

Horizon Wind Energy Develops Revenue Forecasting and Risk Analysis Tools for Wind Farms

Utilities that run coal, natural gas, and oil power plants can control production and predict future revenue. For wind farms, however, business planning presents a challenge. A wind farm's production changes based on local wind speeds, making forecasts much less reliable.

To generate accurate revenue forecasts and revenue-at-risk projections, Horizon Wind Energy combines production estimates for all wind farms in its portfolio with forecasts of power prices on the futures market. Using MATLAB®, Horizon analysts developed an automated risk-forecasting system that factors in historical data, current prices, and forward-looking estimates from expert analysts.

“Because our team already knew MATLAB, we did not need a programmer. Instead, our structuring and market operations analysts, who already had the necessary experience in mathematics and economics, developed the system directly, which is a much more efficient process,” says Manuel Arancibia, market operations manager at Horizon. “MATLAB enabled these analysts to build a reliable, scalable forecasting and analysis solution from scratch.”

THE CHALLENGE

Horizon's initial system for projecting power prices was not feasible. “We had a network of 15 spreadsheets, some with as many as 500,000 rows,” recalls Michael Weeks, market operations analyst at Horizon. “The system wasn't reliable. It crashed, it wasn't scalable, and each new run required hours of manual steps.”



Horizon Wind Energy's Wheat Field Wind Farm.

The team had to link price forecasts to volumetric forecasts for wind-generated power while cross-correlating price and wind levels across multiple geographically dispersed locations—complex tasks that were challenging with spreadsheets.

Horizon needed an automated forecasting and risk management solution that was reliable and scalable and could be deployed easily within the existing IT infrastructure.

THE SOLUTION

Horizon analysts used MATLAB, MATLAB Compiler™, and companion toolboxes to develop two complementary systems: the Price Reporting System (PRS) for price forecasting, and the Portfolio Decision System (PDS) for portfolio and risk analysis.

For the PRS, Weeks used Database Toolbox™ to read data from multiple SQL databases, including internal long-term price forecasts, third-party forecasts, historical prices, and daily forwards contracts. He developed algorithms in MATLAB that analyzed this data to produce monthly price forecasts for the next several years across all Horizon wind farm sites.

THE CHALLENGE

Develop revenue forecasts and quantify risk for wind farms across multiple geographic locations

THE SOLUTION

Use MATLAB and MATLAB Compiler to develop and deploy an automated production system that analyzes historical, current, and forward-looking price and wind-level data

THE RESULTS

- Core process automated
- Standalone program seamlessly integrated with enterprise IT infrastructure
- Risk management improved, saving millions of dollars

Weeks used MATLAB Compiler to deploy a version of the PRS that runs automatically each morning and stores its forecast results in the database.

In developing the PDS, Cedric Kouam, senior structuring analyst at Horizon, used Database Toolbox to access the PRS price forecasts.

Using Econometrics Toolbox™, he determined the short-term and medium-term volatility of the pricing information based on historical options trading information.

With input from Horizon's wind assessment group, Kouam used Statistics Toolbox™ and Curve Fitting Toolbox™ to find a statistical distribution that fit the historical wind-level data at each site.

Kouam generated random numbers with Statistics Toolbox for Monte Carlo simulations to study wind distribution and energy prices. These simulations quantified value at risk, revenue at risk, and overall projected revenue for individual wind farms and Horizon's entire wind farm portfolio using over 2,000 scenarios.

With Spreadsheet Link™ EX, Kouam saved the results to a Microsoft® Excel® spreadsheet. The link enables analysts to use Excel as an interface to Kouam's MATLAB based risk algorithm, saving hours of manual effort.

As a final step, Kouam used MATLAB Compiler to create a standalone version of the PDS that runs each morning 30 minutes after the PRS completes its processing.

Horizon is using the results produced by the PRS and PDS to guide strategy, evaluate potential wind farm sites, and make short-term and long-term business decisions.

“The tools that we developed with MATLAB and MATLAB Compiler are much more reliable, scalable, and maintainable than our spreadsheet-based approach. We can sleep at night because we know the tools will work, we can add new capabilities and data inputs, and we can update the production system without getting IT involved.”

Manuel Arancibia, Horizon Wind Energy

THE RESULTS

■ **Core process automated.** “With spreadsheets, it took me two hours to generate new results from updated inputs,” says Weeks. “The PRS completes the analysis in a few minutes and runs automatically each morning.”

■ **Standalone program seamlessly integrated with enterprise IT infrastructure.** “By creating standalone operational programs using MATLAB Compiler and running them automatically, we can provide up-to-date forecasts and projections to Horizon analysts on a daily basis,” says Arancibia. “Our IT department set us up on the enterprise server, and we simply update the programs without any further help from them,” adds Kouam.

■ **Risk management improved, saving millions of dollars.** “The results produced by our MATLAB based tools raised awareness of the risk magnitude within our wind generation portfolio,” says Arancibia. “That awareness led the company early on to adopt a risk management process and hedge our exposure, which resulted in better price and energy congestion management at Horizon.”

Learn more about Horizon Wind Energy: www.horizonwind.com

INDUSTRY

- Energy production

APPLICATION AREAS

- Algorithm development
- Data analysis
- Desktop and Web deployment
- Computational finance

PRODUCTS USED

- MATLAB®
- Curve Fitting Toolbox™
- Database Toolbox™
- Econometrics Toolbox™
- MATLAB Compiler™
- Spreadsheet Link™ EX
- Statistics Toolbox™

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