# Using the NEEP ccASHP List to better size and select ASHPs

## The Goldilocks Zone: A Contractor and the Three Heat Pump Quotes

A contractor was evaluating three options to propose to the customer. The first was too big; cycling would make the system inefficient and lead to discomfort when cooling. The second was too small; an undersized unit would lack the power to warm in the winter and cool in the summer. The third was just right; they had used the Northeast Energy Efficiency Partnerships Cold Climate Air Source Heat Pump (ccASHP) List to choose this system!

> "While [ASHPs] are an amazing technology, today's systems are not infinitely variable in their ability to modulate down to low delivered capacities…so sizing practices must evolve to account for a systems capability and the needs of particular applications."
> David Lis, NEEP

**Who is the NEEP?**

NEEP is a nonprofit dedicated to reducing building sector energy consumption by accelerating energy efficiency, electrification, and grid flexibility. NEEP built the ccASHP List realizing that the current energy efficiency indicators (HSPF, SEER, and EER) fall short of offering a complete picture of a system's performance, especially at low temperatures. HSPF specifically "does not include low temperature testing points below 17°F, assumes the use of electric resistance elements, and tests in steady-state operation"[1]. As heat pump adoption has increased and we better understand real world operation, it has become increasingly clear that those data points alone cannot accurately describe the performance of an ASHP in the New England climate. Customers and contractors need access to tools and resources that better model ASHP performance in cold climates under actual conditions. Thus, the NEEP ccASHP List was born. Let's take a look at what it does!

The NEEP ccASHP List offers several important functions to support contractors in selecting and sizing equipment: system performance data in low temperatures, capacity graphs that factor in design temperatures and loads, and fields that calculate annual modulation, cycling, and supplemental heat needs. The List has been used as both a qualifying product list and a tool to assist contractors in selecting appropriate equipment.

**Why is the NEEP List important?**

1. In the world of furnaces and boilers, we are used to a limited variability in efficiency. Most modern boilers have an "A" rating or are over 90% efficient. Most furnaces fall in the range of 85-95% efficient. No matter which system is chosen, there is a limited effect on energy savings. Heat pumps are different. If you look at a performance rating for heat pumps like HSPF and SEER, you would understandably draw a similar conclusion that most heat pumps are efficient and variability in operating cost is minimal. When you go a level deeper using the NEEP ccASHP data, the performance variability can be massive! Case in point, two of the most popular four-ton models from different manufacturers have minimum capacity COPs of 4.1 and 6.1 at 47F. That is more than a 39% change in efficiency from model-to-model which can result in hundreds of dollars either lost or saved!
2. Comfort is king. Both over and undersized systems will reduce the ability of homeowners to control temperatures and humidity in their homes. An oversized system will not be as effective at reducing humidity and maintaining consistent temperatures, and an undersized unit, while less common, can struggle to heat or cool spaces to the homeowner's desired temperature.

Contractor and customer interest is aligned in the installation of a heat pump. Both want a system that works in the background providing comfortable and cost-effective heating and cooling. If the information that they currently use cannot always ensure this outcome, then we need better information. The NEEP ccASHP List begins to provide this. Let's check out how it helps contractors better size and select equipment.

**Performance Specs**

This table (see Image 1) offers a glimpse into data that can be incredibly important, but challenging to decipher. It describes the variable speed nature of systems at a wide range of temperatures, identifying how much capacity is delivered at key temperatures, how much the systems can ramp down, and their efficiencies when doing so. The Abode Heat Pump team recommends ensuring that:

**Heating**: The system you are choosing has the highest minimum capacity COP possible at 47F and 17F compared to other like-equipment.

a. The minimum capacity ratings at 47, 17, and 5 can be a good indicator of how forgiving a system is to oversizing and how likely it is to cycle. Look for minimum capacities that either start low and stay low across all 3 temperature ratings, or results that start higher but decrease with lower outdoor temperatures. Avoid minimum capacities that increase as temperatures decrease.

**Cooling**: The cooling load for a home is above the minimum capacity at 82F and below the maximum capacity at 95F. In fact, the minimum capacity at 82F should be as low as possible and the cooling load should be well above that value for maximum modulation and accompanying dehumidification and energy savings!

**Both**: Review the NEEP data when moving up or down a size in the same product line. It's counterintuitive but moving up or down a size in the same product line can have very different outcomes in terms of the performance characteristics described above.

**Capacity and Heating Load graph**

This graph (see image 2) uses the performance spec data listed above, as well as the home's heating design temperature, heating design load, and local weather station data, to highlight project-specific outcomes. Used in conjunction with a Manual J/S, this graph is incredibly helpful in illustrating/communicating system performance for a specific project. It does this by identifying several key points:

- Modulation zone: temperature range within which the heat pump is operating between its minimum and maximum capacity as it responds to the home's heating load (TIP: we want the load to be in between the minimum and maximum capacities as long as possible!),
- Supplemental heat: zone identifying when supplemental or backup heat is needed (this should be minimized!), and
- Low-Load cycling: indicating when a heat pump will begin short-cycling and unable to modulate.

**Conclusion**

So the question is, when do you use the NEEP ccASHP List? Use case #1 is evaluating options on an individual home/job basis. Use case #2 for contractors is to do a one time evaluation of their most commonly installed equipment. As manufacturers update or release new equipment, be sure to review these tables on an ongoing basis.

**Use case 1: Individual home/job**

First off, these features are not meant to replace a Manual J/S. We repeat, these tools are NOT meant to replace Manual J/Ss. Manual J/Ss collect the most important data needed to properly size and select equipment. But, when you run your Manual J/S to determine the heating and cooling load and look up products that you work with that fit that load, you can use these List features to ensure that the equipment will be able to ramp down at high heating season temperatures (and low cooling season temperatures), modulate throughout the year, and ensure that your customers are experiencing maximum comfort! You can also use it when calculating at what temperature your dual-fuel system's switch over temperature should be set at.

**Use case 2: Evaluating commonly installed equipment**

Let's return to the earlier point that HSPF and SEER are often not representative of real-world heat pump performance in New England, and performance variability between ratings and real-world can be significant. This can translate into increases in operating cost by a few hundred dollars to as much as a thousand dollars annually for customers. Evaluating equipment can feel like a daunting task but for most contractors this equates to looking at 10-15 systems that make up ~80% of what they install. Contractors may find their commonly installed equipment looks good or they may want to evaluate alternatives.

This is a free tool that will improve outcomes for your customers. Take a look at it and take advantage of it! As always, please reach out to Abode with any questions.

**Image 1: Performance Specs table** - click "View Detail" under a system

Performance Specs

| Heating / Cooling | Outdoor Dry Bulb | Indoor Dry Bulb | Unit | Min | Rated | Max |
|---|---|---|---|---|---|---|
| Cooling | 95°F | 80°F | Btu/h | 25,000 | 52,000 | 60,000 |
| | | | kW | 1.6 | 4.37 | 5.58 |
| | | | COP | 4.58 | 3.49 | 3.15 |
| Cooling | 82°F | 80°F | Btu/h | 26,500 | - | 62,500 |
| | | | kW | 1.31 | - | 4.88 |
| | | | COP | 5.93 | - | 3.75 |
| Heating | 47°F | 70°F | Btu/h | 22,000 | 55,000 | 60,000 |
| | | | kW | 1.56 | 4.21 | 5.34 |
| | | | COP | 4.13 | 3.83 | 3.29 |
| Heating | 17°F | 70°F | Btu/h | 12,500 | 43,500 | 44,000 |
| | | | kW | 1.51 | 5.16 | 5.16 |
| | | | COP | 2.43 | 2.47 | 2.5 |
| Heating | 5°F | 70°F | Btu/h | 10,000 | - | 40,000 |
| | | | kW | 1.5 | - | 4.93 |
| | | | COP | 1.95 | - | 2.38 |

**Image 2: Capacity and Heating Load Graph -** click "Advanced Data" under a system