



The Rapidly Growing Biofuels Industry –  
*How Will It Affect Animal Agriculture?*

Bryan I. Fancher, Ph.D.  
Vice-President  
Global Technical Operations



# Agenda

- Biofuels – definition
- Basis of industry momentum
- Size of the industry
- Production processes involved
- Biofuels co-products – nutritional considerations
- Implications for the animal feeding industry



# Biofuels – Definition

## Ethanol

- EtOH, ethyl alcohol, grain alcohol
  - majority from fermenting cereal grains or sugar cane
  - cellulosic biomass materials - *bioethanol*

Sugar (glucose, fructose, or sucrose) → Alcohol (ethanol) + Carbon Dioxide + Energy (ATP)



# Biofuels – Definition

## Biodiesel

- Fats/oils chemically reacted with methanol and catalyst (KOH or NaOH)
- Oil molecules (triglycerides) broken apart and reformed into methyl esters and glycerol
  - New or used vegetable oils and animal fats
    - Soya, canola, palm oils
    - Animal fats
    - Algae



# Basis of Industry Momentum

- Energy Tax Act (1978)
  - Exemption of federal gasoline excise tax for **10%** blended gasoline (gasohol)
    - Effective subsidy of \$0.40/gallon (\$0.10/liter) EtOH
  - Alternative Blenders Credit (1980)
    - Subsidy extended to other blends including **E-85 (85% EtOH)**



# Basis of Industry Momentum

- Clean Air Act Amendments (1990)
  - Tetraethyl lead additive banned
  - Oxygenated fuels mandated
    - Methyl Tertiary Butyl Ether (**MTBE**)
      - oxygenate compound; increases octane rating
      - enhances engine performance & efficiency
      - reduces emissions of air pollutants
      - **Water pollutant**
        - H<sub>2</sub>O soluble
        - detected in groundwater in many communities
        - affects drinking water taste & smell
      - **Possible carcinogen** (EPA)



# Basis of Industry Momentum

## Biodiesel and Ethanol Volumetric Ethanol Excise Credit (2004)

- \$.51/pure gallon (\$0.13/liter) of EtOH blended
- Incentive available until 2010
- Biodiesel tax credit
  - \$1.00/gallon (\$0.26/liter) - virgin oil
  - \$0.50/gallon (\$0.13/liter) - recycled oil



# Basis of Industry Momentum

## Energy Policy Act (2005)

- Nationwide renewable fuels standard (RFS)
  - 2X use of EtOH & biodiesel by 2012
  - Extended tax credit for biodiesel producers through 2008

Year	Renewable Fuels (billions of gallons)
2006	4.0
2007	4.7
2008	5.4
2009	6.1
2010	6.8
2011	7.4
2012	7.5



# Basis of Industry Momentum

## USA tariff on EtOH imports

- Regular duty of **2.5% *ad valorem***
- Secondary duty of **\$0.54/gallon EtOH**



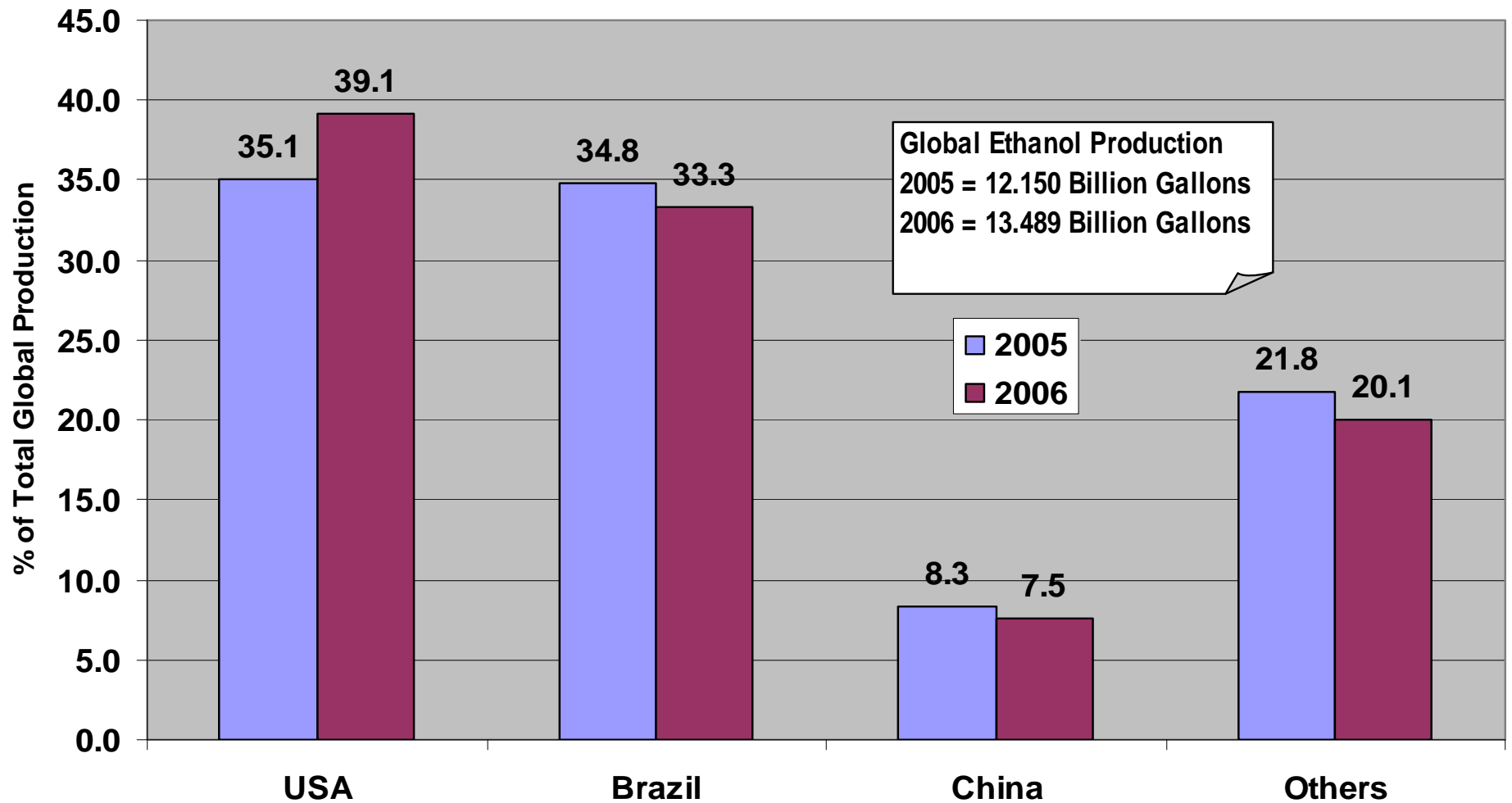
# Basis of Industry Momentum

## Light Crude Oil (CL, NYMEX) Monthly Price Chart



# Size of Industry



2005 Global Ethanol (All Grades) Production by Country - Renewable Fuels Association (RFA)



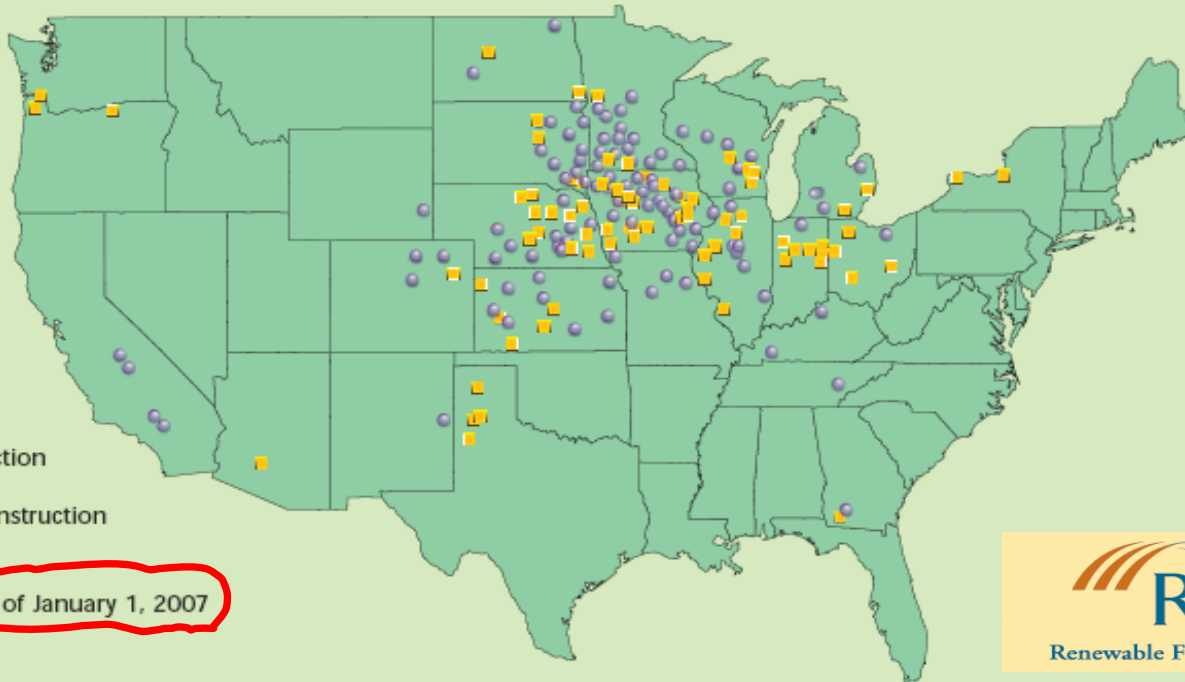
# Size of Industry

## U.S. Ethanol Biorefinery Locations

Dry mill production = 82%  
 Wet mill production = 18%

-  Biorefineries in production
-  Biorefineries under construction

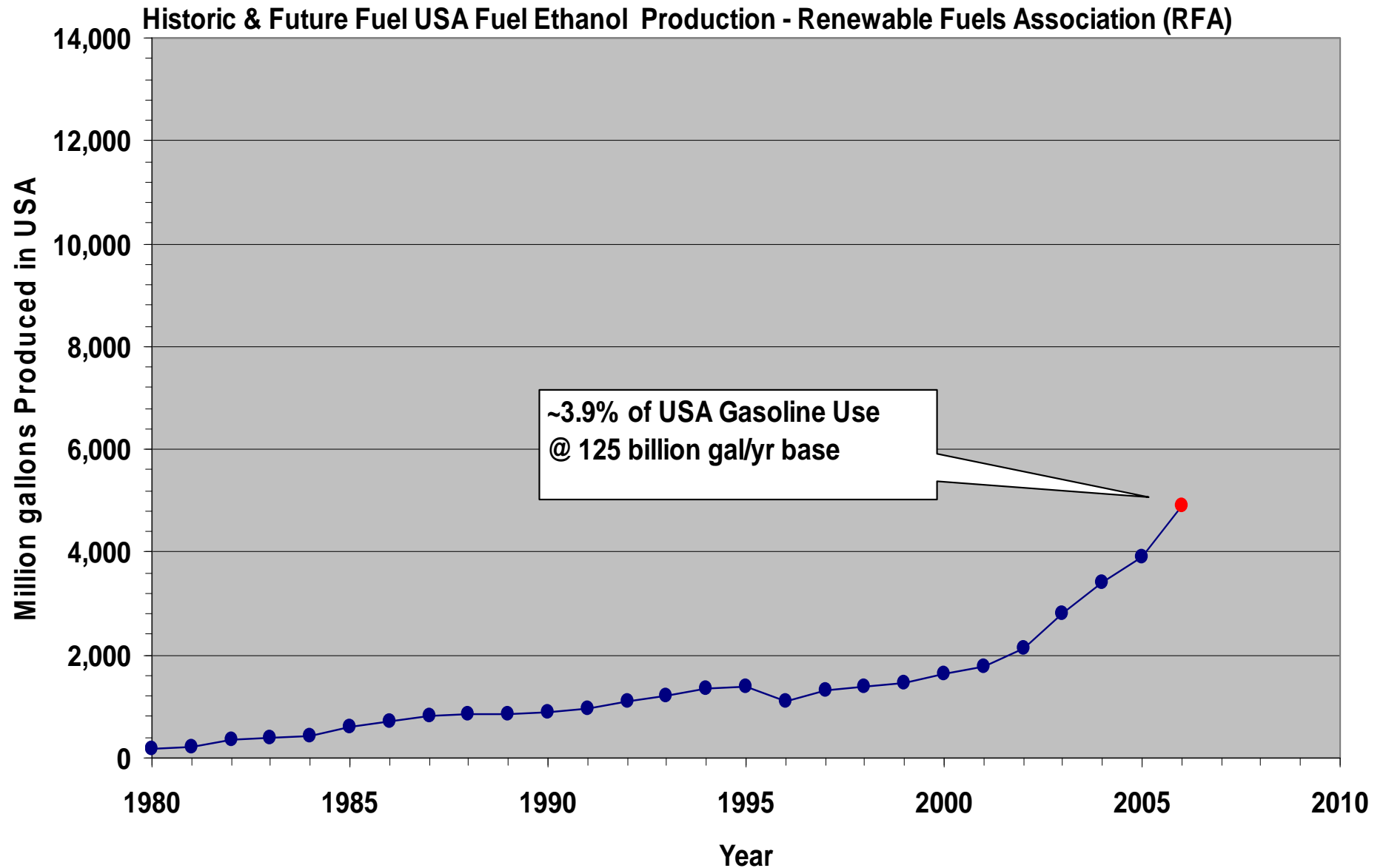
# of biorefineries: 110 as of January 1, 2007



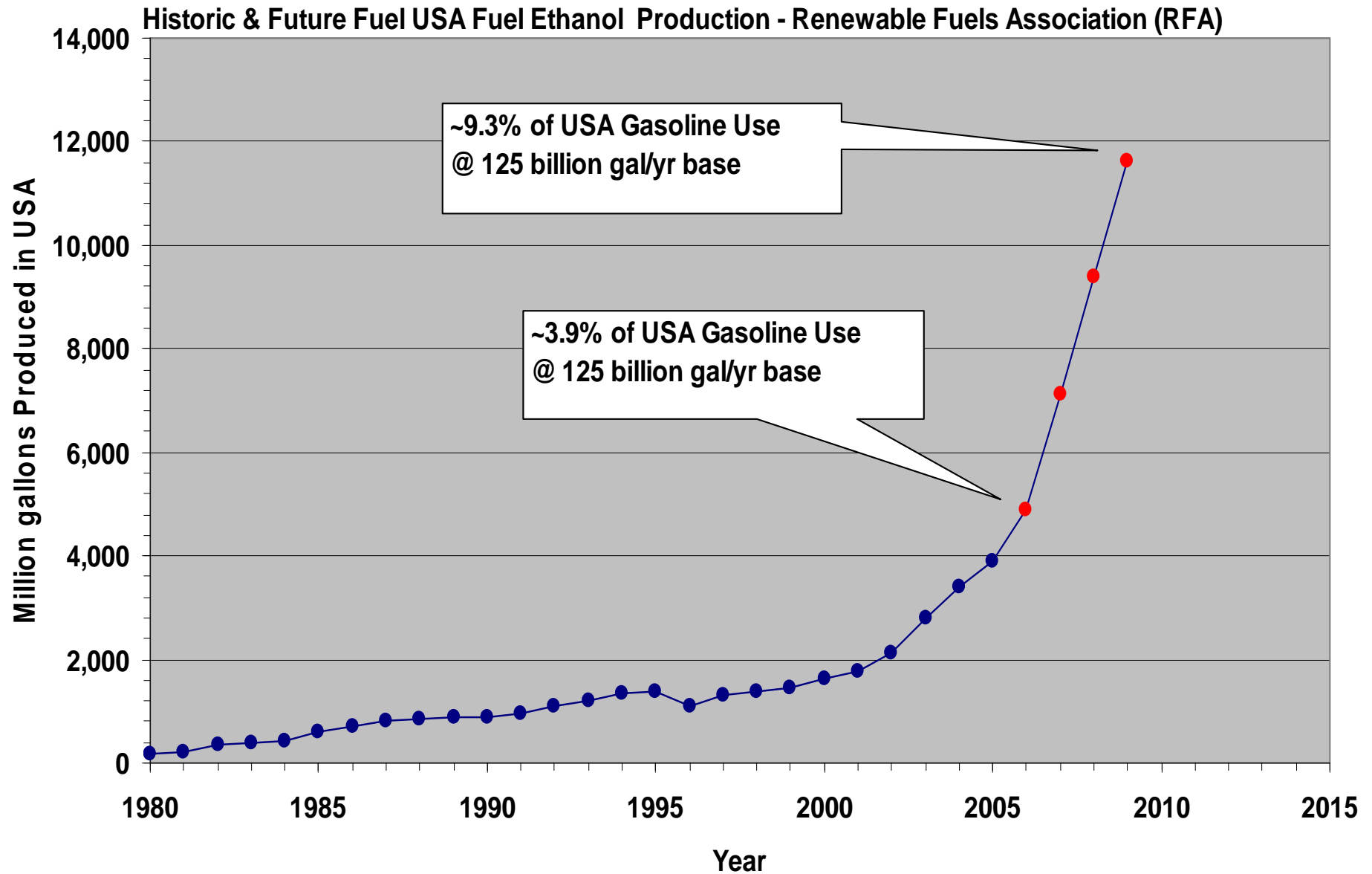
	Jan 2000	Jan 2001	Jan 2002	Jan 2003	Jan 2004	Jan 2005	Jan 2006	Jan 2007
Biorefineries Online	54	56	61	68	72	81	95	110
Capacity (mgy)	1748.7	1921.9	2347.3	2706.8	3100.8	3643.7	4336.4	5493.4



# Size of Industry



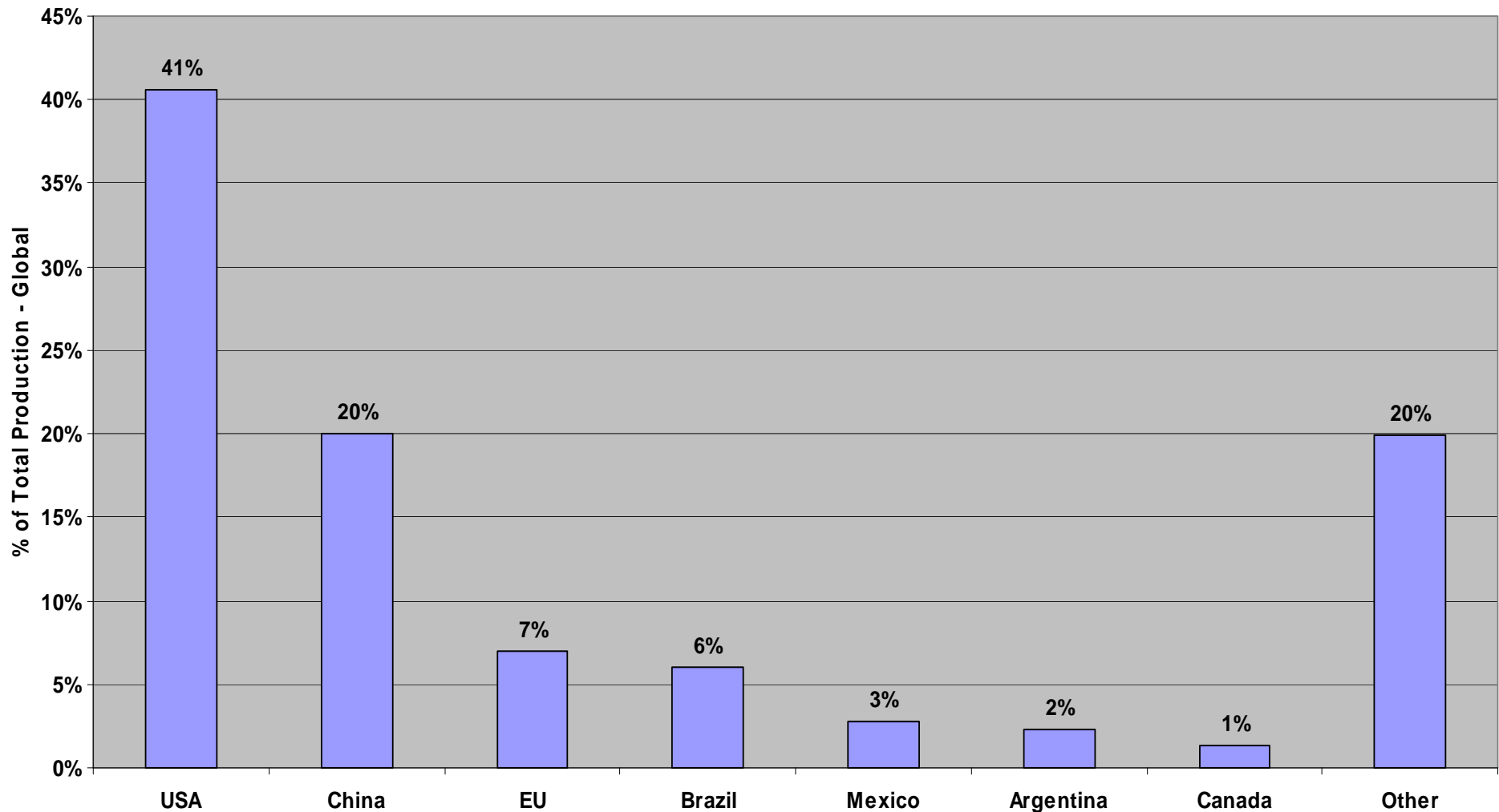
# Size of Industry



# Size of Industry

## Major corn producing countries

Country Specific Contribution to Global Corn Production (695,196,000 Metric Tonnes total)



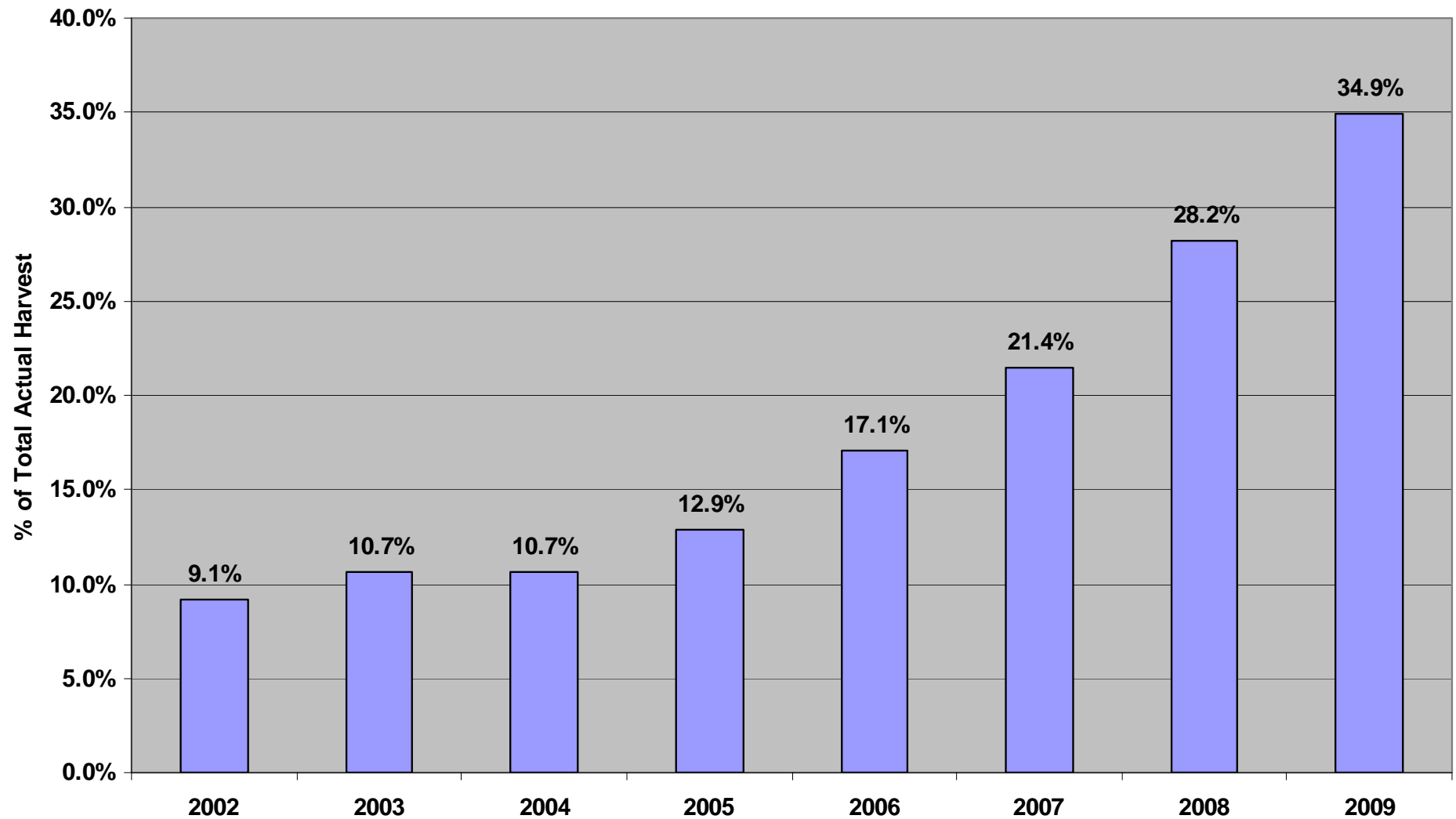
# Size of Industry

- Use of corn in USA for EtOH
  - 2002-2006 actual harvest and EtOH produced
  - 2007-2009 projections
    - Acreage planted **+15%**
    - Yield (**150 bushels/acre; 3.811 tonnes/acre**)
      - Avg 2002-2006 - 145.8 bushels/acre
    - Biorefinery capacity expansion through Jan 2009
    - Yield **2.72** gallon EtOH/bushel corn (**0.4** liters/kg)



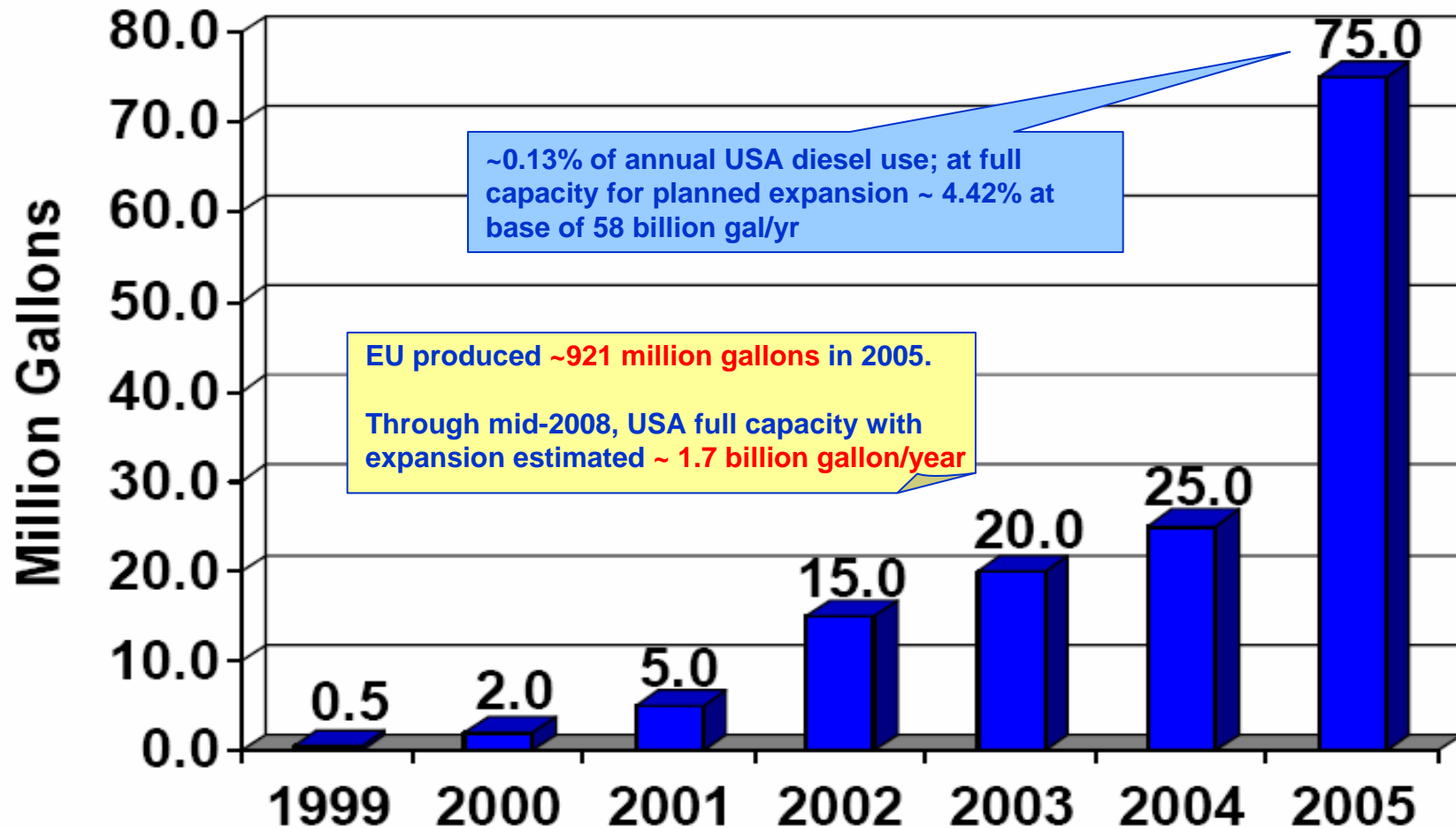
# Size of Industry

Amount of USA Corn Harvest Used for Ethanol Production



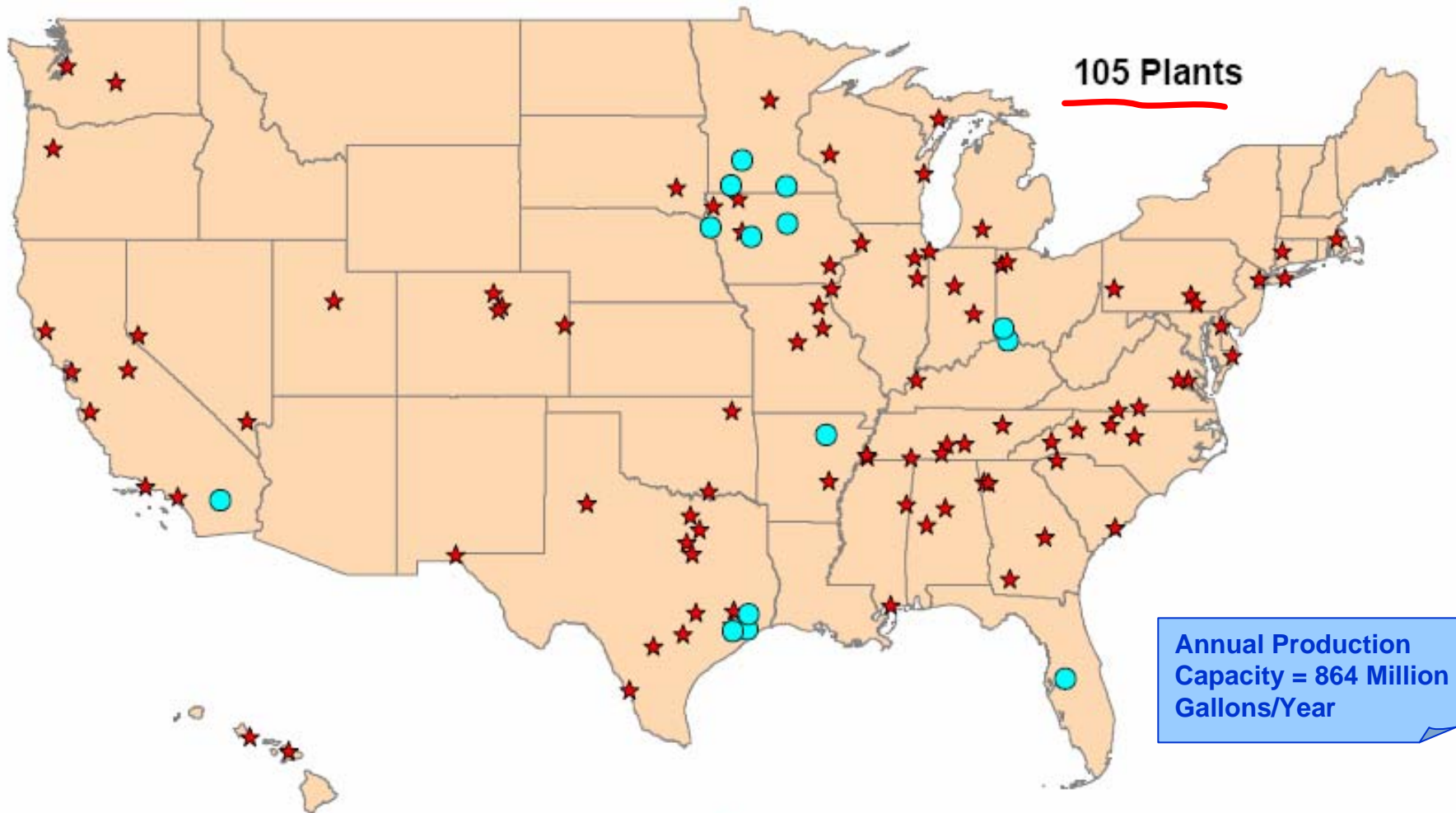
# Size of Industry

## Estimated US Biodiesel Production



# Size of Industry

Commercial Biodiesel Production Plants (January 31, 2007)



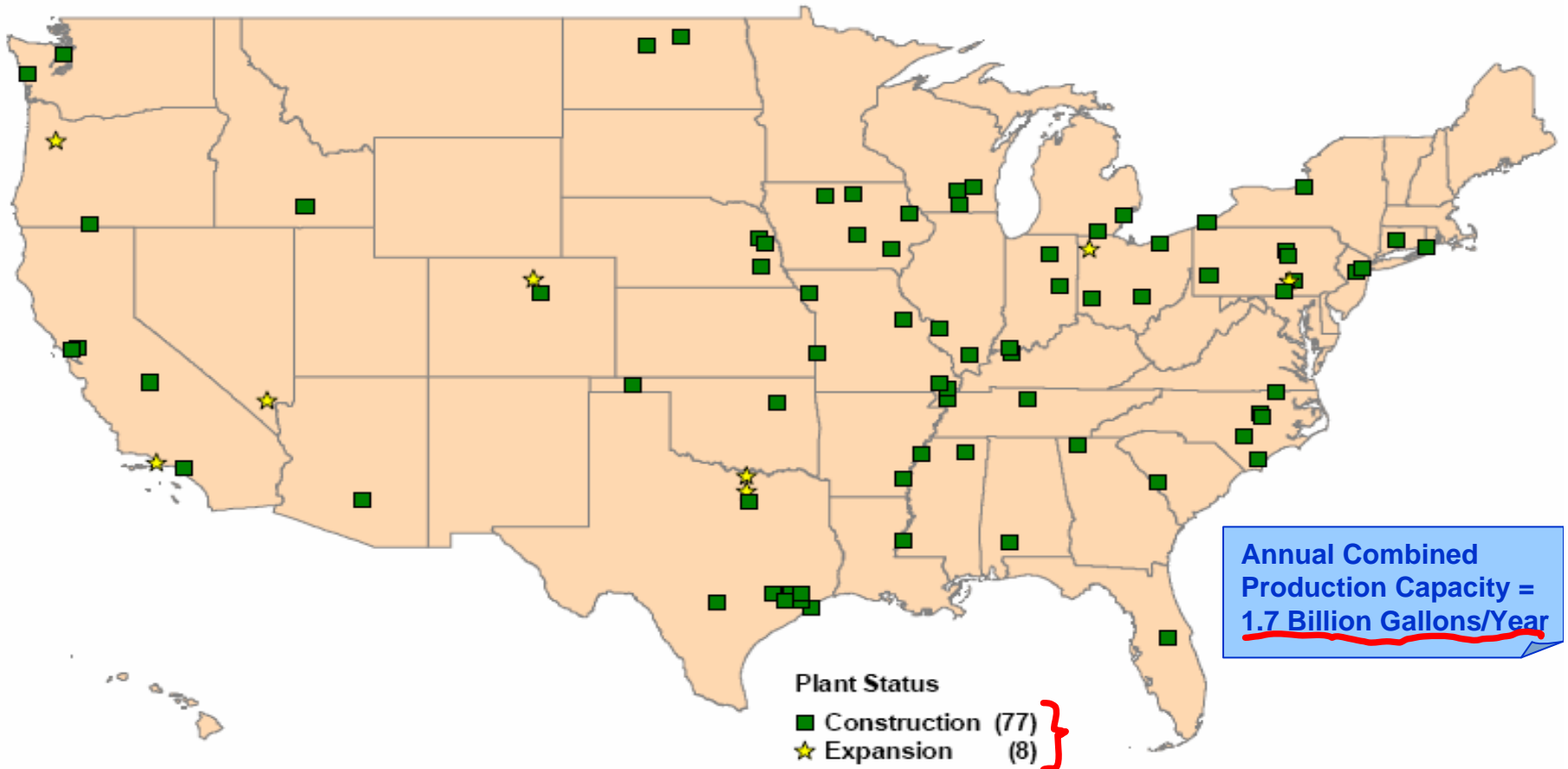
Annual Production Capacity = 864 Million Gallons/Year

● BQ-9000 Accredited Producers

# Size of Industry



Biodiesel Production Plants Under Construction or Expansion (January 1, 2007)



# Production Processes Involved

## *Process Yield Values*

- **Corn EtOH Production**
  - Yield values – per weight unit of corn
    - **EtOH ~ 33%**
    - DDGS ~ 33%
    - CO<sub>2</sub> ~ 33%
- **Biodiesel Production (from soya oil)**
  - Yield values – per weight unit of soybeans
    - **Biodiesel ~ 17%**
    - Glycerin by-product ~ 2%
    - Soybean meal ~ 80%

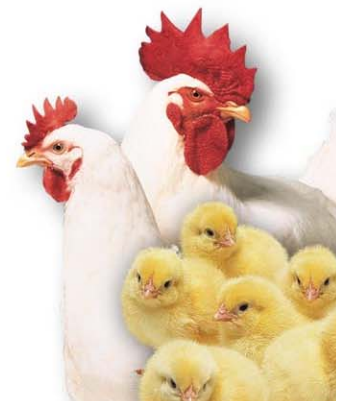


# Production Processes Involved

Starch content and ethanol yield of various feedstocks

Feedstock	Moisture (%)	Starch (%)	Ethanol Yield (L/MT)
Starch	-	100.0	720
Sugar cane	-	-	654
Barley	9.7	67.1	399
Corn	13.8	71.8	408
Oats	10.9	44.7	262
Wheat	10.9	63.8	375

Source: Saskatchewan Agriculture and Food (1993)



# Production Processes Involved

- EtOH (corn) Net Energy Balance (NEB) ~ 25%
  - Majority from credit of DDGS
- Biodiesel NEB ~ 93%
  - Per unit of energy gained - only ~ 1% of N, 8% of P and 13% of pesticide (by weight) used for corn EtOH
  - Reduces GHG by 41% (corn EtOH 12%)
  - Diesel engines ~ 30% more efficient than gasoline engines



# Production Processes Involved Co-Products

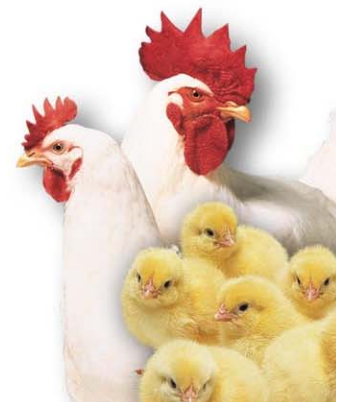
- Ethanol
  - Distillers Dried Grains (DDG)
  - Condensed Distillers Solubles (S)
  - Distillers Dried Grains with Solubles (DDGS)
- Biodiesel
  - Glycerin by-product



# Biofuels Co-products – Nutritional Considerations

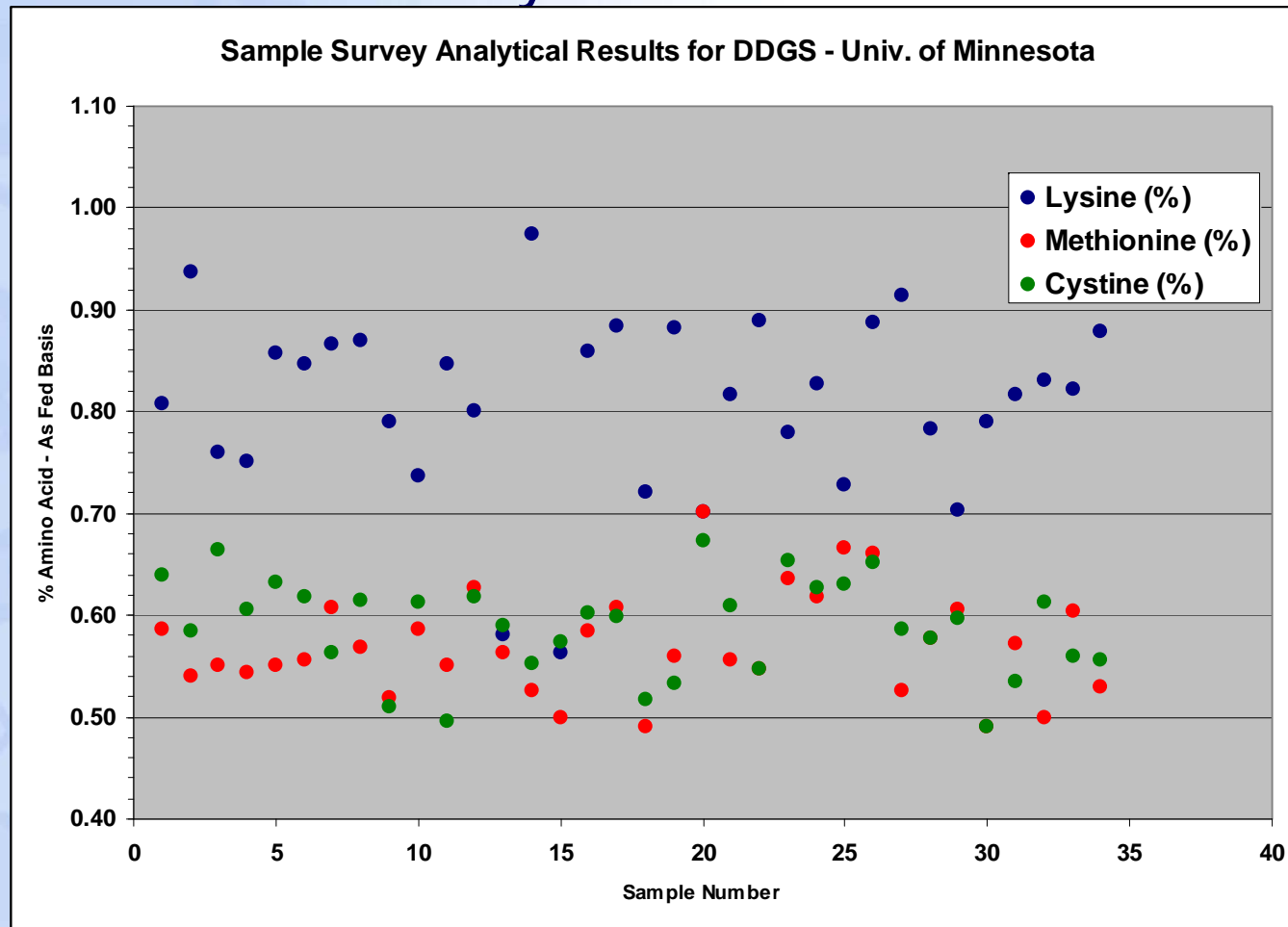
## 3 key factors affecting DDGS nutrient content:

- Variation in nutrient content of corn/grain delivered to EtOH plant
- Variations in mixture ratio of components of DDGS
- Drying time and temperature



# Biofuels Co-products – Nutritional Considerations

## Variation in key nutrient content - DDGS

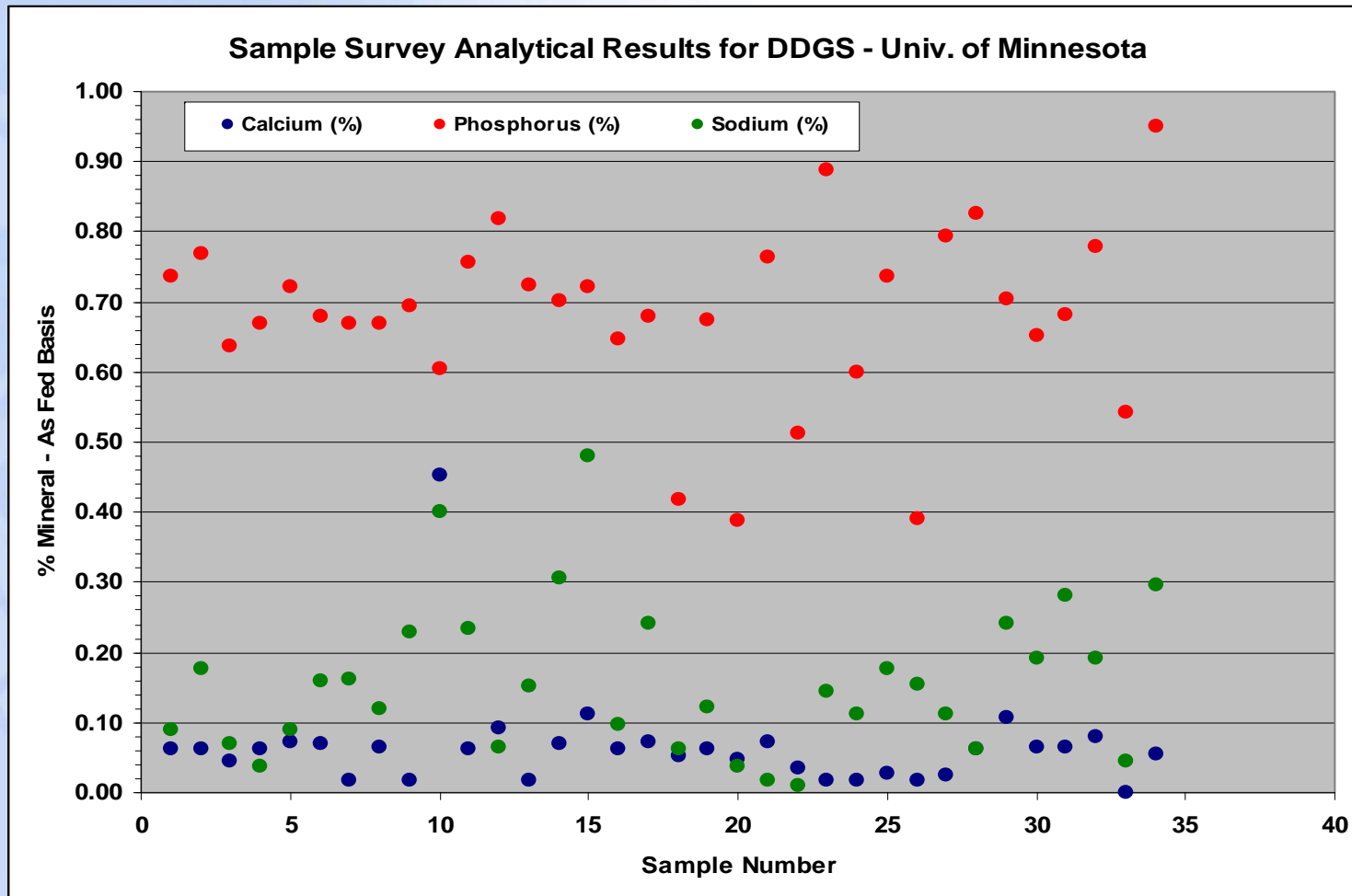


Statistic	Lysine (%)	Methionine (%)	Cystine (%)
Average	0.81	0.57	0.59
Standard Deviation	0.09	0.05	0.05
CV%	11.00	8.94	8.10

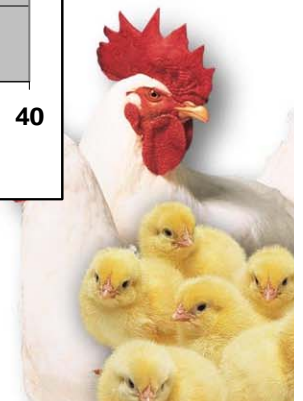


# Biofuels Co-products – Nutritional Considerations

## Variation in key nutrient content - DDGS



Statistic	Calcium (%)	Phosphorus (%)	Sodium (%)
Average	0.07	0.68	0.16
Standard Deviation	0.07	0.12	0.11
CV%	112.69	18.31	68.60



# Biofuels Co-products – Nutritional Considerations

## DDG/DDGS – *Practical Feeding Advice*

- **Know what you are buying** – keep current with analytics
  - mycotoxins
- ME likely higher than NRC (1994)
- Safe upper levels of inclusion
  - Broiler starter - 6%
  - Other broiler diets - 15%
    - 25% if formulating on iso-caloric basis (Waldroup et al., 1981)
  - Chicken Layers – 15%



# Biofuels Co-products – Nutritional Considerations

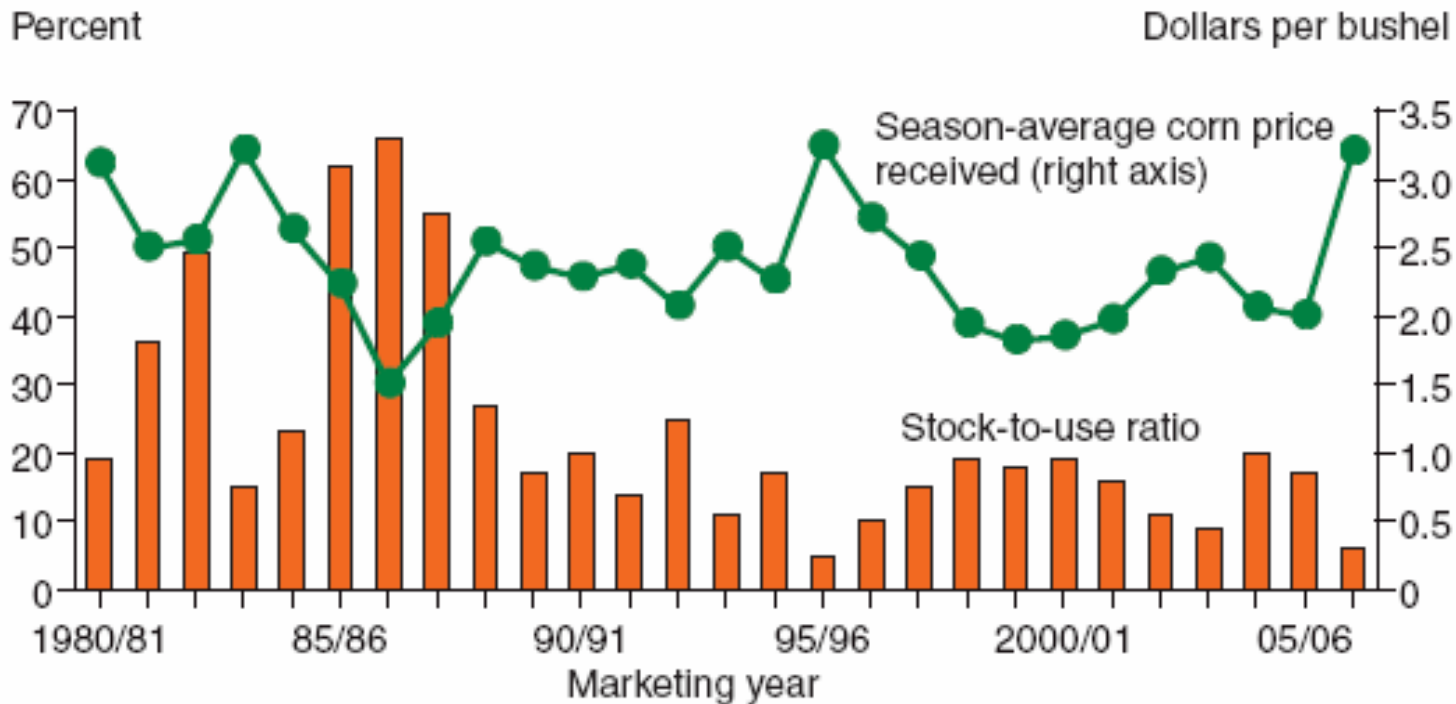
- Biodiesel
  - Glycerin by-product (GBP)
    - Research shows good feeding value in cattle, swine and poultry
    - Feeding value for broilers recently published
      - *Cerrate et al. 2006. Evaluation of glycerin from biodiesel production as a feed ingredient for broilers. Intl. Journal of Poultry Science 5 (11): 1001-1007.*
      - Energy value used **3527 kcal ME/kg**
        - Pure glycerin = 4320 kcal/kg
      - Up to 5% of the diet no negative effect on growth or FCR
      - Breast yield improved with 2.5 or 5% added GBP



# Implications for the Animal Feeding Industry

- Higher and more volatile commodity prices

U.S. corn price and stocks-to-use ratio



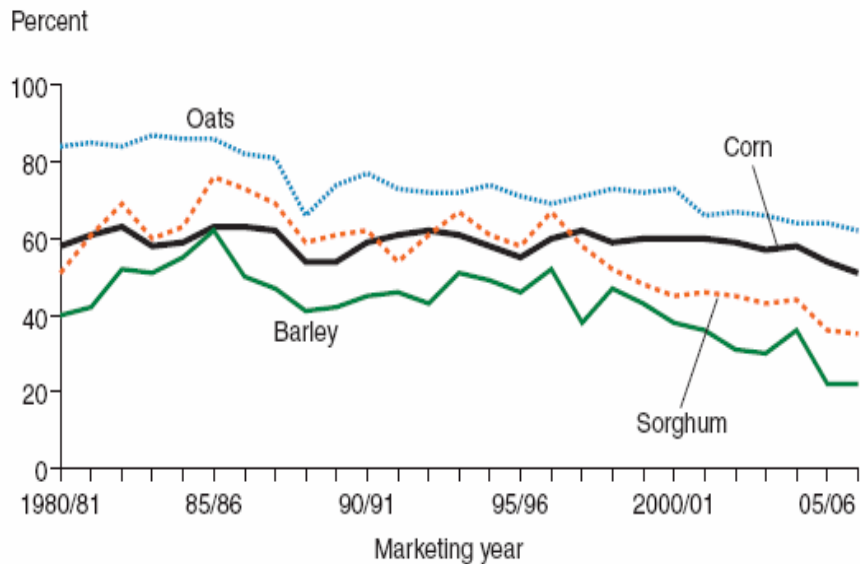
Source: USDA, Economic Research Service, *Feed Grains Database*  
at [www.ers.usda.gov/data/feedgrains/](http://www.ers.usda.gov/data/feedgrains/)



# Implications for the Animal Feeding Industry

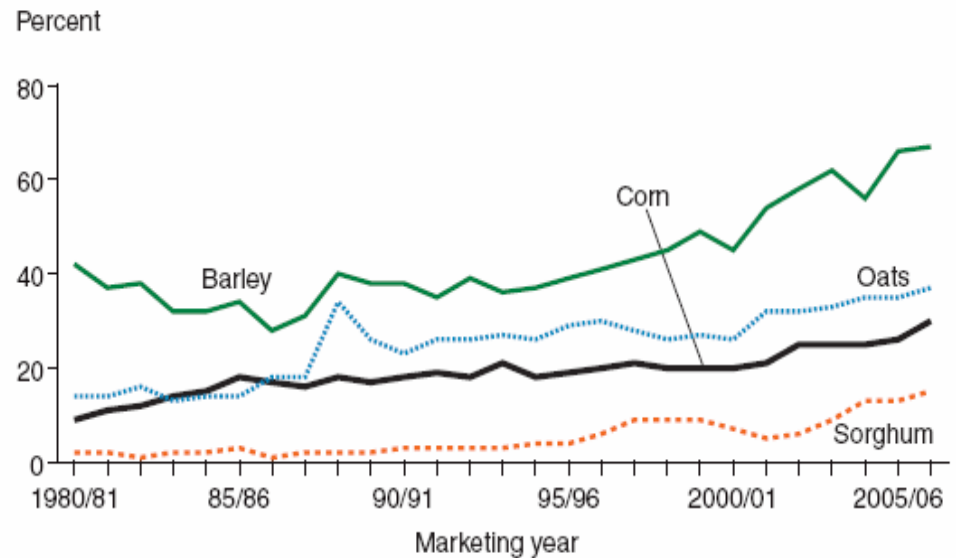
- Feed use of USA feed grains expected to decline somewhat over the next several years due to higher grain prices

Proportion of feed and residual use to total use, by type of feed grain



Source: USDA, Economic Research Service, *Feed Grains Database* at [www.ers.usda.gov/data/feedgrains/](http://www.ers.usda.gov/data/feedgrains/)

Proportion of food, seed, and industrial use to total use, by type of feed grain



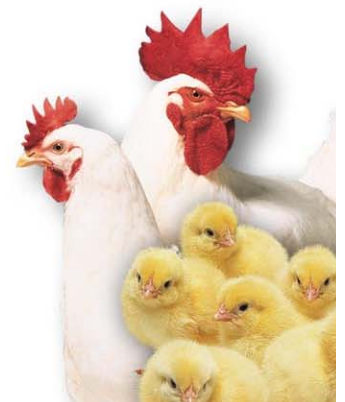
Source: USDA, Economic Research Service, *Feed Grains Database* at [www.ers.usda.gov/data/feedgrains/](http://www.ers.usda.gov/data/feedgrains/)



# Implications for the Animal Feeding Industry

USDA Economic Research Service:

- Returns to USA meat & poultry production expected to decline in next several years
  - Reducing pork and beef production and slowing gains for poultry
- Exports of corn expected to rise slightly in 2006/07 crop year as global clients continue to purchase despite higher prices
  - Continued high prices expected to cause U.S. exports to decline over next several years
- Corn planting going up taking soya planting down
  - Higher soya prices



# Implications for the Animal Feeding Industry

## Continued Growth of Fuel EtOH – *Influencers?*

- Oil \$
- EtOH \$
- Feed stock \$
- Technology changes
  - USA sustainable 60BGY bioethanol
- Government incentives and policy changes
- Oxygenate competitor(s)



# Implications for the Animal Feeding Industry

## *Bottom line...*

- As long as corn is primary feedstock for EtOH in USA, sustained increases in EtOH production will drive price adjustments in the corn market



