



PV/T ENERGY BOOSTING SYSTEM



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PROBLEM

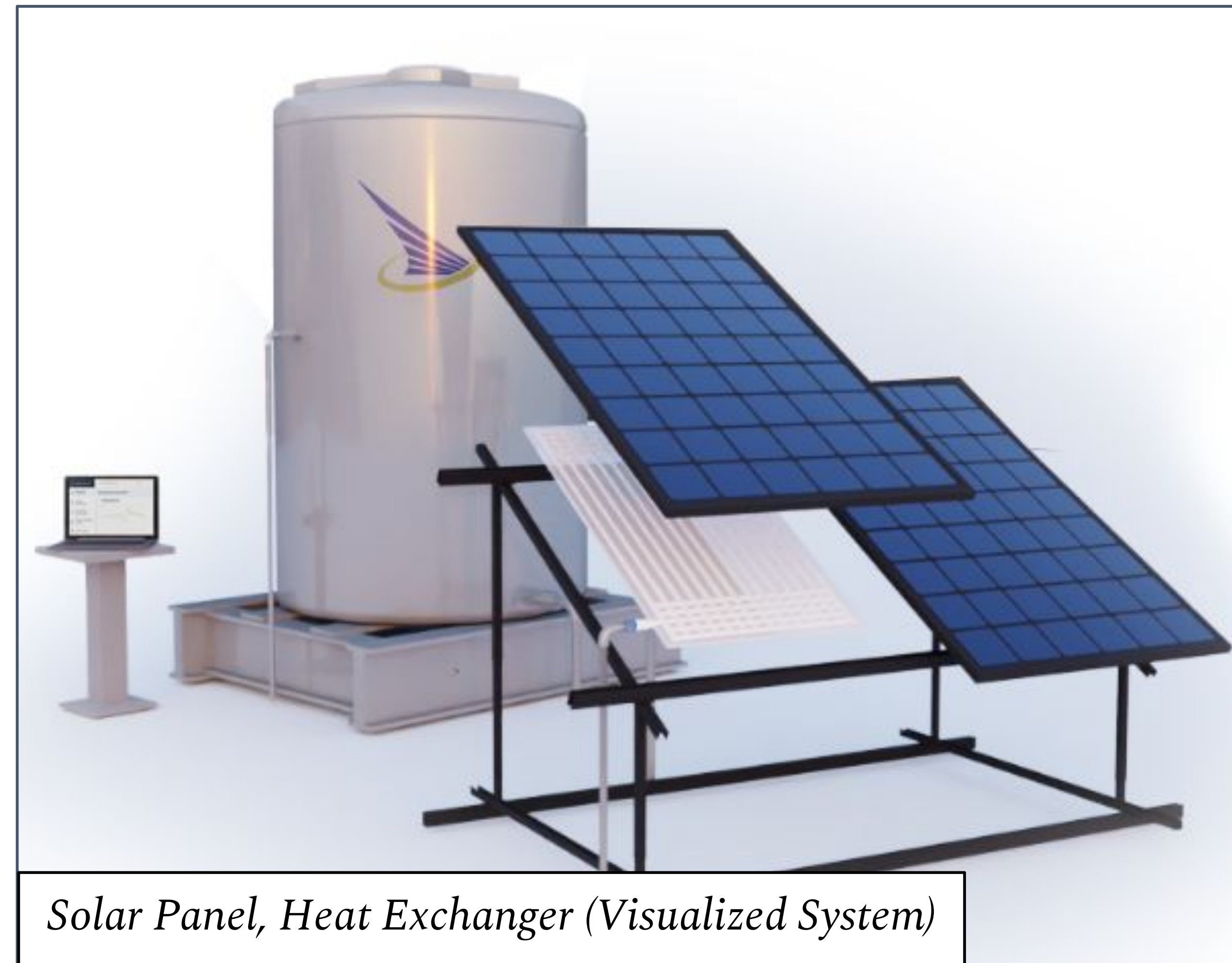
Solar panels lose up to 25% efficiency when heated. Icarus RT designs heat exchangers that attach to and cool panels, improving power and delivering hot water. Icarus RT needs a *Control and Monitoring System* for their residential heat exchangers.



Heat Exchanger Storage Tank

ELECTRICAL CONTROLS

- Runs on Raspberry Pi 5 with an Arduino Mega to read analog sensor signals.
- The Arduino Mega reads: 8 thermistors, 1 pressure transducer, and 1 hall effect flow sensor. Weather data and solar radiation taken from online APIs.
- Voltage monitors divide voltage from solar panel to Arduino.
- System takes real time data to compute a thermal energy balance equation and optimal pump flow rate.
- The pump speed increases proportional to the tank's thermal difference (If the water exiting the heat exchangers is hotter than 5°C from the top of the tank).



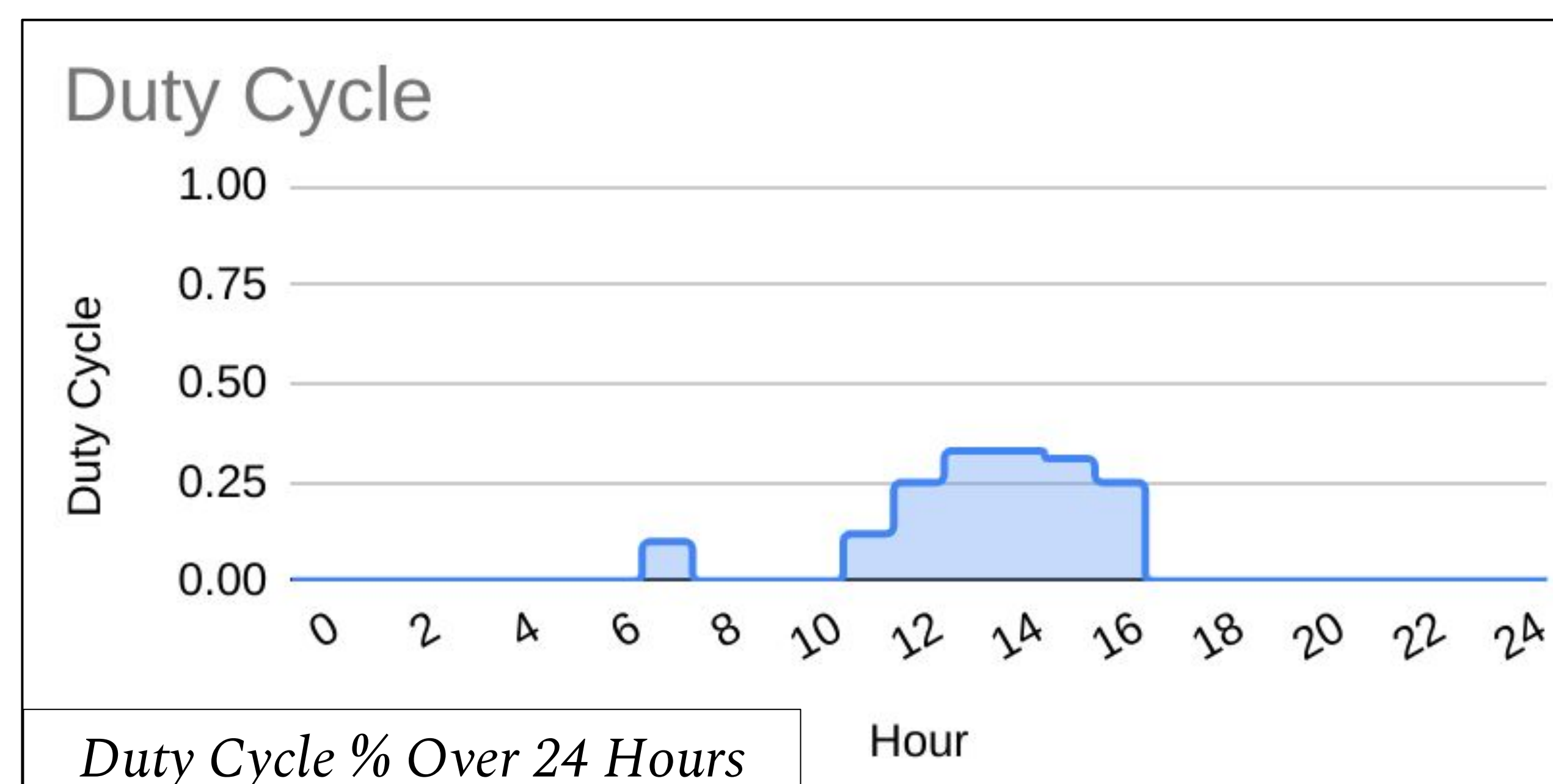
Solar Panel, Heat Exchanger (Visualized System)



Solar Panels (Test System)



Heat Exchanger (Test System)



REQUIREMENTS

1. System measures and records temperature, voltage, pressure, weather, and flow rate.
2. System quantifies wattages and thermal efficiencies.
3. System controls the flow rate through the heat exchangers.
4. Develop a control algorithm.
5. Design functional voltage monitors for the solar panel.



MECHANICAL TEST RIG

- CPVC, copper, and drinking safe piping are used throughout the control and monitoring system.
- Four Icarus RT heat exchangers cool the solar panel.
- Copper coils exchange heat to a 55-gallon tank that stores heated potable water at a temperature gradient, reducing the residential energy demand.
- A water pump controls the flow through the heat exchangers to cool the solar panel, and preheat the potable water.
- The stratified tank thus preheats cold city water before entering a home's water heater.