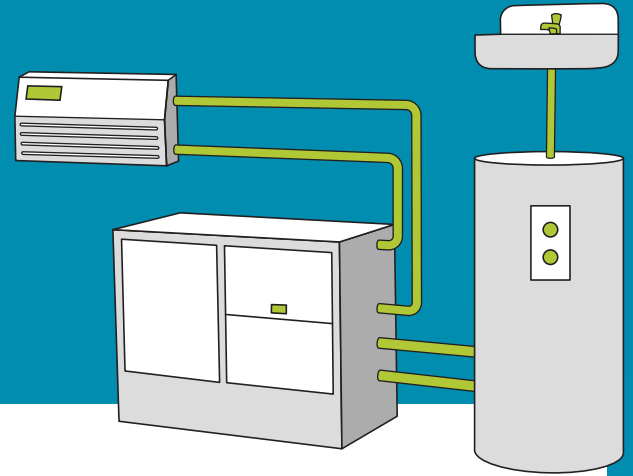




Technology Early Deployment

SHARC Energy Systems

Highly Efficient Electric Thermal Energy Recovery for Simultaneous Hot Water and AC Production.



The PIRANHA™ HC model from SHARC Energy Systems bundles thermal energy recovery to pre-heat domestic hot water using energy captured from wastewater. The same thermal energy also provides cooling capabilities, enabling simultaneous domestic hot water production and air conditioning from the same source. This product is best suited for medium-sized heat transfer applications but can be deployed for any building with a wastewater stream and domestic hot water needs. The PIRANHA™ HC model can also be used to produce hot water for hydronic heating or alternative hot water demand purposes and can reduce carbon emissions in two ways: 1) reducing load on fossil-fuel fired boilers and 2) reducing cooling energy consumption.

TECHNOLOGY BENEFITS



ENABLES HIGH EFFICIENCY

across outdoor air and incoming water temperatures.



USES LOW GWP REFRIGERANT

R-513a (GWP: 573).

60%

INCREASE

in energy savings compared to gas boiler.

140°

HOT WATER

from electric heat pump.



SUSTAINS PEAK LOAD SHIFTING

via hot water storage capacity.



ELIMINATES GAS USAGE

for domestic hot water.

Disclaimer: SHARC Energy Systems' PIRANHA™ HC System was chosen for TED because it supports **California's clean energy goals** for energy efficiency, reduced GHG emissions and demand flexibility. This document does not constitute or imply endorsement, recommendation, or favoring by EPRI or SCE of the product or company described herein. This publication is funded and administered by Southern California Edison's Emerging Technologies Program.

TED SPONSORSHIP:

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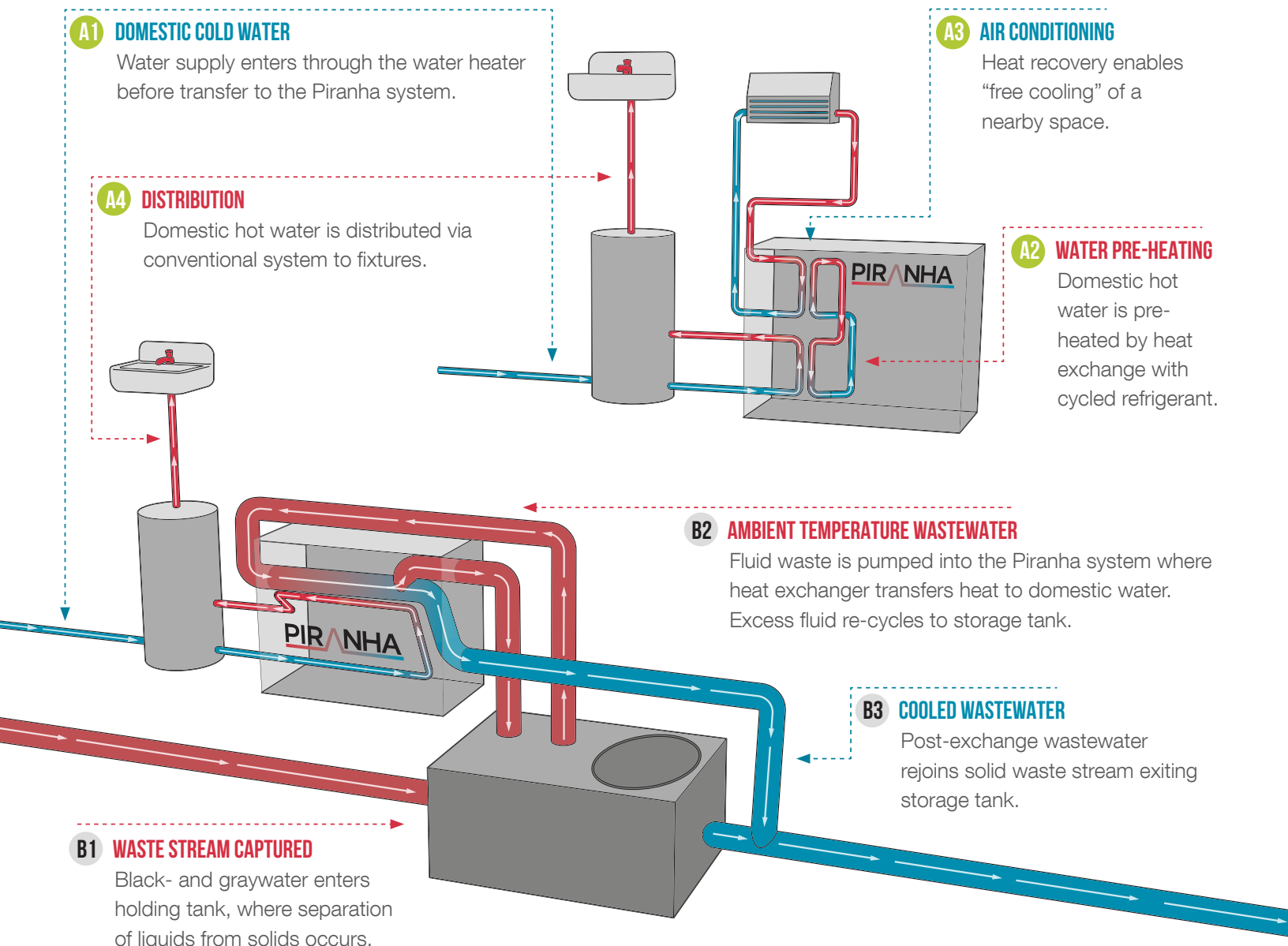
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SHARC heat recovery technology

The PIRANHA HC is a specialized water-to-water heat pump that recovers energy directly from wastewater and uses this source energy to produce hot water. The hot water produced through the unit is typically used for potable domestic hot water (DHW) purposes, however it can also be used for hydronic heating or alternate hot water demand purposes.

An electrically driven heat pump generates up to 140°F hot water, which can either directly supply domestic hot water, or provide pre-heated water for a boiler system. A specially designed evaporator is used to recover and transfer energy from wastewater into the refrigeration circuit. A second evaporator recovers energy from the hydronic cooling loop and boosts system performance. A NSF-372 rated double-wall vented brazed plate heat exchanger then transfers heat to potable water. The sealed system emits no odors in the building.



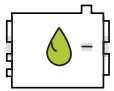
TARGET CUSTOMERS

- ✓ Commercial building owners/operators (hospitals, micro-breweries & distilleries, commercial laundry, community activity centers).
- ✓ Multifamily building owners/operators (50–350 unit apartments/condos, student housing, senior/ assisted living, community housing).
- ✓ Electric utilities that offer energy efficiency and demand response programs.

HARDWARE COMPATIBILITY

- ✓ Can be retrofitted for gas or electric boiler.
- ✓ Can eliminate gas use if replacing a gas boiler, but can increase electric demand charges (impact may be minimized if utilizing storage tanks).
- ✓ Can reduce electricity charges (energy and demand) if replacing an electric boiler.
- ✓ Unit can be scaled from 5 - 15 tons, with 750 to 2250 gallons of minimum wastewater storage.

SYSTEM FEATURES



**ALL-IN-ONE
UNIT**



**ODOR-FREE
& QUIET**



**SIMULTANEOUS
HEATING/COOLING**



**NO MACERATOR OR
PRE-FILTRATION**



**OFF-PEAK
PROGRAMMABLE**



**INTERNAL HEAT
EXCHANGER**



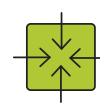
**LOW
MAINTENANCE**



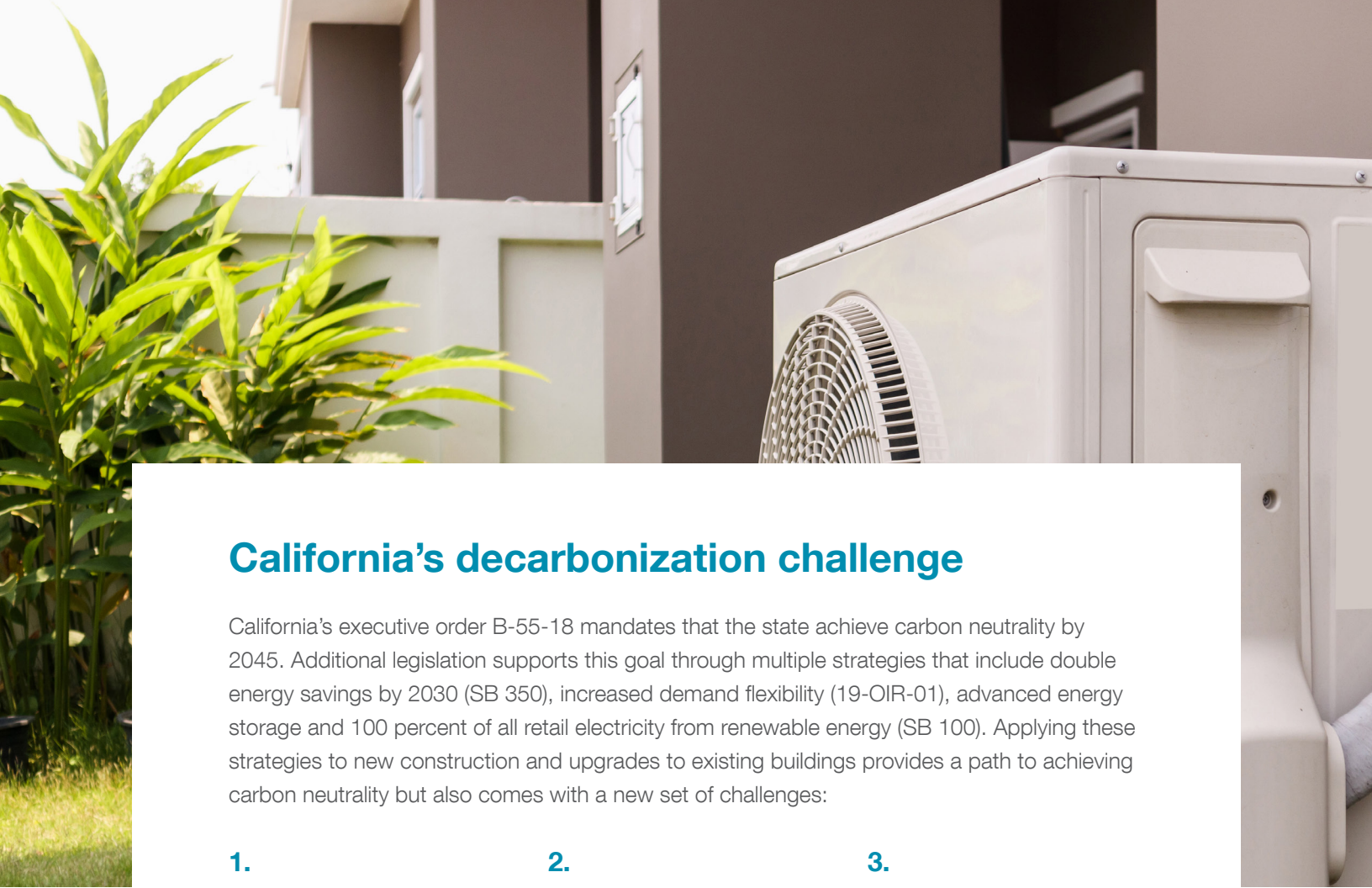
**REMOTE
MANAGEMENT**



**UTILIZES BLACK
& GREY WATER**



**SIZED FOR
RETROFITS**



California's decarbonization challenge

California's executive order B-55-18 mandates that the state achieve carbon neutrality by 2045. Additional legislation supports this goal through multiple strategies that include double energy savings by 2030 (SB 350), increased demand flexibility (19-OIR-01), advanced energy storage and 100 percent of all retail electricity from renewable energy (SB 100). Applying these strategies to new construction and upgrades to existing buildings provides a path to achieving carbon neutrality but also comes with a new set of challenges:

- 1.**
New technologies for buildings

must support most or all of the desired outcomes for California.
- 2.**
Testing, compliance & standards

including utility participation and enabled workforce.
- 3.**
Establishing trust

that replacement of old systems will meet/exceed performance expectations.

SHARC ENERGY SUPPORTS CALIFORNIA'S DECARBONIZATION GOALS

60%
REDUCTION
in refrigerant GWP.

100%
REDUCTION
in GHG emissions.

100%
REDUCTION
in gas boiler usage for domestic hot water.



STORAGE CAPABILITIES
provide demand flexibility and allows the system to run during off-peak hours.

Addressing market barriers to decarbonization of commercial buildings

A state-wide emphasis on decarbonization of commercial and multifamily buildings supports a large potential market for a technology like SHARC Energy Systems. The PIRANHA HC is applicable in many commercial buildings, which consumed 424 trillion BTUs in the US alone (CBESC 2012), resulting in a large total addressable market.

BARRIERS STILL EXIST IN SEVERAL AREAS:

Barriers

FOR EXPANSION

- ✓ Unclear compliance pathway with building energy codes such as CA Title 24.
- ✓ Variable installation costs depending on the building.
- ✓ Field demonstration in the U.S. (Planned installations in Boulder, CO, and Seattle, WA).

TO SCALE

- ✓ Customer distrust of new technologies.
- ✓ Development of distribution and service relationships.

CREATING A PATH TO COMMERCIALIZATION THROUGH THE FOLLOWING ACTIVITIES:

Opportunities

UTILIZE LEVERAGE POINTS

- ✓ Collaboration with EPRI through Incubatenergy Labs Challenge.
- ✓ Networking with SCE and other IOUs.
- ✓ Global presence with active installations in US, Canada, Australia and China.
- ✓ Target markets with carbon reduction incentives and policies that promote electrification.
- ✓ Alignment with CA Priority Partnership Areas.
- ✓ \$1 trillion worth of recoverable thermal energy is wasted every year worldwide, \$40 billion worth in US and Canada.
- ✓ Expanded interest across utilities and industry professionals.

Market readiness



6

**TECHNOLOGY
READINESS LEVEL
SCORE**

- > Limited field demonstrations - would benefit from additional testing to verify performance.
- > Need verification on air conditioning capacity provided by the system.



<1

**YEAR TO
MARKET**

- > High ROI business model with significant recurring revenue via 10-year maintenance contracts.
- > Claims typical payback of ~4 years on equipment installation.



6

**MANUFACTURER
READINESS
LEVEL SCORE**

- > Broader deployment needed to verify full-scale production capability.



2

**KEY
OUTCOMES**

- > Up to 100% reduction in gas boiler usage for domestic hot water.
- > Only requires ~14 hours of runtime to meet total demand, allowing peak load reduction with storage tanks.

Supporting utility goals for decarbonization

1.

Energy savings

Reduces energy consumption by over 70% compared to electric boiler and can be used to produce chilled water at the same time.

2.

Decarbonization

Eliminates gas usage for domestic hot water.

3.

C&S alignment

COP is above 3.5 over a range of operating conditions, comparable to available air-source or water-source heat pumps.

4.

Demand flexibility

Sustainable peak load shifting due to hot water storage capacity.



Performance review

TIMEFRAME

3-MONTHS

A demonstration study was conducted over a 3-month period in a 65-unit apartment building Vancouver, Canada.

SIZE

65-UNIT
APARTMENT BUILDING

No need for gas boilers

PIRANHA was able to provide 100% of domestic hot water at 140°F with no gas usage from boilers.

Met expectations for daily hot water demand

Average runtime of 13 hours to meet daily hot water demand.

LOCATION

VANCOUVER,
CANADA

Exceeded COP goal

Achieved over 3.5 average COP.

Comparable performance

Achieved comparable performance with low-GWP R513A against R134A.

Reduced emissions

- ✓ PIRANHA with gas boiler saves ~160 MWh/year over gas boiler and reduces ~68,000 kg/year CO₂ emissions (British Columbia renewable electricity is ~95%).
- ✓ PIRANHA with electric boiler saves ~126 MWh/year over electric boiler and reduces ~3,500 kg/year CO₂ emissions.

Reduced thermal pollution

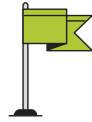
By up to 120,000 BTU/hr.

SHARC Energy Systems Utility Opportunity Assessment



TECHNOLOGY CATEGORY

1. **Water Heating**
2. **SHARC Energy Systems – PIRANHA™ HC System**



ETP PRIORITIES

ENERGY SAVINGS

Reduces energy consumption by 70% compared to electric boiler, and can produce chilled water at the same time.

DECARBONIZATION

Eliminates the use of high GWP refrigerants
Eliminates gas usage for domestic hot water.

C & S ALIGNMENT

COP averages 3.5+ over a range of operating conditions, comparable to available air-source or water-source heat pumps.

DEMAND FLEXIBILITY

Sustainable peak load shifting due to hot water storage capacity.



KNOWLEDGE INDEXES

TECHNICAL PERFORMANCE

Medium

MARKET KNOWLEDGE

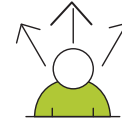
Medium

PROGRAM INTERVENTION

Low

UTILITY VALUE

- Reduces energy consumption by over 70% compared to electric boiler.
- Up to 100% reduction in gas usage if replacing natural gas boiler.



OPPORTUNITIES

CRITICAL ETP ACTIONS

- Socialize within SCE.
- Socialize with other IOUs.
- Field test in CA.

LEVERAGE POINTS

- EPRI Incubator Labs Challenge.
- Align with CA Priority Partnership Areas.
- Target markets with carbon reduction incentives and policies.

GAPS TO FILL

- CA field demo data.
- Utility specific use-case.

MARKET SIZE

- 424 trillion BTUs annual natural gas use for water heating in commercial buildings.



BARRIERS

IN-PROGRESS

- Unclear compliance pathway with building energy codes.
- Variable installation costs depending on the building.
- Lack of field demonstration in CA.

UPCOMING

- Customer adoption
- Development of distribution & service relationships.

SOLUTION

- Build brand awareness.
- Planned US installation in CO and WA.



NEXT STEPS

COMPANY

1. Expanded manufacturing capability.
2. Utility-specific cost-benefit analysis.

UTILITY

1. Field demo results.
2. Value proposition and business use case.

OTHER

1. EPRI M&V testing and/or grant collaborator.
2. Partnerships with developers, HVAC contractors, Building Energy Management Systems.



TED is a process where innovative technologies are selected for assessment and review based on the technology application, team strength, and alignment with the Technology Priority Maps, to fulfill the California decarbonization challenge.

FOR MORE INFORMATION

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