Net Corn Acres Project
Phase I objectives

R. Wisner

• Phase I 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 DGS & corn gluten feed in domestic & export mkts.
• Estimate number of soybean acres potentially released by replacement of SBM
Phase II objectives

• Focus: Corn oil removal from DGS, replacement of soy oil for biodiesel, and soy acres released
• Conversion of corn cobs (and 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 DGS replacement of SBM & SBO
• Estimate potential volume of corn stover available for ethanol production
• Estimate potential ethanol production from corn stover & potential contribution to advanced biofuels blending mandates
Primary Change vs. Spring 2011 Report

• Spring report assumed feed co-product was only DGS
• This report has adjustment for corn gluten feed (CGF) from wet mills
• Net effect: slightly fewer corn acres replaced by co-product corn feeding
• CGF yield: 12 lbs/bu. vs. DGS 14-17 lbs.
• CGF assumed primarily used for cattle
• CGF feed value 90-95% of corn vs. DGS 110%
  – Actual replacement ratio depends on: whole corn vs. coarse ground, finely ground, wet, dry, flaked corn, etc.
• Wet mills account for 12-14% of ethanol production
• SBM replacement not changed from spring report
Major new policy issues affecting Phase I & II results

- Blender’s tax credit – will it be eliminated, modified, shifted to infrastructure emphasis?
- Will industry accept 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 & using E85
- Geo-political developments & U.S. drilling policy as they affect crude oil prices
- Geo-political developments are stimulating ethanol exports
- Key assumptions: net incentives will allow starch ethanol production 12-15% above EISA mandates & biodiesel production at mandates
Major Conclusions

• Net acres needed for corn biofuels peak in 2011-12, gradually decline with increasing bu/A

• After co-product feed credits and corn oil credits, about ¼ of U.S. corn acreage will be needed for biofuels in 2022
  – % varies with corn yield & ethanol use above mandates

• DGS market not likely saturated

• Corn oil extraction to reduce soybean acres needed for biodiesel
  – releases acres for corn or other crops
  – About 5% of soy acres needed for biodiesel in 2022

• Combined corn & soy acres for biofuels in 2022: 14% to 16%

• Potential ethanol from stover may supply about 12% of 2022 cellulosic mandate

• Combined corn & soy biofuels supply 56-58% of 2022 total mandates
Figure 1. Estimated & Projected Gross Corn Use for Starch Ethanol to 2022

2010-11 production: 12.5% above mandate

5.25 Bil. Bu. needed for 15 Bill. Gal mandate

Updated Actual

- USDA 2010 Projections
- 12% above mandate by 2022
- FAPRI 2010 Projections
- 15% above mandate by 2022

Mil. Bu.
Figure 2. Corn Utilization Trends

- Corn production
- Exports
- Corn for Ethanol
- Domestic non-ethanol

Bil. Bu.

Marketing Year Beginning Sept. 1


Short-falls

Stocks incr.
U.S. Corn Yield & Alternative Long-Term Trends, With USDA October Forecast for 2011

Historical yield
Trend, 1960-2007
Trend, 1970-2007
Trend, 1990-2007
Trend, 1995-2007
Trend, 2005-09

210.9
+4.5 bu./A/yr.
vs. trend 2011
Figure 8. Projected U.S. Domestic DGS Use & Production, With Ethanol 12% & 15% Above Mandates in 2022

Historical Data Source: U.S. Census of Manufacturing
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.
Increasing ethanol yield reduces DDGS Yield: Christianson & Associates - 2010
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 USDA trend projection
• Incentives for biodiesel blending will remain as at present & export volumes will remain low
• Biodiesel use will equal but not exceed EISA mandates
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
U.S. Corn Oil Production

- - Total with dry mill corn oil

Mill. Pounds

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Estimated & Projected Soybean Oil Share of U.S. Biodiesel Blending Mandates

- Without Corn Oil
- With Corn Oil
Figure 5. U.S. Gross Acres Needed for Ethanol With Alternative Corn Yield Trends & Ethanol Production 12% Above 2022 Mandate

3.9 Mil. A. Spread

- With 1990-07 yield trend
- With USDA Projection
- With 2005-09 yield trend
Net corn acres for ethanol in 2022: 24-27% of total planted acres, depending on corn yield & ethanol production

Figure 28. Estimated Percentages of Total U.S. Planted Corn & Soybean Acres Needed for Biofuels

1 With 2005-09 Yield Trend and Corn Starch Ethanol Production 12% above 2022 Mandate
Net corn acres for ethanol in 2022: 24-27% of total planted acres, depending on corn yield & ethanol production
14% to 15% of total corn & soy acres

Estimated & Projected Total Corn & SB Acres Needed for Biofuels to 2022

Ethanol 12% above 2022 mandate
U.S. Gross & Net Acres Needed for Biofuels, Ethanol 12 - 15% above 2022 Mandate, & Alternative Corn Yield Trends

- **Gross: USDA Ylds., 12% above mandate**
- **Gross: 2005-09 Yld. Trnd., 15% above mandate**
- **Net Acres- USDA Ylds. 12% Above Mandate**
- **Net Acres - 2005-09 Trend Yld., 15% Above Mandate**

1.4 Mil. A. difference
Figure 11. Estimated & Projected Billions of Bushels of Corn Replaced by DGS With 2022 Ethanol Production 12% & 15% Above Mandates
Corn Cobs & Stover Assumptions

- Economically viable commercial scale production will emerge by 2014 & no blend wall
- 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
Projected Percent of U.S. Corn Cobs & Stover Used for Cellulosic Ethanol

Based on one ton/A. Availability
Projected U.S. Corn Cobs-Stover Cellulosic Ethanol Production & EISA Cellulosic Ethanol Mandates

- Stover-Cobs Ethanol
- 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

Bil. Gallons

Concluding Comments

• Growth in starch ethanol production will slow significantly
• Saturation of DGS market not expected
• Export growth important for DGS 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?

Contact: wisner@iastate.edu
### Table 2. Weighted by Life-cycle DDGs Corn and Soybean Meal Displacement Ratios

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<tr>
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<th>DDGS Substitution rates by Lstd. Species</th>
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<th>Lbs. SBM replaced by one Lb. dry DGS</th>
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### Some Key Sources:
U.S. High protein consuming animal units

- Other livestock
- Other cattle
- Cattle on feed

Million units