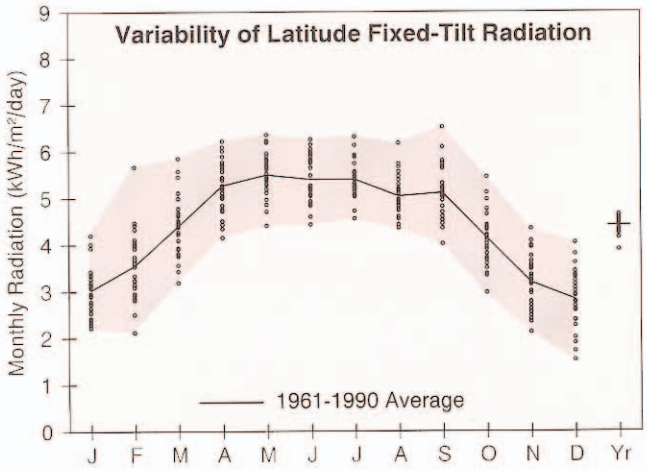


Arcata, CA

WBAN NO. 24283

LATITUDE: 40.98° N
LONGITUDE: 124.10° W
ELEVATION: 69 meters
MEAN PRESSURE: 1010 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	1.8	2.5	3.6	5.0	5.8	6.0	5.9	5.0	4.4	3.1	2.0	1.6	3.9
	Min/Max	1.5/2.2	1.8/3.4	2.8/4.5	4.1/5.8	4.8/6.6	5.0/7.0	5.1/6.8	4.5/6.0	3.7/5.3	2.5/3.7	1.6/2.4	1.1/2.0	3.6/4.1
Latitude -15	Average	2.7	3.3	4.3	5.4	5.9	5.9	5.8	5.3	5.1	3.9	2.9	2.5	4.4
	Min/Max	2.0/3.6	2.1/5.1	3.2/5.6	4.3/6.3	4.7/6.8	4.8/6.8	4.9/6.8	4.6/6.4	4.1/6.4	2.9/5.1	2.0/3.8	1.4/3.5	4.0/4.6
Latitude	Average	3.0	3.5	4.4	5.3	5.5	5.4	5.4	5.0	5.1	4.1	3.2	2.8	4.4
	Min/Max	2.2/4.2	2.1/5.7	3.2/5.8	4.2/6.2	4.4/6.4	4.4/6.3	4.6/6.3	4.4/6.2	4.0/6.5	3.0/5.4	2.1/4.3	1.5/4.0	3.9/4.6
Latitude +15	Average	3.2	3.6	4.3	4.9	4.9	4.7	4.7	4.6	4.9	4.1	3.3	3.0	4.2
	Min/Max	2.3/4.5	2.1/5.9	3.0/5.8	3.8/5.8	3.9/5.6	3.9/5.4	4.0/5.5	4.0/5.6	3.8/6.3	2.9/5.5	2.1/4.6	1.5/4.4	3.6/4.4
90	Average	2.9	3.0	3.2	3.2	2.8	2.5	2.6	2.8	3.4	3.3	2.9	2.8	3.0
	Min/Max	2.0/4.2	1.7/5.1	2.3/4.4	2.5/3.7	2.3/3.1	2.3/2.8	2.3/2.9	2.5/3.4	2.7/4.4	2.3/4.5	1.8/4.2	1.3/4.2	2.5/3.1

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	2.5	3.3	4.7	6.4	7.3	7.5	7.3	6.3	5.8	4.1	2.8	2.3	5.0
	Min/Max	1.9/3.5	1.9/5.4	3.2/6.5	4.8/7.9	5.5/8.8	5.7/9.2	5.9/9.0	5.2/8.0	4.4/7.7	3.0/5.6	1.9/3.8	1.3/3.2	4.5/5.4
Latitude -15	Average	3.2	3.9	5.3	6.8	7.5	7.5	7.4	6.5	6.4	4.8	3.4	2.9	5.5
	Min/Max	2.3/4.6	2.2/6.7	3.5/7.4	5.1/8.4	5.5/8.9	5.6/9.2	5.9/9.1	5.3/8.4	4.8/8.6	3.3/6.6	2.2/4.8	1.5/4.3	4.8/5.9
Latitude	Average	3.5	4.1	5.3	6.7	7.2	7.2	7.1	6.4	6.4	5.0	3.7	3.2	5.5
	Min/Max	2.4/5.0	2.2/7.1	3.5/7.6	4.9/8.4	5.3/8.7	5.3/8.8	5.6/8.8	5.2/8.2	4.7/8.7	3.3/6.9	2.3/5.2	1.6/4.7	4.7/5.9
Latitude +15	Average	3.6	4.2	5.2	6.4	6.8	6.7	6.6	6.0	6.3	5.0	3.8	3.4	5.3
	Min/Max	2.5/5.3	2.2/7.3	3.4/7.5	4.7/8.0	5.0/8.2	4.9/8.3	5.2/8.2	4.9/7.8	4.6/8.5	3.3/6.9	2.3/5.4	1.6/5.0	4.6/5.7

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	3.6	4.2	5.4	6.8	7.5	7.7	7.5	6.5	6.5	5.0	3.8	3.4	5.7
	Min/Max	2.5/5.3	2.2/7.3	3.5/7.6	5.1/8.4	5.6/9.1	5.7/9.4	6.0/9.2	5.3/8.4	4.8/8.7	3.3/6.9	2.3/5.4	1.6/5.1	4.9/6.1

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	2.0	2.1	2.4	3.1	3.5	3.5	3.4	2.8	3.1	2.5	2.1	2.0	2.7
	Min/Max	1.2/3.6	0.7/4.8	1.2/4.3	1.7/4.4	1.9/4.7	1.8/4.9	2.0/4.9	1.7/4.5	1.8/4.9	1.2/4.1	0.8/3.4	0.6/3.4	2.2/3.1
1-Axis, N-S Horiz Axis	Average	1.5	1.8	2.7	3.9	4.5	4.5	4.4	3.6	3.7	2.5	1.6	1.3	3.0
	Min/Max	0.8/2.6	0.6/4.3	1.3/4.8	2.1/5.6	2.5/6.2	2.3/6.4	2.7/6.4	2.2/5.7	2.1/5.9	1.2/4.1	0.7/2.6	0.4/2.3	2.5/3.5
1-Axis, N-S Tilt=Latitude	Average	2.2	2.5	3.2	4.2	4.4	4.2	4.3	3.7	4.2	3.2	2.4	2.1	3.4
	Min/Max	1.3/4.0	0.8/5.8	1.5/5.7	2.3/5.9	2.4/6.1	2.2/6.0	2.5/6.2	2.3/5.9	2.4/6.7	1.5/5.2	0.9/3.9	0.6/3.6	2.7/3.9
2-Axis	Average	2.4	2.6	3.2	4.2	4.7	4.6	4.6	3.9	4.3	3.3	2.5	2.3	3.5
	Min/Max	1.3/4.3	0.8/5.9	1.5/5.7	2.3/6.1	2.5/6.5	2.3/6.5	2.7/6.6	2.3/6.1	2.4/6.7	1.5/5.3	1.0/4.1	0.7/3.9	2.8/4.0

Average Climatic Conditions

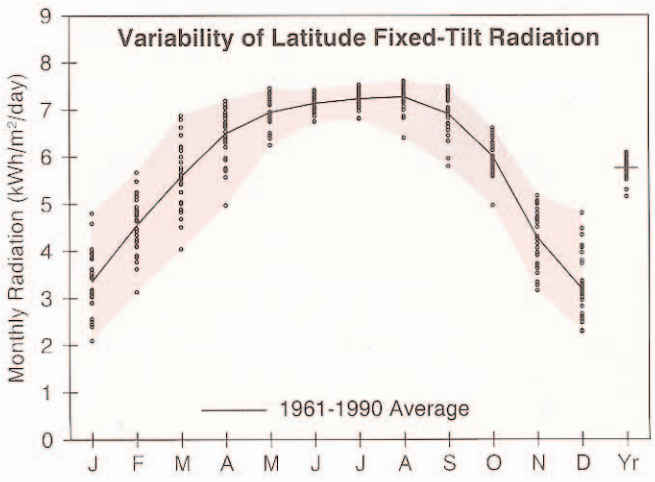
Element	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
Temperature (°C)	7.8	8.7	8.9	9.5	11.2	12.8	13.6	13.8	13.2	11.7	9.9	8.0	10.8
Daily Minimum Temp	3.8	4.7	5.0	5.3	7.2	9.0	10.1	10.4	9.1	7.5	5.9	4.1	6.8
Daily Maximum Temp	12.2	12.7	12.7	13.4	14.7	16.3	17.2	17.4	17.7	16.1	14.2	12.2	14.7
Record Minimum Temp	-6.7	-5.0	-3.9	-1.7	0.0	1.7	2.8	4.4	0.6	-3.3	-2.8	-8.3	-8.3
Record Maximum Temp	23.9	25.6	23.9	25.6	31.1	27.2	27.8	31.7	32.2	29.4	24.4	23.3	32.2
HDD, Base 18.3°C	329	276	295	269	226	171	151	144	157	211	257	324	2809
CDD, Base 18.3°C	0	0	0	0	0	0	0	0	0	0	0	0	0
Relative Humidity (%)	82	81	82	81	83	85	85	87	87	87	84	83	84
Wind Speed (m/s)	2.9	3.2	3.5	3.4	3.4	3.0	2.8	2.4	2.3	2.3	2.8	2.8	2.9

Bakersfield, CA

WBAN NO. 23155

LATITUDE: 35.42° N
LONGITUDE: 119.05° W
ELEVATION: 150 meters
MEAN PRESSURE: 998 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	3.3	4.7	6.2	7.4	8.1	8.0	7.2	5.9	4.4	2.9	2.1	5.2
	Min/Max	1.8/2.9	2.6/3.9	3.6/5.5	4.8/6.8	6.7/7.9	7.6/8.4	7.4/8.4	6.4/7.6	5.1/6.4	3.8/4.8	2.4/3.3	1.8/2.7	4.8/5.4
Latitude -15	Average	3.0	4.2	5.4	6.6	7.4	7.8	7.8	7.5	6.8	5.5	3.8	2.8	5.7
	Min/Max	2.0/4.2	3.0/5.1	4.0/6.5	5.1/7.3	6.7/7.9	7.3/8.1	7.3/8.2	6.6/7.9	5.7/7.3	4.7/6.1	2.9/4.5	2.1/4.1	5.2/6.0
Latitude	Average	3.3	4.5	5.6	6.5	6.9	7.1	7.2	7.3	6.9	6.0	4.3	3.2	5.7
	Min/Max	2.1/4.8	3.1/5.7	4.0/6.9	5.0/7.2	6.2/7.4	6.7/7.4	6.8/7.5	6.4/7.6	5.8/7.5	5.0/6.6	3.2/5.2	2.3/4.8	5.2/6.1
Latitude +15	Average	3.5	4.7	5.5	6.0	6.1	6.1	6.2	6.6	6.7	6.1	4.5	3.4	5.4
	Min/Max	2.1/5.2	3.1/5.9	3.9/6.8	4.6/6.7	5.5/6.5	5.8/6.3	5.9/6.4	5.8/6.9	5.6/7.2	5.0/6.8	3.2/5.5	2.3/5.2	4.8/5.8
90	Average	3.0	3.8	3.8	3.4	2.8	2.4	2.6	3.3	4.3	4.7	3.9	3.0	3.4
	Min/Max	1.7/4.6	2.4/4.8	2.7/4.8	2.7/3.8	2.6/2.9	2.3/2.4	2.5/2.6	3.0/3.4	3.6/4.6	3.8/5.3	2.7/4.8	2.0/4.8	3.0/3.7

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	4.5	6.3	8.4	10.1	11.0	11.1	10.1	8.5	6.3	3.9	2.7	7.2
	Min/Max	1.9/4.3	3.1/5.6	4.4/7.9	6.0/9.5	8.8/11.1	10.2/11.8	10.0/11.9	8.5/10.9	6.9/9.4	5.2/7.1	2.8/4.8	2.0/4.1	6.3/7.6
Latitude -15	Average	3.5	5.1	6.8	8.7	10.2	11.0	11.1	10.5	9.1	7.2	4.7	3.3	7.6
	Min/Max	2.1/5.2	3.4/6.5	4.7/8.7	6.2/9.9	8.8/11.2	10.1/11.7	10.0/11.9	8.7/11.2	7.4/10.1	5.8/8.0	3.3/5.7	2.3/5.1	6.7/8.1
Latitude	Average	3.8	5.4	7.0	8.7	9.9	10.5	10.7	10.3	9.2	7.5	5.0	3.6	7.6
	Min/Max	2.2/5.7	3.5/6.9	4.8/8.9	6.1/9.9	8.6/10.9	9.7/11.2	9.6/11.5	8.6/11.0	7.4/10.3	6.1/8.4	3.5/6.2	2.5/5.7	6.7/8.1
Latitude +15	Average	3.9	5.5	6.9	8.3	9.3	9.8	10.0	9.8	9.0	7.6	5.2	3.8	7.4
	Min/Max	2.2/6.0	3.5/7.1	4.7/8.9	5.9/9.5	8.1/10.3	9.1/10.4	9.0/10.8	8.1/10.5	7.3/10.1	6.1/8.5	3.6/6.5	2.5/6.0	6.4/7.9

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

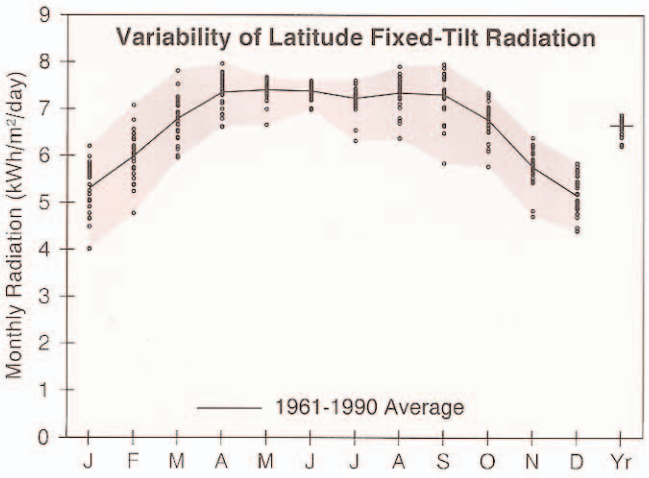
Tracker		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
2-Axis	Average	4.0	5.5	7.0	8.8	10.3	11.2	11.3	10.5	9.2	7.6	5.2	3.8	7.9
	Min/Max	2.2/6.1	3.5/7.1	4.8/9.0	6.2/10.0	8.9/11.4	10.4/11.9	10.1/12.1	8.8/11.3	7.5/10.3	6.2/8.5	3.6/6.5	2.5/6.1	6.9/8.4

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	2.1	2.9	3.5	4.5	5.6	6.5	6.5	5.9	5.2	4.4	3.0	2.0	4.3
	Min/Max	0.6/3.8	1.4/4.2	1.8/5.1	2.5/5.5	4.6/6.6	5.7/7.1	5.6/7.3	4.5/6.6	3.7/6.1	3.3/5.2	1.6/4.0	0.9/3.9	3.5/4.8
1-Axis, N-S Horiz Axis	Average	1.6	2.7	4.0	5.8	7.5	8.6	8.7	7.9	6.5	4.6	2.5	1.5	5.2
	Min/Max	0.5/3.0	1.3/3.9	2.1/5.9	3.2/7.2	6.0/8.8	7.5/9.5	7.3/9.9	5.8/8.9	4.6/7.7	3.4/5.5	1.3/3.3	0.7/2.9	4.1/5.6
1-Axis, N-S Tilt=Latitude	Average	2.2	3.5	4.6	6.0	7.2	8.0	8.2	7.9	7.1	5.5	3.4	2.2	5.5
	Min/Max	0.6/4.2	1.7/5.0	2.4/6.7	3.3/7.4	5.8/8.5	7.1/8.9	6.9/9.4	5.9/8.9	5.0/8.4	4.2/6.6	1.8/4.6	1.0/4.2	4.3/6.0
2-Axis	Average	2.4	3.5	4.6	6.1	7.7	8.7	8.9	8.2	7.1	5.6	3.5	2.3	5.7
	Min/Max	0.7/4.4	1.7/5.1	2.4/6.8	3.4/7.6	6.1/9.0	7.7/9.6	7.4/10.1	6.1/9.2	5.0/8.4	4.2/6.7	1.9/4.8	1.1/4.6	4.5/6.3

Average Climatic Conditions

Element	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
Temperature (°C)	8.8	11.8	14.1	17.2	21.7	25.7	28.9	28.1	24.9	19.9	13.2	8.6	18.6
Daily Minimum Temp	3.7	5.9	7.7	10.1	14.1	17.8	20.9	20.3	17.5	12.7	7.1	3.5	11.8
Daily Maximum Temp	13.8	17.7	20.5	24.4	29.2	33.6	36.9	35.9	32.3	27.1	19.3	13.6	25.4
Record Minimum Temp	-6.7	-3.9	-0.6	1.1	2.8	7.2	11.1	11.1	7.2	-1.7	-2.2	-7.2	-7.2
Record Maximum Temp	27.8	30.6	33.3	38.3	41.7	45.6	46.1	44.4	44.4	39.4	32.8	28.3	46.1
HDD, Base 18.3°C	296	184	137	80	16	3	0	0	4	33	157	302	1212
CDD, Base 18.3°C	0	0	6	47	119	223	329	303	201	82	4	0	1314
Relative Humidity (%)	76	69	61	51	41	36	34	39	44	50	65	76	53
Wind Speed (m/s)	2.5	2.7	3.0	3.3	3.6	3.5	3.3	3.1	2.9	2.7	2.5	2.5	3.0



Daggett, CA

WBAN NO. 23161

LATITUDE: 34.87° N
LONGITUDE: 116.78° W
ELEVATION: 588 meters
MEAN PRESSURE: 947 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	3.2	4.2	5.5	7.0	7.9	8.4	8.0	7.3	6.3	4.9	3.6	2.9	5.8
	Min/Max	2.6/3.5	3.5/4.7	4.9/6.2	6.3/7.5	7.2/8.2	7.9/8.7	6.9/8.5	6.4/7.9	5.1/6.8	4.3/5.2	3.1/3.9	2.6/3.2	5.5/6.0
Latitude -15	Average	4.6	5.4	6.5	7.5	7.9	8.1	7.8	7.6	7.1	6.2	5.0	4.4	6.5
	Min/Max	3.5/5.3	4.4/6.3	5.7/7.4	6.7/8.1	7.1/8.2	7.7/8.4	6.8/8.3	6.6/8.2	5.7/7.8	5.3/6.7	4.2/5.5	3.8/4.9	6.1/6.7
Latitude	Average	5.3	6.0	6.8	7.4	7.4	7.4	7.2	7.3	7.3	6.8	5.8	5.2	6.6
	Min/Max	4.0/6.2	4.8/7.1	6.0/7.8	6.6/8.0	6.7/7.7	7.0/7.6	6.3/7.6	6.4/7.9	5.8/7.9	5.8/7.3	4.7/6.4	4.4/5.8	6.2/6.9
Latitude +15	Average	5.7	6.2	6.7	6.8	6.5	6.3	6.2	6.6	7.0	6.9	6.2	5.6	6.4
	Min/Max	4.3/6.8	4.9/7.4	5.8/7.8	6.1/7.4	5.8/6.7	6.0/6.4	5.5/6.5	5.8/7.1	5.6/7.7	5.9/7.5	5.0/6.9	4.8/6.4	5.9/6.6
90	Average	5.2	5.1	4.7	3.8	2.8	2.4	2.5	3.3	4.4	5.4	5.4	5.2	4.2
	Min/Max	3.7/6.2	3.9/6.2	4.0/5.4	3.4/4.0	2.6/2.9	2.2/2.5	2.3/2.6	3.0/3.4	3.6/4.8	4.5/5.9	4.3/6.1	4.3/6.0	3.8/4.3

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	4.9	6.2	8.1	10.0	11.1	11.8	11.2	10.5	9.3	7.5	5.5	4.6	8.4
	Min/Max	3.7/5.7	4.6/7.4	7.0/9.6	8.6/11.0	9.9/11.6	10.9/12.4	9.0/12.2	8.5/11.6	7.0/10.4	6.2/8.2	4.4/6.3	3.9/5.2	7.7/8.8
Latitude -15	Average	5.9	7.1	8.8	10.4	11.2	11.7	11.1	10.8	10.0	8.4	6.6	5.6	9.0
	Min/Max	4.4/7.0	5.3/8.6	7.6/10.5	8.9/11.5	10.0/11.7	10.8/12.3	9.0/12.2	8.8/11.9	7.5/11.1	6.9/9.3	5.2/7.4	4.7/6.5	8.2/9.4
Latitude	Average	6.5	7.5	9.0	10.3	10.9	11.2	10.7	10.6	10.1	8.8	7.2	6.3	9.1
	Min/Max	4.8/7.7	5.6/9.1	7.8/10.8	8.8/11.4	9.7/11.4	10.4/11.8	8.7/11.8	8.6/11.7	7.6/11.3	7.3/9.7	5.6/8.1	5.2/7.2	8.3/9.5
Latitude +15	Average	6.8	7.7	8.9	10.0	10.3	10.5	10.1	10.1	9.9	8.9	7.5	6.6	8.9
	Min/Max	4.9/8.1	5.7/9.4	7.7/10.8	8.5/11.0	9.1/10.7	9.7/11.0	8.1/11.1	8.2/11.2	7.4/11.1	7.3/9.9	5.8/8.5	5.5/7.7	8.1/9.4

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	6.9	7.7	9.0	10.4	11.3	12.0	11.4	10.8	10.1	9.0	7.5	6.8	9.4
	Min/Max	5.0/8.2	5.7/9.4	7.8/10.9	8.9/11.5	10.1/11.9	11.1/12.6	9.2/12.5	8.8/12.0	7.6/11.3	7.3/9.9	5.9/8.5	5.6/7.8	8.6/9.9

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 Horiz Axis	Average	4.5	4.7	5.0	5.7	6.5	7.1	6.6	6.2	5.9	5.5	4.9	4.6	5.6
	Min/Max	2.9/5.8	3.0/6.2	3.9/6.5	4.4/6.8	5.6/7.0	6.1/7.8	4.6/7.6	4.6/7.2	4.2/6.8	4.1/6.3	3.4/5.9	3.5/5.6	4.8/6.0
1-Axis, N-S Horiz Axis	Average	3.7	4.6	6.1	7.7	8.7	9.6	8.8	8.4	7.5	6.0	4.3	3.5	6.6
	Min/Max	2.4/4.7	2.8/6.2	4.7/8.1	5.8/9.1	7.6/9.5	8.2/10.4	6.0/10.4	6.0/9.9	5.1/9.0	4.3/6.9	2.9/5.2	2.6/4.3	5.6/7.1
1-Axis, N-S Tilt=Latitude	Average	5.1	5.8	6.9	8.0	8.4	8.9	8.4	8.4	8.2	7.2	5.7	5.0	7.2
	Min/Max	3.3/6.5	3.6/7.8	5.3/9.1	6.0/9.4	7.3/9.2	7.7/9.8	5.7/9.8	6.1/9.9	5.6/9.7	5.2/8.3	3.9/6.9	3.7/6.1	6.1/7.7
2-Axis	Average	5.4	5.9	6.9	8.1	8.9	9.7	9.0	8.7	8.2	7.3	6.0	5.4	7.5
	Min/Max	3.5/7.0	3.7/8.0	5.3/9.1	6.1/9.6	7.7/9.7	8.4/10.6	6.1/10.5	6.2/10.2	5.6/9.8	5.3/8.4	4.1/7.2	4.1/6.6	6.3/8.0

Average Climatic Conditions

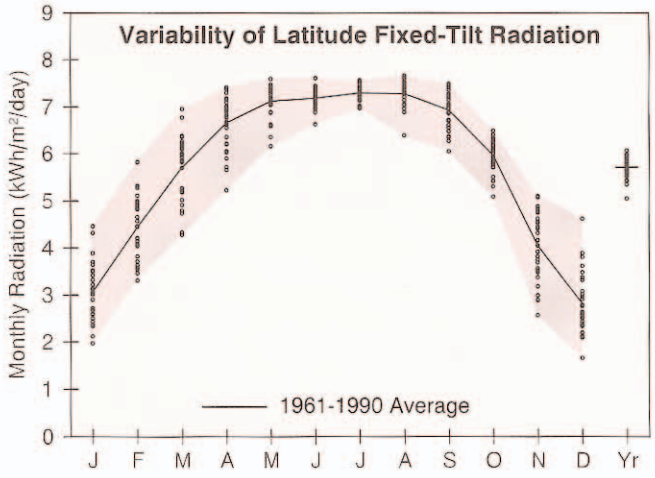
Element	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
Temperature (°C)	9.3	12.1	14.6	18.2	23.1	28.2	31.6	30.6	26.5	20.7	13.8	9.2	19.8
Daily Minimum Temp	2.6	5.2	7.8	10.8	15.3	19.7	23.3	22.7	18.7	13.1	6.9	2.6	12.4
Daily Maximum Temp	15.9	18.9	21.4	25.6	30.8	36.6	39.9	38.6	34.3	28.2	20.8	15.8	27.2
Record Minimum Temp	-12.2	-6.7	-2.8	0.6	6.1	9.4	15.0	14.4	9.4	-1.1	-3.9	-12.2	-12.2
Record Maximum Temp	27.8	30.0	32.8	37.2	43.3	46.1	46.7	44.4	42.8	40.6	32.2	26.7	46.7
HDD, Base 18.3°C	281	178	129	67	8	0	0	0	0	22	139	282	1106
CDD, Base 18.3°C	0	0	13	62	154	295	412	381	245	94	4	0	1659
Relative Humidity (%)	47	42	38	32	29	24	24	28	31	33	40	46	35
Wind Speed (m/s)	3.5	4.5	5.9	6.3	6.8	6.4	5.5	4.9	4.7	4.2	4.3	3.8	5.1

Fresno, CA

WBAN NO. 93193

LATITUDE: 36.77° N
LONGITUDE: 119.72° W
ELEVATION: 100 meters
MEAN PRESSURE: 1004 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	2.1	3.2	4.7	6.3	7.5	8.1	8.0	7.2	5.9	4.3	2.7	1.9	5.2
	Min/Max	1.7/2.7	2.5/3.9	3.7/5.5	5.1/7.0	6.6/8.0	7.4/8.7	7.6/8.4	6.3/7.6	5.2/6.3	3.9/4.6	2.0/3.2	1.4/2.6	4.7/5.4
Latitude -15	Average	2.8	4.1	5.5	6.8	7.6	7.8	7.9	7.5	6.8	5.5	3.6	2.5	5.7
	Min/Max	1.9/3.9	3.1/5.3	4.2/6.6	5.4/7.5	6.6/8.1	7.2/8.3	7.5/8.2	6.6/7.9	5.9/7.3	4.8/6.0	2.4/4.5	1.6/3.9	5.1/6.0
Latitude	Average	3.1	4.4	5.7	6.7	7.1	7.2	7.3	7.3	6.9	6.0	4.1	2.8	5.7
	Min/Max	2.0/4.5	3.3/5.8	4.3/6.9	5.2/7.4	6.2/7.6	6.6/7.6	7.0/7.6	6.4/7.7	6.1/7.5	5.1/6.5	2.6/5.1	1.7/4.6	5.1/6.1
Latitude +15	Average	3.2	4.5	5.6	6.2	6.3	6.1	6.3	6.6	6.7	6.1	4.2	3.0	5.4
	Min/Max	2.0/4.8	3.3/6.1	4.1/6.9	4.8/6.9	5.4/6.7	5.7/6.4	6.0/6.5	5.8/6.9	5.8/7.2	5.1/6.6	2.6/5.4	1.7/5.0	4.7/5.8
90	Average	2.8	3.7	4.0	3.6	3.0	2.6	2.7	3.5	4.4	4.8	3.7	2.6	3.4
	Min/Max	1.6/4.3	2.6/5.1	2.9/4.9	2.9/4.0	2.7/3.2	2.5/2.8	2.6/2.9	3.2/3.6	3.8/4.8	3.9/5.3	2.2/4.8	1.4/4.7	2.9/3.7

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	2.7	4.3	6.4	8.5	10.2	11.0	11.2	10.1	8.3	6.2	3.7	2.4	7.1
	Min/Max	1.8/3.9	3.3/5.7	4.5/8.0	6.5/10.0	8.7/11.3	9.8/12.2	10.1/11.8	8.0/10.9	7.1/9.3	5.0/6.8	2.3/4.7	1.5/3.9	6.0/7.6
Latitude -15	Average	3.2	5.0	7.0	9.0	10.4	10.9	11.2	10.4	9.1	7.1	4.4	2.9	7.5
	Min/Max	2.0/4.8	3.7/6.7	4.9/8.9	6.8/10.5	8.8/11.5	9.8/12.1	10.2/11.8	8.3/11.3	7.7/10.0	5.7/7.8	2.6/5.6	1.6/4.9	6.3/8.1
Latitude	Average	3.4	5.2	7.2	8.9	10.1	10.5	10.8	10.3	9.2	7.4	4.7	3.1	7.6
	Min/Max	2.1/5.2	3.9/7.1	4.9/9.1	6.7/10.5	8.5/11.1	9.3/11.6	9.8/11.4	8.1/11.1	7.8/10.2	6.0/8.2	2.8/6.1	1.7/5.4	6.3/8.2
Latitude +15	Average	3.5	5.3	7.1	8.6	9.5	9.8	10.1	9.8	9.0	7.5	4.9	3.2	7.4
	Min/Max	2.0/5.5	4.0/7.3	4.8/9.0	6.4/10.1	8.0/10.5	8.7/10.9	9.1/10.7	7.7/10.6	7.6/10.0	6.0/8.3	2.8/6.4	1.7/5.8	6.0/8.0

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

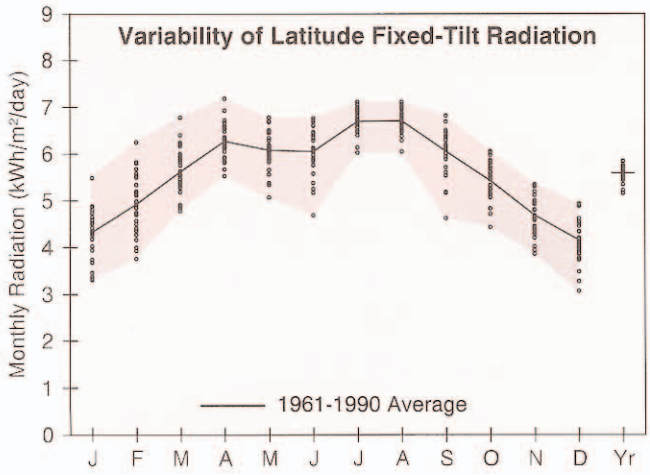
Tracker		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
2-Axis	Average	3.6	5.3	7.2	9.0	10.5	11.2	11.4	10.5	9.2	7.5	4.9	3.3	7.8
	Min/Max	2.1/5.5	4.0/7.3	4.9/9.1	6.8/10.6	8.9/11.6	9.9/12.4	10.3/12.1	8.3/11.4	7.8/10.2	6.0/8.3	2.8/6.4	1.7/5.8	6.5/8.4

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	1.8	2.7	3.6	4.6	5.7	6.4	6.6	5.9	5.1	4.3	2.7	1.7	4.3
	Min/Max	0.5/3.4	1.7/4.4	2.0/5.2	2.7/5.9	4.4/6.8	4.6/7.4	5.7/7.3	4.2/6.7	4.0/5.9	2.9/5.0	1.2/4.0	0.5/3.8	3.2/4.8
1-Axis, N-S Horiz Axis	Average	1.3	2.5	4.1	5.9	7.6	8.4	8.8	7.8	6.3	4.3	2.2	1.2	5.1
	Min/Max	0.4/2.6	1.5/4.1	2.1/6.0	3.6/7.9	5.8/9.0	5.8/10.0	7.2/9.9	5.2/9.0	4.8/7.4	2.8/5.2	0.9/3.3	0.4/2.7	3.7/5.8
1-Axis, N-S Tilt=Latitude	Average	1.9	3.3	4.7	6.2	7.3	7.9	8.4	7.9	6.9	5.4	3.1	1.8	5.4
	Min/Max	0.6/3.7	2.0/5.3	2.5/6.9	3.8/8.2	5.7/8.8	5.4/9.4	6.8/9.4	5.3/9.1	5.3/8.1	3.5/6.3	1.3/4.6	0.5/4.0	3.9/6.2
2-Axis	Average	2.1	3.4	4.8	6.3	7.8	8.6	9.0	8.1	7.0	5.4	3.2	1.9	5.6
	Min/Max	0.6/4.0	2.0/5.4	2.5/6.9	3.8/8.4	6.0/9.3	5.9/10.2	7.3/10.1	5.4/9.4	5.3/8.2	3.5/6.4	1.3/4.8	0.6/4.3	4.1/6.4

Average Climatic Conditions

Element	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
Temperature (°C)	7.6	10.7	12.8	16.2	20.6	24.8	27.7	26.8	23.6	18.4	12.0	7.4	17.4
Daily Minimum Temp	3.0	4.7	6.3	8.5	12.1	15.8	18.4	17.7	14.9	10.4	5.8	2.8	10.1
Daily Maximum Temp	12.3	16.5	19.2	23.9	29.0	33.7	37.0	35.9	32.3	26.5	18.2	12.1	24.7
Record Minimum Temp	-7.2	-4.4	-3.3	0.0	2.2	6.7	10.0	9.4	2.8	-2.8	-3.3	-7.8	-7.8
Record Maximum Temp	25.6	26.7	32.2	37.8	41.7	43.3	44.4	43.9	43.9	38.9	31.7	24.4	44.4
HDD, Base 18.3°C	332	214	174	101	19	0	0	0	4	47	190	338	1420
CDD, Base 18.3°C	0	0	4	38	88	196	291	263	163	51	0	0	1093
Relative Humidity (%)	83	77	69	57	47	42	39	45	50	58	74	84	60
Wind Speed (m/s)	2.2	2.5	3.0	3.4	3.8	3.8	3.4	3.1	2.8	2.3	2.1	2.1	2.9



Long Beach, CA

WBAN NO. 23129

LATITUDE: 33.82° N
LONGITUDE: 118.15° W
ELEVATION: 17 meters
MEAN PRESSURE: 1014 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	2.8	3.6	4.7	6.0	6.4	6.7	7.3	6.7	5.4	4.2	3.1	2.6	5.0
	Min/Max	2.3/3.3	2.9/4.3	4.1/5.6	5.3/6.8	5.4/7.2	5.2/7.5	6.5/7.7	6.1/7.1	4.3/5.9	3.6/4.6	2.8/3.5	2.1/2.9	4.6/5.2
Latitude -15	Average	3.8	4.5	5.4	6.4	6.4	6.5	7.2	6.9	6.0	5.0	4.1	3.6	5.5
	Min/Max	3.0/4.7	3.5/5.6	4.6/6.5	5.6/7.3	5.4/7.2	5.1/7.3	6.5/7.7	6.3/7.3	4.6/6.7	4.2/5.6	3.5/4.7	2.7/4.2	5.1/5.7
Latitude	Average	4.3	4.9	5.6	6.3	6.1	6.0	6.7	6.7	6.1	5.4	4.7	4.2	5.6
	Min/Max	3.3/5.5	3.8/6.3	4.8/6.8	5.5/7.2	5.1/6.8	4.7/6.8	6.0/7.1	6.1/7.1	4.6/6.8	4.4/6.1	3.9/5.3	3.1/4.9	5.2/5.9
Latitude +15	Average	4.6	5.1	5.5	5.8	5.4	5.2	5.8	6.1	5.8	5.5	5.0	4.5	5.4
	Min/Max	3.5/5.9	3.8/6.5	4.7/6.7	5.1/6.7	4.5/6.0	4.1/5.8	5.3/6.2	5.5/6.5	4.4/6.6	4.4/6.2	4.0/5.7	3.2/5.4	4.9/5.6
90	Average	4.1	4.1	3.8	3.2	2.5	2.2	2.4	3.0	3.7	4.2	4.3	4.1	3.4
	Min/Max	3.0/5.3	3.0/5.3	3.2/4.6	2.9/3.6	2.2/2.7	2.0/2.3	2.3/2.5	2.8/3.2	2.8/4.2	3.3/4.7	3.4/4.9	2.8/4.9	3.2/3.7

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	3.9	4.9	6.3	7.9	8.1	8.4	9.3	8.7	7.1	5.7	4.4	3.7	6.5
	Min/Max	3.0/5.0	3.8/6.3	5.3/7.9	6.7/9.4	6.5/9.4	6.1/9.8	8.0/10.2	7.8/9.3	5.2/8.0	4.6/6.4	3.6/5.0	2.7/4.4	6.0/6.9
Latitude -15	Average	4.7	5.6	6.8	8.2	8.1	8.3	9.3	8.9	7.6	6.3	5.1	4.4	6.9
	Min/Max	3.5/6.0	4.2/7.3	5.7/8.6	7.0/9.8	6.5/9.4	6.0/9.7	8.0/10.2	7.9/9.6	5.5/8.6	5.1/7.2	4.1/5.9	3.2/5.3	6.3/7.3
Latitude	Average	5.1	5.9	7.0	8.1	7.9	7.9	8.9	8.8	7.6	6.6	5.6	4.9	7.0
	Min/Max	3.7/6.6	4.4/7.8	5.8/8.8	6.9/9.8	6.3/9.1	5.7/9.3	7.7/9.8	7.8/9.4	5.5/8.7	5.3/7.6	4.4/6.5	3.4/5.9	6.4/7.4
Latitude +15	Average	5.3	6.0	6.9	7.8	7.4	7.4	8.3	8.3	7.5	6.7	5.8	5.1	6.9
	Min/Max	3.9/7.0	4.5/8.0	5.7/8.7	6.6/9.4	5.9/8.6	5.3/8.7	7.2/9.1	7.4/8.9	5.3/8.5	5.3/7.6	4.6/6.8	3.6/6.3	6.2/7.3

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	5.4	6.0	7.0	8.2	8.2	8.4	9.4	8.9	7.7	6.7	5.8	5.2	7.3
	Min/Max	3.9/7.1	4.5/8.0	5.8/8.8	7.0/9.8	6.6/9.5	6.1/9.9	8.1/10.3	8.0/9.6	5.5/8.7	5.3/7.6	4.6/6.8	3.6/6.4	6.6/7.7

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	3.2	3.3	3.5	4.1	4.0	4.2	5.2	4.8	4.0	3.7	3.5	3.2	3.9
	Min/Max	2.0/4.6	2.1/4.9	2.6/5.1	3.2/5.5	2.7/5.1	2.0/5.4	4.1/5.9	3.9/5.5	2.2/4.8	2.6/4.5	2.5/4.3	1.8/4.2	3.3/4.3
1-Axis, N-S Horiz Axis	Average	2.6	3.2	4.1	5.3	5.2	5.4	6.6	6.2	4.8	3.8	2.9	2.4	4.4
	Min/Max	1.6/3.7	1.9/4.7	3.0/6.0	4.0/7.1	3.5/6.6	2.7/7.0	5.1/7.6	5.1/7.0	2.7/5.8	2.8/4.7	2.1/3.7	1.4/3.2	3.7/4.7
1-Axis, N-S Tilt=Latitude	Average	3.5	4.0	4.6	5.4	5.0	5.0	6.2	6.2	5.3	4.6	3.9	3.4	4.8
	Min/Max	2.2/5.1	2.4/5.9	3.4/6.7	4.1/7.4	3.3/6.3	2.5/6.6	4.8/7.2	5.1/7.0	2.9/6.3	3.3/5.6	2.8/4.9	2.0/4.5	4.1/5.2
2-Axis	Average	3.8	4.1	4.6	5.5	5.3	5.5	6.7	6.4	5.3	4.6	4.1	3.7	5.0
	Min/Max	2.3/5.4	2.5/6.1	3.4/6.7	4.2/7.5	3.5/6.7	2.7/7.1	5.2/7.7	5.2/7.2	2.9/6.3	3.3/5.7	2.9/5.2	2.1/4.8	4.2/5.4

Average Climatic Conditions

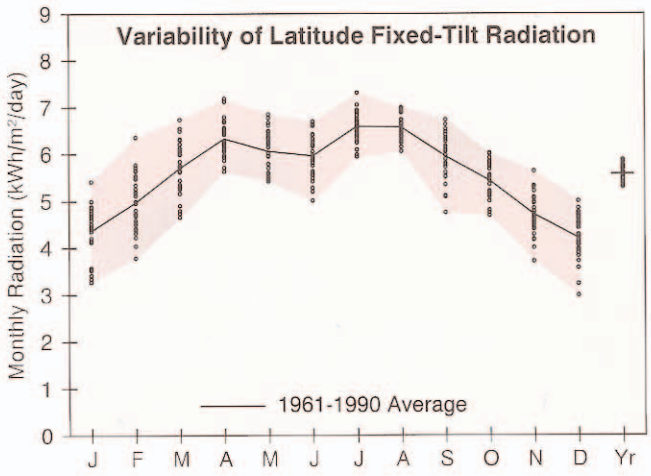
Element	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
Temperature (°C)	13.3	14.1	14.7	16.5	18.2	20.3	22.8	23.6	22.4	20.1	16.3	13.3	17.9
Daily Minimum Temp	7.2	8.3	9.4	11.0	13.5	15.4	17.4	18.2	17.1	14.3	10.2	7.2	12.4
Daily Maximum Temp	19.3	19.8	20.0	21.9	22.9	25.0	28.2	28.9	27.8	25.8	22.3	19.4	23.4
Record Minimum Temp	-3.9	0.6	0.6	3.3	4.4	8.3	10.6	11.1	10.0	3.9	1.1	-2.2	-3.9
Record Maximum Temp	32.8	32.8	36.7	40.6	39.4	42.8	41.7	40.6	43.3	43.9	38.3	33.3	43.9
HDD, Base 18.3°C	158	123	119	74	38	22	0	0	8	13	81	158	794
CDD, Base 18.3°C	0	3	7	19	35	80	142	164	132	67	19	0	667
Relative Humidity (%)	64	67	67	66	68	70	69	69	70	68	66	65	67
Wind Speed (m/s)	2.5	2.8	3.1	3.3	3.3	3.1	3.0	3.0	2.8	2.5	2.5	2.3	2.9

Los Angeles, CA

WBAN NO. 23174

LATITUDE: 33.93° N
LONGITUDE: 118.40° W
ELEVATION: 32 meters
MEAN PRESSURE: 1012 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	2.8	3.6	4.8	6.1	6.4	6.6	7.1	6.5	5.3	4.2	3.2	2.6	4.9
	Min/Max	2.3/3.3	3.0/4.4	4.0/5.6	5.5/6.8	5.7/7.2	5.6/7.7	6.4/8.0	6.1/7.0	4.4/5.8	3.8/4.5	2.7/3.6	2.1/3.0	4.7/5.1
Latitude -15	Average	3.8	4.5	5.5	6.4	6.4	6.4	7.1	6.8	5.9	5.0	4.2	3.6	5.5
	Min/Max	2.9/4.6	3.6/5.7	4.5/6.4	5.8/7.3	5.7/7.3	5.4/7.3	6.3/7.9	6.3/7.2	4.7/6.6	4.4/5.6	3.4/4.9	2.7/4.3	5.2/5.7
Latitude	Average	4.4	5.0	5.7	6.3	6.1	6.0	6.6	6.6	6.0	5.4	4.7	4.2	5.6
	Min/Max	3.3/5.4	3.8/6.4	4.7/6.7	5.6/7.2	5.4/6.8	5.0/6.7	5.9/7.3	6.1/7.0	4.8/6.7	4.7/6.0	3.7/5.6	3.0/5.0	5.3/5.9
Latitude +15	Average	4.7	5.1	5.6	5.9	5.4	5.2	5.8	6.0	5.7	5.5	5.0	4.5	5.4
	Min/Max	3.4/5.9	3.8/6.6	4.5/6.6	5.2/6.7	4.8/6.1	4.4/5.8	5.2/6.3	5.5/6.4	4.5/6.5	4.7/6.1	3.9/6.0	3.1/5.4	5.1/5.7
90	Average	4.1	4.1	3.8	3.3	2.5	2.2	2.4	3.0	3.6	4.2	4.3	4.1	3.5
	Min/Max	2.9/5.2	3.0/5.4	3.1/4.5	2.9/3.6	2.3/2.7	2.1/2.3	2.3/2.5	2.8/3.2	2.9/4.1	3.5/4.7	3.2/5.2	2.7/5.0	3.3/3.7

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	3.9	5.0	6.4	7.9	8.0	8.1	9.0	8.3	6.9	5.6	4.4	3.7	6.4
	Min/Max	3.0/4.9	3.7/6.4	5.1/7.8	6.9/9.3	6.7/9.4	6.6/9.7	7.6/10.8	7.6/9.3	5.3/8.0	4.8/6.3	3.4/5.3	2.6/4.3	6.1/6.8
Latitude -15	Average	4.7	5.6	6.9	8.2	8.0	8.0	9.0	8.6	7.3	6.3	5.2	4.4	6.9
	Min/Max	3.5/5.9	4.1/7.4	5.4/8.5	7.1/9.7	6.8/9.4	6.5/9.6	7.6/10.8	7.8/9.5	5.6/8.5	5.4/7.0	3.9/6.3	3.0/5.3	6.5/7.3
Latitude	Average	5.1	6.0	7.1	8.2	7.8	7.7	8.7	8.4	7.4	6.6	5.6	4.9	7.0
	Min/Max	3.7/6.5	4.3/7.9	5.5/8.7	7.0/9.6	6.5/9.2	6.3/9.3	7.3/10.4	7.7/9.3	5.6/8.6	5.6/7.4	4.2/6.9	3.3/5.9	6.5/7.4
Latitude +15	Average	5.4	6.1	7.0	7.8	7.3	7.1	8.1	8.0	7.2	6.6	5.8	5.2	6.8
	Min/Max	3.8/6.8	4.3/8.1	5.4/8.6	6.7/9.3	6.1/8.6	5.8/8.6	6.8/9.8	7.3/8.9	5.4/8.4	5.6/7.5	4.4/7.2	3.4/6.3	6.4/7.3

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

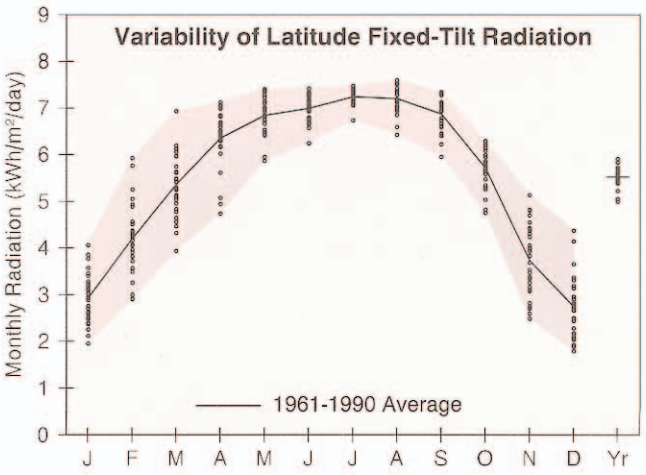
Tracker		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
2-Axis	Average	5.4	6.1	7.1	8.3	8.1	8.2	9.1	8.6	7.4	6.7	5.8	5.3	7.2
	Min/Max	3.9/6.9	4.4/8.1	5.6/8.7	7.1/9.7	6.8/9.6	6.7/9.9	7.7/11.0	7.9/9.5	5.7/8.6	5.6/7.5	4.4/7.2	3.5/6.4	6.7/7.7

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	3.2	3.4	3.6	4.1	3.9	3.9	4.8	4.5	3.8	3.6	3.5	3.2	3.8
	Min/Max	2.0/4.5	1.9/5.0	2.4/4.9	3.3/5.4	3.0/5.1	2.4/5.3	3.7/6.1	4.0/5.3	2.2/4.8	2.8/4.4	2.3/4.7	1.8/4.1	3.4/4.2
1-Axis, N-S Horiz Axis	Average	2.6	3.2	4.1	5.3	5.0	5.0	6.1	5.7	4.6	3.7	2.9	2.4	4.2
	Min/Max	1.6/3.6	1.8/4.8	2.8/5.8	4.2/7.0	3.7/6.6	3.2/6.9	4.6/8.0	4.9/6.8	2.7/5.8	2.9/4.5	1.9/4.0	1.3/3.1	3.8/4.7
1-Axis, N-S Tilt=Latitude	Average	3.6	4.1	4.7	5.5	4.8	4.6	5.8	5.7	5.0	4.5	3.9	3.5	4.6
	Min/Max	2.2/4.9	2.3/6.1	3.2/6.6	4.3/7.2	3.5/6.3	3.0/6.5	4.3/7.6	4.9/6.8	2.9/6.3	3.5/5.4	2.6/5.3	1.8/4.4	4.1/5.1
2-Axis	Average	3.8	4.2	4.7	5.5	5.1	5.0	6.2	5.9	5.0	4.6	4.1	3.8	4.8
	Min/Max	2.3/5.3	2.3/6.2	3.2/6.6	4.4/7.3	3.7/6.7	3.2/7.0	4.7/8.1	5.1/7.0	2.9/6.3	3.5/5.5	2.8/5.6	2.0/4.7	4.3/5.3

Average Climatic Conditions

Element	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
Temperature (°C)	13.8	14.2	14.4	15.6	17.1	18.7	20.6	21.4	21.1	19.3	16.4	13.8	17.2
Daily Minimum Temp	8.8	9.6	10.3	11.6	13.5	15.3	17.1	17.9	17.3	15.1	11.6	8.8	13.1
Daily Maximum Temp	18.7	18.8	18.6	19.7	20.6	22.2	24.1	24.8	24.8	23.6	21.3	18.8	21.3
Record Minimum Temp	-5.0	0.0	1.1	3.9	6.1	8.9	9.4	10.6	8.3	5.0	1.1	0.0	-5.0
Record Maximum Temp	31.1	33.3	35.0	38.9	36.1	40.0	36.1	36.7	43.3	41.1	38.3	34.4	43.3
HDD, Base 18.3°C	143	119	124	88	53	30	5	3	12	18	71	143	810
CDD, Base 18.3°C	0	4	4	6	14	42	76	98	94	49	14	4	404
Relative Humidity (%)	63	68	71	71	74	76	77	77	74	71	65	63	71
Wind Speed (m/s)	3.1	3.4	3.8	4.0	3.9	3.8	3.7	3.7	3.5	3.3	3.2	3.0	3.5



Sacramento, CA

WBAN NO. 23232

LATITUDE: 38.52° N
LONGITUDE: 121.50° W
ELEVATION: 8 meters
MEAN PRESSURE: 1015 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	1.9	3.0	4.3	5.9	7.2	7.9	7.9	7.0	5.7	4.0	2.4	1.7	4.9
	Min/Max	1.6/2.4	2.3/3.8	3.4/5.4	4.6/6.6	6.2/7.8	7.0/8.4	7.4/8.2	6.3/7.4	5.1/6.1	3.5/4.3	1.9/3.0	1.4/2.3	4.6/5.1
Latitude -15	Average	2.6	3.9	5.2	6.5	7.3	7.6	7.8	7.5	6.7	5.3	3.3	2.4	5.5
	Min/Max	1.9/3.6	2.8/5.3	3.9/6.6	4.9/7.2	6.2/7.9	6.8/8.1	7.3/8.1	6.7/7.9	5.9/7.2	4.4/5.8	2.3/4.5	1.7/3.7	5.1/5.8
Latitude	Average	2.9	4.2	5.4	6.3	6.8	7.0	7.2	7.2	6.9	5.7	3.7	2.7	5.5
	Min/Max	2.0/4.1	2.9/5.9	3.9/6.9	4.7/7.1	5.9/7.4	6.2/7.4	6.7/7.5	6.4/7.6	5.9/7.3	4.8/6.3	2.5/5.1	1.8/4.4	5.0/5.9
Latitude +15	Average	3.1	4.3	5.2	5.9	6.0	6.0	6.3	6.5	6.6	5.8	3.9	2.9	5.2
	Min/Max	2.0/4.3	2.9/6.2	3.8/6.8	4.4/6.6	5.2/6.5	5.4/6.3	5.8/6.4	5.8/6.9	5.7/7.1	4.8/6.4	2.5/5.4	1.8/4.7	4.7/5.6
90	Average	2.7	3.6	3.8	3.6	3.0	2.7	2.9	3.6	4.5	4.6	3.4	2.6	3.4
	Min/Max	1.6/3.9	2.3/5.2	2.8/5.0	2.7/4.0	2.7/3.2	2.5/2.8	2.8/2.9	3.3/3.7	3.9/4.8	3.8/5.2	2.1/4.9	1.5/4.4	3.0/3.8

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	2.5	4.0	5.9	8.1	9.9	10.8	11.1	10.0	8.3	5.8	3.3	2.2	6.8
	Min/Max	1.7/3.4	2.7/5.7	4.1/7.9	5.7/9.3	8.2/11.1	9.2/11.9	10.1/11.7	8.8/10.8	6.8/9.0	4.8/6.5	2.2/4.5	1.5/3.5	6.2/7.2
Latitude -15	Average	3.0	4.7	6.6	8.6	10.1	10.8	11.2	10.4	9.1	6.8	4.0	2.8	7.3
	Min/Max	2.0/4.3	3.0/6.8	4.5/8.9	5.9/9.8	8.3/11.3	9.2/11.9	10.2/11.8	9.1/11.2	7.5/9.9	5.6/7.6	2.6/5.6	1.8/4.6	6.5/7.8
Latitude	Average	3.3	4.9	6.7	8.5	9.8	10.3	10.8	10.2	9.2	7.1	4.3	3.0	7.4
	Min/Max	2.0/4.7	3.2/7.3	4.6/9.1	5.9/9.8	8.0/10.9	8.8/11.4	9.8/11.3	8.9/11.1	7.5/10.0	5.8/7.9	2.7/6.1	1.9/5.1	6.5/7.9
Latitude +15	Average	3.4	5.0	6.6	8.2	9.2	9.7	10.1	9.8	9.0	7.2	4.5	3.2	7.2
	Min/Max	2.1/4.9	3.2/7.4	4.5/9.0	5.6/9.4	7.6/10.3	8.2/10.6	9.2/10.6	8.5/10.6	7.4/9.8	5.8/8.0	2.7/6.4	1.9/5.4	6.3/7.7

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	3.4	5.0	6.7	8.6	10.2	11.0	11.4	10.4	9.2	7.2	4.5	3.2	7.6
	Min/Max	2.1/5.0	3.2/7.4	4.6/9.1	6.0/9.9	8.4/11.4	9.4/12.2	10.4/12.0	9.1/11.3	7.6/10.0	5.8/8.1	2.8/6.4	1.9/5.5	6.7/8.1

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	1.8	2.6	3.4	4.3	5.5	6.2	6.6	5.8	5.2	4.1	2.5	1.7	4.1
	Min/Max	0.7/3.0	1.2/4.6	1.8/5.3	2.1/5.4	4.0/6.5	4.9/7.3	5.6/7.1	4.7/6.6	3.8/5.8	3.2/4.8	1.1/4.1	0.6/3.6	3.4/4.6
1-Axis, N-S Horiz Axis	Average	1.3	2.4	3.8	5.6	7.3	8.3	8.8	7.7	6.3	4.1	2.0	1.2	4.9
	Min/Max	0.5/2.2	1.0/4.2	2.0/6.1	2.8/7.0	5.3/8.7	6.4/9.8	7.4/9.6	6.3/8.8	4.4/7.2	3.1/4.9	0.9/3.2	0.4/2.5	4.1/5.3
1-Axis, N-S Tilt=Latitude	Average	1.9	3.1	4.4	5.9	7.1	7.8	8.4	7.9	7.1	5.2	2.8	1.8	5.3
	Min/Max	0.8/3.2	1.4/5.5	2.3/7.1	2.9/7.4	5.2/8.5	6.0/9.2	7.1/9.1	6.4/8.9	5.0/8.0	3.9/6.1	1.3/4.6	0.7/3.8	4.4/5.8
2-Axis	Average	2.1	3.2	4.4	6.0	7.5	8.4	9.0	8.1	7.1	5.3	2.9	1.9	5.5
	Min/Max	0.8/3.5	1.4/5.7	2.3/7.1	3.0/7.5	5.5/9.0	6.5/10.0	7.6/9.8	6.6/9.2	5.0/8.0	4.0/6.2	1.3/4.8	0.7/4.1	4.5/6.1

Average Climatic Conditions

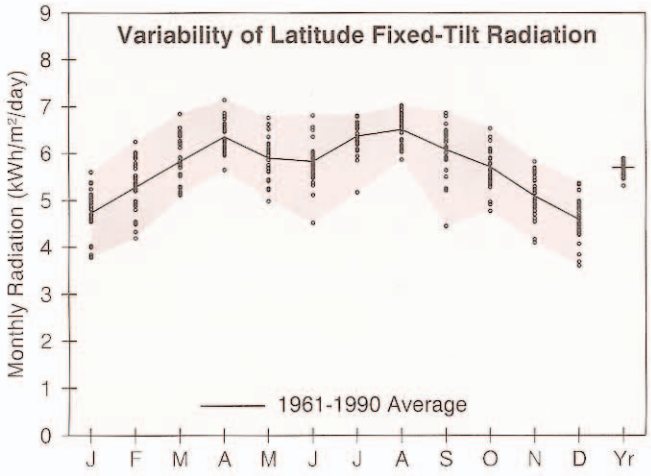
Element	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
Temperature (°C)	7.3	10.4	12.0	14.6	18.5	22.0	24.3	23.9	21.9	17.9	11.8	7.4	16.0
Daily Minimum Temp	3.2	5.2	6.2	7.5	10.2	12.9	14.5	14.4	13.2	10.2	6.3	3.2	8.9
Daily Maximum Temp	11.5	15.6	17.8	21.7	26.8	31.0	34.0	33.4	30.7	25.5	17.3	11.5	23.1
Record Minimum Temp	-5.0	-5.0	-3.3	0.0	2.2	5.0	8.9	9.4	6.1	2.2	-3.3	-7.8	-7.8
Record Maximum Temp	21.1	24.4	31.1	33.9	40.6	46.1	45.6	42.8	42.2	38.3	30.6	22.2	46.1
HDD, Base 18.3°C	341	222	198	128	44	7	0	0	9	43	195	339	1527
CDD, Base 18.3°C	0	0	0	16	49	117	184	174	117	29	0	0	687
Relative Humidity (%)	83	77	72	64	59	55	53	56	57	63	76	83	66
Wind Speed (m/s)	2.5	3.1	3.5	3.6	3.9	4.0	3.8	3.6	3.1	2.5	2.5	2.5	3.2

San Diego, CA

WBAN NO. 23188

LATITUDE: 32.73° N
LONGITUDE: 117.17° W
ELEVATION: 9 meters
MEAN PRESSURE: 1014 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	3.1	3.9	4.9	6.1	6.3	6.5	6.9	6.5	5.4	4.4	3.4	2.9	5.0
	Min/Max	2.6/3.5	3.3/4.4	4.4/5.7	5.5/6.8	5.3/7.2	5.0/7.6	5.6/7.4	5.9/7.0	4.2/6.0	3.8/4.9	3.0/3.7	2.4/3.2	4.7/5.2
Latitude -15	Average	4.1	4.8	5.6	6.4	6.3	6.3	6.8	6.7	6.0	5.3	4.5	3.9	5.6
	Min/Max	3.3/4.8	3.9/5.6	4.9/6.5	5.8/7.2	5.3/7.2	4.9/7.4	5.5/7.3	6.1/7.3	4.5/6.7	4.5/6.0	3.7/5.0	3.2/4.5	5.2/5.7
Latitude	Average	4.7	5.3	5.8	6.3	5.9	5.8	6.4	6.5	6.1	5.7	5.1	4.6	5.7
	Min/Max	3.8/5.6	4.2/6.3	5.1/6.8	5.7/7.1	5.0/6.8	4.5/6.8	5.2/6.8	5.9/7.0	4.4/6.9	4.8/6.5	4.1/5.8	3.6/5.4	5.3/5.9
Latitude +15	Average	5.1	5.5	5.7	5.9	5.2	5.1	5.6	5.9	5.8	5.8	5.4	5.0	5.5
	Min/Max	4.0/6.1	4.3/6.5	5.0/6.8	5.3/6.7	4.5/6.0	4.0/5.8	4.6/5.9	5.4/6.4	4.2/6.6	4.8/6.7	4.3/6.2	3.8/5.9	5.1/5.7
90	Average	4.5	4.3	3.9	3.2	2.4	2.1	2.2	2.9	3.6	4.4	4.6	4.5	3.5
	Min/Max	3.4/5.4	3.3/5.3	3.3/4.5	2.9/3.5	2.2/2.5	1.9/2.1	2.0/2.3	2.7/3.0	2.7/4.0	3.5/5.0	3.6/5.4	3.4/5.4	3.3/3.7

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	4.4	5.4	6.7	8.0	7.7	7.8	8.8	8.4	7.2	6.1	4.9	4.2	6.6
	Min/Max	3.5/5.3	4.1/6.6	5.7/8.1	6.8/9.2	6.1/9.4	5.5/9.9	6.6/9.7	7.3/9.4	4.9/8.3	5.0/7.0	3.9/5.8	3.3/4.9	6.1/6.9
Latitude -15	Average	5.2	6.1	7.2	8.3	7.7	7.8	8.7	8.6	7.6	6.7	5.7	5.0	7.1
	Min/Max	4.1/6.3	4.6/7.4	6.1/8.7	7.1/9.6	6.1/9.4	5.4/9.8	6.6/9.7	7.4/9.6	5.2/8.8	5.5/7.8	4.4/6.7	3.8/5.9	6.4/7.3
Latitude	Average	5.7	6.5	7.4	8.2	7.5	7.4	8.4	8.4	7.7	7.1	6.2	5.5	7.2
	Min/Max	4.4/6.9	4.8/7.9	6.2/9.0	7.0/9.6	5.9/9.1	5.2/9.3	6.3/9.3	7.3/9.4	5.2/8.9	5.7/8.3	4.8/7.3	4.2/6.5	6.5/7.4
Latitude +15	Average	6.0	6.6	7.3	7.9	7.0	6.9	7.8	8.0	7.5	7.1	6.5	5.8	7.0
	Min/Max	4.6/7.3	4.9/8.1	6.1/8.9	6.7/9.2	5.5/8.6	4.8/8.6	5.9/8.7	6.9/8.9	5.0/8.7	5.7/8.4	4.9/7.6	4.4/6.9	6.4/7.3

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

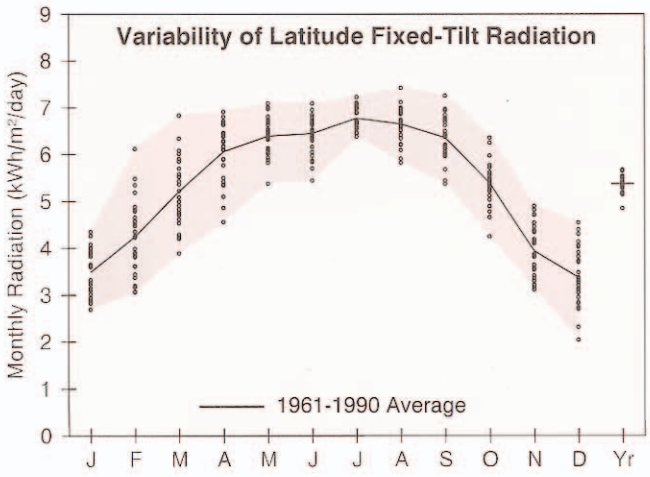
Tracker		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
2-Axis	Average	6.0	6.6	7.4	8.3	7.8	7.9	8.9	8.6	7.7	7.2	6.5	5.9	7.4
	Min/Max	4.6/7.3	4.9/8.1	6.2/9.0	7.1/9.6	6.2/9.5	5.5/10.0	6.7/9.8	7.4/9.6	5.2/8.9	5.8/8.4	5.0/7.7	4.4/7.1	6.8/7.7

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	3.8	3.8	3.9	4.3	3.9	4.0	4.9	4.8	4.2	4.1	4.0	3.8	4.1
	Min/Max	2.4/4.9	2.5/5.1	2.9/5.3	3.4/5.5	2.5/5.2	1.8/5.7	2.9/5.8	3.8/5.6	1.9/5.2	3.0/5.2	2.7/5.2	2.5/4.8	3.6/4.5
1-Axis, N-S Horiz Axis	Average	3.1	3.8	4.6	5.6	4.9	5.0	6.2	6.1	5.1	4.4	3.6	3.0	4.6
	Min/Max	2.0/4.1	2.3/5.1	3.4/6.3	4.3/7.1	3.1/6.8	2.3/7.3	3.6/7.4	4.7/7.2	2.3/6.3	3.2/5.5	2.4/4.6	2.0/3.8	3.9/5.0
1-Axis, N-S Tilt=Latitude	Average	4.2	4.7	5.1	5.7	4.7	4.7	5.8	6.1	5.5	5.2	4.6	4.1	5.0
	Min/Max	2.7/5.4	2.9/6.2	3.8/7.0	4.4/7.3	3.0/6.5	2.1/6.8	3.4/7.0	4.7/7.2	2.5/6.8	3.8/6.5	3.1/6.0	2.7/5.2	4.3/5.4
2-Axis	Average	4.5	4.8	5.1	5.8	5.0	5.1	6.2	6.3	5.5	5.3	4.9	4.5	5.3
	Min/Max	2.9/5.8	3.0/6.4	3.8/7.1	4.5/7.4	3.2/6.9	2.3/7.3	3.7/7.5	4.9/7.4	2.5/6.9	3.8/6.6	3.3/6.3	3.0/5.7	4.5/5.7

Average Climatic Conditions

Element	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
Temperature (°C)	14.1	14.8	15.3	16.7	17.8	19.3	21.7	22.6	21.9	19.8	16.7	14.1	17.9
Daily Minimum Temp	9.4	10.4	11.6	13.1	15.1	16.6	18.7	19.6	18.7	16.1	12.2	9.3	14.2
Daily Maximum Temp	18.8	19.2	19.1	20.2	20.6	22.0	24.6	25.4	25.1	23.7	21.1	18.9	21.6
Record Minimum Temp	-1.7	2.2	3.9	5.0	8.9	10.6	12.8	13.9	10.6	6.1	3.3	1.1	-1.7
Record Maximum Temp	31.1	31.1	33.9	36.7	35.6	38.3	35.0	36.7	43.9	41.7	36.1	31.1	43.9
HDD, Base 18.3°C	136	105	98	63	41	28	7	0	11	13	61	135	698
CDD, Base 18.3°C	5	6	5	13	25	58	111	133	117	59	11	4	547
Relative Humidity (%)	63	66	67	67	71	74	75	74	73	69	66	64	69
Wind Speed (m/s)	2.7	3.0	3.5	3.7	3.7	3.6	3.5	3.5	3.4	3.1	2.8	2.6	3.3



San Francisco, CA

WBAN NO. 23234

LATITUDE: 37.62° N
LONGITUDE: 122.38° W
ELEVATION: 5 meters
MEAN PRESSURE: 1017 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	3.0	4.2	5.7	6.7	7.2	7.3	6.5	5.4	3.9	2.5	2.0	4.7
	Min/Max	1.8/2.5	2.3/3.9	3.3/5.3	4.4/6.4	5.7/7.4	6.1/7.9	6.9/7.9	5.7/7.3	4.7/6.0	3.2/4.4	2.1/2.9	1.4/2.4	4.4/4.9
Latitude -15	Average	3.1	3.9	5.0	6.2	6.8	7.0	7.3	6.9	6.2	5.0	3.5	2.9	5.3
	Min/Max	2.4/3.8	2.9/5.5	3.8/6.5	4.7/7.0	5.7/7.5	5.9/7.7	6.9/7.8	6.0/7.7	5.3/7.1	4.0/5.8	2.8/4.3	1.9/3.9	4.9/5.6
Latitude	Average	3.5	4.2	5.2	6.1	6.4	6.5	6.8	6.7	6.4	5.4	3.9	3.4	5.4
	Min/Max	2.7/4.3	3.1/6.1	3.9/6.8	4.6/6.9	5.4/7.1	5.4/7.1	6.4/7.2	5.8/7.4	5.4/7.3	4.3/6.4	3.1/4.9	2.0/4.6	4.9/5.7
Latitude +15	Average	3.7	4.4	5.1	5.6	5.7	5.6	5.9	6.1	6.1	5.5	4.1	3.6	5.1
	Min/Max	2.8/4.7	3.1/6.4	3.8/6.8	4.2/6.4	4.8/6.3	4.7/6.1	5.6/6.3	5.3/6.7	5.2/7.0	4.3/6.5	3.2/5.2	2.1/5.0	4.6/5.5
90	Average	3.3	3.6	3.7	3.4	2.8	2.5	2.7	3.3	4.1	4.3	3.6	3.3	3.4
	Min/Max	2.5/4.2	2.4/5.4	2.7/4.9	2.6/3.8	2.5/3.0	2.3/2.6	2.6/2.8	3.0/3.6	3.5/4.7	3.4/5.2	2.8/4.6	1.9/4.7	2.9/3.7

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	4.1	5.7	7.6	8.8	9.3	9.7	8.7	7.4	5.5	3.5	2.8	6.3
	Min/Max	2.3/3.7	2.8/6.0	4.1/7.7	5.6/8.9	7.0/10.1	7.5/10.8	9.0/10.7	7.4/10.2	6.2/8.8	4.3/6.5	2.8/4.4	1.7/3.8	5.7/6.7
Latitude -15	Average	3.7	4.7	6.3	8.0	8.9	9.2	9.7	9.0	8.1	6.3	4.3	3.5	6.8
	Min/Max	2.8/4.6	3.3/7.1	4.5/8.6	5.8/9.4	7.1/10.3	7.4/10.7	9.0/10.8	7.7/10.6	6.7/9.6	4.8/7.6	3.3/5.4	2.0/4.8	6.1/7.2
Latitude	Average	4.0	5.0	6.5	8.0	8.7	8.9	9.4	8.8	8.2	6.6	4.6	3.9	6.9
	Min/Max	3.0/5.1	3.4/7.6	4.6/8.9	5.7/9.4	6.8/10.0	7.1/10.3	8.7/10.4	7.5/10.4	6.8/9.7	5.1/8.0	3.5/5.9	2.2/5.4	6.1/7.3
Latitude +15	Average	4.2	5.1	6.4	7.7	8.1	8.2	8.7	8.4	8.0	6.7	4.8	4.1	6.7
	Min/Max	3.1/5.4	3.4/7.8	4.5/8.8	5.5/9.0	6.4/9.4	6.6/9.6	8.1/9.7	7.1/9.9	6.6/9.5	5.1/8.1	3.6/6.1	2.3/5.7	5.9/7.1

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	4.2	5.1	6.5	8.1	9.0	9.4	9.9	9.0	8.2	6.7	4.8	4.1	7.1
	Min/Max	3.1/5.4	3.4/7.8	4.6/8.9	5.8/9.5	7.2/10.4	7.6/11.0	9.2/11.0	7.7/10.6	6.8/9.7	5.1/8.1	3.7/6.2	2.3/5.8	6.3/7.5

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	2.5	2.8	3.3	4.0	4.7	5.1	5.5	4.9	4.6	3.9	2.8	2.5	3.9
	Min/Max	1.6/3.5	1.5/4.9	1.9/5.2	2.4/5.2	3.3/5.7	3.6/6.3	4.9/6.4	3.7/6.1	3.3/5.6	2.6/5.0	1.8/3.9	1.1/3.9	3.2/4.2
1-Axis, N-S Horiz Axis	Average	1.9	2.5	3.8	5.2	6.1	6.5	7.1	6.3	5.4	3.9	2.3	1.8	4.4
	Min/Max	1.2/2.6	1.3/4.6	2.1/6.0	3.1/6.7	4.2/7.5	4.6/8.3	6.2/8.3	4.7/8.0	4.0/6.8	2.5/5.0	1.5/3.2	0.8/2.8	3.7/4.7
1-Axis, N-S Tilt=Latitude	Average	2.7	3.3	4.4	5.4	5.9	6.1	6.8	6.4	6.0	4.8	3.2	2.7	4.8
	Min/Max	1.8/3.8	1.7/6.0	2.5/6.9	3.2/7.0	4.1/7.3	4.3/7.7	5.9/7.9	4.8/8.1	4.4/7.6	3.2/6.3	2.0/4.4	1.2/4.2	4.0/5.3
2-Axis	Average	2.9	3.4	4.4	5.5	6.3	6.7	7.3	6.6	6.1	4.9	3.3	2.9	5.0
	Min/Max	1.9/4.0	1.7/6.1	2.5/6.9	3.3/7.1	4.3/7.7	4.7/8.4	6.4/8.5	5.0/8.3	4.4/7.6	3.2/6.3	2.2/4.7	1.3/4.5	4.2/5.5

Average Climatic Conditions

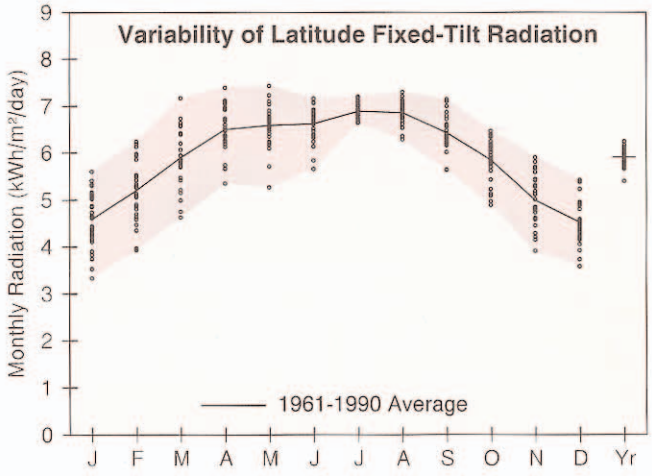
Element	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
Temperature (°C)	9.3	11.2	11.8	13.1	14.5	16.4	17.1	17.6	18.1	16.1	12.7	9.7	13.9
Daily Minimum Temp	5.4	7.2	7.7	8.4	9.8	11.4	12.2	12.8	12.9	11.0	8.4	5.9	9.4
Daily Maximum Temp	13.1	15.2	16.0	17.7	19.2	21.3	22.0	22.4	23.1	21.2	16.9	13.4	18.4
Record Minimum Temp	-4.4	-3.9	-1.1	-0.6	2.2	5.0	6.1	5.6	3.3	1.1	-3.9	-6.7	-6.7
Record Maximum Temp	22.2	25.6	29.4	33.3	36.1	41.1	40.6	36.7	39.4	37.2	29.4	23.9	41.1
HDD, Base 18.3°C	281	199	202	159	121	67	51	38	44	75	170	269	1676
CDD, Base 18.3°C	0	0	0	3	0	9	12	16	36	6	0	0	81
Relative Humidity (%)	78	76	73	71	71	72	73	74	72	72	75	77	74
Wind Speed (m/s)	3.3	4.0	4.8	5.5	6.2	6.2	6.2	5.7	5.0	4.3	3.7	3.5	4.9

Santa Maria, CA

WBAN NO. 23273

LATITUDE: 34.90° N
LONGITUDE: 120.45° W
ELEVATION: 72 meters
MEAN PRESSURE: 1008 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	2.8	3.7	4.9	6.2	7.0	7.4	7.5	6.8	5.6	4.4	3.2	2.7	5.2
	Min/Max	2.3/3.3	3.0/4.2	4.0/5.8	5.3/6.9	5.6/7.9	6.3/8.0	7.1/7.9	6.3/7.2	5.0/6.1	3.8/4.7	2.7/3.6	2.3/3.0	4.8/5.4
Latitude -15	Average	4.0	4.7	5.7	6.6	7.0	7.2	7.4	7.1	6.3	5.4	4.4	3.9	5.8
	Min/Max	3.0/4.8	3.7/5.6	4.5/6.8	5.5/7.5	5.6/7.9	6.2/7.8	7.1/7.8	6.5/7.5	5.6/7.0	4.6/5.9	3.5/5.1	3.1/4.6	5.3/6.1
Latitude	Average	4.6	5.2	5.9	6.5	6.6	6.6	6.9	6.9	6.4	5.8	5.0	4.5	5.9
	Min/Max	3.3/5.6	3.9/6.2	4.6/7.2	5.3/7.4	5.3/7.4	5.7/7.2	6.6/7.2	6.3/7.3	5.6/7.1	4.9/6.5	3.9/5.9	3.6/5.4	5.4/6.2
Latitude +15	Average	4.9	5.4	5.8	6.0	5.8	5.7	6.0	6.2	6.2	6.0	5.3	4.9	5.7
	Min/Max	3.5/6.1	4.0/6.5	4.5/7.1	4.9/6.9	4.7/6.5	4.9/6.1	5.8/6.2	5.7/6.6	5.4/6.9	4.9/6.6	4.1/6.3	3.8/5.9	5.2/6.0
90	Average	4.4	4.4	4.0	3.4	2.7	2.3	2.5	3.2	3.9	4.6	4.6	4.5	3.7
	Min/Max	3.0/5.5	3.2/5.4	3.1/4.9	2.8/3.8	2.4/2.9	2.2/2.4	2.4/2.6	3.0/3.3	3.5/4.4	3.7/5.1	3.5/5.6	3.5/5.5	3.3/4.0

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	4.2	5.2	6.7	8.3	9.0	9.4	9.6	8.8	7.5	6.1	4.7	4.0	7.0
	Min/Max	3.0/5.1	3.8/6.3	5.1/8.4	6.7/9.7	6.8/10.6	7.7/10.8	8.8/10.6	7.9/9.6	6.3/8.7	5.0/7.0	3.7/5.7	3.2/4.8	6.3/7.4
Latitude -15	Average	5.0	6.0	7.3	8.7	9.1	9.4	9.6	9.1	8.1	6.9	5.6	4.9	7.5
	Min/Max	3.5/6.2	4.3/7.3	5.5/9.2	6.9/10.2	6.9/10.8	7.6/10.7	8.8/10.6	8.1/9.9	6.7/9.4	5.6/7.9	4.3/6.7	3.8/5.9	6.7/7.9
Latitude	Average	5.5	6.4	7.5	8.6	8.8	9.0	9.2	8.9	8.2	7.3	6.0	5.4	7.6
	Min/Max	3.8/6.8	4.5/7.8	5.6/9.5	6.8/10.1	6.7/10.4	7.3/10.2	8.5/10.2	8.0/9.7	6.8/9.5	5.9/8.3	4.6/7.3	4.2/6.6	6.8/8.1
Latitude +15	Average	5.7	6.5	7.4	8.3	8.3	8.3	8.6	8.5	8.0	7.3	6.3	5.7	7.4
	Min/Max	4.0/7.2	4.5/8.0	5.5/9.4	6.4/9.8	6.3/9.8	6.8/9.5	7.9/9.5	7.6/9.2	6.6/9.3	5.9/8.4	4.7/7.7	4.4/7.0	6.6/7.9

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	5.8	6.5	7.5	8.7	9.2	9.6	9.7	9.1	8.2	7.4	6.3	5.8	7.8
	Min/Max	4.0/7.3	4.6/8.0	5.6/9.5	6.9/10.2	6.9/10.9	7.8/10.9	8.9/10.8	8.1/9.9	6.8/9.5	5.9/8.4	4.8/7.7	4.4/7.2	7.0/8.4

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	3.6	3.8	4.0	4.5	4.9	5.3	5.6	5.2	4.6	4.3	3.9	3.7	4.5
	Min/Max	2.1/4.9	2.1/5.0	2.3/5.7	3.0/5.7	2.9/6.2	3.6/6.4	4.6/6.4	4.1/5.9	3.2/5.6	3.2/5.2	2.6/5.2	2.6/5.0	3.6/5.0
1-Axis, N-S Horiz Axis	Average	2.9	3.6	4.6	5.9	6.4	6.8	7.1	6.5	5.5	4.5	3.4	2.8	5.0
	Min/Max	1.6/3.9	2.0/4.8	2.7/6.7	4.0/7.5	3.8/8.2	4.5/8.3	5.7/8.3	5.0/7.5	3.7/7.0	3.3/5.5	2.2/4.5	2.0/3.8	4.1/5.5
1-Axis, N-S Tilt=Latitude	Average	4.0	4.6	5.3	6.1	6.2	6.3	6.7	6.6	6.0	5.4	4.5	4.0	5.5
	Min/Max	2.3/5.4	2.5/6.1	3.0/7.6	4.1/7.8	3.7/7.9	4.2/7.8	5.4/7.8	5.1/7.5	4.0/7.6	4.0/6.6	3.0/6.0	2.8/5.4	4.4/6.1
2-Axis	Average	4.3	4.7	5.3	6.2	6.5	6.9	7.2	6.8	6.1	5.5	4.8	4.4	5.7
	Min/Max	2.5/5.8	2.6/6.3	3.0/7.7	4.1/7.9	3.9/8.4	4.6/8.4	5.8/8.4	5.2/7.7	4.0/7.6	4.1/6.7	3.1/6.3	3.1/5.8	4.6/6.4

Average Climatic Conditions

Element	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
Temperature (°C)	10.6	11.4	11.6	12.7	13.9	15.9	17.3	17.8	17.6	16.1	13.1	10.6	14.1
Daily Minimum Temp	3.5	4.7	5.2	5.8	8.0	10.2	11.6	12.2	11.3	8.9	5.7	3.2	7.5
Daily Maximum Temp	17.7	18.2	17.9	19.4	19.9	21.7	22.9	23.4	23.8	23.3	20.4	17.9	20.6
Record Minimum Temp	-6.7	-5.6	-4.4	-0.6	-0.6	2.2	6.1	6.1	2.2	-3.3	-3.9	-6.7	-6.7
Record Maximum Temp	30.0	30.6	35.0	39.4	37.8	38.9	40.0	39.4	39.4	42.2	33.9	32.2	42.2
HDD, Base 18.3°C	239	193	210	173	138	77	53	40	56	79	161	239	1658
CDD, Base 18.3°C	0	0	0	3	0	5	21	23	32	11	0	0	94
Relative Humidity (%)	70	73	76	75	76	76	77	78	78	73	71	70	75
Wind Speed (m/s)	2.8	3.2	3.7	3.8	4.0	3.7	3.2	3.0	2.8	2.8	3.0	2.8	3.2