Roof Top Units
Saving Energy and Improving
Occupant Comfort

Presented by Ethan Bellavance and Mary Jane Poynter
Presentation Outline

• Roof Top Unit (RTU) Overview - how do they work, key components
• Why are RTU’s so prevalent?
• What are problems with RTU’s
• How to improve reliability and reduce energy usage. Good, Better, Best Approach
• Results of Efficiency Vermont RTU pilot
• Conclusion
Roof Top Unit Components

- Outdoor Air Dampers
- Return Air Dampers
- DX Coil
- Indoor fan
- Heat Exchanger
- Outside Air
- Barometric Relief
- Return Air
- Relief Damper
- Condensate Pan
- Condensate Trap
- Compressor
- Supply Air

Efficiency Vermont
Key Energy Components

1.) Compressors
2.) Supply fans, condenser fans
3.) Heat Source
4.) Economizer
5.) Crankcase heaters
Why are they everywhere?

- Simplicity – you can get it all (heating, cooling, ventilation)
- Readily Available
- Great option for leased space
- Low first cost option
University mall
Barnes and Noble
RTU Problems

- Out of sight out of mind
- Lack of maintenance
- Limp along attitude
- False sense of efficiency
What can be done to improve them? We propose three options to fit numerous budget situations.

1. Good - Maintenance

2. Better – Advanced Controls

3. Best – New “Best of the Best” Unit
Average Costs of Approach
10 Ton RTU

<table>
<thead>
<tr>
<th>Cost of Measure</th>
<th>$5,000</th>
<th>$10,000</th>
<th>$15,000</th>
<th>$20,000</th>
<th>$25,000</th>
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<tbody>
<tr>
<td>Maintenance</td>
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<tr>
<td>Controllers</td>
<td></td>
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<td>New Unit</td>
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Method of Savings:
- Maintenance
- Controllers
- New Unit
Age Based Approach Applicability

- **Age of RTU**
  - 0 to 5 Years: GOOD
  - 5 to 10 Years: BETTTER
  - 10 to 25 Years: BEST
  - 15 to 25 Years: 15 to 25 Years
The Good Approach

Overhauling and maintaining your existing RTU

• Quarterly and yearly preventive maintenance
• Planning for failures and replacements
• What do you need to be looking for?
• Education
The Better Approach

*Add advanced controls to existing RTU*

- Definition of advanced controls:
- VFD control of supply fan and compressor or supply fan only
- Advanced Economizer functions
- Fault diagnostics and web based interface
- We’ve worked with Digi RTU and Catalyst
How do Controllers Work?

- **Note:** You need a properly functioning RTU before a controller is installed.
The Best Approach: DOE Challenge Qualifying Units

- Install new “high efficiency” >18IEER unit
- Not cost effective if existing RTU is functioning properly and is well maintained.
- Best when replacing failed units or scheduled replacement due to end of life
- R22 phase-out will have an impact on the market take-up
Potential Energy Savings

- Compared to a code compliant 10 ton RTU
- 5,000 KWH savings/Year
- 30 MMBTU savings/Year
- $1100-1600/year operating cost savings

- Conservative Incremental Cost $8,000
- Return on Investment 5-7 years
Efficiency Vermont RTU Pilot Results
# Pilot Scope

<table>
<thead>
<tr>
<th>Location</th>
<th>Space Type</th>
<th>RTU Size Range</th>
<th>RTU Age Range</th>
<th>Number of RTU’s Metered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vermont Country Store</td>
<td>Mixed Use, Mainly Warehouse, some Office</td>
<td>8 to 20</td>
<td>13 to 21</td>
<td>6</td>
</tr>
<tr>
<td>Vishay</td>
<td>Light Manufacturing</td>
<td>10 to 15</td>
<td>1 to 12</td>
<td>5</td>
</tr>
<tr>
<td>Vermont Energy Investment Corporation</td>
<td>Office</td>
<td>8 to 30</td>
<td>2 to 10</td>
<td>3</td>
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</tbody>
</table>
What did we Find?
Inoperable Compressors
Compacted Coils
Corroded Contactors
Worn Belts
Things to Watch out For
What was the energy impact of the tune-up?
Controller Energy Savings per Ton

- Office
- Warehouse
- Manufacturing

kWh Savings / ton

- 500
- 1,000
- 1,500
- 2,000
- 2,500
- 3,000
- 3,500
The Better Approach: Controller
% Savings

- Office: 60%
- Warehouse: 50%
- Manufacturing: 40%
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.

• Installation of up to another 8 controllers in phase 2

• Published results of all pilot locations
Conclusion

- Options for existing RTU
- Cost effective solutions
- Path to energy savings