

Mr. Eckardt is a forest operations analyst for RE Consulting LLC, which is a forestry business specializing in forest operations and transportation analytics. Previously he worked as an operations analyst for Prentiss & Carlisle Co. Inc., a project analyst for Nicols Brothers Inc., a research assistant for the Forest Resources Association and University of Maine School of Forest Resources. He helped these organization with strategic planning; market research and analysis; operations research and cost analyses; information system design; statistical modeling and analysis; and forest management. Mr. Eckardt has a B.S. in Forest Operations Science and a MBA-Finance, both from the University of Maine. Please Welcome Rory Eckardt.....

Raw Material Supply

An In-Woods Operations Perspective



Rory L. Eckardt
RE Consulting LLC

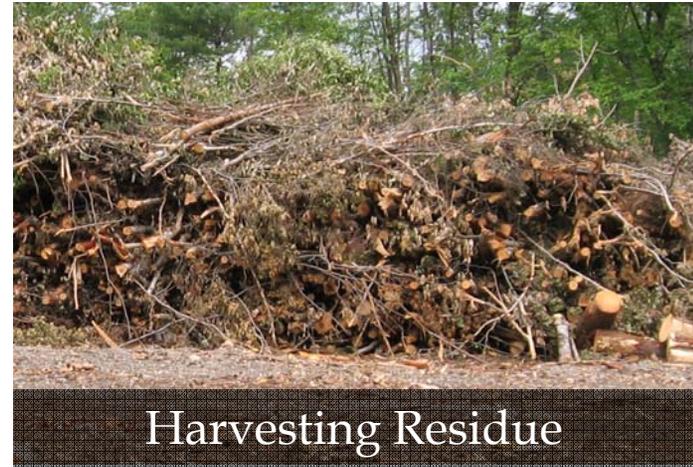
19 October 2007
A Strategic Planning Session for the Forest Bioproducts Industry
The Northeast Forest Bioproducts Puzzle

Outline

- **Raw material sources**
- **Harvest residue properties**
- **Steps involved with utilizing harvesting residue**
- **SWOT analysis of utilizing harvesting residue**
- **Establishing biomass processing operation**
- **Concluding thoughts**



Raw Material Sources



Raw Material Sources

- No changes to in-woods ops.
- Wood-room required at mill
- Competing uses for material
 - Limited supply (S.A.)
 - Expensive material

Roundwood



Harvesting Residue

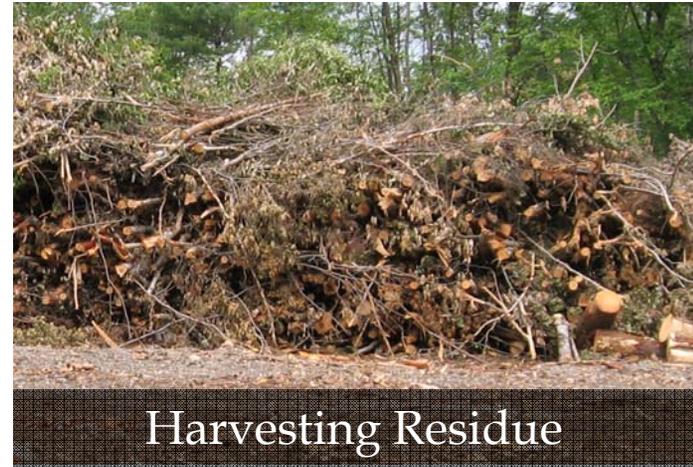
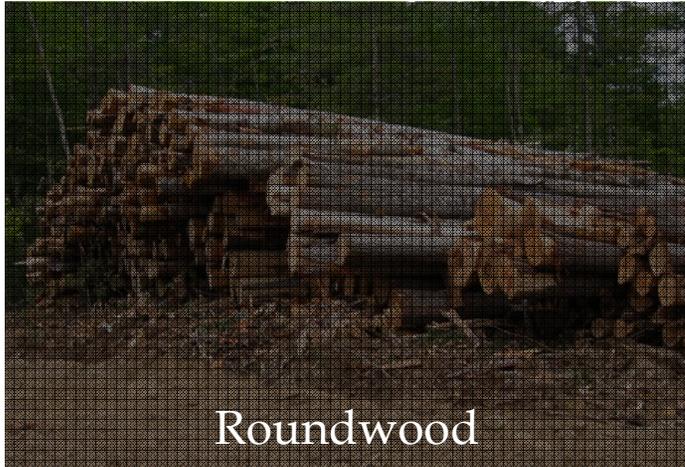


Manufacturing Byproducts



C&D Waste

Raw Material Sources

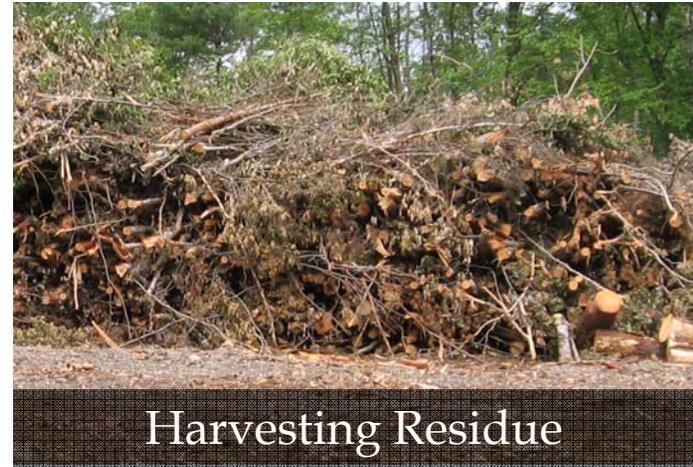


- No impact on in-woods ops.
- Limited supply and tied to health of suppliers' industries
- Competing uses for material
 - Expensive material

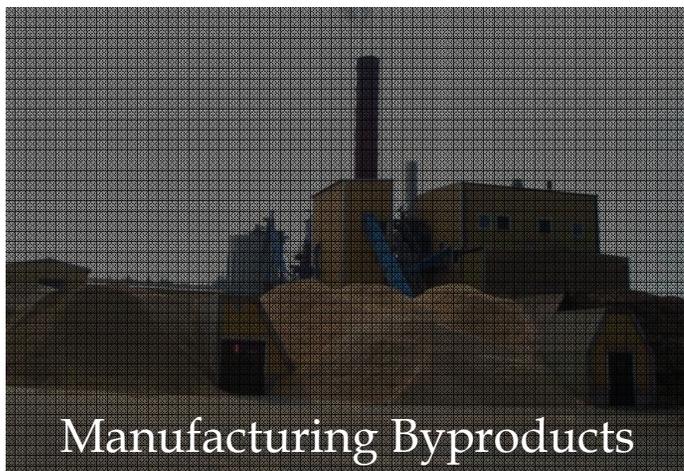
Manufacturing Byproducts



Raw Material Sources



Raw Material Sources



Harvest Residue Properties

- Material is difficult to handle/move efficiently with existing logging equipment.
- Brittle to handle if it sits for more than a year
- Low-bulk density
 - Harvesting residue is 25-30% as dense as solid wood (McDonald et. al, 1993 & Rummer et. al. 2004)



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 - Comminution or compaction is required prior to transport
 - Current compaction methods (e.g. Residue bundlers) can only achieve half a legal payload on log trucks (Rummer et. al. 2004)
 - Most harvest residue is comminuted before transport

Harvesting Residue Utilization

- Four general steps:

101 biomass conversion systems

Biomass Conversion System

1. Harvesting

- Processes required to deliver a delimbed and topped product to roadside

2. Accumulation (not required for all harvesting systems)

- Collecting and piling harvesting residue

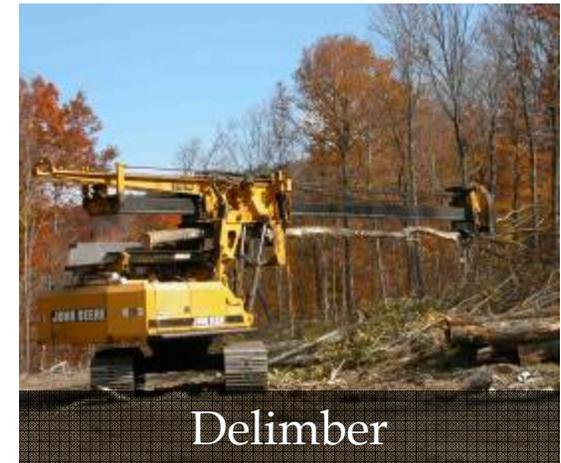
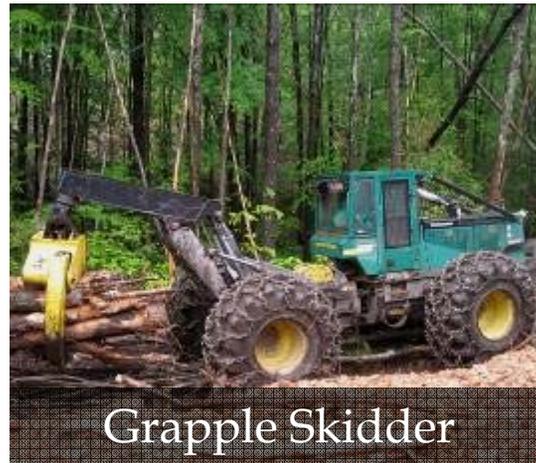
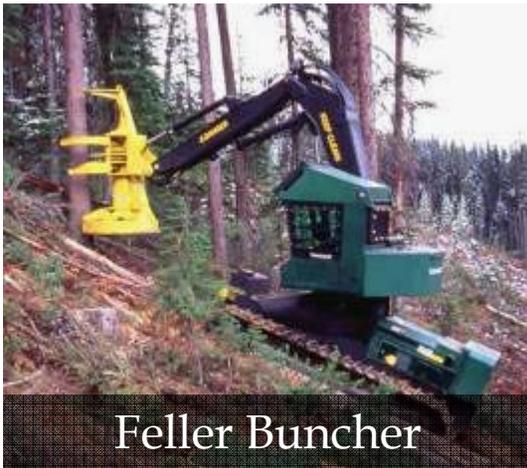
3. Processing

- Converting harvesting residue into smaller pieces (hog fuel or chips)

4. Transport

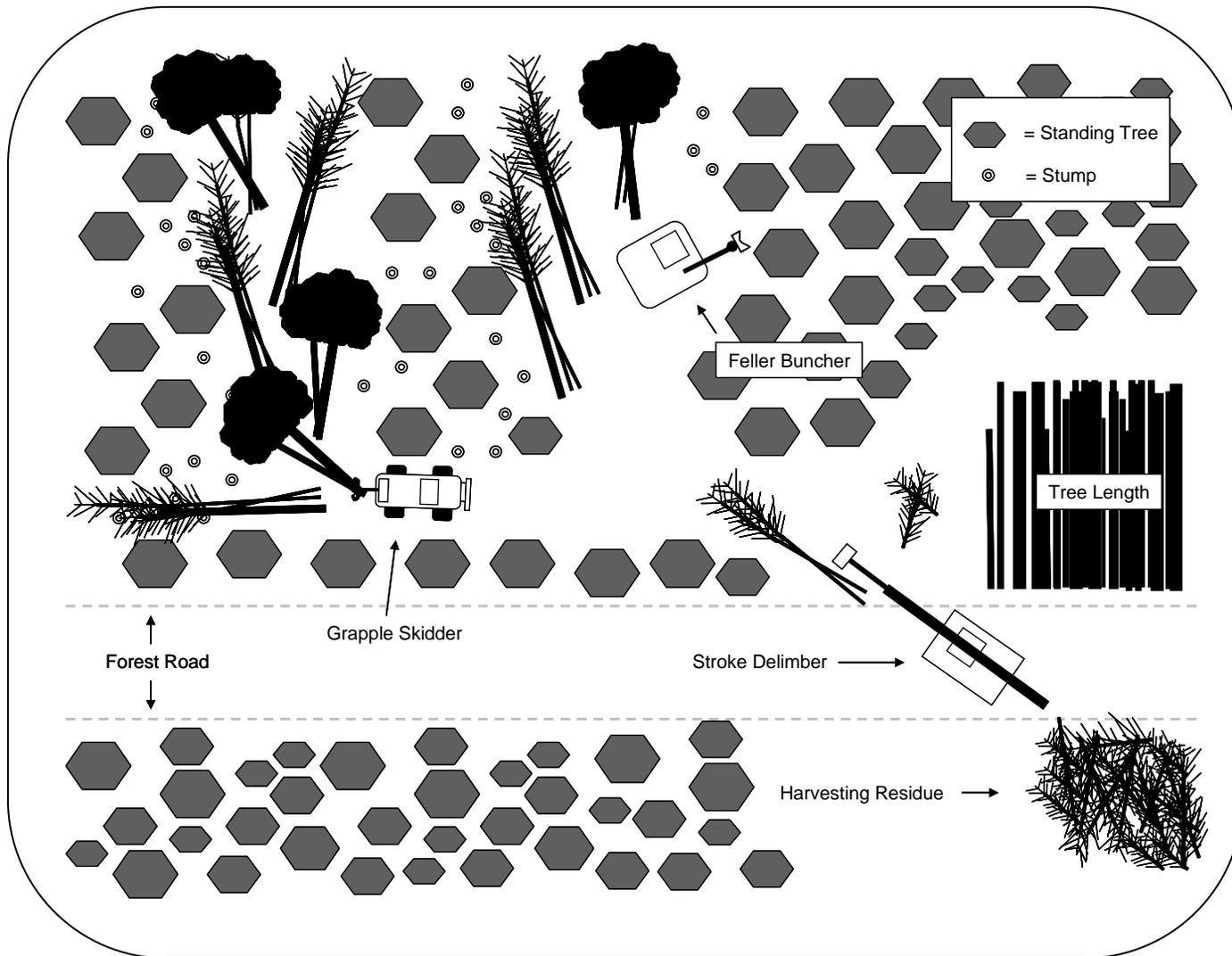
Common Biomass Conversion Systems

Harvesting Step: Mechanical System



Common Biomass Conversion Systems

Harvesting Step: Mechanical System

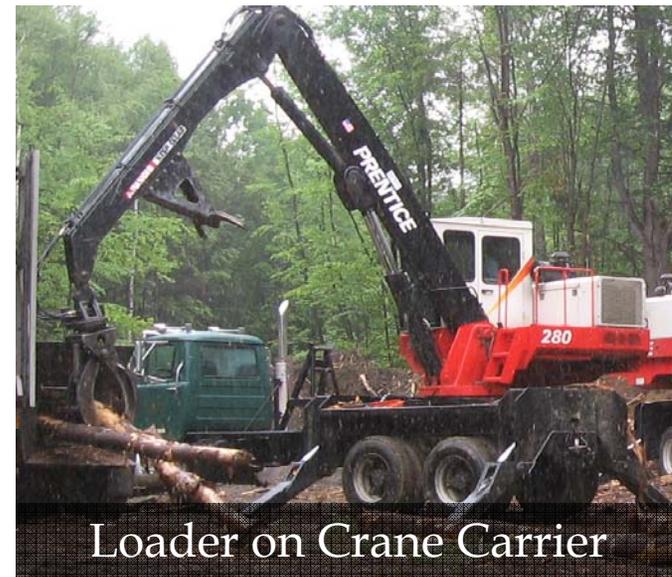


Common Biomass Conversion Systems

Accumulation Step: Skipped

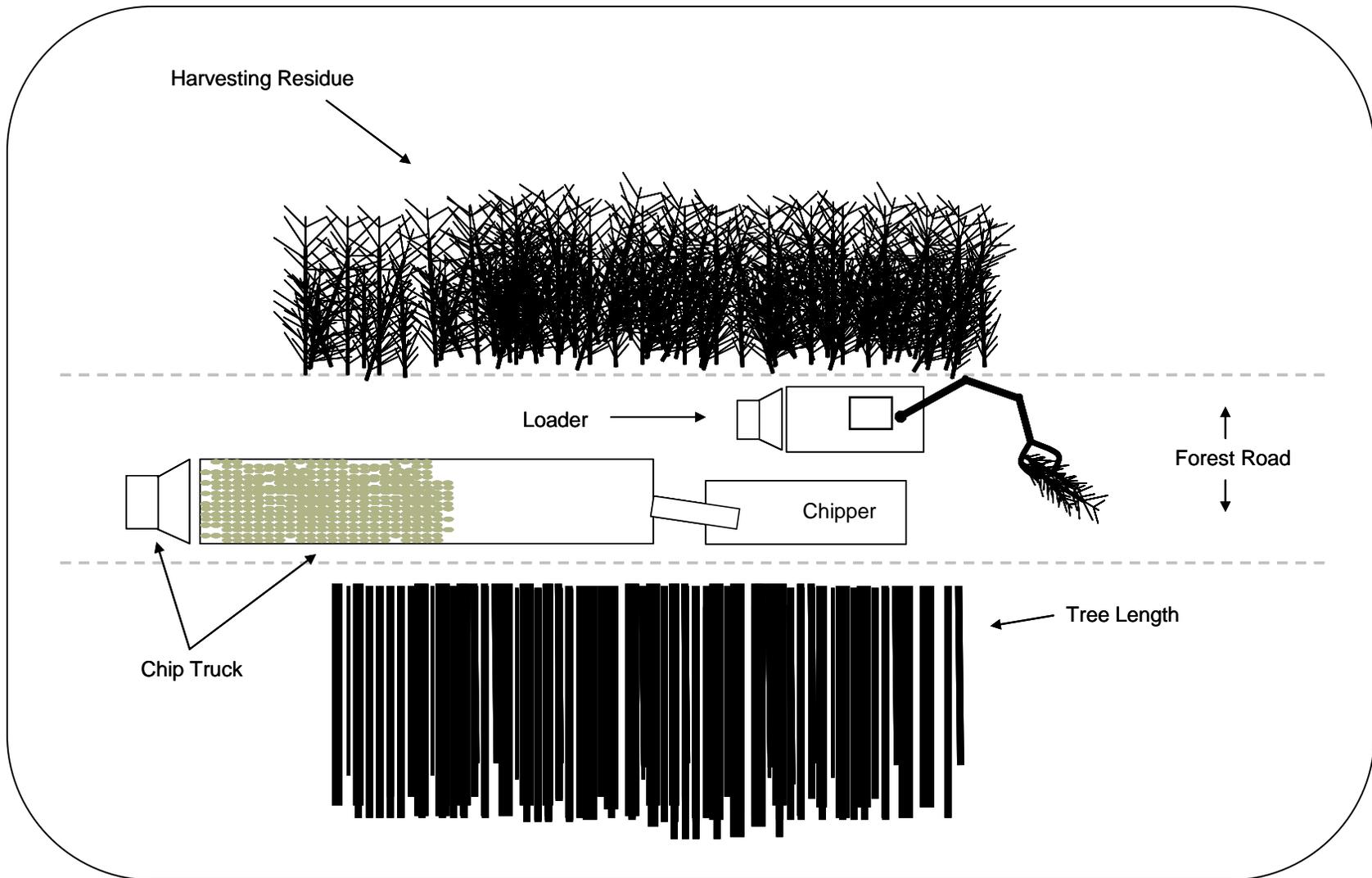
Common Biomass Conversion Systems

Processing Step: Whole-Tree Chipper & Loader on Crane Carrier



Common Biomass Conversion Systems

Processing Step: Whole-Tree Chipper & Loader on Crane Carrier



Common Biomass Conversion Systems

Transport Step: Tractor-Truck and Chip-Van



Tractor-Truck & Chip-Van

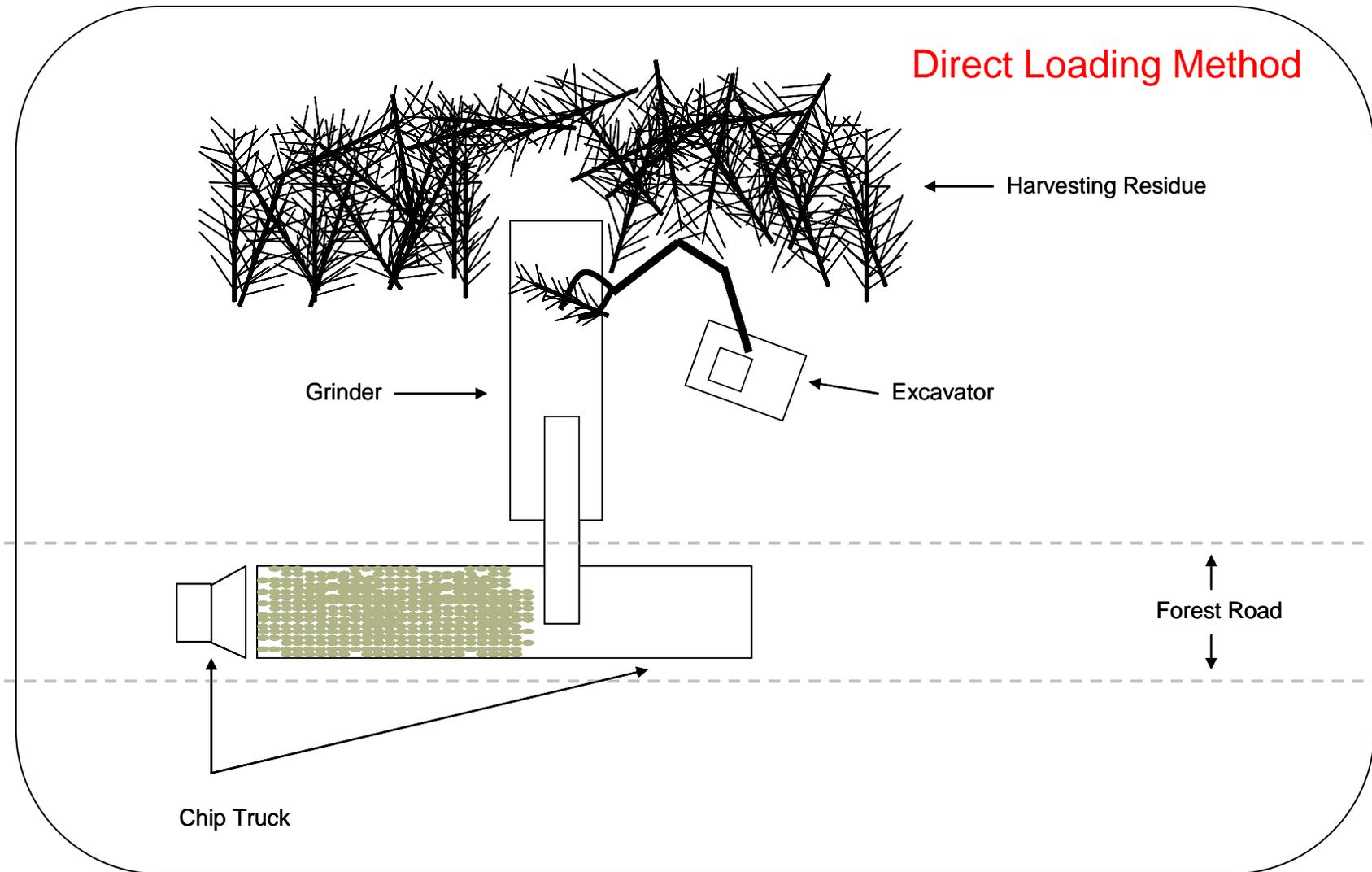
Common Biomass Conversion Systems

Alternative Processing Step: Horizontal Grinder and Excavator



Common Biomass Conversion Systems

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Common Biomass Conversion Systems

Alternative Processing Step: Horizontal Grinder and Excavator

