Using Biochar for Cost-effective CO2 Sequestration in Soils

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Using Biochar for Cost-effective CO2 Sequestration in Soils
The 4-page Conference Paper Outline

1. INTRODUCTION
2. DEFINING “TERRA PRETA” SOIL
3. A NEW BIOCHAR WEBSITE
4. THE IAI CONFERENCE
5. EXPERIMENTAL EVIDENCE
6. CLIMATE QUESTIONS
7. NEAR TERM BIOCHAR OPPORTUNITIES
8. ECONOMICS

Presentation at ISES Conference, Beijing -- September 20, 2007; Slide 2
Additions to Outline

1. Personal agrichar/TP Background
2. Present status of agrichar/TP
3. Understanding TP economics
4. Early niche market examples
5. Policy Issues
6. Summary/recommendations
1. Personal Biochar -TP Background

a. 34 years in RE (policy, economics)
   - US Congress (House Science), OTA, SERI (NREL); USAID (Sudan), Consulting (Pacific, Kyrgyzstan, Zimbabwe, Ethiopia)

b. 10 years in charcoal production (“stoves”)

c. strong climate concerns (ASES, CRES)

d. (no soils knowledge)

e. “terrapreta” group originator, coordinator
EXCERPTS FROM ISES CONFERENCE PAPER

ABSTRACT - Biochar, when placed in soil, greatly improves the soil.

1. INTRODUCTION
   - Amazonian Indians created vast areas of some of the world’s best soils, starting with some of the worst.
   - Solar Today magazine carried a short introduction to this topic as my “Chair’s Corner”.
   - “hobby” to develop charcoal-making (not charcoal-using) stoves

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Importance of the Amazon

There are huge areas of the Amazon where some of the world’s best soils exist.

They are obviously (now) man-made.

The charcoal has been carbon-dated to before Christ.
- … sequestering-biochar promises an essentially infinite continuing benefit.

- … the needed methodology for providing appropriate carbon credits does not exist.

- It is critical... that there be a high-value use for the pyrolysis gases.
2. DEFINING “TERRA PRETA” SOIL

- Positive Charcoal = Negative carbon. Why adding charcoal to the Earth’s soils will also address climate change.
- How could charcoal, prized worldwide for cooking, find a better use by being buried in the ground?
- My invented term “ChAr” has not taken off in the last year
- This proven carbon-sequestration process is important to revisit today for several reasons (next)
2. DEFINING “TERRA PRETA” SOIL, cont’d

First 4 Reasons behind biochar (and my interest):

- (1) ChAr can help promote more common forms of renewable energy (RE). (CSP)

- (2) The more awareness ..., the more likely we will see early R&D funding .... no time to spare.

- (3) We can replace costly natural gas used to make fertilizers, ..... 

- (4) ... require that we find a practical way to get substandard agricultural land into productive use.
2. DEFINING “TERRA PRETA” SOIL, cont’d

*Last 4 reasons behind biochar* (and my interest):

- (5) “Standard” forms of sequestration... a high-cost, marginal chance of success and no auxiliary values....

- (6) Much we can pyrolyze would otherwise enter the atmosphere as methane.....

- (7) We can regain much-needed worldwide goodwill.

- (8) ... special emphasis on... equatorial countries, because of lower cost labor and the higher annual rates of biomass growth in these mostly developing countries.
2. DEFINING “TERRA PRETA” SOIL, cont’d

“The ChAr process must depend on agriculture and forestry interests.

…..the 25x’25 organization is the U.S. key to getting the biochar technology funded rapidly and then introduced into American agriculture.

….. almost nothing is happening at the U. S. Federal level and we are probably years away from early official testing.
3. A NEW BIOCHAR/TERRA PRETA DISCUSSION GROUP WEBSITE

Tom Miles, http://terrapreta.bioenergylists.org/

183 members - adding about 20 per month.

Usually running about 3-4 messages per day

Mostly those interested in the soils side - from an “educated amateur” side
“Terrapreta” message today from a Jon Frank about a customer applying a waste char (loaded with sugar):

“He applied 15-20 tons of this product per acre and plowed it into the soil. He saw tremendous visual difference in the plants and in the root growth as compared to his neighbor with whom he shared part of the pivot for irrigation. When looking at roots that encountered chunks of this charcoal powder the roots would explode with massive growth inside the chunk of charcoal powder.
4. THE INTERNATIONAL AGRICCHAR INITIATIVE (IAI) CONFERENCE

- In late April, a first multi-disciplinary group of about 100 attended a biochar conference in Terrigal, Australia.
- Professor Johannes Lehmann was one of the IAI organizers.
- Now a name change to “IBI” (Biochar)
5. EXPERIMENTAL EVIDENCE

- Mostly we have to rely on the history in Brazil (Portuguese as “terra (earth) preta (dark)”).

- Sites that discuss productivity gains are (still rare)
3. CLIMATE QUESTIONS

- The biochar community well knows about (and believes it is best situated to collect) a $25 million challenge prize from Sir Richard Branson for a first corporation able to remove a (GIGATON)
7. NEAR TERM BIOCHAR OPPORTUNITIES

- The carbonization of bagasse at sugar mills looks especially ......

- The “stoves” discussion list cited earlier contains ....
8. ECONOMICS

- as long as there is a willingness to roughly double the throughput in order to obtain the presumed higher value biochar.
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Presentation at ISES Conference, Beijing -- September, 2007; Slide 1
Part 2. Present view of agrichar

Very positive - but need much R&D. In my worlds - no knowledge and little excitement.

A Triangular “phase” diagram describes the uniqueness of the TP market.
Positive Charcoal = Negative Carbon?
Why adding charcoal to the Earth's soils will also address climate change.

The above, followed by 1000 words in the November 2006 issue of *Solar Today*, was my first attempt (as ASES Chair) to explain why I felt “Terra Preta” to be so important.

It is no less important today. A lot has happened in one year. But not enough.
NOMENCLATURE
I used to use **ChAr**, with

\[
\text{Ch} = \text{Climate healing} \\
\text{Ar} = \text{Agricultural recovery}
\]

Then it became mostly **Agrichar**

Now either **Biochar**

or **Terra preta**

___________________________ (Portuguese for “earth dark”
Timeline:

a. Millenia BC - Amazonians invented Terra preta
   c. 1900’s - first anthropological suspicions
   d. 2001 - First Anthropology conference on TP
   e. 2002 - Eprida Conference in Georgia
   f. 2006 - AAAS Meeting on soils, Science, Nature
   g. 2007 (Jan.) - “www.terrapreta.bioenergy.org”
      (Apr-May) - IAI Conference, Terrigal, Australia
   h. 2008 (June) - IBI Conference, Newcastle, UK
Importance of the Amazon

There are huge areas of the Amazon where some of the world’s best soils exist. They are obviously (now) man-made. The charcoal has been carbon-dated to before Christ.
Oil carbon densities - central USA

Part 3. Understanding TP economics

Equations -

A nomogram presentation
Part 4. Example early niche markets
   Charcoal-making Cookstoves
   Sugar Mills - Bagasse
Part 4. Example early niche markets

Charcoal-making Cookstoves

Sugar Mills - Bagasse
### Part 4. Example Sugar Mills - Bagasse

<table>
<thead>
<tr>
<th>Time Period</th>
<th>Today</th>
<th>With AC/TP Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Combustion Pyrolysis</td>
</tr>
<tr>
<td>Fuel Type</td>
<td>Bagasse</td>
<td>Bagasse + Bamboo?</td>
</tr>
</tbody>
</table>

| Fuel Quantity | Sugar $ determines | Doubled (?) + new |

| Electric revenues | Low | High (dispatchable) |

| Combustion efficiency | Low | High |
# Charcoal from Bagasse

<table>
<thead>
<tr>
<th>Time Period</th>
<th>Today</th>
<th>AC/TP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technology</td>
<td>Combustion</td>
<td>Pyrolysis</td>
</tr>
<tr>
<td>Time Period</td>
<td>Part-year</td>
<td>Full-year</td>
</tr>
<tr>
<td>Fuel type</td>
<td>Bagasse</td>
<td>Add Bamboo ?</td>
</tr>
<tr>
<td>Fuel Quantity</td>
<td>Sugar $</td>
<td>Doubled ++</td>
</tr>
<tr>
<td>Electric $</td>
<td>Low</td>
<td>High (capac.)</td>
</tr>
</tbody>
</table>
Part 5. Policy Considerations

a. We need to understand how to achieve fair treatment for AC/TP.
   - Who are key influencers of policy?
   - Who are our friends and enemies from a competing resource point of view?
Part 5. Policy Heavyweights

**For us:** Farm lobbies (jobs, incomes)

25 x ‘25 (new, rapidly growing)

Environmental (Sierra Club, PIRGs, ..)

RE groups (ASES, ACORE, SEIA…)

**Against:**

Fossil fuels (especially coal); Nuclear

Midway

Labor, Religions, Political parties
On page 31, as one of four foci for recommended RD&D, the plan lists:

"The development of biochar, animal agriculture residues and other non-fossil fuel based fertilizers, toward the end of integrating energy production with enhanced soil quality and carbon sequestration."

Presentation at ISES Conference, Beijing -- September, 2007; Slide 1
Part 5a. Quote #2 from 25x25 Plan

On p 32, recommended as part of an expanded database aspect of infrastructure:

“Information on the application of carbon as fertilizer and existing carbon credit trading systems.”
Part 5a. From ASES “Roadmap”

Chapter 7 - thanks to Dr. Ralph Overend, a recent ASES report mentions TP on p 117 (free download of this biomass section)

www.ases.org/climatechange/toc/07_biomass.pdf

(Too long to quote - also needs careful reading - but is a respected authority)
Part 6. Summary/recommendations

1. We need to understand how to achieve good economics.
   How large an incentive is needed?

2. Both Research and Demonstration projects are needed.

3. We need more proof that TP can make a large contribution.