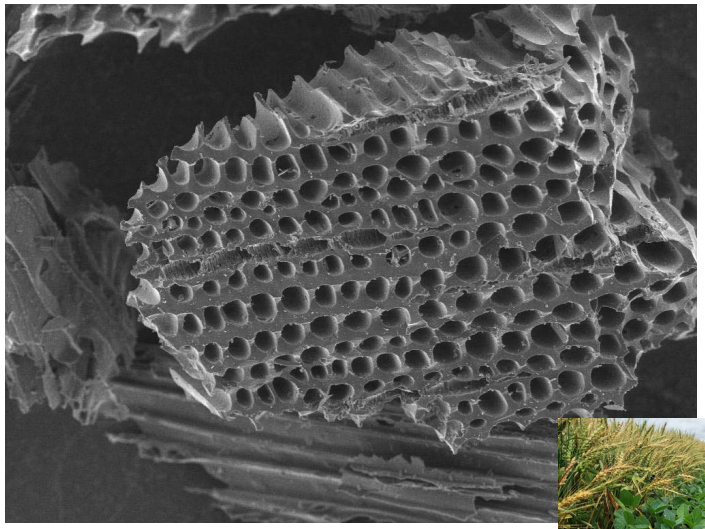
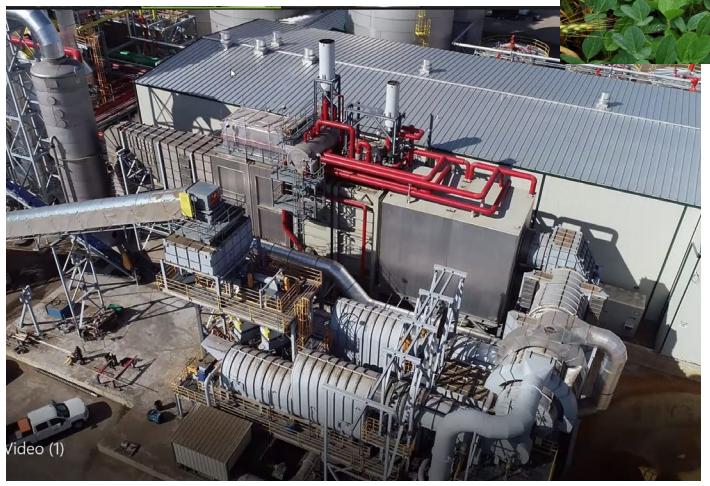
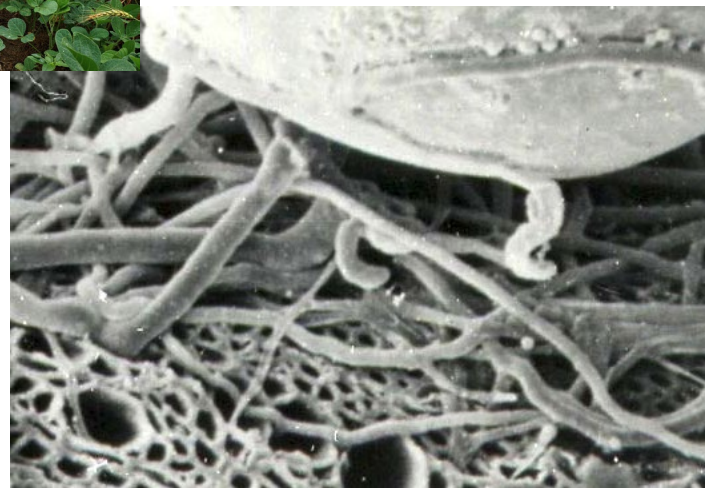
Biochar Production Technologies

USDA ARS-AFT-USBI Practical Biochar Implementation

November 29, 2023







Tom Miles
Executive Director
US Biochar Initiative

USBI
Building the future from the ground up.™

American Farmland Trust
US Biochar Initiative
USDA Agricultural Research Service

American Farmland Trust
SAVING THE LAND THAT SUSTAINS US

USDA

Fact Sheets

ABOUT USBI

Established 2009

In-field Workshops

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

Networking – Education - Demonstration

Online Producers Directory

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

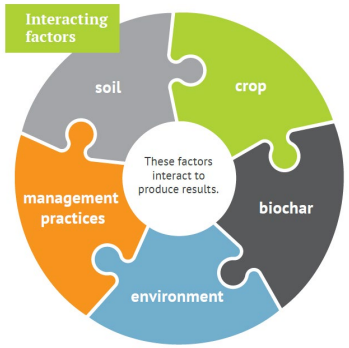
Trade shows & Conferences

Equipment & Technology Development

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

REGISTER NOW

https://www.biocharconference.com/

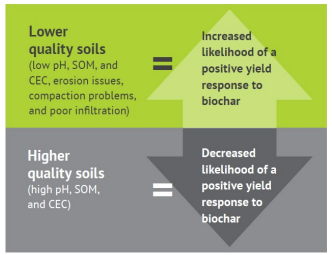


Right source

Selecting the best biochar for your crop

Right place

Applying biochar to the soils that need it



Right rate

Applying the right amount

Right time

Identifying when to apply

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]

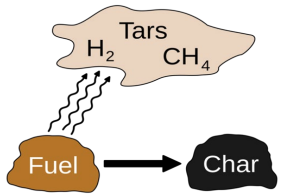
- builds soil organic carbon and soil health
- increases crop yields and soil moisture
- improves nutrient retention
- boosts microbial activity
- alleviates compaction
- reduces soil acidity
- sequesters carbon

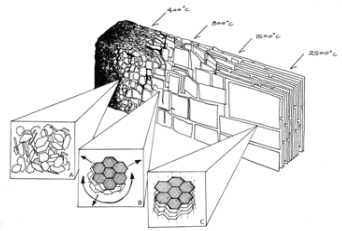
USBI
Building the future from the ground up.™

Biochar 2024
Feb 12-15, 2024
Sacramento, California

Biochar Production Technologies: Topics

- Introduction
  - Feedstocks
  - Pyrolysis
  - Biochar
- Products
  - Biochars
  - Biochar based
- Technologies:
- Place Based
  - Mobile, Portable
- Stationary Systems
  - Small
  - Medium
  - Large
- Transportation and Handling
  - Small bulk
  - Bags
  - Bulk





Right Biochar Source

Right source

Selecting the best biochar for your crop

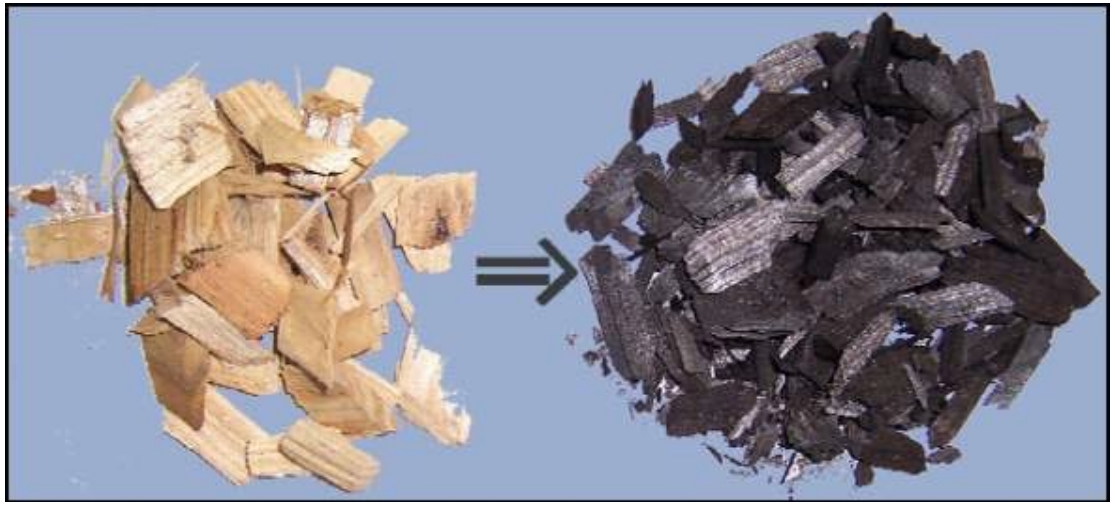
- Sources
  - Local Biochar/Feedstock
  - Available
  - Waste
- Feedstocks
  - Wood
  - Ag Pits, Nuts, Shells
  - Litters
  - Manures
  - Straw, Stalks
- Quality
  - Analysis
  - Needs
- Process
  - Feedstock
  - Temperature
  - Residence Time
- Objectives
  - Filtration
  - Infiltration, Aggregation
  - Water retention
  - Nutrient Use
  - Organic matter
  - pH
  - Carbon
  - Soil Health

What is biochar?

- Biochar is the solid product from pyrolysis of biomass
- High in C ~ 60-80% C
- Highly porous, low bulk density
- Highly aromatic
- Highly recalcitrant in soil
- **A versatile soil amendment and environmental material**
- ***Produced via pyrolysis: heating without oxygen***

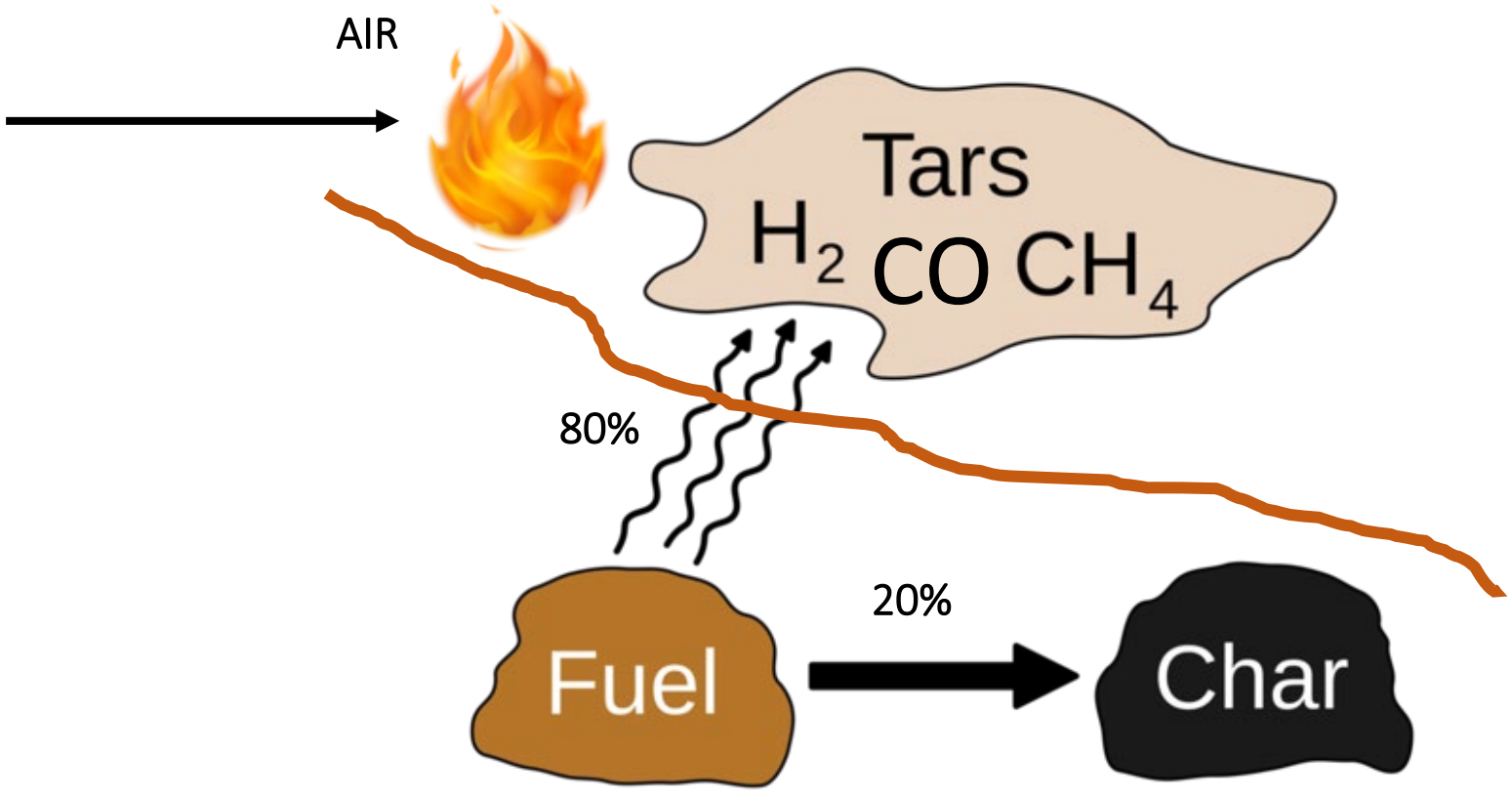
What is pyrolysis?

- Pyrolysis is the conversion of biomass through heating at moderate temperatures (350-900^{o}C) and **in the absence of oxygen**
- Pyrolysis of biomass produces
  - Gases: H_2, CH_4, CO, CO_2, etc.
  - Bio-oil
  - **Biochar**



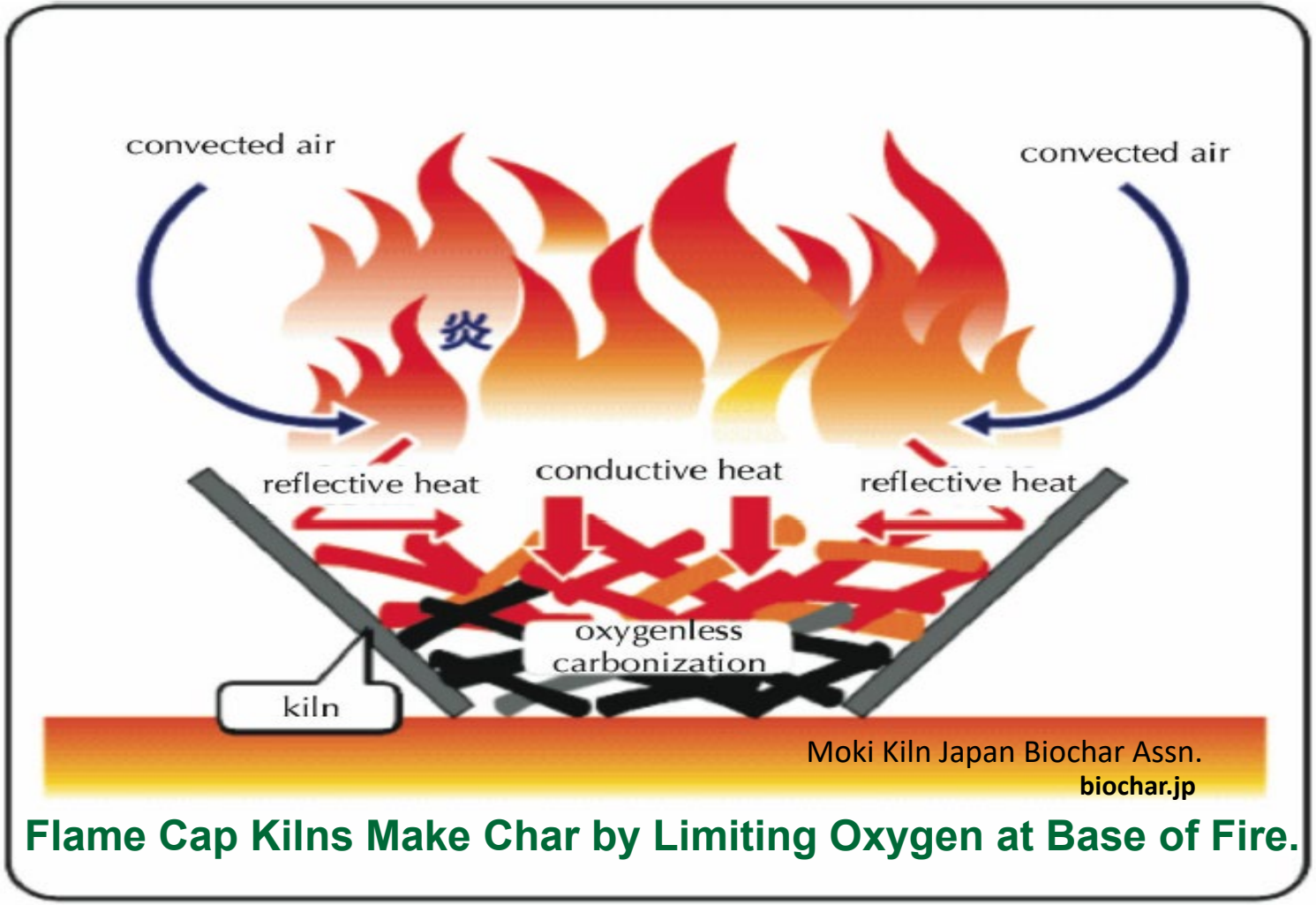
Heat Converts Solids to Gas Leaving Char

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



Radiant flames heat solid wood to make gas and char.

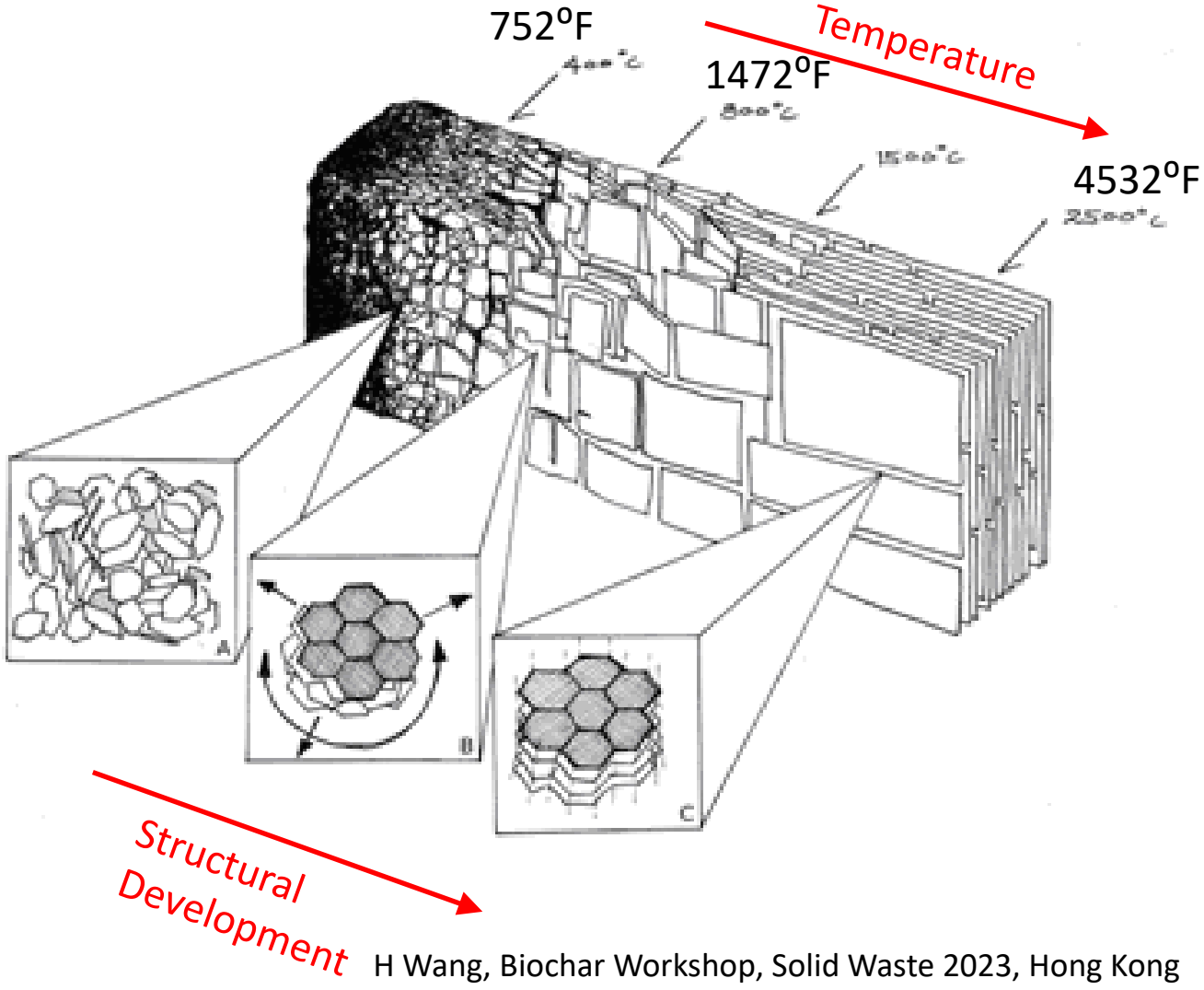
Wilsonbiochar.com



Flame Cap Kilns Make Char by Limiting Oxygen at Base of Fire.

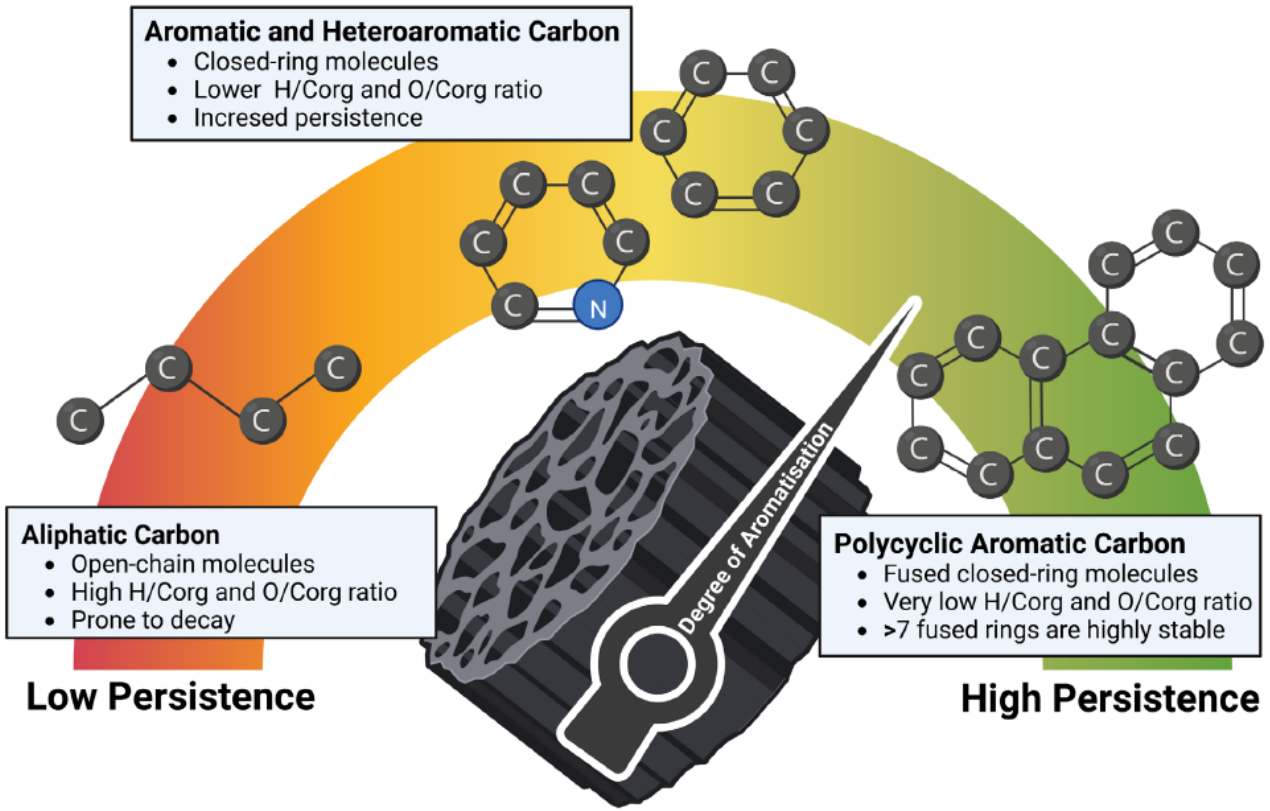
Biochar properties: Process conditions (Peak temperature)

- 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.

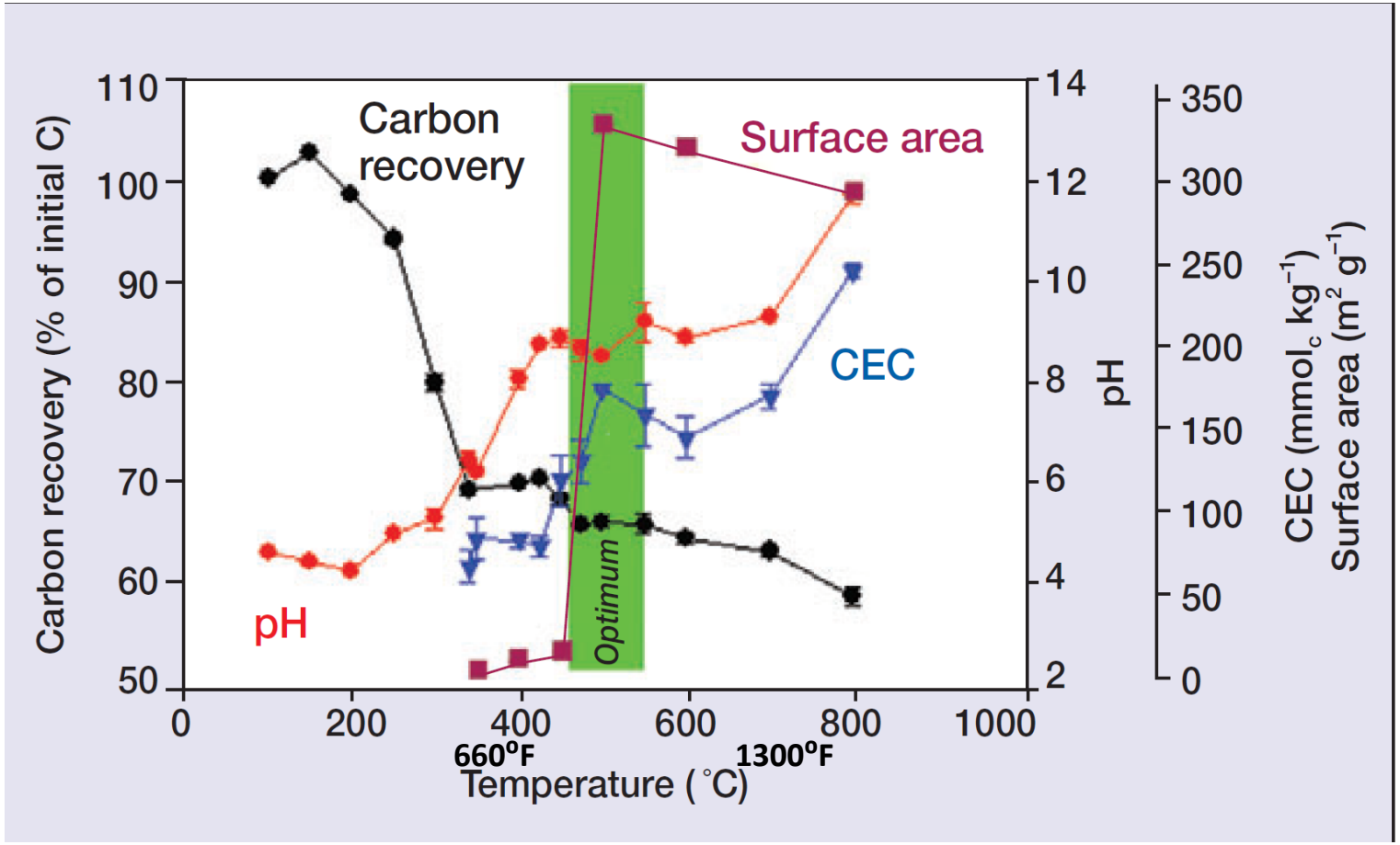
(1) Schmidt HP, Abiven S, Hageman N, Meyer zu Drewer J: Permanence of soil applied biochar. An executive summary for Global Biochar Carbon Sink certification, the Biochar Journal 2022, Arbaz, Switzerland, www.biochar-journal.org/en/ct/109, pp 69-74

(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.

Process Conditions Alter Biochar Properties

To enhance biochar yield:

- Lower temperatures
- Higher pressures
- Longer vapour residence time
- Slower heating rate
- Larger particle size

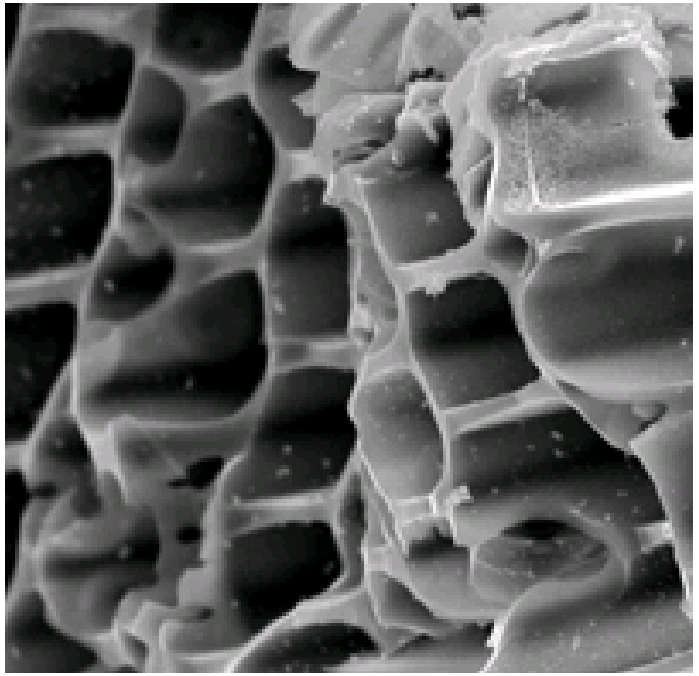


Temperature effects on Black Locust (Robinia pseudacacia L)

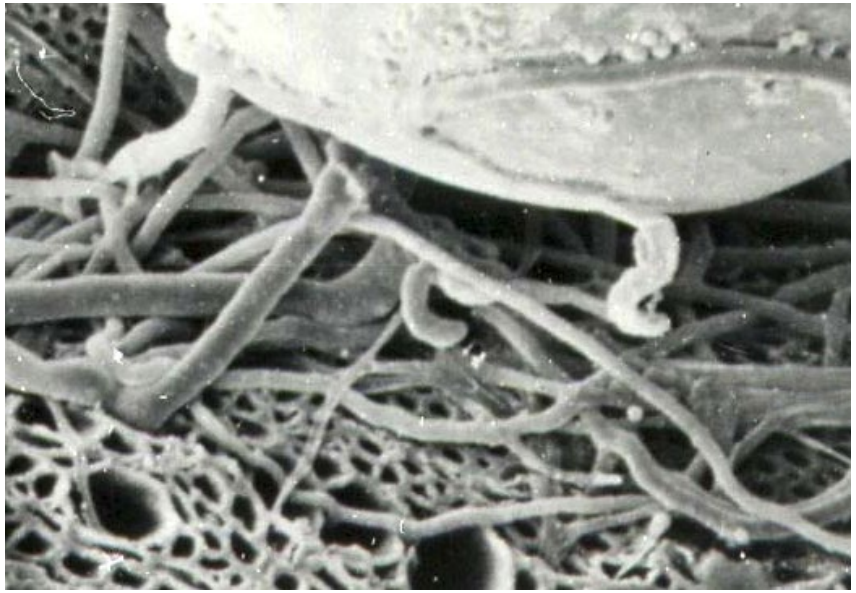
J. Lehmann Front Ecol Environ 2007; 5(7): 381–387

What Biochar Qualities Do You Need?

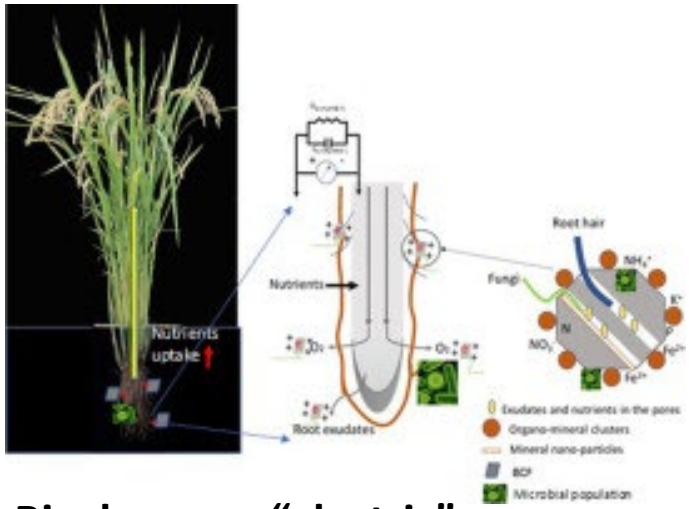
Biochars are fine-grained, highly porous charcoals that help soils retain nutrients and water. International Biochar Initiative



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 Physical Properties

Highly porous; surface area up to 500 m^2/g

Three distinct pore types:

External pores: Dependent on particle size

Macropores: Dependent on feedstock

- 10-100 µm range for wood biochars

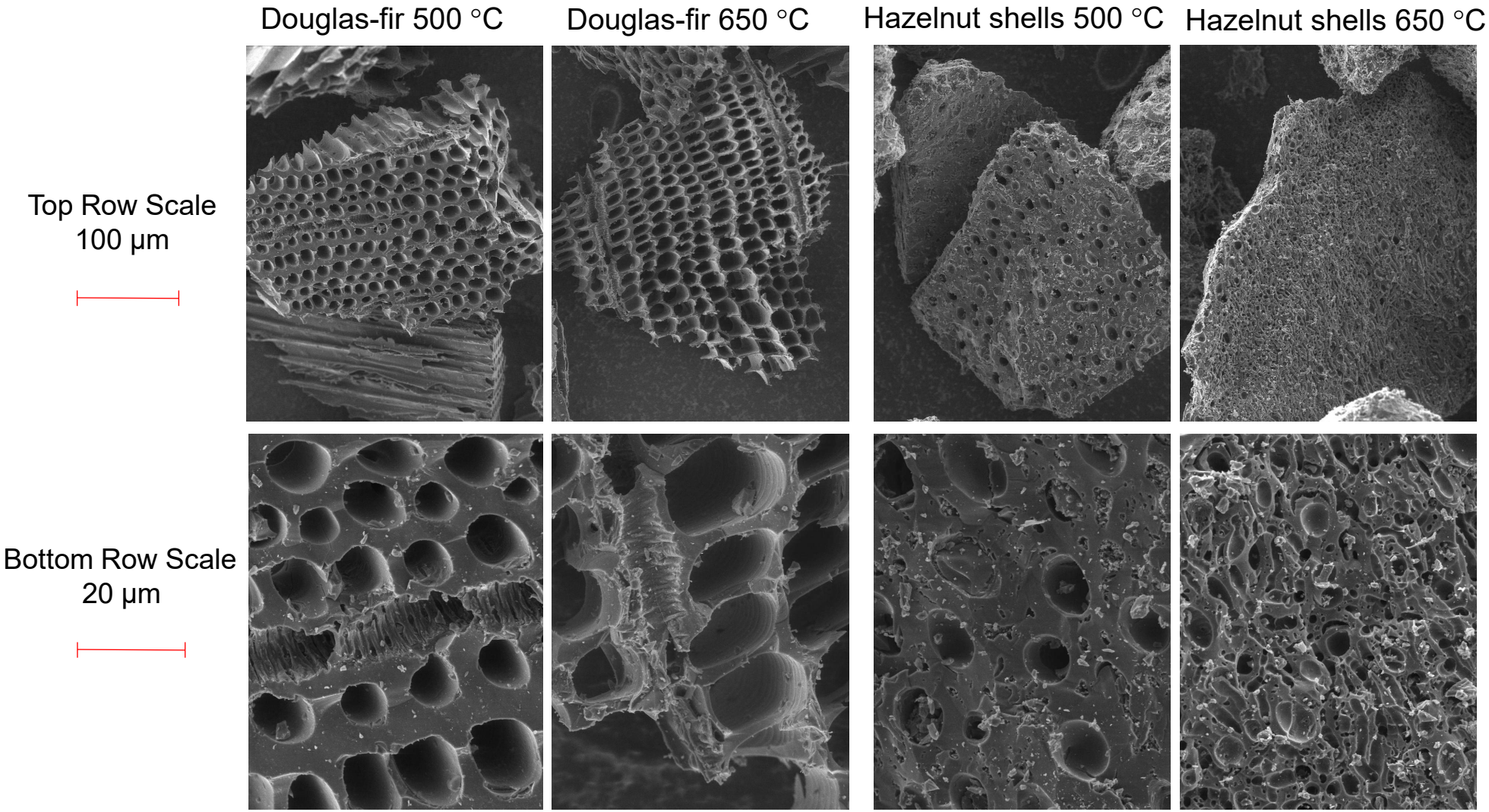
Micropores: Dependent on production

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

Myles Gray

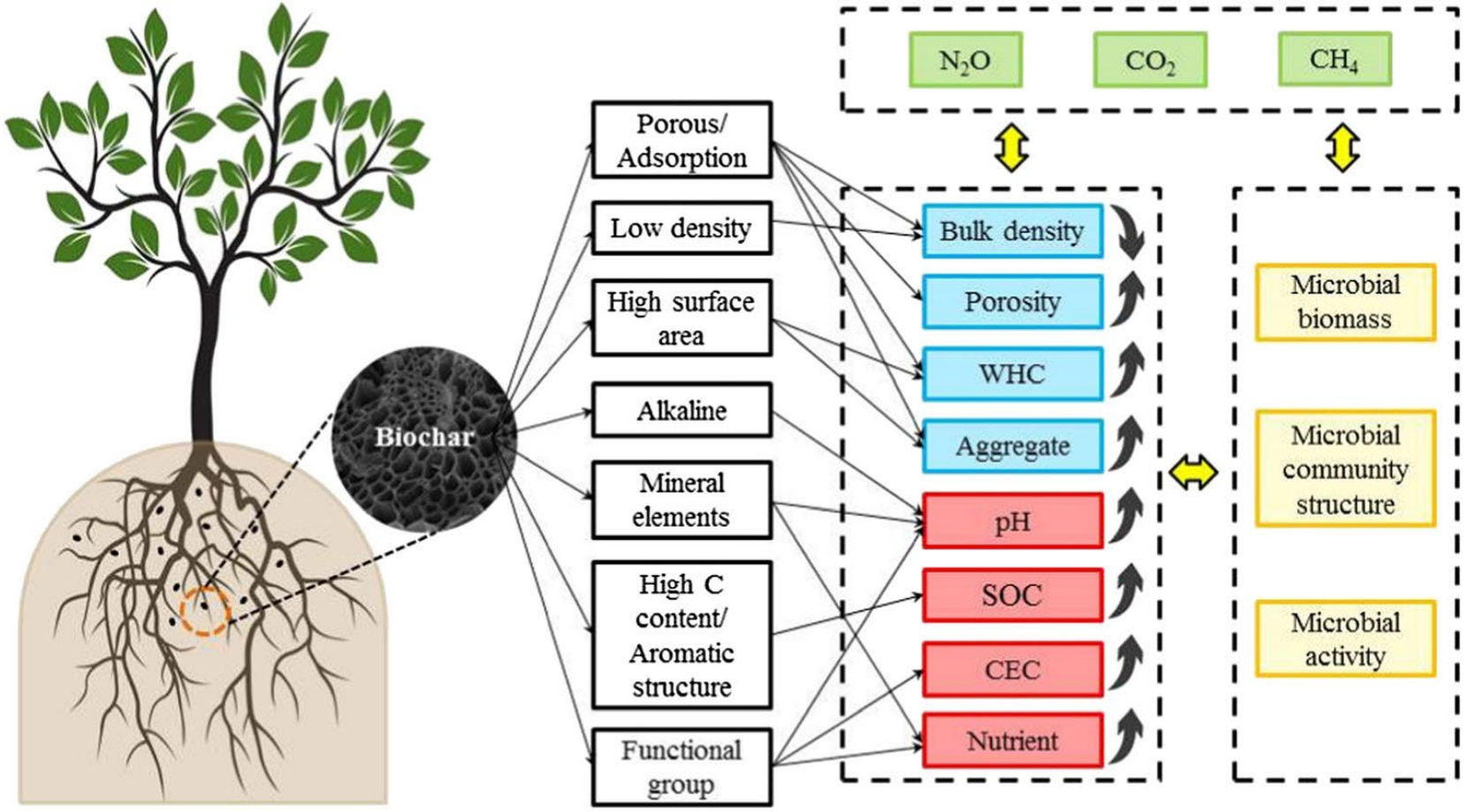
Biochars Can Have Different Properties

Properties depend on feedstock and production process



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

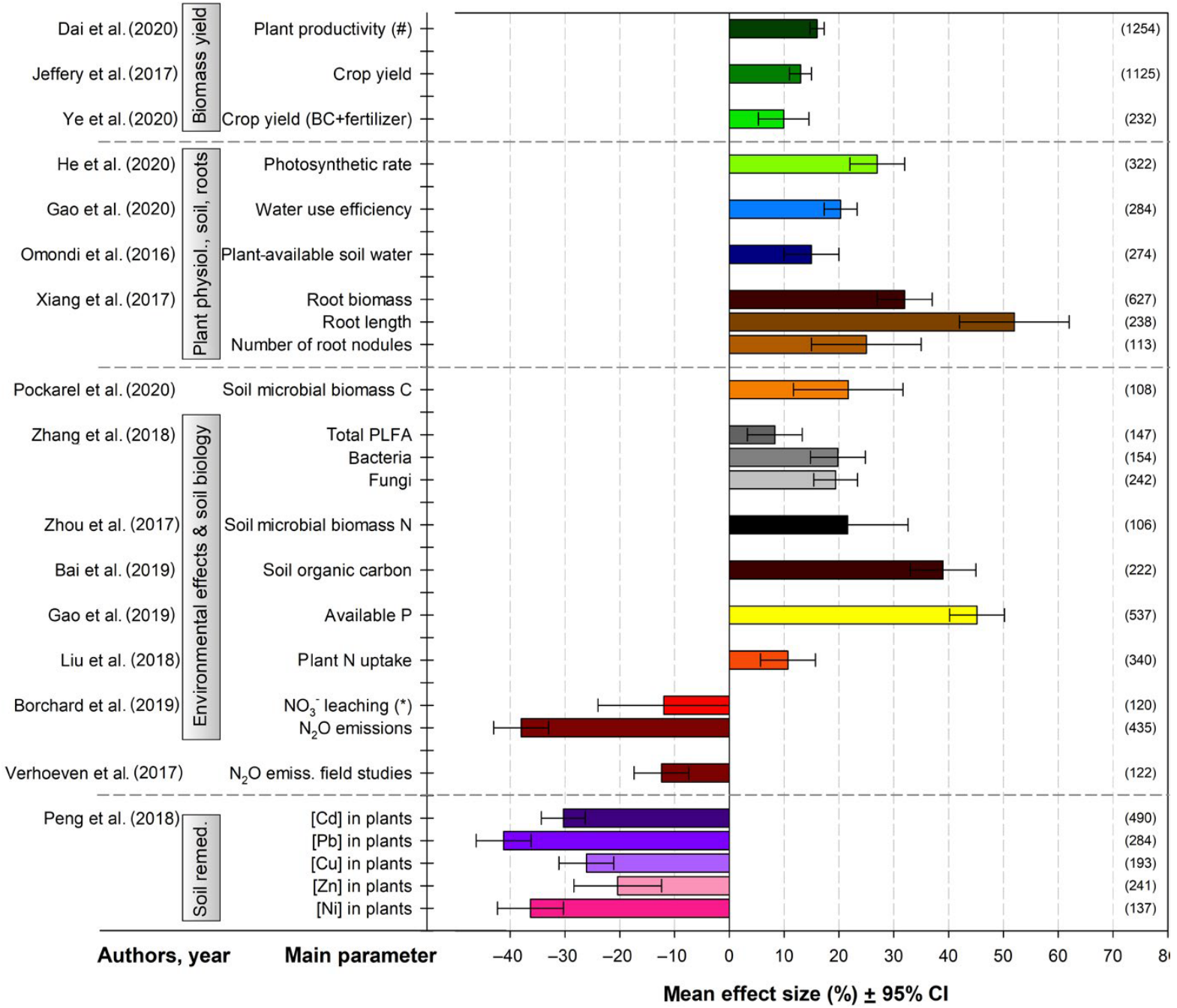
WHC water holding capacity, SOC soil organic carbon, CEC cation exchange capacity



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.

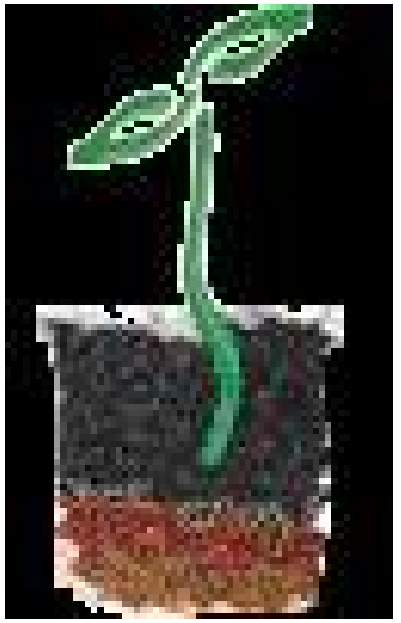
Biochar Benefits from 26 Reviewed Meta-Analyses

(Schmidt et. al. 2021)



Design Biochars to Fit the Needs

- Increase retention of chemicals, minerals
- Enhance immobilization of contaminants and reduce their bioavailability
- Increase mycorrhizal fungal activity
- Reduce GHG emissions (CH_4 and N_2O)
- Reduce acidity
- Reduce irrigation
- ……



Biochars Are Made for Different Uses

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

Glanris

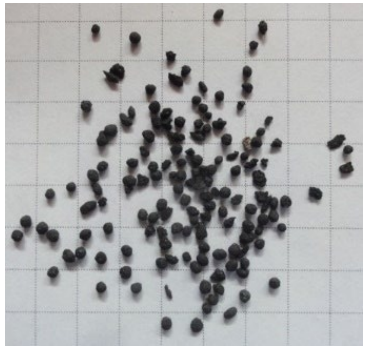
Forestry

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

Biochars are Processed for Different Forms and Qualities for Different Uses:
Size, Densify, Bag, Liquify



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

Seedballs Kenya

seedballskenya.com

Airseed Technologies

airseedtech.com

Biochars are Ingredients in Agriculture, Retail Garden, Horticulture, Turf, Tree, and Landscape Applications

Rexius/OpusGrows, US
www.opusgrows.com

Carbon Gold, UK
www.carbongold.com

G&B Organics Eden Valley Blend Potting Soil with **BiocharMax™**
www.kellogggarden.com

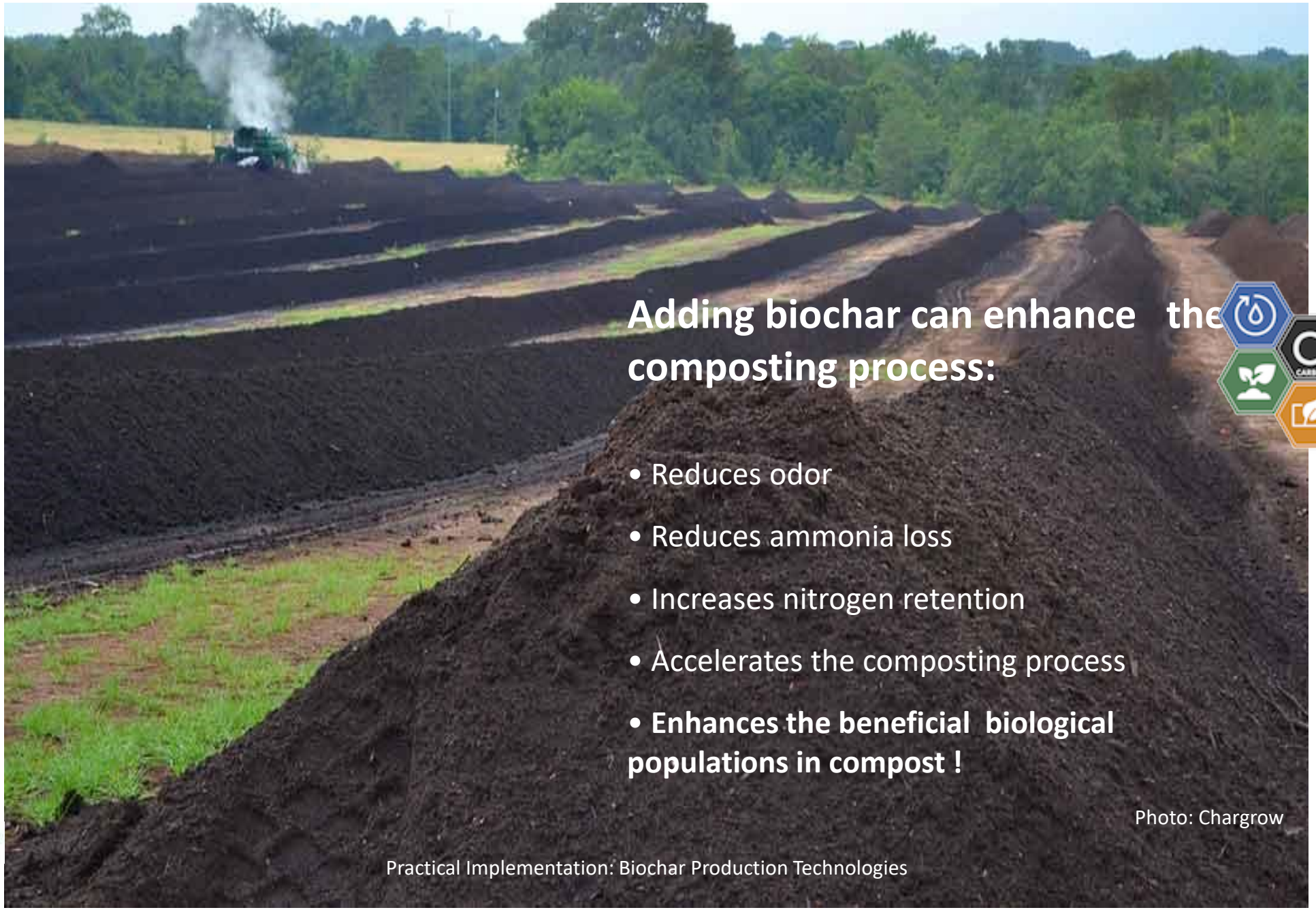
Ingredients in Green Frontier Compost

Yard Waste
Food Waste
Biochar*
Loess Clay
Harvest Quest Fungal Inoculant
Azomite Mineral Supplement
Wood Vinegar

***16% biochar by finished volume**

Missouri Organic Recycling
www.missouriorganic.com/compost

Others: America Biochar Company, Biochar Supreme, Sustane Organic + Biochar, Mirimichi Green CarbonizPn Turf Enhancer, Lesco, Wakefield Biochar Soil Conditioner . . .



Adding biochar can enhance the composting process:

- Reduces odor
- Reduces ammonia loss
- Increases nitrogen retention
- Accelerates the composting process
- **Enhances the beneficial biological populations in compost !**

Photo: Chargrow

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

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.

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 Malawi warmheartworldwide.org/biochar-africa **Warm Heart Worldwide, Kenya**

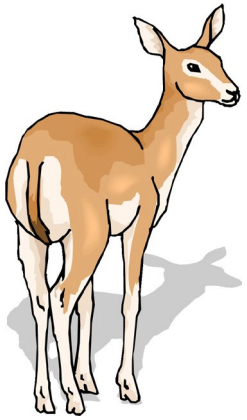
BiocharLife
An Impact Venture by Warm Heart Worldwide

2021 During pandemic 7500 smallholders trained by other biochar users.

USBI

Animals Inoculate, Distribute, and Mix Biochars in Soil, Improve Forage, Animal Health, Soil Health

- Deer, elk, cattle, pigs, chickens, goats, sheep feed on char which improves health and increases egg, milk, and meat production. Enriched biochar is passed out in the dung.
- Dung Beetles mix and inoculate biochars into soil, improving forage quality and production.
- Worms ingest biochar to form inoculated micro and nanocarbons



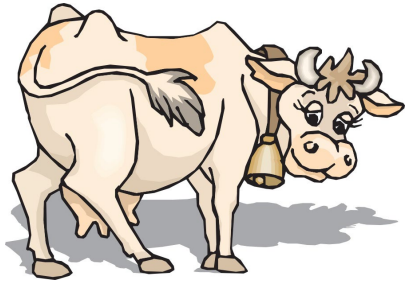


Photo: Kathy Dawson

Photo: Sr. Miriam Paulette

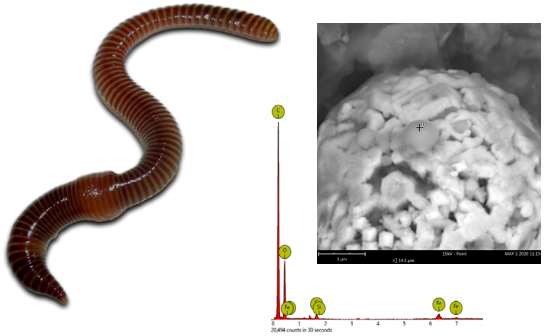


Photo: Stephen Joseph

Analyze Biochar Quality

Comply with Environmental and Soil Requirements

Physical

Chemical

Environmental

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

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:Corg)	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

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

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	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 - LECO
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

Analyst: XXXX

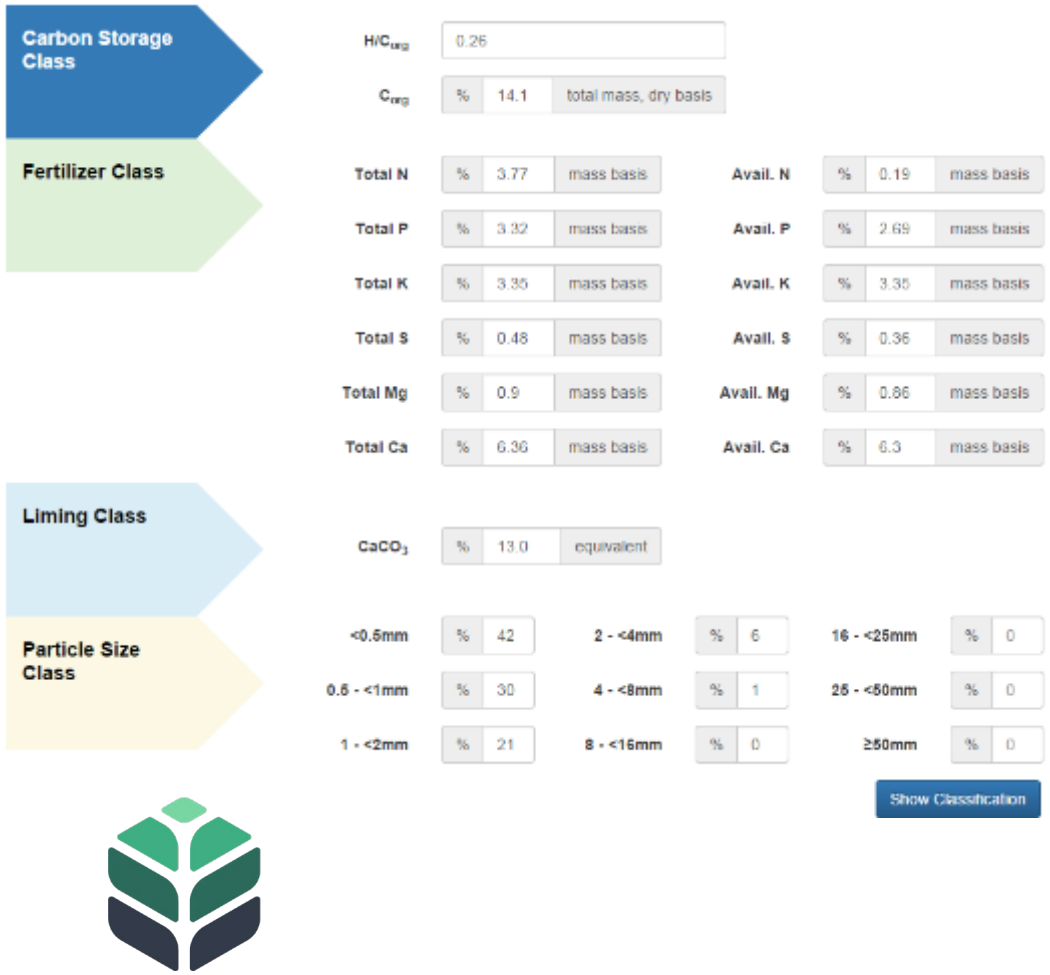
Pacific Biochar

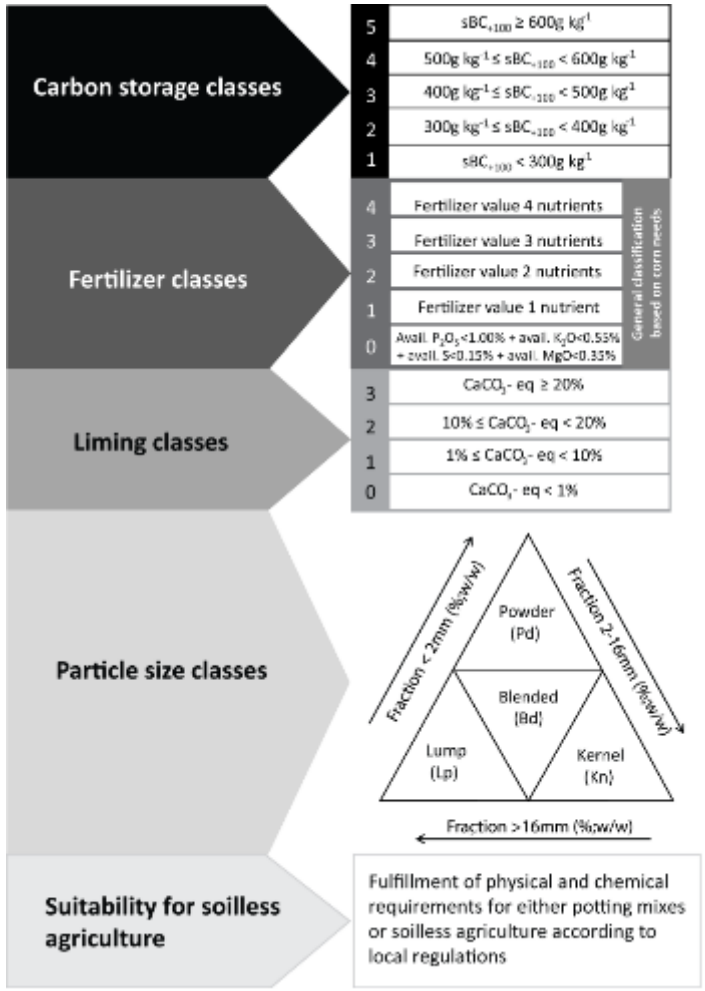
USBI Factsheet:

Interpreting Biochar Analysis

Coming Soon!

Biochar Qualities Help Determine Appropriate Use





IBI Classification Tool https://biochar-international.org/resources/biochar-classification-tool/ibi-biochar-classification-tool-main-page/

Standards, Guidelines, Specifications, Certifications

IBI Certification

International Biochar Initiative
Std. Ver 2.0
Biochar-international.org

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, Certificate (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

Biochars are Produced in Mobile, Modular, and Industrial Systems

“Ring of Fire”
Wilsonbiochar.com

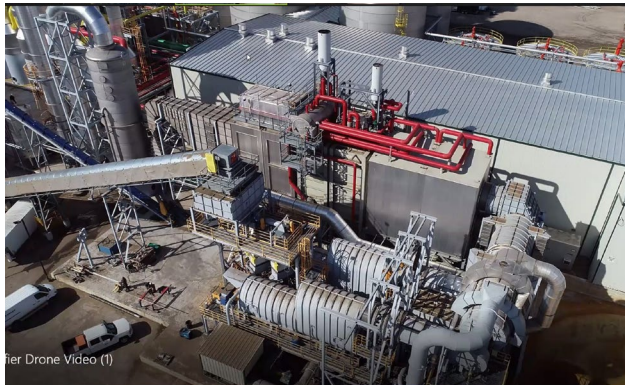
Carbonator 6050
tigercat.com

ARTIchar
artichar.com

Pyreg 500-6000
Pyreg.de

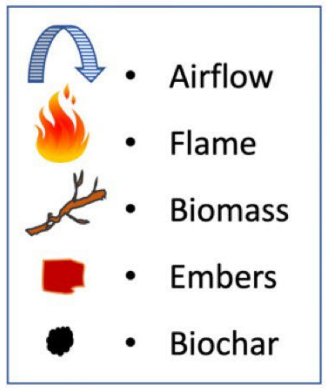
CharBoss
airburners.com

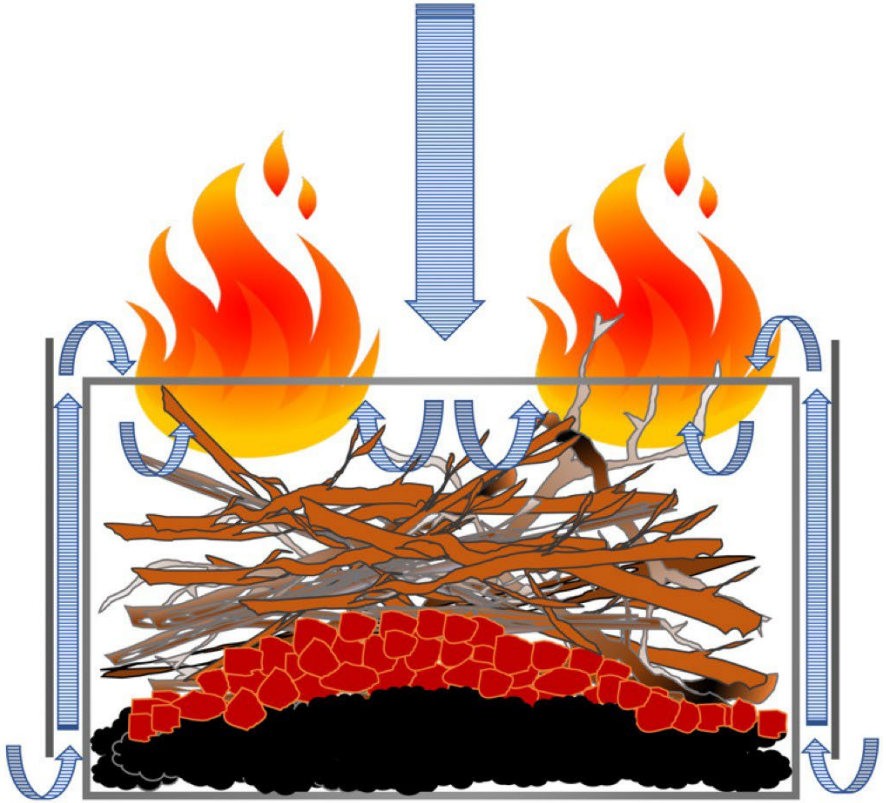
Biomacon
Biomacon.com



ICM Inc
icminc.com

Place Based Biochar: Simple Kilns for Hand Piles



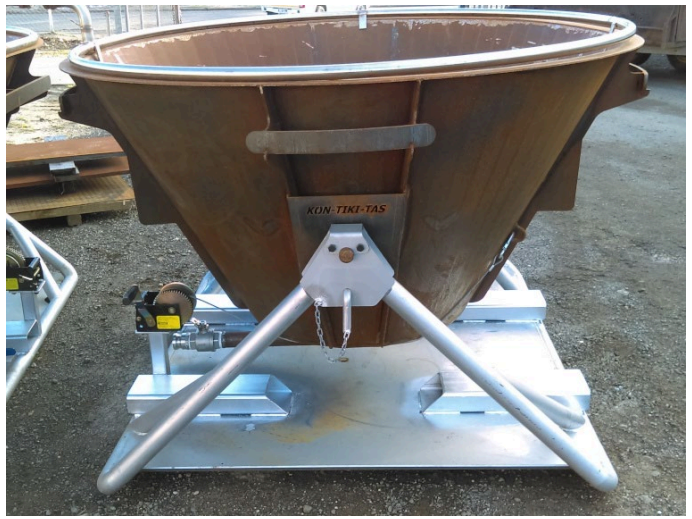


Wood 5.6 CY/kiln
2 CY biochar in 4-5 hours
1-2 people

wilsonbiochar.com

Ring of Fire Kiln®

Place Based Biochar: Portable High Efficiency Kilns



STANDARD" Model:

- Height 4ft 2in
- Volume

Top rim 35 ft3
Filled with char 30 ft3

- Weight empty 1400 lb

1-3 CY/Day
Air assist
Flood quench
Nutrient Rich liquid

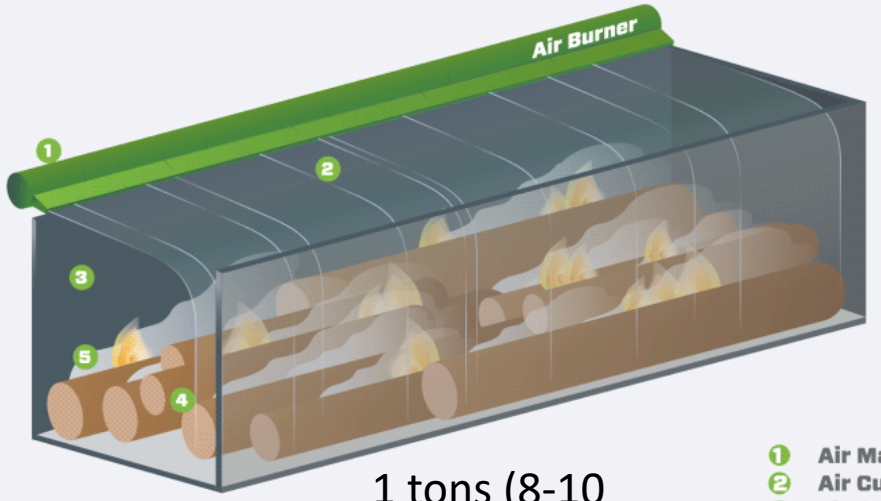
KON TIKI TAS
Terra Preta Developments
Tasmania Australia

www.terrapretadevelopments.com.au

Place Based Biochar: Curtain of air burns gases. Biochar withdrawn continuously through a 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**

1. Air Manifold
2. Air Curtain (left to right)
3. Firebox Refractory Wall
4. Wood Waste or Wood Fuel
5. Smoke (PM or Black Carbon)

airburners.com

7 CY Chamber
4’ x 4’ x 12’

Placed Based Biochar: Air Curtain Burners Recover Biochar and Energy

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

AirBurners

airburners.com

Air Curtain Burner
100-1000 kWe

airburners.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

Convert forest residues, land clearing wood to biochar for direct use on site or export.

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**.

(chip van)

Slash Pile

(Peterson 5710 horizontal grinder)

(excavator)

FORESTS AND BIOCHAR

Excess forest fuels can create energy and help build healthy soils

FOREST SERVICE US DEPARTMENT OF AGRICULTURE

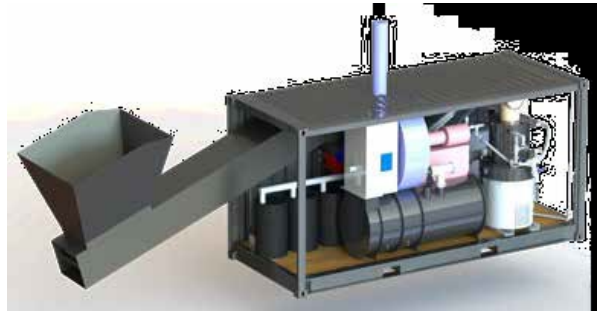
USBI Building the future from the ground up.™

LEARN MORE AT **www.biochar-us.org**

Small Scale Gasifiers: Combined Heat and Biochar

Phoenix Energy
California
2 MWe +
600 lb/hr Biochar 2CY/h
Eqtec.com gasifier
phoenixenergy.net

Qualterraag.com
Molecular Plant Testing
Clean Plant Propagation
Biomass Processing &
Carbon Regeneration



ALL POWER LABS
Carbon Negative Power & Products

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

Biomass: 55 lb/hr
Biochar: 11 lb/hr
Heat: 170,000 Btuh
Operation: ~12 hours
Start-Up Time: 20 – 40min

Charpallet 25

Small Stationary Systems: Small Scale Gasification

Low Capacity

- 600-1200 lb/hr feedstock
- 150-300 lb/hr biochar
- 0.5-1 CY/hr

Simple Operation

- Automated control

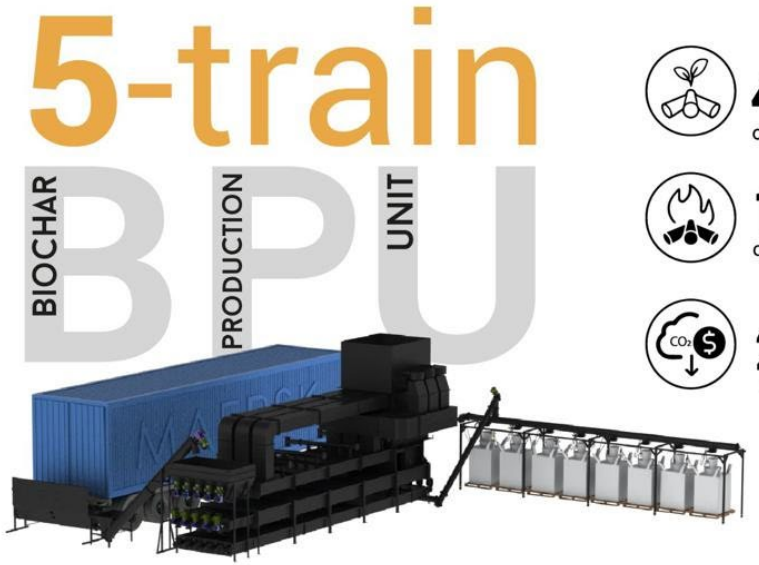
Heat Recovery

- Hot air or hot water

Integrated Modular Pyrolysis Systems: Heat and Biochar – BET, ARTiChar

BET

biomassenergytechniques.com

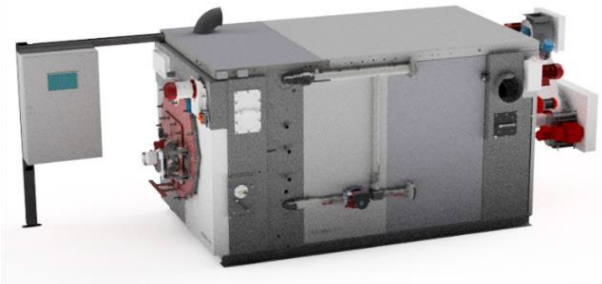


ARTi.com

Small to Medium Scale European Systems

Examples for industrial equipment producing Biochar

SYNCRAFT®
Climate Positive Solutions.



Biomacon

cts CARBON TECHNIK SCHUSTER

VOW

biochar-industry.com

Biochar Boilers: Combined Heat and Biochar

Auen Pflege Dienst – Flaach

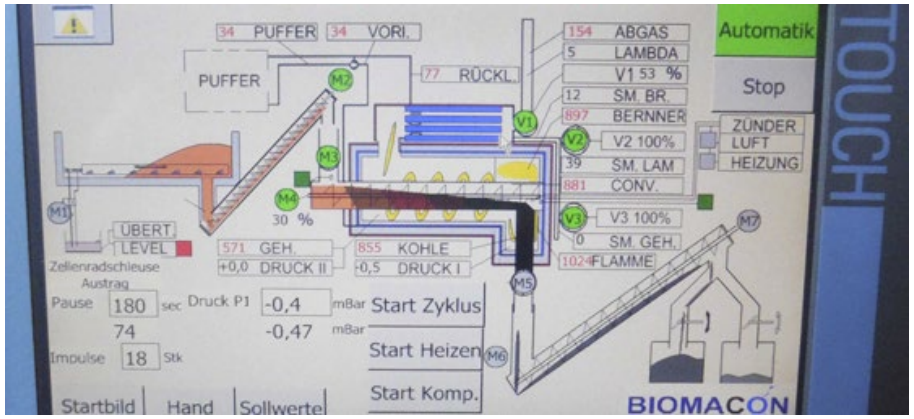
Reference Project ("Small")

- Customer: **Auen Pflege Dienst AG (CH)**
- Equipment: **Biomacon 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**

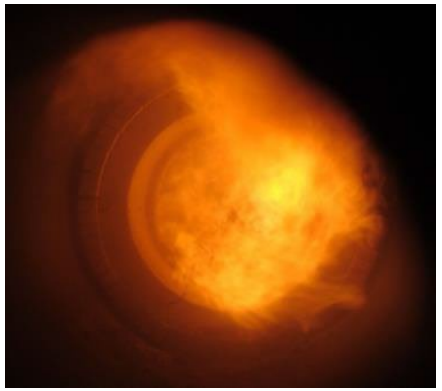
biochar-industry.com

Small Scale Combined Heat and Biochar

Biomacon.com



1.7 MMBtuh (500 KW) + 100 lb/hr biochar



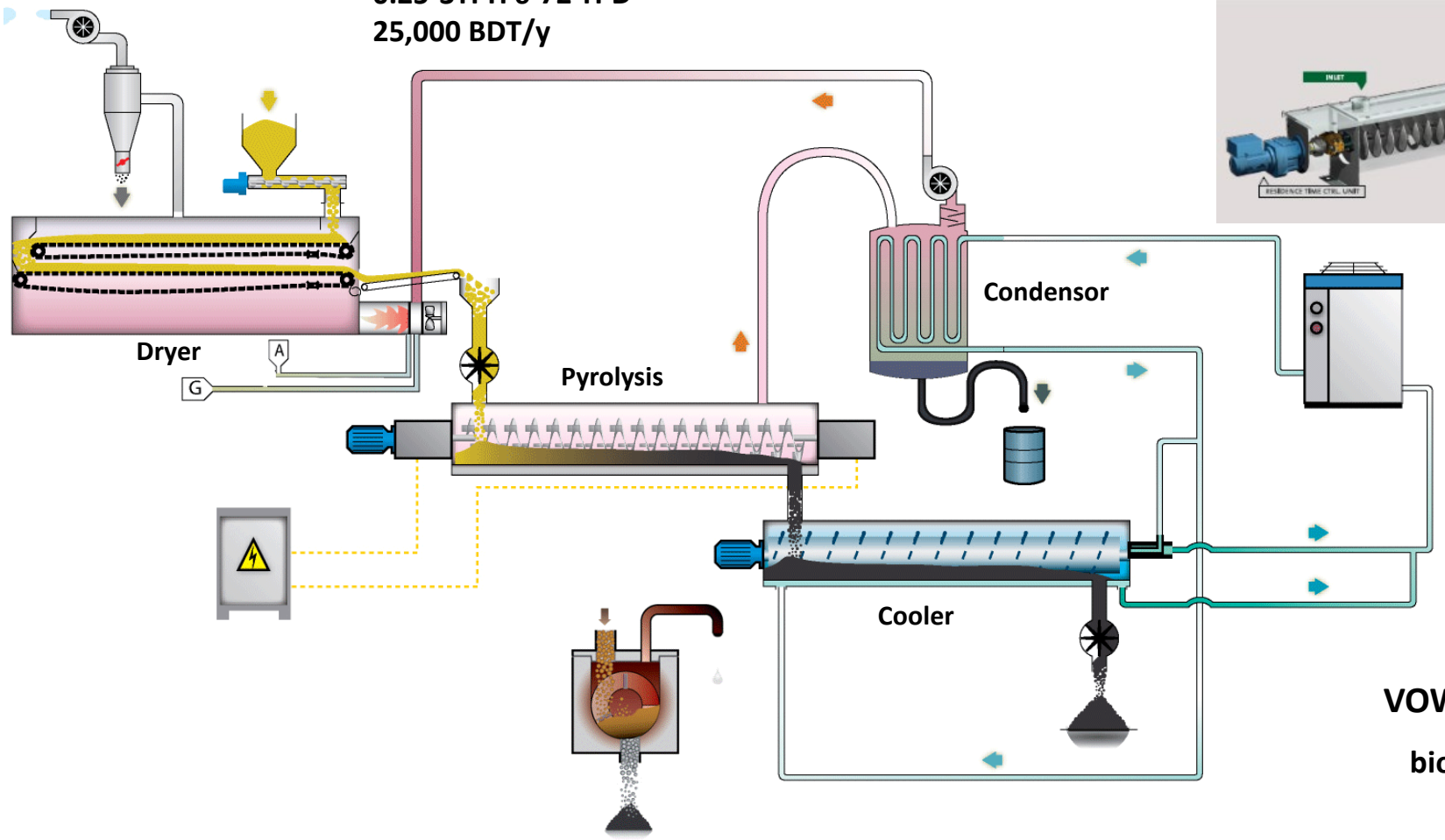
Gasifier-Boiler 4 MMBtuh (1200 kW) + 125 lb/hr biochar

Char used in structured soil

Pyrolyze Chipped Wood to Heat, Biochar, and Oil

– VOW ASA/Biogreen Energy

0.25-3TPH 6-72 TPD
25,000 BDT/y



VOW/Biogreen Energy

biogreen-energy.com

Small Industrial Gasifiers Produce Heat and Biochar

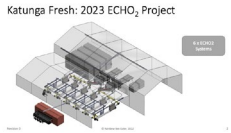
Earthcare LLC
earthcarellc.com
2 tph fuel 50 TPD
12 tpd Biochar

Wood, Manure, Litters, Gasification, Heat

Ecoremedy
Fluid Lift Gasification
ecoremedyllc.com

Wood, Manure, Digestate, Biosolids, Heat

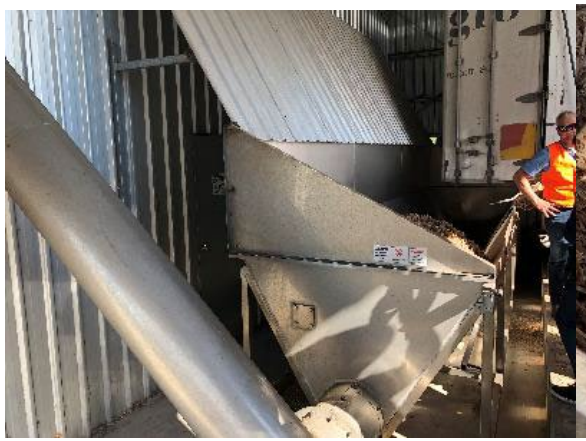
Greenhouse Heating + Biochar (for Compost)



Rainbow Bee Eater


BOILER


GASIFIER




URBAN WOOD DELIVERY


GREENHOUSE


BIOCHAR


BIOCHAR_COMPOST

www.rainbowbeeeater.com.au

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

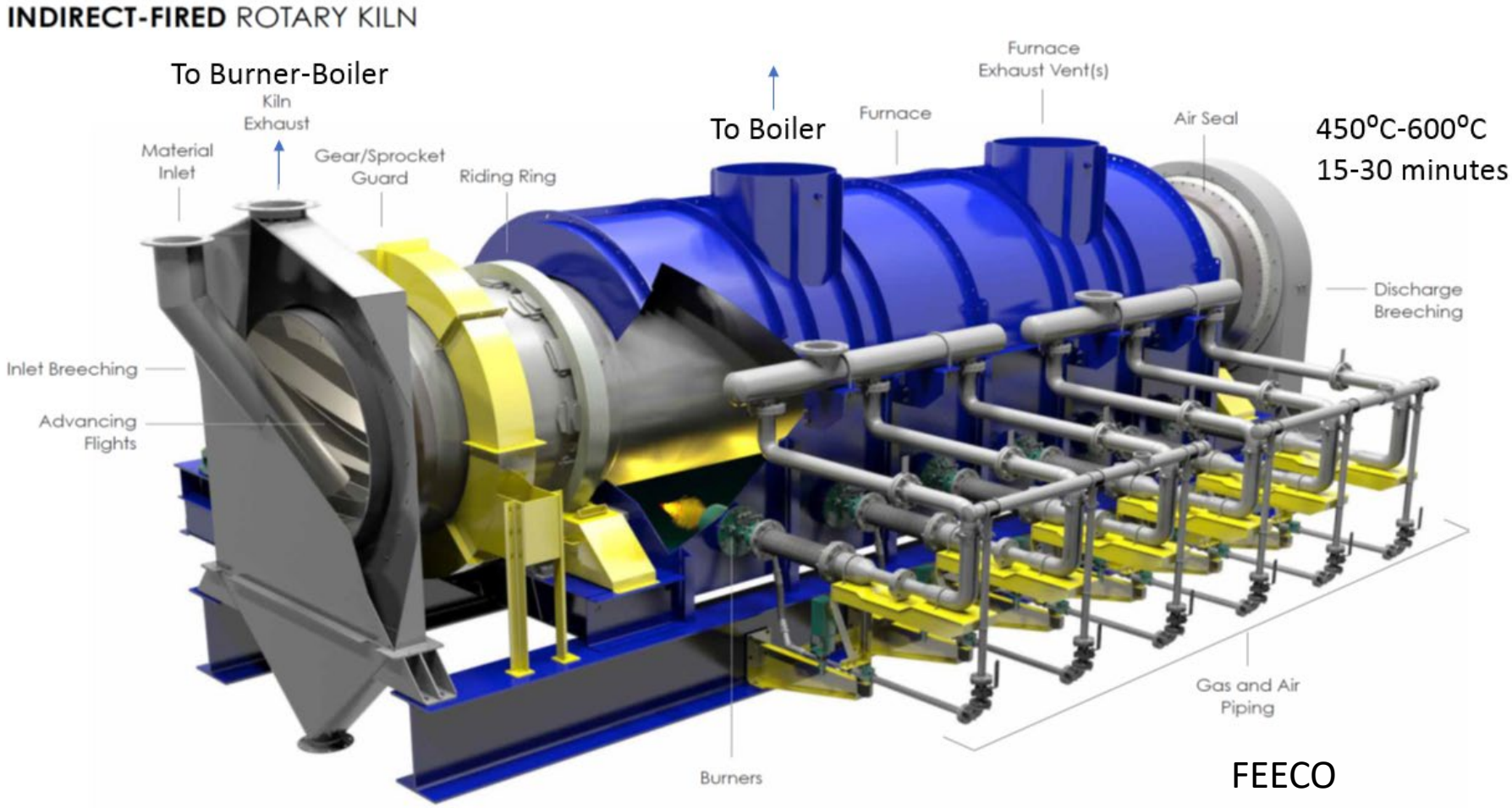
Biochar co-product refined for landscaping

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

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



FEECO

Feeco.com

Rotary Kiln Pyrolysis 48-144 t/d

Char Technologies
chartechnologies.com

Sanju Crop Residue to Biochar Fertilizer Production Facility

2.5 mt/hr, gas+pyrogas

Combined Heat, Power and Biochar

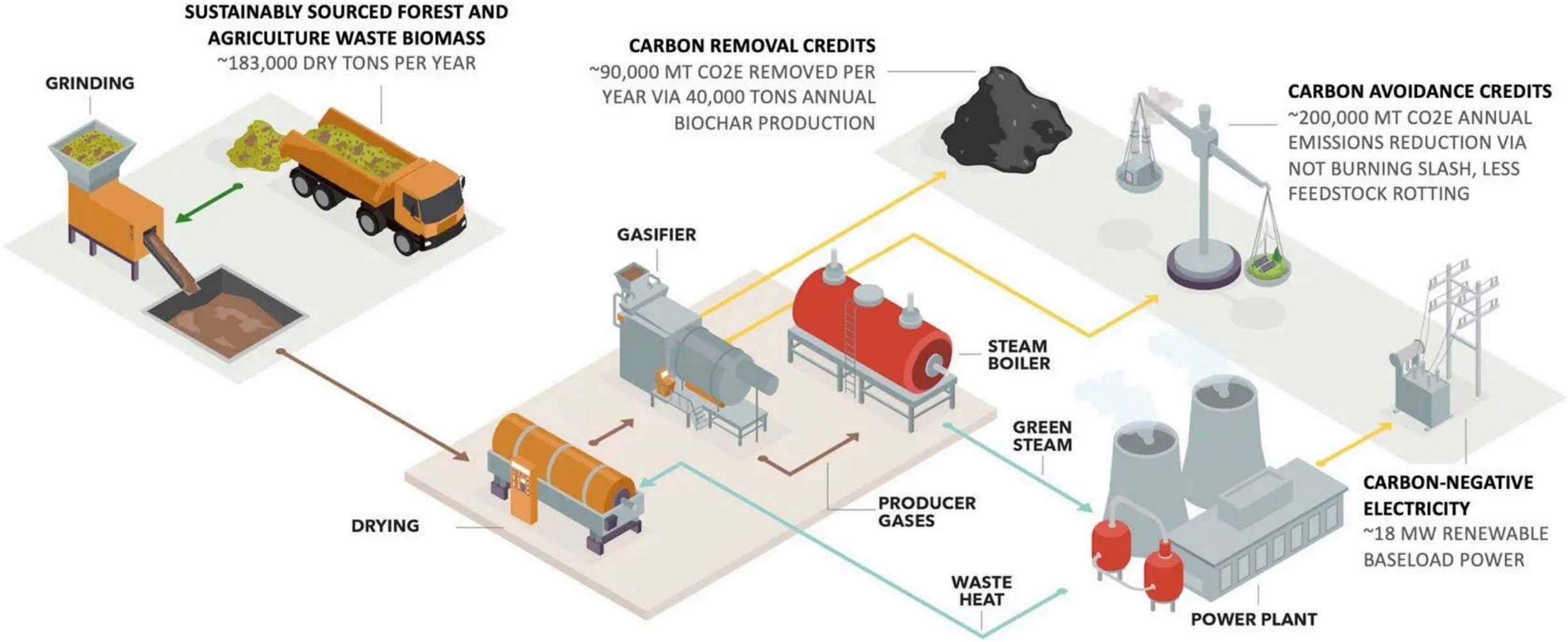
biochar-industry.com

Large Scale Projects: Myno Carbon

Washington:

Biochar Carbon Dioxide Credits Generated in EV Fuel Production

Myno Carbon mynocarbon.com



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

the energy of innovation™

Waste Wood Heats Kansas Ethanol Plant **ICMinc.com**

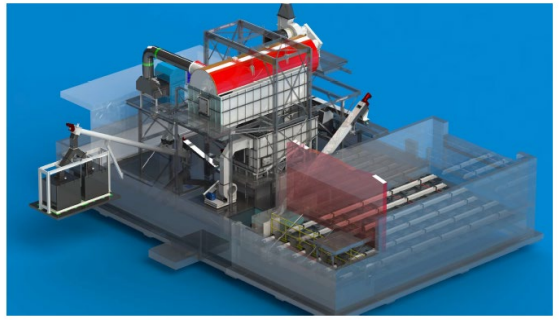
Biochar From Staged Combustion: KMW

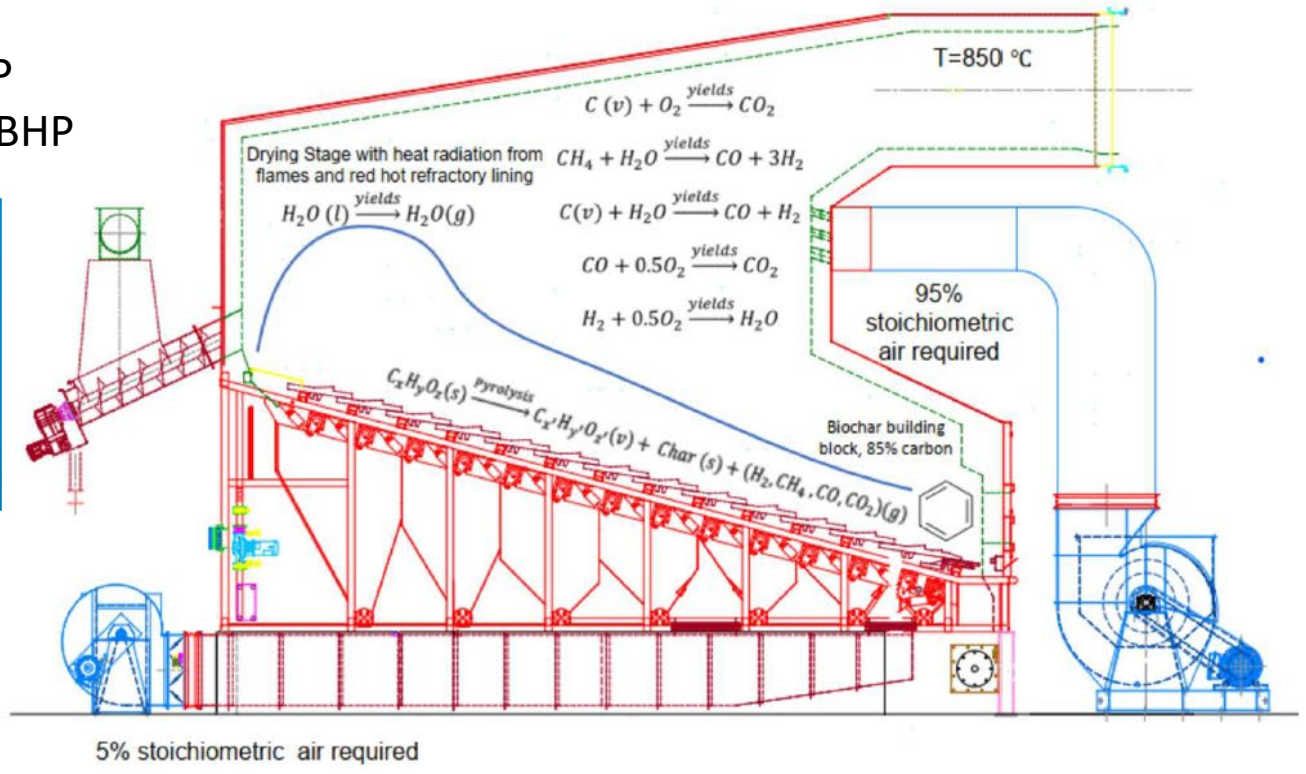
Operational Changes - Heating vs Producing Biochar

KMW Biomass and Biochar Energy Systems

Combined Heat and Biochar Operation

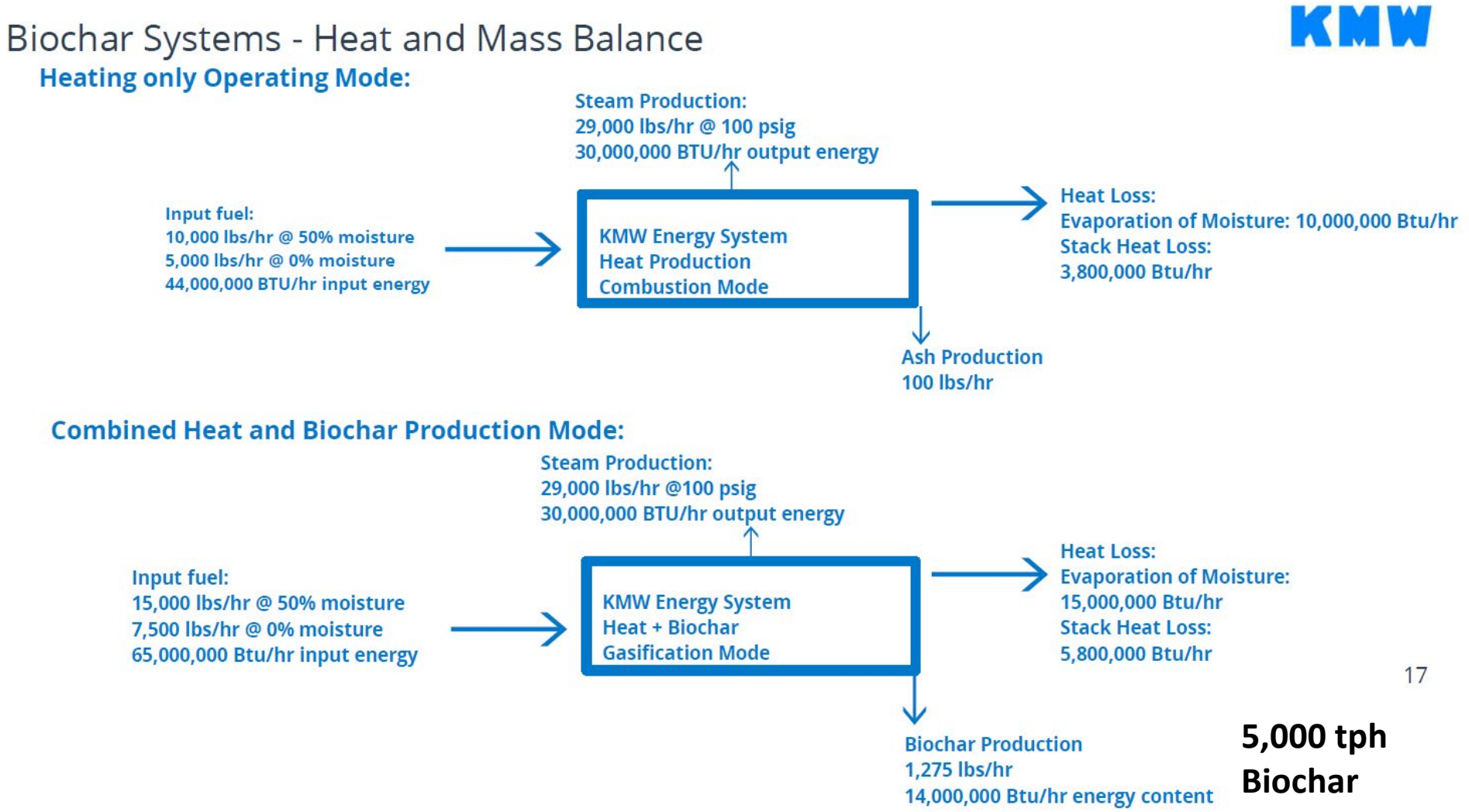
Steam Boilers 200-2500 BHP
Hot Water Boiler 100-1500 BHP





www.kmwenergy.com

Combined Heat and Biochar: KMW



17

5,000 tph Biochar

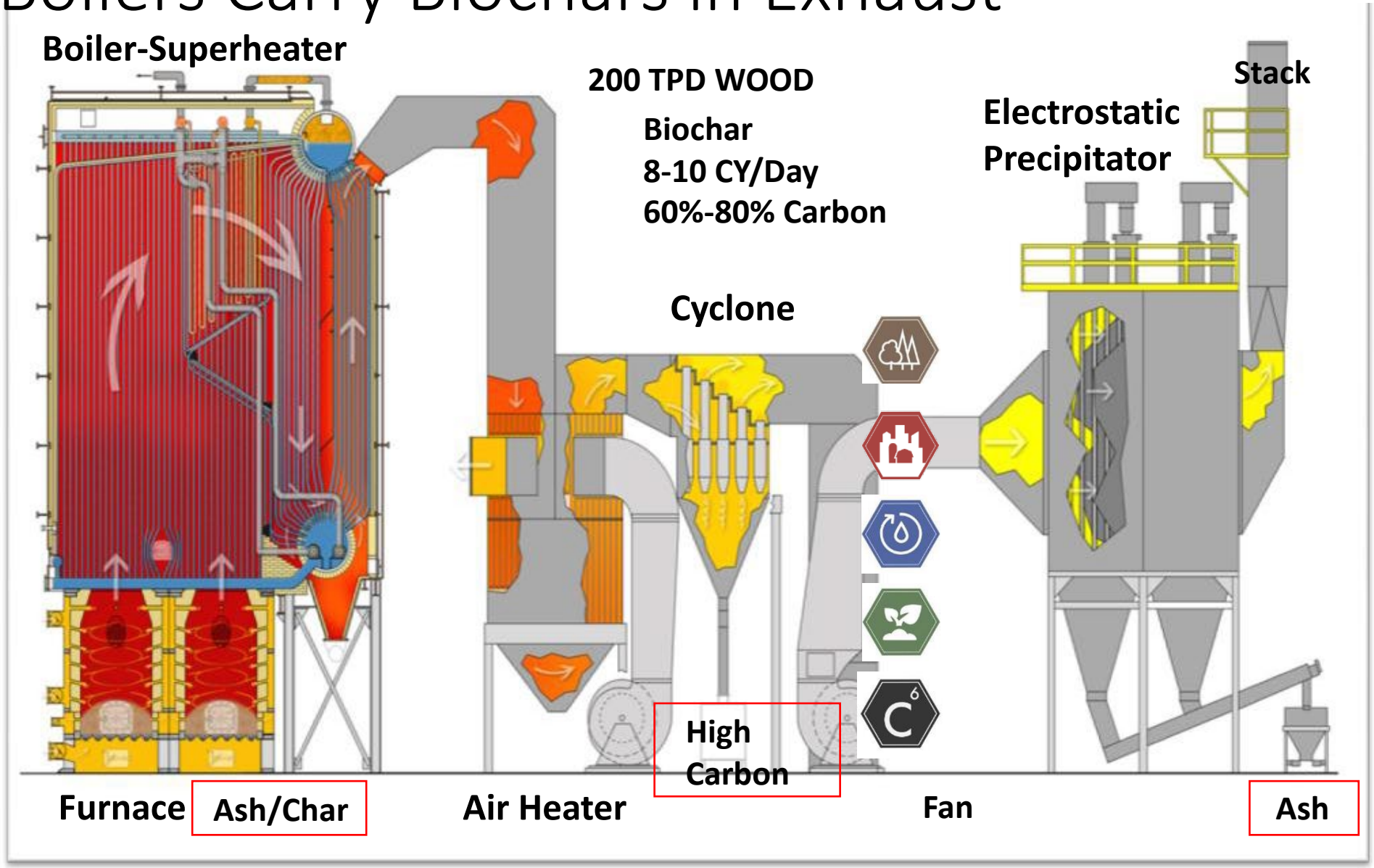
www.kmwenergy.com

Biomass Boilers Carry Biochars in Exhaust

Photo: Capital Press

Freres Lumber

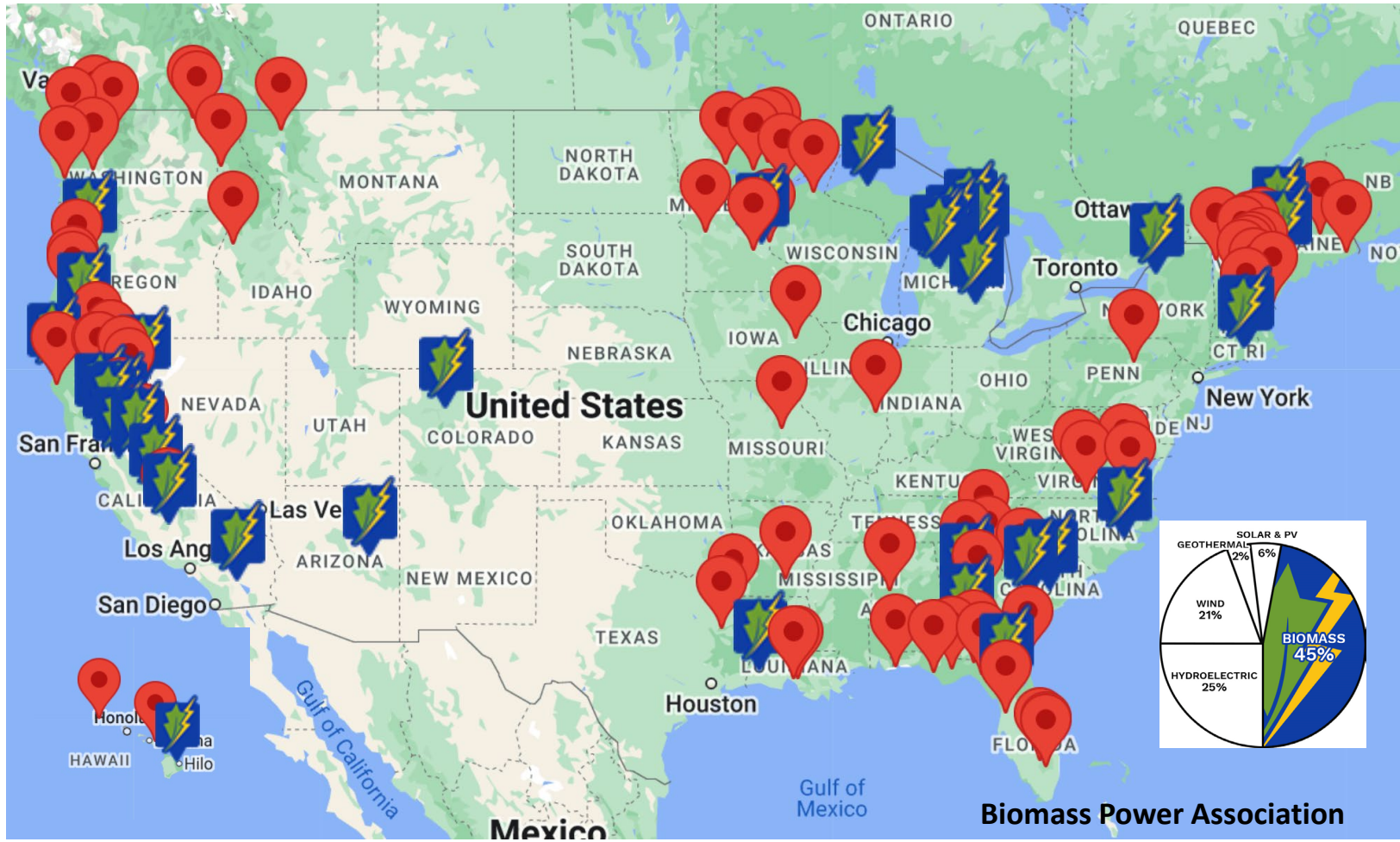
Source: Wellons, Inc.
www.wellonsusa.com



96 Ag and Wood Biomass Plants Could Recover Biochar
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, EIA]



Biomass Power Association
usabiomass.org

US Biochar Production is Growing

135 producer/55 tech suppliers

Pacific West
54/16

Midwest
19/9

Plains
17/7

Northeast
20/5

Southeast
14/7

9/3
3/0
11/1
3/0
1/0
2/1
3/1
4/0
1/1
8/1
6/1
3/2
1/0
4/3
1/1
1/0
2/1
3/3
1/0
1
25/10
1/1
7/4
3/2
2/0
3/1
5/0
3/2
2/1
1/1
1/0
0/1
2/0
1/2
1/0
1/1
1/0
1/1
2/0

Coming Soon:
USBI – IBI Survey
2023-2024

Using Biochar: Biochars are Delivered in Bulk

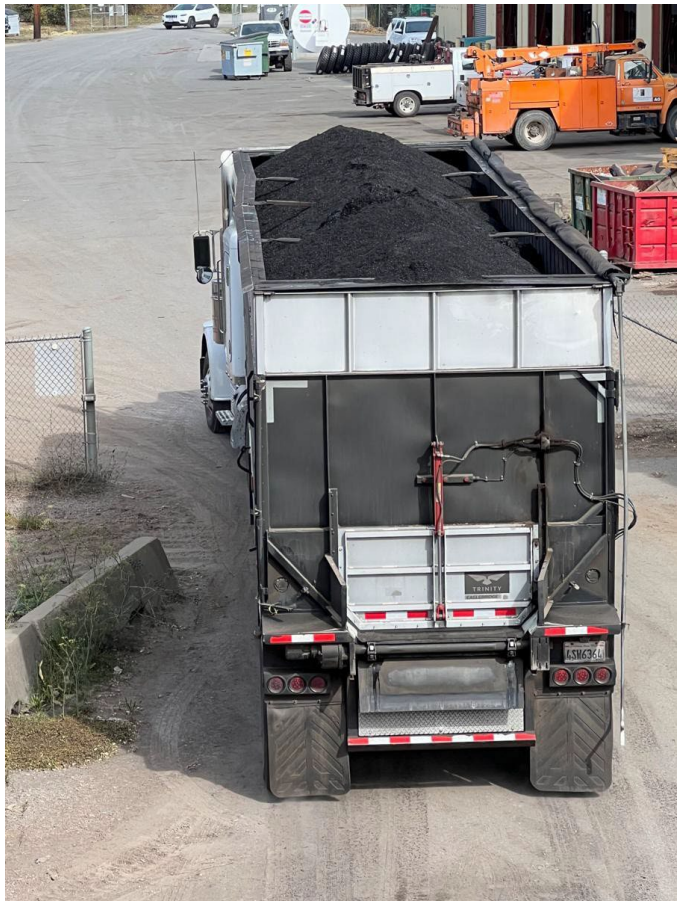
2 CY 400 lb dry

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

Oregon Biochar Solutions
www.chardirect.com

80 CY 8-10 t

From Factory to Use



PACIFIC BIOCHAR

Pacificbiochar.com

Biochars are Delivered in Bulk Bags

Bulk bag - spout top and bottom

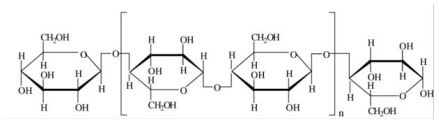
A step deck flatbed truck loaded with 19 pallets of 4 yards – 76 cubic yards of biochar on board. ***Biochar Solutions LTD.***

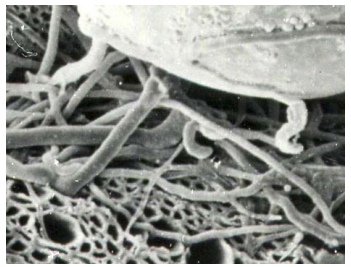
Bags at Distributor
2 pallets/ton

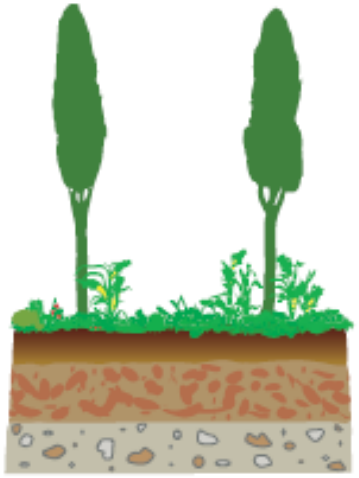
Technologies for Climate Resilience:
Renewable Energy, Increase Soil Carbon, Remove CO2e

Sustainable Biomass 1 Billion tons 500 Million tons C

GREEN CARBON MARKETS
250 Million tons C







Biomass
- manure
- organic wastes
- bioenergy crops (grasses,willows)
- crop residues

(C) 100%

Pyrolysis

Bio-fuel
- bio-oil
- hydrogen

(C) 50%

Transport
Energy
Coproducts (oil, cosmetics)
Industry

Residual heat

(C) 50%

Returned to soil
as Bio-char

Lehmann 2007

BIOCHAR MARKETS

250 million tons C **625 Million tons CO2e**

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

1 mt CO_2e = 1 Carbon Dioxide Removal Certificate (CDR or CORC™) 2.0-3.2 mtCO2e/mt Biochar

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.

Just Add Biochar!

USBI
Building the future from the ground up.™


Photo: Pacific Biochar

Thank you!

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

Connect

info@biochar-us.org
https://biochar-us.org instagram.com/usbiochar
youtube.com/@USBiocharInitiative
linkedin.com/company/us-biochar-initiative
twitter.com/usbiochar
facebook.com/USbiochar
biochar.groups.io

Learning Center
& Fact Sheets