Fast and Simple

Using GAUSS from Aptech Systems to help electric utilities find optimal portfolios of renewable energy sources

Problem

Electric utilities around the United States seek more renewable energy to meet local regulations and/or customer demand for cleaner, carbon-free electricity. Yet the most prominent sources of clean energy – wind and solar – are notoriously unpredictable. The best wind sites in the country, for example, only blow 45% of a typical year. And while the wind shows diurnal (hour to hour within a day) and seasonal (month to month within a year) patterns, wind cannot be counted on as a reliable resource. Thus, attempting to integrate these intermittent sources into a utility's supply can be challenging.

Solution

One way to reduce the impact of this intermittency is for a utility to buy renewable power from a geographically diverse portfolio of sites. By analyzing historical data, a utility can find the optimal set of sites where the diurnal and seasonal patterns of supply best match the utility's patterns of demand.

Project

With funding from the National Science Foundation, we created three simple web-based tools to help utilities find their ideal renewable energy sources.

Data

We first collected data from several different sources: we relied on 600 data sets, each with at least 10,000 data points. Using GAUSS, we quickly compiled these data sets into usable, consistent values. (See Figure 1 for a map with these data sets.) We had initially intended to keep the data in an SQL database and have GAUSS pull the data as needed. This proved overly complex for our needs and for GAUSS. By storing data in GAUSS's native format, we may have sacrificed some flexibility in the future, but we gained simplicity and speed in the present.

Algorithms

Our team included a professor and graduate student at the University of Wyoming's Department of Finance. Because GAUSS is a common, easily understood software application in academia, these statistics experts were able to compose and adapt algorithms in GAUSS very quickly. Almost as important, we were able to test these algorithms with real data on a single desktop before moving them to the web server.

Web Site

Once validated, the "math team" then send the compiled algorithms to our web team for insertion into a GAUSS run-time engine that interacted with an Apache web server using PERL scripts. We had originally attempted to use a Windows server and the .NET framework, but ran into insoluble technical problems. These seemed to vanish when we moved to an open-source platform.
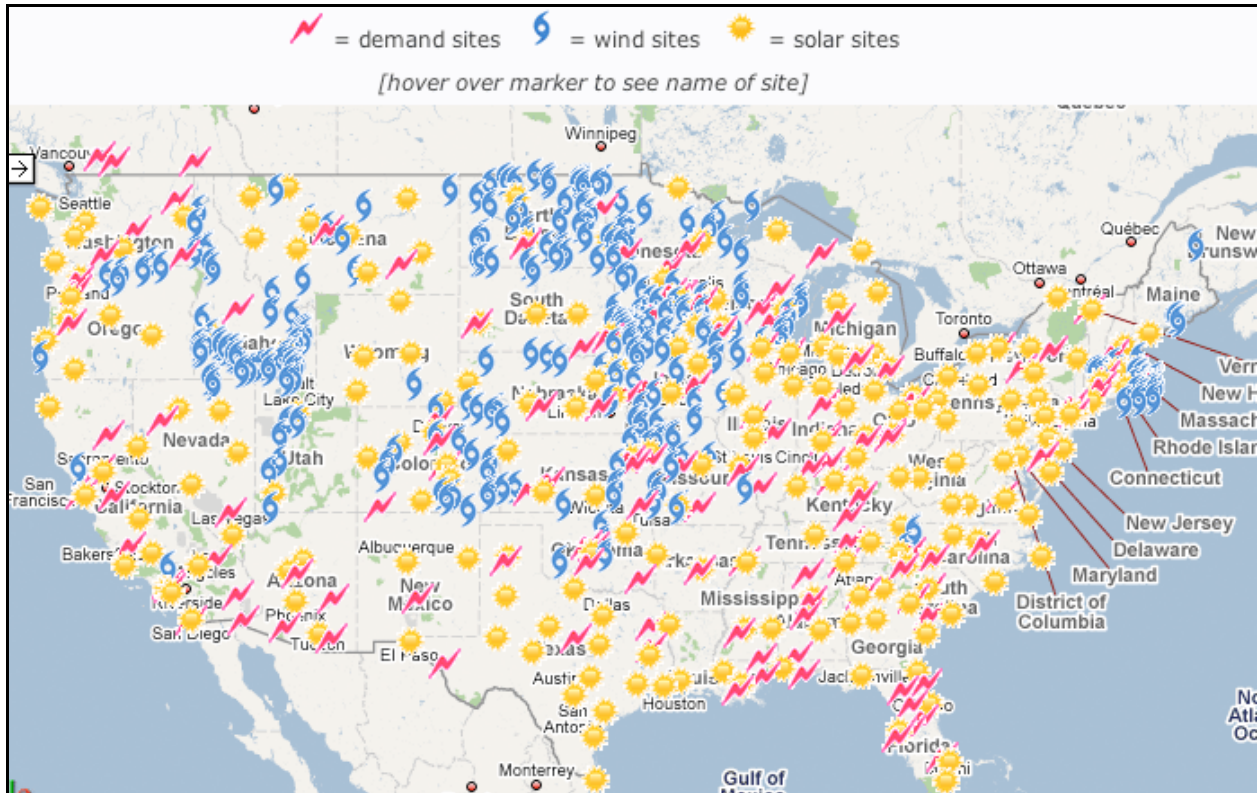
Result

The results of our work can be seen at www.EnergyTiming.com

Notice the speed of the calculation: Even the most complex scenario takes less than 5 seconds tom compute and display. A typical scenario takes less than 1 second.

Service

As in any software project, we encountered some unexpected hurdles. Some may have emanated from the interaction of GAUSS with our web server, database, and overarching framework. Or they may have been caused by our early choice of Windows platform. Or they may have been "pilot error" caused by our own web team.

Regardless of the source of the problems, the staff at Aptech was consistently helpful. They provided us with refreshed codes and licenses and hours of technical support and debugging. When it appeared that our some of our problems lay within our own code, they introduced us to a consultant with a long history with GAUSS who was able to delve into and solve our issues quickly.

Conclusion

- As a math engine, GAUSS is fast and efficient.

- As a programming platform, GAUSS is simple to understand and use in developing algorithms.

- As a component in a wider web-based implementation, GAUSS is stable and comprehensible.

- And as a company, Aptech Systems demonstrated a dedication to customer service that is rare in the software world.

We at Equilibrium Power appreciate their software and their support. Both allowed us to surpass our project objectives on time and under budget.

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