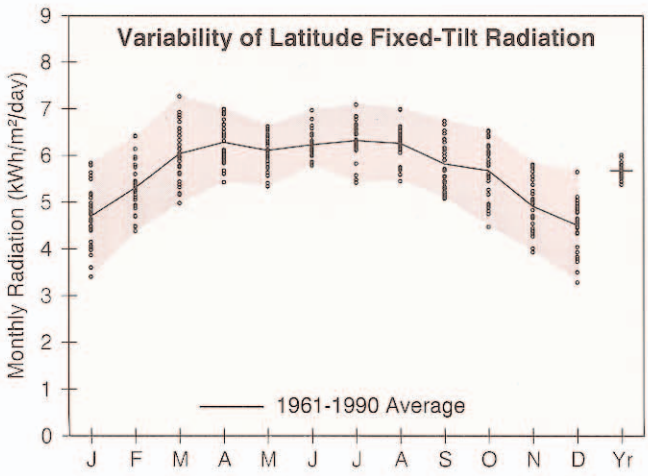
# Abilene, TX

## WBAN NO. 13962

LATITUDE: 32.43° N
LONGITUDE: 99.68° W
ELEVATION: 534 meters
MEAN PRESSURE: 953 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 | 3.1 | 3.9 | 5.1 | 6.1 | 6.5 | 7.0 | 7.0 | 6.3 | 5.2 | 4.4 | 3.3 | 2.9 | 5.1 |
| | Min/Max | 2.5/3.6 | 3.4/4.6 | 4.4/6.0 | 5.3/6.8 | 5.7/7.1 | 6.5/7.9 | 6.0/7.9 | 5.5/7.1 | 4.6/5.9 | 3.7/4.9 | 2.9/3.8 | 2.3/3.3 | 4.9/5.3 |
| Latitude -15 | Average | 4.1 | 4.8 | 5.8 | 6.4 | 6.5 | 6.8 | 6.8 | 6.5 | 5.7 | 5.3 | 4.3 | 3.9 | 5.6 |
| | Min/Max | 3.1/5.0 | 4.0/5.7 | 4.8/6.9 | 5.5/7.1 | 5.7/7.1 | 6.3/7.6 | 5.8/7.7 | 5.6/7.3 | 5.0/6.6 | 4.2/6.0 | 3.5/5.0 | 2.9/4.7 | 5.3/5.9 |
| Latitude | Average | 4.7 | 5.3 | 6.0 | 6.3 | 6.1 | 6.2 | 6.3 | 6.3 | 5.8 | 5.7 | 4.9 | 4.5 | 5.7 |
| | Min/Max | 3.4/5.8 | 4.4/6.4 | 5.0/7.3 | 5.4/7.0 | 5.3/6.6 | 5.8/7.0 | 5.4/7.1 | 5.4/7.0 | 5.1/6.7 | 4.5/6.5 | 3.9/5.8 | 3.3/5.7 | 5.4/6.0 |
| Latitude +15 | Average | 5.1 | 5.5 | 6.0 | 5.8 | 5.4 | 5.4 | 5.5 | 5.7 | 5.6 | 5.8 | 5.2 | 4.9 | 5.5 |
| | Min/Max | 3.5/6.3 | 4.5/6.7 | 4.9/7.2 | 5.1/6.5 | 4.8/5.8 | 5.0/6.0 | 4.7/6.1 | 5.0/6.3 | 4.9/6.5 | 4.5/6.7 | 4.1/6.2 | 3.5/6.2 | 5.2/5.8 |
| 90 | Average | 4.4 | 4.4 | 4.0 | 3.1 | 2.3 | 2.0 | 2.2 | 2.7 | 3.4 | 4.3 | 4.4 | 4.4 | 3.5 |
| | Min/Max | 3.0/5.7 | 3.5/5.4 | 3.3/4.9 | 2.8/3.4 | 2.2/2.4 | 2.0/2.1 | 2.0/2.3 | 2.5/2.9 | 2.9/4.0 | 3.3/5.1 | 3.4/5.4 | 3.0/5.7 | 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 | 4.5 | 5.6 | 7.1 | 8.2 | 8.6 | 9.2 | 9.3 | 8.5 | 7.1 | 6.2 | 4.8 | 4.2 | 7.0 |
| | Min/Max | 3.2/5.6 | 4.6/6.8 | 5.6/8.8 | 6.8/9.4 | 7.2/9.6 | 8.2/10.7 | 7.6/11.0 | 7.1/10.0 | 6.0/8.5 | 4.8/7.3 | 3.8/5.8 | 3.0/5.2 | 6.5/7.4 |
| Latitude -15 | Average | 5.2 | 6.2 | 7.6 | 8.5 | 8.6 | 9.1 | 9.3 | 8.7 | 7.5 | 6.9 | 5.5 | 4.9 | 7.3 |
| | Min/Max | 3.7/6.6 | 5.1/7.7 | 6.0/9.5 | 7.0/9.8 | 7.2/9.6 | 8.1/10.6 | 7.6/11.0 | 7.2/10.2 | 6.3/9.0 | 5.3/8.1 | 4.3/6.7 | 3.5/6.2 | 6.9/7.9 |
| Latitude | Average | 5.7 | 6.6 | 7.8 | 8.4 | 8.4 | 8.7 | 8.9 | 8.6 | 7.6 | 7.2 | 6.0 | 5.4 | 7.4 |
| | Min/Max | 3.9/7.2 | 5.3/8.2 | 6.1/9.8 | 7.0/9.7 | 7.0/9.3 | 7.8/10.2 | 7.3/10.6 | 7.1/10.0 | 6.4/9.1 | 5.4/8.5 | 4.6/7.3 | 3.8/6.9 | 6.9/8.0 |
| Latitude +15 | Average | 6.0 | 6.7 | 7.7 | 8.1 | 7.9 | 8.2 | 8.4 | 8.2 | 7.4 | 7.3 | 6.2 | 5.7 | 7.3 |
| | Min/Max | 4.0/7.6 | 5.4/8.4 | 6.0/9.8 | 6.7/9.3 | 6.5/8.8 | 7.3/9.5 | 6.8/9.9 | 6.7/9.6 | 6.2/8.9 | 5.4/8.6 | 4.8/7.6 | 3.9/7.4 | 6.8/7.9 |

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

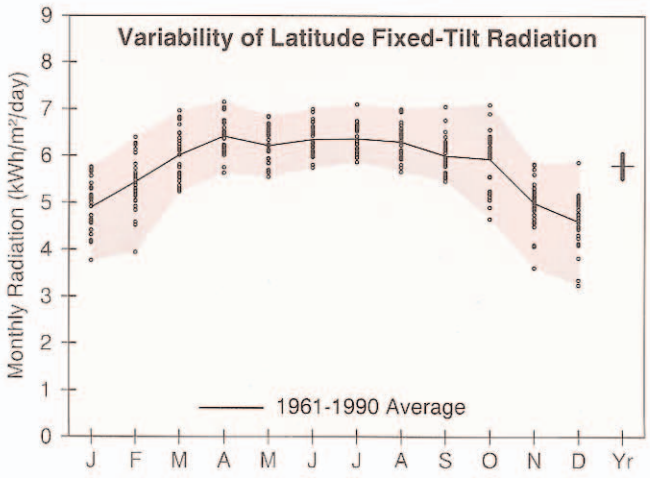
| Tracker | | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec | Year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2-Axis | Average | 6.0 | 6.7 | 7.8 | 8.5 | 8.7 | 9.3 | 9.4 | 8.8 | 7.6 | 7.3 | 6.3 | 5.8 | 7.7 |
| | Min/Max | 4.1/7.7 | 5.4/8.4 | 6.1/9.8 | 7.1/9.8 | 7.3/9.7 | 8.3/10.9 | 7.7/11.2 | 7.2/10.3 | 6.4/9.1 | 5.5/8.6 | 4.8/7.7 | 4.0/7.5 | 7.2/8.2 |

### 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 | 3.7 | 3.9 | 4.1 | 4.3 | 4.4 | 4.9 | 4.9 | 4.4 | 3.8 | 4.1 | 3.8 | 3.7 | 4.2 |
| | Min/Max | 2.0/5.2 | 2.7/5.3 | 2.7/5.9 | 3.0/5.4 | 3.1/5.3 | 3.8/6.3 | 3.5/6.6 | 3.2/5.7 | 2.8/5.0 | 2.6/5.2 | 2.5/5.0 | 2.2/5.2 | 3.7/4.6 |
| 1-Axis, N-S Horiz Axis | Average | 3.1 | 3.9 | 5.0 | 5.7 | 5.8 | 6.4 | 6.5 | 5.9 | 4.8 | 4.5 | 3.4 | 3.0 | 4.9 |
| | Min/Max | 1.7/4.4 | 2.8/5.4 | 3.2/7.2 | 4.1/7.3 | 4.2/7.1 | 5.1/8.3 | 4.6/8.8 | 4.2/7.8 | 3.5/6.5 | 2.9/5.7 | 2.3/4.5 | 1.8/4.2 | 4.3/5.4 |
| 1-Axis, N-S Tilt=Latitude | Average | 4.2 | 4.8 | 5.6 | 5.9 | 5.6 | 6.0 | 6.2 | 5.9 | 5.2 | 5.3 | 4.4 | 4.0 | 5.3 |
| | Min/Max | 2.3/5.8 | 3.5/6.6 | 3.6/8.0 | 4.2/7.5 | 4.0/6.9 | 4.7/7.8 | 4.4/8.4 | 4.2/7.8 | 3.8/7.0 | 3.3/6.7 | 2.9/5.9 | 2.4/5.7 | 4.6/5.9 |
| 2-Axis | Average | 4.5 | 4.9 | 5.6 | 6.0 | 5.9 | 6.5 | 6.6 | 6.1 | 5.2 | 5.4 | 4.6 | 4.4 | 5.5 |
| | Min/Max | 2.5/6.3 | 3.5/6.8 | 3.6/8.0 | 4.2/7.7 | 4.3/7.3 | 5.1/8.4 | 4.7/9.0 | 4.3/8.0 | 3.8/7.0 | 3.4/6.8 | 3.1/6.2 | 2.6/6.2 | 4.8/6.1 |

### Average Climatic Conditions

| Element | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec | Year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | 6.0 | 8.6 | 13.4 | 18.6 | 22.6 | 26.8 | 28.9 | 28.4 | 24.4 | 19.1 | 12.7 | 7.5 | 18.1 |
| Daily Minimum Temp | -0.7 | 1.7 | 6.3 | 11.6 | 16.2 | 20.5 | 22.6 | 22.1 | 18.5 | 12.7 | 6.3 | 1.1 | 11.6 |
| Daily Maximum Temp | 12.7 | 15.4 | 20.5 | 25.4 | 29.1 | 33.0 | 35.1 | 34.7 | 30.4 | 25.5 | 19.1 | 13.9 | 24.6 |
| Record Minimum Temp | -22.8 | -21.7 | -13.9 | -3.9 | 2.2 | 8.3 | 12.8 | 12.8 | 1.7 | -2.2 | -10.0 | -21.7 | -22.8 |
| Record Maximum Temp | 31.7 | 32.2 | 36.1 | 37.2 | 41.7 | 42.8 | 43.3 | 42.8 | 41.1 | 39.4 | 33.3 | 31.7 | 43.3 |
| HDD, Base 18.3°C | 382 | 274 | 166 | 52 | 4 | 0 | 0 | 0 | 3 | 42 | 176 | 336 | 1436 |
| CDD, Base 18.3°C | 0 | 0 | 13 | 59 | 136 | 253 | 327 | 313 | 187 | 66 | 8 | 0 | 1362 |
| Relative Humidity (%) | 60 | 60 | 55 | 55 | 60 | 59 | 53 | 55 | 62 | 61 | 62 | 61 | 59 |
| Wind Speed (m/s) | 5.0 | 5.2 | 5.9 | 5.8 | 5.7 | 5.1 | 4.6 | 4.2 | 4.4 | 4.7 | 5.0 | 4.8 | 5.0 |




# Amarillo, TX

## WBAN NO. 23047

LATITUDE: 35.23° N
LONGITUDE: 101.70° W
ELEVATION: 1098 meters
MEAN PRESSURE: 891 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 | 3.0 | 3.8 | 4.9 | 6.1 | 6.6 | 7.1 | 7.0 | 6.3 | 5.2 | 4.4 | 3.2 | 2.7 | 5.0 |
| | Min/Max | 2.5/3.3 | 3.0/4.3 | 4.4/5.6 | 5.4/6.7 | 5.9/7.3 | 6.4/7.9 | 6.4/7.8 | 5.7/7.0 | 4.9/6.0 | 3.7/5.0 | 2.6/3.6 | 2.1/3.1 | 4.8/5.2 |
| Latitude -15 | Average | 4.2 | 4.9 | 5.8 | 6.5 | 6.6 | 6.9 | 6.9 | 6.5 | 5.9 | 5.5 | 4.4 | 3.9 | 5.7 |
| | Min/Max | 3.3/4.9 | 3.7/5.7 | 5.1/6.6 | 5.7/7.3 | 5.9/7.3 | 6.2/7.7 | 6.3/7.7 | 5.9/7.3 | 5.4/6.9 | 4.4/6.5 | 3.3/5.1 | 2.9/4.9 | 5.4/5.9 |
| Latitude | Average | 4.9 | 5.4 | 6.0 | 6.4 | 6.2 | 6.3 | 6.4 | 6.3 | 6.0 | 5.9 | 5.0 | 4.6 | 5.8 |
| | Min/Max | 3.8/5.8 | 3.9/6.4 | 5.2/7.0 | 5.6/7.2 | 5.6/6.8 | 5.8/7.0 | 5.9/7.1 | 5.7/7.0 | 5.5/7.1 | 4.7/7.1 | 3.6/5.8 | 3.2/5.9 | 5.5/6.1 |
| Latitude +15 | Average | 5.3 | 5.7 | 5.9 | 6.0 | 5.5 | 5.5 | 5.5 | 5.7 | 5.8 | 6.0 | 5.3 | 5.0 | 5.6 |
| | Min/Max | 4.0/6.3 | 4.0/6.7 | 5.1/6.9 | 5.2/6.6 | 4.9/6.1 | 5.0/6.0 | 5.1/6.1 | 5.1/6.3 | 5.2/6.8 | 4.7/7.3 | 3.8/6.3 | 3.5/6.5 | 5.3/5.9 |
| 90 | Average | 4.8 | 4.7 | 4.2 | 3.4 | 2.6 | 2.2 | 2.4 | 2.9 | 3.7 | 4.7 | 4.7 | 4.6 | 3.7 |
| | Min/Max | 3.5/5.7 | 3.2/5.6 | 3.5/4.9 | 3.0/3.7 | 2.4/2.7 | 2.1/2.3 | 2.3/2.5 | 2.7/3.2 | 3.3/4.3 | 3.5/5.7 | 3.2/5.6 | 3.1/6.1 | 3.5/4.0 |

### 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 | 4.5 | 5.6 | 7.0 | 8.4 | 8.8 | 9.5 | 9.4 | 8.6 | 7.3 | 6.4 | 4.8 | 4.1 | 7.0 |
| | Min/Max | 3.4/5.3 | 3.9/6.6 | 5.9/8.2 | 7.2/9.5 | 7.7/9.9 | 8.2/10.9 | 8.3/10.9 | 7.4/9.9 | 6.6/8.8 | 5.0/7.8 | 3.5/5.6 | 2.9/5.3 | 6.6/7.4 |
| Latitude -15 | Average | 5.4 | 6.4 | 7.6 | 8.8 | 8.9 | 9.4 | 9.4 | 8.8 | 7.8 | 7.2 | 5.6 | 5.0 | 7.5 |
| | Min/Max | 4.1/6.5 | 4.4/7.7 | 6.4/9.0 | 7.5/10.0 | 7.7/9.9 | 8.1/10.8 | 8.3/10.8 | 7.6/10.2 | 7.0/9.5 | 5.6/8.9 | 4.0/6.7 | 3.4/6.5 | 7.0/7.9 |
| Latitude | Average | 6.0 | 6.8 | 7.8 | 8.7 | 8.6 | 9.0 | 9.0 | 8.7 | 7.9 | 7.6 | 6.1 | 5.5 | 7.6 |
| | Min/Max | 4.4/7.2 | 4.7/8.2 | 6.5/9.3 | 7.4/9.9 | 7.5/9.7 | 7.8/10.4 | 8.0/10.4 | 7.4/10.0 | 7.1/9.6 | 5.8/9.3 | 4.3/7.3 | 3.8/7.3 | 7.1/8.0 |
| Latitude +15 | Average | 6.3 | 6.9 | 7.7 | 8.4 | 8.1 | 8.4 | 8.4 | 8.2 | 7.7 | 7.7 | 6.4 | 5.9 | 7.5 |
| | Min/Max | 4.6/7.6 | 4.7/8.4 | 6.4/9.2 | 7.1/9.6 | 7.1/9.1 | 7.2/9.7 | 7.5/9.8 | 7.0/9.5 | 6.9/9.4 | 5.8/9.4 | 4.4/7.6 | 3.9/7.7 | 7.0/7.9 |

### 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 | 6.3 | 7.0 | 7.8 | 8.8 | 9.0 | 9.6 | 9.5 | 8.9 | 7.9 | 7.7 | 6.4 | 6.0 | 7.9 |
| | Min/Max | 4.6/7.6 | 4.7/8.4 | 6.5/9.3 | 7.5/10.0 | 7.8/10.1 | 8.3/11.1 | 8.4/11.0 | 7.6/10.2 | 7.1/9.6 | 5.8/9.4 | 4.4/7.7 | 4.0/7.9 | 7.4/8.3 |

### 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 | 4.0 | 4.1 | 4.2 | 4.6 | 4.6 | 5.2 | 5.0 | 4.6 | 4.2 | 4.6 | 4.0 | 3.9 | 4.4 |
| | Min/Max | 2.5/5.3 | 2.3/5.3 | 3.1/5.4 | 3.5/5.6 | 3.6/5.5 | 4.0/6.5 | 4.1/6.5 | 3.6/5.8 | 3.5/5.6 | 3.0/6.0 | 2.2/5.2 | 2.3/5.7 | 3.9/4.8 |
| 1-Axis, N-S Horiz Axis | Average | 3.3 | 4.0 | 5.0 | 6.1 | 6.2 | 6.8 | 6.7 | 6.1 | 5.2 | 4.9 | 3.5 | 3.0 | 5.1 |
| | Min/Max | 2.0/4.3 | 2.2/5.3 | 3.5/6.4 | 4.7/7.5 | 4.9/7.4 | 5.2/8.6 | 5.3/8.6 | 4.7/7.9 | 4.5/7.0 | 3.2/6.5 | 2.0/4.5 | 1.7/4.4 | 4.5/5.4 |
| 1-Axis, N-S Tilt=Latitude | Average | 4.5 | 5.0 | 5.7 | 6.3 | 6.0 | 6.4 | 6.3 | 6.1 | 5.7 | 5.9 | 4.7 | 4.3 | 5.6 |
| | Min/Max | 2.8/5.9 | 2.8/6.6 | 4.1/7.3 | 4.8/7.7 | 4.7/7.2 | 4.9/8.1 | 5.1/8.1 | 4.7/7.9 | 4.9/7.7 | 3.8/7.8 | 2.6/6.0 | 2.5/6.3 | 4.9/6.0 |
| 2-Axis | Average | 4.8 | 5.2 | 5.7 | 6.4 | 6.3 | 6.9 | 6.8 | 6.3 | 5.7 | 6.0 | 4.9 | 4.6 | 5.8 |
| | Min/Max | 3.0/6.4 | 2.9/6.8 | 4.1/7.4 | 4.9/7.9 | 5.0/7.6 | 5.3/8.8 | 5.4/8.7 | 4.8/8.1 | 4.9/7.7 | 3.9/7.9 | 2.8/6.3 | 2.7/6.8 | 5.1/6.2 |

### Average Climatic Conditions

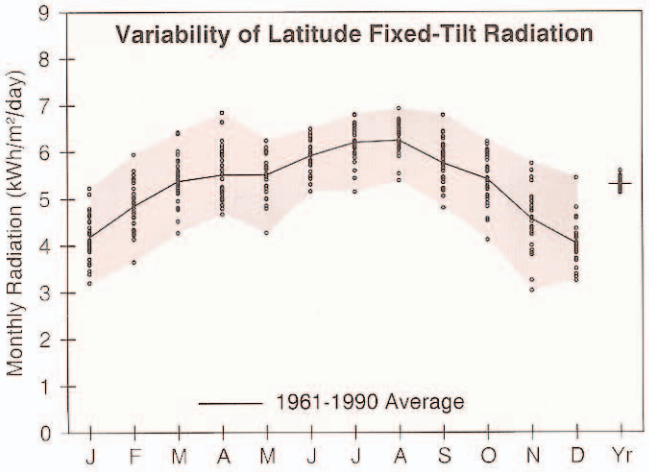
| Element | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec | Year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | 1.7 | 4.0 | 8.4 | 13.8 | 18.6 | 23.4 | 25.9 | 24.7 | 20.6 | 14.7 | 7.8 | 2.7 | 13.8 |
| Daily Minimum Temp | -6.0 | -3.6 | 0.4 | 5.6 | 10.9 | 15.9 | 18.6 | 17.7 | 13.6 | 6.9 | 0.2 | -4.6 | 6.3 |
| Daily Maximum Temp | 9.4 | 11.6 | 16.4 | 21.9 | 26.2 | 30.9 | 33.2 | 31.7 | 27.7 | 22.5 | 15.4 | 10.1 | 21.4 |
| Record Minimum Temp | -23.9 | -25.6 | -19.4 | -10.0 | -2.2 | 5.6 | 10.6 | 9.4 | -1.1 | -9.4 | -17.8 | -22.2 | -25.6 |
| Record Maximum Temp | 27.2 | 31.1 | 34.4 | 36.7 | 38.9 | 42.2 | 40.6 | 41.1 | 38.9 | 35.0 | 30.6 | 27.2 | 42.2 |
| HDD, Base 18.3°C | 515 | 401 | 308 | 148 | 49 | 3 | 0 | 0 | 14 | 126 | 317 | 484 | 2366 |
| CDD, Base 18.3°C | 0 | 0 | 0 | 11 | 57 | 155 | 234 | 198 | 83 | 14 | 0 | 0 | 752 |
| Relative Humidity (%) | 58 | 59 | 52 | 48 | 54 | 56 | 53 | 58 | 61 | 56 | 59 | 59 | 56 |
| Wind Speed (m/s) | 5.9 | 6.2 | 6.8 | 6.8 | 6.6 | 6.2 | 5.8 | 5.3 | 5.7 | 5.8 | 5.9 | 5.7 | 6.0 |

# Austin, TX

## WBAN NO. 13958

LATITUDE: 30.30° N
LONGITUDE: 97.70° W
ELEVATION: 189 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 | 3.0 | 3.8 | 4.7 | 5.4 | 5.9 | 6.6 | 6.8 | 6.3 | 5.2 | 4.4 | 3.3 | 2.8 | 4.9 |
| | Min/Max | 2.5/3.5 | 3.1/4.4 | 3.9/5.5 | 4.7/6.6 | 4.6/6.7 | 5.7/7.3 | 5.6/7.5 | 5.5/7.0 | 4.5/6.1 | 3.5/4.9 | 2.5/3.9 | 2.4/3.4 | 4.7/5.1 |
| Latitude -15 | Average | 3.7 | 4.4 | 5.2 | 5.6 | 5.8 | 6.4 | 6.7 | 6.5 | 5.7 | 5.0 | 4.1 | 3.5 | 5.2 |
| | Min/Max | 2.9/4.5 | 3.5/5.3 | 4.2/6.1 | 4.8/6.9 | 4.5/6.6 | 5.6/7.1 | 5.5/7.3 | 5.6/7.2 | 4.8/6.6 | 3.9/5.7 | 2.8/5.0 | 2.9/4.6 | 5.1/5.5 |
| Latitude | Average | 4.2 | 4.8 | 5.4 | 5.5 | 5.5 | 5.9 | 6.2 | 6.3 | 5.8 | 5.4 | 4.6 | 4.0 | 5.3 |
| | Min/Max | 3.2/5.2 | 3.7/5.9 | 4.3/6.4 | 4.7/6.8 | 4.3/6.2 | 5.2/6.5 | 5.2/6.8 | 5.4/6.9 | 4.8/6.8 | 4.1/6.2 | 3.0/5.8 | 3.2/5.4 | 5.1/5.6 |
| Latitude +15 | Average | 4.4 | 5.0 | 5.3 | 5.1 | 4.9 | 5.1 | 5.4 | 5.7 | 5.5 | 5.5 | 4.8 | 4.3 | 5.1 |
| | Min/Max | 3.3/5.7 | 3.7/6.2 | 4.1/6.3 | 4.3/6.4 | 3.8/5.5 | 4.5/5.6 | 4.6/5.9 | 4.9/6.3 | 4.6/6.6 | 4.1/6.3 | 3.1/6.2 | 3.4/6.0 | 4.9/5.4 |
| 90 | Average | 3.8 | 3.8 | 3.4 | 2.7 | 2.1 | 1.9 | 2.0 | 2.6 | 3.3 | 4.0 | 4.0 | 3.8 | 3.1 |
| | Min/Max | 2.7/4.9 | 2.7/4.8 | 2.7/4.1 | 2.3/3.1 | 1.9/2.2 | 1.7/1.9 | 1.9/2.1 | 2.3/2.7 | 2.8/3.8 | 2.9/4.6 | 2.4/5.2 | 2.8/5.4 | 2.9/3.3 |

### 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 | 4.1 | 5.1 | 6.2 | 6.9 | 7.4 | 8.4 | 8.8 | 8.3 | 6.9 | 6.0 | 4.6 | 3.8 | 6.4 |
| | Min/Max | 3.1/5.2 | 3.9/6.4 | 4.8/7.6 | 5.6/9.0 | 5.3/8.5 | 6.9/9.6 | 6.9/10.1 | 7.0/9.6 | 5.5/8.5 | 4.3/7.0 | 3.0/5.8 | 3.0/5.2 | 6.1/6.8 |
| Latitude -15 | Average | 4.6 | 5.6 | 6.6 | 7.1 | 7.3 | 8.3 | 8.7 | 8.5 | 7.3 | 6.5 | 5.1 | 4.4 | 6.7 |
| | Min/Max | 3.4/5.9 | 4.1/7.1 | 5.0/8.1 | 5.8/9.3 | 5.2/8.5 | 6.9/9.5 | 6.8/10.1 | 7.1/9.7 | 5.7/8.9 | 4.6/7.6 | 3.3/6.6 | 3.3/6.1 | 6.3/7.2 |
| Latitude | Average | 5.0 | 5.9 | 6.7 | 7.0 | 7.1 | 8.0 | 8.4 | 8.3 | 7.3 | 6.8 | 5.5 | 4.8 | 6.7 |
| | Min/Max | 3.6/6.5 | 4.3/7.5 | 5.1/8.3 | 5.7/9.2 | 5.1/8.2 | 6.6/9.1 | 6.6/9.7 | 7.0/9.6 | 5.7/9.1 | 4.8/7.9 | 3.4/7.2 | 3.6/6.7 | 6.4/7.2 |
| Latitude +15 | Average | 5.2 | 6.0 | 6.6 | 6.7 | 6.7 | 7.4 | 7.8 | 7.9 | 7.2 | 6.8 | 5.7 | 5.0 | 6.6 |
| | Min/Max | 3.7/6.8 | 4.3/7.7 | 5.0/8.3 | 5.4/8.8 | 4.7/7.7 | 6.1/8.4 | 6.2/9.0 | 6.7/9.1 | 5.6/8.9 | 4.8/8.0 | 3.5/7.5 | 3.8/7.2 | 6.3/7.1 |

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

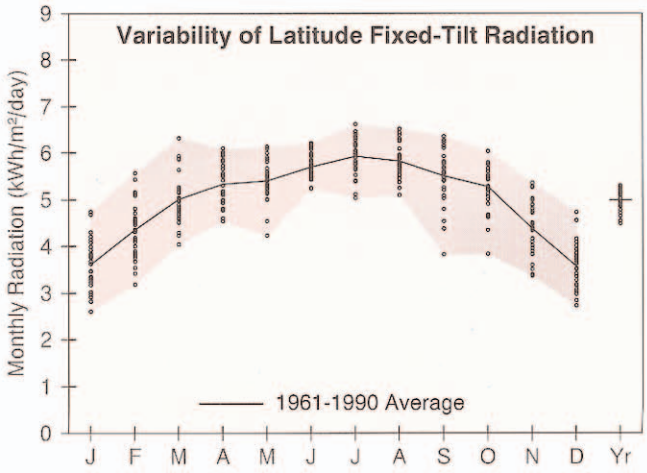
| Tracker | | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec | Year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2-Axis | Average | 5.2 | 6.0 | 6.7 | 7.1 | 7.4 | 8.5 | 8.9 | 8.5 | 7.4 | 6.9 | 5.7 | 5.1 | 7.0 |
| | Min/Max | 3.7/6.9 | 4.3/7.7 | 5.1/8.4 | 5.8/9.3 | 5.3/8.6 | 7.0/9.7 | 6.9/10.2 | 7.2/9.8 | 5.8/9.1 | 4.8/8.0 | 3.5/7.5 | 3.8/7.3 | 6.6/7.5 |

### 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 | 3.0 | 3.3 | 3.3 | 3.3 | 3.4 | 4.2 | 4.5 | 4.3 | 3.6 | 3.7 | 3.3 | 3.0 | 3.6 |
| | Min/Max | 1.6/4.4 | 1.9/4.7 | 2.0/4.6 | 2.2/5.1 | 1.4/4.4 | 3.0/5.3 | 3.0/5.8 | 3.2/5.5 | 2.4/5.0 | 2.1/4.7 | 1.4/4.9 | 1.9/4.9 | 3.2/4.0 |
| 1-Axis, N-S Horiz Axis | Average | 2.6 | 3.4 | 4.0 | 4.3 | 4.4 | 5.4 | 5.9 | 5.6 | 4.5 | 4.1 | 3.0 | 2.5 | 4.2 |
| | Min/Max | 1.4/3.9 | 2.0/4.9 | 2.4/5.6 | 2.9/6.7 | 1.9/5.7 | 3.9/6.9 | 3.9/7.7 | 4.1/7.2 | 2.9/6.4 | 2.2/5.3 | 1.4/4.5 | 1.5/4.1 | 3.7/4.7 |
| 1-Axis, N-S Tilt=Latitude | Average | 3.4 | 4.0 | 4.4 | 4.3 | 4.2 | 5.0 | 5.6 | 5.6 | 4.8 | 4.7 | 3.8 | 3.3 | 4.4 |
| | Min/Max | 1.8/5.0 | 2.4/5.8 | 2.7/6.2 | 3.0/6.9 | 1.8/5.5 | 3.6/6.4 | 3.7/7.2 | 4.1/7.2 | 3.1/6.8 | 2.6/6.1 | 1.7/5.7 | 2.0/5.4 | 4.0/5.1 |
| 2-Axis | Average | 3.6 | 4.1 | 4.4 | 4.4 | 4.5 | 5.5 | 6.0 | 5.7 | 4.9 | 4.8 | 4.0 | 3.6 | 4.6 |
| | Min/Max | 2.0/5.3 | 2.4/6.0 | 2.7/6.2 | 3.0/7.0 | 1.9/5.8 | 3.9/7.0 | 4.0/7.8 | 4.2/7.4 | 3.2/6.8 | 2.7/6.2 | 1.7/6.0 | 2.2/5.8 | 4.1/5.3 |

### Average Climatic Conditions

| Element | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec | Year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | 9.3 | 11.6 | 16.4 | 20.9 | 24.2 | 27.4 | 29.2 | 29.3 | 26.8 | 21.7 | 16.1 | 10.9 | 20.3 |
| Daily Minimum Temp | 3.7 | 5.6 | 10.6 | 15.4 | 19.2 | 21.9 | 23.3 | 23.3 | 21.0 | 15.6 | 9.9 | 5.1 | 14.6 |
| Daily Maximum Temp | 14.9 | 17.4 | 22.2 | 26.3 | 29.3 | 32.8 | 35.0 | 35.3 | 32.5 | 27.8 | 22.1 | 16.7 | 26.1 |
| Record Minimum Temp | -18.9 | -13.9 | -7.8 | 1.7 | 6.1 | 11.7 | 17.8 | 16.1 | 5.0 | 0.0 | -6.7 | -15.6 | -18.9 |
| Record Maximum Temp | 32.2 | 36.1 | 36.7 | 36.7 | 37.8 | 40.6 | 42.8 | 41.1 | 40.0 | 36.7 | 32.8 | 32.2 | 42.8 |
| HDD, Base 18.3°C | 286 | 196 | 97 | 16 | 0 | 0 | 0 | 0 | 0 | 9 | 97 | 237 | 938 |
| CDD, Base 18.3°C | 7 | 6 | 37 | 92 | 183 | 272 | 336 | 341 | 253 | 114 | 29 | 6 | 1676 |
| Relative Humidity (%) | 67 | 66 | 64 | 66 | 71 | 69 | 65 | 64 | 68 | 68 | 69 | 68 | 67 |
| Wind Speed (m/s) | 4.3 | 4.6 | 4.7 | 4.5 | 4.2 | 3.8 | 3.5 | 3.4 | 3.5 | 3.5 | 4.0 | 4.1 | 4.0 |




# Brownsville, TX

## WBAN NO. 12919

LATITUDE: 25.90° N
LONGITUDE: 97.43° W
ELEVATION: 6 meters
MEAN PRESSURE: 1015 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 | 2.9 | 3.7 | 4.6 | 5.3 | 5.8 | 6.4 | 6.5 | 6.0 | 5.2 | 4.5 | 3.4 | 2.7 | 4.8 |
| | Min/Max | 2.2/3.6 | 2.8/4.5 | 3.8/5.6 | 4.6/6.0 | 4.5/6.6 | 5.8/7.0 | 5.5/7.4 | 5.4/6.8 | 3.8/5.9 | 3.6/5.0 | 2.8/4.0 | 2.3/3.4 | 4.4/5.1 |
| Latitude -15 | Average | 3.2 | 4.0 | 4.8 | 5.4 | 5.7 | 6.2 | 6.4 | 6.0 | 5.4 | 4.9 | 3.9 | 3.1 | 4.9 |
| | Min/Max | 2.4/4.1 | 3.0/5.0 | 3.9/6.0 | 4.6/6.2 | 4.4/6.5 | 5.6/6.7 | 5.4/7.2 | 5.3/6.8 | 3.9/6.2 | 3.7/5.6 | 3.1/4.7 | 2.5/4.1 | 4.5/5.2 |
| Latitude | Average | 3.6 | 4.3 | 5.0 | 5.3 | 5.4 | 5.7 | 5.9 | 5.8 | 5.5 | 5.3 | 4.4 | 3.6 | 5.0 |
| | Min/Max | 2.6/4.7 | 3.2/5.6 | 4.0/6.3 | 4.5/6.1 | 4.2/6.1 | 5.2/6.2 | 5.0/6.6 | 5.1/6.5 | 3.8/6.4 | 3.8/6.0 | 3.4/5.4 | 2.7/4.7 | 4.5/5.3 |
| Latitude +15 | Average | 3.8 | 4.4 | 4.9 | 5.0 | 4.8 | 5.0 | 5.2 | 5.3 | 5.3 | 5.4 | 4.6 | 3.8 | 4.8 |
| | Min/Max | 2.7/5.1 | 3.2/5.8 | 3.9/6.3 | 4.2/5.7 | 3.8/5.4 | 4.6/5.4 | 4.5/5.8 | 4.7/5.9 | 3.6/6.2 | 3.8/6.2 | 3.4/5.7 | 2.8/5.1 | 4.2/5.1 |
| 90 | Average | 3.0 | 3.2 | 3.0 | 2.3 | 1.8 | 1.6 | 1.7 | 2.1 | 2.9 | 3.7 | 3.6 | 3.1 | 2.7 |
| | Min/Max | 2.1/4.2 | 2.3/4.3 | 2.4/3.8 | 2.1/2.6 | 1.7/1.9 | 1.5/1.8 | 1.5/1.9 | 1.9/2.3 | 2.1/3.3 | 2.5/4.2 | 2.5/4.6 | 2.2/4.4 | 2.3/2.9 |

### 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 | 3.6 | 4.7 | 5.7 | 6.5 | 7.1 | 8.0 | 8.3 | 7.7 | 6.8 | 6.0 | 4.6 | 3.5 | 6.1 |
| | Min/Max | 2.6/4.9 | 3.3/6.3 | 4.4/7.6 | 5.4/7.5 | 5.0/8.4 | 7.0/9.1 | 6.6/9.8 | 6.8/9.2 | 4.3/8.2 | 4.1/6.9 | 3.4/5.7 | 2.6/4.7 | 5.3/6.6 |
| Latitude -15 | Average | 3.9 | 5.0 | 6.0 | 6.6 | 7.1 | 7.9 | 8.2 | 7.8 | 6.9 | 6.3 | 4.9 | 3.8 | 6.2 |
| | Min/Max | 2.7/5.3 | 3.5/6.7 | 4.6/7.9 | 5.4/7.7 | 5.0/8.3 | 6.9/9.0 | 6.6/9.7 | 6.8/9.2 | 4.3/8.4 | 4.3/7.3 | 3.6/6.2 | 2.8/5.1 | 5.4/6.8 |
| Latitude | Average | 4.2 | 5.2 | 6.1 | 6.6 | 6.8 | 7.6 | 7.9 | 7.7 | 7.0 | 6.6 | 5.3 | 4.1 | 6.3 |
| | Min/Max | 2.9/5.8 | 3.6/7.1 | 4.7/8.1 | 5.4/7.6 | 4.8/8.1 | 6.6/8.6 | 6.3/9.4 | 6.7/9.1 | 4.3/8.5 | 4.3/7.7 | 3.8/6.7 | 3.0/5.7 | 5.4/6.9 |
| Latitude +15 | Average | 4.3 | 5.3 | 6.0 | 6.3 | 6.4 | 7.1 | 7.4 | 7.3 | 6.9 | 6.7 | 5.4 | 4.3 | 6.1 |
| | Min/Max | 3.0/6.0 | 3.6/7.2 | 4.6/8.0 | 5.2/7.3 | 4.5/7.6 | 6.2/8.0 | 5.9/8.7 | 6.4/8.6 | 4.2/8.4 | 4.3/7.7 | 3.8/7.0 | 3.1/6.0 | 5.2/6.7 |

### 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 | 4.4 | 5.3 | 6.1 | 6.6 | 7.1 | 8.1 | 8.4 | 7.8 | 7.0 | 6.7 | 5.5 | 4.4 | 6.5 |
| | Min/Max | 3.0/6.1 | 3.7/7.2 | 4.7/8.1 | 5.5/7.7 | 5.0/8.4 | 7.1/9.2 | 6.6/9.9 | 6.8/9.3 | 4.3/8.5 | 4.4/7.8 | 3.8/7.0 | 3.1/6.1 | 5.6/7.1 |

### 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 | 2.2 | 2.6 | 2.8 | 2.9 | 3.1 | 3.8 | 4.0 | 3.6 | 3.2 | 3.3 | 2.9 | 2.3 | 3.0 |
| | Min/Max | 1.3/3.5 | 1.4/4.2 | 1.9/4.2 | 1.9/3.8 | 1.6/4.2 | 3.0/4.7 | 2.6/5.5 | 2.8/4.9 | 1.0/4.6 | 1.2/4.2 | 1.0/4.1 | 1.2/3.7 | 2.4/3.6 |
| 1-Axis, N-S Horiz Axis | Average | 2.0 | 2.8 | 3.4 | 3.7 | 4.0 | 4.9 | 5.2 | 4.9 | 4.1 | 3.8 | 2.8 | 2.0 | 3.6 |
| | Min/Max | 1.2/3.3 | 1.5/4.4 | 2.2/5.2 | 2.5/5.0 | 2.1/5.6 | 3.8/6.2 | 3.4/7.2 | 3.8/6.7 | 1.4/6.0 | 1.4/4.8 | 1.0/4.0 | 1.0/3.2 | 2.9/4.4 |
| 1-Axis, N-S Tilt=Latitude | Average | 2.5 | 3.2 | 3.6 | 3.7 | 3.8 | 4.5 | 4.9 | 4.8 | 4.3 | 4.3 | 3.4 | 2.5 | 3.8 |
| | Min/Max | 1.5/4.0 | 1.8/5.2 | 2.4/5.6 | 2.5/5.0 | 2.0/5.3 | 3.6/5.8 | 3.2/6.8 | 3.7/6.6 | 1.4/6.3 | 1.6/5.4 | 1.3/4.8 | 1.3/4.0 | 2.9/4.5 |
| 2-Axis | Average | 2.6 | 3.3 | 3.6 | 3.8 | 4.0 | 4.9 | 5.3 | 4.9 | 4.3 | 4.4 | 3.5 | 2.7 | 4.0 |
| | Min/Max | 1.6/4.3 | 1.8/5.3 | 2.4/5.6 | 2.5/5.1 | 2.1/5.7 | 3.9/6.3 | 3.4/7.3 | 3.8/6.8 | 1.5/6.3 | 1.6/5.5 | 1.3/5.1 | 1.4/4.4 | 3.0/4.7 |

### Average Climatic Conditions

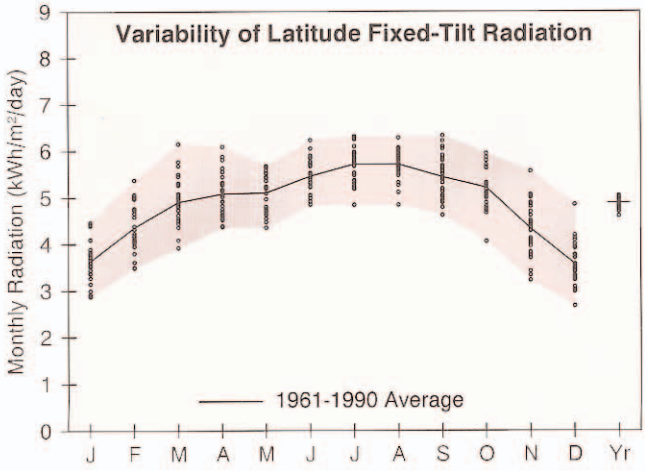
| Element | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec | Year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | 15.2 | 16.9 | 20.4 | 24.1 | 26.6 | 28.3 | 29.2 | 29.2 | 27.7 | 24.3 | 20.4 | 16.7 | 23.2 |
| Daily Minimum Temp | 9.9 | 11.4 | 15.1 | 19.2 | 22.2 | 23.8 | 24.3 | 24.1 | 22.9 | 18.9 | 15.0 | 11.3 | 18.2 |
| Daily Maximum Temp | 20.5 | 22.3 | 25.8 | 28.9 | 31.0 | 32.8 | 34.1 | 34.2 | 32.4 | 29.6 | 25.7 | 22.1 | 28.3 |
| Record Minimum Temp | -7.2 | -5.6 | 0.0 | 3.3 | 11.1 | 15.6 | 20.0 | 17.2 | 12.8 | 4.4 | 0.6 | -8.9 | -8.9 |
| Record Maximum Temp | 33.9 | 34.4 | 41.1 | 38.9 | 38.9 | 38.9 | 38.9 | 38.9 | 40.0 | 35.6 | 36.1 | 34.4 | 41.1 |
| HDD, Base 18.3°C | 129 | 75 | 23 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 28 | 98 | 353 |
| CDD, Base 18.3°C | 33 | 34 | 88 | 173 | 257 | 300 | 336 | 336 | 280 | 184 | 89 | 48 | 2160 |
| Relative Humidity (%) | 79 | 77 | 75 | 75 | 77 | 75 | 73 | 74 | 76 | 75 | 76 | 78 | 76 |
| Wind Speed (m/s) | 4.7 | 5.3 | 5.9 | 6.0 | 5.7 | 5.1 | 5.0 | 4.6 | 4.2 | 4.1 | 4.7 | 4.8 | 5.0 |

# Corpus Christi, TX

## WBAN NO. 12924

LATITUDE: 27.77° N
LONGITUDE: 97.50° W
ELEVATION: 13 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 | 4.4 | 5.0 | 5.5 | 6.1 | 6.3 | 5.8 | 5.0 | 4.3 | 3.3 | 2.7 | 4.6 |
| | Min/Max | 2.4/3.3 | 3.0/4.2 | 3.6/5.4 | 4.4/6.0 | 4.7/6.1 | 5.4/7.0 | 5.2/6.9 | 5.0/6.4 | 4.4/5.8 | 3.5/4.8 | 2.6/4.0 | 2.2/3.3 | 4.3/4.7 |
| Latitude -15 | Average | 3.2 | 4.0 | 4.7 | 5.2 | 5.4 | 5.9 | 6.1 | 5.9 | 5.3 | 4.8 | 3.9 | 3.1 | 4.8 |
| | Min/Max | 2.7/3.9 | 3.3/4.8 | 3.8/5.9 | 4.5/6.2 | 4.6/6.1 | 5.3/6.8 | 5.2/6.8 | 5.1/6.5 | 4.6/6.2 | 3.8/5.5 | 3.0/4.8 | 2.4/4.1 | 4.5/4.9 |
| Latitude | Average | 3.6 | 4.3 | 4.9 | 5.1 | 5.1 | 5.5 | 5.7 | 5.7 | 5.4 | 5.2 | 4.3 | 3.6 | 4.9 |
| | Min/Max | 2.9/4.5 | 3.5/5.4 | 3.9/6.2 | 4.4/6.1 | 4.3/5.7 | 4.8/6.2 | 4.8/6.3 | 4.8/6.3 | 4.6/6.3 | 4.1/5.9 | 3.2/5.6 | 2.7/4.8 | 4.6/5.0 |
| Latitude +15 | Average | 3.8 | 4.5 | 4.8 | 4.7 | 4.6 | 4.8 | 5.0 | 5.2 | 5.2 | 5.3 | 4.6 | 3.8 | 4.7 |
| | Min/Max | 2.9/4.8 | 3.5/5.6 | 3.8/6.1 | 4.1/5.7 | 3.9/5.0 | 4.3/5.4 | 4.3/5.5 | 4.4/5.7 | 4.4/6.1 | 4.1/6.1 | 3.3/6.0 | 2.8/5.3 | 4.4/4.8 |
| 90 | Average | 3.1 | 3.3 | 3.0 | 2.3 | 1.8 | 1.7 | 1.8 | 2.2 | 3.0 | 3.7 | 3.7 | 3.2 | 2.7 |
| | Min/Max | 2.3/4.0 | 2.5/4.2 | 2.5/3.8 | 2.1/2.7 | 1.7/1.9 | 1.6/1.7 | 1.7/1.8 | 2.0/2.3 | 2.5/3.4 | 2.8/4.3 | 2.6/4.9 | 2.2/4.6 | 2.6/2.9 |

### 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 | 3.6 | 4.7 | 5.6 | 6.3 | 6.8 | 7.7 | 8.0 | 7.6 | 6.7 | 5.9 | 4.5 | 3.5 | 5.9 |
| | Min/Max | 2.8/4.5 | 3.6/5.9 | 4.3/7.3 | 5.1/7.7 | 5.5/7.8 | 6.5/9.2 | 6.3/9.3 | 6.1/8.6 | 5.5/8.0 | 4.4/6.8 | 3.2/5.9 | 2.5/4.8 | 5.5/6.1 |
| Latitude -15 | Average | 3.9 | 5.0 | 5.9 | 6.4 | 6.8 | 7.6 | 8.0 | 7.7 | 6.9 | 6.3 | 4.9 | 3.8 | 6.1 |
| | Min/Max | 3.0/5.0 | 3.8/6.4 | 4.4/7.7 | 5.1/7.9 | 5.5/7.8 | 6.4/9.1 | 6.3/9.3 | 6.2/8.6 | 5.7/8.3 | 4.7/7.3 | 3.4/6.5 | 2.7/5.3 | 5.6/6.3 |
| Latitude | Average | 4.2 | 5.2 | 6.0 | 6.3 | 6.5 | 7.3 | 7.7 | 7.5 | 7.0 | 6.5 | 5.2 | 4.2 | 6.1 |
| | Min/Max | 3.2/5.4 | 3.9/6.8 | 4.5/7.9 | 5.1/7.9 | 5.3/7.6 | 6.2/8.7 | 6.1/8.9 | 6.0/8.5 | 5.7/8.4 | 4.8/7.7 | 3.6/7.0 | 2.9/5.9 | 5.7/6.4 |
| Latitude +15 | Average | 4.4 | 5.3 | 5.9 | 6.1 | 6.1 | 6.8 | 7.2 | 7.2 | 6.8 | 6.6 | 5.4 | 4.4 | 6.0 |
| | Min/Max | 3.2/5.7 | 4.0/6.9 | 4.4/7.8 | 4.8/7.6 | 5.0/7.1 | 5.8/8.1 | 5.7/8.3 | 5.7/8.1 | 5.6/8.2 | 4.8/7.8 | 3.7/7.3 | 3.0/6.3 | 5.6/6.3 |

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

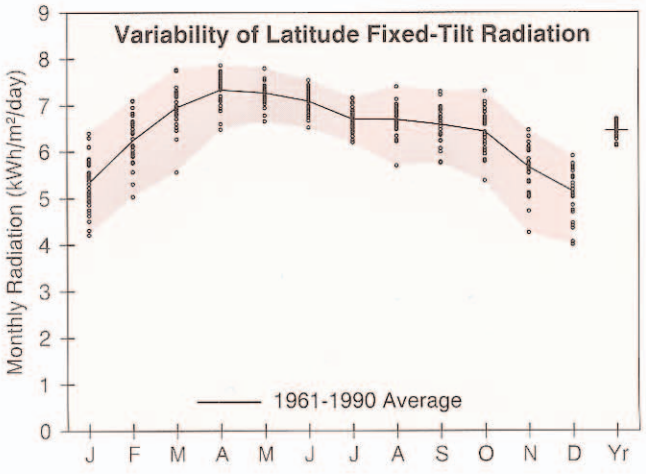
| Tracker | | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec | Year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2-Axis | Average | 4.4 | 5.3 | 6.0 | 6.4 | 6.8 | 7.7 | 8.1 | 7.7 | 7.0 | 6.6 | 5.5 | 4.4 | 6.3 |
| | Min/Max | 3.3/5.7 | 4.0/6.9 | 4.5/7.9 | 5.1/7.9 | 5.5/7.9 | 6.6/9.3 | 6.4/9.4 | 6.2/8.7 | 5.7/8.4 | 4.9/7.8 | 3.8/7.4 | 3.0/6.4 | 5.9/6.6 |

### 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 | 2.3 | 2.7 | 2.8 | 2.8 | 2.9 | 3.6 | 3.9 | 3.6 | 3.2 | 3.4 | 3.0 | 2.4 | 3.1 |
| | Min/Max | 1.3/3.4 | 1.5/3.9 | 1.6/4.3 | 1.8/3.9 | 1.9/3.9 | 2.7/5.0 | 2.5/5.1 | 2.5/4.4 | 2.2/4.4 | 2.0/4.3 | 1.6/4.6 | 1.4/4.1 | 2.6/3.3 |
| 1-Axis, N-S Horiz Axis | Average | 2.0 | 2.8 | 3.4 | 3.6 | 3.9 | 4.7 | 5.1 | 4.8 | 4.2 | 3.9 | 2.9 | 2.0 | 3.6 |
| | Min/Max | 1.2/3.1 | 1.6/4.1 | 1.9/5.2 | 2.3/5.1 | 2.5/5.2 | 3.5/6.5 | 3.3/6.7 | 3.3/5.8 | 2.9/5.7 | 2.3/4.9 | 1.5/4.4 | 1.1/3.5 | 3.1/3.9 |
| 1-Axis, N-S Tilt=Latitude | Average | 2.6 | 3.3 | 3.7 | 3.7 | 3.7 | 4.3 | 4.8 | 4.7 | 4.4 | 4.4 | 3.5 | 2.6 | 3.8 |
| | Min/Max | 1.5/3.9 | 1.8/4.8 | 2.1/5.7 | 2.3/5.2 | 2.4/4.9 | 3.2/6.1 | 3.1/6.3 | 3.2/5.7 | 3.0/6.0 | 2.6/5.6 | 1.9/5.4 | 1.5/4.4 | 3.3/4.1 |
| 2-Axis | Average | 2.8 | 3.4 | 3.7 | 3.7 | 3.9 | 4.7 | 5.1 | 4.9 | 4.4 | 4.5 | 3.7 | 2.8 | 4.0 |
| | Min/Max | 1.6/4.1 | 1.9/5.0 | 2.1/5.7 | 2.3/5.3 | 2.5/5.2 | 3.5/6.6 | 3.3/6.8 | 3.4/5.9 | 3.0/6.0 | 2.6/5.7 | 2.0/5.7 | 1.6/4.8 | 3.4/4.3 |

### Average Climatic Conditions

| Element | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec | Year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | 12.8 | 14.7 | 18.7 | 22.5 | 25.5 | 27.7 | 28.9 | 29.0 | 27.2 | 23.3 | 18.7 | 14.6 | 22.0 |
| Daily Minimum Temp | 7.4 | 8.9 | 12.9 | 17.3 | 20.8 | 23.0 | 23.8 | 23.9 | 22.4 | 17.7 | 13.1 | 9.1 | 16.7 |
| Daily Maximum Temp | 18.3 | 20.6 | 24.3 | 27.6 | 30.1 | 32.4 | 34.1 | 34.1 | 32.1 | 28.8 | 24.3 | 20.2 | 27.2 |
| Record Minimum Temp | -10.0 | -7.8 | -4.4 | 0.6 | 8.3 | 14.4 | 17.8 | 17.8 | 10.0 | 3.9 | -1.7 | -10.6 | -10.6 |
| Record Maximum Temp | 32.8 | 36.7 | 38.9 | 38.9 | 39.4 | 38.3 | 40.0 | 39.4 | 39.4 | 36.7 | 36.7 | 32.8 | 40.0 |
| HDD, Base 18.3°C | 188 | 118 | 56 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 53 | 145 | 564 |
| CDD, Base 18.3°C | 17 | 17 | 66 | 130 | 222 | 282 | 329 | 331 | 267 | 156 | 64 | 29 | 1911 |
| Relative Humidity (%) | 77 | 76 | 74 | 77 | 79 | 78 | 75 | 75 | 76 | 75 | 76 | 76 | 76 |
| Wind Speed (m/s) | 5.4 | 6.0 | 6.4 | 6.4 | 5.7 | 5.0 | 5.1 | 5.0 | 4.9 | 4.8 | 5.5 | 5.5 | 5.5 |




# El Paso, TX

## WBAN NO. 23044

LATITUDE: 31.80° N
LONGITUDE: 106.40° W
ELEVATION: 1194 meters
MEAN PRESSURE: 882 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 | 3.5 | 4.5 | 5.9 | 7.1 | 7.8 | 8.0 | 7.4 | 6.8 | 5.9 | 4.9 | 3.8 | 3.2 | 5.7 |
| | Min/Max | 2.9/4.0 | 3.8/5.1 | 4.9/6.5 | 6.3/7.6 | 7.2/8.5 | 7.3/8.7 | 6.8/7.9 | 5.8/7.5 | 5.2/6.4 | 4.2/5.5 | 3.1/4.2 | 2.7/3.6 | 5.5/5.9 |
| Latitude -15 | Average | 4.6 | 5.6 | 6.6 | 7.4 | 7.8 | 7.7 | 7.2 | 6.9 | 6.4 | 5.9 | 4.9 | 4.4 | 6.3 |
| | Min/Max | 3.7/5.4 | 4.6/6.3 | 5.4/7.3 | 6.6/8.0 | 7.1/8.3 | 7.1/8.3 | 6.7/7.7 | 5.9/7.7 | 5.7/7.1 | 5.0/6.7 | 3.8/5.6 | 3.5/4.9 | 6.0/6.5 |
| Latitude | Average | 5.3 | 6.2 | 7.0 | 7.3 | 7.3 | 7.1 | 6.7 | 6.7 | 6.6 | 6.4 | 5.7 | 5.1 | 6.5 |
| | Min/Max | 4.2/6.4 | 5.0/7.1 | 5.6/7.8 | 6.5/7.9 | 6.7/7.8 | 6.5/7.5 | 6.2/7.2 | 5.7/7.4 | 5.8/7.3 | 5.4/7.3 | 4.3/6.5 | 4.0/5.9 | 6.1/6.7 |
| Latitude +15 | Average | 5.8 | 6.5 | 6.9 | 6.8 | 6.4 | 6.0 | 5.8 | 6.1 | 6.3 | 6.6 | 6.1 | 5.6 | 6.2 |
| | Min/Max | 4.5/7.0 | 5.2/7.5 | 5.4/7.7 | 6.0/7.3 | 5.9/6.8 | 5.6/6.4 | 5.4/6.2 | 5.2/6.7 | 5.5/7.1 | 5.4/7.5 | 4.4/6.9 | 4.3/6.5 | 5.9/6.5 |
| 90 | Average | 5.1 | 5.2 | 4.6 | 3.5 | 2.5 | 2.1 | 2.2 | 2.8 | 3.8 | 4.9 | 5.2 | 5.1 | 3.9 |
| | Min/Max | 3.9/6.2 | 4.1/6.0 | 3.6/5.1 | 3.2/3.7 | 2.4/2.6 | 2.0/2.3 | 2.1/2.3 | 2.5/3.0 | 3.3/4.2 | 4.0/5.6 | 3.7/6.0 | 3.8/6.0 | 3.6/4.1 |

### 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 | 5.1 | 6.6 | 8.3 | 9.9 | 10.7 | 10.8 | 9.6 | 9.0 | 8.1 | 7.1 | 5.6 | 4.8 | 8.0 |
| | Min/Max | 4.0/6.2 | 5.3/7.8 | 6.4/9.6 | 8.5/10.7 | 9.6/11.9 | 9.5/11.9 | 8.6/10.5 | 7.5/10.2 | 7.0/9.1 | 5.9/8.3 | 4.1/6.5 | 3.6/5.6 | 7.6/8.3 |
| Latitude -15 | Average | 5.9 | 7.4 | 8.9 | 10.2 | 10.7 | 10.6 | 9.5 | 9.1 | 8.6 | 7.8 | 6.4 | 5.6 | 8.4 |
| | Min/Max | 4.7/7.2 | 5.9/8.7 | 6.9/10.4 | 8.8/11.1 | 9.6/12.0 | 9.4/11.8 | 8.6/10.4 | 7.7/10.4 | 7.4/9.7 | 6.5/9.2 | 4.6/7.5 | 4.2/6.6 | 8.0/8.8 |
| Latitude | Average | 6.5 | 7.9 | 9.2 | 10.1 | 10.4 | 10.2 | 9.2 | 9.0 | 8.7 | 8.2 | 7.0 | 6.3 | 8.6 |
| | Min/Max | 5.1/8.0 | 6.2/9.3 | 7.0/10.7 | 8.7/11.0 | 9.3/11.6 | 9.0/11.3 | 8.2/10.0 | 7.5/10.3 | 7.4/9.8 | 6.8/9.7 | 5.0/8.2 | 4.6/7.3 | 8.1/9.0 |
| Latitude +15 | Average | 6.9 | 8.1 | 9.1 | 9.7 | 9.8 | 9.5 | 8.6 | 8.5 | 8.5 | 8.3 | 7.3 | 6.6 | 8.4 |
| | Min/Max | 5.3/8.4 | 6.3/9.6 | 6.9/10.6 | 8.4/10.6 | 8.7/10.9 | 8.4/10.5 | 7.7/9.4 | 7.2/9.8 | 7.2/9.6 | 6.8/9.8 | 5.1/8.5 | 4.9/7.8 | 7.9/8.9 |

### 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 | 6.9 | 8.1 | 9.2 | 10.2 | 10.8 | 10.9 | 9.7 | 9.2 | 8.7 | 8.3 | 7.4 | 6.7 | 8.9 |
| | Min/Max | 5.3/8.6 | 6.3/9.6 | 7.0/10.7 | 8.8/11.1 | 9.7/12.1 | 9.6/12.1 | 8.7/10.6 | 7.7/10.5 | 7.4/9.8 | 6.8/9.8 | 5.2/8.6 | 4.9/8.0 | 8.3/9.3 |

### 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 | 4.5 | 4.9 | 5.2 | 5.6 | 6.1 | 6.3 | 5.2 | 4.8 | 4.7 | 4.9 | 4.7 | 4.4 | 5.1 |
| | Min/Max | 3.0/5.9 | 3.4/6.3 | 3.3/6.6 | 4.3/6.4 | 5.2/7.3 | 4.9/7.6 | 4.2/6.1 | 3.9/5.9 | 3.7/5.6 | 3.7/6.2 | 2.7/5.8 | 2.8/5.5 | 4.6/5.6 |
| 1-Axis, N-S Horiz Axis | Average | 3.8 | 5.0 | 6.3 | 7.6 | 8.2 | 8.2 | 6.8 | 6.4 | 5.9 | 5.4 | 4.2 | 3.6 | 6.0 |
| | Min/Max | 2.7/5.1 | 3.5/6.5 | 4.0/8.2 | 5.8/8.8 | 7.0/9.9 | 6.4/10.0 | 5.4/8.1 | 5.1/7.8 | 4.7/7.1 | 4.0/6.9 | 2.4/5.3 | 2.2/4.5 | 5.4/6.5 |
| 1-Axis, N-S Tilt=Latitude | Average | 5.0 | 6.1 | 7.0 | 7.7 | 7.9 | 7.7 | 6.4 | 6.3 | 6.3 | 6.3 | 5.4 | 4.8 | 6.4 |
| | Min/Max | 3.5/6.7 | 4.3/7.9 | 4.4/9.1 | 5.9/9.0 | 6.7/9.6 | 5.9/9.4 | 5.1/7.7 | 5.1/7.8 | 5.1/7.6 | 4.7/8.1 | 3.1/6.8 | 3.1/6.1 | 5.8/7.1 |
| 2-Axis | Average | 5.4 | 6.3 | 7.1 | 7.9 | 8.4 | 8.3 | 6.9 | 6.5 | 6.4 | 6.4 | 5.7 | 5.2 | 6.7 |
| | Min/Max | 3.7/7.1 | 4.4/8.1 | 4.5/9.1 | 6.0/9.1 | 7.1/10.1 | 6.4/10.2 | 5.5/8.2 | 5.3/8.0 | 5.1/7.7 | 4.8/8.2 | 3.2/7.2 | 3.3/6.6 | 6.0/7.3 |

### Average Climatic Conditions

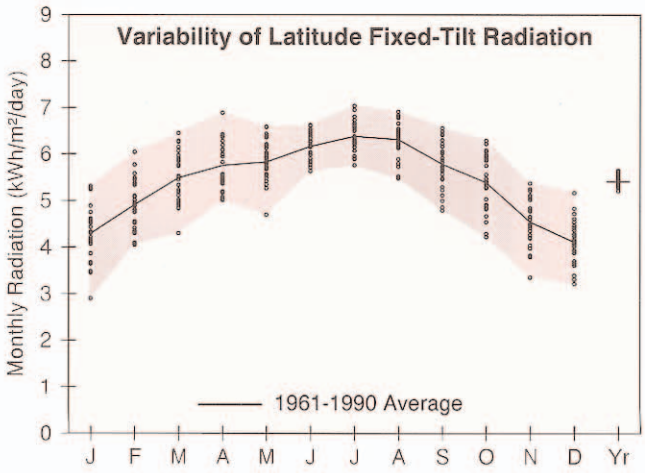
| Element | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec | Year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | 6.0 | 8.9 | 12.8 | 17.4 | 22.1 | 26.9 | 27.9 | 26.7 | 23.6 | 17.8 | 11.3 | 6.7 | 17.3 |
| Daily Minimum Temp | -1.4 | 1.1 | 4.6 | 8.9 | 13.6 | 17.9 | 20.2 | 19.2 | 16.4 | 9.8 | 3.6 | -0.7 | 9.4 |
| Daily Maximum Temp | 13.4 | 16.8 | 21.1 | 25.9 | 30.6 | 35.8 | 35.6 | 34.2 | 30.6 | 25.8 | 19.1 | 14.2 | 25.3 |
| Record Minimum Temp | -22.2 | -13.3 | -10.0 | -5.0 | -0.6 | 7.8 | 13.9 | 13.3 | 5.0 | -3.9 | -17.2 | -15.0 | -22.2 |
| Record Maximum Temp | 26.7 | 28.3 | 31.7 | 36.7 | 40.0 | 43.9 | 44.4 | 42.2 | 40.0 | 35.6 | 30.6 | 26.7 | 44.4 |
| HDD, Base 18.3°C | 382 | 263 | 176 | 61 | 4 | 0 | 0 | 0 | 0 | 49 | 210 | 360 | 1504 |
| CDD, Base 18.3°C | 0 | 0 | 6 | 34 | 121 | 257 | 298 | 260 | 157 | 32 | 0 | 0 | 1163 |
| Relative Humidity (%) | 51 | 42 | 32 | 27 | 27 | 30 | 44 | 48 | 51 | 47 | 47 | 52 | 41 |
| Wind Speed (m/s) | 3.2 | 3.5 | 4.4 | 4.4 | 4.1 | 3.5 | 3.2 | 3.0 | 2.9 | 2.8 | 3.1 | 3.0 | 3.4 |

# Fort Worth, TX

## WBAN NO. 03927

LATITUDE: 32.83° N
LONGITUDE: 97.05° W
ELEVATION: 164 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 | 2.9 | 3.7 | 4.7 | 5.6 | 6.2 | 6.9 | 7.0 | 6.4 | 5.2 | 4.2 | 3.1 | 2.7 | 4.9 |
| | Min/Max | 2.2/3.3 | 3.2/4.3 | 3.9/5.4 | 4.9/6.6 | 5.1/7.0 | 6.3/7.5 | 6.3/7.8 | 5.6/7.0 | 4.5/5.8 | 3.5/4.8 | 2.6/3.6 | 2.3/3.1 | 4.7/5.1 |
| Latitude -15 | Average | 3.8 | 4.5 | 5.3 | 5.9 | 6.2 | 6.7 | 6.9 | 6.5 | 5.7 | 5.0 | 4.0 | 3.5 | 5.3 |
| | Min/Max | 2.7/4.6 | 3.8/5.4 | 4.2/6.2 | 5.1/7.0 | 5.0/7.0 | 6.1/7.2 | 6.2/7.6 | 5.7/7.2 | 4.8/6.4 | 4.0/5.8 | 3.1/4.7 | 2.9/4.4 | 5.1/5.6 |
| Latitude | Average | 4.3 | 4.9 | 5.5 | 5.7 | 5.8 | 6.2 | 6.4 | 6.3 | 5.8 | 5.4 | 4.5 | 4.1 | 5.4 |
| | Min/Max | 2.9/5.3 | 4.1/6.0 | 4.3/6.4 | 5.0/6.9 | 4.7/6.6 | 5.6/6.6 | 5.8/7.0 | 5.5/6.9 | 4.8/6.6 | 4.2/6.3 | 3.3/5.4 | 3.2/5.2 | 5.2/5.7 |
| Latitude +15 | Average | 4.6 | 5.1 | 5.4 | 5.3 | 5.2 | 5.3 | 5.6 | 5.7 | 5.6 | 5.5 | 4.8 | 4.4 | 5.2 |
| | Min/Max | 3.0/5.7 | 4.1/6.3 | 4.2/6.4 | 4.7/6.4 | 4.2/5.8 | 4.9/5.7 | 5.1/6.1 | 5.0/6.3 | 4.6/6.3 | 4.2/6.4 | 3.4/5.7 | 3.4/5.7 | 5.0/5.4 |
| 90 | Average | 4.0 | 4.0 | 3.6 | 2.9 | 2.3 | 2.1 | 2.3 | 2.8 | 3.4 | 4.1 | 4.1 | 4.0 | 3.3 |
| | Min/Max | 2.5/5.1 | 3.2/5.1 | 2.8/4.3 | 2.6/3.4 | 2.1/2.5 | 2.0/2.2 | 2.1/2.3 | 2.5/3.0 | 2.8/3.9 | 3.1/4.8 | 2.8/4.9 | 2.9/5.2 | 3.1/3.5 |

### 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 | 4.0 | 5.1 | 6.3 | 7.3 | 7.9 | 8.9 | 9.2 | 8.4 | 6.9 | 5.8 | 4.4 | 3.8 | 6.5 |
| | Min/Max | 2.7/5.1 | 4.1/6.3 | 4.8/7.6 | 6.0/9.1 | 6.1/9.1 | 7.8/10.0 | 8.0/10.7 | 6.9/9.7 | 5.6/8.2 | 4.5/6.9 | 3.3/5.3 | 2.9/4.7 | 6.2/6.9 |
| Latitude -15 | Average | 4.7 | 5.7 | 6.7 | 7.5 | 7.9 | 8.8 | 9.1 | 8.6 | 7.3 | 6.4 | 5.1 | 4.4 | 6.9 |
| | Min/Max | 3.0/5.9 | 4.6/7.1 | 5.1/8.2 | 6.2/9.5 | 6.0/9.1 | 7.8/9.9 | 7.9/10.6 | 7.1/9.9 | 5.8/8.7 | 4.9/7.7 | 3.6/6.1 | 3.4/5.6 | 6.5/7.3 |
| Latitude | Average | 5.1 | 6.0 | 6.9 | 7.4 | 7.7 | 8.4 | 8.8 | 8.5 | 7.4 | 6.7 | 5.5 | 4.9 | 6.9 |
| | Min/Max | 3.2/6.5 | 4.8/7.6 | 5.2/8.4 | 6.1/9.4 | 5.8/8.9 | 7.4/9.5 | 7.7/10.3 | 6.9/9.7 | 5.8/8.8 | 5.1/8.0 | 3.8/6.6 | 3.7/6.2 | 6.6/7.4 |
| Latitude +15 | Average | 5.3 | 6.1 | 6.8 | 7.1 | 7.2 | 7.8 | 8.2 | 8.0 | 7.2 | 6.8 | 5.7 | 5.1 | 6.8 |
| | Min/Max | 3.3/6.9 | 4.8/7.8 | 5.1/8.4 | 5.8/9.0 | 5.5/8.3 | 6.9/8.9 | 7.2/9.6 | 6.6/9.3 | 5.7/8.6 | 5.1/8.1 | 3.9/6.9 | 3.8/6.6 | 6.4/7.2 |

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

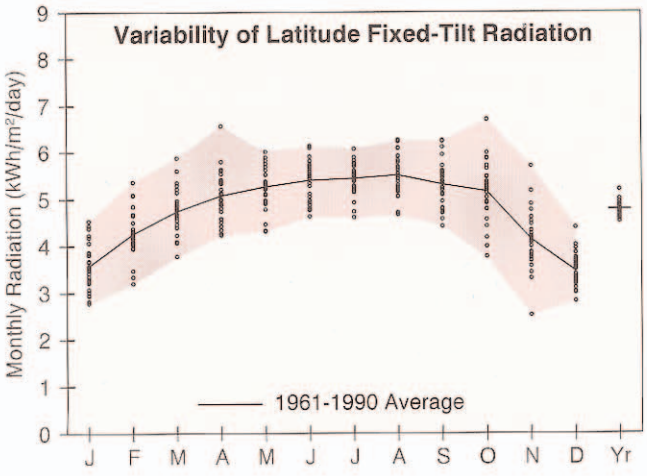
| Tracker | | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec | Year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2-Axis | Average | 5.4 | 6.2 | 6.9 | 7.5 | 8.0 | 9.0 | 9.3 | 8.6 | 7.4 | 6.8 | 5.7 | 5.2 | 7.2 |
| | Min/Max | 3.3/6.9 | 4.9/7.8 | 5.2/8.4 | 6.2/9.5 | 6.1/9.3 | 7.9/10.1 | 8.1/10.9 | 7.1/9.9 | 5.9/8.8 | 5.1/8.1 | 3.9/6.9 | 3.8/6.7 | 6.8/7.6 |

### 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 | 3.2 | 3.4 | 3.4 | 3.5 | 3.7 | 4.4 | 4.7 | 4.2 | 3.6 | 3.7 | 3.4 | 3.2 | 3.7 |
| | Min/Max | 1.5/4.5 | 2.3/4.8 | 2.1/4.7 | 2.4/5.2 | 2.0/4.9 | 3.5/5.4 | 3.5/6.2 | 2.9/5.4 | 2.4/4.8 | 2.3/4.9 | 1.8/4.4 | 1.9/4.5 | 3.3/4.1 |
| 1-Axis, N-S Horiz Axis | Average | 2.7 | 3.4 | 4.1 | 4.6 | 4.9 | 5.7 | 6.2 | 5.6 | 4.5 | 4.0 | 3.0 | 2.5 | 4.3 |
| | Min/Max | 1.2/3.8 | 2.3/4.7 | 2.5/5.7 | 3.2/6.8 | 2.7/6.5 | 4.5/7.2 | 4.7/8.3 | 3.8/7.4 | 3.0/6.1 | 2.5/5.3 | 1.7/4.0 | 1.5/3.5 | 3.8/4.7 |
| 1-Axis, N-S Tilt=Latitude | Average | 3.6 | 4.2 | 4.6 | 4.7 | 4.7 | 5.3 | 5.9 | 5.6 | 4.9 | 4.7 | 3.9 | 3.5 | 4.6 |
| | Min/Max | 1.6/5.1 | 2.8/5.9 | 2.8/6.4 | 3.3/7.0 | 2.6/6.3 | 4.2/6.7 | 4.4/7.8 | 3.8/7.3 | 3.3/6.6 | 2.9/6.3 | 2.1/5.2 | 2.1/4.9 | 4.1/5.1 |
| 2-Axis | Average | 3.9 | 4.3 | 4.6 | 4.8 | 5.0 | 5.8 | 6.3 | 5.8 | 4.9 | 4.8 | 4.1 | 3.8 | 4.8 |
| | Min/Max | 1.7/5.5 | 2.9/6.0 | 2.8/6.4 | 3.3/7.1 | 2.8/6.6 | 4.6/7.2 | 4.7/8.4 | 3.9/7.6 | 3.3/6.6 | 3.0/6.4 | 2.2/5.4 | 2.3/5.3 | 4.3/5.4 |

### Average Climatic Conditions

| Element | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec | Year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | 6.3 | 8.8 | 13.7 | 18.6 | 22.7 | 27.2 | 29.6 | 29.4 | 25.2 | 19.6 | 13.4 | 8.3 | 18.6 |
| Daily Minimum Temp | 0.4 | 2.7 | 7.6 | 12.6 | 17.0 | 21.1 | 23.4 | 23.1 | 19.4 | 13.2 | 7.4 | 2.4 | 12.6 |
| Daily Maximum Temp | 12.3 | 14.9 | 19.9 | 24.6 | 28.3 | 33.3 | 35.8 | 35.7 | 31.0 | 25.8 | 19.3 | 14.2 | 24.6 |
| Record Minimum Temp | -15.6 | -13.9 | -9.4 | -1.7 | 5.0 | 10.6 | 15.0 | 13.3 | 6.1 | -1.7 | -6.7 | -18.3 | -18.3 |
| Record Maximum Temp | 31.1 | 31.1 | 35.6 | 35.0 | 39.4 | 45.0 | 43.3 | 42.2 | 41.1 | 38.9 | 31.7 | 31.1 | 45.0 |
| HDD, Base 18.3°C | 372 | 269 | 159 | 42 | 0 | 0 | 0 | 0 | 0 | 28 | 153 | 314 | 1337 |
| CDD, Base 18.3°C | 0 | 3 | 16 | 50 | 137 | 267 | 349 | 343 | 207 | 66 | 6 | 3 | 1446 |
| Relative Humidity (%) | 68 | 66 | 64 | 65 | 70 | 66 | 60 | 59 | 67 | 66 | 67 | 68 | 65 |
| Wind Speed (m/s) | 5.1 | 5.4 | 5.8 | 5.7 | 5.2 | 4.6 | 4.3 | 4.0 | 4.2 | 4.4 | 4.9 | 4.9 | 4.9 |




# Houston, TX

## WBAN NO. 12960

LATITUDE: 29.98° N
LONGITUDE: 95.37° W
ELEVATION: 33 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 | 2.7 | 3.4 | 4.2 | 5.0 | 5.6 | 6.0 | 5.9 | 5.6 | 4.9 | 4.2 | 3.1 | 2.5 | 4.4 |
| | Min/Max | 2.2/3.2 | 2.8/4.1 | 3.6/5.1 | 4.3/6.4 | 4.6/6.4 | 5.1/6.9 | 5.0/6.7 | 4.8/6.3 | 4.2/5.7 | 3.3/5.2 | 2.2/3.9 | 2.2/2.9 | 4.2/4.8 |
| Latitude -15 | Average | 3.2 | 3.9 | 4.6 | 5.2 | 5.6 | 5.9 | 5.8 | 5.7 | 5.2 | 4.8 | 3.7 | 3.0 | 4.7 |
| | Min/Max | 2.6/3.9 | 3.1/4.8 | 3.8/5.6 | 4.3/6.7 | 4.6/6.4 | 5.0/6.7 | 4.9/6.6 | 4.8/6.5 | 4.4/6.1 | 3.6/6.1 | 2.4/4.9 | 2.6/3.8 | 4.5/5.1 |
| Latitude | Average | 3.6 | 4.3 | 4.7 | 5.1 | 5.3 | 5.4 | 5.4 | 5.5 | 5.3 | 5.2 | 4.1 | 3.5 | 4.8 |
| | Min/Max | 2.8/4.5 | 3.2/5.4 | 3.8/5.9 | 4.2/6.6 | 4.3/6.0 | 4.6/6.1 | 4.6/6.1 | 4.7/6.3 | 4.4/6.3 | 3.8/6.7 | 2.5/5.7 | 2.8/4.4 | 4.5/5.2 |
| Latitude +15 | Average | 3.8 | 4.4 | 4.6 | 4.7 | 4.7 | 4.7 | 4.8 | 5.0 | 5.1 | 5.2 | 4.3 | 3.7 | 4.6 |
| | Min/Max | 2.9/4.9 | 3.2/5.6 | 3.6/5.8 | 3.9/6.1 | 3.8/5.3 | 4.1/5.3 | 4.1/5.3 | 4.3/5.7 | 4.2/6.0 | 3.8/6.9 | 2.5/6.1 | 2.9/4.8 | 4.3/5.0 |
| 90 | Average | 3.1 | 3.3 | 3.0 | 2.5 | 2.0 | 1.8 | 1.9 | 2.4 | 3.0 | 3.8 | 3.5 | 3.2 | 2.8 |
| | Min/Max | 2.3/4.2 | 2.3/4.3 | 2.3/3.8 | 2.2/3.0 | 1.8/2.2 | 1.7/1.9 | 1.8/2.0 | 2.1/2.6 | 2.5/3.6 | 2.6/5.0 | 1.9/5.1 | 2.4/4.2 | 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 | 3.5 | 4.5 | 5.4 | 6.3 | 7.0 | 7.6 | 7.5 | 7.2 | 6.4 | 5.7 | 4.1 | 3.3 | 5.7 |
| | Min/Max | 2.7/4.5 | 3.3/5.8 | 4.1/7.0 | 4.9/8.8 | 5.3/8.3 | 6.1/9.0 | 6.0/8.9 | 5.9/8.4 | 5.3/7.7 | 3.9/7.4 | 2.4/5.8 | 2.7/4.2 | 5.3/6.3 |
| Latitude -15 | Average | 3.9 | 4.9 | 5.7 | 6.4 | 7.0 | 7.5 | 7.4 | 7.3 | 6.7 | 6.1 | 4.6 | 3.7 | 5.9 |
| | Min/Max | 3.0/5.1 | 3.5/6.3 | 4.3/7.4 | 5.0/9.0 | 5.3/8.3 | 6.0/8.9 | 6.0/8.8 | 6.0/8.5 | 5.5/8.0 | 4.2/8.1 | 2.6/6.6 | 3.0/4.8 | 5.6/6.5 |
| Latitude | Average | 4.2 | 5.1 | 5.8 | 6.4 | 6.8 | 7.2 | 7.2 | 7.2 | 6.7 | 6.4 | 4.9 | 4.0 | 6.0 |
| | Min/Max | 3.1/5.5 | 3.7/6.7 | 4.3/7.6 | 4.9/8.9 | 5.1/8.1 | 5.8/8.5 | 5.8/8.5 | 5.8/8.4 | 5.5/8.1 | 4.3/8.5 | 2.7/7.2 | 3.2/5.3 | 5.6/6.6 |
| Latitude +15 | Average | 4.3 | 5.2 | 5.7 | 6.1 | 6.4 | 6.7 | 6.7 | 6.8 | 6.6 | 6.4 | 5.1 | 4.2 | 5.9 |
| | Min/Max | 3.2/5.8 | 3.7/6.9 | 4.2/7.6 | 4.7/8.6 | 4.8/7.6 | 5.4/7.9 | 5.4/7.9 | 5.6/8.0 | 5.3/8.0 | 4.3/8.6 | 2.7/7.5 | 3.3/5.6 | 5.5/6.5 |

### 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 | 4.4 | 5.2 | 5.8 | 6.5 | 7.1 | 7.7 | 7.6 | 7.3 | 6.7 | 6.5 | 5.1 | 4.2 | 6.2 |
| | Min/Max | 3.2/5.8 | 3.7/6.9 | 4.3/7.6 | 5.0/9.0 | 5.3/8.4 | 6.1/9.1 | 6.1/8.9 | 6.0/8.6 | 5.5/8.1 | 4.3/8.6 | 2.7/7.5 | 3.3/5.7 | 5.8/6.8 |

### 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 | 2.3 | 2.7 | 2.7 | 2.8 | 3.1 | 3.4 | 3.3 | 3.2 | 3.1 | 3.4 | 2.8 | 2.3 | 2.9 |
| | Min/Max | 1.4/3.6 | 1.4/4.1 | 1.4/3.9 | 1.6/4.8 | 1.6/4.1 | 2.4/4.6 | 2.2/4.5 | 2.3/4.1 | 2.1/4.1 | 1.7/4.9 | 0.8/4.8 | 1.5/3.7 | 2.6/3.3 |
| 1-Axis, N-S Horiz Axis | Average | 2.0 | 2.8 | 3.2 | 3.7 | 4.1 | 4.5 | 4.4 | 4.3 | 3.9 | 3.7 | 2.6 | 1.9 | 3.4 |
| | Min/Max | 1.2/3.2 | 1.5/4.3 | 1.7/4.8 | 2.1/6.5 | 2.1/5.4 | 3.0/6.0 | 3.0/6.0 | 3.1/5.4 | 2.8/5.3 | 1.9/5.4 | 0.8/4.5 | 1.2/3.1 | 3.1/3.9 |
| 1-Axis, N-S Tilt=Latitude | Average | 2.6 | 3.3 | 3.6 | 3.7 | 3.9 | 4.2 | 4.1 | 4.3 | 4.1 | 4.3 | 3.3 | 2.5 | 3.7 |
| | Min/Max | 1.6/4.1 | 1.8/5.1 | 1.9/5.3 | 2.2/6.6 | 2.0/5.2 | 2.8/5.6 | 2.8/5.6 | 3.0/5.3 | 2.9/5.6 | 2.2/6.3 | 1.0/5.6 | 1.6/4.0 | 3.3/4.2 |
| 2-Axis | Average | 2.8 | 3.4 | 3.6 | 3.8 | 4.1 | 4.6 | 4.4 | 4.4 | 4.2 | 4.3 | 3.4 | 2.8 | 3.8 |
| | Min/Max | 1.7/4.3 | 1.8/5.2 | 1.9/5.3 | 2.2/6.7 | 2.1/5.5 | 3.1/6.1 | 3.0/6.0 | 3.1/5.5 | 3.0/5.6 | 2.2/6.3 | 1.0/5.9 | 1.8/4.4 | 3.4/4.3 |

### Average Climatic Conditions

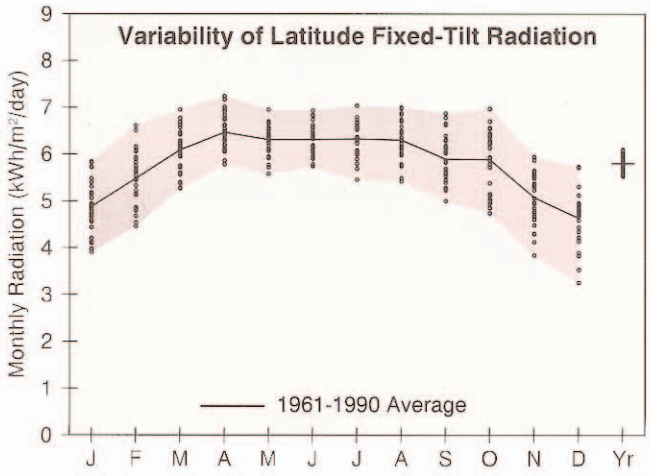
| Element | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec | Year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | 10.2 | 12.2 | 15.9 | 20.2 | 23.6 | 26.9 | 28.1 | 27.9 | 25.7 | 20.9 | 16.1 | 11.9 | 19.9 |
| Daily Minimum Temp | 4.3 | 5.9 | 10.0 | 14.5 | 18.0 | 21.4 | 22.4 | 22.2 | 19.9 | 14.2 | 9.8 | 5.7 | 14.1 |
| Daily Maximum Temp | 16.1 | 18.5 | 21.7 | 25.8 | 29.2 | 32.3 | 33.7 | 33.6 | 31.3 | 27.6 | 22.4 | 18.2 | 25.9 |
| Record Minimum Temp | -11.1 | -6.7 | -5.6 | -0.6 | 6.7 | 11.1 | 16.7 | 16.7 | 8.9 | 0.0 | -7.2 | -13.9 | -13.9 |
| Record Maximum Temp | 28.9 | 32.8 | 32.8 | 35.0 | 36.1 | 39.4 | 40.0 | 41.7 | 38.9 | 35.6 | 31.7 | 28.3 | 41.7 |
| HDD, Base 18.3°C | 260 | 179 | 104 | 20 | 0 | 0 | 0 | 0 | 0 | 17 | 101 | 208 | 888 |
| CDD, Base 18.3°C | 9 | 6 | 28 | 75 | 164 | 257 | 303 | 298 | 220 | 97 | 34 | 10 | 1500 |
| Relative Humidity (%) | 75 | 73 | 73 | 74 | 75 | 75 | 75 | 75 | 76 | 74 | 75 | 75 | 75 |
| Wind Speed (m/s) | 4.0 | 4.2 | 4.4 | 4.4 | 3.9 | 3.6 | 3.2 | 3.0 | 3.3 | 3.4 | 3.8 | 3.9 | 3.8 |

# Lubbock, TX

## WBAN NO. 23042

LATITUDE: 33.65° N
LONGITUDE: 101.82° W
ELEVATION: 988 meters
MEAN PRESSURE: 904 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 | 3.1 | 3.9 | 5.1 | 6.2 | 6.7 | 7.1 | 7.0 | 6.3 | 5.2 | 4.4 | 3.3 | 2.8 | 5.1 |
| | Min/Max | 2.7/3.5 | 3.4/4.6 | 4.5/5.7 | 5.6/6.9 | 5.9/7.4 | 6.4/7.8 | 6.0/7.8 | 5.5/7.0 | 4.5/6.0 | 3.7/5.1 | 2.8/3.7 | 2.2/3.3 | 4.9/5.3 |
| Latitude -15 | Average | 4.2 | 5.0 | 5.8 | 6.6 | 6.7 | 6.9 | 6.8 | 6.5 | 5.8 | 5.4 | 4.4 | 3.9 | 5.7 |
| | Min/Max | 3.5/5.0 | 4.1/5.9 | 5.1/6.6 | 5.9/7.3 | 5.9/7.4 | 6.2/7.6 | 5.9/7.6 | 5.7/7.3 | 4.9/6.7 | 4.4/6.4 | 3.5/5.1 | 2.9/4.8 | 5.4/5.9 |
| Latitude | Average | 4.9 | 5.5 | 6.1 | 6.5 | 6.3 | 6.3 | 6.3 | 6.3 | 5.9 | 5.9 | 5.1 | 4.6 | 5.8 |
| | Min/Max | 3.9/5.8 | 4.5/6.6 | 5.3/6.9 | 5.8/7.2 | 5.6/6.9 | 5.7/6.9 | 5.4/7.0 | 5.4/7.0 | 5.0/6.9 | 4.7/7.0 | 3.8/5.9 | 3.3/5.7 | 5.5/6.1 |
| Latitude +15 | Average | 5.3 | 5.7 | 6.0 | 6.0 | 5.6 | 5.4 | 5.5 | 5.7 | 5.7 | 6.0 | 5.4 | 5.0 | 5.6 |
| | Min/Max | 4.2/6.3 | 4.6/6.9 | 5.2/6.9 | 5.4/6.7 | 5.0/6.1 | 5.0/5.9 | 4.8/6.0 | 4.9/6.3 | 4.8/6.6 | 4.8/7.2 | 4.0/6.4 | 3.5/6.3 | 5.3/5.9 |
| 90 | Average | 4.7 | 4.6 | 4.1 | 3.3 | 2.5 | 2.1 | 2.2 | 2.8 | 3.5 | 4.6 | 4.7 | 4.6 | 3.6 |
| | Min/Max | 3.7/5.7 | 3.6/5.7 | 3.5/4.7 | 3.0/3.6 | 2.3/2.6 | 2.0/2.2 | 2.1/2.3 | 2.5/3.0 | 3.1/4.1 | 3.6/5.5 | 3.4/5.6 | 3.0/5.9 | 3.4/3.9 |

### 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 | 4.6 | 5.7 | 7.1 | 8.5 | 8.9 | 9.4 | 9.3 | 8.6 | 7.2 | 6.4 | 4.9 | 4.2 | 7.1 |
| | Min/Max | 3.6/5.5 | 4.6/7.0 | 6.0/8.4 | 7.3/9.7 | 7.7/10.0 | 8.0/10.6 | 7.7/10.9 | 7.1/10.0 | 5.8/8.7 | 5.1/7.8 | 3.7/5.9 | 2.9/5.2 | 6.7/7.4 |
| Latitude -15 | Average | 5.4 | 6.4 | 7.7 | 8.8 | 9.0 | 9.3 | 9.3 | 8.8 | 7.6 | 7.2 | 5.7 | 5.0 | 7.5 |
| | Min/Max | 4.2/6.6 | 5.1/8.0 | 6.4/9.1 | 7.6/10.1 | 7.8/10.1 | 7.9/10.5 | 7.7/10.9 | 7.2/10.2 | 6.2/9.3 | 5.6/8.8 | 4.3/6.9 | 3.4/6.3 | 7.1/7.9 |
| Latitude | Average | 5.9 | 6.8 | 7.9 | 8.7 | 8.7 | 8.9 | 8.9 | 8.6 | 7.7 | 7.5 | 6.2 | 5.6 | 7.6 |
| | Min/Max | 4.6/7.2 | 5.4/8.5 | 6.6/9.3 | 7.5/10.1 | 7.5/9.8 | 7.6/10.1 | 7.4/10.5 | 7.1/10.0 | 6.2/9.4 | 5.9/9.2 | 4.5/7.5 | 3.7/7.1 | 7.2/8.1 |
| Latitude +15 | Average | 6.2 | 7.0 | 7.8 | 8.4 | 8.2 | 8.3 | 8.4 | 8.2 | 7.5 | 7.6 | 6.5 | 5.9 | 7.5 |
| | Min/Max | 4.8/7.6 | 5.5/8.7 | 6.5/9.3 | 7.2/9.7 | 7.1/9.2 | 7.1/9.4 | 6.9/9.9 | 6.7/9.6 | 6.0/9.2 | 5.9/9.3 | 4.7/7.8 | 3.9/7.5 | 7.0/7.9 |

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

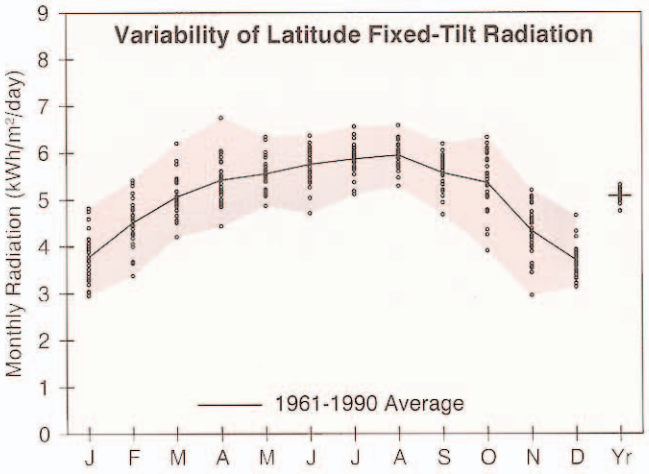
| Tracker | | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec | Year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2-Axis | Average | 6.3 | 7.0 | 7.9 | 8.8 | 9.1 | 9.5 | 9.4 | 8.8 | 7.7 | 7.6 | 6.5 | 6.0 | 7.9 |
| | Min/Max | 4.8/7.7 | 5.5/8.7 | 6.6/9.4 | 7.6/10.2 | 7.8/10.2 | 8.1/10.8 | 7.8/11.1 | 7.3/10.3 | 6.2/9.4 | 5.9/9.4 | 4.7/7.9 | 4.0/7.7 | 7.4/8.3 |

### 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 | 4.0 | 4.1 | 4.2 | 4.6 | 4.7 | 5.1 | 5.0 | 4.5 | 3.9 | 4.4 | 4.1 | 3.9 | 4.4 |
| | Min/Max | 2.6/5.3 | 2.9/5.7 | 3.0/5.4 | 3.6/5.7 | 3.6/5.7 | 3.8/6.2 | 3.5/6.5 | 3.3/5.8 | 2.8/5.4 | 3.1/5.9 | 2.5/5.3 | 2.2/5.5 | 3.9/4.8 |
| 1-Axis, N-S Horiz Axis | Average | 3.3 | 4.1 | 5.1 | 6.1 | 6.2 | 6.7 | 6.6 | 6.1 | 5.0 | 4.8 | 3.6 | 3.1 | 5.1 |
| | Min/Max | 2.1/4.4 | 2.8/5.7 | 3.6/6.5 | 4.7/7.6 | 4.8/7.6 | 5.0/8.1 | 4.7/8.7 | 4.3/7.8 | 3.5/7.0 | 3.3/6.5 | 2.2/4.7 | 1.7/4.3 | 4.5/5.5 |
| 1-Axis, N-S Tilt=Latitude | Average | 4.4 | 5.1 | 5.7 | 6.3 | 6.0 | 6.2 | 6.2 | 6.1 | 5.4 | 5.7 | 4.7 | 4.3 | 5.5 |
| | Min/Max | 2.9/5.9 | 3.5/7.0 | 4.0/7.4 | 4.8/7.9 | 4.7/7.3 | 4.6/7.6 | 4.4/8.3 | 4.3/7.8 | 3.8/7.5 | 4.0/7.7 | 2.9/6.1 | 2.4/6.0 | 4.9/6.0 |
| 2-Axis | Average | 4.8 | 5.2 | 5.7 | 6.4 | 6.4 | 6.8 | 6.7 | 6.2 | 5.4 | 5.8 | 5.0 | 4.6 | 5.7 |
| | Min/Max | 3.1/6.3 | 3.6/7.2 | 4.0/7.4 | 4.9/8.0 | 4.9/7.7 | 5.0/8.3 | 4.8/8.9 | 4.4/8.0 | 3.8/7.6 | 4.1/7.8 | 3.1/6.5 | 2.6/6.5 | 5.1/6.3 |

### Average Climatic Conditions

| Element | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec | Year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | 3.8 | 6.2 | 10.7 | 16.2 | 20.8 | 25.1 | 26.7 | 25.5 | 21.7 | 16.3 | 9.9 | 4.8 | 15.6 |
| Daily Minimum Temp | -4.1 | -1.9 | 2.4 | 8.2 | 13.2 | 17.9 | 20.0 | 19.0 | 15.2 | 8.9 | 2.5 | -2.7 | 8.2 |
| Daily Maximum Temp | 11.6 | 14.2 | 18.9 | 24.1 | 28.4 | 32.2 | 33.3 | 32.0 | 28.3 | 23.7 | 17.3 | 12.3 | 23.1 |
| Record Minimum Temp | -26.7 | -22.2 | -16.7 | -5.6 | -1.1 | 6.7 | 10.6 | 11.1 | 0.6 | -6.7 | -18.3 | -18.9 | -26.7 |
| Record Maximum Temp | 28.3 | 30.6 | 35.0 | 37.8 | 40.0 | 43.3 | 42.2 | 41.1 | 39.4 | 36.7 | 30.0 | 27.2 | 43.3 |
| HDD, Base 18.3°C | 451 | 341 | 243 | 89 | 14 | 0 | 0 | 0 | 9 | 86 | 253 | 420 | 1906 |
| CDD, Base 18.3°C | 0 | 0 | 6 | 24 | 90 | 203 | 258 | 222 | 111 | 23 | 0 | 0 | 938 |
| Relative Humidity (%) | 58 | 57 | 50 | 47 | 53 | 56 | 55 | 59 | 64 | 59 | 58 | 60 | 56 |
| Wind Speed (m/s) | 5.6 | 5.9 | 6.5 | 6.7 | 6.5 | 5.9 | 5.1 | 4.5 | 4.7 | 5.1 | 5.3 | 5.3 | 5.6 |




# Lufkin, TX

## WBAN NO. 93987

LATITUDE: 31.23° N
LONGITUDE: 94.75° W
ELEVATION: 96 meters
MEAN PRESSURE: 1006 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 | 2.7 | 3.5 | 4.5 | 5.3 | 5.9 | 6.4 | 6.4 | 6.0 | 5.1 | 4.3 | 3.1 | 2.5 | 4.6 |
| | Min/Max | 2.3/3.2 | 2.9/4.0 | 3.8/5.3 | 4.4/6.5 | 5.2/6.8 | 5.2/7.1 | 5.6/7.2 | 5.4/6.6 | 4.4/5.6 | 3.4/4.9 | 2.4/3.6 | 2.3/3.0 | 4.4/4.8 |
| Latitude -15 | Average | 3.4 | 4.1 | 4.9 | 5.5 | 5.9 | 6.2 | 6.3 | 6.2 | 5.5 | 5.0 | 3.9 | 3.2 | 5.0 |
| | Min/Max | 2.7/4.2 | 3.2/4.9 | 4.1/5.9 | 4.6/6.8 | 5.1/6.7 | 5.1/6.9 | 5.5/7.1 | 5.5/6.8 | 4.7/6.1 | 3.8/5.8 | 2.8/4.6 | 2.8/4.0 | 4.7/5.2 |
| Latitude | Average | 3.8 | 4.5 | 5.1 | 5.4 | 5.6 | 5.8 | 5.9 | 6.0 | 5.6 | 5.4 | 4.3 | 3.7 | 5.1 |
| | Min/Max | 3.0/4.8 | 3.4/5.4 | 4.2/6.2 | 4.4/6.8 | 4.9/6.3 | 4.7/6.4 | 5.1/6.6 | 5.3/6.6 | 4.7/6.2 | 3.9/6.3 | 3.0/5.2 | 3.1/4.7 | 4.8/5.3 |
| Latitude +15 | Average | 4.0 | 4.6 | 5.0 | 5.0 | 4.9 | 5.0 | 5.2 | 5.4 | 5.4 | 5.4 | 4.6 | 4.0 | 4.9 |
| | Min/Max | 3.1/5.2 | 3.4/5.6 | 4.1/6.1 | 4.1/6.3 | 4.4/5.6 | 4.1/5.5 | 4.5/5.7 | 4.8/6.0 | 4.5/6.0 | 3.9/6.4 | 3.0/5.5 | 3.3/5.1 | 4.5/5.1 |
| 90 | Average | 3.4 | 3.6 | 3.3 | 2.7 | 2.2 | 1.9 | 2.1 | 2.6 | 3.2 | 4.0 | 3.8 | 3.5 | 3.0 |
| | Min/Max | 2.5/4.5 | 2.5/4.4 | 2.6/4.0 | 2.3/3.2 | 2.1/2.3 | 1.8/2.0 | 1.9/2.2 | 2.4/2.8 | 2.7/3.6 | 2.8/4.7 | 2.3/4.7 | 2.8/4.6 | 2.8/3.1 |

### 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 | 3.6 | 4.7 | 5.8 | 6.8 | 7.4 | 8.1 | 8.1 | 7.8 | 6.6 | 5.8 | 4.2 | 3.4 | 6.0 |
| | Min/Max | 2.8/4.7 | 3.5/5.8 | 4.6/7.4 | 5.3/9.0 | 6.1/8.9 | 6.4/9.4 | 6.8/9.6 | 6.6/9.0 | 5.4/7.4 | 4.0/7.0 | 2.8/5.1 | 2.9/4.4 | 5.5/6.4 |
| Latitude -15 | Average | 4.1 | 5.2 | 6.2 | 6.9 | 7.4 | 8.0 | 8.0 | 7.9 | 7.0 | 6.4 | 4.8 | 4.0 | 6.3 |
| | Min/Max | 3.1/5.4 | 3.7/6.5 | 4.8/7.9 | 5.4/9.3 | 6.1/8.9 | 6.3/9.3 | 6.8/9.5 | 6.7/9.1 | 5.6/7.8 | 4.3/7.7 | 3.1/5.8 | 3.3/5.1 | 5.8/6.7 |
| Latitude | Average | 4.4 | 5.5 | 6.3 | 6.9 | 7.2 | 7.7 | 7.8 | 7.8 | 7.0 | 6.6 | 5.2 | 4.3 | 6.4 |
| | Min/Max | 3.3/5.9 | 3.9/6.8 | 4.9/8.1 | 5.3/9.2 | 5.9/8.7 | 6.0/8.9 | 6.5/9.1 | 6.6/9.0 | 5.6/7.9 | 4.4/8.1 | 3.3/6.3 | 3.6/5.6 | 5.8/6.8 |
| Latitude +15 | Average | 4.6 | 5.5 | 6.2 | 6.6 | 6.7 | 7.1 | 7.2 | 7.4 | 6.9 | 6.7 | 5.3 | 4.5 | 6.2 |
| | Min/Max | 3.4/6.2 | 3.9/7.0 | 4.8/8.0 | 5.1/8.9 | 5.5/8.1 | 5.6/8.3 | 6.1/8.6 | 6.2/8.6 | 5.5/7.7 | 4.4/8.2 | 3.3/6.6 | 3.7/6.0 | 5.7/6.7 |

### 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 | 4.6 | 5.6 | 6.3 | 7.0 | 7.5 | 8.2 | 8.2 | 8.0 | 7.1 | 6.7 | 5.4 | 4.6 | 6.6 |
| | Min/Max | 3.5/6.2 | 3.9/7.0 | 4.9/8.1 | 5.4/9.3 | 6.1/9.0 | 6.4/9.5 | 6.9/9.6 | 6.7/9.2 | 5.7/7.9 | 4.5/8.2 | 3.3/6.7 | 3.8/6.1 | 6.0/7.0 |

### 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 | 2.6 | 2.9 | 3.0 | 3.1 | 3.3 | 3.8 | 3.8 | 3.7 | 3.3 | 3.6 | 3.0 | 2.6 | 3.2 |
| | Min/Max | 1.5/3.9 | 1.6/4.1 | 1.9/4.3 | 2.0/5.0 | 2.2/4.6 | 2.5/4.9 | 2.8/5.1 | 2.7/4.8 | 2.2/4.1 | 1.7/4.7 | 1.3/4.2 | 1.9/3.9 | 2.8/3.6 |
| 1-Axis, N-S Horiz Axis | Average | 2.2 | 3.0 | 3.6 | 4.1 | 4.4 | 4.9 | 4.9 | 4.9 | 4.1 | 3.9 | 2.8 | 2.1 | 3.7 |
| | Min/Max | 1.3/3.3 | 1.6/4.2 | 2.2/5.3 | 2.6/6.7 | 2.8/6.1 | 3.3/6.4 | 3.6/6.7 | 3.5/6.3 | 2.7/5.1 | 1.8/5.2 | 1.2/3.8 | 1.5/3.2 | 3.2/4.3 |
| 1-Axis, N-S Tilt=Latitude | Average | 2.9 | 3.6 | 4.0 | 4.2 | 4.2 | 4.6 | 4.7 | 4.8 | 4.4 | 4.6 | 3.5 | 2.9 | 4.0 |
| | Min/Max | 1.7/4.4 | 2.0/5.1 | 2.5/5.9 | 2.7/6.8 | 2.7/5.9 | 3.1/6.0 | 3.4/6.3 | 3.5/6.3 | 2.9/5.5 | 2.2/6.0 | 1.5/4.8 | 2.1/4.2 | 3.4/4.6 |
| 2-Axis | Average | 3.1 | 3.7 | 4.0 | 4.2 | 4.4 | 5.0 | 5.0 | 5.0 | 4.4 | 4.6 | 3.7 | 3.1 | 4.2 |
| | Min/Max | 1.8/4.7 | 2.0/5.2 | 2.5/5.9 | 2.7/6.9 | 2.8/6.2 | 3.3/6.5 | 3.6/6.8 | 3.6/6.5 | 2.9/5.5 | 2.2/6.1 | 1.6/5.1 | 2.3/4.6 | 3.6/4.8 |

### Average Climatic Conditions

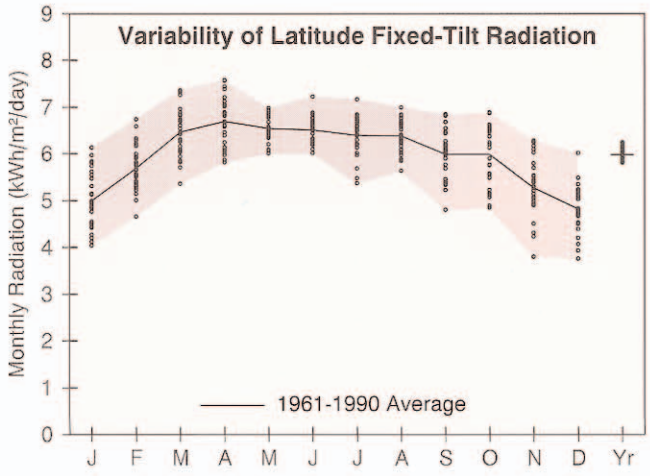
| Element | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec | Year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | 8.7 | 10.8 | 15.3 | 19.7 | 23.3 | 26.6 | 28.2 | 28.1 | 25.2 | 19.8 | 14.6 | 10.2 | 19.2 |
| Daily Minimum Temp | 2.7 | 4.3 | 8.6 | 13.2 | 17.3 | 20.8 | 22.3 | 21.8 | 19.2 | 12.7 | 8.0 | 3.8 | 12.9 |
| Daily Maximum Temp | 14.6 | 17.3 | 21.9 | 26.1 | 29.2 | 32.3 | 34.0 | 34.2 | 31.2 | 26.9 | 21.2 | 16.5 | 25.4 |
| Record Minimum Temp | -13.3 | -8.9 | -7.2 | -1.1 | 6.1 | 10.6 | 14.4 | 12.8 | 3.9 | -1.0 | -7.8 | -16.1 | -16.1 |
| Record Maximum Temp | 29.4 | 32.8 | 32.2 | 34.4 | 36.7 | 37.8 | 39.4 | 41.7 | 38.9 | 35.0 | 32.0 | 27.8 | 41.7 |
| HDD, Base 18.3°C | 306 | 215 | 119 | 30 | 0 | 0 | 0 | 0 | 0 | 27 | 129 | 259 | 1084 |
| CDD, Base 18.3°C | 6 | 5 | 24 | 70 | 153 | 247 | 307 | 302 | 207 | 73 | 17 | 6 | 1417 |
| Relative Humidity (%) | 74 | 71 | 70 | 72 | 75 | 75 | 74 | 73 | 75 | 73 | 75 | 76 | 74 |
| Wind Speed (m/s) | 3.2 | 3.4 | 3.6 | 3.5 | 3.1 | 2.6 | 2.4 | 2.4 | 2.6 | 2.6 | 3.0 | 3.3 | 3.0 |

# Midland, TX

## WBAN NO. 23023

LATITUDE: 31.93° N
LONGITUDE: 102.20° W
ELEVATION: 871 meters
MEAN PRESSURE: 916 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 | 3.3 | 4.2 | 5.5 | 6.5 | 7.0 | 7.3 | 7.0 | 6.5 | 5.4 | 4.6 | 3.6 | 3.0 | 5.3 |
| | Min/Max | 2.8/3.8 | 3.6/4.8 | 4.8/6.1 | 5.7/7.3 | 6.4/7.4 | 6.7/8.2 | 5.9/8.0 | 5.7/7.1 | 4.4/6.1 | 3.9/5.2 | 2.7/4.1 | 2.6/3.6 | 5.2/5.5 |
| Latitude -15 | Average | 4.3 | 5.1 | 6.2 | 6.8 | 7.0 | 7.1 | 6.9 | 6.6 | 5.9 | 5.5 | 4.6 | 4.1 | 5.8 |
| | Min/Max | 3.6/5.2 | 4.3/6.0 | 5.2/7.0 | 5.9/7.7 | 6.4/7.4 | 6.5/7.9 | 5.8/7.8 | 5.8/7.3 | 4.8/6.7 | 4.5/6.3 | 3.4/5.4 | 3.3/5.0 | 5.7/6.1 |
| Latitude | Average | 5.0 | 5.7 | 6.5 | 6.7 | 6.5 | 6.5 | 6.4 | 6.4 | 6.0 | 6.0 | 5.3 | 4.8 | 6.0 |
| | Min/Max | 4.0/6.1 | 4.7/6.7 | 5.4/7.4 | 5.8/7.6 | 6.0/7.0 | 6.0/7.2 | 5.4/7.2 | 5.6/7.0 | 4.8/6.8 | 4.8/6.9 | 3.8/6.3 | 3.8/6.0 | 5.8/6.2 |
| Latitude +15 | Average | 5.4 | 5.9 | 6.4 | 6.2 | 5.8 | 5.6 | 5.5 | 5.8 | 5.8 | 6.1 | 5.6 | 5.2 | 5.8 |
| | Min/Max | 4.3/6.7 | 4.8/7.1 | 5.2/7.3 | 5.4/7.1 | 5.3/6.2 | 5.2/6.2 | 4.7/6.2 | 5.1/6.3 | 4.6/6.6 | 4.9/7.1 | 4.0/6.8 | 4.0/6.6 | 5.6/6.1 |
| 90 | Average | 4.7 | 4.7 | 4.2 | 3.2 | 2.4 | 2.0 | 2.2 | 2.7 | 3.5 | 4.5 | 4.8 | 4.7 | 3.6 |
| | Min/Max | 3.7/6.0 | 3.8/5.7 | 3.5/4.9 | 2.9/3.6 | 2.3/2.5 | 2.0/2.1 | 2.0/2.2 | 2.6/2.9 | 2.8/4.0 | 3.6/5.3 | 3.3/5.8 | 3.5/6.1 | 3.4/3.9 |

### 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 | 4.8 | 6.0 | 7.7 | 8.8 | 9.3 | 9.6 | 9.4 | 8.7 | 7.4 | 6.6 | 5.2 | 4.5 | 7.3 |
| | Min/Max | 3.9/5.9 | 4.8/7.2 | 6.0/8.9 | 7.3/10.2 | 8.2/10.1 | 8.4/11.2 | 7.4/11.0 | 7.3/9.8 | 5.7/8.6 | 5.2/7.8 | 3.7/6.4 | 3.4/5.6 | 7.0/7.7 |
| Latitude -15 | Average | 5.6 | 6.7 | 8.2 | 9.1 | 9.3 | 9.5 | 9.3 | 8.8 | 7.8 | 7.3 | 6.0 | 5.3 | 7.7 |
| | Min/Max | 4.4/6.9 | 5.3/8.1 | 6.4/9.6 | 7.6/10.5 | 8.3/10.2 | 8.3/11.1 | 7.4/10.9 | 7.5/10.0 | 6.0/9.1 | 5.7/8.6 | 4.2/7.3 | 4.0/6.7 | 7.4/8.1 |
| Latitude | Average | 6.1 | 7.1 | 8.4 | 9.0 | 9.0 | 9.1 | 9.0 | 8.7 | 7.8 | 7.6 | 6.5 | 5.8 | 7.9 |
| | Min/Max | 4.8/7.7 | 5.6/8.7 | 6.5/9.9 | 7.5/10.4 | 8.0/9.9 | 8.0/10.6 | 7.1/10.5 | 7.3/9.9 | 6.1/9.3 | 5.9/9.1 | 4.6/8.0 | 4.3/7.5 | 7.5/8.3 |
| Latitude +15 | Average | 6.4 | 7.3 | 8.3 | 8.7 | 8.5 | 8.5 | 8.4 | 8.3 | 7.7 | 7.7 | 6.8 | 6.2 | 7.7 |
| | Min/Max | 4.9/8.1 | 5.7/8.9 | 6.4/9.8 | 7.2/10.1 | 7.5/9.3 | 7.4/9.9 | 6.6/9.8 | 7.0/9.4 | 5.9/9.1 | 6.0/9.2 | 4.7/8.3 | 4.6/7.9 | 7.4/8.2 |

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

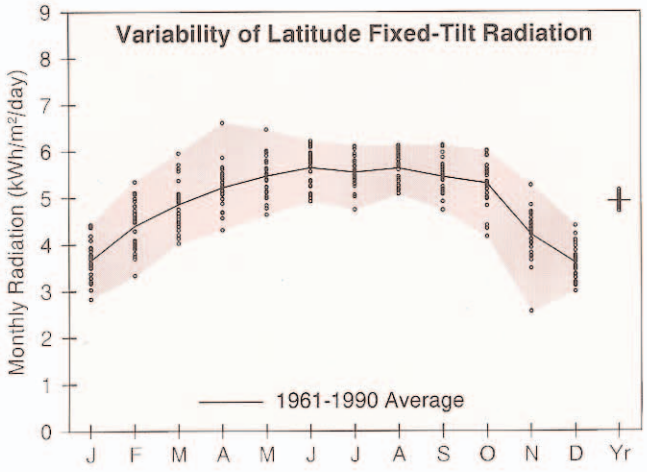
| Tracker | | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec | Year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2-Axis | Average | 6.5 | 7.3 | 8.4 | 9.1 | 9.4 | 9.7 | 9.5 | 8.9 | 7.9 | 7.7 | 6.8 | 6.3 | 8.1 |
| | Min/Max | 5.0/8.2 | 5.8/8.9 | 6.5/9.9 | 7.6/10.6 | 8.3/10.3 | 8.5/11.3 | 7.5/11.1 | 7.5/10.1 | 6.1/9.3 | 6.0/9.2 | 4.8/8.4 | 4.6/8.1 | 7.8/8.6 |

### 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 | 4.0 | 4.3 | 4.6 | 4.7 | 4.9 | 5.2 | 4.9 | 4.5 | 4.0 | 4.5 | 4.2 | 4.1 | 4.5 |
| | Min/Max | 2.7/5.6 | 3.0/5.6 | 3.0/5.9 | 3.6/6.0 | 3.9/5.7 | 4.2/6.8 | 3.2/6.4 | 3.3/5.6 | 2.9/5.2 | 3.1/5.8 | 2.8/5.6 | 2.6/5.7 | 4.2/4.9 |
| 1-Axis, N-S Horiz Axis | Average | 3.5 | 4.4 | 5.5 | 6.3 | 6.6 | 6.8 | 6.5 | 6.0 | 5.1 | 4.9 | 3.9 | 3.3 | 5.2 |
| | Min/Max | 2.3/4.8 | 3.0/5.7 | 3.5/7.2 | 4.7/8.1 | 5.2/7.7 | 5.3/8.9 | 4.2/8.6 | 4.5/7.6 | 3.6/6.8 | 3.3/6.5 | 2.5/5.1 | 2.1/4.6 | 4.9/5.7 |
| 1-Axis, N-S Tilt=Latitude | Average | 4.6 | 5.3 | 6.2 | 6.5 | 6.3 | 6.4 | 6.2 | 6.0 | 5.5 | 5.8 | 4.9 | 4.5 | 5.7 |
| | Min/Max | 3.1/6.3 | 3.7/7.0 | 3.9/8.0 | 4.8/8.2 | 5.0/7.4 | 5.0/8.3 | 4.0/8.1 | 4.5/7.5 | 3.9/7.3 | 4.0/7.6 | 3.2/6.6 | 2.8/6.3 | 5.2/6.2 |
| 2-Axis | Average | 4.9 | 5.5 | 6.2 | 6.6 | 6.7 | 6.9 | 6.6 | 6.2 | 5.5 | 5.9 | 5.2 | 4.8 | 5.9 |
| | Min/Max | 3.3/6.8 | 3.8/7.2 | 3.9/8.0 | 4.9/8.4 | 5.3/7.8 | 5.4/9.0 | 4.3/8.7 | 4.6/7.8 | 3.9/7.3 | 4.0/7.7 | 3.4/6.9 | 3.1/6.8 | 5.4/6.5 |

### Average Climatic Conditions

| Element | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec | Year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | 5.8 | 8.4 | 13.2 | 18.1 | 22.7 | 26.4 | 27.8 | 27.1 | 22.9 | 17.8 | 11.4 | 7.0 | 17.4 |
| Daily Minimum Temp | -1.9 | 0.3 | 4.6 | 9.7 | 14.5 | 18.7 | 20.3 | 19.7 | 16.2 | 10.3 | 3.8 | -0.7 | 9.6 |
| Daily Maximum Temp | 13.6 | 16.4 | 21.8 | 26.6 | 30.8 | 34.1 | 35.2 | 34.5 | 29.7 | 25.2 | 19.0 | 14.7 | 25.1 |
| Record Minimum Temp | -22.2 | -23.9 | -12.8 | -6.7 | 1.1 | 8.3 | 11.7 | 12.2 | 2.2 | -3.3 | -10.6 | -18.3 | -23.9 |
| Record Maximum Temp | 28.9 | 32.2 | 35.0 | 38.3 | 42.2 | 42.8 | 44.4 | 41.7 | 41.7 | 37.8 | 31.7 | 29.4 | 44.4 |
| HDD, Base 18.3°C | 388 | 278 | 172 | 60 | 6 | 0 | 0 | 0 | 6 | 59 | 209 | 351 | 1528 |
| CDD, Base 18.3°C | 0 | 0 | 12 | 53 | 140 | 243 | 293 | 272 | 144 | 42 | 3 | 0 | 1202 |
| Relative Humidity (%) | 57 | 55 | 46 | 45 | 51 | 53 | 51 | 54 | 61 | 60 | 59 | 58 | 54 |
| Wind Speed (m/s) | 4.8 | 5.1 | 5.8 | 5.9 | 5.8 | 5.6 | 5.0 | 4.7 | 4.6 | 4.6 | 4.8 | 4.7 | 5.1 |




# Port Arthur, TX

## WBAN NO. 12917

LATITUDE: 29.95° N
LONGITUDE: 94.02° W
ELEVATION: 7 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 | 2.7 | 3.5 | 4.3 | 5.2 | 5.8 | 6.3 | 6.1 | 5.7 | 5.0 | 4.3 | 3.1 | 2.6 | 4.6 |
| | Min/Max | 2.3/3.1 | 2.9/4.1 | 3.8/5.1 | 4.3/6.4 | 4.9/6.9 | 5.4/6.9 | 5.2/6.7 | 5.2/6.2 | 4.4/5.5 | 3.5/4.8 | 2.2/3.7 | 2.3/3.0 | 4.4/4.7 |
| Latitude -15 | Average | 3.3 | 4.1 | 4.7 | 5.3 | 5.8 | 6.1 | 6.0 | 5.8 | 5.4 | 4.9 | 3.8 | 3.2 | 4.9 |
| | Min/Max | 2.6/3.9 | 3.2/4.8 | 4.0/5.7 | 4.4/6.7 | 4.9/6.9 | 5.3/6.7 | 5.1/6.6 | 5.3/6.3 | 4.7/6.0 | 4.0/5.6 | 2.5/4.6 | 2.7/3.8 | 4.7/5.1 |
| Latitude | Average | 3.7 | 4.4 | 4.9 | 5.2 | 5.5 | 5.7 | 5.5 | 5.6 | 5.5 | 5.3 | 4.2 | 3.6 | 4.9 |
| | Min/Max | 2.8/4.4 | 3.3/5.3 | 4.0/6.0 | 4.3/6.6 | 4.6/6.5 | 4.9/6.2 | 4.8/6.1 | 5.1/6.1 | 4.7/6.1 | 4.2/6.0 | 2.6/5.3 | 3.0/4.4 | 4.7/5.2 |
| Latitude +15 | Average | 3.9 | 4.5 | 4.8 | 4.9 | 4.9 | 4.9 | 4.9 | 5.2 | 5.3 | 5.4 | 4.4 | 3.9 | 4.7 |
| | Min/Max | 2.9/4.7 | 3.3/5.6 | 3.9/5.9 | 4.0/6.2 | 4.2/5.7 | 4.3/5.4 | 4.2/5.3 | 4.7/5.6 | 4.6/5.9 | 4.2/6.1 | 2.6/5.6 | 3.1/4.8 | 4.5/5.0 |
| 90 | Average | 3.2 | 3.4 | 3.1 | 2.5 | 2.0 | 1.8 | 1.9 | 2.4 | 3.1 | 3.9 | 3.6 | 3.3 | 2.9 |
| | Min/Max | 2.3/4.0 | 2.5/4.3 | 2.5/3.8 | 2.2/3.0 | 1.9/2.2 | 1.7/1.9 | 1.8/2.0 | 2.2/2.5 | 2.8/3.5 | 2.9/4.5 | 1.9/4.7 | 2.6/4.2 | 2.7/3.0 |

### 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 | 3.5 | 4.7 | 5.6 | 6.5 | 7.3 | 8.0 | 7.6 | 7.3 | 6.5 | 5.8 | 4.2 | 3.4 | 5.9 |
| | Min/Max | 2.8/4.3 | 3.5/5.8 | 4.3/7.2 | 4.9/8.7 | 5.8/9.1 | 6.6/8.9 | 6.4/8.8 | 6.4/8.3 | 5.5/7.6 | 4.5/6.7 | 2.5/5.3 | 2.8/4.2 | 5.5/6.3 |
| Latitude -15 | Average | 4.0 | 5.1 | 5.9 | 6.7 | 7.3 | 7.9 | 7.6 | 7.4 | 6.8 | 6.3 | 4.7 | 3.9 | 6.1 |
| | Min/Max | 3.0/4.9 | 3.7/6.4 | 4.5/7.6 | 5.0/8.9 | 5.8/9.2 | 6.5/8.8 | 6.4/8.7 | 6.5/8.4 | 5.7/8.0 | 4.8/7.3 | 2.6/6.0 | 3.1/4.8 | 5.8/6.5 |
| Latitude | Average | 4.3 | 5.3 | 6.0 | 6.6 | 7.1 | 7.5 | 7.3 | 7.3 | 6.9 | 6.6 | 5.0 | 4.2 | 6.2 |
| | Min/Max | 3.2/5.3 | 3.8/6.8 | 4.6/7.8 | 5.0/8.8 | 5.6/8.9 | 6.3/8.4 | 6.2/8.4 | 6.4/8.2 | 5.7/8.1 | 5.0/7.7 | 2.7/6.5 | 3.4/5.3 | 5.8/6.6 |
| Latitude +15 | Average | 4.4 | 5.4 | 5.9 | 6.3 | 6.7 | 7.0 | 6.8 | 6.9 | 6.7 | 6.7 | 5.2 | 4.4 | 6.0 |
| | Min/Max | 3.2/5.6 | 3.8/6.9 | 4.5/7.7 | 4.8/8.5 | 5.3/8.4 | 5.8/7.9 | 5.8/7.9 | 6.0/7.8 | 5.6/7.9 | 5.0/7.7 | 2.8/6.8 | 3.5/5.6 | 5.7/6.5 |

### 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 | 4.5 | 5.4 | 6.0 | 6.7 | 7.4 | 8.0 | 7.7 | 7.5 | 6.9 | 6.7 | 5.2 | 4.5 | 6.4 |
| | Min/Max | 3.2/5.6 | 3.9/6.9 | 4.6/7.8 | 5.1/8.9 | 5.8/9.3 | 6.7/9.0 | 6.5/8.9 | 6.5/8.4 | 5.7/8.1 | 5.0/7.7 | 2.8/6.8 | 3.5/5.7 | 6.0/6.8 |

### 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 | 2.4 | 2.8 | 2.8 | 2.9 | 3.3 | 3.7 | 3.4 | 3.3 | 3.2 | 3.5 | 2.9 | 2.5 | 3.1 |
| | Min/Max | 1.3/3.4 | 1.5/4.1 | 1.6/4.2 | 1.7/4.8 | 1.8/4.9 | 2.8/4.6 | 2.5/4.3 | 2.5/4.1 | 2.2/4.2 | 2.3/4.4 | 0.9/4.3 | 1.8/3.6 | 2.8/3.5 |
| 1-Axis, N-S Horiz Axis | Average | 2.1 | 2.9 | 3.4 | 3.9 | 4.4 | 4.9 | 4.5 | 4.4 | 4.0 | 3.9 | 2.7 | 2.1 | 3.6 |
| | Min/Max | 1.1/3.0 | 1.6/4.3 | 1.9/5.2 | 2.1/6.3 | 2.4/6.4 | 3.6/6.0 | 3.3/5.7 | 3.3/5.5 | 2.7/5.4 | 2.6/4.9 | 0.8/3.9 | 1.4/3.0 | 3.2/4.1 |
| 1-Axis, N-S Tilt=Latitude | Average | 2.7 | 3.5 | 3.7 | 3.9 | 4.2 | 4.5 | 4.3 | 4.4 | 4.3 | 4.5 | 3.4 | 2.8 | 3.8 |
| | Min/Max | 1.5/3.9 | 1.9/5.1 | 2.1/5.8 | 2.2/6.4 | 2.3/6.2 | 3.4/5.6 | 3.1/5.4 | 3.2/5.5 | 2.9/5.7 | 2.9/5.6 | 1.0/4.9 | 1.9/3.9 | 3.4/4.4 |
| 2-Axis | Average | 2.9 | 3.6 | 3.7 | 4.0 | 4.4 | 4.9 | 4.6 | 4.5 | 4.3 | 4.6 | 3.5 | 3.0 | 4.0 |
| | Min/Max | 1.6/4.1 | 2.0/5.2 | 2.1/5.8 | 2.2/6.5 | 2.5/6.5 | 3.7/6.1 | 3.4/5.8 | 3.3/5.6 | 2.9/5.7 | 3.0/5.7 | 1.1/5.2 | 2.1/4.3 | 3.6/4.6 |

### Average Climatic Conditions

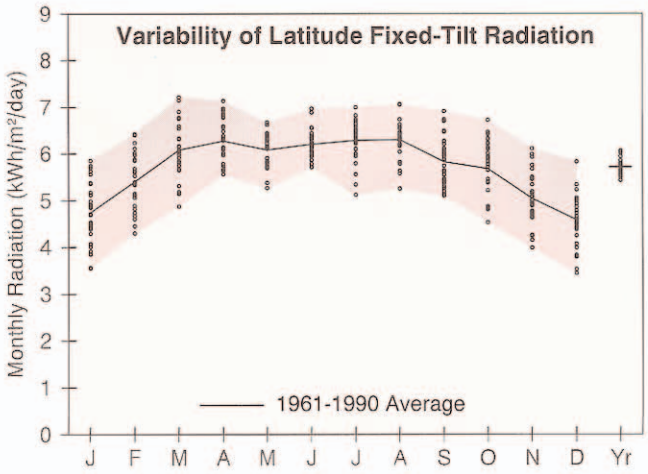
| Element | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec | Year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | 10.5 | 12.4 | 16.3 | 20.5 | 24.0 | 27.1 | 28.2 | 28.1 | 25.9 | 20.9 | 16.2 | 12.4 | 20.2 |
| Daily Minimum Temp | 5.3 | 6.9 | 10.7 | 15.3 | 19.1 | 22.2 | 23.2 | 22.9 | 20.9 | 15.1 | 10.7 | 6.8 | 14.9 |
| Daily Maximum Temp | 15.7 | 17.9 | 21.9 | 25.7 | 28.9 | 31.9 | 33.3 | 33.2 | 30.7 | 26.8 | 21.8 | 17.9 | 25.5 |
| Record Minimum Temp | -10.0 | -6.7 | -5.0 | 0.0 | 7.8 | 13.3 | 16.1 | 15.6 | 7.2 | 0.0 | -5.6 | -11.1 | -11.1 |
| Record Maximum Temp | 27.2 | 29.4 | 30.6 | 34.4 | 36.1 | 37.8 | 39.4 | 41.7 | 37.8 | 35.0 | 31.1 | 28.9 | 41.7 |
| HDD, Base 18.3°C | 250 | 171 | 86 | 18 | 0 | 0 | 0 | 0 | 0 | 14 | 98 | 196 | 833 |
| CDD, Base 18.3°C | 7 | 6 | 24 | 83 | 176 | 262 | 307 | 303 | 227 | 96 | 35 | 12 | 1536 |
| Relative Humidity (%) | 79 | 77 | 76 | 77 | 79 | 79 | 81 | 80 | 79 | 77 | 78 | 79 | 78 |
| Wind Speed (m/s) | 4.6 | 4.9 | 5.0 | 5.1 | 4.4 | 3.8 | 3.2 | 3.1 | 3.6 | 3.8 | 4.4 | 4.5 | 4.2 |

# San Angelo, TX

## WBAN NO. 23034

LATITUDE: 31.37° N
LONGITUDE: 100.50° W
ELEVATION: 582 meters
MEAN PRESSURE: 949 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 | 3.2 | 4.1 | 5.2 | 6.1 | 6.5 | 7.0 | 6.9 | 6.4 | 5.3 | 4.5 | 3.5 | 3.0 | 5.1 |
| | Min/Max | 2.6/3.7 | 3.4/4.6 | 4.3/6.0 | 5.4/6.9 | 5.6/7.1 | 6.4/7.9 | 5.6/7.8 | 5.3/7.2 | 4.7/6.1 | 3.8/5.1 | 3.0/4.0 | 2.4/3.5 | 4.9/5.4 |
| Latitude -15 | Average | 4.1 | 4.9 | 5.8 | 6.4 | 6.5 | 6.7 | 6.8 | 6.5 | 5.7 | 5.3 | 4.4 | 3.9 | 5.6 |
| | Min/Max | 3.2/5.0 | 4.0/5.7 | 4.7/6.8 | 5.6/7.2 | 5.6/7.1 | 6.2/7.6 | 5.5/7.6 | 5.4/7.3 | 5.0/6.7 | 4.3/6.2 | 3.6/5.3 | 3.0/4.9 | 5.3/5.9 |
| Latitude | Average | 4.7 | 5.4 | 6.1 | 6.3 | 6.1 | 6.2 | 6.3 | 6.3 | 5.8 | 5.7 | 5.0 | 4.6 | 5.7 |
| | Min/Max | 3.5/5.8 | 4.3/6.4 | 4.9/7.2 | 5.6/7.1 | 5.3/6.7 | 5.7/7.0 | 5.1/7.0 | 5.3/7.1 | 5.1/6.9 | 4.5/6.7 | 4.0/6.1 | 3.4/5.8 | 5.4/6.1 |
| Latitude +15 | Average | 5.1 | 5.6 | 6.0 | 5.8 | 5.4 | 5.3 | 5.5 | 5.7 | 5.6 | 5.8 | 5.4 | 5.0 | 5.5 |
| | Min/Max | 3.7/6.4 | 4.4/6.7 | 4.7/7.2 | 5.2/6.6 | 4.7/5.9 | 4.9/5.9 | 4.5/6.0 | 4.8/6.4 | 4.9/6.7 | 4.5/6.9 | 4.2/6.6 | 3.7/6.4 | 5.2/5.9 |
| 90 | Average | 4.4 | 4.4 | 4.0 | 3.0 | 2.3 | 1.9 | 2.1 | 2.7 | 3.4 | 4.3 | 4.5 | 4.4 | 3.4 |
| | Min/Max | 3.1/5.7 | 3.4/5.3 | 3.1/4.7 | 2.8/3.3 | 2.1/2.4 | 1.9/2.0 | 1.9/2.1 | 2.4/2.8 | 2.9/4.0 | 3.2/5.1 | 3.4/5.6 | 3.2/5.9 | 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 | 4.6 | 5.7 | 7.1 | 8.1 | 8.4 | 9.1 | 9.2 | 8.6 | 7.1 | 6.3 | 5.0 | 4.3 | 7.0 |
| | Min/Max | 3.4/5.7 | 4.5/6.8 | 5.5/8.8 | 6.8/9.6 | 6.7/9.6 | 8.2/10.7 | 6.8/10.7 | 6.7/10.0 | 6.0/8.7 | 4.9/7.6 | 4.0/6.2 | 3.1/5.5 | 6.5/7.5 |
| Latitude -15 | Average | 5.2 | 6.3 | 7.6 | 8.3 | 8.4 | 9.0 | 9.2 | 8.7 | 7.5 | 6.9 | 5.7 | 5.0 | 7.3 |
| | Min/Max | 3.8/6.6 | 4.9/7.6 | 5.8/9.4 | 7.1/9.9 | 6.7/9.6 | 8.1/10.6 | 6.8/10.7 | 6.8/10.2 | 6.3/9.2 | 5.3/8.4 | 4.4/7.1 | 3.6/6.5 | 6.9/7.9 |
| Latitude | Average | 5.7 | 6.7 | 7.8 | 8.3 | 8.2 | 8.6 | 8.8 | 8.6 | 7.6 | 7.2 | 6.2 | 5.5 | 7.4 |
| | Min/Max | 4.1/7.3 | 5.2/8.1 | 5.9/9.7 | 7.0/9.8 | 6.5/9.3 | 7.8/10.1 | 6.6/10.3 | 6.7/10.0 | 6.3/9.3 | 5.4/8.8 | 4.8/7.8 | 3.9/7.2 | 7.0/8.0 |
| Latitude +15 | Average | 6.0 | 6.8 | 7.8 | 8.0 | 7.7 | 8.0 | 8.3 | 8.2 | 7.4 | 7.3 | 6.4 | 5.8 | 7.3 |
| | Min/Max | 4.2/7.7 | 5.2/8.4 | 5.8/9.6 | 6.7/9.5 | 6.1/8.8 | 7.2/9.4 | 6.1/9.6 | 6.4/9.5 | 6.2/9.1 | 5.4/8.9 | 4.9/8.1 | 4.1/7.7 | 6.8/7.9 |

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

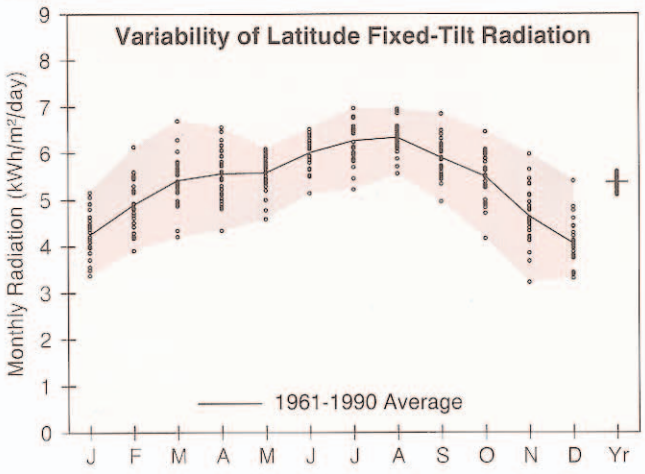
| Tracker | | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec | Year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2-Axis | Average | 6.1 | 6.9 | 7.8 | 8.4 | 8.5 | 9.2 | 9.3 | 8.8 | 7.6 | 7.3 | 6.5 | 5.9 | 7.7 |
| | Min/Max | 4.3/7.8 | 5.3/8.4 | 5.9/9.7 | 7.1/9.9 | 6.8/9.7 | 8.3/10.8 | 6.9/10.9 | 6.8/10.2 | 6.3/9.3 | 5.5/8.9 | 4.9/8.2 | 4.2/7.8 | 7.2/8.3 |

### 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 | 3.7 | 3.9 | 4.2 | 4.3 | 4.3 | 4.8 | 4.8 | 4.5 | 3.8 | 4.1 | 3.9 | 3.7 | 4.2 |
| | Min/Max | 2.0/5.3 | 2.7/5.3 | 2.6/5.7 | 3.3/5.5 | 2.9/5.4 | 4.0/6.4 | 2.9/6.2 | 2.8/5.8 | 2.7/5.2 | 2.6/5.5 | 2.6/5.4 | 2.3/5.5 | 3.7/4.7 |
| 1-Axis, N-S Horiz Axis | Average | 3.2 | 4.0 | 5.1 | 5.6 | 5.7 | 6.3 | 6.4 | 6.0 | 4.8 | 4.5 | 3.6 | 3.0 | 4.9 |
| | Min/Max | 1.7/4.6 | 2.7/5.3 | 3.2/7.0 | 4.2/7.4 | 3.7/7.2 | 5.2/8.4 | 3.8/8.4 | 3.8/7.8 | 3.4/6.8 | 2.9/6.1 | 2.4/5.0 | 1.8/4.4 | 4.3/5.5 |
| 1-Axis, N-S Tilt=Latitude | Average | 4.2 | 4.9 | 5.6 | 5.8 | 5.4 | 5.9 | 6.1 | 6.0 | 5.2 | 5.3 | 4.6 | 4.1 | 5.2 |
| | Min/Max | 2.3/6.0 | 3.3/6.5 | 3.5/7.8 | 4.3/7.5 | 3.5/6.9 | 4.8/7.8 | 3.6/7.9 | 3.8/7.8 | 3.6/7.2 | 3.3/7.1 | 3.1/6.4 | 2.5/6.0 | 4.7/6.0 |
| 2-Axis | Average | 4.5 | 5.0 | 5.6 | 5.8 | 5.7 | 6.4 | 6.5 | 6.1 | 5.2 | 5.4 | 4.8 | 4.5 | 5.5 |
| | Min/Max | 2.4/6.4 | 3.4/6.7 | 3.5/7.8 | 4.4/7.7 | 3.7/7.3 | 5.3/8.5 | 3.9/8.5 | 3.9/8.0 | 3.7/7.3 | 3.4/7.2 | 3.3/6.7 | 2.7/6.5 | 4.9/6.2 |

### Average Climatic Conditions

| Element | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec | Year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | 6.5 | 9.1 | 14.5 | 19.4 | 23.4 | 26.4 | 28.2 | 27.7 | 24.1 | 19.0 | 13.0 | 7.8 | 18.3 |
| Daily Minimum Temp | -0.8 | 1.5 | 6.4 | 11.5 | 16.2 | 19.1 | 20.6 | 20.2 | 17.8 | 12.0 | 5.9 | 0.6 | 10.9 |
| Daily Maximum Temp | 13.8 | 16.7 | 22.6 | 27.3 | 30.8 | 33.7 | 35.7 | 35.2 | 30.4 | 26.0 | 20.1 | 15.0 | 25.6 |
| Record Minimum Temp | -15.0 | -18.3 | -13.3 | -3.9 | 1.7 | 8.9 | 13.3 | 12.2 | 2.8 | -2.2 | -10.6 | -20.0 | -20.0 |
| Record Maximum Temp | 32.2 | 32.8 | 36.1 | 39.4 | 41.7 | 43.3 | 43.9 | 42.8 | 41.7 | 37.8 | 33.9 | 32.8 | 43.9 |
| HDD, Base 18.3°C | 367 | 258 | 137 | 39 | 4 | 0 | 0 | 0 | 3 | 39 | 166 | 327 | 1341 |
| CDD, Base 18.3°C | 0 | 0 | 18 | 72 | 162 | 242 | 305 | 291 | 177 | 60 | 6 | 0 | 1333 |
| Relative Humidity (%) | 61 | 60 | 54 | 54 | 60 | 59 | 54 | 57 | 65 | 65 | 64 | 63 | 60 |
| Wind Speed (m/s) | 4.6 | 4.8 | 5.5 | 5.3 | 5.1 | 4.6 | 4.2 | 3.9 | 3.9 | 4.0 | 4.4 | 4.3 | 4.6 |




# San Antonio, TX

## WBAN NO. 12921

LATITUDE: 29.53° N
LONGITUDE: 98.47° W
ELEVATION: 242 meters
MEAN PRESSURE: 988 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 | 4.8 | 5.5 | 6.0 | 6.7 | 6.9 | 6.4 | 5.4 | 4.5 | 3.4 | 2.9 | 4.9 |
| | Min/Max | 2.6/3.5 | 3.3/4.6 | 3.8/5.8 | 4.3/6.4 | 4.9/6.5 | 5.7/7.3 | 5.6/7.7 | 5.6/7.1 | 4.7/6.2 | 3.6/5.1 | 2.7/4.1 | 2.5/3.5 | 4.7/5.2 |
| Latitude -15 | Average | 3.7 | 4.5 | 5.2 | 5.7 | 5.9 | 6.5 | 6.7 | 6.6 | 5.8 | 5.1 | 4.1 | 3.5 | 5.3 |
| | Min/Max | 3.0/4.5 | 3.7/5.5 | 4.1/6.4 | 4.4/6.7 | 4.9/6.4 | 5.5/7.1 | 5.6/7.5 | 5.7/7.2 | 4.9/6.7 | 4.0/5.9 | 3.0/5.2 | 3.0/4.6 | 5.0/5.5 |
| Latitude | Average | 4.3 | 4.9 | 5.4 | 5.6 | 5.6 | 6.0 | 6.3 | 6.3 | 5.9 | 5.5 | 4.6 | 4.1 | 5.4 |
| | Min/Max | 3.4/5.2 | 3.9/6.1 | 4.2/6.7 | 4.3/6.6 | 4.6/6.1 | 5.1/6.5 | 5.2/7.0 | 5.6/6.9 | 5.0/6.8 | 4.2/6.5 | 3.2/6.0 | 3.3/5.4 | 5.1/5.6 |
| Latitude +15 | Average | 4.5 | 5.0 | 5.3 | 5.2 | 5.0 | 5.2 | 5.5 | 5.8 | 5.7 | 5.6 | 4.9 | 4.4 | 5.2 |
| | Min/Max | 3.5/5.6 | 4.0/6.4 | 4.1/6.6 | 4.0/6.1 | 4.1/5.4 | 4.5/5.6 | 4.6/6.1 | 5.1/6.3 | 4.8/6.6 | 4.2/6.6 | 3.3/6.4 | 3.5/5.9 | 4.9/5.4 |
| 90 | Average | 3.8 | 3.8 | 3.4 | 2.7 | 2.1 | 1.9 | 2.0 | 2.6 | 3.3 | 4.0 | 4.0 | 3.8 | 3.1 |
| | Min/Max | 2.9/4.8 | 2.9/5.0 | 2.7/4.2 | 2.2/3.0 | 1.9/2.2 | 1.8/2.0 | 1.9/2.1 | 2.4/2.7 | 2.8/3.8 | 2.9/4.8 | 2.5/5.4 | 2.9/5.3 | 2.9/3.3 |

### 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 | 4.2 | 5.2 | 6.3 | 6.9 | 7.3 | 8.4 | 8.7 | 8.3 | 7.1 | 6.1 | 4.7 | 3.9 | 6.4 |
| | Min/Max | 3.3/5.1 | 4.1/6.6 | 4.6/8.0 | 4.9/8.6 | 5.6/8.2 | 6.6/9.5 | 6.6/10.2 | 6.9/9.5 | 5.7/8.6 | 4.4/7.4 | 3.2/6.1 | 3.2/5.3 | 6.0/6.8 |
| Latitude -15 | Average | 4.7 | 5.7 | 6.6 | 7.1 | 7.3 | 8.3 | 8.7 | 8.4 | 7.4 | 6.6 | 5.2 | 4.4 | 6.7 |
| | Min/Max | 3.6/5.8 | 4.4/7.3 | 4.9/8.5 | 5.0/8.8 | 5.6/8.2 | 6.5/9.4 | 6.6/10.1 | 7.0/9.6 | 5.9/9.0 | 4.7/8.0 | 3.5/6.9 | 3.5/6.0 | 6.2/7.1 |
| Latitude | Average | 5.1 | 6.0 | 6.8 | 7.0 | 7.1 | 7.9 | 8.4 | 8.3 | 7.5 | 6.9 | 5.6 | 4.8 | 6.8 |
| | Min/Max | 3.9/6.3 | 4.6/7.7 | 5.0/8.8 | 4.9/8.7 | 5.4/8.0 | 6.2/9.0 | 6.3/9.7 | 6.9/9.5 | 5.9/9.1 | 4.8/8.4 | 3.6/7.5 | 3.8/6.7 | 6.3/7.2 |
| Latitude +15 | Average | 5.3 | 6.1 | 6.7 | 6.7 | 6.7 | 7.4 | 7.8 | 7.9 | 7.3 | 6.9 | 5.8 | 5.0 | 6.6 |
| | Min/Max | 4.0/6.7 | 4.6/7.9 | 4.9/8.7 | 4.7/8.4 | 5.0/7.5 | 5.8/8.4 | 5.9/9.1 | 6.6/9.0 | 5.8/8.9 | 4.8/8.5 | 3.7/7.8 | 4.0/7.1 | 6.2/7.0 |

### 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 | 5.3 | 6.1 | 6.8 | 7.1 | 7.4 | 8.4 | 8.8 | 8.4 | 7.5 | 6.9 | 5.8 | 5.1 | 7.0 |
| | Min/Max | 4.0/6.7 | 4.7/7.9 | 5.0/8.8 | 5.0/8.8 | 5.6/8.3 | 6.6/9.6 | 6.7/10.3 | 7.1/9.7 | 5.9/9.1 | 4.9/8.5 | 3.7/7.9 | 4.0/7.2 | 6.5/7.4 |

### 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 | 3.0 | 3.3 | 3.3 | 3.2 | 3.3 | 4.0 | 4.4 | 4.1 | 3.6 | 3.7 | 3.3 | 3.0 | 3.5 |
| | Min/Max | 2.0/4.2 | 2.2/4.8 | 1.9/5.0 | 1.5/4.5 | 1.6/4.1 | 2.5/5.1 | 2.6/5.8 | 2.9/5.2 | 2.2/5.1 | 2.0/5.0 | 1.5/5.1 | 2.1/4.7 | 3.1/3.9 |
| 1-Axis, N-S Horiz Axis | Average | 2.7 | 3.4 | 4.0 | 4.2 | 4.2 | 5.2 | 5.7 | 5.4 | 4.5 | 4.1 | 3.1 | 2.5 | 4.1 |
| | Min/Max | 1.7/3.8 | 2.3/5.0 | 2.3/6.1 | 1.9/6.0 | 2.1/5.3 | 3.1/6.7 | 3.3/7.6 | 3.8/6.8 | 2.8/6.4 | 2.2/5.7 | 1.5/4.8 | 1.7/4.0 | 3.6/4.6 |
| 1-Axis, N-S Tilt=Latitude | Average | 3.4 | 4.1 | 4.4 | 4.2 | 4.1 | 4.8 | 5.3 | 5.3 | 4.8 | 4.7 | 3.9 | 3.2 | 4.4 |
| | Min/Max | 2.2/4.8 | 2.7/5.9 | 2.6/6.7 | 1.9/6.1 | 2.0/5.1 | 2.9/6.2 | 3.1/7.1 | 3.8/6.7 | 3.0/6.9 | 2.5/6.5 | 1.8/6.0 | 2.3/5.2 | 3.8/4.9 |
| 2-Axis | Average | 3.7 | 4.2 | 4.4 | 4.3 | 4.3 | 5.3 | 5.7 | 5.5 | 4.8 | 4.8 | 4.1 | 3.5 | 4.5 |
| | Min/Max | 2.3/5.1 | 2.8/6.1 | 2.6/6.7 | 1.9/6.2 | 2.2/5.4 | 3.2/6.7 | 3.3/7.7 | 3.9/6.9 | 3.0/6.9 | 2.6/6.6 | 1.9/6.3 | 2.4/5.7 | 4.0/5.1 |

### Average Climatic Conditions

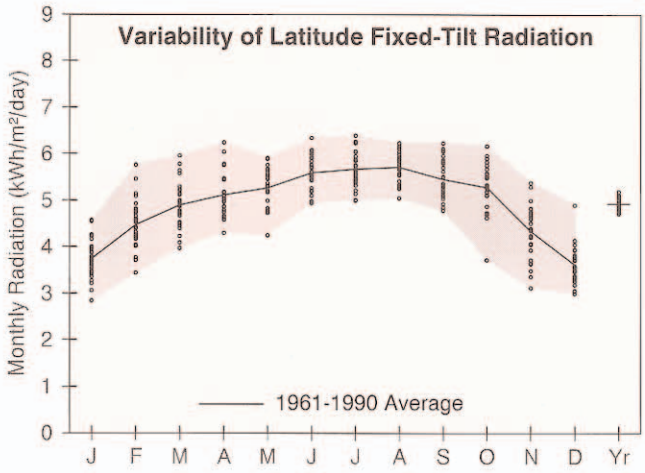
| Element | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec | Year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | 9.6 | 11.9 | 16.5 | 20.7 | 24.2 | 27.9 | 29.4 | 29.4 | 26.3 | 21.2 | 15.8 | 11.2 | 20.3 |
| Daily Minimum Temp | 3.3 | 5.2 | 9.8 | 14.7 | 18.7 | 22.6 | 23.9 | 23.6 | 20.7 | 14.9 | 9.3 | 4.9 | 14.3 |
| Daily Maximum Temp | 16.0 | 18.7 | 23.1 | 26.8 | 29.6 | 33.2 | 35.0 | 35.2 | 31.8 | 27.6 | 22.2 | 17.5 | 26.4 |
| Record Minimum Temp | -17.8 | -14.4 | -7.2 | -0.6 | 6.1 | 11.7 | 16.7 | 16.1 | 5.0 | 0.6 | -6.1 | -14.4 | -17.8 |
| Record Maximum Temp | 31.7 | 36.1 | 37.8 | 37.8 | 39.4 | 40.6 | 41.1 | 42.2 | 39.4 | 37.2 | 34.4 | 32.2 | 42.2 |
| HDD, Base 18.3°C | 274 | 184 | 93 | 18 | 0 | 0 | 0 | 0 | 0 | 17 | 100 | 227 | 913 |
| CDD, Base 18.3°C | 4 | 6 | 36 | 89 | 181 | 287 | 344 | 343 | 238 | 106 | 23 | 7 | 1664 |
| Relative Humidity (%) | 67 | 65 | 63 | 66 | 71 | 69 | 65 | 65 | 68 | 67 | 68 | 68 | 67 |
| Wind Speed (m/s) | 3.9 | 4.2 | 4.5 | 4.4 | 4.4 | 4.3 | 4.2 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 4.1 |

# Victoria, TX

## WBAN NO. 12912

LATITUDE: 28.85° N
LONGITUDE: 96.92° W
ELEVATION: 32 meters
MEAN PRESSURE: 1012 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 | 4.4 | 5.1 | 5.7 | 6.2 | 6.2 | 5.8 | 5.0 | 4.3 | 3.3 | 2.7 | 4.6 |
| | Min/Max | 2.4/3.3 | 3.0/4.4 | 3.7/5.2 | 4.4/6.1 | 4.6/6.3 | 5.5/7.1 | 5.4/7.1 | 5.2/6.4 | 4.5/5.7 | 3.3/4.9 | 2.6/3.9 | 2.3/3.3 | 4.4/4.8 |
| Latitude -15 | Average | 3.3 | 4.1 | 4.8 | 5.2 | 5.6 | 6.1 | 6.1 | 5.9 | 5.4 | 4.9 | 3.9 | 3.2 | 4.9 |
| | Min/Max | 2.6/4.0 | 3.3/5.2 | 3.9/5.7 | 4.4/6.3 | 4.5/6.3 | 5.3/6.9 | 5.3/6.9 | 5.3/6.5 | 4.7/6.1 | 3.6/5.7 | 2.9/4.7 | 2.7/4.2 | 4.7/5.1 |
| Latitude | Average | 3.7 | 4.5 | 4.9 | 5.1 | 5.3 | 5.6 | 5.7 | 5.7 | 5.4 | 5.3 | 4.3 | 3.6 | 4.9 |
| | Min/Max | 2.8/4.6 | 3.4/5.8 | 4.0/6.0 | 4.3/6.2 | 4.3/5.9 | 4.9/6.3 | 5.0/6.4 | 5.1/6.2 | 4.8/6.2 | 3.7/6.2 | 3.1/5.4 | 3.0/4.9 | 4.7/5.2 |
| Latitude +15 | Average | 3.9 | 4.6 | 4.8 | 4.8 | 4.7 | 4.9 | 5.0 | 5.2 | 5.2 | 5.4 | 4.6 | 3.8 | 4.7 |
| | Min/Max | 2.9/4.9 | 3.4/6.0 | 3.8/5.9 | 4.0/5.8 | 3.8/5.3 | 4.3/5.5 | 4.4/5.6 | 4.6/5.7 | 4.6/6.0 | 3.7/6.3 | 3.2/5.7 | 3.1/5.3 | 4.5/5.0 |
| 90 | Average | 3.2 | 3.4 | 3.0 | 2.4 | 2.0 | 1.8 | 1.9 | 2.4 | 3.0 | 3.8 | 3.7 | 3.3 | 2.8 |
| | Min/Max | 2.3/4.2 | 2.5/4.6 | 2.5/3.7 | 2.1/2.8 | 1.8/2.1 | 1.7/1.9 | 1.8/2.0 | 2.1/2.5 | 2.7/3.5 | 2.5/4.5 | 2.5/4.7 | 2.6/4.7 | 2.7/3.0 |

### 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 | 3.7 | 4.7 | 5.6 | 6.3 | 7.0 | 7.8 | 7.9 | 7.5 | 6.6 | 5.9 | 4.4 | 3.5 | 5.9 |
| | Min/Max | 2.8/4.6 | 3.6/6.2 | 4.4/7.1 | 5.1/8.1 | 5.1/8.1 | 6.5/9.2 | 6.5/9.5 | 6.5/8.4 | 5.6/7.8 | 4.0/7.0 | 3.0/5.5 | 2.9/4.8 | 5.6/6.3 |
| Latitude -15 | Average | 4.1 | 5.1 | 5.9 | 6.4 | 7.0 | 7.7 | 7.8 | 7.6 | 6.9 | 6.3 | 4.8 | 3.9 | 6.1 |
| | Min/Max | 3.0/5.1 | 3.8/6.8 | 4.6/7.5 | 5.2/8.3 | 5.1/8.1 | 6.4/9.1 | 6.5/9.4 | 6.6/8.5 | 5.8/8.1 | 4.2/7.6 | 3.3/6.2 | 3.2/5.4 | 5.8/6.5 |
| Latitude | Average | 4.4 | 5.4 | 6.0 | 6.3 | 6.7 | 7.4 | 7.5 | 7.5 | 6.9 | 6.6 | 5.2 | 4.2 | 6.2 |
| | Min/Max | 3.1/5.6 | 4.0/7.2 | 4.6/7.7 | 5.1/8.2 | 4.9/7.9 | 6.2/8.7 | 6.3/9.1 | 6.4/8.4 | 5.9/8.2 | 4.3/7.9 | 3.5/6.7 | 3.4/6.0 | 5.8/6.6 |
| Latitude +15 | Average | 4.5 | 5.5 | 5.9 | 6.1 | 6.3 | 6.9 | 7.1 | 7.1 | 6.8 | 6.6 | 5.4 | 4.4 | 6.0 |
| | Min/Max | 3.2/5.8 | 4.0/7.4 | 4.5/7.6 | 4.8/7.9 | 4.6/7.4 | 5.7/8.1 | 5.9/8.5 | 6.1/8.0 | 5.7/8.0 | 4.2/8.0 | 3.5/6.9 | 3.5/6.3 | 5.7/6.4 |

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

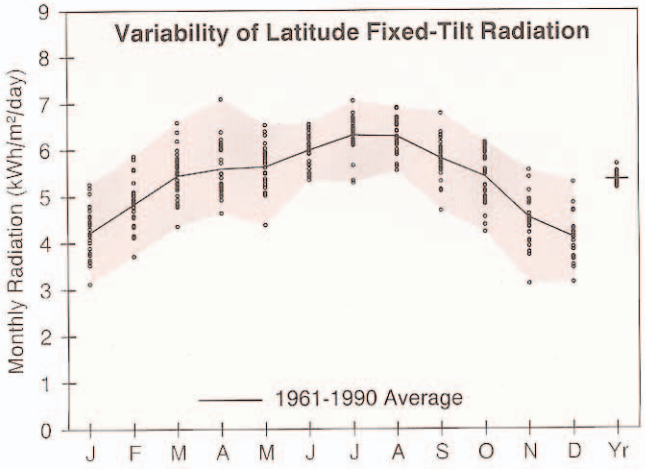
| Tracker | | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec | Year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2-Axis | Average | 4.6 | 5.5 | 6.0 | 6.4 | 7.0 | 7.9 | 7.9 | 7.7 | 6.9 | 6.7 | 5.4 | 4.4 | 6.4 |
| | Min/Max | 3.2/5.9 | 4.0/7.4 | 4.6/7.7 | 5.2/8.3 | 5.2/8.2 | 6.6/9.3 | 6.6/9.6 | 6.6/8.6 | 5.9/8.2 | 4.3/8.0 | 3.5/7.0 | 3.5/6.4 | 6.0/6.8 |

### 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 | 2.3 | 2.7 | 2.7 | 2.6 | 2.9 | 3.5 | 3.5 | 3.3 | 3.1 | 3.4 | 2.9 | 2.4 | 2.9 |
| | Min/Max | 1.3/3.5 | 1.5/4.3 | 1.5/3.9 | 1.7/4.2 | 1.3/3.8 | 2.4/4.7 | 2.5/4.9 | 2.5/4.1 | 2.2/4.0 | 1.6/4.5 | 1.5/4.2 | 1.6/4.1 | 2.6/3.3 |
| 1-Axis, N-S Horiz Axis | Average | 2.1 | 2.9 | 3.3 | 3.4 | 3.9 | 4.6 | 4.6 | 4.5 | 4.0 | 3.8 | 2.7 | 2.0 | 3.5 |
| | Min/Max | 1.1/3.2 | 1.6/4.5 | 1.8/4.9 | 2.2/5.5 | 1.8/5.1 | 3.1/6.1 | 3.2/6.6 | 3.4/5.5 | 2.9/5.3 | 1.7/5.1 | 1.3/4.0 | 1.4/3.4 | 3.0/3.8 |
| 1-Axis, N-S Tilt=Latitude | Average | 2.6 | 3.4 | 3.6 | 3.5 | 3.7 | 4.3 | 4.4 | 4.4 | 4.2 | 4.4 | 3.4 | 2.6 | 3.7 |
| | Min/Max | 1.4/4.0 | 2.0/5.3 | 2.0/5.3 | 2.2/5.6 | 1.7/4.9 | 2.9/5.7 | 3.1/6.2 | 3.4/5.4 | 3.0/5.6 | 2.0/5.8 | 1.7/4.9 | 1.8/4.5 | 3.2/4.1 |
| 2-Axis | Average | 2.8 | 3.5 | 3.6 | 3.6 | 3.9 | 4.6 | 4.7 | 4.5 | 4.2 | 4.4 | 3.6 | 2.8 | 3.9 |
| | Min/Max | 1.5/4.3 | 2.0/5.5 | 2.0/5.4 | 2.3/5.7 | 1.8/5.1 | 3.1/6.2 | 3.3/6.7 | 3.5/5.6 | 3.1/5.6 | 2.0/5.9 | 1.8/5.2 | 2.0/4.9 | 3.4/4.3 |

### Average Climatic Conditions

| Element | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec | Year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | 11.5 | 13.4 | 17.4 | 21.4 | 24.8 | 27.6 | 28.9 | 28.9 | 26.4 | 22.1 | 17.2 | 13.1 | 21.1 |
| Daily Minimum Temp | 5.8 | 7.4 | 11.6 | 16.1 | 19.8 | 22.6 | 23.7 | 23.4 | 21.3 | 16.1 | 11.3 | 7.3 | 15.6 |
| Daily Maximum Temp | 17.1 | 19.3 | 23.2 | 26.8 | 29.6 | 32.6 | 34.2 | 34.4 | 31.6 | 28.0 | 23.0 | 18.9 | 26.6 |
| Record Minimum Temp | -10.0 | -7.2 | -6.1 | 0.6 | 9.4 | 15.0 | 16.7 | 17.2 | 9.4 | 2.2 | -4.4 | -12.8 | -12.8 |
| Record Maximum Temp | 31.1 | 35.0 | 36.1 | 36.7 | 38.3 | 38.3 | 40.0 | 41.7 | 38.9 | 37.2 | 33.9 | 31.1 | 41.7 |
| HDD, Base 18.3°C | 224 | 148 | 71 | 8 | 0 | 0 | 0 | 0 | 0 | 8 | 82 | 179 | 720 |
| CDD, Base 18.3°C | 12 | 9 | 42 | 102 | 200 | 278 | 329 | 329 | 243 | 124 | 47 | 17 | 1732 |
| Relative Humidity (%) | 76 | 74 | 72 | 74 | 76 | 76 | 74 | 74 | 76 | 74 | 75 | 76 | 75 |
| Wind Speed (m/s) | 4.7 | 5.1 | 5.3 | 5.2 | 4.9 | 4.3 | 4.1 | 3.8 | 4.0 | 4.1 | 4.5 | 4.6 | 4.6 |




# Waco, TX

## WBAN NO. 13959

LATITUDE: 31.62° N
LONGITUDE: 97.22° W
ELEVATION: 155 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 | 2.9 | 3.7 | 4.7 | 5.5 | 6.0 | 6.7 | 6.9 | 6.4 | 5.2 | 4.3 | 3.2 | 2.7 | 4.9 |
| | Min/Max | 2.4/3.4 | 3.1/4.3 | 4.0/5.5 | 4.6/6.8 | 4.7/7.0 | 5.9/7.4 | 5.8/7.8 | 5.6/7.0 | 4.4/6.0 | 3.5/4.7 | 2.5/3.7 | 2.3/3.3 | 4.7/5.1 |
| Latitude -15 | Average | 3.7 | 4.4 | 5.3 | 5.7 | 6.0 | 6.5 | 6.8 | 6.5 | 5.7 | 5.0 | 4.0 | 3.6 | 5.3 |
| | Min/Max | 2.9/4.5 | 3.5/5.3 | 4.3/6.3 | 4.8/7.2 | 4.7/6.9 | 5.8/7.2 | 5.7/7.7 | 5.8/7.2 | 4.7/6.6 | 4.0/5.7 | 2.9/4.8 | 2.8/4.5 | 5.1/5.6 |
| Latitude | Average | 4.2 | 4.8 | 5.4 | 5.6 | 5.6 | 6.0 | 6.3 | 6.3 | 5.8 | 5.4 | 4.5 | 4.1 | 5.4 |
| | Min/Max | 3.1/5.3 | 3.7/5.9 | 4.4/6.6 | 4.6/7.1 | 4.4/6.5 | 5.3/6.6 | 5.3/7.1 | 5.6/6.9 | 4.7/6.8 | 4.2/6.2 | 3.1/5.6 | 3.1/5.3 | 5.2/5.7 |
| Latitude +15 | Average | 4.5 | 5.0 | 5.3 | 5.2 | 5.0 | 5.2 | 5.5 | 5.7 | 5.6 | 5.5 | 4.8 | 4.4 | 5.1 |
| | Min/Max | 3.2/5.7 | 3.8/6.1 | 4.2/6.5 | 4.3/6.6 | 3.9/5.8 | 4.7/5.6 | 4.7/6.1 | 5.1/6.3 | 4.5/6.6 | 4.2/6.3 | 3.2/5.9 | 3.3/5.8 | 5.0/5.5 |
| 90 | Average | 3.9 | 3.9 | 3.5 | 2.8 | 2.2 | 2.0 | 2.1 | 2.7 | 3.4 | 4.1 | 4.0 | 3.9 | 3.2 |
| | Min/Max | 2.6/5.0 | 2.8/4.9 | 2.8/4.3 | 2.4/3.3 | 2.0/2.4 | 1.8/2.0 | 2.0/2.2 | 2.5/2.8 | 2.7/3.9 | 3.0/4.7 | 2.5/5.1 | 2.8/5.3 | 3.0/3.4 |

### 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 | 4.1 | 5.1 | 6.3 | 7.1 | 7.6 | 8.6 | 9.1 | 8.5 | 7.0 | 6.0 | 4.5 | 3.8 | 6.5 |
| | Min/Max | 3.0/5.1 | 3.9/6.3 | 4.9/7.8 | 5.7/9.5 | 5.4/9.2 | 7.4/9.8 | 7.3/10.8 | 7.3/9.6 | 5.6/8.6 | 4.5/6.8 | 3.1/5.6 | 2.9/5.0 | 6.1/7.0 |
| Latitude -15 | Average | 4.6 | 5.6 | 6.7 | 7.3 | 7.6 | 8.6 | 9.1 | 8.7 | 7.4 | 6.5 | 5.1 | 4.4 | 6.8 |
| | Min/Max | 3.3/5.9 | 4.2/7.0 | 5.1/8.4 | 5.8/9.8 | 5.4/9.3 | 7.3/9.7 | 7.3/10.7 | 7.4/9.8 | 5.8/9.0 | 4.9/7.5 | 3.3/6.4 | 3.3/5.8 | 6.4/7.4 |
| Latitude | Average | 5.0 | 5.9 | 6.8 | 7.2 | 7.4 | 8.2 | 8.7 | 8.5 | 7.5 | 6.8 | 5.5 | 4.9 | 6.9 |
| | Min/Max | 3.5/6.5 | 4.4/7.4 | 5.2/8.6 | 5.8/9.8 | 5.2/9.0 | 7.0/9.3 | 7.0/10.3 | 7.3/9.7 | 5.8/9.1 | 5.1/7.9 | 3.5/7.0 | 3.6/6.5 | 6.5/7.4 |
| Latitude +15 | Average | 5.3 | 6.0 | 6.8 | 6.9 | 7.0 | 7.6 | 8.2 | 8.1 | 7.3 | 6.9 | 5.7 | 5.1 | 6.7 |
| | Min/Max | 3.6/6.8 | 4.4/7.6 | 5.1/8.5 | 5.5/9.4 | 4.9/8.4 | 6.5/8.7 | 6.5/9.6 | 6.9/9.2 | 5.7/9.0 | 5.1/7.9 | 3.6/7.3 | 3.7/6.9 | 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 | 5.3 | 6.0 | 6.9 | 7.3 | 7.7 | 8.7 | 9.2 | 8.7 | 7.5 | 6.9 | 5.7 | 5.2 | 7.1 |
| | Min/Max | 3.6/6.9 | 4.4/7.6 | 5.2/8.6 | 5.8/9.9 | 5.5/9.4 | 7.5/9.9 | 7.4/10.9 | 7.4/9.9 | 5.9/9.2 | 5.1/8.0 | 3.6/7.3 | 3.8/7.0 | 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 | 3.1 | 3.3 | 3.4 | 3.4 | 3.6 | 4.4 | 4.8 | 4.4 | 3.7 | 3.8 | 3.3 | 3.2 | 3.7 |
| | Min/Max | 1.6/4.5 | 1.9/4.7 | 2.1/4.9 | 2.3/5.5 | 1.6/5.0 | 3.2/5.4 | 3.2/6.3 | 3.4/5.3 | 2.5/5.1 | 2.4/4.7 | 1.5/4.7 | 1.9/4.7 | 3.3/4.2 |
| 1-Axis, N-S Horiz Axis | Average | 2.6 | 3.3 | 4.1 | 4.4 | 4.8 | 5.7 | 6.3 | 5.9 | 4.7 | 4.1 | 3.0 | 2.6 | 4.3 |
| | Min/Max | 1.4/3.9 | 2.0/4.8 | 2.5/6.0 | 3.0/7.3 | 2.1/6.6 | 4.2/7.1 | 4.3/8.4 | 4.5/7.2 | 3.2/6.6 | 2.6/5.1 | 1.4/4.3 | 1.6/3.8 | 3.8/4.9 |
| 1-Axis, N-S Tilt=Latitude | Average | 3.5 | 4.1 | 4.5 | 4.6 | 4.6 | 5.3 | 6.0 | 5.9 | 5.0 | 4.8 | 3.9 | 3.5 | 4.6 |
| | Min/Max | 1.8/5.1 | 2.4/5.8 | 2.8/6.6 | 3.1/7.5 | 2.0/6.3 | 3.9/6.6 | 4.0/7.9 | 4.5/7.1 | 3.4/7.0 | 3.1/6.0 | 1.8/5.5 | 2.1/5.2 | 4.1/5.3 |
| 2-Axis | Average | 3.7 | 4.2 | 4.6 | 4.6 | 4.8 | 5.8 | 6.4 | 6.0 | 5.1 | 4.9 | 4.1 | 3.8 | 4.8 |
| | Min/Max | 1.9/5.5 | 2.5/6.0 | 2.8/6.7 | 3.1/7.6 | 2.2/6.7 | 4.3/7.2 | 4.3/8.5 | 4.6/7.4 | 3.4/7.0 | 3.1/6.1 | 1.8/5.8 | 2.3/5.6 | 4.3/5.5 |

### Average Climatic Conditions

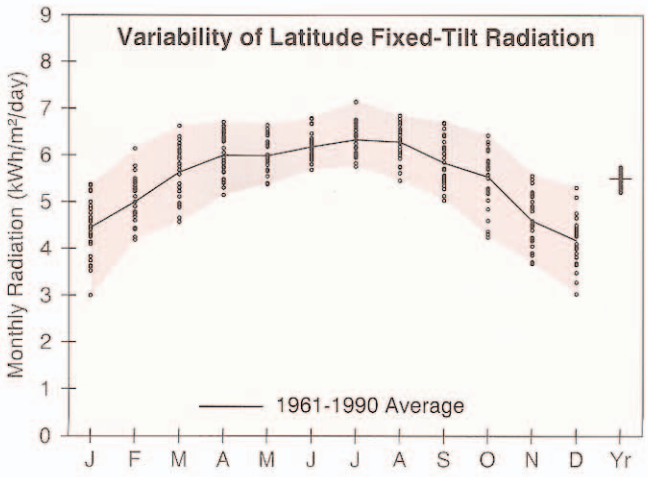
| Element | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec | Year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | 7.3 | 9.7 | 14.6 | 19.5 | 23.5 | 27.5 | 29.8 | 29.8 | 25.9 | 20.3 | 14.3 | 9.1 | 19.3 |
| Daily Minimum Temp | 1.2 | 3.3 | 8.2 | 13.4 | 17.9 | 21.6 | 23.6 | 23.3 | 19.8 | 13.8 | 8.1 | 2.9 | 13.1 |
| Daily Maximum Temp | 13.4 | 16.0 | 20.9 | 25.6 | 29.1 | 33.3 | 36.0 | 36.2 | 32.0 | 26.8 | 20.4 | 15.2 | 25.4 |
| Record Minimum Temp | -20.6 | -15.6 | -9.4 | -2.8 | 2.8 | 11.1 | 15.6 | 13.9 | 4.4 | -1.7 | -8.3 | -20.0 | -20.6 |
| Record Maximum Temp | 31.1 | 33.3 | 37.8 | 38.3 | 38.9 | 42.8 | 42.2 | 44.4 | 41.1 | 38.3 | 33.3 | 32.8 | 44.4 |
| HDD, Base 18.3°C | 344 | 245 | 137 | 37 | 0 | 0 | 0 | 0 | 0 | 21 | 135 | 291 | 1211 |
| CDD, Base 18.3°C | 3 | 0 | 20 | 72 | 160 | 275 | 355 | 355 | 227 | 81 | 13 | 3 | 1564 |
| Relative Humidity (%) | 71 | 69 | 66 | 68 | 71 | 67 | 60 | 60 | 67 | 67 | 71 | 71 | 67 |
| Wind Speed (m/s) | 5.1 | 5.5 | 5.9 | 5.8 | 5.4 | 4.9 | 4.8 | 4.5 | 4.5 | 4.6 | 4.9 | 4.9 | 5.1 |

# Wichita Falls, TX

## WBAN NO. 13966

LATITUDE: 33.97° N
LONGITUDE: 98.48° W
ELEVATION: 314 meters
MEAN PRESSURE: 979 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 | 2.9 | 3.7 | 4.8 | 5.8 | 6.4 | 6.9 | 7.0 | 6.3 | 5.2 | 4.2 | 3.1 | 2.6 | 4.9 |
| | Min/Max | 2.3/3.3 | 3.2/4.3 | 4.0/5.4 | 5.0/6.4 | 5.8/7.0 | 6.4/7.7 | 6.3/7.9 | 5.5/6.9 | 4.5/5.8 | 3.4/4.7 | 2.7/3.5 | 2.1/3.1 | 4.7/5.1 |
| Latitude -15 | Average | 3.9 | 4.6 | 5.4 | 6.1 | 6.4 | 6.7 | 6.8 | 6.5 | 5.7 | 5.1 | 4.1 | 3.6 | 5.4 |
| | Min/Max | 2.8/4.6 | 3.9/5.5 | 4.5/6.3 | 5.3/6.8 | 5.7/7.1 | 6.2/7.4 | 6.2/7.8 | 5.7/7.1 | 5.0/6.5 | 4.0/5.9 | 3.3/4.8 | 2.7/4.5 | 5.1/5.6 |
| Latitude | Average | 4.5 | 5.0 | 5.6 | 6.0 | 6.0 | 6.2 | 6.3 | 6.3 | 5.8 | 5.5 | 4.6 | 4.2 | 5.5 |
| | Min/Max | 3.0/5.4 | 4.2/6.1 | 4.6/6.6 | 5.2/6.7 | 5.4/6.6 | 5.7/6.8 | 5.8/7.1 | 5.5/6.8 | 5.0/6.7 | 4.3/6.4 | 3.7/5.6 | 3.0/5.3 | 5.2/5.8 |
| Latitude +15 | Average | 4.8 | 5.2 | 5.5 | 5.6 | 5.3 | 5.3 | 5.5 | 5.7 | 5.6 | 5.6 | 4.9 | 4.5 | 5.3 |
| | Min/Max | 3.1/5.8 | 4.3/6.4 | 4.5/6.6 | 4.8/6.2 | 4.8/5.9 | 4.9/5.8 | 5.1/6.2 | 5.0/6.2 | 4.8/6.4 | 4.3/6.6 | 3.8/6.0 | 3.2/5.8 | 5.0/5.6 |
| 90 | Average | 4.2 | 4.2 | 3.8 | 3.1 | 2.4 | 2.2 | 2.3 | 2.9 | 3.5 | 4.3 | 4.2 | 4.1 | 3.4 |
| | Min/Max | 2.6/5.2 | 3.3/5.2 | 3.1/4.6 | 2.8/3.4 | 2.2/2.6 | 2.1/2.2 | 2.2/2.4 | 2.6/3.0 | 3.1/4.1 | 3.2/5.0 | 3.1/5.2 | 2.8/5.4 | 3.2/3.6 |

### 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 | 4.1 | 5.2 | 6.5 | 7.7 | 8.3 | 9.1 | 9.3 | 8.5 | 7.1 | 6.0 | 4.4 | 3.8 | 6.7 |
| | Min/Max | 2.8/5.0 | 4.2/6.5 | 5.2/7.8 | 6.4/9.0 | 7.2/9.4 | 8.3/10.4 | 7.9/11.0 | 7.1/9.7 | 5.8/8.5 | 4.5/7.1 | 3.5/5.4 | 2.8/4.8 | 6.2/7.1 |
| Latitude -15 | Average | 4.9 | 5.8 | 7.0 | 8.0 | 8.4 | 9.0 | 9.2 | 8.7 | 7.5 | 6.7 | 5.1 | 4.5 | 7.1 |
| | Min/Max | 3.2/6.0 | 4.7/7.4 | 5.5/8.5 | 6.6/9.3 | 7.2/9.4 | 8.2/10.3 | 7.9/11.0 | 7.2/10.0 | 6.2/9.1 | 5.0/8.0 | 4.0/6.4 | 3.2/5.9 | 6.6/7.5 |
| Latitude | Average | 5.3 | 6.2 | 7.2 | 7.9 | 8.1 | 8.6 | 8.9 | 8.6 | 7.6 | 7.0 | 5.6 | 5.0 | 7.2 |
| | Min/Max | 3.4/6.6 | 4.9/7.9 | 5.6/8.7 | 6.5/9.3 | 7.0/9.2 | 7.8/9.8 | 7.6/10.6 | 7.1/9.8 | 6.2/9.2 | 5.2/8.4 | 4.3/6.9 | 3.5/6.5 | 6.7/7.6 |
| Latitude +15 | Average | 5.6 | 6.3 | 7.1 | 7.6 | 7.6 | 8.1 | 8.3 | 8.2 | 7.4 | 7.1 | 5.8 | 5.2 | 7.0 |
| | Min/Max | 3.5/6.9 | 5.0/8.1 | 5.5/8.6 | 6.3/8.9 | 6.6/8.6 | 7.3/9.2 | 7.1/9.9 | 6.8/9.3 | 6.1/9.0 | 5.2/8.4 | 4.4/7.2 | 3.6/6.9 | 6.5/7.4 |

### 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 | 5.6 | 6.3 | 7.2 | 8.0 | 8.5 | 9.2 | 9.4 | 8.8 | 7.6 | 7.1 | 5.8 | 5.3 | 7.4 |
| | Min/Max | 3.5/7.0 | 5.0/8.1 | 5.7/8.7 | 6.6/9.4 | 7.3/9.5 | 8.4/10.5 | 8.0/11.2 | 7.3/10.0 | 6.2/9.2 | 5.2/8.5 | 4.4/7.3 | 3.6/7.1 | 6.9/7.8 |

### 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 | 3.4 | 3.5 | 3.7 | 3.9 | 4.1 | 4.7 | 4.9 | 4.4 | 3.9 | 4.0 | 3.5 | 3.3 | 3.9 |
| | Min/Max | 1.6/4.7 | 2.4/5.0 | 2.5/4.9 | 2.8/4.9 | 3.2/5.1 | 4.0/5.9 | 3.7/6.6 | 3.2/5.4 | 2.7/5.1 | 2.5/5.2 | 2.2/4.7 | 2.0/4.9 | 3.4/4.3 |
| 1-Axis, N-S Horiz Axis | Average | 2.8 | 3.5 | 4.4 | 5.2 | 5.5 | 6.2 | 6.5 | 5.9 | 4.9 | 4.3 | 3.0 | 2.6 | 4.6 |
| | Min/Max | 1.3/3.9 | 2.4/5.1 | 3.0/5.8 | 3.6/6.6 | 4.2/6.7 | 5.3/7.8 | 4.8/8.8 | 4.2/7.4 | 3.4/6.6 | 2.7/5.6 | 1.8/4.2 | 1.5/3.8 | 4.0/5.1 |
| 1-Axis, N-S Tilt=Latitude | Average | 3.8 | 4.3 | 4.9 | 5.4 | 5.3 | 5.8 | 6.1 | 5.9 | 5.3 | 5.1 | 4.0 | 3.6 | 5.0 |
| | Min/Max | 1.7/5.3 | 3.0/6.3 | 3.4/6.6 | 3.8/6.8 | 4.0/6.5 | 4.9/7.3 | 4.5/8.3 | 4.2/7.4 | 3.7/7.1 | 3.2/6.7 | 2.5/5.5 | 2.1/5.3 | 4.3/5.5 |
| 2-Axis | Average | 4.1 | 4.4 | 4.9 | 5.4 | 5.6 | 6.3 | 6.6 | 6.1 | 5.3 | 5.2 | 4.2 | 4.0 | 5.2 |
| | Min/Max | 1.9/5.6 | 3.0/6.5 | 3.4/6.7 | 3.8/6.9 | 4.3/6.8 | 5.3/7.9 | 4.8/8.9 | 4.4/7.6 | 3.7/7.2 | 3.2/6.8 | 2.6/5.8 | 2.3/5.8 | 4.5/5.7 |

### Average Climatic Conditions

| Element | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec | Year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | 4.3 | 7.1 | 11.9 | 17.3 | 21.8 | 26.6 | 29.4 | 28.7 | 24.1 | 18.1 | 11.3 | 6.0 | 17.2 |
| Daily Minimum Temp | -2.4 | 0.1 | 4.8 | 10.2 | 15.1 | 20.0 | 22.6 | 21.9 | 17.7 | 11.2 | 4.8 | -0.7 | 10.4 |
| Daily Maximum Temp | 11.1 | 14.0 | 19.1 | 24.3 | 28.5 | 33.1 | 36.2 | 35.5 | 30.4 | 24.9 | 17.9 | 12.7 | 24.0 |
| Record Minimum Temp | -20.6 | -22.2 | -13.3 | -4.4 | 2.2 | 10.6 | 12.2 | 12.2 | 3.3 | -3.9 | -10.0 | -21.7 | -22.2 |
| Record Maximum Temp | 30.6 | 33.3 | 37.8 | 38.9 | 40.6 | 47.2 | 45.6 | 45.0 | 42.2 | 38.9 | 31.7 | 31.1 | 47.2 |
| HDD, Base 18.3°C | 434 | 316 | 209 | 69 | 6 | 0 | 0 | 0 | 3 | 58 | 213 | 382 | 1690 |
| CDD, Base 18.3°C | 0 | 0 | 11 | 38 | 112 | 247 | 344 | 321 | 177 | 51 | 0 | 0 | 1300 |
| Relative Humidity (%) | 66 | 66 | 61 | 62 | 66 | 64 | 56 | 58 | 67 | 66 | 68 | 68 | 64 |
| Wind Speed (m/s) | 5.1 | 5.4 | 5.9 | 5.9 | 5.7 | 5.2 | 5.0 | 4.6 | 4.7 | 4.9 | 5.1 | 4.9 | 5.2 |