

LCA of Biochar: How feedstocks and production systems stack up

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*Production of Quality Feedstock From
Forest Residues for Emerging Biomass
Conversion Technologies*

U.S. DEPARTMENT OF
ENERGY

 **HUMBOLDT
STATE UNIVERSITY**

For more information please visit WasteToWisdom.com

Waste to Wisdom Project Overview

Forest residuals and slash are an immense, underutilized resource.

But transportation costs are prohibitively expensive due to their low bulk density and low market value.

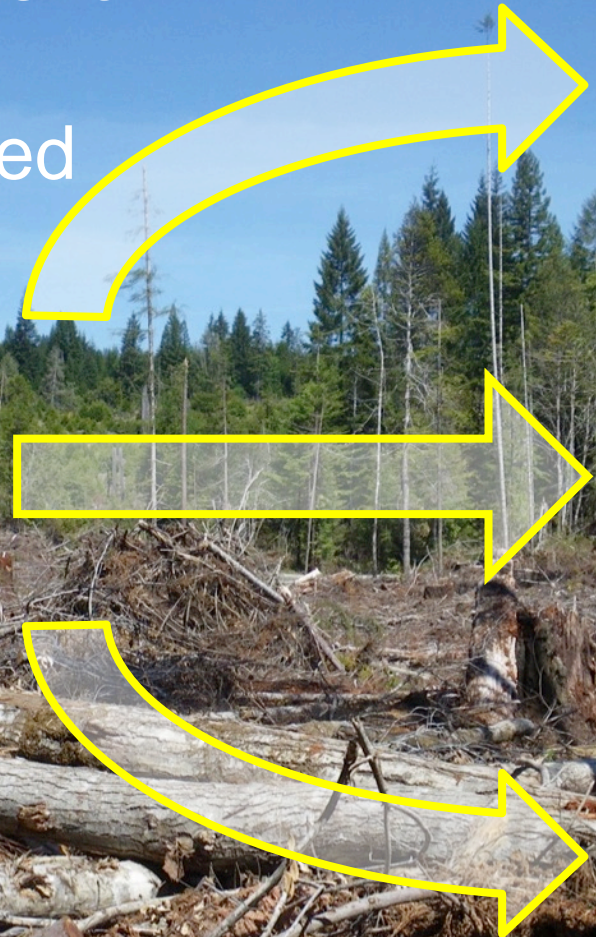
These economic barriers can be overcome by

- increasing the transportation efficiency, and/or
- increasing the value of the residuals



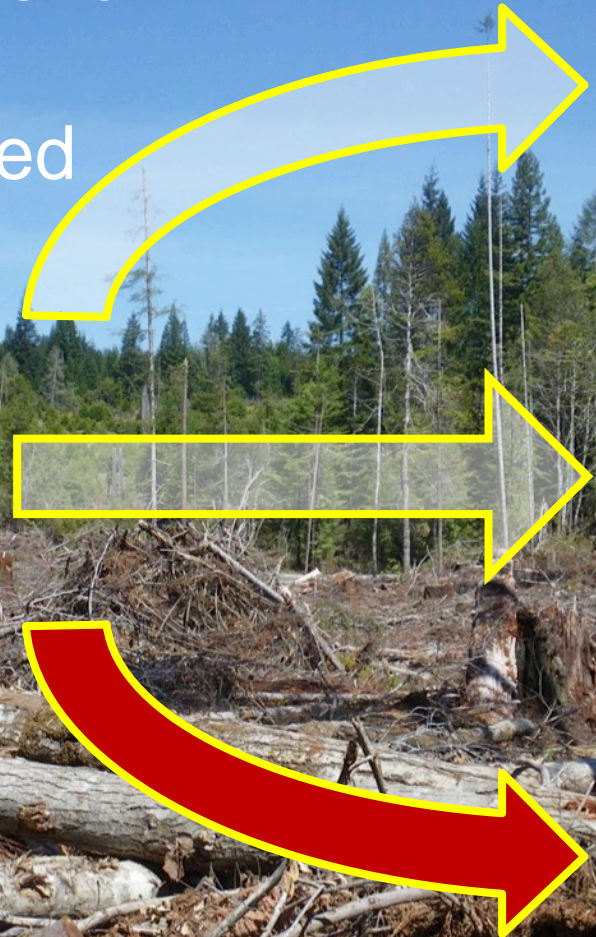
Waste to Wisdom Project Overview

Utilizing forest residuals for the production of bioenergy and bio-based products.

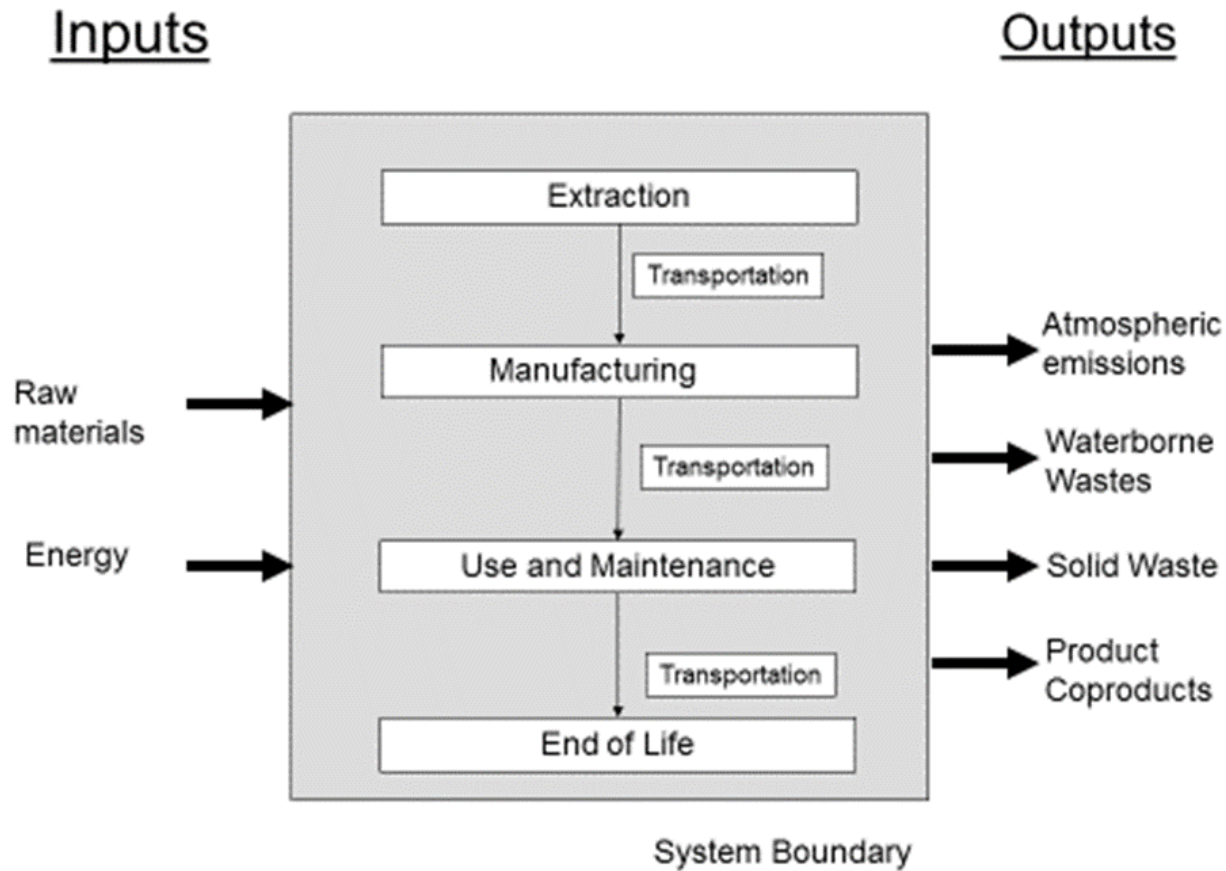


Waste to Wisdom Project Overview

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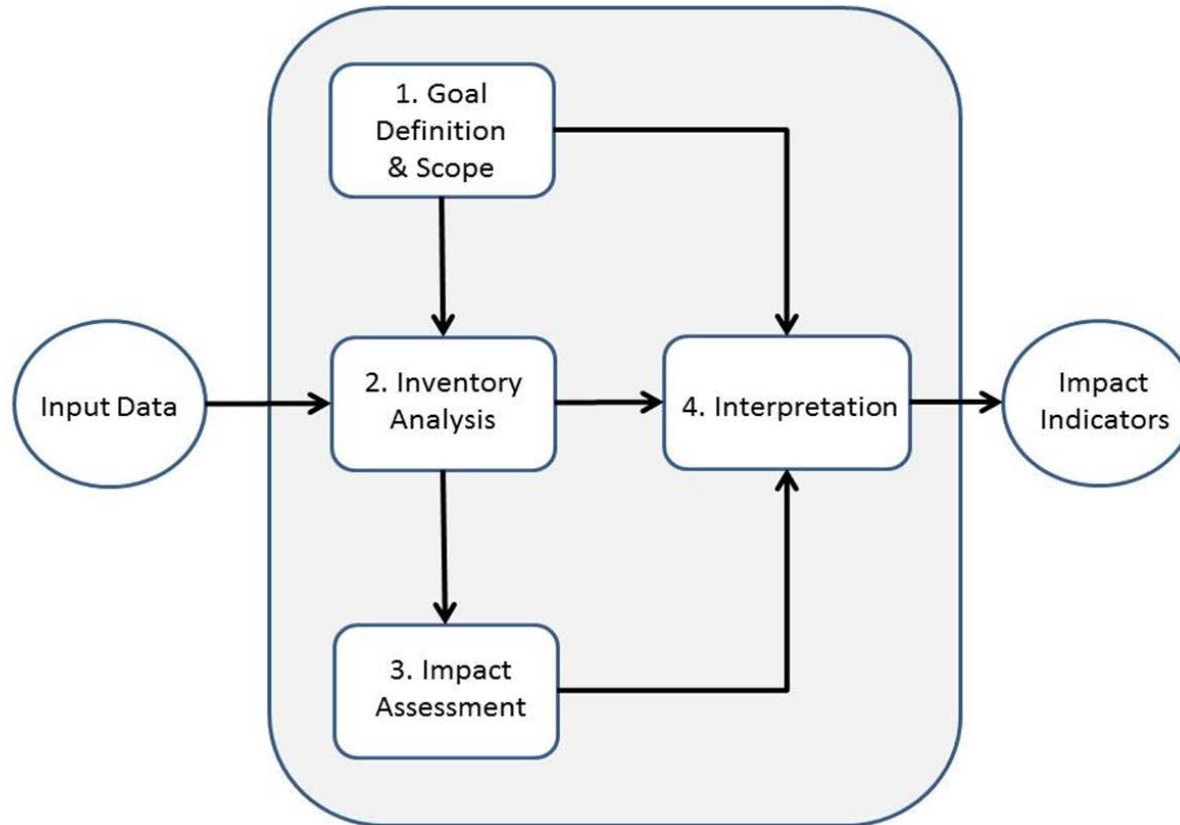


What is LCA?



Source: EPA 1993

LCA Framework



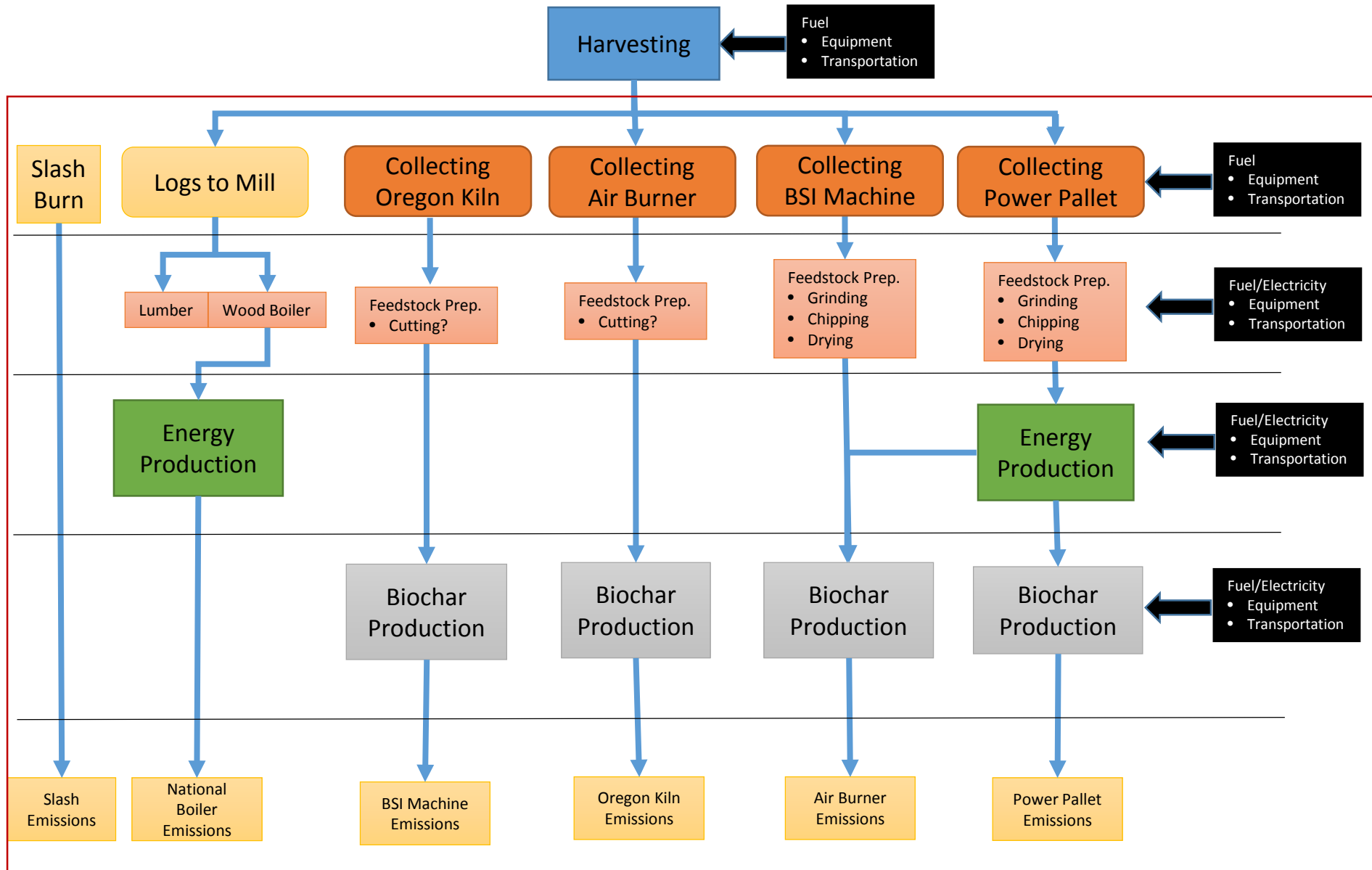
LCA of Biochar

- What are the environmental impacts of producing biochar?
- What environmental impacts are we looking at?
 - Energy consumption from each system
 - Emissions generated from each system (eg. CO, CO₂, particulates, NO_x, CH₃)
 - Impact categories such as GWP and respiratory effects
- Compare to “pile & burn” of forest residues/slash in the woods

Slash – you can use it or burn it



LCA Framework for Biochar Production – Cradle to gate



Slash Recovery Operations



Whole Tree Chipping



LCA: Biochar

Bringing forest residue to landing

- Skidders
- Log loaders
- Feller bunchers
- Chain saws

Processing residue at landing

- Chain saws
- Small loaders
- Water pump trucks
- Grinders
- Chippers
- Sifters
- Dryers

LCA: Biochar Systems

1. Biochar Solutions Inc. (BSI)
 - Western forest residues
 - 7 combinations of feedstock, comminution methods, and contaminant level were tested.
2. Oregon Kiln (Biochar Wilson Associates)
 - Western forest residues
3. Air Burner
 - Western forest residues

Biochar Production Systems



BSI Biochar Machine

Biochar Solutions, Inc

Biochar Production Systems



Photo credit: Wilson Biochar

Oregon Kiln

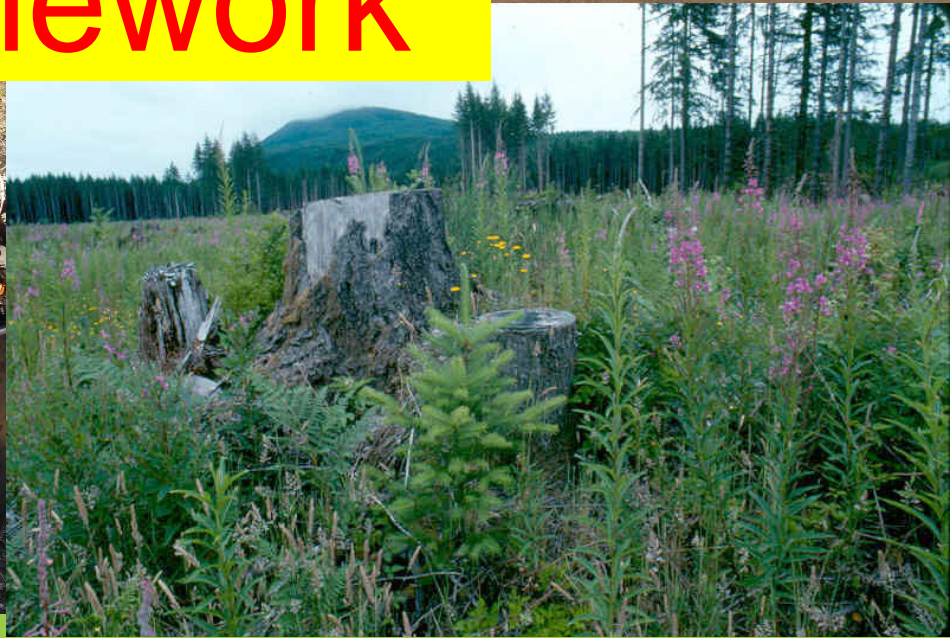
Biochar Production Systems

Air Burner





Framework



Conclusions - LCA of Biochar

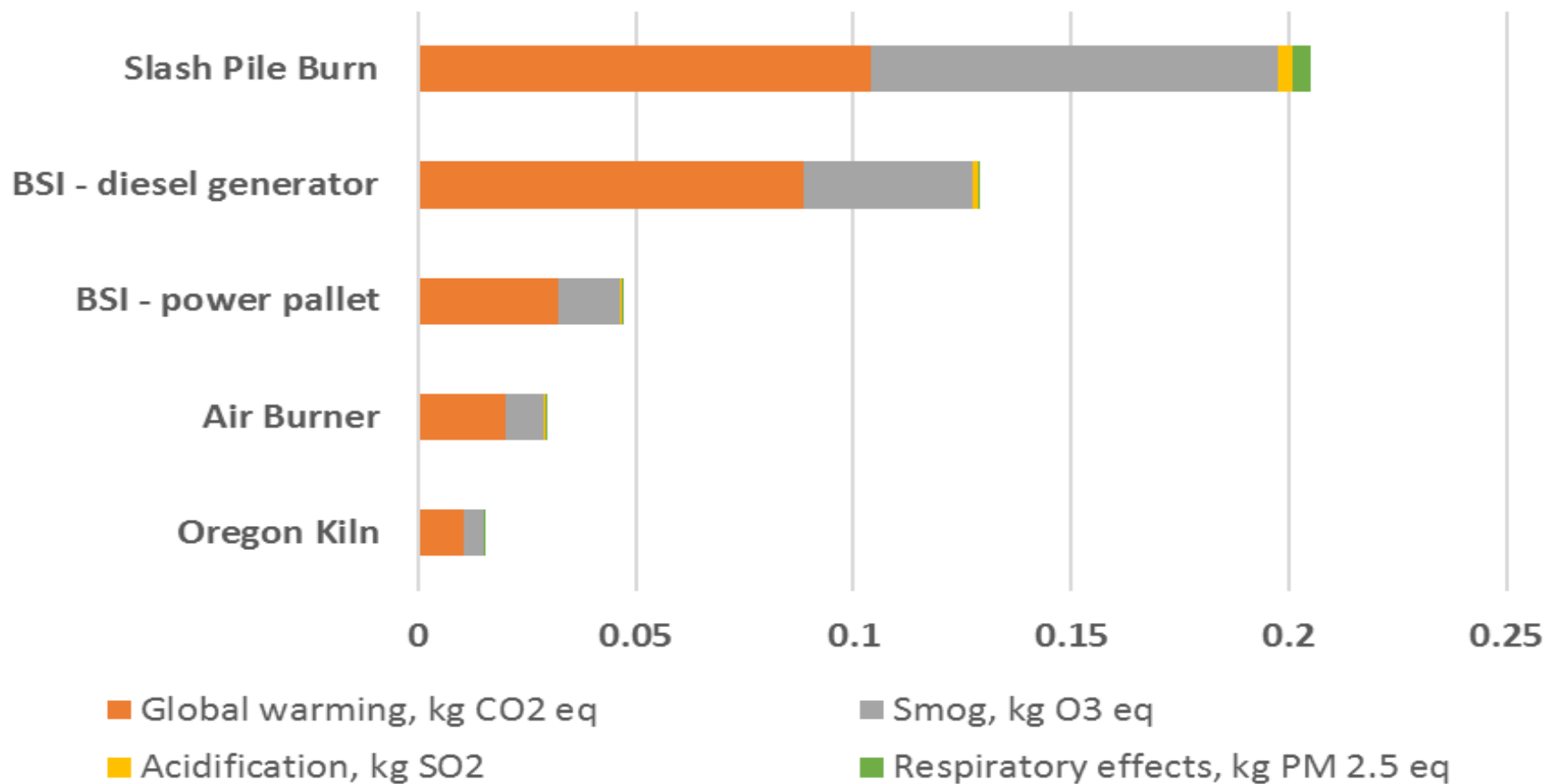
- Large data uncertainty in the biochar systems
- Missing data present between systems
- BSI system data is based on a first trial run, second trial run data will be available by mid-September
- No feedstock drying system in the current model

Conclusions - LCA of Biochar

- **Power Pallet** (small gasification generator potentially used to power the biochar machine and the drying system) data is just rolling in.
- **Preliminary!!** - Power Pallet reduced impacts by 73% in most categories over a diesel generator
- For reports and presentations see www.wastetowisdom.com

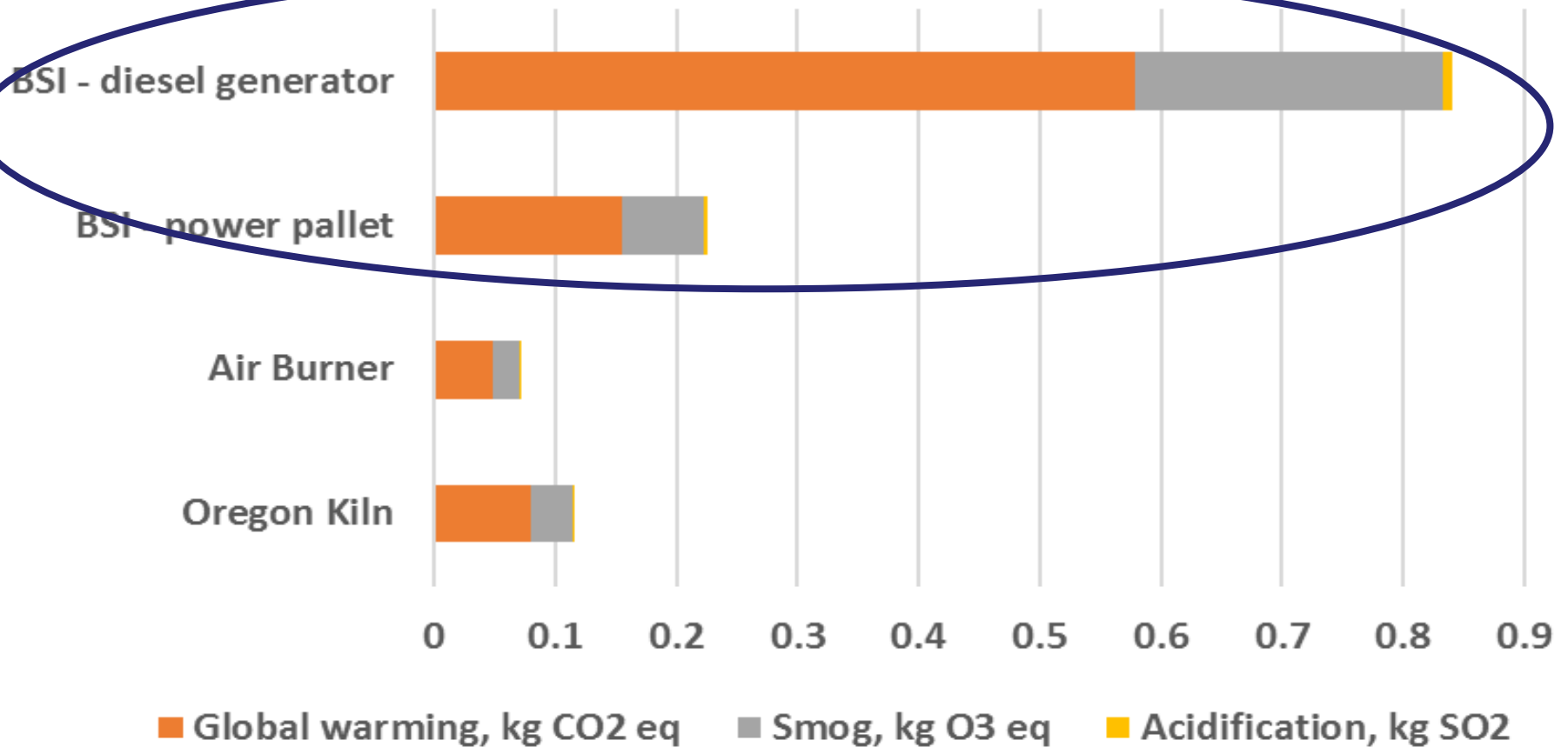
Results – Biochar Systems

Equivalent Feedstock Consumed



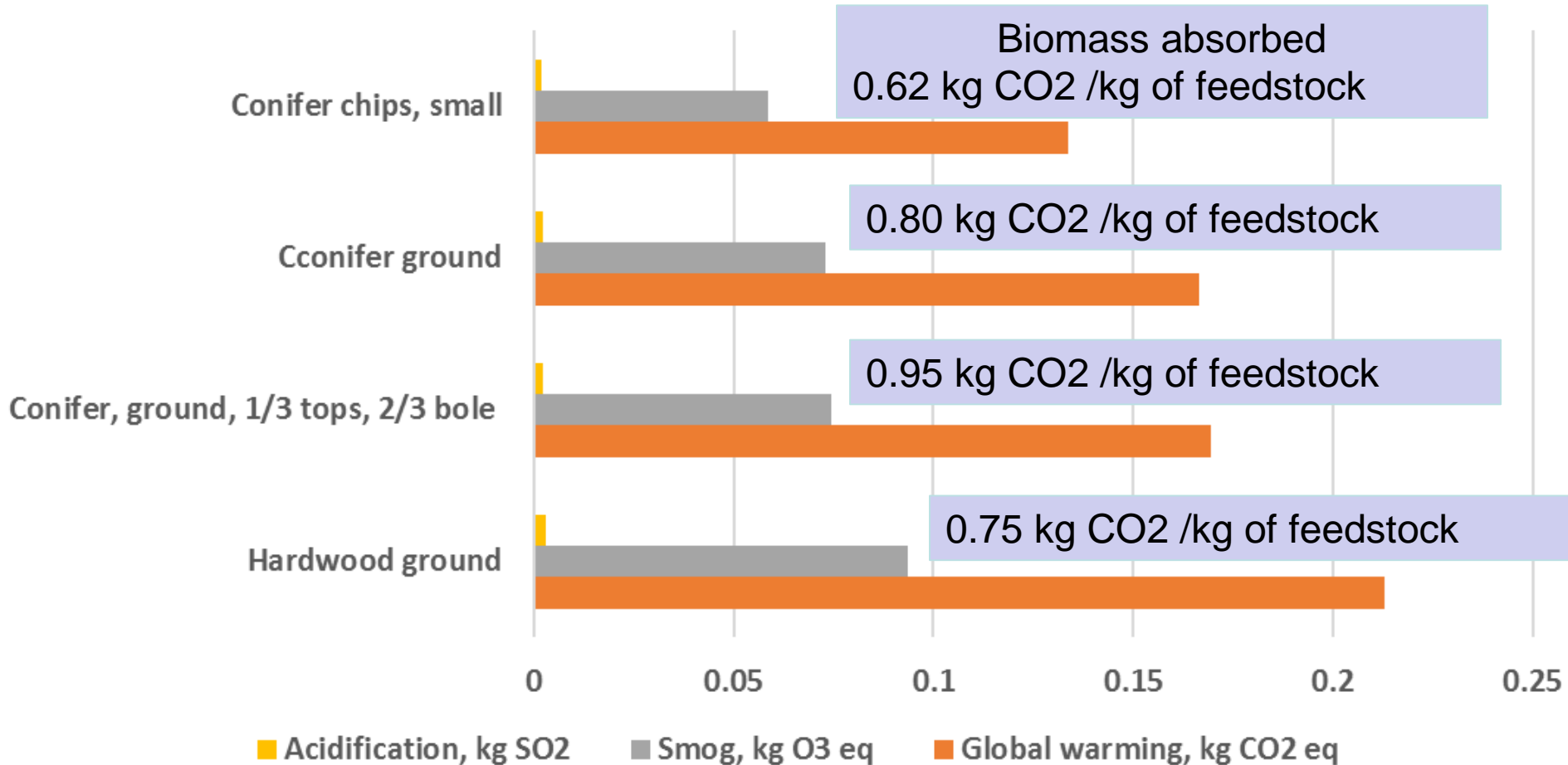
Results – Biochar Systems

Equivalent Biochar Produced



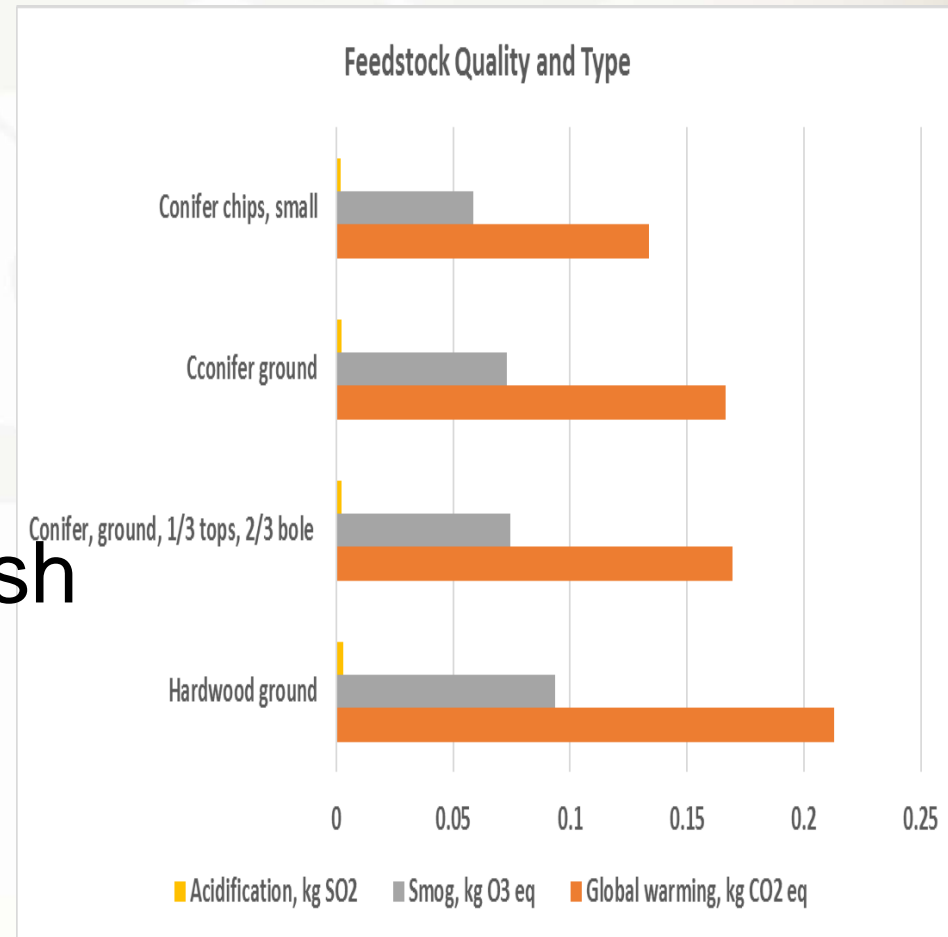
Results – Biochar Feedstocks

Feedstock Quality and Type



Results – Biochar Feedstocks

- Does not show biochar quality
- Does not show feedstock input composition (mc, ash etc.)
- Labor hours/per kg input



LCA Biochar – Next Steps

- Obtain updated input/output data for BSI unit
- Obtain complete data set for Power Pallet for use in drying and energy for BSI unit
- Addition of the dryer! Relationship between productivity and feedstock moisture content
- Incorporate biochar quality into the LCA
- Sensitivity analysis on biochar quality to feedstock quality.
- Obtain additional upstream data on feedstock collection and handling of forest residues

Thank you!

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