

The have-it-all synergy between monitoring & aerial data for solar PV

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Every company that owns solar plants wants to generate the highest return. In order to achieve this, the system's maintenance teams need to constantly ensure the optimal functioning of all system components, especially the panels and inverters. A solar monitoring system enables you to be informed of your PV system's performance.



The industry standard: solar site monitoring

It offers information about energy consumption and generation as well as possible damage to your solar system. It's important to monitor your solar assets in some manner. Without monitoring, it is impossible to determine if your solar panels are operating at their full capacity.

While system monitoring is considered a

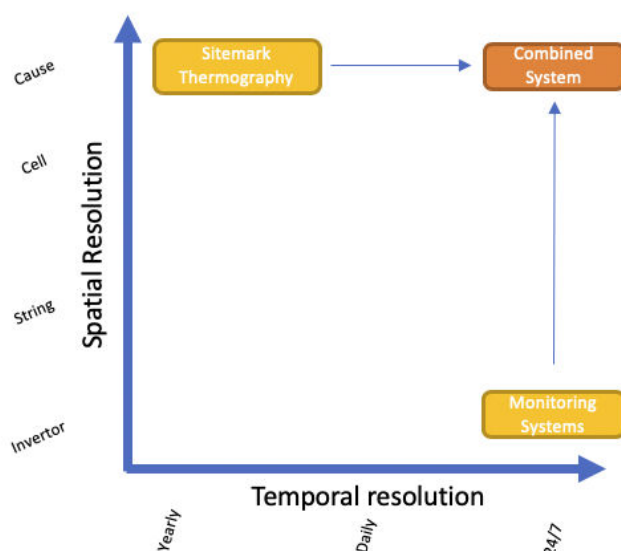
minimum requirement, detecting and identifying panel faults in large solar systems can be a complex process. Monitoring systems help detect low-performing areas, but finding the specific panel that harms the string output requires more time and advanced testing devices. By utilizing the best of both worlds with system monitoring and aerial data inspections, asset owners can improve the performance of their systems and maintain yields over time.

How does the addition of aerial inspections fill these gaps?

The solar PV system is a yielding asset that should provide investors with a maximum return every year. Detecting and addressing poorly performing panels through visual data inspections and analysis helps maintenance and asset managers maintain site performance for the system's lifetime. So how do you streamline the process and manage your solar assets effectively? Aerial site surveys with their software analytic tools are the most reliable, comprehensive and cost-effective approach.

Drone inspections that cover 100% of the modules with a thermographic scan are the most efficient way to get a complete analysis of a site, and to identify what the monitoring systems cannot. As a cost saving measure, it is currently becoming less common to do string monitoring. Without string monitoring, it is particularly important to have the thermal drone scan. However, even with string monitoring, locating the weakest module on the string in utility scale projects is a difficult and often inefficient mission. But by using aerial data gathered from drones, now the asset owner can prioritize corrective maintenance in conjunction with the O&M.

If inspections don't cover 100% of the



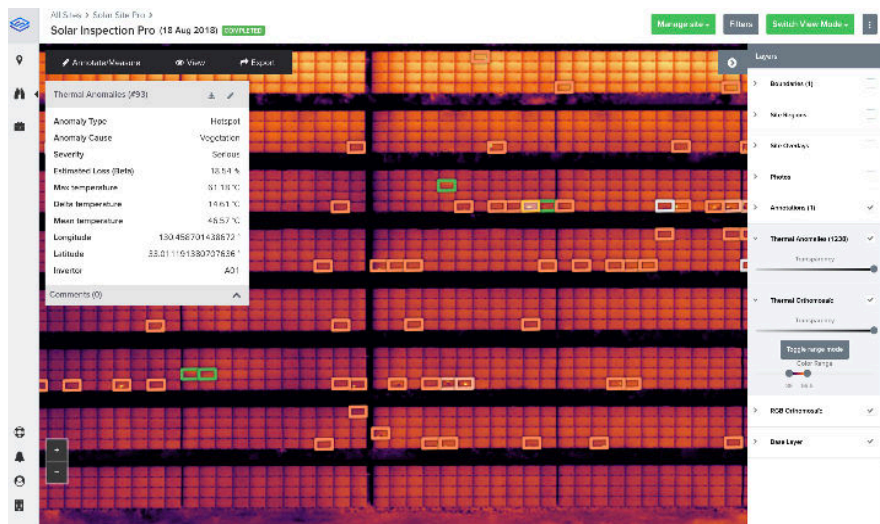
modules or produce a snapshot-in-time report, you are unable to track the history of inspections and compare them year over year.

By using visual data technology and a web platform, comparing history is simple and you have a verified track record performance of the site. Capturing and visualizing the aerial data is not about drones but taking data science to the next level. Since working with an aerial data platform enables users to compare inspections side by side and over time, you can make a verified assessment of the health of your site.

Real-world examples using this synergy as a service

The EU's largest solar PV asset owner is Enerparc AG. Enerparc has been closely following the rapidly developing landscape for aerial inspections and platforms available for managing PV sites. In 2020, over one GWp of their solar assets will be inspected by drones equipped with high resolution visual cameras and thermographic sensors.

The captured aerial data will be processed and analyzed using the Sitemark Fuse platform. Powered by AI, the platform identifies and analyzes PV module anomalies at the cell, module and string level. All while offering state-of-art features that optimize maintenance work and ultimately, result in



Thermal view of a solar site with anomalies identified and analyzed

greater portfolio returns.

Another pertinent example is GiraSol Renewable Energy, a leading consulting firm that covers multiple services for the PV and Renewable Energy market in Israel.

Girasol recently performed an aerial thermographic scan for a client's rooftop site. After gathering and uploading the images, over 200 panels with different faults were found. Among the faults were single

hotspots, multi-point hotspots, and single or double broken bypass diodes. What is interesting is that the customer had noticed the low performance of the system from their monitoring system, even before the aerial scan. But now, through the web platform, they were able to obtain a complete snapshot of the site. The most important being an estimate of the loss of production due to the faults. Through this information, the customer began a claim process with the panel manufacturer.

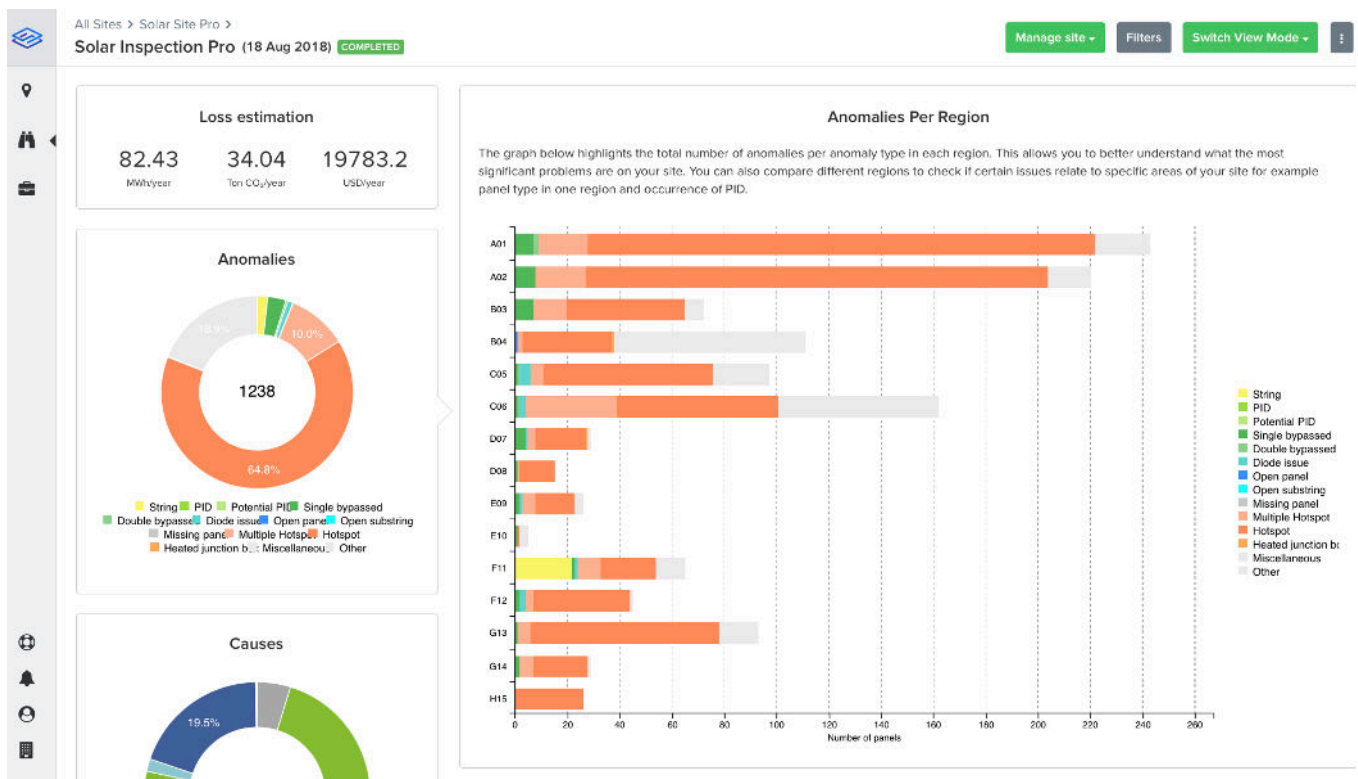
The aerial data analytics platform is capable of analyzing most common faults on the solar site including PID, inactive strings, hotspots, bypass diode faults and panel connection boxes defects. All the gathered data is available to the user via a web platform on a map configuration of the site. The faulty panels are detailed on the map and the original site design can be uploaded and layered so maintenance teams know the exact location of the faulty panels. This allows the fault handling to be prioritized according to the cost severity and areas of the site that are underperforming.

This analysis is automated and filtered for the user. With the web platform and a mobile app, the technicians that do the corrective maintenance don't need to search through the original plant diagrams to determine location of the defective panels in order to replace them or make any repairs. This makes their work much more efficient, an added value for both the O&M and Asset owner.

Evaluating your aerial data options

If your objective is to capture and visualize the most accurate and quality output available in the industry today, then a full visual and thermal orthomosaic of your site is





your best option. Ensure no anomalies are missed with easy auditing of the detection quality. The final report includes deeper context into your site such as loss estimation and cause classification for a single source of truth.

Another choice, ideal for larger sites is a photo-based data capture solution which locates site maintenance issues and their causes on a photo level. Acquiring the data is faster, enabling cost efficiencies especially for the larger sites. The final report also includes critical context into your site's health providing a single source of truth.

Both options are suitable for O&Ms, EPC contractors and asset owners. The bottom line and true benefits come from the thermal scan. While the visual RGB is interesting and helpful, it offers no insight into the productivity of the actual panels. Additionally, even with a basic report listing poorly performing panels, without analysis of the defect and priority by loss estimation, it is very difficult to determine what is urgent and what is just 'nice to have' regarding site health and optimization.

What exactly does an aerial site inspection deliver?

- Drone-captured visual and thermal single images
- Geo-located solar anomalies, each including:

- Thermal cause classification in 12 categories i.e. open string, PID, Potential PID, single bypassed substring, double bypassed substring, diode, open panel, missing panel, multi hotspot, hotspot, junction box, unknown
- Visual Cause Classification in 9 categories i.e. soiling, physical, vegetation, unknown, fuse, shadowing, dropping, inverter, wiring
- Temperature deltas
- Loss estimation
- Link to source visual and thermal image

Conclusion

All stakeholders in the solar site lifecycle have the same goal - maximize yield over the lifetime of the asset. Ideally, you need to be evaluating the health of your site from the data and basing your decisions on a single source of truth. Even after panel faults and anomalies are identified, you need to prioritize and correctly evaluate the urgency for repairs, which can be especially challenging with larger sites. For optimal yield, the complementary pairing of site monitoring plus annual aerial inspections delivers the most efficient and cost-effective approach.

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Sitemark

Sitemark is a world-leading aerial data analytics company active in over 30 countries within the energy, construction, mining and agricultural industries.

Through the use of aerial data, Sitemark is advancing the development of ground-breaking technologies and artificial intelligence that fuse the physical and digital worlds.

Our products and services enable users to improve their understanding of their assets and make better decisions while increasing the efficiency and profitability of their field operations.

Girasol

GiraSol Renewable Energy is a leading consulting company covering multiple aspects of the PV and renewable energy market in Israel.

Girasol's mission is to empower its clients to extract the best performance possible from their renewable energy investment.

To achieve this goal, Girasol has partnered with leading global companies to provide the highest quality products and services to the PV industry.