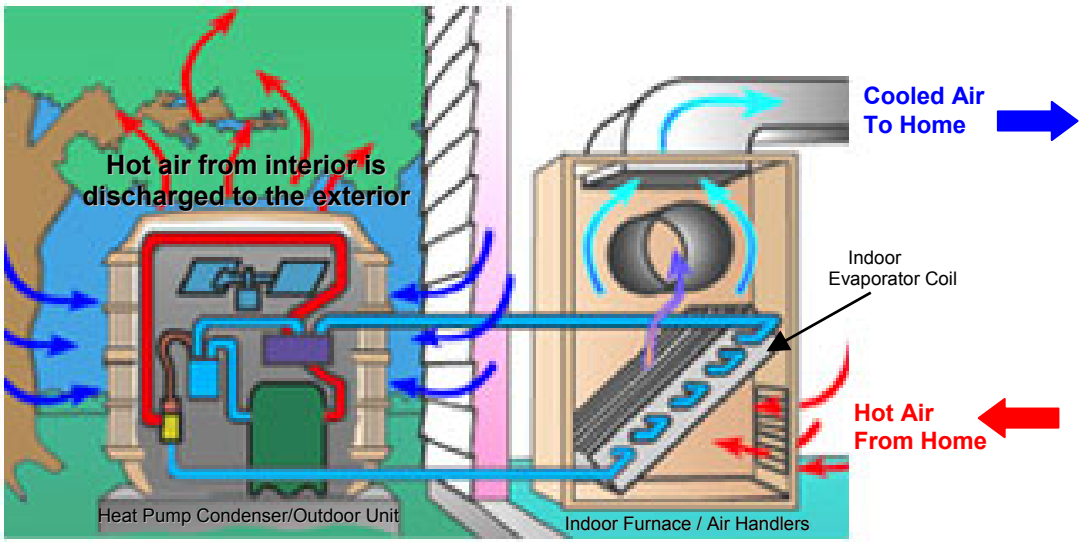
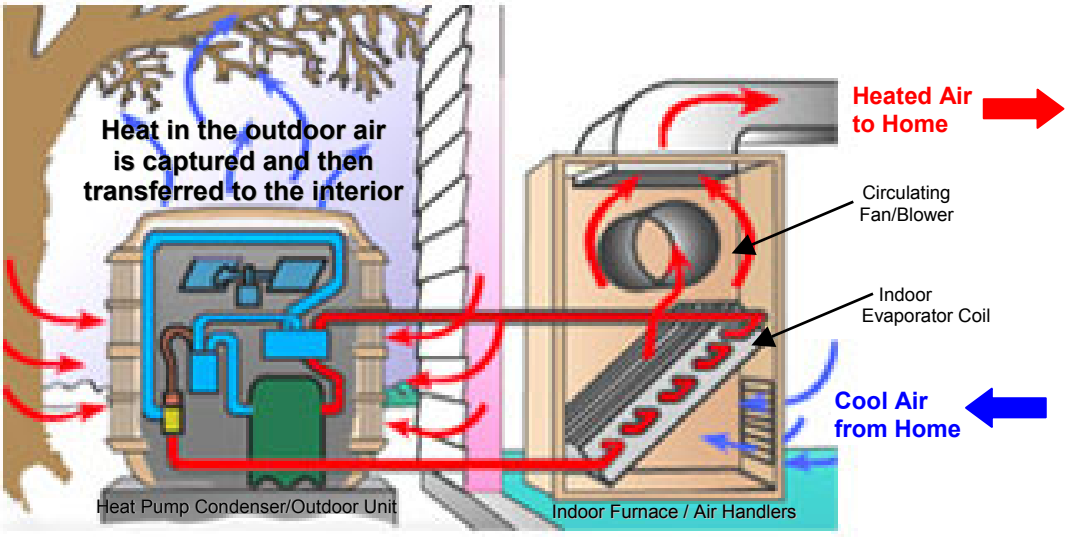
How Does an Air Source Heat Pump Work?

A Heat Pump provides heating & cooling by simply transferring heat. In the summer, it transfers heat from inside the home to the exterior. In the winter, the heat pump operates in reverse and is capable of extracting thermal heat energy from cool outdoor air and then transferring this heat into your home - the same way a refrigerator expels heat from inside the appliance by transferring this heat out the rear of it.



Summer Cooling (Air Conditioning)

When used for summer cooling, a heat pump is not saving energy but simply acts as an air conditioner. In this mode, there is an 'evaporator coil' with Freon gas (refrigerant) mounted in the furnace, which absorbs heat from the air inside the home and then transfers this heat to the heat pump condenser/outdoor unit, where this heat is then released to the exterior. Cooling efficiency ratings are commonly measured in EER or SEER ratings.



Winter Heating (Energy Cost Savings)

During cool conditions such as spring, fall, and mild winter days when heating is required, a heat pump can provide significant energy savings. The heating 'cycle' operates in the reverse of air conditioning, which means that the outdoor unit/condenser is capable of absorbing heat energy from the air outside and transferring it by way of the Freon gas in copper tubing to the indoor coil at the furnace. This heat is then transferred to the indoor air by the furnace's circulating fan and distributed through the home. Heating efficiency ratings are measured in C.O.P. & HSPF ratings.

How Does a Heat Pump Save You Dollars in Energy Cost?

In order to provide a reasonable explanation there are a few factors that need to be understood. These are listed as the A, B, Cs below.

A) Energy Cost Savings in Heating Mode:

Heat Pumps save energy *only* during heating. On cooler days, when a heat pump is in heating mode, its design provides the ability to extract (or absorb) free heat energy from the outside air to heat the home, rather than the typical means of a homeowner paying for their energy from a utility (electric, gas, or oil). While a heat pump needs electricity to operate, under mild (cold) outdoor temperature conditions the average heat pump can extract as much as 3.00 to 3.75 times more thermal energy from the outside air than the energy used to operate the heat pump.

B) Energy Efficiency – C.O.P. Rating:

Unlike 'SEER' which is actually a cooling efficiency rating, the best way of measuring a heat pumps efficiency is the C.O.P. (Coefficient Of Performance) rating and is a ratio based on the following formula:

$$\frac{\textbf{\textit{Energy Output of Heat Pump}} \textit{ (BTU or Kilowatts)}}{\textbf{\textit{Energy Consumed}} \textit{ (to operate the heat pump equipment)}} = \textbf{\textit{C.O.P.}}$$

As the outdoor temperature drops, so does the C.O.P. efficiency of the heat pump (chart 1). As the outdoor temperature drops, it will eventually reach a point that is commonly referred to as the heat pump '***balance point'***. This is the point where the amount of heat energy needed to maintain a warm home exceeds the energy output provided by the heat pump. At this point, a backup – or supplemental source of heat is required. It is also at this point that there is little or no energy cost savings benefit provided by a heat pump. While this point will differ slightly from home to home depending on certain factors, in general the heat pump balance point range is anywhere from -5°C to +5°C.

C) Energy Cost Savings:

As mentioned, a heat pump only provides energy cost savings in heating mode. A heat pump will produce its highest C.O.P. ratings (or efficiency) in the milder temperatures during the spring, fall, and mild winter days. Unfortunately, there is a lot of confusing and contradictory information regarding efficiencies such as the *SEER* rating - which is actually a cooling efficiency rating. Realistically, it is not possible to make a *single* general statement regarding heat pump efficiencies or energy cost savings that will to apply to all combinations of equipment, climate conditions, or utility rates.

Chart 1 is intended to illustrate the correlation between outdoor temperatures, C.O.P. efficiencies at certain outdoor temperatures, and the associated energy cost savings. It demonstrates how the C.O.P. rating (energy output) of the heat pump is the greatest under the milder outdoor temperatures resulting in the greatest energy cost savings, and decreases as the outdoor temperature drops. ***Chart 2*** illustrates the average monthly energy savings based on average outdoor temperatures.

Chart 1 – C.O.P. Ratings Efficiency Scale
Illustration of energy cost savings percent versus fossil fuels at certain outdoor temperatures.

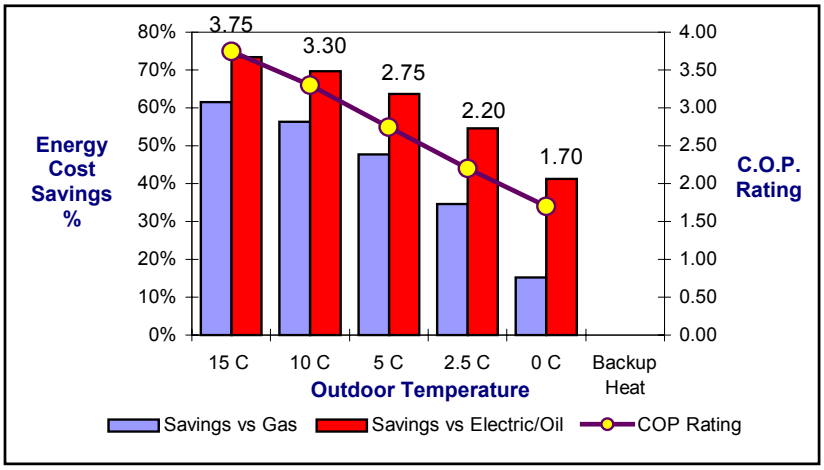
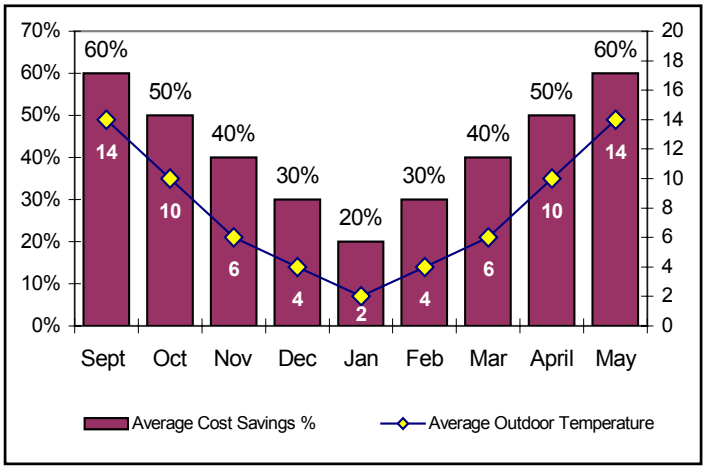


Chart 2 – Average Monthly Temperature / Energy Cost Savings
This chart is an example illustration that shows the average monthly cost savings percent based on average outdoor temperatures – in GVRD.



* All ratings vary by equipment and utility rates. The amounts shown are approximations for illustration purposes and are based on the C.O.P. average of a random selection of brands, and average temperatures.