Combination space and water heating systems

ACEEE Hot Water Forum

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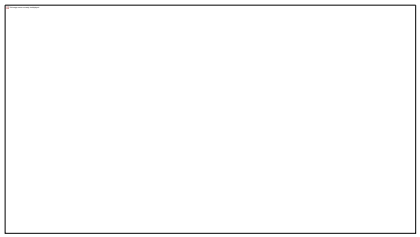
GTI's Combi Systems Program

- Techno-economic studies
  - Market analyses
  - Load profiling
- Laboratory testing
  - Performance evaluations
  - System comparisons
- Field demonstrations
  - Evaluate combi types
  - Address knowledge gaps
- Product development
  - Collaborative

UTD
Utilization
Technology
Development



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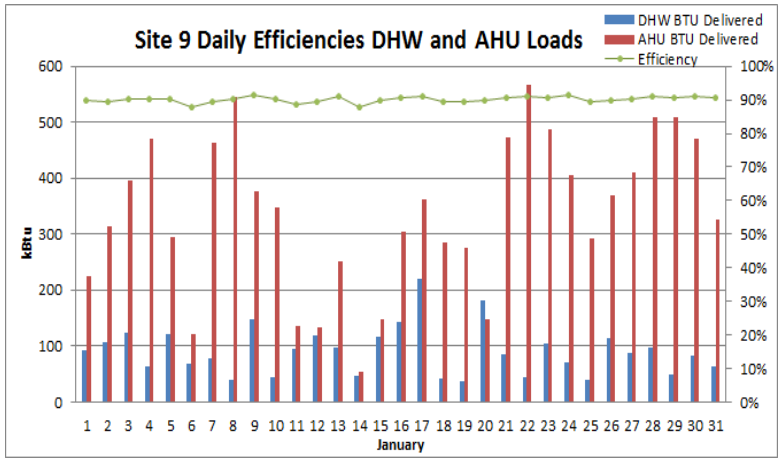
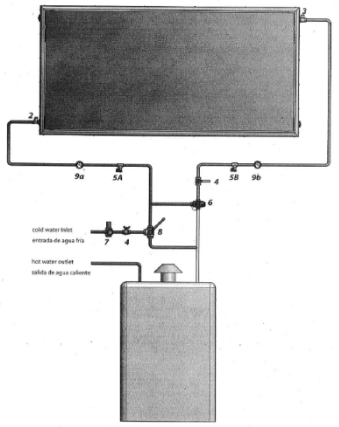
Combi Promise

- Technology solution
  - High efficiency space and DHW
  - Minimizes fossil fuel
  - Can integrate solar thermal
- Business solution
  - Some gas utilities no longer offering residential, high efficiency, stand-alone water heater incentives because TRCs too low
  - Combi systems can raise water heating efficiencies along with space heating efficiencies
  - Builders need only install one system – saves space and installation costs





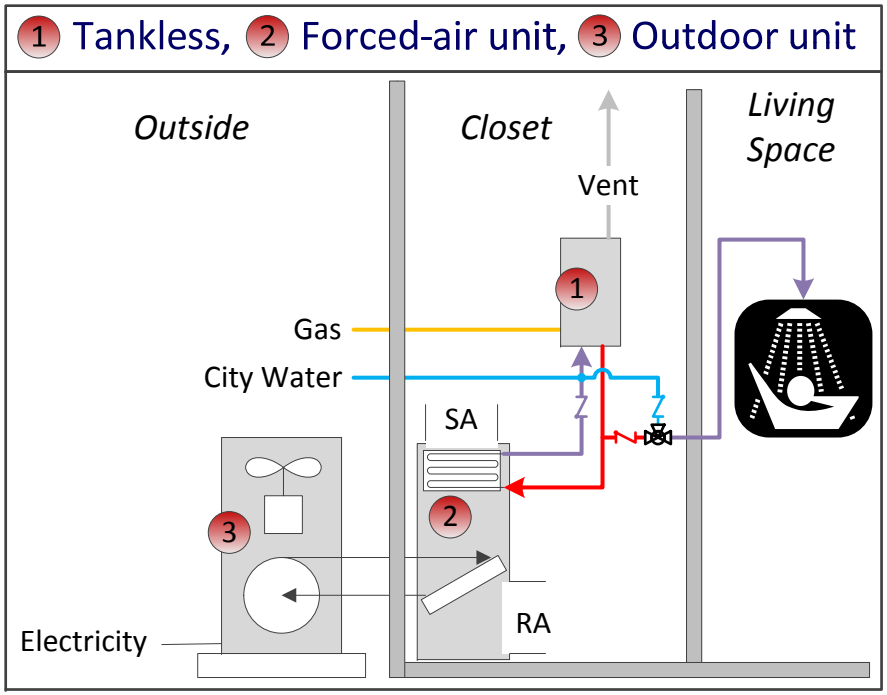
Tankless-Hydonic Air Handler Combi

> Benefits

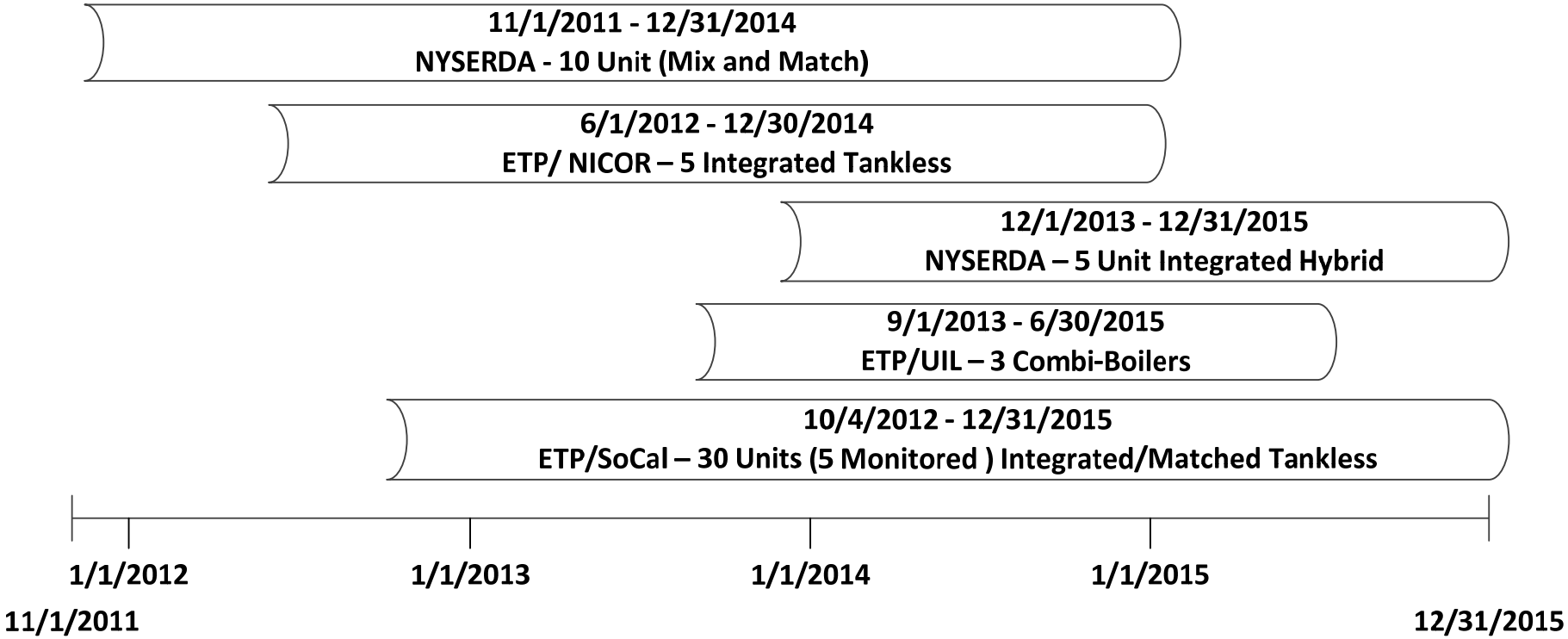
- Lowest cost combi option
- High efficiency and capacity
- Easy forced-air integration
- Space savings
- Improved utility TRCs

> Challenges

- Sizing dilemma
- Inconsistent condensing
- Typical tankless issues
- Pump timer



GTI Combi Field Activities



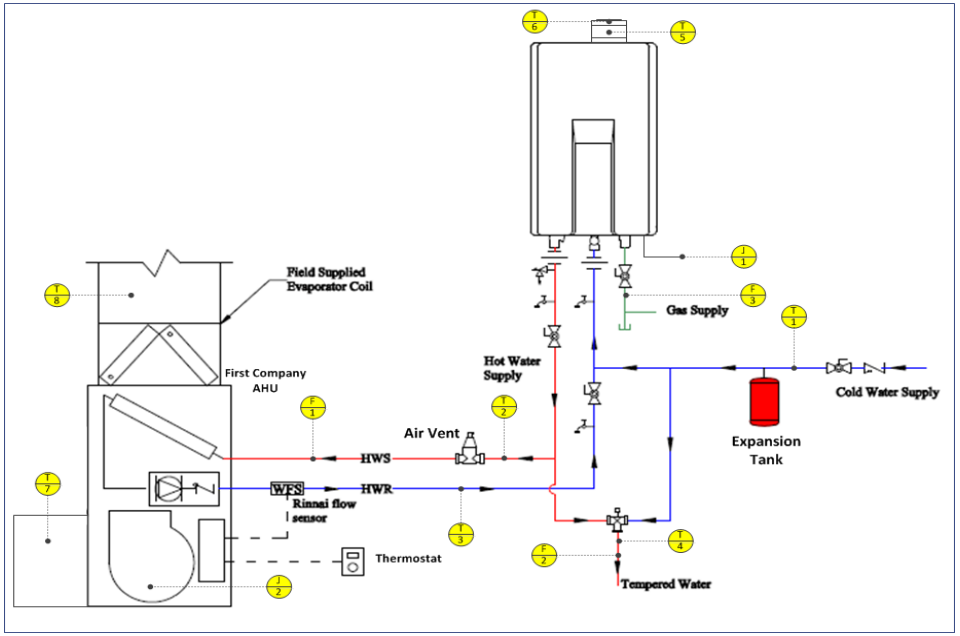
- > 15 Completed
- > 38 Underway

NYSERDA/Nicor Demo/Pilot Scopes

> Determine performance attributes of tankless-hydronic air handler combis

> 12 months of in-field monitoring (weather normalization)

- Trained contractors
- Recruited host-sites
- Analyzed gas bills
- Contractor load calcs
- Manufacturer approvals
- Contractor installed **w/o GTI intervention**
- GTI commissioned
- Data collected/reduced



NYSERDA/Nicor Performance Results

An average of 130 therms per year (or 11.5% of DHW and SH gas use) was saved with the combi system when compared to a furnace 80% AFUE/ Water Heater 0.59 EF.

Host Site Cumulative Data	Therm Savings Combi Versus Baselines		Percent Savings 0.59 DHW 80% SH	Percent Savings 0.59 DHW 90% SH
	0.59 DHW 80% SH	0.59 DHW 90% SH		
Nicor	127.5	4.0	9.4%	0.0%
NYSERDA	129.5	42.5	13.0%	4.6%

Nicor					
Site-System	1B	2B	3B	4B	5B
Cumulative Eff.	82.8%	88.0%	86.4%	85.6%	82.8%

NYSERDA										
Site-System	1G	2A	3A	4B	5C	6B	7D	8E	9F	10A
Cumulative Eff.	74.4%	77.3%	90.3%	82.0%	72.0%	82.4%	92.2%	93.0%	91.7%	87.4%

- Systems D, E, and F used third-party AHUs designed specifically for use with condensing water heaters

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Cost Observations

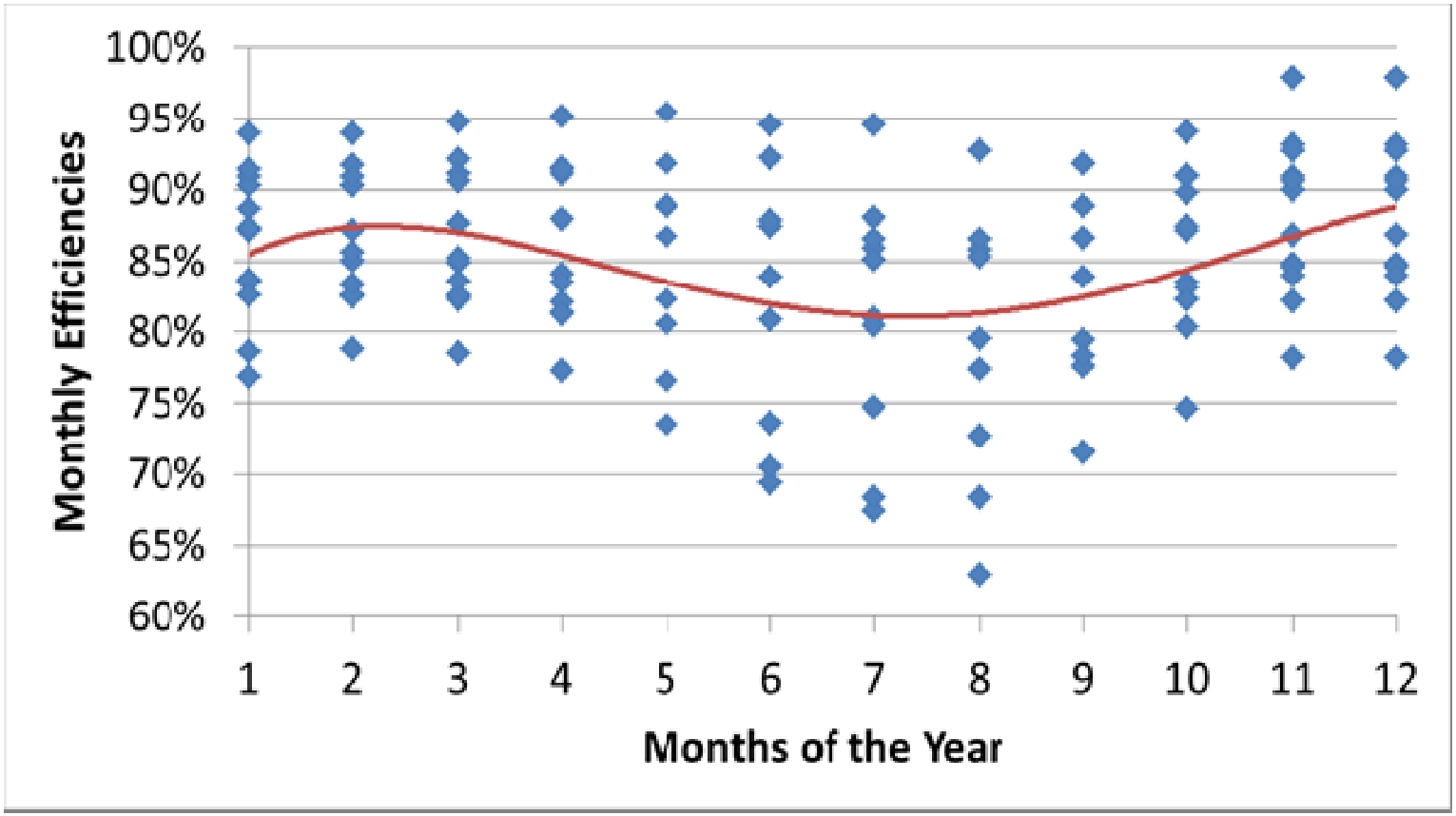
The 15 SoCal sites listed below were non-monitored sites that required only combi system installation.

	Water Heater		Air Handler		Combi System
	Equip Cost	Install Cost	Equip Cost	Install Cost	Total Cost
	$1,750.00	$956.77	$1,460.00	$1,680.01	$5,846.78
	$1,520.00	$1,205.00	$1,180.00	$1,573.92	$5,478.92
	$1,250.00	$1,765.41	$1,460.00	$1,680.01	$6,155.42
	$1,750.00	$1,205.00	$1,180.00	$1,573.92	$5,708.92
	$1,750.00	$956.77	$1,460.00	$1,680.01	$5,846.78
	$1,750.00	$956.77	$1,460.00	$1,680.01	$5,846.78
	$1,060.00	$1,169.80	$1,180.00	$1,573.92	$4,983.72
	$1,750.00	$956.77	$1,460.00	$1,680.01	$5,846.78
	$1,750.00	$956.77	$1,460.00	$1,680.01	$5,846.78
	$1,750.00	$956.77	$1,460.00	$1,680.01	$5,846.78
	$1,520.00	$1,205.00	$1,460.00	$1,680.01	$5,865.01
	$1,520.00	$1,205.00	$1,460.00	$1,680.01	$5,865.01
	$1,750.00	$956.77	$1,460.00	$1,600.86	$5,767.63
	$1,750.00	$956.77	$1,460.00	$1,680.01	$5,846.78
	$1,750.00	$1,205.00	$1,430.00	$1,172.53	$5,557.53
Average:	$1,624.67	$1,107.62	$1,402.00	$1,619.68	$5,753.97

	Average Installed Costs
High-Eff Furnace – 92% AFUE	$3,196
High-Eff Furnace – 95% AFUE	$3,591
Storage Water Heater – EF 0.67	$1,111

Field Data Observations

Seasonal efficiencies are reduced in shoulder and summer months as cycling and standby losses become a high fraction of the thermal load.



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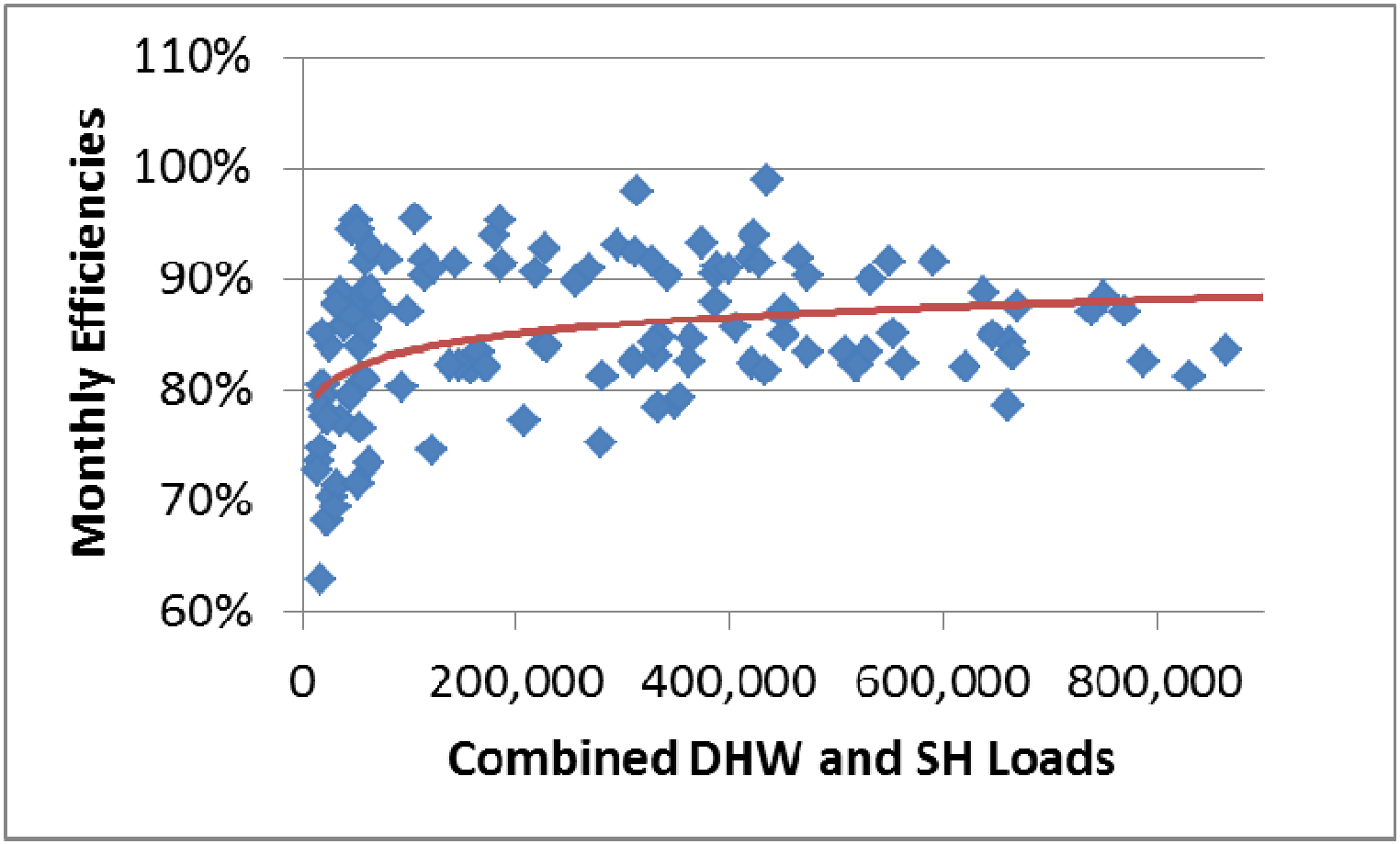
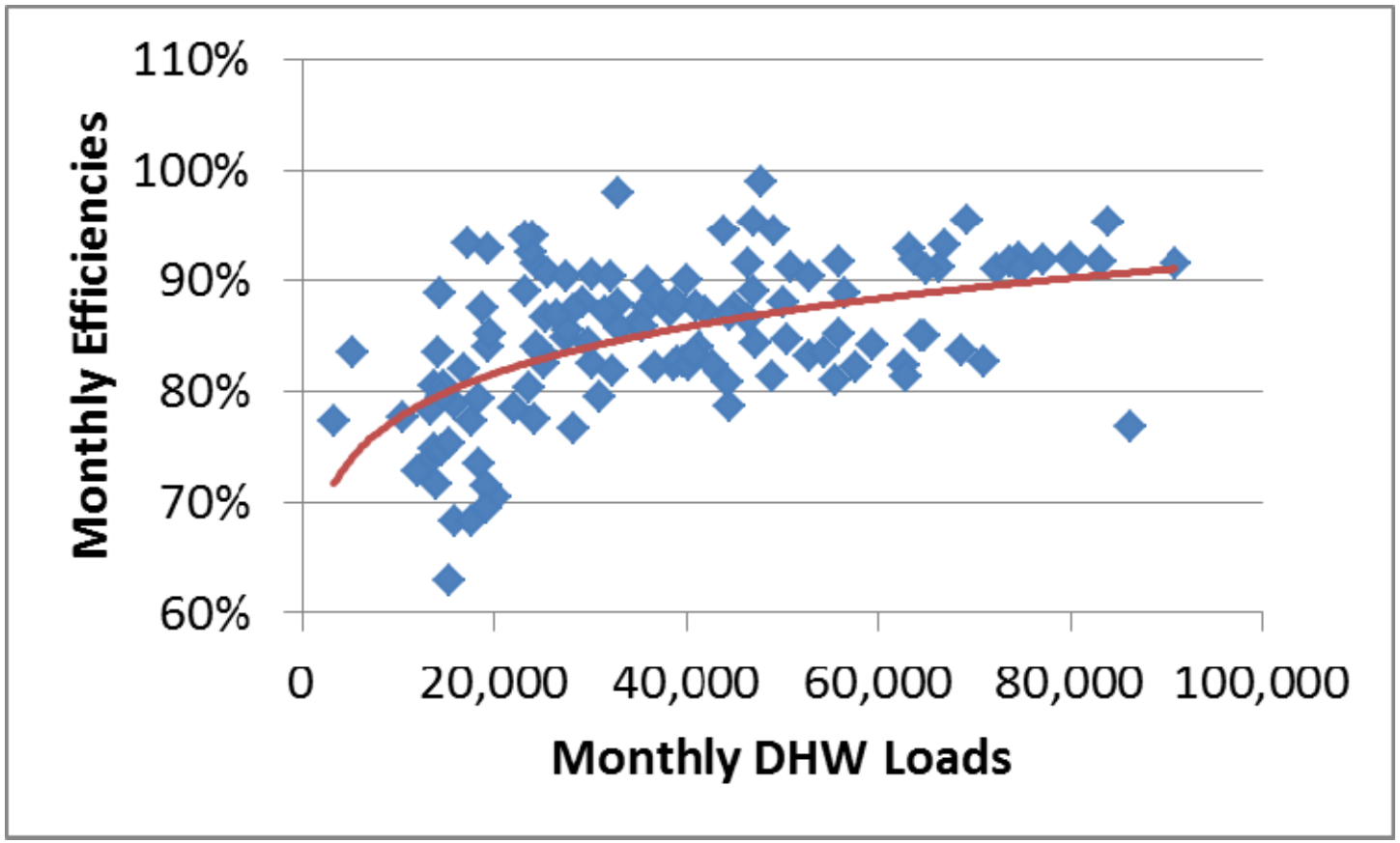
Field Data Observations

Low DHW and space heating use tend to generate low overall efficiency.



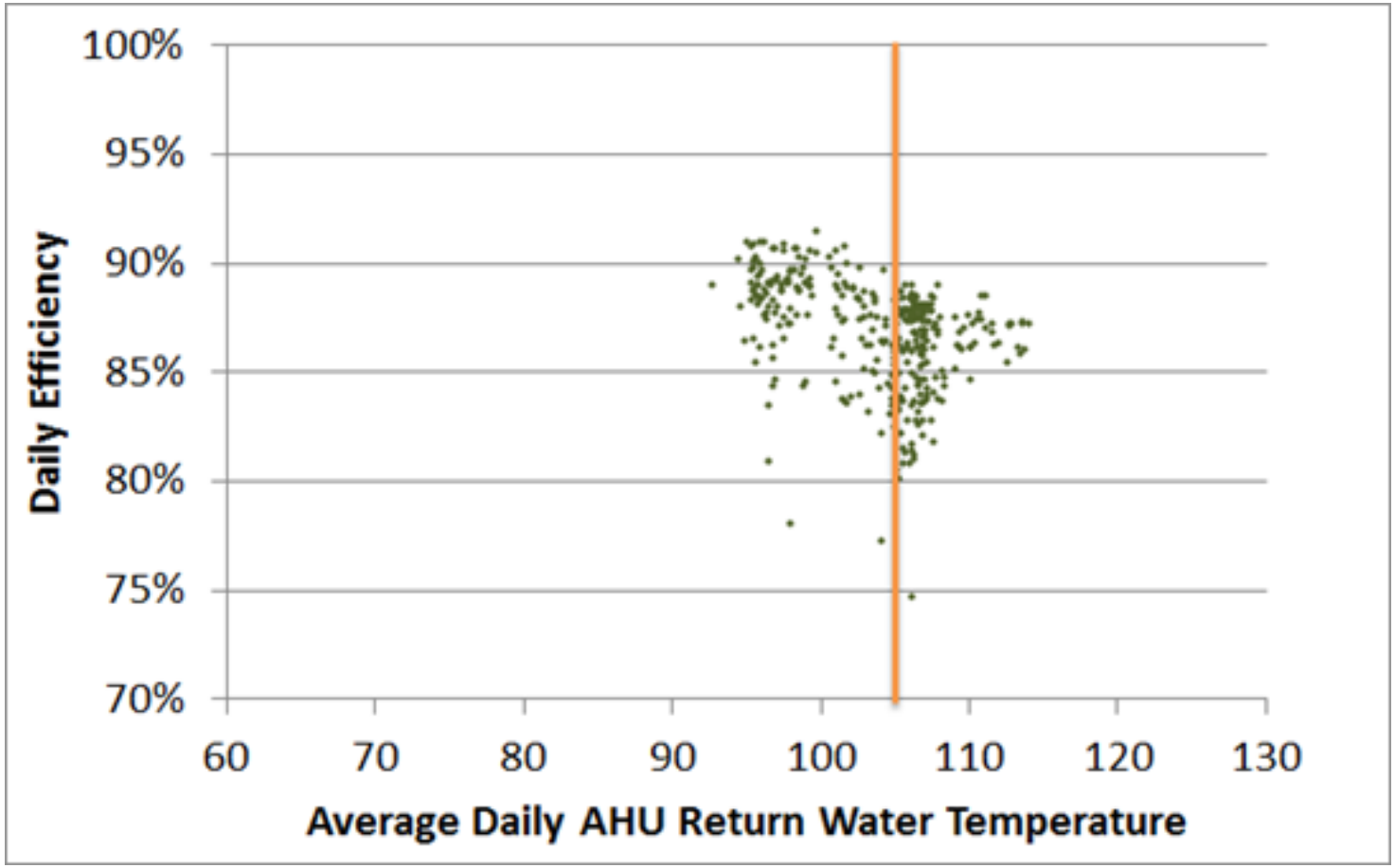
Field Data Observations

There is a general trend toward higher efficiency when more DHW is used.



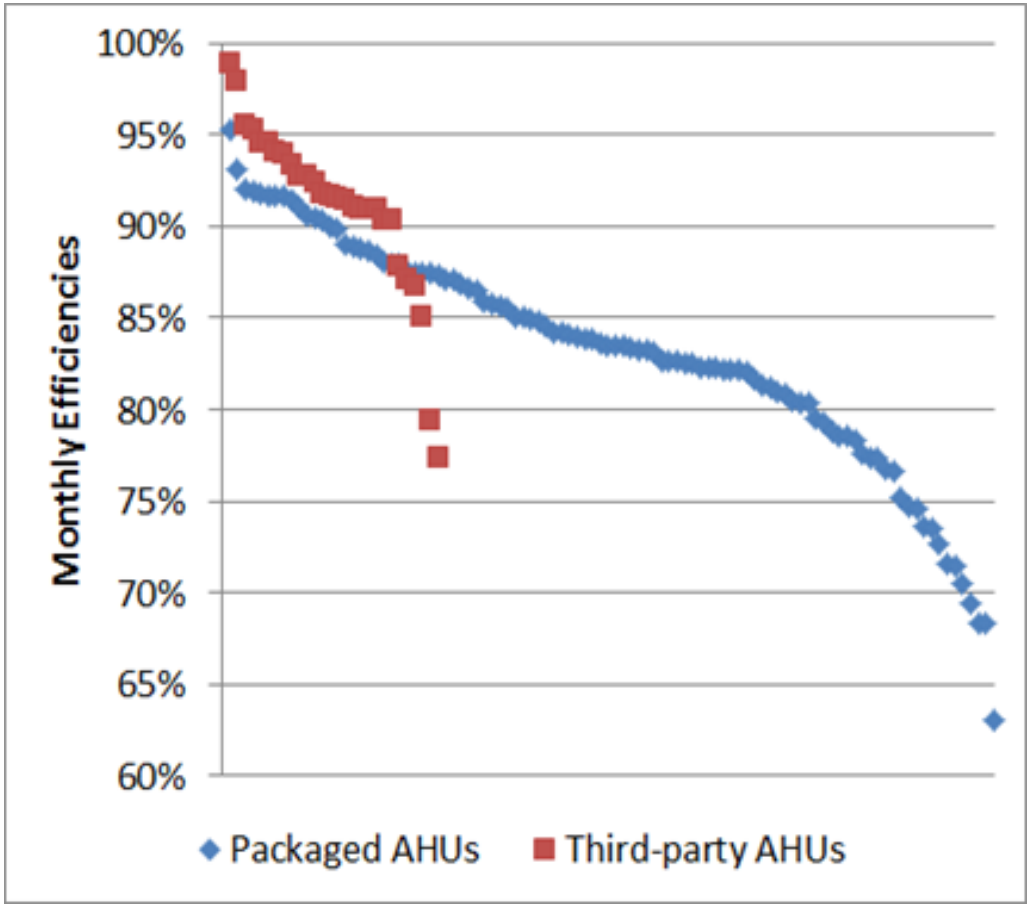
Field Data Observations

The lower the return water the higher the efficiency.



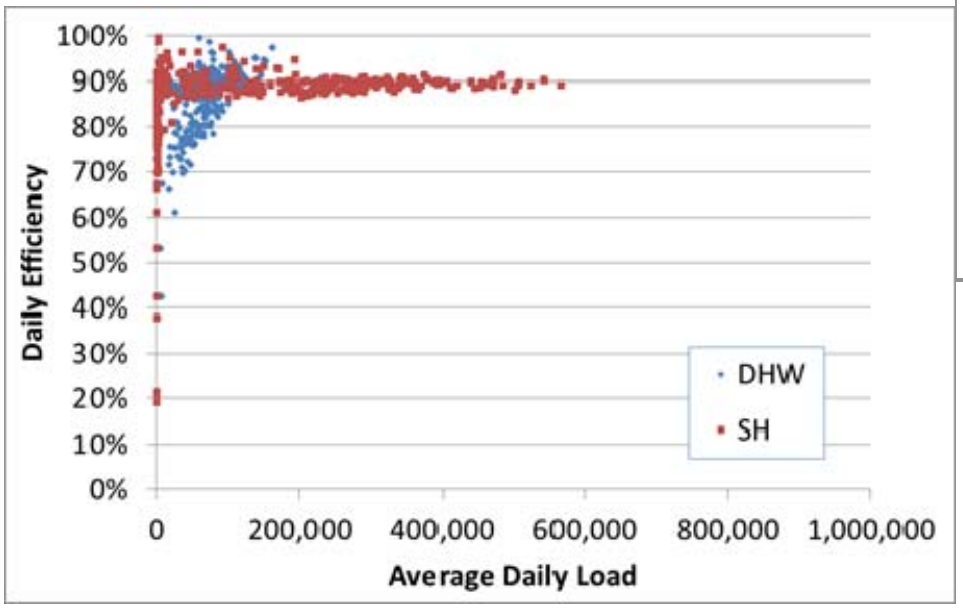
Field Data Observations

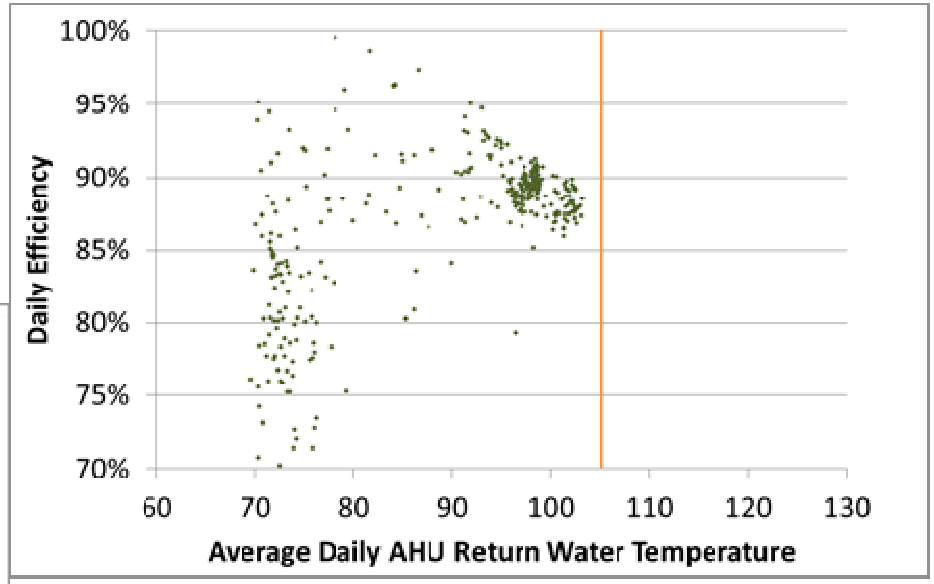
3rd party AHUs had higher monthly efficiencies than packaged AHUs



Field Data Observations

NYSERDA Site 9 – 3rd party AHU designed for condensing combi system operation.



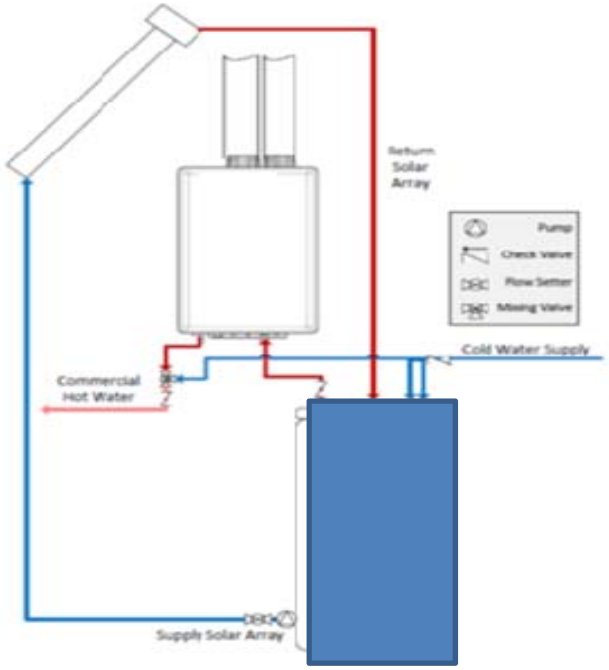


Field Data Observations

- Pump timers to circulate water for 30 sec/ 6 hours (Legionella)
- This control strategy heats air conditioned supply air briefly ~85°F in Summer
- 199k Btuh Burner on-time = ~2 min/day or ~6kBtus/day to circulate AHU water

Field Data Observations

NYSERDA Site 1 (Hybrid Solar)- The tankless maintained 130°F stand-by tank temperature resulting in significant standby loses and reduced system efficiency



NYSERDA Site 5 (Combi-Boiler)- The non-condensing operation due to mismatch of flow rates and potential lack of emitters [Under investigation].

NYSERDA Site 8 (Hybrid) - Heat exchanger failure. Unapproved venting resulted in back pressure issues [Unit replaced venting corrected].

Questions?