



Equipment Development for Improving Harvest Efficiency for Agricultural Biomass

July 10, 2012

DOE Biomass 2012, Washington, DC

Presented By:

Kevin Comer

Antares Group, Inc.

Phone: 540-442-9848, ext 111

Cell: 540-421-2254

Email: kcomer@antaresh.org

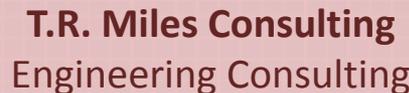
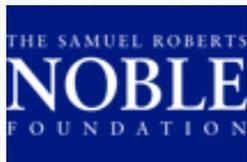


Presentation Outline

- Brief Background on DOE Biomass Feedstocks Supply System Design & Demonstration Project
- High Level Overview of Developing Harvest Technologies
 - Show Examples
- Key Accomplishments & Needed Next Steps



Design and Demonstration of a Comprehensive Biomass Feedstock Supply System



FDCE Team Members

Target End Users

 ABENGOA BIOENERGY Science. Solutions. Service. Key Biomass Buyer	 Buyer	 Power Company
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OEM/Technology Collaborators

 Tractor OEM	 Harvest OEM	 A Division of Allied Systems Company Baler OEM	 Farm Equipment OEM
 Grinder OEM			

Harvest Fields & Services

 Energy Crop Seeds	 Switchgrass Producer Group	 Crop Establishment	 Forage and Native Grass Seed	Burrows Custom Hay Custom Harvesting
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Research, System Integration, Planning & Evaluation Partners

 Engineering Consulting	 Agricultural Resource Development	 Biomass Research	 Business Consulting	 Carbon Accounting
T.R. Miles Consulting Engineering Consulting				

Cost-Share & Funding Entities



- Comprehensive professional team
- End to end capabilities; energy crop establishment to delivered bale.
- Team genesis over a decade ago
- Move field ops to an **Industrial Approach and Scale**



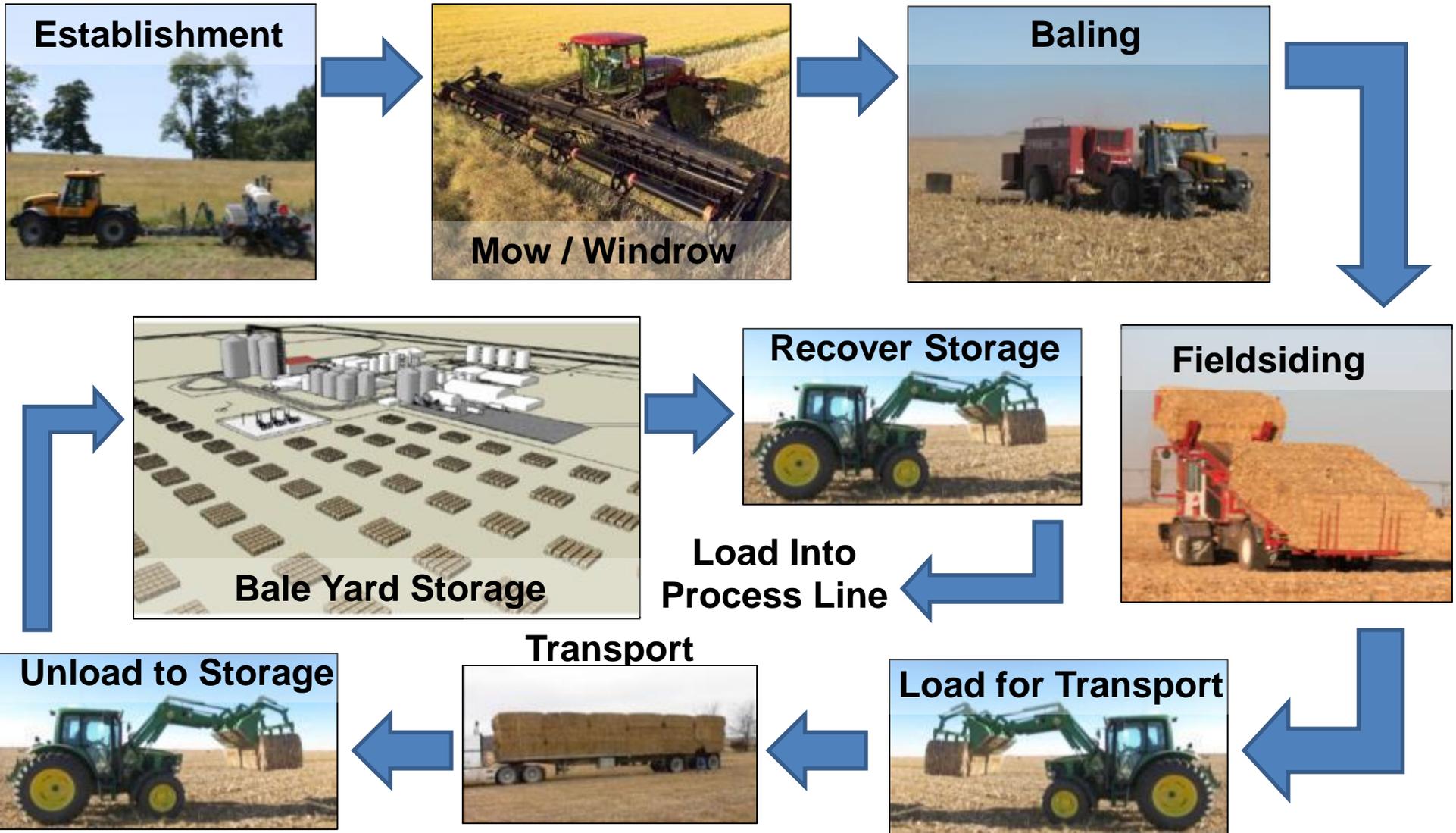
Goal Statement (Project Objectives)

Demonstrate all aspects of an innovative industrial-scale feedstock supply system for Abengoa's Hugoton, KS Biorefinery (and others to follow).

- Cost reductions for large scale feedstock delivery estimated to be ~\$13.00 per ton (conservative)
 - Worth \$3.9 million/yr at 300,000 ton/yr scale
- Identify and measure costs at every step from start to finish
- Support development of material quality and sustainability specifications



Conventional Equipment (One Example)





Focus of Proposed System (and Savings)

- Eliminate all possible separate operations
 - Mowing/conditioning, raking, trips through field
- Handle fewer pieces
 - Increase bale densities
 - Goal is to gross out a truck (> 12 lb/ft³)
 - Accumulate bales in field
 - Drop 2 or 3 from baler, in strategically good locations if possible (field side)
 - Modularize as soon as possible into truckload package
- Automate operations
 - Loading/Unloading onto trucks, and on process line

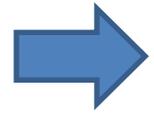


Focus of Proposed System (and Savings)

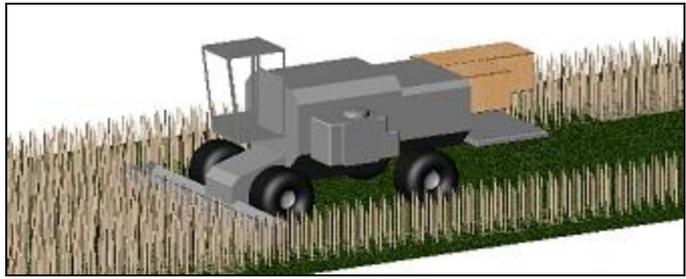
- Reduce life cycle costs of equipment
 - Increase life and reliability
 - Reduce fuel use
- **Increase crop yields**
 - **But must be able to get it out of the field efficiently**
- Maintain quality control from start to finish
 - Pays huge dividends at processing facility



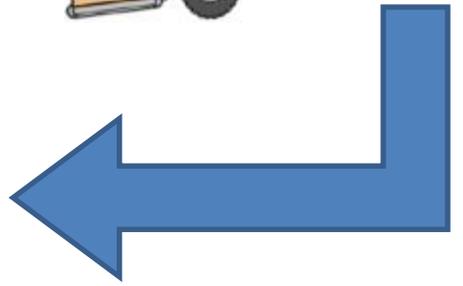
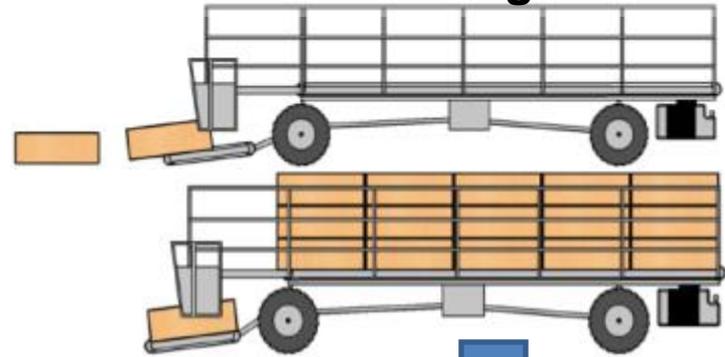
Proposed / Developing System



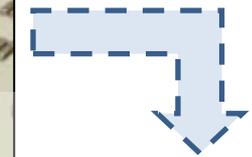
Single Pass Harvesting
Freeman 1592D Self-Propelled



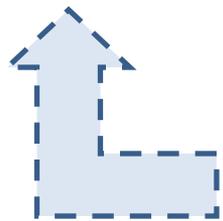
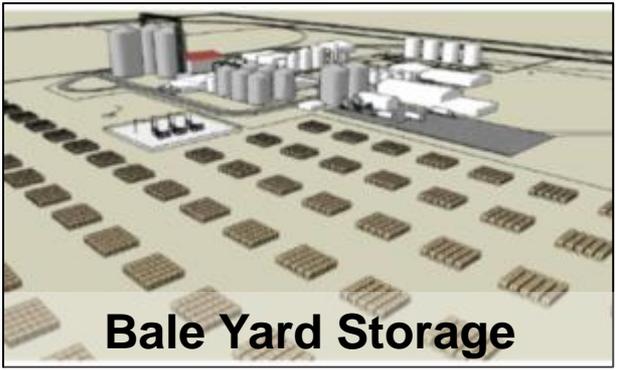
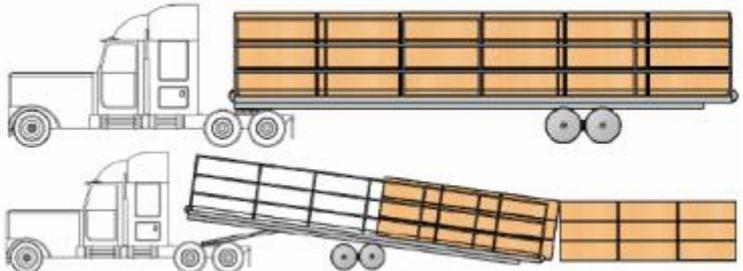
Roadsiding
Bale Picking Truck



Load Directly
Onto Process
Line

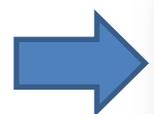


Transport
Self Loading Trailer





Proposed / Developing System



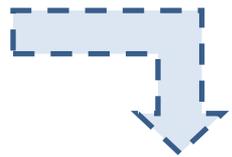
Single Pass Harvesting
Freeman 1592D Self-Propelled



Roadsiding
Bale Picking Truck



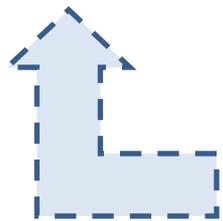
Bale Yard Storage



Transport
Self Loading Trailer



Load Directly
Onto Process
Line





(Launch Video here)

SYSTEM ANIMATION & INITIAL DEMONSTRATIONS



(Designed by Project Team Members, Installed by Kelderman Manufacturing)

EXAMPLE BALE HANDLING SYSTEM WITH SEVERAL SIMILAR COMPONENTS



**Microwave sensor
for moisture
content**













































Change can occur rapidly with
the proper focus, people, and
resources



Self-propelled Baler (Kelderman / Freeman)

THEN . . .



NOW . . .





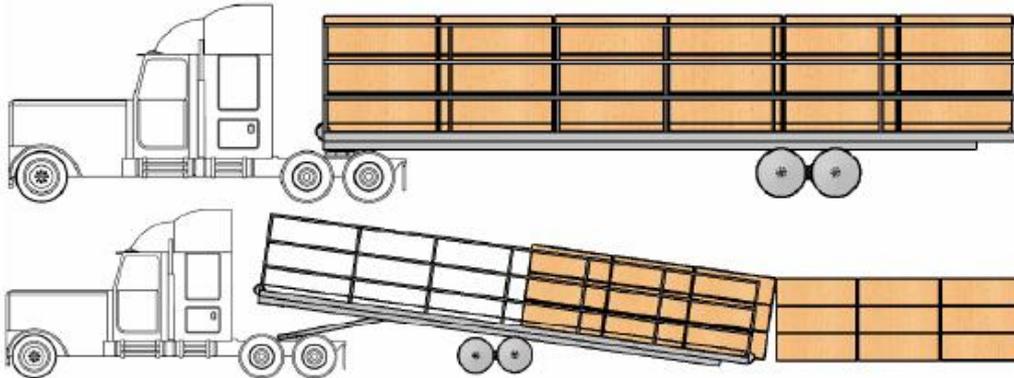
Self-propelled Baler with Vermeer Basket Rake





Self-Loading Trailer (Kelderman)

THEN . . .



NOW . . .



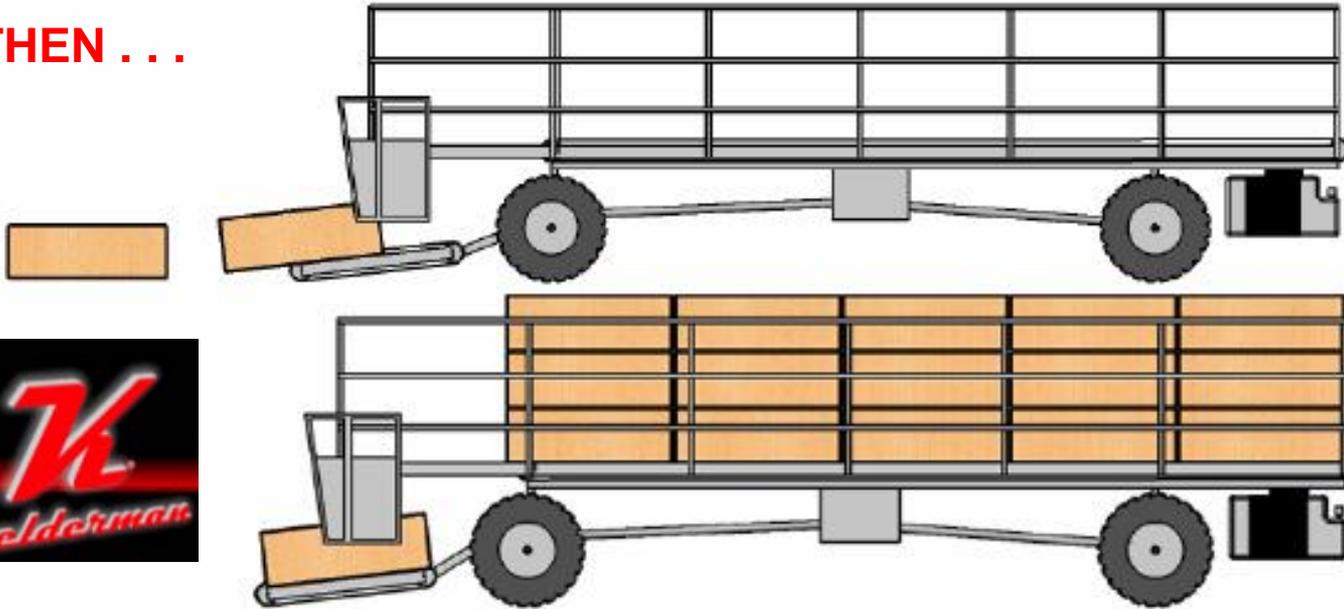
Fundamental Load / Unload Times (~5 minutes) and operation confirmed. Field commissioning under way.





Bale Picking Trailer (Kelderman)

THEN . . .



Groups 36 bales into “modules.”
Reduces distance traveled in field (less frequent loading/ unloading: saves trips). Less soil compaction. Construction under way. Initial field testing in 2012.

NOW . . .





Heavy Crop Header





Single-Pass Round Bale System (FDCE)





Detailed Cost & Performance Data Collection

- Labor, Fuel, Equipment, Parts, Travel, Freight, Field Rates





Key Accomplishments to Date

- Prototyped and demonstrated all targeted pieces of equipment
 - Bale Picking Truck is final piece to be demonstrated (2012)
- Confirmed *most* fundamental savings principals and functionality of all tested equipment
 - Eliminate 1 or more field passes using Self-Propelled Baler (SPB)
 - Demonstrate flexibility of SPB using different header/implements
 - Load / Unload cycle times of Self Loading Trailers (5 – 8 minutes)
 - Corn stover bale densities of 14 lb/ft³ achieved
 - Heavy crop header can operate at 4 to 6 mph while conditioning crop well for efficient baler pick-up
- Extensive cost / performance data collection



Needed Next Steps

- Field commissioning & testing of Bale Picking Truck
- Testing of all new equip. as integrated operation
- Significantly more field testing & performance documentation on multiple crops
 - Operational reliability must be improved
 - Demonstrate effective (and extended life) of equipment
 - Still very early in product life cycle
- Reduce dirt pick-up / improve in-process removal
- Production scale-up and funding

We have achieved much, but much remains to be done.



QUESTIONS?

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Why Miscanthus?





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