Section IV: Discussion

Overall, many of the objectives were accomplished, including:

- Using a phase change material (water) allowing the conversion of electrical energy by using the Peltier effect to create a “cold sink” for a temperature differential
- Using a phase change material (paraffin wax) allowing the conversion of electrical energy by using resistive heating to create a “hot sink” for a temperature differential

The output voltage was converted to +5VDC V, which continued for XX minutes. An Arduino processor and control boards were successfully used and built to control and digitally monitor the hot and cold portions of the battery.

Limitations included the lack of contact that the Peltier modules had with the heat sinks and heating/cooling tins, as the tins themselves were not sturdy. This created the issue of the thermoelectric cooler modules not making good thermal contact with the cold sink, and inability to freeze water. The tins were replaced with aluminum junction boxes of sturdy construction and large surface area for the thermal electric generator to simultaneously allow more efficient cooling and also more efficient thermal electric generation.

Previous studies found have only ever done this concept on a large scale and used non-phase change materials such as sand. Applying this method to a home-scale device is a novel solution to sustainable energy storage.

Application of the direct technology used in this device may not be feasible for home use, as the technology for Peltier devices is inefficient and not cost effective when scaled. However, the same concepts could be used by utilizing different technologies for cooling (using compressors as heat pumps) and thermal generators powered by Stirling engines rather than the Seeback effect.

Future Research

The thermal transfer efficiency was found to be paramount in the success of storing and utilizing a temperature differential to generate electricity. Some future research can be done on the most efficient way to transfer heat energy, including testing of different thermal pastes, glues, and tape; and testing of heat transfer coils embedded in the cold and hot sinks themselves.

Section V: Conclusion

The goal of this project was to construct a thermal battery that could store electricity without the use of harsh chemicals for home use. In doing so, a temperature differential needed to be created using sustainable electricity. To store the maximum amount of electrical energy, it was decided that phase changes were to be made. Overall, three aspects of the battery were developed and completed: cooling (freezing water), heating (melting paraffin wax), and thermoelectric generation. Freezing water was done by Peltier modules by providing them clean energy. Melting paraffin was done with resistive heating, and electricity was generated by thermoelectric generator modules. Each aspect was tested separately before testing the entire system. The energy input was XX in total, while the output was XX. Extrapolating this data for a home system, this system would be to be adapted to be feasible for home use. Future work is needed to improve battery efficiency.