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# Emerging Biofuels: Outlook of Effects on U.S. Grain, Oilseed, and Livestock Markets

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# Outline

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- Based on the CARD study “Emerging Biofuels: Outlook of Effects on U.S. Grain, Oilseed, and Livestock Markets”
- S. Tokgoz, A. Elobeid, J. Fabiosa, D.J. Hayes, B.A. Babcock, T. Yu, F. Dong, C.E. Hart, and J.C. Beghin
- <http://www.card.iastate.edu>

# Objectives

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- To estimate how large the U.S. corn-based ethanol sector can become in the long-run
- To estimate the impact of the emerging U.S. ethanol sector on
  - U.S. grain, oilseed, livestock, and dairy sectors
  - International agricultural markets

# General Description of the Models

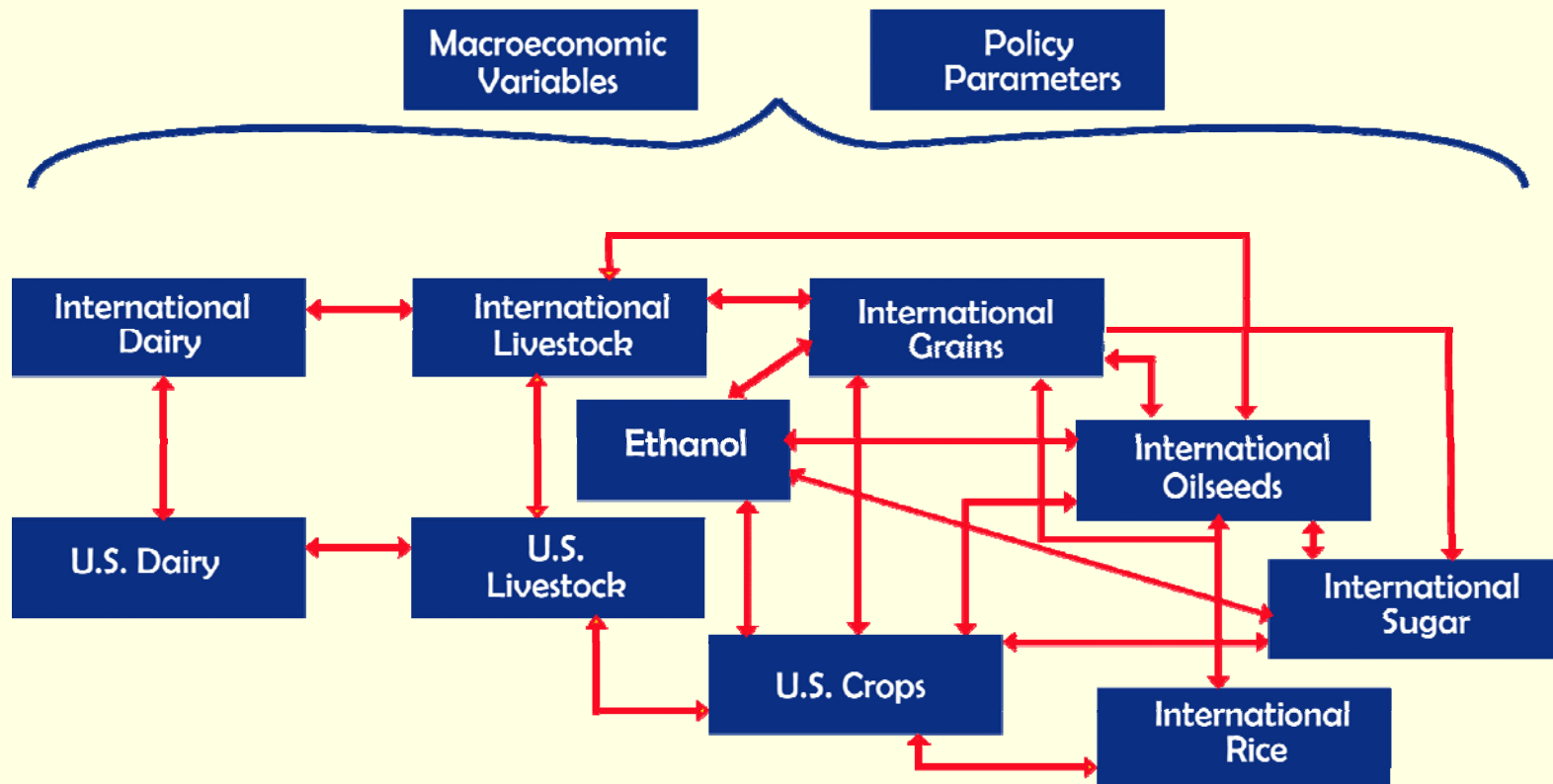
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- Broad modeling system of world agricultural economy
- Non-spatial multi-market deterministic partial equilibrium models of supply and demand
- Behavioral equations for production, consumption, stocks, and net trade
- Solve for a representative world price in each market
- Domestic prices linked to world price through price transmission equations
- Linkages between all agricultural commodity markets and energy markets

# Model Interactions

## Model Interactions

Trade, Prices, and Physical Flows



# Outline

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- We first set up a baseline for all agricultural markets
- Then, we ran a number of scenarios, including
  - high crude oil price with no bottleneck
  - high crude oil price with bottleneck
  - drought with an ethanol mandate
  - removal of CRP land for ethanol production

# Baseline

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- All models are calibrated on 2006 historical data and projections cover the period between 2007 and 2016 (2007/08 and 2016/17 marketing year)
- Existing domestic and trade policies remain unchanged
- Counted operating and plants under construction to determine ethanol sector capacity till 2009/10; used economic models to determine the subsequent capacity building to 2016/17 based on net returns over costs

# Baseline Assumptions

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- No impact on trend yields from changes in planted acreage
- No impact on meat quality from feeding distillers' grains (DDG) at less than maximum inclusion rates
- All potential bottlenecks involved in transporting ethanol, DDG, corn and fertilizer are solved
- Cellulosic ethanol is not competitive under current policy incentives
- Only direct food price increases caused by increased feed costs are accounted for



# Long-run Equilibrium

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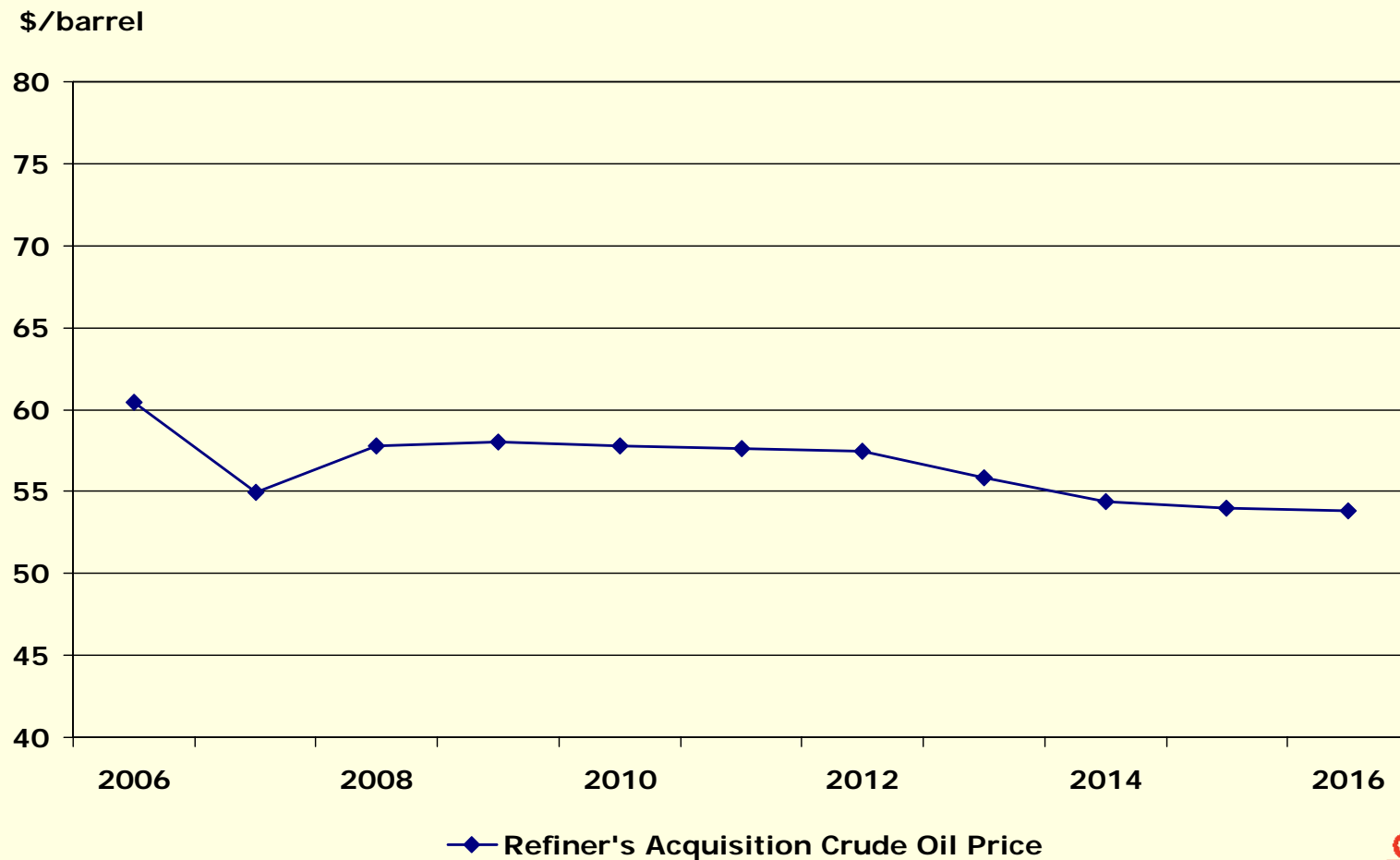
- The ethanol industry grows until the net profit margin for corn-based ethanol sector is zero; and
- Enough flex-fuel vehicles are sold to accommodate the additional ethanol production
- How large will the U.S. ethanol industry become and how does the rest of world agriculture adjust to let this happen?

# Key Determinants of Impacts

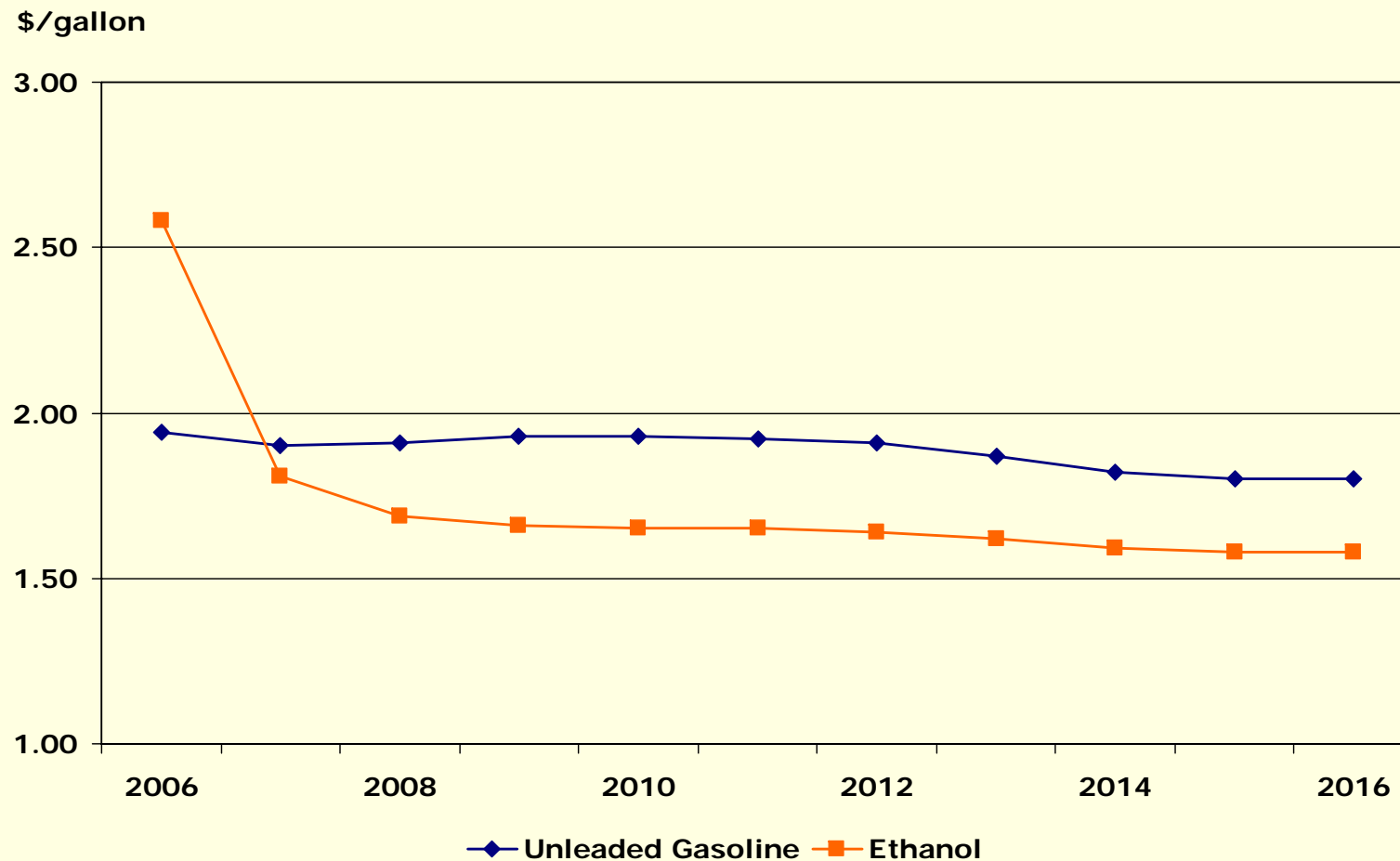
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- Crude oil prices
  - Used NYMEX futures prices as a guide
  - Computed RAC of crude oil price
- Policy incentives in the U.S.
  - \$0.51/gallon ethanol blenders credit
  - \$0.54/gallon import duty and 2.5% import tariff
- Demand for E-85 included
- Response of Rest-of-the-World to higher grain prices
  - Let models dictate the equilibrium

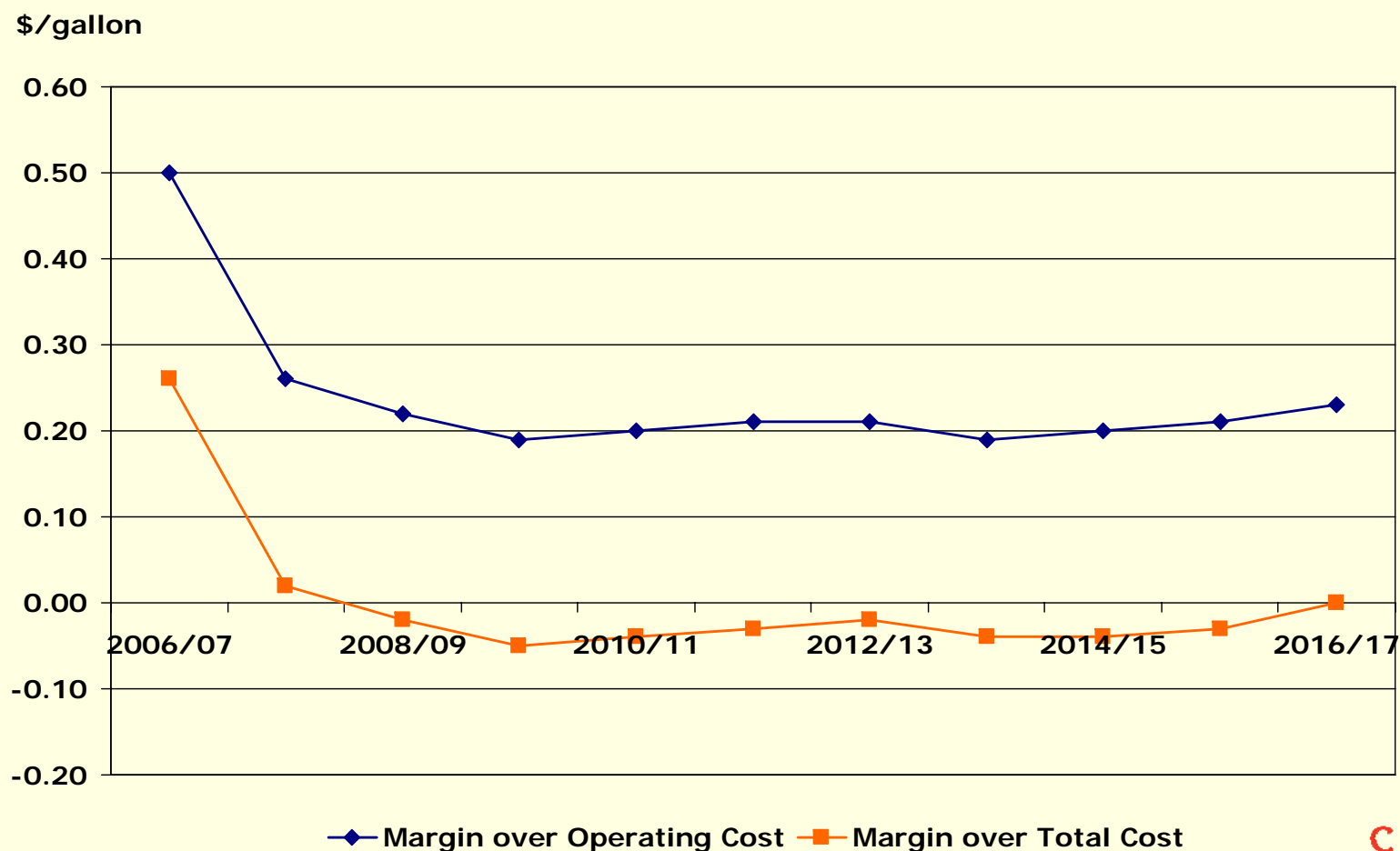
# Projected Crude Oil Price



# Projected Ethanol and Gasoline Prices

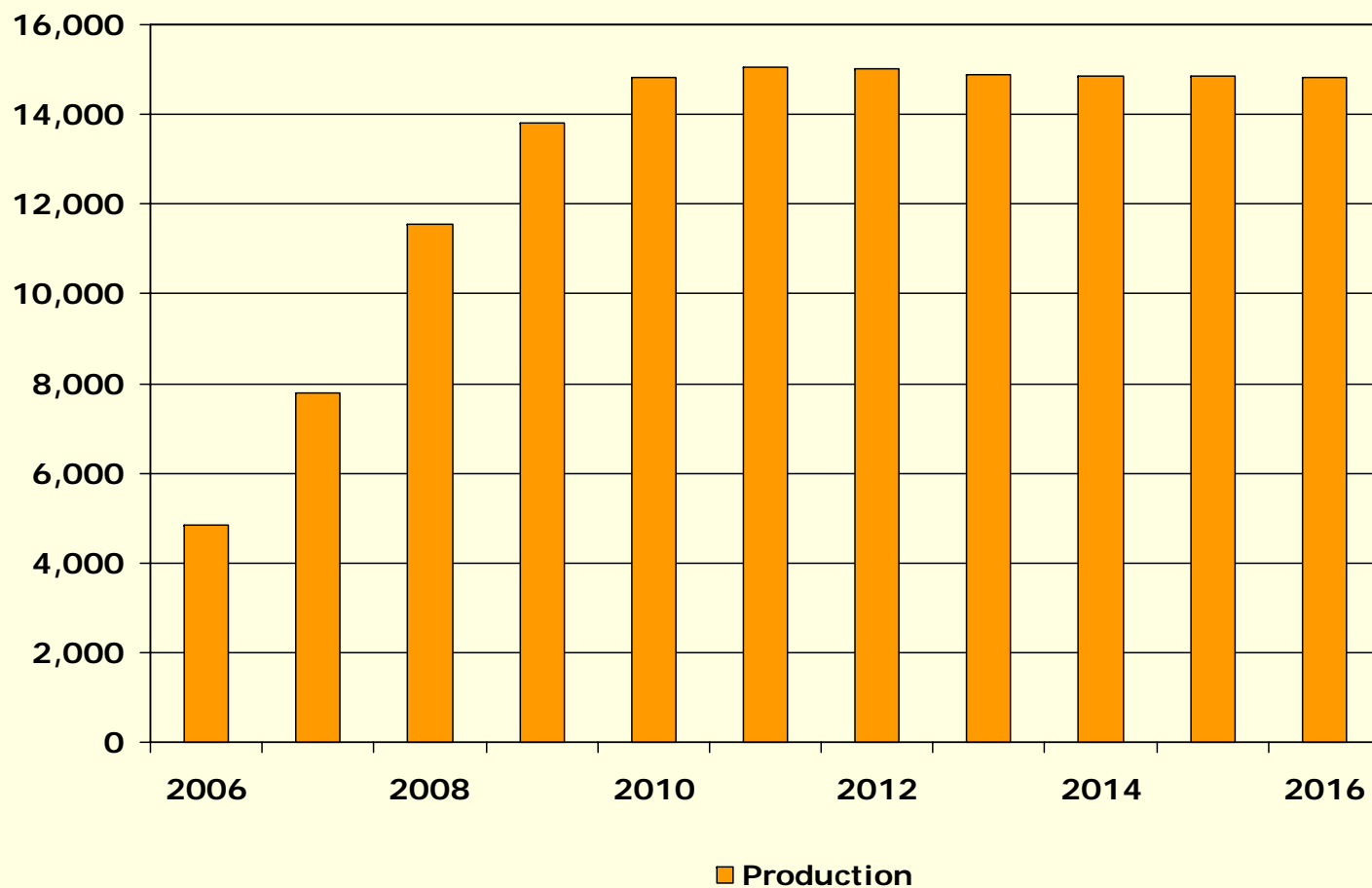


# Projected Dry Mill Margins



# Projected Ethanol Production

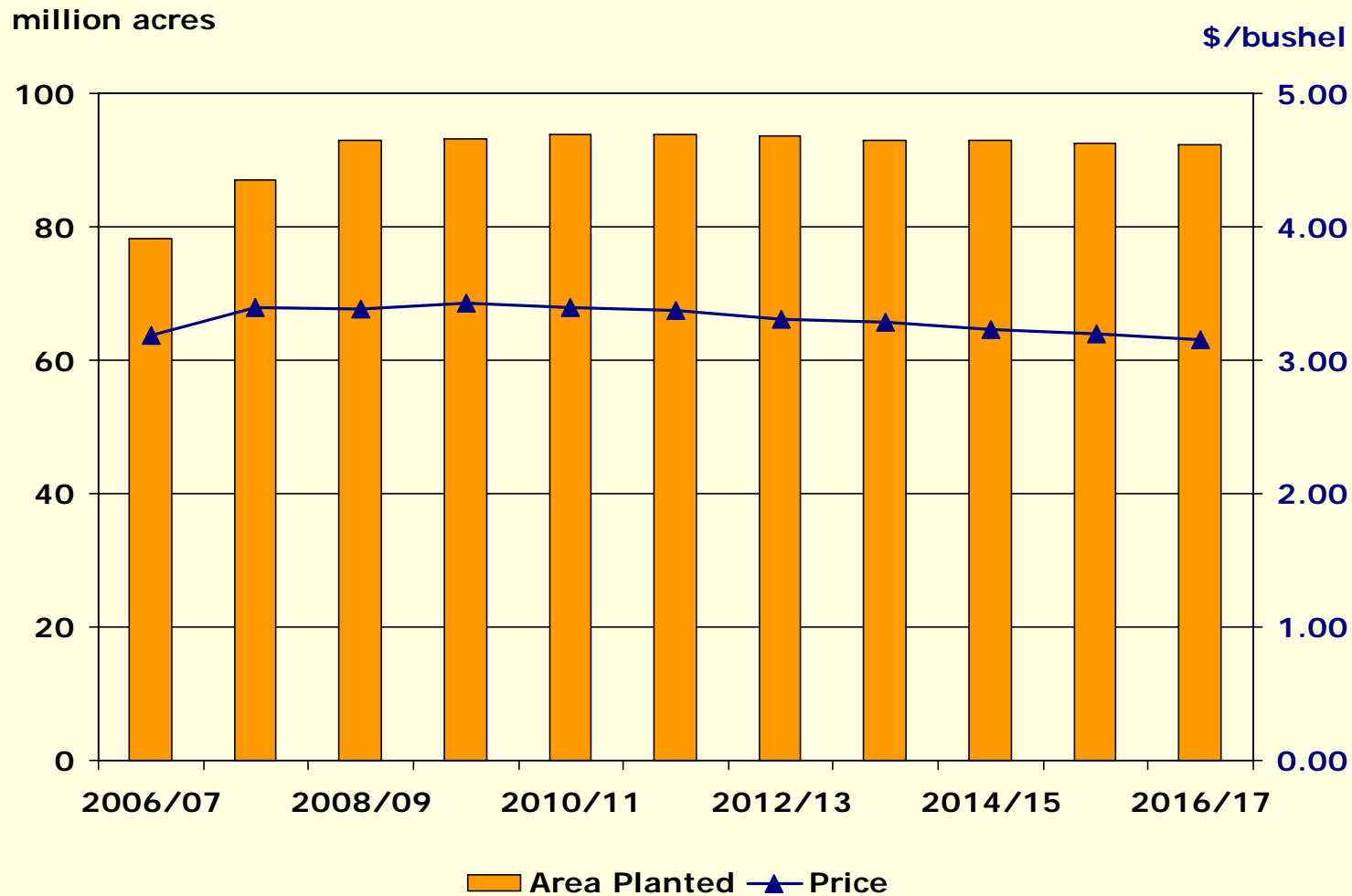
million gallons



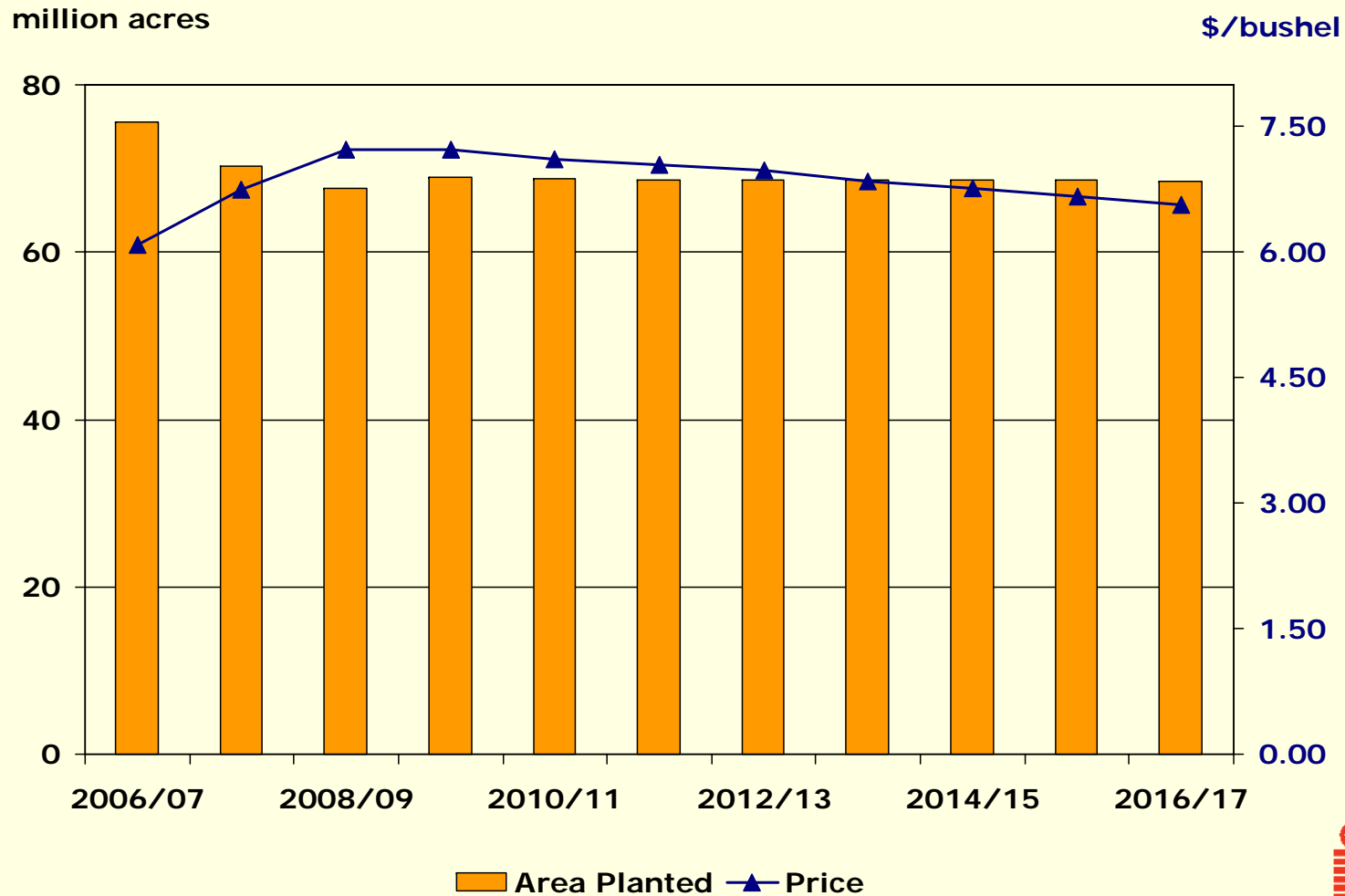
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# Projected Corn Planted Acreage



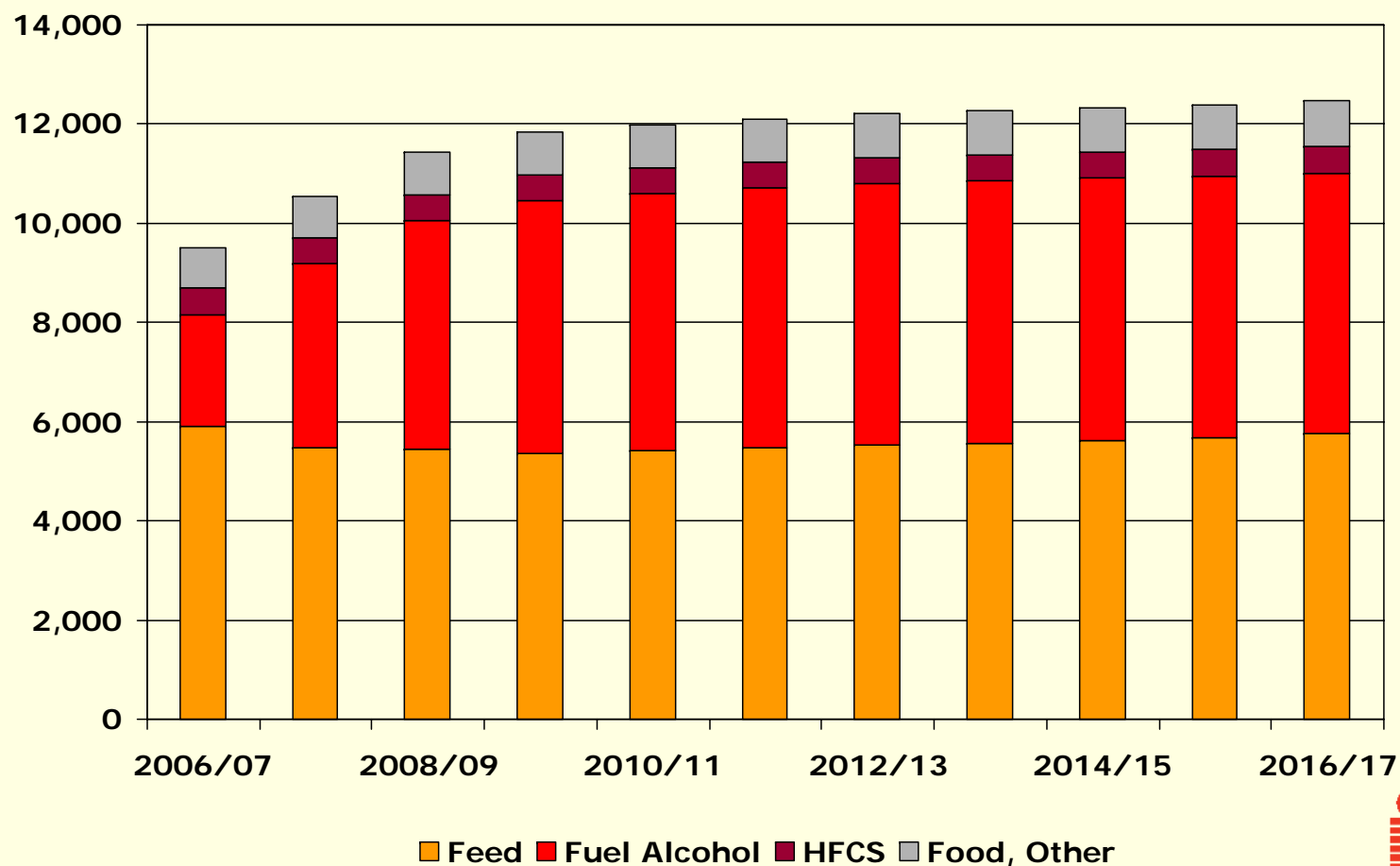
# Projected Soybean Planted Acreage





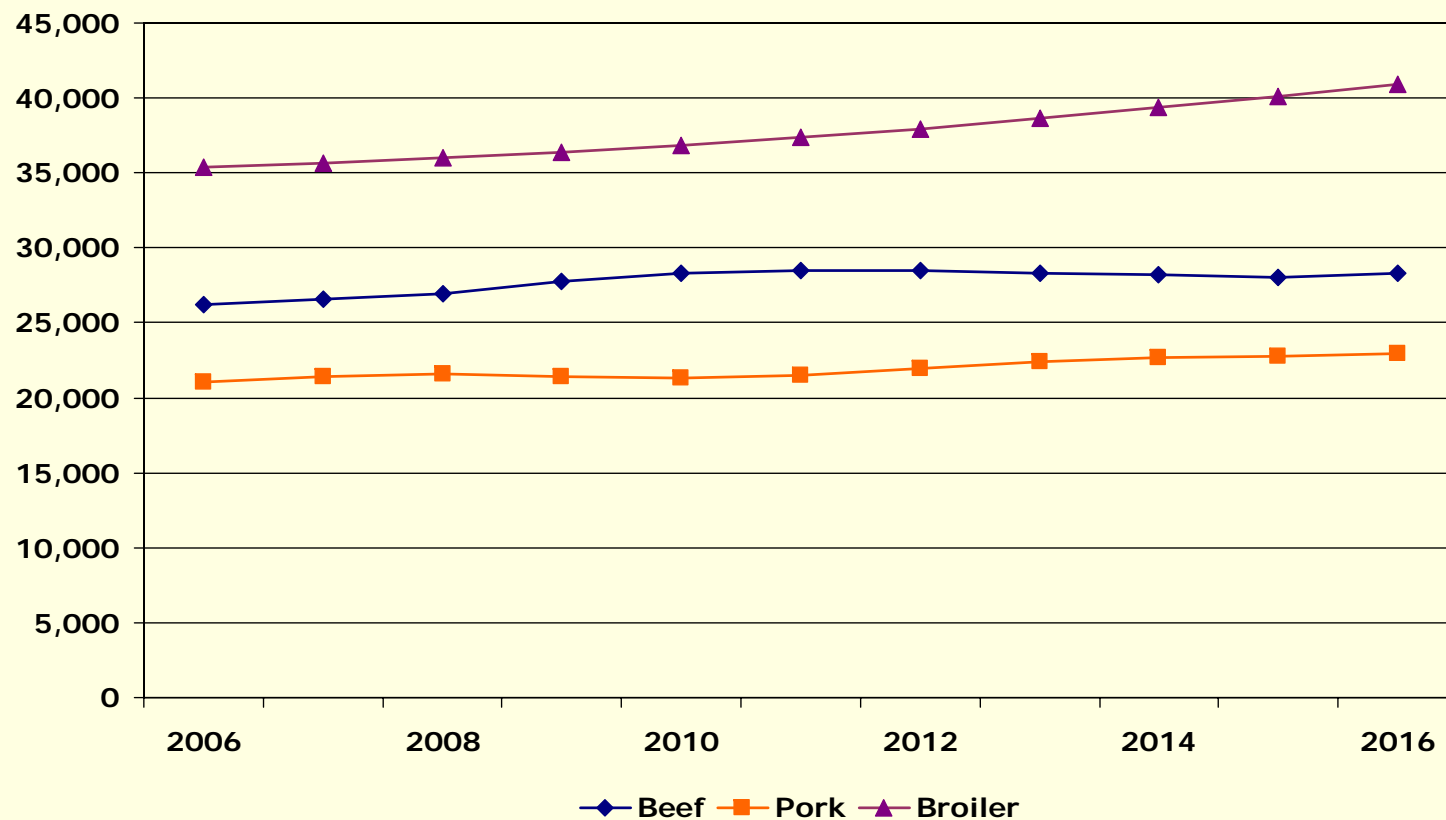
# Projected Utilization of Corn

million bushels



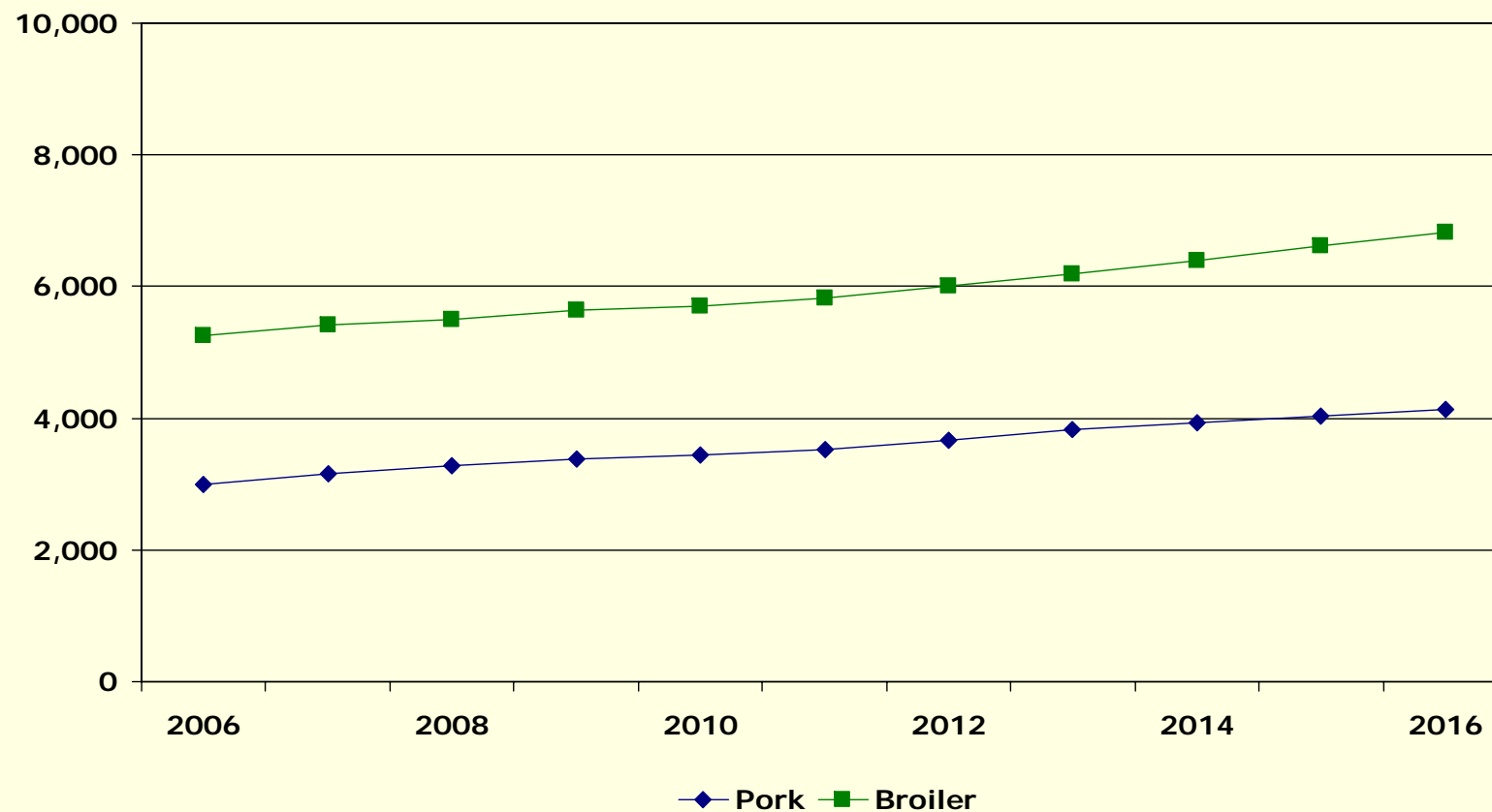
# Projected Livestock Production

million pounds



# Projected Livestock Exports

million pounds

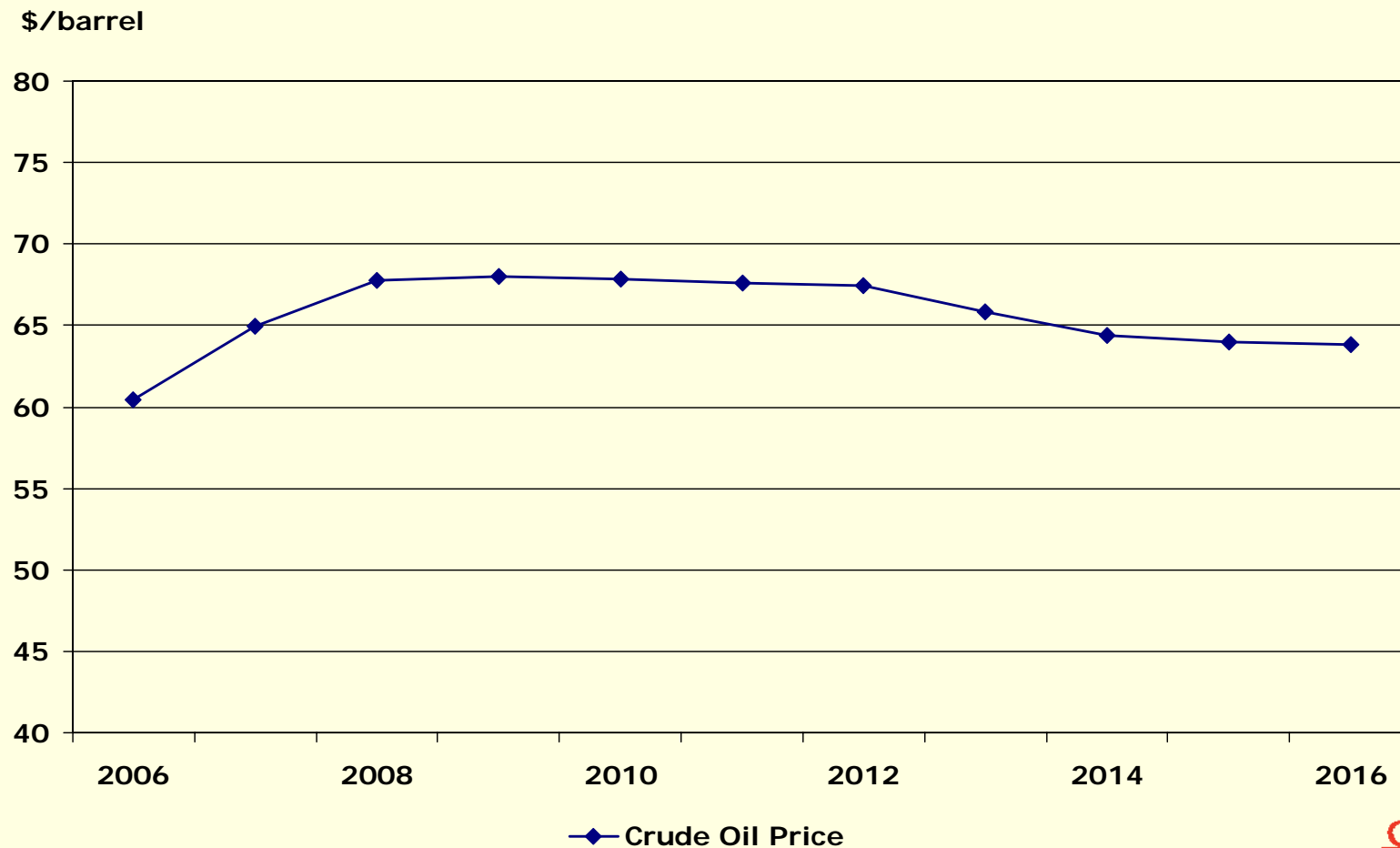


# Scenario Analysis

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- What if the crude oil price rises?
  - Increase the crude oil price by \$10 per barrel throughout the projection period
- Estimate the impact on the U.S. and world agricultural sector
- How sensitive is the agricultural sector the crude oil Price?
- We assume no bottleneck in the ethanol demand, i.e. enough flex-fuel vehicles sold to meet the production capacity
- Net profit margins of ethanol plants reach zero

# Projected Crude Oil Price



# Impacts of Higher Crude Oil Price

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- Profit margins on ethanol plants increase
- New incentive to invest in added capacity for ethanol production
- Eventually, a new equilibrium reached where there is no incentive to invest in or exit the ethanol industry
- Will demand for ethanol be enough?
  - E-10 market will saturate around 15 billion gallons
  - Drop in ethanol price will eventually encourage increase in demand by the flex-fuel vehicles

# Corn Market

	Baseline (2016)	Crude Oil Price Scenario	Percentage Change
Corn Price (\$/bushel)	3.16	4.42	39.9%
Corn Area (million acres)	92.4	112.7	22.0%
Corn Production (million bushels)	14,733	18,013	22.3%
Corn Use in Ethanol (million bushels)	5,013	10,819	115.8%
Corn Feed Use (million bushels)	5,7468	4,904	-91.5%
Corn Exports (million bushels)	2,458	935	-62.0%

# Ethanol and Distillers Grains Markets

	Baseline (2016)	Crude Oil Price Scenario	Percentage Change
Ethanol Production from Corn (million gallons)	14,807	29,632	100.1%
Ethanol Consumption (million gallons)	15,122	29,864	97.5%
Ethanol Wholesale Price (US\$/gallon)	1.58	1.92	21.5%
Ethanol Net Imports (million gallons)	315	338	7.3%
Distillers Grains Production (thousand tons)	39,929	87,678	119.6%
Distillers Grains Price (US\$/ton)	105.49	143.79	36.3%
Distillers Grains Domestic Use (thousand tons)	37,491	63,410	69.1%



# Soybean Market

	Baseline (2016)	Crude Oil Price Scenario	Percentage Change
Soybean Planted Area (million acres)	68.5	58.8	-14.2%
Soybean Production (million bushels)	3,051	2,585	-15.3%
Soybean Domestic Use (million bushels)	2,166	1,956	-9.7%
Soybean Exports (million bushels)	882	624	-29.3%
Soybean Price (US\$/bushel)	6.56	7.85	19.7%
Soybean Meal Price (US\$/ton)	158.6	185.6	17.02%
Soybean Meal Use (thousand tons)	38,822	34,672	-10.7%

# Livestock Market

	Baseline (2016)	Crude Oil Price Scenario	Percentage Change
Beef Production (million pounds)	28,295	27,500	-2.8%
Pork Production (million pounds)	22,920	21,855	-4.6%
Broiler Production (million pounds)	40,944	38,905	-5.0%
Turkey Production (million pounds)	6,275	6,090	-2.9%
Egg Production (million dozen)	8,257	8,144	-1.4%
Milk Production (million pounds)	204,112	202,726	-0.7%

# Livestock Market

	Baseline (2016)	Crude Oil Price Scenario	Percentage Change
Beef Retail Price (US\$/pound)	4.52	4.72	4.4%
Pork Retail Price (US\$/pound)	3.30	3.42	3.6%
Broiler Retail Price (US¢/pound)	196.01	204.13	4.1%
Turkey Retail Price (US¢/pound)	126.25	135.57	7.4%
Egg Retail Price (US¢/dozen)	162.96	175.32	7.6%
Milk Retail Price (US\$/cwt)	14.64	18.04	23.2%

# Impact on Rest of the World

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- World grain and oilseed prices increase
- This translates into higher feed prices
- Higher feed prices mean higher livestock production costs
- Food prices in the U.S. and the world increase
- Countries in South America and Asia fill the gap in the demand for corn and soybeans by higher production

# Impact of Short Crop Scenario

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- We introduce a drought in 2012, similar to 1988 U.S. drought
  - Regional yields of corn, soybeans, wheat and barley change from trend levels
  - Yields fall by 25% for corn, 18% for soybeans, 11% for wheat and 30 % for barley
- Ethanol mandate for 2012-onwards assumed to be 14.7 billion gallons

# Corn, Soybean and Ethanol Markets

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- Corn price increases by 44% above baseline levels
- Soybean price rises by 22%
- Corn exports and stock levels decline by more than 60%
- Corn exports from South America, China, etc. fill part of the gap from decline in U.S. corn and soybean exports
- Corn feed use declines by 16%
- Ethanol net imports increase moderately

# Livestock Market

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- Higher feed costs affect the livestock sector, but to a lesser extent as the shock is perceived as temporary
  - Production declines
    - Broiler production declines the most (over 2.7%)
    - Milk production declines the least (0.5%)
    - Decline for beef, pork and turkey ranges between 1.3% and 2.4%
  - Retail prices increase
    - Egg prices increase the most (about 5.4%)
    - Prices of other products increase by a range between 2% and 4%

# Conclusions

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- Crude oil price increase expands the U.S. ethanol sector's production capacity, but the final impact depends on the vehicle fleet's ability in the U.S. to absorb the production and therefore the relative price of ethanol to gasoline
  - We have “no bottleneck” and “bottleneck” crude oil price shock scenarios.
- A drought with an ethanol mandate will keep the ethanol demand from falling, therefore other sectors will adjust to a short-crop situation



Thank you!