



## Electricity, Resources, & Building Systems Integration

# Resource Information and Forecasting Group

Electricity generated by renewable energy resources such as wind, solar, biomass, geothermal, ocean kinetics, and hydro, is rapidly becoming a large part of the electric power supply in the United States. The optimal use of these renewable energy resources depends largely on measured and modeled historical and real-time meteorological data to identify the best sites for renewable energy generation and accurately forecast wind, sun, and precipitation to ensure cost-effective operations of generating facilities.

Researchers in the Resource Information and Forecasting group at the National Renewable Energy Laboratory (NREL) provide scientific, engineering, and analytical expertise to help characterize renewable energy resources and facilitate the integration of these clean energy sources into the electricity grid. As part of NREL's Electricity, Resources, and Building Systems Integration Center, we provide renewable energy resource information and analyses to support renewable energy research and development across the entire electricity system—from generation, to transmission and distribution, down to the end user.

### Non-Biased, World-Class Information

NREL's mission and strategy are focused on advancing the U.S. Department of Energy's goals. With no vested interest other than upholding NREL's mission, our Resource Information and Forecasting group, comprised of atmospheric scientists, electrical engineers, physicists, computer scientists and applied math professionals, provides stakeholders with integrated resource assessments critical to the design, deployment, and cost-effectiveness of renewable energy generation and distribution systems.

### Renewable Energy Planning

Almost every area of the country can take advantage of renewable energy technologies, but some technologies are better suited for particular areas than others. Energy planners, project developers, and policy makers use renewable energy technologies more effectively when they have accurate and thorough information about their renewable energy resources.

By integrating resource information with accurate representations of spatial and temporal resource characterizations and interfacing the data with key analytical models, our experts provide tools to accurately assess renewable energy density (watts per square meter) as it varies with time and location and information on how to design efficient integrated renewable energy systems for central and distributed power production.

### Site Characterization

Optimal siting of renewable energy systems requires knowledge of the resource characteristics at any given location. However, resource characteristics vary with the renewable resource and the technology being used, and therefore



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command unique sets of data elements to accurately assess both sides of the energy equation: which technology is to be used where and how well it will perform. Whether we're assessing a given location for the best technology, or a renewable energy technology for the best location, accurate assessment of the renewable resource potential is essential to ensuring the availability, reliability, sustainability, and profitability of any renewable energy investment. This information is critical to project developers in order to obtain financing.

### Resource Information

To put it simply, wind must blow where wind farms are sited; sun must shine on solar farms; feedstock crops must grow for bioenergy; hot rocks are needed for geothermal energy; and water must move for hydro or ocean power. But to accurately measure the potential of a renewable energy source at any given location is not a simple process. Carefully measured and modeled data are used to characterize variations in time and space of crucial parameters (i.e. wind velocity, solar irradiation, precipitation, subsurface temperatures, stream flow) directly related to the optimization of each resource.

The development of databases that incorporate the various data sets for different renewable energy sources is a necessary step for resource assessment. NREL's Resource Information and Forecasting group determines the data elements or factors that are significant to a particular renewable energy generating technology, gathers the data pieces from a variety of different sources, generates data elements when needed (e.g. model estimates of solar fluxes from observed cloud amounts), and maintains these unique data pieces in databases that are specific to renewable energy. Data are frequently collected from the U.S. Geological Survey (USGS), U.S. Department of Agriculture (USDA), Environmental Protection Agency (EPA), the National Oceanic Atmospheric Administration (NOAA), as well as NREL's own measuring devices and resource models and the National Aeronautics and Space Administration (NASA).

The resulting resource databases are then used as key inputs to model energy conversion system performance (e.g., PVWatts for photovoltaic systems), building energy performance (e.g.,

BEopt for optimal building energy design), and resource characterizations (e.g., TMY typical meteorological year data sets).

### Who Uses Resource Information?

Everyone associated with a renewable energy project has use for accurate, reliable, unbiased, resource information. Policy makers want to know where renewable generation projects are located and how they interconnect into the existing system. Developers want to know where to deploy renewable energy conversion systems and in what form. Engineers use resource information for system design and implementation strategies and scientists use the data for the development and validation of computer models used in atmospheric science and climate change research. System operators use resource information to maintain peak performance and provide customers with stable generation, and end users use it to determine energy generating capacity and installed system performance. Investors use resource information to evaluate the viability of investing in a project.

### Analytical Tools and Websites

**PVWatts™ Calculator** estimates the electrical energy produced by grid-connected photovoltaic systems. [www.nrel.gov/rredc/pvwatts/](http://www.nrel.gov/rredc/pvwatts/)

**Solar Advisor Model (SAM)** allows users to investigate the impact of variations in physical, cost, and financial parameters to better understand their impact on key figures of merit. [www.nrel.gov/analysis/sam](http://www.nrel.gov/analysis/sam)

**HOMER**, the micropower optimization model, simplifies the task of evaluating design options for both off-grid and grid-connected power systems. <https://analysis.nrel.gov/homer/>

**In My Backyard (IMBY)** estimates the electricity you can produce with a solar PV array or wind turbine at your home or business. [www.nrel.gov/eis/imby](http://www.nrel.gov/eis/imby)

**Geospatial Toolkit** is a map-based software application that integrates resource data and GIS for integrated resource assessment. [www.nrel.gov/applying\\_technologies/geospatial\\_toolkits.html](http://www.nrel.gov/applying_technologies/geospatial_toolkits.html)

**ViPOR**, an optimization model for designing village electrification systems can determine which houses should be powered by isolated power systems and which should be included in a centralized distribution grid when given a map of a village and some information about load sizes and equipment costs. <http://analysis.nrel.gov/vipor/>

**Renewable Resource Data Center:** [www.nrel.gov/rredc](http://www.nrel.gov/rredc)

**Measurement & Instrumentation Data Center:** [www.nrel.gov/midc](http://www.nrel.gov/midc)

**Wind Resource Assessment:** [www.nrel.gov/wind/resource\\_assessment.html](http://www.nrel.gov/wind/resource_assessment.html)

### Resource Forecasting

The use of renewable resource forecasting is becoming a critical component in the operation of the electrical grid as more renewable energy generation is added. Because of the variability of energy production from weather-driven renewable technologies, the need for reliable short-term forecasting is essential to the optimization of renewable electricity generation and grid performance.

Researchers at NREL are working with the renewable energy industry to provide utilities and grid operation organizations with weather forecast techniques that incorporate meteorological data to predict renewable electrical generation. One of those techniques is mesoscale modeling. A familiar tool in weather forecasting, mesoscale modeling offers resource assessment potential for local and site-specific applications by simulating with reasonable accuracy, complex wind flows and cloud formations in areas where surface measurement are scant or non-existent.

### Working with Us

Key resource questions must be answered to accelerate the deployment of renewable energy. NREL's researchers establish technology partnerships to conduct joint research, provide technical assistance, and perform testing. For more information, contact Tom Stoffel at [Thomas.Stoffel@nrel.gov](mailto:Thomas.Stoffel@nrel.gov).

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NREL is a national laboratory of the U.S. Department of Energy Office of Energy Efficiency and Renewable Energy Operated by the Alliance for Sustainable Energy, LLC

NREL/FS-550-46441 • November 2009