Meeting Energy Efficiency Requirements with Voltage Optimization

The Challenge
Across the nation, utility companies, state regulators and policy makers are considering many potential solutions and strategies for managing an evolving power grid and energy industry. From policy measures like the Environmental Protection Agency’s (EPA) Clean Power Plan regulations, to the President’s first Quadrennial Energy Review, to infrastructure modernization efforts, utility companies and state regulators are in a period of intense progress and scrutiny.

Of these measures, the EPA’s Clean Power Plan is particularly significant. It aims to reduce carbon dioxide emissions from existing fossil fuel-fired power plants. Citing authority under Section 111(d) of the Clean Air Act, the EPA released the final regulations in August 2015, requiring states to develop and submit state plans to achieve the federal emissions reduction goals. The Clean Power Plan also fosters a spirit of state/federal collaboration urging states to work hand-in-hand with each other and the EPA to come to optimal reduction structures. Despite the debate over the legality of the EPA’s proposed plan, utilities and regulatory bodies are already analyzing the cost and benefits of a variety of measures to respond including coal plant conversions, renewable energy investments, energy efficiency programs and more.

While much public debate and attention has surrounded the integration of renewable energy resources, such as wind and solar, and consumer-based energy efficiency programs that include home energy audits, insulation and replacing lightbulbs, there is another valuable path for states and utilities to consider: Voltage Optimization.

Energy Savings & Reliability

AEP Project Highlights
- Peak demand reduction of 1.5 MW
- Energy savings of 4.27%
- Voltage Tap reduction of 30%

The AdaptiVolt™ Potential
If Utilidata’s VVO solution, AdaptiVolt™, were deployed on all cost-effective circuits in the United States, our nation would experience an annual energy savings of 97,560,000,000 kWh. That would mean a reduction in utility customers’ bills across all sectors of $9.84 billion every year.

That’s equivalent to:
- Avoiding the emission of 67 million metric tons of CO2 that would have polluted the atmosphere
- Removing the greenhouse gas emissions from 14.2 million passenger vehicles

Learn More
Contact a Utilidata Sales Representative:
sales@utilidata.com
(401) 383 - 5800
VVO for Energy Efficiency

In order to significantly reduce energy consumption and emissions, the United States must embrace a variety of solutions. Some have already been implemented in states across the country, often relying on consumer engagement and commitment, but there are steps utilities can take to save energy that don't require families and businesses to actively participate.

One of these innovative solutions is Volt/VAR Optimization (VVO), increasing the efficiency of the electric distribution system by using mechanical devices like voltage regulators and capacitor banks to control voltage and reactive power.

Utilities use VVO to deliver electricity at more optimum voltage levels which improve the efficiency of customer devices. This is called Conservation Voltage Reduction (CVR) and it is a mode of modern VVO system.

Applied to an electric distribution system, CVR can achieve peak demand reduction and energy savings of up to 5 percent. When treated as an energy efficiency measure, the business case of CVR is significantly affected by the amount of voltage reduction that any particular technology can achieve through its control algorithms.

The Technology

Utilidata’s patented VVO technology delivers 25-50% greater voltage reduction than its competitors; decreases equipment operations by 30-50% from baseline operations; and, is the only real-time VVO solution that has been proven to mitigate the effects of intermittent distributed energy resources. Utilidata has consistently produced energy savings and demand reduction in the 3-5% range.

Utilidata’s VVO solution, AdaptiVolt™, bases its decisions on real observations. It is the only system on the market that uses digital signal processing (DSP) to extract real time information from the distributed grid. An adaptive decision-making algorithm uses that information to make coordinated voltage and VAR control decisions on an electric distribution feeder.

The AdaptiVolt™ software is responsible for data collection from field devices, execution of the decision-making algorithms necessary to implement optimal control and data logging for Measurement & Verification (M&V) purposes. The AdaptiVolt™ solution can be integrated with any utility communications network that supports standard distribution and automation protocols. The AdaptiVolt™ VVO solution takes supervisory control of all substation and field located control devices, such as voltage regulators and capacitor banks, to implement coordinated control of the electric distribution system.

The Utility

Headquartered in Columbus, Ohio, American Electric Power (AEP) is one of the largest electric utilities in the U.S., serving more than 5 million customers in 11 states. In addition to their 5.3 million customers, they also operate over 38,000 miles of transmission lines, making them the largest transmission utility in North America.
The Project
AEP deployed Utilidata’s VVO solution, AdaptiVolt™, across six 13.8 kV electric feeders originating at a substation in Gahanna, Ohio.

Using an RF mesh telemetry network, AdaptiVolt™ communicates with eight line voltage monitors (deployed on the distribution system’s primary), fifteen field-based switched capacitor banks, two banks of mid-line voltage regulators and six banks of three single-phase voltage regulators in the substation.

AdaptiVolt™ implements coordinated control of the voltage regulators and capacitor banks based on information it extracts from data it collects from all the field devices. Visibility and control of the AdaptiVolt™ system is provided to AEP system operators through their distribution management system user interface.

Over a one-year period starting in 2012, AEP and Utilidata conducted an extensive M&V test on their pilot project in Gahanna, Ohio in order to validate the energy savings and voltage reduction secured with the AdaptiVolt™ VVO solution.

The Results
During the AEP pilot project, Utilidata’s AdaptiVolt™ solution demonstrated the significant energy savings that can be achieved through VVO-based Energy Efficiency initiatives. Using Utilidata’s M&V protocol, AEP had access to the most precise metric on the decrease in energy consumption associated with CVR. In fact, Utilidata’s M&V protocol is recognized across North America as the reference standard for the estimation and analysis of VVO benefits.

Using the AdaptiVolt™ system in CVR mode, AEP achieved a peak demand reduction of 1.5 MW and energy savings of 4.27%.
Having secured the aforementioned energy savings across the Gahanna distribution circuits, AEP has moved forward with a multi-jurisdictional deployment across Ohio, Indiana, Kentucky and Michigan. AEP's efforts in these states showcase the effectiveness of using Utilidata's VVO solution to meet energy efficiency goals.

In addition to a reduction in energy demand and consumption, AEP achieved greater reliability and stability with a reduction in voltage regulator operations. The results below illustrate a reduction of approximately 30% from baseline tap operations.

Tap Operations Summary
Feeder #3

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<tr>
<th>Tap Operations per Day</th>
<th>CVR Off</th>
<th>CVR On</th>
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<td>35</td>
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