Tribal Opportunities: Ethanol Production

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Presentation Outline

- BBI International
- Ethanol Overview
- Cellulosic Opportunities
- Project Development and Business Startup Issues
BBI International

- Bryan & Bryan, Inc. founded in 1995 by Mike and Kathy Bryan (dba BBI International)
- 45 full-time employees
- 100+ years combined ethanol and biofuels experience
- Services:
  - Ethanol and Bioenergy Project Development
  - International Conferences and Workshops
  - Ethanol Producer and Biodiesel Magazines
- An independent source of information and data for owners, lenders and policy makers
BBI Consulting Division

- Leading ethanol consulting company in the US with more than 150 technical studies and business plans in the last five years
- Expertise in ethanol production from corn, milo, wheat, sugar cane, potatoes, etc.
- Expertise in emerging technologies for the production of ethanol and chemicals from lignocellulosic feedstocks
- Expertise in anaerobic digestion, biomass gasification, and biodiesel project evaluation
BBI’s Role in the Ethanol Industry

• BBI-affiliated projects total >600 mmgy
• “Affiliated” means BBI provided:
  • Feasibility Study
  • Business Plan
  • Project Development
  • Bank Inspections/Independent Engineers
• BBI has been involved in over 14% of the current standing production capacity in the United States
• Currently developing a 40 mmgy ethanol plant for Chippewa-Cree in Montana
The Ethanol Industry
Overview

- Ethanol has been known to man for thousands of years
- Distillation was invented in the middle ages
- Henry Ford used ethanol in early cars
- Fuel ethanol has been growing steadily since the early 1970’s
Current Ethanol Production

• 103 operating ethanol plants in the U.S. with a production capacity of 4.4 billion gallons

• 31 plants under construction with 1.6 billion gallons of additional production capacity

• 6 billion gallon of production capacity

• Most built in the last 3 years
Current Ethanol Production

- Earlier plants used to be <20 mmgy
- Plants under construction now range from 40 – 100 mmgy, most > 50 mmgy: ADM: 275 mmgy
- Approximately 45% is wet milling and 55% from dry milling and growing
- Most built in the last 3 years
- 95% of the current production is from corn
- Handful of other feedstocks
- Spent beverage plants are <10 mmgy
Ethanol Producers – Where are they?
Industry Drivers:
Legislated Ethanol Market Growth:
RFS: 7.5 billion gallons by 2012

Growth of the U.S. Ethanol Industry

Source: BBI International
Industry Drivers: MTBE Phase Out
Other Industry Drivers

- Oxygenated Fuel
- International Trade Deficit
- Dependence on Foreign Oil (>65%)
- Energy Security
- War
- Value-Added Agriculture
- Special incentives to develop commercial production from cellulosic feedstocks
Ethanol Process Design Companies

- Fagen and ICM
- Broin and Associates
- Delta T
- Katzen International
- Lurgi/PSI
- Vogelbusch USA
- MECS
Raw Material - Corn

• Low cost source of starch
• Easily grown, harvested, stored, transported
• Existing infrastructure
• Price well-known
• High value co-products
• Standard grade available
Raw Materials Corn

- Components of corn
  - Moisture 14 – 16 %
  - Starch 65 – 72 %
  - Protein 8.5 %
  - Fibre 9.5 %
  - Fat 4.3 %
Other Feedstocks for Alcohol Production

- Cereal Grains
  - Corn
  - Milo (sorghum)
  - Wheat
  - Barley
  - Rye
- Potatoes
- Cellulosic Biomass

- Sugar Based
  - Molasses
  - Sugar cane
  - Sugar beets
  - Agave
  - Tapioca
Production Requirements

• 2.68 gal/bu anhydrous; 2.8 gal/bu denatured
• 17,500,000 bu/yr for 50 mmgy of EtOH
• Utilities required include natural gas, electricity, water and wastewater disposal
• Steam: 32,000 BTU/gal ethanol
• Electricity: 0.7 kWh/gal ethanol
• Water: 4-12 gal/bushel corn
• Wastewater: can vary considerable with plant design, but about 25% of makeup water
Fuel Options

- Natural Gas
- Biomass Combustion
- Biomass Gasification
- Anaerobic Digestion

Boiler

400,000 Lbs/hr steam
100 MMGPY Ethanol Plant

Cogeneration of electricity is also an option
Natural Gas Fuel Option

- Natural Gas
- Biomass Combustion
- Biomass Gasification

Boiler

No emissions credits

400,000 Lbs/hr steam

100 MMGPY Ethanol Plant
Biomass Fuel Option

- Natural Gas
- Biomass Combustion
- Biomass Gasification

Boiler

400,000 Lbs/hr steam

100 MMGPY Ethanol Plant

Emissions credits?
Products From Corn

- Ethanol
  - 1/3
- Dried Distillers Grains (DDG)
  - 1/3
- Carbon Dioxide (CO2)
  - 1/3
Ethanol Production

1. Starch
2. Sugars
3. Ethanol
Corn Receiving and Storage
Dry Milling Process

1. Grain Receiving
2. Mash Preparation
   - Ammonia
   - Enzymes
3. Corn Meal
4. Fermentation
   - CO₂
5. Beer
6. Distillation
   - 190 Proof Ethanol
7. Whole Stillage
8. Centrifugation
   - Wet Grains
9. Thin Stillage
10. Evaporation
    - Syrup
11. Process Condensate
12. Dryer
   - DDGS
13. Dehydration
   - 200 Proof Ethanol
14. Product Storage
15. Denaturant
16. Fuel Ethanol
17. DDGS Storage
18. DDGS
Grinding

- Hammermills
- Meal analysis
  - Avg. particle size 1.5 mm
  - 60% on sieve # 18 to 60
  - less than 10% fine and coarse
Mashing

- Slurry
- Cooking
- Conversion
- Saccharification
- Enzymes
- Time / temperature
Fermentation

- Batch vs. Continuous
- Yeast
- Time / Temperature
- Infections
Downstream Operations

- Distillation
- Dehydration
- Centrifugation
- Syrup Evaporation
- Distillers Grains Drying
- Process Water Recycling: AD & UF/RO
- Product Denaturation and Loadout
Cellulosic Ethanol -- Commercialization Issues and Strategies
Biomass Feedstocks

- Ethanol production potential from corn stover in the U.S. is greater than 10 billion annual gallons
- Add all other agricultural residues, forest residues, urban green waste, MSW, and energy crops in the U.S. and the potential is as high as 50 billion gallons
- Feedstocks will not limit the size of the cellulosic ethanol market
Status of Technology

- Enzymatic hydrolysis to produce sugars has the lowest cost potential.
- The cost of cellulase enzymes has prevented commercialization of the enzymatic process.
- Other processes – two stage dilute acid, concentrated acid, gasification – have not made the jump to commercial deployment.
Projects

- BCI – Jennings still not financed…
- BCI – Gridley and Collins Pine cancelled
- Masada – long delay for air permit (now issued), Middletown, NY project may be financed soon? (2 years and waiting)
- Arkenol – project in Japan?
- Iogen – making perpetual progress
- Gasification – (catalytic conversion of syngas to ethanol) lots of interest, little published data
Projects

• Cargill-Dow – PLA plant in Blair, NE using wet mill sugars; working on biomass as sugar source
• Williams/Purdue – Conversion of fiber in DDG to ethanol
• Abengoa – has just built a 5 million liter/year cellulosic plant in Europe with a 200 million liter/year wheat/barley ethanol plant
Increasing equipment size and development costs

Laboratory scale research and process development → Pilot scale process development and demonstration → Demonstration scale plant

Recent commercialization projects have skipped the demonstration step, increasing the risk of failure of the commercial launch
Technology Issues

• Pretreatment
• Enzymatic hydrolysis
• Pentose fermentation
• Secondary issues:
  – Lignin utilization
  – Ethanol concentration
  – GMOs
Financial Issues

• Technology risk
  – Small technology companies cannot guarantee their process
  – Risk mitigation drives up the project cost to the point of insufficient returns

• Cellulosic ethanol must compete with ethanol from corn
Commercialization Strategy

• Follow corn ethanol “model”
  – Site with adequate feedstock supply, utilities, transportation and markets
  – Utilize successful design/build firms
  – Hire experienced ethanol marketing firm
  – Assemble first rate management team
  – Need 40% equity, 50% better
  – Projected Return on Equity should be 30% or higher
Commercialization Strategy

• Lower capitalization for the first project – $20 million, not $100+

• Examples:
  – Pulp mill sludge does not require pretreatment; may have a negative cost
  – DDGS or brewers grains
  – Rice hulls/feedstocks collected by others
  – Existing infrastructure i.e. Coors brewery

• Projects in Europe – tax breaks
Conclusions Regarding Cellulosic Ethanol

- Availability of low cost cellulase enzyme is the key issue
- Start with small, but profitable niche opportunities
- Tribes has access to cellulosic feedstock resources
- Native American organizations have the opportunity to be involved in the groundfloor of a new industry
Project Development
Project Development Path

- Organize business and secure seed money
- **Conduct a Feasibility Study**
- Write a Business Plan
- Develop a Prospectus
- Conduct a Membership Drive
- Obtain Financing
- Hire a Project Manager
- Begin Construction and Startup
Key Elements of the Ethanol Feasibility Study

• Site selection
• Feedstock analysis
• Market analysis
  – Ethanol
  – DDGS or animal feed
  – CO2
• Financial analysis
  – Construction costs
  – Owner’s costs
  – Operating costs
  – Projected profitability and sensitivity studies
Site Selection

• Typically 30 to 40 acres in a rural area with:
  – Low cost feedstock (typically corn)
  – Good rail access
  – Good road access
  – Adequate utilities at reasonable cost
  – Close proximity to co-product markets
  – Access to ethanol markets
  – Access to labor
Feedstock Analysis

- Local or imported feedstock?
- Availability and price (10-yr history)
- Ethanol yield
- Co-product yield
- Competition for feedstock
Ethanol Market Analysis

• Define local, regional and national markets for the project’s ethanol
• Document historical ethanol use and price in the markets
• Estimate transportation costs to markets
Co-Product Market Analysis

• Distillers Grains – traditionally marketed wet or dry to cattle feedlots and dairies; dry to poultry and swine
• Depending on feedstock, need to establish value and potential market for alternate co-products
• Carbon Dioxide – markets in major cities; less demand in areas with existing CO2 production (refineries, ethanol plants, etc.)
• Are there nearby markets for the coproducts?
Financial Analysis

• Use conservative assumptions
• Use ROI or IRR for profitability
• 25% minimum ROI, 30% for better projects
• Returns are most sensitive to feedstock and ethanol pricing
Construction Costs

Typical Corn Dry Mill Ethanol Plant

Installed cost/gallon capacity

- Ethanol Plant Capacity, mmgpy

- Ethanol Diesel
- Ethanol 85
- Ethanol 10
- Ethanol Fuel Cells
Owner’s Costs

- Land, roads, rail & site development
- Administration building/furnishings
- Utilities, water treatment, fire water
- Permits
- Startup costs and training
- Construction interest and loan fees
- Inventory costs
- Owner’s Costs add 20-30¢ per gallon to the overall project cost
Typical Operating Costs & Revenue

- Production costs .................. $1.20/gal
  - Feedstock (Corn)
  - Energy
  - Chemicals, enzymes, yeast, denaturant
  - Labor
  - Water
- Administrative costs .............. $0.07/gal
- Debt service ........................ $0.13/gal
- Revenue .............................. $1.55/gal
  - Ethanol
  - Distillers grain and possibly CO2
- Pre-tax income ...................... $0.15/gal
Gaining an Advantage

- Strong local/regional ethanol market
- Low feedstock price
- Low energy costs (alternative fuels)
- Sell wet distillers grain
- Developed site/co-location
- Risk management
- State incentives
After the Feasibility Study

- Project Leadership
- Legal Organization and Tax Status
- Equity Capitalization
- Site Selection
- Feedstock Procurement
- Design-Build Team
- Senior Lender
- Ethanol Sales
- Co-Product Sales
- Risk Management Strategy
Project Structure

- EPC Contractor
- Ethanol Marketer
- DDG Marketer
- Grain Procurement
- CO2 Contract
- Legal Counsel
- Accounting/CPA
- Utility Contracts
- Rail Contract
- Permitting
- Risk Management
- Plant Staffing
- Energy Management
Your Ultimate Goal – Debt Financing

- The three M’s of lending:
  - Markets
    - Who, what and how much
  - Management
    - Board/local leadership
    - Operational leadership
  - Money
    - Capital and cash flow
Thank You!

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