What 'The Smart Grid' Means For You & Your Building

"The Smart Grid"—just three words, abbreviated in this piece as TSG—has become an increasingly important element in discussions of how we can improve energy efficiency and reduce global warming. But many building owners may be left scratching their heads, wondering what, exactly TSG will mean for their operations—and bottom lines.

Decades may pass before TSG's real impact is understood, but utilities and equipment manufacturers are beginning to get a clearer picture. Real-world installations are now underway. A number of pilot programs now coming online are beginning to provide some answers to these questions.

What does "smart" really mean?

Of course, understanding what TSG might accomplish first requires an understanding of the many meanings attached to the phrase actually mean.

In essence, electric utilities and their partners want to turn what is now a "dumb" one-way flow of electricity—from the generating station to end-use devices—into a two-way stream. With more intelligence in the system, the electric-supply contributions of renewable resources can more easily be accommodated by the local/regional grid.

What's more, utility grid operations—many of them limited by 1950s-era technology—can become more reliable and efficient.

To achieve these goals, utilities are adding new two-way communications capabilities to every component through which electricity passes, from power plant to substation to transformer to the individual meter—and beyond.

Funding pushes TSG along

Implementing TSG and its various technologies became a national priority with the 2009 passage of the American Recovery and Reinvestment Act (also known as the stimulus package). That legislation dedicates $3.4 billion in federal matching funds to a range of utilities and manufacturers across the country, for projects ranging from transmission-line upgrades to the design of new home appliances capable of communicating with local utilities.

Batteries & The Smart Grid:

Helping Renewables Grow

A longstanding problem with electricity provided by the sun and the wind is that it won't be available on a 7x24 basis. The sun doesn't shine around the clock; in many places, the wind is stronger at night (and stops blowing without warning).

This is where battery storage comes in. By connecting a solar panel or wind turbine to a battery, instead of directly to a meter, energy can be stored to meet later demand. Utility systems will be able to communicate with the batteries to release energy to the grid during peak-demand periods, providing a valuable, pollution-free alternative to peaking power plants.

Obviously, this area of TSG research and development is especially important for building owners investigating photovoltaic (PV) panels for their facilities. New Mexico-based utility PNM is beginning an effort to incorporate customer- and substation-based PV panels, along with customer-based battery-storage units, to better match the electricity the panels generate to actual utility demand.

Pricing information and, perhaps, control signals will be passed on to building owners—enabling them to take advantage of real-time discounts. This means that connected appliances, such as air conditioners or water heaters, might get set back automatically when rates rise, lessening peak demand for the utility . . . and lowering electricity rates for the building owner.

What will building owners obtain in return for this large capital investment? It's a reasonable question, with specific answers—*although the date on which these returns will appear* is not yet clear. TSG proponents claim numerous advantages, including:

- Increased reliability, because utilities will be able to identify potential problems before they occur
- Improved power quality, as utilities will be better able to monitor and control voltage fluctuations and other irregularities
- Up-to-the-minute rate information for customers, through the millions of new smart meters that will be installed over the next decade or more
- Greater control over how and when electricity is used, along with the ability for more customers to take advantage of the load-shedding discounts only larger users now enjoy
- Easier integration of a range of distributed energy resources, including solar panels, wind turbines and, in the future, plug-in electric vehicles.

Keeping outages at bay

As you went through those bullets, you may have concluded that many of the biggest benefits for businesses and building owners will be somewhat intangible. These benefits are based on avoided costs rather than direct, bottom-line savings.

Utilities believe their business customers will face fewer outages and reduced risk from the damage power surges and other irregularities can inflict on computers and other sensitive electronics. Additionally, when outages do occur, utilities say they will be able to pinpoint problem connections more easily and also reroute electricity supplies around these locations to minimize the number of affected customers.

In theory, a large regional blackout like the 2003 incident that left 50 million people in the Eastern U.S. (and parts of Canada) without power should be avoided. At least, that's the promise—and hope.

Take a load off

Several utilities are developing pilot programs focusing on load-shedding applications of the TSG.

Example: Jersey City Power & Light (Morristown,

How Electric Vehicles Fit Into TSG's Future

TSG will be a critical component in the success of plug-in electric vehicles (PEVs), which will begin hitting showroom floors in late 2010.

All-electric cars, trucks, and buses promise to reduce vehicle-related pollution significantly. However, keeping these new models powered and on the road will require significant infrastructure investment. There is more involved than simply having building owners add outlets to all their parking spaces (or plugging in to an existing outlet in your garage).

One possibility: Adding "smart" charging stations to public buildings. The vision here (called V2G, for vehicle-to-grid) includes having parked vehicles connected to charging stations during the day act as electricity resources. In other words, the PEV might supply electricity during the day, helping the local utility cope with peak loads.

But it's not as simple as these sentences might make it sound. Utilities face a number of challenges in their efforts to support electric-vehicle deployment, many of which can be addressed using smart grid technologies, including:

- How to encourage drivers to charge their cars' batteries when overall power demand is low (so PEVs don't worsen peak demand problems).
- Who should be charged for refilling each vehicle, whether it's the owner of the building where the car is parked or the individual vehicle owner
- How to credit car owners when their batteries are called on to feed electricity back to the larger grid

Ford's plans

Ford Motor Company, which plans to release three electric or electric/gasoline hybrid vehicles between 2010 and 2012, has developed one possible solution that could help address several of these challenges, which depends on the smart grid's communications capabilities. This communication technology will communicate to owners using a touchscreen navigation interface, letting owners program when plugged-in vehicles should be charged, for how long and at what utility rate.

As of this writing, the company is testing the technology in partnership with several electric utilities, including Southern California Edison and American Electric Power.

N.J.), has begun an effort that will allow it to shed megawatts of demand from its system during the summer's hottest days. The project, one of a number being led by the Electric Power Research Institute's Integrated Distributed Energy Resource initiative, involves installing 1,000 hybrid air-conditioning units throughout the utility's service territory. These commercial-sized systems use ice storage—previously only economically feasible in large, industrial-size installations—to create cooling capacity overnight, for use the next day.

Controls embedded within the units will allow the utility to switch units from operating off standard compressors to drawing on stored, ice-based cooling as system loads rise.

In a real sense, the aggregated cooling-storage capacity of the 1,000 units JCP&L is installing will become a new energy resource for the utility, reducing its load by up to 5 MW when fully operational. This reduction will help to limit the need to call on expensive peaking power plants that only operate for those few days or weeks a year when baseload plants are unable to keep up with demand. These plants also are often the least efficient in a utility's portfolio, producing less energy and more greenhouse gases than other generating units, so limiting their use also can help meet environmental goals.

What's new in Boulder

Customers of Xcel Energy in Boulder, Colo., already are seeing benefits. The site of the largest early implementation of TSG technologies, Boulder now has 16,000 smart meters. The utility additionally automated three distribution substations and installed grid-monitoring software.

Xcel claims it already has averted four potentially long-term outages through system alerts warning of potential transformer failures.

There's more to come: The next phase will bring added energy-use intelligence to those customers who've had smart meters installed. These users will be able to access an online energy-management portal, allowing them to develop personalized energy-use profiles.

Such smart meters are one key element in giving building owners and other consumers more control over their energy use and energy bills. While meters that enable utilities to automate their monthly readings have been around for some time, these new devices allow utilities to communicate their rate information back to customers.

As lighting, appliances, and other equipment gain their own communications capabilities—and many such products should be coming to market in the next few years—that utility-supplied rate data could be used to automatically set back non-essential equipment operation to reduce peak-period energy demand.

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