



PERCEPTO

AUTONOMOUS DRONES FOR EFFICIENT AND SECURE SOLAR ENERGY PRODUCTION



REAL-WORLD PERCEPTO SOLAR SITE BENEFITS*

90%

site inspection
time savings

\$670K

annual O&M
cost savings

1100mWh

added annual
production

1400

additional
homes powered
per year

*based on actual data for a 50MW solar farm

The renewable energy generation promises a cleaner, brighter energy future, and thus governments have placed ambitious goals and binding renewable energy targets. However, solar parks around the globe face several critical challenges. The common remedies fall short in the face of the massive scale of today's solar arrays, whereas autonomous drones are increasing the security and productivity of these solar energy farms.



SOLAR INDUSTRY

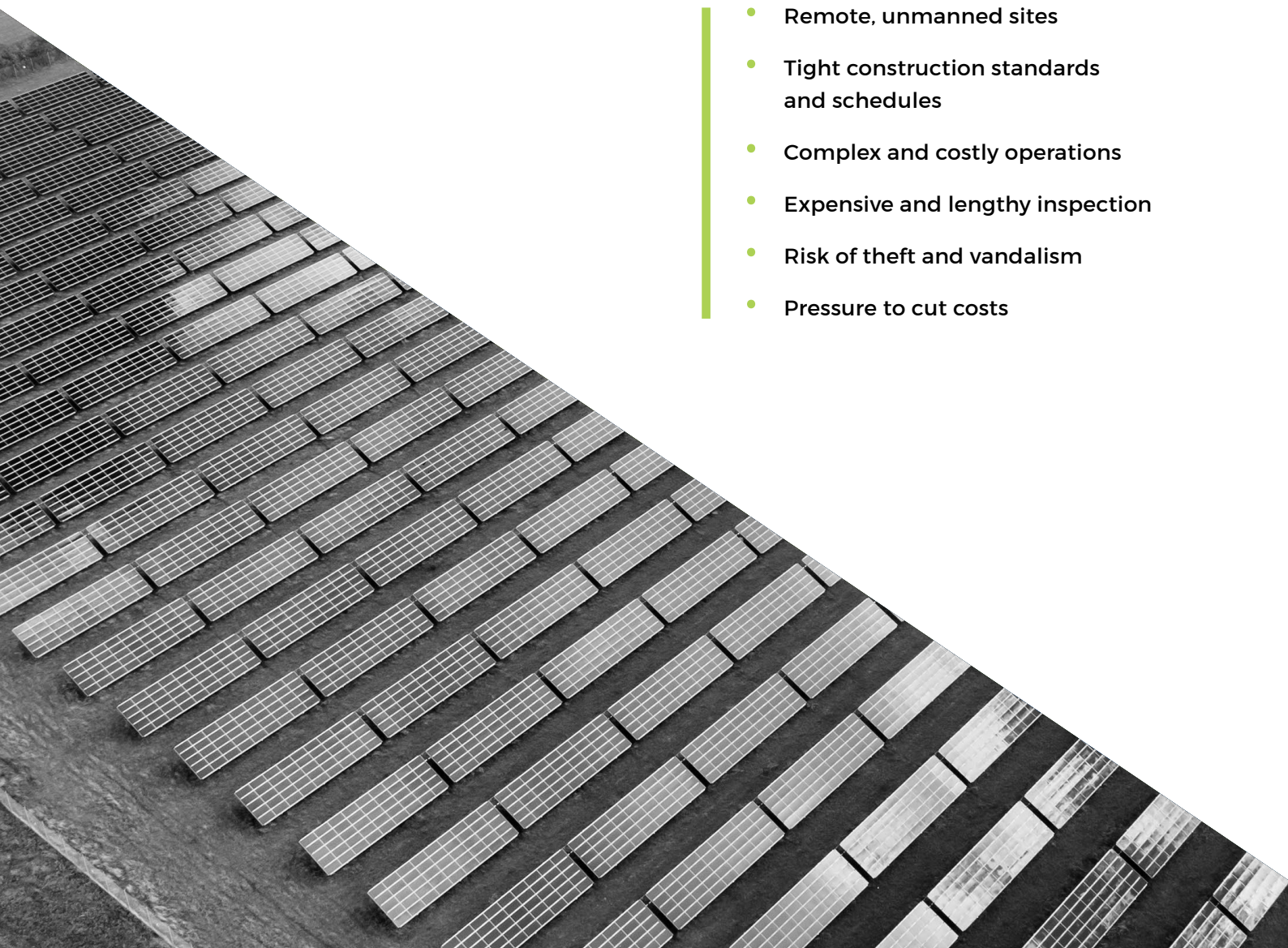
Solar energy has become one of the most important global sources of renewable energy. Less costly than nuclear, coal, or combined cycle gas turbines – utility scale solar farms are being built around the world.

In these solar parks, the promise of solar power encounters the challenge of large-scale operations in harsh environments. Typically located in remote, unmanned sites and spread over large geographic areas, solar park operations are complex and expensive due to stringent construction requirements and the needs for regular inspection and maintenance. Solar park equipment is susceptible to mechanical and technical failures, as well as wear and tear.

Moreover, solar equipment is costly - increasing the risk of unauthorized access, vandalism and theft. At the same time, solar energy providers are under immense pressure to improve efficiency and lower CAPEX and OPEX. To this end, operators are seeking solutions to safeguard their technology investments while maximizing energy output. Such solutions must address not only security and safety but also operations. They must also easily scale to accommodate future demands, and be sufficiently flexible to integrate with diverse systems and sensors.

SOLAR FARM CHALLENGES

- Remote, unmanned sites
- Tight construction standards and schedules
- Complex and costly operations
- Expensive and lengthy inspection
- Risk of theft and vandalism
- Pressure to cut costs





EXISTING SOLUTIONS FALL SHORT

Until recently, solar farm operators relied on either manual equipment inspection or piloted drones to monitor key points of failure in large-scale solar installations. Yet these solutions fall short in the face of the massive scale of today's solar arrays:

MANUAL INSPECTION

Teams of field engineers physically connect meters to individual modules, searching for underperforming components.

MANUAL INSPECTION SHORTFALLS

- High cost of employment: requiring teams of skilled technicians.
- Long duration: in industrial scale solar farms a facility-wide inspection can take months or even years to complete.
- Revenue loss: significant revenue can be lost due to undetected module failures that reduce output.

PILOTED DRONES

A human-piloted drone equipped with cameras scans the site for defects, identifies issues and collects data.

PILOTED DRONE SHORTFALLS

- Monitoring drones is labor-intensive.
- Consistency and quality of inspection is subject to operator error, potentially leaving serious faults undiscovered.
- Drone service is expensive: a single day of monitoring for a solar farm site can cost thousands of dollars.
- Manual piloted drone systems generally lack a central data repository for comparative analysis.
- Rely on third party software or on manual analysis of captured data.

8 WAYS AUTONOMOUS DRONES MAKE SOLAR FARMS MORE PRODUCTIVE AND SECURE



Providing optimal awareness from the air, on-site autonomous drones enable automatic, continuous oversight of even hard-to-reach areas, according to predefined scenarios and schedules.

Percepto's autonomous drones support the entire site life cycle, which can span decades - from monitoring construction to ongoing production, and including site decommissioning. Offering multi-mission operational versatility, the same Percepto drone ensures solar site efficiency while also conducting security and safety missions based on real-time computer vision and built-in anomaly detection.

1

SAFE, CONTINUOUS, EFFICIENT SITE CONSTRUCTION

Ambitious and binding renewable energy targets have resulted in massive construction of solar farms, and contractors are under pressure to complete construction and move to production in record times. Facility commissioning dates are fixed, and delays in solar farm qualification and acceptance can result in high penalties.

Percepto's autonomous drones drive CAPEX savings during solar farm setup, enabling safer and more efficient construction, and facilitating site delivery and acceptance by:

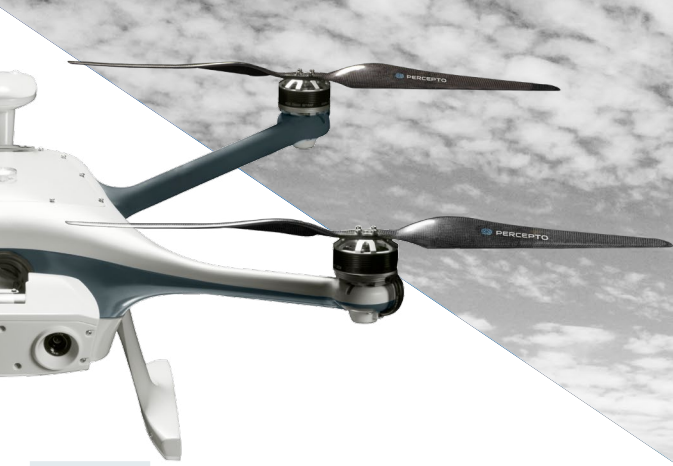
- Monitoring actual construction progress on a daily and hourly basis to optimize construction.
- Detecting safety issues during construction - which involves multiple workers operating heavy equipment.
- Providing aerial data during construction and positioning of photovoltaic panels (PV), surveying and terrain mapping.
- Providing timely alerts of construction bottlenecks to enable corrective action that minimizes delays.

2

WARRANTY ENFORCEMENT

Solar panels are a significant and long-term investment which is covered by warranty, as well as production and performance guarantees. Consistent aerial monitoring can ensure warranty coverage and support warranty claims, by:

- Efficiently providing end-of-construction inspection reports confirming panel integrity and proper operation.
- Mitigating risks of undetected faulty equipment, breakage or underperformance that might affect warranty coverage.

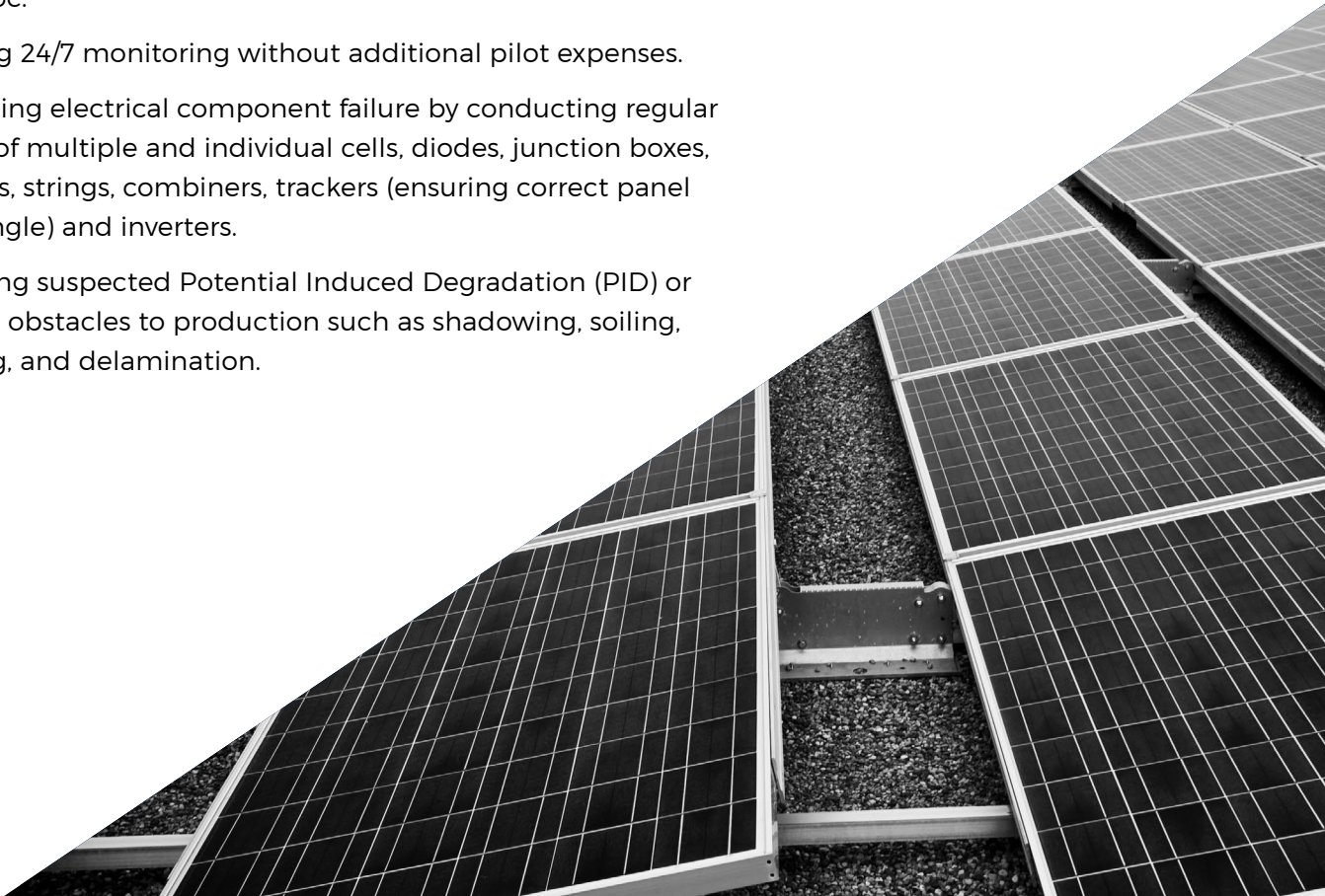


3 CONTINUOUS MONITORING OF SITE PRODUCTIVITY

Operations and Maintenance (O&M) for industrial solar farms is complex and costly. Where the need to control CAPEX in the construction phase is clear, tighter operational monitoring and control can have a major impact on the OPEX of solar energy production.

Autonomous drone systems offer better maintenance and fault detection at a lower cost – reducing overall site OPEX and turbocharging ROI. Percepto's autonomous drones feature a **DUAL PAYLOAD** that enables **COMBINED VISUAL, THERMAL AND RADIOMETRIC** solar panel monitoring and detection for:

- Ensuring optimal temperature, angle and reception.
- Conducting frequent inspections - regular, pre-planned or ad-hoc.
- Enabling 24/7 monitoring without additional pilot expenses.
- Minimizing electrical component failure by conducting regular checks of multiple and individual cells, diodes, junction boxes, modules, strings, combiners, trackers (ensuring correct panel tilt or angle) and inverters.
- Mitigating suspected Potential Induced Degradation (PID) or physical obstacles to production such as shadowing, soiling, cracking, and delamination.





4 IMPROVING RESPONSE THROUGH INTEGRATION WITH SCADA AND SMART METERING SOLUTIONS

Solar farm operators may already use an array of systems to detect flaws in operations and safety. Percepto's solution seamlessly integrates with these systems to:

- Deliver root cause analysis for a problem or failure reported – identifying which specific panel and cell are causing an issue detected by another system.
- Provide real-time visibility and situational awareness.
- Enable more efficient investigation of problems and use of resources dispatched to service faulty components.

5 AUGMENTING SITE SECURITY AND SAFETY

Solar panels are prone to theft, as are the expensive equipment and copper used in solar farm operations. Additionally, operating mechanical equipment in often harsh weather conditions entails considerable safety risks. Autonomous drones enhance solar farm security and safety by:

- Conducting pre-scheduled automatic security patrols - increasing patrol frequency without raising costs.
- Providing threat assessment via dynamic video stream rather than fixed cameras, while fully integrating with existing VMS systems.
- Triggering intruder alert and deterrence measures.
- Offering early detection of safety hazards like fire.
- Decreasing employee risk in inspections of hard to reach locations or dangerous infrastructure.

6 HEIGHTENING WEATHER AND ENVIRONMENTAL AWARENESS

Percepto's drone solutions contribute to sustainability and the reduction of environmental impact by mitigating risks related to solar farms, including:

- Early detection of weather conditions such as site flooding.
- Lower risk of wildlife damage to production by nonlethally deterring birds, bats and other wildlife with periodic drone missions.

7 FACILITATING EVENT RESPONSE

Enhanced event detection provides better ability to respond, including:

- More immediate responses to both routine and emergency needs.
- Smart response using real-time machine vision and artificial intelligence (AI), on-demand or via integration with third party systems like smart fences.

8 PROVIDING INTELLIGENCE AND CUSTOMIZED REPORTS

Percepto creates a centralized cloud-based archive of mission data that is accessible to all stakeholders, and also features:

- On-board intelligence and computational capabilities that continuously collect and archive data.
- Analytics that provide data for baselining and process improvement.
- Customizable reports generated at the end of each mission - providing per case, per period or trend reports.



USE CASE SCENARIO

An industrial solar company in South America adopted Percepto's autonomous drone solution to regularly conduct automated PV inspections. A routine mission is described below:

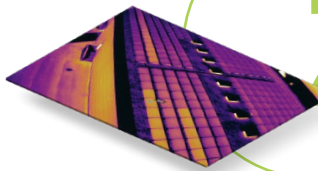


1

The Percepto Sparrow is launched from the Percepto Base and flies the defined area of the solar farm.

The dual payload is active and provides rich data: several hot cells are spotted, as well as a hot junction box. The thermal camera also detects a solid line of elevated temperature.

2

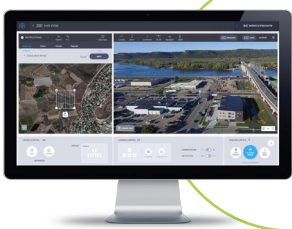


3

PerceptoCore analyzes the data. The location of the hot cells and junction box is tagged, and the 4K RGB camera provides real-time visual confirmation of the issue; the solid line is analyzed to indicate a String Out situation. An automatic alert is sent to the technician along with a photo and the exact location.

The operator receives the data and sends personnel to the location of the faults found, taking action accordingly.

4



5

Data is automatically shared with all relevant shareholders without need to manually download from various systems.

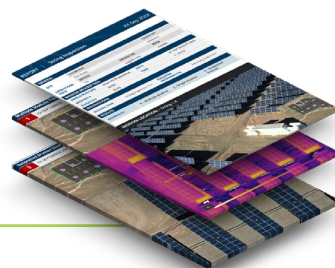
The drone returns to the Percepto Base. All data is downloaded including visual images and video in full resolution.

6



7

Automatic reports are created and stored for future reference.





ABOUT PERCEPTO

Founded in 2014, Percepto is the market leader of on-site autonomous drone solutions for critical infrastructures and industrial sites. Operating with no need for human intervention, Percepto's autonomous Sparrow drones perform multi missions, around the clock. The solution is ideally suited to any large-scale enterprises looking to improve security, increase productivity, and reduce safety risks and operational costs.

Organizations using the Percepto solution are better aware of events taking place, allowing them to be proactive and more efficient in addressing risks and operational needs. The Percepto solution is currently in use around the world including Enel in Europe, as well as a number of Fortune 500 organizations. The company is the recipient of the Frost & Sullivan Global Enabling Technology Leadership Award.

For more information, please visit www.percepto.co