



## Pacific Northwest Smart Grid Demonstration Project SUCCESS STORIES

SEPTEMBER 30, 2014



### Creating a smart city by focusing on grid efficiencies

Before Washington was granted statehood, the utility known as Avista had already built the world’s longest transmission line and would later go on to create the country’s first electric stove. Today, Avista’s rich history of innovation is being applied to one of the greatest challenges facing the energy industry — integrating new technologies. Avista’s vision for modernizing its grid resulted in the region’s first smart grid city as part of the Pacific Northwest Smart Grid Demonstration Project.

With an investment of \$19 million, matched by funds from the Department of Energy through the American Recovery and Reinvestment Act of 2009, Avista has the momentum to deploy a system-of-systems architecture model. Through this project, the largest of its kind in the nation, utilities in five states launched new technologies addressing key elements of modern energy supply systems. The Bonneville Power Administration is a major partner in the cost-share project, led by Battelle Northwest, which also involves two universities, five technical partners and 11 utilities, both public and private. Washington State

University partnered with Avista as part of its project.

As Avista’s funding accelerated, so did the pace of the upgrades. Yet the approach to planning one of the region’s first smart cities remained strategic and forwarding-looking.

### The case for a system of systems

“You have to look at the business case with respect to the current reality and potential new realities,” said Curtis Kirkeby, Avista’s



**AVISTA CORPORATION**  
Spokane, Washington

- Investor-owned utility since 1889
- 125-year history of innovation
- 30,000 square-mile service territory
- Serves population of 1.5 million in eastern Washington, northern Idaho and eastern Oregon
- Electricity and gas service
- 359,000 electric customers

#### INVESTMENT

- \$19 million

#### HIGHLIGHTS

- Voltage optimization
- Capacitor bank controls
- Smart transformers
- Customer thermostats and apps
- WSU air handlers, chillers and generators

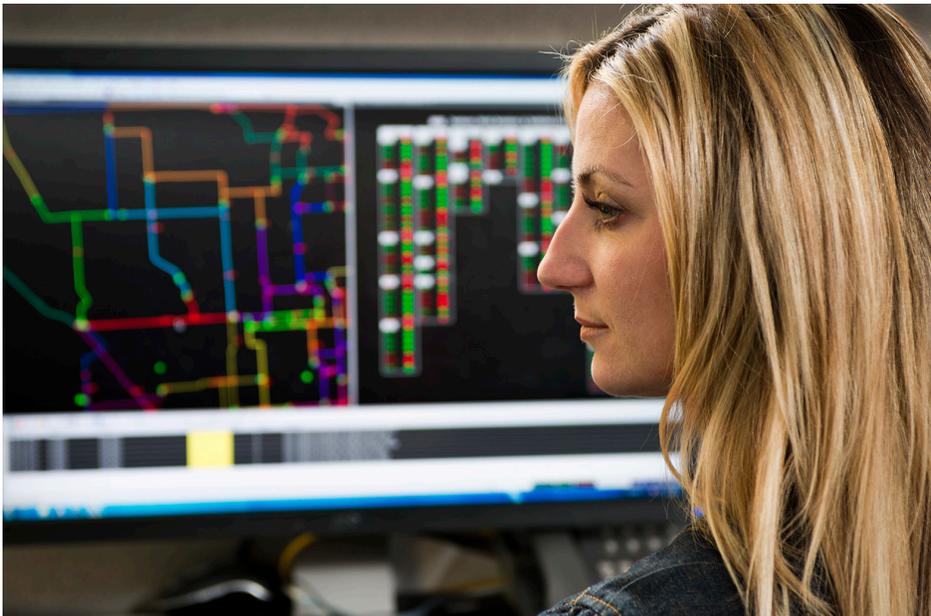
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principal investigator for the smart grid demonstration. “The economics that we have used forever in utilities may not be the economics that are actually valid anymore.”

Instead of looking at one particular system, Avista’s business case for smart grid concentrated on a much broader set of objectives, with a deliberate focus on interoperability and the ability to share information across multiple systems.



An Avista dispatcher is able to see, in real-time, the current state of portions of Avista’s distribution network.

“It made for strong solutions as we move forward,” said Kirkeby. “You don’t want to limit yourself or short the vision.”

After all, to create a smart city, scale is important.

“Our goal was to do everything possible that would result in better operation of our system. At the same time, we wanted to maximize reliability, system efficiency and the customer experience. We knew that’s where we would find the greatest value, when we could achieve all three of these objectives,” said Heather Rosentrater, Avista’s director of engineering.

## Smart circuits set the stage

First, Avista upgraded electrical facilities and automated the electrical distribution system in Spokane and Pullman. A distribution management system was put in place to serve as the brains for the smart city, along with intelligent devices and a communications system to benefit more than 110,000 electric customers.

Smart circuits reduce energy losses, lower system costs and improve reliability and efficiency in the electricity distribution system.

The system efficiencies will save about 42,000 megawatt-hours per year, enough to power 3,500 homes, and prevent 14,000 tons of carbon from being released into the atmosphere from power generation.

Problem areas on the system are instantly identified by the advanced distribution management system, which was deployed for one-third of the customer base. A whole new level of information is displayed, which can be operated manually or fully

automated around the clock — not a typical installation. The distribution management system features predictive applications and auto-restoration technology.

The new, advanced distribution management system revolutionizes how the system is designed, built, tuned and operated. Real-time power management systems require an accurately maintained calculation model so that the distributed resources can be managed regardless of location.

## Smart transformers

Every home or business uses different amounts of energy that’s distributed through a transformer on a pole to multiple sites. Smart transformers installed in the Pullman area gather information about how much energy each transformer supplies, so Avista can determine the appropriate size transformer to meet customers’ energy needs. The “right sizing” of transformers makes the distribution system more efficient as energy is delivered to customers.

## Biggest bang for your buck

Efficiency equals managing voltage and power factors.

Using voltage optimization, the utility can lower the voltage on the feeder — the line from a substation to the home or business — to minimize the loss of electricity.

“As we scoped the project, we realized this is where the biggest bang for the buck is,” said Kirkeby. “This is where the real dollars are. We estimated 1.86 percent savings by applying this technology to the feeders in Pullman on WSU’s campus based on a regional study, but we’re actually seeing 2.5 percent.”

There’s also still room to grow this efficiency savings. Fine tuning continues.

## “Be part of the study that may change everything”

The two-way communication foundation requires installation of advanced meters at the customer’s location. All of Pullman and Albion — a total of 13,600 customers — now have advanced meters. The digital meters operate via a secure wireless network, allowing two-way, real-time communication between the customer’s meter and Avista.

“We didn’t have any opposition to putting advanced meters there, which may not be typical across the country,” Kirkeby said.

Building awareness and understanding among customers was critical to successfully deploying new technology and engaging people. Inspirational key messages were disseminated through focus groups, targeted email and direct mail, print advertising, town meetings and board meetings. Cutting through the clutter of busy lives was



Smart thermostat pilot participants received a free thermostat.

challenging. Customers responded best to the in-person communication.

“They had the feeling that they were part of a project of national importance. The research aspect of our work resonated in a college community like Pullman. It was a feel-good thing for the customer — they felt like they were making a difference,” said Laurine Jue, a senior communications manager at Avista.

A dedicated point of contact was critical to answer tough questions about the pilot.

## Smart thermostat pilot

The smart thermostat pilot was one of the customer-experience components of the project. Customers who volunteered to participate in the two-year pilot received a free smart thermostat, plus \$100 per year in exchange for allowing the utility to remotely adjust the thermostat by 2 degrees Fahrenheit for a period of 10 minutes to 24 hours. The customer could always override the setting at any time.

“You can set up a program to override at any point,” said Joshah Jennings, a smart thermostat pilot participant.

Settings, including alerts, can be adjusted directly, over the Internet or with a smart phone. Using the application on a regular basis keeps energy usage “top of mind” for customers. Participants could view energy usage down to the hour, make adjustments, and start saving energy. A price curve was set for hourly consumption. For the Jennings, a fiscally conservative family of five, saving money is important.

“But being a technology buff too, it was kind of fun to play with the new technology,” Jennings said.

All customers with the smart thermostats also had advanced meters that provided usage data. At the end of the pilot, data indicated that smart thermostat participants reduced consumption between 4.5 and 9 percent.

**AVISTA TIP:** The thermostat was designed so that the vendor and its product were not dependent on Avista — the connection was through public Internet. The thermostat read the meter and sent data back to the thermostat vendor through its own mechanism. That means no maintenance for Avista.

## Energy Analyzer needs actionable items

Another aspect of the customer experience was giving customers access to information about their energy use. Using a web portal, called the Energy Analyzer, customers could

Avista's marketing campaign used inspirational language to recruit volunteers.

log in to their account to see their energy use patterns and make informed decisions about choices that drive energy costs.

The launch of the web portal was promoted with direct marketing and an online video to help educate customers about how to use it. While some customers looked at the portal frequently, most customers did not find it compelling. Although the average site visit was six minutes and 36 seconds, access to the web portal did not result in a measureable change in consumption.

One of the main factors that could have contributed to this is the absence of time-of-use rates, which could directly impact customers' usage patterns. Plus, every customer has a preferred method for accessing information, whether it's direct mail, email, a website or a mobile device.

Avista suspected that if an actionable item doesn't result from the data, it's not something a customer will get excited about. If a customer wants a lower bill, suggestions based on the data provided would be more useful.

"That's why we launched a texting pilot," said Kirkeby. "It allowed customers to opt-in to receive daily or weekly usage updates via text or email, which included usage predictions based on all kinds of factors. Weather factors, household factors, HVAC factors, are useful to

a customer trying to manage their bill through their own efforts."

"All of the work that we did in Pullman really has helped our customers understand on a personal level what Avista is doing to modernize our grid," said Rosentrater. "What it means for customers is improved reliability; they're going to experience fewer and shorter outages. What used to take hours to restore, can now be done in minutes."

In the long run, fewer and shorter outages, plus options for saving energy, matter most. It's a big win for customers.

## A big win for Washington State University

As a key partner in the project, Washington State University brought its best minds and dozens of facilities to the table. The campus can now be operated as a micro grid with the ability to control both loads and generation resources on campus, as well as respond to a transactive control request from Avista based on regional grid needs.

Working with Avista and with WSU professors Anurag Srivastava and Anjan Bose, students helped simplify the process

for computing real-time savings from improved power factors and voltage reduction. They also developed new tools for reliability benefit calculations, for data transfer between software tools and for real-time load characteristic estimations.

The project resulted in award-winning work and provided valuable, hands-on experience to prepare students to be leaders in the 21st century power industry.

With its cost-share investment of \$2.1 million, WSU also installed 88 smart electric meters, providing direct feedback to Avista for voltage optimization of the campus power circuits, and built sophisticated building control programs to automate its chillers, air handlers and three generators for smart grid operations.

For example, the air handlers in 29 campus buildings used to run without consideration of building occupancy levels. Air handlers ensure the air quality in buildings is consistent. With the new programs, the air handlers automatically ramp down when occupancy levels are low and ramp up before higher occupancy periods. While the technology doesn't change what happens within the building, it optimizes the efficiency of the system by scheduling appropriate actions based upon campus needs.

"Their systems are smart enough to be able



Washington State University was a centerpiece of Avista's smart city in Pullman.

to manage all air handlers individually to get to some level of cumulative benefit,” said Kirkeby.

The voltage optimization and new air handler programs save the university a lot of money; it expects to save about \$150,000 a year. Each one of the controllable assets can be managed in a much more efficient way and fine-tuned as conditions change.

Students helped to simplify the process of validating real-time savings from power factor and voltage reduction. A new tool was built to validate, or at least estimate with a high degree of accuracy, every circuit that’s involved in the system for every five-minute interval.

## Avista generates a request

These generation assets are also connected to Avista’s distribution management system through an Avista Generated Signal. Avista can generate a request to reduce those loads or generate power for various needs.

“If you think back to the energy crisis in 2000 when, in the Northwest, we were all looking for generation, now we have a push button for three of them,” said Kirkeby. “All Avista does now is make a request and they can be online.”

For the smart grid demo, a transactive control signal request came from Battelle. Avista then translated that into an Avista Generated Request Signal that went to WSU, asking for one of five tiers: one tier for air handlers, one tier for chillers, and three different tiers for generators.

Avista’s request asked for deployment of certain assets based on the request from Battelle. A WSU facilities operator decided whether or not to honor that request. If not, software sent Avista a text explaining why. Automatic texts were also generated. Codes were built into the system so that it still functions even without the transactive signal.

“Being a part of this pilot project has really opened doors for improved communica-

“It’s been really exciting! A year and a half after the distribution management system went live, we hit our one-millionth avoided outage minute. That’s a tangible benefit for our customers. Avista is also realizing benefits – we’ve learned so much and we’re applying these lessons every day.”

– HEATHER ROSENTRATER, AVISTA DIRECTOR OF ENGINEERING

tions, metering, power system operations, and building controls, which provide the tools for WSU to assist with regional needs while also reducing our operating costs,” said Terry Ryan, WSU director of Energy System Operations.

## Win! Win! Win!

Leveraging university assets is a model that Avista believes can be used elsewhere. After all, utilities and universities alike are always looking for ways to reduce costs.

“That’s exactly what we did,” said Kirkeby. “It’s a win-win-win for WSU, Avista and for the region.”

The project also greatly improved cyber security across the utility footprint. National Institute of Standards and Technology guidelines were used to assess risk. Then mitigation measure was assigned to each risk to determine whether to proceed or how to proceed.

By participating in the project, Avista learned in a real-world environment the benefit stream from each component in a particular use case, and which pieces will extend well beyond the project and into the future to create an ultimate smart city configuration.

Some pieces of that puzzle are important lessons learned.

## Learn! Learn! Learn!

It’s not always easy to change an established paradigm, especially when redesigning business processes around technologies such as automating grid control. Even some vendors pushed back.

“Some said: you don’t really want automation,” said Kirkeby. “To which we responded, ‘Yes! We really do!’ That’s why we’re doing this. We don’t want an army of people operating it; we want it to be automated.”

When working with vendors, “It always comes down to relationships and partnerships,” said Kirkeby.

Ironically, the very people expected to push back on automation were the most supportive: the linemen. For them, doing away with mundane tasks was positive. For others, it took trust that the system wouldn’t make mistakes and that, if it did make a mistake, consequences were managed.

Creating a smart city meant embracing change. It’s everywhere.

“We’ve changed as part of this project,” said Kirkeby. “We’ve revised the design, engineering and equipment standards going forward. We’ll add to those standards as new learnings come about and as we add more technologies or benefit streams we find.”



## WHAT'S NEXT for Avista?

The future is an evolving vision. The grid will be a system that's flexible, scalable and understandable by the people building it. Avista's roadmap includes a grid modernization program

budgeted for the next 25 to 30 years.

“We're trying to be really proactive and create the utility of the future — now,” said Rosentrater. “So we're trying to figure out as a utility where we need to be, what we need to do to provide the most value to customers, and where customers will value us — value what we do and keep our business viable.”

With an increased capital budget for grid modernization, Avista is leveraging what's already in place to advance the rest of the system. Armed with a smart grid roadmap from the demonstration, each feeder in Spokane will be modernized. In Pullman, a new battery unit is already in the works as part of a Washington State Department of Commerce grant. Avista will explore how battery storage capabilities can be integrated onto the grid to address the intermittent energy from renewable power.

Participating in the Pacific Northwest Smart Grid Demonstration project gave Avista the opportunity to realize the “endless” possibilities. And the many lessons learned have provided a solid foundation for Avista as it continues to modernize the grid to meet the energy needs of its customers well into the future.