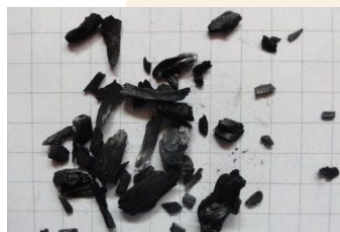




Biochar Introduction and Overview



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



Urban Soil Repair
Ecotone Inc.
ecotoneinc.com

Urban Forestry and
Tree Survival



Biochar Amended Compost
Missouri Organic Recycling
www.missouriorganic.com



Biochar + No-till
Constantcanopy.com
Natural Plant
Solutions



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



Char Technologies
chartechnologies.com



Earthcare LLC earthcarellc.com



Biochar and Carbon Markets
Oregon Biochar Solutions
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
info@biochar-international.org



Asia Pacific Biochar Conferences



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 mtCO₂e/mt biochar)



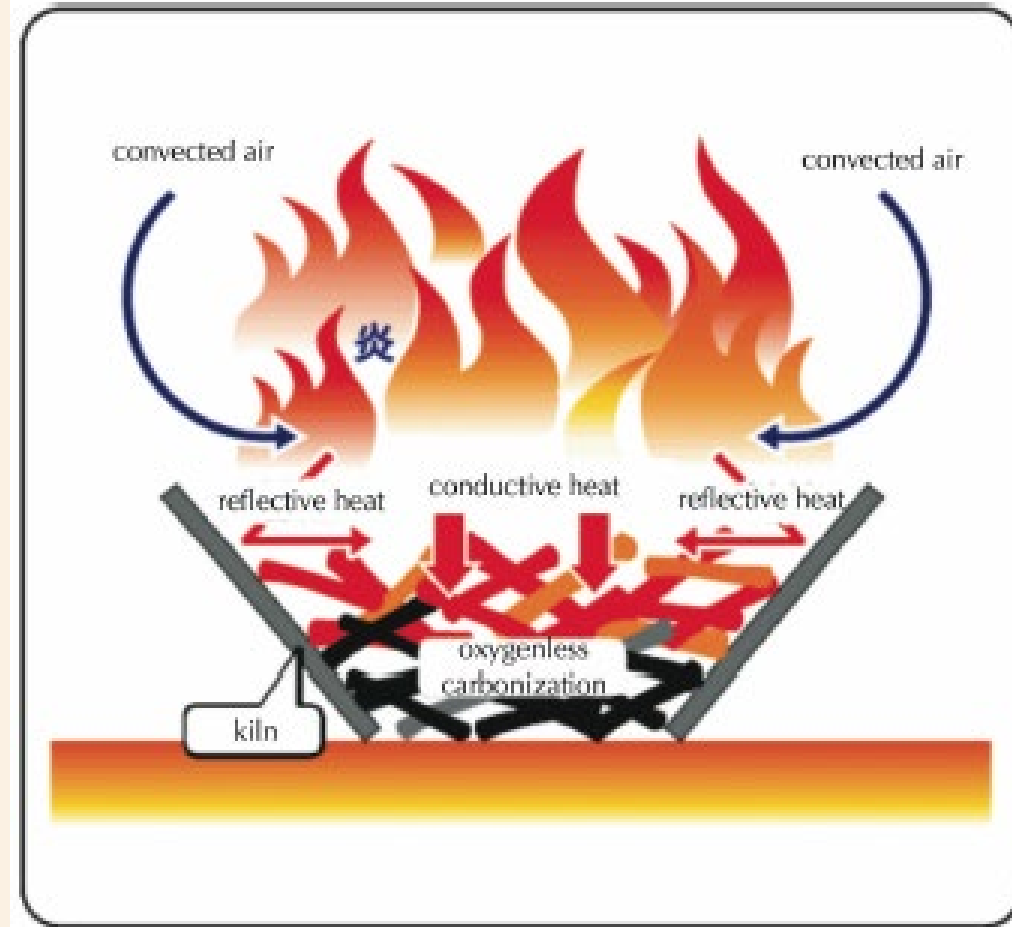
In Japan Biochar Research Began With Forest Health



**Makato
Ogawa**



Genji



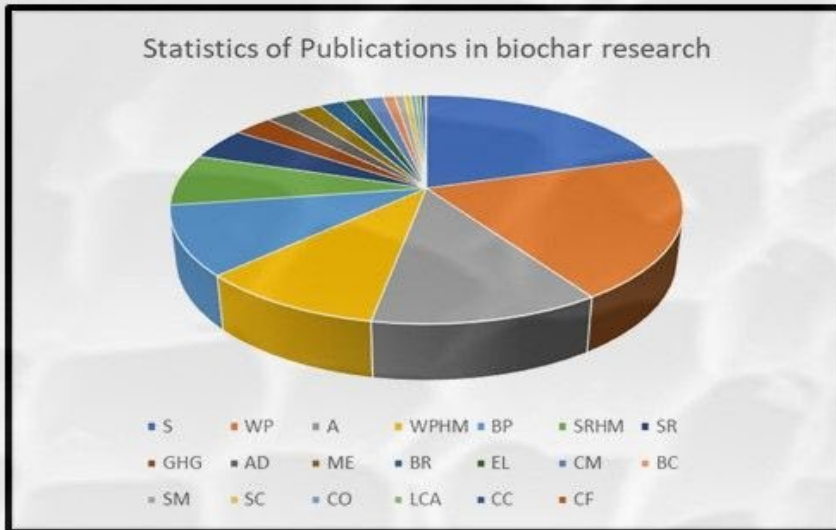
Smokeless Carbonizing Kiln Charring Schematic

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



20,000+ Peer Reviewed Papers 2008-2022

Peer reviewed papers on biochar from May 2021 to May 2022

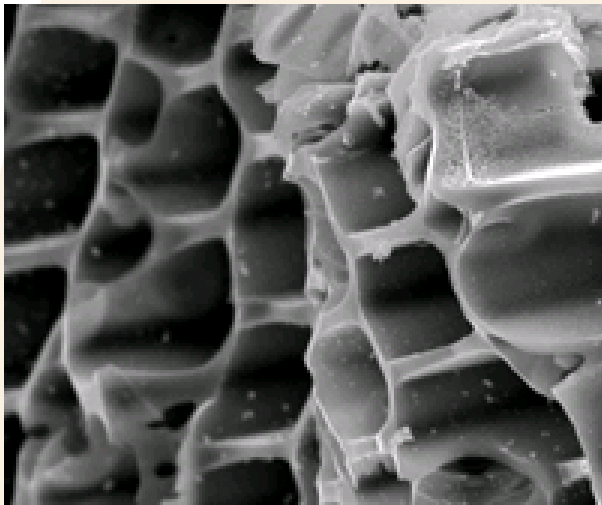


Increased biochar specific funding
USFS Wood Innovation Program, Research
Growing media, reforestation, grazing,
watershed restoration
USDA ARS, NRCS, Climate Hubs

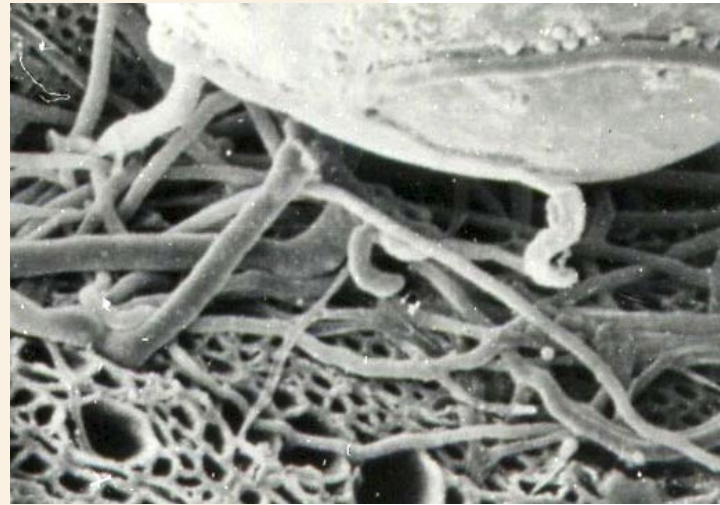
Sl. No.	Broad catagories	Abbrev.	Total
1	Biochar in soil	S	708
2	Water purification	WP	707
3	Application	A	425
4	Water purification heavy metal	WPHM	347
5	Biochar prepartaion	BP	340
6	Soil remediation heavy metal	SRHM	254
7	Soil remediatin	SR	159
8	Green house gases from soil	GHG	103
9	Anaerobic digestion	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 microorganisms	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

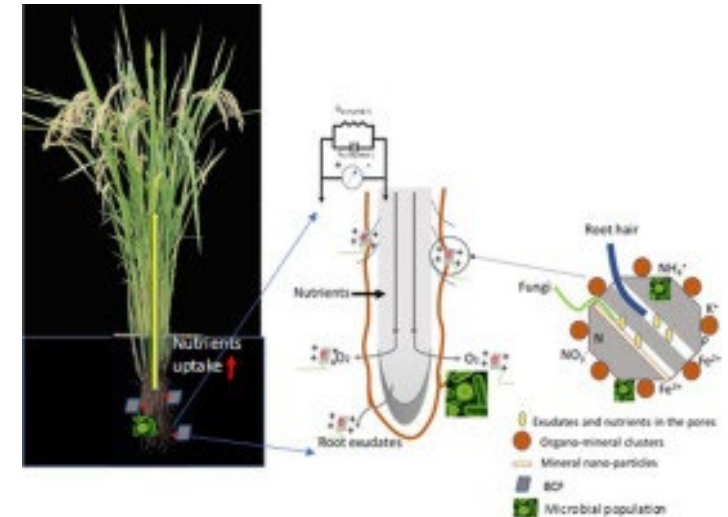
Biochars are fine-grained, highly porous charcoals that help soils retain nutrients and water. International Biochar Initiative



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

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.



Warm Heart Worldwide Malawi

warmheartworldwide.org/biochar-africa

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, 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

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

Biochar

Biochar-organic fertilizer

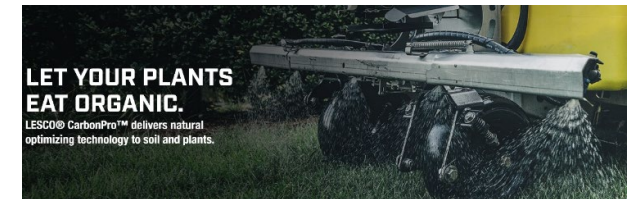
Biochar-based fertilizer

Liquid suspension



“Biochar Is A Change Agent”

Jason Mauck, Constant Canopy constantcanopy.com



CarbonPro

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

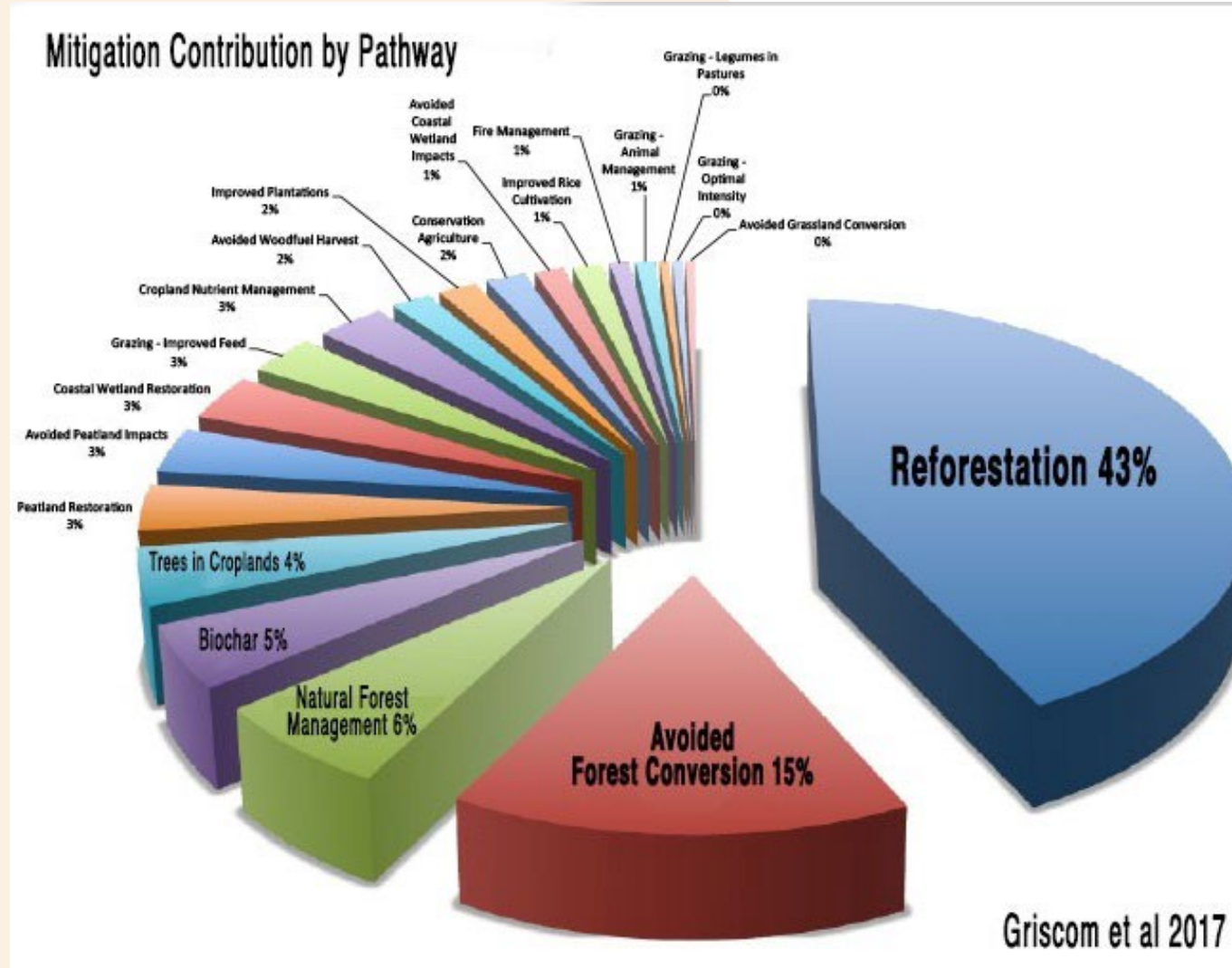


Carbon, Renewable Energy Offsets, and Non-Soil Products

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 CO₂e

Biochar \$120/mt CO₂e

2-2.5 mt CO₂e/mt biochar

Others \$30/mt CO₂e

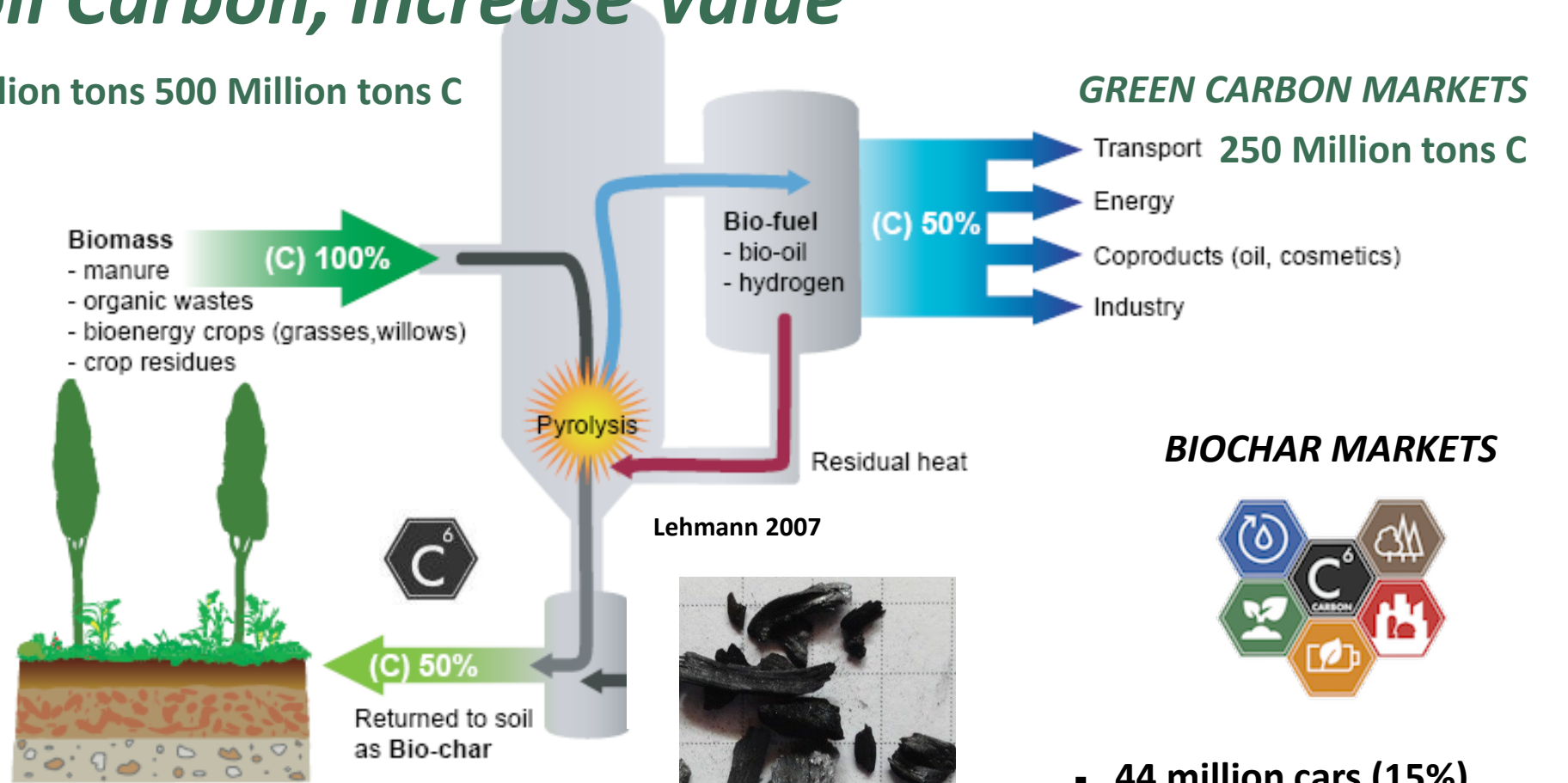
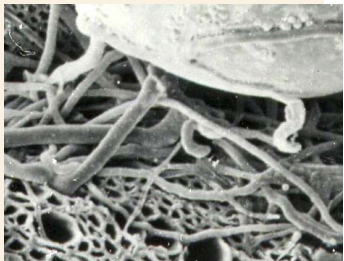
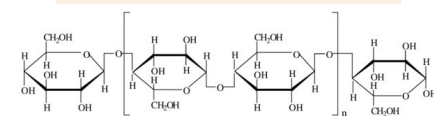
Griscom et al 2017

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 CO₂e

1 mt CO₂e = 1 Carbon Dioxide Removal Certificate (CDR) 2.0-3.2 CDRs/mt Biochar

Co-Products: Green Carbon Markets



Transport

Liquid fuels, Sustainable Aviation Fuels
Renewable Natural Gas
Hydrogen

Energy

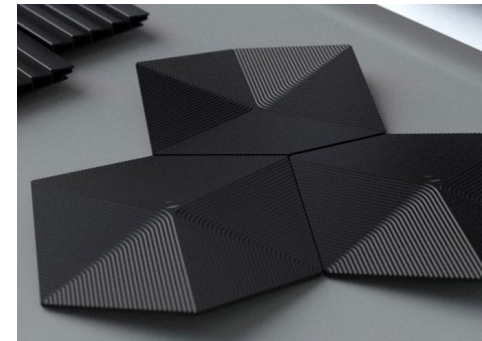
Heat or Steam
Power
Biocarbons

Chemicals

Oils
Cosmetics
Wood vinegar (pyroligneous acid)

Industry

Resins and chemicals, bioplastics



www.madeofair.com

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



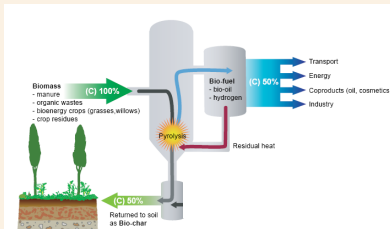
Autothermal Pyrolysis
refined gas, biochar
frontlinebioenergy.com

Hydrogen
RNG
Biochar
Acetic Acid
Polymers



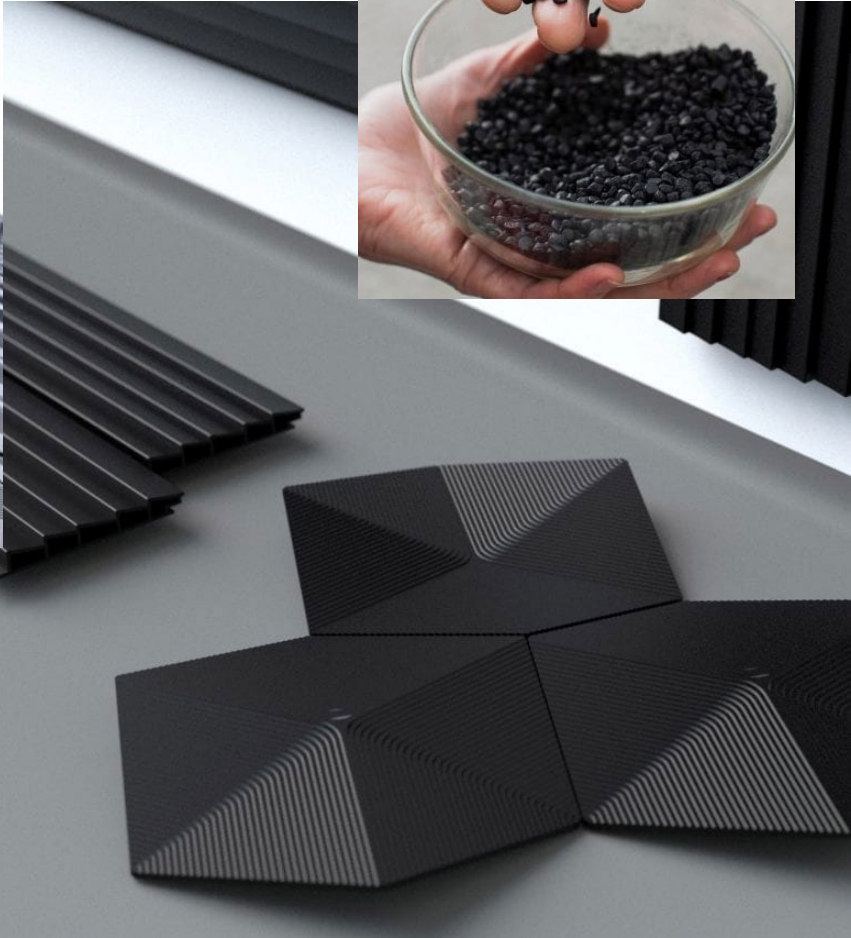
Pyrolysis to biocarbon,
biochar, RNG
chartechnologies.com

RNG
Biocarbon
Biochar





Innovative Biochar Products

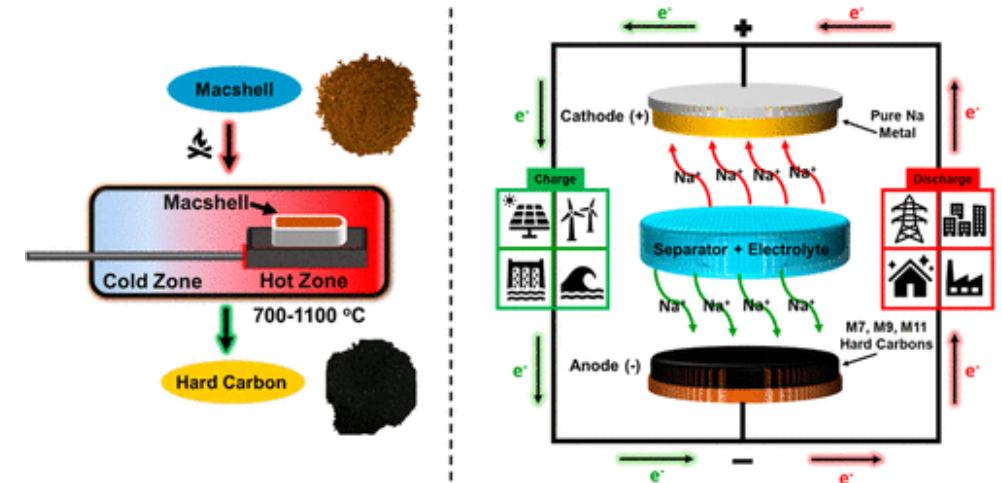


Made of Air
www.madeofair.com
www.dezeen.com/carbon



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

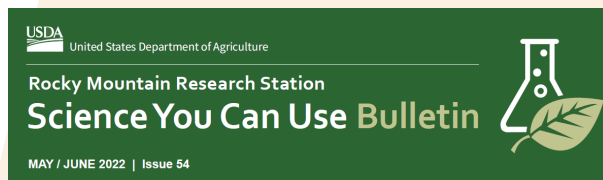
Conferences, Workshops, Demos

Newsletter, Website, Directory

Social Media, Biochar@groups.io

www.biochar-us.org

USBiochar@gmail.com



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



USFS Biochar Basics bit.ly/3Nctv78

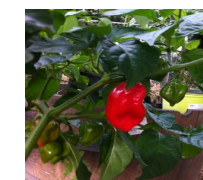
Pacific Northwest Biochar Atlas

www.pnwbiochar.org

USDA ARS, NRCS

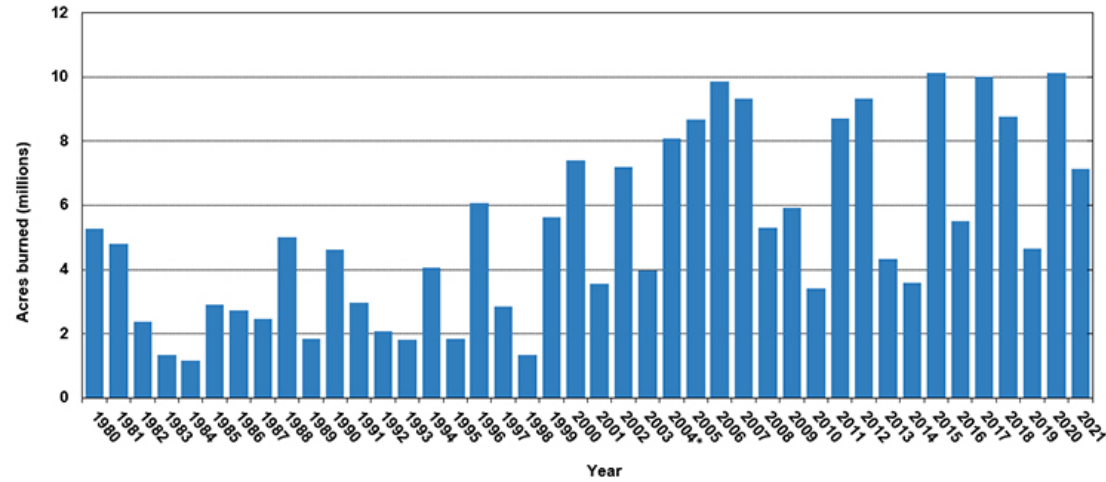
Urban Biochar

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

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



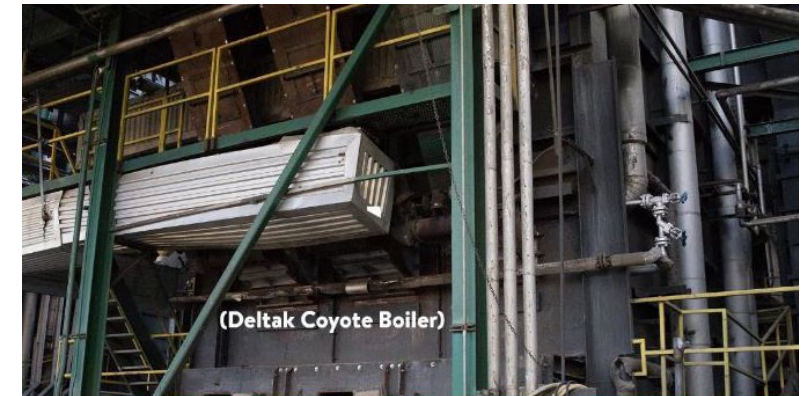
Pyreg 500
Pyreg.de



CharBoss
airburners.com



Biomacn
Biomacn.com



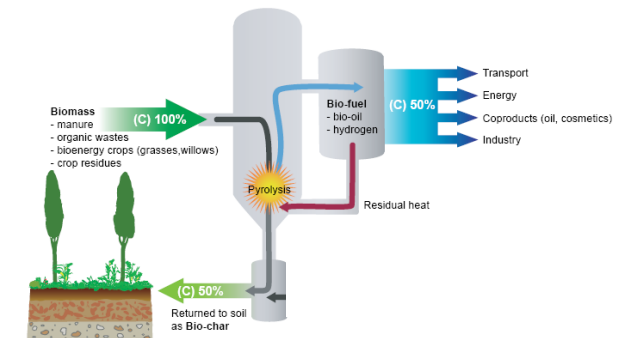
Oregon Biochar Solutions
Chardirect.com

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

US Biochar Initiative biochar-us.org USBiochar@gmail.com

Biochar Listserv www.biochar.bioenergylists.org