

ET Summit 2024

Presented by



Pool Heating Analysis

Gas emerging technologies program (GET)



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Agenda

- Introduction
- Research objectives
- Literature review findings: pool heating technologies
- Regulatory context
- CEDARS analysis
- Subject matter expert interview findings
- Next steps and project plan

Introduction

Pool Heater Market Characterization

- About 97% of the pools in the U.S. are residential (10.4 million)
- California: second highest number of pools per state in the U.S. (1.34 million)
- Most of the pools in California are outdoors
- Typical season for swimming: May through September
- Pool heaters extend the typical swimming season and useful life of the pool and resources



[1] Swimming Pool Statistics, Report by RubyHome, January 2024.

[2] Open Pool Time, Report by Pool Research, August 2023.

[3] <https://www.energy.gov/energysaver/swimming-pool-heating-and-maintenance>

Research Objectives

- To conduct literature review of pool heating and associated alternative technologies such as gas absorption heat pumps (GAHPs), electric or hybrid, and solar pool heaters
- To analyze existing CPUC approved relevant measure packages and CEDARS claims data
- To conduct up to 5 subject matter expert interviews (SME) of technology developers and manufacturers and summarize the findings
- To update existing ICF excel based tool to incorporate GAHPs, electric or hybrid, and solar pool heaters

Pool Heat Losses

- Evaporation heat loss is one of the major contributors to overall pool heat loss (approximately 60% of total heat loss)
- Factors affecting evaporation heat loss: air temperature, wind speed, humidity, pool water temperature
- Convective heat loss- due to temperature differences between the ambient air and pool
- Solar radiation- adds heat to the pool, reducing the pool heating energy requirements
- Conductive heat loss to surrounding materials is small and can be neglected
- Typical pool water setpoint temperatures: 78°F to 82°F
- Typical pool heater size: about 250 kBTU/h for 30,000 gallons average sized pool; range between 75 to 450 kBTU/h

Pool Heating Technologies

Traditional gas pool heater

- Typical efficiencies: 82% to 90%
- Useful life: 10 years
- Costs of outdoor pool gas heating by location

Location	Season	78°F	80°F	82°F
San Francisco	6/1-8/31	\$2,126	\$2,529	\$2,954
Los Angeles	5/1-10/31	\$2,540	\$3,237	\$3,957

Note: These are heating costs for a 1,000 sq. ft. swimming pool with an 80% efficient gas pool heater at \$1.09 per therm

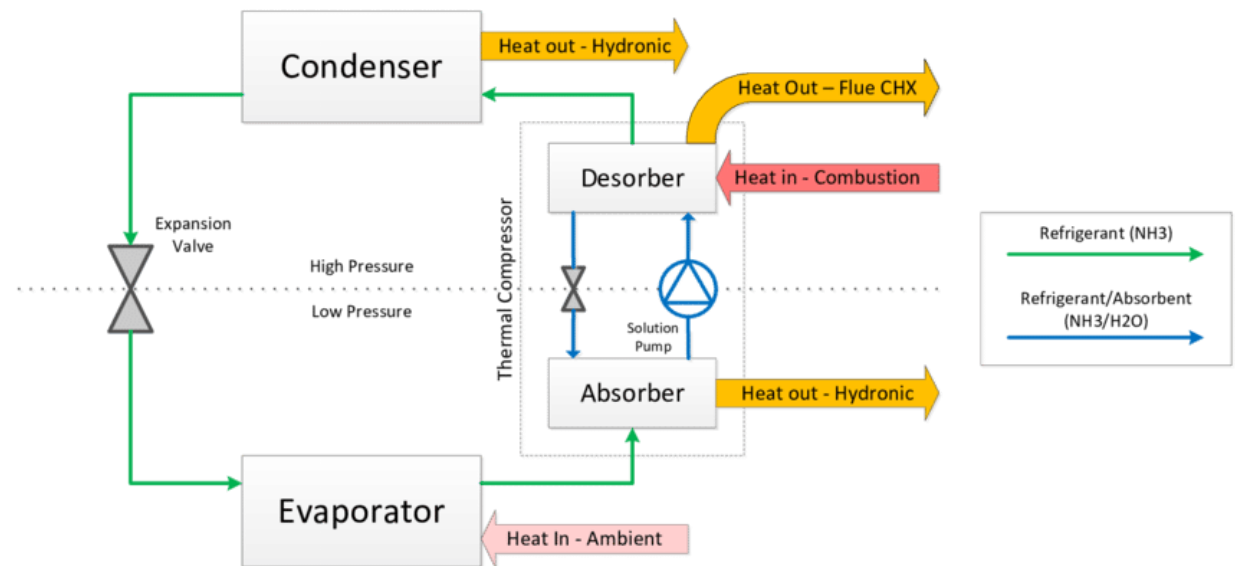
[1] <https://www.energy.gov/energysaver/gas-pool-heaters>

Pool Heating Technologies

Gas absorption heat pump (GAHP)

- Heating output between 80 kBTU/h and 123 kBTU/h depending upon manufacturer
- Electrical draw of unit less than 1 kW
- Typical COPs between 1.2-1.4
- GAHP would require external heat exchanger in the pool water loop and require outdoor installation
- Maintain high efficiencies at lower ambient temperatures
- GAHP for base loads, integration of units

Limitations: bulky, noisy, high contractor costs



[1] Gas Absorption Heat Pumps Best Practices Guide, Report by FortisBC, October, 2023.

Pool Heating Technologies

Summary of best practices: Fortis BC, 2023

- GAHPs are ideal for steady loads, compared to intermittent type loads
- Drainage required for all external units
- Approximately 6%-12% heat losses across the double walled heat exchanger
- Right sizing of GAHP is crucial in preventing short cycling of units



[1] Gas Absorption Heat Pumps Best Practices Guide, Report by FortisBC, October, 2023.

Pool Heating Technologies

Heat pump pool heater

- High efficiency, low emissions
- Relatively quiet systems, lower operating cost compared to traditional gas pool heaters
- Lower heating capacity output per unit, low speeds of heating (typically between 75 kBTU-125 kBTU)
- Reduced performance at low ambient temperatures

Solar pool heater

- don't require energy input in electricity or gas once installed
- Pool heating limited to solar energy availability
- No emissions post installation
- Glazed collectors are more suitable for cooler climates and year-round use
- May not be able to handle peak loads

Hybrid pool heater

- Combine the benefits of both gas and electric technologies
- Switching based on efficiency and ambient air temperatures

[1] <https://www.energy.gov/energysaver/heat-pump-swimming-pool-heaters>

[2] <https://www.energy.gov/energysaver/solar-swimming-pool-heater>

Regulatory Context: Pool Heaters

- CA Title 20 requirements: minimum efficiency requirement of gas fired pool heater is 82%
- Heat pump pool heaters must have an average COP at both standard and low temperature rating of minimum 3.5
- No regulations in place for GAHPs or hybrid pool heaters
- South Coast AQMD 1146.2 rule: any heater with input capacity less than or equal 400 kBTU/h is subject to zero NOx and CO emission limits as per Phase II compliance schedule (January 1, 2028, for new buildings and January 1, 2031, for existing buildings)

[1] <https://www.energy.ca.gov/rules-and-regulations/appliance-efficiency-regulations-title-20>

[2] Rule 1146.2 Details, Report by South Coast Air Quality Management District.

CEDARS Analysis

- Analysis of 4 existing measure packages related to pool heaters
- Pool and spa heaters in residential buildings (84% TE) accounted for 98% of the claims
- Residential: claims for pool heater only
- Commercial: claims for pool covers as well
- Split up of measure packages in 2023 into 4 subsets by sector, pool location, and efficiency

Year	Number of Claims Made	Measures	Offering	Com	Res
2020	3,166	SWRE001A	Outdoor Pool Cover	10	-
		SWRE003A	Commercial Pool and Spa Heater	21	4
		SWRE004A	Pool & Spa Heaters in Res Bldgs - 84% TE		3,119
		SWRE004B	Pool & Spa Heaters in Res Bldgs - 90% TE		12
2021	4,513	SWRE001A	Outdoor Pool Cover	25	-
		SWRE001B	Indoor Pool Cover	1	-
		SWRE003A	Commercial Pool and Spa Heater	70	4
		SWRE004A	Pool & Spa Heaters in Res Bldgs - 84% TE		4,407
		SWRE004B	Pool & Spa Heaters in Res Bldgs - 90% TE		6
2022	3,145	SWRE001A	Outdoor Pool Cover	52	-
		SWRE001B	Indoor Pool Cover	1	-
		SWRE003A	Commercial Pool and Spa Heater	26	-
		SWRE004A	Pool & Spa Heaters in Res Bldgs - 84% TE		3,066
2023	2,622	SWRE001A	Outdoor Pool Cover	21	-
		SWRE003A	Commercial Pool and Spa Heater	2	-
		SWRE003C	Commercial Pool and Spa Heater, Outdoor - 84% TE	30	-
		SWRE003E	Commercial Pool and Spa Heater, Outdoor - 94% TE	3	-
		SWRE003B	Commercial Pool and Spa Heater, Indoor - 84% TE	1	-
		SWRE004A	Pool & Spa Heaters in Res Bldgs - 84% TE		2,556
		SWRE004B	Pool & Spa Heaters in Res Bldgs - 90% TE		8
		SWRE005B	Heat Pump Pool Heater, Residential, Fuel Substitution	-	1

[1] <https://www.caetrm.com/dashboard/>

Subject Matter Expert (SME) Interview Findings

- Most of the pool heaters used are traditional gas pool heaters
- No GAHP units have been installed for heating pools
- Savings of 30%-50% are possible by installing pool covers
- One of the barriers in implementing GAHPs for pools: lack of customer awareness, installer training, and high contractor costs
- Residential solar pool heating technology doesn't have a federal tax credit

Number of organizations contacted	Number of organizations that responded	Target number of interviews	Actual participation	Response rate	Participation rate
10	6	5	5	60%	83.3%

Note: Organizations consisted of product manufacturers, utility, and pool maintenance specialists.

Next Steps and Project Plan

- Hourly analysis of energy consumption, costs, and GHG emissions for 16 climate zones in California
- Parametric analysis- analyze the impact of several parameters such as pool size, pool heater size, activity factor, wind speed, solar shading factor, pool water temperature setpoint and utility rates
- Cost effectiveness evaluation of pool heating technologies in selected climate zones of California (TRC/TSB)
- Scheduled analytical ET project completion: Q4 2025
- Plan to install GAHP unit for pool heating application (multifamily or small commercial sector): anticipated field study kickoff around Q1 2025

This project was conducted through the ICF implemented, SoCalGas administered California Statewide Gas Emerging Technologies Program.

The project report can be found on cagastech.com
For more information, contact get@caenergyprograms.com

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