Photovoltaic (PV) System Improvement and Thermal Electric Dissipation

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Goal

We ventured into improving the Photovoltaic efficiency of solar panels by reducing the heat generated, transforming the wasted heat into usable electricity, and improving the power output of the system in the inverter's transformer. Overall reduction of wasted energy, be it in solar or heat, and improving the system as a whole.

Motivations and Objectives

- *Motivations*
  - Sunlight is free and ubiquitous.
  - Solar technology still expensive and wasteful.
  - Renewable energy is the future for safe green power.
- *Objectives*
  - Improve Photovoltaic cell efficiency.
  - Build a system that is simple and accessible.
  - Cool the panel while transforming the heat into electricity.
  - Make the inverter reliable and efficient with BiTT Technology.

Research Challenges

- *Funding;*
  - In order to do proper R&D, our team set out to try different approaches. We wanted to be sure that we achieved excellency within the time constraint.
- *Dealing with heat;*
  - Reducing the effect of heat on the panel's efficiency, and effectively transforming the heat into energy.
- *Transformer Manufacturing;*
  - We initially started working with a company to develop the transformer, but it drastically raised the overall cost of the system.
  - In order to make keep this project accessible and green, we recycled transformers and built our own BiTT.

Acknowledgement

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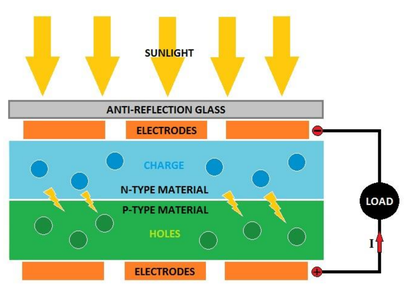
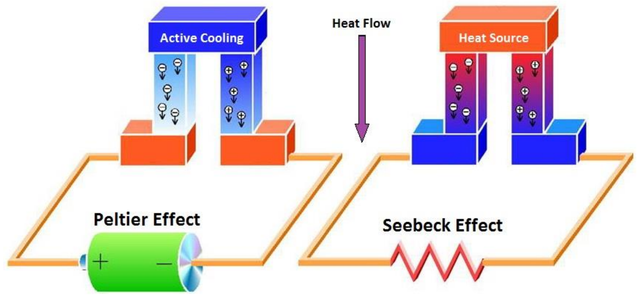
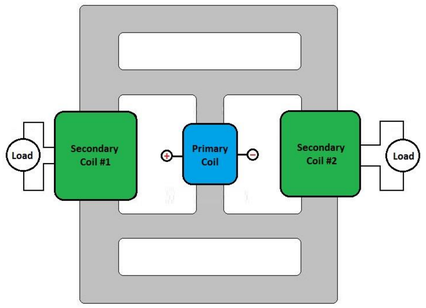
Methodology

- *Thermoelectric Effects*
  - Seebeck Effect: Conversion of temperature difference across a thermoelectric material into electrical power.
  - Peltier Effect: Temperature difference that occurs when voltage is applied to the end-points of two plates connected by semiconductors materials.
- *Laws of Thermodynamics*
  - Energy can neither be created nor destroyed, only transferred or changed from one form to another.
  - The entropy of any isolated system always increases.
  - The entropy of a system approaches a constant value as the temperature approaches absolute zero.

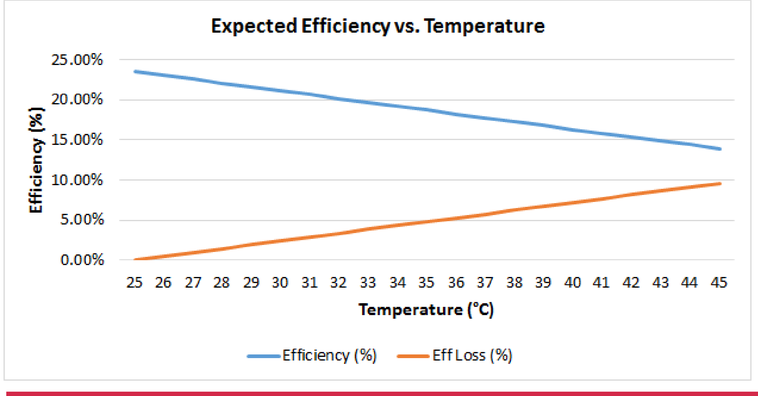


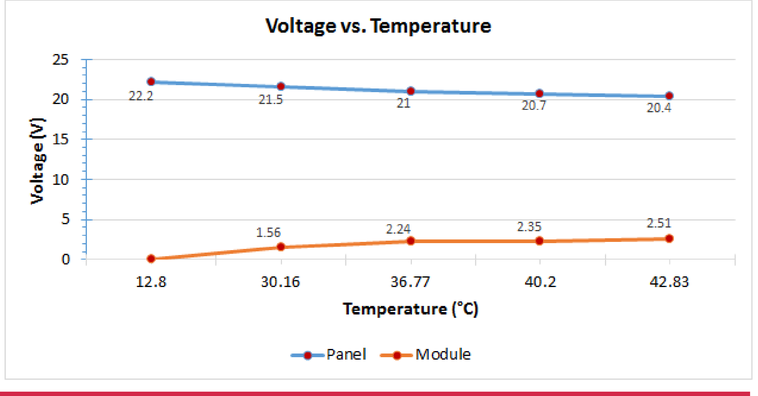




Results

- *Solar Panel*
  - On a 15°C sunny day, the panel alone had an initial output voltage of 22.2 V, and a final output of 20.4V. The TEG modules output rest at about 2.51 V at approximately 42.8°C.
  - This shows that as the solar panel lost efficiency due to temperature rise, the TEG modules made up and exceeded the voltage difference.
- *Bi-Toroid Transformer, or BiTT*
  - With plenty of room for development, our BiTT demonstrated to be very different from conventional transformers.
  - In one experiment, the phase shifting between the voltage and the current did not alter by much when using a 5Ω/10W resistor to produce ~7W.





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