Pre-Heated Air Improved Rocket (PHAIR) Stove

Background
Conceptual design which pre-heats primary combustion air to:
- Lower harmful emissions.
- Increase fuel efficiency.
- Work with multiple fuels.

Theory
- Combustion chamber is surrounded by an air channel.
- Buoyancy induces air downwards from the top of the channel.
- Pre-heated air raises combustion temperature.
- Higher temperature increases the reaction rate.
- This results in more complete combustion.

Design Development
Experiments were conducted to find best performing design:
- Varied chimney height and channel gap.
- Water boiling test for efficiency.
- Visual assessment of smoke.

Results
Best performing PHAIR stove was tested against three stone fire and rocket stove:
- PHAIR stove more thermally efficient than three stone fire but less than rocket stove.
- Rocket stove produced more smoke.
- PHAIR stove more efficient with door open;
  - Operating at less than stoichiometric mixture of fuel and air.

Future Work
Concept of PHAIR stove has been proven, but much work is still required:
- Quantification of emissions.
- Testing of more parameters to improve design.