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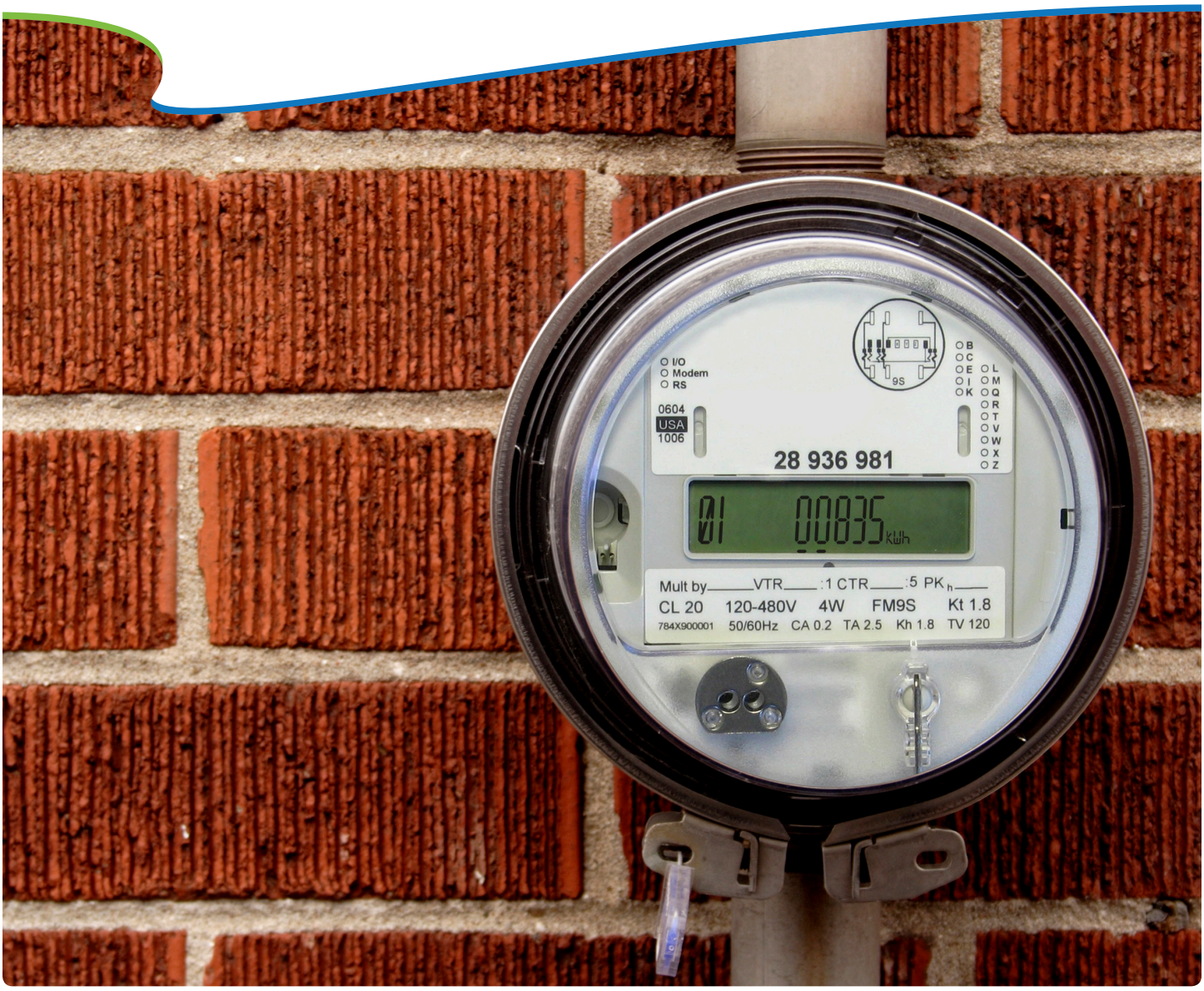

WHITEPAPER

Improving Electric Reliability with Smart Meters

Smart meters serve as an essential, transformational tool to improve grid reliability for utility customers

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Executive Summary

Smart meters serve as an essential, transformational tool to improve grid reliability for utility customers. Meters are the most widely distributed assets across every utility's grid, and smart meters can generate, capture, and communicate invaluable data that help utilities:

» Accelerate outage detection, response, and restoration by providing more detailed and timely data to utility field operations

» Keep customers better informed about the status of the power grid by automatically gathering and communicating relevant information, such as field-estimated times to restoration ("when will the lights come back on?"), outage causes ("why are the lights out?"), and public safety notices ("is my family safe?")

» Reduce potential outages and improve resilience against disruptions by enhancing the accuracy of grid asset planning and management

Utilities across the US and around the world are using smart meters to reduce outage frequency and duration for their customers. This allows businesses to return to activity and lets people to get on with their lives with less interruption and greater comfort. Smart meters, when deployed as the foundation of a multi-functional smart grid platform, are a highly cost-effective tool for improving reliability compared to one-off, reliability-only investments. When implemented wisely, smart meters establish a common smart grid network infrastructure for delivering both immediate benefits and future services, built upon a ubiquitous, utility-grade communications backbone that is largely paid for through efficiencies in day-to-day utility metering operations.

Electricity Is Essential

Electricity is the foundation of modern society; it "powers life" as we know it today, from devices we use every day like computers, televisions, and telephones, to being the driver of modern industry, powering factories, commercial buildings, and the internet. As we increasingly depend on electricity, outages have grown from being infrequent interruptions to becoming competitive liabilities for our economy; the National Energy Technology Laboratory (NETL) estimates the US loses $100 billion per year due to power outages, approximately 1% of our national economic output.[1] To residential users, power outages can be dangerous for families reliant on electric heat during the cold of winter or even life-threatening for those with requiring the support from medical devices. Impacts to businesses are undoubtedly greater, as manufacturing processes are interrupted, sensitive machinery can be damaged, and raw materials rendered useless. The consultancy Freeman Sullivan and the US Department of Energy's Lawrence Berkeley Livermore National Laboratory estimate that outages cost the average medium to large commercial and industrial customers $12,487 per hour.[2]

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Manual Operation In The Digital Era

The core function of an electric utility is to provide reliable electric service to its customers. They achieve reliability by carefully planning and operating the grid, and by responding to outages as swiftly and efficiently as possible. While the most visible parts of the power system are large central power plants and transmission towers, the reality is that many outages originate from events that occur on the distribution part of the grid, such as downed trees, transformer failures, and contact with small animals. Some events also originate from a problem on the customer side of the meter; for example, a tripped circuit breaker.

Today, most distribution grids are analog, electromechanical systems with rudimentary monitoring and control capabilities. As a result, utilities have to wait until equipment fails and customers call in an outage before they can fix or replace equipment. In the case of problems on the customer side of the meter, utilities may send a crew to repair the problem and not find out the problem is in the customer's premises until they have arrived. Some utilities still use paper-based systems for tracking outage events, phone calls to communicate with customers, and verbal radio communications with field crews to confirm such information as location, placement of tags, operation of switches, and estimated times for restoration.

The Future Is Smart

Smart meters represent a powerful new digital tool that fundamentally changes the way the grid works. In addition to lowering the costs, raising the accuracy, and enhancing the resolution of the standard billing functions performed by traditional meters, smart meters can serve as widely deployed sensors across the entire distribution grid. Such newfound capabilities enable utilities to measure voltage, track current, measure power factor, send outage/restoration notifications, and much more, providing a rich set of previously unavailable information for utilities to improve reliability in all stages of its operations.

Smart meters can help utilities transform grid reliability by providing new data to greatly enhance the planning, operation, and outage response of the grid. Smart meters provide utilities with many orders-of-magnitude higher resolution data on the flow of electricity across the distribution grid. This helps utilities more accurately plan circuit expansions and conduct proactive asset management to preemptively bolster the grid against interruptions, rather than waiting for equipment failures and outage events.

Nested Outages

At the Midwestern utility Commonwealth Edison (ComEd), smart meters deployed as part of a pilot project sent "last gasp" messages to the utility to instantly report outages during one event, allowing the utility's Outage Management System to accurately identify and scope these events ahead of customer calls. Smart meters not only help utilities identify where and when outages have occurred, but also notify the utility when power has been fully restored. This helps ensure that customers are not stranded without electricity when the utility incorrectly believes it has fully repaired an outage (this is called a "nested outage"). Conversely, smart meters' ability to report when all nested outages have been resolved also allows utility field crews to move on immediately and confidently to the next area in need of repair, accelerating overall service restoration. In ComEd's case, the utility received 100% of restoration notifications within 10 minutes of the lights actually coming back on.

Peak Period Demand Reductions

Beyond detecting outages, smart meters also help utilities prevent outages from occurring by managing the electric demand on the grid during periods of high stress. Oklahoma Gas & Electric (OGE) will be able to avoid the costly construction of two otherwise-necessary new peak generation power plants by utilizing smart meters as gateways for Home Area Networks (HANs) that enabled customers to reduce power during peak periods. The result: $300 million in avoided peaking power generation costs by achieving up to 57% reductions in peak demand by sending price and reliability signals to participating customers equipped with smart thermostats that are connected to HAN-enabled smart meters.[3]

AEP Ohio, the largest operating company in American Electric Power's system, is using smart meters to improve the efficiency of the distribution system with Voltage-VAR optimization, by tactically managing grid operations to lower overall energy consumption by 2-3% and relieve the stress on the grid during peak periods. Averting under or over-voltage conditions to customers also helps avoid damage to commercial and industrial customer equipment.

Emerging technologies, coordinated and networked by smart meters, such as electric vehicle charging and smart inverters for distributed generation, will also enable utilities to better manage electricity flows during peak periods and allow them to navigate effectively through system emergencies.

Assessing Distribution Automation Performance

Additionally, smart meters can be used to assess the performance of distribution automation equipment (e.g. - reclosers, switches, FCI's) during storm and outage situations. For example, metrics such as last gasps help to define the outage perimeter and restoration times help to measure the efficacy of the recloser functionality. As more and more DA devices are being deployed on the grid it is essential to provide "fine grained" tracking of these devices during extreme weather conditions. Smart meters provide a way to automate the validation of proper operation of these devices.

Keeping Customers Informed

Some outages are simply unavoidable, but even in these situations, customers can benefit from smart meters. During Hurricane Irene in 2011, Pepco's Delaware utility, Delmarva Power, was able to proactively identify 1,300 customers without power by utilizing recently-installed smart meters. Pepco also used smart meters to understand where and when power remained out, enabling them to cancel nearly 600 unnecessary outage work orders to speed up overall service restoration. This prevented the need to call back customers or to roll trucks to confirm power restoration, both traditional utility activities that needlessly delay more critical restoration work.[4] Ongoing evolution in utility communications with customers through such channels as text messaging, email, and social media can enable customers to receive and access timely updates about the status of their power, including whether the lights are back on, when they are estimated to come back on, and why they went out in the first place.

Human Threats

Human threats to the grid can be mitigated through careful design and rigorous implementation of such technologies as smart meters. By using proven, Internet Protocol (IP)-based security methodologies, smart meters can provide robust security against manmade cyber-attacks on the electric grid, isolate them quickly, and improve the overall resilience of the system by allowing grid operators more operating flexibility to keep the lights on in the face of adversity. In other words, even if smart meters introduce more entry points from a cybersecurity perspective, sound security architecture boosts the resilience of the overall grid, which otherwise remains susceptible to cascading failures.

Conclusion

Smart meters can be put to work beyond their primary billing function to also serve as distributed sensors to enhance grid reliability. In doing so, smart meters become the foundation of an efficient, effective smart grid platform. Smart meters cost-effectively improve reliability for customers by accelerating restoration, informing customers, and reducing potential outages. The reliability benefits of smart meters should not be overlooked or underestimated in building the business case for smart meters and smart grid. At a time when electric grid reliability is more important than ever, smart meters are poised to transform utility operations and improve reliability for families and businesses.

Sources:

[1] "Modern Grid Benefits", National Energy Technology Laboratory, August 2007

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[4] "Smart Grid Implementation: the PHI Story", Presentation to the 2011 GreenGov Symposium, November 2011

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