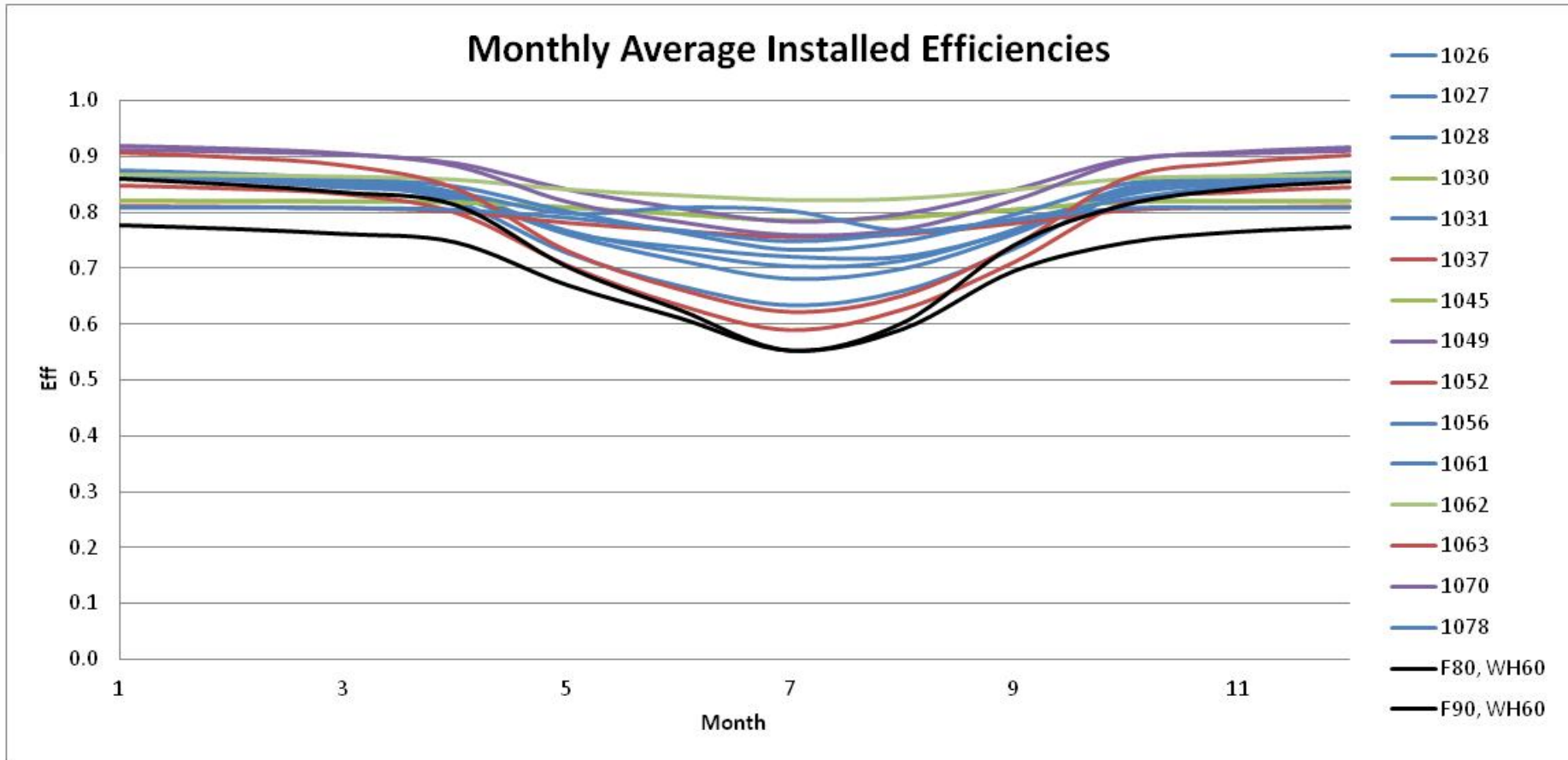
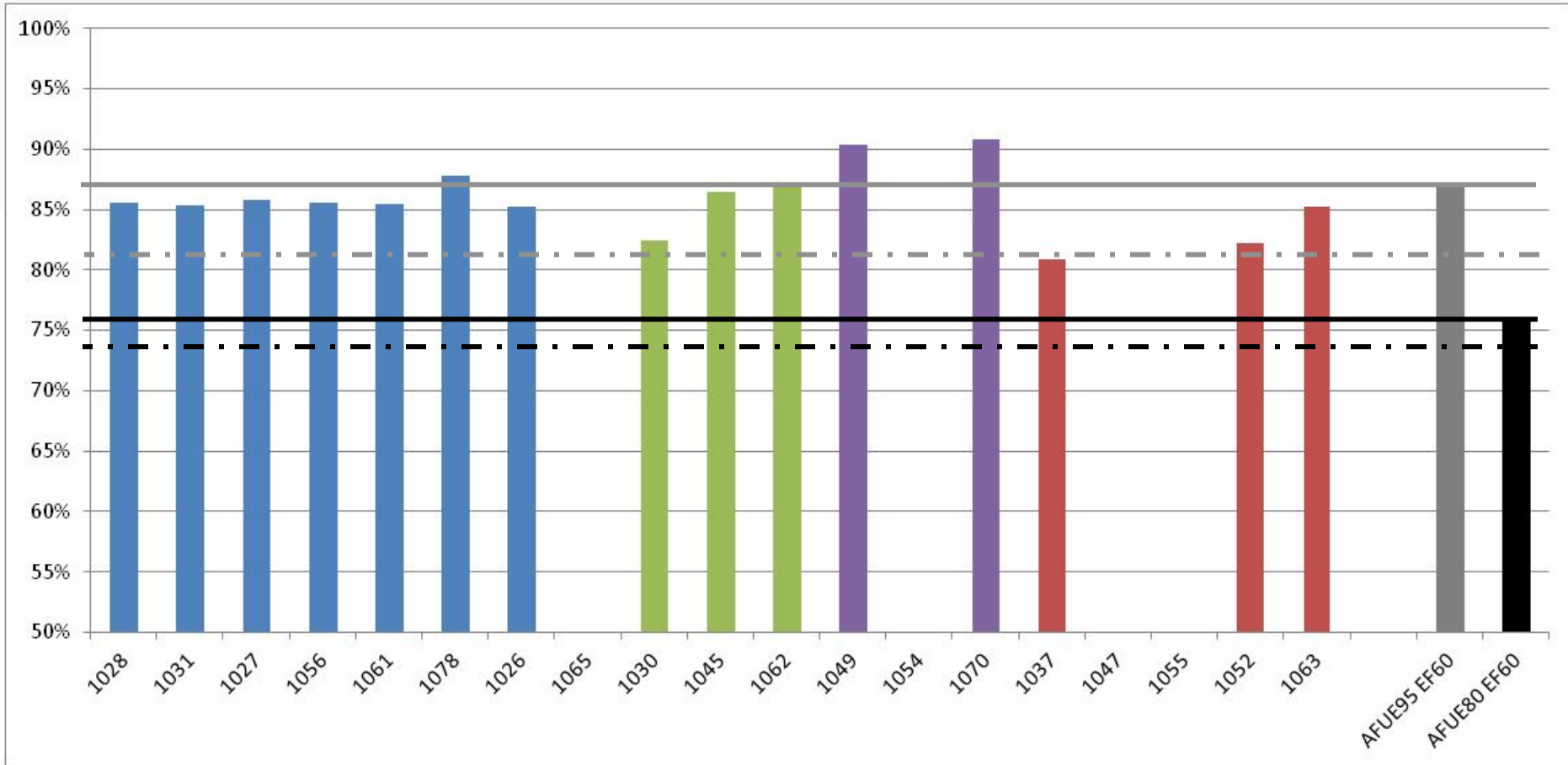


Site	Storage		Site	Tankless		Site	Hybrid		Site	Boiler	
	Energy Output kBtu/day	Water Volume GPD		Energy Output kBtu/day	Water Volume GPD		Energy Output kBtu/day	Water Volume GPD		Energy Output kBtu/day	Water Volume GPD
1028	3.1	12.7	1030	47.2	106.8	1049	34.1	67.7	1037	29.5	72.7
1031	19.0	42.3	1045	41.4	81.1	1054	6.0	13.5	1047	18.4	23.7
1027	25.0	54.6	1062	20.0	41.5	1070	2.4	5.7	1055	6.3	16.5
1056	4.7	10.8							1052	7.2	13.0
1061	19.9	33.3							1063	18.9	34.0
1078	50.8	89.0									
1026	17.2	33.9									
1065	8.1	19.5									

System Efficiencies under Typical Loads



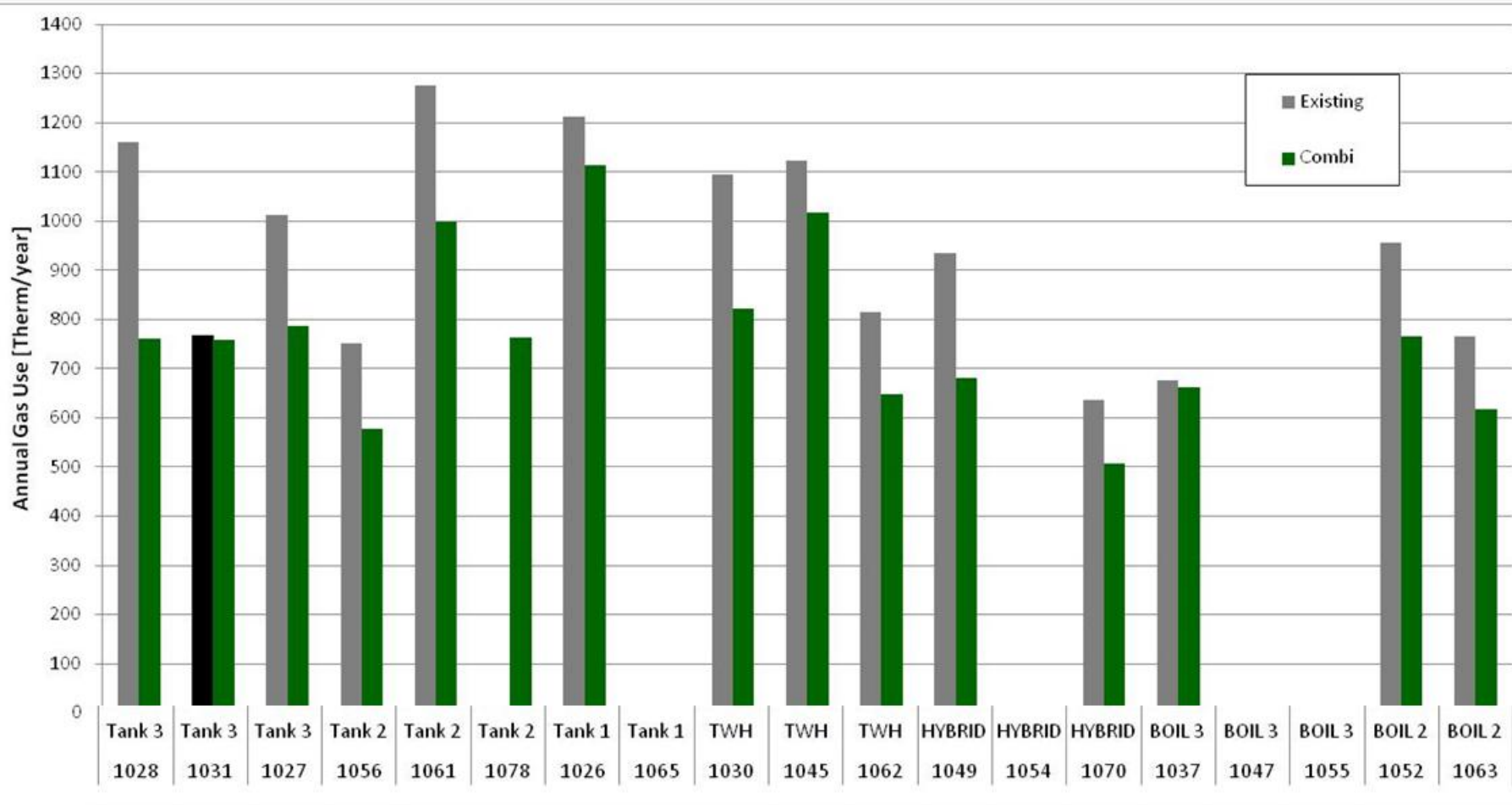
System Efficiencies Under Typical Loads



25,000 btu/hr design heating load
and 40 gpd of hot water

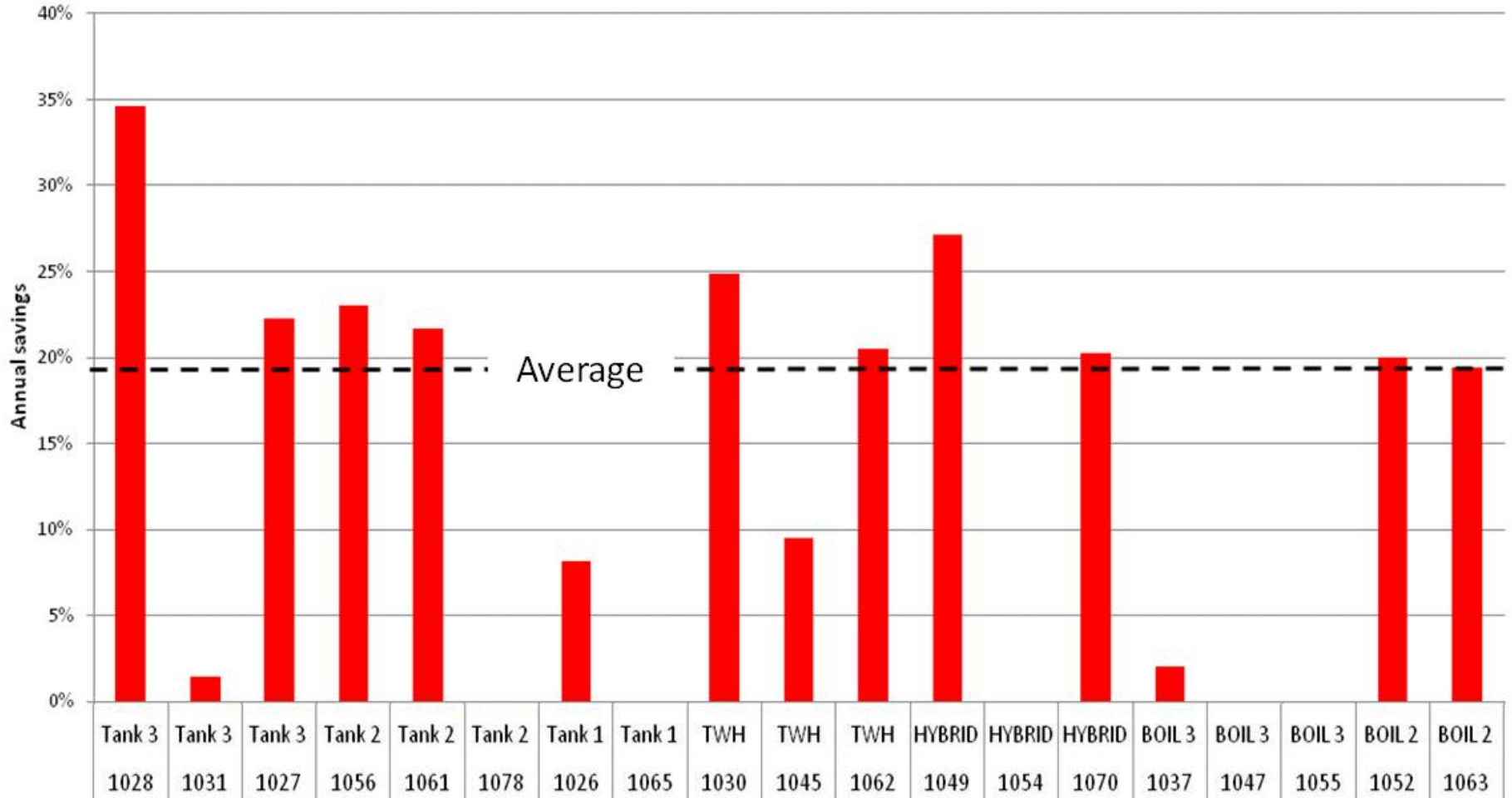
Dashed lines represent possible
installed efficiency

Savings Potential



1047 – Early removal, 1054 – additional heating source, 1055+1065 – late installs

On average 19%
reduction in gas
consumption

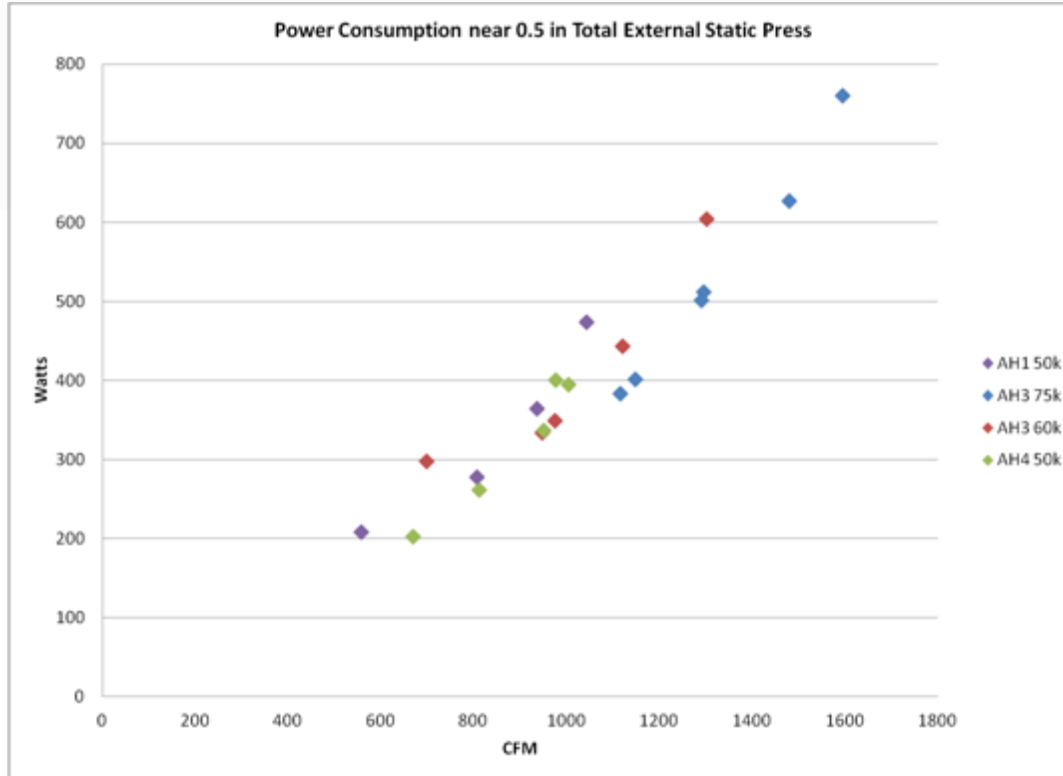


1028 – possible 70% eff furn

1037 – Combi boiler annual eff 81%

1031 – Condensing Furn

Power

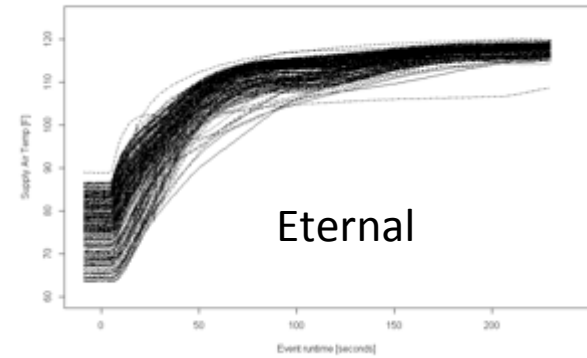
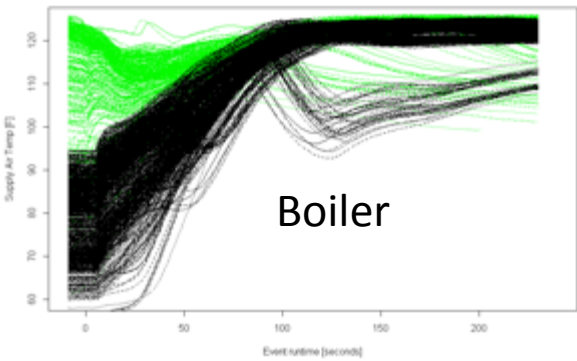
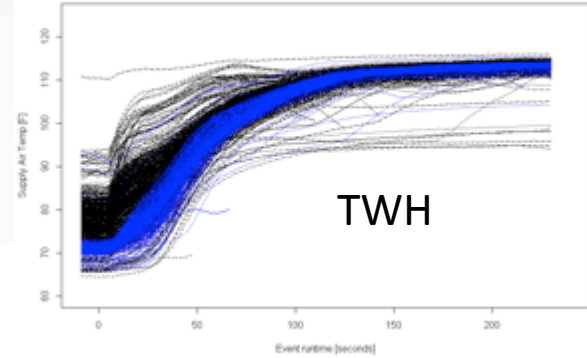
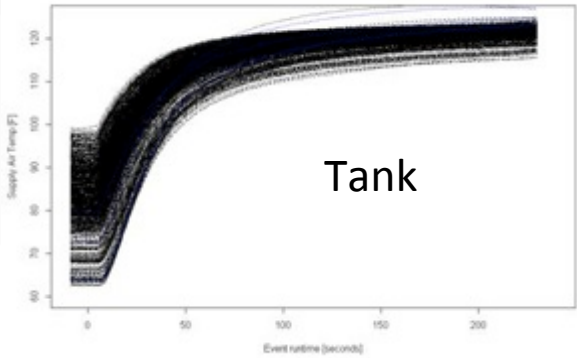


Serc #	Existing Space On	Combi Space On	% change Heating
1028		425	
1031			
1027	635	474	25%
1056	478	392	18%
1061	517	416	20%
1078	525	488	7%
1026	540	524	3%
1065	539	408	24%
1030	325	431	-33%
1045	302	397	-31%
1062	656	430	35%
1049			
1054			
1070	647	476	26%
1037		629	
1047		551	
1055	640	519	19%
1052	707	809	-14%
1063	501	283	43%
Avg	539	478	11%

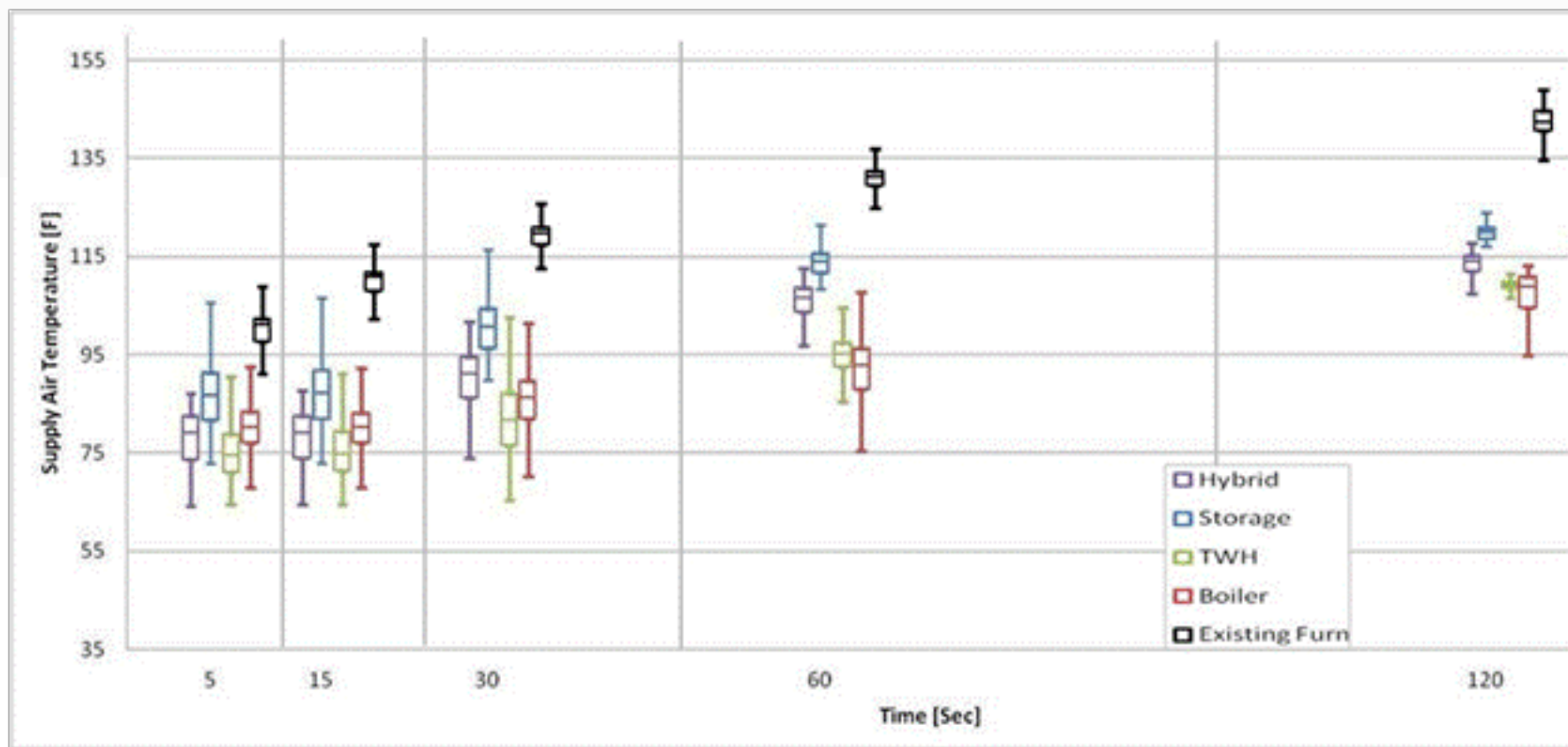
Continuous Fan Performance
Exist ~425W
Combi ~ 50W

Occupant Comfort

Supply Air Temps



Supply Air Temp Comparison



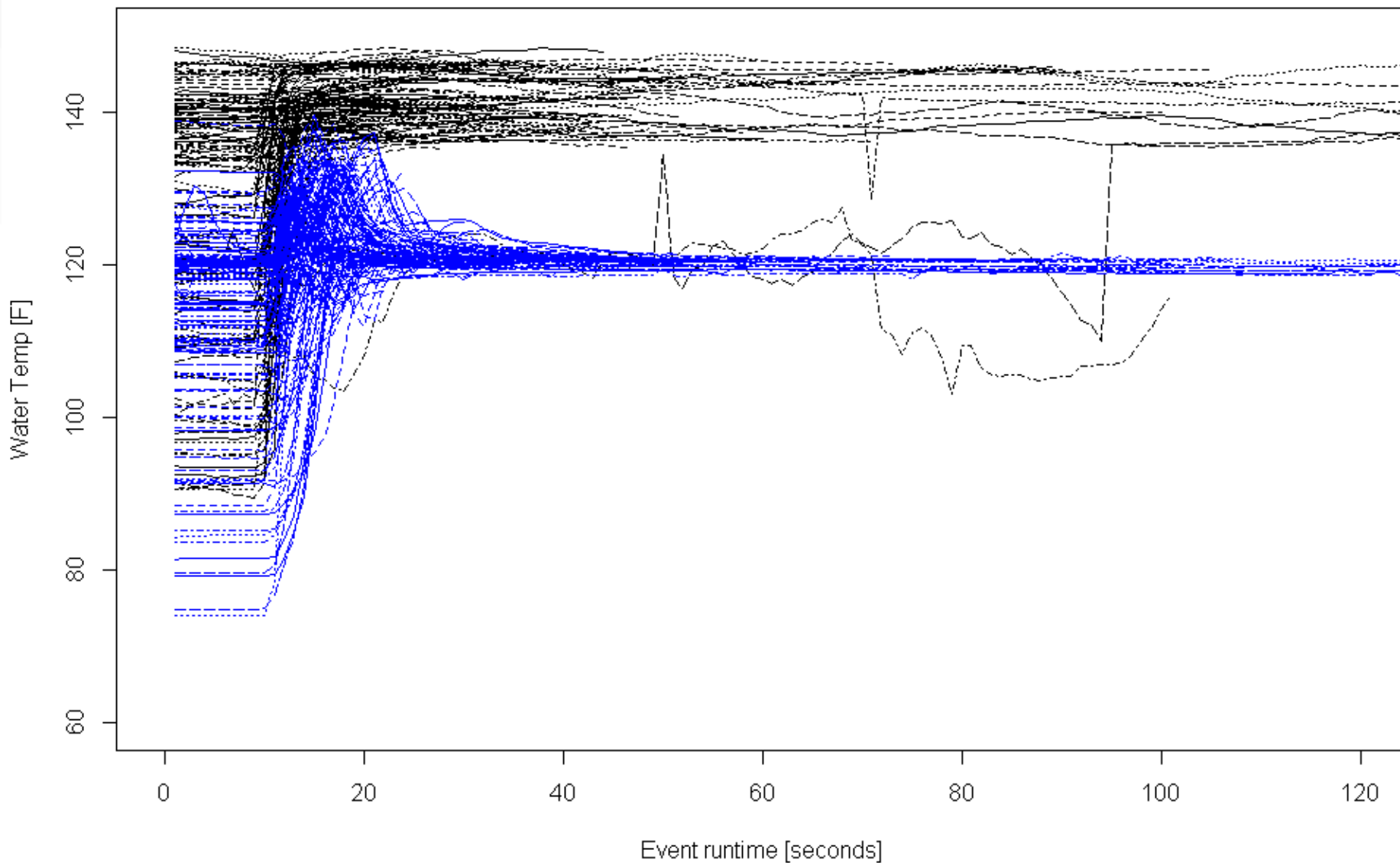
❖ Supply Air Summary

- + Non-condensing furnaces: 130 - 140 ° F
- + Condensing furnaces: 115 – 130 ° F
- + Space heating heat pumps: 77 – 115 ° F

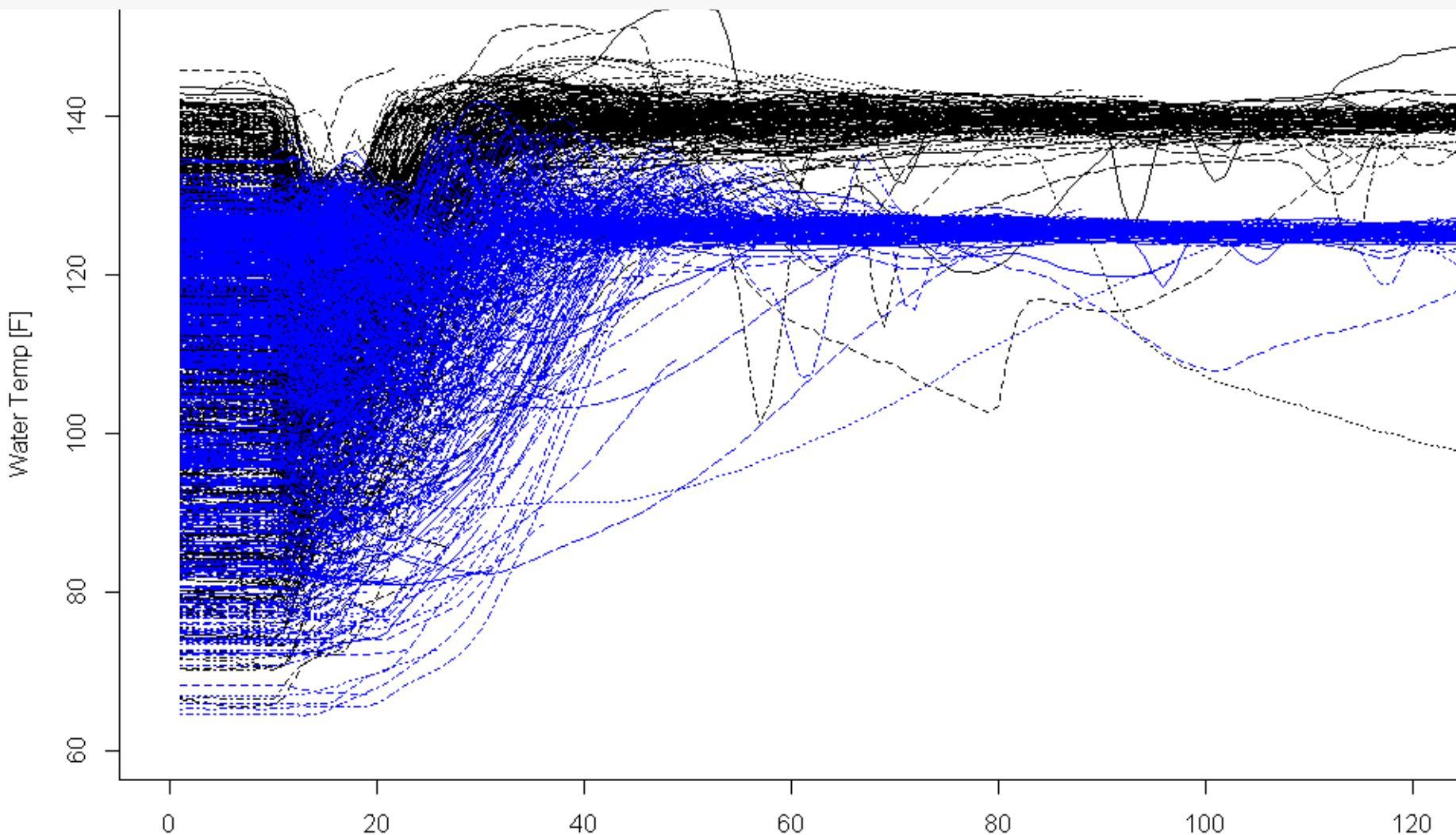
- + Combis this project :110 – 115 ° F

- + Could improve efficiency 3-5% allowing 105 °F air temps.

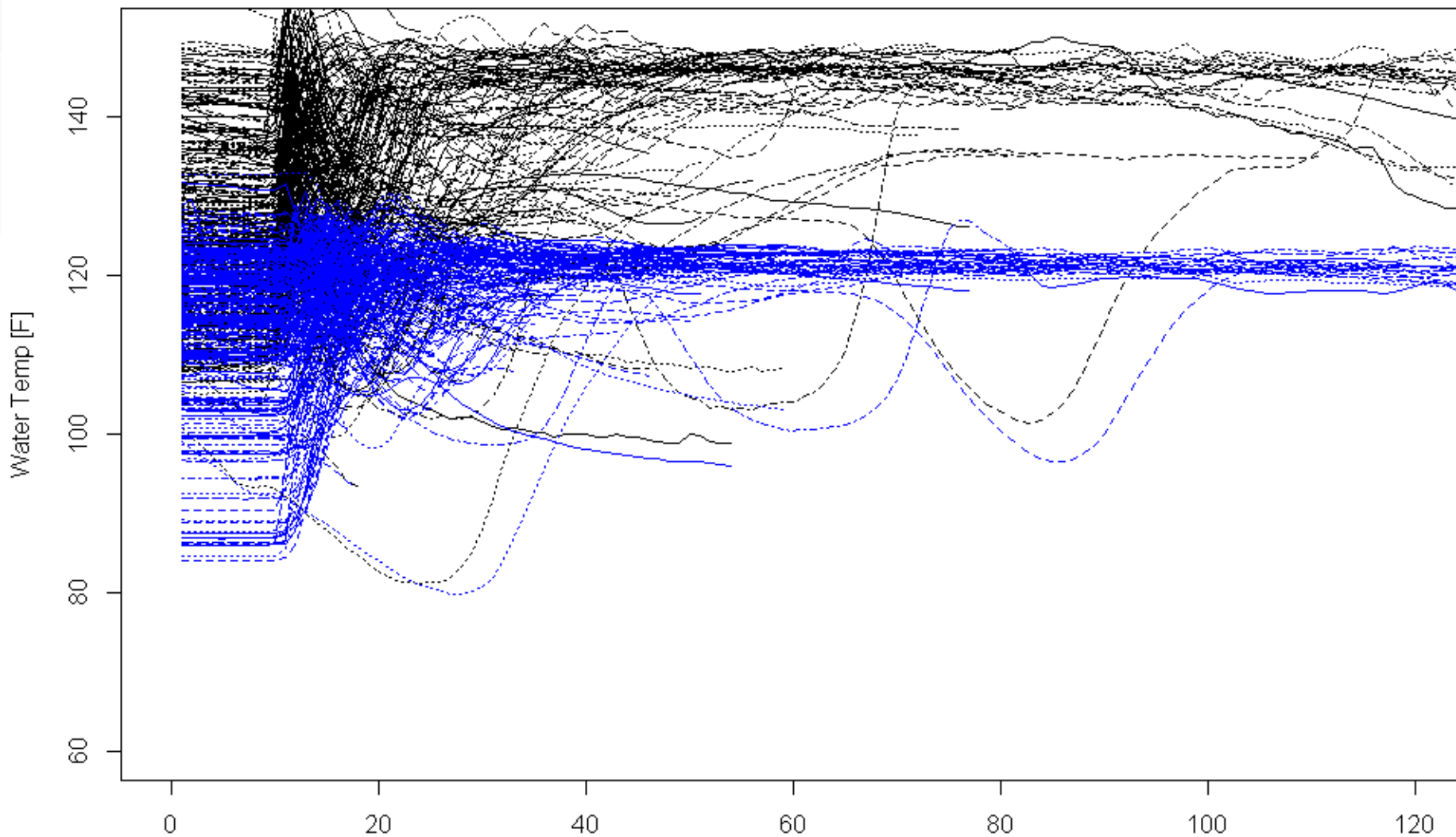
Delivered Water Temperature – Storage Water Heater



Delivered Water Temperature – Tankless Water Heater

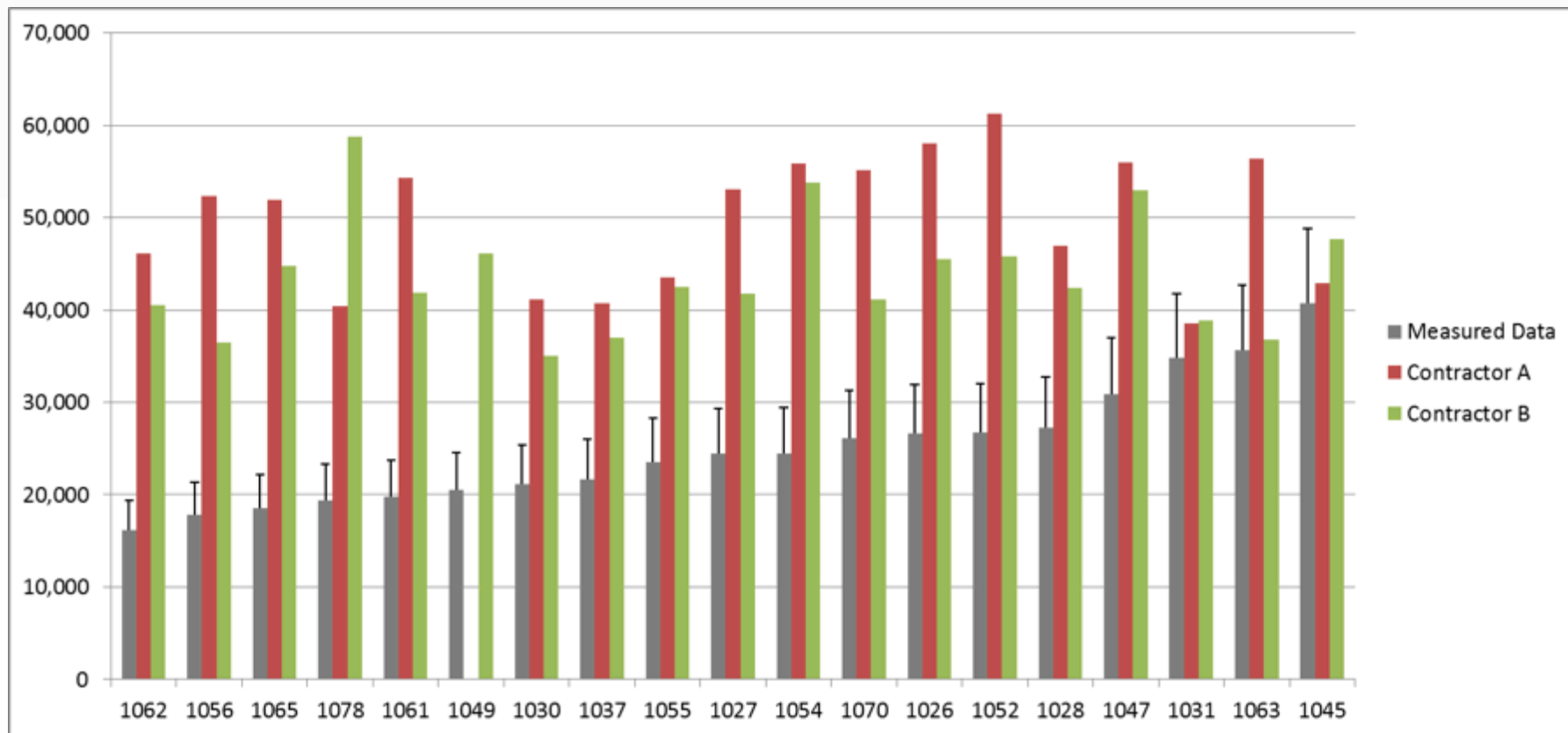


Delivered Water Temperature – Hybrid Water Heater

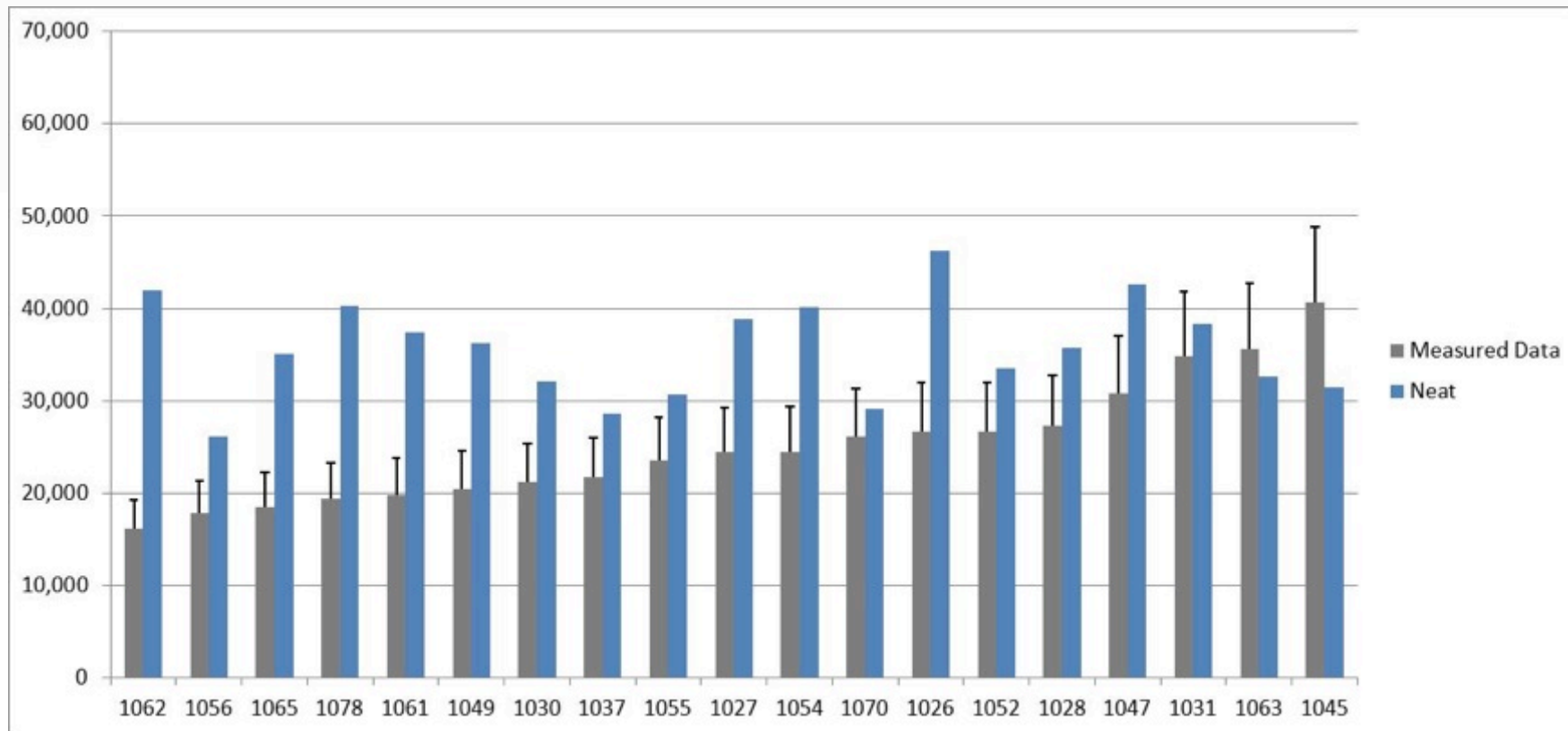


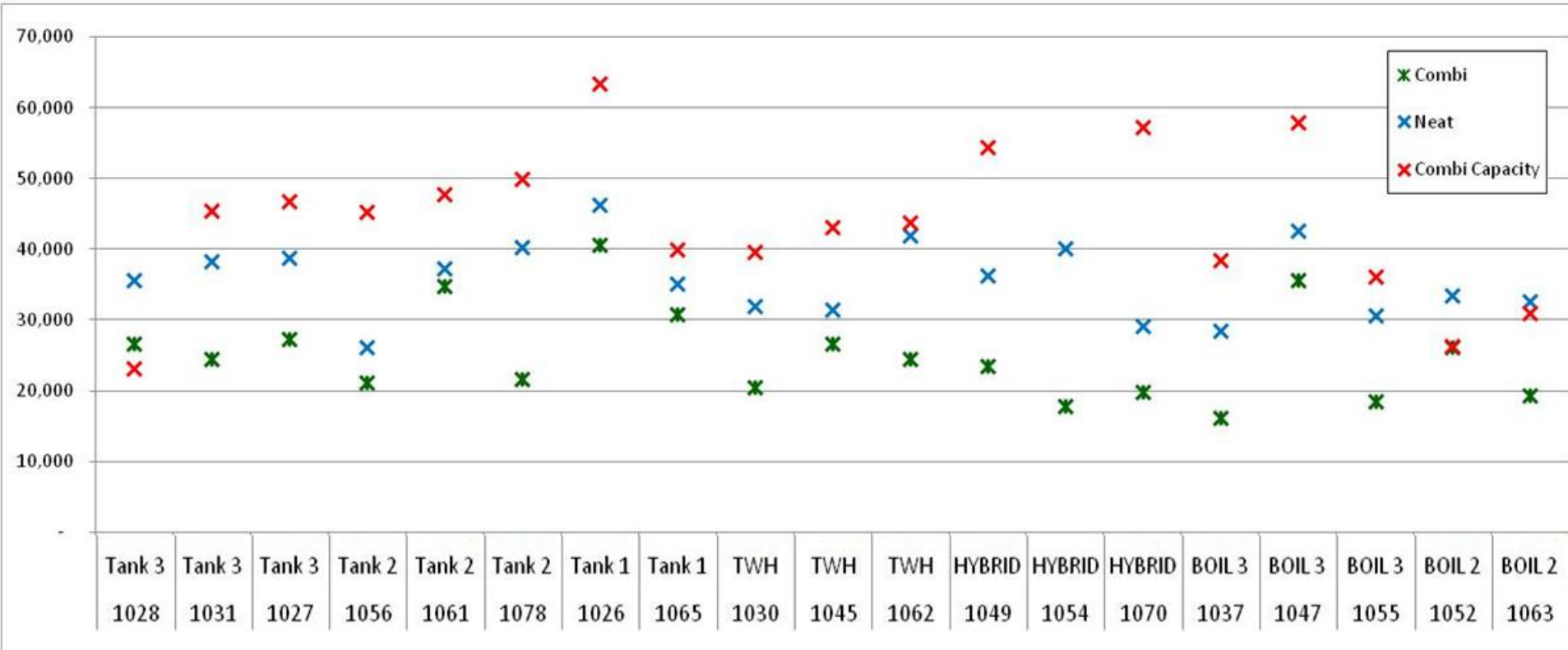
Space Heating Design Loads and System Sizing

Calculated Load versus Actual Load



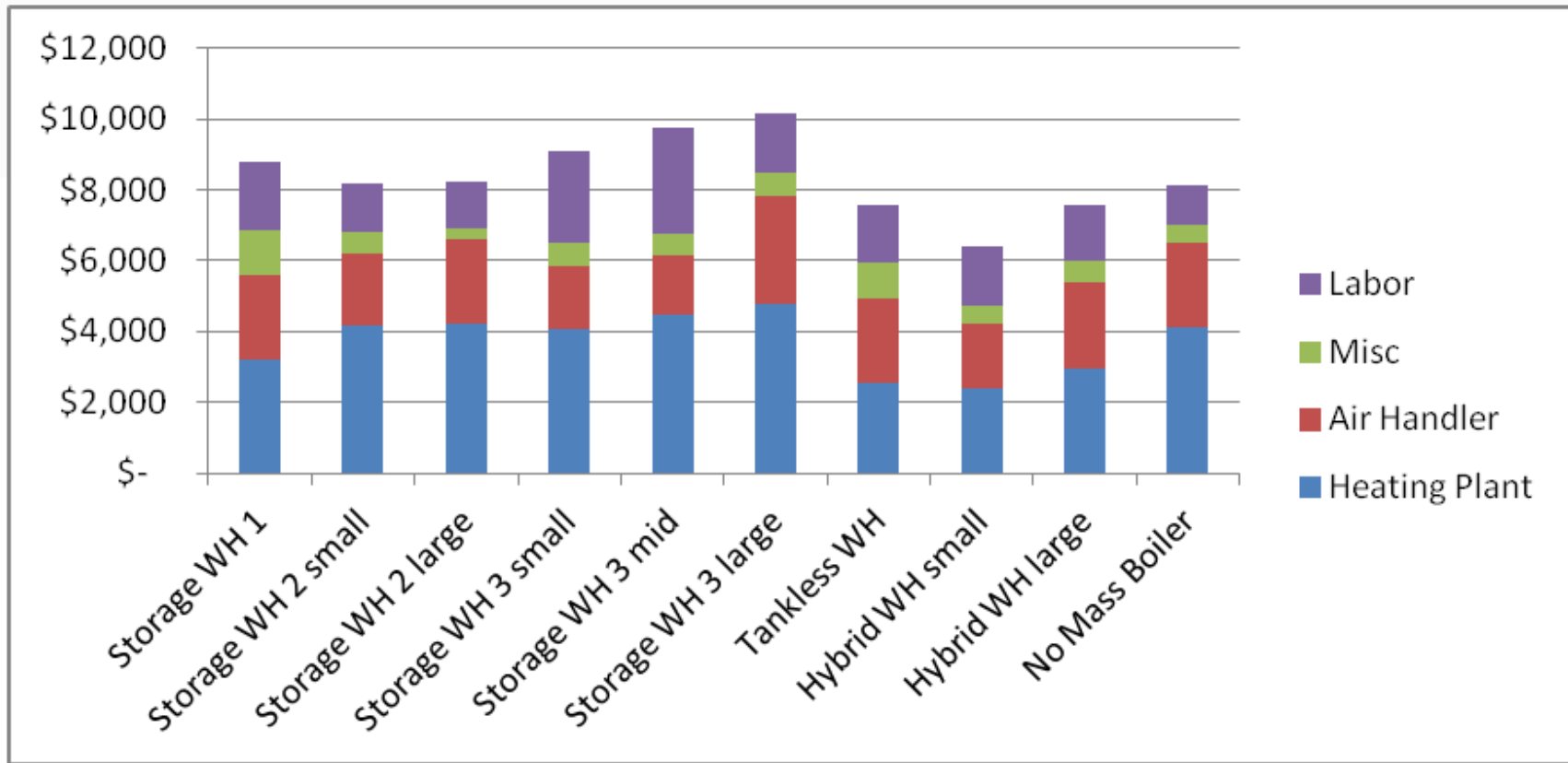
Calculated Load versus Actual Load





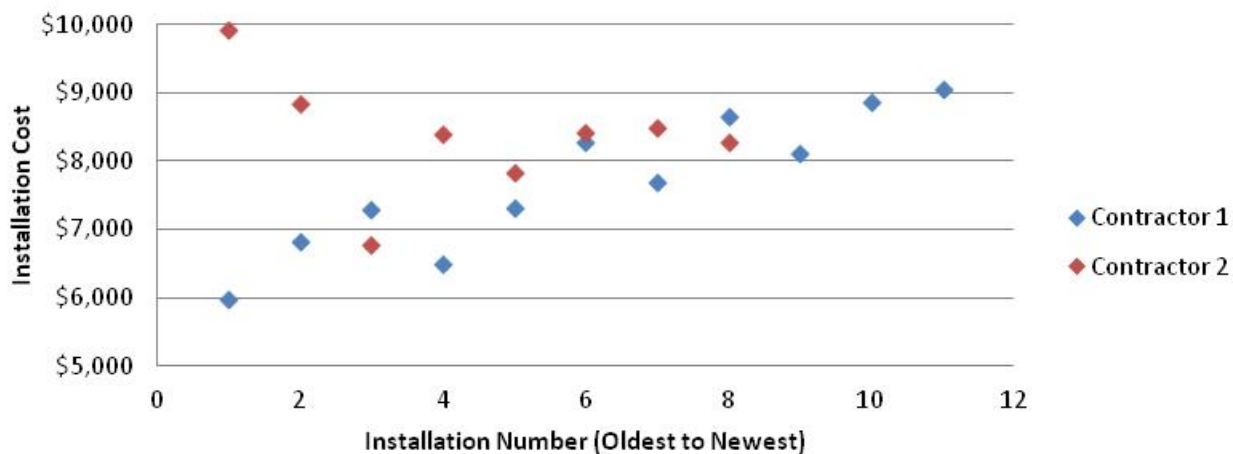
Costs, Savings, and Payback

❖ Average Installation Costs

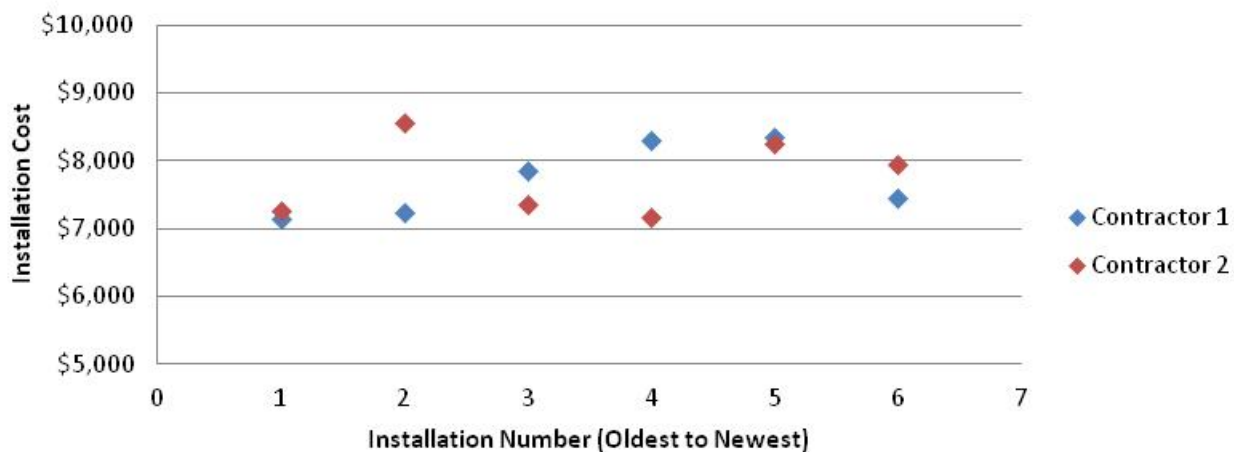


Impacts on cost

Combi with Storage Heating Plant



Combi with Hybrid Heating Plant



• Savings and paybacks compared to an 80% AFUE furnace and 60% EF water heater

Combi System	Load	Savings	Needed Install Cost		SIR
		\$/year	5 yr payback	10 yr payback	
Cond Storage	Small	\$108	\$4,740	\$5,280	0.2
Cond Storage	Large	\$251	\$5,455	\$6,710	0.5
Cond Storage	Small	\$140	\$4,900	\$5,600	0.4
Cond Storage	Large	\$322	\$5,810	\$7,420	0.8

Assumes an install cost of \$4,200 for a natural draft furnace and water heater

• Savings and paybacks compared to an 95% AFUE furnace and 60% EF water heater

Combi System	Load	Savings	Needed Install Cost		SIR
		\$/year	5 yr payback	10 yr payback	
Cond Storage	Small	\$10	\$5,350	\$5,400	0.0
Cond Storage	Large	\$18	\$5,390	\$5,480	0.0
Cond Storage	Small	\$42	\$5,510	\$5,720	0.1
Cond Storage	Large	\$89	\$5,745	\$6,190	0.2

Assumes an install cost of \$5,300 for a condensing furnace and power vent water heater

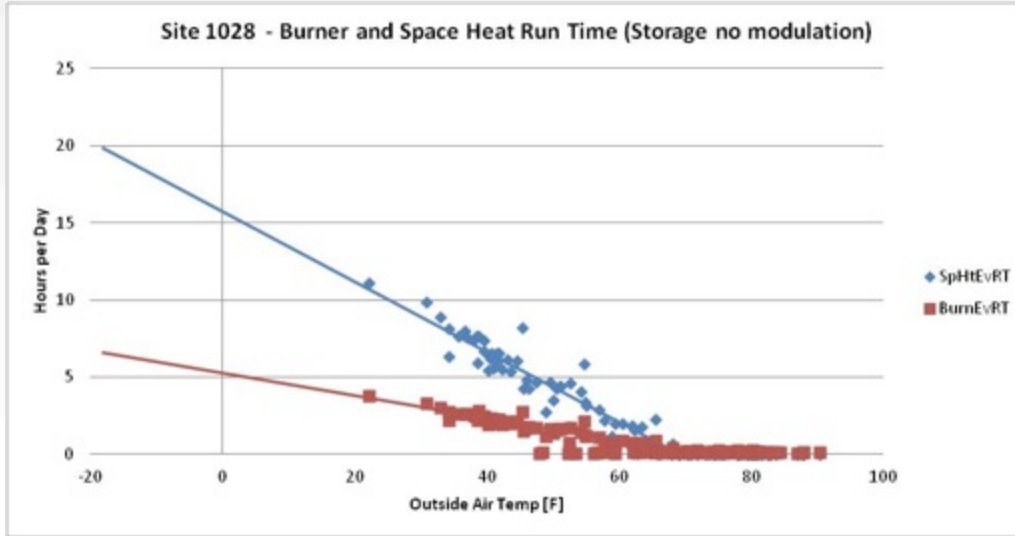
❖ What else do we need to know?

+ 2013 Work: Controls

- + What cycle lengths are necessary to prevent short cycling for efficiency? Room temperature?
- + How will fan and pump modulation improve efficiency and comfort?
- + How will system performance change if we remove the air temperature restrictions?

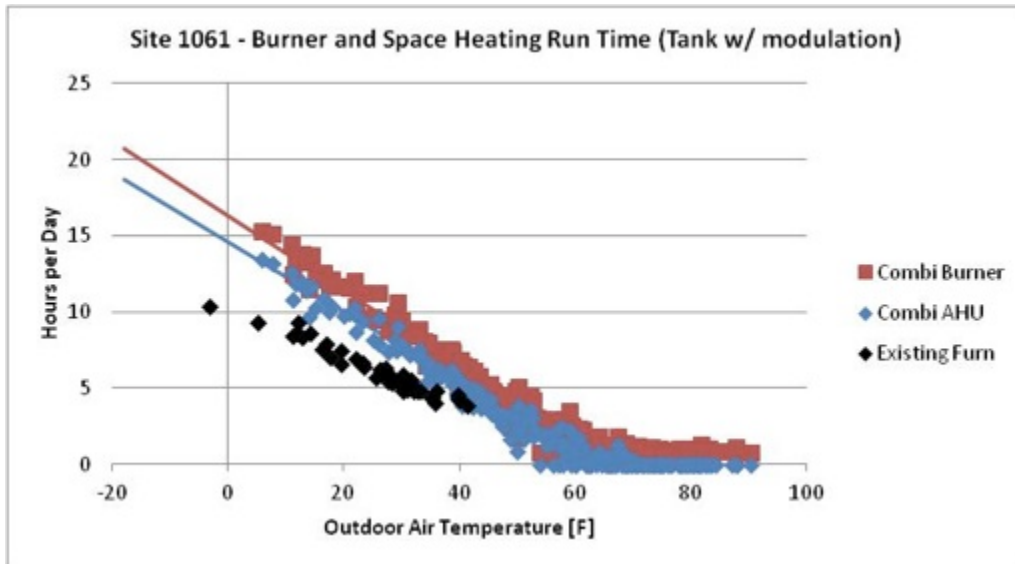
+ Other Needs

- + Fan and pump power improvement
- + Improvements to air and water temperature delays
- + DHW priorities impact on comfort



26.6 kBtu/hr load
100 kBtu/hr burner input

87% eff in Jan



35.5 kBtu/hr load
26-130 kBtu/hr burner input

87% eff in Jan

❖ Questions?

Ben Schoenbauer

bschoenbauer@mncee.org

Jake McAlpine

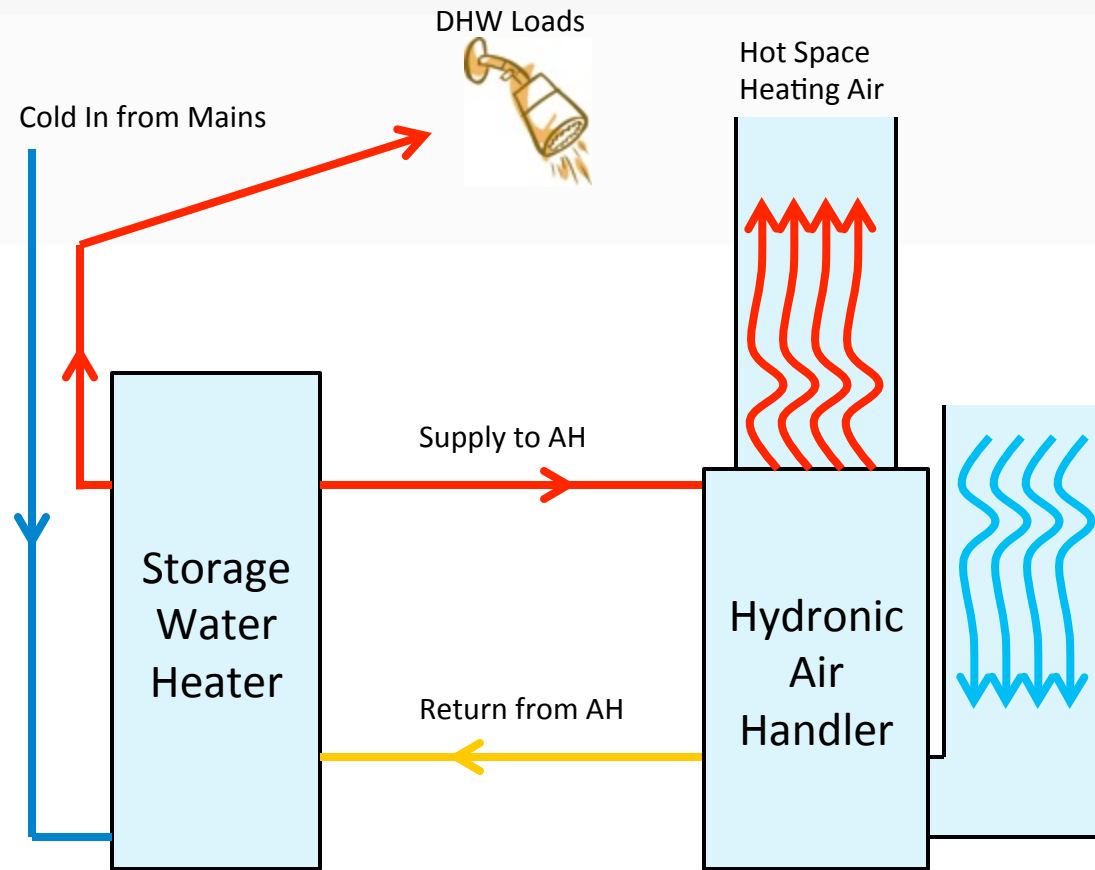
j.mcalpine@src-mn.org

More information available at:

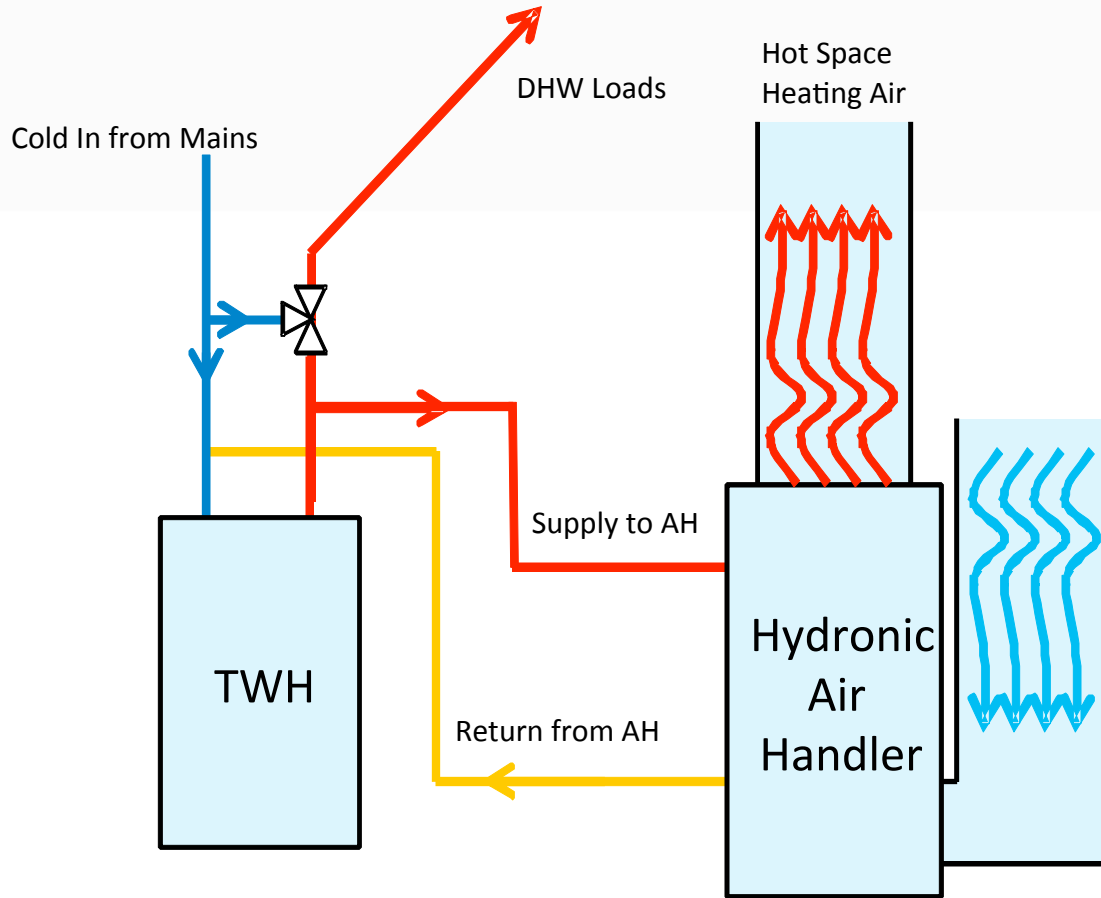
www.mncee.org/dia



Storage water heater based system



❖ Tankless Water Heater Based System



Combi boiler based system

