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ENERGY SYSTEMS INTEGRATION

ESI optimizes the design and performance of electrical, thermal, fuel, and water pathways at all scales.

RESEARCH HIGHLIGHTS

Best Practices Handbook for the Collection and Use of Solar Resource Data for Solar Energy Applications

Comprehensive handbook helps the solar industry collect and interpret solar resource data for each stage of a solar energy project.

About the Handbook

The *Best Practices Handbook for the Collection and Use of Solar Radiation Data for Solar Energy Applications* provides the solar energy industry with a single document addressing key aspects of solar resource characterization needed for planning each stage of a large solar power system, from initial site selection to system operations.

The handbook was assembled by scientists and engineers who have many decades of combined experience in state-of-the-art atmospheric science, radiometry, meteorological data processing, and renewable energy technology development. It contains contributions from an international group of experts primarily from knowledge gained through participation in the International Energy Agency's Solar Heating and Cooling Programme.

The handbook discusses solar resource components, instrument types, measurement station design, current best practices in modeling and forecasting solar radiation, historical radiation data, and methods to apply solar radiation data to solar energy projects. It also contains a summary of solar forecasting and its development throughout the last few years. Solar energy project developers; engineering, procurement, and construction firms; utility companies; electric power system operators; energy suppliers; financial investors; and others involved in solar energy systems planning and development will find this handbook to be a valuable resource for collecting and interpreting data that can be used as a reference during each project stage.

Solar Resource Data

Reliable information about the solar resource is required for every solar energy application, from small installations on a rooftop to large solar power plants. However, solar resource information is of particular interest for large installations, because they require substantial investment. Before such a project is undertaken, project developers need to have reliable data about the solar resource available at specific locations, including historic trends with seasonal, daily, hourly, and (preferably) subhourly variability to predict the daily and annual performance of a proposed power plant. Without this data, an accurate financial analysis is not possible.

The variability of the supply of solar radiation represents the single greatest uncertainty in a solar power plant's predicted performance. Solar resource data and modeling factor into three elements of a solar project's life:

- Selecting a site
- Modeling and forecasting plant production
- Optimizing performance and operating strategies.

Senior scientist Ibrahim Reda adjusts some solar trackers on the deck of NREL's Solar Radiation Research Laboratory.
Photo by Dennis Schroeder, NREL 19546

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Selecting a Site

Site selection includes numerous factors, but a top priority is a good solar resource. For site selection, data from individual years and a representative annual solar resource are required to make comparisons to alternative sites and estimate power plant output. Because site selection is always based on historical solar resource data, and because changes in weather patterns occur from year to year, more years of data are better for determining a representative annual data set. The handbook describes methods to derive a typical meteorological year (TMY). TMY data are used to compare the relative solar resource at alternative sites and to estimate the probable annual performance of a proposed solar power plant. Data from individual years are required to assess the annual variability that can be expected for a proposed location.

Modeling and Forecasting Plant Performance

In the absence of long-term ground data, development of TMY data for large regions requires the use of models that rely mostly on satellite imagery. In regional terms, identifying prime solar resource areas is fairly simple. The southwestern United States, for example, has broad areas of excellent solar resource. However, narrowing down the data to a specific few square kilometers of land requires considering local impacts. Satellite data are very useful in mapping large regions, but individual sites should be vetted by using ground-monitoring stations. Local measurements can be compared to same-day satellite data to test for bias in the satellite model results. Any correction in the satellite model can then be applied to the historical data sets. Correcting any bias in the satellite data will allow the modeler to more accurately apply multiple years of satellite data to generate an improved TMY data set for a site.

Resource forecasting is becoming more important for plant dispatch as higher penetrations of solar power are planned for the electric grid. An accurate forecast can increase power plant profits by optimizing energy dispatch into the time periods of greatest value. Forecasting requires the proper use of satellite- and ground-based data sources and models.

Optimizing Performance and Operating Strategies

After a plant is built, resource data are immediately required to complete acceptance testing. The owner and financiers will need to verify that the power plant output meets its design specifications for a specific solar input. Often the acceptance tests will be for a short duration, perhaps a few days, but the owners will want to extrapolate the results to estimate annual performance. Annual performance estimates can be improved by comparing locally measured ground data to the satellite-derived data for the same time interval.

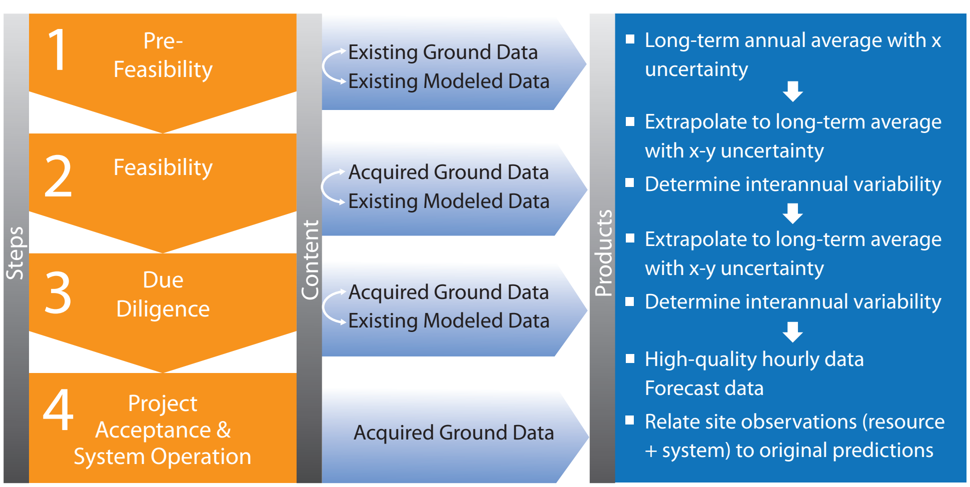
Comparing plant output as a function of solar radiation resource is a global indicator of power plant performance. A drop in overall efficiency implies a degradation of one or more power plant components and indicates that maintenance is required. Accurate resource data will remain essential to a power plant's efficient operation throughout its service life.

Download the Handbook

Download the *Best Practices Handbook for the Collection and Use of Solar Resource Data for Solar Energy Applications* at *www.nrel.gov/docs/fy15osti/63112.pdf*.

For More Information

Visit *www.nrel.gov/solar_radiation/* or contact Manajit Sengupta, NREL Resource Assessment and Forecasting group manager, Manajit.Sengupta@nrel.gov.



The four stages of a solar power plant project.

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