SPEED meters will help evaluate weatherization measures

ORNL is implementing a new remote monitoring system to collect data on electricity loads in low-income homes served by DOE's Weatherization Assistance Program.

The Weatherization Program now offers electric-efficiency measures (such as compact fluorescents and more efficient refrigerators) to its clients, along with its traditional building shell retrofits. Because electricity use accounts for more than two-thirds of an average residential energy bill, new evaluation methods were needed to understand the potential for weatherization measures to affect electric loads.

ORNL's study employs single-point end-use energy disaggregation (SPEED) meters and the Nonintrusive Appliance Load Monitoring System (NIALMS) software. SPEED/NIALMS is a whole-house monitoring system that allows collection of electric load data by end use without entering houses or installing meters on specific appliances. Field testing has shown the system to be 90–95% accurate for most end uses.

A SPEED meter can be installed behind an existing electric utility meter in about 20 minutes. The SPEED recorder collects data and transmits them over existing telephone lines. It samples incoming current and voltage 2000 times per second and looks for edge transitions to determine when an appliance turns on and off. It calculates and stores the date and time of each transition along with the voltage, current, and real and reactive power.

NIALMS receives the stored data from the SPEED meter when the recorder initiates a telephone call. The software then matches load characteristics to a library of appliance signatures. It produces graphs and charts of electricity consumption by end use. After a study is completed, the SPEED meter can be moved to another location.

ORNL's computing equipment can receive data remotely from up to 300 SPEED meters and process them into end-use-specific descriptions of electric loads in each house monitored.

A SPEED meter ready for installation behind an electricity meter. Installation takes only about 20 minutes.

The research effort will collect baseline electric load profiles by end-use in monitored homes, compare profiles for a pre-and post-weatherization year to identify savings by end use, and compare savings predicted by energy audits with measured savings.

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Sponsor: Office of Building Technology Assistance

NEAT 7.0 upgrades the weatherization toolbox

Thanks to DOE and ORNL, state agencies and utilities have an updated, expanded tool for determining the most cost-effective retrofit measures for single-family homes, aimed at increasing energy efficiency and comfort levels.

NEAT, the National Energy Audit, was developed by ORNL for DOE and first released in 1993. More than 600 agencies in 30 states use NEAT to make decisions about retrofitting low-income homes. During 1995 alone, NEAT was used on more than 80,000 homes, and helped save some $70 million in energy costs over the lifetime of that year's retrofits.

In April 2001, ORNL and DOE released NEAT Version 7.0. New features make the package more user-friendly and expand its functionality.

- NEAT now features a Windows graphical user interface. Users of Windows and Microsoft Access will be comfortable with the look and feel of NEAT.

Attic insulation is one of 34 measures that NEAT might recommend to save energy and improve comfort.

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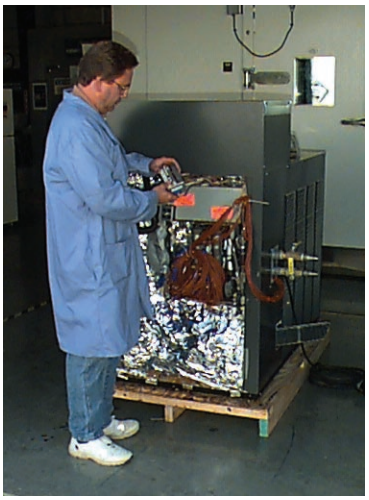
Hi-Cool promises breakthrough in natural gas heating and cooling

An advanced natural gas heat pump that uses at least a third less energy than a conventional electric unit could be available to consumers within two years. ORNL and its research partners have worked for several years to develop the technology.

The advanced heat pump uses an absorption cycle (conventional units use a compression cycle) and uses an ammonia-water mixture instead of ozone-depleting refrigerants. In tests conducted at ORNL, a prototype proved to be 33% more efficient for heating than the best existing gas furnace. That prototype used an off-the-shelf chiller fan coil. A complete absorption unit should be even more efficient.



ORNL technician Jerry Atchley works with a lab prototype of a natural gas heat pump.

The advanced ammonia-water absorption technology was developed largely at ORNL under DOE sponsorship. The Ammonia-Water Absorption Venture, a partnership of U.S. gas companies (Mississippi Energies, Southern California, Williams/Texas, Southwest, and Southern Natural) is now working with researchers and equipment manufacturers to bring the advanced heat pump to the market in large volumes. The Venture hopes to introduce high-efficiency, competitively priced units to the consumer market over the next two years.

The cooling efficiency of the advanced absorption heat pump is about the same as for a conventional electric heat pump. A more efficient cooling technology will be needed to expand the market for absorption heat pumps into warm climates. ORNL is leading a research effort to develop next-generation heat pump products (Hi-Cool absorption cycles) having at least 30% more cooling efficiency than current technologies (with a potential for even higher heating efficiency, also). The Hi-Cool cycles are also expected to work well in rooftop commercial units, where annual cooling loads are greater than for residences.

Laboratory test model of a Hi-Cool natural gas cooling system.

Hi-Cool cost-shared contracts are in place with two research companies to build prototype units using higher-efficiency cooling technologies. Testing of the prototypes is expected to begin this year; it is hoped the Hi-Cool technology can be introduced to the market in 2004–2005.

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- Users can see and enter data in either "form" view (data displayed on fillable forms) or "datasheet" view (as in a spreadsheet).
- All input and output data are stored in a relational database, enabling interaction with other management or financial database tools.
- Additional base load measures can be evaluated: refrigerator and water heater replacement, water heater pipe insulation and tank wrap, and low-flow showerheads.
- Refrigerator and water heater descriptions use an extensive database of manufacturers' models, eliminating input of detailed equipment descriptions by users.
- ASHRAE Draft Standard 152P algorithms for estimating savings from duct sealing are incorporated. NEAT accommodates three alternatives for measuring and recording duct leakage: whole house blower-door, blower-door subtraction, and duct-blower measurements.
- Individual windows can be evaluated separately for any window retrofit measure. Users can categorize the leakiness of each window to better estimate retrofit energy savings attributable to conduction and infiltration.

As part of DOE's Weatherization Assistance Program, NEAT is free to state agencies; but other companies and individuals must pay for the software. NEAT can be obtained from the Energy Science and Technology Software Center of the Office of Scientific and Technical Information, 865 576-2606 or estsc@adonis.osti.gov. A demonstration version of the software may be downloaded from http://eber.ed.ornl.gov/pub as wa711d.zip. Unzip the file into a temporary directory and then execute setup.exe for installation. A copy of the user's manual is included as a pdf file.

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Sponsor: Office of Building Technology Assistance