The Northwest’s First Smart Grid
Community Pullman, WA

March 22nd, 2012
Curtis Kirkeby, PE
Sr. Electrical Engineer
Technology Strategy
Avista Utilities
Who Is Avista?

• Founded in 1889 as Washington Water Power

• Investor-owned, regulated gas and electric utility, headquarters in Spokane, Washington USA

• 1,554 employees serving 359,000 electric and 319,000 natural gas customers in the states of Washington, Idaho and Oregon
Pacific NW Demonstration Project

**What:**
- $178M, ARRA-funded, 5-year demonstration
- 60,000 metered customers in 5 states

**Why:**
- Quantify costs and benefits
- Develop communications protocol
- Develop standards
- Facilitate integration of wind and other renewables

**Who:**
Led by Battelle and partners including BPA, 11 utilities, 2 universities, and 5 vendors

Website: [http://www.pnwsmartgrid.org/](http://www.pnwsmartgrid.org/)
• 13 Circuits (59 circuits in Spokane)
• 3 Substations (14 more in Spokane)
• 13,000 Electric Customers (110,000 more in Spokane)
• 5,000 Gas Customers

(Focused on Reliability, Energy Efficiency, and the Customer Experience)
The Opportunity for Reliability

Demonstration Project (40 Months)

All Outages
- 650 Incidents
- 97,074 Customer-hrs
- ~ $970,740 Customer Cost

FDR Lockout
- 24 Incidents (4%)
- 88,201 Customer-hrs (91%)
- ~ $882,010 Customer Cost

Reduction
- 24 Incidents (4%)
- 44,100 Customer (45%) Outage Hours
- ~ $440,100 Customer Cost (SAVED)
The Opportunity for Energy Efficiency

- Real-time, all the time
- Approximately 2% savings in load and losses
- Approximately 95% of savings is reduced customer loads
- Small reserve available for demand response
- Automated Optimization via Distribution Management System

(6,700 MWhr/yr)
The Opportunity for Customers

- Understand energy consumption
- Understand how to affect energy consumption
- Gain budget control of energy usage
- Participate in a national experiment for transactive grid response
- Gain insight into energy savings opportunities via home upgrades such as insulation, windows, etc
- Encourage competition between neighbors, friends, blocks, co-workers, etc
Reliability Scenario
Reliability Scenario

LOCKOUT CONDITION

Substation A

FAULT

Substation C

Substation B
Reliability Scenario
Reliability Scenario

AMI IDENTIFIES SERVICE OUTAGE
Reliability Scenario

AMI IDENTIFIES SERVICE OUTAGES
Energy Efficiency-Smart Transformers

• High Efficiency Exceeding National Standards

• Real-time Sensors for Watts, VAr, Voltage, Winding Temperature, Loss of Life

• Equipped with Wi-Fi Routers to Extend the Control Communications Network
Energy Efficiency-Voltage Optimization

- Power Factor Correction to Near Unity (fixed and switched capacitor banks)
- Voltage Regulation on Each Phase at Head End of Feeder
- Measures at Each Switch, Cap Bank, Voltage Regulator, Smart Transformer, and AMI Meter
- Automated Optimization via DMS
- AMI low & high voltage alarms for calibration of voltage optimization
The Customer Experience

- Provide energy consumption data
- Establish and test regional signals
- Understand customer experience, satisfaction, and program participation
- Validate the need for and type of customer incentives
- 1,500 customers in Pullman

Testing, Understanding, Learning
## The Customer Experience

### Enabling Technologies

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Battelle Req</th>
<th>Battelle ID</th>
<th>Web Only</th>
<th>Web + Real Time</th>
<th>Web + Tstat</th>
<th>Web + DR</th>
<th>Web + DR + Full Analytics</th>
</tr>
</thead>
<tbody>
<tr>
<td>This asset would provide tools to the customer to decrease their energy consumption and will also measure reduction in load due to customer behavior modification (Behavior Conservation)</td>
<td>yes</td>
<td>AV-05-3.1</td>
<td><strong>X</strong></td>
<td><strong>X</strong></td>
<td><strong>X</strong></td>
<td><strong>X</strong></td>
<td></td>
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<tr>
<td>Transactive signal will provide automated demand response through AMI (Automated direct demand response)</td>
<td>yes</td>
<td>AV-05-1.2</td>
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<td><strong>X</strong></td>
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<td><strong>X</strong></td>
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<tr>
<td>Transactive signal will provide automated real time response through AMI (Automated Real Time)</td>
<td>yes</td>
<td>AV-05-1.4</td>
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<tr>
<td>Avista will conduct survey for customer acceptance of the load control devices. (Customer Acceptance)</td>
<td>yes</td>
<td>AV-05-4.1</td>
<td></td>
<td><strong>X</strong></td>
<td></td>
<td><strong>X</strong></td>
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<tr>
<td>Avista will conduct survey for customer acceptance of load control devices if incentives are provided. (Customer Incentives)</td>
<td>yes</td>
<td>AV-05-4.2</td>
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<td></td>
<td><strong>X</strong></td>
</tr>
<tr>
<td>Avista will conduct survey for customer acceptance of the load control devices if incentives are provided. (recruitment practices)</td>
<td>yes</td>
<td>AV-05-4.3</td>
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<td><strong>X</strong></td>
</tr>
<tr>
<td>AMI can help in customer behavior modification by providing real time info of their energy usage. This asset would provide tools to the customer to decrease their energy consumption and will also measure reduction in load due to customer behavior (Behavior Conservation)</td>
<td>yes</td>
<td>AV-06-3.1</td>
<td></td>
<td></td>
<td><strong>X</strong></td>
<td><strong>X</strong></td>
<td><strong>X</strong></td>
</tr>
</tbody>
</table>
Customer Empowerment
The Components

- 43 Smart Reclosers
- 31 Switched Capacitor Banks
- 39 Advanced Voltage Regulator Controls
- 400 Smart Transformers
- 300 Smart Fault Indicators
- 3 Smart Switchgear
- 13,000 Electric/5000 Gas AMI Meters
- Advanced Demand Response System
- 1500 Advanced Programmable Thermostats
- Customer Web Portal and Mobile Tools
- WSU Chillers (9), Generators (4), and Air Handlers (39)
- Transactive System for Distributed Energy Resource Management
- Advanced Communications Network
- Advanced DMS
- Security Design and Risk Assessment
- Advanced Analytics Engine
The Smart Grid Brains

Facility Management & Outage Management Tool

Distribution Management System
The Matter of Security
Analytics for Results

- Real-time Calculation of Results
- Elimination of Manual Analysis
- Automated Work Order Creation for Trouble
- Identification of Outage Scenarios
- Revenue Protection
- Loss Savings Validation
- Customer Energy Savings
- Condition Based Maintenance Program
- Grid Optimization Automation

Flowchart:

Start → Get SCADA data for network → Solve problem for feeder k → Check problem? → Yes → No → Check network and channel? → Yes → No → Find feeder to identify list of operable capacitors → Sort capacitors in order of increasingly high flows → Open or close capacitor based on QSO values → Issue control commands to open close capacitors → Any capacitor failed? → Yes → No → Disable failed capacitors and create failure reports → Create operational reports

Flowchart:

Start → Compare meter reads to Xfrm read → No problem? → Yes → No → Tamper flag? → Yes → No → Date edited? → Yes → No → Evaluate flags → Possible theft? → Yes → No → Field investigate → ID meter
Challenges

• Project Management and Hard Deadlines
• Change Management
• Documentation of Decisions, Designs and Processes
• Procedures and Organizational Structure (Roles & Responsibilities)
• Cross Functional Teamwork and Governance
• Partnership Relationship with Vendors
• Security
• Communication to Customers
• Massive Quantity of Data to Process/Analyze
The Project To-Date

- AMI complete includes meters, MDM, and collection engine
- Smart switches and switchgear installed.
- Capacitor banks installed
- Voltage regulator controls installed
- DMS in production for field measures and remote control
- Tropos Wi-Fi network complete
- Customer Community Builder Tools Deployed
- Smart transformers scheduled for delivery
- Analytics engine being installed
- Customer bill analytics web tools 2nd quarter 2012
- DR and transactive signal system in design
- Tstat recruitment to begin in April 2012
- All systems live end of August 2012
Avista’s Future

- **Efficiency**
  - 2011: Active Volt Var Management
  - 2012: Automatic Service Switch
  - 2013: Adaptive Fusing

- **Reliability**
  - 2011: Remote Operation & Control
  - 2012: Fault Location & Automatic Restoration

- **Asset Management**
  - 2011: Feeder Rebuild Coordination
  - 2012: Smart Grid Work & Asset Management

- **Customer Participation**
  - 2011: AMI Demonstration
  - 2012: Home Area Network Demonstration

- **Grid Optimization**
  - 2014: Distributed Generation
  - 2015: Electric Vehicles, Trusted Energy Advisor Services
Questions??

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