

# Overview of characterizing approaches to collecting forest residues



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# “Slash Piles”







Sub-merchantable size trees  
from fuel reduction thinning  
treatments





# Forest Residues

- Materials difficult to handle:
  - Not uniform in size and shape
  - Low bulk density





# In-woods Biomass Handling Methods

## Grinding



## Chipping



## Bundling



# In-woods Forest Biomass Production Systems





## Slash Recovery Operations





# Whole Tree Chipping





# Integrated Harvesting

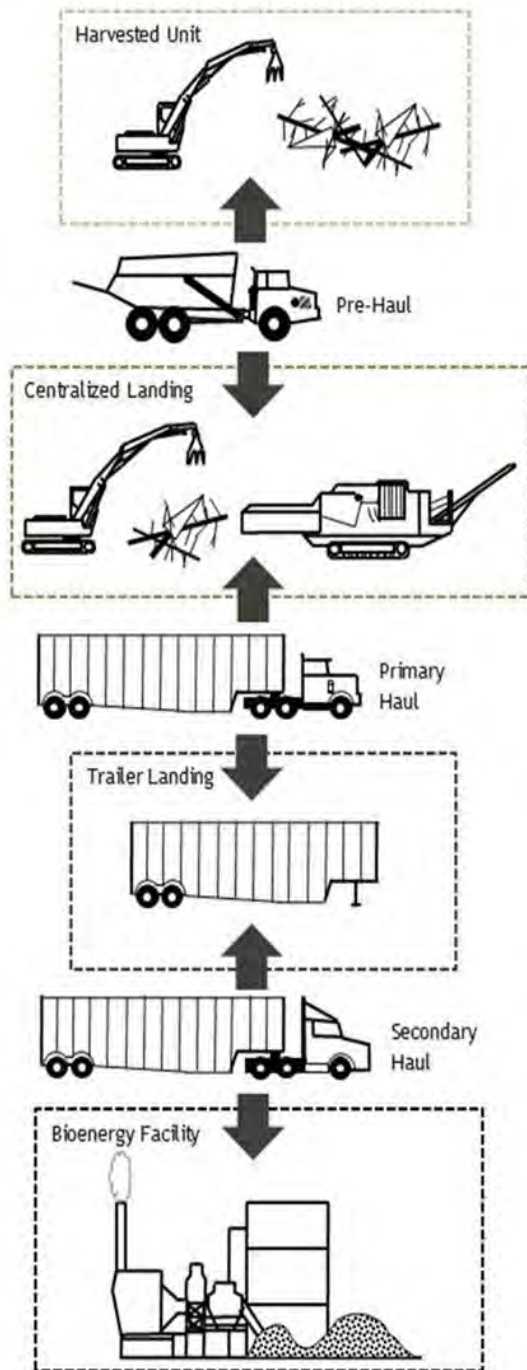




# Biomass Operations Logistics







Upstream

**Grinder:  
38 BDT/hour**

Downstream

Decoupled

# System Balance

- Matching upstream and downstream production
- Decoupling transportation to bioenergy facility

Key to high harvesting productivity and low cost



# Equipment Selection





Loading





# Biomass Forwarding to Grinder/Chipper

**Modified Dump Truck**



**Hook-lift Container**



**Roll-on/off Container**



**Logging Truck  
for whole trees**





# Production of Quality Feedstocks from Forest Residues

## Quality:

- ✓ Low moisture content
- ✓ Sized to conversion technologies
- ✓ Low contamination



# “Slash Piles”





# Sorting of Forest Biomass



+

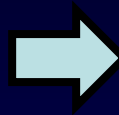




# Two-Stage Biomass Harvesting



Phase 1



Phase 2

**Time**  
(three months  
to one year)



# Integration of Mobile Biomass Conversion Technologies with In-woods Biomass Operations



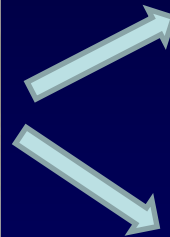
# Mobile Torrefaction & Densification



**Wood Chips**



**Torrefied  
Wood Chips**

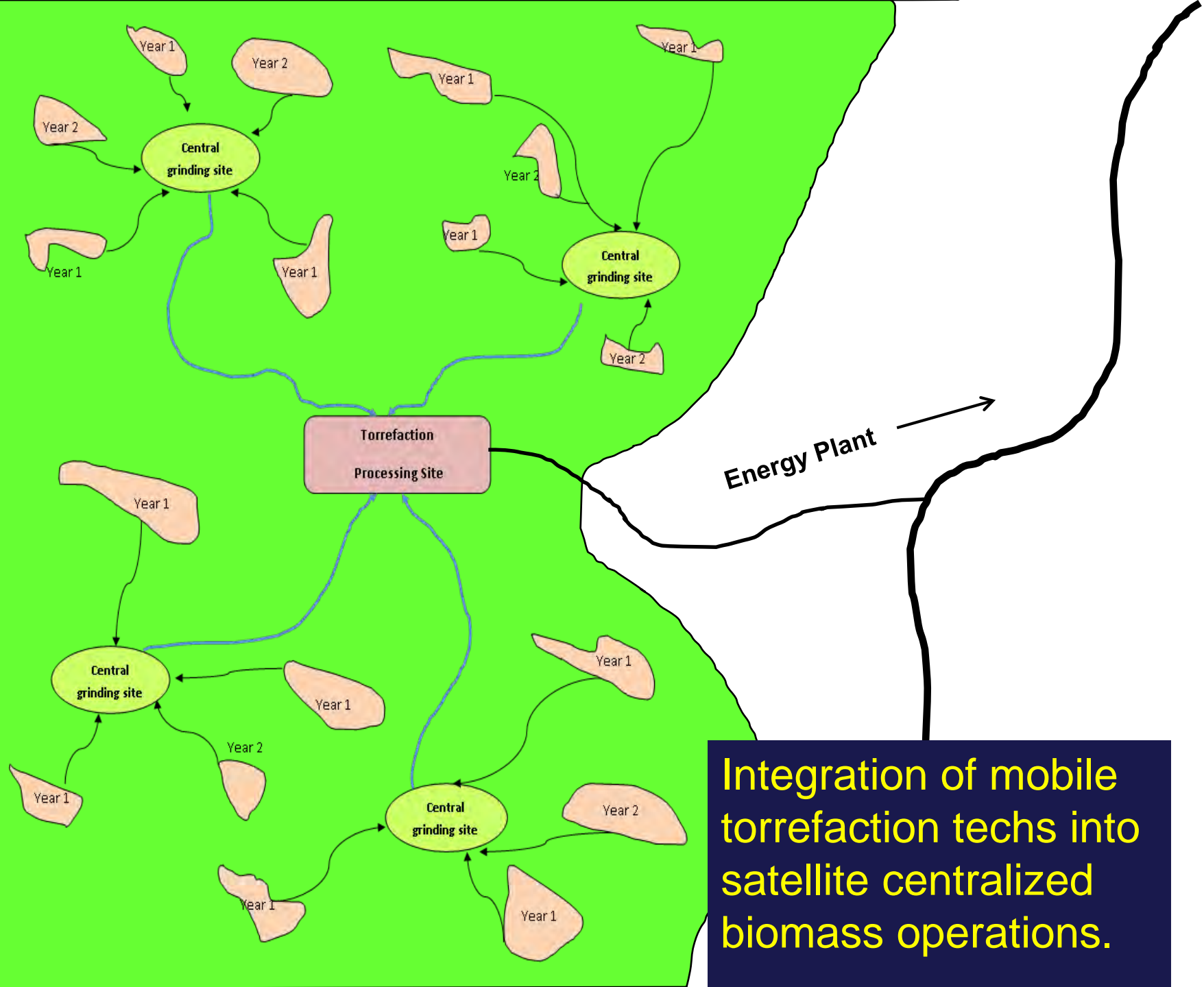


**Biocoals**



**Biochar Pellets**





Integration of mobile torrefaction techs into satellite centralized biomass operations.

# Acknowledgement

The Rocky Mountain Research Station of the U.S. Forest Service, Department of Agriculture and Humboldt State University are partners in a biomass research project funded through the Biomass Research and Development Initiative (BRDI) and will help increase the availability of alternative renewable fuels and biobased products to diversify the nation's energy resources. Funding is provided through USDA's National Institute of Food and Agriculture (NIFA) and the Department of Energy's Biomass Program. Each award was made through a competitive selection process. This project will develop an integrated approach to investigate biomass feedstock production, logistics, conversion, distribution and end use centered on using advanced conversion technologies at existing forest industry facilities.





Questions?