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Savings through the Proper Installation of Combined Heat and Hot Water Systems



2014 Industry Partner Meeting

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Center for Energy and Environment

• What we do

- Engineering Services
- Innovation Exchange
 - Research
 - Education and Outreach
- Sound Insulation Program
- Public Policy
- Lending Center
- Energy Program Design and Delivery



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- NorthernSTAR - A DOE Building America Research Team
- Sustainable Energy Resources for Consumers Grants



- Center for Energy and Environment
- Sustainable Resources Center
- University of Minnesota
- The Energy Conservatory





Agenda

- Introduction to Combination Systems
- Savings Potential
- Best Installation Practices
 - Home Assessment
 - Combi Equipment
 - Installation
 - Optimization
 - Verification
- Performance
- Conclusions

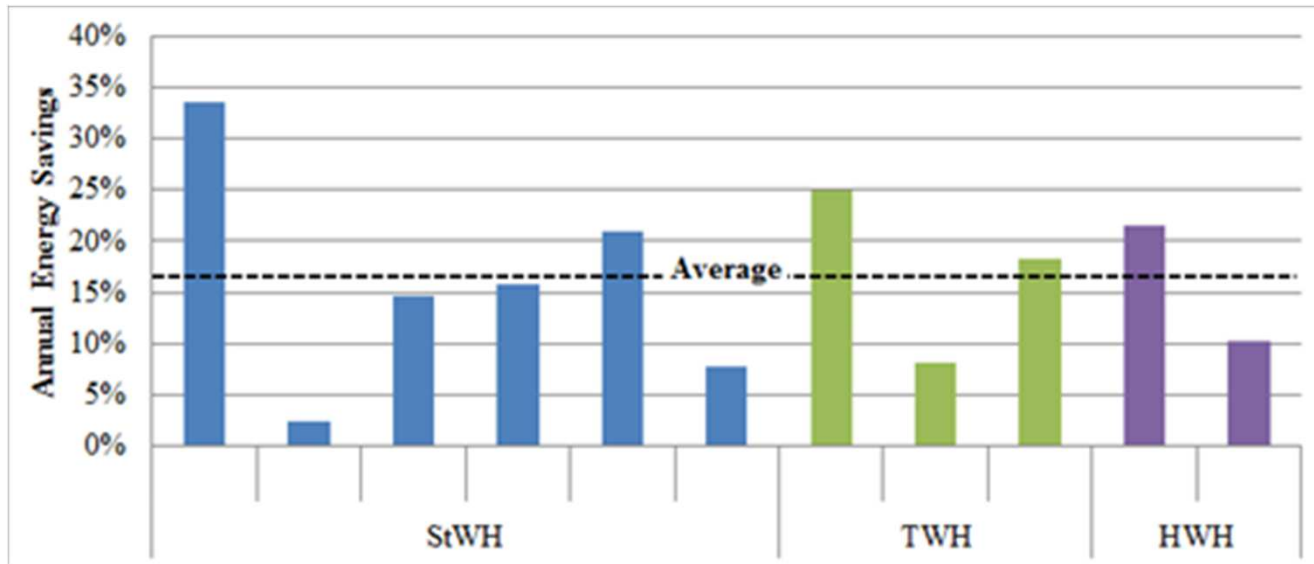


Energy Savings Potential

- LIWX agency installed 200+ in Twin Cities metro
- Typically replaced a 80% AFUE furnace and a 0.59 EF water heater
- Utility bills showed an median savings of 13%

- 11 home detailed pre/post analysis
- Savings of 16%

Savings



Heating Plant	Installed Efficiency			Rated Efficiency	
	Annual	Winter Space Heat	Summer DHW	Rating Method	Rating
StWH	86%	87%	60%	Thermal Efficiency	95%
TWH	86%	85%	85%	Energy Factor	93%
HWH	90%	92%	61%	Energy Factor	95%
Existing ¹	71%	72%	47%	AFUE/Energy Factor	79% / 59%



Home Assessment

- Space Heating Load
 - Manual J
- DHW Load
 - Number of bathrooms/Number of people
 - Inlet water temperature

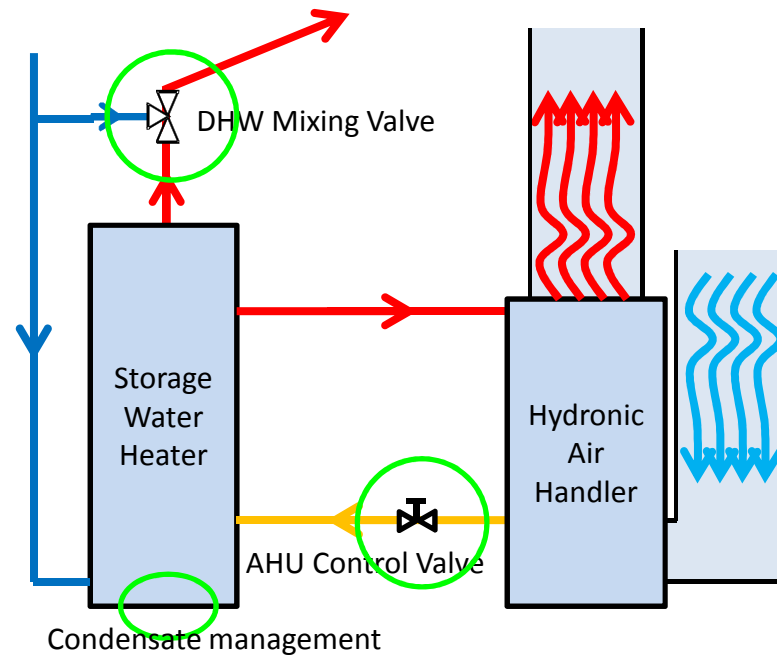


Installation

- Codes
 - Open loop requires hydronic air handlers and pumps rated for potable water
 - Stagnation prevention mode
 - Lack of familiarity of codes officials
 - Can water heaters be used for space heat?
 - Closed loop system required?
 - Other concerns???

Installation

- Special equipment
 - Venting
 - Mixing valve
 - Condensate pump
 - Air Handler flow rate control valve

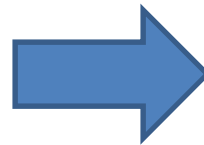


Installation: Venting

Venting

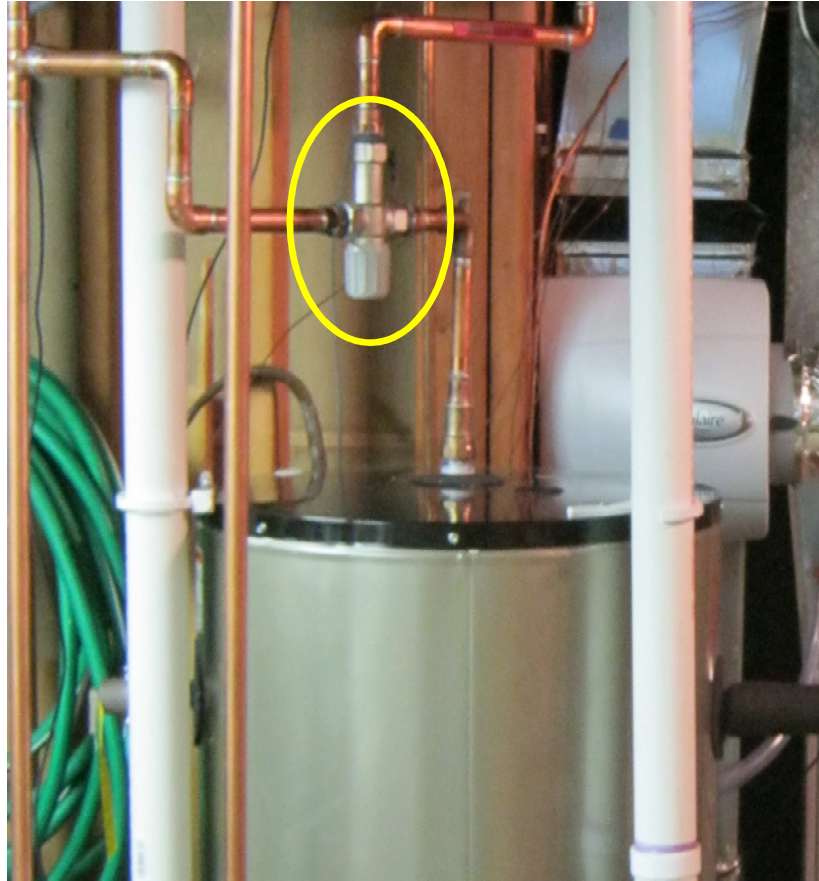


B-Vent



Direct

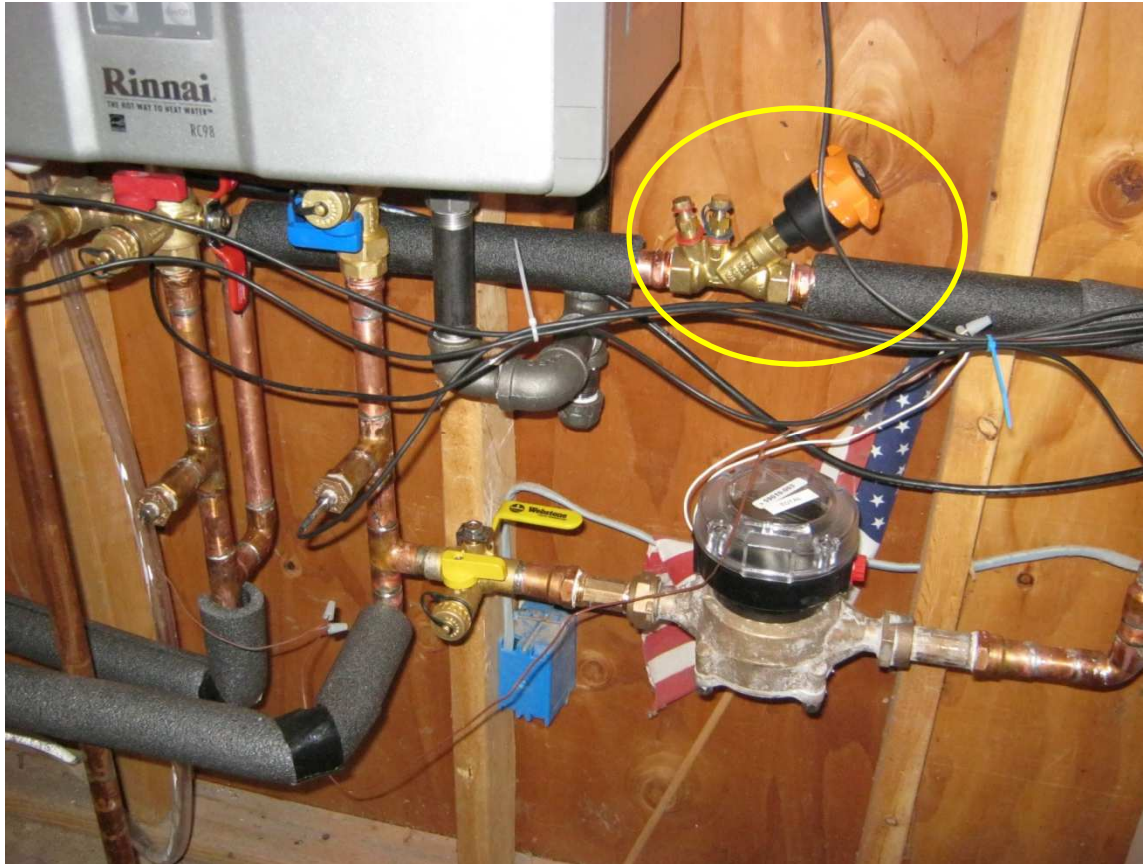
Installation: Mixing Valve



Installation: Condensate Management



Installation: Air Handler Control Valve



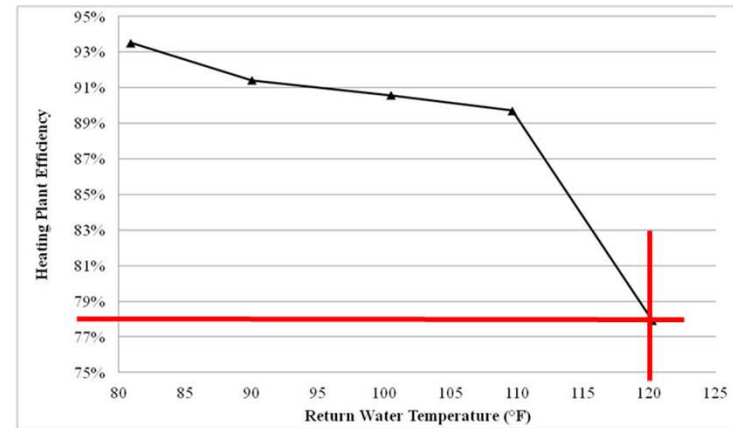
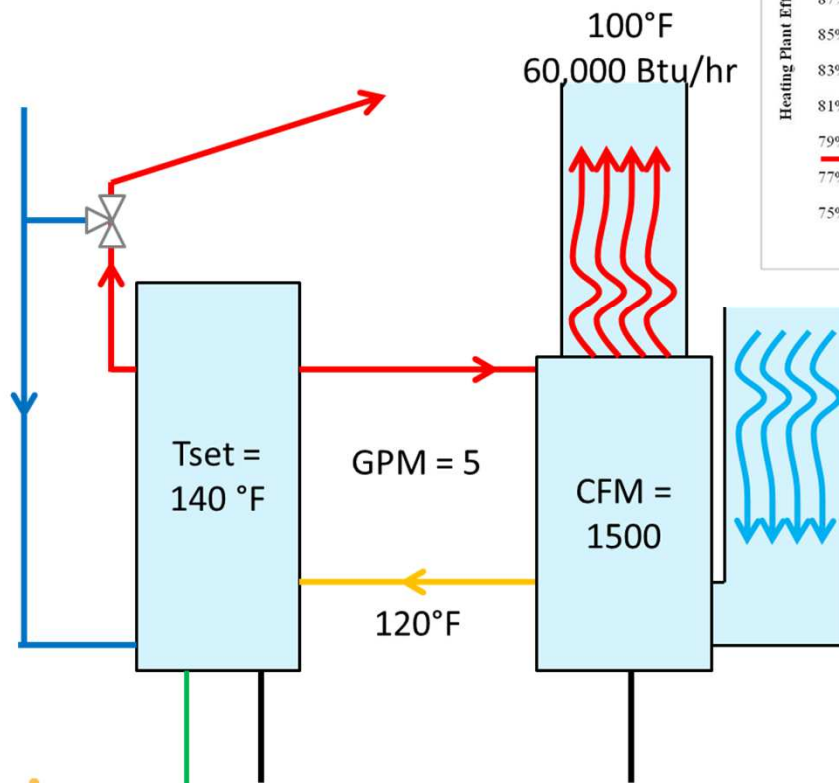


Installation

- Other considerations
 - May need to install an electric outlet for the water heater
 - May need to increase the size of the gas line or even the gas meter/supply line
 - Hybrid and tankless water heaters typically can be wall mounted which will reduce system footprint – can also mean changing the location of the plumbing

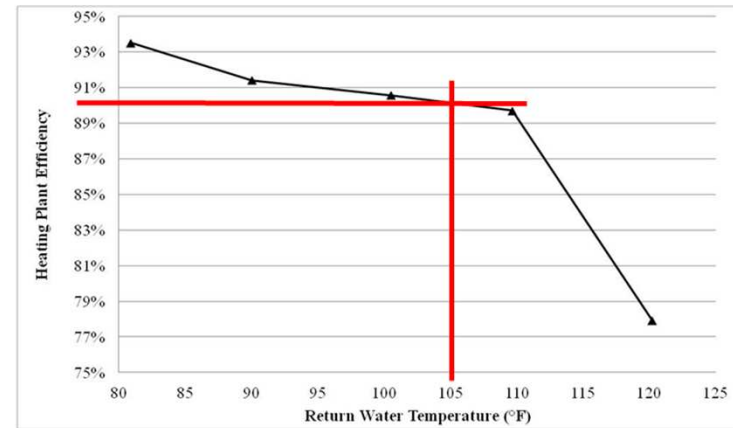
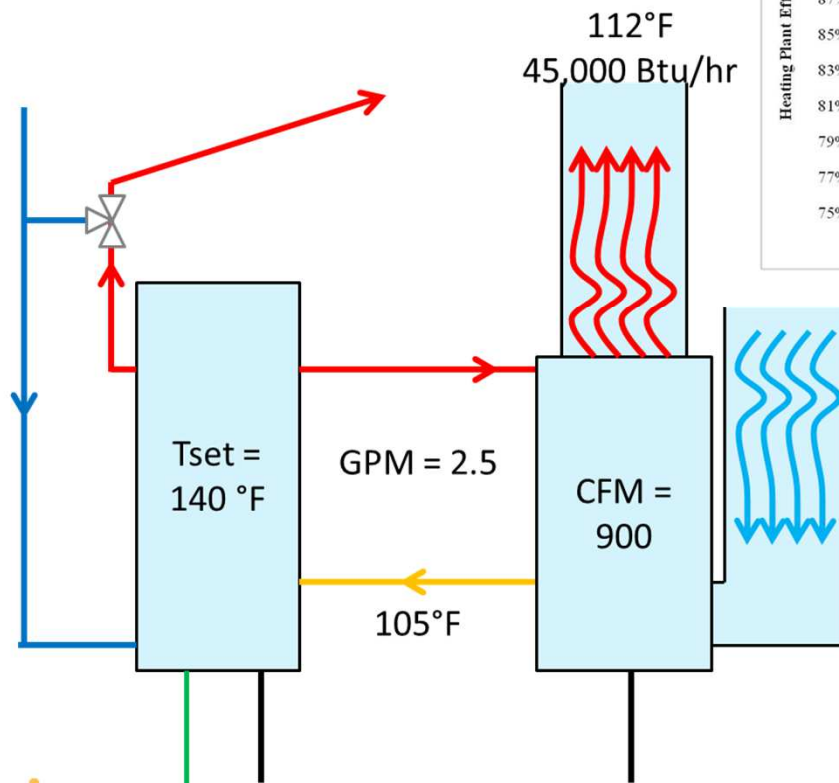
No Optimization

(for a 40,000 Btu/hr design load)



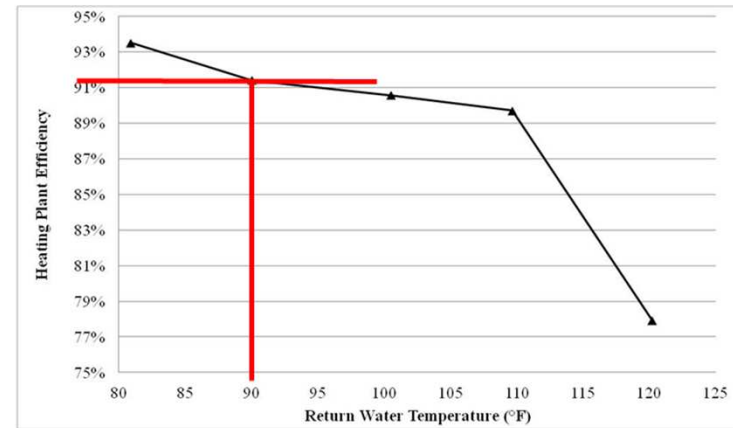
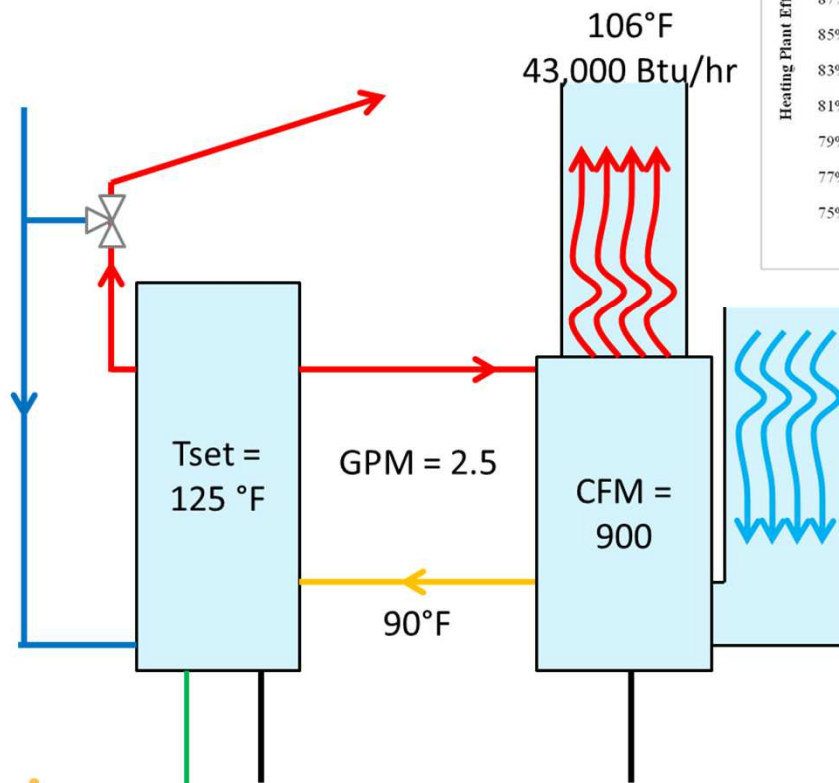
Improved Installation

(for a 40,000 Btu/hr design load)



Fully Optimized

(for a 40,000 Btu/hr design load)



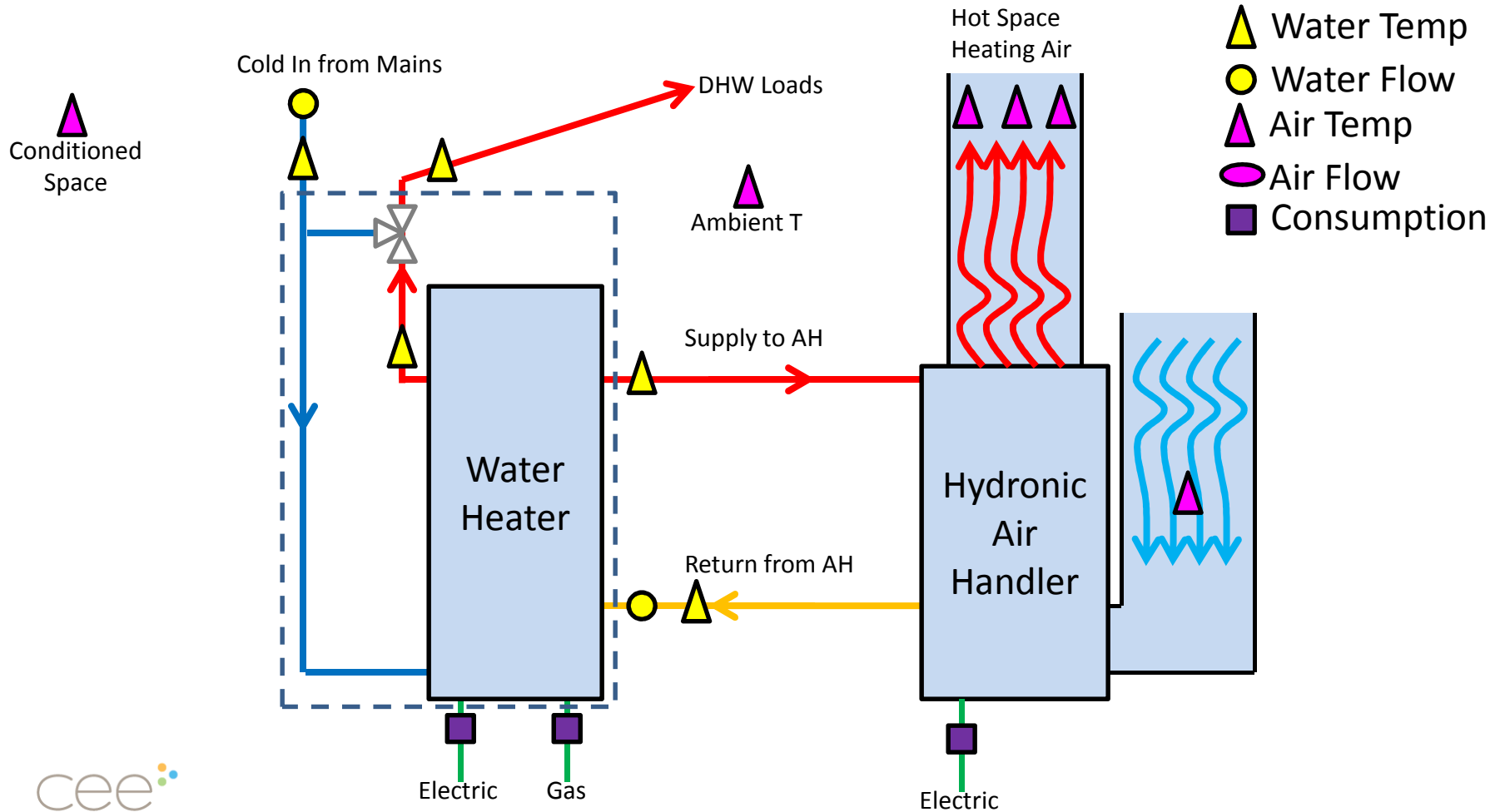


Verification

- 3 Tiers of Verification

Verification Measures			Expected Performance	
Approved Equipment	Trained Contractor	Verified Performance	Space Heat	DHW
✓			80% of Optimal	Optimal
✓	✓		90% of Optimal	Optimal
✓	✓	✓	Optimal	Optimal

Performance: Field Monitoring

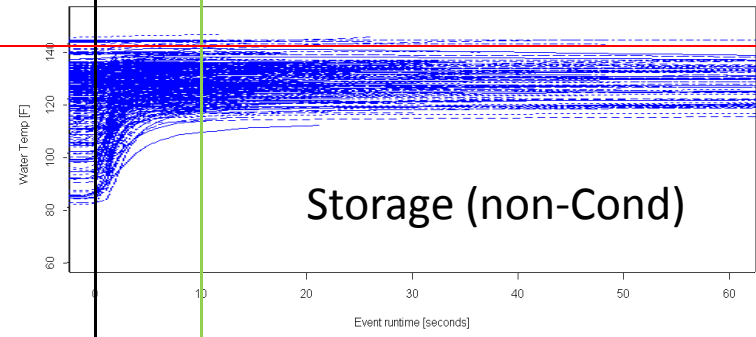
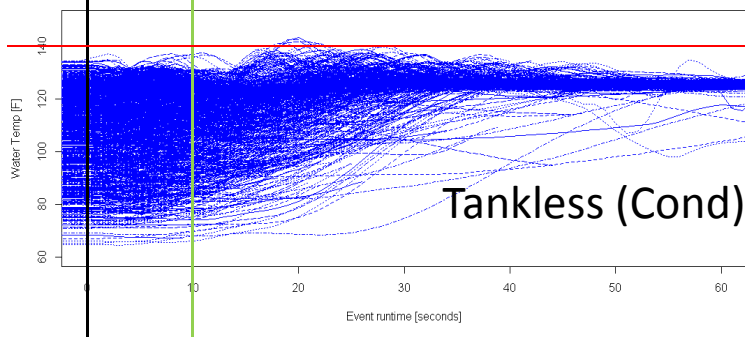
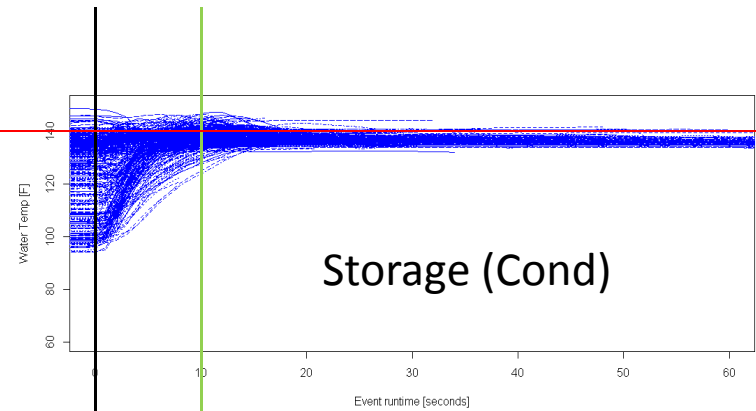
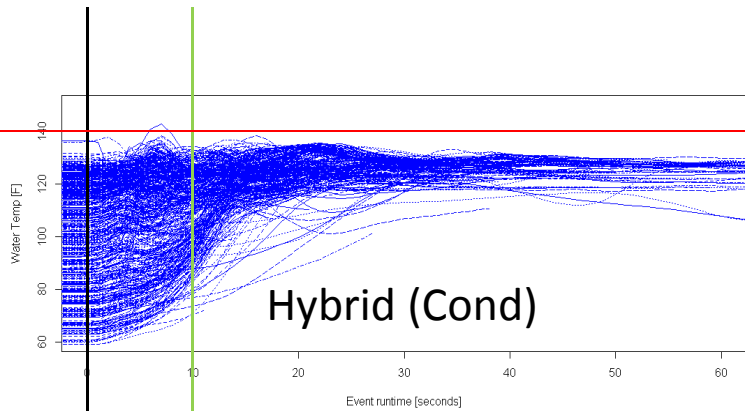




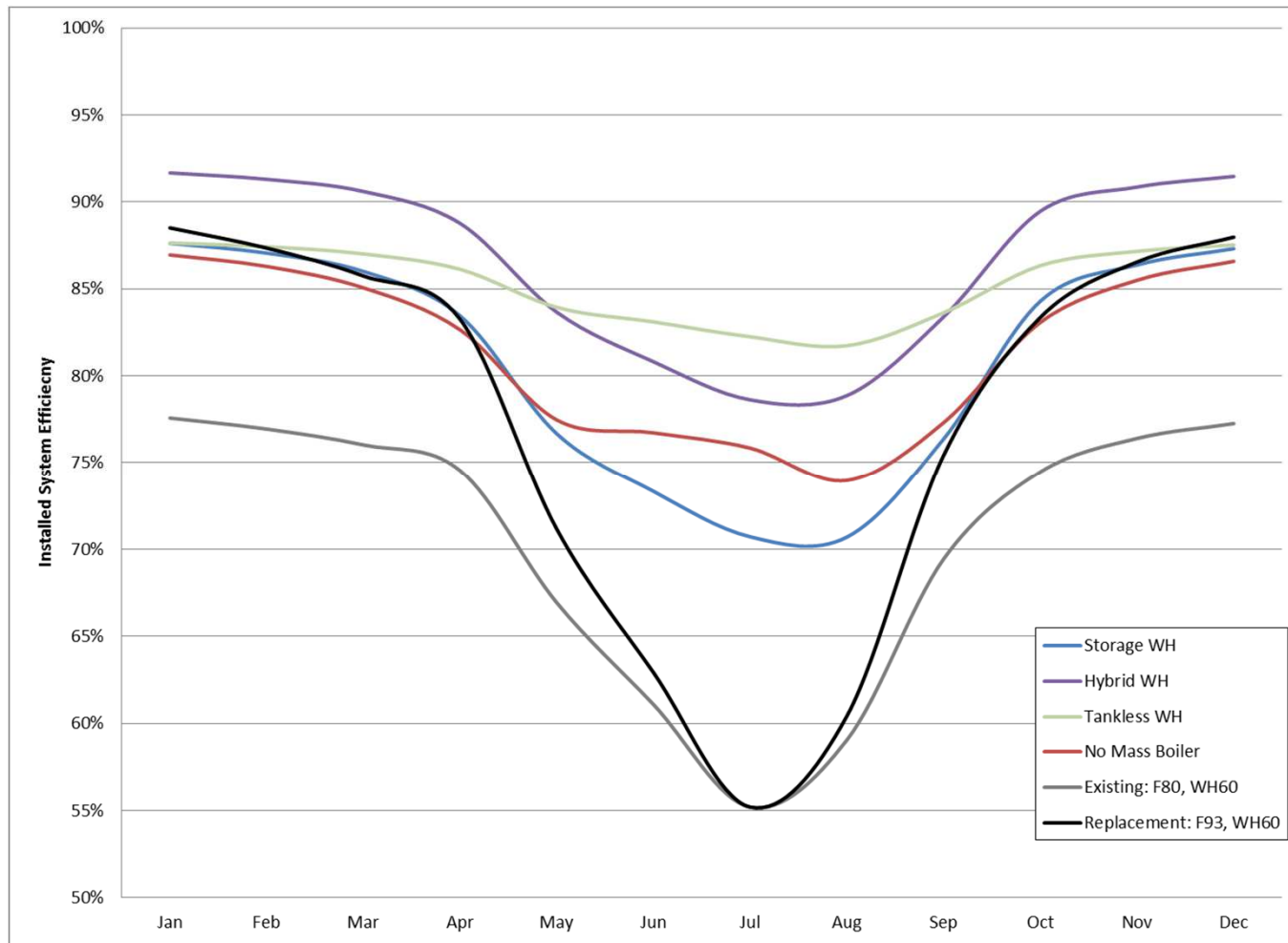
Performance

- Delivered air temperature may be slightly cooler than a furnace
- Hot water may change slightly depending on water heater type
- Maintenance and durability

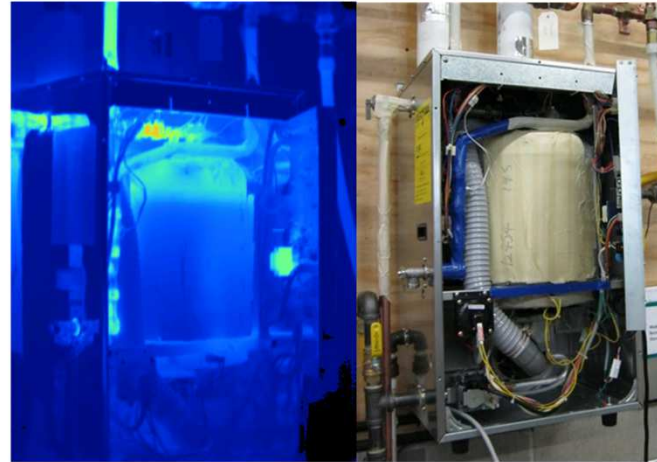
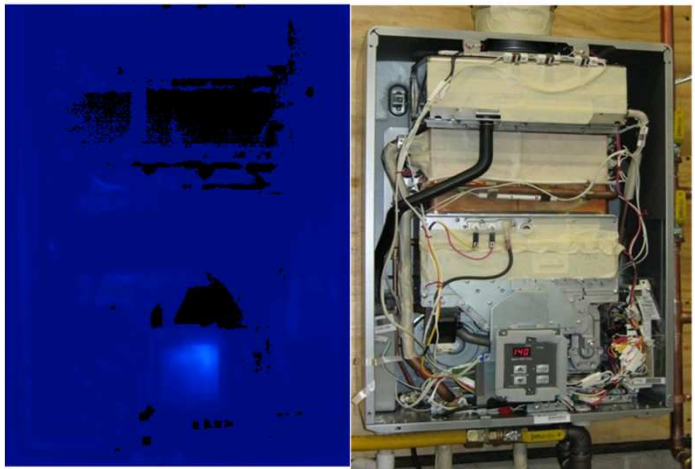
Water Temperature Delivery



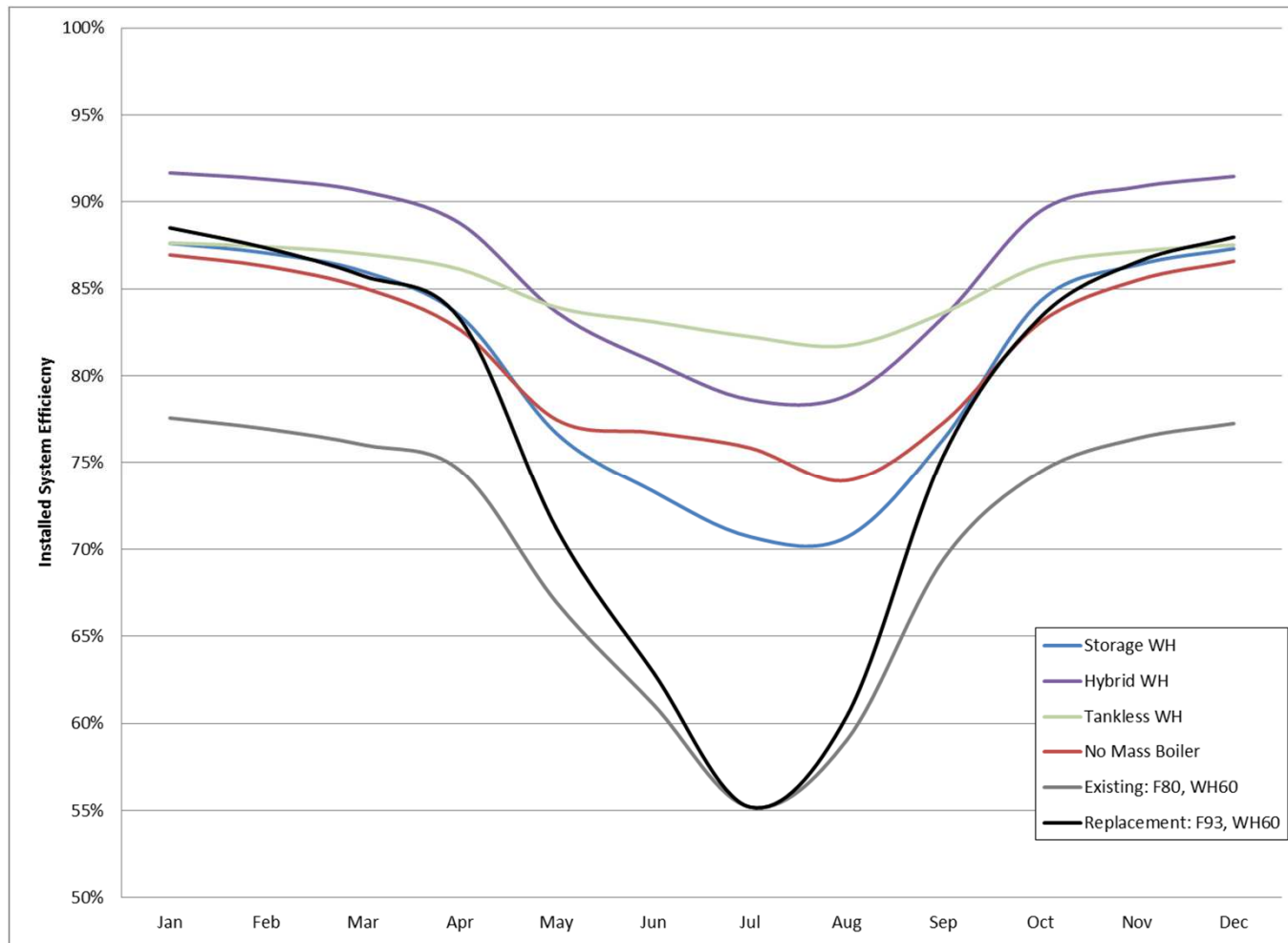
Performance



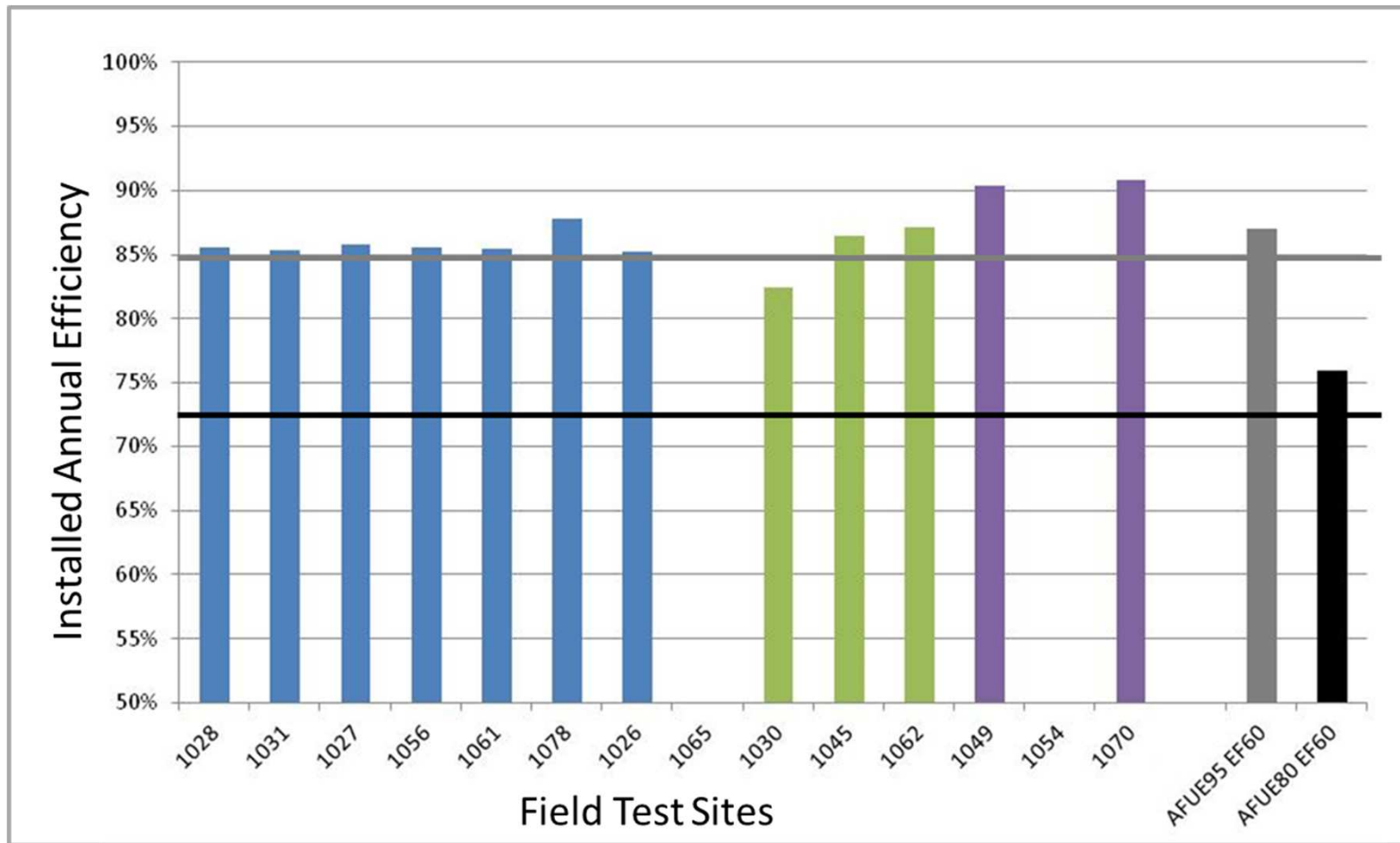
Performance: Stand-by Loss



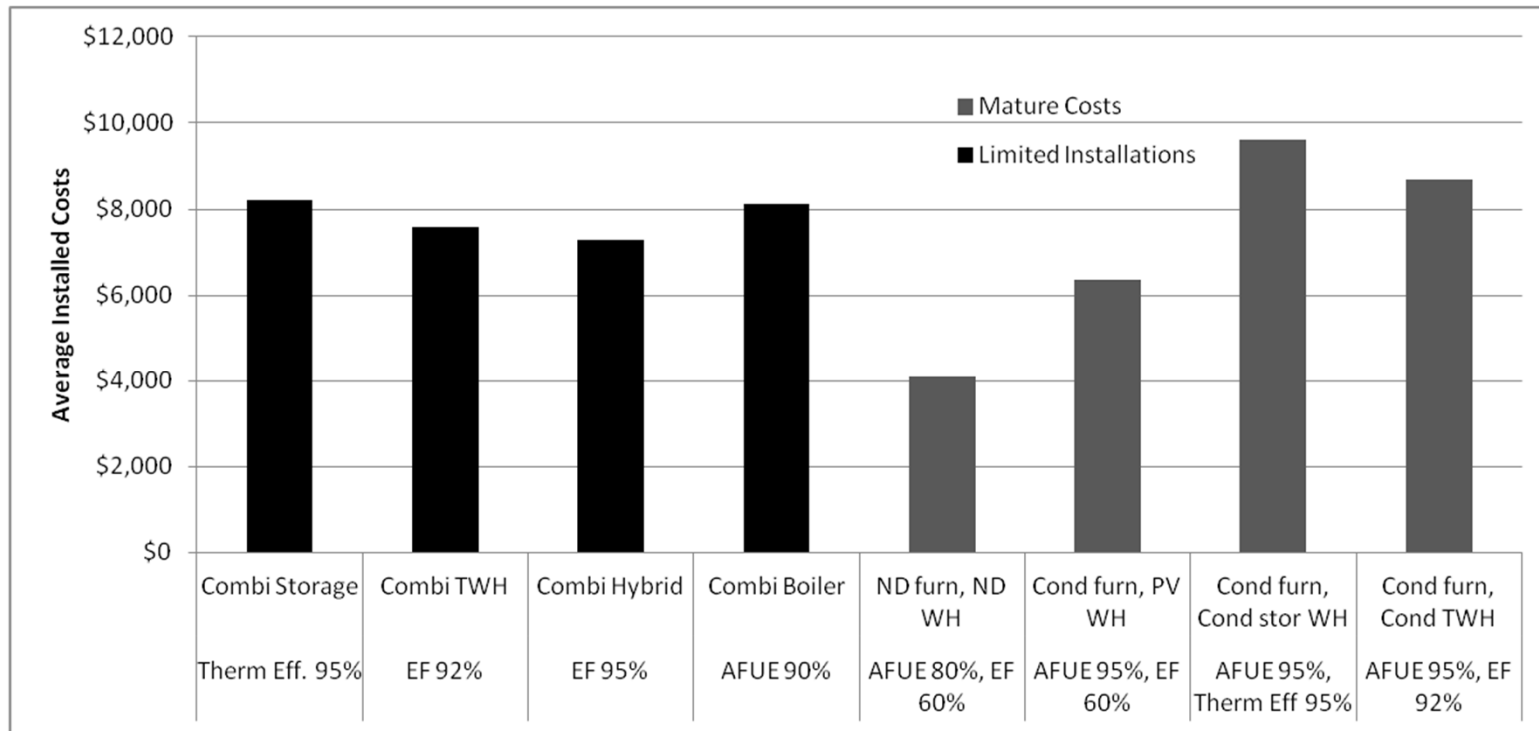
Performance



Installed Performance



Cost





Conclusions

- Condensing combi systems can achieve efficiencies equal to or slightly greater than a condensing furnace and PV water heater
- Oversize the hydronic air handlers
- Carefully adjust water flow, air flow, and heater setpoint to achieve return water temperature < 105F
- Work with code officials to address their concerns prior to installations
- New water heaters and air handlers should improve performance (and lower cost?)



Future

- Water Heaters
- Air Handlers
- ASHRAE 124 method of test is being updated and would include integrated water heaters and air handlers – provide method for higher efficiency systems for utility incentives

THANK
you!

www.mncee.org/dia

