



# Getting the Most from Air-Source Heat Pumps

North American Passive House Conference  
Boston, September 2018

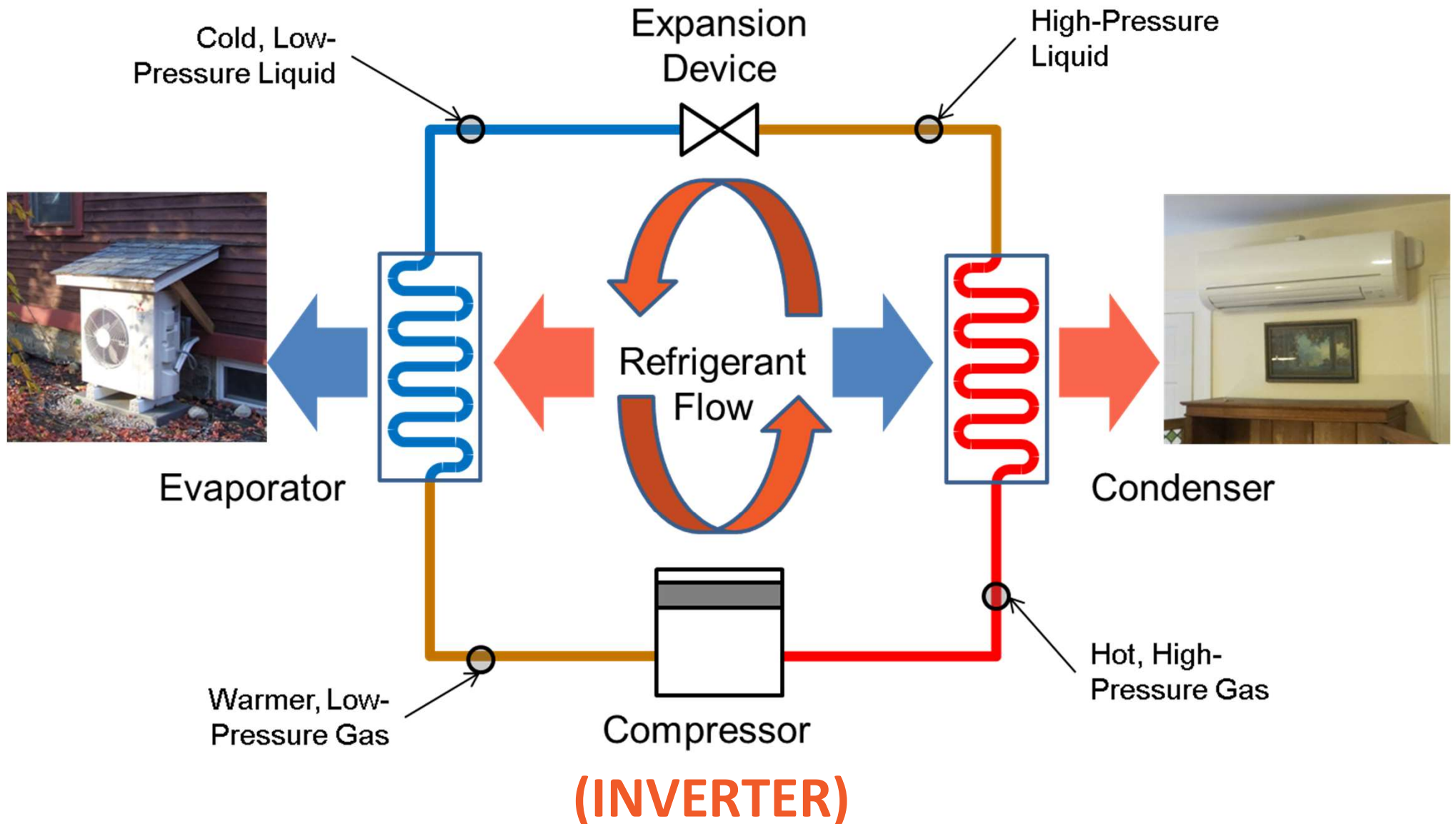
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# We're talking about...



- Air to Air
- Split (mostly mini)
- **Inverter**
- Mostly ductless

# Basic Operation



# We're not talking about...

## VRF (variable refrigerant flow)

Modular outdoor units, ~6-12 tons typ.

Many indoor units, many types



# Looks good on paper...

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## DOE-funded study (2013-14)

- 10 homes, ductless, cold winter
- Average SCOP: **2.0**
- SCOP range: **1.0 – 2.3**

[https://www1.eere.energy.gov/buildings/publications/pdfs/building\\_america/inverter-driven-heat-pumps-cold.pdf](https://www1.eere.energy.gov/buildings/publications/pdfs/building_america/inverter-driven-heat-pumps-cold.pdf)

# MA Utility Study

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- ~100+ homes, ductless
- 2014-15, cold, record-breaking snow
  - Median SCOP: **1.7**
  - SCOP Range: <1, >5
- 2015-16, absurdly mild
  - Median SCOP: **2.5**
  - SCOP Range: <1, >5

<http://ma-eeac.org/wordpress/wp-content/uploads/Ductless-Mini-Split-Heat-Pump-Impact-Evaluation.pdf>

# Snow & Ice





# Outdoor Unit





# Outdoor Units

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# Other Heat Pumps



# Stacked Outdoor Units





# Under Deck



# Outdoor Units



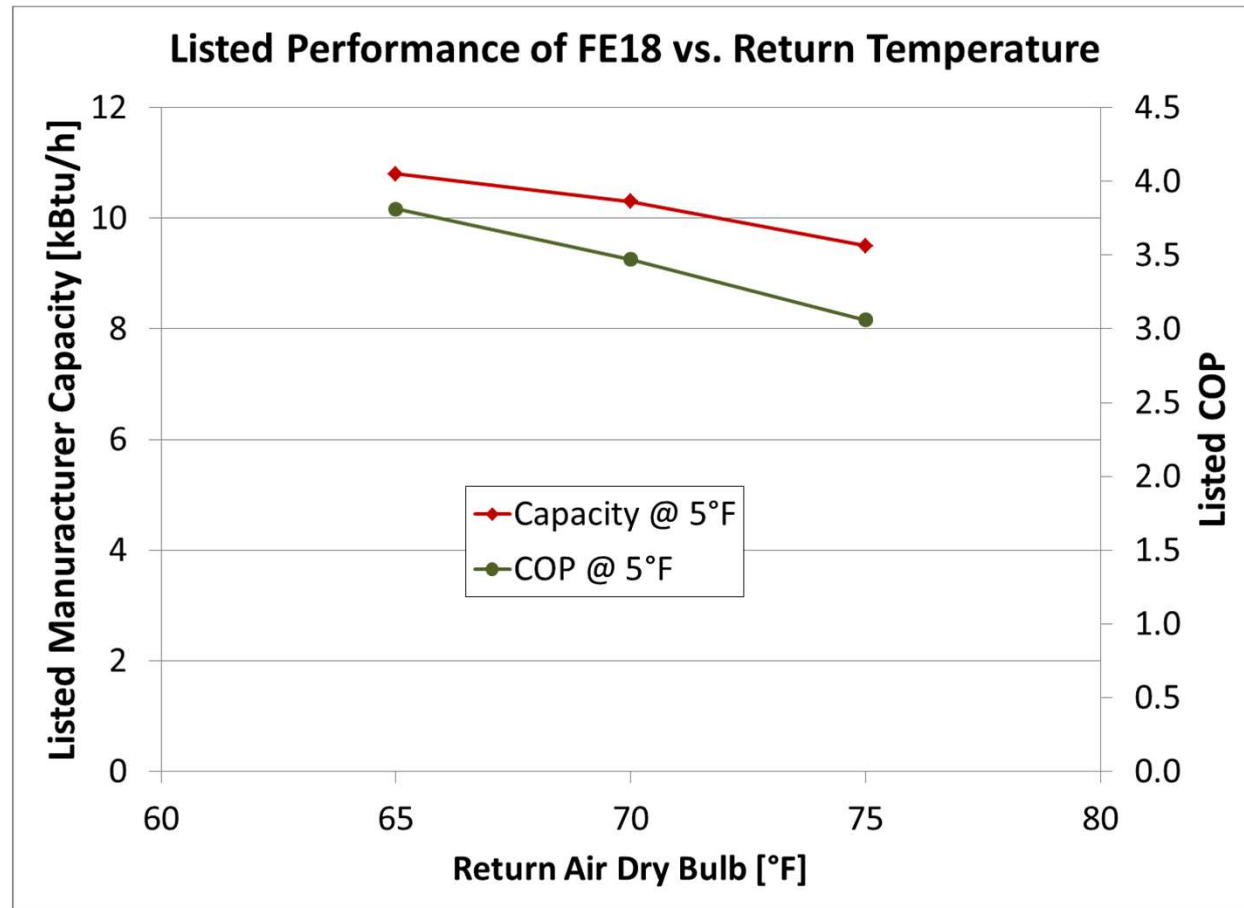


# Piped Solution?





# Indoor Units



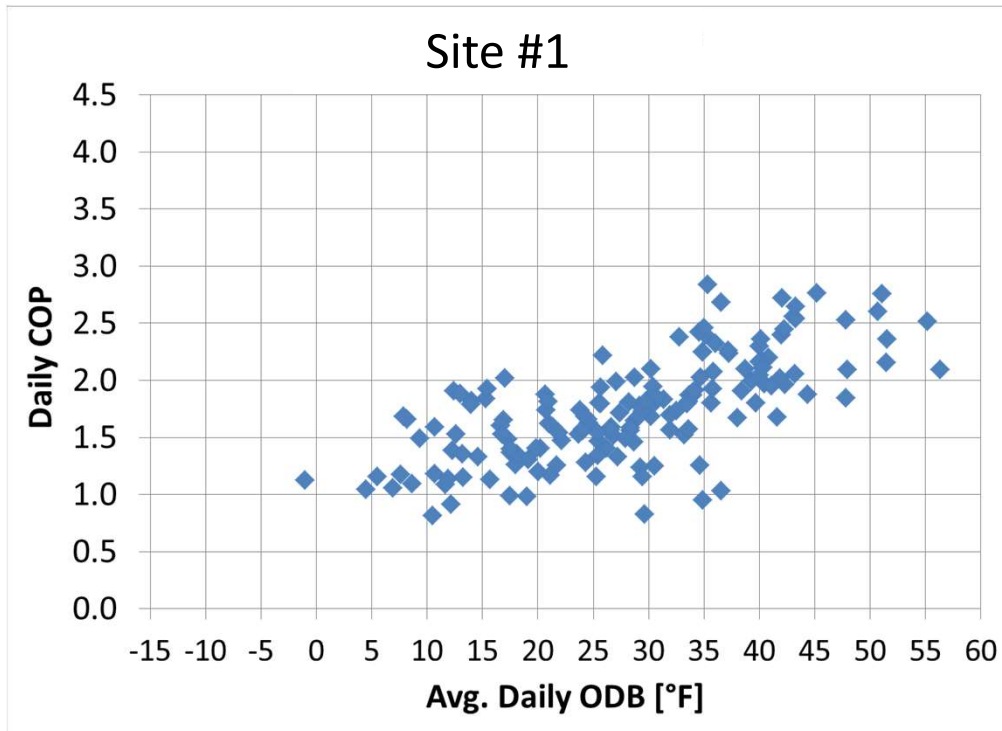
# High Return Temp?



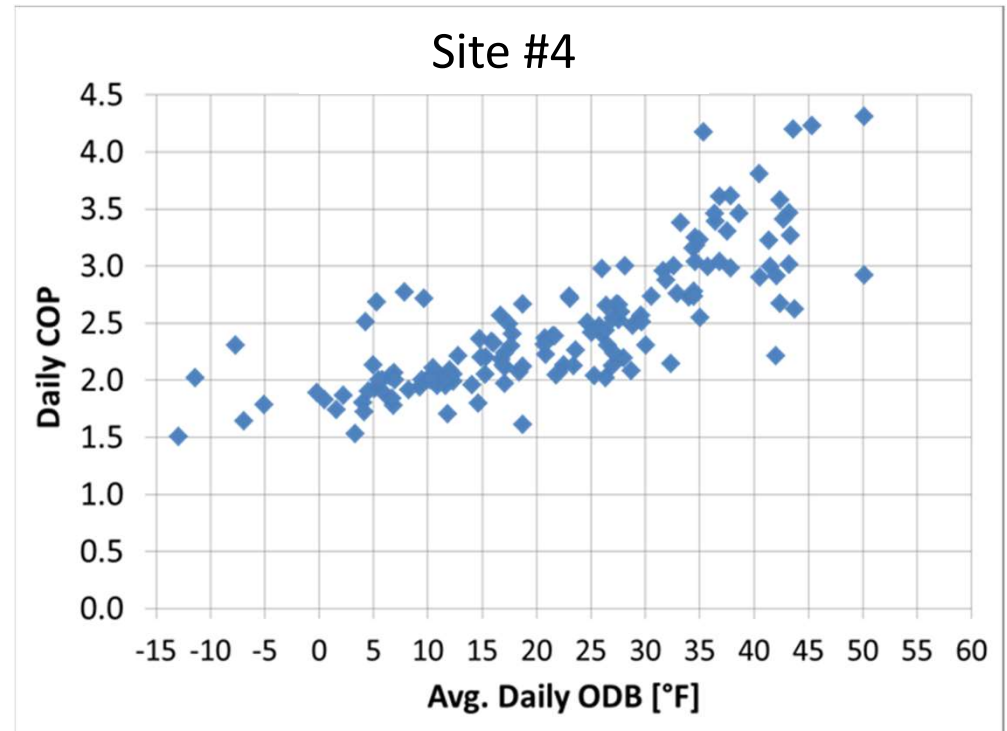
# Low Wall?



# Same HP- Different Results



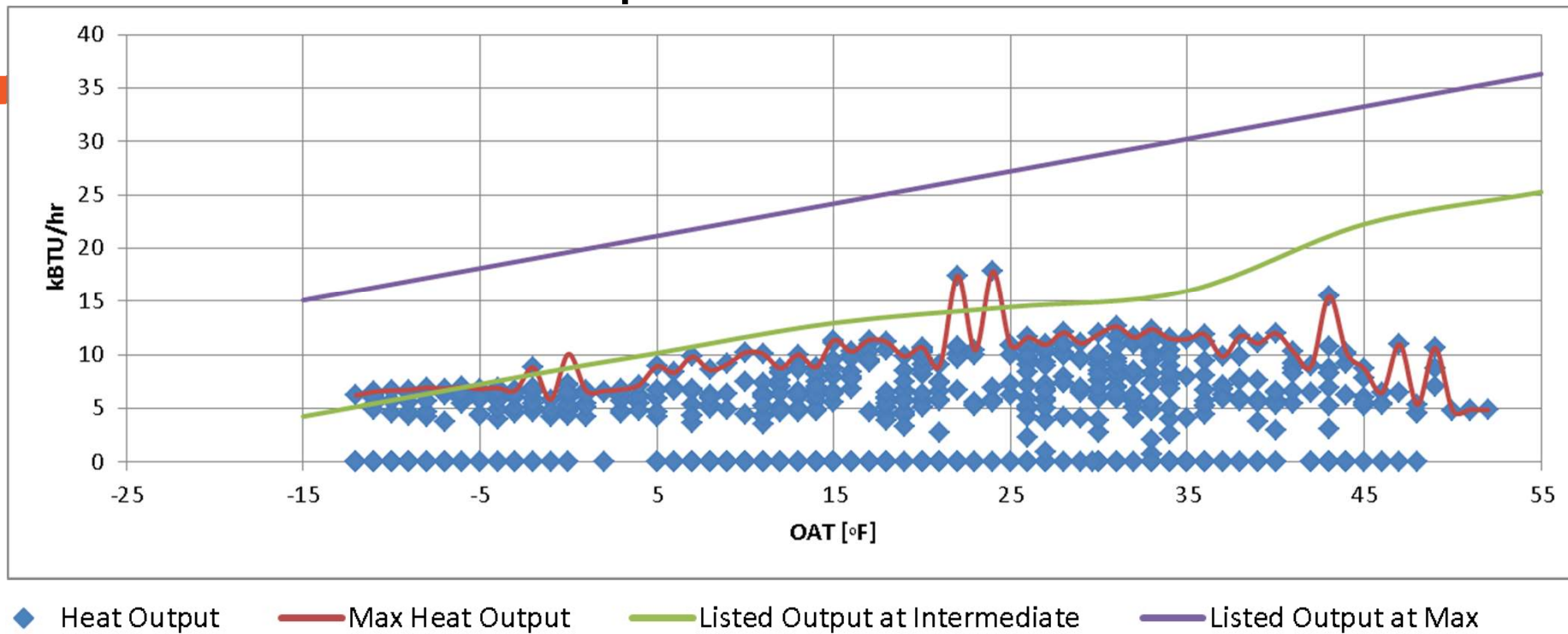
Western MA  
HDD65: 6,929  
Design Temp: 2°F  
SCOP: 1.6



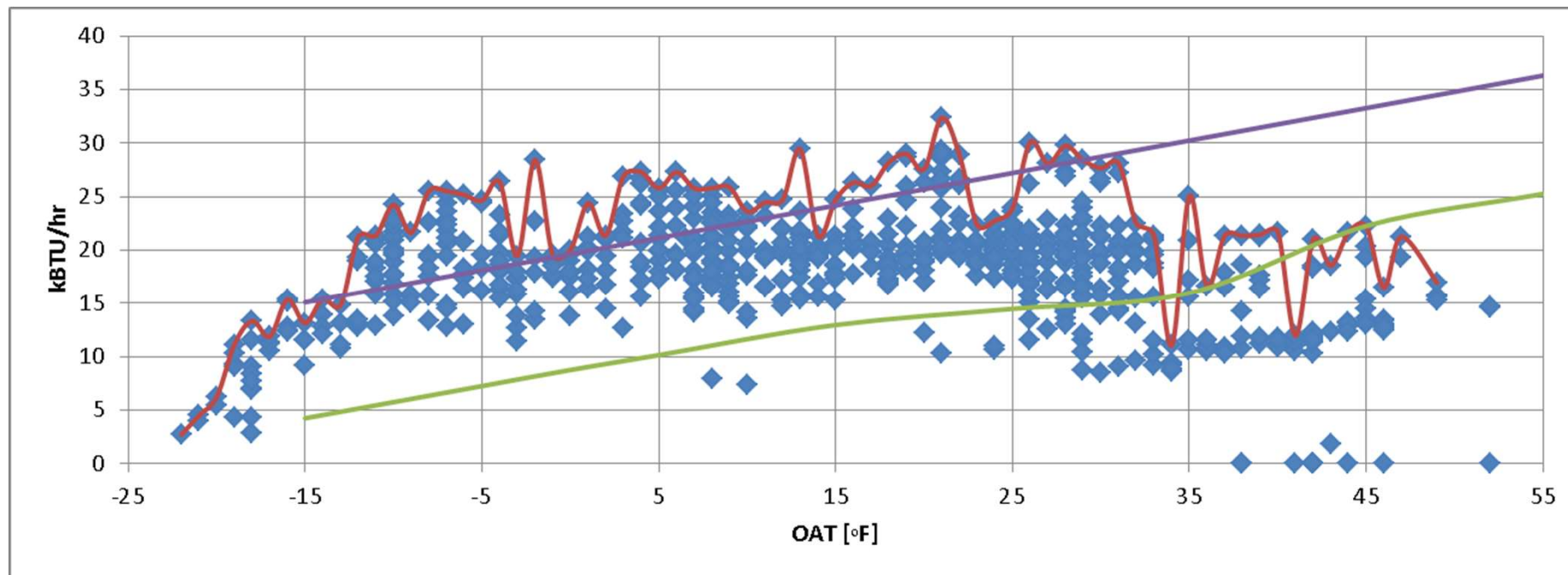
Near Burlington, VT  
HDD65: 7,956  
Design Temp: -4°F  
SCOP: 2.3

# Heat Output – 1.5 ton

Site 1



Site 4



# Size to Load!

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- Low fan speed cripples **ductless** capacity and efficiency.
- Study in test homes found forcing ductless HP in **HIGH speed** increased COP by 60%

[www.levypartnership.com/s/65436.pdf](http://www.levypartnership.com/s/65436.pdf)



# Multi-Split

- MA Study:  
More Fan Coils = Less Efficient!
- **Oversizing** likely reason
- 1 head/bedroom is oversized!  
Esp. with low loads!

# Consider Ducted (Mini or Otherwise)



- 9-18 kBtu/h
- Some very low pressure
- Cost ~2x ductless fan coil

# Ductless Mini-Splits



# Use Right Equipment!

## NEEP:

1. Guide to Sizing & Selecting ASHPs in Cold Climates  
<http://www.neep.org/sites/default/files/Sizing%20%26%20Selecting%20ASHPs%20In%20Cold%20Climates.pdf>
2. Guide to Installing ASHPs in Cold Climates  
<http://www.neep.org/sites/default/files/Installing%20Air-Source%20Heat%20Pumps%20in%20Cold%20Climates.pdf>
3. Cold-Climate ASHP Performance Specification  
<http://www.neep.org/initiatives/high-efficiency-products/emerging-technologies/ashp/cold-climate-air-source-heat-pump>

**Look at expanded performance data –  
not (only) nameplate ratings**

# Installation

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- Locate indoor unit
- Locate outdoor unit
- Pay attention to water/ice/snow
- Pay attention to line set lengths
- Make good connections
- **Evacuate and leak test**
- **Charge properly!**

# One More Study...

- Efficiency Vermont
- 70+ ductless heat pumps, 2015-17
- Average heating SCOP: **3.0**

Per evaluators:

- HPs **installed** very well
- HPs **sized** properly
- HPs **operated** properly – very savvy owners

[http://publicservice.vermont.gov/sites/dps/files/documents/Energy\\_Efficiency/Reports/Evaluation%20of%20Cold%20Climate%20Heat%20Pumps%20in%20Vermont.pdf](http://publicservice.vermont.gov/sites/dps/files/documents/Energy_Efficiency/Reports/Evaluation%20of%20Cold%20Climate%20Heat%20Pumps%20in%20Vermont.pdf)



# Thank you!

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## Questions?

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