BLUELINE INNOVATIONS. The PowerCost Monitor is a wireless energy monitor that displays how much electricity the user's home consumes from moment to moment and in total. A countertop display unit can present total electricity costs in dollars and cents and in kilowatt hours, and users can see their peak energy cost within the last 24 hours. A sensor unit attaches to the outside of a home's electric utility meter and wirelessly transmits use information to the Power Monitor. 866.607.2583. www.bluelineinnovations.com. Circle 300.

Real-Time Feedback

Energy management systems put homeowners in the driver's seat.

By Jeffrey Lee

If you've ever driven a Toyota Prius hybrid, you know the car's dashboard includes a monitor that displays which power source is operating and how many miles per gallon you're getting. The functionality has spawned a practice called "hypermiling," in which drivers squeeze every little bit of fuel efficiency out of their cars by making adjustments to the way they drive.

Now homeowners can do the same thing. An array of manufacturers offer residential energy monitoring and management systems that serve much the same purpose. These "dashboards" give feedback that homeowners can use to maximize a house's energy and resource efficiency, and help your homes live up to their performance expectations. And some manufacturers are adding even more advanced features that will help them monitor and control the sources and use of resources.

At the most basic level, energy monitors provide a simple readout of the total amount of energy the home is using, often by attaching a sensor to the electric meter that sends a wireless signal to the in-home display. The monitors may show the dollar cost of the electricity based on electric rates that the user enters or may let users monitor energy usage by day or time.

Research has shown that even such basic feedback can lead to savings. In a 2006 paper "The Effectiveness of Feedback on Energy Consumption" for the University of Oxford, Sarah Darby says the literature demonstrates "that instantaneous, direct feedback in combination with frequent, accurate billing is needed as a basis for sustained demand reduction." She adds that the norm for energy savings from direct feedback is 5% to 15%, and studies using a table-top interactive cost and power display unit have shown savings as high as 20%.

"If you can see it on a display, people then take a real interest in lowering [energy] demand," says Keith Davis, president of

Residential Technologies, a Charlotte, N.C.–based electrical and electronic systems contractor. "Having knowledge allows them to control energy use within their budget and financial means and within their lifestyle."

No matter how carefully you plan for the operation of your homes, the occupants' lifestyles and habits determine the buildings' ultimate performance. Energy management systems can help customers achieve the energy efficiency they thought they would get from a green home.

Beyond basic whole-house monitors, installers can turn to packaged monitoring systems that offer more detailed feedback or to control systems that let homeowners automate energy-saving tasks.

FINE-TUNE FEEDBACK

While simple, whole-house monitoring can lead to proven energy savings, builders and remodelers can help homeowners fine-tune their homes further with energy management systems, such as Agilewaves or EcoView, that give feedback on individual systems or resources like gas and water. Agilewaves, for instance, has a resource monitor that can track individual electric loads, rooms, or floors of the home, or alternative power generation, in addition to gas and water.

For example, one Agilewaves customer installed a powerful solar array and discovered his inverter was failing at peak production—data he most likely never would have seen otherwise, says company chief technical officer David Brock.

Adding to the options are home control systems and intelligent HVAC controllers that not only monitor the energy a system uses, but also control settings based on occupancy, temperatures, or the cost of energy at a given time. Such systems, including Control4 and Crestron, are better known for their home theater and "smart home" controls, but some are now set up to integrate energy monitoring features, and at a more reasonable cost than luxury systems of the past, acccording to Bill Ablondi, director of home systems for research firm Parks Associates.

These systems build off such useful but underused technologies as programmable thermostats and lighting controls to also

CONTROL4. The company's control products let users manage systems, such as temperature and smart lighting, from a touchpanel, TV, or remote Web connection. Load-sensing modules enable the system to monitor a device's energy usage. The system also can use an Energy Star database to calculate the energy draw of lighting, TVs, or other appliances. 801.523.3100. www.control4.com. Circle 301.

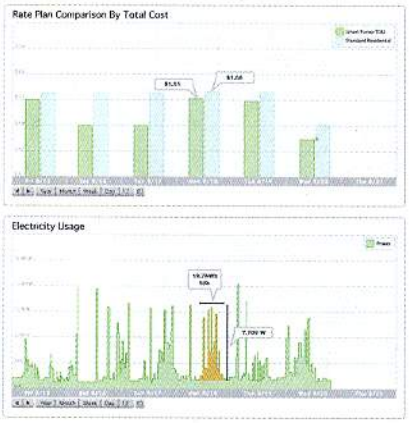
ADVANCED TELEMETRY. The EcoView energy management system captures and displays the use of energy and other resources within a residence. A basic package includes a touchscreen display and electricity monitor, but the system can be programmed to control or monitor water, natural gas, lighting, HVAC, and other home systems. The package is Web-enabled for remote control and analysis. 415.464.4872. www.advancedtelemetry.com. Circle 302.

KEEPING SCORE

Sustainability dashboards appeal to three types of consumers, says Mike Ruth, senior director of product strategy for Tendril, which offers an energy management platform that bridges consumers and utilities. Some are cost-conscious and want to see how much money they're saving. Some are green and want to see how eco-friendly they are.

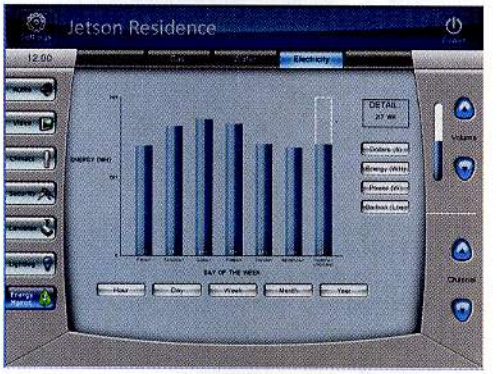
And some are competitive. "They really care about how they're doing against the Joneses," Ruth says. Tendril plans to offer a system that lets users compare the performance of their homes against homes in the same ZIP code or homes of the same size, providing benchmarking information on a regional or even national level. Consumers would have to opt in with their demographic data in order to participate.

Such a system could expand on an even grander scale with a regional feedback system that would feature real-time information on environmental, economic, demographic, or social trends, suggests Gil Friend, president and CEO of sustainability consulting firm Natural Logic. Information could be displayed on billboards, the Internet, or even in sports stadiums, he says. Keeping score would let people see the results of their actions—and indulge their competitive side. —*J.L.*



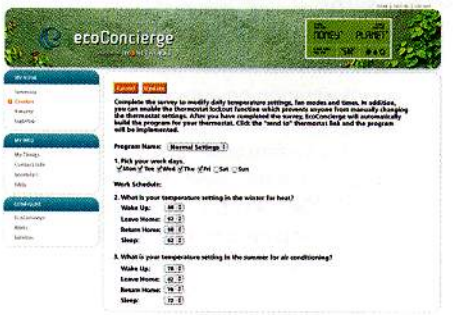
^ GREENBOX. Installed by the utility, Greenbox is a Web-based interface that provides real-time feedback on energy usage. It also supports monitoring water, gas, and solar energy. The service collects, stores, and analyzes usage data, rate plans, and billing information and offers historical charts, usage and cost analysis, billing simulations, community comparison, e-mail alerts, and carbon footprint displays. 650.292.8270. www.getgreenbox.com. Circle 304.

˘ AGILEWAVES. The Resource Monitor is a Web-based system that tracks electric, gas, and water usage in real time while automatically calculating a carbon footprint. The technology can monitor each individual circuit, water line, and gas appliance as well as other factors such as temperature and humidity, output from photovoltaics, performance of solar or geothermal water heating, or indoor air quality. The system can send automatic notifications of leaks, excessive energy use, or carbon emissions via e-mail or text message, and can communicate with home or building control systems to let users manage systems based on the feedback they receive. 650.839.0170. www.agilewaves.com. Circle 303.



‹ ONSET. The HOBO U30-WIF station is a remote data-logging and monitoring device with built-in WiFi communications that can be reconfigured and adapted to a variety of applications, such as measuring energy usage of a device, outside temperature, or carbon dioxide. Up to 15 channels of data can be recorded and monitored remotely via HOBOlink, a Web-enabled software package that lets users access current and historical data, set alarm notifications, and manage remote monitoring systems. 800.564.4377. www.onsetcomp.com. Circle 305.

› IN2 NETWORKS. Operating in conjunction with Honeywell's thermostats and other products, the Internet Communications Module connects building systems, like thermostats and water and irrigation systems, to the Internet, letting the units function as a broader, integrated system that logs data, performs diagnostics, and suggests energy-saving recommendations. The EcoConcierge Web site allows homeowners to access energy-use feedback and control and to monitor systems through a computer or PDA. 801.685.8778. www.in2networks.com. Circle 306.



monitor the energy used by the products they control and provide feedback. In short, they make it easier to operate the home at peak performance. While they face many of the same challenges as home automation systems—builders may be unwilling to add to the home's initial cost, and the systems might intimidate less tech-savvy homeowners—they can be a differentiator.

Homeowners can now operate and manage control and monitoring systems in a variety of formats, from the traditional wall-mounted touchscreen to a Web application to mobile phones or devices. Many of the companies offer e-mail or text alerts when certain energy or carbon footprint thresholds are met and can automatically take action, such as setting back the temperature, to decrease the load.

The systems vary in how they monitor usage. Some use individual load sensors that track the electrical draw of a device—a more accurate but more expensive method. Others simply calculate predicted energy use based on runtime and settings for a device.

SMART THINKING

Proving a return on investment is still an obstacle. At $500 for an entry-point controller and several thousand dollars for a full home control system, payback at current energy prices is six to eight years, says Eric Smith, chief technology officer of Control4, though he adds the company is working on a basic package that would cost less than $250. Agilewaves' typical whole-house gas and electric monitoring system with details on seven circuits retails for $7,500, and prices can range higher or lower depending on capabilities.

Home energy hypermilers also will ask about the systems' own energy use, which varies depending on the device. Brock says Agilewaves has been conscious about the resource monitor's energy draw, and that the system pulls up to 30 watts at maximum.

Analysts say energy management will be key to the growth of home control systems in coming years but note that the category still has room to grow. In the meantime, manufacturers expect to roll out additional capabilities. Several companies are building intelligent recommendation engines that

can offer energy-saving advice based on the home's energy usage. Some brands already offer sensors that measure particulate matter or carbon dioxide in the air, though a representative from the U.S. Department of Energy says more research is needed to know how to monitor air quality the best.

The largest growth opportunity for energy management may come from utilities. Several already are installing "smart meters" that provide two-way communication between the home and electric provider. The meters will enable load-management efforts, where the utility can shut off certain appliances at critical energy peaks, and targeted variable pricing programs that charge different rates based on the time of day.

Energy management system providers are riding the smart-meter boom, licensing products and software to utilities, which can offer them to residents as part of an energy-efficiency program. Greenbox, for example, offers a Web-based service through utilities that lets users monitor energy use by time of day, cost, or carbon footprint, and plans to furnish real-time monitoring and control capabilities as upgrades.

Utilities allow consumers access to the technology with a lower barrier to entry because the electric company installs the device for free, says Matt Smith, vice president of marketing for Greenbox. "Because the infrastructure is put in place [by the utility], it's something homeowners can leverage going forward," he says.

But by combining other products with its baseline offering, smart-meter programs also give builders an opportunity to offer those utility customers a customized energy management solution with better service than the utility can provide. The smart-grid initiative "is definitely going to be an absolute plus for integrators," says Michael Tangora, president of Menands, N.Y.–based integration firm Tangora Technologies. "It's just getting us further involved with consumer awareness."

Jeffrey Lee is a freelance writer in Washington.

For more products from this article, visit **ecohomemagazine.com.**

› **GRIDPOINT.** GridPoint Central is an online energy management portal that gives homeowners detailed information and control over their energy consumption and costs. By comparing a utility rate schedule against a customer's energy consumption patterns, the system can recommend the most cost-effective time to run appliances. Users can create a personal energy profile to automatically manage energy according to fluctuating utility rates and consumption patterns. 888.998.4743. www.gridpoint.com. Circle 307.

‹ **TENDRIL.** The Tendril Residential Energy Ecosystem connects utilities with consumers, letting homeowners manage their consumption to a pre-determined budget and receive alerts about peak energy prices, demand-response incidents, and other information from utilities. The in-home wireless network allows appliances and outlets to communicate directly to a home-energy monitor or Web portal. Users can track their consumption with Vantage (pictured), a Web portal, or Insight, an in-home display. 303.951.4360. www.tendrilinc.com. Circle 308.

› **BLACK & DECKER.** The Power Monitor tells homeowners how much electricity they are using in real time and the cost in dollars and cents. A wireless sensor attaches to the electric meter outside a home, monitors the rate at which electricity is consumed, and transmits the information to a handheld display monitor. Users can program cost-per-kilowatt-hour and billing plan information from their electric bills into the monitor. 800.544.6986. www.energysaverseries.com. Circle 309.

RESOURCES

"The Effectiveness of Feedback on Energy Consumption" for the Environmental Change Institute, the University of Oxford, April 2006:
www.eci.ox.ac.uk/research/energy/downloads/smart-metering-report.pdf

ZigBee Alliance's Smart Energy protocol:
www.zigbee.org