

Science & Technology HIGHLIGHTS

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Near-Zero-Energy Homes Help Electric Utilities Meet Record Peaks

The DOE Building America Project collaborated with ORNL, the Tennessee Valley Authority (TVA), the Habitat for Humanity Loudon County Affiliate, and members of the building and energy service equipment industries to build an energy research park comprising five homes in the Harmony Heights neighborhood of Lenoir City, Tennessee. The five homes provide a living laboratory for research on integrated energy-saving technologies that will lead to the development of marketable near-zero-energy homes (ZEHs). Four of the homes range in size from 1,000 to 1,240 ft². At the suggestion of TVA, a 2,600 ft² house (designated "ZEH5") was included in the research park so that it could be determined whether the unique integrated technology package is scalable to larger homes. One of the smaller homes, a 1,200 ft² two-story, designated "ZEH4," was selected for comparison with ZEH5.

When designing and pricing ZEH5, ORNL collaborated with designers, builders, and prospective owners to ensure that, in addition to being energy-efficient, the design would have broad appeal in the housing market in the TVA service area, which averages 35,000 housing starts per year. The design meets the criteria of the U.S. Internal Revenue Service for a \$2,000 builder business tax credit. The plans are available to building contractors and homeowners who are willing to build in early 2008.



ZEH4, a 1,200 ft² Habitat for Humanity home in the research park in Harmony Heights, Lenoir City, Tennessee.

Space conditioning of ZEH5, which is unoccupied, is undergoing 2 years of detailed thermal performance monitoring (2006–2008). The other four homes are all occupied and have

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SOUTHEAST
SOLAR SUMMIT

First Solar Summit a Success

With its abundance of sunshine, the desert Southwest of the United States is often associated with the production of solar energy. In fact, the use of solar energy is increasing worldwide, and right now Germany is the fastest growing market for photovoltaic solar cells. In each of the last two years, Germany has added more than ten times as much photovoltaic capacity to its electric grid as the United States has added to the domestic grid, demonstrating that solar power

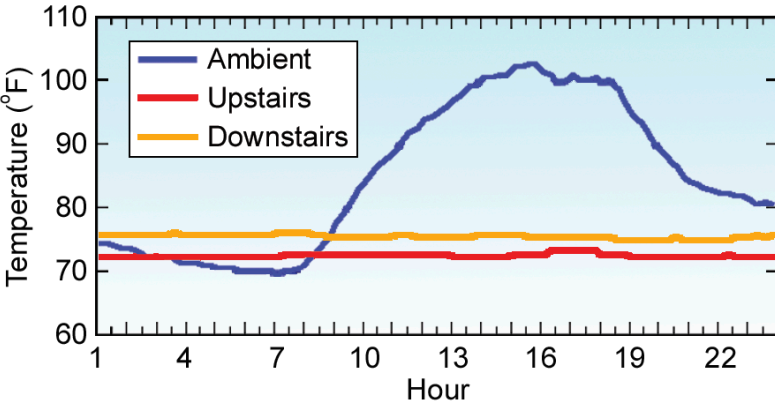
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Among the Southeast Solar Summit attendees were (left to right) Stephen Smith, SACE; Anda Ray, TVA; Helen Hardin, chief of staff for Congressman Zach Wamp; ORNL Director Thom Mason; Ryan Gooch, Tennessee DECD; Beth Hickman, field representative for Congressman Lincoln Davis; and Craig Cornelius, acting program manager, DOE EERE Solar Energy Technologies Program.

Near-Zero-Energy Homes continued from p.1

at least one year of performance measurements. The data collected were used to validate a whole-house simulation model, which in turn is used to predict performance compared to a benchmark house with identical occupancy patterns. The best-performing home during the 2006 calendar year was ZEH4, which experienced average energy costs of less than \$.50/day. The average energy costs for non-ZEH homes in the same region is \$5 to \$6/day.



Ambient temperatures compared with temperatures in ZEH5 on August 16, 2007, the day that TVA met its all-time high demand for electrical power.

Preliminary results indicate that 1,000 to 2,600 ft² craftsman-cottage-style dwellings can be built to produce as much electric energy as the occupants consume. The current research is focused on the mixed humid climate typical of the TVA service area. However, the findings are relevant to all U.S. regions.

Data collected by the research team in the test homes provide a continuous record of the demand for electricity under real-world conditions as demand peaks and ebbs during the course of a day. Data collected independently by PJM Interconnection, a federally regulated regional transmission organization, records the corresponding cost of the electricity. PJM establishes the market price of electricity by matching supply with demand. Thus the researchers know both the energy consumption and the cost for any given hour of the day. This comparison provides a key metric for the researchers because, for example, on a hot summer day, the cost can nearly triple from 9 a.m., when demand is low, to about 6 p.m., when demand typically peaks for the day.

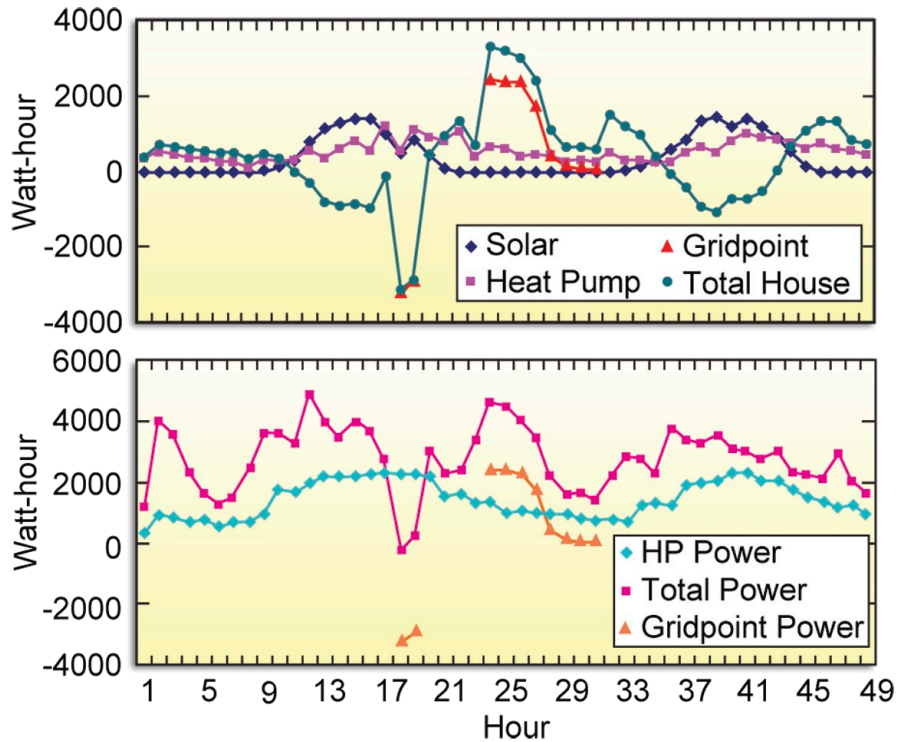
It happened that during part of the test period (the summer of 2007), East Tennessee was experiencing record high temperatures and drought, among the most extreme conditions documented in 113 years of record keeping. TVA continued to meet the increasing demand of electricity during the month of August. It reached its all-time record at around 6 p.m. on August 16, by meeting a demand of 33,482 MW. Also,

because of the extreme drought conditions, hydropower, TVA's cheapest source of electricity, had been cut by 40%, transmission line capacity was at its lowest rate, and cooling water for generation plants was limited.

In Harmony Heights, ZEH4 and ZEH5 maintained comfortable temperature and humidity during the hottest part of the day while demanding no energy from the grid. There were TVA critical system peak times during August when electricity produced by the homes was flowing back onto the grid. The research has shown that the ZEHs use about 40% less electricity when compared with non-ZEHs of similar size and occupancy if the ZEHs are outfitted with energy efficiency features and photovoltaics alone. Adding features, such as solar water heaters, "demand-side" tools, such as "smart" controls (which govern energy use and storage) and batteries, contribute to even greater savings.

The results have enabled the researchers to refine the strategy and thus maximize energy savings. For example, they found that "precooling" a ZEH (lowering the thermostat a little for a few hours before a peak demand period and raising the thermostat during the peak) saves energy with no impact on thermal comfort. They were also able to determine the best way to program the smart controls and to help the utility decide on appropriate time-of-day rate structures so that the house truly saves money rather than shifting the demand and thus the cost from the peak to another part of the day. This work shows that a summer peak load reduction from conventional homes to ZEHs can save on average 7 kW/home. This

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Demand for electricity was lowest at the hottest part of the day on August 16, 2007. Top, ZEH4, bottom, ZEH5.

suggests that, by linking about 17,000 of these homes together by dispatchable controls, a TVA customer aggregator would have a 120 MW green power peaking facility, 10% of the agency's goal of 1,200 MW from demand-side management.

A future direction in the research will be to take the information obtained from the individual homes and to apply it to a "zero energy neighborhood," where homes are treated in aggregate to maximize their performance and to minimize the demand for electricity. TVA is currently revising the Green Power Generation

Program and is considering enhancing the incentives for builders and home buyers to consider the ZEH approach. TVA, DOE, and ORNL are also working with builders to promote ZEH technology and with the financial industry to help make available ZEH mortgage packages.

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Sponsors: DOE Building America Project, Tennessee Valley Authority, Habitat for Humanity

Solar Summit continued from p. 1

can be practical, even in northern latitudes. In the southeastern United States, the average amount of sunlight available for producing electricity is twice that available in Germany, but it has yet to be fully exploited. Thus, the time is right for new public-private partnerships to work on advanced solar technologies that will benefit the region for years to come.

Solar energy was in the spotlight at ORNL on October 24 and 25, when renewable-energy experts from the region convened for the first Southeast Solar Summit. The summit focused on opportunities to promote solar R&D and market transformation within the southeastern United States. It served to facilitate strategic partnerships with established regional organizations that understand the energy needs, economics, and market of the Southeast demographic.

Sponsors of the event included ORNL, DOE, Tennessee's Department of Economic and Community Development (DECD), the Tennessee Valley Authority (TVA), the Solar Energy Industries Association, Sustainable Future, Lightwave Solar Electric, the Georgia Institute of Technology, and the Southern Alliance for Clean Energy (SACE). Other participants included Lakeland Electric, the Solar Electric Power Association, Sterling Planet, SunLight Direct, Inc., the North Carolina Solar Center, and the Florida Solar Energy Center.

About 200 participants attended the conference. Dana Christensen, Associate Laboratory Director for Energy and Engineering Science Directorate, welcomed them on behalf of ORNL. Ryan Gooch, Director of Energy Policy, Tennessee DECD, followed with welcoming remarks on behalf of the state of Tennessee.

Craig Cornelius, Acting Program Manager of the DOE EERE Solar Energy Technologies Program, presented the opening plenary, "The Department of Energy's Solar America Initiative." The goals of the Southeastern Solar Summit fall in line with those of the initiative, which is part of the president's Advanced Energy Initiative, the goal being to make solar energy cost-competitive with conventional forms of electricity by 2015.

The final speaker, Suzanne Shelton, president and CEO of the Shelton Group, talked about trends in public opinion for solar technologies. Results from the group's 2007 survey indicated several challenges to consumer acceptance of solar and other renewable technologies. Shelton told the participants that consumers have become very cost-conscious and that they prefer to see a return on their investment, through either reduced up-front costs or increased savings.

The opening activities concluded with the dedication of the Arizona Public Services photovoltaic solar array. ORNL

Director Thom Mason, ORNL EERE Director Robert Hawsey, TVA Vice President of Environmental Stewardship and Policy Anda Ray, SACE Director Stephen Smith, Craig Cornelius, and Ryan Gooch participated in the ceremony. The array, which uses Memphis-based Sharp Solar's photovoltaic modules, is currently providing some of the electricity used at ORNL (about 9,000 kWh/year).

The ORNL Center for Advanced Thin Film Solar Cells (CATS), a new user center that focuses on photovoltaics R&D, was also unveiled at the summit. Solid-state lighting research will also be conducted in the CATS facility.

A concentrator photovoltaic system from JX Crystals, Inc., was on display. Participants were offered workshops on hybrid solar lighting and solar air heating and were given tours of the near-zero-energy Habitat for Humanity homes in Lenoir City (the homes boast electric bills as low as \$.41 per day); the Buffalo Mountain Wind Farm near Oliver Springs, where 15 1.8-MW turbines are installed; and the Spallation Neutron Source.

Visit www.ornl.gov/solarsummit to see the presentations.

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Sponsor: DOE EERE Solar Energy Technologies Program



The Arizona Public Services single-axis tracker installed on the ORNL campus was dedicated at the Solar Summit.



ORNL Looking for Big Energy Savings Through DOE TEAM Initiative

The Transformational Energy Action Management (TEAM) Initiative is a very aggressive approach by DOE Headquarters to address recently legislated energy and environmental requirements and goals. In January 2007 President Bush issued an executive order requiring all federal facilities to reduce their energy intensity by 30% over 10 years and to provide for 7.5% of energy demand through renewable resources such as solar, wind, and biomass-derived energy. There are also aggressive goals for reduction in water and petroleum consumption and for greenhouse gas emissions. Certain high-intensity facilities are excluded from meeting the goals but are expected to be the subject of additional studies and actions in the future.

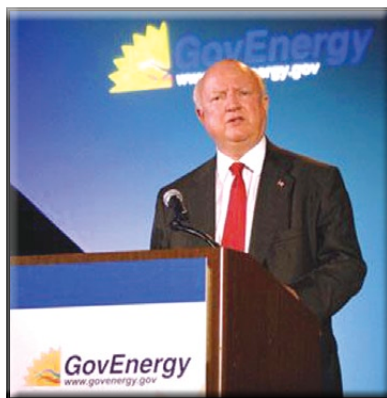
DOE Secretary Samuel Bodman formally announced the TEAM Initiative on August 8, 2007, at a national energy conference in New Orleans. His intent is for DOE to meet or exceed the requirements and goals and to become the leader of other federal agencies in the TEAM effort. Because of their unique geographical and operational circumstances, the DOE laboratories proposed in September that they be allowed to meet the TEAM goals as a group rather than requiring each laboratory to meet each goal individually. Secretary Bodman approved that approach.

ORNL staff made an initial independent assessment and determined that indeed the Laboratory could meet or exceed the TEAM initiative goals. They then focused attention on identifying the projects that would make it happen, including past successful efforts. In one recent

instance, the Laboratory was able to cut its energy use when it received a request from the Tennessee Valley Authority to reduce energy consumption during the mid-August heat wave. ORNL raised thermostats 5 to 8°F and turned off all unnecessary lighting in offices and hallways. The result was about a 3% reduction in demand. To achieve Secretary Bodman's TEAM goals at ORNL will require much more. For example, roughly one-third of the required 30% energy savings must come from major new or retrofit projects related to the Laboratory's cold-war-era steam and chilled water/hot water systems.

Some appropriated funds will be needed to enable the aggressive targets for energy savings and renewable energy use. In addition, the Laboratory is looking forward to receiving a proposal from Johnson Controls, which will be the Laboratory's energy savings performance contractor. Projects identified by Johnson Controls may be financed via long-term instruments that pay for themselves from the energy savings.

At ORNL Wayne Parker, Greg Palko, and Bob Hawsey are leading the TEAM initiative activities, which involve a number of other staff members from around the Laboratory. There is also an ad hoc group of EERE program staff who advise the group on opportunities for EERE tech-



DOE Secretary Samuel Bodman at the GovEnergy Workshop in New Orleans.

nologies to help meet the TEAM goals and to look for ways to reduce the energy intensity of the excluded facilities. The ad hoc group includes Patrick Hughes, Julia Kelley, and Jeff Christian (Building

Technologies and Federal Energy Management Programs); Sharon Robinson and Bob DeVault (Industrial Technologies, including on-site generation, boilers, and data centers); Richard Smith (Vehicle Technologies); and Melissa Lapsa (Solar Technologies). They are also working with Facilities and Operations Directorate staff to evaluate opportunities to reduce the energy intensity of ORNL's supercomputer installations, a topic that recently garnered the attention of DOE Assistant Secretary of Energy, Andy Karsner, after visits to Google headquarters and Wall Street, where memoranda of understanding were signed with the DOE to work together to improve the energy efficiency of those data centers. The group at ORNL expects to share best practices with other laboratories and EERE industrial partners in FY 2008 as the TEAM initiative goes into high gear.

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Sponsor: DOE

Ethanol Fuel Studies

The renewable fuel target in the president's "20 in 10" Initiative (to replace 20% of U.S. gasoline consumption in 10 years) is 35 billion gal of renewable or alternative fuel per year by 2017, most of that being corn ethanol. Most ethanol is currently consumed in a blend with gasoline (up to 10% ethanol or E10). A small but growing portion is being consumed as E85 (or 85% ethanol blended with gasoline) in "flex-fuel" vehicles, which can operate on gasoline or on any blend of gasoline and ethanol. However, several obstacles remain. For example, ethanol consumption is limited by both the number of vehicles that can burn E85 (only about 3%) and the number of E85 fueling stations (only about 1%). Also, U.S. flex-fuel vehicles are optimized for gasoline and are made to tolerate ethanol.

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ORNL's 2007 Saab 9-5 BioPower test vehicle.

Oak Ridge National Laboratory



That is, the manufacturers have not tuned the engines to take advantage of some of ethanol's favorable properties.

The staff at ORNL's Fuels, Engines, and Emissions Research Center (FEERC) imported and evaluated a new research vehicle—a 2007 Saab 9-5 BioPower (see *Science & Technology Highlights*, 2007, No. 1). Only available in Europe, it is the first commercial flex-fuel vehicle optimized to run on ethanol. It was purchased directly from a dealership in Sweden with funds from the DOE EERE Office of the Biomass Program. Benchmarking the Saab against U.S. flex-fuel vehicles is important to DOE in its effort to understand the progress of flex-fuel vehicles and to increase fuel mileage. The benchmarking includes measuring the Saab's emissions profile to determine whether it meets the more stringent U.S. requirements.

Tests at ORNL determined that the Saab produces about 20% more power on ethanol than on gasoline. It gets somewhat better fuel economy on ethanol than would be expected based on the energy content of the fuel, on par with or slightly above that of the existing U.S. flex-fuel-vehicle fleet. Emissions appear to be within U.S. limits, meaning that it is significantly cleaner than it has to be to meet European emissions standards. Overall, it is a well-designed vehicle that does not sacrifice emissions levels to improve performance; however, the difference in fuel economy between E85 and gasoline needs to be reduced or eliminated.

In 2006 ORNL demonstrated in a fleet flex-fuel minivan that "lean-burn" technology could increase the fuel economy on E75 by about 2 mpg (about 4%). Similar experiments with the Saab and E85 are currently under way and should demonstrate even greater improvements in fuel economy. Significant improvements in the fuel economy are expected to encourage consumers to use E85.

Another key limiting factor in the widespread use of E85 is the relatively small number of E85 fueling stations. The effort to

add more E85 stations hit an unexpected snag in 2006, when Underwriters Laboratories, Inc., (UL) suspended authorization to use its markings on components for E85 fuel dispensers, citing a lack of data and the potential for increased corrosion.

DOE tasked the National Renewable Energy Laboratory (NREL) and ORNL to assist UL by developing suitable data on E85 dispensers.

Researchers in the ORNL

Materials Science and Technology Division Corrosion Sciences group teamed with FEERC engineers to work with NREL and UL to build prototype E85 and E25 dispenser units to rapidly supplement UL's static data for ethanol. Data for moving fluids (dynamic evaluation data) are still being collected for UL. On October 16, 2007, UL began accepting submittals for certification of E85 dispensers. The efforts of DOE, NREL, and ORNL are specifically cited.

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Sponsor: DOE EERE Office of Biomass Program and Office of FreedomCar and Vehicle Technologies



Test units being used to obtain data about E85 and E25 fuel dispensers for Underwriters Laboratories.

Lignin-Based Carbon Fibers for Automotive Applications

Researchers in the ORNL Carbon Materials Technology Group are pursuing energy-efficient, cost-effective techniques to produce carbon fibers for use in lightweight composite materials for vehicles. To support their efforts, custom-designed melt-spinning equipment was built for the project and was installed in the group's facilities. The equipment is the main workhorse for establishing process conditions for melt-spinning of lignin fiber tows and for producing precursor fiber for thermal processing into carbon fiber.

Carbon fibers have great potential for use in vehicle components because of their remarkable high strength, high modulus, and low density. Their use would substantially reduce weight without sacrificing strength, which would increase fuel economy and thus would result in lower CO₂ emissions. Currently, however, at about \$40/kg, suitable carbon fiber is too expen-

sive for large-scale automotive use. To be practical, the cost would have to come down to about \$10/kg.

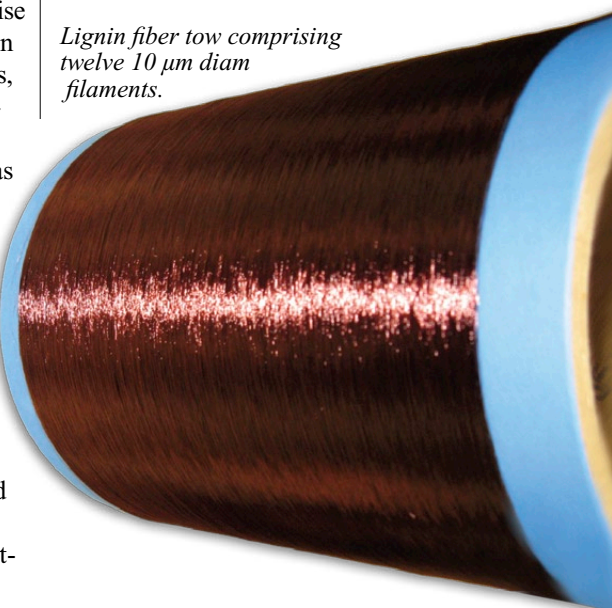
Lignin, a natural polymer found in woody vascular plants, shows great promise as a precursor material for low-cost carbon fiber production. Among natural polymers, lignin is second only to cellulose in abundance. It fills the spaces in cell walls and imparts mechanical strength to the plant as a whole. It also plays a significant role in the carbon cycle by sequestering atmospheric carbon into plant tissues.

Lignin is produced in large quantities as a co-product of the wood-pulping step in making paper. Pulp-derived lignin is a candidate precursor for carbon fibers, and the ORNL researchers have successfully processed it into carbon fibers. However, pulp-mill-derived lignin contains impurities and requires substantial, and relatively expensive treat-

ment before it can be used for carbon fiber production. In addition, in modern, highly integrated papermaking processes, lignin

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Lignin fiber tow comprising twelve 10 μm diam filaments.



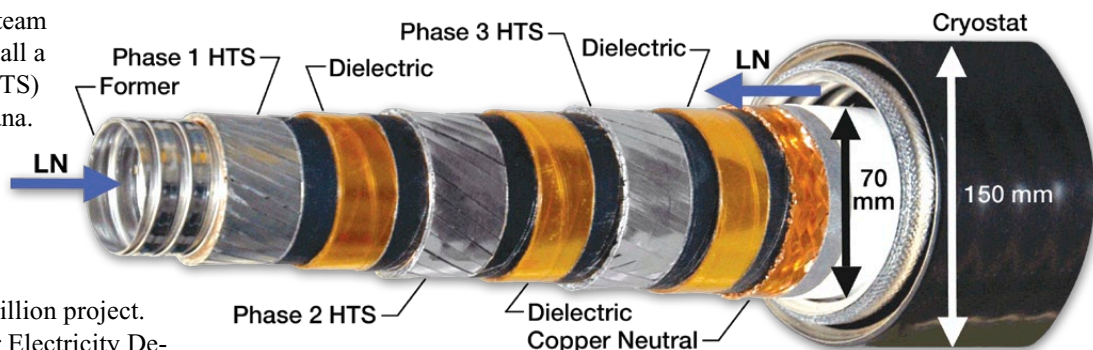
Modernizing the Electric Grid in the New Orleans Area

ORNL is part of an industry-led team that recently received an award to install a high-temperature superconducting (HTS) cable in greater New Orleans, Louisiana. The project team includes Southwire, Entergy, nkt cables, and ORNL. ORNL is responsible for cable, termination, and high-voltage research and testing.

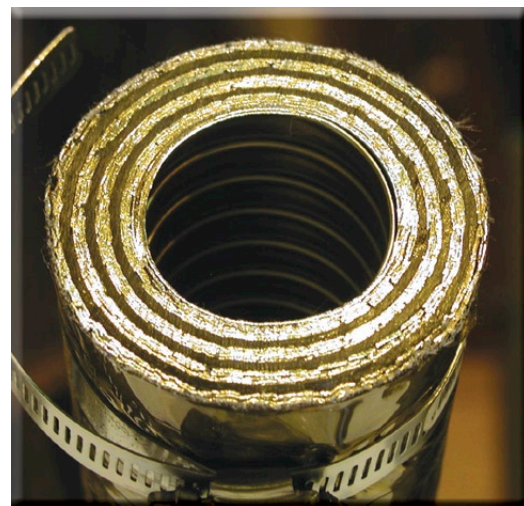
DOE is cost-sharing the \$26.6 million project. Kevin Kolevar, assistant secretary for Electricity Delivery and Energy Reliability, kicked off the HTS cable project on August 28, 2007, exactly two years after Hurricane Katrina ravaged the region. The system will be installed in Jefferson Parish, just outside the downtown New Orleans area, in Entergy Louisiana's service territory. It will eliminate the need for Entergy to build a new substation.

The 1.1 mile, 13.8 kV Triax™ HTS cable will connect Entergy's Labarre substation to the Metairie substation to accommodate load growth and to reduce transmission congestion. Expected to be completed in 2011, it will be the longest HTS cable in the world.

The Triax™ HTS cable design, co-developed by ORNL and Southwire, places three phases concentrically on a common axis. The coaxial design reduces the amount of superconducting material required and results in a cable that is the most compact and that has the highest current density in the world. One Triax™ HTS



The New Orleans and Columbus cables feature an innovative three-phase coaxial design (top). Coolant circulates through the hollow core (right).



Notables in attendance at the signing ceremony for the HTS cable installation in Jefferson Parish, Louisiana, include (left to right) Jay Blossman, chairman, Louisiana Public Service Commission; Charlie Murrah, president, Southwire Energy Division; E. Renae Conley, president and CEO, Entergy Louisiana; and Kevin Kolevar, DOE assistant secretary for Electricity Delivery and Energy Reliability. Photo courtesy of Southwire.

cable can carry as much current as 10 copper cables and delivers power with minimal energy losses. A shorter (200 meter) Triax™ HTS cable is presently in operation on the grid at American Electric Power's Bixby substation in suburban Columbus, Ohio, and is providing reliable power to more than 8,600 residential, commercial, and light industrial customers.

HTS materials are ceramic compounds. When applied to metal tape, they form a material that has the structural integrity to be wound into a cable. When cooled to very low temperatures (below -321°F [-196°C]), the HTS cable can deliver power more efficiently than traditional cables made of copper wire. Thus the installation will include a liquid nitrogen-based cryogenic cooling system.

The installation in Jefferson Parish is one of five HTS projects selected by DOE to receive new funding totaling almost \$52 million to help modernize and secure the nation's electric delivery system. The success of demonstration projects such as the one in New Orleans will assure utilities that HTS cables and cooling systems will operate reliably and that they can alleviate electrical transmission and distribution congestion.

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Sponsor: DOE/OE Superconductivity Program





Energy Efficiency Global Forum and Exposition

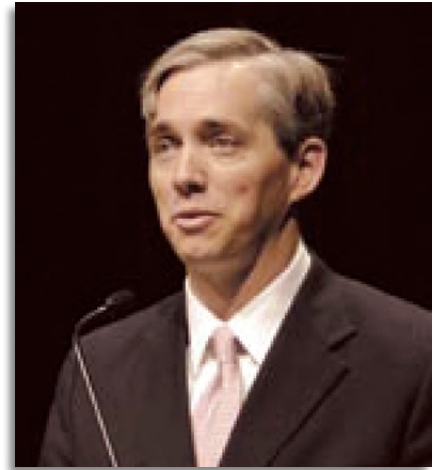
The ORNL EERE Program hosted an exhibit at the Energy Efficiency Global Forum and Exposition, which was held in Washington, D.C., on November 11–14 for the energy-efficiency industry. The forum attracted senior executives, industry professionals, policymakers, and academics from around the world, who met to exchange the latest technical, commercial, and policy information; to forge partnerships; and to develop “best practices” policies and strategies for global implementation.

Deputy Secretary of Energy Clay Sell spoke at the forum and described DOE’s “six pillars of energy efficiency”:

- energy efficient utilities as described in National Action Plan for Energy Efficiency and in “Save Energy Now” assessments;
- model building codes (e.g., near-zero-energy building codes developed in partnership with ASHRAE);

- new appliance and lighting standards and eliminating the backlog in new standards;
- improved civic infrastructure (e.g., increase the Energy-Smart Schools Program);
- accelerated R&D and market deployment for efficient lighting and zero-energy buildings through mechanisms such as the Industrial Technologies Program and the Green Grid Consortium; and
- public education.

Today’s achievements in energy efficiency were highlighted at the forum, as were developing plans and commitments for a sustainable energy future. The forum provided information on how energy efficiency has a positive impact on every end-use sector, including transportation, the built environment, electricity generation, and more. It demonstrated to policymakers that energy efficiency is the cheapest, quickest, and



Deputy Secretary of Energy Clay Sell at the EE Global Forum and Exposition.

cleanest resource for meeting the world’s ever-increasing demand for energy.

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Sponsor: Alliance to Save Energy

Martin Leads U.S. Team for Greening Chinese Industry

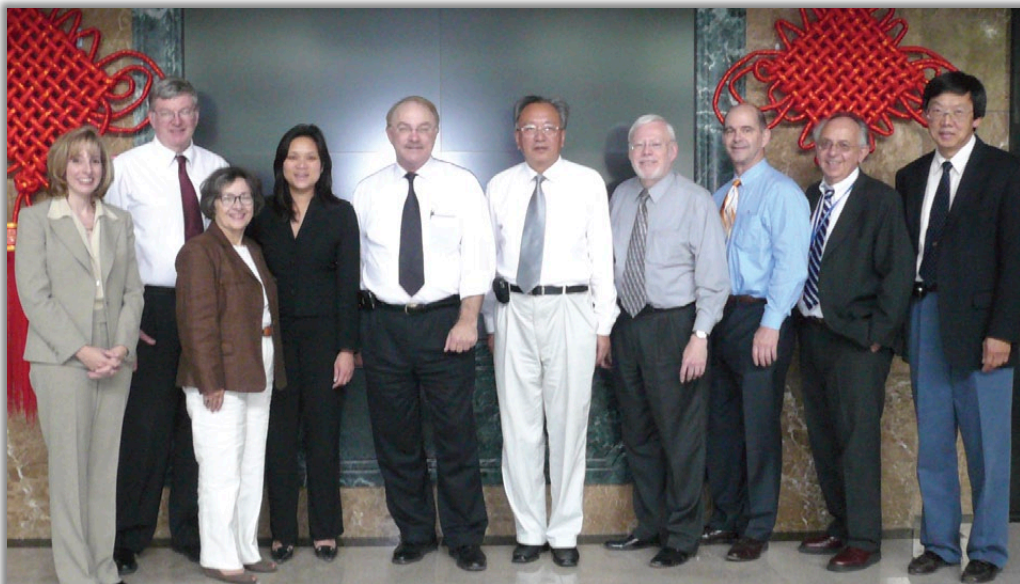
In August 2007 ORNL R&D staff member Michaela Martin participated in an official DOE delegation visit to China to discuss cooperative efforts between the two countries on improving energy efficiency in buildings and industry. These efforts include establishing a conduit for American companies to export their efficient products and services into the Chinese market. The delegation was led by Principal Deputy Assistant Secretary John Mizroch. Other members included Mark Ginsberg, Amy Chiang, and Jim Quinn (DOE Headquarters); Maria Holleran Rivera and Marco DiCapua (DOE, China Office); Joe Huang (Lawrence Berkeley National Laboratory); and Alan Gagnet (DOE consultant). The delegation met with state and provincial government officials in Beijing and Shanghai to review progress on buildings projects in preparation for the Olympics and to work out the details of a memorandum of understanding (MOU) addressing energy efficiency in China’s industrial sector, which accounts for 70% of the country’s total

energy demand. The industrial efficiency MOU was later signed by U.S. and Chinese officials during the Energy Policy Dialogue meeting in San Francisco in September. Under Michaela’s management, ORNL will be the lead laboratory on the industrial energy efficiency tasks under the MOU. Tasks include conducting energy assessments in Chinese industrial plants and training plant engineers on energy efficiency. Additional information on the MOU may be found in the DOE press release at www.energy.gov/news/5495.htm.

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Sponsor: DOE EERE Industrial Technologies Program

Delegation participants at the Agenda 21 Building in Beijing, China’s first LEED-certified facility. Left to right: Michaela Martin, Jim Quinn, Maria Rivera, Amy Chiang, John Mizroch, Yang Guoxiong (Director of the Chinese National Research Center for S&T Development), Mark Ginsberg, Alan Gagnet, Marco DiCapua, and Joe Huang.



Honors and Awards

Two Honored at Awards Night

Jeff Christian and Vinod Sikka were among the more than 90 ORNL staff members honored at the 2007 ORNL Awards Night celebration, held on November 16 in the Knoxville Convention Center.

Jeff received the Director's Award for Community Service, for his effective communication of building technologies research and development to the public. He was recognized "for sustained and extraordinary communication skills, and passionate, visionary advocacy of the Zero Energy Home concept."

Vinod received both the Inventor of the Year Award and the Director's Award for Outstanding Individual Accomplishment in Science and Technology, "for sound, commercially viable inventions in a broad field of materials development and processing."



Jeff Christian

Two Projects Funded by EERE and OE Win FLC Southeast Regional Awards

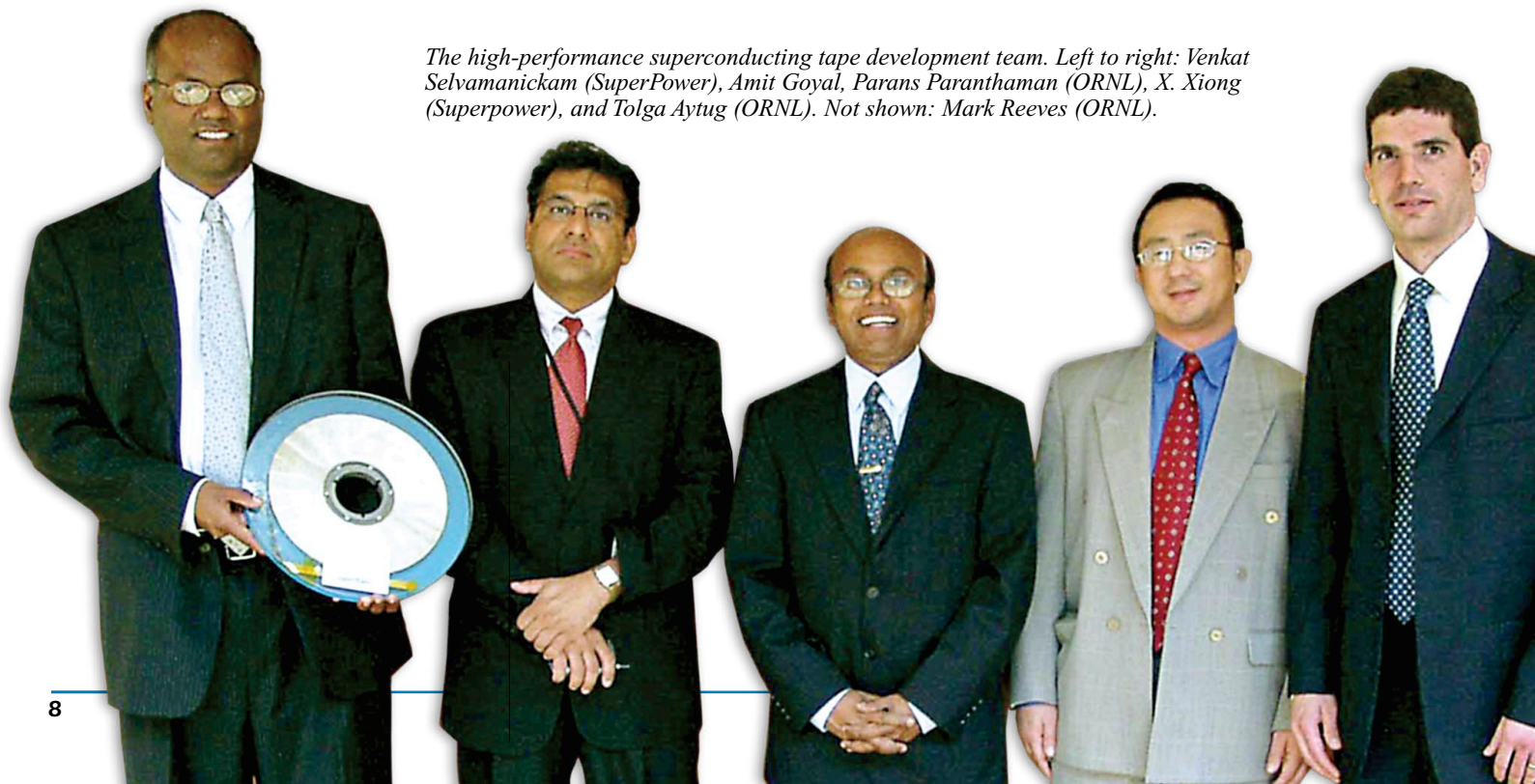
IC-221M cast nickel aluminide and lanthanum manganese oxide-enabled high-temperature superconducting tape were among the six 2007 FLC Southeast Regional Awards won by ORNL in 2007. Both technologies won an R&D 100 award in 2007.

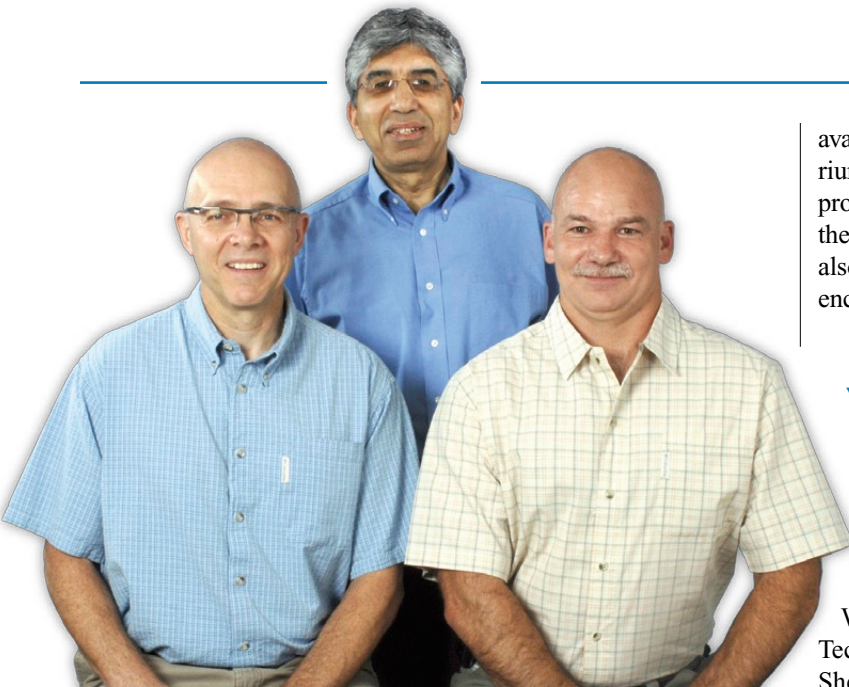
IC-221M cast nickel aluminide, which was developed and transferred to Duraloy Technologies by ORNL's Vinod Sikka, Michael Santella, Jeffery McNabb, and Ashok Choudhury, won project of the year. The alloy improves the operation of heat-treating furnaces used to make steel. It eliminates the need for frequent furnace shutdowns, provides significant savings in energy and cost, and reduces CO₂ emissions. Roman Pankiw of

Duraloy, independent consultant Anthony Martocci, and John Mengel of Mittal Steel shared in the award.

High-temperature superconducting tape is made to carry electricity with no resistance when cooled by liquid nitrogen. Intended as replacements for copper power cables through the power grid, cables based on the ORNL technology will carry more electricity much more efficiently and can be retrofitted to the standard underground transmission power grid infrastructure. The development and technology transfer team include Parans Paranthaman, Tolga Aytug, Amit Goyal, and Mark Reeves of ORNL, and Venkat Selvamanickam and X. Xiong, of SuperPower, Inc. The technology is licensed to SuperPower.

The high-performance superconducting tape development team. Left to right: Venkat Selvamanickam (SuperPower), Amit Goyal, Parans Paranthaman (ORNL), X. Xiong (Superpower), and Tolga Aytug (ORNL). Not shown: Mark Reeves (ORNL).





The ORNL IC-221M development team. Left to right: Michael Santella, Vinod Sikka, and Jeffery McNabb. Not shown: Ashok Choudhury.

available at ORNL. The results showed how the cells of a bacterium, *C. thermocellum*, responded to cellulose, consumed it, and produced ethanol and other products. In addition to pure cellulose, the impact of fermentation of mixed carbohydrate substrates has also been evaluated. This work continues in the BioEnergy Science Center as it is a perfect fit with its goals and mission.

YWCA Tribute to Women Award

Sharon Robinson (EERE) was the winner in the YWCA Knoxville Tribute to Women, Science and Technology category. She was honored at a gala ceremony in the Historic Bijou Theatre on August 23, 2007. Patti Garland (Engineering Science and Technology Division) was a finalist in the same category.



Patti Garland, left, and Sharon Robinson

Left to right: Babu Raman and Jonathan Mielenz with Jim Roberto, ORNL Deputy for Science and Technology. Not shown are team members Steven Brown, Patricia Lankford, Catherine McKeown, and Miguel Rodriguez, Jr. (Biosciences Division); Gregory Hurst (Chemical Sciences Division); and Chongle Pan and Nagiza Samatova (Computer Science and Mathematics Division).

"Pride of India" Gold Award

Amit Goyal has been honored with the "Pride of India" Gold award. Sponsored by the NRI Institute, the award recognizes people of Indian origin around the world for outstanding achievements in their chosen fields. It also recognizes their public service contributions toward the economic development of India and their country of residence. Award recipients are chosen

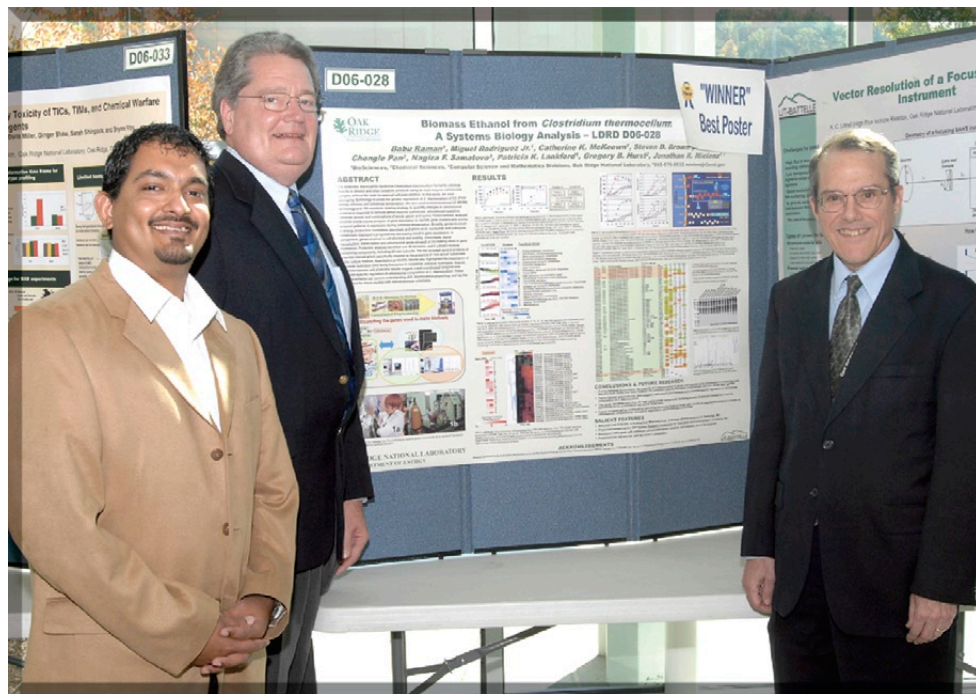


Amit Goyal

from leaders, pioneers, and professionals worldwide from the fields of technology, medicine, business management, law, creative arts, public service, and academia. Nonresident Indians or people of Indian origin who serve as an inspiration to their fellows and who are recognized as pioneers in their professions are selected.

Winning LDRD Poster Describes a Multidisciplinary Effort

Jonathan Mielenz (principal investigator) and Babu Raman, of the Biosciences Division, presented the winning poster at the 2007 Laboratory Directed Research and Development Poster Session. The research examined the biological process of fermentation of cellulose directly to ethanol using systems biology tools



Carbon Fibers continued from p.5

is used as the source of fuel and reducing agent for recovery of the pulping chemicals. Thus, although lignin is very abundant, relatively little of the lignin suitable for carbon fiber production is currently isolated from papermaking processes for the production of value-added chemicals for many applications, including transportation; furthermore, conventional papermaking processes may not be able to meet the long-term demand for lignin for large-scale use of carbon fiber in automotive composites.

Lignin is a by-product of the process in which ethanol is obtained from biomass. For example, switchgrass, a feedstock for ethanol production, has a lignin content that is similar to that of wood (15–25%). The biomass conversion process is expected to produce relatively high-purity lignin. It has been demonstrated at ORNL that biomass-derived lignins can readily be processed into carbon fiber. As biomass refineries come on-stream, the lignin by-product from cellulosic ethanol fuel production will represent a valuable resource material, and thus the cost of producing ethanol from biomass could be offset by production of lignin-based carbon fiber for increasing the fuel economy of vehicles.

Although the current research is focused on producing carbon fibers for lightweight composite materials for vehicles, other uses are also anticipated. In particular, the fibers could be “activated”; i.e., made porous and thus given a very large surface area. Then, for example, the activated carbon in conventional evaporative gasoline emission-control devices could be replaced with lignin-based activated-carbon fibers. Such devices could be more versatile than conventional devices. Because the fibers conduct electricity, an evaporative loss control device incorporating lignin-based activated carbon fibers would have the potential for “electrical swing adsorption” regeneration of the adsorbent, unlike conventional activated carbon adsorbents, which would benefit lean-burn engine technologies. The fibers may also be used in electrochemical capacitors for hybrid vehicles; certain activated carbon



ORNL's multifilament melt spinning equipment.

materials are known to exhibit very high energy and power densities in electrochemical capacitors, but their cost is too high for large-scale automotive use; activated carbon fibers produced from lignin have the potential for much lower cost. An activated carbon fiber filter may also be used one day to purify the hydrogen stream that powers hydrogen fuel cells; based on the principle of electrical swing adsorption, the filter would cause little parasitic loss of energy.

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More Than 1,200 University Students, Faculty at “Day of Science”



More than 1,200 students and faculty from 125 U.S. colleges and universities gathered at the Knoxville Convention Center in October for one of the largest DOE science education events ever held.

Hosted by DOE and ORNL, the sixth annual Day of Science presented speakers, exhibits, and other attractions to help top students, particularly those at historically black schools, pursue science careers. This year’s event, expanded to include all the DOE laboratories, had nearly three times the participants and exhibitors of any previous Day of Science. Nearly 70 different exhibits were on display.

“Day of Science creates a pipeline between DOE, the national laboratories, and U.S. colleges and universities for developing the nation’s scientific workforce,” said Jeff Pon, DOE’s chief human capital officer. “It also gives us a wonderful opportunity to meet and support America’s future scientific leaders.”

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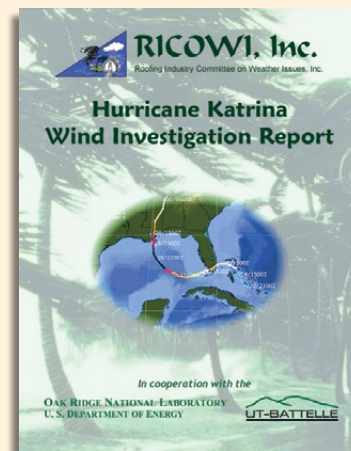
ORNL researcher Bill Miller demonstrates sloped roofs to visitors at the 2007 Day of Science.

COVER STORIES

Hurricane Chasers Survey Roof Damage

The Roofing Industry Committee on Wind Issues (RICOWI) recently published its report on wind damage to roofs from Hurricane Katrina. Six teams involving 25 RICOWI members hit the ground in September 2005 to inspect and document the condition of commercial, institutional, industrial, and residential roofing systems in the path of Hurricane Katrina. More than 82 roofs were inspected on buildings between Bay St. Louis and Pascagoula, Mississippi, and a few as far north as Hattiesburg, Mississippi.

The teams found that wind damage was much less dramatic than the storm surge damage. Roofs designed according to building codes and installed according to manufacturers' guidelines performed well. Lack of protection against wind uplift pressure at eaves and corners, and careless installation practices that led to progressive failure of the roof membrane, were consistently the causes of significant roof damage. For a copy of the Katrina report, see www.ricowi.com.



Wal-Mart Project Featured on Cover of ASHRAE Journal

Mike MacDonald's work with Wal-Mart earned him the cover article in the September 2007 issue of *ASHRAE Journal* (published by the American Society of Heating, Refrigerating, and Air Conditioning Engineers). Mike was the lead author of "The Wal-Mart Experience, Part One." His co-author was Michael Deru, of the National Renewable Energy Laboratory (NREL). The research took place in experimental Wal-Mart stores in McKinney, Texas (conducted by ORNL) and in Aurora, Colorado (conducted by NREL). In 2005, Wal-Mart opened these two experimental stores with the hope that lessons learned would allow important improvements in new store prototypes.

Part One of the article describes the results of refrigeration; cogeneration; and heating, ventilating and air conditioning (HVAC) experiments. Part Two, which was published in the October issue, discusses lighting and renewable energy experiments taking place in the two stores. Wal-Mart applied the lessons learned from the experimental stores to the design of two new "high-efficiency" stores that opened in 2007, the first in Kansas City, Missouri, and the second in Rockton, Illinois.



"Some of the students participating in this event will be making the important scientific discoveries of tomorrow," ORNL Director Thom Mason said. "ORNL is proud to be a major partner in encouraging them to pursue science careers." Gen. Lester Lyles, retired commander of the Air Force Materiel Command at Wright-Patterson Air Force Base, Ohio, delivered the keynote address, titled "Science and Technology Opportunities—The Perspectives of a Technology Leader."

Sessions on science and technology at DOE laboratories featured presentations on X-ray analysis of historical documents, nanoscience, green energy, the International Thermonuclear Experimental Reactor (ITER) fusion project, and astrophysics. The program also included a career fair, interactive exhibits, networking opportunities, and a Cyber-Café for Internet access (provided by Dell Inc.). Workshops were held for partnering with DOE laboratories; for grants, internships, employment, and subcontracts; and for other opportunities.

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Sponsor: DOE

CALENDAR



2008 IEEE PES Transmission and Distribution Conference and Exposition

Registration is now open for the 2008 IEEE PES Transmission and Distribution Conference and Exposition. Those who register before March 21 will receive a discounted rate. The conference will be held on April 21–24, in Chicago's McCormick Place conference facility. ORNL-OE will be exhibiting at the exposition.

This year's theme is "Powering Toward the Future." The goal is to provide attendees with information on practical, solution-oriented topics, including case studies and lessons learned. The technical program is designed to examine the methods and procedures for operating and maintaining power-delivery systems at peak levels in the future.

Information and registration: www.ieeet-d.org/

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News Briefs



President of Alliance to Save Energy Visits ORNL

On October 23, 2007, ORNL hosted Kateri Callahan, president of the Alliance to Save Energy, for a kick-off of the “Year of Energy Efficiency” seminar series.

Jeff Christian briefs Kateri Callahan on near-zero-energy homes.

Ms. Callahan presented a seminar entitled “Discovering New Energy Resources: The Global Drive to Energy Efficiency.” She was presented with an overview of research in the areas of Building Technologies, Industrial Technologies, and Transportation and was given a tour of the National Transportation Research Center and the near-zero-energy homes in a Habitat for Humanity subdivision.

ORNL BestPractices Team Releases 2006 “Save Energy Now” Report

ORNL’s Anthony Wright and Michaela Martin, along with Bob Gemmer, Paul Scheihing, and James Quinn from DOE, completed the report, *Results from the U.S. DOE 2006 Save Energy Now Initiative: DOE’s Partnership with U.S. Industry to Reduce Energy Consumption, Energy Costs, and Carbon Dioxide Emissions*, on September 17, 2007, for the Industrial Technology Program’s Save Energy Now Initiative. The report summarizes the results of 200 steam and process heating assessments, which identify the potential for more than 50 trillion Btu in natural gas savings, energy cost savings of about \$500 million, and CO₂ emissions reductions of 4.04 million metric tons annually. An additional 250 assessments in large U.S. industrial plants are planned for 2007 and will also address pumping, compressed air, and fan systems.

The report is available at www.eere.energy.gov/industry/saveenergynow/partners/pdfs/sena_2006_report_final_09_17_07.pdf

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