

# Cold-Climate Air-Source Heat Pumps

All-electric heat pumps — already used in many parts of the country — are continuing to grow in popularity for their many advantages and [available incentives](#) to help improve comfort, lower energy bills and reduce utility grid stress. Rather than generating heat by burning fossil fuels or heating resistive elements, heat pumps use refrigerant to absorb ambient heat from one location and release it somewhere else. Air-source heat pumps (ASHPs), the most common type, use the outside air to absorb and release heat. In the summer, an ASHP takes heat from inside and dumps it outside, like a refrigerator. In the winter, it takes heat from the outside and distributes it inside, like a refrigerator running in reverse.

But one specific type of ASHP has been of particular interest among energy-conscious consumers and electric cooperatives: the cold-climate heat pump.

## 1. High Efficiency Year-Round, Even on the Coldest of Days

Most ASHPs — both standard- and some high-efficiency models — don't heat as well as fossil-fueled heating systems when outdoor temperatures fall below 47°F (let alone in below-freezing environments). That's because they can't absorb enough outdoor heat at those temperatures to keep air warm inside the home, and must instead rely

on supplemental strip, or auxiliary, heat: large electric resistance coils that generate heat like an oversized toaster.

Figure 1, from the Northwest Energy Efficiency Alliance (NEEA), shows example heating capacity curves of various ASHPs by outdoor air

temperature — or their heating output in refrigerant mode only. As the outdoor temperature drops, the supply temperature of a standard heat pump (in heat pump mode) also drops, and supplemental heat is added to maintain comfort. The use of supplemental heat causes these systems to lose their advantage in efficiency and operational savings.

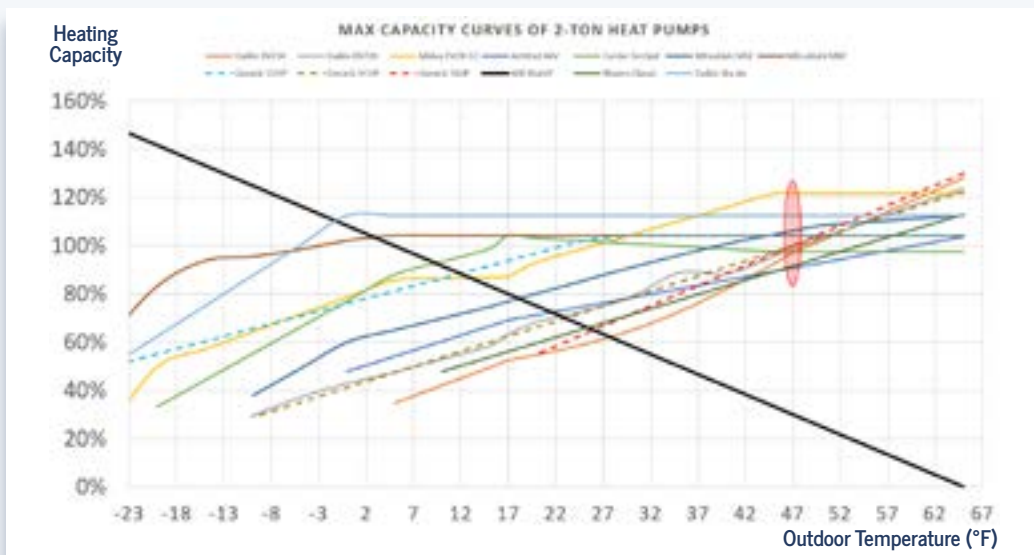


Figure 1. Example Heating Capacity Curves by Outdoor Air Temperature of Different ASHPs. Modified by Advanced Energy for Clarity.

The cold-climate heat pumps, however, depicted by the roughly horizontal light blue and dark red lines, don't lose their heating capacity until a much lower outdoor temperature. These systems are so efficient that they don't depend on supplemental strip heat (and may not even include it) and can maintain their higher efficiency through typical winter conditions across the U.S. They do this thanks to improvements in technology and software; essentially, they run their outdoor fan at full speed to absorb as much heat as possible from cold outdoor air. At the same time, they operate their indoor fan as slowly as necessary to deliver comfortably warm supply air to occupants. (Note: All cold-climate heat pumps are high-efficiency heat pumps, but not all high-efficiency heat pumps are cold-climate heat pumps.)

## 2. COP Values Allow for System Comparison

While there are a variety of metrics to evaluate the efficiency of heating systems, including annual fuel utilization efficiency (AFUE) and heating seasonal performance factor (HSPF), any unit can be described by its ratio of heat output to energy input (in the form of either electricity or fossil fuels). This ratio is called the coefficient of performance (COP), and the higher the number, the more efficient the system. (COP can also measure the efficiency of cooling systems by comparing the cooling capacity to the energy input.)

The COP for a gas or electric furnace doesn't change much with outdoor temperatures because it generates all its heat output by burning fuels or heating resistive elements. That also means these systems can't have a COP greater than 1. In comparison, the COP for ASHPs is frequently much greater than 1, because rather than generating heat, these devices are moving it from one place to another.

Figure 2 shows the COP of cold-climate heat pumps in relation to that of other heating systems for two outdoor conditions, a mild winter day at 47°F and a cold winter day at 5°F.

The COP of gas and electric furnaces doesn't vary with temperature, but the COP of ASHPs does. Furthermore, the COP of most ASHPs on a cold winter day is the same as the COP of a standard electric furnace — that's because these ASHPs have stopped being heat pumps and are relying on supplemental strip heat, the same technology used by the electric furnaces. Cold-climate heat pumps, though, keep working at cold temperatures and maintain their high efficiency.

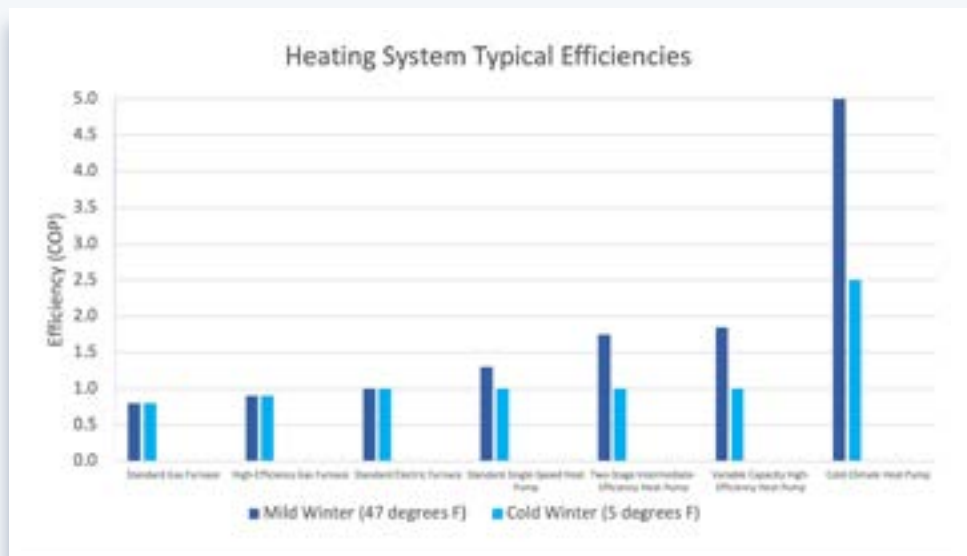


Figure 2. Typical Efficiencies of Different Heating Systems Listed from [AHRI Directory](#)

## 3. Other Benefits Make Cold-Climate Heat Pumps a Win-Win Technology

Cold-climate heat pumps offer a variety of additional benefits.

**Lower Bills, but Not Comfort, During Extreme Weather:** Cold-climate heat pumps use the more-efficient heat pump process instead of less-efficient supplemental strip heat to meet comfort needs. This can reduce heating energy usage by up to 66% while maintaining indoor temperatures, reducing the likelihood of being surprised by steep winter utility bills.

**Quiet Flexibility:** Cold-climate heat pumps use variable-speed motors, which means they can slow down and be quieter when the weather is mild during spring and fall. These variable-speed systems can supply small amounts of heating or cooling more frequently throughout the day, compared to standard systems that can only run at one or two speeds. This ability to run at low load means cold-climate heat pumps are often whisper-quiet, always super-efficient and reliably friendly to your wallet.

**Better Indoor Moisture Management (Especially in Humid Climates):** By dynamically controlling their fan speeds, cold-climate heat pumps can slowly move humid air across the indoor coil to be a better dehumidifier compared to running at full speed like standard systems.

**More Uniform Indoor Temperatures:** Variable-speed operation is better at mixing conditioned air between rooms. Slow and steady fan speeds are more efficient at blending room air than the short bursts common with standard systems.

**Utility Grid Stress Relief:** Cold-climate heat pumps are a boon for electric cooperatives and other utilities, as they help limit stress on the grid during the coldest times of the year, which often have high demand. This benefit can be as much as 10 kilowatts of savings per system — and utilities may pass on those savings through larger purchase incentives.

**Remember to contact your local co-op with questions about or for more information on cold-climate heat pumps.**

### Resources:

· [Database of State Incentives for Renewables & Efficiency](#)

· [ENERGY STAR: Air-Source Heat Pumps](#)

· [Northeast Energy Efficiency Partnerships: CCASHP Specification & Product List](#)

· [U.S. Department of Energy: Purchasing Energy-Efficient Residential Air-Source Heat Pumps](#)