


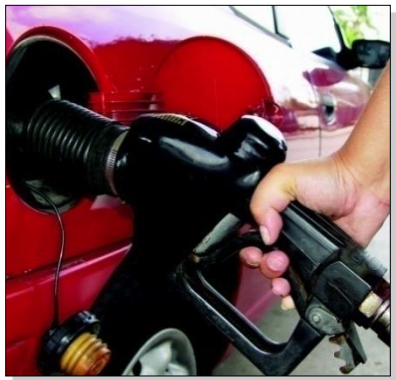


# High Tonnage Forest Biomass Production Systems from Southern Pine Energy Plantations

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Feedstock Production and Logistics

Steven Taylor, Bob Rummer, Frank Corley, Dana Mitchell, Grant Somerville, Oladiran Fasina, Tim McDonald, Tom Gallagher, Mathew Smidt, Brian Via

Auburn University

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# Project Goals

- Develop design improvements in tree-length harvesting machines for southern pine energy plantations;
- Assemble a harvesting, pre-processing and transportation system for southern pine biomass: and
- Demonstrate and document performance of the system at full industrial scale

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# Quad Chart Overview

## Timeline

- Project start: 10.01.2010
- Project end: 08.30.2013
- 80% complete

## Barriers

- Barriers addressed
  - Ft-D Sustainable Harvesting
  - Ft-L Material Handling and Transportation
  - Ft-M Integration and Scale-Up

## Budget

- Funding for FY11 = $795k / 884k
- Funding for FY12 = $795k / 884k
- Funding for FY13 = $3.4 mil / $3.2 mil

## Partners

- Consortium: Auburn University, USDA Forest Service, Corley Land Services, Tigercat
- Other collaborators: Precision Husky, Genera Energy, Rentech, Coskata

# Approach

## Phase I - R&D

- Design new harvest and transport machines and systems for dedicated southern pine energy plantations
- Develop benchmarks for existing system productivity, cost, feedstock quality

## Stage Gate Review

## Phase 2 - Commercial-Scale Test and Demonstration

- Test new machines
- Test transpirational drying
- Test extended shifts
- Develop and demonstrate information systems
- Quantify industry and landowner acceptance

# Dedicated Energy Plantation

## “Short” rotation pine

- Southern pine
  - Proposed final harvest at age 10 – 12
  - Target production of 7 dry tons/acre*year
  - 15 million acres could produce 100 million tons/yr
- Benefits
  - Increased harvesting productivity (and lower costs) over traditional thinnings
  - More frequent cash flow for landowner with flexible management options

# Technical Accomplishments

- New Tigercat 845D track-type feller buncher
  - Shear felling head
  - Tier 4i engine
  - Energy recovery swing system
  - ER Boom

- New Tigercat 630D wheeled skidder
  - Industry's largest grapple
  - Ergonomic/productivity improvements

# Technical Accomplishments

- New Precision WTC2675 whole tree disk chipper
  - Pulp chips or micro chips
  - Clean chips or whole tree chips
- New high-capacity chip trailers
  - Volume increases up to 30%
  - Designed for transpirationally dried wood

# Technical Accomplishments

- Industrial scale tests of harvest and transport system show system performance
- Field tests validate transpirational drying
  - Summer tests show drop in MC from 56% to 35% in 6 weeks

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# Technical Accomplishments

- Example transport costs for wood chips at various moisture contents (for 50 mile haul distance @ $4 per one-way mile).

| % Moisture | Net Tons per Load | Dry Tons per Load | Cost per Dry Ton |
|---|---|---|---|
| 56% | 28.5 | 12.5 | $15.91 |
| 50% | 28.5 | 14.3 | $14.00 |
| 45% | 28.5 | 15.7 | $12.73 |
| 40% | 28.5 | 17.1 | $11.67 |
| 35% | 28.5 | 18.5 | $10.78 |
| 30% | 28.5 | 20.0 | $10.00 |

# Technical Accomplishments

- Tests of extended shifts showed no change in productivity
- Information systems measure productivity and provide useful feedback to machine operators
  - Combine GPS data with CAN bus data to determine productivity, tree size, location, etc.
- Focus groups show that landowners and loggers accept these systems

# Relevance

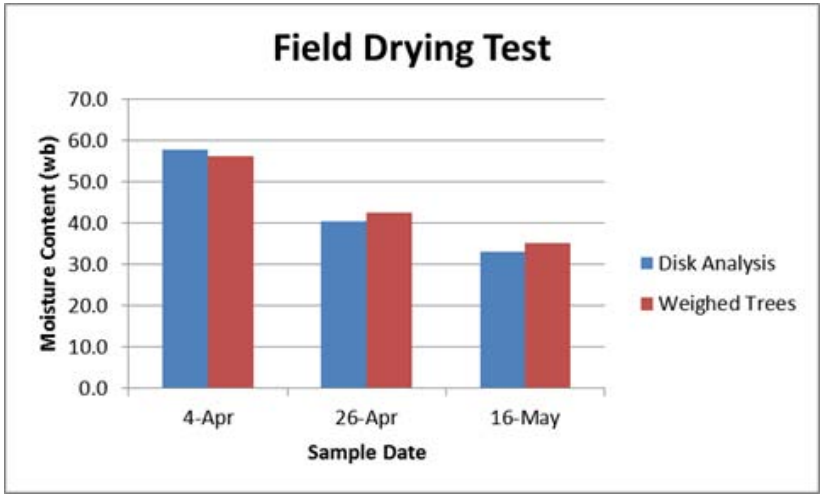
- New machines have demonstrated
  - Reductions in operating and maintenance costs
  - Reductions in fuel consumption and emissions
  - Increases in productivity
  - Reductions in overall system costs


- Harvest and transport costs of southern pine biomass have been reduced by as much as 45% - resulting in reduction in final biomass delivered cost

- Loggers and landowners indicate acceptance of systems as long as markets exist for the biomass

# Critical Success Factors

- Transpirational drying showed reductions in moisture content from 56% to 35% in summer tests
- Reducing moisture content can make significant reductions in transportation costs

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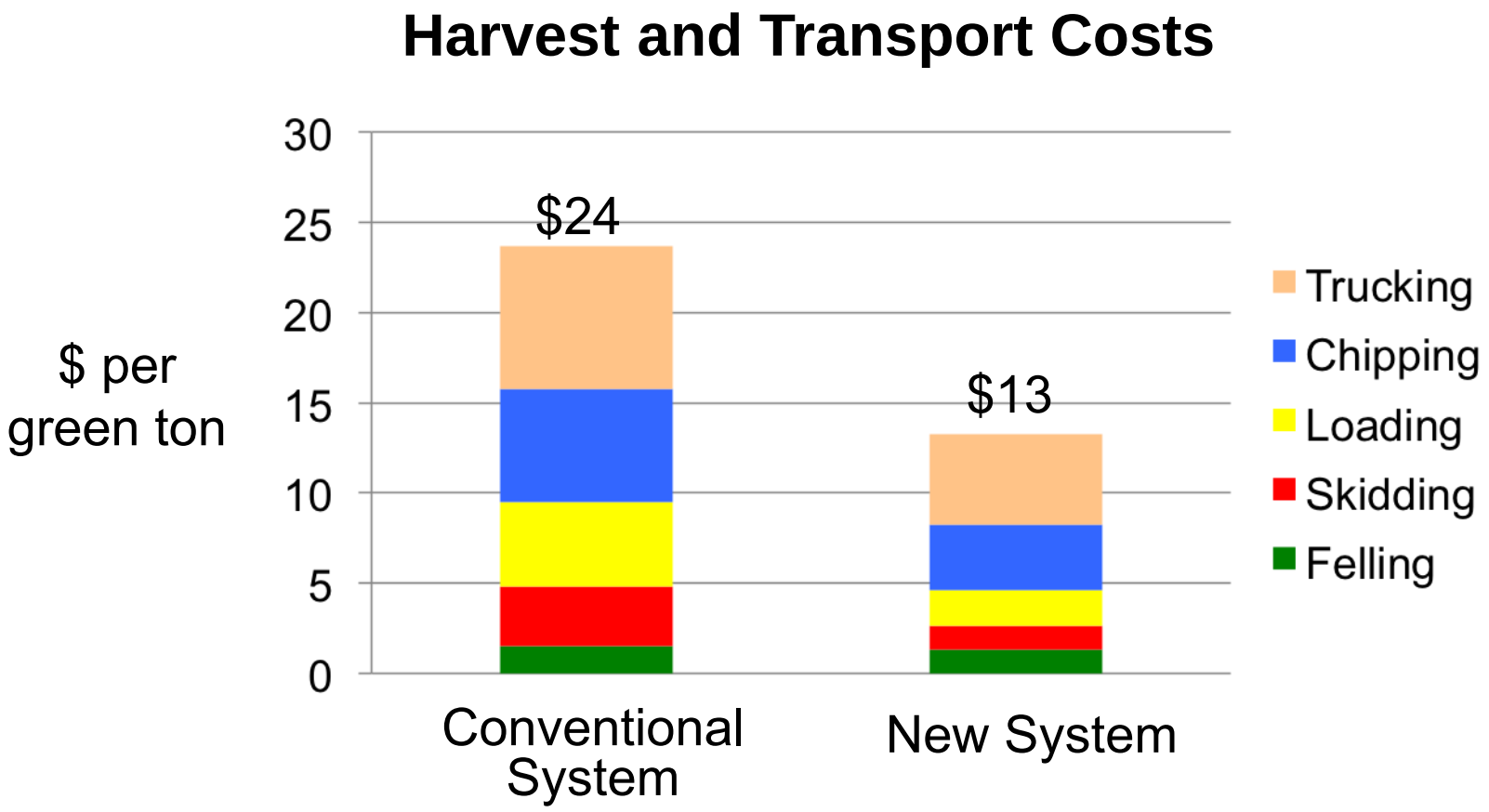


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# Future Work

- Continue field scale testing of new machine systems.
- Continue testing and development of information systems.
  - GPS-based productivity measurement and display systems for feller buncher and skidder
  - Mass flow and moisture sensors for chipper
- Continue field scale testing of transpirational drying and roadside storage

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# Summary

- New machines and systems can reduce delivered cost of southern pine biomass
  1) High productivity = Low cost
  2) Reduced operating costs for feller buncher and skidder
  3) Reduced fuel consumption for feller buncher and skidder
  4) Transpirational drying can reduce moisture content significantly
  5) Transpirational drying can reduce transportation costs
  6) Information systems provide feedback to operators to improve productivity
  7) Loggers and landowners are willing to accept new systems if appropriate markets develop

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