A Heat Pump Water Heater Savings and Cost Effectiveness Screening Tool

Residential Heat Pump Water Heater Technology and Markets: Progress since Atlanta and Prospects for 2003, A National Workshop
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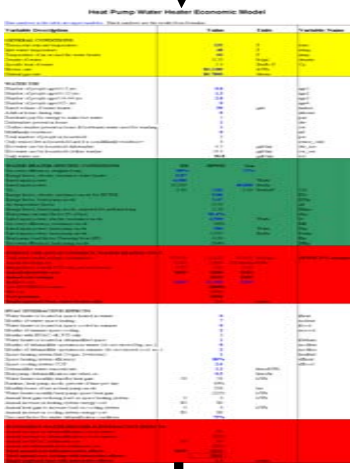
Agenda

1. Overview
2. Input
3. Calculations
4. Output



5. Results - Sensitivity Analysis

Overview

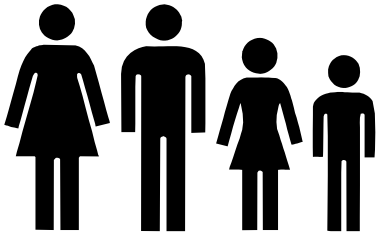
Goal of Tool:

Determine conditions under which contractors should advise HPWH installation

- Back office program development tool

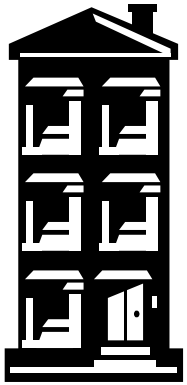
- Use available data for inputs
- Use existing engineering relationships
- Calculate simple payback for upgrade to HPWH at time of normal replacement

Inputs - Water use



– Number & ages of residents

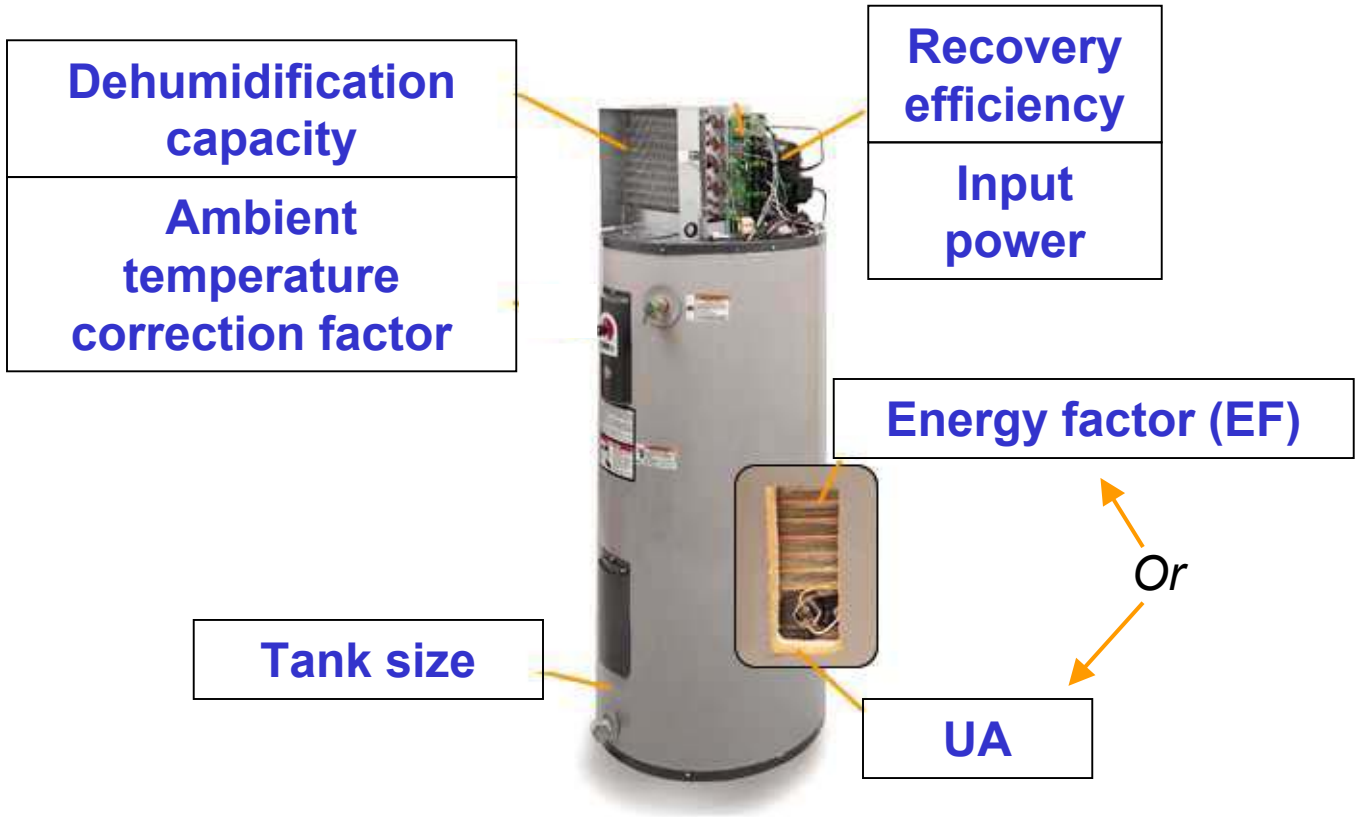
– Appliances



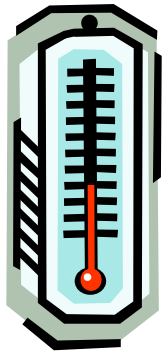
– Single Family or multifamily

– Home during day

Inputs - Water Heater Performance Specifications

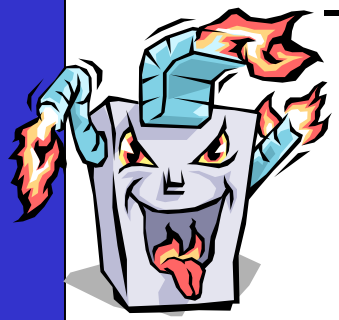


Inputs - Location



- Temperatures
  - Ambient
  - Supply water
  - Setpoint

- Utility rates
- Installation costs



- Space heating, cooling, dehumidification
  - In which space(s)
  - Months of each
  - Efficiencies

Calculations

- Water use relationships from
  - DOE LBL *Home Energy Advisor*
  - http://homeenergysaver.lbl.gov/hes/aboutwhm.html
- HPWH performance data from
  - ECR, published and unpublished data
  - Could be used for any brand with performance data

See presentation attachment for details

Calculations (cont.)

- Water heater performance:
  - Ambient air temperature correction factor from ECR regression
  - UA (derived from EF) from federal test procedure
  - Energy use from WHAM equation (Lutz)
- Heating, cooling & dehumidification interactive effects from
  - Straightforward hours and efficiency calculations

Outputs

- Water use
- Annual cost of operation
  - Resistance, heat pump, and gas
  - Oil could be added
  - With and without HVAC interactive effects
- Simple payback time

Sensitivity Analysis - Base Conditions

- Normal occupancy, nearly ideal location
- Base conditions:
  - Albany NY (48F inlet water, $0.118 /kWh)
  - 57 gpd combination of people
  - ECR Watter$aver
  - In dehumidified unconditioned 60F basement
  - $500 net cost ($1050 + $250 - $400 - $400)
- HPWH vs. electric resistance
  - $339 /yr savings
  - 1.5 yr payback

Sensitivity Analysis - Results

Adjusted variable	Savings	Payback	Sensitivity-Change in saving
Base case	$339	1.5	
Decrease electricity cost by $0.04 /kWh	$224	2.2	($115)
Decrease by 1 adult	$244	2.0	($95)
Decrease by 1.2 children	$258	1.9	($81)
Decrease by 1 adult and 1.2 children to a single adult	$163	3.1	($176)
Change to 2 seniors at home day, in multifamily, no kids	$125	4.0	($214)
Increase to adult(s) at home during day	$399	1.3	$60
No dishwasher	$301	1.7	($38)
No clothes washer	$228	2.2	($111)
Default space is in unconditioned basement with 2 mo. Dehumidification			
In unconditioned space, no dehumidification	$318	1.6	($21)
In conditioned space-electric cool and heat, no DH	$163	3.1	($176)
In conditioned space-electric cool, gas heat, no DH	$296	1.7	($43)
In conditioned space-electric heat, no cool, no DH	$132	3.8	($207)
In conditioned space-gas heat, no cool, no DH	$265	1.9	($74)
Add a month to heating season, in electric heated, cooled space, no DH	$136	3.7	($203)
Add a month to heating season, in gas heated, cooled space, no DH	$289	1.7	($50)
Remove a month from cooling season, gas heat, no DH	$286	1.7	($53)

Sensitivity Analysis - Conclusions

- Don't recommend in Albany if:
  - WH is in electrically heated + uncooled space
  - Elderly
  - Just one resident
- Do recommend if:
  - As few as two non-elderly adults
  - Any other space conditions
  - Electric rates as low as 50% of base case

Aside from practical installation issues (clearance, min. ambient temperature, drain, etc.)

Sensitivity Analysis - Conclusions

Don’ts

- Analyze each candidate home
- Teach tool to contractors

Do’s

- Teach rules of thumb to contractors
- Use model for engineering-based impact evaluation (consumer data collected in apps.)
- **Invest in promotion more than analysis**

Thanks/Disclaimer

- Thanks:
  - All who presented metering results in March
  - LBL/Jim Lutz for WHAM equation and water use
  - ECR for HPWH performance relationships
  - NYSERDA for program support
- Disclaimer:
  - Not developed as commercial software
  - Use at own risk
  - Please report errors and enhancements
  - Credit if used elsewhere

Summary

- Model using DOE water use and water heater energy use calcs.
- Broadly cost-effective in NY as ER replacement
- For copy of spreadsheet, email:

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