A national laboratory of the U.S. Department of Energy
Office of Energy Efficiency & Renewable Energy

NREL National Renewable Energy Laboratory

Innovation for Our Energy Future

Center for Electric & Hydrogen Technologies & Systems
Resource Integration Group

Data, Analysis, Metrology, and Measurements of Renewable Energy Resources

Renewable resources can vary considerably from one geographic location to another. Consequently, optimal siting of renewable energy systems requires knowledge of the resource characteristics at any given location. Determining these characteristics — magnitude and variability — draws on the combined knowledge of measurement experts, modelers, and analysts.

The Resource Integration Group, which includes a Geographic Information System (GIS) Team and a Measurement and Instrumentation Team, provides renewable resource data for U.S. and international locations.

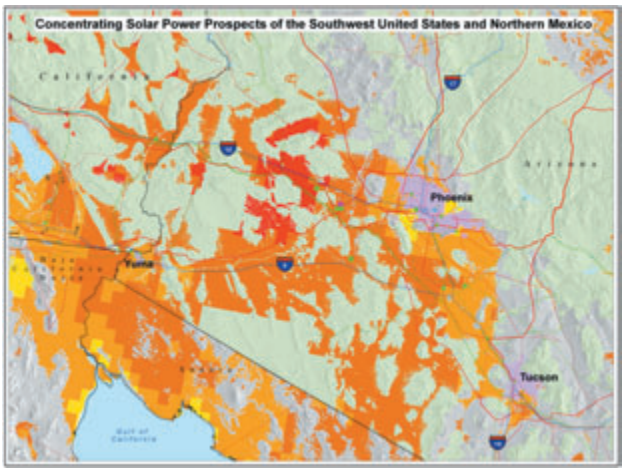
Modeling

Using satellite and ground-based weather information, the Resource Integration Group constantly upgrades and refines its solar resource models. The group uses these models to provide reliable and accurate data and maps on the solar resource anywhere in the world. Industry, government planners, and others use the data generated by these models to find the most likely locations of favorable energy resources, or to define the resource at specific locations where renewable technologies might be installed to meet a particular need. The data serve as a reliable guide for siting and sizing renewable energy systems, and follow up analysis on system performance.

Using historical or recent meteorological data from weather stations around the world, the group developed models that provide hour-by-hour solar radiation data at thousands of locations. These data are used to predict the performance of stand-alone and grid-connected solar systems for any time period (hourly, daily, monthly, etc.), and how well those systems may meet load requirements.

Geographic Information System Capabilities

The GIS team uses state-of-the-art geographic information system tools to organize, display, and analyze geospatial data important to solar, wind, biomass, hydrogen and geothermal technologies. The team manipulates, analyzes, and compares the data sets to extract information for optimized technology deployment. For example, to determine whether a particular type of solar technology would pay back on a startup investment, one could use GIS data to compare a region's solar resource with its electrical



Site analysis based on modeled direct normal solar radiation with 10km resolution, screened to show only areas with excellent solar resources, minimal ground slope, excluding major urban areas, water features and environmentally sensitive lands.

transmission network, and availability of flat land suitable for large solar trough arrays.
The capabilities of GIS are greatly enhanced by NREL's team of experts — who can perform the manipulation and analysis to link topographic, demographic, utility, facility, resource, environmental, land use, and other data for a variety of uses, including energy planning and forecasting, policy formulation, and project development assistance.

The GIS team also maintains a web site, where users can view a variety of interactive maps, and download various datasets from an ftp site. Users can access some of NREL's solar and wind resource data as well as view and use the internet map server GIS capabilities through their web site at http://www.nrel.gov.

Measurements and Instrumentation

The Solar Radiation Research Laboratory (SRRL) is a unique research facility located on South Table Mountain in Golden, Colorado. The lab continually measures solar radiation and other meteorological data and makes the information available nearly instantly via a real-time web server to the public, government, industry, academia, and international laboratories and agencies. The measured data include global, diffuse, and direct-normal solar radiation, ultraviolet and infrared radiation, atmospheric aerosols, wind speed and direction, temperature, barometric pressure, relative humidity, and more.

These research-quality meteorological data are used for climate change studies, atmospheric research, renewable energy conversion system testing, and more.

A wide range of measurement functions are conducted at the SRRL, including:

- Operating a baseline measurement system, an array of more than 100 instruments to collect minute-by-minute radiation and atmospheric data. Among other applications, these data are used by the World Meteorological Organization's World Radiation Data Centre.

- Operating the Metrology Laboratory to provide internationally traceable calibrations for all NREL measurement and test equipment, including pyrgeometers, pyranometers, pyrheliometers.

- Serving as a U.S. facility for maintaining and transferring international radiometer calibration standards to government, industry, and academic laboratories.

Operating the Optics Laboratory to support outdoor and indoor characterization of photovoltaic devices with broadband and spectral irradiance standards and specialized measurements.

- Research support for measurement networks, such as radiometer calibration and automated data quality assessment techniques for the Atmospheric Radiation Measurement (ARM) program, DOE's global climate change research program.

Additional information, including real-time data displays and access to the SRRL Baseline Measurement System are available at http://www.nrel.gov/srrl.

Combined Capabilities

NREL's Resource Integration Group brings expertise and resources to provide the data and tools necessary to address leading-edge renewable-energy resource issues, both domestically and internationally.

To support system design and project planning and to promote the understanding of renewable resource collection, analysis, and modeling, the Resource Integration Group develops and disseminates data manuals, resource maps, and other data products.

The SRRL employs scores of instruments to measure radiation and atmospheric data. The equipment shown here measures direct-beam, diffuse-sky and global solar irradiances, ultra-violet and infrared radiation, and atmospheric aerosols and water vapor.

Typically, these products provide data on the renewable resource across large regions. But for particular projects or user's special needs, the group also develops customized maps and data sets.

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General products immediately available to the public in printed, electronic, or on-line formats include:

- Maps and atlases of solar and wind resources for monthly, seasonal, and annual periods.

- Base maps of biomass and geothermal resource data provided by other research groups.

- Clear-sky broadband and spectral solar radiation models and attendant documentation.

- Manuals and research publications on solar radiation data, solar spectral models, and more.

- Glossaries.

- Primers on solar radiation data and its measurement.

- Links to other useful solar radiation measurement and data sites.

The Resource Integration Group's Renewable Resource Data Center posts some of the above information at http://rredc.nrel.gov.

National Renewable Energy Laboratory 1617 Cole Boulevard, Golden, Colorado 80401-3393
303-275-3000 · www.nrel.gov

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