California Department of Food and Agriculture
ENVIRONMENTAL FARMING ACT SCIENCE ADVISORY PANEL

MEETING AGENDA

December 19, 2014
10 AM to 4 PM

Room 133
California Department of Food and Agriculture
1220 N Street
Sacramento, CA 95814

Call in information:
Please call 1-877-238-3903
Participant passcode - 6655460#

GoToMeeting Information
Meeting ID: 921-143-141
https://global.gotomeeting.com/join/921143141

Don Cameron, Member and Chair
Mark Nechodom, PhD, Member
Jocelyn Gretz, MSc, Member
Mike Tollstrup, Member
Jeff Dlott, PhD, Member
Luana Kiger, MSc, Subject Matter Expert
Doug Parker, PhD, Subject Matter Expert

1. Introductions	Mr. Cameron
2. updates	
• Minutes from previous meetings	Dr. Gunasekara
• State Water Efficiency and Enhancement Program (SWEEP)	Mrs. Cook
• GEELA update	Mr. Whatmore
• AB 32 Scoping Plan activities	Mrs. Cook
3. Biochar	Mr. Cameron
• Speaker 1 – Steve McIntyre, Monterey Pacific	
• Speaker 2 – Jim Boyd, Clean Tech Advocates	
• Speaker 3 – Peter Hirst, New England Biochar LLC	
• Speaker 4 – Dr. Johannes Lehmann, Chairman of International Biochar Initiative (1-2 pm)	
Discussion	Mr. Cameron
4. Public comment	
5. Next meeting and adjournment	Mr. Cameron

Amrith Gunasekara, PhD, CDFA Liaison to the Science Panel

All meeting facilities are accessible to persons with disabilities. If you require reasonable accommodation as defined by the American with Disabilities Act, or if you have questions regarding this public meeting, please contact Amrith Gunasekara at (916) 654-0433.
More information at: http://cdfa.ca.gov/Meetings.html and http://www.cdfa.ca.gov/EnvironmentalStewardship/Meetings_Presentations.html

MONTEREY PACIFIC

Biochar

Why Use of Biochar is Attractive for Farming

- Increases water holding capacity of soil, increasing crop tolerance to drought by increasing the ability of soils to retain water and nutrients.
- Increases soil capacity to absorb chemicals and minerals, providing nutrients to plants rather than being lost to groundwater (eg. absorbs phosphate)
- Biochar still contains most of the nutrients in the feedstock and will release these nutrients over time
- Biochar is a relatively low density material that helps to lower the bulk density of heavy soils, increasing drainage, aeration, and root penetration.
- Biochar is a liming agent that will help off set the acidifying effects of N fertilizers, thereby reducing the need for liming.
- Soil incorporation improves resource use by soil biota, creating healthier soils

Current Drawbacks to Increased Biochar Use in Agriculture

- Limited availability
- High cost (due to biochar scarcity and transport of feedstocks)
- Lack of comprehensive knowledge re biochar benefits
- Similar manufacturing methods can still produce a variable product
- Farmers grow their own carbon, so are reticent to purchase carbon as a fertilizer
- Sometimes advertised as such, but not a silver bullet

How Biochar use in Ag can reduce GHG

- Avoiding the emissions from biomass decomposition at land fill sites.
- Avoiding emissions from burning of ag waste

- Biochar is a stable form of carbon and will remain in the soil for many hundreds of years (effective sequestration).
- N_2O and CH_4 emissions from soil can be reduced by biochar application.
- Reduced emissions associated with fertilizer usage, less N and P lost
- The energy produced in the pyrolysis process is 2-4x what it takes to make it

How to Increase Biochar Use in Ag

- Utilize abundant local sources of carbon for pyrolysis – agricultural and woody waste
- Focus on high value crops with a long-term payback
- Develop biochar standards and testing (IBI)
- Develop standardized trials to test feedstocks/pyrolysis so benefits can be confirmed

- Credits of some kind for biochar use?
- <u>Bring biochar production to the local level</u>

Solution:
Mobile Pyrolysis Plant that follows the feedstock

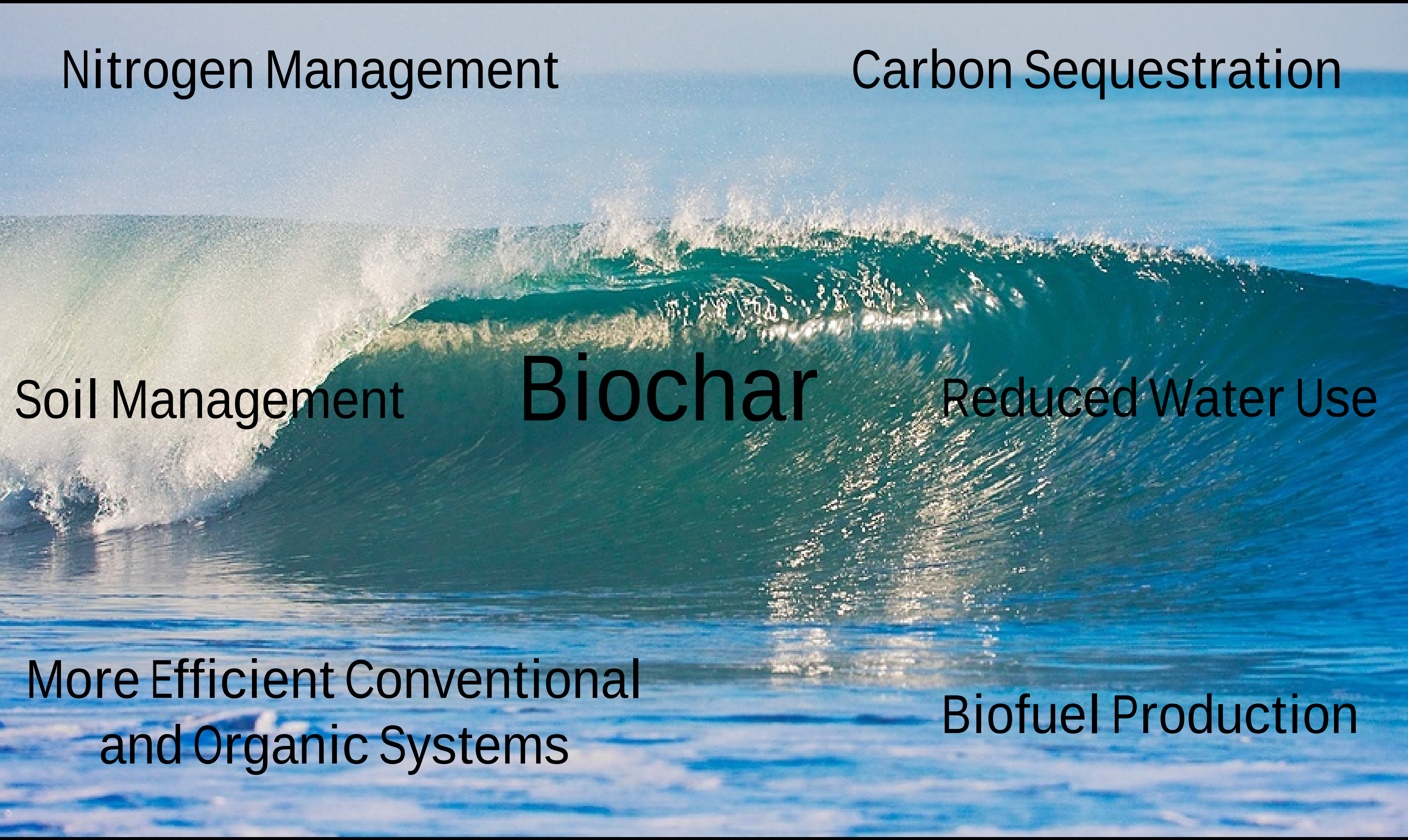

SYSTEM RESET
SYSTEM START
OPERATOR INTERFACE PANEL
ALARM
ALARM SILENCE


Quenching

Immediate applications for use of mobile pyrolysis

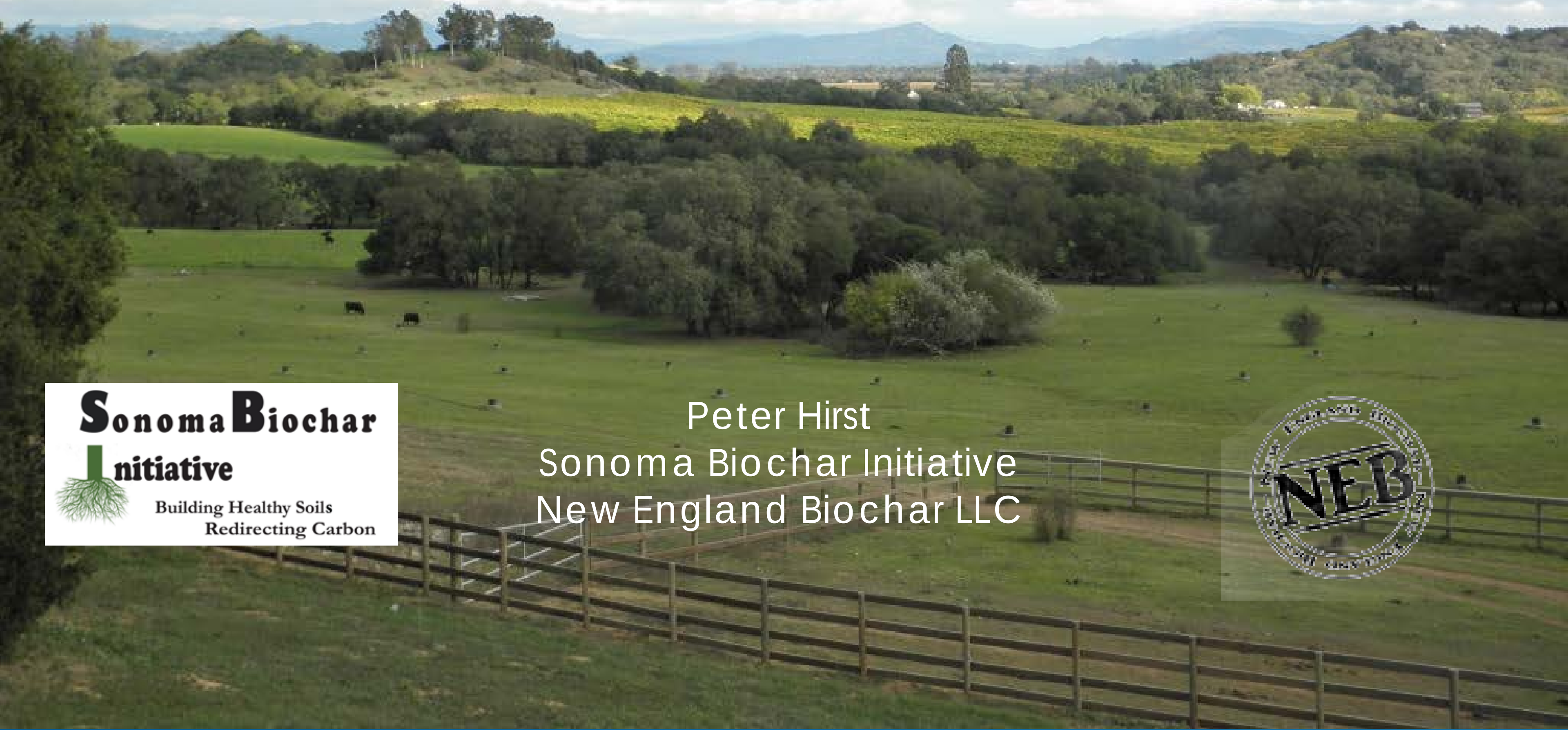
½ mile long, 80 year old eucalyptus windbreak along Hwy 101 to be removed by CALTRANS in 2015 (alongside ranch managed by MPI)


Salinas River channel removal of invasive woody weeds for improved flow and flood control 2015-?


Nitrogen Management
Carbon Sequestration
Biochar
Soil Management
Reduced Water Use
More Efficient Conventional and Organic Systems
Biofuel Production

Biochar for Water Conservation

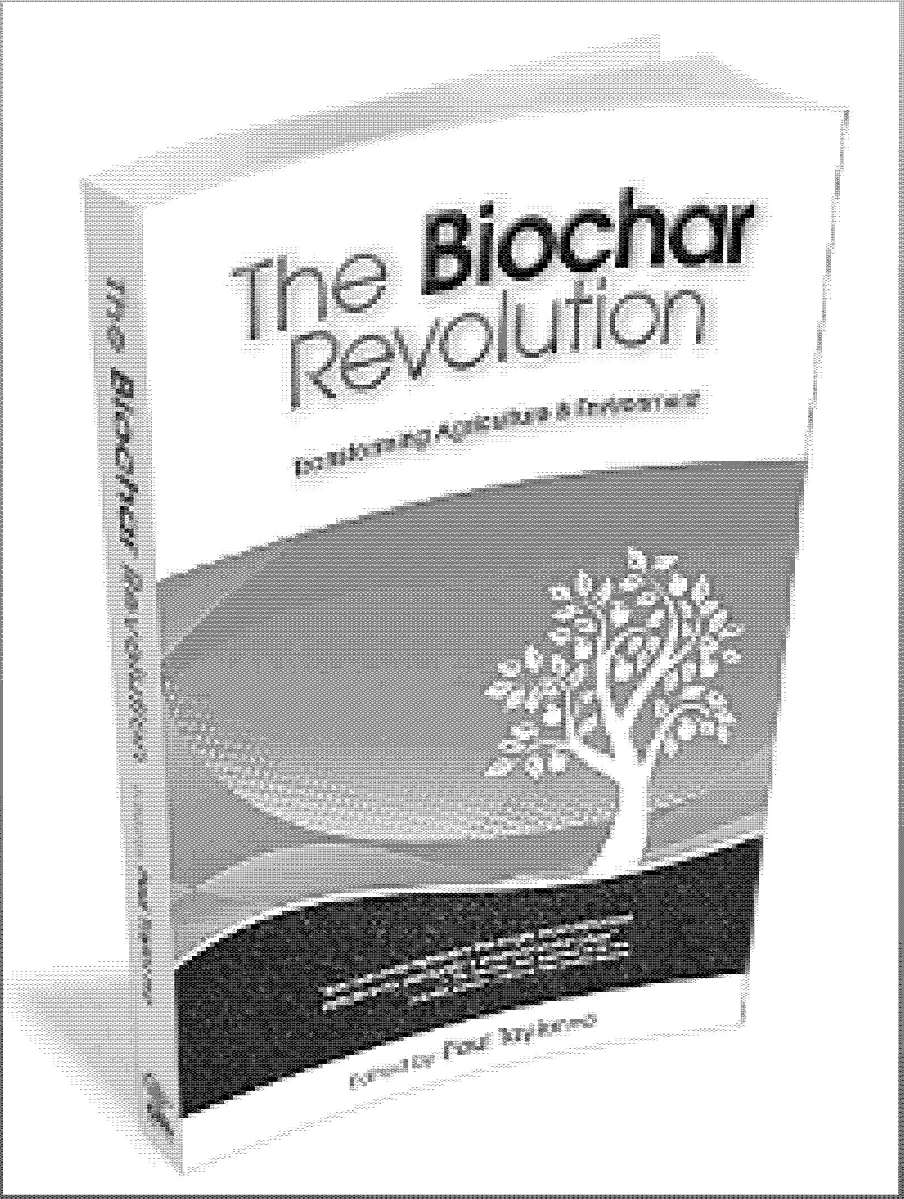
Environmental Farming Act Science Advisory Panel Meeting - December 19, 2014

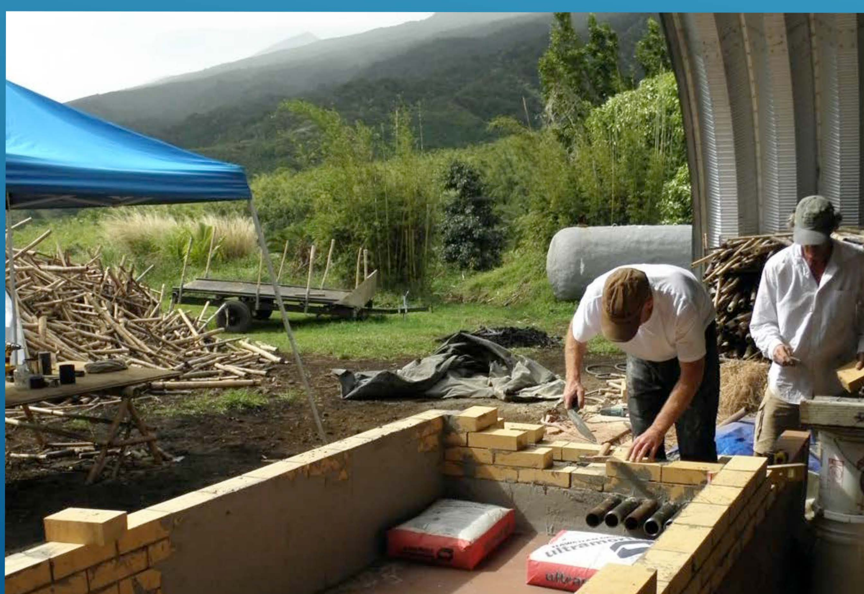


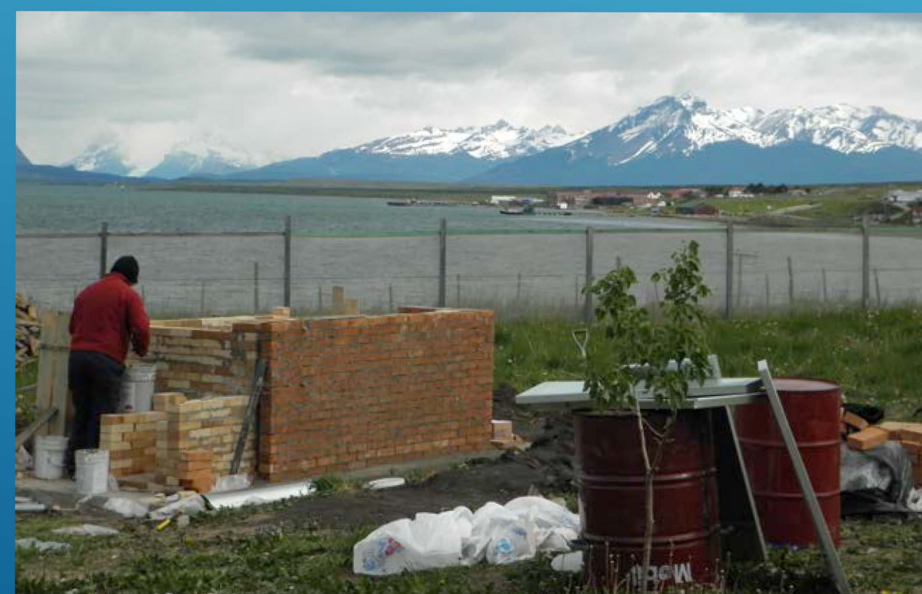
Peter Hirst
Sonoma Biochar Initiative
New England Biochar LLC

NEW ENGLAND BIOCHAR
NEB


Shelburne Farms


The Biochar Revolution






ITCI

Triple Adam Retort at Living Web Farm, NC

13-Foot tall tomatoes in second set: 22lbs per plant to date, Nov 12, 2013

2012 US Biochar Initiative National Conference - Sonoma State University

CAFF Workshop at Santa Rosa Junior College Shone Farm

SBI Workshop Circle Bar Ranch Carneros

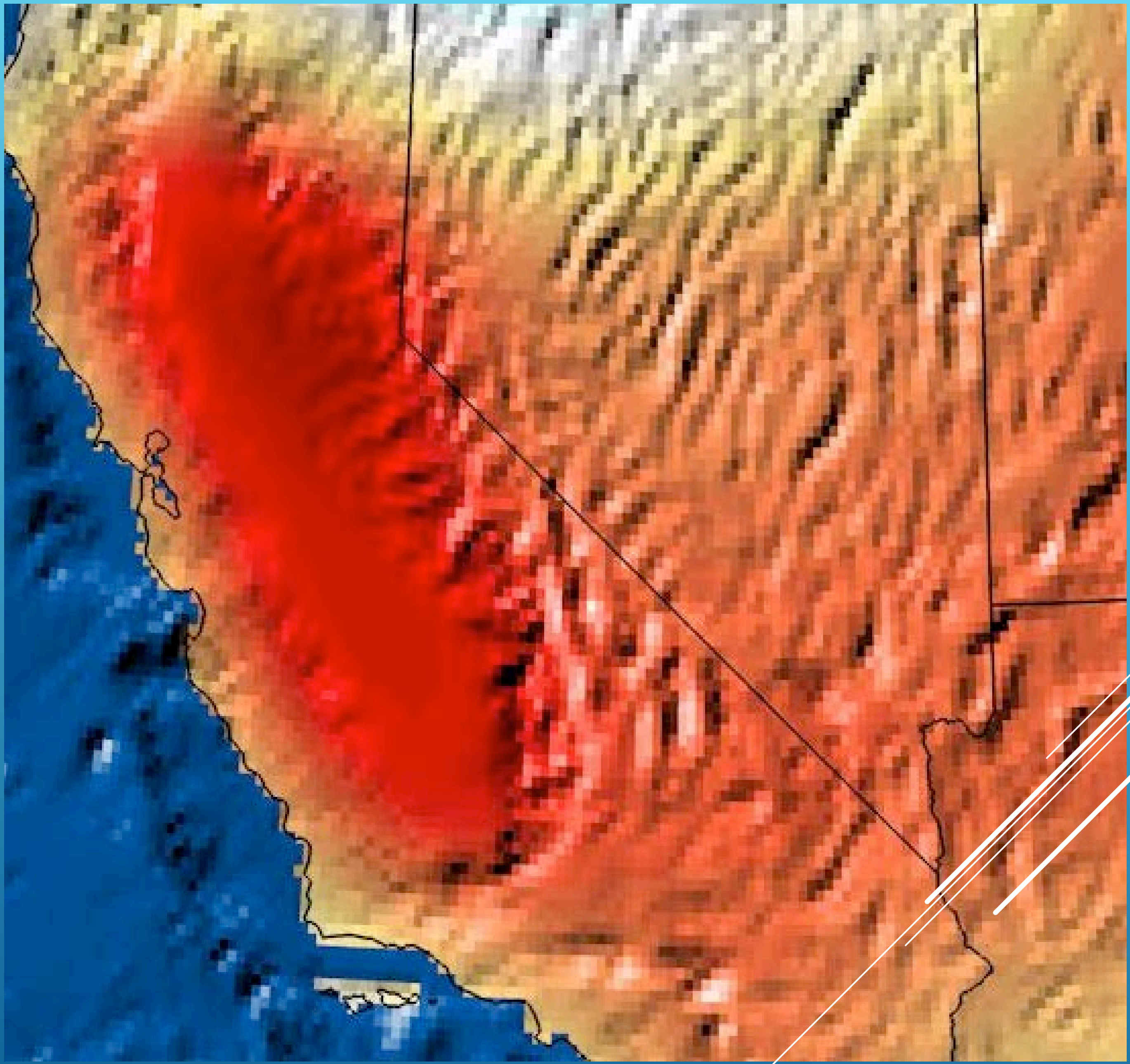

Inaugural Session of The Biochar School
November 7th-11th / Swallow Valley Farm
Valley Ford, California
Photo: Raymond Baltar

Swallow Valley Farm
Valley Ford

Green String Farm
Petaluma

Oak Hill Farm
Glen Ellen

NASA calculates that it will take 11 trillion gallons of water to turn this red patch blue again.



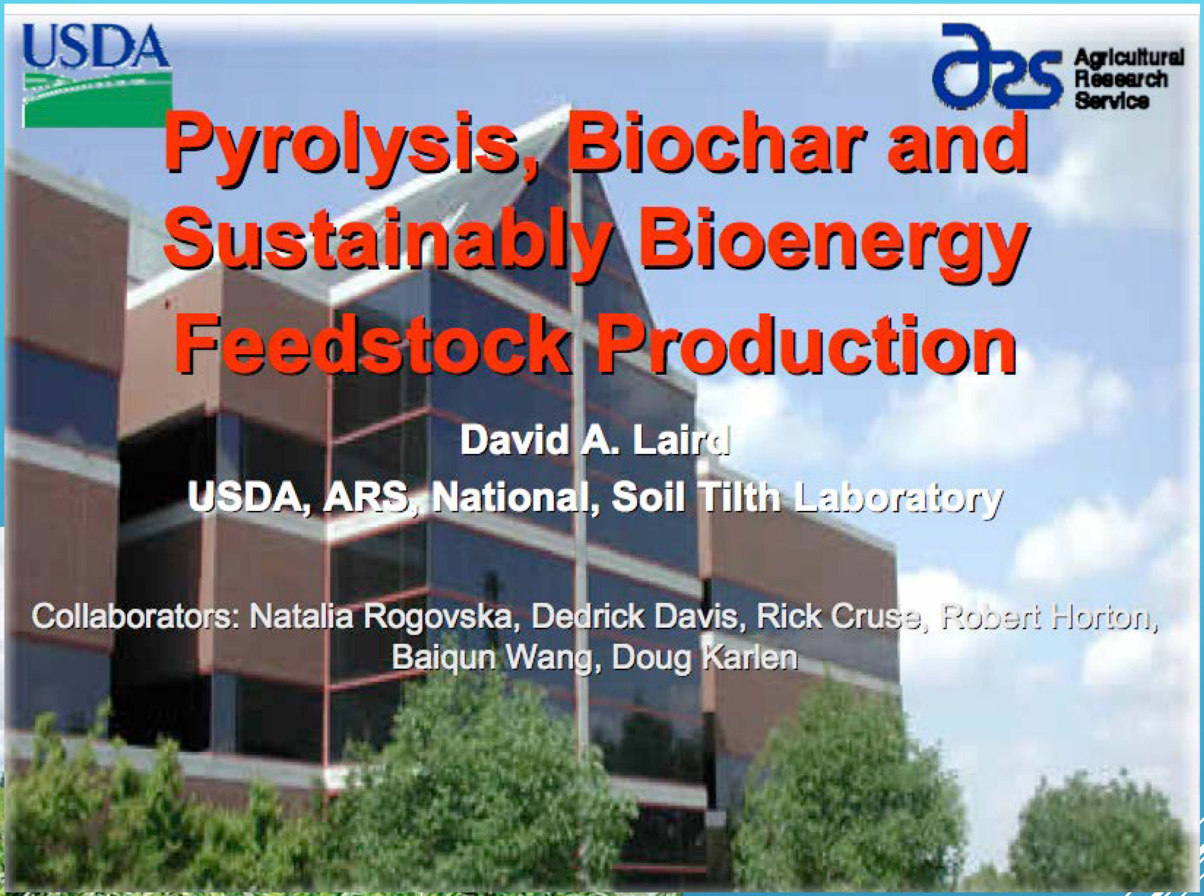
“Field trials are a potentially powerful communication tool . . .”

--Field Trials as an Extension Technique: David G. Abler, Ganesh P. Rauniyar, and Frank M. Goode, 1992

Rick Green, 3d generation family rice farmer, WIllows

Biochar compost trials finding faster rates of maturation


Copyright Brett Cole


USDA
Agricultural Research Service
Pyrolysis, Biochar and Sustainably Bioenergy Feedstock Production
David A. Laird
USDA, ARS, National, Soil Tilth Laboratory
Collaborators: Natalia Rogovska, Dedrick Davis, Rick Cruse, Robert Horton, Baiqun Wang, Doug Karlen


CA Suppliers/Consultants

- Greenleaf Energy, Scotia Biomass Plant
- New England Biochar LLC, Valley Ford
- Pacific Biochar, Willows
- Blue Sky Biochar, Thousand Oaks
- Phoenix Energy, Merced, Modesto, Cabin Creek
- Cool Planet Energy, Camarillo
- Charborn, Santa Barbara
- BioCharm, San Rafael
- Full Circle Biochar, San Francisco
- Sonoma Compost, Petaluma

CA Labs- Biochar

Dr. Sanjai Parikh, Environmental Soil Chemistry, UCD
Dr. David Smart, Oakville Station, UCD
Frank Shields-Soil Control Lab, Watsonville
reNUWit Research Center, Stanford University
Dr. Gerardo Diaz, Dept. of Engineering, UC Merced

- SBI-Sonoma County Biochar Project
- Southern CA Biochar Initiative, Thousand Oaks
- Rick Green, 3d gen family rice grower, Willows
- City of Manteca & MUSD - Teaching Farm
- Steve McIntyre - Monterey Pacific
- Bob Cannard/Alice Waters- Green String Farm
- Redwood Forest Foundation Inc., Usal Forest, Mendocino
- Randall Grahm, Bonny Doon Vineyards
- Regenerative Design Institute, Penny Livingston, Bolinas
- Dixon Ridge Farms, Winters

"As most biochar research has been conducted at the laboratory- or bench-scale, large-scale field applications of biochar practices and technologies are needed..."

Eric Byous, Physical Scientist, Water Efficiency Sustainable Infrastructure Office, USEPA, Region 9

“The country needs and, unless I mistake its temper, the country demands bold, persistent experimentation. It is common sense to take a method and try it: If it fails, admit it frankly and try another. But above all, try something.”

-Franklin Delano Roosevelt-

Oglethorpe University Commencement Address
22 May 1932

RESOURCE
CONSERVATION DISTRICTS

North Coast RC&D Council

SONOMA
ECOLOGY
CENTER

SONOMA
COUNTY
WATER
AGENCY

USDA

Gold Ridge
Resource Conservation District

Sonoma Biochar
Initiative
Redirecting Carbon
Building Healthy Soil

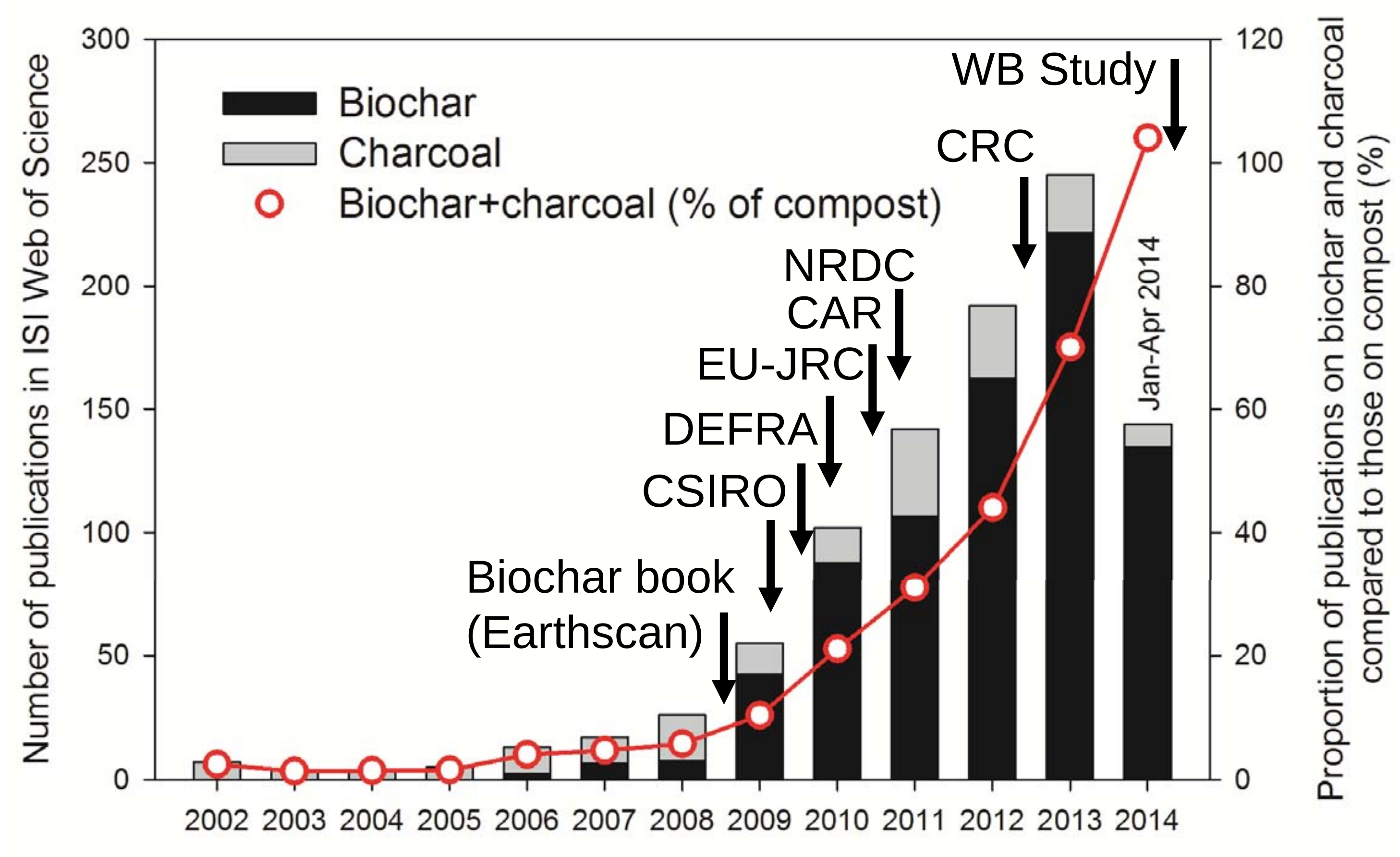
Biochar Systems:
Climate Mitigation and Soil Fertility Management

Johannes Lehmann

Cornell University

International Biochar Initiative

Biochar Science over the Past Decade

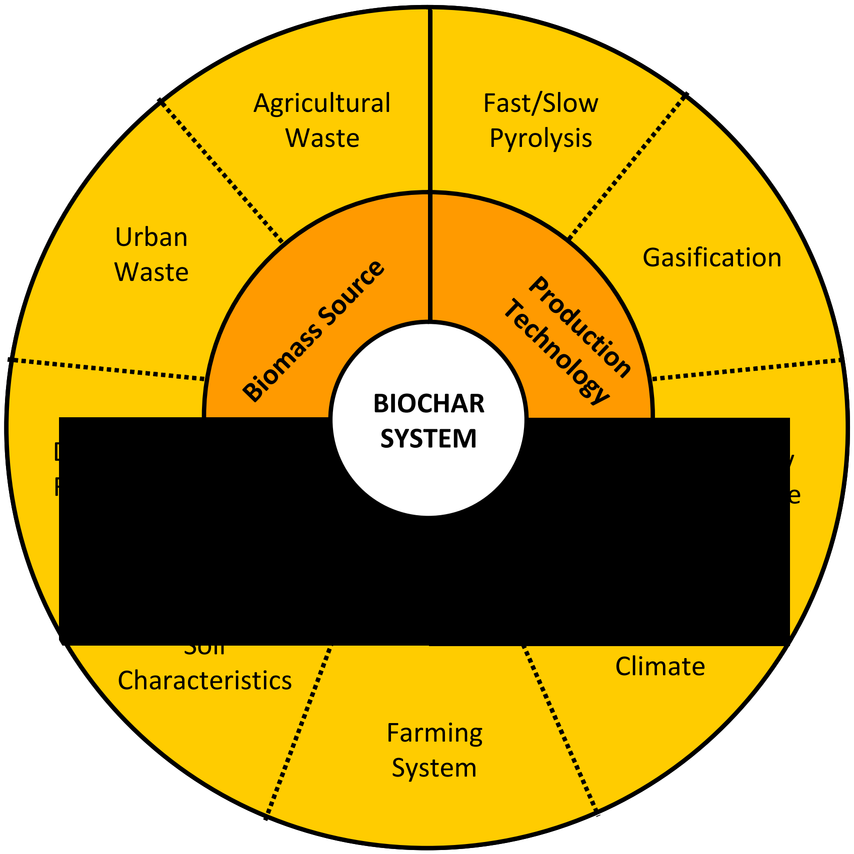


Biochar research has accelerated over the past 5 years

Cornell University

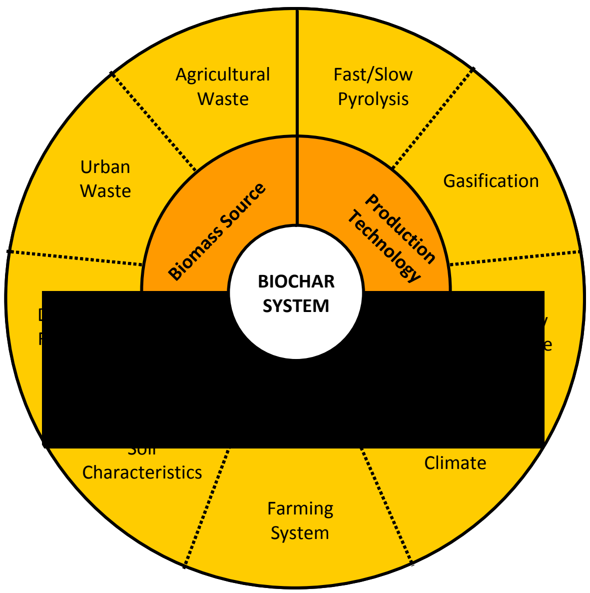
Lehmann and Joseph, 2015, *Earthscan*

Biochar Systems



Biochar ≠ Biochar

Biochar system ≠ Biochar system

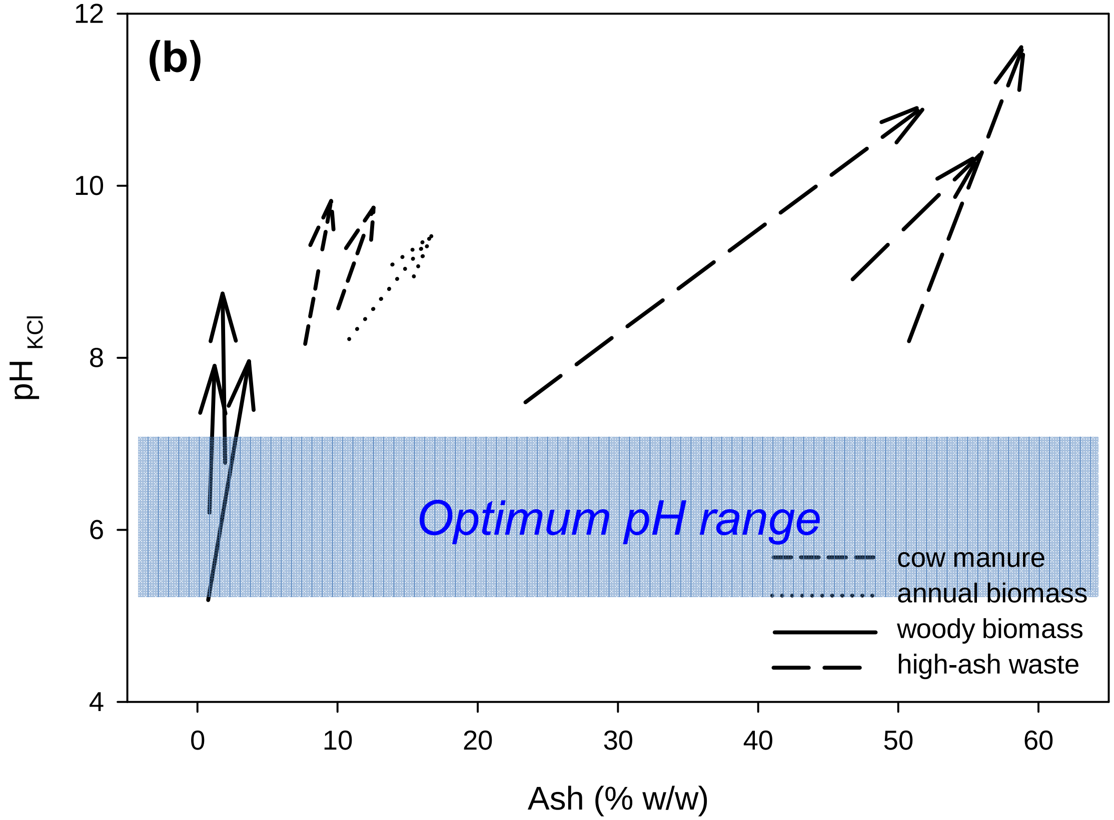


Key Biochar Properties

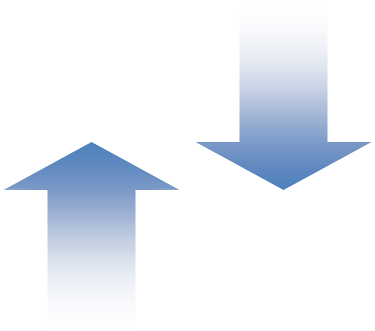
	Other organic amendments	Biochars
Persistence (MRT)	weeks to years	years to millenia
Water retention	↑↑↑	↑↑↑
Nutrient retention	↑↑↑	↑↑↑↑ (after oxidation)
Plant diseases	↓↓↓	↓↓↓
Nutrient additions	↓ to ↑↑↑	↓ to ↑↑↑↑
Liming effect	↓	↓ to ↑↑↑
Pollutant remediation	↓ to ↑	↓ to ↑↑↑↑↑

"Tunable"
Not fully combinable (trade-offs)

Biochar Properties



Arrows from lowest to highest temperature within a given feedstock



Example pH: biochars can be generated with pH above or below optimum soil pH – opportunity for tuning biochar to soil needs (within limits)

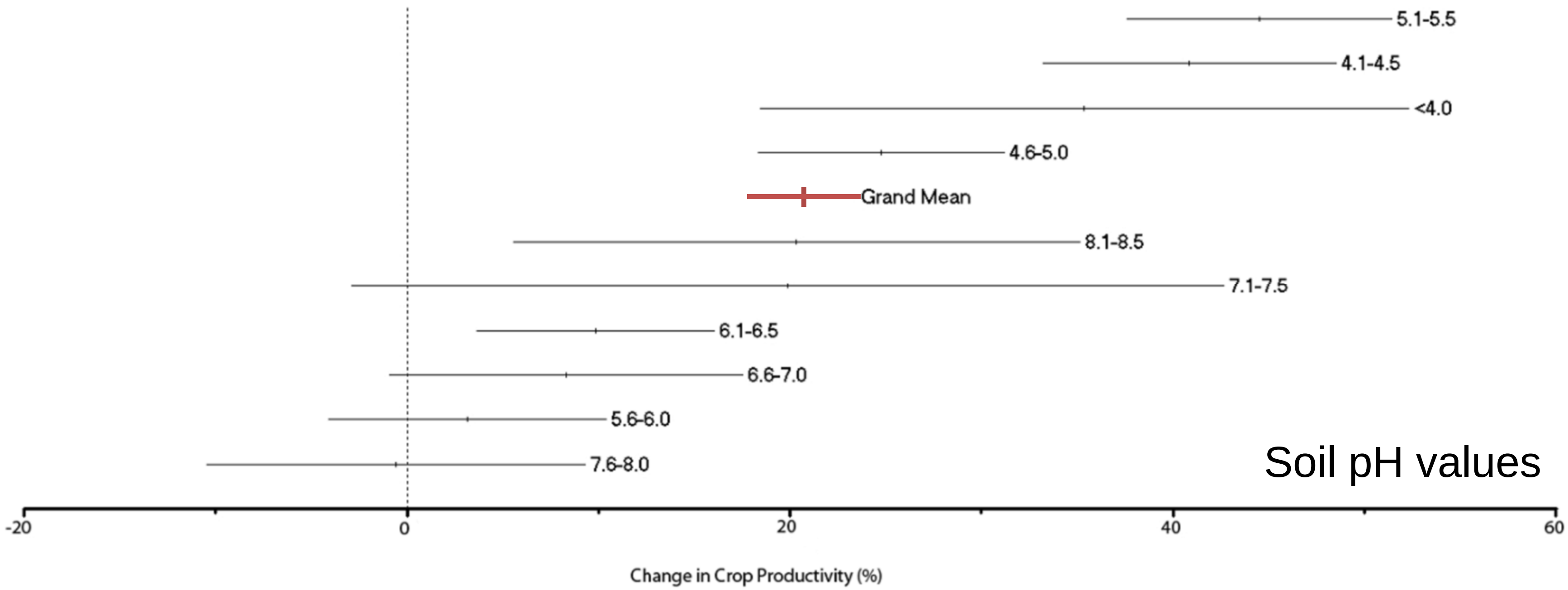
Slow pyrolysis

Enders et al.,2012, Bioresource Technology 114, 644-653

Cornell University

Yield Effects of Biochars

Meta-analysis



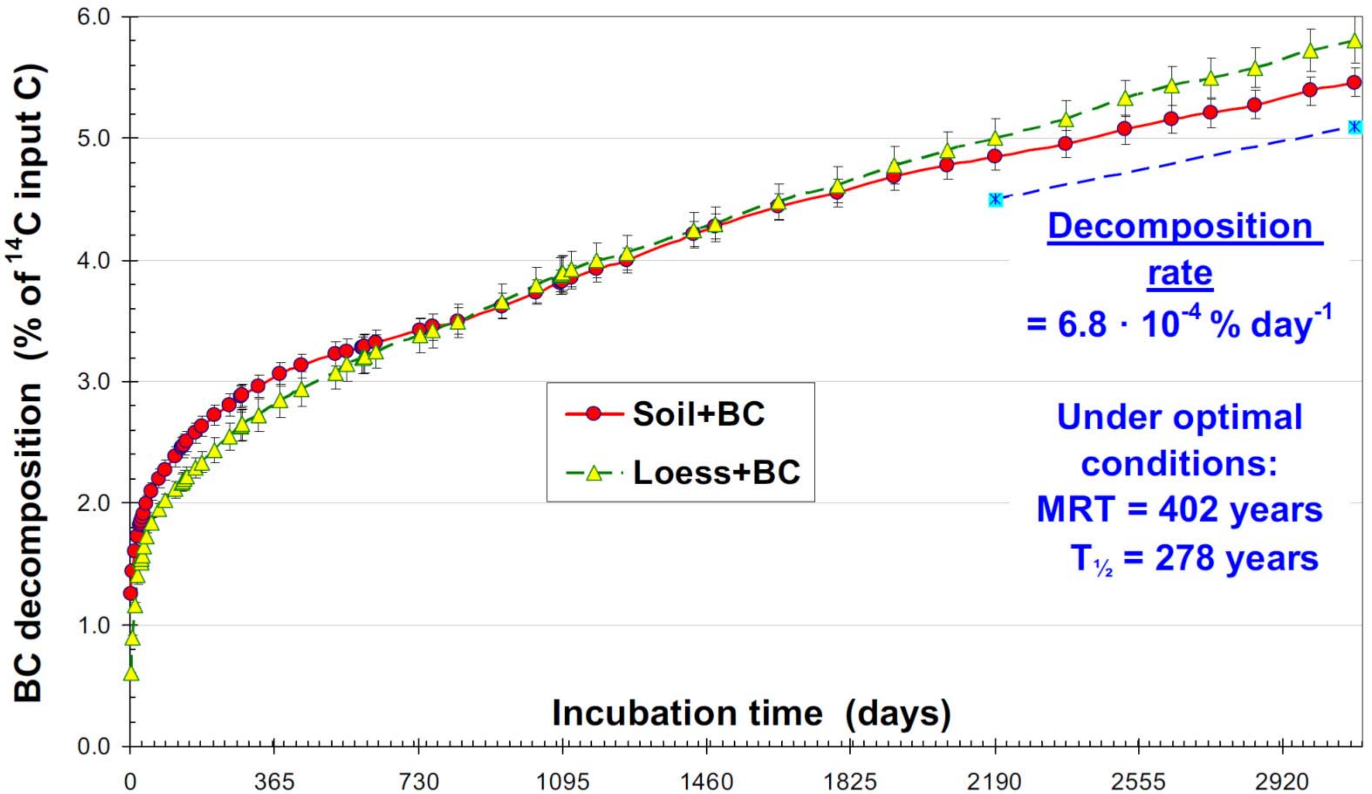
(n=60 studies)

Cornell University

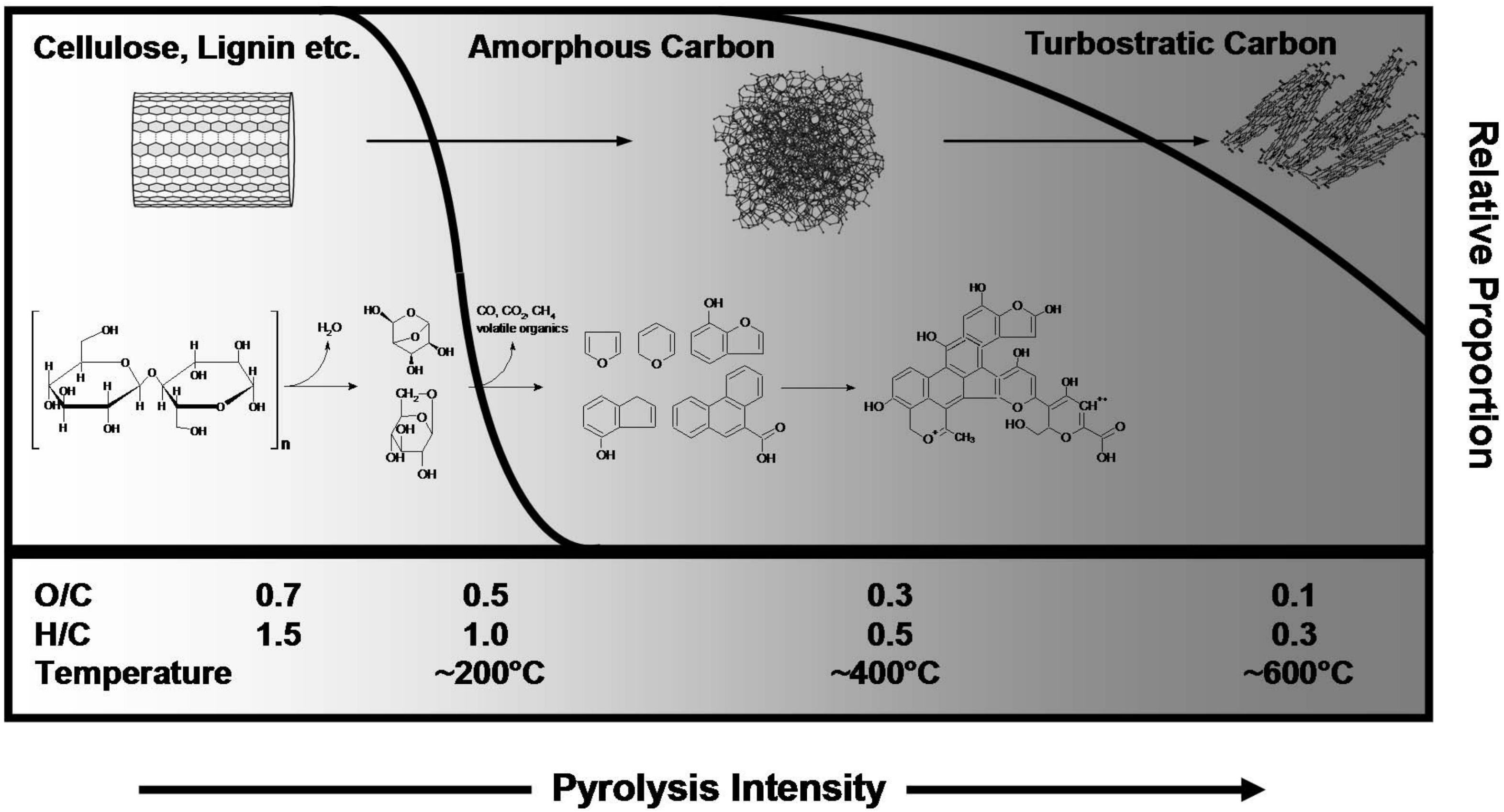
Jeffery et al, 2015, *Earthscan*

Biochar Persistence in Soil

Mean residence time of 400 years under optimum water and temperature (calculated to 4,000 years in the field)

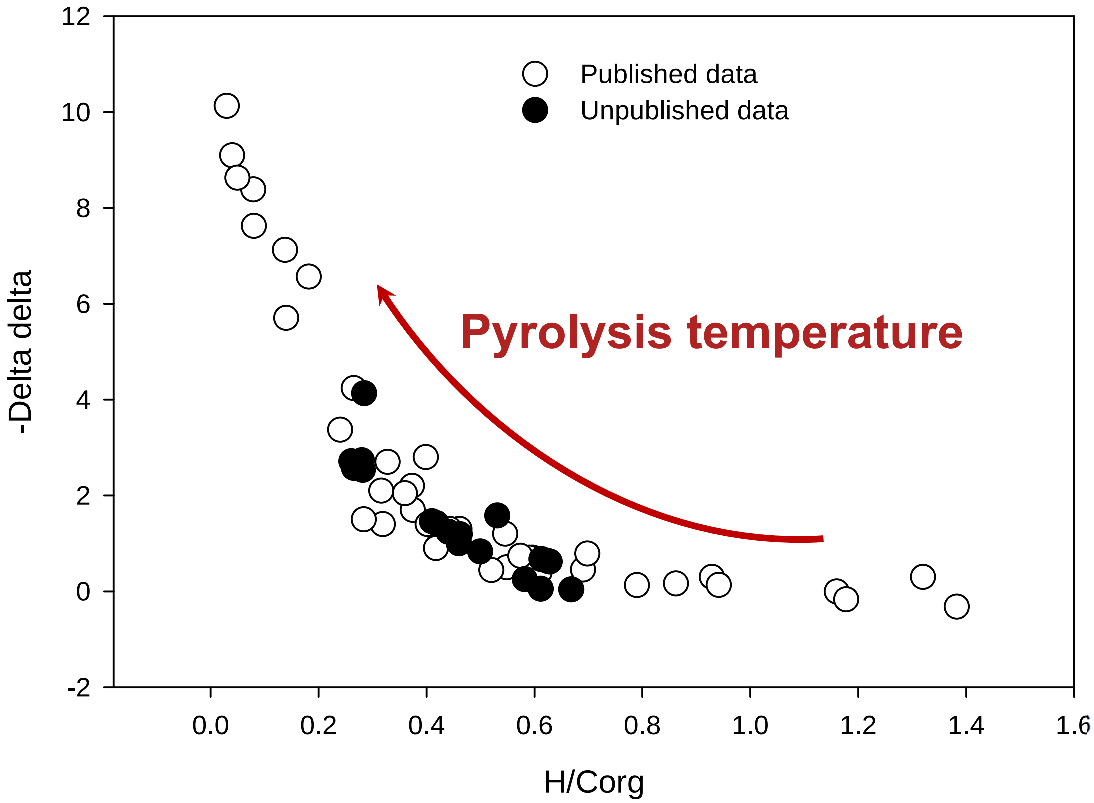


What happens during Pyrolysis?

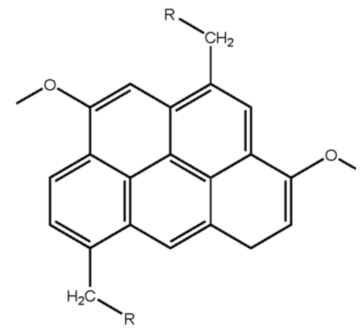


Lehmann et al., 2010, in: Imperial College Press, London

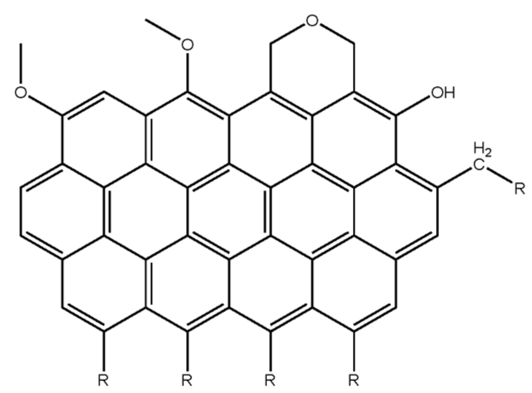
H/Corg as a Proxy for Fused Aromatic C



Corn-350-BC



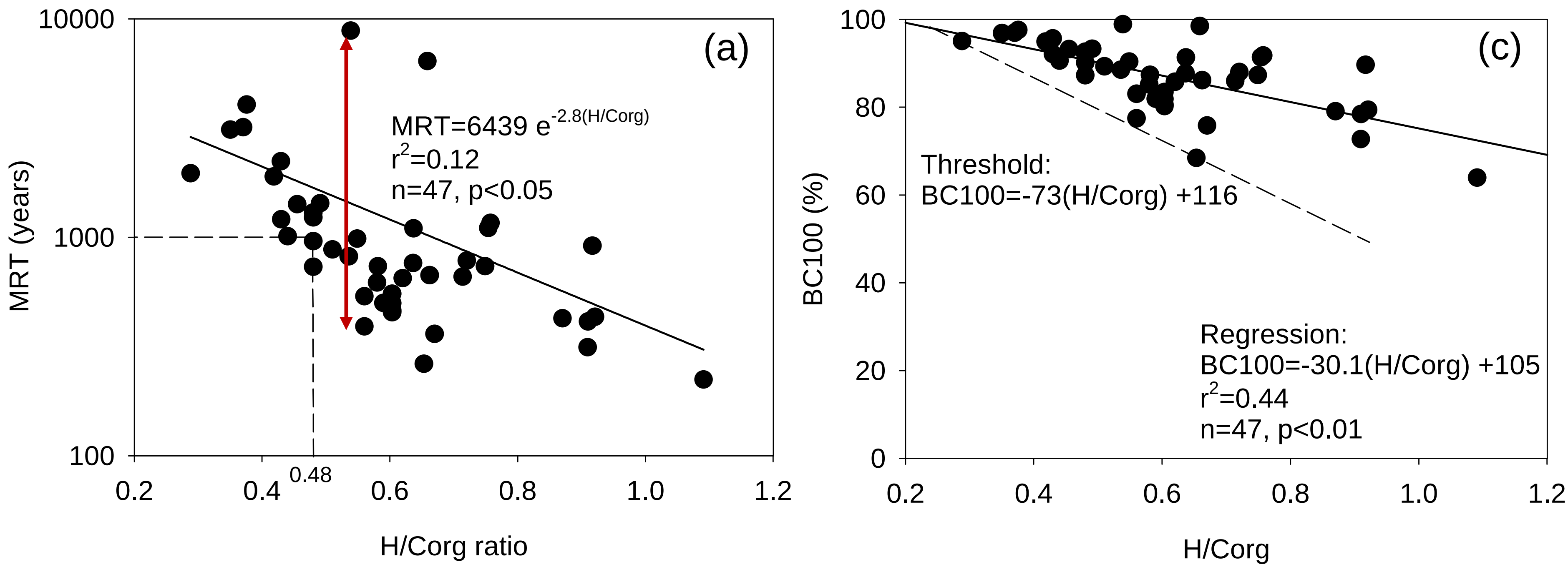
Corn-600-BC



Cornell University

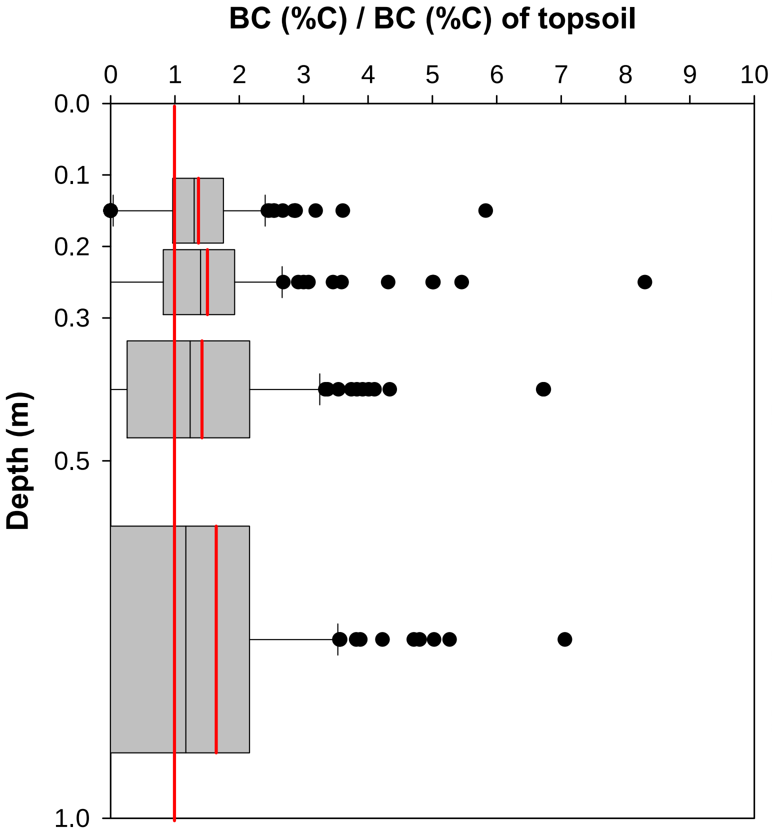
Nguyen et al. 2010, ES&T
McBeath and Smernik, 2009, OG
McBeath et al., 2011, OG
Sydney Expert meeting 2014, unpubl.

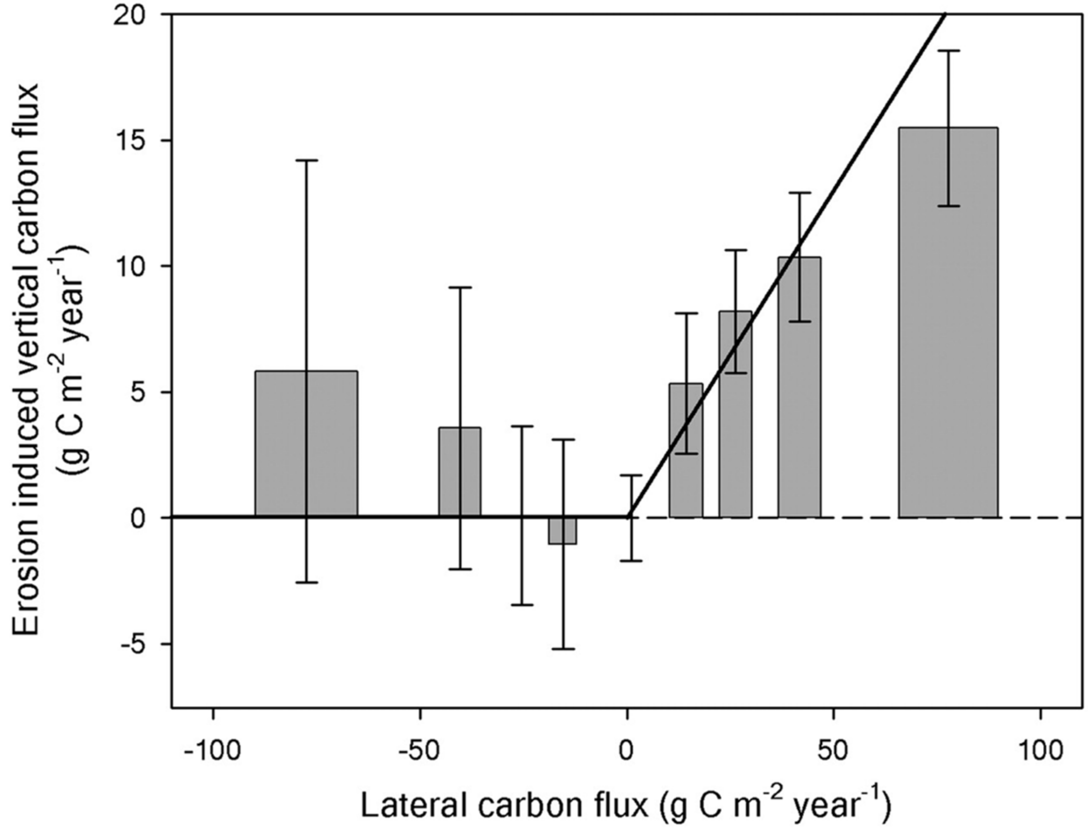
Biochar Persistence in Soil



Biochars with low H/Corg ratios have high persistence
Biochars made at >500ºC from wood have H/Corg <0.48
Biomass has H/Corg >1.4
Very conservative, includes field and laboratory experiments

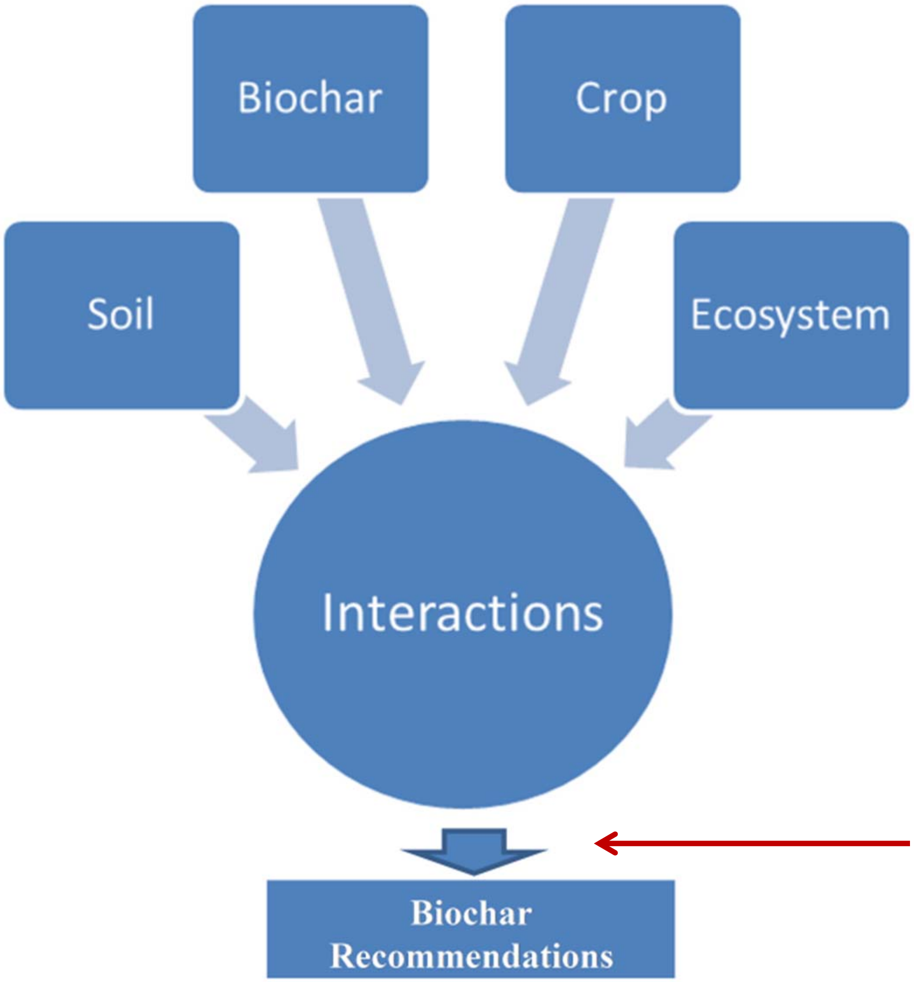
Movement ≠ Mineralization

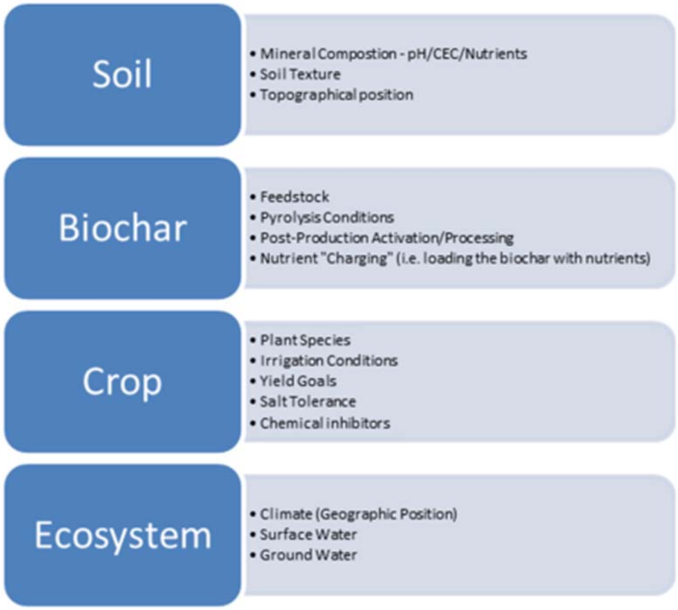




Van Oost et al., 2007, Science 318:626-629
Disaggregated from
Lehmann et al., 2008, Nature Geo. 1: 832–835

Biochar Decision System



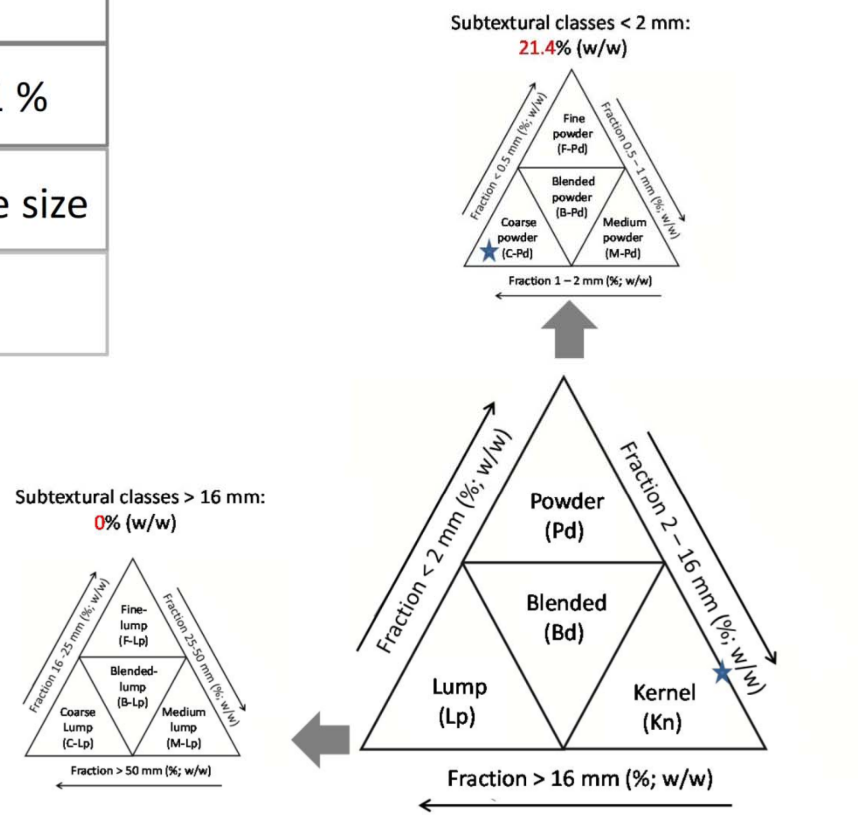


International Biochar Initiative

Biochar Decision System

Carbon storage classes	1	sBC_{+100} = 240 g kg^{-1}
Fertiliser classes	2	P_{3t} Mg_{9t}
Liming classes	3	$Liming_{eq}$ 15.1 %
Particle size classes	Kn	Kernel particle size
Suitability for soilless agriculture		Not tested

Example: Biochar from biosolids mixed with eucalyptus wood produced at 550°C



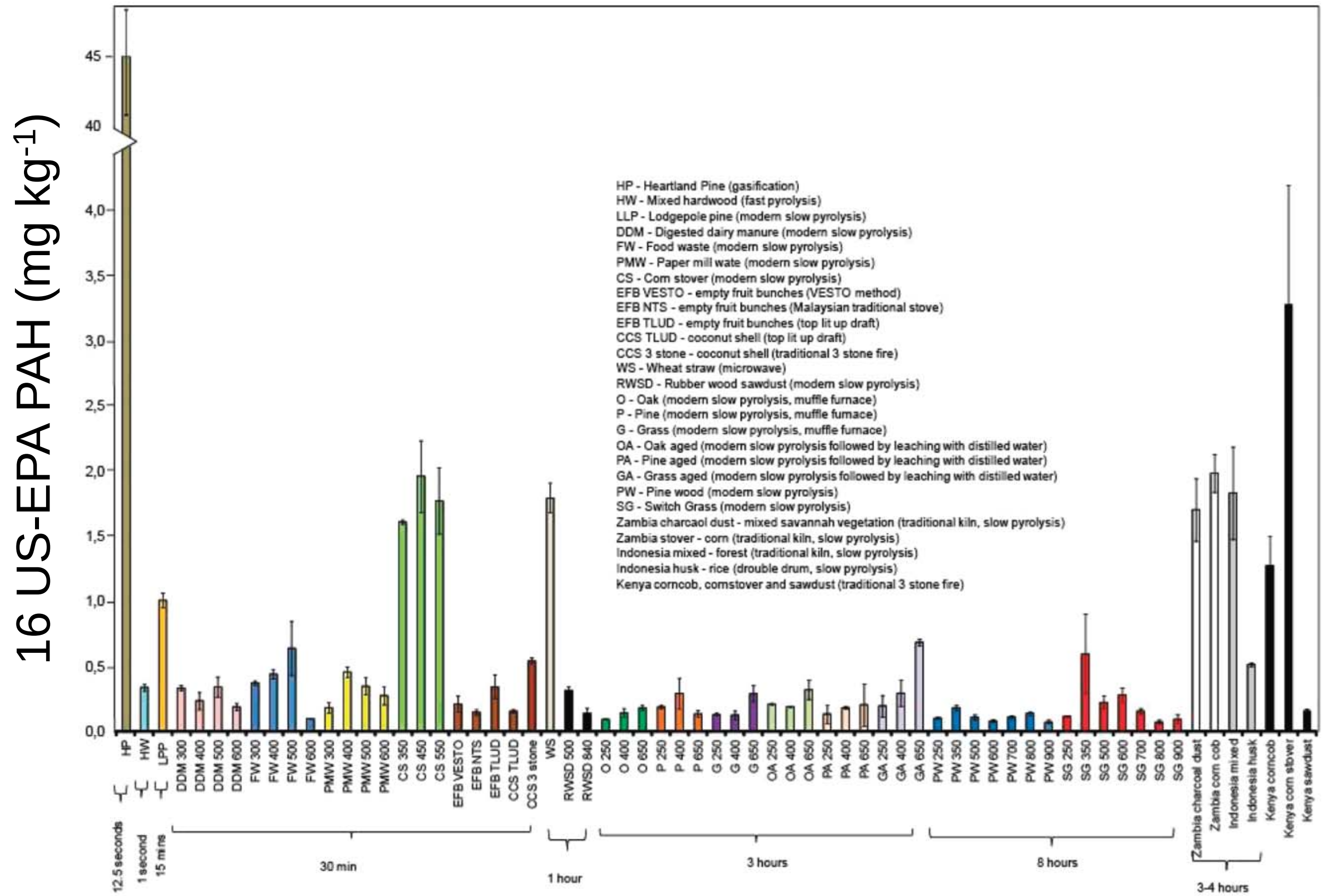
FERTILISER GRADE

Total N = 1.66%	Avail. N/total N = 4.6%
Total P_2O_5 = 11.60%	Avail. P/total P = 36.4%
Total K_2O = 0.84%	Avail. K/total K = 53.6%
Total S = 0.21%	Avail. S/total S = 34.9%
Total MgO = 0.52%	Avail. Mg/total Mg = 79.3 %
Total CaO = 3.22%	Avail. Ca/total Ca = 84.5 %

Camps et al., 2015, *Earthscan*

Biochar Toxins

Heavy metal in = heavy metal out, but for PAH:



PAH (mg kg^{-1}):

Australian regulation on soil amendments: 300

Cattle manure slurries: 87−309
Pig slurries: 66−339
Sewage sludge: 1.7−126
Compost: 0.8−2.7

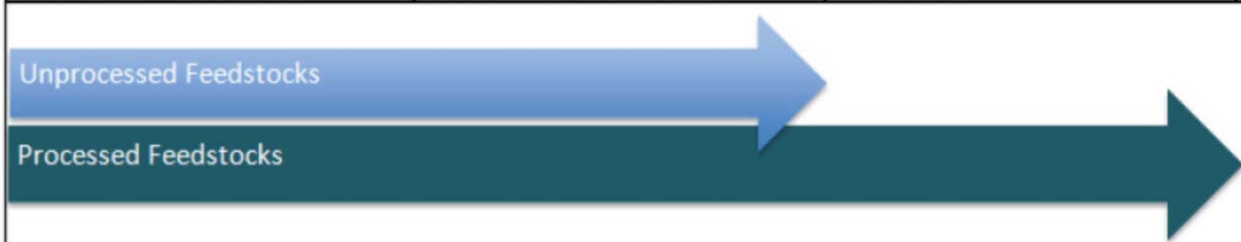
Cornell University

Hale et al, 2012, *ES&T 46, 2830−2838*

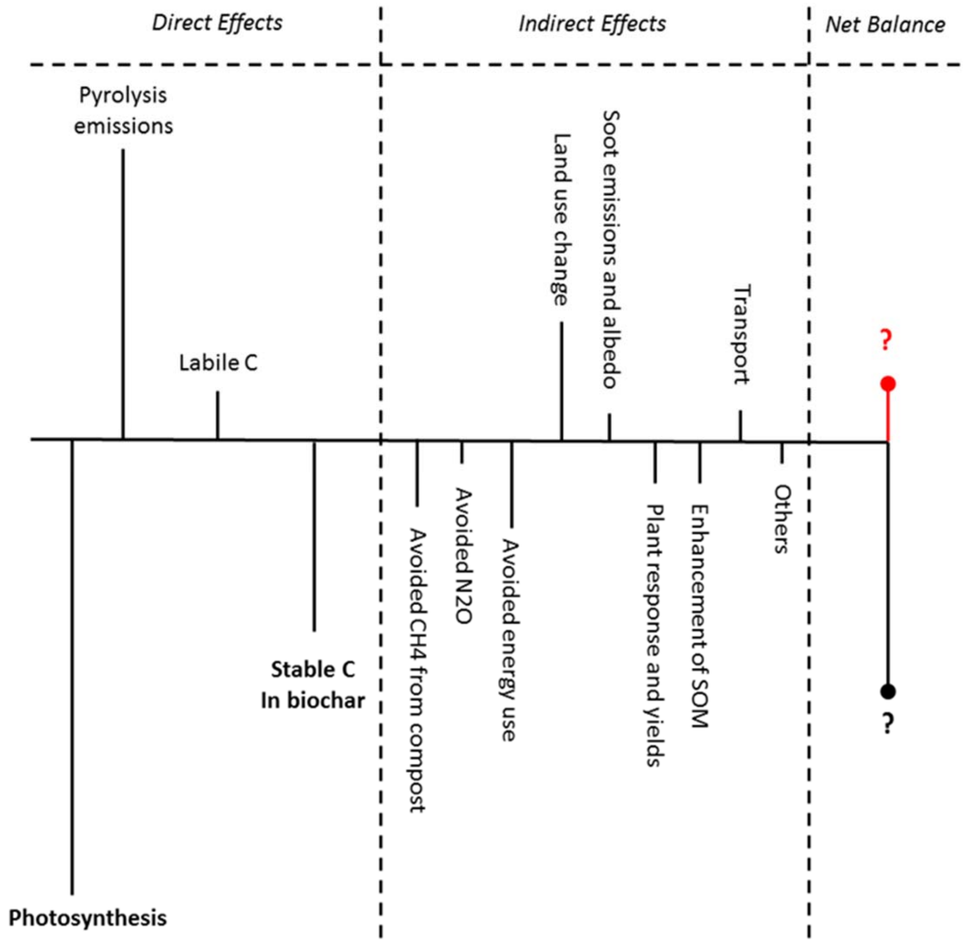
Guidelines and Certification

International Biochar Initiative

A. Basic Utility Properties	B. Basic Toxin Assessment	C. SupplementalToxin Assessment	D. Advanced Analysis and Soil Enhancement Properties
Measures the most basic parameters required to assess the utility of biochars for use in soil.	Analyzes potential toxins that are not feedstock-dependent that can be produced by the thermochemical processes used to make biochar – Polycyclic Aromatic Hydrocarbons (PAH), dioxin and furan. Tests for vegetative and invertebrate vigor are also required.	Tests for additional toxins and elements that may be found in processed feedstocks – heavy metals, other metals and PCB.	Tests for additional biochar characteristics. Biochar advanced analysis characteristics are the electrical conductivity, porosity and surface area of biochars. Biochar soil enhancement properties identify plant nutrients contained in the biochar.
Required for all biochars	**Required for all biochars**	**Required** for Processed Feedstocks	**Optional**. Producers may report on all, some or none.

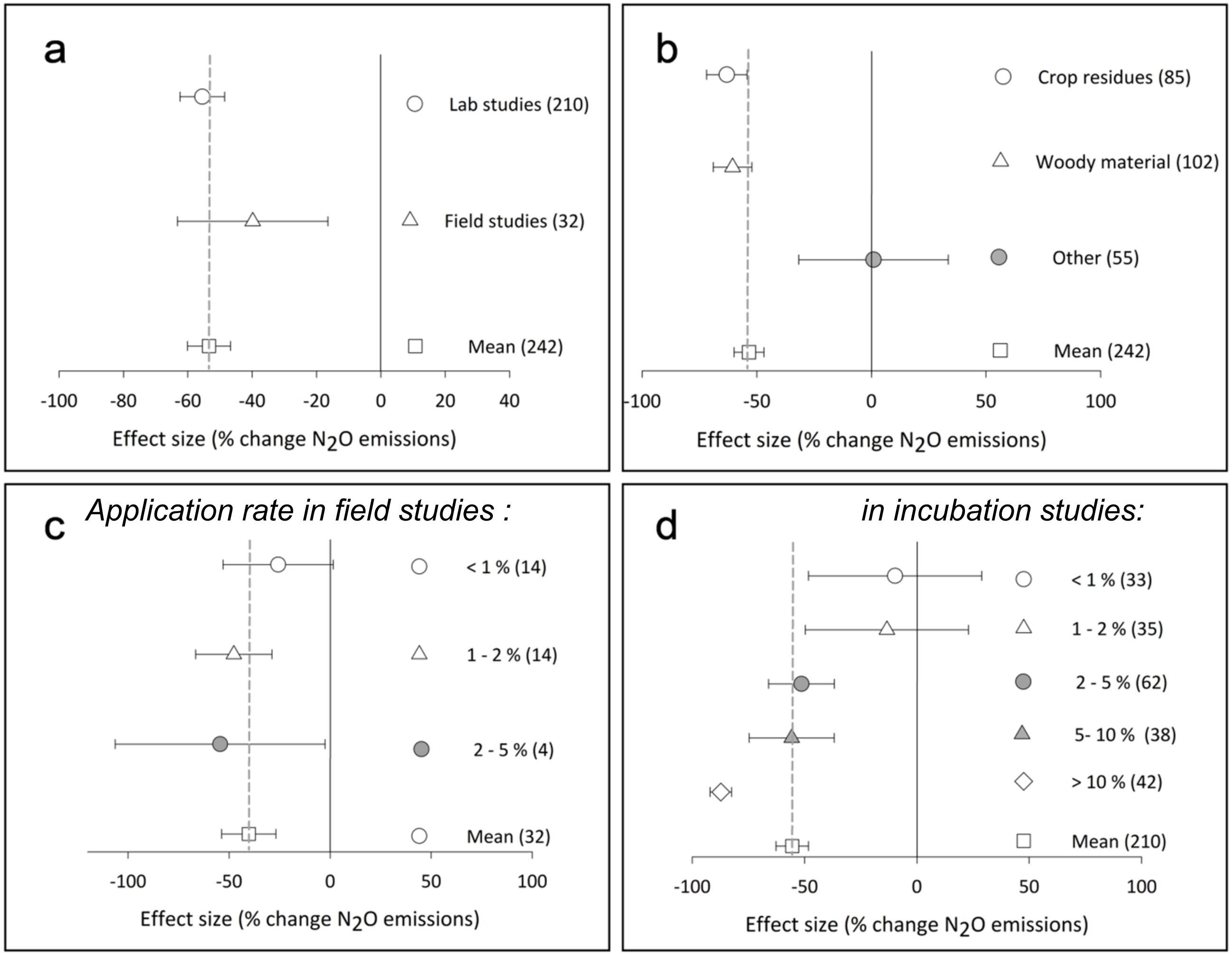


Greenhouse Gas Emission Reductions



World Bank Report, 2014

Soil Nitrous Oxide Emissions with Biochar



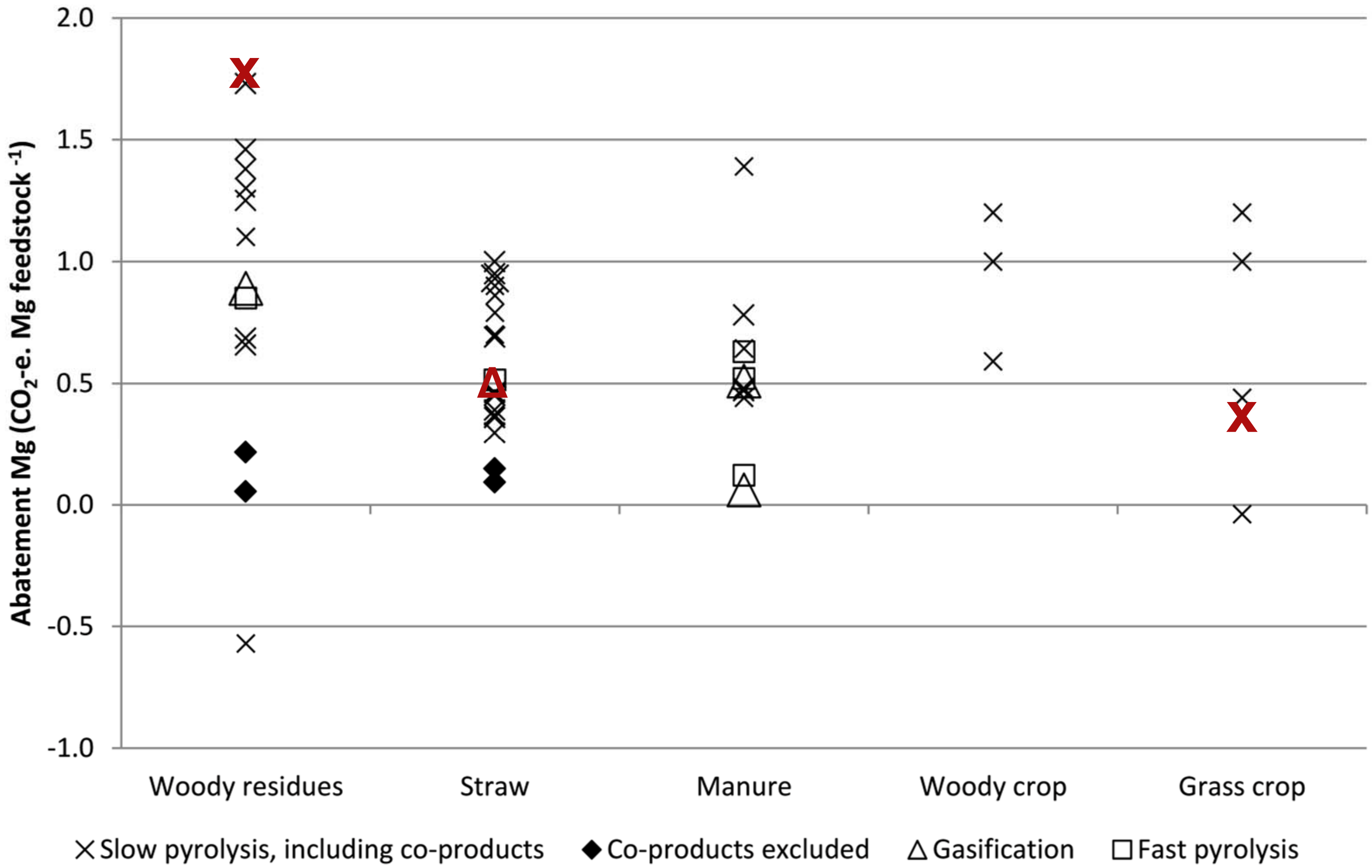
Average reduction 55%

(n=30 studies)

Cornell University

Van Zwieten et al. 2015, *Earthscan*

Biochar Systems Effects on GHG



n=16 studies with 51 scenarios

Cowie et al., 2015, *Earthscan*

Red: WB Report, 2014

Biochar Offset Protocols/Carbon Market

Registry/ Market	Voluntary or Compliance Market	Region of Applicability or Use	Status	Notes
American Carbon Registry	Voluntary Market	N. America (registry); global applicability	ACR Internal Anonymous Peer Review Process	Undergoing 2nd round of two anonymous peer reviews
CAPCOA GHG Rx	Voluntary Market	Placer County CA; can be adopted by any CA Air Districts	Final review completed; submission to Placer County in preparation.	Anticipated adoption by Placer County in January 2015
Verified Carbon Standard	Voluntary Market	Global	Inactive	No response submitted to peer reviewers

The Way Forward?

- Development of biochar platforms
- Systems energy, GHG balance and economics