



DETAILED DESIGN REVIEW



University of Idaho

TEAM MISSION STATEMENT

Our team's mission is to develop and prototype a model of a scalable, practical retrofit for modern, industrial boilers that will produce biochar for sale and heat energy. This design must account for multiple variables and allow control of input and output flow rates amongst other factors.



PROBLEM STATEMENT

An abundance of biomaterial exists in the region as a byproduct of industrial lumber production, this material has little value and is currently being used primarily for steam generation.

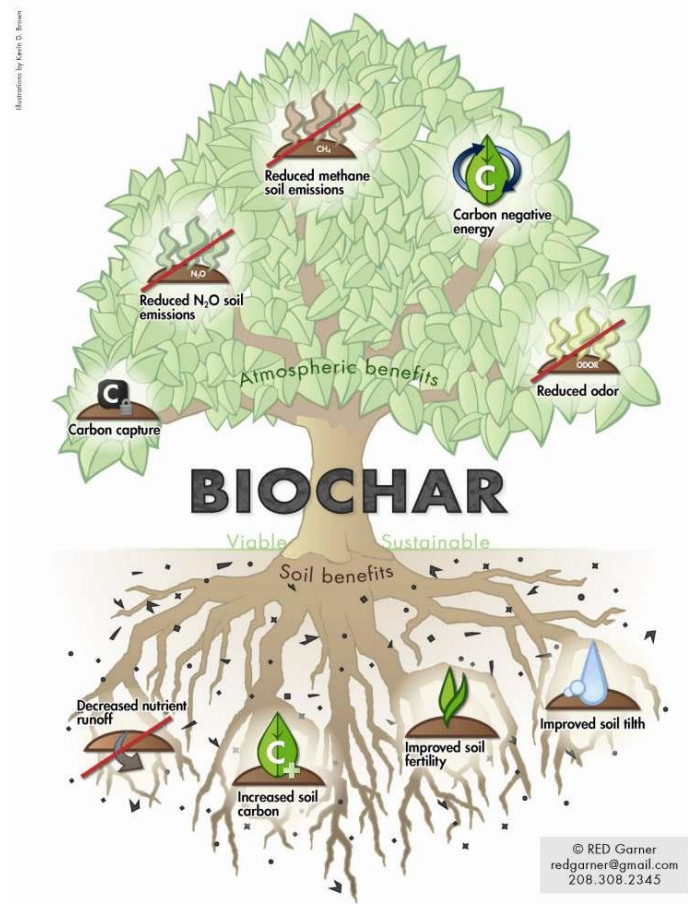


PROJECT LEARNING



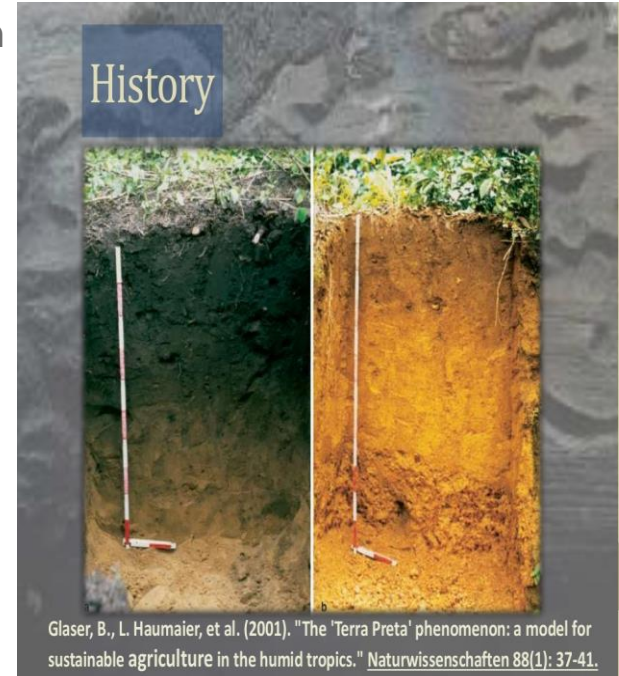
BENEFITS OF BIOCHAR

- Biochar is rich in fixed carbon and has an enhanced surface area caused by micro and macro pores that easily absorb and maintain moisture and nutrients.
- Can be used as a filtering media to absorb contaminants in rainwater and storm water runoff.
- As a soil enhancer, biochar makes soil more fertile, boosts food security, and reduces the need for some chemical and fertilizer inputs.



HISTORY OF BIOCHAR

- Biochar dates back 2,000 years to a civilization in a remote region of the Amazon Basin where regions of dark, highly fertile soil has been discovered.
- It is theorized that the ancient Amazonians used a process known as “slash and char”, where the biomass (plant material) were cut, ignited and buried to smolder.
- This process allowed the Amazonians to support a diverse agriculture and explains how their population grew to immense numbers.



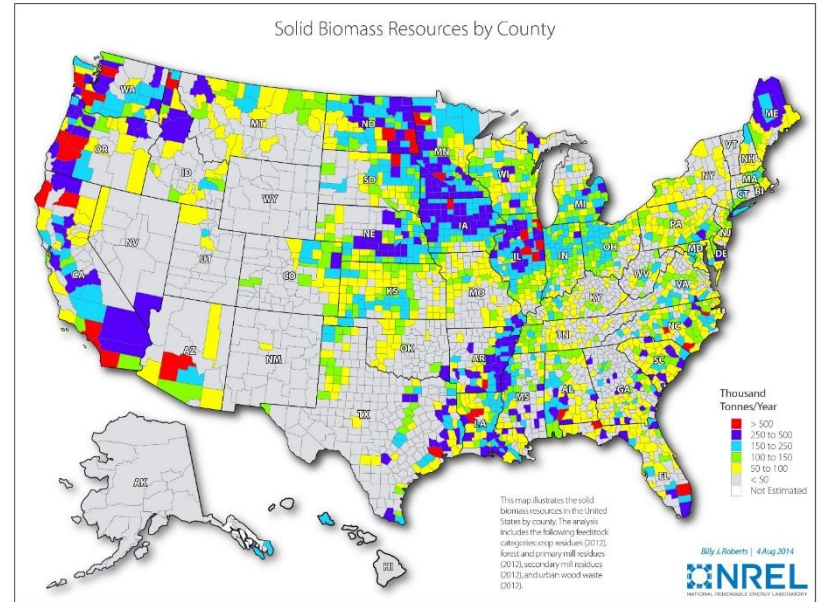
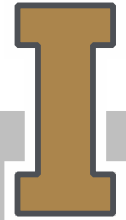
Glaser, B., L. Haumaier, et al. (2001). "The 'Terra Preta' phenomenon: a model for sustainable agriculture in the humid tropics." *Naturwissenschaften* 88(1): 37-41.

BIOMASS RESOURCES IN THE NORTHWEST

The National Renewable Energy Laboratory estimates that in 2012 over 6,000,000 tons of waste biomass were produced in area surrounding Moscow (150 mi. radius).

Of that waste biomass, about 1,750,000 tons were from primary mill residues.

Another 2,250,000 tons were from crop residues.



https://www.nrel.gov/gis/images/biomass_2014/national_biomass_solid_total_2014-01.jpg

DESIGNS

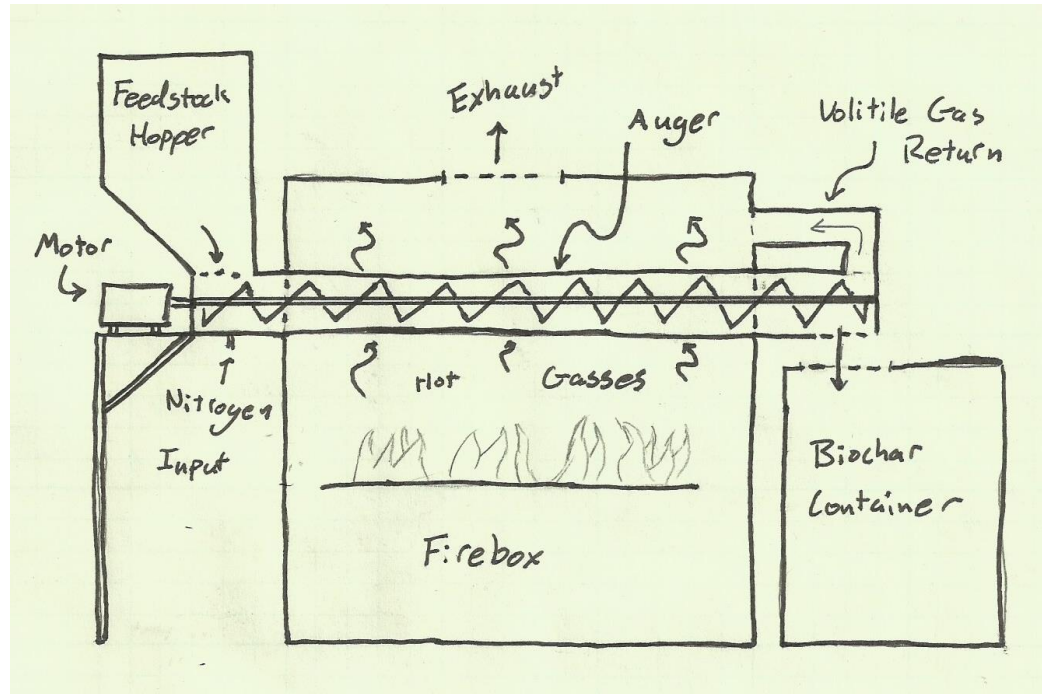


NEEDS AND CONSTRAINTS

- Continuous process
- Easily integrated to a boiler system
- Scalable industrial design
- Energy efficient design
- Dynamic control system
- Heat exchanger



DESIGN MODEL



OPTION 1

Pros –

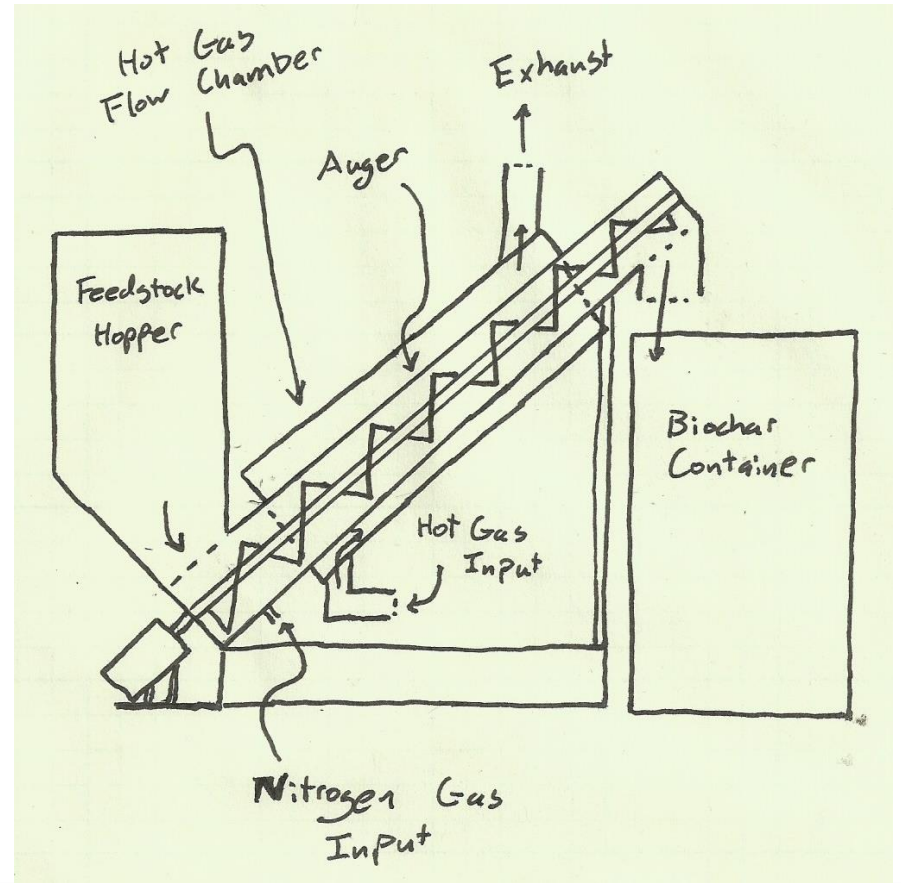
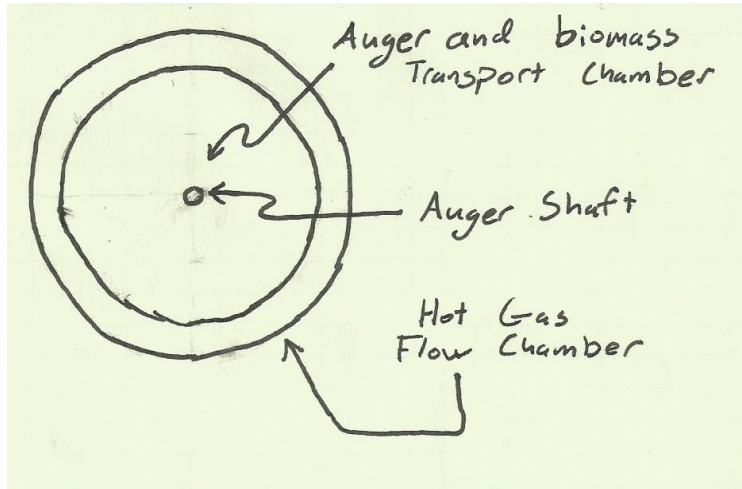
- Uses less materials
- Direct heating source
- Biochar moved through system quickly

Cons –

- Interferes with boiler system
- Manipulating heat source is not possible
- Down time in the factory
- Less biochar production



DESIGN MODEL



OPTION 2

Pros –

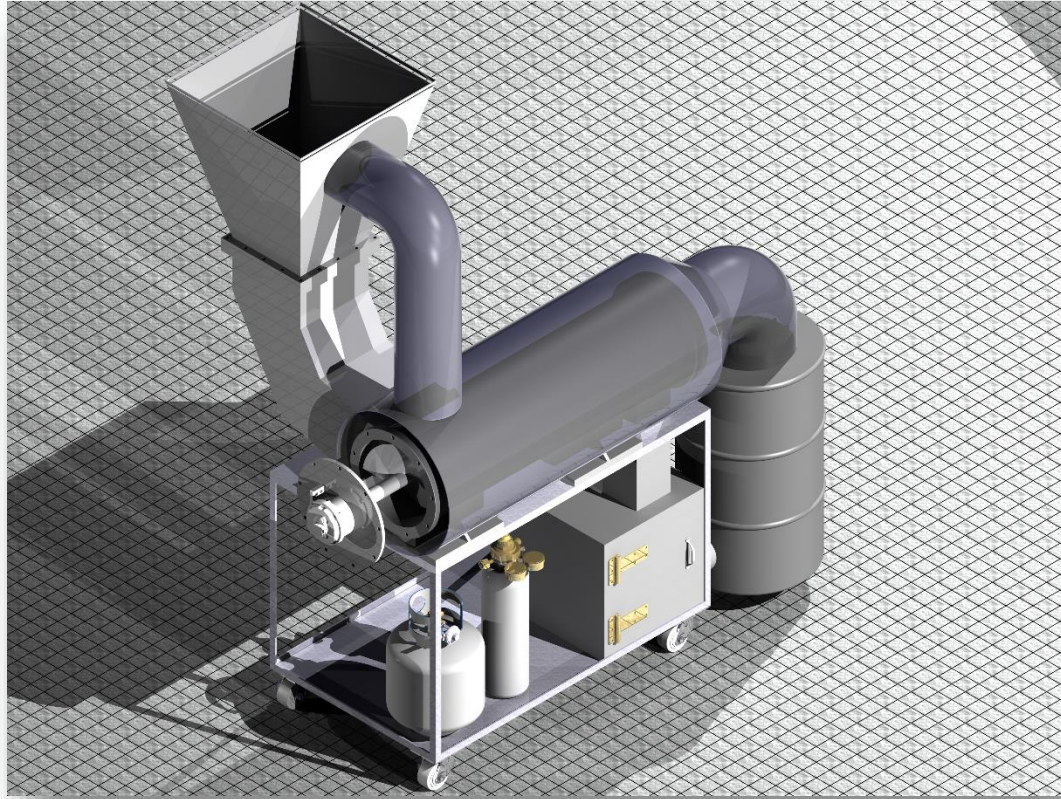
- Fairly energy efficient
- Effective heat exchanger
- Higher mass flow rate

Cons –

- Loss of heat
- Hard to integrate into the existing system.



DESIGN RENDER



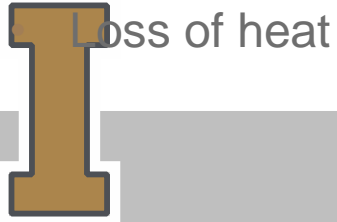
OPTION 3

Pros –

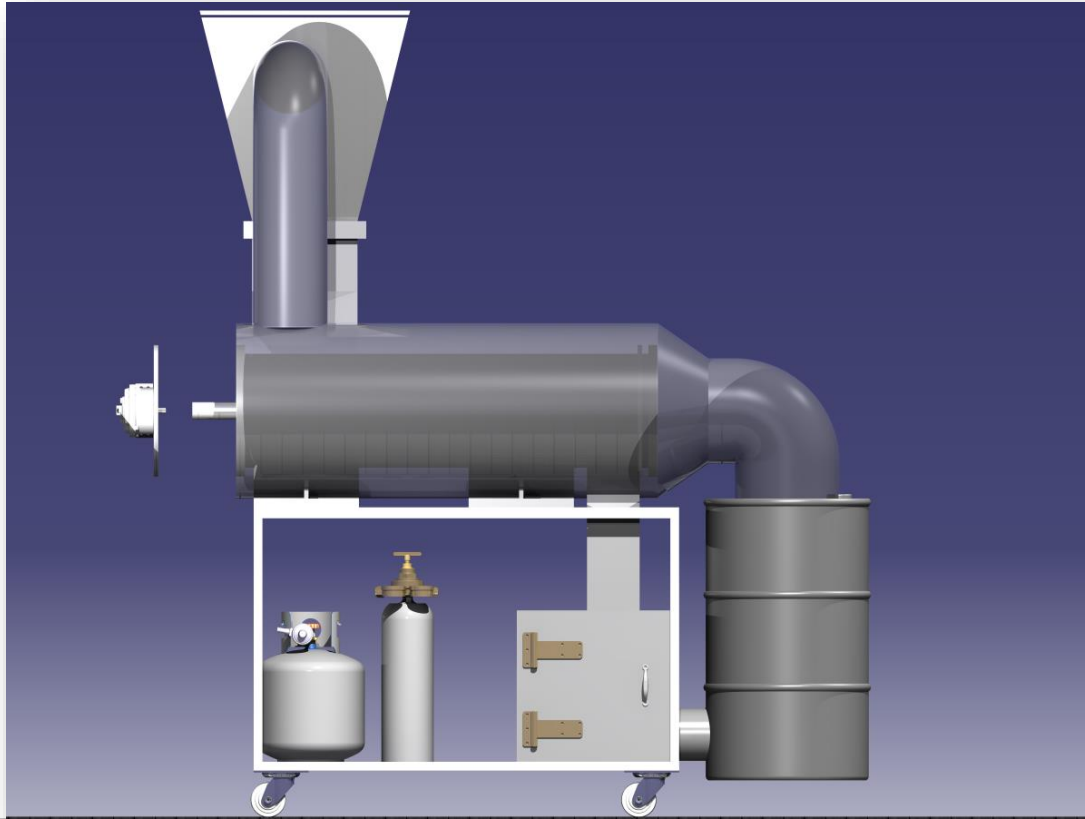
- Energy efficient
- Simpler to build
- Easily scalable
- Minimal adjustment to existing systems

Cons –

- Installing the design into existing system may be difficult



DESIGN RENDER



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SENSORS

Known Sensors –

- Oxygen – Automotive O₂ Sensor
- Temperature – Type K Thermo-Couples

Additional Sensor Considerations –

- Air-Flow
- Power/Electrical Current



ESTIMATED COSTS

Item	Source	Quantity	Cost (Line Totals)
Motor ½ HP	AutomationDirect	1	\$91.00
Oxygen Sensor	Denso	1	\$20.02
Thermo-Couple	OMEGA	3	\$78.00
Fabrication Costs (Conservative)		1	\$750.00



PROJECT SCHEDULE

- Production/Fabrication: Starts 27th November
- Auger Built: January 29th
- Hopper Attached: February 19th
- Boiler Assembled: March 19th
- Rework: March 26th – April 16th

