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**Project Name:** Sheraton PV Plant - Rooftop

13-Apr-23

## Your PV system from Helios Energy LLC

### Address of Installation

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01.17.01.125.001

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### Project Description:

Rooftop PV Plant - Level 12

## Project Overview

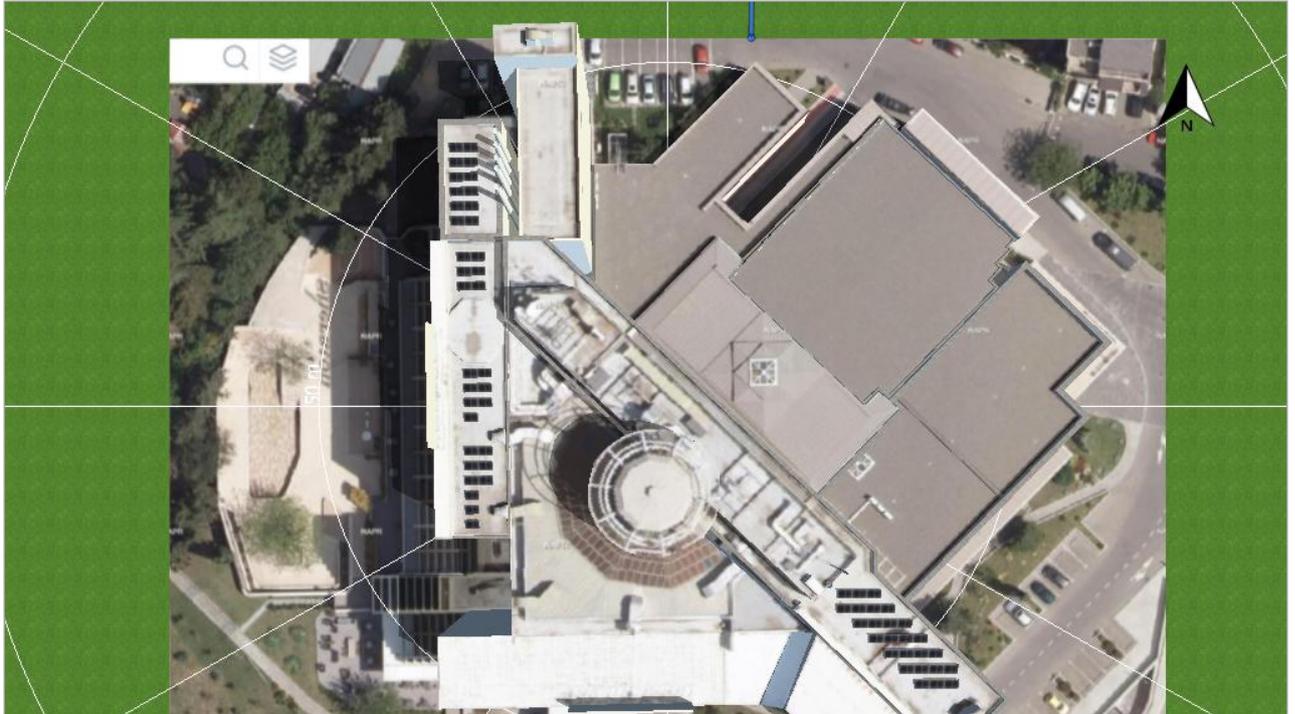


Figure: Overview Image, 3D Design

## PV System

### 3D, Grid-connected PV System

Climate Data	Tbilisi, GEO (1991 - 2010)
PV Generator Output	24.9 kWp
PV Generator Surface	117.2 m <sup>2</sup>
Number of PV Modules	60
Number of Inverters	2

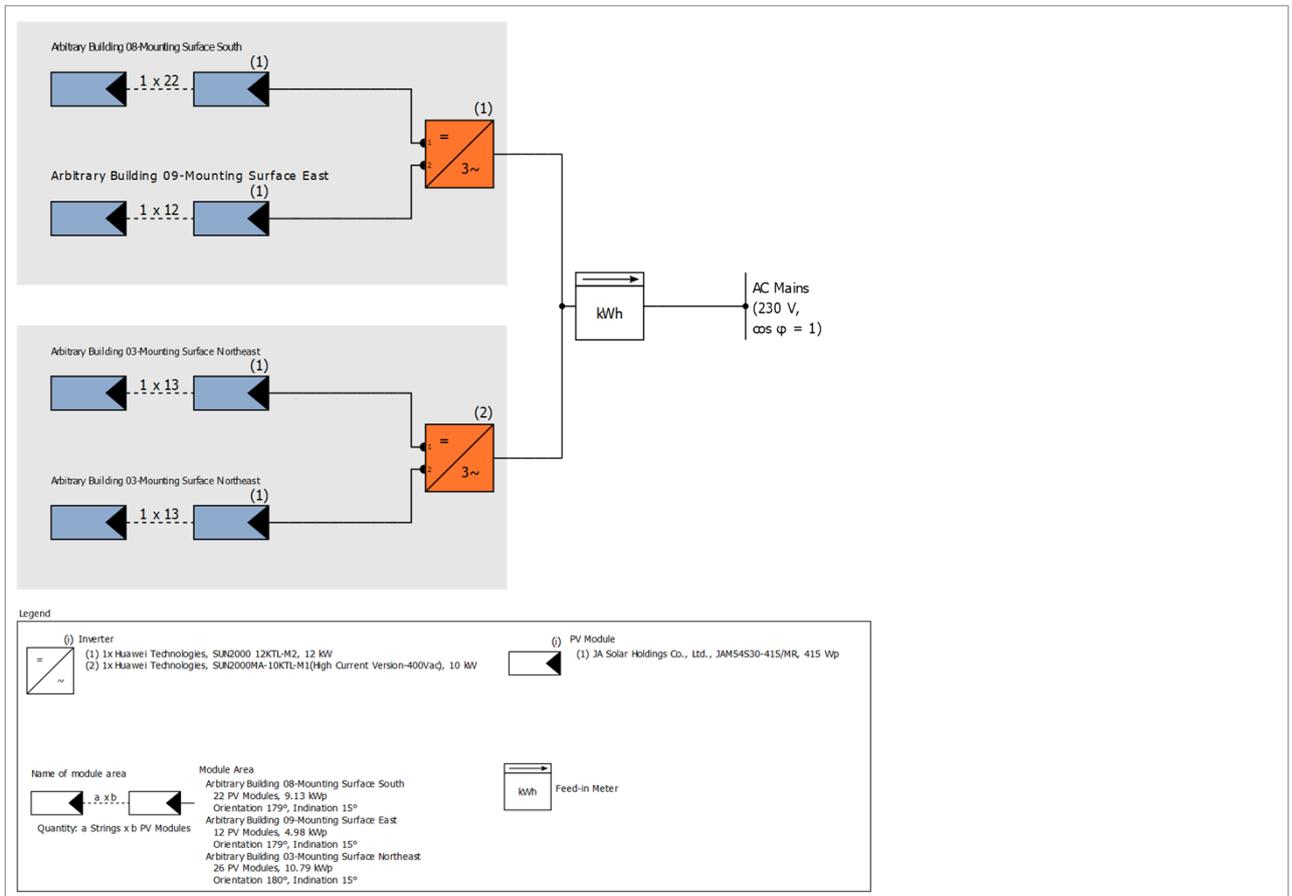


Figure: Schematic diagram

## The yield

### The yield

PV Generator Energy (AC grid)	27,265 kWh
Grid Feed-in	27,265 kWh
Down-regulation at Feed-in Point	0 kWh
Own Power Consumption	0.0 %
Solar Fraction	0.0 %
Spec. Annual Yield	1,092.79 kWh/kWp
Performance Ratio (PR)	79.1 %
Yield Reduction due to Shading	14.2 %/Year
CO <sub>2</sub> Emissions avoided	12,789 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	08-Sep-22

### Climate Data

Location	Tbilisi, GEO (1991 - 2010)
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 Building 08-Mounting Surface South

#### PV Generator, 1. Module Area - Arbitrary Building 08-Mounting Surface South

Name	Arbitrary Building 08-Mounting Surface South
PV Modules	22 x JAM54S30-415/MR (v4)
Manufacturer	JA Solar Holdings Co., Ltd.
Inclination	15 °
Orientation	South 179 °
Installation Type	Mounted - Roof
PV Generator Surface	43.0 m <sup>2</sup>

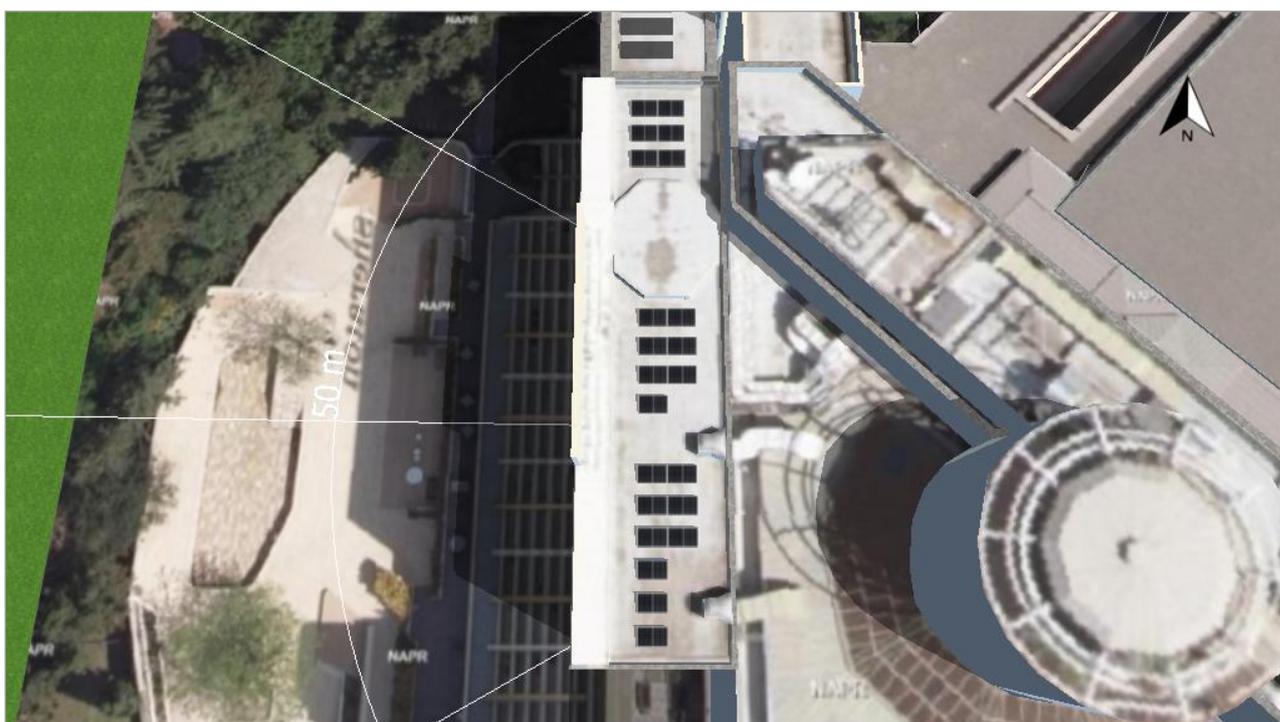


Figure: 1. Module Area - Arbitrary Building 08-Mounting Surface South

Degradation of Module, 1. Module Area - Arbitrary Building 08-Mounting Surface South

Remaining power (power output) after 1 year	98 %
Remaining power (power output) after 25 years	84.8 %

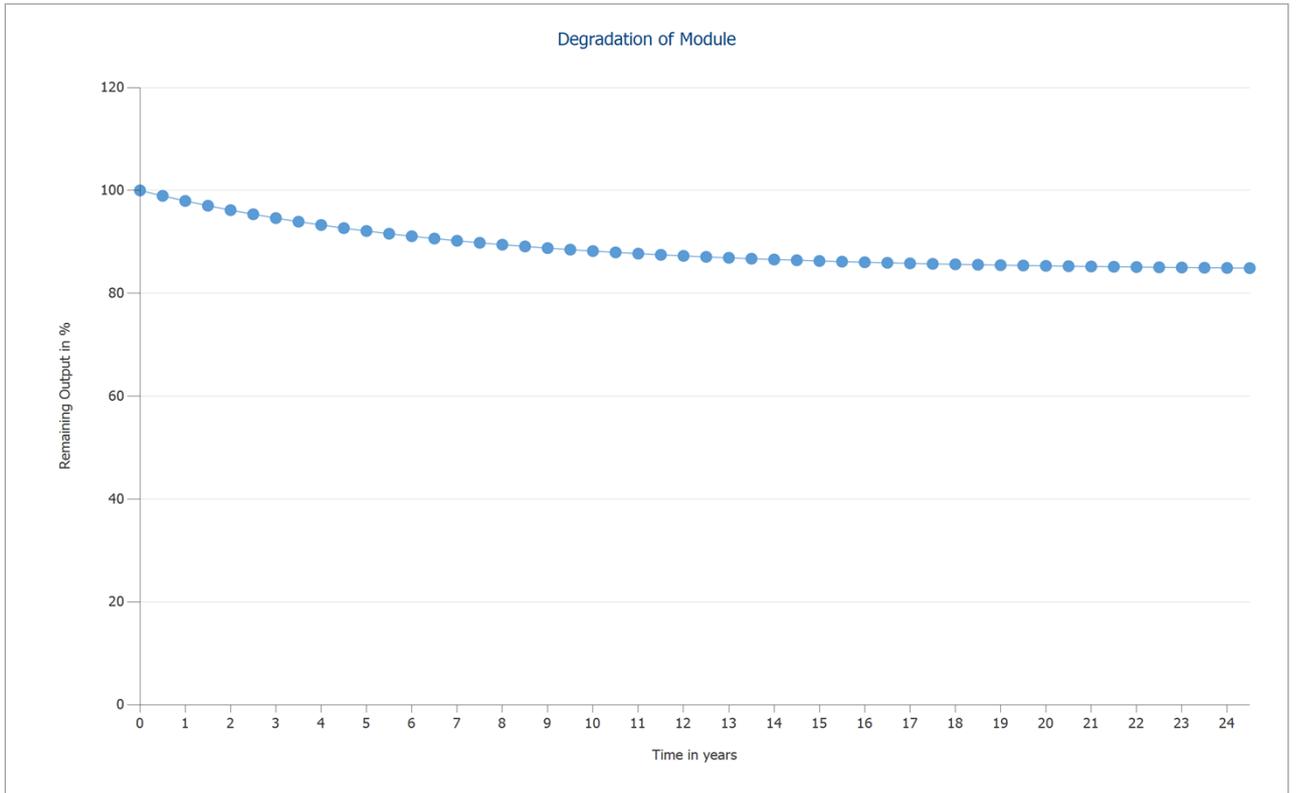


Figure: Degradation of Module, 1. Module Area - Arbitrary Building 08-Mounting Surface South

## 2. Module Area - Arbitrary Building 09-Mounting Surface East

### PV Generator, 2. Module Area - Arbitrary Building 09-Mounting Surface East

Name	Arbitrary Building 09-Mounting Surface East
PV Modules	12 x JAM54S30-415/MR (v4)
Manufacturer	JA Solar Holdings Co., Ltd.
Inclination	15 °
Orientation	South 179 °
Installation Type	Mounted - Roof
PV Generator Surface	23.4 m <sup>2</sup>

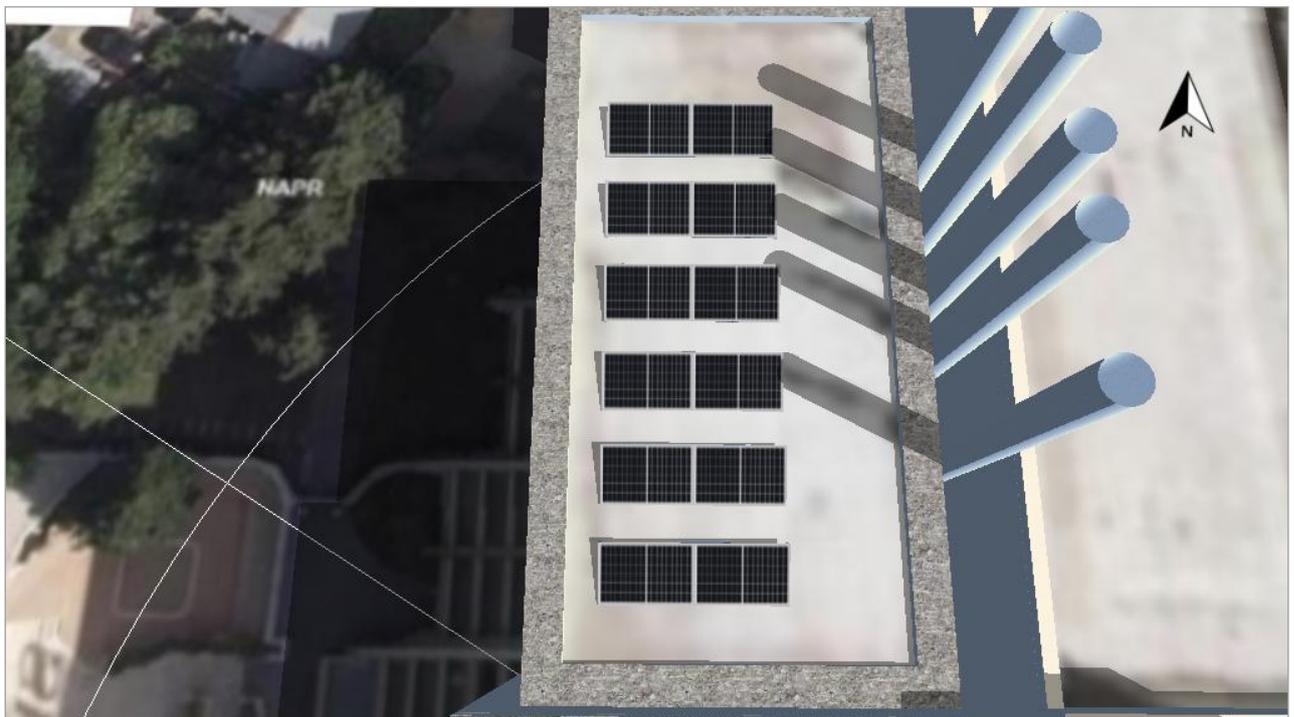


Figure: 2. Module Area - Arbitrary Building 09-Mounting Surface East

Degradation of Module, 2. Module Area - Arbitrary Building 09-Mounting Surface East

Remaining power (power output) after 1 year	98 %
Remaining power (power output) after 25 years	84.8 %

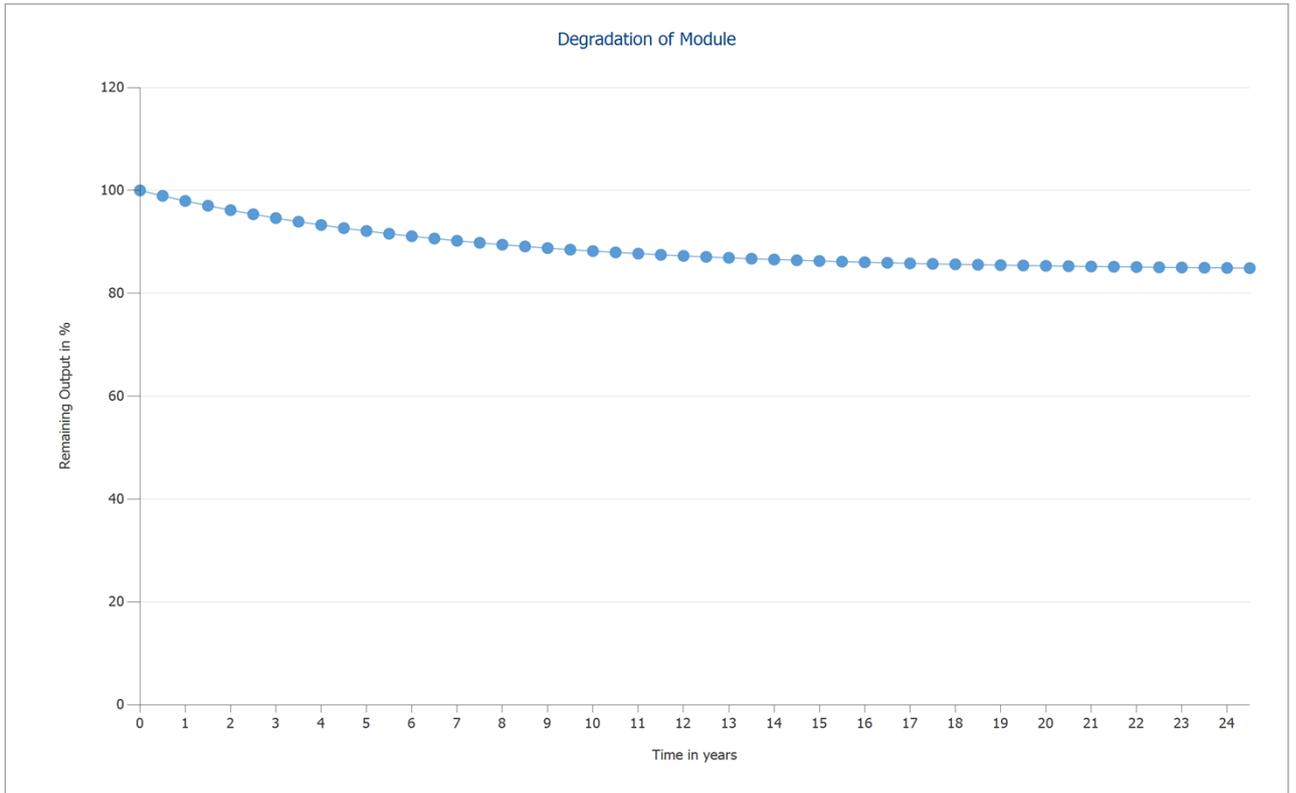


Figure: Degradation of Module, 2. Module Area - Arbitrary Building 09-Mounting Surface East

### 3. Module Area - Arbitrary Building 03-Mounting Surface Northeast

#### PV Generator, 3. Module Area - Arbitrary Building 03-Mounting Surface Northeast

Name	Arbitrary Building 03-Mounting Surface Northeast
PV Modules	26 x JAM54S30-415/MR (v4)
Manufacturer	JA Solar Holdings Co., Ltd.
Inclination	15 °
Orientation	South 180 °
Installation Type	Mounted - Roof
PV Generator Surface	50.8 m <sup>2</sup>

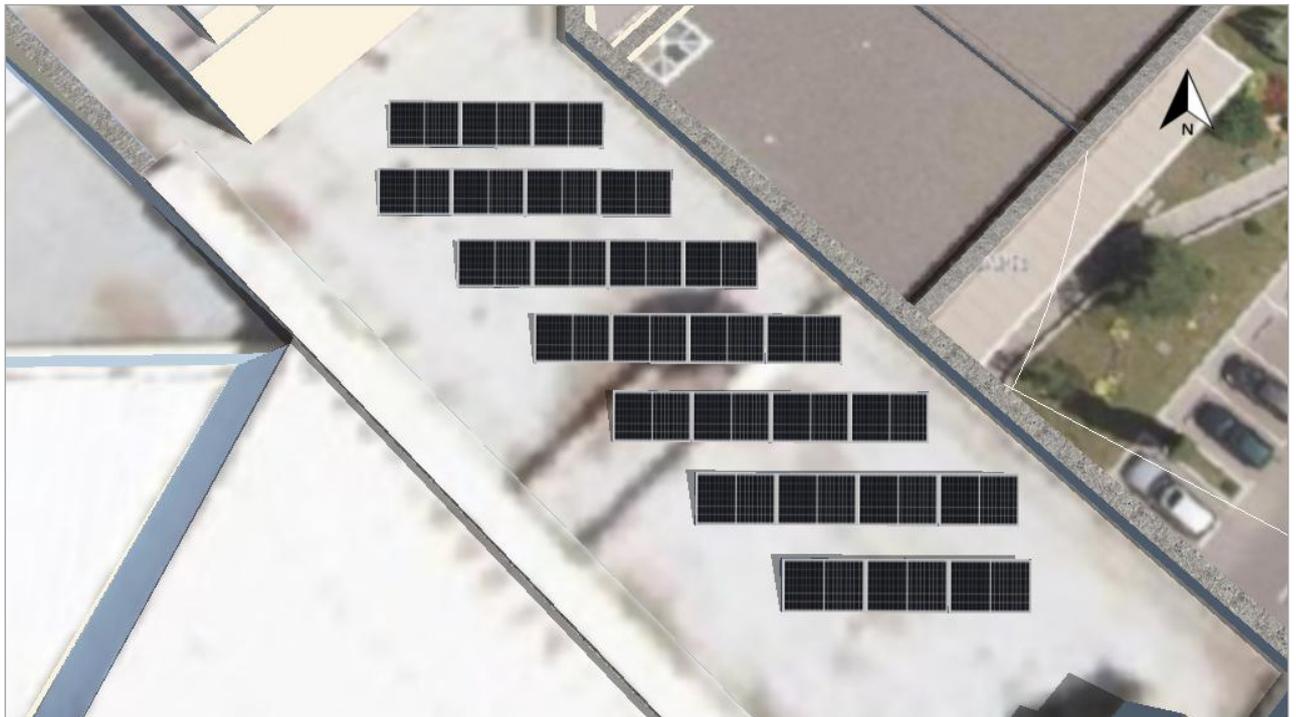


Figure: 3. Module Area - Arbitrary Building 03-Mounting Surface Northeast

Degradation of Module, 3. Module Area - Arbitrary Building 03-Mounting Surface Northeast

Remaining power (power output) after 1 year	98 %
Remaining power (power output) after 25 years	84.8 %

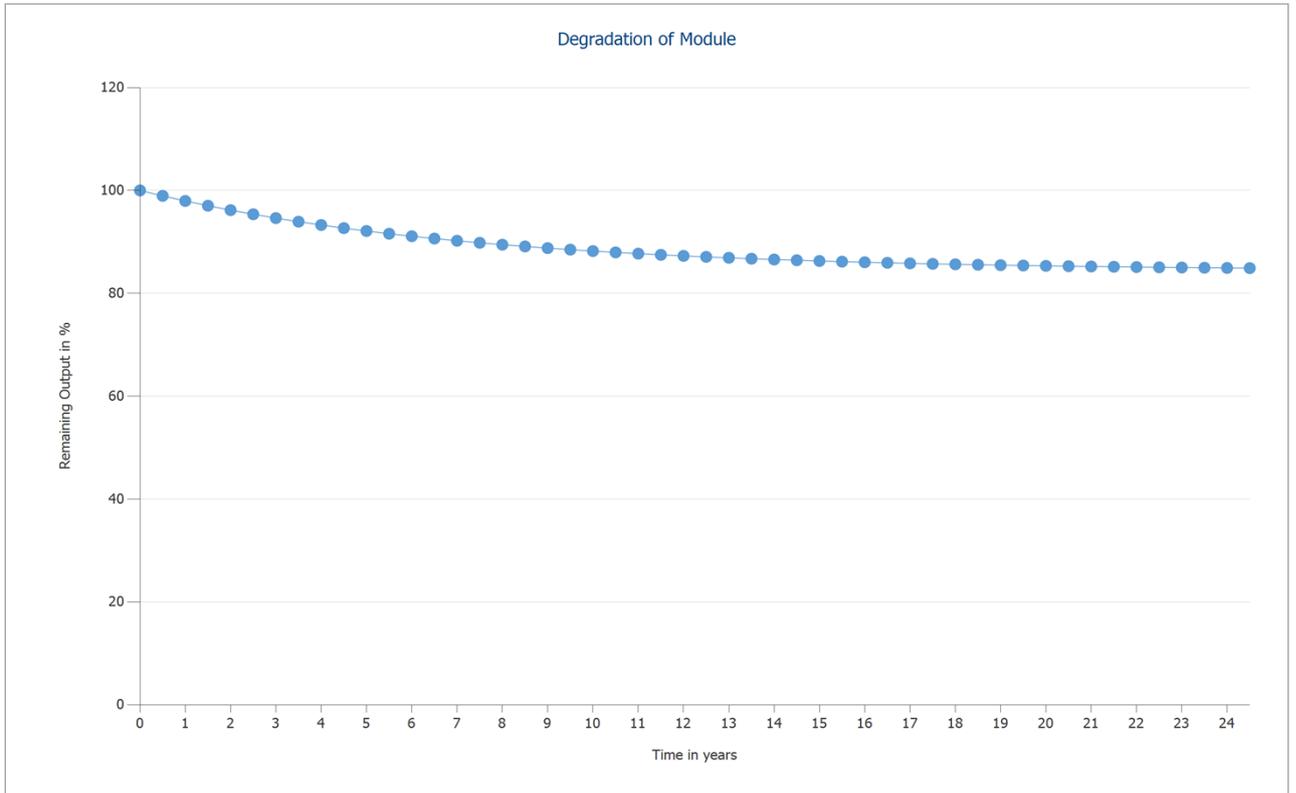


Figure: Degradation of Module, 3. Module Area - Arbitrary Building 03-Mounting Surface Northeast

Horizon Line, 3D Design

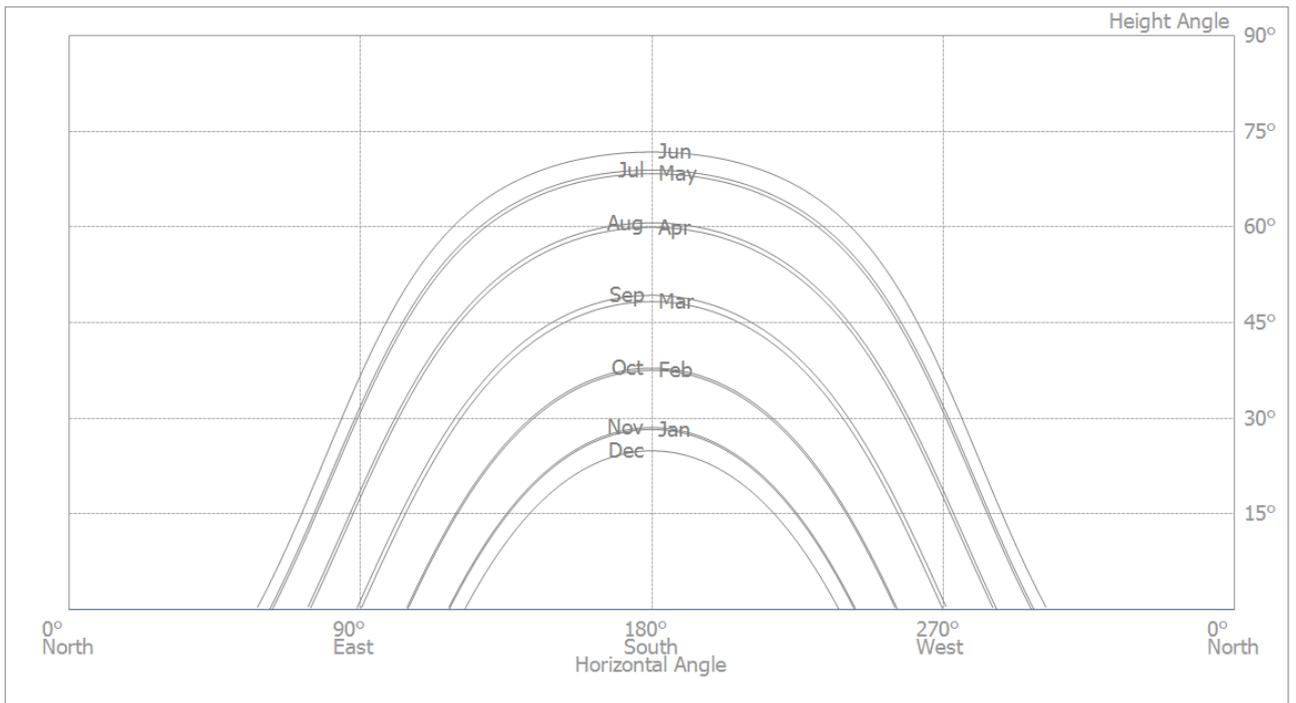


Figure: Horizon (3D Design)

## Inverter configuration

### Configuration 1

Module Areas	Arbitrary Building 08-Mounting Surface South + Arbitrary Building 09-Mounting Surface East + Arbitrary Building 03-Mounting Surface Northeast
<b>Inverter 1</b>	
Model	SUN2000 12KTL-M2 (v1)
Manufacturer	Huawei Technologies
Quantity	1
Sizing Factor	117.6 %
Configuration	MPP 1: 1 x 22 MPP 2: 1 x 12
<b>Inverter 2</b>	
Model	SUN2000MA-10KTL-M1(High Current Version-400Vac) (v2)
Manufacturer	Huawei Technologies
Quantity	1
Sizing Factor	107.9 %
Configuration	MPP 1: 1 x 13 MPP 2: 1 x 13

## AC Mains

### AC Mains

Number of Phases	3
Mains Voltage (1-phase)	230 V
Displacement Power Factor (cos phi)	+/- 1

# Simulation Results

## Results Total System

### PV System

PV Generator Output	24.9 kWp
Spec. Annual Yield	1,092.79 kWh/kWp
Performance Ratio (PR)	79.1 %
Yield Reduction due to Shading	14.2 %/Year
Grid Feed-in	27,265 kWh/Year
Grid Feed-in in the first year (incl. module degradation)	26,905 kWh/Year
Standby Consumption (Inverter)	55 kWh/Year
CO <sub>2</sub> Emissions avoided	12,789 kg / year

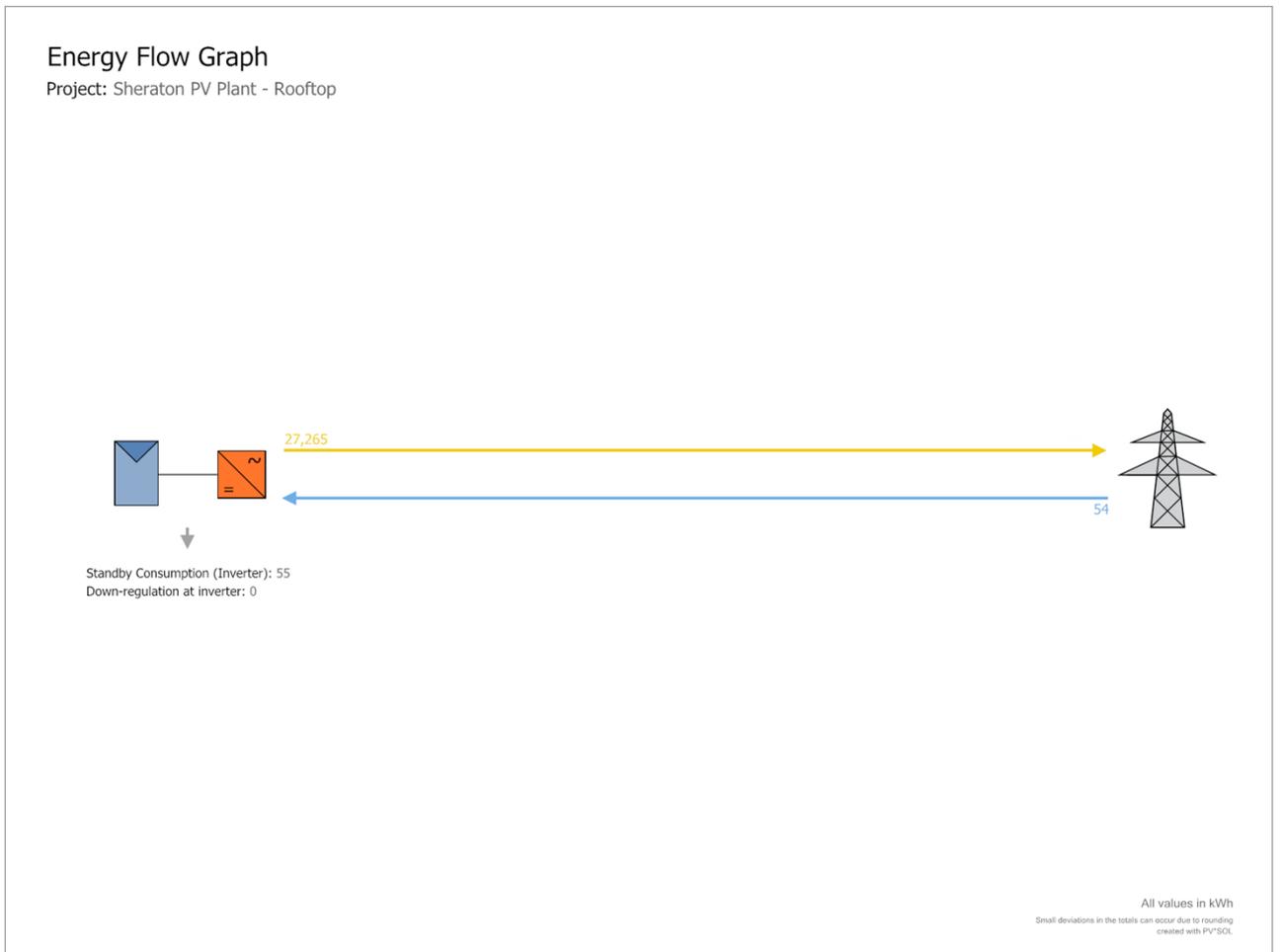


Figure: Energy Flow Graph

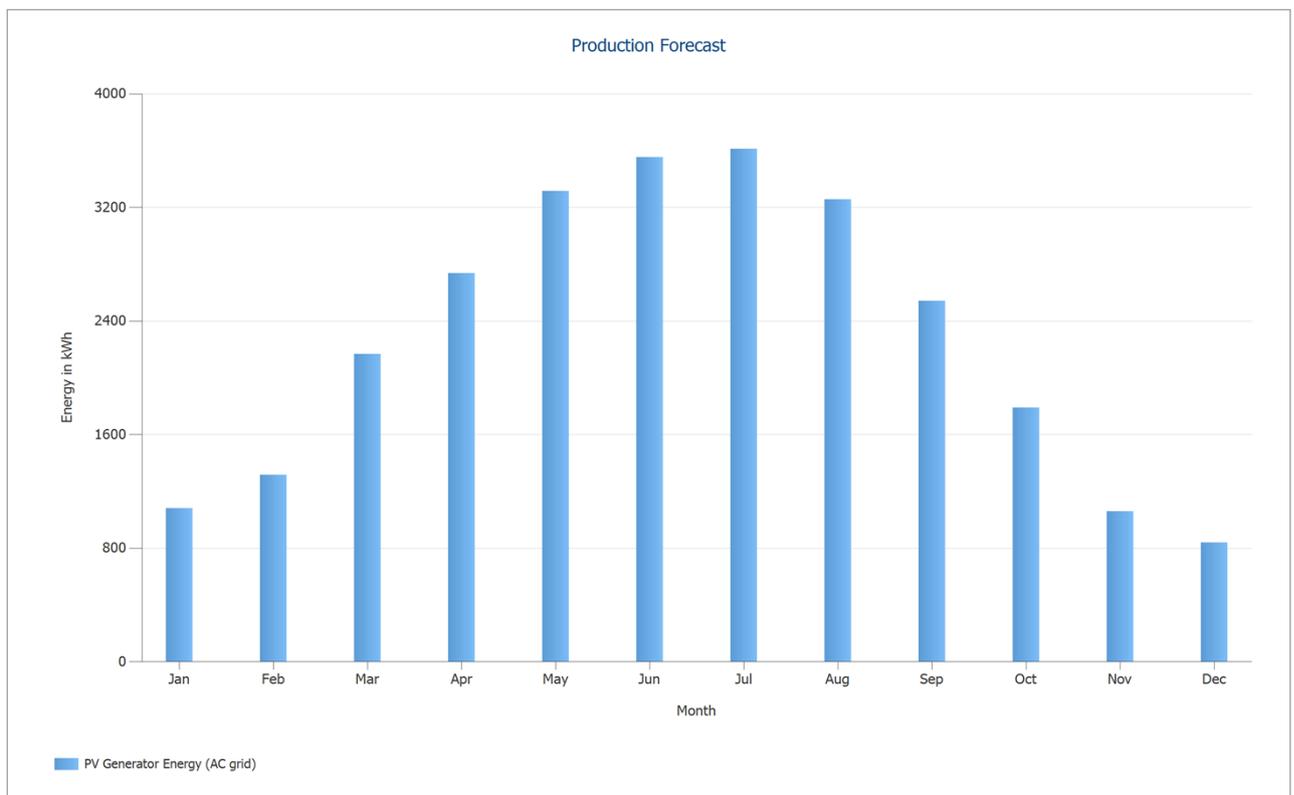


Figure: Production Forecast

## Results per Module Area

### Arbitrary Building 08-Mounting Surface South

PV Generator Output	9.13 kWp
PV Generator Surface	42.96 m <sup>2</sup>
Global Radiation at the Module	1345.90 kWh/m <sup>2</sup>
Global Radiation on Module without reflection	1373.34 kWh/m <sup>2</sup>
Performance Ratio (PR)	73.06 %
PV Generator Energy (AC grid)	9160.82 kWh/Year
Spec. Annual Yield	1003.38 kWh/kWp

### Arbitrary Building 09-Mounting Surface East

PV Generator Output	4.98 kWp
PV Generator Surface	23.43 m <sup>2</sup>
Global Radiation at the Module	1356.17 kWh/m <sup>2</sup>
Global Radiation on Module without reflection	1383.82 kWh/m <sup>2</sup>
Performance Ratio (PR)	75.56 %
PV Generator Energy (AC grid)	5207.25 kWh/Year
Spec. Annual Yield	1045.63 kWh/kWp

### Arbitrary Building 03-Mounting Surface Northeast

PV Generator Output	10.79 kWp
PV Generator Surface	50.77 m <sup>2</sup>
Global Radiation at the Module	1361.27 kWh/m <sup>2</sup>
Global Radiation on Module without reflection	1389.02 kWh/m <sup>2</sup>
Performance Ratio (PR)	86.05 %
PV Generator Energy (AC grid)	12897.23 kWh/Year
Spec. Annual Yield	1195.29 kWh/kWp

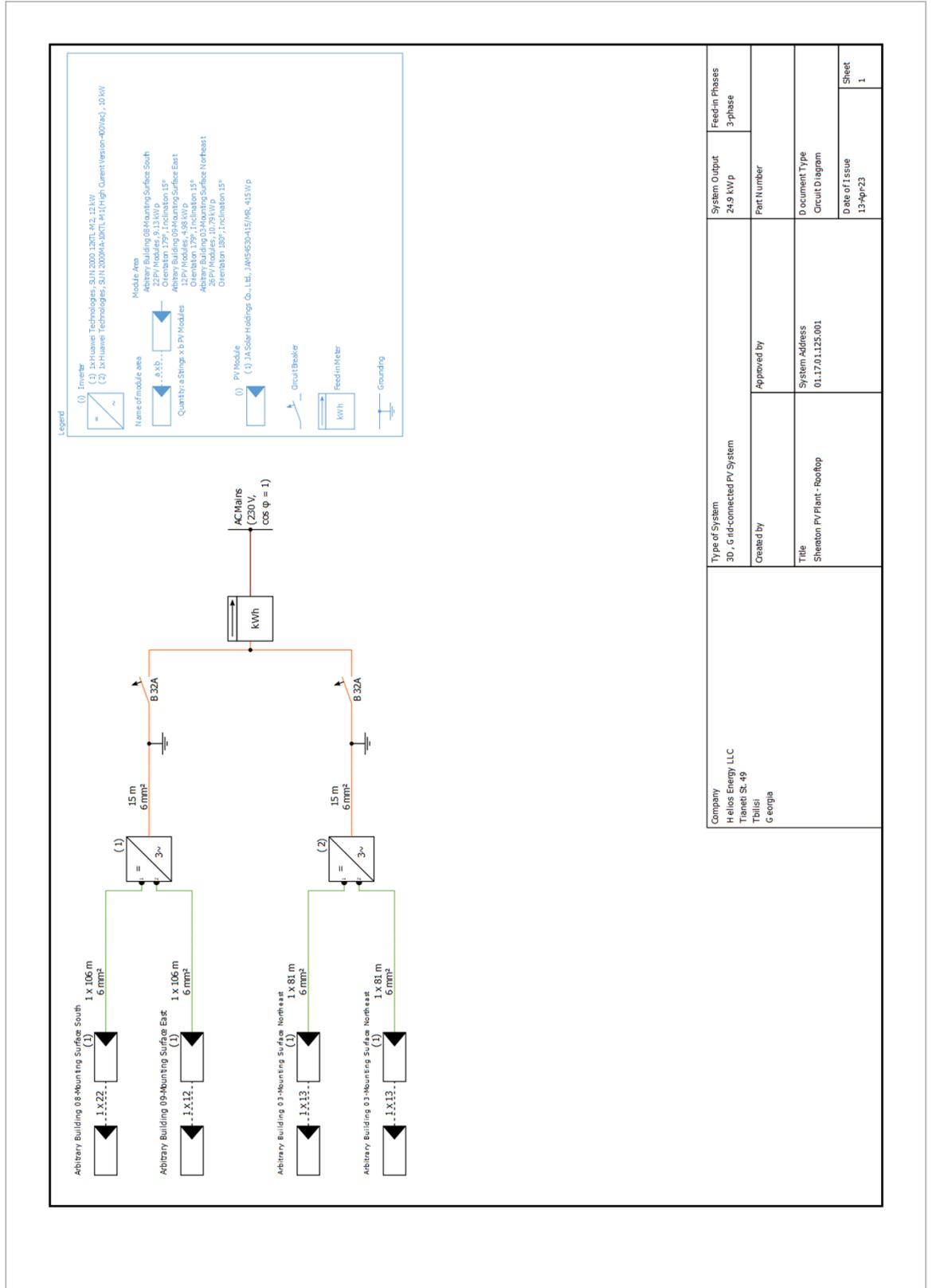
# PV System Energy Balance

## PV System Energy Balance

<b>Global radiation - horizontal</b>	<b>1,334.70 kWh/m<sup>2</sup></b>	
Deviation from standard spectrum	-13.35 kWh/m <sup>2</sup>	-1.00 %
Ground Reflection (Albedo)	4.50 kWh/m <sup>2</sup>	0.34 %
Orientation and inclination of the module surface	89.38 kWh/m <sup>2</sup>	6.74 %
Module-independent shading	-33.01 kWh/m <sup>2</sup>	-2.33 %
Reflection on the Module Interface	-27.62 kWh/m <sup>2</sup>	-2.00 %
<b>Global Radiation at the Module</b>	<b>1,354.61 kWh/m<sup>2</sup></b>	
	1,354.61 kWh/m <sup>2</sup>	
	x 117.165 m <sup>2</sup>	
	= 158,712.89 kWh	
<b>Global PV Radiation</b>	<b>158,712.89 kWh</b>	
Soiling	0.00 kWh	0.00 %
STC Conversion (Rated Efficiency of Module 21.25 %)	-124,979.87 kWh	-78.75 %
<b>Rated PV Energy</b>	<b>33,733.02 kWh</b>	
Module-specific Partial Shading	-3,251.81 kWh	-9.64 %
Low-light performance	-72.63 kWh	-0.24 %
Deviation from the nominal module temperature	-889.87 kWh	-2.93 %
Diodes	-104.00 kWh	-0.35 %
Mismatch (Manufacturer Information)	-588.29 kWh	-2.00 %
Mismatch (Configuration/Shading)	-410.84 kWh	-1.43 %
String Cable	-134.05 kWh	-0.47 %
<b>PV Energy (DC) without inverter down-regulation</b>	<b>28,281.53 kWh</b>	
Failing to reach the DC start output	-5.76 kWh	-0.02 %
Down-regulation on account of the MPP Voltage Range	-105.36 kWh	-0.37 %
Down-regulation on account of the max. DC Current	-0.73 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	-5.01 kWh	-0.02 %
MPP Matching	-14.15 kWh	-0.05 %
<b>PV energy (DC)</b>	<b>28,150.52 kWh</b>	
<b>Energy at the Inverter Input</b>	<b>28,150.52 kWh</b>	
Input voltage deviates from rated voltage	-237.92 kWh	-0.85 %
DC/AC Conversion	-602.75 kWh	-2.16 %
Standby Consumption (Inverter)	-54.76 kWh	-0.20 %
AC cables	-44.56 kWh	-0.16 %
<b>PV energy (AC) minus standby use</b>	<b>27,210.54 kWh</b>	
<b>PV Generator Energy (AC grid)</b>	<b>27,265.29 kWh</b>	

# Plans and parts list

## Circuit Diagram



Company Helios Energy LLC Tianeti St., 49 Tbilisi Georgia	Type of System 3D, Grid-connected PV System	System Output 24.9 kW p	Feed-in Phases 3-phase
Created by Sheraton PV Plant - Rooftop	Approved by	Part Number	
Title Sheraton PV Plant - Rooftop	System Address 01.17.0.1.125.001	Document Type Circuit Diagram	
		Date of Issue 13-Apr-23	Sheet 1

Figure: Circuit Diagram

# Dimensioning Plan

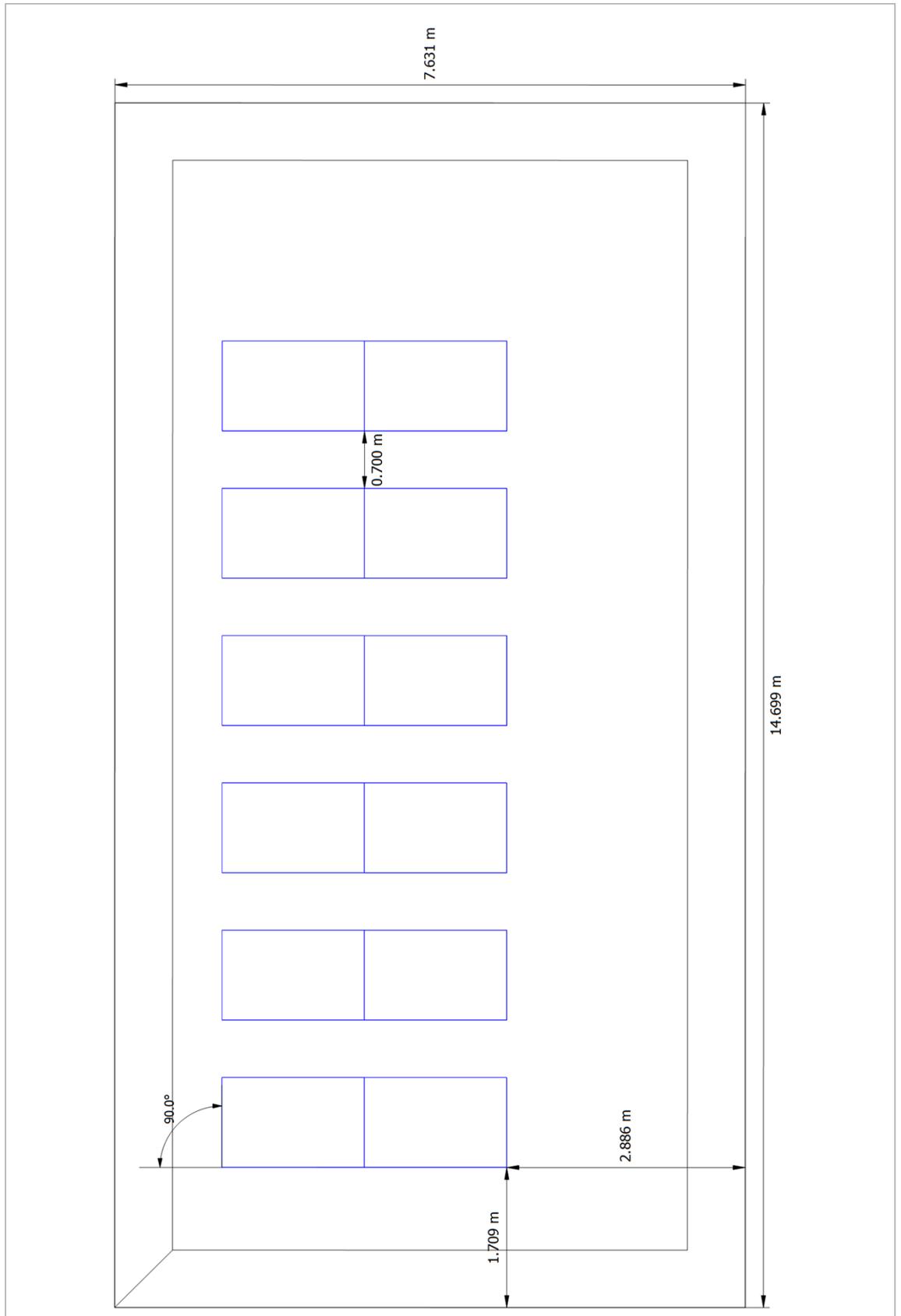


Figure: Arbitrary Building 09-Mounting Surface East

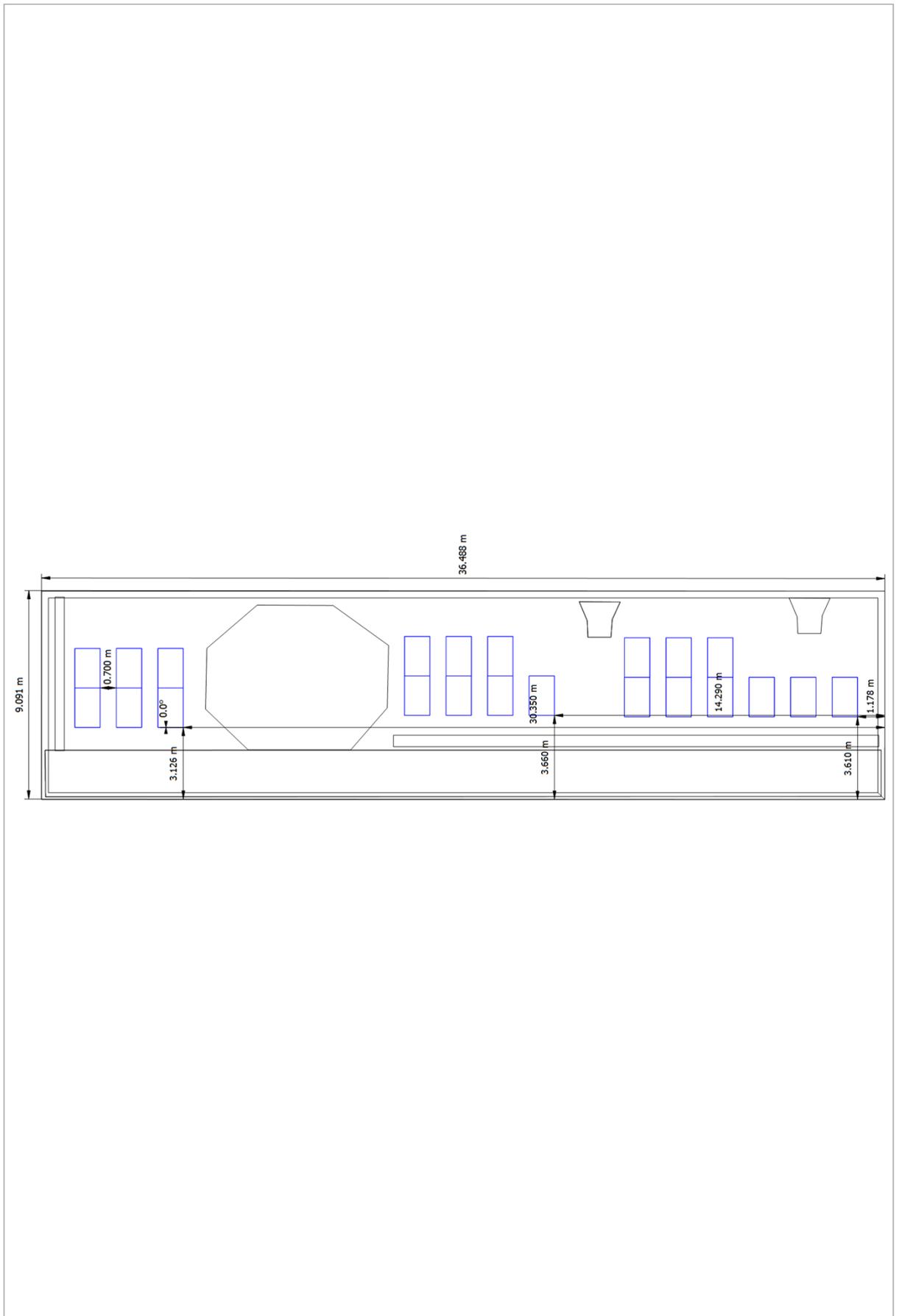


Figure: Arbitrary Building 08-Mounting Surface South

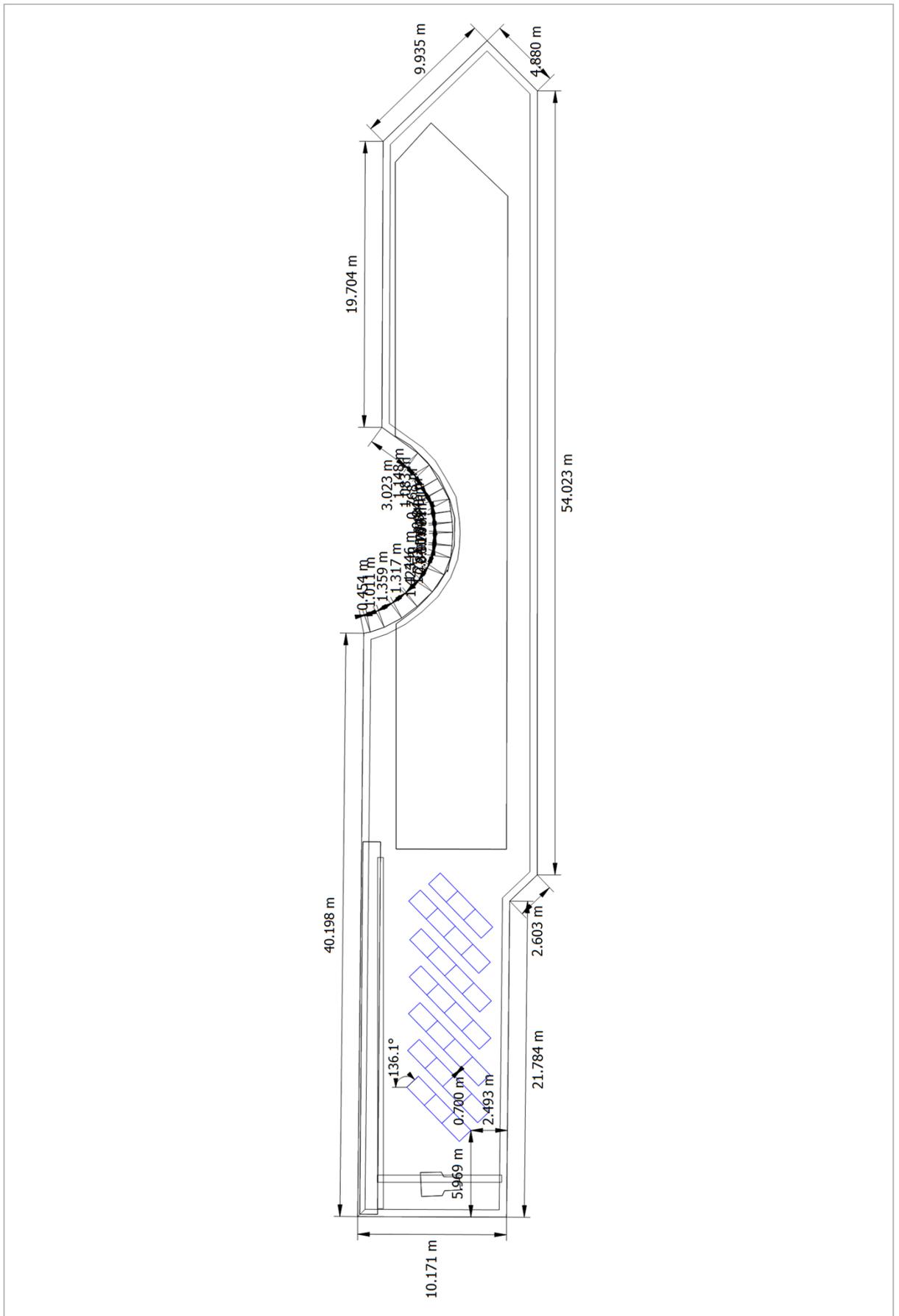


Figure: Arbitrary Building 03-Mounting Surface Northeast

# String Plan

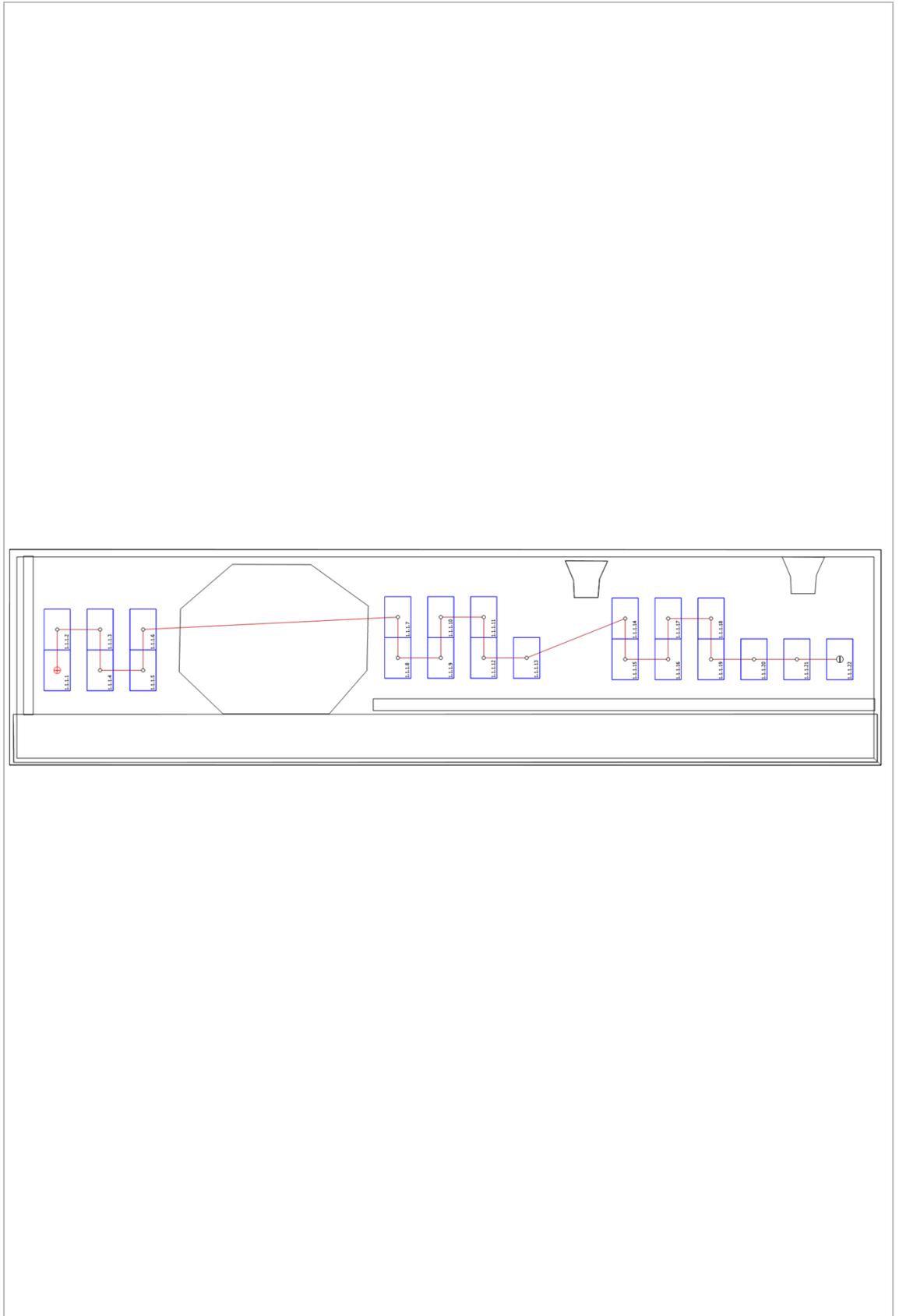


Figure: Arbitrary Building 08-Mounting Surface South

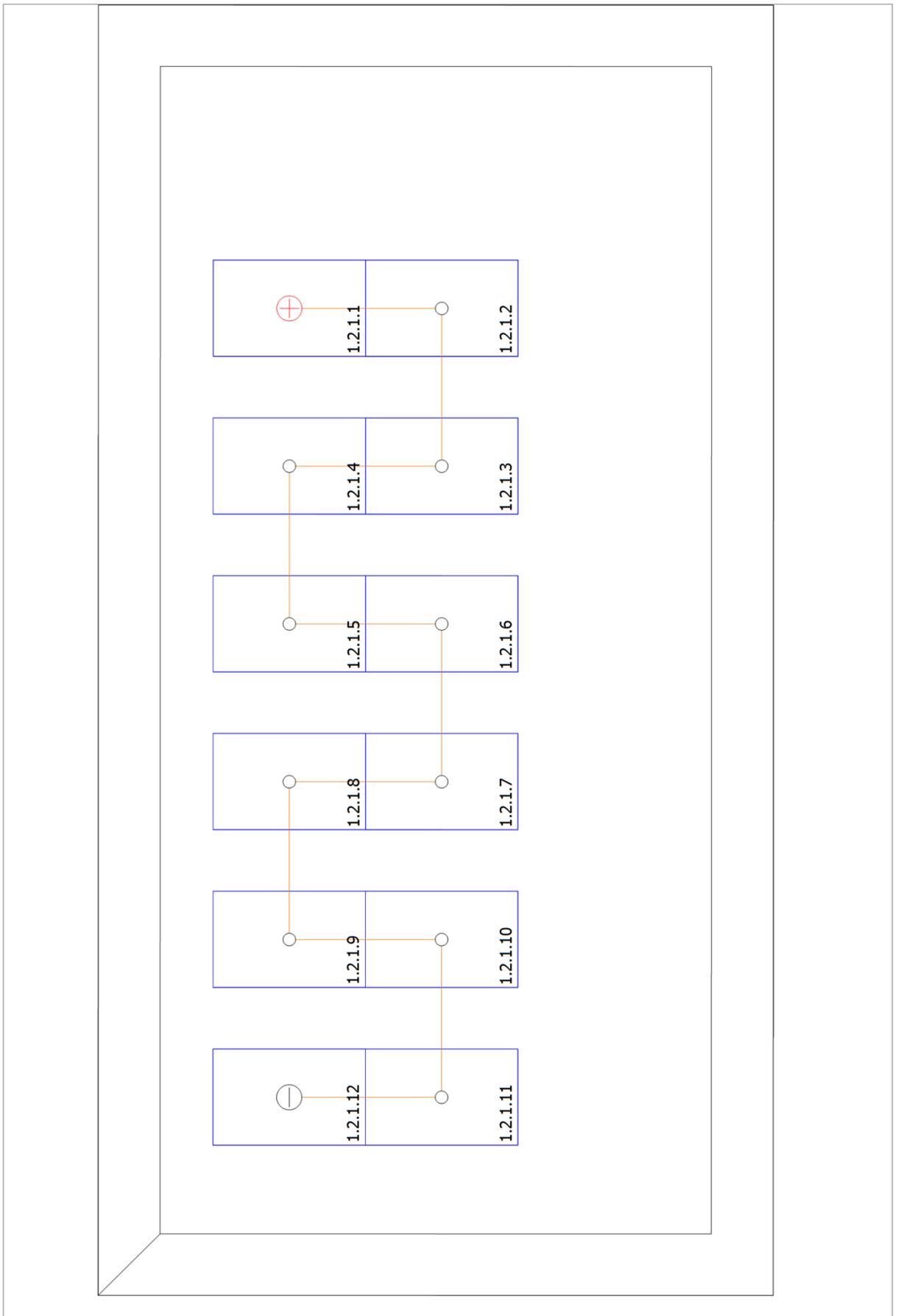


Figure: Arbitrary Building 09-Mounting Surface East

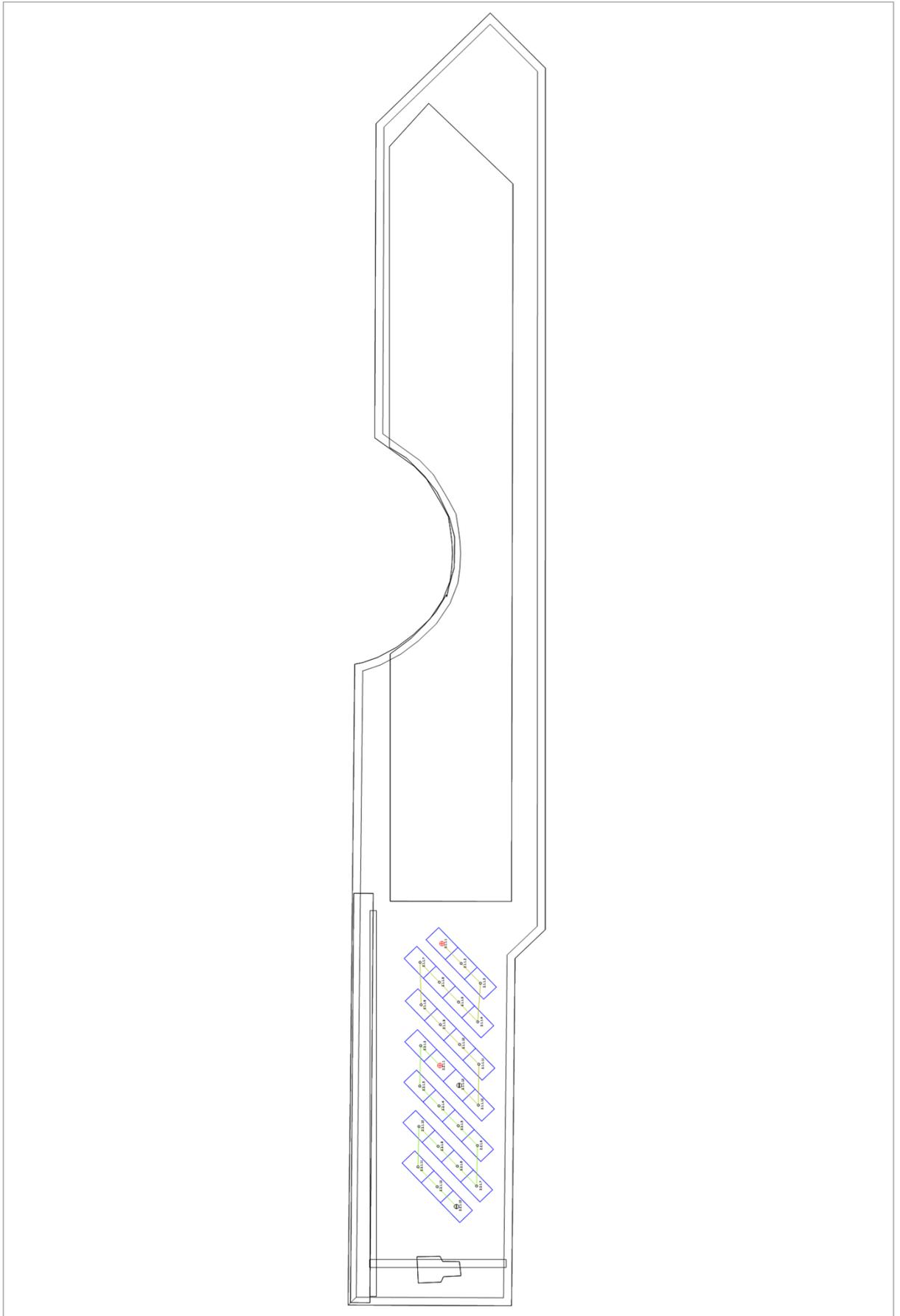


Figure: Arbitrary Building 03-Mounting Surface Northeast

## Parts list

### Parts list

#	Type	Item number	Manufacturer	Name	Quantity	Unit
1	PV Module		JA Solar Holdings Co., Ltd.	JAM54S30-415/MR	60	Piece
2	Inverter		Huawei Technologies	SUN2000 12KTL-M2	1	Piece
3	Inverter		Huawei Technologies	SUN2000MA-10KTL-M1(High Current Version-400Vac)	1	Piece
4	Cable			AC cables 3-phase 6 mm <sup>2</sup> Copper	30	m
5	Cable			String Cable 6 mm <sup>2</sup> Copper	374	m
6	Components			Feed-in Meter	1	Piece
7	Components			Circuit Breaker B 32A	2	Piece

# Screenshots, 3D Design Environment

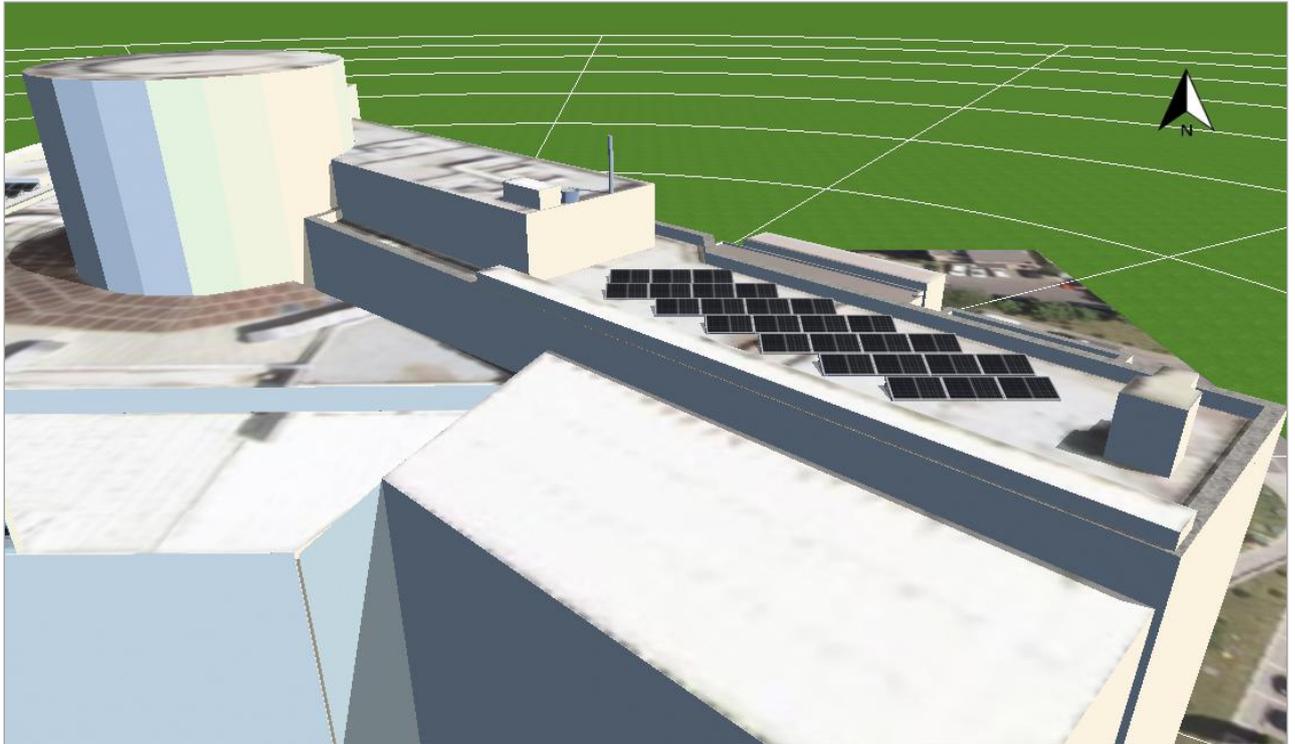


Figure: Screenshot04

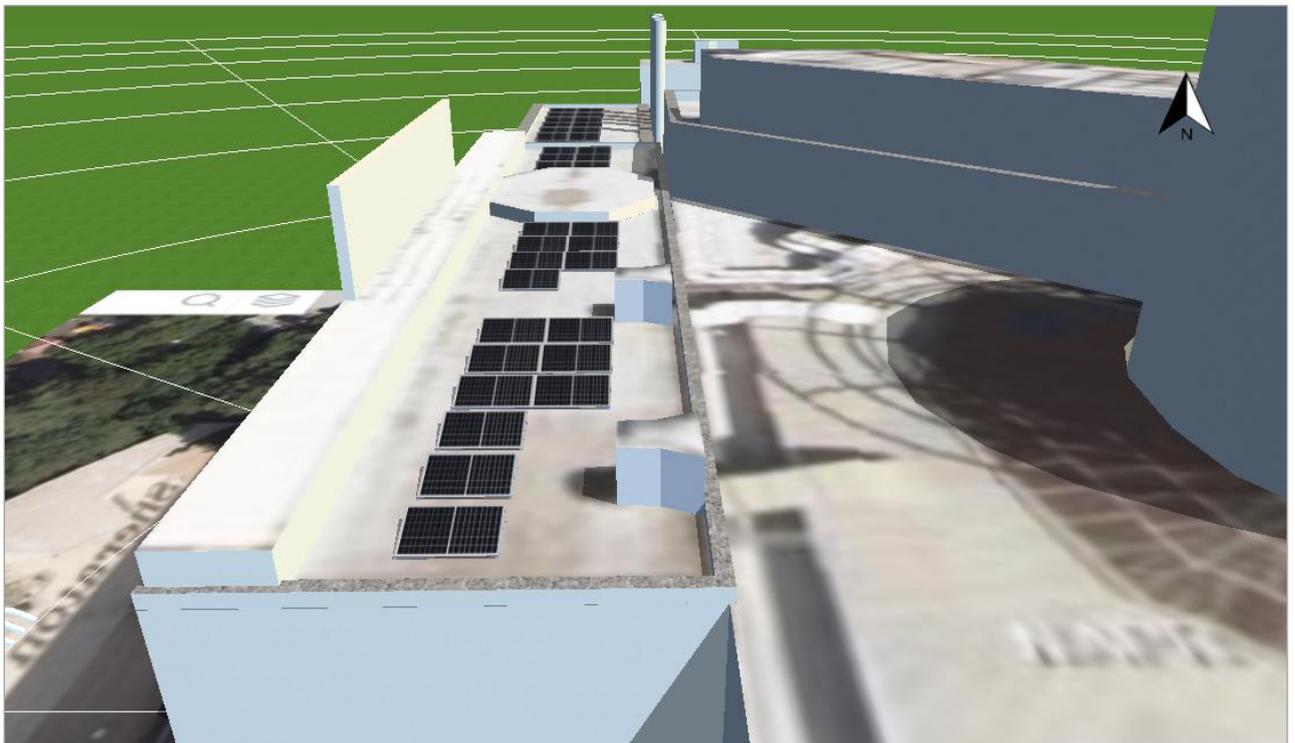


Figure: Screenshot05

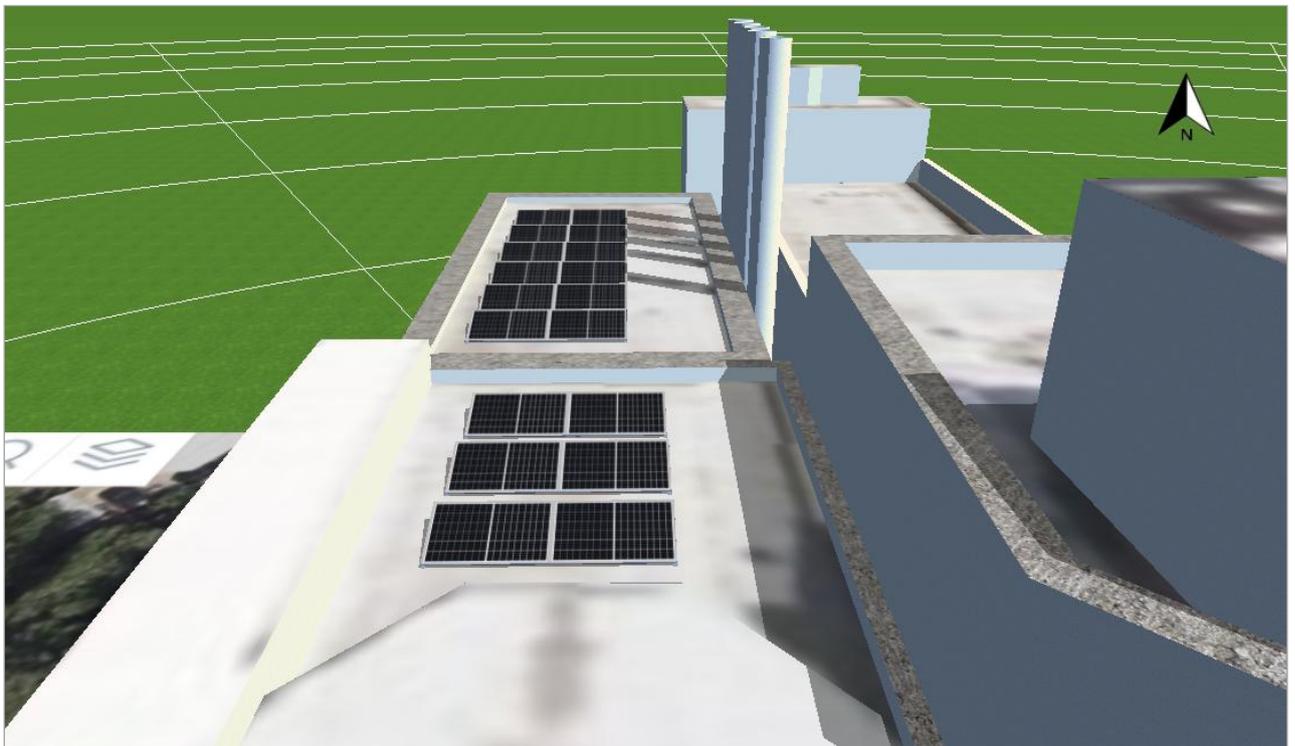


Figure: Screenshot06

### Shading

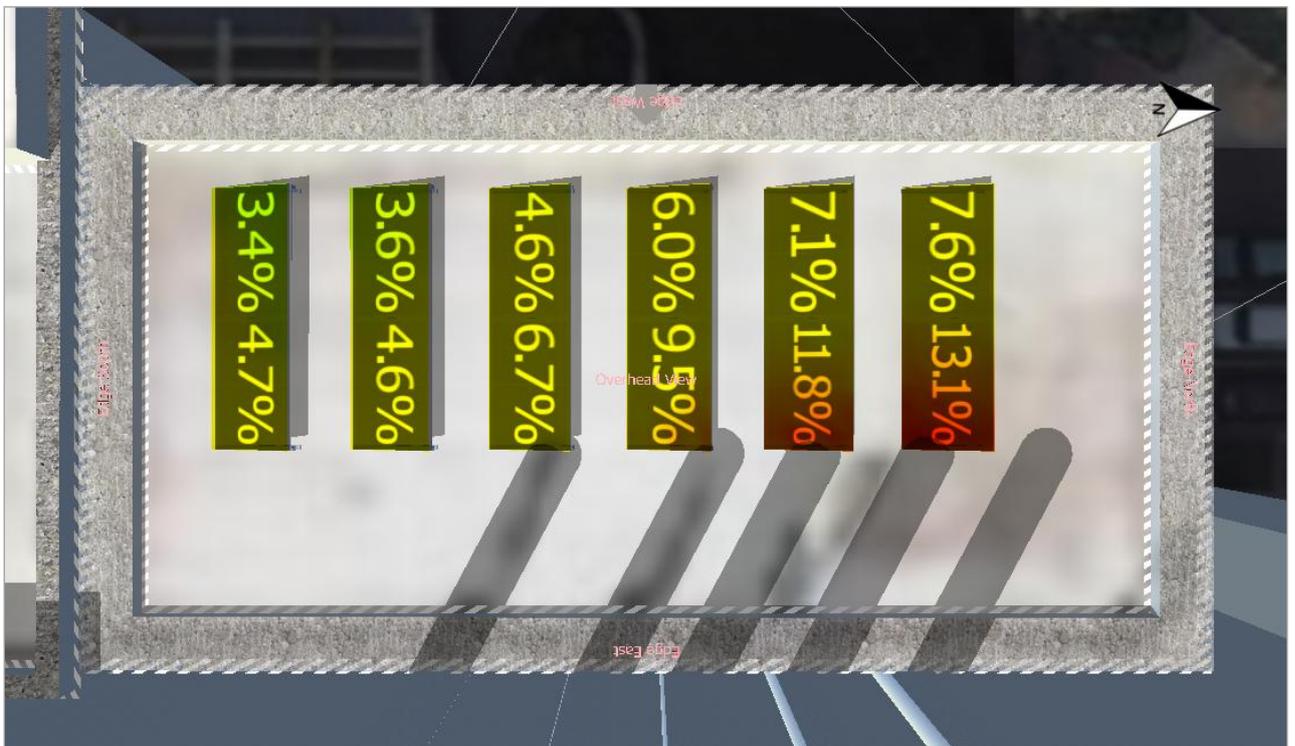


Figure: Screenshot01

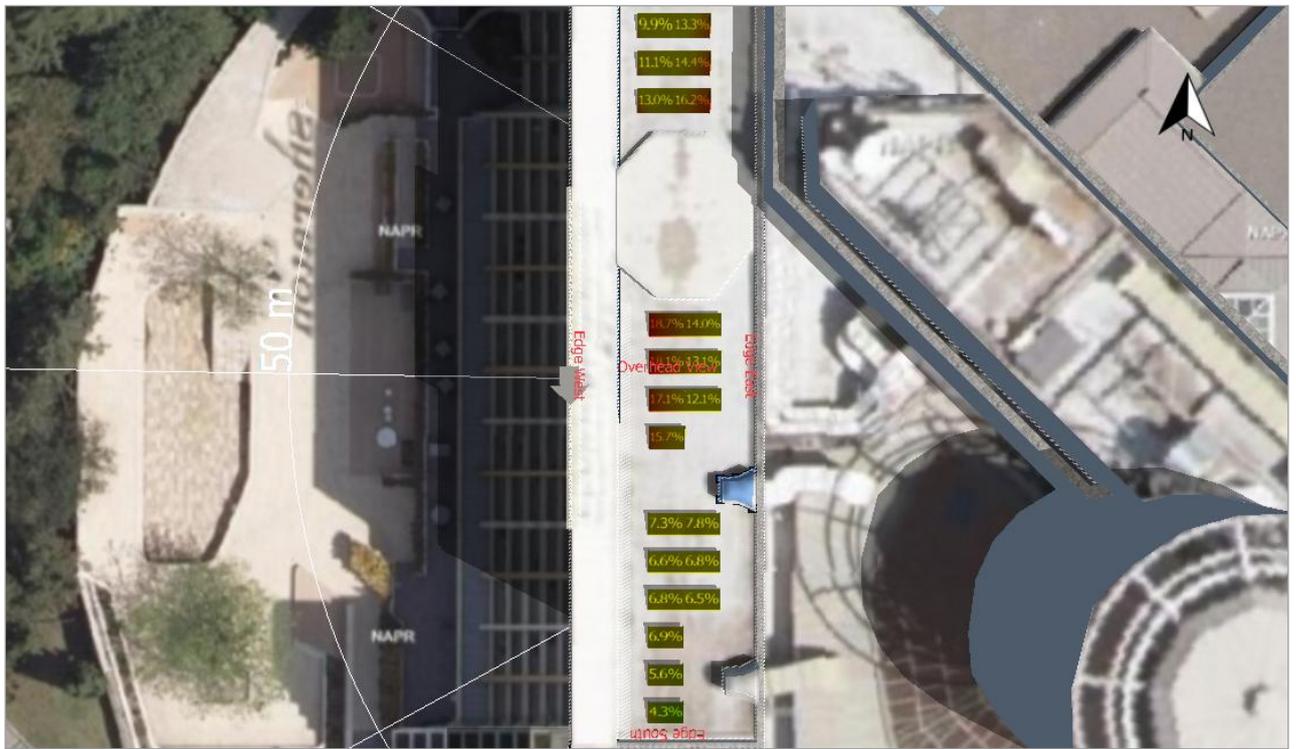


Figure: Screenshot02



Figure: Screenshot03