



# Mitigation of Ecosystem Degradation by Bioenergy with Biochar



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## Why Biochar and Bioenergy?

- Enhances soil and environmental quality, avoiding problems faced by alternative bioenergy products which can lead to (i) soil quality degradation due to excessive removal of organic matter and (ii) off-site pollution due to agro-chemicals used to maximize biomass production [1]
- Produces electricity with net negative greenhouse gas emissions compared to lifecycle emissions of 800-1200 kg CO<sub>2</sub>/MWh for electricity produced from coal or natural gas [2]
- Optimizes feedstock and biochar management systems for both energy production and maximizes the potential to avoid greenhouse gas emissions [2]

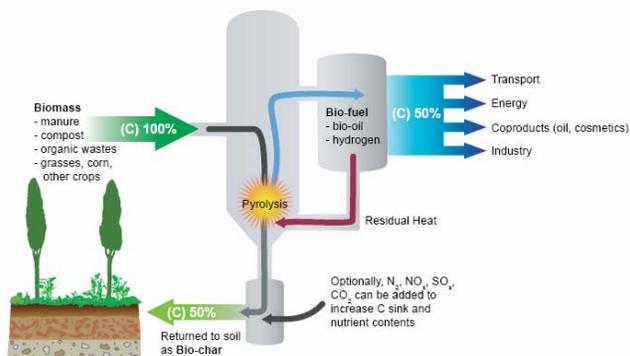


## What is Biochar?

Biochar is a form of charcoal produced by heating biomass in the absence (or under reduction) of air. Biochar is found in soils around the world as a result of vegetation fires and historic soil management practices. Intensive studies of biochar rich dark earths in the Amazon (*Terra Preta*), has led to a wider appreciation of biochar's unique properties as a soil conditioner.

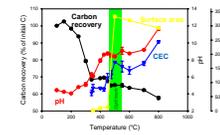
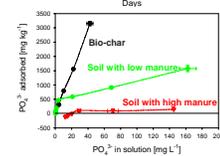
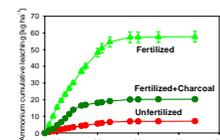


## Pyrolysis with Biochar return



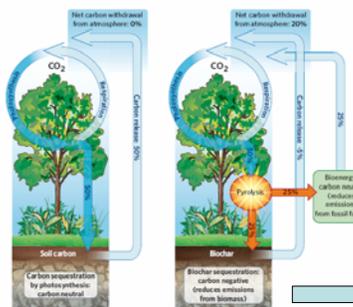
## Biochar: Soil Fertility and Pollution Reduction

- Biochar retains many nutrients (cations) better than other organic matter in soil [5] and reduces leaching [6]
- Biochar appears to retain phosphates with the potential to reduce losses to water bodies
- There are significant interactions between production conditions and biochar behavior

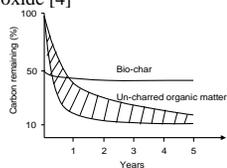


Corn field showing increased crop productivity

## Biochar: Carbon Sequestration and Emission Reduction



- Biochar has much greater resistance against microbial decay than uncharred organic matter [3]
- Biochar application to soil has shown to reduce emissions of more potent greenhouse gases such as methane and nitrous oxide [4]



## We need to know:

- Optimum feedstock properties and production conditions for biochar to increase stability in soil
- Magnitude of biochar decomposition in soil
- Emission reductions associated with biochar in soils
- Energy and emission balances for feasible pyrolysis bioenergy systems with and without biochar return to soil

## We need to know:

- Optimum feedstock properties and production conditions for biochar to increase soil fertility
- Rate and type of property change of biochar in soil
- Any detrimental effects of biochar, possibly at high application rates

## NYSERDA Project: Biochar for New York State

Our goal is to assess the feasibility of Pyrolysis and Bio-energy Production for New York State. To do this we are:

- Identifying feedstock availability in NYS
- Defining potential applications for biochar in NYS and exploring pyrolysis process conditions which affect biochar behavior
- Undertaking greenhouse and field experiments to quantify the environmental and agronomic benefits of applying biochar to soil
- Describing potential Pyrolysis and Biochar models for NYS and their feasibility

## Assessment of the Biochar Potential in New York State

### Biochar products and sequestration potential for New York State

A sequestration potential of 116,591,916 tons carbon exists in New York State in the following sectors:

	Area (acres)	Application rate (t / acre)	Carbon sequestered (t C)
Mitigated Wetland	10,000	25	170,081
Grass establishment	843,223	57	32,578,474
Golf course green construction	100	77	5,251
Topdressing	3,428,322	9	21,364,538
Vegetable production	143,967	30	2,938,330
Field and Misc crops	2,917,000	30	59,535,241
<b>Total</b>			<b>116,591,916</b>

### Financial viability

Our preliminary analysis for a pyrolysis facility costing \$15M to construct using yard waste as a feedstock suggests that a facility would be financially viable and pay off the initial investment by year 6.

### Assumptions

Tipping fee for feedstock (\$ per wet ton)	\$ 50
Wholesale price for biochar per t	\$ 200
Carbon trading value \$ per metric ton CO2	\$ 10
Location based marginal price \$ per kW	\$ 0.1191

Net Present Value	\$5,696,913
Cost of capital	5.00%

### Next Steps:

We are working with potential stakeholders in the biochar and bio-energy sector to refine our models systems and analysis of biochar feasibility

### Citations

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