

Whole-Building and Community Integration Group

The Whole-Building and Community Integration Group (WBCI) supports the U.S. Department of Energy's (DOE's) goals for commercially viable homes and buildings that maximize cost-effective energy efficiency. WBCI's research focuses on whole-building and community integration and sustainability, including cross-cut activities to use green buildings and communities as test-beds and seed markets for emerging deep-savings energy efficiency, solar and other renewable energy, sustainable transportation, distributed energy, and grid-integration technologies.

Residential Systems and Whole-Buildings/ Renewables & Grid Integration/Materials/Components Advancement

Building America

Building America is an industry-driven research program, sponsored by the U.S. Department of Energy, designed to accelerate the development and adoption of advanced building energy technologies in new and existing homes. Through Building America, ORNL works to:

- Develop retrofit strategies for existing houses that achieve significant energy savings and ensure the safety and quality of the homes
- Produce new homes on a community scale that use on average 40% to 100% less energy
- Improve indoor air quality and comfort
- Implement innovative energy- and material-saving technologies
- Improve builder profitability
- Provide new product opportunities to manufacturers and suppliers

High Quality Home Energy Retrofits with Energy Savings greater than 30%

By partnering with utilities and local contractors, ORNL is working to expand the understanding of how to cost-effectively retrofit existing homes to generate energy savings greater than 30%. A primary outcome of this research will be to provide pertinent information that utility partners can use to inform residential retrofit incentive programs.

ZEBRAlliance Homes (www.zebralliance.com)

The ZEBRAlliance facilitates progress toward DOE's goal of maximizing cost-effective energy efficiency through a highly leveraged, public/private partnership that so far has built four extraordinarily high performing houses. The Alliance integrates new ultra-high-efficiency components emerging from ORNL's industry partners and other manufacturers into the construction of research houses and subsequent retrofits. Several generations of retrofits (equipment, appliances, controls, etc.) are typically evaluated during the research period and then the homes are released for sale to the public. When these new components are proven, they will become available to serve regional and national, homebuilding markets, in addition to existing housing retrofit markets.



Campbell Creek Research Homes

TVA and DOE are also sponsoring ORNL to develop a sound database of costs and energy savings associated with energy-efficiency retrofits of typical existing homes in the Tennessee Valley and the construction of market-driven highly energy efficient homes. The data will help TVA implement various incentive programs to stimulate energy savings in the region within their 5-year strategic planning period. The center piece for this research is a trio of houses that are being used to document costs and energy savings of energy efficiency measures in mid-market homes representing what is typical in the region. The three research homes are in the Campbell Creek subdivision in west Knox County.



Light Commercial Systems and Whole-Buildings/ Renewables & Grid Integration/Materials/Components Advancement

Ground Source Heat Pumps

ORNL has accumulated decades of unique experience in developing Ground Source Heat Pump (GSHP) technologies, evaluating their energy savings performance and cost, and assisting practitioners in their application. Staff accomplishments include development of the first-ever energy model of a building served with a GSHP system, the leadership role for a series of GSHP projects that in 1987 received a DOE Award for Energy Innovation for a “distinguished contribution to our Nation’s energy efficiency”, evaluation of a community-wide GSHP retrofit that included every home in a city of 12,000 people, the International Ground Source Heat Pump Association’s “Outstanding Engineering Achievement Award” in 1998, development of a new method for determining soil/rock formation thermal properties from short-term borehole tests, and independent research on ground heat exchanger sizing algorithms that led to increased consistency in available design software. ORNL has provided technical assistance on the design of hundreds of high-profile domestic and international projects, including the ASHRAE headquarters building, the Oklahoma Governor’s Mansion, the Metro Complex building in Turkey, the Future House in China, and numerous federal agency facilities. In addition to technical assistance, current work focuses on cost reduction for new and retrofit applications.



Maximum Energy Efficiency Building Research Laboratory (MAXLAB)

The Maximum Energy Efficiency Building Research Laboratory (MAXLAB) is under development and will include a new standalone laboratory building and two light commercial building “flexible research platforms (FRPs).” The FRPs provide, for light

commercial buildings, what the research houses provide for housing—unoccupied research apparatus with known occupancy effects on energy consumption because occupancy effects are simulated during the tests. The FRPs expose ‘test buildings’ to natural weather conditions for purposes of R&D leading to system/building-level advanced energy efficiency solutions for new and retrofit light commercial building applications. The platforms provide the opportunity to prove solutions in a low risk environment so they can be accepted with speed and scale in actual commercial buildings. Using the FRPs, essentially everything about the ‘test buildings’ can be changed and evaluated to capture interactive effects, reduce costs and energy consumption, and provide physical validation of models.

Solar Technologies

ORNL is a significant partner in The Electric Vehicle (EV) Project led by Ecotality, and is providing the leadership for the team to design and build solar-assisted electric vehicle charging infrastructure in several locations across Tennessee including Knoxville, Nashville, Chattanooga, and Memphis. Other partners include Nissan, TVA, the University of Tennessee, the State of Tennessee, and city governments.



In 2008, the city of Knoxville was selected as one of 12 Solar America Cities by DOE and received a grant plus technical assistance to increase its use of solar technology. ORNL was selected to serve as the technical assistance Tiger Team lead. The goal of the Knoxville Solar Cities project is to achieve a sustainable solar infrastructure through a comprehensive citywide approach that facilitates mainstream adoption of solar power. ORNL has worked closely with the city to help design and build an initial solar array at the new Knoxville Transit Center. Since then, the amount of grid-connected PV installed in Knoxville has grown by 100-fold from the ~15kW that was pre-existing at the time the grant was awarded.

ORNL completed installation of its first substantial solar array in 2008, a 288 foot long 51.25 kW system that supplies power to the Building Technologies Research and Integration Center (BTRIC). The energy supplied offsets the energy use of one of the BTRIC office buildings, enabling ORNL to achieve the first zero-energy commercial office building in the state. Since 2008, ORNL has installed an additional 80 kW of solar PV, including a solar-covered parking area over 25 electric vehicle charging stations as part of the EV Project.

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