Version 7.4.7

PVsyst - Simulation report

Grid-Connected System

Project: Swarna Dweep Analysis

Variant: Simulation v11

Tables on a building

System power: 60.8 kWp

Swarna Dweep - Bangladesh

Author

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Project summary

Geographical Site
Swarna Dweep
Bangladesh

Situation

Latitude	22.54 °N
Longitude	91.30 °E
Altitude	8 m
Time zone	UTC+6

Project settings
Albedo 0.20

Weather data
Swarna Dweep
PVGIS api TMY

System summary

Grid-Connected System
Simulation for year no 10

Tables on a building

PV Field Orientation
Fixed plane
Tilt/Azimuth 27 / 7 °

Near Shadings
Linear shadings : Slow (simul.)

User's needs
Fixed constant load
6.11 kW
Global
53.5 MWh/Year

System information

PV Array

Nb. of modules	98 units
Pnom total	60.8 kWp

Inverters

Nb. of units	0.7 unit
Pnom total	57.2 kWac
Pnom ratio	1.063

Results summary

Produced Energy	92360 kWh/year	Specific production	1520 kWh/kWp/year	Perf. Ratio PR	77.96 %
Used Energy	53524 kWh/year			Solar Fraction SF	41.55 %

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General parameters

Grid-Connected System

Tables on a building

PV Field Orientation

Orientation	
Fixed plane	
Tilt/Azimuth	27 / 7 °

Sheds configuration	
Nb. of sheds	98 units
Sizes	
Sheds spacing	5.28 m
Collector width	2.47 m
Ground Cov. Ratio (GCR)	46.7 %
Shading limit angle	
Limit profile angle	19.9 °

Models used	
Transposition	Perez
Diffuse	Imported
Circumsolar	separate

Horizon
Free Horizon

Near Shadings
Linear shadings : Slow (simul.)

User's needs
Fixed constant load
6.11 kW
Global
53.5 MWh/Year

PV Array Characteristics

PV module

Manufacturer	Generic
Model	JAM72D42-620/LB
(Custom parameters definition)	
Unit Nom. Power	620 Wp
Number of PV modules	98 units
Nominal (STC)	60.8 kWp
Modules	7 string x 14 In series
At operating cond. (50°C)	
Pmpp	57.1 kWp
U mpp	580 V
I mpp	98 A

Inverter

Manufacturer	Generic
Model	MAX 80KTL3 LV
(Original PVsyst database)	
Unit Nom. Power	80.0 kWac
Number of inverters	5 * MPPT 14% 0.7 unit
Total power	57.2 kWac
Operating voltage	200-1000 V
Pnom ratio (DC:AC)	1.06
No power sharing between MPPTs	

Total PV power

Nominal (STC)	61 kWp
Total	98 modules
Module area	274 m²

Total inverter power

Total power	57.2 kWac
Nb. of inverters	1 unit
	0.3 unused
Pnom ratio	1.06

Array losses

Array Soiling Losses
Loss Fraction 3.0 %

Thermal Loss factor

Module temperature according to irradiance	
Uc (const)	29.0 W/m²K
Uv (wind)	0.0 W/m²K/m/s

DC wiring losses

Global array res.	95 mΩ
Loss Fraction	1.5 % at STC

Serie Diode Loss

Voltage drop	0.7 V
Loss Fraction	0.1 % at STC

LID - Light Induced Degradation
Loss Fraction 2.0 %

Module Quality Loss
Loss Fraction -1.3 %

Module mismatch losses
Loss Fraction 2.0 % at MPP

Module average degradation

Year no	10
Loss factor	0.4 %/year
Mismatch due to degradation	
Imp RMS dispersion	0.4 %/year
Vmp RMS dispersion	0.4 %/year

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Array losses

IAM loss factor

Incidence effect (IAM): Fresnel smooth glass, n = 1.526

0°	30°	50°	60°	70°	75°	80°	85°	90°
1.000	0.998	0.981	0.948	0.862	0.776	0.636	0.403	0.000

Spectral correction

FirstSolar model

Precipitable water estimated from relative humidity

Coefficient Set	C0	C1	C2	C3	C4	C5
Monocrystalline Si	0.85914	-0.02088	-0.0058853	0.12029	0.026814	-0.001781

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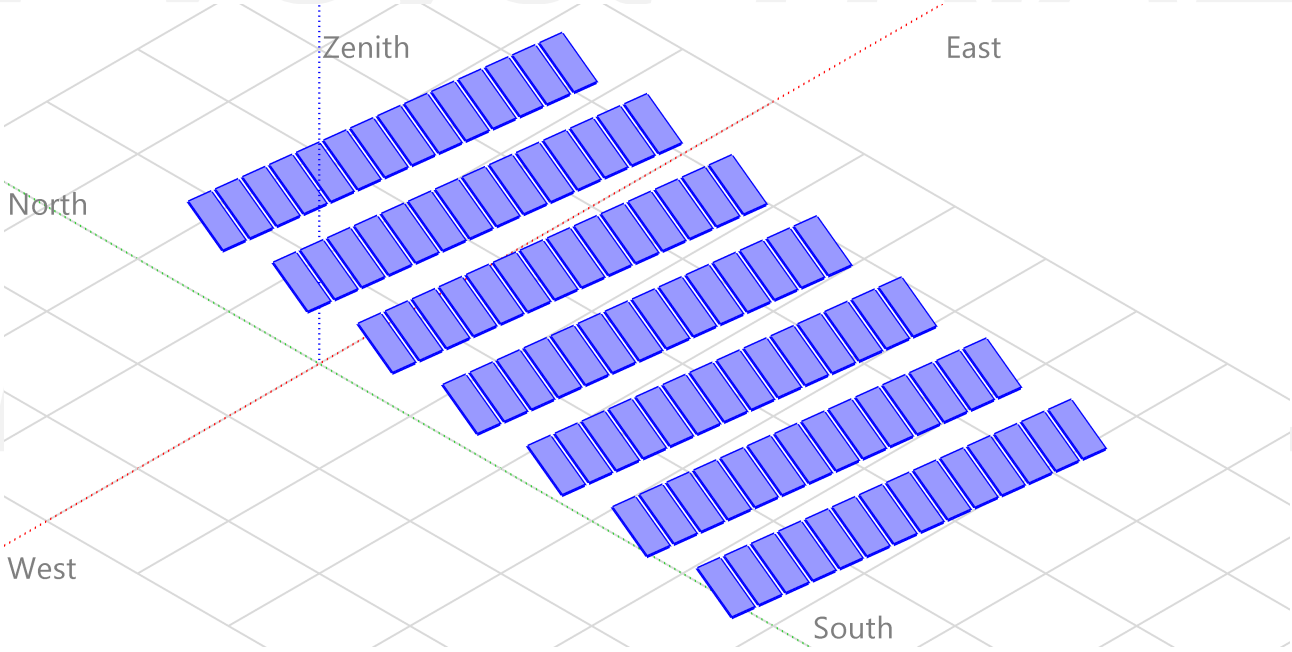
Near shadings parameter

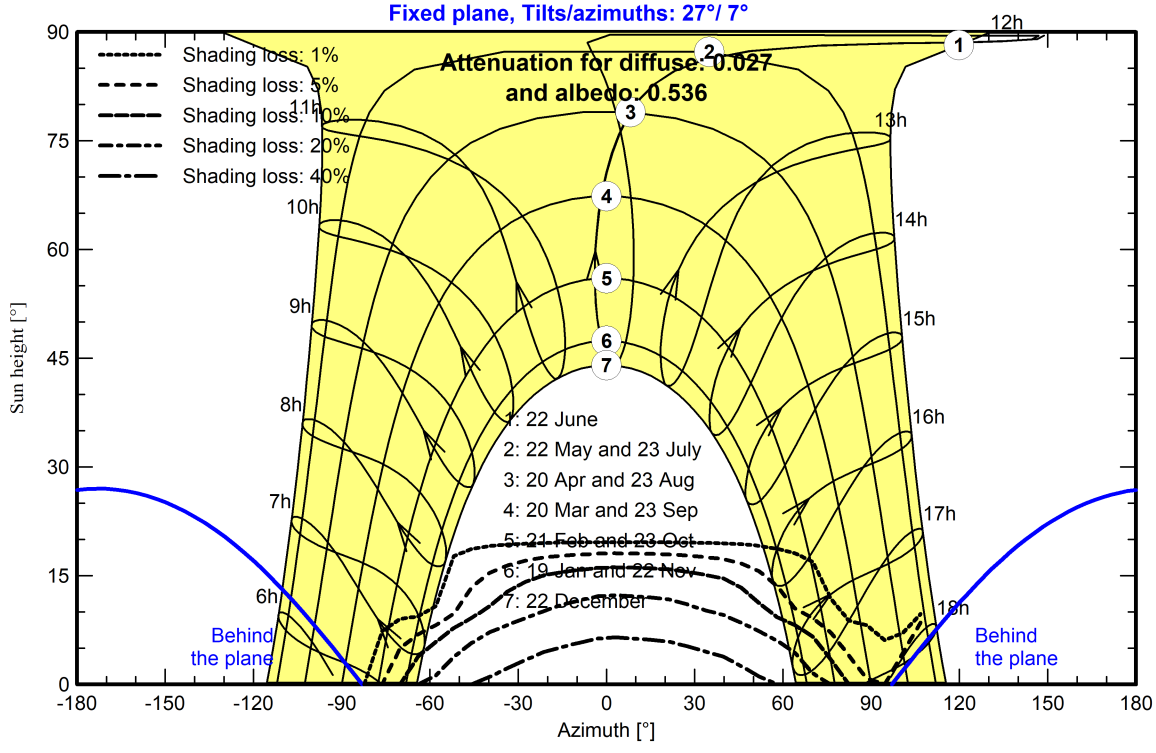
Perspective of the PV-field and surrounding shading scene



Iso-shadings diagram

Orientation #1

Fixed plane, Tilts/azimuths: 27°/ 7°



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Main results

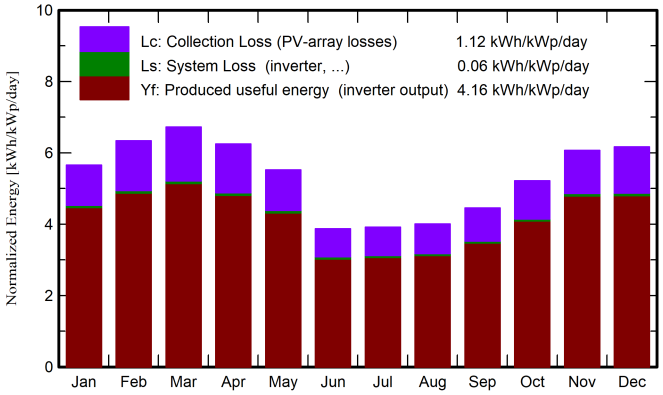
System Production

Produced Energy	92360 kWh/year	Specific production	1520 kWh/kWp/year
Used Energy	53524 kWh/year	Perf. Ratio PR	77.96 %
		Solar Fraction SF	41.55 %

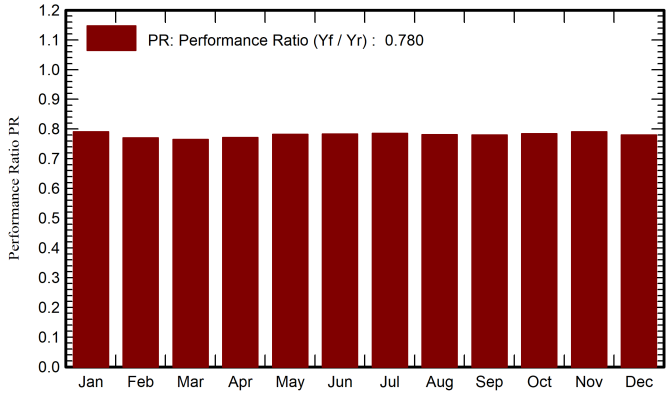
Economic evaluation

Investment		Yearly cost		LCOE	
Global	4560713.60 BDT	Annuities	0.00 BDT/yr	Energy cost	12.0 BDT/kWh
Specific	75.1 BDT/Wp	Run. costs	795783.28 BDT/yr		
		Payback period	4.1 years		

Normalized productions (per installed kWp)



Performance Ratio PR



Balances and main results

	GlobHor kWh/m²	DiffHor kWh/m²	T_Amb °C	GlobInc kWh/m²	GlobEff kWh/m²	EArray kWh	E_User kWh	E_Solar kWh	E_Grid kWh	EFrGrid kWh
January	131.9	47.33	20.61	175.4	165.4	8534	4546	1794	6627	2752
February	145.7	49.90	23.17	177.4	167.4	8410	4106	1688	6611	2418
March	189.9	68.58	27.86	208.4	196.0	9818	4546	1983	7703	2563
April	189.1	74.66	28.57	187.4	175.3	8905	4399	1970	6809	2430
May	185.9	84.68	28.59	171.3	159.5	8264	4546	2063	6078	2483
June	128.9	75.51	28.37	116.0	107.3	5627	4399	1792	3731	2607
July	132.6	77.69	27.37	121.4	112.3	5897	4546	1864	3926	2682
August	128.4	72.15	27.67	124.0	115.4	5994	4546	1792	4092	2753
September	128.9	64.24	28.09	133.6	124.8	6438	4399	1752	4581	2648
October	140.1	61.73	28.13	161.8	152.0	7816	4546	1872	5834	2674
November	140.2	49.93	24.64	181.9	171.5	8863	4399	1824	6921	2575
December	138.0	44.05	20.30	191.2	180.3	9177	4546	1845	7210	2701
Year	1779.7	770.46	26.12	1949.8	1827.2	93742	53524	22239	70121	31285

Legends

GlobHor	Global horizontal irradiation	EArray	Effective energy at the output of the array
DiffHor	Horizontal diffuse irradiation	E_User	Energy supplied to the user
T_Amb	Ambient Temperature	E_Solar	Energy from the sun
GlobInc	Global incident in coll. plane	E_Grid	Energy injected into grid
GlobEff	Effective Global, corr. for IAM and shadings	EFrGrid	Energy from the grid

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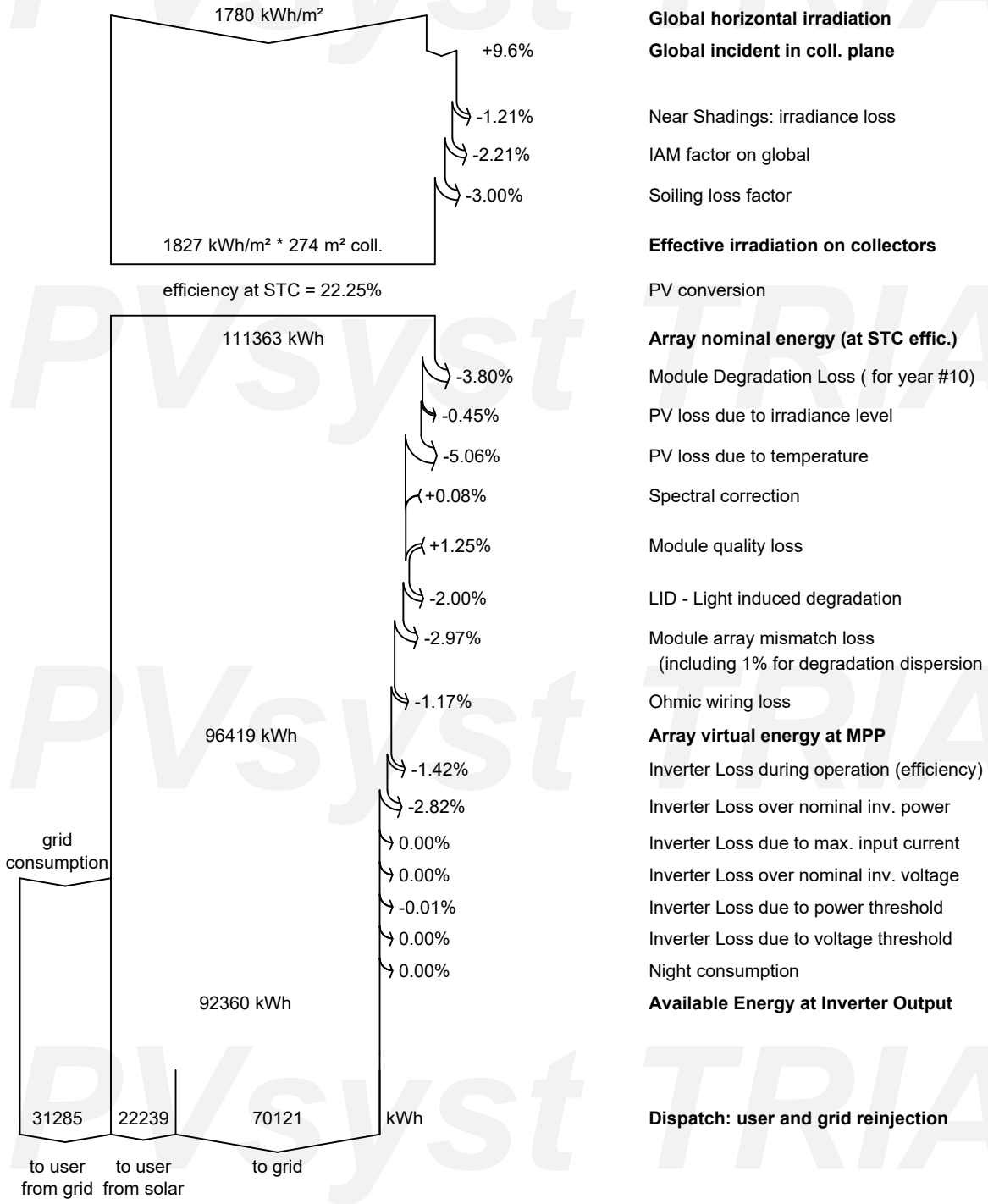
Loss diagram



Global horizontal irradiation
Global incident in coll. plane
Near Shadings: irradiance loss
IAM factor on global
Soiling loss factor
Effective irradiation on collectors
PV conversion
Array nominal energy (at STC effic.)
Module Degradation Loss (for year #10)
PV loss due to irradiance level
PV loss due to temperature
Spectral correction
Module quality loss
LID - Light induced degradation
Module array mismatch loss
(including 1% for degradation dispersion
Ohmic wiring loss
Array virtual energy at MPP
Inverter Loss during operation (efficiency)
Inverter Loss over nominal inv. power
Inverter Loss due to max. input current
Inverter Loss over nominal inv. voltage
Inverter Loss due to power threshold
Inverter Loss due to voltage threshold
Night consumption
Available Energy at Inverter Output
Dispatch: user and grid reinjection

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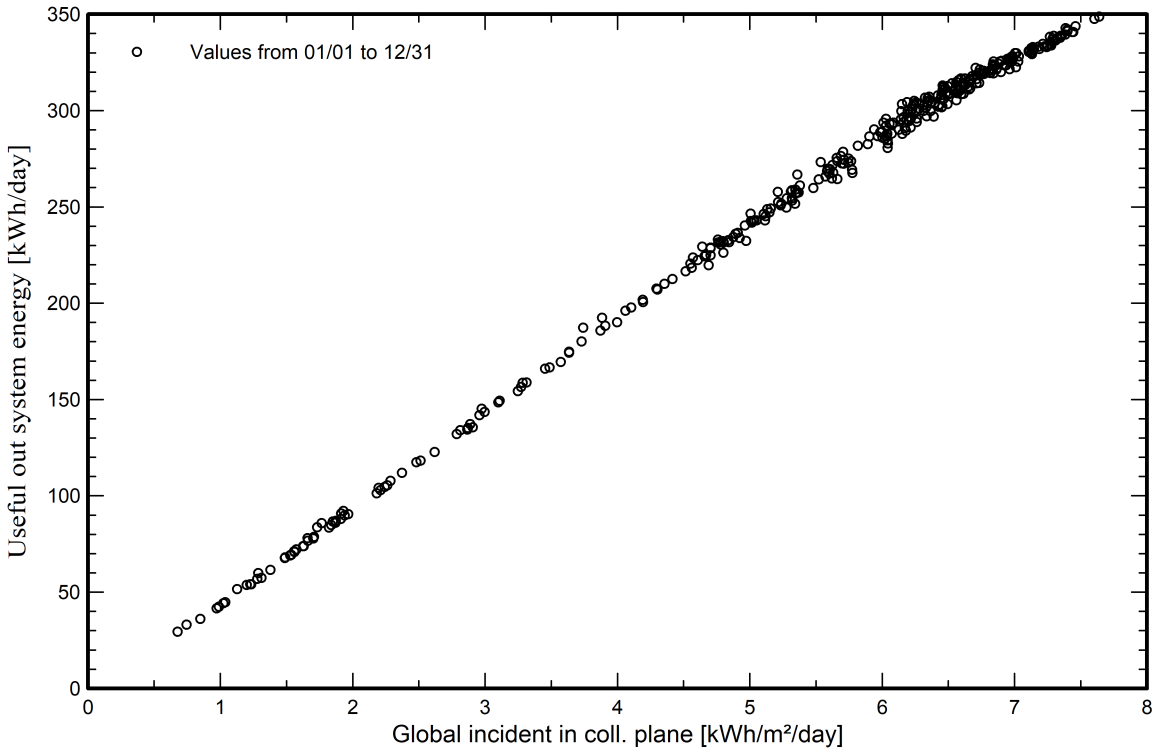
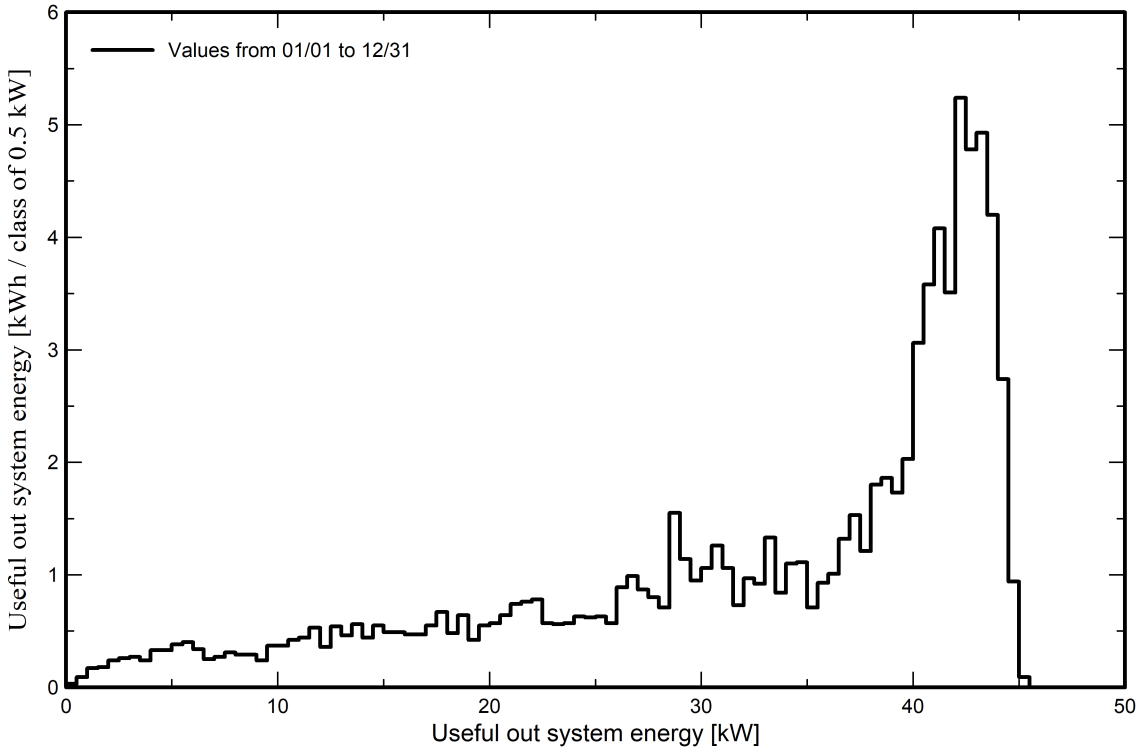
Predef. graphs

Daily Input/Output diagram



System Output Power Distribution



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Aging Tool

Aging Parameters

Time span of simulation 20 years

Module average degradation

Loss factor 0.4 %/year

Mismatch due to degradation

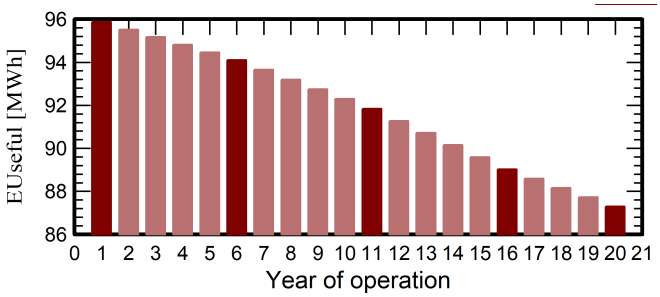
Imp RMS dispersion 0.4 %/year
Vmp RMS dispersion 0.4 %/year

Weather data used in the simulation

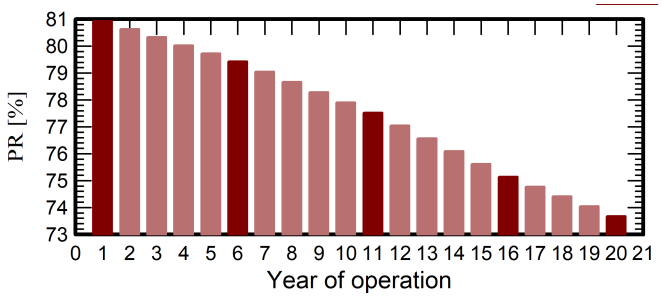
Swarna Dweep PVGIS API TMY

Years reference year

Useful out system energy



Performance Ratio



	EUseful	PR	PR loss
Year	MWh	%	%
1	95.87	80.93	-0.19
2	95.52	80.63	-0.56
3	95.16	80.33	-0.93
4	94.81	80.03	-1.30
5	94.45	79.73	-1.67
6	94.10	79.43	-2.04
7	93.65	79.05	-2.51
8	93.19	78.67	-2.98
9	92.74	78.28	-3.45
10	92.29	77.90	-3.92
11	91.84	77.52	-4.39
12	91.27	77.04	-4.98
13	90.71	76.57	-5.56
14	90.15	76.09	-6.15
15	89.58	75.62	-6.74
16	89.02	75.14	-7.33
17	88.58	74.77	-7.78
18	88.15	74.41	-8.23
19	87.72	74.05	-8.68
20	87.29	73.68	-9.13

Cost of the system

Installation costs

Item	Quantity units	Cost BDT	Total BDT
PV modules			
JAM72D42-620/LB	98	10010.00	980980.00
Inverters			
MAX 80KTL3 LV	1	751660.00	533678.60
Other components			
Accessories, fasteners	1	823895.00	823895.00
Wiring	1	488160.00	488160.00
Combiner box	3	17666.67	53000.00
Monitoring system, display screen	1	40000.00	40000.00
Measurement system, pyranometer	1	30000.00	30000.00
Surge arrester	2	1500.00	3000.00
Studies and analysis			
Engineering	4	80000.00	320000.00
Permitting and other admin. Fees	2	80000.00	160000.00
Environmental studies	2	80000.00	160000.00
Economic analysis	2	80000.00	160000.00
Installation			
Global installation cost per module	98	1000.00	98000.00
Global installation cost per inverter	1	42253.52	30000.00
Transport	8	15000.00	120000.00
Settings	4	15000.00	60000.00
Grid connection	1	500000.00	500000.00
		Total	4560713.60
		Depreciable asset	2338553.60

Operating costs

Item	Total BDT/year
Maintenance	
Provision for inverter replacement	26845.00
Salaries	150000.00
Repairs	60000.00
Cleaning	30000.00
Security fund	40000.00
Subsidies	-20000.00
Total (OPEX)	286845.00
Including inflation (9.72%)	795783.28

System summary

Total installation cost	4560713.60 BDT
Operating costs (incl. inflation 9.72%/year)	795783.28 BDT/year
Useful energy from solar	22.2 MWh/year
Energy sold to the grid	70.1 MWh/year
Cost of produced energy (LCOE)	11.9677 BDT/kWh

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Financial analysis

Simulation period

Project lifetime	20 years	Start year	2024

Income variation over time

Inflation	9.72 %/year
Production variation (aging)	Aging tool results
Discount rate	9.00 %/year

Income dependent expenses

Income tax rate	3.00 %/year
Other income tax	0.00 %/year
Dividends	20.00 %/year

Depreciable assets

Asset	Depreciation method	Depreciation period (years)	Salvage value (BDT)	Depreciable (BDT)
PV modules				
JAM72D42-620/LB	Straight-line	20	0.00	980980.00
Inverters				
MAX 80KTL3 LV	Straight-line	20	0.00	533678.60
Accessories, fasteners	Straight-line	20	0.00	823895.00
		Total	0.00	2338553.60

Financing

Own funds	4160713.60 BDT
Subsidies	400000.00 BDT

Electricity sale

Feed-in tariff	19.12965 BDT/kWh
Duration of tariff warranty	20 years
Annual connection tax	1000.00 BDT/kWh
Annual tariff variation	+5.0 %/year
Feed-in tariff decrease after warranty	15.00 %

Self-consumption

Consumption tariff	7.50000 BDT/kWh
Tariff evolution	+5.0 %/year

Return on investment

Payback period	4.1 years
Net present value (NPV)	9010080.99 BDT
Internal rate of return (IRR)	31.43 %
Return on investment (ROI)	216.6 %
Paid dividends	5079626.96 BDT

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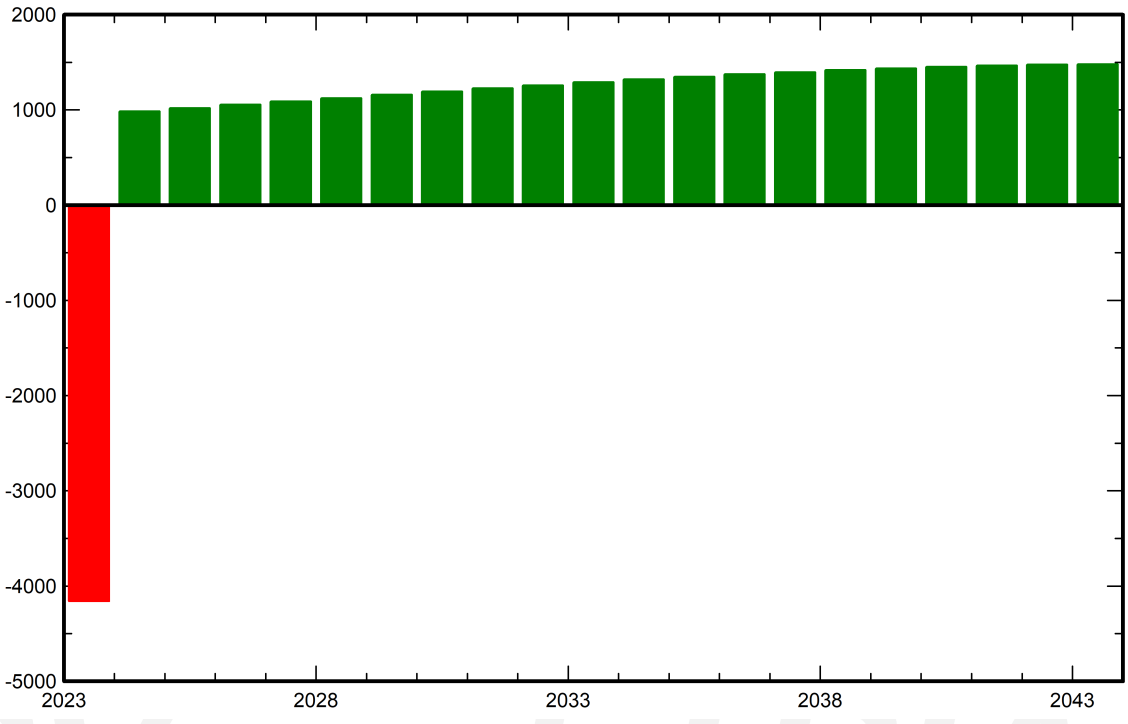
Financial analysis

Detailed economic results (kBDT)

Year	Electricity sale	Own funds	Run. costs	Deprec. allow.	Taxable income	Taxes	After-tax profit	Divid. 20.00%	Self-cons. saving	Cumul. profit	% amorti.
0	0	4160714	0	0	0	0	0	0	0	-4160714	0.0%
1	1338005	0	286845	116928	934232	28027	1023133	204627	166484	-3069322	26.2%
2	1399743	0	314726	116928	968089	29043	1055974	211195	174160	-2033942	51.1%
3	1464308	0	345318	116928	1002063	30062	1088929	217786	182188	-1052407	74.7%
4	1531828	0	378883	116928	1036017	31081	1121865	224373	190583	-122636	97.1%
5	1602436	0	415710	116928	1069798	32094	1154632	230926	199362	757368	118.2%
6	1676273	0	456117	116928	1103228	33097	1187059	237412	208542	1589519	138.2%
7	1751667	0	500452	116928	1134287	34029	1217186	243437	217917	2374569	157.1%
8	1830407	0	549095	116928	1164384	34932	1246380	249276	227707	3114364	174.9%
9	1912639	0	602468	116928	1193244	35797	1274374	254875	237931	3810671	191.6%
10	1998516	0	661027	116928	1220561	36617	1300872	260174	248608	4465188	207.3%
11	2088197	0	725279	116928	1245990	37380	1325538	265108	259759	5079543	222.1%
12	2179187	0	795776	116928	1266483	37994	1345416	269083	271072	5654260	235.9%
13	2274053	0	873126	116928	1283999	38520	1362407	272481	282867	6190914	248.8%
14	2372955	0	957994	116928	1298034	38941	1376020	275204	295164	6691010	260.8%
15	2476060	0	1051111	116928	1308022	39241	1385709	277142	307983	7155993	272.0%
16	2583540	0	1153279	116928	1313334	39400	1390862	278172	321347	7587246	282.4%
17	2699585	0	1265377	116928	1317280	39518	1394689	278938	335775	7987110	292.0%
18	2820773	0	1388372	116928	1315473	39464	1392936	278587	350843	8356780	300.8%
19	2947328	0	1523322	116928	1307078	39212	1384794	276959	366578	8697404	309.0%
20	3079484	0	1671389	116928	1291167	38735	1369360	273872	383010	9010081	316.6%
Total	**42026983**	**4160714**	**15915666**	**2338554**	**23772764**	**713183**	**25398135**	**5079627**	**5227881**	**9010081**	**316.6%**

Yearly net profit (kBDT)



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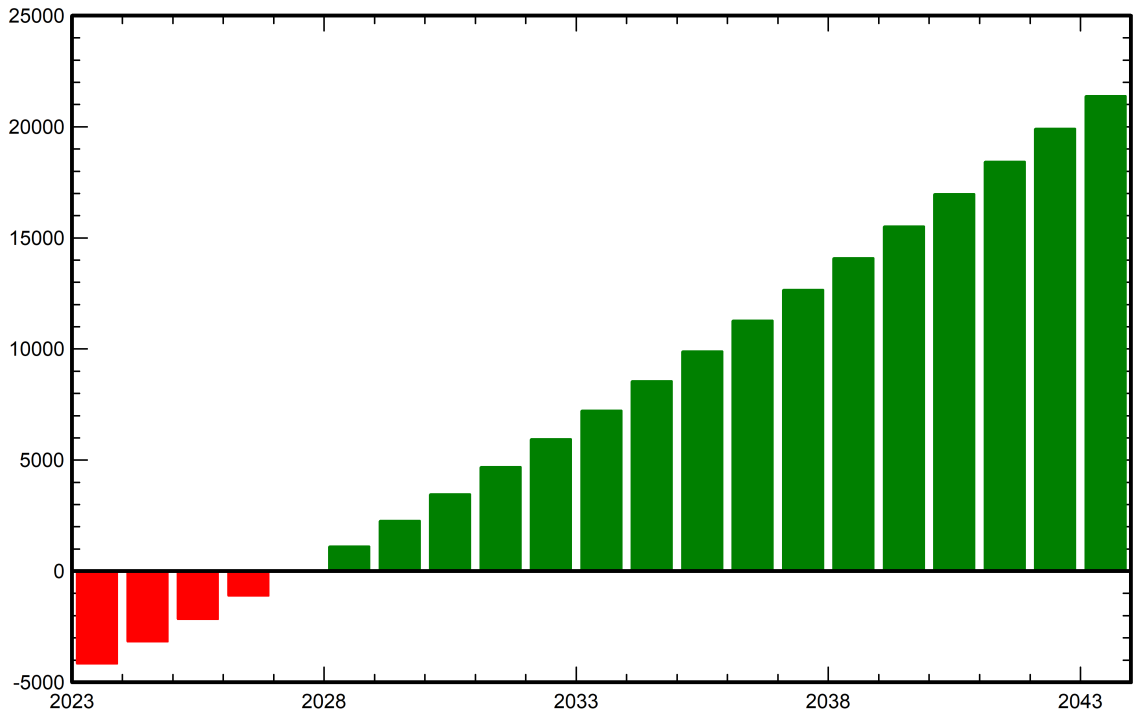
Financial analysis

Cumulative cashflow (kBDT)



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CO_2 Emission Balance

Total: 877.6 tCO_2

Generated emissions

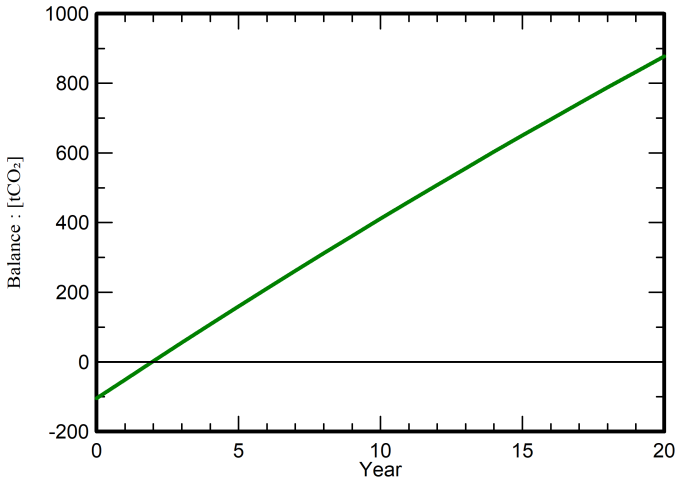
Total: 104.58 tCO_2

Source: Detailed calculation from table below

Replaced Emissions

Total:	1078.8 tCO_2
System production:	92.36 MWh/yr
Grid Lifecycle Emissions:	584 gCO_2/kWh
Source:	IEA List
Country:	Bangladesh
Lifetime:	20 years
Annual degradation:	1.0 %

Saved CO_2 Emission vs. Time



System Lifecycle Emissions Details

Item	LCE	Quantity	Subtotal
			[$kgCO_2$]
Modules	1062 kgCO2/modules	98.0 modules	104060
Transport1	35.0 gCO2/km	5.00 km	0.59
Transport2	59.7 gCO2/km	5.00 km	1.01
Inverters	522 kgCO2/units	1.00 units	522