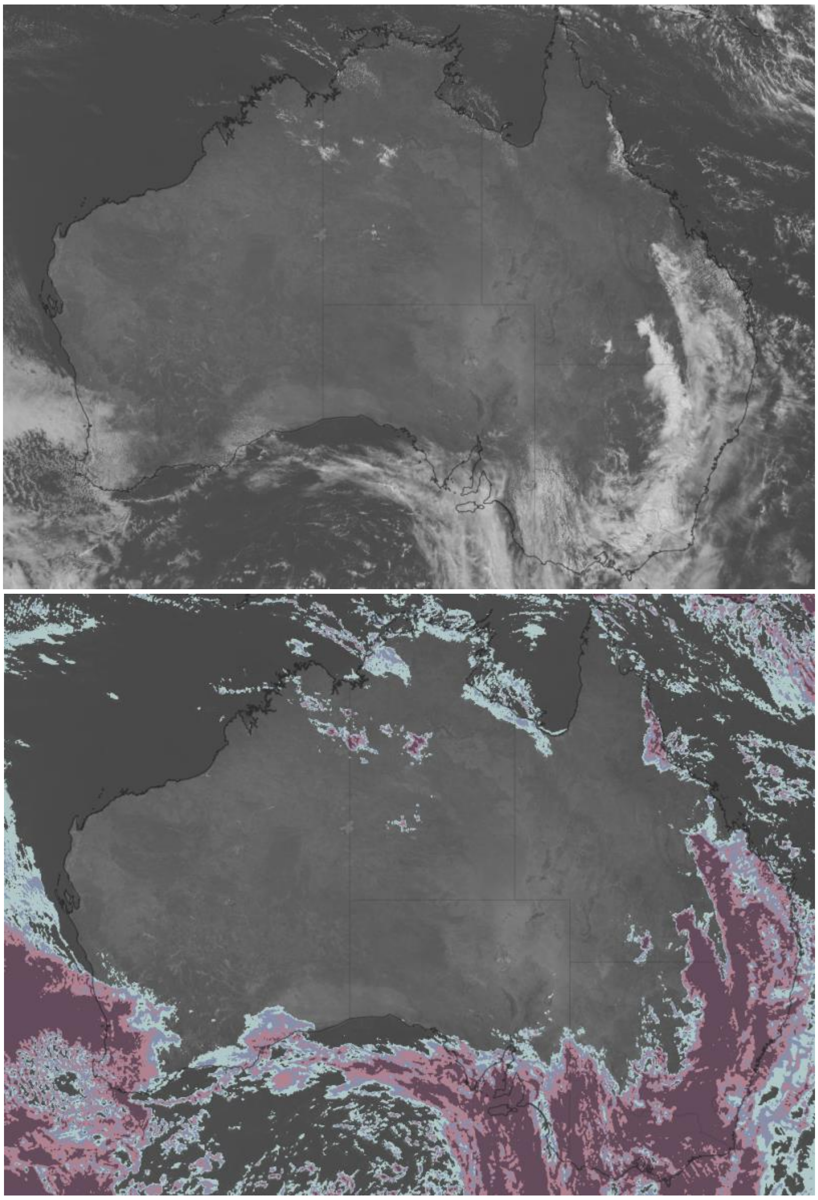
SOLCAST

# Gridded Renewable Nowcasting Demonstration over South Australia

## LESSONS LEARNT REPORT No: 2



*Raw satellite imagery from the Himiwari-8 (top) and Solcast cloud cover estimated actuals (bottom)*

## PROJECT DETAILS

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|---|---|
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| **Reporting Period** | July – September 2020 |

This Project received funding from ARENA as part of ARENAs Advancing Renewables Program.



## 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.

Formed in early 2016, Solcast is the culmination of several years of work by co-founders James Luffman and Dr Nick Engerer and their team, who saw tremendous opportunity to approach solar modelling and forecasting from their perspectives as meteorologists working with the electricity sector.

In this ARENA funded project, Solcast aims to enhance existing weather forecast services by developing a proof of concept demonstration of a forecasting tool which will track and predict renewable output in real time. Solcast's forecasting tool will aim to predict up to six hours ahead in five-minute increments, distributed into 1-2km grids across SA.

Solcast will track the real-time evolution of weather systems over SA and forecast the positions and characteristics of cloud cover, as well as improve predictions of wind-speeds at the wind turbine nacelles (above ground) enabling energy generation to be forecast with greater accuracy. The forecasts will also focus on six hour ahead forecasting to provide more accurate information for grid operation and enhanced management of generation, energy storage, and demand response.

Solcast will utilise a range of data sets and data streams, including historical surface meteorological measurement data and wind and solar farm weather data, to develop high quality forecasts. These forecasts will be shared via project partners, Weatherzone and Tesla Asia Pacific, to be assessed and used by the Australian Energy Market Operator (AEMO), the local distribution network operator (SA Power Networks), and generator asset operators.

## KEY LEARNINGS

### Lesson learnt No. 1: Holistic approach to forecasting for the electrical grid

**Category:** Commercial
**Objective:** Build an understanding of the long-term forecast requirements of grid operators and transmission and distribution networks

Solcast has developed a global real-time cloud detection, tracking, and forecast system at a scale and update cycle that is to date unheard across the nowcasting horizon of 0 to + 6 hours ahead. Our goal is to support the transition to the solar power future through commercial and academic leadership in solar forecasting and solar irradiance modelling. Great solar forecasting is critical to support high penetrations of solar PV across grids of all sizes, but this capability alone does not go far enough to really solve the renewable energy integration challenges that Australia faces in the coming decades.

Looking to AEMO's 2020 Integrated System Plan, their models examine scenarios of a tripling of solar capacity, and dramatic growth in other renewables + batteries, while dramatically scaling back coal. Networks are planning for record lows of minimum operational demand. The projected increase in grid-connected renewable energy drives the need for a holistic, highly accurate, rapid updating, granular, intra-day focused weather forecast system.

The market will require nowcasting of the 'weather' to coordinate a new energy future where 'weather is the fuel', driving not only generation (utility wind & solar), but demand (temperature, rooftop PV) and in an environment of elevated risk to storm outages (lightning, precipitation). This ARENA funded Project is focused on the development of utility wind, utility solar, rooftop PV and precipitation nowcasts in the state of SA, but there is an emerging market need across the NEM and other Australian electrical markets for nowcasting of other weather parameters - weather nowcasting data as a whole is critical to a functioning high renewable energy penetration future.

Future projects should view the key takeaways as this: There is a shift in forecasting requirements of grid operators, networks, and gentailers towards high-quality, rapidly-updating short-term nowcasting, which they have identified as required to orchestrate high penetration of renewables in an electrical grid. In developing a weather forecasting system for the electrical grid, these elements should be considered highly desirable.

### Lesson learnt No. 2: Infrastructure planning

**Category:** Technical
**Objective:** Build scalable & reliable infrastructure systems

This lesson views the market trend toward weather nowcasting of Lesson 1 through a technical lens. With these market signals (including from AEMO's 2020 Integrated System Plan, and this Project's participants) indicating a future appetite for comprehensive weather nowcasting systems, forward thinking infrastructure design should be a key component when building a forecast system to ensure any system designed now will meet the needs of customers in the future.

In the design of forecasting system for this Project, Solcast has made decisions that will facilitate the expansion of the system across all of Australia and international coverage for the suite of utility wind, utility solar, rooftop PV and precipitation nowcasts, with the ability to add in other weather parameters of interest as they are required by customers.

This Project employed the use of scalable compute and storage resources via Amazon Web Services. These allow the system to scale up or scale down as the system requires. This caters for short-term variability in compute resources required, while catering for the expansion of the system as it grows spatially and parametrically. Scalable compute and storage resources reduce the upfront cost of developing a new system through reduced capex and allows the system operating cost to scale with system growth.

For future projects in this space, considerations should be paid to development of future systems, how they will be integrated into existing infrastructure, and how existing infrastructure and scientific models can be leveraged to speed up deployment time for additions. In the short term, this may translate to over-engineering a product solution and bring with it associated issues of increased design and development time, and volume of operational support required. Long term however, this can reduce the need for a structural overhaul of a forecast system in favour of development of smaller add-on modules.

## Lesson learnt No. 3: Training data for Precipitation algorithm development

**Category:** Technical
**Objective:** Source appropriate training data for algorithm development

In developing a precipitation rate algorithm, QPE (Quantitative precipitation estimation) radar data is highly valuable as a training dataset due to its high spatial and temporal resolution. However in Australia it is limited in its coverage (see Figure 1). To ensure our precipitation algorithm was well generalised we used Global Precipitation Measurement (GPM) data to validate in areas outside of radar coverage.

Future projects focused on developing algorithms to identify meteorological features will find accurate and independent datasets maybe limited in spatial and temporal coverage. When developing capabilities that are intended to operate outside this coverage, care needs to be taken when building your models to ensure they generalise well and will be representative of other regions. Validation using datasets for other areas, even those outside your target region, can help ensure your models are not over specified.


*Figure 1 - QPE radar coverage in Australia*

## Lesson learnt No. 4: Modelling low-frequency high-value events

**Category:** Technical
**Objective:** Produce a robust forecast algorithm that correctly identifies low-frequency high-impact events

Identifying low-frequency, high-impact events (such as very heavy rain) is a difficult problem for meteorological modelling. Specifically for precipitation algorithmic developments in this Project, capturing periods of high intensity rainfall was found to fit this problem. The imbalanced distribution of intense rainfall events can make them difficult to capture when training a model to predict a numeric value, as standard prediction metrics will often favour accurate prediction of the more numerous, low priority values.

Using an alternate sampling approach to increase the relative distribution of these high values events can increase the propensity of the model to predict those events while still using standard metrics. This is the approach we used for our precipitation training dataset to ensure that very high precipitation rates were being predicted, despite their infrequency relative to low level precipitation. Future projects should be mindful of the difficulty in modelling these events, and may find alternative sampling approaches to be beneficial.