Net Corn Acres Project
Phase I objectives

- **Focus**: net acres needed for corn starch ethanol
- **Future corn yields/A. with USDA Projections & Alternatives**
- **U.S. ethanol demand to 2022**
- **Ethanol yield/bu. & gross corn acres needed**
- **Estimate life-cycle corn bu. & acres replaced by DDGS feeding in domestic & export mkts.**
- **Estimate number of soybean acres potentially released by replacement of SBM**
Added Progress on Phase I

- Additional work on DDGS export projections
- Added work on DDGS replacement of soybean meal (SBM)
- Further work on issue of possible DDGS market saturation
Net Corn Acres Project
Phase II objectives

- Focus: Corn oil removal from DDGS, corn oil replacement of soy oil for biodiesel, and soybean acres released
- Conversion of corn cobs (& now stover) to ethanol & potential contribution to advanced biofuels mandates
- Project potential % of dry-mill ethanol biorefineries extracting corn oil
- Estimate oil extraction rates per bushel
- Project future soy oil (SBO) use for biodiesel
- Estimate net soybean acres needed for SBO biodiesel after corn oil replacement
- Estimate net soybean acres needed for biofuel after DDGS replacement of SBM
- Estimate potential volume of corn stover available for ethanol production
- Estimate potential ethanol production from corn stover & potential contribution to advanced biofuels blending mandates
Major new policy Issues affecting Phase I & II results

- Blender’s tax credit – will it be eliminated, modified, shifted to infrastructure emphasis?
- Will courts allow E-15 for 2001 & newer vehicles?
- Future value of U.S. $ - related to monetary & fiscal policies. It affects oil price & energy economics
- Incentives for retail blender pumps
- Incentives for producing flex-fuel vehicles
- Geo-political developments & U.S. drilling policy as they affect crude oil prices
- Geo-political developments are stimulating ethanol exports
- DDGS policy issues with China
- Key assumption: net incentives will allow starch ethanol production 12-15% above EISA mandates & biodiesel at mandates
### Table 3. Percentage Inclusion Rates of DDGS in Livestock Diets, by Class of Livestock

**Study by Berger & Good & National Corn Growers Assn.**

<table>
<thead>
<tr>
<th>Class of Livestock</th>
<th>Berger &amp; Good</th>
<th>Nat’l Corn Growers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dairy Cows</td>
<td>15%</td>
<td>20%</td>
</tr>
<tr>
<td>Beef Cows</td>
<td>5%</td>
<td>10-20%</td>
</tr>
<tr>
<td>Other Cattle</td>
<td>20%</td>
<td>10-20%</td>
</tr>
<tr>
<td>Cattle on Feed</td>
<td>20%</td>
<td>na</td>
</tr>
<tr>
<td>Breeding Swine</td>
<td>15%</td>
<td>20%</td>
</tr>
<tr>
<td>Market Swine</td>
<td>15%</td>
<td>20%</td>
</tr>
<tr>
<td>Broilers</td>
<td>5%</td>
<td>10%</td>
</tr>
<tr>
<td>Layers</td>
<td>10%</td>
<td>15%</td>
</tr>
<tr>
<td>Pullets</td>
<td>na</td>
<td>na</td>
</tr>
<tr>
<td>Turkeys</td>
<td>na</td>
<td>10-20%</td>
</tr>
</tbody>
</table>

Dooley\textsuperscript{a} Maximum Domestic DDGS Market Size & Projected Production

- Concluded dairy & hog DDGS markets will be saturated by late 2009
- Long-term likely upper limit = 50.04 mil. tons
- 2008 estimated upper limit = 30.82 mil. tons
- Estimated DDGS production in 2009-10 = 38.37 Mil. tons (41.4 mil. T. expected ’10-11) with ’09-10 domestic consumption at 30.31 mil. tons
- Projected production in 2022: 48.33 mil. tons

\textsuperscript{a}F.J. Dooley, U.S. market potential for dried distillers grain with solubles, Agricultural Economics Department, Purdue University, Working Paper #08-12, December 2008
Barriers to increased use of DDGS

- 2007 survey by NASS and Nebraska Corn Development, Utilization & Marketing Board identified primary reasons for not feeding co-products

- Listed by degree of importance:
  - Availability
  - Infrastructure and handling
  - Cost
  - Concerns with nutrition and quality issues
  - Produces own feed
  - Satisfied with current feeding program
  - Lack of knowledge about DDGS feeding
  - Operation too small
  - Transportation problems
  - Shelf life/product longevity
  - Other

Dooley: Size of livestock farm

Many of these are being overcome
U.S. Distillers & Brewers Grain Exports

Data Source: U.S. Census of Manufacturing
Other researchers’ estimates of maximum export potential = 20 to 52 million tons.
Key Corn Oil Assumptions

- Future expansions in ethanol production will almost all be dry mill plants
- Dry mill plants will use end-stream oil removal rather than front-stream fractionation
- 75% of dry mill ethanol plant capacity will have oil removal by 2022
- 2008 % with oil removal – from Argonne Lab survey
- All added dry-mill corn oil production is for biodiesel
- Wet-mill corn oil will be used mainly for food
- Dry-mill extraction rate: constant @ 1/3 pound per bushel
- Syrup from ethanol also has a feed market so not all available supply will have oil removal
Other Key Assumptions in Corn Oil Projections

• Census data understate dry mill corn processing
• SB yields per acre will follow 1980-2007 trend
• Incentives for biodiesel blending will remain as at present & export volumes will remain low
• Biodiesel use will equal but not exceed EISA mandates
Procedures for Estimating Soy Acres Credits from Corn Oil Extraction & Use in Biodiesel

• Estimate & project share of corn processing from dry mill plants, partly with Census data
• Use Mueller 2008 survey data as initial estimate of % of dry mill plants extracting corn oil. With this base, project to 75% of plants extracting corn oil by 2022
• Use oil extraction rate of major Iowa dry mill ethanol plant (higher than yield of Mueller 2008 survey @ 1/3 lb./bu.)
• Compare projected dry-mill corn oil production with historical Census corn oil production & use data
• Translate dry mill corn oil production into SB equivalent acres, using SBO yield/bu., trend SB yields, & assume all of increase is for biodiesel
• Project future soy oil biodiesel production & needed SB acres, assuming biodiesel production = EISA mandates
• Determine net SB acres for biodiesel with corn oil & DDGS-SBM credits
Estimated & Projected Percentages of Corn Biorefinery Capacity that are from Dry Mill Plants

Based partly on Census of Manufacturers
Estimated & Projected Percentages of Dry Mill Corn Ethanol Plants Extracting Corn Oil

Steffen Mueller 2008 survey
Census of Manufacturing understates dry mill corn processing

- - Total with dry mill corn oil
U.S. Corn Oil Uses

Domestic Use
Exports

Mil. Pounds

Assumes all added dry-mill oil production will be used for biodiesel

Estimated & Projected Net SB Acres Needed for Biodiesel to 2022

SB Acres Needed for Biodiesel w/o corn Oil

Net Acres for Biofuels with DDGS SBM & SBO Credits with corn oil & USDA Yields.
Net corn acres for ethanol in 2022: 23-27% of total planted acres, depending on corn yield & ethanol production.

Total corn & SB acres needed for biofuels to 2022 (Ethanol 15% above 2022 mandate & 2004-09 corn yield trend)

Corn oil extraction from biorefineries is included.
Total corn & SB acres needed for biofuels to 2022. Ethanol 12-15% above 2022 mandate & alternative corn yield trends.

- Gross Acres
- Net Acres

Corn oil extraction from biorefineries is included.

Legend:
- Red: 15% above mandate, 2004-09 yld. trend
- Blue: 15% above mandate, 2004-09 yld. trend
- Purple: USDA ylds. & 12% above ethanol mandate
- Green: USDA ylds. & 12% above ethanol mandate

Data points for years 2003 to 2021.
Total corn & SB acres & acres needed for biofuels to 2022, Ethanol 12-15% above 2022 mandate & alternative corn yield trends

- 15% above mandate, 2004-09 yld. trend
- USDA ylds. & 12% above ethanol mandate
- USDA Total corn & SB acres

Gross Acres

Net Acres

Corn oil extraction from biorefineries is included

13.7 to 15% of total acres
U.S. Corn Yield & Alternative Long-Term Trends

- Historical yield
- Trend, 1960-2007
- Trend, 1995-2007
- 2005-09 trend

210.9 bu./A. +4.8 bu./A./yr
+4.5 bu./A./yr.
vs. trend 2011

1990-2007 yield trend to 2022 = 187.2 bu./A.

- Soybean yield
- 1970-08 trend
- 1980-08 trend
- 1990-08 trend
- USDA projection
Non-ethanol domestic use & exports are USDA 10-year projections

Corn Production & Use Projections to 2022 With USDA Yield and 2004-09 Yield Trend

- USDA Proj Prod'
- Proj Prod'n with 2005-09 Yld
- Corn Avail for Other Uses
- Total Use
- Non-Ethanol Domestic Use
- Net Corn Bu. for Ethanol after DDGS Credits
- Exports

4/21/11
U.S. Domestic SBM Use, Exports, & Stocks in Days' Use at Crushing Plants

- Red: Exports
- Checkered: Domestic use
- Blue: Carryover, days' use

DDGS Impact
Corn Cobs & Stover Assumptions

- Economically viable commercial scale production will emerge by 2014
- Available stover tonnage is limited by (1) needs for erosion control & soil health (2) demand for livestock & (3) other emerging bioenergy demands including electric power plants
- One ton/A. on 28% of the corn for grain land will be available for cellulosic ethanol, with 100% of this used for ethanol by 2022
- Ethanol yield initially at 75 gallons/ton, gradually increasing to 85 gallons/ton by 2022
Crop residue is required for land classified by USDA as Highly Erodible
Projected Percent of U.S. Corn Cobs & Stover Used for Cellulosic Ethanol

- 2003
- 2006
- 2009
- 2012
- 2015
- 2018
- 2021
Projected U.S. Corn Cobs-Stover Cellulosic Ethanol Production & EISA Cellulosic Ethanol Mandates

- Stover-Cobs Ethanol

Bil. Gallons

Original EISA Cellulosic Ethanol Mandates

Projected U.S. Corn Starch & Corn Cobs-Stover Cellulosic Ethanol

Corn to contribute 56% of 36 billion gallon biofuels mandate by 2022

- Starch Ethanol 15% above 2022 Mandate
- Stover-Cobs Ethanol

Corn Starch Ethanol, 12% Above Mandate in 2022
Concluding Comments

- Growth in starch ethanol production will slow significantly
- Saturation of DDGS market not expected
- Export growth important for DDGS market
- Ethanol export demand may also increase
- If blend wall can be eliminated, starch ethanol may continue to exceed EISA mandates by 12% to 15%
- **Net corn for biofuel by 2022: 23-27% of total corn acres**
- **Net corn & SB acres for biofuel by 2022: 13.7-15% of total**
- Corn cob-stover ethanol may contribute around 12% of cellulosic ethanol mandate by 2022
- Corn ethanol & biodiesel may contribute up to 56% of 36 bil. gal. biofuels mandate for 2022
Thanks!

Questions & Comments?

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