

Converting PNW Wood and Straw to Biochar for Agriculture: Where Do We Go From Here?

PNW-Biochar Meeting
April 3, 2009, Corvallis, OR



T R Miles Technical Consultants

Topics

- Biochar, Sources and Applications
- Examples of companies making Biochar
 - Biochar Engineering: biochar
 - Best Energies : biochar and power
 - Alterna Energy: biochar , heat, pellets
- What it will take to commercialize Biochar?
 - Technology, process
 - Products
 - End user markets / prices
- Economics for biochar
 - Capital
 - Operating expenses
- Next steps
 - Small Scale Production
 - Field Testing

What is Biochar?

Biochar is a fine-grained, highly porous charcoal that helps soils retain nutrients and water.



IBI

The carbon in biochar resists degradation and can sequester carbon in soils for hundreds to thousands of years.

What is Biochar?

- As a **soil amendment**, biochar creates a recalcitrant soil carbon pool that is carbon-negative, serving as a net withdrawal of atmospheric carbon dioxide stored in highly recalcitrant soil carbon stocks.
- As a **soil amendment**, biochar significantly increases the efficiency of and reduces the need for traditional chemical fertilizers, while greatly enhancing crop yields.
- The enhanced nutrient retention capacity of biochar-amended soil **reduces the total fertilizer requirements** but also the climate and environmental impact of croplands.
- Water pollution by agro-chemicals: Biochar **improves water quality** by helping to retain nutrients and agrochemicals in soils for use by plants and crops, resulting in less pollution.
- Char-amended soils have shown 50 - 80 percent **reductions in nitrous oxide emissions** and reduced runoff of phosphorus into surface waters and leaching of nitrogen into groundwater.
- Renewable **oils and gases co-produced** in the pyrolysis process can be used as fuel or fuel feedstocks.

IBI

Applications: Soil Amendment



BIOCHAR LOOSENS HEAVY GEORGIA CLAY SOIL



EPRIDA

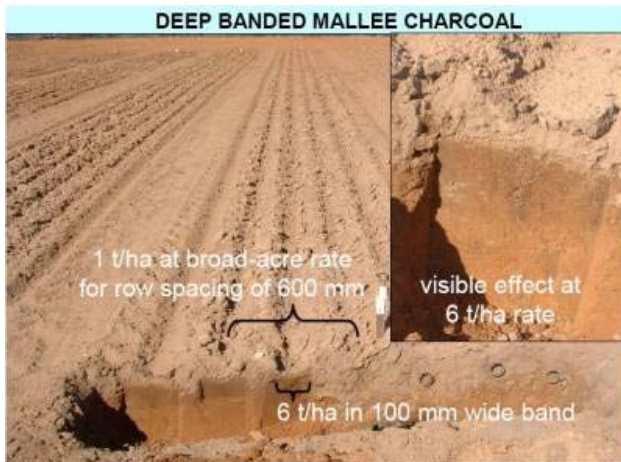
Applications: PNW Crops



4CN



NURSERY



STRIP TILLAGE IN FIELD CROPS

NURSERY AND CROP TRIALS



CORN WITH (L) AND W/O BIOCHAR (R)

APPLICATIONS: Growing Medium



IBI

BIOCHAR IN POTTING MIX



**IN SOIL UP TO 20% BY VOL or 10% BY WT
1-4 T/ACRE
25% IN COMPOST**

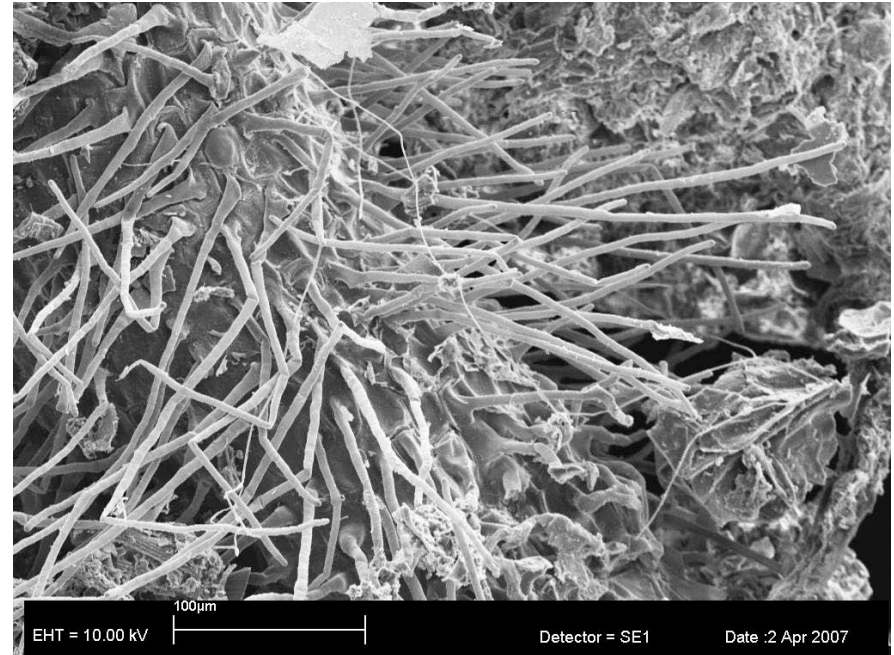


**SUBSTITUTE FOR IMPORTED
VERMICULITE IN TREE NURSERY
30% OF GROWING MIX**

How it Works



**BIOCHAR IS INHABITED BY
MICROORGANISMS THAT FEED NUTRIENTS
TO FINE PLANT ROOTS (IBI)**



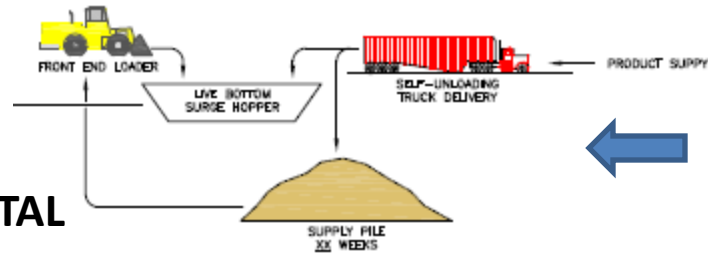
**ROOT HAIRS FEED FROM CHARCOAL-RIGHT
(Alfred Harris)**

BIOCHAR CAN BE USED AS CARRIER FOR MICRO-ORGANISMS AND FERTILIZERS

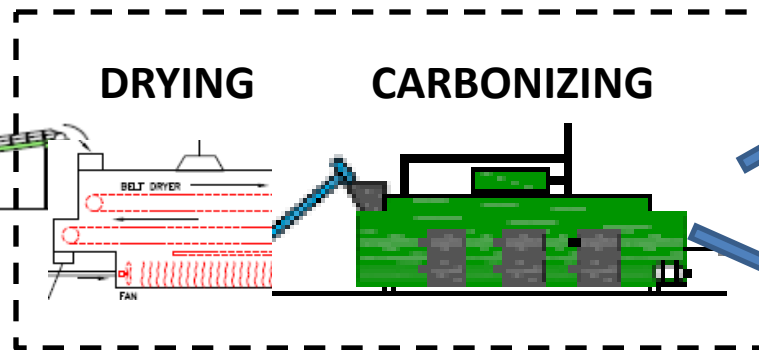
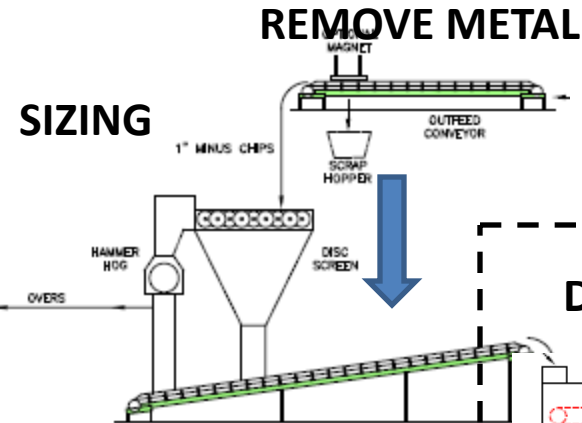
PNW Sources and Markets

- Sources
 - Unused Straw – grain and grass seed
 - Forest Residues – slash, fuel reduction
 - Agricultural and Forest Industry Residues
 - Urban Wood Waste
- Markets
 - Soil remediation and storm water nutrient management
 - Horticulture, nursery and urban landscaping
 - Crops and soil amendment, e.g. biochar + digested solids, composting

How biochar is made



SHRED DEBRIS

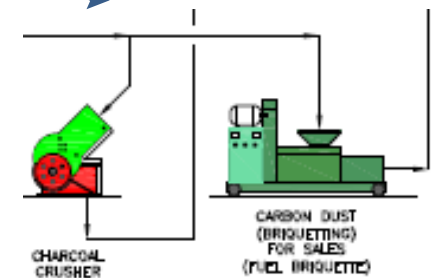


GAS TO HEAT OR POWER

BIOCHAR

SCREEN

**3 DRY TON BIOMASS-->
1 TON BIOCHAR +
16 MMBtu (1 MWhe)**



GRIND

DENSIFY

Examples of Biochar Companies

- Alterna Energy, Canada (p, P), South Africa (P)
- Biochar Engineering, CO (p)
- Best Energies, WI, NSW Australia (p)
- Carbon Diversions Inc., Hawaii (P,M)
- Eprida/Genesis, GA, VA (p,M)
- Mantria, EternaGreen, TN (M, P?)
- 3R Agrocarbon (Terra Humana) , Hungary (P)
- Japan (P)
- Bio-oil Producers (p, M)
 - Dynamotive, Ensysn, Agritherm, Advanced Biorefinery,

M- Marketing
P – Production
p - Pilot



Biochar Engineering

- Top Fed Carbonizer
- Wood Chips
- Gas recycle in Afterburner
- Temperature Control
- Field designs
- BLM Field Tests Colorado Slash 2009
- 1TPH in Development
- Prior experience:
 - Down Draft gasifiers
 - EPRIDA

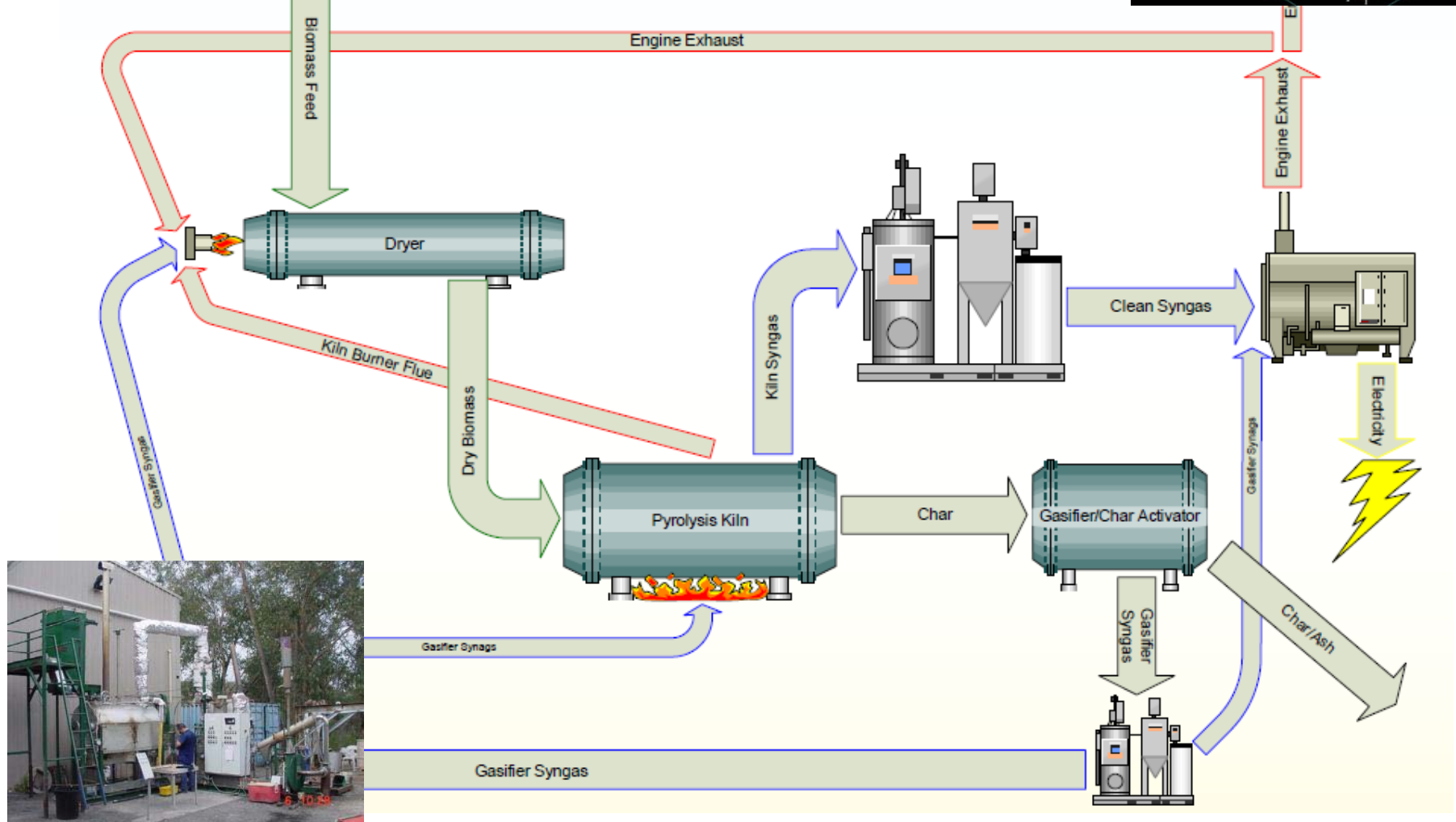
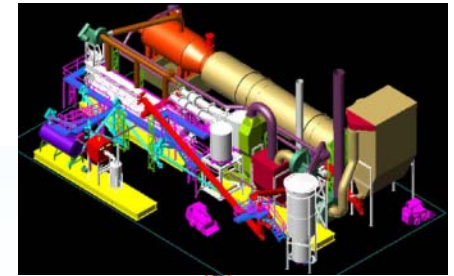


www.biocharengineering.com



BEST Energies

Simplified Process Flow Diagram (PFD)





Alterna Energy

- Pilot product and process development in South Africa since 2003
- Pilot production in British Columbia since 2005
- Biochar from macadamia shells used with commercial fertilizer in South Africa since 2003.
- 100,000 tpy wood production to be built in Prince George, BC, at wood pellet plant May 2009.
- Production facility to be built in Utah in 2009.
- 2.5 tph (11 cu yd/hr) production modules include drying and carbonization.



McBride Biocarbon Technical Fac.

Alterna Energy



McBride Biocarbon Technical Fac.

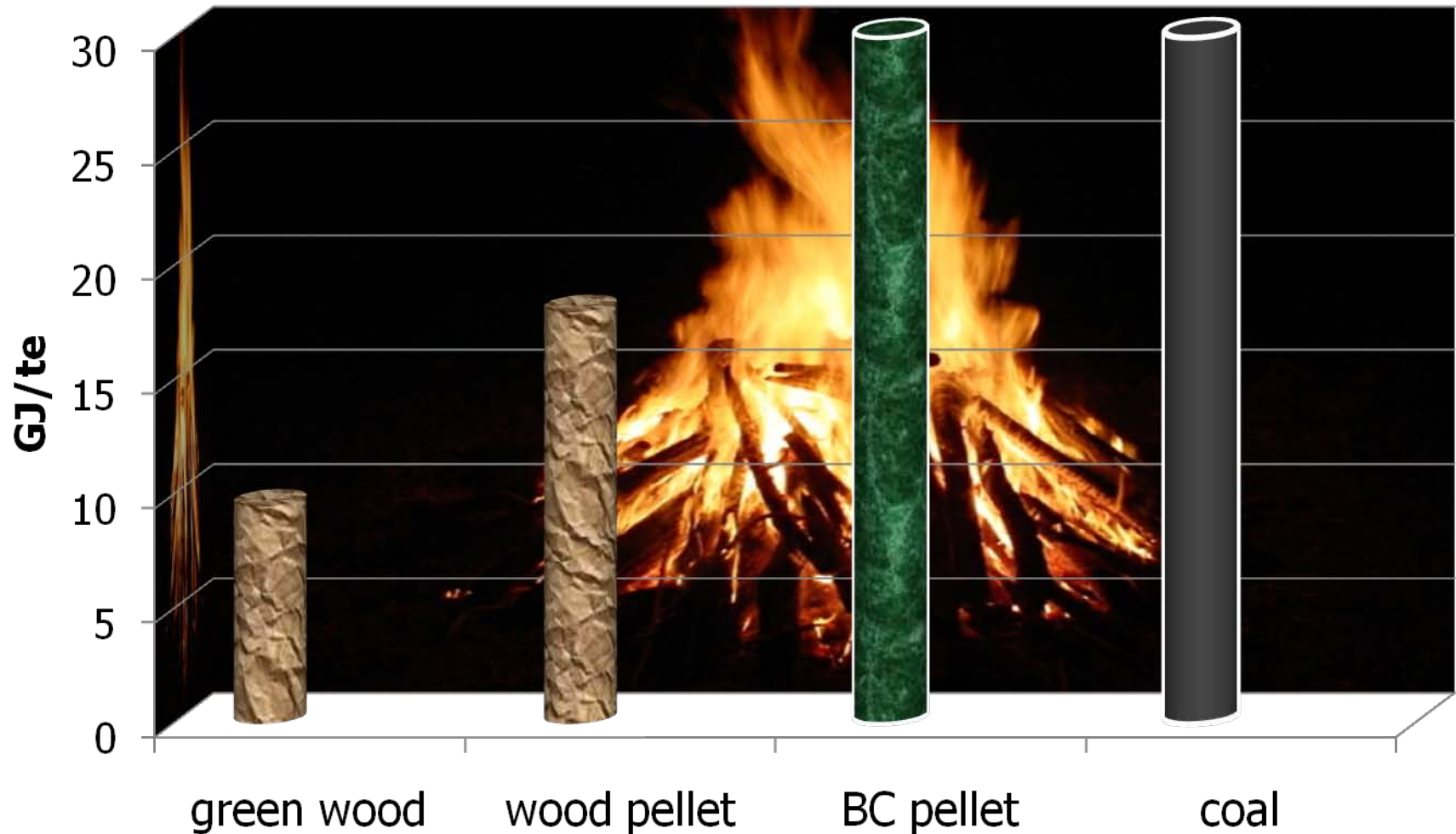
Alterna Energy



Alterna Energy

Golden Green

Energy Co-Products : BIOCARBON Pellets



ALTERNA ENERGY

Technology

Sawmill or Urban Wood Waste Only

Receiving

2 dry ton/hr, 48 ton/day, 3000 hrs/yr

6,000 tons/yr dry

Processing

Shred, Fill, Dry, Carbonize, Cool, Screen, Grind, Bag, Ship
Continuous Kiln (Basis: Alterna Energy)

1 process lines; 2-2.7 t/hr

1 -70' x 100' process area, 2 operators

Capital: \$500,000

Installation: 18 months

Products:

Biochar 2,000 tons per year (\$200/t wholesale)

Excess Gas 10.6 MMBtu ~ 31,000 MMBtu/yr

Products and Markets

Sawmill or Urban Wood Waste Only

- Gas or Heat
 - 10.6 MMBth
 - \$10/MMBtu
- Biochar 2,000 tpy
 - Additive to compost (25%)
 - Soil amendment
 - Commercial Fertilizer/Garden Wholesaler
 - Wholesale \$200/ton in bulk bag 1000 lb/bag
 - Retail packaging \$250/ton
- Voluntary Green Credit \$1.8 million/yr
 - $2,000 \text{ tC} \times 3 \text{ t CO}_2/\text{tC} = 6,000 \text{ tCO}_2 @ \$20/\text{tCO}_2$

Economics

Sawmill or Urban Wood Waste Only

Product	Quantity	Price/unit	Revenue
Biochar	2,000 odt/y	\$200/ton	\$ 400,000
Heat	32,000 MMBtu	\$10/MMBtu	\$ 320,000
Green Credit*	6,000 tCO ₂	\$20/tCO ₂	<u>\$ 120,000</u>
Total			\$ 840,000
Expenses per dry ton logyard waste			Expenses
Wood waste	6,000 t/y	\$30/ton	\$ 180,000
O&M			
2 empl/shift	6,000t/y	\$70/ton	\$ 420,000
Capital	6,000t/y	\$10/ton	<u>\$ 60,000</u>
Total		\$110/ton	\$ 660,000
Income			\$ 180,000

* 3 tCO₂/tC

Technology

Full Capacity 1 Line

Receiving

2.5 dry ton/hr, 48 ton/day, 8000 hrs/yr
20,000 tons/yr dry

Processing

Shred, Fill, Dry, Carbonize, Cool, Screen, Grind, Bag, Ship
Continuous Kiln (Basis: Alterna Energy)
1 process line; 2-2.7 t/hr
1 -70' x 100' process area, 2 operators

Capital: \$500,000

Installation: 18 months

Products:

Biochar 6,600 tons per year (\$200/t wholesale)
Excess Gas 13.2 MMBtu ~ 105,600 MMBtu/yr

Products and Markets

Full Capacity 1 Line

- Gas or Heat
 - 13.6 MMBth
 - \$10/MMBtu
- Biochar 6,600 tpy
 - Additive to compost (25%)
 - Soil amendment
 - Commercial Fertilizer/Garden Wholesaler
 - Wholesale \$200/ton in bulk bag 1000 lb/bag
 - Retail packaging \$250/ton
- Voluntary Green Credit \$1.8 million/yr
 - $6,600 \text{ tC} \times 3 \text{ t CO}_2/\text{tC} = 19,800 \text{ tCO}_2 @ \$20/\text{tCO}_2$

Economics

Full Capacity : 1 Line

Product	Quantity	Price/unit	Revenue
Biochar	6,600 odt/y	\$200/ton	\$ 1,320,000
Heat	105,600 MMBtu	\$10/MMBtu	\$ 1,056,000
Green Credit*	19,800 tCO2	\$20/tCO2	<u>\$ 396,000</u>
Total			\$ 2,772,000
Expenses per dry ton logyard waste			Expenses
Area woodwaste	20,000 t/y	\$30/ton	\$ 600,000
O&M			
2 empl/shift	20,000t/y	\$30/ton	\$ 600,000
Capital	20,000t/y	\$3/ton	<u>\$ 60,000</u>
Total		\$63/ton	\$ 1,260,000
Income			\$ 1,512,000

* 3 tCO2/tC

Technology

Full Capacity Five Lines

Receiving

11 dry ton/hr, 270 ton/day; 56 cu yd/hr, 1345 cu yd/day
90,000 tons/yr dry; 448,000 cu yd/yr

Processing

Shred, Fill, Dry, Carbonize, Cool, Screen, Grind, Bag, Ship
Continuous Kiln (Basis: Alterna Energy)
5 process lines; 2.7 t/hr/ea, 11 cu yd/hr /ea
2 -70' x 100' bldgs, 2 operators

Capital: \$7 million

Installation: 18 months

Products:

Biochar 30,000 tons per year (\$200/t wholesale)

Excess Gas 475,000 MMBtu ~ 30,000 Mwhe
(\$50/MWhe wholesale, \$100/MWh retail)

Products and Markets

Full Capacity 5 Lines

- Gas or Heat
 - 60 MMBth ~ 4.5 Mwhe
 - 60 MMBtuh/15 Mmbtu/Mwe 32,000 MWhe
 - \$10/MMBtu
- Biochar 30,000 tpy
 - Additive to compost (25%)
 - Soil amendment
 - Commercial Fertilizer/Garden Wholesaler
 - Wholesale \$200/ton in bulk bag 1000 lb/bag
 - Retail packaging \$250/ton
- Voluntary Green Credit \$1.8 million/yr
 - $30,000 \text{ tC} \times 3 \text{ t CO}_2/\text{tC} = 90,000 \text{ tCO}_2 @ \$20/\text{tCO}_2$

Economics

Full Capacity 5 Lines

Product	Quantity	Price/unit	Revenue
Biochar	30,000 odt/y	\$200/ton	\$ 6,000,000
Heat	475,000 MMBtu	\$10/MMBtu	\$ 4,750,000
Green Credit*	90,000 tCO2	\$20/tCO2	<u>\$ 1,800,000</u>
Total			\$ 12,550,000
Expenses per dry ton biomass			Expenses
Shredded Biomass	90,000 t/y	\$30/ton	\$ 2,700,000
O&M			
2 empl/shift	90,000t/y	\$20/ton	\$ 1,800,000
Capital	90,000t/y	\$10/ton	<u>\$ 900,000</u>
Total		\$60/ton	\$ 5,400,000
Income			\$ 7,150,000

* 3 tCO2/tC

Next steps

- Feasibility of Production and Distribution
 - Organize wholesale sales and distribution
- Organization
 - JV XYZ Biochar + Technology Provider
 - Host Plant and Wood Supply
 - Marketing
- Next Steps
 - Small production and Field Trials
 - Validate Benefits

Links

- International Biochar Initiative
www.biochar-international.org
- Terra Preta @ Bioenergylists.org
www.biochar.bioenergylists.org
- T R Miles, Technical Consultants, Inc.
www.trmiles.com

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