Biomass Supply Chain Development in Tennessee

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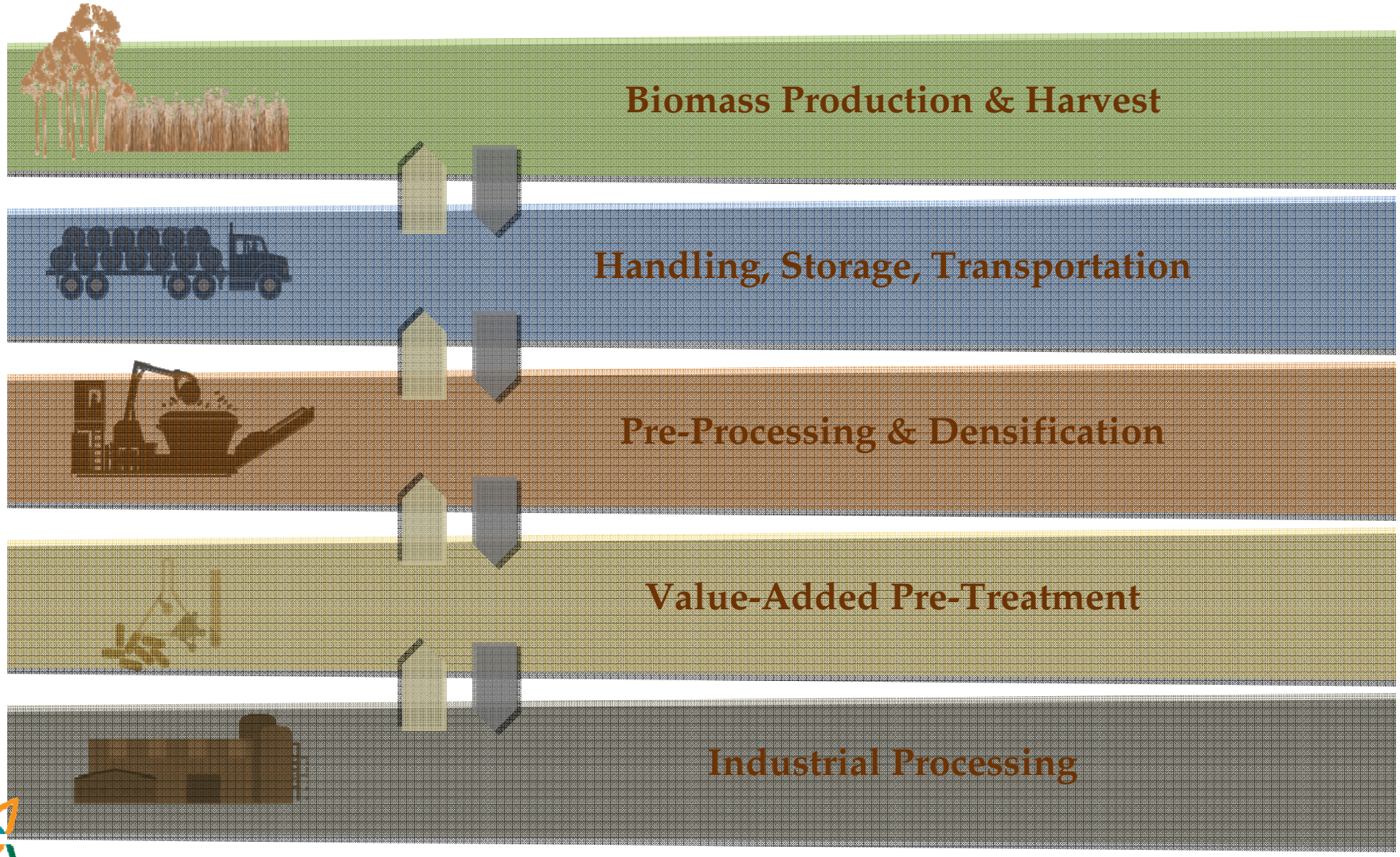
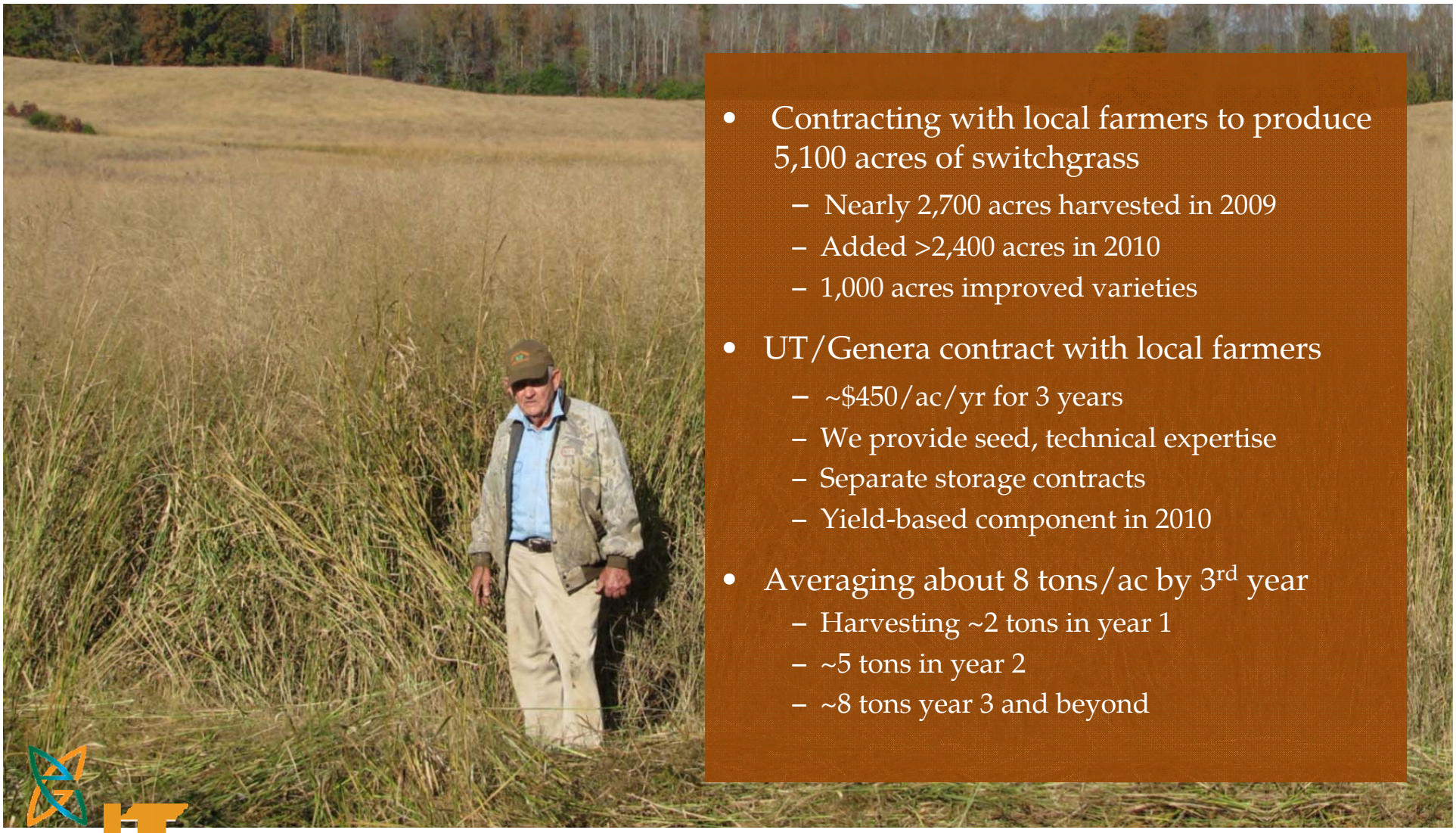
University of Tennessee Institute of Agriculture

Integrated Biomass Supply Chain

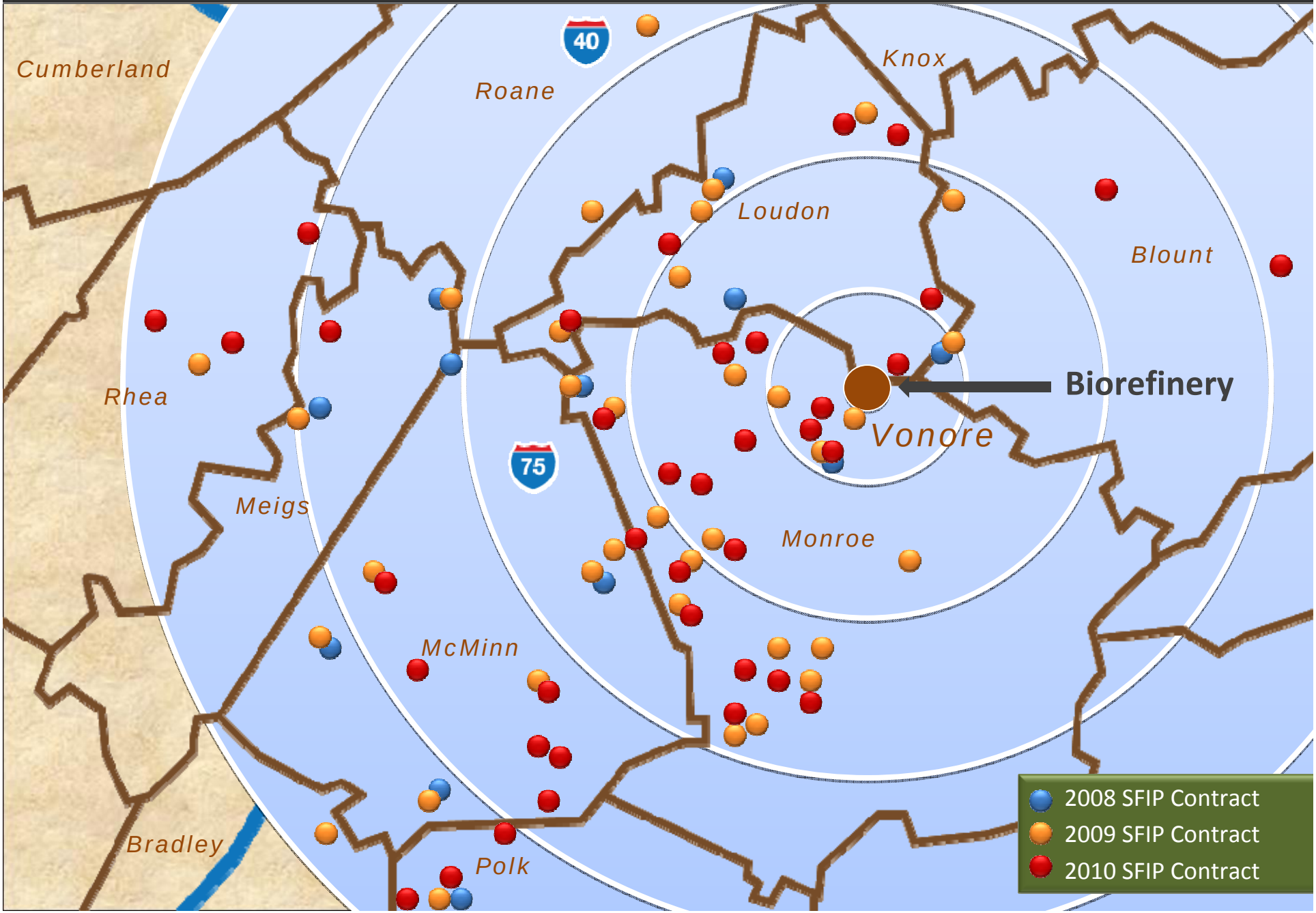


Tennessee Switchgrass Experience



- Contracting with local farmers to produce 5,100 acres of switchgrass
  - Nearly 2,700 acres harvested in 2009
  - Added >2,400 acres in 2010
  - 1,000 acres improved varieties
- UT/Genera contract with local farmers
  - ~$450/ac/yr for 3 years
  - We provide seed, technical expertise
  - Separate storage contracts
  - Yield-based component in 2010
- Averaging about 8 tons/ac by 3rd year
  - Harvesting ~2 tons in year 1
  - ~5 tons in year 2
  - ~8 tons year 3 and beyond

Switchgrass Contract Farms



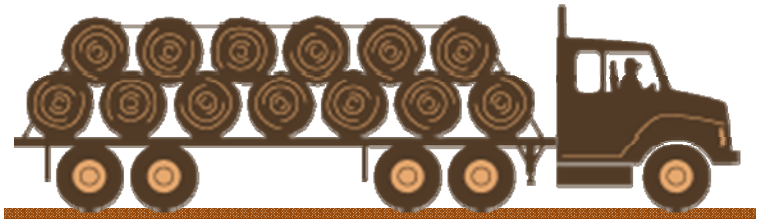
Feedstocks for Biofuels

- Feedstock composition/quality is driven by genetics and production systems
- However, feedstock composition/quality can be significantly impacted by proper logistics, storage and handling of material
- Careful management of supply chains can address many feedstock quality concerns

Switchgrass Baling Systems

- Round bales
  - Common baler that most farmers have/have access to
  - Varying sizes/densties can cause issues
  - Difficult to achieve axle weights
- Square bales
  - More expensive equipment
  - Stacks/stores in a more condensed space
  - Low to medium bulk densities

Biomass Handling, Storage & Transportation



- Year-round supply
- Minimize Individual handling
- Maximize bulk handling
- Minimize storage loss
- Maintain quality
- Manage moisture
- Potentially Increase bulk density

Switchgrass Bale Storage

- Storage critical for quality management
  - Moisture management
  - Large footprint required
  - Dry matter loss does occur
- Significant research underway in bale storage and alternative storage methods

Switchgrass Transport Systems

- Efficiencies in Bale Transport
  - Maximize individual bale densities to reduce transport costs
- Significant labor involved in bale movement
  - Staging, Loading, & Unloading
- Alternative densification and shipping methods need to be considered!

Bale Storage

Biomass Pre-Processing

- Particle size – coarse chop to flour
- Conveyance & flowability
- Energy intensity
- New systems, systems integration
- Multiple feedstocks
- Packaging & transportation

Biomass Handling Today…

High Tonnage Logistics

DOE High Tonnage grant

Project Objectives:

Develop an appropriately-scaled bulk-based switchgrass harvest, handling, storage, compaction, transport, and off-load system to supply a demonstration biorefinery

Determine switchgrass handling efficiencies of the bulk system and identify areas to improve efficiencies with respect to equipment investments and operators

Determine switchgrass quality associated with the bulk system compared to the current bale system based on ethanol production and potential

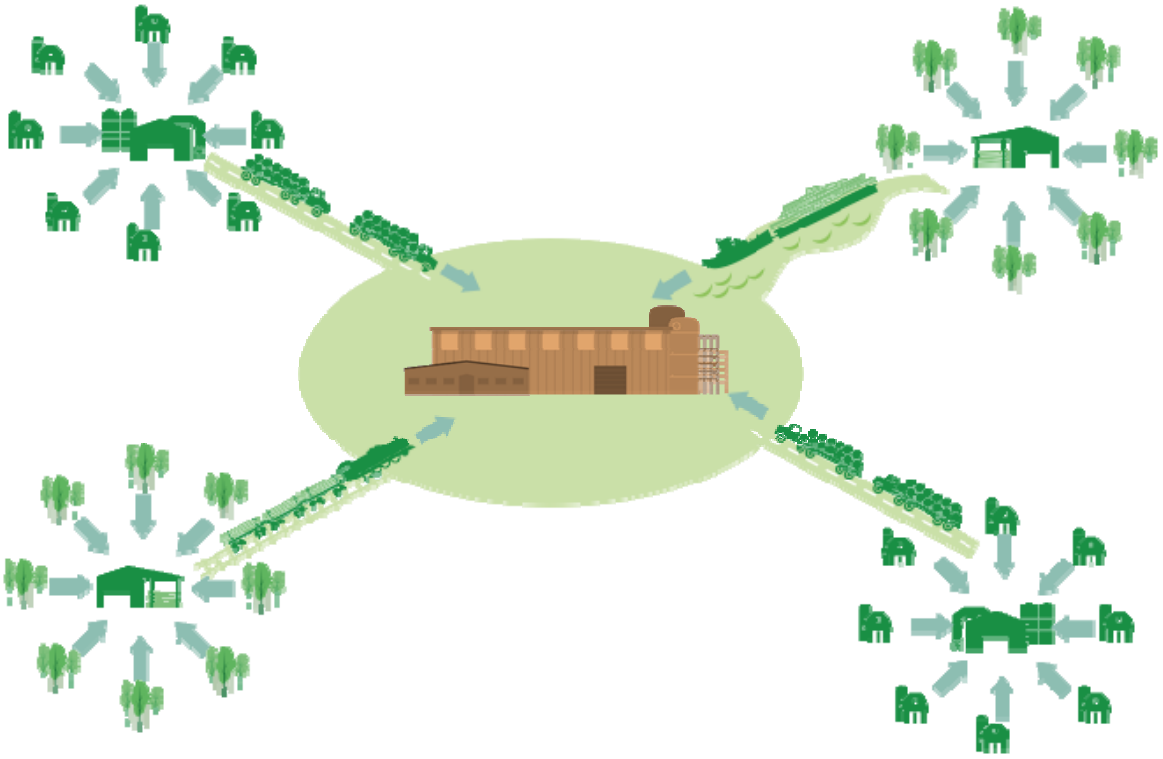
High Tonnage Logistics

- Issues to better understand
  - In-field logistics
  - Storage impacts
  - Achieving maximum axle weights
- Advantages
  - Reduced preprocessing costs
  - Higher rates of harvest
  - Automated handling

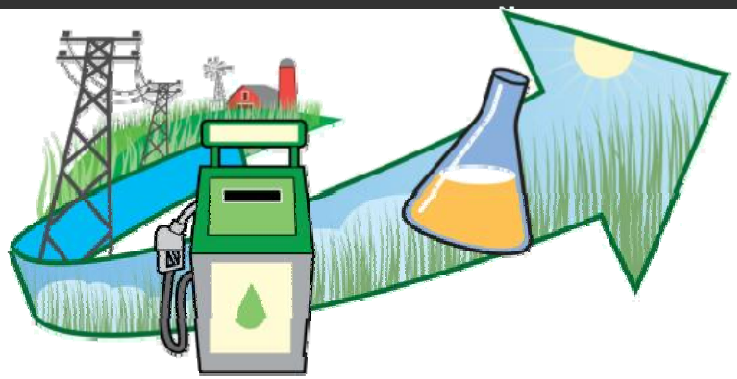
Regional Aggregation & Processing Centers

- Optimized Systems will be case dependent
  - Harvest form drives storage and transport methods
  - End use will determine quality and preprocessing requirements

RAPCs will be important to the development of the industry to coordinate logistics and delivery!



Summary



- Improved Efficiencies
  - Reduced supply chain costs
  - Maintain chemical and structural quality of material
- Critical research and development still needed
- Must collaborate across the supply chain to provide simple solutions for bioenergy producers and biomass producers

Thank You!

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