

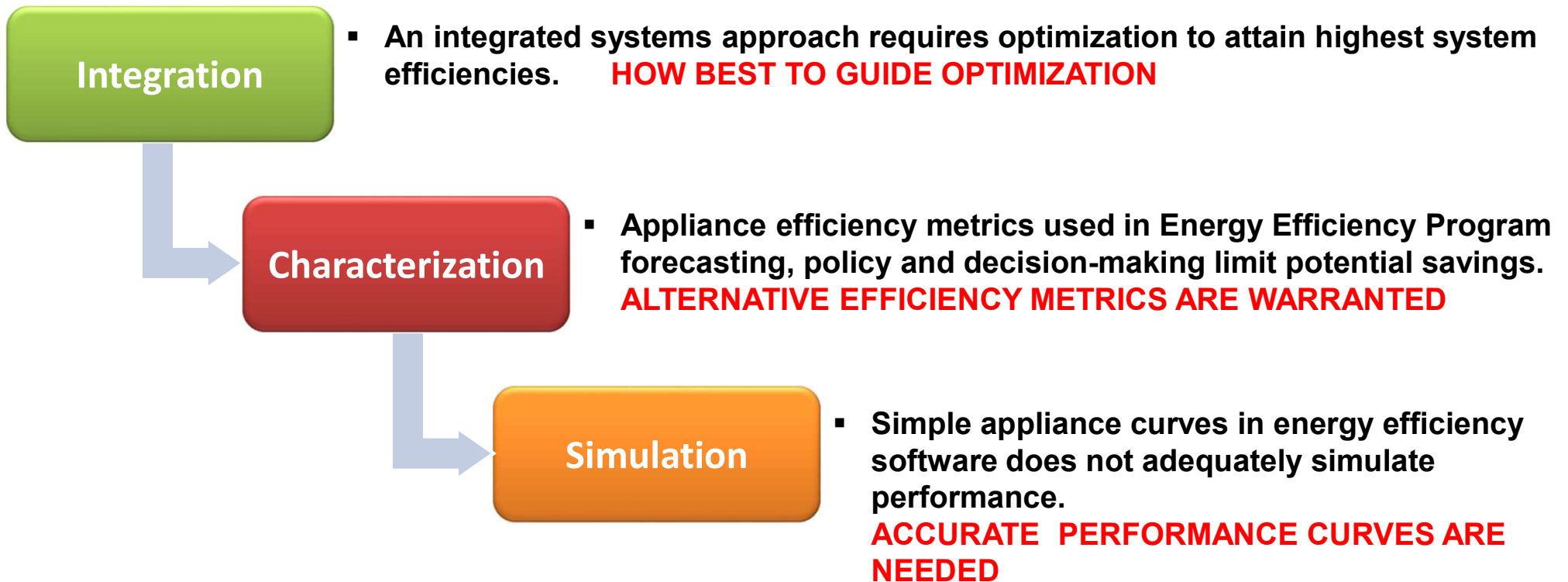
Session 7B

ACEEE 2018 Hot Water Forum

# Optimal Approaches for Space Heating with Combi Systems

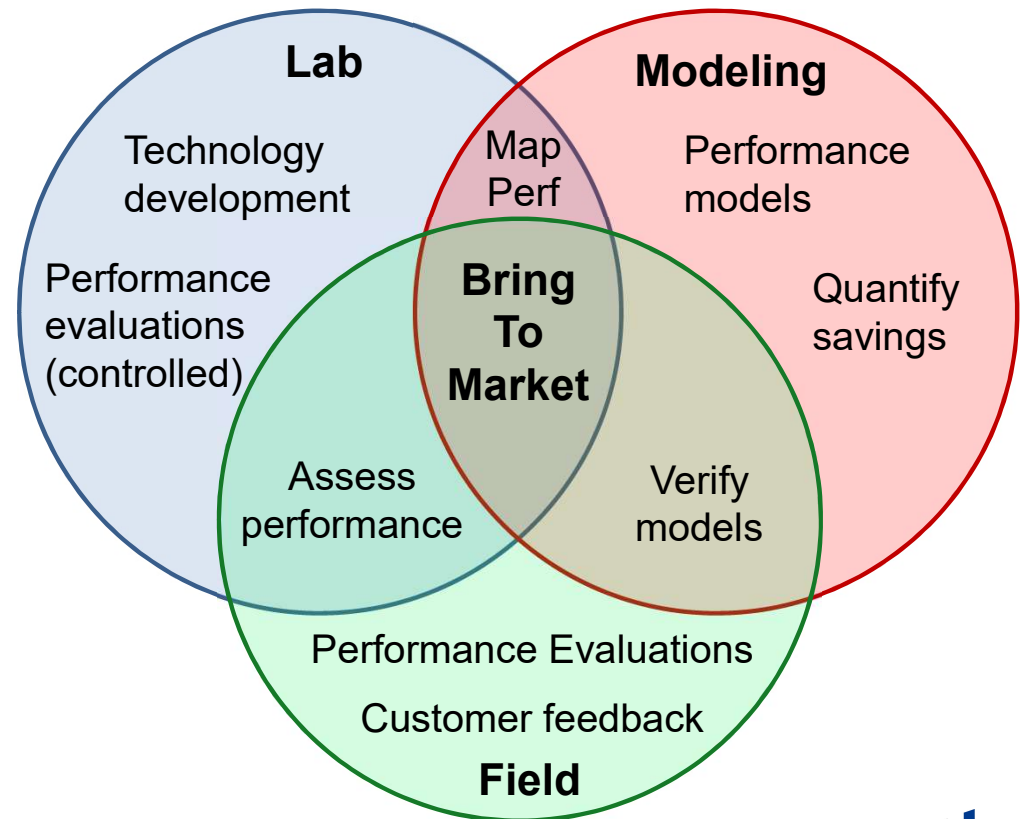
- 
- > Tim Kingston and Dave Kalensky, GTI
  - > March 22, 2018

# Overview

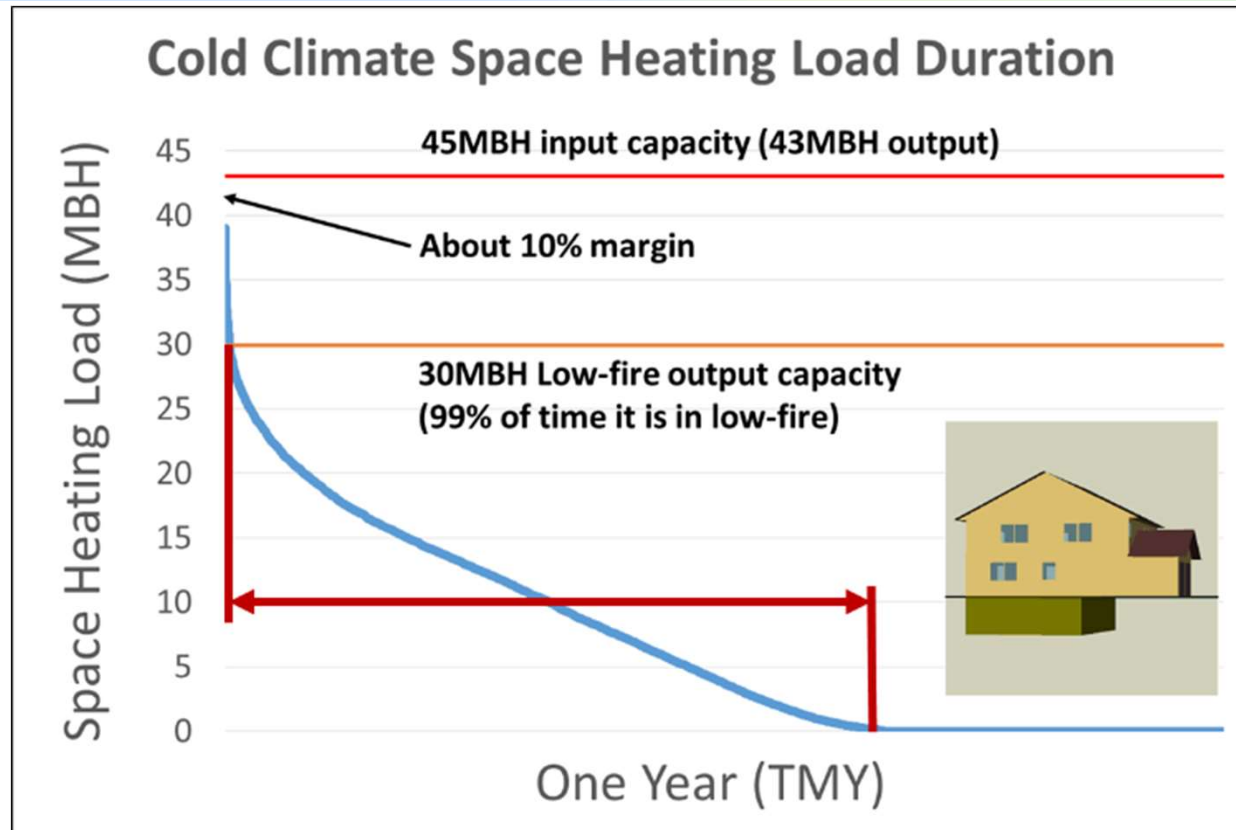


# An Holistic Approach to R&D

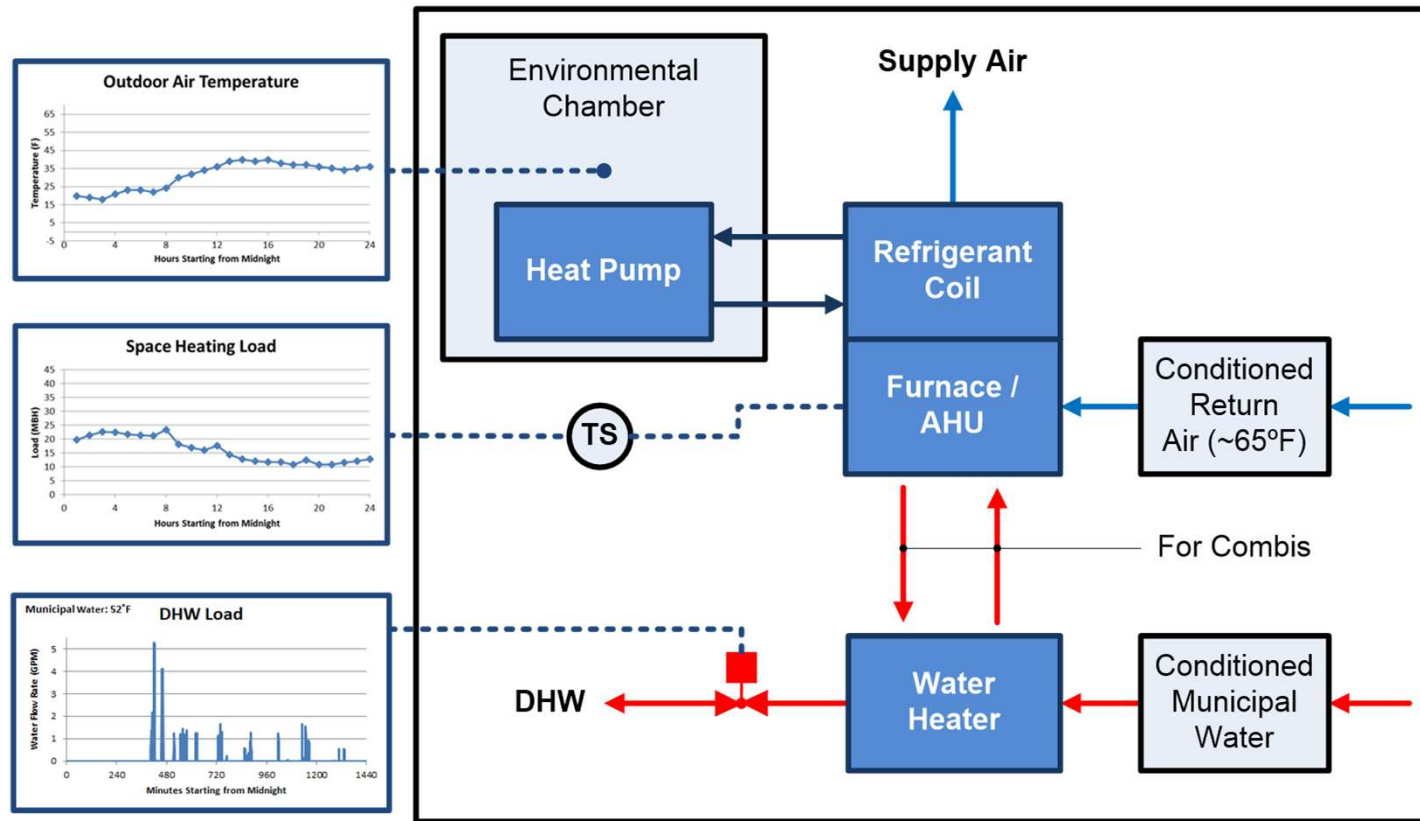
- > “Virtual Test Home” in the lab
  - Data sets for performance mapping
- > Modeling Software development
  - Advanced Energy Plus modules
- > Building Energy Analysis
  - Identify technology gaps
  - **Quantified energy savings**
- > Field Demonstration projects
  - Pilots, feedback, training



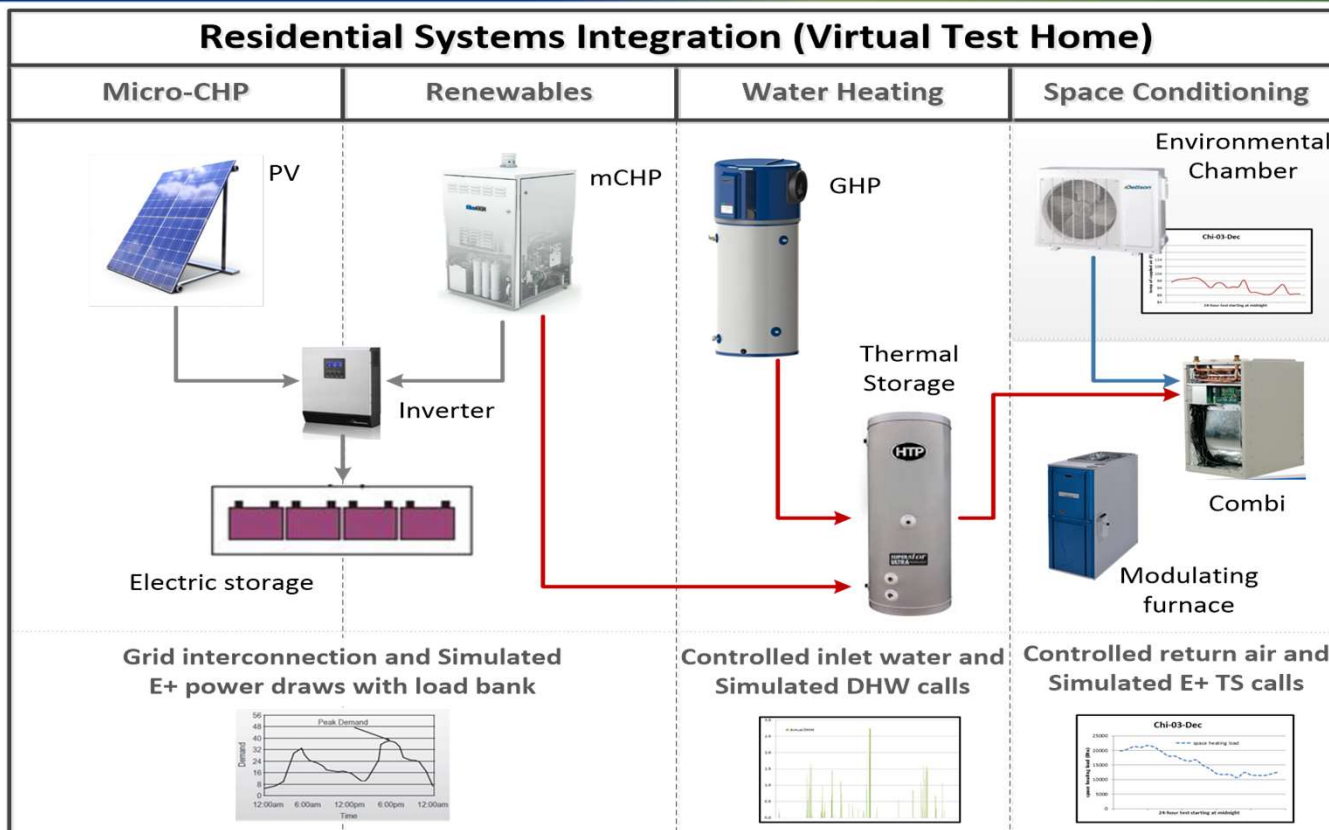
# Critical to Characterizing Part-load Performance



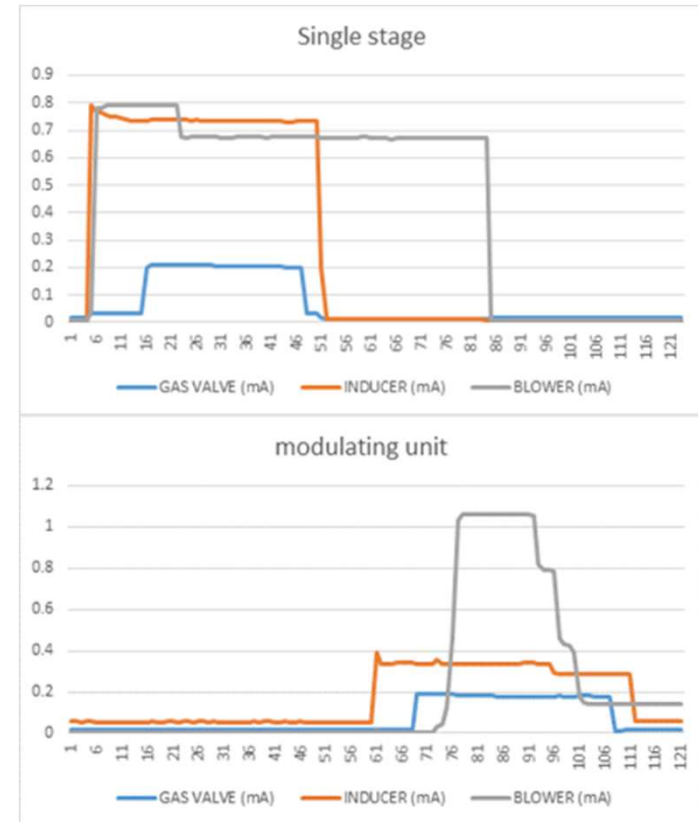
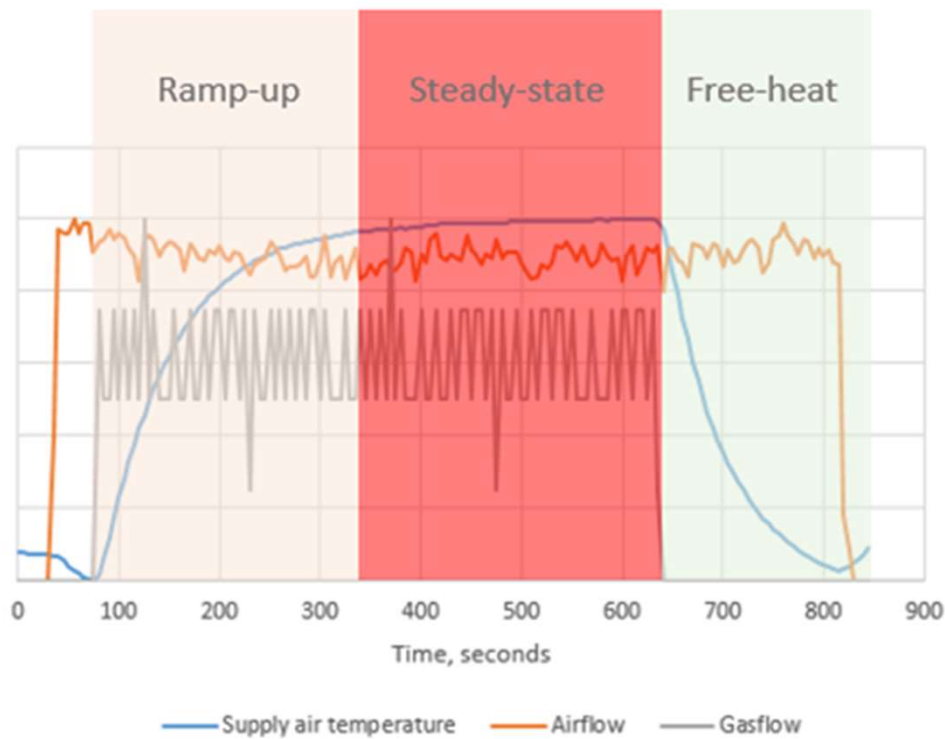
# The Virtual Test Home (Phase 1)



# The Virtual Test Home (Phase 2)

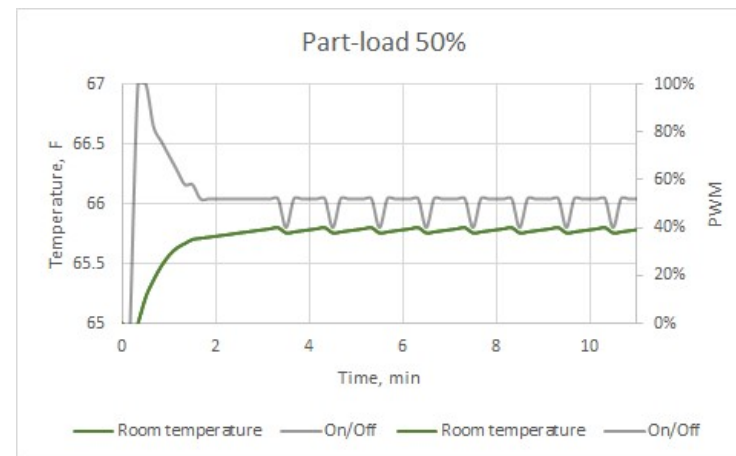
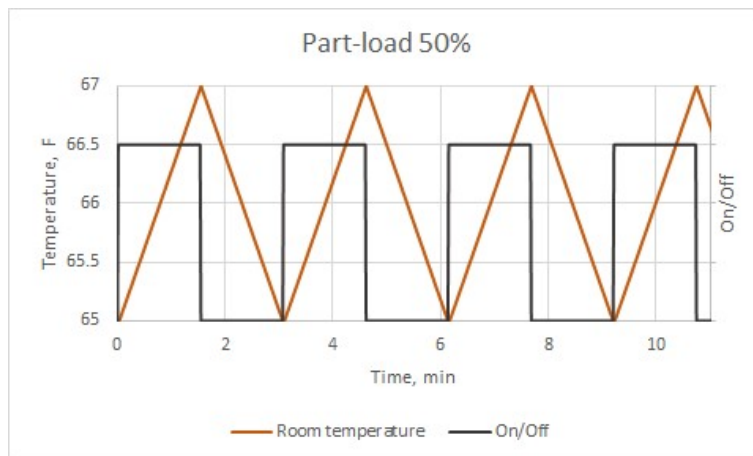


# Forced-air Heating Systems Characterization



# Thermostat Cycling Simulation

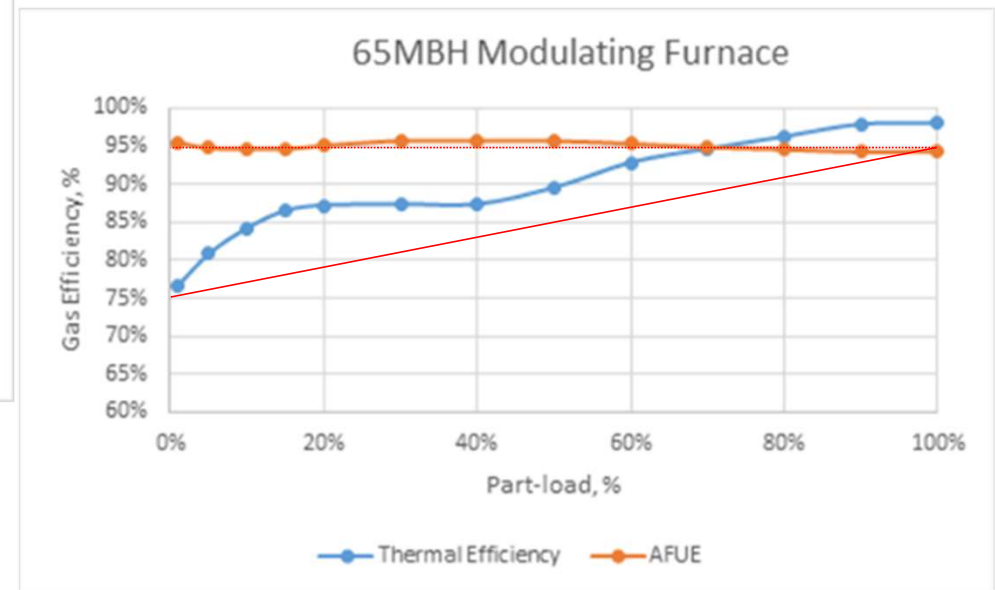
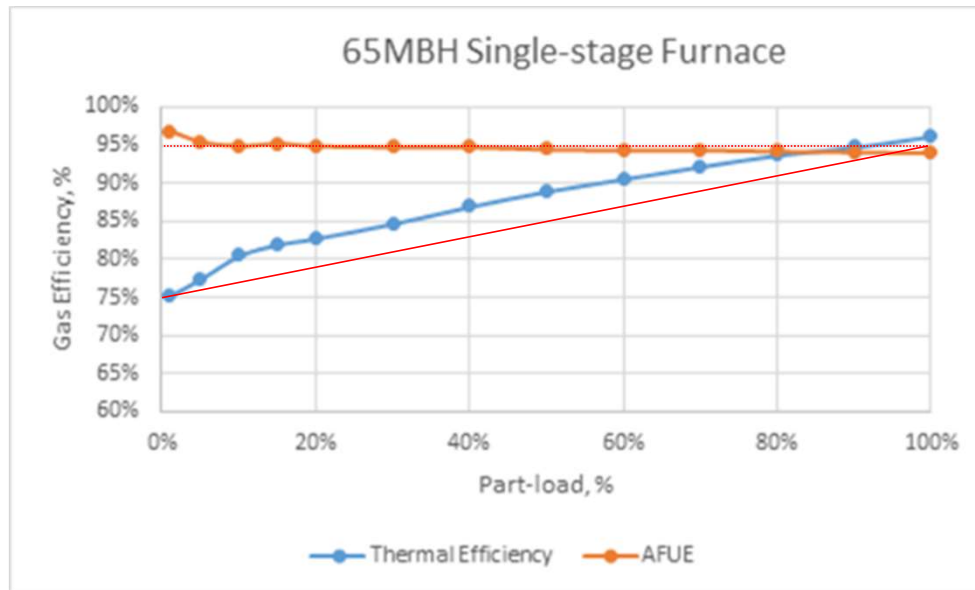
- > Calculated heat delivered: Based on continually measured airflows and temperatures
- > Calculated conditioned space temperature: Based on required and delivered heat
- > Assumes 2°F conditioned space dead band



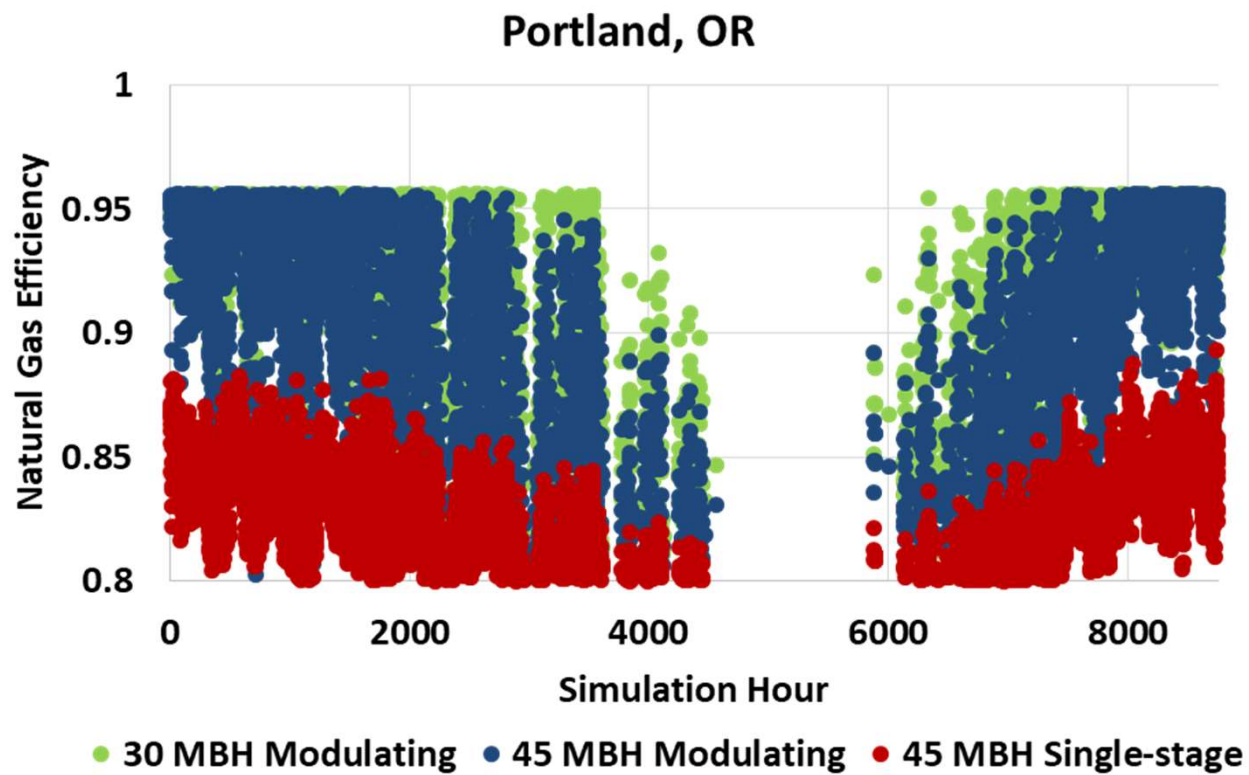
Part Loads: 1% - 5% - 10% - 20% - 30% - 40% - 50% - 60% - 70% - 80% - 90% - 100%



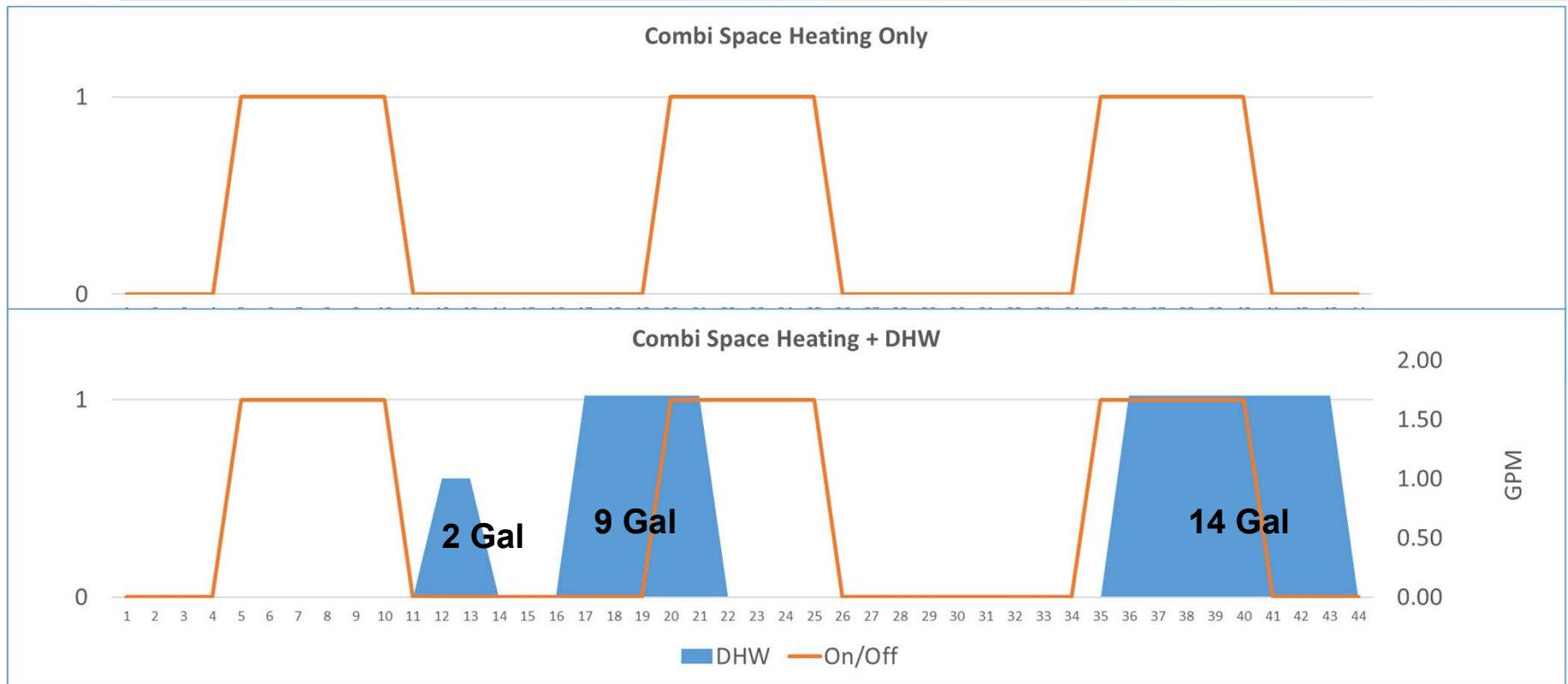
# Example Heating Systems Characterizations



# Modeled Efficiency Results



# Combi Systems Strategy



# Observations

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- > Test can be done over a 24 hour period
- > High correlation between testing and real world
- > Performance curves for EnergyPlus

# Next Steps

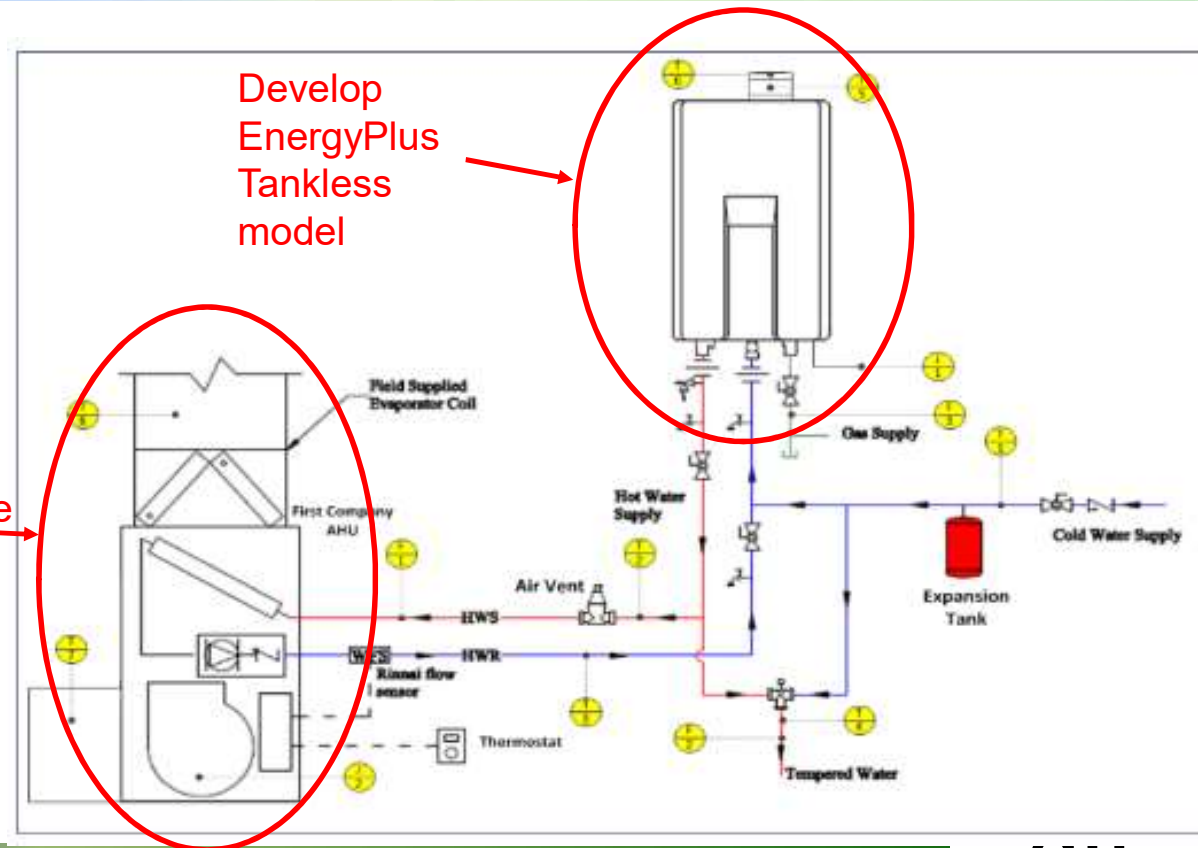
## > Testing

- (8) furnaces [1Q18 -2Q18]
- (3) combi-systems [3Q18 – 4Q18]

## > Model

- confirm hydronic heat exchanger models are adequate
- develop tankless water heater combi system (no storage)

Confirm Hydronic Models are Adequate



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**Thank You!**