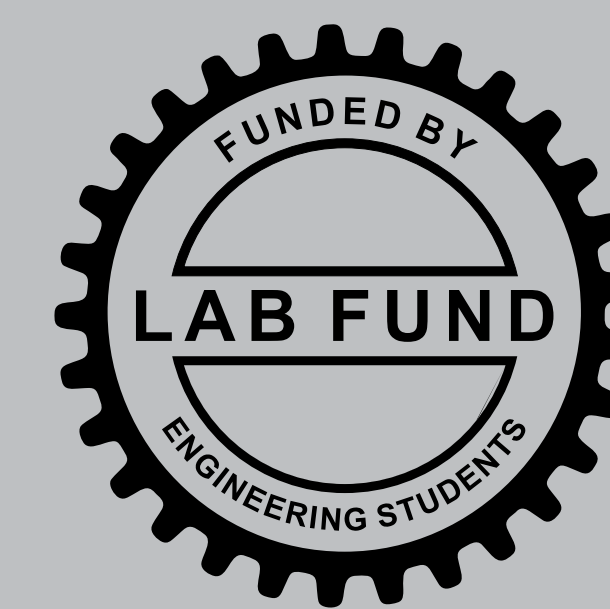


Thermoelectric Climate Control Unit

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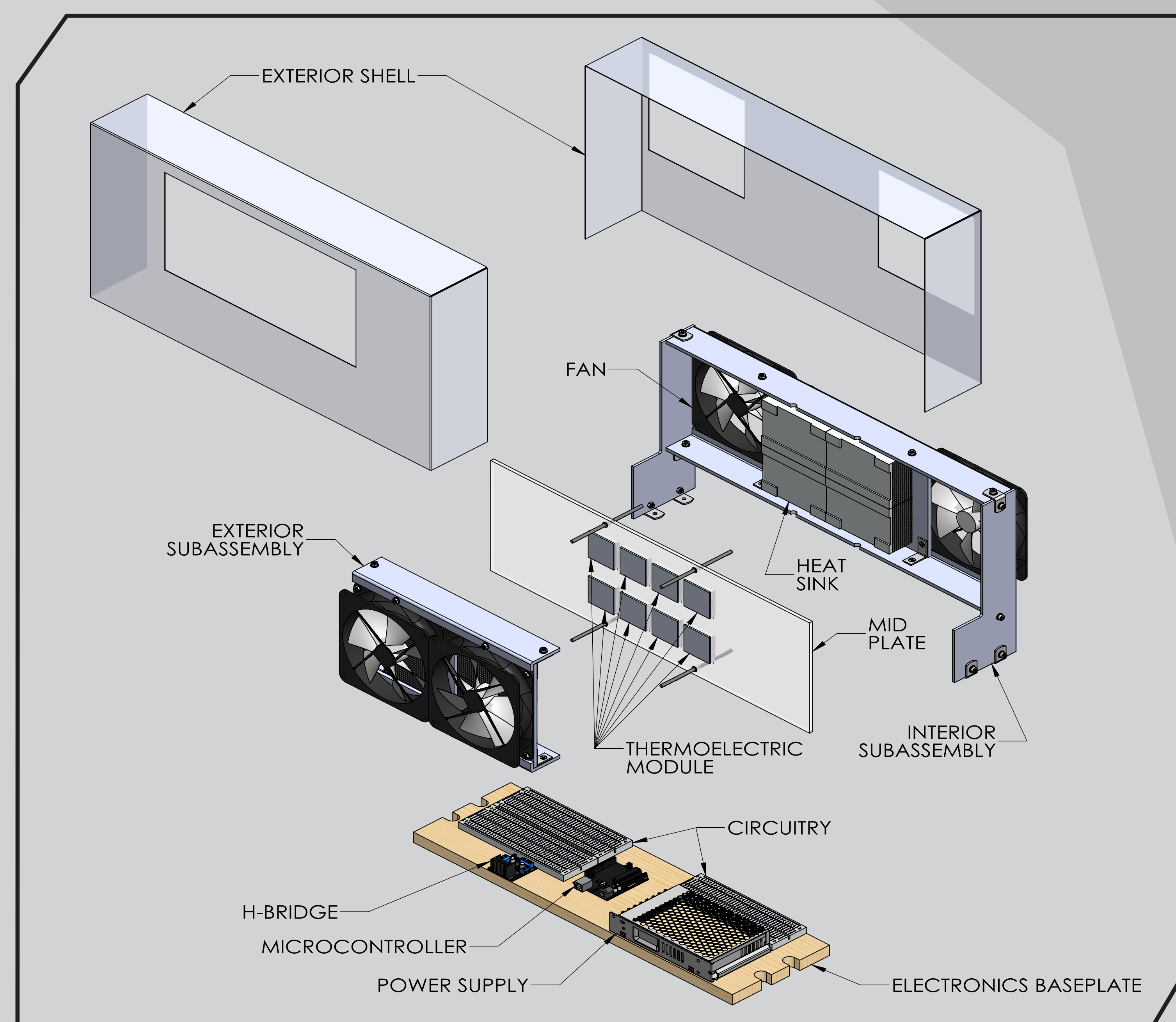
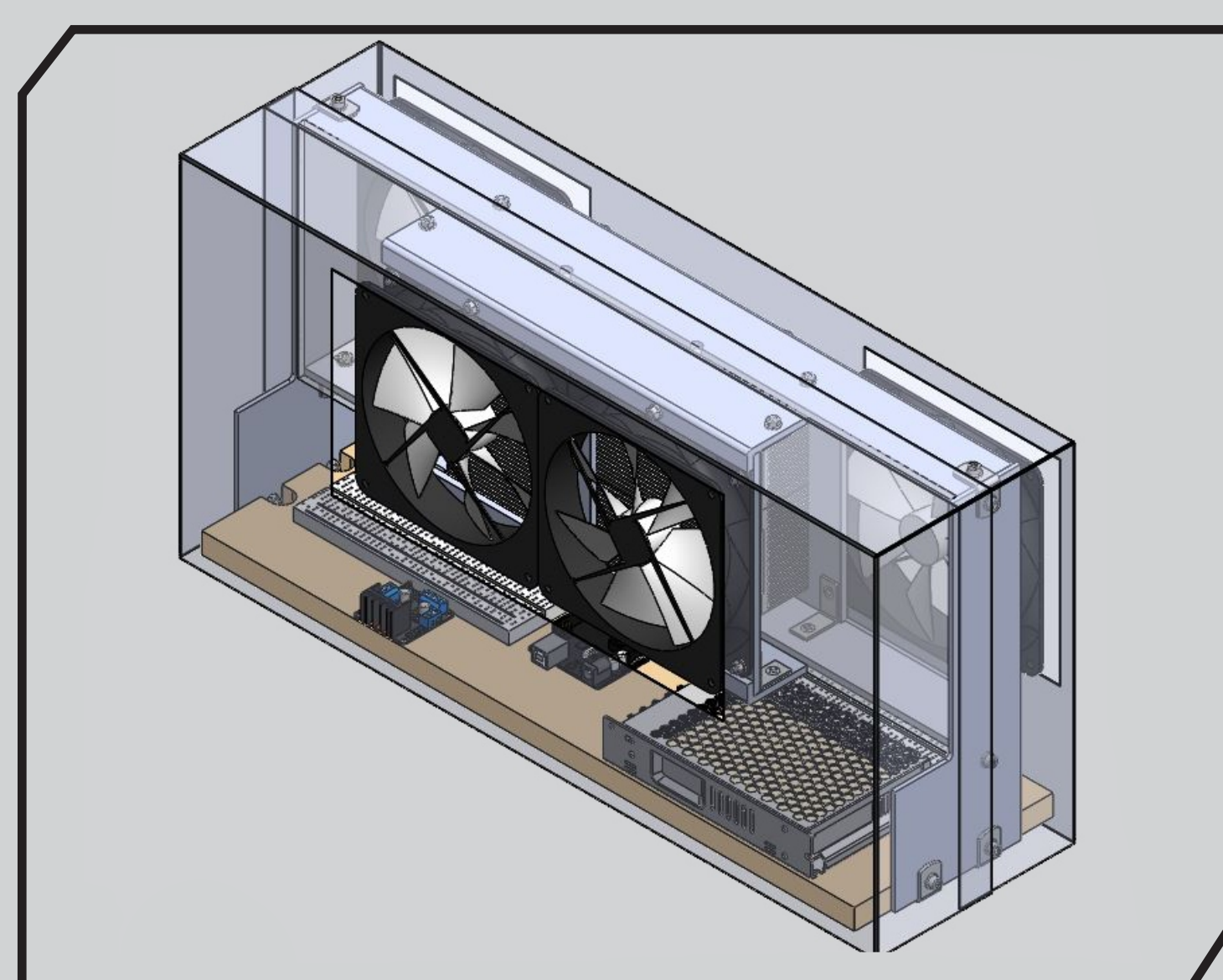


Problem Statement

Climate control is a very important factor for many different reasons and applications, including occupant comfort and safety. In terms of air conditioning, almost all commercial units operate using the vapor-compression refrigeration cycle which includes large and noisy components, such as a compressor, and hazardous refrigerant that presents a significant hazard to the environment.

Objective

Design a device that is capable of performing both heating and cooling applications that is more compact and efficient than traditional heating and air conditioning units. Additional requirements include incorporating components that are quiet when operating to reduce any unwanted noise that could be produced and eliminate the need to include hazardous refrigerant.



Final Design

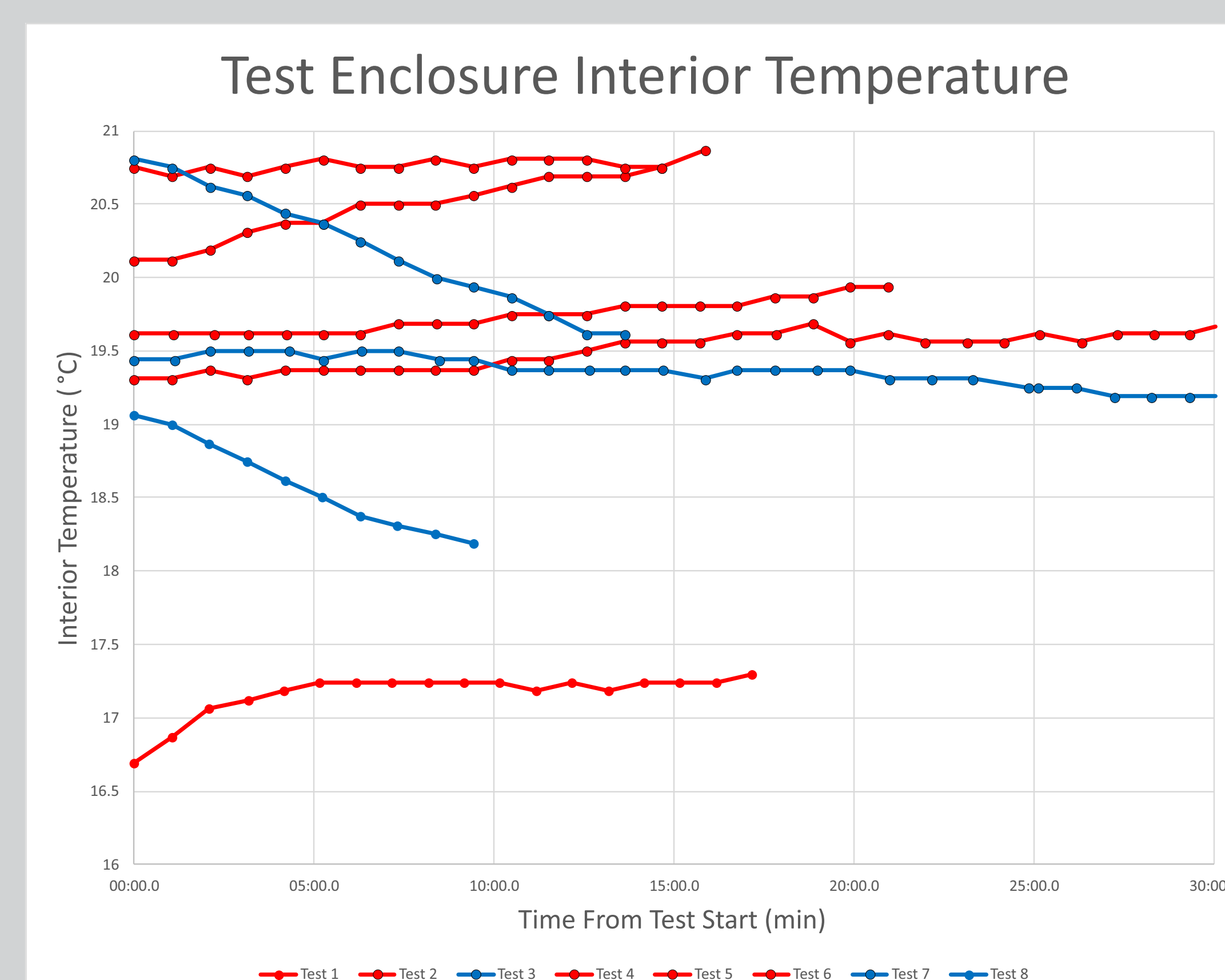
Main Components:

- Overall size: 150 mm x 260 mm x 530 mm
- 8 – 60W thermoelectric modules that are connected to four aluminum heat sinks on both the climate-controlled and exhaust sides of the unit.
- Two fans cycle air to get conditioned for the interior space, while two exterior fans push excess heat from the device to increase efficiencies.
- A custom, exterior casing that encloses all interior components of the device reducing the risk of internal damage to the unit and mitigating any potential electrical hazards to users.

Design Features:

- 60W Heating Capacity.
- Automatically switches the polarity of the TE modules which in turn swaps the hot and cold sides of the module thus allowing the ability to perform heating and cooling applications.
- Built in logic allows the unit to maintain the desired interior temperature set by the user.

Test Results



Climate control tests were conducted in a 64 ft³ enclosure to determine the device effectiveness and the results showed that the average heating and cooling rates are 0.61 °C/hour and 0.51 °C/hour, respectively.

Conclusions

The objective of this project was to design a climate controlling device, utilizing thermoelectric modules and the Peltier Effect as the key component of the design. The final design of the unit includes 8 thermoelectric modules and possesses the functionality to switch between cooling and heating of interior spaces. Our test results yield the following recommendations:

- Maximize the current and voltage sent to TE modules.
- Ensure optimal surface contact between the TE modules and the heat sinks.
- Clearly isolate exhaust and climate controlled chambers.