

The Case for Soil Restoration with the Use of Biochar

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Truth In Action with Unitarian
Universalists - 24 Hours of Reality

<https://www.facebook.com/events/441689836539682/>

UU Whidbey, Island County, WA

<https://uucwi.org/>

Introductions

- Ph.D. Brown University
- Research Background in Paleoclimatology / Paleoceanography
- 12 years Denver Climate Study Group Forum and Web page
 - <https://denverclimatestudygroup.com/>
 - After 2 years went to yahoo list email group
 - Web page morphed to:
 - OLLI Courses
 - Biochar - https://denverclimatestudygroup.com/?page_id=28
 - Ethics and Ecological Economics in Denver / ILIFF - <https://eeeforum.org/>
 - other

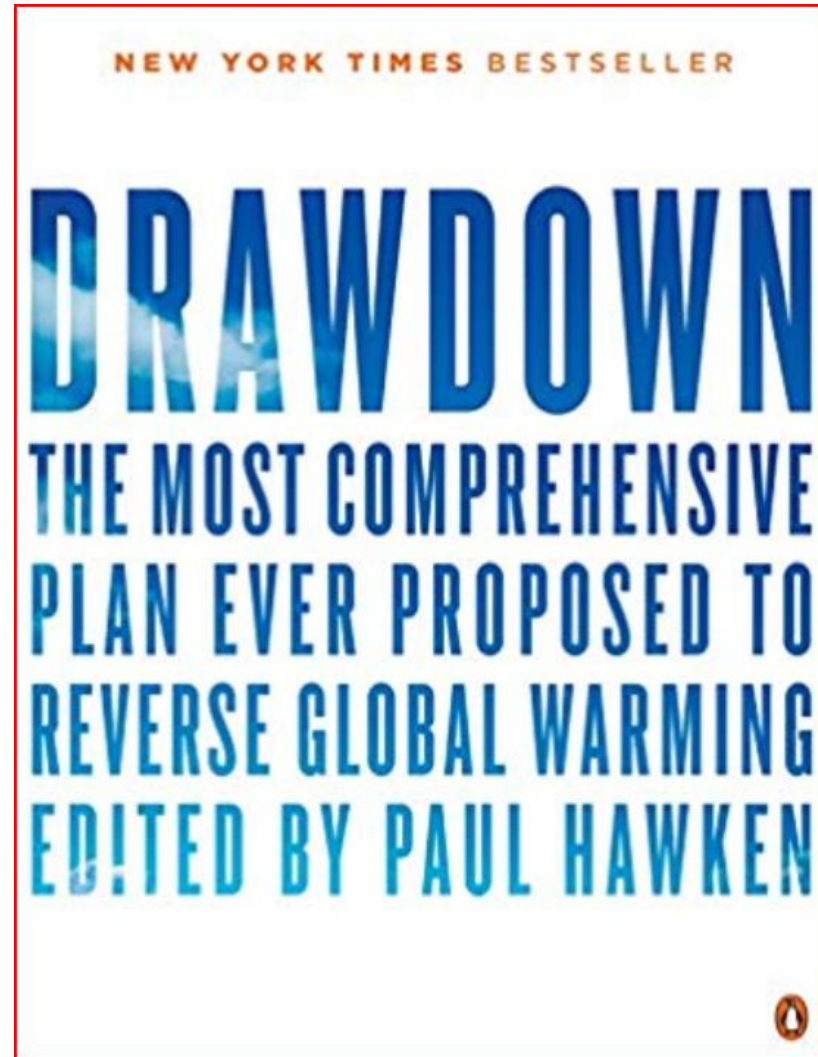
THIS TALK TO FOCUS ON

BIOCHAR

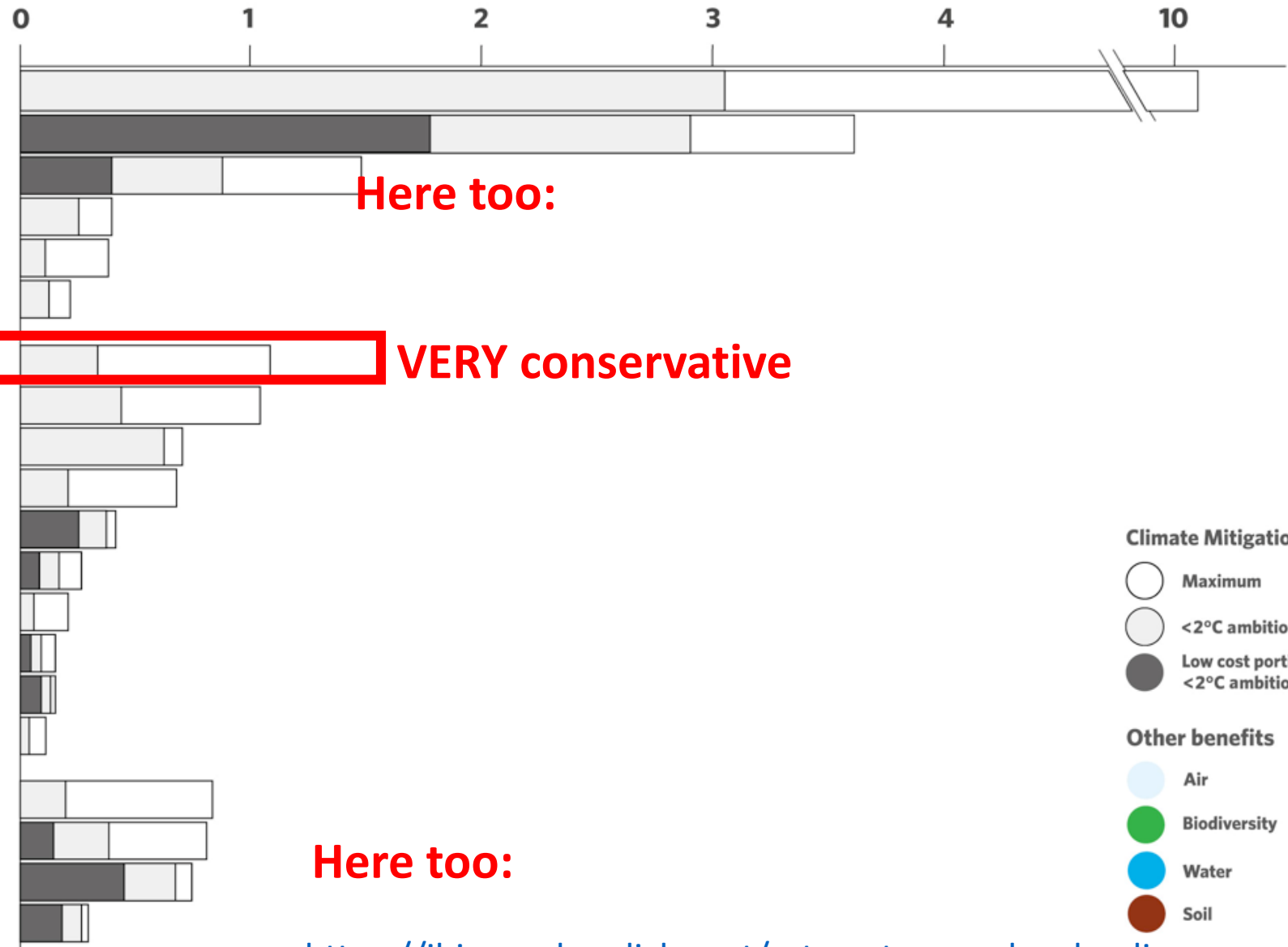
= SEQUESTRATION

= CO₂ REMOVAL (CDR)

Popular Book by Paul Hawken (editor) DRAWDOWN



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



Here too:

VERY conservative

Here too:

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

Climate Mitigation

- Maximum
- <2°C ambition
- Low cost portion of <2°C ambition

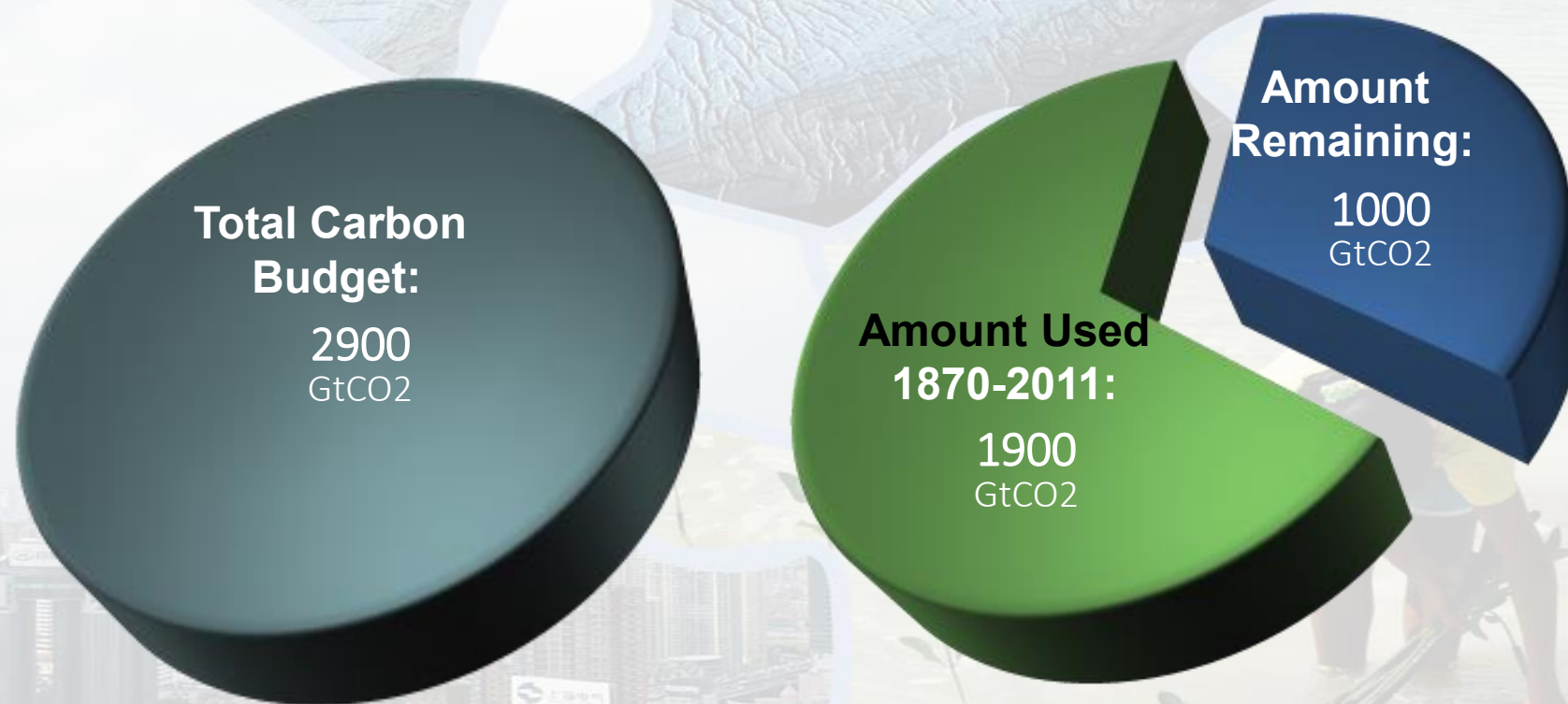
Other benefits

- Air
- Biodiversity
- Water
- Soil

If you are Wondering WHY

WHY: The window for action is rapidly closing

65% of our carbon budget compatible with a 2°C goal already used

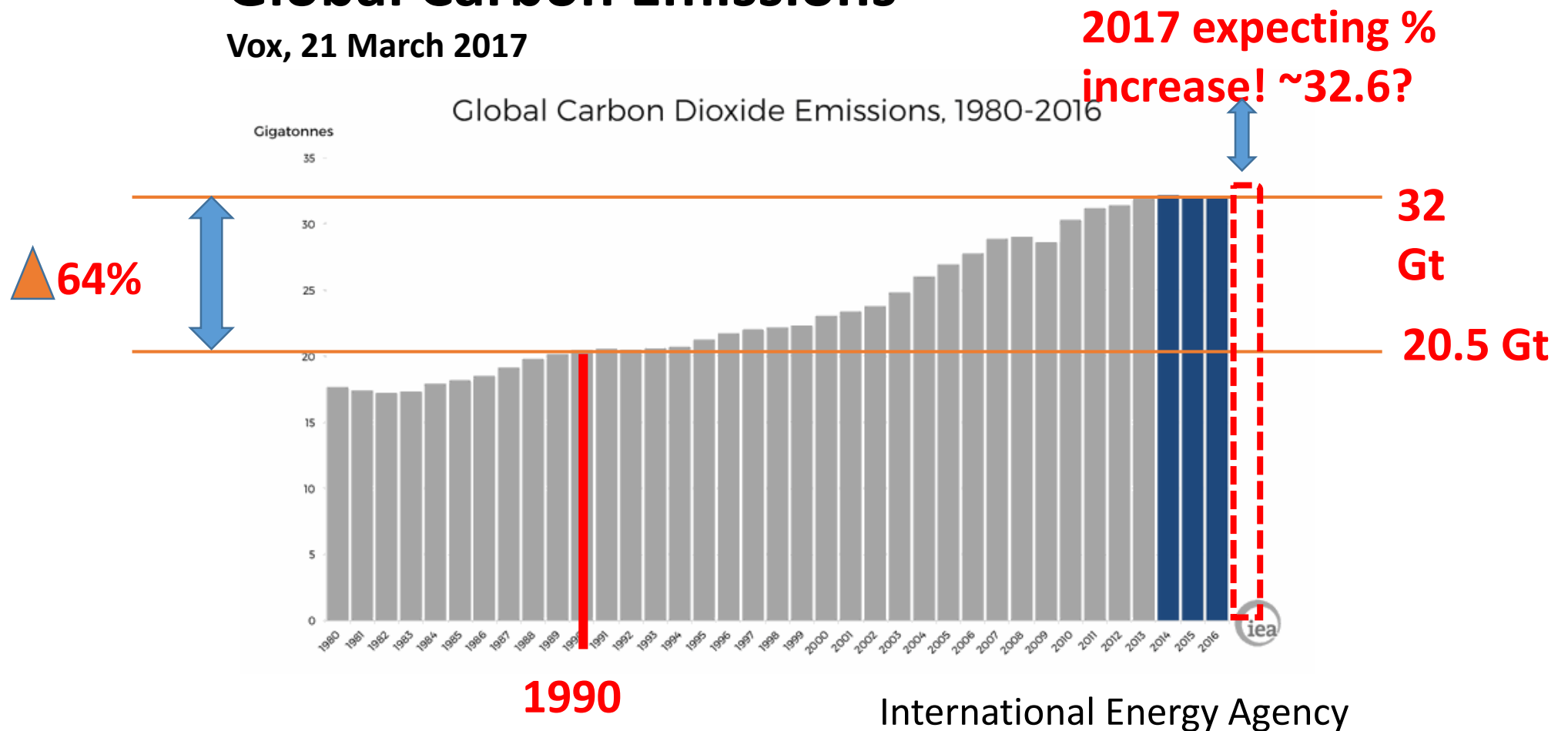


AR5 WGI SPM

CO₂ Emissions Continue to Rise

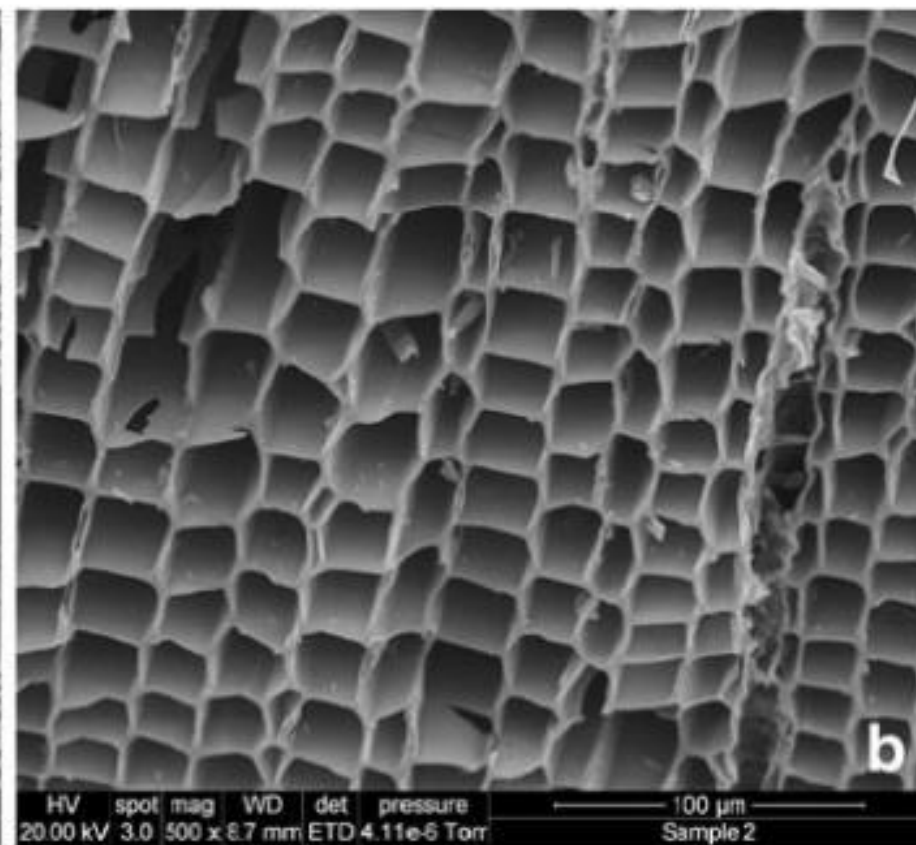
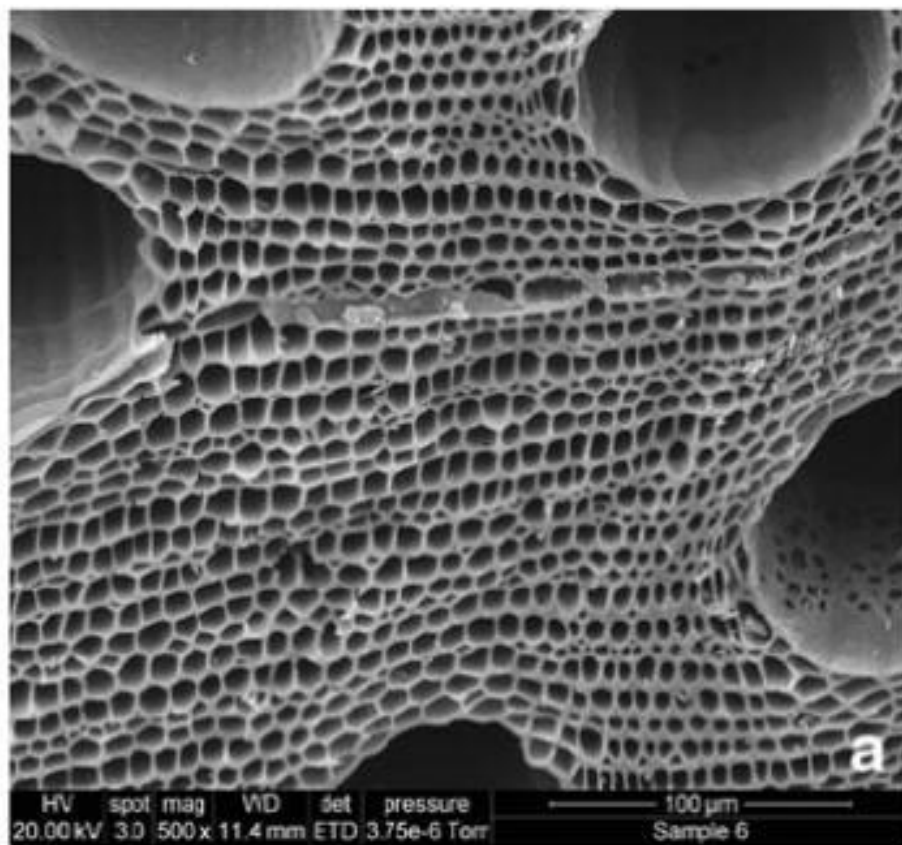
Global Carbon Emissions

Vox, 21 March 2017



So, 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)**





www.permaculture.co.uk

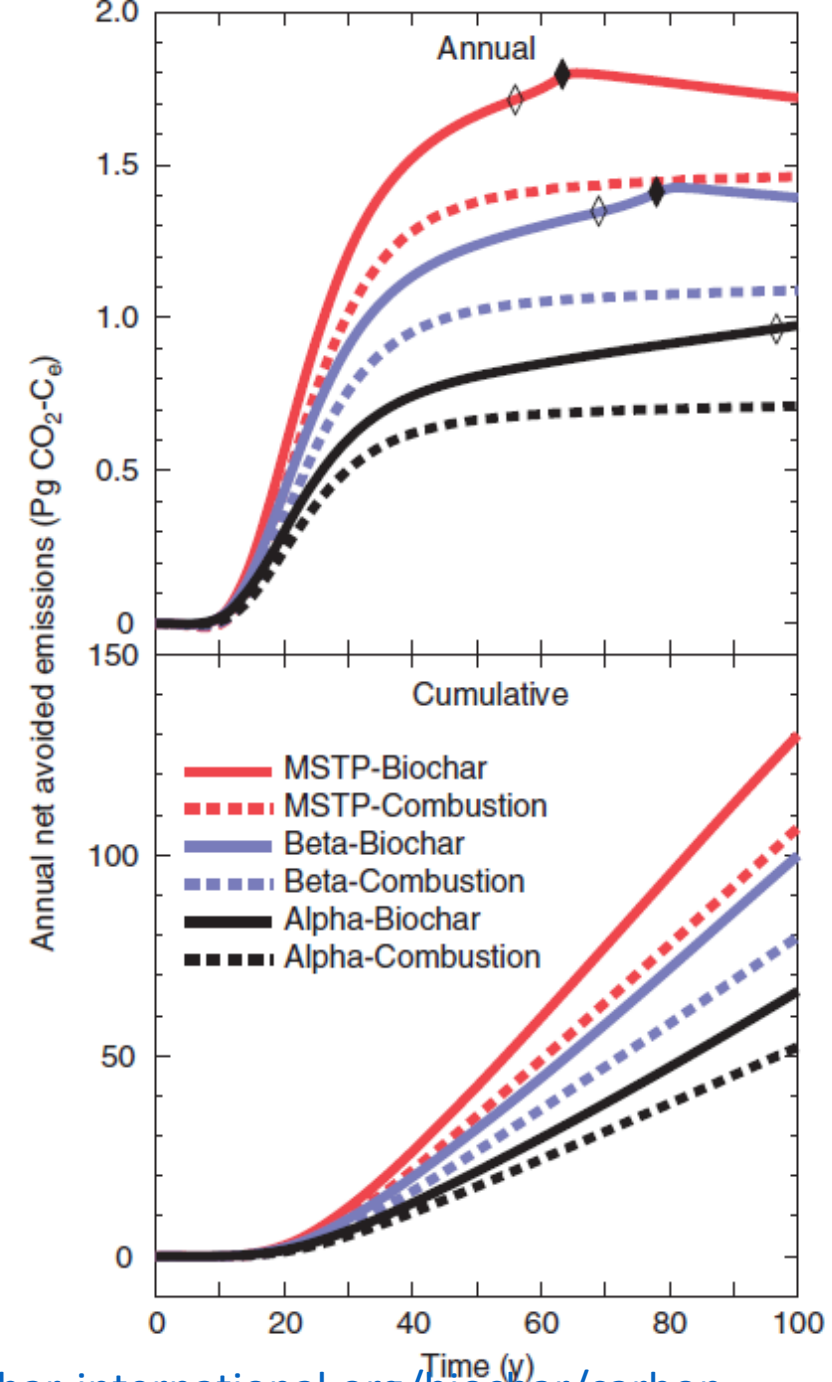
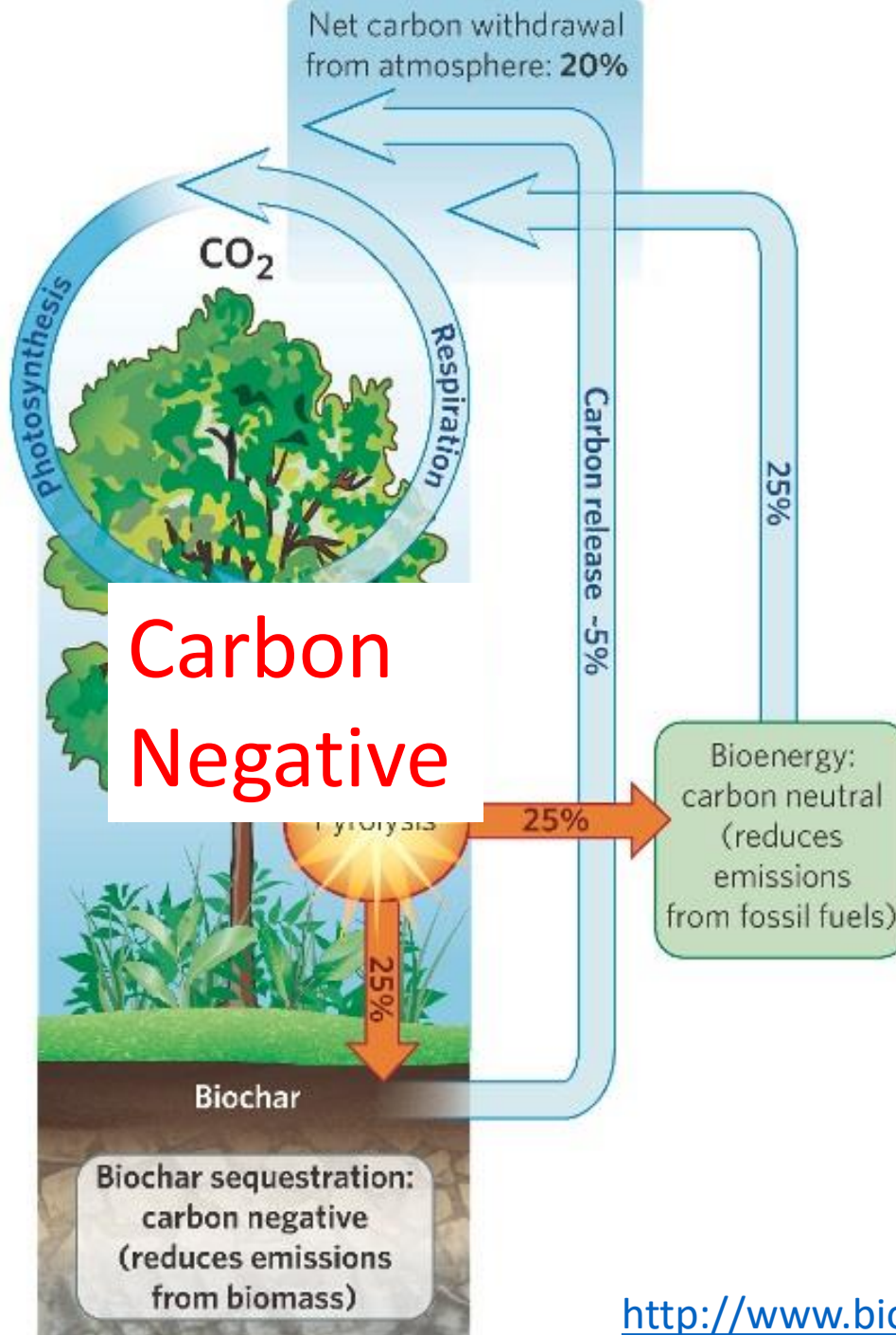
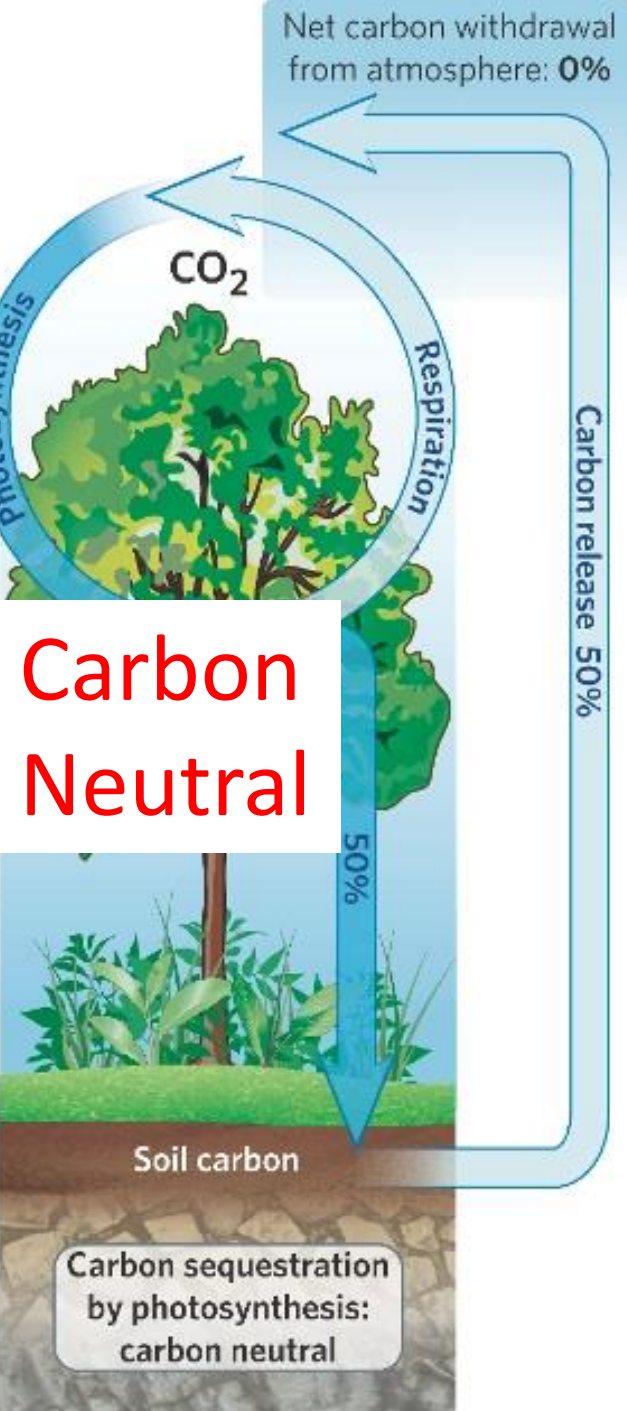
Buried in the Soil it looks like this:



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.



Thermal decomposition of organic matter

Oxidation

Carbon combines with oxygen, and is driven off as CO and CO₂
(NO₂, NO₃, and other oxides also form)

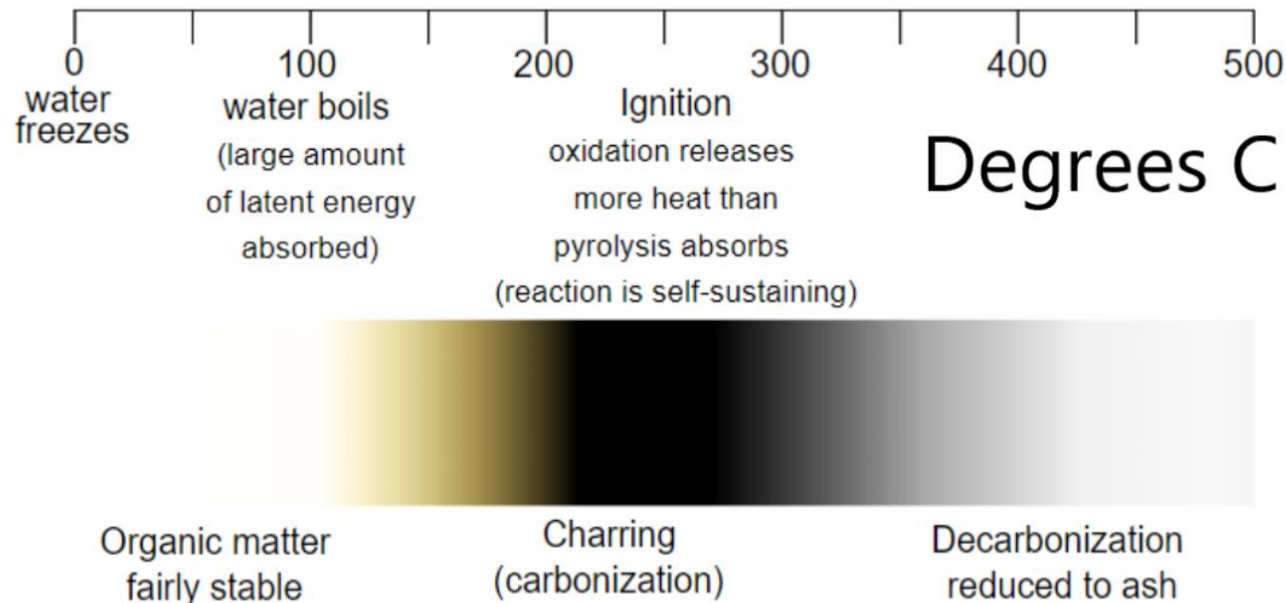
Pyrolysis

("fire-breakdown")

Organic molecules are chemically altered, then mostly driven off

Evaporation and Vapourization

Volatiles are driven off, but not chemically altered



Combustion of Burning Wood

Pyrolysis that makes Biochar - Volatile gases start evaporating at 260 C.

Pyrolysis occurs before combustion at approximately 450 C. Mostly CH_4 and CO and H_2

Incomplete combustion **does not burn all the gases and creates smoke.**

Complete combustion we are completely **burns all the gases** coming off the wood.

Basic Composition of Wood

60% is Synthetic oil or **Syn-Oil**

Need complete Combustion of Syn –Oil
Chemically this is an Oxidizing Flame

10% is Synthetic gas or **Syn-gas**

Need Pyrolysis (or incomplete)
combustion here

30% can be made into **Biochar**

Save and use the biochar
Chemically is a Reduction Flame

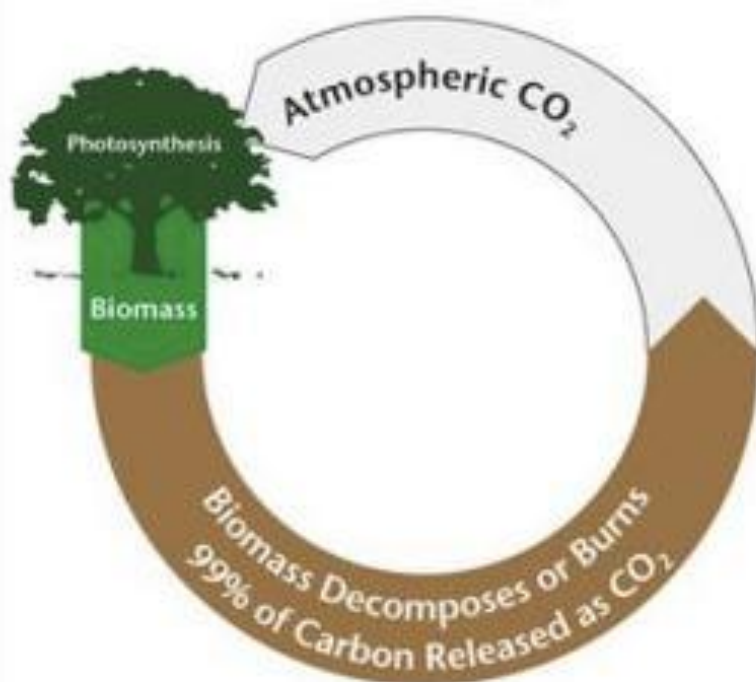
This is the problem and the question.

How do we save the biochar and have complete combustion?

Slide courtesy of Norm Baker



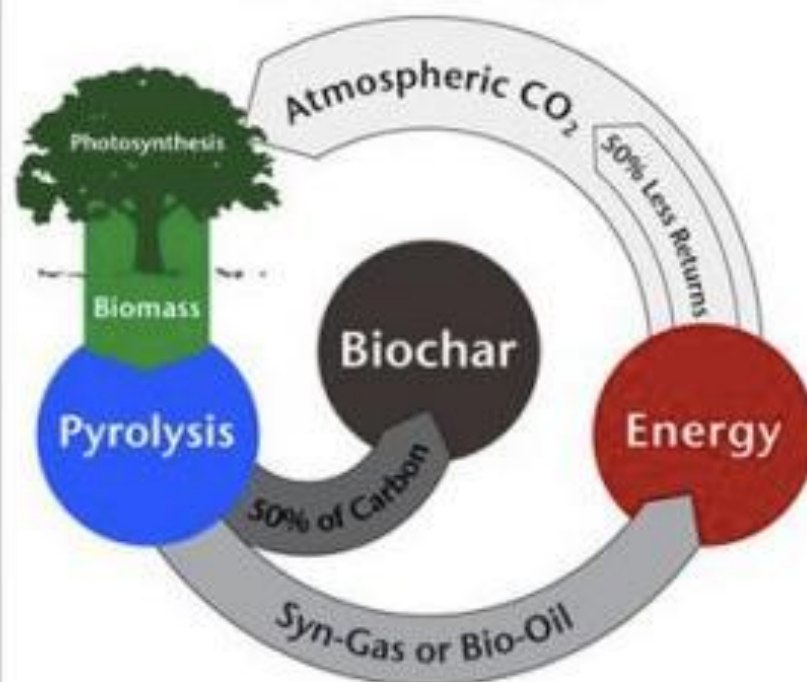
The Carbon Cycle



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

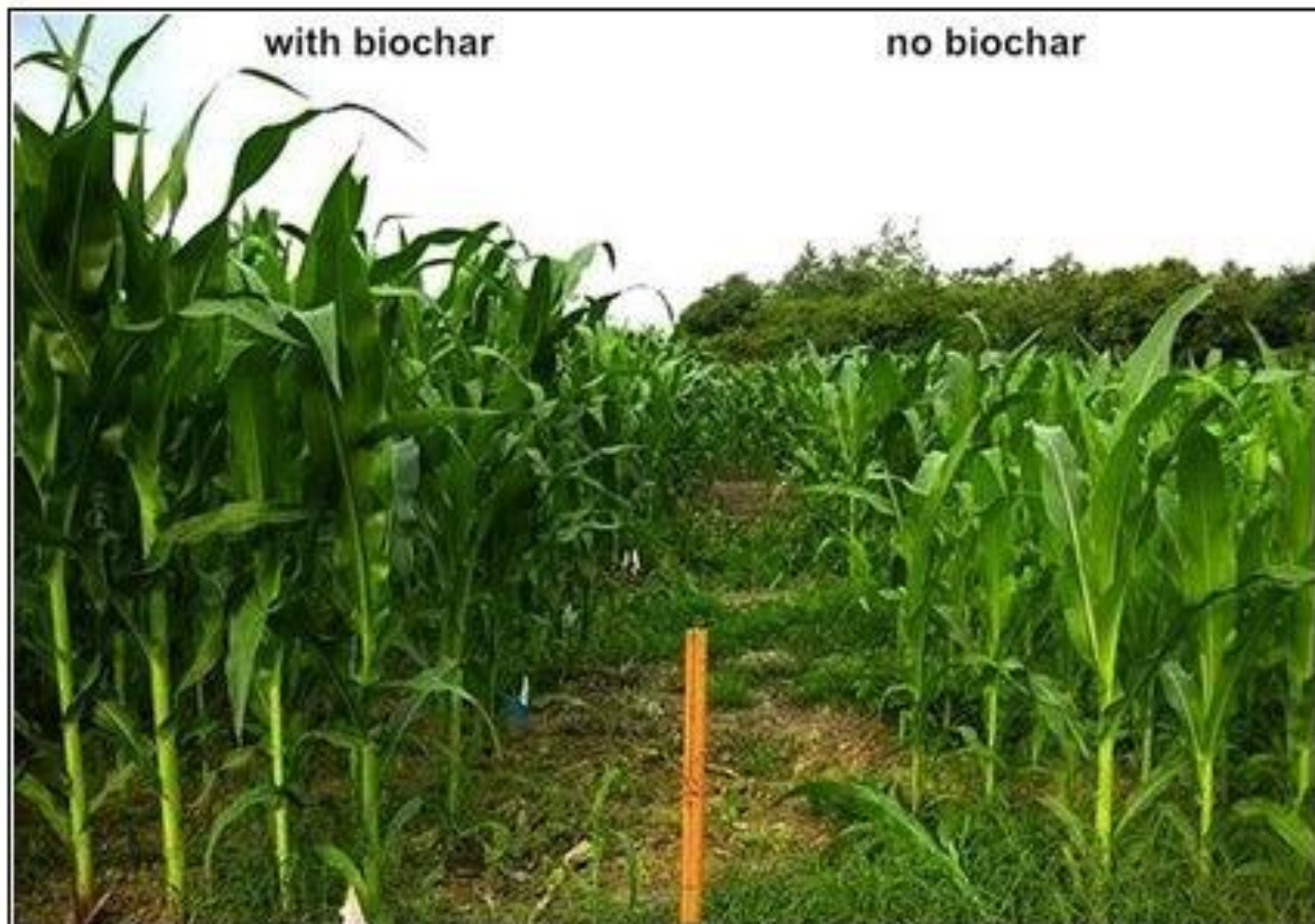


Improving Soils?

Transforming Waste?



Dedicated waste through



Corn Field Trial, Virginia Tech University

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

Advantages

- 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)

Plays a huge role in Sustainability



BIOCHAR

Viable

Sustainable

Soil benefits

Decreased nutrient runoff



Increased soil carbon



Improved soil fertility



Improved soil tilth



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 it?

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

- 1. Stoves (“TLUDs” (Top Load Up-Draft):**
(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**



Examples

Flame Cap/TLUD?

Don't Flame Caps and TLUDs
Function Differently?
Ethos/2019
Norman T. Baker



Slide courtesy of Norm Baker



Biochar Retort vs Pit Trials, Ah...
terrapreta.bioenergylists.org



Resources - permachar
permachar.net



Pyrolizer 150L Biochar Kiln - A...
activevista.com.au



Note on Terminology: Flame C...
greenyourhead.typepad.com



TERRA: Carbon Negative
carbon-negative.us



Biochar Kilns Australia - Bioch...
thebiocharsolution.com



How to Make Biochar With Onl...
pacificbiochar.com



New biochar ideas from The W...
biocharproject.org



Mobile units:



The smaller batch unit



To Simply Incomplete burning and burial in Trenches



AllBlackEarth | Biochar in New Zealand

Where to buy - Colorado

- 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

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/



International Biochar Initiative



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Biochar Certification

WHAT IS BIOCHAR?

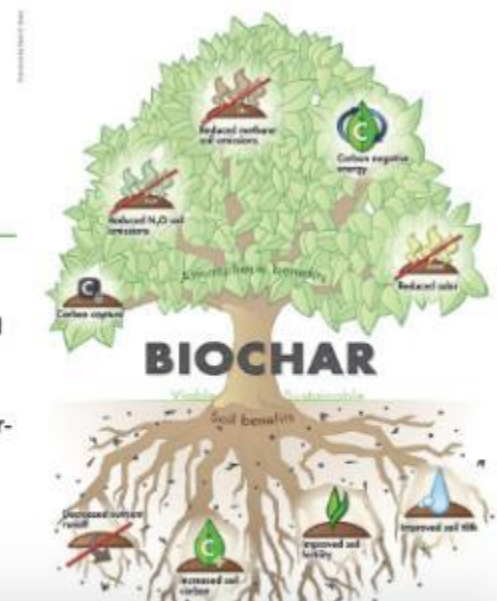
- [Terms and Definitions](#)
- [FAQs](#)
- [Biochar and Soils](#)
- [Production Technology](#)
- [Climate Change and Biochar](#)

Biochar Is a Valuable Soil Amendment

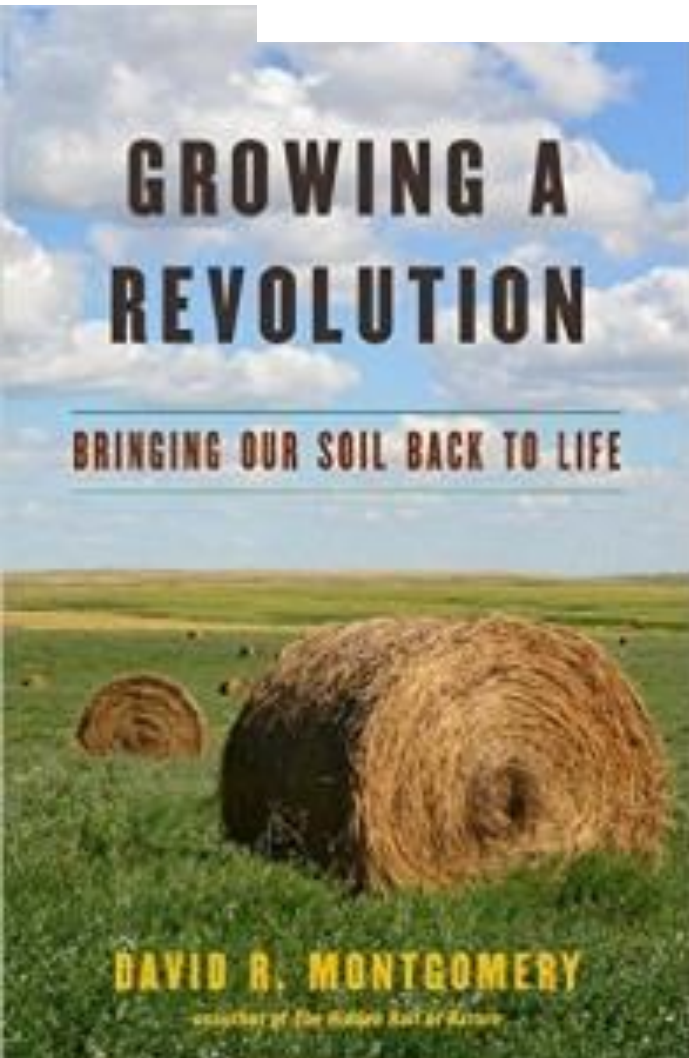
This 2,000 year-old practice converts agricultural waste into a soil enhancer that can hold carbon, boost food security, and increase soil biodiversity, and discourage deforestation. The process creates a fine-grained, highly porous charcoal that helps soils retain nutrients and water.

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.



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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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

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
 - 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**."
 - By burial and
 - By continued microhabitat support for microbes and bacteria to replenish the soil

CREDITS:

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

IBI,
Ron Larson
Norm Baker
others

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Web page on BIOCHAR:

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

