Embracing the future

Digitalisation | As outlined on the previous pages, although still relatively embryonic in the solar industry, big data-based analytics innovations are already being deployed. Representatives from Enel Green Power, Aquila Capital and Pöyry discuss where their digitalisation efforts have so far been focused

Credit: Aquila Capital

Big data and predictive analytics open up new opportunities for solar plant management

Greater scale, greater precision

The growing PPA market will drive greater take-up of big data-based asset management tools, say Saul Butt, investment associate, and Christian Ahrens, head of asset management photovoltaics, at Aquila Capital

Big data and predictive analytics, together, offer a means to apply scalable maintenance solutions with more granular precision, quantifiable insight into operational amendments and early warnings, allowing managers to be more proactive in their duties.

Big data, naturally, is the resource upon which these new insights into PV assets' operational performance is founded. This area has changed significantly on two fronts: 1) the amount of information collected; 2) the variety of data sources becoming available.

The depth of information now available to analysts has increased drastically. The costs of sensors and the storage of data have fallen precipitously over the past decade and consequently a lot more data is being retained in a way which is easily processable. Additionally, more advanced monitoring systems have been included into the system architecture of inverters and sensors are being placed upon each PV panel to test operational performance. This allows the asset manager a very deep overview of the best and worst performing panels in a PV farm and can allow them to undertake further exploration or rectification as necessary.

The breadth of data allows for a more comprehensive understanding of asset performance, whereby aspects such as weather can be considered, allowing a fuller context surrounding fluctuations in production volumes.

With this increasingly detailed historical backlog of information, highly accurate and sophisticated statistical models can be established to develop insights into the key factors driving PV performance. From these models, optimisation initiatives can be implemented or data can be extrapolated into the future to predict the likelihood of events occurring. With probabilistic models in place an expected value calculation can be undertaken to understand whether preventative measures should be completed. This adds value by reducing O&M costs during the lifetime of the project. The closer monitoring of single components allows a better and more reliable tracking of quality issues and reduces spare part cost.

In a more generalised sense, once data is being collected and statistical models are put in place it allows asset management to run automated performance reviews which are scalable, cost effective and should result in improved performance.

We are currently checking the suitability of single-component sensors in field tests, as well as working with component producers to shape the IT environment for our needs. Furthermore, we are in the testing phase for analytical software, with the target of getting on time recommendations for our O&M providers to enhance the performance of our projects.

In a first step, we are going to be better informed regarding the standard issues like soiling and shadow issues, enhancing production and therefore revenue. Furthermore, a tighter monitoring of single components will allow a better quality management. The introduction of the analytics software will indirectly decrease the cost of the asset management, increase the efficiency of the O&M provider and thus reduce the overall O&M costs. In a PPA market, in some cases there is a contractual agreement that the producer guarantees to deliver certain amounts of energy to the off-taker within a given timeframe. The producer has to accommodate a trading capability to act on the spot market. The more the producer is able to forecast its production, the less risk he has to take on the spot market.

Risks

There are of course some risks associated with embracing these new technologies:

1) Insufficient data to establish actionable insights – A fatal flaw in developing any analytics initiative would be to utilise predicted results from a model trained on a limited set of observations. Utilising large data sets is key to establishing a suitably accurate statistical model to generate insights to act upon.
2) Overly complex models – when histori-

cal data is limited, it may appear that utilising larger models with a greater number of independent variables would be a solution to improve the model. However, this could simply be a case of over-fitting the model, where the model itself can very closely model the training data, but would likely not be generalisable on test data or in future occasions.

3) By neglecting the additional costs for implementing and running these new tools, the positive effect can be erased.
4) By implementing these measures, the asset manager is also bound to act on results of the analysis. This requires in some cases additional resources to handle the flow of information and recommendation.

Big data's future

In some years' time, and with a growing PPA market, the big data trend will become more and more significant.

As has been widely discussed the development of predictive analytics and big data will ideally lend itself to more accurate and nuanced predictive maintenance. This could potentially extend to the modelling of the effective lifetime of the asset, such that it becomes clear exactly how long assets on a PV farm will be productive.

Further applications could be based on weather and topographic analysis of PV plant locations. This could allow investment managers to deepen their project due diligence, considering how a project's geographic location or surroundings will likely support its performance.

The use of predictive analytics will be essential in effectively deploying energy reserves as the propensity of battery storage incorporated onto PV plants increases. In order to maintain the rollout of PV projects, the impact of production correlation on market prices needs to be, to the greatest extent possible, mitigated. This will be achieved through appropriately reducing simultaneous energy injection into the grid and increasing it at times of high price or demand.

The increasing number of sensors on plants, along with live streaming of data (likely to improve significantly with the 5G rollout) allows asset managers to be more cognisant of emerging problems and oversee a larger number of plants simultaneously. This should allow asset managers to scale their portfolios without becoming constrained by employee capacity so quickly, allowing for leaner higher margin operations.

Preparing for the digital age

Stephen Woodhouse, Alessio Giuffra and Lynn Dimayuga of Pöyry, and Horst Dulle of Pöyry Management Consulting, look at the many benefits of digitalisation in the solar industry

Digital applications in energy have the potential to transform the sector, by delivering greater efficiency throughout the entire supply chain, by revolutionising companies' relationships with their customers and by unlocking the potential for deep decarbonisation through automating flexibility to match production patterns of renewable energy. The earliest digital breakthroughs are in predictive asset maintenance, improved forecasting and real-time monitoring, and digital tools that aim to attract and retain customers. Drones and UAVs for remote inspections, as well as process mining and text mining, are also helping to improve efficiency. Digital twins allow 'what-if' and predictive analysis to be performed on virtual representations of physical assets. Artificial intelligence is unlocking value almost everywhere it is applied.

While still a nascent technology, predictive asset maintenance is becoming one of the more mature digital technologies in the energy sector – and it tells us important things about the changes to come. Today, predictive maintenance is at the cutting edge, but tomorrow it will be part of a much bigger system. We are still at the cusp of what the Industrial Internet of Things (IIoT) can do.

The guiding star for all "industry 4.0" technologies will be data. The data that these IIoT sensors gather will enable companies to identify and resolve problems remotely, allow engineers to deploy their time more efficiently and, eventually, machine learning might help plants automate simple engineering jobs. It will also allow plant owners to gain insights into their own operations and identify how assets can be used more productively.

Digitalisation in the solar industry is of major importance for different aspects.

Predictive asset maintenance: Simultaneous digital collection of information and data from different power plants across several countries with a certain level of details (strings, inverters, Scada, etc.) can be processed to assess each power plant's behaviour and evaluate any underperforming assets in operation. Big amounts of data can be quickly and accurately processed so that standard maintenance or alternative maintenance approaches can be evaluated and applied to increase each asset's performance. In addition, PV panel cleaning, for instance, can be suggested and predicted by the analysis resulting from a comparison of energy losses in a specific moment with cleaning costs.

Centralised control room: One of the most important deployments of digitalisation in the solar industry is related to the creation of a "centralised control room" (CCR), allowing for operation supervision of each power plant by remote in real time through a centralised, dedicated team with a comprehensive data analysis tool available to hand. One of the main advantages is that you will be able to plan maintenance, specific site visits and inspections, and avoiding permanent workers or staff at site, overall vastly increasing the site's performance. During the inspection by local staff, a virtual remote camera mounted on their helmets or glasses will facilitate the supervision remotely and allow a quicker and more effective identification of issues and subsequent solutions.

One more useful application is the use of drones in order to provide visual inspections and thermo-camera analysis, helping international experts to identify all critical panels without necessarily visiting the site.

Big data analysis for energy trading: Analysing big amounts of data is useful for clusters of PV plants. For example, intraday meteo forecast (15-20 minutes) and expected power production compared with declared power production will be used to reformulate strategies to sell energy in the market and gain better revenue.

Incremental steps

Naturally the focus of these technologies should not be the technology itself, but rather the expected outcome. Utilities are looking at improving their predictions, minimising costs or reducing downtime, and want to empower the business functions to engage with technology to find the most suitable solutions. When we work with customers along their digital readiness journeys, we often see that the first steps that help business units discover new technological capabilities relate to small process improvements. Only once a broader group of key personnel has gained first-hand experience can these organisations improve key services or even business models.

Data analytics and predictive analytics technologies can add value in a wide range of applications throughout the value chain, from customer segmentation to operational excellence, from dispatching optimisation to operations and maintenance support. Different organisations and often different departments have adopted quite a range of innovative approaches to help them solve their specific needs. Most of the time the issues are very similar, but the current situation is very different from one organisation to another and solutions that add great value in one organisation are not necessarily suitable for another. A key success factor is therefore more about driving quick and effective progress and unlocking innovative ideas.

When working on digital transformation with our clients we don't see the biggest disruption from off the shelf solutions, but rather from innovative initiatives that empower the digital literacy of the entire organisation.

We conduct a "digital readiness check" to show a company where it is in comparison with best practice in the market. These results help identify measures that can elevate an organisation to high-performance status via digitalisation.

Drivers of change

Digital investments in the solar industry should start in the private sector and normally they are always driven by the biggest international IPPs or funds interested in increasing their revenue. In the PV sector, and in those countries where grid parity has been reached such as Australia, Germany, Spain and Italy among others, the convenience of increasing revenues from a more accurate and precise maintenance and operation, as well as a better selling strategy become of fundamental importance. This will undoubtedly be the driver of change in the solar industry, with significant investment predicted over the next couple of years.

Better results, lower costs

Luigi La Pegna, head of operation and maintenance, Enel Green Power says digitalisation is helping the Italian developer improve O&M processes while reduce operating costs

Digital technologies, together with even more sophisticated cloud computing capabilities and analytics, all present emerging opportunities to reduce operational costs and to increase asset performance as well as safety for workers.

The standard Enel Green Power solar O&M process is already highly digitalised. Our monitoring systems measure and process, in real-time, a huge amount of operative data from small- and large-scale solar plants. Advanced software (Computerised Maintenance Management System – CMMS) is also used in the management of operational data (interventions, reaction and resolution time, cost of interventions, logistics, etc.) with the aim to improve time of operation and maintenance of our asset and, finally, to reduce overall operative costs.

We use drones to capture visual and infrared thermal images of modules, wiring and other plant components. These data are stored and processed to detect anomalies and trends.

We are working on the development of algorithms to predict module degradation, component failure (at inverter or combiner box level) and, in general, to predict as much as possible all unplanned interventions and maintenance, with the main purpose to reduce the number of periodical visual inspections.

Specifically, we are using sophisticated algorithms developed internally that are able to predict soil quantity and debris on solar panels and to optimise cleaning.

Operational costs, performance improvement, Health, Safety and Environment (HSE), as well as sustainability are all key to addressing the implementation of every kind of innovation in our O&M processes. Big data and analytics are expected to generate improvement in all the above mentioned areas.

Advanced Internet of Things platforms and low-cost wireless technology can boost data collection at plant level. However, the solar industry is not currently fully leveraging on big data and predictive analytics, which are the only systems allowing for the operation of new, large-scale solar plants. In most cases, the main obstacles to widespread adoption of these innovative technologies are plant connectivity, which is difficult to extend to the full power units when the solar plant is spread across a wide territory, and the availability of reliable equipment at reasonable cost.

At Enel Green Power we are working on a programme called "Ro-boost", with the aim to increase the development and implementation of automated and robotic applications in O&M processes, not limited to solar projects. These applications include fully autonomous drones, cleaning robots and grass cutting machines. As such, our projects will employ an increasing number of "digital workers" through mobile technologies and smart glasses applications. Furthermore, technologies like augmented reality or virtual reality will support training programmes and will help best practice sharing. ■

Credit: Enel Green Power

Enel Green Power is developing algorithms to predict all unplanned interventions and maintenance across its PV fleet