

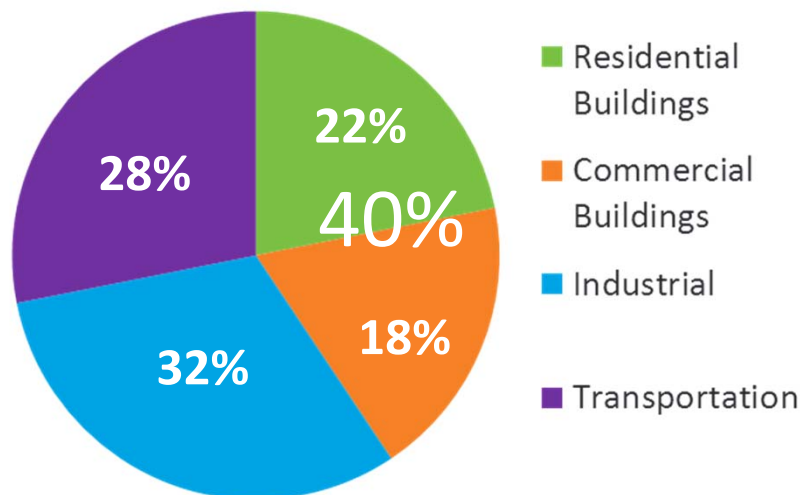
Policy Supporting Energy Efficiency and Heat Pump Technology

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Technology Development Manager

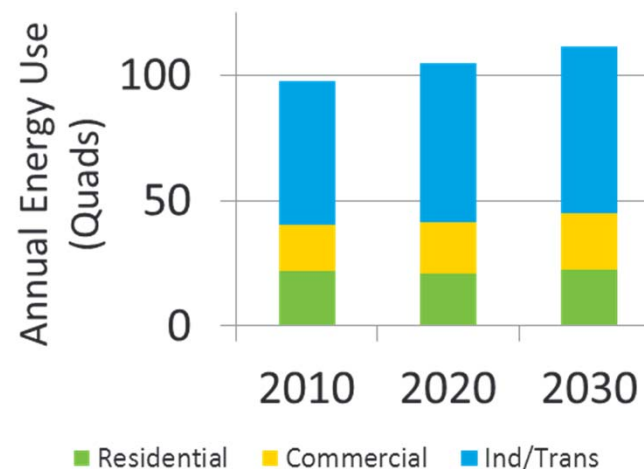
November 13, 2012

The U.S. Energy Big Picture...

U.S. Primary Energy Consumption



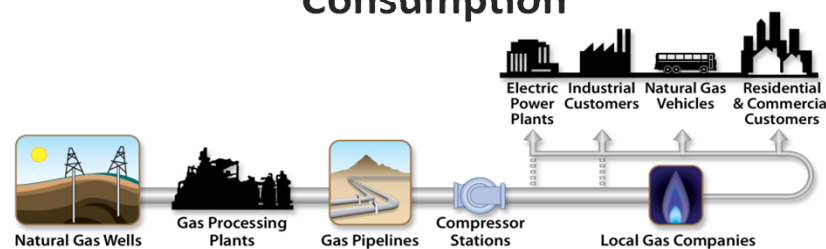
Total U.S. Energy Consumption



Buildings represent 73% of U.S. Electricity Consumption

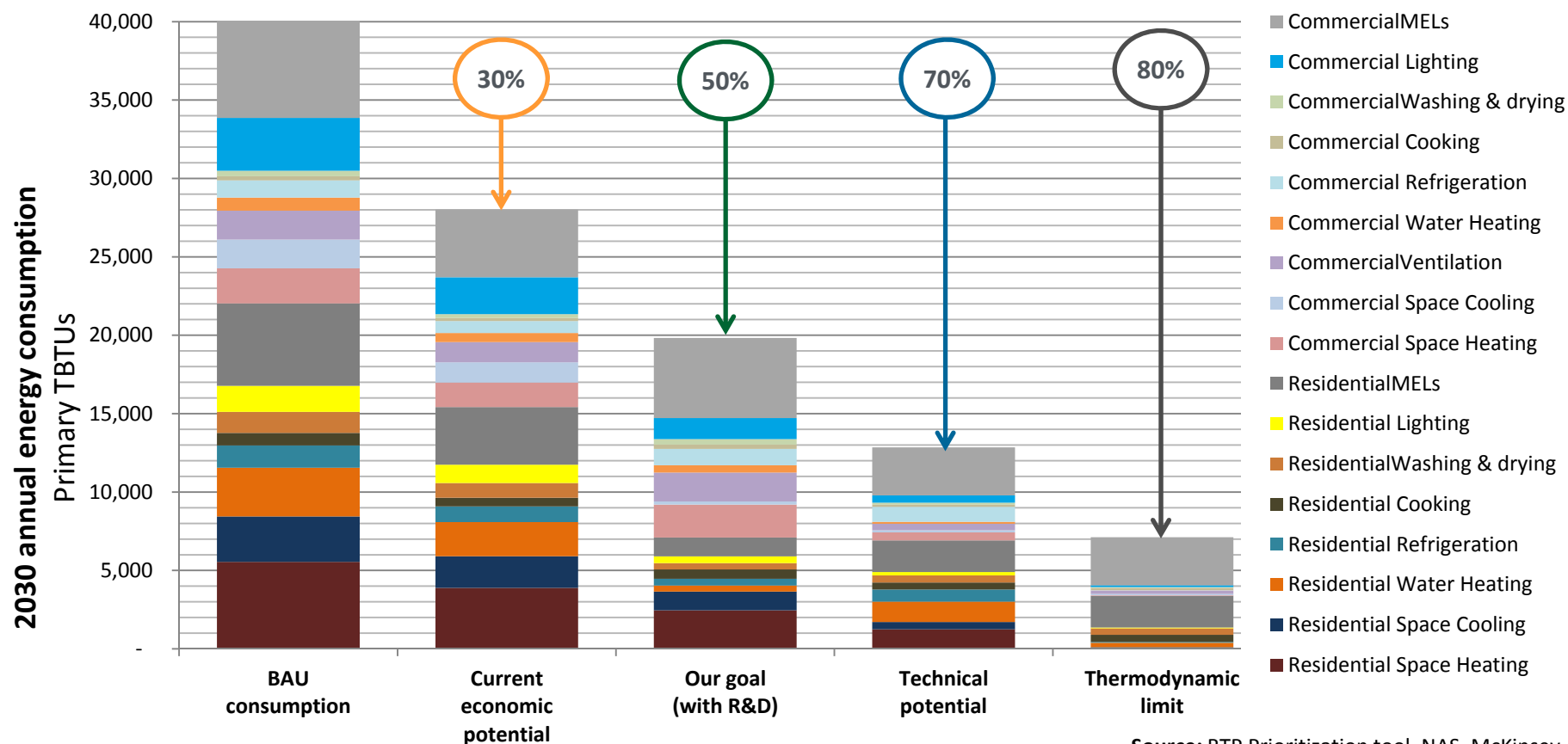


and 55% of U.S. Natural Gas Consumption



DOE Building Technologies Program (BTP) Pursues an Overarching Goal

Reduce Building-Related Energy Use 50% by 2030

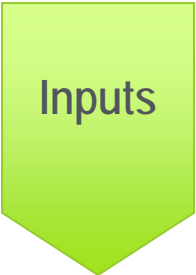


Source: BTP Prioritization tool, NAS, McKinsey.

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

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

The Prioritization Tool



Inputs

Each measure (e.g. technology) requires four data inputs:

- **Performance improvement:** technical energy savings
- **Cost:** incremental cost of the technology over common baseline
- **Market:** stock this measure (e.g. technology) can impact
- **Supporting information:** lifetime, adoption rate, code/standard date, etc.



Method

We apply standard analysis methodology:

- **Energy savings (technical potential):** maximum technical savings is percent savings multiplied by market energy use
- **Stock and flow dynamics (two family):** end-of-life equipment stock turn-over used to determine practical limit to technology adoption
- **Staging framework:** overlapping savings identified by segmenting energy use; measure with lowest cost of conserved energy stages first
- **Technology diffusion:** innovator/follower dynamics
- **Cost of conserved energy:** present value cost of technology divided by lifetime energy savings (i.e. \$/MMBTU)



Outputs

This produces useful outputs (e.g. strategic game board) that can be tested through sensitivity analyses and viewed through various lenses such as:

- Maximum technical potential
- Energy savings vs. cost of conserved energy (no interaction – unstaged)
- Energy savings vs. cost of conserved energy (interaction – staged)
- Adoption adjusted energy savings potential

The Building Technologies Program (BTP) uses an Integrated Approach to Deliver Savings

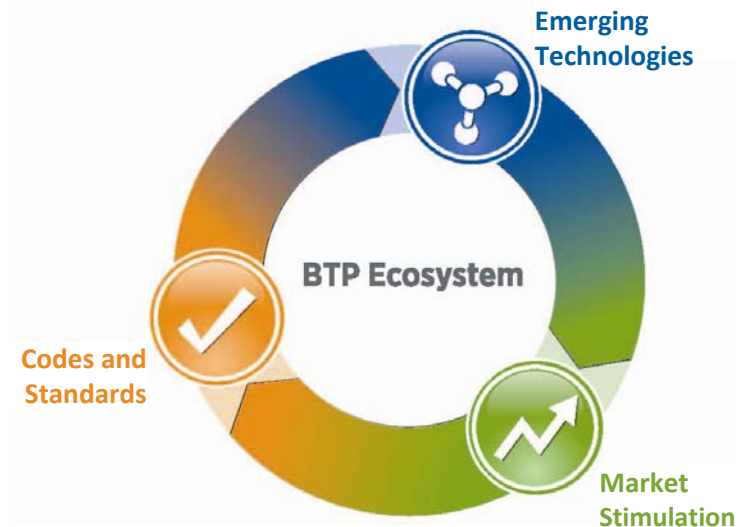
Research & Development

- 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



Emerging Technologies

Strategic research, development and commercialization of building technologies that are five years or less to market-ready, cost-effective and significantly reduce energy use

Strategy:

- Yearly strategic analysis reveals high impact technologies (HITs)
- Sub-programs have clearly defined goals aligned with ET and BTP goals
- Roadmap 'snapshots' for HITs to identify best funding paths forward
- Targeted funding: 80% of portfolio supports HITs
- Innovation funding: 20% of portfolio supports exploratory or alternative technologies
- Budget: 1/3 FOAs (on **HITs**), 1/3 CRADAs (or equivalent industry participation), 1/3 lab directed
- Targeted technologies will receive no more than 5 yrs. of support
- Streamlined and active project management: go/no go decision making on all projects

BTP'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

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 (CO2), 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

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
- *No active, recognized test procedures or rating standards exist for IHP product*
- *Rebates or Tax credits? Energy Star?*



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.mass.gov/energyefficiency/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/codesmart.

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

*Your energy efficiency provider (check one)

☐ NETAAR ☐ Cape Light Compact ☐ Western Massachusetts Electric Company

☐ National Grid ☐ Unitel

*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 2.0 or higher): _____

Total Cost: \$ _____ Purchase Date: ____/____/____ Install Date: ____/____/____

Location of Equipment Installation: ☐ Basement ☐ Garage ☐ Attic ☐ Other _____ *Closed 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: NETAAR, National Grid, Cape Light Compact, Western Massachusetts Electric Company and UNITEL. 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 installation. This right to access extends up to one year after date of installation, even if installation was done prior to the date of this rebate. Participating utility or energy efficiency service provider does not guarantee the performance of installed equipment, nor its longevity. Customer agrees that the Energy Efficiency Program Provider (EPP) has the exclusive right to apply for any federal, state, or local energy efficiency incentives or rebates. Customer agrees to provide the EPP with such information as the EPP may request to confirm the EPP'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 performance of the installation contractor. Participating utility or energy efficiency service provider makes no representation regarding manufacturers, dealers, contractors, or retailers. Customers will not be responsible for any fee 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, its (its) listed, 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 2.0 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 (including sales tax and installation costs). Eligible heat pump water heaters can be found on www.mass.gov/energyefficiency/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

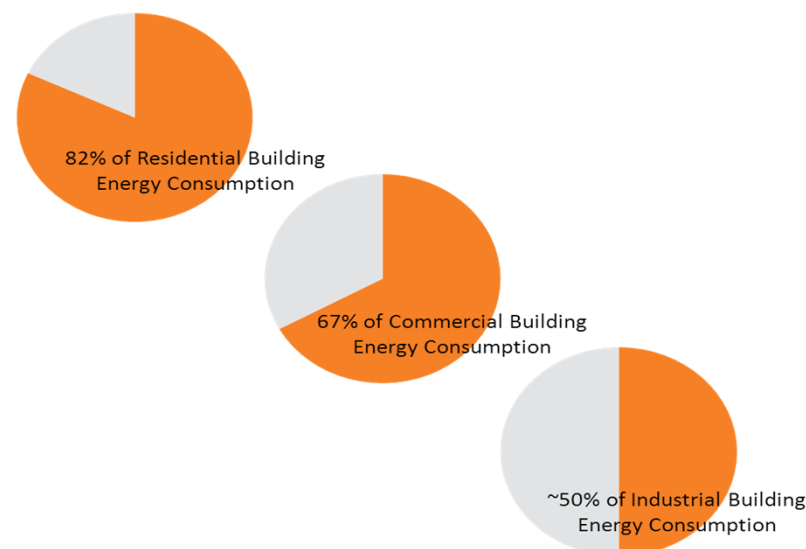
http://www.energystar.gov/index.cfm?c=tax_credits.tx_index#c3

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

Quad = 1.055 exajoule (EJ)

- <\$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:

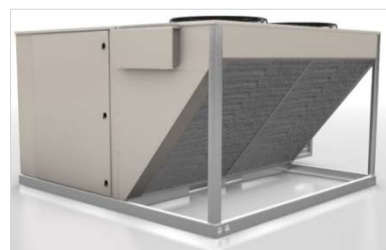


*Net present value
U.S. DEPARTMENT OF
ENERGY | Energy Efficiency & Renewable Energy

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



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

Free download:

www.ashrae.org/technology/page/938

