Place-Based Biochar in Space and Time

Kelpie Wilson

Wilson Biochar

USBI Biochar in the Woods Network

Place-based biochar for fuels reduction, carbon emissions reduction, carbon removal and climate-adapted forest health

Presenter: Kelpie Wilson, Wilson Biochar, LLC

- **Manufacturer** of Ring of Fire Biochar Kiln®
- **Chair** of the USBI Biochar in the Woods Committee
- **Biochar Consultant** since 2012 – technology assessment, market analysis, biochar kiln development, workshops and training, biochar kiln manufacturing and sales
- **International Biochar Initiative** from 2008-2012 working in communications and project development
- **Journalist** covering environment, energy and climate change
- **Forest Protection Advocate** in SW Oregon working for Siskiyou Regional Education Project

Biochar in the Woods: WORKSHOP OVERVIEW

- Many companies are making biochar from agricultural and forestry residues, but these are in the commercial space of producing biochar as a product for sale.

- Place-based biochar has a different economic model that is based on utilizing stranded biomass for ecosystem services and carbon removal. Contractors and conservation crews are paid by land owners and managers to convert what would normally be incinerated into biochar for use on site.

- We are convening a network of practitioners through the USBI Biochar in the Woods forum and a once a month online meeting to share techniques and experiences.

BIW Workshop Schedule

- 12:30 - Kelpie Wilson - Wilson Biochar Associates
- 1:00 - Stephen Feher - Butte College and Butte Fire Safe Council
- 1:15 - Ken Scherer and Tabor Teachout - The Biochar Coalition
- 1:30 - Eric Mayer - Napachar
- 1:45 - Darren McAvoy – Utah State University
- 2:00 – Ryan Ramage – Valley Environmental

- 2:15 -2:45 BREAK

- 2:45 - Wihan Bekker - Ikhala Impact
- 3:15 - Eric Carlson - Clean Burn Company
- 3:30 - Roger Smullen – Earth Foundries, Inc
- 3:45 - Debbie Page-Dumroese - USDA Forest Service, Rocky Mountain Research Station
- 4:00 - Elaine Oneil – Washington Farm Forestry Association
- 4:15 - Justin Britton – CAL FIRE

- 4:30 – 5:30 Group Discussion and Meeting to Develop a Biochar in the Woods Support Network

Place-Based Biochar in Space and Time

1. The place-based sector of the biochar economy uses “stranded biomass” that cannot be transported to industrial facilities.
2. Make it on site – use it on site (or nearby). Priority uses:
    - Ecological Restoration
    - Small Farm Sustainability
3. Place-based biochar scales by scaling OUT across the landscape, not UP by centralizing production.
4. Time now: Place-based biochar builds support for the larger biochar economy by bringing biochar to everyone’s backyard.
5. Time future: Place-based biochar restores vitality to ecosystems that will produce sustainable biomass for the future.

Background on the Technologies

1. Flame Carbonization
2. Flame-cap kilns
3. Conservation Burns
4. Air Curtain Burners
5. Site Plans – where to use a certain tech approach?

Addressing Barriers to Place-Based Biochar

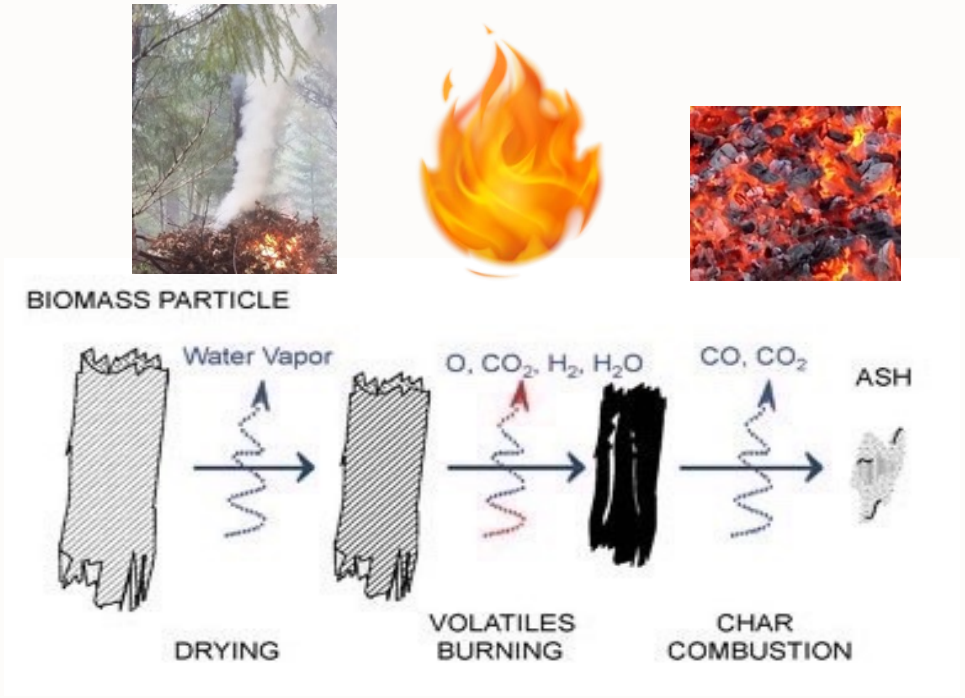
1. Demonstrate benefits of place-based biochar
2. Develop workable permitting systems
3. Find funding to pay for the work
4. Train and employ the place-based workforce
5. Build robust networks to capture opportunities

How to Make Biochar in the Woods

- The Technique:
  - How Flame Carbonization works
- The Methods:
  - Conservation Burns
  - Flame Cap Kilns
  - Air Curtain Burners

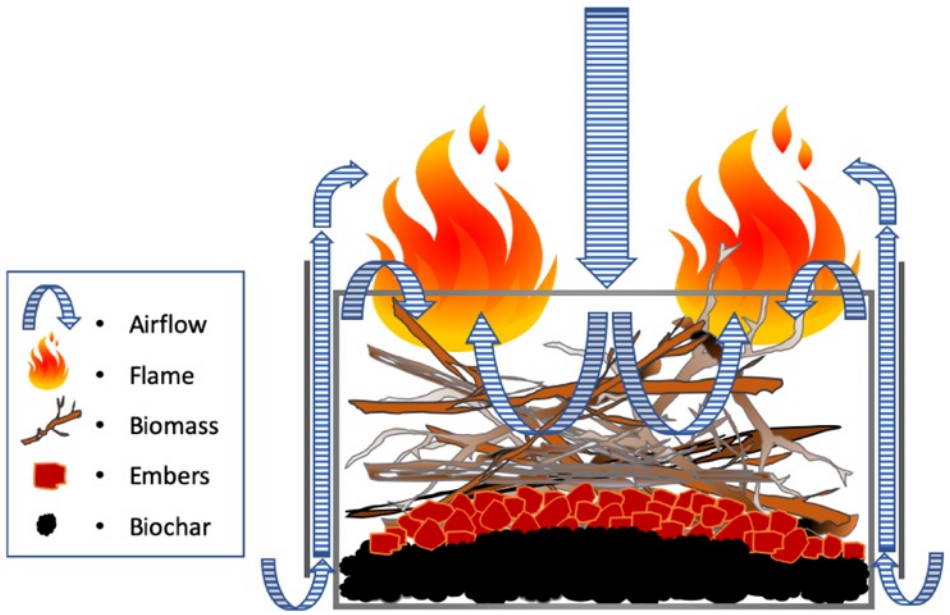
Flame Carbonization - A form of Pyrolysis

Making biochar in an open flame



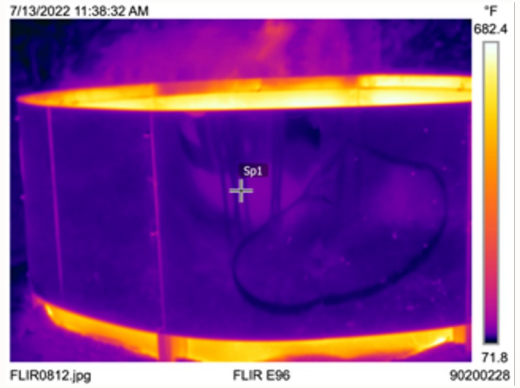
- Biomass burns in 3 stages.
- To make char, stop the process before it goes to ash
- Small pieces char more efficiently than large pieces

How does the Ring of Fire Kiln work?



Ring of Fire Biochar Kiln

Airflow and Flames – Counter-flow air from the top keeps embers contained and flame lengths low.



Counter-flow combustion draws smoke back into the kiln where it burns up – resulting in fewer emissions.

Ring of Fire Process

Production Process:

1. Initial Loading
2. Lighting
3. Continual Loading
4. Quenching and Unloading

“Always Keep a Strong Flame on Top”

Li’l Pyro says: “Always keep a strong flame on top.

- The flame is your heat source.
- Heat transfers down into the pile by radiation.

Biochar in the Woods Technologies – Preliminary results from USFS General Technical Report – We looked at 8 different methods:

Conservation Burn Piles

Hand piles

Machine piles

Flame-cap Kilns

Ring of Fire Kiln®

Utah Big Box Kiln

Oregon Kiln

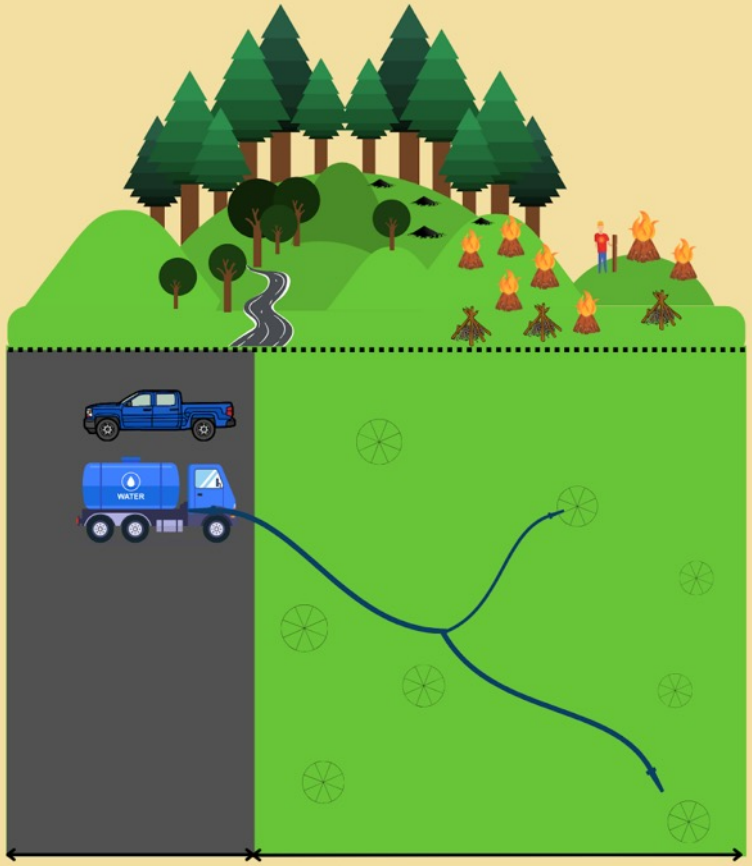
Air Curtain Burners

Tigercat 6050

Burnboss®

CharBoss®

TYPICAL SITE PLAN FOR HAND CONSERVATION BURN PILE



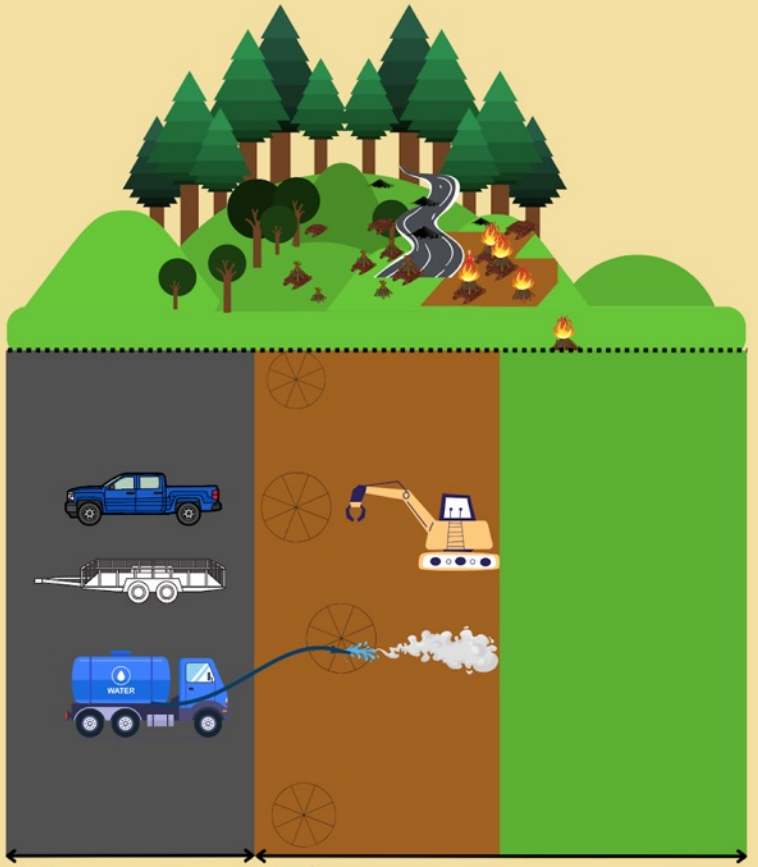
Technology Footprint
Biochar production site
1x Water tender
1x Pickup Truck - Crew

Overview:

- 25 piles per acre (62 piles/ha)
- Pile size - 6'x 6'x 6'(2m x 2m x 2m)
- Site is 5 acres (2 ha) of uneven terrain, off-road
- 1 crew transport (Truck holds up to 5 crew with hand tools in back)
- 1 water tender (holds 2 crew members)
- One supervisor and 4 hand crew in total

Feedstock Diameter Limit for optimal biochar (seasoned feedstock) — **Small** up to 4", or 10cm

TYPICAL SITE PLAN FOR MACHINE CONSERVATION BURN PILE

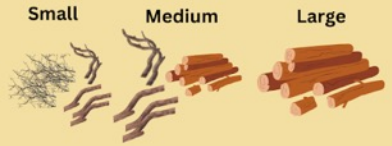


Landing Zone
1x Log loader
1x Loader trailer
1x Water tender
1x Pickup Truck - Crew

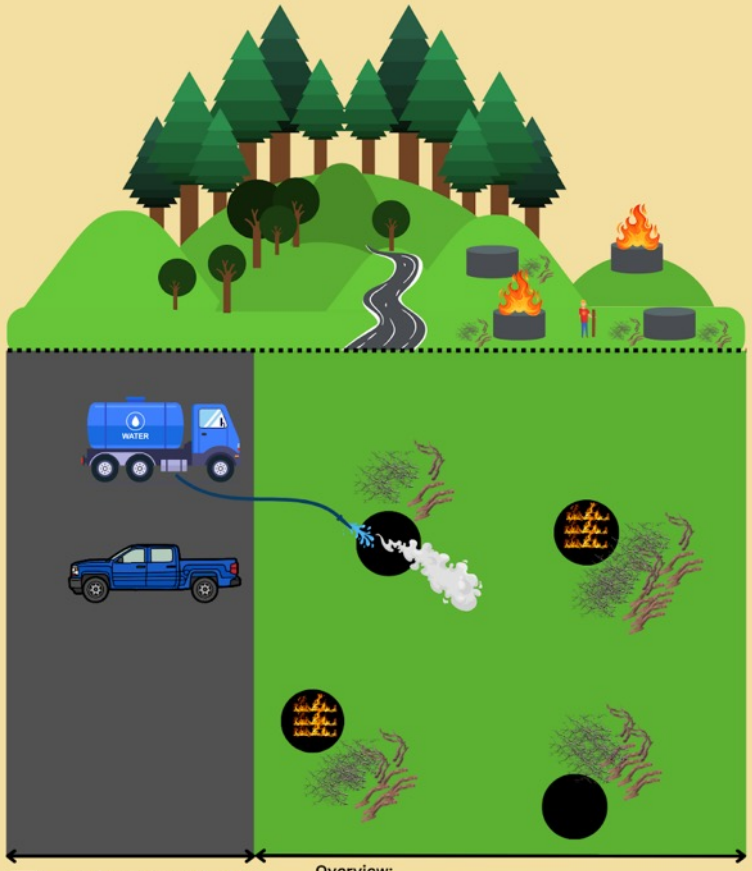
Overview:

- 30 piles along a roadside
- Maximum pile footprint 15 foot (4.6 m) diameter
- Log loader on tracks
- 3x hand crew, 1x machine operator

Feedstock Diameter Limit for optimal biochar (seasoned feedstock) — **Small to Large** up to 18", or 46cm



TYPICAL SITE PLAN FOR RING OF FIRE KILN®



Technology Footprint
Biochar production site
1x Water tender
1x Pickup Truck - Crew & kiln

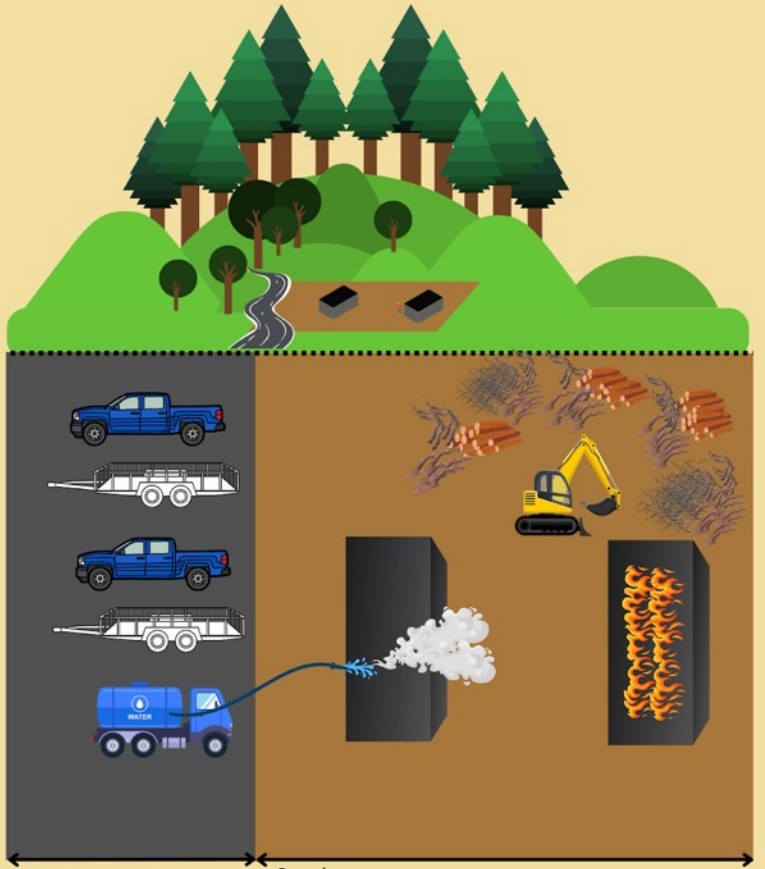
Overview:

- 4 kilns on about 2 acres (0.8 ha) of land, with cut material, unpiled, all around
- Kilns are within 300 feet (91 m) of the road
- Site is uneven but not too steep
- 1x pickup truck with kilns and tools in bed
- 1x water tender
- Four hand crew riding in pickup truck and water tender

Feedstock Diameter Limit for optimal biochar (seasoned feedstock)

Small — up to 4", or 10cm

TYPICAL SITE PLAN FOR BIG BOX KILN



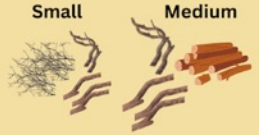
Technology Footprint
Landing Zone
1x Water tender
1x Feedstock Loader
2x Kiln trailer
2x Pickup Truck - Crew & kiln trailer

Overview:

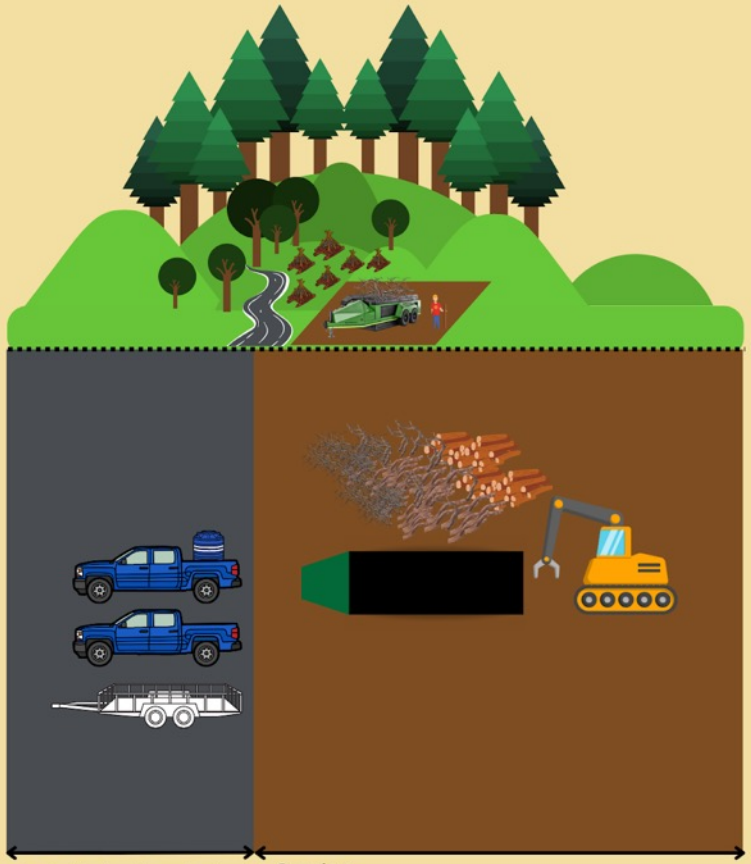
- 2 kilns deployed on about 3 acres (1.2 m) about 100 feet (31 m) apart with cut material, unpiled, all around.
- Site is uneven but not too steep - gentle topography. Kilns are within 300 feet (91 m) of the road.
- Crew rides in equipment transport
- one supervisor, one machine operator per project and one hand crew per kiln
- 1x truck and trailer for kilns, 1x truck and trailer for loader
- 1x water tender

Feedstock Diameter Limit for optimal biochar (seasoned feedstock)

Small to Medium — up to 12", or 30 cm



TYPICAL SITE PLAN FOR AIR BURNERS INC BURNBOSS®

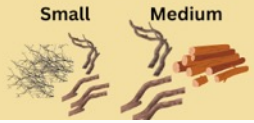


Technology Footprint
Landing Zone
1x Feedstock Loader
1x Loader trailer
2x Pickup Truck - Crew

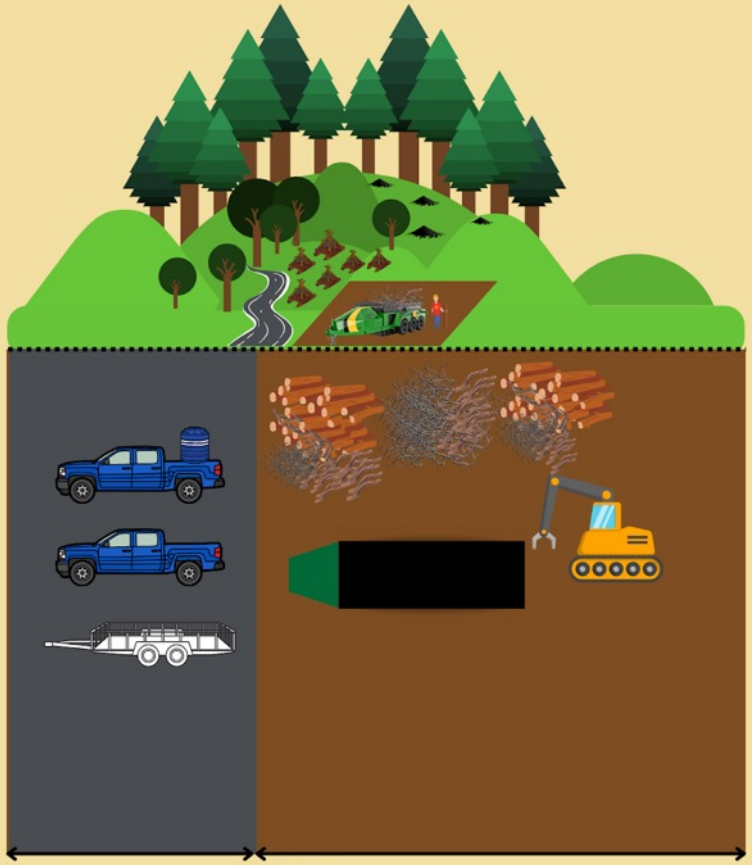
Overview:

- Site is flat but off road, in an orchard, park or road berm
- Biomass already piled (2x wind rows around 10x30feet (3m x 9m))
- The Burn Boss is unloaded by lifting the box and driving forward. It takes about 50 feet (15 m) for all the char to drop out the bottom (site needs to have at least 50 feet (15 m) to pull forward)
- 1x truck and trailer to haul Burn Boss
- 1x water tank on truck hauling Burn Boss
- 1x truck and trailer to haul mini excavator/loader
- Crew rides in equipment transport, one hand crew, one machine operator

Feedstock Diameter Limit for optimal biochar (seasoned feedstock): **Small to Medium** up to 12", or 30 cm



TYPICAL SITE PLAN FOR AIR BURNERS INC CHAR BOSS®

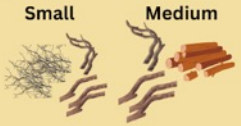


Technology footprint
Landing Zone
1x Feedstock Loader
2x Pickup Truck
1x Loader trailer

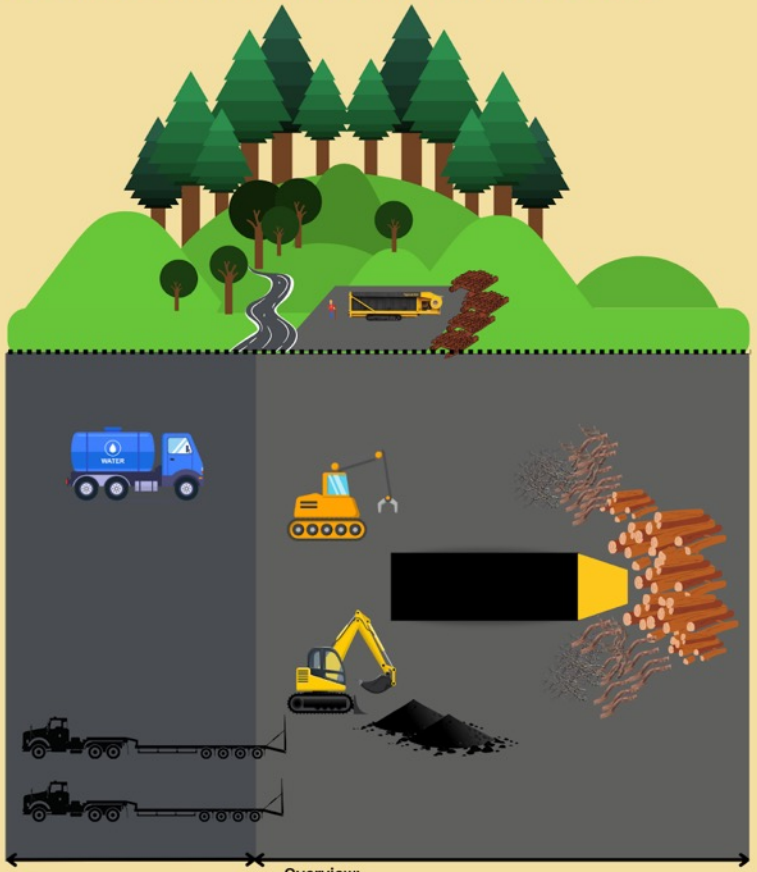
Overview:

- Replace Site is on road berm with Site is on level ground on roadside
- Biomass is already piled in piles just like the machine piles along a roadside, and the Char Boss can process approx 5 machine conservation burn piles per day
- 1x truck and trailer to haul Char Boss + 1 water tank on truck
- 1x truck and trailer to haul mini excavator/loader
- one supervisor, one machine operator, one hand crew
- Crew rides in equipment transport

Feedstock Diameter Limit for optimal biochar (seasoned feedstock): **Small to Medium** up to 12", or 30 cm



TYPICAL SITE PLAN FOR TIGERCAT CARBONATOR®

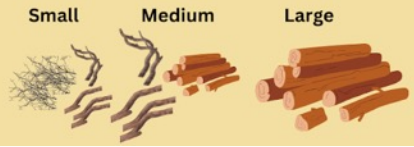


Technology Footprint
Landing Zone
1x Water tender
2x Semi Truck - Loader + Carbonator
1x Biochar Loader
1x Feedstock Loader

Overview:

- Site is flat but off road, in a logging landing in the forest
- Site foot print is at least 40' x 12' (12m x 3.6m)
- Large semi-truck and flatbed to haul carbonator
- Truck and flatbed to haul large excavator/loader for loading biomass
- Truck and flatbed to haul small excavator/loader for moving biochar out of quenching pond
- Water tender
- Crew rides in equipment transport, two hand crew, two machine operators

Feedstock Diameter Limit for optimal biochar (seasoned feedstock): **Small to Large** up to 18", or 46cm



Technology Productivity Comparison, Daily Basis

Technology Type	Typical scenario	Hand crew per shift	Machine operators per shift	Biomass processed per shift by dry mass (MT)	Biochar production per shift by volume (cubic meters)	Total water required per shift, gal (liters)
Conservation Burn Piles (CBP)	hand piles (150 piles)	5		22 tons (20)	11 cy (8)	1,000 (3,785)
	machine piles (30 piles)	3	2	99 tons (90)	27 cy (21)	9,000 (34,069)
Flame-cap Kilns (FK)	Ring of Fire® (4 kilns)	5		8 tons (7)	12 cy (9)	600 (2,271)
	Oregon Kiln (6 kilns, 2 batches)	5		8 tons (7)	12 cy (9)	600 (2,271)
	Big Box Kiln (2 kilns)	3	1	11 tons (10)	16 cy (12)	600 (2,271)
Air Curtain Burners (ACB)	Burn Boss® (1 unit, 2 batches)	1	1	17 tons (15)	6 cy (5)	500 (1,893)
	Char Boss® (1 unit, continuous)	2	1	17 tons (15)	6 cy (5)	300 (1,136)
	Tigercat 6050 (1 unit, continuous)	2	2	72 tons (65)	25 cy (19)	4,500 (17,034)

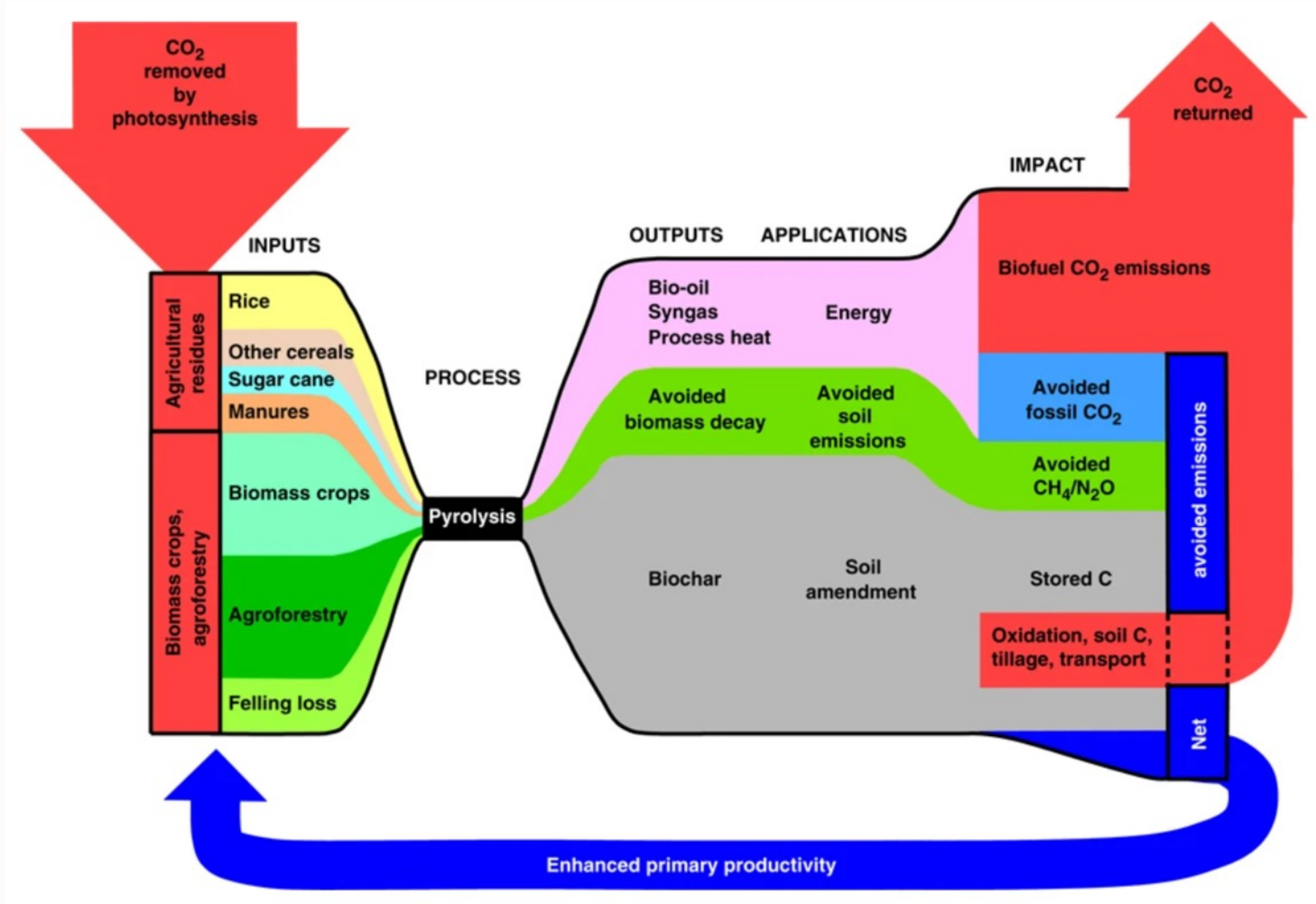
Addressing Barriers to Place-Based Biochar

1. Demonstrate benefits of place-based biochar
2. Develop workable permitting systems
3. Find funding to pay for the work
4. Train and employ the place-based workforce
5. Build robust networks to capture opportunities

Benefits of Place-Based Biochar

- Make it on site – use in on site (or nearby) means lower carbon foot print on production side
- Biochar is prioritized for ecological restoration and especially forest health
- Healthy, productive forests are the source of future biomass for biochar and other uses
- Biochar in soil increases net primary production, leading to more biomass to make more biochar and more carbon storage, and so on….

The Virtuous Carbon Cycle of exponentially increasing NPP – the real CCS machine!



Woolf, D., Amonette, J. E., Street-Perrott, F. A., Lehmann, J., & Joseph, S. (2010). Sustainable biochar to mitigate global climate change. *Nature communications*, *1*(1), 56.

How does biochar restore ecosystems?

- **Wildfire Crisis:** In the western US, climate change, drought, and a century of fire suppression have created a wildfire crisis that threatens ecosystems and communities.
- **Loss of Carbon Storage:** As forests go up in smoke, we are also experiencing the loss of one of our most important natural carbon sinks, at a time when we must rely more and more on natural climate solutions to drawdown carbon.
- **Forest Health:** Fire adapted forests need frequent fire for nutrient cycling and optimum health. Biochar is a natural component of forest soils.

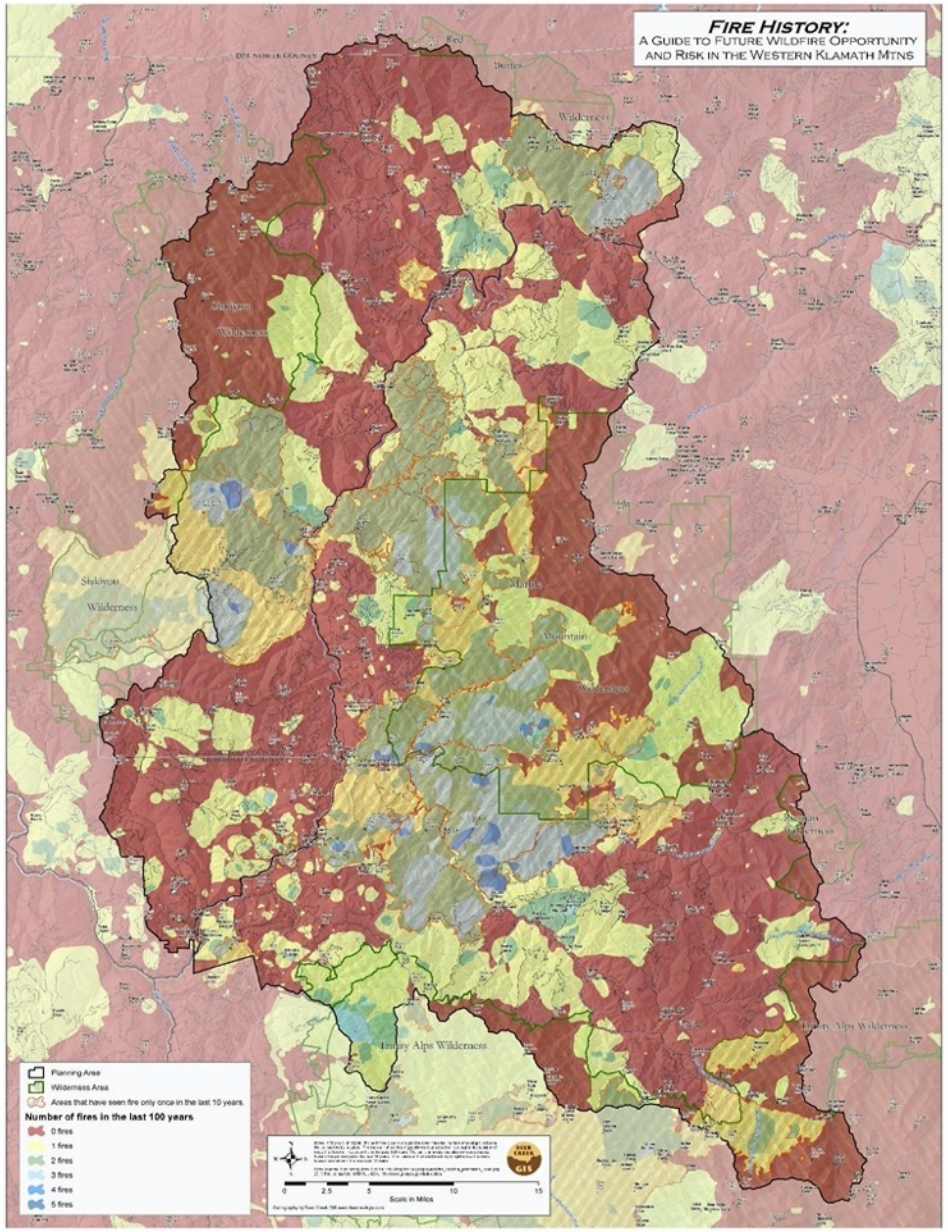
Natural Biochar from Wildfires

The amount of charcoal generated by wildfire depends on fire intensity, fire return interval, vegetation type, fuel loading and fire behavior. **From 10-50% of the carbon found in forest soils is charcoal** (Pingree 2012)

Pingree, M. R. A., Homann, P. S., Morrissette, B., & Darbyshire, R. (2012). Long and Short-Term Effects of Fire on Soil Charcoal of a Conifer Forest in Southwest Oregon. Forests, 3(4), 353-369. http://doi.org/10.3390/f3020353

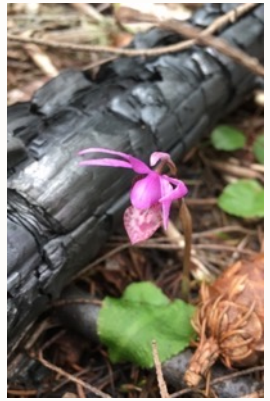
Klamath Fire History

- Red areas have not burned in the last 100 years
- Brimmer (2006) found that sites that experienced multiple fires contained 3x more char than sites where fire was excluded
  - *Brimmer, R.J. 2006. Sorption potential of naturally occurring charcoal in ponderosa pine forests of western Montana (MS thesis). Missoula, MT: University of Montana.*



Biochar Mimics Natural Fire

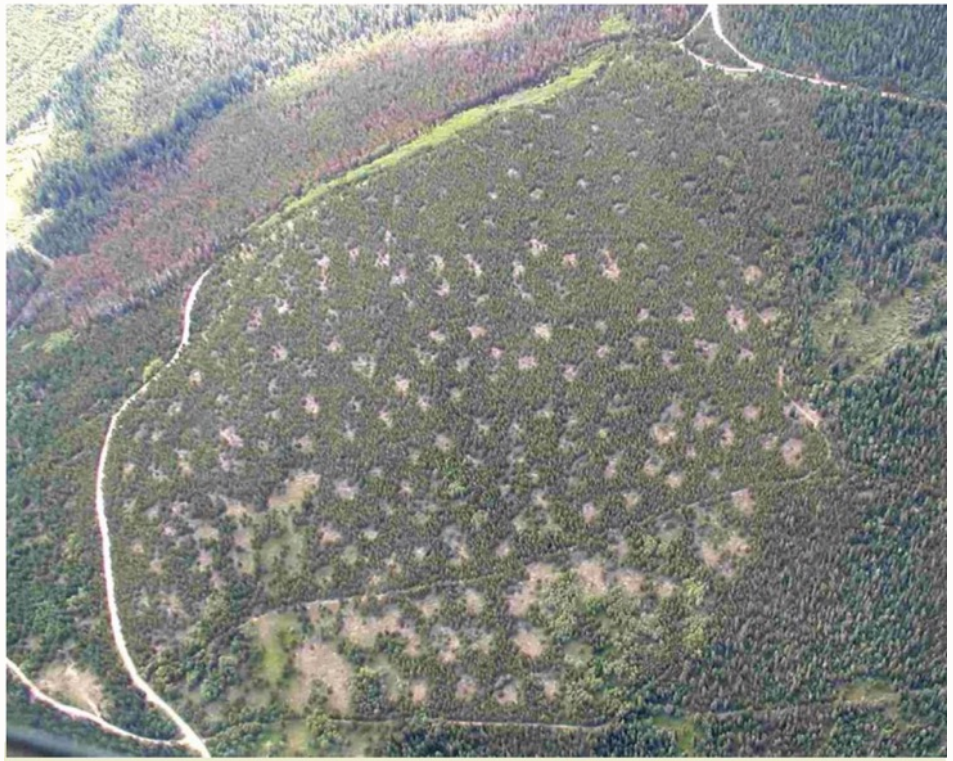
- Excluding fire from landscapes has created the current dangerous fuel loading conditions
- Periodic, low-intensity fire provides a regular input of biochar and minerals to rejuvenate forest soils
- Biochar is a form of biomimicry that restores important soil components and helps retain water
- he er




Traditional Ecological Knowledge (TEK)

Tribes, agencies and the public putting good fire back on the land

Current Practice: Pile Burning to Ash



Pile burning can create grass and forb-filled openings that often remain treeless for decades, as can be seen in this aerial photo of a 40-year-old regenerating lodgepole pine stand in Grand County, Colorado. (Photo by C. Rhoades)

Burn pile scars are long-lasting

Typical fuels project hand piles

The problem with pile burning: jackpot piles burn hot & complete

- Designed so that piles burn completely to ash
- Generate smoke
- Destroy forest soil
- Increase soil erosion, invasive species

Let's Make Biochar Instead

Photos courtesy of Ashley Durham, Bureau of Land Management, Dillon, MT

Develop workable permitting systems

Air emissions data is crucial but limited

Completed:

- Air Curtain Burner, Oregon Dept of Envir. Quality, Montrose Report
- ACB emissions testing by USFS from 2002
- KonTiki kilns, Cornelissen et al, 2016

Current efforts underway:

- Sonoma Biochar Initiative, Raymond Baltar
- USFS Fire Science Lab
- Yew Creek Alliance, Ken Carloni

Perspectives on Problem Biomass

1. From the biochar perspective: Stranded Biomass
2. From the wildfire perspective: Hazardous Fuels or Liability Biomass
3. From the forestry perspective: Low Value Material
4. From the pollution perspective: Waste Disposal

Terminology matters!

Waste Disposal = Incineration

Biomass is not waste. It has value.

Emissions factors for wildfires, open burn piles, FK, and ACB							
Type	PM 10, g/kg dry biomass	PM 2.5, g/kg dry biomass	NOx, g/kg dry biomass	CH4 emissions, g/kg dry biomass	CO2 emissions, g/kg dry biomass	CO emissions, g/kg dry biomass	Source
Wildfire, NW conifer forest		23.2	2.0	7.3	1600	135.0	Urbanski 2014
Burn pile, flaming	4.0			1.0		28.0	Springsteen et al. 2011
Burn pile, smoldering	7.0			8.5		116.0	Springsteen et al. 2011
Burn pile, dry		4.5		1.1	1785	29.0	Aurell et al. 2017
Burn pile, wet		18.0		5.7	1689	82.0	Aurell et al. 2017
Flame-cap kiln	1.3		0.1	2.6	780	2.6	Puettmann et al. 2020 derived from Cornelissen et al. 2016
Large ACB		0.55		0.7	1808	1.3	Sussot et al. 2002
BurnBoss® ACB	2.1		1	0.3		7.1	Montrose 2023

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USFS CharPalooza, Tooele UT, 4-19-23

Find funding to pay for place-based biochar

Monetizable values – happening now

- Part of fuels and fire safety (WUI) we are already paying for
- Part of landscape management, parks, erosion control, we already pay for
- Agriculture – replace current ag burning of orchard and vineyard waste
- Ecosystem values – enhance current payments for nutrient management, soil carbon (NRCS), mine reclamation
- Carbon removal credits

Who will fund it?

- Landowners who already pay for biomass management
- Government subsidies
- Carbon finance

Biochar Markets - Making a Product

- Air Curtain Burners make a consistent product that can enter biochar markets
- High quality
- Fit for purpose for many applications

Control Laboratories
42 Hangar Way
Watsonville, CA 95076
www.biocharlab.com
Tel: 831 724-5422
Fax: 831 724-3188

Account No: 12028
Batch: Feb 23 A
CODE: BioChar IBI

Ashley Durham
Bureau of Land Management (MT)
12 Eagle Drive
Sheridan, MT 59749

Date Received: 1/26/2023
Sample ID: Lake Canyon BioChar Sample
Lab ID. Number: 3010486-01

International BioChar Initiative (IBI) Laboratory Tests for Certification Program

	Dry Basis Unless Stated:	Range	Units	Method
Moisture (time of analysis)	60.9		% wet wt.	ASTM D1762-84 (105c)
Bulk Density	9.2		lb/cu ft	
Organic Carbon	84.9		% of total dry mass	Dry Combust-ASTM D 4373
Hydrogen/Carbon (H:C)	0.27	0.7 Max	Molar Ratio	H dry combustion/C(above)
Total Ash	8.0		% of total dry mass	ASTM D-1762-84
Total Nitrogen	0.57		% of total dry mass	Dry Combustion
pH value	8.32		units	4.11USCC:dil. Rajkovich
Electrical Conductivity (EC20 w/w)	0.083		dS/m	4.10USCC:dil. Rajkovich
Liming (neut. Value as-CaCO3)	7.5		%CaCO3	AOAC 955.01
Carbonates (as-CaCO3)	2.9		%CaCO3	ASTM D 4373
Butane Act.	6.4		g/100g dry	ASTM D 5742-95
Surface Area Correlation	335		m2/g dry	G

All units mg/kg dry unless stated:		Results	Range of Max. Levels	Reporting Limit (ppm)	Method
Arsenic	(As)	**ND**	13 to 100	0.49	J
Cadmium	(Cd)	**ND**	1.4 to 39	0.20	J
Chromium	(Cr)	3.9	93 to 1200	0.49	J
Cobalt	(Co)	**ND**	34 to 100	0.49	J
Copper	(Cu)	10.0	143 to 6000	0.49	J
Lead	(Pb)	0.81	121 to 300	0.20	J
Molybdenum	(Mo)	7.3	5 to 75	0.49	J
Mercury	(Hg)	**ND**	1 to 17	0.001	EPA 7471
Nickel	(Ni)	2.0	47 to 420	0.49	J
Selenium	(Se)	**ND**	2 to 200	0.98	J
Zinc	(Zn)	225	416 to 7400	0.98	J
Boron	(B)	15.6	Declaration	4.9	TMECC
Chlorine	(Cl)	98.6	Declaration	20.0	TMECC
Sodium	(Na)	1164	Declaration	491	E
Iron	(Fe)	368	Declaration	24.5	E
Manganese	(Mn)	289	Declaration	0.49	J

Particle Size Distribution	Results	Units	Method
< 0.5mm	1.7	percent	F
0.5-1mm	0.8	percent	F
1-2mm	0.8	percent	F
2-4mm	2.8	percent	F
4-8mm	9.0	percent	F
8-16mm	30.3	percent	F
16-25mm	54.7	percent	F
25-50mm	0.0	percent	F
>50mm	0.0	percent	F

Basic Soil Enhancement Properties			
Total (K)	7372	mg/kg	E
Total (P)	2030	mg/kg	E
Ammonia (NH4-N)	22.3	mg/kg	A
Nitrate (NO3-N)	1.9	mg/kg	A
Organic (Org-N)	5679	mg/kg	Calc.
Volatile Matter	14.3	percent dw	D

* "ND" stands for "not detected" which means the result is below the reporting limit.

Method A Rayment & Higginson
D ASTM D1762-84
E EPA3050B/EPA 6010
F ASTM D 2862 Granular
G Butane Activity Surface Area Correlation Based on McLaughlin, Shields, Jagiello, & Thiele's 2012 paper: Analytical Options for Biochar Adsorption and Surface Area
J EPA3050B/EPA 6020

Analyst: Nik Zumberge

Control Laboratories
42 Hangar Way
Watsonville, CA 95076
www.biocharlab.com
Tel: 831 724-5422
Fax: 831 724-3188

Account No: 8539
Batch: Aug 21 C
CODE: BioChar IBI

Raymond Baltar
Sonoma Ecology Center
P.O. Box 1486
Eldridge, CA 95431

Date Received: 8/11/2021
Sample ID: 0
Lab ID. Number: 1080322-01

International BioChar Initiative (IBI) Laboratory Tests for Certification Program

	Dry Basis Unless Stated:	Range	Units	Method
Moisture (time of analysis)	5.9		% wet wt.	ASTM D1762-84 (105c)
Bulk Density	13.4		lb/cu ft	
Organic Carbon	86.8		% of total dry mass	Dry Combust-ASTM D 4373
Hydrogen/Carbon (H:C)	0.37	0.7 Max	Molar Ratio	H dry combustion/C(above)
Total Ash	4.9		% of total dry mass	ASTM D-1762-84
Total Nitrogen	0.59		% of total dry mass	Dry Combustion
pH value	8.40		units	4.11USCC:dil. Rajkovich
Electrical Conductivity (EC20 w/w)	0.081		dS/m	4.10USCC:dil. Rajkovich
Liming (neut. Value as-CaCO3)	10.7		%CaCO3	AOAC 955.01
Carbonates (as-CaCO3)	3.1		%CaCO3	ASTM D 4373
Butane Act.	6.1		g/100g dry	ASTM D 5742-95
Surface Area Correlation	327		m2/g dry	G

All units mg/kg dry unless stated:		Results	Range of Max. Levels	Reporting Limit (ppm)	Method
Arsenic	(As)	**ND**	13 to 100	0.28	J
Cadmium	(Cd)	**ND**	1.4 to 39	0.11	J
Chromium	(Cr)	1.5	93 to 1200	0.28	J
Cobalt	(Co)	0.67	34 to 100	0.28	J
Copper	(Cu)	2.8	143 to 6000	0.28	J
Lead	(Pb)	0.41	121 to 300	0.11	J
Molybdenum	(Mo)	**ND**	5 to 75	0.28	J
Mercury	(Hg)	**ND**	1 to 17	0.001	EPA 7471
Nickel	(Ni)	1.9	47 to 420	0.28	J
Selenium	(Se)	**ND**	2 to 200	0.56	J
Zinc	(Zn)	21.5	416 to 7400	0.56	J
Boron	(B)	10.0	Declaration	2.81	TMECC
Chlorine	(Cl)	52.3	Declaration	20.0	TMECC
Sodium	(Na)	**ND**	Declaration	281.2	E
Iron	(Fe)	545	Declaration	14.1	E
Manganese	(Mn)	203	Declaration	0.28	J

Particle Size Distribution	Results	Units	Method
< 0.5mm	4.8	percent	F
0.5-1mm	3.8	percent	F
1-2mm	8.0	percent	F
2-4mm	19.9	percent	F
4-8mm	33.9	percent	F
8-16mm	27.7	percent	F
16-25mm	2.0	percent	F
25-50mm	0.0	percent	F
>50mm	0.0	percent	F

Basic Soil Enhancement Properties			
Total (K)	2078	mg/kg	E
Total (P)	249	mg/kg	E
Ammonia (NH4-N)	3.1	mg/kg	A
Nitrate (NO3-N)	2	mg/kg	A
Organic (Org-N)	5935	mg/kg	Calc.
Volatile Matter	14.3	percent dw	D

* "ND" stands for "not detected" which means the result is below the reporting limit.

Method A Rayment & Higginson
D ASTM D1762-84
E EPA3050B/EPA 6010
F ASTM D 2862 Granular
G Butane Activity Surface Area Correlation Based on McLaughlin, Shields, Jagiello, & Thiele's 2012 paper: Analytical Options for Biochar Adsorption and Surface Area
J EPA3050B/EPA 6020

Analyst: Nik Zumberge

Raman Spectroscopy

on the left side through to the least carbonised on the right side.

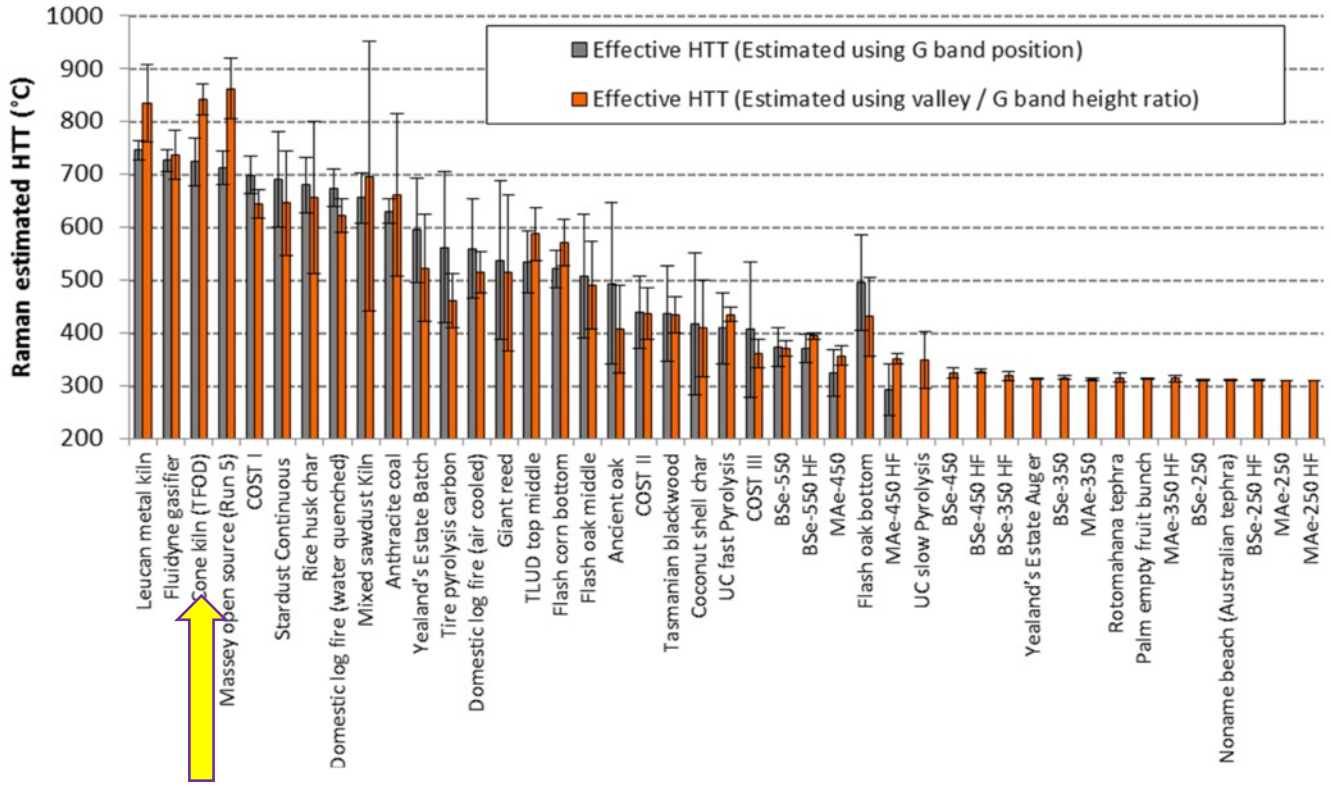


Figure 3. Raman estimated effective HTTs. Samples are ranked along X-axis from highest value of apparent G band position on the left to lowest on the right. Error bars represent 99% confidence intervals.


Carbon Removal $$$?

Volume measurement is easy

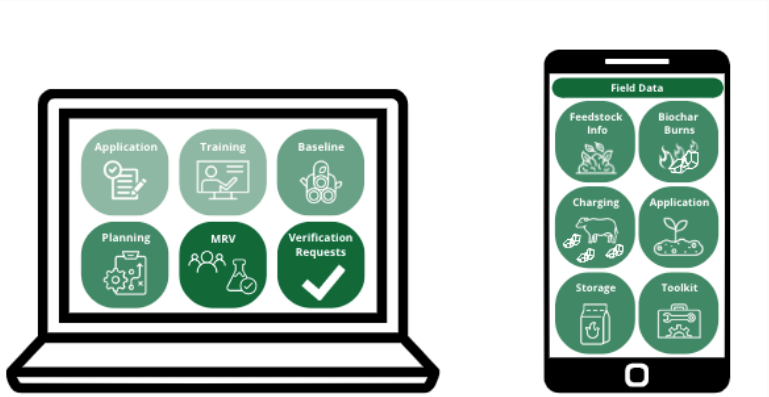
- Measure level of biochar in the kiln
- $\pi\, r^2\, h = V$

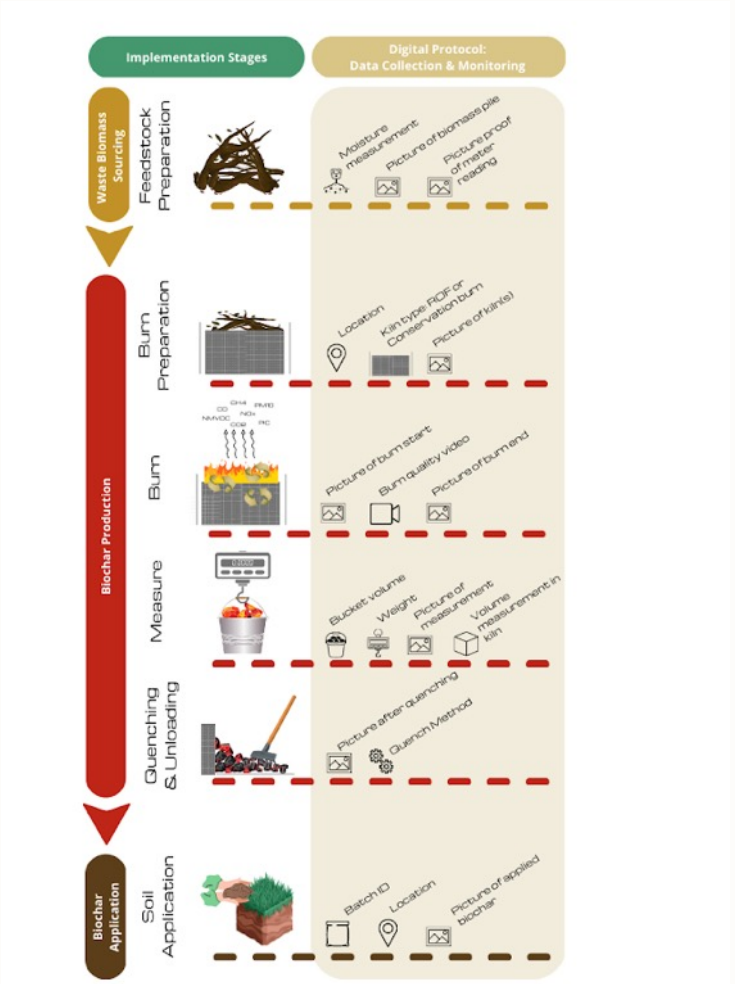
Mass from Dry Bulk Density

- Weigh a metal bucket of hot coals before quenching
- Thanks to Tabor of the Biochar Coalition for figuring this out!

Digital Monitoring, Reporting and Verification (D-MRV)

IKHALA IMPACT





CM002 Component Methodology

Train and employ the place-based workforce

Train and employ the place-based workforce

1. Fire fighter capacity and off-season work
2. Prescribed fire technicians
3. Tribes and TEK (Traditional Ecological Knowledge)
4. Forestry contractors and arborists
5. Ag services contractors
6. Youth conservation corps groups
7. Parks and landscaping grounds maintenance crews
8. Volunteers and landowners

Project Youth Plus Natural Resources On-Ramp Camp

On Ramp Camp is for students, high school age and older, who are interested in careers in forestry, natural resource protection and wildland firefighting.

We used biochar made the year before in planting holes for streamside willows

We learned how to make biochar in kilns and in “swamper” burns

Partners: Project Youth Plus, Table Rock Foundation, Lomakatsi Restoration Project, Wilson Biochar Associates

Redwood Forest Foundation and California Conservation Corps

Karen Youngblood, Forest Conservation Specialist

Summary of Work Conducted on Usal Redwood Forest							
	Stand Thinning (ac)	Piling Biomass (ac)	Making Biochar (days)	Biochar Made (cy)	Biomass Burned (cy)***	Biochar to Soils (ac)	Established Soil Monitoring Plots
Millbank	5	2.5	7	81	567	10,000 sq ft	1 - 100x100 ft
5100 Rd	0	5	8	46	322	20,000 sq ft	2 - 50 x 50 ft
Duggan's	3	3	3	16	112	10,000 sq ft	1 - 100 x 100 ft
TOTAL	8	10.5	18	143	1001	0.9 acre	4 plots
Total tons of CO2 sequestered:			38				
***assume a 7:1 ratio							

Kai Hoffman-Krull, Forest Health Manager, San Juan Islands Conservation District:

Biochar in the Woods with the Island Conservation Corps

- Western Washington University students get a stipend and college credit for a semester of Biochar in the Woods
- Mostly using Conservation Burn methods

Clearing flammables from power line right of ways. Work supported by local utility.

Urban Biochar

- The water treatment plant for the cities of Eugene and Springfield, Oregon grows poplar plantations as part of their water treatment.
- Poplar is harvested for various uses, and now the slash can also be turned into biochar.

Northwest Youth Corps at work – September 2021

Howard EcoWorks - Maryland

- **Our mission** is to empower communities and diverse workforces to respect and restore our natural systems for future generations.
- Our vision is to create innovative solutions, partnerships, and a skilled workforce to support resilient communities.

Potter Valley Tribe

- The Potter Valley Tribe held a Forest Biochar Production Demonstration day on April 23, 2021.
- Five Indian Tribes were represented: Potter Valley Tribe, Coyote Valley NSN, Pinoleville Pomo Nation, Round Valley Indian Tribes, and Robinson Rancheria.

Sponsored and supported by North Coast Resource Partnership, with assistance from the California Conservation Corps, Ukiah Center and Sonoma Ecology Center

The teacher: Cuauhtemoc Villa, a regenerative ag teacher from the Portland, Oregon area and expert in biochar production and use

US Rake Force – employing veterans

US Rake-Force
Veteran-owned forestry contractors
Training Day
October 30, 2021
Toledo, WA

Biochar Coalition – Northern California

Biochar Coalition statistics:

- 117 biochar batches
- 300 cubic yards made
- Feedstocks: Oak, maple, apple, pine, walnut, ash, willow, scotch broom, grasses, grape vine, non pressure treated lumber, bamboo, bones.

Lots of videos and photos at biocharcoalition.org

Training and Learning Opportunities

- USBI Biochar in the Woods
  - Recordings available for online seminar on January 27
  - USBI YouTube channel:
  - https://www.youtube.com/c/USBiocharInitiative/videos
- **Wilson Biochar Associates and other practitioners and consultants are available for field demos and webinars**
- Contact Kelpie for more info: kelpiew@gmail.com

Build robust networks to capture opportunities

Bringing together contractors, forest and land managers, agencies

#1 Topic for today's Biochar in the Woods Technical Meeting
4:30 – 5:30

Biochar in the Woods Network

- Join us!
- If you'd like to subscribe to the free ***Biochar in the Woods Discussion Group***, visit https://biochar.groups.io/g/Biocharinthewoods
- Monthly Zoom meetup – first Wednesday at noon, PST



Thank You

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