Harvest Thermal Extraction System R&D

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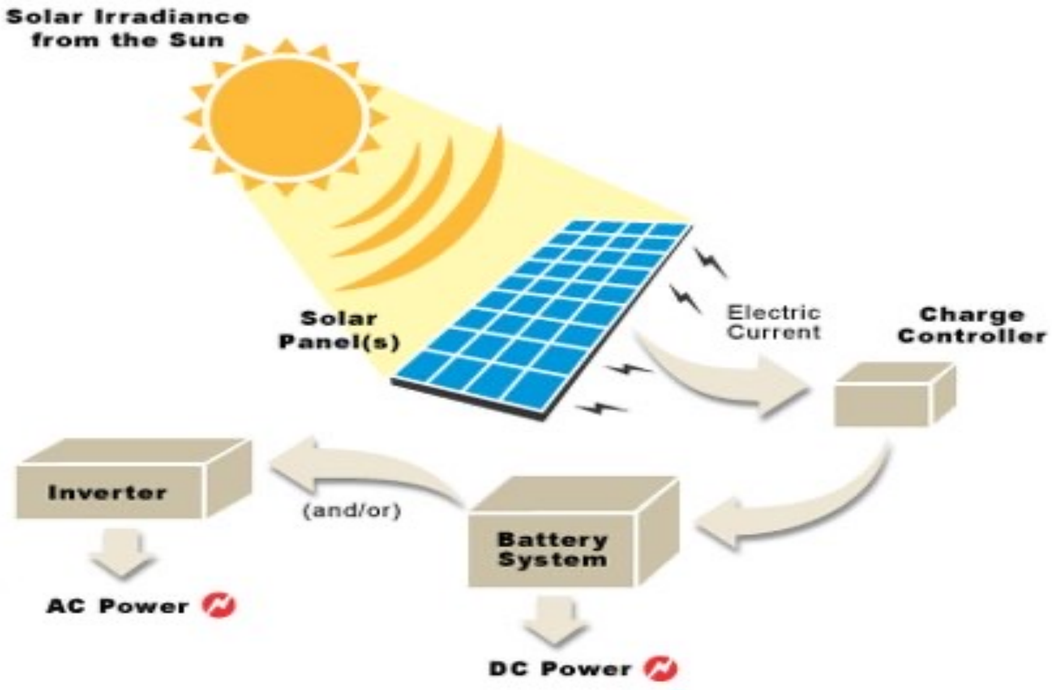
Project Background: Over the years solar panels have been a big contributor in making a mark in the efforts of sustainable energy. One of the main issues that puts its global potential on hold is the temperature during extreme weather conditions. Due to insufficient methods of dissipating solar heat, solar panels experience internal temperatures that can go north of 65.6 degrees C. Solar panels are estimated to experience a minimum of around 12% electrical production loss during high temperature days. Resulting in an average temperature coefficient loss of 0.3% deg C for every degree above 25 deg C.

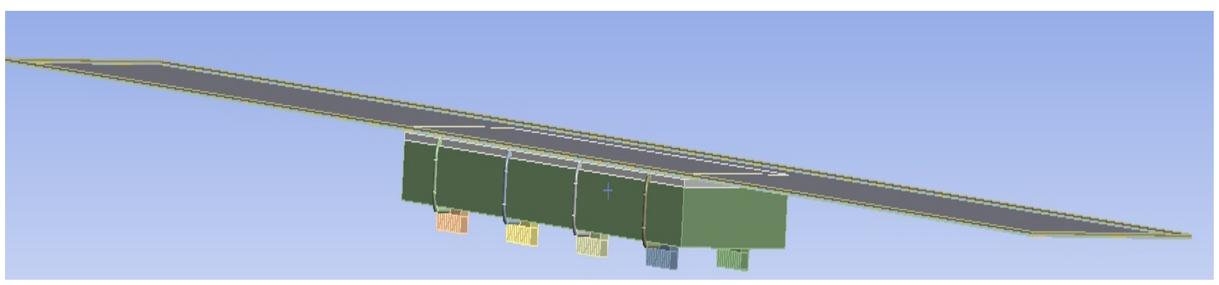
Project Goal/Objective: The objective is to create an integrated PV panel and battery system in place that will include a cooling method which will eventually reduce heat to the battery and ultimately increase efficiency. This is prospected to be achieved with a layer of argon attached to the panel for cooling to help with the heat dissipation.

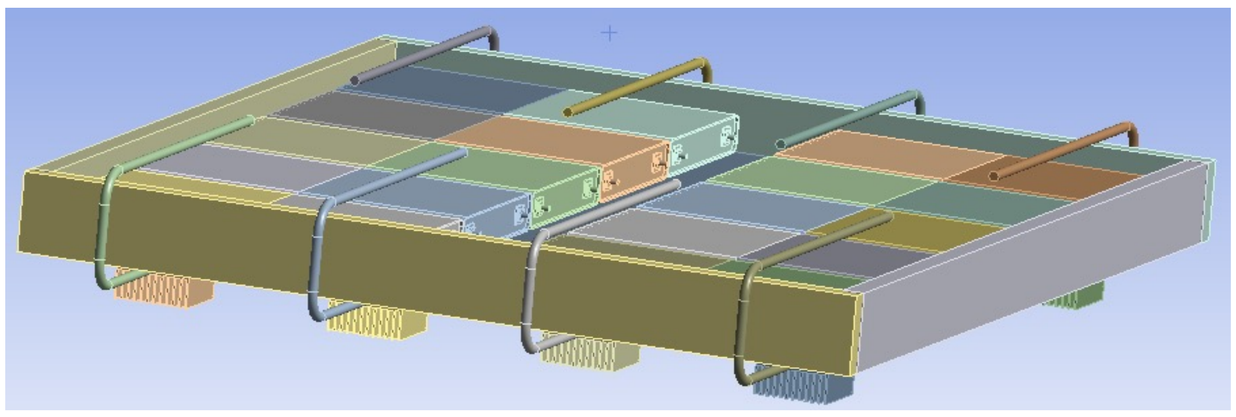


System-Level Requirements: Some of the system requirements include the following

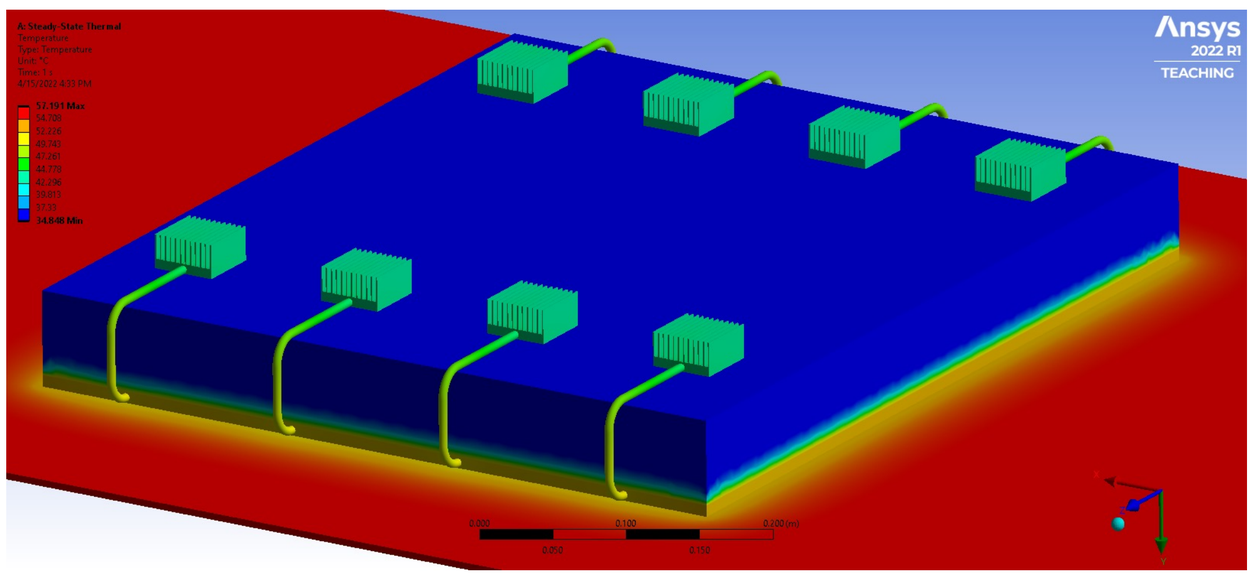
No.	Requirement Name	Requirement Objective	Capability
1	System Energy	Output Energy	1kWh
2	Single Battery	Output Energy	0.05 kWh
3	Temperature Limit	Maximum Temp	100 F or below
4	System Power	Output Power	400 W

Overall Design Approach

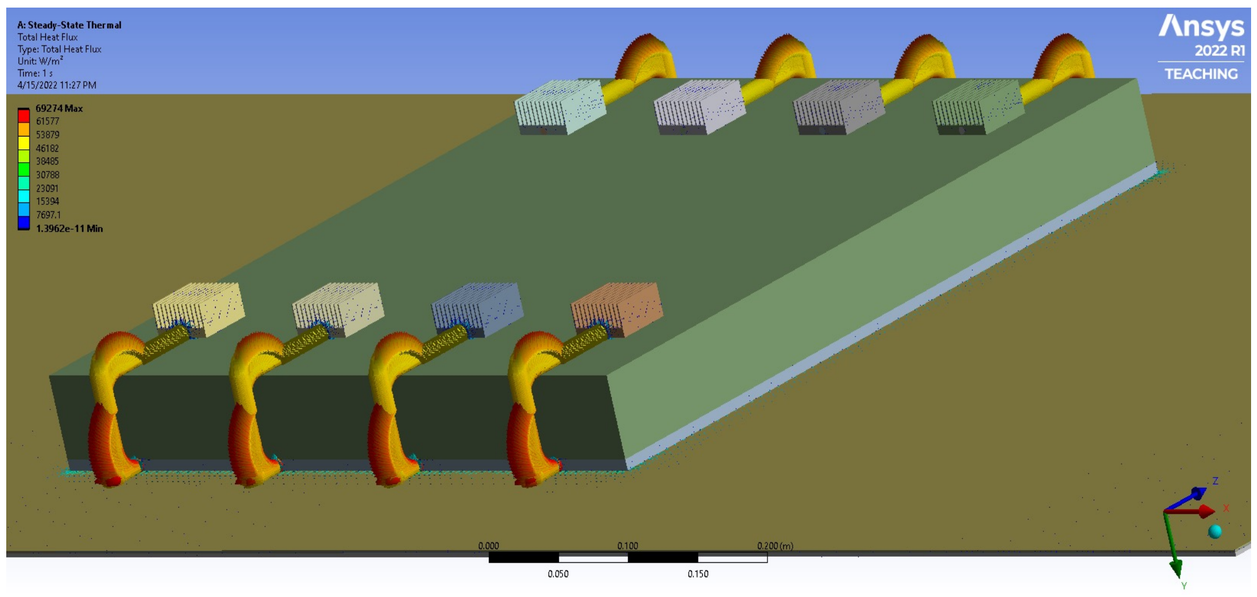




Results (From testing etc.):



Temperature results from the revision model (Min: 34.8 C – Max: 57.2 C)



Total Heat Flux results from revision model (Min: 7697 W/m^2 – Max: 69274 W/m^2)

Major Conclusions/Findings:

By creating a method to divert the heat that occurs from the PV Panel away from the battery casing, it allows the batteries to experience less thermal load. Adding an additional layer of insulation on top of the batteries also prevented heat penetration to the case. The heat generated from the batteries was not significant enough under expected loads from testing that required a separate thermal extraction method.

Future Improvements:

Implementing a pumping system to circulate water through the pipes. This would also include power expectations to operate. Testing other coolants and see if they would provide a greater benefit while comparing the cost. Another improvement can be applying a cooling method to the PV Panel itself to see if it the advantage from a lower temperature would justify the cost from cooling.