Economic Impacts to the S.E. if We Can Meet the EISA Fuel Goal from Cellulosic Materials

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Opportunities and Challenges in the Utilization of Alternative Fibers
Atlanta, GA • August 28, 2012
Some Important Issues to Keep In Mind

- “One thing we know how to grow is grass”
- “Biomass is the renewable energy feedstock of choice in the South”
- “Why don’t we adopt? Can’t people see what is happening?”
- “If we could just level the Playing Field”
- “It is a win, win, win, and win. Rarely do we get four wins”
- RPA and RFA legislation
Quest for Answers

- 1978 – Looked at crop residues and their potential for co-firing with Coal.
- 1990’s – looked at switchgrass and its ability to provide either fuel or power.
- Early 2000’s – Examined regional impacts.
- Mid to late 2000’s – initiated production studies, examined national impacts, established a southern analytical tool.
- Currently, besides the above, logistics
What have we found?

- Disappointment
- Economics is the key
- Protection of the environment is essential
- Farmers are ready to adopt an alternative crop
- America has the land resources to meet a 25% renewable energy demand, 15 Quads coming from biomass without significantly impacting food prices. This would create 5 million new jobs mostly in rural areas
South’s Resources

<table>
<thead>
<tr>
<th>Hardwoods</th>
<th>Softwoods</th>
</tr>
</thead>
</table>

[Map showing distribution of Hardwoods on the left and Softwoods on the right.]
South’s Resources

<table>
<thead>
<tr>
<th>Cropland</th>
<th>Pastureland</th>
</tr>
</thead>
<tbody>
<tr>
<td>[Map of Cropland]</td>
<td>[Map of Pastureland]</td>
</tr>
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</table>
How have we found answers to these questions

- **Models**
  - Linear programming efforts at the farm (FLARE), and regional (BESTA) levels
  - Spatial model (BioFLAME)
  - Simulation Model (POLYSYS) – national and regional

- **Experiments**
  - Growth – Seeding rate, fertilization rate, harvesting time, soil type
  - Storage
  - Preprocessing
BioFLAME

1.3 Million Hexagon “Crop Zones”
Each representing 21.65 sq. mile area

Actual Switchgrass Expense ($E_a$) + Opportunity Cost (OC) = Profits Foregone

Actual Switchgrass Yield

Farmer’s Breakeven (FB) $/ton

Farmer’s Breakeven + Transport Cost = Delivered Price
Case Study: 13 Counties in East Tennessee
Feedstock Supply Regions & the Location of the Biorefinery

- The 50-mgy refinery is located at the northwest Monroe County
- Switchgrass supply region covers all 13 counties
- 70,000+ acres needed
## Costs and land use changes incurred

<table>
<thead>
<tr>
<th>Logistic System</th>
<th>Round Top</th>
<th>Round Unprotected</th>
<th>Square Top and Bottom</th>
<th>Square Unprotected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Candidate ID</td>
<td>438</td>
<td>438</td>
<td>438</td>
<td>438</td>
</tr>
<tr>
<td><strong>Total ($)</strong></td>
<td>$48,804,714</td>
<td>$48,213,995</td>
<td>$46,256,941</td>
<td>$53,000,052</td>
</tr>
<tr>
<td>Production</td>
<td>$8,674,911</td>
<td>$8,979,650</td>
<td>$9,210,098</td>
<td>$11,247,618</td>
</tr>
<tr>
<td>Harvest</td>
<td>$25,638,978</td>
<td>$26,541,025</td>
<td>$23,898,454</td>
<td>$29,187,083</td>
</tr>
<tr>
<td>Storage</td>
<td>$1,849,872</td>
<td>$0</td>
<td>$3,322,649</td>
<td>$2,462,736</td>
</tr>
<tr>
<td>Transportation</td>
<td>$12,640,953</td>
<td>$12,693,320</td>
<td>$9,825,740</td>
<td>$10,102,615</td>
</tr>
<tr>
<td><strong>Cost/ton</strong></td>
<td>$71.23</td>
<td>$67.98</td>
<td>$63.60</td>
<td>$59.70</td>
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</table>

### Cropland Converted

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Hay</td>
<td>71,868</td>
<td>74,502</td>
<td>76,449</td>
<td>94,093</td>
</tr>
<tr>
<td>Corn</td>
<td>300</td>
<td>300</td>
<td>299</td>
<td>299</td>
</tr>
<tr>
<td>Soybeans</td>
<td>560</td>
<td>572</td>
<td>629</td>
<td>646</td>
</tr>
<tr>
<td>Wheat</td>
<td>2,426</td>
<td>2,430</td>
<td>2,430</td>
<td>2,482</td>
</tr>
<tr>
<td><strong>Total Acres</strong></td>
<td>75,154</td>
<td>77,804</td>
<td>79,807</td>
<td>97,520</td>
</tr>
<tr>
<td><strong>Total Tonnage (tons)</strong></td>
<td>685,135</td>
<td>709,206</td>
<td>727,366</td>
<td>887,835</td>
</tr>
<tr>
<td><strong>Tons/acre</strong></td>
<td>9.1</td>
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### Summary

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Regional Economic Impact of **Switchgrass Establishment** – Round Bale Top

- Direct economic impact: $7.0 million
- Total economic impact: $11.7 million
- Total employment created: 75 person
- Top 5 industry impacted in terms of total output:
  - Pesticide and other ag. chemical manufacturing
  - Monetary authorities & banking services
  - Accounting, tax preparation, bookkeeping, & payroll
  - Industrial machinery & equipment repair/maintenance
  - Support activities for agriculture and forestry
Regional Economic Impact of Biorefinery Investment

- Direct economic impact: $374.6 million
- Total economic impact: $658.8 million
- Total employment created: 4,635 person
- Top 5 industry impacted in terms of total output:
  - Waste management and remediation services
  - Material handling equipment manufacturing
  - Air purification and ventilation equipment manufacturing
  - Power boiler and heat exchanger manufacturing
  - Metal tank (heavy gauge) manufacturing
Regional Economic Impact of Switchgrass Annual Operating

Induced Effects
$14 million
125 jobs

Indirect Effects
$23 million
236 jobs

Direct Effects
$49 million
895 jobs
Regional Economic Impact of Biorefinery Annual Operating

**Induced Effects**
- $17 million
- 150 jobs

**Direct Effects**
- $169 million
- 60 jobs

**Indirect Effects**
- $47 million
- 330 jobs
## Cropland is Converted

### Land Use Change

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<td><strong>75,154</strong></td>
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### Economic Losses

<table>
<thead>
<tr>
<th>Type of Impact</th>
<th>Output</th>
<th>Jobs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct</td>
<td>-$13,311,715</td>
<td>-307</td>
</tr>
<tr>
<td>Indirect</td>
<td>-$7,205,179</td>
<td>-67</td>
</tr>
<tr>
<td>Induced</td>
<td>-$3,461,453</td>
<td>-31</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>-$23,978,347</strong></td>
<td><strong>-406</strong></td>
</tr>
</tbody>
</table>
### In Summary

#### Total Impacts -- Investment

<table>
<thead>
<tr>
<th>Type of Impact</th>
<th>Output Million $</th>
<th>Jobs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct</td>
<td>$381.6</td>
<td>4,705</td>
</tr>
<tr>
<td>Indirect</td>
<td>$130</td>
<td>1,000</td>
</tr>
<tr>
<td>Induced</td>
<td>$158</td>
<td>1,428</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>-$23,978,347</strong></td>
<td><strong>7,133</strong></td>
</tr>
</tbody>
</table>

#### Total Annual Impacts

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<tr>
<th>Type of Impact</th>
<th>Output Million $</th>
<th>Jobs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct</td>
<td>-$205.4</td>
<td>648</td>
</tr>
<tr>
<td>Indirect</td>
<td>-$63.4</td>
<td>499</td>
</tr>
<tr>
<td>Induced</td>
<td>-$27.0</td>
<td>243</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>-$295.8</strong></td>
<td><strong>1,390</strong></td>
</tr>
</tbody>
</table>
Now expanding the analysis to the South

Will Require 293 facilities with a capacity of 75 million gallons/facility

Will require 29 million acres

Could create ½ million jobs and Impact the economy by $87 billion/year.

Based on an one time investment of $111 billion.
Forest Module

- National Programming Model with 305 supply regions constructed under the premise that removals can not exceed growth
- Timber products include hardwood, softwood saw logs and pulpwood, residues, whole tree biomass
- U.S. Forest Service provided data
Harvested hardwood pulpwood volumes for biomass in 2015 under the ALResidues and HarvALtrees scenarios.
Selected Forest Resources

LoggingResidues

ALResidues

$ per dry ton

million dry tons

2010
2015
2020
2025
2030
Selected wood supply curves
Take Home Messages

- Developing a successful regional biofuel industry needs collaborations of farmers, foresters, investors, Extension and entrepreneurs.
- Prosperity from the development of a regional biofuel industry could assist in increasing prosperity at home if local investment occurs.
- Feedstock will cost between $50 and 75/dry ton delivered. Advancements in yield per acre and ability for growth on underutilized lands will reduce the feedstock costs.
- Developing Cellulosic fuels can be a win, win, win, win.
Thank you!

Questions & Comments?
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  benglish@utk.edu