

# Modeled Production Data Improves Planning

*Atmospheric models can provide historical, time-varying wind data that can be delivered quickly and within specific accuracy guidelines.*

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Accurate, time-varying wind plant production data are necessary for transmission planning and financial analysis of merchant wind plants. Unfortunately, the hub-height wind data necessary to compute production are often not readily available or do not cover a sufficiently long period for reliable analysis.

One alternative is to use off-site wind data from meteorological stations, but this can be inaccurate and the number of suitable stations may be limited. Physics-based atmospheric models, on the other hand, can provide historical, time-varying wind data for any site of interest for any period over the last 40 years. The results can be delivered in a matter of weeks and are within the accuracy requirements of these applications.

## **Transmission planning**

AWS Truewind has supported numerous grid integration and grid planning studies using its proprietary atmospheric models. These studies have been commissioned to inform policy decisions, develop new system control techniques, and identify promising areas for future power system upgrades.

One of the first and most comprehensive such studies, a two-phase

effort done for the New York State Energy Research and Development Authority (NYSERDA) and led by GE Energy, identified the impacts of increased wind penetration on the New York State Bulk Power System.

In Phase I, GE made a preliminary assessment of New York's bulk power system with regard to potential wind generation. For this part of the study, AWS Truewind identified a total of 101 prospective wind generation sites.

Data from the New York State Wind Map, generated by AWS Truewind using MesoMap, was input into a geographic information system-based site screening tool. Sites were identified throughout the state, with a total generation capacity of 10,026 MW. For each of the 101 prospective sites, this data included statistically derived hourly power output in megawatts for a full calendar year.

In Phase II, GE focused on two scenarios with 3,300 MW of wind distributed among 33 sites. AWS Truewind produced four years of hourly production data. Also provided were day-ahead and hour-ahead forecasts tuned to the New York Independent System Operator's (NY-ISO) existing operating practices, as well as samples of short-term one-

minute and one-second data during significant time periods (e.g., summer mornings, when loads tend to rise rapidly while wind output tends to drop).

In both phases, hourly production data were produced by running a mesoscale model at an 8-km resolution. The hourly temperature and wind data were stored for each grid point. The wind speeds were then scaled to match the predicted mean annual wind speed at 65-m height for each site from the wind map.

Next, the scaled hourly wind speeds were applied to a power curve for a generic 1.5-MW wind turbine; the power curve was adjusted to the site air density for each hour derived from the elevation and simulated temperature.

Last, a moving-average filter was applied to simulate the smoothing effect of the turbines within each project, which slightly reduces the variability of the plant output.

The results demonstrated the economic benefit of wind generation, including cost reductions because of reduced fuel use, start-up costs, variable operations and maintenance costs, and emission payments.

System-wide, the 3,300-MW wind scenario offered an economic benefit of \$335 million per year without the

use of a forecasting service to optimize unit commitment. With forecasting, wind provided an even larger system benefit of \$430 million per year. (The final report is publicly available on the NYSERDA Web site, [www.nysesda.org](http://www.nysesda.org).)

### **Merchant plant finance**

Merchant plant finance is developing in many markets. Beyond a deregulated market, the following factors can make merchant plants attractive:

- a high percentage of natural gas or oil generators in a system;
- favorable locational marginal pricing at the point of interconnection;
- a sufficient number of market participants; and
- wind-friendly market rules, such as regarding ancillary services.

Currently, the New York, New England and California markets show the most promise for merchant plant finance. Conditions in these and other markets will likely improve over the coming years.

An added challenge of merchant plant finance is estimating the revenue stream – especially the variability of the revenue stream – for investors. Merchant plant revenue varies as a function of wind resource availability and market price, both of which

fluctuate by season and time of day.

Obtaining historical market prices is generally no problem. To simulate the plant production, however, a source of historical, time-varying wind data for the site is needed. When a sufficient period of on-site data is not available – preferably several years – wind data from a regional meteorological station can be used, but this may not be very accurate.

For example, the short towers at these stations usually record a much different daily wind pattern than observed by tall towers at or near turbine hub height. The height gap can mean the difference between predicting that the wind resource peaks strongly during the day or just as strongly at night.

Another approach is to use a numerical weather model to simulate historical, time-varying winds at the site for a long period. Transmission planning studies we have participated in show that this method produces a realistic seasonal and daily wind pattern, which is essential to accurately calculating revenues.

Moreover, the long period that can be spanned by such simulations – as long as 40 years if desired – allows the capture of the full range of variation of revenues on an annual and seasonal basis. Any available on-site wind data can be used

to improve the accuracy.

Merchant plant finance and operation may also benefit from wind plant forecasting services once the project is online. Providing forecasts from minutes to days ahead, such services allow plant operators to take advantage of more advanced trading systems. Forecast accuracy is increased with the use of atmospheric models and advanced statistical techniques. Greater accuracy means greater benefits for the plant operator.

Time-varying wind production data can facilitate transmission planning and merchant plant finance. With present methods, data can be produced quickly and with sufficient accuracy to allow transmission service companies, utilities, system operators, developers and investors to make more informed decisions. **SWP**

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