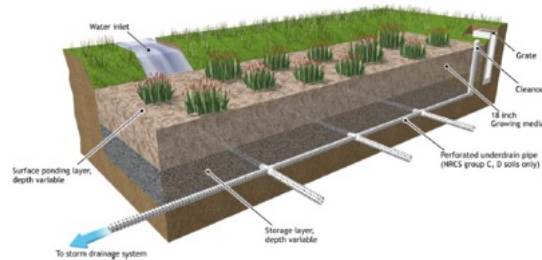
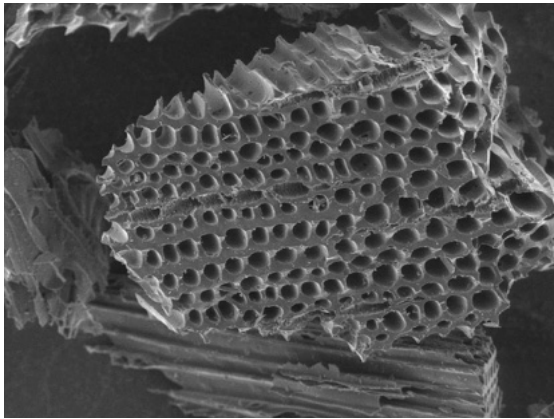


SCALING UP BIOCHAR: RIGHT BIOCHAR SOURCE

Biochar Products, Qualities, Production, and Use



COMMUNITY OF
PRACTICE
October 25, 2023

Tom Miles
Executive Director
US Biochar Initiative



ABOUT USBI

Established 2009



Fact Sheets



Online Producers Directory



Equipment & Technology Development

USBI is a not-for-profit organization promoting the sustainable production and use of biochar through research, policy, technology & doing it!

Activities:

North America Conferences, Workshops, Demos, Fact Sheets, Newsletter, Website, Provider Directory, Social Media, Biochar Advocacy, Referrals, Forestry Partner, Technical Advisory Team, Research, Outreach & Education, biochar.groups.io



In-field Workshops



Trade shows & Conferences



biochar-us.org/biochar-crop-application-guidelines





2024 North American Biochar Conference

FEBRUARY 12-15, 2024
SAFE Convention Center
Sacramento, California, USA

US BIOCHAR INITIATIVE

BIOCHAR-US.ORG

BIOCHAR GUIDELINES FOR AGRICULTURE APPLICATIONS

Practical insights for applying biochar to annual and perennial crops



A sustainable soil amendment that: ¹⁻⁴

- builds soil organic carbon and soil health
- increases crop yields and soil moisture
- improves nutrient retention
- boosts microbial activity
- alleviates compaction
- reduces soil acidity
- sequesters carbon



Learning Center

Biochar 2024
Feb 12-15, 2024
Sacramento,
California





Right Biochar Source

Sources

- Local
- Available
- Waste

Feedstocks

- Wood
- Ag Pits, Nuts, Shells
- Litters
- Manures

Quality

- Analysis
- Needs

Process

- Feedstock
- Temperature
- Residence Time

Objectives

- Filtration
- Infiltration, Aggregation
- Water retention
- Nutrient Use
- Organic matter
- pH
- Carbon
- Soil Health



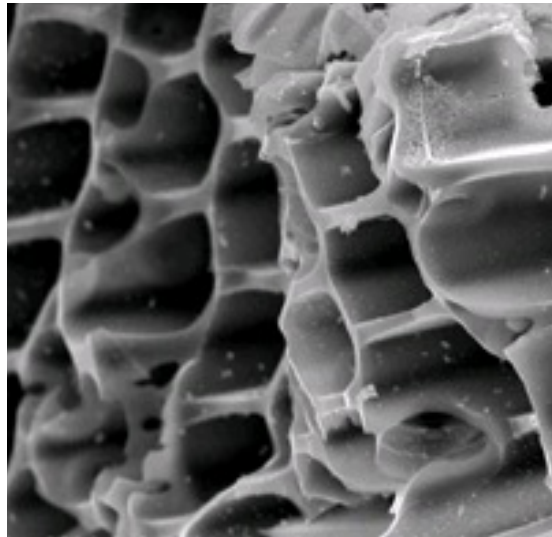
WHAT IS BIOCHAR?

- Granular black carbon, like charcoal
- Produced via pyrolysis: heating without oxygen
- Resistant to decay for 100's - 1,000's years
- Multiple beneficial environment applications such as stormwater filtration
- When produced from waste biomass it can be part of an approach to:
 - Produce renewable biomass energy
 - Remove carbon from the atmosphere
 - Create valuable environmental and agriculture materials



What Biochar Qualities Do You Need?

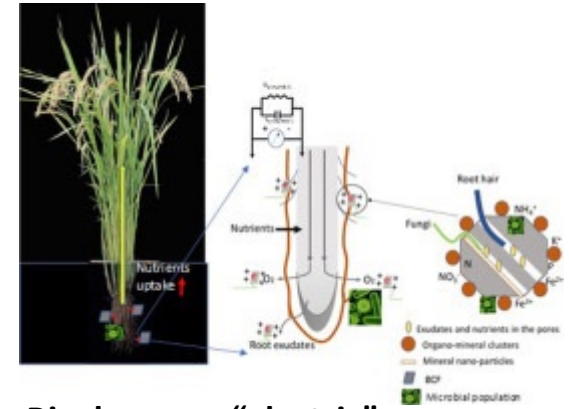
Biochars are fine-grained, highly porous charcoals that help soils retain nutrients and water. International Biochar Initiative



Collins 2009



Mycorrhizal fungal hyphae growing from spore base invade large charcoal pores Ogawa 2004



Biochars are “electric”

Biochar-based fertilizer redox potential, eH
Chew et al. 2020 bit.ly/30TQnIB

BIOCHAR CHARACTERISTICS

Physical Properties

Highly porous; surface area up to 500 m²/g

Three distinct pore types:

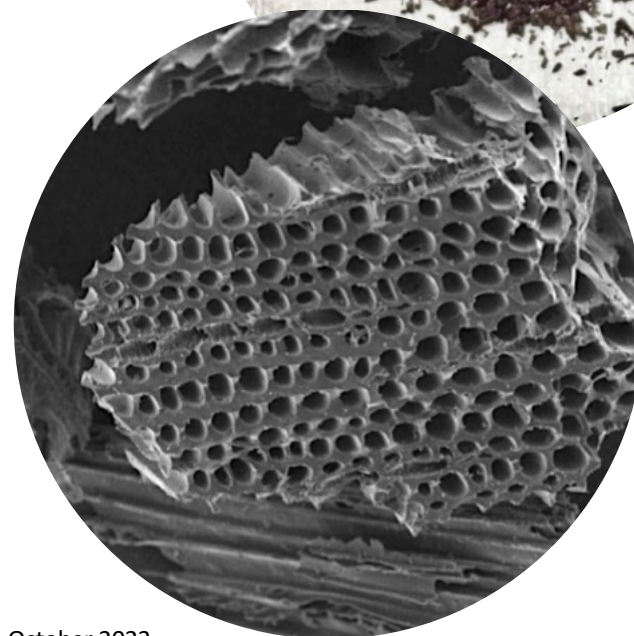
External pores: Dependent on particle size

Macropores: Dependent on feedstock

- 10-100 µm range for wood biochars

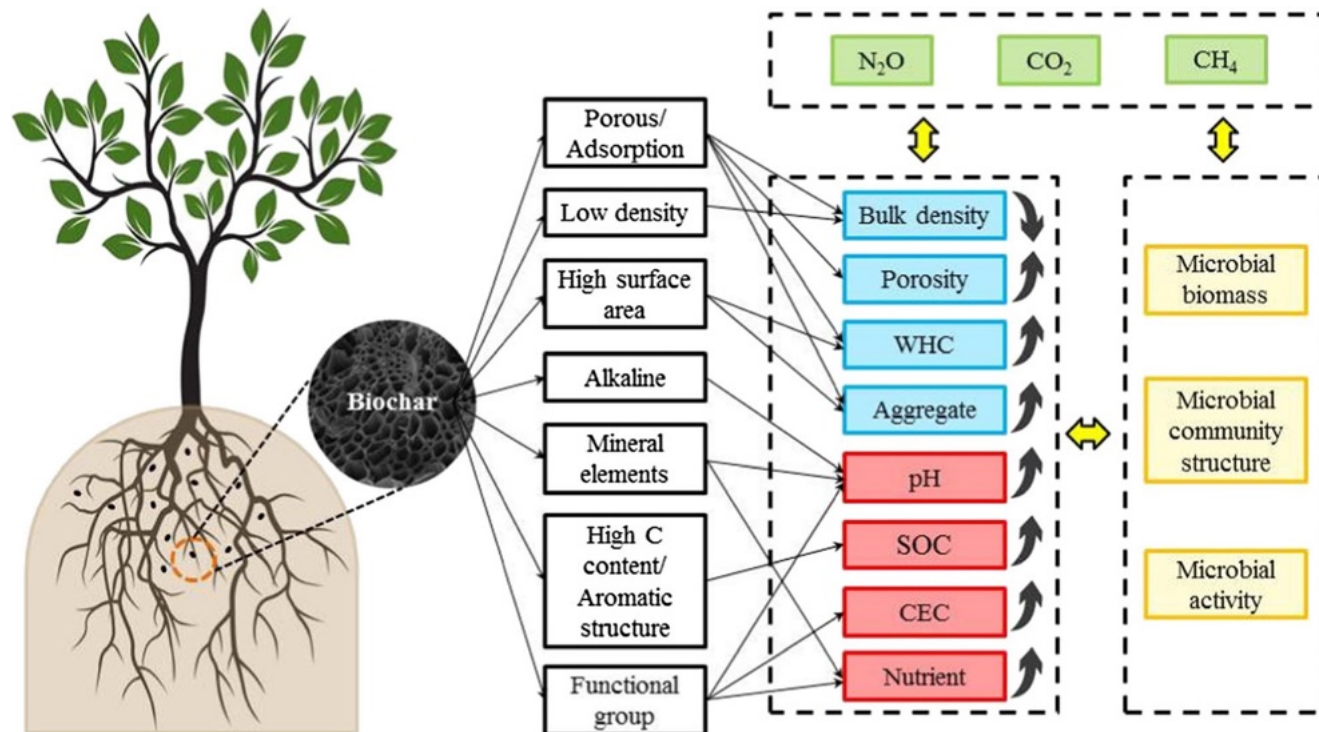
Micropores: Dependent on production

- 1-10 nm range = 10-100 water molecules!
- Majority of surface area with high potential sorption



Myles Gray

Conceptual scheme for the effects of biochar application on the soil physical, chemical, and microbial properties and greenhouse gas emissions in forest ecosystems



WHC = water holding capacity SOC = soil organic carbon CEC = cation exchange capacity

Li et al. 2018. Effects of biochar application in forest ecosystems on soil properties and greenhouse gas emissions: a review. *Journal of Soils and Sediments* 18: 546–563.

BIOCHAR IS NOT CREATED EQUAL

Properties depend on feedstock and production process

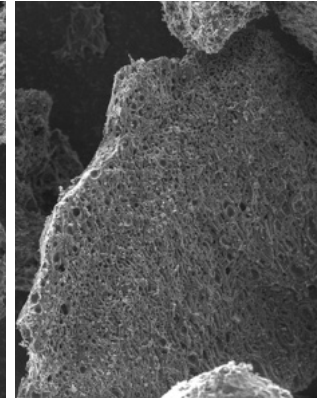
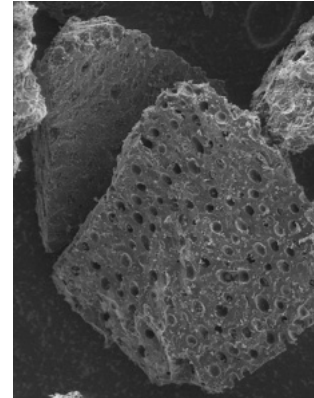
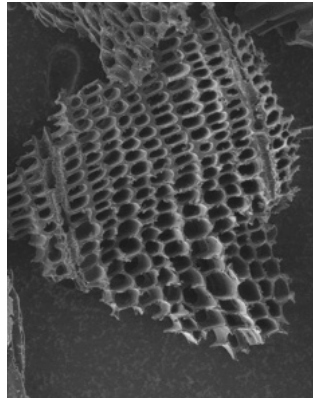
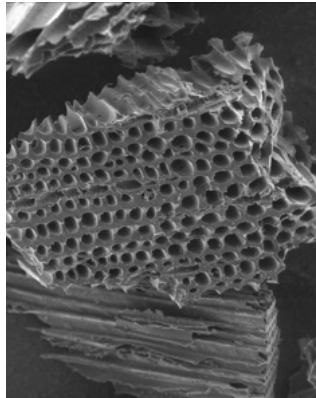
Douglas-fir 500 °C

Douglas-fir 650 °C

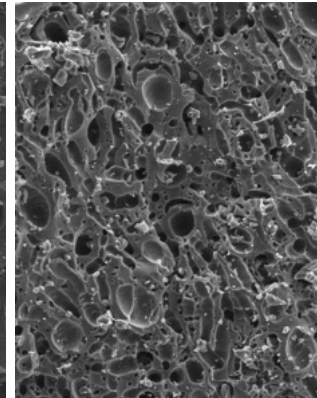
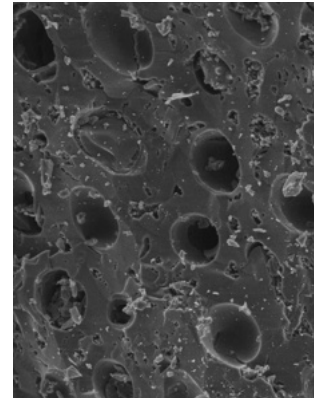
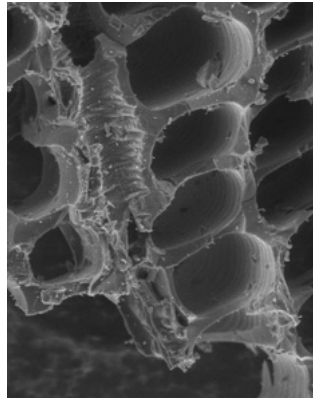
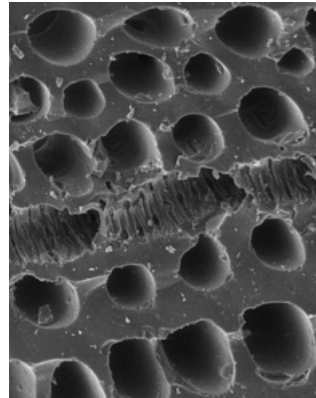
Hazelnut shells 500 °C

Hazelnut shells 650 °C

Top Row Scale
100 µm



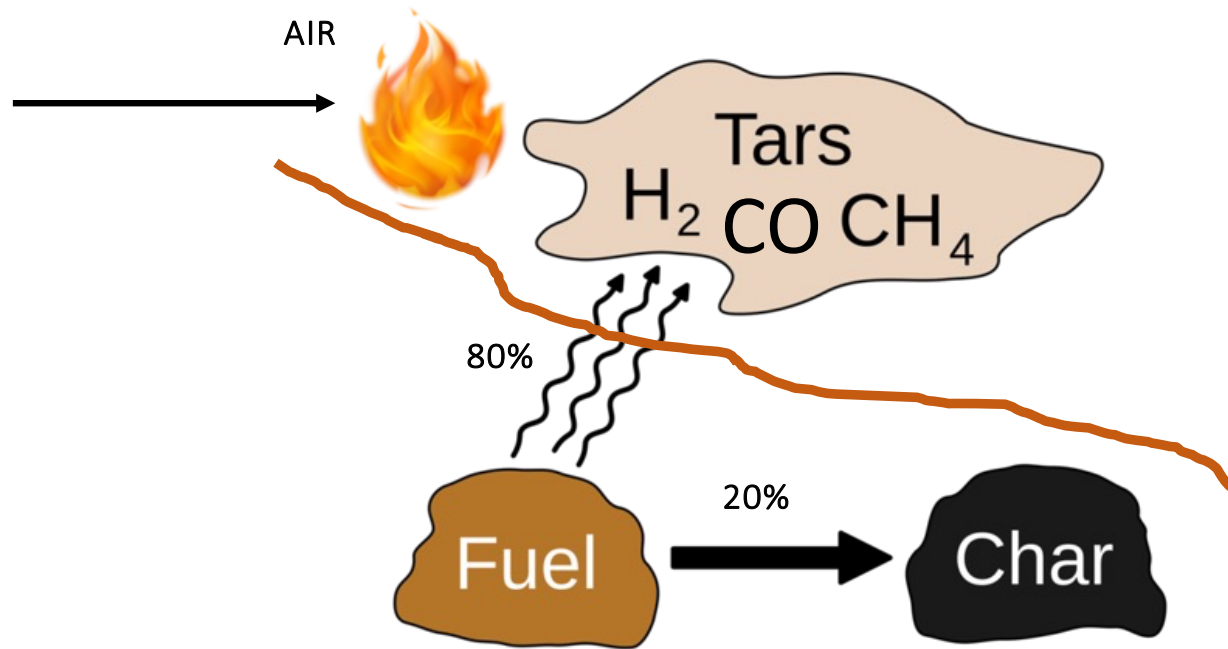
Bottom Row Scale
20 µm



HOW BIOCHARS ARE MADE:

Heat Converts Solids to Gas Leaving Char

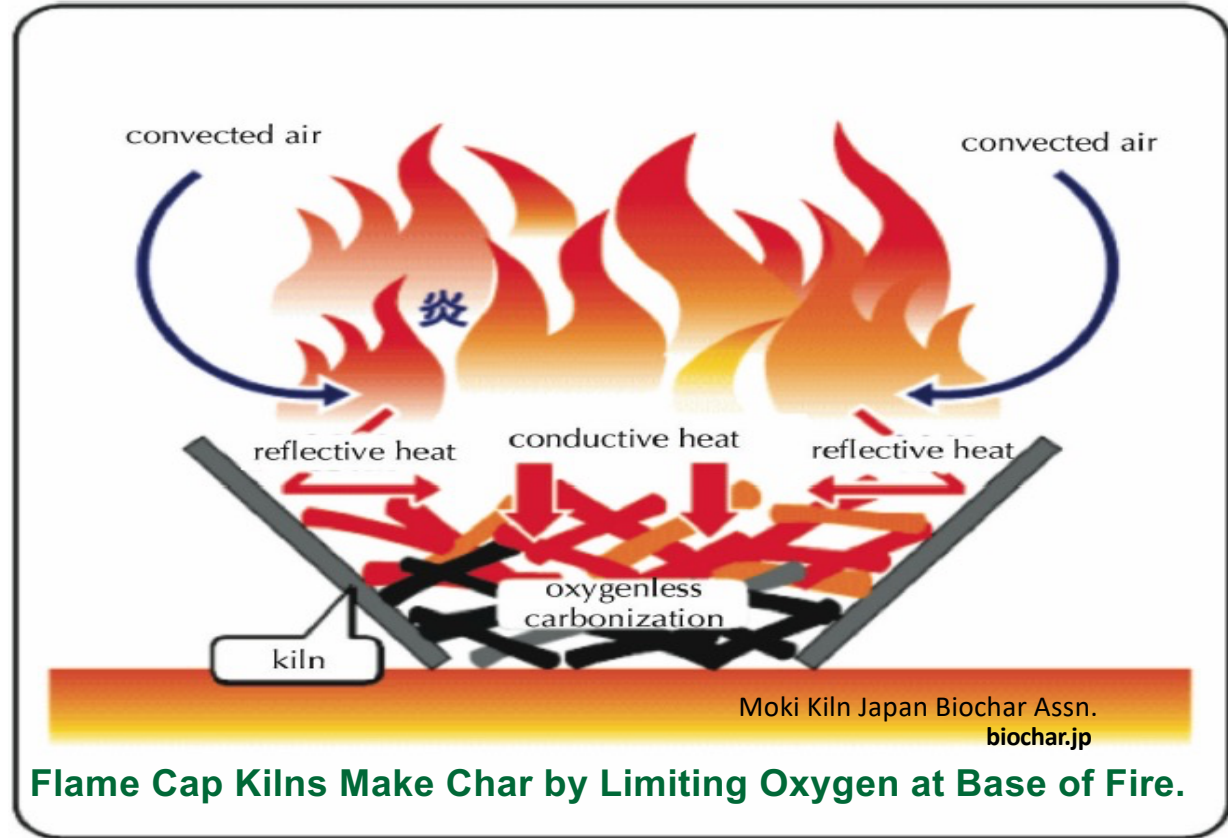
Pyro-lysis: from pyro (fire) and lysis (separation)



Radiant flames heat solid wood to make gas and char.



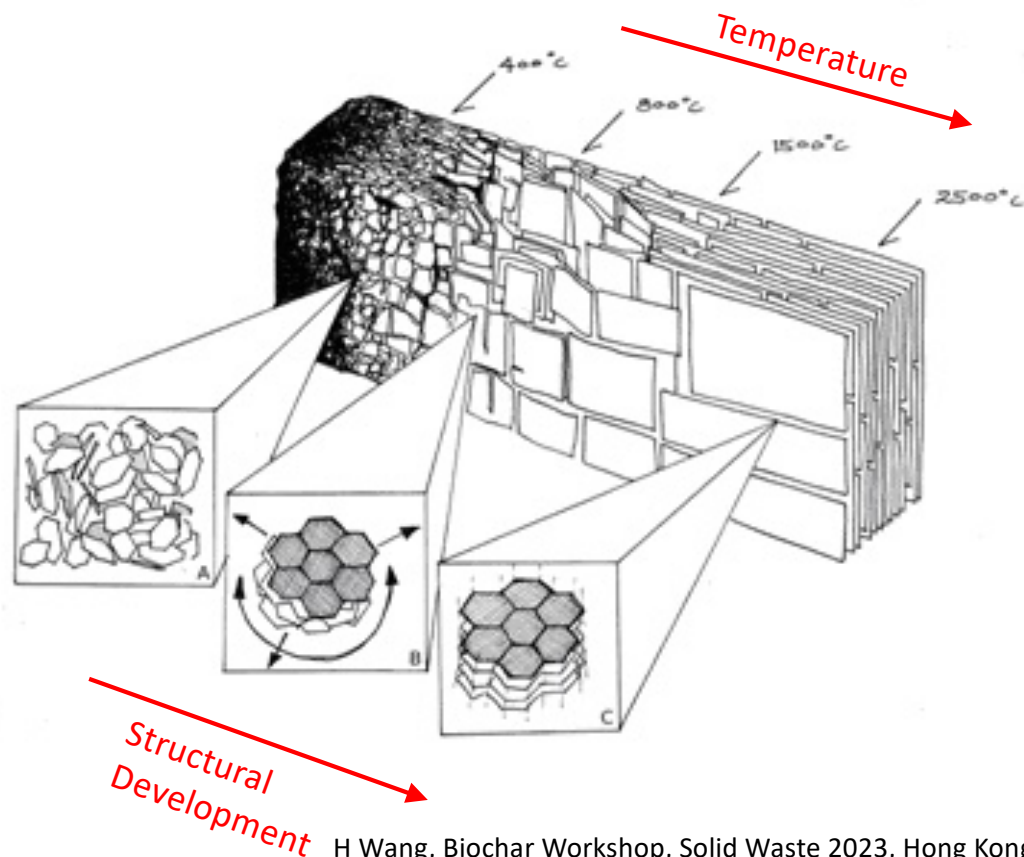
Photo: wilsonbiochar.com



Biochar properties: Process conditions (Peak temperature)

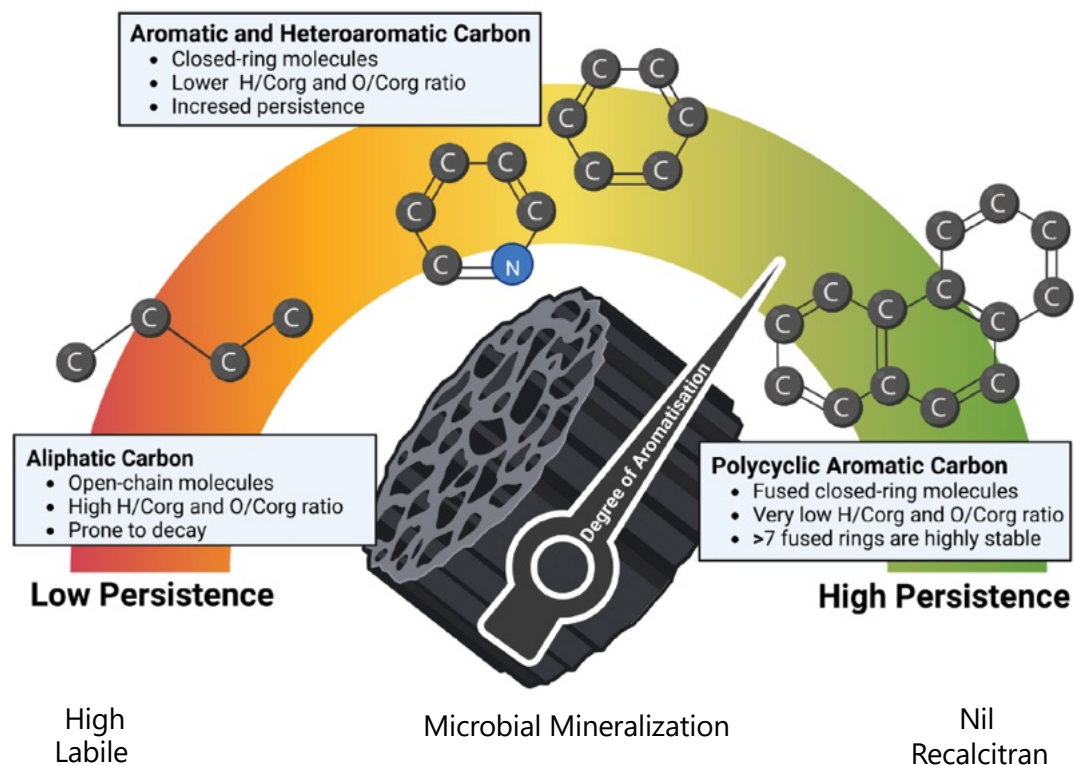
As temperature increases:

- Biochar yield decreases
- Fixed carbon increases
- Surface area increases
- Ash content increases



H Wang, Biochar Workshop, Solid Waste 2023, Hong Kong

Processes Determine Biochar's Persistence

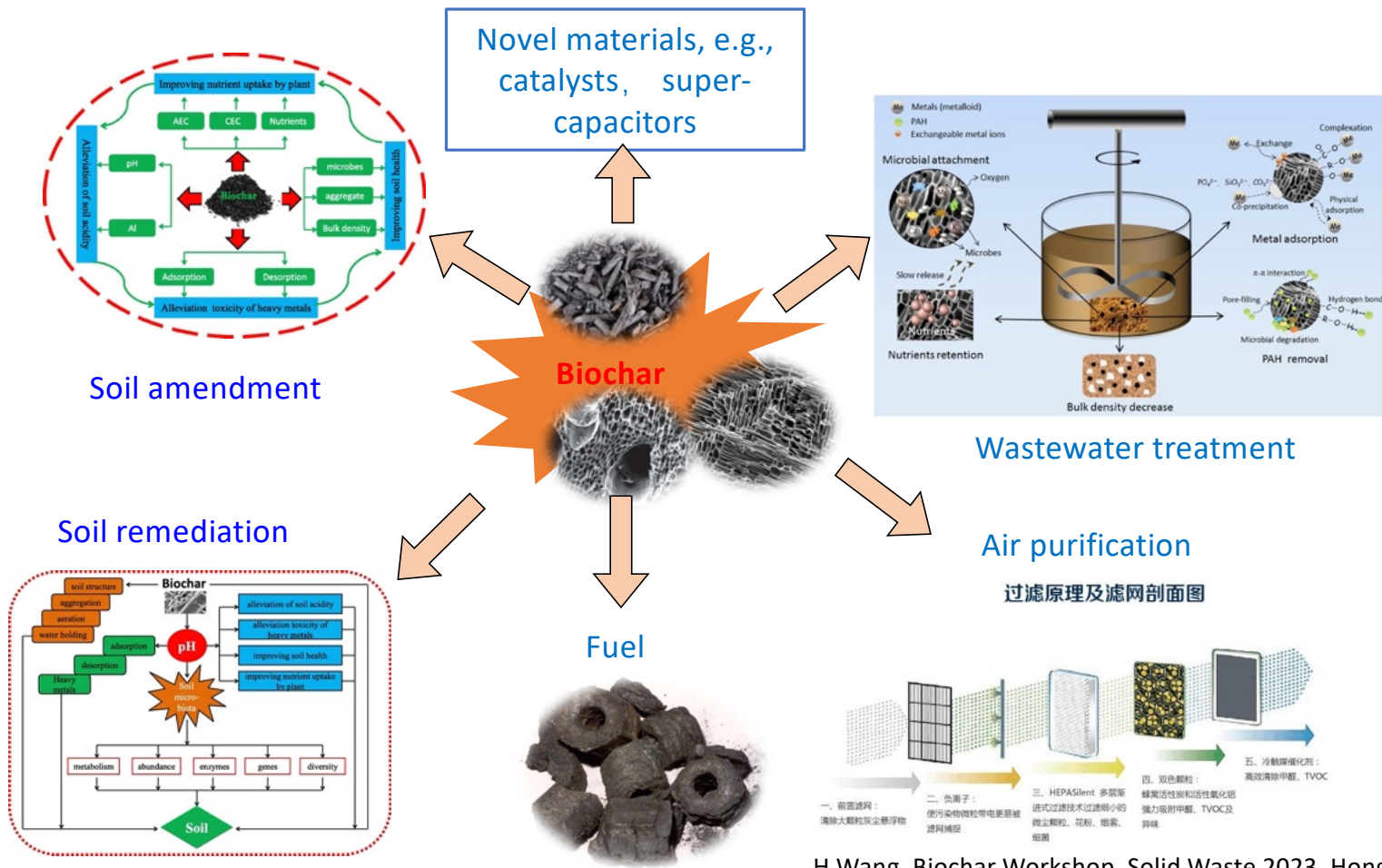


Using Organic geochemistry and petrology methodologies determine that biochar:

- With increasing temp., carbon increase, H/C & O/C decrease
- At 500°C+ 97% TOC is almost infinitely geochemically stable lasting 1000 years or longer
- Limited semi persistent carbon (SPC) has been found to last 50 to 100 years.

- (1) Schmidt HP, Abiven S, Hageman N, Meyer zu Drewers J: Permanence of soil applied biochar. An executive summary for Global Biochar Carbon Sink certification, the Biochar Journal 2022, Arbaz, Switzerland, www.biochar-journal.org/en/ct/109, pp 69-74
- (2) Peterson, H.I., Lassen, L., Rudra, A., Nguyen, L.X., Do, P.T.M., Sanei, H.: Carbon stability and morphotype composition of biochars from feedstock in the Mekong Delta, Vietnam, International Journal of Coal Geology, April 4, 2023, 104233.

Potential Uses of Biochar



H Wang, Biochar Workshop, Solid Waste 2023, Hong Kong



No Smoke. Healthy Crops. Healthy Animals. Happy Farmers. “Biochar Is A Farmer’s Best Friend”



Sr. Miriam Paulette with biochar from flame cap pit at the Carmelite Monastery in Zomba, Malawi.



Metal cover to quench char.



Training to make biochar in flame cap pit kiln. No smoke.



Warm Heart Worldwide Malawi

warmheartworldwide.org/biochar-africa

Kenya: Trainer Everline with bumper sorghum crop.



Biochar + Manure

Everline’s corn with biochar + manure



vs

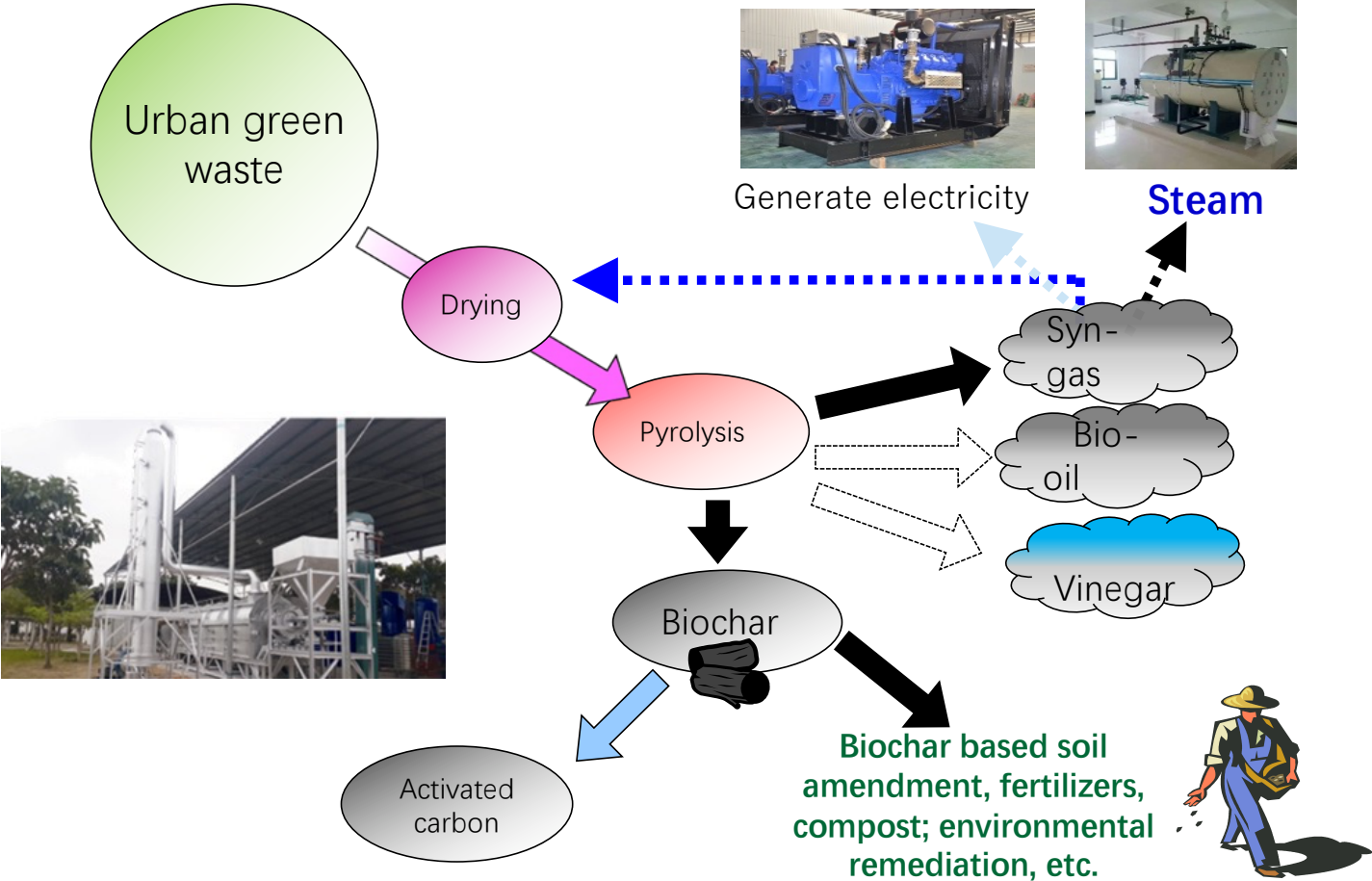
Her poor harvest with commercial fertilizer.



Warm Heart Worldwide, Kenya

2021 During pandemic 7500 smallholders trained by other biochar users.

Biomass pyrolysis and products



Biochars are Handed in Bulk and Processed for Different Forms and Qualities for Different Uses: Size, Density, Bag, Liquify

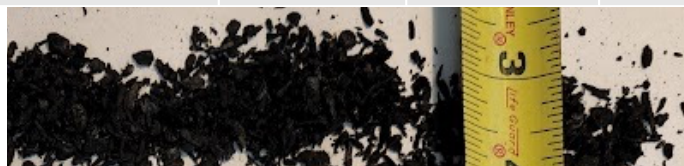


Biochar Properties Influence Storage and Transport

Feedstock-Particle Size-Moisture-Ash

Type	Size	Range mm	Moisture %	Carbon %	Ash %	Density Lb/CY
Fine	3mm	0.5-4	6%	82%	8%	270
Fine	3mm	0.5-4	35%	82%	8%	284
Mixed Granular	4-150 mesh	0.1-5	67%	78%	14%	464
Dry Powder	<40 Mesh	.005-.03	2.5%	94%	6%	678
Power Plant Ash	40-5 mesh	0.1-4	18%	14%	78%	788
Power Plant Carbon	40-2.5 mesh	.1-8	4%	50%	25%	234

Fine



Dry Powder



Biochar Solutions LLC

BIOCHAR QUALITY

Complies with Environmental and Soil Requirements

Date Received: 12/8/2022
 Sample ID: SOFTWOOD BIOCHAR 01
 Lab ID. Number: XXXXX-01

Physical

General Properties	Result	Units	Method
Moisture (as received)	65.5	% wet wt.	A
Bulk Density	6.6	lb/cu ft (dry)	
Organic Carbon	87.5	%	B
Hydrogen/Carbon (H:Org)	0.21	Molar Ratio	B
pH value	8.87	units	C
Electrical Conductivity	0.985	dS/m	C
Liming (as-CaCO3)	7.3	% CaCO3	I
Carbonates (as-CaCO3)	2.2	% CaCO3	J
Butane Act.	10.0	g/100g dry	G
Surface Area Correlation	451	m ² /g	G

Chemical

Particle Size Distribution	Result	Units	Method
< 0.5 mm	13.1	%	F
0.5 - 1 mm	17.4	%	F
1 - 2 mm	32.9	%	F
2 - 4 mm	34.5	%	F
4 - 8 mm	2.0	%	F
8 - 16 mm	0.0	%	F
16 - 25 mm	0.0	%	F
25 - 50 mm	0.0	%	F
> 50 mm	0.0	%	F

Environmental

Primary Nutrients	Result	Units	Method
Nitrogen N	0.72	%	E
Phosphorus P	0.07	%	E
Potassium K	0.74	%	B

Secondary Nutrients	Result	Units	Method
Calcium Ca	7410	mg/kg	E
Magnesium Mg	972	mg/kg	E
Sulfur S	211	mg/kg	E

Proximate Analysis	Result	Units	Method
Carbon C	87.8	%	B
Hydrogen H	1.56	%	B
Nitrogen N	0.72	%	B
Sulfur S	0.02	%	E
Oxygen O	5.3	%	Calc
Ash	4.6	%	A
	100.0	% Total	

EPA 503 Metals	Result	Units	MRL	Method
Arsenic As	0.62	mg/kg	0.45	H
Cadmium Cd	ND	mg/kg	0.18	H
Chromium Cr	39.9	mg/kg	0.45	H
Cobalt Co	1.4	mg/kg	0.45	H
Lead Pb	0.83	mg/kg	0.18	H
Mercury Hg	ND	mg/kg	0.001	K
Molybdenum Mo	0.48	mg/kg	0.45	H
Nickel Ni	19.9	mg/kg	0.45	H
Selenium Se	ND	mg/kg	0.90	H
Zinc Zn	13.6	mg/kg	0.90	H

Other Elements	Result	Units	MRL	Method
Sodium Na	553	mg/kg	451	E
Chlorine Cl	442	mg/kg	20	D
Aluminum Al	901	mg/kg	45.1	E

Trace Nutrients	Result	Units	MRL	Method
Copper Cu	7.8	mg/kg	0.45	H
Zinc Zn	13.6	mg/kg	0.90	H
Iron Fe	1307	mg/kg	22.5	E
Manganese Mn	190	mg/kg	0.45	H
Boron B	18.9	mg/kg	4.5	H

* "ND" stands for "not detected" which means the result is below the Method Reporting Limit (MRL).

Method A ASTM D1762-84
 B Dry Combustion - LECC
 C TMECC (2001) 4.10 & 4.11, 1:20 dilution
 D 1:20 dilution, Ion Chromatography
 E EPA3050B/EPA 6010
 F ASTM D 2862 Granular
 G Surface area correlation based on 'Analytical Options for Biochar Adsorption...' (McLaughlin et al, 2012)
 H EPA3050B/EPA 6020
 I AOAC 955.01
 J ASTM D 4373
 K EPA 7471

Pacific Biochar

USBI Factsheet:

Interpreting Biochar Analysis

Coming Soon!

Sign up for USBI newsletter for updates.



Biochar Qualities Help Determine Appropriate Use

Carbon Storage Class

H/C_{org}

C_{org} % total mass, dry basis

Fertilizer Class

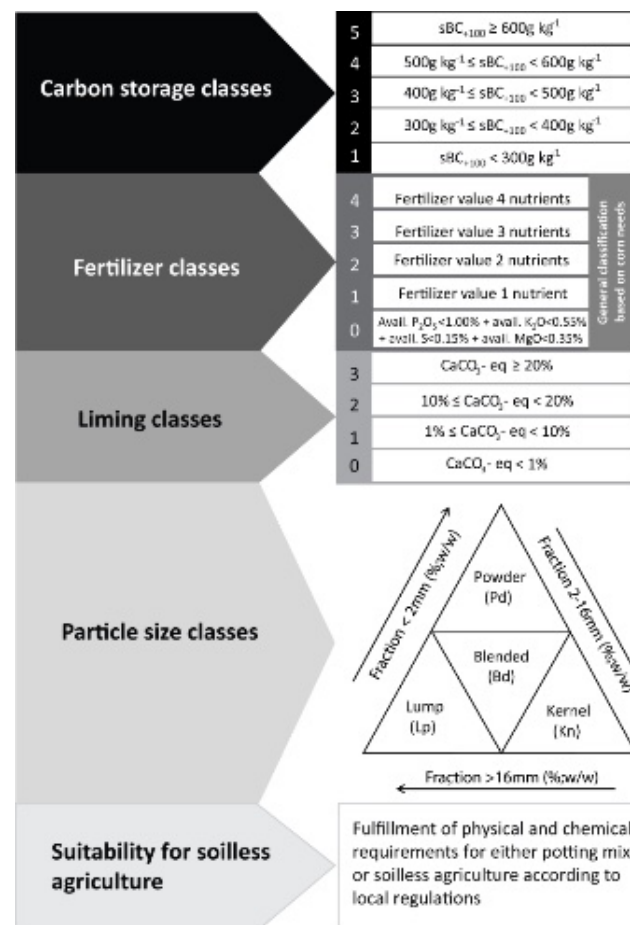
Total N	%	<input type="text" value="3.77"/>	mass basis	Avail. N	%	<input type="text" value="0.19"/>	mass basis
Total P	%	<input type="text" value="3.32"/>	mass basis	Avail. P	%	<input type="text" value="2.69"/>	mass basis
Total K	%	<input type="text" value="3.35"/>	mass basis	Avail. K	%	<input type="text" value="3.35"/>	mass basis
Total S	%	<input type="text" value="0.48"/>	mass basis	Avail. S	%	<input type="text" value="0.36"/>	mass basis
Total Mg	%	<input type="text" value="0.9"/>	mass basis	Avail. Mg	%	<input type="text" value="0.86"/>	mass basis
Total Ca	%	<input type="text" value="6.36"/>	mass basis	Avail. Ca	%	<input type="text" value="6.3"/>	mass basis

Liming Class

CaCO₃ % equivalent

Particle Size Class

<0.5mm	%	<input type="text" value="42"/>	2 - <4mm	%	<input type="text" value="6"/>	16 - <25mm	%	<input type="text" value="0"/>
0.6 - <1mm	%	<input type="text" value="30"/>	4 - <8mm	%	<input type="text" value="1"/>	25 - <50mm	%	<input type="text" value="0"/>
1 - <2mm	%	<input type="text" value="21"/>	8 - <16mm	%	<input type="text" value="0"/>	≥50mm	%	<input type="text" value="0"/>



IBI Classification Tool www.biochar-international.org/classification_tool
 IBI Classification Webinar Jan 30, 2017 www.biochar-international.org/node/8730



Standards, Specifications, Certifications

IBI Certification

Safe for use in soil - Non toxic

Stable (Carbon enriched for lost C)

≥10%, ≥30%, ≥60% Carbon

H:C ratio <0.7 (stability)

Sustainable Carbon smart

European Biochar Standards (2015)

World Biochar Certificate (2023)

(Basis for carbon dioxide removal credits, feeding biochar, soil and non soil uses)

Australia New Zealand Biochar Industry Group (ANZBIG)

AAPFCO Association of American Plant Food Control Officials

biochar definition (2016)

OMRI Organic Materials Review Institute

International Biochar Initiative

Std. Ver 2.0

<http://biochar-international.org>



States Follow AAPFCO Biochar Definition (2016)

- **Biochar** - is a solid material obtained from thermochemical conversion of biomass in an oxygen-limited environment (pyrolysis) containing at least 60% carbon. Feedstocks may be composed of crop residue, wood or other forest waste, and animal manures. Materials transported in salt water, painted, or treated with preservatives are not permitted. When listing biochar in an ingredient statement, the feedstock shall be designated by prefixing the term biochar with the feedstock from which it was produced; i.e. poultry litter biochar, green waste biochar, papermill biochar, etc. When more than one feedstock is involved, all feedstocks greater than 10% of the total volume are to be listed by decreasing volume. Their uses include soil amendments.

State regulating the sales and distribution of soil amendments includes:

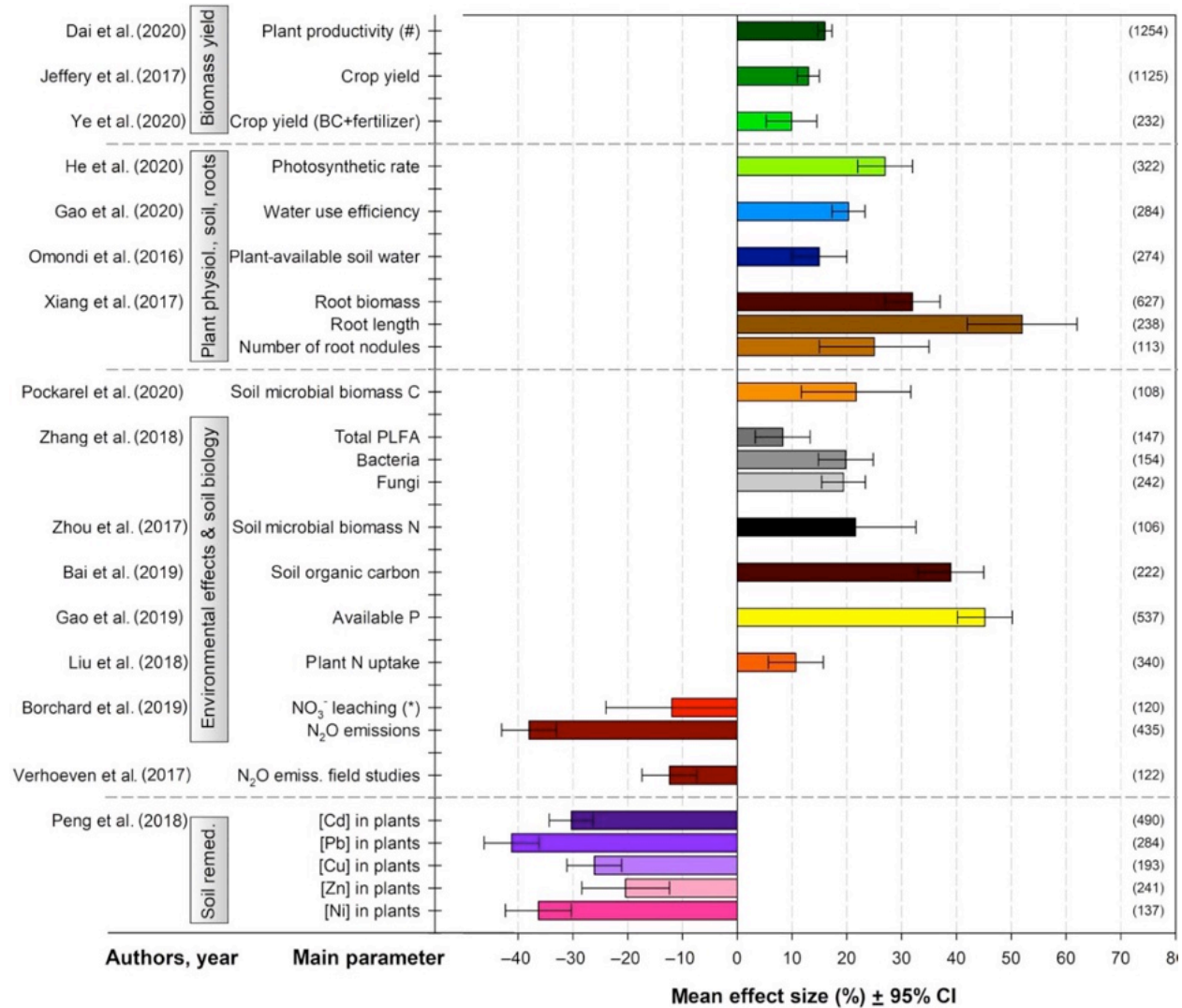
Arkansas	Illinois	Mississippi	Ohio (ag use only)	Utah
California	Iowa	Montana	Oregon	West Virginia
Colorado	Kansas	Nebraska	Pennsylvania	Wisconsin
Connecticut	Maine	New Jersey	Rhode Island	Wyoming
Delaware	Maryland	New Mexico	South Carolina	
Florida	Massachusetts	North Carolina	South Dakota	
Georgia	Michigan	North Dakota	Tennessee	
Idaho	Minnesota	Oklahoma	Virginia	



Biochar Labelling Guidance Document, USBI 2019

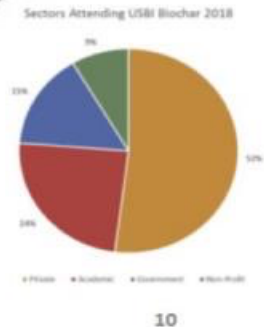
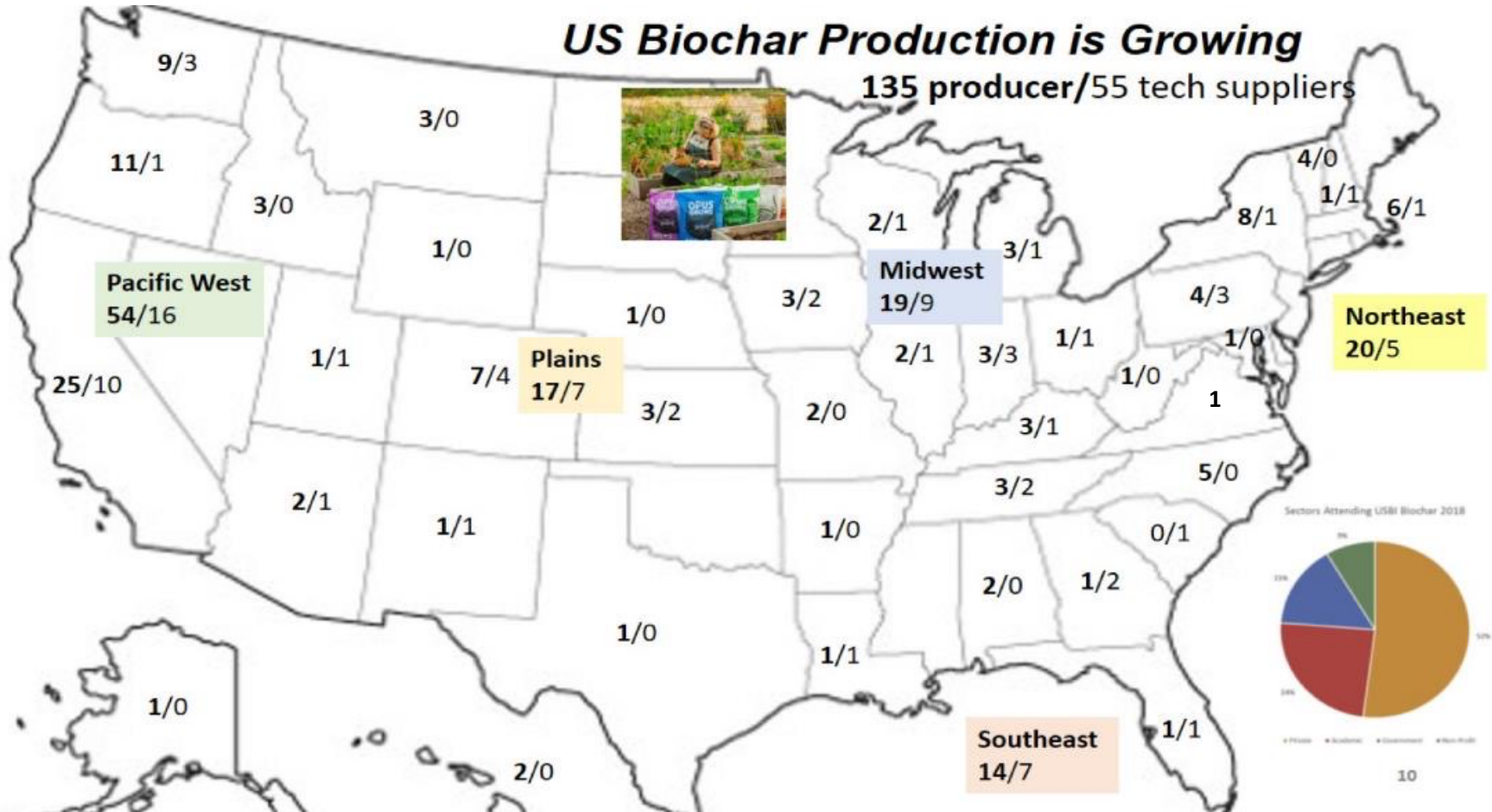
Biochar Benefits from 26 Reviewed Meta-Analyses

(Schmidt et al. 2021)



US Biochar Production is Growing

135 producer/55 tech suppliers



Coming Soon: USBI – IBI Global Market Survey 2023-2024



BIOCHARS ARE MADE FOR DIFFERENT MARKETS



Soil Health: Agriculture, Retail Garden, Landscape, Turf, Trees, Orchards, Vineyards, Horticulture

Biochar, Compost, Composted biochar (5%-20% biochar)
Animal bedding, litter, feed trials
Biochar-Based Fertilizers (15%-25% biochar)
Biotic Soil Amendments (biochar + organics+ minerals and biologicals)
Granulated and liquid products for seeding, foliar sprays (extracts)
Micro/nano carbons, nanofertilizers



Environment, Remediation, Erosion Control

Revegetation, Biosolids, Urban Soils, Erosion Control, Wetlands, Odor, Waste, Remediation Persistent Herbicides (USCC), PFOS/PFAS



Water quality stormwater filtration, water treatment

- functionalized chars, 3d aerogels, antibiotics



Forestry

Wildfire fuel reduction, Reforestation, Range Improvement
Growing media for nursery and out planting
Revegetation, Reclamation of mines and degraded land



Carbon, Renewable Energy Offsets, and Non-Soil Products

Carbon markets, building products, odor control, batteries



Retail Garden, Horticultural, Landscape and Fertilizer Products and Bagged and Palletized



Rexius/OpusGrows
www.opusgrows.com



Kellogg Garden Products
www.kelloggarden.com



15-10-10 Biochar
Compound Fertilizer

Others: Sustane Organic + Biochar, Mirimichi Green CarbonizPn Turf Enhancer, Engineered Biocarbon, Wakefield Biochar Soil Conditioner . . .

See: Role of biochar as an additive in organic waste composting. Miguel A. Sanchez-Monedero, Cayulela, M.L. Roig, A., Jindo, K., Mondini, C & Bolan, N. (2018) Bioresource Technology, 247-1155-164

Biochars Complement Beneficial Supplements



American Biochar Company VITAL Blend Soil Amendment, Activated BioChar charged with freshwater-sourced Humate
ambiochar.com/products



The Andersons® Hemic DG Granular Soil Conditioner (Humic Acid) with Biochar - Hemic DG CharX
andersonshumates.com/products/#HemicDG

Granulated Biochar Seedballs Aid Aerial Seeding for Green Carbon Cover in Africa, Australia and America



Seedballs Kenya
seedballskenya.com



Airseed Technologies
airseedtech.com



IN CALIFORNIA'S SAN JOAQUIN VALLEY, WHERE WATER IS BOTH EXPENSIVE AND PRECIOUS, WATER CONSERVATION STUDIES USING BIOCHAR ARE ALSO CURRENTLY UNDERWAY*.



(tomatoes)



(harvest)

* (working with the California Department of Water Resources)

AGRICULTURAL USES FOR BIOCHAR
Biochar can be used as a soil amendment to build healthy soil in a variety of applications



LEARN MORE AT www.biochar-us.org

Produced in Mobile, Modular, & Industrial Systems



"Ring of Fire"
Wilsonbiochar.com



Carbonator 6050
tigercat.com



ARTIchar
artichar.com



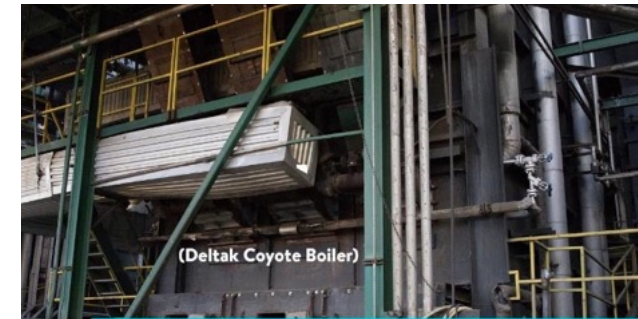
Pyreg 500
Pyreg.de



CharBoss
airburners.com








Biomacon
Biomacon.com

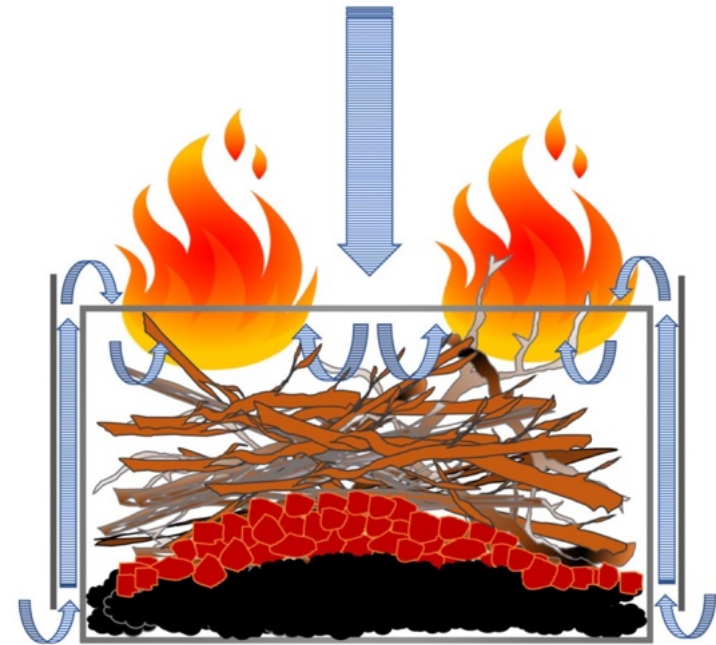


Oregon Biochar Solutions
Chardirect.com

SIMPLE KILNS USED FOR HANDPILES



-  • Airflow
-  • Flame
-  • Biomass
-  • Embers
-  • Biochar



Wood 5.6 CY/kiln
2 CY biochar in 4-5 hours
1-2 people

wilsonbiochar.com

Ring of Fire Kiln®

Making Biochar: Air Curtain Burners Reduce Volume Recover Biochar and Energy



8 tons biomass/hr 80 t/day
2-4 ton/day biochar (16 CY)

Cooperative Research and Development Agreement with
US Forest Service for continuous biochar recovery



Air Curtain Burner
100-1000 kWe

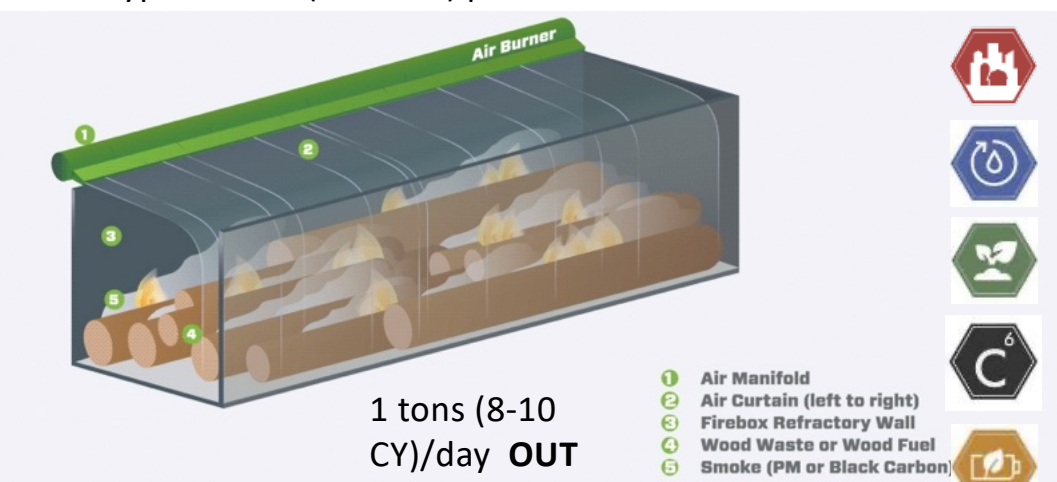


ONSITE PRODUCTION: Curtain of air burns gases. Biochar withdrawn continuously through exit grate.



Air Burners Inc.- USFS Cooperative Research and Development Agreement

Prototype – 1 ton (10-20CY) per hour IN



1 tons (8-10
CY)/day OUT

airburners.com



7 CY Chamber
4' x 4' x 12'



Mobile Carbonizers Reduce Residue Volume and Recover Biochar



Convert residues, land clearing, road construction wood to biochar for direct use on site.

www.roi-equipment.com



Mobile Carbonizers Recover Biochar from Forest Fuels and Urban Wood: Biochar Shipped in Bag or Bulk



www.tigercat.com

**Biochar Recovered From Wildfire Debris
Oregon 2020**



FORESTERS CAN ALSO REMOVE FOREST FUELS USING PORTABLE WOOD GRINDING EQUIPMENT. THESE PRODUCE WOOD CHIPS THAT CAN BE LOADED INTO CHIP VANS FOR TRANSPORT TO NEARBY BIOMASS POWERPLANTS, WHERE THEY ARE CONVERTED INTO ENERGY AND BIOCHAR.



FORESTS AND BIOCHAR
Excess forest fuels can create energy and help build healthy soils



LEARN MORE AT
www.biochar-us.org

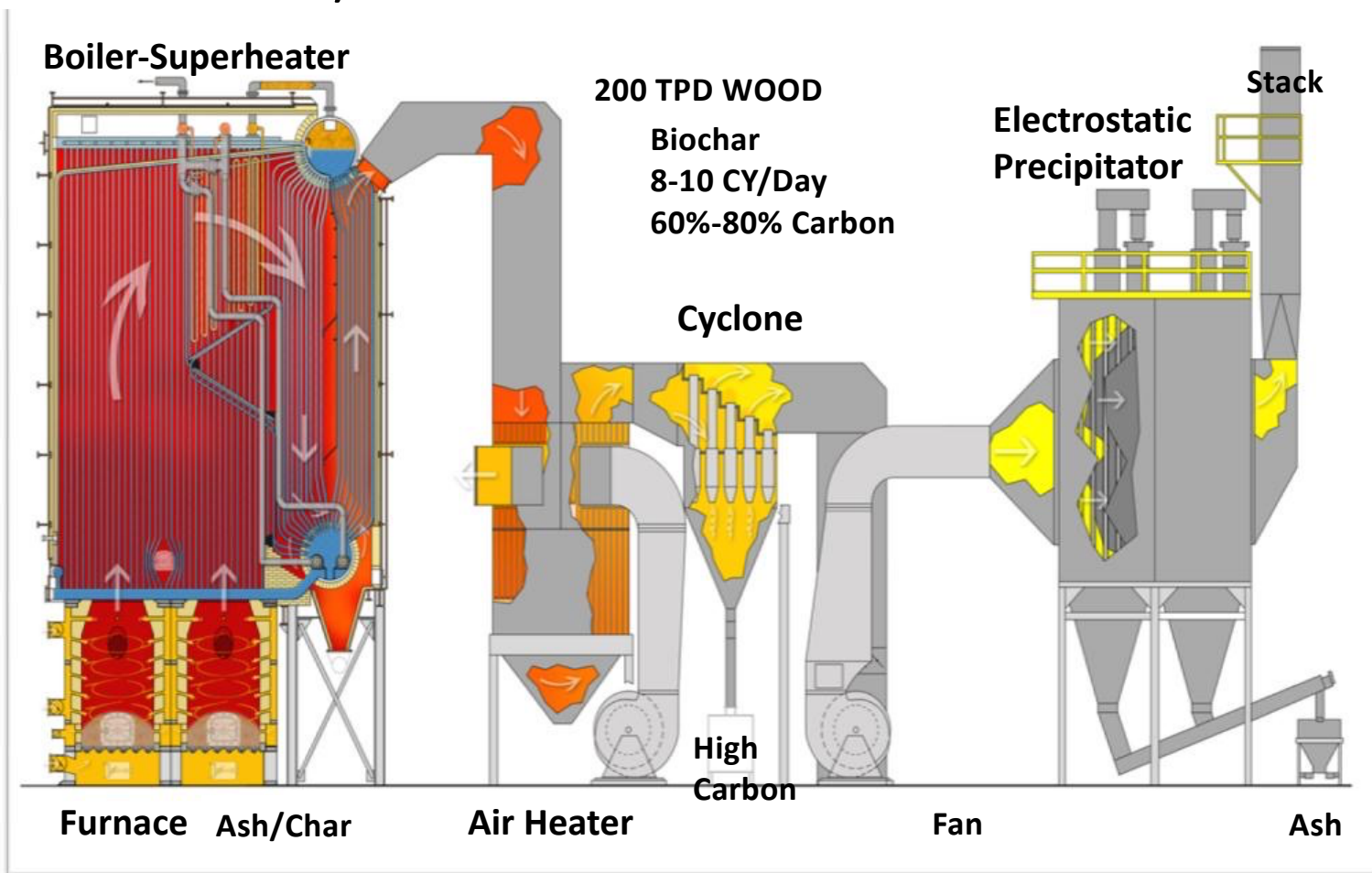
Biomass Boilers Carry Biochars in Exhaust



Photo: Capital Press

Freres Lumber

Source: Wellons, Inc.
www.wellonsusa.com

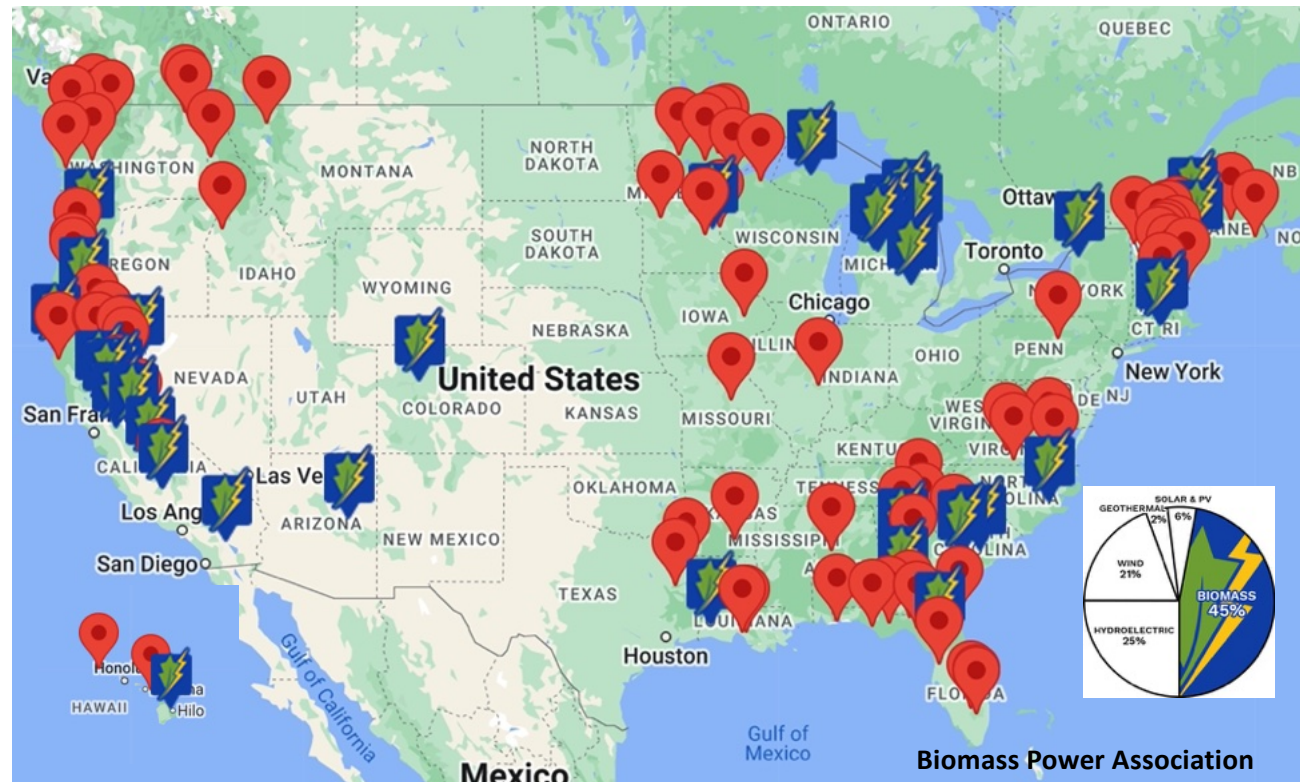


96 Ag and Wood Biomass Plants

27 Million Tons per year -> 3,200 MW

Type	No.	MWe	MMTPY dry
Biomass Plants	159	5,583	45
Ag Waste	6	203	2
Wood	90	3,036	24
MSW	66	2,346	19
Industry			70

[U.S. Biomass Power Plants biomassmagazine.com](https://biomassmagazine.com), [EIA](#)



Biomass Power Association
usbiomass.org

Integrated Modular Pyrolysis Systems: Heat and Biochar

– BET, ARTiChar



BET

biomassenergytechniques.com



ARTi

ARTi.com



Small Industrial Gasifiers Produce Heat and Biochar



Earthcare LLC

earthcarellc.com

2.5 tph fuel

Wood, Manure, Litters,
Gasification, Heat



EcoRemedy

Fluid Lift Gasification

ecoremedyllc.com

Wood, Manure, Digestate,
Biosolids, Heat



Green Sawdust Gasifier Chars Enhance Turf and Trees

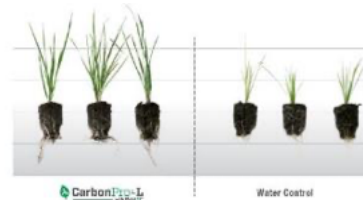


KDS Systems Green Sawdust Gasifier heats Lumber Dry Kilns www.kdskilns.com
3-5 tph fuel input, .25-0.4 t/hr biochar

Biochar co-product refined for landscaping



Liquid or granular biotic soil amendment for golf and turf (LESCO CarbonPro lesco.com)



CarbonPro

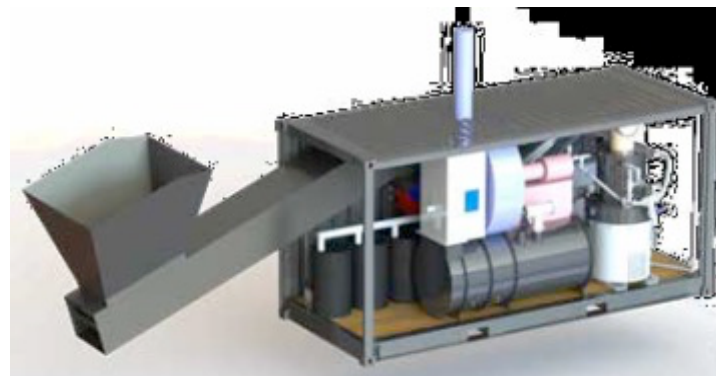
www.lesco.com/products/carbonpro

- Deeper stronger roots
- Improved greening
- Improved Soil and Seed Establishment
- Increased Nutrient Uptake and Efficiency
- Reduced Water Requirements
- Targeted Benefits

Small Scale Gasifiers for Combined Heat & Biochar



Phoenix Energy
California
2 MWe + Biochar
Eqtec.com gasifier
phoenixenergy.net



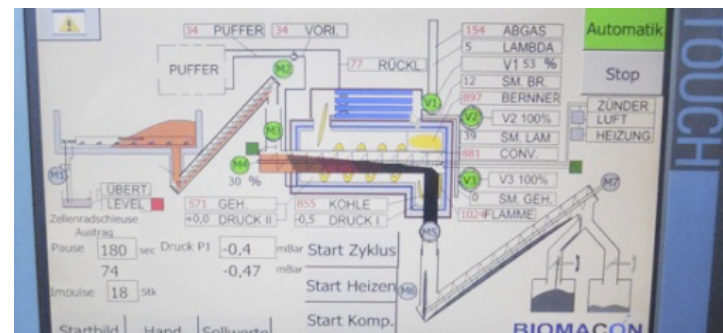
All Power Labs
Chartainer 150 kWe+biochar
(Under development)
www.allpowerlabs.com



Small Scale: Urban Combined Heat & Biochar



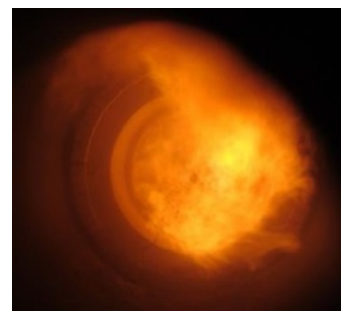
Biomaccon.com



500 KW, + 45 kg/hr biochar



Char used in structured soil



Gasifier-Boiler 1200 kW + 709 kg/hr biochar

Auen Pflege Dienst – Flaach

Reference Project (“Small”)



- Customer: **Auen Pflege Dienst AG (CH)**
- Equipment: **Biomacron C400-I**
- Commissioning: **2019**
- Feedstock: **Natural wood (forest and landscape management)**
- Energy utilization: **Feeding up to 400 kWth into the local district heating network and an own district heating network for industry**
- Biochar production: up to **360 t/yr of Biochar**

biochar-industry.com

Innovative Producers: Qualterra



Washington:

Qualterra, Pullman – Qualterraag.com

- Molecular Plant Testing
- Clean Plant Propagation
- Biomass Processing & Carbon Regeneration



Qualterra BPU at Vaagen Timbers, Colville

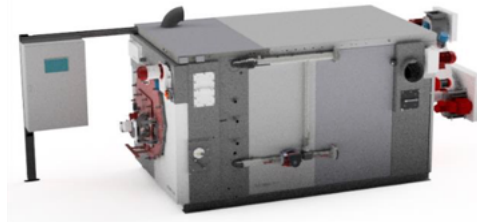


Equipment manufacturers

Examples for industrial equipment producing Biochar



SYNCRAFT[®]
Climate Positive Solutions.

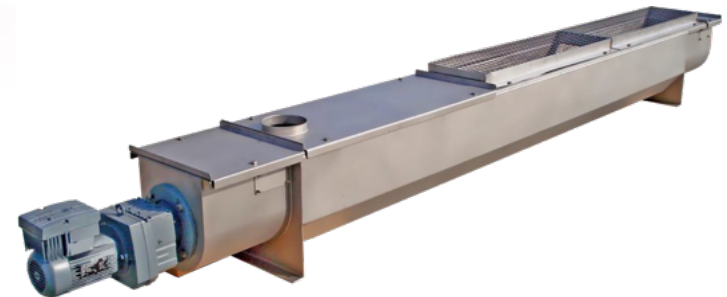


Biomacon



PYREG

NET ZERO TECHNOLOGY

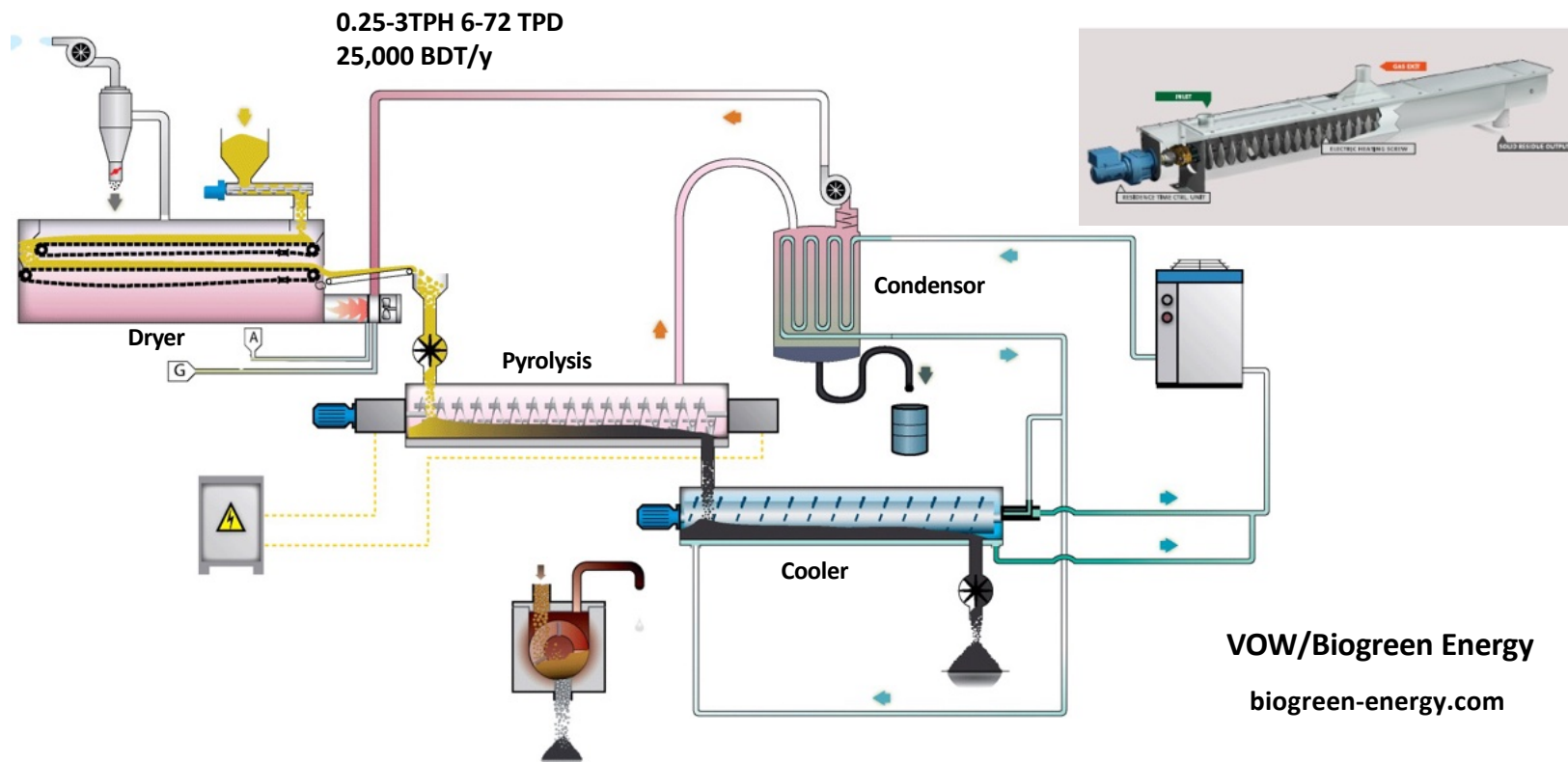


VOW

biochar-industry.com

Pyrolyze Chipped Wood to Heat, Biochar, and Oil

– VOW ASA/Biogreen Energy



Small Scale Gasification

Low Capacity

- 300 kg/hr feedstock
- 80-100 kg/hr biochar

Simple Operation

- Automated control

Heat Recovery

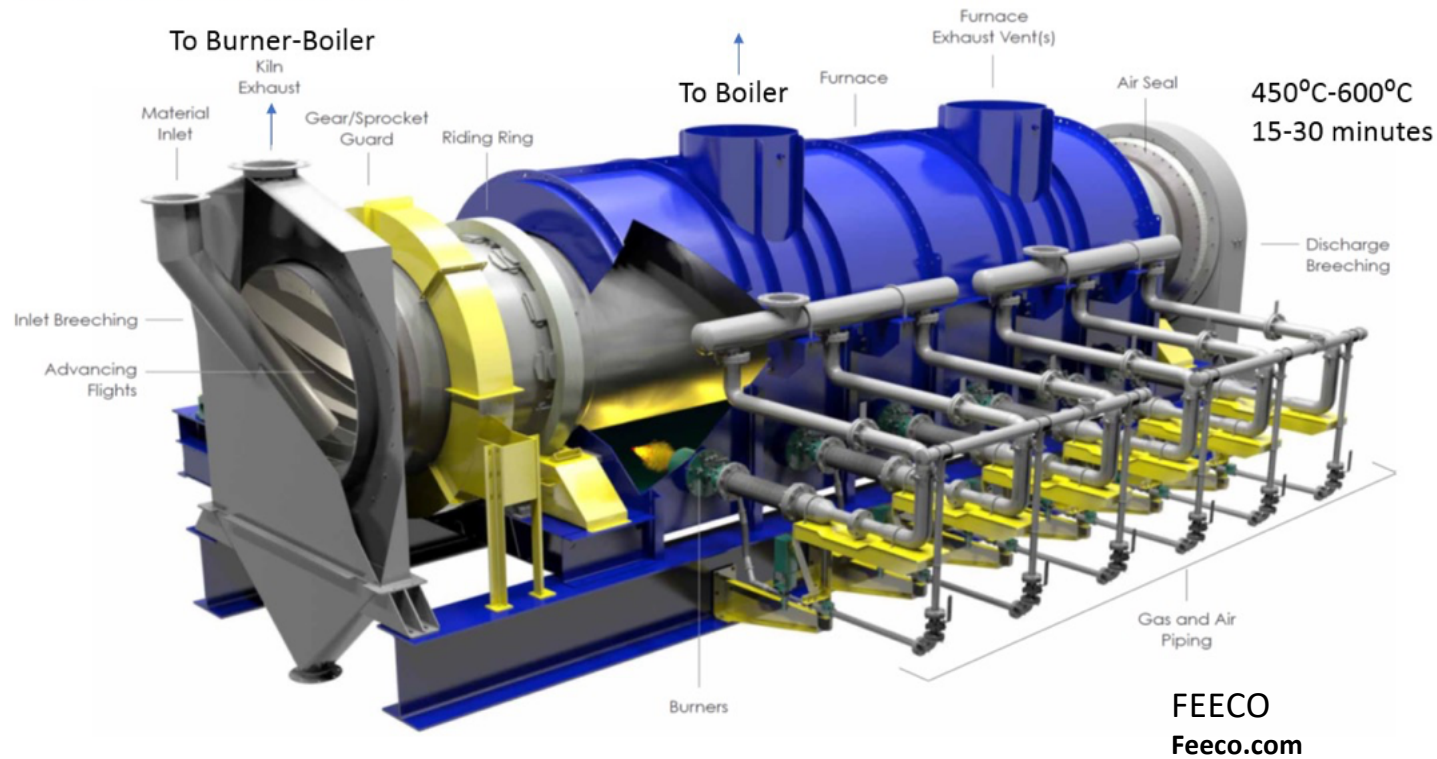
- Hot air or hot water

Appliedgaia.com



Rotary Kiln Heats Biomass in Rotating Drum Using Pyrolysis or Auxiliary Gas 48-144 t/d

INDIRECT-FIRED ROTARY KILN



Rotary Kiln Pyrolysis



Char Technologies
chartechnologies.com



USBI – Scaling Up Biochar – Right Biochar Source – October 2023

Rotary Kiln Heats Biomass in Rotating Drum Using Pyrolysis or Auxiliary Gas 48-144 t/d



Sanju Crop Residue to Biochar Fertilizer Production Facility
2.5 mt/hr, gas+pyrogas



Urban Wood Gasified to Heat, Biochar (for Compost)





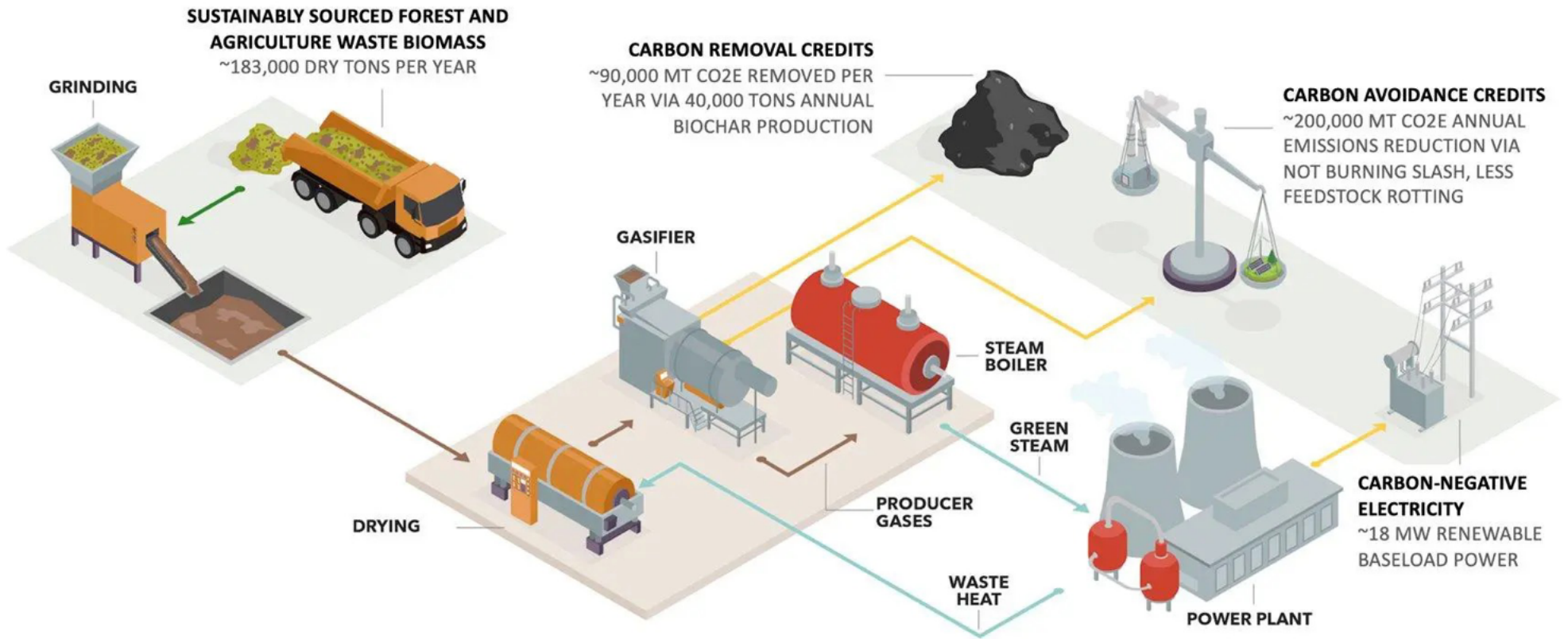
biochar-industry.com



Innovative Producers: Myno Carbon

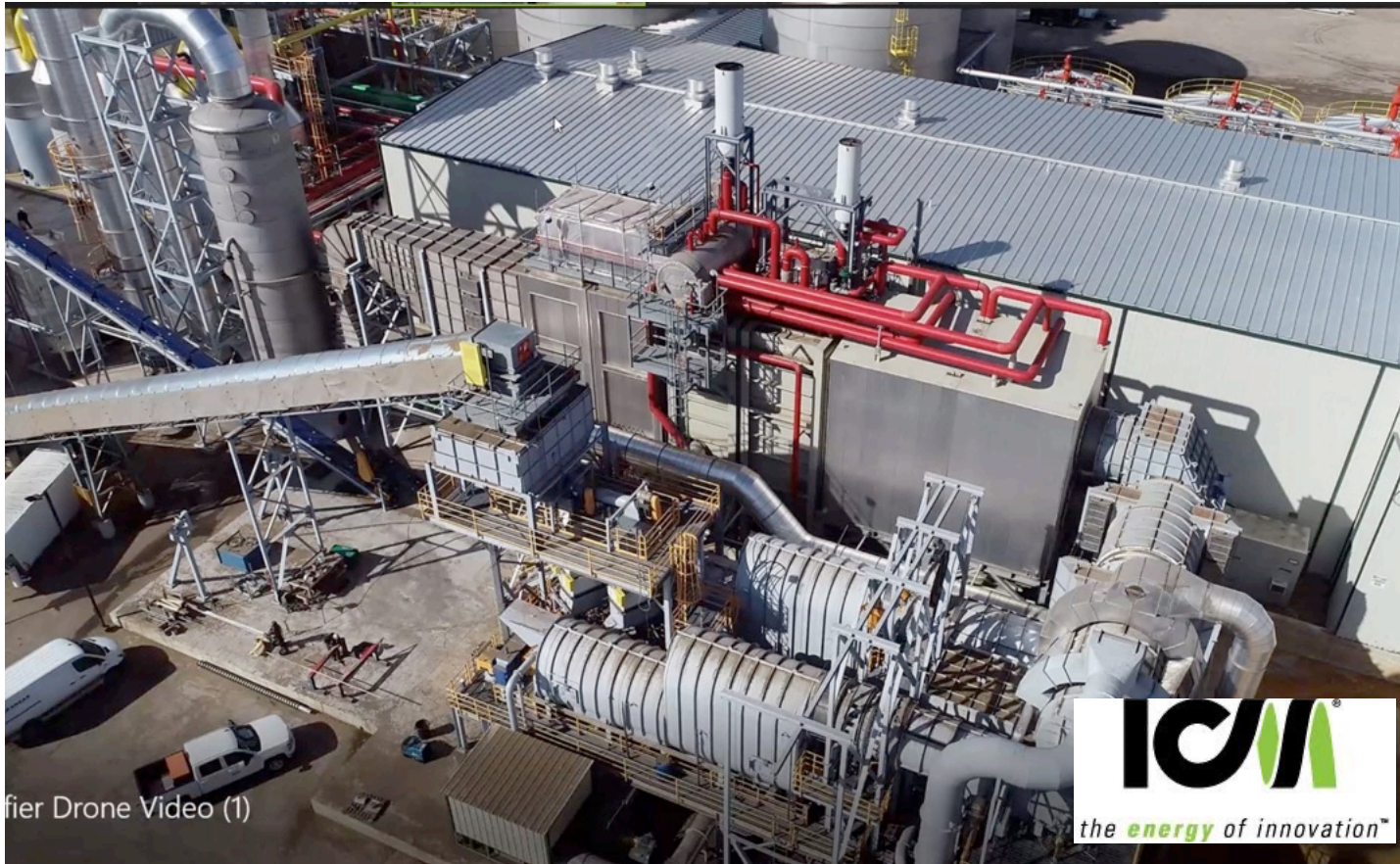
Washington: Myno Carbon, Kettle Falls

Biochar Carbon Dioxide Credits Generated in EV Fuel Production



Wood Gasifier: Biochar, Steam and Power (7 MWe)

Waste Wood Heats Kansas Ethanol Plant



Gasifier Drone Video (1)



ICMinc.com



Using Biochar: Biochars are Delivered in Bulk



2 CY 400 lb dry

- High carbon
- Low Volatiles
- Low Ash
- Low Fines
- Good Flowability



80 CY 8-10 t



Oregon Biochar Solutions
www.chardirect.com



(biochar)

BIOCHAR PRODUCED AT A NORTHERN CALIFORNIA BIOMASS POWERPLANT IS A VALUABLE INPUT FOR CREATING COMPOST.

AGRICULTURAL USES FOR BIOCHAR

Biochar can be used as a soil amendment to build healthy soil in a variety of applications



LEARN MORE AT www.biochar-us.org

Biochars are Delivered in Bulk Bags



**Bulk bag
spout top
& bottom**



**Step deck flatbed truck loaded with 19 pallets of 4 yards
76 cubic yards of biochar on board.** *Biochar Solutions LTD.*

FROM FACTORY TO USE



 **PACIFIC
BIOCHAR**
Pacificbiochar.com



Increased Use of Biochars in Urban Soil Repair

Compaction, drainage, aggregation, filtration



Urban Soil Repair - Highway /Toll Plaza Biochar Filter Strip, MD & DE



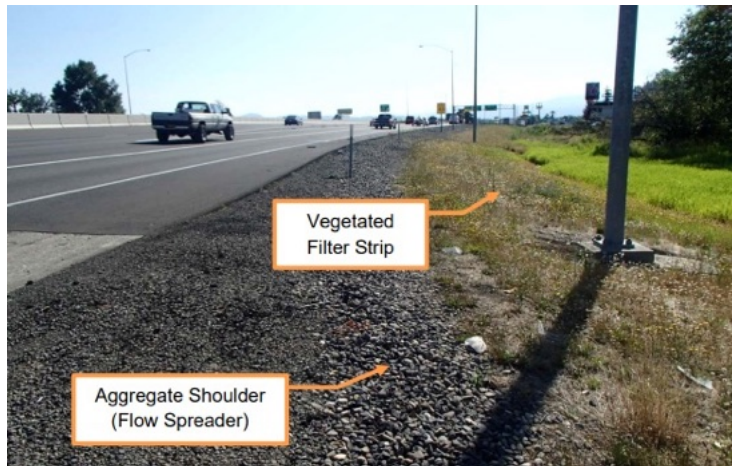
Courtesy Ecotone ecotoneinc.com



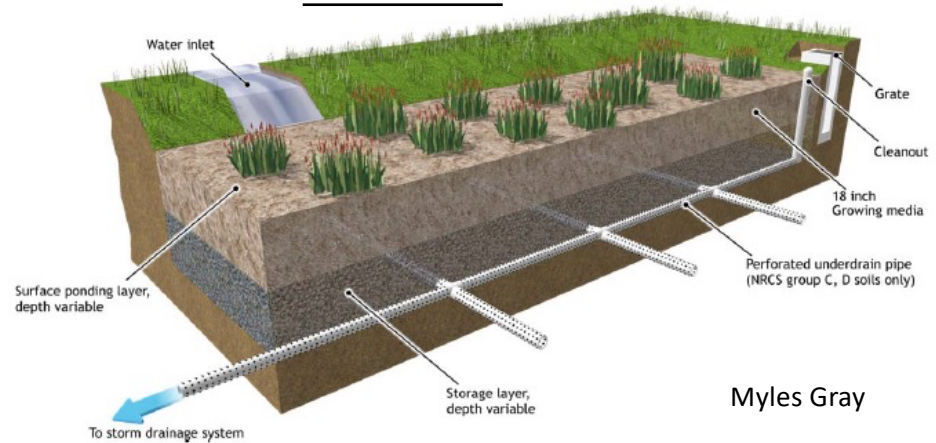
GREEN INFRASTRUCTURE

Hydrology, Pollutant Removal, & Co-Benefits

Vegetated Filter Strip



Bioretention



Green Infrastructure BMPs are vegetated treatment systems that harness plants and sandy soil to manage hydrology and remove pollutants

PROS	CONS
Good pollutant removal	Larger footprint
Infiltration to mitigate hydromodification	Can initially export pollutants
Co-benefits	Often high maintenance cost



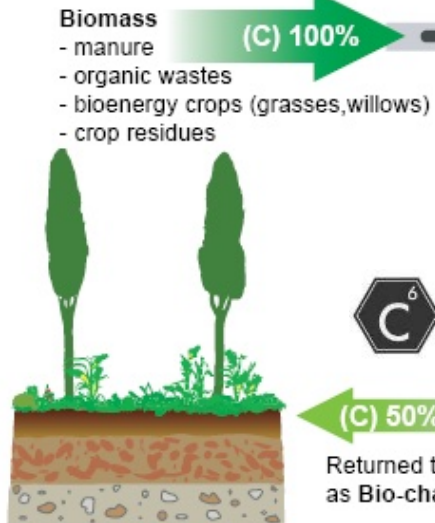
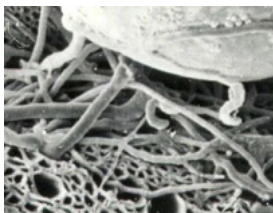
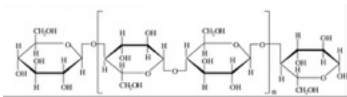
INDUSTRIAL GREEN INFRASTRUCTURE

Engineered Solutions to Remove Specific Pollutants

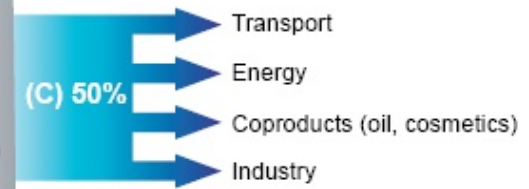


SCALE UP CLIMATE RESILIENCE: Make Renewable Energy, Sequester Carbon, Increase Soil Carbon

Sustainable Biomass 1 Billion tons 500 Million tons C



GREEN CARBON MARKETS
 250 Million tons C



BIOCHAR MARKETS



250 million tons C 625 Million tons CO₂e

1 mt CO₂e = 1 Carbon Dioxide Removal Certificate (CDR or CORC™) 2.0-3.2 mtCO₂e/mt Biochar

44 million cars (15%)
 247 million acres of forest



New climate friendly technologies
convert low-value wood waste to biochar
reduce urban waste, wildfire risk and
facilitate biochar applications.



Carbon Markets fund increased biochar production
reduce costs



USDA and States create tools and opportunities to
increase Soil Carbon and
improve Water Quality and Soil Health



Biochars and biochar amended products from wood residues
help improve food and fiber production and climate resilience.



Thank you!

Scaling Up Biochar
October 25, 2023

Tom Miles
Executive Director
US Biochar Initiative
tom@biochar-us.org



Connect



info@biochar-us.org

<https://biochar-us.org> [instagram.com/usbiochar](https://www.instagram.com/usbiochar)

[youtube.com/@USBiocharInitiative](https://www.youtube.com/@USBiocharInitiative)

[linkedin.com/company/us-biochar-initiative](https://www.linkedin.com/company/us-biochar-initiative)

twitter.com/usbiochar

[facebook.com/USbiochar](https://www.facebook.com/USbiochar)

biochar.groups.io



Learning Center
& Fact Sheets

