

Performance of Heat Pump Water Heaters



Evaluation Overview

- 2000-2002 Evaluated 20 installations with CL&P
- Product had problems; not ready for prime time (average COPs of 1.67 was not the problem)
- New batch of heaters available, including:
 - GE's GeoSpring Hybrid (50 gal)
 - A.O.Smith's Voltex Hybrid (60 & 80 gal)
 - Stiebel-Eltron's Accelera 300 (80 gal)
- Evaluating 14 installations for National Grid, NSTAR, & Cape Light Compact.

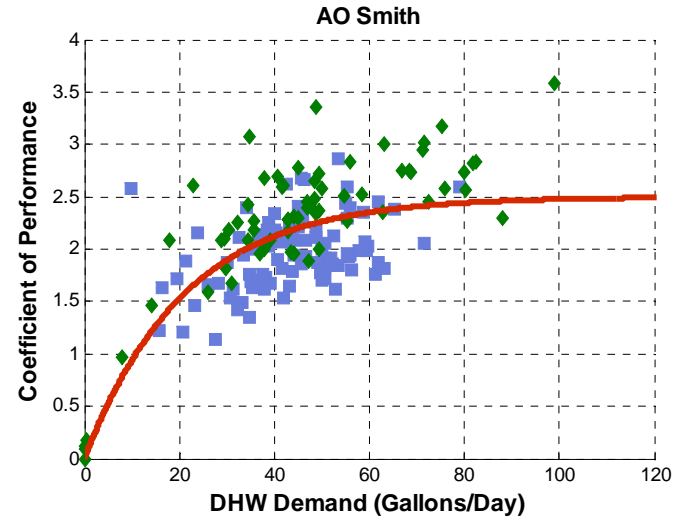
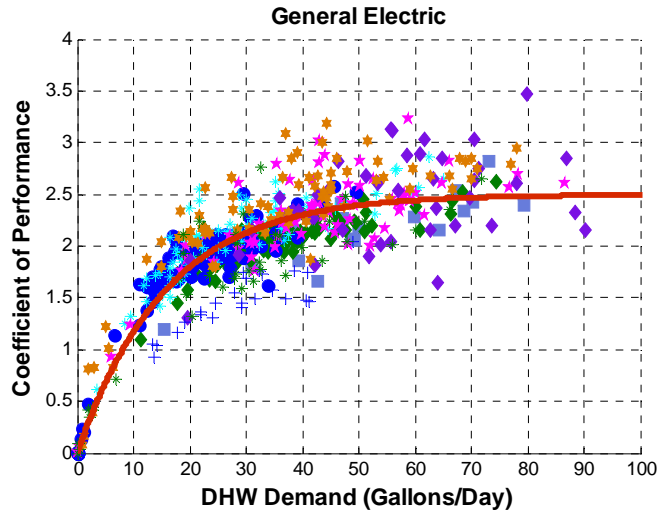
HPWH: Monitored Results To Date

HPWH model	No. Monitored	Capacity (gal)	Energy Factor	First Hour Rating (gal)	Avg. COP	% Electric Resistance
GE	10	50	2.35	63	1.82*/ 1.64	33%*/ 41%
AO Smith	2	60/80	2.33	68.0/84.0	2.13	5%
Stiebel Eltron	2	80	2.51	78.6	2.35	6%

Performance Depends On

- Ambient Temperature
- Total HW Consumption
- Draw Patterns / Concentrated Draws

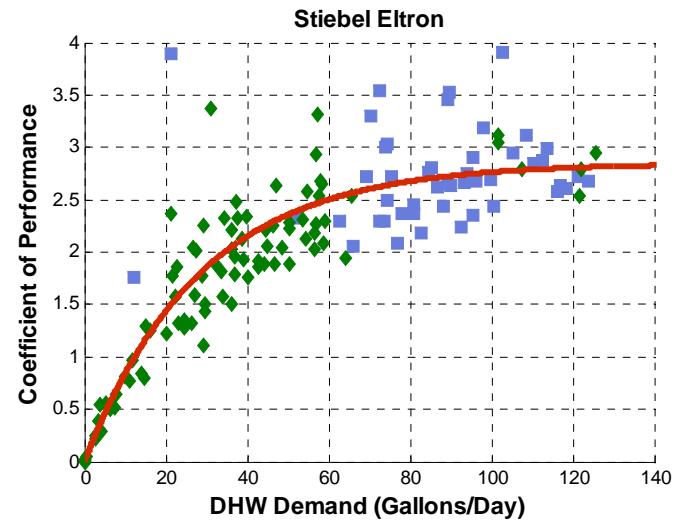
HW Consumption (HP Only)



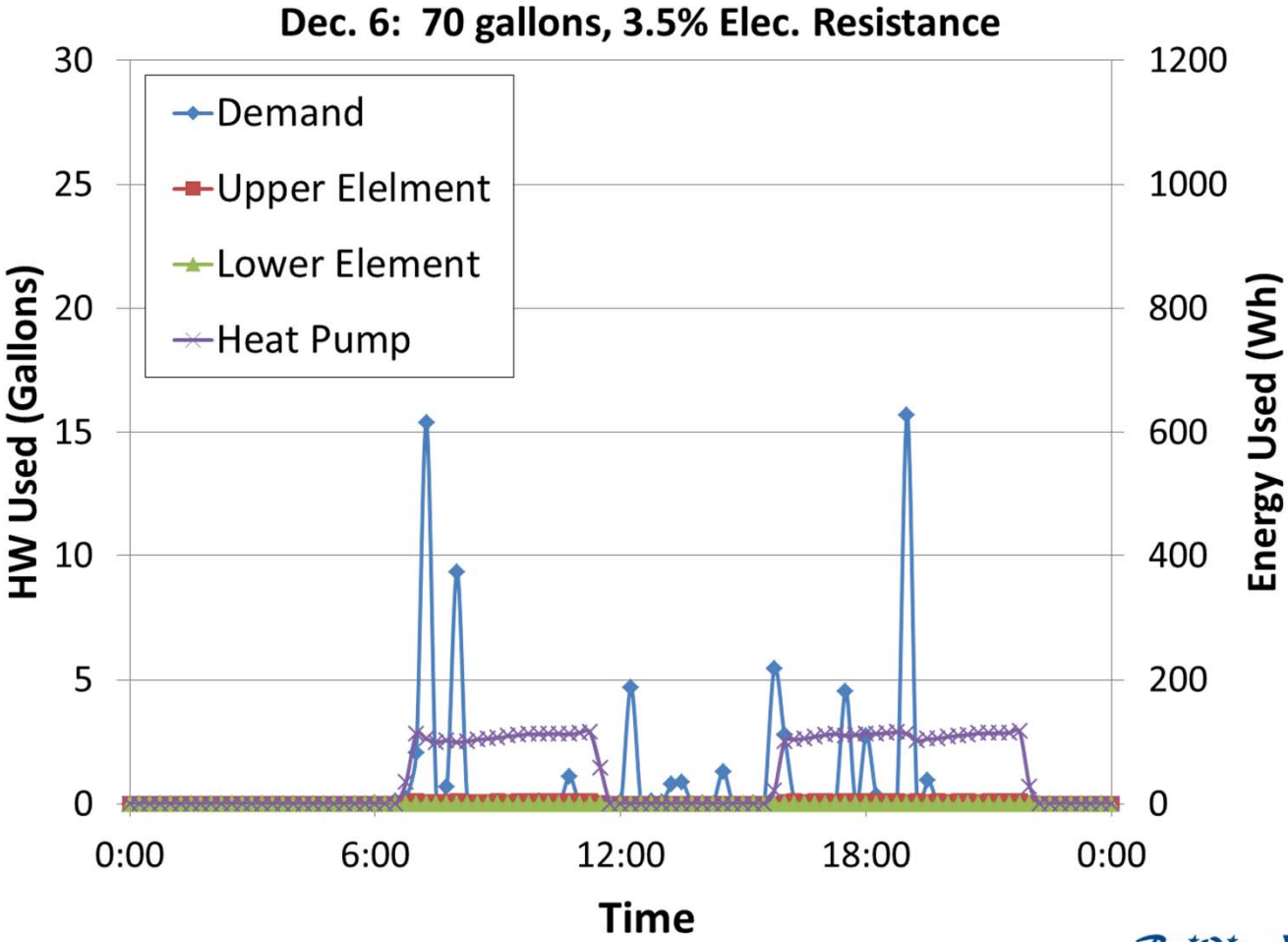
Defining Exponential Performance Curves

$$COP = a(1 - e^{bV})$$

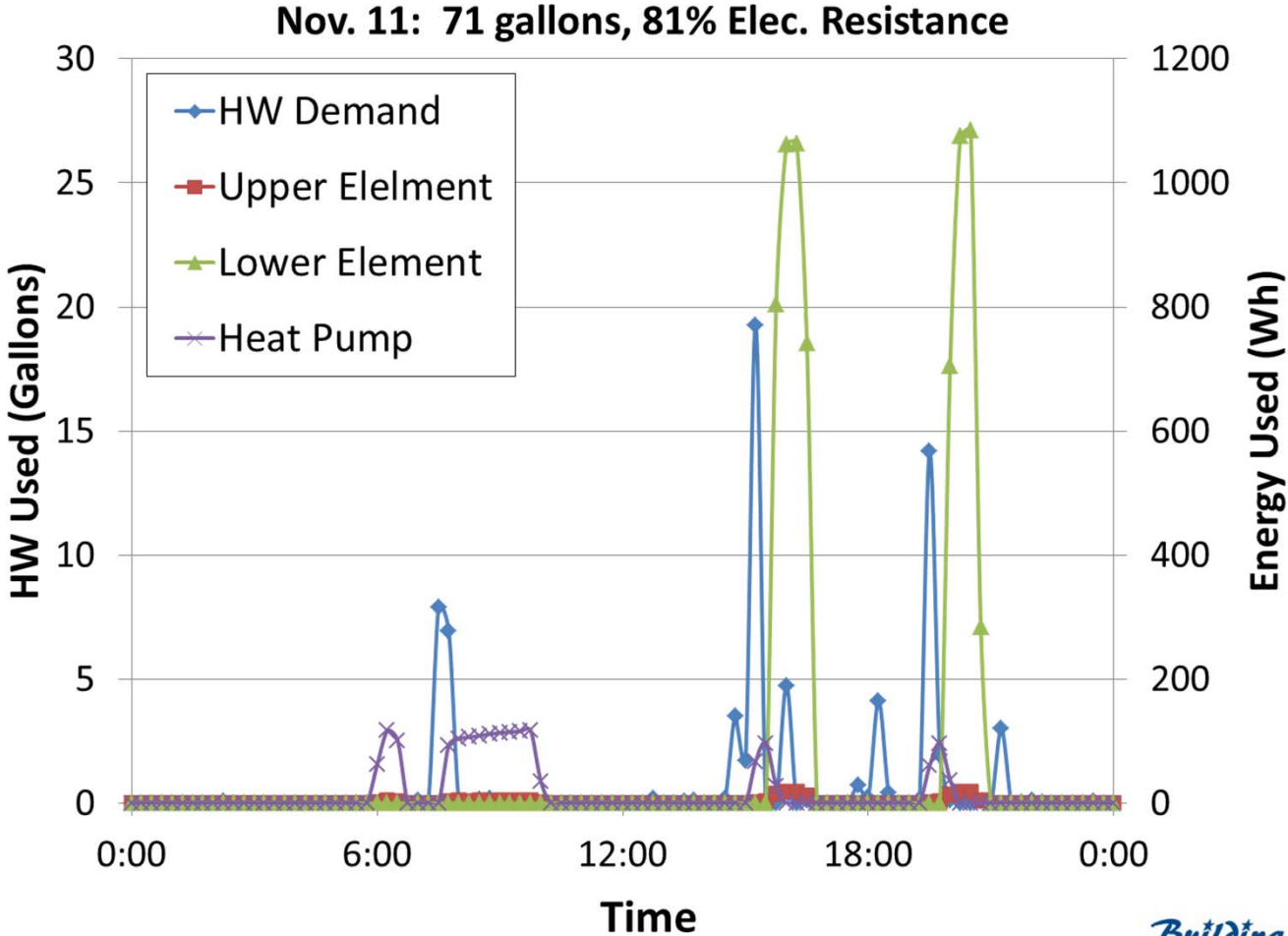
	a	b	RMSE
GE	2.51	-0.062	0.011
AO Smith	2.51	-0.046	0.029
Stiebel Eltron	2.94	-0.031	0.027



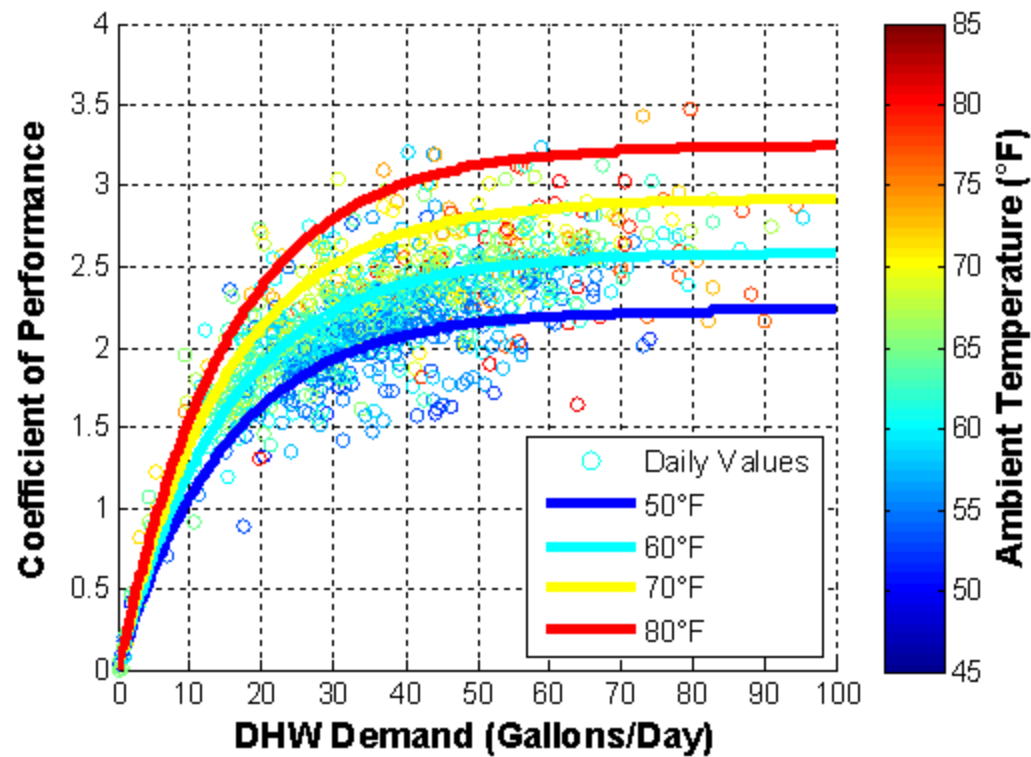
Site 3: Concentrated Draws



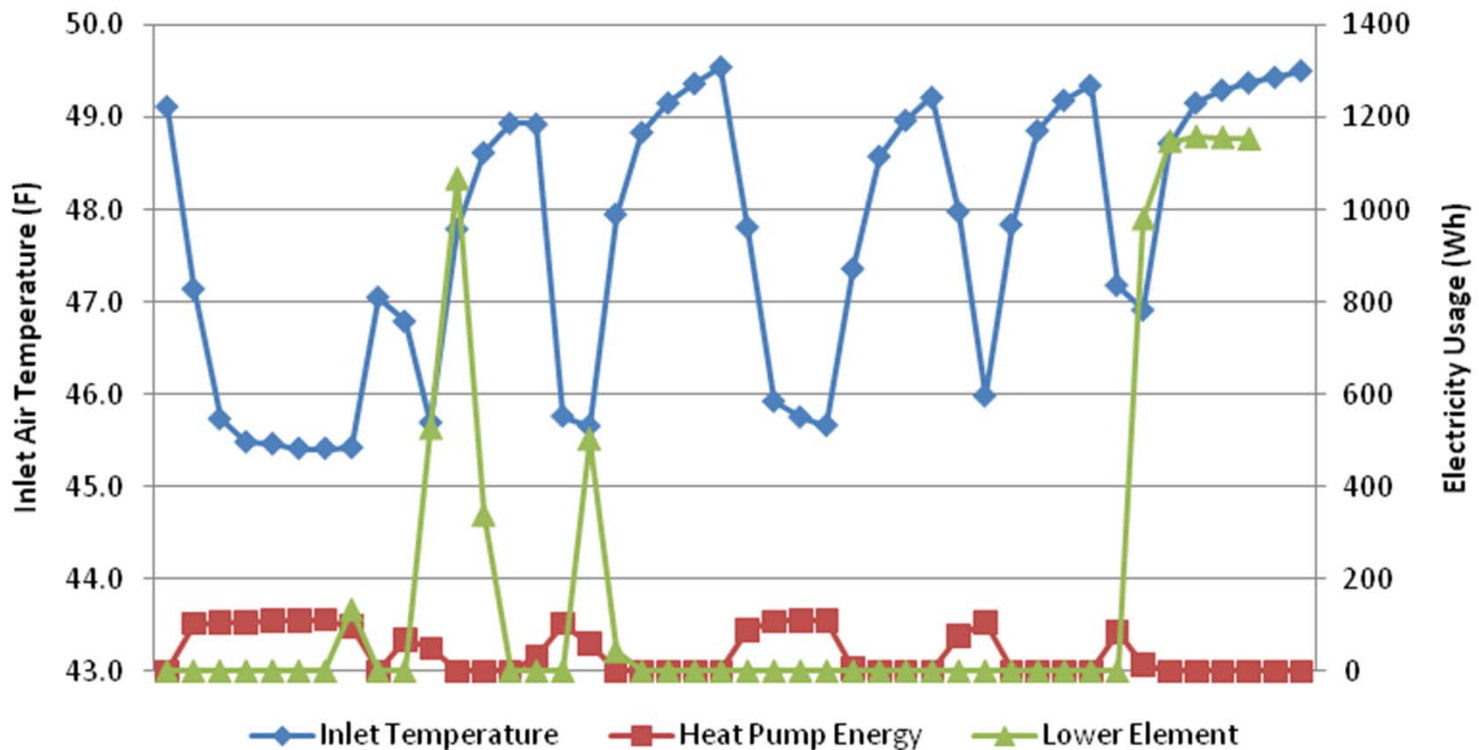
Site 3: Concentrated Draws



Temperature Dependence



Site 5: Low Ambient Temps



Site 5: GE Unit; COP = 0.77; Average Ambient Temperature = 48°F

Gaps...

- Last generation of HPWH was not good. How does this generation look?
... so far so good. Ours and others' studies.
- Where & when do HPWHs make sense?
... we've got a pretty good handle on this.
- Average savings: \$430/yr compared to electric resistance (\$0.17/kWh)
- \$1,400 - \$2,700 incremental cost (std. elec. tank)

Gaps...

- We know performance varies with consumption patterns. How exactly?
- How to model this effectively?
 - ▣ Checking NEEA, BEopt models
 - ▣ When resistance kicks in
- How much better is bigger?
- Do we need a better handle on space conditioning interactions? Ducted options?
- Longer term issues: maintenance, durability?

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