

Title: Benefits from on-site measurements for the purpose of evaluating solar potential

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The market of photovoltaics is growing by 40% annually, which is mainly attributed to the significant technological advancements in the past decade that improved solar module efficiency and brought their price down. But yet, solar is considered a risky investment, due to the high up-front capital needed.

Just like for any other investment, one of the questions that a prospective investor needs to have answer for, is "In how many years will I make a return on my investment?". The answer to that question varies greatly from 5 to more than 20 years and depends on many factors. Some of them include: business model of the project, incentives and support schemes for faster adoption of renewable energy sources, LCOE (levelized cost of electricity) and etc.

Every location has specific energy potential which is dependent on the climate, geographical position of the location, topology, nearby buildings or objects that may shade the modules, sunlight duration and others. To make the most out of the available solar energy, many parameters need to be optimized. The angle and azimuth of the modules are important to capture the available sunlight: fixed, seasonaly adjusted and fully dynamic sunlight tracking solutions are available and every scenario needs to be considered. Optimizing the peak power output of the modules, their technical specifications such as efficiency, type of solar cells (poly-crystalline, mono-crystalline and etc.), specifications and selection of other system components such as inverters is not an easy task.

After selecting the site, the components of the system, the business model on which it will be based on, one needs to estimate the expected power yield from the system.

When calculating the expected power yield from a system, there are many uncertainties in the estimation, but the solar resource estimate is the highest driver to the uncertainty that typically ranges from 5% to 17%. Translated in plain English, how much solar energy is available to be captured at the specific site is the biggest unknown.
There are mainly two types of data from which we can take insights about the solar resource variable: modeled data sources and on-site measurements. Modeled data sources is equivalent to processed satellite images and complex mathematical equations. On-site measurements is referring to sensors that measure solar irradiation such as those typically found at meteorological stations. The solar resource estimate uncertainty can be broken down into several components out of which measurement accuracy (or the accuracy of the models, in the modeled case) is the greatest contributor.

Modeled data sources have measurement uncertainties in the 8 to 15% range. On-site measured data usually have a measurement uncertainty between 2 and 7%, depending on the quality of instrumentation and the frequency of on-site maintenance.

The industry has historically relied on modeled data to estimate the on-site solar resource. One may question why is that the case when it is evident that on-site data are more accurate?The answer is simple, long term on-site measurements are not available for every site. So, a combination of both is used to get a lower uncertainty, comparable to that of long-term on-site measurements while still being widely available for most locations, even when long term measurements do not exist. Short-term quality measurements can be used to correct modeled data sources and improve their certainty. By comparison and validation of satellite based models, the uncertainty can be reduced by 2% to 6%.

Reducing uncertainty correlates with reduced risk of investment, a higher financial viability and a greater confidence about the expected outcome. To be able to illustrate the benefit of the reduced uncertainty in an empirical way, one needs to be familiar with probability of exceedance. P90 and P99 are estimates of the electricity to be generated that have probability to be exceeded 90% and 99%, accordingly. P50 is the most probable value, also called best estimate, and it will be exceeded with 50% probability. P90 is to be exceeded with 90% probability, and it is considered as a conservative estimate. P90 and P99 are the industry standards for evaluating the potential of a location.

A study from Marie Schnitzer et. al. shows that: short-term on-site measurements can increase P90 by over 5%, and P99 by over 10%.

Biography

Damjan Postolovski is a computer science engineer and entrepreneur. He was part of the winning team of NASA Space Apps Challenge 2017 in Macedonia, which later founded the startup Solar Data Collector. The startup has been awarded a grant for R&D and was a SpaceCOM Entrepreneurship summit finalist.

Damjan has been actively participating in the entrepenership community of South East Europe, taking part in events from the region including PODIM, WebIT, EU4Tech and others. His pursuit for innovation is formalized by the European Innovation Academy, which he is an alumnni of.

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