



Echo™ Solar System Operation Is Complementary To The Home

The **Echo™** solar system is in addition to the home's regular heating and cooling systems, it is not a replacement for those systems. The system does not interact with the regular heating and cooling systems in such a way that the failure of one system can cause the failure of the other system. If the solar system experiences any mode of failure, it will revert to an idle mode that does not interfere with the operation of the buildings' primary heating and cooling systems. On those days when there is no solar energy available, the solar system remains idle and the furnace, water heater, and air conditioner maintain home comfort. This paper briefly summarizes how the normal operation of the home is not impacted by the operation of the **Echo** solar system.

Echo does not interfere with the operation of the HVAC system

Echo delivers home heating and home cooling through the homes' existing duct system or optionally through its own dedicated air registers. Air is never supplied through the furnace or air conditioner, which remain isolated from the solar system. The management of the air is accomplished by the Energy Transfer Module (ETM), which behaves nearly identically to a mechanical ventilation system (it provides pre-heated ventilation air on winter days and pre-cooled ventilation air on summer nights). The ETM employs a "normally closed" damper system, which in the case of power failure or other failure isolates the system from the home: the unit reverses to an idle mode with the blower off and the dampers isolate the system from the home. In the worst case, the home loses the mechanical ventilation supplied by the ETM.

Design and Materials: The design of the ETM is very similar to that of conventional air handlers¹. The ETM employs a highly efficient and reliable European motorized impeller rated at over 35 thousand hours MTBF (mean time between failure), which is over 20 years of service in standard operation. This unique motor design affixes the rotor (the motor shaft) and spins the outer motor housing. It increases the bearing surface area by over 300% which reduces wear and provides an extremely smooth and accurate spin. Unlike motors designed for standard air handlers which are designed for 77 °F air, the ETM's special blower has been designed to operate with air temperatures of 155 °F on a standard basis and as high as 200 °F on an intermittent basis.

To promote efficient heat transfer to the water-heating system, the ETM incorporates a standard 3-row hydronic coil. This type of coil is extremely reliable and is commonly found in residential and commercial air handlers with 20+ year operating lives. The coils utilize a generous 11 FPI fin spacing that is highly resistant to clogging and requires no maintenance cleaning.

¹ For example, those made by Carrier, Lennox, Magic Air or First Company



Echo does not interfere with normal water heating

Echo provides water heating that is supplemental to the operation of the regular water heater. On those days when there is no solar energy available for water heating, or in the case of a system failure, the regular water heating equipment is still in place to carry the full water heating load of the home.

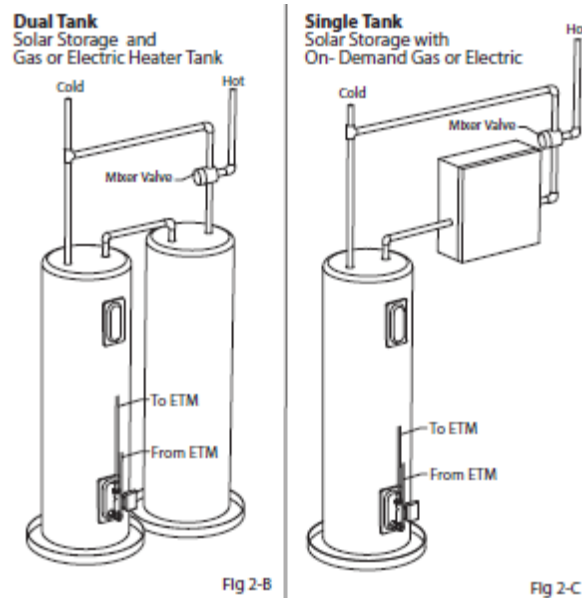
Design and Materials: The methods of connection, and the components used for water management, are identical to those used by standard solar water heating systems. Modern solar water heating practice and components have been proven “tried and true” through decades of use and thousands of installations (approximately 25,000 systems are sold annually in the US and approximately 300,000 are sold annually in Europe). The **Echo** solar system uses top quality Grundfos circulating pumps and Rheem storage tanks. Both companies have 50 plus year records of performance in the building trades.

Where electric water heating is used:

The Rheem solar storage tanks used in the system come standard with a 4.5kW heating element in the upper portion of the tank. This element is identical to those used in standard electric water heaters. If in any case the solar system fails, or there is no solar contribution, this heating element is capable of carrying the full water heating load for the home *with exactly the same performance as a standard electric water heater*. Tank life is subject to the same conditions as a non-solar tank and lifetime is dependent on water quality.

Where gas water heating is used:

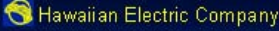
The system works with either traditional storage type gas heaters or tankless gas water heaters as shown below.



In standard operation the system provides pre-heated water to the backup gas heater at temperatures which range from 80-125 F. If the system fails, the standard gas backup heater is capable of supplying the full water heating load to the home without a solar pre-heat.



Extensive reliability data for these solar water heating components has been assembled by the Hawaiian Electric Company (HECO) and is illustrated in the figure below. Of the more than 27,000 systems installed over the 8-year period by HECO, the failure rate of the tanks and pumps was approximately 0.1% with an estimated product lifetime of 10-15 years.



Warranty Claims (1996-2004)

	<u>Equip.</u>	<u>Claims</u>	
Collectors	~40,000	63	0.16%
Tanks	~27,000	21	0.08%
Pumps	~27,000	38	0.14%
Controllers	~25,000	36	0.14%

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Advanced controls ensure proper system commissioning and rapid repair

Every **Echo** solar system employs a robust embedded system controller that carries a full ETL product listing and certifications. The controller enables the optimization of energy production and advanced system functions, including real time performance monitoring.

The controller also enables on-site system commissioning and provides on-going remote diagnostics capabilities. This ensures that every system is fully functional from ‘Day 1’ and any issues that might develop over the life of the system are identified immediately and accurately.

On-Site System Commissioning and Diagnostics: We provide our installation crews with commissioning terminals that connect to the system controllers on site and allow them to run through a 15-minute diagnostic sequence to ensure the system is working at 100% capacity. It is during this sequence that all the sensor inputs are verified and mechanical systems are physically cycled to ensure efficient operation and flow rates within the design parameters.

Remote Diagnostics: The controller communicates with PVT Solar enterprise servers which record and store all operating parameters at 15-minute intervals. This data is used to remotely identify and diagnose systems for under-performance or failure. Normally this type of capability exists only for high-end commercial building systems but our controllers and enterprise systems enable it to be applied cost effectively on residential homes.