

TLUD, Small scale gasification and flame cap kilns:

Small to Medium Devices for Low-cost Biochar Production

Presentation on the

Biochar Production Technology Panel

National Biochar Week Virtual Conference

December 8, 2020; 12:30 PM-12:40 PM EST

Paul S. Anderson, PhD psanders@ilstu.edu

Woodgas Pyrolytics, Inc. www.woodgas.energy

Normal, Illinois, USA

- This presentation slide deck and other documents mentioned today are already available now at:

www.woodgas.energy/resources

- Also available there is the **white paper**:

Climate Intervention with Biochar

This white paper will be discussed on a

Free webinar this Thursday 10 December 2020

from 9:00 to 10:30 AM Eastern Standard Time

on the www.GreenCarbonWebinar.org series.

Registration is by contacting c.wurzer@ed.ac.uk

Numerous Profit Centers from Pyrolytic Char Making

To only produce biochar
is usually NOT
sufficiently profitable.

Often production of
biochar is a nice
secondary co-benefit.

Charcoal Products

Biochar into soil
Char gasification
Fuel, filter, etc.

Thermal Energy

Applications of heat
Replace fossil fuels
Energy for life

Pyrolytic
Devices and
Technologies

Biomass Disposal

Avoid landfill
Fire protection
Air quality

Other

Benefits

Chemicals
Carbon Offsets
Climate benefits

Pyrolytic Technologies for Dry Biomass Fuels Are NOT Specific to Sizes of Devices

Without oxygen	Limited oxygen	Much oxygen
Retort Laboratory Adam retort Rotary kilns	Gasifiers (various types) Glowing pyrolysis (TLUD) Flame cap (Cavity kilns) <u>Open top:</u> Pit; trench; trough; pyramid; cone; Kon Tiki <u>Covered top:</u> "4C kiln" and RoCC kiln	"Conservation burn" Air curtain machines Industrial furnaces Incinerators Forest fire

Technical Note:
Not referring to the
oxygen that is in every
hydrocarbon molecule
of biomass.

Sizes for Pyrolytic Biochar Production

Classified by **Orders of Magnitude** of input of biomass per 10 hrs of operation

- Laboratory (< 1 kg)
- Micro (1 to 10 kg.)
- Small (10 to 100 kg)
- Midi (100 kg to 1 ton)
- Medium (1 t to 10 t)
- Large (10 ton to 100 t)
- Industrial (> 100 t)

**Seven
Orders of
Magnitude !**

Sizes for Pyrolytic Biochar Production

Classified by **Orders of Magnitude** of input of biomass per 10 hrs of operation

- | | <u>Objectives</u> |
|----------------------------------|--------------------------|
| • Laboratory (< 1 kg) | R&D /testing |
| • Micro (1 to 10 kg.) | Cooking |
| • Small (10 to 100 kg) | Making |
| • Midi (100 kg to 1 ton) | Biochar |
| • Medium (1 t to 10 t) | To be determined |
| • Large (10 ton to 100 t) | Char/chem/power |
| • Industrial (> 100 t) | CHP (char secondary) |

Yes my topic if low cost

NOT my topic

Sizes for Pyrolytic Biochar Production **NOT my topic**

Air Curtain for Biomass
Reduction w/ less biochar



Rotary Kiln



Industrial furnaces
for heat with char
in the ashes.

- Large (10 ton to 100 t)
- Industrial (> 100 t)
Char production is secondary



Sizes for Pyrolytic Biochar Production **Yes, my topic**

- **Laboratory (< 1 kg)**
 - **Micro (1 to 10 kg.)**
 - Small (10 to 100 kg)
 - Midi (100 kg to 1 ton)
 - Medium (1 t to 10 t)
 - Large (10 ton to 100 t)
 - Industrial (> 100 t)
- **Cookstoves for heat; char is secondary**
 - TLUD (Top-Lit UpDraft) make very good char.
 - Residential & institutional stoves



**FABSTOVE**
MAKES & BURNS GAS FROM BIOMASS

Forced air (FA)



Natural draft (ND)

Sizes for Pyrolytic Biochar Production

- **Laboratory (< 1 kg)**
 - **Micro (1 to 10 kg.)**
 - ~0.8 kg/day of biochar
= ~300 kg/yr
 - Nearly 100,000 TLUD stoves in West Bengal and Assam, India
= ~80 tonnes/day
 - **World potential:**
• > 75 Mt/yr of biochar
= 0.25 Gt CDR/yr
- **Cookstoves for heat; char is secondary**
 - TLUD (Top-Lit UpDraft) make very good char.
 - Residential & institutional stoves



**FABSTOVE**
MAKES & BURNS GAS FROM BIOMASS

Forced air (FA)



Natural draft (ND) "Champion"

Sizes for Pyrolytic Biochar Production

- Laboratory (< 1 kg)
 - Micro (1 to 10 kg.)
 - **Small (10 to 100 kg)**
 - **Midi (100 kg to 1 ton)**
Making Biochar
 - Medium (1 t to 10 t)
 - Large (10 ton to 100 t)
 - Industrial (> 100 t)
- TLUD barrels:**
Singles or multiples
Very low cost for good biochar.
Must have dry fuel !!
Needs labor; Never automated



Retorts:

Adam Retort

Moderate investment

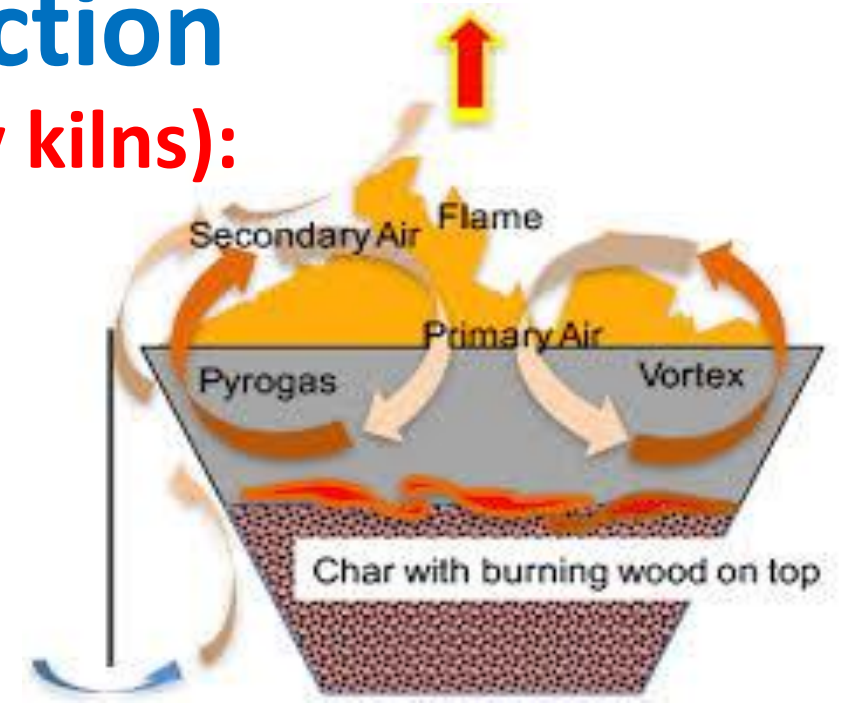
Not automated

Sizes for Pyrolytic Biochar Production

Pit and trench designs
Physical labor

- Small (10 to 100 kg)
- Midi (100 kg to 1 ton)

Flame cap (open cavity kilns):



Trough



Pyramid



Cone / Kon Tiki

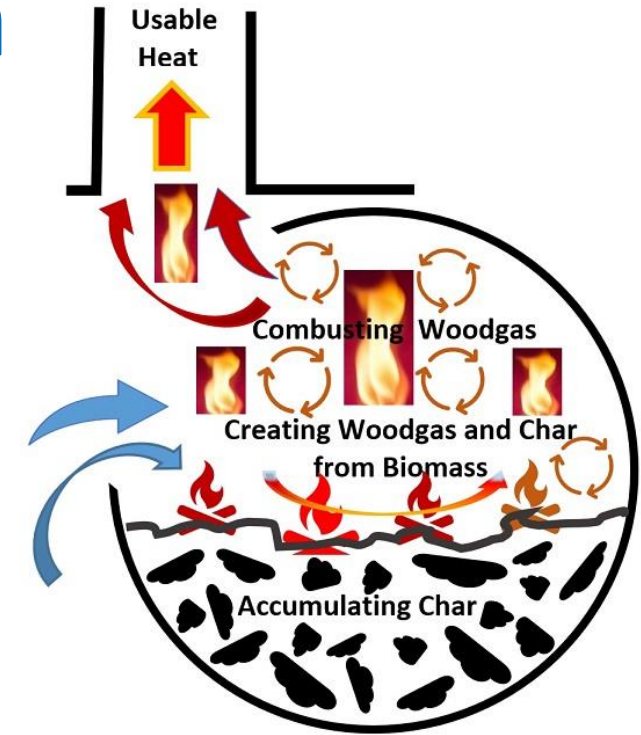


Sizes for Pyrolytic Biochar Production

Flame cap (covered cavity kilns):



- Small (10 to 100 kg)
- Midi (100 kg to 1 ton)



Sizes of RoCC Kilns: Midi

Barrel-size kilns:

(100 to 1000 kg/day biomass input)

Upper left is front view in Illinois, USA.

38-inch (970 mm)
Diameter x 48-inch
(1220 mm) Length
unit in India.

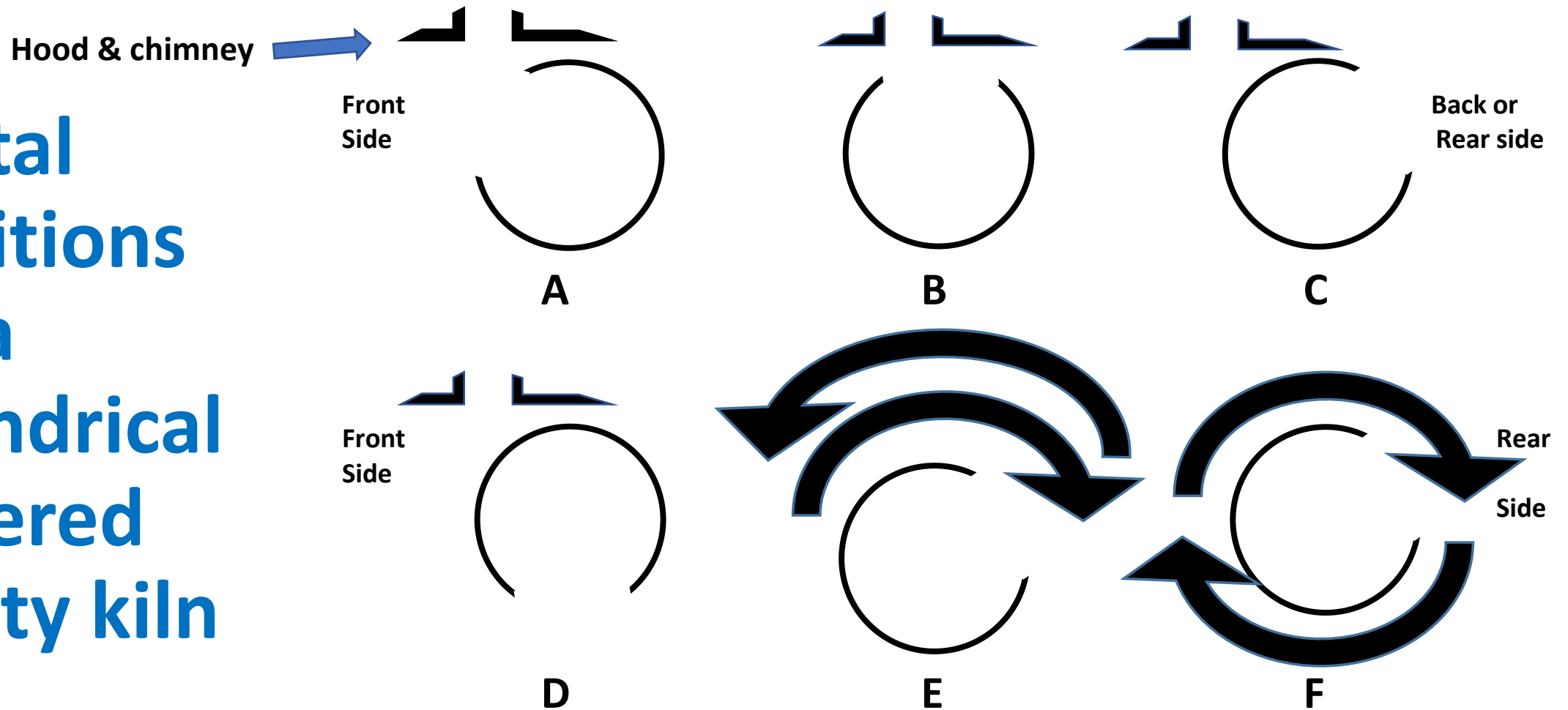
In Kenya, lower left is front view and below is rear view when not in the normal operational position.

Front view at right.
Rear view below.



Prior presentations about RoCC technology are at www.woodgas.energy/resources

Portal positions on a cylindrical covered cavity kiln



Portal position	Position Name	Purpose	Observations
6A 270 to 350	Shelf fuel feeding	Slide in fuel on shelf	"Normal" position; best flame cap.
6B 320 to 40	Straight up	Slow the fire	Least air entry; "simmer".
6C 10 to 90	Bulk fuel feeding	Drop in fuel	Short time only; lacks draft.
6D 140 to 220	Straight down	Unloading	Used sparingly for brief times.
6E Roll 240	Rocking back and forth	Tumble w/o dumping	Use common sense; varies w/ fuel type.
6F Roll 360+	Full rotation	Mixing extensively	Subject to conditional limitations.

RoCC n' Roll kiln

- Designed for "residential," woodlot and educational use.
- Shown is number four of the five experimental versions thus far.
- Latest design and further information will be given at the webinar on Thursday December 10, 2020.

RoCC n' Roll barrel kiln processes approximately 25 kg per hour, or a quarter ton in 10 hours of operation, yielding about 50 kg of biochar.



Availability of product or construction plans is not yet determined. Seeking associates for development and/or business.

**RoCC n' Roll
kiln
sequence of
biochar
production**



RoCC n' Roll kilns for woodlot, field and residential biochar production

A [Past] presentation to the

Green Carbon Webinar Series on 12 November 2020

Recording available at www.greencarbonwebinar.org

Paul S. Anderson, PhD

psanders@ilstu.edu

Woodgas Pyrolytics, Inc

[Including content from Gary Gilmore]



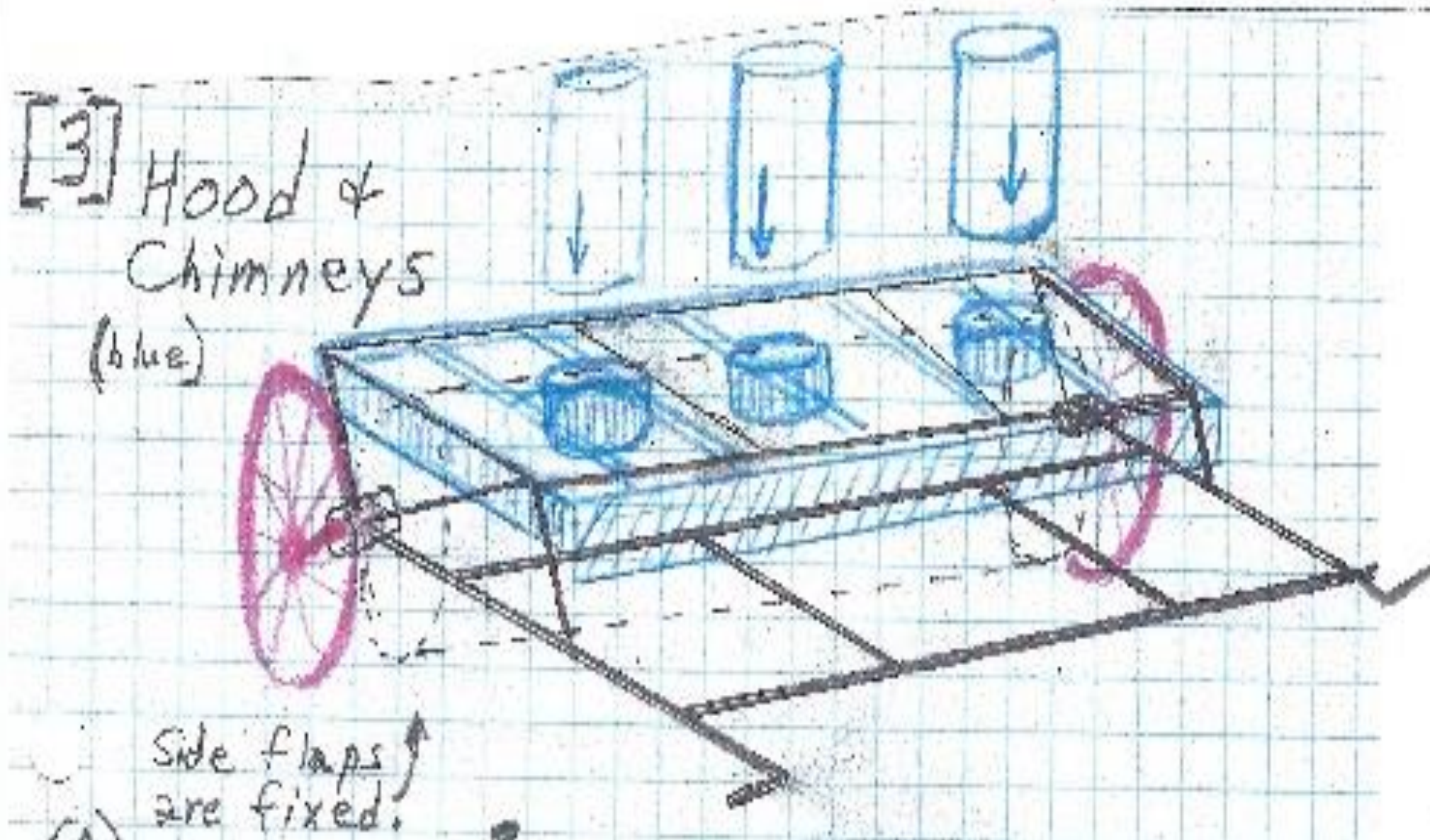
Sizes of RoCC Kilns: Medium

(100 to 1000 kg/day biomass input)



Size shown
is 4- ft
(1.22 m)
diameter
by 5-ft
(1.52 m)
length

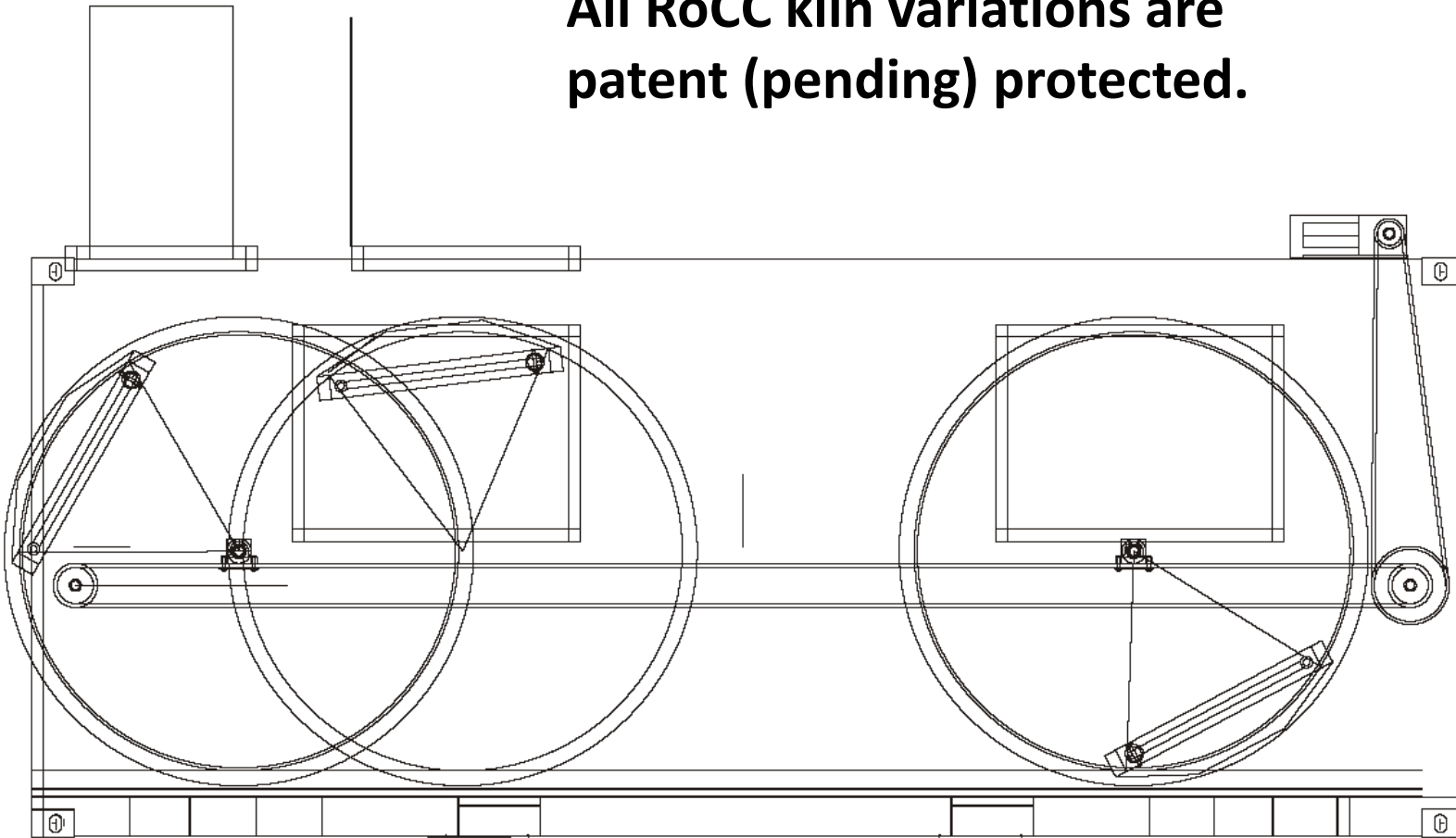
In-field RoCC Kiln for Crop Refuse (Design only)



RoCC Kiln in Construction: 6 ft D x 7 ft L

Inside a 20- ft Shipping Container

**All RoCC kiln variations are
patent (pending) protected.**



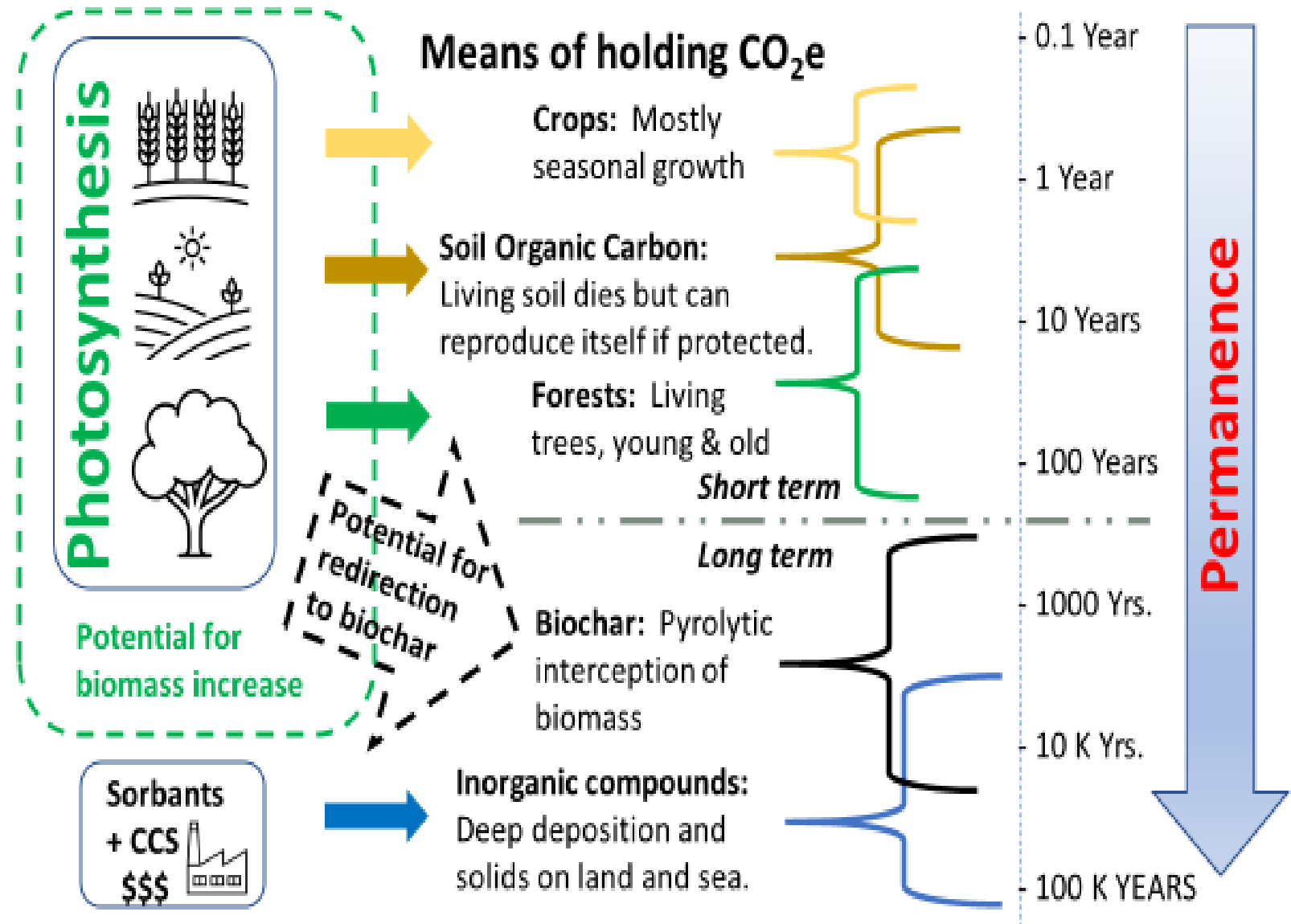
- Currently in construction in central Illinois with testing scheduled for January 2020.
- Scale to larger sizes will depend on results and future funding / sales / business associates.
- If interested, write to Paul S. Anderson at: psanders@ilstu.edu

The objective is
CO₂ Removal
and
Keeping it removed.

**Long-term
Sequestration**

**Clear winners
are plants with
Biochar !**

Options for Carbon Dioxide Removal (CDR) with Permanence



Contact Information

Paul S. Anderson, PhD -- aka "Dr TLUD"

Phones: Mobile and Text: +1-309-531-4434

Home Office: +1-309-452-7072 (USA Central Time Zone)

Email: psanders@ilstu.edu

Websites:

www.woodgas.energy (Site of **Woodgas Pyrolytics, Inc.**, home of RoCC kilns)

www.drctlud.com (Site of materials about TLUD micro-gasifier stoves)

www.JuntosNFP.org (Site of non-profit efforts about stoves and biochar)

Active with the Biochar discussion group. Join at: main@biochar.groups.io

Further deliveries during Biochar Week 2020

- Yesterday Monday **7 December**. Public release of **white paper** at

www.woodgas.energy

"Climate Intervention with Biochar"

Why and how there can be **removal of 5 to 10 gigatons of CO₂e/yr via Biochar and Energy (BC&E)** as a Negative Emission Technology (NET).

- Thursday **10 December** on the free **Green Carbon Webinar series** that starts at 9:00 AM (EST). 90-minutes for presentation, panel, and Q&A **about the white paper** without duplication of the material at the Nat'l Biochar Week. Hosted in the UK. Access to Zoom via registration with host Christian Wurzer c.wurzer@ed.ac.uk Website: **www.greencarbonwebinar.org**