

# University of Idaho

# BIOCHAR **PRODUCTION SYSTEM**

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## **PROBLEM STATEMENT**

- An abundance of biomass exists in the region as a byproduct of industrial lumber production
  - Material has little value and is currently being used primarily for steam generation.
- Farmers around the Palouse are struggling with topsoil degradation, erosion, water retention, and nutrient loss.





## **TEAM MISSION STATEMENT**

Our team's mission is to deve practical retrofit for modern, sale and heat energy. This de allow control of input and out



- 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.





# PROJECT LEARNING



# **HISTORY OF BIOCHAR**

- Biochar dates back 2,000 years to a civilization in a remote region of the Amazon Basin where 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



Pine wood biochar



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.

Soil profile







# **BENEFITS OF BIOCHAR**







- Rich in fixed carbon
- Enhanced surface area caused by micro and macro pores
- Easily absorbs and maintains moisture and nutrients.
- Acts as filter to absorb contaminants in rainwater and storm water runoff.
- Increases soil fertility
- Reduces need for some chemical and fertilizer inputs



# **BIOMASS RESOURCES IN THE** NORTHWEST



https://www.nrel.gov/gis/images/biomass\_2014/national\_biomass\_solid\_total\_2014-01.jpg



- 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).
- 1,750,000 tons were from primary mill residues.
- 2,250,000 tons were from crop residues.



# **BOILER SYSTEM INTEGRATION**

- Lumber mills have a pre-existing boiler that is already being used to generate steam
- Flue gas comes off of the boiler at extremely high temperatures Would not need to add any extra energy to pyrolyze waste
- wood chips





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# **NEEDS AND CONSTRAINTS**

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





### **DESIGN MODEL**







## **DESIGN MODEL**











### **DESIGN MODEL**







### **DESIGN RENDER**







### **DESIGN RENDER**







### **DESIGN RENDER**





# ELECTRONICS





# **CONTROL SYSTEM**

Programmable Logic Controller – Productivity P-2000 by Automation Direct

- Master control unit for attached VFDs and subsequent 1- and 3phase motors
- Central data logging
- Built in system automation and demo
- Emergency shutoff and lockout

Sensory Feedback and Monitoring

- Boiler, auger, and collector temperature
- Boiler visible flame detection
- Oxygen monitoring







## **USER INTERFACE**













# PROJECT MANAGEMENT





### COSTS

S	S Last Updated Tor		Today	/											
		2017			2018							tem			
Expense l	Sept	Oct	Nov	Dec	Jan	Feb	Mar		Apr	May	1	Total			
Equipmen	t														
Motor			<mark>\$ 91</mark>								\$	91			
Gear box (pulleys)		\$ 210	)								\$	210			
Propane		\$ 47	7								\$	47			
Nitrogen		\$ 230	)								\$	230			
Propane Hose							\$ 25	5			\$	25			
Demonstration Equi		uip									\$	-			
Solenoid Valve								\$	35		\$	35			
Brass Bushings					\$ 30						\$	30			
Insulation				\$ 53							\$	53			
Oxygen Sensor			\$ 20								\$	20			
Thermocouples			\$ 78								\$	78			
Electronics					\$ 389						\$	389			
Propane burner					\$ 36						\$	36			
											\$	-			
Filing Ca	binet						\$ 15	5			\$	15			
											\$	-			
											\$	-			
Nuts and Bolts							\$ 20	)			\$	20			
Facilities Charges						\$ 300					\$	300			
Miscellaneous parts		ts					\$ 71	L			\$	71			
Hopper							?				\$	_			
Poster								\$	100		\$	100			
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# FINAL PROTOTYPE





## FINAL PROTOTYPE





## FINAL PROTOTYPE









### QUESTIONS?





