Biomass Harvest Solutions

Northwest Wood Based

Biofuels + Co-Products Conference

April 29, 2014

Bruce Summers

Greenwood Resources

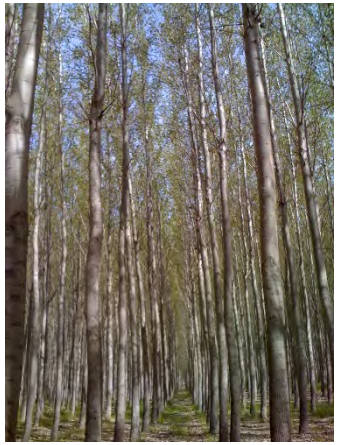
Pulpwood Traditional Biomass

6-8 year rotation

600 t/a

12gt/a/year

Clean Chips



Pulpwood Harvesting

Available harvesting equipment has determined rotation age

Economics of Harvesting

Equipment cost/hr

Divided by

Volume/stem x stems/hr

Equals

$/unit

Hybrid Poplar Short Rotation Woody Crop

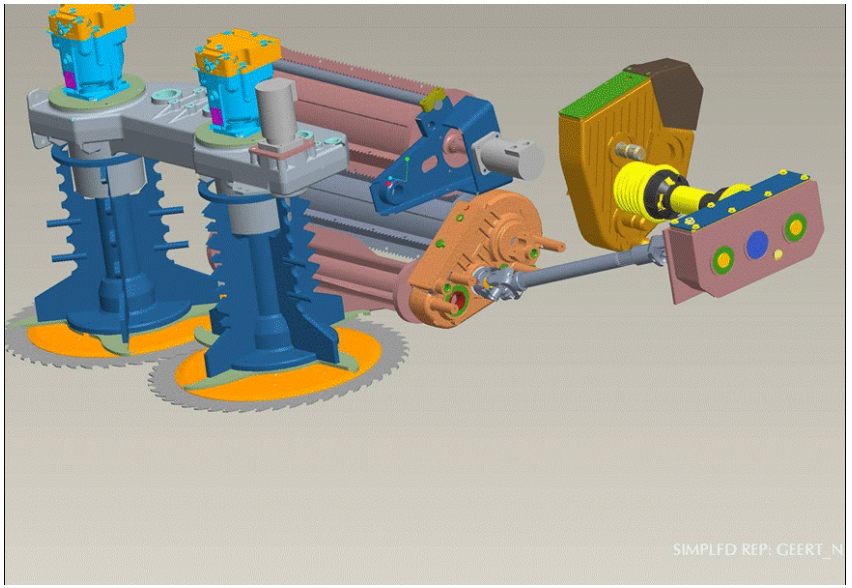
20 sgt/acre/yr

3 year rotation after coppice

1100 t/a

SRWC
Why Focus on Harvesting Systems?

Harvesting is the single largest cost for SRWC making up 30 – 50% of the final delivered cost from willow biomass crops (Buchholz and Volk, 2011)



Harvester

System Development
Willow

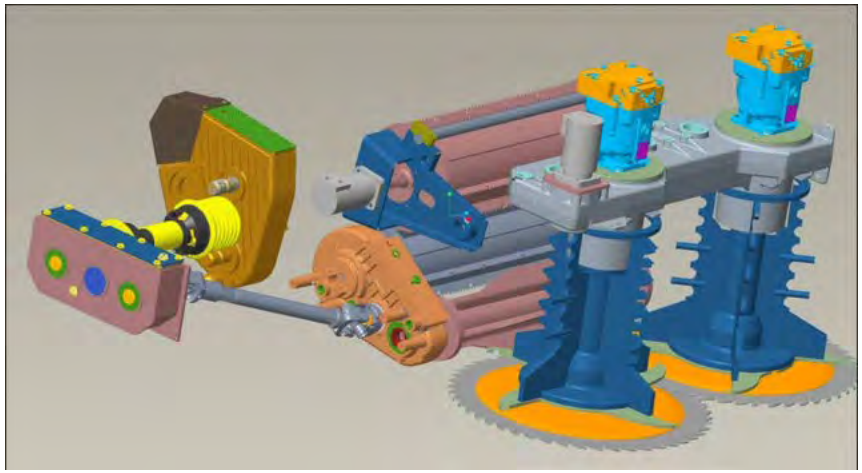
Case New Holland

State University of New York

Developing a Harvesting System

FR-9000 series Forage Harvester

130-FB Coppice Header



130-FB Biomass Header

Willow head with Poplar Kit

- More robust saws
- Heavier push arm
- Direct Attachment

CNH 9080 Forage Harvester

- 685 Horsepower
- 8 knife chopper
- 130-FB Biomass Head
- Forestry Tires
- Poplar Kit

Product

Variable Length Chip

In feed press roll feed speeds adjust chip length

- Minimum 1/4” length
- Maximum 1-3/4” length

CNH Forage Harvester

F130FB biomass harvest header

Productivity Influences

Crop conditions
- Plant morphology

Field conditions
- Mobility
- Rutting!!

Field layout
- Headlands Size
- Border Rows
- Staging Areas

Logistical Chain
- Keep moving !

Dormant Season Harvest

Soft and slick ground conditions?

Equipment requirements:

- Low ground pressure forage harvester
- Low ground pressure tractor with trailer to reload

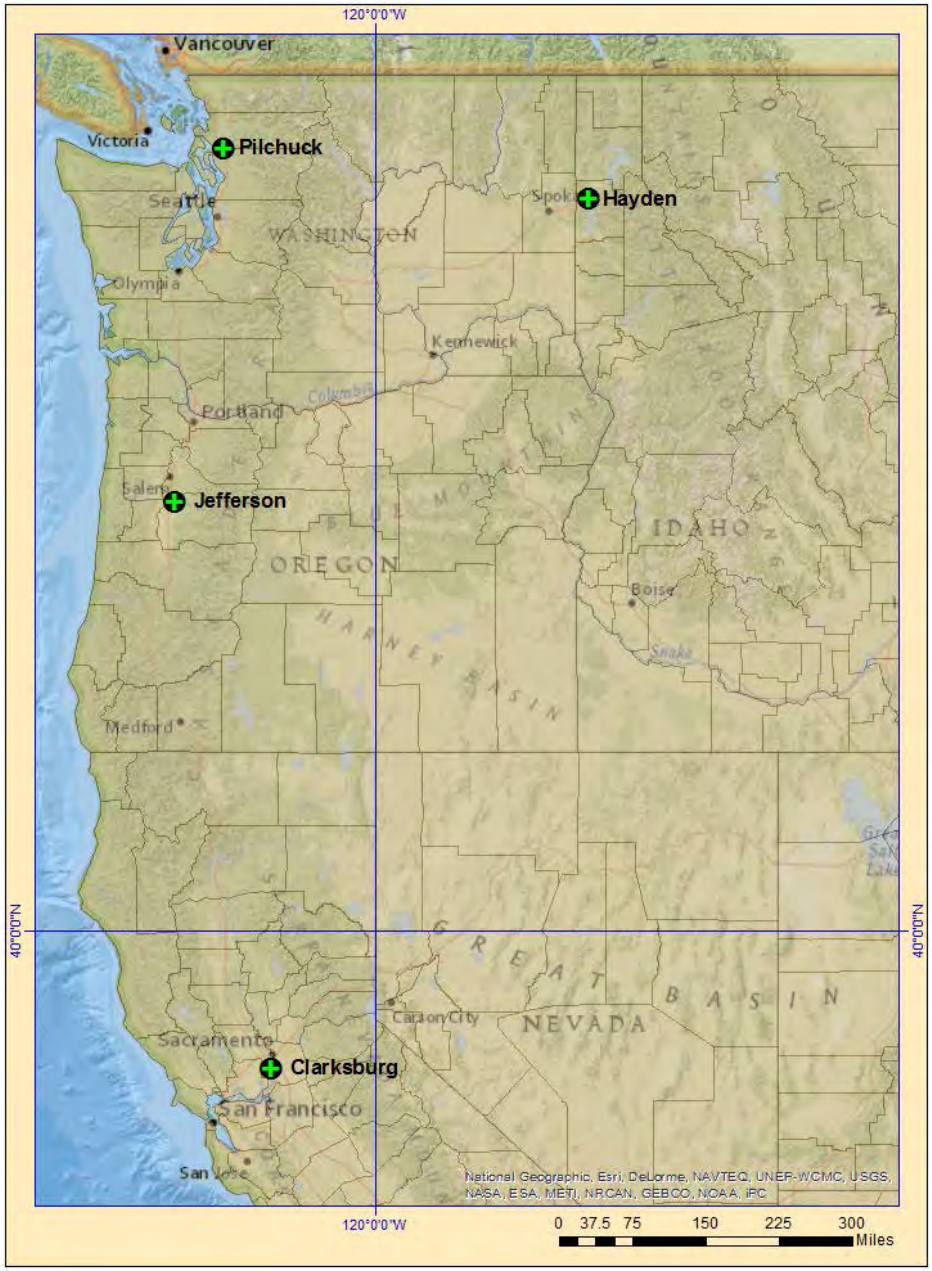
Growing Season Harvest

Favorable ground conditions for utilizing direct loading into trucks

AHB Demonstration Plantings

Jefferson, Oregon

Hayden, Idaho



Jefferson, OR

Sept 22, 2013

Growing Season Harvest

Willamette Valley Oregon

Marginal Operating Conditions

Hayden, Id

October 2, 2013

Growing Season Harvest

Glacial Till Soil

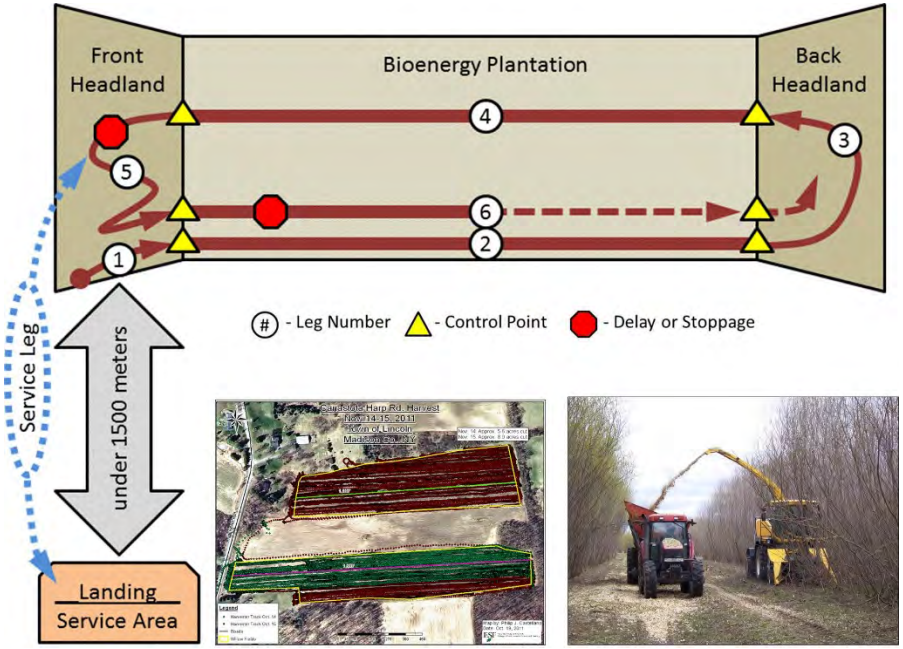
Good Operating Conditions

Growing Season Product

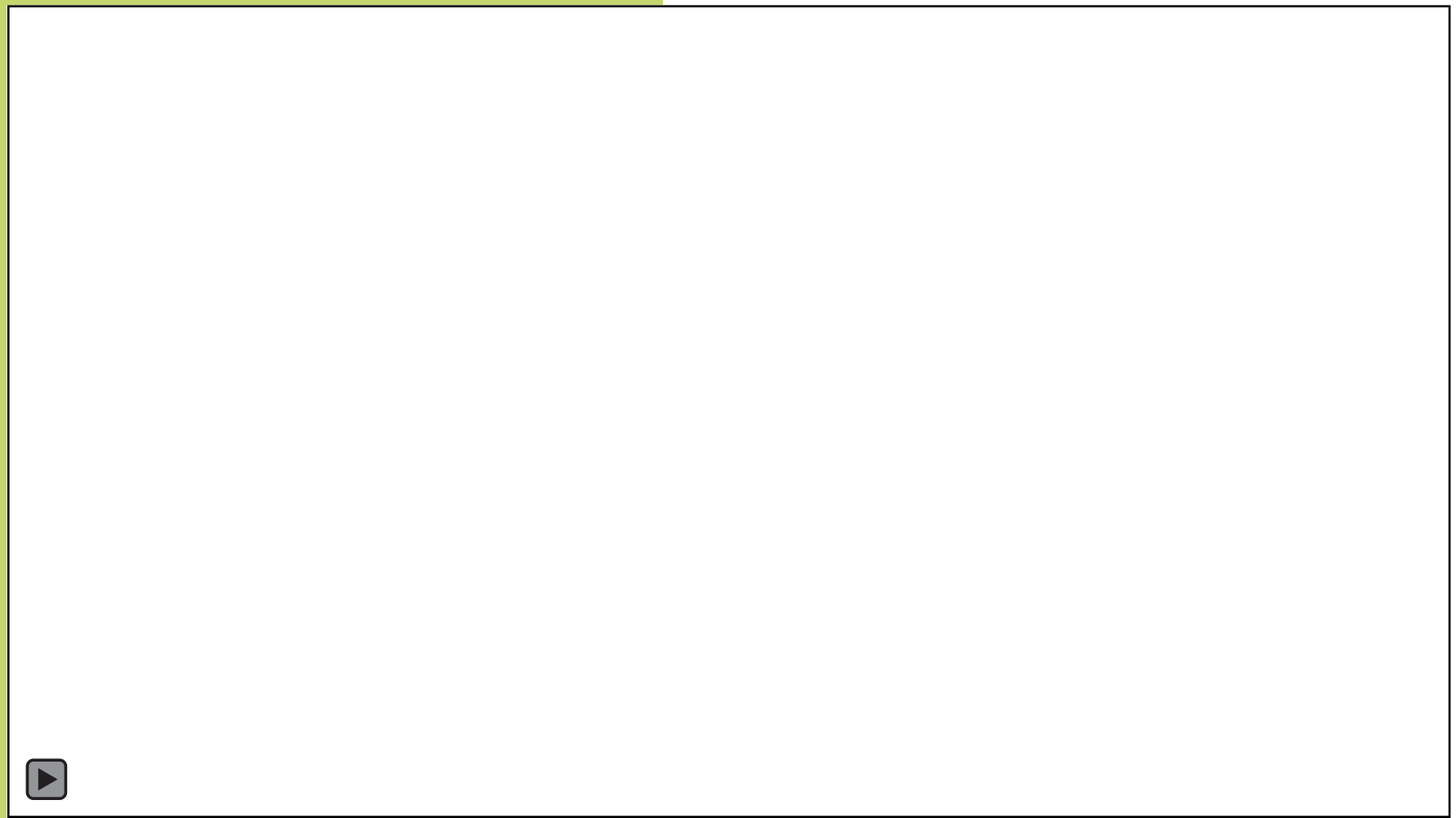
Suitable for cellulosic ethanol conversion

Time Motion Study

A time motion analysis was conducted during harvest at the Jefferson and Hayden tracts using GPS tracking in conjunction with traditional timepieces.

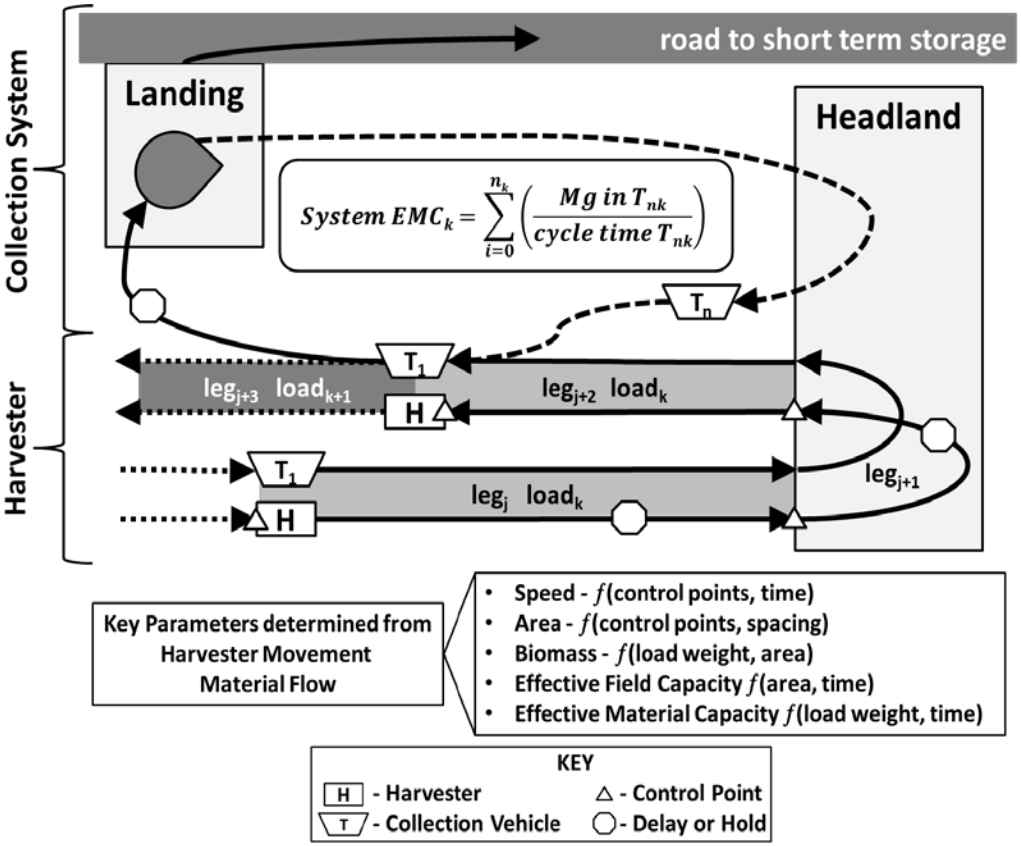


Hayden, Id



Objective

The purpose of this study was to evaluate the performance of a New Holland FR-9080 forage harvester, 130FB coppice header, and associated collection systems on first-rotation hybrid poplar stands located at Jefferson, OR and Hayden, ID using revised time motion methods.



Hayden and Jefferson Results

In both harvests slightly over **50%** of the monitored time was spent actively **harvesting**, approximately **15% turning in the headlands**, and the remainder spent on **"exceptional" headland turns** (> 5 minutes) which may include stops for vehicles, addressing mechanical issues, or field meetings

Harvester Performance

The in-field effective material capacity (including in-field delays, excluding turns) of the harvester at Hayden and Jefferson ranged **between 20 and 100 tons/hr** and increased linearly with standing biomass. As standing biomass increased the variability of the effective material capacity also increased. There was no reduction in speed relative to standing biomass at Hayden, ID and Jefferson, OR.

Collection System Performance

Steadily decreasing material capacities as chips moved through the system were observed at Hayden and Jefferson each day of harvesting. Generally, there was **over a 60% decrease between the theoretical material capacity of the harvester,** and the rate at which chips were delivered to short-term storage. **At both sites, the pattern is indicative of struggles with turns and long wait times in the headlands,** possibly due to factors such as too few collection vehicles supporting the harvester, the trucks turning radius and less traction compared to the harvester.

Conclusions

- Field layout is critical to cost effective harvest.
- Growing season harvest allows direct load and delivery to customer, where as dormant season harvest requires additional equipment with reload capability.
- The 130-FB harvest head and CNH forage harvester can meet the challenge of harvesting hybrid poplar biomass fields.
- We harvested at 60-90 gt/hr at current yields, therefore validating a potential of 150+ gt/hr at final harvest yield.