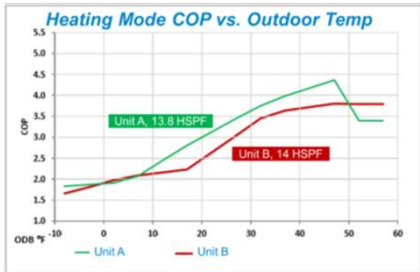


SOLAR-ASSISTED HEAT PUMPS TO DECARBONIZE THE HEATING OF HOMES

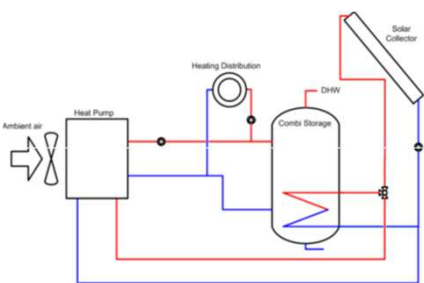
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Heating Coefficient of Performance (COP) vs. Outdoor Temperature for 2 Variable Speed Ductless Units
(Test results using Canadian Standards Association EXP07:19 by Bruce Harley Energy Consulting LLC)

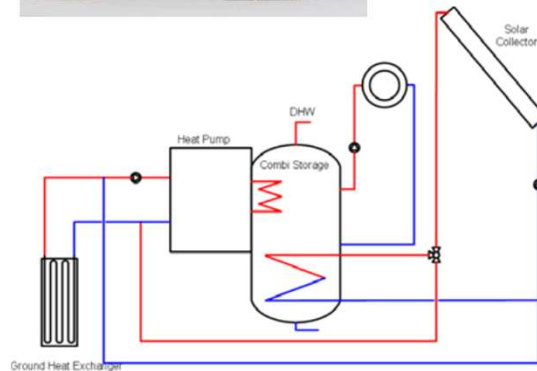
it is possible to provide a solar assist to a home's heat pump by using solar thermal collectors in combination with the outdoor evaporator coil. In one configuration, refrigerant flowing through the collectors during the day is heated above the outside air evaporator temperature, which in turn increases the efficiency of the heat pump when that refrigerant is pumped to the indoor condenser fan coil. This is the direct expansion (DX) solar-assisted heat pump type.



Solar-assisted Air-to-Water Heat Pump for Heating and Hot Water
(IEA SHC Task 44/ HPP Annex Task 38)

While great for decarbonizing space heating, heat pumps need an alternative source of heat when outside temperatures plummet.

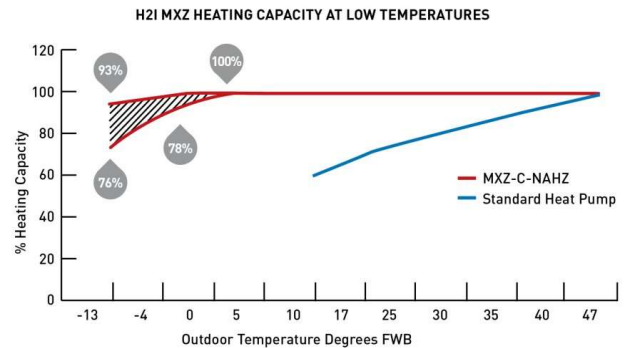
Air-source heat pumps (ASHPs) quickly lose efficiency as outside temperatures go below freezing. Below 0 degrees F, even variable-speed inverter-driven "cold-climate" ASHPs struggle to maintain capacity and typically operate with a coefficient of performance (COP) below 2.0



Solar-assisted Ground-source Heat Pump for Heating and Hot Water
(IEA Solar heating & Cooling Task 44/ Heat Pump Program Annex Task 38)

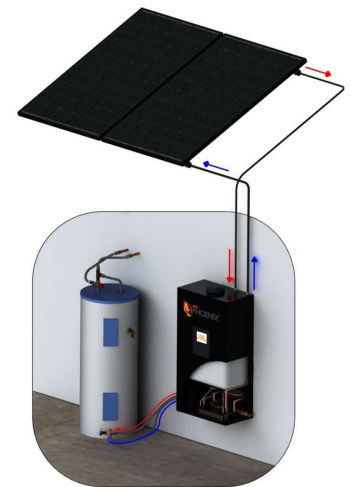
Common Solar-assisted Heat Pump Types

1. Water-source heat pump
 - Glazed collectors with water/brine storage
 - PV/thermal (PV/T) collectors with water/brine storage
2. Air-source heat pump
 - Direct expansion (DX) with unglazed collectors
 - DX with PV/thermal collectors
 - DX with glazed/evacuated tube/tracking collectors
3. Air-to-water heat pump
 - Glazed collectors with water/brine storage
 - PV/T collectors with water/brine storage
4. Ground-source heat pump
 - Unglazed collectors with brine storage



Heating Capacity vs. Outdoor Temperature for Standard & "Cold Climate" Heat Pumps
(Mitsubishi Electric Trane HVAC / Daikin Comfort Technologies)

Water-source heat pumps (WSHPs) can also be used with solar thermal collectors in order to increase the efficiency and capacity of the heat pump at cold outdoor temperatures. Solar-assisted WSHPs also provide the ability to store water or brine heated during the day for use at night by using a storage tank and immersing the heat pump's indoor condenser inside the storage tank. This is the most common solar-assisted heat pump configuration especially in a baseboard or radiant heating system.



Solar-assisted Heat Pump Water Heater with PV/T Collectors
(FAFCO Phoenix)



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