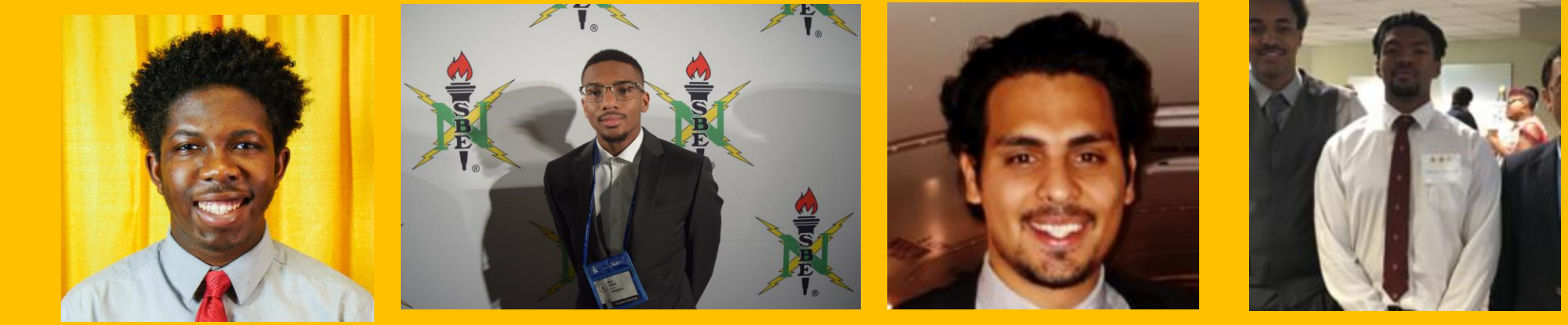




# Equilibrium – Hybrid Pressure Cooker

ENME 444 Mechanical Engineering Systems Design Spring 2020  
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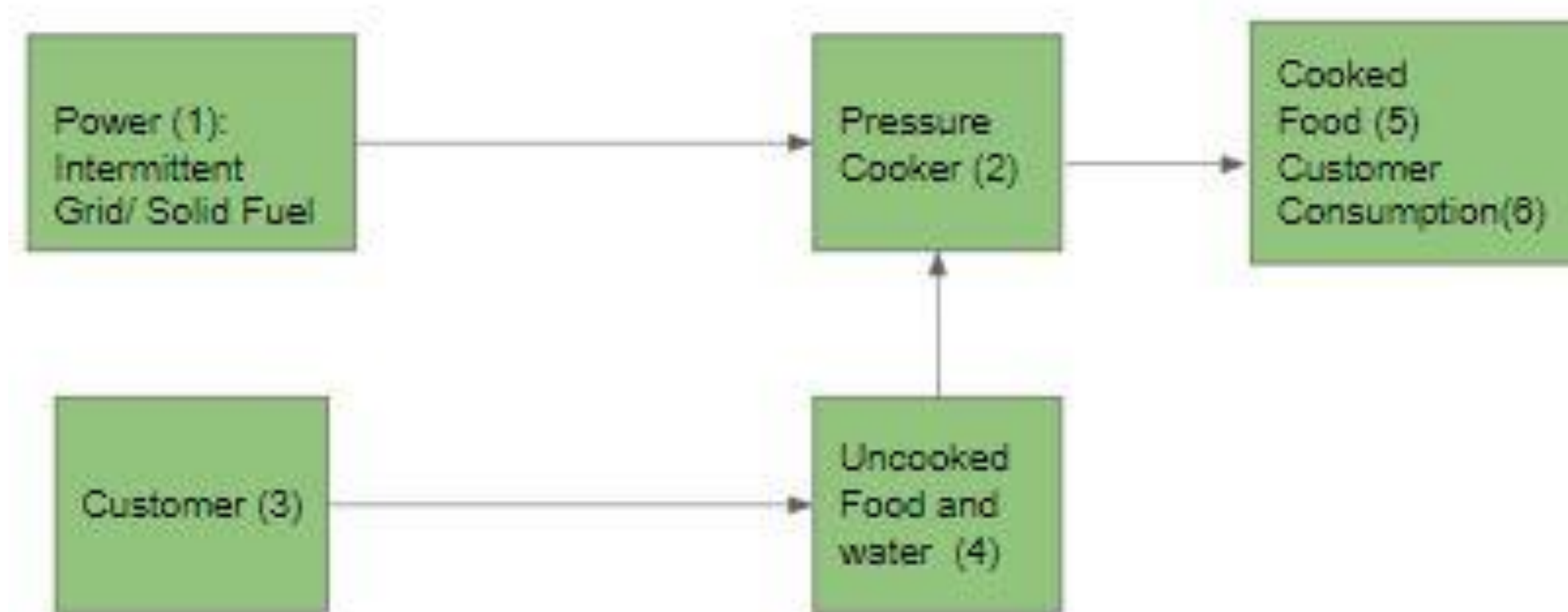


## Project Scope

**Background:** Across the developing world, *open flame* conventional cooking methods continue to have negative health and environmental consequences. Due to pollution levels, traditional cuisine, and team member cultural proficiency, Mongolia and Kazakhstan were chosen as target countries.

**Objective:** Develop a hybrid pressure cooker that takes advantage of solid fuel (coal, wood, dung, etc.) and electric resistance heating to reduce cooking time and minimize harmful solid fuel emissions.

## System Requirements

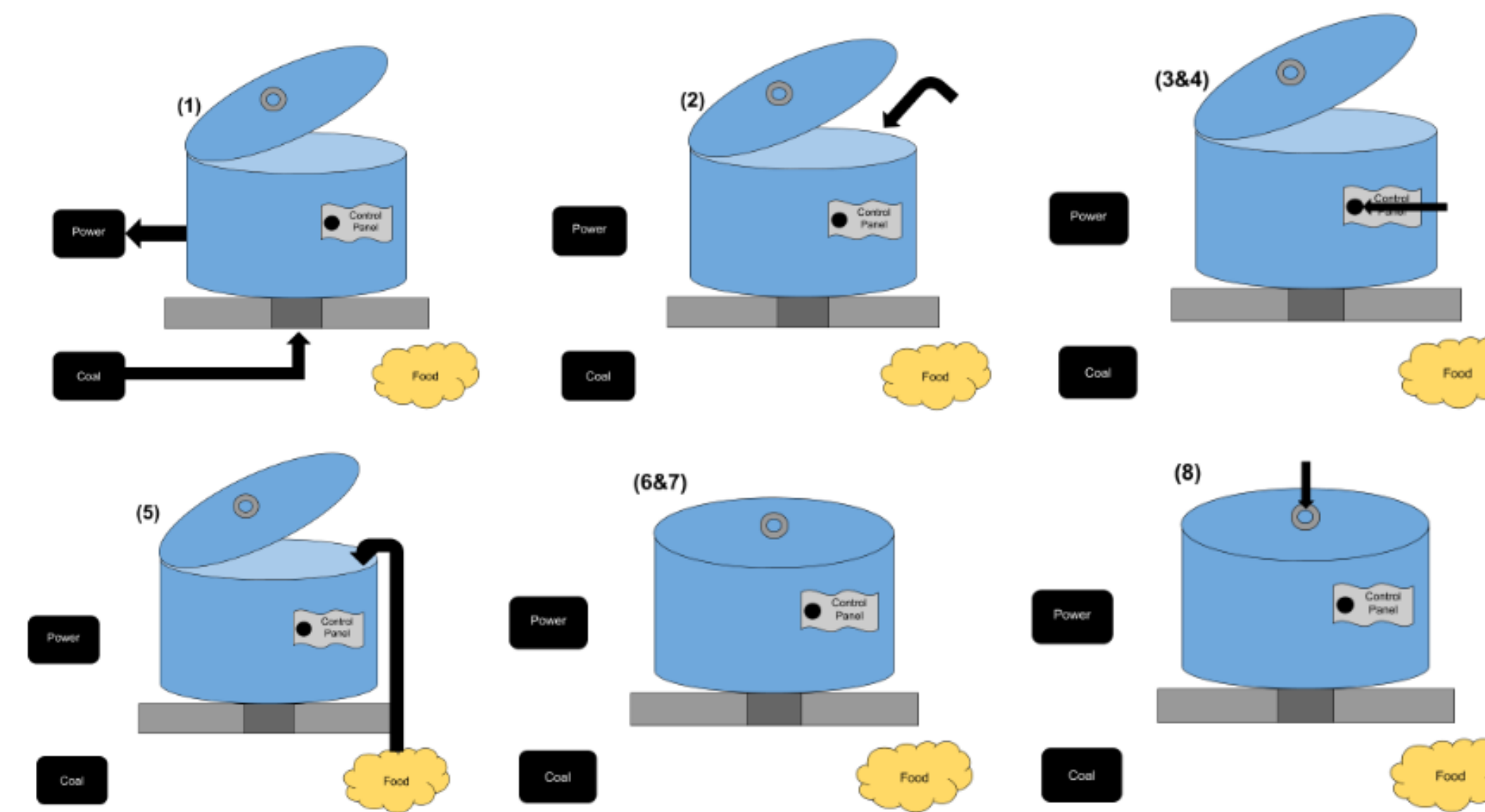


**Figure 1:** Functional block diagram

The pressure cooker requirements were found by emulating current pressure cooker models and adding in components to enable hybrid functionality.

- Maintain an internal pressure of 12psi
- Reach Pressure in < 30 min
- Be useable with either electric or solid fuel source

## Mission Scenario

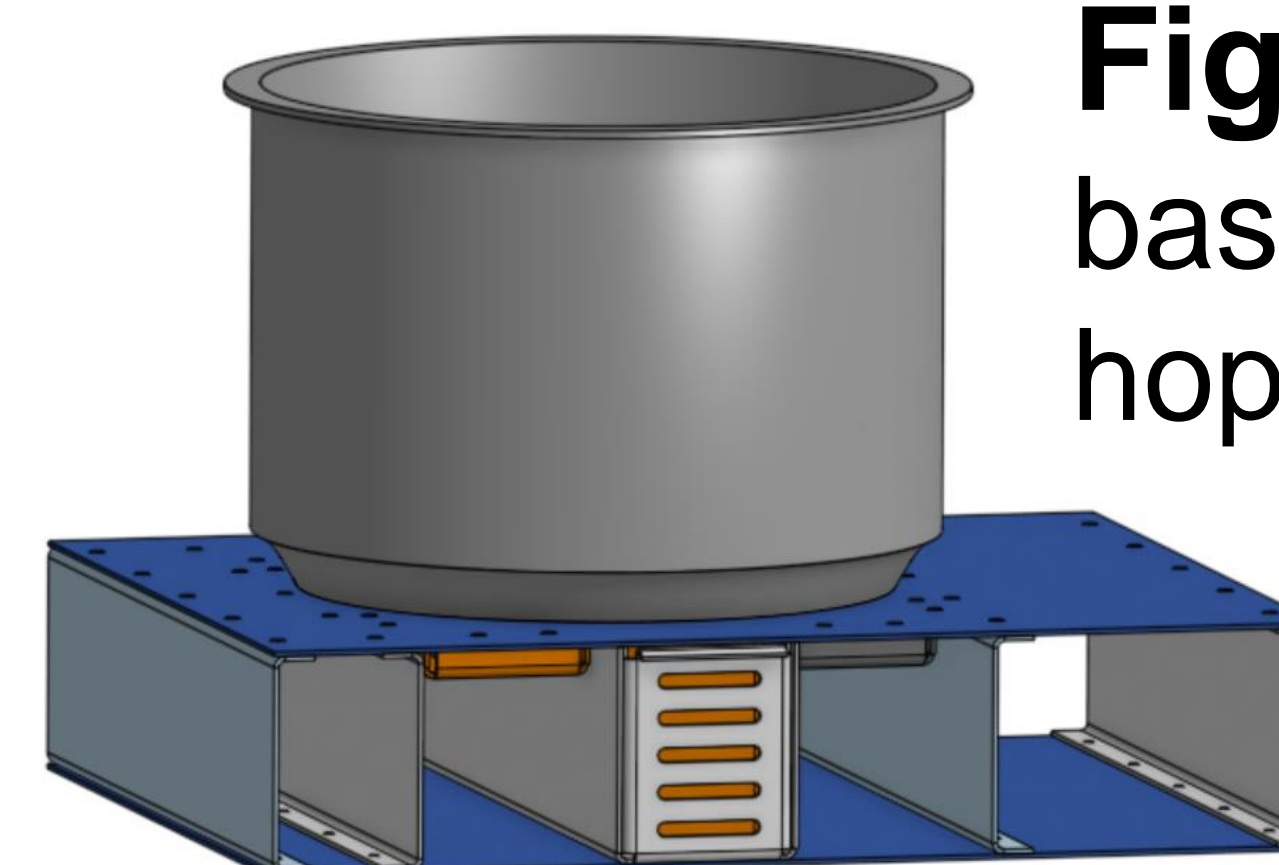


- (1) Connect the pressure cooker to its power supply and add coal to hopper.
- (2) Fill it with water.
- (3&4) Push the start button and the pressure cooker begins heating up.
- (5) Put the food to be cooked inside
- (6,7) Seal the lid and allow the system to pressurize and cook the food.
- (8) After sufficient time has passed depressurize the cooker before retrieving food

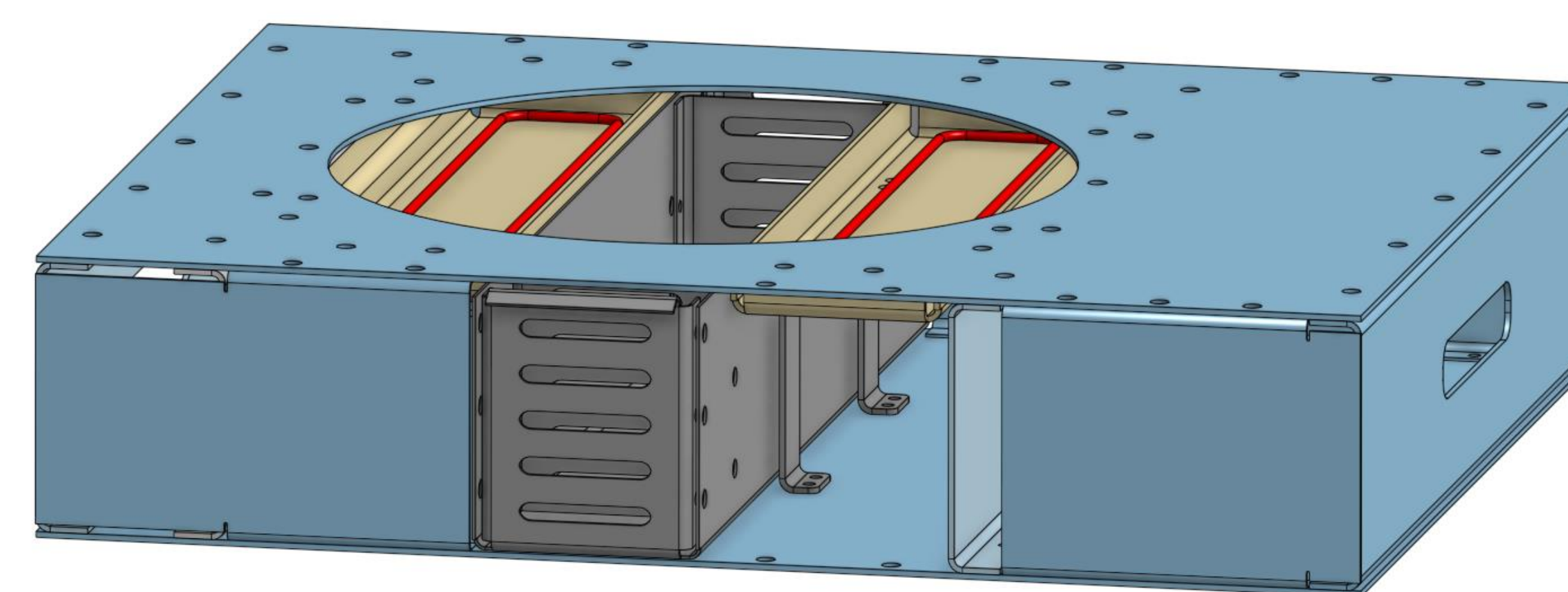
## Prototypes



**Figure 2:** Physical mockup that provided insight on the end users interaction and appropriate dimensions for the hybrid pressure cooker

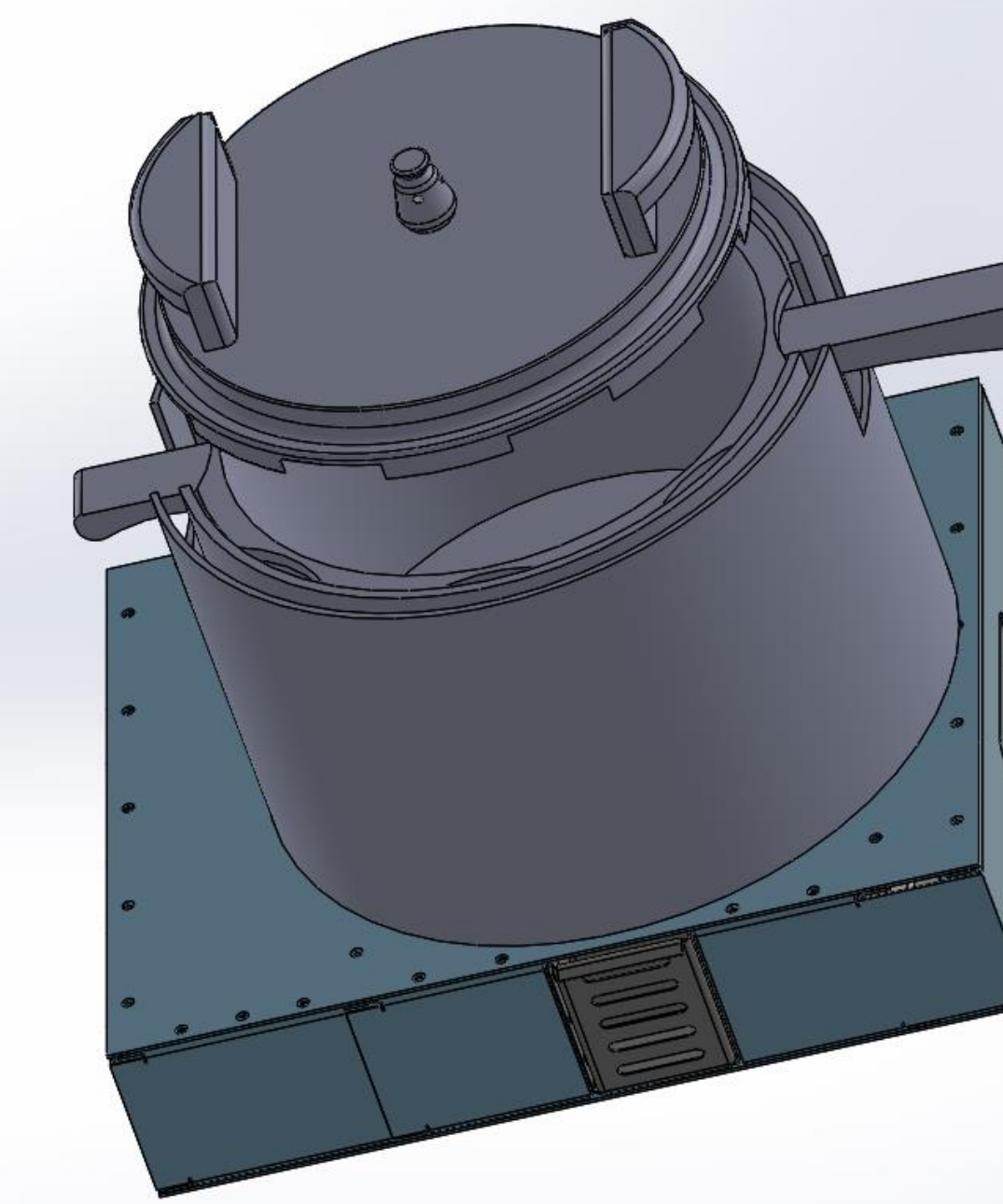


**Figure 3:** Initial revision of heating base CAD, focused on solid fuel hopper and calrod placement

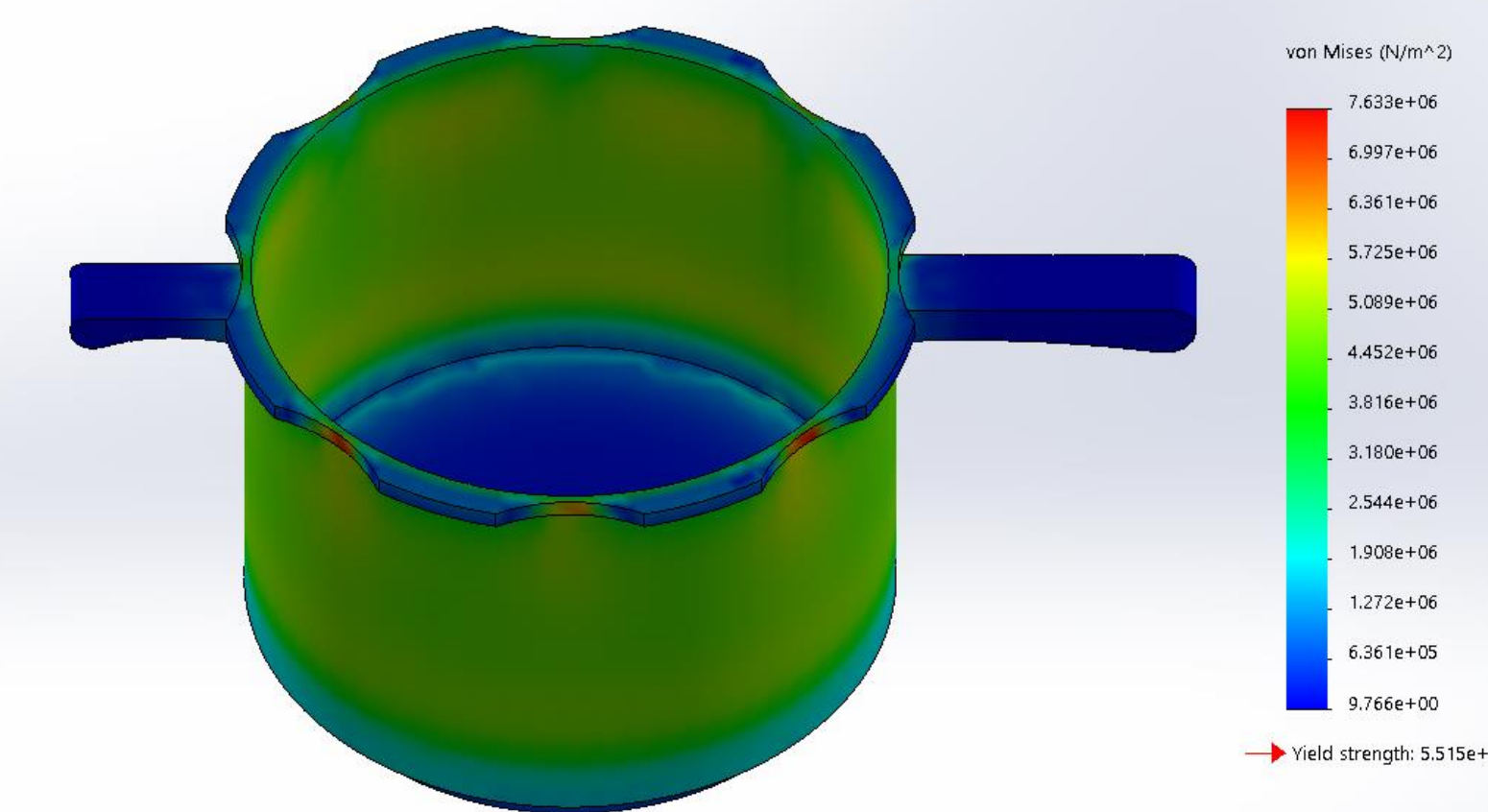


**Figure 4:** Final revision of heating base exposing the red calrod heating elements, inner supports, and consumer carrying slots

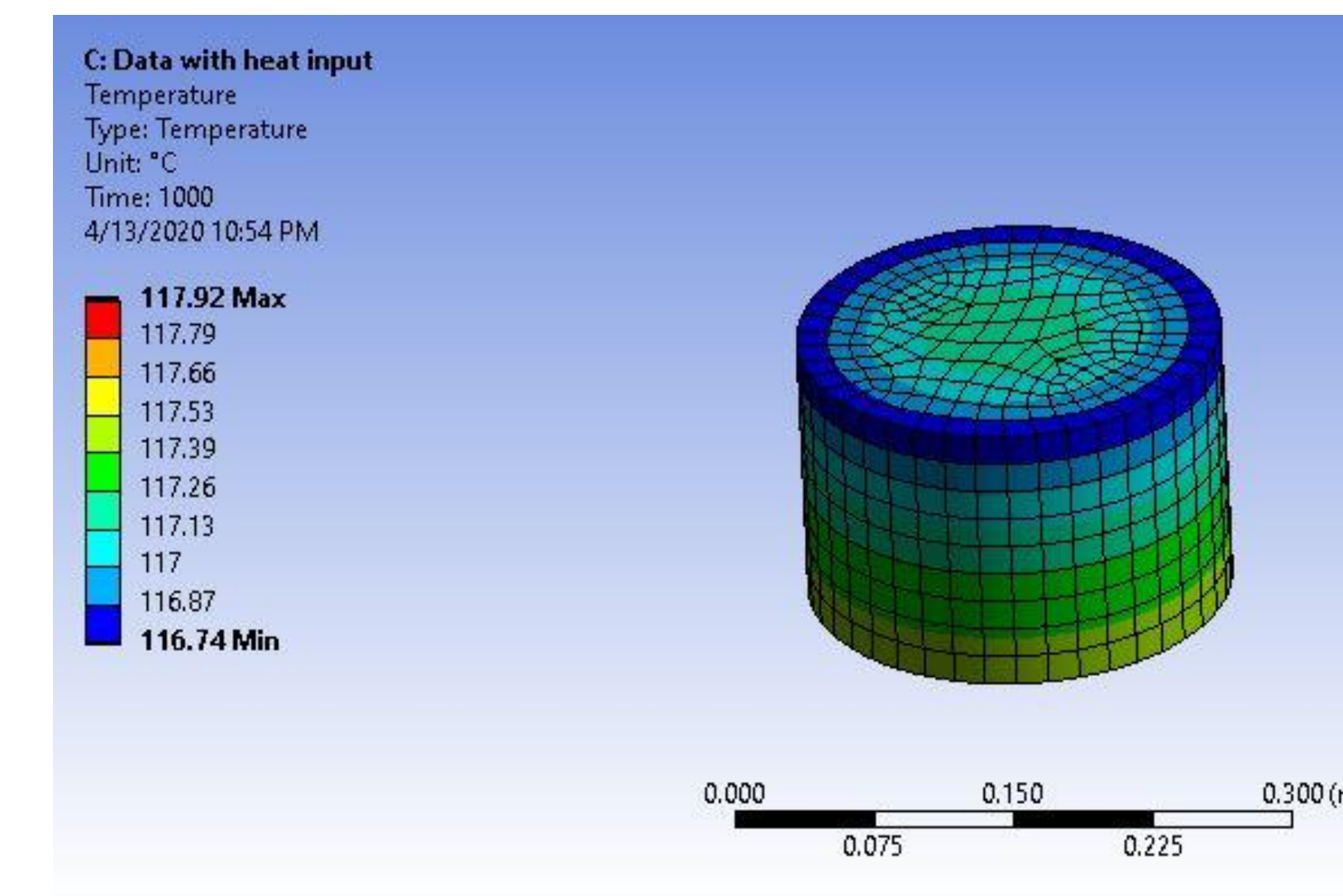
## Design and Development



**Figure 5:** The assembly of the pressure cooker inside its hub and hybrid heating base.



**Figure 6:** Finite Element Analysis contour simulating a 15psi pressure inside pressure cooker



**Figure 7:** Temperature contour of the internal water after 16 minutes with a 2W input

## Future Work

**Finalize the Design after extensive testing in the following categories:**

- Product Effectiveness**
  - Cook common Mongolian cuisine in pressure cooker and test if the food can be cooked thoroughly in the 15-20-minute time constraint
- Thermal Testing**
  - Have an electronic thermometer placed in the pot measure the temperature over the time of cooking. We analyze the data and see if there is any problems with the with transition from coal to electric heating
- Customer Satisfaction**
  - Put the product in the hands of a controlled audience and have them take a survey on the usability, comfort, and simplicity of the product
- Durability**
  - Continuously run through pressure cooker tests to identify points of failure and estimate life cycle of the product