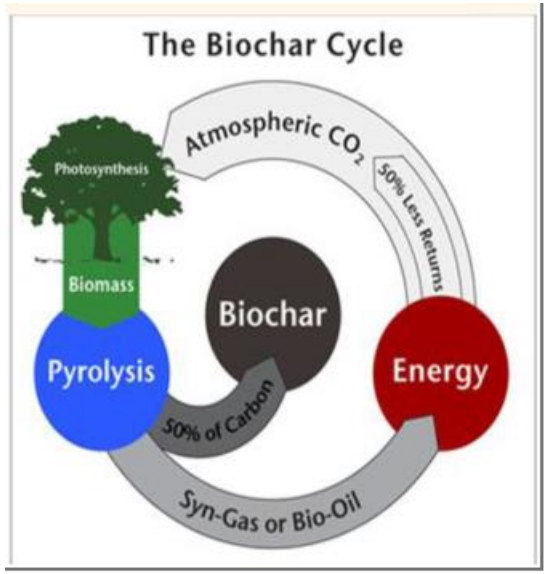
The Case for BIOCHAR



Whidbey Camano Land Trust (WCLT) 2022.11.13
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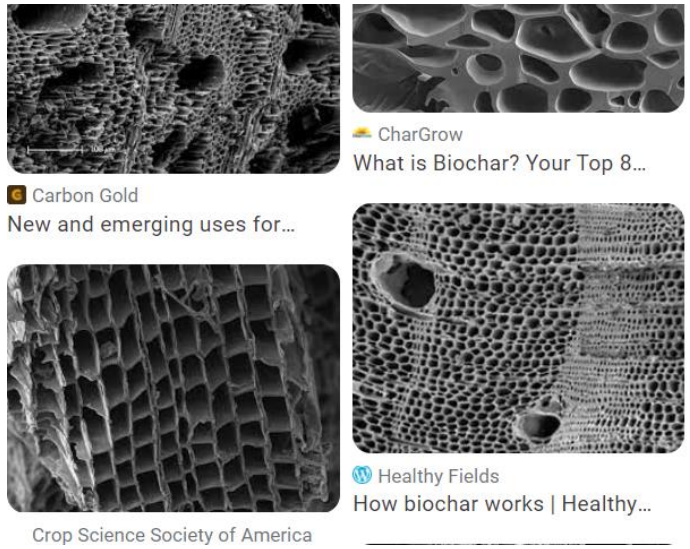
Outline

- What is Biochar
  - Where is it found
  - How is it made - pyrolysis
- The Carbon Cycle
  - Human activity and disruption
  - Carbon storage concepts
    - Carbon Positive (burning of fossils fuels, deforestation, etc.)
    - Carbon Neutral (short term renewable growing cycles)
    - Carbon Negative (sequestration)
- The Benefits of Biochar – a WIN-WIN for the:
  - Soil
  - Climate Carbon Sequestration
- The Environmental and Sustainable Benefits
- Economic Benefits

Slides from U.S. Biochar initiative (https://biochar-us.org/) and Biochar colleagues, notably Ronal Larson, Dr. TLUD Paul Anderson, Norm Baker, Kelpie Wilson (https://wilsonbiochar.com/) and Francesco Tortorici

What is BIOCHAR – SIMPLE?

- **Biochar = Charcoal buried in the soil**
  - **Charcoal is a fuel**
  - **Biochar is inert carbon buried in the soil**
- **Essentially inert**
  - **Porous**
  - **Microhabitat**
    - **For fungi and microbes**
    - **Retains moisture**



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

What is BIOCHAR – not Simple

- **Biochar** is the lightweight black residue, made of carbon and ashes, remaining after the pyrolysis of biomass. Biochar is defined by the International Biochar Initiative as "the solid material obtained from the thermochemical conversion of biomass in an oxygen-limited environment".[1] Biochar is a stable solid that is rich in pyrogenic carbon and can endure in soil for thousands of years.[2]
- The refractory stability of biochar leads to the concept of pyrogenic carbon capture and storage (PyCCS),[3] i.e. carbon sequestration in the form of biochar.[2] It may be a means to mitigate climate change.[4][5][6] Biochar may increase the soil fertility of acidic soils and increase agricultural productivity.[7]

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

What is Biochar

Biochar – A solid carbon based material obtained from the heating of biomass.

Biochar may be added to soils with the intention to improve soil functions and to reduce emissions from biomass that would otherwise naturally degrade to greenhouse gases.

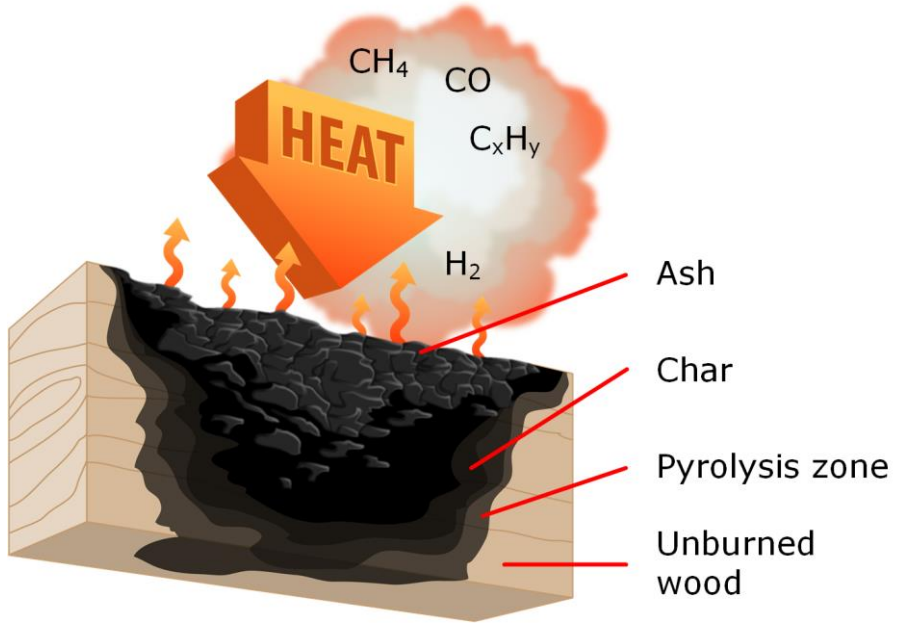
Biochar in can: Convert by product biomass to value added products
Increase biomass growth
Sequester atmospheric carbon
Co-produce renewable energy

Fire vs. Pyrolysis

- **So, What is fire?**
  - **Need: fuel, temperature (activation energy), oxygen**

- **What is Pyrolysis?**
  - **Need: fuel and temperature**

So, What is Pyrolysis?



Pyrolysis is **the heating of an organic material, such as biomass, in the absence of oxygen**. Biomass pyrolysis is usually conducted at or above 500 °C, providing enough heat to deconstruct the strong bio-polymers mentioned above

https://www.ars.usda.gov/

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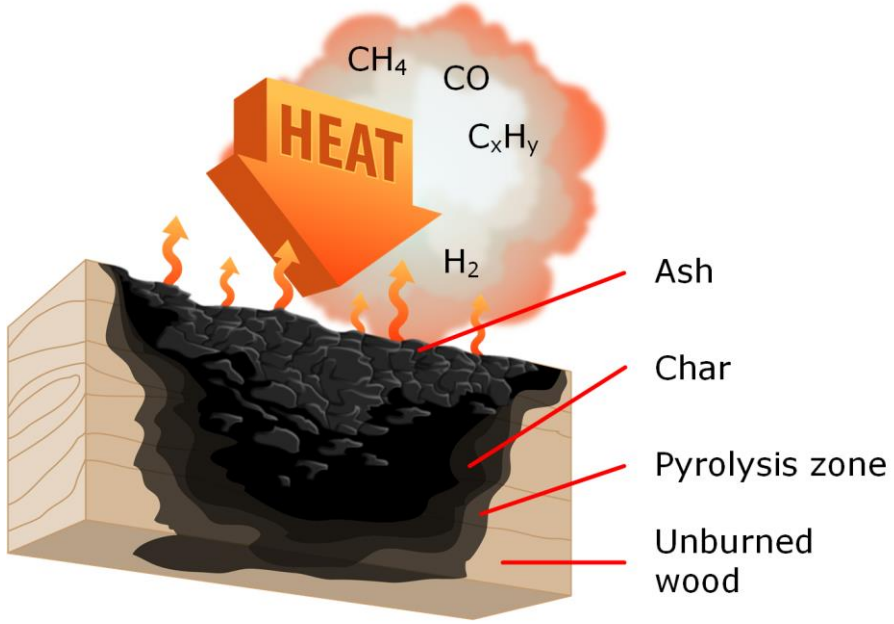
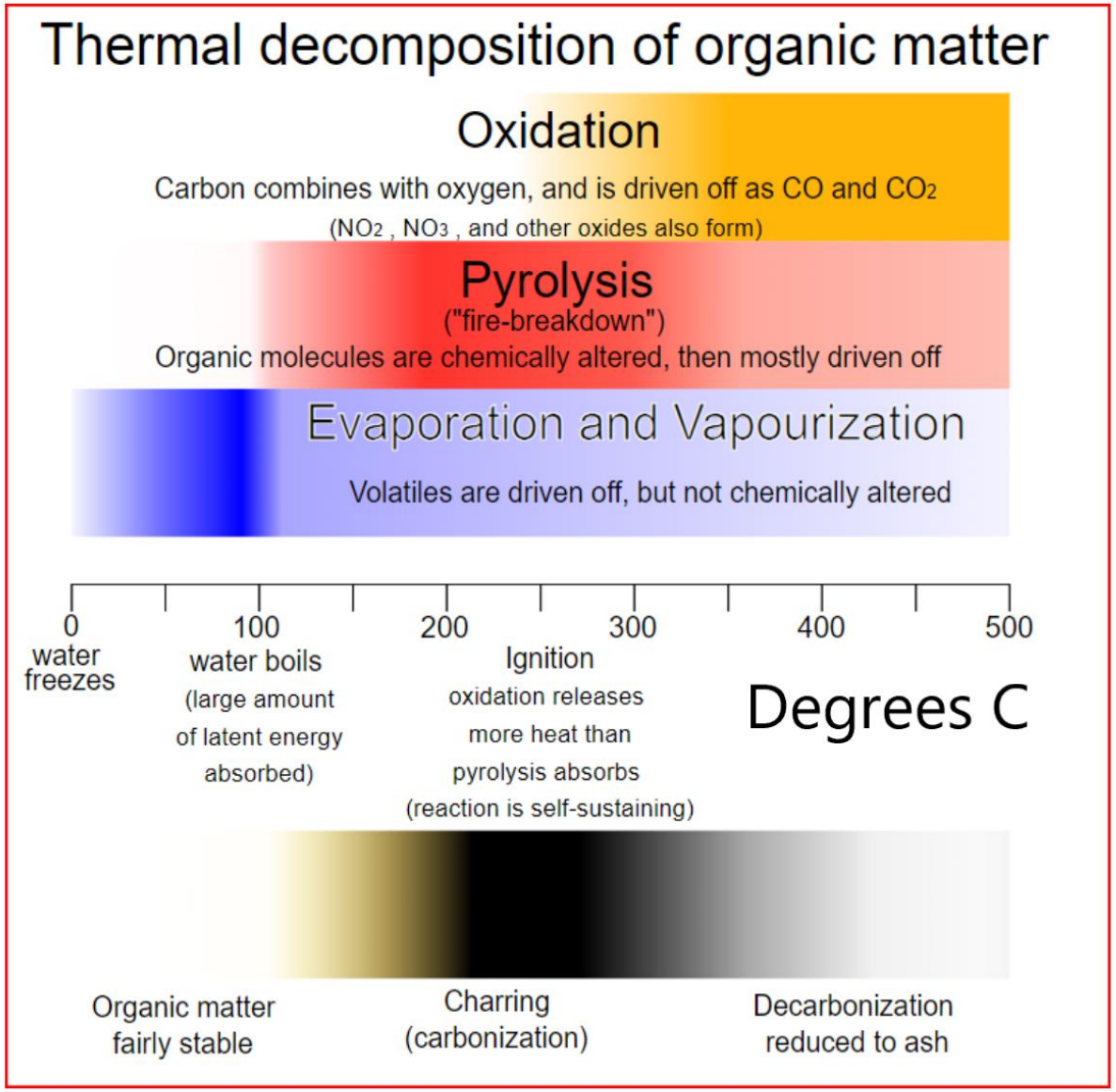
So, What is Pyrolysis?





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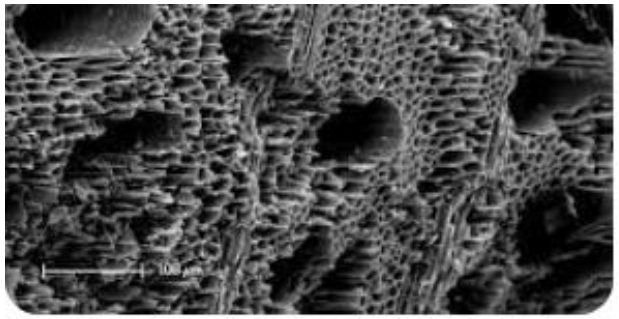
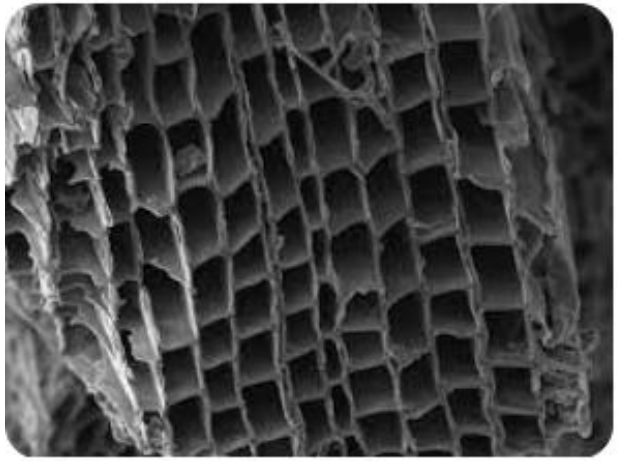
SOIL Profiles; detailed structure

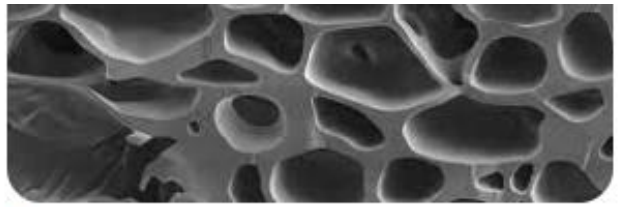


Carbon Gold

New and emerging uses for...

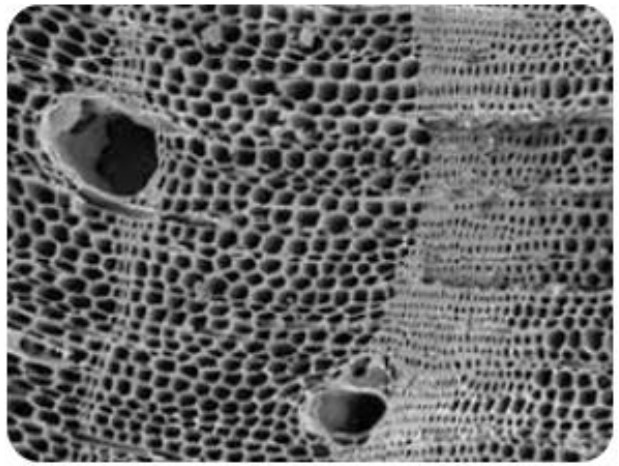


Crop Science Society of America



CharGrow

What is Biochar? Your Top 8...



Healthy Fields

How biochar works | Healthy...

https://www.wakefieldbiochar.com/science-of-biochar/

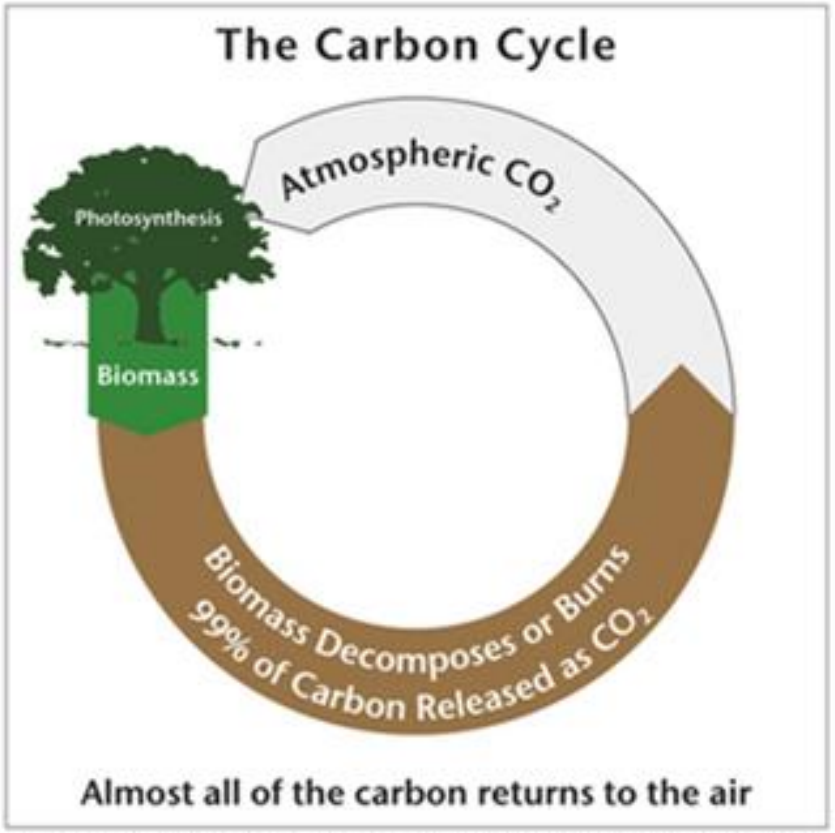
What is Biochar- History

Terra Preta - Basic Information

"Terra Preta de Indio" (Amazonian Dark Earths; earlier also called "Terra Preta do Indio" or Indian Black Earth) is the local name for certain dark earths in the Brazilian Amazon region. These dark earths occur, however, in several countries in South America and probably beyond. They were most likely created by pre-Columbian Indians from 500 to 2500 years B.P. and abandoned after the invasion of Europeans (Smith, 1980; Woods et al., 2000). However, many questions are still unanswered with respect to their origin, distribution, and properties.

http://www.css.cornell.edu/faculty/lehmann/research/terra%20preta/terrapretamain.html

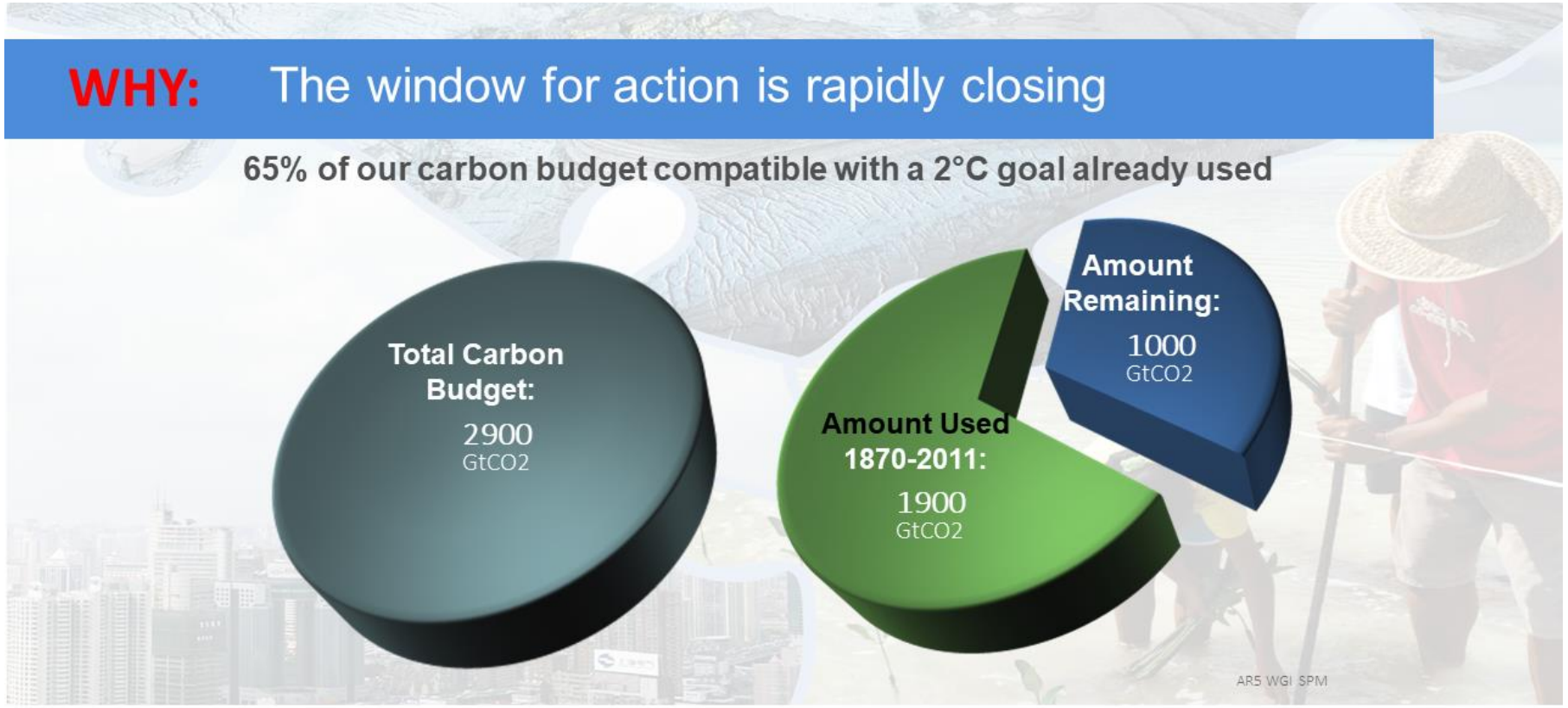
The Carbon Cycle



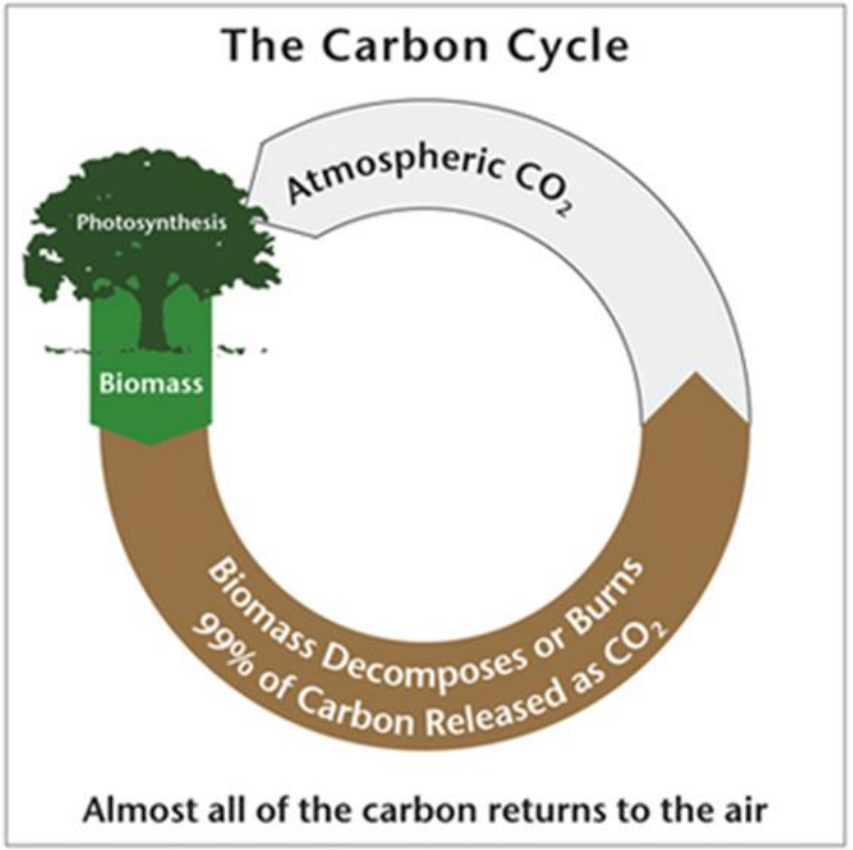
Green plants remove CO_2 from the atmophere via photosynthesis and convert it into biomass. Virtually all of that carbon is returned to the atmosphere when plants die and decay, or immediately if the biomass is burned as a renewable substitute for fossil fuels.

- **CARBON NEUTRAL:** Every day/every year growing – Natural cycles = no changes in CO_2 year to year
- **CARBON POSITIVE = adds CO_2 to the Atmosphere:** Burning of fossil fuels, deforestation, etc. Upsetting the "normal" balance – Man made impacts
- **CARBON NEGATIVE: Sequestration:** taking **CO_2** out of the atmosphere and storing it underground for long periods of time
  - **Natural processes (geologic)**
  - **Man made**

The Carbon Cycle regarding climate impacts



The role of Biochar – Carbon Negative Sequestration



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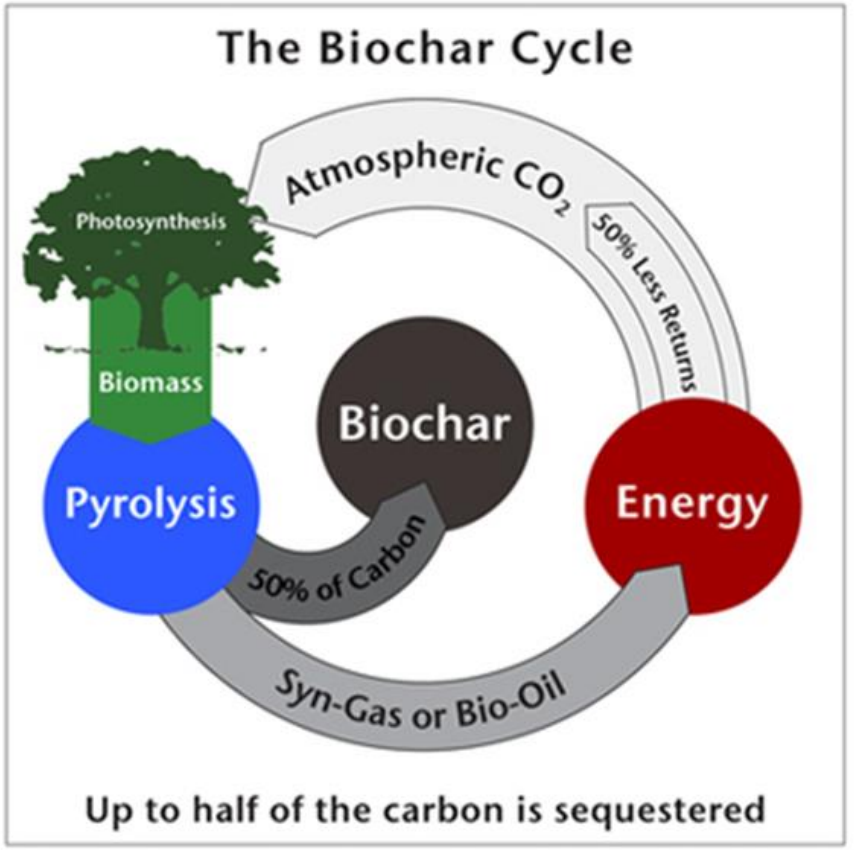
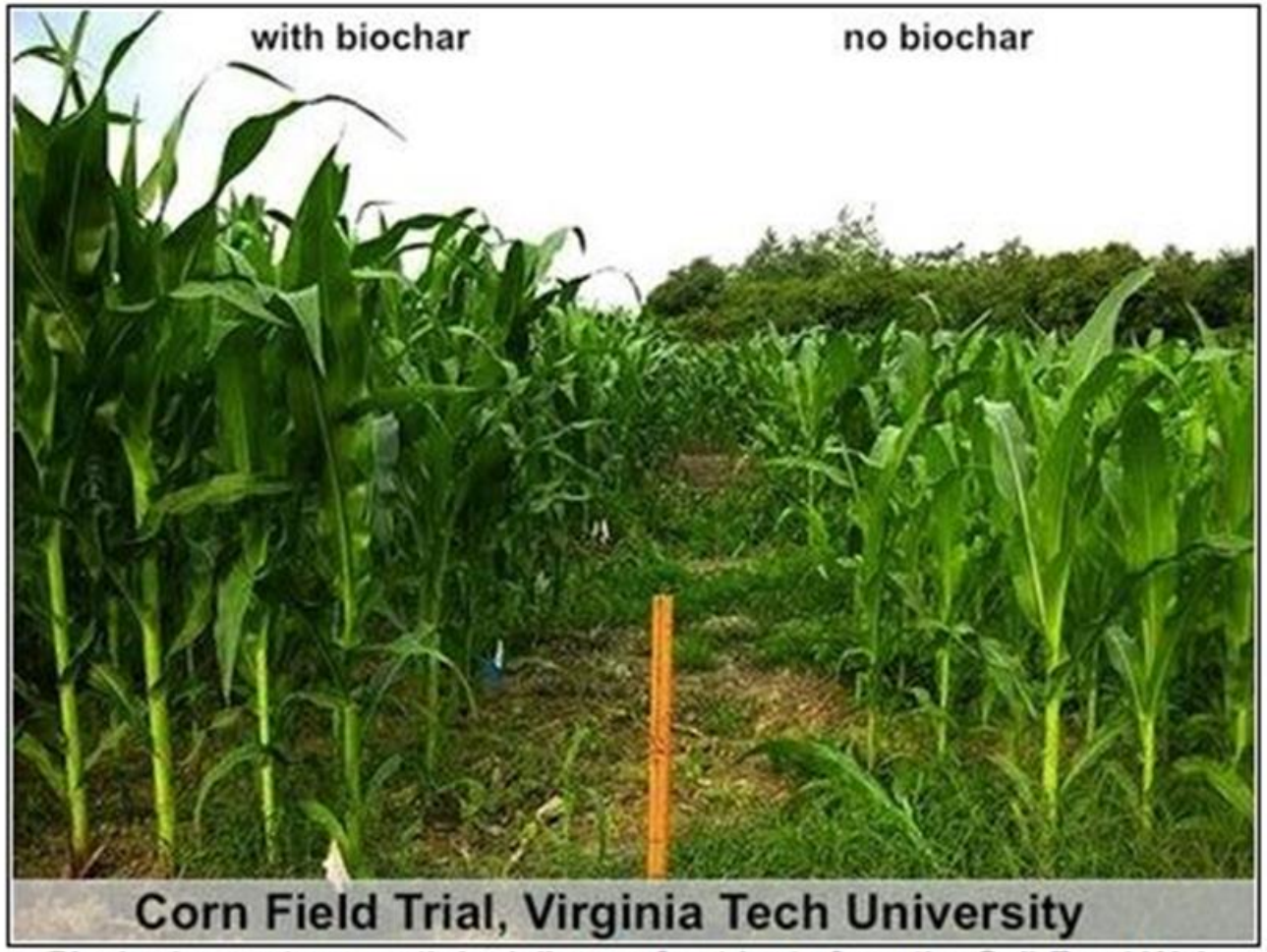


Green plants remove CO_2 from the atmophere via photosynthesis and convert it into biomass. Up to half of that carbon is removed and sequestered as biochar, while the other half is converted to renewable energy co-products before being returned to the atmosphere.

Increased Yields, Lessens need for fertilizers



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

Carbon Sequestration

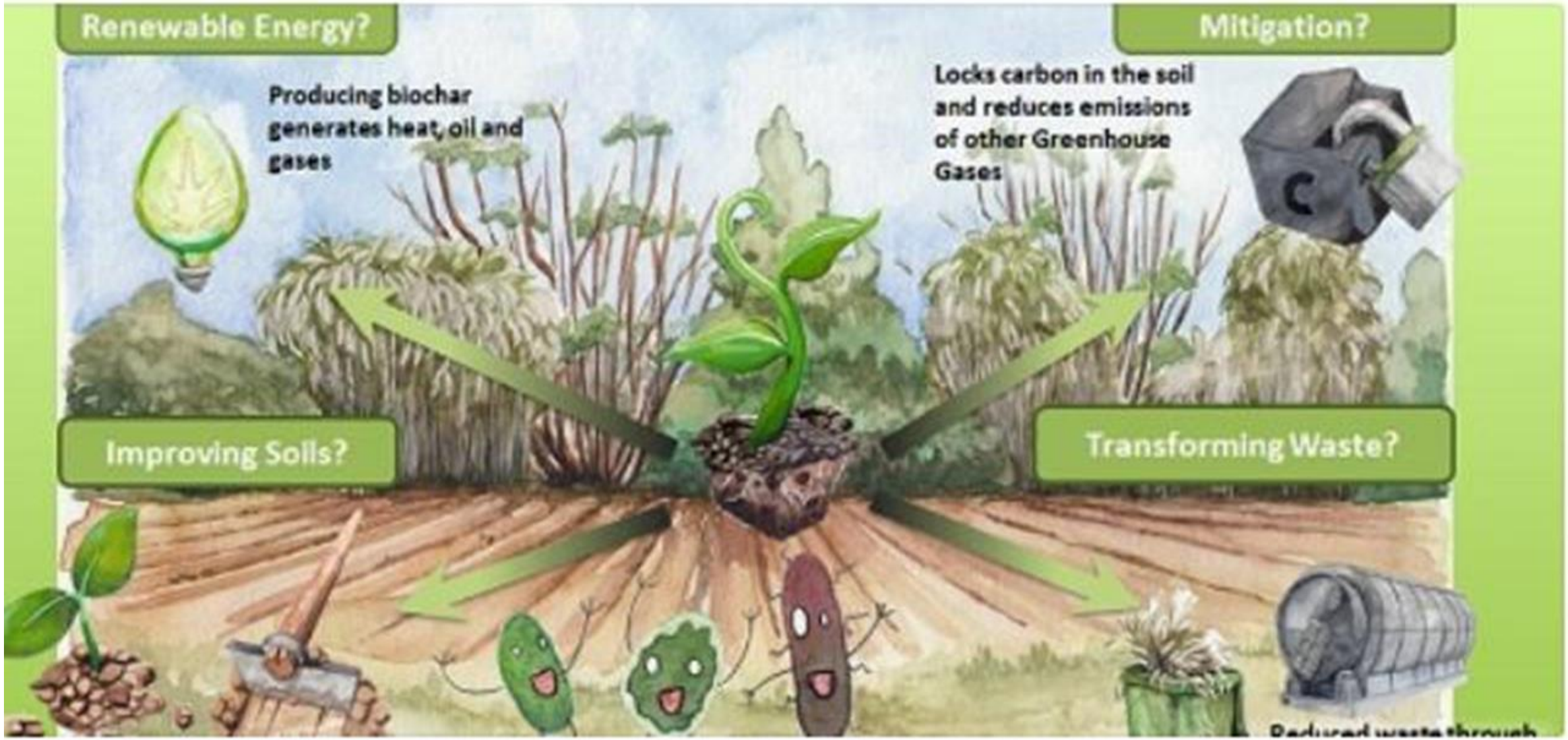
- Back to our Future - https://www.backtoourfuture.net/ 2023
  - Trailer 1, 8 minutes: https://www.youtube.com/watch?v=YYaWKS6fgIE&list=WL&index=2
  - Trailer 2, 4 minutes: https://www.youtube.com/watch?v=OJAJDhNT07U https://www.youtube.com/watch?v=YYaWKS6fgIE&list=WL&index=2
- James Lovelock **Biochar - Return to Ancient Wisdom, 2014;** https://youtu.be/stHgSUTEja8
- Geologic Carbon Sequestration in Washington State, 12/12/2020: Will Gallin,DNR/WA Geologic society: https://youtu.be/ODtKbt1ovGc

Added value of Biochar

Why Important ?

a. Soil & Food (long life in soil, not an expense)
b. Carbon negativity (CO_2, CH_4, N_2O)
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)

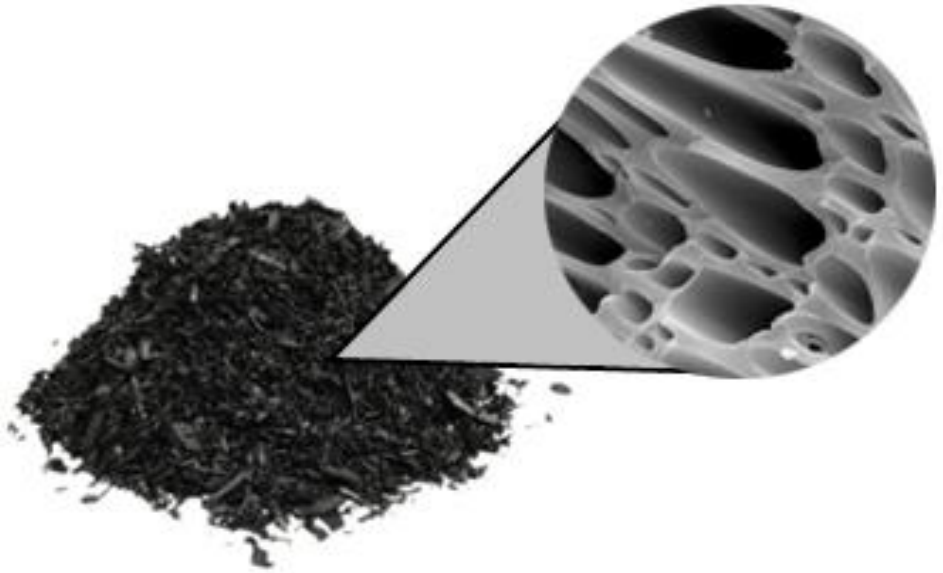
* https://www.sciencetimes.com/articles/12641/20170417/htc-ocean-will-blow-mind-revolutionary-specs-features.htm


Renewable Energy?
Producing biochar generates heat, oil and gases
Mitigation?
Locks carbon in the soil and reduces emissions of other Greenhouse Gases
C
Improving Soils?
Transforming Waste?

Biochar Production

How do we scale up from

Biochar for re-vegetation



+ soil water holding capacity
+ soil fertility
+ micro-organisms
+ stable (1000's of years)

Terra Preta (ADE) example from N. Amazon Basin. Left photo is a native Soil Anthrosol the right photo is ADE which has recalcitrant carbon content + nutrients and other products- this is the historical Biochar basis.

See text: Dark Earths Origin Properties management, By Lehmann, Kern, Glaser, Woods

What is Biochar?

	Charcoal	Biochar	Activated Carbon
Feedstock	Hardwood, sawdust + Binding Agents	Ag, forestry & other organic materials/waste	Coconut shells, peat, coal, petroleum pitch
Common Uses	Fuel (Cooking)	Soil Amendment Remediation Filtration Binding Agent (livestock)	Filtration Odor Control Remediation Binding Agent (humans)
Relevant Qualities	Burnability Low smoke	Adsorption/Porosity CEC Sequestration	Adsorption
Cost	$ - $$	$$	$$$
Production	Slow Pyrolysis; Kiln	Slow Pyrolysis; Kiln; Gasification	Pyrolyzed at 600 – 900C + activated at 250C OR Chemically impregnated & cooked @ 450 – 900C
Carbon Footprint	Carbon Neutral: May lead to Deforestation	Carbon Negative (in many situations) ★	Carbon Positive

Additional:
Storm water management
Anaerobic Digestion
Bedding/Litter
Compost
Cosmetics

Making Biochar – top-down burning

Open pit - https://youtu.be/5M4ntJi_JmY &
https://pacificbiochar.com/how-to-make-biochar-with-only-a-match/

Kilns –

Top Lit Updraft Systems (TLUDS) -

Rocket Stoves -

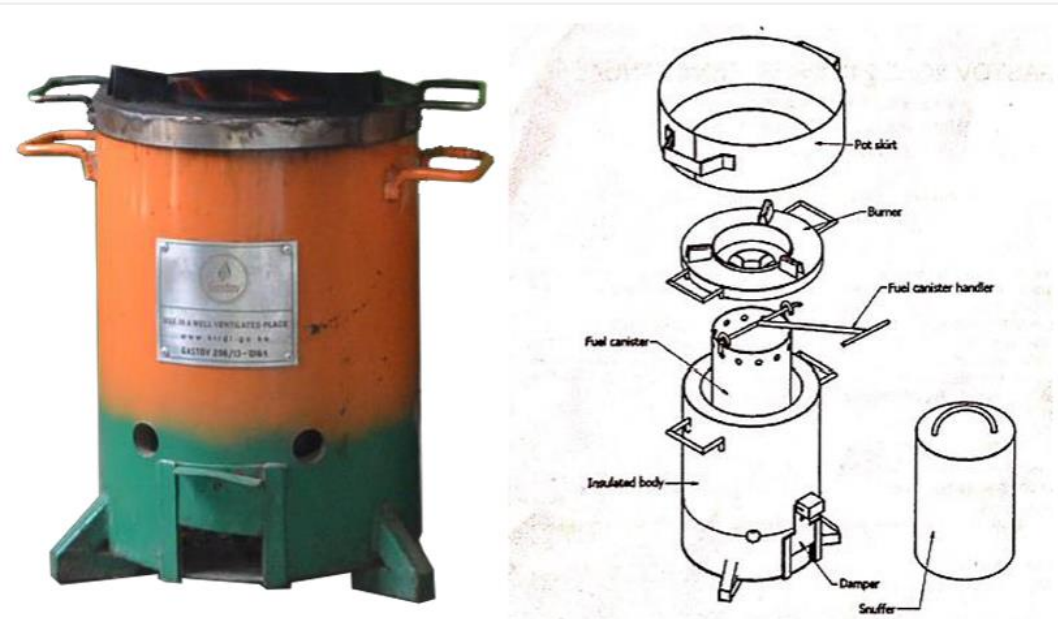


Figure 2. 3. TLUD gasifier stove used in BSFK project (left), and the accessories (right) ((KIRDI, n.d.-b)

Flame Cap or Open Cavity Kilns

- **Flame cap kiln is a cavity kiln with an open top:**
  - Cone, pyramid, trough, barrel/tube (vertical), trench/pit, etc.
- None have features to facilitate re-exposure of once-covered fuel.
- The cavities where charcoal collects remain relatively cool.
- There is less stress on the metal than from the higher temperatures of burning charcoal.

A comparison of burning a pile from the bottom vs. top-down

Lower emissions with top-down burning (right):

https://youtu.be/5M4ntJi_JmY

Using a TLUD for cooking

https://denverclimatestudygroup.com/wp-content/uploads/2022/11/2-burner-TLUD-Plancha-Stove.mp4

- Ultimately – USE THE WASTE HEAT – here's an example
- Retort units – where you capture the wood gas and convert that gas to biofuels + Charcoal

Resources

- U.S. Biochar Initiative (USBI) - https://biochar-us.org/welcome-biochar-learning-center
- Kelpie Wilson - https://wilsonbiochar.com/
- My compilation on BIOCHAR - https://denverclimatestudygroup.com/?page_id=28

- Subscribe to BIOCHAR discussion group: https://biochar.groups.io/g/main - This forum is dedicated to conversations on the emerging and exciting climate-energy-soils-carbon technology called "Biochar" and the industry growing around it.

A Summary: BIOCHAR FIXES CARBON

Sequestration (aka “fixes”:

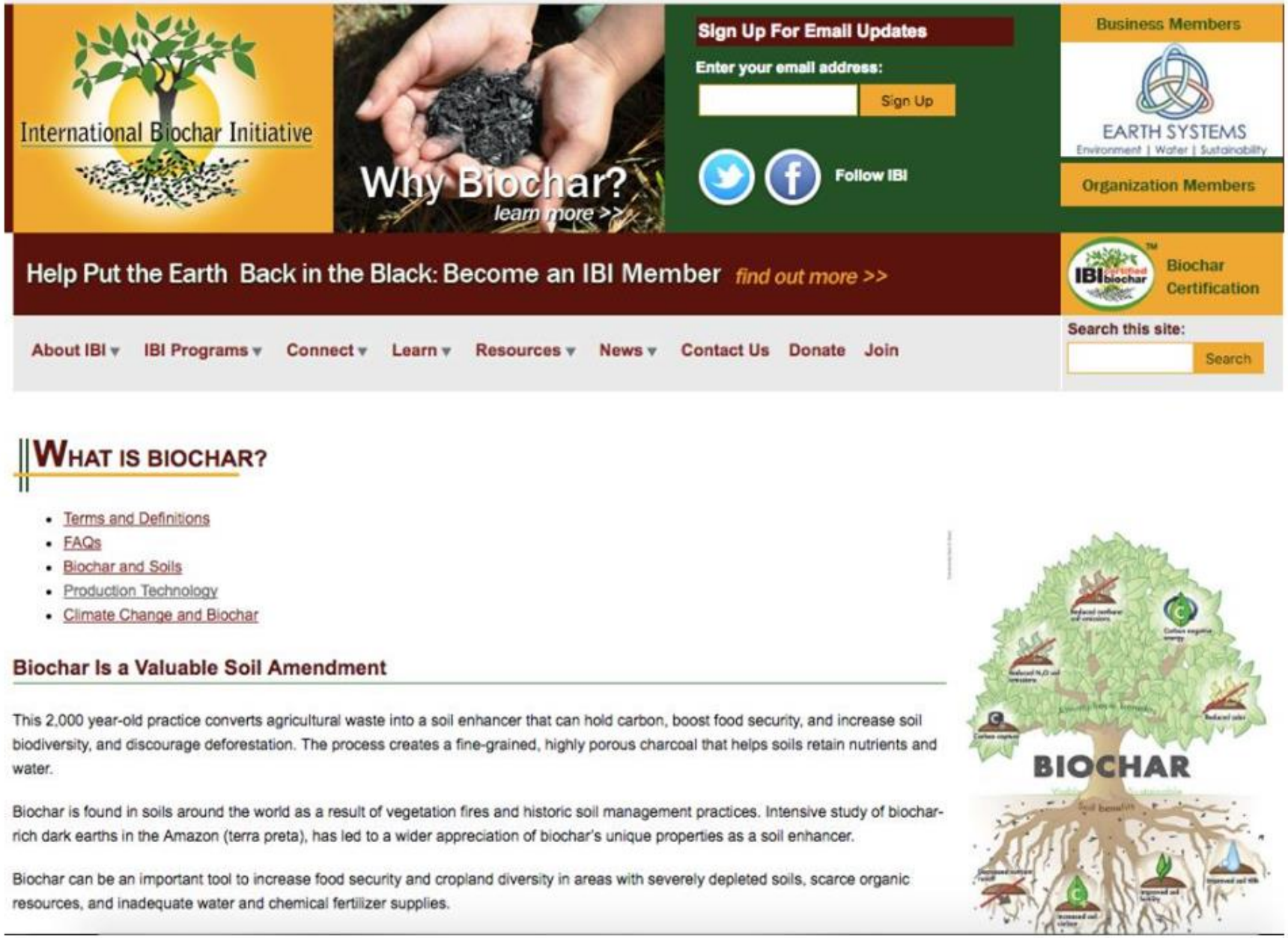
- Biochar fixes climate, and it also solves many other problems that are both related and unrelated to climate:
- · Biochar fixes drought conditions by holding water in soil
- · Biochar fixes fertilizer shortages by holding nutrients in soil
- · Biochar fixes dead soil by improving conditions for beneficial soil microbes
- · Biochar fixes smelly manure and compost by supporting good microbes, balancing C:N and retaining nutrients
- · Biochar fixes polluted soil by immobilizing heavy metals and other contaminants
- · Biochar fixes flooding by improving rainwater infiltration
- · Biochar fixes eutrophication by absorbing nitrogen in water bodies
- · Biochar fixes drinking water by filtering out contaminants
- · Biochar fixes building material impacts when used as a substitute for resource-intensive components of asphalt, concrete and other building materials
- · Biochar fixes human health and well-being as an ingredient in health and beauty products and for management of human sanitation
- · Biochar fixes animal health when used as an animal feed supplement and for manure management and sanitation
- · Biochar fixes forest fires by converting excess fuel loads to water-holding soil

https://wilsonbiochar.com/blog/f/biochar-fixes-carbon

A Summary: BIOCHAR FIXES CARBON – cont.

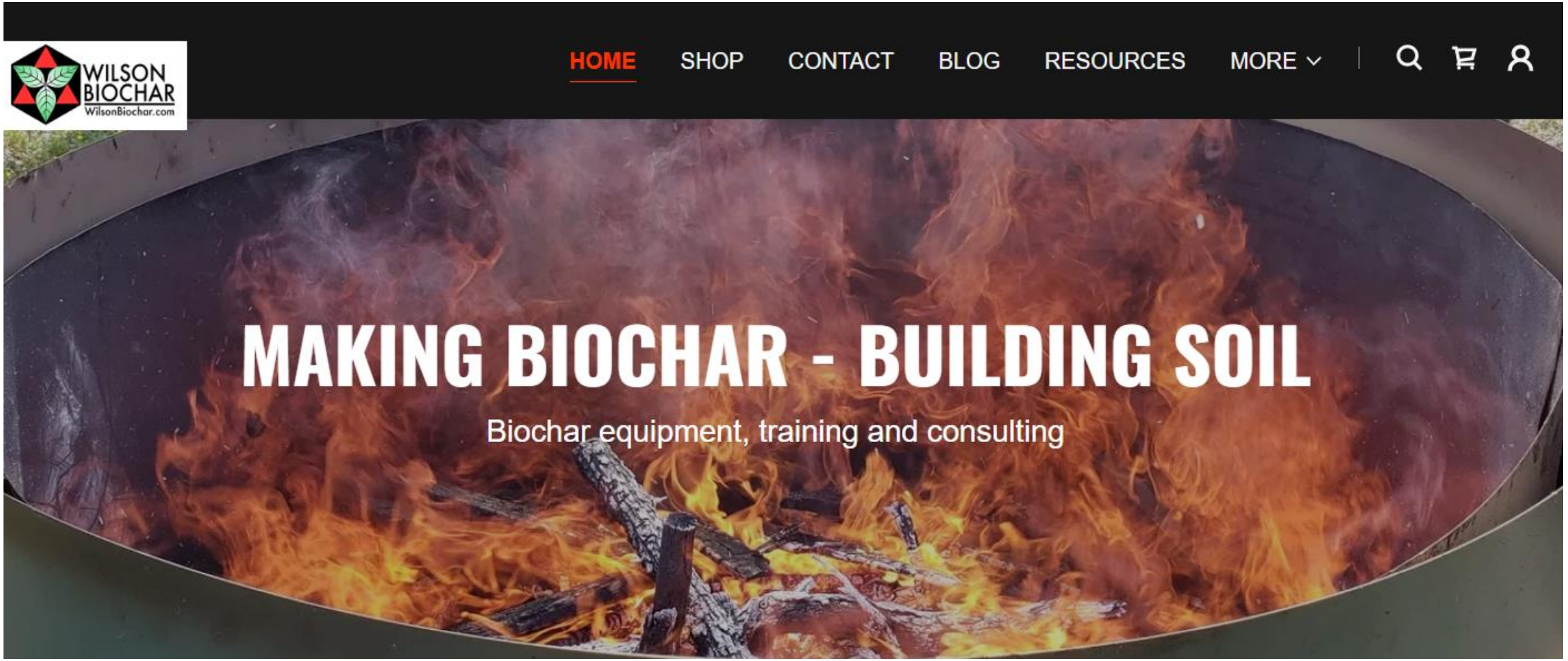
- The biochar industry has been focused on biochar as a product and the uses are all over the map, which makes it hard to talk about it in a unifying way.
- Perhaps we can make more headway by thinking in terms of actions. Biochar fixes things. It fixes our climate problem. It fixes a variety of other environmental and health problems.
- Biochar Fixes Carbon.
- Biochar is revolutionary. That's why so many of us have stuck with this for so long, even though our progress feels abysmally slow at times. We have to think bigger than just selling products. We have to think about transforming our relationship to carbon.
- Biochar as a verb has a new definition:
- biochar, *v*. To biochar is to fix carbon drawn from the atmosphere through plant photosynthesis into long-lived forms of carbon that are useful for fixing many environmental problems in the biosphere of Planet Earth.
- Finally, a point I like to make in my workshops:
- Our biggest problem is not too much carbon in the atmosphere, it is not enough carbon in our soils, forests, grasslands and farms. The problem is the solution.
- BIOCHAR FIXES CARBON!

https://wilsonbiochar.com/blog/f/biochar-fixes-carbon



https://biochar-us.org/welcome-biochar-learning-center

Kelpie Wilson Biochar – Wilson Biochar

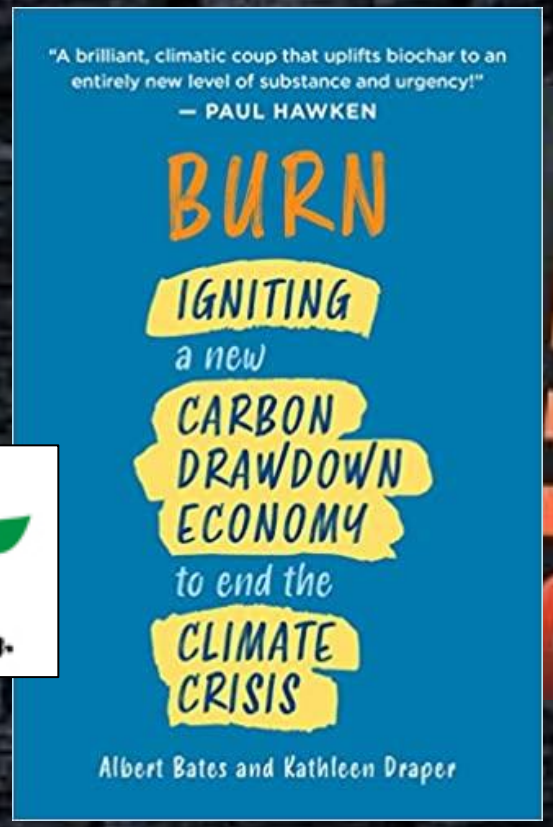


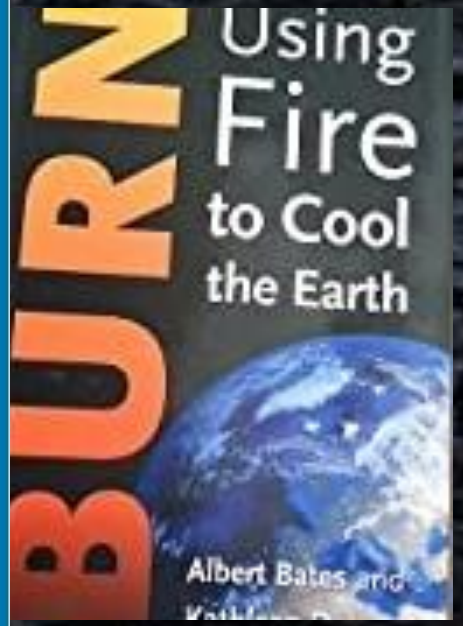
https://wilsonbiochar.com/

For more info

International Biochar Initiative

USBI
Building the future from the ground up.™





the Biochar Journal

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Questions?

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