ASIA-PACIFIC
SOLAR RESEARCH CONFERENCE

A forecasting system with a range of technologies to optimally forecast solar generation at different time-scales

Victor Depoorter[1], Matthew Jeppesen

[1] *Proa Analytics, Melbourne 3053, Australia*

As distributed and utility-scale solar photovoltaic (PV) continue to rapidly grow in Australia, the operation and planning of the power system and electricity market need to be adapted to accomodate the variability and uncertainty of the solar resource. Improved solar PV forecasts at different timescales can help managing the uncertainty from solar PV generation. While short-term forecasts (0-6 hours ahead) are particularly useful for real-time dispatch, frequency regulation, power plant operations and trading, long-term forecasts (one to a few days ahead) allow improving UC decisions, scheduling and performance control of balancing areas. In addition, these forecasts are also necessary to plan the operational needs of distribution and transmission systems. Hence, PV forecasting is likely to become a key component in integrating large amounts of solar PV into the grid, reducing the costs of managing its variability and uncertainty.

A range of forecasting technologies are available, providing better performance at different time scales. In the short-term (0-6 h ahead), solar irradiance fluctuations at the ground level are mostly due to the motion of clouds. In this sense, geostationary satellites taking high resolution images of the Earth in near-real time provide valuable information on current cloud cover. Cloud motion vectoring (CMV) algorithms can then be used to identify cloud structures, calculate their speed and direction, and extrapolate their motion into the future to produce forecasts. In the case of utility scale solar farms, with highly concentrated PV capacity, the forecasting performance for very short-term time scales (0-15 min) can be improved by using ground-based total-sky imagers that provide images of local cloud structures with greater spatial and temporal resolution. In the long-term (6 h to several days ahead), clouds change their shape, form and dissipate, making Numerical Weather Predictions (NWP) models that solve the differential equations describing the physical laws governing the atmosphere dynamics the optimal solution.

A novel solar forecasting system with a range of technologies to optimally forecast solar generation at different timescales is presented. The system was developed in Australia for Australian conditions and combines skycam CMV, satellite CMV, live generation data and numerical weather prediction (NWP). This system develops and extends the state of the art in solar forecasting in several ways, including the development of a new method for night detection of clouds using IR. While each technology provides benefits at different time scales, the optimal combination of the different component forecasts can be used to reduce forecasting errors at all time-scales. This talk will introduce each forecasting technology, with insights and lessons learnt from running these in production since 2017, and analyse their integration in utility scale and distributed solar PV applications in the context of the National Electricity Market (NEM).