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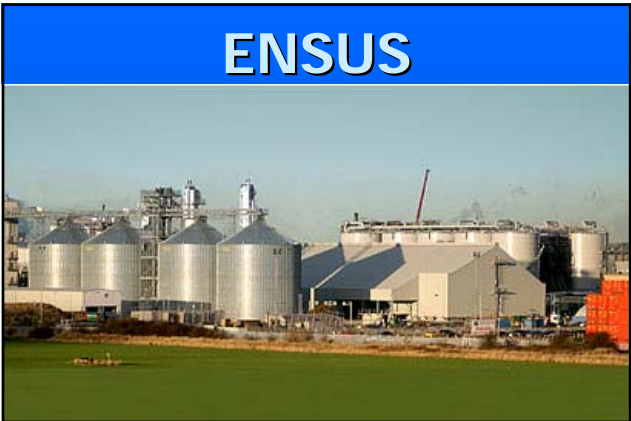
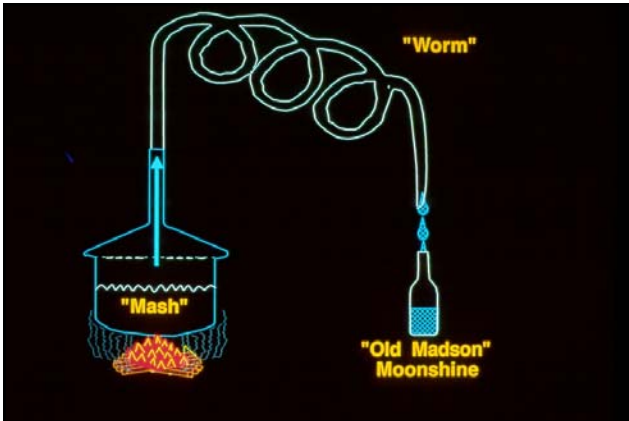
# THE FUTURE OF FUEL ETHANOL

Do Small Grains Have a Rightful Place?

**MORE THAN 6,000 ETHANOL PLANTS WORLDWIDE**

SOURCE: DR. JOHN MURTAGH

**RANGE OF TECHNOLOGIES EMPLOYED**

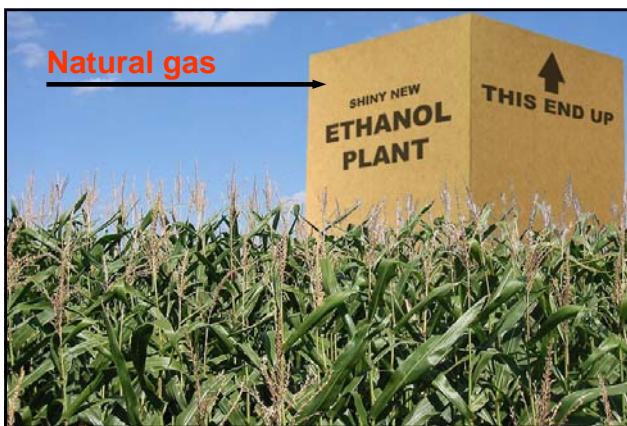


## AGENDA

- PERSPECTIVE
- AGRICULTURAL INTEGRATION
- LIGNO-CELLULOSE
- FUTURE FEEDSTOCKS
- TECHNOLOGY ASSESSMENT

## TODAY IN USA

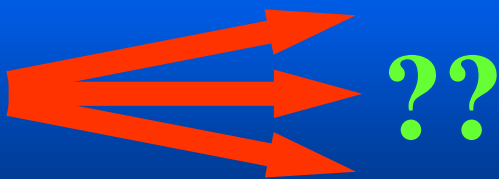
“SQUARE BOX  
IN A CORNFIELD”



## THE “SQUARE BOX” RISK

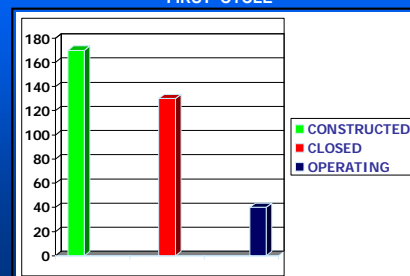
- COMMODITY CYCLES

## WORLD COMMODITY PRICES



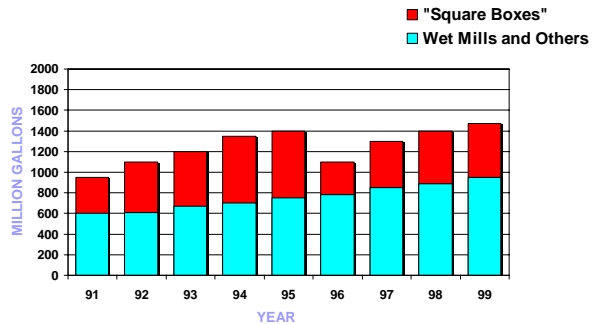
## FUEL ETHANOL PLANT HISTORY – (1980 – 1990)

- FIRST CYCLE -



## U.S. FUEL ETHANOL PRODUCTION

- Second Cycle - 1991-1999



## THIRD CYCLE USA

2009 – 50+ bankruptcies

~\$1.50 investment loss  
per bushel of corn  
processed into ethanol

**CAN THE COMMODITY  
RISK BE MITIGATED  
??**

## MULTIPLE FEEDSTOCKS

- WHEAT
- BARLEY
- CORN (MAIZE)
- GRAIN SORGHUM (MILO)
- TRITICALE
- SUGAR JUICE
- MOLASSES
- WINE ETHANOL

Minnedosa, Manitoba



## HUSKY ENERGY

Lloydminster, Saskatchewan



## TARKIM





# CASTILLA y LEON

**WHEAT, BARLEY, AND OTHER GRAINS YIELD PROPORTIONAL TO STARCH CONTENT**

**EXAMPLE 20 MM GPY PLANT**

|             | <u>FEEDSTOCK</u><br>Ton/Yr | <u>DDGS</u><br>Ton/Yr |
|-------------|----------------------------|-----------------------|
| CORN (base) | 194,000                    | 55,500                |
| WHEAT       | 210,000 (+8%)              | 70,000 (+26%)         |
| BARLEY      | 234,000 (+21%)             | 98,000 (+77%)         |

**WHEAT vs. CORN PLANT**

INVESTMENT + 15 - 20 %

OPERATING COST + 2 - 3 CENTS PER GALLON

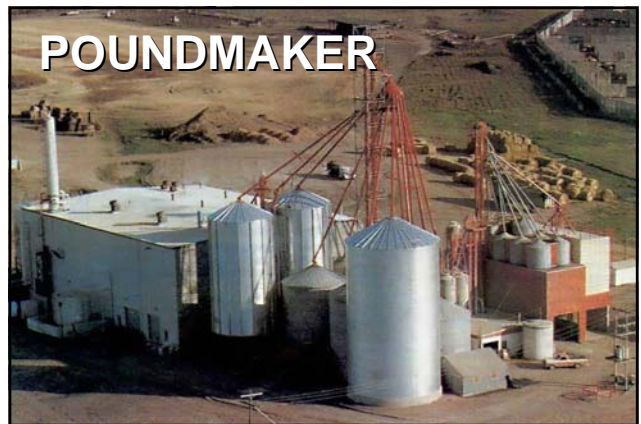
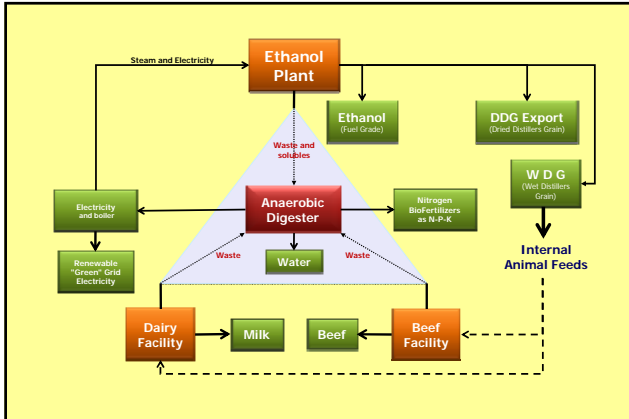
**BARLEY vs. CORN PLANT**

INVESTMENT + 20 - 30 %

OPERATING COST + 4 - 6 CENTS PER GALLON

**INTEGRATED AGRICULTURE FOOD, FEED, FUEL**

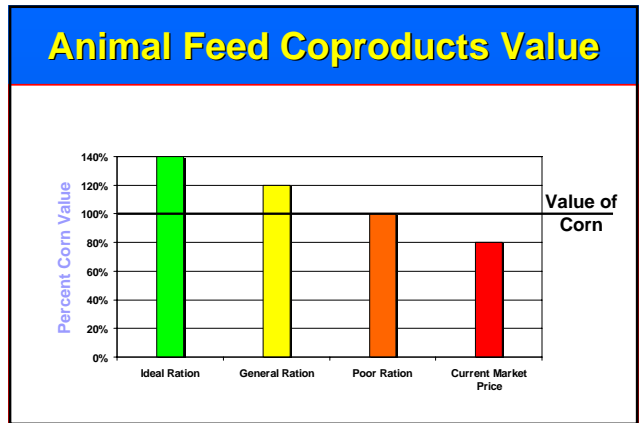
**Cattle Manure Digestion for Boiler Fuel**



## Animal Feed Coproducts The Forgotten Value

previous. In fact, most animal sectors have seen a decline in overall numbers over the past industry has been the increase in export demand for distillers' grains. China has been one as exports to that nation have increased rapidly. Last year 600,000 tons were exported to to grow to as much as 2 million tons this year. There appears to be a large amount of competition in the market right now from other sources of protein. Soybean meal price for instance has fallen from \$318 per ton in December to \$251 per ton in early March on the May contract. DDG values have fallen to around 80% the value of corn in early April, but we are starting to see an increase in cattle on feed as a backlog of cattle works into the system after January and February weather-related delays.

Ethanol Today | 23  
May 10



Even if capture half of differential between “fire sale” pricing and true value...

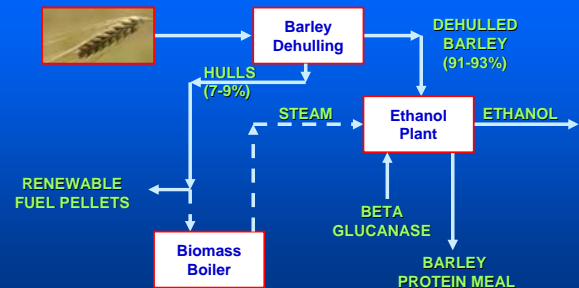
Adds \$1 billion per year  
Or 10¢ per gallon  
Or 25¢ per bushel

### Consequences of Industry Practice re: Animal Feed Coproducts

- If agriculture system is viewed as a whole, the livestock industry captures the differential. Therefore, the value-added money remains in the ag community.
- If export, the differential value-added potential is lost to USA agriculture.

Why do we fret about the **blend wall** and ignore the **feed wall**?

### Osage Bio Energy



## BIOMASS

*IF*

**BIOMASS FOR BOILER FUEL (USA)**  
(10MMM GPY ETHANOL)

**@ US\$50 / TON BIOMASS**

**THEN – \$1,000,000,000**

**OR – 10¢ / GAL**

**VS. – 25¢ / GAL (NATURAL GAS)**

**SAVINGS – \$1,500,000,000 PER YEAR**

**ALTERNATIVELY, IF  
SAME BIOMASS CONVERTED  
TO ETHANOL**

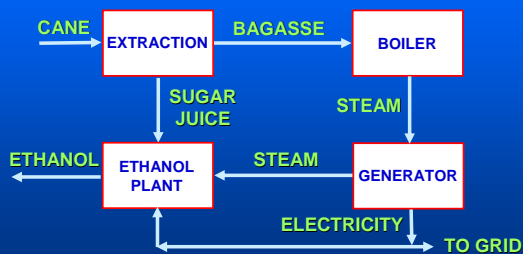
**THEN – 1.5 BILLION GAL / YR.**

**VS.  
BOILER FUEL VALUE  
\$1.5 BILLION / YR.**

## **BIOMASS**

**BOILER FUEL  
OR  
ETHANOL FEEDSTOCK  
???**

### **BRAZIL STRATEGY**



### **TOTAL ENERGY BALANCE (Energy ratio\*)**

- Gasoline ■ 0.8 to 1
- Ethanol (SUGAR) ■ 9 to 1
- Ethanol (GRAIN) ■ 1.67 to 1 (fossil fueled)
- Ethanol (GRAIN) ■ 5 to 1 (biomass fueled)
- Ethanol (Cellulose) ■ ?

\*Energy ratio = useful energy produced to total fossil energy consumed

### **NORTH WEST TERMINAL UNITY, SASKATCHEWAN**

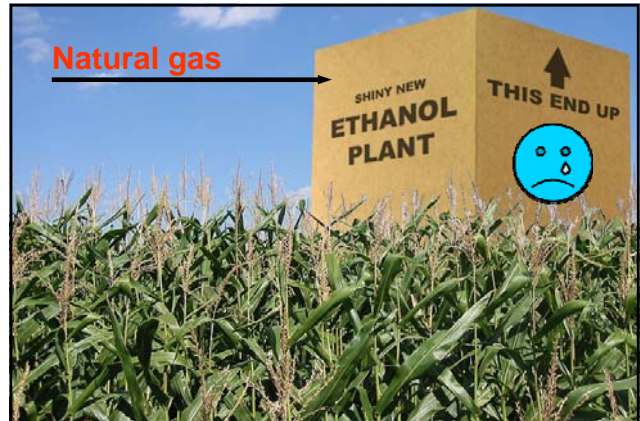


**Why are creative  
alternatives needed?**

## U.S.A. LIQUID FUEL DEMAND

175 Billion Gallons per year

| <u>Corn</u>              | <u>Million Tons</u> |
|--------------------------|---------------------|
| Required                 | 1,850               |
| Produced                 | 310                 |
| Max. Possible Production | 500                 |



## IS THERE ANOTHER WAY?



## GENERATION 1.5

## LET "MOTHER NATURE" HELP



**“Wild Wheat”**

**“High Protein”**

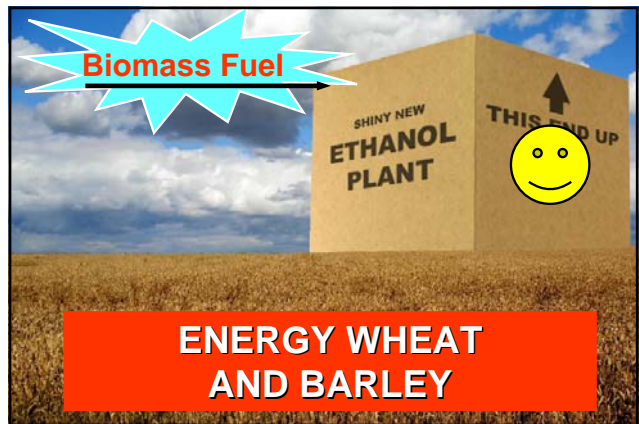


**“Wheat”**

**“High Starch”**



**“Energy Wheat”**



## **TECHNOLOGY ASSESSMENT**

## **FEEDSTOCK PROCESSING TO ETHANOL**

- Sugar
- Starch (grains)
- Ligno-cellulose
- Proven, reliable, economic
- Proven, reliable, economic
- Unproven, unreliable, uneconomic



## Do we need a new paradigm?

(Generation 1.5)

- Sugar
- Starch
- Ligno-cellulose

New sources, conventional technology

Boiler fuel with ethanol in special circumstances

