

## Waste-to-Watts: An Energy Analysis of Municipal Solid Waste as Fuel

Marianna Fischer  
*Eastern Washington University*

Brandon Lewis  
*Eastern Washington University*

Avary Zachary  
*Eastern Washington University*

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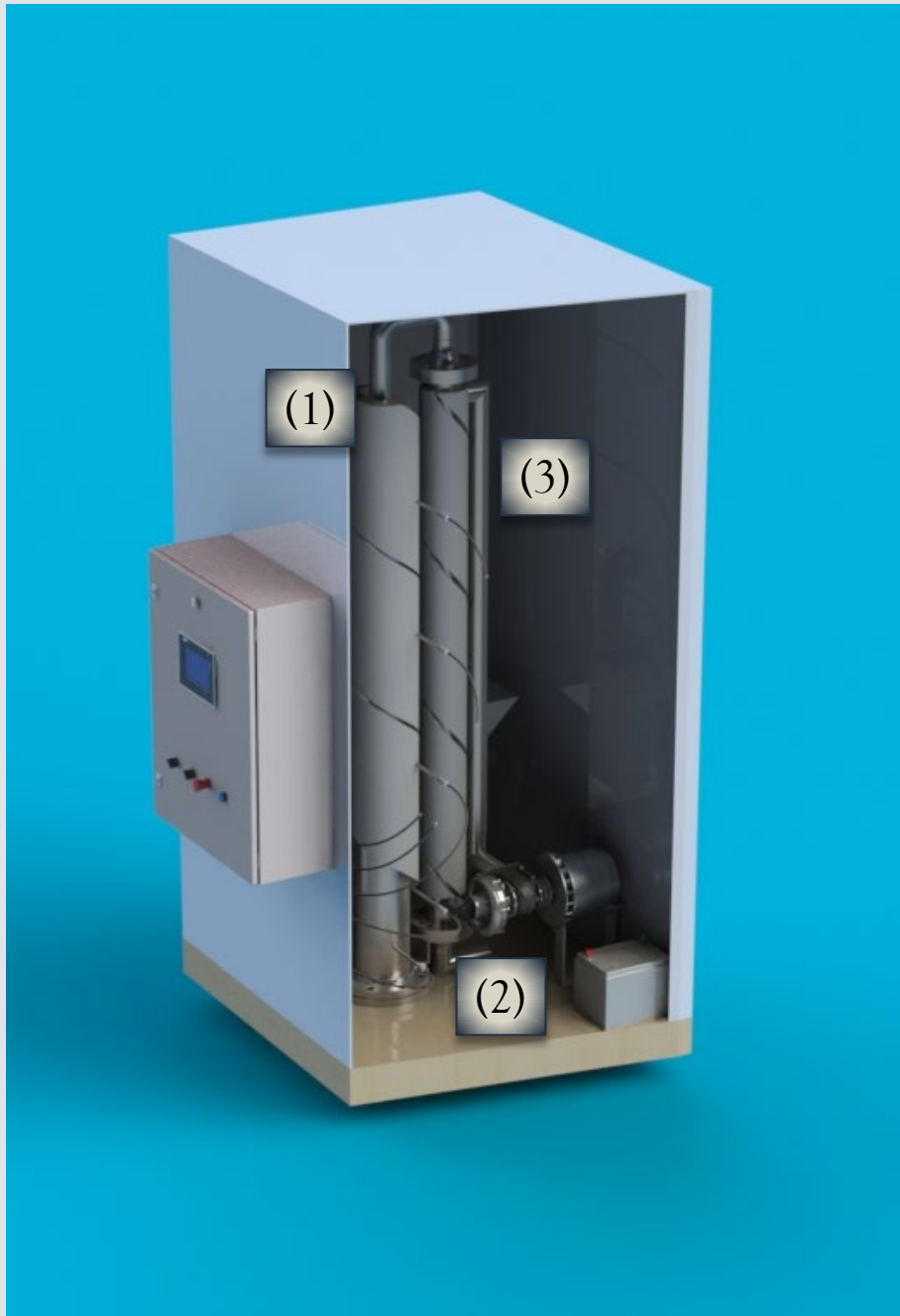
# Waste-to-Watts

AN ENERGY ANALYSIS OF MUNICIPAL SOLID  
WASTE AS FUEL

# Meet the Researchers

- Waste-to-Watts is a startup company changing how the world views trash and energy

Marianna Fischer, Brandon Lewis, Avary Zachary, Mentor: Dr. Philip Appel



# The Foundation

- (1) Incineration Chamber
  - Disposal of solid waste
  - Adiabatic environment
- (2) Turbine Generator
  - High efficiency
  - High service life
- (3) Heat Exchanger
  - Separation of exhaust gases
  - Method for cooling exhaust gases

# Our Aim

- Our aim is to observe the characteristics of combusting various materials to properly design a waste-to-energy system for Waste to Watts



# Method

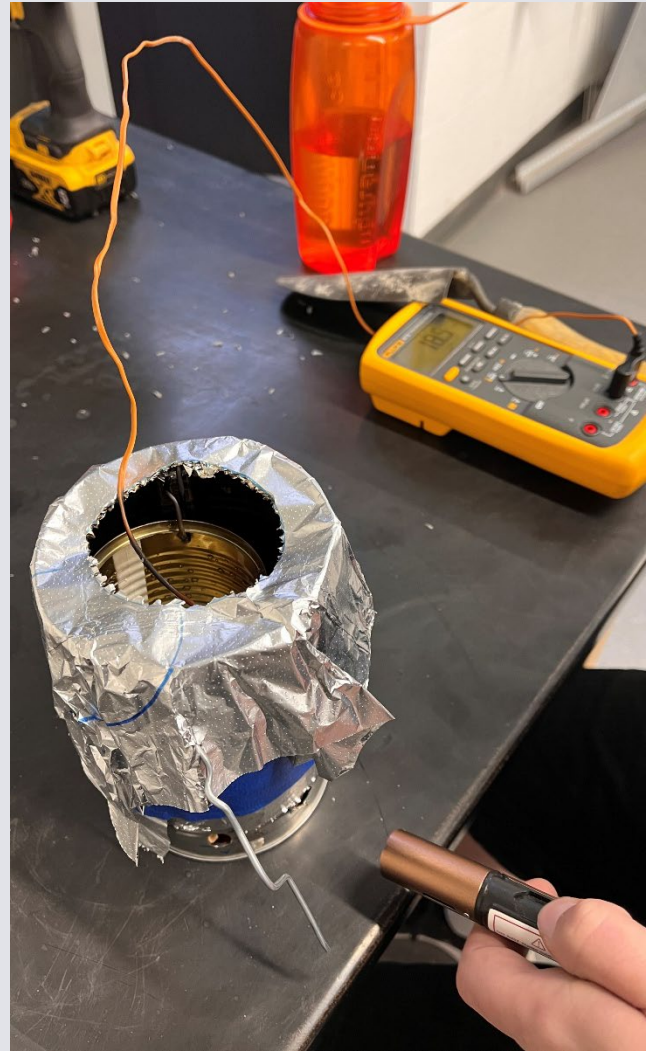
Using Calorimetry:

- Feedstock below pot of water
- Combustion contained through aluminum insulated walls
- Measuring temperature of water against amount of mass leftover from combustion



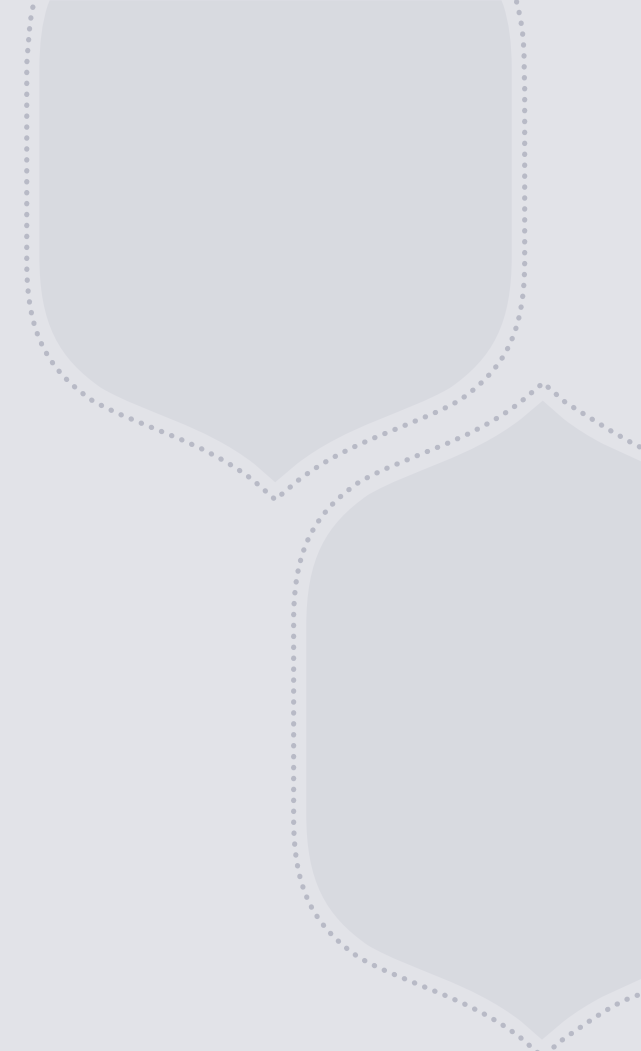
# Key Control Factors

- ♦ Shape of material
  - Pelletized wood or plastic
- ♦ Material Mass
  - Measured amounts per trial
- ♦ Liquid fuel ignition
  - Timed butane injection
- ♦ Power Setting
  - 90 volts from power supply
- ♦ Water Mass
  - Measured amounts per trial



# Material's Analyzed

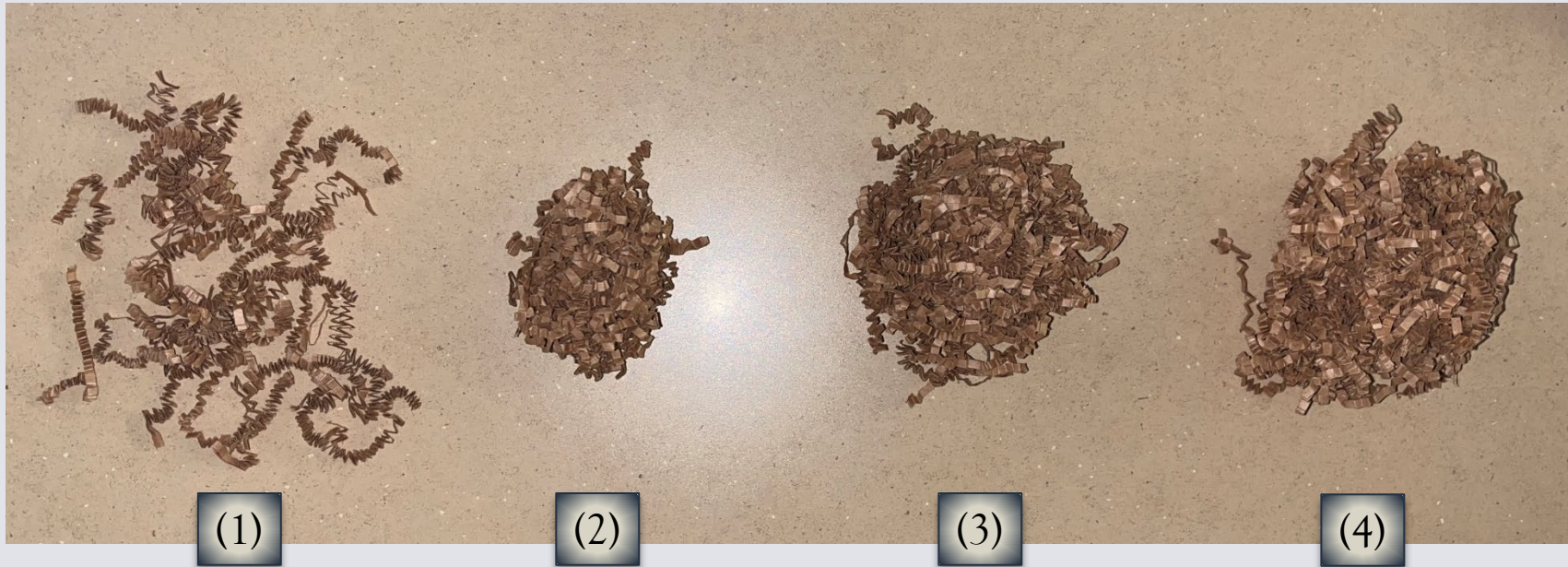
*What materials did we burn  
and how?*





# Material Analyzed: Paper

- ♦ Mrs. Frizz Crinkle Cut Packing Paper
  - (1) Loose, (2) 3 grams, (3) 7.5 grams, (4) 10 grams



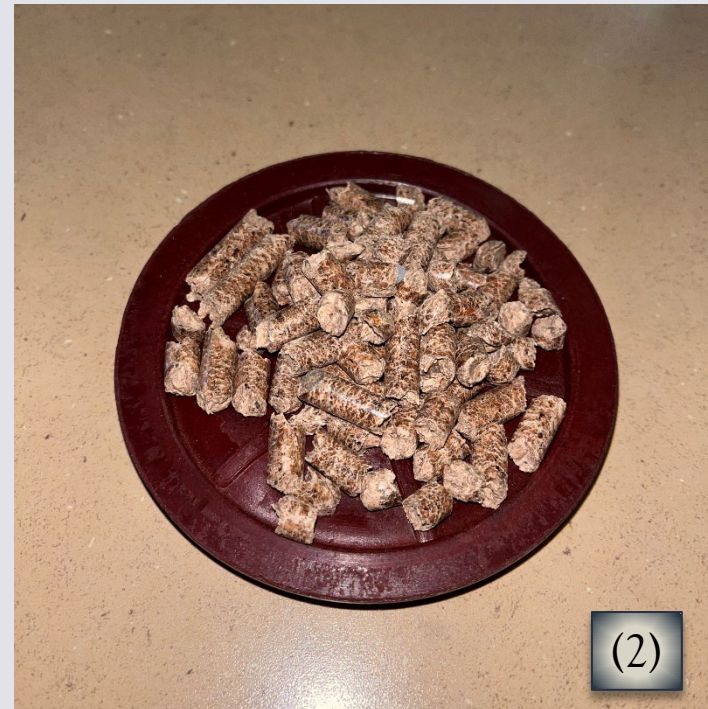
# Material Analyzed: Plastics

- (1) VViViD HDPE Plastic Pellets
- (2) Tailor Spot Polypropylene Plastic Pellets
- (3) Polly Plastics Polycaprolactone Plastic Pellets



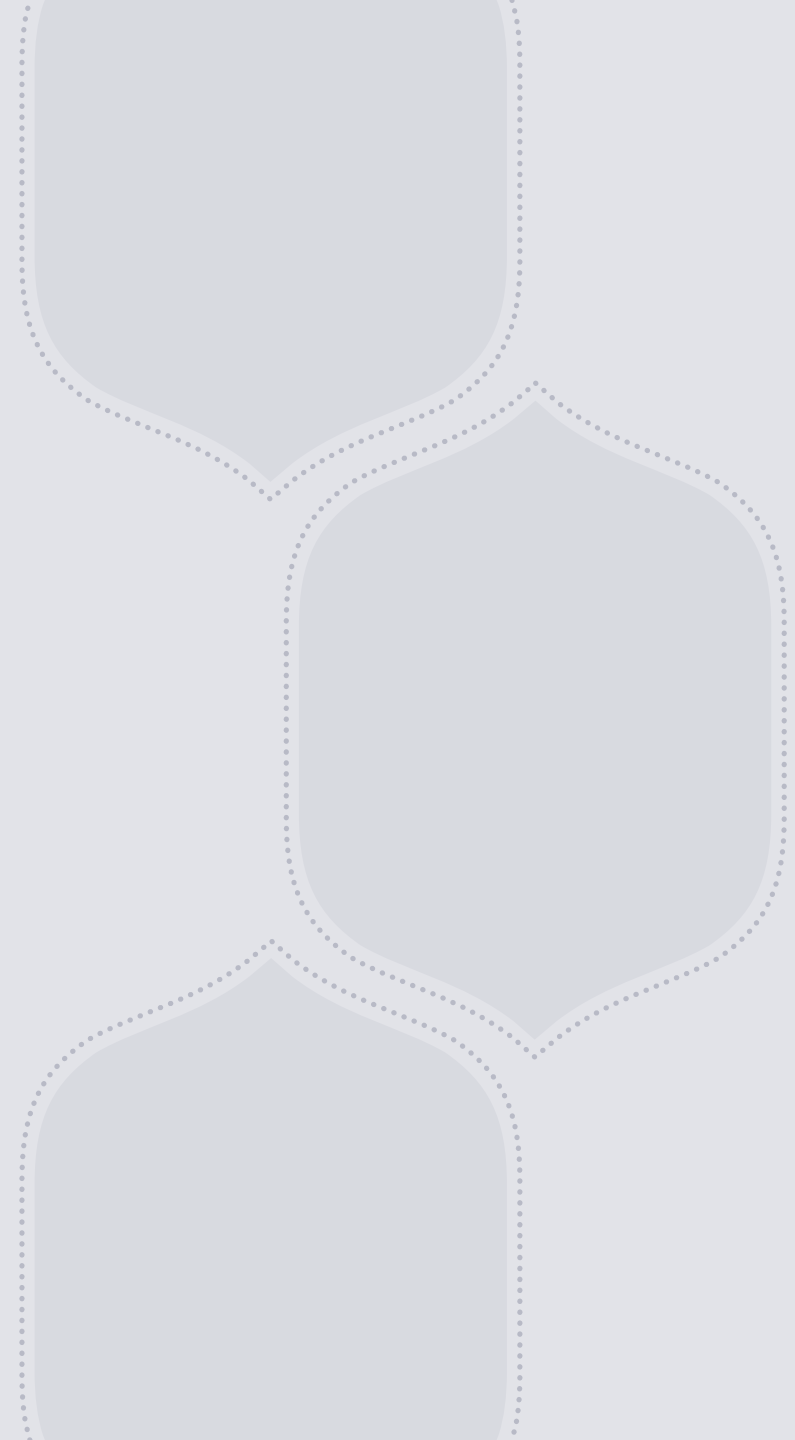
# Material Analyzed: Wood Pellets

- (1) Flame Genie FG-P20 Wood Pellet Fuel
- (2) Lignetics Wood Pellet Fuel



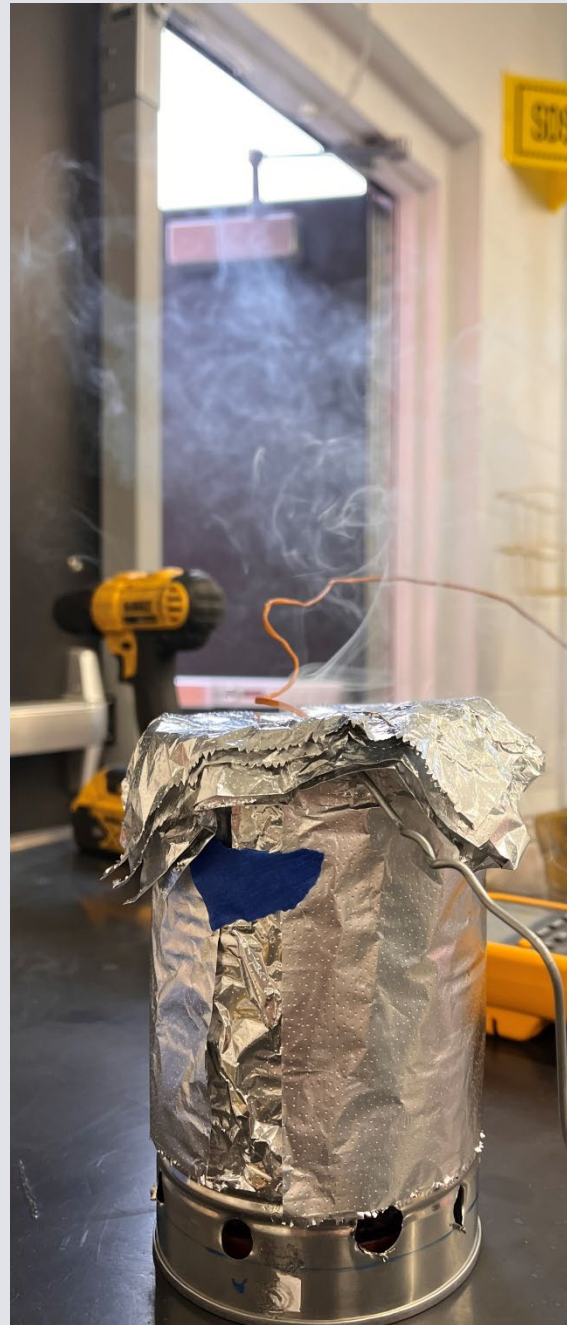
# Material Response

*What burning conditions did each material create?*



# Paper Behavior

- ♦ Generated:
  - paper ash (mass-dependent)
  - paper charr (mass-dependent)
  - slight smoke
  - quick burn (mass-negligible)

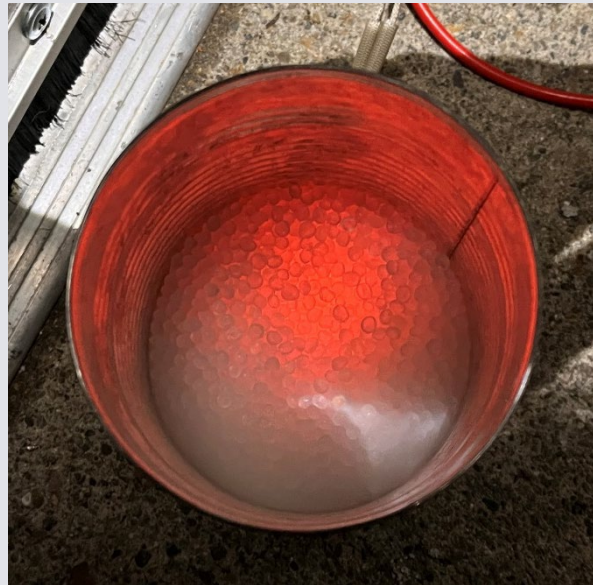


# Plastic Behavior

- ♦ Generated:

- smelly/ heavy smoke at low temperatures
- glowing red until combustion
- melted gooey substance

- long combustion time for complete burn
- leftover plastics exhibited carbon browning
- unburned plastic insulated other plastics from heat



# Wood Pellets Behavior

- ♦ Generated:
  - medium smoke
  - Charred remains (mass dependent)
  - ash (mass dependent)
  - smoldered (mass dependent)
  - long burn (mass dependent)



# Sources of Error

Scale: + or - 0.5 g  
measuring accuracy

Glass Beaker: Every  
25 mL

Hand-Made  
Calorimeter:  
Environment  
Losses

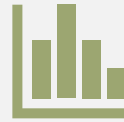
Burning  
Environment:  
Door to lab open

Thermocouple:  
continual wire  
damage

Still Water: vertical  
temperature  
distribution



# What's Next?



Using a temperature data logging system for further analyzing energy content



Building a new calorimeter based upon the behaviors learned in this project for more true results



Utilizing the burn behaviors in the design of an incineration chamber for disposing of plastic, wood, and paper

# Thank you!

- Dr. Appel, our mentor, and the TCA
- STEM Department
- MENT Faculty that allowed us access to laboratories and equipment



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