WESTERN COOLING CONNECTION

Energy Efficiency Forum

Read about our successful and informative forum with manufacturers and stakeholders for both HVAC and lighting.

Current Project Updates

Read about a selection of projects currently being worked on.

PROJECT SPOTLIGHT: Behavioral Research Initiative

An introduction to WCEC's research into how we all interact with HVAC equipment, why and how this research can influence efficiency

NEW ARTICLE: 'This Old House' loves UC Davis Professor's leak-stoppers

Read about the success of an Aerosol sealant technology developed by our very own director, Mark Modera

2011 | Q4

WCEC
WESTERN COOLING EFFICIENCY CENTER

A Word from the Director

Growth at the Center: Broadening Our Reach

WCEC is growing in size and influence. We are in talks with SWEEP (Southwest Energy Efficiency Project), a public interest organization promoting greater energy efficiency in Arizona, Colorado, Nevada, New Mexico, Utah, and Wyoming. Together, with SWEEP's broad reach to 6 other hot-dry states, we will collaborate with their corresponding utilities to bring our technical expertise in HVAC energy efficiency, and our efficiency initiatives (e.g. Western Cooling Challenge) to a much larger user base. Our potential partnership with SWEEP could also have a larger, more lasting impact on energy efficiency in the greater United States.

Growth at the Center: Broadening Our Scope

Water-cooled condensers, indirect evaporative pre-cooling, variable speed fans, and building/duct sealing are all great examples of device-level energy efficiency technologies that are significantly reducing energy use and peak demand, but device-level energy efficiency is only a part of the larger energy-use equation. The average user of these systems does not interact with the technologies directly; they most commonly use some type of energy display or thermostat to express their heating and cooling needs. WCEC recognizes this interaction as a potential for energy savings if the users of these displays are actively using the displayed information to make energy-saving decisions. To determine how or why energy users interact with their thermostats and energy displays, the Center added a Behavioral Scientist to our staff to further study these issues and ultimately, to help produce solutions that will promote better energy efficiency at the interface level.

Western Cooling Challenge Adds More Entrants

The Western Cooling Challenge (WCC) continues to make headway as the Hot-Dry-Climate RTU challenge. The popularity and importance of the challenge is growing, as is the competition, with new entrants, including TRANE and potentially Munters. We look forward to testing these units to see if they can meet the challenge benchmarks and thus, earn the honor of being WCC Certified.

WCEC has some exciting updates to our current projects and some new additions. Clearly, not every project is covered in this Newsletter, though we will highlight some newsworthy activities:

- Energy Efficiency Forum: Retrofitting Corporate Campuses
- Current Project Updates
- Project Spotlight: HVAC Behavioral Research Initiative
- Aeroseal Recognized on the DOE Website and This Old House

Mark Modera, *Director*
mpmodera@ucdavis.edu

WCEC is an element of the Energy Efficiency Center at the University of California, Davis, with a mission to "partner with stakeholders to identify technologies, conduct research and development, disseminate information, and facilitate programs that reduce cooling system electrical demand and energy consumption in the Western United States."

WCEC Affiliates

Beutler
Carrier
Coolerado
Davis Energy Group
Integrated Comfort
Lennox
Munters
Novatorque
Octus Energy
Pacific Gas and Electric
Seeley
Sempra Energy
Southern California Edison
Speakman
Target
Trane
United Metal Products
Uponor
Viega
Walmart
Sacramento Municipal Utility District
California Energy Commission

WCEC Research Partners

National Renewable Energy Laboratory
New Buildings Institute
Lawrence Berkeley National Laboratory
Gas Technology Institute
Pacific Northwest National Laboratory
Oak Ridge National Laboratory
California Institute for Energy and Environment
Consol Energy

Personnel Updates

The WCEC would like to welcome some new faces:

Claudia Barriga

Claudia Barriga is the WCEC's Behavioral Research Associate. In collaboration with Kristin Heinemeier, she is in charge of leading and coordinating the center's new Behavioral Research Initiative. She is responsible for social science research that looks at people's motivations, goals, and values as they impact their behavior and choices on energy consumption and use of HVAC systems. Claudia is currently leading a project to look at the behavior of homeowners and small-business owners on HVAC maintenance decision-making processes.

Caton Mande

Caton Mande earned his B.S. in Biomedical Engineering from the University of California, Davis. Previously, Caton Mande Tutored Math and Chemistry at the College of the Siskiyous. Today Caton works to refine the WicKool project by researching other viable media and innovative ways to secure it. Caton is also working with Will Allen and Jonathan Woolley on data acquisition for both the Radiant Cooling project and Western Cooling Challenge equipment.

Perry Young

Perry Young is an assistant development engineer with a BS in Mechanical Engineering from the Rochester Institute of Technology. At the Rochester Institute of Technology, she researched the effect of surface roughness on heat transfer and pressure drop in micro-channels. After graduation, she worked at Aurora Algae, Inc as an R&D test engineer researching fluid dynamics of the algae growth ponds. Perry joined WCEC in July 2011 and is working on analyzing pre-evaporative coolers for the RTU retrofit project.

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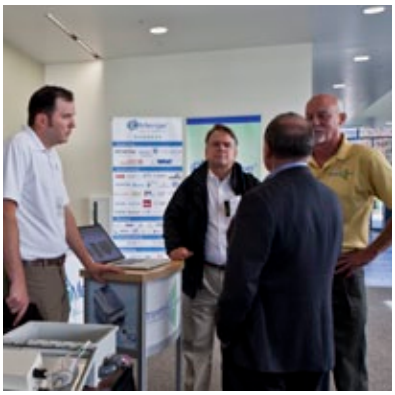
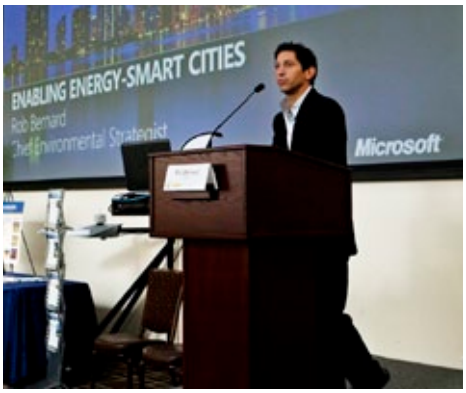
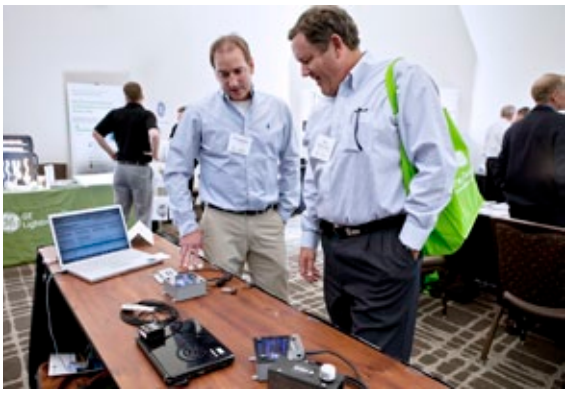
Please let us know at **wcec@ucdavis.edu** *if you would like to be added to or removed from our mailing list.*

UC DAVIS
ENERGY EFFICIENCY FORUM

Retrofitting Corporate Campuses Nov. 8th & 9th







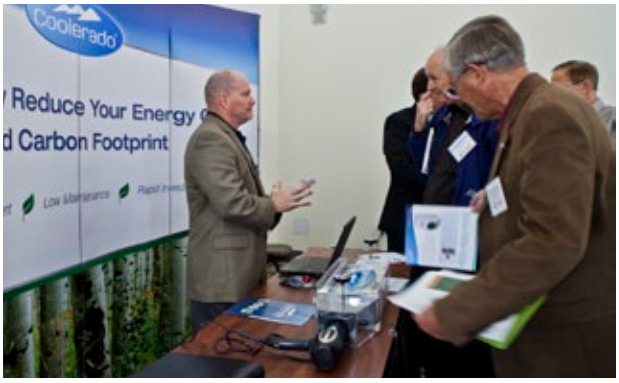
(Taken from the California Lighting Technology Center's website)

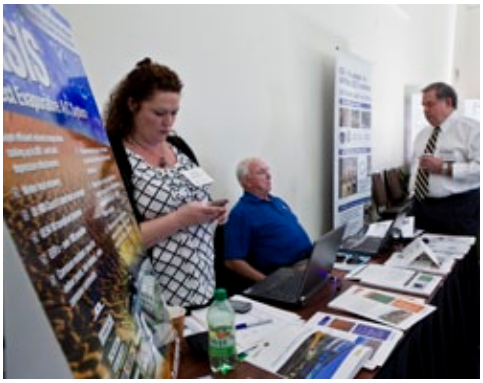
The UC Davis Energy Efficiency Centers hosted a two-day forum on "Retrofitting Corporate Campuses," November 8 and 9 at the UC Davis Conference Center. Over 200 attendees, including facility managers, policy makers, manufacturers, and researchers, gathered to share ideas and retrofit success stories, and to begin implementing strategies and facility upgrades.

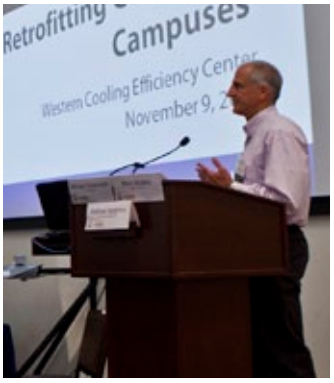
Microsoft Chief Environmental Strategist Rob Bernard was among the keynote speakers. He urged those at the forum to "keep pushing, keep pushing, keep pushing" for a wider embrace of deeper energy efficiency measures. "Our biggest challenge is cultural," said Bernard. "It isn't the technological infrastructure."

Microsoft has reduced its data centers' energy consumption by 50 percent in the past three years, implemented a system to monitor and adjust its energy consumption, and achieved many other efficiency goals. Bernard shared those strategies and urged companies to set high goals for energy savings. "Five percent is not where we need to be. We need to be at 90 or 99 percent."

Leading the way, representatives from companies already achieving deep energy savings through retrofits—including net-zero, or nearly-net-zero, operations—shared their strategies and experience.

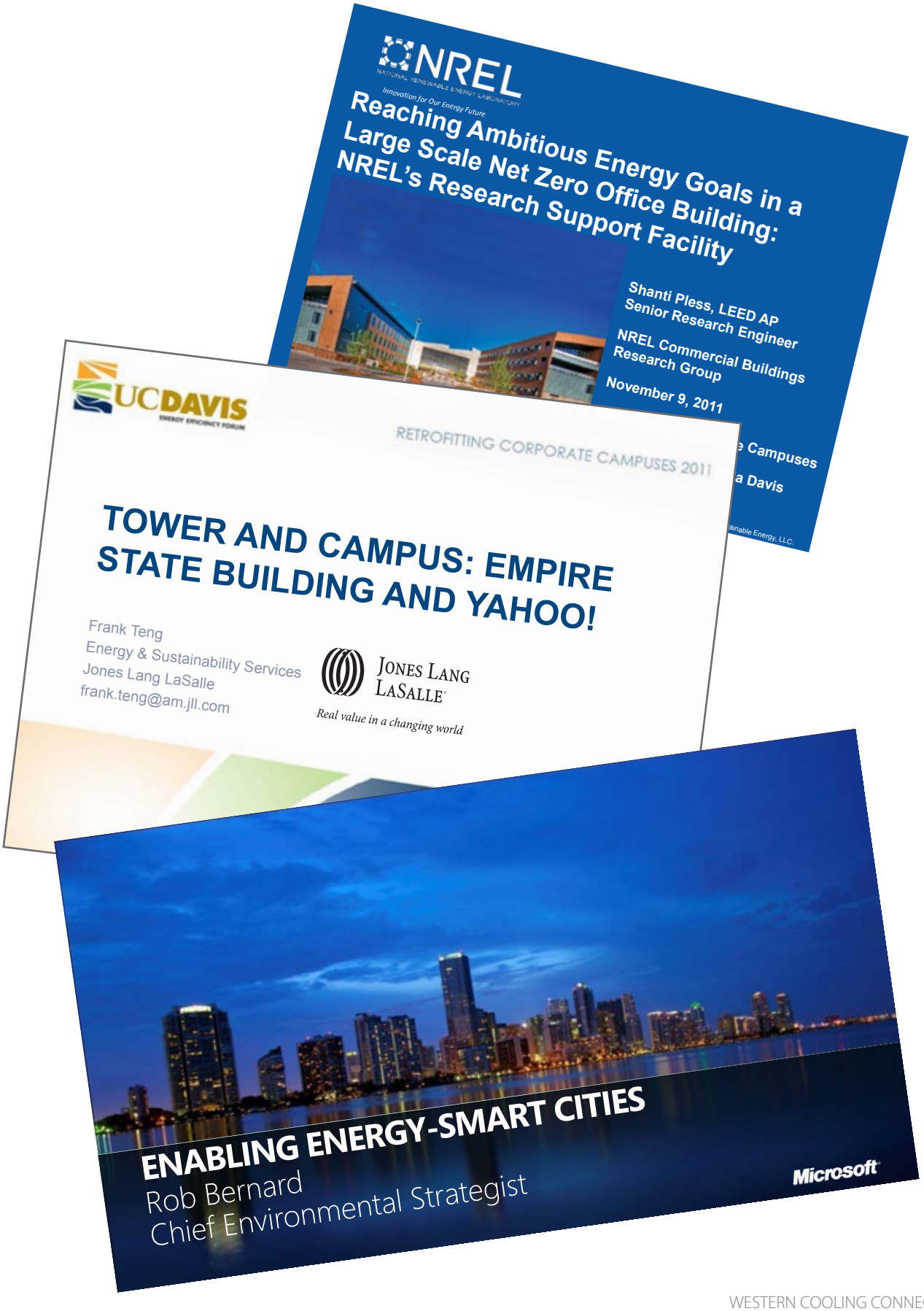






Download the presentations: wcec.ucdavis.edu

UC DAVIS ENERGY EFFICIENCY FORUM



Current Project Updates

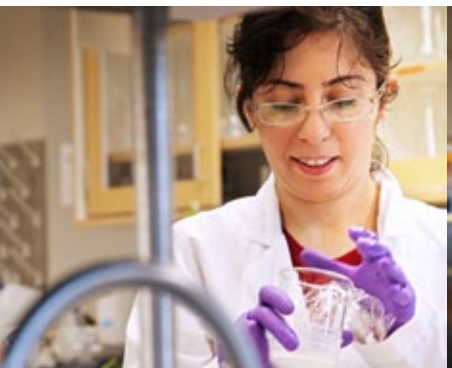
(Only a partial list of projects currently being researched. Check wcec.ucdavis.edu for more information on other concurrent projects)

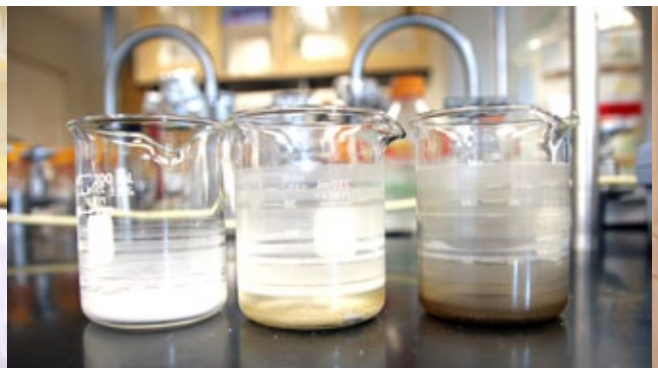
Graywater Re-Use Update

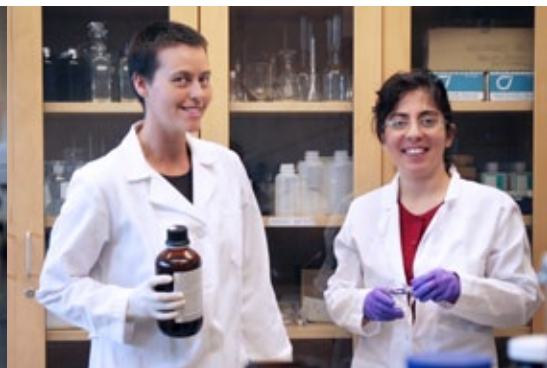
Using gray water for evaporative, or hybrid evaporative cooling has a significant potential to reduce energy use in hot and dry climates. However, since water is continuously evaporated when used in cooling applications, the water quantity and quality pose major concerns. This project focuses on how to approach graywater reuse in California while adhering to applicable public health and safety regulations, including California's Title 22 and 24 Standards. To achieve this, a high efficiency washer machine and dryer were acquired to ensure a reliable graywater supply with semi-controllable contaminant/nutrient loading and storage time control. Graywater effluent was generated and tested for constituents that would impact sizing, design and material selection of a treatment system.

Analysis of washer effluent showed that, the water quality analyses were within the range reported in many other studies for graywater generated from laundering but trended toward greater concentration loading than was found in earlier studies, as was expected from a high efficiency washing machine. A full gravimetric analysis was done on graywater samples to determine size distribution and characterization of solids. Chemical oxygen demand analysis did not show significant differences between four types of detergents used, however liquid plant based detergent samples showed putrescibility within a few days, which may indicate potentially higher contaminant removal potential by biological oxidation.

The biological oxidation process will be built and tested in the near future. Construction and testing materials lists are being made for the construction of two parallel intermittent media filter columns for comparison. One will be filled with fine sand and the other with fine granulated activated carbon (GAC).







Residential Radiant Cooling Field Testing

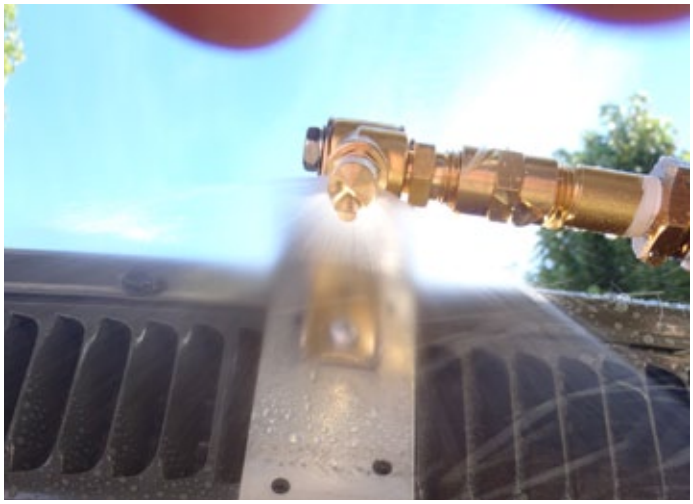
Our off peak residential radiant cooling/heating project has reached the field test stage, with installation and commissioning taking place in September and October. Two systems have been installed using identical chilled water storage tanks and condenser units, but with different radiant components. One of the test systems uses custom built aluminum faced panels, with PEX tubing sandwiched between the aluminum and an insulating backing, mounted directly to the existing ceiling, designed to be used in retrofit applications. The other test system uses a drywall panel with PEX tubing embedded in the drywall and a layer of EPS insulation above. This design is best suited to use in new build houses where it would be installed instead of the standard drywall ceiling.

The retrofit panels are designed to be installed with minimal disruption and need for finish work. As such they are, necessarily, visible.

The drywall panels (shown here prior to finishing) cover the whole ceiling, with areas where no active panels are needed being filled in with regular drywall.

Direct Water-Sprayed Condenser Units

We are seeking to quantify the improvement of Daikin's "EneCut" retrofit on a traditional split system condenser with R-410 as compared to baseline operation. EneCut sprays water directly on the coils which, when evaporated, helps to cool the condensing coils faster than by just conventional methods. It has a variable duty cycle that is linked to outdoor air temperature. When it is cold outside it does not spray, when it is warm it sprays intermittently, when it is hot it sprays continuously.

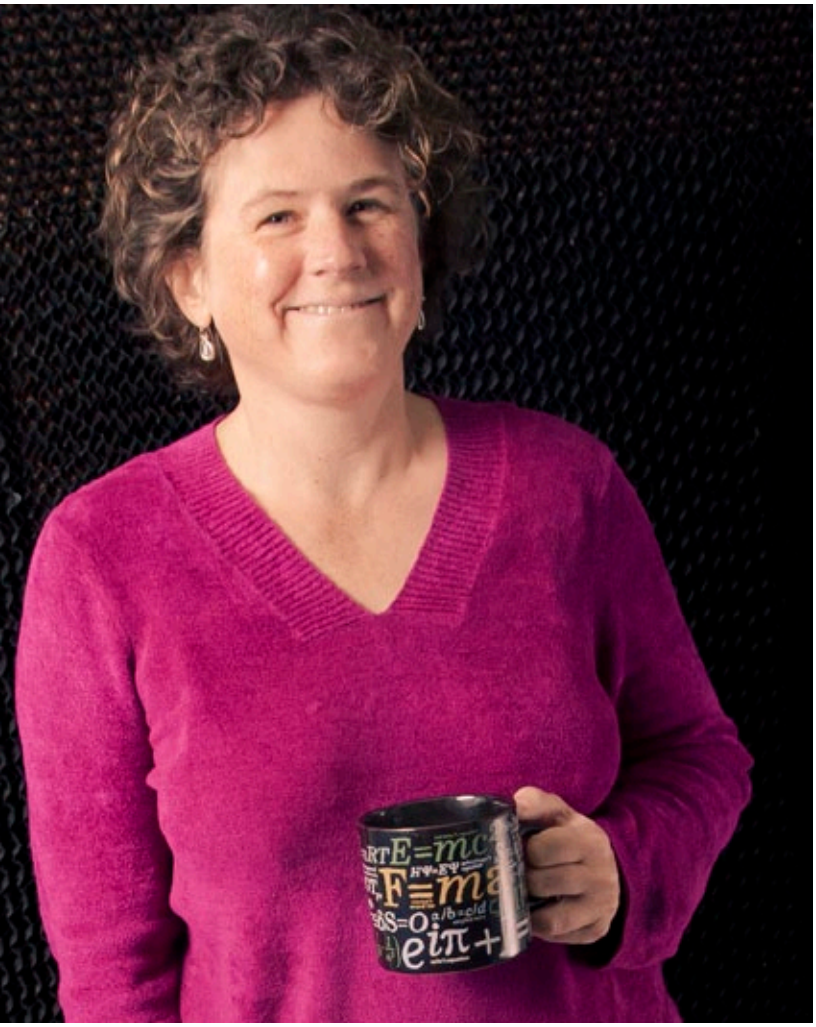


We are using hot water as a load. The refrigerant from the condenser is being piped through a chiller coil, and the refrigerant is being boiled by the hot water. The capacity is quantified by measuring the change in the water temperature and the water flow rate. Power consumption is also quantified. From these we can calculate COP and determine this system's overall efficiency compared to a traditional condensing unit.

We have made this experimental rig on a cart to facilitate us moving, or whatever the future may bring. We ran out of hot weather, and will continue in the spring.

Project Spotlight:

HVAC Behavioral Research Initiative



Kristin Heinemeier, project lead

The Western Cooling Efficiency Center focuses on the technologies that will be needed to achieve significant reductions in cooling energy and demand use in hot/dry climates. There is clearly a great deal of work to do on the fundamental physics and engineering behind these technologies. However, it is clear that no matter how advanced a technology is, it will not be successful and it will not save energy unless it accommodates the individual and organizational behavior of the people that choose and use the technology. The need to directly address the complex interaction between people and energy efficient technologies is being increasingly acknowledged at a national level. The ACEEE Summer Study on Energy Efficiency in Buildings has long held a "Human Factors" panel, and the Behavior, Energy and Climate Change Conference (BECC) was organized as a one-time event in 2007, but generated so much interest that it has become an annual well-attended conference.

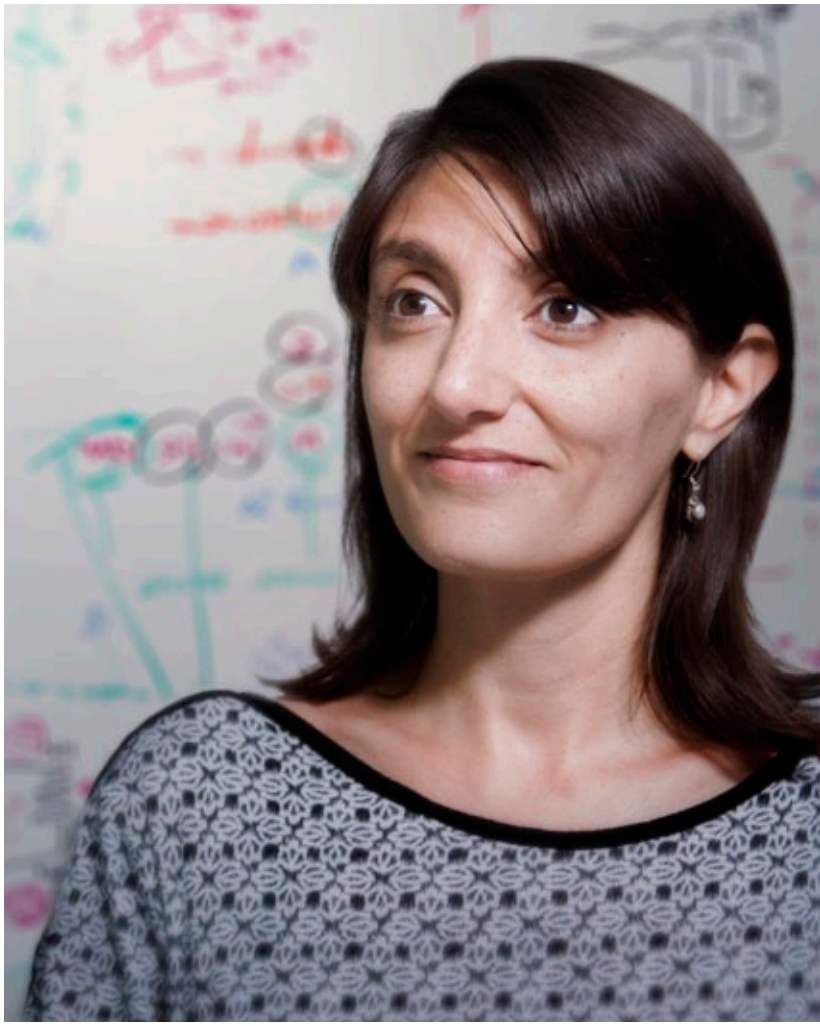
The HVAC Behavioral Research Initiative is the WCEC's response to this need, specifically as it relates to the way in which individuals and organizations perceive, choose and use efficient cooling technologies. To address this challenge, the center has assembled an interdisciplinary team of researchers with expertise in Social Psychology of Communication, Sociology, Energy Policy, Engineering, Transportation Studies, Community Development, Human Comfort, Real Estate, Market Research and HVAC Sales. The broad scope of the team's expertise will allow us, in the long run, to address not only the behavior of the "members of the general public" as consumers of cooling technologies, but of the complex human systems involved in the diffusion and adoption of efficient cooling systems. Human behavior is part of the process at every step of the way, and the Behavioral Initiative will eventually include research on residential and commercial area consumers, HVAC contractors and technicians, HVAC sales agents, energy management consultants, facility managers, trade organizations, and others who have a say in making decisions about HVAC technologies.

Ongoing Projects

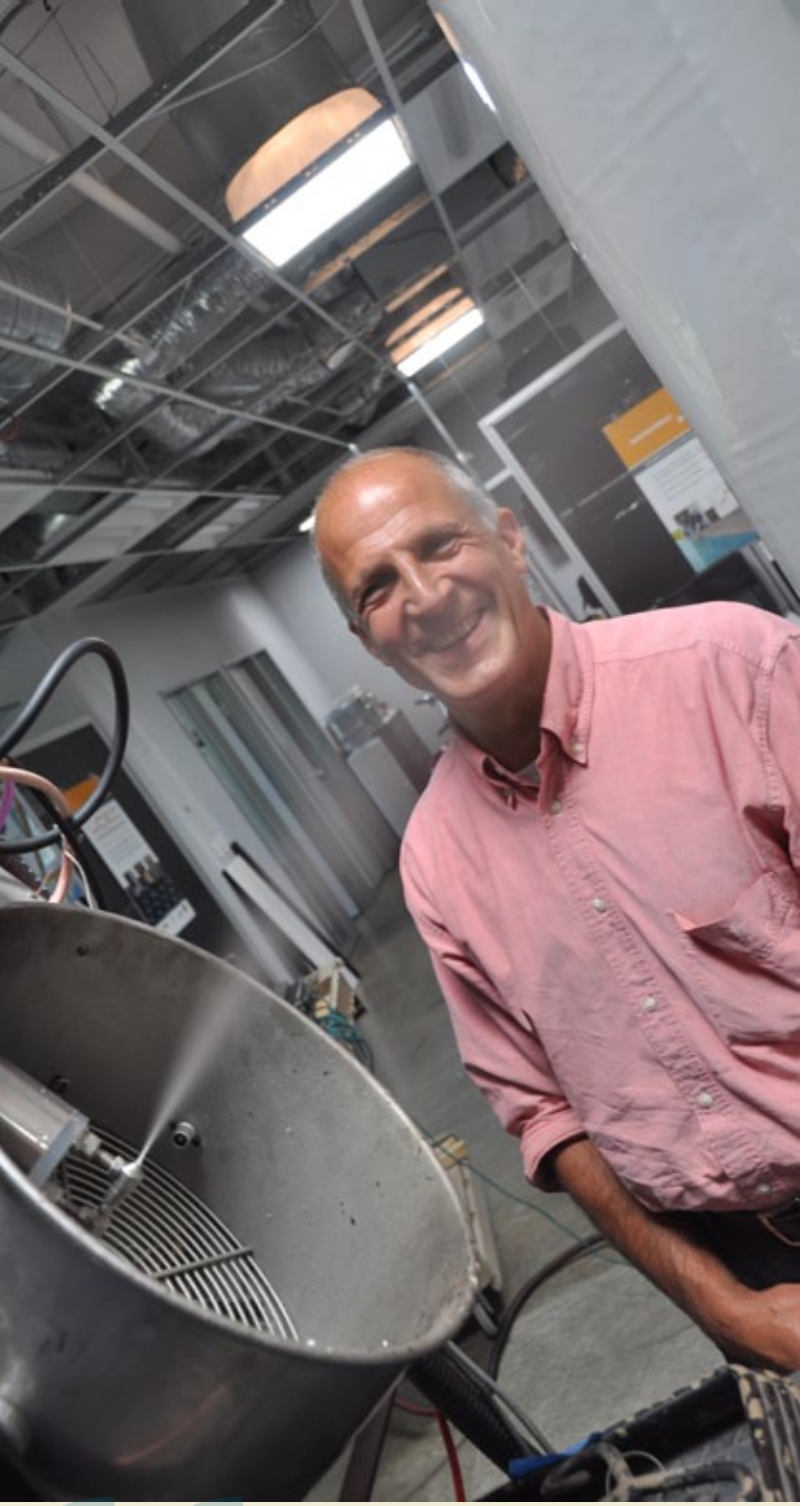
In order to achieve our long term goals, the Behavioral Research Initiative will develop a Roadmap for Research on the Impacts of Human and Institutional Behavior on HVAC Performance, which will include a review of current and past research in the area, a discussion of gaps in our understanding of behavioral impacts, a prioritized list of research questions and an action plan to address them through our studies.

It is not all in the future, though. The WCEC Behavioral Research Area is already active in 4 studies:

- The Understanding Maintenance Behavior in Residential and Light Commercial End Users project examines the values and beliefs that lead end users to regularly maintain their cooling equipment, and explores what role energy efficiency benefits play when they make maintenance decisions.
- The Understanding Contractor and Technician Behavior project, conducted in collaboration with consultants from Energy Marketing Innovations, takes a look at the way in which contractors and technicians conduct maintenance visits. Field observations of "technicians at work" will allow us to see how they discuss HVAC technologies with customers and how they make decisions about services to be offered and performed.
- The Low-Energy (Evaporative) Cooling study, in which we collaborate with UC Berkeley's Center for the Built Environment and Fisher Center for Real Estate and Urban Economics, will evaluate barriers and opportunities for the adoption of low energy cooling technologies in the hot-dry areas of California.
- Finally, the Lab and Field Usability of In Home Energy Displays project will test whether users of IHEDs can effectively use these devices to understand and control their energy usage. The study includes an evaluation of IHEDs available in the market, a lab testing of their usability, and a field observation of the ways in which the devices are used in a community with goals of energy efficiency.



Claudia Barriga, Behavioral Research Scientist



Using the concept of aerosol particles has a lot of other potential applications, such as sealing building envelopes and other components, shipping containers and even underground pipelines.

—Mark Modera, WCEC Director

'This Old House' loves UC Davis Professor's leak-stoppers

While studying building ventilation systems in the 1980's as a Staff Scientist, Mark Modera discovered that a great deal of heated and cooled air was escaping before it reached its destination, wasting billions of dollars and raising carbon emissions unnecessarily.
"I noticed that every time the air conditioner would kick on, the air change rate in the building would triple. I suspected that leaks in the ductwork were causing all that excess airflow," said Modera, now director of the Western Cooling Efficiency Center at UC Davis, and a Professor in the Civil/Environmental and Mechanical/Aerospace Engineering departments.

For several years, Modera looked at a variety of solutions, including methods used to repair underground sewer pipes and small robots that repair gas lines. "The 'Aha!' moment came when I found a small company that sprayed an aerosolized product into a duct to kill dust mites," he said.

Many iterations later, Aeroseal was born, and it's commercial incarnation, "Aeroseal", was just named one of the Top 100 Best New Products by This Old House magazine – and the No.1 product in the home technology category.

Aeroseal was chosen because of its proven impact on home energy savings and comfort, said Thomas Baker, the magazine's building technology editor. "I've been watching the development of the Aeroseal technology and eagerly awaiting its general availability," he said. "Leaky air ducts are responsible for a huge energy loss problem in America, and having the Aeroseal solution made available for the first time to many home owners is very exciting to see." (Read more: http://www.prweb.com/releases/2011/10/prweb8906113.htm)

How Aeroseal works

Aeroseal quickly repairs almost 100% of leaks in ducts that are otherwise inaccessible without significant building renovation. The installation begins with pressurizing the duct network with a calibrated-flow fan. Once the ducts are pressurized, the technician injects a suspended aerosolized adhesive that moves only where the momentum of aerosol particles accelerates through leaks in the ducts. This system works with such precision that the interior duct walls do not get needlessly coated with adhesive. The adhesive nucleates on the edges of a leak and builds a seal that blocks air flow.

The result is a fast, non-invasive method to seal inefficient air ducts, helping reduce energy costs due to over-burdened air-handlers and infiltration of unwanted hot or cool air into the ducts and the building.

The Future of Aerosol Based Sealing

Today, the UC Davis Western Cooling Efficiency Center, under Mark Modera's direction, is researching other vital uses for aerosol-based sealant applications similar to Aeroseal.

"Using the concept of aerosol particles has a lot of other potential applications, such as sealing building envelopes and other components, shipping containers and even underground pipelines," says Modera.

Initial tests of aerosol sealants in building envelopes were limited to small-scale testing with an 8-foot-tall box just to see if aerosol particles could do the sealing and how long it would take to seal leaks in a large open environment. "The box leaks actually sealed much faster than we anticipated," says Curtis Harrington, the Western Cooling Efficiency Center lead engineer on the project "It only took about 5 minutes to fully seal the enclosure with a total of 41 square inches of leak area."

Harrington said tests on an actual building envelope are planned soon. "We are working with CONSOL (a building energy consulting firm in Stockton) and Habitat for Humanity to test the process in a home before the end of the year."

Energy Dept. features Aeroseal

Here's how the U.S. Energy Department describes Aeroseal on its website:

Who knew air leaks could be costing Americans $5 billion every year? Typical air duct systems, both residential and commercial, typically lose 25-40 percent of heating and cooling energy, accounting for billions added to utility bills.

But what if there was a simple mist that could seal thousands of leaks in 4 to 8 hours, saving a home owner, on average, $600 to $850 a year on his or her heating and cooling costs?

Thanks to a breakthrough technology developed at the Energy Department's Lawrence Berkeley National Lab, such technology exists. Aeroseal LLC, a start-up that licensed the technology, has now made the technology available to thousands of home owners and business owners concerned with high utility bills and sustainable living.

(Read more: http://energy.gov/articles/breakthrough-berkeley-mist-sealant-technology-potential-save-americans-5-billion-year)