Oregon State University

HydroBee

Capturing Waste Energy from Stove Exhaust Using Thermoelectric Generators

ETHOS 2020
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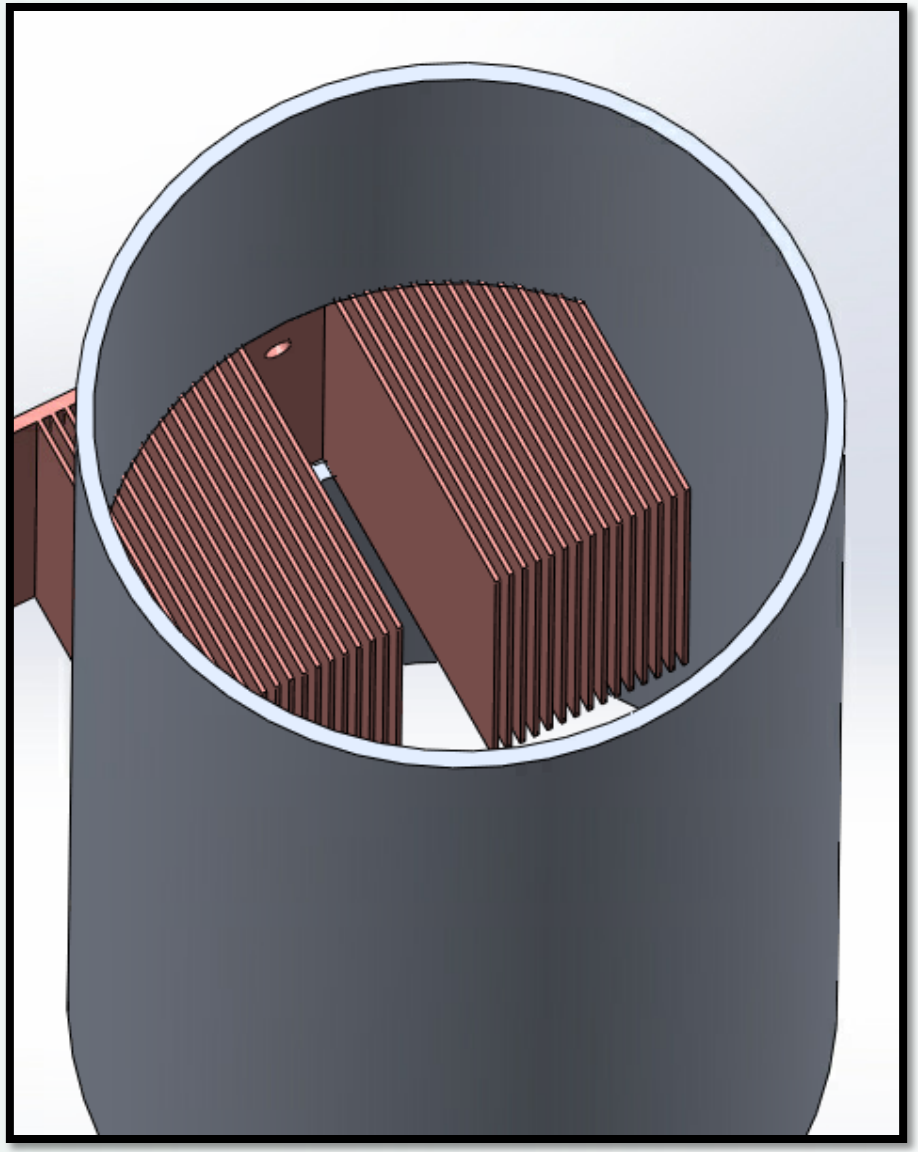
SYSTEM OVERVIEW

- Power generation for electronic appliances
  - Use waste heat
  - Create light
  - Charge cell phones → 5 Watts USB

- Temperature drop across Thermoelectric Generator (TEG)
  - “Hot side” powered by heat of chimney flue gases
  - “Cold side” provided by reservoir of water

CAPTURING HEAT

- Passive, solid-state heat sink
  - Cooling cannot be powered
  - No replacement or serviceability
- Must not disrupt flue operation
  - Long enough fins to catch heat
  - Not so long to disturb drafting
- Fin size affects heat transfer rate
  - Thicker fins improve heat transfer
  - More surface area increases heat transfer
- Flow condition influences heat transfer

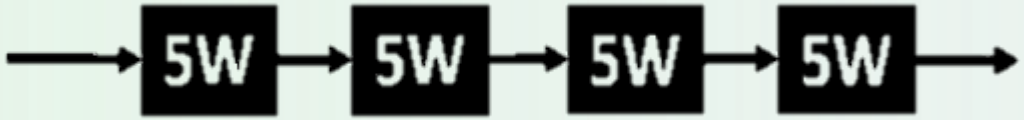


TEG POWER REQUIREMENTS

- Must achieve 5 Watts of power output
- Wiring TEGs in parallel vs series

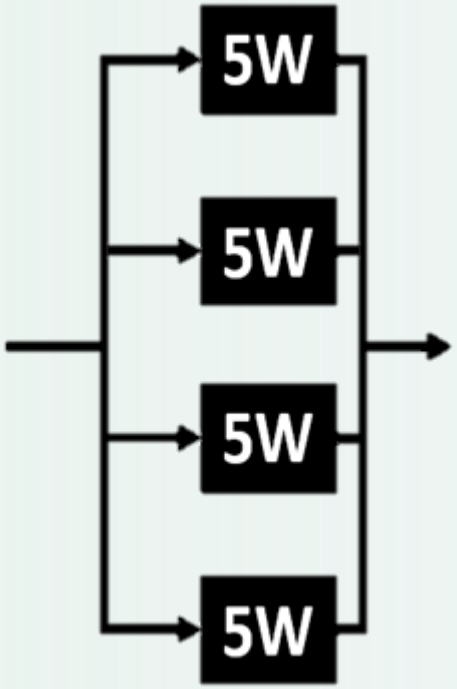
A

TEGs in parallel:
↓ voltage, ↑ current



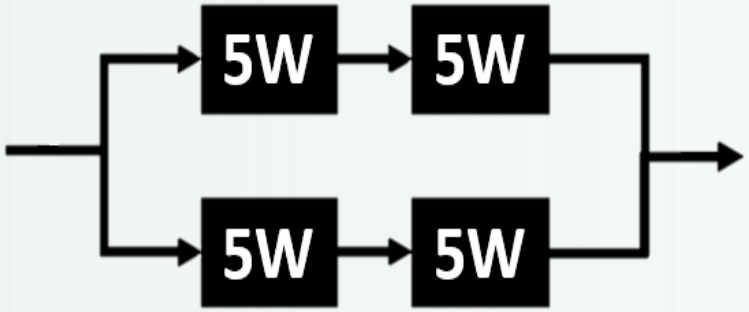
B

TEGs in series:
↑ voltage, ↓ current



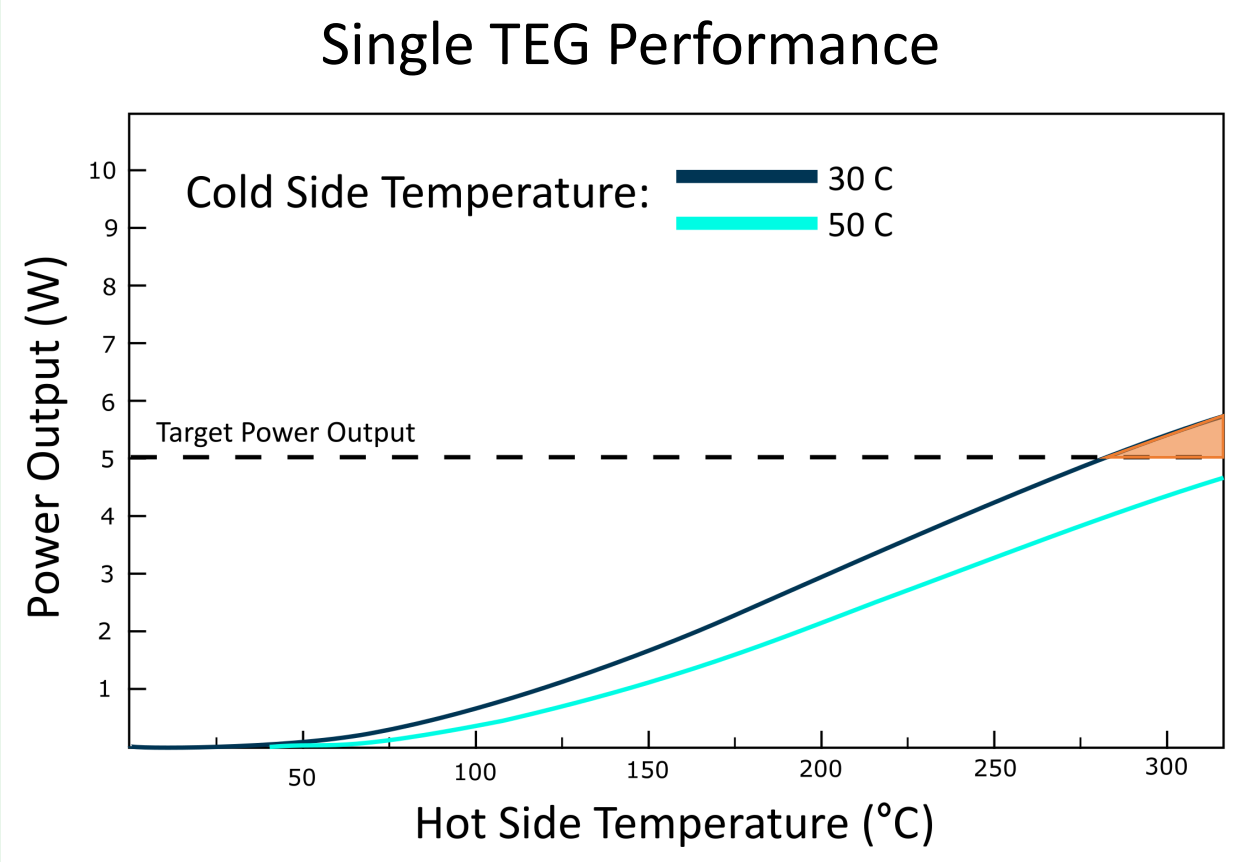
C

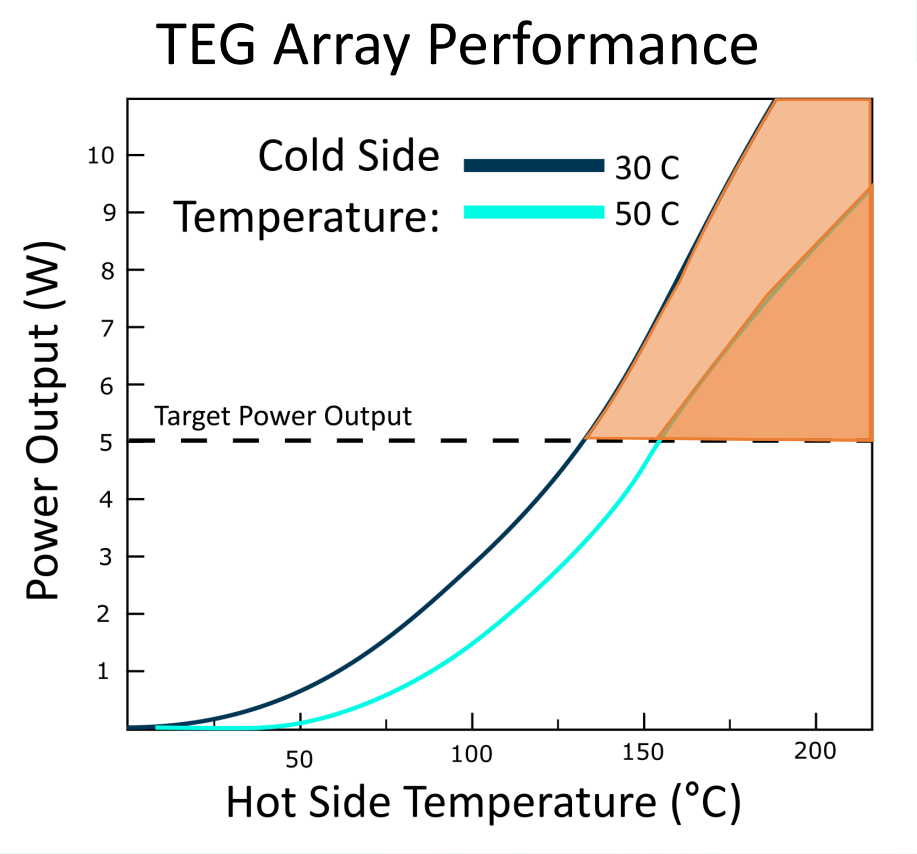
Proposed Design:



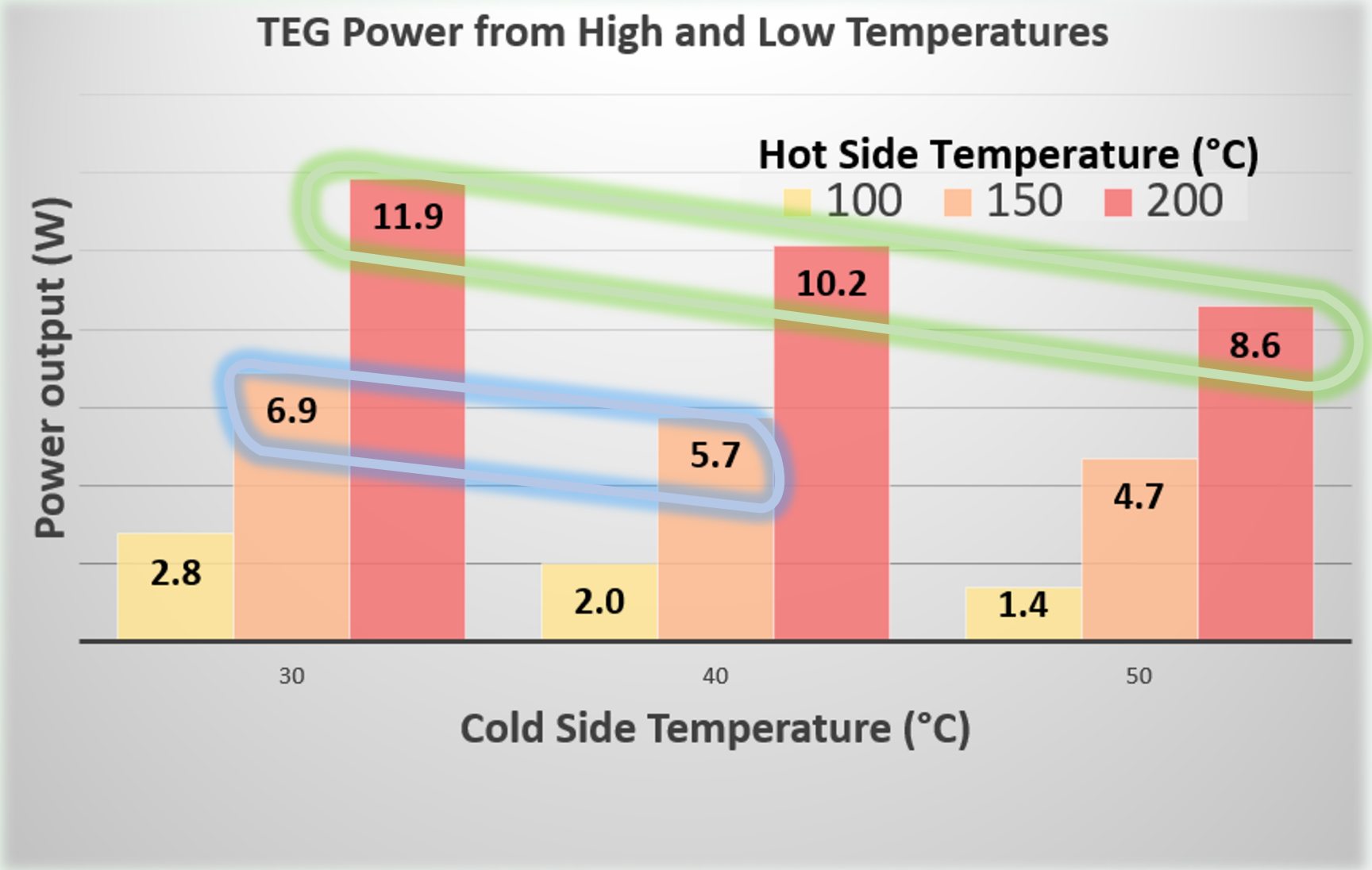
TEG POWER REQUIREMENTS

- Nominal data does not match empirical results
- TEG efficiency is 3% to 7%





TEG POWER REQUIREMENTS



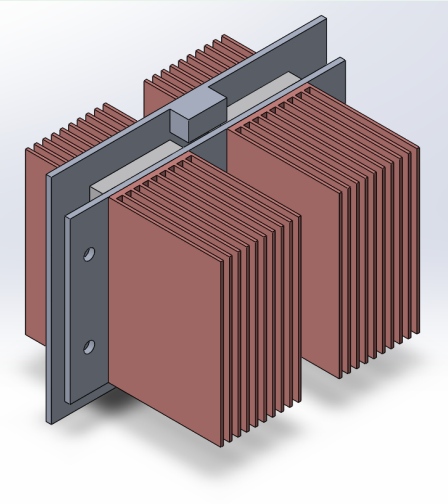
Typical Flue Temperatures

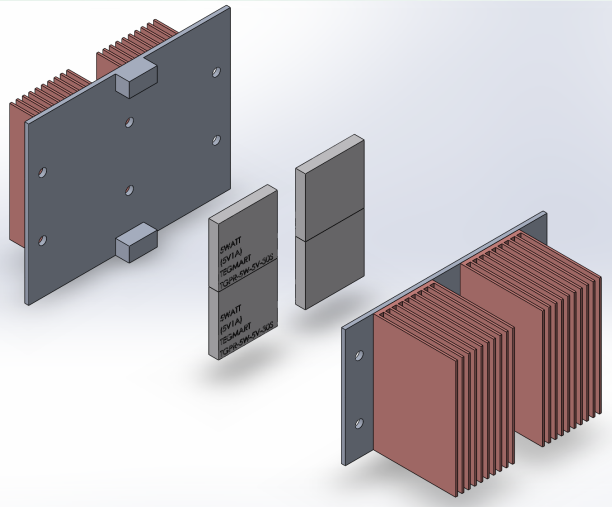
175°C to 350°C

Up to 50% losses through heat sink

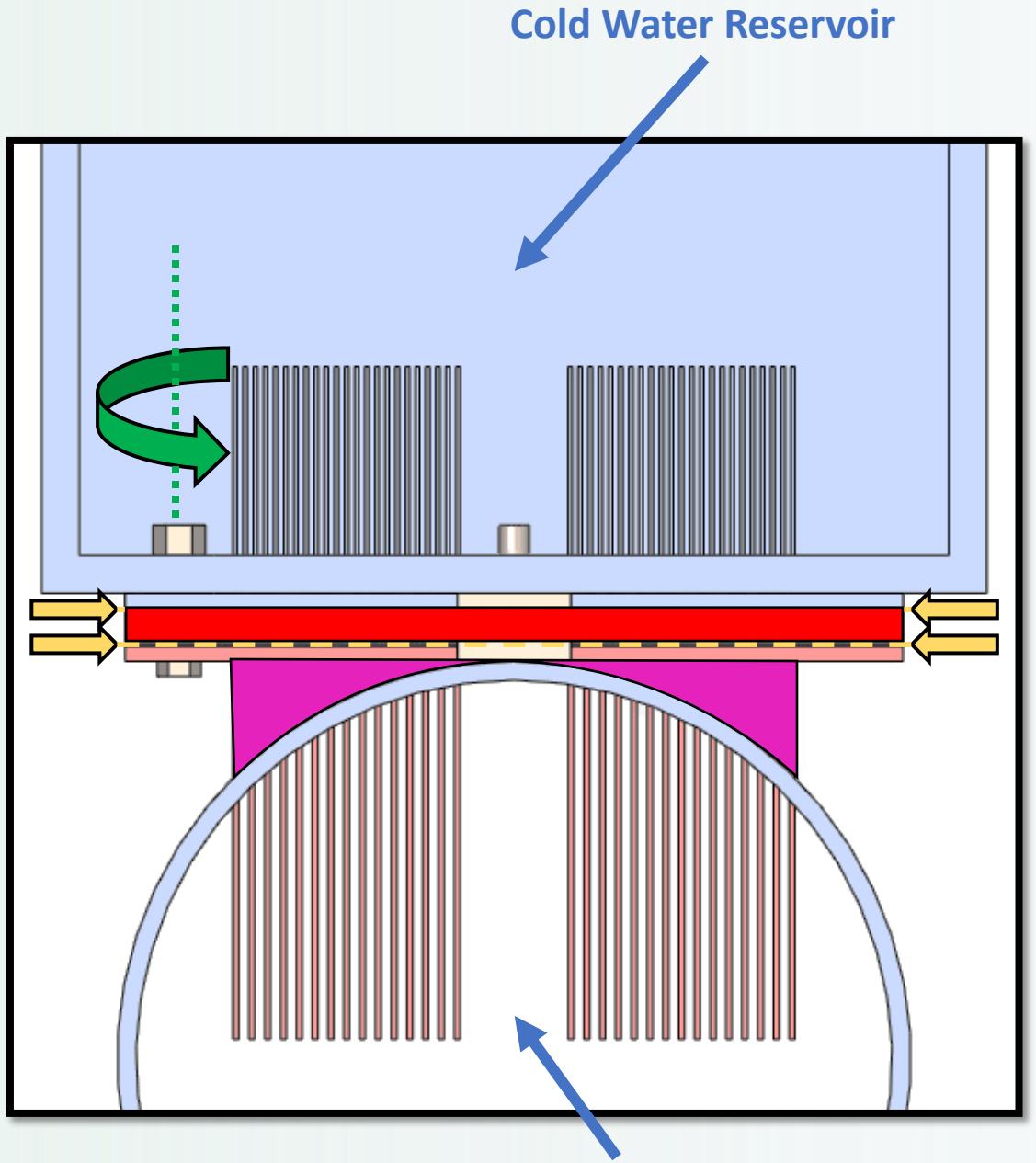
SYSTEM INTEGRATION

- Required specs for TEG mounting
  - Fastener location and spacing
  - Bolt torque for proper pressure





- Heat loss prevention
  - Ideal surface interfaces
  - Thermal paste to fill air gaps
  - Insulation surrounding TEG
  - Exposed heat sink due to chimney geometry



CONCLUSIONS

- Benefits of design concept
  - Works only from waste heat
  - Increases utility of stove
  - Makes stove price more worthwhile
- Drawbacks to design concept
  - Works opposite stove efficiency
  - May promote unproductive stove use
  - High implementation cost

NEXT STEPS

- What is the future of this design's technology?

Watts

- Microcontrollers
- Sensors
- Data Loggers

THANK YOU

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QUESTIONS?

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