



ENERGY STAR[®] HVAC Opportunities

*An Overview for
Energy Efficiency Program Sponsors*

February 7, 2017

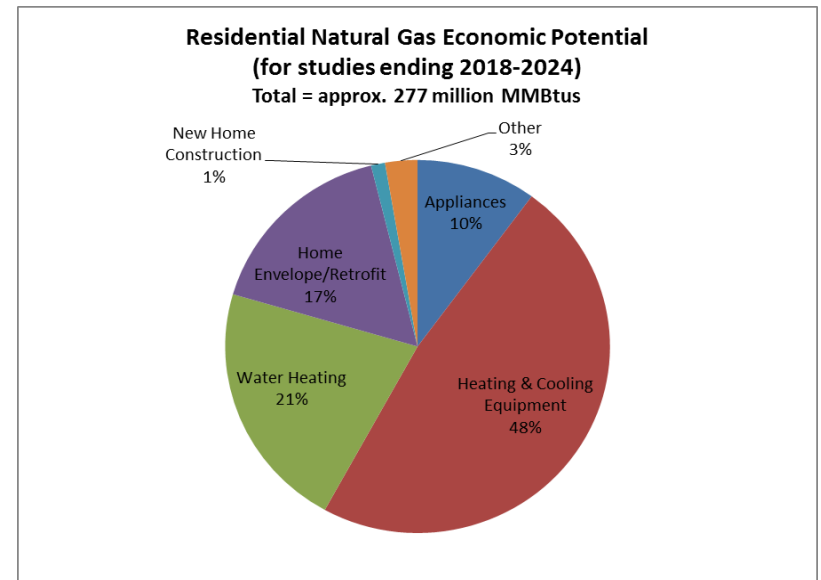
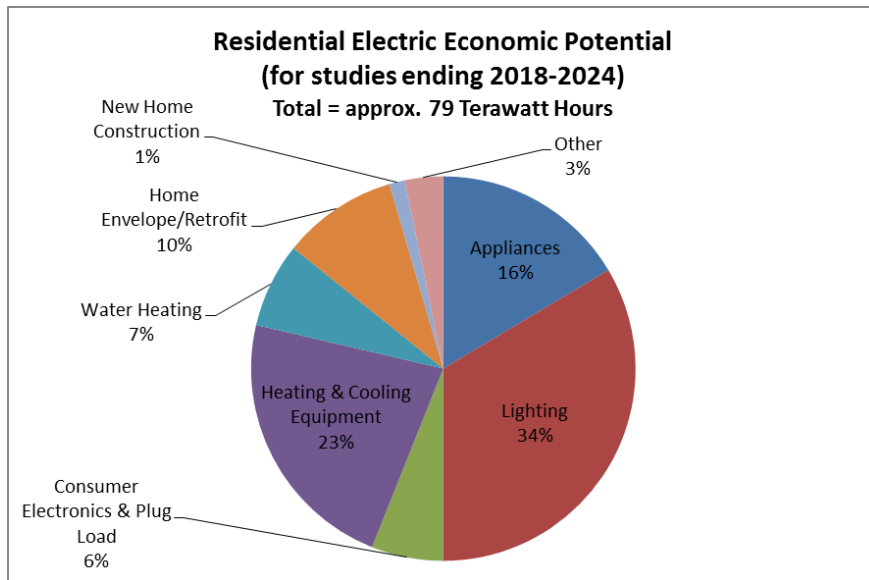


Agenda

- 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



Economic Potential: Residential Sector for Studies Ending 2018-2024



NOTE: 79 TWhs equals 269 million MMBtus.
Conversion: 1 TWh = 3,412,141.633 MMBtus
Source: <http://www.convert-measurement-units.com/conversion-calculator.php>

Opportunities exist through:
Efficient technology
Nexus of technology and behavior
Behavior



Efficiency Opportunities and Solutions

Barrier	Solutions
Emergency replacement/lack of EE equipment	ENERGY STAR certified products Midstream incentives
Equipment used inefficiently	ENERGY STAR certified smart thermostats
Equipment installed poorly	Advanced technology solutions ENERGY STAR Verified Installation
Poor air handling systems (ducts)	ENERGY STAR Verified Installation



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



QUALIFIED ONLY IN
U.S. SOUTH: AL, AZ, AR, CA, DC, DE, FL, GA, HI, KY, LA, MD, MS, NV, NM, NC, OK, SC, TN, TX, VA



- 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:

Water to air	Closed loop	17.1 EER, 3.6 COP
	Open loop	21.1 EER, 4.1 COP
Water to water	Closed loop	16.1 EER, 3.1 COP
	Open loop	20.1 EER, 3.5 COP
DGX		16.0 EER, 3.6 COP



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

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

- 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 $\pm 2^{\circ}\text{F}$
 - Network standby power $\leq 3\text{ W}$
 - Time to standby $\leq 5\text{ min}$
- 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

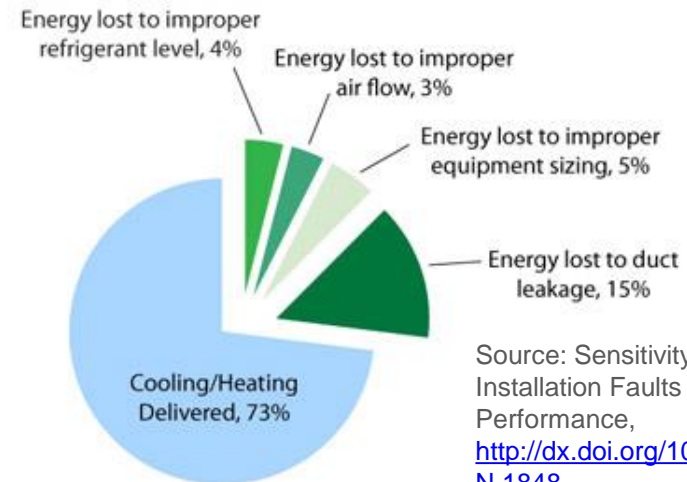
Nationally, 50–70% of HVAC systems are improperly installed

Sources: Mowris and Jones, 2008

<https://www.bae.uky.edu/energy/residential/guide/english/Chapter%207%20Heating%20Ventilation%20Air%20Conditioning.pdf>

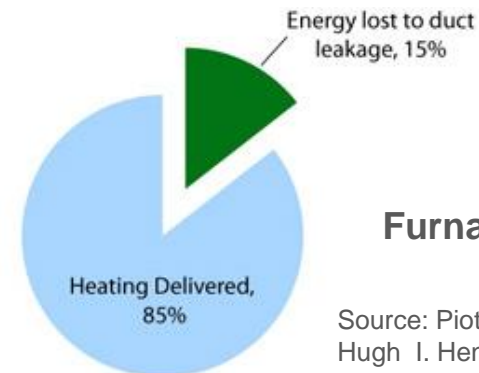


Heat Pumps and ACs



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

Furnaces



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

- 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



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 image shows a digital form for an ENERGY STAR® VERIFIED HVAC INSTALLATION CERTIFICATE. The form has a blue header with the ENERGY STAR logo and the title. Below the title, it says "CONGRATULATIONS!" and "Your new heating system has been designed, installed, and verified to meet ENERGY STAR Verified HVAC Installation (ESVI) requirements." There is a "JOB DETAILS" section with fields for Certificate / Job Number, Home Address, Technician, Date, Contractor Company, System Location, and System Description. To the right, there is a section titled "YOUR ESVI PROGRAM IS SPONSORED BY:" with a dashed box and the text "[Click to insert logo]".



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

ENERGY STAR Verified HVAC Installation is your assurance the job will be done right.

A properly installed high-efficiency system can lower your energy bills, increase your home's comfort, and extend equipment life.

ENERGY STAR Verified HVAC Installation Guidelines are based on the Air Conditioning Contractors of America's (ACCA) HVAC Quality Installation Specification and are recognized by the American National Standard Institute (ANSI). These standards help ensure that these critical steps have been completed properly:

- 1 All equipment is sized to your specific home.**
Oversized equipment may cycle too frequently, resulting in less comfort and shortened equipment life. Your contractor will calculate the right size for your air conditioner, furnace, or heat pump to optimize performance.
- 2 All ducts are checked for leaks and sealed.**
Over time, existing duct connections can leak, resulting in air loss and unnecessary energy waste. Your contractor will inspect the duct system, perform a test for duct leakage, and make the repairs needed to minimize loss.
- 3 Airflow is adjusted for optimal performance.**
If the volume of air flowing through the system is too high or low, it could mean higher utility bills and reduced comfort. Your contractor will measure the new system's air flow and make adjustments to optimize performance.
- 4 The proper amount of refrigerant is added.**
An improperly charged air conditioning pump may consume more energy than the air overly damp. Your contractor will check the refrigerant charge and make adjustments to ensure optimal comfort.

With ENERGY STAR in your house, better is better.
Your ENERGY STAR Verified HVAC Installation means better quality, better comfort, and better performance along with the added peace of mind that you'll be saving energy and helping reduce greenhouse gas emissions with EPA's ENERGY STAR. After all, better is better.

Once the installation is complete, a third party verifies the installation. With the completion of the installation, many contractors skip a step and are not ready to perform as prescribed. An EPA-approved over-the-counter multi-point ENERGY STAR Verified HVAC Installation checklist provides a certificate of verification.

The quality of an HVAC installation can mean a difference in heating and cooling costs of as much as 30%.

Only ENERGY STAR® Verified HVAC Installation® ensures the best in comfort, performance, and energy savings.



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

Solutions	Learn More
<p>ENERGY STAR certified products</p> <p>Midstream incentives</p>	<p>Energystar.gov/productdevelopment</p> <p>Stay tuned for upcoming webinar</p>
<p>ENERGY STAR certified smart thermostats</p>	<p>Energystar.gov/productdevelopment</p> <p>@energystar.gov</p>
<p>Advanced technology solutions</p> <p>E* Verified Installation</p>	
<p>Poor air handling systems (ducts)</p>	<p>E* Verified Installation</p>



Thank You!

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