Impact of U.S. Ethanol Fuel Policy on Feed & Food Prices

AMI Foundation 2008 Environmental Conference,
June 5-6, 2008 Kansas City

Ron Plain, Ph.D.
D. Howard Doane Professor
Dept of Agricultural Economics
University of Missouri-Columbia
http://web.missouri.edu/~rplain

Change is inevitable…..

Except from a vending machine.

Summary

The key economic force today is raising energy prices

- **Higher energy prices make ethanol more valuable**
- **Higher ethanol prices means more corn is processed into ethanol and less is fed to livestock and people**
- **High corn prices mean more corn acres and fewer acres of other crops**

Outline

- **Basics of ethanol production**
  - Cellulosic
  - Grain
- Overview of U.S. policy
  - Subsidies
  - Mandates
  - Tariff
- Economics of ethanol
- Impact of ethanol policy

Basics of Ethanol Production

- Ethanol is an alcohol made by fermenting grain and other carbohydrates
- This is an old process which traditionally has been used to produce ethanol for use as a beverage
- 97% of U.S. ethanol is made from corn
- Rest: milo, wheat, brewery waste, whey, etc
- <0.01% made from cellulose

Cellulosic Ethanol

- Cellulose is a long chain polymeric polysaccharide of beta glucose: $(C_6H_{12}O_5)_n$
- Cellulose is the chief constituent of the cell walls of all plants.

  Cotton in its raw state contains about 91% and is the purest form of natural cellulose. Other sources include hemp (77%), softwoods & hardwoods (57% to 65%).

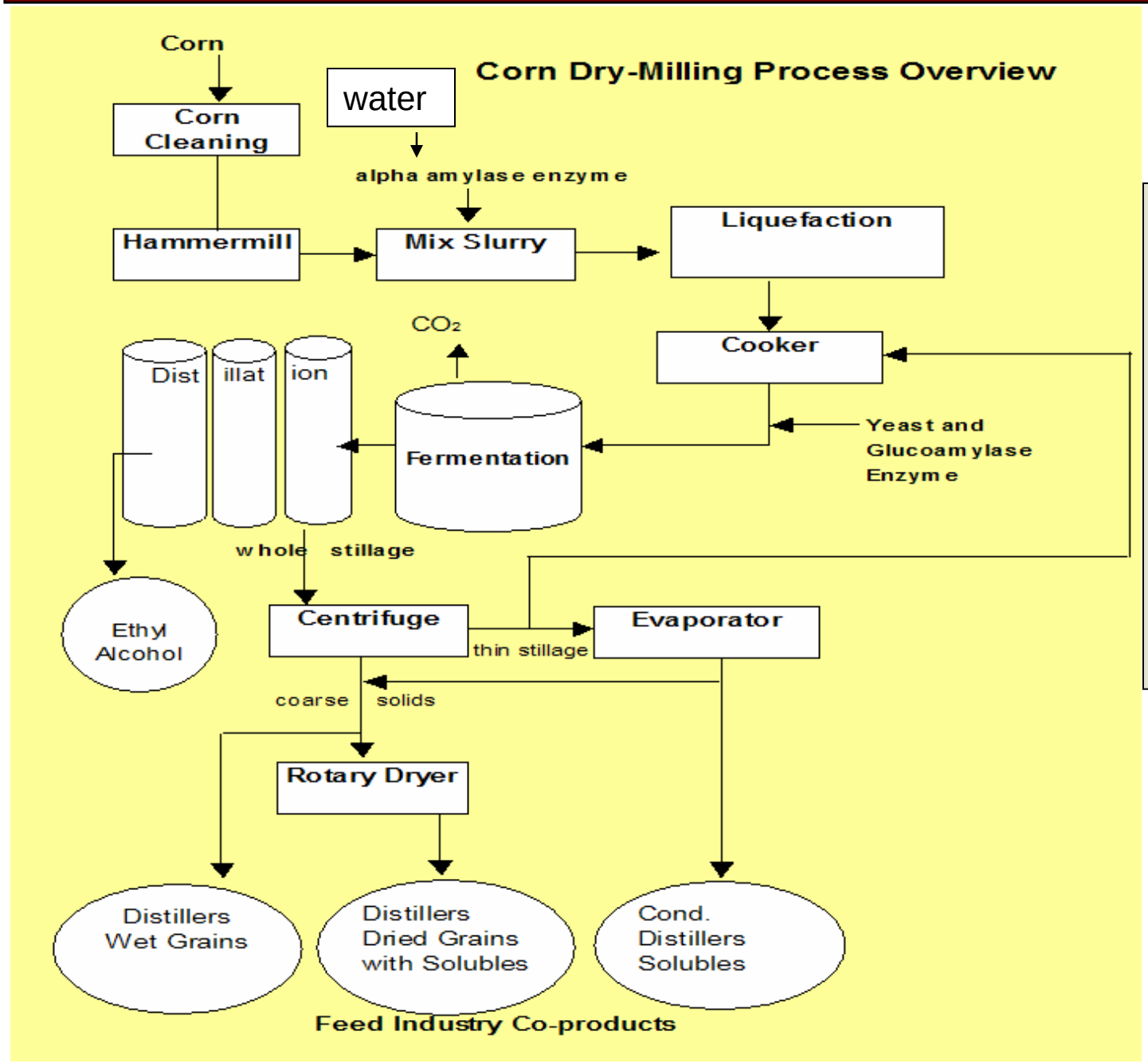
Cellulosic Ethanol

- Cellulosic ethanol is ethanol made from cellulose. It is the same as grain ethanol: C_2H_5OH. The only difference is the source material.
- The interest in cellulosic ethanol comes from the huge supply of low-value source material:
  - Wood – trees, limbs, paper, cardboard
  - Grass - switchgrass, corn stalks, straw, fescue
  - Distillers Grains

Cellulosic Ethanol

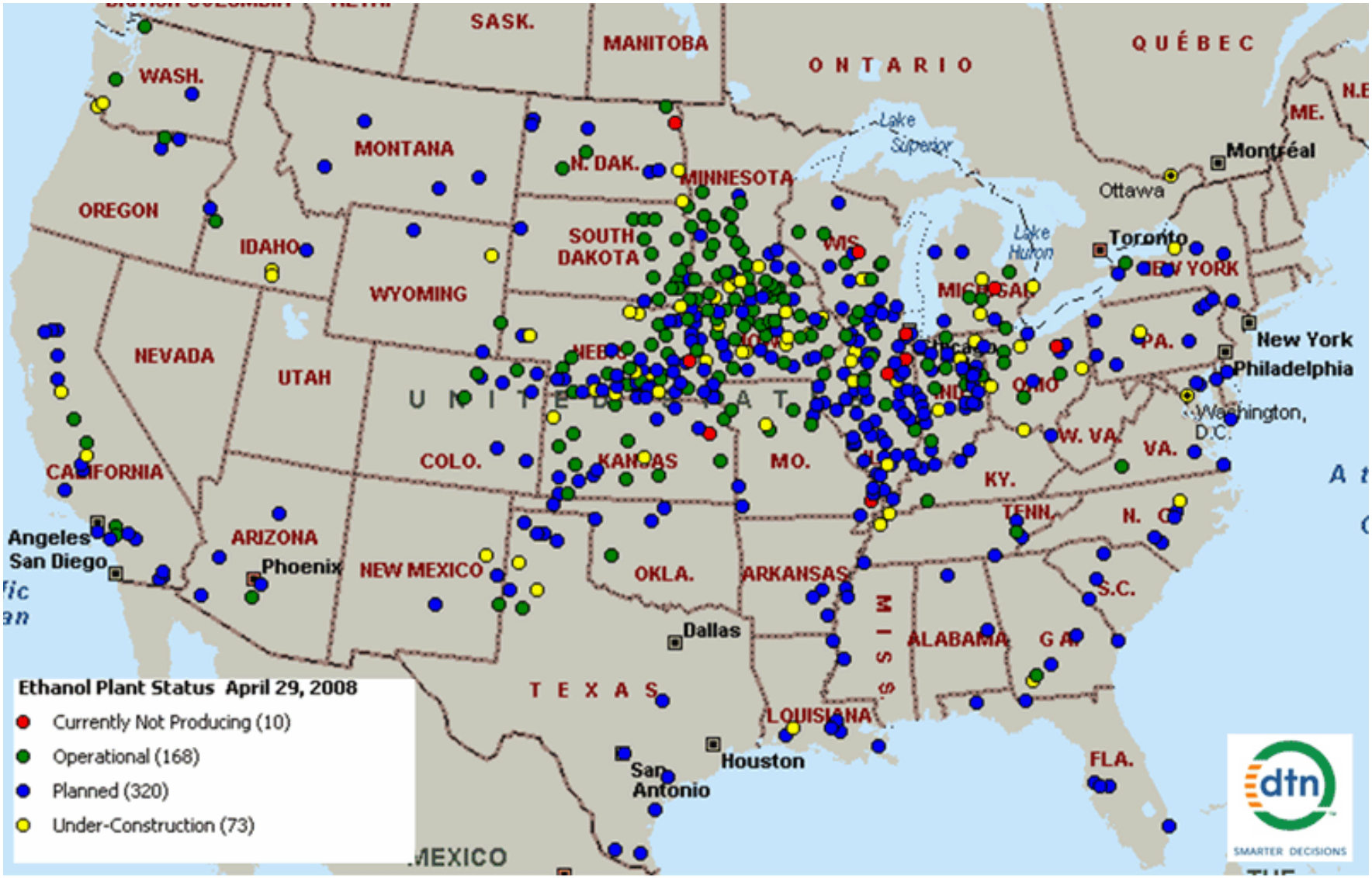
- Producing ethanol from cellulose is something we've known how to do for over 100 years
- Doing it in a cost-competitive manner is something we have yet to learn
- However, there are many people seeking research grants who claim to be close to solving the cost problem

Grain Ethanol



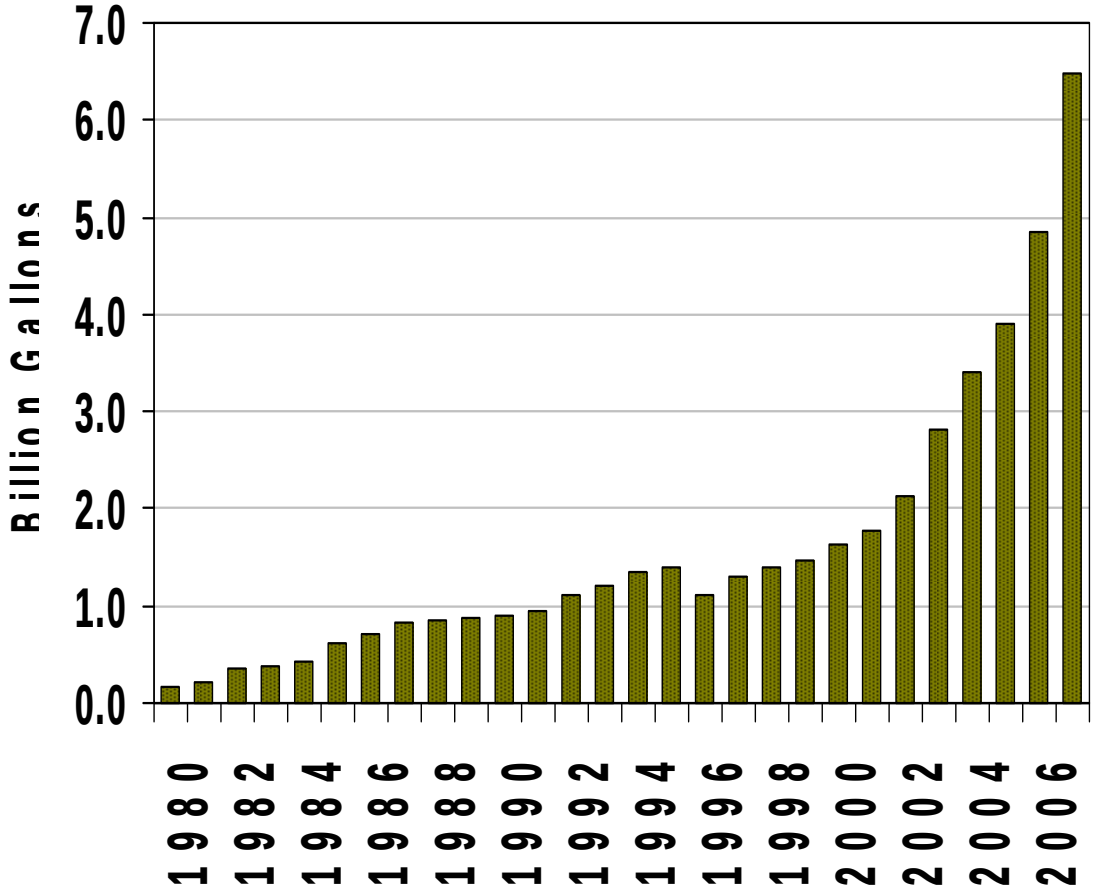
A bushel of corn will produce ~2.8 gallons of ethanol, 17 lbs of CO_2 and 17 lbs of DDGS

Laddonia Ethanol Plant



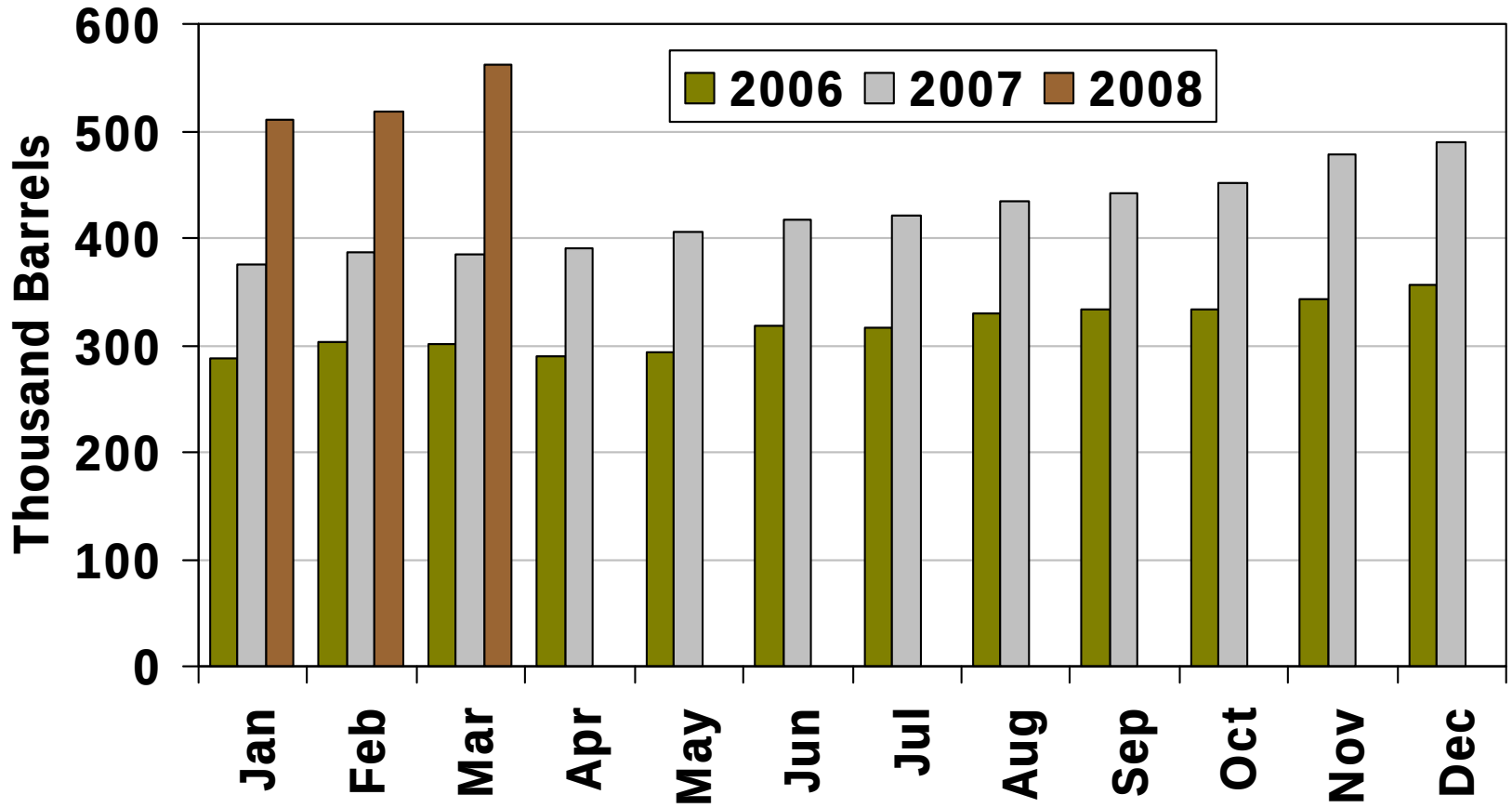
*Alaska has one ethanol plant in the planning stage
*Hawaii has two ethanol plants in the planning stage

Ethanol Production, 1980-07



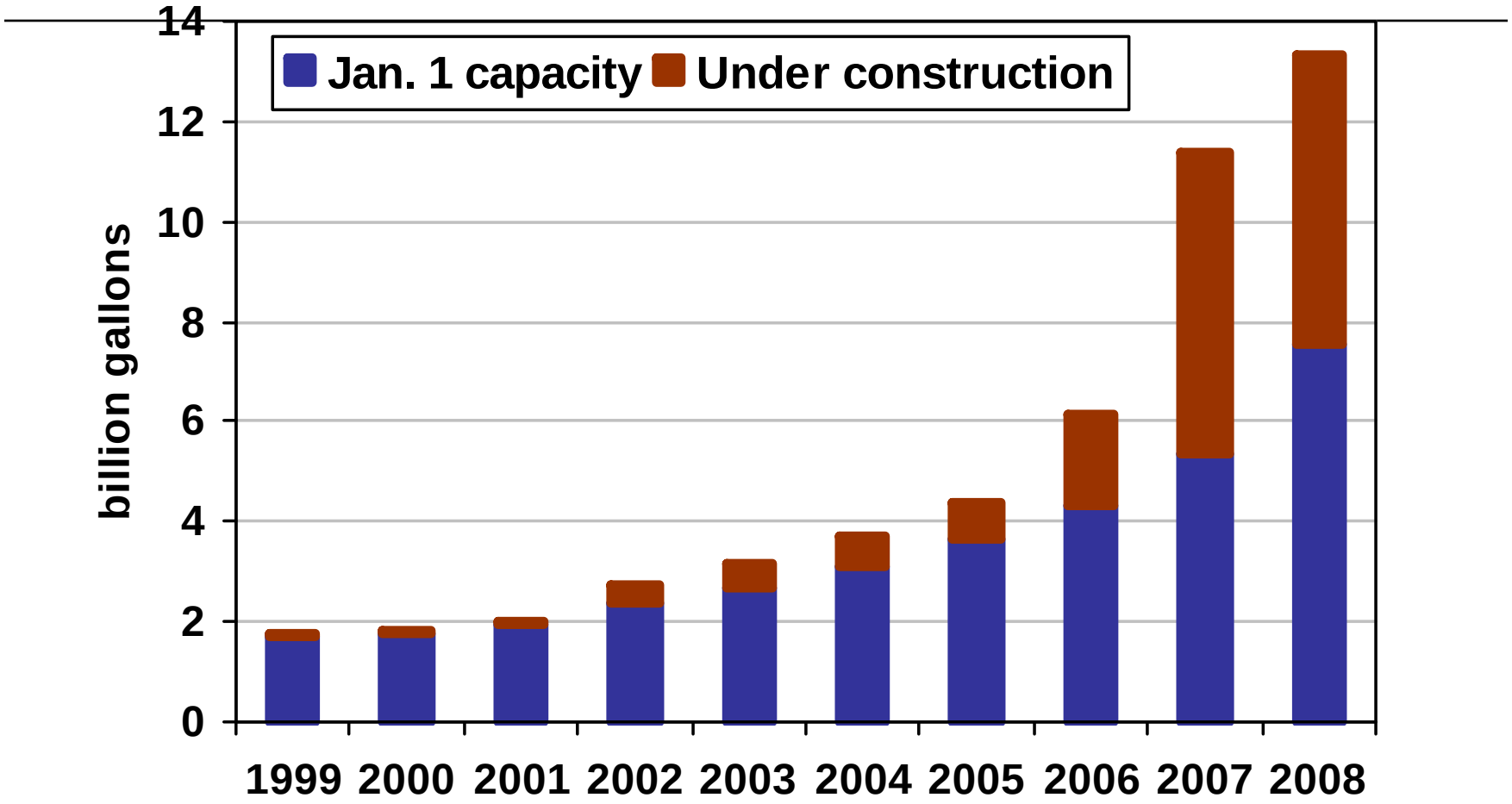
Source: Renewable Fuels Association

U.S. Daily Ethanol Production



Source: Renewable Fuels Association

Ethanol Capacity Growth



Source: Renewable Fuel Association website http://www.ethanolrfa.org/industry/statistics/#B

Ethanol Plant Statistics, 5/28/08

- 151 existing plants in 26 states with capacity to produce 8.6919 billion gallons of ethanol per year (49 plants farmer owned)
- 51 new plants under construction and 7 expansions with capacity to produce 4.914 billion gallons of ethanol per year
- >50 plants being planned

Source: Renewable Fuels Association

Outline

- Basics of ethanol production
  - Cellulosic
  - Grain
- **Overview of U.S. policy**
  - Subsidies
  - Mandates
  - Tariff
- Economics of ethanol
- Impact of ethanol policy

Table 1. *History of Ethanol Subsidy Legislation*

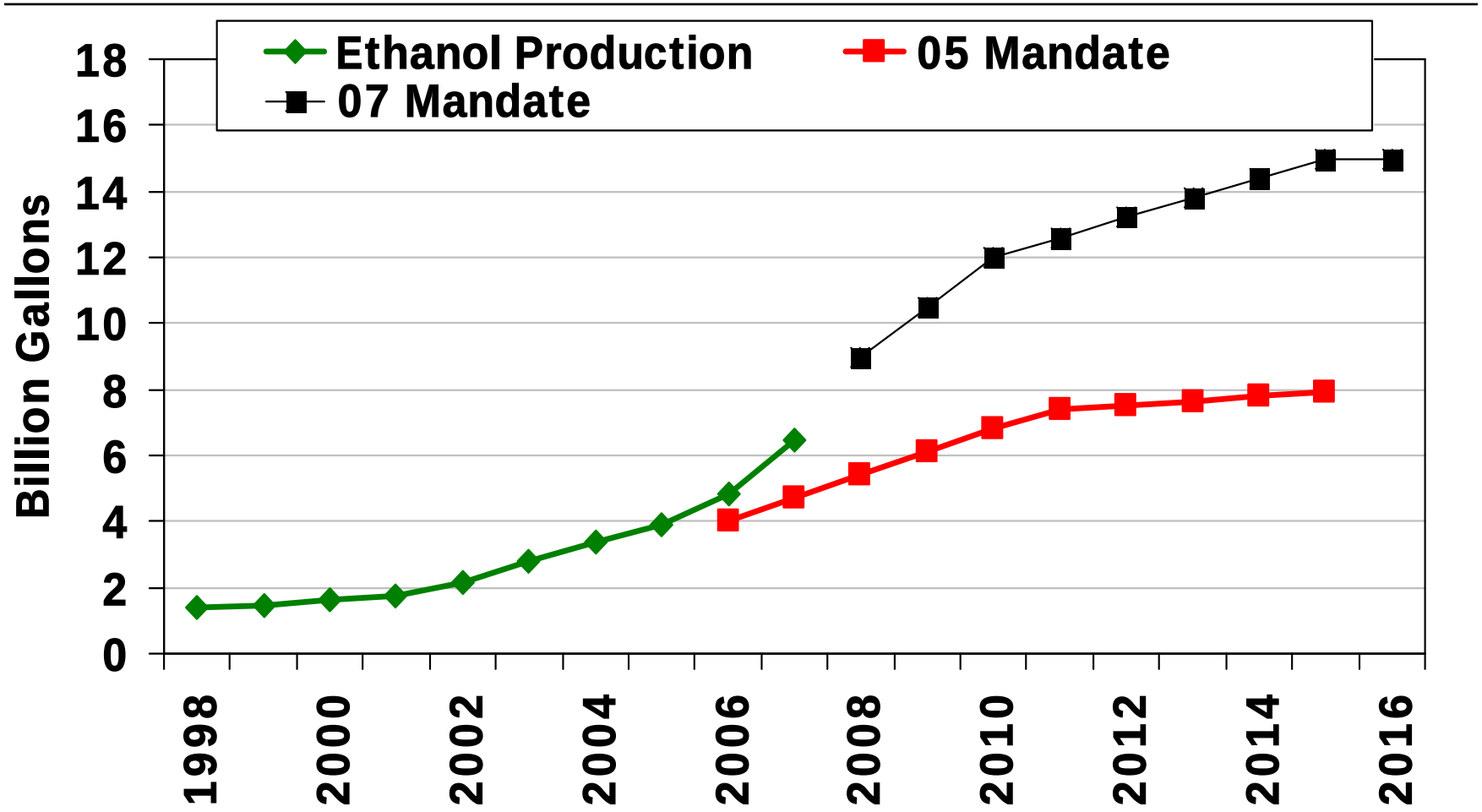
1978	Energy Tax Act of 1978	$0.40 per gallon of ethanol tax exemption on the $0.04 gasoline excise tax
1980	Crude Oil Windfall Profit Tax Act and the Energy Security Act	Promoted energy conservation and domestic fuel development
1982	Surface Transportation Assistance Act	Increased tax exemption to $0.50 per gallon of ethanol and increased the gasoline excise tax to $0.09 per gallon
1984	Tax Reform Act	Increased tax exemption to $0.06 per gallon
1988	Alternative Motor Fuels Act	Created research and development programs and provided fuel economy credits to automakers
1990	Omnibus Budget Reconciliation Act	Ethanol tax incentive extended to 2000 but decreased to $0.54 per gallon of ethanol
1990	Clean Air Act amendments	Acknowledged contribution of motor fuels to air pollution
1992	Energy Policy Act	Tax deductions allowed on vehicles that could run on E85
1998	Transportation Efficiency Act of the 21st Century	Ethanol subsidies extended through 2007 but reduced to $0.51 per gallon of ethanol by 2005
2004	Jobs Creation Act	Changed the mechanism of the ethanol subsidy to a blender tax credit instead of the previous excise tax exemption. Also extended the ethanol tax exemption to 2010.
2005	Energy Policy Act	Established the Renewable Fuel Standard starting at 4 billion gallons in 2006 and rising to 7.5 billion in 2012.

Source: (Commerce, 2006) North Dakota Chamber of Commerce.

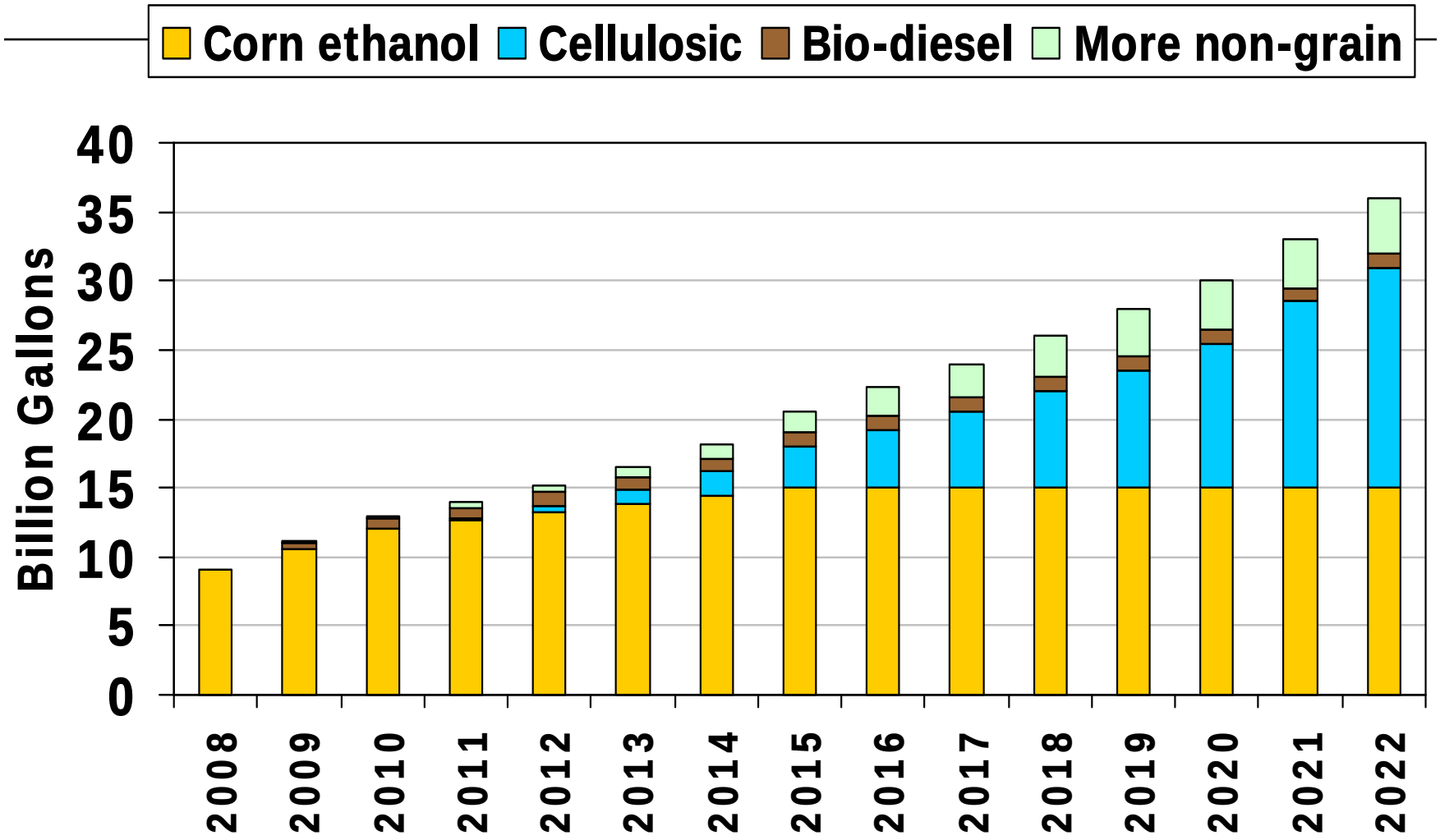
Subsidies for Ethanol Production

- 51 cent per gallon federal excise tax credit
- 45 cent per gallon under new Farm Bill
- Missouri has producer tax credits
  - 20 cents on first 12.5 million gallons
- Iowa and Illinois state excise tax exemptions
  - 1 to 1.5 cents per gallon with income tax credits for Iowa retailers selling more than 60 percent ethanol-blended fuel

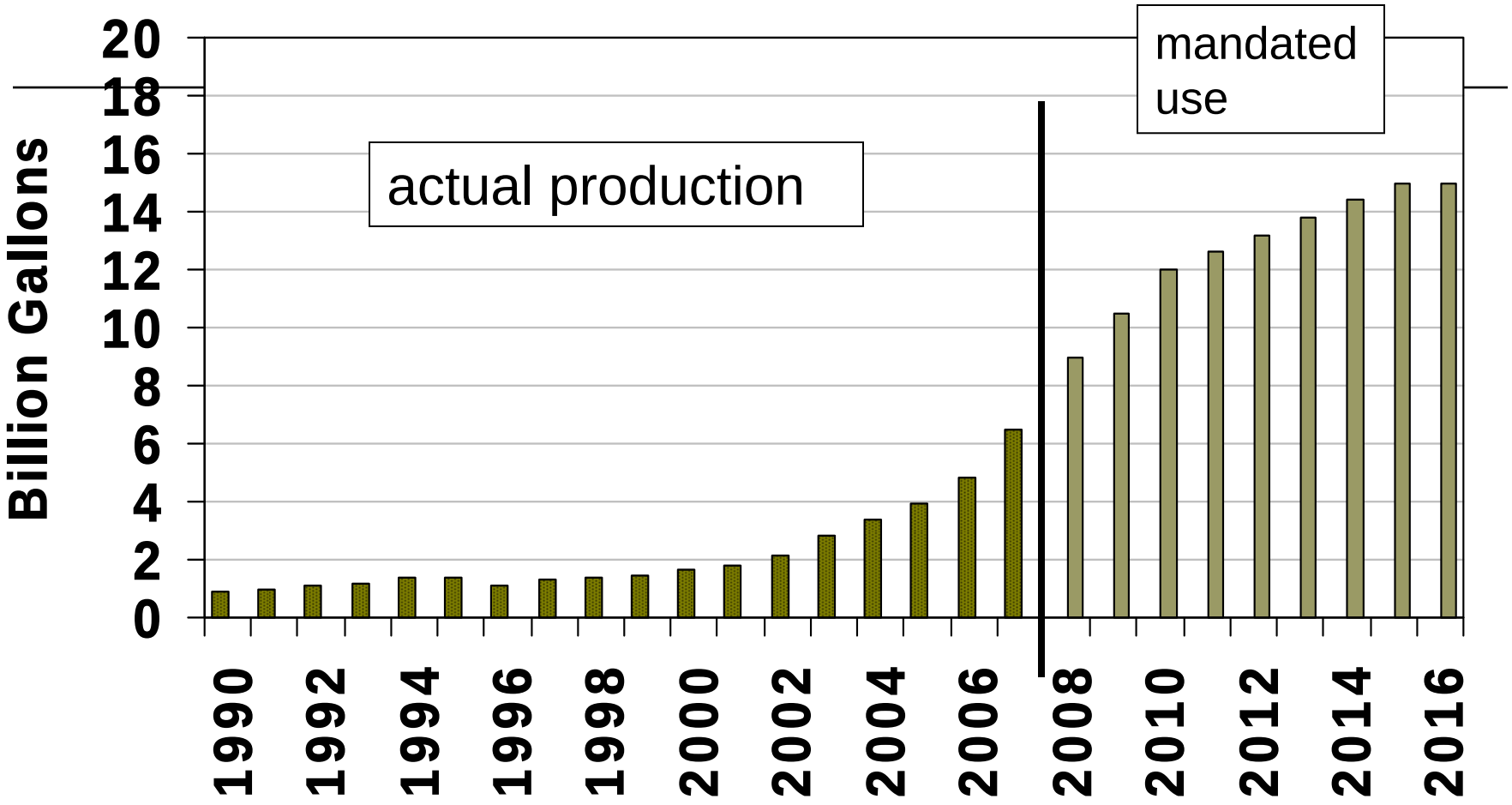
Ethanol Production & Renewable Fuels Mandate



2007 Renewable Fuels Mandate

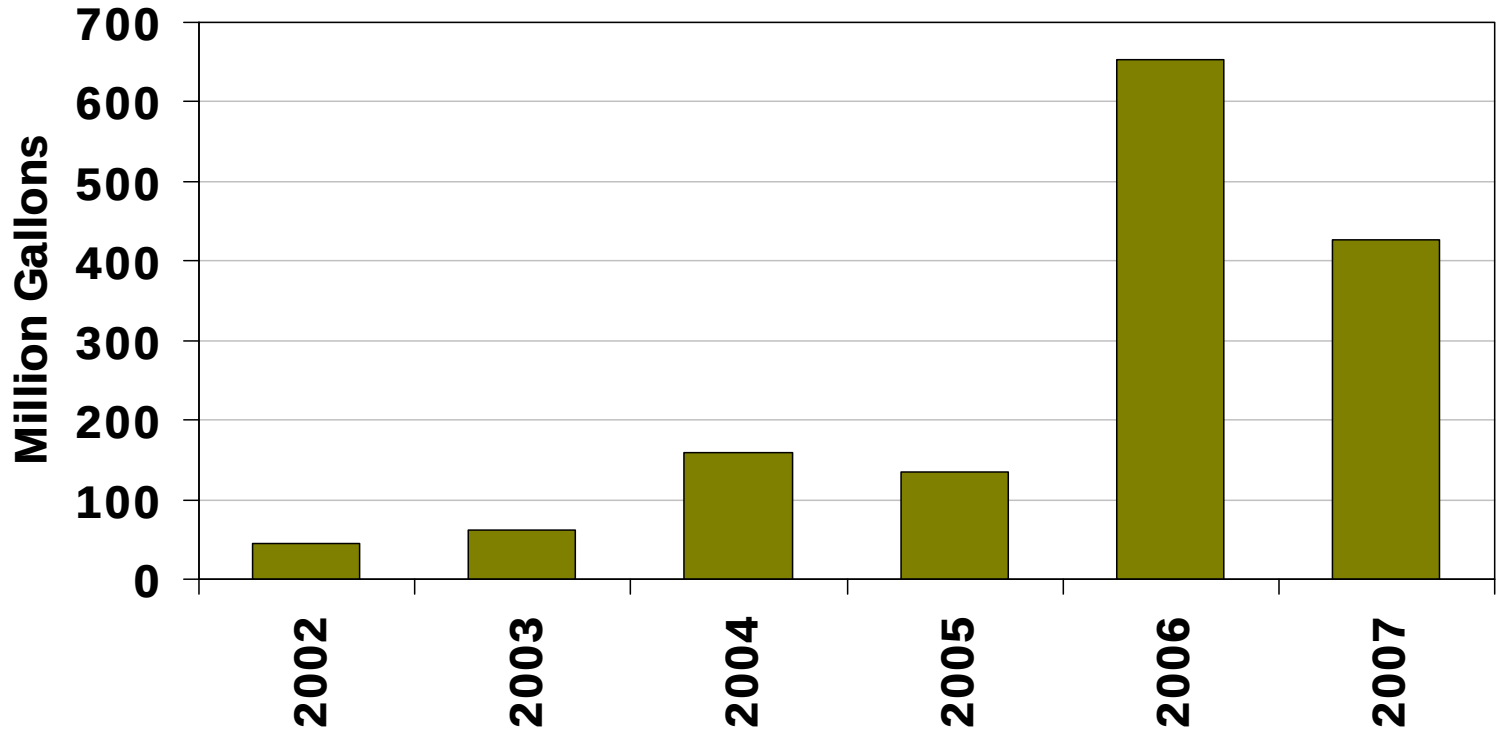


Ethanol Production, 1990-2016



Beginning in 2015, the U.S. will annually use more corn to make ethanol than the U.S. produced in any year before 1971

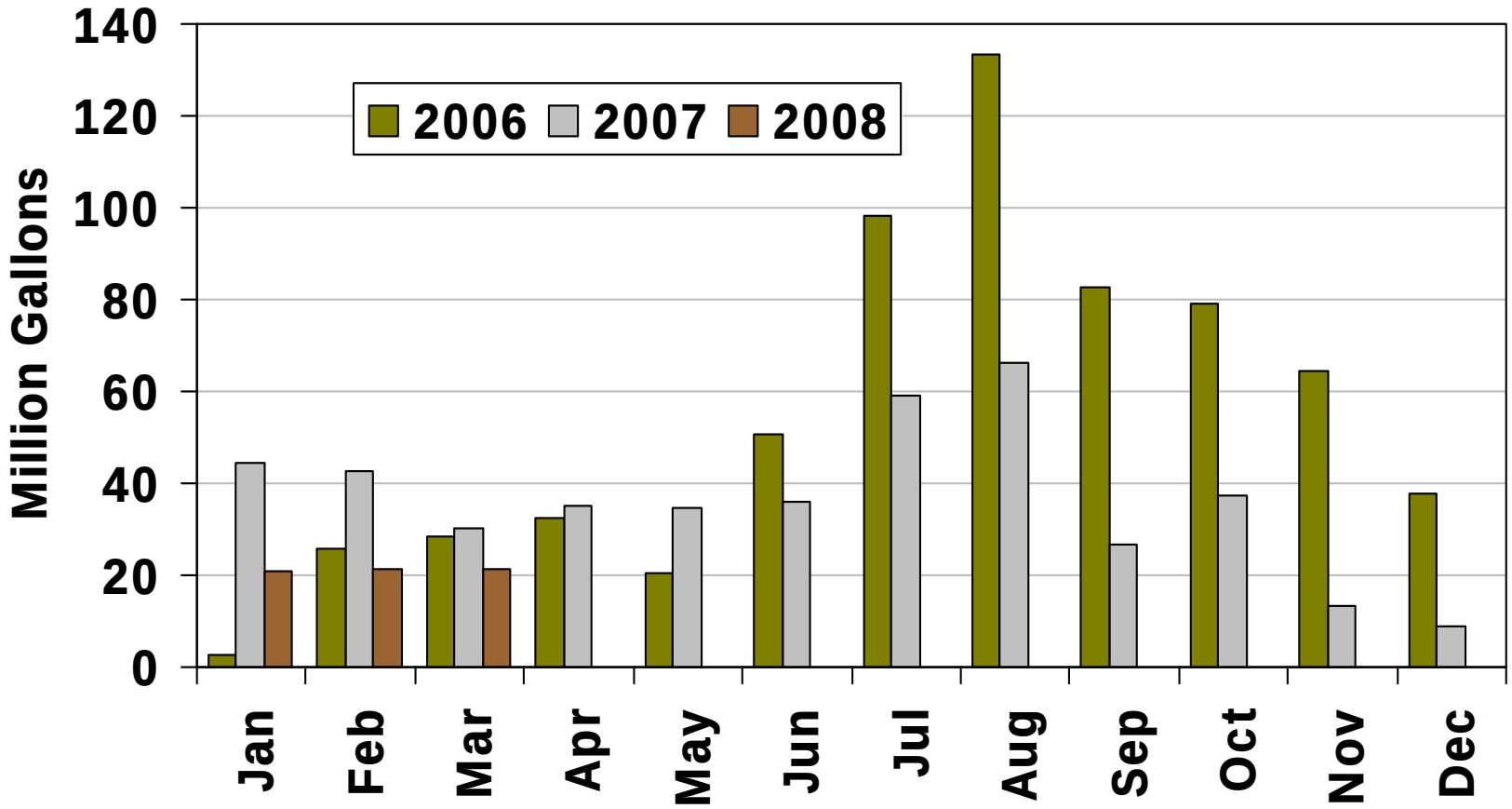
U.S. Ethanol Imports, 2002-07



There is a 54¢ per gallon tariff on imported ethanol

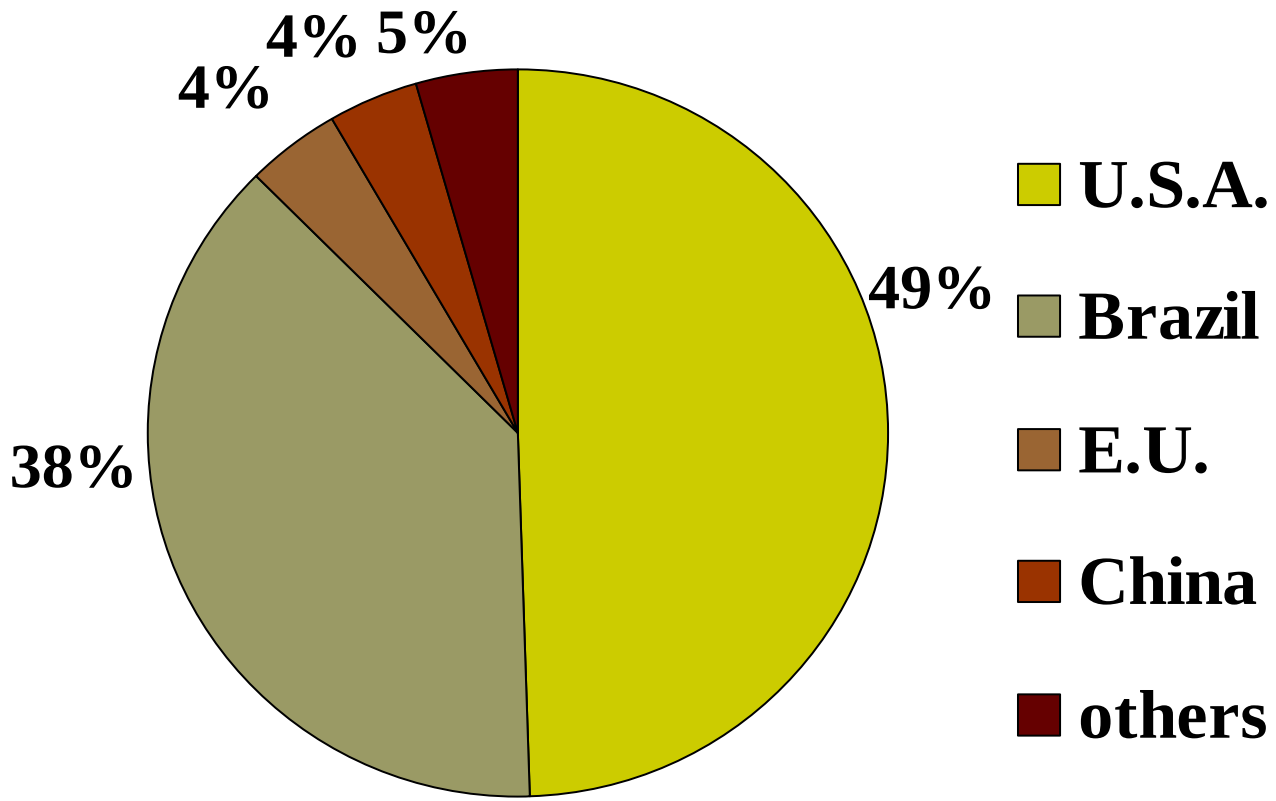
Source: Renewable Fuels Association

U.S. Ethanol Imports



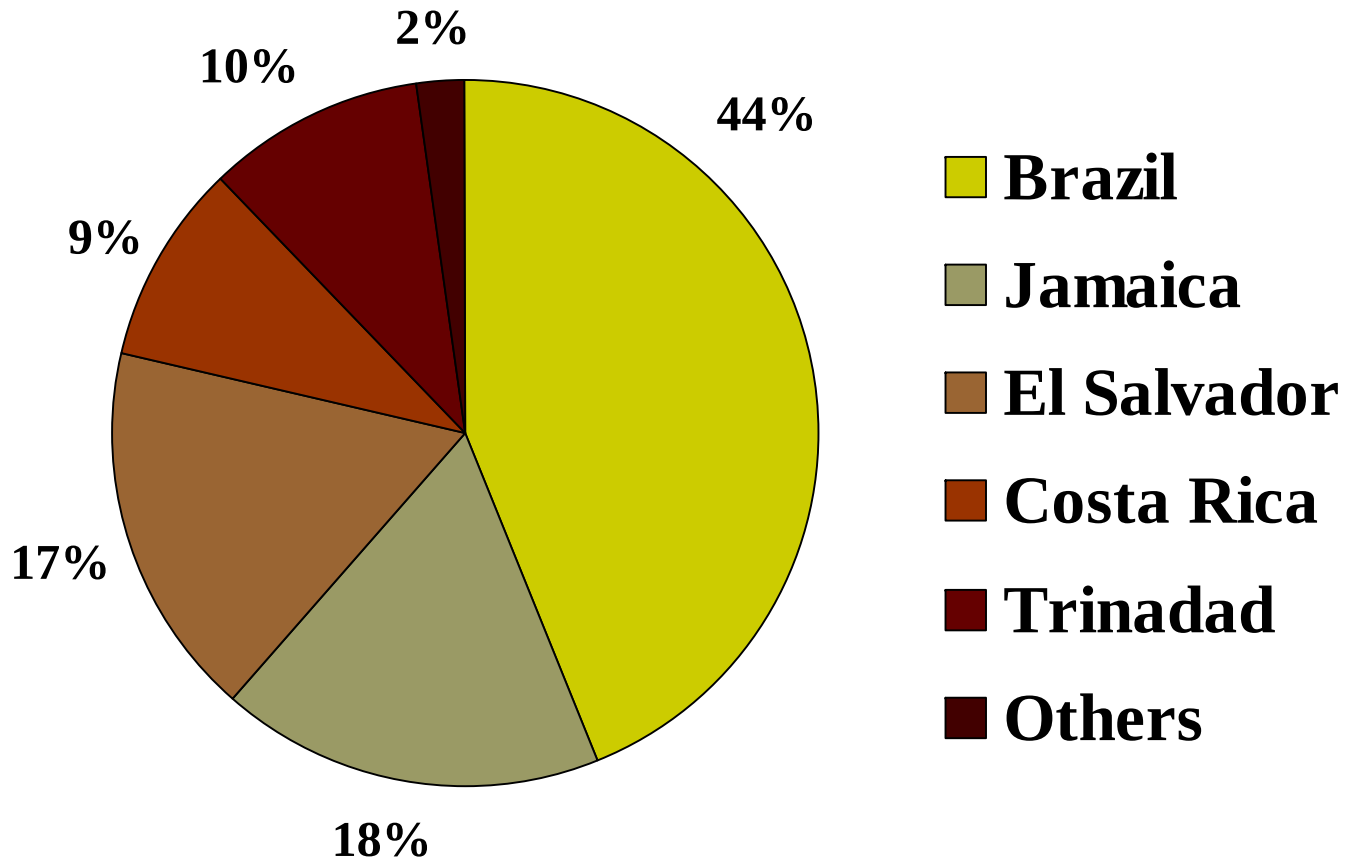
Source: Renewable Fuels Association

World Ethanol Production, 2007



Source: Renewable Fuels Association

U.S. Ethanol Imports, 2007



Source: Renewable Fuels Association

Outline

- Basics of ethanol production
  - Cellulosic
  - Grain
- Overview of U.S. policy
  - Subsidies
  - Mandates
  - Tariff
- **Economics of ethanol**
- Impact of ethanol policy

Economics of BioFuels

- The economics of biofuels is confusing, in part, because we measure gasoline and diesel in gallons and corn and soybeans in bushels
- Measuring everything in pounds makes the economics easier to understand

Economics of Ethanol

- Corn is worth 10¢ per pound
- Gasoline is worth 45¢ per pound
- DDGS is worth 9.5¢ cents per pound
- The cost of conversion is 4¢ per pound
- There is a federal government subsidy of 2.5¢ for each pound of corn converted to ethanol and DGS

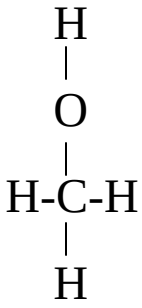
Ethanol Plants Have Been Very Profitable

In 2006, U.S. plants produced ethanol for about $1.34 per gallon. The average price of ethanol was about $2.58 per gallon.

Profit=$1.24/gal or $3.42/bu

Value of ethanol

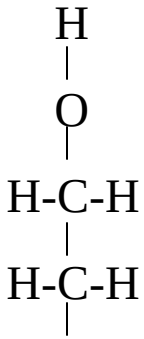
Formulation of Alcohols



Methanol

CH_3OH

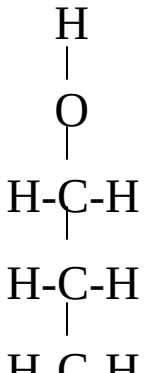
62,800 BTU



Ethanol

C_2H_5OH

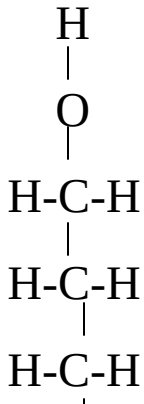
84,400 BTU



Propanol

C_3H_7OH

100,000 BTU



Butanol

C_4H_9OH

110,000 BTU

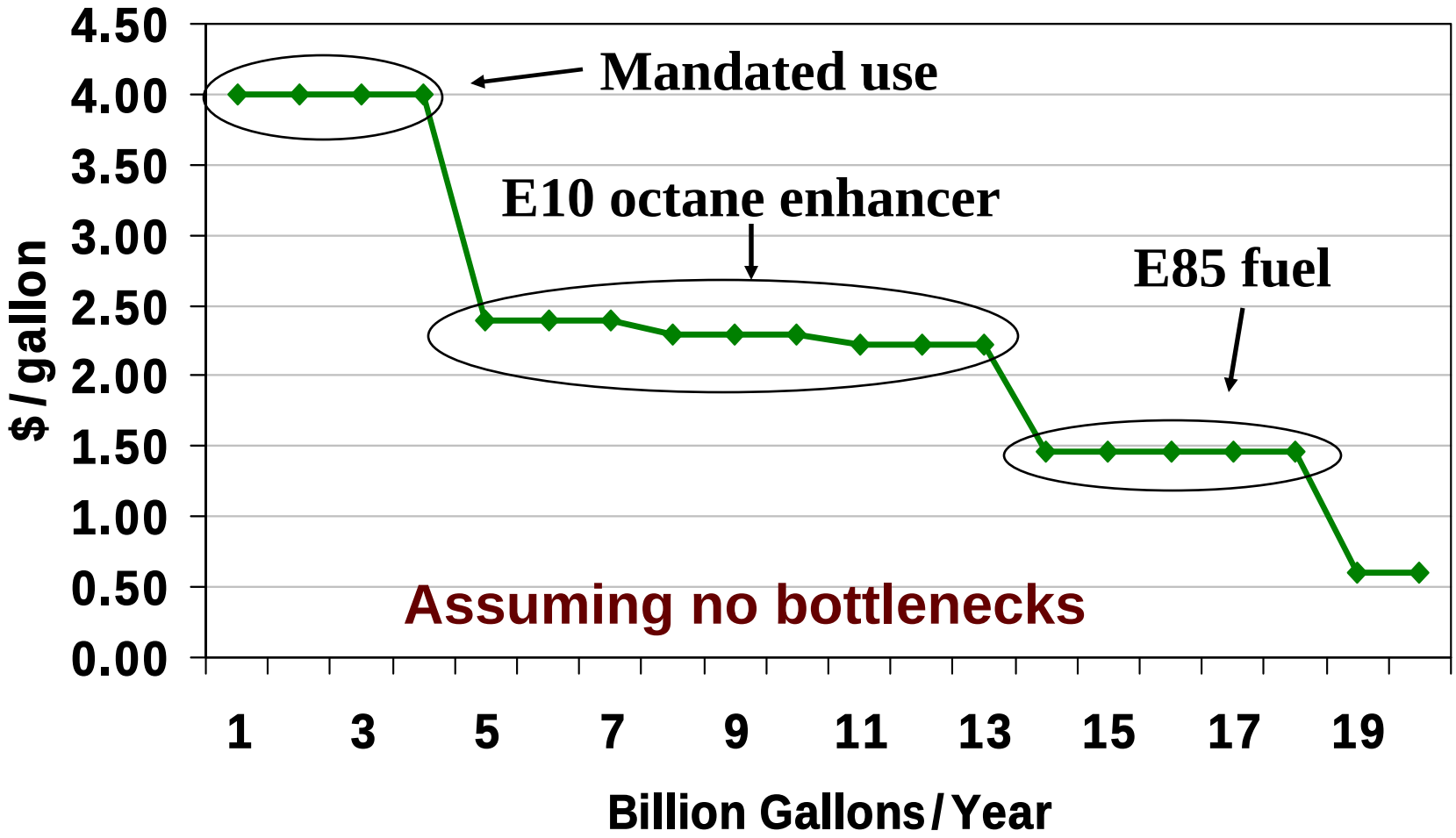
Gasoline is mostly C_8H_{18}

Gasoline has 125,000 BTU/gallon

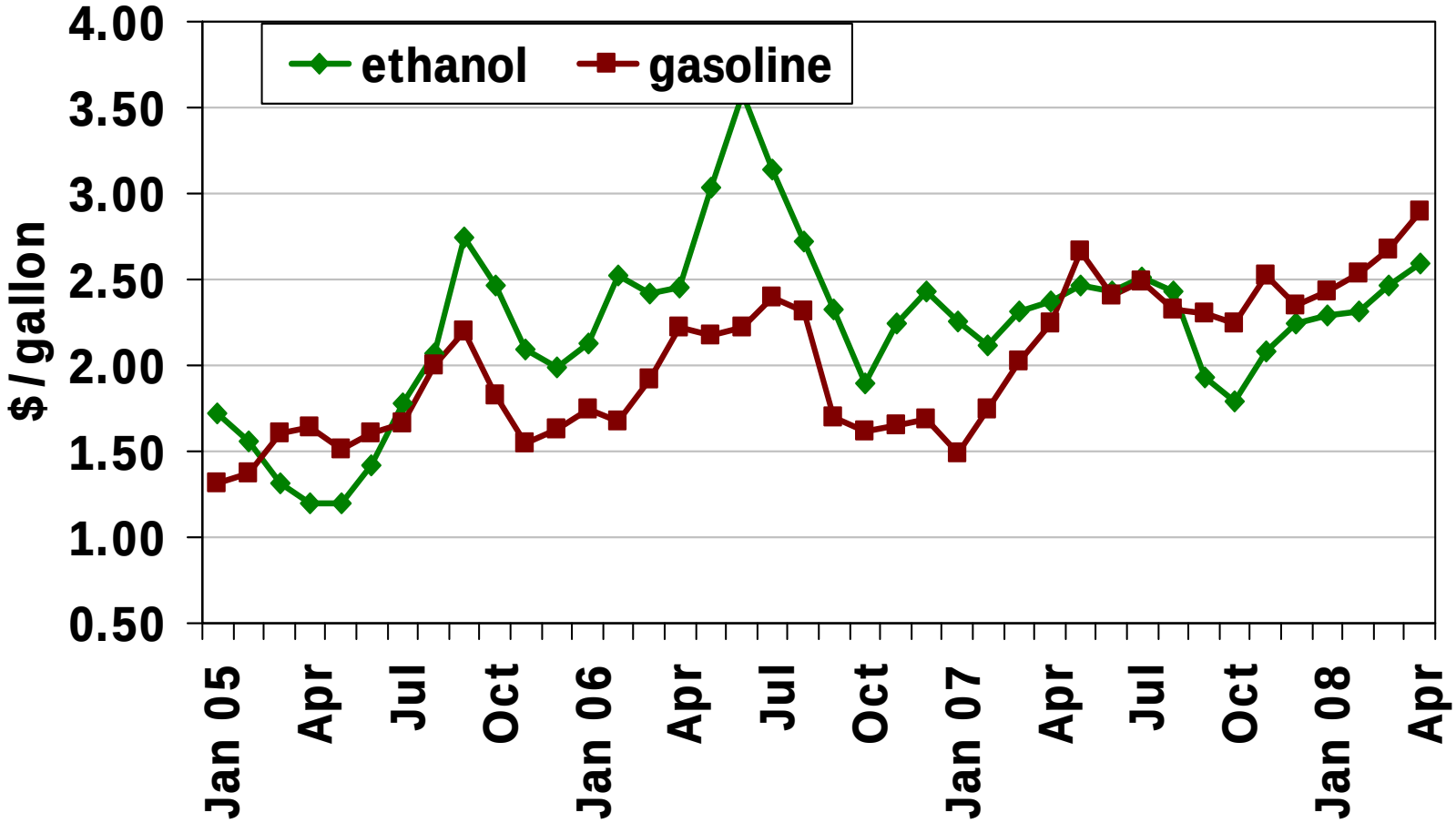
Ethanol as Fuel

- Over 90% of U.S. ethanol is used as fuel
- Although ethanol and gasoline can be blended in any proportion, in the U.S. it is largely:
  - 10% ethanol & 90% gasoline
  - 85% ethanol & 15% gasoline (E85)
- Blends with high ethanol content require modifications in the automobile (flexible fuel vehicle)
  - Sensor to detect ethanol/gasoline ratio
  - Corrosion resistant fuel tank & lines

Ethanol Price with $2 Gasoline Rack Price ~ $2.70 Retail Gasoline

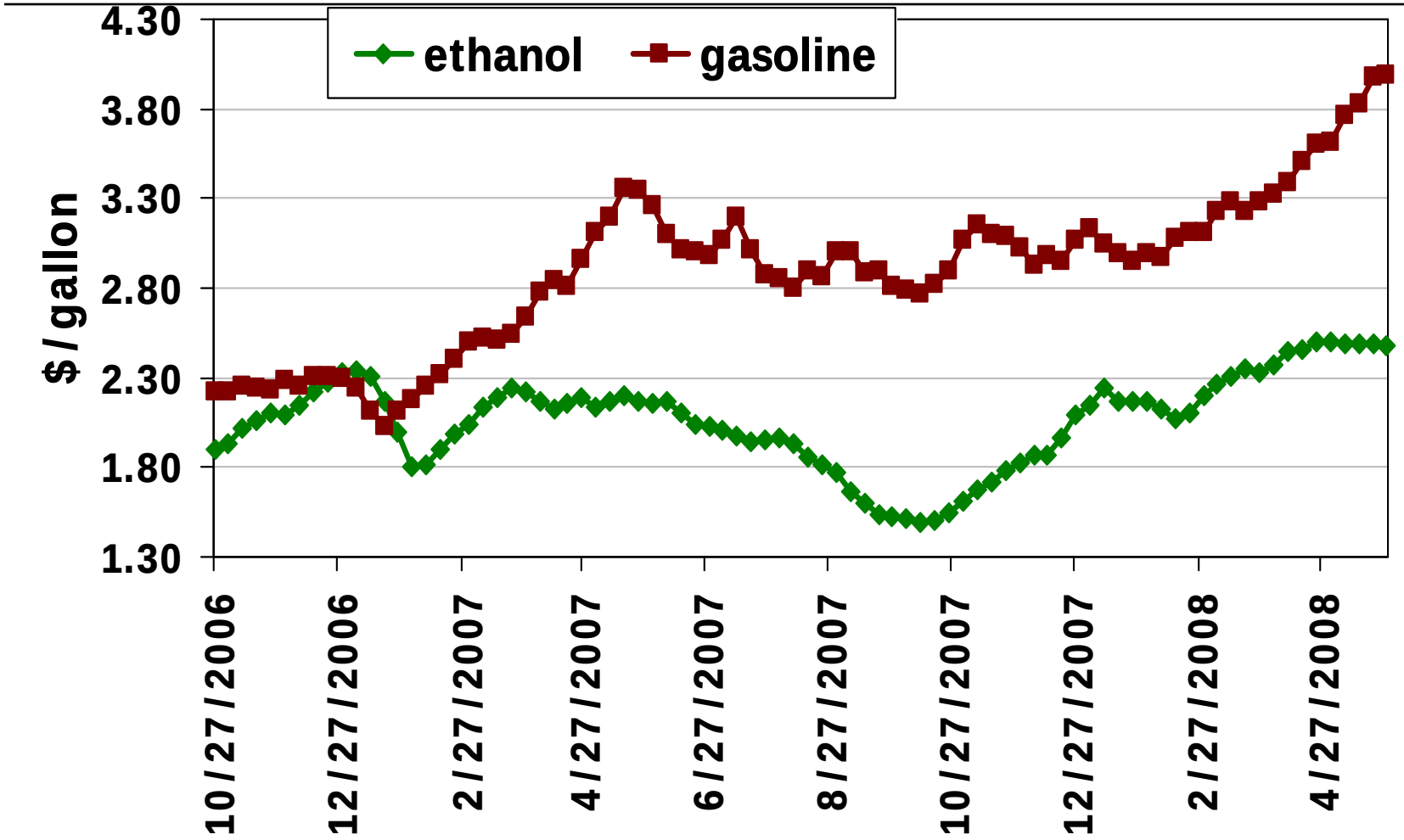


Ethanol & Unleaded Gasoline Average Rack Price – FOB Omaha



Source: http://www.neo.ne.gov/statshtml/66.html

Iowa Ethanol & Midwest Retail Gasoline Prices

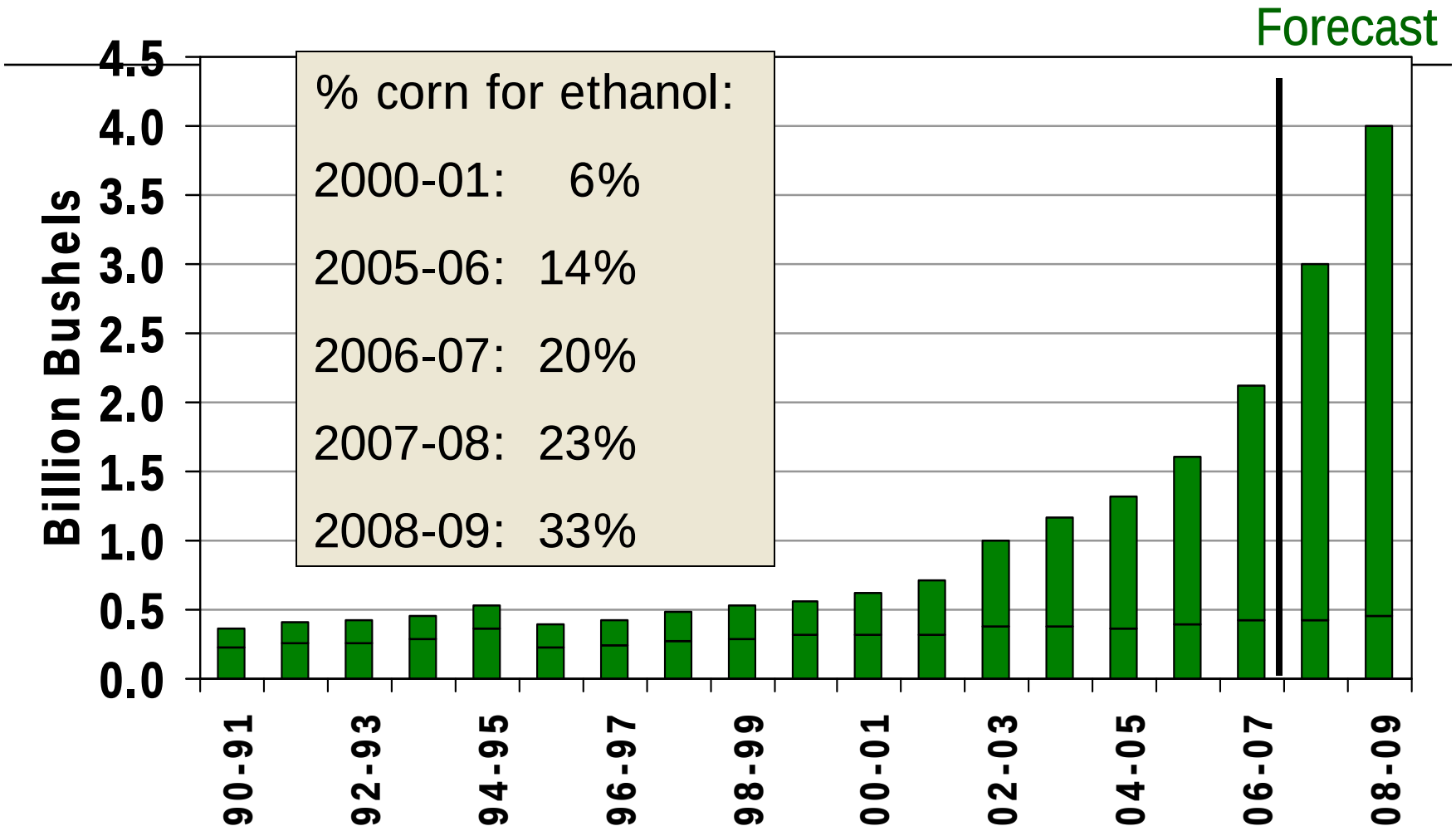


Outline

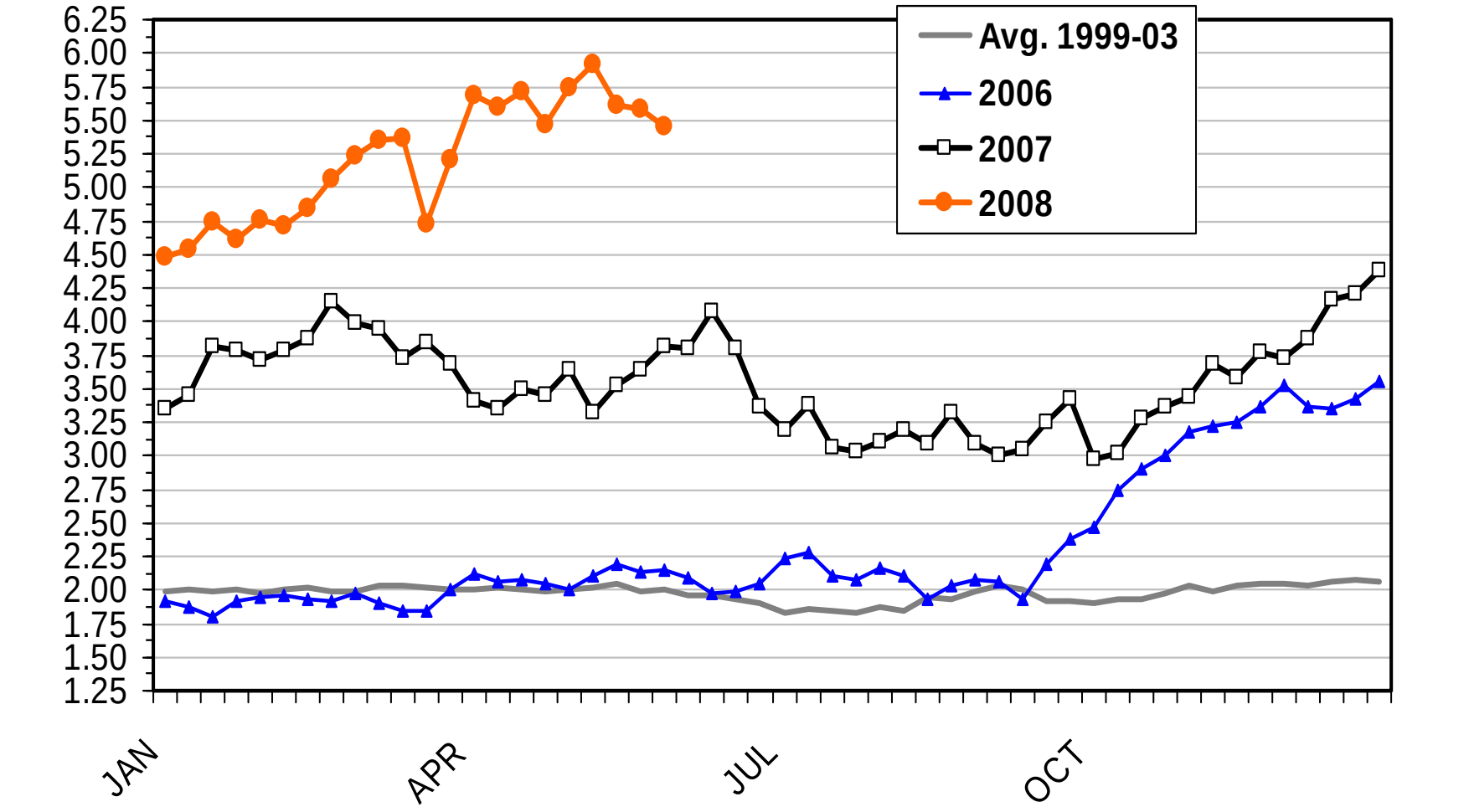
- Basics of ethanol production
  - Cellulosic
  - Grain
- Overview of U.S. policy
  - Subsidies
  - Mandates
  - Tariff
- Economics of ethanol
- **Impact of ethanol policy**

Impact on corn prices

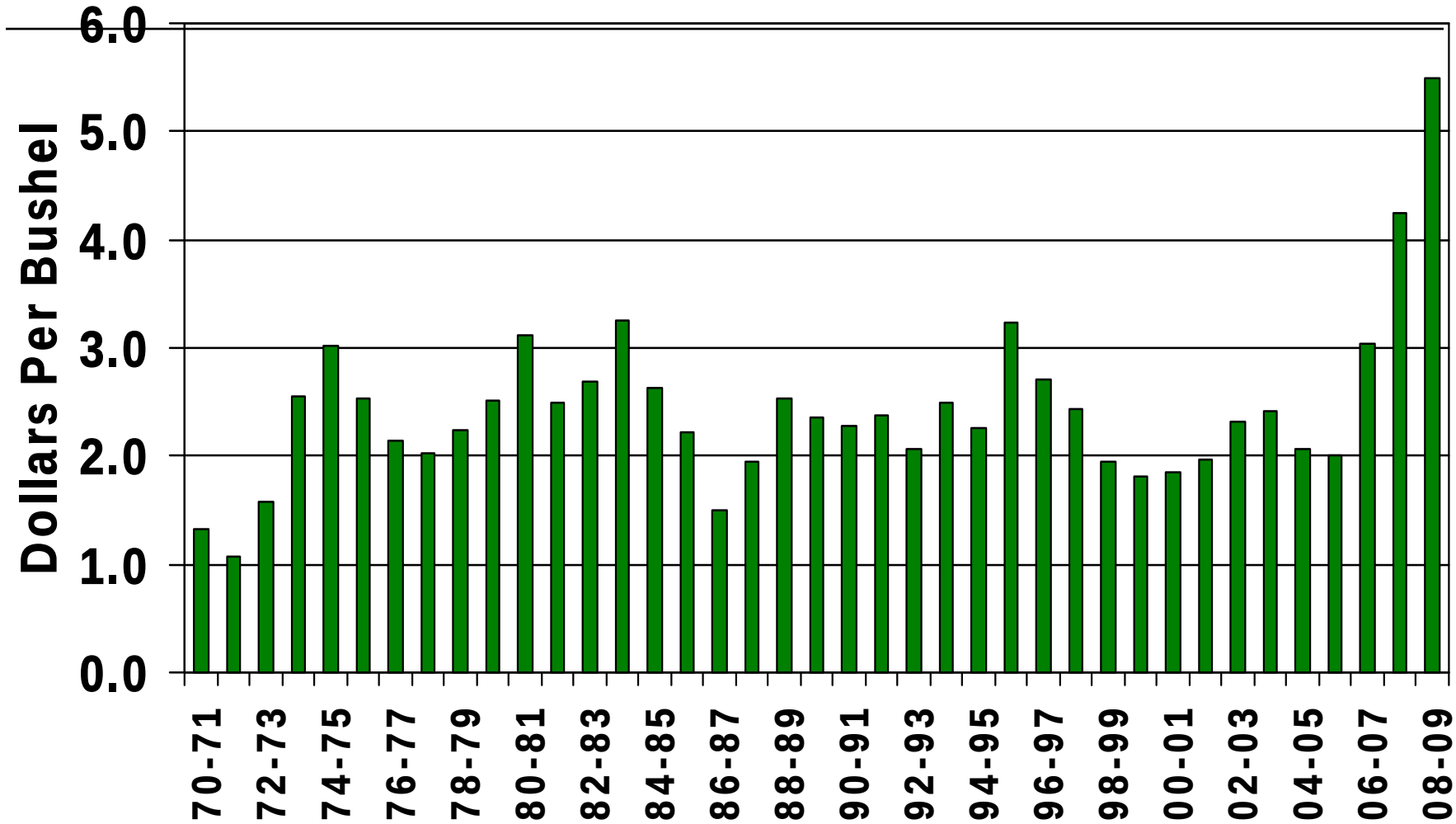
Corn Milled for Ethanol



Omaha Corn Prices, weekly

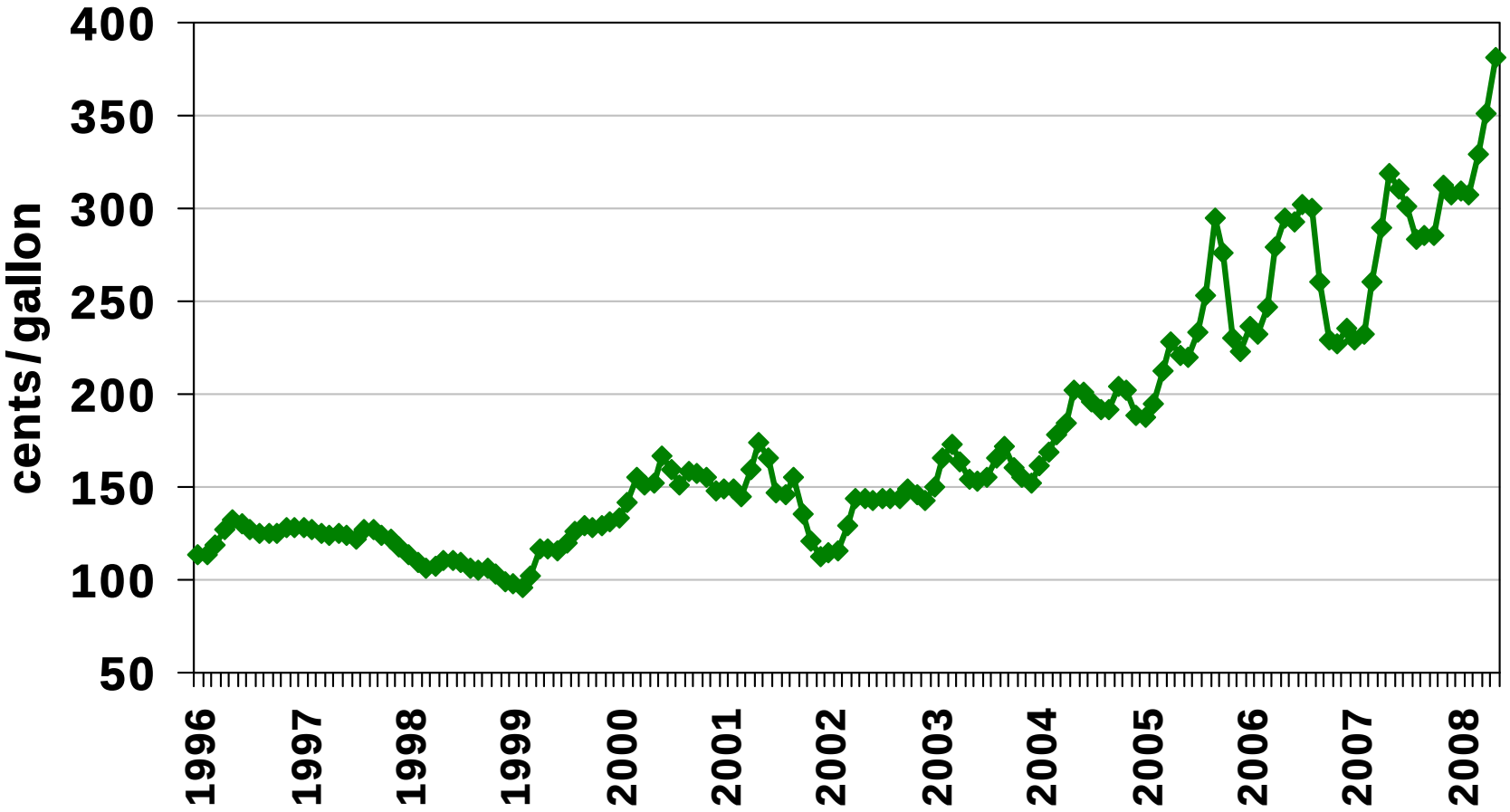


U.S. Corn Price, 1970-09



U.S. Retail Gasoline Prices,

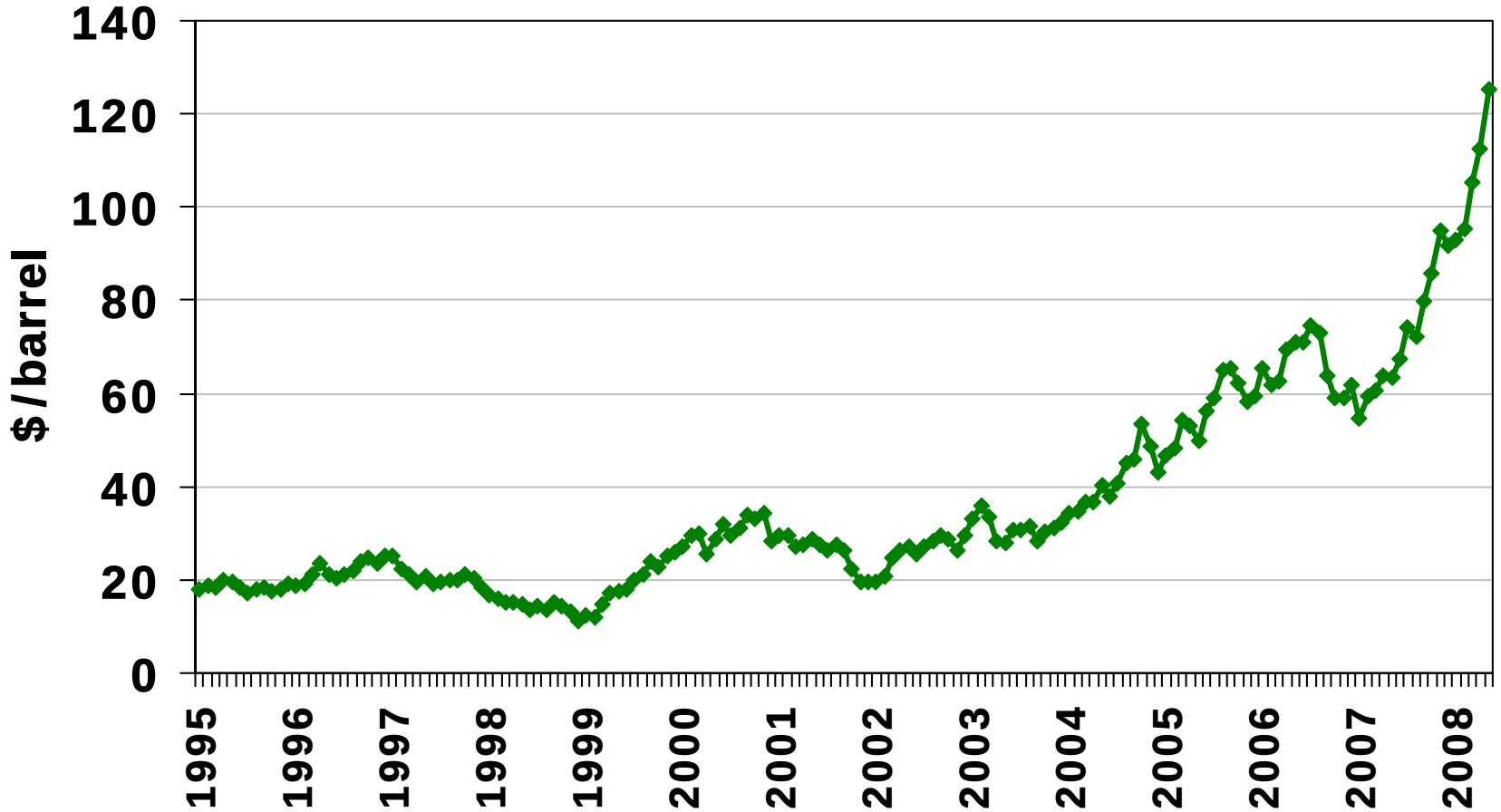
All Grades, All Formulations, 1996-2008



Source: U.S. Energy Information Administration

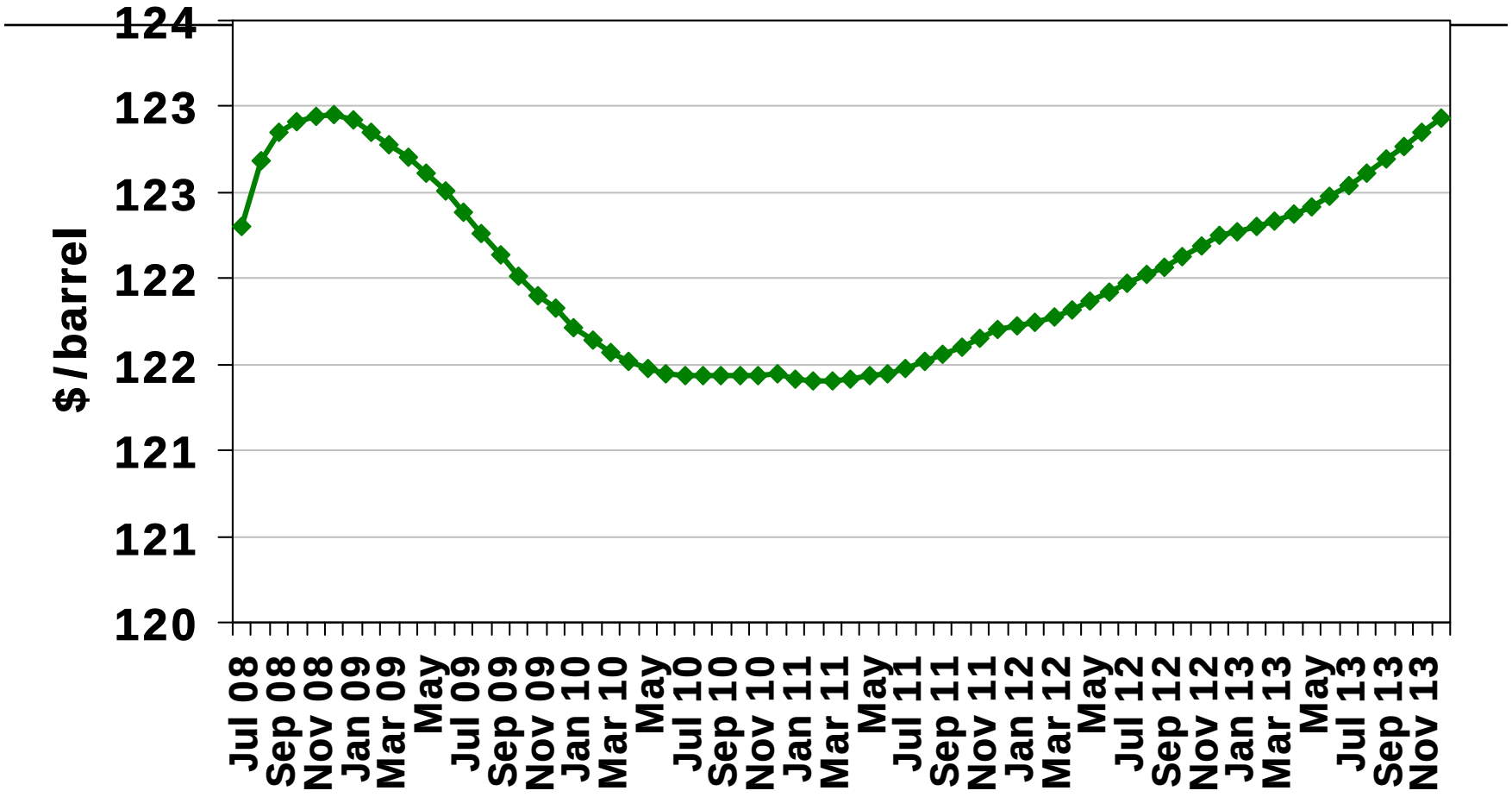
Spot Crude Oil Prices 1995-2008

WTI, Monthly Average Price, Cushing, Oklahoma



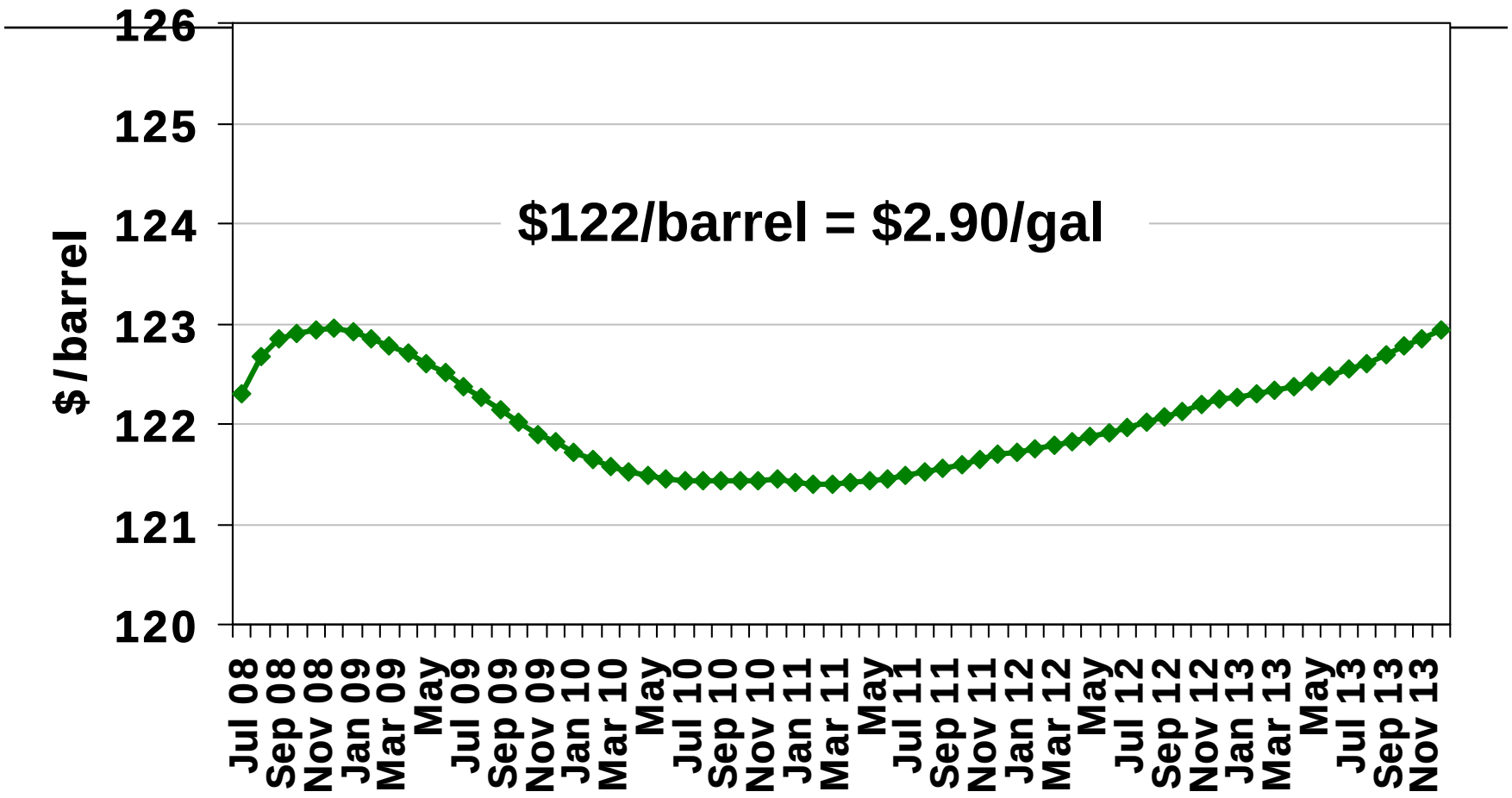
Source: U.S. Energy Information Administration

Crude Oil Futures Prices



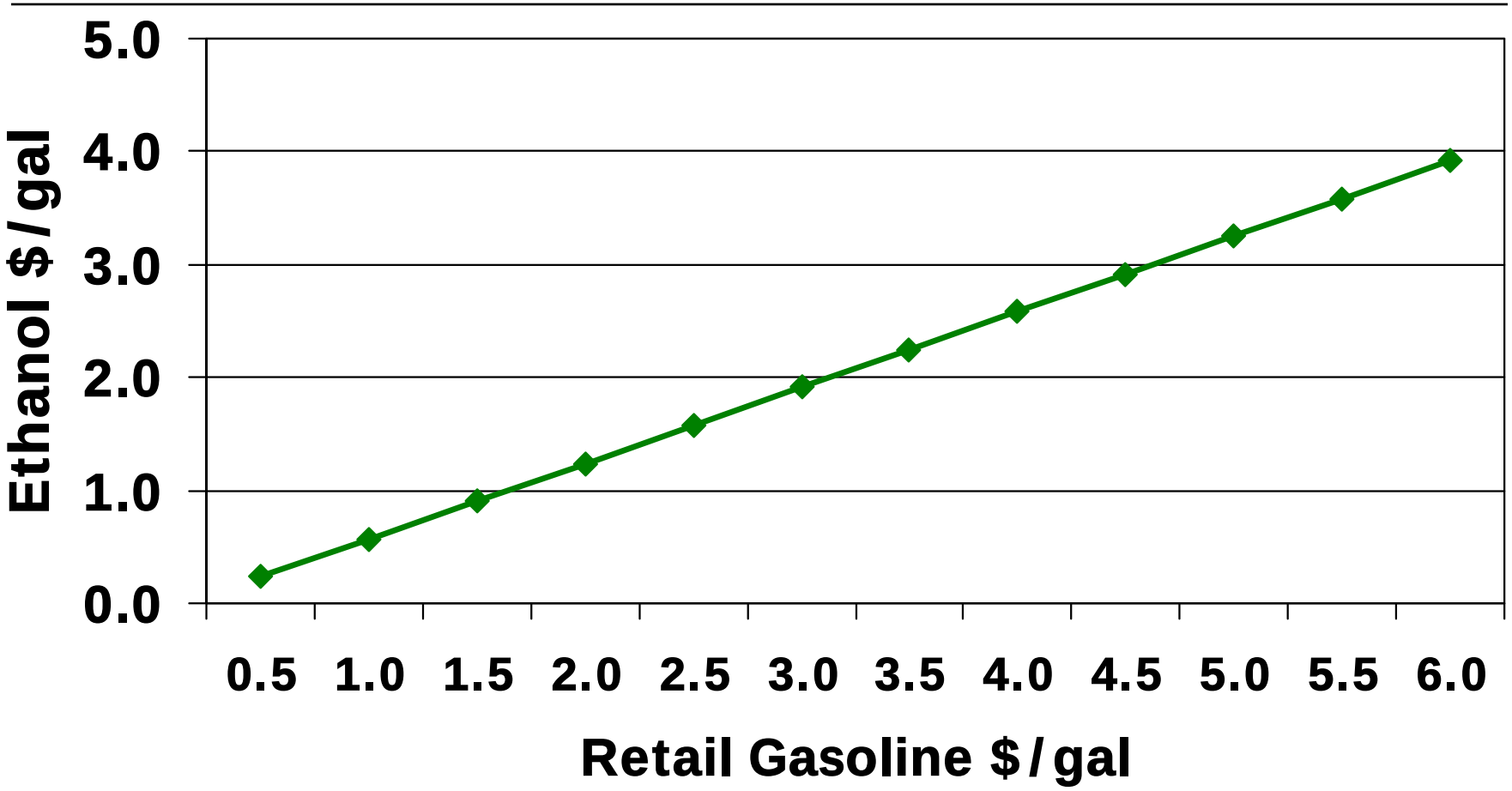
Source: New York Mercantile Exchange close on 6/04/08

Crude Oil Futures Prices



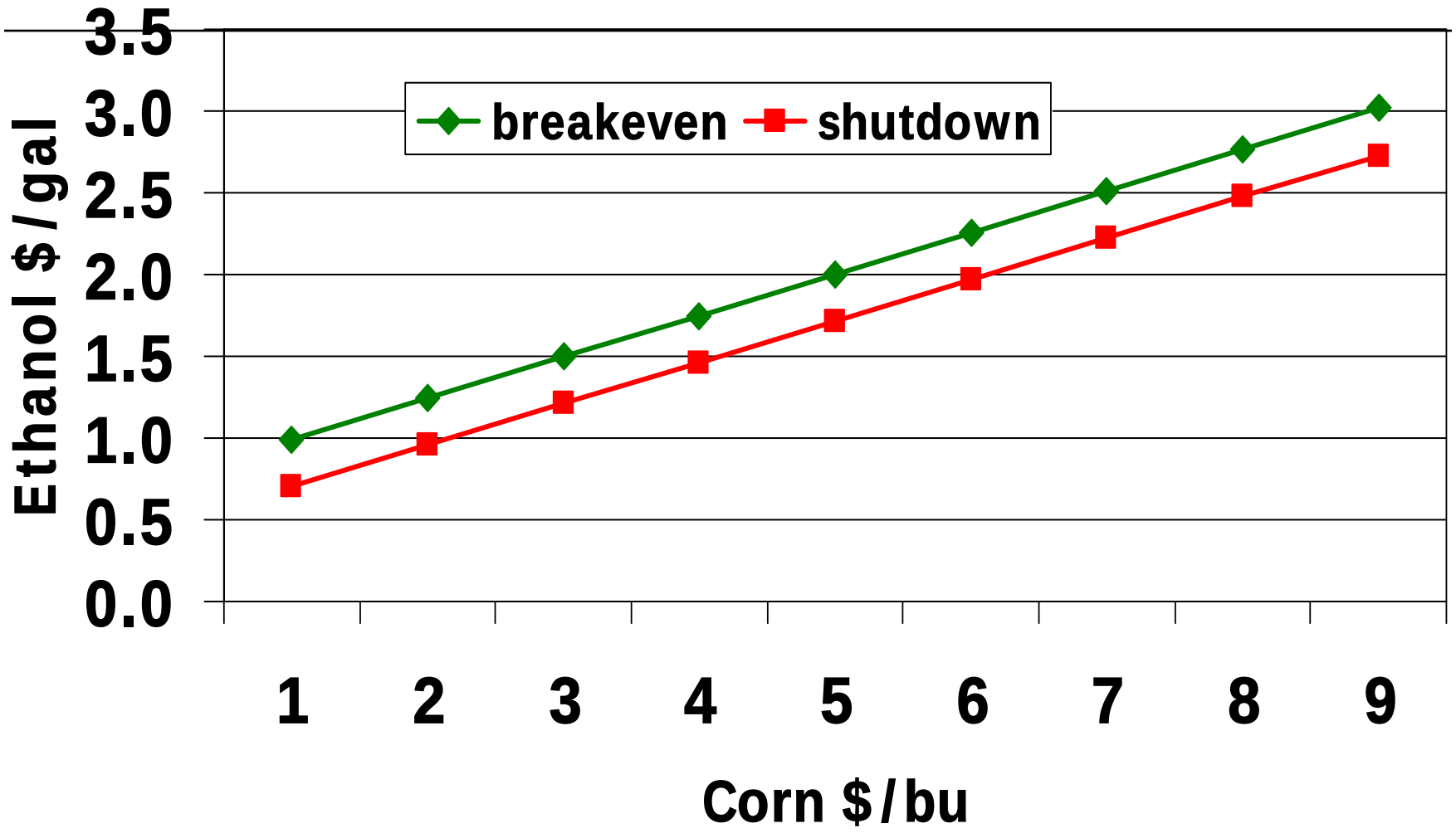
Source: New York Mercantile Exchange close on 6/04/08

Ethanol-Gasoline Price Relationship



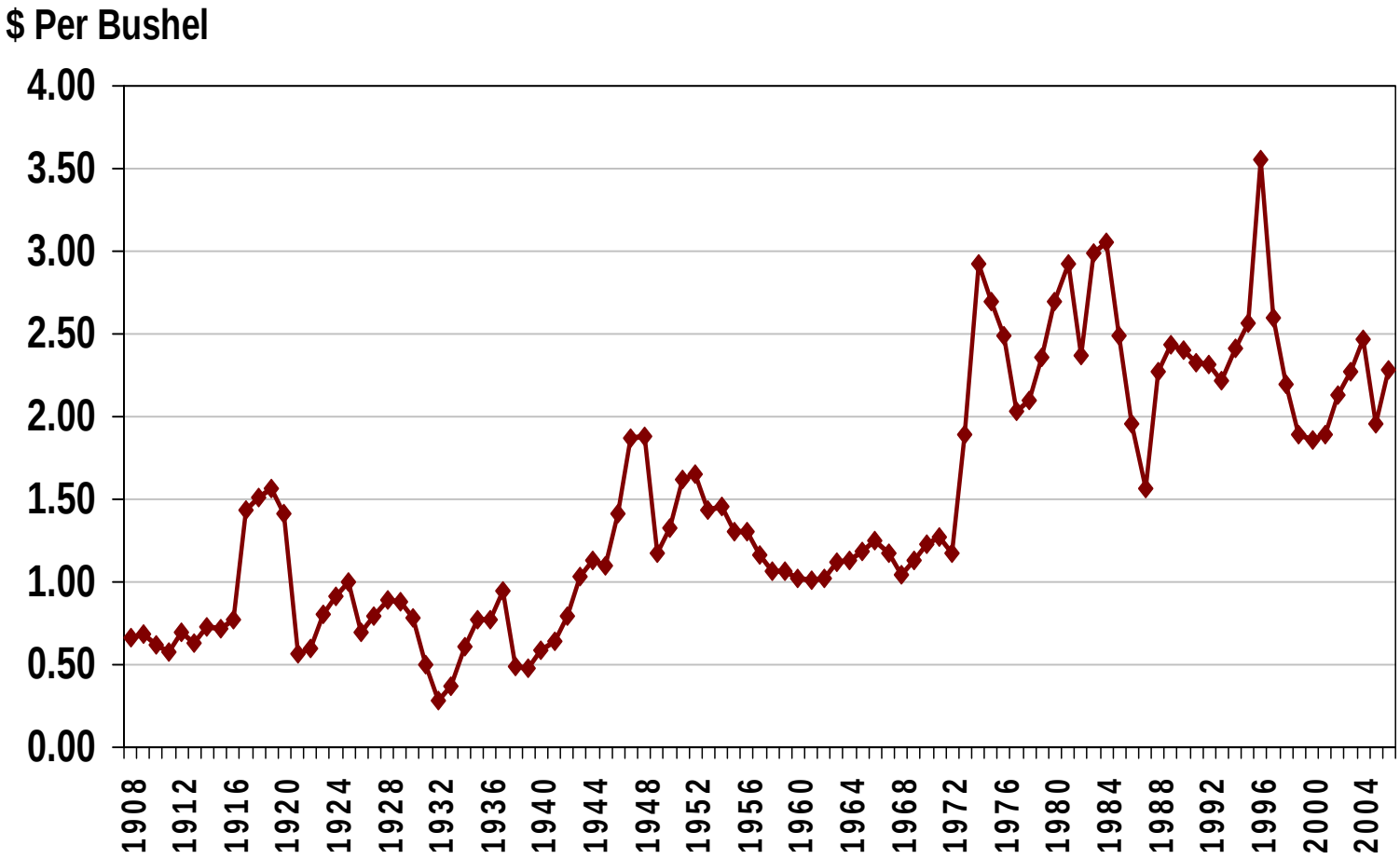
Source: Ron Plain

2007 Ethanol-Corn Price Relationship



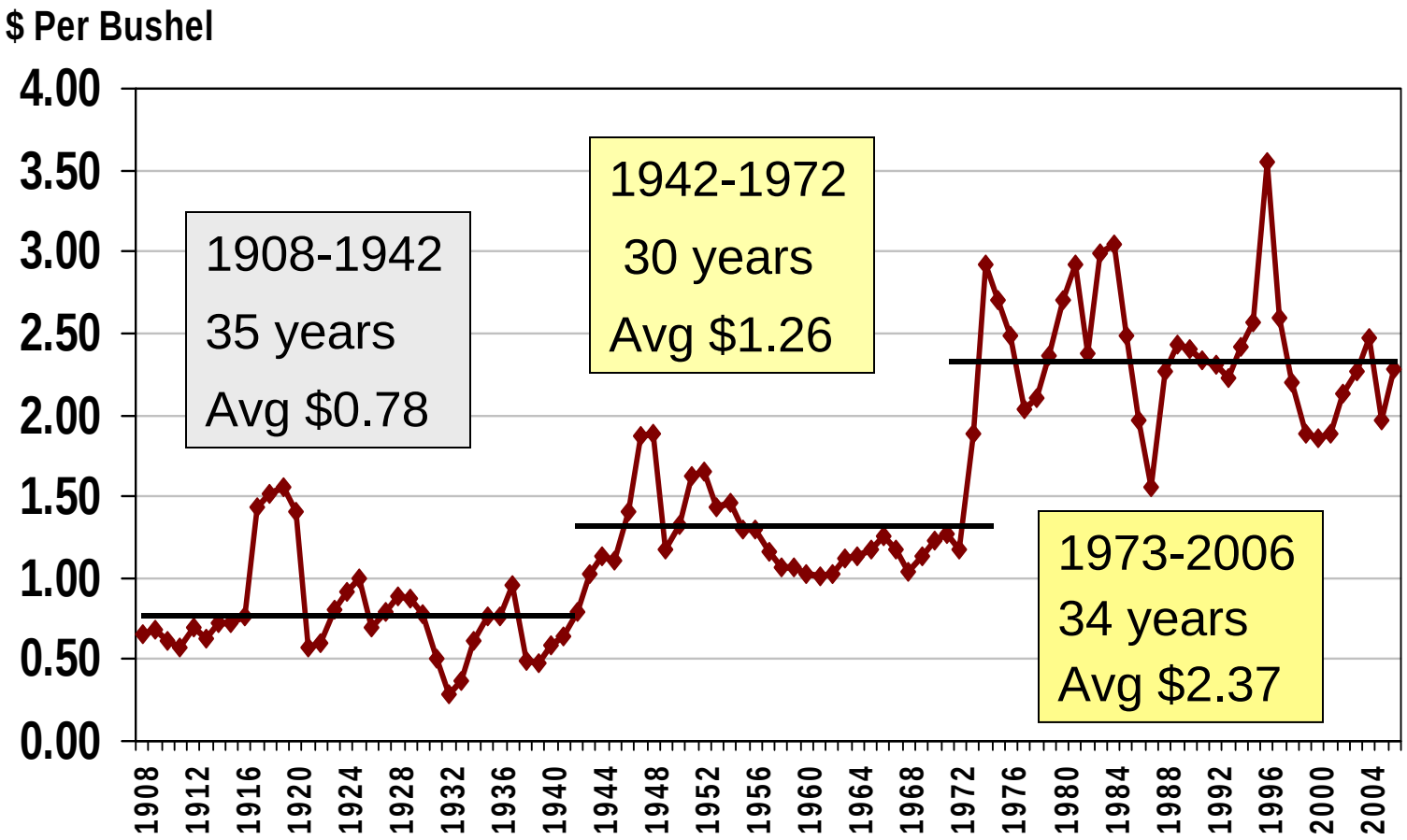
Source: Ron Plain

U.S. Average Corn Price, 1908-2006



Source: USDA/NASS

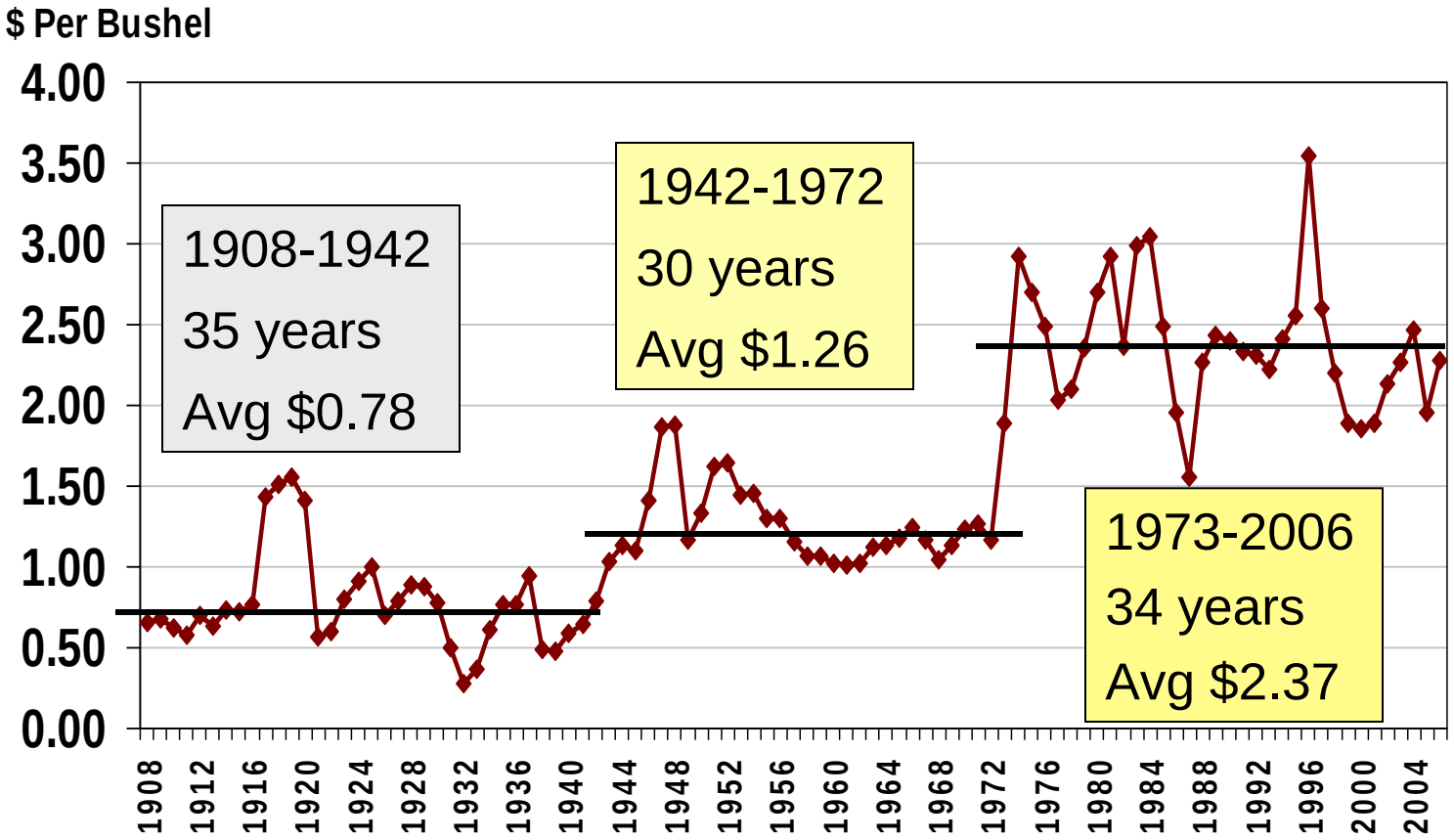
U.S. Average Corn Price, 1908-2006



Source: USDA/NASS

U.S. Average Corn Price, 1908-2006

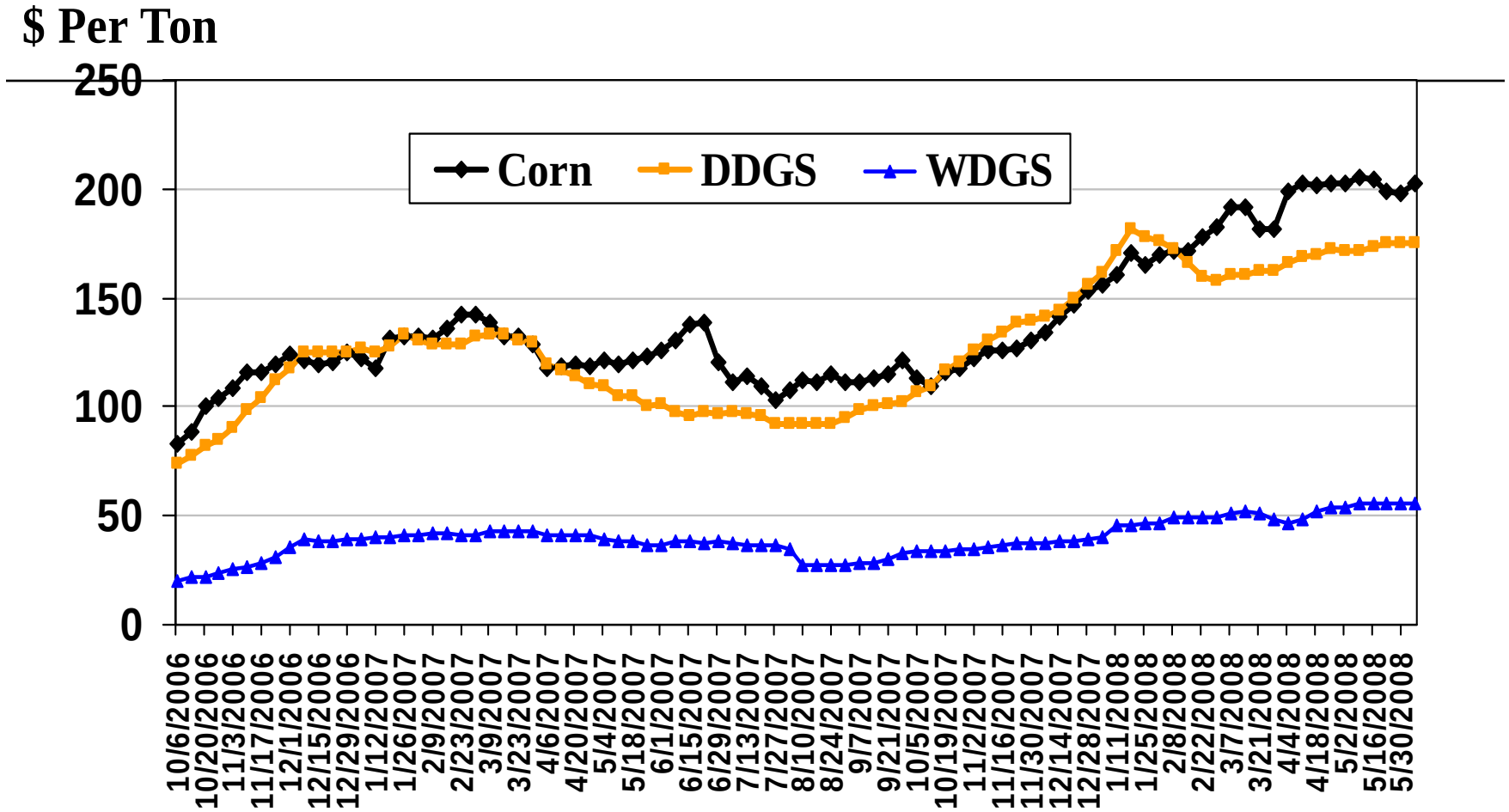
What's the next level?



The 1940s step raised corn price 62%; the 70s step 88%.
A 75% step will take corn to $4.15/bu

Impact on DDGS Prices

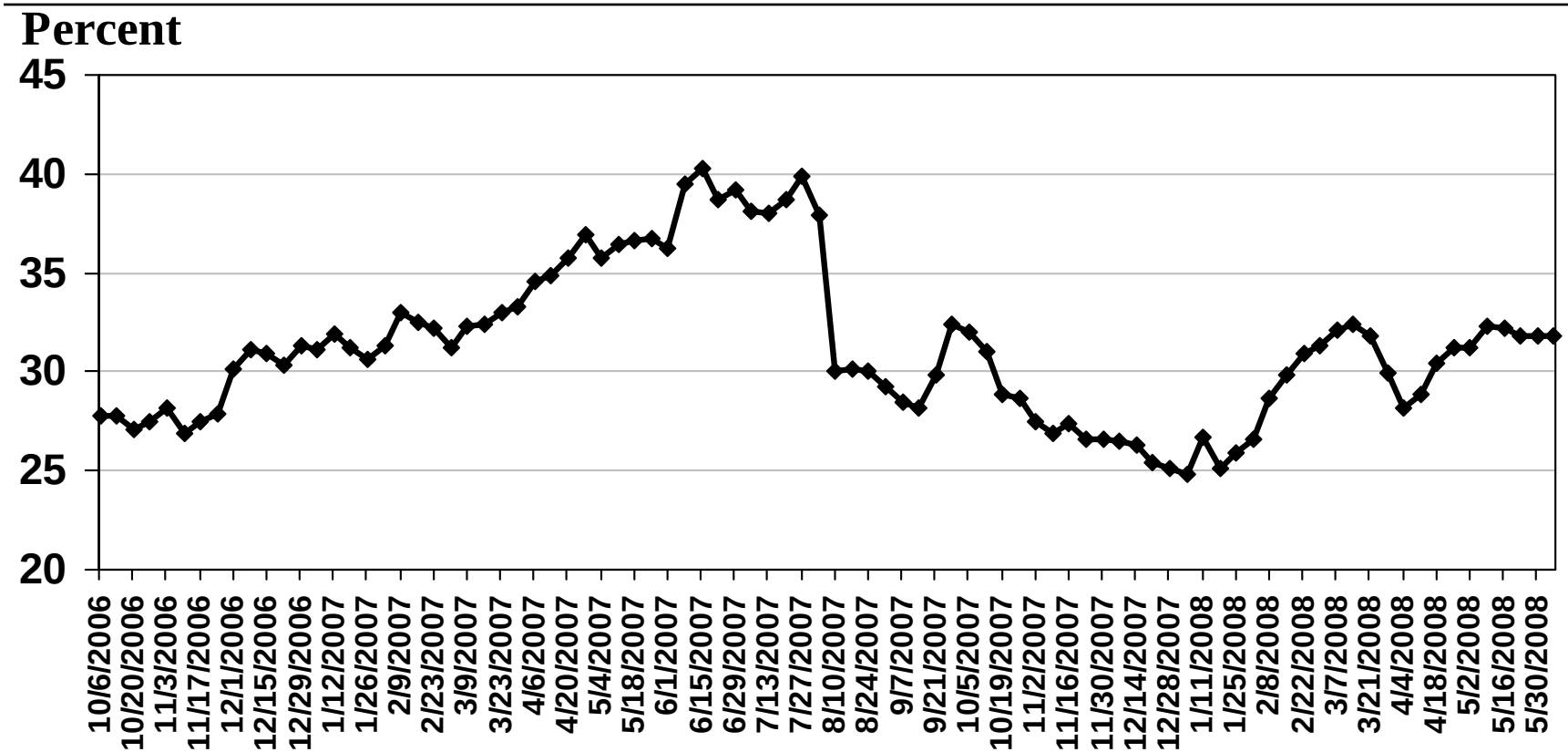
Northwest Iowa Prices, 2006-08



Source: LMIC

WDGS Price as % of DDGS Price,

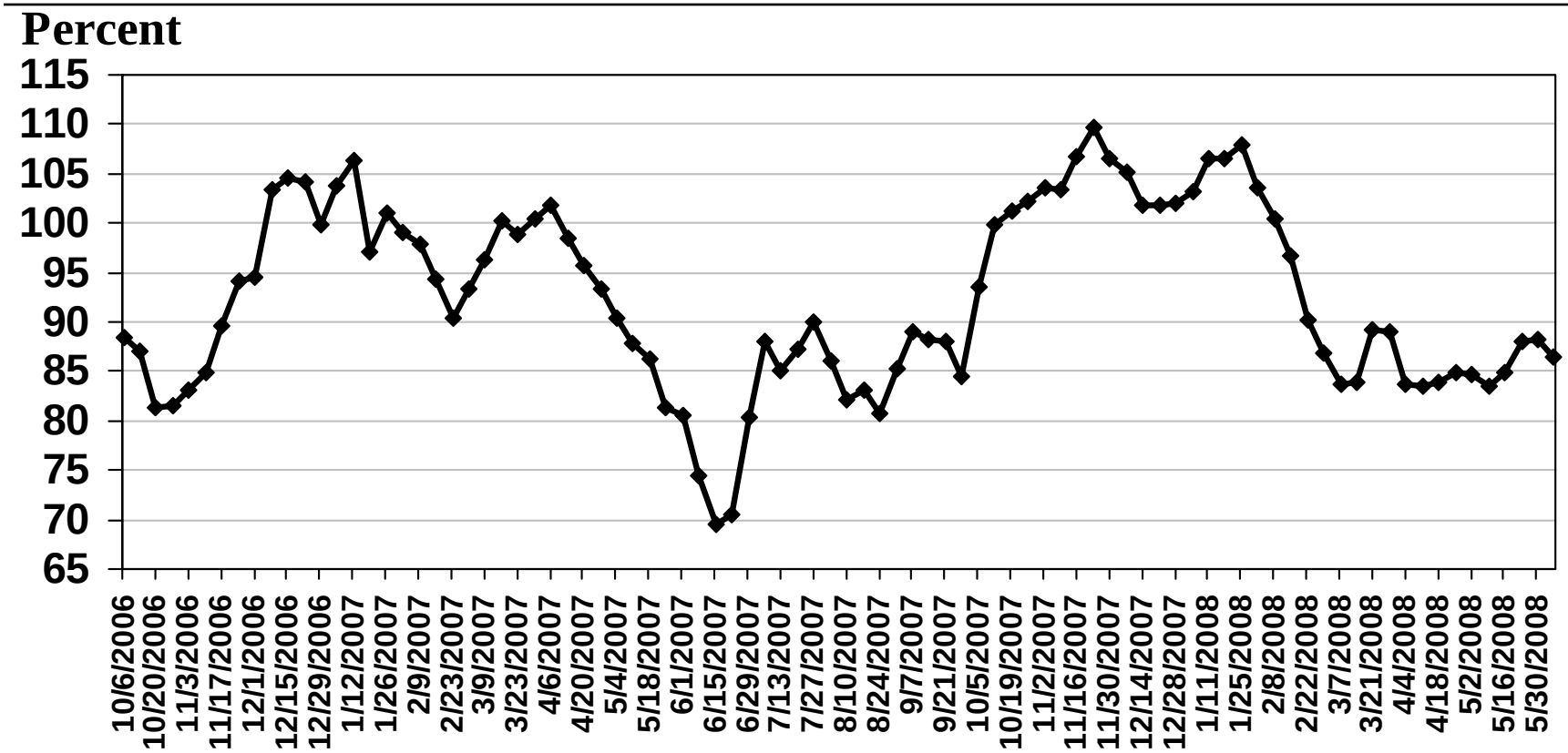
Northwest Iowa, 2006-08



Source: LMIC

DDGS Price as % of Corn Price,

Northwest Iowa, 2006-08

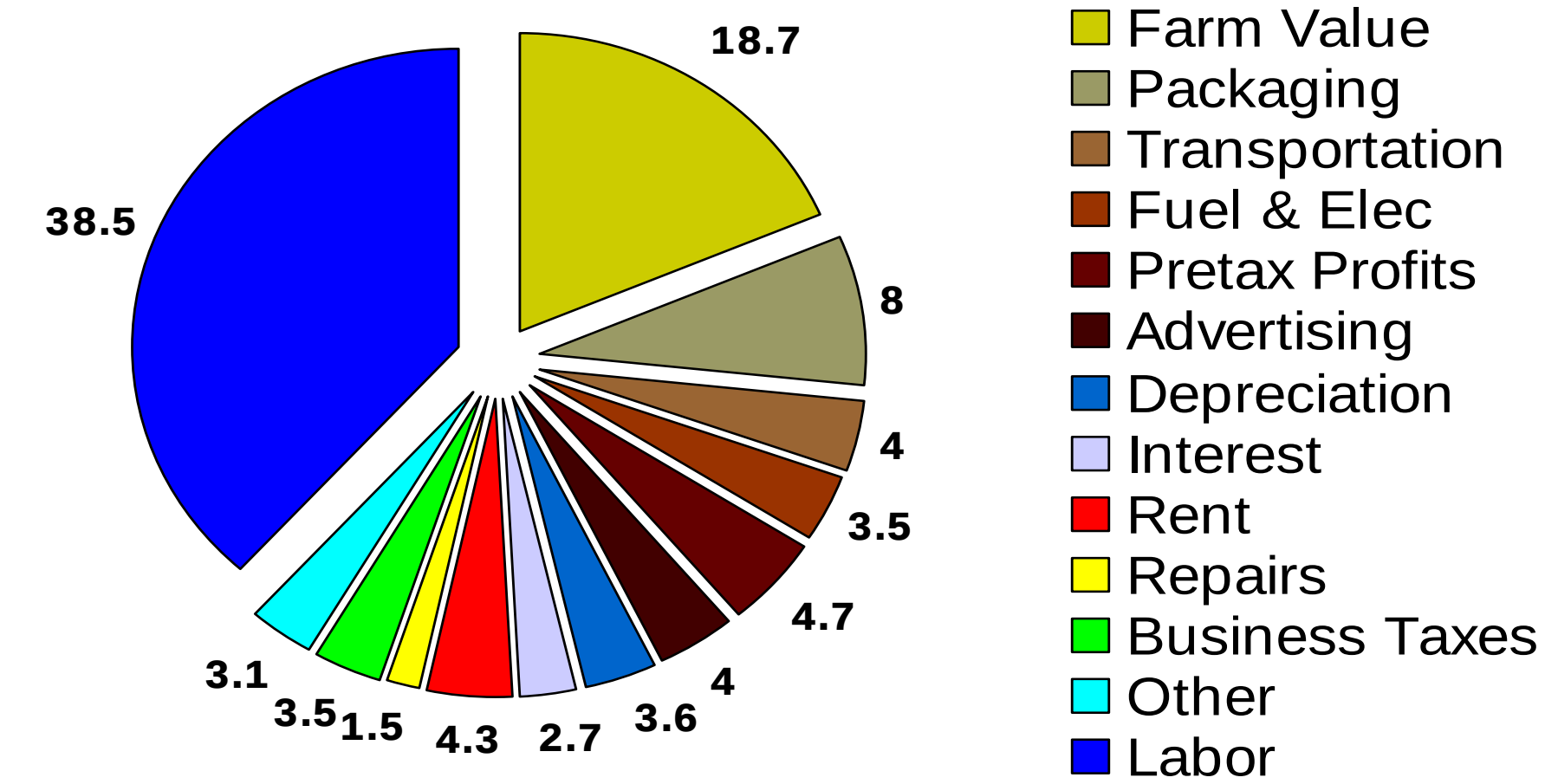


Source: LMIC

Ethanol's Impact on Food Prices

- Primary
  - Through corn products
- Secondary
  - Through animal products
- Tertiary
  - Through competitive crops
    - More corn acres = fewer acres for other crops

Food Marketing Bill

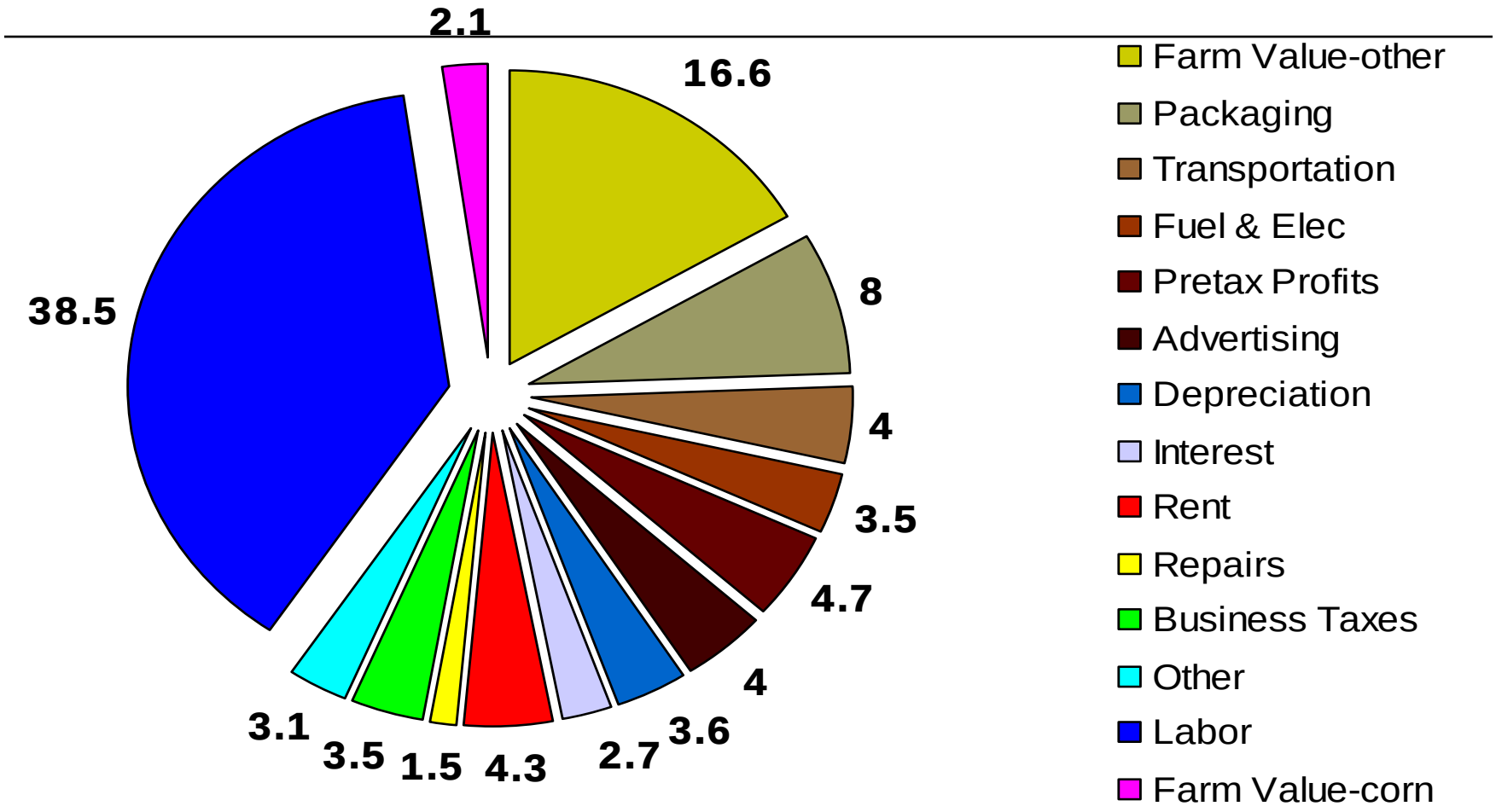


Source: USDA/ERS data for 2002

Impact on Food Prices

In 2002, the farm value of U.S. consumer food expenditures was 18.7%. Corn made up 11.3% of that farm value. Thus, corn, directly and mostly indirectly, accounted for 2.1% of consumer food expenditures.

Food Marketing Bill



Source: USDA/ERS data for 2002

Impact on Food Prices

Since corn only accounted for 2.1% of consumer food expenditures, doubling corn prices should raise the cost of food by 2.1%; tripling the price of corn should raise the cost of food by 4.2%.

Impact on Food Prices

American spend 10% of their disposable personal income on food. A 4.2% increase in food costs due to a tripling in corn prices should increase the cost of living by 0.42%.

Food Prices, April 08 vs April 07

Food		+ 5.1%
At home	+5.9%	
Away from home	+4.1%	
Cereals & bakery		+ 8.9%
Meat, poultry, fish & eggs		+ 3.7%
Dairy		+11.8%
Fats & oils		+12.3%
Sugar & sweets		+ 5.1%
Fruits & vegetables		+ 4.1%

Impact on crop acres

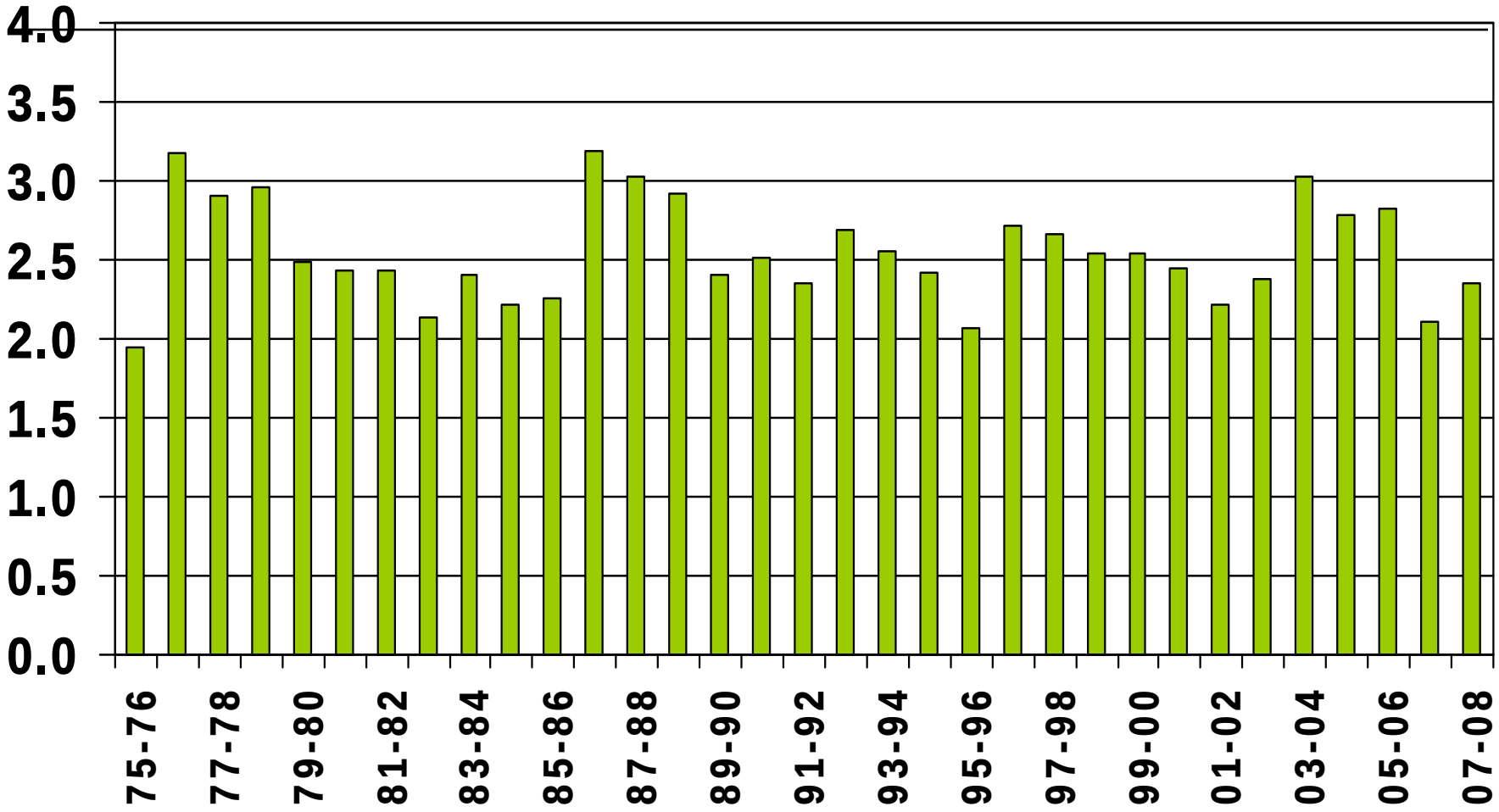
Million Acres Planted by Crop

	2006	2007	Change
Corn	78.327	93.600	+ 15.273
Soybeans	75.522	63.631	- 11.891
Wheat	57.344	60.433	+ 3.089
Cotton	15.274	10.830	- 4.444
Sorghum	6.522	7.718	+ 1.196
Oats	4.168	3.760	- 0.408
Barley	3.452	4.020	+ 0.568
18 crops	315.835	319.990	+ 4.030

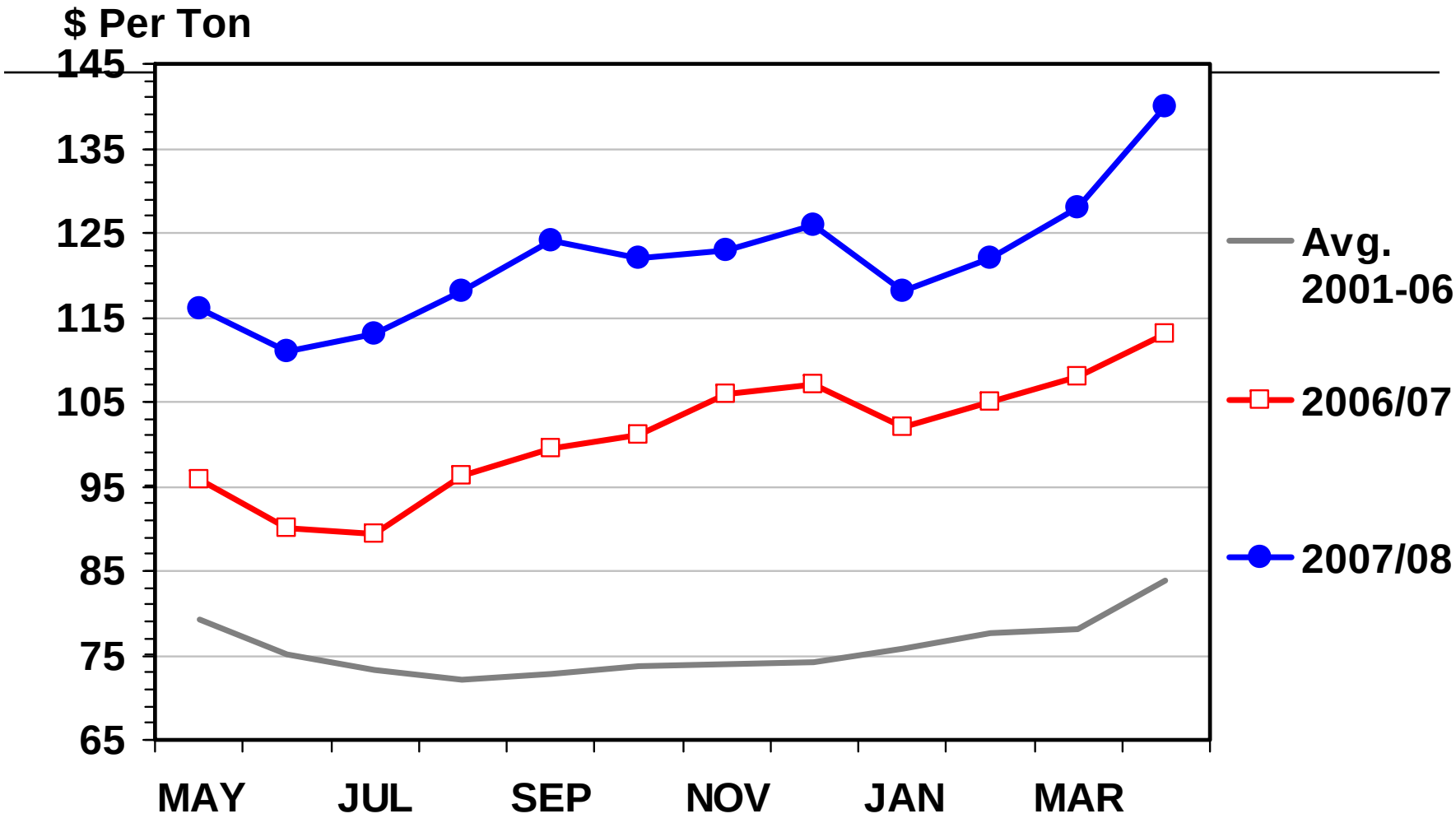
July 08 Corn Futures

July 08 Soybean Futures

U.S. Soybean/Corn Price Ratio, 1975-08

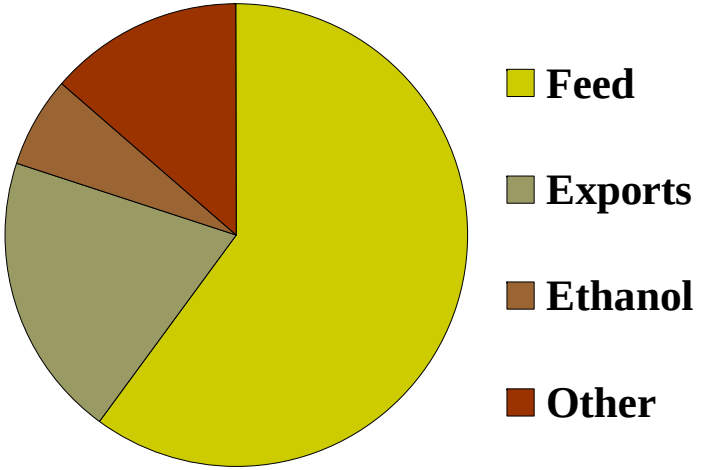


Average Price Non-Alfalfa Hay

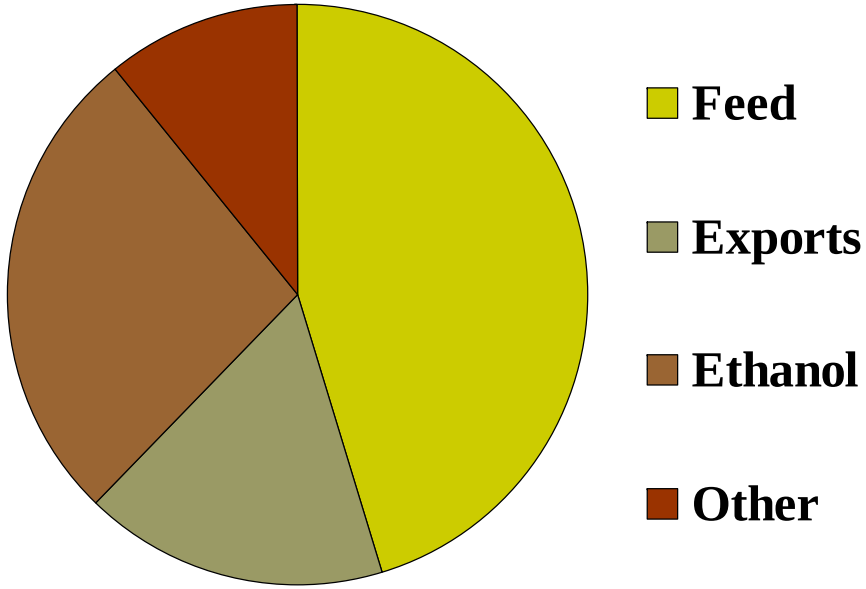


Impact on livestock

U.S. Corn Usage



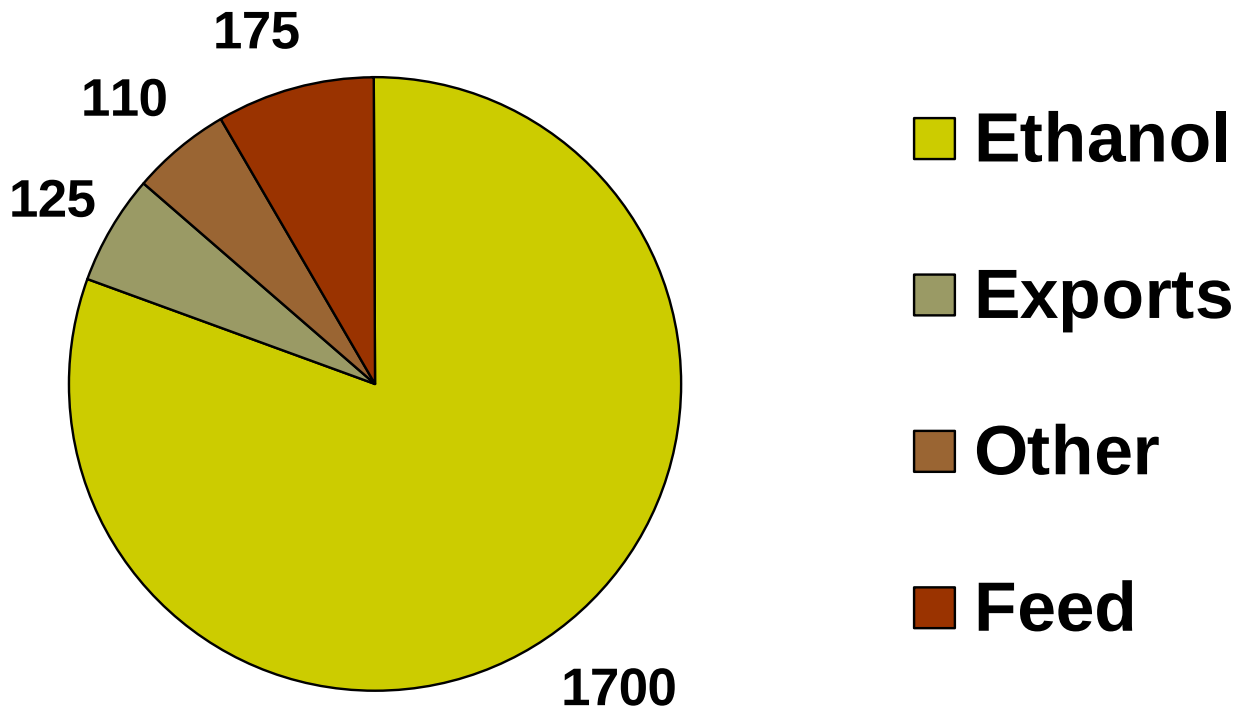
2000 crop



2007 crop

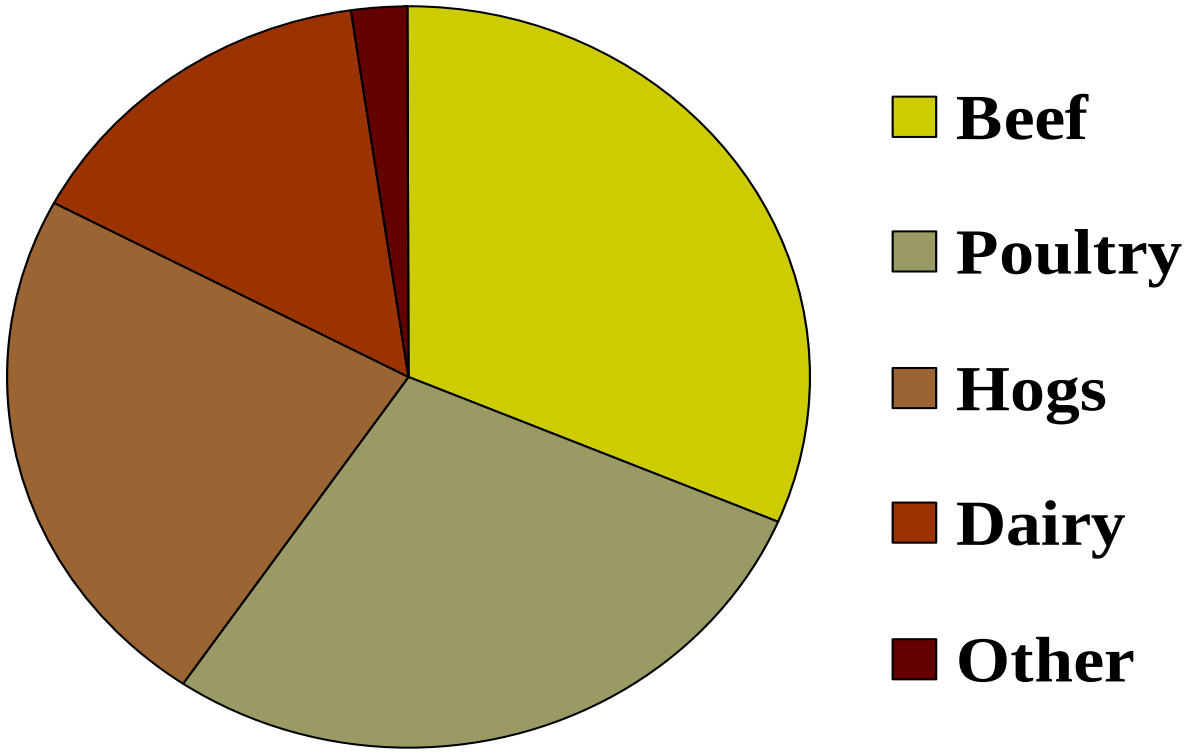
Corn usage is up 30% since 2000

FORECAST CHANGE IN CORN USAGE 2007-17 (million bushels)



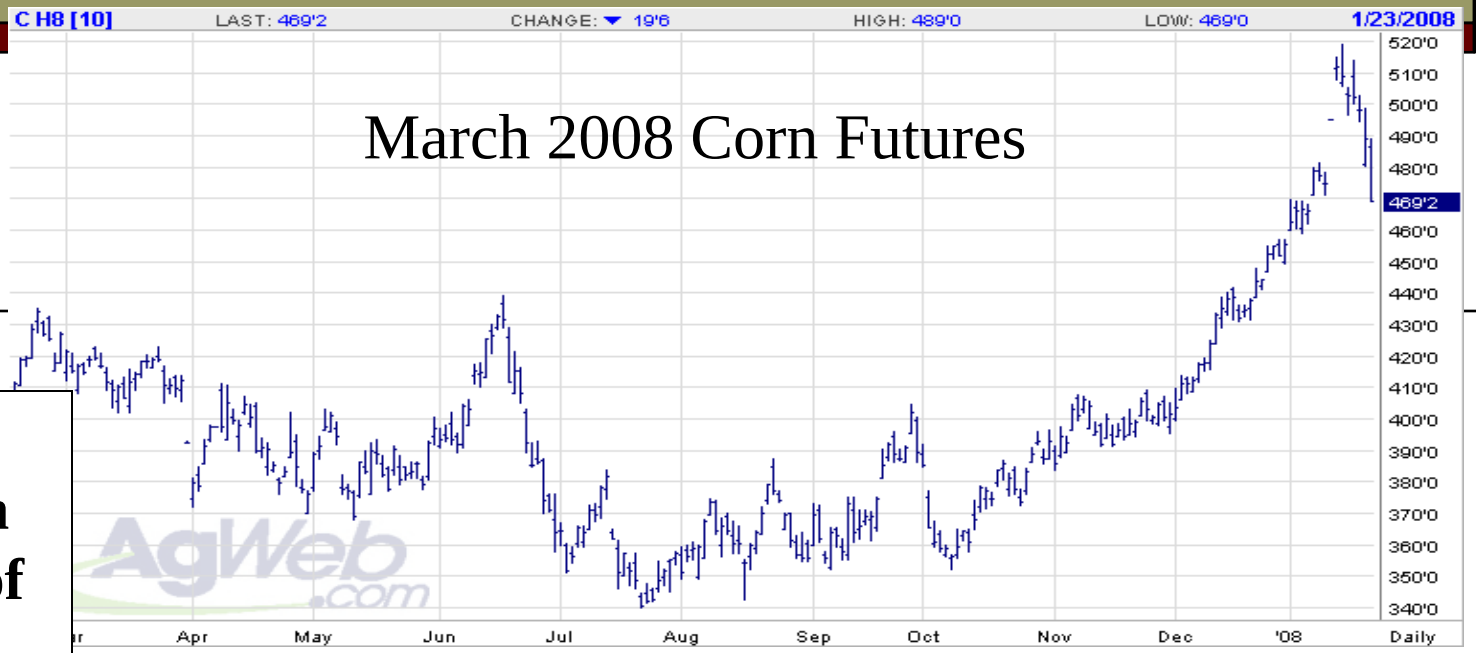
Source: February 2008 USDA Agricultural Baseline Projections

U.S. Feeding of Corn, 2005-06

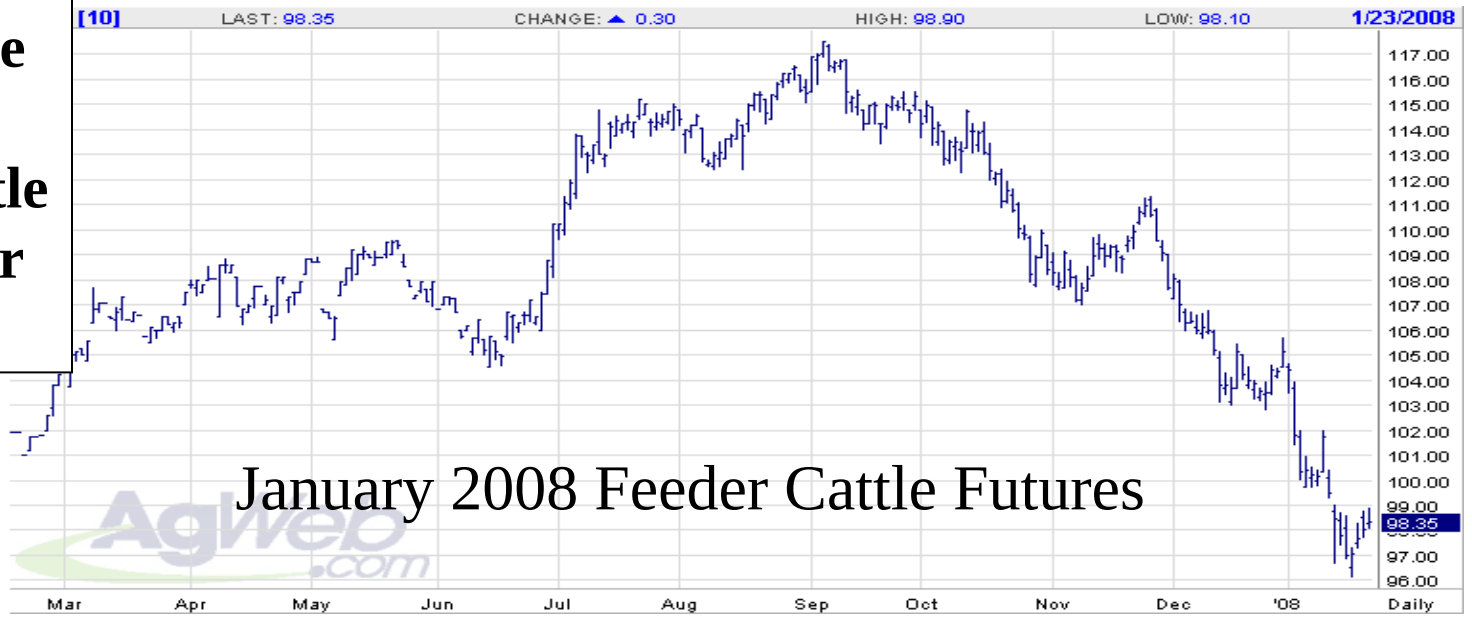


Source: PRX ProExporter Network

A dime increase in the price of corn reduces the value of feeder cattle by $6-9 per head



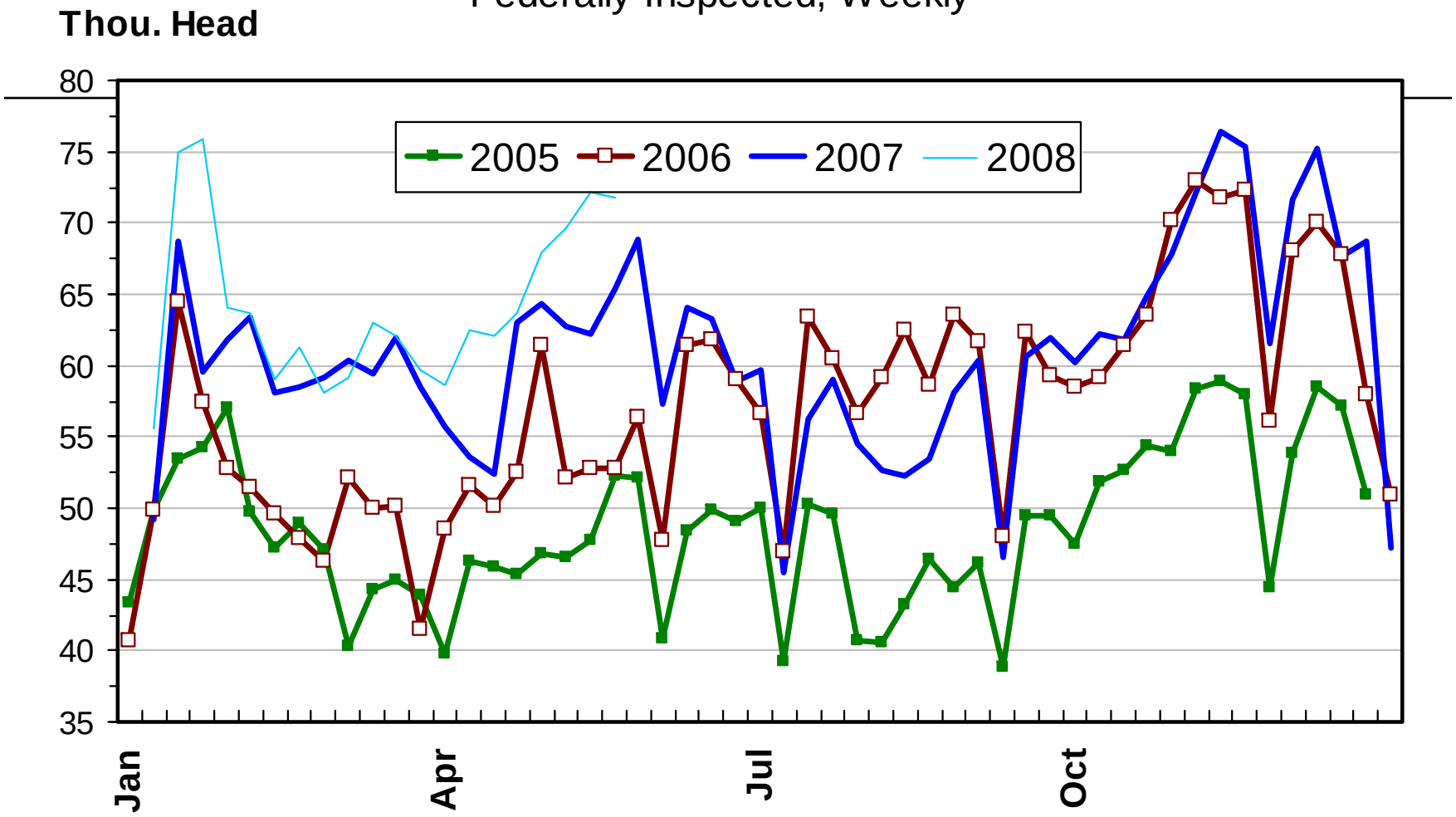
March 2008 Corn Futures



January 2008 Feeder Cattle Futures

Beef Cow Slaughter

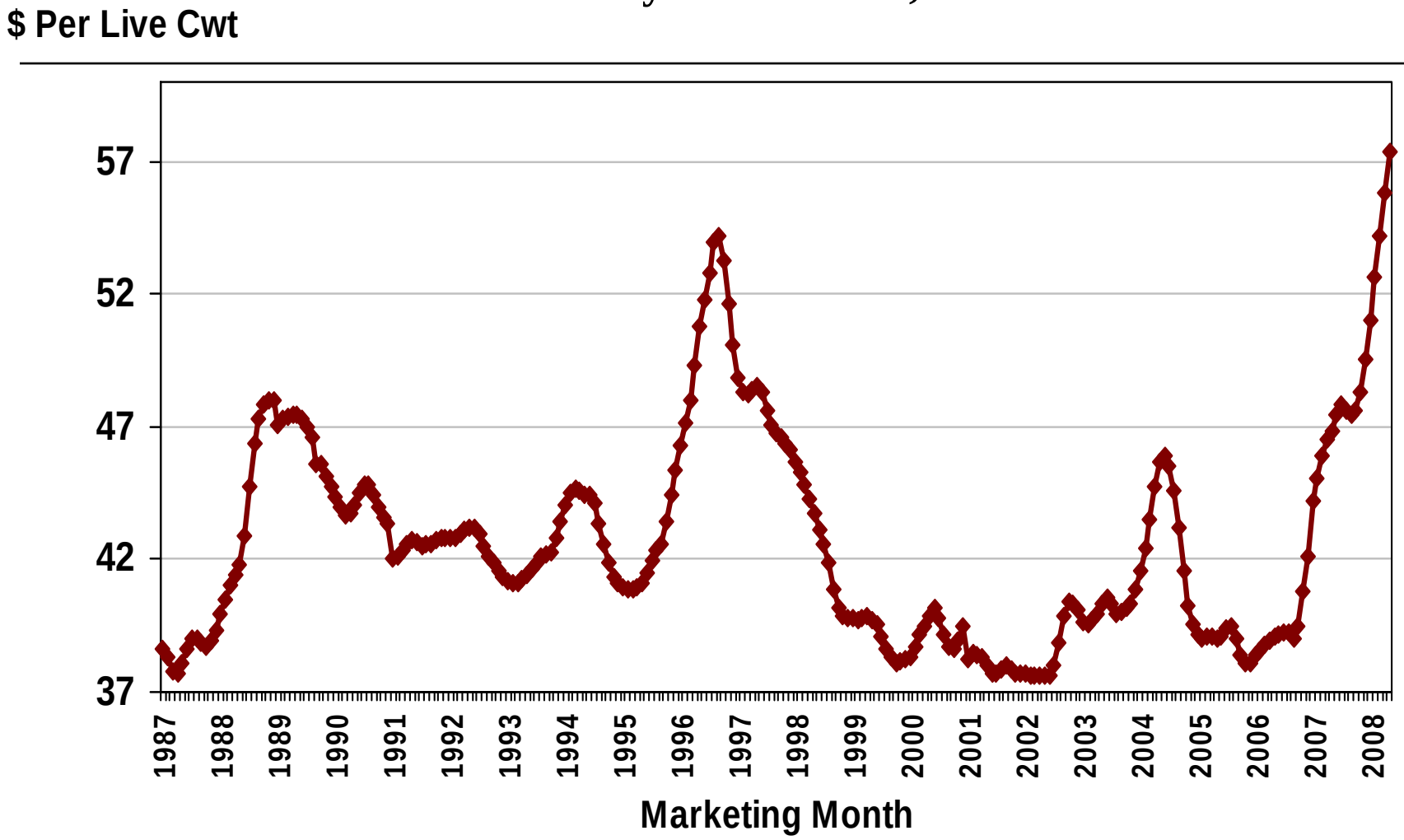
Federally Inspected, Weekly



2008 cow slaughter is up 4.2%

Cost of Slaughter Hog Production

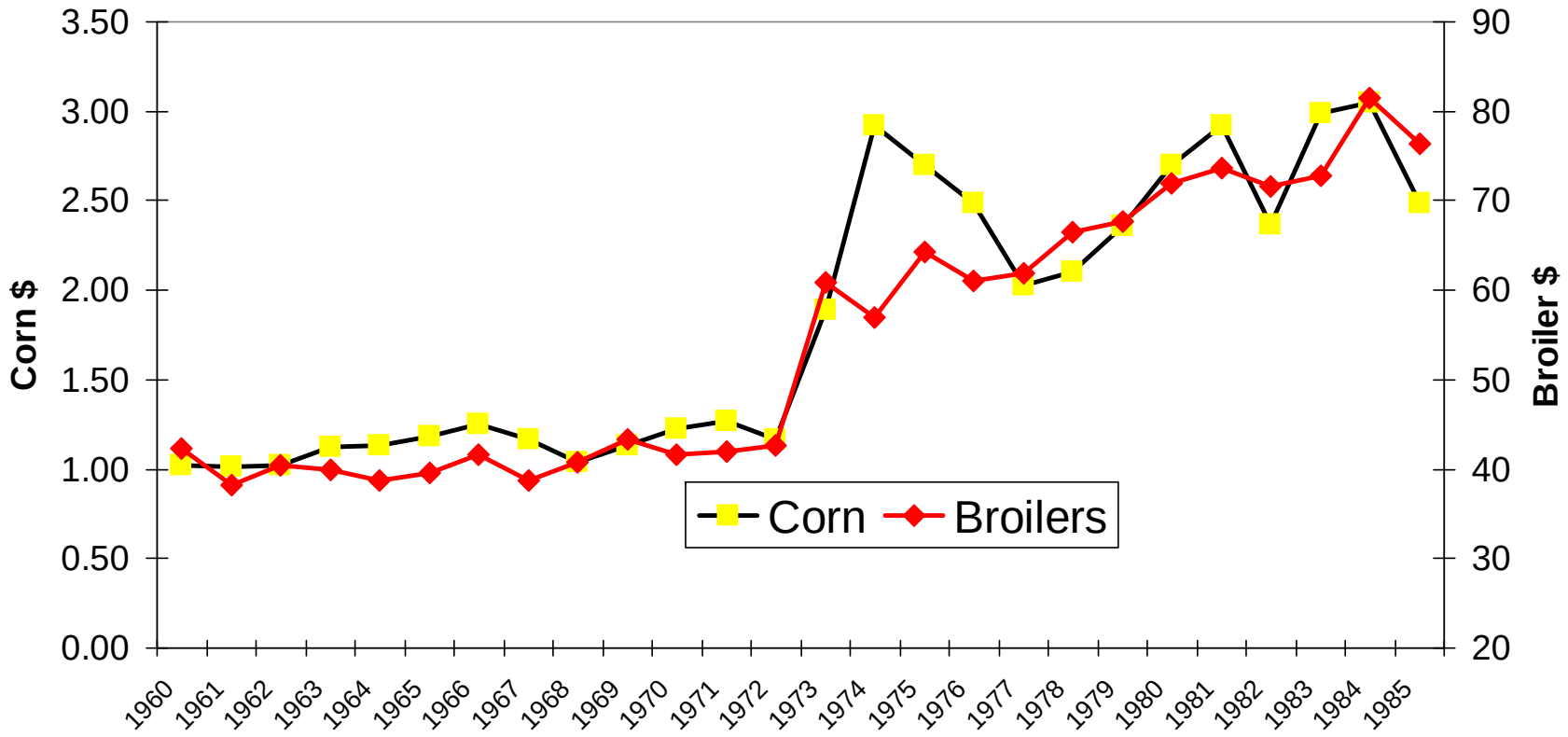
Iowa State University Calculations, 1987-2008



Source: John Lawrence, Iowa State University

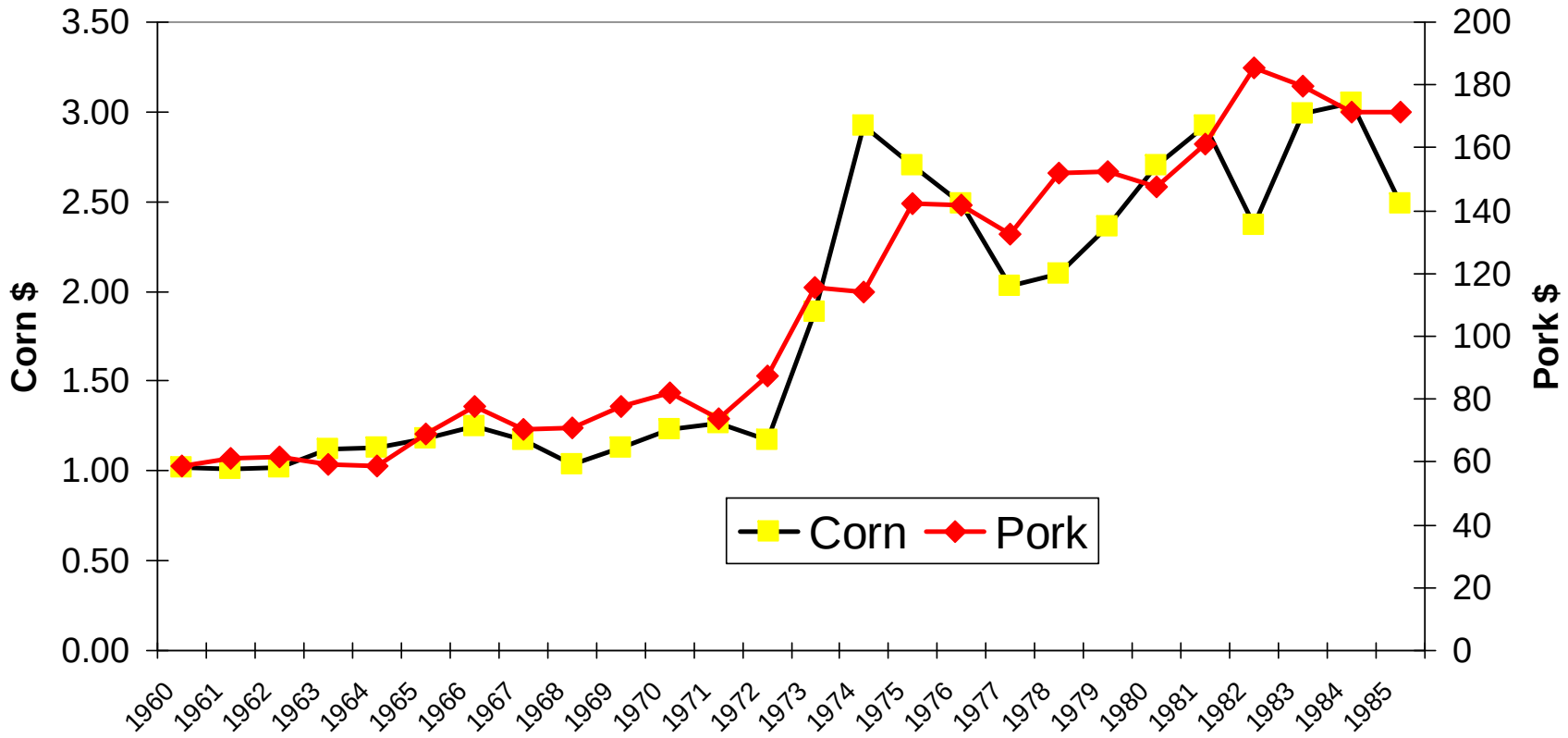
Over time, the price of a commodity will equal the cost of production

U.S. Average Corn & Broiler Price, 1960-1985



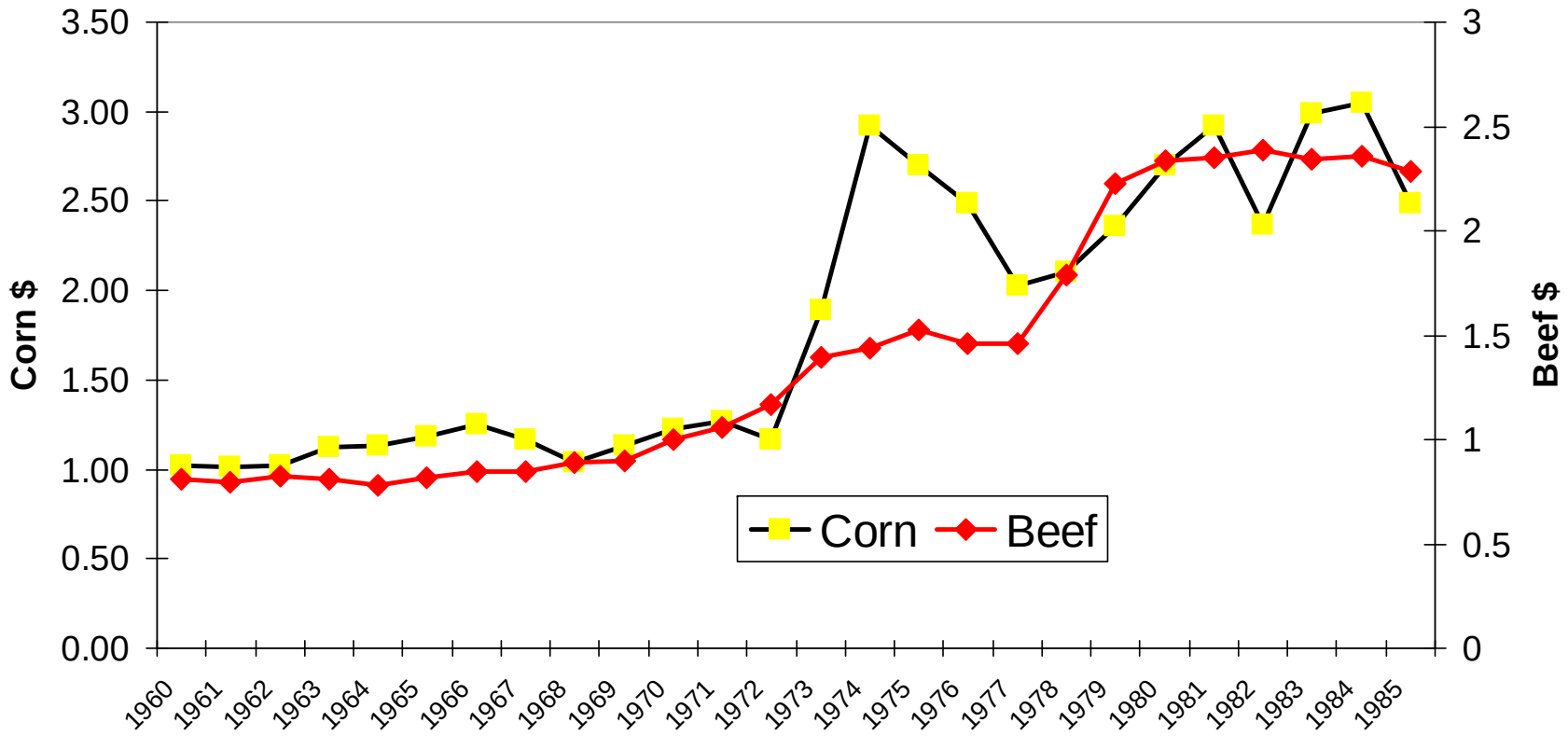
Source: USDA/NASS

U.S. Average Corn & Pork Price, 1960-1985



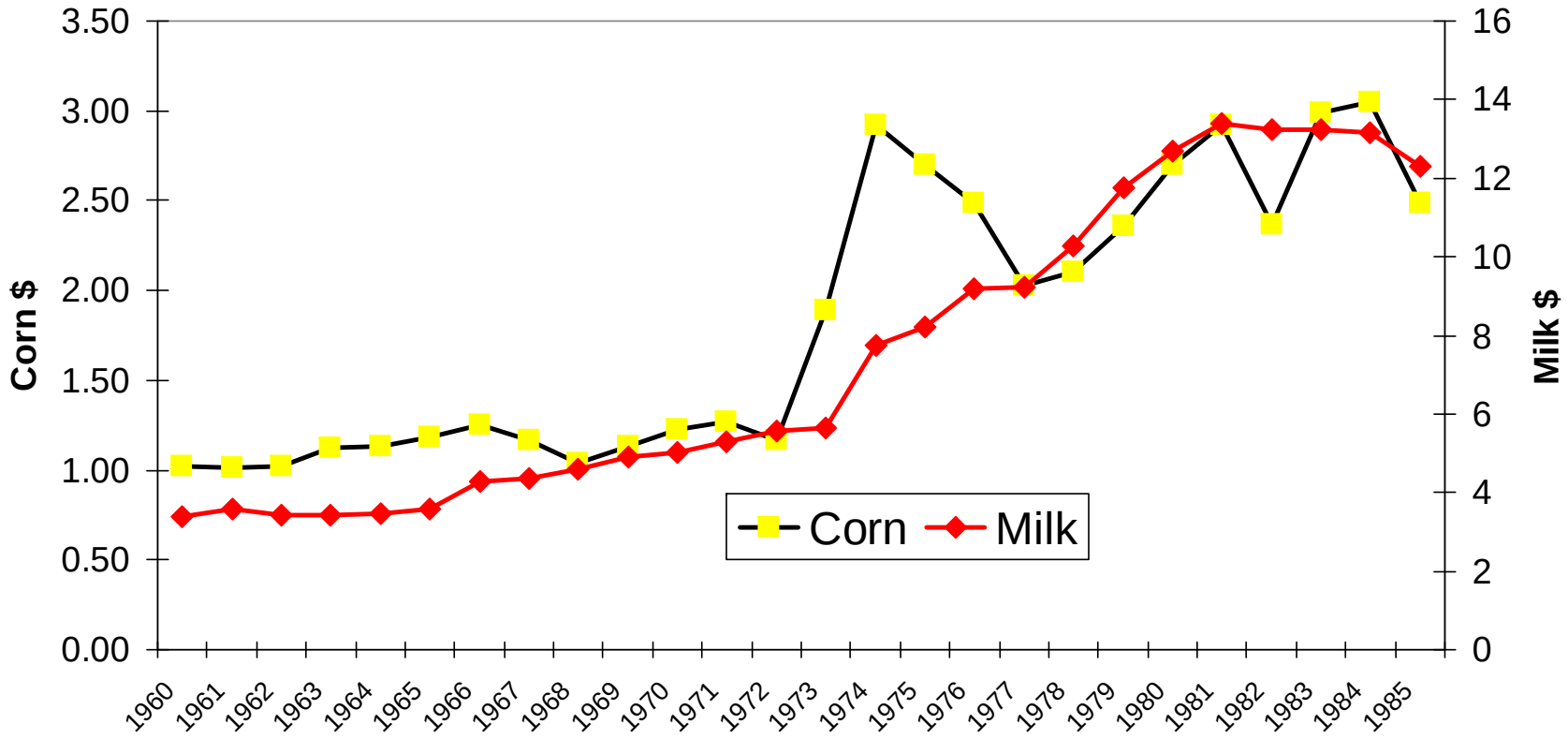
Source: USDA/NASS

U.S. Average Corn & Beef Price, 1960-1985



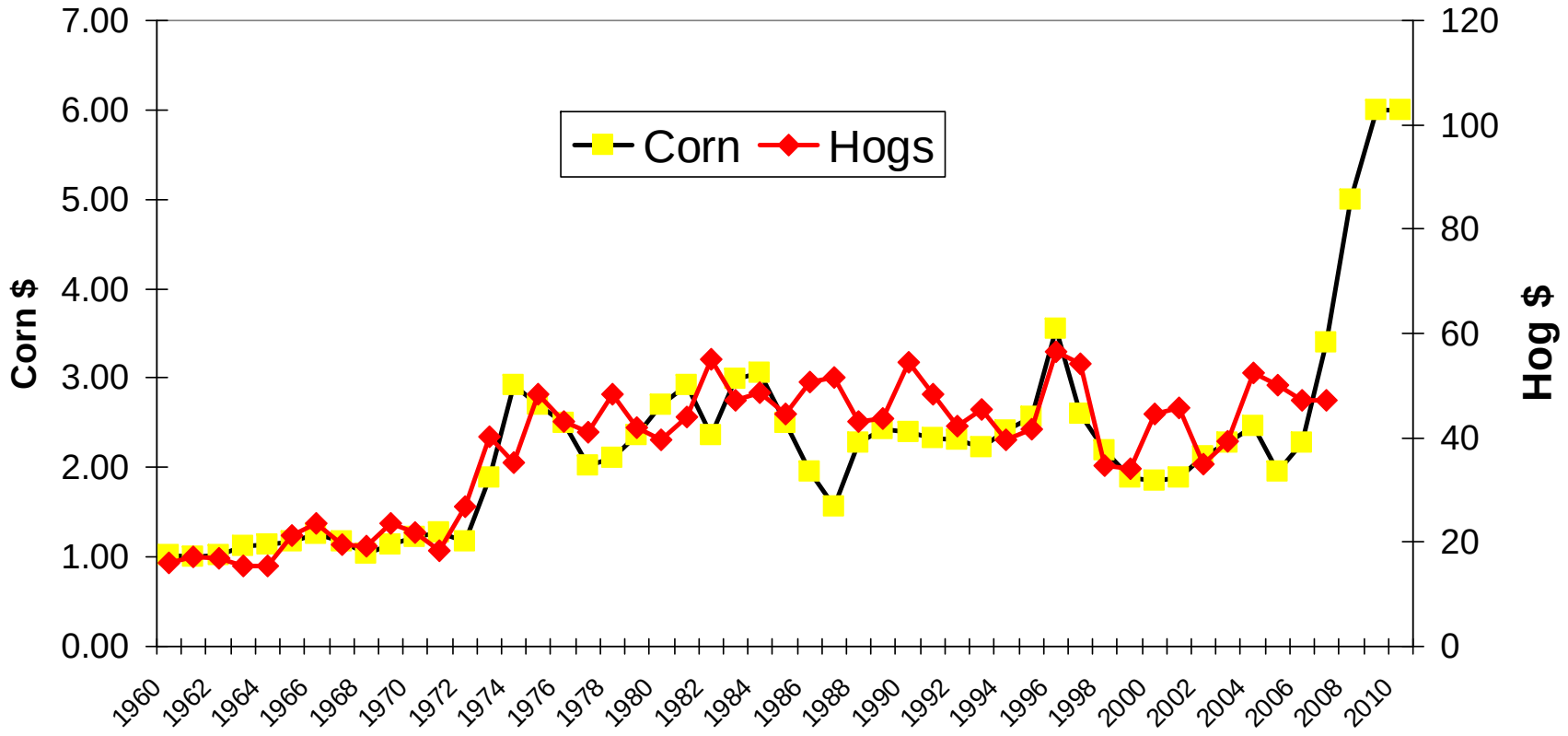
Source: USDA/NASS

U.S. Average Corn & Milk Price, 1960-1985



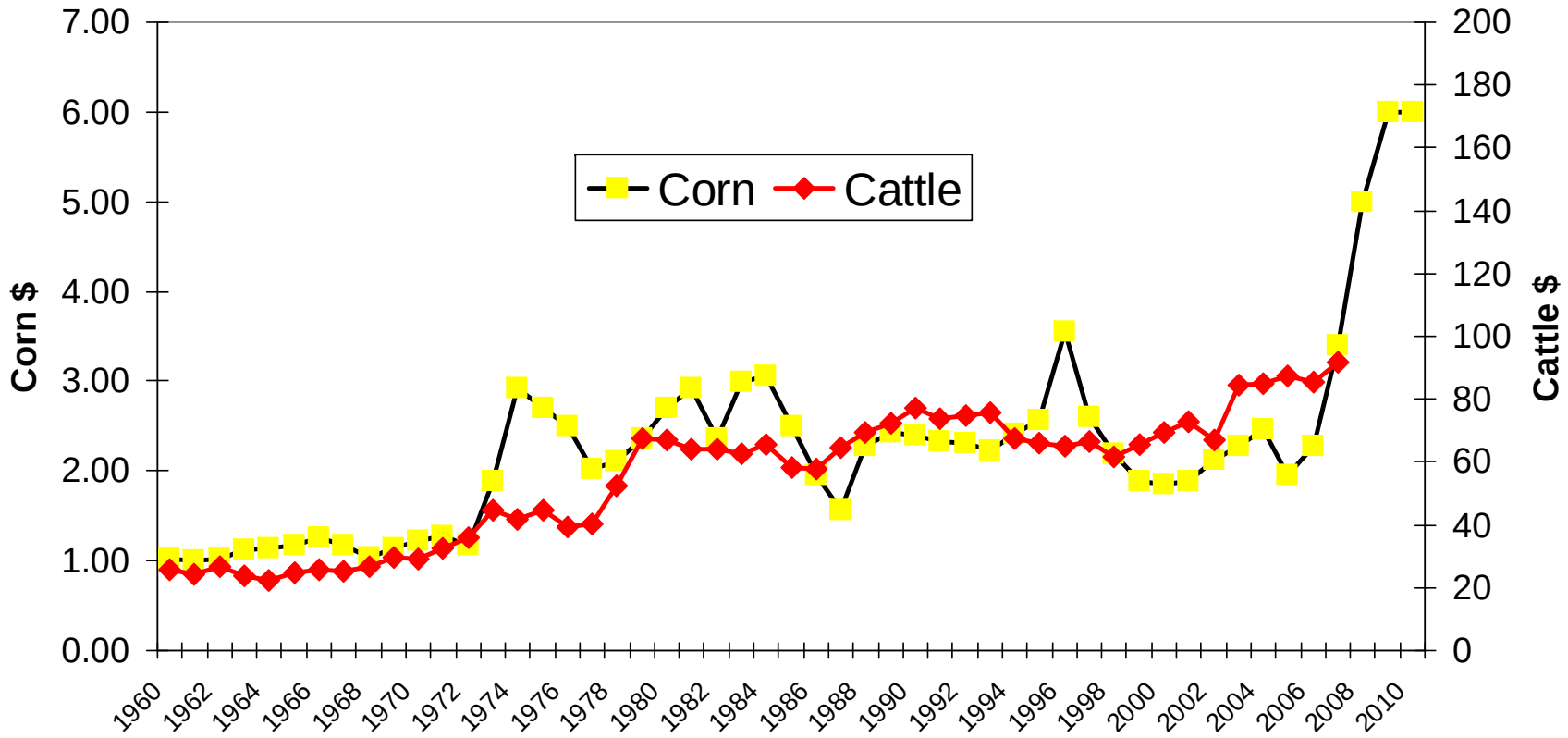
Source: USDA/NASS

U.S. Average Corn & Hog Price, 1960-2007



Source: USDA/NASS

U.S. Average Corn & Cattle Price, 1960-2007

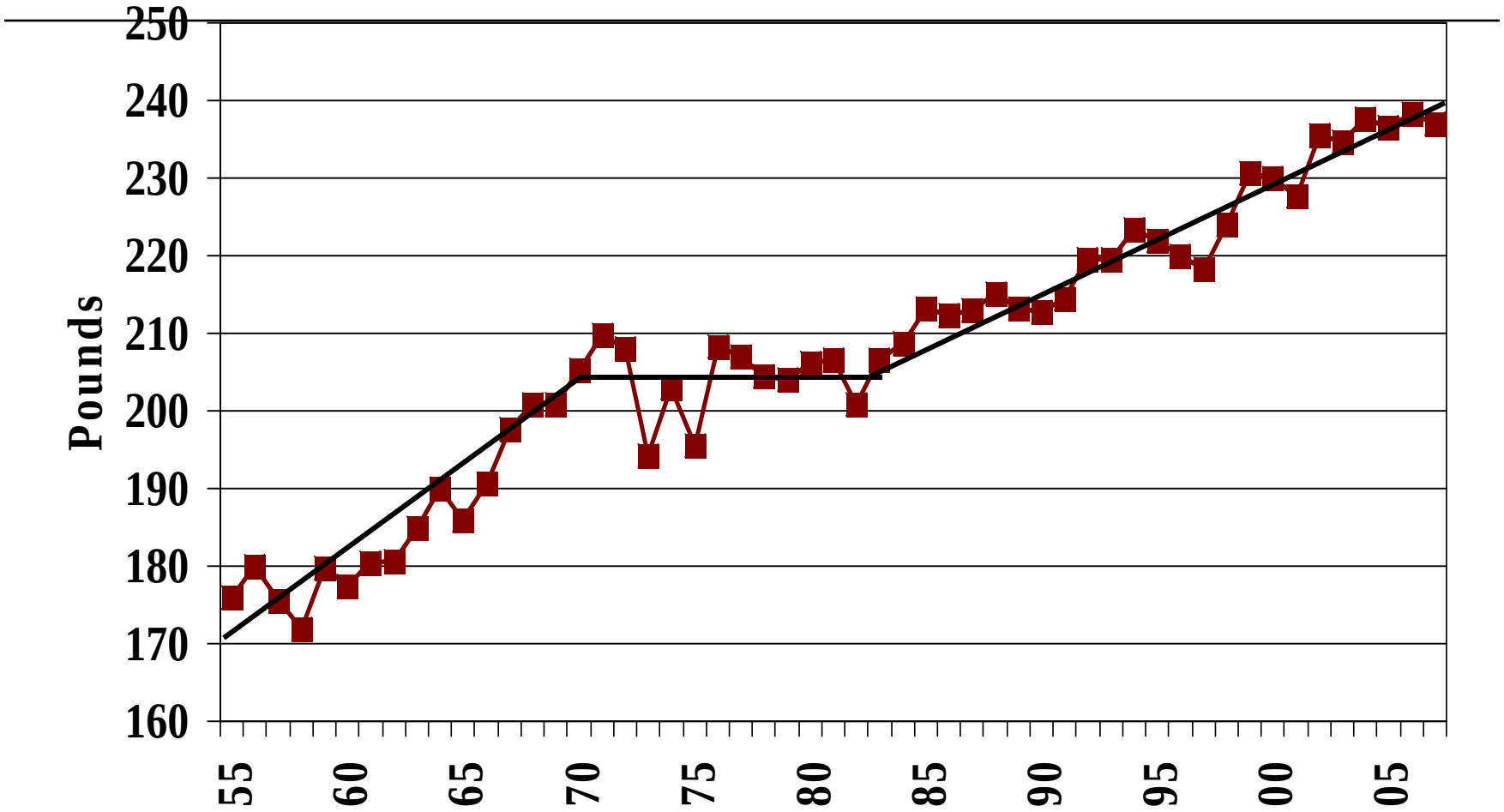


Source: USDA/NASS

Meat Consumption

U.S. Per Capita Meat Consumption

Retail Weight, 1955-2007



Impact of Ethanol

- Building lots of ethanol plants
- Driving up corn prices
  - More corn acres
  - Fewer acres of other crops
    - Higher prices for other crops
  - Record net farm income
- Driving up cash rents and land prices
- Driving up livestock production costs
  - Less meat, milk and eggs being produced
- Lots of DDGS will benefit cattle
- New grain storage/shipping patterns

The New Ag Market?

- Crude oil drives ethanol prices
- Ethanol drives corn prices
- Corn drives livestock production
- Livestock production drives meat prices

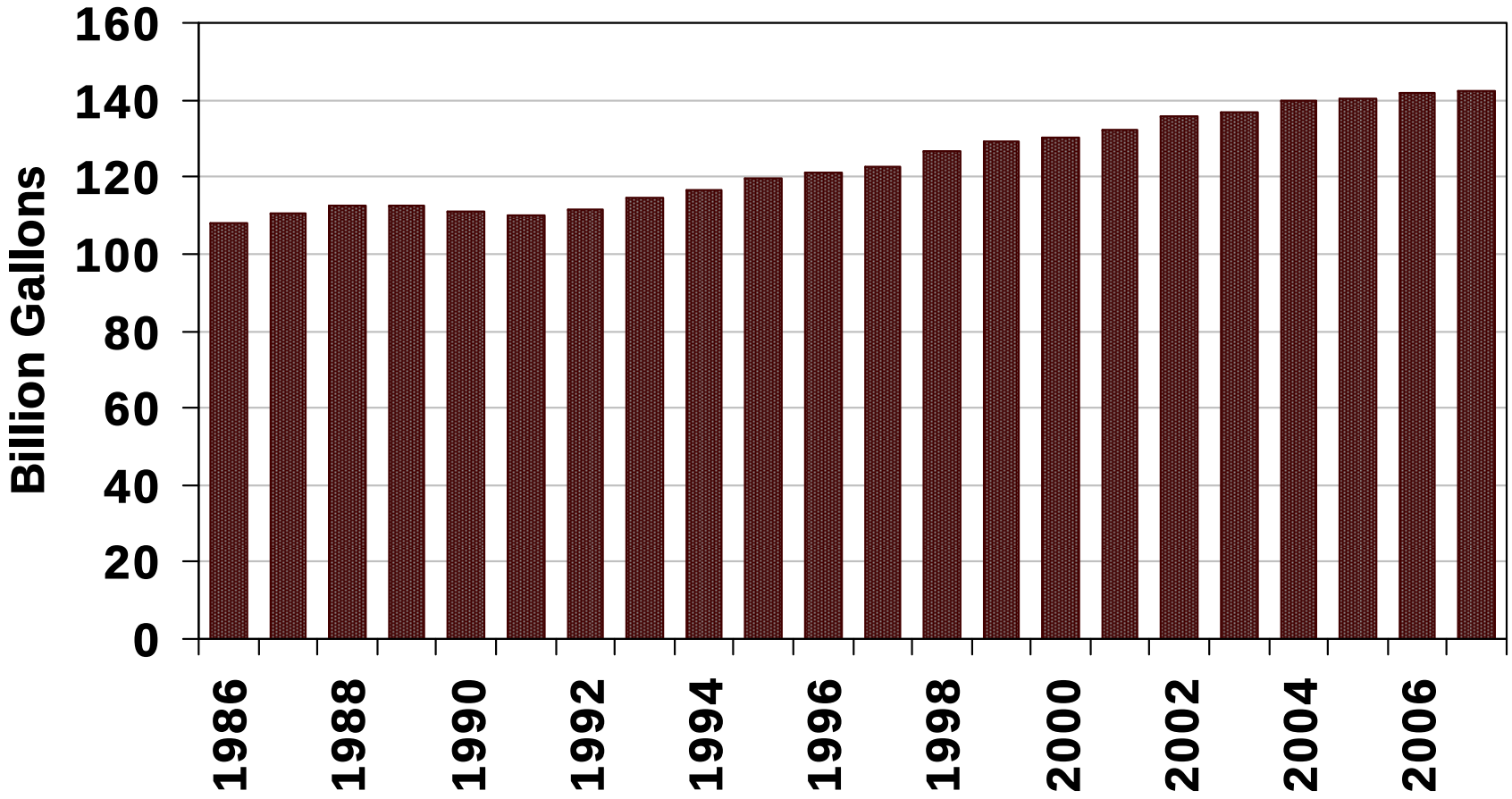
Impact on Oil Prices

Spot Crude Oil Prices 1996-2008

WTI, Cushing, Oklahoma

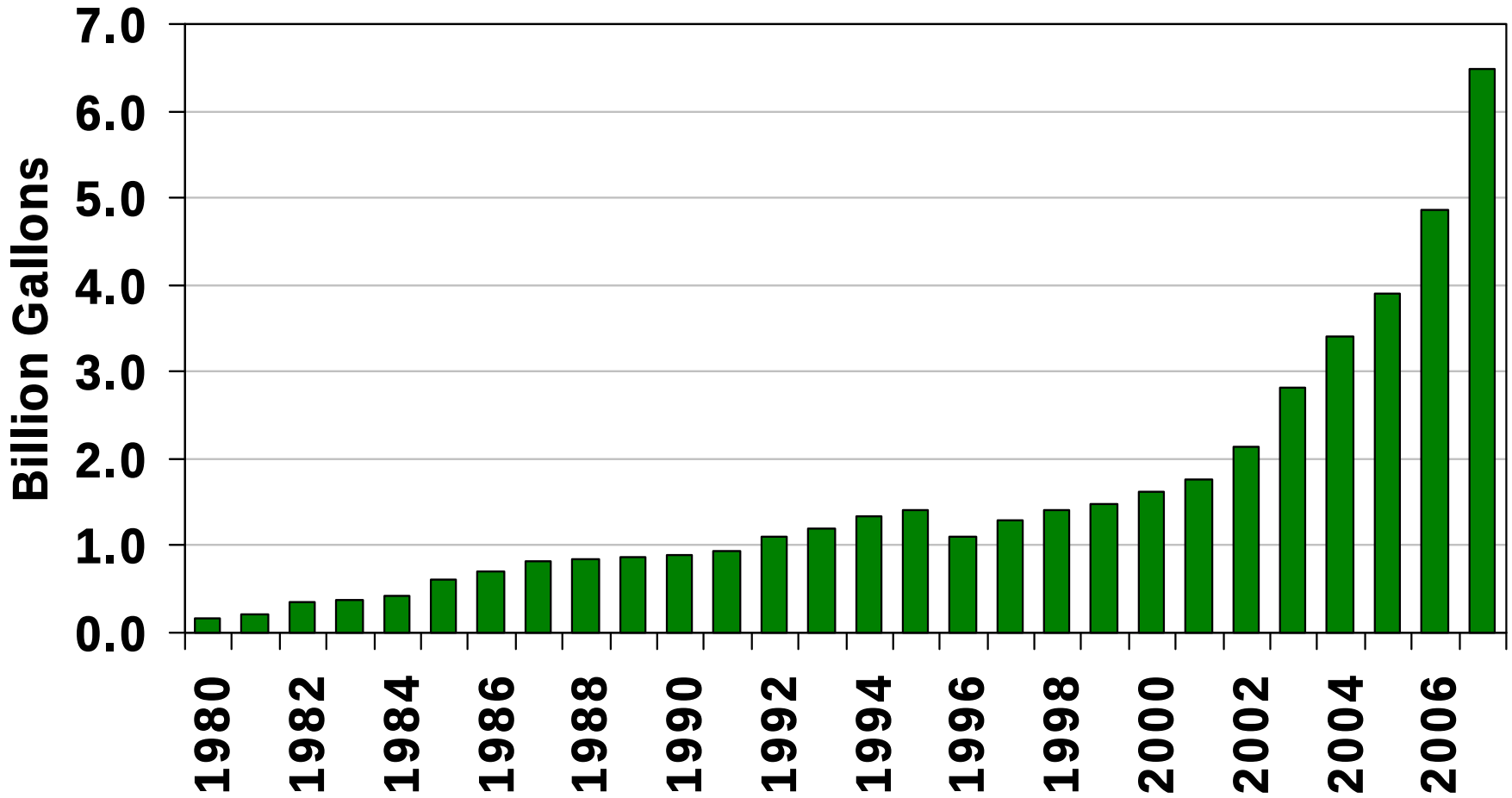
Source: U.S. Energy Information Administration

U.S. Gasoline Usage, 1986-07



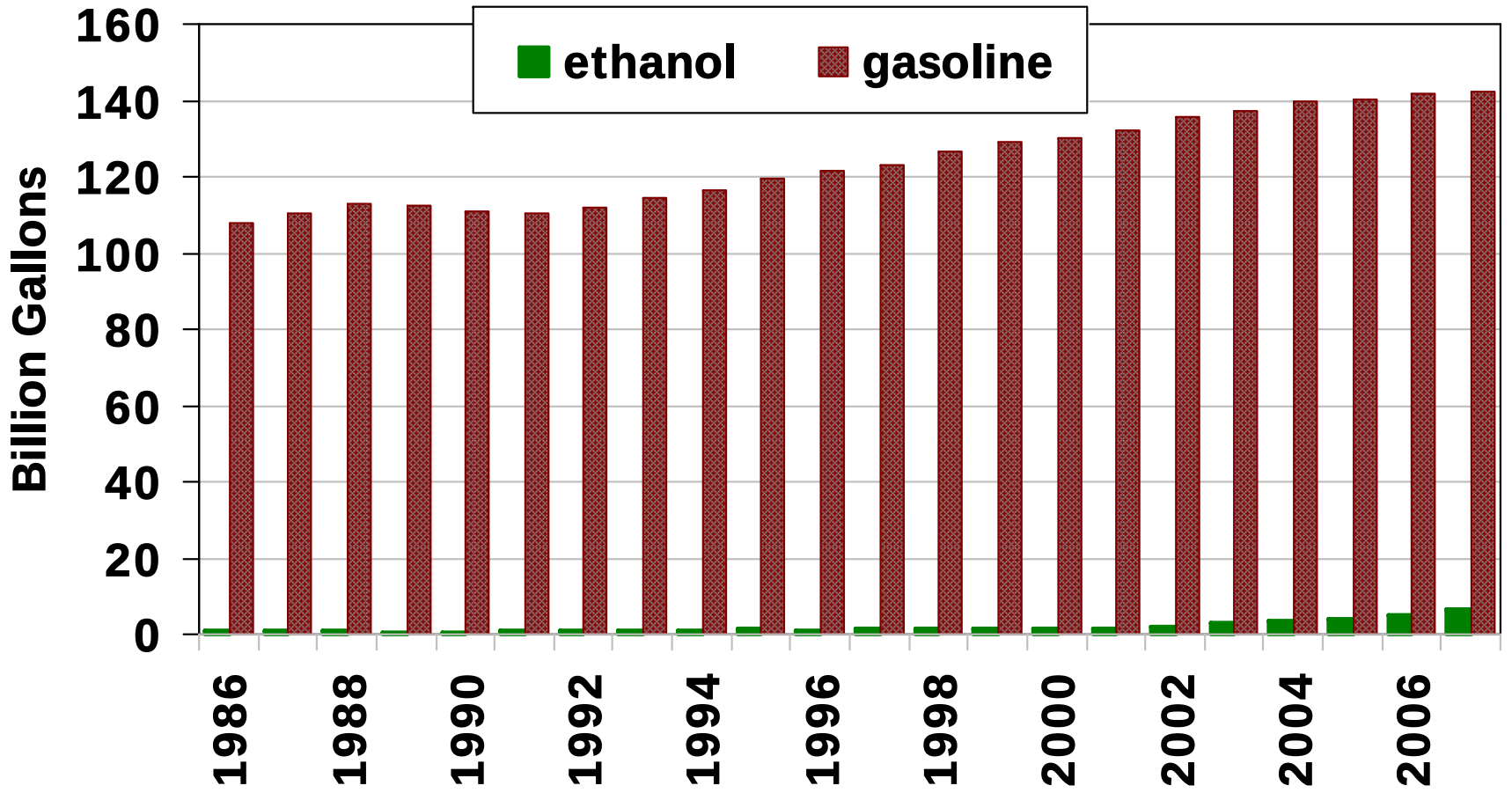
Source: U.S. Energy Information Administration

Ethanol Production, 1980-07



Source: Renewable Fuels Association

Gasoline & Ethanol Production, 1986-07



Source: U.S. Energy Information Administration

U.S. Gasoline Usage

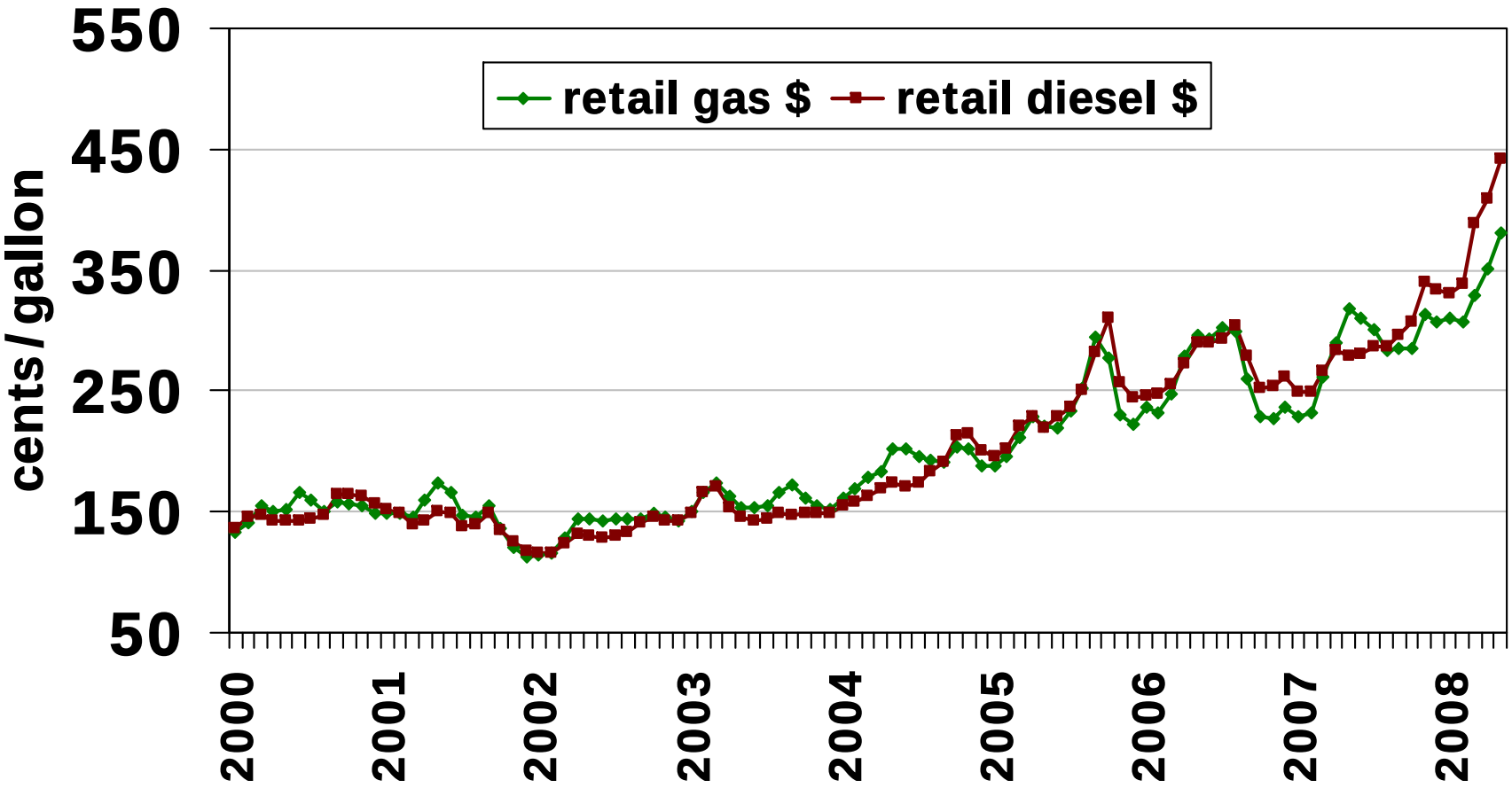
- 142 billion gallons gasoline used per year
- Mandating 10% ethanol in all gasoline would require that nearly half of the U.S. corn crop be processed into ethanol
- If all U.S. corn were made into ethanol, it would produce 33 billion gallons per year
- To replace all U.S. gasoline would require 78 billion bushels of corn annually

78 Billion Bushels of Corn

- Record U.S. corn yield is 160 bu/acre
- 78 billion bushels at 160 bu/acre would require 488 million harvested acres of corn
- Equals **164%** of 2007 U.S. harvested acreage of corn, soybeans, wheat, sorghum, cotton, rice, sunflowers, barley, oats, rye, peanuts, tobacco, canola, sugar beets, sugarcane, potatoes, dry edible beans, proso millet and hay **combined**.

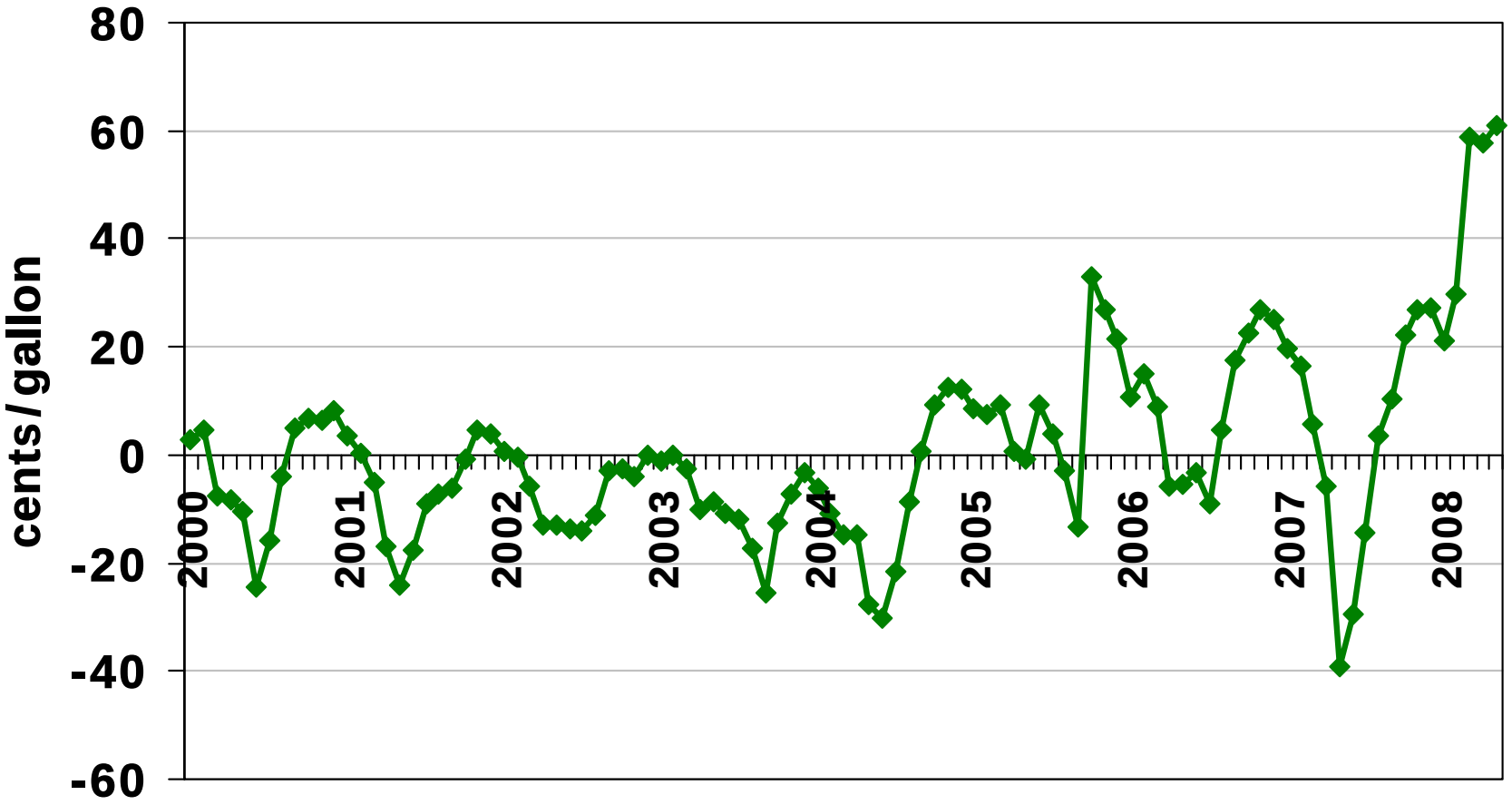
Diesel-Gasoline Price Spread

U.S. Retail Fuel Prices, 2000-2008



Source: U.S. Energy Information Administration

U.S. Retail Diesel-Gasoline Price Spread, 2000-2008



Source: U.S. Energy Information Administration

Gas-Diesel Price Spread

Crude oil yields roughly 58% gasoline and 30% diesel fuel.

- When gasoline demand is greater than 193% of diesel demand, gasoline prices are high relative to diesel
- When gasoline demand is less than 193% of diesel, gasoline prices are low relative to diesel

Impact on Environment

Ethanol: energy gain or loss?

The fossil fuel energy gain from ethanol in new dry milled plants is above 30%. This is higher than in the past because of efficiency gains

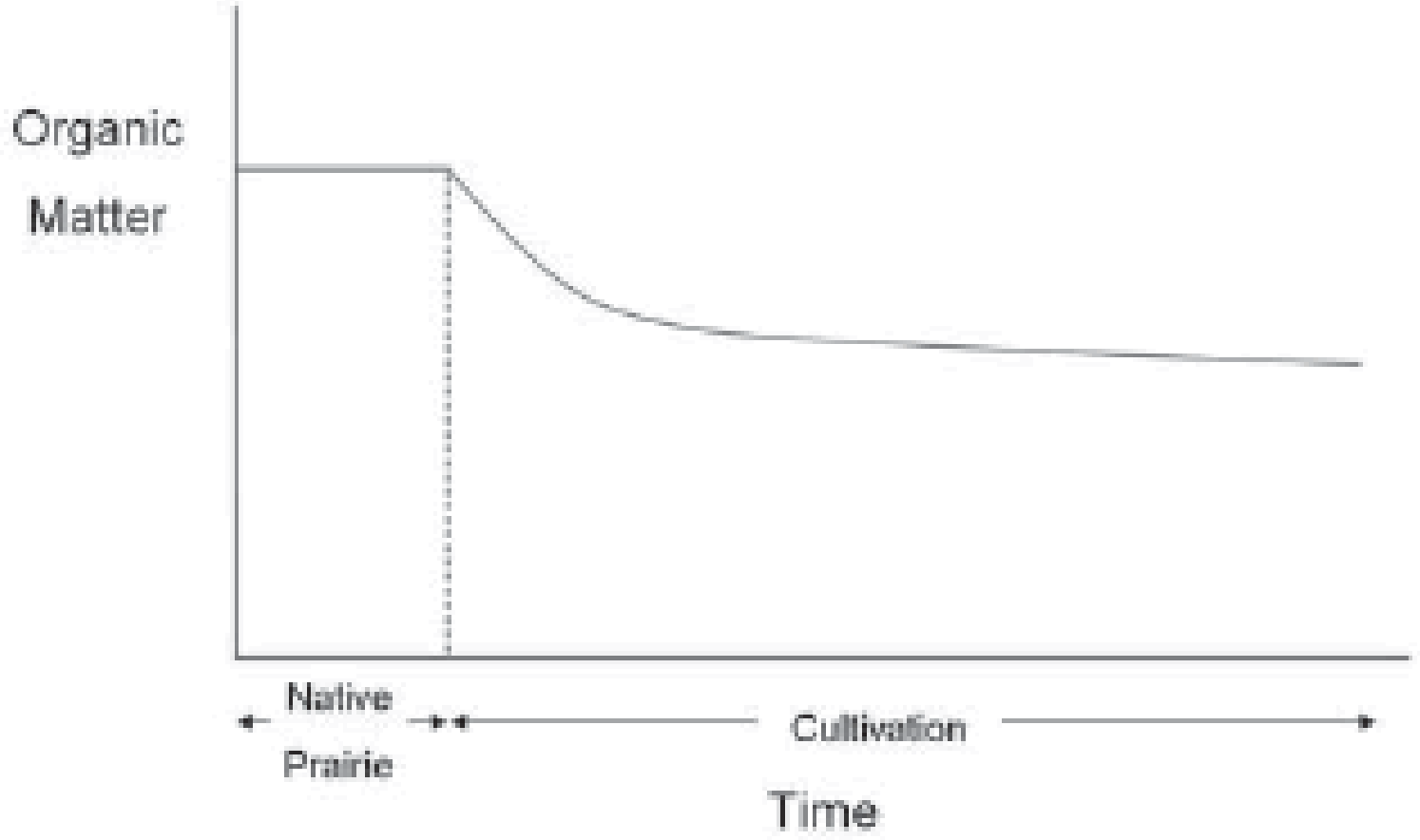
- On the farm
  - Reduced tillage
- In ethanol plants
  - Faster, higher yielding conversion

Greenhouse Gas Emissions

	Gasoline	Corn Ethanol	Biomass Ethanol
	--grams of GHG/MJ of energy--		
Feedstock	+ 4	+ 24	+ 10
Refining fuel	+15	+ 40	+ 9
Vehicle	+72	+ 71	+ 71
Feedstock Uptake	0	- 62	- 62
Land use change	0	+104	+111
Total	+92	+177	+138

Source: Searchinger, et al, *Science*, February 29, 2008

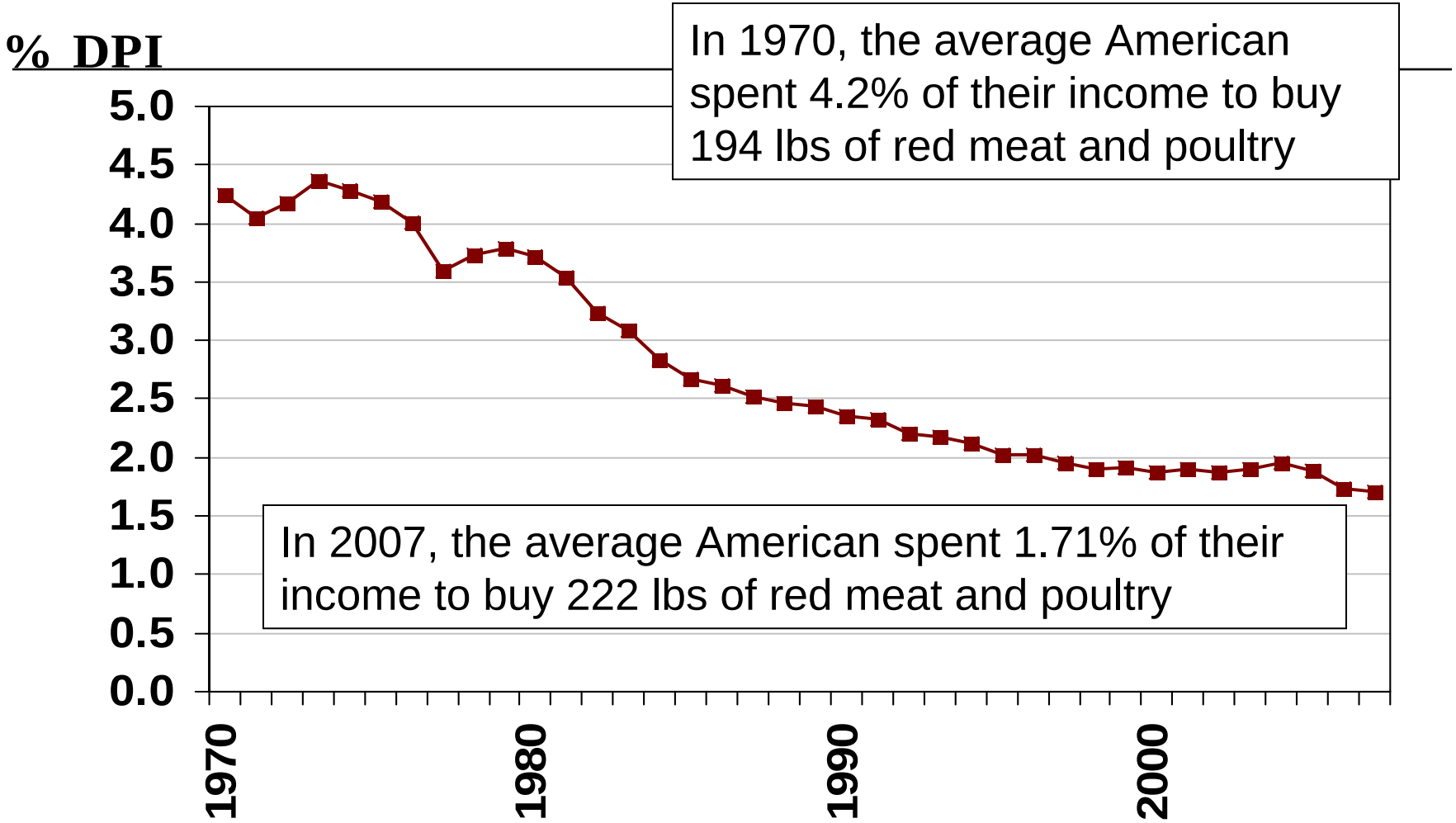
Figure 1. Depletion of organic matter and carbon from midwest soils.



Source: Takle & Hofstrand, Iowa State University

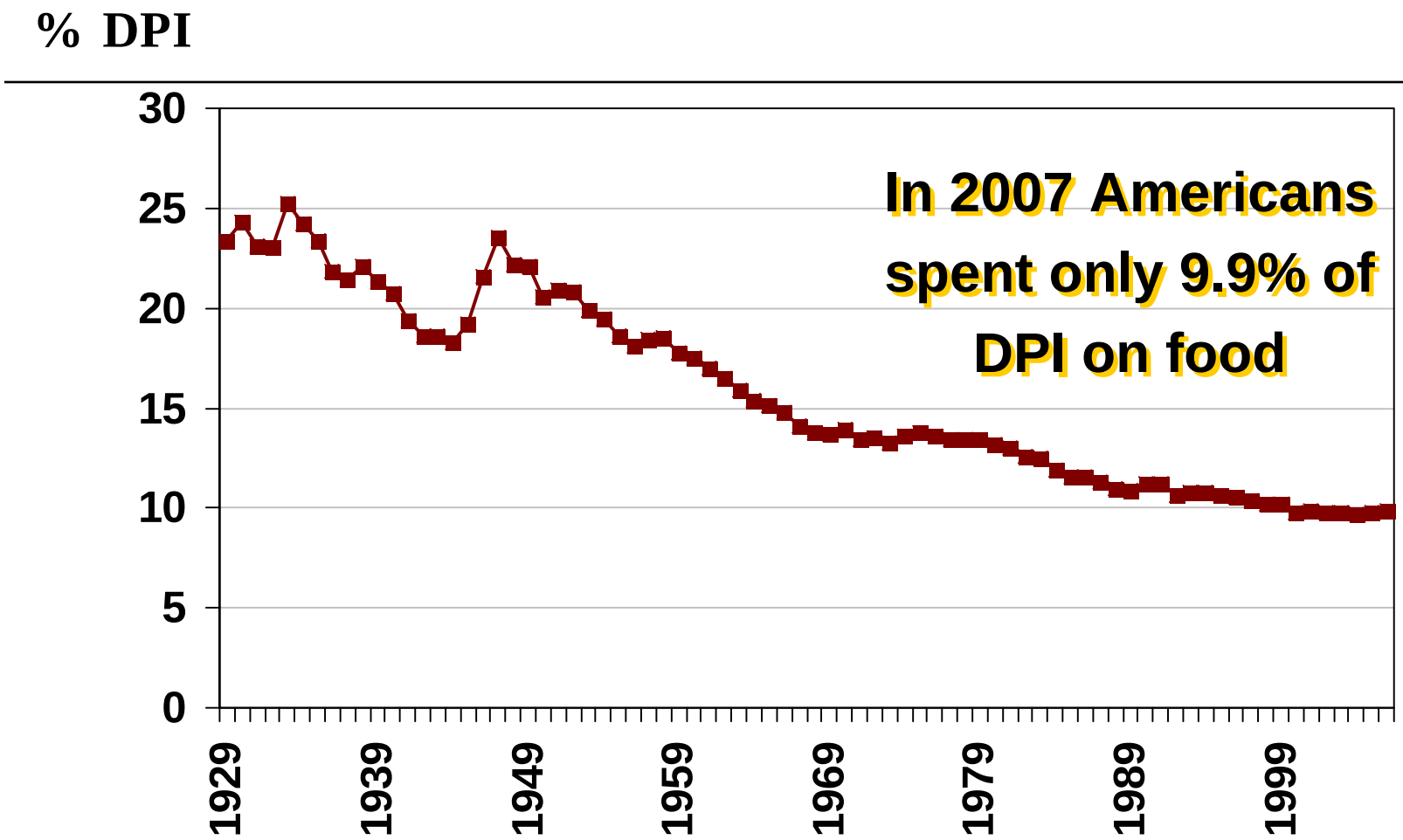
Questions?

U.S. Meat Expenditures, 1970-07



Source: Livestock Marketing Information Center

U.S. Food Expenditures, 1929-07



Source: USDA/ERS