Advanced RTU Campaign:
Overview for Efficiency Vermont and Burlington Electric Department
Commercial Buildings Audience

April 29, 2014
Advanced RTU Campaign

- Launched May 30, 2013
- Runs through 2015
- Promotion of high-efficiency RTU solutions
  - High-efficiency replacements and new installations – CEE Tier 2 and above
  - Advanced control retrofits
- Organizing Partners
# Supporting Partners (83)

## Utility or Efficiency Organization
- 360 Energy Group, LLC
- Burlington Electric Department
- Columbia Water & Light
- Commercial Building Consortium
- DNV GL
- Efficiency Vermont
- Energy Center of Wisconsin
- Fort Campbell DPW Utilities
- HVACRedu.net
- New Buildings Institute
- Nicor Gas
- NYSERDA
- RealWinWin, Inc.
- Red Rocks Community College
- Rocky Mountain Education Center
- SPEER
- SWEEP

## Manufacturer
- Allied Commercial
- BELIMO Americas
- Carrier
- Daikin McQuay
- Emerson
- Enerfit
- Ingersoll Rand (Trane)
- Integrated Comfort Inc.
- Lennox
- Mitsubishi Electric Cooling & Heating
- NexRev
- Transformative Wave Technologies

## Consultant/Contractor/Service Provider
- 4Sight Energy Solutions
- Advantek Consulting Engineering, Inc.
- Air Comfort Corporation
- Aire Rite Air Conditioning and Refrigeration
- All State Air Control Sales And Service Inc.
- Anura Systems Inc
- Arbogast Energy Auditing
- Automated Decision
- Bay Air Systems Inc.
- Benchmark Group
- Better Efficiency Solutions & Technologies (BEST)
- Buffalo Energy, Inc
- Capital Engineering
- Capitol Engineering Company
- ClimaCheck
- Comfort Systems USA - VA, NC, SC
- Comprehensive Energy Services

## Consultant/Contractor/Service Provider
- Cooper Oates Air Conditioning
- Crosby-Brownie
- Design-Aire Engineering, Inc.
- Ecova
- EMCOR Facility Services
- Emerging Energy Solutions
- Fusion Systems Engineering
- Greenspeed Energy Solutions
- GridNavigator
- Grunau Company
- Hauser Mechanical
- Horizon Energy Services
- Incenergy
- JashGroup
- John Chardoul, P.E. Consulting
- M&E Engineers
- MacDonald-Miller Facility Solutions
- Magran
- Mechanical Design Studio Inc.
- Murphy & Miller, Inc.
- Rise Engineering
- SEDESCO
- Solution Dynamics
- Southland Industries
- The Wasmer Company
- Total Performance Diagnostics
- Van Boerum & Frank Associates, Inc.
- Vital Engineering Corporation
- W.L. Gary Company Inc
- WorkingBuildings of North Carolina PLLC

## Trade or Industry Organization
- BOMA International
- HARDI
- International Ground Source Heat Pump Assoc.
- NAIOP
- PRSM

## RTU Supplier
- cfm Distributors, Inc.
- Coburn Supply
- Temperature Equipment Corp.
Participating Partners (27)

Adidas  
Belk, Inc.  
Cadmus  
City of Greensboro  
City Of St Cloud Florida  
Drury Southwest Inc.  
Empire Screen Printing  
Johnstone Supply  
JT Katrakis & Associates  
Kallen & Lemelson Engineers  
L-3 Communications - CS West  
Macy’s, Inc.

NASA  
National Grid  
Newhall Property Partnership  
PetSmart  
REI  
Riverdale Country School  
Taitem Engineering  
Target  
The Campus At Marlborough- Hines Global REIT  
West Holt Medical Services  
Westmoreland County Community College  
Whole Foods
Why RTU’s Are Important

- RTUs cool over 60% of U.S. commercial building floor area
- Lots of 10 to 20 year old RTUs installed

Source: AHRI
Credit: Michael Deru

Large stock of 6-18 year old equipment
Decline in purchases with a recent upward trend

Source: AHRI
What Can we do with all these RTUs?

- Planned replacement with high-efficiency RTU
  - Consider for all RTUs > 10 years old
- Retrofit with variable speed controls
  - Consider for RTUs > 7 tons and < 10 years old
What is a High-Efficiency RTU Replacement?

- High-Efficiency replacement before failure
- “High Efficiency” = CEE Tier 2 and above

Example: 10-ton RTU

<table>
<thead>
<tr>
<th>90.1-1999</th>
<th>90.1-2001</th>
<th>90.1-2004</th>
<th>90.1-2010</th>
<th>CEE Tier 2</th>
<th>RTU Challenge</th>
</tr>
</thead>
<tbody>
<tr>
<td>EER</td>
<td>EER</td>
<td>EER</td>
<td>EER</td>
<td>EER</td>
<td>IEER</td>
</tr>
<tr>
<td>8.7</td>
<td>10.1</td>
<td>10.1</td>
<td>11</td>
<td>12</td>
<td>13.8</td>
</tr>
</tbody>
</table>

Credit: Michael Deru

90.1-1999

90.1-2001

90.1-2004

90.1-2010

CEE Tier 2

RTU Challenge

Credit: Ian Doebber
RTU Evaluation Process

Gather Information
- Initial RTU Inventory: RTU Inventory Spreadsheet
- Preliminary Screening: Bin RTUs for retrofit, replacement, or no action
- Detailed Inventory: RTU Inventory Spreadsheet
- Visual-Based Field Evaluation: RTU Field Evaluation Checklist

Analyze
- Analysis: make the business case and prioritize actions. RTU Incentives Database, RTU Comparison Calculator, 179D DOE Calculator, RTU Sizing Guidance, and ARC Case Studies

Plan
- Project Planning: See the list of ARC Supporting Partners

Take Action
- Procurement: Procurement Specifications for guidance
- Measurement and Verification (M&V): Use the M&V Guidance
RTU Inventory Spreadsheet

- Starting point – modify to fit your needs
- Combines
  - Preliminary Screening
  - Detailed Inventory
  - Field Evaluation results
# Preliminary Screening Example

## Rooftop Unit Inventory Spreadsheet

<table>
<thead>
<tr>
<th></th>
<th>RTU #1</th>
<th>RTU #2</th>
<th>RTU #3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Building ID</strong></td>
<td>A</td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td><strong>Space type</strong></td>
<td>lobby</td>
<td>Retail/Service</td>
<td>Office</td>
</tr>
<tr>
<td><strong>Age or installation date</strong></td>
<td>1 year</td>
<td>10 years</td>
<td>13 years</td>
</tr>
<tr>
<td><strong>Cooling capacity (ton, Btu/h, W)</strong></td>
<td>10</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td><strong>Manufacturer</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Model number</strong></td>
<td>50TC-A12A1A5A0A0A0</td>
<td>50HJ-012-C561</td>
<td>TCH240B300JB</td>
</tr>
<tr>
<td><strong>Serial number</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Original nominal efficiency (EER, SEER, IEER)</strong></td>
<td>11.2 EER</td>
<td>10.4</td>
<td>10</td>
</tr>
<tr>
<td><strong>Maintenance history</strong></td>
<td>Regular</td>
<td>Unknown</td>
<td>Unknown</td>
</tr>
<tr>
<td><strong>Major repairs</strong></td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td><strong>General condition (good, fair, poor)</strong></td>
<td>Good</td>
<td>Poor</td>
<td>Poor</td>
</tr>
<tr>
<td><strong>Initial Screening Recommendation</strong></td>
<td>Retrofit</td>
<td>Needs Further Analysis</td>
<td>Replace</td>
</tr>
</tbody>
</table>
# RTU Field Evaluation Checklist

## RTU Evaluation Checklist

<table>
<thead>
<tr>
<th>Component</th>
<th>Rating</th>
<th>Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>Condenser Coil.</td>
<td>Good</td>
<td>No</td>
</tr>
<tr>
<td>Refrigerant Piping.</td>
<td>Good</td>
<td>No</td>
</tr>
<tr>
<td>Cabinet.</td>
<td>Good</td>
<td>No</td>
</tr>
<tr>
<td>Evaporator Coil.</td>
<td>Good</td>
<td>No</td>
</tr>
<tr>
<td>Burner Section.</td>
<td>Good</td>
<td>NA</td>
</tr>
<tr>
<td>Compressor.</td>
<td>Good</td>
<td>NA</td>
</tr>
<tr>
<td>Air Dampers (OA, economizer, and return air).</td>
<td>Good</td>
<td>No</td>
</tr>
<tr>
<td>Fan Motors (supply and condenser).</td>
<td>Good</td>
<td>No</td>
</tr>
<tr>
<td>Overall rating (determined by individual component ratings) and service requirement</td>
<td>Good</td>
<td>No</td>
</tr>
</tbody>
</table>

Document advanced functionality not inherent to unit make and model (Y/N)

<table>
<thead>
<tr>
<th>Function</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy Recovery.</td>
<td>No</td>
</tr>
<tr>
<td>Evaporative Cooling.</td>
<td>No</td>
</tr>
<tr>
<td>Variable Speed Fan Operation.</td>
<td>No</td>
</tr>
<tr>
<td>Economizing.</td>
<td>No</td>
</tr>
</tbody>
</table>
Contact Information

www.AdvancedRTU.org

- Michael Deru, National Renewable Energy Laboratory
  - Michael.deru@nrel.gov
  - 303-384-7503

- Marta Milan, Waypoint Building Group
  - MartaMilan@waypointbuilding.com
  - 231-598-2332
Efficiency Vermont and Burlington Electric Department

Advanced RTU Campaign Webinar
April 29, 2014
Presentation Outline

• RTU Challenges and Barriers
• Influencing the Market
  • Maintenance
  • Enhancing existing equipment
  • Replacement
• Who to contact
Efficient Rooftop Units: Challenges and Barriers

• Leased Space
• Awareness
• Education of options
• Not considered in capital planning
How is EVT Working to Influence the Market?

- Identify opportunities for Energy Savings, increased occupant comfort, and decreased maintenance calls through one of the following:
  - Preventative Maintenance
  - Retrofit Existing Equipment
  - Replacement
Preventative Maintenance

• You only get what you ask for.
• Awareness of energy and comfort implications.
• Asses Key Energy Components
  • Compressors
  • Supply fans, condenser fans
  • Heat Source
  • Economizer
  • Crankcase heaters
• Planning for future replacement.
RTU Problems

- Out of sight out of mind
- Lack of maintenance
- Limp along attitude
- False sense of efficiency

Source: NBI - REVIEW OF RECENT COMMERCIAL ROOF TOP UNIT FIELD STUDIES IN THE PACIFIC NORTHWEST AND CALIFORNIA, 2004; pg. 6
Energy Impact of Comprehensive Tune Up

- Best: 520 kWh/ton
- Average: 19 kWh/ton
- Worst: -373 kWh/ton

Efficiency Vermont
Retrofitting Existing Equipment

Advanced RTU Controllers (Current EVT Pilot)

• Best Applicable when:
  • Unit has been properly maintained
  • Fan motor(s) are VFD compatible
  • No complicated DDC to integration
  • Occupant is responsible for the unit (vs. building owner)
  • Option of web interface of multiple units
  • Long run hours
• Realized savings of 40% - 60%.
Fan Savings

Controller Fan Speed

- no call: 45%
- 1st Stage: 75%
- 2nd stage: 90%
- Economizer Mode: 100%

Catalyst

Digi

Efficiency Vermont
Energy Savings per Ton

- Office: 647 kWh Savings/ton
- Warehouse: 1,605 kWh Savings/ton
- Manufacturing: 2,983 kWh Savings/ton
Pilot Status

• Data will continue to be collected at phase 1 sites in 2014.
• Identification and metering of Phase 2 clients will begin in spring 2014.
  o Full building vs. zone.
• Installation of up to another 8 controllers in phase 2
• Published results of all pilot locations
Replacement Equipment

Opportunity for Energy Savings:
• Evaluation of capacity
• Single Zone VAV
• CEE Tier 2
• Hybrid RTUs
• Advanced economizer controllers
• Demand Controlled Ventilation
• Integrated energy recovery wheel
• DOE Challenge qualifying units
DOE RTU Challenge Units

- **Requirements:**
  - IEER of 18
  - Direct digital controls
  - Operational fault detection
  - Reduce energy use by up to 50% of ASHRAE 90.1 standard.
  - Cost effective

- **EVT Findings, 10T unit:**
  - 5,000 kWh/yr Savings
  - 30mmBtu/yr Savings
  - $1100-1600/yr Savings
  - 5 – 7 yr ROI before incentives.
EVT & BED Support

Technical
• Identifying operation strategy
• Discuss options
• Coordination with contractors
• Evaluate energy (Cost) implications

Financial
• Standard Rebate
• Custom Project Incentive
• Cost share system engineering study
Conclusion

• Options for existing RTU
• Options for new equipment
• Cost effective solutions for every situation
• Resources to help you get on the path to energy savings
Contact Information

Efficiency Vermont

Rachael Mascolino
rmascolino@veic.org
802-540-7846

Ethan Bellavance
ebellavance@veic.org
802-540-7716

Burlington Electric Department

J.C. McCann
JMcCann@burlingtonelectric.com
802-865-7336