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What is solar insolation?

The amount of electromagnetic energy (solar radiation) incident on the surface of the earth. Basically that means how much sunlight is shining down on us.

Why is knowing the insolation level useful?

By knowing the insolation levels of a particular region we can determine the size of solar collector that is required. An area with poor insolation levels will need a larger collector than an area with high insolation levels. Once you know your region's insolation level you can more accurately calculate collector size and energy output.

What units are used to express Insolation levels?

The values are generally expressed in kWh/m²/day. This is the amount of solar energy that strikes a square metre of the earth's surface in a single day. Of course this value is averaged to account for differences in the days' length. There are several units that are used throughout the world.

The conversions based on surface area as follows:

$$1 \text{ kWh/m}^2/\text{day} = 317.1 \text{ btu/ft}^2/\text{day} = 3.6\text{MJ/m}^2/\text{day}$$

The raw energy conversions are:

$$1\text{kWh} = 3412 \text{ Btu} = 3.6\text{MJ} = 859.8\text{kcal}$$

Is my region's insolation level low, moderate or high?

The following scale is a basic guide for insolation levels. Although a value of 5 is not considered very high during the summer months, as an average annual value this is very high. You will see that in central Australia, which is a hot, sunny place, the annual average insolation is 5.89.

You may compare you location to the following two extreme locations.

Average annual insolation levels:

Central Australia = 5.89 kWh/m²/day – Very High

Helsinki, Finland = 2.41 kWh/m²/day – Very Low

Insolation Levels (Africa)

Average Insolation (10 year average) kWh/m²/day

Country	State/City	Latitude	Longitude	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Avg
BF	Ouagadougou	12' 24" N	1' 30" E	5.48	6.43	6.56	6.62	6.53	6.16	5.76	5.48	5.87	6.18	5.83	5.35	6.02
CF	Bangui	18' 32" N	120' 36" E	4.13	4.97	5.99	6.61	6.17	5.53	5.73	4.87	5.07	4.55	4.07	3.81	5.12
CM	Yaounde	3' 48" N	11' 30" W	4.94	5.38	5.16	4.68	4.46	4.42	5.17	5.07	5.03	5.4	5.29	4.83	4.98
DJ	djibouti	11' 33" N	43' 09" E	5.6	5.77	6.59	6.81	6.85	6.87	6.46	6.47	6.56	6.77	6.22	5.55	6.37
DZ	alger	36 ' 50" N	3' E	2.22	2.94	3.87	5	5.88	6.69	7.23	6.48	5.15	3.53	2.43	2.02	4.45
EG	Cairo	29' 35" N	31' 09" E	3.39	4.17	5.24	6.49	7.11	8	7.88	7.4	6.42	5.07	3.86	3.19	5.68
ET	addis abeba	9' 2" N	38' 42" E	5.96	5.8	6.23	6.31	6.11	5.79	5.03	5	5.64	6.31	6.15	5.75	5.84
GH	accra	5' 36` N	0' 12` W	5.65	6.01	5.65	5.33	5	4.49	4.5	4.59	4.67	5.25	5.7	5.55	5.2
GM	gambia	13' 28" N	16' 39" W	5.01	5.93	6.67	6.92	6.72	6.06	5.48	5.09	5.3	5.67	5.36	4.95	5.76
GN	conakry	9' 36" N	13' 36" E	5.81	6.41	6.51	6.22	5.69	5.69	5.09	5.05	5.46	5.87	5.98	5.6	5.78

KE	nairobi	1' 16" S	36' 48" E	6.05	6.24	6.07	5.7	5.42	5.14	4.88	5.09	5.78	6.03	5.48	5.6	5.62
LR	liberia	6' 30" N	9' 30" W	5.43	5.72	5.59	5.31	5.11	4.61	4.25	4.19	4.67	5.13	5.24	5.2	5.03
LY	tarabulus	32' 54" N	13' 11" E	3.1	4.03	5.19	6.48	6.89	7.77	8.11	7.45	6.12	4.58	3.35	2.76	5.48
MA	rabat	32' 32" N	9' 17" W	3.13	3.86	5.09	6.08	6.89	7.31	7.34	6.8	5.69	4.37	3.25	2.82	5.21
ML	bamako	12' 30" N	7' 54" E	5.61	6.35	6.64	6.78	6.42	6.47	5.87	5.65	6.04	6.13	5.85	5.36	6.09
MR	nouakchott	17' 45" N	15' 45" E	5.31	6.21	6.8	7.54	7.57	7.63	7.2	6.9	6.78	6.34	5.49	4.88	6.55
NE	niamey	13' 30" N	2' 12" W	5.42	6.39	6.72	6.79	6.75	6.31	6.07	5.78	6.07	6.16	5.79	5.29	6.12
NG	abuja	9' 12" N	7' 11" E	5.57	6.33	6.22	6.1	5.89	5.47	4.92	4.65	5.12	5.82	5.81	5.42	5.61
SD	al khur-tum	15' 33" N	32' 32" E	5.46	6.19	6.75	7.25	6.85	6.96	6.52	6.35	6.42	6.17	5.66	5.22	6.31
SL	freetown	8' 29" N	13' 14" W	5.19	5.91	6.08	5.47	4.76	4.09	3.6	3.58	4.25	4.84	4.93	4.94	4.8
SN	dakar	14' 38" N	17' 27" W	4.84	5.77	6.56	6.81	6.7	5.7	5.15	5.01	5.13	5.46	5.03	4.63	5.56
SO	muqdisho	2' 02" N	45' 20" E	6.38	6.81	6.71	6.28	5.85	5.45	5.21	5.61	6.15	6.16	6	5.91	6.04
TN	tunis	36' 47.8" N	10' 6.8" E	2.29	3.06	4.09	5.47	6.38	7.16	7.57	6.8	5.33	3.65	2.54	2.08	4.7

Insolation Levels (Asia & Sth Pacific)

Average Insolation (10 year average) kWh/m²/day

Country	City	Latitude	Longitude	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Avg
AE	Abu Dhabi	24' 28" N	54' 22" E	3.92	4.50	5.22	5.87	7.06	7.33	6.90	6.64	6.39	5.53	4.54	3.79	5.64
AU	Adelaide	34" 55" S	138" 36" E	7.2	6.58	5.18	3.85	2.65	2.23	2.48	3.2	4.46	5.69	6.59	6.74	4.74
AU	Brisbane	27" 99" S	153" 8" E	6.93	6.09	5.44	4.34	3.5	3.29	3.52	4.43	5.62	6.18	6.74	6.93	5.25
AU	Hobart	42" 52" S	147" 19" E	5.97	5.33	4.05	2.73	1.79	1.44	1.68	2.41	3.6	4.78	5.92	6.18	3.82
AU	Melbourne	37" 47" S	144" 58" E	6.78	6.22	4.76	3.4	2.29	1.84	2.04	2.79	3.94	5.27	6.28	6.46	4.34
AU	Perth	31" 57" S	115" 52" E	7.7	6.75	5.41	4.16	3.06	2.67	2.89	3.66	4.76	6.09	7.04	7.76	5.16
AU	Sydney	34" S	151" 0" E	6.34	5.68	4.87	3.6	2.74	2.5	2.67	3.53	4.67	5.61	6.32	6.6	4.59
BD	Dhaka	23' 42" N	90' 22" E	4.44	5.08	5.87	6.06	5.50	4.41	4.09	4.37	4.17	4.50	4.37	4.13	4.75
CN	Beijing	39' 55" N	116' 25" E	2.37	2.92	3.58	5.61	4.83	5.68	5.42	4.49	4.25	3.20	2.66	2.04	3.92
CN	Nanjing	32' 03" N	118' 53" E	2.04	2.22	2.65	4.50	3.84	4.47	4.93	4.50	3.67	3.02	2.88	2.08	3.40

CN	Shanghai	31' 10" N	121' 28" E	2.29	2.63	3.07	4.54	4.38	4.59	5.52	5.23	4.03	3.39	2.97	2.38	4.01
CN	Hongkong	22' 18" N	114' 10" E	2.59	2.56	3.06	3.93	4.13	4.74	5.81	4.95	4.68	4.05	3.56	2.93	4.18
ID	Jakarta	6' 11" S	106' 50" E	4.15	4.59	5.00	4.94	4.88	4.71	5.09	5.46	5.66	5.36	4.76	4.47	5.03
IL	Tel Aviv	32' 05" N	34' 46" E	2.78	3.5	4.73	6.03	6.86	7.87	7.81	7.22	6.19	4.63	3.32	2.62	5.73
IR	Tabriz	38' 48" N	46' 18" E	1.79	2.40	3.37	4.58	5.54	6.71	6.97	6.06	5.20	3.26	2.14	1.56	4.13
IR	Tehran	35' 40" N	51' 26" E	2.23	2.84	3.72	5.12	5.99	7.32	7.20	6.41	5.59	3.90	2.61	2.02	4.58
IR	Mashhad	36' 16" N	59' 34" E	2.22	2.97	3.88	5.21	6.29	7.49	7.41	6.78	5.70	4.13	2.78	2.06	4.74
IR	Bandar ^o Abbas	27' 15" N	56' 15" E	3.63	4.43	5.14	6.29	7.43	7.96	7.41	6.97	6.58	5.51	4.29	3.37	5.75
IN	New Delhi	28' N	77" E	3.68	4.47	5.50	6.60	7.08	6.55	5.01	4.62	5.11	4.99	4.15	3.42	5.10
IN	Bombay	18' 33" N	72' 32" E	5.22	6.03	6.66	7.05	6.77	4.59	3.54	3.40	4.72	5.39	5.15	4.80	5.28
IN	Bangalore	12' 57" N	77' 37" E	5.00	5.90	6.44	6.42	6.13	4.76	4.48	4.59	4.98	4.68	4.34	4.40	5.18
IQ	Baghdad	33' 20" N	44' 24" E	2.79	3.64	4.59	5.76	6.83	8.10	7.97	7.29	6.25	4.44	3.04	2.52	5.27
JO	Amman	31' 57" N	35' 57" E	2.93	3.67	4.83	6.04	6.88	7.91	7.86	7.27	6.25	4.71	3.47	2.76	5.80

JP	Tokyo	35' 45" N	139' 38" E	2.31	2.99	3.70	4.90	5.07	4.47	4.88	5.42	3.82	2.98	2.50	2.23	4.00
KH	Phnom penh	11' 33" N	104' 51" E	5.27	5.78	6.02	5.76	5.09	4.30	4.55	4.07	4.34	4.41	4.88	5.03	4.85
KP	P" yongyang	39' N	125' 18" E	2.50	3.35	4.50	5.17	5.60	5.35	4.51	4.63	4.22	3.51	2.46	2.09	4.20
KR	Seoul	37' 31" N	127' E	2.62	3.40	4.29	5.24	5.63	5.15	4.26	4.55	3.99	3.64	2.60	2.24	4.16
LA	Vientiane	18' 07" N	102' 35" E	4.30	4.94	5.52	5.74	5.11	4.24	4.22	4.19	4.61	4.26	4.21	4.24	4.63
LB	Beirut	33' 54N	35' 28E	2.64	3.4	4.63	6.03	6.96	7.9	7.84	7.19	6.13	4.5	3.14	2.44	5.68
MM	Yangon	16' 47" N	96' 09" E	5.40	6.06	6.65	6.69	5.14	3.24	3.30	2.99	4.12	4.51	4.82	5.05	4.65
MN	Ulaanbaatar	47' 55" N	106' 54" E	1.79	2.77	4.24	5.53	6.26	6.15	5.55	4.88	4.17	3.00	1.82	1.40	4.30
MY	Kuala Lumpur	3' 07" N	101' 42" E	4.54	5.27	5.14	5.05	4.80	4.98	4.91	4.78	4.54	4.51	4.23	4.07	4.70
NZ	Auckland	36" 52" S	174" 45" E	6.37	5.9	4.71	3.43	2.44	2	2.25	2.95	4.13	5.23	6.05	6.56	4.34
NZ	Christchurch	43" 32s	172" 37e	5.9	4.95	3.86	2.75	1.72	1.31	1.47	2.15	3.3	4.34	5.43	5.64	3.57
NZ	Wellington	41" 17" S	174" 47" E	6.27	5.31	4.17	3	1.95	1.54	1.74	2.46	3.66	4.7	5.73	6.01	3.88
OM	Mascat	23' 37" N	58' 37" E	4.34	5.00	5.85	6.69	7.54	7.56	6.91	6.71	6.55	5.93	4.95	4.23	6.29

PH	Cebu	10' 19" N	123' 54" E	4.53	5.15	5.83	6.25	5.90	4.83	4.76	4.93	4.96	4.75	4.49	4.44	5.07
PH	Manila	14' 37" N	120' 58" E	4.82	5.62	6.42	6.75	6.19	4.96	4.94	4.41	4.86	4.63	4.59	4.50	5.22
SA	Riyadh	24' 39" N	46' 42" E	4.03	4.92	5.56	6.24	7.27	7.99	7.86	7.46	6.83	5.80	4.58	3.82	6.03
SG	Singapore City	1' N	103' E	4.43	5.52	5.05	5.05	4.62	4.66	4.51	4.61	4.49	4.50	3.98	3.93	4.61
TH	Bang Kok	13' 45" N	100' 30" E	4.42	4.65	4.84	5.03	4.75	3.77	4.22	3.46	3.63	3.89	4.16	4.40	4.27
TH	Chiang Mai	18' N	99' E	4.79	5.51	6.11	6.29	5.53	4.44	4.16	4.18	4.50	4.34	4.28	4.48	4.88
TR	Ankara	39' 57" N	32' 53" E	1.77	2.38	3.69	4.54	5.53	6.63	6.99	6.55	5.22	3.24	1.99	1.51	4.17
VN	Hanoi	21' N	105' 54" E	2.52	2.94	3.81	4.34	4.66	4.51	4.62	4.62	4.57	3.64	3.29	3.17	3.89
YE	Aden	12" 50" N	45' 02" E	5.45	5.78	6.52	6.48	6.71	6.72	6.33	6.33	6.41	6.54	5.99	5.39	6.22

Insolation Levels (Canada)

Average Insolation (10 year average) kWh/m²/day

State	City	Latitude	Longitude	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Avg
AB	Edmonton	53° 34' N	113° 31' W	1.45	2.36	3.41	4.25	4.91	5.42	5.55	4.76	3.52	2.18	1.43	1.21	3.37
BC	Victoria	48° 25' N	123° 19' W	1	1.82	2.93	4.01	5.13	5.54	5.85	5.28	3.88	2.17	1.11	0.86	3.29
MB	Winnipeg	49° 54' N	97° 14' W	1.21	2.08	3.27	4.55	5.54	5.8	5.85	4.84	3.32	2.21	1.33	1.02	3.41
NL	St. Johns	45° 19' N	65° 53' W	1.56	2.27	3.48	4.19	4.76	5.05	5.05	4.54	3.53	2.29	1.43	1.27	3.28
NS	Halifax	44° 39' N	63° 34' W	1.56	2.31	3.46	4.09	4.82	5.27	5.41	4.86	3.92	2.54	1.53	1.3	3.42
ON	Toronto	43° 41' N	79° 38' W	1.44	2.27	3.19	4.13	5.15	5.83	5.67	4.82	3.66	2.47	1.48	1.20	3.44
QC	Montreal	45° 28' N	73° 45' W	1.45	2.36	3.41	4.25	4.91	5.42	5.55	4.76	3.52	2.18	1.43	1.21	3.37
SK	Regina	45° 19' N	65° 53' W	1.14	1.96	3.02	4.69	5.48	5.79	6.14	4.96	3.42	2.29	1.30	0.95	3.42

Insolation Levels (Europe)

Average Insolation (10 year average) kWh/m²/day

Country	State/City	Latitude	Longitude	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Avg
AT	Vienna	48' 13" N	16' 22" E	1.10	1.81	2.80	3.76	4.76	5.12	5.72	4.98	3.68	2.15	1.28	0.93	3.52
BE	Bruxelles	50' 45" N	4' 30" E	0.74	1.31	2.29	3.68	4.67	4.48	4.82	4.20	2.86	1.73	0.92	0.56	3.02
BG	Sofija	42' 40" N	23' 18" E	1.5	2.04	2.97	4.05	5	5.8	6.29	5.68	4.46	2.75	1.62	1.27	3.99
CY	Limassol	34' 40" N	33' 03" E	2.52	3.26	4.54	6.00	6.85	7.81	7.80	7.18	6.11	4.43	3.02	2.31	5.61
CR	Zagreb	45' 29" N	15' 35" E	1.30	2.00	2.94	3.91	5.03	5.37	5.93	5.19	3.94	2.39	1.39	1.09	3.72
DE	Hamburg	53' 33" N	9' 59" E	0.54	1.11	2.09	3.68	4.86	4.47	4.47	3.89	2.59	1.48	0.69	0.40	2.52
DE	Munich	48' 05" N	11' 23" E	1.05	1.80	2.82	3.95	4.84	4.65	5.14	4.46	3.20	2.00	1.02	0.79	2.98
ES	Madrid	40' 25" N	3' 41" W	1.93	2.75	4.09	4.83	5.85	6.52	7.11	6.30	4.91	3.07	1.97	1.59	4.62
ES	Malaga	36' 42" N	4' 42" W	2.52	3.24	4.51	5.40	6.35	7.09	7.64	6.81	5.39	3.70	2.58	2.14	5.16
ES	Barcelona	41' 24" N	2' 9" E	1.89	2.71	3.97	4.99	5.82	6.56	7.01	6.07	4.72	3.11	2.04	1.70	4.60

ES	Alicante	38' 40" N	0' 30" W	2.23	3.02	4.26	5.39	6.13	6.89	7.34	6.53	5.11	3.45	2.34	1.94	4.94
FX	Lyon	45' 46" N	4' 50" E	1.26	1.97	3.02	4.08	4.97	5.40	6.03	5.23	3.93	2.27	1.43	1.08	3.74
FX	Paris	48' 52" N	2' 20" E	0.89	1.62	2.62	3.95	4.90	4.83	5.35	4.61	3.33	2.00	1.12	0.72	3.34
FX	Toulouse	43' 37" N	1' 26" E	1.39	2.14	3.19	4.03	4.82	5.16	5.86	5.07	4.09	2.48	1.58	1.25	3.75
GR	Athens	38' N	23' 43" E	2.00	2.52	3.67	5.21	6.38	7.52	7.61	6.91	5.57	3.50	2.16	1.63	4.56
HU	Budapest	47' 30" N	19' 3" E	1.00	1.71	2.76	3.90	5.03	5.30	5.62	4.84	3.57	2.24	1.17	0.88	3.17
IE	Dublin	53' 20" N	6' 15" W	0.56	1.07	1.97	3.32	4.40	4.30	4.30	3.40	2.69	1.43	0.77	0.43	2.39
IT	Milan	45' 28" N	9' 12" E	1.27	1.89	2.91	3.65	4.84	5.36	5.97	5.21	3.91	2.40	1.42	1.08	3.33
IT	Rome	41' 53" N	12' 30" E	1.78	2.52	3.71	4.87	5.98	6.84	7.08	6.34	4.83	3.08	1.98	1.56	4.21
NL	Amsterdam	52' 21" N	4' 54" E	0.61	1.21	2.27	3.76	4.88	4.73	4.78	4.13	2.80	1.60	0.78	0.45	2.67
NO	Oslo	59' 56" N	10' 44" E	0.3	0.87	1.68	3.12	4.65	4.84	4.59	3.36	2.22	1.02	0.42	0.19	2.27
RO	Bucharest	44' 26" N	26' 06" E	1.36	1.94	2.91	3.94	5.03	5.6	6.15	5.53	4.15	2.59	1.37	1.1	3.47
PT	Lisboa	38' 42" N	9' 11" W	2.27	2.99	4.3	5.15	6.13	6.46	6.89	6.33	5.11	3.44	2.27	1.84	4.43

PT	Oviedo	43' 21" N	5' 50" W	1.67	2.29	3.44	4.59	5.56	6.32	6.86	5.95	4.51	2.71	1.77	1.46	3.93
UA	Odessa	46' 30" N	30' 46" E	1.08	1.78	2.68	3.87	5.4	5.7	6.39	5.63	3.96	2.45	1.06	0.87	3.41
UK	Edinburgh	55' 55" N	3" 10" W	0.44	0.94	1.86	3.18	4.33	4.34	4.13	3.41	2.43	1.2	0.59	0.32	2.26
UK	London	51' 32" N	0' 5" W	0.67	1.26	2.22	3.48	4.54	4.51	4.74	4.01	2.86	1.65	0.89	0.52	2.61
SZ	Bern	46' 57" N	7' 26" E	1.1	1.77	2.74	3.6	4.7	5.07	5.68	4.95	3.66	2.18	1.26	0.92	3.14
SZ	Lausanne	46' 32" N	6' 39" E	1.10	1.81	2.80	3.76	4.76	5.12	5.72	4.98	3.68	2.15	1.28	0.93	3.17
YU	Beograd	44' 50" N	20' 30" E	1.29	1.89	2.92	3.86	4.88	5.45	6	5.3	4.05	2.5	1.4	1.11	3.39

Insolation Levels (Sth America)

Average Insolation (10 year average) kWh/m²/day

Country	State/City	Latitude	Longitude	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Avg
Belize	Belize City	17° 30' N	88° 11' W	3.73	4.59	5.45	5.97	5.75	5.19	5.03	5.16	4.82	4.50	3.99	3.54	4.81
Costa Rica	San Jose	09° 59' N	84° 04' W	6.09	6.74	7.23	6.64	5.26	5.00	4.94	4.84	4.76	4.63	4.63	5.30	5.51
El Salvador	San Salvador	13° 40' N	89° 10' W	5.58	6.23	6.68	6.52	5.95	5.74	6.22	6.18	5.49	5.61	5.42	5.30	5.91
Guatemala	Guatemala City	14° 37' N	90° 31' W	4.93	5.48	5.90	5.81	5.35	4.91	5.27	5.12	4.59	4.68	4.65	4.62	5.11
Honduras	Tegucigalpa	14° 05' N	87° 14' W	4.26	5.08	5.84	5.99	5.54	5.35	5.34	5.47	5.04	4.43	4.15	3.91	5.03
Mexico	Acapulco	16° 50' N	99° 54' W	5.46	6.30	7.17	7.41	7.06	6.16	6.29	6.20	5.45	5.94	5.56	5.19	6.18
Mexico	Cancun	21° 10' N	86° 50' W	4.16	5.14	6.04	6.86	6.79	6.47	6.63	6.65	5.86	5.19	4.51	3.90	5.68

		N														
Mexico	Chihuahua	28° 39' N	106° 05' W	3.41	4.34	5.63	6.43	6.88	6.53	5.69	5.30	5.14	4.65	3.89	3.26	5.10
Mexico	Guadalajara	20° 40' N	103° 40' W	4.24	5.18	6.21	6.71	6.89	6.00	5.23	5.41	5.14	5.11	4.79	4.13	5.42
Mexico	La Paz	24° 09' N	110° 18' W	3.73	4.67	5.75	6.63	7.16	7.07	6.40	6.06	5.52	4.93	4.11	3.51	5.46
Mexico	Mexico City	19° 26' N	99° 08' W	4.34	5.07	5.89	5.95	5.90	5.03	4.76	4.86	4.57	4.73	4.57	4.29	5.00
Mexico	Monterrey	25° 40' N	100° 23' W	3.33	4.20	5.40	5.71	6.06	5.89	5.59	5.44	4.76	4.49	3.90	3.23	4.83
Mexico	Oaxaca	17° 04' N	96° 43' W	4.36	4.99	5.74	6.08	5.86	5.01	4.92	4.95	4.43	4.63	4.38	4.08	4.95
Mexico	Puerto Vallarta	20° 39' N	105° 14' W	4.20	5.29	6.39	7.12	7.51	6.96	6.17	5.99	5.32	5.30	4.82	4.00	5.76
Mexico	Tijuana	32° 32' N	117° 01' W	3.32	4.15	5.23	6.37	6.61	6.43	6.46	6.31	5.40	4.26	3.65	3.08	5.11

Mexico	Veracruz	19° 10' N	96° 07' W	3.55	4.13	4.86	5.35	5.40	5.12	5.15	5.17	4.66	4.45	3.92	3.43	4.60
Nicaragua	Managua	12° 10' N	86° 15' W	5.34	5.89	6.59	6.54	5.83	5.67	5.70	5.69	5.43	5.39	5.15	5.05	5.69
Panama	Panama City	08° 58' N	79° 33' W	5.27	5.92	6.23	5.75	4.78	4.11	4.16	4.15	4.24	3.99	4.23	4.66	4.79
Cuba	Havana	23° 09' N	82° 21' W	4.09	4.97	5.92	7.06	7.15	7.10	6.90	6.86	6.10	5.12	4.26	3.74	5.77
Jamaica	Kingston	17° 58' N	76° 48' W	4.92	5.67	6.45	6.80	6.50	6.82	6.84	6.61	6.23	5.45	4.76	4.58	5.97
Puerto Rico	San Juan	18° 15' N	66° 30' W	4.26	4.90	5.70	6.09	5.89	6.09	6.08	5.78	5.26	4.80	4.36	4.15	5.28
Martinique	Fort de France	14° 37' N	61° 05' W	5.35	5.98	6.59	6.94	6.70	6.42	6.49	6.45	6.03	5.87	5.15	5.15	6.09
Dominican Rep.	Santiago	18° 29' N	69° 54' W	3.89	4.46	5.24	5.53	5.52	5.48	5.41	5.13	4.80	4.46	4.03	3.78	4.81
Argentina	Buenos Aires	34° 36' S	58° 23' W	6.44	5.67	4.53	3.53	2.74	2.04	2.31	3.27	4.23	5.12	6.36	6.44	4.39

Argentina	Cordoba	31° 24' S	64° 12' W	7.07	6.30	4.90	3.87	3.01	2.65	2.79	3.63	4.76	5.93	6.63	6.96	4.88
Argentina	Rio Gallegos	51° 37' S	69° 13' W	5.47	4.63	3.32	2.02	1.07	0.71	0.81	1.61	2.87	4.26	5.53	5.79	3.17
Bolivia	La Paz	16° 29' S	68° 08' W	5.30	5.57	5.16	5.01	4.78	4.37	4.51	4.96	5.66	5.98	6.15	5.92	5.28
Bolivia	Santa Cruz	17° 47' S	63° 10' W	4.57	4.90	4.57	3.92	3.44	3.25	3.44	4.01	4.45	5.00	5.21	5.01	4.31
Bolivia	Sucre	19° 02' S	65° 15' W	1.67	2.29	3.47	4.58	5.59	6.37	6.86	5.97	4.51	2.73	1.77	1.46	3.94
Brazil	Belem	01° 27' S	48° 29' W	4.54	4.34	4.26	4.46	4.75	4.99	5.27	5.50	5.85	5.79	5.52	4.96	5.02
Brazil	Belo Horizonte	19° 55' S	43° 56' W	5.45	5.63	5.34	4.78	4.30	4.09	4.32	4.82	5.05	5.26	5.25	4.98	4.94
Brazil	Brasilia	15° 52' S	47° 56' W	5.21	5.15	5.09	4.99	4.80	4.59	4.86	5.46	5.28	5.23	4.97	4.82	5.04
Brazil	Curitiba	25° 26' S	49° 15' W	5.48	4.88	4.32	3.57	2.95	2.83	2.96	3.47	3.87	4.65	5.44	5.41	4.15

Brazil	Fortaleza	03° 43' S	38° 31' W	5.85	5.44	4.82	4.80	5.11	5.34	5.74	6.34	6.60	6.62	6.50	6.16	5.78
Brazil	Manaus	03° 08' S	60° 01' W	4.15	4.12	4.22	4.34	4.08	4.24	4.55	4.98	5.23	4.93	4.72	4.23	4.48
Brazil	Porto Alegre	30° 02' S	51° 13' W	6.08	5.56	4.54	3.48	2.81	2.27	2.50	3.06	3.89	5.01	5.93	6.50	4.30
Brazil	Recife	08° 05' S	34° 54' W	6.59	6.22	5.95	5.05	4.84	4.61	4.38	5.07	5.78	6.23	6.40	6.48	5.63
Brazil	Rio de Janeiro	22° 54' S	42° 10' W	5.40	5.34	4.87	4.11	3.43	3.35	3.39	3.83	3.77	4.41	4.97	4.98	4.32
Brazil	Salvador	12° 59' S	38° 30' W	5.89	5.79	5.28	4.59	4.09	3.75	3.83	4.26	4.79	5.32	5.38	5.61	4.88
Brazil	Sao Paulo	23° 33' S	46° 39' W	5.44	5.05	4.75	4.21	3.47	3.36	3.54	4.19	4.25	5.09	5.73	5.38	4.54
Chile	Iquique	20° 13' S	70° 10' W	7.42	7.34	6.19	4.70	3.45	2.78	3.04	3.39	4.53	5.37	6.36	7.40	5.16
Chile	Osorno	40° 35' S	73° 14' W	6.78	6.02	4.34	2.93	1.91	1.43	1.69	2.48	3.50	4.95	6.47	6.98	4.12

Chile	Santiago	33° 27' S	70° 42' W	7.55	6.56	5.13	3.83	2.59	2.22	2.38	3.09	4.08	5.64	6.84	7.82	4.81
Chile	Valparaiso	33° 01' S	71° 38' W	7.55	6.56	5.13	3.83	2.59	2.22	2.38	3.09	4.08	5.64	6.84	7.82	4.81
Columbia	Bogota	04° 36' N	74° 05' W	4.50	4.48	4.67	4.46	4.45	4.63	4.71	4.70	4.80	4.28	4.24	4.32	4.52
Columbia	Cali	03° 27' N	76° 30' W	3.63	3.90	4.09	3.89	3.76	3.71	4.05	3.93	3.89	3.52	3.49	3.44	3.78
Columbia	Cartagena	10° 25' N	75° 32' W	5.74	6.18	6.54	6.30	5.62	5.56	5.66	5.72	5.35	4.72	4.90	5.30	5.63
Columbia	Medellin	06° 14' N	75° 34' W	3.95	4.22	4.38	3.95	4.01	4.36	4.67	4.51	4.37	3.82	3.78	3.86	4.16
Ecuador	Guayaquil	02° 13' S	79° 54' W	6.07	6.01	6.31	6.31	5.83	4.88	4.50	4.50	4.95	4.69	5.29	5.93	5.44
Ecuador	Quito	00° 14' S	78° 30' W	3.57	3.56	3.71	3.71	3.73	3.81	3.85	3.88	3.89	3.79	3.85	3.68	3.75
French Guiana	Cayenne	04° 56' N	52° 27' W	3.91	4.34	4.55	4.66	4.04	4.25	4.96	5.40	5.81	5.51	4.91	4.29	4.72

Guyana	Georgetown	06° 50' N	58° 12' W	4.12	4.57	4.98	5.09	4.49	4.32	4.65	4.90	5.15	4.88	4.42	4.01	4.63
Peru	Arequipa	16° 25' S	71° 32' W	4.95	5.26	4.88	4.90	4.80	4.53	4.78	5.16	5.70	5.84	5.96	5.54	5.19
Peru	Cusco	13° 30' S	71° 58' W	4.19	4.43	4.23	3.99	3.74	3.56	4.01	4.29	4.55	4.72	4.67	4.50	4.24
Peru	Lima	12° 03' S	77° 02' W	7.27	7.52	7.25	6.28	4.78	3.34	3.17	3.39	4.33	5.11	6.02	6.85	5.44
Paraguay	Asuncion	25° 20' S	57° 31' W	6.10	5.77	4.98	3.84	3.48	2.76	3.09	3.97	4.49	5.26	6.22	6.26	4.69
Suriname	Paramaribo	05° 49' N	55° 09' W	4.13	4.63	5.07	5.08	4.78	4.78	5.12	5.42	5.87	5.61	4.97	4.47	4.99
Venezuela	Caracas	10° 30' N	66° 54' W	5.14	5.82	6.11	5.94	5.76	5.63	5.77	5.77	5.72	5.56	5.01	4.84	5.59
Venezuela	Maracaibo	10° 39' N	71° 36' W	4.71	5.09	5.42	5.22	5.12	5.28	5.49	5.31	5.20	4.68	4.55	4.51	5.05
Venezuela	Valencia	10° 09' N	68° 00' W	5.75	6.68	7.17	7.28	6.48	5.11	5.92	6.26	6.26	6.13	5.76	5.41	6.18

Insolation Levels (USA)

Average Insolation (10 year average) kWh/m²/day

State	City	Latitude	Longitude	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Avg
AL	Birmingham	33° 34' N	86° 45' W	2.29	3.31	4.04	5.14	5.92	5.98	5.81	5.7	4.8	3.93	2.96	2.25	4.34
AK	Anchorage	61° 10' N	150° 1' W	0.21	0.76	1.68	3.12	3.98	4.58	4.25	3.16	1.98	0.98	0.37	0.12	2.09
AR	Little Rock	32° 25' N	94° 44' W	2.36	3.39	4.01	5.32	5.71	6.19	6.15	5.85	5.25	4.17	2.95	2.25	4.46
AZ	Phoenix	33° 26' N	112° 1' W	3.25	4.41	5.17	6.76	7.42	7.7	6.99	6.11	6.02	4.44	3.52	2.75	5.38
CA	Los Angeles	34° N	118° W	3.09	4.25	5.09	6.58	7.29	7.62	7.45	6.72	6.11	4.42	3.43	2.72	5.40
CA	San Francisco	38° 31' N	121° 30' W	2.35	3.33	4.42	5.95	6.84	7.39	7.55	6.51	5.75	3.92	2.65	2.06	4.89
CO	Denver	39° 45' N	104° 52' W	2.25	3.2	4.32	5.61	6.11	6.71	6.5	5.86	5.47	4.01	2.59	1.98	4.55
CT	Hartford	41° 44' N	72° 39' W	1.7	2.43	3.48	4.07	5.14	5.58	5.38	5.04	4.13	2.91	1.81	1.42	3.59
DE	Dover	39° 8' N	75° 28' W	1.85	2.62	3.6	4.33	5.44	5.91	5.64	5.3	4.38	3.23	2.21	1.66	3.84
FL	Miami	25° 48' N	80° 16' W	3.72	4.61	5.42	6.4	6.61	6.29	6.26	6.08	5.47	4.84	3.96	3.46	5.26

GA	Atlanta	33' 39" N	84' 26" W	2.31	3.37	4.08	5.2	6.02	6.01	5.81	5.59	4.76	3.95	2.98	2.33	4.37
HI	Honolulu	21' 20" N	157' 55" W	4.38	5.15	5.99	6.69	7.05	7.48	7.37	7.07	6.51	5.46	4.41	4.01	5.96
IA	Dubuque	42' 24" N	90' 42" W	1.64	2.58	3.34	4.57	5.54	6.06	5.81	5.26	4.33	3.03	1.72	1.35	3.77
ID	Boise	43' 34" N	116' 13" W	1.73	2.72	3.77	5.22	5.9	6.57	7.17	6.12	5.28	3.29	1.74	1.46	4.24
IN	Indianapolis	39' 44" N	86' 17" W	1.67	2.59	3.28	4.67	5.46	6.11	5.79	5.37	4.76	3.33	1.97	1.46	3.87
IL	Chicago	41' 53" N	87' 38" W	1.5	2.45	3.2	4.48	5.56	6.07	5.68	5.27	4.51	3.07	1.69	1.26	3.72
KS	Kansas City	39' 12" N	94' 36" W	2.06	2.89	3.62	4.92	5.58	6.17	6.21	5.59	4.9	3.49	2.2	1.75	4.11
KY	Louisville	38' 11" N	85' 44" W	1.71	2.65	3.32	4.73	5.38	6.08	5.79	5.35	4.8	3.42	2.1	1.56	3.9
LA	New Orleans	29' 37" N	90' 5" W	2.64	3.73	4.67	5.8	6.6	6.15	6.09	5.7	5.13	4.48	3.49	2.68	4.76
MA	Boston	42' 22" N	71' 2" W	1.66	2.5	3.51	4.13	5.11	5.47	5.44	5.05	4.12	2.84	1.74	1.4	3.58
MD	Annapolis	38' 35" N	76' 21" W	1.96	2.8	3.71	4.55	5.54	6.03	5.77	5.34	4.48	3.4	2.37	1.81	3.98
ME	Portland	45' 36" N	122' 36" W	1.38	2.33	3.49	4.57	5.46	6.09	6.64	5.78	4.8	2.79	1.41	1.1	3.82
MI	Detroit	42' 25" N	83' 1" W	1.43	2.33	3.19	4.34	5.44	5.98	5.64	4.99	4.25	2.73	1.52	1.14	3.58

MO	St.Louis	38' 45" N	90' 23" W	2.02	2.82	3.52	4.97	5.56	6.21	6.05	5.63	4.91	3.55	2.21	1.73	4.09
MN	Minneapolis	44' 53" N	93' 13" W	1.6	2.61	3.3	4.55	5.44	5.86	5.77	5.12	4.12	2.9	1.62	1.34	3.68
MS	Jackson	42' 16" N	84' 28" W	1.47	2.41	3.22	4.33	5.46	5.93	5.57	4.99	4.3	2.78	1.55	1.17	3.59
MT	Billings	45' 48" N	108' 32" W	1.55	2.57	3.52	4.82	5.63	6.45	6.39	5.75	4.67	3.19	1.77	1.3	3.96
MT	Great Falls	43' 33" N	96' 42" W	1.3	2.36	3.41	4.84	5.56	6.18	6.44	5.53	4.4	2.9	1.53	1.11	3.79
NC	Charlotte	35' 13" N	80' 56" W	2.22	3.17	3.95	4.98	5.8	6.01	5.76	5.27	4.58	3.75	2.76	2.21	4.2
ND	Fargo	46' 54" N	96' 48" W	1.44	2.39	3.36	4.79	5.62	5.82	5.94	5.14	4.01	2.83	1.59	1.31	3.68
NE	Omaha	41' 18" N	95' 54" W	1.92	2.76	3.45	4.74	5.6	6.14	6.11	5.46	4.74	3.34	2	1.57	3.98
NH	Manchester	42' 56" N	71' 26" W	1.66	2.5	3.51	4.13	5.11	5.47	5.44	5.05	4.12	2.84	1.74	1.4	3.58
NJ	Trenton	40' 13" N	74' 46" W	1.71	2.39	3.43	4.04	5.26	5.67	5.39	5.14	4.18	3	1.98	1.48	3.63
NM	Albuquerque	35' 3" N	106' 37" W	2.92	3.97	4.92	6.3	6.68	6.94	6.66	5.8	5.68	4.18	3.16	2.5	4.97
NV	Las Vegas	36' 18" N	115' 16" W	3.02	4.13	5.05	6.57	7.25	7.69	7.37	6.42	6.08	4.26	3.18	2.6	5.3
NY	New York	41' N	74' W	1.67	2.37	3.41	3.93	5.11	5.48	5.26	5.01	4.05	2.85	1.82	1.4	3.53

OH	Columbus	39' 16" N	85' 54" W	1.64	2.57	3.26	4.63	5.4	6.08	5.73	5.29	4.74	3.29	1.96	1.45	3.83
OK	Tulsa	36' 12" N	95' 54" W	2.33	3.22	3.9	5.25	5.58	6.32	6.4	5.8	5.08	3.8	2.62	2.06	4.36
OR	Portland	45' 32" N	122' 40" W	1.38	2.33	3.49	4.57	5.46	6.09	6.64	5.78	4.8	2.79	1.41	1.1	3.82
PA	Philadelphia	39' 53" N	75' 15" W	1.85	2.62	3.6	4.33	5.44	5.91	5.64	5.3	4.38	3.23	2.21	1.66	3.84
PA	Pittsburgh	40' 27" N	79' 57" W	1.59	2.4	3.26	4.07	5.05	5.53	5.27	4.94	4.05	2.88	1.86	1.41	3.53
RI	Providence	41' 44" N	71' 26" W	1.7	2.46	3.53	4.2	5.17	5.67	5.48	5.08	4.21	2.97	1.8	1.43	3.64
SC	Columbia	38' 58" N	92' 22" W	2.14	2.91	3.62	5.03	5.56	6.22	6.13	5.64	4.95	3.57	2.25	1.82	4.15
SD	Sioux Falls	45' 27" N	98' 25" W	1.72	2.71	3.31	4.65	5.61	6.1	6.04	5.42	4.47	3.2	1.78	1.43	3.87
TN	Nashville	36' 7" N	86' 41" W	1.94	2.9	3.54	4.76	5.57	5.9	5.86	5.62	4.63	3.53	2.45	1.82	4.04
TX	San Antonio	29' 32" N	98' 28" W	2.57	3.7	4.43	5.54	5.94	6.62	6.49	6.28	5.7	4.67	3.43	2.62	4.83
TX	Houston	29' 59" N	95' 22" W	2.47	3.5	4.4	5.59	6.03	6.45	6.36	6.07	5.46	4.61	3.3	2.44	4.72
UT	Salt Lake City	40' 46" N	111' 52" W	2.23	3.15	4.09	5.57	6.26	6.98	6.86	5.98	5.39	3.68	2.29	1.97	4.53
VA	Washington	38' 51" N	77' 2" W	1.95	2.8	3.66	4.46	5.42	5.88	5.63	5.22	4.38	3.36	2.34	1.79	3.9

VT	Montpelier	44' 16" N	72' 35" W	1.58	2.54	3.5	4.05	5	5.24	5.37	4.92	3.79	2.46	1.52	1.28	3.43
WA	Seattle	47' 32" N	122' 18" W	1.14	2.04	3.23	4.26	5.19	5.75	6.27	5.46	4.43	2.5	1.21	0.9	3.53
WI	Milwaukee	42' 57" N	87' 54" W	1.43	2.41	3.29	4.48	5.6	6.09	5.74	5.21	4.34	2.9	1.6	1.2	3.69
WV	Charleston	38' 22" N	81' 36" W	1.75	2.64	3.34	4.26	5.2	5.67	5.49	5.19	4.26	3.19	2.15	1.62	3.73
WY	Casper	42' 55" N	106' 28" W	1.93	2.8	3.79	5.13	5.9	6.68	6.5	5.9	5.13	3.59	2.06	1.65	4.25