Smart Grid and Smart Home Technologies Gain Momentum

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Intelligent monitoring and management of energy usage is an area of high activity at the present time, with many "smart grid" conferences, research projects and early implementation of operating systems. In addition, in-home management of additional functions for security, and safety, as well as comfort and energy usage, is undergoing similar development.

There are many common aspects that connect these two activities, since many of the household management functions involve electrical appliances and electronic communications. In current research and implementation, the electric power distribution system is the common element. Smart meters gather usage data and deliver it to the electric utilities. They also can (or will soon) control some of the devices in the home, with the goal of conserving energy by reducing unnecessary usage.

These efforts are of great interest to the high frequency industry because most of the communications among the devices and systems being managed will be wireless or RF-based wireline. Various systems are being developed, or proposed, that utilize the existing "cell phone" infrastructure, Wi-Fi, power line communications (PLC), and proprietary networks using both licensed and unlicensed bands, including new 700 MHz spectrum and TV white space channels.

Smart Grid Objectives and Methods

In general, the "smart grid" is a collection of methods, protocols and hardware that improves the efficiency of electric power generation, distribution and usage. Figure 1 is a block diagram of the present system of electric power distribution in the U.S. Estimates of the size of the national grid are in the range of 1 million miles of distribution lines.

In a 2010 report [1] the the U.S. Department of Energy's Pacific Northwest National Laboratory identified several mechanisms by which a smart grid could reduce electric power consumption, with the benefits of reduced cost, reduced demand on the present system and slower expansion grid infraastructure. Further benefits would be reduced carbon emissions and, potentially, reduced emission of pollutants from power plants.

The mechanisms for improved efficiency identified in the report are:

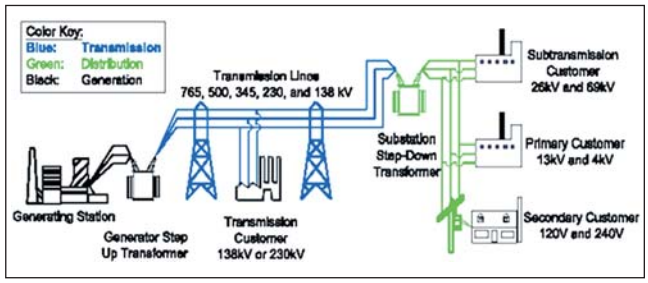

Figure 1 · Electricity distribution in the U.S. ***(Source: U.S. Dept. of Energy, Electricity 101 at http://www.oe.energy.gov/information_center/electricity101.htm)***

- Conservation effect of consumer information and feedback systems (3% savings)
- Joint marketing of energy efficiency and demand response programs (0.5% indirect savings)
- Deployment of diagnostics in residential and small/medium commercial buildings (3% savings)
- Measurement & Verification (M&V) for energy efficiency programs (1% direct, 0.5% indirect savings)
- Shifting load to more efficient generation (<0.1% savings)
- Support additional electric vehicles and plug-in hybrid electric vehicles (3% savings)
- Conservation voltage reduction and advanced voltage control (2% savings)
- Support penetration of renewable wind and solar generation; 25% renewable portfolio standard [RPS] (0.1% direct, 5% indirect savings)

This analysis assumes 100% implementation of smart grid techniques, with totals of 12% direct energy savings and 6% indirect savings. Uncertainty of any item is as high as ±50%, but the net uncertainty should be much less.

Among the major benefits of an efficiently managed grid is the ability to support the integration of renewable energy—solar and wind (and presumably, small-scale conventional generation from systems based on methane-producing waste digesters or non-fossil fuel combustables). At present, the electric power grid would require expansion to serve large solar arrays or wind farms in many parts of the U.S.

Smart Home Objectives and Methods

The "smart home" is an extension of the large-scale methods of the smart grid to individual homes and businesses. The data shown in Figures 1 and 2 (opposite page) make it clear that total household energy usage has grown from primarily heating to include many convenience and comfort devices, i.e, electronic devices and air conditioning. The potential impact from a significant reduction in any of these uses should be apparent.

Some savings are simple, such as a "sleep" mode for devices that go unused for long periods of time, and shifting optional activities to off-peak demand hours.

Some of the other energy management ideas being explored for smart home systems include:

- Motion- or heat-sensing controls for lighting.
- Internet and smartphone monitoring and control (e.g., forgot to turn off an appliance or reduce a thermostat setting).
- Programmable overall household lighting according to time and function, including number of lights and their intensity.
- Automatically operating insulating or reflecting window coverings.
- Zoned control systems in addition to individual devices, e.g., living, kitchen/dining and sleeping areas.
- Multiple-user programmability for preferences of different members of the household.
- Management of on-site renewable energy, e.g., solar and wind power.

In addition to the above list, there is a much longer list of functions for comfort, convenience and security. In general these fall into two categories: automation of functions, and remote monitoring and control.

For both energy and convenience purposes, smart home technologies include nearly all common short-range wireless technologies, plus powerline communications (PLC), RFID and optical links—applied as necessary for the required data rate and range

Summary

The potential of both energy and cost savings, along with many security and convenience functions, is a strong argument for implementation of smart grid home technologies the work togerther with the smart grid. These systems are now beginning deployment, and product development is accelerating as the market approaches large-scale implementation.

Reference

1. "The Smart Grid: An Estimation of the Energy and CO_2 Benefits," U.S. Department of Energy, Pacific Northwest National Laboratory (PNNL).

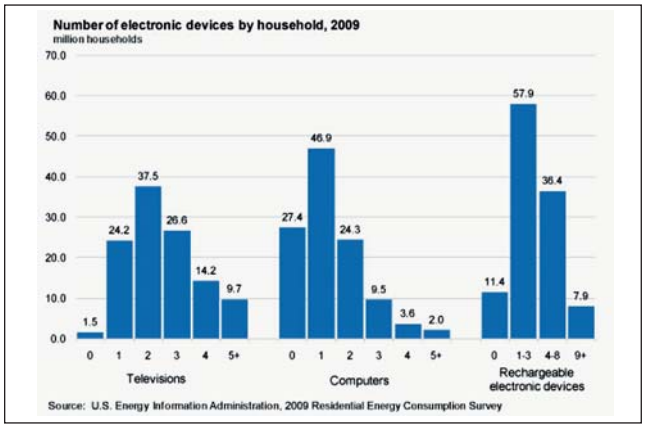

Figure 2 · Results of a 2009 survey of the number of electronic devices per U.S. household.

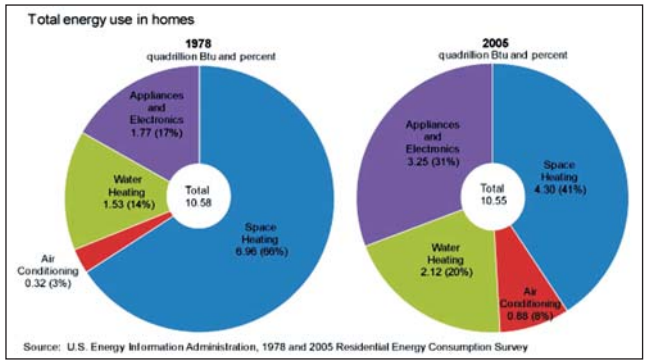

Figure 3 · Pie charts showing the increased household energy usage between 1978 and 2005, with the greatest growth in energy usage for electrical/electronic devices and air conditioning.

Smart Grid & Smart Home News—

GE Announces New $40M Grid IQ™ Innovation Center

GE and the Government of Ontario announced a new $40 million Grid IQ™ Innovation Center, the first center of its kind for GE in Canada, to be located in Markham, Ontario. Grid IQ is GE's companywide commitment to solving customers' toughest challenges with more efficient, reliable and sustainable energy solutions. The 200,000 square foot center will develop and manufacture grid modernization technologies and will encompass a global testing and simulation laboratory. The building is expected to open in July 2012.

With global energy demand forecasted to increase 75 percent by 2030 and more than 40 percent of the world's current environmental emissions resulting from electricity generation, consumers and governments alike are calling for new ideas to improve our current infrastructure.

GE's Grid IQ™ Innovation Center will focus on delivering solutions to improve system efficiency and reliability and to protect and automate the power system. Specific activities planned for GE's Grid IQ™ Innovation center include leading edge research and development in substation and distribution automation, electrical system protection and control, microgrid control and cyber security.

Home Monitoring Control Test Operation

Verizon's Home Monitoring Control test started in January in several homes in New Jersey. Customers are able to use smartphones, tablets, laptops, or other connected devices to control what's happening in their homes: Lock and unlock doors from a smartphone, adjust the thermostat using a tablet PC, or see what's going on at home via networked cameras. The system will also let users control lights and appliances.

Customers who sign up for this service will have their homes equipped with a number of devices, such as an energy reader, smart appliance and thermostat switches, smart power strips, smart door and windows locks, motion sensors, advanced panning and tilting cameras, and fixed indoor and outdoor cameras.

Energy Usage Data Standard Passes Key Advisory Panel Vote

The governing board of the public-private Smart Grid Interoperability Panel (SGIP) has voted in favor of a new standard important for two-way data communications between utilities and their customers, bringing the next-generation "smart" electrical power grid a step closer to reality. The board voted on a foundational standard, an "energy usage data model," for the information used to communicate between utilities and the customer, and the way in which that information is organized. The data standard was developed by the North American Energy Standards Board (NAESB) at the request of the SGIP and the National Institute of Standards and Technology (NIST).

The recommended standard is also expected to create opportunities for innovation. With utilities now installing "smart" electric meters in millions of homes and business, established companies and start-ups are developing new products and services tailored to the energy-use behaviors and objectives of consumers. Smart-meter technology will enable real-time (or near real-time) communication of energy use, consumption, quality and source, among other information. The standard is "Internet-friendly," and its applications will include enabling customers to view their energy usage and cost, accessed locally and over the Internet.

The SGIP, a consensus-based group of public and private organizations, was created in 2009 by NIST to support the agency in its role to coordinate the development of Smart Grid standards.