Problem Statement
A common theme in the automotive industry, but also all over the world, is “going green.” Everyone wants sustainable energy, or a new way to save money. Using electricity in vehicles is the next best thing to save gas. The range of electric vehicles is vast, anything from using electricity and gas together, or full electric. Something that every vehicle has in common is that it generates a lot of heat, or energy. Most of that energy is contained and used, but there is also waste heat. Most waste heat exits the engine or generator through the exhaust on conventional combustion engines. Most designs start expensive, and bulky. As the technology of thermoelectric generators (TEGs) advances and improves, the overall design becomes more effective. We set out to find an innovative, inexpensive solution to harness waste heat from the engine to recharge the car battery. Any temperature difference on the opposing faces of the TEG will generate current, so whenever the engine is on, and heat is being produced, the TEG will be generating current.

Design Concepts

Final Design

DVP&R

FMEA

Design Criteria
The car that we have chosen to use as our baseline vehicle is the 2016 Chevy Volt. It has a moderate price, moderate range, and moderate rate, all comparable to non-range extending hybrid electric vehicles. The battery capacity, therefore, the range, and the weight of the vehicle are the most important factors in our project that we will need to pay attention to. The battery capacity of the Volt is 18.4 kWh, making the pure electric range of the vehicle 50 (mi), the total non-stop range 400 (mi), and the total range with plug-in 1000 (mi). The weight of the vehicle is 3,530 lbs.

The main criteria that we have set forth for this project is that the design must be very efficient, meaning it must work to the best of its capability while being light and cheap. We would also like to make as few changes to the car as possible. The last thing that we want is for the system to be “Smart”, meaning it has the capability of protection from overcharging, over current, and overheating.

Final Results
Chevy Volt moving 30 m/s, with an outside temperature of 20 C. The average engine temperature was 120 C and engine bay air speed was 5 m/s. From this information at steady state we concluded that 630 W of thermal power were going through the TEG. The Seebeck effect (thermal energy in = electrical energy out) is only about 5% efficient, meaning only 31.5 W of electrical energy were coming out of one node to be used to charge the battery. This means that to add 5% to the 18.4kWh battery, we would need 30 nodes in our system to pass the requirement to an additional 0.945kWh. The system can be placed into two rows and take up an 80 x 600mm area at the back of the hood, each node costs $2.99 and 0.2 lb, making the total $89.70 and 6 lb.