# DR18.03 – Connected Pool Pump Market Assessment

# **OPPORTUNITY**

#### WHAT IS THE PURPOSE OF THIS PROJECT?

The purpose of this project was to conduct a CPP (CPP) Market Assessment to better understand the market potential for the flexible control of residential pool pumps. This report is an interim deliverable incorporating a literature review of previous pool pump demand response (DR) programs, an assessment of current pool manufacturer technologies, and a characterization of the pool pump supply chain. Also included is an estimation of the flexible resource potential of residential pools in SCE territory. The complete scope of work (SOW) also includes a field-testing component where equipment will be purchased, installed and tested at four residential pools in Southern California Edison's (SCE) territory. The final deliverable will be a completed market assessment report to be published in Q4 of 2020, including descriptions of field installations and next steps to realize the opportunity from CPPs.

#### Background

In the early 2000s, in response to the energy crisis, California utilities and the California Energy Commission (CEC) began exploring residential pool pump energy efficiency opportunities that ultimately resulted in the development of energy saving variable-speed pumps up to 4 horsepower (HP) for residential size pools. Since then, energy efficiency efforts throughout the country have moved much of the pool pump market from single-speed to variable-speed through incentive programs, state level efficiency standards, and a national pool pump efficiency standard set to take effect in on July 19, 2021. This new Department of Energy (DOE) national standard will effectively require all in-ground pool pumps over roughly 1 horsepower to be variable-speed, significantly expanding the number of variable-speed pool pump motors sold in CA that will require variable-speed capability for all replacement pool pump motors are currently under consideration at DOE.

Starting in 2016, as the national saturation of variable-speed pool pumps grew, many pool pump and replacement motor manufacturers began offering connected capabilities for their variable-speed pool pumps and motors where users can change motor speed, flow, turn on/ off, modify schedules, and control auxiliary loads instantaneously through a Wi-Fi or other remote connection, creating a significant opportunity for load flexibility.



Figure 1: Past and Future of Pool Pump Technology

This opportunity is significant in SCE territory as each residential in-ground pool may have up to 1.3 kW of year-round flexible load. There are an estimated 486,000 residential in-ground swimming pools in SCE territory and 1.2 million in California, each with at least one filtration pump between 1-4 HP. With new connected capabilities now available on the market, in-ground variable-speed pool pumps alone (excluding above-ground pool pumps) have a significant opportunity to become a flexible distributed energy resource (DER) with up to 750 MW of technical potential in SCE territory.

# **TECHNOLOGY**

#### WHAT IS THE TECHNOLOGY?

According to the U.S. Environmental Protection Agency (EPA) ENERGY STAR® program a "CPP" must have smart grid functionality involving the capability to receive, interpret, and act upon certain types of control signals. Additionally, more consumer-oriented features must also be included, such as the ability to report energy consumption data, operational statuses, adjust pump/user settings, and transfer messages. This Market Assessment explores CPPs extensively, however, it is important to understand that CPPs build upon two decades of pool pump efficiency innovation, much of which occurred in California.



Figure 2: Pentair Intelliflo pool pump with CTA-2045 modular communication standard.

# **APPROACH**

#### WHAT WAS THE EVALUATION APPROACH?

The Market Assessment is divided into three activities:

Activity 1: Literature Review. This literature review examined the publicly available pool pump DR emerging technology studies, active pool pump DR programs, and pilot programs using pool pumps as a flexible resource in California, the United States and internationally. The purpose is to analyze previous and current efforts in this field to help inform how new connected variable-speed pool pumps can create a significant year-round, flexible load resource for SCE. This activity has focused on lessons learned regarding tested communication protocols, connectivity issues, customer acceptance, and flexible load capacity.

Activity 2: Technology Assessment. Between 2016 and 2018, many pool pump and pool pump motor manufacturers began offering affordable connected capabilities for their variable-speed pool pumps. These technologies allowing homeowners, service technicians and/or manufacturers to change motor speed, flow, turn on/off, modify schedules, and control auxiliary loads instantaneously through a Wi-Fi or other remote connection. This section explored the commercialization status of CPP, and the communication standards,

protocols, and languages currently being employed by different manufacturers or those which may be appropriate for pool pumps.

Activity 3: Supply Chain and Market Potential. The supply chain and market assessment research activity focused on the CPP DR market potential in SCE territory. It explored and quantifies pool pump equipment stock and shipments, distribution channels, and other market factors unique to the Southern California pool market. Additionally, based on upcoming DOE national standards and other available data, this review discusses the technical connected-DR potential, use cases, business models for deployment and utility intervention strategies. The technical flexible demand potential for common backyard in-ground pool pumps is large, at nearly 750 MW in SCE territory. However, realizing this potential is a function of appropriate market interventions and consumer protections to create a strong value proposition for customers and other market actors in the supply chain.

## FINDING

#### WHAT WERE THE MAJOR FINDINGS?

The findings from this project are broken out based on the three activities:

### **Activity 1: Literature Review**

- Since 2008, SCE and San Diego Gas & Electric (SDG&E) have sponsored four emerging technology studies examining various aspects of DR related to pool pumps. One key finding is that the efforts to date have not researched pool pumps to utilize excess supply on the grid, only to shed load.
- A fifth study completed in 2018 and conducted by the National Renewable Energy Laboratory (LBNL) tested pool pumps, among other products, in a laboratory setting and did explore the potential to employ pool pumps for excess supply.
- Pool pumps have been used in demand response and load management for many years, most prominently in Florida which, behind California, has the largest pool market in the country.
- There are numerous pilot programs focusing on using pool pumps as a more flexible demand-side management resource. Examples include Marin Clean Energy's Demand Response Pilot and Australia's "Pooled Energy" Intelligent Pool Control System Pilot.

## Activity 2: Technology Assessment

- A new Title 20 efficiency standard is set to take effect in 2021. This new national standard will require all pool pumps to meet a Weighted Energy Factor (WEF) requirement which, for most self-priming pool pumps will effectively require variable-speed capabilities.
- As of 2018, at least four major manufacturers offered CPP systems that are designed for a typical residential in-ground pool: Hayward, Pentair, Jandy, and Century Motors (replacement motors only).
- There are two established communication specifications/standards currently being used or considered for use in this market. The first is the ENERGY STAR Connected Product Criteria optional standard. Second, the Electric Power Research Institute (EPRI) TA-2045 modular communication protocol for pool pumps. The specifications are similar in several ways and there are ongoing efforts to align these standards.
- To-date, the pool pump market has focused on enabling communicating with three communication pathways: 1) Radio Frequency (RF) to Internet; 2) Wired Ethernet; and 3) Wi-Fi.

## **Activity 3: Supply Chain and Market Potential**

- The main SCE residential pool pump equipment types include Self-Priming Pool Pumps, Non-Self-Priming Pool Pumps, Pressure Cleaner Booster Pumps, and Waterfall Pumps. Self-Priming Pool Pumps have the largest stock in SCE territory and are market-ready for DR and represent a majority of the technical-connected load potential, at roughly 750 MW.
- There are multiple distribution channel influencers who impact the selection of replacement pool pumps and motors such as pool builders, supply stores, online retailers, and maintenance coordinators.
- With few technical or operational constraints, CPPs have the potential to be a valuable flexible DR resource. Based on the definitions created by LBNL, CPPs have the potential to provide three of the four types of DR: Shape, Shift, and Shed.
- There are several market intervention strategies which could create the incentive for residential CPPs, including economic signals and technology incentives such as: load increase program, TOU rates, critical peak pricing, flexible ramp products, and proxy demand response source.

The full findings are based on the report "DR18.03 – Connected Pool Pump Market Assessment" which is available at <u>www.dret-ca.com</u>.