Battelle
The Business of Innovation

Battelle

Helping reduce energy costs and enhancing power grid reliability and performance

Smart is...

Engaging consumers and responsive assets throughout the power system to help optimize the system and better integrate renewable resources.

Battelle is spearheading a bold experiment in electric power conservation in the U.S. Pacific Northwest that will help reduce the region's carbon footprint, smooth out peaks in electricity use, and better integrate intermittent renewable resources—like solar and wind power—to help keep future costs from rising as quickly as they otherwise would. The project provides unprecedented insight into the cost of electricity at any point in time, relaying information about varying demand levels to support informed consumption decisions.

What if consumers could manage their energy consumption based on up-to-the minute data on energy costs? Imagine the impact this insight would have in reducing demand during peak periods and lowering overall energy consumption.

Given the enormous opportunity, today's energy production and delivery providers are rapidly moving toward placing smart sensors and meters on production, transmission and distribution systems to get granular, near real-time data about the current state of faults and load. These "smart grid" investments will provide consumers with near real-time information about their energy use and allow them to manage their usage based on both need and cost.

For example, today most residential water heaters turn on when the water temperature reaches a certain level—even if the homeowner isn't at home and electricity demand is high. With these smart systems, the technology can assess in near real time the consumer's requirements against current and expected energy costs over a 72-hour period and determine, based on both price and need, the best time to reheat the water.

The opportunity for savings is huge. But because the technology is so new, utility providers are grappling to understand which smart grid technologies will provide the greatest return on investment. As a result, a number of research projects have been launched in the past few years to help utility providers understand the costs and benefits of different smart grid technologies and approaches.

IBM

Business benefits

- Engages consumers and responsive assets throughout the power system to help optimize the system and better integrate renewable resources.
- Increases grid efficiency and reliability through system self-monitoring and feedback
- Enabled one town to avoid a potential power outage by using a two-way advanced meter system to shut off home water heaters during peak periods, reducing the strain on an unreliable underwater cable

Understanding energy usage in near real time

At Battelle—the world's largest, independent research and development organization working to advance scientific discovery and application—a groundbreaking project in the U.S. Pacific Northwest is helping assess the viability of one smart grid technique called transactive control.

"Transactive control is an incentive and feedback signal that helps coordinate smart grid resources," says Ronald Melton, PhD, the project director for the Pacific Northwest Smart Grid Demonstration Project, led by Battelle. "Right now, people tend to worry about electricity usage when they get their bill and realize that they've spent a hundred dollars more than they expected to. This project will engage residential and other responsive assets throughout the power system to help optimize the system and better integrate renewable resources."

Through the Pacific Northwest Smart Grid Demonstration Project, Battelle is working with 11 utility providers in five states—Washington, Oregon, Idaho, Montana and Wyoming—along with the Bonneville Power Administration (a U.S. Department of Energy agency), and approximately 60,000 metered customers to implement transactive control technology. On the customer side, the project entails the installation of smart meters and in-home systems that empower consumers to voluntarily reduce energy use and save money. At the power source, a "transactive" control signal contains information about what power is available, at what price, and what power is needed by end users. This signal moves through the system, incentivizing the use and movement of power.

Melton explains: "Every five minutes, the system sends signals that communicate the cost of delivering power to specific locations, allowing loads and distributed energy resources to react to price incentives. Data for the signal originates at the power generators and

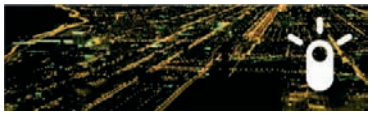
Smarter Energy: Near real-time insight drives informed energy choices

Instrumented

Smart meters throughout the power grid capture information regarding power demand.

Interconnected

Two-way communication systems carry messaging from the source of the electricity to a consumer's home and back to help participants track price changes and demand in near real time.



Intelligent

The project's transactive incentive signaling system uses algorithms to continuously set the cost of delivering electricity based on demand factors.

Solution components

- IBM® InfoSphere® Streams
- IBM Netezza® High Capacity Appliance
- IBM System x®

IBM Business Partner

- Alstom Grid

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—Ronald Melton, PhD, Project Director, Pacific Northwest Smart Grid Demonstration Project, Battelle

is propagated downstream through a network, following the flow of power and corresponding to physical locations in the electrical system called nodes. At each node in the system, a decision is made to increase the incentive signal value if less electric load is needed below that point, or decrease the incentive signal value if more electric load is needed. At the destination or end-use points, information about energy use is accumulated and forwarded to the source."

This two-way communication system significantly increases opportunities for the region to optimize the use of resources, such as renewable energy, and helps the system meet operational objectives, such as reliability. In fact, one Pacific Northwestern town was able to avoid a potential power outage during a peak period because consumers scheduled their home water heaters to turn on during non-peak periods, reducing the strain on an unreliable underwater cable.

From a regional and national perspective, the project is also expected to stimulate the economy by expanding the smart grid industry by creating new jobs in the manufacturing, installation and operation of smart grid equipment, communications networks, software and controls.

Journey to Smarter Computing

To implement this two-way communication between consumers and utility providers, Battelle needed to create an infrastructure that facilitates two-way data flow and provides the computing power capable of continuously processing large amounts of data. Battelle is using IBM® System x® x86 servers and IBM InfoSphere® Streams software to facilitate the streaming of data. InfoSphere Streams software, an IBM big data solution, provides a high performance computing platform that allows user-developed applications to rapidly ingest, analyze and correlate information as it arrives from thousands of near real-time sources. The Demonstration Project will install 80,000 smart-grid-enabling assets, such as smart meters, and 12,000 smart-grid-responsive assets, such as water heater load controllers, solar panels, battery storage units, and backup generators.

"Every five minutes, information from all these data sources is moving through the system. InfoSphere Streams software supports our project with handling this data."

—Ronald Melton

"Every five minutes, information from all these data sources will be moving through the system," says Melton. "InfoSphere Streams software supports our project with handling this data."

The IBM Netezza® High Capacity Appliance is capable of providing the processing speed and power to support analyzing and gaining insight from up to 10 PB of data in minutes. Initially, the organization considered using a traditional database architecture, but found that this approach was not practical for managing massive data volumes and making them accessible for analysis as quickly as possible.

Completing the demonstration project are software, equipment and consulting services from additional vendors:

- IBM Business Partner, Alstom Grid, will provide operations software and services that can enable near real-time dynamic pricing and renewable energy management in the project. The Smart-Grid-ready Network Management Solution from Alstom Grid is validated to the IBM Solution Architecture for Energy and Utilities Framework (SAFE) under the Asset Lifecycle Management Option. The SAFE framework enables Battelle to build an IBM software infrastructure that is designed for growth and flexibility.
- 3TIER will provide hourly, daily and week-ahead forecasts of wind and solar power generation that can be integrated into the project's transactive incentive signal.
- QualityLogic will develop tools to test the transactive control system's conformance to specifications and interoperability. The company will also perform testing to confirm that the signals are correctly communicated along the nodal hierarchy.

The inside story: Getting there

This USD178 million Pacific Northwest Smart Grid Demonstration Project, which was launched in 2010, is one of 16 regional smart grid demonstrations currently underway. Each project is receiving 50 percent of its funding from the U.S. Department of Energy through the American Recovery and Reinvestment Act, with consortium members paying the remaining costs.

"This project and all of the regional Smart Grid Demonstration projects currently underway are primarily focused on gathering data about the performance of the different pieces of equipment and smart grid applications to establish cost-benefit information," says Melton.

It's a five-year initiative, and according to Melton, the organization is midway through the design and implementation phase. "We've just finished our first release cycle with our first set of consumer participants and are in the middle of our second release cycle," says Melton. "We'll have a third release cycle that will end in September 2012, at which point, we'll move to a 24-month data collection and analysis period. By February 2015, we expect to have the data required to show how well this worked, what we learned, what the cost-benefit is, how we might make this a sustainable system within the Pacific Northwest, and finally how it might be transitioned to other parts of the United States."

For more information

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To learn more about IBM big data, visit: **ibm.com**/software/data/bigdata

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To get involved in the conversation, visit: www.smartercomputingblog.com/category/big-data

For more information about the Pacific Northwest Smart Grid Demonstration Project, visit: www.pnwsmartgrid.org

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