Historic Salt Production Plant Transformed into Solar Power Goldmine

Case Study

The Challenge

When Shinfox Power renewable energy investment firm decided to finance one of the largest utility-scale PV plants in the world, they searched for a PV system with the maximum energy output and the lowest operating costs, to secure the highest long-term return on their investment.

Shinfox Power, a subsidiary of the Foxlink group, develops, constructs and provides O&M services for renewable power plants, wanted to take advantage of a Feed-in-Tariff (FIT) incentive program offered by the Taiwanese government. They signed a 20-year lease agreement for a vast piece of government-owned land for constructing a 77 MW PV project for generating renewable electricity. This enabled Shinfox Power to sell the electricity produced by the PV system to the utility company, in return for 20 years of revenue.

The plot, spanning 559,705 square meters (the size of 78 soccer fields) just outside of Tainan City in southern Taiwan, is near the popular scenic spot of Qigu Mountain, a 300-year-old abandoned salt production plant.

Shinfox Power needed to address the following challenges before choosing the most suitable PV system components:

- **Maximizing energy production:** module mismatch at a site of this magnitude can result in significant power losses. This could be due to coverage by clouds and sand carried by strong sea winds; soiling from migratory bird droppings; and other common reasons like thermal mismatch and varying module degradation.
- **O&M:** complex maintenance of the PV modules is a massive undertaking at solar farms with such large PV arrays.
- **Electrical hazard:** The safety of maintenance crews was a major concern, due to heavy rainstorms during the East-Asian rainy and typhoon season. During these torrential rainfalls the site becomes a huge retention pond that can hold more than 130K cubic meters of rainwater, which helps limit overflowing of the surrounding streams. However, when floodwater reaches knee level or higher, this poses the risk of electrocution.

The Solution

The SolarEdge DC optimized solution was selected for its proven ability to maximize energy yield. The site was designed with inverters and Power Optimizers—the latter continuously tracking MPPs (Maximum Power Points) and adjusting current and voltage at module-level, which maximizes energy production. Furthermore, SolarEdge's advanced PV Monitoring Platform was chosen for its proven ability to save O&M costs.

System Details

- **Capacity:** 77.52MW
- **System owner:** Shinfox Power
- **Inverter:** 674 X 100KW Three Phase Inverters with Synergy Technology
- **Power Optimizers:** 57,000 X M1600 POs with 1:4 configuration
- **Modules:** 340W ANJI Modules/URE x 22,800
- **System type:** ground-mounted utility-scale system

Reducing Module Mismatch Yields More Energy

The SolarEdge solution maximizes energy output by minimizing power losses caused by module-mismatch, which in such a large PV array, where many thousands of modules are affected, could lead to significant revenue loss.

With SolarEdge's Power Optimizers, underperforming modules do not affect other modules on the same string, which results in higher energy production. By contrast, when using central or traditional string inverters, any underperforming module reduces the output of all the other modules on the string.

SolarEdge's built-in module mismatch mitigation mechanism maximizes energy, addressing numerous scenarios attributed to factors, such as:

- **Partial shading** from clouds, dust from the saline soil, and large amounts of sand carried by the strong South China Sea winds, especially during tropical cyclones, accumulate on the modules. Soiling is intensified further due to the site's location along a main migration route where flocks of migratory birds leave their droppings. All these factors could cause a "hotspot effect" on modules, where cells overheat when the current cannot flow around weaker cells, decreasing module performance.
- **Thermal mismatch:** A module's surface temperature is a key factor that impacts its output power. The lower the temperature of a module's surface, its output current increases exponentially, and vice versa. This could affect output efficiency by up to 10-25%. Furthermore, temperatures may differ among modules depending on their locations, e.g., in the center or at the edge of a row, which results in variances in efficiency and output of different modules.
- **Uneven module aging:** Over the 20-year FIT period, modules will inevitably degrade at different paces due to normal wear and tear, resulting in mismatch related power losses. Most PV module manufacturers specify that within the warranty period, degradation reduces the power output of each module by as much as 20%. Output drops at various points in time cause mismatches in a string, which may result in inconsistencies in production.
- **Micro-cracks**: Modules are subjected to thermal and mechanical stress due to fluctuating temperatures and heavy winds, which cause micro-cracks (or micro-fractures) in the silicon wafers and decreases power generation.

Saves O&M Costs with At-a-Glance Troubleshooting

SolarEdge Monitoring Platform, accessed remotely from any laptop, receives granular data from the Power Optimizers, each automatically tracking the performance of every four modules and of the inverters. By receiving real time notifications, O&M personnel can quickly pinpoint and identify faulty modules and troubleshoot remotely, which translates into fewer and shorter site visits. It also spares additional costs of thermal imaging drone cameras typically used at these vast sites for inspection and diagnostics of PV panels, potentially saving up to 50% in overall O&M costs.

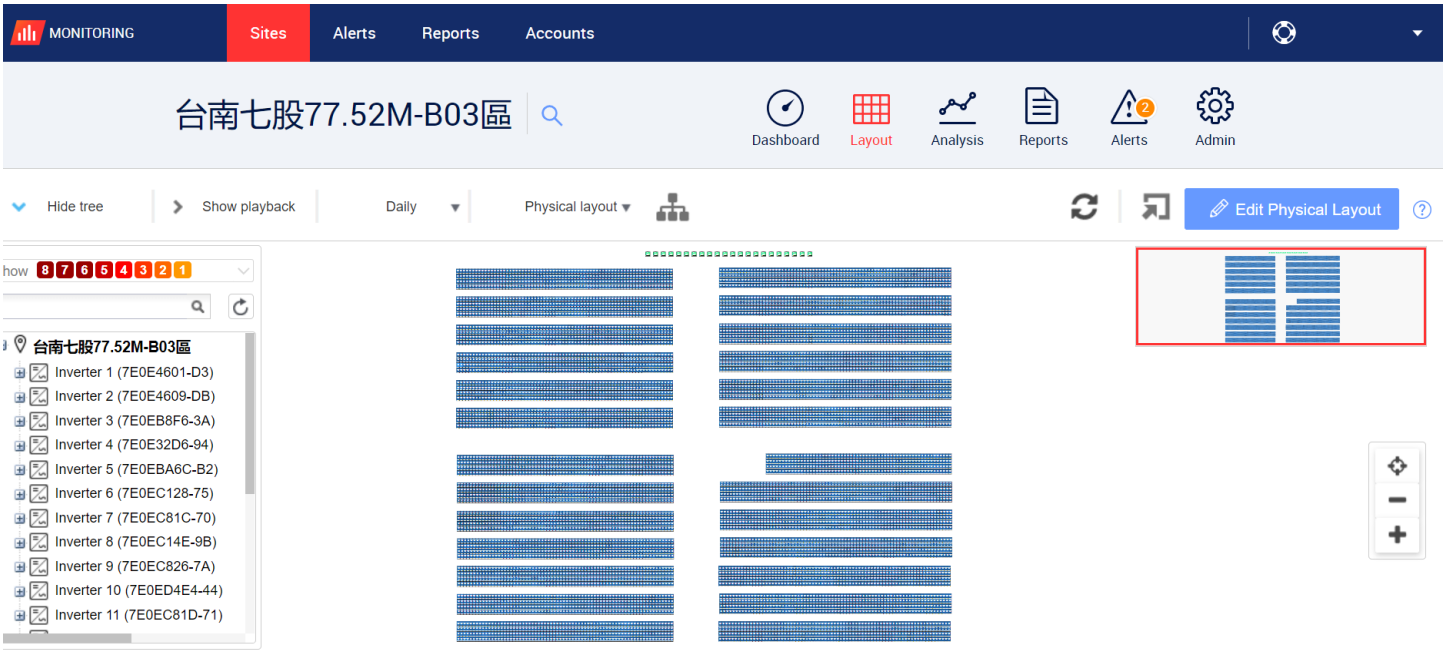

Fig 1: SolarEdge's module-level Monitoring Platform showing a physical layout of one of the 30 subarrays of this huge ground-mounted site, each with 2.5 MW capacity.

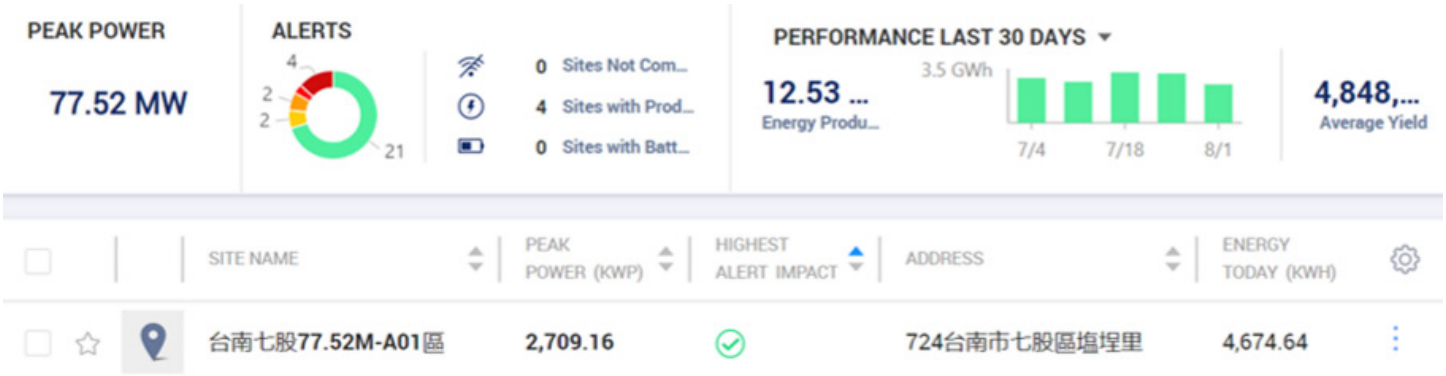

Fig 2: The SolarEdge monitoring dashboard provides alerts color coded by severity level, enabling more efficient and advanced remote troubleshooting.

Additional O & M costs are spared, due to the modular design of the Three Phase inverter with Synergy technology. Accordingly, if one inverter unit fails the others are unaffected, and will continue to operate independently until the faulty unit is replaced. Moreover, these units are lightweight, so if a replacement is needed, it can be lifted by two people, without the need of using a forklift. Conversely, the maintenance of string or central inverters can be costly, as they require special expertise and equipment.

Reduced BOS Costs by Supporting Longer Strings

The SolarEdge solution provides greater flexibility when it comes to design, as it enables the connection of up to 60 modules per string. This saves on DC cabling costs, combiner boxes and fuses, and reduces incidents of insulation faults associated with moisture (which is common in warm and humid climates) resulting potentially in up to 40% increase of BOS savings.

Keeping People and Assets Safe

A major concern of the system owner were the torrential rainstorms and flooding especially during the rainy season, posing a risk of electrocution to maintenance crews. SolarEdge technology, safe and reliable by design, complies with stringent international safety standards. The SolarEdge IP65-rated inverters are water and humidity resistant with a wide ambient temperature range, and they comply with the UL 1699B standard for Arc Fault Circuit Protection. In addition, the built-in SafeDC™ feature can automatically drop the output voltage of each module to a touch-safe level of 1V within up to 5 minutes, which provides extra protection to maintenance and firefighting crews. The automatic Arc Fault Detection prompts the inverter to shut down when an arc fault is detected, reducing the risk of fire due to faulty or improperly connected cables.

Fig 3: Tainan PV site flooding during the rainy season

Fig 4: SolarEdge Power Optimizers connected to PV modules enable optimized energy output of the system

Long-term Warranty

SolarEdge provides its standard industry-leading 12-year warranty for the inverter, extendable to 20 years, and a 25-year warranty for Power Optimizers, which spares Shinfox Power extra costs on replacing the inverters for the system's lifetime.

The Bottom Line

Utility-scale installations provide a fast, efficient and sustainable way to meet renewable energy demands. This trend is accelerating in recent years as a result of declining PV system costs, decarbonization targets being enforced in many countries, the growing need for energy independence from fossil fuels, and rising energy prices.

When investing in large-scale solar plants, it's essential to choose a technology that will maximize profitability in the long-term by increasing the output of each module and reducing BoS costs and O&M costs.

About SolarEdge

SolarEdge is a global leader in smart energy, delivering innovative commercial and residential solutions that power our lives and drive future progress. Leveraging world-class engineering and worldwide experience, SolarEdge developed a ground-breaking intelligent inverter solution that changed the way power is harvested and managed in photovoltaic (PV) systems. As a result of this and other innovations, today SolarEdge is the world's #1 solar inverter company in revenue with millions of systems installed in 133 countries. SolarEdge addresses a broad range of smart energy market segments through its PV, storage, EV charging, battery, and grid service solutions.

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