

## Preliminary assessment of site solar irradiance

### Project: Flacq (Mauritius)

Geographical coordinates	-20.153786°,057.678401° (-20°09'14", 057°40'42")
Report number	SG-P-trial-220810-204212
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Customer	

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## 1 Overview

Table 1.1: Yearly average

Global horizontal irradiation	GHI	1892.2 kWh/m <sup>2</sup>
Direct normal irradiation	DNI	1571.0 kWh/m <sup>2</sup>
Diffuse horizontal irradiation	DIF	825.9 kWh/m <sup>2</sup>
Air temperature	TEMP	23.5 °C

## 2 Project info

Project name	Flacq
Address	Radhakisson Road, Flacq, Mauritius
Geographical coordinates	-20.153786°,057.678401° (-20°09'14", 057°40'42")
Time zone	UTC+04, Indian/Mauritius [MUT]
Elevation	112 m
Land cover	Cropland, rainfed
Population density	445 inh./km <sup>2</sup>
Terrain azimuth	59°
Terrain slope	2°
Location on the map	<a href="https://apps.solargis.com/prospect/map?c=-20.153786,57.678401,10&amp;s=-20.153786,57.678401">https://apps.solargis.com/prospect/map? c=-20.153786,57.678401,10&amp;s=-20.153786,57.678401</a>

Figure 2.1: Project location

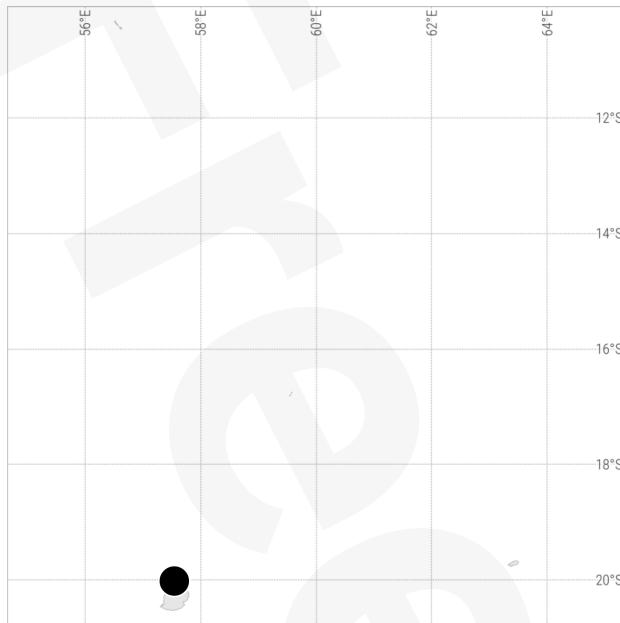


Figure 2.2: Detailed map view



Figure 2.3: Project horizon and sunpath

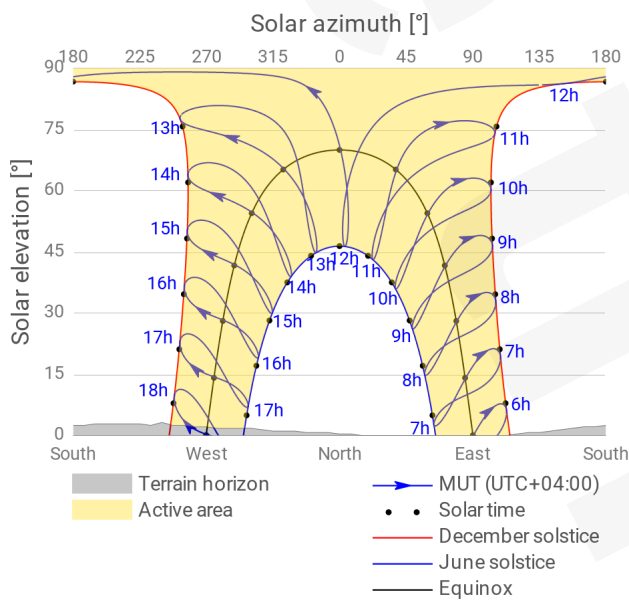
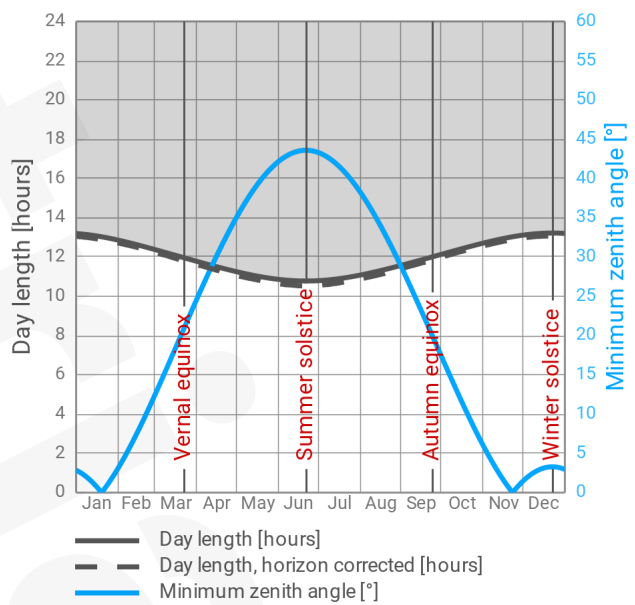


Figure 2.4: Day length and solar zenith angle



### 3 Solar and meteo: Monthly statistics

The most important project-specific meteorological parameter that determines solar electricity production is solar radiation, which fuels a PV power system. Power production is also influenced by air temperature. Other meteorological parameters also affect the performance, availability and ageing of a PV system.

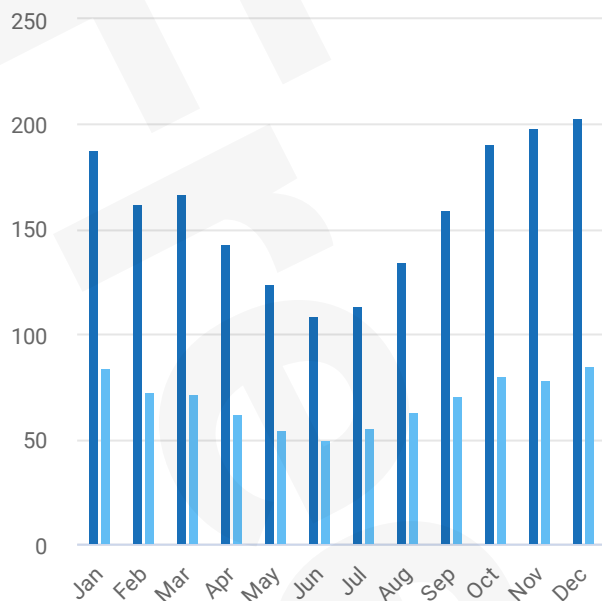
**Table 3.1:** Solar radiation and meteorological parameters

Month	GHI kWh/m <sup>2</sup>	DNI kWh/m <sup>2</sup>	DIF kWh/m <sup>2</sup>	D2G	GTI <sub>opta</sub> kWh/m <sup>2</sup>	TEMP °C	WS m/s	CDD degree days	HDD degree days
Jan	188.0	141.3	83.5	0.444	175.2	25.8	5.3	248	0
Feb	161.9	122.8	72.4	0.447	158.1	26.0	5.3	232	0
Mar	166.7	132.8	71.5	0.429	174.2	25.7	5.3	257	0
Apr	143.3	124.6	61.8	0.431	160.6	25.0	5.4	225	0
May	123.7	122.1	54.1	0.438	147.5	23.4	5.6	187	0
Jun	108.7	108.3	49.6	0.457	132.8	22.0	6.4	130	0
Jul	114.0	105.1	55.4	0.486	136.4	21.1	6.8	106	0
Aug	134.1	114.5	63.3	0.472	153.0	20.9	6.6	93	0
Sep	159.7	127.7	71.0	0.444	171.6	21.3	6.2	102	0
Oct	190.6	150.6	80.0	0.420	191.0	22.4	5.8	146	0
Nov	198.6	160.8	78.7	0.396	187.5	23.7	5.2	197	0
Dec	203.0	160.5	84.6	0.417	186.0	25.1	5.1	233	0
<b>Yearly</b>	<b>1892.2</b>	<b>1571.0</b>	<b>825.9</b>	<b>0.436</b>	<b>1973.9</b>	<b>23.5</b>	<b>5.8</b>	<b>2021</b>	<b>0</b>

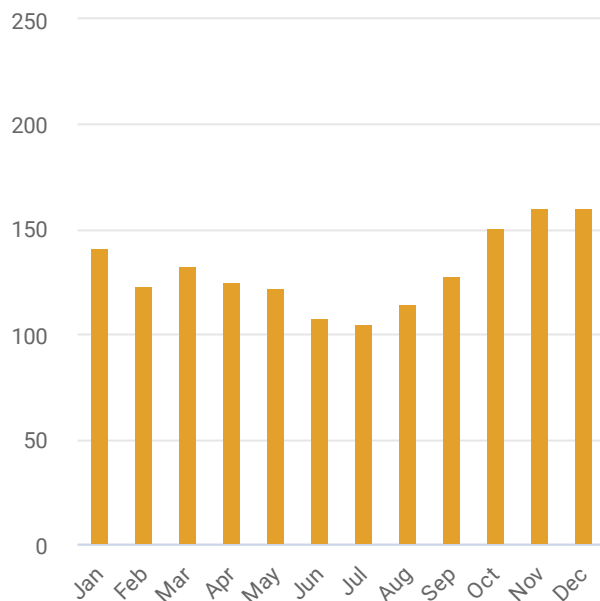
**Table 3.2:** Other meteorological parameters

Month	ALB	RH %	PWAT kg/m <sup>2</sup>	PREC mm
Jan	0.16	83	43	252
Feb	0.17	84	44	265
Mar	0.17	83	41	203
Apr	0.17	83	37	185
May	0.16	79	30	114
Jun	0.16	76	24	89
Jul	0.16	77	23	89
Aug	0.16	75	22	80
Sep	0.16	76	22	58
Oct	0.16	76	26	56
Nov	0.16	77	30	69
Dec	0.16	79	37	181
<b>Yearly</b>	<b>0.16</b>	<b>79</b>	<b>32</b>	<b>1641</b>

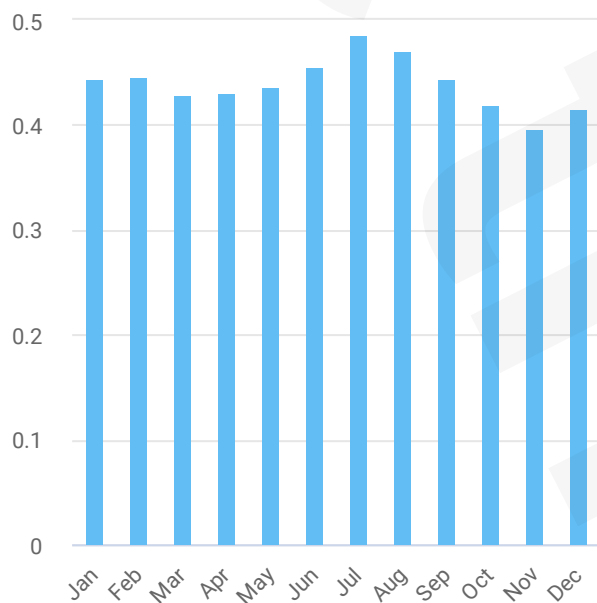
**Figure 3.1:** Global + diffuse horizontal irradiation



**Figure 3.2:** Direct normal irradiation



**Figure 3.3:** Ratio of diffuse to global irradiation



**Figure 3.4:** Global tilted irradiation at optimum angle

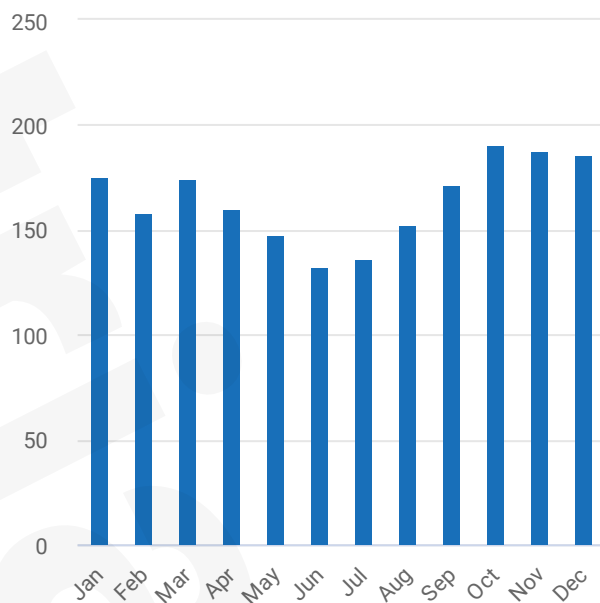


Figure 3.5: Air temperature

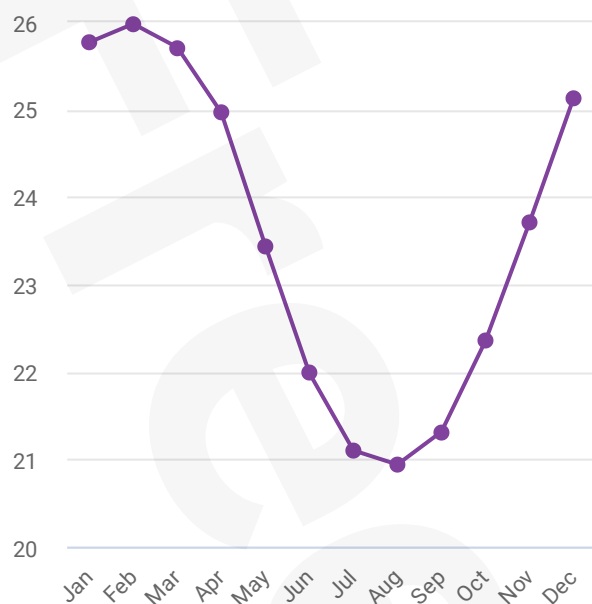


Figure 3.6: Surface albedo

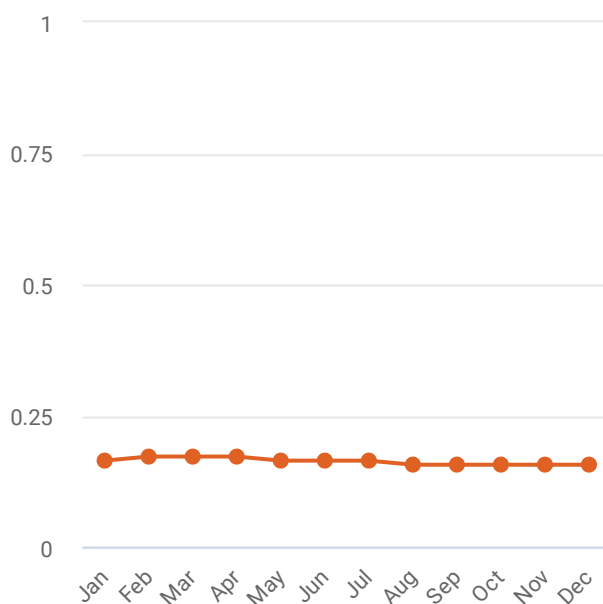


Figure 3.7: Wind speed

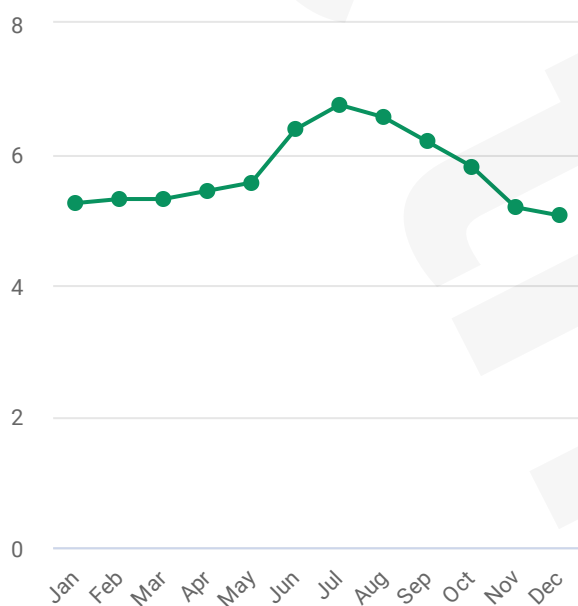


Figure 3.8: Relative humidity

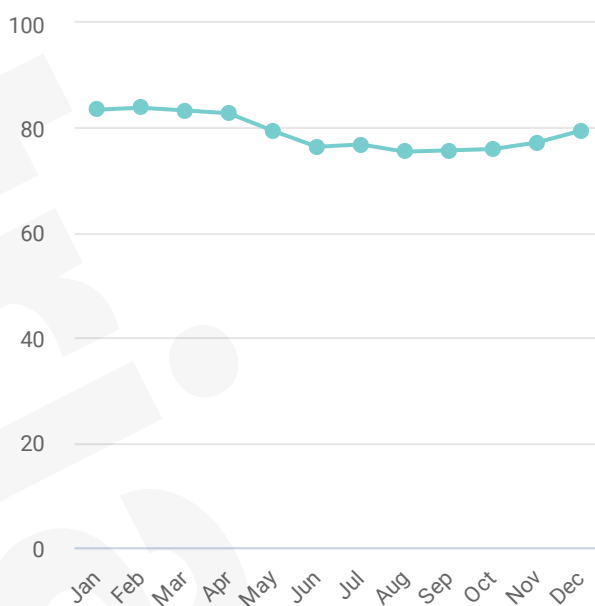


Figure 3.9: Precipitation (rainfall)

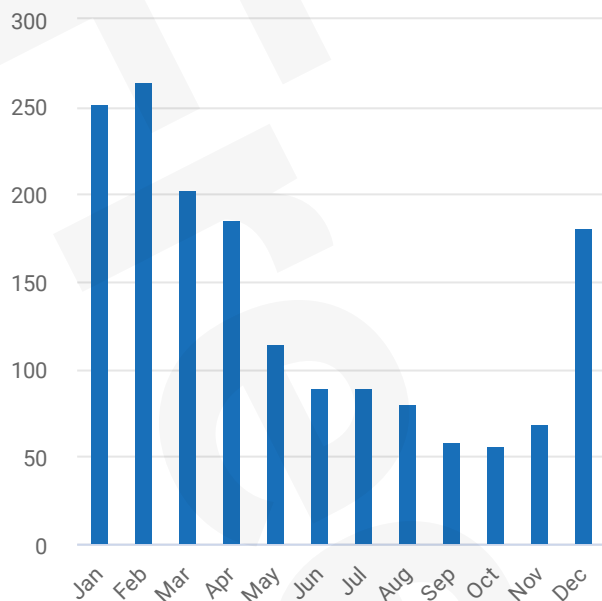


Figure 3.10: Precipitable water

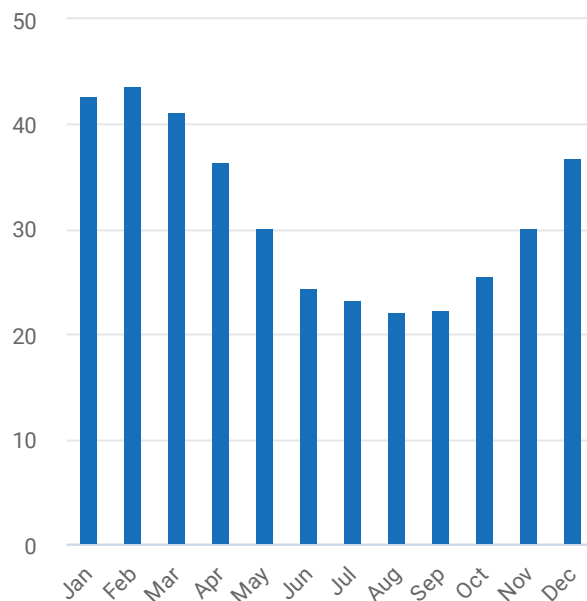
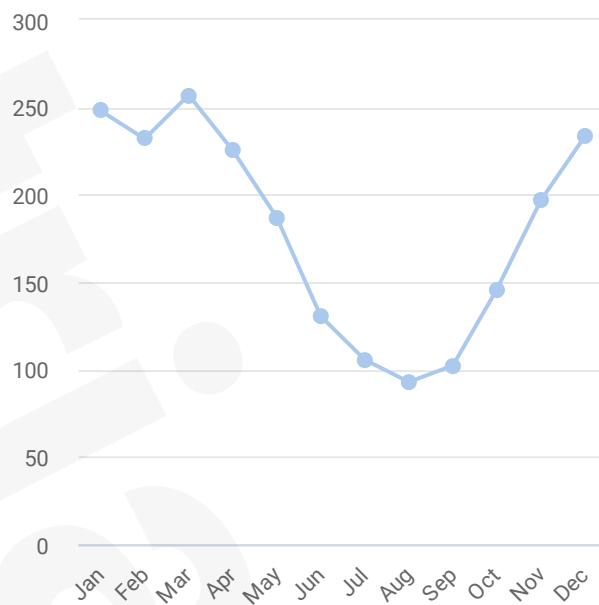


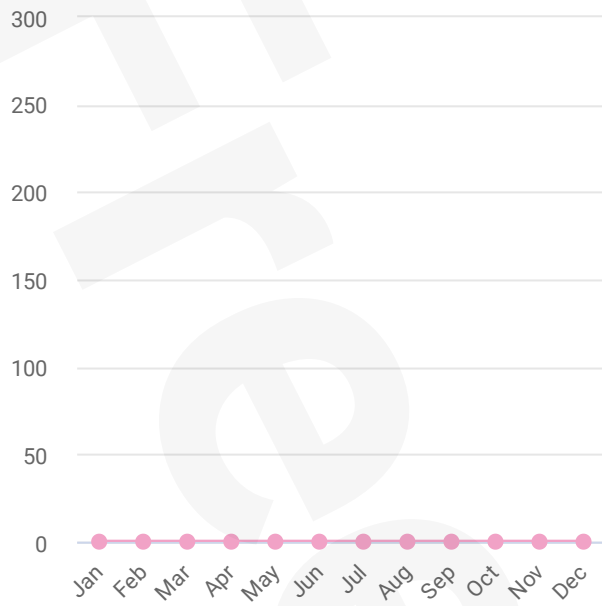
Figure 3.11: Snow days



Figure 3.12: Cooling degree days



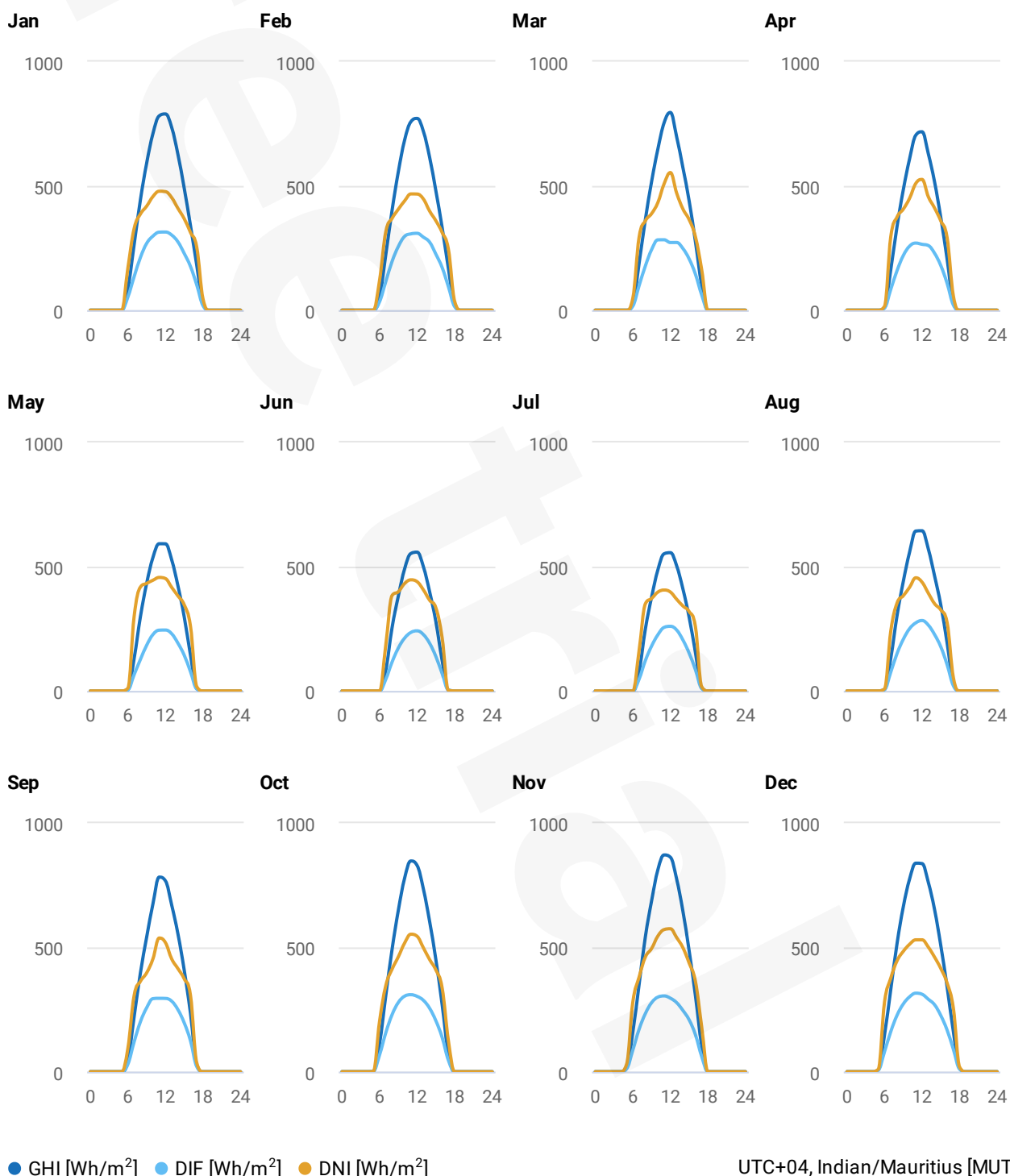


**Figure 3.13:** Heating degree days

## 4 Solar and meteo: Daily statistics

Solar radiation profiles below are calculated as an average of all hourly data for each month. The profiles give an indication of changing patterns of GHI per day, separately for each month. These patterns are driven by local geography, astronomy and climate of the site.

**Figure 4.1:** GHI, DNI, DIF - daily averages



**Table 4.1:** Global horizontal irradiation - hourly averages [Wh/m<sup>2</sup>]

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0 - 1	-	-	-	-	-	-	-	-	-	-	-	-
1 - 2	-	-	-	-	-	-	-	-	-	-	-	-
2 - 3	-	-	-	-	-	-	-	-	-	-	-	-
3 - 4	-	-	-	-	-	-	-	-	-	-	-	-
4 - 5	-	-	-	-	-	-	-	-	-	-	-	-
5 - 6	0	-	-	-	-	-	-	-	-	2	14	7
6 - 7	86	52	22	10	5	-	-	6	44	112	159	147
7 - 8	264	224	188	163	131	83	79	131	222	307	351	331
8 - 9	444	402	364	336	298	255	249	302	397	492	543	515
9 - 10	592	557	518	484	433	382	378	440	541	649	688	663
10 - 11	710	684	648	608	537	491	487	558	675	778	813	775
11 - 12	782	758	754	704	592	553	552	643	783	848	872	839
12 - 13	790	772	796	718	592	558	556	645	768	830	863	837
13 - 14	735	720	697	629	527	500	503	571	670	736	775	762
14 - 15	626	615	573	516	422	399	410	463	554	604	646	652
15 - 16	491	480	439	371	298	278	296	345	408	450	485	506
16 - 17	340	332	275	206	144	122	155	194	235	270	306	341
17 - 18	181	167	100	30	9	4	12	29	27	70	105	161
18 - 19	25	19	-	-	-	-	-	-	-	-	-	12
19 - 20	-	-	-	-	-	-	-	-	-	-	-	-
20 - 21	-	-	-	-	-	-	-	-	-	-	-	-
21 - 22	-	-	-	-	-	-	-	-	-	-	-	-
22 - 23	-	-	-	-	-	-	-	-	-	-	-	-
23 - 24	-	-	-	-	-	-	-	-	-	-	-	-
Sum	6066	5781	5377	4776	3990	3624	3676	4326	5324	6148	6619	6549

Table 4.2: Direct normal irradiation - hourly averages [Wh/m<sup>2</sup>]

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0 - 1	-	-	-	-	-	-	-	-	-	-	-	-
1 - 2	-	-	-	-	-	-	-	-	-	-	-	-
2 - 3	-	-	-	-	-	-	-	-	-	-	-	-
3 - 4	-	-	-	-	-	-	-	-	-	-	-	-
4 - 5	-	-	-	-	-	-	-	-	-	-	-	-
5 - 6	-	-	-	-	-	-	-	-	-	1	30	9
6 - 7	170	120	48	15	11	-	-	8	94	203	280	279
7 - 8	328	316	293	295	300	186	163	240	307	347	380	376
8 - 9	387	369	359	375	418	384	351	353	363	412	461	446
9 - 10	418	406	389	406	433	399	372	383	398	462	496	484
10 - 11	457	440	433	450	445	432	398	417	454	517	546	513
11 - 12	479	468	509	510	457	447	406	455	538	553	572	531
12 - 13	477	467	554	526	452	439	398	438	519	545	575	531
13 - 14	453	447	471	456	416	407	369	393	454	498	540	501
14 - 15	409	399	407	411	382	365	342	351	415	451	499	461
15 - 16	368	360	364	359	346	334	319	326	374	409	437	415
16 - 17	313	312	295	292	260	213	258	275	307	337	363	357
17 - 18	253	245	163	57	17	2	17	54	36	124	180	255
18 - 19	45	35	-	-	-	-	-	-	-	-	-	19
19 - 20	-	-	-	-	-	-	-	-	-	-	-	-
20 - 21	-	-	-	-	-	-	-	-	-	-	-	-
21 - 22	-	-	-	-	-	-	-	-	-	-	-	-
22 - 23	-	-	-	-	-	-	-	-	-	-	-	-
23 - 24	-	-	-	-	-	-	-	-	-	-	-	-
Sum	4557	4384	4285	4153	3938	3609	3392	3693	4257	4860	5359	5176

## 5 Acronyms and glossary

**Table 5.1:** Acronyms and glossary

Acronym	Full name	Unit	Explanation
GHI	Global horizontal irradiation	kWh/m <sup>2</sup>	Average annual, monthly or daily sum of global horizontal irradiation
DNI	Direct normal irradiation	kWh/m <sup>2</sup>	Average yearly, monthly or daily sum of direct normal irradiation
DIF	Diffuse horizontal irradiation	kWh/m <sup>2</sup>	Average yearly, monthly or daily sum of diffuse horizontal irradiation
D2G	Ratio of diffuse to global irradiation		Ratio of diffuse horizontal irradiation and global horizontal irradiation (DIF/GHI)
GTI opta	Global tilted irradiation at optimum angle	kWh/m <sup>2</sup>	Average annual, monthly or daily sum of global tilted irradiation for PV modules fix-mounted at optimum angle
OPTA	Optimum tilt of PV modules	°	Optimum tilt of fix-mounted PV modules facing towards Equator set for maximizing GTI input
GHI season	GHI seasonality		Ratio of maximum and minimum monthly averages of global horizontal irradiation (GHI_month_max/GHI_month_min)
DNI season	DNI seasonality		Ratio of maximum and minimum monthly averages of direct normal irradiation (DNI_month_max/DNI_month_min)
ALB	Surface albedo		Fraction of solar irradiance reflected by surface. Ratio of upwelling to downwelling (GHI) radiative fluxes at the surface
GTI theoretical	Global tilted irradiation (theoretical)	kWh/m <sup>2</sup>	Average annual, monthly or daily sum of global tilted irradiation without consideration of terrain shading
TEMP	Air temperature	°C	Average yearly, monthly and daily air temperature at 2 m above ground
WS	Wind speed	m/s	Average yearly, monthly and daily wind speed at 10 m above ground
RH	Relative humidity	%	Average yearly or monthly relative humidity at 2 m above ground
PWAT	Precipitable water	kg/m <sup>2</sup>	Precipitable water is the depth of water vapour in a column of the atmosphere, if all the water in that column were precipitated as rain. It indicates the amount of moisture above ground
PREC	Precipitation (rainfall)	mm	Average yearly and monthly sums of precipitation
SNOWD	Snow days	days	Snow days are calculated as days with snow water depth equivalent to or higher than 5 mm

Acronym	Full name	Unit	Explanation
CDD	Cooling degree days	degree days	Quantifies energy demand needed to cool a building. "Cooling degree days" are a measure of how much (in degrees), and for how long (in days), outside air temperature was higher than a specific base daily average temperature (18°C). Yearly and monthly values are aggregated from daily values
HDD	Heating degree days	degree days	Quantifies energy demand needed to heat a building. "Heating degree days" are a measure of how much (in degrees), and for how long (in days), outside air temperature was lower than a specific base daily average temperature (18°C). Yearly and monthly values are aggregated from daily values

## 6 Metadata

This report is based on high-resolution solar and meteorological database developed and operated by Solargis. The data parameters presented in this report are computed by Solargis models and algorithms. The data used as inputs to the models come from different sources. The data characteristics are explained below.

Time step: Monthly and yearly long-term statistics  
 The estimations assume a year having 365 days  
 Solargis Prospect database version 1.2

Parameter	Source of data inputs (Organisation)	Time representation	Solargis method	Last updated
ELE	SRTM v4.1 (CGIAR CSI), Viewfinder Panoramas (Jonathan de Ferranti BA), GEBCO_2014 Grid (GEBCO)		Data merging, cleaning, processing	2019-02-01
PVOUT_csi	GHI, DNI, TEMP, OPTA, ALBEDO, ELE (Solargis)	1999 - 2021	PV simulation model	2022-01-25
GHI	Solargis solar model (Solargis)	1999 - 2021	Solar model	2022-01-25
DNI	Solargis solar model (Solargis)	1999 - 2021	Solar model	2022-01-25
DIF	GHI DNI (Solargis)	1999 - 2021	Solar model	2022-01-25
D2G	GHI, DNI (Solargis)	1999 - 2021	Solar model	2022-01-25
GTL_opta	GHI DNI ALB HORIZON (Solargis)	1999 - 2021	Solar model	2022-01-25
OPTA	GHI, DNI, ALBEDO (Solargis)	1999 - 2021	PV simulation model	2022-01-22
GHI_season	GHI (Solargis)	1999 - 2021	Data processing	2022-01-25
DNI_season	DNI (Solargis)	1999 - 2021	Data processing	2022-01-25
ALB	Modis MCD43GF (NASA and LP DAAC), ERA5 (ECMWF)	2006 - 2015	Data merging, cleaning, processing	2019-03-01
TEMP	ERA5 (ECMWF)	1994 - 2021	Data processing	2022-01-20
WS	ERA (ECMWF)	1994 - 2021	Data processing	2022-01-20
RH	ERA (ECMWF)	1994 - 2021	Data processing	2022-01-20
PWAT	ERA (ECMWF)	1994 - 2021	Data processing	2022-01-20
PREC	GPCC database (DWD)	1891 - 2018	Data processing	2018-06-01
CDD	TEMP (Solargis)	1994 - 2021	Data processing	2022-01-25
HDD	TEMP (Solargis)	1994 - 2021	Data processing	2022-01-20
POPUL	GPW v4, UN WPP-Adjusted Population Density, v4.11, year 2020 (CIESIN)		Data processing	2022-02-09
LANDC	C3S global land cover (LC) maps at 300m, v2.1.1 (ESA CCI)		Post-processing	2022-02-09
SLO	ELE (Solargis)		Data processing	2019-02-01
AZI	ELE (Solargis)		Data processing	2019-02-01

### Documentation

Data uncertainty <https://solargis.com/docs/accuracy-and-comparisons/combined-uncertainty/>

Methodology <https://solargis.com/docs/methodology/solar-radiation-modeling/>

PV energy simulation <https://solargis.com/docs/methodology/pv-energy-modeling/>

## 7 Disclaimer and legal information

Considering the uncertainty of data and calculations, Solargis s.r.o. does not guarantee the accuracy of estimates. The maximum possible has been done for the assessment of weather parameters and preliminary assessment of the photovoltaic electricity production based on the best available data, software and knowledge. Solargis s.r.o. shall not be liable for any direct, incidental, consequential, indirect or punitive damages arising or alleged to have arisen out of use of the provided report.

This report shows solar power estimation in the start-up phase and over the entire lifetime of a PV system. The estimates are accurate enough for preliminary project assessment. For large projects planning and financing, more information is needed: 1. Statistical distribution and uncertainty of solar radiation 2. Detailed specification of a PV system 3. Inter-annual variability and P90 uncertainty of PV production 4. Lifetime energy production considering performance degradation of PV components.

More information about full PV yield assessment can be found at:

<https://solargis.com/products/pv-yield-assessment-study/overview/>

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