Greenhouse Gas Protocol for Biochar Projects

Stakeholder Consultation Webinar

September 9th, 2014

The Climate Trust | International Biochar Initiative | Placer County Air Pollution Control District | The prasino Group

Agenda

- Introduction to the webinar and presenter introductions
  - *Bruce Springsteen, Placer County Air Pollution Control District*
- Overview of CAPCOA Program & Protocol Review Process
  - *Bruce Springsteen, Placer County Air Pollution Control District*
- Biochar Protocol Introduction
  - *Teresa Koper, The Climate Trust*
- Quantification of Emission Reductions
  - *Keith Driver, The Prasino Group*
- Carbon Stability
  - *Debbie Reed, International Biochar Initiative*
- Questions & Next Steps
  - *Teresa Koper, The Climate Trust*

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Webinar logistics

- To ask questions:
  - Either type questions into '**Chat**' box near bottom of your webinar pane.
  - Or '**Raise Hand**' (in vertical bar at left of your webinar pane) to hold your place in line to ask a question verbally
- The Protocol is open for public comment through October 9, 2014

  All public and webinar comments will be addressed and posted with the protocol
- Webinar will be recorded and will be circulated to all registered attendees.

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CAPCOA Greenhouse Gas Reduction Exchange (GHG Rx)

Bruce Springsteen, Placer County Air Pollution Control District

- Launched in February 2014
- Joint effort of Bay Area AQMD, Placer County APCD, Sacramento Metro AQMD, South Coast AQMD, San Joaquin Valley APCD, and Northern Sonoma APCD
- Provide California-based Greenhouse Gas Credits
  - Secure, transparent, and low-transaction cost exchange
  - Local jobs, air pollution co-benefits
- Responds to request from local governments and private industry for credits for compliance with CEQA, climate action plans, and other voluntary purposes
- Protocols – biomass-for-energy, boiler efficiency, livestock manure, forest management, case-by-case

Protocol Development and Approval Process

- Protocol review and approval process
  - 30 day public review
  - CAPCOA Engineering Protocol Review Committee
  - CAPCOA Board Approval
- Protocol criteria
  - Real
  - Additional/surplus
  - Quantifiable
  - Verified
  - Enforceable
  - Permanent
  - Occur in California, after date specified in protocol
- Details concerning criteria and Engineering review forms can be found in CAPCOA GHG Rx Appendix D, J, K, available on CAPCOA GHG Rx website **http://www.ghgrx.org/**

Placer County APCD Forest-based GHG Offset Protocols

- **Biomass waste-for-energy** – CAPCOA Board Approved
- **Biochar** – in process, subject of today's webinar, Board Approval anticipated late 2014
- **Black carbon** – working to secure funding, in planning stages
- **Forest fuel reduction thinning treatments** – securing funding to extend previous research
- http://www.placer.ca.gov/departments/air/apcdbiomass

Greenhouse Gas Protocol for Biochar Projects

Teresa Koper, Senior Project Analyst, The Climate Trust

History:

- This protocol has been modified from the Emissions Reductions from Biochar Projects methodology, that was submitted for approval under the American Carbon Registry –
  - Funded by blue moon fund
  - Prepared by Teresa Koper, Peter Weisberg (The Climate Trust); Alison Lennie, Brad Lively, Keith Driver, Hannah Simons (The Prasino Group); Miguel Rodriguez, Debbie Reed, Stefan Jirka (International Biochar Initiative); and John Gaunt (Carbon Consulting)

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Greenhouse Gas Protocol for Biochar Projects

Process:

- Introductory Webinar (September 9, 2014)
- Public comment period (September 9, to October, 9, 2014), followed by a an additional public webinar. Public comments will be addressed in a written document
- The public comments/written responses, and recorded webinar will be posted shortly to: http://www.placer.ca.gov/departments/air

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Emission Reductions From Biochar Projects

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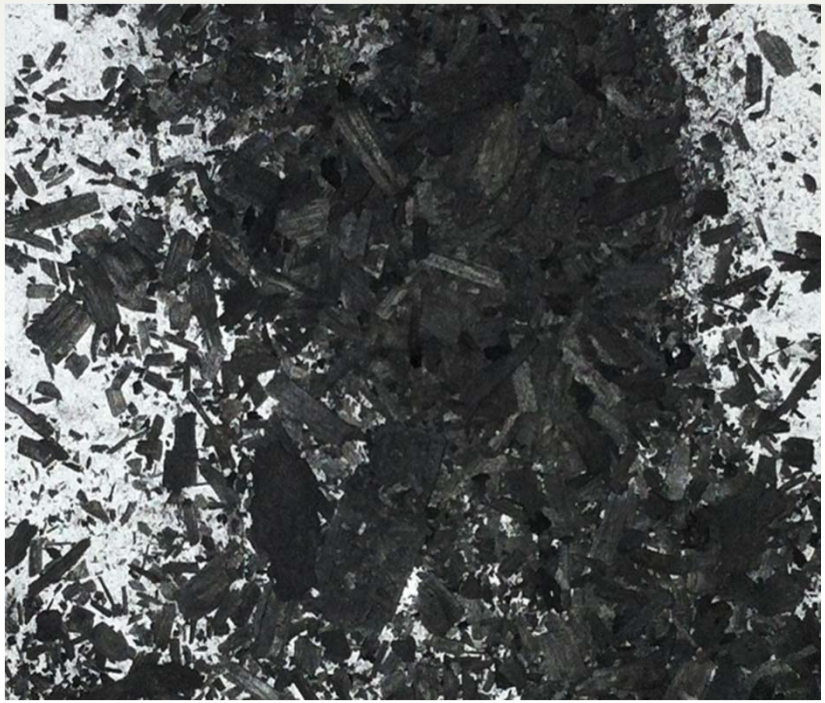
Scope and Eligible Activities

Keith Driver, Senior Partner, The Prasino Group

- This protocol is applicable to biochar production project operations that are located within the state of California, including source of feedstock.

- The production operations must protect or enhance long-term productivity of the site by maintaining or improving soil productivity, water quality, wildlife habitat, and biodiversity where the biomass originated.

- Harvesting of material must meet regulations from the National Environmental Policy Act (NEPA), California Environmental Quality Act (CEQA), California Forest Practices Rules and Regulations, and/or Timber Harvest Plans.



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Applicability Requirements

- Qualified sustainable feedstocks – biomass source or biogenic in nature
- IBI Standardized Product Definition and Product Testing Guidelines for Biochar that is used in soil. Annually submit compliance documentation
- Submit a Greenhouse Gas (GHG) Project Plan for certification by CAPCOA
- Secure independent validation / approved third-party validation / verification body.
- Comply with CAPCOA protocol requirements

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Allowable Feedstocks

- Under this protocol biochar feedstock is restricted to biomass that is generated from forestry, agriculture, urban landscaping, and related industries
- Eligible biochar feedstocks include but are not limited to:
  - Forest slash (non-merchantable) remains from forest management activities
  - Biomass waste from wildfire fuel reduction
  - Defensible space clearing residues
  - Orchard and vineyard removals and prunings
  - Field straws and stalks
  - Urban prunings/cuttings residues

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Evaluation of Feedstock Criteria

- One – time evaluation for each 7-year crediting period
- Biochar producer collects necessary documentation and submits to Validation / Verification Body (VVB)
- Periodic and random evaluation for adherence to the criteria

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Applicability Requirements Continued

- H/C_{org} = or < 0.7
- Land applied or mixed with soil, compost, or medium intended as a soil amendment.
- Meet local, regional, state, and national air quality standards.
- Facility operating under applicable facility permits and meeting all regulations
- Demonstrate uncontested and exclusive claim to the ownership of the GHG benefits

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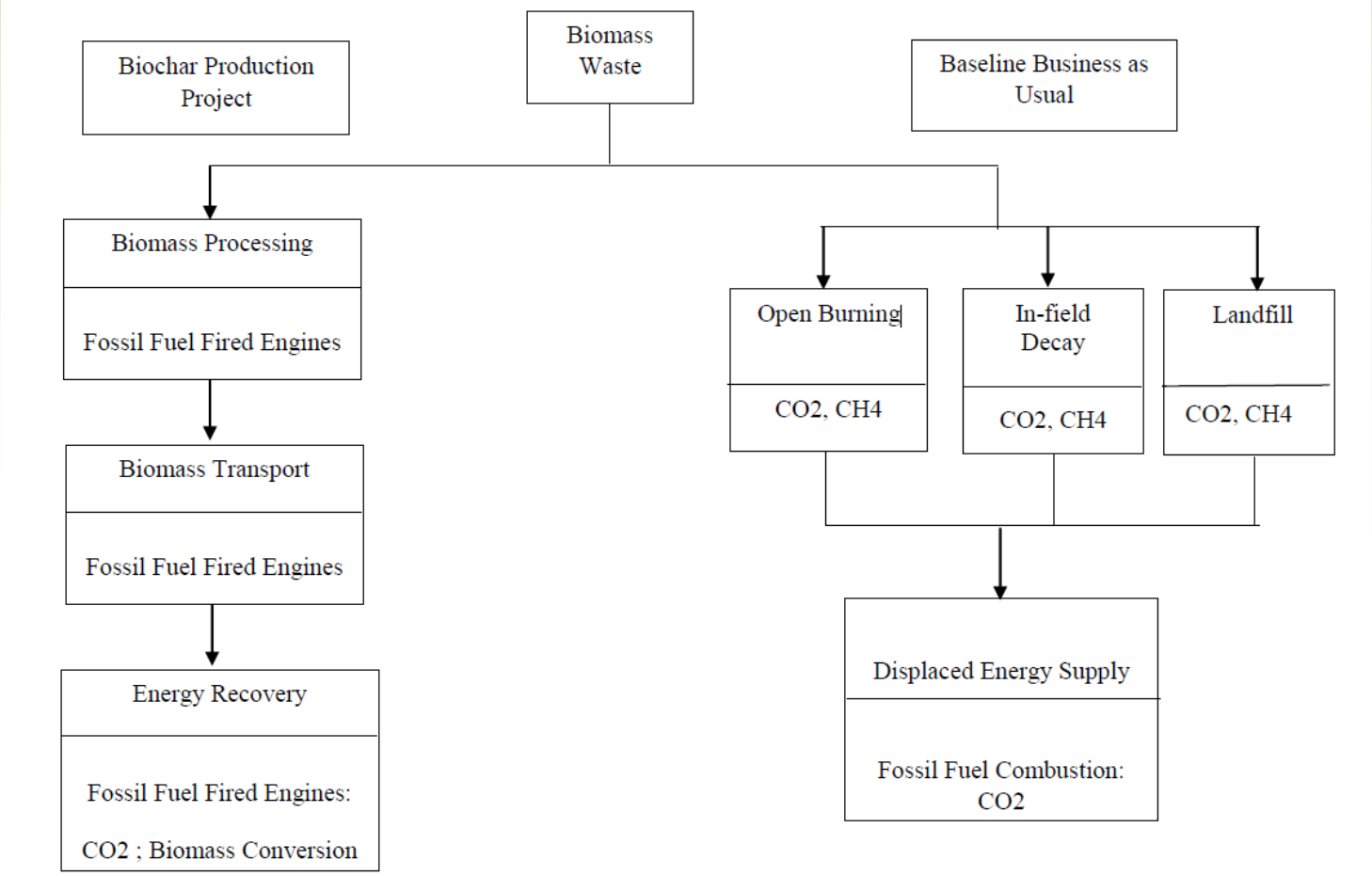
System Boundary



Temporal Boundaries

- Project start date must have occurred after January 1, 2007
- Crediting period can span 7 years from the start date

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Baseline

- Primary baseline scenario for projects consists of the combustion of feedstocks in a bioenergy production facility
  - Considers potential for these uses to generate other environmental credits.
  - Results in the exclusion of all electricity, heat, bio-oil, and biogas production, as well as methane generation avoidance.
- Alternative baselines positive but high burden of proof
  - Aerobic/anaerobic digestion
- Documentation must be provided of all previous historical disposal practices, current disposal practices in the absence of the proposed project, and future planned/anticipated disposal practices.

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Additionality

- Project GHG emission reductions must be "additional" to what would have otherwise occurred.
- It must be demonstrated that the existing, baseline business as usual disposal practice of the biochar feedstocks at the beginning date of the project is through either:
  - Open burning in the vicinity of the production site
  - Decay and decomposition in the vicinity of the production site, with no commercial value derived from the end-product.
  - Landfilled.
- It must not be currently economical within the local market to utilize or sell the biochar feedstock as a product or process feedstock.

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Quantification

- Summary of Emission Reductions

$$ER_{NET} = BE_{BASE} - PE_{PROJ} - Leakage_y$$

- Baseline Condition

$$BE_{BASE} = BE_{B,y}$$

or

$$BE_{BASE} = BE_{A,y} + BE_{An,y} + BE_{C,y} + BE_{E,y} + BE_{O,y} + BE_{G,y} + BE_{H,y}$$

- Project Condition

$$PE_{PROJ} = PE_{TR,y} + PE_{P,y} + PE_{Py,y} + PE_{E,y} + PE_{PNB,y} + PE_{B,y} + PE_{OP,y} + PE_{GP,y} + PE_{OU,y} + PE_{GU,y} - C_{BS,y}$$

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Quantification

- Summary of Emission Reductions

$$ER_{NET} = BE_{BASE} - PE_{PROJ} - Leakage_y$$

Where:

ER_{NET} = Net GHG emissions reductions and/or removals in year *y*

Y = year, where the baseline year is 0 and the first year of production is 1

BE_{BASE} = Baseline emissions in year *y*

PE_{PROJ} = Project emissions in year *y*

$Leakage_y$ = Leakage that occurs in year *y*

Quantification

- Baseline Condition

$$BE_{BASE} = BE_{B,y}$$

Where:

BE_{Base} = the sum of the baseline emissions in year *y*

$BE_{B,y}$ = emissions due to the combustion of Feedstock for bioenergy *B* production in year

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Quantification

- Alternative Baseline Condition

$$BE_{BASE} = BE_{A,y} + BE_{An,y} + BE_{C,y} + BE_{E,y} + BE_{O,y} + BE_{G,y} + BE_{H,y}$$

Where:

BE_{BASE} = the sum of the baseline emissions in year *y*

$BE_{A,y}$ = emissions due to the aerobic decomposition *A* of Feedstock in year *y*

$BE_{An,y}$ = emissions due to the anaerobic decomposition *An* of Feedstock in an SWDS in year *y*

$BE_{C,y}$ = emissions due to the combustion *C* of Feedstock without bioenergy production in year *y*

$BE_{E,y}$ = auxiliary emissions due to the use of electricity *E* in year *y*

$BE_{O,y}$ = auxiliary emissions due to the use of fossil oil *O* in year *y*

$BE_{G,y}$ = auxiliary emissions due to the use of fossil gas *G* in year *y*

$BE_{H,y}$ = auxiliary emissions due to the use of heat *H* in year *y*

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Quantification

- Project Condition

$$PE_{PROJ} = PE_{TR,y} + PE_{P,y} + PE_{Py,y} + PE_{E,y} + PE_{PNB,y} + PE_{B,y} + PE_{OP,y} + PE_{GP,y} + PE_{OU,y} + PE_{GU,y} - C_{BS,y}$$

Where:

PE_{PROJ} = the sum of the project emissions in year *y* (t CO_2e)

$PE_{TR,y}$ = emissions due to the transportation *T* of Feedstocks in year *y* (t CO_2e).

$PE_{P,y}$ = emissions associated with the processing *P* and drying of Feedstock in year *y* (t CO_2e)

$PE_{Py,y}$ = emissions due to the combustion of auxiliary fuel for the purpose of Thermochemical Conversion *Py* of Feedstock in year *y* (t CO_2e)

$PE_{E,y}$ = auxiliary emissions from the net consumption of electricity *E* under the project condition in year *y* (t CO_2e)

$PE_{PNB,y}$= emissions due to the Thermochemical Conversion *P* of non-biogenic *NB* Feedstock materials in year *y* (t CO_2e)

$PE_{B,y}$ = auxiliary emissions due to the blending and processing of Biochar *B* in year *y* (t CO_2e)

$PE_{OP,y.}$ = auxiliary emissions due to the processing of bio-oil *OP* in year *y* (t CO_2e)

$PE_{GP,y}$ = auxiliary emissions due to the processing of syngas *GP* in year *y* (t CO_2e)

$PE_{OU,y}$ = auxiliary emissions due to the use of bio-oil *OU* in year *y* (t CO_2e)

$PE_{GU,y}$ = auxiliary emissions due to the use of syngas *GU* in the year *y* (t CO_2e)

$C_{BS,y}$ = carbon sequestration *S* associated with the appropriate end use and/or in-situ application of Biochar *B* in year *y* (t CO_2e)

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Leakage

- Three issues identified related to Leakage:
  - Restricted use of purpose grown biomass
  - Control depletion of soil organic carbon
  - Bioenergy production relative to biochar yield

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Data Procedures

Monitoring and Parameter Measurements

Parameter	Description	Data Unit	How Measured	Measurement Frequency	Reported Measurement
$FS_{i,j,y}$	Total amount of Feedstock type *j* diverted from baseline condition *i* in year *y*. (dry weight)	t	Sample the Feedstock composition, using the Feedstock categories *j*, and weigh each Feedstock fraction	Continuously, aggregated monthly or annually	
$p_{n,j,y}$	Weight fraction of the Feedstock type *j* in the sample *n* collected during year *y* (dry weight)	t	Sample the Feedstock composition, using the Feedstock categories *j*, and weigh each Feedstock fraction	Minimum of three samples every three months	

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Data Management

- Record keeping practices shall be established that include:
  - Electronic recording of values of logged primary parameters for each measurement interval;
  - Offsite electronic back-up of all logged data;
  - Written logs of operations and maintenance of the project system including notation of all shut-downs, start-ups and process adjustments;
  - Storage of all documents and records in a secure and retrievable manner for 10 years after it is generated, or 7 years after the last verification

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Data Management Continued

- The Project Proponent must also develop a QA/QC plan to add confidence that all measurements and calculations have been made correctly. QA/QC measures that may be implemented include, but are not limited to:
  - Protecting monitoring equipment (sealed meters and data loggers);
  - Protecting records of monitored data and check integrity (hard copy and electronic storage);
  - Comparing current estimates with previous estimates as a 'reality check';
  - Provide sufficient training to operators to perform maintenance and calibration od monitoring devices;
  - Establish minimum experience and requirements for operators in charge of project and monitoring; and
  - Performing recalculations to ensure no mathematical errors have been make.

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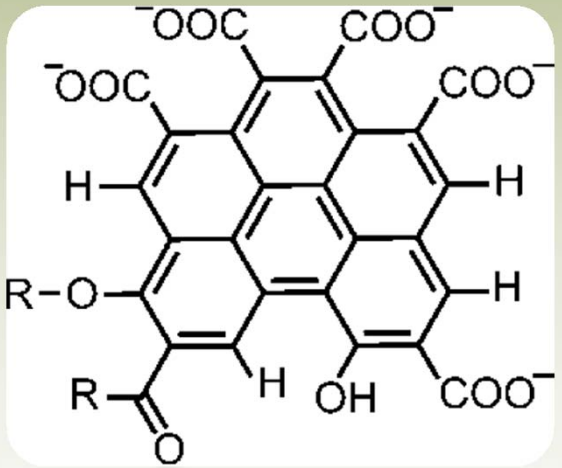
Biochar Carbon Stability

Debbie Reed, Executive Director, International Biochar Initiative (IBI)

- **Biochar** contains both labile and stable carbon.
- Thermochemical conversion of biomass carbon into biochar *physically* and *chemically* alters the stable carbon molecules of the feedstock.
- The methodology measures the stable carbon fraction of biochar.

Biochar Carbon Stability



- **Fused aromatic carbon rings →** material property most likely responsible for biochar Stability compared to feedstock biomass.

- Microorganisms in soil lack enzymes to break down these complex structures, which makes them recalcitrant to oxidation or degradation.

- Simple physical/chemical tests can measure the degree of carbon aromaticity : these form the basis of the stable carbon methodology.

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Biochar Carbon Stability Test Method

- **"BC_{+100}" → biochar C stability test method**

- Developed by an expert panel of leading biochar C stability researchers

- Compared 27 methods to characterize stable biochar C content
  1. **"alpha" methods** → simple physical/chemical measures
  2. **"beta" methods** → directly quantify BC_{+100} in laboratory or field experiments
  3. **"gamma" methods** → provide physiochemical underpinning for alpha and beta

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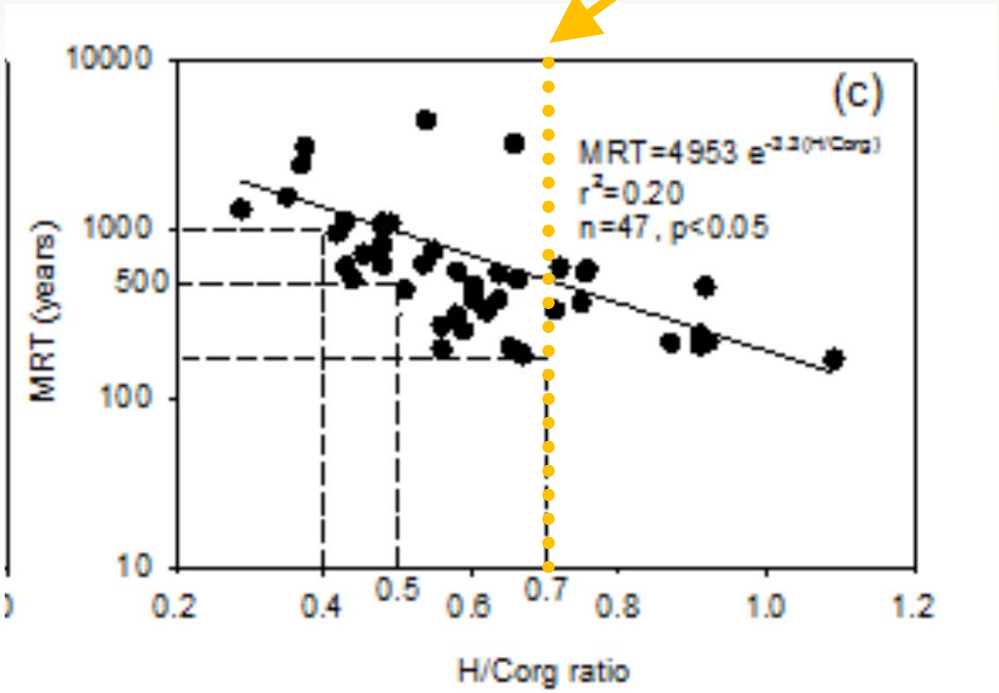
Hydrogen/Organic Carbon (H/C_{org})

- H/C_{org} ratio of biochars correlated to the **Mean Residence Time** → the average time that biochar will remain present when incorporated into soil

At H/C_{org} <0.7 all biochars have MRT of >100 years



J. Lehmann, S. Abiven, M. Kleber, G. Pan, B.P. Singh, S. Sohi, A. Zimmerman. Persistence of biochar in soil. In: Biochar for Environmental Management - Science and Technology, 2nd edition. Johannes Lehmann and Stephen Joseph (eds.). Earthscan, and references therein

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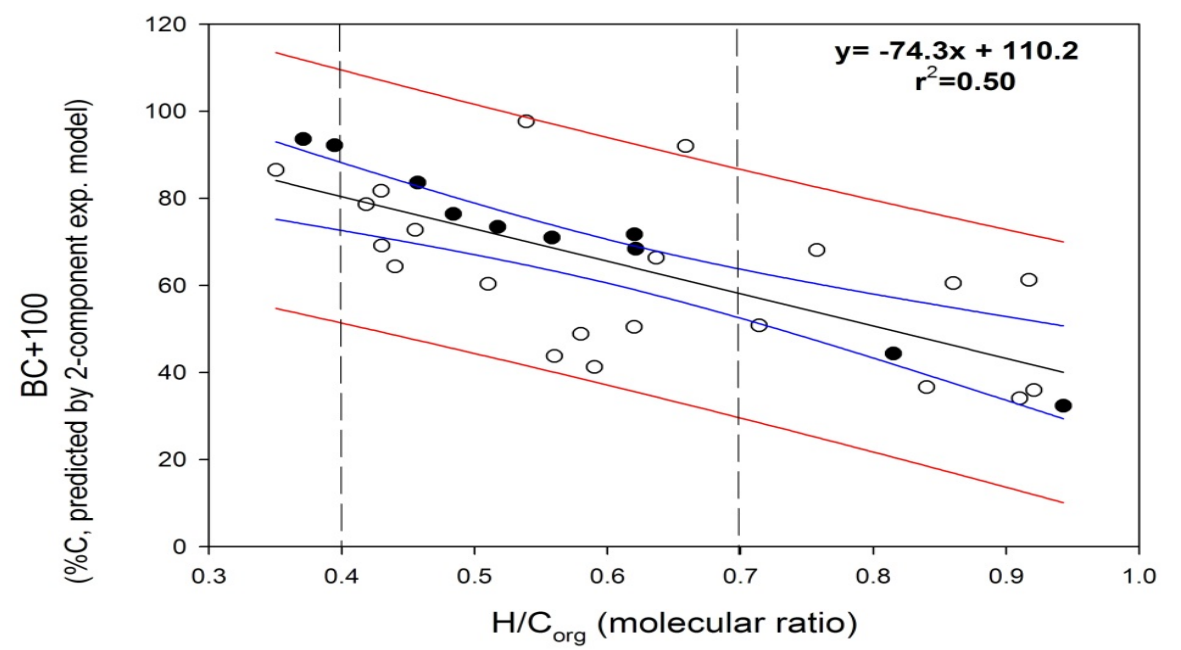
BC_{+100} Predicts Biochar C Stability

- An alpha method based on the ratio of ***hydrogen to organic carbon*** **(H/C_{org})** in biochar
- Strong correlation between H/C_{org} and biochar carbon predicted to remain after 100 years



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H/C_{org} and BC_{+100} equivalences at 95% confidence

Chosen values represent **conservative estimates** of biochar C expected to remain based on experimental data

Two levels identified:

1. **$H/C_{org} < 0.4$** → at least 70% biochar C expected to remain after 100 years
2. **$H/C_{org} < 0.7$** → at least 50% biochar C expected to remain after 100 years

	BC_{+100} (%)			
H/C_{org}	Mean	Lower Limit	Upper Limit	Chosen Value
0.4	**80.5**	**72.6**	**88.2**	**70**
0.5	73.1	67.1	78.9	50
0.6	65.6	60.5	70.6	50
0.7	**58.2**	**52.5**	**63.8**	**50**

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H/C_{org} and BC_{+100} equivalences at 95% confidence

Example:

- H/C_{org} of biochar ABC = 0.55
- BC_{+100} = 50%

- So, 50% of organic C in biochar ABC will be credited in methodology

	BC_{+100} (%)			
H/C_{org}	Mean	Lower Limit	Upper Limit	Chosen Value
0.4	**80.5**	**72.6**	**88.2**	**70**
0.5	73.1	67.1	78.9	50
0.6	65.6	60.5	70.6	50
0.7	**58.2**	**52.5**	**63.8**	**50**

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International Biochar Initiative

Further Information

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Further Information

To provide comments during public comment period
(closing October 9th)
placercountybiocharcomments@climatetrust.org

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