Western Wind Dataset

Here you will find information about the Western Wind Dataset, including the methodology used to develop the dataset, the accuracy of the data, site selection, and power output.

This dataset was originally created for the Western Wind and Solar Integration Study. These data are modeled data and not actual measured data. Learn more about the datasets including the similarities and differences between the Eastern and Western datasets and the differences from the NREL state wind maps.

Alert! Important Note
Obtain the Western Wind Dataset

Methodology

3TIER created the Western Dataset with oversight and assistance from NREL. Numerical Weather Prediction (NWP) models were used to essentially recreate the historical weather for the western U.S. for 2004, 2005, and 2006. The modeled data was temporally sampled every 10 minutes and spatially sampled every arc-minute (~2 kilometers). The wind data is presented in Greenwich Mean Time.

In conjunction with NREL, these 1.2 million grid points were screened to eliminate recreational and other non-developable areas. Further sites were chosen from the remaining sites using an iterative selection algorithm. First, promising sites were selected based on proximity to planned transmission projects and energy zones and based on wind energy density. The next selection phase chose a number of sites in each state (determined by the relative importance of the state in the study) based on the correlation of the wind's diurnal cycle matched with the load profile in the study (with a mean wind energy density of at least 300 W/sqm).

The final selection phase chose a number of sites in each state (determined by the relative importance of the state in the study) based on the highest wind energy density. In total, we selected 32,043 locations. Each grid point is estimated to hold ten Vestas V90 3-MW turbines, therefore the 32,043 locations total to more than 960 GW of wind sites.

3TIER modeled the power output of ten turbines at 100 meters above ground level on each grid point using a version of their SCORE methodology which replicates the stochastic nature of wind plant output. NREL modeled hysteresis around wind turbine cut-out to further replicate how real wind plants operate.

3TIER has completed a final report describing the overall project and a conference paper detailing the modeling and inputs.

NREL Review and Data Accuracy

NREL meteorologists and wind resource scientists are in the process of reviewing the Western Wind Resources Dataset. Revised versions of the dataset may be released in the future. The goal of the review process will be to increase the accuracy of the modeled wind characteristics such as average wind speeds and wind power densities. Future reviews may also aim to increase the accuracy of model seasonal and diurnal wind profiles.

NREL released the dataset prior to review because there were several immediate needs for this dataset and this dataset is currently far more accurate and realistic than any other public time-series wind dataset that covers this region.

The best gauge of accuracy is the comparison of model results with actual measured wind speeds, such as that done in 3TIER's validation reports. 3TIER has compared the wind dataset to 28 public wind measurement towers and also some proprietary towers. The model tends to be more accurate in non-complex terrain (no sharp features, flat or rolling terrain) and less accurate in complex terrain (canyons, mountains, terrain with sharp features). East of the Rocky Mountains, the model appears to work well, with some underestimation of the resource during the warm season. West of the Rocky Mountains, in downslope acceleration areas, the model may overestimate downslope winds. In thermally driven areas (Altamont, Solano, Columbia Gorge, Stateline/Vansycle, Ellensburg/Columbia River), the model may underestimate winds, especially in the summer. To accurately model complex terrain, the model must be specifically tuned to that location, ideally using on-site data.

Site Selection

Not all good wind resource sites were included in this dataset. The main driver for the creation of this dataset was to provide input to the Western Wind and Solar Integration Study (WWSIS). As a result, sites were selected so that NREL could build scenarios for WWSIS that would specifically consider certain factors such as load correlation. Sites were selected based on several criteria:

Alert! An important note to the users of the Western Wind Dataset.

- Using NREL's standard exclusion criteria (protected lands, etc) plus additional criteria (10% slopes or greater, forested lands, high elevation), sites were excluded
- Using the Platt's database, existing wind plants were selected
- 200 GW of sites were selected in the WWSIS footprint near proposed new transmission corridors or in energy zones with the highest wind energy density
- 250 GW of sites were selected in the WWSIS footprint that correlate best with the WWSIS diurnal load profile and have at least 300 W/sqm
- 415 GW of the highest wind power density sites across the western U.S. were selected, with specified amounts selected for each state and offshore, and
- An additional 45 GW were selected to help validate and characterize model accuracy.

Modeling of Excluded Sites

NREL used standard exclusion criteria used in the NREL wind maps to exclude sites that were unlikely to be developed. Many remaining areas were still judged to be undevelopable, so additional criteria such as slope, forest cover, and elevation were added. Because this was automated and implemented on a large-scale, there are likely to be many sites that:

- fell between the cracks, and
- should have been excluded due to their feasibility for development but were not.

The geographic information system, or GIS, databases that are used for screening are not perfect. These automated screening techniques are also no substitute for a real person. For this reason, 3TIER modeled many more sites than were needed in the Western Wind and Solar Integration Study so that there would be ample sites to generate scenarios for the study.

Wind Plant Output

The rated power output is the power output that would be determined by using the manufacturer's rated power curve and looking up the power output that corresponds to the wind speed. Each grid point is estimated to hold ten Vestas V90 3 MW turbines; 3TIER modeled the power output of ten turbines at 100 meters above ground level on each grid point.

The SCORE-lite power output was developed by 3TIER because real wind turbines and real wind plants do not produce as smooth output as this "rated power output". The SCORE technique is a methodology to put the observed stochastic behavior of real wind turbines and real wind plants back into the wind output. The SCORE process is stochastic so while it is accurate in the long-term, the specific wind power outputs at t and t+1 may not be accurate. For regions where wind speeds are often near wind turbine cut-out (~25 m/s), SCORE output does not replicate the hysteresis of real wind turbines in which wind turbines that have cut-out (wind speed greater than 25 m/s for the Vestas V90) cannot restart until the wind speed drops below a cut-back-in speed (20 m/s for the Vestas V90). The hysteresis-corrected SCORE is an attempt to put the wind turbine hysteresis at cut-out back into the plant output. While this hysteresis should be put back in on a turbine level, it is put back in on a 30 MW wind plant level because that is the granularity of 3TIER's wind plant modeling.