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Life cycle assessment of biochar production from southern pine

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Life Cycle Analysis of Biochar production from Southern Pine

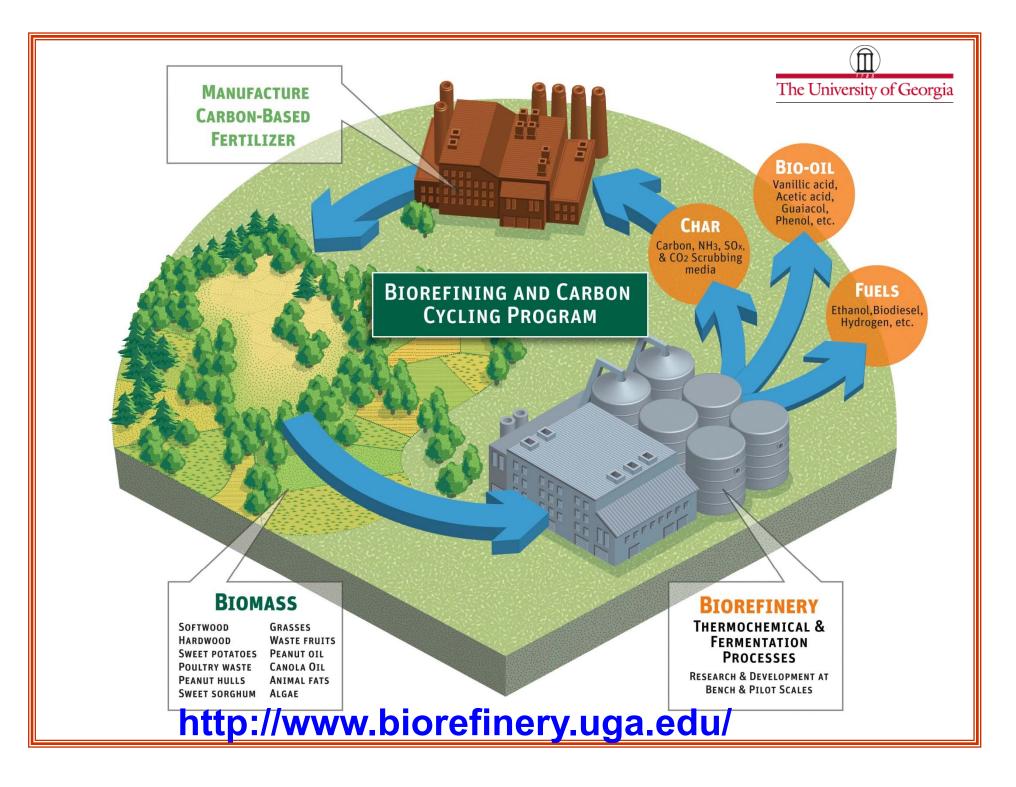


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Historical Development -Biochar

- Charcoal is considered as a first synthetic material produced by human 38,000 yrs ago (Brad, 2001)
- Late 1800s- Black earth in Amazon
- 1950s Biochar for seedling growth medium
- 1950s 1970s Charcoal production for energy
- 1980s Japan biochar research for soil application
- 1990s Biochar as potting mix
- 2000s Intensive Biochar R & D; Rediscovery of Amazonian Black soil (*Terra Preta de Indio*) – 2500 yrs ago. Soil contains 150g of C/kg of soil compared to 20-30 g of C/kg of soil.



Life Cycle Analysis Approach

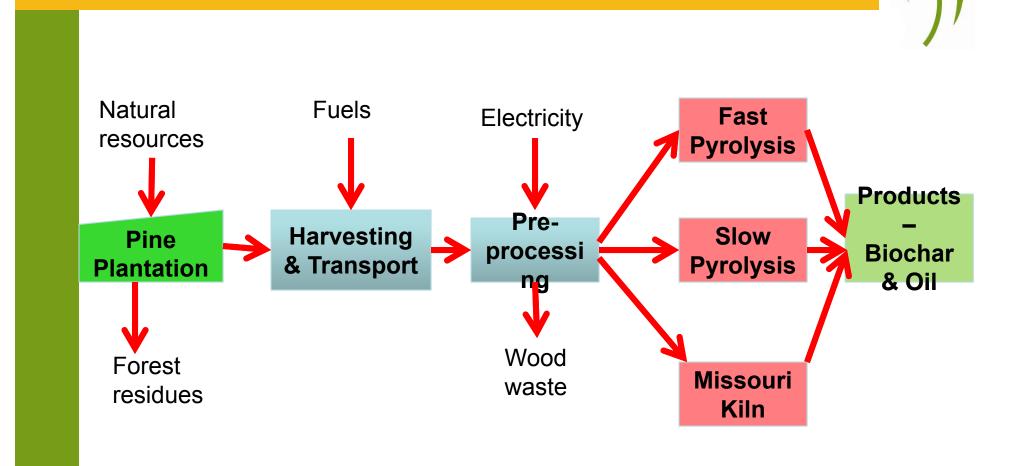
- Cradle to Gate approach to assess the environmental impacts of biochar with co-product allocations (mass)
- Functional unit per tonne of biochar produced
- Feedstock Southern Pine in US (average of 25 year harvest cycle)
- Clean chips are produced from regular pulp wood logs and barks are used as a heat source for drying
- Soil Carbon Sequestration is not considered
- Computing platform: SimaPro 7.4(US LCI database)
- Impact assessment TRACI & BEES





Production Pathways

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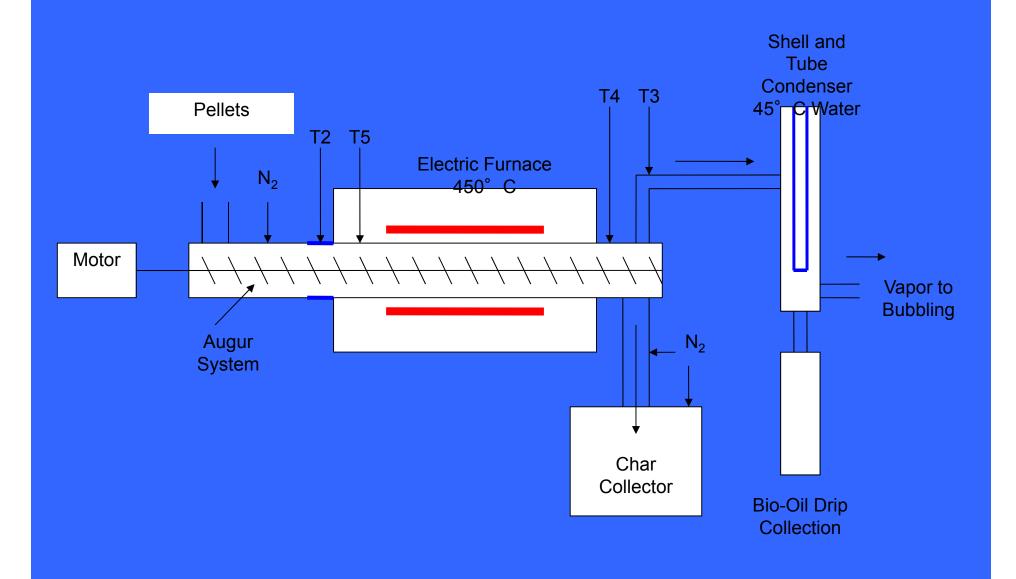




Biochar Production & Technologies

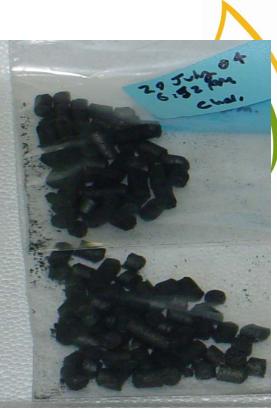
- World Production 41 million t
- South Africa 50% of the production
- Char yield
 - Traditional kilns = 10-20%
 - Missouri kiln = 20-30%
 - Linann Kiln = ~ 30% (China, Brazil)
 - High pressure kilns = ~45% (U of Hawaii)
- Pyrolysis Technologies with co-production
 - Slow pyrolysis 30% (char) & 35% (bio-oil)
 - Fast pyrolysis 15% (char) & 50-60% (bio-oil)

UGA's Continuous Pyrolysis Unit









Biochar



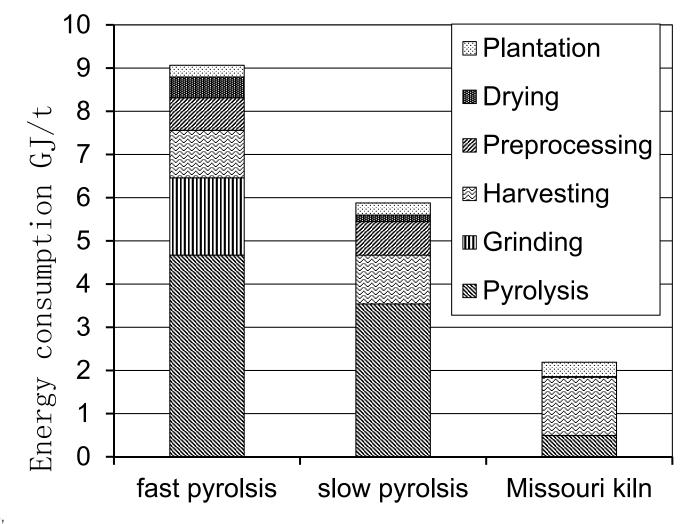
Bio-oil

Rotary drum reactor – UGA (indirect heating)





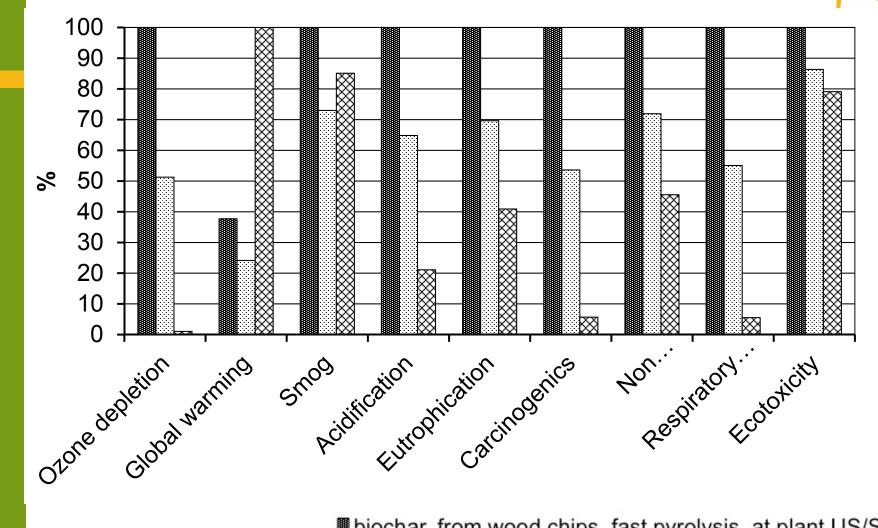
Results: Energy Consumption







Results: Environmental Impacts

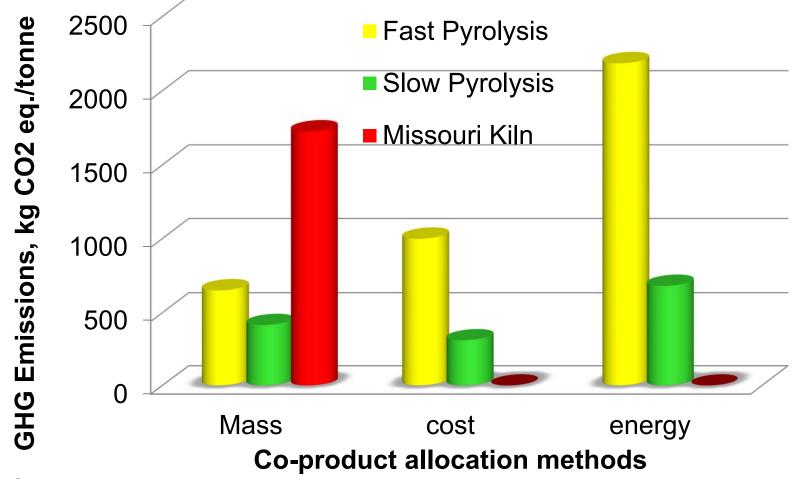


biochar, from wood chips, fast pyrolysis, at plant US/SE
biochar, from wood chips, slow pyrolysis, at plant US/SE
biochar, from small logs, Missouri kiln US/SE US

11

Results: Co-product allocation methods

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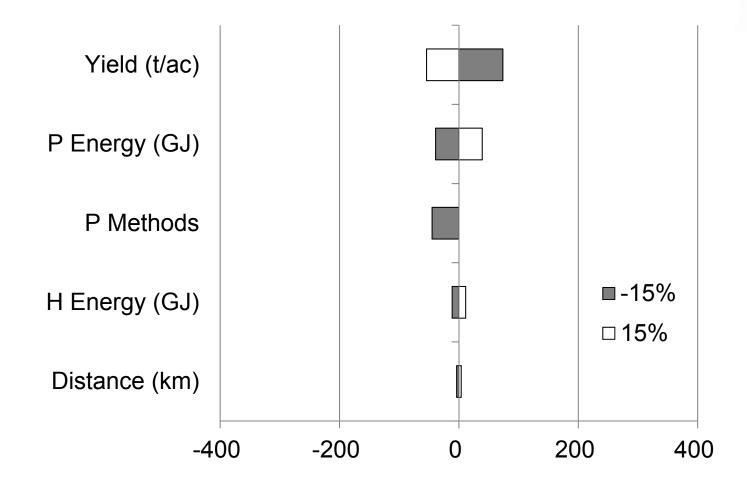


December 8,



Sensitivity Analysis of GHG emissions (kg CO₂ eq./tonne): Slow Pyrolysis

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Decem ber 8,

Conclusions

14

- A cradle to gate assessment of producing biochar via three production of routes were investigated from Southern Pine wood.
- Environmental impacts, specifically GHG emissions were the lowest for slow pyrolysis technology – (417 kg of CO₂ eq./tonne)
- Among different co-product allocation methods (mass, cost and energy use), both cost and mass based allocation methods had lower emissions for the slow pyrolysis technology
- Pine wood yield and pyrolysis and pre-processing energy consumption data were more sensitive to the GHG emissions for the slow pyrolysis technology
- Future research is focused on estimating the GHG emissions savings from biochar use in soil applications (2,600 to 16,000 kg CO₂ eq./tonne of biochar).







Thank you