

WESTERN COOLING CONNECTION

WESTERN COOLING CHALLENGE

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LETTER FROM THE DIRECTOR

Affiliates Forum and Steering Committee: Focusing WCEC's Work to a More Sustainable Future

The WCEC's Affiliates Forum on May 1st brought together a diverse audience of industry stakeholders, including: governmental policy makers, HVAC manufacturers, Utilities and Contractors. The focus of the Forum was to explore barriers and find solutions for HVAC energy efficiency acceptance in the marketplace. I would like to personally thank all those who participated in the event; your contributions help to shape WCEC's future research, and further the over-arching goal of moving towards a more energy efficient future. The day after the Forum, WCEC's Steering Committee met to discuss the future of our research and help prioritize projects according to energy efficiency impact and the strengths of the center.

Western Cooling Challenge Developments

Warmer weather is coming, and with it, WCEC's continued applied research through Western Cooling Challenge Demonstrations and many other ongoing projects. Our featured article for July highlights the many new milestones for the Challenge and details the new challengers entering the field.

WCEC Preparing to Move

The WCEC is slated to move into West Village in the fall and will have a new, 2,000 square foot laboratory that is more than 4 times the size of our current lab. In the new lab we will be able to test a multitude of HVAC products with up to 5-ton cooling capacity. It will allow fine tuning of temperature, air flow, and humidity to accurately mimic the conditions need to determine seasonal and peak-demand performance.

WCEC in the News

WCEC will be featured in the July issue of Energy Design Update. This monthly newsletter on Energy-Efficient Housing focuses on WCEC's efforts in aerosolized sealants for building envelopes. We will update our website when the article officially launches.

In This Issue

WCEC has some exciting updates to our current projects and some new additions. Please note, we cannot cover every project in each Newsletter:

- > Featured article: Western Cooling Challenge
- > WCEC Affiliates Forum
- > Latest Projects and Updates
- > WCEC Outreach efforts timeline and notable visitors



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

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:



Peter Breyfogle

Peter Breyfogle holds a B.S. degree in Mechanical Engineering from UC Davis along with a B.A. degree in Environmental Studies & Biology from the UC Santa Cruz. He primarily assists with conducting laboratory research into evaporative cooling technologies and effective water treatments.



Laura Flynn

Laura Flynn is a Graduate Student Researcher working on a Masters in Community Development. She holds a B.A. in Community Studies and Politics from UC Santa Cruz. Prior to joining WCEC, she worked with the Department of Energy's Weatherization Assistance Program (DOE WAP), which provides energy efficiency retrofits to the low-income community. She helped implement over 2.6 million dollars in funding from the American Recovery and Reinvestment Act of 2009, which led to over 500 retrofits in Northern California. At the WCEC, she works on the Behavioral Research Initiative that looks at people's motivations, goals and values as they impact their behavior and choices on energy consumption and use of HVAC systems. She is also collaborating in a project to examine the usability of In-Home Energy Displays and the impact of attitudes and other social and psychological constructs on residential energy use and response to energy use feedback.



Chloe Villarreal

Chloe Villarreal is a Sociology student at UC Davis. She is interested in studying the social determinants of health and illness, with a focus on the impact of access to education and community resources on public health. Her other interests include social stratification, gender, and ethnic studies. Chloe is also a busy mother of two school-age children and enjoys writing on current politics and issues of equality in her spare time.

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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.

WESTERN COOLING EFFICIENCY CENTER AFFILIATES FORUM MAY 1, 2012



WCEC Affiliates Forum 2012: Exploring the barriers and solutions for HVAC energy efficiency acceptance. This successful event brought professionals from all corners of the HVAC industry to examine the issues of HVAC energy efficiency acceptance. The Forum gave voice to specific stakeholders to explain and evaluate what barriers they, and their industry face and what we collectively can do to help them.

WCEC shared with the affiliates the status of the Center, including research project technical updates, proposed projects, and funding status. All presentations are available at: <http://wcec.ucdavis.edu/2012/03/16/wcec-affiliates-forum-information-page/>





**WESTERN
COOLING CHALLENGE:
HIGHLIGHTS FROM THE LAB & THE FIELD**

Highlights from the Lab

Intertek-Plano, TX

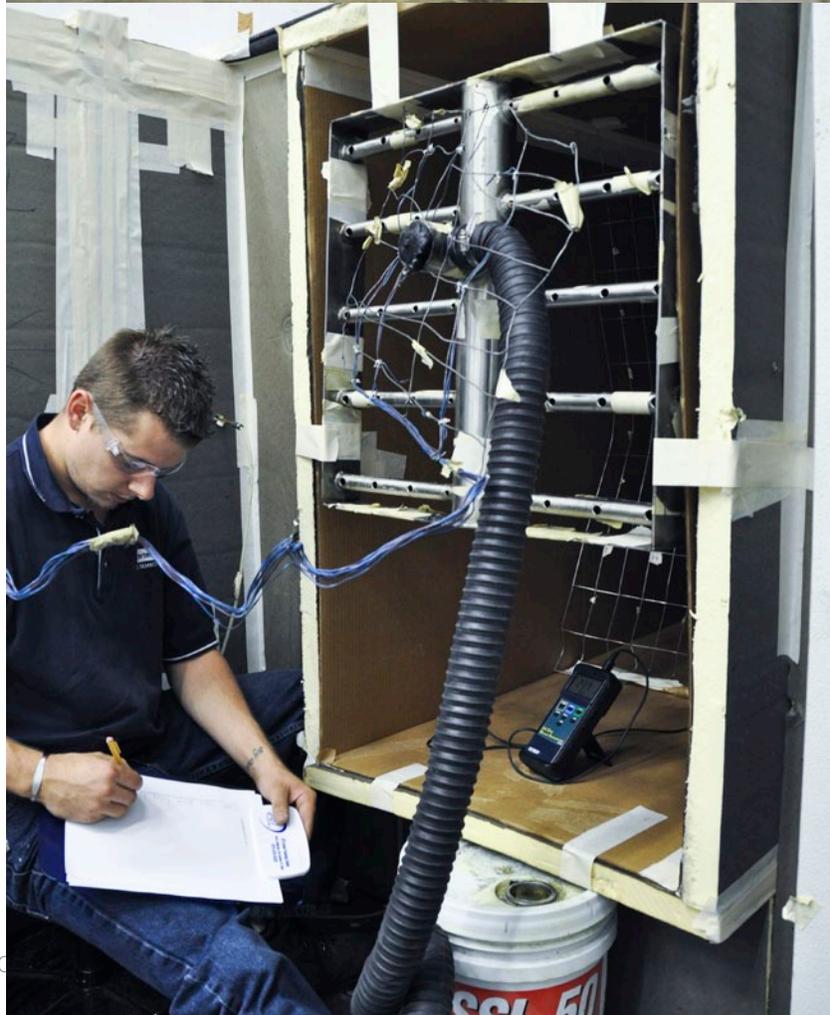
While laboratory testing may not always be indicative of how a technology will operate in the field, it does offer a solid and consistent mechanism to compare performance trends between products. However, testing protocols can significantly impact the laboratory characterization of a technology. Typical ANSI/AHRI 340/360 test procedures for rooftop air conditioners cannot be applied to measure hybrid cooling equipment utilizing indirect evaporative cooling that capture significant savings from ventilation air cooling. The Western Cooling Challenge provides a method to compare these new technologies against conventional alternatives operating at typical hot-dry climate conditions:

Preliminary results from laboratory testing of the Trane Voyager DC show the system draws 42% less power while operating at full load under peak design conditions of 105db/73wb. Laboratory testing is not yet complete, but it is clear that Trane's entry to the Western Cooling Challenge is a promising technology, and certainly fits the California Public Utility Commissions vision for climate-appropriate commercial HVAC equipment.

Laboratory testing the 23-ton Trane Voyager DC has proven to be a heroic technical challenge. Testing smaller equipment for the Challenge has previously been handled at National Renewable Energy Laboratory's thermal test facility, but we are not aware of an environmental chamber that is capable of removing adequate moisture to test a 12,000 cfm evaporatively cooled condenser. WCEC is collaborating with Intertek to work around this challenge, and has implemented a number of temporary renovations for Intertek's largest environmental chamber in Plano, TX to reach the appropriate psychrometric conditions prescribed by the Western Cooling Challenge. The effort has been successful so far, but underscores the need for a full-scale environmental test facility designed to evaluate evaporative equipment in arid climate conditions.

Highlights from the Field

WCEC has partnered with Southern California Edison, Pacific Gas & Electric and a range of equipment manufacturers to field test the performance of several different hybrid rooftop air conditioners. These demonstrations will serve to characterize system performance across a wide range of field applications, and will offer our manufacturing partners heuristic insight into any product improvements needed for broad scale field deployment. Our utility partners want to move these products toward rebate programs, and will rely



on WCEC's field performance reports to justify future financial incentives.

WCEC's 2012 field evaluations span much of California, and include several building types. Manufacturers in the Western Cooling Challenge spotlight include Coolerado, Trane, Seeley, Munters, Daikin-McQuay, and AirMax. Ultimately, the detailed field performance from monitoring each of these systems will inform a unified benchmarking report that compares these products' price and performance against conventional alternatives. A partial list of the Western Cooling Challenge field efforts underway in 2012 includes:

- » In collaboration with Seeley International, WCEC is innovating a control scheme that will allow the Climate Wizard to operate in unison with a conventional RTU. This will allow the Climate Wizard to be added on to an existing RTU, and for the pair to be controlled by a single room thermostat. The equipment will be installed and monitored in Cabazon, CA.
- » Working with SMUD and Daikin McQuay, WCEC is field testing the first winner of DOE's Advanced Rooftop Unit Challenge, to be installed in partnership with Harley Davidson of Sacramento.
- » Through a partnership with Southern California Edison, WCEC will test 3-4 Trane Voyager DC systems. Two are slated for installation at Simon Group's Ontario Mills, and another will be installed in partnership with Marie Callender's in Ontario CA. This work will provide essential data to support the lab results for Trane's Western Cooling Challenge entry.

- » July 12th-15th, WCEC will install monitoring for a 13,000 cfm Munters Oasis system at the City of Temecula Civic Center. The hybrid equipment includes indirect evaporative, direct evaporative, and vapor compression cooling. It is a 100% outside air system that uses the return air stream as scavenger air for indirect evaporative cooling, and for condenser cooling.
- » In cooperation with Starwood Capital Group, and with incentive funding from PG&E, we will be monitoring two Trane Voyager DC units to be installed at the Solano Mall in Fairfield, CA.

Conclusion and Other Thoughts

In addition to evaluating these hybrid RTUs and indirect evaporative air conditioners, we are working to create new test protocols and metrics that will provide fair comparison for a wider range of western-climate appropriate cooling technologies. For example, the energy savings impact of a Dedicated Outdoor Air System (DOAS) cannot be recognized by comparison of the typical EER metric. A DOAS system works in conjunction with existing standard RTUs to cool outside air with incredible efficiency, thus offsetting energy that would be used for ventilation air cooling by other systems in a building. Munters has recently developed the EPX 5000, a DOAS system that couples indirect evaporative and vapor compression cooling; and has challenged WCEC to laboratory test and evaluate the extended energy savings of their system in comparison with conventional equipment and unitary packaged hybrid systems typical of other Western Cooling Challenge entries.



EQUIPMENT WE ARE TESTING/EVALUATING



Trane® Voyager DC

Trane Voyager DC units add a DualCool™ evaporative pre-cooling package to a high efficiency Voyager. DualCool uses rigid evaporative media to directly pre-cool condenser inlet air, significantly increasing efficiency of the vapor-compression system. DualCool also pumps evaporatively-cooled water through a ventilation air pre-cooling coil to reduce cooling load without adding moisture to indoor air. DualCool increases basic Voyager capacity 25 to 45% depending on peak design temperature and outdoor air fraction.



Munters EPX 5000™

The Munters EPX 5000 is a dedicated outdoor air system that offers an extremely energy efficient retrofit solution to already existing building cooling systems. Using indirect evaporative cooling as the first stage of cooling makeup air, substantially reduces energy costs.

On a typical summer day, indirect evaporative cooling alone can lower the incoming air temperature by 30°F or more. The second stage of cooling is handled by conventional air conditioning. The use of an indirect evaporative cooling system, in conjunction with a mechanical A/C system, offsets cooling loads and significantly reduces energy consumption during peak design conditions. This same exchanger can recover 50% of the heat exhausted from the space in the winter months.



Seeley Climate Wizard®

Climate Wizard is a high-performance indirect evaporative air conditioner. Climate Wizard's cooling performance can rival that of refrigerated systems, using up to 80% less energy and can be used as a stand-alone cooler, or as a retrofit to already existing systems. That's not only great for reducing power bills, it's also great for the environment. And, no matter how hot it gets outside, Climate Wizard uses the same amount of power and still delivers amazingly cool air inside. This is in direct contrast to refrigerated systems, which require increasing amounts of power as outside temperatures rise.

PREVIOUS WESTERN COOLING CHALLENGE ENTRANTS

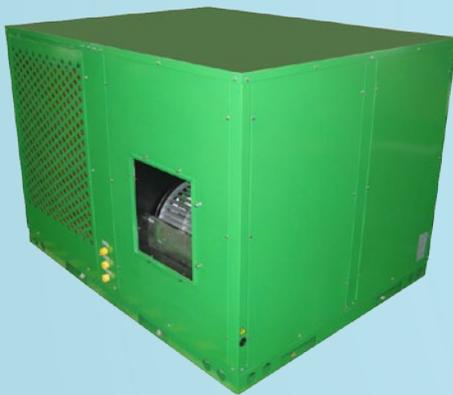
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CERTIFIED



Coolerado H80®

The Coolerado H80 equipment utilizes a combination of Coolerado indirect evaporative cooling, and conventional compressor-based cooling. The H80 is nominally rated to provide 5 tons of cooling (8 tons of equivalent make up air cooling), and is designed principally for commercial buildings.

The Coolerado H80 RTU Hybrid beat the University of California Davis Western Cooling Challenge EER targets by 44% at the peak test condition, and 170% at the seasonal test condition—according to UC Davis. This translates to an estimated peak savings of 58%, and a seasonal energy savings estimate of 80% compared to 2010 DOE standards.



AirMax AIR₂0

The AirMax AIR₂0 IDEC Hybrid Air Conditioning System uses the latest two stage evaporative coolers that take into consideration the changes in indoor environments as well as people's evolving requirements. Maximum comfort and maximum energy savings—IDEC AC systems monitor outdoor conditions and choose the most economical cooling mode to operate in. You enjoy indoor air comfort and save both, money and energy.

Learn more about the Western Cooling Challenge

- *Download test lab reports*
- *Download the WCC test protocols and factsheets*
- *Read more about the WCC entrants*

<http://wcec.ucdavis.edu/programs/western-cooling-challenge/>

Our Latest Projects & Updates

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

Aquachill Water Management for Water-Cooled Condensers

The goal of this project is to monitor the effects water has on the longevity of a water-cooled condenser and to provide useful water management strategies that help increase the lifespan and efficiency of water-cooled condensing HVAC solutions. The data after the small-scale and full-scale testing (over a period of approximately 2 cooling seasons) revealed some interesting information:

1. Scale build-up doesn't effect energy efficiency rates too significantly, but it does greatly increase the likelihood of pump failures
2. Low water-flow bleed cycles have great potential to both conserve water and sustain the longevity of the unit

WCEC will complete the full-scale testing on June 30th. The next phase of the project will have WCEC testing other various methods of water management that will require even less water loss due to bleed cycles.

Occupancy Sensing Thermostats

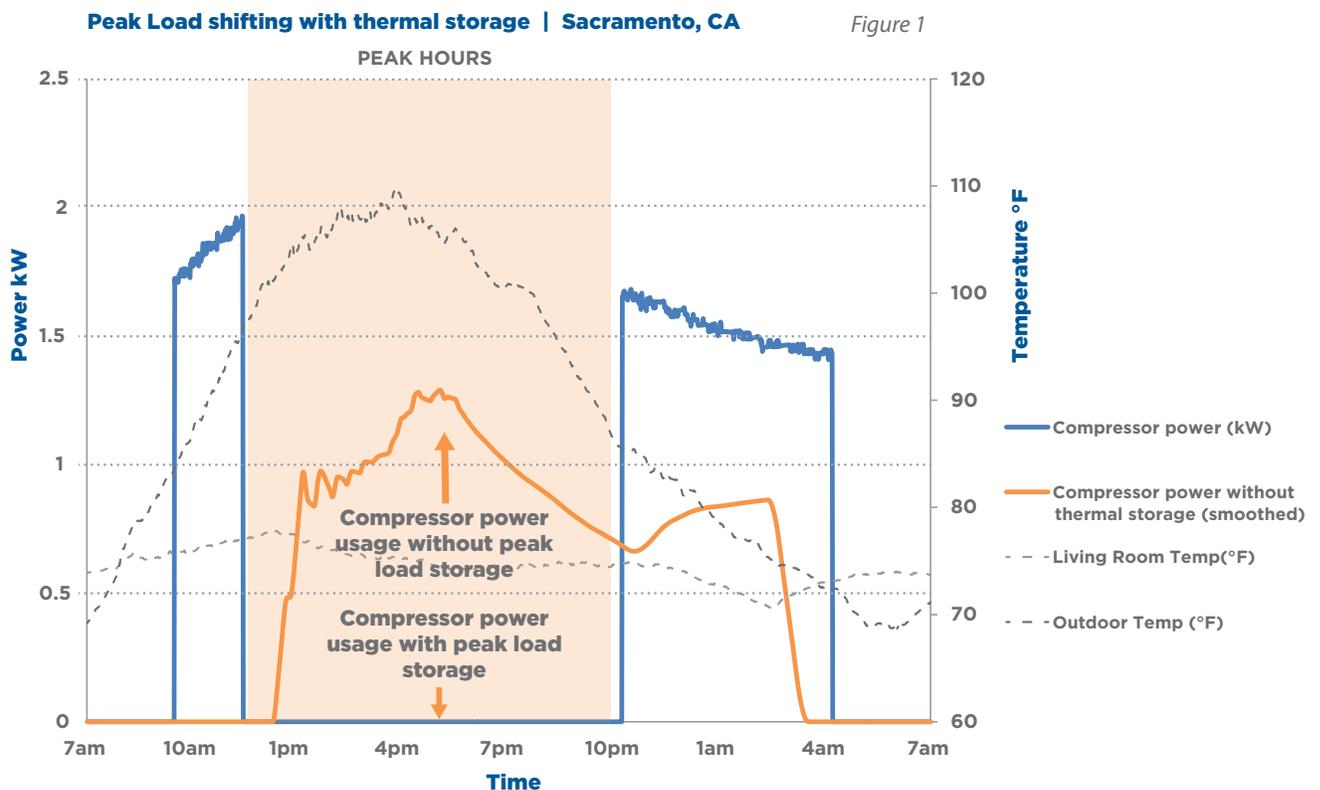
Occupancy sensing thermostats have been around for roughly a decade. They were developed to reduce the amount of energy wasted heating or cooling unoccupied spaces. The reduction is accomplished by incorporating a passive infrared motion sen-

sor with a thermostat- allowing the thermostat to "see" when the room is no longer occupied and respond accordingly. The ability to detect occupancy in a room negates the need for a user to program a schedule to maximize energy savings. This feature is especially promising in applications where users are unlikely to program a schedule because of a highly sporadic schedule.

The WCEC is currently monitoring the installations of occupancy sensing thermostats in the UC Davis Residence Halls where two pipe fan coil systems are used to heat and cool the dormitory rooms. The goal of this research is to quantify how occupancy sensors, alone, contribute to HVAC energy savings. The monitoring plan analyzes certain points in each room, obtained from the thermostat data stream, and the residence hall energy management system.

Radiant Cooling for Residential

Installed and monitored radiant ceiling panels and a chilled water storage tank in a home in Sacramento, CA. Preliminary data suggests that the small chilled storage tank is sufficiently keeping the water cool through the main peak load hours. (See figure 1)



Our Latest Projects & Updates (continued)

Behavior Research Initiative: In-home Energy Displays

Using the results of a technical and heuristic review of In Home Energy Displays available in the market, the Behavior Research Initiative Team has designed a set of IHED interface simulations to test the way in which different IHED features influence users' motivation to engage in energy saving behaviors.

In a study to be conducted throughout July 2012, researchers will present study participants with one of a series of simulated In Home Energy Display interfaces. The study will evaluate and compare people's ability to retrieve useful information from the simulated IHED interfaces. The IHED presents information in ways that are consistent with the WCEC's appraisal of common features in market available IHEDs. It also includes and tests the effects of social norms (via neighbor usage information) and personal goals (via energy budget information). Social norms and goals are increasingly being used and promoted as strategies to incentivize energy savings. Moreover, the experimental study includes a test of the effectiveness of specific energy use alerts.

The simulated IHED will provide specific diagnostics regarding appliances that may be wasting energy. Responses to this feature, which is not currently available in most feedback devices, will provide meaningful information about the way in which Fault Detection feedback can be used in residential contexts to increase energy saving motivation and self-efficacy.

Multi-Family Ventilation

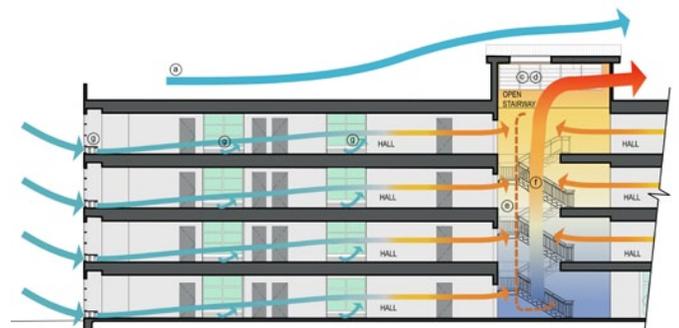
The MFV project aims to research and evaluate current codes and standards with respect to ventilation in multi-family buildings such as apartments and condominiums. To do this, the MFV team must first analyze the performance of ventilation systems through modeling and correlate these models with field measurements.

At this stage, the MFV project has identified several potential improvements to Title 24 and has submitted a report summarizing these findings to the CEC. The project's work is still ongoing, with significant research still needed in these areas:

- Evaluate and characterize the multi-family construction practices and existing building stock
- Identifying on-site verification of HVAC system installation, condition, and ventilation performance
- Mathematical models are being developed to evaluate ventilation strategies and will be calibrated against survey data



Example IHED screen from the IHED interface simulation to be tested throughout July 2012



Natural ventilation schematic for UCD Tercero Student Housing. Architectural design and illustration by Mogavero Notestine Associates

WCEC NOTABLE OUTREACH EVENTS TIMELINE

LEGEND

- Mark Modera
- Jonathan Woolley
- ◈ Kristin Heinemeier
- ▲ David Grupp
- ▼ Jim Rix
- ★ Paul Fortunato

Meeting with Honda regarding partnership for building net zero homes

Spoke at an event hosted by Daikin in Napa, CA

Met with the Center for the Built Environment

H80 Instrumentation setup at China Lake

WCEC Affiliate's Forum

WCEC Steering Committee Meeting

Meeting with CEATI in Portland

Presentation at Utility Energy Forum

Visit by the Energy Commission

LAWDP visits and tours WCEC

Lockheed Martin Visits WCEC

Testing of the Trane DC Voyager for the WCC

APRIL

MAY

JUNE

APRIL 3RD

APRIL 15TH

APRIL 19TH

APRIL 25TH

MAY 1ST

MAY 2ND

MAY 3RD

MAY 11TH

JUNE 4TH

JUNE 5TH

JUNE 12TH

JUNE 18TH

JUNE 22TH

APRIL 26TH

MAY 14TH

MAY 17TH

MAY 25TH

JUNE 18TH

JUNE 22TH

Siemens visits WCEC for tour

Meeting with the CPUC in San Francisco

Planning meeting with SCE

Visit from Honda regarding net zero homes

Monitoring WCC equipment at Target Store in Palmdale

Presentations given and booth at the California Higher Education Sustainability Conference

Presentations given at ASHRAE Conference

WCEC NOTABLE VISITORS TIMELINE