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CBEA Space Conditioning Project Team

Discussion Materials for Energy Efficiency Forum

May 23-24, 2012

Space Conditioning Breakout
May 23 Agenda

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- Introductions
- 2012 Projects (30 min), for each project capture barriers and potential solutions
  - RTU Challenge – Michael Deru and Scott Williams, Target
- Lunch break
- 2012 Projects – continuation after lunch (30 min each)
  - Gas Unit Heater specification – Michael Deru
  - Advanced RTU Control retrofit – Michael Deru
- 2013 Project brainstorm (separate into working groups) (30min)
- Compile 2013 project ideas (15 min)

RTU Challenge Project Overview

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Fall 2010: DOE with CBEA input drafts stretch RTU spec: performance + features

- 18 IEER: up to 50% energy reduction relative to ASHRAE 90.1 requirements
- $1 billion annual energy savings if all 10-20 ton units in U.S. were replaced

Jan 2011: Spec released - a “challenge”, but feasible

May 2012: Deadline to ***Enter*** the RTU Challenge

Apr 2013: Deadline to ***Meet*** the RTU Challenge

Current Status

- Five manufacturers have committed to the RTU Challenge
- One RTU available for order now
- Others coming next spring

RTU Challenge Barriers

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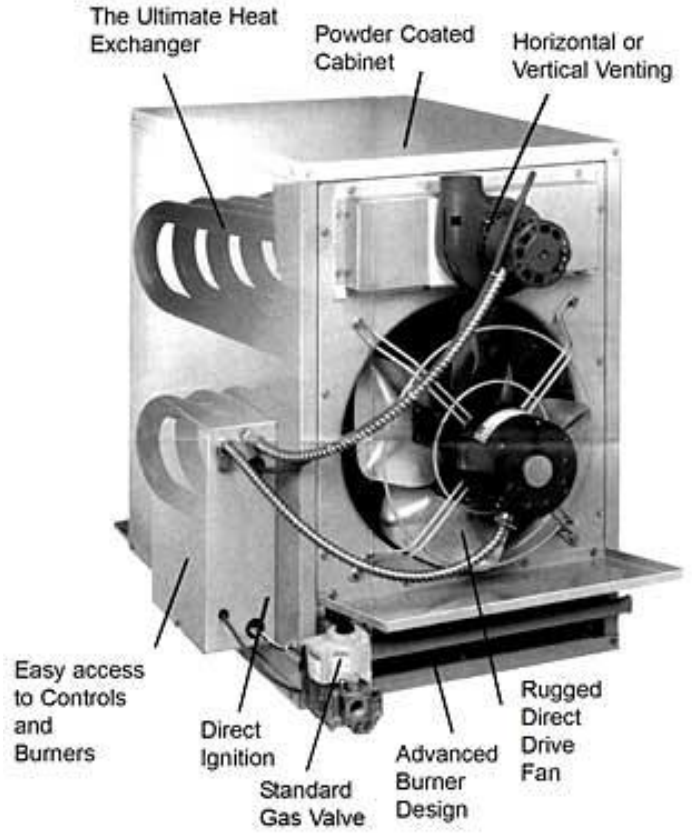
- What are the barriers to implementation?

- What are potential solutions?
  - Within CBEA
  - Outside of CBEA (asks or coordination with other groups)

Product Scope

Gas unit heaters are self-contained systems designed for large open facilities with high ceilings, often exposed to outdoor conditions.

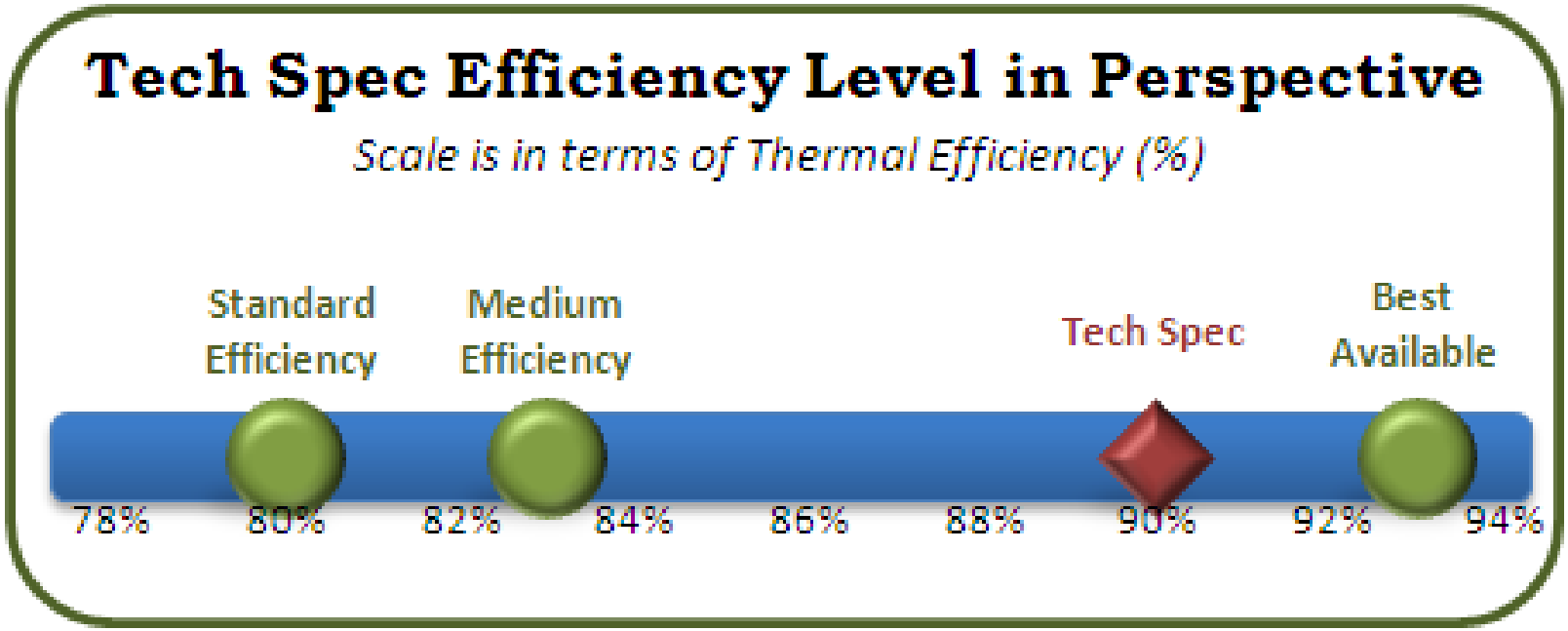
- Common characteristics :
  - No ducts
  - Natural gas but can be propane
  - 25,000 Btuh and 400,000 Btuh
  - weight between 150-400 lbs
  - Average life of 15-20 years



Source: Lennox

Gas unit heaters meeting this specification would have higher efficiency than what is typically installed today.

– Standard- and medium-efficiency equipment make up 95% of shipments.



Advanced Gas Unit Heater Specification Payback

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Based on a two year simple payback, spec'd gas unit heaters could be allowed moderate price premiums.

- Assuming Medium operating conditions (1,500-2,000 hrs/yr) at $0.9-$1.0 per therm of natural gas.
  - High (3,000 hours) would have a shorter payback.
  - Low (1,000 hours) would have a longer payback.

Allowable Price Premium for 2-year Payback

Rated Input (BTU/hr)	Energy Savings (therms/yr)	Allowable Price Premium for 2-year Payback ($)	
		1,500 hrs/yr	2,000 hrs/yr
135,000	375	$500-$575	$650-$750
180,000	500	$675-$750	$900-$1,000
260,000	722	$975-$1,075	$1,300-$1,500
310,000	861	$1,150-$1,300	$1,500-$1,750

Gas Unit Heater Specification Barriers

- What are the barriers to implementation?

- What are potential solutions
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Why is there a Need for an Advanced RTU Controller?

- Packaged air conditioners and heat pumps are used in about 46% of all commercial buildings, serving about 60% of the commercial building floor space (EIA 2003)
- Most RTUs operate inefficiently
  - lack of equipment maintenance and
  - **lack of advanced controls strategies that rely on constant supply speed fan and constant ventilation**
- Operating efficiency can be improved significantly with the use of advanced control strategies

Collaborators and Manufacturing Partners

- U.S. Department of Energy (DOE) funded FY11 activities, FY12 activities are being funded by DOE and Bonneville Power Administration (BPA)
  - Field tests will be coordinated with Center of Energy and Environment (CEE), Minneapolis
- Technologies being evaluated by PNNL and CEE are similar but not identical

Technology Comparisons

- Control Company#1: combines advanced controls with variable speed drives (VSDs) for both supply fan and compressor to adjust RTU capacity to match the dynamic nature of building heating and cooling loads.
  - Estimated energy savings for a 10 ton RTU in Minnesota results in a simple payback of 6 years. The payback increases to 8-10 years for a smaller 5 ton RTU
- Control Company #2: based premium ventilation package incorporates advanced control sequences, replacement economizer damper motor, and zone sensors. Most of the retrofit is based on a “smart” thermostat and new sensors, with RTU modification limited to the economizer damper
  - Estimated energy savings applied to a 5 ton RTU in Minnesota results in a simple payback of 4 years
- Control Company #3: replaces existing RTU controller, which provides integrated economizer controls, demand controlled ventilation and makes the supply fan variable speed
  - Estimated savings applied to 7 ton or bigger RTU will result in less than 3 year payback and with smaller units the payback will closer to 4 years

What is the Technology?

- An advanced controller that can be retrofitted to existing packaged rooftop units
- Features of the controller
  - Integrated differential (or high limit) dry-bulb or enthalpy economizer
  - Multi-speed supply fan controls; converts existing 3-phase supply fan into a multi-speed supply fan by adding a variable speed drive
  - Demand controlled ventilation using a return air CO_2 measurement
- A commercial product with UL listing

FY11 and FY12 Project Activities

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1. In FY11, report estimated savings from use of advance control strategies with RTUs
    1. Results indicate significant fan savings and some cooling and heating energy savings as well http://www.pnnl.gov/main/publications/external/technical_reports/PNNL-20955.pdf
2. In FY12, extensive field tests
    1. To demonstrate the technology and validate the savings resulting from the technology
    2. Analyze results to support development of lower priced controller
    3. Provide recommendations to manufacturer on opportunities to "optimize" the controls

FY11 Research Study Findings

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- Advanced controls (integrated economizer, multi speed fan, 2-speed capacity control and demand control ventilation) can achieve significant electricity and gas savings and improved comfort
  - Savings vary by climate zone and building type
  - Range of total HVAC savings* by climate zone
    - Small office building – 22% to 56%
    - Stand-alone retail – 25% to 47%
    - Strip Mall – 24% to 46%
    - Supermarket – 16% to 47%
  - Savings compared to a base case with **constant speed supply fan and no economizer**
  - Range of electricity savings (fan and cooling); low-end of the percent savings are for hot and hot/humid climates and the high-end of the savings are for mild and cold climates
    - Small office building – 38% to 67%
    - Stand-alone retail – 36% to 60%
    - Strip Mall – 26% to 59%
    - Supermarket – 28% to 55%

*Total heating ventilation and air condition energy savings (HVAC), which includes fan and compressor electricity (cooling) savings and gas savings (heating)

Estimated Savings Across 4 Building Types and 16 Climate Zones

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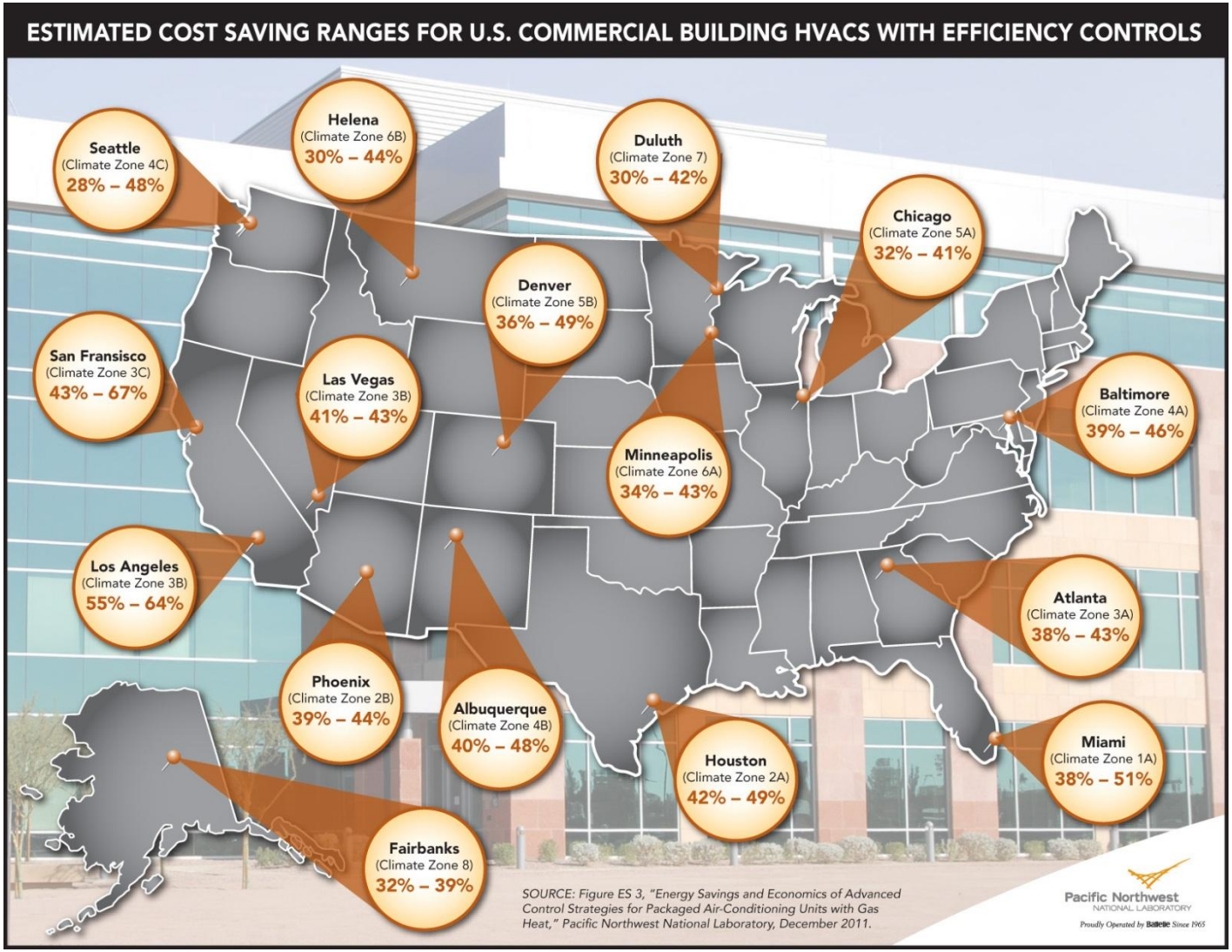

FY12 Research Activities

- DOE funded field tests
  - Across the nation (CA, PA, OH, WA), at several Commercial Building Energy Alliance Member sites
  - Over 25 RTUs
- BPA funded field tests
  - Primarily in Pacific Northwest
  - Over 50 RTUs
- CEE funded field test conducted by CEE
  - Mostly in Minnesota
  - Over 50 RTUs
- Preliminary results for PNNL field tests will be available in October 2012 and final report will be released in October 2013

For more information contact:

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Advanced RTU Controls Retrofit Barriers

- What are the barriers to implementation?

- What are potential solutions
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2013 Project Ideas

- Packaged system working group

- Built-up system working group