Solar Resource Assessment

Databases, Measurements, Models, and Information Sources

Understanding the Resource

Like the weather, solar radiation resources vary with geographic location and time. Understanding these spatial and temporal variations is important for addressing key aspects of renewable energy technology development:

- Technology Selection
- Site Selection
- System Design
- System Performance
- System Operations

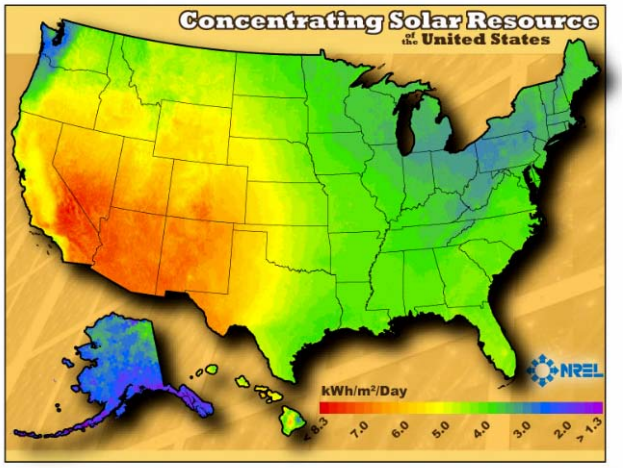
This fact sheet introduces key concepts and reference information useful for solar power developers and other stakeholders.

Databases

The National Solar Radiation Database (NSRDB) was developed by the National Renewable Energy Laboratory (NREL) and the National Climatic Data Center (NCDC) to provide solar planners and designers, building architects and engineers, renewable energy analysts, and countless others with extensive solar radiation information.

The database has two periods of record with content based upon solar and meteorological data available at the time. The 1991-2005 NSRDB Update contains hourly solar radiation (including global, direct, and diffuse) and meteorological data for 1,454 stations. This update builds on the original 1961-1990 NSRDB, which contains data for 239 stations. The update includes the conventional time series for NSRDB ground stations as well as a one-tenth-degree gridded data set that contains hourly solar records for 8 years (1998-2005) for the United States (except Alaska above 60º latitude) for about 100,000 pixel locations (at a nominal 10-km-by-10-km pixel size).

Typical Meteorological Year (TMY) data sets have been produced from each of the NSRDB periods. These data sets contain 8,760 hourly records selected from the NSRDB to represent a single year of solar resources and weather conditions at each station. TMY data provide a consistent basis for analyses.

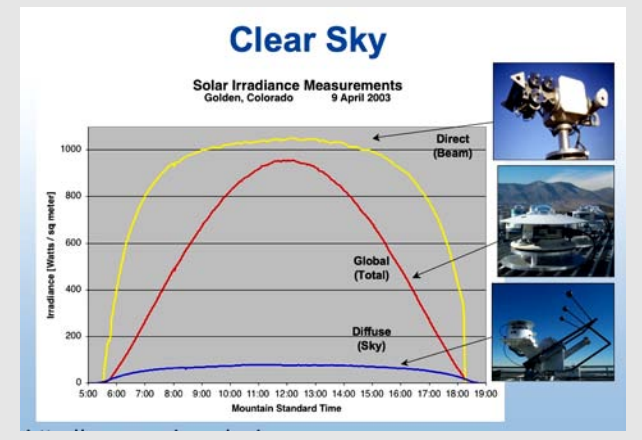


Direct Normal Irradiance (DNI) from satellite-based model estimates (1998-2005)

Measurements and Instrumentation

Historically, measurements of solar radiation in the U.S. have been limited due to the expense of deploying and maintaining the instruments. For example, 40 of the 1,454 stations in the updated NSRDB included solar measurements. Available measured data have been used to validate radiation models developed for estimating the solar resources. However, the renewable energy and climate research communities are finding these measurements of increasing value.

A variety of commercially available instruments can be used to accurately monitor solar irradiance (http://www.nrel.gov/solar_radiation).



Pyrheliometers and Pyranometers provide 1-min data at NREL's Solar Radiation Research Laboratory.

When developing a solar measurement system, there are several important aspects to consider:

- measurement accuracy must be sufficient to achieve the desired analysis goals,
- instrument performance specifications, methods of installation, frequency of calibrations and maintenance will directly affect measurement uncertainty,
- equipment installation should provide adequate solar access, ease of maintenance, and sufficient security, and
- data from the measurement station should be reviewed regularly for proper system performance, with discrepancies reported promptly for corrective action.

Models

In the absence of actual ground measurements of solar irradiance, models have been developed that use cloud information and other more available meteorological data to estimate the temporal and spatial variability of the solar resources. The NSRDB (1961-1990) and the NSRDB Update (1991-2005) relied on the *Meteorological Statistical (METSTAT)* and a satellite-based model developed by the State University of New York at Albany (SUNYA). In each case, the need was to develop a method suited to the availability of cloud information. These models estimate hourly values of global horizontal (total hemispheric), direct normal (beam), and diffuse horizontal (sky) irradiances.

Selected Information Sources

National Solar Radiation Database (NSRDB)	http://rredc.nrel.gov/solar/old_data/nsrdb/
The NSRDB contains 45 years (1961-2005) of solar radiation and supplementary meteorological data from over 1,400 sites in the U.S., plus sites in Guam and Puerto Rico.	
Typical Meteorological Year (TMY) Data	http://www.nrel.gov/rredc/solar_data.html
Solar and weather data derived from the 1952-1975 SOLMET/ERSATZ database. TMY data are hourly values of solar radiation and meteorological elements for a 1-year period. Their intended use is for computer simulations of solar energy conversion systems and building systems. Because they represent typical rather than extreme conditions, they are not suited for modeling extreme or worst-case conditions.	
TMY2	http://rredc.nrel.gov/solar/old_data/nsrdb/1961-1990/tmy2/
Hourly values of solar radiation and meteorological elements derived from the 239 locations of the 1961-1990 NSRDB. TMY2 data files are included in the Solar Advisor Model (SAM).	
TMY3	http://rredc.nrel.gov/solar/old_data/nsrdb/1991-2005/tmy3/
Hourly values of solar radiation and meteorological elements derived from the 1961-1990 and 1991-2005 NSRDB. Because they are based on more recent and accurate data, these new TMY3 data sets are recommended for use in place of earlier TMY2 data. Can be used in SAM when saved in EPW format (see guidance in SAM).	
NREL Measurement & Instrumentation Data Center	http://www.nrel.gov/midc/
Nearly real-time measurements from selected stations in the U.S.	
NREL Geographic Information System (GIS)	http://www.nrel.gov/gis/solar.html
Data and maps.	
NASA Surface Meteorology and Solar Energy	http://eosweb.larc.nasa.gov/sse/
Satellite-derived meteorology and solar energy parameters for 1,195 sites around the world.	
Solar and Wind Energy Resource Assessment (SWERA)	http://swera.unep.net
Source of international DNI maps and data.	
NREL Concentrating Solar Power (CSP) Research	http://www.nrel.gov/csp/modeling_analysis.html
Modeling, analysis, maps. Access to **Solar Power Prospector** interactive resource map.	
Solar Advisor Model (SAM)	https://www.nrel.gov/analysis/sam/
Simulation model for analyzing and comparing solar power system costs and performance across a range of solar technologies and markets.	
NREL Renewable Resource Data Center	http://www.nrel.gov/rredc/models_tools.html
Clear Sky Irradiance, DNI from Global, Spectral Irradiances, Solar Position, & PVWatts.	

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