Capturing Waste Energy from North Dakota Oil Field Flares

Spilman, Eric

Flaring natural gas at oil production sites continues in North Dakota at elevated levels. Building on my project from last year, a proof of concept device was constructed from thermo-electric chips to recover electricity from waste heat oil field flares. This prototype was tested using a portable lab butane-fuel burner to simulate flare heat. Assuming an average USA household consumption of 90 MMBTU/year, the flared gas in North Dakota if captured could heat 2.7 million households at current efficiency levels. My project explored production of electricity directly from heat via the phenomena known as the Seebeck Effect. This project focuses on how it can be used to generate commercial quantities of electricity. Measurements of temperature, and electrical potential and current were taken. The cycle was repeated multiple times using different flame intensity as recorded by a thermo-imaging camera. The data was plotted to identify behavior on temperature impacts to the on amount and quality of electricity produced. Based on the data collected during this experiment, conclusions from the project include: 1. Electricity can be generated directly from heat flow using a solid state thermoelectric device. 2. Both electrical potential and current in a thermoelectric device are directly affected by both configuration and size of the device(s) temperature difference. 3. Proof of concept device successfully demonstrated direct recovery of electrical energy from flame waste heat. I expect to use my experience from this year as the basis for a future science fair project.