OAK RIDGE National Laboratory

BUILDING TECHNOLOGIES Update

March 2015

Innovative, lower cost sensors and controls yield better energy efficiency

Regulating comfort in small commercial buildings could become more efficient and less expensive thanks to an innovative low-cost wireless sensor technology being developed by researchers at ORNL.

Buildings are responsible for about 40 percent of the energy consumed in the United States. Studies indicate that advanced sensors and controls have the potential to reduce the energy consumption of buildings by 20–30 percent.

"It is widely accepted that energy-consuming systems such as heating, ventilating, and air conditioning (HVAC) units in buildings are under-, or poorly, controlled, causing them to waste energy," said Patrick Hughes, director of ORNL's Building Technologies Program. "Buildings could increase their energy efficiency if control systems had access to additional information."

Often collecting data such as outside air and room temperature, humidity, light level, occupancy, and pollutants is cost-prohibitive, whether the information is gathered by inexpensive conventional sensors that must be wired, or by using today's expensive $150–$300 per node wireless sensors.

ORNL's new wireless sensor prototype could reduce costs to $1–$10 per node by leveraging advanced manufacturing techniques such as additive roll-to-roll manufacturing. This process enables electronics components like circuits, sensors, antennae, and photovoltaic cells and batteries to be printed on flexible plastic substrates (base materials). The nodes can be installed without wires using a peel-and-stick adhesive backing.

"If commercially available at the target price point, there would be endless application possibilities where the installed cost to improve the control of energy-consuming systems would pay for itself through lower utility bills in only a few years," Hughes said.

The ultra-low power smart sensors collect and send data to a receiver, which can capture data from many different peel-and-stick nodes and provide information to the energy-consuming system. The more information received, the better the building's energy management.

Both new construction and retrofitted buildings can benefit from ORNL's smart sensors.

ORNL's Pooran Joshi demonstrates the flexibility of printed electronics on plastic substrates used in manufacturing wireless sensors for buildings.

"This technology provides the information that enables ongoing continuous commissioning, fault detection and diagnosis, and service organization notifications when needed, ensuring optimal building system operations throughout their service life," said ORNL's Teja Kuruganti, principal investigator on the low-cost wireless sensors project.

ORNL recently established a Cooperative Research and Development Agreement with Molex, a premier international electronics manufacturer, to make the low-cost wireless sensors commercially available.

The research team used ORNL's Nanoscale Science and Technology Laboratory (NSTL) cleanroom facility to select the best substrate material.

"We used a combination of physical vapor deposition techniques for low-temperature thin film processing in the NSTL and pulse-thermal-processing technology for low thermal-budget curing on paper and plastic substrates, which helped us overcome a key technology barrier in flexible sensor development," said ORNL researcher Pooran Joshi.

This project is sponsored by DOE's Building Technologies Office in DOE's Office of Energy Efficiency and Renewable Energy.—*Sara Shoemaker*

ORNL industry partners develop next-generation insulation material

Inadequate insulation is one of the largest causes of wasted energy, quickly allowing heating or cooling comfort to slip away to outdoor air.

That's why researchers at ORNL are collaborating with industry to develop a high-performance material

continued on page 2

FEATURES

continued from page 1

that nearly doubles the performance of traditional insulations without a high cost premium.

"Buildings are responsible for 40 percent or more of the energy consumption in the United States," says Kaushik Biswas of ORNL's Building Envelope Systems Research Group. "There's a huge opportunity to save energy."

More specifically, about 6 percent of the entire US energy consumption, which includes the building, industrial, and transportation sectors, can be attributed to energy used by heating and cooling equipment in compensating for heat transfer through opaque sections of building roofs and walls, Biswas said.

In residential and commercial buildings, roofs and walls are insulated to reduce heating and cooling losses. But the lower the insulation performance, the more heat is lost during winter or gained during summer and the more often a heating or air-conditioning unit will have to run.

"Insulation is important because you want to reduce heat transfer between indoors and outdoors," Biswas said, adding, "You want your air conditioning or heating unit running as little as possible to keep your home cool during summer and warm during winter."

Commercial buildings commonly use polyisocyanurate, or polyiso, foam boards, while many residential structures are insulated with spray foam. Compared with the product ORNL is developing with partners NanoPore and Firestone Building Products, these materials have low "R-values"—the measure of resistance to heat transfer through an insulation material.

The material being developed by ORNL and its partners is a composite polyiso foam board containing modified atmosphere insulation, or MAI, cores. While polyiso and spray foam hover around an R-value of 6 per inch of thickness, the goal for MAI-polyiso composites is 12.

"With what we are targeting, you can get a similar R-value in half the thickness," Biswas said, adding, "What we want to do is get a new insulation product that's cost effective and achieves R-12 per inch."

ORNL researcher Kaushik Biswas analyzes the thermal performance of a 2 × 2 foot composite panel covered with smaller MAI panels separated by foam insulation.

To reach the increased R-value, MAI technology borrows from the design of vacuum insulation panels (VIPs), which display some of the highest R-values but are expensive to produce because of steps in the current manufacturing process. To make MAIs more viable, NanoPore changed how they're made and knocked off about half the cost.

MAI panels are made of a porous core material with nanoscale pore diameters, which are evacuated and sealed within multiple barrier layers. The nanoporous structure and vacuum within the MAI cores help to reduce two out of the three modes of heat transfer in insulation materials: solid conduction and gas/vapor conduction. The third mode of heat transfer, radiation, can also be reduced by adding opacifiers to the core. The lower the heat transfer the higher the R-value.

Truly separating MAIs from VIPs, however, is the manufacturing process. Almost 75 percent of the cost for VIPs is bundled up in the processing and overhead stages. But MAI manufacturing cuts out around half the price by reducing the processing steps and eliminating the need for much of the specialized equipment used in making VIPs.

Unlike VIPs, the vacuum in MAI panels is produced by filling the porous core with a condensable vapor at high temperature, which then condenses to liquid when cooled and occupies a tiny fraction of its original volume, leaving the remaining space a vacuum. Further, the MAI sealing process is mature technology and comparable to that used in sealing potato chip bags.

"NanoPore fundamentally changed the manufacturing process for MAIs," Biswas said.

While NanoPore has a grip on constructing MAIs and ORNL on characterizing the performance of the product, Firestone Building Products is developing a composite that uses polyiso foam to encapsulate the MAI cores and protect against puncture of the barrier layers. An added advantage of the new composite is that it allows MAIs to be integrated into buildings without any special installation considerations. For instance, the new MAI-polyiso composite will be a drop-in replacement for existing polyiso board insulation.

Additionally, following preliminary research, Biswas said the ORNL team and industry partners are confident that an R-value of 12 per inch is reasonable and can be reached. And with its high R-value and cheaper cost than VIPs, MAIs are shaping up to be a promising alternative to current insulations.

"Development of next-generation insulation materials achieving R-10 to 12 per inch can lead to sub-

continued on page 3

continued from page 2

stantial energy savings in the buildings sector," Biswas said. "Modified atmosphere insulation is a lower cost alternative to vacuum insulation panels and is a good candidate for next-generation insulation materials."

Funding for the project was competitively awarded by DOE BTO, and research is being conducted at ORNL's Building Technologies Research and Integration Center (BTRIC) user facility and in the facilities of NanoPore and Firestone.—*Chris Samoray*

Neutron imaging of refrigerant flow aids in understanding heat transfer

ORNL researchers have captured undistorted snapshots of refrigerants flowing through small heat exchangers, helping to further elucidate characteristics of heat transfer in the process.

The team used additive manufacturing and neutron imaging capabilities to examine microchannel heat exchangers, which hold refrigerants used to move thermal energy and provide cooling or heating in many applications. The noninvasive techniques allowed the researchers to visualize how refrigerants reacted to different temperature levels without disrupting the refrigerant flow.

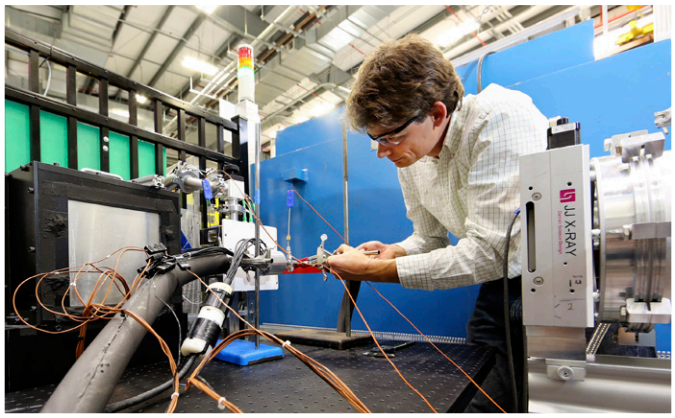
"That's what we're trying to understand—what does the refrigerant look like on the inside of these channels?" said Patrick Geoghegan, a building technologies researcher with BTRIC. "Then you can understand how the heat transfer is actually taking place."

The goal with microchannel heat exchangers is to improve overall heat transfer, which reduces the temperature difference between air and refrigerant across the heat exchangers. If applied in an HVAC system, for example, this would result in energy savings because the unit's compressor does not work as hard while moving refrigerant from the evaporator to the condenser. Additionally, the heat exchangers minimize airside pressure drop, which reduces fan energy consumption resulting in more energy savings.

The ORNL team is the first to make use of neutron imaging to visualize two-phase (vapor/liquid) refrigerant flow in a microchannel heat exchanger of an operating vapor compression machine.

Previously, the usual mode of operation was to cut off the top of a larger heat exchanger tube, cover it with Plexiglas, and then peer inside as it was heated, a method Geoghegan said could lead to inaccurate results.

The ORNL team is the first to make use of neutron imaging to visualize two-phase (vapor/liquid) refrigerant flow in a microchannel heat exchanger of an operating vapor compression machine.



ORNL's Patrick Geoghegan uses neutron imaging of refrigerant flow through heat exchangers to understand heat transfer.

With this issue in mind, the team turned to microchannels and specifically designed them for neutron imaging using additive manufacturing. This kept the microchannels small and compact, eliminating the need for extra material and refrigerant, and provided a cost-effective and environmentally friendly approach to the research.

"Additive manufacturing helped achieve the best experimental conditions," Geoghegan said, adding, "The microchannel heat exchangers use very little material and refrigerant and that's great for minimizing the global-warming potential."

To observe the effects of heat level on microchannels, the researchers ran refrigerant through the microchannels and subjected them to increasing amounts of heat over five days. At a number of cool-, medium-, and high-heat stages, the team used neutrons from ORNL's High Flux Isotope Reactor—a DOE Office of Science user facility—to take images of the refrigerant while it was in the microchannel.

The microchannels rested horizontally, and the expected outcome was that gravity would cause the liquid portion of the refrigerant liquid/vapor mixture to sink to the bottom of the microchannel, leaving less wetted area for evaporation.

Instead, the images showed that surface tension properties of the microchannels caused the refrigerant liquid to stick to all sides of the microchannel, "maximizing the amount of wetted area and rate of evaporation. Only at elevated heat levels was the refrigerant liquid forced to the center by vapor and no longer able to absorb and take heat away from the microchannel walls at a rapid rate.

"The beauty with microchannels is that surface tension comes into play, and surface tension holds the refrigerant liquid onto all the surfaces of the microchannel," Geoghegan said. "That's why you see equal refrigerant liquid on the top and bottom surfaces.

continued on page 3

continued from page 3

"The entire area is still available for evaporation—and to maximize heat transfer, that's what you want," he said.

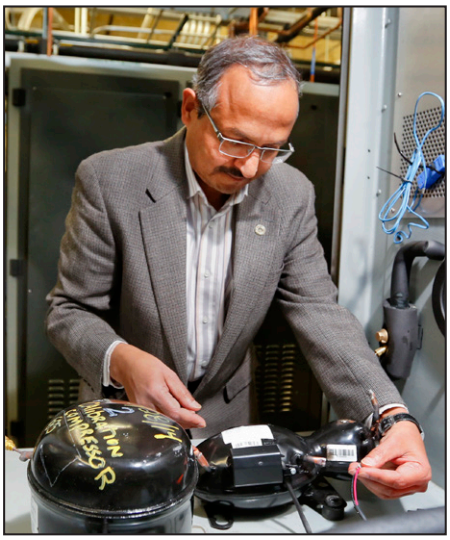
With the additive manufacturing, neutron imaging, and microchannels work, the team is just heating up. Geoghegan also expects to publish a journal article and continue experimenting with the ability of refrigerants in small microchannels to work efficiently in high heat by keeping all surfaces wetted with liquid until the evaporation process is completed and no more liquid remains.

Funding for the study was provided by ORNL's Laboratory Directed Research and Development Program. Researchers also made use of the Manufacturing Demonstration Facility (MDF) and BTRIC at ORNL.

View a video of ORNL's Patrick Geoghegan explaining the science behind microchannel heat exchangers at https://www.youtube.com/watch?v=-d-LHQI7t3w.—*Chris Samoray*

ORNL signs CRADA with Whirlpool Corporation to develop new energy-efficient refrigerator

The ORNL and Whirlpool Corporation are collaborating to design a refrigerator that could cut energy use by up to 40 percent compared with current models.



ORNL's Pradeep Bansal leads a team with Whirlpool to develop innovative linear compressor technology for more energy-efficient household refrigeration.

The goal of the CRADA is to make a next-generation household refrigerator more energy efficient by using WISEMOTION, an innovative linear compressor manufactured by Embraco, and other novel technologies and materials.

In the 1970s, the average refrigerator used approximately 4 to 5 kilowatt hours (kWh) per day; today's models average about 1.5 kWh per day. The result is massive utility savings for consumers, and ORNL and Whirlpool will further that innovation with the goal to build a refrigerator that consumes less than 1 kWh per day.

"If every refrigerator in the United States were replaced with the advanced refrigerator design, the projected primary energy savings would be 0.56 quads per year—the equivalent of 100 million barrels of oil," said ORNL's Ed Vineyard, BTRIC director.

The team will redesign a refrigerator to incorporate a linear compressor, which reduces energy losses by continuously matching the compressor pumping rate to the refrigerator's cooling requirements. Associated components will provide additional efficiency gains.

Together, these features could cut refrigerator energy use by approximately 40 percent, which would translate into an estimated $26 savings per year on the average consumer's electricity bill.

The ORNL building technologies staff draws on nearly four decades of experience working with appliance manufacturers, as well as advanced expertise in heat transfer, alternative refrigerants, and insulation materials. The project will make use of the BTRIC user facility at ORNL, including resources at the Maximum Building Energy Efficiency Research Laboratory (MAXLAB).

The three-year project is supported by the BTO in the DOE EERE.—*Morgan McCorkle*

ORNL encourages collaboration, idea sharing through new crowdsourcing tool

As part of their efforts to reduce energy consumption of the nation's buildings and enhance the manufacturing competitiveness of the United States, DOE has partnered with ORNL to launch the ORNL Buildings Crowdsourcing Community. Designed as a crowdsourcing website, buildings.ideascale.com is a forum that allows technology innovators to gather feedback from customers and other stakeholders about next-generation building technologies.

continued on page 5

ORNL is seeking new technical design ideas from across the buildings sector.

continued from page 4

By combining the ORNL crowdsourcing community with the state-of-the-art capabilities at ORNL, innovators and their potential customers can rapidly collaborate to develop the next big thing for the buildings market, allowing residential and commercial buildings customers to save money and energy.

The crowdsourcing site was officially launched with an announcement that reached nearly 40,000 email recipients through EERE's communications channels. The campaigns on the site will close on May 31. Then, a predetermined, independent panel of experts will review the most popular idea submissions, and the best ideas will be recognized during the DOE BTO Industry Day, to be hosted at ORNL in September 2015. Site members and users can still view the submissions, comments, and votes after May 31, but participation on the site for these three campaigns will discontinue.

The ORNL Buildings Crowdsourcing Community is sponsored by BTO.

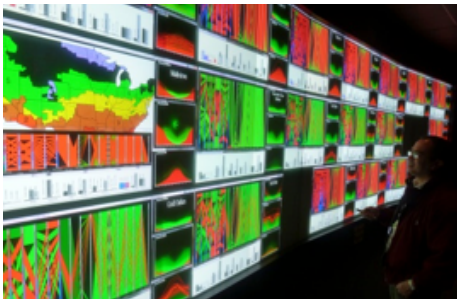
New labs for visualization and control and for microgrid research open in MAXLAB

Two new laboratory facilities—one for visualization and control and another for microgrid research—went online recently and will support projects from across ORNL.

The visualization and control laboratory for buildings and grid analysis and discovery, which houses a 5760 x 3240 pixel powerwall display, will showcase integrated analysis of building data from ongoing research and technology deployment and will enable staff to control research experiments at the Distributed Energy Communications and Control Facility.

The visualization system is connected to a server room in the MAXLAB and has the capability of using a web-based tool suite for dashboarding and analyzing sensor data from BTRIC's live experimental facilities including the one- and two-story flexible research platforms, the Campbell Creek research homes, and the Yarnell Station research home. It will also enable research into grid-related situational awareness and the presentation of actionable intelligence to grid operators based on real-time measurements, simulations, and big data analytics. BTRIC's Joshua New serves as the laboratory space manager (LSM).

The Software-defined Intelligent Grid Research Integration and Development (SI-GRID) facility provides an open, low-voltage microgrid research platform designed to accelerate the execution and transition of microgrid-related science from the lab into the field. It addresses networked microgrid control; optimization, standardization, and integration of distributed energy resources, buildings, equipment, appliances, vehicles, renewables, and energy storage; and protection and cyber-physical security. Michael Starke from the Power and Energy Systems research group serves as LSM for the SI-GRID lab.



The new visualization and control laboratory has the functionality to showcase data similar to ORNL's EVEREST wall, shown here.

Both facilities are located in the MAXLAB, which is part of BTRIC.—*Sara Shoemaker*

New sprayable liquid flashing shields against energy loss

ORNL collaborated with Dow Chemical to develop LIQUIDARMOR, a sprayable liquid flashing that installs four times faster than peel-and-stick tapes. Photo courtesy of Dow Chemical.

Air leakage through the building envelope is responsible for a large amount of wasted energy each year. To combat this problem, researchers at ORNL collaborated with Dow Chemical Company to use unique apparatus at BTRIC to characterize, on an accelerated basis, the performance of a sprayable liquid flashing. Developed by Dow, the flashing is more cost effective than traditional sealing materials such as peel-and-stick tapes.

The new technology can be used in residential and commercial construction, and its ease of use results in increased energy savings and decreased labor and installation costs. Branded as LIQUIDARMOR, it's the only one-step flashing on the market today and can be installed four times faster than tapes. The liquid sealant performs well on substrates that provide adhesion challenges for traditional tapes such as masonry blocks and exterior grade drywall. Dow introduced the residential and commercial versions of the LIQUIDARMOR technology to the US market in 2014.

This project was funded by DOE BTO's US-China Clean Energy Research Center (CERC) for Building Energy Efficiency (BEE).

BTRIC to partner with GE Appliances' FirstBuild operation

GE Appliances plans to work with ORNL to evaluate the potential for innovative products before making significant multimillion dollar investments. GE's FirstBuild business model takes advantage of open innovation and advanced technologies and manufacturing techniques to define new products, perform rapid prototyping, produce in low volumes, and validate new product concepts through low-volume sales. Success at these volumes—20 to 30 units—will enable GE Appliances to better justify the significant investment needed to move graduates of the FirstBuild process to full production. The arrangement, which will take advantage of ORNL's BTRIC and MDF, will be formalized later this spring.

ORNL helps Army reduce energy use at military facilities

A cross-functional group of ORNL experts, led by Dan Howett with BTRIC's Residential and Commercial Energy Efficiency group, was one of several parties that helped to reduce energy use at military facilities under the framework of a memorandum of understanding between the US Department of Defense and DOE. This successful interagency partnership leveraged the highly specialized capabilities of the DOE national laboratories to conduct industrial assessments that identify energy conservation measures on US Army installations, including those operated by the Army Materiel Command (AMC).

Before ORNL's project contribution, representatives from industrial assessment centers (funded by DOE's Advanced Manufacturing Office [AMO]) conducted energy assessments at three AMC installations and developed site-specific recommendations. Under a Work for Others contract with the Army, the ORNL team then took those recommendations and applied best practices and lessons learned to other AMC industrial sites. As a result, more than $8 million in annual energy cost reductions were identified at the AMC industrial sites alone, which is the equivalent to the amount of energy consumed by approximately 14,000 US homes each year.

ORNL assisted in reducing energy use at the Lake City Army Ammunition Plant in Independence, MO, which conducts contract oversight and provides quality small caliber munitions for the federal government.

Design charrette kicks off Integrated Energy Systems demonstration

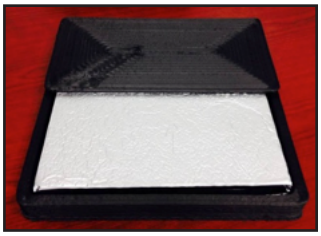
Researchers from BTRIC and MDF are collaborating to conceptualize, design, and 3D print a residential building envelope to be showcased as part of the Integrated Energy Systems demonstration at BTO's Industry Day to be hosted at ORNL on September 23–24, 2015. Also participating are the UT-ORNL Governor's Chair for High-Performance Energy Practices in Urban Environments team from Skidmore, Owings & Merrill (SOM), UT College of Architecture and Design faculty and students, and Clayton Homes.

Before the initial design charrette, Gavin Mabe, product engineering manager for Clayton Homes, hosted a tour of Clayton Homes' current construction methods at the manufactured home plant in Andersonville, Tennessee, as well as an overview of the process for bringing new techniques onto the assembly line. This reality check proved useful in channeling the brainstorming exercises in productive directions.

The team is currently iterating designs and printing 2 × 2-foot envelope sections to prove designs before scaling to full size. The printed envelope will feature MAI panels, which are introduced in a feature article on page 2. As the envelope is printed, the MAI panels will be encapsulated during the additive manufacturing process, protecting the MAI barrier layers from puncture during envelope construction and throughout the life of the building.

Seminars given by participants in the Governor's Chair for High-Performance Energy Practices in Urban Environments team:

- Douglas Voigt of SOM presented on "The Human Footprint: Case Studies on Sustainable Models for High-Performance Infrastructure and Livable Communities" in October as part of the Governor's Chair for High-Performance Energy Practices in Urban Environments Seminar Series. The multidisciplinary collaboration and research highlighted in these case studies are applicable to principles and design strategies for 21st century cities.
- Benton Johnson of SOM spoke on "Urban Mass Timber: Rethinking Embodied Energy" in January, detailing how SOM applied improved mass-timber technology, which is both stronger and more resistant to fire, in its Timber Tower Research Project.



An early concept shows integration of MAI panels (white material) into additively manufactured walls (black material).

EMPLOYEE EXCELLENCE:

Lapsa

Energy and Transportation Science Division Director Johney Green presents service award to Bill Miller.

- Melissa Lapsa received a 2014 DOE Sustainability Award for "fervently championing sustainability across ORNL and beyond." As a winner, Melissa will participate in a best practices workshop in which the 2014 award winners will describe successful sustainability projects.
- In 2014, the following staff were promoted to new management positions:
  - The dual role of program director and center director was split into two more manageable positions with Patrick Hughes maintaining the position of Building Technologies Program director and Ed Vineyard assuming the role of BTRIC director.
  - Omar Abdelaziz was promoted to group leader for Building Equipment Research.
  - Roderick Jackson was promoted to group leader for Building Envelope Systems Research.
- Roderick Jackson was named to the eighth annual edition of the Greater Knoxville Business Journal's 40 under Forty, which honors 40 individuals younger than 40 who are leaving an imprint on the Knoxville area through their professional efforts.
- Congratulations to Johney Green on winning the UT-Battelle Award for Research Leadership—division level—for exemplary leadership and for successfully integrating science and technology activities supporting DOE's EERE Office.
- Bill Miller was presented with a service award for his 35 years with ORNL researching diverse topics such as roof/attic systems, vapor compression systems, and absorption heat and mass transfer.

NEW HIRES:

The Building Technologies Program welcomes the following new staff members in the Residential and Commercial Energy Efficiency (RCEE) Group: Doug Culbreth, Scott Wolf, and Thomas Hattery. These federal project executives will support federal agency development of task orders under the Federal Energy Management Program's (FEMP's) Indefinite Delivery, Indefinite Quantity (IDIQ) energy savings performance contracts. They will work closely with FEMP headquarters, federal agencies, project facilitators, and other technical experts to ensure that awarded task orders are consistent with FEMP's high standards for quality and represent the best value to federal customers.

ORNL new hires (from left) Culbreth, Wolf, and Hattery will support federal agency use of FEMP's IDIQ energy savings performance contracts.

VISITS AND EVENTS:

- Karma Sawyer, Brent Nelson, and Chioke Harris from the DOE BTO visited BTRIC and MDF in November. During their visit, discussions began on a new BTO–AMO collaboration to explore the application of additive manufacturing to buildings.
- Knoxville Mayor Madeline Rogero visited ORNL, including the MAXLAB facilities, to promote the city's interest in serving as a wireless spectrum "Model City." Participating in the visit were ORNL Director Thom Mason; Martin Keller, director of the Energy and Environmental Sciences Directorate; Johney Green, director of the Energy and Transportation Science Division; and Ken Tobin, director of the Electrical and Electronics Systems Research Division and tour host.
- An adult study group tour composed of 42 members of the Smithsonian Associates visited the MAXLAB, receiving an overview and tour of the appliance lab, wall climate chambers, and multizone HVAC chambers.
- Several ORNL staff hosted 20 mid- to senior-level professionals from Eurasia as part of the Special American Business Internship Training program's Energy Efficiency in Construction focus. This is a unique opportunity for US organizations and companies to provide industry insight and training while showcasing their facilities, products, and services to their Eurasian counterparts.

continued on page 8

continued from page 7

- Dan Howett, Julia Kelley, and Gayle Jones organized a visit by five cadets and three faculty members from West Point. The visit was sponsored by Boeing Corporation and FEMP. The students are part of a capstone project in which they are to design and evaluate the energy usage of a forward operating base in the year 2040 that is free of the need to be resupplied with fossil fuels. During their visit they met with representatives from the RCEE, Whole-Building and Community Integration, Building Equipment Research, and Building Envelope Research groups.
- Other visitors to the MAXLAB included representatives from the Alabama Center for Sustainable Energy, Australian National University, Avion Solutions, Emerson Climate Technologies, EPB, GAF, General Electric, Motorola Foundation/Georgia Institute of Technology, Pella Corporation, Richmond Surry, Rockwool International, Samsung, and Thin Film Electronics.

ORNL supports DOE's Excellence In Energy Awards, which FEMP awards annually to innovative student energy projects at the academies of the Army, Navy, Air Force, and Merchant Marines.

BTRIC's Science Research Seminar Series highlights buildings Research and Development

Bill Miller gave a seminar in January titled "Technologies and Approaches for More Efficient, More Durable, and More Affordable Roofs and Attics." The talk covered the use of data collected during combined analytical and experimental field studies to benchmark computer tools, which in turn, simulated homes with high-performance roofs and attics in hot and moderate climates.

Visit the Innovations in Buildings website for information on all BTRIC speakers and seminars at http://web.ornl.gov/sci/buildings/seminars/.

MEDIA MENTIONS:

DOE featured ORNL–Honeywell Refrigerant development project

In February, EERE Communications posted a success story about ORNL's work with Honeywell Refrigerants to energy.gov: http://energy.gov/eere/success-stories/articles/new-refrigerant-boosts-energy-efficiency-supermarket-display-cases-0

This story is also highlighted on the BTO and Emerging Technologies (ET) webpages:

BTO: http://energy.gov/eere/buildings/building-technologies-office

ET: http://energy.gov/eere/buildings/emerging-technologies

Autotune software garners media attention

"Autotune," an automated calibration software developed by ORNL to reduce the amount of time and expertise needed to optimize building parameters for cost and energy savings, has caught the attention of many national media outlets. Developers Joshua New and Jibonananda Sanyal have been quoted in numerous articles on the value of Autotune to building owners, including the following:

- Oak Ridge Leadership Computing Facility announcement: http://www.ornl.gov/ornl/news/features/2014/cb8f55ed-c9f2-4e74-a373-3df68666afb7
- HPCwire: http://www.hpcwire.com/2014/09/23/autotune-software-helps-model-energy-use/
- Phys.org: http://phys.org/news/2014-09-team-autotune-software-quicker-easier.html
- Newswise: http://newswise.com/articles/ornl-researchers-develop-autotune-software-to-make-it-quicker-easier-and-cheaper-to-model-energy-use-of-buildings

continued on page 9

continued from page 8

- **ScienceDaily:** http://www.sciencedaily.com/releases/2014/09/140929093712.htm
- **Energy Manager Today:** http://www.energymanagertoday.com/national-lab-creates-autotune-building-modeling-software-0105320/
- **Clean Energy, ORNL's Energy and Environmental Sciences Directorate newsletter:** http://www.ornl.gov/science-discovery/clean-energy/newsletters-and-media/clean-energy-newsletters/ce-no--4-2014
- **Energy.gov EERE site:** http://energy.gov/eere/buildings/articles/ornl-researchers-develop-autotune-software-make-it-quicker-easier-and
- **BTO homepage newsfeed:** http://energy.gov/eere/buildings/
- **GCN Technology, Tools and Tactics for Public Sector IT:** http://gcn.com/Articles/2014/10/16/Energy-management-tools.aspx?Page=2
- **Sourceable Industry News & Analysis:** http://sourceable.net/autotune-software-help-building-energy-modelling/

Six-Year Campbell Creek project featured in Popular Science

A November 2014 article in Popular Science featured the results of a project in which automated systems that simulate human behavior were set up in three houses in Campbell Creek subdivision in Knoxville, Tennessee. The project was a collaboration among the Tennessee Valley Authority, Electric Power Research Institute, and ORNL. The full story can be viewed at: http://www.popsci.com/robohouse-project-pumped-simulated-sweat-and-breath-empty-homes.

Hughes interviewed for ORNL Reporter

Patrick Hughes gave an interview for a feature article on the MAXLAB that appeared in the fall 2014 issue of the ORNL Reporter, a newsletter for ORNL retirees: http://web.ornl.gov/info/reporter/no152/fall_2014.pdf

Do you have news or information you would like to share?

Please submit ideas or suggestions to
ORNL Building Technologies Research and Integration Center at
buildings@ornl.gov or (865) 574-7267.

The Building Technologies Update newsletter aims to cover news and technical highlights associated with building technologies and building technologies-related research activities and projects. This publication is produced and distributed by the Oak Ridge National Laboratory's Energy and Transportation Science Division.

www.ornl.gov/buildings