

Saving Electricity in the State of Washington: Improving Efficiency of Small Commercial Buildings

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Battelle's Pacific Northwest Division has just initiated a new project for the State of Washington focused on changing the way heating, ventilating, and air conditioning (HVAC) systems in commercial buildings in Washington State are operated, serviced and maintained. One aspect of this project focuses on improving the efficiency of small (<50,000 sf) commercial buildings. The approach is to train businesses to install low-cost wireless condition monitoring and diagnostic technology and show that it can save electricity cost-effectively. The technology was developed by Pacific Northwest National Laboratory (operated by Battelle) in partnership with the U.S. Department of Energy (DOE) and private industry.

A significant portion of the electricity cost in small commercial buildings is from HVAC systems and lighting. Small commercial buildings typically have several air-conditioning units on the roof to meet heating and cooling needs; these units are generally referred to as packaged rooftop systems. During commissioning and energy auditing, packaged rooftop systems are often found with inoperable dampers, dirty or clogged filters and coils, incorrect refrigerant charges, failing compressors, failed fans, missing enclosure panels, incorrectly implemented controls, and other problems. These units are often run until a catastrophic failure occurs. Upon complete failure, a service company repairs or replaces the unit—unnecessarily expensive options. Minor adjustments and maintenance can lower energy bills and prevent system failures.

The monitoring system that will be used in this project includes hardware and software that automatically detect and diagnose improper operations of rooftop HVAC systems. This technology is deployed as a subscription service with results provided to users via a personal computer with an Internet connection and web browser. The system collects data from sensors installed on the rooftop units and processes them with software embedded in the hardware unit installed on each HVAC unit. Diagnostic conclusions and important monitored information are communicated using long-distance wireless telemetry (similar to cell phone technology) to a network operations center (NOC), where data are archived, further processed, and results are made available to users on web pages. A commercial firm hosts the web pages that provide the information to users. This makes the service easy to use and inexpensive. Building owners, operations staff, and service providers then securely view the condition of rooftop packaged units in their buildings simply using a web browser on a computer with an Internet connection. No software need be installed on each user's computer. With the right security permissions, authorized users can access the information for their buildings from anywhere they have access to a web-connected computer.



This system, targeted at small- and medium-size commercial buildings, enables continuous monitoring of the status of rooftop HVAC systems. There is no longer a need to wait for semi-annual servicing. The system alerts operators and service providers when problems occur. Damage can be preempted by condition-based servicing. Systems run more efficiently, using less energy, having lower peak electric demands, saving bill payers money, and prolonging the useful life of capital investments.

Time spent by service providers is minimized by informing them of the condition of all equipment prior to traveling to a site. Before arriving, the service provider knows the type of servicing needed by each system. Service actions can be targeted, spending more time on units that require the attention. Technicians can plan ahead, arriving on site with the parts and equipment to meet the unique needs of each situation.

Building owners and operators save time and money. Service providers can offer a level of service a step above the competition at the same cost. They can provide a level of performance and efficiency not possible currently for small-to-medium commercial buildings.

The project will provide the monitoring system and services free to participating customers for the duration of the project. HVAC service providers selected to participate in the project will be reimbursed for the time their staff spend installing the monitoring and diagnostic systems.

The objective of the project is both to save participating rate payers money on their electricity bills, but more importantly to demonstrate that small commercial building rate payers, service providers, and the State can all benefit from using the monitoring and diagnostic system. Rate payers will benefit from lower

electricity bills and more comfortable conditions in their buildings. Service providers will benefit by learning how to offer a new service that distinguishes them in the market, and the State will benefit by lowering its electric demand.

The project will involve five key steps:

- recruit 10 to 15 HVAC service companies that provide service to small commercial buildings to deliver project services and help recruit customers;
- in collaboration with the selected service providers, select approximately 10 to 15 buildings with a total of 30 to 40 rooftop units for use in hands-on training of technicians;
- train the technicians on installing and using the monitoring and diagnostic system on the buildings selected for training;
- each service provider company will then install and use the monitoring and diagnostic system on 10 to 30 additional units;
- after the program, ideally service providers will continue to offer this installation service as part of service offerings to their clients.

Service providers selected for participation in the program will need to demonstrate enthusiasm for the project, genuine interest in long-term use of the technology, a history of servicing rooftop units on small commercial buildings, and a suitable number of candidate buildings for participation in the project. Committed service providers are key to ensuring that condition monitoring of rooftop units continues beyond this project. We intend to work with property managers, energy service providers, utility partners, trade

organizations and others to identify suitable candidate service providers.

After installation, the service providers are required to: 1) regularly monitor the condition of the units using the system, 2) make cost-effective repairs and maintenance that have been identified by the condition monitoring system, and 3) log all repairs and maintenance to the participating HVAC units in an online log provided by Battelle. The cost of the maintenance will not be covered by the project but must be provided under a maintenance contract or billed to clients.

The project team anticipates service providers installing monitoring and diagnostic systems on a total of 175 to 200 units (including those used in training) over the course of the project. Battelle staff will spot check the installations to verify installation quality and provide hints and guidance to the service technicians.

Near the end of the project, Battelle will de-brief each participating service provider, giving participants an opportunity to suggest potential improvements to the training, the monitoring/diagnostic system, and the installation protocol. This feedback will help improve the program for the future. Battelle will also measure, evaluate and document the electricity use impacts at each site and the overall impacts of the program.

For more information, contact

Michael Brambley

**Pacific Northwest National
Laboratory**

P.O. Box 999, K5-16

Richland, WA 99352

Michael.Brambley@pnl.gov

509-375-6875

OR

Srinivas Katipamula

Srinivas.Katipamula@pnl.gov

509-372-4281