**The Summer Undergraduate Research Fellowship (SURF) Symposium**
**2 August 2018**
**Purdue University, West Lafayette, Indiana, USA**

# Thermophotovoltaic Devices: Combustion Chamber Optimization and Modelling to Maximize Fuel Efficiency

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## ABSTRACT

Currently, 110 billion cubic meters of natural gas (primarily methane), a potent greenhouse gas, are flared off for environmental and safety reasons. This process results in enough fuel to provide the combined natural gas consumption of Germany and France. The research team developed a thermophotovoltaic device to convert thermal energy to electricity at a high efficiency using proprietary emitters and combustion system. With the current focus being fuel efficiency and the combustion process, the assembly was simulated using ANSYS Fluent modelling software and the following parameters were optimized: air/fuel ratios, flow rates, and inlet sizes. Simultaneously the heat transfer across the combustion chamber was modeled and its geometry was optimized. Higher flow rates resulted in higher temperatures on the combustion chamber walls; lean mixtures with higher air/fuel ratios also resulted in high exhaust gas temperatures. However, the residual curves hint towards a potentially unstable solution and require more iterations in the simulation process. The results of these efforts indicated that the combustion chamber has been optimized yet further work needs to take place to deem the process to be sufficiently fuel efficient.

## KEYWORDS

Thermophotovoltaics, Energy, Simulation, Modelling, Combustion