

NATURAL CLIMATE SOLUTIONS

David Carlson

Ethics and Ecological Economics Forum

davidcarlson824@gmail.com

- 20 minutes –

Biochar and Related Soil Restoration Solutions

Paul Belanger and Ron Larson

(with contributions from Don Sorenson)

ILIFF School of Theology, Denver CO

March 26, 2018

http://denverclimatestudygroup.com/?page_id=28

Ron Larson

- 12 years studying biochar
- Suggests Entire EEE Forum on this topic
- SO, as geologist/paleoclimatologist – though I've been studying it a few years, I'm hardly a substitute for him

Climate Mitigation Potential in 2030 (Gt CO_{2e} yr⁻¹)



FEBRUARY 26, 2018 WEBINAR

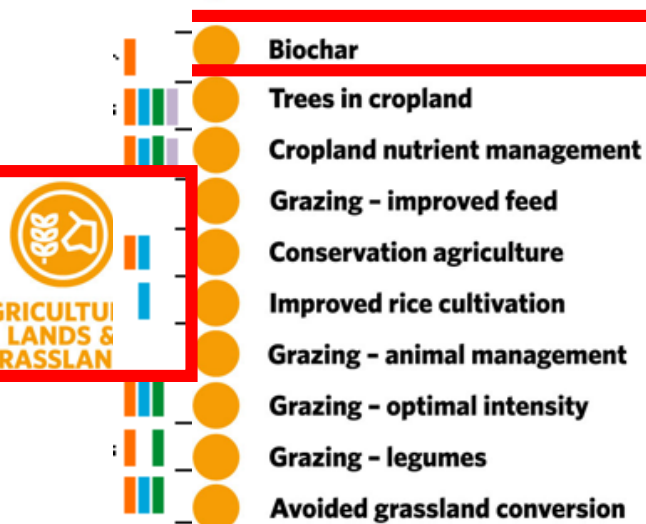


• [Forestry Management and Biochar](#), presented by Dr. Deb Page-Dumroese, Dr. Nate Anderson, and Dr. Ted Bilek and moderated by Kathleen Draper

- [Part I](#) (1.9 MB)
- [Part II](#) (1.9 MB)
- [Part III](#) (1.9 MB)
- [Part IV](#) (884 KB)

Here too:

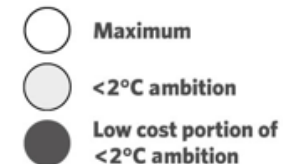
<https://ibi.memberclicks.net/return-to-member-landing-page>



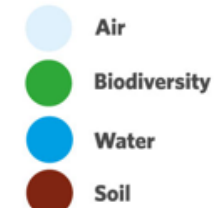
VERY conservative



Climate Mitigation



Other benefits



Here too:

What is Biochar?

1. Main: Biochar is “ordinary” charcoal - after placement in the ground. (Not for combustion.)

2. Also - dozens of other [long-life] uses of charcoal (cattle feed, water quality, construction materials,.....)

3. Terra Preta (1000's of years, Amazon)

http://denverclimatestudygroup.com/?page_id=28

<https://en.wikipedia.org/wiki/Biochar>

BLACK GOLD of the Amazon: http://www.denverclimatestudygroup.com/08-7THMeeting200709-reviewANDTerraPreta/black-gold_DiscoverMag2007.pdf

Author info: http://www.denverclimatestudygroup.com/08-7THMeeting200709-reviewANDTerraPreta/black-gold_DiscoverMag2007authorinfo.pdf

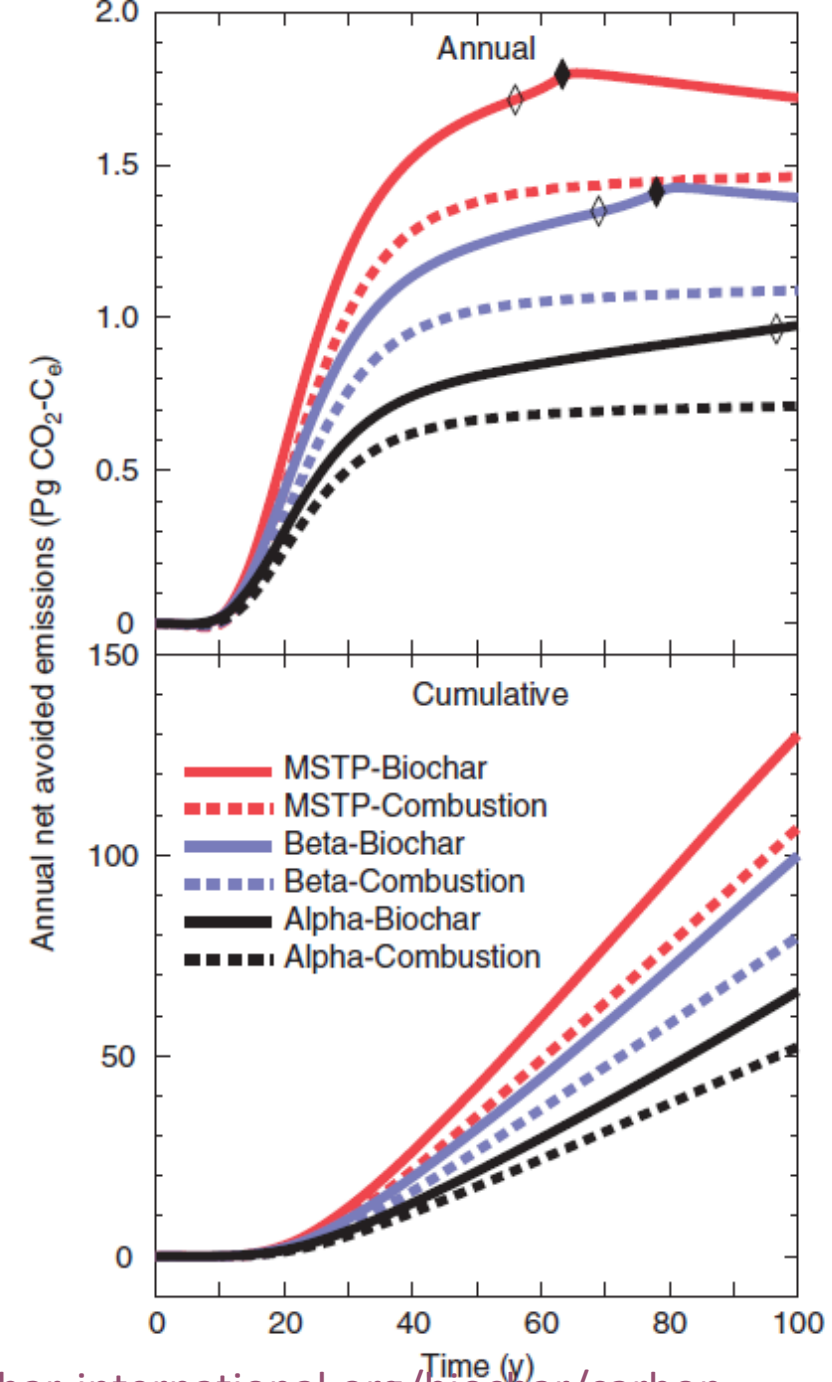
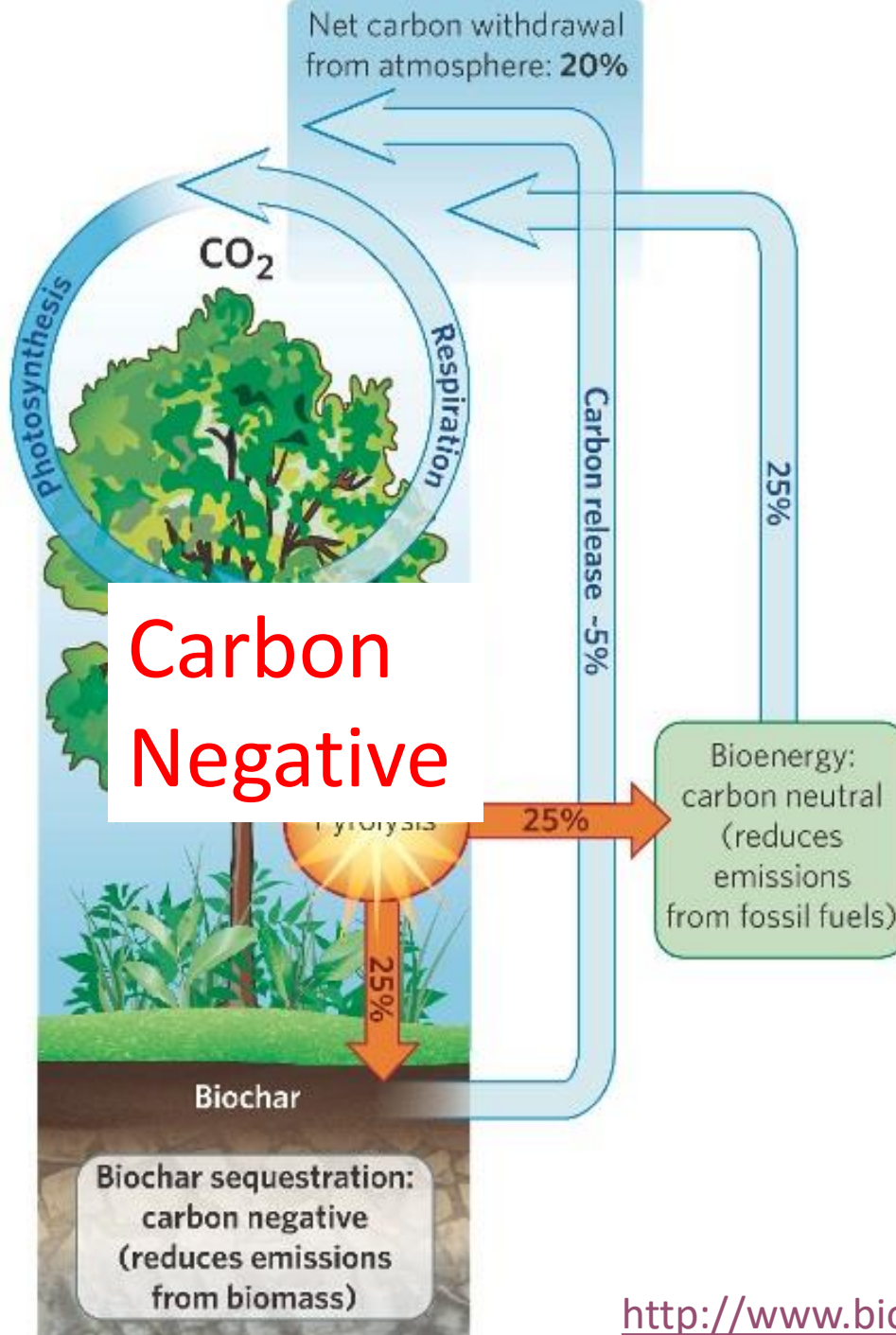
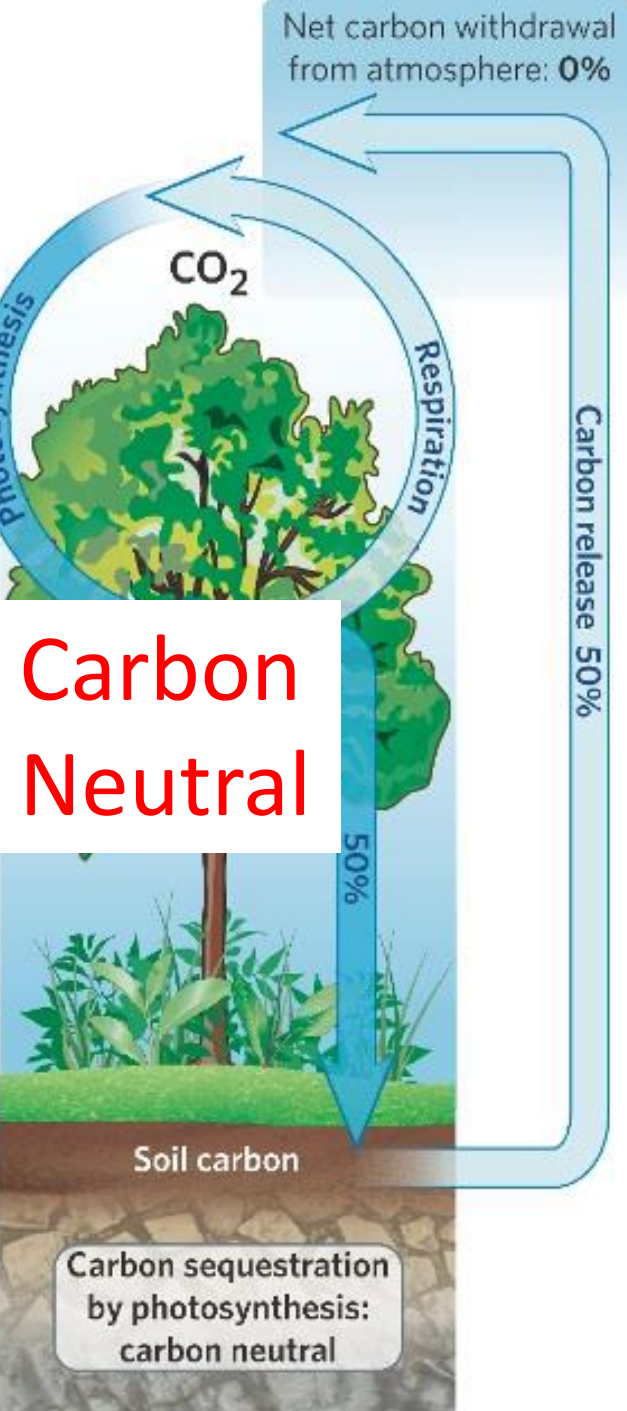
BIOCHAR ATTRIBUTES

- <http://www.biochar-international.org/biochar> : Biochar is produced through pyrolysis or gasification — processes that heat biomass in the absence (or under reduction) of oxygen.
- ATTRIBUTES:
 - resists degradation
 - hold carbon in soils for hundreds to thousands of years. soil enhancer,
 - produce oil and gas byproducts that can be used as fuel, providing clean, renewable energy.
 - When buried in the ground as a soil enhancer, the system can become "carbon negative."

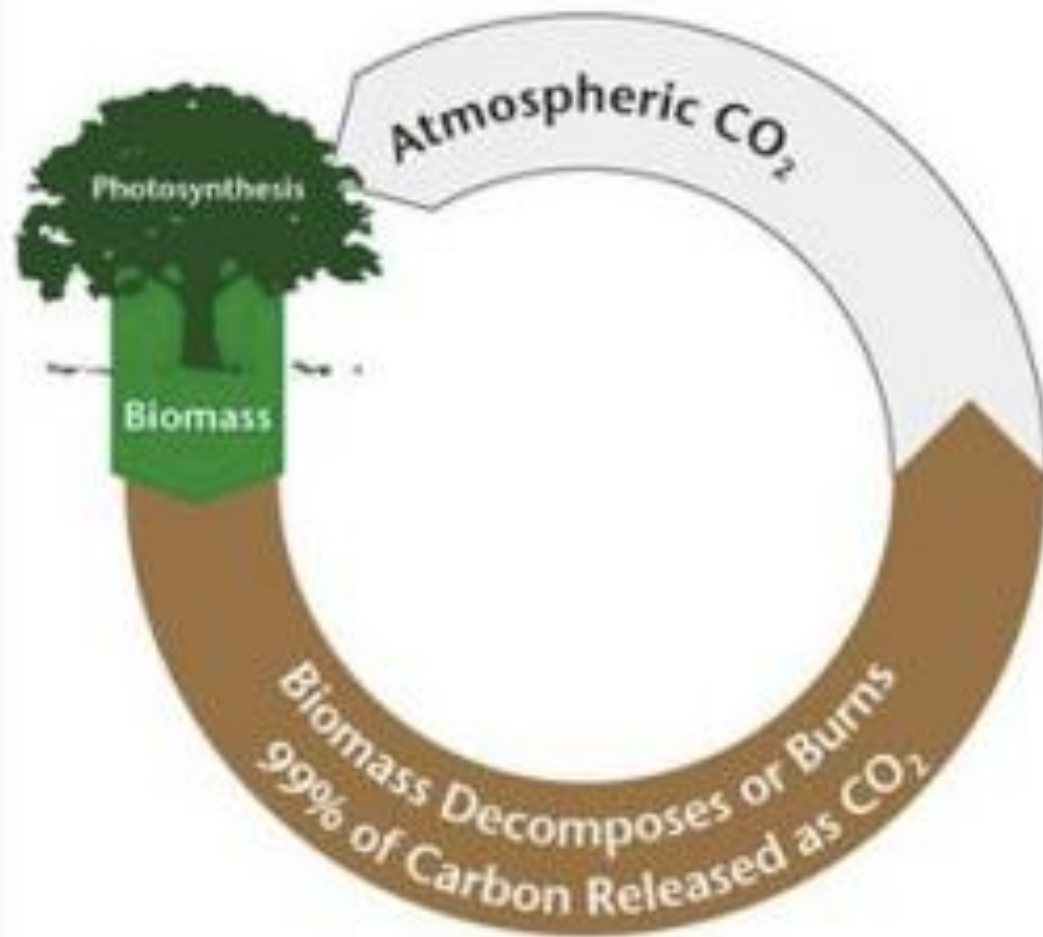
Why is BIOCHAR Important ?

Carbon negativity (CO₂, CH₄, N₂O) - How?

- Fossil fuels are **carbon positive**; they add more carbon dioxide (CO₂) and other greenhouse gasses to the air and thus exacerbate global warming.
- Compost and Ordinary biomass fuels are **carbon neutral**; the carbon captured in the biomass by photosynthesis would have eventually returned to the atmosphere through natural processes like decomposition.
- Sustainable biochar systems can be **carbon negative** by transforming the carbon in biomass into stable carbon structures in biochar which can **remain sequestered in soils for hundreds and even thousands of years**. The result is a net reduction of CO₂ in the atmosphere, as illustrated in the diagram.



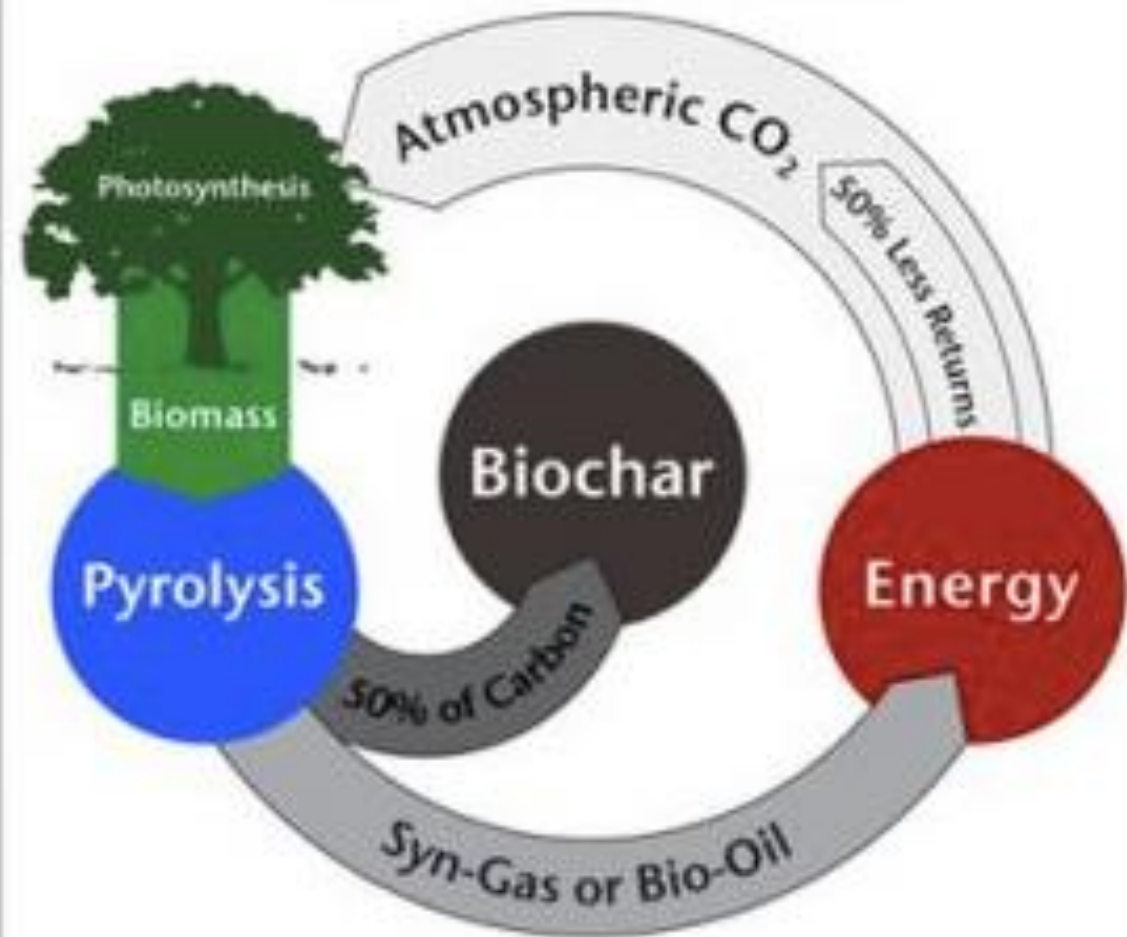
The Carbon Cycle



Almost all of the carbon returns to the air

Green plants remove CO₂ from the atmosphere via photosynthesis and convert it into biomass. Virtually all of that carbon is returned to the atmosphere when plants die and decay, or immediately if the biomass is burned as a renewable substitute for fossil fuels.

The Biochar Cycle



Up to half of the carbon is sequestered

Green plants remove CO₂ from the atmosphere via photosynthesis and convert it into biomass. Up to half of that carbon is removed and sequestered as biochar, while the other half is converted to renewable energy co-products before being returned to the atmosphere.

Renewable Energy?

Producing biochar generates heat, oil and gases



Mitigation?

Locks carbon in the soil and reduces emissions of other Greenhouse Gases

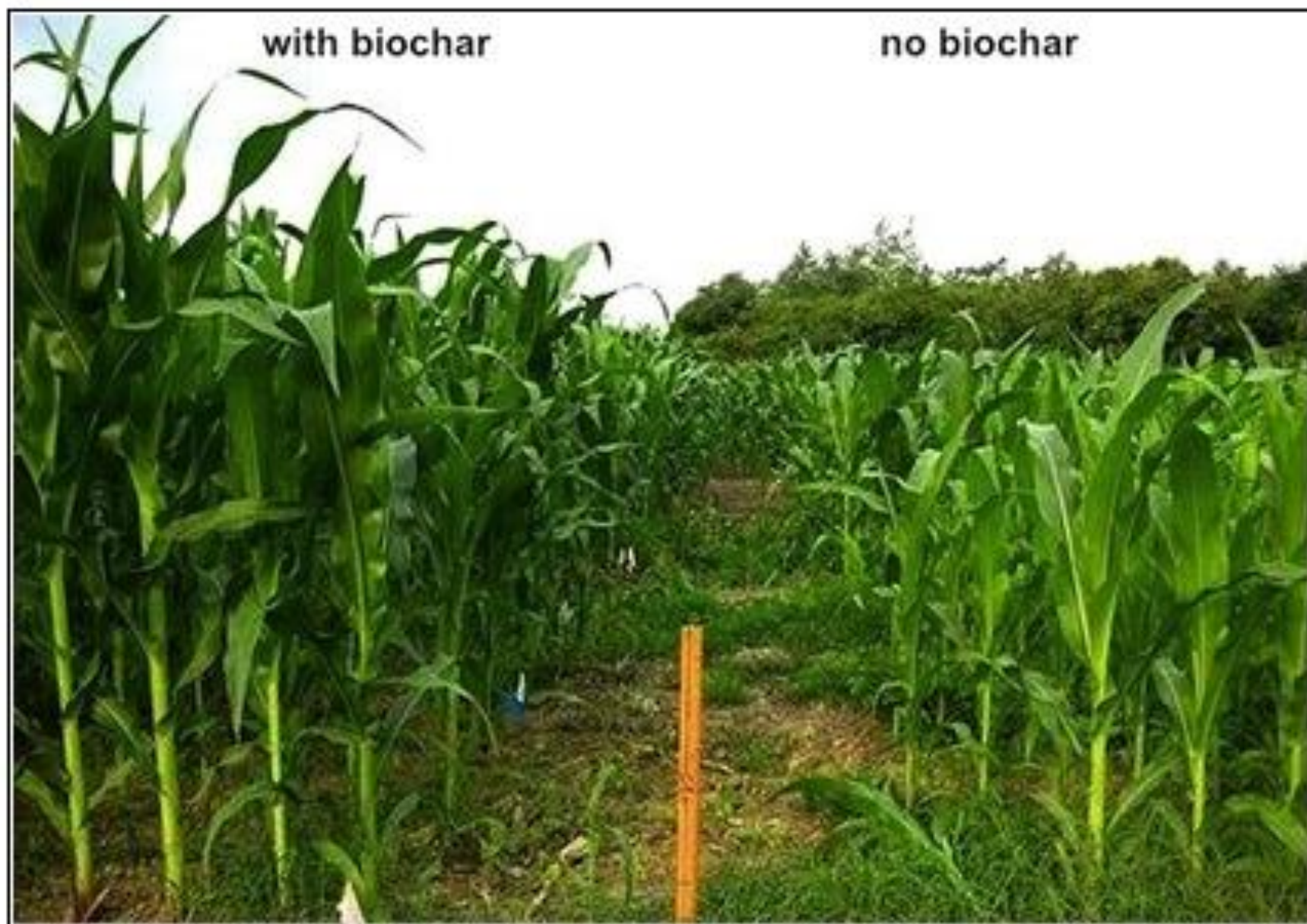


Improving Soils?

Transforming Waste?



Dedicated waste through



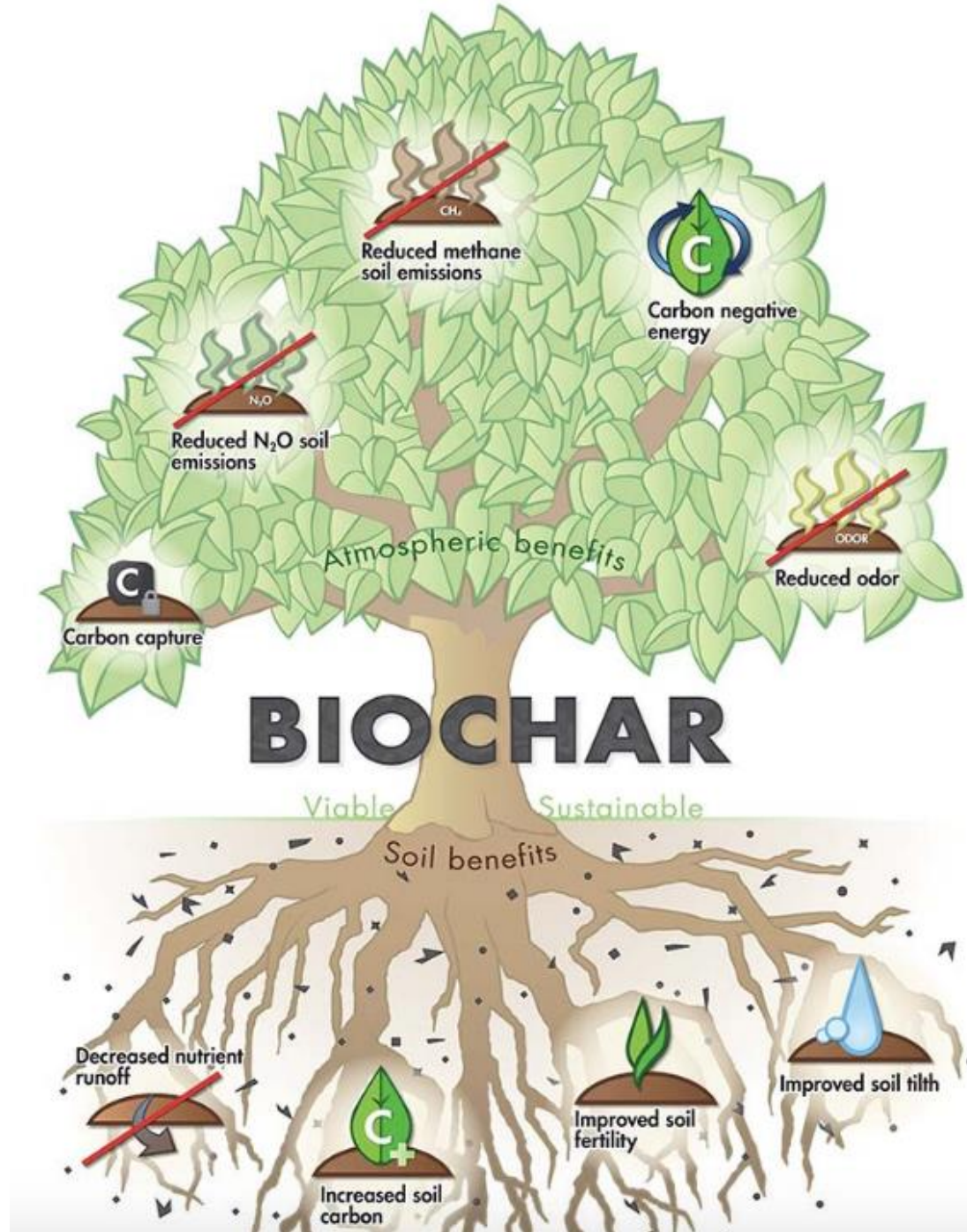
Corn Field Trial, Virginia Tech University

Biochar's greater growth is delivery of nutrients from the Soil Food Web

Why Important ?

- a) Soil & Food (long life in soil, not an expense)
- b) Carbon negativity (CO₂, CH₄, N₂O)**
- c) Energy (solar & woodstove backup, stored energy)
- d) Water quantity/quality
- e) Waste disposal (biogas competitor)
- f) Lowered fertilizer, irrigation costs
- g) Jobs, rural income (and land value)
- h) Forest health (Fires)
- i) Ocean and HTC potential
- j) Other (including sustainability)





BIOCHAR MARKETS



Biochar's long-term benefits to soil proven

12th May 2017 7:00 AM



1 COMMENT



CARBON COPY: The Wollongbar site simulating an intensive dairy pasture used to test biochar's long-term effects upon the soil.

How to Make??

Found under “Pyrolysis, Gasification, Carbonization, HTC, Synthesis gas”

- 1. Stoves (“TLUDs”; metal, ceramic, cleaner, more efficient, 25% char by weight)**
- 2. “World Stove” (down-flow hot nitrogen)**
- 3. “Kon Tiki” (cones, pits “flame caps”)**
- 4. Oil barrels (air separation, control)**
- 5. Convert wood boilers (speed avoids ash)**
- 6. With biofuels (petrol, etc. - Cool Planet)**
- 7. Above, after pelletizing crop residues**

Mobile units:



The smaller batch unit



Where to buy

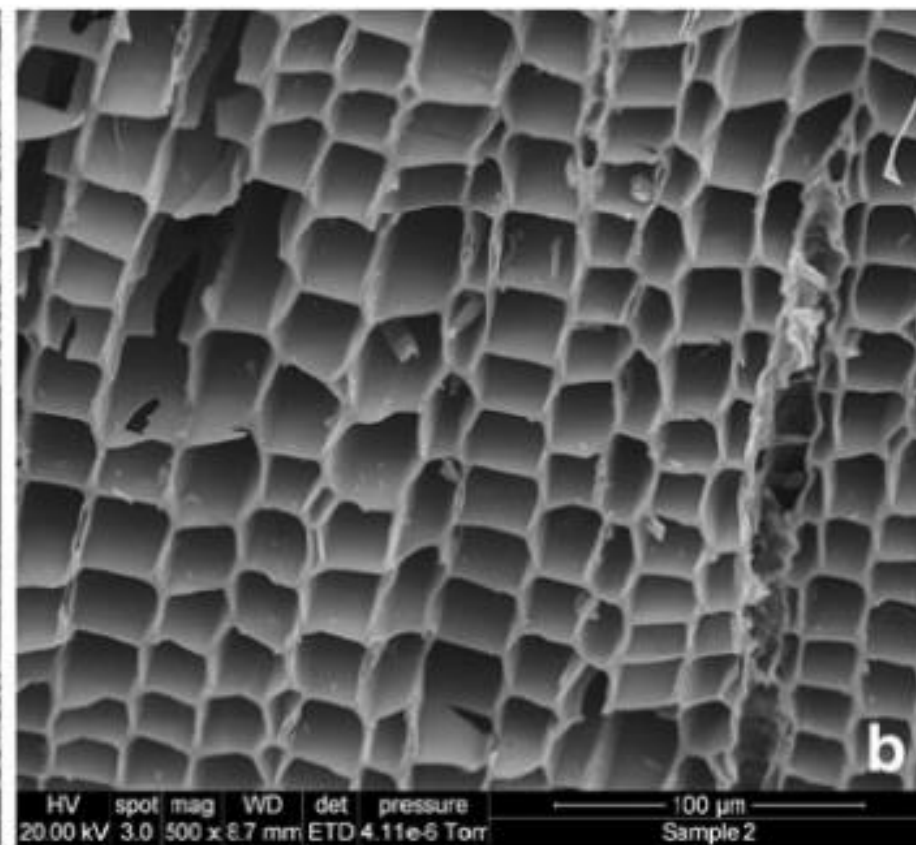
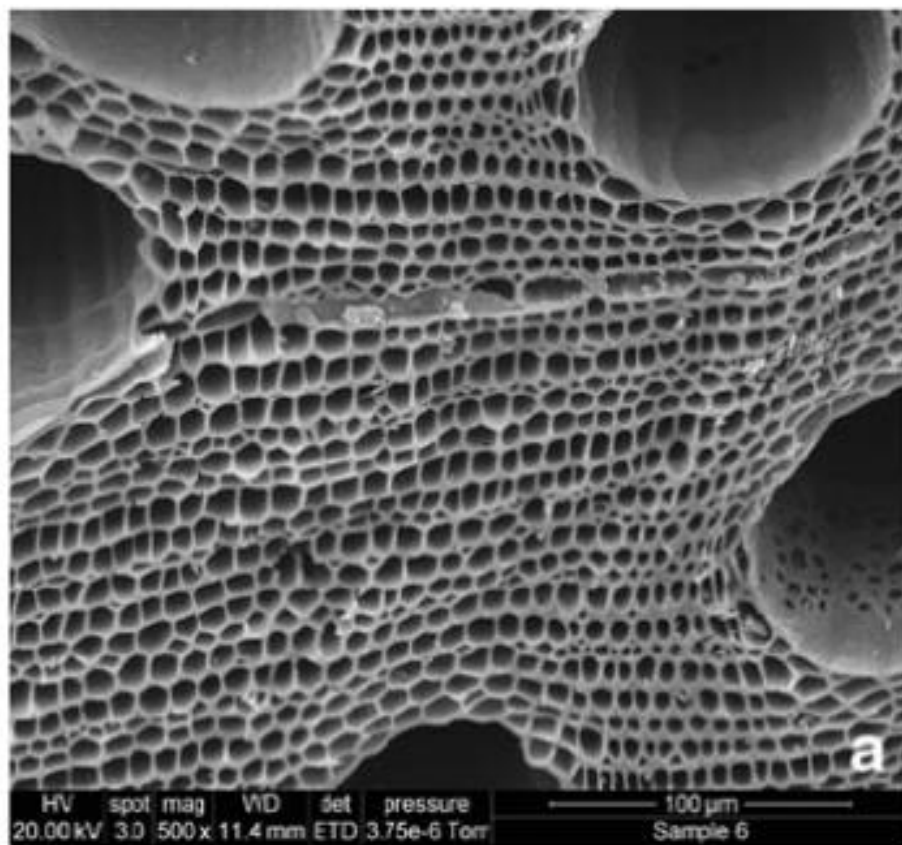
- From Jonah Levine: under the label – **Walden Organics** – based in Walden Colorado Distributed by **Garden Wise** – or direct from **Confluence Energy/Walden Organic**
 - Windy point mountain flowers in Morrison
 - All Colorado Jax home and ranch locations
 - ACW supply – on Bryant in Denver
 - Most Colorado – MURDOCHS locations carry – EcoPett Coop – this is a chicken coop bedding that has biochar in it
 - Dons – Colorado springs
 - Ranch Foods Direct – Colorado Springs
 - Happy Life – Evans
 - Bath Garden Center – Fort Collins
 - Harmony Gardens – Fort Collins
 - Stutz and Copeland – Boulder
 - McConnell Green House – Lafayette
 - Urban Garden Center – Louisville
 - Glenwood Gardens – Glenwood Springs
 - Taddikin Tree Service – Boulder
 - Native Roots – Durango

<http://denverclimatestudygroup.com/wp-content/uploads/2018/03/LocalFrontRangeCO-BIOCHAR-sources.pdf>

http://denverclimatestudygroup.com/?page_id=28

CDR Competitors ? (All expenses - not investments; NOT the SRM part of Geoengineering: “Geo”)

- 1. BECCS (Biomass Energy with Carbon Capture and Sequestration [“Clean Coal”] liquid, high pressure, deep underground)**
- 2. DAC (Direct Air Capture of 400 ppm CO₂)**
- 3. Convert rocks to carbonates**
- 4. Ocean chemistry (bicarbonates)**
- 5. Ocean biomass**
- 6. Land management (afforestation, cattle, no till, etc.)**





www.permaculture.co.uk



International Biochar Initiative

Why Biochar?
learn more >>

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WHAT IS BIOCHAR?

- [Terms and Definitions](#)
- [FAQs](#)
- [Biochar and Soils](#)
- [Production Technology](#)
- [Climate Change and Biochar](#)

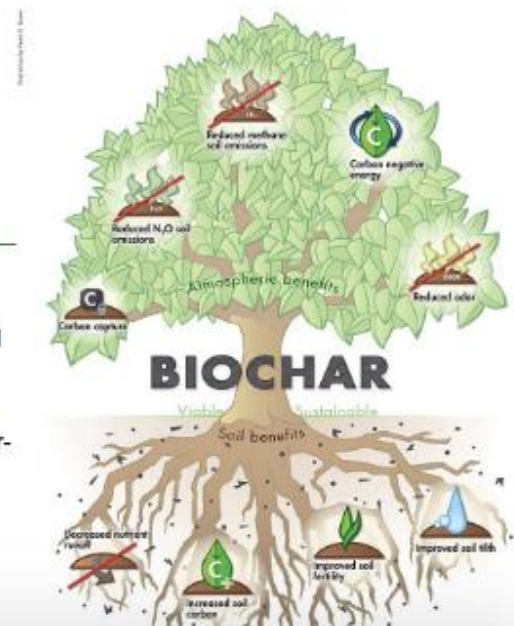
<http://www.biochar-international.org/>

Biochar Is a Valuable Soil Amendment

This 2,000 year-old practice converts agricultural waste into a soil enhancer that can hold carbon, boost food security, and increase soil biodiversity, and discourage deforestation. The process creates a fine-grained, highly porous charcoal that helps soils retain nutrients and water.

Biochar is found in soils around the world as a result of vegetation fires and historic soil management practices. Intensive study of biochar-rich dark earths in the Amazon (terra preta), has led to a wider appreciation of biochar's unique properties as a soil enhancer.

Biochar can be an important tool to increase food security and cropland diversity in areas with severely depleted soils, scarce organic resources, and inadequate water and chemical fertilizer supplies.



Biochar-international resources

- Newsletters
- Monthly list of publications (e.g. March = 21 pages)
- Monthly Webinars
- Bibliography
- Training
- Publications
- Networking

Ron's FAVORITE BIOCHAR WEB RESOURCES

Once or more per day: biochar@yahoogroups.com

CarbonDioxideRemoval@googlegroups.com

info2@carbonbrief.org

stoves@lists.bioenergylists.org

2. Once or more per week: www.biochar-international.org

www.biochar-journal.org/en/

Biochar in Colorado - background

NREL – (National Renewable Energy Lab) Golden has large biomass staff (+ pyrolysis)
www.nrel.gov

CU-B hosted the first US Biochar Conference (2009)

CSU has knowledgeable staff (soils, pyrolysis)

CSU NREL – Natural Resource Ecology Lab <https://www.nrel.colostate.edu/>

Producers - three major biochar

(Cool Planet, Confluence energy, Biochar Now)

USFS - largest(?) contract (CSU - NREL- BANR)

(Biofuels from beetle kill - some biochar)

Legislation - first state re biochar (SJR - 17 - 002)

(Forests, fire fighting, beetle kill - Unanimous)

New Biochar for Colorado - Option #1

A cost-effective municipal system

(combined heat & power, waste management,
biochar for use and sale, reduced irrigation, fertilizers.)

Proven success in Stockholm, Sweden: STOCKHOLM BIOCHAR STUDY TOUR - PRESENTATIONS

(US expertise is good - IBI webinar) <http://www.biochar-international.org/node/8940>

Would be the first in US

(Good PR for state - which is already on record))

Many cities probably ready

(Boulder, Denver, Ft. Collins, Lakewood, Pueblo)

Biochar for Colorado - Option #2a

State Incentive - (possibly popular) for CDR = NET
new, might be called “NET-FIT”

NET = Negative Emission Technology
applicable for about 6 different approaches
biochar likely to be cheapest
same as CDR = Carbon Dioxide Removal
or GGR = Greenhouse Gas Removal

FIT = Feed-In Tariff
Main past incentive in Germany
Subsidy - not a tax / fee; not a dividend
Need not be national
Funds from end-users of all forms of energy

Biochar for Colorado - Option #2b, cont'd

Private, not Governmental investment

Payments - investors respond to fixed price

- Units = tonnes C, possibly \$30-\$50/t C to start
 - value can change any time, per perceived need.
 - can start immediately and small

Some Detail - payment to Investors mostly as

- annual, fixed term, tax credits
- biochar unusual in having out-year benefits
- not regressive
- nothing forced, entirely optional



International Biochar Initiative

<http://www.biochar-international.org/>



- Some of us interested in going to CSU?
- Might be better to Join \$40-\$75+: <http://www.biochar-international.org/join>
- Not ready? Newsletter: https://ibi.memberclicks.net/index.php?option=com_mc&view=mc&mcid=form_102947

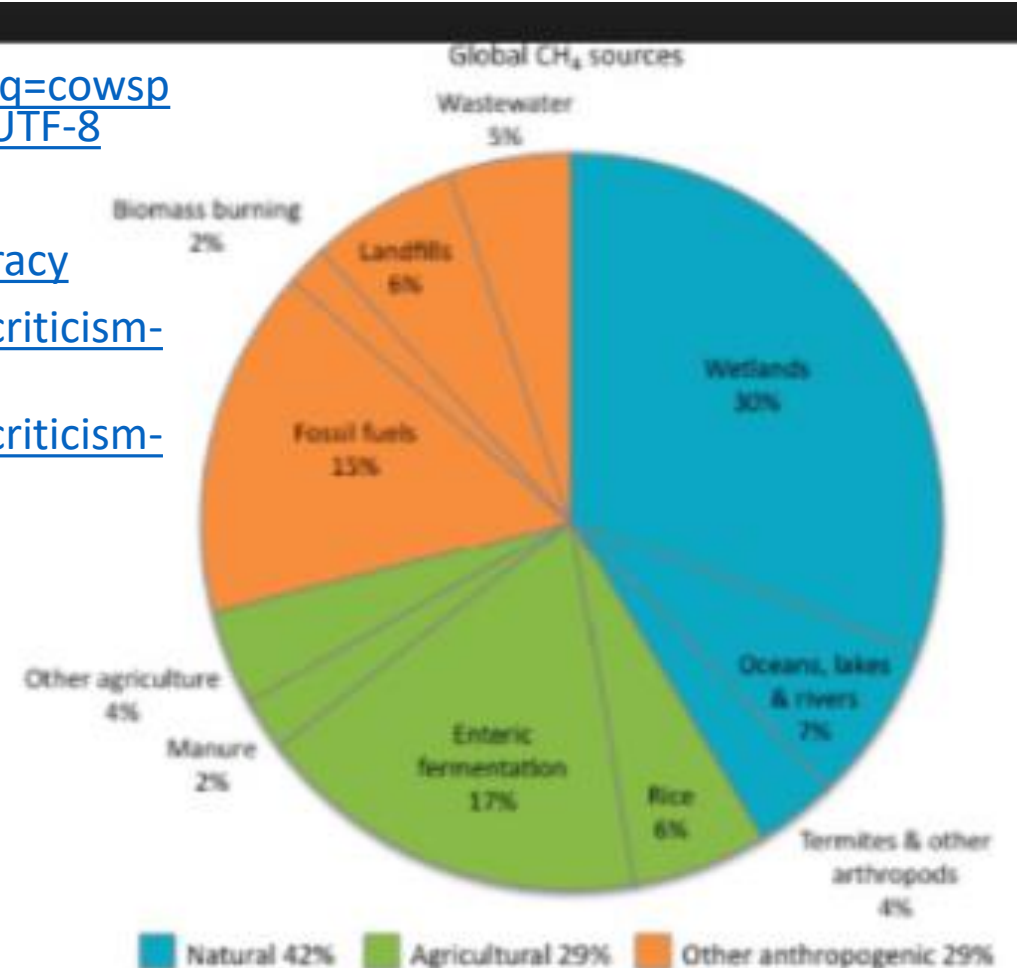
Agricultural Controversies

- **COMPLEX**
- **BIOCHAR UNDERAPPRECIATED**
- **FARM MANAGEMENT ISSUES**
- **AGRO-CHEMICAL INDUSTRY DOMINATES**
- **SOIL DEPLETION ISSUE**
- **RESTORE SOILS**

Enteric methane produces ~ 25% methane

- <https://www.google.com/search?q=cowspiracy+summary&oq=cowspiracy&aqs=chrome.4.69i57j0l5.9491j0j7&sourceid=chrome&ie=UTF-8>
- <https://www.quora.com/How-accurate-is-the-movie-Cowspiracy>
- <http://www.cowspiracy.com/blog/2015/11/23/response-to-criticism-of-cowspiracy-facts>
- <http://www.cowspiracy.com/blog/2015/11/23/response-to-criticism-of-cowspiracy-facts>

<https://www.sciencedirect.com/science/article/pii/S0022030214002896>



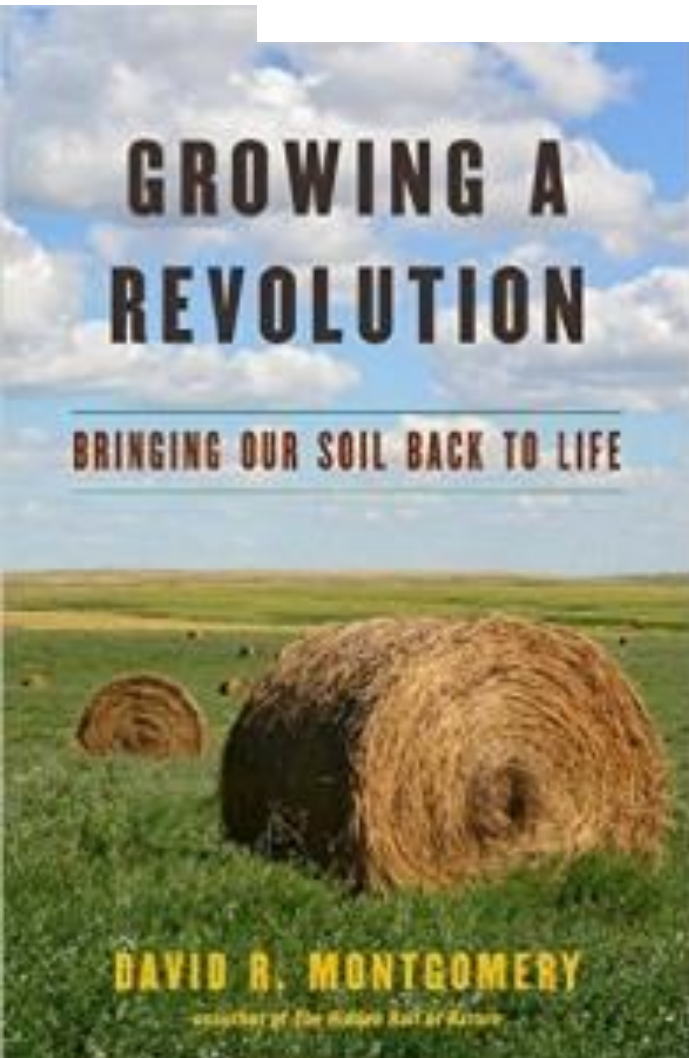
Updated Biochar Webpage

- http://denverclimatestudygroup.com/?page_id=28
- Lists:
 - Colorado New
 - Links
 - Videos
 - Resources
 - Plant types

2017 Colorado Senate Bill

- Senate Bill on Biochar that Ellen Roberts had passed with Ron Larson help (he says 5% of credit – he certainly supported) –
- https://leg.colorado.gov/sites/default/files/documents/2017A/bills/2017a_sjr002_signed.pdf
- <https://durangoherald.com/articles/102888>

New book by UW's David R. Montgomery addresses how to rebuild Earth's soils



- PUT CARBON IN GROUND: IDEALLY 5-8% BIOCHAR WITH COMPOST/OTHER ORGANIC MATTER
- NO TILL - to allow soil to stabilize
- COVER: to control weeds
- ROTATE CROPS: to control pests

<http://www.washington.edu/news/2017/05/02/new-book-by-uws-david-r-montgomery-addresses-how-to-rebuild-earths-soils/>

Podcast with Dr. David Montgomery, U. Washington



Reversing Climate Change « »

12: Dr. David Montgomery, Geomorphologist at UW

4 weeks ago 44:20 🔒

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By Nori. Discovered by Player FM and our community — copyright is owned by the publisher, not Player FM, and audio streamed directly from their servers.

Modern conventional agriculture is destroying our soil. At the rate we're going, we will lose one-third of our agricultural production capacity in the

<https://player.fm/series/reversing-climate-change/ep-12-dr-david-montgomery-geomorphologist-at-uw>

Science Tech Natural Sciences

Blockchain Carbon Change

COLORADO STATE UNIVERSITY – Biochar experts (some)

- Professor Thomas Borch (et. al.) : <https://source.colostate.edu/carbon-coating-gives-biochar-garden-greening-power/>
 - CSU fact sheet on biochar: <http://extension.colostate.edu/topic-areas/agriculture/biochar-in-colorado-0-509/>
- Professor Cotrufo (co-author of the fact sheet): <http://soilcrop.agsci.colostate.edu/faculty-2/cotrufo-m-francesca/>
 - Ongoing research: <https://www.nrel.colostate.edu/investigator/francesca-cotrufo-homepage/francesca-cotrufo-research/>
 - CSU NREL involved
 - She expresses and interest in public outreach
- Jim Ippolito is an associate professor also involved in biochar: <http://soilcrop.agsci.colostate.edu/faculty-2/ippolito-jim/>
 - current research: https://www.researchgate.net/profile/Jim_Ippolito2
- CSU has a mobile Pyrolysis they have been demonstrating, events on this link are all in the recent past:
 - http://tamariskcoalition.org/sites/default/files/files/pyrolysis_event_flyer.pdf

EEE Forum Announcements, Archives and Slides

The screenshot shows the Denver Climate Study Group website. A red box highlights the URL `denverclimatestudygroup.com/?page_id=683` in the browser's address bar. A red arrow points from this box to the 'Ethics and Ecological Economics Forum (EEE)' link in the navigation menu, which is also highlighted with a red box. Another red arrow points from the menu link down to the main heading 'Ethics and Ecological Economics Forum (EEE)'. Below the heading, the text 'THIS PAGE WAS UPDATED 3/7/2018' is displayed. A red announcement reads: '2018 – SAVE THE DATE: MONDAY March 26TH: CO2 Removal and Nature Conservancy presentation by Betsy Neely'. At the bottom, the text 'NATURAL CLIMATE SOLUTIONS' is visible.

denverclimatestudygroup.com/?page_id=683

Meetup AHPS Precipitation A WxCoder III - observe CoCoRaHS - Commu Ethics and Eco

Denver Climate Study Group

Climate: past, present & future and associated contemporary issues

Home Climate: ▾ OLLI courses: ▾ Biochar Ethics and Ecological Economics Forum (EEE) IPO

Ethics and Ecological Economics Forum (EEE)

THIS PAGE WAS UPDATED 3/7/2018

2018 – SAVE THE DATE: MONDAY March 26TH: CO2 Removal and Nature Conservancy presentation by Betsy Neely

NATURAL CLIMATE SOLUTIONS

ANNOUNCEMENT – CRES April 26th, 2018

<https://www.cres-energy.org/>



Monthly Energy Speaker Series
JUC Green Task Force, New Energy Colorado
and the
Colorado Renewable Energy Society
CRES, Jeffco Chapter, 1712 Rimrock St, Golden, CO 80401



Jonah Levine, Confluence Energy



How Manmade Coal Removes CO₂ and Improves Soil

Th, April 26, 7pm

Jefferson Unitarian Church 14350 W. 32nd Ave, Golden (Applewood)

<https://www.meetup.com/J-CRES/events/248477906/>