Redding, California

Summer indoor Heat Pump Water Heater installed in installed in two existing homes in Redding, California in a hot-dry climate, monitored and evaluated by the Alliance for Residential Building Innovation.

Key facts

Building

Location	Redding, California
Heat distribution	Air conditioning cooling
Heated area	189 m² (3 story)
	254 m² (2 story)
Level of insulation	minimal

Heat pump and source

Number of heat pumps	2
Installed capacity	2.5 kW
Operation mode	Electric element 4 kW
Heat source	indoor air source
Brand and type:	Air Generate
	66-gallon ATI66 model for Site 1
	80-gallon ATI80 for Site 2
Refrigerant	R410A
Sound level	48 dB

Heating system

Heat demand	kW
Heating temperature	°C

Domestic hot water

Type of system	air source monobloc
Max. Temperature	50 °C
Circulation system - individual	
Legionella measures	thermal
Storage size	300 and 364 litres
Number of storage tanks	2
Storage losses	
Temperature control	in tank

Other information

Electric energy
Consumption year kWh

Investments costs: The installing contractor in Redding indicates typical incremental costs of $1,800 relative to an electric storage retrofit.

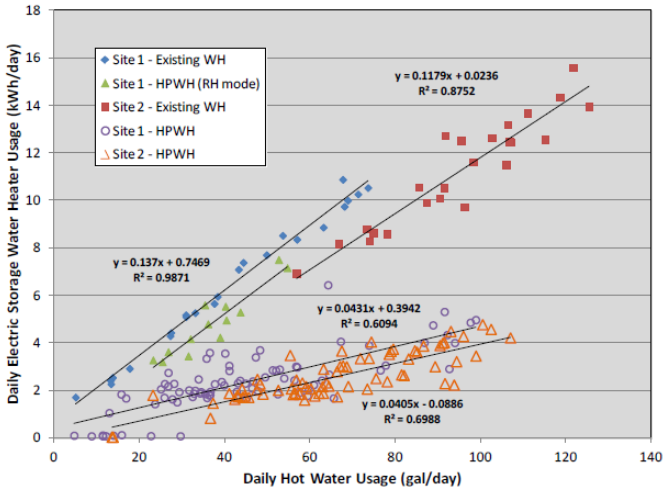
Experience

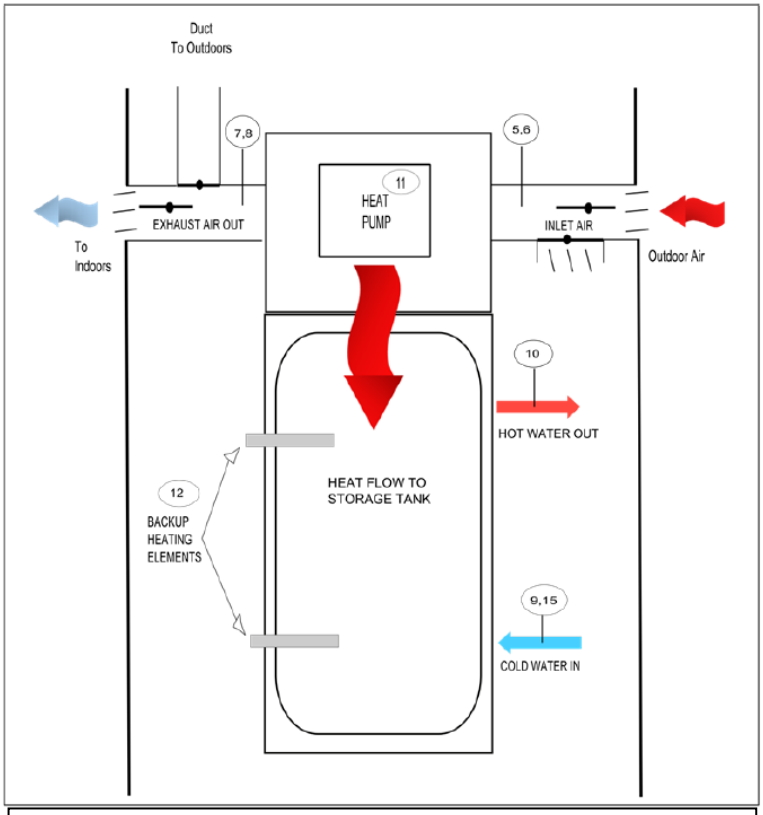
For more information, see the Building America report '[Summer Indoor Heat Pump Water Heater Evaluation in a Hot-Dry Climate]', Marc Hoeschele and Matthew Seitzler, Alliance for Residential Building Innovation

Much of the prior work on ducted Heat Pump Water Heaters (HPWHs) focuses on cold climates or hot-humid areas. To meet the end-of-year project completion constraints, this study evaluated only summer performance of indoor HPWHs installed in two existing homes in Redding, California. Redding is located in a hot, dry region of the state with more than 2,000 annual cooling degree days and 2,827 heating degree days. The existing electric storage water heaters in the two homes were monitored in detail over a four-week period, followed by the HPWH retrofit in late May 2013. The monitoring included detailed flow and temperature readings at the water heater (at both the water- and air-sides for the HPWH), indoor and outdoor conditions, and space-cooling energy consumption.

Customer satisfaction with the installed HPWHs was generally high with both households valuing the cooling delivery indoors. In addition, one site (a six-person household) strongly noted improved hot water delivery characteristics relative to their prior electric-storage water heater.

Redding, California, Technical details





Schematic of ducted HPWH configuration and monitoring points

Description of the technical concept

Summer results indicated favourable water heating performance—2.60 to 2.85 average coefficient of performance (COP)—and average monitored space cooling delivery from the HPWH in the range of 3.51 to 4,98 KWh/day per day. A combination of high space cooling energy use at the two sites, along with fairly strong variability in cooling usage, made it challenging to resolve the small HPWH cooling benefit from the monitored cooling system energy use. However, given the observed patterns of cooling operation at the two sites and the measured HPWH delivered cooling, annual space cooling energy savings of 121–135 kilowatt-hours (kWh) per year are projected. These savings increase the annual estimated HPWH energy savings by 5-9%.

Even in a very hot climate such as Redding, California, the ability to utilize the space cooling benefit from the HPWH was found to be highly variable. One site, with 50% higher hot water loads than the second site, was expected to generate greater cooling benefit. However, higher cooling thermostat setpoints at that site and an improved thermal envelope resulted in about 1/3 fewer days during the summer when the air conditioner operated. The net effect was that the site with less HPWH operation generated greater cooling benefit in offsetting actual air conditioning use.

A key consideration for indoor HPWHs is noise. Many manufacturers have paid attention to this issue and deliver products that are quiet. There were no homeowner concerns about noise from the two field test sites with indoor HPWHs.

Water heating savings of 59–61% are projected relative to a standard electric storage water heater. These savings are significant and would provide simple paybacks in the 6.2–8.8 year range. In California, relatively inexpensive natural gas and high electric rates makes competition against natural gas challenging. Local rates and available incentives will change the economics.

A good resource on HPWHs is the Building America report, Measure Guideline: Heat Pump Water Heaters in New and Existing Homes.