

Project Name: 3.6 MW galios saulės elektrinių parko įrengimas

2023-01-19

Documentation

Customer Details

Company	Ukmergės šiluma
Customer Number	
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Project Data

Project Name	3.6 MW galios saulės elektrinių parko įrengimas
Offer no.	
Project Designer	
Address	Lakštingalų g. 1 ir S. Daukanto g. 24, Ukmergė



UAB Ignitis Projektų vadovas



Project Overview

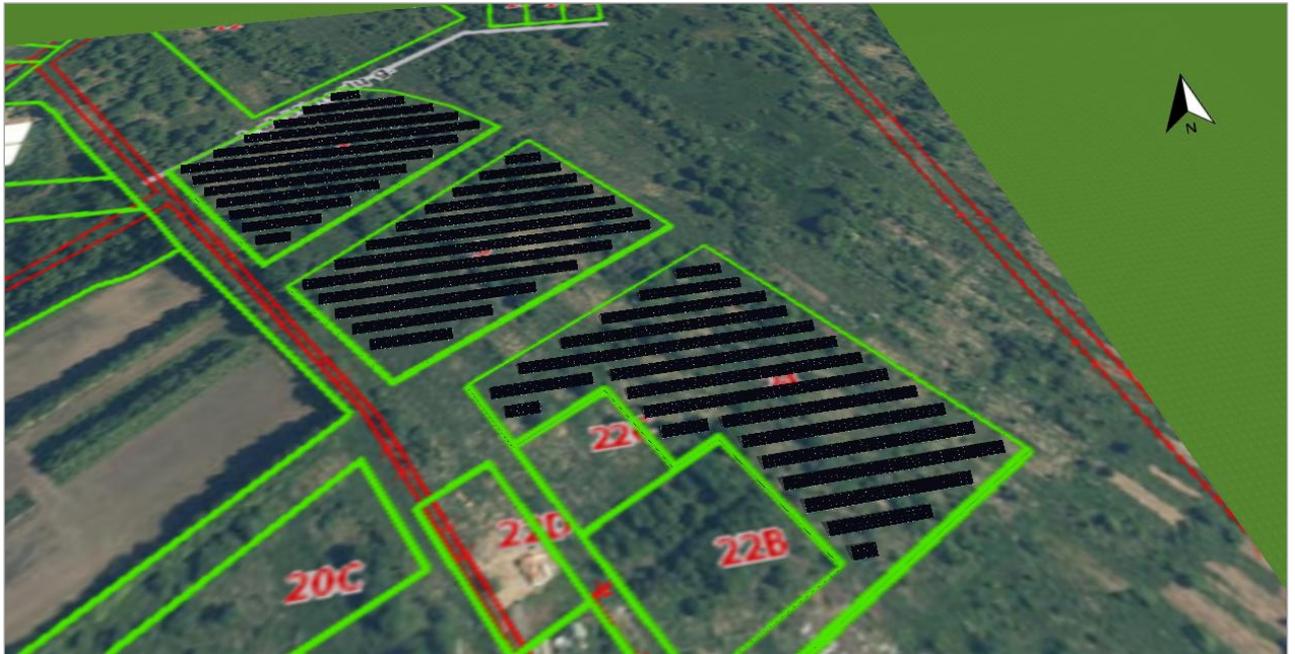


Figure: Overview Image, 3D Design

PV System

3D, Grid-connected PV System

Climate Data	Meteo7, LTU (1991 - 2010)
Values source	Measuring station
PV Generator Output	3599,1 kWp
PV Generator Surface	16 563,1 m ²
Number of PV Modules	5332
Number of Inverters	28

3.6 MW galios saulės elektrinių parko įrengimas

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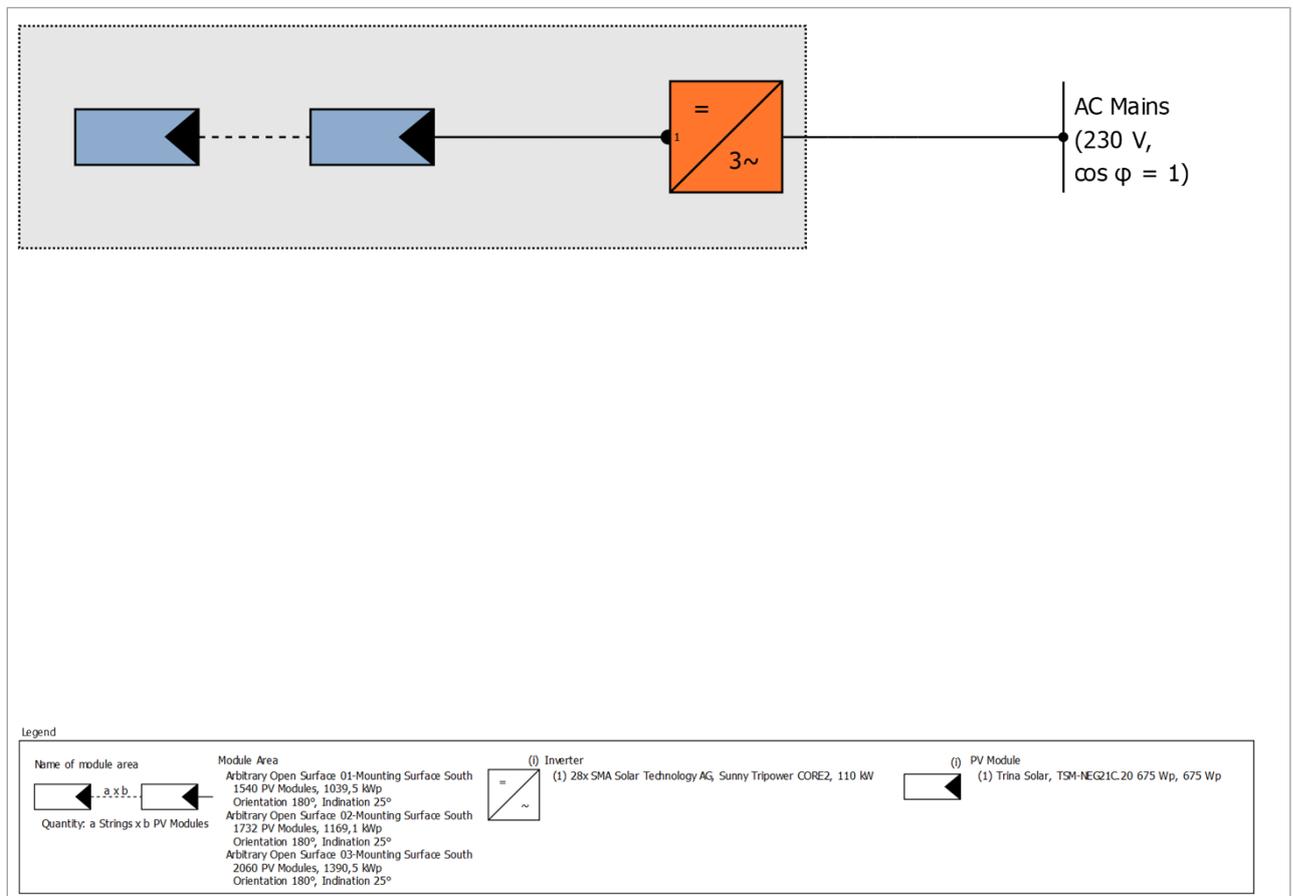


Figure: Schematic diagram

Production Forecast

Production Forecast

PV Generator Output	3 599,10 kWp
Spec. Annual Yield	1 000,08 kWh/kWp
Performance Ratio (PR)	81,02 %
Yield Reduction due to Shading	2,5 %/Year
Grid Feed-in	3 600 034 kWh/Year
Grid Feed-in in the first year (incl. module degradation)	3 600 034 kWh/Year
Standby Consumption (Inverter)	639 kWh/Year
CO ₂ Emissions avoided	1 691 716 kg / year

The results have been calculated with a mathematical model calculation from Valentin Software GmbH (PV*SOL algorithms). The actual yields from the solar power system may differ as a result of weather variations, the efficiency of the modules and inverter, and other factors.

Set-up of the System

Overview

System Data

Type of System	3D, Grid-connected PV System
Start of Operation	2022-04-26

Climate Data

Location	Meteo7, LTU (1991 - 2010)
Values source	Measuring station
Resolution of the data	1 h
Simulation models used:	
- Diffuse Irradiation onto Horizontal Plane	Hofmann
- Irradiance onto tilted surface	Hay & Davies

Module Areas

1. Module Area - Arbitrary Open Surface 01-Mounting Surface South

PV Generator, 1. Module Area - Arbitrary Open Surface 01-Mounting Surface South

Name	Arbitrary Open Surface 01-Mounting Surface South
PV Modules	1540 x TSM-NEG21C.20 675 Wp (v1)
Manufacturer	Trina Solar
Inclination	25 °
Orientation	South 180 °
Installation Type	Mounted - ground
PV Generator Surface	4 783,8 m ²

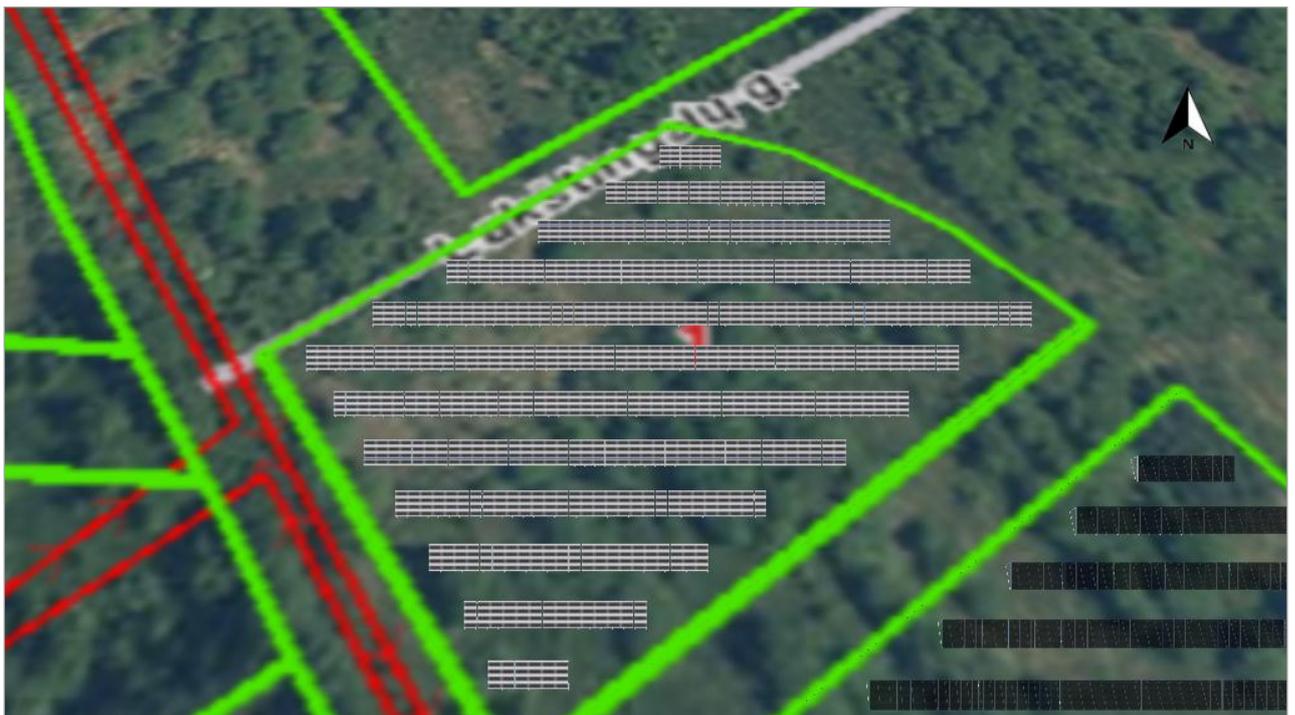


Figure: 1. Module Area - Arbitrary Open Surface 01-Mounting Surface South

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2. Module Area - Arbitrary Open Surface 02-Mounting Surface South

PV Generator, 2. Module Area - Arbitrary Open Surface 02-Mounting Surface South

Name	Arbitrary Open Surface 02-Mounting Surface South
PV Modules	1732 x TSM-NEG21C.20 675 Wp (v1)
Manufacturer	Trina Solar
Inclination	25 °
Orientation	South 180 °
Installation Type	Mounted - ground
PV Generator Surface	5 380,2 m ²



Figure: 2. Module Area - Arbitrary Open Surface 02-Mounting Surface South

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3. Module Area - Arbitrary Open Surface 03-Mounting Surface South

PV Generator, 3. Module Area - Arbitrary Open Surface 03-Mounting Surface South

Name	Arbitrary Open Surface 03-Mounting Surface South
PV Modules	2060 x TSM-NEG21C.20 675 Wp (v1)
Manufacturer	Trina Solar
Inclination	25 °
Orientation	South 180 °
Installation Type	Mounted - ground
PV Generator Surface	6 399,1 m ²



Figure: 3. Module Area - Arbitrary Open Surface 03-Mounting Surface South

Simulation Results

Results Total System

PV System

PV Generator Output	3 599,10 kWp
Spec. Annual Yield	1 000,08 kWh/kWp
Performance Ratio (PR)	81,02 %
Yield Reduction due to Shading	2,5 %/Year
Grid Feed-in	3 600 034 kWh/Year
Grid Feed-in in the first year (incl. module degradation)	3 600 034 kWh/Year
Standby Consumption (Inverter)	639 kWh/Year
CO ₂ Emissions avoided	1 691 716 kg / year

Energy Flow Graph

Project: 3.6 MW galios saulės elektrinių parko įrengimas



All values in kWh
Small deviations in the totals can occur due to rounding
created with PV*SOL

Figure: Energy flow

3.6 MW galios saulės elektrinių parko įrengimas

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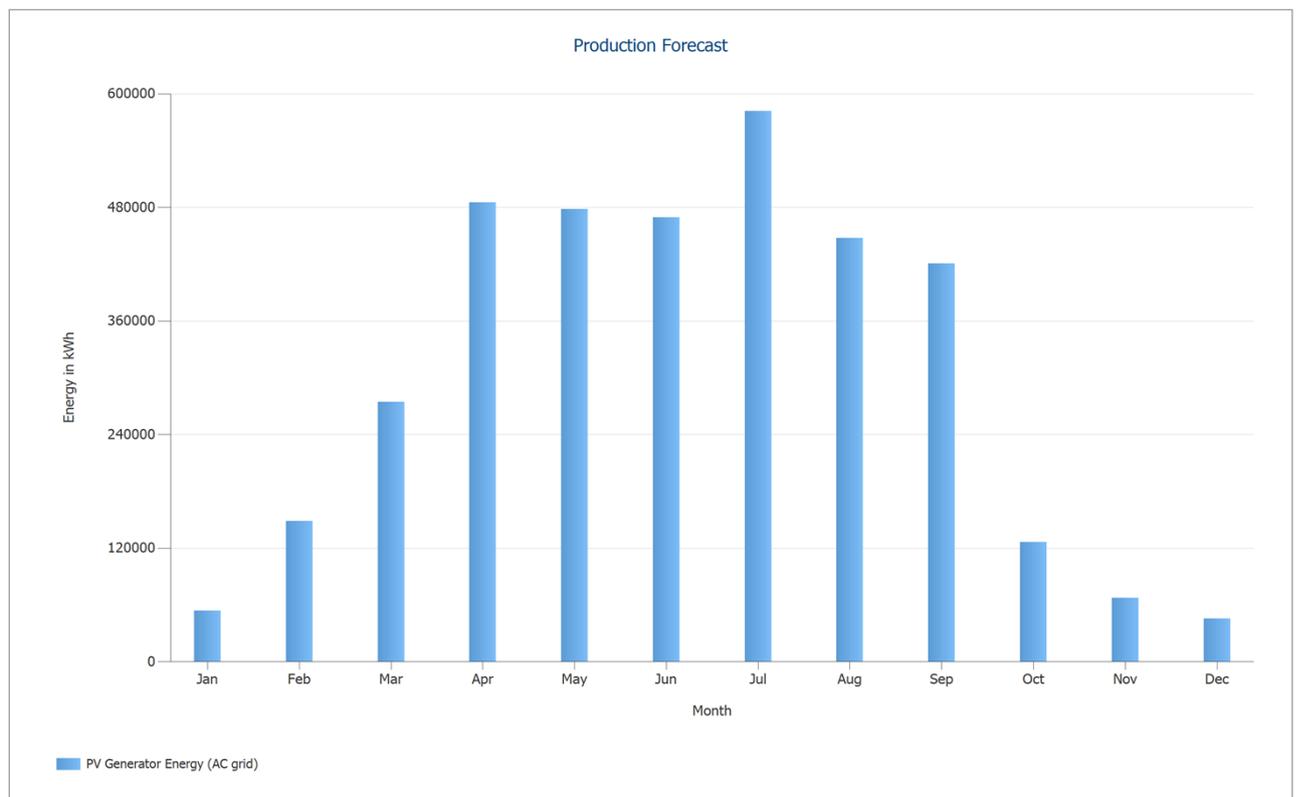


Figure: Production Forecast

PV System Energy Balance

PV System Energy Balance

Global radiation - horizontal	1 047,64 kWh/m²	
Deviation from standard spectrum	-20,95 kWh/m ²	-2,00 %
Ground Reflection (Albedo)	9,62 kWh/m ²	0,94 %
Orientation and inclination of the module surface	137,46 kWh/m ²	13,26 %
Module-independent shading	0,00 kWh/m ²	0,00 %
Reflection on the Module Interface	-58,17 kWh/m ²	-4,96 %
Irradiance on the rear side of the module	61,48 kWh/m ²	5,51 %
Global Radiation at the Module	1 177,08 kWh/m²	
	1 177,08 kWh/m ²	
	x 16563,069 m ²	
	= 19 496 044,66 kWh	
Global PV Radiation	19 496 044,66 kWh	
Bifaciality (80 % of back irradiance)	-203 658,29 kWh	-1,04 %
Soiling	-385 841,36 kWh	-2,00 %
STC Conversion (Rated Efficiency of Module 21,71 %)	-14 801 088,19 kWh	-78,29 %
Rated PV Energy	4 105 456,82 kWh	
Module-specific Partial Shading	-73 441,13 kWh	-1,79 %
Low-light performance	-27 480,79 kWh	-0,68 %
Deviation from the nominal module temperature	-57 568,52 kWh	-1,44 %
Diodes	-8 044,52 kWh	-0,20 %
Mismatch (Manufacturer Information)	-90 595,20 kWh	-2,30 %
Mismatch (Configuration/Shading)	-16 363,45 kWh	-0,43 %
PV Energy (DC) without inverter down-regulation	3 831 963,20 kWh	
Failing to reach the DC start output	-519,81 kWh	-0,01 %
Down-regulation on account of the MPP Voltage Range	-82,59 kWh	0,00 %
Down-regulation on account of the max. DC Current	0,00 kWh	0,00 %
Down-regulation on account of the max. DC Power	0,00 kWh	0,00 %
Down-regulation on account of the max. AC Power/cos phi	-2 981,18 kWh	-0,08 %
MPP Matching	-8 893,19 kWh	-0,23 %
PV energy (DC)	3 819 486,43 kWh	
Energy at the Inverter Input	3 819 486,43 kWh	
Input voltage deviates from rated voltage	-11 889,03 kWh	-0,31 %
DC/AC Conversion	-95 456,81 kWh	-2,51 %
Standby Consumption (Inverter)	-639,06 kWh	-0,02 %
Total Cable Losses	-112 106,65 kWh	-3,02 %
PV energy (AC) minus standby use	3 599 394,88 kWh	
PV Generator Energy (AC grid)	3 600 033,94 kWh	

Data Sheets

PV Module Data Sheet

PV Module: TSM-NEG21C.20 675 Wp (v1)

Manufacturer	Trina Solar
Available	Yes

Electrical Data

Cell Type	Si monocrystalline
Half-cell module	Yes
Cell Count	132
Number of Bypass Diodes	12
Loss voltage per bypass diode	0,2 V
Integrated power optimizer	No
Only Transformer Inverters suitable	No

I/V Characteristics at STC

MPP Voltage	39,4 V
MPP Current	17,12 A
Open Circuit Voltage	47,2 V
Short-Circuit Current	18,14 A
Increase open circuit voltage before stabilisation	0 %
Nominal output	675 W
Fill Factor	78,78 %
Efficiency	21,71 %

I/V Part Load Characteristics

Values source	Manufacturer/user-created
Irradiance	200 W/m ²
Voltage in MPP at Part Load	38 V
Current in MPP at Part Load	3,52 A
Open Circuit Voltage (Part Load)	46 V
Short Circuit Current at Part Load	3,7 A

Additional Parameters

Temperature Coefficient of Voc	-118 mV/K
Temperature Coefficient of Isc	7,26 mA/K
Temperature Coefficient of Pmpp	-0,3 %/K
Incident Angle Modifier (IAM)	95 %
Bifacial factor	80 %
Maximum System Voltage	1500 V

Mechanical Data

Width	1303 mm
Height	2384 mm
Depth	35 mm
Frame Width	35 mm
Weight	38,7 kg

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Inverter Data Sheet

Inverter: Sunny Tripower CORE2 (v1)

Manufacturer	SMA Solar Technology AG
Available	Yes
Electrical data - DC	
DC nominal output	110 kW
Max. DC Power	110 kW
Nom. DC Voltage	585 V
Max. Input Voltage	1100 V
Max. Input Current	312 A
Number of DC Inlets	24
Electrical data - AC	
AC Power Rating	110 kW
Max. AC Power	110 kVA
Number of Phases	3
With Transformer	No
Electrical data - other	
Change in Efficiency when Input Voltage deviates from Rated Voltage	-0,4 %/100V
Min. Feed-in Power	200 W
Standby Consumption	5 W
Night Consumption	5 W
MPP Tracker	
Output Range < 20% of Power Rating	99,5 %
Output Range > 20% of Power Rating	99,8 %
Count of MPP Trackers	12
MPP Tracker 1-12	
Max. Input Current	26 A
Max. Input Power	13,75 kW
Min. MPP Voltage	200 V
Max. MPP Voltage	800 V

Plans and parts list

Overview plan

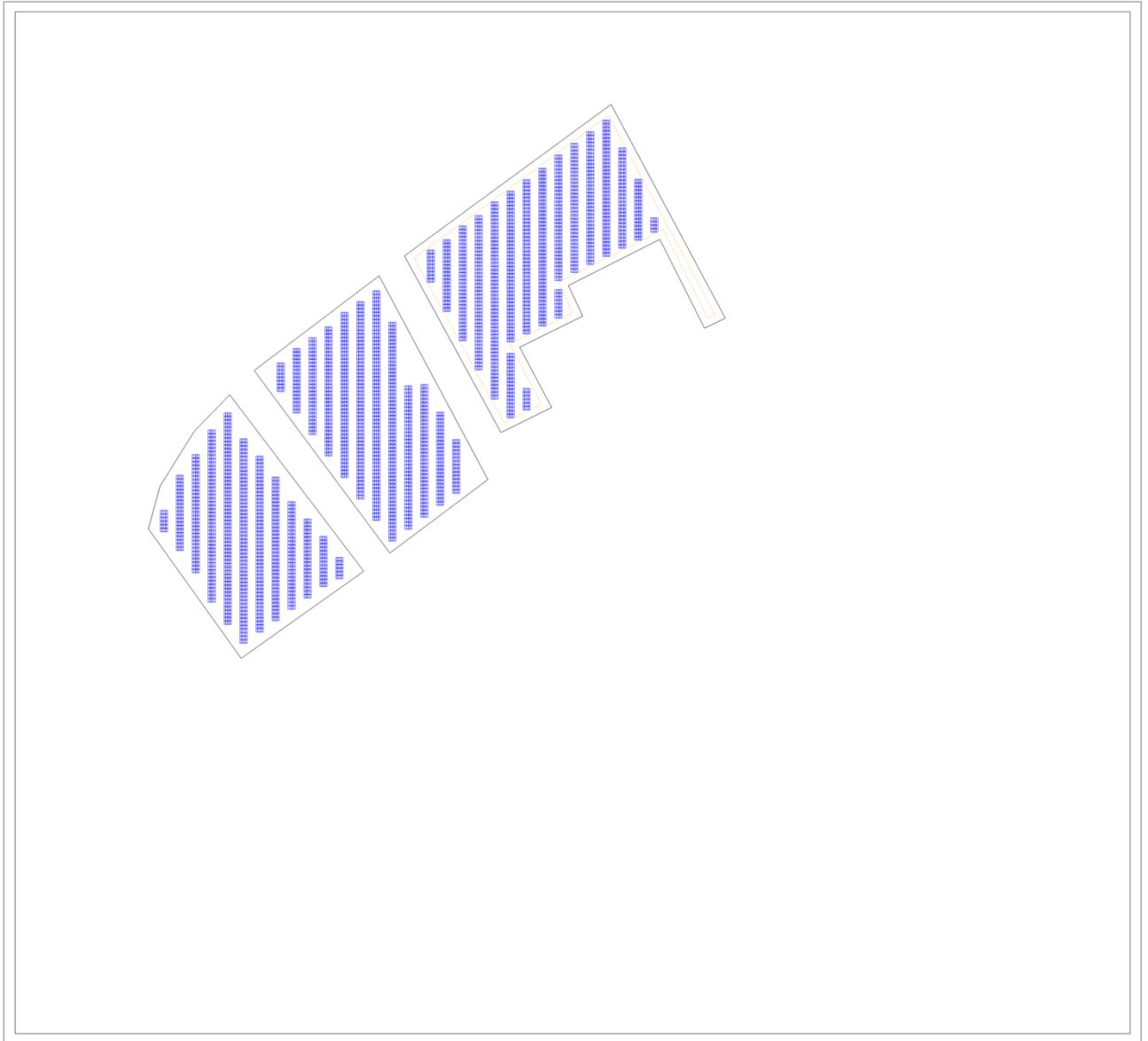


Figure: Overview plan

Parts list

Parts list

#	Type	Item number	Manufacturer	Name	Quantity	Unit
1	PV Module		Trina Solar	TSM-NEG21C.20 675 Wp	5332	Piece
2	Inverter		SMA Solar Technology AG	Sunny Tripower CORE2	28	Piece

Screenshots, 3D Design

Module Areas

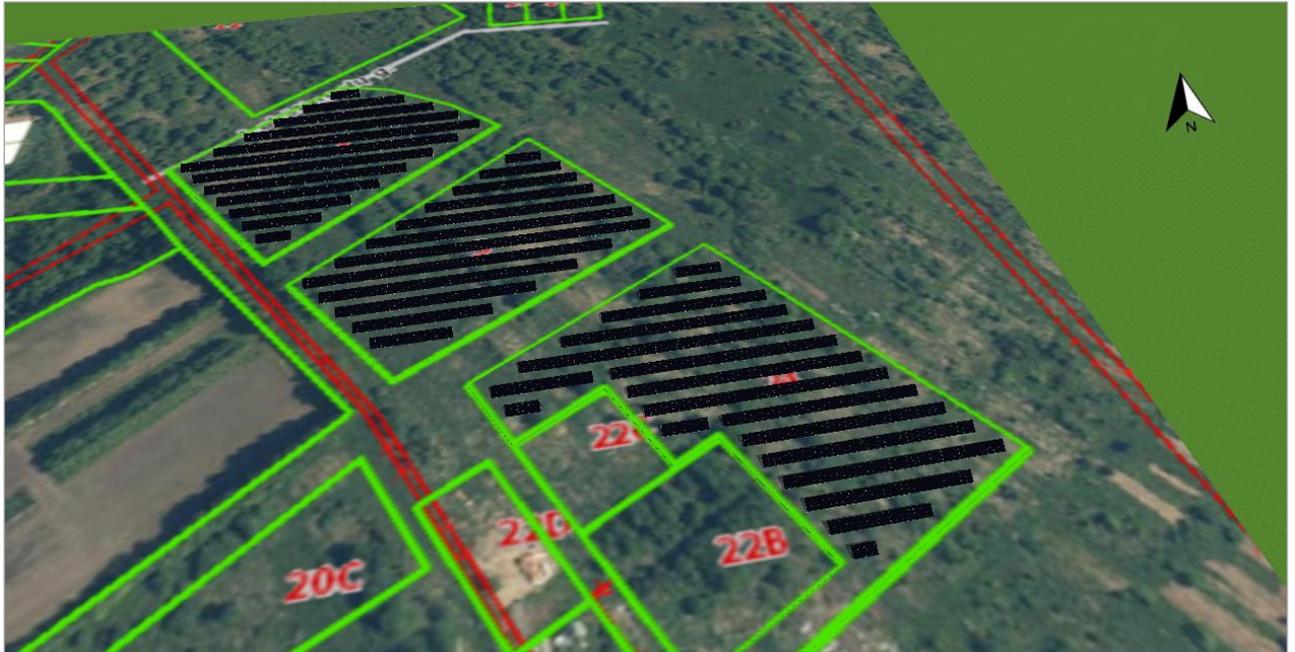


Figure: Screenshot01