How Do They Do That? Heating Buildings with Cold Air

An air-source heat pump is an energy-efficient heating and cooling technology that uses outside air as its heat source, providing year-round comfort in millions of U.S. homes and businesses. With energy-efficiency ratings of well over 100 percent, this is not surprising. But how do heat pumps use cold air for heating, and how do you get energy efficiency of more than 100 percent out of any device?

How they work

Heat pumps provide both heating and cooling. During the heating season, heat pumps move heat from the cold outdoors to the warmer indoor space. How does cold air provide heat? Hot and cold are relative terms. All outside air down to absolute zero degrees (-460°F) contains some heat. An air-source heat pump extracts some of this heat and moves it indoors to provide space heating.

A heat pump system consists of a compressor and two coils made of copper tubing; one coil is located indoors and the other one is located outdoors. Liquid refrigerant in the outdoor coil absorbs heat from the air and evaporates it into a gas. The indoor coil releases heat from the gas refrigerant as it condenses back into liquid. In the summer, this process is reversed as the heat pump provides cooling by moving warm inside air outdoors.

Heat pump efficiency

How do heat pumps have efficiencies greater than 100 percent? This is because heat pumps move or *pump* heat, rather than create it. A conventional furnace creates its own heat by burning fuel. Combustion losses result in an energy efficiency of less than 100 percent. While a furnace can achieve a high efficiency level, the amount of heat produced is ultimately bound by the amount of fuel input.

Since heat pumps are merely moving heat from one place to another, they are not bound by such restrictions. Heat pumps still use energy, but not nearly as much as the heat energy they provide. When properly installed, an air-source heat pump can deliver one-and-a-half to three times more heat energy to a building than the electrical energy it consumes, according to the U.S. Department of Energy. This translates into energy efficiencies of 150 to 300 percent.

Air-source heat pumps lose efficiency and heating capacity as the outdoor air temperature decreases. When outdoor temperatures drop below 32°F, a less efficient, electric resistance or gas-fired backup system kicks in to provide extra heating capacity. For this reason, standard air-source heat pumps are not always the most cost-effective heating option in areas with cold winters. Cold-climate heat pump models have been developed by some manufacturers, but they are not widely available. In moderate climates, however, heat pumps can provide highly efficient and economical space conditioning all year long.

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Added note: Backup heat strips are not necessary in the New Orleans climate. Modern heat pumps typically contain auto-defrost controls that allow them to continue to operate in occasional mildly freezing weather.
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