

Project Name: Maafaru Hospital

07.03.2022

Documentation

Customer Details

Company

Customer Number

Contact person

Address

Phone

Fax

E-Mail

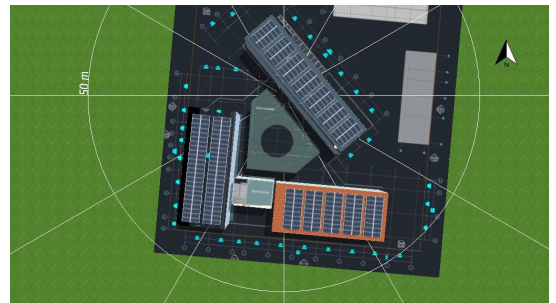
Project Data

Project Name Maafaru Hospital

Offer no.

Project Designer

Address



Project Overview

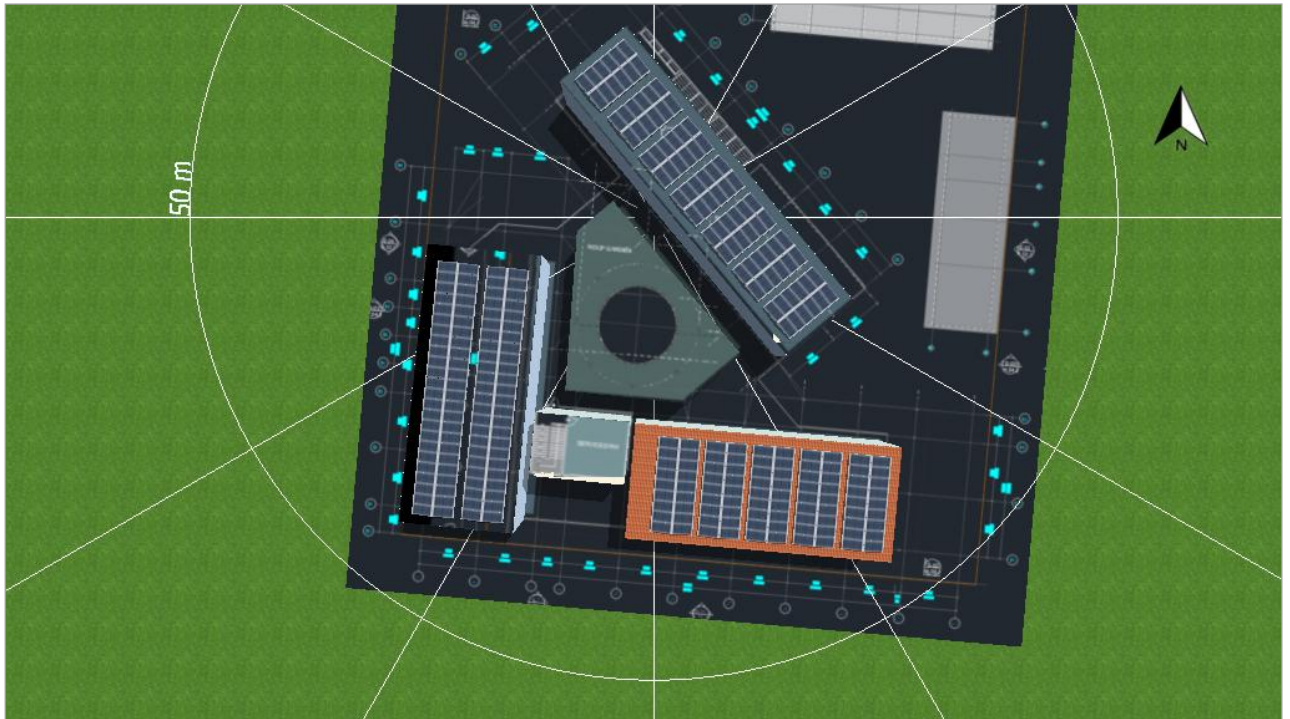


Figure: Overview Image, 3D Design

PV System

3D, Grid-connected PV System

Climate Data	Maafaru, MDV (1996 - 2015)
Values source	Meteonorm 8.1(i)
PV Generator Output	122,85 kWp
PV Generator Surface	590,2 m ²
Number of PV Modules	270
Number of Inverters	3

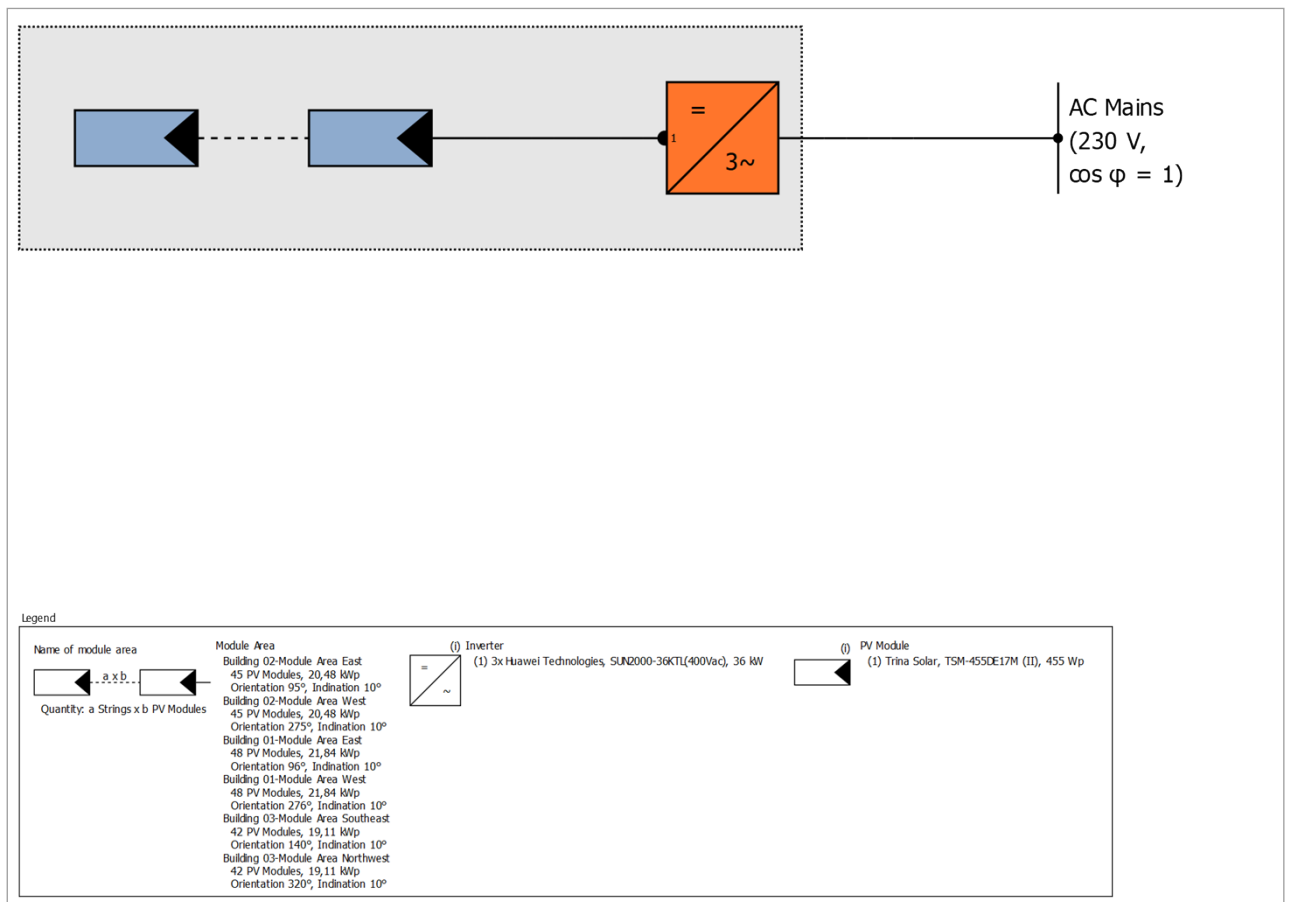


Figure: Schematic diagram

Production Forecast

Production Forecast

PV Generator Output	122,85 kWp
Spec. Annual Yield	1 557,51 kWh/kWp
Performance Ratio (PR)	79,41 %
Yield Reduction due to Shading	0,7 %/Year
Grid Feed-in	191 370 kWh/Year
Grid Feed-in in the first year (incl. module degradation)	188 718 kWh/Year
Standby Consumption (Inverter)	30 kWh/Year
CO ₂ Emissions avoided	89 930 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
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Climate Data

Location	Maafaru, MDV (1996 - 2015)
Values source	Meteonorm 8.1(i)
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 - Building 02-Module Area East

PV Generator, 1. Module Area - Building 02-Module Area East

Name	Building 02-Module Area East
PV Modules	45 x TSM-455DE17M (II) (v1)
Manufacturer	Trina Solar
Inclination	10 °
Orientation	East 95 °
Installation Type	Mounted - Roof
PV Generator Surface	98,4 m²

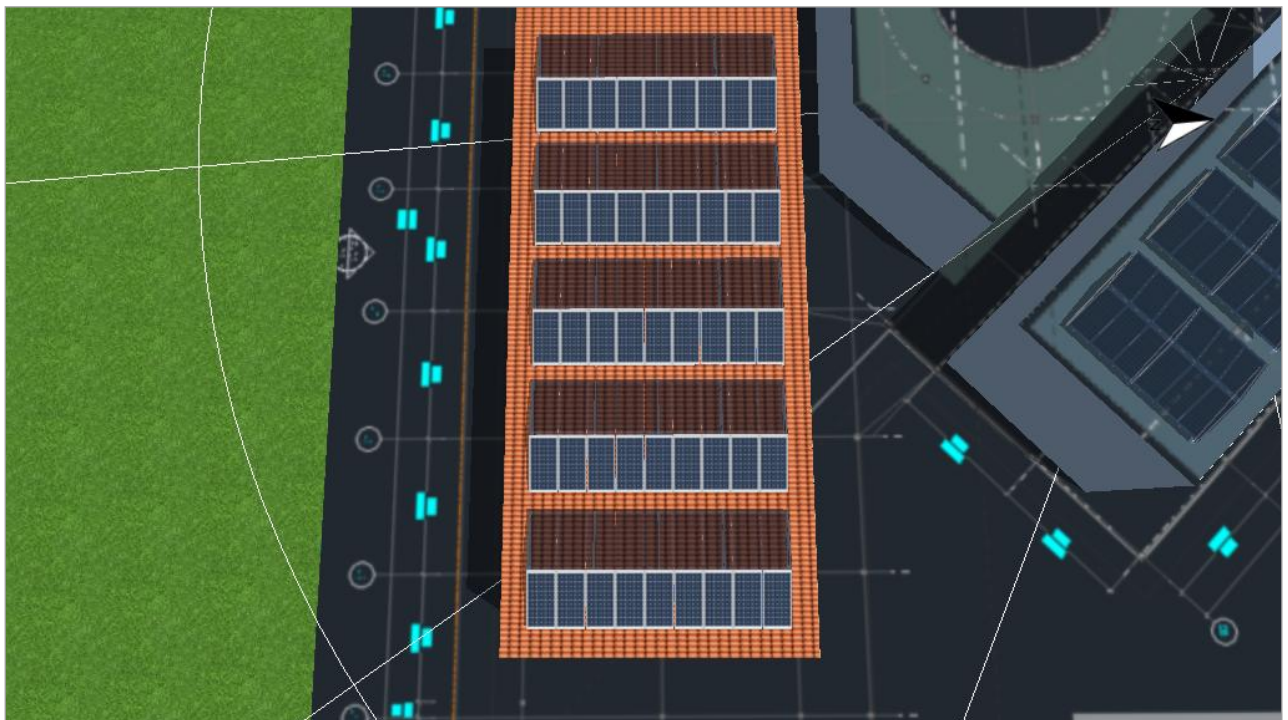


Figure: 1. Module Area - Building 02-Module Area East

Degradation of Module, 1. Module Area - Building 02-Module Area East

Characteristic curve	Exponential
Remaining power (power output) after 1 year	97,5 %
Remaining power (power output) after 30 years	83 %

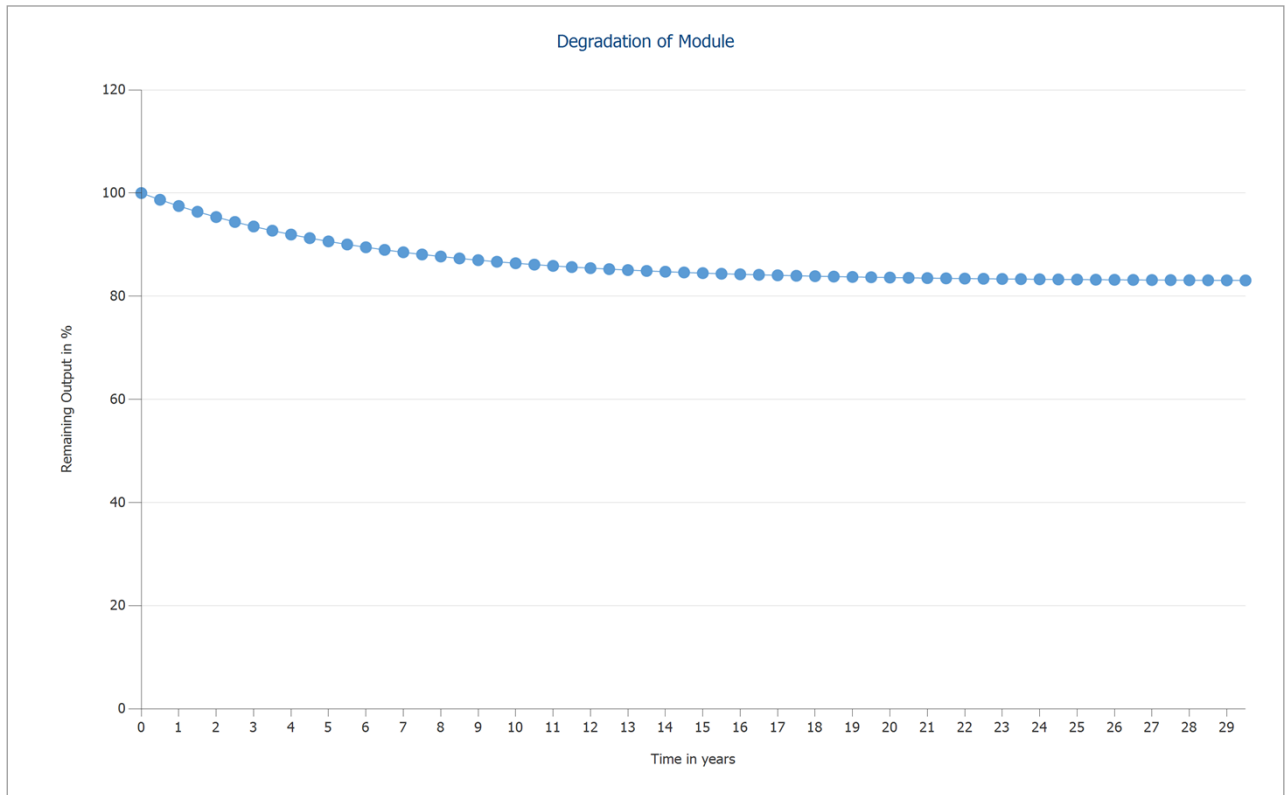


Figure: Degradation of Module, 1. Module Area - Building 02-Module Area East

2. Module Area - Building 02-Module Area West

PV Generator, 2. Module Area - Building 02-Module Area West

Name	Building 02-Module Area West
PV Modules	45 x TSM-455DE17M (II) (v1)
Manufacturer	Trina Solar
Inclination	10 °
Orientation	West 275 °
Installation Type	Mounted - Roof
PV Generator Surface	98,4 m ²

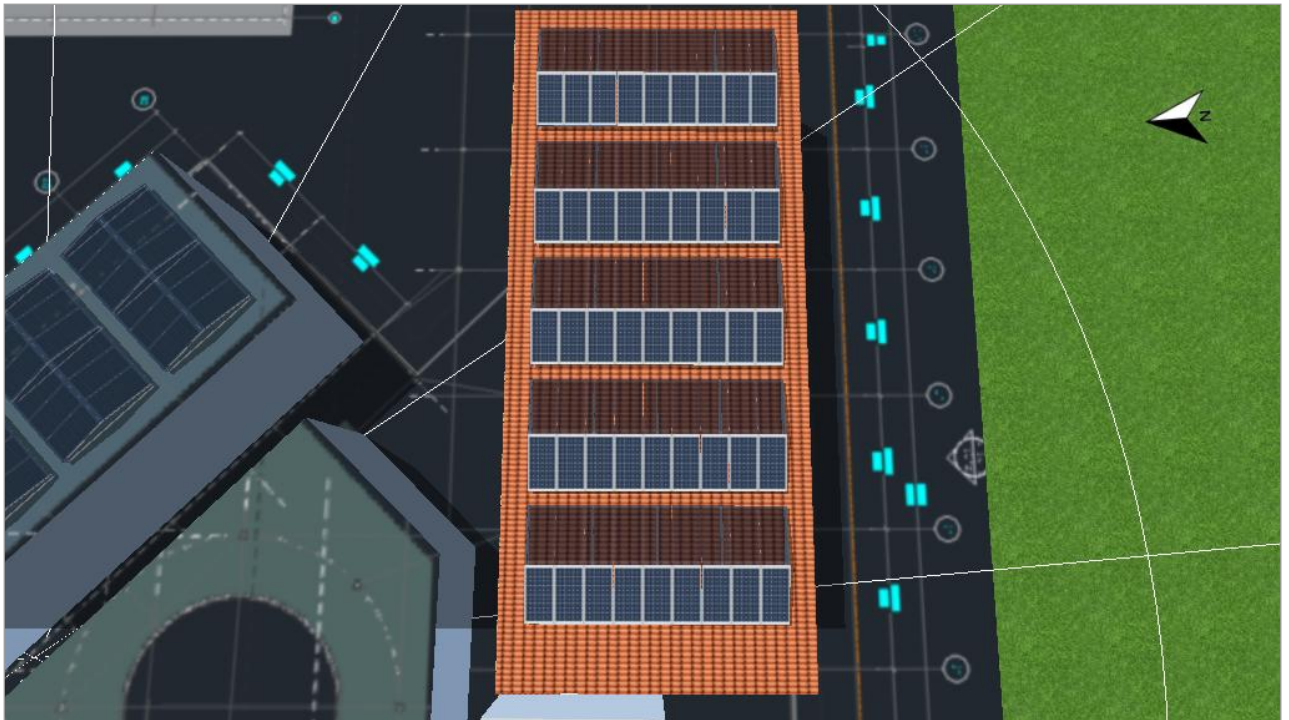


Figure: 2. Module Area - Building 02-Module Area West

Degradation of Module, 2. Module Area - Building 02-Module Area West

Characteristic curve	Exponential
Remaining power (power output) after 1 year	97,5 %
Remaining power (power output) after 30 years	83 %

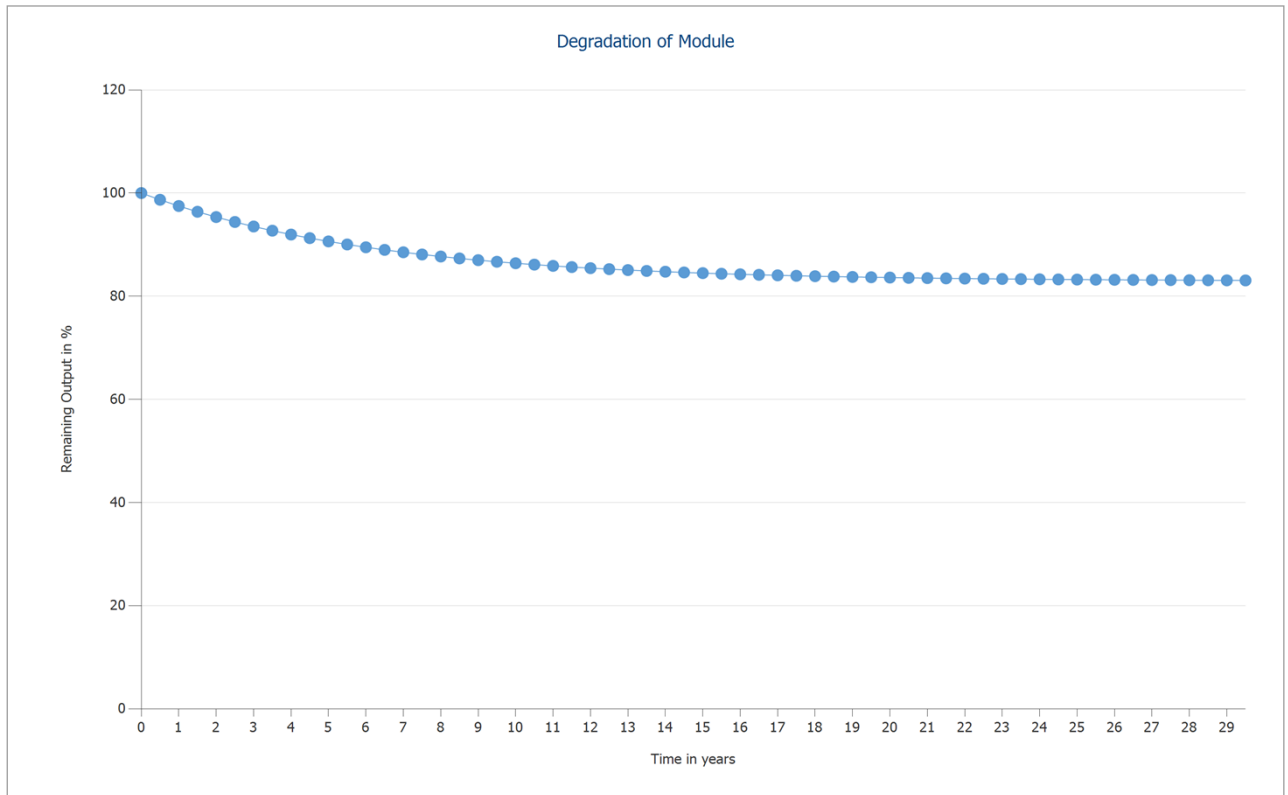


Figure: Degradation of Module, 2. Module Area - Building 02-Module Area West

3. Module Area - Building 01-Module Area East

PV Generator, 3. Module Area - Building 01-Module Area East

Name	Building 01-Module Area East
PV Modules	48 x TSM-455DE17M (II) (v1)
Manufacturer	Trina Solar
Inclination	10 °
Orientation	East 96 °
Installation Type	Mounted - Roof
PV Generator Surface	104,9 m ²

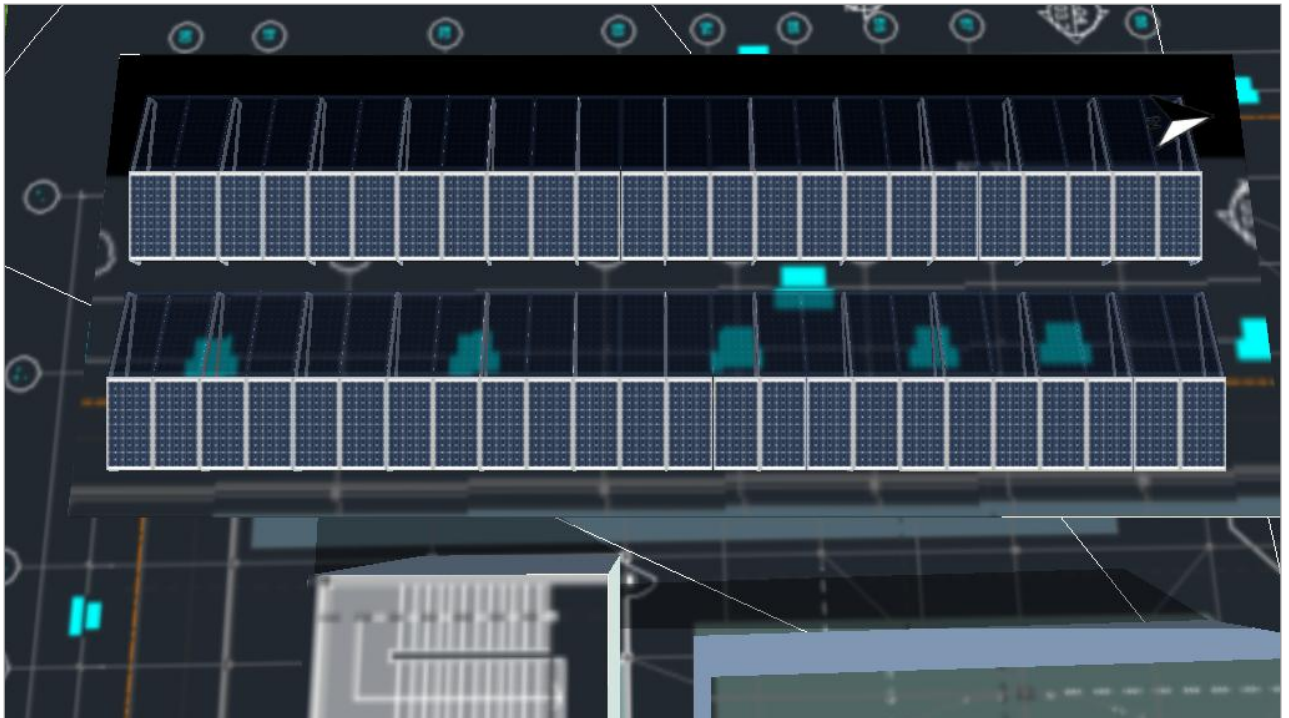


Figure: 3. Module Area - Building 01-Module Area East

Degradation of Module, 3. Module Area - Building 01-Module Area East

Characteristic curve	Exponential
Remaining power (power output) after 1 year	97,5 %
Remaining power (power output) after 30 years	83 %

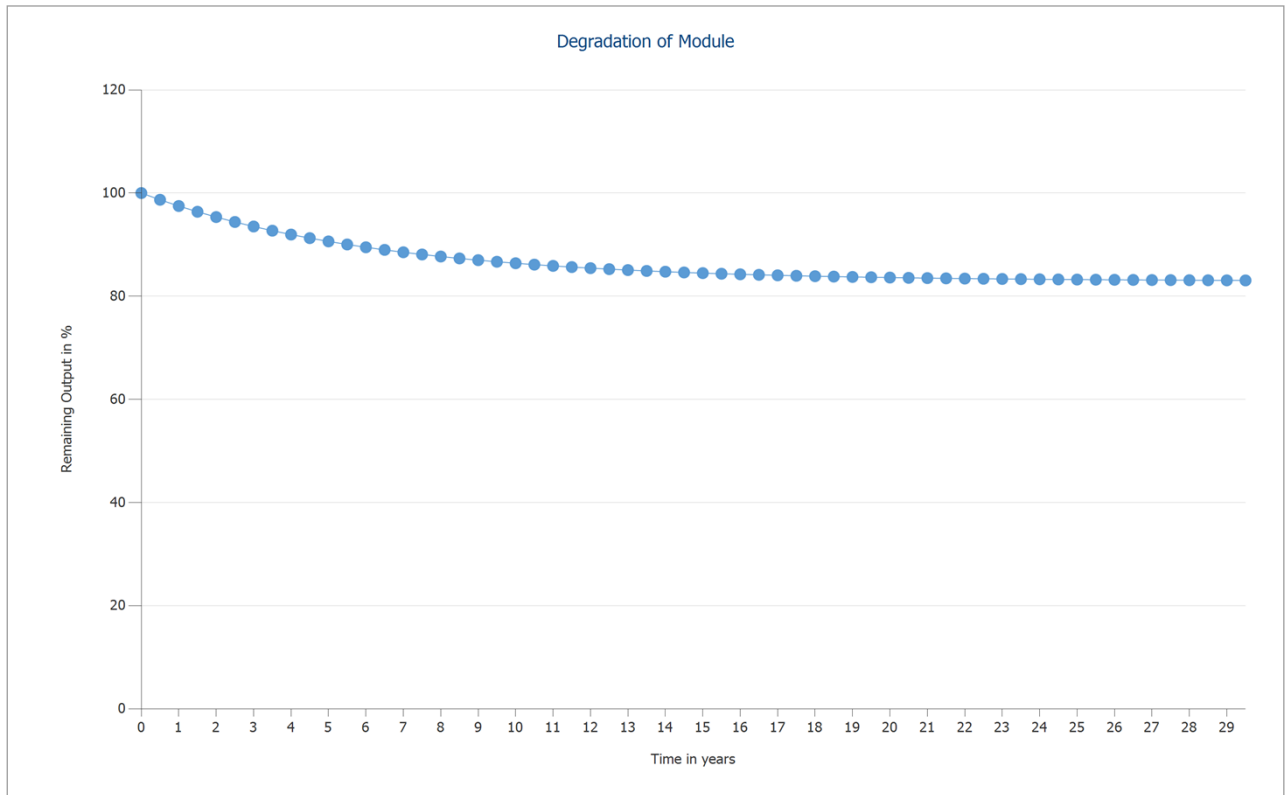


Figure: Degradation of Module, 3. Module Area - Building 01-Module Area East

4. Module Area - Building 01-Module Area West

PV Generator, 4. Module Area - Building 01-Module Area West

Name	Building 01-Module Area West
PV Modules	48 x TSM-455DE17M (II) (v1)
Manufacturer	Trina Solar
Inclination	10 °
Orientation	West 276 °
Installation Type	Mounted - Roof
PV Generator Surface	104,9 m²

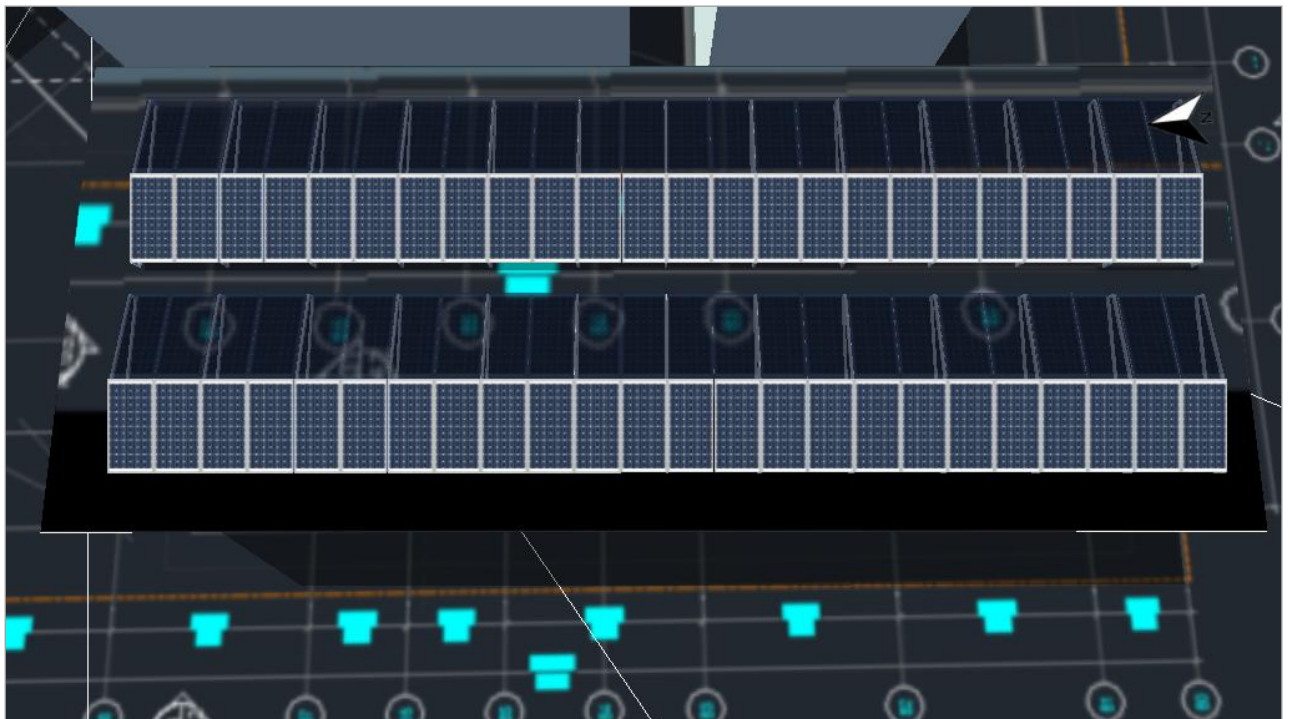


Figure: 4. Module Area - Building 01-Module Area West

Degradation of Module, 4. Module Area - Building 01-Module Area West

Characteristic curve	Exponential
Remaining power (power output) after 1 year	97,5 %
Remaining power (power output) after 30 years	83 %

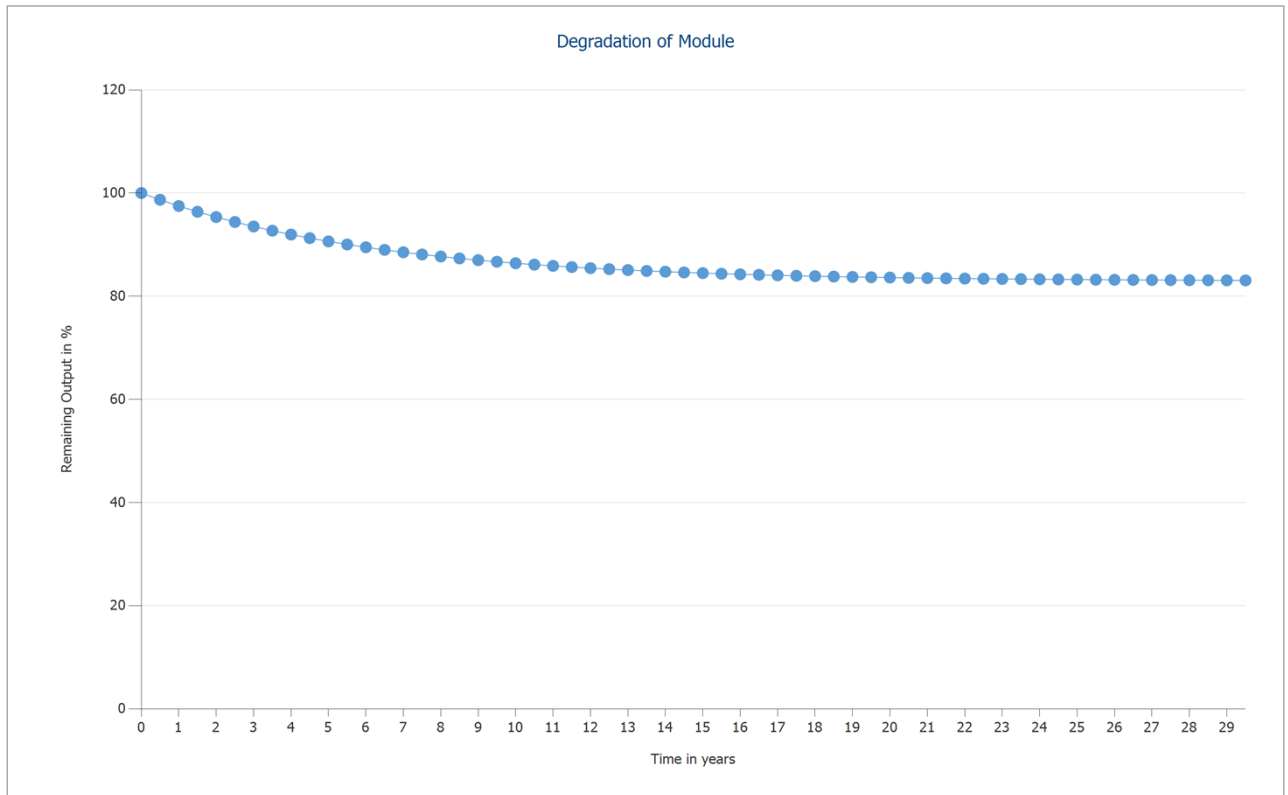


Figure: Degradation of Module, 4. Module Area - Building 01-Module Area West

5. Module Area - Building 03-Module Area Southeast

PV Generator, 5. Module Area - Building 03-Module Area Southeast

Name	Building 03-Module Area Southeast
PV Modules	42 x TSM-455DE17M (II) (v1)
Manufacturer	Trina Solar
Inclination	10 °
Orientation	Southeast 140 °
Installation Type	Mounted - Roof
PV Generator Surface	91,8 m²

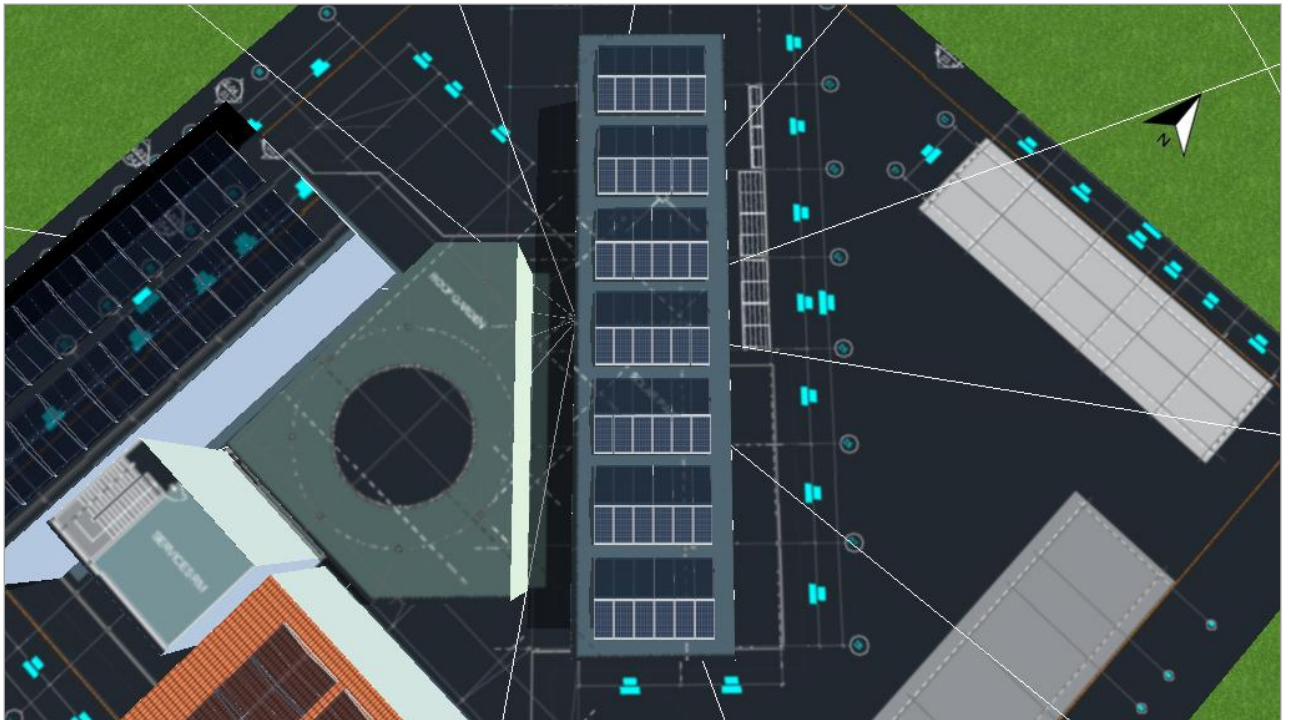


Figure: 5. Module Area - Building 03-Module Area Southeast

Degradation of Module, 5. Module Area - Building 03-Module Area Southeast

Characteristic curve	Exponential
Remaining power (power output) after 1 year	97,5 %
Remaining power (power output) after 30 years	83 %

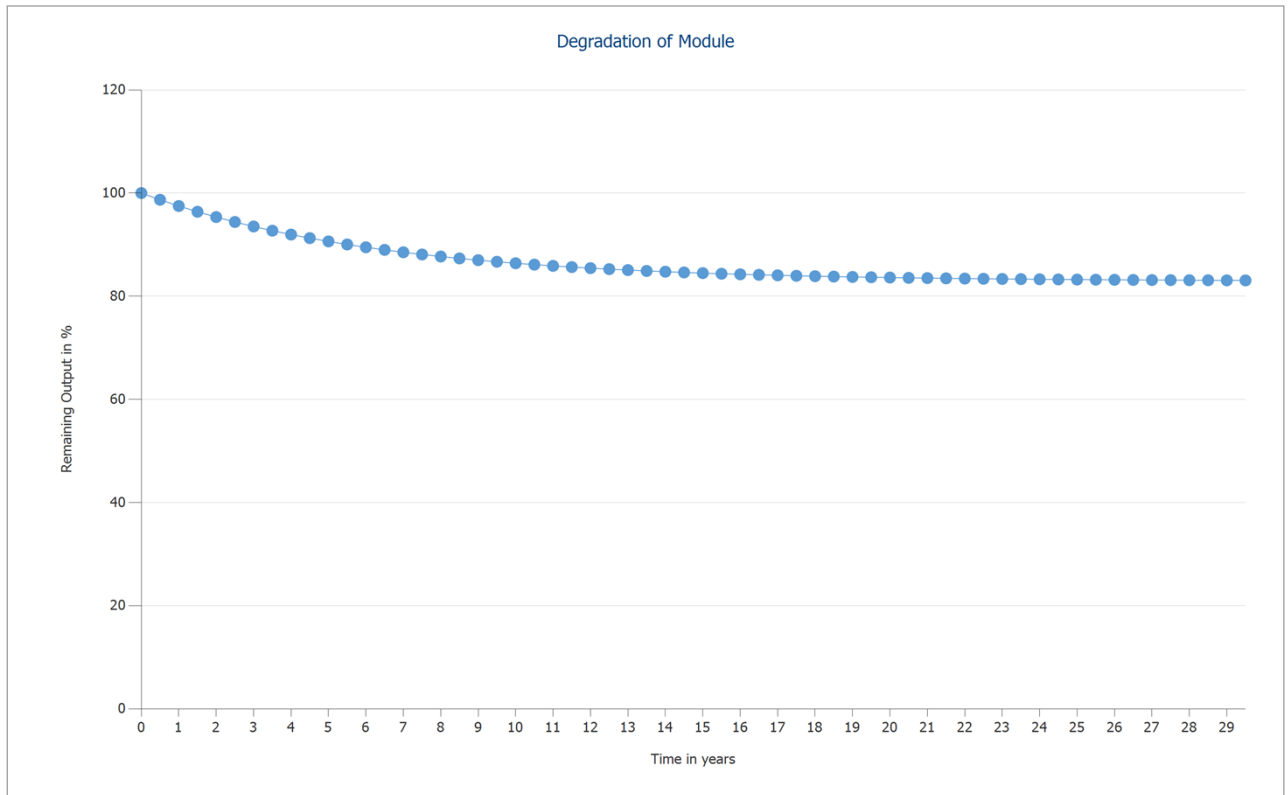


Figure: Degradation of Module, 5. Module Area - Building 03-Module Area Southeast

6. Module Area - Building 03-Module Area Northwest

PV Generator, 6. Module Area - Building 03-Module Area Northwest

Name	Building 03-Module Area Northwest
PV Modules	42 x TSM-455DE17M (II) (v1)
Manufacturer	Trina Solar
Inclination	10 °
Orientation	Northwest 320 °
Installation Type	Mounted - Roof
PV Generator Surface	91,8 m²

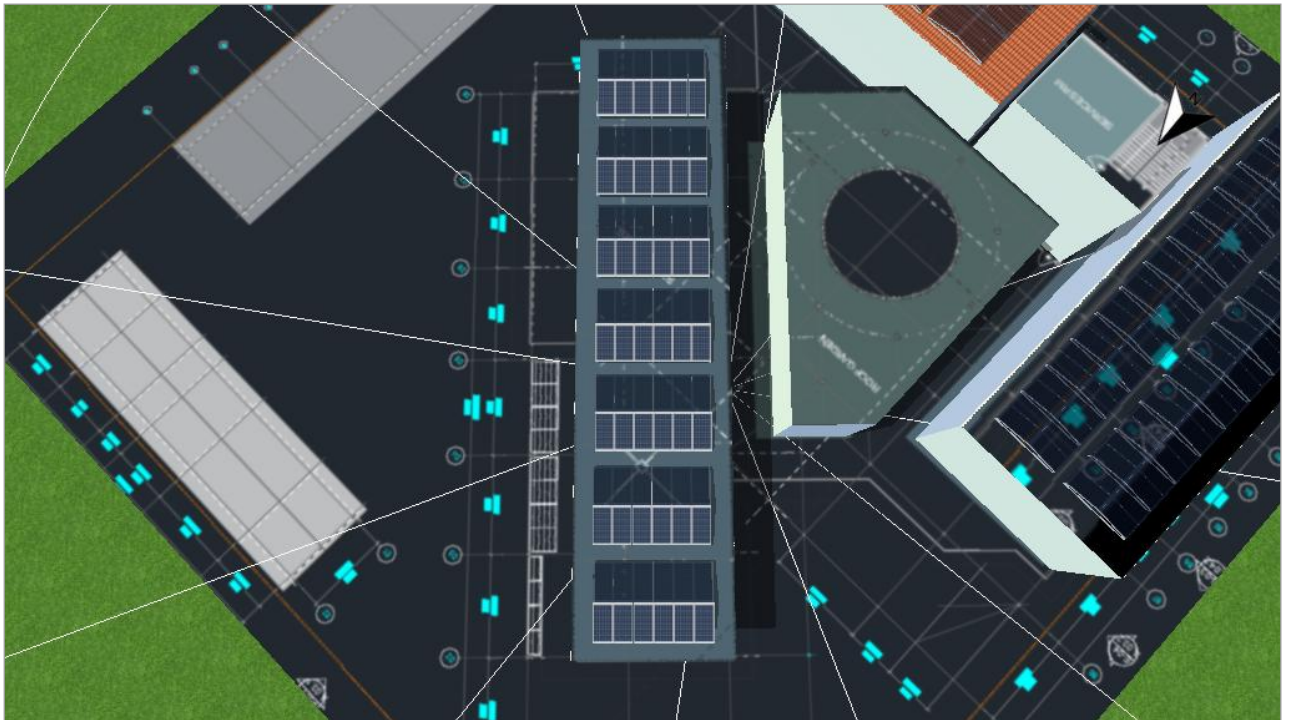


Figure: 6. Module Area - Building 03-Module Area Northwest

Degradation of Module, 6. Module Area - Building 03-Module Area Northwest

Characteristic curve	Exponential
Remaining power (power output) after 1 year	97,5 %
Remaining power (power output) after 30 years	83 %

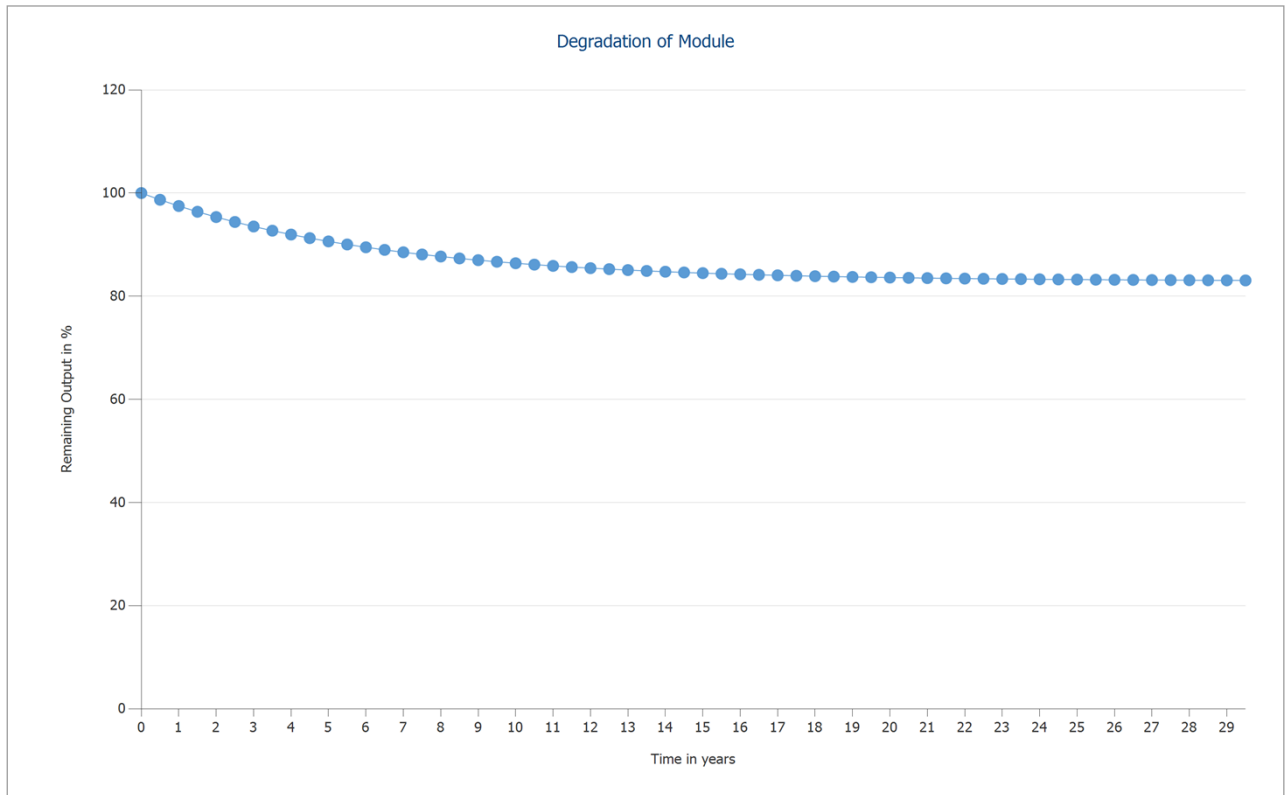


Figure: Degradation of Module, 6. Module Area - Building 03-Module Area Northwest

Horizon Line, 3D Design

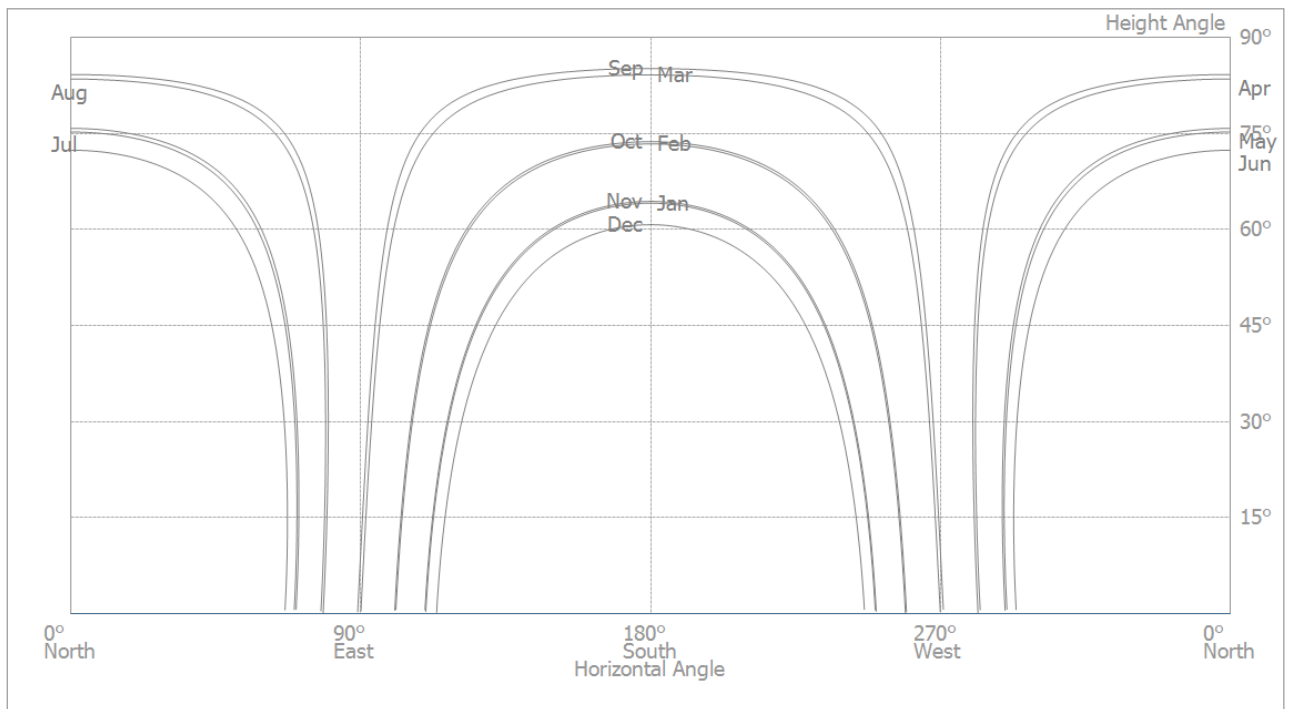


Figure: Horizon (3D Design)

Inverter configuration

Configuration 1

Module Areas	Building 02-Module Area East + Building 02-Module Area West
Inverter 1	
Model	SUN2000-36KTL(400Vac) (v1)
Manufacturer	Huawei Technologies
Quantity	1
Sizing Factor	113,8 %
Configuration	MPP 1: 2 x 15
	MPP 2: 1 x 15
	MPP 3: 2 x 14
	MPP 4: 1 x 17

Configuration 2

Module Areas	Building 01-Module Area East + Building 01-Module Area West
Inverter 1	
Model	SUN2000-36KTL(400Vac) (v1)
Manufacturer	Huawei Technologies
Quantity	1
Sizing Factor	121,3 %
Configuration	MPP 1: 2 x 15
	MPP 2: 1 x 18
	MPP 3: 2 x 15
	MPP 4: 1 x 18

Configuration 3

Module Areas	Building 03-Module Area Southeast + Building 03-Module Area Northwest
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Inverter 1

Model	SUN2000-36KTL(400Vac) (v1)
Manufacturer	Huawei Technologies
Quantity	1
Sizing Factor	106,2 %
Configuration	MPP 1: 2 x 13
	MPP 2: 1 x 16
	MPP 3: 2 x 13
	MPP 4: 1 x 16

AC Mains

AC Mains

Number of Phases	3
Mains voltage between phase and neutral	230 V
Displacement Power Factor (cos phi)	+/- 1

Simulation Results

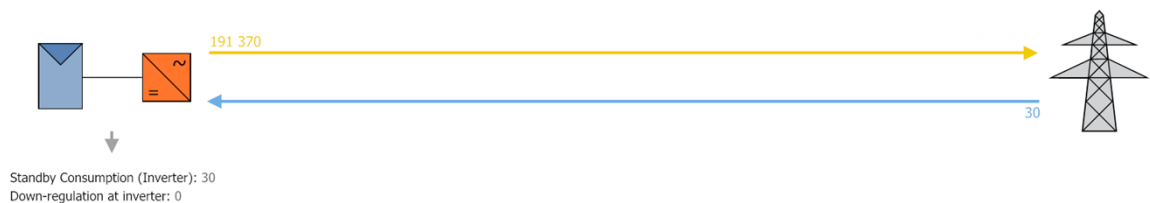
Results Total System

PV System

PV Generator Output	122,85 kWp
Spec. Annual Yield	1 557,51 kWh/kWp
Performance Ratio (PR)	79,41 %
Yield Reduction due to Shading	0,7 %/Year
Grid Feed-in	191 370 kWh/Year
Grid Feed-in in the first year (incl. module degradation)	188 718 kWh/Year
Standby Consumption (Inverter)	30 kWh/Year
CO ₂ Emissions avoided	89 930 kg / year

Energy Flow Graph

Project: Maafaru Hospital



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

Figure: Energy flow

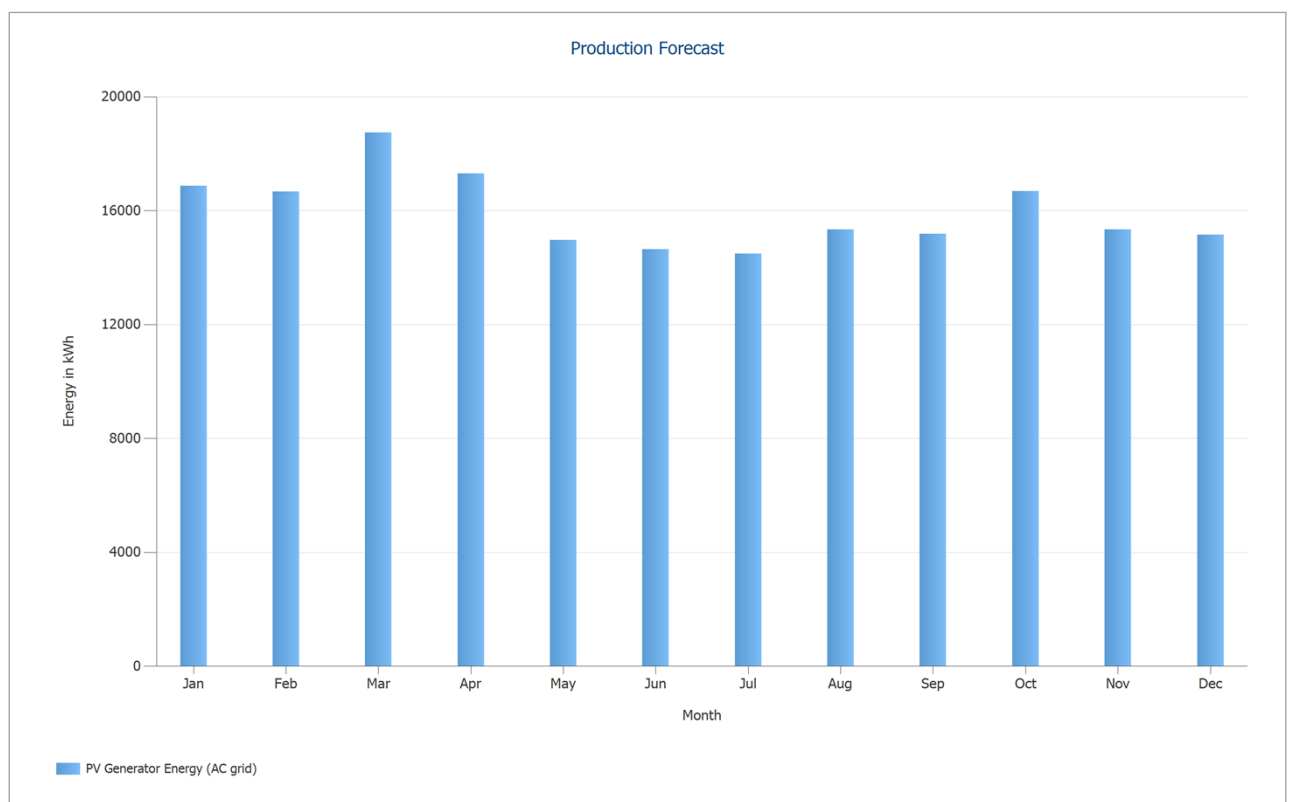


Figure: Production Forecast

Results per Module Area

Building 02-Module Area East

PV Generator Output	20,48 kWp
PV Generator Surface	98,37 m ²
Global Radiation at the Module	1798,00 kWh/m ²
Global Radiation on Module without reflection	1960,99 kWh/m ²
Performance Ratio (PR)	79,86 %
PV Generator Energy (AC grid)	32111,73 kWh/Year
Spec. Annual Yield	1568,34 kWh/kWp

Building 02-Module Area West

PV Generator Output	20,48 kWp
PV Generator Surface	98,37 m ²
Global Radiation at the Module	1784,93 kWh/m ²
Global Radiation on Module without reflection	1952,52 kWh/m ²
Performance Ratio (PR)	79,20 %
PV Generator Energy (AC grid)	31707,69 kWh/Year
Spec. Annual Yield	1548,61 kWh/kWp

Building 01-Module Area East

PV Generator Output	21,84 kWp
PV Generator Surface	104,93 m ²
Global Radiation at the Module	1798,65 kWh/m ²
Global Radiation on Module without reflection	1961,57 kWh/m ²
Performance Ratio (PR)	79,12 %
PV Generator Energy (AC grid)	33947,96 kWh/Year
Spec. Annual Yield	1554,39 kWh/kWp

Building 01-Module Area West

PV Generator Output	21,84 kWp
PV Generator Surface	104,93 m ²
Global Radiation at the Module	1789,36 kWh/m ²
Global Radiation on Module without reflection	1957,60 kWh/m ²
Performance Ratio (PR)	79,42 %
PV Generator Energy (AC grid)	34003,74 kWh/Year
Spec. Annual Yield	1556,95 kWh/kWp

Building 03-Module Area Southeast

PV Generator Output	19,11 kWp
PV Generator Surface	91,82 m ²
Global Radiation at the Module	1819,44 kWh/m ²
Global Radiation on Module without reflection	1983,69 kWh/m ²
Performance Ratio (PR)	79,86 %
PV Generator Energy (AC grid)	30317,41 kWh/Year
Spec. Annual Yield	1586,47 kWh/kWp

Building 03-Module Area Northwest

PV Generator Output	19,11 kWp
PV Generator Surface	91,82 m ²
Global Radiation at the Module	1758,45 kWh/m ²
Global Radiation on Module without reflection	1933,90 kWh/m ²
Performance Ratio (PR)	79,11 %
PV Generator Energy (AC grid)	29281,44 kWh/Year
Spec. Annual Yield	1532,26 kWh/kWp

PV System Energy Balance

PV System Energy Balance

Global radiation - horizontal	2 001,52 kWh/m²	
Deviation from standard spectrum	-20,02 kWh/m ²	-1,00 %
Ground Reflection (Albedo)	3,01 kWh/m ²	0,15 %
Orientation and inclination of the module surface	-25,17 kWh/m ²	-1,27 %
Module-independent shading	-0,95 kWh/m ²	-0,05 %
Reflection on the Module Interface	-166,81 kWh/m ²	-8,52 %
Global Radiation at the Module	1 791,58 kWh/m²	
	1 791,58 kWh/m ²	
	x 590,242 m ²	
	= 1 057 466,90 kWh	
Global PV Radiation	1 057 466,90 kWh	
Soiling	0,00 kWh	0,00 %
STC Conversion (Rated Efficiency of Module 20,84 %)	-837 045,84 kWh	-79,16 %
Rated PV Energy	220 421,05 kWh	
Module-specific Partial Shading	-1 041,76 kWh	-0,47 %
Low-light performance	-3 337,19 kWh	-1,52 %
Deviation from the nominal module temperature	-16 399,05 kWh	-7,59 %
Diodes	-41,25 kWh	-0,02 %
Mismatch (Manufacturer Information)	-3 992,04 kWh	-2,00 %
Mismatch (Configuration/Shading)	-311,19 kWh	-0,16 %
PV Energy (DC) without inverter down-regulation	195 298,58 kWh	
Failing to reach the DC start output	-6,38 kWh	0,00 %
Down-regulation on account of the MPP Voltage Range	-0,23 kWh	0,00 %
Down-regulation on account of the max. DC Current	-38,91 kWh	-0,02 %
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	-89,18 kWh	-0,05 %
MPP Matching	-113,21 kWh	-0,06 %
PV energy (DC)	195 050,68 kWh	
Energy at the Inverter Input	195 050,68 kWh	
Input voltage deviates from rated voltage	-165,27 kWh	-0,08 %
DC/AC Conversion	-3 515,45 kWh	-1,80 %
Standby Consumption (Inverter)	-29,92 kWh	-0,02 %
Total Cable Losses	0,00 kWh	0,00 %
PV energy (AC) minus standby use	191 340,04 kWh	
PV Generator Energy (AC grid)	191 369,96 kWh	