AMI and Reliability:

Fewer Outages, Faster Restorations, Improved Communications

The Situation Today

Weather-related outages have been on the rise in recent years. A report by Climate Central evaluated 28 years of power outage data that was supplied to the federal government by utilities and found that major outages – those impacting 50,000 customer sites or more – increased tenfold between the mid-1980s and 2012.

Climate Central's researchers also found that some of this increase could be attributed to improved reporting, however they note that the average annual number of weather-related outages each year doubled between 2003 and 2012. By 2003, improved reporting was already in effect and wouldn't contribute to the increases during those years.[1]

These trends are evident in the increasing number and duration of service interruptions over the past few years. The Energy Information Administration found that U.S. customers experienced an average of four hours without power in 2016[2] and nearly eight hours in 2017.[3]

Weather isn't the only reason reliability issues are on the rise.

The American Society for Civil Engineers continues to give U.S. energy infrastructure a grade of D+. "Most electric transmission and distribution lines were constructed in the 1950s and 1960s with a 50-year life expectancy, and the more than 640,000 miles of high-voltage transmission lines in the lower 48 states' power grids are at full capacity," noted the ASCE website.[4]

Between weather variability and aging infrastructure, reliability has become a key challenge.

Advanced Metering Infrastructure Improves Reliability and Resiliency

THE TECHNOLOGY

Advanced Metering Infrastructure (AMI) includes three crucial elements: smart meters that have energy management and communications capabilities, networking infrastructure, and software to manage this system. AMI must also have the capability to supply crucial data to other utility software, such as an Outage Management System (OMS), which helps utilities pinpoint fault location and probable cause, thereby reducing restoration times and costs.

AMI supports outage management, prevention and restoration speed with the following functions:

OUTAGE NOTIFICATION

Industry experts estimate that only 20 to 25 percent of customers who have been impacted by an outage will report it to their utility.[5][6] Utilities rely on customer calls and other data to inform the OMS system, which uses this information to identify the number and location of customers who are out of service.

Often called a "last gasp" communication, AMI meters use capacitors to power a high-priority message to the utility when they've been de-energized. This gives the OMS system more data to use evaluating the location and extent of the outage and speeds restoration efforts.

FAULT LOCATION

Utilities analyze where the fault is likely to have occurred on the system using AMI, line sensor and substation data. Outage management systems are typically linked to a utility geographic information system (GIS), which enables increasingly precise location of the fault and the affected circuit(s).

CONFIRMING RESTORATION

AMI lets utilities read meters on demand, a process also called "pinging the meter." By verifying restoration is complete, utilities avoid having to send crews back into an area to deal with "nested" outages from multiple disruptions on the same feeder or circuit. Without the ability to verify restoration, crews often leave an area, only to be called back. Verification reduces SAIDI numbers and saves the expense of having to send crews back into an area after they've already left it.

ACCURATE RECORDING OF MOMENTARY OUTAGES

Momentary or transient faults are those that don't require corrective action to clear the fault from the system, allowing the system to be re-energized quickly. Transients may result from things like lightening, animal intrusion or tree limb contact with the line. Each of these faults would likely be cleared by recloser operations. However, frequent transients on a section of line may indicate the need for proactive maintenance, such as sending out vegetation management crews or adding animal guards to the lines. Analytics using AMI data can help prevent future outages by identifying the probable cause of transients, including possible equipment failure, such as degraded line connectors or sagging lines that have phase-to-phase contact in high winds, in addition to customer-owned equipment problems.

EFFICIENCY AND CUSTOMER SERVICE BENEFITS

The benefits of improved outage response and prevention extend beyond economic and operational savings to include enhanced quality of life and safety for consumers:

GREATER SITUATIONAL AWARENESS

AMI's last-gasp signals eliminate the need for utilities to wait for customer calls before rolling trucks to restore service. After Oncor, the largest electricity provider in Texas, tied AMI data to its outage management system, more than 1,400 notifications alerted system operators to trouble within the first six weeks of the integration. Among the issues that were actual outages, more than half were fixed before customers called to complain. More important, the alerts also identified power-quality issues that the utility could proactively address, such as bad connections and open neutrals. This likely prevented other service troubles.

FASTER RESTORATION AND COST SAVINGS

AMI also provides the communications backbone for more line sensors on the distribution system. Line sensors provide measurements of fault current, direction and magnitude of faults, allowing the utility to pinpoint location quickly and precisely to significantly reduce outage duration. Such sensors are crucial to fault location, isolation and restoration (FLISR) systems.

FLISR is proven to reduce SAIDI numbers and lower restoration costs from labor and overtime charges. Utilities also save with reduced truck rolls and, in some cases, monetary penalties for poor SAIDI numbers. These savings can be significant. Labor savings and elimination of patrol times was enough for American Electric Power to calculate a billion dollars in savings over a 14-year period from FLISR investments.

ADDRESSING PROBLEMS ASSOCIATED WITH MOMENTARY OR TRANSIENT FAULTS

As noted earlier, higher-than-normal occurrences of momentaries could result from vegetation hitting lines, animals or both utility or customer-owned equipment problems. Several factors impact the number of transients a utility experiences, including service territory, vegetation, insulated or bare conductors, percentage of underground lines and more. Proper analysis of AMI data allows the right crews to show up with the right equipment for proactive repairs.

Researchers at the Lawrence Berkeley National Lab evaluated financial losses associated with outages in 2004. They found that frequency of outages, not their duration, drove the cost to U.S. electricity consumers from power interruptions and power-quality events. The LBNL scholars estimated this cost to be $79 billion annually. More than two thirds of the outages tracked – 67 percent – lasted fewer than five minutes. These outages accounted for $52 billion of the money researchers deemed to have been lost to outages.[7]

ASSET MANAGEMENT FOR OUTAGE PREVENTION

Advanced meters provide both consumption and voltage data that can be used to monitor distribution assets, such as service transformers or renewable energy resources. Using analytics, utilities can detect if a transformer is under or oversized and if it is degrading and potentially failing. Burbank Water and Power is one utility that used loading data, mixed with weather and GIS data, to efficiently and proactively replace at-risk transformers before failures caused outages.

In pre-analytics days, heat-wave-driven outages were generally how the utility found its weak points. Using analytics, utility staff could see exactly where their high-risk assets sat on a system map and create a "transformer most-wanted list." As a result of proactively addressing trouble spots, utility customers suffered zero outages from transformer events during a prolonged heatwave in 2014. That was a dramatic improvement for this quality-focused utility.

BETTER OUTAGE ALERTS FOR CUSTOMERS

AMI data can be used to automate customer alerts during outage events. An example is My Oncor Alerts, a 24/7 notification service that enables customers to enroll in a program that sends outage information, including restoration updates. Customers receive their alerts via text, phone, or email when Oncor's systems detect an outage in their area or at their address. If known, alerts come with an estimated time of restoration.

The system uses AMI data as well as information from Oncor's OMS. If both systems validate the outage, Oncor sends a message saying service is out. If the two systems disagree, the utility advises customers that there may be an outage at their premises.

In 2017, Oncor sent out more than 860,000 messages and 440,000 restoration updates. The system was estimated to have deflected some 325,000 calls to the Oncor service center. A customer survey conducted in 2018 showed 97 percent of people who receive Oncor Alerts would recommend the program to friends and family.

BENEFITS OF AMI FOR RELIABILITY

	Utility Operations Benefits	Customer Focused Benefits
Automated Outage Notification	• Faster response • Reduced inbound call volume	• Faster restoration • Increased outage information available
Fault Location	• Lower restoration labor costs	• Faster restoration
On-Demand Reads	• Lower restoration cost • Extend asset life and mitigate consequences associated with equipment failures • Identify nested outages for faster restoration	• Faster restoration
Tracking Transients	• Enhance predictive maintenance practices • Reduced outages • Lower costs	• Better power quality • Fewer outages
Increased Situational Awareness	• Faster response to outages • Predictive maintenance • Reduced operational costs • Improved power quality	• Improved power quality • Faster restoration • Fewer outages • Ability to identify and work with utility to solve issues on customer-owned equipment
Enhanced Outage Notification	• Improved customer satisfaction	• Improved situational awareness

1 Blackout: Extreme Weather, Climate Change and Power Outages
2 https://www.eia.gov/todayinenergy/detail.php?id=35652
3 https://www.eia.gov/todayinenergy/detail.php?id=37652
4 https://www.infrastructurereportcard.org/cat-item/energy/
5 Enhancing Outage Communications, Electric Light & Power, March 2013.
6 Smart Meters Can Reduce Power Outages and Restoration Time, National Electrical Manufacturers Association.
7 Understanding the Cost of Power Interruptions to U.S. Electricity Consumers, Lawrence Berkeley National Lab