

Technical Assistance: Pool Heat Pump Strategies



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Introduction

This technical guidance is directed at pool contractors, architects, educators, and program staff at relevant agencies, authorities having jurisdiction, and community choice energy programs. This guide is most appropriate for the single-family residential market, and touches on equipment sized for large pools only briefly.¹

This guide includes the results of interviews with four Bay Area swimming pool contractors who install heat pumps, including the products they sell and best practices for designing with heat pump

pool heaters. This guide draws from product documentation to identify the best products for Bay Area climates.

While common world-wide and regionally in the U.S. (e.g. Florida, Hawaii), heat pump pool heaters are a growing market in the Bay Area due to the ~1% adoption of all-electric new construction in California from 2010-2019, according to SCE's internal review of building permits.² As of spring of 2021, many Bay Area cities have adopted prohibitions or Code-based discouragements on installing natural gas infrastructure, making it necessary to provide technical assistance to designers who are supporting new construction of swimming pools.

Pool Heat Pump Contractor Perspectives

They are simpler: Heat pump pool heaters are relatively new to most contractors on the market in the Bay Area, but a common consensus is that heat pump pool heaters are simpler to install than gas pool heaters in new single-family construction because of the challenges of running gas lines compared to the simplicity of running a 40-Amp electrical wire in residential settings.

They work well: Heat pump pool heaters work well year-round, they can do both pool heating and pool cooling, and Hayward and AquaCal are the locally favored brands due to their contractor technical support. AquaCal is especially favored for integration into automatic pool covers. The AquaCal HeatWave SuperQuiet lives up to its name and is especially quiet. Large outdoor pools that are kept warm during the winter can use multiple standard heat pumps that are designed to be integrated together to meet the higher heating demand. Generally, these are plumbed in parallel, with a logic system for automation such as Hayward Omnilogic^l, and no storage tank.



They cost less to operate: Heat pump pool heaters save pool owners on their utility bills compared to gas because they collect 5 or more units of heat for every 1 unit of electricityⁱⁱ, while gas pool heaters use 6 times as much energy, collecting only 0.8 to 0.9 units of heat for every 1 unit that is burned. See cost calculations in the Appendix for further detail.

¹ Larger pools require larger equipment such as the [Great Big Bopper](#), or combining multiple residential units sized appropriately and compatibly.

² SCE internal review of over 200,000 CF-1Rs, 2-Rs and 3-Rs, determining that only 1% were all-electric.

Winter pools should be paired with efficiency measures: Pool covers dramatically reduce heat loss, and contractors also advocate for automatic pool covers. Floor return lines, which prevent stratification (cold water at the bottom of the pool and hot water at the top) are common in older pool designs and are an important efficiency measure. See the schematic in the Appendices.

More skilled contractors are needed in the pool industry: EPA 608 Technicianⁱⁱⁱ Certification is recommended for pool contractors to service the refrigeration components of heat pump pool heaters, and indicates a level of training similar to HVAC professionals. There are workarounds, including partnering with an HVAC professional who has the certification, but that can add additional delays to the repair due to scheduling. EPA 608 is not necessary to install most new construction heat pump pool heaters, but is important to properly service the refrigerant lines or compressor over the course of its life.

Warranties

Most pool contractors will warranty their labor for longer than a year if they are able to be a part of the entire pool installation process, from digging the pool to the final check. This criterion allows the contractor to be more involved and to be sure that all aspects of the work – techniques, parts, and brands used onsite are to their internal specification. Automation of pool systems - which allows them to work on a schedule and for two heat pump units to work together - is much less expensive and but time-consuming to design when working within one manufacturer. Warranty information is provided in Table 1: Selected companies that responded to requests for a pool heat pump installation quote. for a set of pool heat pump contractors, and Table 2: Selected Standard Warranties by Manufacturer. "Parts" as a category includes refrigeration components, which require EPA 608 Technician to replace. for a set of pool heat pump manufacturers.

Table 1: Selected companies that responded to requests for a pool heat pump installation quote.

Company Name	Phone Number	Warranty Offered	Will they also service from the Manufacturer warranty?
Pacific Radiant Heat ^{iv} 1039 Goettingen St, San Francisco, CA 94134	(415) 378-4334	1 Year warranty on Installation (includes materials)	Yes
Canderle Pools ^v 2803 Cabrillo Ave, Santa Clara, CA 95051	(408) 243-1989	1 Year warranty on Labor	Yes
Hill's Pool Service ^{vi} 23 Edwards Ct, Burlingame, CA 94010	(650) 342-2484	1 Year warranty on Labor	Yes
Excel Pool & Spa ^{vii} 1924 Plymouth St, Mountain View, CA 94043	(650) 961-5888	90 days Labor Warranty	Yes

Table 2: Selected Standard Warranties by Manufacturer. "Parts" as a category includes refrigeration components, which require EPA 608 Technician to replace.

Heat Pump Pool Heater Warranty Periods				
	Product	Parts	Compressor	Labor ³

³ On Labor warranties, the installing contractor's time is paid for a set amount of hours based on what needs to be fixed.

AquaCal	Heatwave SuperQuiet ^{viii}	2 Years	10 Years	2 Years
	TropiCal ^{ix}	2 Years	7 Years	2 Years
	Great Big Bopper ^x (Community Pool-sized)	2 Years	5 Years	2 Years
Hayward	HP50A, HP50HA	1 Year	2 Years	1 Year
	HeatPro	2 Years	5 Years (Labor for first 2)	1 Year
Raypak	Crosswind Series	2 Years	Included in parts.	1 Year
	Models 2450, 3450, 4450, 5450, 6450, 8450 Professional Series Models PS9350, PS9353, PS10353, PS10354, PS10355	7 Years	Included in parts.	2 Years
Pentair	Ultratemp Heat Pumps	2 Years	10 Years	2 Years
Gas Pool Heaters for Comparison				
Hayward Gas units	H150FD, H200FD, H250FD, H300FD, H350FD, H400FD & H500FD	1 Year	N/A, Gas Unit	1 Year
Raypak Gas units (low NOx)	106, 156, 206A, 266A, 336A, 406A, 207A, 267A, 337A, 407A	2 Years, 1 Year if not Single Family	N/A, Gas Unit	2 Years, 1 Year if not Single Family
Pentair	ETi [®] 400 High-Efficiency Heater	3 Years	N/A, Gas Unit	3 Years
AquaCal	Does not manufacture gas heaters.	N/A	N/A	N/A

Sizing

To right-size a heat pump pool heater, assume the heat pump must produce **4 to 6 BTUs/Hour for each gallon⁴** of heated pool water, with higher productivity needed when the incoming water is colder in the winter. Most heat pumps are sized for industry standard sized back yard pools, which often range between 10,000 to 35,000 gallons.⁵

Right-sized heat pump pool heaters are designed to run without interruption and can modulate their heat output to match both large and small demands. By contrast, gas-fueled pool heaters will cycle on and off to maintain the desired pool temperature, particularly during summer weather when only a small amount of heat is needed to maintain the pool temperature relative to winter use.

A given month's average soil and incoming water temperatures are equal to the average of the previous month's air temperature. If the average air temperature over the course of March is 60 degrees, the average inlet water temperature in April will be approximately 60 degrees. This means that the temperature of public water sources in much of the Bay Area ranges from 50 to 70 degrees Fahrenheit over the year. A rule-of-thumb from pool heat pump

⁴ Depending on factors such as relative humidity, temperature, sun exposure, and wind speed.

⁵ For Homeowners: To find the estimated amount of water in a pool, calculate the volume of the pool in cubic feet and convert it to US gallons. One cubic foot is equal to 7.48 US gallons. Generally, you can take the average of the shallowest and deepest depths, i.e. $(3 + 8) / 2 = 5.5$ feet. For more complicated pool shapes, use methods found [here](#).

manufacturers is that a well-sized pool heat pump can raise and maintain water temperatures at most 30 degrees above the source water temperatures. This guideline provides us a maximum **wintertime** pool water temperature of between 80 to 88 degrees in most of the Bay Area, which is sufficient for most pool owners.

Aquacal provides an excellent heat pump pool heater sizing estimator that also performs cost-of-use estimates: <https://www.aquacal.com/sizing-and-savings-calculator/>

Recommended Residential Heat Pump Pool Heater Products

The products in Table 3 have been vetted by contractor interviews. The lowest operating outdoor temperature specification is based on our conversations with manufacturers and has not been verified by the Air Conditioning, Heating, and Refrigeration Institute (AHRI) or other third-party testing programs, and operating any pool heater (including gas) below freezing will produce inconsistent heating and reduced efficiency results.

The key technology involved in heat pump operation at low temperatures is pairing an **inverter** with the compressor, which allows the compressor to operate at multiple speeds depending on the output needed due to environmental conditions. Inverter-compressor units are often called “Variable Speed” or “VS”. Pairing two of the same unit increases the total pool volume that the system can handle, and good design allows the heat pumps to communicate with each other for greater efficiency. Communication with the power grid is

Table 3. Recommended Residential Heat Pump Pool Heaters.

	AquaCal HeatWave SuperQuiet SQ166R ICEBREAKER 	AquaCal Heatwave SuperQuiet Variable Speed SQ150VS 	Hayward HeatPro VS Variable Speed 	Pentair UltraTemp 110 Heat Pump 
Unit Price	\$4,800	\$5,700	\$3,000	\$3,270
Heating Capacity (BTU/h)	126,000	115,000	90,000	108,000
Gallons Served when one unit installed, at demand of 5 BTU/h/gal	25,200	23,000	18,000	21,600
Inverter-driven compressor	<u>YES</u>	<u>YES</u>	<u>YES</u>	<u>NO</u>
Rated COP at 47F	5.6	5.0	5.1	5.8
Lowest Operating Weather Condition	25°F Air	25°F Air	30°F Air	45°F Water

Pool Covers

It's important to inform the client or customer that using a pool cover will not only save on pool cleaning, but it will **reduce energy bills** as well.

- Using a pool cover properly can halve the pool heat pump sizing by preventing heat from escaping.
- Pick a dark-colored, solid material for improved solar heat absorption.^{xi}
- Automatic pool covers are a convenient and aesthetic option.
- A traditional, manual pool cover made of vinyl will achieve the same efficiency benefit as an automatic pool cover if used properly.



Figure 1: An automatic pool cover, the AutoGuard Under Track is made by the brand Automatic Pool Covers. Pool covers can be aesthetically pleasing and functional.

Further Resources

[How to Install a Hayward HeatPro Heat Pump Pool Heater by InyoPools](#)



[This Old House: How to Heat a Pool with an Air Conditioner](#)



Appendices and References

AquaCal Heat Pump Pool Heater Sizing and Cost Calculator Example^{xii}

The example calculations from [AquaCal's pool sizing calculator](#) compare the same size pool with three types of covering: no pool cover, a liquid blanket product ([a fatty alcohol solution](#)), and a true vinyl pool cover. This allows one to see the relative effect of different types of pool covering on the cost savings, as well as the overall cost savings of switching to a heat pump pool heater from a gas-fired pool heater.

Table 4: Report generated from the AquaCal Heat Pump Pool Heater Sizing Calculator, with the HeatWave SuperQuiet SQ166R compared against a typical efficiency gas boiler installed at a 37,500-gallon pool in San Jose, CA, with average electricity rates of \$0.30/kWh and average gas rates of \$1.20/therm used, and a full year of heating as opposed to the typical March-October season.

HEATWAVE SUPERQUIET HEATING PROPOSAL

AIR SOURCE POOL / SPA HEAT PUMPS

POOL LOCATION: Example	DISTRIBUTOR:
TELEPHONE:	TELEPHONE:
PREPARED BY: <u>Dylan Anderson</u>	FACSIMILE:
Sizing based on weather statistics for: SAN JOSE, CA	DATE: 03/12/2021

SWIMMING POOL SIZING DATA PROFILE

Pool Dimensions (width X length):	20 Ft. X 50 Ft.	Pool Surface Area:	1,000.0 Sq. Ft.
Estimated Surface Area:	1,000.0 Sq. Ft.	Pool Volume:	37,500.0 Gallons
Average Depth:	5.0 Ft.	Water Weight:	312,375.0 lbs.
Wind Conditions:	No	It takes 1 BTU to heat 1 lb of water 1° F.	
Temperature Rise Required:	30° F	Disclaimer:	Target Water Temperatures Vary Depending on the Season.
Hertz:	60 Hz		
Source Water Temperature:	N/A		
Unit Type:	HEATWAVE SUPERQUIET		

PEAK MONTH HEATING REQUIREMENTS

HEATWAVE SUPERQUIET SAVINGS

	<u>Blanket</u>	<u>Aqua Blanket</u>	<u>No Blanket</u>
Heat Loss/Day	6.0° F	9.0° F	15.0° F
BTU Req'd/Day	1,874,250	2,811,375	4,685,625
Peak Month			
	<u>Qty</u>	<u>Model</u>	<u>Qty</u>
Heat Pump(s)	1	SQ166R	1
Coldest Day			
Max Run Time	14.9 hrs	22.3 hrs	37.2 hrs

	<u>Blanket</u>	<u>Aqua Blanket</u>	<u>No Blanket</u>
1 Year			
Gas Heating Costs	\$8,000.37	\$12,000.58	\$20,000.95
AquaCal Heating Costs	\$7,051.61	\$10,577.41	\$17,629.02
AquaCal Savings	\$948.76	\$1,423.17	\$2,371.93
Savings Percent	11.86%	11.86%	11.86%
5 Year			
Gas Heating Costs	\$40,001.85	\$60,002.90	\$100,004.75
AquaCal Heating Costs	\$35,258.05	\$52,887.05	\$88,145.10
AquaCal Savings	\$4,743.80	\$7,115.85	\$11,859.65
Savings Percent	11.86%	11.86%	11.86%

ENERGY PROFILE

Natural Gas Cost Per Therm:	\$1.20
Electric Kwh Rate:	\$0.30

	<u>Blanket</u>	<u>Aqua Blanket</u>	<u>No Blanket</u>
10 Year			
Gas Heating Costs	\$80,003.70	\$120,005.80	\$200,009.50
AquaCal Heating Costs	\$70,516.10	\$105,774.10	\$176,290.20
AquaCal Savings	\$9,487.60	\$14,231.70	\$23,719.30
Savings Percent	11.86%	11.86%	11.86%

AVERAGE MONTHLY HEATING COST COMPARISON

	<u>Blanket</u>		<u>Aqua Blanket</u>		<u>No Blanket</u>		AVERAGE MONTH	Swim		LAST CLIMATE TEMP °F
	HEAT PUMP	GAS	HEAT PUMP	GAS	HEAT PUMP	GAS		HALF	HALF	
January	\$849.59	\$963.90	\$1,274.39	\$1,445.85	\$2,123.98	\$2,409.75	January	☑	☑	50.0
February	\$736.31	\$835.38	\$1,104.47	\$1,253.07	\$1,840.78	\$2,088.45	February	☑	☑	54.0
March	\$651.35	\$738.99	\$977.03	\$1,108.49	\$1,628.38	\$1,847.48	March	☑	☑	57.0
April	\$594.71	\$674.73	\$892.07	\$1,012.10	\$1,486.78	\$1,686.83	April	☑	☑	59.0
May	\$481.44	\$546.21	\$722.15	\$819.32	\$1,203.59	\$1,365.53	May	☑	☑	63.0
June	\$509.75	\$578.34	\$764.63	\$867.51	\$1,274.39	\$1,445.85	June	☑	☑	68.0
July	\$453.12	\$514.08	\$679.67	\$771.12	\$1,132.79	\$1,285.20	July	☑	☑	70.0
August	\$453.12	\$514.08	\$679.67	\$771.12	\$1,132.79	\$1,285.20	August	☑	☑	70.0
September	\$311.52	\$353.43	\$467.28	\$530.15	\$778.79	\$883.58	September	☑	☑	69.0
October	\$453.12	\$514.08	\$679.67	\$771.12	\$1,132.79	\$1,285.20	October	☑	☑	64.0
November	\$707.99	\$803.25	\$1,061.99	\$1,204.88	\$1,769.98	\$2,008.13	November	☑	☑	55.0
December	\$849.59	\$963.90	\$1,274.39	\$1,445.85	\$2,123.98	\$2,409.75	December	☑	☑	50.0
Totals	\$7,051.61	\$8,000.37	\$10,577.41	\$12,000.58	\$17,629.02	\$20,000.95				

If your pool gets too hot in the summer, AquaCal's Heat'n'Cool heat pump can also cool your pool!

This has been prepared with historical data of the past 30 years. Weather patterns will vary each year. Heat gains and costs will vary accordingly.

AQUACAL AUTOPILOT, INC. 2737 24th STREET NORTH ST. PETERSBURG, FL 33713 Phone 727-823-5642 Fax 727-821-7471

*This applies to all Liquid Blanket products

Typical Pool System Schematic

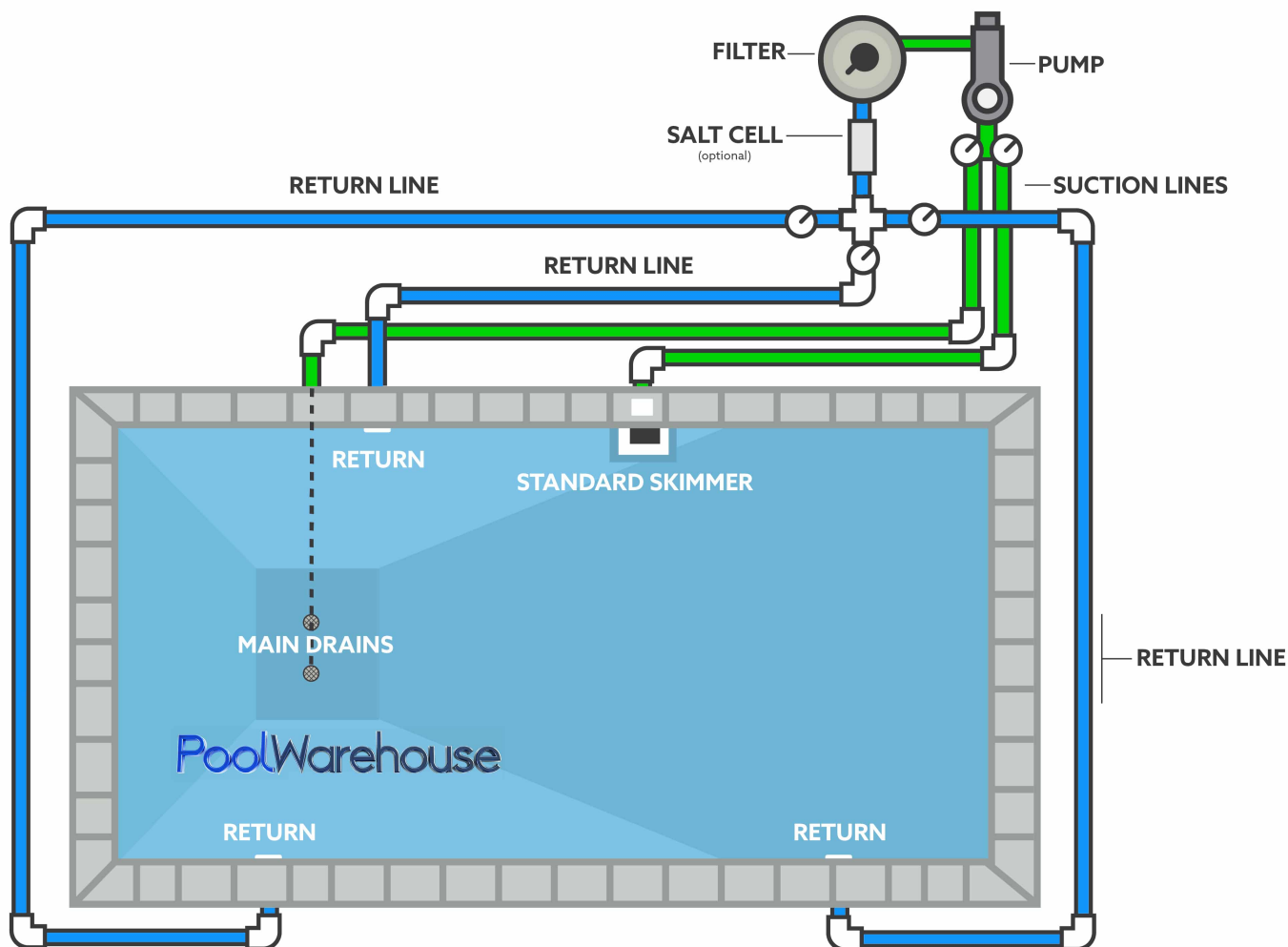


Figure 2: Schematic drawing of a pool plumbing system without a heater by PoolWarehouse.^{xiii} The pool heat pump would be plumbed in line after the filter and/or salt cell. Returns can be plumbed close to the bottom of the pool or on the floor of the pool so that the cooled water at the top of the pool sinks to the main drains and the warm water “rises” to prevent “stratification” – which means the warm water is only found at the top of the pool. Not only will this improve comfort, but it will mean that the pool is more efficiently heated.

Sites Referenced

- ⁱ <https://www.hayward-pool.com/shop/en/pools/omnilogic-i-auomni--1>
- ⁱⁱ <https://s3.amazonaws.com/AWSProd/sites/raypakcom/documents/6000.56.pdf>
- ⁱⁱⁱ <https://www.epa.gov/section608/section-608-technician-certification-0>
- ^{iv} <https://www.pacificradiantheat.com/index.html>
- ^v <https://www.canderlepoolsinc.com/>
- ^{vi} <https://www.hillspoolservice.com/>
- ^{vii} <http://www.excelpool.com/>
- ^{viii} <https://www.aquacal.com/product/heatwave-superquiet/>
- ^{ix} <https://www.aquacal.com/product/tropical/>

^x <https://www.aquacal.com/product/great-big-bopper/>

^{xi} <https://www.riverpoolsandspas.com/blog/swimming-pool-covers-the-good-the-bad-the-ugly>

^{xii} <https://www.aquacal.com/sizing-and-savings-calculator/>

^{xiii} <https://www.poolwarehouse.com/swimming-pool-plumbing-diagrams/>