Bringing the Smart Grid Into the Home: The Value of Home Energy Management for Utilities

Home energy management (HEM), enabled by the smart grid, is an extension of smart-meter deployments that provides interesting benefits for residential customers and utilities. IDC found that customers reduce overall energy use by 4 to 15 percent when they receive real-time feedback on power consumption. Also, according to a study by Zogby International, 74 percent of Americans are likely to change their energy use to save money on their utility bills if they are given the technology solutions to do so.

For utilities, HEM solutions open new opportunities for strengthening customer relationships, managing power loads, defending against new competitors, and realizing new revenue from value-added services.

However, for HEM to achieve mass-market penetration, the industry must overcome challenges for easily selling, installing, managing, and securing these solutions. Each utility must also define its preferred role for offering HEM solutions, whether providing only a referral to approved retailers or creating a new business to offer HEM products and related services to customers.

Home Energy Management: The Opportunity

Several factors influence a utility's outlook for offering HEM products and services:

- **Regulatory mandates and market pressures**: Utilities are under increasing pressure—from regulators, customers, and public opinion—to increase energy efficiency, reduce carbon generation, and integrate more power from renewable sources, including customer homes. Smart meters and HEM tools are important resources for meeting these goals by reducing power usage, especially during critical peak periods.

- **Widespread deployment of residential smart meters**: Significant changes in a household's energy use begin with the detailed data that smart meters provide. Parks Associates estimates that more than 50 million smart meters will be installed by 2014.

- **Energy-consumption data produced by a smart meter**: Energy-consumption data produced by a smart meter is useful to utilities for developing time-of-day pricing, encouraging customers to shift their demand patterns, and increasing customer participation in demand-response programs to better balance power load against generated supply during peak periods.

- **New revenue**: Home energy management gives utilities potential new revenue streams from offering new services and strengthening relationships with customers. In addition to sales of specific HEM products and services, these solutions can increase customer interest in energy-efficiency audits and rebate programs, as well as purchasing power from green energy sources.

- **Competition for customers**: In the future, utilities will compete with other retail energy suppliers and other types of companies (such as communications service providers) that also want to expand their relationships with residential customers. Offering HEM services can help a utility retain customer loyalty and deflect potential competition from new market entrants.
● **Customer interest:** Consumers are increasingly interested in green living. They will expect utilities to deliver HEM capabilities because reduced power consumption is an important part of a green lifestyle. A Parks Associates study indicates that customers who are interested in HEM have highly appealing market demographics, with incomes higher than US$50,000 per year, high levels of education, and interest levels across all adult age groups. In addition, more utilities will be introducing time-of-use and other pricing packages that will make it cost-effective for consumers to shift their power usage away from peak pricing periods.

● **Electric vehicles:** In the future, electric plug-in vehicles are expected to bring potential revenue and new challenges for balancing electricity loads to utilities from residential customers.

**What Home Energy Management Means for Utilities**

For utilities, residential homes represent approximately 50 percent of the potential for reducing power consumption in the United States. Reduced demand in turn helps utilities avoid costly investments in facilities and reduce the greenhouse gas emissions associated with power generation.

However, early smart-meter pilots are demonstrating the need to provide visibility and communicate clearly to residential customers about their energy use. An accompanying HEM solution provides this visibility into smart-meter data, while also giving utilities a new avenue for sharing energy conservation incentives and tips.

Offering HEM solutions to customers yields several additional benefits for utilities in managing power loads and enhancing customer relationships:

● **Demand-response programs:** When a demand-response program is extended to residential customers, utilities can significantly improve grid capacity and asset usage at peak times by reducing the load on generation and distribution facilities.

  Traditional demand-response solutions rely on one-way communications systems and cannot provide feedback on the actual load reduction. In comparison, a HEM solution gives a utility the information necessary to know the effectiveness of a demand-response event. Additionally, studies demonstrate that notifying customers of their energy savings and bill reduction soon after the demand-response event increases their participation rate in these programs.

● **Dynamic pricing programs:** Pricing programs such as critical-peak and time-of-day are desirable to utilities for their ability to motivate customers to reduce and shift their power demand. But customers may find the variability of these programs confusing, a situation that curtails participation. Through the HEM solution, a utility can educate customers about pricing plans, deliver proactive alerts, and give customers more control over energy consumption—all factors that help increase customer satisfaction.

● **Broadband network connection:** The low-bandwidth networks used by smart meters limit the utility’s ability to communicate with the variety of customers’ in-home smart devices. Introducing a HEM solution into the home complements a utility’s Advanced Metering Initiative (AMI) investment and makes the customer’s broadband Internet connection available to utilities for a richer customer engagement. Broadband access also creates an alternative mechanism to deliver price signals to the home if no smart meter is available.

● **Additional value-added services:** HEM solutions provide an avenue for a utility to offer additional promotions and value-added services that are attractive to customers. Utility examples include prepaid programs, enrollment in green power programs, management of gas and water meters, and customer billing alerts and budgeting tools.
The Key Role of a HEM Solution

A complete HEM solution offering from a utility encompasses devices, network connections, data, and services to help customers monitor and manage their energy consumption. The solution particularly focuses on power use by the highest-consuming systems in the home: heating, ventilation, and air conditioning (HVAC) systems, hot-water heaters, and large appliances (Figure 1).

Figure 1. A Complete HEM Solution from the Utility’s Perspective

The HEM solution allows customers to perform tasks such as:

- View data on energy use
- Control thermostats for HVAC systems
- See tips on ways to save energy
- Manage a profile for participation in demand-response programs
- View customer account and billing information
- Control individual home appliances

Within the home, a complete solution for HEM includes the elements presented in Table 1.
Table 1. Key Elements of a HEM Solution

<table>
<thead>
<tr>
<th>Solution Element</th>
<th>Capabilities</th>
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<tbody>
<tr>
<td>Home-energy-controller (HEC) device</td>
<td>The HEC device, typically a countertop display unit, includes applications for monitoring and controlling energy consumption by individual systems and appliances in the home as well as interfaces for networking, peripherals, and a smart meter.</td>
</tr>
<tr>
<td>Utility-provided smart meter</td>
<td>The smart meter tracks power consumption and provides that data to the HEC device.</td>
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</table>
| Network connections                      | • An in-home network connects programmable thermostats, appliances, and smart plugs to the smart meter and to the HEC device.  
• A broadband Internet connection is used for sending utility messages to the HEC, downloading new applications or software versions from the utility or third parties, and providing device support. |
| Engaging user experience                 | • Energy usage information and utility messages are displayed on the HEC.  
• The HEM solution supports third-party applications and user access to the HEC from a smart phone or other handheld device. |
| Smart plugs and smart appliances         | • Third-party wireless, controllable sensors monitor and manage power consumption by “dumb” appliances and other devices (for example, water heaters and pool pumps) through smart plugs.  
• These appliances relay utility signals to control smart appliances. |
| Programmable communicating thermostat (PCT) | A PCT is a third-party home thermostat with an interface to the HEC to monitor and control heating and cooling systems. |
| Hosted services                          | Hosted services provide HEC provisioning and management, integrate third-party applications, and support consumer- and utility-facing portals. |

The core device in the solution is the HEC, which delivers the essential features to help customers with typical energy management activities, as shown in Table 2.

Table 2. Target Consumer Tasks and User Features in a Home Energy Controller

<table>
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<tr>
<th>Customer Activity</th>
<th>HEC Features</th>
</tr>
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</table>
| Monitor energy consumption and cost      | Energy consumption data:  
• Real-time  
• Historical  
• Individual appliances and devices |
| Monitor and control individual devices    | • Control HVAC system with a PCT.  
• Control smart appliances and smart plugs.  
• The devices offer scheduling (day/night/away) and scene (home/away/vacation) modes. |
| Access information in a consumer portal  | • Predict energy costs.  
• View peer group energy comparisons.  
• Receive energy-savings tips. |
| Participate in demand-response programs  | • Receive and react to utility demand-response requests.  
• Generate demand-response mode profiles.  
• Override demand-response requests |
| Respond to dynamic pricing programs      | • Receive utility price signals.  
• React to a utility pricing event. |
| Protect privacy and the home network     | • Encryption protects customer data.  
• Access control and other security measures protect the HEC device from attacks, viruses, and other threats. |

In addition to the capabilities of a specific HEM solution, a utility should also consider whether that solution is easily deployed and managed. An ideal home energy management solution should have the robust capabilities to provide:

- An engaging, easy-to-use experience so the consumer does not lose interest and set aside the device
- Comprehensive networking, security, and privacy features to enable optimal communications with a variety of devices: At the same time, stringent security and privacy controls must be in place to protect both the consumer and the utility network.
• Back-end services to enable device management by the utility: Services should provide auto-provisioning of devices, remote software upgrade capabilities, hierarchical management of groups of devices, and analytics capabilities for insight into power-consumption trends.

The Cisco Strategy for Home Energy Management

As part of the Cisco® Connected Grid portfolio of solutions for the smart grid, Cisco offers comprehensive solutions for home energy management. At the heart of these solutions is the Cisco Home Energy Controller (HEC), a countertop display unit that incorporates multiple networking protocols with an application engine. Through the touch-screen display, you can view and control individual components such as PCTs, intelligent sockets and power strips, and smart appliances such as refrigerators and water heaters.

The Cisco Home Energy Controller is part of a higher-level solution architecture for home energy management (Figure 2). This architecture covers the HEC connections within a customer's home, communication with the smart-grid data network, and data integration with other utility systems and third-party applications.

The architecture also gives utilities a directly managed HEM solution that is scalable to match smart-meter deployment. The modular and standards-based design of Cisco products within the Cisco HEC architecture also makes it easy for utilities to expand customer relationships and markets by developing and integrating new in-home services.

Figure 2. Cisco Home Energy Management: High-Level Solution Architecture
To give utilities flexible, fully featured HEM solutions, Cisco is working with third parties to develop an ecosystem of compatible peripherals and applications. These partners include:

- Power and utility integrators for energy infrastructure
- Technology vendors for smart meters, grid automation, and business and home automation solutions
- Communication service providers for network connectivity and transport
- Systems integrators and consultants for business processes, applications, and data management
- Retailers and other vendors for value-added sales and support

**Why Cisco?**

Cisco offers utilities the value of in-depth networking experience, both in the home and in large enterprises. The Cisco portfolio includes industry-leading networking equipment, computing platforms, integrated software services, and professional services that cover the spectrum of functional requirements for a scalable, reliable, and secure smart grid. Cisco also has a proven track record of success in using the network as a platform to roll out advanced services and applications to businesses, and to reach consumer markets through retail channels.

With a commitment to open standards and the influence to create ecosystems of third-party products, the benefits of a Cisco HEM solution will increase over time. Cisco remains on the forefront of open, standards-based technologies for IP communications and the smart grid through engagement with bodies such as IETF, IEEE, Alliance IPSO (IP for Smart Objects), Smart Grids EU, Global Clinton Initiative, EPRI Intelligrid, Gridwise Alliance, and the Smart Energy Alliance (SEA).

**For More Information**

For more information about specific Cisco products for home energy management and the smart grid, please visit: