



Technologies for Making Biochar



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Biocarbon Webinar:
How Bioenergy Can Help Store Carbon in Soil
Southern Alliance for Clean Energy
www.cleanenergy.org
Jun 24, 2014

Biochar Production at Large and Small Scales

- **Dry Fuel** – Air Dried or Less than 20% MC
- **Temperatures** – 400°C, 600 °C, 800 °C
- **Industrial Scale**
 - High Carbon Flyash, 10-30 CY/day
 - ICM Biochar Gasifier 200 CY/day
 - Biogreen Energy Pyrolysis 70 CY/day
 - Earth Systems Pyrolysis 10-20 CY/day
- **Farm Scale**
 - Adam Retort 1-2 CY/day
- **Small scale** –
 - Top Lit Burn Pile – >0.5CY/day
 - Small Ovens – <10 ft³/day,
Firepit kiln, Jolly Roger, Gasifiers
 - Stoves, BBQ – <ft³/day



Biochar Is Made in Large and Small Systems



BioChar TLUD Cook Stove
Seachar.org

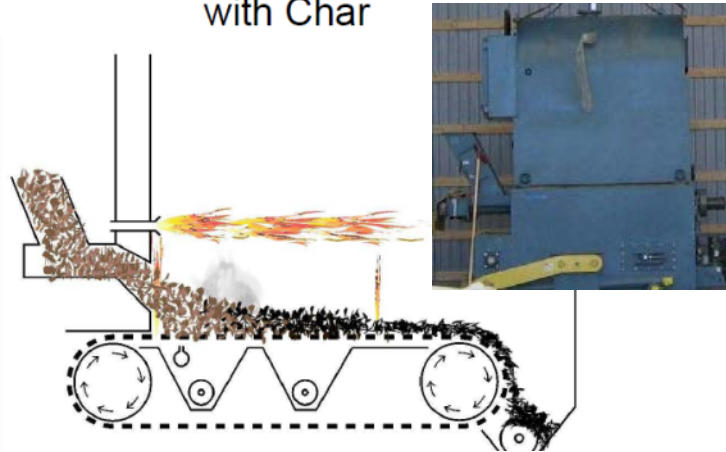


**Greenhouse scale heat and
biochar NE Biochar 1 t/10h**



**Mobile Pyrolysis
Black is Green (BIG) AUS**

Two Stage Combustion
with Char



Burt's Greenhouses
Ontario, CAN



Boiler 3 MMBtuh Hot Water
500 lb/h 25% Char



ICM Gasifier
4-8 tph

Biochar Can Be Made From Different Feedstocks



Urban and Forest Wood



Wood Char

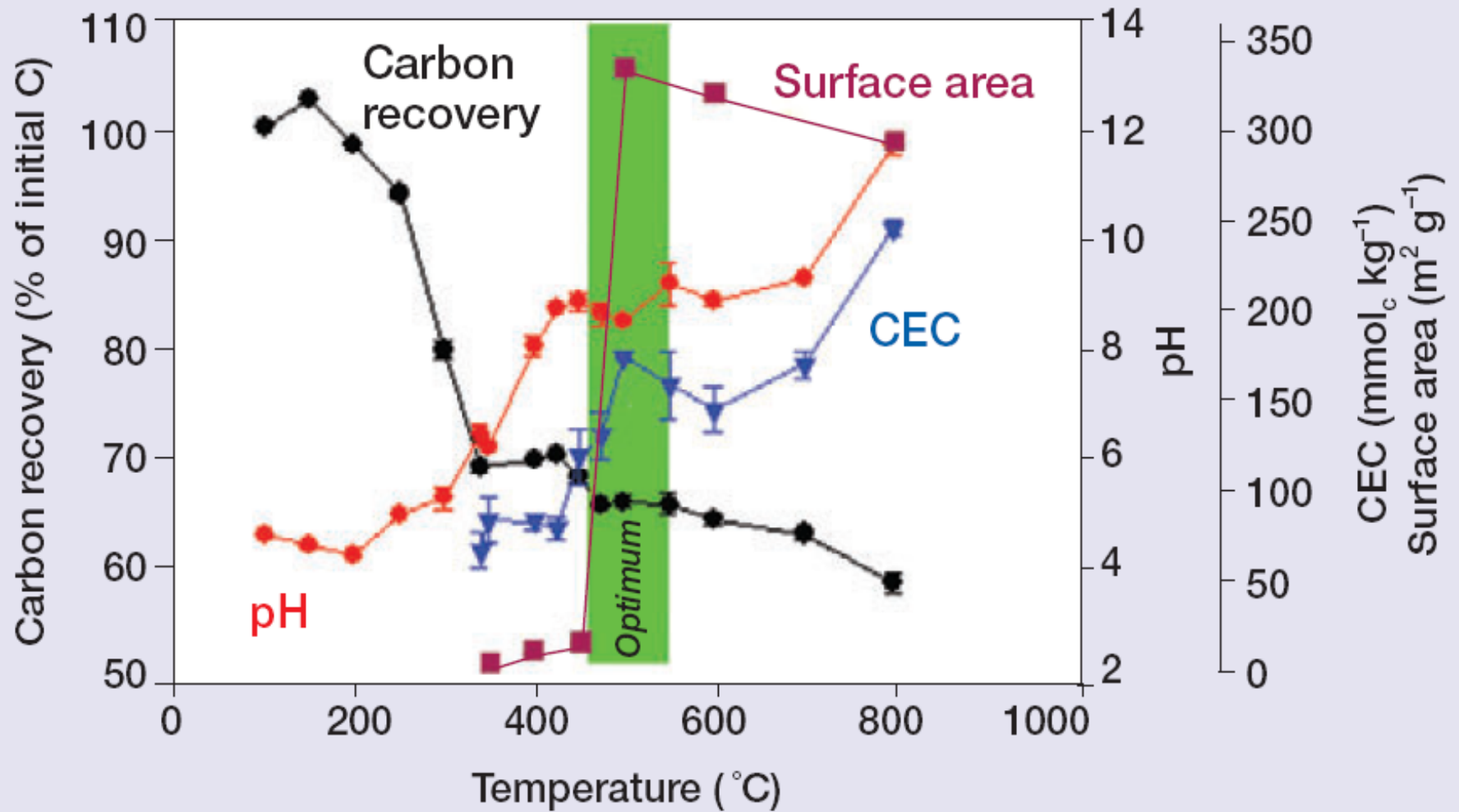


Wheat Straw or Corn Stover



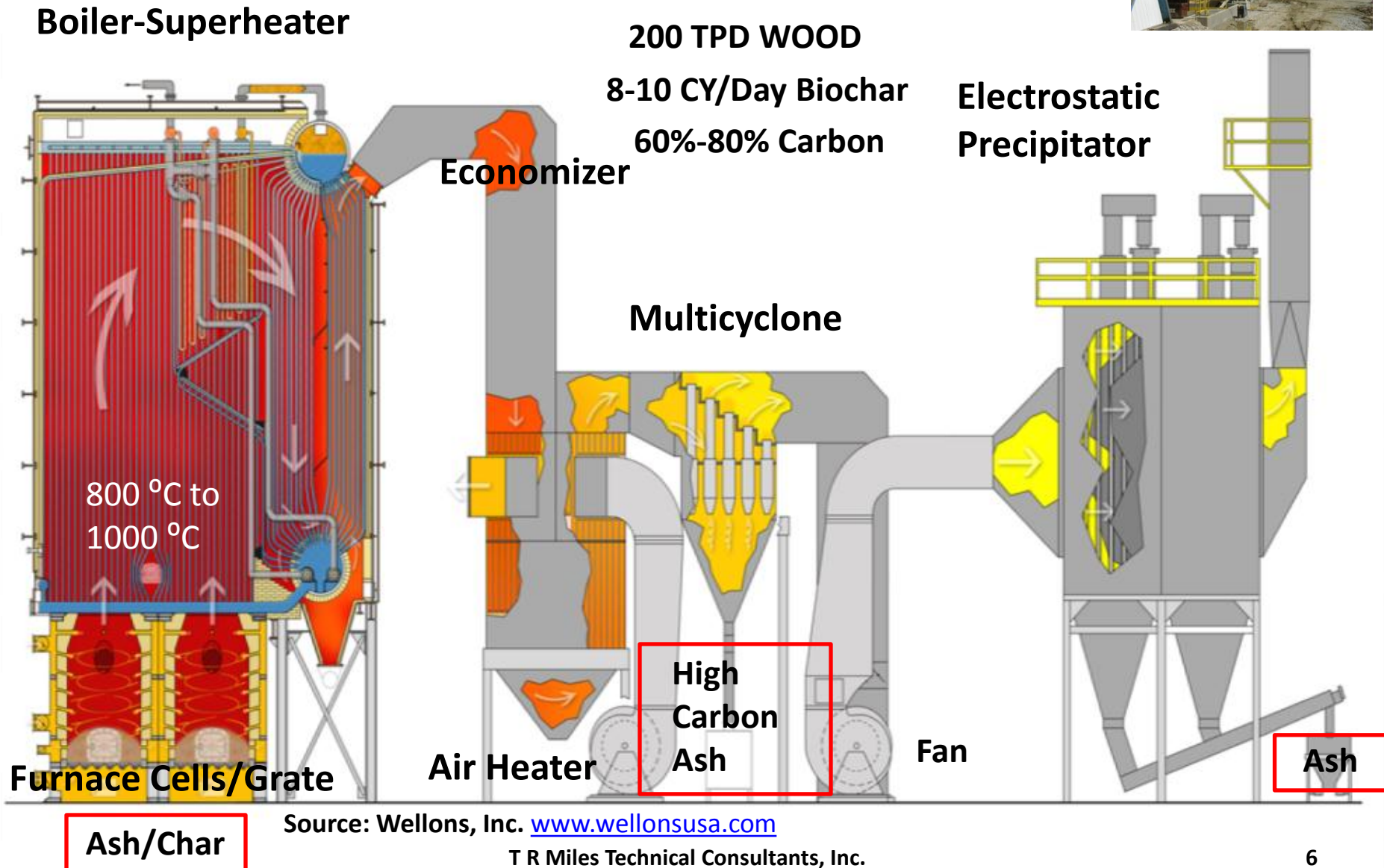
Straw Char

Temperatures Affect Biochar Properties



LEHMANN

Some Industrial Biomass Boilers Can Produce High Carbon Wood Ash With Biochar-like Properties



Source: Wellons, Inc. www.wellonsusa.com

T R Miles Technical Consultants, Inc.

Industrial Systems Convert Wood/Straw to Heat, Power and Biochar

Makes 10-30 TPD 200 CY/Day BIOCHAR



ICM 200 tpd Gasifier
Wood, Straw, Stover
www.icminc.com

**4-8 TPH Biomass 2-5 MWe
30-60,000 BDT/y**

T R Miles Technical Consultants, Inc.



Biomass

Gas

Pyrolysis

Char





Amaron Energy
www.amaronenergy.com

Gas

Biomass

Pyrolysis

Char

**Full-scale
MPP20/40**

Mobile Charmaker
20 CY/DAY
2 ton 10 CY/4 hours
Fully automated
Earth Systems (Aus)
USD \$345,000

<http://www.esenergy.com.au/services/charmaker/charmaker-techprocess>



EARTH SYSTEMS
Environment - Water - Sustainability



T R Miles Technical Consultants Inc

Mobile Retort Makes Char from Cordwood and Waste Wood

**1 Cord (4 CY) wood /Batch
8 hr burn ->1-2 CY Biochar**



Living Web Farm

www.biochar.bioenergylists.org/living-web-biochar-workshop-2013

New England Biochar

www.newenglandbiochar.org

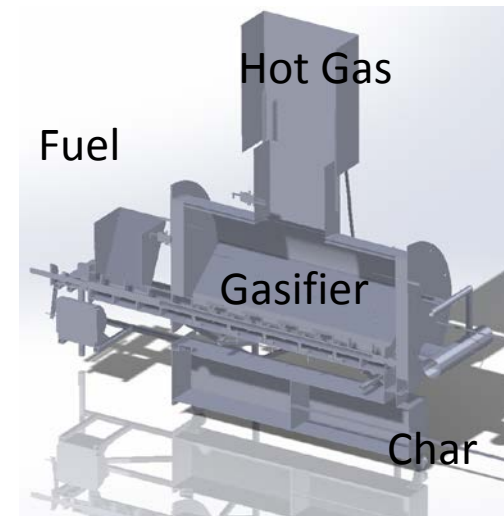
Stationary Retort with Greenhouse Heating



Sullivan Center for Sustainable
Agriculture and CSA, NH
sullivancsa.com
New England Biochar
newenglandbiochar.org

**1 Cord ~ 4 CY
8 hr burn 1-2 CY Biochar
+ 300,000 Btuh Hot Water**

Trough Gasifier For Bark, Litter, Sawdust



Biomass 800 lb/hr chips, litter
Heat 1.4 MMBtuh
Biochar 140 lb/hr 4-12 CY/Day
Cost \$150,000

BES Australia Stephen Joseph 2014

Poultry Litter to Biochar

Fry Poultry Farm, Wardensville, WV



www.coaltecenergy.com

1400 lb/hr Poultry litter converted to 700 lb/hr biochar and 3 MMBtuh heat.
Offsets propane. Indirect heated air improves bird health. Rich biochar for sale.

www.biochar-international.org/Frye/Poultry

Adapting a Greenhouse Boiler to make Biochar

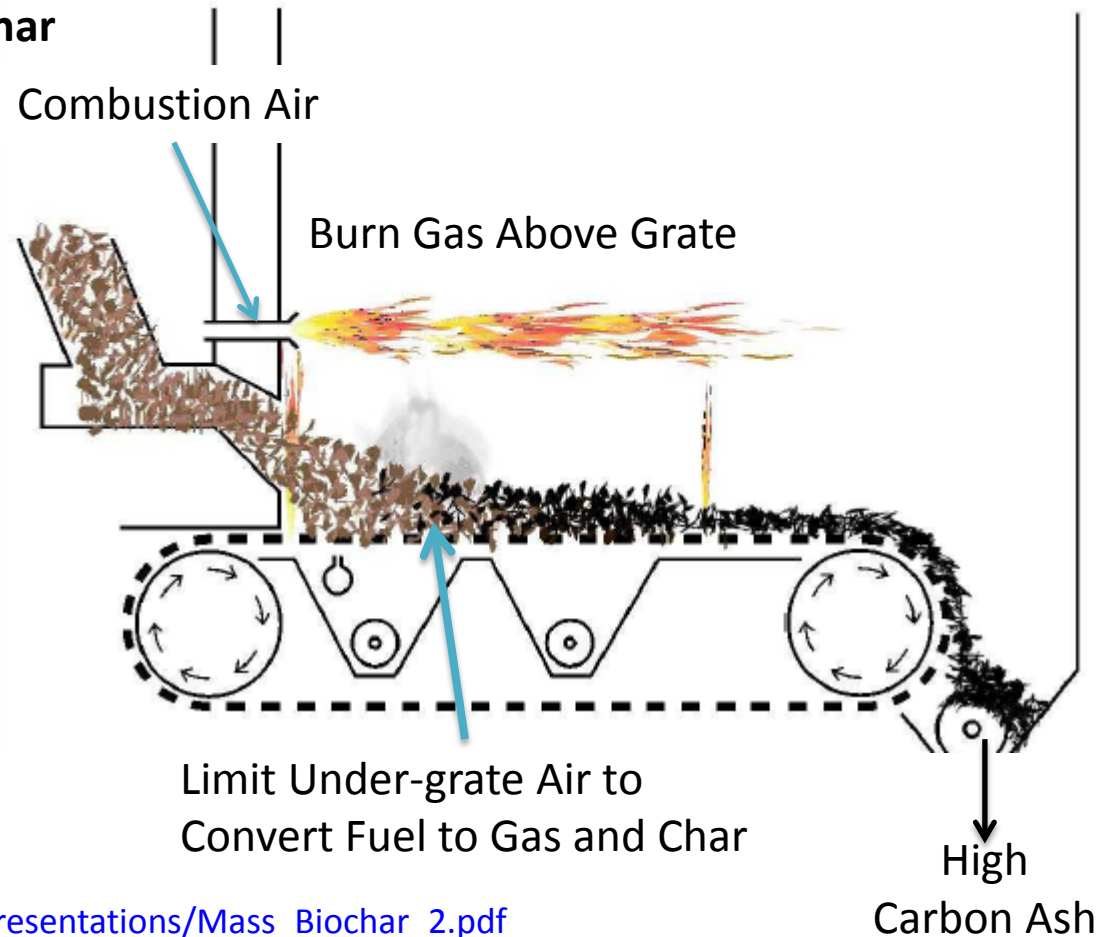
10 MMBtuh Heat From Boiler
Chain Grate Stoker
1 ton fuel/hr->5-10 CY/day biochar



Burt's Greenhouses, Ontario, CAN
Alex English
NE Biochar Symposium 2009

http://www.cns.umass.edu/biochar09/presentations/Mass_Biochar_2.pdf

Two Stage Combustion with Char



Small Scale Biochar Production



Firepit Cone Kiln



Gasifier



Top Lit Burn Pile



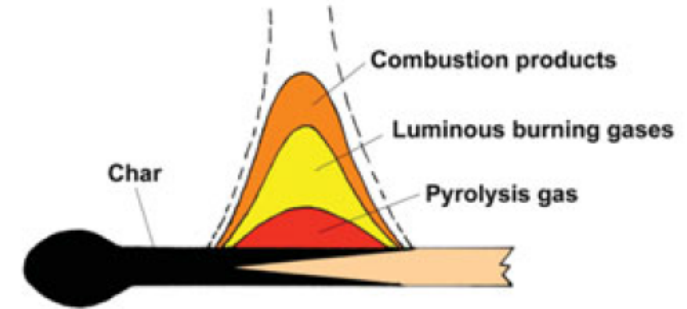
**Top Lit TLUD Gasifying
Cook Stove**



**“J-RO” Jolly Roger Oven
Top Lit Gasifier + Barrel Oven**

Top Lit Burn Reduces Oxygen Increases Char

Light From Top



Smoke is consumed

World's smallest biochar reactor

- Heat transfers by radiation into the wood
- Heated wood releases gases that rise
- When hot gases rise they are exposed to air and they burn
- Heat converts remaining wood to charcoal
- Charcoal will not burn if it is protected from oxygen by the gas flare
- If rising gases cool too fast or do not get enough air, smoke results

Wilson Biochar

http://tcia.org/digital_magazine/tci-magazine/2014/02/index.htm#?page=26

Water Quench at Base

Char residue

Quench

Burn 5 hrs dry wood
Biochar ~13-27 ft³/burn
(0.5-1 CY)

Enclosed Pile Gasifier Limits Air



**Limits combustion air to make gas and char
Gas burns cleanly above kiln**

**Wood size max 3" diameter
Burn 3-5 hrs with dry wood
Biochar ~20 ft³/burn (0.75 CY)**

- Prevents heat damage to soil organisms
- Reduces pollution from gas and particulate
- Recovers biochar



Top Lit (Firepit) Cone Kiln

Makes Char by Limiting Oxygen at Base of Fire

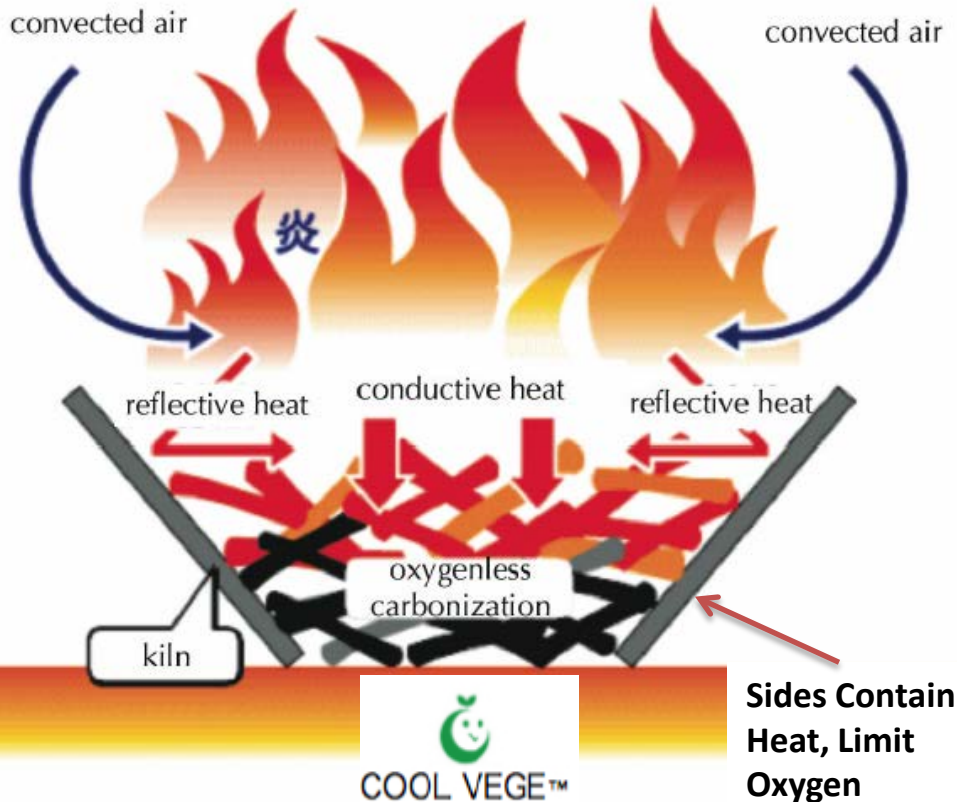


Bluesky Biochar

<http://youtu.be/bO9-RBaAq3U>

Wilson Backyard Biochar

www.backyardbiochar.net



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

Burn 2 hrs with dry wood
Biochar ~4.5 ft³/burn
(0.17 CY) Cost \$400

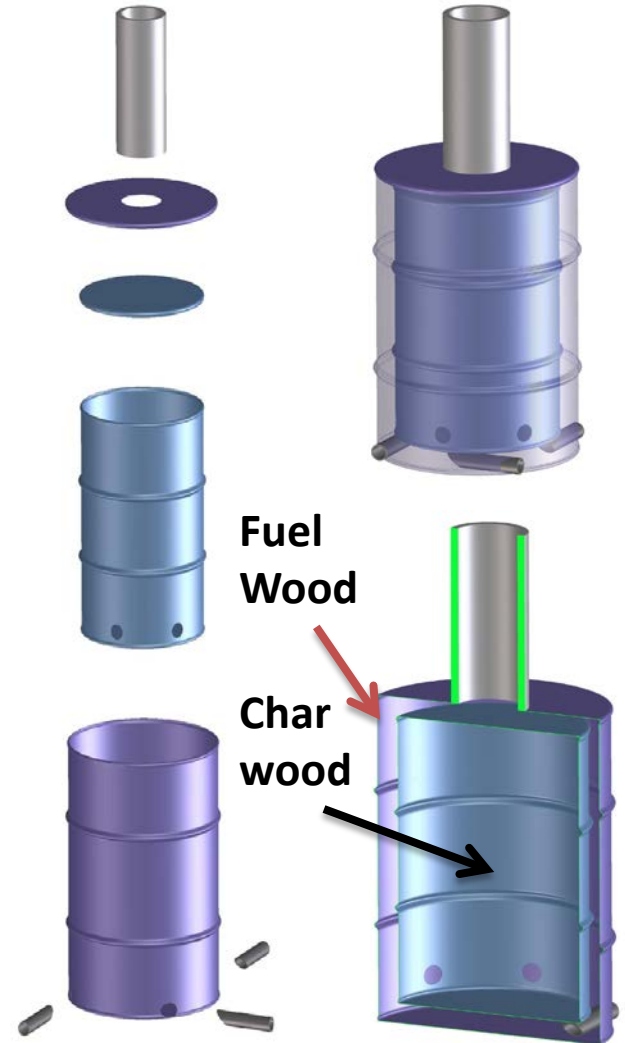
Heating Wood to Make Gas +Char in a Barrel Oven



Max Henderson
Kelpie Wilson



SIMPLE CHAR KILN
Folke Gunther



30 Gal in 50 Gal Barrel
1.5 ft³/Burn

Single Chamber Top Lit (TLUD) Batch Ovens



David Yarrow 55 Gal TLUD
Barrel Burner 3 ft³/burn .2CY

www.dyarrow.org/CarbonSmart

Karl Frogner, Doug Clayton
55 Gal TLUD Ovens

www.youtube.com/watch?v=IGsdma-2CkQ

www.youtube.com/watch?v=Kg95KYrH8PI

Making Biochar in TLUD Ovens for Water Treatment in Burma

55-gal TLUD drum pyrolyzer design can be made using only a machete – no electricity or power tools required. (**Josh Kearns, Aqueous Solutions**)



<https://www.facebook.com/media/set/?set=a.409998402469204.1073741830.119213051547742&type=3>

Cook and Char With Top Lit Updraft Gasifiers

- Batch load.
- Gases burn above fuel/char.
- Heat from flame and partial burning drives volatile gases from fuel.
- *Char* remains after volatiles burn



BioChar Cook Stove
Seachar.org



Cooking on the TLUD “Estufa Finca” in Costa Rica

Summary

- Biochar is made at large and small scales.
- Processing temperature determines biochar qualities.
- High carbon wood ash can be an useful source of carbon.
- Gasification systems can recover energy and biochar.
- Industrial pyrolyzers are growing in capacity.
- Small scale batch or continuous pyrolyzers and gasifiers systems can recover heat for on farm use.
- Small scale gasifiers can make biochar from residues.
- Stoves and small gasifiers can recover heat for cooking and drying.



www.biochar.bioenergylists.org

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Design and development of energy and environmental processes

Industries

Biomass energy

Pollution control

Materials handling

Feed, Food and Fuels

