Policy Supporting Energy Efficiency and Heat Pump Technology

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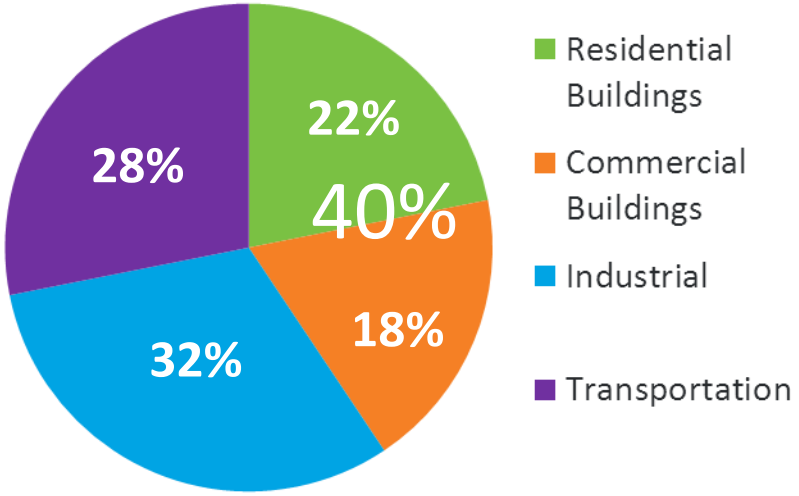
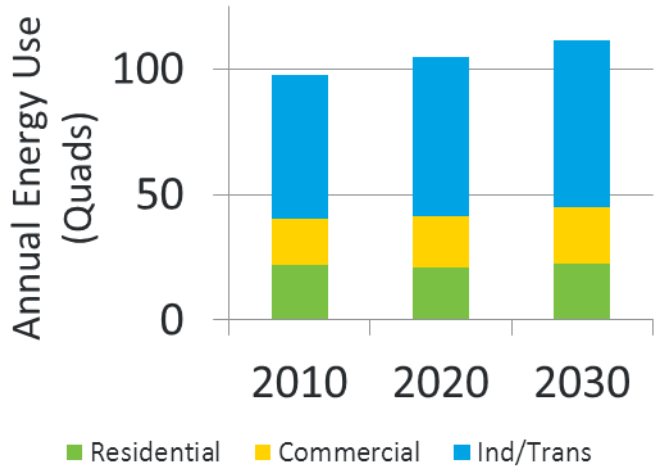
U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

The U.S. Energy Big Picture…

U.S. Primary Energy Consumption

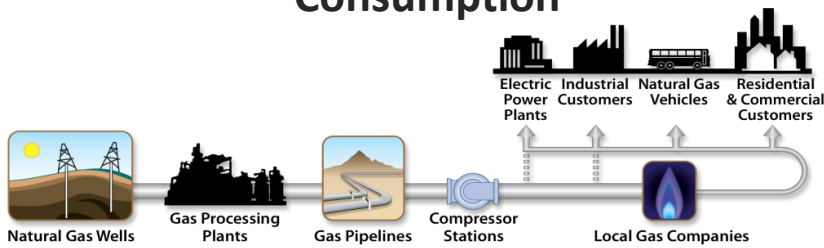


Total U.S. Energy Consumption



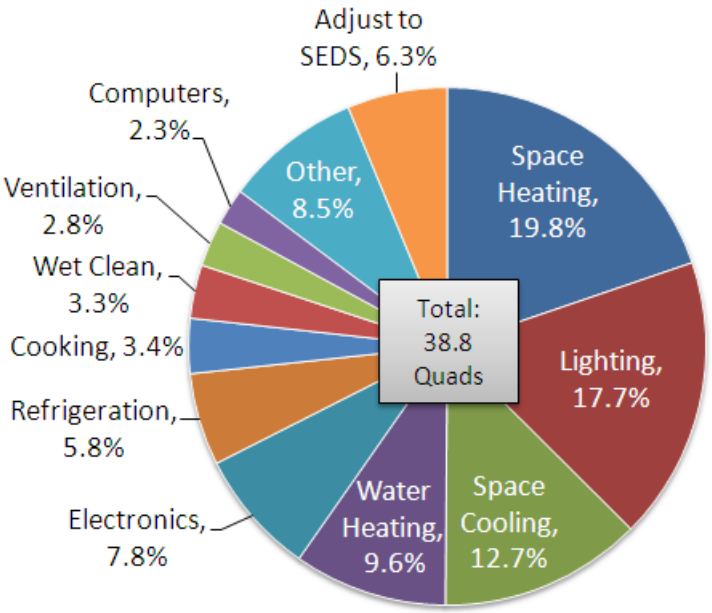
Buildings represent 73% of U.S. Electricity Consumption

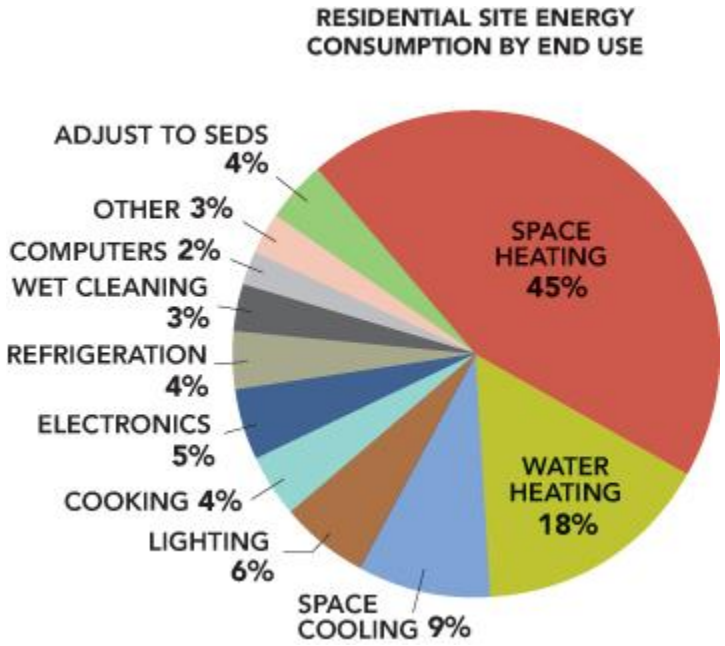
and 55% of U.S. Natural Gas Consumption



The challenge…

Buildings Primary Energy Consumption



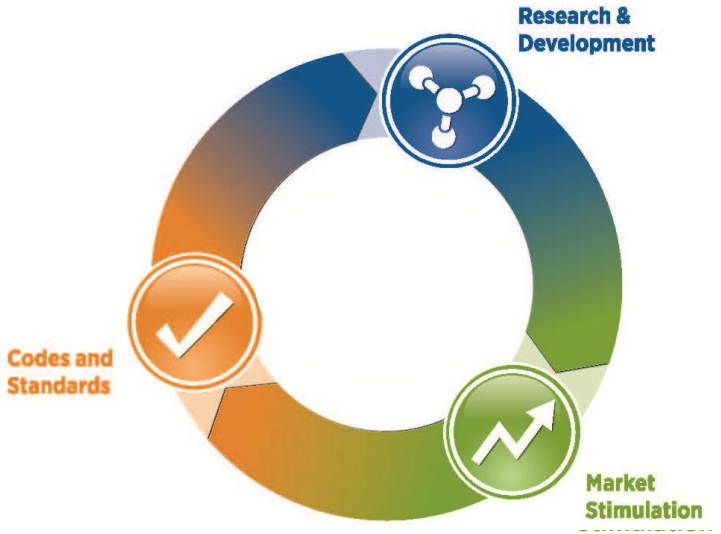


Source: http://buildingsdatabook.eren.doe.gov/ChapterIntro2.aspx

The Building Technologies Office (BTO) uses an Integrated Approach to Deliver Savings

Research & Development

- Develop technology roadmaps
- Prioritize opportunities for DOE
- Solicit and select innovative technology solutions
- Collaborate with researchers and market performers
- Solve technical barriers and test innovations to prove effectiveness
- Measure and validate energy savings



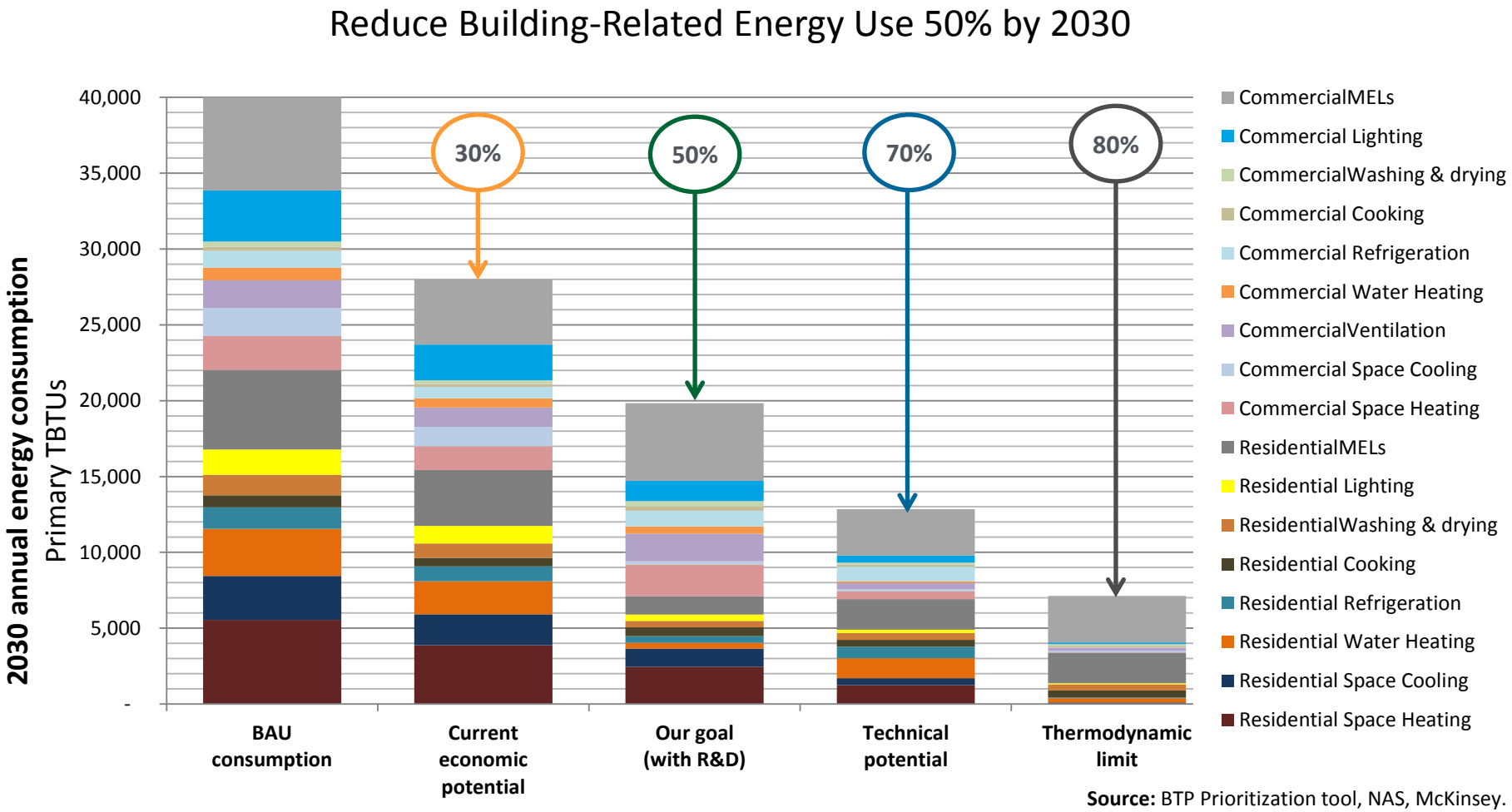
Market Stimulation

- Identify barriers to “speed and scale” adoption
- Develops solutions to policy, adoption, and financial barriers
  - Collaborate with industry partners to improve market adoption
  - Increase usage of products and services
  - Communicate the importance and value of energy efficiency
  - Provide technical assistance
  - Support development of workforce training and certification

Codes and Standards

- Establish minimum energy use in a transparent public process- raise the efficiency bar
- Protect consumer interests
- Reduce market confusion
- Enhance industry competitiveness and profitability
- Expand portfolio of energy efficient appliances and equipment

DOE Building Technologies Office (BTO) Pursues an Overarching Goal



Source: BTP Prioritization tool, NAS, McKinsey.

Advanced Heat Pump Technology for HVAC is a HUGE opportunity for BTO : up to 3.3 quads of energy savings potential in 2030 (at relatively low cost)

Report: http://www.nrel.gov/docs/fy12osti/54799.pdf

BTO's Heat Pump Research Program

HVAC Integrated Heat Pump (IHP) Technologies:

- *Ground Source –IHP (variable speed), 55% to 65% energy savings vs. min efficiency equipment suite*
- Air Source (AS)-IHP (2-speed), 40% to 45% energy savings vs. min efficiency equipment suite
- AS-IHP (variable speed), 45% to 55% energy savings vs. min efficiency equipment suite
- Multifunction Natural Gas-driven HP (10 to 17.5 kW), 70% peak demand savings; 40% source energy savings vs. minimum efficiency electric heat pump
- Developing Standard Method of Test (MOT) for IHP, working with ASHRAE/AHRI

HVAC Heat Pump (HP) Technologies, non-IHP:

- Next Generation Roof Top Unit (RTU) (70 kW), 25% energy savings vs. ASHRAE 90.1 RTU minimum efficiency unit
- Next Generation Window AC 30% energy savings vs. current min efficiency unit
- Cold Climate HP (10 to 17.5 kW), 50% to 70% energy savings at low ambient vs. current min efficiency ASHP

Water Heating Heat Pump (HP), non-IHP:

- Electric Heat Pump Water Heater (HPWH) with low-GWP (CO_2), 15% energy savings compared to Energy Star HPWH
- Absorption HPWH, 45% energy savings compared to Energy Star Natural Gas Storage WH

Heat Pump (HP) Appliances:

- HP Dryer, 40% energy savings

BTO's Crosscutting technologies

BTO's Crosscutting technologies:

- Heat exchangers: Compact designs [University of Maryland] and advance designs [Sandia Cooler]
- Working Fluids: Low GWP efforts at ORNL and NIST
- Cold Climate Heat Pump research: Technologies that improve heat pumps in general
- DOE is also starting to explore technologies with Separate Sensible and Latent Cooling (SSLC) capabilities
  - Max Tech and Beyond Design Competition for Ultra-Low-Energy-Use Appliances and Equipment Winner for 2012, University of Maryland Window Unit
  - DOE workshop, Spring 2013
  - Next Steps being worked on and evaluated against other priorities

What comes after vapor compression technology?

- Thermoelectric, Electrocaloric, Magnetocaloric, Thermoacoustic, Electrochemical, Adsorption, Thermoelastic, etc.

Desirable characteristics:

- Good LCCP (Life Cycle Climate Performance), continuous response to part-load conditions, integrated thermal storage, minimal/zero water consumption, cost effective, reduced size/weight and readily available materials

Building Technologies Office (BTO) *Future Technologies*

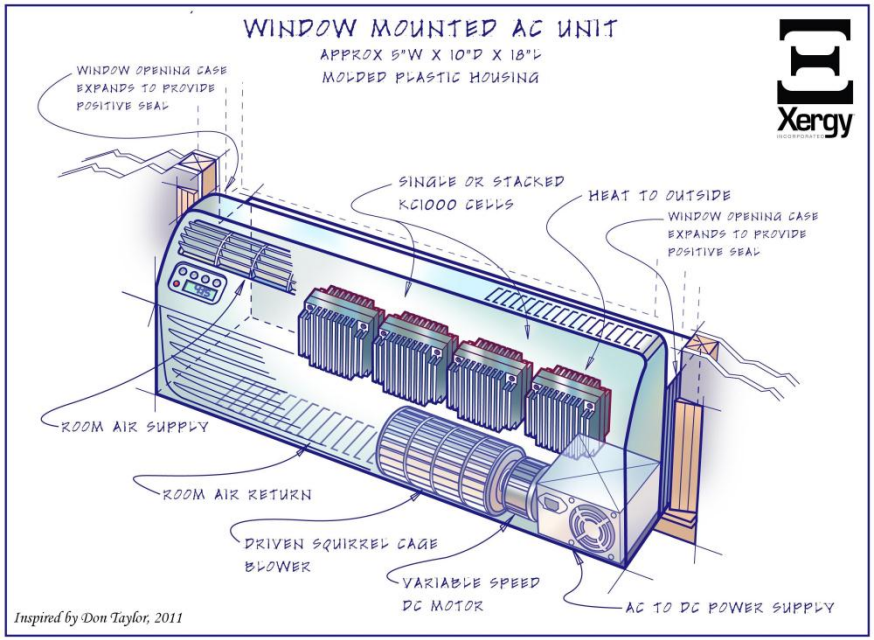
Electrochemical compressor, using water heating as starting point towards future HVAC products.

Xergy:

Advanced Hybrid Water-Heater

Xergy's technology is an electrochemical (EC) compressor that produces a small-volume of lightly pressurized hydrogen from electricity. It leverages existing proton-exchange-membrane (PEM) technology, and hydrogen's excellent thermodynamic characteristics to create this refrigeration cycle.

Future HVAC Product



Examples….

- Developing test procedures to facilitate market penetration
- Rebates and Tax Credit
- Mandatory efficiency performance standards (MEPS)
- Working with Industry to drive innovation (non R&D)
- Advanced Energy Design Guides
  - Offer designers and contractors the tools needed for achieving energy savings over minimum requirements of Standard 90.1-2004

GS-IHP, more than just developing technology

ClimateMaster CRADA

- Multifunction Electric Heat Pumps, GS-IHP
- Space conditioning, water heating, dehumidification, and ventilation
- Trilogy 40 Q-Mode™ could save about 60% of annual energy use and cost for space conditioning and water heating in residential applications
- 30% more efficient than any other available ground-source heat pump
- Broke the 40 EER Barrier in the USA
- Award Winning Product
- *No active, recognized test procedures or rating standards exist for IHP product*
- *Rebates or Tax credits? Energy Star?*

2012 DEALER DESIGN AWARDS
the NEWS | GOLD

R&D 100

AHR EXPO®
Dallas, TX • January 28 - 30, 2013

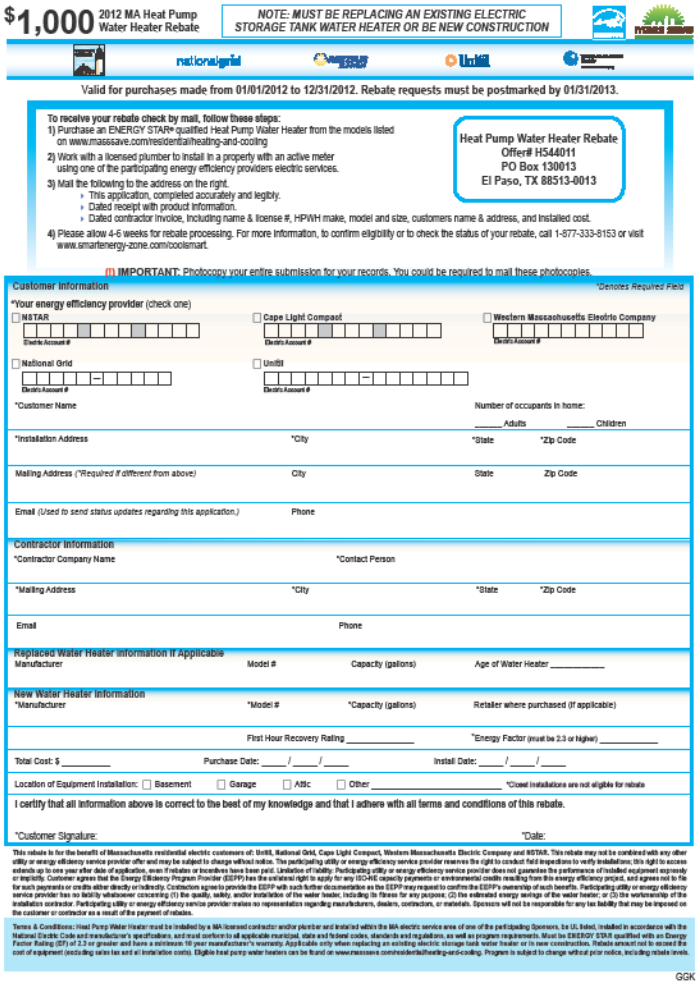
Develop Standard Test Method for IHPs to Facilitate Market Penetration

Draft test method for multi-function heat pumps like IHP

- Establishment of the testing and rating standards necessary for market success
- ASHRAE standard project committee (SPC 206) formed – "Method of Test for Rating Multi-Purpose Residential Heat Pumps for Space Conditioning, Water Heating and Dehumidification"
- Work began spring 2011
- Principal US contribution to Annex 39
- Support future rating standard by AHRI

Heat Pump Products

- Many States in the US have rebates for Heat Pump products
- State of Maryland: Save up to $1,150 per system, with rebates on high-efficiency equipment and services
- State of Massachusetts: $1000 rebate for HPWH if replacing an existing electric storage water heater
- Federal Tax credit for Ground Source Heat Pumps, 30% of cost with no upper limit, expires: December 31, 2016



$1,000 2012 MA Heat Pump Water Heater Rebate

NOTE: MUST BE REPLACING AN EXISTING ELECTRIC STORAGE TANK WATER HEATER OR BE NEW CONSTRUCTION

Valid for purchases made from 01/01/2012 to 12/31/2012. Rebate requests must be postmarked by 01/31/2013.

To receive your rebate check by mail, follow these steps:
1) Purchase an ENERGY STAR® qualified Heat Pump Water Heater from the models listed on www.masssave.com/residential/heating-and-cooling
2) Work with a licensed plumber to install in a property with an active meter using one of the participating energy efficiency providers electric services.
3) Mail the following to the address on the right.
- This application, completed accurately and legibly.
- Dated receipt with product information.
- Dated contractor invoice, including name & license #, HPWH make, model and size, customers name & address, and installed cost.
4) Please allow 4-6 weeks for rebate processing. For more information, to confirm eligibility or to check the status of your rebate, call 1-877-333-8153 or visit www.smartenergy-zone.com/coolsmart.

Heat Pump Water Heater Rebate
Offer# H544011
PO Box 130013
El Paso, TX 88513-0013

IMPORTANT: Photocopy your entire submission for your records. You could be required to mail these photocopies.

Customer Information *Denotes Required Field

*Your energy efficiency provider (check one)
NSTAR Cape Light Compact Western Massachusetts Electric Company
National Grid Unitil

*Customer Name Number of occupants in home: ____ Adults ____ Children
*Installation Address *City *State *Zip Code
Mailing Address (*Required if different from above) City State Zip Code
Email (Used to send status updates regarding this application.) Phone

Contractor Information
*Contractor Company Name *Contact Person
*Mailing Address *City *State *Zip Code
Email Phone

Replaced Water Heater Information if Applicable
Manufacturer Model # Capacity (gallons) Age of Water Heater

New Water Heater Information
*Manufacturer *Model # *Capacity (gallons) Retailer where purchased (if applicable)
First Hour Recovery Rating *Energy Factor (must be 2.3 or higher)
Total Cost: $ Purchase Date: ____/____/____ Install Date: ____/____/____
Location of Equipment Installation: Basement Garage Attic Other *Closet installations are not eligible for rebate

I certify that all information above is correct to the best of my knowledge and that I adhere with all terms and conditions of this rebate.

*Customer Signature: *Date:

This rebate is for the benefit of Massachusetts residential electric customers of: Unitil, National Grid, Cape Light Compact, Western Massachusetts Electric Company and NSTAR. This rebate may not be combined with any other utility or energy efficiency service provider offer and may be subject to change without notice. The participating utility or energy efficiency service provider reserves the right to conduct field inspections to verify installations; this right to access extends up to one year after date of application, even if rebates or incentives have been paid. Limitation of liability: Participating utility or energy efficiency service provider does not guarantee the performance of installed equipment expressly or implicitly. Customer agrees that the Energy Efficiency Program Provider (EEPP) has the unilateral right to apply for any ISO-NE capacity payments or environmental credits resulting from this energy efficiency project, and agrees not to file for such payments or credits either directly or indirectly. Contractors agree to provide the EEPP with such further documentation as the EEPP may request to confirm the EEPP's ownership of such benefits. Participating utility or energy efficiency service provider has no liability whatsoever concerning (1) the quality, safety, and/or installation of the water heater, including its fitness for any purpose; (2) the estimated energy savings of the water heater; or (3) the workmanship of the installation contractor. Participating utility or energy efficiency service provider makes no representations regarding manufacturers, dealers, contractors, or materials. Sponsors will not be responsible for any tax liability that may be imposed on the customer or contractor as a result of the payment of rebates.

Terms & Conditions: Heat Pump Water Heater must be installed by a MA licensed contractor and/or plumber and installed within the MA electric service area of one of the participating Sponsors, be UL listed, installed in accordance with the National Electric Code and manufacturer's specifications, and must conform to all applicable municipal, state and federal codes, standards and regulations, as well as program requirements. Must be ENERGY STAR qualified with an Energy Factor Rating (EF) of 2.3 or greater and have a minimum 10 year manufacturer's warranty. Applicable only when replacing an existing electric storage tank water heater or in new construction. Rebate amount not to exceed the cost of equipment (excluding sales tax and all installation costs). Eligible heat pump water heaters can be found on www.masssave.com/residential/heating-and-cooling. Program is subject to change without prior notice, including rebate levels.

GGK

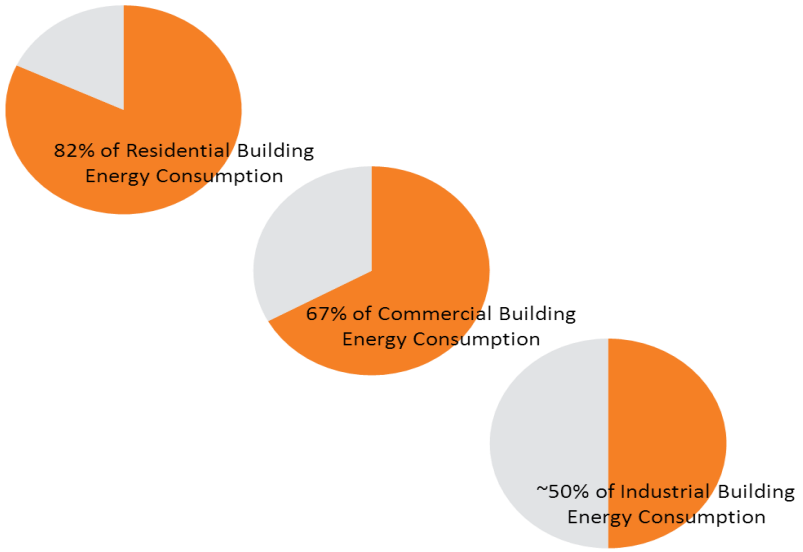
http://www.energystar.gov/index.cfm?c=products.pr_find_es_products

http://www.energystar.gov/index.cfm?c=tax_credits.tx_index#c3

Appliance Standards and Test Procedures is DOE's Most Effective Energy Saving Program

- Energy saved since first 1987 standards = construction of ~31 power plants avoided or the amount of electricity consumed annually by Spain
- 1988 – 2006 standards est. cumulative energy savings = **39 quads by 2020** and **63 quads by 2030**
- Cumulative consumer benefit*:
  - $64 billion at the end of 2005
  - $150 billion as of 2010
  - $241 billion by 2030
  - $269 billion by 2045
- Annual carbon savings will reach 38 million tons by 2020
- Cumulative carbon savings by 2045 is estimated at 1,200 million tons

- <$650 in net savings for every federal dollar spent
  - Consumers and businesses are saving $15 billion a year as of 2010 and this is expected to nearly double by 2025
- Over 50 products covered:



Quad = 1.055 exajoule (EJ)

*Net present value

Commercial Building Energy Alliance (CBEA) HVAC Roof Top Unit (RTU) Challenge

Working with Industry to Drive Innovation: The RTU Challenge

- Package units like RTUs use ~ 50% of the cooling energy in commercial buildings
- ~40,000 ten ton RTUs sold/year in the U.S.
- Challenge U.S. manufacturers to build and deliver innovative, competitively priced, energy-saving RTUs that meet high-performance specifications:
  - Efficiency from baseline 11.0 EER to 18 IEER
  - Decrease air flow by specifying variable over constant air volume
  - Increase fan efficiency from 45% to at least 60% with variable volume or multi-stage operation capability

TARGET

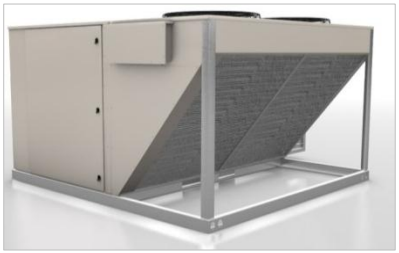
Walmart

LOWE'S

THE HOME DEPOT

McQuay International
a member of DAIKIN group

Carrier
A United Technologies Company



50% Advanced Energy Design Guides Series

Two AEDG series:

- 30% energy savings
- **50% energy savings**

50% energy savings over *ASHRAE Standard 90.1—2004*

50% AEDG Building Types:

1. Small to Medium Office Buildings
2. K-12 Schools
3. Medium to Big Box Retail
4. Large Hospitals

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www.ashrae.org/technology/page/938