OAK RIDGE NATIONAL LABORATORY FACT SHEET
MANAGED BY UT-BATTELLE FOR THE DEPARTMENT OF ENERGY

Energy-Efficient Building Appliances for Market Success

Building equipment experts in ORNL's Energy Efficiency and Renewable Energy Program find success through cooperative RD&D, market research, and collaboration with industry.

Buildings consume 72% of the electricity and 58% of the natural gas used in the United States, using more energy and generating more carbon emissions than transportation or industry. Buildings of the future must incorporate reduced energy consumption, environmental stewardship, and indoor environmental quality, and must also be durable and affordable to the consumer. Our goal for building equipment is to meet energy service needs with much greater energy efficiency. A key element of our strategy for successful market penetration and deployment of energy-efficient building appliances is *early* collaboration with equipment manufacturers, retailers, and consumers, as well as being at the inception of the R&D effort.

Market Research and Analysis

ORNL's market-focused activity for DOE's Energy Efficiency and Renewable Energy Program analyzes both the energy-saving and non-energy attributes of technologies and how they influence end users' purchasing decisions. Products developed without considering market conditions and consumers' values cannot be expected to succeed commercially. The ORNL analysis team has conducted market research assessments and developed business plans geared to market-readiness and acceptance for several technologies including: demand response appliances, ground source and air source integrated heat pumps, HVAC (Heating, Ventilating and Air Conditioning) systems, waste heat recovery from appliances, dehumidifying water heater, and other technologies. Published reports are located at: www.ornl.gov/mkt_trans/reports.shtml).

R&D Capabilities

The DOE/ORNL Heat Pump Design Model (HPDM) is a well-proven hardware-based analysis tool that supports the development and evaluation of advanced vapor-compression equipment ranging from air-source, single-speed to ground-source, multi-speed, and/or multi-function applications. The HPDM was recently linked to TRNSYS for analyzing the annual performance of advanced designs such as integrated heat pumps having space conditioning, dehumidification, ventilation, and water heating capability. A Web version of the basic program for air conditioning, heat pump, and dehumidifier analysis and related reports are online at www.ornl.gov/~wlj/hpdm/MarkVI_DH.shtml.

Environmental Chambers

- A small single room chamber for testing appliances such as residential water heaters and refrigerators.
- Two large two-room, side-by-side chambers can test gas heat pumps, electric heat pumps and air conditioners, gas/electric packaged units, desiccant systems, and small distributed generation/combined heat and power (CHP) systems with capacities of up to 20 tons.
- A very large two-room (over/under) chamber system can be programmed with representative diurnal temperature cycles to test heat pump/AC equipment under quasi-field conditions.

Environmental Chambers at ORNL

Water Durability Test Facility

This facility is capable of simultaneously testing up to 10 residential water heaters (including HPWHs) according to the 24-h Simulated Use Test, and First-Hour Rating Test of the DOE Water Heater Test Procedure.

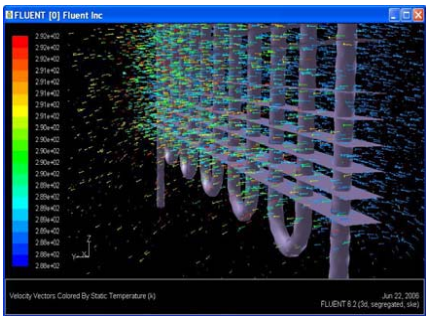
Water Heater Test Facility

Compressor Calorimeters

These calorimeters are used to verify performance of compressor designs. One calorimeter is designed for testing small fractional-ton compressors, such as those used in refrigerators and other small appliances and equipment. The second calorimeter is capable of testing compressors over the 1.5 to 4.0-ton range.

Air Coil Testing Loop

BTRIC at ORNL currently has three air coil testing loops in its program. These loops are designed for testing and evaluating the performance of refrigerant-to-air coils that are commonly used in most unitary HVAC equipment. Evaporator coils with a 2-ton capacity over the range of 40-50F and condenser coils up to 3-tons at 120F can be tested. The loop can move 7000 cfm of air against a 4-in (w.g.) coil pressure drop.



Air Coil Flow Simulation

Geothermal Heat Pumps

Geothermal heat pumps offer inherent efficiency, but excavation and installation costs can be a drawback. The BTRIC program is investigating the use of a highly water-absorbent material (a solid water sorbent) to enhance ground HX effectiveness and reduce the size and cost of excavation needed. Both laboratory and field experiments have indicated a 30% improvement in heat transfer using this material, which is inexpensive and environmentally safe.

Development, market research, and preliminary business case studies are underway for both air-source and geothermal integrated heat pumps (IHPs). The goal is to produce a single appliance to provide space-conditioning, water heating, ventilation, and humidity control. The IHP makes use of otherwise wasted energy streams and, because of higher duty cycles, can more readily justify the cost of advanced energy-efficient components. The IHP is projected to reduce energy consumption by 50%.

ORNL Building Technologies Research and Integration Center (BTRIC)

All of the facilities and capabilities discussed above are centered at the BTRIC, a National User Facility. DOE awarded five Energy 100 Awards to BTRIC in 2001 for (1) Refrigeration R&D (judged the second most important achievement in DOE's 32-year history), (2) Energy Efficient Large Commercial Chiller Project, (3) CFC/HCFC Alternatives for the Buildings Sector, (4) National Energy Auditing Tool (NEAT), and (5) Durable Energy-Efficient Lighting for Public Housing. BTRIC has also won many R&D100 awards since it first began operation. All of these achievements were accomplished through collaboration with private industry, other research institutions, and utilities.

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