Energy Re-Forecasting Methodology for Solar PV Plants Using ASTM E2848-13

Saurav Kadel | Black & Veatch

1. Introduction

- System owners and developers consistently strive to maximize energy yield from operational solar plants. The early years of operation often present challenges due to unforeseen issues such as unknown performance factors, unexpected outages, and equipment downtime, which can result in underperformance and raise concerns for stakeholders.
- In response, system owners and developers are increasingly requesting early-stage energy forecasting and reassessment based on operating data to establish updated production benchmarks.
- However, because of the limited operational data that is available at this early stage there is no widely established methodology for performing such evaluations. Conventional re-forecasting methods often fall short in providing accurate assessments under these conditions.
- In this presentation, we examine the applicability of the ASTM E2848-13 methodology for evaluating early operational data and generating forward-looking energy forecasts for newly commissioned plants. Our approach involves analyzing a range of operational datasets and applying the ASTM-based procedure including systematic filtering of unknown events and downtime, adjustments for revised availability, and regression modeling using measured irradiance, energy, and weather data to estimate future energy production. Finally, we present our end-to-end process, summarize key insights, and provide practical guidelines for effectively using this methodology to reassess energy expectations during the critical early years of plant operation.

2. Methods

- For any Project, Net Meter Power, Plane of Array (POA), Global Horizontal Irradiance (GHI), curtailment data, ambient temperature, wind speed, and availability data as measured on site for a period was taken as a starting point.
- These site measured data were then processed by filtering several data points including POA, Meter power, Plant Clipping, Curtailment and Availability.
- Data outliers that were present after filtering were further refined using a linear regression analysis between POA and Meter power to determine the residuals and standard error and removing data that were beyond a certain number of standard deviation.
- Second regression was then run based on ASTM E2848-13 equation using the final filtered data including POA, ambient temperature, wind speed, and meter power to get the Coefficients of regression $(a1, a2, a3, a4)$:

$$P\_0 = E\_0 * (a1 + a2 * E + a3 * T\_0 + a4 * V\_0)$$

  Where:
  P = Meter Power/Energy, E = POA, T= Temperature and V = Wind Speed
- These regression coefficients were then utilized with preconstruction variables i.e., ambient temperature, wind speed and adjusted POA* to estimate the energy forecast values based on ASTM E2848-13 equation again.
  *adjusted POA is preconstruction POA which is tuned down based on differences seen between onsite POA and Satellite POA for the same time.
- This forecasted value is adjusted for POI clipping to get the final forward looking P50 value.
- The final forward looking P50 value is a gross value with 100% availability. Availability loss can be applied based on historical availability and project availability numbers to get a net P50 value.

3. Results

- This above methodology was applied to a few projects listed in the table below. These projects have varying years of operation/COD, different AC capacities and were in different parts of North America.

AC Capacity (MW)	COD	Years of Operation	Preconstruction P50 (MWh)	Forecasted P50 (MWh)	Delta %
80	Jun-21	5	218,673	222,703	-1.8%
56	Apr-22	3.75	163,413	155,016	5.4%
40	Feb-21	5	102,754	97,011	5.9%
150	Nov-20	6	446,990	440,036	1.6%

- Final forecasted P50 for a lot of these sites came close to the Preconstruction value as shown in the delta % and in one case exceeded the preconstruction number.

4. Conclusion

- This methodology includes additional granularity and data variables particularly missed by conventional RBEF methods.
- Instead of relying on monthly operation report (MOR) data, this method allows to use hourly and sub hourly operation data and capture all the filterable events which would have been hard to capture in MORs.
- Additional operational sites needs to be accounted for in this analysis, which will be a future scope for this analysis.