Advanced RTU Campaign: Utility Barriers and Solutions to RTU Controls Incentives

Lauren Smith
Southwest Energy Efficiency Project (SWEEP)
March 23, 2015
SWEEP is a regional energy efficiency organization promoting greater energy efficiency in the Southwest.
SWEEP Program Areas

- State and Local Government
- Buildings and Energy Codes
- Combined Heat and Power
- Transportation
- Industrial Efficiency
- Utilities
Commercial Utility Programs

- Design assistance programs
- Net zero energy
- EDAPT
- Upstream incentives
- Advanced technologies
Advanced Technologies

- Provide recommendations and information to utilities so that they can evaluate the feasibility of incorporating advanced technologies.
- Support addition of new measures into utility programs.
- Example technologies:
  - advanced RTU controls
  - advanced power strips
  - wireless meters
  - new lighting devices and controls
Energy Design Assistance Program Tracker

- Provides a standardized energy modeling platform using OpenStudio and EnergyPlus;
- Program managers and project team can quickly see project status, and who is responsible for the next step;
- Notifications are automatically sent out when new material is posted to the site;
- The utility can review the projected savings for individual projects or for all EDA projects.
Utility Programs in the Southwest

- Prescriptive rebates
- Custom rebates based on savings
Advanced RTU Campaign (ARC) - Advanced RTU Control Retrofits

Michael Deru
Advanced RTU Campaign
March 23, 2015
Advanced RTU Campaign

- DOE/Industry partnership
- Launched May 30, 2013
- Promote high-efficiency RTU solutions:
  - High-efficiency replacements and new installations (CEE Tier 2 and above)
  - Advanced RTU control retrofits
  - Quality Installation and Quality Maintenance

www.advancedrtu.org
Why Are RTUs Important?

- RTUs cool over 60% of U.S. commercial building floor area
- Consume 4.3 Quads annually
- Large stock of 6 to 16 year old RTUs

Source: AHRI

Credit: Michael Deru
What Can we do with all these RTUs?

1. Planned replacement with high-efficiency RTUs
   - Consider for all RTUs > 10 years old

2. Retrofit with variable speed controls
   - Consider for RTUs > 7 tons and < 10 years old

Advanced RTU Campaign: Decision Tree for RTU Replacements or Retrofits

Preliminary Screening
What is the general condition, age, and size of each RTU?

Is the RTU a candidate for retrofit or replacement?

- General Condition
  - Fair-Good, Under 10 years
    - Under 7 tons
    - Over 7 tons
  - Fair-Good, Over 10 years
  - Poor

- Age
- Size

Initial Inventory
- Building name
- Space type
- Manufacturer
- Model
- General condition
- Maintenance history

No Action  Retrofit  Replace  Replace
RTU Evaluation Process and Resources

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
- **Measurement and Verification (M&V)**: Use the M&V Guidance
What are RTU Retrofit Controls?

**Common Features**
- Integrated Economizer Control
- Demand Controlled Ventilation

**Variable Speed Fan Control**
- FDD and Remote Monitoring
- Variable Speed Condenser Fan Control
- Compressor control

Credit: Ian Dobeber
Essential features:
- Multi-speed or variable speed supply fan control with, at a minimum, reduced fan speed operation for first stage cooling and ventilation modes
- Modulating outdoor air damper control to maintain proper ventilation rates according to ASHRAE Standard 62.1 under different fan speeds

Highly desirable features:
- Demand controlled ventilation
- Integrated economizer control
- Remote monitoring and control
- Automated fault detection and diagnostic capabilities
- Economizer control with differential dry-bulb and dew-point lockout
- Demand response or demand management

Additional features:
- Advanced thermostat control:
  - Optimum start
  - Predictive cooling with smart economizer control
- Condenser fan control
- Compressor variable capacity control
## RTU Advanced Control Retrofits

<table>
<thead>
<tr>
<th>Case</th>
<th>Number of RTUs</th>
<th>Energy Savings</th>
<th>Cost Savings</th>
<th>Payback</th>
</tr>
</thead>
<tbody>
<tr>
<td>BJs Wholesale</td>
<td>12</td>
<td>52% (RTU electricity)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>U.S. Navy JBPHH</td>
<td>11</td>
<td>100,000 kWh/year</td>
<td>$58,000/yr</td>
<td>3-5 years</td>
</tr>
<tr>
<td>PNNL demo report</td>
<td>61</td>
<td>Average 57% (RTU electricity)</td>
<td></td>
<td>2 years average</td>
</tr>
<tr>
<td>CEE Minnesota</td>
<td>37</td>
<td>29% (RTU electricity)</td>
<td></td>
<td>5-25 years</td>
</tr>
</tbody>
</table>
Best Applications for Control Retrofits

- **Existing RTUs**
  - constant speed supply fan operation
  - greater than 7.5 tons (evaporator fan $\geq 2$ hp)
  - at least 5 years of remaining life

- **Existing buildings**
  - more than 50 hours per week of operation
  - high electricity rates ($\geq 0.10$ $$/kWh$ blended rate)
  - located in a climate with significant swing seasons (more time in first stage cooling or ventilation only)
How to Join the Advanced RTU Campaign

Join as a Participant

*Building owners and managers with influence over building operations and management*

- Pledge to evaluate existing RTUs, implement a replacement or retrofit, and share savings with the Campaign
- Agree to be listed on the Campaign website as a Participant
- If applicable, evaluate your energy savings potential and share this information with the Campaign
- If applicable, submit documentation of RTU replacements or retrofits to earn an Award that demonstrates your leadership in building energy efficiency

Join as a Supporter

*Organizations that provide technical services and products, electric utilities, or regional efficiency organizations*

- Spread the Campaign’s message
- Recruit Participants
- Offer resources to help building owners and managers improve their buildings' efficiency
- Share data from energy efficient RTU replacement/retrofit cases

www.advancedRTU.org
Utility Programs for Advanced RTU Controls

Mary Horsey
Associate Director
Technology Assessment Service
E Source
Who Is E Source?

- Research and advisory firm with 25 years of utility experience
- 80 staff, headquartered in Boulder, Colorado
- Membership-based
Today’s Topics

Energy Efficiency Incentives
  ✓ Prescriptive
    ➢ Upstream
    ➢ Downstream
  ✓ Custom

Who Has What Goals?
  ✓ Energy
  ✓ Power

A Snapshot of Utility Programs

- Bonneville Power Administration
- OPPD
- City of Fort Collins Utilities
Utility Energy Efficiency Incentives

Prescriptive

Upstream

Downstream

Custom

Courtesy: Simbach

Courtesy: Sky-2.png
HVAC Upstream Program Potential

Figure 2 | PG&E Commercial HVAC Program Results: 1993-2013

Downstream Years vs. Upstream Years

Courtesy: SWEEP
Who Has What Goals?

Energy efficiency (kWh)
Meet annual goals

Demand (kW)

**Overall:** Defer future T&D investments and mitigate future capacity constraints

**Demand response:** Reduce daily peak demand

Advanced RTU controls can help meet both ... and more.
Bonneville Power’s ARC Program

Advanced RTU Controls (ARC): Downstream Program

1. Supply Fan Control
   Fan-cycling
   Multi-speed
   VSD
2. Demand Controlled Ventilation
3. Digital, integrated economizer control
4. Web-enabled
BPA’s ARC Energy and Cost Savings

<table>
<thead>
<tr>
<th>Occupied Hours</th>
<th>Energy Savings (kWh/ton)</th>
<th>Incentive ($/kWh)</th>
<th>Incentive ($/ton)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000 - 4000</td>
<td>750</td>
<td>$0.20</td>
<td>$150</td>
</tr>
<tr>
<td>4001 - 8760</td>
<td>1125</td>
<td>$0.20</td>
<td>$225</td>
</tr>
</tbody>
</table>
BPA’s ARC-Lite Retrofit Measure

ARC-Lite: Field Testing New Controls Technology in 2015

1. Supply Fan Control
   - Fan-cycling
   - Multi-speed
   - VSD

2. Demand Controlled Ventilation

3. Digital, integrated economizer control

4. Web-enabled

- Achieves additional reduction in supply fan energy use
- Adds web-enabled monitoring of system status points

Targeted Applications

Buildings with long operating hours
- Non-grocery retail
- Gyms
- Offices
- Restaurants

[Image of Bonneville Power Administration]
ARC-Lite’s Projected Energy and Cost Savings

<table>
<thead>
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<th>Occupied Hours</th>
<th>Energy Savings (kWh/ton)</th>
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- BPA will fully fund up to 30 ARC –Lite Retrofits
- Review both technology and ET Field Test concept
Omaha Public Power District

RTU Controller Incentive Program
1. Supply Fan Control
   Fan-cycling
   Multi-speed
   VSD
2. Variable Speed Compressor Control
3. Demand Controlled Ventilation
4. Digital, integrated economizer control
5. Web-enabled
OPPD – KW Savings Only

<table>
<thead>
<tr>
<th>Average Savings</th>
<th>Incentive ($/ton)</th>
</tr>
</thead>
<tbody>
<tr>
<td>41% kW, 52% kWh</td>
<td>184</td>
</tr>
</tbody>
</table>

Program Requirements
- Partner with approved Trade Ally (Upstream)
- 3 yr maintenance agreement on RTU
- RTU size 20 tons or less
- Incentive paid to Trade Ally or Customer
City of Fort Collins ARC Program

Advanced RTU Controls (ARC): Current Program

1. Supply Fan Control
   - Fan-cycling
   - Multi-speed
   - VSD
2. Demand Controlled Ventilation
3. Digital, integrated economizer control
4. Web-enabled
Customer Recruitment

1. RTU Survey
   Multiple units
   Various sizes of units

2. Targeted three sectors
   Retail
   Office
   Public Assembly
## City of Fort Collins ARC Energy and Cost Savings

<table>
<thead>
<tr>
<th>Average Occupied Hours</th>
<th>Average RTU Demographic</th>
<th>Energy Savings (kWh/RTU)</th>
<th>Incentive ($/RTU)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6,875</td>
<td>70% of RTUs &lt; 15 yrs old</td>
<td>15,000</td>
<td>$2,000</td>
</tr>
<tr>
<td></td>
<td>50% of RTUs = 5 tons in size</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Take-aways

- Incenting for kWh, kW, or both?
- Design upstream program if possible
For More Information

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Have a question? Ask E Source!
Submit an inquiry: www.esource.com/question
Developing Effective Utility Programs for Advanced Rooftop Unit Controls

Challenges & Solutions

Transformative Wave Technologies
Kent, Washington
TransformativeWave.com

Danny Miller,
President
North America’s Leading Retrofit Solution for Rooftop Packaged HVAC Systems
3 Pillars of RTU Efficiency

1. Optimize
2. Upgrade
3. Perpetuate
Solutions to Excessive RTU Energy Use

• Traditional programs have focused on:
  • REPLACE: with higher efficiency equipment – early retirement.
    • Less than 10% of purchased equipment are above code minimum
  • TUNE-UP: Using enhanced service procedures (ACCA 180)
    • Quality Maintenance Programs by SCE & NYSERDA
    • Air Care Plus by PG&E & ComEd
    • Premium Efficiency Cooling Program by SDG&E
    • Premium HVAC Service Program by PSE

• Retrofitting RTUs with Advanced Rooftop Controls provides another option that can be very cost-effective and impactful, especially with proper utility program support.
Is It Supported by Proven Results?

• Our product provides consistent and verifiable results.
  • Verified by multiple third party trials, including 2 PNNL year study of 66 units across 4 different climate zones in various building types.
  • Many utility-funded demonstrations with published results.
  • Over 5-years track record in the field.

• E-Source named RTU Retrofit as “ready for prime time” and full scale utility program support.

• Thousands of installations exist across the country

• Market is responding as commercial building operators are becoming aware of the potential of this new energy conservation measure.
Utility Trends

• There is a surge of interest by utilities looking to develop their own programs for RTU Retrofit with advanced controls.

• Utilities and 3rd party program operators increasingly approach us directly for information that will assist them in developing a program for the CATALYST.

• The northeast and west coast utilities have been the leaders to date with some noteworthy exceptions.

• Prescriptive incentives are emerging in many markets.

• Some pay for Fault Detection and connected “smarts”
Program Challenges

• Each utility insists upon its own path to adoption and has its own regulatory reality to navigate.

• Some focus on energy savings and some on demand reduction.

• Advanced Rooftop Controls are not an off-the-shelf product like lighting, VFDs, Tstats, etc. Utilities prefer hardware widgets.

• Requires a capable and trained contractor network (*We do not self perform exclusively. We tap into the local contractors*)

• Need for consistent installation techniques to avoid undisciplined encroachment into the RTU. (*We deliver as a complete kit*)

• Not all products are created equal. Variations in control approaches with different ARC products. Some raise concerns about equipment impact.

• Variations in the amount of 3rd party validation among ARC products
Barriers to Market Uptake

• The diverse program and incentive landscape makes it extremely difficult to provide a singular message to large customers.

• Program Problems:
  • Multi-year validation process is too lengthy.
  • Utilities often require their own demonstration projects.
  • Lack of consistent incentive structures, requirements across utilities
  • Small scale demonstrations may not be representative.
  • Too many unnecessary restrictions: age, size, factory controls
Keys to a Meaningful & Attractive Program

- Trust the work of others, don’t reinvent the wheel
- Manage the Gate Keepers
- Kick Start your Program by funding a trial of sufficient scale.
- Avoid Lowest Common Denominator Syndrome
- Avoid “One-Size-Fits-All” incentive approach that fails to reward important product distinctions and/or overpays those who lack them.
- Support Code Compliance
- Go Prescriptive
  - Custom programs take too long and are unnecessary.
  - Avoid being overly conservative – pay fully for the savings.
  - Support the factors that also contribute to savings persistence
Be Patient and Spread the Word

• This is a new area of energy efficiency and the consumers need to gain awareness and confidence.
• Don’t expect immediate overwhelming results. They will come.
• It has taken over 5 years for the efficiency industry to come around to support this measure with prescriptive incentives. It will take some time to gain market momentum that will produce big numbers.
• Communicate internally and create program awareness
• Educate Key Account Reps who have the ear of the customer
• Eliminate the reluctance to mention proven products by name. It doesn’t have to be a product endorsement to share the facts.
Thank You!

danny@twavetech.com

http://transformativewave.com/contact-us
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