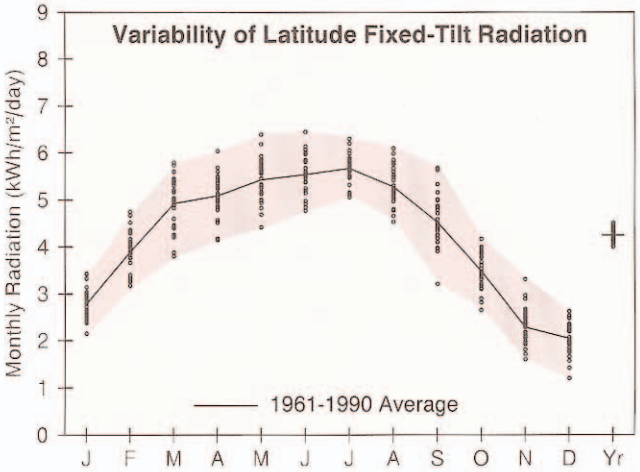
Alpena, MI

WBAN NO. 94849

LATITUDE: 45.07° N
LONGITUDE: 83.57° W
ELEVATION: 210 meters
MEAN PRESSURE: 990 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	1.6	2.5	3.7	4.7	5.7	6.2	6.1	5.1	3.8	2.5	1.5	1.2	3.7
	Min/Max	1.4/1.8	2.2/2.9	3.1/4.3	4.0/5.3	4.7/6.6	5.4/7.2	5.5/6.8	4.5/5.8	3.0/4.4	2.2/2.8	1.2/1.8	0.9/1.4	3.6/3.9
Latitude -15	Average	2.5	3.6	4.7	5.2	5.8	6.1	6.1	5.5	4.5	3.3	2.1	1.8	4.3
	Min/Max	2.0/3.0	3.0/4.3	3.7/5.5	4.3/6.1	4.8/6.8	5.2/7.1	5.5/6.8	4.7/6.3	3.3/5.6	2.6/3.9	1.5/3.0	1.1/2.3	4.1/4.5
Latitude	Average	2.8	3.9	4.9	5.1	5.4	5.5	5.7	5.3	4.5	3.5	2.3	2.0	4.2
	Min/Max	2.2/3.4	3.2/4.8	3.8/5.8	4.2/6.0	4.4/6.4	4.8/6.4	5.1/6.3	4.5/6.1	3.2/5.7	2.7/4.2	1.6/3.3	1.2/2.6	4.0/4.5
Latitude +15	Average	2.9	4.0	4.9	4.7	4.8	4.8	4.9	4.8	4.3	3.5	2.3	2.1	4.0
	Min/Max	2.3/3.7	3.3/5.0	3.7/5.8	3.8/5.7	3.9/5.7	4.1/5.6	4.4/5.5	4.1/5.5	3.0/5.5	2.6/4.2	1.6/3.5	1.2/2.8	3.8/4.3
90	Average	2.9	3.8	4.2	3.4	3.0	2.8	2.9	3.1	3.2	2.9	2.1	2.1	3.0
	Min/Max	2.2/3.6	3.0/4.7	3.0/5.1	2.7/4.2	2.5/3.4	2.5/3.1	2.7/3.2	2.7/3.6	2.2/4.2	2.1/3.5	1.4/3.2	1.1/2.8	2.8/3.3

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	2.2	3.6	5.2	6.3	7.6	8.2	8.2	7.0	5.2	3.4	1.9	1.6	5.0
	Min/Max	1.8/2.8	2.8/4.3	4.0/6.1	5.0/7.4	5.8/9.2	6.8/10.0	7.1/9.3	5.9/8.4	3.5/6.5	2.6/4.1	1.4/2.7	1.0/2.0	4.7/5.4
Latitude -15	Average	2.9	4.3	6.0	6.8	7.8	8.2	8.4	7.4	5.7	4.0	2.4	2.1	5.5
	Min/Max	2.2/3.7	3.4/5.4	4.5/7.1	5.3/8.1	5.9/9.6	6.8/10.1	7.2/9.5	6.2/8.9	3.8/7.4	3.0/4.9	1.6/3.6	1.2/2.7	5.2/5.9
Latitude	Average	3.1	4.6	6.1	6.7	7.5	7.9	8.1	7.2	5.8	4.2	2.5	2.2	5.5
	Min/Max	2.4/4.0	3.6/5.7	4.6/7.3	5.2/8.1	5.7/9.3	6.6/9.7	7.0/9.2	6.0/8.8	3.8/7.5	3.0/5.2	1.7/3.8	1.2/2.9	5.1/5.9
Latitude +15	Average	3.3	4.7	6.1	6.4	7.1	7.4	7.6	6.9	5.6	4.2	2.6	2.3	5.4
	Min/Max	2.5/4.2	3.6/5.8	4.5/7.3	4.9/7.8	5.4/8.8	6.1/9.1	6.5/8.6	5.7/8.4	3.6/7.3	3.0/5.2	1.7/4.0	1.3/3.1	5.0/5.7

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

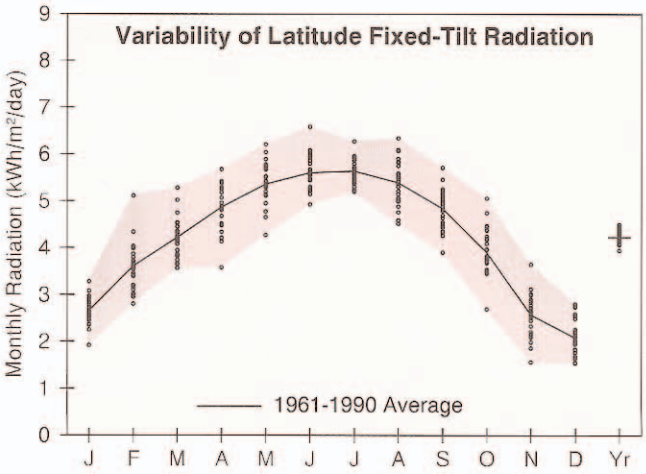
Tracker		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
2-Axis	Average	3.3	4.7	6.1	6.8	7.9	8.5	8.6	7.4	5.8	4.2	2.6	2.4	5.7
	Min/Max	2.5/4.2	3.6/5.8	4.6/7.3	5.3/8.1	6.0/9.7	7.0/10.4	7.4/9.7	6.2/9.0	3.8/7.5	3.0/5.2	1.7/4.0	1.3/3.1	5.3/6.1

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	1.5	2.1	2.7	3.1	3.7	4.0	4.1	3.4	2.7	2.1	1.2	1.0	2.6
	Min/Max	0.8/2.3	1.4/2.8	1.9/3.5	2.0/4.0	2.2/5.2	2.7/5.6	3.2/5.0	2.5/4.6	1.3/4.1	1.0/2.8	0.6/2.4	0.4/1.5	2.3/3.0
1-Axis, N-S Horiz Axis	Average	1.0	1.7	2.9	3.9	4.9	5.3	5.5	4.5	3.2	1.9	0.9	0.6	3.0
	Min/Max	0.5/1.5	1.1/2.4	2.0/4.0	2.5/5.1	2.9/6.9	3.7/7.4	4.2/6.6	3.3/6.1	1.6/4.8	1.0/2.7	0.4/1.8	0.3/1.0	2.7/3.5
1-Axis, N-S Tilt=Latitude	Average	1.6	2.5	3.6	4.3	4.9	5.1	5.3	4.7	3.7	2.6	1.4	1.0	3.4
	Min/Max	0.9/2.5	1.6/3.4	2.5/4.8	2.7/5.6	2.9/6.8	3.5/7.1	4.1/6.4	3.4/6.4	1.8/5.6	1.3/3.6	0.7/2.7	0.4/1.6	3.0/3.9
2-Axis	Average	1.7	2.5	3.6	4.3	5.2	5.5	5.7	4.9	3.7	2.6	1.5	1.1	3.5
	Min/Max	0.9/2.7	1.6/3.5	2.5/4.8	2.8/5.6	3.0/7.2	3.8/7.7	4.4/6.8	3.5/6.6	1.8/5.6	1.3/3.6	0.8/2.8	0.5/1.8	3.1/4.1

Average Climatic Conditions

Element	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
Temperature (°C)	-8.0	-7.6	-2.2	4.9	11.1	16.3	19.5	18.2	14.1	8.3	2.1	-4.6	6.0
Daily Minimum Temp	-12.9	-13.2	-7.8	-1.1	4.0	8.9	12.2	11.4	7.9	2.8	-2.0	-8.6	0.2
Daily Maximum Temp	-3.1	-2.1	3.3	10.9	18.2	23.6	26.8	24.9	20.2	13.8	6.1	-0.6	11.8
Record Minimum Temp	-33.3	-38.3	-32.8	-17.8	-6.7	-2.2	1.1	-1.1	-3.9	-8.9	-18.3	-27.8	-38.3
Record Maximum Temp	11.1	18.3	24.4	32.2	34.4	36.7	38.9	38.9	34.4	31.1	24.4	18.3	38.9
HDD, Base 18.3°C	816	727	637	402	228	81	24	44	132	312	488	711	4602
CDD, Base 18.3°C	0	0	0	0	4	19	60	41	3	0	0	0	128
Relative Humidity (%)	76	73	72	67	66	70	71	76	78	76	78	79	73
Wind Speed (m/s)	4.1	3.9	4.2	4.2	3.8	3.5	3.3	3.1	3.3	3.6	4.0	3.9	3.8



Detroit, MI

WBAN NO. 94847

LATITUDE: 42.42° N
LONGITUDE: 83.02° W
ELEVATION: 191 meters
MEAN PRESSURE: 992 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	1.6	2.5	3.4	4.6	5.6	6.2	6.1	5.3	4.1	2.8	1.7	1.3	3.8
	Min/Max	1.3/1.9	2.1/3.2	3.1/4.0	3.6/5.2	4.6/6.5	5.5/7.3	5.7/6.8	4.6/6.1	3.5/4.7	2.2/3.4	1.3/2.1	1.1/1.5	3.6/4.0
Latitude -15	Average	2.4	3.3	4.1	5.0	5.7	6.1	6.1	5.6	4.8	3.7	2.4	1.9	4.3
	Min/Max	1.8/2.9	2.7/4.6	3.5/5.1	3.7/5.8	4.6/6.7	5.4/7.2	5.6/6.8	4.8/6.6	3.9/5.6	2.6/4.7	1.5/3.3	1.4/2.5	4.0/4.5
Latitude	Average	2.7	3.6	4.2	4.9	5.4	5.6	5.6	5.4	4.8	3.9	2.6	2.1	4.2
	Min/Max	1.9/3.3	2.8/5.1	3.6/5.3	3.6/5.7	4.3/6.2	4.9/6.6	5.2/6.3	4.5/6.3	3.9/5.7	2.7/5.1	1.6/3.7	1.5/2.8	4.0/4.5
Latitude +15	Average	2.8	3.7	4.1	4.5	4.8	4.9	4.9	4.9	4.6	3.9	2.6	2.2	4.0
	Min/Max	2.0/3.5	2.8/5.4	3.5/5.2	3.3/5.3	3.8/5.5	4.3/5.7	4.6/5.5	4.1/5.8	3.7/5.5	2.6/5.1	1.5/3.8	1.6/3.0	3.7/4.2
90	Average	2.6	3.3	3.2	3.0	2.8	2.7	2.8	3.1	3.3	3.2	2.3	2.0	2.9
	Min/Max	1.8/3.4	2.5/5.0	2.7/4.1	2.2/3.6	2.3/3.1	2.5/3.0	2.6/3.0	2.6/3.6	2.6/4.0	2.1/4.2	1.3/3.5	1.4/2.9	2.7/3.1

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	2.2	3.3	4.5	5.9	7.2	8.0	7.9	6.9	5.5	3.8	2.2	1.7	4.9
	Min/Max	1.6/2.7	2.6/4.6	3.8/5.7	4.3/7.1	5.6/9.0	6.7/9.8	7.1/9.1	5.8/8.3	4.3/6.4	2.6/5.0	1.4/3.1	1.2/2.2	4.6/5.3
Latitude -15	Average	2.8	4.0	5.0	6.3	7.4	8.0	8.0	7.3	6.0	4.5	2.7	2.1	5.3
	Min/Max	1.9/3.5	3.0/5.7	4.1/6.5	4.4/7.5	5.7/9.2	6.7/9.8	7.2/9.3	6.0/8.8	4.7/7.2	3.0/5.9	1.6/4.0	1.5/2.9	4.9/5.8
Latitude	Average	3.0	4.2	5.1	6.2	7.1	7.7	7.7	7.1	6.1	4.7	2.9	2.3	5.3
	Min/Max	2.0/3.8	3.2/6.1	4.2/6.6	4.3/7.5	5.5/8.9	6.4/9.4	6.9/9.0	5.8/8.6	4.7/7.3	3.0/6.2	1.6/4.3	1.6/3.2	4.9/5.8
Latitude +15	Average	3.1	4.3	5.0	5.9	6.7	7.1	7.2	6.8	5.9	4.7	2.9	2.4	5.2
	Min/Max	2.1/4.0	3.2/6.3	4.1/6.6	4.1/7.2	5.1/8.4	5.9/8.8	6.4/8.4	5.5/8.2	4.5/7.1	3.0/6.3	1.6/4.4	1.7/3.3	4.8/5.6

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	3.1	4.3	5.1	6.3	7.5	8.2	8.2	7.3	6.1	4.7	3.0	2.4	5.5
	Min/Max	2.1/4.0	3.2/6.3	4.2/6.7	4.5/7.6	5.8/9.3	6.8/10.1	7.3/9.4	6.0/8.8	4.7/7.3	3.0/6.3	1.6/4.4	1.7/3.4	5.1/6.0

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	1.5	2.0	2.2	2.7	3.2	3.7	3.6	3.2	2.8	2.3	1.5	1.1	2.5
	Min/Max	0.9/2.1	1.2/3.3	1.2/3.5	1.2/3.6	2.0/4.6	2.6/5.1	2.9/4.6	2.3/4.4	1.7/3.7	1.1/3.5	0.4/2.6	0.6/1.9	2.2/2.9
1-Axis, N-S Horiz Axis	Average	1.0	1.7	2.4	3.4	4.3	4.8	4.8	4.2	3.3	2.2	1.1	0.7	2.8
	Min/Max	0.6/1.4	1.0/2.7	1.4/3.8	1.7/4.6	2.7/6.2	3.4/6.7	3.9/6.2	3.1/5.7	2.0/4.3	1.0/3.4	0.3/2.0	0.4/1.2	2.5/3.3
1-Axis, N-S Tilt=Latitude	Average	1.6	2.4	2.9	3.7	4.2	4.6	4.6	4.3	3.7	2.9	1.7	1.2	3.2
	Min/Max	1.0/2.3	1.4/3.9	1.6/4.6	1.8/4.9	2.6/6.1	3.2/6.4	3.7/5.9	3.2/5.9	2.3/4.9	1.3/4.4	0.5/3.0	0.6/2.0	2.7/3.6
2-Axis	Average	1.8	2.5	2.9	3.7	4.4	5.0	5.0	4.5	3.8	3.0	1.7	1.3	3.3
	Min/Max	1.0/2.5	1.4/4.0	1.6/4.6	1.8/5.0	2.8/6.4	3.5/6.9	4.0/6.4	3.3/6.1	2.3/4.9	1.4/4.5	0.5/3.1	0.7/2.2	2.9/3.8

Average Climatic Conditions

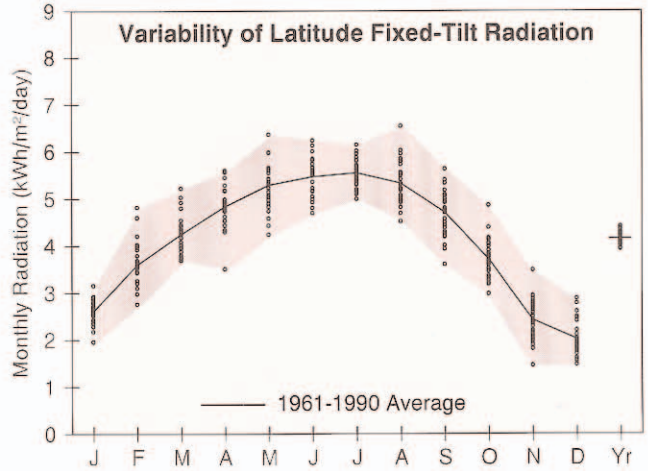
Element	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
Temperature (°C)	-5.1	-3.7	2.1	8.5	14.7	19.8	22.4	21.4	17.3	10.7	4.6	-2.1	9.2
Daily Minimum Temp	-9.1	-8.0	-2.8	2.7	8.4	13.5	16.3	15.3	11.4	4.9	0.1	-5.9	3.9
Daily Maximum Temp	-0.9	0.7	6.9	14.3	20.9	26.1	28.5	27.4	23.3	16.4	8.9	1.8	14.5
Record Minimum Temp	-29.4	-26.1	-20.0	-12.2	-3.9	2.2	5.0	3.3	-1.7	-8.3	-12.8	-23.3	-29.4
Record Maximum Temp	16.7	18.3	27.2	31.7	33.9	40.0	38.9	37.8	36.7	32.8	25.0	20.0	40.0
HDD, Base 18.3°C	725	616	504	295	135	21	0	9	57	242	413	632	3649
CDD, Base 18.3°C	0	0	0	0	21	64	128	103	27	4	0	0	348
Relative Humidity (%)	75	73	70	66	65	67	69	72	73	72	75	77	71
Wind Speed (m/s)	5.4	5.1	5.3	5.2	4.6	4.2	3.8	3.7	3.9	4.4	5.0	5.1	4.6

Flint, MI

WBAN NO. 14826

LATITUDE: 42.97° N
LONGITUDE: 83.73° W
ELEVATION: 233 meters
MEAN PRESSURE: 988 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	1.6	2.5	3.4	4.6	5.6	6.1	6.0	5.2	4.0	2.7	1.6	1.3	3.7
	Min/Max	1.4/1.8	2.1/3.0	3.1/4.0	3.5/5.1	4.6/6.6	5.2/6.9	5.4/6.6	4.5/6.3	3.3/4.6	2.4/3.3	1.3/2.0	1.1/1.6	3.6/3.9
Latitude -15	Average	2.3	3.3	4.1	5.0	5.7	6.0	6.0	5.6	4.7	3.5	2.2	1.8	4.2
	Min/Max	1.8/2.8	2.6/4.4	3.6/5.0	3.7/5.7	4.6/6.8	5.1/6.8	5.4/6.6	4.7/6.8	3.7/5.5	2.9/4.5	1.4/3.1	1.4/2.5	4.0/4.4
Latitude	Average	2.6	3.6	4.2	4.8	5.3	5.5	5.5	5.3	4.7	3.7	2.4	2.0	4.1
	Min/Max	2.0/3.2	2.8/4.8	3.7/5.2	3.5/5.6	4.2/6.4	4.7/6.2	5.0/6.2	4.5/6.6	3.6/5.6	3.0/4.9	1.5/3.5	1.5/2.9	3.9/4.4
Latitude +15	Average	2.7	3.7	4.1	4.5	4.7	4.7	4.8	4.8	4.5	3.7	2.5	2.1	3.9
	Min/Max	2.0/3.4	2.8/5.1	3.6/5.1	3.2/5.2	3.8/5.6	4.1/5.4	4.4/5.4	4.1/5.9	3.4/5.4	2.9/4.9	1.4/3.6	1.5/3.1	3.7/4.2
90	Average	2.6	3.3	3.3	3.0	2.8	2.7	2.8	3.1	3.3	3.0	2.2	2.0	2.8
	Min/Max	1.9/3.3	2.4/4.7	2.8/4.1	2.2/3.6	2.3/3.3	2.4/2.9	2.5/3.0	2.6/3.7	2.4/4.0	2.4/4.1	1.1/3.3	1.3/3.0	2.6/3.1

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	2.1	3.3	4.5	5.9	7.1	7.8	7.8	6.9	5.3	3.6	2.1	1.6	4.9
	Min/Max	1.6/2.5	2.5/4.3	3.8/5.6	4.2/6.9	5.5/9.0	6.2/9.2	6.9/8.9	5.6/8.8	4.0/6.4	2.8/4.7	1.3/3.0	1.2/2.2	4.6/5.2
Latitude -15	Average	2.7	4.0	5.0	6.3	7.3	7.8	7.9	7.2	5.9	4.3	2.5	2.0	5.2
	Min/Max	2.0/3.3	2.9/5.3	4.2/6.4	4.4/7.4	5.5/9.3	6.2/9.3	7.0/9.0	5.8/9.3	4.3/7.2	3.2/5.7	1.5/3.8	1.5/2.9	4.9/5.6
Latitude	Average	2.9	4.2	5.1	6.2	7.1	7.5	7.6	7.0	5.9	4.4	2.7	2.2	5.2
	Min/Max	2.1/3.6	3.0/5.7	4.3/6.6	4.3/7.3	5.3/9.0	5.9/8.9	6.7/8.7	5.7/9.1	4.3/7.3	3.3/5.9	1.5/4.1	1.5/3.2	4.9/5.7
Latitude +15	Average	3.0	4.3	5.1	5.9	6.6	7.0	7.2	6.7	5.7	4.4	2.8	2.3	5.1
	Min/Max	2.2/3.8	3.0/5.9	4.2/6.5	4.1/7.0	5.0/8.5	5.5/8.3	6.3/8.2	5.4/8.7	4.1/7.1	3.3/6.0	1.5/4.2	1.6/3.4	4.7/5.5

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

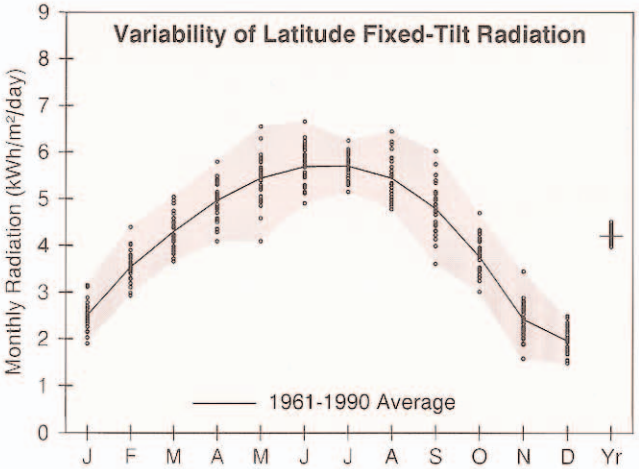
Tracker		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
2-Axis	Average	3.1	4.3	5.1	6.3	7.4	8.0	8.1	7.2	6.0	4.5	2.8	2.3	5.4
	Min/Max	2.2/3.8	3.1/5.9	4.3/6.6	4.4/7.4	5.6/9.4	6.4/9.5	7.1/9.2	5.8/9.3	4.3/7.3	3.3/6.0	1.5/4.2	1.6/3.5	5.0/5.8

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	1.4	1.9	2.2	2.6	3.2	3.5	3.6	3.2	2.7	2.2	1.3	1.0	2.4
	Min/Max	0.8/1.9	1.0/2.9	1.4/3.4	1.2/3.5	1.8/4.7	2.2/4.6	2.9/4.4	2.3/4.8	1.5/3.6	1.3/3.4	0.3/2.5	0.4/1.9	2.1/2.7
1-Axis, N-S Horiz Axis	Average	1.0	1.6	2.4	3.4	4.2	4.6	4.7	4.1	3.2	2.1	1.0	0.6	2.7
	Min/Max	0.5/1.2	0.8/2.4	1.6/3.7	1.7/4.4	2.4/6.2	2.9/6.0	3.9/5.8	3.0/6.2	1.8/4.3	1.2/3.3	0.2/1.9	0.3/1.2	2.4/3.1
1-Axis, N-S Tilt=Latitude	Average	1.5	2.3	2.9	3.6	4.1	4.4	4.6	4.3	3.6	2.7	1.5	1.1	3.0
	Min/Max	0.9/2.0	1.2/3.4	1.9/4.5	1.8/4.8	2.4/6.1	2.8/5.7	3.7/5.6	3.0/6.4	2.1/4.9	1.6/4.3	0.3/2.8	0.4/2.0	2.7/3.5
2-Axis	Average	1.6	2.4	2.9	3.7	4.4	4.7	4.9	4.4	3.7	2.7	1.5	1.2	3.2
	Min/Max	0.9/2.1	1.2/3.5	1.9/4.5	1.8/4.9	2.5/6.5	3.0/6.2	4.0/6.0	3.1/6.6	2.1/4.9	1.6/4.3	0.3/2.9	0.5/2.1	2.8/3.6

Average Climatic Conditions

Element	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
Temperature (°C)	-5.8	-4.7	1.1	7.8	13.8	18.8	21.4	20.3	16.3	10.1	4.1	-2.7	8.4
Daily Minimum Temp	-9.9	-9.1	-3.6	2.2	7.6	12.6	15.4	14.4	10.6	4.7	0.1	-6.3	3.2
Daily Maximum Temp	-1.8	-0.4	5.7	13.3	20.0	24.9	27.5	26.2	22.0	15.4	8.1	1.0	13.5
Record Minimum Temp	-31.7	-30.0	-24.4	-14.4	-5.6	0.6	4.4	2.8	-3.3	-7.2	-14.4	-24.4	-31.7
Record Maximum Temp	15.6	17.2	25.6	30.6	33.9	38.3	38.3	36.7	33.9	31.7	24.4	19.4	38.3
HDD, Base 18.3°C	749	646	534	317	162	36	6	14	76	260	427	651	3877
CDD, Base 18.3°C	0	0	0	0	21	51	102	76	16	3	0	0	268
Relative Humidity (%)	75	73	70	66	66	68	70	73	76	73	76	77	72
Wind Speed (m/s)	5.1	4.8	5.1	4.9	4.4	4.0	3.6	3.4	3.8	4.2	4.8	4.9	4.4



Grand Rapids, MI

WBAN NO. 94860

LATITUDE: 42.88° N
LONGITUDE: 85.52° W
ELEVATION: 245 meters
MEAN PRESSURE: 987 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	1.6	2.5	3.5	4.7	5.7	6.3	6.2	5.3	4.1	2.7	1.6	1.3	3.8
	Min/Max	1.4/1.9	2.2/2.9	3.1/3.9	4.0/5.3	4.4/6.8	5.5/7.4	5.6/6.7	4.7/6.1	3.3/4.8	2.4/3.2	1.4/2.0	1.1/1.5	3.6/4.0
Latitude -15	Average	2.3	3.3	4.2	5.1	5.8	6.2	6.1	5.7	4.8	3.6	2.2	1.8	4.3
	Min/Max	1.8/2.8	2.8/4.0	3.6/4.9	4.2/5.9	4.4/7.0	5.3/7.3	5.5/6.7	5.0/6.7	3.7/5.9	2.9/4.4	1.5/3.1	1.4/2.2	4.0/4.5
Latitude	Average	2.5	3.5	4.3	5.0	5.4	5.7	5.7	5.4	4.8	3.8	2.4	2.0	4.2
	Min/Max	1.9/3.2	2.9/4.4	3.7/5.0	4.1/5.8	4.1/6.5	4.9/6.7	5.1/6.2	4.8/6.4	3.6/6.0	3.0/4.7	1.6/3.4	1.5/2.5	4.0/4.5
Latitude +15	Average	2.6	3.6	4.2	4.6	4.8	4.9	5.0	4.9	4.6	3.8	2.5	2.0	4.0
	Min/Max	2.0/3.3	3.0/4.6	3.6/4.9	3.8/5.4	3.6/5.8	4.3/5.7	4.5/5.4	4.3/5.8	3.4/5.8	3.0/4.7	1.5/3.6	1.5/2.7	3.8/4.3
90	Average	2.5	3.3	3.4	3.1	2.9	2.7	2.8	3.1	3.3	3.1	2.2	1.9	2.9
	Min/Max	1.8/3.2	2.7/4.3	2.8/3.9	2.6/3.6	2.3/3.3	2.5/3.0	2.6/3.0	2.8/3.7	2.4/4.3	2.4/3.9	1.3/3.3	1.4/2.5	2.7/3.1

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	2.1	3.3	4.6	6.1	7.4	8.2	8.1	7.1	5.5	3.7	2.1	1.6	5.0
	Min/Max	1.6/2.5	2.7/4.0	3.9/5.3	4.9/7.1	5.3/9.1	6.8/10.0	7.2/9.0	6.0/8.6	4.1/6.9	3.0/4.6	1.4/2.9	1.3/2.0	4.7/5.4
Latitude -15	Average	2.6	3.9	5.1	6.5	7.6	8.2	8.2	7.4	6.0	4.3	2.5	2.0	5.4
	Min/Max	1.9/3.3	3.2/4.9	4.2/6.1	5.1/7.6	5.3/9.4	6.7/10.1	7.2/9.2	6.3/9.1	4.4/7.8	3.4/5.5	1.6/3.7	1.5/2.5	5.0/5.8
Latitude	Average	2.8	4.1	5.2	6.4	7.3	7.9	7.9	7.3	6.1	4.5	2.7	2.1	5.4
	Min/Max	2.0/3.5	3.3/5.2	4.3/6.3	5.0/7.6	5.2/9.1	6.4/9.7	6.9/8.8	6.1/8.9	4.4/7.8	3.5/5.8	1.6/4.0	1.5/2.8	5.0/5.8
Latitude +15	Average	2.9	4.2	5.1	6.1	6.9	7.4	7.4	6.9	5.9	4.5	2.7	2.2	5.2
	Min/Max	2.1/3.7	3.3/5.3	4.2/6.2	4.8/7.3	4.8/8.6	6.0/9.1	6.5/8.3	5.8/8.5	4.2/7.7	3.4/5.8	1.6/4.1	1.5/2.9	4.9/5.7

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	2.9	4.2	5.2	6.5	7.7	8.4	8.3	7.5	6.1	4.5	2.8	2.2	5.5
	Min/Max	2.1/3.8	3.3/5.3	4.3/6.3	5.1/7.7	5.4/9.4	6.9/10.3	7.3/9.3	6.3/9.1	4.4/7.9	3.5/5.8	1.6/4.2	1.5/3.0	5.2/6.0

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	1.2	1.8	2.2	2.8	3.4	3.9	3.8	3.3	2.8	2.2	1.3	0.9	2.5
	Min/Max	0.7/2.0	1.1/2.4	1.4/3.2	1.8/3.7	1.8/4.8	2.6/5.4	3.0/4.8	2.4/4.6	1.5/4.2	1.4/3.3	0.4/2.4	0.2/1.6	2.2/2.8
1-Axis, N-S Horiz Axis	Average	0.8	1.5	2.4	3.5	4.5	5.1	5.0	4.4	3.3	2.1	1.0	0.6	2.9
	Min/Max	0.5/1.3	0.9/2.0	1.6/3.4	2.3/4.6	2.4/6.3	3.5/7.2	4.0/6.2	3.2/6.0	1.9/4.9	1.3/3.2	0.3/1.8	0.1/1.0	2.6/3.3
1-Axis, N-S Tilt=Latitude	Average	1.3	2.1	2.9	3.8	4.5	4.9	4.8	4.5	3.8	2.8	1.4	0.9	3.2
	Min/Max	0.7/2.1	1.3/2.8	1.9/4.2	2.5/5.0	2.4/6.2	3.3/6.8	3.8/6.0	3.3/6.2	2.2/5.7	1.7/4.1	0.5/2.7	0.2/1.6	2.8/3.6
2-Axis	Average	1.4	2.2	2.9	3.8	4.7	5.3	5.2	4.7	3.8	2.8	1.5	1.0	3.3
	Min/Max	0.8/2.2	1.3/2.9	1.9/4.2	2.5/5.0	2.5/6.5	3.6/7.4	4.1/6.4	3.4/6.4	2.2/5.7	1.8/4.1	0.5/2.8	0.2/1.8	3.0/3.8

Average Climatic Conditions

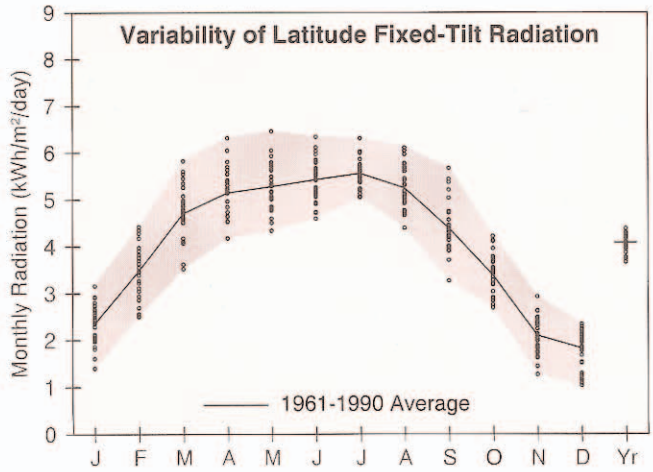
Element	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
Temperature (°C)	-5.7	-4.6	1.2	7.8	14.2	19.4	22.0	20.8	16.1	9.7	3.3	-2.7	8.4
Daily Minimum Temp	-9.6	-9.0	-3.7	1.9	7.6	12.9	15.8	14.7	9.9	3.9	-1.0	-6.3	3.1
Daily Maximum Temp	-1.7	-0.2	6.0	13.7	20.7	25.9	28.2	26.9	22.2	15.4	7.7	0.8	13.8
Record Minimum Temp	-29.4	-28.3	-22.2	-16.1	-5.6	0.6	5.0	3.9	-2.8	-7.8	-15.0	-27.8	-29.4
Record Maximum Temp	16.7	19.4	25.6	31.1	33.3	36.7	37.8	37.8	33.9	30.6	25.0	19.4	37.8
HDD, Base 18.3°C	744	642	532	317	152	28	0	10	77	269	450	653	3874
CDD, Base 18.3°C	0	0	0	0	22	61	116	87	11	0	0	0	297
Relative Humidity (%)	77	75	71	66	65	67	69	73	76	74	77	79	72
Wind Speed (m/s)	5.1	4.7	5.1	4.9	4.3	4.0	3.7	3.5	3.7	4.0	4.6	4.8	4.4

Houghton, MI

WBAN NO. 94814

LATITUDE: 47.17° N
LONGITUDE: 88.50° W
ELEVATION: 329 meters
MEAN PRESSURE: 974 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	1.3	2.2	3.5	4.6	5.5	6.0	6.0	5.0	3.6	2.3	1.3	1.1	3.6
	Min/Max	1.0/1.6	1.7/2.6	2.8/4.1	4.0/5.3	4.6/6.6	5.2/7.0	5.5/6.7	4.3/5.7	3.0/4.3	2.0/2.7	1.1/1.6	0.7/1.3	3.3/3.8
Latitude -15	Average	2.1	3.2	4.5	5.2	5.6	5.9	6.0	5.5	4.4	3.2	1.9	1.6	4.1
	Min/Max	1.3/2.8	2.4/4.0	3.5/5.5	4.3/6.3	4.7/6.9	5.0/6.9	5.4/6.8	4.6/6.3	3.3/5.6	2.6/3.9	1.3/2.6	1.0/2.1	3.7/4.4
Latitude	Average	2.3	3.5	4.7	5.2	5.3	5.4	5.6	5.2	4.4	3.4	2.1	1.8	4.1
	Min/Max	1.4/3.2	2.5/4.4	3.5/5.8	4.2/6.3	4.3/6.5	4.6/6.3	5.1/6.3	4.4/6.1	3.3/5.7	2.7/4.2	1.3/2.9	1.0/2.3	3.7/4.4
Latitude +15	Average	2.5	3.6	4.7	4.8	4.7	4.7	4.8	4.7	4.2	3.4	2.1	1.9	3.8
	Min/Max	1.4/3.4	2.5/4.6	3.4/5.9	3.8/6.1	3.8/5.7	4.0/5.4	4.4/5.5	4.0/5.5	3.1/5.4	2.7/4.3	1.2/3.1	1.0/2.5	3.4/4.1
90	Average	2.4	3.3	4.1	3.7	3.0	2.9	3.0	3.2	3.2	2.9	2.0	1.8	3.0
	Min/Max	1.2/3.3	2.2/4.4	2.7/5.3	2.7/5.0	2.5/3.6	2.5/3.2	2.8/3.3	2.8/3.8	2.3/4.3	2.3/3.7	1.0/2.8	0.9/2.5	2.5/3.2

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	1.8	3.1	4.9	6.3	7.4	8.1	8.1	6.9	5.0	3.2	1.7	1.4	4.8
	Min/Max	1.1/2.4	2.2/4.0	3.7/6.2	5.0/7.4	5.8/9.4	6.6/10.0	7.2/9.3	5.7/8.5	3.6/6.3	2.5/4.1	1.1/2.4	0.8/1.7	4.4/5.2
Latitude -15	Average	2.4	3.8	5.7	6.8	7.6	8.2	8.3	7.4	5.6	3.9	2.2	1.8	5.3
	Min/Max	1.4/3.3	2.7/5.0	4.2/7.2	5.4/8.3	6.0/9.8	6.6/10.1	7.3/9.6	6.0/9.1	3.9/7.3	3.0/5.0	1.3/3.2	1.0/2.3	4.8/5.8
Latitude	Average	2.6	4.1	5.8	6.8	7.4	7.8	8.0	7.2	5.6	4.0	2.3	2.0	5.3
	Min/Max	1.5/3.6	2.8/5.3	4.3/7.4	5.3/8.3	5.8/9.6	6.3/9.8	7.0/9.3	5.9/8.9	3.9/7.4	3.0/5.2	1.3/3.4	1.0/2.6	4.7/5.8
Latitude +15	Average	2.7	4.1	5.8	6.6	7.0	7.3	7.5	6.9	5.5	4.0	2.4	2.1	5.2
	Min/Max	1.5/3.8	2.8/5.5	4.2/7.4	5.0/8.2	5.4/9.1	5.9/9.2	6.6/8.7	5.6/8.5	3.7/7.2	3.0/5.3	1.3/3.5	1.0/2.7	4.5/5.6

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

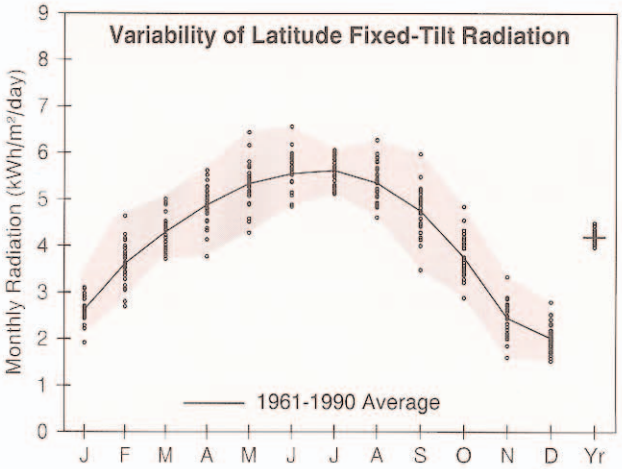
Tracker		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
2-Axis	Average	2.7	4.1	5.8	6.9	7.7	8.4	8.4	7.4	5.7	4.1	2.4	2.1	5.5
	Min/Max	1.5/3.8	2.8/5.5	4.3/7.4	5.4/8.3	6.1/10.0	6.8/10.4	7.4/9.8	6.1/9.1	3.9/7.4	3.0/5.3	1.3/3.5	1.1/2.8	4.9/6.0

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	Average	1.2	1.8	2.4	2.9	3.6	3.9	4.0	3.4	2.6	2.0	1.1	0.8	2.5
Horiz Axis	Min/Max	0.5/2.0	1.1/2.7	1.6/3.4	2.0/3.7	2.3/5.3	2.8/5.4	3.1/5.1	2.4/4.6	1.5/4.0	1.1/3.0	0.3/2.0	0.3/1.3	2.2/2.9
1-Axis, N-S	Average	0.8	1.5	2.6	3.7	4.7	5.3	5.3	4.5	3.1	1.9	0.7	0.5	2.9
Horiz Axis	Min/Max	0.3/1.3	0.8/2.3	1.7/3.7	2.6/4.6	3.1/7.0	3.6/7.2	4.2/6.7	3.2/6.2	1.7/4.5	1.0/2.8	0.2/1.4	0.2/0.8	2.5/3.3
1-Axis, N-S	Average	1.3	2.2	3.2	4.1	4.8	5.1	5.2	4.7	3.6	2.6	1.2	0.9	3.2
Tilt=Latitude	Min/Max	0.6/2.2	1.3/3.3	2.1/4.6	2.9/5.1	3.1/7.0	3.5/6.9	4.1/6.5	3.4/6.5	2.0/5.4	1.4/3.8	0.3/2.3	0.3/1.4	2.8/3.7
2-Axis	Average	1.4	2.2	3.2	4.1	5.0	5.5	5.6	4.9	3.6	2.6	1.3	0.9	3.4
	Min/Max	0.6/2.4	1.3/3.4	2.1/4.6	2.9/5.2	3.3/7.4	3.8/7.6	4.4/7.0	3.5/6.7	2.0/5.4	1.4/3.9	0.4/2.4	0.3/1.5	3.0/3.9

Average Climatic Conditions

Element	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
Temperature (°C)	-8.4	-7.7	-2.1	5.7	12.3	17.1	19.7	18.4	14.1	8.2	1.8	-5.2	6.2
Daily Minimum Temp	-13.1	-13.2	-7.7	-0.2	5.6	10.3	13.0	12.1	8.3	3.1	-2.0	-9.1	0.6
Daily Maximum Temp	-3.7	-2.2	3.4	11.5	18.9	23.8	26.4	24.7	19.9	13.2	5.6	-1.4	11.7
Record Minimum Temp	-32.2	-36.7	-30.6	-16.1	-6.1	-1.7	0.6	-1.7	-6.1	-8.9	-18.9	-29.4	-36.7
Record Maximum Temp	11.7	15.0	24.4	30.0	32.2	35.0	36.7	34.4	33.3	29.4	21.1	17.2	36.7
HDD, Base 18.3°C	828	728	634	380	199	67	19	39	130	315	497	730	4566
CDD, Base 18.3°C	0	0	0	0	11	28	62	41	0	0	0	0	142
Relative Humidity (%)	79	76	74	68	65	69	71	75	78	77	81	82	75
Wind Speed (m/s)	4.5	4.1	4.4	4.5	4.1	3.8	3.4	3.3	3.5	3.9	4.3	4.3	4.0



Lansing, MI

WBAN NO. 14836

LATITUDE: 42.78° N
LONGITUDE: 84.60° W
ELEVATION: 256 meters
MEAN PRESSURE: 985 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	1.6	2.5	3.5	4.6	5.6	6.2	6.1	5.2	4.0	2.7	1.7	1.3	3.8
	Min/Max	1.4/1.9	2.1/3.0	3.2/3.9	3.8/5.1	4.6/6.7	5.4/7.3	5.6/6.5	4.7/6.0	3.2/4.8	2.3/3.3	1.4/2.0	1.1/1.6	3.6/4.0
Latitude -15	Average	2.4	3.3	4.2	5.0	5.7	6.0	6.1	5.6	4.7	3.6	2.3	1.8	4.2
	Min/Max	1.8/2.8	2.6/4.2	3.7/4.8	3.9/5.7	4.6/6.9	5.3/7.2	5.5/6.5	4.8/6.5	3.5/5.8	2.8/4.5	1.6/3.0	1.4/2.5	4.0/4.5
Latitude	Average	2.6	3.6	4.3	4.9	5.3	5.6	5.6	5.4	4.8	3.8	2.4	2.0	4.2
	Min/Max	1.9/3.1	2.7/4.6	3.7/5.0	3.8/5.6	4.3/6.4	4.8/6.6	5.1/6.1	4.6/6.3	3.5/6.0	2.9/4.8	1.6/3.3	1.5/2.8	4.0/4.5
Latitude +15	Average	2.8	3.7	4.2	4.5	4.7	4.8	4.9	4.9	4.5	3.7	2.5	2.1	4.0
	Min/Max	2.0/3.3	2.7/4.8	3.6/4.9	3.5/5.2	3.8/5.7	4.2/5.7	4.5/5.3	4.2/5.7	3.3/5.8	2.8/4.9	1.6/3.5	1.6/3.0	3.7/4.3
90	Average	2.6	3.4	3.4	3.1	2.8	2.7	2.8	3.1	3.3	3.1	2.2	2.0	2.9
	Min/Max	1.8/3.2	2.4/4.5	2.8/4.2	2.4/3.6	2.3/3.3	2.5/3.0	2.6/3.0	2.7/3.6	2.3/4.2	2.3/4.1	1.3/3.1	1.4/2.9	2.7/3.1

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	2.2	3.3	4.6	5.9	7.2	7.9	7.9	6.9	5.4	3.7	2.1	1.6	4.9
	Min/Max	1.6/2.5	2.5/4.1	3.9/5.3	4.6/6.9	5.5/9.1	6.5/9.8	7.1/8.8	5.9/8.4	3.9/6.8	2.8/4.8	1.4/2.8	1.3/2.2	4.6/5.3
Latitude -15	Average	2.7	4.0	5.1	6.3	7.4	7.9	8.0	7.2	5.9	4.3	2.6	2.1	5.3
	Min/Max	2.0/3.2	2.9/5.1	4.3/6.1	4.8/7.4	5.6/9.4	6.5/9.9	7.1/8.9	6.2/8.8	4.2/7.7	3.2/5.7	1.6/3.6	1.5/2.8	5.0/5.7
Latitude	Average	2.9	4.2	5.2	6.2	7.1	7.6	7.7	7.1	6.0	4.5	2.7	2.2	5.3
	Min/Max	2.1/3.5	3.0/5.4	4.3/6.2	4.7/7.4	5.4/9.1	6.2/9.5	6.8/8.6	6.0/8.7	4.2/7.8	3.2/6.0	1.6/3.8	1.6/3.1	5.0/5.8
Latitude +15	Average	3.1	4.3	5.1	6.0	6.7	7.1	7.2	6.7	5.8	4.5	2.8	2.3	5.1
	Min/Max	2.1/3.7	3.0/5.6	4.2/6.1	4.4/7.1	5.0/8.6	5.7/8.9	6.4/8.0	5.7/8.3	4.0/7.6	3.2/6.0	1.6/4.0	1.6/3.3	4.8/5.6

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	3.1	4.3	5.2	6.3	7.5	8.1	8.1	7.3	6.0	4.5	2.8	2.3	5.5
	Min/Max	2.1/3.7	3.0/5.6	4.4/6.2	4.8/7.5	5.7/9.5	6.6/10.1	7.2/9.0	6.2/8.9	4.2/7.8	3.3/6.1	1.6/4.0	1.7/3.3	5.1/6.0

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	1.4	1.9	2.2	2.7	3.3	3.6	3.6	3.2	2.7	2.2	1.3	1.0	2.4
	Min/Max	0.8/1.9	1.0/2.6	1.6/3.1	1.4/3.6	2.0/4.8	2.4/5.2	2.8/4.3	2.3/4.3	1.4/4.1	1.2/3.4	0.4/2.3	0.4/1.7	2.1/2.8
1-Axis, N-S Horiz Axis	Average	0.9	1.6	2.4	3.4	4.3	4.8	4.8	4.2	3.2	2.1	1.0	0.6	2.8
	Min/Max	0.6/1.3	0.8/2.2	1.7/3.4	1.9/4.5	2.6/6.3	3.1/6.8	3.7/5.7	3.1/5.7	1.7/4.7	1.1/3.3	0.3/1.7	0.3/1.0	2.4/3.3
1-Axis, N-S Tilt=Latitude	Average	1.5	2.3	2.9	3.7	4.2	4.5	4.6	4.3	3.7	2.7	1.5	1.0	3.1
	Min/Max	0.9/2.1	1.1/3.0	2.1/4.2	2.0/4.9	2.6/6.2	2.9/6.5	3.6/5.5	3.2/5.9	1.9/5.5	1.5/4.3	0.4/2.6	0.4/1.8	2.7/3.6
2-Axis	Average	1.6	2.4	2.9	3.7	4.5	4.9	5.0	4.4	3.7	2.8	1.6	1.1	3.2
	Min/Max	0.9/2.2	1.2/3.1	2.1/4.2	2.1/5.0	2.7/6.6	3.2/7.1	3.8/5.9	3.3/6.1	2.0/5.5	1.5/4.4	0.4/2.7	0.5/1.9	2.8/3.7

Average Climatic Conditions

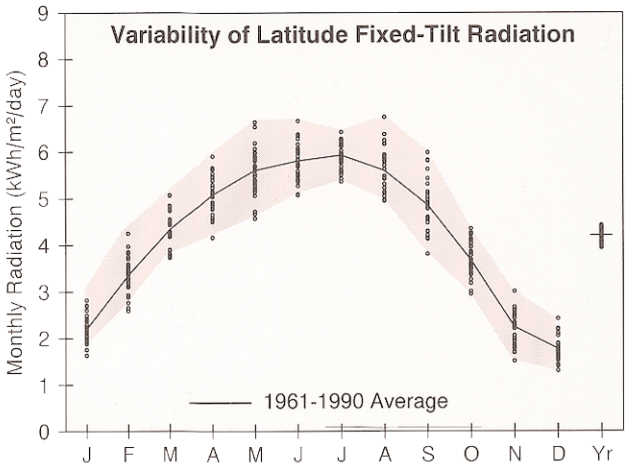
Element	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
Temperature (°C)	-6.2	-5.1	0.9	7.7	13.9	19.1	21.6	20.4	16.1	9.6	3.5	-3.1	8.2
Daily Minimum Temp	-10.4	-9.9	-4.2	1.7	7.2	12.5	15.0	13.8	9.9	4.0	-0.7	-7.1	2.7
Daily Maximum Temp	-1.9	-0.2	5.9	13.7	20.6	25.7	28.1	26.9	22.2	15.2	7.7	0.8	13.7
Record Minimum Temp	-33.9	-31.1	-26.1	-18.9	-7.2	-1.1	2.8	1.7	-5.6	-9.4	-15.6	-27.2	-33.9
Record Maximum Temp	18.9	17.8	25.6	30.0	34.4	37.2	37.8	37.8	36.1	31.7	25.0	18.9	37.8
HDD, Base 18.3°C	759	655	541	318	157	33	4	14	82	271	445	665	3945
CDD, Base 18.3°C	0	0	0	0	19	57	104	78	13	0	0	0	272
Relative Humidity (%)	79	76	73	68	67	69	71	75	77	76	79	81	74
Wind Speed (m/s)	5.4	4.9	5.2	5.1	4.5	4.1	3.6	3.4	3.7	4.1	4.8	5.0	4.5

Muskegon, MI

WBAN NO. 14840

LATITUDE: 43.17° N
LONGITUDE: 86.25° W
ELEVATION: 191 meters
MEAN PRESSURE: 993 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	1.6	2.4	3.5	4.7	5.9	6.4	6.4	5.4	4.1	2.7	1.6	1.2	3.8
	Min/Max	1.3/1.8	2.1/2.9	3.1/4.0	4.0/5.4	4.9/6.9	5.7/7.4	5.8/6.9	4.9/6.4	3.4/4.8	2.3/3.0	1.3/1.9	1.0/1.4	3.6/4.0
Latitude -15	Average	2.0	3.1	4.2	5.2	6.0	6.3	6.4	5.8	4.8	3.5	2.1	1.6	4.3
	Min/Max	1.6/2.5	2.5/3.9	3.7/4.9	4.3/6.0	4.9/7.1	5.5/7.3	5.8/6.9	5.2/7.0	3.8/5.9	2.9/4.1	1.5/2.7	1.3/2.1	4.0/4.5
Latitude	Average	2.2	3.3	4.3	5.1	5.6	5.8	5.9	5.6	4.9	3.7	2.2	1.8	4.2
	Min/Max	1.6/2.8	2.6/4.3	3.7/5.1	4.2/5.9	4.6/6.6	5.1/6.7	5.4/6.4	4.9/6.8	3.8/6.0	3.0/4.3	1.5/3.0	1.3/2.4	3.9/4.4
Latitude +15	Average	2.3	3.4	4.2	4.7	5.0	5.0	5.2	5.1	4.6	3.7	2.3	1.8	3.9
	Min/Max	1.6/3.0	2.6/4.4	3.6/5.1	3.8/5.5	4.1/5.9	4.4/5.7	4.7/5.6	4.5/6.1	3.6/5.8	2.9/4.4	1.5/3.1	1.3/2.6	3.7/4.2
90	Average	2.1	3.1	3.4	3.2	2.9	2.8	2.9	3.2	3.4	3.0	2.0	1.7	2.8
	Min/Max	1.5/2.8	2.3/4.1	2.8/4.4	2.6/3.7	2.5/3.4	2.5/3.0	2.7/3.1	2.8/3.8	2.6/4.3	2.3/3.6	1.2/2.8	1.1/2.4	2.6/3.0

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	1.9	3.1	4.6	6.2	7.6	8.3	8.4	7.3	5.5	3.6	1.9	1.5	5.0
	Min/Max	1.4/2.3	2.4/3.9	3.9/5.4	4.9/7.3	5.9/9.3	6.9/10.1	7.5/9.2	6.2/9.1	4.2/6.8	2.9/4.3	1.3/2.6	1.1/1.9	4.6/5.4
Latitude -15	Average	2.3	3.7	5.1	6.6	7.8	8.3	8.5	7.6	6.1	4.2	2.3	1.8	5.4
	Min/Max	1.6/3.0	2.7/4.7	4.3/6.2	5.2/7.9	6.0/9.5	6.9/10.2	7.6/9.4	6.5/9.6	4.6/7.6	3.3/5.1	1.5/3.2	1.3/2.5	4.9/5.7
Latitude	Average	2.4	3.8	5.2	6.6	7.6	8.0	8.2	7.5	6.1	4.4	2.5	1.9	5.3
	Min/Max	1.7/3.2	2.8/5.0	4.3/6.3	5.1/7.8	5.8/9.3	6.6/9.8	7.3/9.0	6.3/9.4	4.5/7.7	3.3/5.3	1.5/3.5	1.3/2.7	4.9/5.7
Latitude +15	Average	2.5	3.9	5.2	6.3	7.1	7.5	7.7	7.1	6.0	4.3	2.5	2.0	5.2
	Min/Max	1.7/3.4	2.9/5.1	4.3/6.3	4.8/7.5	5.4/8.7	6.1/9.2	6.8/8.5	6.0/9.0	4.4/7.6	3.3/5.3	1.5/3.6	1.3/2.8	4.7/5.5

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

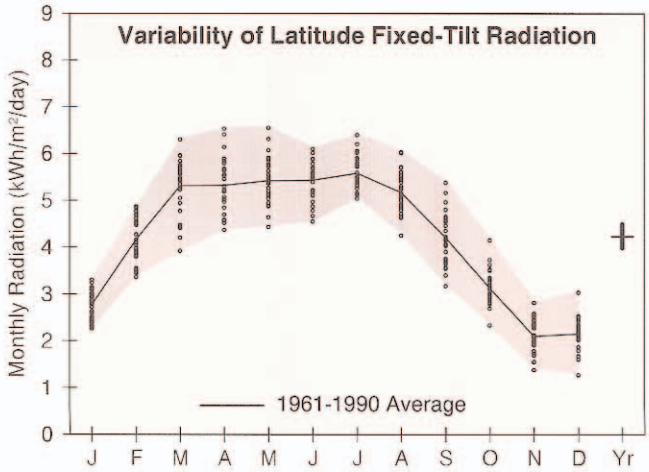
Tracker		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
2-Axis	Average	2.5	3.9	5.3	6.7	7.9	8.5	8.7	7.7	6.2	4.4	2.5	2.0	5.5
	Min/Max	1.7/3.4	2.9/5.1	4.4/6.3	5.2/7.9	6.1/9.6	7.1/10.4	7.7/9.5	6.5/9.6	4.6/7.8	3.4/5.3	1.5/3.6	1.3/2.9	5.0/5.9

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	0.8	1.5	2.2	3.0	3.7	4.1	4.2	3.6	2.9	2.1	1.1	0.7	2.5
	Min/Max	0.3/1.8	0.7/2.4	1.2/3.3	1.9/3.9	2.3/5.0	2.9/5.6	3.5/5.0	2.7/5.1	1.8/4.2	1.3/2.8	0.4/1.9	0.1/1.5	2.1/2.8
1-Axis, N-S Horiz Axis	Average	0.5	1.3	2.4	3.8	4.8	5.3	5.5	4.7	3.4	2.0	0.8	0.4	2.9
	Min/Max	0.2/1.2	0.6/2.0	1.4/3.5	2.4/4.9	2.9/6.6	3.8/7.3	4.5/6.6	3.5/6.7	2.0/4.8	1.2/2.8	0.3/1.4	0.1/1.0	2.5/3.3
1-Axis, N-S Tilt=Latitude	Average	0.8	1.8	2.9	4.0	4.7	5.0	5.3	4.8	3.9	2.7	1.2	0.7	3.2
	Min/Max	0.3/1.9	0.9/2.8	1.7/4.3	2.6/5.3	2.9/6.5	3.6/6.9	4.4/6.4	3.6/6.9	2.3/5.6	1.6/3.6	0.4/2.1	0.1/1.6	2.7/3.6
2-Axis	Average	0.9	1.8	2.9	4.1	5.0	5.5	5.7	5.0	3.9	2.7	1.3	0.8	3.3
	Min/Max	0.4/2.1	0.9/2.8	1.7/4.3	2.7/5.4	3.0/6.8	3.9/7.5	4.7/6.8	3.7/7.1	2.4/5.7	1.6/3.6	0.4/2.3	0.2/1.7	2.8/3.7

Average Climatic Conditions

Element	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
Temperature (°C)	-4.8	-4.2	0.7	7.2	13.3	18.3	21.3	20.3	16.2	10.2	4.1	-1.9	8.4
Daily Minimum Temp	-7.9	-7.8	-3.7	1.9	7.3	12.4	15.7	14.9	10.8	5.3	0.4	-4.8	3.7
Daily Maximum Temp	-1.8	-0.7	5.1	12.5	19.2	24.2	26.8	25.6	21.6	15.0	7.8	0.9	13.1
Record Minimum Temp	-25.0	-25.6	-23.3	-17.2	-5.6	-0.6	4.4	2.2	-2.8	-6.1	-25.6	-26.1	-26.1
Record Maximum Temp	17.2	16.7	26.7	30.0	33.9	36.1	35.6	37.2	35.0	28.3	24.4	17.8	37.2
HDD, Base 18.3°C	718	632	546	333	172	43	6	14	74	253	427	629	3847
CDD, Base 18.3°C	0	0	0	0	15	43	97	74	11	0	0	0	239
Relative Humidity (%)	78	75	71	65	64	68	71	75	76	74	75	79	73
Wind Speed (m/s)	5.6	5.1	5.4	5.3	4.5	4.2	4.0	3.9	4.2	4.7	5.3	5.4	4.8



Sault Ste. Marie, MI

WBAN NO. 14847

LATITUDE: 46.47° N
LONGITUDE: 84.37° W
ELEVATION: 221 meters
MEAN PRESSURE: 989 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	1.6	2.6	3.9	4.8	5.7	6.1	6.0	5.0	3.5	2.2	1.4	1.2	3.7
	Min/Max	1.4/1.7	2.3/2.9	3.1/4.5	4.1/5.7	4.7/6.7	5.1/6.7	5.5/6.8	4.2/5.7	2.9/4.3	2.0/2.7	1.1/1.6	0.9/1.5	3.5/3.9
Latitude -15	Average	2.5	3.8	5.1	5.4	5.8	5.9	6.0	5.4	4.2	3.0	1.9	1.9	4.3
	Min/Max	2.1/2.9	3.1/4.4	3.8/6.0	4.5/6.5	4.8/7.0	5.0/6.7	5.5/6.9	4.5/6.3	3.2/5.3	2.3/3.9	1.3/2.5	1.2/2.6	4.0/4.5
Latitude	Average	2.8	4.2	5.3	5.3	5.4	5.4	5.6	5.2	4.2	3.1	2.1	2.2	4.2
	Min/Max	2.3/3.3	3.4/4.9	3.9/6.3	4.4/6.5	4.4/6.6	4.6/6.1	5.0/6.4	4.3/6.0	3.2/5.4	2.3/4.2	1.4/2.8	1.3/3.0	4.0/4.5
Latitude +15	Average	2.9	4.3	5.3	5.0	4.8	4.7	4.9	4.7	4.0	3.1	2.1	2.3	4.0
	Min/Max	2.4/3.5	3.5/5.1	3.8/6.3	4.0/6.2	3.9/5.8	4.0/5.3	4.4/5.6	3.8/5.5	3.0/5.1	2.3/4.2	1.4/2.9	1.3/3.3	3.8/4.3
90	Average	2.9	4.1	4.7	3.7	3.0	2.8	3.0	3.2	3.0	2.6	2.0	2.2	3.1
	Min/Max	2.3/3.5	3.2/4.8	3.2/5.6	3.0/4.9	2.6/3.6	2.5/3.1	2.7/3.3	2.6/3.7	2.2/3.9	1.9/3.6	1.2/2.7	1.2/3.3	2.8/3.3

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	2.1	3.7	5.5	6.6	7.6	8.0	8.1	6.8	4.8	3.0	1.7	1.6	5.0
	Min/Max	1.8/2.5	2.9/4.3	4.1/6.6	5.4/8.0	5.8/9.6	6.3/9.4	7.1/9.6	5.3/8.1	3.5/6.2	2.3/4.0	1.2/2.3	1.0/2.2	4.6/5.3
Latitude -15	Average	2.9	4.6	6.4	7.1	7.9	8.1	8.3	7.2	5.3	3.6	2.2	2.2	5.5
	Min/Max	2.3/3.5	3.6/5.5	4.7/7.8	5.8/8.8	5.9/10.0	6.3/9.4	7.2/9.8	5.6/8.6	3.8/7.0	2.6/4.9	1.4/3.0	1.3/3.1	5.1/5.9
Latitude	Average	3.1	4.9	6.6	7.1	7.6	7.8	8.0	7.0	5.3	3.7	2.3	2.4	5.5
	Min/Max	2.5/3.8	3.8/5.8	4.7/8.0	5.7/8.8	5.7/9.7	6.1/9.1	6.9/9.5	5.4/8.5	3.8/7.1	2.6/5.1	1.5/3.3	1.3/3.4	5.1/5.9
Latitude +15	Average	3.2	5.0	6.6	6.8	7.2	7.3	7.5	6.7	5.2	3.7	2.4	2.5	5.3
	Min/Max	2.6/4.0	3.9/6.0	4.7/8.0	5.5/8.6	5.3/9.2	5.7/8.5	6.5/8.9	5.1/8.1	3.6/6.9	2.6/5.1	1.5/3.3	1.4/3.6	4.9/5.7

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	3.3	5.0	6.6	7.1	8.0	8.3	8.5	7.2	5.4	3.7	2.4	2.5	5.7
	Min/Max	2.6/4.0	3.9/6.0	4.8/8.0	5.8/8.8	5.9/10.1	6.5/9.7	7.4/10.0	5.6/8.7	3.8/7.1	2.6/5.1	1.5/3.4	1.4/3.7	5.2/6.1

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	1.4	2.3	2.8	3.2	3.8	4.0	4.1	3.4	2.4	1.7	1.0	1.1	2.6
	Min/Max	0.8/2.0	1.3/3.1	1.6/3.7	2.3/4.2	2.2/5.5	2.5/5.1	3.3/5.4	2.2/4.6	1.3/3.8	0.8/2.8	0.3/1.9	0.5/2.0	2.3/2.9
1-Axis, N-S Horiz Axis	Average	0.9	1.8	3.0	4.1	5.0	5.3	5.5	4.4	2.8	1.6	0.7	0.6	3.0
	Min/Max	0.5/1.3	1.1/2.5	1.7/4.0	3.0/5.3	2.8/7.3	3.4/6.8	4.4/7.1	2.8/5.9	1.6/4.4	0.8/2.6	0.2/1.4	0.3/1.1	2.6/3.3
1-Axis, N-S Tilt=Latitude	Average	1.5	2.7	3.7	4.4	5.0	5.0	5.3	4.6	3.3	2.2	1.2	1.1	3.3
	Min/Max	0.8/2.2	1.6/3.7	2.1/5.0	3.3/5.9	2.8/7.3	3.2/6.5	4.3/6.9	3.0/6.2	1.8/5.1	1.0/3.5	0.4/2.2	0.5/2.0	2.9/3.7
2-Axis	Average	1.6	2.7	3.7	4.5	5.3	5.5	5.7	4.7	3.3	2.2	1.2	1.2	3.5
	Min/Max	0.9/2.3	1.7/3.8	2.1/5.0	3.3/5.9	3.0/7.7	3.5/7.1	4.6/7.4	3.1/6.4	1.8/5.1	1.0/3.6	0.4/2.3	0.5/2.2	3.0/3.9

Average Climatic Conditions

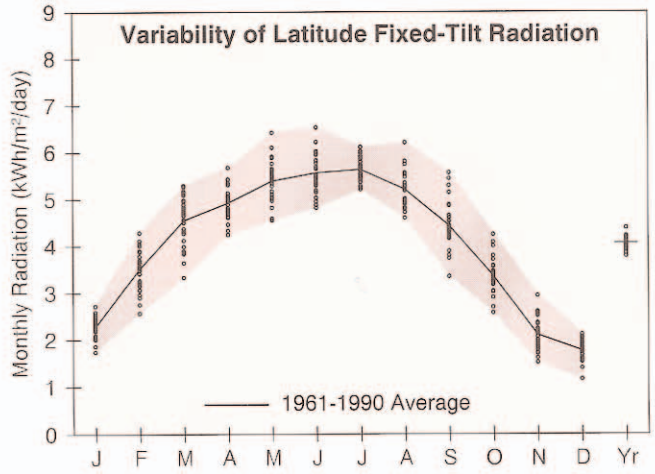
Element	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
Temperature (°C)	-10.6	-10.0	-4.4	3.4	10.3	14.4	17.7	17.0	12.8	7.4	0.6	-7.2	4.3
Daily Minimum Temp	-15.2	-15.1	-9.3	-2.0	3.6	7.5	10.7	10.7	6.8	2.3	-3.4	-11.2	-1.2
Daily Maximum Temp	-6.1	-4.9	0.4	8.9	17.0	21.4	24.6	23.2	18.8	12.4	4.4	-3.2	9.8
Record Minimum Temp	-37.8	-37.2	-31.1	-18.9	-7.8	-3.3	2.2	-1.7	-3.9	-8.9	-23.3	-31.7	-37.8
Record Maximum Temp	7.2	8.3	23.9	29.4	31.7	33.9	36.1	36.7	35.0	26.7	19.4	15.6	36.7
HDD, Base 18.3°C	897	793	706	447	254	124	51	71	167	339	533	792	5176
CDD, Base 18.3°C	0	0	0	0	4	8	31	30	0	0	0	0	73
Relative Humidity (%)	77	75	75	70	68	75	76	80	82	80	82	81	77
Wind Speed (m/s)	4.2	3.9	4.3	4.4	4.1	3.7	3.4	3.3	3.6	3.8	4.2	4.1	3.9

Traverse City, MI

WBAN NO. 14850

LATITUDE: 44.73° N
LONGITUDE: 85.58° W
ELEVATION: 192 meters
MEAN PRESSURE: 993 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	1.5	2.4	3.5	4.6	5.6	6.2	6.1	5.1	3.7	2.4	1.4	1.2	3.6
	Min/Max	1.3/1.7	1.9/2.8	2.8/4.0	4.1/5.1	4.8/6.6	5.4/7.2	5.7/6.6	4.6/5.9	3.1/4.4	2.0/2.9	1.2/1.7	0.9/1.4	3.5/3.8
Latitude -15	Average	2.1	3.3	4.4	5.0	5.8	6.1	6.1	5.4	4.4	3.2	2.0	1.6	4.1
	Min/Max	1.6/2.4	2.4/3.9	3.3/5.0	4.4/5.8	4.9/6.8	5.3/7.1	5.6/6.6	4.8/6.4	3.4/5.5	2.5/4.0	1.5/2.7	1.1/1.9	3.9/4.4
Latitude	Average	2.3	3.5	4.6	4.9	5.4	5.6	5.6	5.2	4.4	3.4	2.1	1.8	4.1
	Min/Max	1.7/2.7	2.6/4.3	3.3/5.3	4.2/5.7	4.6/6.4	4.8/6.5	5.2/6.1	4.6/6.2	3.3/5.6	2.6/4.2	1.5/2.9	1.1/2.1	3.8/4.4
Latitude +15	Average	2.4	3.6	4.5	4.6	4.8	4.8	4.9	4.7	4.2	3.3	2.1	1.8	3.8
	Min/Max	1.8/2.9	2.6/4.4	3.2/5.3	3.9/5.3	4.0/5.7	4.2/5.6	4.5/5.3	4.2/5.6	3.1/5.3	2.5/4.3	1.5/3.1	1.1/2.2	3.5/4.1
90	Average	2.2	3.3	3.8	3.2	2.9	2.8	2.9	3.1	3.1	2.8	1.9	1.7	2.8
	Min/Max	1.7/2.8	2.3/4.1	2.5/4.7	2.7/3.7	2.6/3.4	2.5/3.1	2.7/3.1	2.8/3.7	2.3/4.0	2.0/3.6	1.3/2.8	1.0/2.2	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	1.9	3.2	4.8	6.1	7.4	8.1	8.1	6.8	5.0	3.2	1.8	1.4	4.8
	Min/Max	1.4/2.2	2.3/3.9	3.4/5.6	5.2/6.9	5.9/9.0	6.8/9.9	7.4/8.9	5.9/8.4	3.7/6.3	2.5/4.2	1.3/2.5	0.9/1.7	4.4/5.2
Latitude -15	Average	2.3	3.8	5.4	6.5	7.6	8.1	8.2	7.1	5.6	3.8	2.2	1.8	5.2
	Min/Max	1.7/2.8	2.7/4.8	3.8/6.5	5.5/7.5	6.0/9.4	6.8/10.0	7.5/9.1	6.2/8.9	4.0/7.1	2.9/5.0	1.5/3.2	1.1/2.1	4.8/5.7
Latitude	Average	2.5	4.0	5.6	6.4	7.4	7.8	7.9	7.0	5.6	3.9	2.3	1.9	5.2
	Min/Max	1.8/3.1	2.8/5.0	3.8/6.7	5.4/7.5	5.8/9.1	6.5/9.6	7.2/8.8	6.0/8.7	3.9/7.2	3.0/5.2	1.6/3.4	1.2/2.3	4.7/5.7
Latitude +15	Average	2.6	4.1	5.5	6.2	7.0	7.3	7.4	6.6	5.4	3.9	2.4	2.0	5.0
	Min/Max	1.9/3.2	2.9/5.2	3.8/6.7	5.2/7.2	5.4/8.6	6.1/9.0	6.8/8.2	5.7/8.3	3.7/7.1	2.9/5.2	1.6/3.5	1.2/2.4	4.6/5.5

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	2.6	4.1	5.6	6.5	7.7	8.3	8.3	7.2	5.6	4.0	2.4	2.0	5.4
	Min/Max	1.9/3.2	2.9/5.2	3.8/6.7	5.6/7.6	6.1/9.5	7.0/10.3	7.7/9.3	6.2/8.9	4.0/7.2	3.0/5.3	1.6/3.5	1.2/2.5	4.9/5.9

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	0.9	1.6	2.3	2.9	3.5	3.9	3.9	3.2	2.5	1.9	1.0	0.7	2.4
	Min/Max	0.5/1.4	0.9/2.5	1.3/3.4	2.1/3.7	2.3/4.9	2.8/5.6	3.3/4.6	2.4/4.4	1.2/3.8	1.1/2.9	0.4/2.0	0.2/1.2	2.1/2.7
1-Axis, N-S Horiz Axis	Average	0.5	1.3	2.5	3.7	4.7	5.1	5.2	4.2	2.9	1.7	0.7	0.4	2.7
	Min/Max	0.3/0.9	0.8/2.1	1.4/3.7	2.7/4.6	2.9/6.3	3.6/7.3	4.3/6.1	3.2/5.8	1.5/4.3	1.0/2.8	0.3/1.5	0.1/0.7	2.4/3.2
1-Axis, N-S Tilt=Latitude	Average	0.9	1.9	3.0	4.0	4.6	4.9	5.0	4.3	3.4	2.3	1.1	0.7	3.0
	Min/Max	0.6/1.5	1.1/3.0	1.7/4.6	2.9/5.0	2.9/6.3	3.5/7.0	4.2/5.9	3.3/6.1	1.7/5.1	1.4/3.7	0.5/2.3	0.2/1.2	2.6/3.5
2-Axis	Average	1.0	1.9	3.0	4.0	4.9	5.3	5.4	4.5	3.4	2.4	1.2	0.7	3.2
	Min/Max	0.6/1.6	1.1/3.1	1.7/4.6	3.0/5.1	3.1/6.7	3.8/7.6	4.5/6.4	3.4/6.3	1.7/5.1	1.4/3.7	0.5/2.4	0.3/1.3	2.8/3.7

Average Climatic Conditions

Element	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
Temperature (°C)	-6.8	-6.8	-1.4	5.8	12.1	17.5	20.7	19.5	15.3	9.3	2.9	-3.7	7.1
Daily Minimum Temp	-10.4	-11.6	-6.6	-0.1	5.0	10.6	14.1	13.3	9.6	4.2	-0.8	-6.9	1.7
Daily Maximum Temp	-3.2	-2.1	3.6	11.8	19.1	24.4	27.4	25.7	20.9	14.4	6.6	-0.4	12.3
Record Minimum Temp	-28.9	-37.8	-31.7	-15.0	-6.1	-1.7	0.0	0.0	-2.2	-5.6	-15.0	-26.1	-37.8
Record Maximum Temp	11.7	14.4	25.6	32.2	33.3	37.2	37.2	36.7	33.3	31.1	23.3	17.2	37.2
HDD, Base 18.3°C	778	703	613	375	206	64	14	32	96	279	463	682	4305
CDD, Base 18.3°C	0	0	0	0	11	39	88	68	4	0	0	0	209
Relative Humidity (%)	77	74	71	66	66	69	68	73	76	74	76	79	72
Wind Speed (m/s)	4.6	4.2	4.2	4.3	3.8	3.7	3.4	3.4	3.6	3.8	4.2	4.3	3.9