

# The Renewable Fuels Situation

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### Energy: Non-petroleum Sources

- Wind
- Solar
- Hydro
- Hydrogen cells
- Nuclear
- Bio-fuels

## Industries Reliant on Petroleum

- Fuel (Gasoline, diesel, jet, heating)
- Transportation
- Agricultural Production
- Fertilizer
- Pharmaceuticals
- Plastics and resins
- Coatings
- Man-made fibers
- Synthetic rubber
- Explosives

## Years of Oil Remaining

Total Reserves	<u>1,277,702,000,000</u>	≈
Usage Rate (Barrels)	25,000,000,000	50 years

Source: [en.wikipedia.org/wiki/Fossil\\_fuel](http://en.wikipedia.org/wiki/Fossil_fuel)

## The Fossil Fuel Inventory

<u>Type</u>	<u>Amount</u>	<u>Location</u>
Oil	1,278 BBOE	78% E. Hemisphere
Heavy Oil (Tar Sands)	608 BBOE	64% W. Hemisphere
Bitumen (Oil Shale)	345 BBOE	88% W. Hemisphere
Nat. Gas	1,239 BBOE	77% E. Hemisphere
Coal	4,786 BBOE	Widely Distributed (60% in U.S., Russia, and China)

Source: [en.wikipedia.org/wiki/Fossil\\_fuel](http://en.wikipedia.org/wiki/Fossil_fuel)

## The United States and Oil

- Use 20 million barrels per day
- Produce 6 million barrels per day
- Oil usage increases 2% per year but the economy has been growing at 3.3% per year
- Usage in barrels per dollar of GNP is one-half of the 1947 level
- Cost per year to import oil - \$175 to \$200 billion

## Estimated Extraction Cost per Barrel of Oil

- U.S. \$10 to \$12
- Arabian Peninsula \$1

## OPEC – Organization of Petroleum Exporting Countries

- A cartel is organized to control the supply and price of a commodity
- Cartels work only if:
  - Absolute control over supply
  - No substitute products
  - Members don't cheat
- Conclusion: OPEC does not work very well

## U.S. Oil Import Suppliers

1. Canada
2. Mexico
3. Saudi Arabia (OPEC)
4. Venezuela (OPEC)
5. Nigeria (OPEC)
6. Iraq
7. Angola
8. Algeria (OPEC)
9. Russia
10. Ecuador

Source: Energy Information Administration

## Replace Imports?

The U.S. uses 91 billion gallons of gasoline per year and 28 billion gallons of diesel fuel made from oil of which 65% is imported.

To replace the imported gasoline with ethanol would require 33 billion bushels of corn. This year's production – 11 billion bushels.

To replace the diesel with soy-diesel would require 18.6 billion bushels of soybeans. This years projected production – 2.9 billion bushels.

## Land Needed to Replace Imported Fuels

Corn	238 mil. A. (79.4 mil. A.)
Soybeans	<u>479 mil. A.</u> (74.9 mil. A.)
Total Needed	717 mil. A.
Total Available	349 mil. A.
Plus Idle Land	387.5 mil. A.

## Biological Value-added Processing

To fractionate agricultural commodities into component parts and use biological or chemical processes to produce useful bio-products or intermediary compounds.

Objective – make the sum of the parts more valuable than the whole.

‘Leave no molecule behind.’

## Bio-refining Assumptions

- Petroleum will remain relatively expensive
- Bio-products can be produced for less
- Raw materials can be replenished each year (non-depleting)
- May yield entirely new compounds

## Renewable Fuels Drivers

- High oil price
- Instability in oil exporting regions of the world
- Flow of dollars out of the United States
- Energy Policy Act of 2005
- Mandates and tax reductions
- Phase out of MTBE
- Good Returns on Investment

## Net Energy Balance

<u>Product</u>	<u>Energy Out/Energy In</u>
Gasoline	.81
Ethanol from grain	1.35
Ethanol from cellulose	4.17
Diesel	.91
Bio-diesel	3.24

Sources: Argonne National Laboratory and OECD International Energy Agency

# ETHANOL

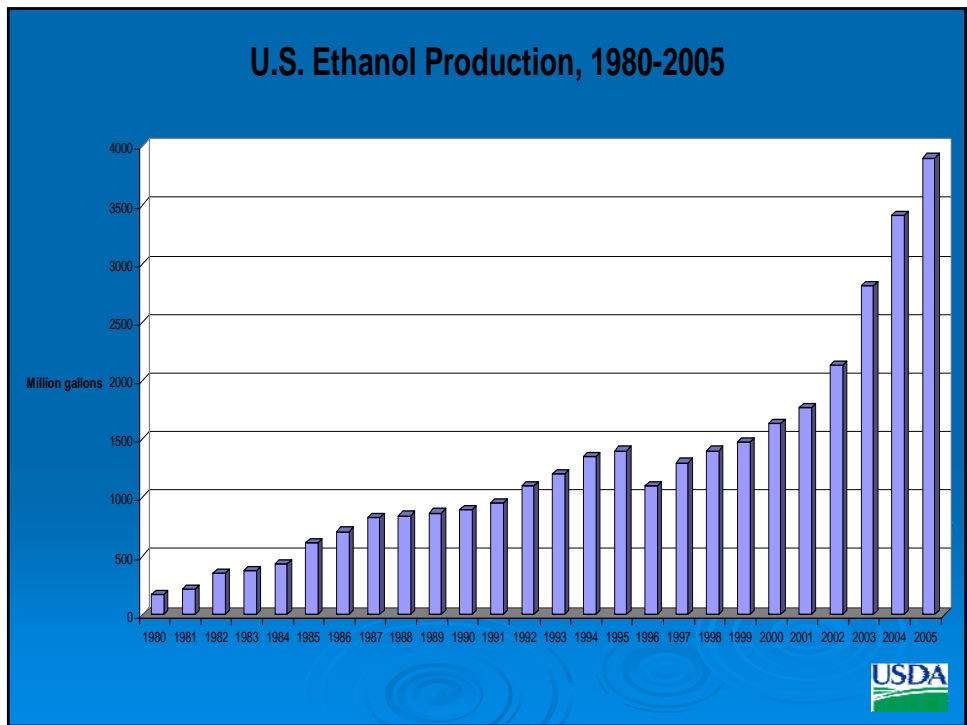
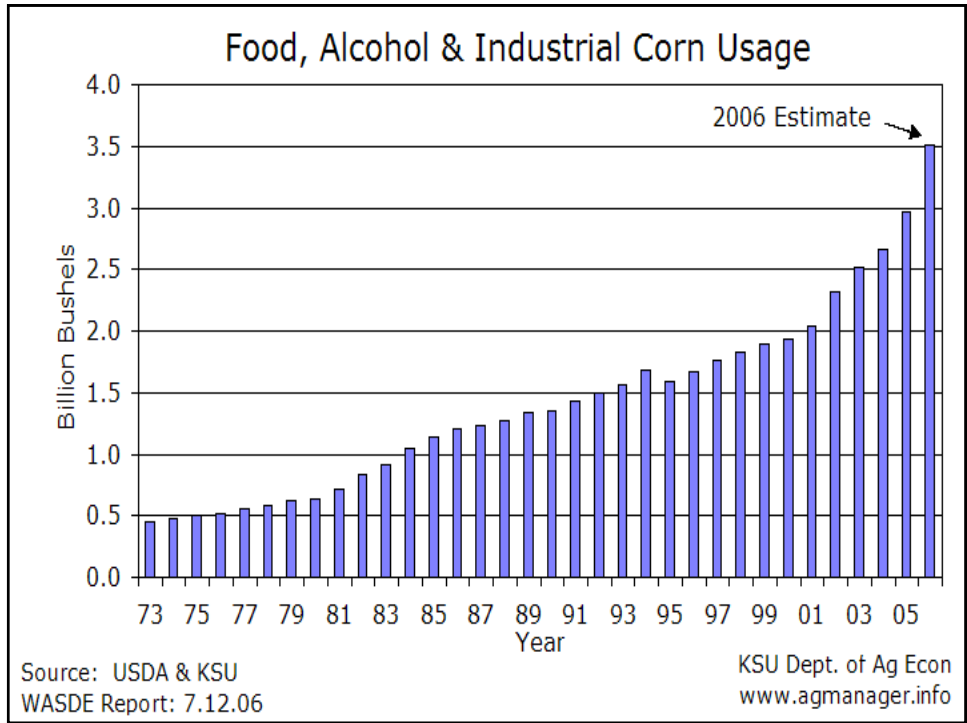
## Industry at a Glance

- Number of operating ethanol plants: 97
- Plants under construction and expanding: 35
- Announced plants: 150\*
- Current production capacity: 4.8 billion gallons per year
- 2005 production, 3.9 BG (BGPY)
- Projected production capacity, 7.4 BGPY by early 2007
- Size: Newer plants 100 MGPY
- Process: wet or dry
- Feedstock percentage:

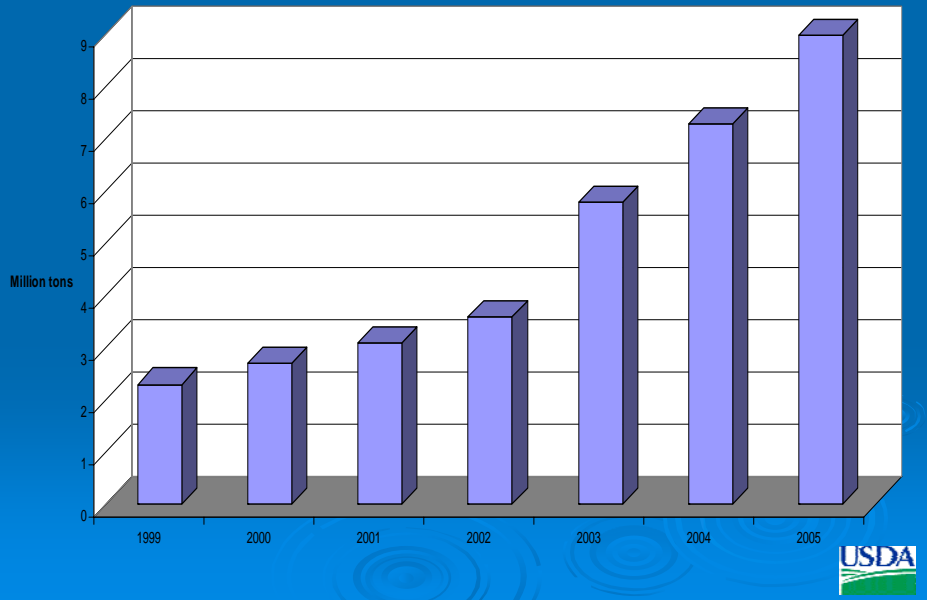
Corn	97
Sorghum	2
Other	1

## Ethanol Plant Economics

- Cost to build a 100 MGPY plant - \$140 million
- Will purchase about 37 million bushels of corn (240,000 A.)
- Two million gallons of water per day
- Natural gas expense - \$15 to \$25 million
- Payroll expense about \$2 million
- Distiller's Dried Grains income about \$25 million
- CO<sup>2</sup> income about \$4 million
- B.E. ethanol price \$1.30 to \$1.35 per gallon when corn is \$2.25 per bu.
- Goal 30% R.O.I.

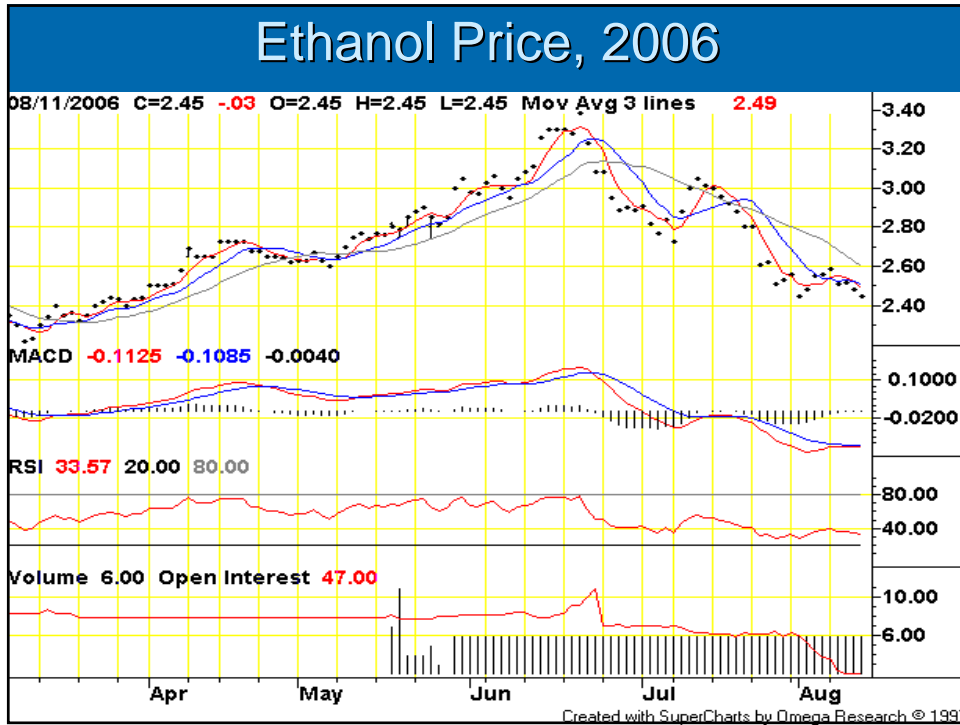


### Distillers Dried Grains Production



### Fermentable Sugar Cost per Gallon of Ethanol

- Sugarcane      \$.30
- Corn            .91
- Sugarbeets    .95



## Corn/Ethanol Projections, U.S.

	<u>06/07</u>	<u>07/08</u>
Corn Acres	79.4 mil.	82 mil.
Corn Production	11.0 bil.	12.3 bil.
Corn Exports	2.15 bil.	2.0 bil.
Corn for Ethanol	2.15 bil.	3.4 bil.
Ethanol Production	6.4 bil. g.	8.6 bil. g.
DDG Production	9.5 bil. T.	16.0 bil. T.

(Thirty to 40 percent will replace corn in rations. Sixty to 70% will replace soybean meal.)

Source: Paul Smolen, AgriNetwork Management and Mike Woolverton, KSU.

## Dangers Ahead for Ethanol

- Over expansion – On-line capacity in 2007 is expected to be 7.4 billion gallons
- Competition from iso-octane and iso-octene oxygenates made in converted MTBE plants
- Low cost imports
- Food or fuel debate
- Drop in the price of oil

**BIO-DIESEL**

## The Bio-diesel Formula

100 gallons of veg. oil or animal fats  
+10 gallons of methanol

=

100 gallons of bio-diesel  
+10 gallons of glycerol

## Advantages of Bio-diesel

- No sulfur and less carbon emissions
- Higher cetane rating – better mileage
- Superior lubricity

One disadvantage:

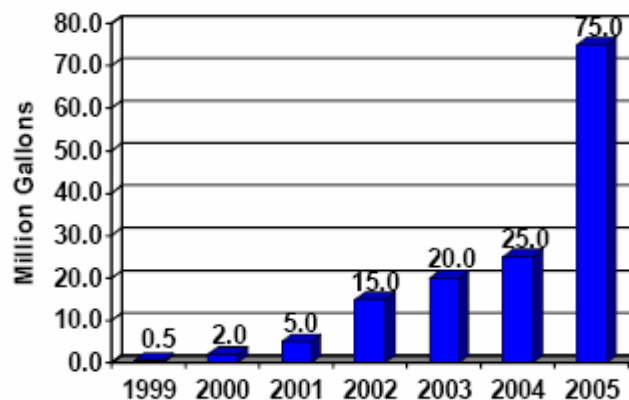
Bio-diesel requires an additive to prevent jelling at low temperatures

## Value-Added Benefits per Gallon

- **Soybeans to Bio-diesel Conversion:**
- Soybeans per bushel                   -\$5.71
- Biodiesel 1.5 gallons/bu.               +\$4.95
- Byproducts, soymeal                   +\$4.28
- Cost of methanol = Glycerin credit
- Value of biodiesel  
    & byproducts                       +\$9.23
- Net Value-added                       +\$3.52

The industry believes it can compete directly with petrol-diesel when oil price is \$40 or above.

## Estimated US Biodiesel Production



## U.S. Soy-diesel Production

- Currently 65 plants in U.S.
- Total capacity 365 mg – ave. size 7.45 mil.
- Output 2005 – 75 mg of biodiesel Why?
- Plants under 10 mg batch process using waste fats and oils
- Much of output has been going to soap and shampoo rather than biodiesel

## U.S. Soy-diesel Production

- 58 plants expanding or under construction  
projected capacity 713 mil. gal.
- Many of the new plants - 30 mil. gal.  
(Require the oil from 400,000 A. soybeans.)
- Continuous processing using multiple  
feedstocks of veg oil

## Vegetable Oil Yields

Corn	18 gal./A.
Soybeans	48
Sunflowers	102
Rapeseed	127
Castor Beans	151
Oil Palm	635

## World Production of Fats and Oils, 2003/04, MMT

<b>Vegetable</b>		<b>Tropical</b>	
Soy	30.1	Palm	28.7
Rape	14.1	Palm Kernel	3.5
Sun	9.3	Coconut	3.3
Peanut	5.0		
Cotton	3.8		
Olive	2.8		

## Soybean/Bio-diesel Projections, U.S.

	<u>06/07</u>	<u>07/08</u>
Soybean Acres	74.9	73.0
Soybean Production	3 bil. bu.	3.1 bil. bu.
Soybean Exports	1.1 bil bu.	900 mil. bu.
Soybean Oil for BD	2.35 bil lbs.	4.65 bil. lbs.
Bio-diesel Production	400 mil. g. <small>(330 from SBO)</small>	730 mil. g. <small>(600 from SBO)</small>
Soybean Meal Exports	7.5 mil. T.	11 mil. T.

Source: Paul Smolen, AgriNetwork Management and Mike Woolverton, KSU

## Bio-diesel Conclusions

- The industry is ramping up production capacity.
- Increased demand for vegetable oil will drive price up.
- Soybean meal will become the by-product and increased supply will cause price to fall.
- U.S. soybean meal exports will increase.
- Bio-diesel production will be constrained by the supply of oil.
- Corn and soybeans will be fierce competitors for available acres of land.

## Alternative Technologies

- Cellulosic Ethanol
- Bio-diesel from Algae Oil

Stay Tuned!

