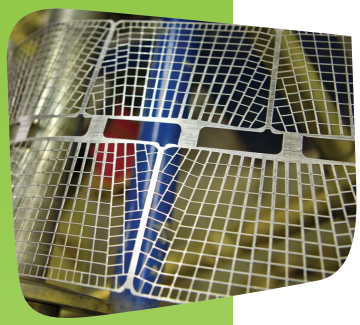

White Paper

Smart Meters, Smart Grid, Sustainable City

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Smart Meters, Smart Grid, Sustainable City

The real power of the Smart Grid concept for municipal utilities goes far beyond metering technology and better system control. It lies in the communication network that makes the concept possible – while creating opportunities to deliver popular new services, attract businesses, energize economic growth, and engage residents in community improvement with sustainable solutions.

City of Elmwood Mayor Joyce Smith has just won re-election, unopposed, to a second term in office. In the past four years, a Smart Grid initiative she launched with the Common Council has helped stabilize water and electricity prices and reduce the property tax rate.

All residents and the school system have access to low-cost wireless broadband Internet through a city-owned network. City departments – police and fire, public works, utilities – communicate better and function more efficiently. The city is earning accolades for conserving energy and water, for reducing its carbon footprint, and for community outreach and engagement programs that helped make the progress possible.

An influx of businesses to a new technology park has started. The population is growing, and surveys show high satisfaction with city services. The Smart Grid initiative came about with no up-front capital cost – and in fact will save the city $50,000 per year for the next 15 years. Now a new phase of the initiative promises even more benefits.

* * *

This particular City of Elmwood is fictitious, but the advantages of the Smart Grid concept for communities are very real.

Consider the City of Cumberland, Md., where an infrastructure upgrade to accommodate new businesses and jobs included investment in a Smart-Grid-style system with automated meter reading on a network that also provides citywide WiFi service. Those improvements were part of a $3.7 million project package that is expected to save $8 million in energy and operating costs over 15 years.

In Cuyahoga Falls, Ohio, the municipal utility installed new water and electric meters that allow automated reading on a fixed-base system. The 24,000 electric meters have two-way communication capability that in the future could help support demand response programs for commercial and industrial customers. The total $17.1 million package, which includes investments in building efficiency, comes with annual savings of $2 million for 10 years.

In the ways described here, and in other ways still being explored, the Smart Grid concept can help communities support sustainability's triple bottom line of economic prosperity, environmental protection, and social benefit.

Smart Grid adherents include Gerry Smallegange, president and CEO of Burlington (Ont.) Hydro Electric Inc. Writing in *Municipal World* magazine, he noted that the City of Burlington, the sole shareholder of Burlington Hydro, "shares in the vision that a strong and progressive utility that invests in Smart Grid modernization and green energy contributes to the vitality of a city."

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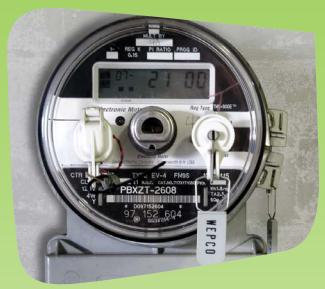

What does it mean?

The term "Smart Grid" gets tossed about so freely that its basic meaning can get lost. The concept originated with the electric utility industry and refers to a system in which intelligent controls and automation tie the power grid together in an automated network that makes delivery of electricity more secure, reliable, economical, efficient, and environmentally friendly.

Essential to the concept is the enabling of active consumer participation, so that power users can engage electricity markets and respond to supply and demand signals, for their own advantage and to the benefit of the larger system.

In the municipal utility context, the Smart Grid concept easily extends to electricity, gas and water. It allows two-way digital communication between the utility and customers, helping the utility operate its systems more efficiently, curtail waste, and hold down prices. Meanwhile, it helps customers see their own use and make informed choices on how much to use, when, and at what cost.

To appreciate Smart Grid, it is essential to understand the concept as more than smart metering technology, with which it is often confused. In fact, thinking of Smart Grid merely as smart meters is like thinking of the Internet solely as a place for document searches and e-mail.

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The greatest value of Smart Grid technology may be the wired or wireless network on which it functions. That network can serve other community purposes limited only by the imagination. To cite just a few examples, it can provide:

- Efficiency-boosting communication to utility service people and between city departments.
- Monitoring and control for functions as diverse as facility security, lighting, and parking enforcement.
- A vehicle on which the utility can communicate with and educate residents, and where residents can communicate with each other and the world.
- A platform to collect and analyze information for improved planning, pricing, and customer support.

All that, combined with user fee and tax savings, appeals to homeowners and even more so to businesses considering where to locate or expand. While a smart utility system is not a sole deciding factor, it can help attract up-and-coming companies and their well-educated, well-paid employees.

Simply stated, progressive residents may prefer a city with an infrastructure that looks less like a traditional desktop PC and more like an iPad.

How does it work?

To understand how the Smart Grid concept works, it helps to start with a simple (not quite perfect) analogy to Smart Buildings. Here, building systems that control comfort, energy usage, security, life safety and other functions communicate with one another on one network, while the building communicates with the outside world.

Software then lets building systems optimize performance and cost automatically, reacting to signals such as changes in the weather or forecast increases in electricity prices. In addition, the system translates performance data into easy-to-read displays (dashboards)

so that management can see opportunities for operational changes that reduce cost and increase efficiency.

From individual buildings, it is easy to extend the Smart Buildings concept to an entire campus, and from there to a Smart Grid system serving an entire city (although the dynamics are different when a municipal utility interacts with multiple diverse and independent users).

What does it include?

The Smart Grid is a major departure from the traditional structure of water, gas and electric utilities as separate collections of pipes and wires that need intensive physical inspection and at best provide one-way communication – via meters.

System control and data acquisition (SCADA) technology enables remote monitoring of field facilities such as electric substations and water towers, reservoirs and pump stations, but that communication typically stops well short of the end user: The interface with customers begins and ends with the meter.

Enter smart metering. The concept began with automated meter reading (AMR), in which meters transmit usage data to a mobile or fixed-base system, saving the cost of manual reading. Advanced metering infrastructure (AMI) goes farther, allowing utilities to collect more information, engage in two-way communication with customers, and even control certain customer-level functions on a more timely basis.

In the broadest sense, AMR/AMI helps communities cut costs and save money to invest in larger initiatives that attract business, promote job growth, and improve quality of life. The utility-specific benefits include improved billing accuracy and timeliness, better cash flow, limited tampering and theft and, in the case of water service, faster leak detection that can save costs, prevent property damage, and preserve system capacity.

But it is the communication network on which AMR/AMI functions that turns smart metering into Smart Grid. For only a modest investment, that wired, fiber-optic or wireless network can be "oversized" to provide a large array of other capabilities. These may include:

- Providing in-home displays or dashboards that show customer usage in real time. Homeowners can use the display to make wise usage choices or to help teach family members conservation habits. The utility can use it to send information on matters such as water advisories or special usage limits.
- Providing broadband Internet connectivity to homes, schools and businesses.
- Using acoustic devices on customer meters to "listen back" into the distribution system for small leaks, which then can be mapped and assigned priorities for repair.
- Monitoring homes' power or water usage at intervals as small as 15 minutes to collect near-real-time data on demand patterns as an aid to operations and system planning.
- Enabling remote shutoff of air conditioners for load-control programs, or disconnection of water and electricity for nonpayment (where allowed).
- Managing traffic-related functions from streetlights to parking meters.
- Regulating lawn irrigation and supporting enforcement of special water conservation rules.

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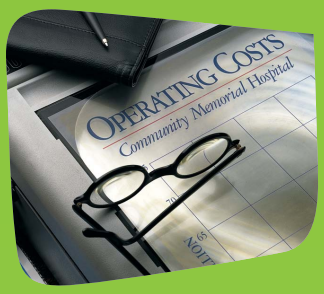

Investments in AMR/AMI and Smart Grid technology typically have attractive payback periods that make them well suited to performance contracting.

Who pays, and how?

Smart Grid technologies require investments that can seem daunting in hard economic times. But as progressive utilities have found, a financing tool called performance contracting makes it possible to complete substantial and sweeping improvements with no up-front investment and without the need for rate or tax increases.

Under a performance contract, an energy service company (ESCO) performs a set of projects that reduce operating and energy costs by a defined amount over a contract term of 10 to 15 years.

The city then pays for the cost of the improvements over a specified period of time from the savings that result. Annual savings are guaranteed by the ESCO itself: If savings in a given year fall short of the contract amount, the ESCO writes the city a check for the difference. Usually, financing is structured so that monthly savings are greater than the monthly payment on the improvements, and the city thus sees immediate positive cash flow. At the end of the contract when the improvements are fully paid for, the city reaps the full benefit of the savings on an ongoing basis.

Investments in AMR/AMI and Smart Grid technology typically have attractive payback periods that make them well suited to performance contracting. For even greater benefit, the projects can be bundled with other high-return solutions, such as lighting retrofits, control automation, and upgrades to high-efficiency boilers, motors and drives in water plants and city buildings. Going further, improvement packages can include even long-payback projects, like window replacement in buildings, that might not otherwise be financially justified on their own.

Who's doing it well?

The cities of Cumberland and Cuyahoga Falls provide lessons in the immediate benefits of the Smart Grid concept and its future potential.

Cumberland's $3.7 million performance contract bundled energy projects (lighting improvements, building lighting retrofits, building weatherization and HVAC system upgrades) with an AMR/AMI program that featured installation of transmitters on nearly 9,000 existing residential water meters.

As part of the project, two tower gateway base stations, a regional network interface, and six repeater stations were installed for the wireless network. In addition, a series of nodes were added for citywide WiFi, available to residents at substantially lower costs than for commercial systems.

City administrator Jeff E. Repp says the WiFi system probably could not have been cost-justified if not included in the larger performance contract. Residents can use the system free for limited minutes per day and can also subscribe on daily, weekly, monthly, quarterly, or annual plans.

Already, without marketing support, the WiFi system has enough users to break even, and the city is gearing up for a spring 2011 marketing push executed by students from nearby Frostburg State University. As the subscriber base grows, profits will be placed in a fund for reinvestment to sustain and improve the system.

"Our aim was to provide low-cost Internet service for our citizens that basically pays for itself," Repp says. "If it generates enough revenue, we may have some money to transfer to the general fund to be used for other city purposes. We list the WiFi system in our literature as one of our community amenities, and in the future we will market it heavily as one of the major items we can offer to companies that locate in Cumberland."

The WiFi system also creates a new channel for communicating with residents on city matters from water utility updates to general news. Meanwhile, the energy-efficiency improvements are meeting expectations and show the city's commitment to being green.

In Cuyahoga Falls, the city replaced a total of 42,000 meters (18,000 water, 24,000 electric) and installed a robust wireless AMR/AMI infrastructure. The immediate benefits include reduction in meter-reading and billing labor, the elimination of unpopular estimated meter readings, increased billing accuracy, and improved cash flow.

Looking ahead, the city hopes to make several uses of the electric meters' two-way communication capability. "We envision the system helping us work with our commercial and industrial customers on demand management," says Valerie Wax Carr, director of public service.

"We would be able to chart their demand and consumption data, show them where their peaks are, and help them formulate plans to reduce demand and shift consumption to lower-priced off-peak times. That would help the city as well, since by shaving our loads, we can reduce the amount of power we have to buy."

Going to the next level, the city could create a web-based dashboard where all types of customers could log on with their account number, see their real-time demand and consumption, and use the data as a basis for changing behaviors. In the longer term, the metering technology would enable the city to automate demand response for residents who so desire.

Meanwhile, the metering system also enables the city to pinpoint the extent of power outages and so respond and restore service faster, shut off meters remotely in case of nonpayment, and get instant meter reads (such as for residents who are moving and ending service). On the water side, the system detects anomalies that may indicate leaks, so that staff can better manage the city's resources and quickly notify residents to investigate whenever necessary.

What's the next step?

The SmartGrid concept and the technologies that enable it have potential to make municipal utility operations much more efficient, keep costs competitive, improve service to customers, and even help revitalize cities themselves.

As Smallegange of Burlington Hydro Electric observes, "Smart Grid development has a direct relationship with smart growth, fostering the type of initiatives that open doors for model businesses and suburban centers that leave smaller carbon footprints, while cultivating economic hubs for green energy, R&D, manufacturing and engineering."

The time is now to explore Smart grid technologies and to seek help from companies with experience in its successful application.

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