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The First Heat Pump Water Heating System in Hawaii

In 1978, the Hawaiian Electric Company (HECO) proposed that Westinghouse Electric Corporation modify the design of their "Templifier" industrial heat pump water heater so that it could be used to provide potable hot water for service water heating applications in hotels, hospitals and multi-unit apartment buildings.

HECO also arranged for a Westinghouse representative to make a formal presentation at a Pacific Coast Electrical Association Conference in Hawaii and to meet with various contractors and utility customers with large water heating loads. In addition, HECO identified other potential equipment suppliers and encouraged local distributors to become familiar with this emerging technology.

The timing was very fortunate because in 1980 over 90% of Hawaii's energy came from imported oil and, for this reason, the 1979 oil embargo was having a devastating effect on the cost of electricity, utility gas, bottled gas and fuel oil in HECO's service area. (There is no natural gas in Hawaii – Utility gas is manufactured from imported oil.)

Hotels, apartment buildings and hospitals were desperate to find ways to control their energy costs. As a result, a number of local contractors became active in the field.



By 1994, over 600 commercial-size heat pump water heaters were installed in Hawaii. The two heat pump water heating pioneers in Hawaii were a 12-story, 260-unit retirement residence and a 428-unit, high-rise apartment condominium. The chairman of the board at the retirement residence was a retired mechanical engineer, and the manager at the other project had an aerospace background. They both understood the principles of heat pump technology and believed that the potential savings justified the risk. HECO worked closely

with the professional engineers retained by the retirement residence and was also with the energy service contractor who prepared the proposal for the 428-unit condominium, to insure that these customers were comfortable with the proposals that were developed for these two projects.

Both of these were water source heat pumps designed to extract waste heat from the buildings' cooling tower and recycle this energy for water heating purposes. The heat pump at the retirement residence recorded first year's energy cost savings equal to 51% of its installed cost. The unit at the high-rise apartment condominium realized first year's savings that were 72% of its installed cost.

heaters could be directly compared with the savings that appeared on the customers' gas bills.

HECO then looked for opportunities to publish the results of these recorded heat pump water heating case histories and at the same time to submit this information and data for peer review.

For many years, the State of Hawaii offered a state a state energy tax credit to homeowners and businesses who installed solar water heaters. This tax credit was modeled after the federal tax credit that was in effect at that time.

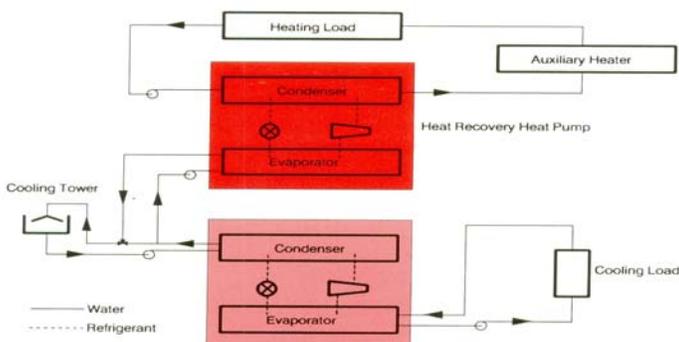
There are three basic types of heat pumps now operating in Hawaii: water-to-water heat pumps, air-to-water heat pumps, and high-lift lead chillers.

1. **Water-to-water heat pumps** are usually applied in conjunction with existing central air-conditioning. These heat pumps simply recycle the waste heat from the air conditioning chiller's condenser that was previously vented by the building's cooling tower. In most cases these water-to-water designs have improved the operation of the building's existing air conditioning system.
2. The **air-to-water heat pumps** are the most common variety used in Hawaii. They are self-contained systems utilized whenever supplies of waste heat from existing air conditioning or refrigeration equipment are not available. Hundreds of these systems have been installed in projects ranging from the Banyan Tree Plaza and Nuuanu Brookside to 1717 Ala Wai Canal, the Canal House and many others.
3. **High-lift lead chillers**, the third type of heat pump have been installed in both the Ilikai Hotel and the Mahana condominium on Maui. These heat pumps extract the waste heat directly from the air conditioning system's chilled water loop and deliver this energy directly to the building's hot water system.

In this design, both ends of the lead chiller's refrigeration cycle are used simultaneously, this arrangement represents the ideal case and is often specified as original equipment in new hotels.

HVAC Engineers and contractors who pioneered in the design and construction of these heat pump water heating projects included Fred Kohloss, Ben Botkin, Van Darrow, Duane Hartmann, Shannon Dickson and The Cody Company.

Heat Recovery Heat Pump Systems



Large heat pump water heater installations can cost several hundred thousand dollars to install. Before a customer is willing to commit that amount of money, assurance must be given that the concept is valid and that the vendor's estimate of the energy cost savings and estimated return of investment is supported by sound historical data. In order to verify the performance of these new water heating systems, HECO arranged for the permanent installation of sub-meters on two dozen of these early heat pump installations. As a result, the actual energy (kWh) requirements of these new heat pump water