistent measurements (e.g. high irradiance measurements with zero active power)
2. Spurious forecasts by sky-imagers caused by foreign objects. Most commonly this is caused by dust, but we have also encountered birds attempting to land on the sky-imager, and bugs crawling across the lens.
3. Authentication issues with AMEOs API