ENERGY STAR® HVAC Opportunities

An Overview for Energy Efficiency Program Sponsors

February 7, 2017
Agenda

- ENERGY STAR HVAC Overview
  - Residential sector opportunity
  - Barriers to energy efficiency
- Solutions
  - Lack of efficient equipment availability emergency nature of replacement
  - Oversizing, airflow, refrigerant charge
  - Duct leakage
- Questions/discussion

**NOTE:** 79 TWhs equals 269 million MMBtus.

Conversion: 1 TWh = 3,412,141.633 MMBtus

Opportunities exist through:
- Efficient technology
- Nexus of technology and behavior
- Behavior
## Efficiency Opportunities and Solutions

<table>
<thead>
<tr>
<th>Barrier</th>
<th>Solutions</th>
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<tbody>
<tr>
<td>Emergency replacement/lack of EE equipment</td>
<td>ENERGY STAR certified products</td>
</tr>
<tr>
<td></td>
<td>Midstream incentives</td>
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<tr>
<td>Equipment used inefficiently</td>
<td>ENERGY STAR certified smart thermostats</td>
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<tr>
<td>Equipment installed poorly</td>
<td>Advanced technology solutions</td>
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<tr>
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<td>ENERGY STAR Verified Installation</td>
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<tr>
<td>Poor air handling systems (ducts)</td>
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Barrier 1: Inefficient Equipment/Emergency Replacement

- Majority of sales are replacements, and most of these are on an emergency basis
  - We’ve heard emergency replacements may be 80% of replacements; what have you heard?
- Inefficient/federal minimum equipment dominates distributor stock
- Inertia and a lack of incentives at the distributor level lead to ‘lowest common denominator’ choices by contractors
- Emergency replacement also limits quality installation (QI) because of the additional cost and time to install right
  - Who wants a duct check and repair when they don’t have heat?
Equipment Solutions: Defining Efficiency through ENERGY STAR

- Furnaces: 90 AFUE South, 95 AFUE North

- Split system CAC and ASHP, including ductless mini-splits and multi-splits: 15 SEER, 12.5 EER, 8.5 HSPF

- Single package CAC and ASHP: 15 SEER, 12 EER, 8.2 HSPF

- Gas boilers: 90 AFUE, Oil boilers: 87 AFUE

- GHP:

<table>
<thead>
<tr>
<th>Type</th>
<th>Closed loop</th>
<th>Open loop</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water to air</td>
<td>17.1 EER, 3.6 COP</td>
<td>21.1 EER, 4.1 COP</td>
</tr>
<tr>
<td>Water to water</td>
<td>16.1 EER, 3.1 COP</td>
<td>20.1 EER, 3.5 COP</td>
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<tr>
<td>DGX</td>
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<td>16.0 EER, 3.6 COP</td>
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</table>
Heating and Cooling Savings:

• Heating and cooling costs the average homeowner about $930 a year—nearly half the home's total energy bill.

• ENERGY STAR certified central air conditioners use 8% and heat pumps 5% less energy than conventional new models.

• If your central air conditioning unit is more than 12 years old, replacing it with a model that has earned the ENERGY STAR could cut your cooling costs by 30 percent.

• Certified gas furnaces are 12%-16% more efficient than standard models and can save from $35 to $95 in energy costs per year.

• Also look for ENERGY STAR certified boilers and geothermal heat pumps
Midstream Incentives for ENERGY STAR HVAC

- Midstream approaches to delivering incentives have several distinct advantages in this space.
- EPA is in the beginning stages of engaging with manufacturers, distributors, and utilities to kick start such a program.
- Midstream incentives allow distributors to make more $ per product sold, reduce administrative costs to utilities, and improve efficient offerings to consumers.
- Work will begin mid-2017. If you are interested in this new approach, please contact Dan Cronin (Cronin.Daniel@epa.gov)
### More Efficient Use of Equipment: ENERGY STAR Certified Smart Thermostats Criteria

<table>
<thead>
<tr>
<th>Metric</th>
<th>Statistical measure</th>
<th>Performance Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual % run time reduction, heating (HS)</td>
<td>Lower 95% confidence limit of weighted national average</td>
<td>≥ 8%</td>
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<tr>
<td></td>
<td>20\textsuperscript{th} percentile of weighted national average</td>
<td>≥ 4%</td>
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<tr>
<td>Annual % run time reduction, cooling (CS)</td>
<td>Lower 95% confidence limit of weighted national average</td>
<td>≥ 10%</td>
</tr>
<tr>
<td></td>
<td>20\textsuperscript{th} percentile of weighted national average</td>
<td>≥ 5%</td>
</tr>
<tr>
<td>Average resistance heat utilization for heat pump installations (RU)</td>
<td>National mean in 5°F outdoor temperature bins from 0 to 60°F</td>
<td>Reporting requirement</td>
</tr>
</tbody>
</table>

- Demonstrated by software output (.csv file) from CT service provider
- Alternate path: metric results still required, but field savings demonstrated by A/B test (agreed to by EPA) instead
Smart Thermostat Qualification Criteria (continued)

- **Device**
  - In the absence of connectivity, acts as basic thermostat
  - Static temperature accuracy of $\pm 2^\circ F$
  - Network standby power $\leq 3$ W
  - Time to standby $\leq 5$ min
- **Product**
  - Users can set and maintain a schedule.
  - Feedback to occupants about energy impacts of their choices.
  - Provide users info related to their HVAC energy consumption, e.g., HVAC run time.
  - Can collect data needed for field savings metric calculation.
  - Includes basic Demand Response (DR) criteria.
Smart Thermostats Present a Unique Opportunity

- Addresses households that are not going to upgrade their HVAC equipment
- Addresses the intersection of behavior and equipment
- Some households will save more than others
  - Homes that are unoccupied part of the time (doesn’t matter how irregularly)
  - Homes with broadband access
  - Those with high HVAC bills, but limited ability to invest in envelope or equipment improvements
- Also provides the potential for demand savings, and additional opportunities for customer interaction
- Requirements include 10% cooling/8% heating average reduction in HVAC run time, and limited standby power draw
Smart Thermostat Savings:

- Per ST: Approximately $50 per year or 8% savings.  
  - Surprisingly consistent across climates, except in the mildest
- Particularly compelling for homes with relatively inefficient equipment or high heating/cooling loads.
- Nationwide:

  *If all residential central heating and cooling controlled by a thermostat in the U.S. switched to an ENERGY STAR ST, it would save 56 trillion BTU and offset 13 billion pounds of greenhouse gas emissions, equivalent to the emissions of 1.2 million motor vehicles each year.*
Smart Thermostats: Implications for Utilities

• Many utilities already provide rebates for STs, but based on one to one agreements with manufacturers
• Can provide both gas and electric savings
• ENERGY STAR introduces a neutral metric to evaluate energy savings (i.e., not reliant on manufacturer-funded white papers or studies).
• Not reliant on metered data. Allows programs to be credible without data-sharing agreements between thermostat service provider & utility; particularly attractive to smaller utilities.

ENERGY STAR is the most trusted mark for energy efficiency and will lend existing incentive programs even more credibility and visibility!
Smart Thermostats: Opportunities to Co-Brand

- Smart Thermostats are coveted products that engage the user in ways unique to the category:
  - Remote control.
  - Connected Home hub.
  - (Subjectively) can improve the aesthetics of a home.
- Given that, EPA expects this to be an enormously successful product category and, for perhaps the first time, serves as a way to make saving energy fun!
Untapped Equipment Installation Savings

- Right sizing: ~ 5% of energy is lost to oversizing
- Air flow: ~3% of energy lost to improper airflow
- Refrigerant charge: ~ 4% lost to improper refrigerant levels
- Duct leakage improvement: 10-15% energy lost through leakage

Nationally, 50–70% of HVAC systems are improperly installed

Sources: Mowris and Jones, 2008

Source: Sensitivity Analysis of Installation Faults of Heat Pump Performance,
http://dx.doi.org/10.6028/NIST.TN.1848

Source: Piotr A. Domanski, Hugh I. Henderson, W. Vance Payne,
http://dx.doi.org/10.6028/NIST.TN.1848
Advanced Equipment Features Help with Some Installation Issues

- ENERGY STAR Most Efficient (ESME): pushing toward a future of smarter HVAC equipment
- Products covered: Furnaces, CAC, ASHP, ductless heating and cooling, and GHP
ENERGY STAR Most Efficient Requirements for HVAC

• In addition to aggressive requirements for EE performance, ESME requires:
  – At least 2 capacity steps: mitigates energy cost of oversizing
  – Plain text system alerts to homeowners suggesting specific actions, at least filter change and call for service: improves maintenance and supports ongoing contractor relationships
  – Automatic setup requirements including easy to set airflow and system tests: can help prevent airflow and refrigerant charge problems at installation

• ESME products are very high end and do not include all potential system status issues – this is an effort to set up for a future of smarter HVAC.

• Also ESME for AFUE gas and oil boilers without other requirements
ESVI Comprehensively Addresses HVAC Equipment Installation Including Air Handling Issues

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ESVI Technical Requirements

- Correctly sized and matched equipment based on load calculations
- Connected, well-sealed duct system (maximum leakage 20% or 50% reduction in leakage)
- Proper refrigerant charge
- Sufficient airflow in the system
- Contractor market based delivery
- Automated Validation Systems can provide “just in time” guidance to commissioning tech and verify performance targets have been met.

The factsheet can be found here.
Duct Leakage Solution

• Distribution system diagnostics is not delivered in a typical installation.
• ENERGY STAR aims to educate homeowners to seek an ESVI certificate that requires assessing and improving ductwork
• Ducts are the Achilles Heel of HVAC – generally undersized, leaky, out of sight (attics and crawlspaces) AND often main reason for poor airflow and comfort.
• Testing and duct remediation often not part of utility’s domain – sadly the same for HVAC contractors.
  – Getting contractors to take static pressure tests is hard enough!
ESVI – Tools & Resources

• Program design and implementation support
• Support Guide
• Sample program documents and forms
• Contractor training covering both technical and marketing topics
• Marketing materials including co-brandable “tear sheet”
• Training and technical support

For additional information visit www.energystar.gov/ESVI
Benefits of ESVI to Utility Companies

- Increase customer participation rates, increasing demand for:
  - Higher efficiency equipment and for
  - Distribution system improvements
- Add credibility when promoting the program to contractors, homeowners, utility commissions, and other stakeholders
- Unified consumer-centric messaging, regardless of specific rebates and program offerings
- Quicker quality installation program launch
- Ability to focus on marketing and ENERGY STAR messaging
- Increased likelihood that rated performance (energy savings) are real
# Efficiency Opportunities and Solutions

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Thank You!

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