

# Biochar Quality and Market Assessment:

Comparing Physical Properties to Market Value

**Mark Severy, P.E.**

Schatz Energy Research Center  
Humboldt State University  
Arcata, California

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Not all biochars are created equally  
... and market price does not reflect quality.



The lack of consistent quality metrics and labeling practices hurts both consumers and producers.

## Objectives:

- Identify quality metrics and their relation to value

## Methods:

- Survey consumers and producers about price and important characteristics
- Measure properties of biochar

# Outline

1. Background
2. What is the problem?
3. How can we evaluate quality?
4. How does quality relate to price?
5. Discussion



“Promoting the use of clean and renewable energy”



## Core Research Areas:

- Energy access
- Smart grids
- Transportation
- Energy planning
- Bioenergy

Goals: Improve the production efficiency and quality of biochar from forest residues.



2014-2015

- Characterized biochar machine and biochar
- Field testing
- Emissions control



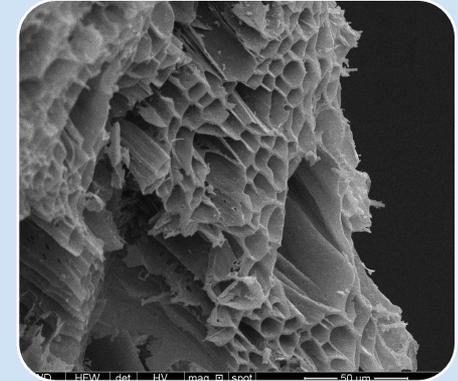
2016

- Integrated waste heat dryer
- Used biomass gasifier as electricity source



2017-2018

- Implement automated controls
- Improved safety
- Reduced labor
- Improved biochar consistency



2018-2020

- Evaluate properties of commercial chars
- Market assessment
- Determine method value biochar based on properties

## Funding Sources

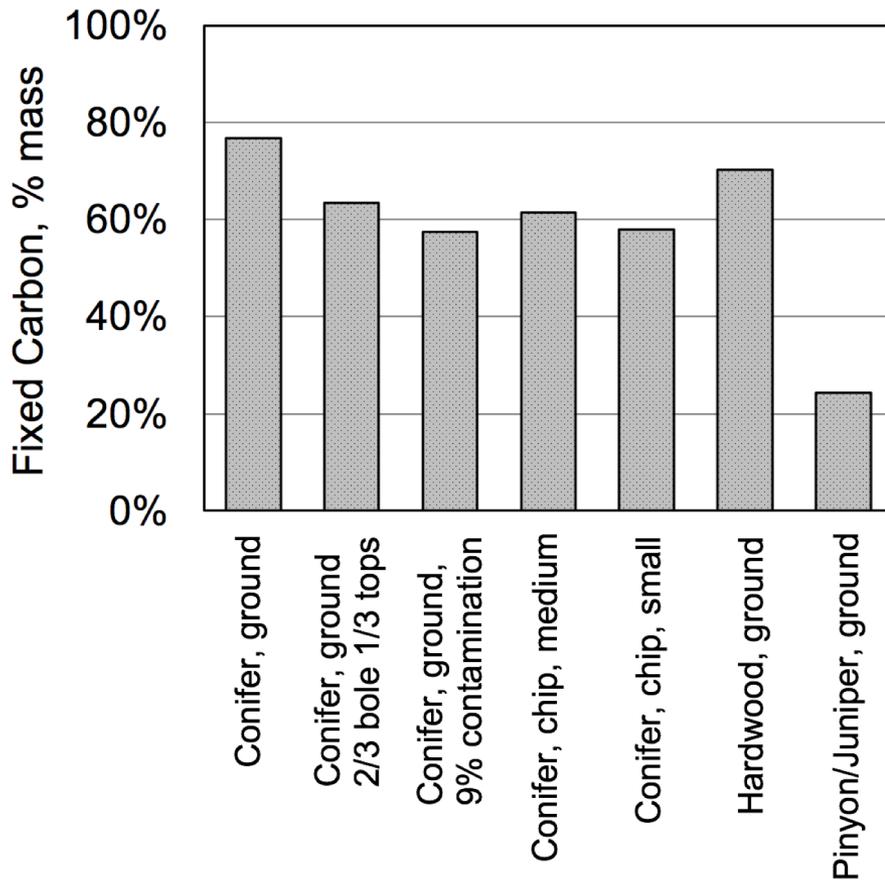
DOE

DOE & ARI

DOE, ARI, & RFFI

ARI & Industry

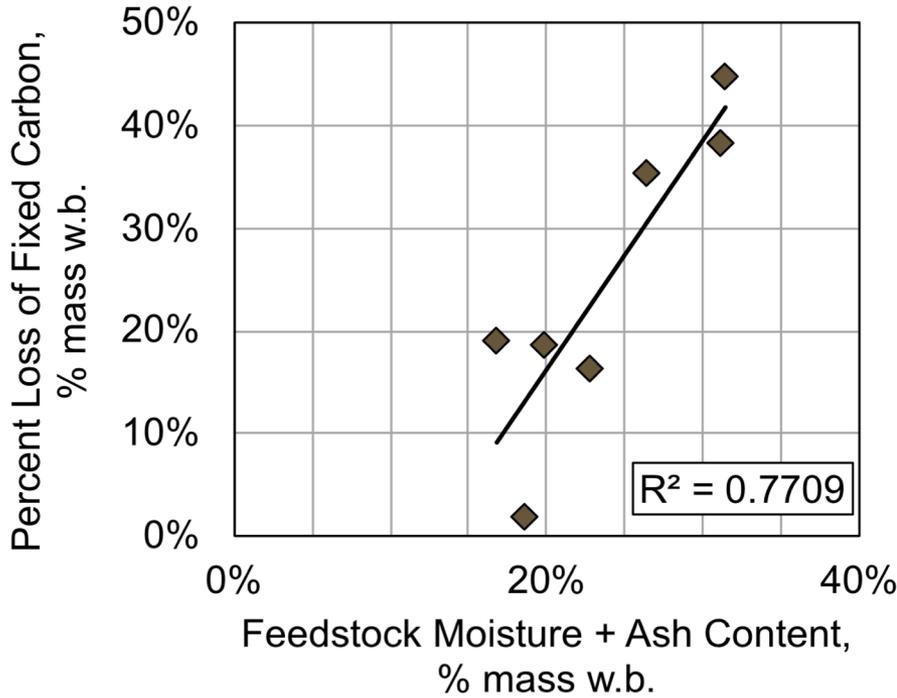
Biochar properties are dependent on feedstock species and type



Feedstock moisture and/or ash content

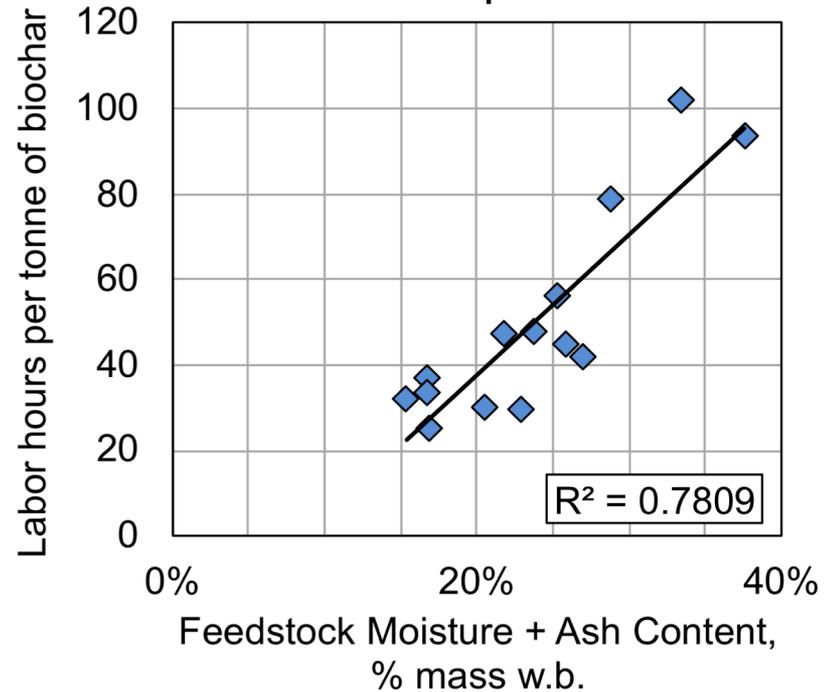
- increases carbon lost in process
- increases labor requirements

Fixed Carbon Lost in Process



Severy et al. (2018)

Labor Required



# Past Biochar Projects

Pore structure of biochar changes with biochar source and production method.

	Magnification					
	40x	80x	~160x	300x	~600x	~2,400x
RFFI 2017 Biochar						
Raw Tan Oak 2017 Feedstock						
Low Fixed carbon Biochar RFFI 2016						
High Fixed carbon Biochar RFFI 2016						
Activated Carbon						
Douglas Fir Biochar						

## Redwood Forest Foundation, Inc. (RFFI) – Northern California

- Produced biochar from 2015 to 2018 using forest residues
- Manufactured with pyrolysis
- Large demand in 2015 – 2016, then priced out of market in 2018
- Their pyrolysis char was in competition with combustion char

“How do we set a competitive price that is still reflecting the quality of our char?”



## Problem Definition

No universally accepted method for quality determination.

- Inconsistent labeling
- Wide variation in properties
- Specific use cases of char, soil, crop system
- Price often set by marketing and branding
- Using aesthetics as a guide for quality rather than measurements



There are two sets of biochar standards, but neither is widely adopted



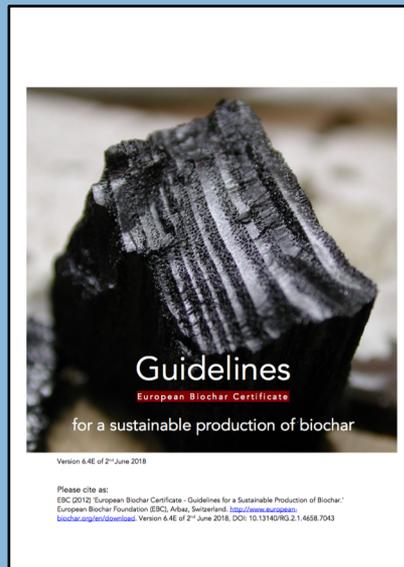
TM

## International Biochar Initiative (IBI)

Standardized Product Definition

Version 2.1, November 2015

- 1 manufacturer certified



## European Biochar Certificate (EBC)

Guidelines for sustainable production of biochar  
Version 6.4E, June 2018

- 12 European producers certified by EBC  
out of 52 reported European businesses

Both standards require many tests, but only a few are used to classify the biochar quality.

<i>Test</i>	<i>IBI</i>	<i>EBC</i>
Moisture	✓	✓
Organic Carbon *	✓	✓
H:C Ratio*	✓	✓
Ash	✓	✓
O:C Ratio *	✓	
Total N	✓	✓
Total P & K	✓	●
Electrical Conductivity	✓	✓
pH	✓	✓
Bulk Density		✓
Liming Equivalence	✓	
Particle Size		✓

<i>Test</i>	<i>IBI</i>	<i>EBC</i>
Water holding		●
VOC Content	●	✓
Surface Area	●	✓
Heavy Metals *	✓	✓
PAHs *	✓	✓
PCBs *	✓	✓
PCDD/Fs *	✓	✓
Germination inhibition *	✓	✗

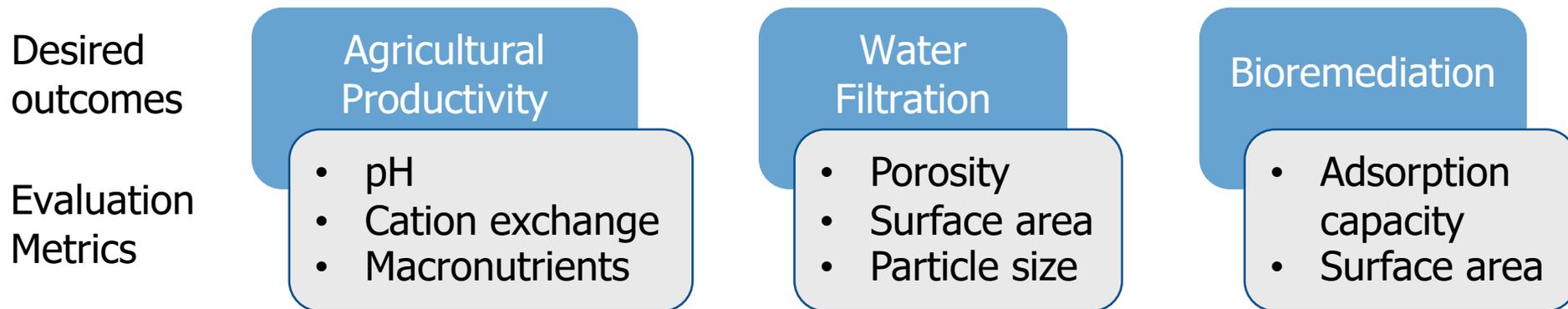
\* - used for classification  
 ✓ - required  
 ● - optional  
 ✗ - not required

These measurements describe biochar's physical characteristics, but there is not a clear translation to intended use or value.

Biochar quality should be evaluated by considering:

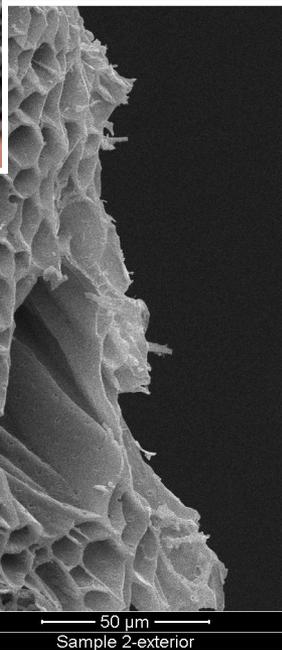
What are the desired outcomes from using biochar?

How does biochar achieve those outcomes?



Evaluation criteria need to be based on context.

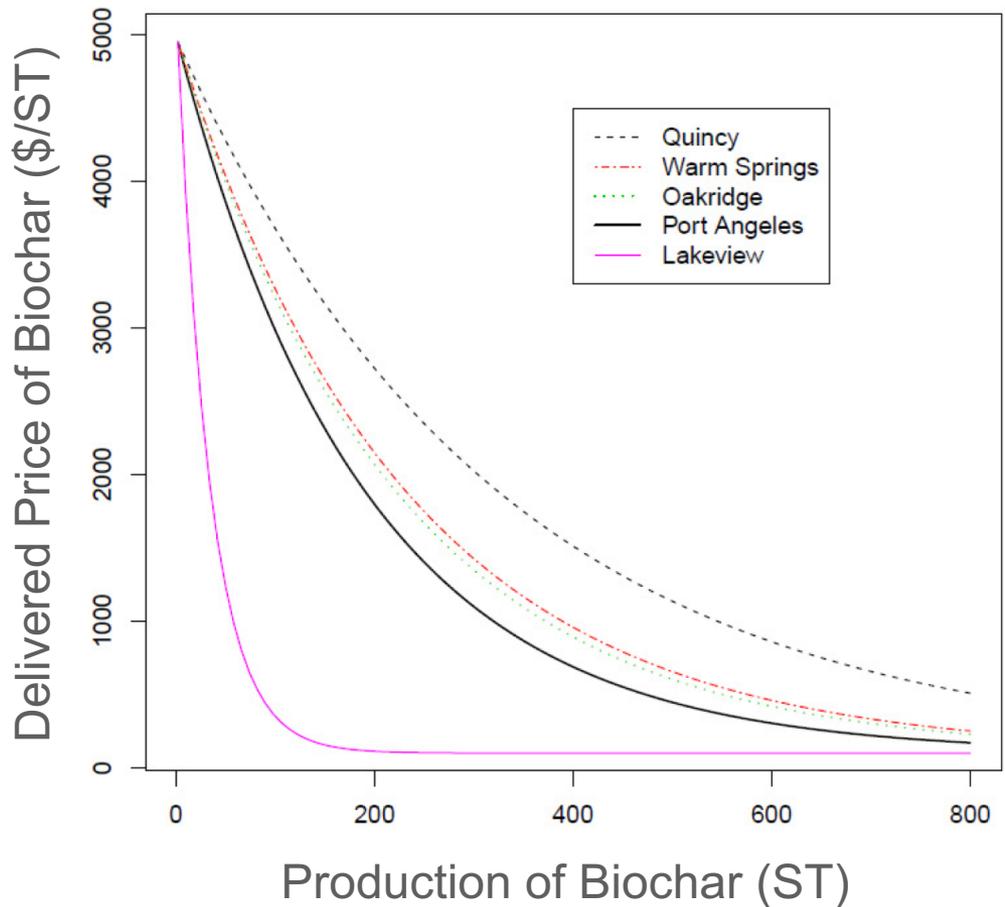
Biochar markets are still developing and prices are unstable.



## Price Statistics

- Wide range of prices: \$250 to \$4,950 per ton
- Volatile market: changes up to 55% per year
- New companies going in and out each year.

Price varies by location, market, and production capacity.



Sasatani & Eastin (2018)

Values at an assumed 2% penetration of the soil amendment market.



## Challenges to Biochar Price Stability

- High transportation costs favor local markets
- Localized, often niche markets
- Lack of widely adopted market standards
- Market awareness of benefits or value
- Often blended before sale
- Varying degrees of quality



## **Problem:**

Biochar price does not accurately reflect quality.

## **Objective:**

Using existing test protocol, identify which characteristics are related to value.

## **Methods:**

- Purchase samples from manufacturers
- Test samples according to biochar standards
- Relate properties to the selling price
- Survey consumers and producers to determine what properties they value

## Consumers:

What metrics are important when selecting a biochar for your application?

## Manufacturers:

What quality parameters do you target during production?

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## Questions and Discussion

Mark Severy, P.E.  
Research Engineer  
Schatz Energy Research Center  
Humboldt State University

[mark.severy@humboldt.edu](mailto:mark.severy@humboldt.edu)  
[www.schatzcenter.org](http://www.schatzcenter.org)

