MicroEra Power – Enhancing Thermal Energy Storage Installation and Efficiency

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Customer:
MicroEra Power

Project Overview

The shift to renewable energy is limited by the reliability of sources like solar and wind. MicroEra Power's THERMAplus system stores energy efficiently using phase change materials, helping customers buy electricity when demand and costs are low. Today, the system faces installation and layout challenges. Our project focuses on making it more modular, optimizing the component layout, and optimizing space efficiency to drive broader adoption and support a more sustainable energy future.

Problem Statement

Broader Problem

- Solar and wind energy are unpredictable in their output
- Electricity prices fluctuate wildly throughout the day
- Consumers are stuck paying more, slowing the transition to sustainable energy.

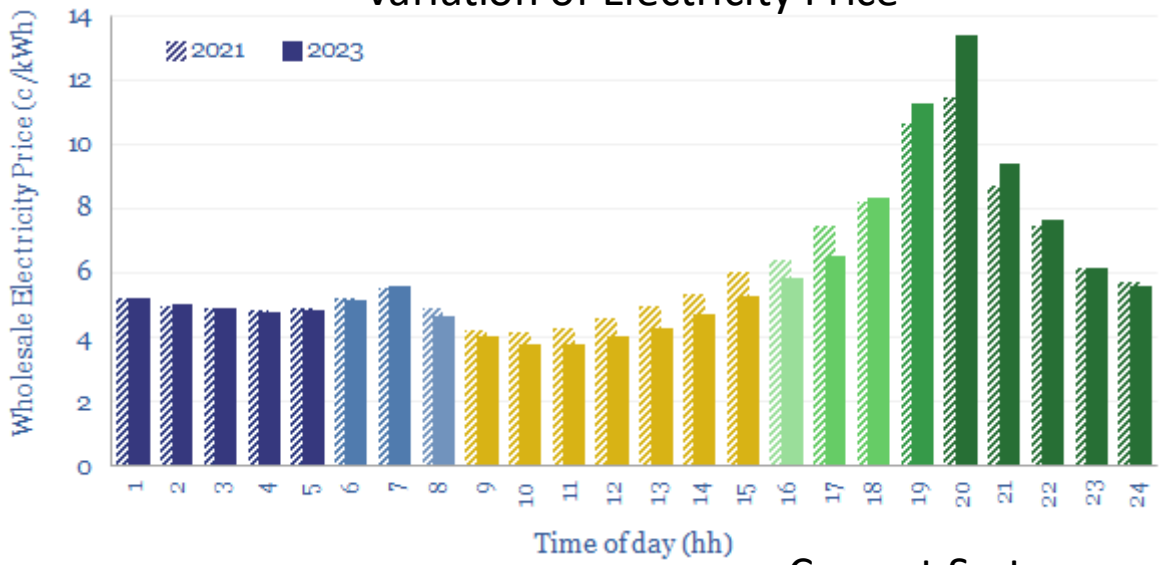
MicroEra Power

MicroEra Power is a local HVAC startup specializing in thermal energy storage systems using their proprietary tuneable phase change materials to enhance energy density

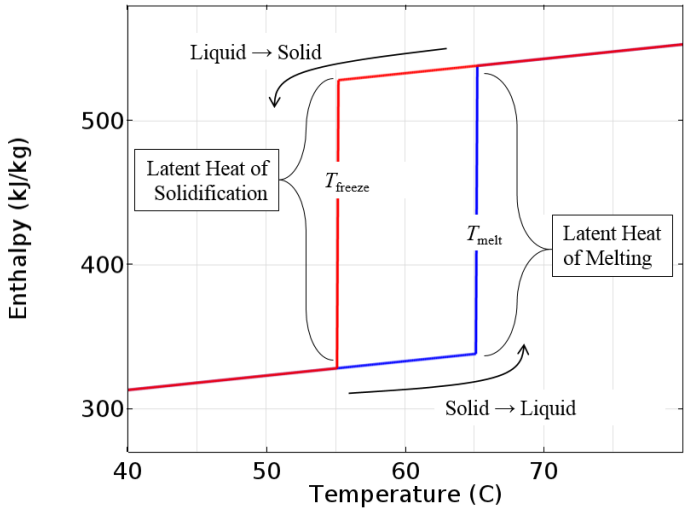
MicroEra's Problem

- Current system is too large and complex
- Very inefficient to install
- Cannot be effectively transported or produced in large quantities.

Variation of Electricity Price



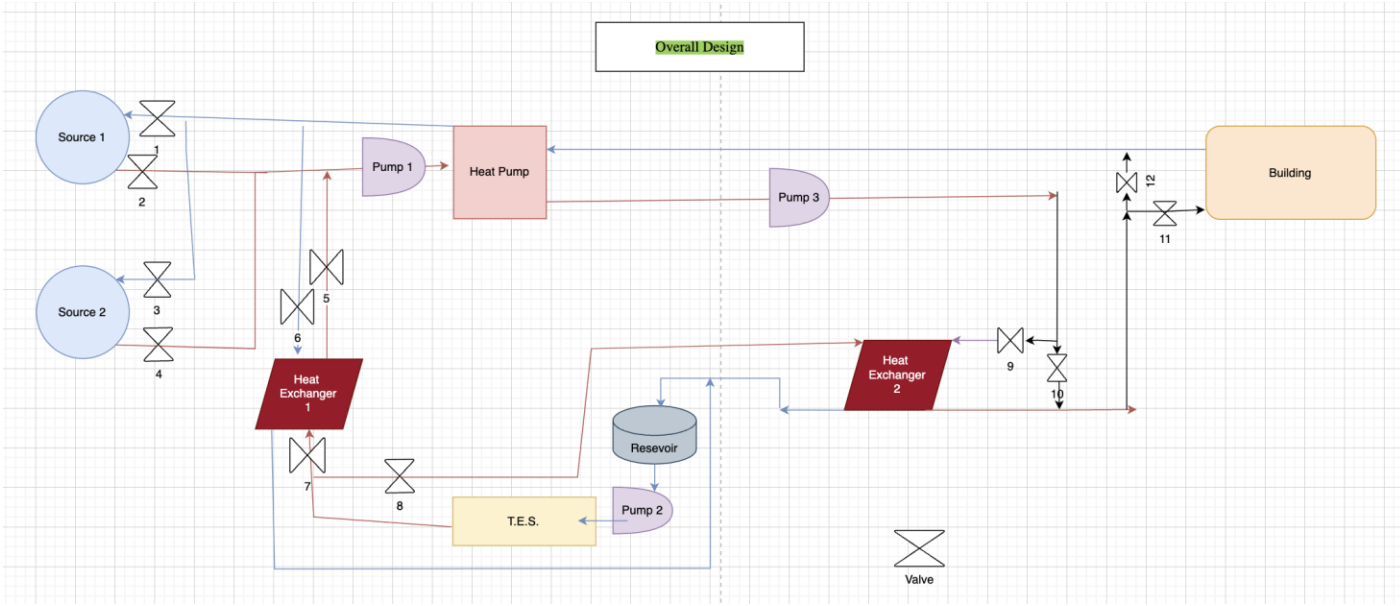
Solid Liquid Transition, T, h



Current System

Deliverables, Requirements and Specifications

The deliverables, requirements and specifications define what will be done and how to be objective about what it means to have a “successful” project.

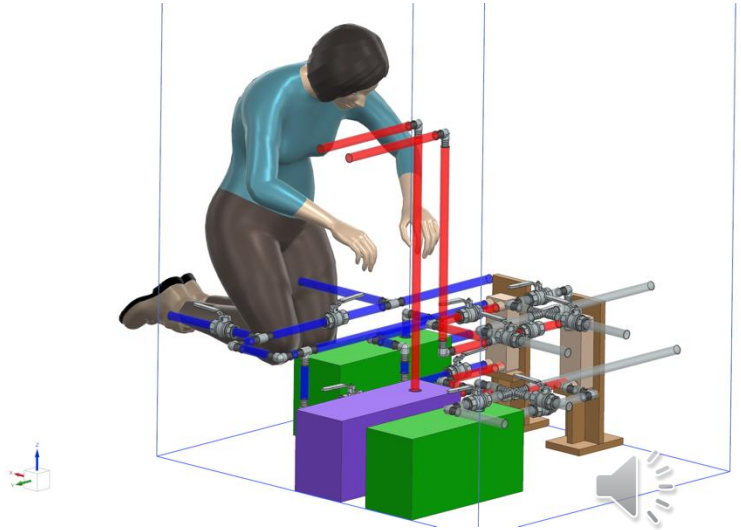


Deliverables:

- Prototype system demonstrating capability
- Report including simulation result
- Theory of Operation Manual
- CAD with detailed BOM

Requirements:

- Easy access to critical components; modular design
- Have separate piping loops for the thermal storage, the building, and the heat pump sources.
- Have 2 sources for the heat pump
- For no TES, the building loop must be on supply side of heat pump with the TES loop on source side of heat pump.
- For TES as a source, the building loop must be on the supply side of heat pump with TES loop on the source side of the heat pump.
- For direct heating/cooling with the TES, the TES must exchange with the building loop.
- For TES charge, the TES must be on the supply side with sources on the source side of the heat pump.



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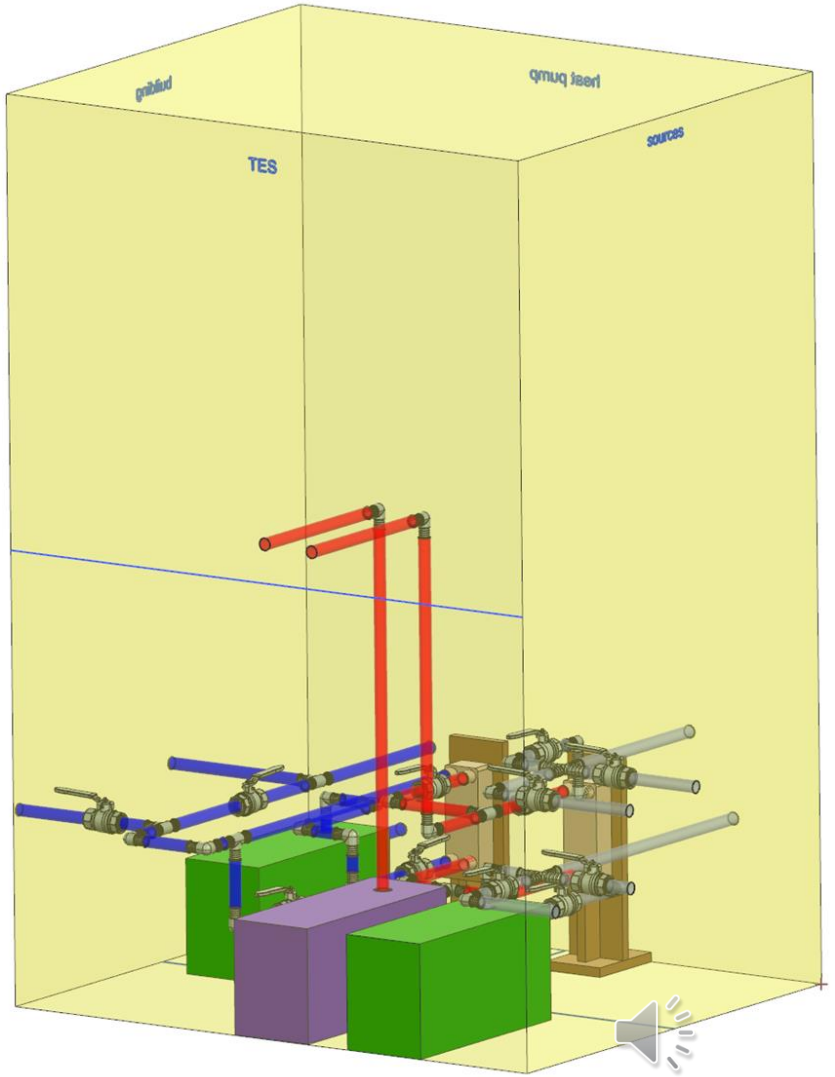
Specifications:

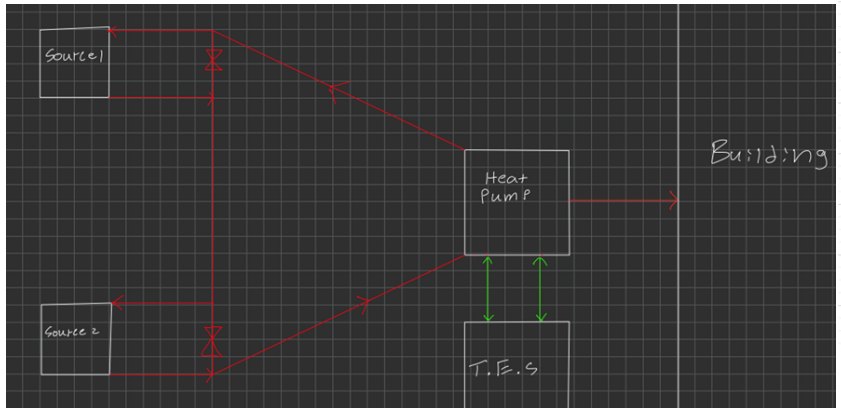
- Fit onto a standard pallet
  - 48” x 40” space envelope, with 72” max height
- 5% efficiency target. The pumping losses must be less than or equal to 5% of the total stored energy amount, for both the charging and discharging times of the system
- 24 gal/min flowrate of the system
- 4 hour heat transfer discharge rate from the TES to the building
- 8 hour heat transfer charge rate of the TES from the sources
- 3°C max temperature change for a metal heat exchanger
- Connections to the TES system must be 3 ft high or above



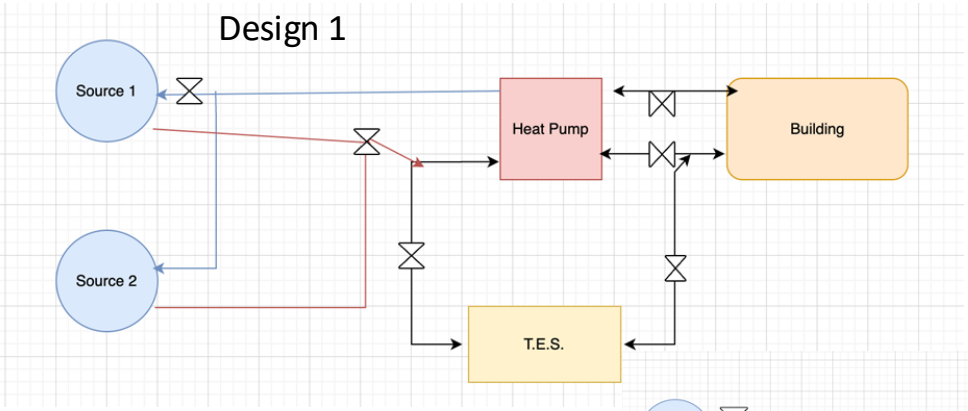
Current Project Status

Concepting

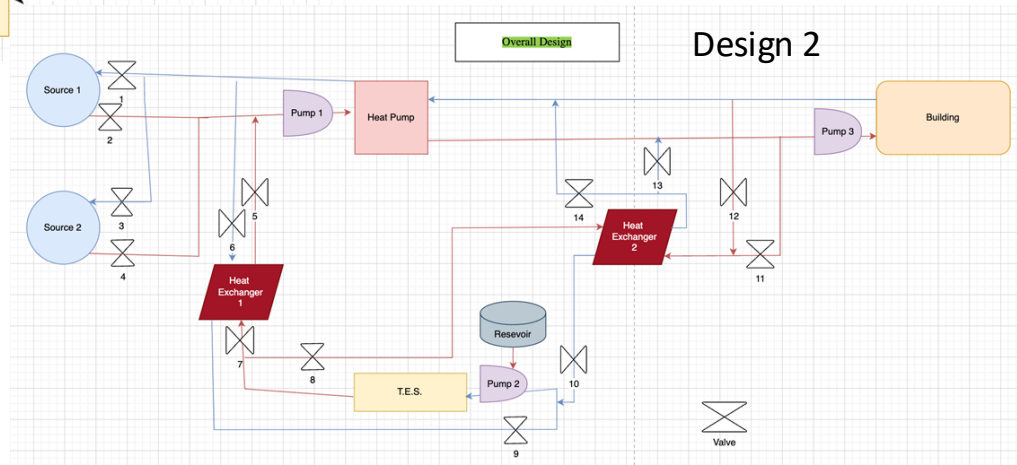
Baseline



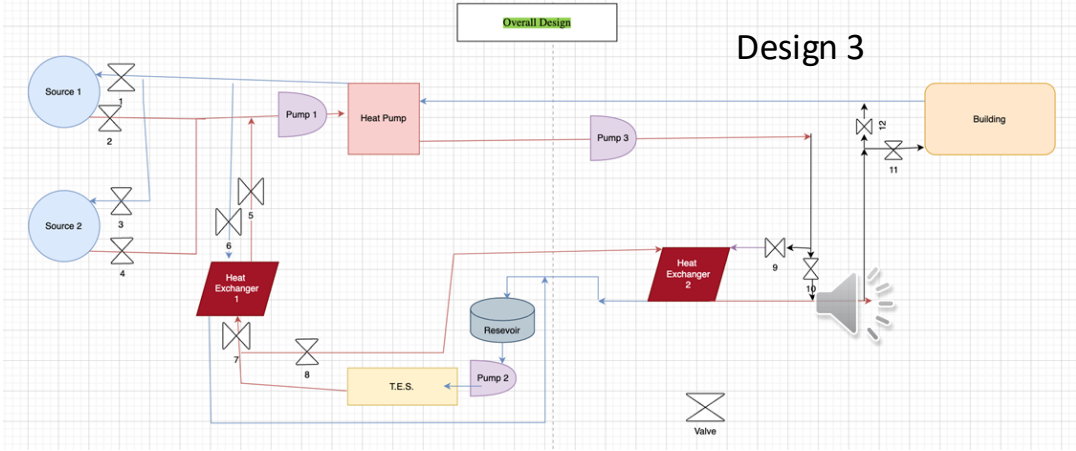
Design 1



Design 2



Design 3



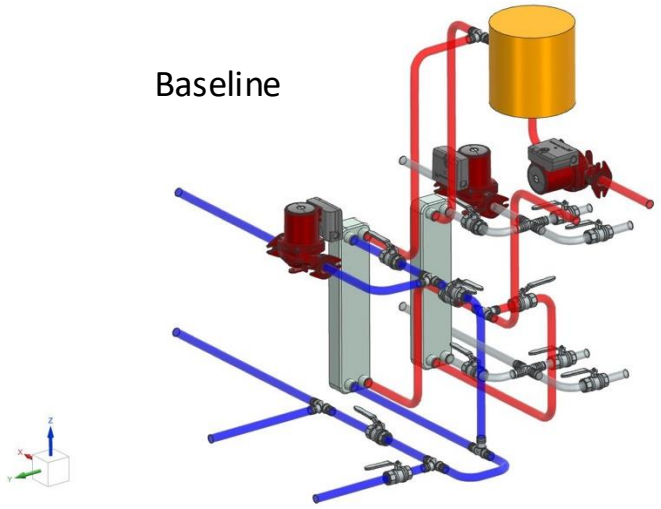
CRITERION	BASELINE	DESIGN 1	DESIGN 2	DESIGN 3
Meets requirements of the 4 different cases	0	-	-	+
Has all required components	0	-	+	+
Complexity	0	-	-	-
Cost	0	-	-	-
Functionality	0	+	+	+
Total	0	-3	-1	+1

System schematics – what components are connected to one another and how?

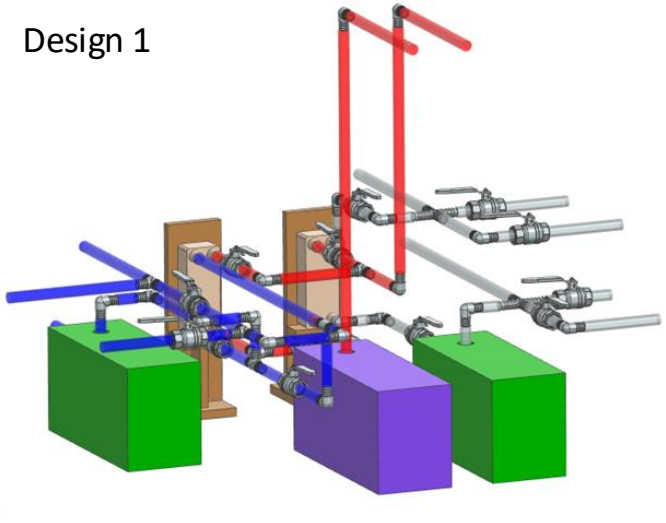
Current Project Status

Concepting

Baseline

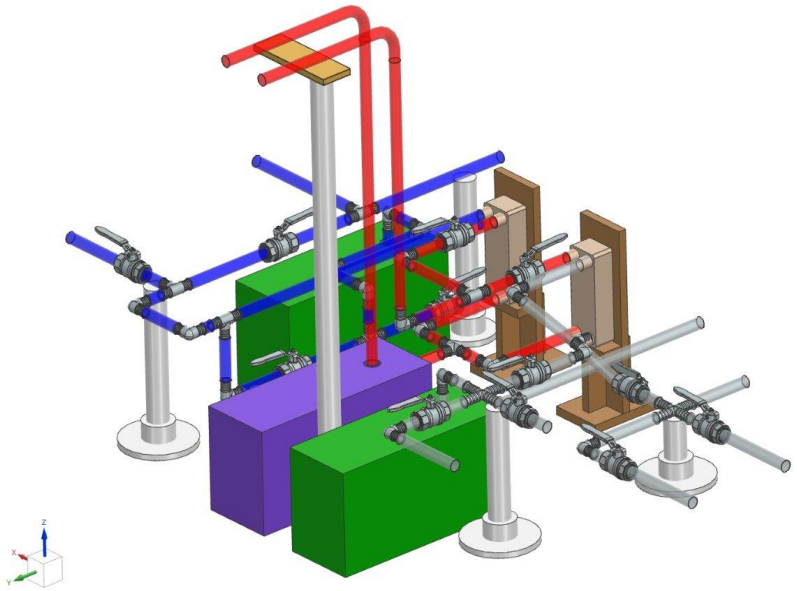


Design 1



CRITERION	BASELINE	DESIGN 1	DESIGN 2
Meets requirements of the 4 different cases	0	-	+
Head loss	0	+	+
Accessibility	0	+	+
Total	0	+1	+3

Design 2



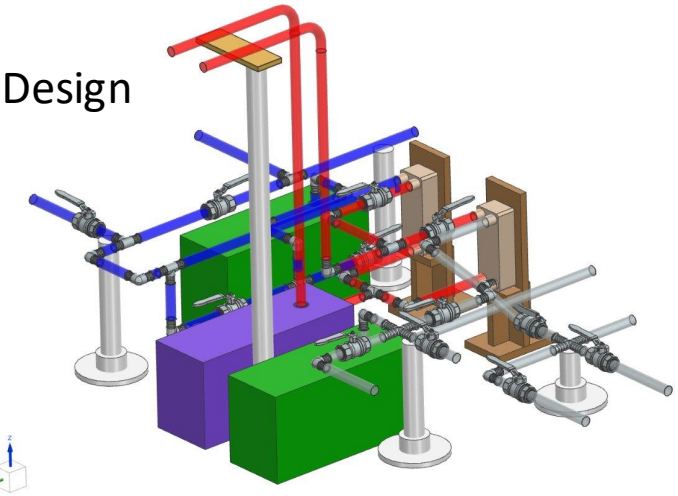
CAD Designs – general outline of system piping

Current Project Status

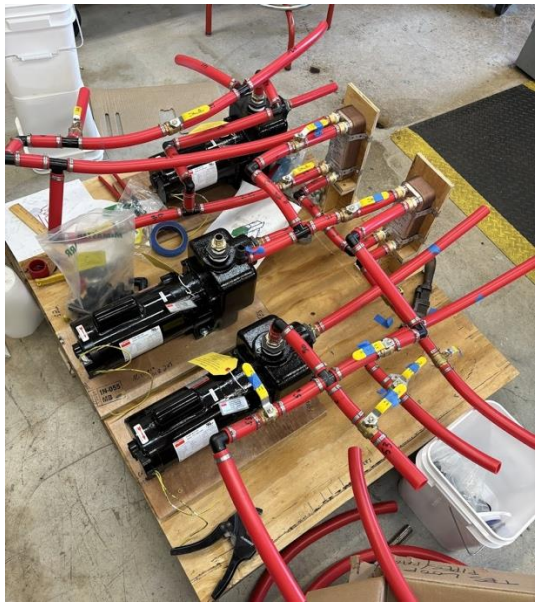
Completed this week

- Built supports out of purchased PVC and remaining plywood
- Connected remaining PEX pipes on TES loop and replaced fauty clamps
- Configured wiring between pumps and extension cords to finalize system for operation
- Linked system to reservoir to test and turn on each pump and the overall system
- Observe system for leaks and ensure secure fittings

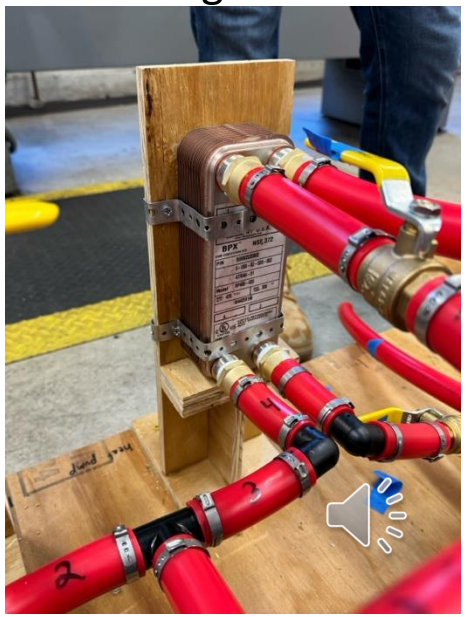
Final Design



Current Build State



Heat Exchanger Stand Setup



Conclusions/Future Work

Conclusions

- Met all specifications except for specifications 4 and 5 – pump losses must be less than or equal to 5% of TES energy discharge rate, and the flow rate
- Our system is most useful as a design to build off of as it is not fully integrated without a VFD and electronic valves.
- Have not tested/ verified Heat transfer rates and performance due to lack of thermal sources, heat pump, and TES

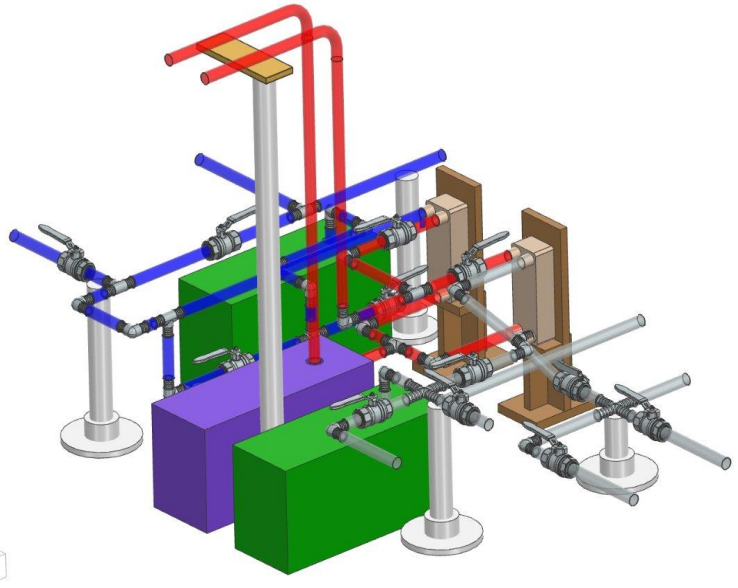
Next Steps by MicroEra For System Development

- Automate operation using electronic valves, VFD, computerized system with sensors for input
- Streamline manufacturing processes
- Component upgrades
- Further optimization and testing/verification

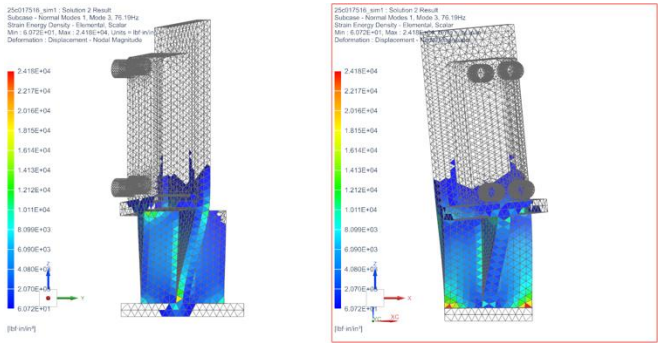
Acknowledgments

Molly Over, Chris Pratt, Samantha Kriegsman
Bill Mildenberger, Jim Alkins, Alex Prideaux, Sebastian Gomez, Christopher Muir, and the rest of the University Staff who helped us along the way

Final Design



Vibration FEM model



Head Loss Calculator