OAK RIDGE NATIONAL LABORATORY

FACT SHEET

MANAGED BY UT-BATTELLE FOR THE DEPARTMENT OF ENERGY

Efficient Technologies for Affordable Zero Energy Buildings

In March 2002, technical experts from the Department of Energy building research national laboratories met to explore the plausibility of developing "zero energy buildings," or buildings that, through the use of advanced construction, energy-efficient appliances and renewable technologies, returned to the power grid as much energy as they took. Oak Ridge National Laboratory formed a partnership with the Tennessee Valley Authority, Habitat for Humanity and a dozen manufacturers. In June, they broke ground on the first attempt to build an affordable zero energy home.

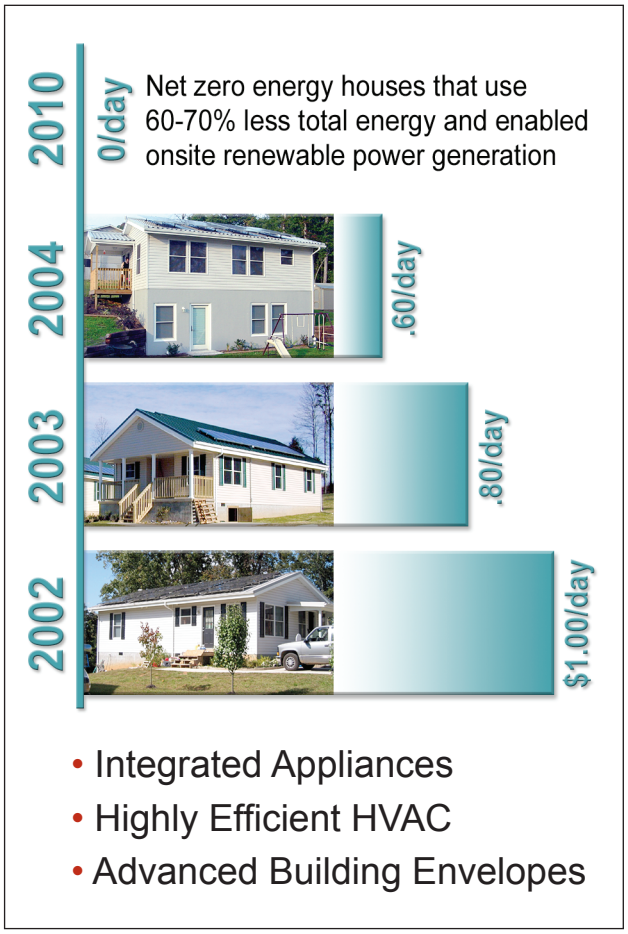
An all-electric house was constructed for less than $100,000. After a year of tests, the house was found to consume energy from the electric grid at a rate of less than $1 a day for the Habitat for Humanity family of four. The national average total energy cost per household is $4.30/day. Three subsequent houses have brought the energy daily cost down to 80 cents and then 60 cents a day. On a sunny day, it is not unusual to see the electric meter running backward as the home's roof-mounted solar panels actually generate more electricity than is being used. These houses were the first four to sell energy back to TVA, the country's largest public electric utility.

The Road to Zero Energy

Two ORNL technologies have already made a dramatic difference in the thrust toward super-efficient home appliances:

Fridge of the future: ORNL Buildings Technology Center improvements have reduced home refrigerator power consumption from 1700 kWh to 300 kWh per year. If Americans replaced their aging refrigerators with these new, efficient ones by 2010, they would use 58 percent less energy to chill their foods and beverages and reduce carbon dioxide emissions by 48 million metric tons per year. The high efficiency refrigerators in the Habitat Houses use about 1 kWh per day.

Heat Pump Water Heater: ORNL researchers have developed low-energy-use water heating technologies and a "drop-in" residential heat pump water heater that can cut energy consumption for water heating by at least half. Widespread use of heat pump water heaters could generate a savings equal to one percent of the entire U.S. energy consumption. The heat pump water heaters in the Habitat Houses use less than 3 kWh per day.



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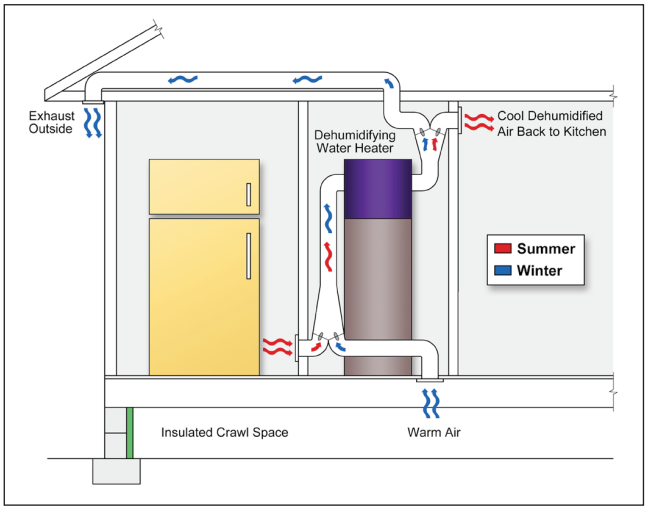
The Future: Integrated Appliances

Dehumidifying Water Heater: The need for efficient space dehumidification, combined with a need for more efficient electric heating of water can be satisfied with a new appliance: the dehumidifying water heater. Dehumidification is one of the fastest growing energy uses in U.S. homes. A heat pump produces domestic hot water, using only half the electricity of a conventional electric water heater. The byproduct — cool, dry air — provides space dehumidification, regardless of whether additional hot water is needed. The concept is under study and development through ORNL and the Energy Research Consortium of the Western Carolinas, which is currently testing prototypes. The water heaters in the near zero energy test houses are configured to improve the performance of the refrigerator and the home dehumidification in the summer.



Advanced Structural Panels: More than a century of field trial and error has resulted in today's framing techniques. ORNL is helping industry to regionally optimize steel-faced structural insulated panels (SIPs) that reduce labor and minimize air leakage. The panels also provide significant energy savings through improved wind and fire resistance, seams, rigidity, dimensional stability, air seals, insulating foam aging characteristics, and moisture tolerance. These panels are reusable, which will give them a salvage value after the lifetime of the structure.

Low-Cost Geothermal: Geothermal heat pumps are proven energy savers. The key to commercialization of the heat pumps is the development of a low-cost ground heat exchanger. ORNL's solid-water-sorbent heat exchanger uses both conduction and water-vapor transport, requires modest excavation, is made of low-cost materials and requires no secondary fluid. While current geothermal systems are economical for large-scale uses such as schools and factories, ORNL's system will be sufficiently economical for single-dwelling residential use. The goal is an installed cost of geothermal heat pumps below $5000 per house.

Integrated Heat Pumps: Small, integrated space heating, cooling, hot water and ventilation triple-function systems offer maximized use of energy for a suite of home appliance needs. Particularly suited for near zero-energy homes, the systems are the most efficient approach to dehumidification, ventilation, water heating and space heating and cooling.

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