

CASE STUDY

Increasing Solar Inspection Efficiency with Drones

Introduction

UAV technologies provide operational efficiency gains to solar asset management. To quantify these gains, Measure compared time, costs, and results of its **100% IR drone inspections** to relevant manual inspection scenarios across four sites. These comparisons yielded the following results:

Drones Increased Efficiency by 97%
Drones Saved an Average of \$1254/MW

Test Site Descriptions

SITE 1: Preventative maintenance of 74MW in Sunrall, MS
 Comparison: Clamp Testing with 20% IV Curve Tracing Testing

SITE 2: Preventative maintenance of 30MW in Spargue, CT
 Comparison: Voc/Isc Testing at the Combiner Box with Visual Inspection

SITE 3: System Commissioning for 21MW in Rincon, GA
 Comparison: 100% handheld IR scanning with 15% IV Curve Tracing Testing

SITE 4: System Commissioning for 12.5MW in Herald, CA
 Comparison: 100% IV Curve Tracing Testing

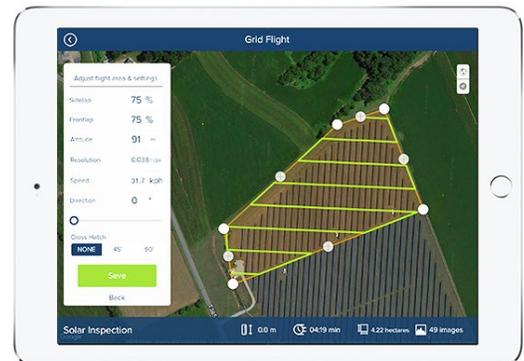
Test Site Conditions

Vetted environmental factors ensure the highest quality thermal data.

- Site Irradiance greater than 600 watts/m²
- Wind speed less than 15 mph
- Cloud cover less than 2/8ths
- Panel orientation 5° – 60°, where 0° is horizontal
- Solar noon with adjustments made to minimize site shading

Data Collection

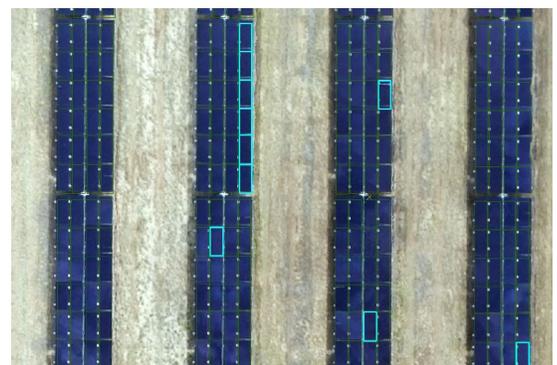
Grid flight parameters using high overlap settings and high capture frequency are required to create quality orthomosaics. Adjustable settings include altitude, overlap, image ratios, file format, and thermal camera gain setting.



Each site is flown twice, using different sensors and at different altitudes. One flight collects RGB imagery, while a second flight collects thermal imagery. **Drone inspection time is 10 Min/MW.**

Data Engineering

RGB and thermal data sets are combined and defects are detected using automated processing and manual review. The process includes outlining each individual panel, the identification and geo-location of thermal anomalies, and manual quality control and defect classification. Defect reporting categories include hot spot, sub-module, module, partial string and full string.



Data Delivery

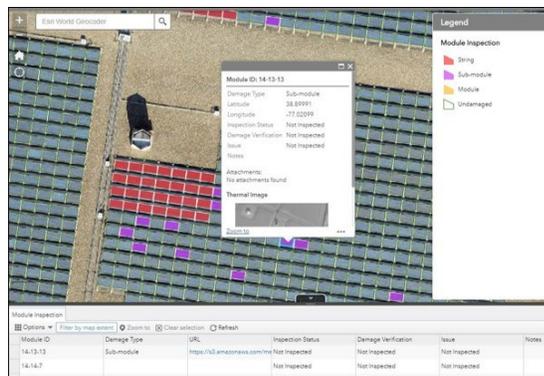
Following processing and analysis, data is delivered to the client in a user-friendly, actionable format.

Total time from data collection to data delivery is less than 5 business days.

PDF Inspection Reports: High level, punch list summaries of inspection results.

Online Portal Webmaps: Interactive data hosting platform that includes a visual representation of aerial inspection results and a dataset that is exportable, georeferenced, and interactive.

Field Repair Application: Smartphone application that routes technicians to malfunctioning modules and allows corrective maintenance or field validation results to be uploaded while on-site.



Data Accuracy

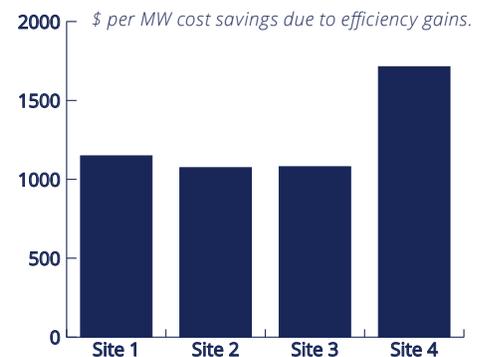
To test the accuracy of our data, we took the results of a solar inspection by drone and sent out manual inspection crews to run the same inspection on the same plants. The results from the manual inspection mirrored the results from the drone data with **99 percent accuracy**, but the manual inspection took two days for each site compared to two hours with the drone.

Results

Comparing drone inspection time to relevant manual inspections across the 4 sites, we saw an **increase in inspection efficiency of 97%**.

	Site 1	Site 2	Site 3	Site 4
Size	74MW	30MW	21MW	12.5MW
Drone Inspection Time	24 Hrs	6 Hrs	7 Hrs	4 Hrs
Manual Inspection Time	778 Hrs	293 Hrs	208 Hrs	195 Hrs
Hazardous Manhours Avoided	754 Hrs	287 Hrs	201 Hrs	191 Hrs
Increased Efficiency	97%	98%	97%	98%
Net Cost Saving	\$68,399	\$25,485	\$17,063	\$19,552

On a per MWdc basis, cost savings due to efficiency gains ranged from \$1074 to \$1717 per MW, for an **average of \$1254/MW cost savings**.



In addition, large sites where only a percentage (e.g. 20%) of the facility undergoes IV curve tracing each year will benefit from enhanced revenue opportunities realized through 100% IR scanning. In this case, Site 1 saw an additional \$91/MW in enhanced revenue opportunity.

Want help putting drones to work at your solar plant? Contact us at measure.com.