

Pacific Northwest National Laboratory provides energy solutions that form the building blocks for secure, reliable, affordable and sustainable energy systems. PNNL develops solid-oxide fuel cell technology, new lightweight materials for transportation structures, emissions controls, electronics, energy storage and tools for energy-efficient and environmentally friendly buildings. We help craft the nation's response to global climate change by advancing science and technology as well as policy and economic analysis relating to carbon management and carbon sequestration.

Pacific Northwest National Laboratory

## Grid Friendly™ Controller Helps Balance Energy Supply and Demand



**Electricity.** We've come to depend on it. But what happens when too many of us want too much of it at once? Or mechanical failure puts a crunch on the system? Pacific Northwest National Laboratory has developed a device that helps make the power system more reliable by managing electricity at the grid level.

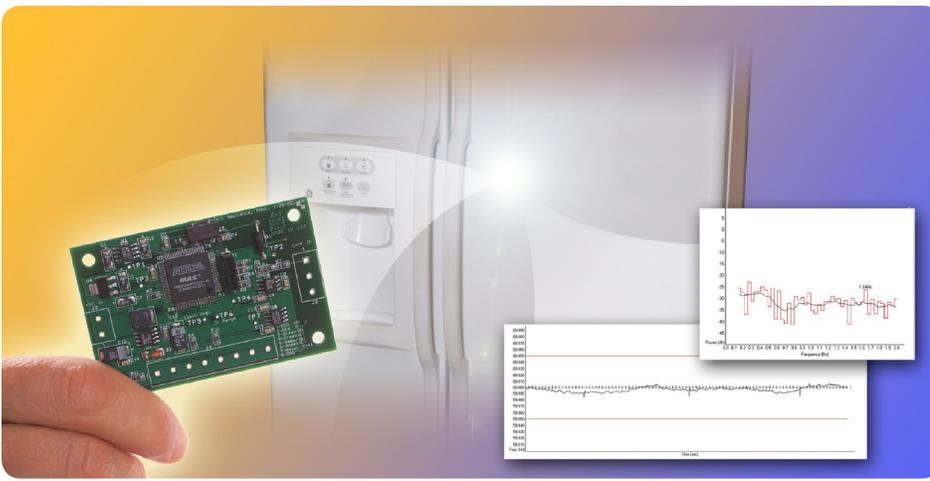
The Grid Friendly controller, a two by two-and-a-half inch circuit board, is at the heart of Grid Friendly appliances. Installed in refrigerators, air conditioners, water heaters and various other household appliances, this device would monitor the power

grid and turn appliances off for a few seconds to a few minutes in response to power grid overload. When power plants cannot generate enough power to meet customer needs, Grid Friendly appliances reduce some of the load on the system to balance supply and demand.

Consumers won't even notice Grid Friendly appliances turning on and off occasionally, helping to balance power demand. Food would stay fresh. Hot water would be available when needed. Appliances would turn back on automatically within a few minutes. Consumers will feel good knowing the small devices built into their appliances are adding up to much larger benefits for the country. And for them. Consumers will benefit from avoided blackouts and from lower electric rates since they won't have to pay for unneeded backup power plants.

Grid Friendly appliances could help stabilize power grids and prevent outages. By triggering appliances to turn on and off at different times, this device could help control power oscillations that occur in different parts of the grid. These oscillations can result from system overload or a destabilizing event, such as a tree branch falling on a power line. In either case, instability can shut down entire electricity grids, disrupting power supply to huge areas of the country at once.

The Grid Friendly controller has been tested in a laboratory environment and in a demonstration project, and is ready for licensing and installation in the next generation of appliances.



The Grid Friendly controller uses data from the power grid to balance energy supply and demand.

## BENEFITS

- ▶ **More reliable power grids cost less to run.** Grid Friendly appliances respond to system overload in about a quarter of a second. It takes gas and oil plants up to 10 minutes to start producing power. The Grid Friendly controller would allow better use of base load plants, which often produce less costly power, saving money for the consumer.
- ▶ **Smaller electricity bills.** Using the Grid Friendly device would support power plants in meeting the demands of more customers with the same number of plants. Each appliance outfitted with a Grid Friendly device will offset new power plant capital costs, decreasing the need to build power plants and helping reduce energy costs to consumers.
- ▶ **Grid Friendly appliances** would provide the response the power grid needs to maintain stability. Only the minimum number of devices required to control the imbalance are triggered so Grid Friendly appliances would not destabilize the system.
- ▶ **More efficient power plant use.** Most electricity in the United States is produced by energy-efficient power plants, supplying a base load

of power that doesn't change. When our energy needs peak, other less efficient power plants answer these demands. These "peaker plants" are the least energy-efficient resources, emitting more greenhouse gas per unit of electricity produced than a base load plant using the same fuel. They often are kept running for frequency control even when they're not producing energy. With Grid Friendly appliances managing load, many peaker plants could become obsolete.

## FEATURES

- ▶ **Inexpensive.** The cost is about \$25 per appliance. Because Grid Friendly appliances assess the health of the grid using only the voltage available within the appliance, there is no need for costly communications to a regional control center.
- ▶ **Partnering with Rooftop Diagnostician.** The Grid Friendly controller is being incorporated in another PNNL innovation called the Rooftop Diagnostician. This remote monitoring device evaluates a building's rooftop heat and air-conditioning systems, uncovering problems that could lead to wasted energy and occupant discomfort. As part of the Rooftop

Diagnostician, the Grid Friendly controller would help manage large amounts of demand.

- ▶ **A look to the future.** The Grid Friendly controller is expected to be part of the U.S. Department of Energy's efforts to transform the U.S. energy system into a more interactive and dynamic system where power plants and consumers communicate automatically, making self-regulating adjustments in real time. The results of such a system would be greater customer efficiency and load management as well as enhanced stability, security and crisis management.

## ABOUT PNNL

Pacific Northwest National Laboratory, a U.S. Department of Energy Office of Science laboratory, solves complex problems in energy, the environment, and national security by advancing the understanding of science. PNNL employs more than 4,000 staff, has a business volume of nearly \$900 million annually, and has been managed by Ohio-based Battelle since the lab's inception in 1965.

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