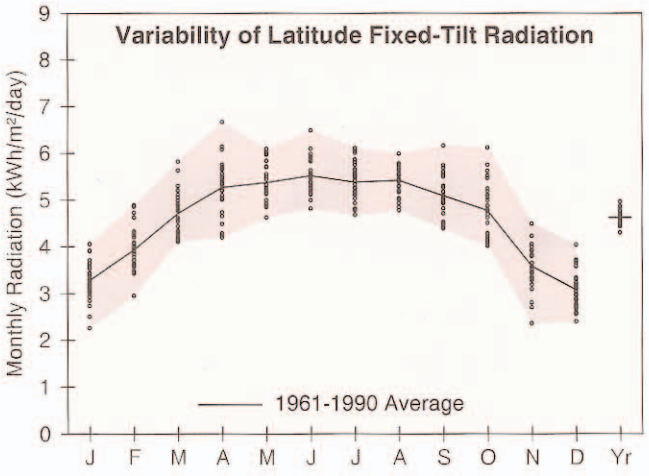


Bristol, TN

WBAN NO. 13877

LATITUDE: 36.48° N
LONGITUDE: 82.40° W
ELEVATION: 459 meters
MEAN PRESSURE: 964 millibars

STATION TYPE: Secondary

Solar Radiation for Flat-Plate Collectors Facing South at a Fixed Tilt (kWh/m²/day), Uncertainty ±9%

Tilt (°)		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
0	Average	2.2	2.9	4.0	5.1	5.7	6.1	5.8	5.4	4.5	3.6	2.4	1.9	4.1
	Min/Max	1.8/2.5	2.4/3.4	3.6/4.7	4.2/6.3	5.0/6.5	5.3/7.2	5.1/6.6	4.8/5.9	4.0/5.3	3.2/4.4	1.9/2.8	1.7/2.3	3.9/4.4
Latitude -15	Average	2.9	3.6	4.6	5.4	5.7	6.0	5.8	5.6	5.0	4.5	3.2	2.7	4.6
	Min/Max	2.1/3.5	2.8/4.4	4.0/5.6	4.3/6.8	4.9/6.5	5.2/7.1	5.0/6.6	5.0/6.2	4.4/6.0	3.8/5.6	2.2/4.0	2.2/3.5	4.3/4.9
Latitude	Average	3.3	3.9	4.7	5.3	5.4	5.5	5.4	5.4	5.1	4.8	3.6	3.1	4.6
	Min/Max	2.3/4.1	3.0/4.9	4.1/5.8	4.2/6.7	4.6/6.1	4.8/6.5	4.7/6.1	4.8/6.0	4.4/6.2	4.0/6.1	2.4/4.5	2.4/4.0	4.3/5.0
Latitude +15	Average	3.5	4.0	4.6	4.9	4.8	4.8	4.7	5.0	4.9	4.8	3.7	3.3	4.4
	Min/Max	2.3/4.4	3.0/5.1	4.0/5.7	3.9/6.2	4.1/5.4	4.2/5.6	4.1/5.3	4.4/5.5	4.2/5.9	4.0/6.2	2.4/4.8	2.5/4.4	4.1/4.7
90	Average	3.1	3.3	3.3	2.9	2.4	2.2	2.3	2.7	3.2	3.8	3.2	3.0	3.0
	Min/Max	1.9/4.0	2.4/4.4	2.8/4.1	2.4/3.6	2.2/2.7	2.1/2.4	2.1/2.5	2.5/3.0	2.8/3.9	3.1/4.9	2.0/4.2	2.2/4.1	2.7/3.2

Solar Radiation for 1-Axis Tracking Flat-Plate Collectors with a North-South Axis (kWh/m²/day), Uncertainty ±9%

Axis Tilt (°)		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
0	Average	3.0	3.9	5.2	6.6	7.2	7.7	7.3	6.8	5.9	4.9	3.3	2.7	5.4
	Min/Max	2.0/3.7	2.9/4.9	4.4/6.6	5.1/8.7	5.9/8.6	6.4/9.4	6.1/8.6	5.9/7.7	4.9/7.4	4.1/6.4	2.2/4.1	2.1/3.5	5.0/5.9
Latitude -15	Average	3.5	4.5	5.7	6.9	7.2	7.6	7.3	7.1	6.3	5.6	3.9	3.2	5.7
	Min/Max	2.3/4.4	3.2/5.7	4.8/7.2	5.2/9.2	5.9/8.6	6.4/9.4	6.1/8.6	6.1/8.0	5.3/8.0	4.6/7.3	2.5/5.0	2.5/4.3	5.3/6.3
Latitude	Average	3.8	4.7	5.8	6.8	7.0	7.3	7.0	6.9	6.3	5.8	4.2	3.5	5.8
	Min/Max	2.4/4.8	3.3/6.0	4.8/7.3	5.1/9.1	5.7/8.4	6.1/9.0	5.8/8.3	5.9/7.8	5.3/8.1	4.8/7.7	2.6/5.4	2.7/4.8	5.3/6.4
Latitude +15	Average	4.0	4.8	5.7	6.5	6.6	6.8	6.5	6.6	6.2	5.9	4.3	3.7	5.6
	Min/Max	2.5/5.1	3.4/6.2	4.8/7.3	4.9/8.8	5.4/7.9	5.7/8.4	5.4/7.8	5.6/7.5	5.2/7.9	4.8/7.8	2.6/5.6	2.8/5.1	5.2/6.2

Solar Radiation for 2-Axis Tracking Flat-Plate Collectors (kWh/m²/day), Uncertainty ±9%

Tracker		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
2-Axis	Average	4.0	4.8	5.8	6.9	7.3	7.8	7.4	7.1	6.4	5.9	4.3	3.7	6.0
	Min/Max	2.5/5.2	3.4/6.2	4.9/7.4	5.2/9.2	6.0/8.8	6.5/9.6	6.2/8.8	6.1/8.0	5.4/8.1	4.8/7.8	2.6/5.7	2.8/5.2	5.5/6.6

Direct Beam Solar Radiation for Concentrating Collectors (kWh/m²/day), Uncertainty ±8%

Tracker		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
1-Axis, E-W Horiz Axis	Average	2.2	2.4	2.8	3.2	3.3	3.6	3.3	3.2	3.0	3.2	2.4	2.2	2.9
	Min/Max	0.9/3.2	1.3/3.6	2.0/4.0	1.7/5.0	2.3/4.6	2.6/5.1	2.3/4.5	2.4/4.0	2.2/4.3	2.3/4.6	1.0/3.5	1.4/3.5	2.6/3.4
1-Axis, N-S Horiz Axis	Average	1.7	2.3	3.2	4.1	4.4	4.6	4.2	4.1	3.6	3.2	2.0	1.6	3.3
	Min/Max	0.7/2.5	1.3/3.4	2.3/4.8	2.3/6.5	3.0/6.1	3.4/6.6	2.9/5.8	3.0/5.1	2.7/5.3	2.3/4.8	0.9/2.9	1.0/2.6	2.9/3.9
1-Axis, N-S Tilt=Latitude	Average	2.4	3.0	3.7	4.3	4.2	4.3	4.0	4.1	4.0	4.0	2.8	2.3	3.6
	Min/Max	1.0/3.5	1.6/4.4	2.6/5.5	2.4/6.8	2.9/5.9	3.2/6.2	2.7/5.6	3.0/5.2	3.0/5.8	2.9/5.9	1.2/4.0	1.5/3.8	3.2/4.3
2-Axis	Average	2.6	3.1	3.7	4.4	4.5	4.7	4.3	4.3	4.0	4.0	2.9	2.5	3.7
	Min/Max	1.1/3.8	1.6/4.5	2.6/5.5	2.4/6.9	3.1/6.2	3.4/6.7	3.0/5.9	3.2/5.3	3.0/5.8	2.9/5.9	1.3/4.2	1.6/4.1	3.3/4.4

Average Climatic Conditions

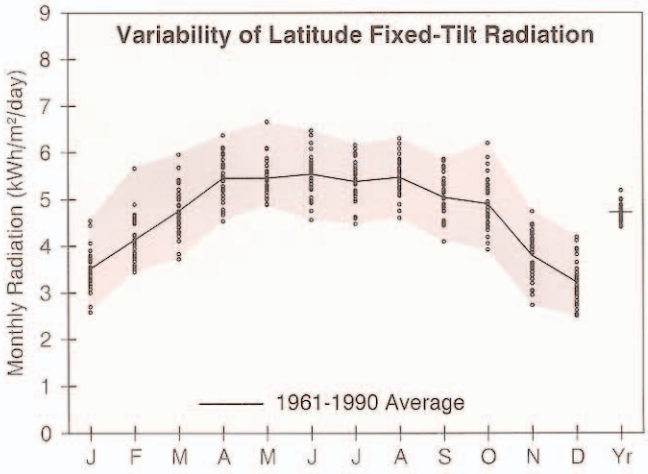
Element	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
Temperature (°C)	1.1	3.0	8.4	12.9	17.4	21.7	23.6	23.1	19.9	13.7	8.3	3.4	13.1
Daily Minimum Temp	-4.3	-2.9	1.9	6.1	10.9	15.5	17.8	17.3	13.7	6.8	2.2	-2.1	6.9
Daily Maximum Temp	6.5	8.9	14.9	19.7	24.0	27.9	29.2	28.9	26.2	20.6	14.6	8.9	19.2
Record Minimum Temp	-29.4	-20.6	-18.9	-6.1	-1.1	3.3	7.2	6.1	1.1	-6.7	-15.0	-22.8	-29.4
Record Maximum Temp	26.1	26.7	29.4	31.7	33.3	36.1	38.9	38.3	37.8	32.2	27.2	25.6	38.9
HDD, Base 18.3°C	534	429	307	166	67	3	0	0	24	156	300	462	2448
CDD, Base 18.3°C	0	0	0	0	39	105	162	148	73	13	0	0	540
Relative Humidity (%)	71	68	64	62	71	74	76	77	76	72	71	72	71
Wind Speed (m/s)	2.8	3.0	3.2	3.1	2.4	2.1	1.9	1.7	1.9	2.1	2.5	2.7	2.4

Chattanooga, TN

WBAN NO. 13882

LATITUDE: 35.03° N
LONGITUDE: 85.20° W
ELEVATION: 210 meters
MEAN PRESSURE: 994 millibars

STATION TYPE: Secondary



Solar Radiation for Flat-Plate Collectors Facing South at a Fixed Tilt (kWh/m²/day), Uncertainty ±9%

Tilt (°)		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
0	Average	2.4	3.1	4.1	5.3	5.8	6.1	5.9	5.5	4.5	3.8	2.6	2.1	4.3
	Min/Max	2.0/2.8	2.8/3.9	3.4/4.9	4.4/6.0	5.2/7.1	5.1/7.2	4.9/6.7	4.7/6.2	3.8/5.2	3.2/4.6	2.1/3.0	1.9/2.5	4.0/4.6
Latitude -15	Average	3.1	3.8	4.6	5.6	5.8	6.0	5.8	5.7	5.0	4.6	3.4	2.8	4.7
	Min/Max	2.4/3.9	3.3/5.1	3.7/5.7	4.6/6.5	5.2/7.1	4.9/7.0	4.8/6.6	4.8/6.5	4.1/5.8	3.7/5.7	2.5/4.2	2.3/3.6	4.4/5.1
Latitude	Average	3.5	4.1	4.8	5.4	5.4	5.5	5.4	5.5	5.0	4.9	3.8	3.2	4.7
	Min/Max	2.6/4.5	3.4/5.7	3.7/6.0	4.5/6.4	4.9/6.7	4.6/6.5	4.5/6.2	4.6/6.3	4.1/5.9	3.9/6.2	2.7/4.7	2.5/4.2	4.4/5.2
Latitude +15	Average	3.7	4.2	4.6	5.1	4.9	4.8	4.7	5.0	4.8	4.9	4.0	3.4	4.5
	Min/Max	2.6/4.9	3.5/5.9	3.6/5.9	4.2/5.9	4.4/5.9	4.0/5.6	3.9/5.4	4.2/5.7	3.9/5.6	3.9/6.3	2.8/5.0	2.6/4.6	4.2/5.0
90	Average	3.2	3.4	3.2	2.9	2.4	2.2	2.2	2.7	3.1	3.8	3.4	3.0	3.0
	Min/Max	2.2/4.4	2.8/4.9	2.5/4.1	2.5/3.4	2.2/2.7	1.9/2.3	2.0/2.4	2.3/3.0	2.6/3.7	2.9/4.9	2.3/4.4	2.2/4.2	2.7/3.2

Solar Radiation for 1-Axis Tracking Flat-Plate Collectors with a North-South Axis (kWh/m²/day), Uncertainty ±9%

Axis Tilt (°)		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
0	Average	3.2	4.2	5.3	6.8	7.3	7.6	7.2	6.9	5.8	5.1	3.5	2.8	5.5
	Min/Max	2.4/4.1	3.4/5.7	4.1/7.0	5.4/8.3	6.3/9.5	6.1/9.4	5.8/8.8	5.7/8.1	4.5/6.9	3.9/6.6	2.5/4.4	2.2/3.7	5.1/6.2
Latitude -15	Average	3.8	4.7	5.7	7.1	7.3	7.6	7.2	7.1	6.2	5.7	4.1	3.4	5.8
	Min/Max	2.7/4.9	3.8/6.6	4.3/7.6	5.5/8.6	6.4/9.6	6.1/9.3	5.8/8.8	5.8/8.4	4.7/7.3	4.3/7.4	2.8/5.3	2.6/4.5	5.4/6.6
Latitude	Average	4.1	4.9	5.9	7.0	7.1	7.2	6.9	6.9	6.2	5.9	4.4	3.7	5.9
	Min/Max	2.8/5.4	4.0/7.1	4.4/7.8	5.5/8.6	6.2/9.3	5.8/8.9	5.6/8.4	5.6/8.2	4.7/7.4	4.4/7.8	3.0/5.7	2.7/5.0	5.4/6.6
Latitude +15	Average	4.2	5.0	5.8	6.7	6.6	6.7	6.5	6.6	6.0	6.0	4.6	3.9	5.7
	Min/Max	2.9/5.7	4.0/7.3	4.3/7.7	5.2/8.3	5.8/8.7	5.4/8.3	5.2/7.9	5.3/7.8	4.6/7.3	4.4/7.9	3.0/5.9	2.8/5.3	5.3/6.5

Solar Radiation for 2-Axis Tracking Flat-Plate Collectors (kWh/m²/day), Uncertainty ±9%

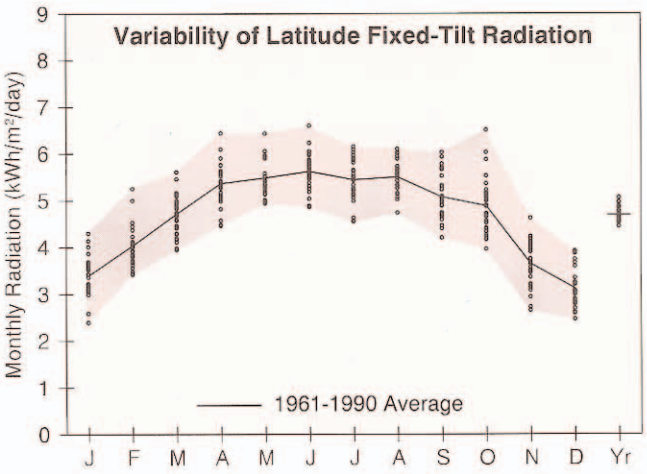
Tracker		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
2-Axis	Average	4.3	5.0	5.9	7.1	7.4	7.7	7.3	7.1	6.2	6.0	4.6	3.9	6.0
	Min/Max	2.9/5.7	4.0/7.3	4.4/7.8	5.6/8.7	6.4/9.7	6.2/9.5	5.9/8.9	5.8/8.4	4.7/7.4	4.5/7.9	3.0/6.0	2.8/5.4	5.6/6.9

Direct Beam Solar Radiation for Concentrating Collectors (kWh/m²/day), Uncertainty ±8%

Tracker		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
1-Axis, E-W	Average	2.4	2.6	2.7	3.3	3.3	3.4	3.1	3.1	2.8	3.2	2.6	2.2	2.9
Horiz Axis	Min/Max	1.3/3.7	1.7/4.6	1.5/4.2	1.9/4.4	2.6/5.1	2.3/5.0	1.9/4.4	2.1/4.2	1.6/3.8	1.9/4.7	1.3/3.8	1.3/3.6	2.5/3.6
1-Axis, N-S	Average	1.9	2.5	3.2	4.2	4.3	4.4	4.1	4.0	3.4	3.3	2.2	1.7	3.3
Horiz Axis	Min/Max	1.0/2.9	1.6/4.4	1.7/5.1	2.5/5.9	3.4/6.8	3.0/6.5	2.5/5.8	2.8/5.4	1.9/4.5	1.9/4.9	1.1/3.2	0.9/2.7	2.8/4.1
1-Axis, N-S	Average	2.6	3.2	3.6	4.4	4.1	4.1	3.8	4.0	3.7	4.0	2.9	2.4	3.6
Tilt=Latitude	Min/Max	1.4/4.0	2.0/5.6	1.9/5.8	2.6/6.1	3.3/6.5	2.8/6.1	2.4/5.5	2.8/5.4	2.1/5.0	2.3/5.9	1.4/4.3	1.4/3.9	3.0/4.5
2-Axis	Average	2.8	3.3	3.7	4.5	4.4	4.5	4.1	4.1	3.7	4.0	3.1	2.6	3.7
	Min/Max	1.5/4.3	2.1/5.8	1.9/5.8	2.7/6.2	3.5/6.9	3.0/6.6	2.6/5.9	2.8/5.6	2.1/5.0	2.3/6.0	1.5/4.5	1.5/4.2	3.2/4.7

Average Climatic Conditions

Element	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
Temperature (°C)	3.0	5.4	10.2	15.1	19.4	24.0	25.9	25.5	22.4	15.8	10.3	5.1	15.2
Daily Minimum Temp	-2.2	-0.5	3.9	8.2	13.0	17.7	20.2	19.8	17.0	9.4	4.4	-0.4	9.2
Daily Maximum Temp	8.2	11.3	16.6	21.9	25.8	30.2	31.7	31.2	27.8	22.2	16.2	10.4	21.1
Record Minimum Temp	-23.3	-17.2	-13.3	-3.3	1.1	5.0	10.6	10.0	2.2	-5.6	-15.6	-18.9	-23.3
Record Maximum Temp	25.6	26.1	30.6	33.9	37.2	40.0	41.1	40.6	38.9	34.4	28.9	25.6	41.1
HDD, Base 18.3°C	476	361	252	109	32	0	0	0	5	106	242	412	1993
CDD, Base 18.3°C	0	0	0	11	64	170	236	222	128	26	0	0	858
Relative Humidity (%)	71	68	66	64	71	73	75	76	77	75	73	73	72
Wind Speed (m/s)	3.0	3.2	3.4	3.2	2.6	2.3	2.2	2.1	2.2	2.2	2.6	2.9	2.7



Knoxville, TN

WBAN NO. 13891

LATITUDE: 35.82° N
LONGITUDE: 83.98° W
ELEVATION: 299 meters
MEAN PRESSURE: 983 millibars

STATION TYPE: Secondary

Solar Radiation for Flat-Plate Collectors Facing South at a Fixed Tilt (kWh/m²/day), Uncertainty ±9%

Tilt (°)		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
0	Average	2.3	3.0	4.0	5.2	5.8	6.2	5.9	5.5	4.5	3.7	2.5	2.0	4.2
	Min/Max	1.8/2.6	2.7/3.6	3.5/4.6	4.4/6.0	5.3/6.8	5.4/7.4	4.9/6.7	4.8/6.1	3.9/5.3	3.2/4.7	2.0/2.9	1.8/2.3	4.1/4.5
Latitude -15	Average	3.0	3.7	4.6	5.5	5.8	6.1	5.8	5.7	5.0	4.6	3.3	2.8	4.7
	Min/Max	2.2/3.7	3.2/4.7	3.9/5.4	4.6/6.5	5.3/6.8	5.3/7.2	4.9/6.6	4.9/6.3	4.2/5.9	3.8/6.0	2.5/4.1	2.3/3.4	4.5/5.0
Latitude	Average	3.4	4.0	4.7	5.4	5.5	5.6	5.4	5.5	5.1	4.9	3.7	3.1	4.7
	Min/Max	2.4/4.3	3.4/5.3	4.0/5.6	4.5/6.4	4.9/6.4	4.9/6.6	4.6/6.2	4.7/6.1	4.2/6.0	4.0/6.5	2.7/4.6	2.5/3.9	4.4/5.1
Latitude +15	Average	3.6	4.1	4.6	5.0	4.9	4.9	4.8	5.0	4.8	4.9	3.8	3.3	4.5
	Min/Max	2.5/4.6	3.5/5.4	3.8/5.5	4.1/6.0	4.4/5.7	4.3/5.7	4.0/5.4	4.3/5.6	4.0/5.8	3.9/6.7	2.7/4.9	2.5/4.2	4.2/4.8
90	Average	3.2	3.3	3.2	2.9	2.4	2.2	2.3	2.7	3.2	3.8	3.3	3.0	3.0
	Min/Max	2.0/4.2	2.7/4.5	2.7/3.8	2.5/3.5	2.3/2.7	2.0/2.4	2.1/2.5	2.4/3.0	2.6/3.8	3.0/5.2	2.2/4.3	2.2/3.9	2.7/3.2

Solar Radiation for 1-Axis Tracking Flat-Plate Collectors with a North-South Axis (kWh/m²/day), Uncertainty ±9%

Axis Tilt (°)		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
0	Average	3.1	4.0	5.2	6.7	7.3	7.8	7.3	6.9	5.8	5.0	3.4	2.7	5.5
	Min/Max	2.1/3.8	3.3/5.2	4.3/6.5	5.3/8.2	6.3/9.1	6.4/9.8	5.7/8.7	5.8/7.9	4.6/7.2	4.1/6.9	2.4/4.3	2.2/3.4	5.2/6.1
Latitude -15	Average	3.6	4.6	5.7	6.9	7.4	7.7	7.3	7.1	6.2	5.7	4.0	3.3	5.8
	Min/Max	2.5/4.7	3.7/6.1	4.6/7.1	5.4/8.6	6.3/9.2	6.4/9.8	5.7/8.7	5.9/8.1	4.9/7.7	4.5/7.9	2.8/5.1	2.5/4.2	5.5/6.4
Latitude	Average	3.9	4.8	5.8	6.9	7.1	7.4	7.1	7.0	6.3	5.9	4.3	3.6	5.8
	Min/Max	2.6/5.1	3.8/6.5	4.6/7.2	5.3/8.6	6.1/8.9	6.1/9.4	5.4/8.4	5.8/8.0	4.9/7.8	4.7/8.3	2.9/5.6	2.7/4.6	5.5/6.5
Latitude +15	Average	4.1	4.9	5.7	6.6	6.7	6.9	6.6	6.7	6.1	6.0	4.4	3.7	5.7
	Min/Max	2.7/5.4	3.9/6.6	4.5/7.2	5.1/8.3	5.7/8.4	5.7/8.7	5.1/7.9	5.5/7.6	4.7/7.6	4.7/8.4	3.0/5.8	2.8/4.9	5.3/6.3

Solar Radiation for 2-Axis Tracking Flat-Plate Collectors (kWh/m²/day), Uncertainty ±9%

Tracker		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
2-Axis	Average	4.1	4.9	5.8	7.0	7.4	7.9	7.4	7.2	6.3	6.0	4.4	3.8	6.0
	Min/Max	2.7/5.4	3.9/6.6	4.7/7.3	5.4/8.6	6.4/9.3	6.5/10.0	5.8/8.9	5.9/8.2	4.9/7.8	4.7/8.4	3.0/5.8	2.8/4.9	5.7/6.7

Direct Beam Solar Radiation for Concentrating Collectors (kWh/m²/day), Uncertainty ±8%

Tracker		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
1-Axis, E-W Horiz Axis	Average	2.2	2.5	2.7	3.1	3.3	3.6	3.2	3.2	2.8	3.2	2.4	2.1	2.9
	Min/Max	1.1/3.4	1.4/3.9	1.8/3.8	1.8/4.4	2.6/4.8	2.5/5.4	1.9/4.5	2.1/4.0	1.8/4.0	2.2/5.1	1.3/3.6	1.3/3.1	2.6/3.5
1-Axis, N-S Horiz Axis	Average	1.8	2.4	3.1	4.1	4.4	4.6	4.2	4.1	3.4	3.3	2.0	1.6	3.2
	Min/Max	0.9/2.7	1.2/3.7	2.0/4.5	2.3/5.7	3.3/6.4	3.2/7.1	2.4/5.8	2.8/5.1	2.1/4.9	2.3/5.3	1.1/3.0	1.0/2.3	2.9/4.0
1-Axis, N-S Tilt=Latitude	Average	2.5	3.0	3.6	4.2	4.2	4.3	4.0	4.1	3.8	4.0	2.8	2.3	3.6
	Min/Max	1.3/3.8	1.6/4.8	2.3/5.2	2.4/6.0	3.2/6.2	3.0/6.7	2.3/5.5	2.8/5.2	2.3/5.4	2.7/6.5	1.5/4.1	1.4/3.4	3.2/4.3
2-Axis	Average	2.6	3.1	3.6	4.3	4.5	4.7	4.3	4.2	3.8	4.1	2.9	2.5	3.7
	Min/Max	1.3/4.0	1.7/4.9	2.3/5.2	2.5/6.0	3.4/6.5	3.3/7.2	2.5/5.9	2.9/5.3	2.3/5.4	2.8/6.5	1.6/4.3	1.5/3.7	3.3/4.5

Average Climatic Conditions

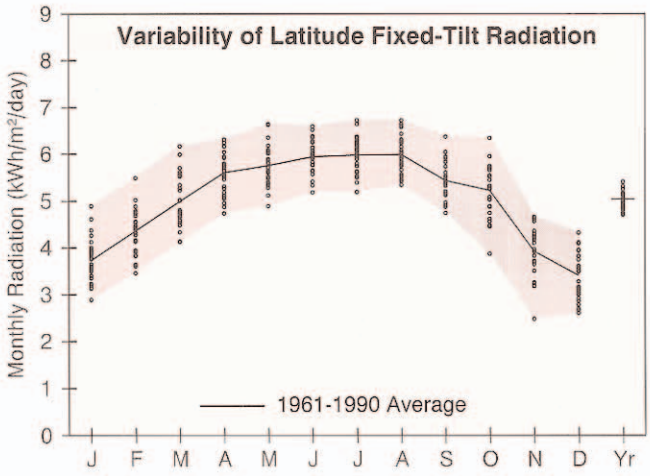
Element	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
Temperature (°C)	2.2	4.5	9.4	14.2	18.6	22.9	24.8	24.4	21.2	14.7	9.3	4.5	14.2
Daily Minimum Temp	-3.3	-1.6	2.6	7.0	11.7	16.6	18.9	18.5	15.0	7.8	3.1	-1.1	7.9
Daily Maximum Temp	7.7	10.5	16.3	21.3	25.3	29.2	30.6	30.4	27.3	21.4	15.5	10.1	20.5
Record Minimum Temp	-31.1	-18.9	-17.2	-5.6	0.0	6.1	9.4	9.4	2.2	-3.9	-15.0	-21.1	-31.1
Record Maximum Temp	25.0	28.3	30.0	33.3	34.4	38.9	39.4	38.9	39.4	32.8	28.9	26.7	39.4
HDD, Base 18.3°C	499	387	276	130	52	0	0	0	10	132	272	429	2187
CDD, Base 18.3°C	0	0	0	5	59	137	200	189	95	18	0	0	703
Relative Humidity (%)	72	68	65	63	71	73	76	76	76	73	72	73	72
Wind Speed (m/s)	3.4	3.5	3.7	3.7	3.0	2.8	2.7	2.5	2.5	2.5	3.0	3.2	3.0

Memphis, TN

WBAN NO. 13893

LATITUDE: 35.05° N
LONGITUDE: 89.98° W
ELEVATION: 87 meters
MEAN PRESSURE: 1008 millibars

STATION TYPE: Secondary



Solar Radiation for Flat-Plate Collectors Facing South at a Fixed Tilt (kWh/m²/day), Uncertainty ±9%

Tilt (°)		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
0	Average	2.5	3.2	4.2	5.4	6.1	6.6	6.5	6.0	4.8	4.0	2.7	2.2	4.5
	Min/Max	2.1/2.9	2.8/3.8	3.6/5.0	4.6/6.0	5.2/7.0	5.8/7.4	5.7/7.3	5.3/6.6	4.3/5.5	3.1/4.6	2.0/3.0	1.8/2.5	4.3/4.8
Latitude -15	Average	3.3	4.0	4.8	5.7	6.1	6.4	6.4	6.2	5.4	4.9	3.5	3.0	5.0
	Min/Max	2.6/4.2	3.3/4.9	4.0/5.9	4.8/6.4	5.2/7.1	5.6/7.2	5.6/7.3	5.5/6.9	4.7/6.2	3.7/5.8	2.3/4.1	2.3/3.7	4.7/5.3
Latitude	Average	3.7	4.4	5.0	5.6	5.8	5.9	6.0	6.0	5.4	5.2	3.9	3.4	5.0
	Min/Max	2.9/4.9	3.5/5.5	4.1/6.2	4.7/6.3	4.9/6.6	5.2/6.6	5.2/6.7	5.3/6.7	4.7/6.4	3.9/6.3	2.5/4.7	2.6/4.3	4.7/5.4
Latitude +15	Average	4.0	4.5	4.9	5.2	5.1	5.1	5.2	5.5	5.2	5.3	4.1	3.6	4.8
	Min/Max	3.0/5.3	3.5/5.7	4.0/6.1	4.4/5.9	4.3/5.9	4.5/5.6	4.6/5.8	4.9/6.1	4.5/6.2	3.9/6.5	2.5/4.9	2.7/4.7	4.5/5.2
90	Average	3.5	3.6	3.4	3.0	2.4	2.2	2.3	2.9	3.4	4.1	3.5	3.3	3.1
	Min/Max	2.5/4.8	2.8/4.7	2.8/4.2	2.6/3.3	2.2/2.7	2.1/2.4	2.2/2.5	2.6/3.1	2.9/4.0	2.9/5.0	2.0/4.3	2.3/4.3	2.9/3.4

Solar Radiation for 1-Axis Tracking Flat-Plate Collectors with a North-South Axis (kWh/m²/day), Uncertainty ±9%

Axis Tilt (°)		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
0	Average	3.4	4.4	5.6	7.1	7.9	8.5	8.4	7.8	6.4	5.5	3.7	3.0	6.0
	Min/Max	2.7/4.4	3.5/5.6	4.6/7.2	5.8/8.3	6.3/9.5	7.2/9.8	6.9/9.9	6.8/9.1	5.5/7.7	4.0/6.9	2.3/4.4	2.3/3.8	5.5/6.6
Latitude -15	Average	4.0	5.0	6.1	7.4	8.0	8.5	8.4	8.1	6.8	6.2	4.3	3.6	6.4
	Min/Max	3.1/5.4	3.9/6.4	4.9/7.9	5.9/8.7	6.4/9.6	7.1/9.8	6.9/9.8	6.9/9.3	5.9/8.2	4.4/7.8	2.6/5.2	2.7/4.7	5.9/7.0
Latitude	Average	4.4	5.3	6.2	7.3	7.7	8.1	8.1	7.9	6.9	6.5	4.6	3.9	6.4
	Min/Max	3.3/5.9	4.0/6.9	5.0/8.1	5.9/8.6	6.2/9.3	6.8/9.4	6.7/9.5	6.8/9.1	5.9/8.3	4.6/8.1	2.7/5.6	2.9/5.2	5.9/7.0
Latitude +15	Average	4.6	5.4	6.1	7.0	7.3	7.6	7.6	7.5	6.7	6.5	4.8	4.1	6.3
	Min/Max	3.4/6.2	4.1/7.0	4.9/8.0	5.6/8.3	5.8/8.8	6.3/8.7	6.2/8.9	6.5/8.7	5.8/8.2	4.5/8.2	2.7/5.9	3.0/5.4	5.7/6.9

Solar Radiation for 2-Axis Tracking Flat-Plate Collectors (kWh/m²/day), Uncertainty ±9%

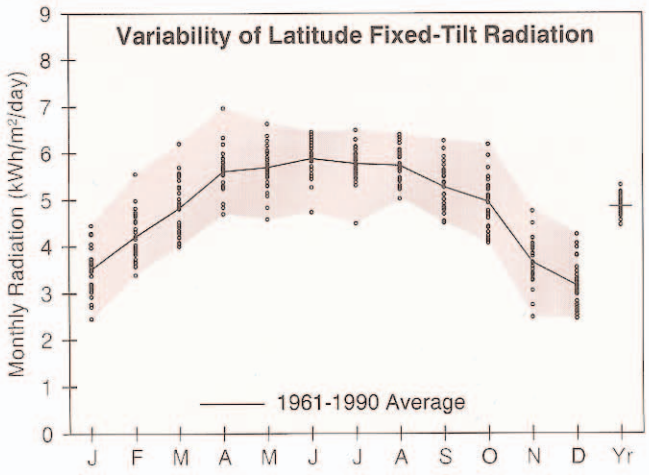
Tracker		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
2-Axis	Average	4.6	5.4	6.2	7.4	8.0	8.6	8.5	8.1	6.9	6.5	4.8	4.2	6.6
	Min/Max	3.4/6.3	4.1/7.0	5.0/8.1	6.0/8.7	6.4/9.7	7.2/10.0	7.0/10.0	7.0/9.3	5.9/8.3	4.6/8.2	2.8/5.9	3.0/5.5	6.1/7.3

Direct Beam Solar Radiation for Concentrating Collectors (kWh/m²/day), Uncertainty ±8%

Tracker		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
1-Axis, E-W Horiz Axis	Average	2.6	2.9	3.0	3.5	3.7	4.1	4.0	3.8	3.2	3.6	2.7	2.5	3.3
	Min/Max	1.6/4.1	1.7/4.3	2.0/4.5	2.5/4.6	2.6/5.0	3.1/5.4	2.8/5.4	3.0/4.9	2.6/4.5	2.1/4.9	1.0/3.6	1.5/3.6	2.8/3.9
1-Axis, N-S Horiz Axis	Average	2.1	2.8	3.6	4.6	5.0	5.4	5.3	5.0	4.0	3.7	2.3	1.8	3.8
	Min/Max	1.3/3.2	1.7/4.2	2.4/5.3	3.2/6.1	3.4/6.7	4.0/7.1	3.7/7.1	3.9/6.5	3.2/5.5	2.2/5.2	0.9/3.1	1.1/2.8	3.3/4.5
1-Axis, N-S Tilt=Latitude	Average	2.9	3.5	4.0	4.7	4.8	5.0	5.0	5.0	4.4	4.5	3.1	2.6	4.2
	Min/Max	1.8/4.5	2.2/5.3	2.7/6.0	3.3/6.3	3.3/6.5	3.8/6.6	3.5/6.7	3.9/6.5	3.5/6.0	2.6/6.2	1.2/4.2	1.6/3.9	3.5/4.9
2-Axis	Average	3.1	3.6	4.1	4.8	5.1	5.5	5.4	5.2	4.4	4.6	3.3	2.9	4.3
	Min/Max	1.9/4.8	2.2/5.4	2.7/6.0	3.4/6.4	3.5/6.9	4.1/7.2	3.8/7.2	4.0/6.7	3.5/6.1	2.6/6.3	1.2/4.4	1.8/4.2	3.7/5.1

Average Climatic Conditions

Element	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
Temperature (°C)	4.3	6.8	11.7	17.2	21.8	26.2	28.1	27.2	23.4	17.3	11.4	6.5	16.8
Daily Minimum Temp	-0.6	1.6	6.1	11.3	16.2	20.5	22.7	21.7	18.1	11.1	5.9	1.6	11.3
Daily Maximum Temp	9.2	11.9	17.3	22.9	27.2	31.8	33.5	32.7	28.8	23.5	16.8	11.4	22.3
Record Minimum Temp	-20.0	-23.9	-11.1	-1.7	3.3	8.9	11.1	8.9	2.2	-3.9	-12.8	-25.0	-25.0
Record Maximum Temp	25.6	27.2	29.4	34.4	37.2	40.0	42.2	40.6	39.4	35.0	29.4	27.2	42.2
HDD, Base 18.3°C	436	323	213	71	14	0	0	0	6	73	211	367	1712
CDD, Base 18.3°C	0	0	8	36	121	235	303	276	159	40	0	0	1177
Relative Humidity (%)	68	66	63	62	66	67	69	70	71	66	68	69	67
Wind Speed (m/s)	4.2	4.4	4.6	4.5	3.9	3.5	3.3	3.1	3.3	3.4	3.9	4.2	3.8



Nashville, TN

WBAN NO. 13897

LATITUDE: 36.12° N
LONGITUDE: 86.68° W
ELEVATION: 180 meters
MEAN PRESSURE: 996 millibars

STATION TYPE: Primary

Solar Radiation for Flat-Plate Collectors Facing South at a Fixed Tilt (kWh/m²/day), Uncertainty ±9%

Tilt (°)		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
0	Average	2.3	3.1	4.1	5.4	6.0	6.5	6.3	5.7	4.7	3.8	2.5	2.0	4.4
	Min/Max	1.8/2.7	2.7/3.8	3.5/5.0	4.6/6.5	4.9/7.1	5.2/7.2	4.9/7.1	5.0/6.3	4.1/5.4	3.3/4.5	2.0/3.0	1.6/2.4	4.0/4.7
Latitude -15	Average	3.1	3.9	4.7	5.7	6.0	6.4	6.2	5.9	5.2	4.6	3.3	2.8	4.8
	Min/Max	2.3/3.9	3.2/5.0	3.9/5.9	4.8/7.0	4.9/7.1	5.1/7.0	4.8/7.0	5.2/6.6	4.5/6.2	3.9/5.7	2.3/4.2	2.2/3.6	4.4/5.2
Latitude	Average	3.5	4.2	4.8	5.6	5.7	5.9	5.8	5.7	5.3	4.9	3.6	3.1	4.9
	Min/Max	2.5/4.4	3.4/5.6	4.0/6.2	4.7/7.0	4.6/6.6	4.7/6.4	4.5/6.5	5.0/6.4	4.5/6.3	4.1/6.2	2.5/4.8	2.5/4.3	4.5/5.3
Latitude +15	Average	3.7	4.3	4.7	5.2	5.0	5.1	5.1	5.2	5.0	5.0	3.8	3.4	4.6
	Min/Max	2.5/4.8	3.4/5.8	3.9/6.1	4.3/6.5	4.1/5.8	4.2/5.6	4.0/5.7	4.6/5.8	4.3/6.0	4.1/6.3	2.5/5.0	2.6/4.6	4.3/5.1
90	Average	3.3	3.5	3.3	3.1	2.5	2.3	2.4	2.9	3.3	3.9	3.3	3.0	3.1
	Min/Max	2.1/4.3	2.8/4.8	2.7/4.3	2.6/3.8	2.1/2.8	2.1/2.5	2.1/2.6	2.5/3.1	2.8/4.0	3.1/4.9	2.0/4.4	2.2/4.3	2.9/3.4

Solar Radiation for 1-Axis Tracking Flat-Plate Collectors with a North-South Axis (kWh/m²/day), Uncertainty ±9%

Axis Tilt (°)		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
0	Average	3.1	4.2	5.4	7.0	7.6	8.2	7.8	7.3	6.1	5.1	3.4	2.7	5.7
	Min/Max	2.2/3.9	3.3/5.5	4.4/7.1	5.7/8.9	6.0/9.5	5.9/9.3	5.7/9.4	6.3/8.5	5.0/7.5	4.1/6.5	2.3/4.5	2.2/3.6	5.1/6.3
Latitude -15	Average	3.8	4.8	5.8	7.3	7.7	8.1	7.8	7.5	6.5	5.8	4.0	3.3	6.0
	Min/Max	2.5/4.8	3.7/6.4	4.7/7.8	5.9/9.4	6.0/9.6	5.8/9.3	5.7/9.4	6.4/8.8	5.3/8.0	4.6/7.4	2.6/5.3	2.5/4.5	5.4/6.7
Latitude	Average	4.1	5.0	6.0	7.2	7.5	7.8	7.5	7.3	6.5	6.0	4.2	3.6	6.1
	Min/Max	2.7/5.2	3.9/6.9	4.8/8.0	5.8/9.3	5.8/9.3	5.6/8.9	5.5/9.1	6.3/8.6	5.3/8.1	4.8/7.8	2.7/5.8	2.7/5.1	5.5/6.8
Latitude +15	Average	4.2	5.1	5.9	6.9	7.0	7.3	7.0	6.9	6.3	6.1	4.4	3.8	5.9
	Min/Max	2.7/5.5	3.9/7.0	4.7/7.9	5.5/9.0	5.4/8.8	5.2/8.3	5.1/8.5	6.0/8.2	5.2/7.9	4.7/7.9	2.7/6.0	2.8/5.4	5.3/6.6

Solar Radiation for 2-Axis Tracking Flat-Plate Collectors (kWh/m²/day), Uncertainty ±9%

Tracker		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
2-Axis	Average	4.3	5.1	6.0	7.3	7.8	8.3	7.9	7.5	6.5	6.1	4.4	3.8	6.3
	Min/Max	2.8/5.6	3.9/7.1	4.8/8.0	5.9/9.4	6.1/9.7	5.9/9.5	5.8/9.6	6.5/8.8	5.4/8.1	4.8/7.9	2.7/6.0	2.8/5.4	5.7/7.0

Direct Beam Solar Radiation for Concentrating Collectors (kWh/m²/day), Uncertainty ±8%

Tracker		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
1-Axis, E-W Horiz Axis	Average	2.4	2.7	2.8	3.4	3.5	3.7	3.4	3.2	2.9	3.2	2.5	2.2	3.0
	Min/Max	1.3/3.5	1.5/4.4	1.9/4.4	2.3/5.0	2.3/5.2	1.9/4.8	1.8/4.9	2.5/4.3	2.2/4.2	2.2/4.6	1.1/3.8	1.4/3.7	2.6/3.6
1-Axis, N-S Horiz Axis	Average	1.8	2.5	3.3	4.4	4.6	4.8	4.4	4.2	3.6	3.3	2.0	1.6	3.4
	Min/Max	1.0/2.7	1.4/4.1	2.2/5.2	2.9/6.5	3.0/6.8	2.3/6.3	2.4/6.5	3.1/5.7	2.5/5.1	2.2/4.8	0.9/3.3	1.0/2.8	2.8/4.1
1-Axis, N-S Tilt=Latitude	Average	2.6	3.2	3.8	4.6	4.4	4.5	4.2	4.2	3.9	4.1	2.8	2.4	3.7
	Min/Max	1.4/3.8	1.8/5.3	2.5/5.9	3.0/6.8	2.9/6.6	2.2/5.8	2.3/6.1	3.2/5.8	2.8/5.6	2.7/5.8	1.2/4.4	1.5/4.0	3.2/4.6
2-Axis	Average	2.8	3.3	3.8	4.7	4.7	4.9	4.5	4.4	3.9	4.1	2.9	2.6	3.9
	Min/Max	1.5/4.1	1.9/5.5	2.5/5.9	3.1/6.9	3.1/7.0	2.4/6.3	2.4/6.6	3.3/5.9	2.8/5.6	2.7/5.9	1.3/4.6	1.6/4.3	3.3/4.8

Average Climatic Conditions

Element	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
Temperature (°C)	2.3	4.7	10.1	15.1	19.8	24.2	26.3	25.6	22.1	15.8	10.0	4.7	15.1
Daily Minimum Temp	-3.1	-1.2	3.9	8.6	13.7	18.2	20.5	19.8	16.2	9.1	4.2	-0.6	9.1
Daily Maximum Temp	7.7	10.4	16.2	21.6	26.0	30.3	31.9	31.3	28.1	22.5	15.8	10.1	21.0
Record Minimum Temp	-27.2	-25.0	-16.7	-5.0	1.1	5.6	10.6	8.3	2.2	-3.3	-18.3	-23.3	-27.2
Record Maximum Temp	25.6	28.9	30.0	32.8	36.1	41.1	41.7	40.0	40.6	34.4	28.9	26.1	41.7
HDD, Base 18.3°C	496	383	261	107	33	0	0	0	12	108	250	422	2072
CDD, Base 18.3°C	0	0	6	11	79	177	246	226	125	29	0	0	898
Relative Humidity (%)	70	69	65	63	69	70	73	73	74	69	70	72	70
Wind Speed (m/s)	4.1	4.2	4.5	4.2	3.5	3.3	3.0	2.9	3.0	3.2	3.8	4.2	3.7