Advisor: Derek Dunn-Rankin
Project Manager: David Baltazar
Team Members: Alex Masamitsu
Cameron Colley
Nate Chan
Anthony Ruiz

Solar Water Heating System

UCI Samueli School of Engineering

Innovation

A modular solar water heater will allow new solar energy users to try out the systems without fully investing in a new water heater system. It allows customers to be able to direct where their heat goes, allowing them to heat up more frequently used appliances faster.

Current Status

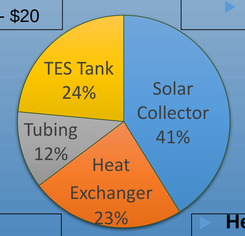
We are conducting tests on our prototype thermal collector and recording its performance under winter climates. We have finalized the TES tank design and are ordering the parts to begin manufacturing.

Next Steps

We will be gathering data on the thermal collector's performance under spring conditions. We will then compare the efficiency to our theoretical calculations and determine where losses are, if any. We will also begin the manufacturing of the TES tank in the early weeks of Spring. We are hoping to place the purchase order forms for the TES tank materials by the end of the quarter. We will begin the designing of the heat exchanger, as well.

Budget Breakdown

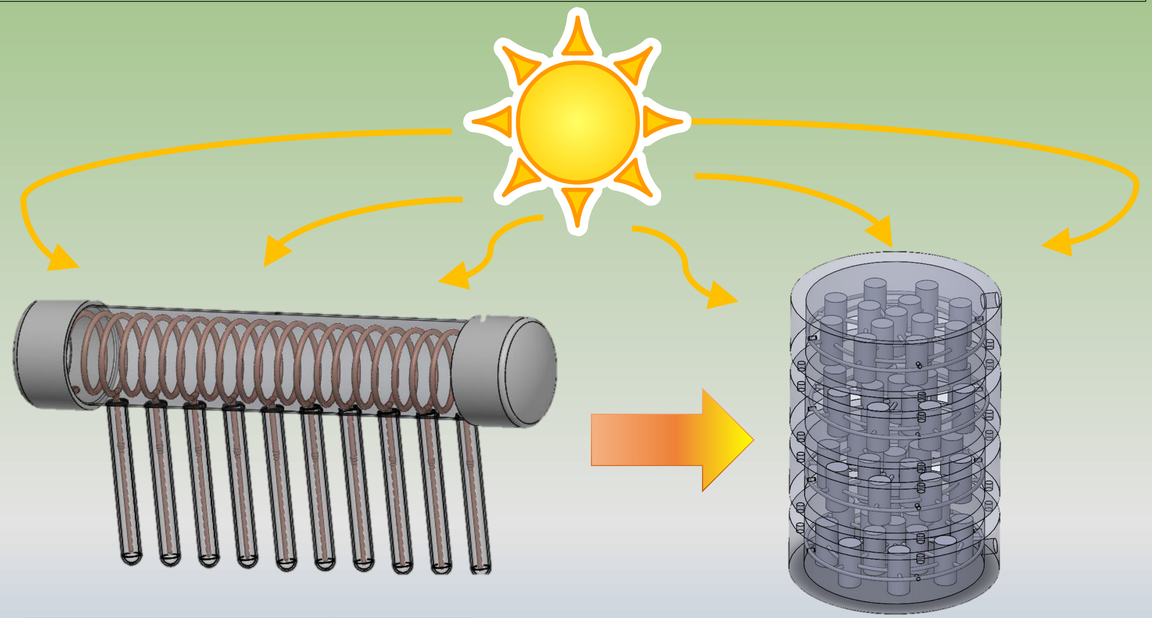
- **TES Tank- $80**
  - Thermal Wax - $30
  - Water Tank - $30
  - Insulator & Piping - $20
- **Thermal Collector - $170**
  - Vacuum Tubes: $110
  - Copper Heads: $30
  - Frame: $30



- **Tubing- $40**
  - Collector to TES: $20
  - TES to Appliance: $20
- **Heat Exchanger- $80**
  - Outer Casing: $40
  - Insulator: $40

Background

While solar electric integration is expanding, solar water heating is not, due to gas heating being already cheap and efficient as is. We are developing a commercial device not with the intention of saving on heating bills, but with water bills, by reducing the amount of water wasted during water heating, saving time and money for users, while addressing the California drought.



Time (min)	Temp Tube 1 (°C)	Solar (W/m^2)
0	23.4	545
10	28.5	530
20	32.7	507
30	35.3	486
40	38.1	462
50	40.4	446
60	42.3	430
70	44.2	413
80	46.3	384
90	47.1	356

Material	Melting Temperature (C)	Freezing Temperature (C)	Latent heat (KJ / kg)	Cost $
n-Eicosane	37	36	246	$50 / 100 g
n-Docosane	44.5	44	190	$85 / 100 g
Rubitherm (RT) 42	41	42	165	---

	September 2016	October 2016	November 2016	December 2016	January 2017	February 2017	March 2017	April 2017	May 2017
	Solar Collector Purchase parts and assemble			**TES Tank** Finalize tank design & wax		**TES Tank** Test the performance		**Combination** Test installation and performance	
Solar Collector Design frame and manifold		**Solar Collector** Test the performance		**TES Tank** Manufacture parts and assemble		**Combination** Combine TES with solar collector		**Combination** Redesign/Move to heat exchanger	

Goal

Create a solar water heating system that can passively preheat a household's water to reduce the amount of wasted water made when waiting for water to heat up. As a commercial device, we need to make it smaller and lighter (so as not to interfere with other solar systems a house might already have), but also cost-efficient, in terms of both labor and money.

Objectives/Requirements

- **Weight of the Solar Collector**: To meet building codes and be eligible for government subsidiaries, the thermal collector must not be over a certain weight.
- **Size of the Solar Collector**: Big enough to absorb enough heat, but small enough to not interfere with current/future solar systems.
- **Temperatures of the Working Fluid**: Need to preheat the water to about 50°C. During the day, we aim for a higher temperature, while at night, we expect a lower temperature.
- **Working Temperatures**: Ensure working fluid doesn't freeze or boil in average California temperatures.
- **Maintenance**: On par, if not better, than current solar water heating systems on the market.
- **Total Cost**: Low enough to appeal to customers. Make it low enough so people buy multiple units.

Objectives	Goals	Current
Weight of Solar Collector	100 lbs	130 lbs
Size of Solar Collector	36" x 36" x 10"	28" x 40" x 10"
Working Fluid Temp (Day)	150 °F	100°F
Working Fluid Temp (Night)	105°F	N/A
Water After Preheating	120°F	N/A
Working Temperatures	-10°F - 220°F	18°F - 213°F
Maintenance Times	5-6 Years	N/A
Total Cost	<$1000	$600-$700