Objective

**OBJECTIVE** Recapture fireplace heat in order to increase the heat envelope of the room through mechanical means using the thermal energy from the fireplace.

**JUSTIFICATION** Common fireplaces are inefficient—often resulting in a net loss of energy from within the home. To recapture energy normally expended out the chimney, our team is designing a product to output recaptured heat into the room through mechanical means.

**MARKET** Fireplace installation companies are direct customers. Homeowners are end users.

Concept Generation

**CUSTOMER REQUIREMENTS**
- High heat output
- Low noise level
- Maintain standard fireplace aesthetics
- Does not require frequent maintenance (low serviceability)
- Turns on/off automatically
- Does not obstruct cleaning of fireplace

**CONCEPT A** Magnet Impeller
- Decreased risk of leaks
- Few moving parts
- Requires high fluid flow

**CONCEPT B** Stirling Engine
- Well-documented technology
- Low number of moving parts
- Requires frequent maintenance

**CONCEPT C** Dual Piston with Actuator
- Versatile with regards to power source options
- High risk of leaks or broken seals

Design

**PRODUCT OPERATION**
- Boiler draws heat from fireplace to create high pressure steam
- High pressure flow expands over Tesla turbine blades rotating the output shaft
- Fan is directly connected to shaft and located in fireplace output vent for forced air flow
- Fan is directly connected to output vent for forced air flow
- Output steam is condensed and recycled back to the boiler

**SATISFIES CUSTOMER REQUIREMENTS**
- Minimal user interaction—only add water before use
- System hidden in fireplace

Prototype and Testing

Our prototype was tested to demonstrate the difference in the output heat envelope with and without the system running. A thermal imaging camera was used to visualize the effect a fireplace fan has on the output heat envelope using a flat screen perpendicular to the fireplace.

Test Results and Future Work

**PDP SUMMARY**
- Designed a system that met the design objective
- Derived final design from several iterations of concept selection process
- Satisfied critical to quality customer needs by expanding heat envelope

**HEAT ENVELOPE TESTING**
- Without Fan
- With Fan

**FUTURE WORK**
- Determine turbine’s max power output under ideal conditions
- Reduce noise output
- Design less intrusive boiler shape