Growing a Future of Clean Renewable Energy™

Contract Agreements & Business Models

Renewable Energy Biomass Field Days
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Integrated Value Chain

Production

Collection & Transportation

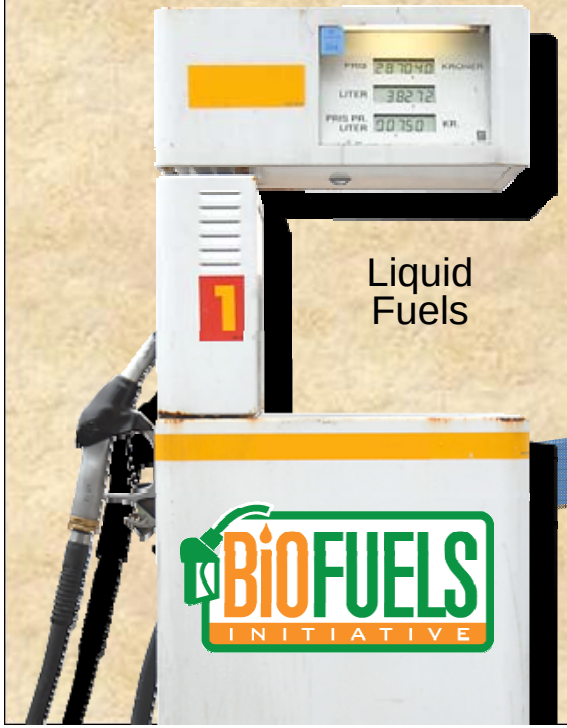
Storage & Handling

Pre-processing

Biorefining

Co-Products

Liquid Fuels



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Tailoring Biomass Supply Chain Solutions

Biochemical Biofuels & Products

- Achieving carbohydrate structure for specific conversion processes
- Blending, if at all, within species for a commodity market like wheat

Thermochemical Biofuels & Heat/Power

- Achieving ash, moisture & rheological property specs
- Blending to produce a commodity market like corn or coal

Petroleum Refinery Markets

- Achieving energy density & feedstock stability
- Blending to produce a stabilized liquid "bio-crude" for a commodity market like petroleum crude

Biomass Selection & Pre-Processing

*While **one size** of feedstock **may fit** all downstream conversion uses*

...

*It **doesn't mean** that one size/type/ source/ spec is necessarily the most **efficient or cost effective** for all downstream conversion uses*

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Feedstock Characteristics

Perennial Energy Crops

- Multi-year production decision
- High up-front establishment costs
- Slow yield ramp after establishment
- Minimal annual production risk post-establishment
- Moderate/high yield

Annual Energy Crops

- Annual production decision
- Full yield harvested in first crop cycle
- Higher annual production risk
- May be part of multi-year rotations
- High yield potential

Ag Residues

- Secondary value stream
- Annual quantity fluctuations
- Higher annual crop yield (production) risk
- Low annual yield potential

Forest Residues

- Secondary value stream
- Quantity limited by primary products
- Potentially high collection cost
- Low annual yield potential

Short Rotation Woody Crops

- Multi-year production decision
- High up-front establishment costs
- Slow yield ramp after establishment
- Moderate yield potential

Time Horizon, Risk, Capital Investment, Downstream Processing

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Contract/ Business Structure Considerations

- Business models tailored to feedstock characteristics
  - Perennials different from annuals
  - Primary product different from residual product
- Business models tailored to conversion process characteristics and requirements
- Diverse feedstock portfolio strategy reduces supply risk (in theory)
- Carbon credits
- Sustainability certification
- Specialized equipment
- Seed propagation vs. vegetative propagation
- Risk management
- Intermediate products
- Forward/ backward integration

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Switchgrass Managed as an Energy Crop

- One annual harvest after first killing frost
  - — In TN, November-February
- Allows nutrients to translocate back into the root system
- Dries on the stalk (~18% moisture)
- Builds soil carbon
- Get a harvest first year
- Can be managed for multiple uses
  - — Forage crop
  - — Wildlife

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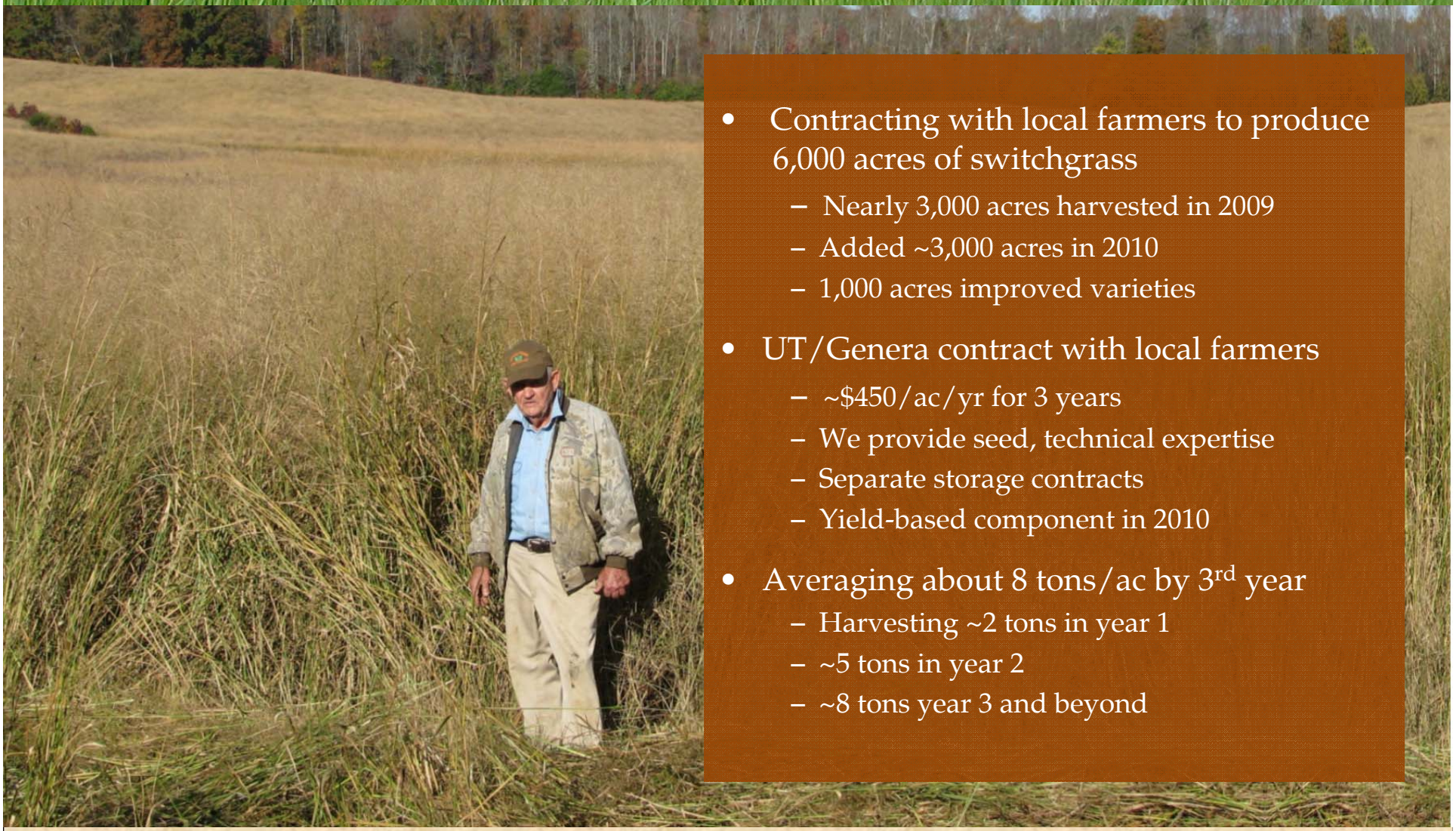
Tennessee Switchgrass Experience



- Contracting with local farmers to produce 6,000 acres of switchgrass
  - Nearly 3,000 acres harvested in 2009
  - Added ~3,000 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

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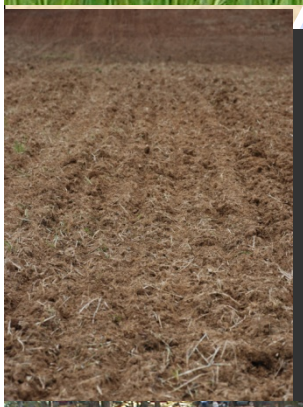
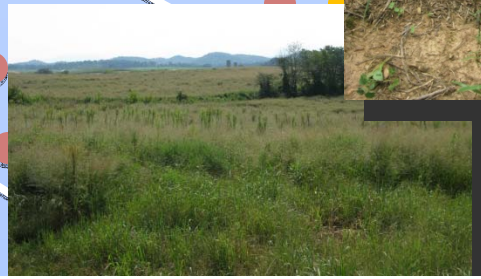
Switchgrass Contract Farms

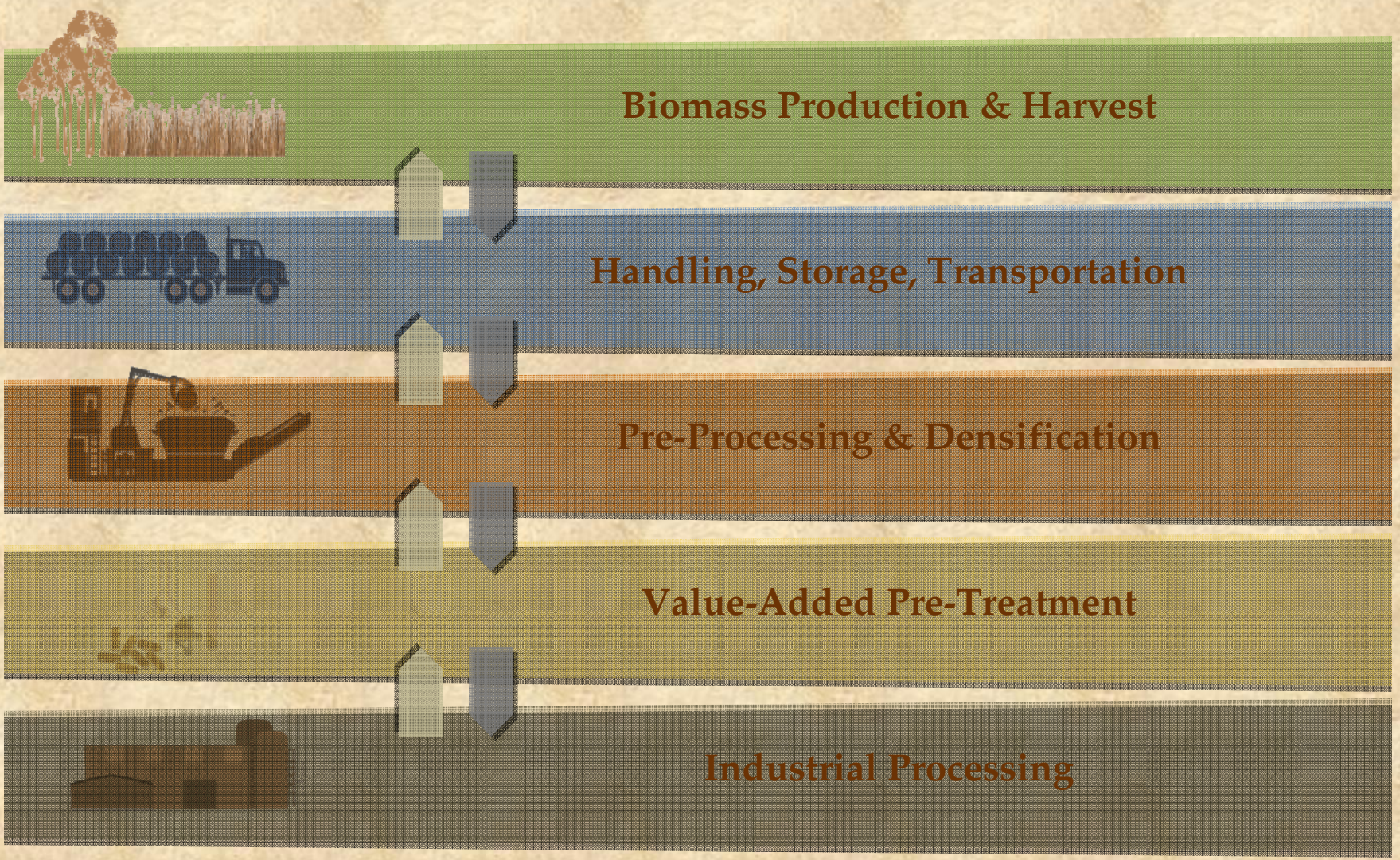




2008 SFIP Contract
2009 SFIP Contract
2010 SFIP Contract

Preliminary, as of 5/21/10

Integrated Biomass Supply Chain



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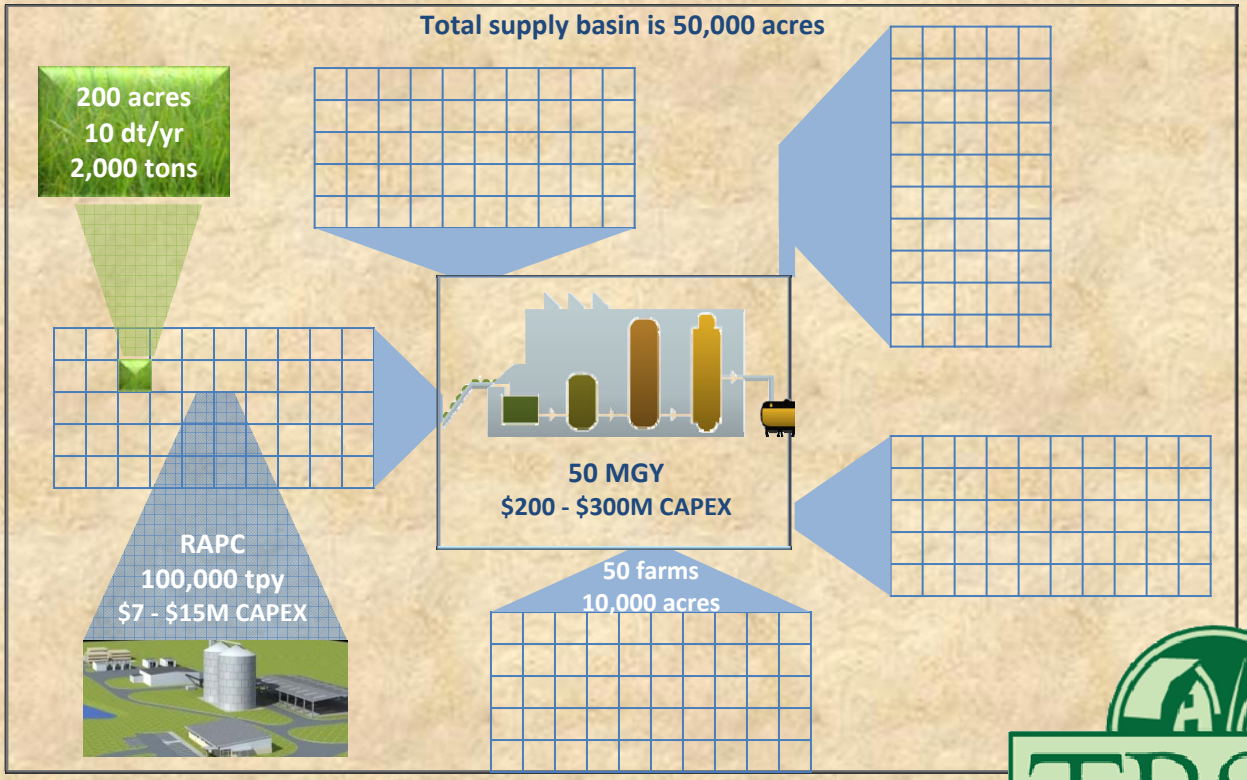
RAPC – Regional Aggregation & Processing Cooperatives



Hub & spoke supply system (RAPC) for supplying, aggregating, storing, processing, marketing biomass is a natural fit for a value-added farmer processing cooperative

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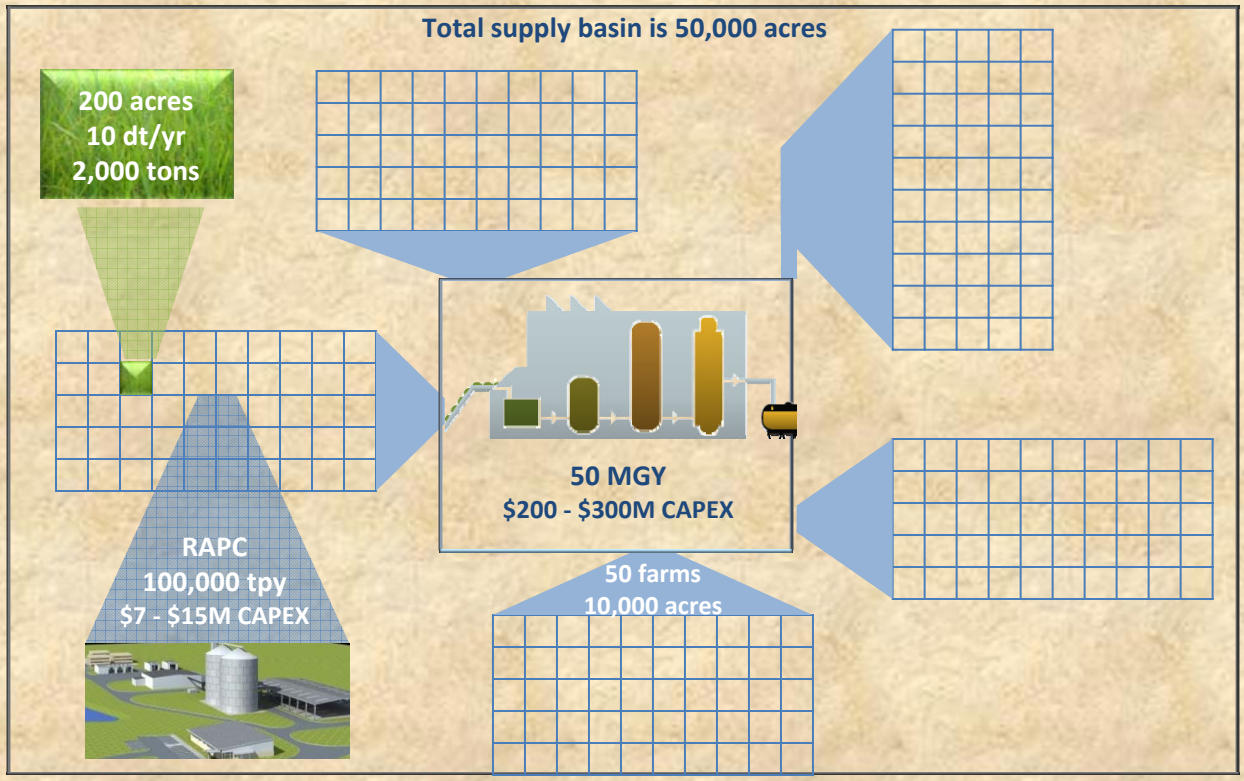
RAPC – Regional Aggregation & Processing Cooperatives

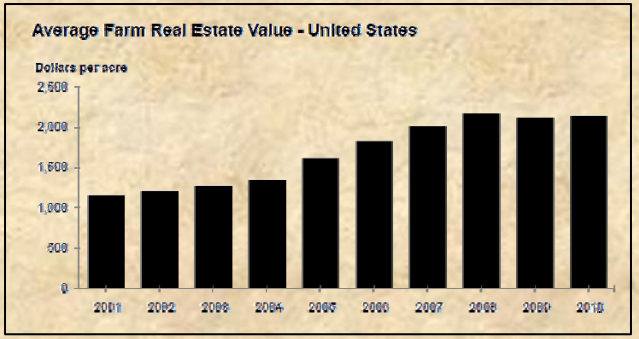


Switchgrass RAPC Model

- Supply 500K dt/yr, milled
- 5 regional processing coops, each 100K dt/yr
- CAPEX at $15M/RAPC:
  - $1,500/acre
  - $150/dt
  - $1.50/gallon
- Initial SG establishment cost $300-$400/acre
  - Half is seed cost
  - Assume 90% establishment
- Total farmer investment $1,800-$2,000/acre

Corn Stover RAPC Model (at 2 dt/acre)

- Each farm block supplying 2,000 dt represents 1,000 acres
- Each RAPC serves 50,000 acres
- Total supply basin is 250,000 acres
- RAPC CAPEX costs are basically the same



Source: *USDA/NASS, August 2010, Land Values & Cash Rents 2010 Summary, ISSN: 1949-1867*

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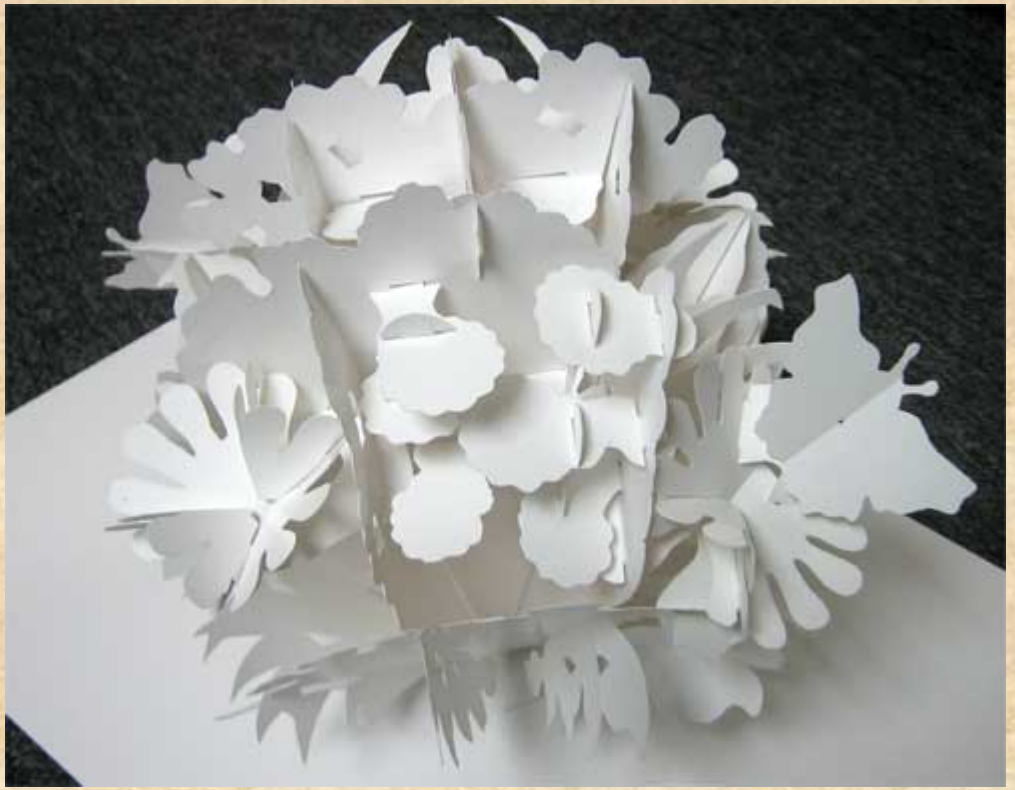
World's Most Complicated Pop-up Book



The Gap: Arm-Chair Farming

"Farming looks mighty easy **when your plow is a pencil**, and you are **a thousand miles** from the corn field."

Dwight Eisenhower

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Adapted from Ceres, Inc., 2009

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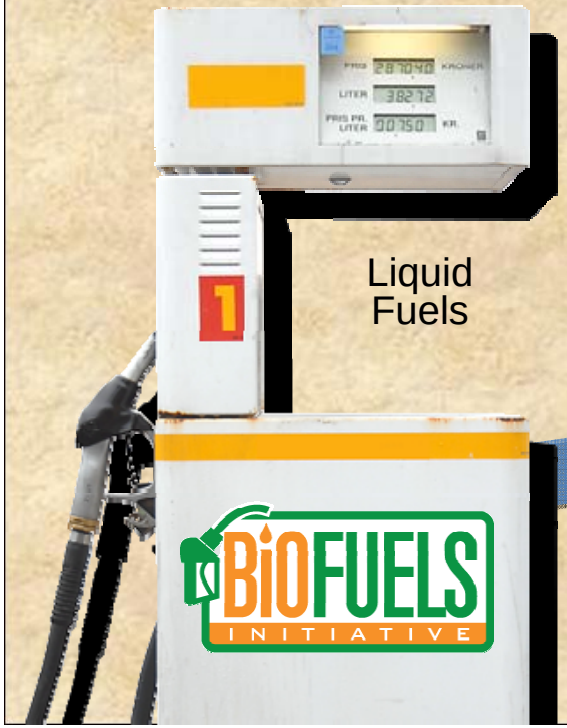

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Tennessee Leading by Example

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