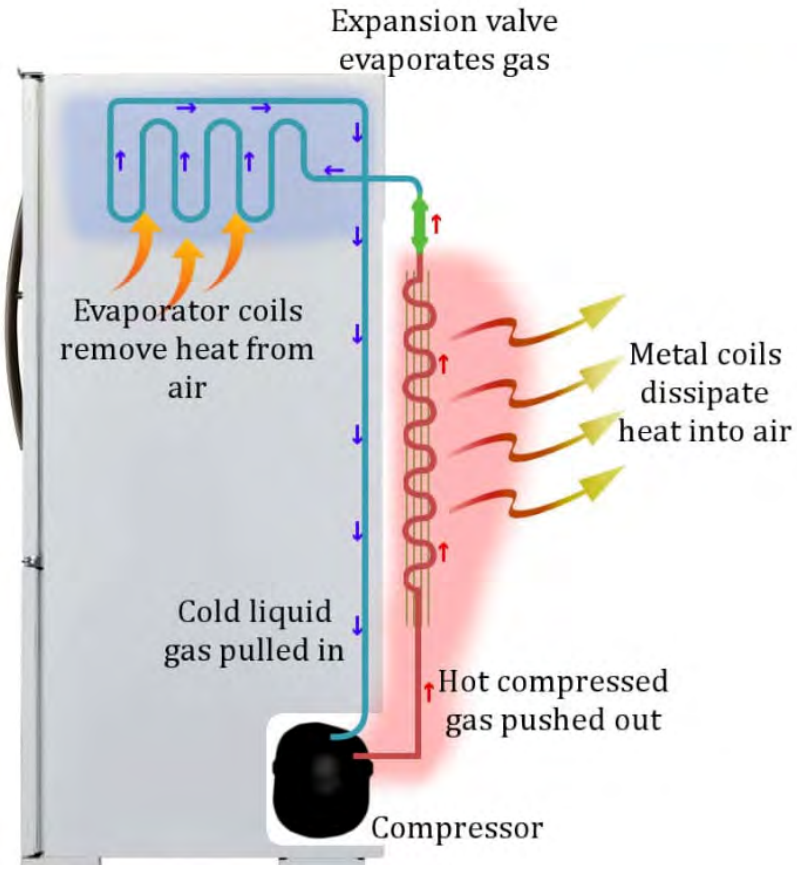
HEATING AND COOLING A UNITY HOME

A look inside the "Comfort System"

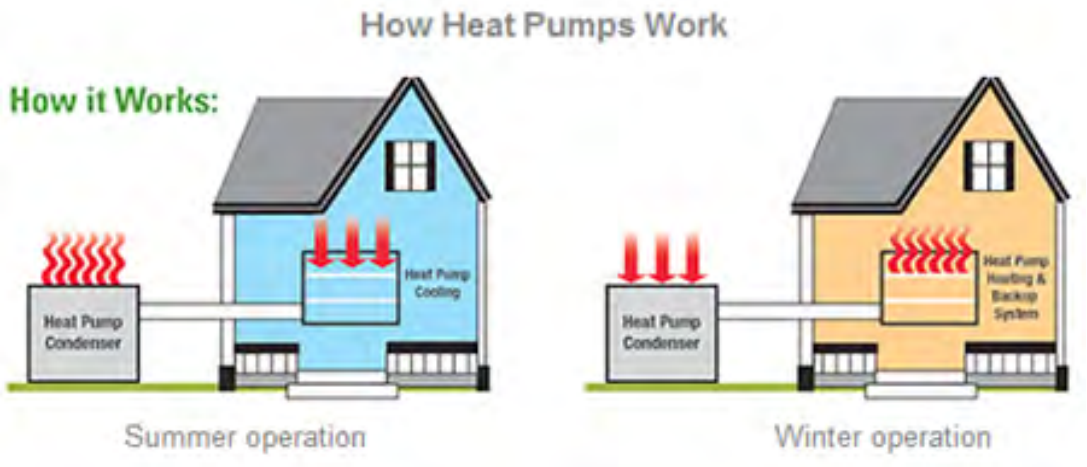
Pulling Energy from Thin Air

While the building science and technology that underlie a high performance home are complex, in principle the systems that heat and cool them are relatively simple. Think of a refrigerator: inside it's cool, and in back it's warm. The same principles that underlie refrigeration keep Unity Homes warm in winter and cool in summer.



from scienceabc.com

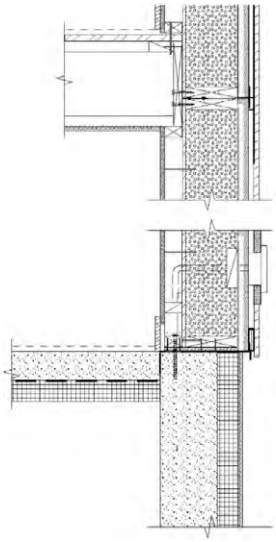
Unity's preferred heating system is called an air source heat pump, sometimes also known as a "mini-split" system. Rather than burning fossil fuels to create heat, or relying on expensive electric resistance elements, heat pumps use a relatively small amount of electricity to "pump" heat to where it's needed. In a refrigerator, heat pumps move warmth from inside the fridge to out. When heating a home, heat pumps move heat from the outside air—even air that is very cold—to inside. In fact, the technology has progressed so far in recent years that the heat pumps Unity uses are capable of pulling heat from outside air that is -15 degrees below zero!



Air source heat pump operation in a house (www.mncee.org)

Unity's Preferred Choice for Heating and Cooling

Heat pumps are a good fit for Unity's high performance homes because:



- Heating and cooling loads in our homes are low, thanks to the thick insulation and meticulous air sealing
- Air source heat pumps are straightforward to install, they require very little room within the house, and they have well-developed options for conditioning different types of spaces
- The systems are quiet, they produce no exhaust, and they are simple to control
- Cooling comes automatically with heating—the cycle is simply run in reverse to provide cooling in summer
- Since heat pumps require only electricity to run, they are the best heating/cooling choice for net zero homes and for any homes that have photovoltaic (PV) systems producing power from the sun

Components of the Heating/Cooling System

Air source heat pumps consist of two primary components: a compressor located outside the house, and a distribution system—either a single point, or ducted to several areas—inside the house. The compressor is connected to the distribution system via refrigerant lines, or "line sets," that convey the heat either into the house or out.

wall-mounted compressor and refrigerant lines

Using the principles of the refrigerant cycle, the compressor pulls heat from outside air in the winter to warm the inside, and heat from inside air during the summer to cool the inside. Unity will determine the size of the compressor needed, based on the heating/cooling loads and number of zones (separately controlled areas) within the house.

wall cassette in vaulted Master Bedroom

Distribution of heating and cooling within the house can happen in two different ways. The simplest distribution mechanism is a cassette that is typically mounted on an interior wall. This “point source” distribution works best to condition large rooms and open areas.

When multiple rooms are conditioned on a single zone, the air first runs through a box called an air handler. The heated or cooled air is then distributed via a system of ducts to the different rooms.

Early on in the design and planning of a new Unity home, we discuss heating and cooling strategies with our clients, and determine how the system will be configured: just a single wall cassette, multiple wall cassettes, or a wall cassette and an air handler with ducts. This decision has implications for the design (we may need a space for the air handler and ducts), and for costs (systems with air handlers are more expensive than systems having just wall cassettes).

For most homes, Unity specifies simple supplemental heating units—typically electric baseboard—so that the primary heating system does not have to be sized for the few coldest days of the winter. We have found that our clients vary when it comes to temperatures they deem comfortable, and the supplemental heating units provide inexpensive insurance. Some Unity homeowners never turn them on!

Installation Considerations

wall-mounted compressor

Compressors for air source heat pump systems can be mounted either on racks on the ground, or on brackets mounted to the building. The choice is based on several factors, including aesthetics, proximity to the inside distribution system, snow fall off of roofs, and potential for vibration to be transferred into the building.

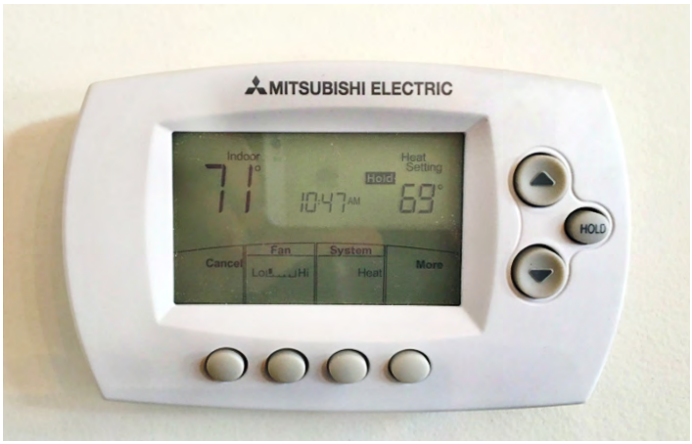
wall cassette in bedroom supplying fresh air

Wall cassettes are mounted high in open spaces so that air can flow easily to and from them. Since cool air flows from these cassettes in cooling mode, we try not to locate them above beds.

Air handlers are typically located near the ceilings of mechanical rooms, in conditioned attic space, or in basements. Clearance is required around the air handler to provide access for maintenance and service. During the planning process, we will ensure that ducts can be run from the air handler to the rooms being conditioned.

In cooling mode, when heat is being pulled from inside air, the wall cassette or air handler will generate condensation—liquid water—that runs through piping either to a drain or to the outside. In some cases, a simple condensate pump is required to drain the water.

Operation and Maintenance



Mitsubishi controller

Air source heat pump systems are controlled via a wall-mounted thermostat. Remote controllers are also available.

"Set it and forget it" is our recommendation for controlling these systems in Unity homes. Heat pumps tend to work most efficiently when maintaining the home consistently in a narrow range of temperature.

As with any heating/cooling system, heat pumps require periodic maintenance. The readily-accessible filters in wall cassettes should be cleaned every 3 months, or as needed. An annual tune-up of the compressor will keep it running optimally, and benefit comfort levels, utility bills and the air quality in the home.

Additional Information

- US Dept of Energy on air source heat pumps
- Mitsubishi Hyper Heat units