

# MINI-SPLIT APPLICATIONS



# ASHP market potential

## Furnace and AC Homes

- **81%** of Xcel's residential customers have furnaces and/or air-conditioners
- **1,300,000 customers** are a great application for ducted ccASHPs
  - 40,000 - 50,000 customers annually

## Electrically Heated Homes

- **6%** of Xcel's residential customers heat with electricity
- **96,000 customers** can save over **55%** from a heat pump install

## Boiler Heated Homes

- **9%** of Xcel's residential customer heat with boilers
- **144,000 customers** could use ductless mini-splits for cooling and heating

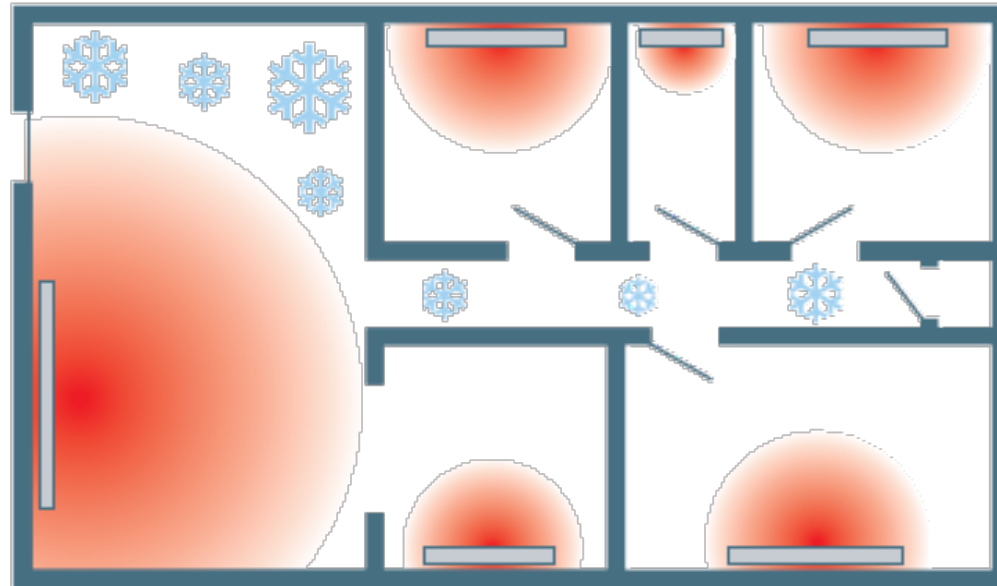
# Electric Displacement via Ductless – 55% savings



# Cold Climate Ductless Heat Pump Displaces Electric Baseboard Heat

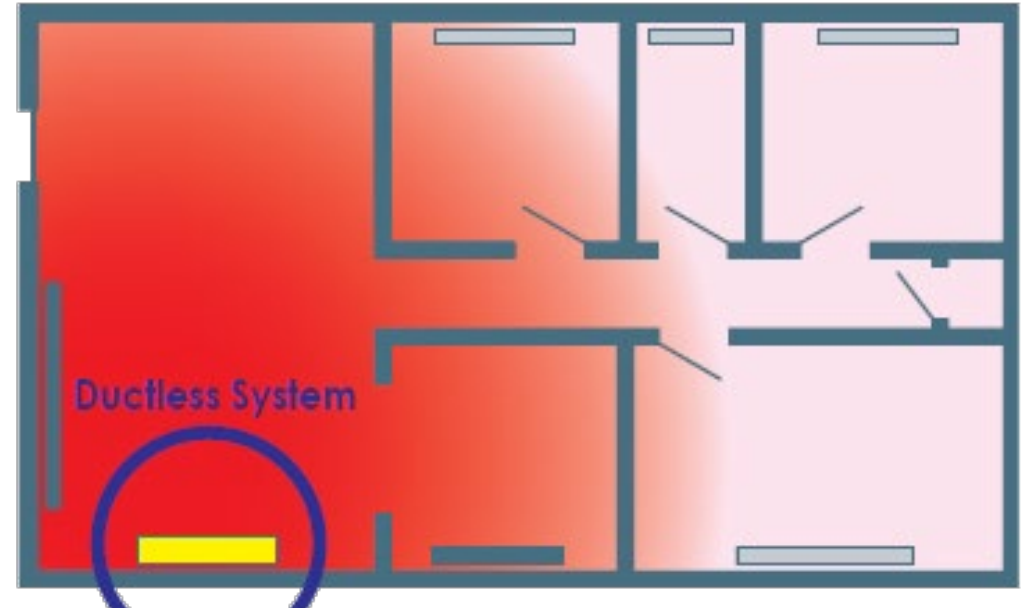
- » Partial loads
- » Ideal for open floorplans
- » Baseboards remain (backup heating)

- » Summer air conditioning
- » Half the heating cost
- » No ductwork needed



**Pre-Existing System**

Baseboard heating system



**Displacement Heating**

Single-head DHP in the main living area

# Cold-Climate Mini-Split HP

Many options

- 1 to 1
- Short ducted
- Indoor heads



\$600 rebate

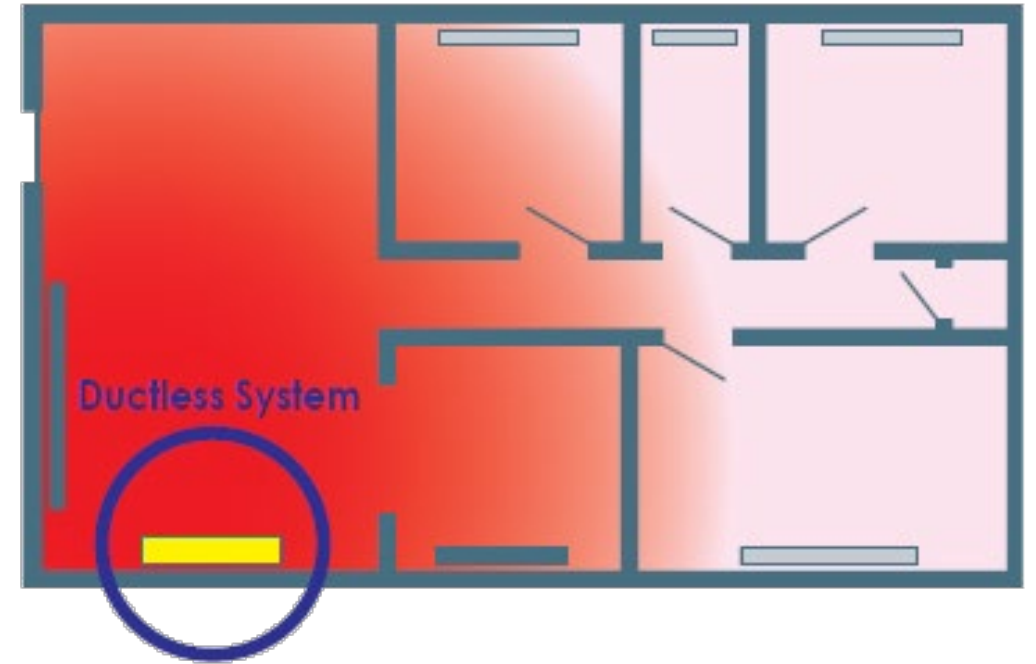
- $\geq 18$  SEER
- $\geq 11$  EER
- $\geq 10.5$  HSPF **9.5 HSPF**



**NOTE:** Likely change to HSPF soon

# Application Considerations

- Head location is important
  - Size for space
- Controls – integration with other heating sources is key
- Ductless will operate whenever system is capable
- Lots of design and install flexibility





# Customer Benefits

- Energy Savings – 55%
- Air-conditioning
- Provides comfort, solves problems
- Control – zonal heat – where and when you want it
- No ductwork!



# Adding Mini-Splits to Homes with Natural Gas Boilers





# ASHP Market Potential

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# Mini-Split Heat Pump

## Many Options

- 1 to 1
- Short ducted
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## \$500 rebate

- $\geq 15$  SEER
- $\geq 11$  EER
- $\geq 9$  HSPF



# Application Considerations

Ask customer about needs/wants

- Cooling or heating focused?
- What areas of the home?

Address comfort issues

- Mini-splits are problem solvers

Provides shoulder season heat

- Don't "fire up" the boiler on 50F days





# Customer Benefits

## Comfort - zonal cooling and heating

- Heating and cooling where and when you want it

## No ductwork needed

- Low-cost cooling addition

## Energy efficient cooling and heating

- Supplement boiler heat at moderate temps  
35F – 55F





# MINI-SPLIT BEST PRACTICES

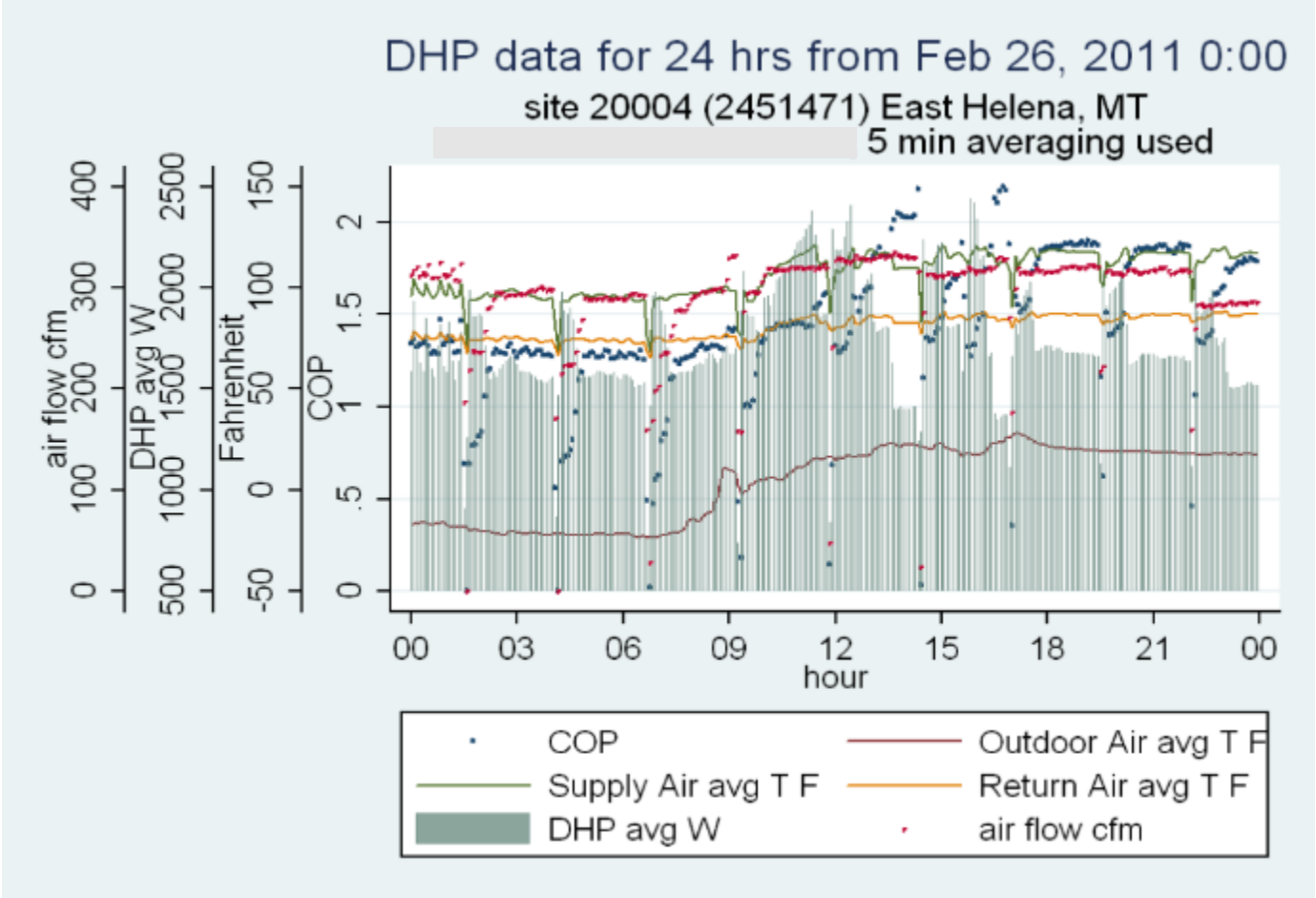
# WHAT WE KNOW NOW

## Mini-split heat pumps:

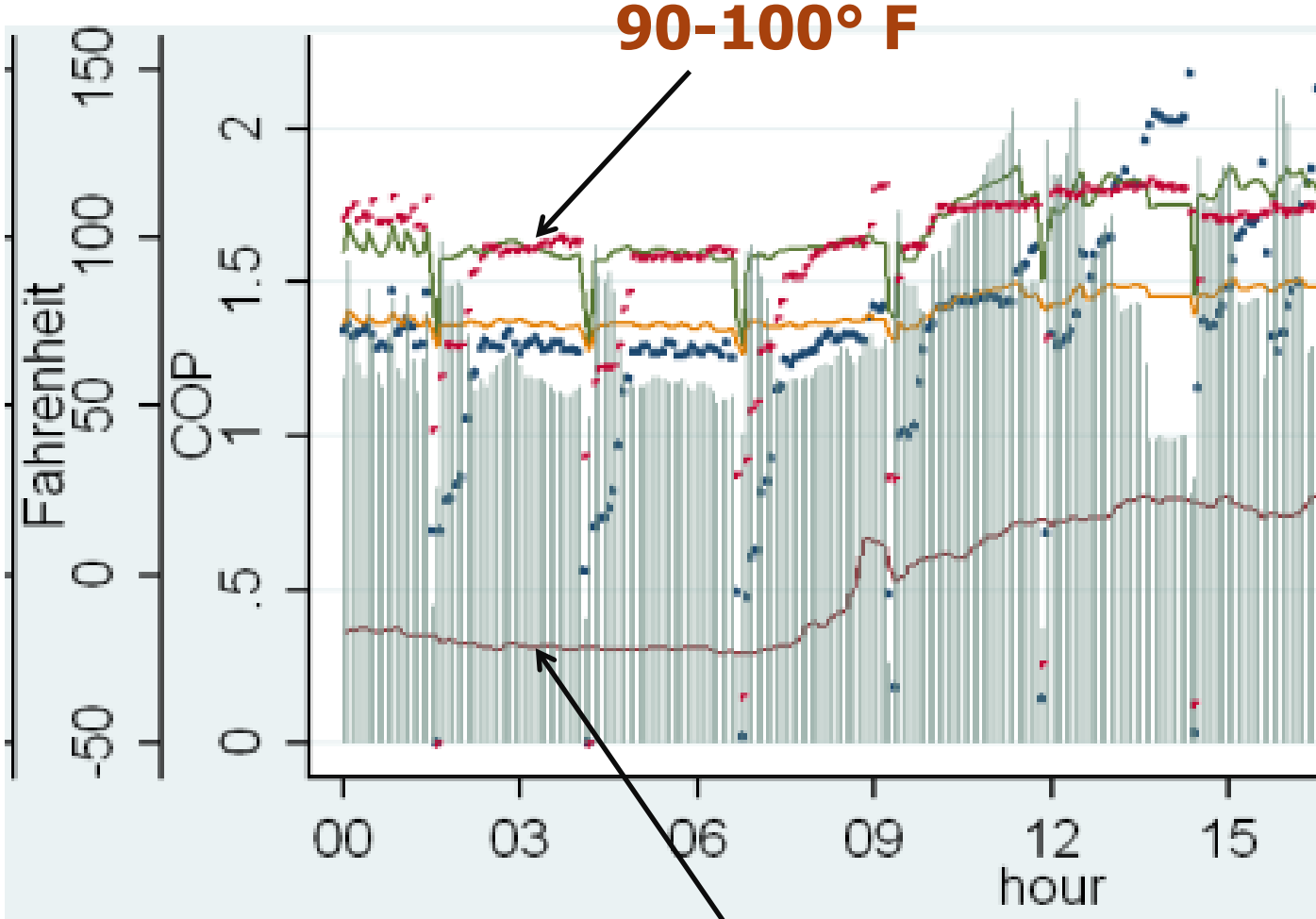
- Reliable
- Efficient
- Energy saving
- Aesthetics matter
- Give homeowners high levels of satisfaction



# MSHP Cold Weather Performance



# How Hot Would You Like Your Supply Air?



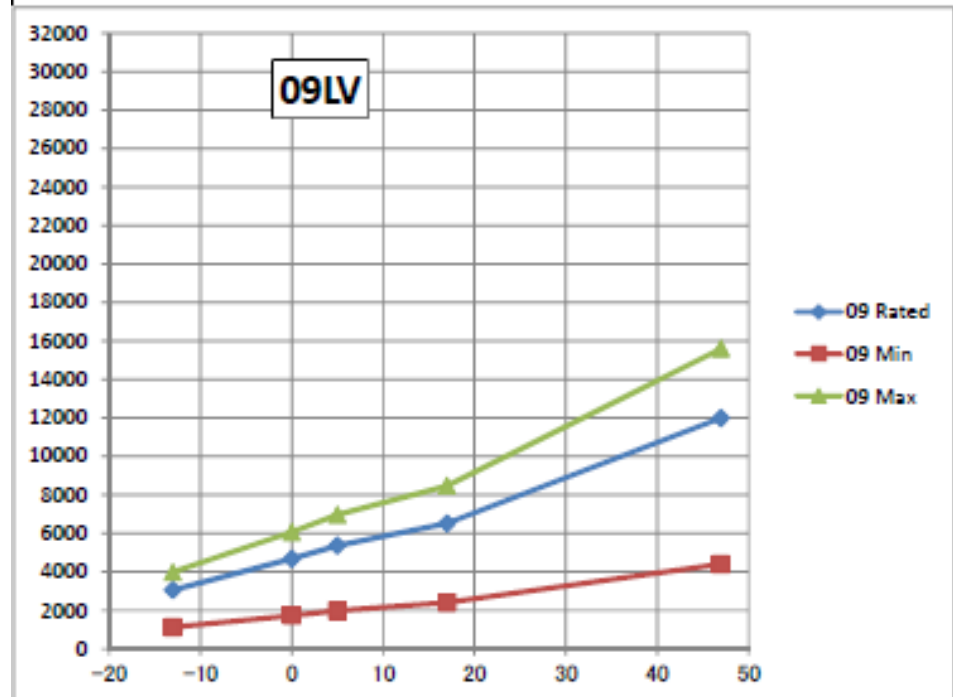


# What We Have Learned

- Sizing and Selection are REALLY important!
- Placement is really important
- Homeowner education is really important
- There are BIG differences between models with same nominal size

Detailed capacity must be known

Heating Cooling Loads Must Be Calculated



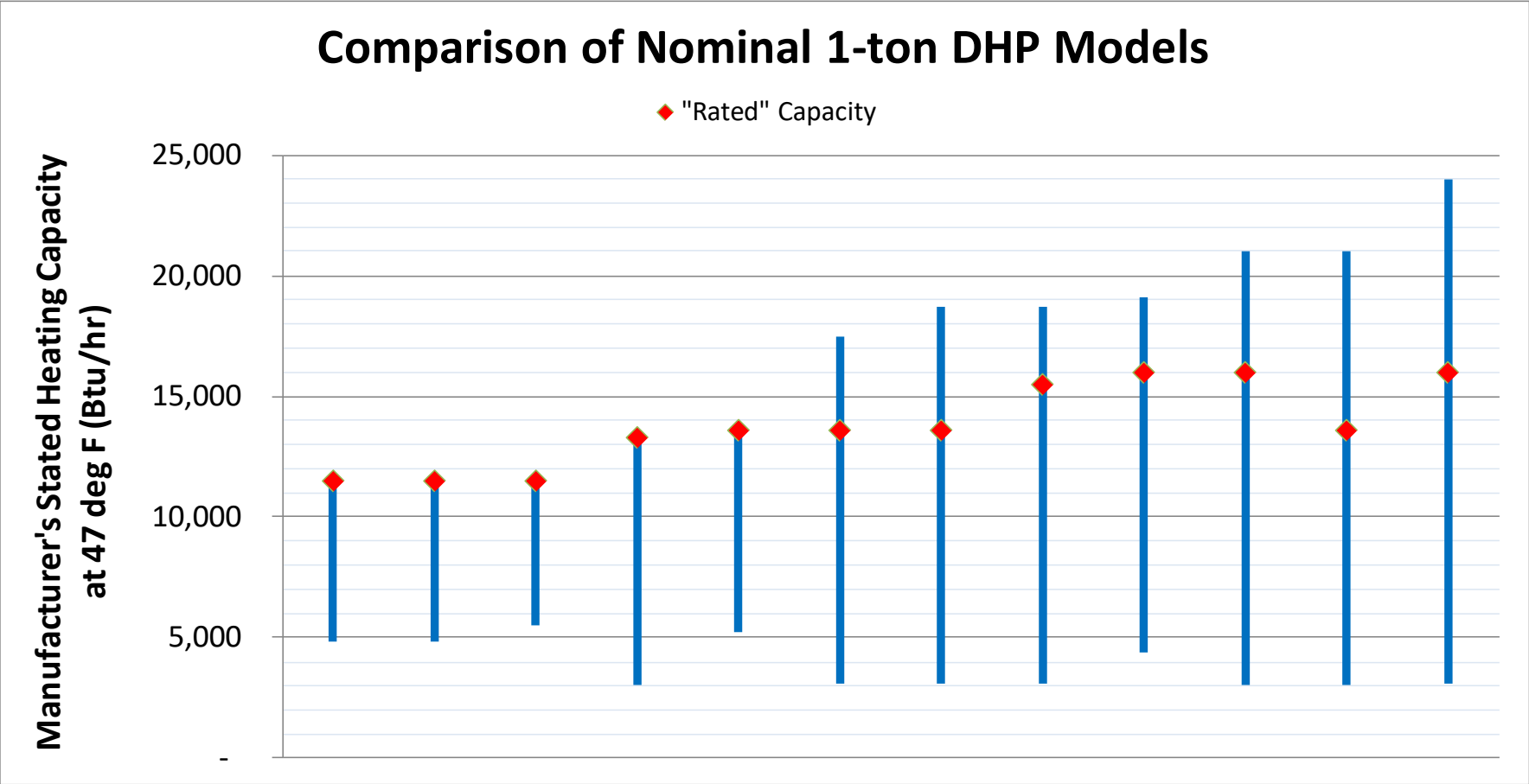
# The Nature of Equipment Selection

- The goal of sizing HVAC equipment is to find the best match between the house and the equipment
- Optimal size is the best match, *or balance*, between the load of the house and the capacity of the HVAC equipment

# Sizing Mini-Split Heat Pumps

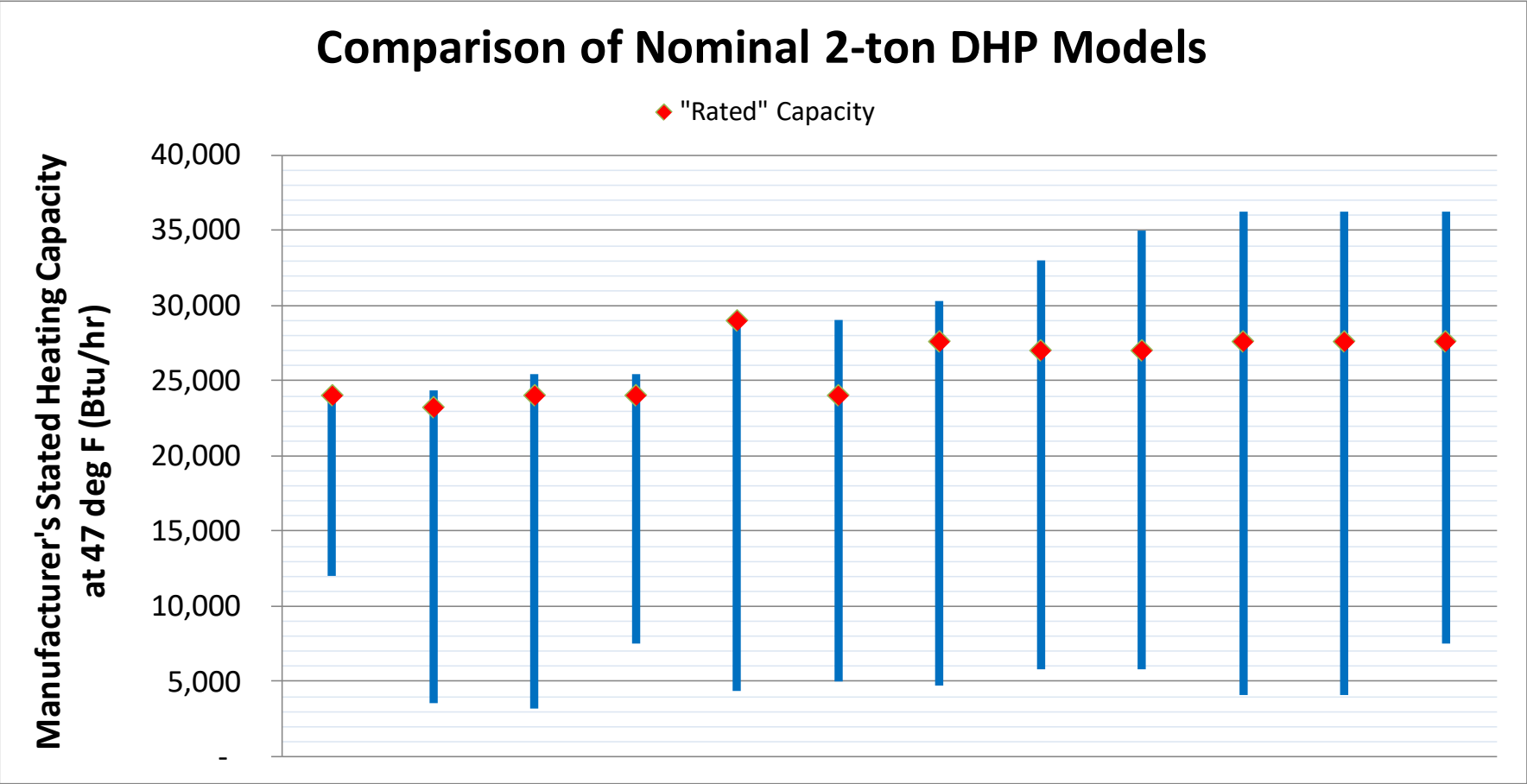
- Size to meet the load of the zone(s) at design conditions
  - Take into account supplemental sources and overall design
- When sizing, the minimum capacity is nearly as important as the maximum capacity
  - When the house load drops below minimum capacity, performance drops from severe short-cycling
  - A look at the max/min capacity at 47° F can be an indicator of how the unit will perform in these conditions
  - We call this the unit's "turn-down ratio".
  - It varies greatly by model.
- Look for a unit with at least a 4:1 ratio or higher between its maximum and minimum capacity at 47° F

# Sizing Mini-Split Heat Pumps

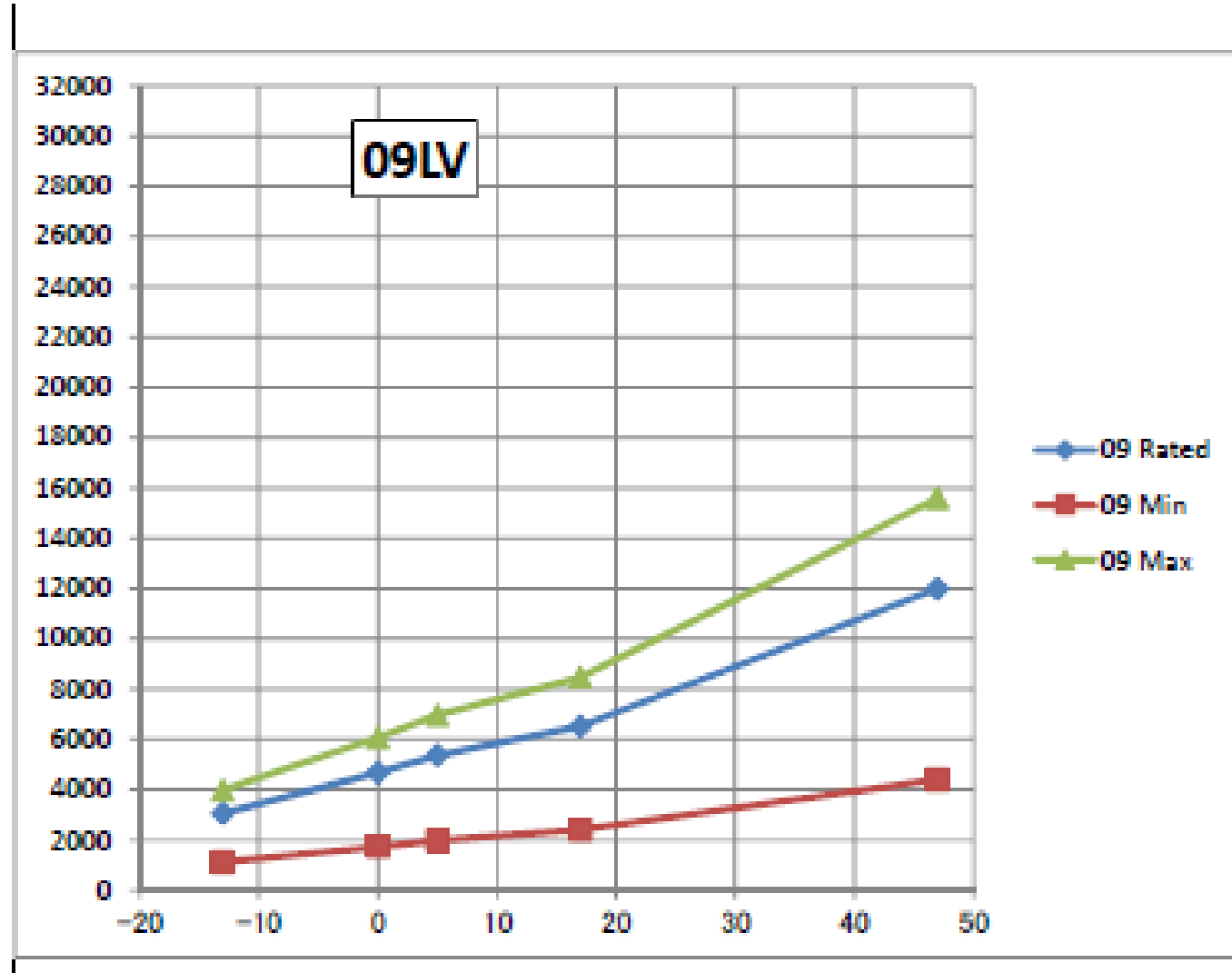




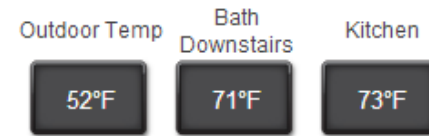
# Sizing Mini-Split Heat Pumps



# Sizing Mini-Split Heat Pumps



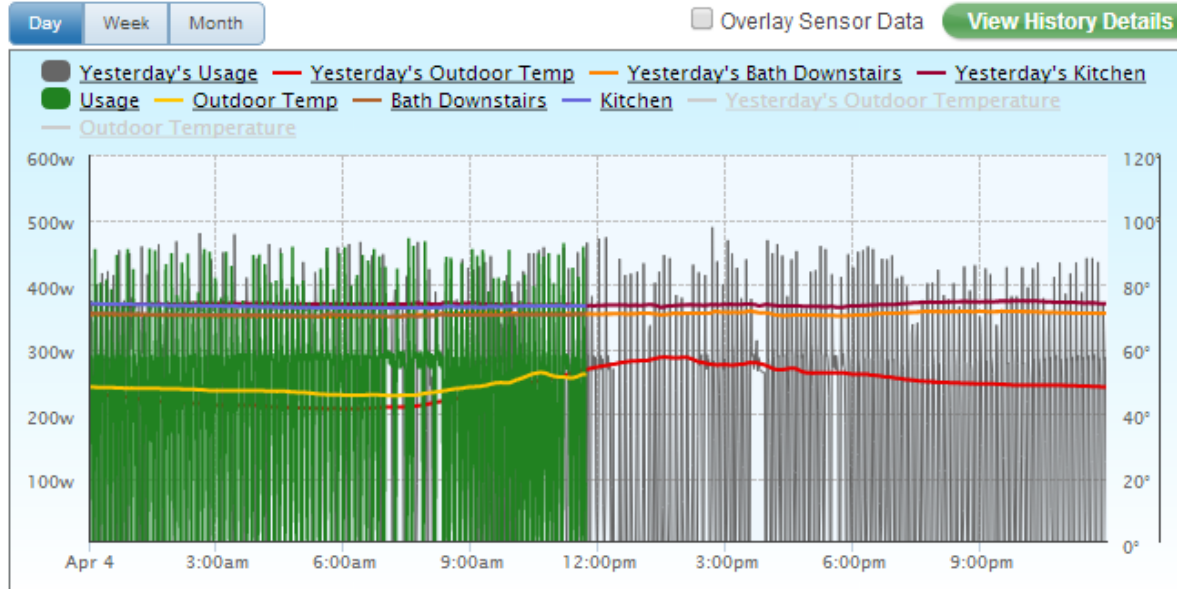
# Sizing Mini-Split Heat Pumps



Projected Usage in kWh vs Previous Period     kWh     Cost

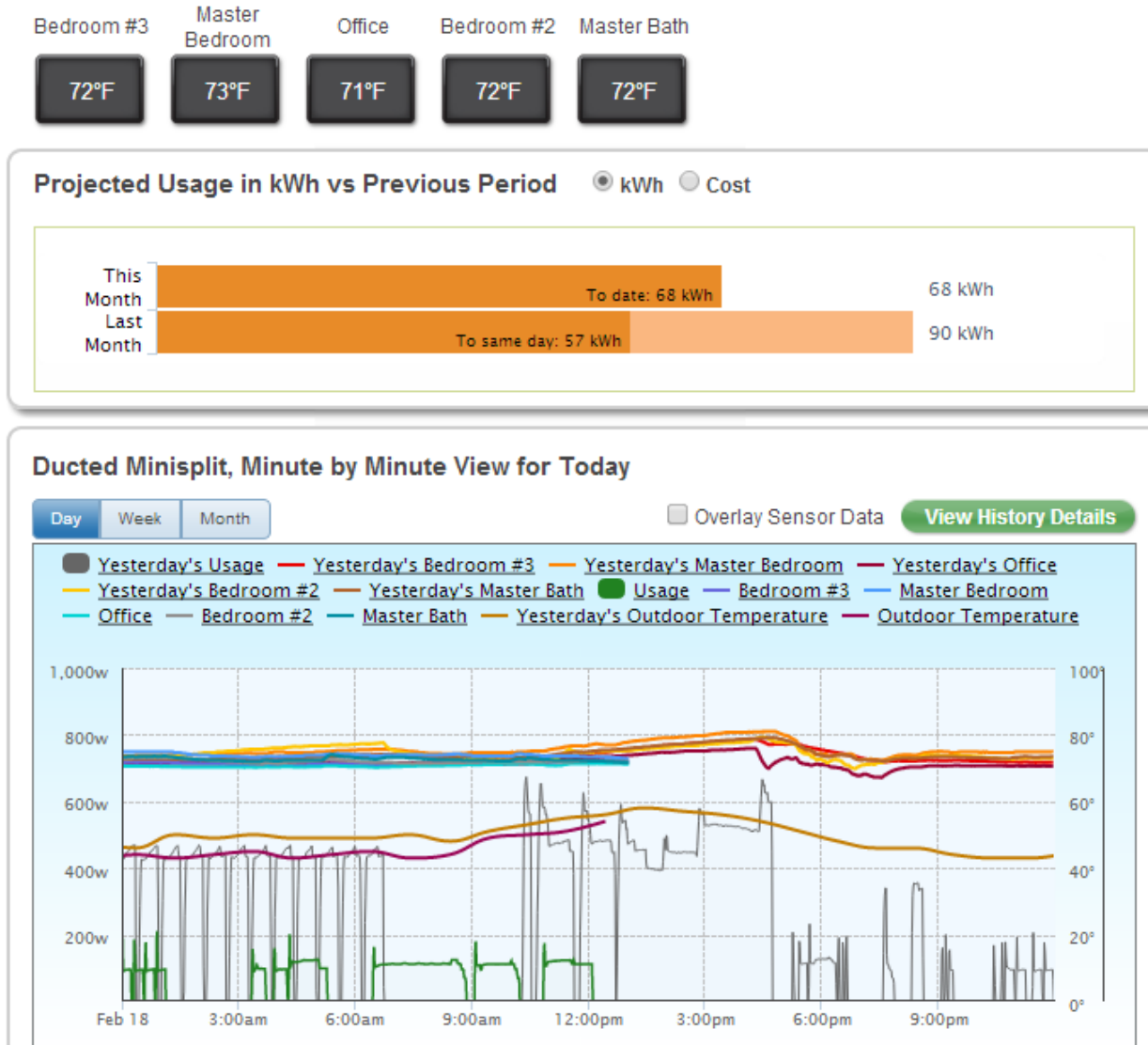


DHP Downstairs, Minute by Minute View for Today



- Each green line is a HP cycle
- This HP cycling on and off to much!

# Sizing Mini-Split Heat Pumps

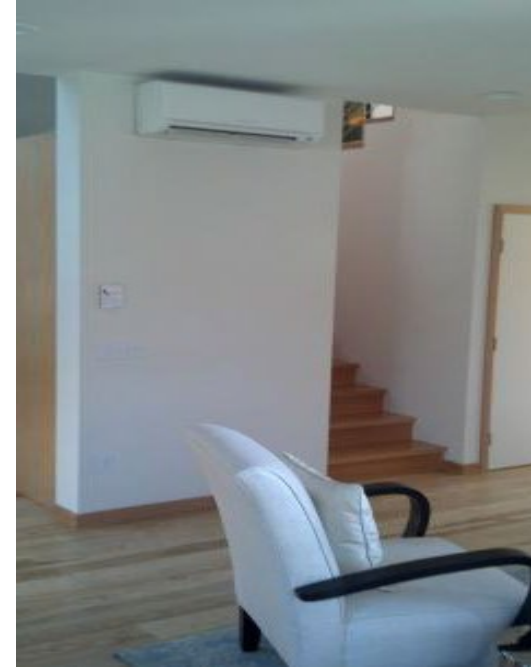


- Notice the HP is running for longer and much lower wattage (green line)
- This is how HPs are designed to work

# MSHP System Design

## Considerations:

- How to heat and cool remote rooms
- Home geometry and floor plan influence heat distribution



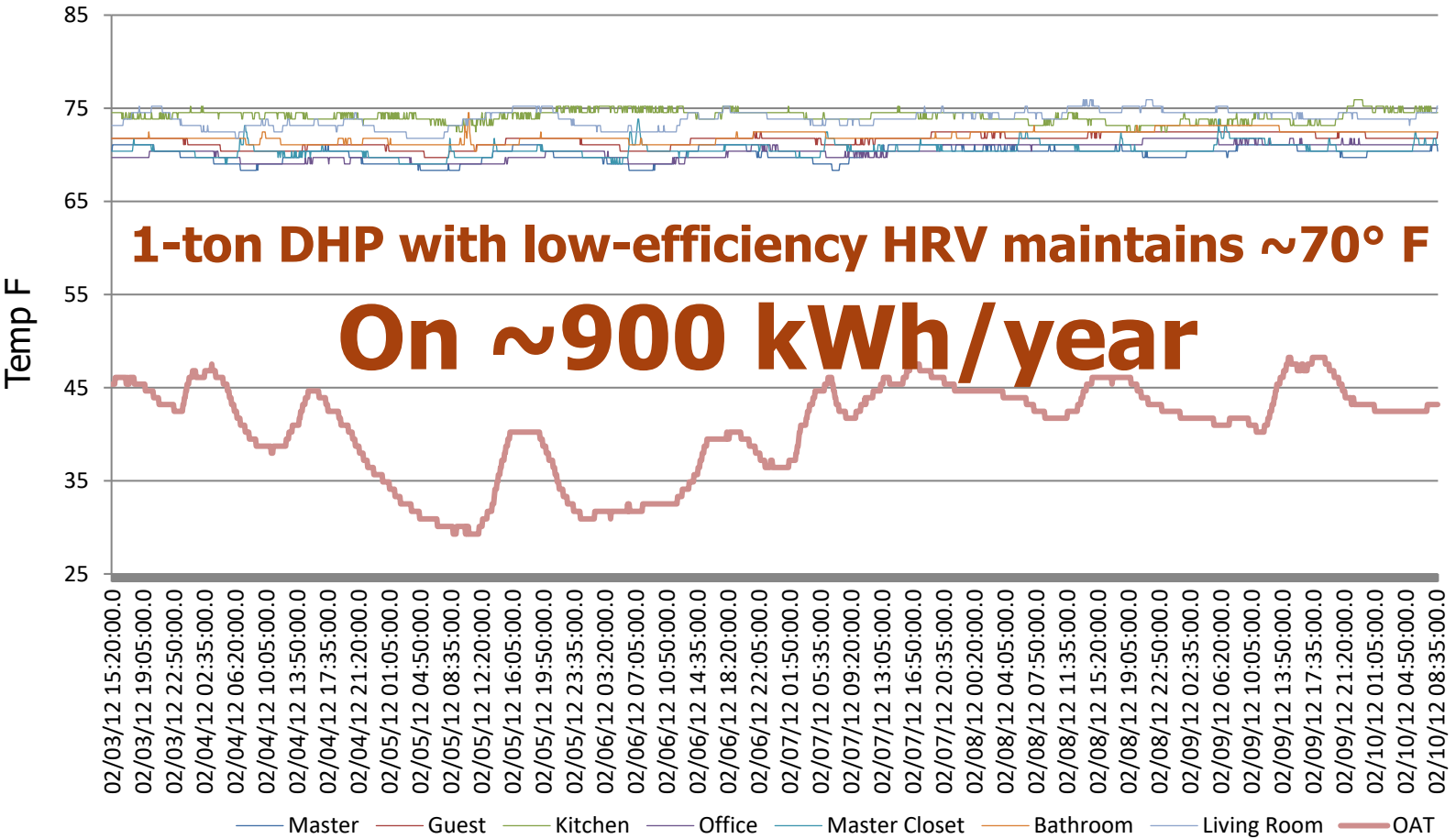
# MSHP System Design

- Orient heads to take advantage of throw and mixing
  - Place in largest, most open areas
  - Orient to blow down central hallways
- In rooms with high ceilings, place DHP  $\leq 8'$  off the floor to minimize stratification effects
- Don't leave units set in "Auto" mode





# Room Temps. In Low-load Home

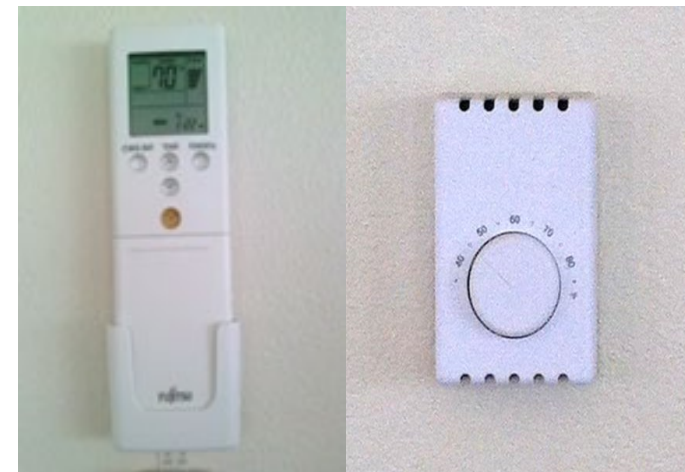


**1-ton DHP with low-efficiency HRV maintains ~70° F  
On ~900 kWh/year**

**House has low UA. Very tight. 12K ductless heat pump and low-efficiency ERV. About 900 kWh/year for space heat.**

# Homeowner Education

- Leave interior doors open
- Clean filters
- Don't make big changes in the set points
- Homeowners must be educated on the operation of systems in their homes
  - The best system in the world does nothing if it isn't used properly



# Ducted Mini-split Design

- Place and orient indoor heads to allow for future maintenance/service
  - Closets and dropped ceiling are good options
  - Locate ducts and equipment in conditioned space



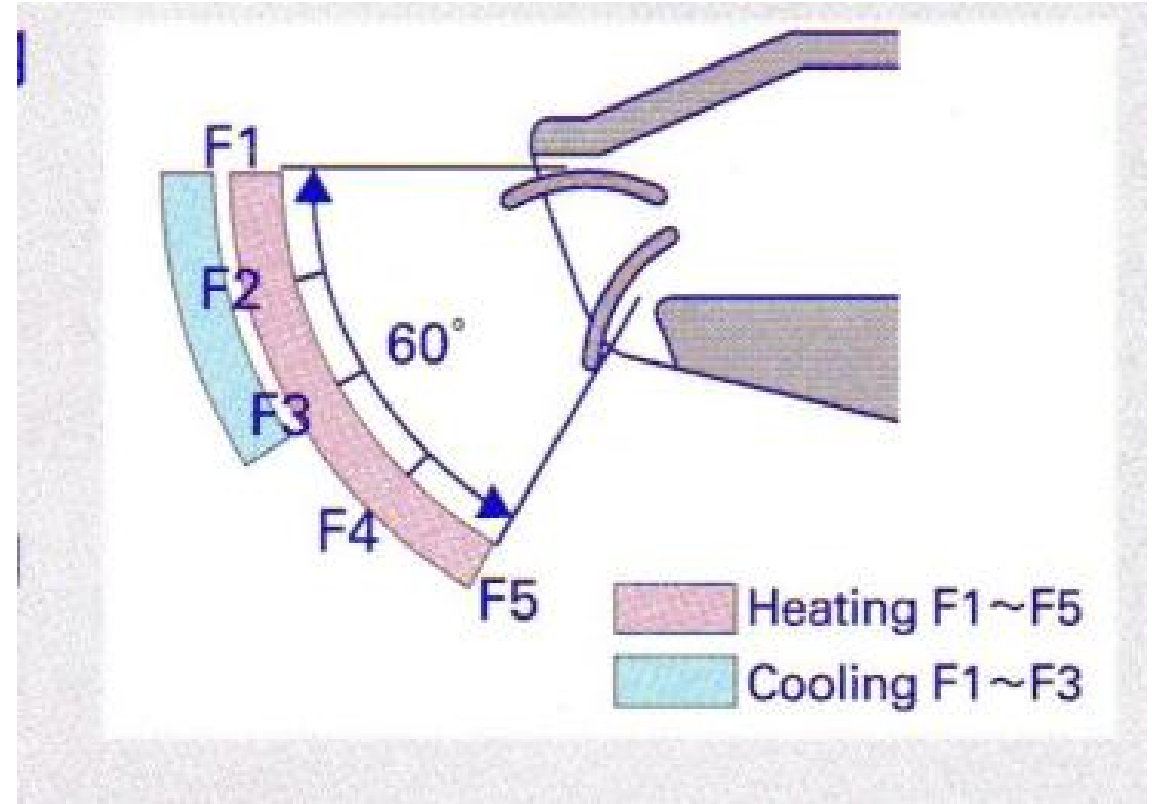
# Ducted Mini-split Design

- **Good duct design is key**
  - Adhere to manufacturer's guidance – some specify ducting limitations for their units, others just provide static pressures for the fan
  - Do a real duct design – follow Manual D guidance
  - Design and install to minimize restriction
  - Use grilles that have a good throw and mix well
- **Use with a wall-mounted T-stat**
  - Locate T-stat appropriately
  - Make sure controls reflect the necessary settings

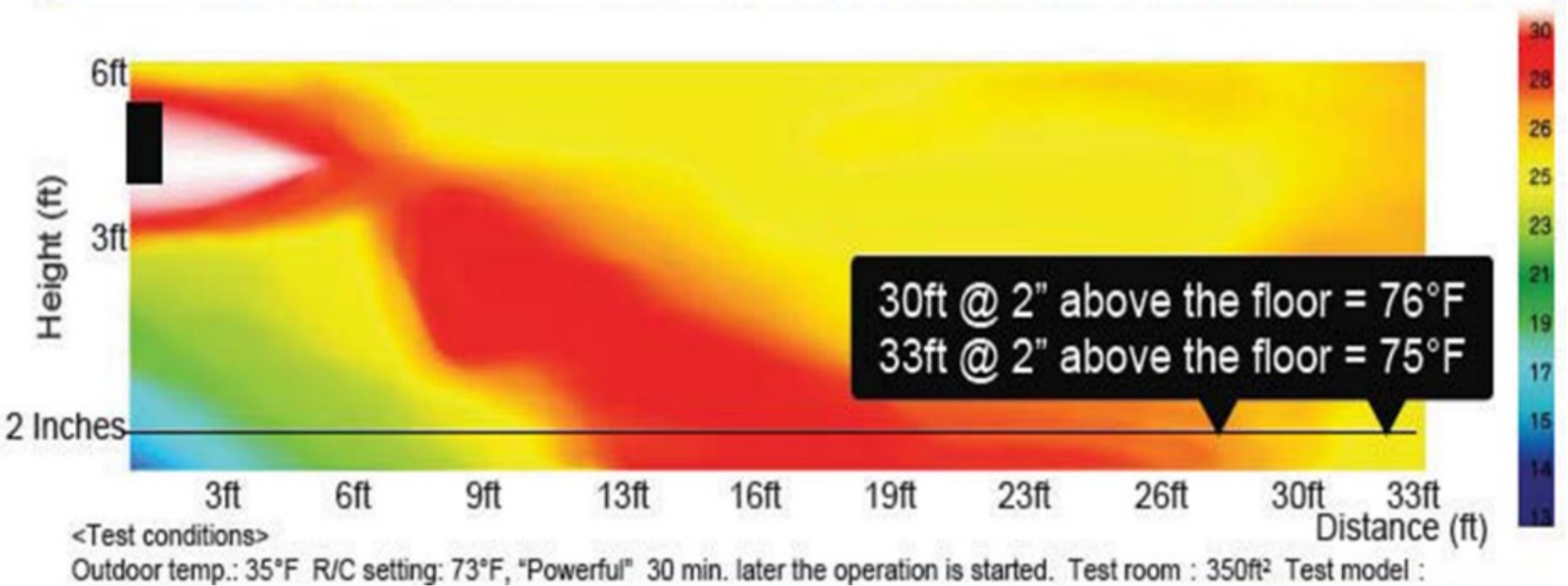
# Airflow

## Sizing MSHPs Also Means Sizing and Placing of that Really Cool Diffuser

- Let the flow go.
- Don't block the indoor unit: no close walls, beds, etc.
- Try to align larger units with central hallways.



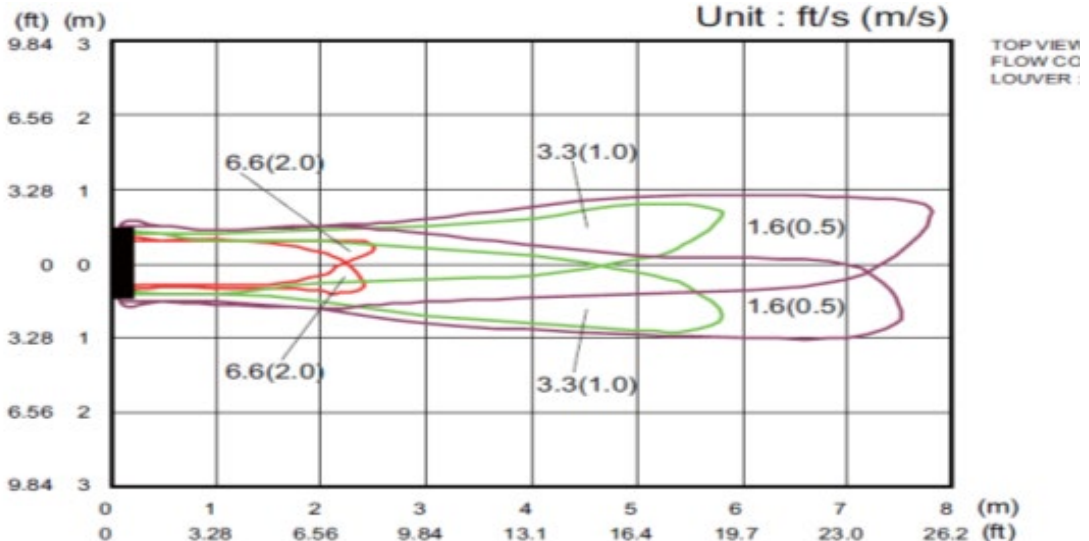
# Effective Air Throw & Temperature Distribution for Larger Rooms



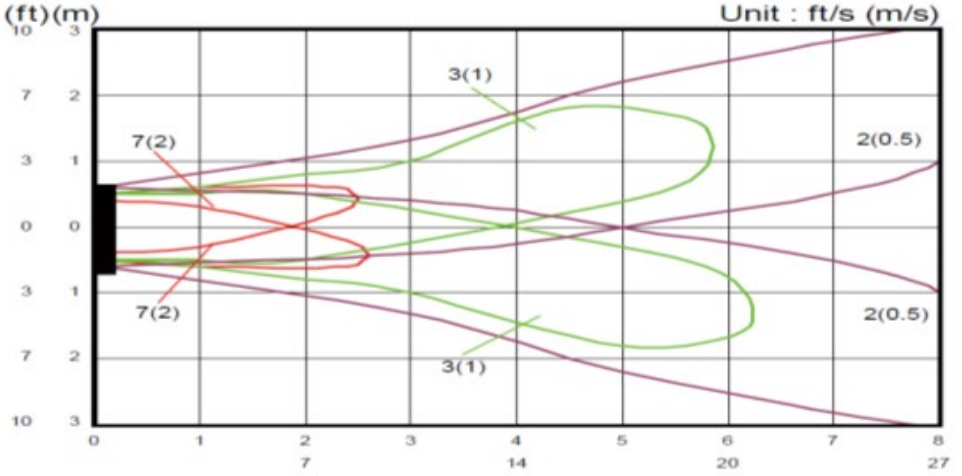


# Birds Eye View of Spread of Conditioned Air

From manufacturer Specifications:



Model: ASU9RLS,  
ASU12RLS



Model: ASU24RLF

# Recommended Installation Practices

## Avoid Installing Outdoor Units on Walkways and Patios



Defrost cycle melt water can re-freeze on ground surfaces and create a dangerous slip hazard.

If you cannot locate the outdoor unit to a flower bed or other helpful area, a drain pan heater and heat tape can allow for the melt water to be drained away.

# Recommended Installation Practices

## Do Not Install Outdoor Units Under a Roof's Driplines

Rain, ice fall and snow melt from roof overhangs and driplines can re-freeze on the compressor's coil surface and overwhelm the unit's defrost cycle.

When needed, outdoor units should be installed with drip caps or shields.



# Recommended Installation Practices

## Do Not Install Outdoor Units Facing the Dominant Wind

If the outdoor unit is facing into dominant wind direction, this could cause counter-rotation of the outdoor fan and lead to failure of the fan motor, fan circuit board, or both.

- **TIP 1:** If you cannot avoid the dominant wind direction, install an optional wind baffle offered by the manufacturer.
- **TIP 2:** Also, avoid placing units where drifting snow may accumulate.





# Recommended Installation Practices

## Locate Outdoor Units Where Noise Will Not Disturb Occupants

In colder climates, defrost cycle and full power operations occur frequently and run at higher decibels than typical operations. In homes with little or no insulation or single pane windows full power noise may bother occupants.



# Recommended Installation Practices

## Install Outdoor Units Above Average Snowfall Depths

Outdoor units always need free-flowing air. Install using wall brackets or an equipment platform that will raise the outdoor unit above average snow levels.

- **TIP 1:** Remind the homeowner to regularly clear snow away from their outdoor unit, and to keep an eye on the unit during extreme weather.
- **TIP 2:** Install vibration absorbers when mounting the unit using wall brackets. Use double-ended vibration absorbers to reduce noise from transmitting through the wall.
- **TIP 3:** If ground clearance allows, use brackets designed to attach to the foundation wall.





# Recommended Installation Practices

## Ensure Outdoor Units Stay Level



The outdoor unit must be level (front-to-back and side-to-side) and remain so for its useful life. This is important for allowing the defrost cycle to work properly and to prevent ice buildup in the outdoor unit.

**TIP:** For ground pad-secured units with snow-level risers, create a strong, long-lasting foundation by removing grass, topsoil and mulch and getting down to base soil. Then build back up using dry cement or 1/4" minus gravel before adding a ground pad or stand to prevent saturated soils from shifting.

# Recommended Installation Practices

## Ensure Insulation Covers the Entire Lineset Including Flare Fittings

Make sure insulation covers the flare nuts, as well as the entire lineset length. This ensures liquid or frost will not develop under the flare nut and cause cracks. Full insulation coverage also retains heat and improves system efficiency.



# Recommended Installation Practices

## Air-seal and Insulate the Wall Penetrations



Unsealed holes cause internal temp sensor errors which can lead to serious performance issues. Effects also exacerbate when under low temperature conditions.

**TIP:** This is a common installation oversight. Add it to your installation checklist.