



# Biochar Introduction and Overview



Tom Miles  
US Biochar Initiative  
International Biochar Initiative



NAUFRP General Assembly  
September 20, 2022



# Highlights

- Organizations
- Research
- Progress
- Opportunities



VITAL Blend Soil Amendment,  
Activated BioChar charged  
with freshwater-sourced  
Humate [ambiochar.com](http://ambiochar.com)



Urban Soil Repair  
Ecotone Inc.  
[ecotoneinc.com](http://ecotoneinc.com)

Urban Forestry and  
Tree Survival



Biochar Amended Compost  
Missouri Organic Recycling  
[www.missouriorganic.com](http://www.missouriorganic.com)



Biochar + No-till  
[Constantcanopy.com](http://Constantcanopy.com)  
Natural Plant  
Solutions



[Pacific Biochar.com](http://PacificBiochar.com)



Char Technologies  
[chartechnologies.com](http://chartechnologies.com)



Earthcare LLC [earthcarellc.com](http://earthcarellc.com)



Biochar and Carbon Markets  
Oregon Biochar Solutions  
[Chardirect.com](http://Chardirect.com)



# International Biochar Initiative

## Network – Education - Demonstration



2008 - 2022

International

Members (Professional, Business, Organizations)

Newsletters

White Papers (Science Committee)

Webinars

Study tours

Website, Social Media

Education and Outreach

[www.biochar-international.org](http://www.biochar-international.org)

[info@biochar-international.org](mailto:info@biochar-international.org)



African Biochar Partnership

# Biochar Research, Production and Use

## From Terra Preta to Biochar Compound Fertilizers



- Accelerated Research
- Improved Chemistry and Biology
- Improved Technologies for biochar and co-products
- More Sectors are Engaged in Biochar Development
- More demonstrations and use in forestry, water, and agriculture
- Many Different Markets and Uses – Livestock Feed, Structured Soils
- Forest and Urban uses complement agricultural markets
- Slow Adoption by North American Agriculture
- Growing Markets for Carbon Removal (2-2.5 mtCO<sub>2</sub>e/mt biochar)



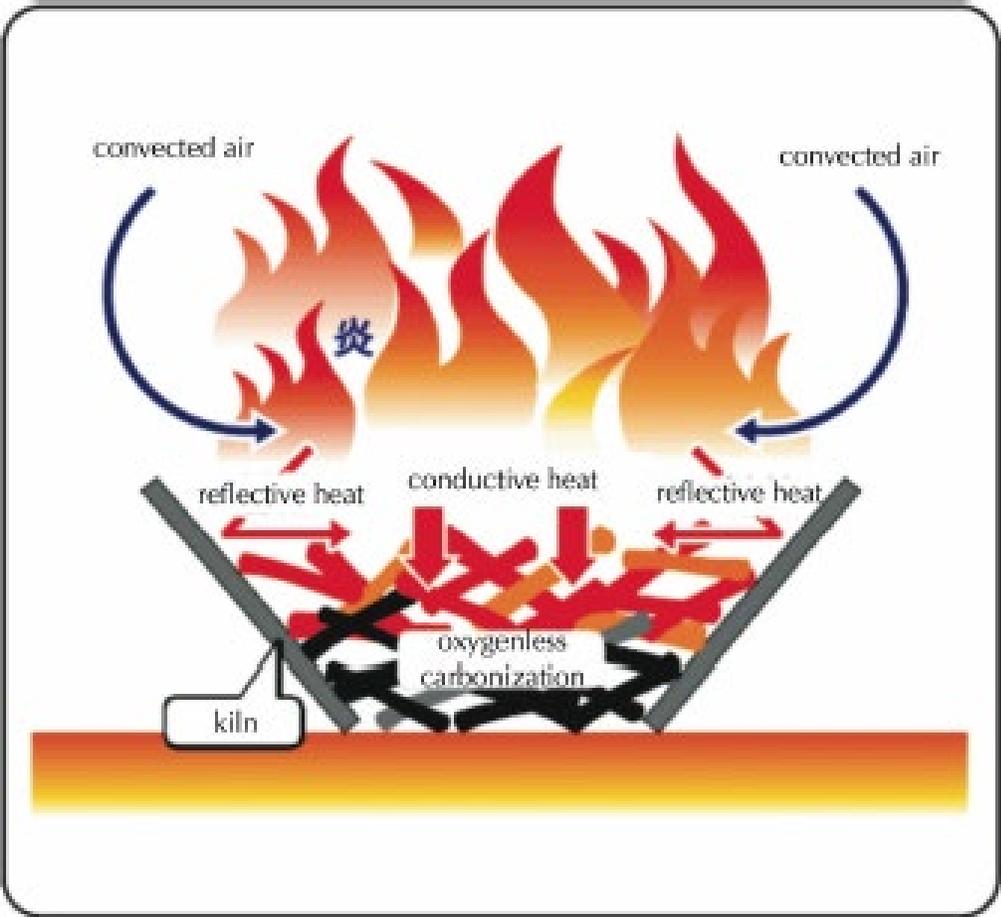
# In Japan Biochar Research Began With Forest Health



Makato Ogawa



Genji



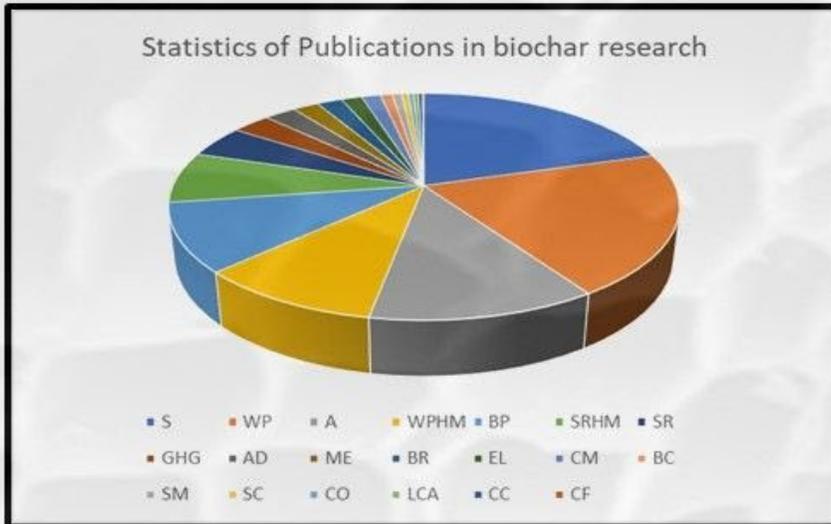
Smokeless Carbonizing Kiln Charring Schematic

<http://hdl.handle.net/2047/d20000347>



# 20,000+ Peer Reviewed Papers 2008-2022

## Peer reviewed papers on biochar from May 2021 to May 2022

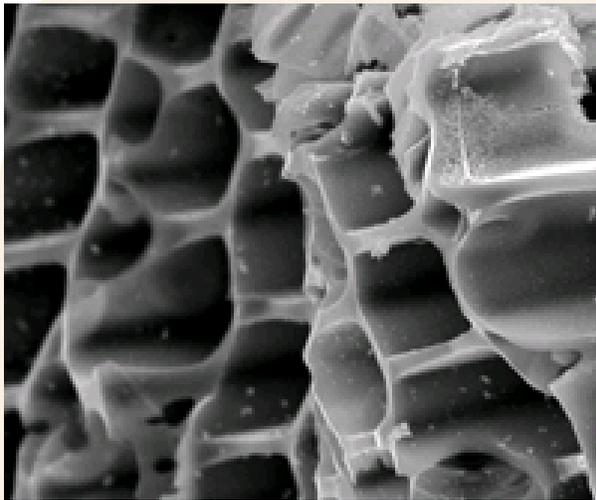


Increased biochar specific funding  
 USFS Wood Innovation Program, Research  
 Growing media, reforestation, grazing,  
 watershed restoration  
 USDA ARS, NRCS, Climate Hubs

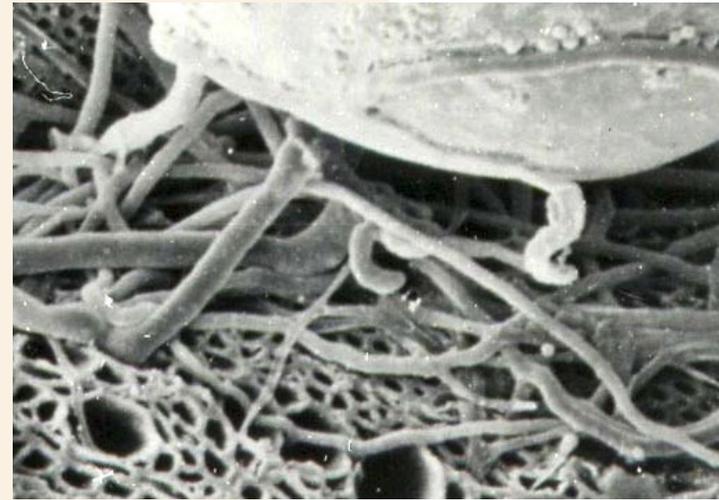
Sl. No.	Broad catagories	Abbrev.	Total
1	Biochar in soil	S	708
2	Water purification	WP	707
3	Application	A	425
4	Water purification heavy metal	WPHM	347
5	Biochar prepartaion	BP	340
6	Soil remediation heavy metal	SRHM	254
7	Soil remediatin	SR	159
8	Green house gases from soil	GHG	103
9	Anaerobic digestion	AD	83
10	Treatment of medical waste	ME	69
11	Biochar review	BR	66
12	Electrical device	EL	54
13	Construction material	CM	50
14	Biochar characterization	BC	31
15	Soil microrganisms	SM	25
16	Soil Carbon	SC	18
17	Composting	CO	13
18	Life cycle assesment	LCA	13
19	Climate change	CC	10
20	Cattle feed	CF	5
Total			3480

# Biochars are Processed From Biomass So That Physical, Biological, and Chemical Properties Improve Soil Health and Hydrology

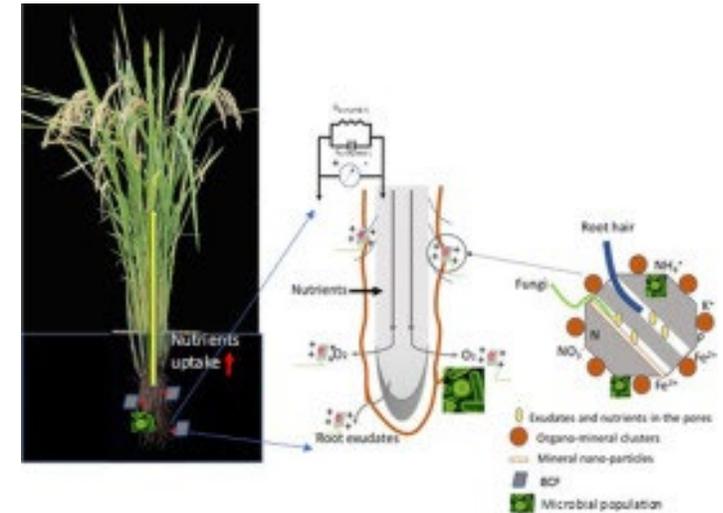
**Biochars are fine-grained, highly porous charcoals that help soils retain nutrients and water.** International Biochar Initiative



Collins 2009



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



**Biochar-based fertilizer redox potential, eH**  
Chew et al. 2020 [bit.ly/30TQnIB](https://bit.ly/30TQnIB)

# Malawi and Kenya Tells Us: "Biochar Is A Farmer's Best Friend"



## Biochars Made in Smokeless Engineered Pits

Sr. Miriam Paulette with biochar from flame cap pit at the Carmelite Monastery in Zomba, Malawi. 7/12/2020



Metal cover to quench char.



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

Kenya: Trainer Everline with bumper sorghum crop. 7/20/2020



### Biochar + Manure

Everline's corn with biochar + manure



VS

Her poor harvest with commercial fertilizer.



Warm Heart Worldwide Malawi

[warmheartworldwide.org/biochar-africa](http://warmheartworldwide.org/biochar-africa)

Warm Heart Worldwide, Kenya

**7500 smallholders trained by other biochar users during pandemic**



# China Stimulates Biochar-Based Fertilizers using Rotary Kiln Pyrolyzers in Fertilizer Plants



500,000 tons/yr

62 Suppliers in National Alliance of Biochar Science and Technology Innovation

[bit.ly/2RqkZh8](https://bit.ly/2RqkZh8)

# Progressive Farms Incorporate Biochars and Blends



Overseeding pasture applying seed, biochar and organic amendments with a No-till drill.

Natural Plant Solutions, WA [naturalplantsolutions.com](http://naturalplantsolutions.com)

**Biochar**

**Biochar-organic fertilizer**

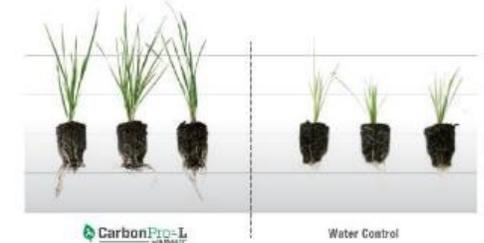
**Biochar-based fertilizer**

**Liquid suspension**



**“Biochar Is A Change Agent”**

Jason Mauck, Constant Canopy [constantcanopy.com](http://constantcanopy.com)



**CarbonPro**

[www.lesco.com/products/carbonpro](http://www.lesco.com/products/carbonpro)



# Biochar Markets and Uses Continue to Grow



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

Biochar, Compost, Composted biochar (5%-20% biochar)  
Animal bedding, litter, manure management, *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



## Forestry

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

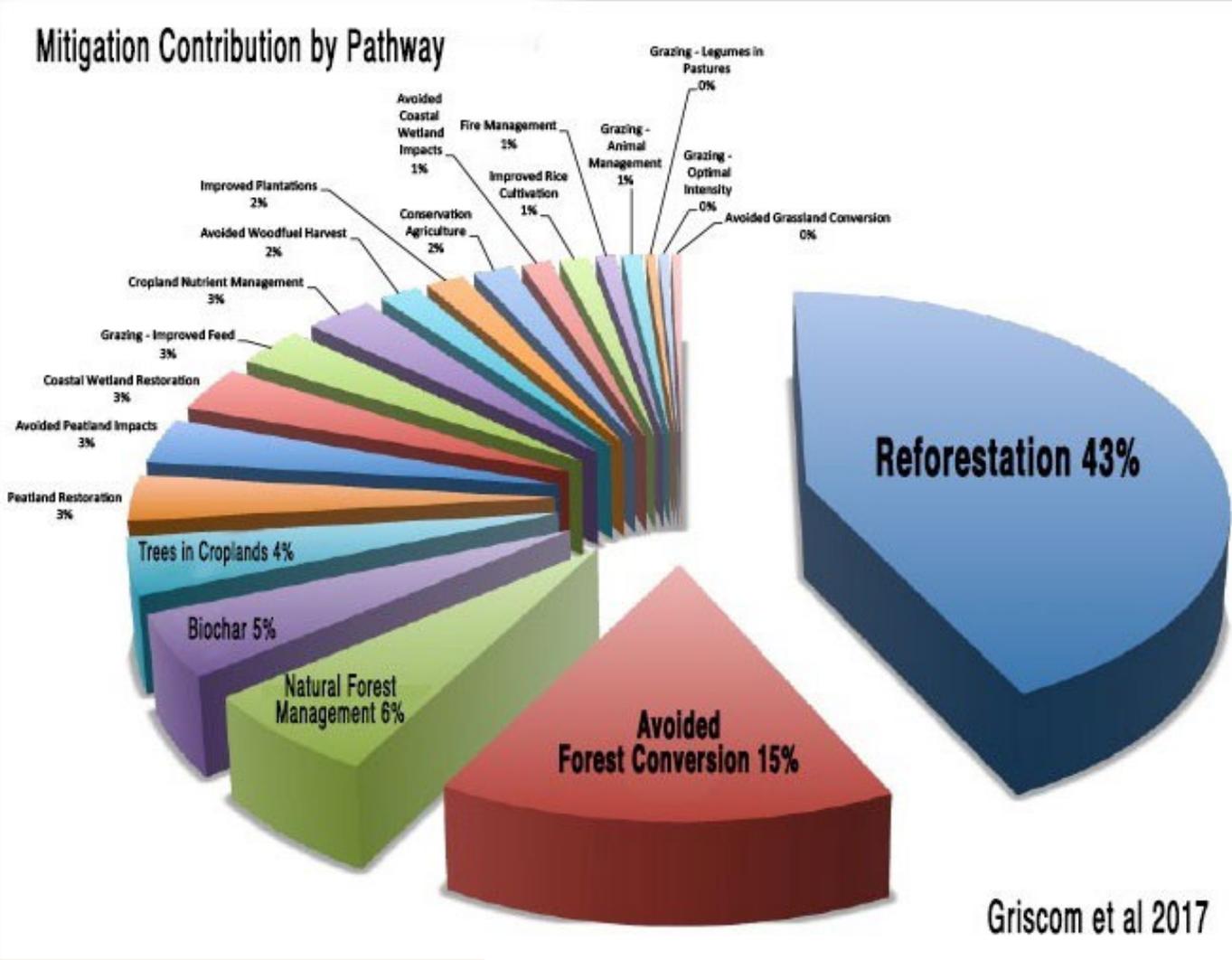


## Carbon, Renewable Energy Offsets, and Non-Soil Products

Carbon markets, building products, odor control, batteries



# Climate Change: Biochar Among Top 4 Natural Cause Pathways to Carbon Sequestration: Biochar Trades in International Markets



2-5 GT CO<sub>2</sub>e  
 Biochar \$120/mt CO<sub>2</sub>e  
 2-2.5 mt CO<sub>2</sub>e/mt biochar  
 Others \$30/mt CO<sub>2</sub>e

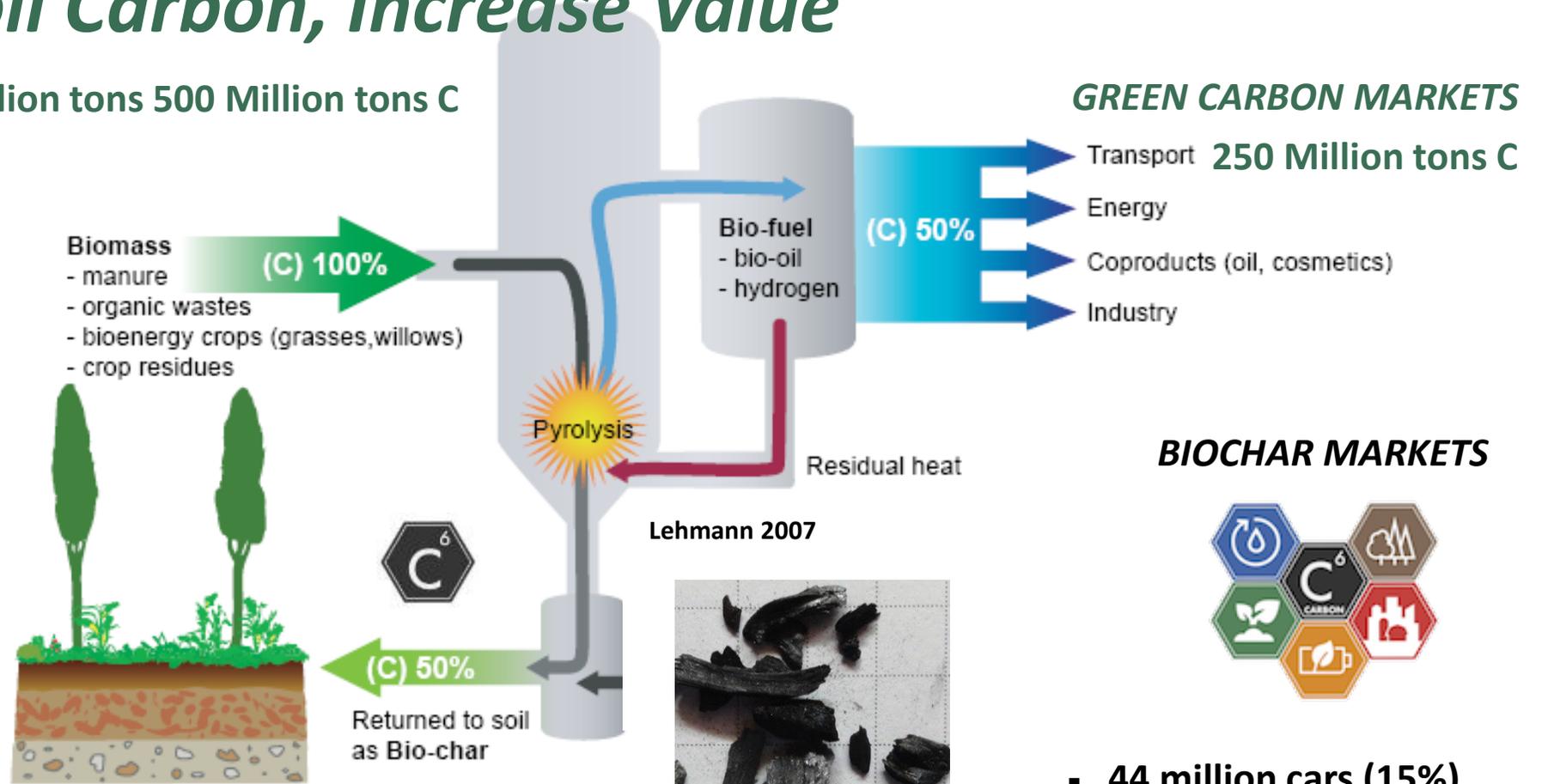
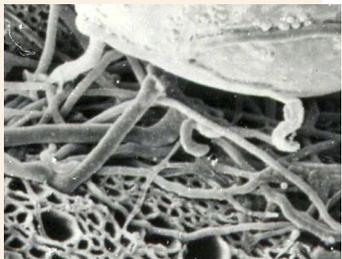
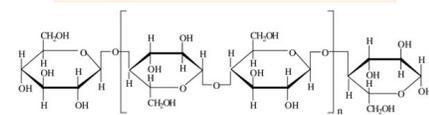
Griscom et al 2017  
 Albert Bates



# Climate Opportunities: Mitigation and Adaptation

## Produce Renewable Energy, Sequester Carbon, Increase Soil Carbon, Increase Value

Sustainable Biomass 1 Billion tons 500 Million tons C



250 million tons C 625 Million tons CO<sub>2</sub>e

1 mt CO<sub>2</sub>e = 1 Carbon Dioxide Removal Certificate (CDR) 2.0-3.2 CDRs/mt Biochar

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

# Co-Products: Green Carbon Markets



## Transport

Liquid fuels, Sustainable Aviation Fuels  
Renewable Natural Gas  
Hydrogen

## Energy

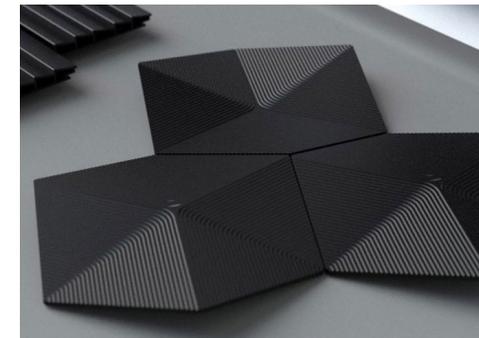
Heat or Steam  
Power  
Biocarbons

## Chemicals

Oils  
Cosmetics  
Wood vinegar (pyroligneous acid)

## Industry

Resins and chemicals, bioplastics



[www.madeofair.com](http://www.madeofair.com)

# Biofuel/Biochemical Technologies to Jet Fuel, Biocarbon, and Biochar



Groundbreaking at a Sustainable Aviation Fuel plant  
redrockbio.com

Transport  
Biocarbon  
Biochar



Torrefied wood, biocarbon, biochar  
restorationfuels.com

Torrefied  
Biocarbon  
Biochar



Torrefaction/Fast pyrolysis: oil, biochar  
airex-energy.com

Transport  
Biocarbon  
Biochar



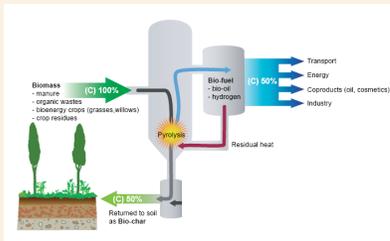
Autothermal Pyrolysis refined gas, biochar  
frontlinebioenergy.com

Hydrogen  
RNG  
Biochar  
Acetic Acid  
Polymers



Pyrolysis to biocarbon, biochar, RNG  
chartechnologies.com

RNG  
Biocarbon  
Biochar





# Innovative Biochar Products

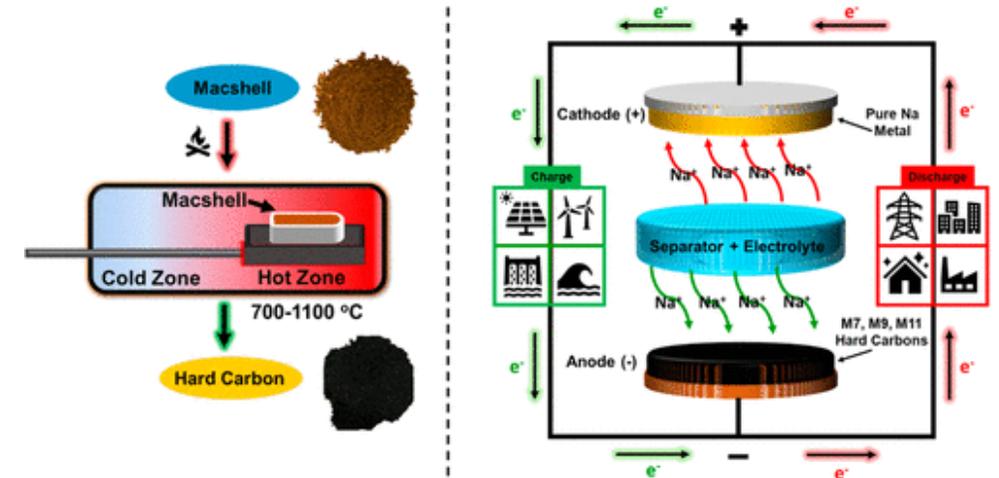


Made of Air  
[www.madeofair.com](http://www.madeofair.com)  
[www.dezeen.com/carbon](http://www.dezeen.com/carbon)



# Biochars Improve Urban Environments

## Building and Non-structural materials – Sodium Ion Batteries



Kumar et. al. 2021



**Factsheet: Biochar in Compost**



# Networking – Education – Demonstration



**Market and Technical Support**

**2009- 2022 North America**

**Conferences, Workshops, Demos**

**Newsletter, Website, Directory**

**Social Media, [Biochar@groups.io](mailto:Biochar@groups.io)**



**Biochar Basics: An A-to-Z Guide to Biochar Production, Use, and Benefits**

**A Little Background**

When considering the amount of organic matter in soil, there is too much in some places and not enough in others. Many forests have too much organic matter to last.



**USFS Biochar Basics [bit.ly/3Nctv78](https://bit.ly/3Nctv78)**

[www.biochar-us.org](http://www.biochar-us.org)  
[USBiochar@gmail.com](mailto:USBiochar@gmail.com)

**Pacific Northwest Biochar Atlas**

[www.pnwbiochar.org](http://www.pnwbiochar.org)

USDA ARS, NRCS

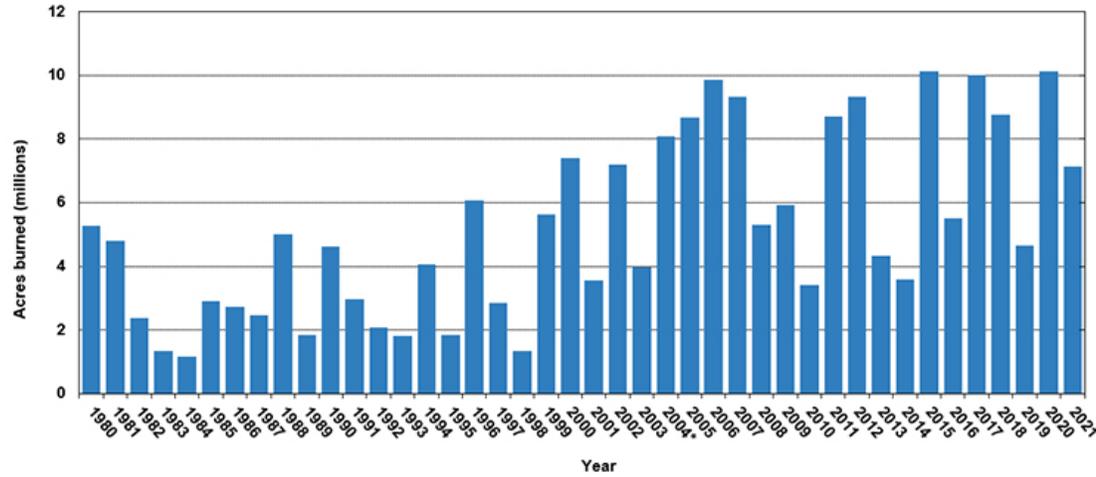
**Urban Biochar**

**Task Group**



**NAUFRP General Assembly September 2022**

# Severe North American Wildfire Destruction Increases Interest in Biochar from Forest Fuels



Insurance Information Institute  
[iii.org/fact-statistic/facts-statistics-wildfires](http://iii.org/fact-statistic/facts-statistics-wildfires)

Federal Lands	Treated Acres Million	Wildfires #	Acres Burned Million
2021		58,948	7.1
2020		57,000	10.4
2019	5.4	48,484	4.6
2018		60,000	8.4

Highest Risk: CA, TX, CO, AZ, ID, WA, OK, OR, MT, UT



airburners.com

**Char Boss**



tigercat.com



- \$200 million+ in Infrastructure Bill to convert forest residues to “biochar and innovative products”
- Long term research proposed to use forest residue char for agricultural soil health.



Wilsonbiochar.com

**Portable Flame Cap Kilns**

**Biochar in the Woods**  
 (USBI Jan 2022)



# Biochars are Produced in Mobile, Modular, and Industrial Systems



**"Ring of Fire"**  
Wilsonbiochar.com



**Carbonator 6050**  
tigercat.com



**ARTIchar**  
artichar.com



**Pyreg 500**  
Pyreg.de



**CharBoss**  
airburners.com



**Biomacon**  
Biomacon.com



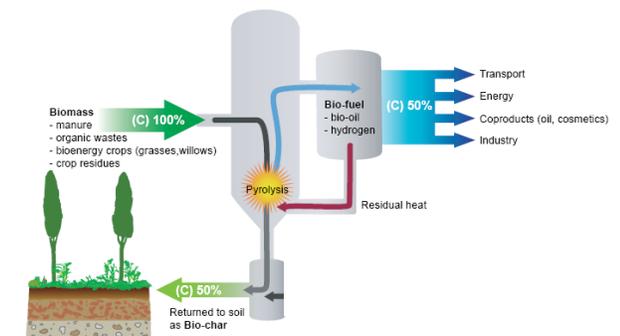
**Oregon Biochar Solutions**  
Chardirect.com

# Opportunities: Convert residues to biochar as a long-term investment in soil health and climate resilience.

- Reduce hazardous fuels and restore watersheds
- Increase Soil Organic Carbon
- Increase available water in coarse textured soils
- Reduce wildfire risk with increased water
- Remove atmospheric carbon dioxide for \$ (CDR)
- Enhance conservation and revegetation practices
- Improve soil biology long term 3-5 years +
- Increase soil quality to provide vegetative cover
- Reduce wind and water erosion
- Reduce organic and inorganic contaminants



## FOREST TO FOREST



**Just Add Biochar!**

**Thank you!**



**International Biochar Initiative** [Biochar-international.org](http://Biochar-international.org)

**US Biochar Initiative** [biochar-us.org](http://biochar-us.org) [USBiochar@gmail.com](mailto:USBiochar@gmail.com)

**Biochar Listserv** [www.biochar.bioenergylists.org](http://www.biochar.bioenergylists.org)