“Partner with stakeholders to identify technologies, conduct research and demonstrations, disseminate information, and implement programs that reduce cooling-system electrical demand and energy consumption in the Western United States.”
CA Energy Efficiency Strategic Plan

• Accelerate market penetration of climate appropriate HVAC
  • 15% penetration by 2015
  • 70% of systems installed in 2020 to be optimized for California’s climate
WCEC TEAM
Established April 2007
Part of the Energy Efficiency Center at UC Davis
Mark Modera, Director
Kristin Heinemeier, Principal Engineer
Will Allen, Senior Engineer

5 Associate Engineers
4 Assistant Engineers
5 Graduate Students
15 Undergraduate Students
1 Behavioral Research Specialist
2 Support Staff
WCEC RESEARCH PROGRAM

RESIDENTIAL
Ground Source Heat Pumps
Honda Smart Home (PNE)
Diurnal Heat Rejection
Evaporative Pre-Cooler Testing
In Home Energy Displays

LIGHT COMMERCIAL AND RETAIL
Western Cooling Challenge
RTU Retrofit Initiative
**Dew-Point Fluid Cooler**
Multi-Tenant Light Commercial
Advanced Controls
Energy Plus Model of Hybrid Evaporative Cooling
Open Source Building Automation System

INSTITUTIONAL SECTOR
PIER HVAC Technology Demonstrations
WCEC RESEARCH PROGRAM

MULTI-FAMILY RESIDENTIAL, HOTELS, DORMS

- Smart Thermostats
- Ventilation Diagnosis, Modeling and Improvement
- Phase-Change Hydronic Distribution

CODES AND STANDARDS

- CASE Demonstration Project
- Fault Detection and Diagnostics Standard
  - (ASHRAE Standard 207P)
- Evaporative Pre-Cooler Standard
  - (ASHRAE Standard 212P)
WCEC RESEARCH PROGRAM

CROSS-CUTTING

- Evaporative-Equipment Water Management
- Hybrid Evaporative Vapor-Compression Equipment
- HVAC Performance Alliance
- Aerosol-Based Sealing of Enclosures
- HVAC Technician Instrument Lab
- Automated Fault Detection and Diagnostics
- Maintenance Behavior
- Tracer Gas Air Flow Measurement
- Rainwater Reclamation for Evaporative Systems

OTHER RESEARCH

- Efficiency Improvement for U.S. Army Cooling
- Polymer Bead Laundry
- Gas Pipeline Sealing
Sub-Wetbulb Cooling

Supply Air

Wet Channel

Dry Channel

Exhaust Air

Outside Air

Top View

Ambient Air

Heat Exchanger

Sump

Outdoor SWEC Unit

Warm water return from building

Water flows

Cold water piped to building load

Airflows
Can reproduce hot, dry CA climate conditions regardless of Davis weather
# Sub-Wetbulb Fluid Cooling

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MANAGING WATER ISSUES

Activities

• Testing to Failure
  • Indirect Evaporative Cooler
  • Evaporative Condenser
  • Miniature heat exchangers and coils
• Testing Water Management Strategies
  • Bleed Rates
  • Magnetic Treatment
  • Other Treatments
• Alternative Water
  • Grey water
  • Rain water
Calcium/Magnesium in CA Water

- Calcium mg/L
- Magnesium mg/L

Davis, CA
(Semi) Optimized Bleed Rates

![Graph showing total deposited scale (kg/yr) vs. percent increase for bleed (%).]

<table>
<thead>
<tr>
<th>Location</th>
<th>Mg (mg/L)</th>
<th>Ca (mg/L)</th>
<th>Lifespan (yr)</th>
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<td>Riverside</td>
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<tr>
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</table>

* % increase for bleed = \( \frac{V_{\text{bleed}}}{V_{\text{evaporation}}} \times 100\% \)
* Use bleed to eliminate magnesium precipitation
Building Shell Sealing with Aerosol Particles
New York City Apartment Sealing