Getting the Most from Air-Source Heat Pumps

North American Passive House Conference

Boston, September 2018

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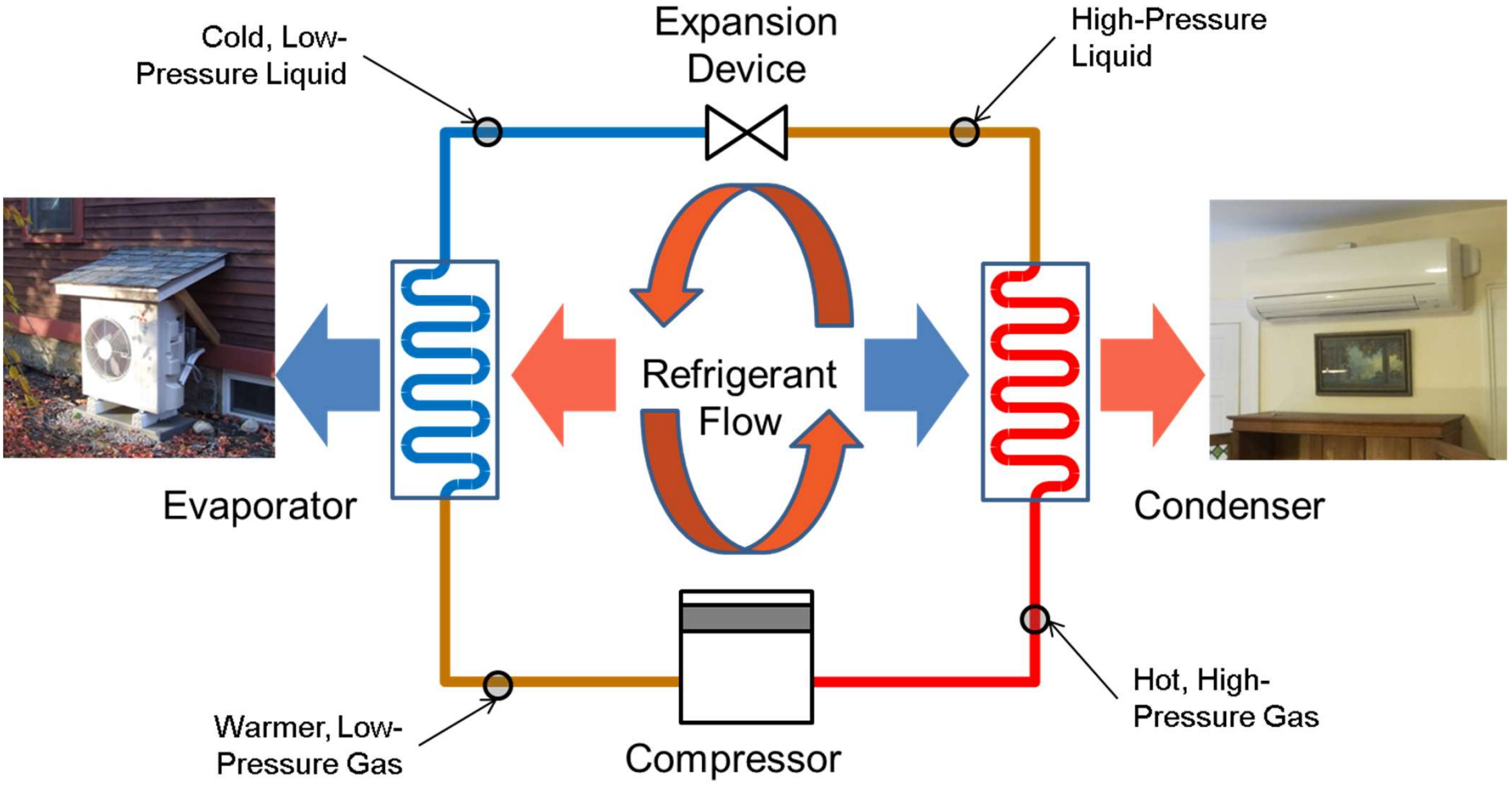
We're talking about…

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

Basic Operation



(INVERTER)

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…

DOE-funded study (2013-14)

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

https://www1.eere.energy.gov/buildings/publications/pdfs/building_america/inverter-driven-heat-pumps-cold.pdf

MA Utility Study

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

Other Heat Pumps

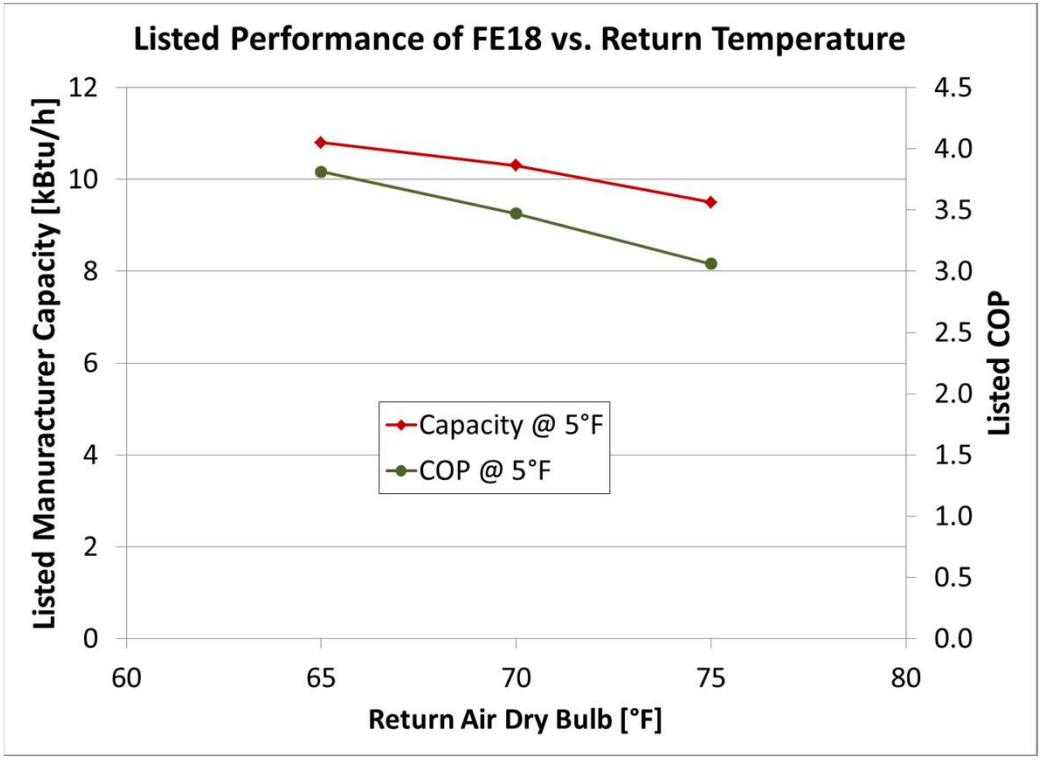
Stacked Outdoor Units

Under Deck

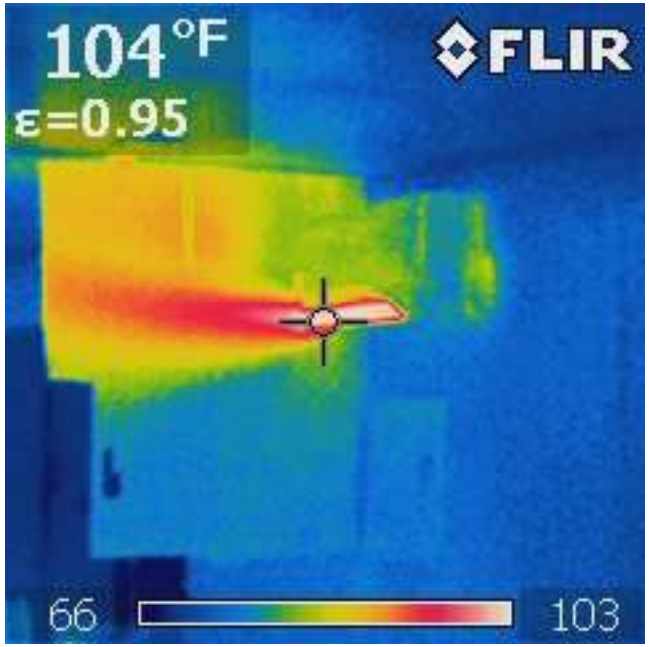
Outdoor Units

Piped Solution?

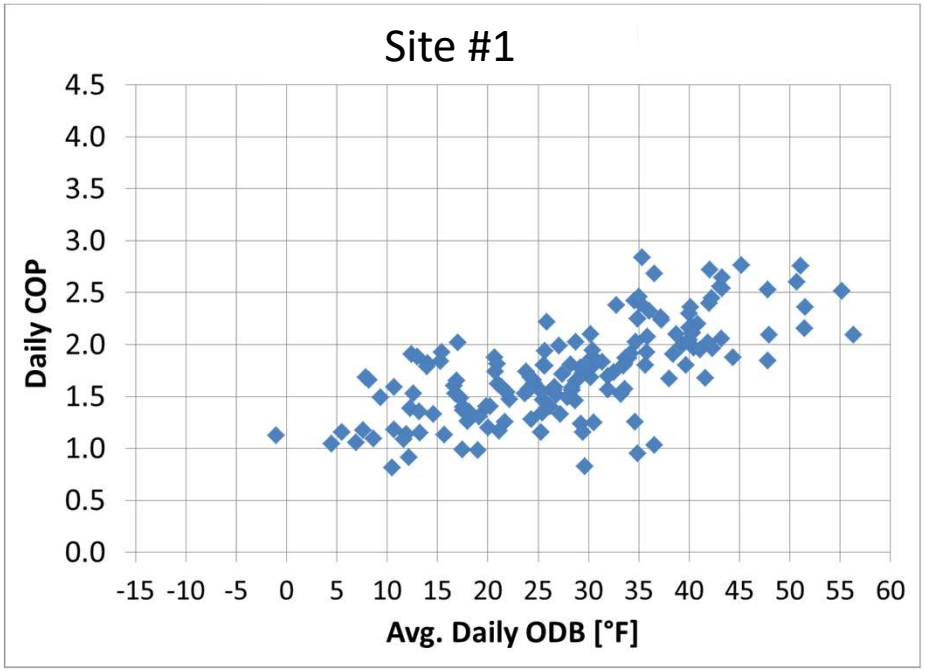
Indoor Units

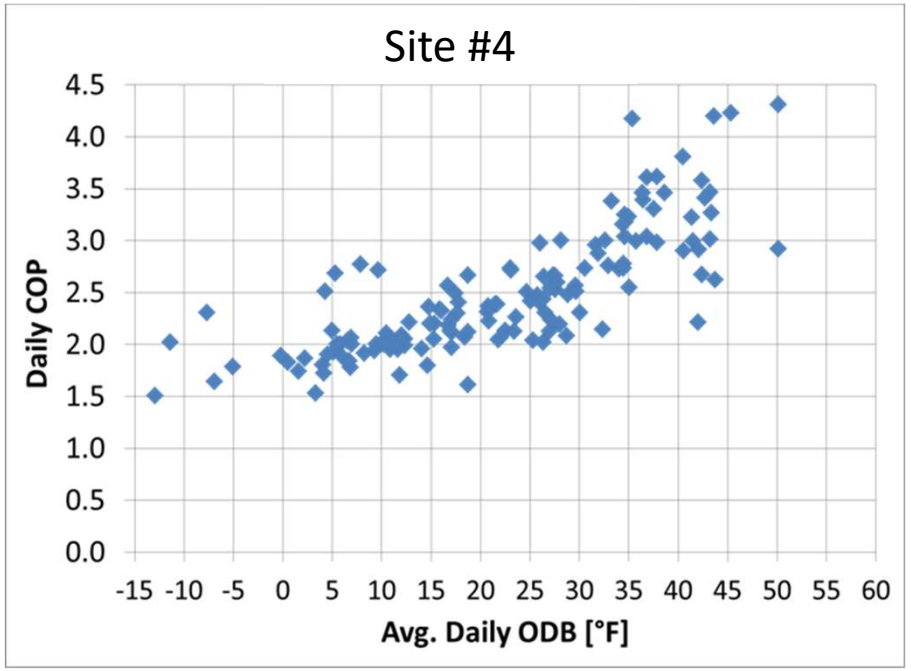


High Return Temp?



Same HP- Different Results



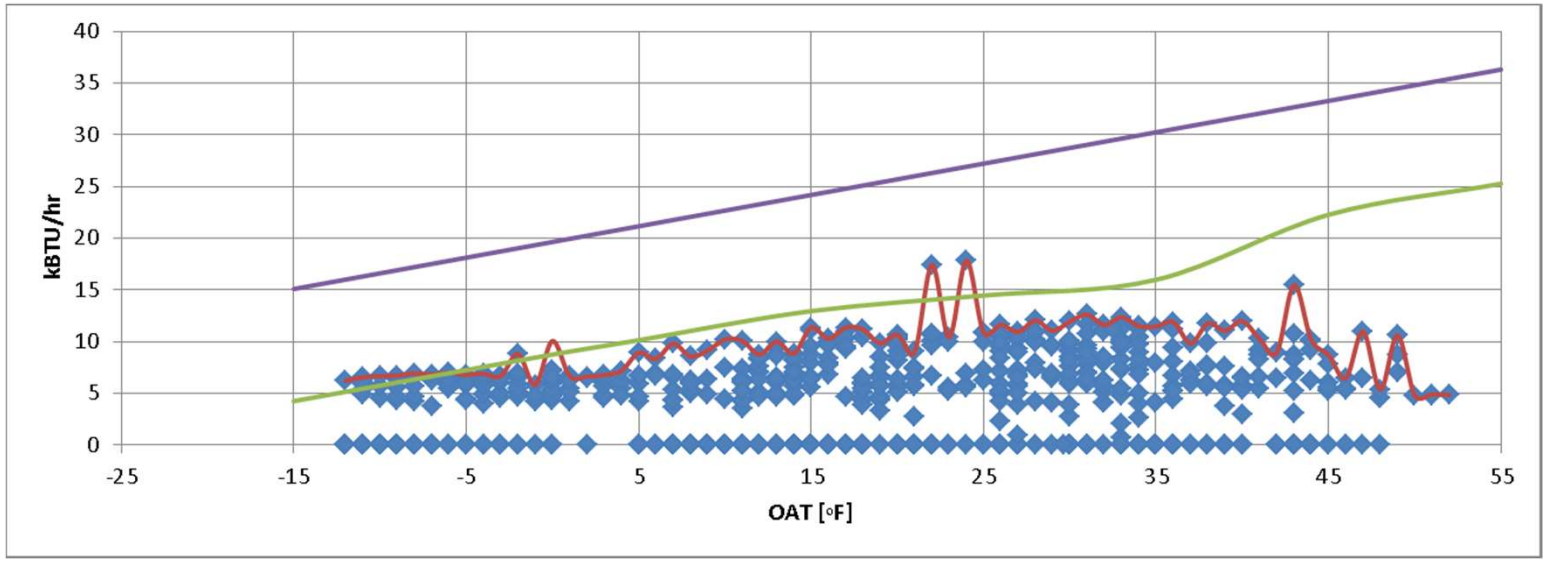


Western MA
HDD65: 6,929
Design Temp: 2°F
SCOP: 1.6

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

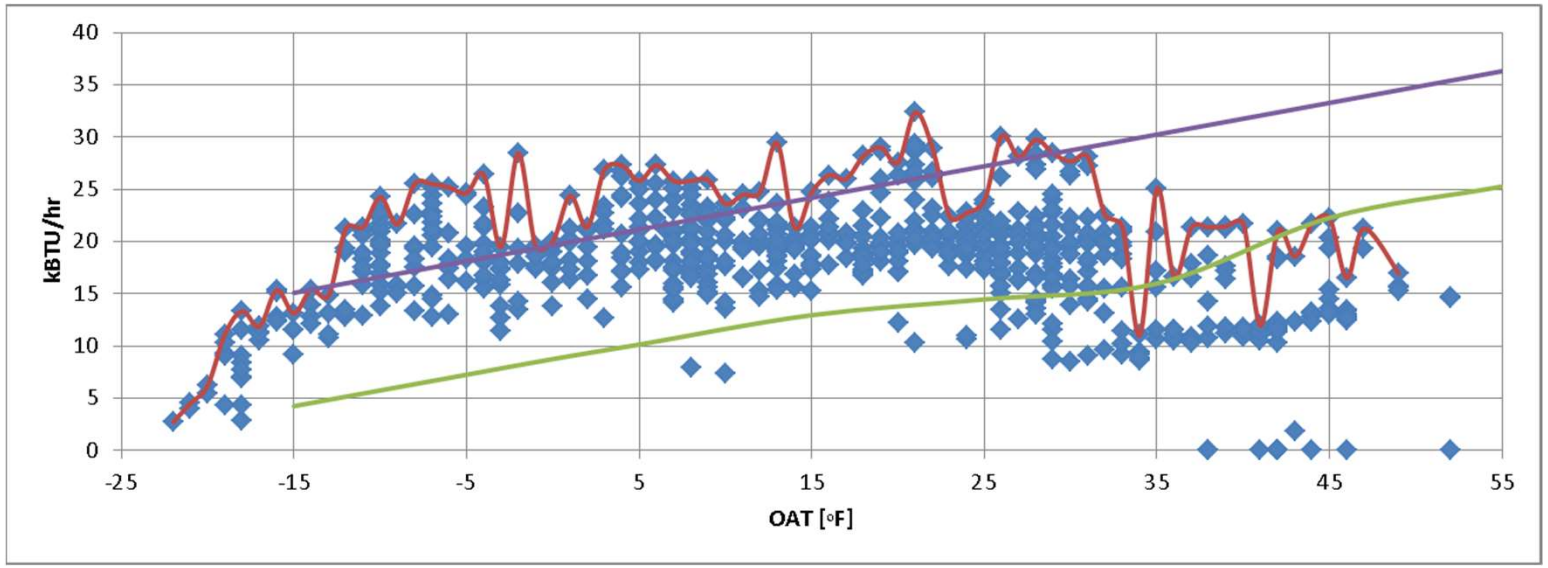
Heat Output – 1.5 ton

Site 1



Heat Output Max Heat Output Listed Output at Intermediate Listed Output at Max

Site 4



Size to Load!

- 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

Multi-Split

- MA Study:

  More Fan Coils = Less Efficient!

- **Oversizing** likely reason

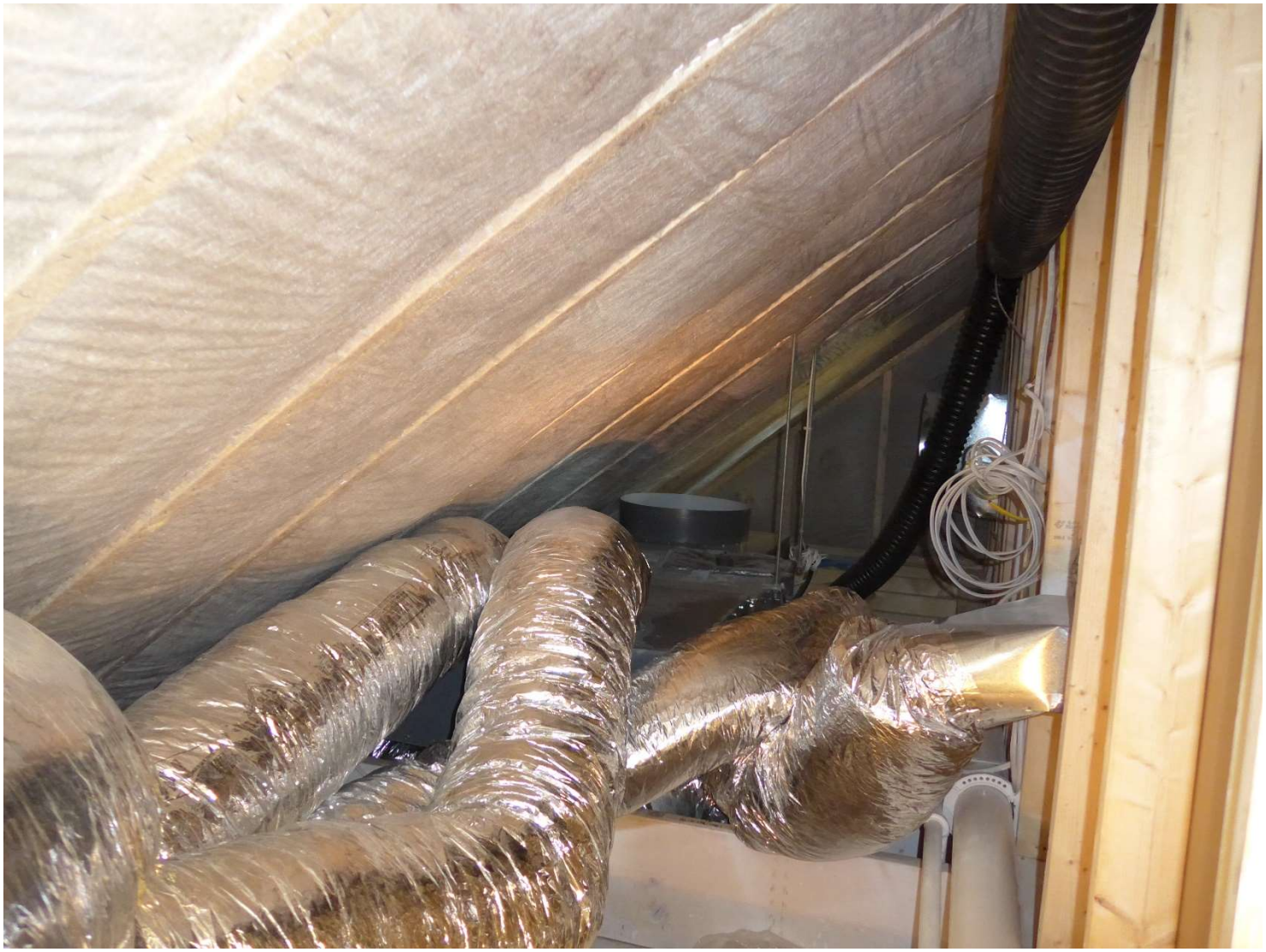
- 1 head/bedroom is oversized!

  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

- 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 COP: **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

Thank you!

Thanks to:

- U.S. DOE Building America Program
- Efficiency Vermont
- Massachusetts & Rhode Island Utilities
- NEEP
- Homeowners participating in the studies
- PHIUS

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