PIRANHA™ WASTEWATER HEAT RECOVERY

Incubatenergy Labs 2020 Pilot Project Report

SHARC ENERGY SYSTEMS

Startup

SHARC Energy Systems

EPRI ELECTRIC POWER RESEARCH INSTITUTE

Host

EPRI

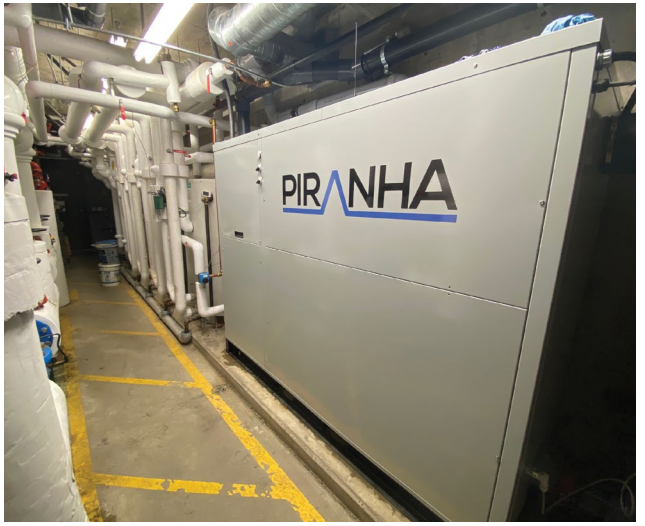
Technology Solution

Rising climate change awareness and new government laws, regulations, and incentives that focus on cutting carbon emissions are positioning cleantech and green building innovations as very relevant in the residential and commercial building sectors. Just as exhaust air from buildings is run through heat-recovery ventilators, wastewater represents a potential contributor to energy and cost savings. Thermal energy sources may include black and gray water, laundry effluent, sanitary sewers, lift stations and treatment centers, and steam condensate.

The SHARC pilot was designed for field demonstration of Piranha technology, which supplies domestic hot water by capturing and reusing heat contained in wastewater. Thermal energy is extracted from wastewater and transferred to a refrigerant using an electric heat pump and direct expansion heat exchanger that enable high-efficiency operation year-round, in any climate.

The Piranha T10 HC model also integrates cooling capabilities for simultaneous delivery of up to 100% of domestic hot water needs throughout the year, plus supplemental space conditioning. The system can provide significant energy cost savings to customers while avoiding consumption of gas or other fossil fuels and, consequently, greenhouse gas (GHG) emissions.

Challenge: Customer and Community Engagement

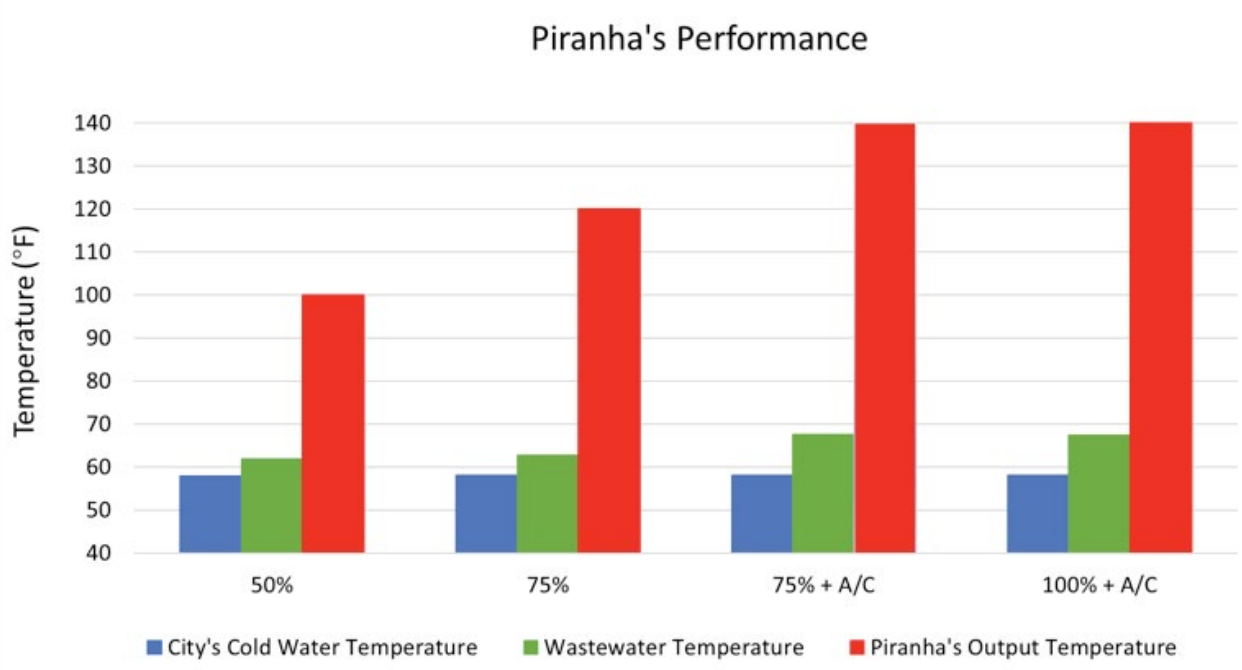


Installed Piranha T10 HC system

Project Overview

This project's objectives were to assess the performance of a Piranha T10 HC system, with a heat capacity of 120,000 Btu/h, relative to its impact on building energy use and GHG emissions; and to evaluate its cost-effectiveness as an energy storage and load management resource for utilities. The SHARC team coordinated with EPRI and interested utilities—including Ameren, AEP, Con Edison, SCE, and TVA—to develop a test plan.

The site chosen to perform the study was the Seven35 Building, a 60-unit multi-family complex with a variety of sustainable features located in North Vancouver, British Columbia, Canada. The average hot water



Temperature plots for incoming municipal water, wastewater, and Piranha output for varying domestic water heating loads

usage at the Seven35 is 2,000 gallons per day at an average exiting temperature of 20°C (68°F).

On the basis of this thermal energy resource, the Piranha system was deployed, connecting on one side to the building's gray water system and on the other to the existing hot water distribution system. Additional flow meters, temperature sensors, and electrical and gas meters were installed for test purposes to provide a comprehensive picture of water and energy flows. The primary refrigerant used to run the system was R513A, which has a much lower global warming potential (GWP) than the incumbent chemistry.

The study was performed in phases, where the domestic hot water load provided by the Piranha was increased progressively, from 50% load (100°F) and 75% load (120°F) with peak avoidance to 100% load (140°F) with and without peak avoidance. The air conditioning (AC) system operation was performed in the last phases, at 75% and 100% load. The existing natural gas boiler was left in place as a backup or to supply non-domestic hot water applications.

TESTIMONIAL: EPRI

In this brief demonstration, we were able to learn about the operation of a new promising water heating and air conditioning technology. I'm excited to see a heat pump with high COP year-round while utilizing a lower-GWP refrigerant.

Doug Lindsey

Results & Learnings

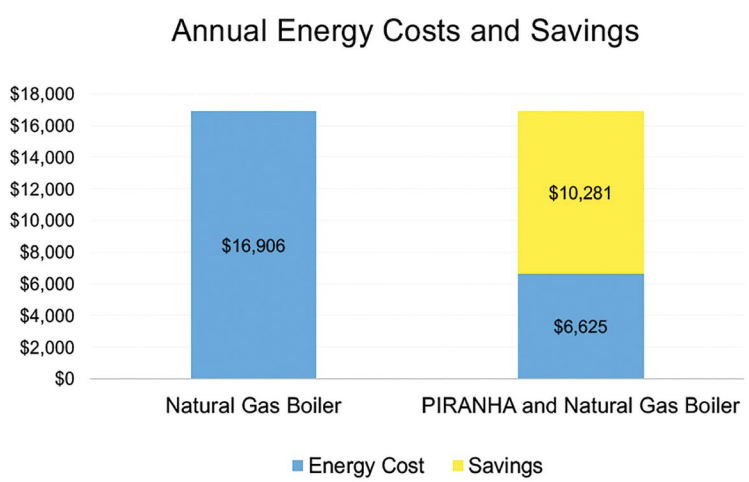
The figure at left shows the temperature gain achieved by the Piranha system. On an overall basis, results show that domestic wastewater heat recovery has value in the residential and commercial building retrofit markets, in new construction, and in developing integrated strategies for reducing carbon emissions at the community level and for urban areas. The Piranha T10 HC was able to produce 100% of the building's hot water at 140°F and also to provide cooling, with an average coefficient of performance (COP) of 3.7 and average running time over 13 hours/day. The system created no noise issues and has no need for defrosting.

A reduction of almost 100% in GHG emissions was calculated, due to the local utility's reliance on renewable electricity generation. The Piranha system is expected to result in a 60% savings in annual energy cost compared to the gas boiler at the Seven35 site, as well as offer the capacity to shift peak load due to the 878 gallons of wastewater storage capacity. This creates opportunities to reduce customer demand charges and benefit the grid.

According to the building manager of the Seven35 facility, the Piranha fit within a small room in an underground parking lot but quickly had a big impact by helping recapture heat from gray water that was going down the drain to significantly reduce energy bills. Additionally, residents have taken pride in the system's contributions toward carbon neutrality.

Implications & Next Steps

This pilot helped in demonstrating favorable cost-performance potential for the innovative concept of wastewater heat recovery for electricity-based domestic water heating, as illustrated in the figure at



Comparison of annual energy costs for standalone gas-fired system and for the Piranha system supplying 100% of domestic hot water needs plus air conditioning, with gas backup

left. Piranha systems are available in different sizes to serve a wide range of residential and commercial building types as well as industrial facilities. In addition to supplying hot water, the technology can also provide space heating and cooling.

The next step is to conduct a longer and broader demonstration involving independent evaluation of the Piranha product line's operating characteristics and performance in different types of settings, such as larger apartment buildings, laundromats, and commercial kitchens. Working in collaboration with utilities to understand and integrate the technology within energy efficiency, demand response, electrification, and emission reduction programs will support broader implementation.

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TESTIMONIAL: SHARC

Working with the Incubatenergy Labs 2020 team proved to be very beneficial for the development of our Piranha product line. We were able to complete a first-class, real-time equipment test supervised by EPRI and our utility partners with meaningful verified outcomes. The exposure we received from the broader EPRI audience has meant an exponential growth in inquiries and implementations of Piranha systems. The credibility of EPRI, coupled with the value proposition of our technology, has launched us into a market that was looking for the Piranha. Incubatenergy Labs has been a catalyst to our corporate success.

Lynn Mueller

TESTIMONIAL: Con Edison

SHARC figured out how to reuse the heat from the wastewater we all generate on a daily basis, so it's a renewable wastewater heat. They are on track to make a positive impact by not only cutting the cost of domestic water heating and space conditioning for customers but also reducing air emissions and thermal discharges.

Silvia Khurrum

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