Building Technologies

With more than 120 million buildings in the United States consuming approximately 40 percent of the nation's total primary energy and 75 percent of its electricity, reducing energy consumption is essential to achieving a sustainable future. Oak Ridge National Laboratory is focused on developing new technologies to enable grid-interactive efficient buildings that provide beneficial impacts to energy security and affordability, resilience, the environment, and the US economy. Public-private partnerships allow ORNL to focus on basic research while industry focuses on later stage research, development, and implementation.

Research and Development

Building envelopes and advanced manufacturing—Exploring new and emerging materials, components, systems, and automation and the fundamental science of heat, air, and moisture transfer for walls, attics, foundations, sheathings, membranes, and coatings

Building systems integration—Testing new components, equipment, and systems in realistic environments, such as a research house and flexible research platforms, before market introduction and using computer modeling, visualization, and analytics

Buildings-to-grid—Pursuing advanced wireless sensor technologies, building energy modeling, communications and controls, and energy-optimized solutions for neighborhoods of the future

Energy-efficient equipment—Developing energy-efficient building equipment technologies including heat pumps, heating ventilation and air-conditioning, dehumidifiers, appliances, water heaters, and refrigeration systems

Energy storage—Advancing new technologies that integrate energy storage in equipment and envelope systems, flexibility in building loads, complex design in building facades, and thermal energy storage in materials

REIMAGINING thermodynamic processes for efficiency breakthroughs

CREATING two to five times greater insulating value per unit thickness

CUTTING cost per wireless sensor node by more than 10 times

FLEXING building loads for grid resilience without compromising comfort

AUTOMATING building energy model generation and calibration

Recent Impacts

Building envelope

- Developed a primer-less self-healing sealant that adheres to dusty surfaces in less than 30 minutes
- Created a self-healing barrier film that instantaneously self-repairs punctures and prevents vacuum loss of high R-value vacuum insulation panels (VIPs), while maintaining the thermal performance of VIPs

"We are advancing the understanding of buildings from a holistic perspective, specifically in regard to energy efficiency and sustainability."

Diana Hun, ***Building Envelope Engineer***

OAK RIDGE National Laboratory

U.S. DEPARTMENT OF ENERGY

- Produced a modified atmosphere insulation (MAI)/vinyl siding composite with multifunctional insulation and cladding system
- Developed an anisotropic thermal management system that tailors the cooling and heating loads so that energy savings and peak loads can be controlled on demand
- Additively manufactured molds for the architectural precast concrete industry, enabling many more castings per mold

Building equipment

- Developed self-powered gas-fired furnaces that harness the energy of exhaust gases to generate the electricity required by the furnace
- Produced a prototype window air-conditioner using 260 grams of R290 (EPA acceptable charge limit for propane refrigerant) that achieved an Energy Efficiency Ratio (EER) of 14, exceeding standard energy efficiency ratings
- Created low-cost ground heat exchangers that use phase change materials for geothermal heat pump systems that can be installed in shallow boreholes, addressing the significant cost associated with installation

10 R&D 100 Awards

156 Industry Partners

28 University Partners

227 Publications in FY 2019

Building Technologies Research and Integration Center

The Maximum Building Energy Efficiency Research Laboratory is the flagship facility of BTRIC, which is the only DOE-designated National User Facility devoted to building technologies research and development.

Energy-saving tools

- Launched Automatic Building detection and Energy Modeling (AutoBEM) software leveraging scalable data and algorithms to automatically create models of all buildings in an area of interest
- Launched the Building Science Advisor, a web-based expert system that puts guidance on how to achieve highly energy-efficient, moisture-durable wall systems in any climate into the hands of builders

Emerging solutions

- Developing a refraction-based building air leakage detector to locate air leaks and measure flow rate without disturbing occupants by installing testing equipment
- Developing an active insulation system that will enable the effective use of the thermal storage capacity of building envelopes so that heating/cooling loads can be decreased by up to 70%
- Developing a gas-driven highly efficient thermo-vacuum clothes dryer with a 1.5 times higher combined energy factor and capable of a drying time of 5–10 minutes
- Developing a hybrid inverter that provides a universal interface improving an inverter's ability to connect with other distributed energy resources

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Oak Ridge National Laboratory is managed by UT-Battelle LLC for the US Department of Energy

January 2020