Enhanced Profitability through Technology, Integration, & Diversification

Presented by:
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Enhanced Profitability through Technology, Integration, & Diversification

- Historical Impact of Technology
- Current State of Technology *(Financial Perspective)*
- New Technology Introductions/Developments
- Opportunities/Challenges for Future Technology
HISTORIC U.S. FUEL ETHANOL PRODUCTION

Source: U.S. Energy Information Administration / Renewable Fuels Association
## Historical Impact of Technology

### Evolution to Current State

<table>
<thead>
<tr>
<th>PERIOD</th>
<th>CAPITAL ($US/gal)*</th>
<th>ENERGY (BTU/gal)*</th>
<th>CO-PRODUCTS</th>
<th>POLICIES</th>
</tr>
</thead>
</table>
| Early 80's | $7.20 | 160,000 | Preliminary Product Development | • Oil Embargo  
• Fed Incentives |
| Early 90's | $1.60 | 63,000 | Significant Expansion as Cattlefeed | • Clean Air Act  
• State Incentives |
| Early 00's | $1.25 | 36,000 | Excess Supply = Depressed DDGS Pricing | • Phase Out of MTBE |

### Contributions by Enzyme and Yeast Technology Significant

* Basis: 40 mmpy AEtOH plant adjusted to 2002 $US CPI

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# Historical Plant Financial Returns

**Total Revenues**

<table>
<thead>
<tr>
<th></th>
<th>Jan ’03</th>
<th>Nov ’05</th>
<th>Jan ’06</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethanol</td>
<td>70.9%</td>
<td>84.9%</td>
<td>88.2%</td>
</tr>
<tr>
<td>DDGS</td>
<td>16.8</td>
<td>10.3</td>
<td>8.7</td>
</tr>
<tr>
<td>Other</td>
<td>1.6</td>
<td>0.2</td>
<td>0.1</td>
</tr>
<tr>
<td>Incentives</td>
<td>10.7</td>
<td>4.6</td>
<td>3.0</td>
</tr>
<tr>
<td>Total Revenue</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

*Assumes: 40Mgpy Dry Grind Corn Plant in Midwest USA*
Historical Plant Financial Returns

Natural Gas Pricing (NG, NYMEX)
## Historical Plant Financial Returns

*Variable Costs (as a % of Revenues)*

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<th>Jan ’03</th>
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<tr>
<td>Grain</td>
<td>46.0%</td>
<td>33.6%</td>
<td>36.9%</td>
</tr>
<tr>
<td>Additives</td>
<td>6.5</td>
<td>8.4</td>
<td>8.7</td>
</tr>
<tr>
<td>Energy</td>
<td>6.3</td>
<td>23.2</td>
<td>23.2</td>
</tr>
<tr>
<td>Labor</td>
<td>2.2</td>
<td>2.2</td>
<td>2.2</td>
</tr>
<tr>
<td><strong>Total COGS</strong></td>
<td><strong>61.2%</strong></td>
<td><strong>67.4%</strong></td>
<td><strong>70.7%</strong></td>
</tr>
<tr>
<td><strong>Gross Margin</strong></td>
<td><strong>38.8%</strong></td>
<td><strong>32.6%</strong></td>
<td><strong>29.3%</strong></td>
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*Assumes: 40Mgpy Dry Grind Corn Plant in Midwest USA*
Impact of Technology Today

Maturing Commodity Mindset

- Smaller/Older plants *(pre 2002)* will survive in long run
- Newer/Larger Plants *(post 2002)* using “current technology” will struggle financially
- Future Plants, with New Technology & Risk-Embracing Investors, will set the bar for the market

*Survival of the Fittest …*

**ONLY THE STRONG WILL SURVIVE**
Impact of Technology Today

Maturing Commodity Mindset

Market is demanding Technology Providers to:

1. Provide Acceptable Returns to Investor
   
   *while* …

2. Minimizing Technology/Investment Risk
   
   *while* …

3. Producing THE Lowest Cost Ethanol on the Market
New Technology Commercialization
Life Cycle Challenges – Previous High Risk/High Return Model

New Technology

Will the Client Want/Pay for It?
Will the Technology Provider Guarantee It?

Build It!!
New Technology Commercialization

*Life Cycle Challenges – Today’s Low Risk Position*

New Technology

- Will the **Client** Want/Pay for It?
- Will the **Technology Provider** Guarantee It?
- Will the **Bank** Finance/Fund It?
- Will the **Construction Firm** Build/Bond It?

Build It !!
## Impact of Technology Today

*Transition in Marketplace - Change is Coming*

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<td>36,000</td>
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<td>Current State</td>
<td>$1.00 - $1.75</td>
<td>36,000 to &lt;&lt; 20,000</td>
<td>New Product Development &amp; Market Diversification</td>
<td>● Permanent Energy Policy</td>
</tr>
<tr>
<td></td>
<td><em>Technology Dependent</em></td>
<td></td>
<td></td>
<td>● Phase Out of Gov. Incentives</td>
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* Basis: 40 mmgy AEtOH plant adjusted to 2002 $US CPI

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Ethanol Manufacturing
Configuration Considerations

Fixed Costs will increase with Increased Technology
Therefore, Technology must reduce Variable Costs

Examples:
1. Energy Consumption
2. Energy Cost
3. Higher Integration
4. Effectively Lower the Cost of the Feedstock
5. Diversification of Non-Starch Components to other markets
Ethanol Manufacturing
Traditional Configuration

Corn → EtOH
Corn → CO₂
Corn → DDGS
@ 28% Protein (db)

**Advantages**
- “Lowest” Capital per Gallon Produced
- Increased Scale Reduces $/Gallon
- Lowest Technology Risk (Standard US Design)

**Disadvantages**
- “High” Energy Consumption
- Low-quality, High Volume Animal Feed By-product
Ethanol Manufacturing

Traditional Configuration with Retrofit and Integration

Corn → EtOH

CO₂

DDGS @ 28% Protein (db)

- High Efficiency Drying (“steam” drying)
- More Highly Integrated DD&E
- Mechanical Vapor Recompression
- Membrane Separations of Whole Stillage
- Vapor Permeation (MolSieve Replacement)

**Advantages**
- Reduced energy by 4-6,000 BTU/gal
- Relatively Low Capital. Therefore, stays “under the radar”

**Disadvantages**
- Reduced Operational Flexibility
- Reduced Operational Robustness

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**Ethanol Manufacturing**

*Grain Fractionation*

- **Corn** → **Germ** → **Fiber** → **EtOH**
- **CO₂** → **High Protein Distiller’s** @ 40-68% Protein (db)

**Advantages**
- EtOH Production increased by 10%+
- Thermal Energy reduced by 15-25%
- Increased By-Product Revenues
- Diversify outside of Cattle Feed
- Retrofit with minor process adjustments

**Commercial Demonstrations**
- Broin Companies (installed)
- Delta-T Corp (installed by 2007)
- Cargill/Monsanto (development site)
- Other Commercial Offerings
Ethanol Manufacturing

Co-Generation

Corn → EtOH → CO₂ → DDG (32% Protein (db))

Steam ↔ CDS

Advantages
- Thermal Energy reduced by 45%
- 4.5 yr Payback reported

Commercial Demonstrations
- Corn Plus, LLC
Ethanol Manufacturing
Grain Fractionation & Co-Gen

Advantages
- EtOH Production increased by 10%+
- Thermal Energy reduced by 60-65%
- Increased By-Product Revenues

Commercial Demonstrations
- None to date
- Being developed

Corn → EthOH, CO₂, High Protein Distiller’s @ 40-65% Protein (db)
Germ, Fiber → Steam, CDS
Ethanol Manufacturing
Grain Fractionation & Co-Gen

- Corn
- Germ & Fiber
- Steam
- CDS
- EtOH
- CO₂
- High Protein Distiller’s
  @ 40-65% Protein (db)

**Advantages**
- EtOH Production increased by 10%+
- Thermal Energy reduced by 80-90%
- Increased By-Product Revenues

**Commercial Demonstrations**
- None to date
- Being developed
Ethanol Manufacturing

Highly Integrated and Diversified

Advantages
- EtOH Production increased by 10%+
- Thermal Energy reduced by 95%+
- Potential for Surplus Energy
- Increased By-Product Revenues

Commercial Demonstrations
- Being Developed
- 2008 - 2010 Start Up?
Opportunities/Challenges for the Future

How will New Technology be Commercialized?

- Alliances/Partnerships will be the Key
- Retrofit Market for New Technology will be Large
- Institutions & Entrepreneurs will Finance ?!?
- Balance between Technology Advancement vs Risk Management will be Critical
Enhanced Profitability through Technology, Integration, & Diversification

The Only Constant is Change …

Think Big!!