Advanced RTU Campaign
Taking Action Toward Efficient RTUs
Michael Deru
February 25, 2014
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
- Big decline 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>IEER</td>
<td>IEER</td>
</tr>
<tr>
<td>8.7</td>
<td>10.1</td>
<td>10.1</td>
<td>11</td>
<td>11.2</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>13.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>18</td>
</tr>
</tbody>
</table>

Credits: Michael Deru, Ian Doebber
Replacement Example

- Assume a 10 ton RTU that runs an equivalent 1,500 full load hours per year and $0.15/kWh (New York average)

<table>
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<tr>
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<th>Existing 15 year old RTU</th>
<th>90.1-2010</th>
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<tr>
<td>EER/IEER</td>
<td>7.3</td>
<td>11</td>
</tr>
<tr>
<td>Energy Cost</td>
<td>$3,699</td>
<td>$2,455</td>
</tr>
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<td>Annual Savings</td>
<td>$1,244</td>
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Credit: Michael Deru
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<td>$2,455</td>
</tr>
<tr>
<td><strong>Annual Savings</strong></td>
<td>$1,244</td>
<td>$1,742</td>
</tr>
<tr>
<td><strong>NYSERDA Incentive ($80/ton)</strong></td>
<td></td>
<td>$800</td>
</tr>
<tr>
<td><strong>First Year Savings</strong></td>
<td></td>
<td>$2,542</td>
</tr>
</tbody>
</table>

Credit: Michael Deru
What are RTU Retrofit Controls?

- For units <10 years old and > 7 tons of cooling capacity
- 40% to 50% energy savings with a 2-4 year payback

Common Features
- Integrated Economizer Control
- Variable Speed Fan Control
- Demand Controlled Ventilation

Other Potential Features
- FDD and Remote Monitoring
- Variable Speed Condenser Fan Control
- Compressor control

Credit: Ian Doebber
57% Average Electricity Savings
- 61 RTUs (45 RTUs with gas and 16 heat pumps)

Source: PNNL Report #22656
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
## Preliminary Screening Example

### Rooftop Unit Inventory Spreadsheet

**Version 2.0, 10/28/2013**

<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

- Visual based inspection, no measurements required
- Need to be familiar with RTUs but not a trained technician

<table>
<thead>
<tr>
<th>Component Description</th>
<th>Rating</th>
<th>Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>Condenser Coil. (Good, Fair, or Poor; Schedule a Service)</td>
<td>Good</td>
<td>No</td>
</tr>
<tr>
<td>Refrigerant Piping. (Good, Fair, or Poor; Schedule a Service)</td>
<td>Good</td>
<td>No</td>
</tr>
<tr>
<td>Cabinet. (Good, Fair, or Poor; Schedule a Service)</td>
<td>Good</td>
<td>No</td>
</tr>
<tr>
<td>Evaporator Coil. (Good, Fair, or Poor; Schedule a Service)</td>
<td>Good</td>
<td>No</td>
</tr>
<tr>
<td>Burner Section. (Good, Fair, or Poor; Schedule a Service)</td>
<td>Good</td>
<td>NA</td>
</tr>
<tr>
<td>Compressor. (Good or Poor)</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). (Good, Fair, or Poor; Schedule a Service)</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**

<table>
<thead>
<tr>
<th>Feature</th>
<th>(Y/N)</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>
Analysis

- RTU Incentives Database, DSIRE
- RTU Comparison Calculator
- 179D DOE Calculator
- Case Studies
Contacts

Advanced RTU Campaign: www.advancedrtu.org
Michael Deru, 303-384-7503  michael.deru@nrel.gov
Marta Milan, 231-598-2332  martamilan@waypointbuilding.com
Keeping the “Efficient” Part in Efficient RTUs:

Design Correctly
Install Wisely
Optimize Effectively

Ed Smyth, MBA, CEM
edward.smyth@dnvgl.com
It’s only an efficient RTU out of the factory...unless it’s:

- Designed to fit correctly... ANSI/ASHRAE/ACCA Quality Installation (QI) standards

- Installed correctly using QI

- Optimized correctly... ANSI/ASHRAE/ACCA Quality Maintenance
Industry need for standards...

Most states and municipalities do not have certification or licensing for HVAC

- In US, 30 states do not require state-level licensing...including New York

- In NY State, only selective municipalities require licenses
design
install
optimize
CORRECTLY
ASHRAE/ACCA standards for

Quality Maintenance

and

Quality Installation
Quality Installation

Quality Maintenance
Standard 180-2008 (revised 2012)
design

CORRECTLY
Section 3: Design

Ensures proper...

- **Ventilation** calculations
- **Building** heat gain/loss load calculations
- **Equipment** capacity selection
- **Matched** systems
install
CORRECTLY
Section 4: Equipment Installation

- **Airflow** and **water flow** within acceptable ranges
- Proper **refrigerant charge**
- **Electrical** requirements are met
- Matched systems
- Fuel-fired equipment **combustion “on rate”**
- Proper sizing, design of **combustion gas venting**
- Proper selection /functioning of **system controls**
Section 5: Distribution

– Duct leakage minimized
– Airflow and hydronic flows meets design requirements
ANSI/ASHRAE/ACCA Quality Installation

Section 6: System Documentation

Owner Education

– Proper system documentation to the owner
– Owner/operator educated on O&M requirements
optimize

CORRECTLY

Section 4: Implementation

4.1 Responsible Party

“The building owner shall be responsible for meeting the requirements of this standard.”

Owner may designate other parties to fulfill the owner’s responsibility

4.2 Maintenance Program

Written Maintenance Requirement

– Inventory of all HVAC equipment and systems inspected and maintained.

– List details unacceptable performance indicators

– List includes inspection frequencies and maintenance tasks
Frequencies and Metrics

- **Set performance objectives** from design and operational criteria (such as...design documents, ASHRAE standards, or similar)

- **Define condition indicators** (ex. deformation, discoloration, oxidation, corrosion, scale, leakage of fluid or vapor, excessive noise / vibration, and similar)

- **Define how maintenance will be performed** – Section 5 details minimum recommended frequencies
Maintenance indicator & checklist: Example

Visible indicator: *Dust build up*

Inspect and clean frequency: *Quarterly*

Modify frequency if needed.
Section 5: Tables

Examples...

- Table 5-3  Boilers
- Table 5-16  Furnaces
- Table 5-12  Economizers
- Table 5-22  Rooftop units
Training for HVAC contractors – Rooftop AC unit QM plus use of diagnostic tool

Classroom

follow up & mentoring

Incentives paid for training, tool purchase, and QM projects

Case studies, press releases, newsletters

Dedicated website

Ongoing promotional support for Partners

Case studies, press releases, newsletters

Dedicated website

NYSERDA HVAC Business Partners – 2014
Rooftop unit projects by qualified HVAC Partners

Test in, test out
- Use approved diagnostic tool
- Data shows system improvement

Quality Maintenance tune up
- Refrigerant charge and airflow
- Follows QM standard for rooftop units and economizers
Quality Maintenance and Savings

Sampling of things uncovered in a proper QM-specified inspection, and estimated savings.
Found: **Bad wire**

Repair saved the compressor from internal damage and needed replacement.

*Est. savings on avoided compressor replacement:*

$2,500 - $3,000

Photo credit: Frank Cerbone, All State Air
Found: **Bad bearing**

Replacement prevented fan wheel and cover from being torn apart.

*Est. savings on avoided fan housing and fan replacement:*

*$900 - $1,500*

*Photo credit: Frank Cerbone, All State Air*
Found: **Bad belt**

Unit had extended run cycles to meet load.

*Est. one year energy savings for proper cycling:*

$352

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Photo credit: Frank Cerbone, All State Air
Handheld diagnostic tool

Photo credit: Frank Cerbone, All State Air
Diagnostic tool – close up
Temperature probe – close up

Photo credit: Frank Cerbone, All State Air
Condenser coil cleaning
Ampmeter use

Photo credit: Frank Cerbone, All State Air
Who Benefits?
Customer Benefits

- Reduce energy costs
- Reduce emergency svc. calls
- Increase comfort
- Reduce dust, mold, mildew
- Expand equipment life
- Positive working relationship with Business Partner
Business Partner is differentiated as trusted industry expert

Enhance business value

Reduce emergency service call scheduling

QM – Uncover problems, sell proper repairs

QI – Avoid call backs

Business Partners use NYSERDA incentives and support for QM projects

Contractor Benefits
Takeaways and Recommendations

For rooftop AC unit replacement projects:

- **Use, specify, or recommend** the ANSI/ASHRAE Quality Installation for design and installation.
- Use installation documents as O&M foundation for ASHRAE/ACCA Quality Maintenance Construct QM plan according to QM Standard.
- **Apply diagnostic testing** or on-board diagnostics to safeguard optimal operation.
Questions or follow up

Lou Tisenchek
louis.tisenchek@dnvgl.com
518-266-9360 ext. 306