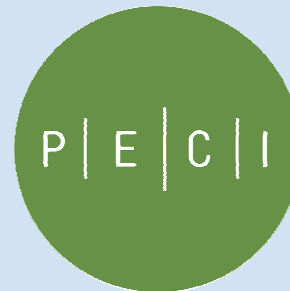


The Past, Present, and Future of Commercial HVAC Savings Opportunities

Afroz K. Khan, CEE

CEE General Meeting
January 15, 2009
San Francisco, CA

Reid Hart, PE
Portland Energy Conservation, Inc.



Presentation Outline

- Background on CEE Commercial HVAC Initiative
 - Focused on equipment efficiency
- Evolution of efficiency parameters
 - Reaching limits in equipment efficiency
- Future opportunities
 - Integrated systems approach to achieve greater savings

CEE High Efficiency Commercial Air Conditioning Initiative

- Launched in 1993 focusing on Unitary Air-Conditioning and Heat Pump Equipment
- Unitary equipment represents more than half of equipment in commercial sites and largest energy consuming space cooling device.
- Uses industry accepted parameters for defining efficient performance (SEER, EER, COP, IPLV)
- Over 32 members currently promoting CEE specifications in their programs.

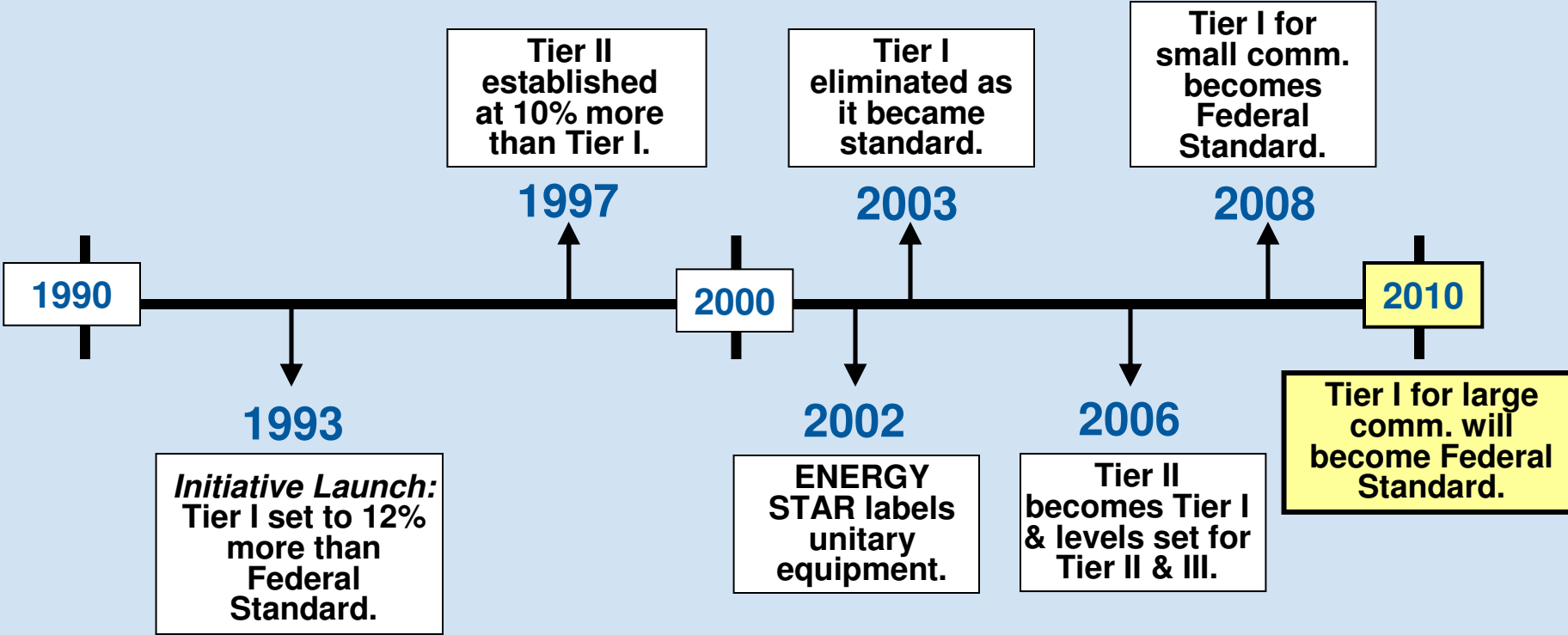


Working Together, Advancing Efficiency

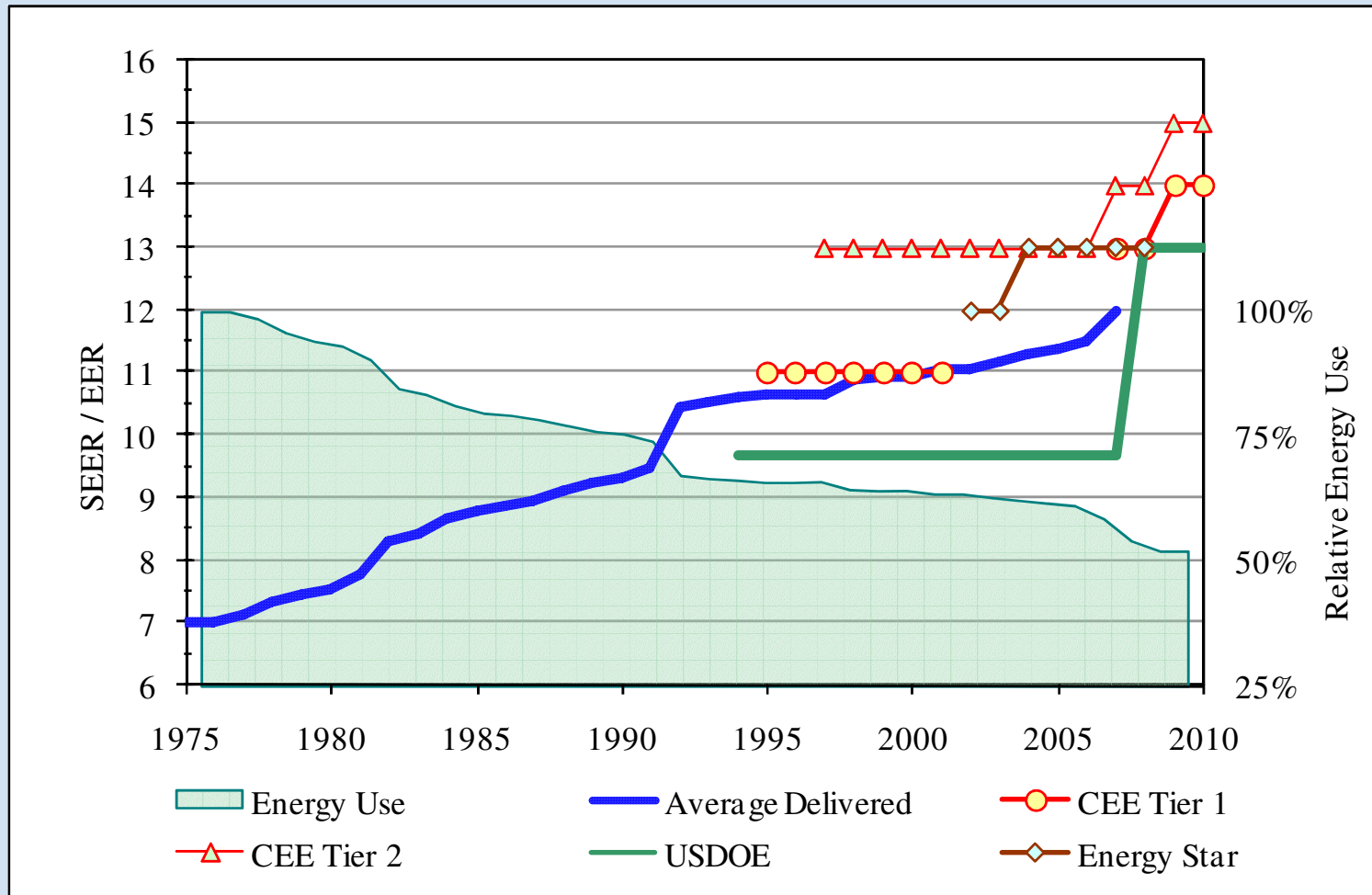
CEE Unitary AC and HP Specification Updates

- CEE requesting Board to approve replacing current Tier 1 with current Tier 2 and Tier 2 with current Tier 3.
- Industry replacing IPLV with IEER and ICOP in January 2010.
- ENERGY STAR revising Light Commercial Specification in First Quarter 2009.

CEE Unitary AC and HP tiers have evolved since Initiative launch.



Progress in Rooftop Unit Efficiency

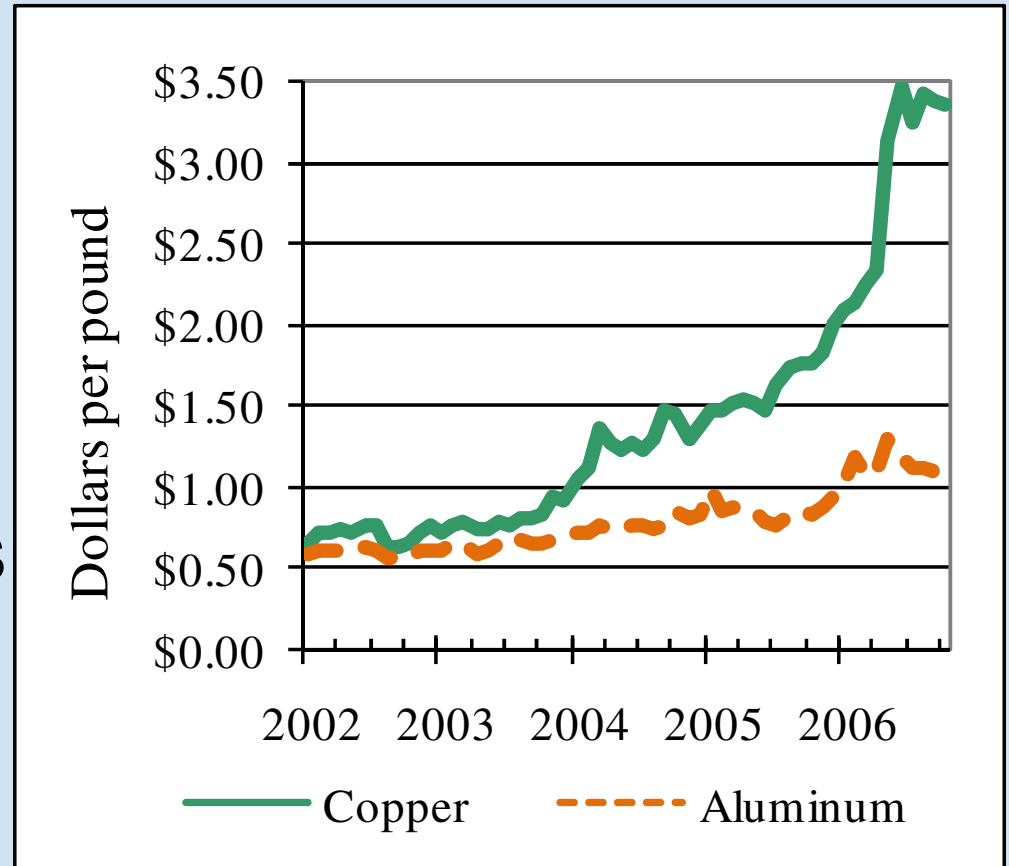


Reaching ceiling in equipment efficiency.

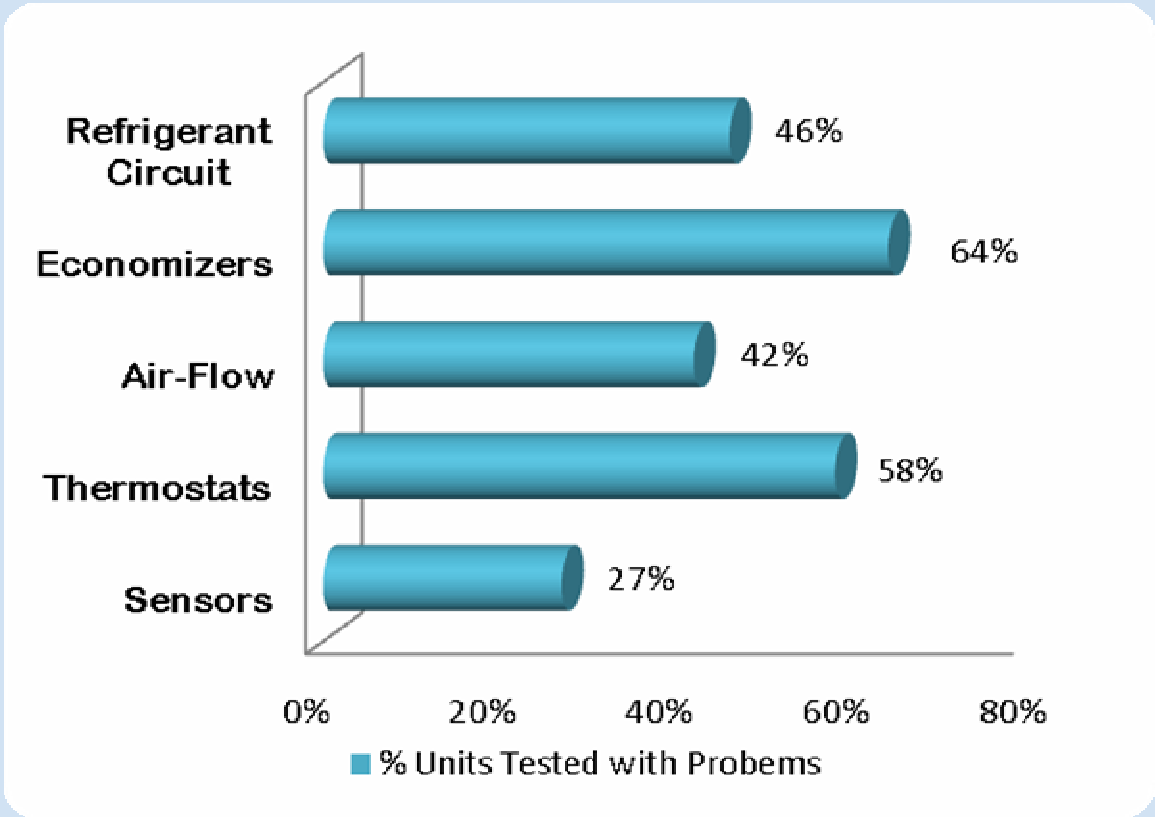
- Increasing efficiency at the unit itself is becoming cost prohibitive.
- Limitations in component design and performance.
- Efficiency parameters (EER) do not necessarily guarantee more efficient performance.

Efficiency Fights Material Costs

- Biggest impact on SEER/EER/IEER improvement is more surface area for heat exchange
- Higher material costs make increasing surface area more expensive



Failures seen in many key functions of unitary equipment.

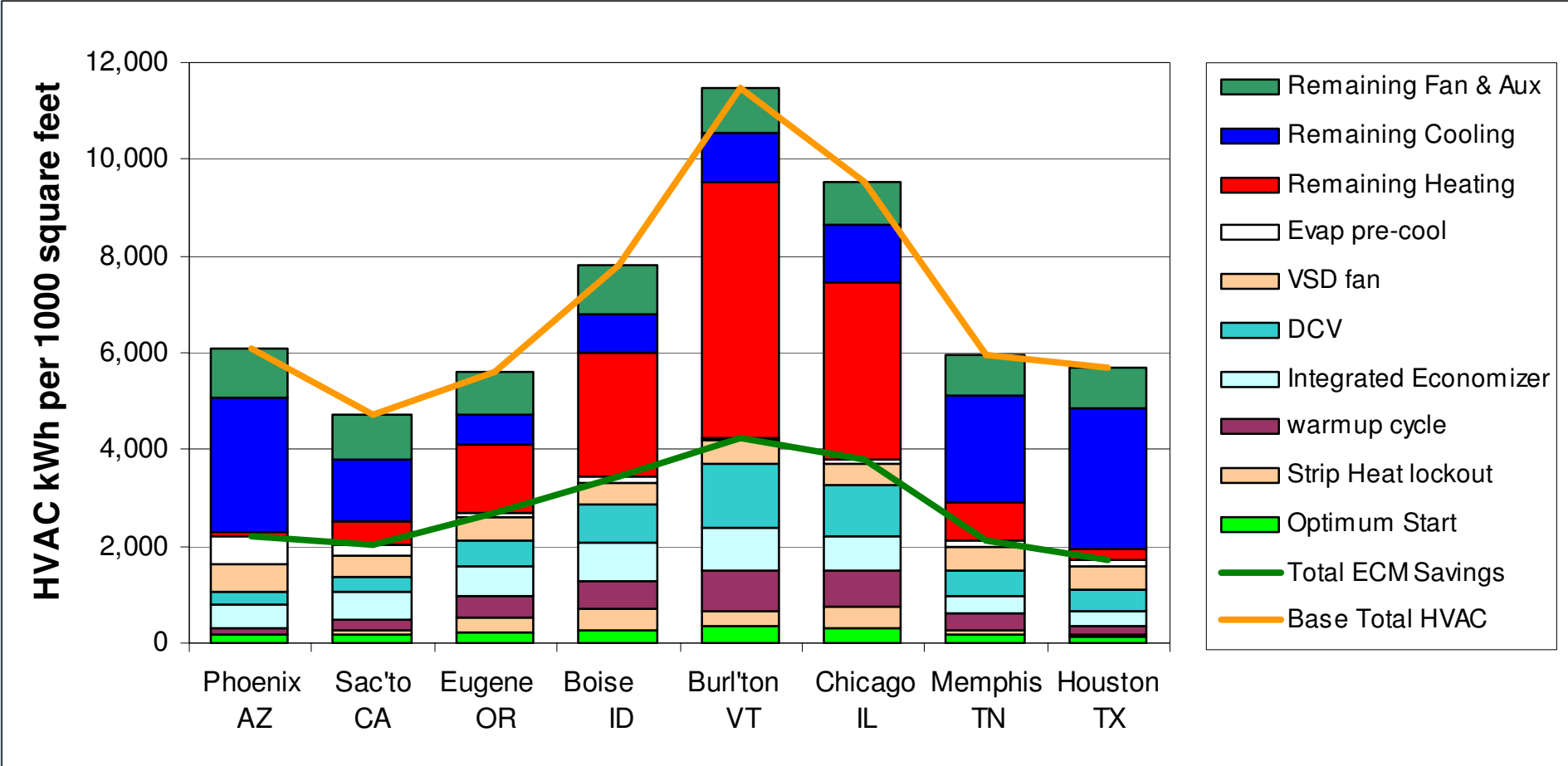


Note: Meta study covering 4 studies, 500 units in Western states.

Ten Times the Savings!

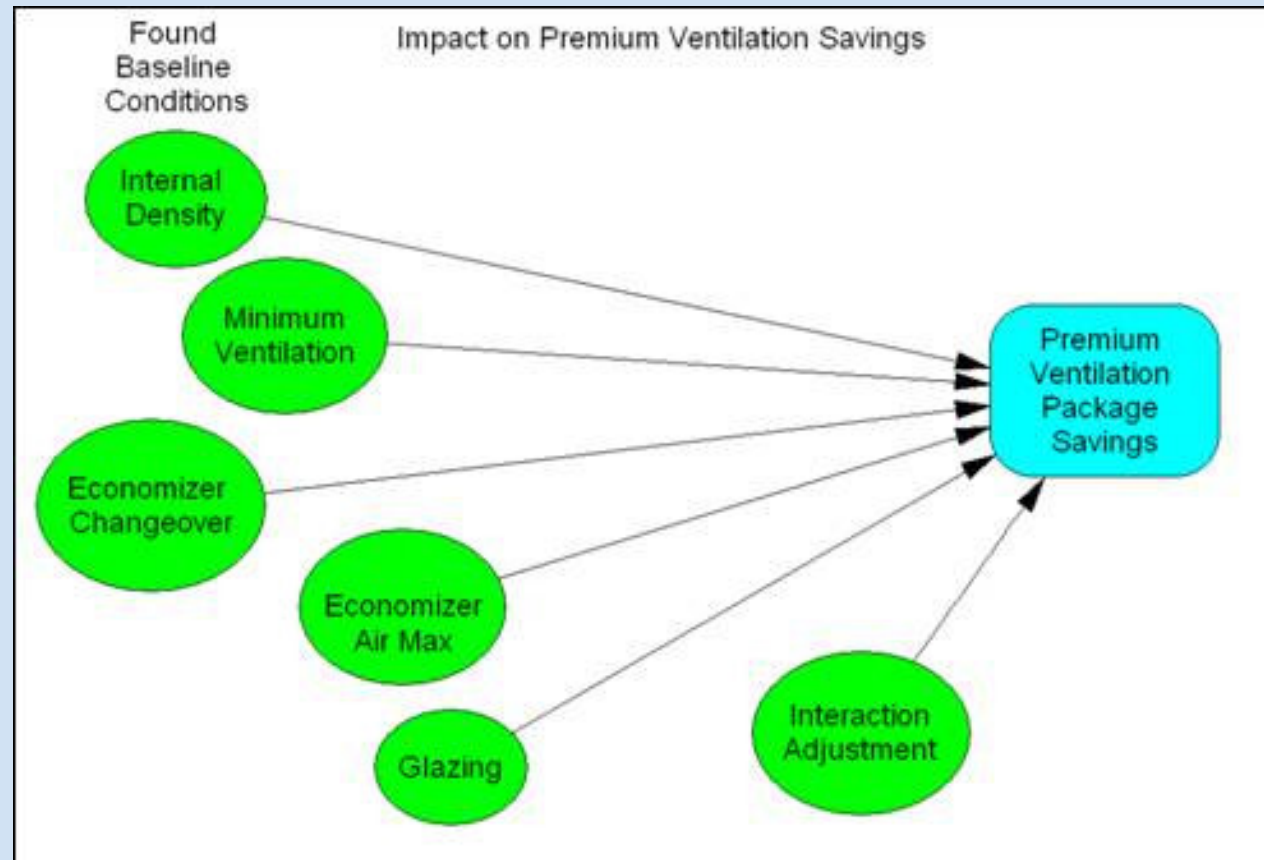
- Premium Economizer Savings, plus
 - Fan savings when not heating or cooling
 - Savings during warm-up
 - Ventilation savings when building not fully occupied
 - Easier setting of outside air minimum
- Retrofit package currently being tested in Northwest: EWEB, BPA, ETO, PECl
- Significant Gas Savings
- Compare savings for Sacramento, California:
 - SEER 13 to 15 at 0.22 kWh/sf
 - Premium Ventilation Package at 2.0 kWh/sf

Regional Savings – Premium Ventilation



Textured Deemed Savings

- Most deemed approaches (DEER) use “typical” baseline
- Textured approach allows for the variation of commercial baselines
- Apply Decision Analysis
- Find most sensitive influencing parameters
- Find range of savings
- Interaction adjustment
- Find expected value



Advanced Rooftop Unit (ARTU)

Significant improvements possible in current unitary products (some are evident today).

- Outdoor air control
- Fan Control & Refrigeration Control
- Economizer reliability
- Self-diagnostics
- Fault-tolerant design

Total benefits from \$600 to \$830 annually.

Estimated cost for 36 ARTU features

currently \$4,100 (5-ton RTU)

Simple payback between 4.9 and 6.9 years



ARTU Scorecard

- Conceived in a CEE forum; carried forward by PIER
- Each unit rated for desired features
- Possible next step for CEE:
 - Evaluate as an approach for higher tier unit rating

Table 8. ARTU Rating Scorecard, Category 7.

| Level | Cat. No. | ARTU Incorporated Features | Available Points | | |
|--|----------|---|-------------------|----|---------------|
| | | | Feature Provided? | | Earned Points |
| | | | Yes | No | |
| | 7 | Category 7 = THERMOSTATS | | | |
| 1 | 7-1 | Supplied thermostats are appropriate for use in commercial buildings and meet the following requirements: | | | |
| | | ASHRAE 90.1 | | | |
| | | • Separate heating and cooling setpoints ("dual" setpoints) | 1 | | |
| | | • Capable of a deadband of at least 5 degrees between the heating and cooling setpoints | 1 | | |
| | | • The thermostat prevents: | | | |
| | | – Reheating of previously cooled air (except in humidity control applications) | 1 | | |
| | | – Recooling of previously heated air | 1 | | |
| | | – Mixing or simultaneously supplying air that has been previously mechanically heated and air that has been previously cooled, either by mechanical cooling or by economizer systems. | 1 | | |
| | | Other | | | |
| | | • Solid state electronic | 1 | | |
| • Capable of continuous fan operation during occupied hours | 1 | | | | |
| • Capable of programming time-of-day schedules (night setback / setup) and multiple day types (weekday, weekend) | 1 | | | | |

Breakout Session Today at 3:00pm

Join our discussion in shaping the future of addressing Commercial HVAC savings opportunities by hearing about regional efforts that can be applied nationally.

Time: 3:00 to 4:30pm
Location: Amador Room

Featured presenters:

Reid Hart, PEI

Mark Cherniack, NBI

Mark Modera, Western Cooling Efficiency Center



Working Together, Advancing Efficiency