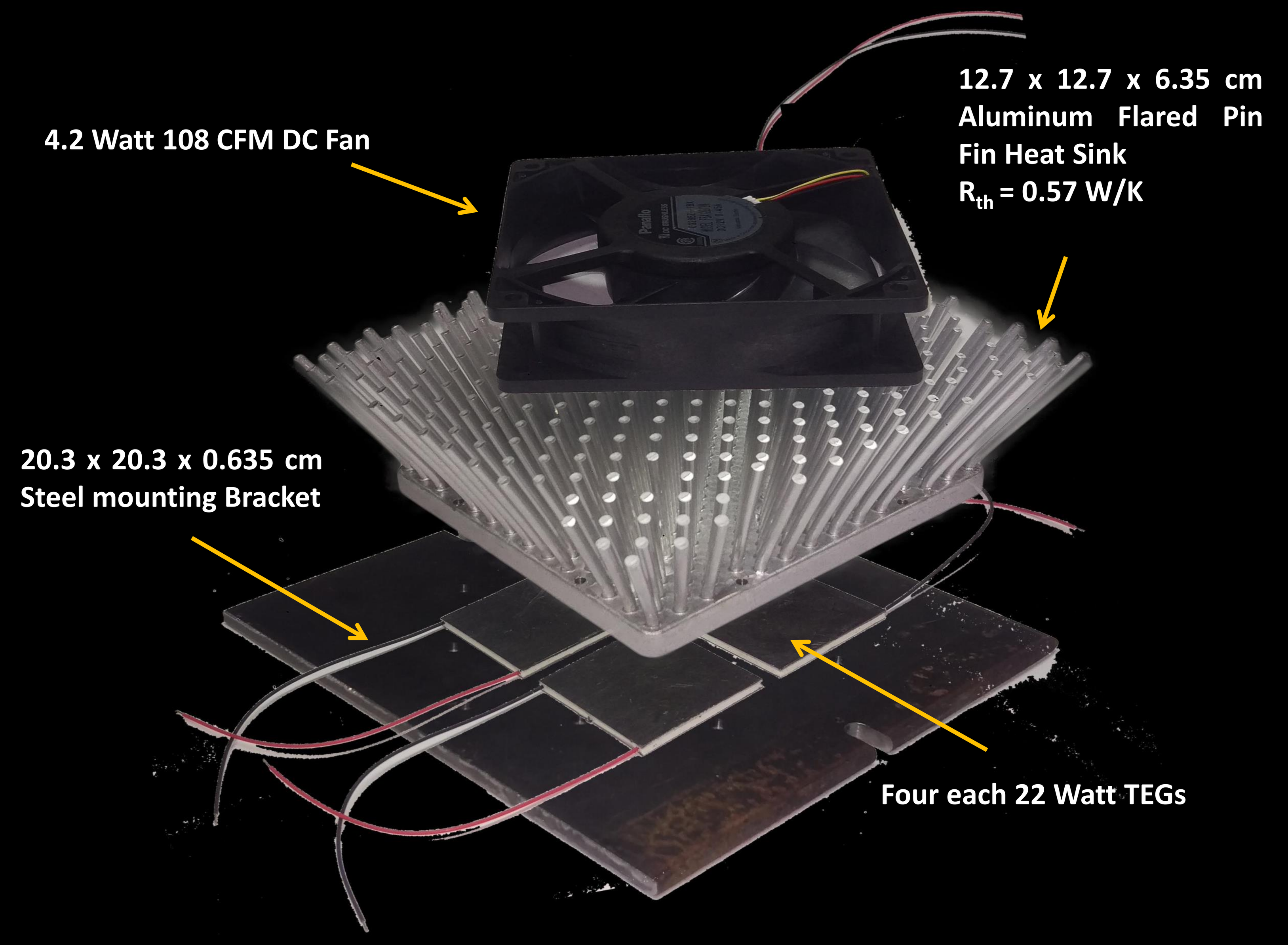
XXIV TwentyFourth Annual engineering ▪ design expo 2017

Flue Gas Energy Recovery

University of Idaho College of Engineering

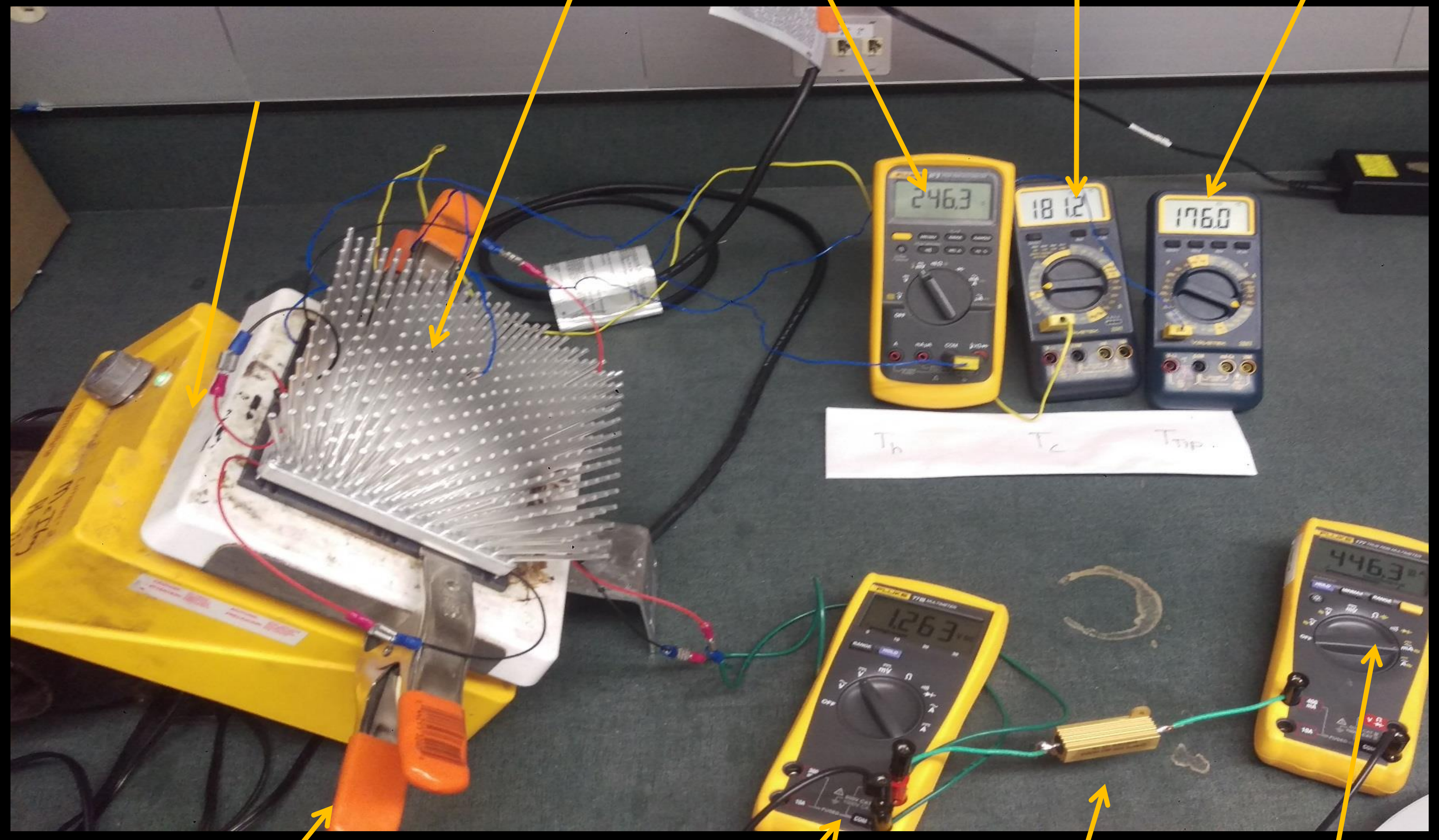
Modular Design



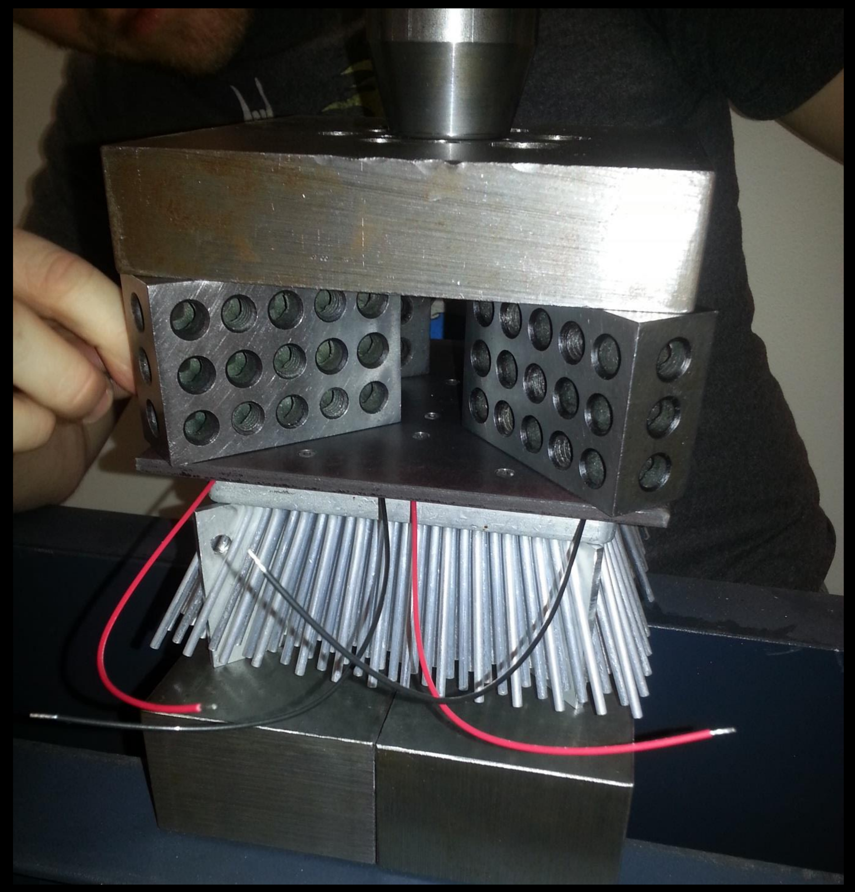
Team Fire and Ice:

Brandon Nafsinger Scott McMurdie Garrett Oman and Bryan Perkins

Testing



Manufacturing



Process:

- TEGs Require 4000 Newtons of compression for maximum heat transfer
- The Module is preloaded using a hydraulic press
- Bolts are tighten while under compression
- Through bolt design increases strength

Final Product:

- 6 modules
- Produces 72 watts of power (12 watts each)
- Electric Fans consume 24 watts (4 watts each)
- Producing 48 watts of usable power (8 watts each)
- 48 usable watts per 2000 watts of waste heat
- Connected electrically in parallel
- V_{out} = 12V @ I_{out} = 4A total (V_{out} = 12V @ I_{out} = 600mA each)

Problem

The steam plant at the University of Idaho has a large amount of waste heat that is expelled from many different surfaces. This is a common issue that occurs in many different power plants and industrial settings.

Solution

Our solution is to capture a portion of this waste heat by utilizing Thermoelectric Generators (TEG). This is accomplished by achieving a temperature difference across the TEGs surfaces. As the ΔT across the TEGs increases, the power generation also increases. Flared pin heat sinks and electric fans are used to attain this temperature difference. Therefore, heat that would normally be wasted is now turned into power used at the steam plant.

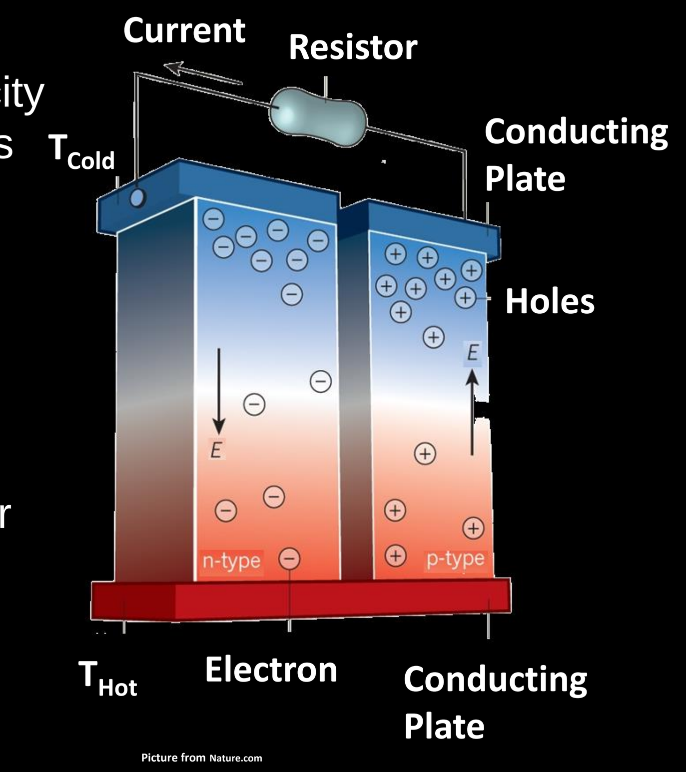
Project Learning

What is a Thermoelectric Generator :

- A device that utilizes heat flux to produce electricity
- Constructed of n-type and p-type semiconductors (Bismuth Telluride)
- Common efficiency between 5% to 9%

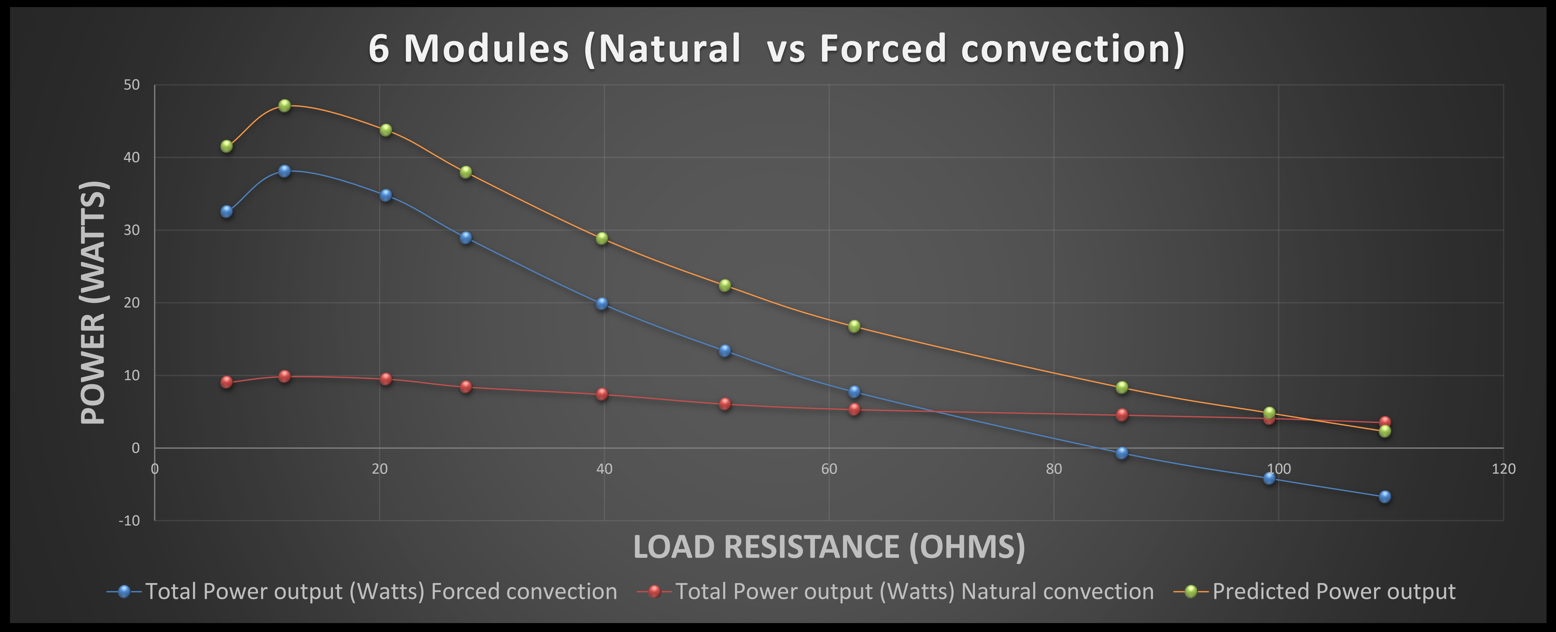
How a TEG works:

- Operate according to the Seebeck Effect
- Temperature difference across thermoelectric material is converted directly into electrical power
- The p-type semiconductors create an excess of electrons and the n-type semiconductors create valence holes for the electrons to flow into.



Results

T_{HOT}=240°C T_{COLD}=100°C



Thermal Modeling