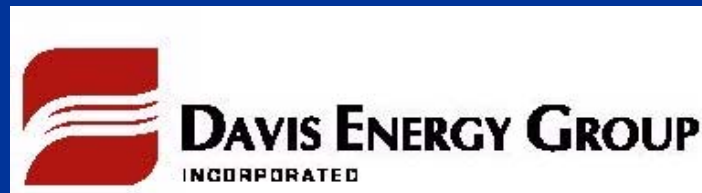


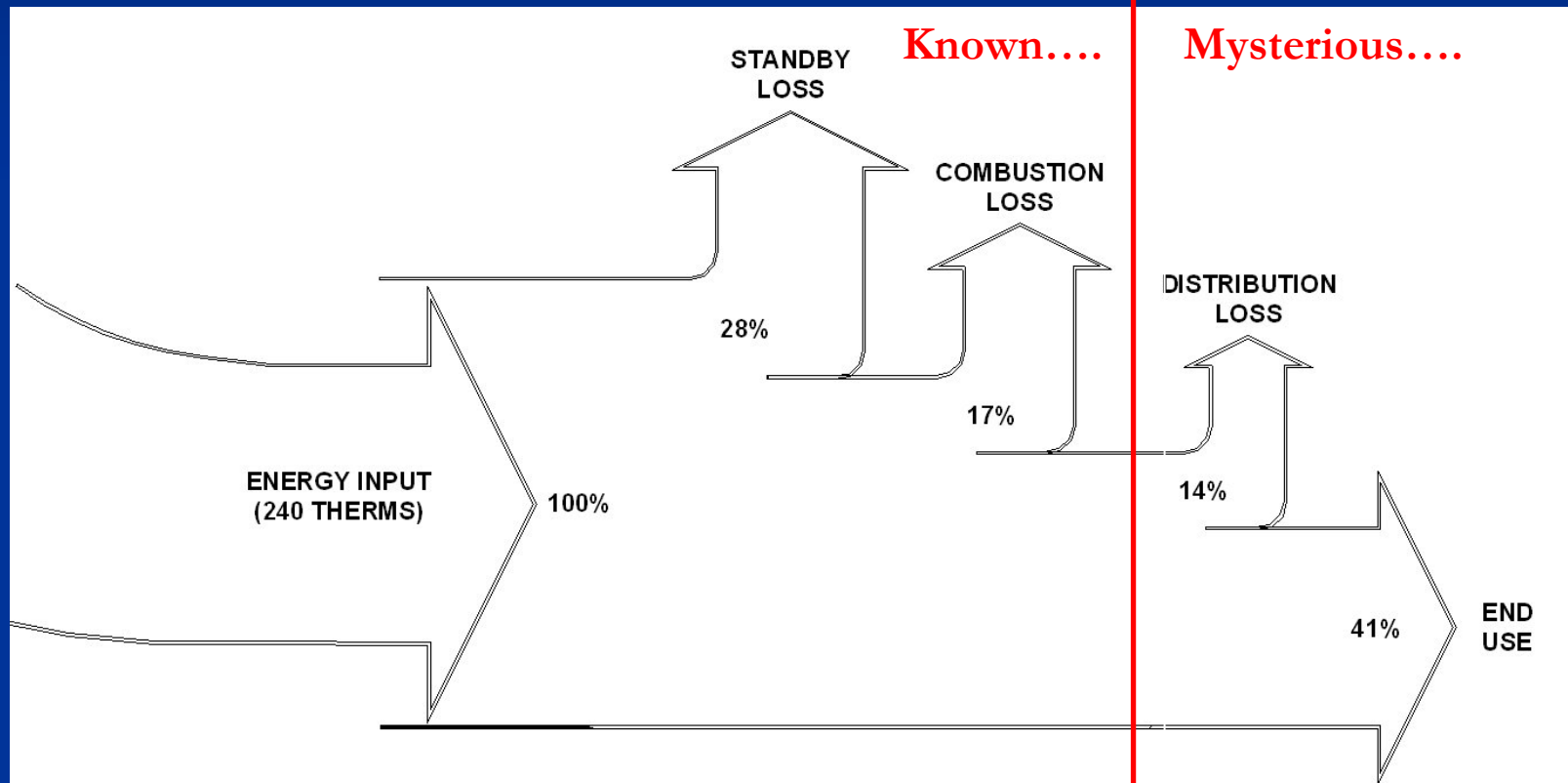
**The Real World:
Detailed Usage Patterns from One House
& How Do Load Patterns Affect Gas
Tankless Performance?**

ACEEE Water Heating Forum

June 2, 2008



What do we need to know?

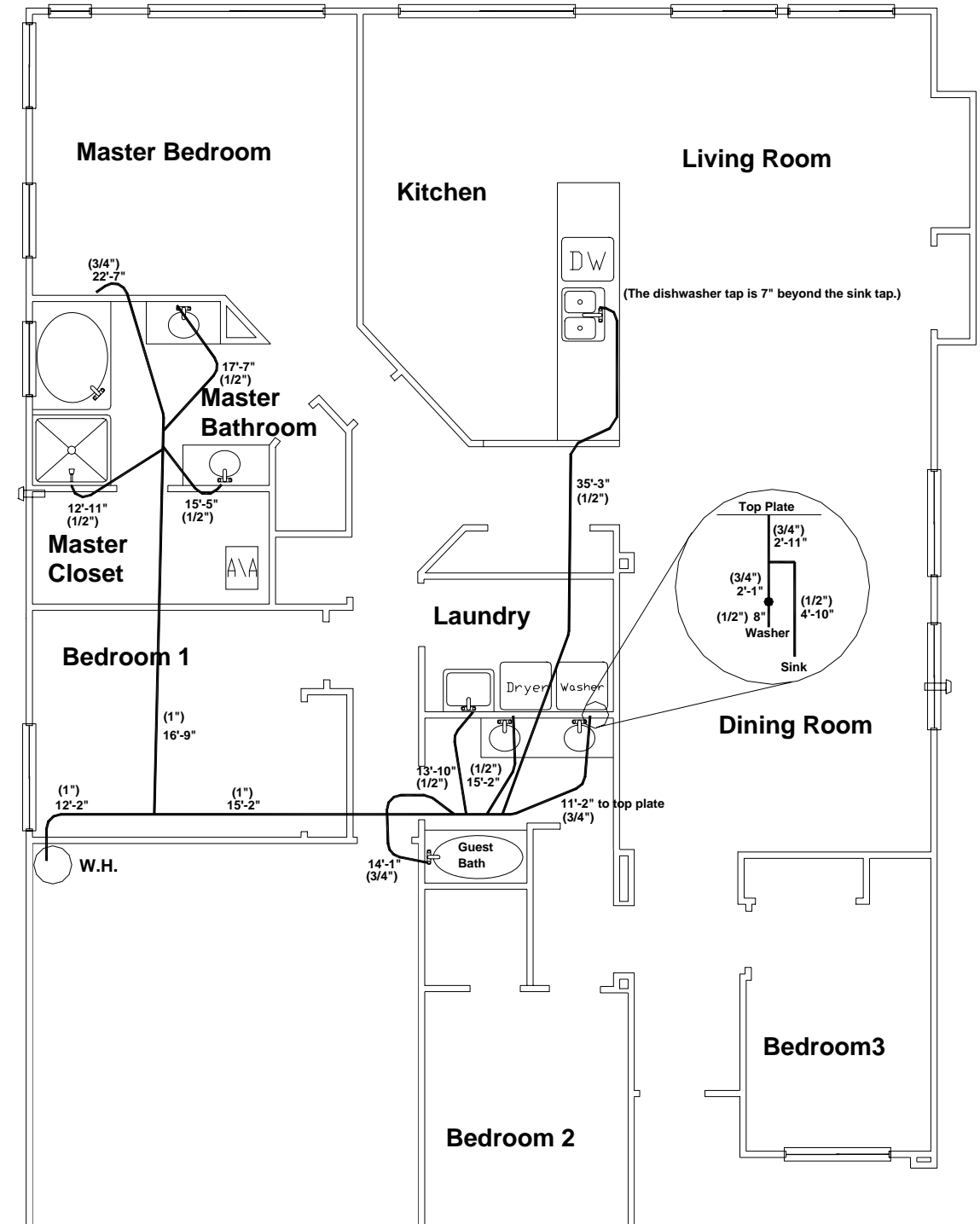


Part 1: Distribution System and Hot Water End Use Field Test

2,070 ft² single-story new home

PEX piping in attic

Water heater in garage

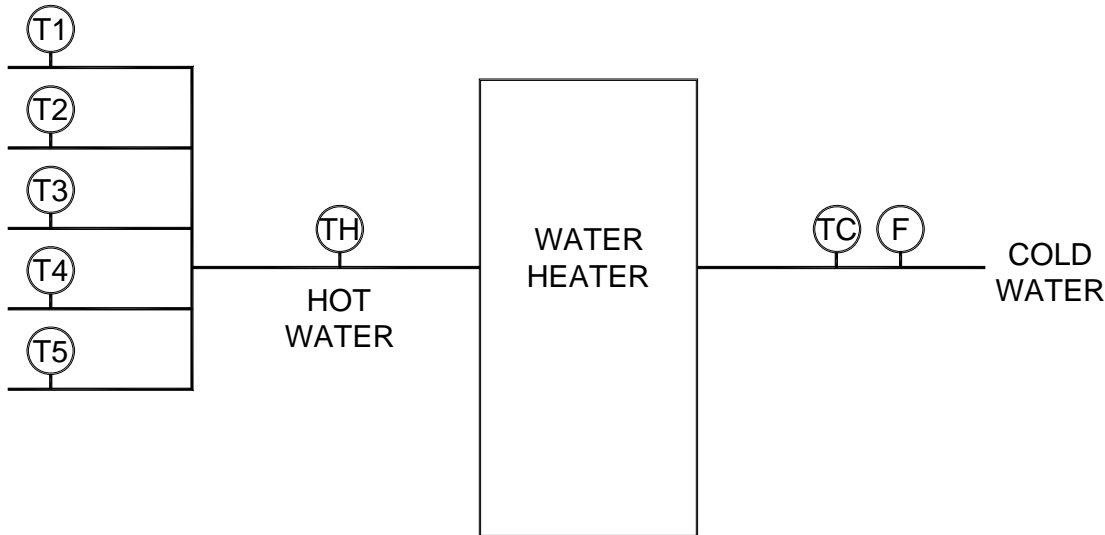


Monitoring Configuration

House was being monitored for other Building America research

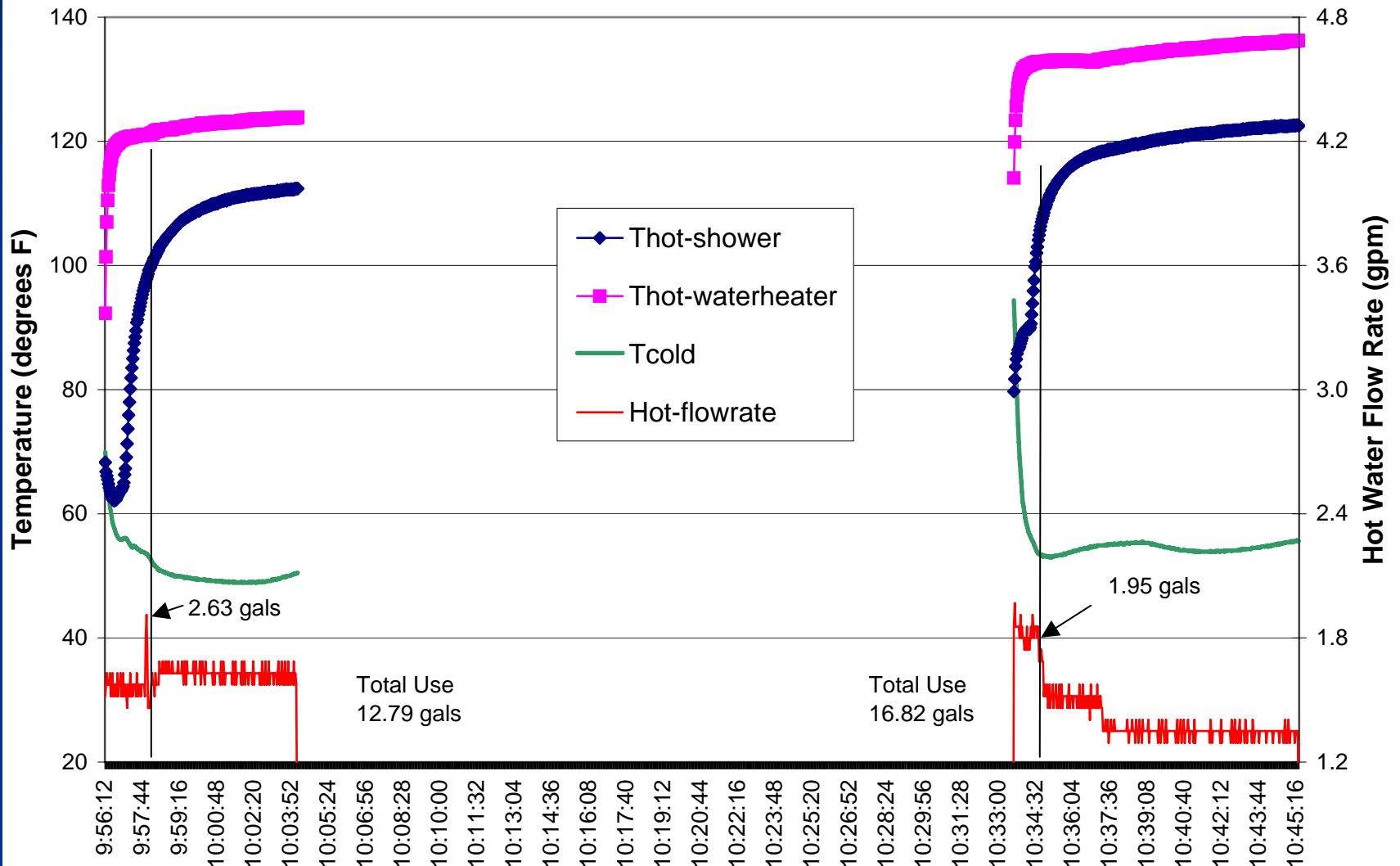
Incremental cost for hot water monitoring ~\$4,000-\$5,000

FIXTURES



Sample Two Second Interval Data

Hot Water Characteristics of Consecutive Master Bath Showers



Summary Data (October '03 - August '04)

	# of draws	Total gals	Average Draw Vol	% of total Usage	Total gals > 100F	Distribution Efficiency
Coincident Draws	955	3061	3.2	21%	n/a	n/a
No Hot Water Use	4748	1065	0.2	7%	0	0%
Guest Bath Shower	67	294	n/a	2%	196	56%
Guest Bath Sink1	16	5	0.3	0%	0	14%
Master Bath Shower	495	6310	12.7	44%	5379	70%
Master Bath Big Tub	6	100	16.6	1%	43	56%
Master Bath Sink1	381	423	1.1	3%	101	27%
Master Bath Sink2	506	788	1.6	6%	355	40%
Laundry Room Sink	5	10	2.0	0%	1	37%
Guest Bath Sink2	46	14	0.3	0%	1	5%
Clothes Washer	250	1758	7.0	12%	1480	71%
Kitchen Sink	211	133	0.6	1%	32	29%
Dishwasher	215	356	1.7	2%	112	37%
	7901	14317			7700	
			42.8 gpd			59%

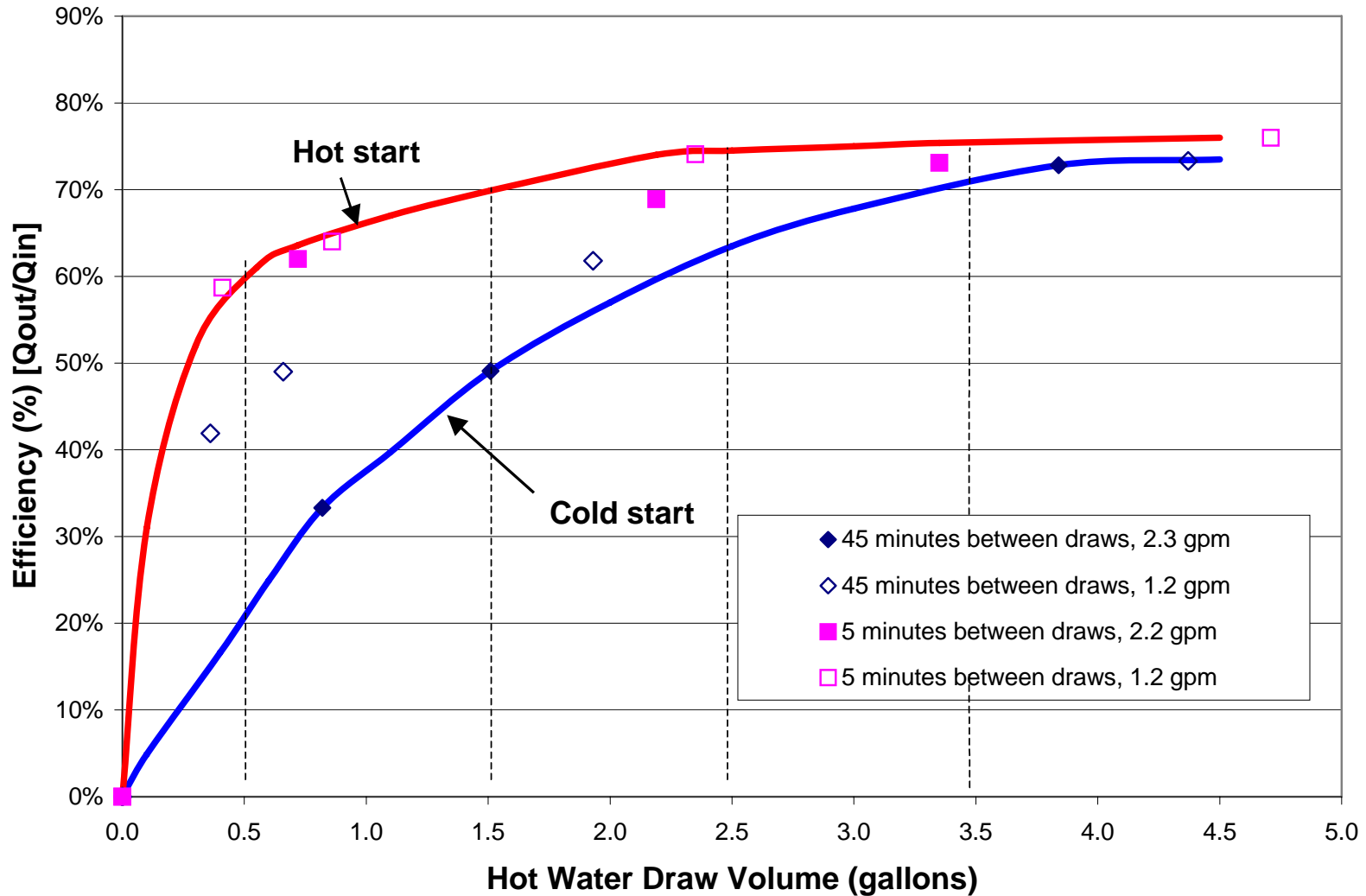
Lessons Learned, Part 1

- More:
 - Draws than expected
 - Draws with no hot water end use
- Lower:
 - Distribution efficiency than anticipated
 - Fraction of hot water that is actually hot
- About Right:
 - Daily per capita hot water usage
- Interesting study..... More data needed!!!

Part 2: How Do Load Variations Affect Gas Tankless Performance?

- Energy Factor test has six ~ 11 gallon draws separated by one hour followed by 19 hours of standby mode
- Reasonable for gas storage water heaters, but...
What about for tankless units where HX cycling degrades performance?
- Plan: Instrument gas tankless WH with a flow meter, immersion thermocouples and 20 pulse/ft³ gas meter. Vary flow rates, draw volume, and time between draws to assess impact on efficiency.

Test Results



Lessons Learned, Part 2

- Draw patterns (both volume and time interval between draws) have a large impact on efficiency
- Using a “typical” draw pattern, a 0.82 EF unit has
 - “hot” efficiency of 77.3%
 - “cold” efficiency of 70.3%
- Title 24 adopting 8% EF rating for 2008 Standards
- Interesting study..... More data needed!!!

Discussion Question....

How do we define typical draw schedules to evaluate both distribution systems and systems that are affected by load pattern (gas tankless, solar, HPWH)?

Marc Hoeschele, PE

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