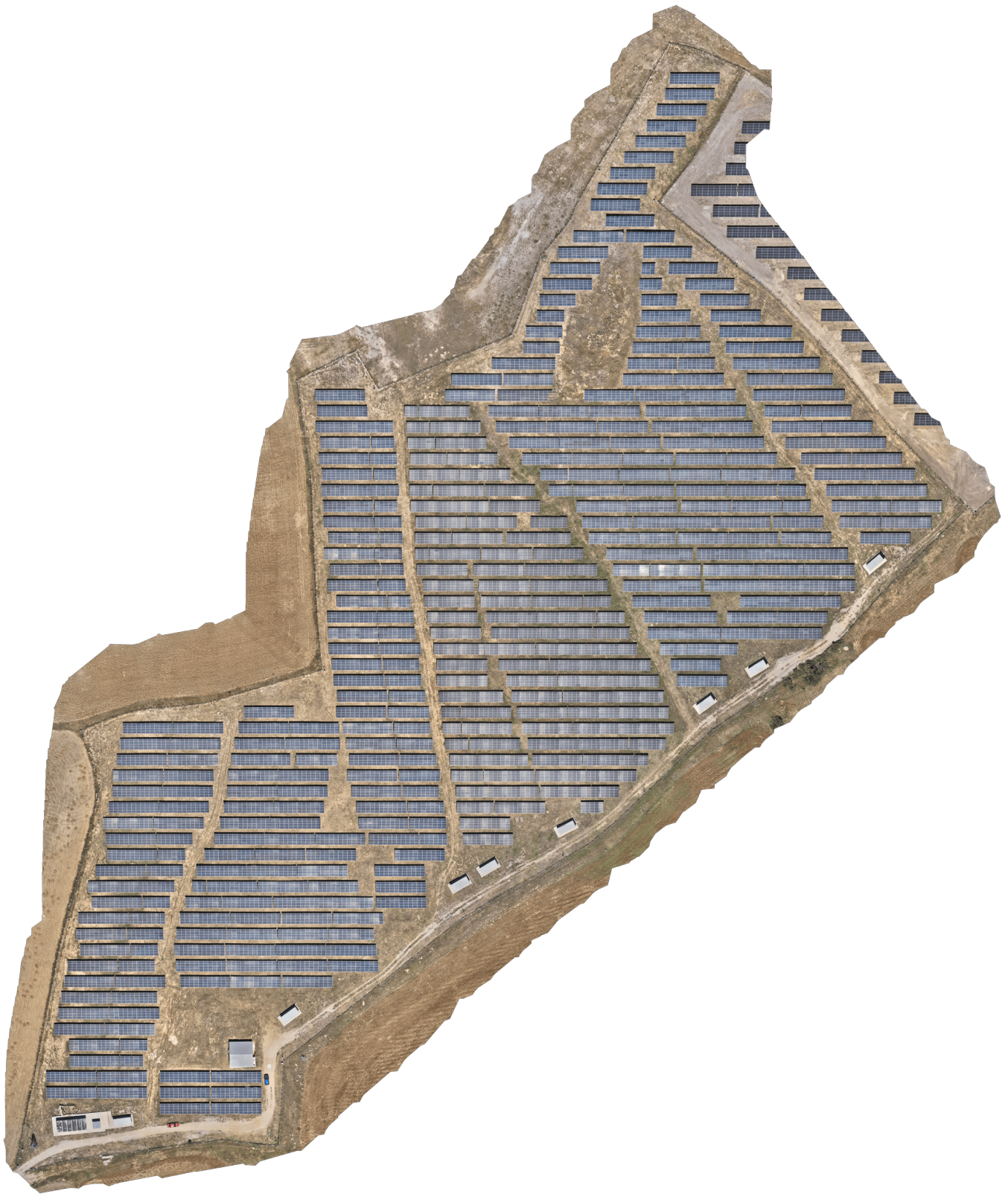
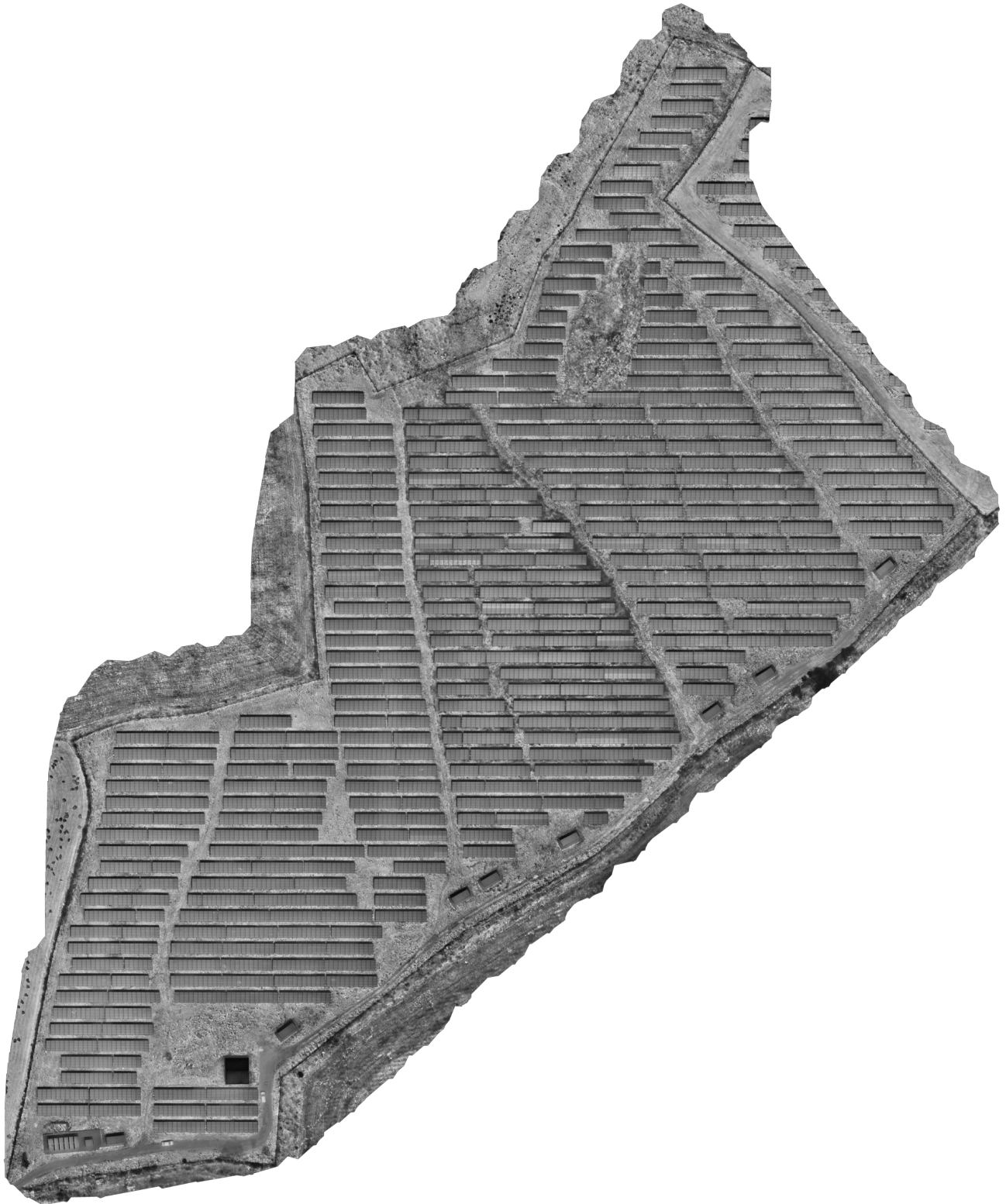


2.2 Solar Power Plant RGB Orthomosaic Image



2.3 Solar Power Plant Thermal Orthomosaic Image



2.4 Solar Power Plant Module Polygon Network Image



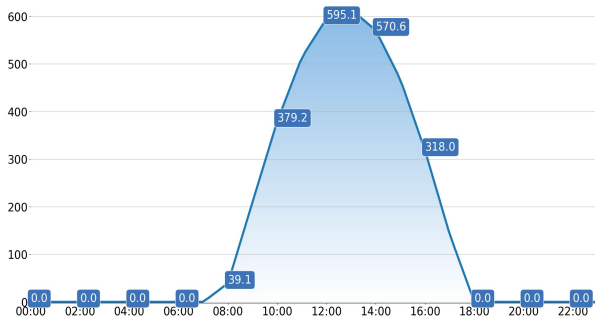
3. Inspection Results

3.1 Measurement Conditions

This section presents the operational and technical details of the plant. It includes information on location details, RGB and thermal orthophoto data, and a polygon network detailing PV modules. These data are critical for measuring the plant's performance and energy efficiency.

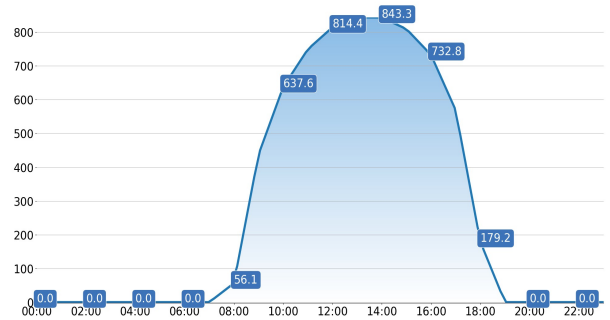
Global Horizontal Irradiance

Represents the total amount of sunlight reaching the Earth's surface, including both direct and scattered rays.



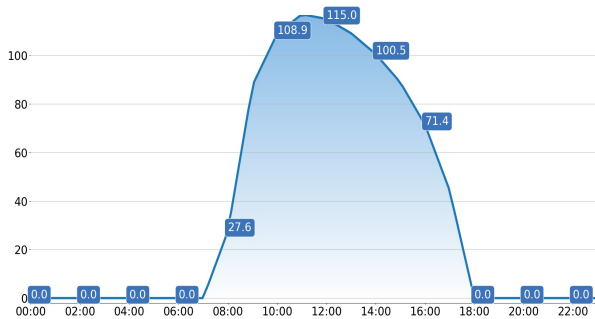
Direct Normal Irradiance

Shows the portion of sunlight that reaches the Earth's surface in a straight line without scattering in the atmosphere.



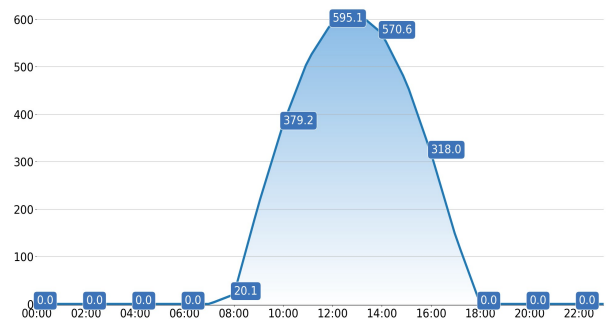
Diffuse Horizontal Irradiance

Indicates the amount of sunlight that has been scattered in the atmosphere and reaches the Earth's surface on a horizontal plane.



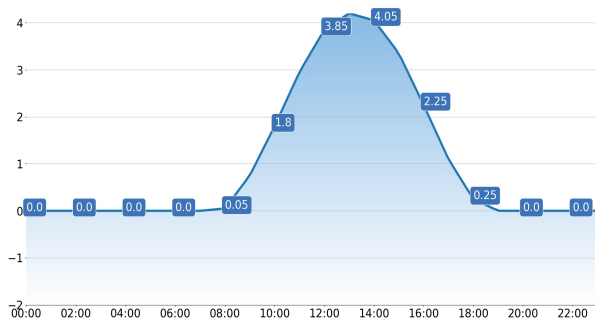
Global Tilted Irradiance

Represents the total amount of sunlight received by a surface at a specific tilt angle. It includes GHI, DNI, and reflected irradiance.



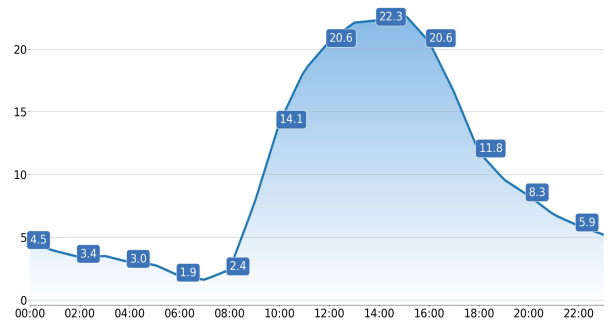
UV Index

A measure that indicates the intensity of ultraviolet (UV) rays from the sun.



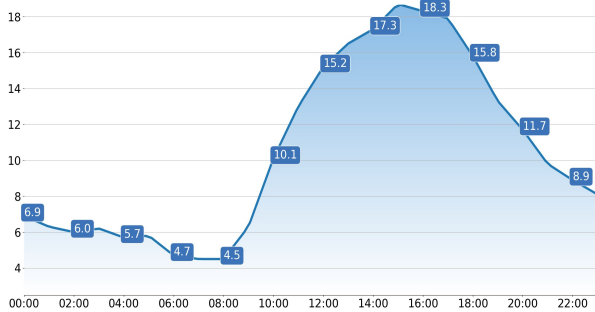
Soil Temperature

The measurement of heat in the ground, which affects panel efficiency and system performance in solar power plants.



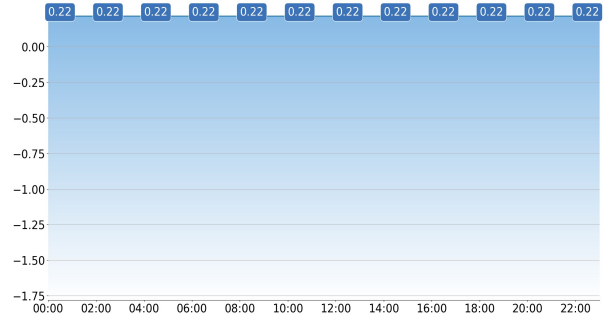
Air Temperature

Measures the temperature of the air at a specific altitude, typically used in meteorological observations and environmental models.



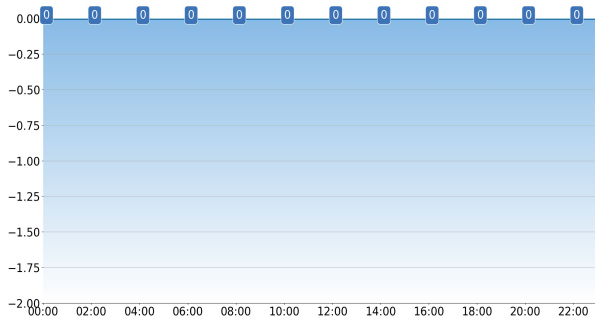
Albedo

A measure of how much sunlight a surface reflects. A high albedo indicates more light reflection.



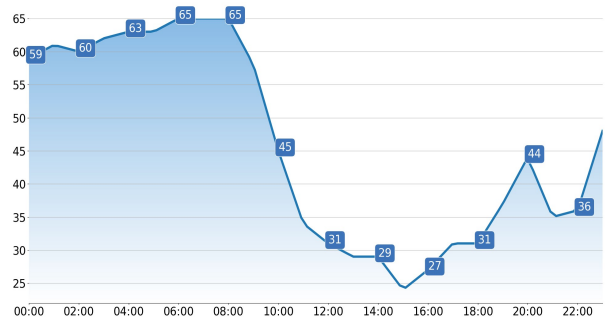
Cloud Opacity

Indicates the opacity or transparency of clouds in the sky, usually affecting the amount of sunlight reaching the Earth's surface.



Relative Humidity

The percentage of water vapor in the air compared to how much the air can hold at a given temperature.



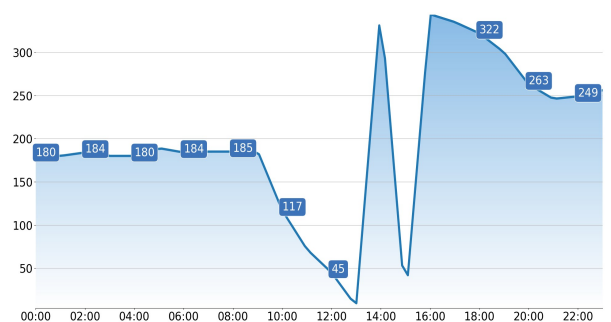
Wind Speed

Represents the speed of the wind at 10 meters height, usually measured in meters per second (m/s).



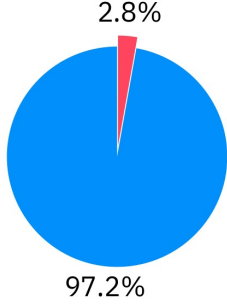
Wind Direction

Indicates the direction of the wind at 10 meters height, usually expressed in degrees, determined by the direction the wind is blowing from.

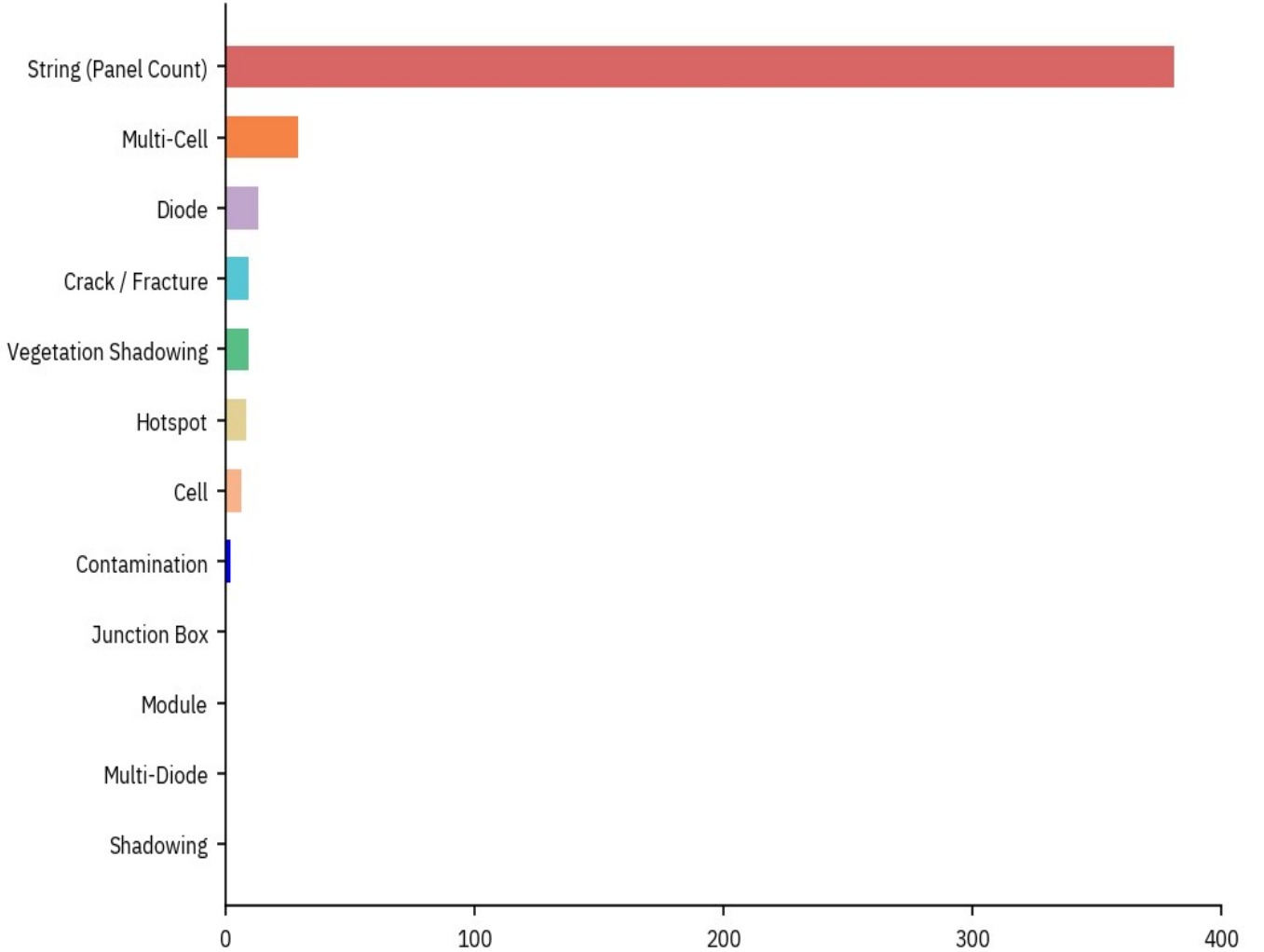
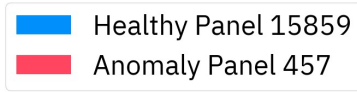


4.0 Thermographic Inspection Results

4.1 Field Inspection Information



After inspecting the solar panel field, faults were detected in 457 panels. The number of faulty panels covers %2.80's of the entire field.



Field Information

Total Panels	Healthy Panels	Faulty Panels	String Fault
16316	15859	457	20

Operation Information

Pending Inspection	In Progress	Completed
457	0	0

Fault Types

As a result of the inspections, a total of 8 anomalies in the category of Anomaly Type have been detected in the PV Plant. The detailed table containing the anomaly classes is as follows.

Anomaly Type	Total	Pending Inspection	In Repair Process	Completed
String (Panel Count)	381	381	0	0
Multi-Cell	29	29	0	0
Diode	13	13	0	0
Crack / Fracture	9	9	0	0
Vegetation Shadowing	9	9	0	0
Hotspot	8	8	0	0
Cell	6	6	0	0
Contamination	2	2	0	0
Junction Box	0	0	0	0
Module	0	0	0	0
Multi-Diode	0	0	0	0
Shadowing	0	0	0	0

4.2 Visualization of Faulty PV Modules on the GYP

[Click here for a larger version of the map.](#)



4.3 Efficiency Calculation and Approximate Financial Loss

Solar panel efficiency is a measure of the ability of panels to convert sunlight into electrical energy. High-efficiency panels produce more energy in less space, reducing energy costs. MapperX conducts efficiency analysis of panels and calculates the monthly and yearly financial impact of anomalies in the plant.

Initial Inspection Date
02/04/2024 18:14



Fault Percentage
 457 Panels
 %2.80 Anomalies



Total Plant
 Panel Count
16316



Average Daily
 Sunshine Duration
12.2 Hours

Daily Financial Loss
 02/04/2024 18:14
\$ 299.92

Monthly Financial Loss
 02/04/2024 18:14
\$ 9,122.56

Yearly Financial Loss
 02/04/2024 18:14
\$ 109,470.71

Fault Type	Total Anomaly	Daily Financial Loss	Monthly Financial Loss	Yearly Financial Loss
	02/04/2024 18:14	02/04/2024 18:14	02/04/2024 18:14	02/04/2024 18:14
String (Panel Count)	381	\$ 278.19	\$ 8,461.76	\$ 101,541.09
Multi-Cell	29	\$ 9.53	\$ 289.83	\$ 3,477.98
Diode	13	\$ 6.96	\$ 211.73	\$ 2,540.75
Crack / Fracture	9	\$ 2.96	\$ 89.95	\$ 1,079.37
Hotspot	8	\$ 0.88	\$ 26.65	\$ 319.81
Cell	6	\$ 0.66	\$ 19.99	\$ 239.86
Vegetation Shadowing	9	\$ 0.53	\$ 15.99	\$ 191.89
Contamination	2	\$ 0.22	\$ 6.66	\$ 79.95
Junction Box	0	\$ 0	\$ 0	\$ 0
Module	0	\$ 0	\$ 0	\$ 0
Multi-Diode	0	\$ 0	\$ 0	\$ 0
Shadowing	0	\$ 0	\$ 0	\$ 0
Total	457	\$ 299.92	\$ 9,122.56	\$ 109,470.71

4.4 Detailed Thermographic Inspection Results of the Modules

Solar energy systems are one of the cornerstones of clean and sustainable energy production. However, the correct operation of solar panels depends on careful monitoring of various technical parameters. In this context, timely detection and analysis of faults in solar panels are critical to optimizing system performance.

This report examines various fault conditions in solar panels in detail. Prepared in accordance with IEC TS 62446-3 standards, this report includes technical data related to each fault condition. These include measured operating temperatures of the modules, weather conditions, and information about the camera and lens used to take the photos, as well as the serial numbers of the devices.

Fault analysis is important to increase the efficiency of solar energy systems and minimize maintenance costs. This report details the origins and potential impacts of faults occurring in solar modules. It also provides recommended solutions and improvement strategies for each fault condition.

4.4.1 Solar Panel Field Panel Numbering System:

The numbering system has been carried out by always aligning the appearance of the field on the map to the north.

Letter Code (a): This indicates the type of panels. For example, the letter "a" represents inverters.

Number Code (1): This indicates the string where the panel is located. Each string is represented by a number. For example, the number "1" indicates the first string.


Sequence Code (0001): This indicates the position of the panel. Panels are arranged from right to left and top to bottom, starting from the northernmost point on the map. For example, the code "0001" represents a panel located in the top right corner of the map.

An example panel number: "a-1-0001" This numbering system facilitates monitoring and management of field operations while allowing for quick location of a specific panel when maintenance, repair, or replacement is required.

		Modül								
A-1-0001 Modül String İvertör		A-1-0008	A-1-0007	A-1-0006	A-1-0005	A-1-0004	A-1-0003	A-1-0002	A-1-0001	String (Dizi)
		A-1-0016	A-1-0015	A-1-0014	A-1-0013	A-1-0012	A-1-0011	A-1-0010	A-1-0009	
		A-1-0024	A-1-0023	A-1-0022	A-1-0021	A-1-0020	A-1-0019	A-1-0018	A-1-0017	
		A-1-0032	A-1-0031	A-1-0030	A-1-0029	A-1-0028	A-1-0027	A-1-0026	A-1-0025	

Demo Santral2

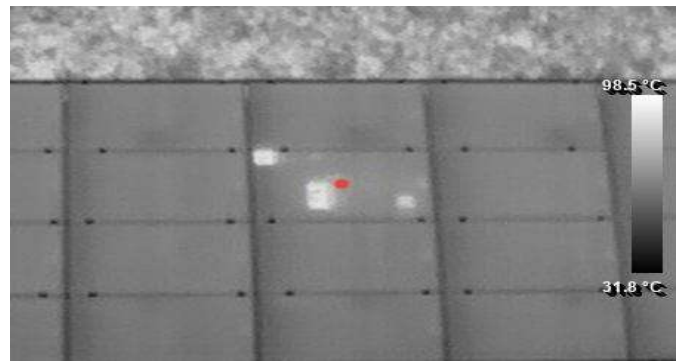
Demo Şirket

Anomaly Type Crack / Fracture	Panel Brand / Model Energy System / Es230	Field Installation Type Fixed Mounting
Anomaly Cause Unknown	Panel Serial No Unknown	Panel Tilt Angle -
Anomaly Priority High	String (Series) Number 303	 Panel Location 40.22207160048811 33.15852076920163



DJI_20230719112118_0951_V.JPG
DJI Mavic 3T Enterprise

19/07/2023 11:21:18
MPX-4236123214



DJI_20230719112007_0888_T.JPG
DJI Mavic 3T Enterprise

19/07/2023 11:20:07
MPX-4236123214

Panel Electrical Measurement Values

Current : - A
Voltage : - V
Power : - W

Measurement Date: -

Measurement values of a healthy panel in the same string:

Current - A | Voltage - V | Power - W

Weather Data

Tref : 11°C
Wind Speed : 1.1 km/s
Temperature : 13°C
Pollution Rate : -%
Efficiency : -%

Panel Temperature Measurement

Minimum : 40.1°C
Maksimum : 98.5°C
OAverage : 52.35°C
Delta T (Δ T) : 58.4C
Emissivity : 0.85

Solar Radiation



GHI : 513.9 W/m²
DNI : 749.4 W/m²
DHI : 116.9 W/m²
GTI : 513.9 W/m²

Sunshine Duration



Average Daily Sunshine Duration
12.2 Hours

Cloudiness



Inspection At the Hour Cloudiness Percentage
0%

Financial Loss

Per-Panel Loss Summary
Daily
0.329 USD
Monthly
9.857 USD
Yearly
119.93 USD

Panel Operation Information

- Inspection Pending**
 - MapperX Software İşlem Tarihi: 19/10/2023 12:32
- Anomaly Detected**
 - MapperX Software İşlem Tarihi: 19/10/2023 12:32

Anomaly Explanation


Cracks or fractures occurring in solar panels cause the panels to heat up and reduce their overall performance. Additionally, cracks allow moisture and other external factors to penetrate inside the panel, damaging internal components and causing corrosion.

Operation Suggestion

When a crack is detected, it is important to intervene considering the size and location of the damage. If the crack is small, replacing the cracked top layer can extend the panel's lifespan and minimize performance loss. However, if the cracks have spread over a large area, it is recommended to replace the entire module.

Demo Santral2

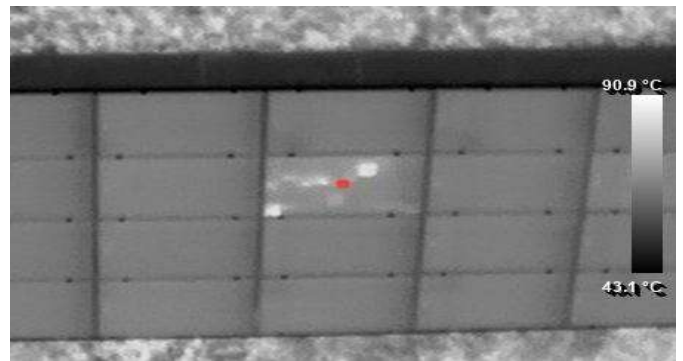
Demo Şirket

Anomaly Type Crack / Fracture	Panel Brand / Model Energy System / Es230	Field Installation Type Fixed Mounting
Anomaly Cause Unknown	Panel Serial No ZSM10201603000676	Panel Tilt Angle -
Anomaly Priority High	String (Series) Number 96	 Panel Location 40.2233363052825 33.16007331067625



DJI_20230719115220_0804_V.JPG
DJI Mavic 3T Enterprise

19/07/2023 11:52:20
MPX-4236123214



DJI_20230719115220_0804_T.JPG
DJI Mavic 3T Enterprise

19/07/2023 11:52:20
MPX-4236123214

Panel Electrical Measurement Values

Current : - A
Voltage : - V
Power : - W

Measurement Date: -

Measurement values of a healthy panel in the same string:

Current - A | Voltage - V | Power - W

Weather Data

Tref : 11°C
Wind Speed : 1.1 km/s
Temperature : 13°C
Pollution Rate : -%
Efficiency : -%

Panel Temperature Measurement

Minimum : 40.1°C
Maksimum : 89.2°C
OAverage : 53.65°C
Delta T (Δ T) : 49.1C
Emissivity : 0.85

Solar Radiation



GHI : 513.9 W/m²
DNI : 749.4 W/m²
DHI : 116.9 W/m²
GTI : 513.9 W/m²

Sunshine Duration



Average Daily Sunshine Duration
12.2 Hours

Cloudiness



Inspection At the Hour Cloudiness Percentage
0%

Financial Loss

Per-Panel Loss Summary
Daily
0.329 USD
Monthly
9.857 USD
Yearly
119.93 USD

Panel Operation Information

Inspection Pending
● MapperX Software
İşlem Tarihi: 19/10/2023 12:32
Anomaly Detected
● MapperX Software
İşlem Tarihi: 19/10/2023 12:32

Anomaly Explanation

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