

Water Quality Implications of Ethanol Production

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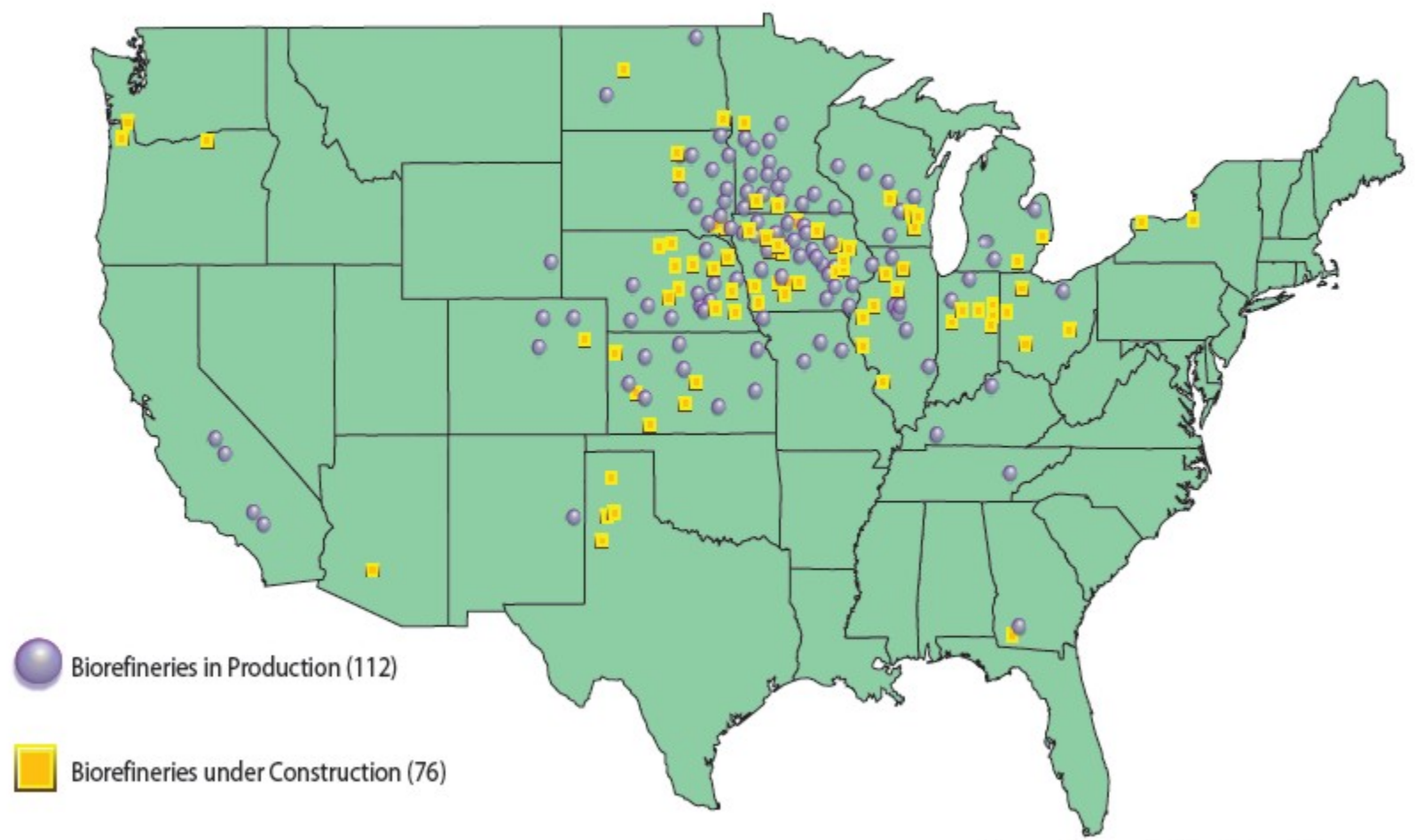
Water Use and Ethanol Production Facilities

■ Consumptive water use

- About 3.5 to 6 gallons of water is consumed for each gallon of ethanol produced *
- Consumption largely comes from evaporation during cooling
- Plants are achieving greater efficiency over time
- About 3 gallons of water per gallon of ethanol

*Institute for Agriculture and Trade Policy
Water use by ethanol plants--potential challenges

U.S. Ethanol Biorefinery Locations



Source: Renewable Fuels Association
1.29.07

Ethanol Production: Why dominantly grain based?

- Grain-based
 - Fermentation of starches relatively easy
 - Operational technology exist
 - Feedstock production, storage and handling capabilities exist
 - Makes grains profitable w/ less *direct* Gov subsidy?
 - Farmers like to grow grains
- Cellulose-based
 - None of the above
 - Will be discussed later today

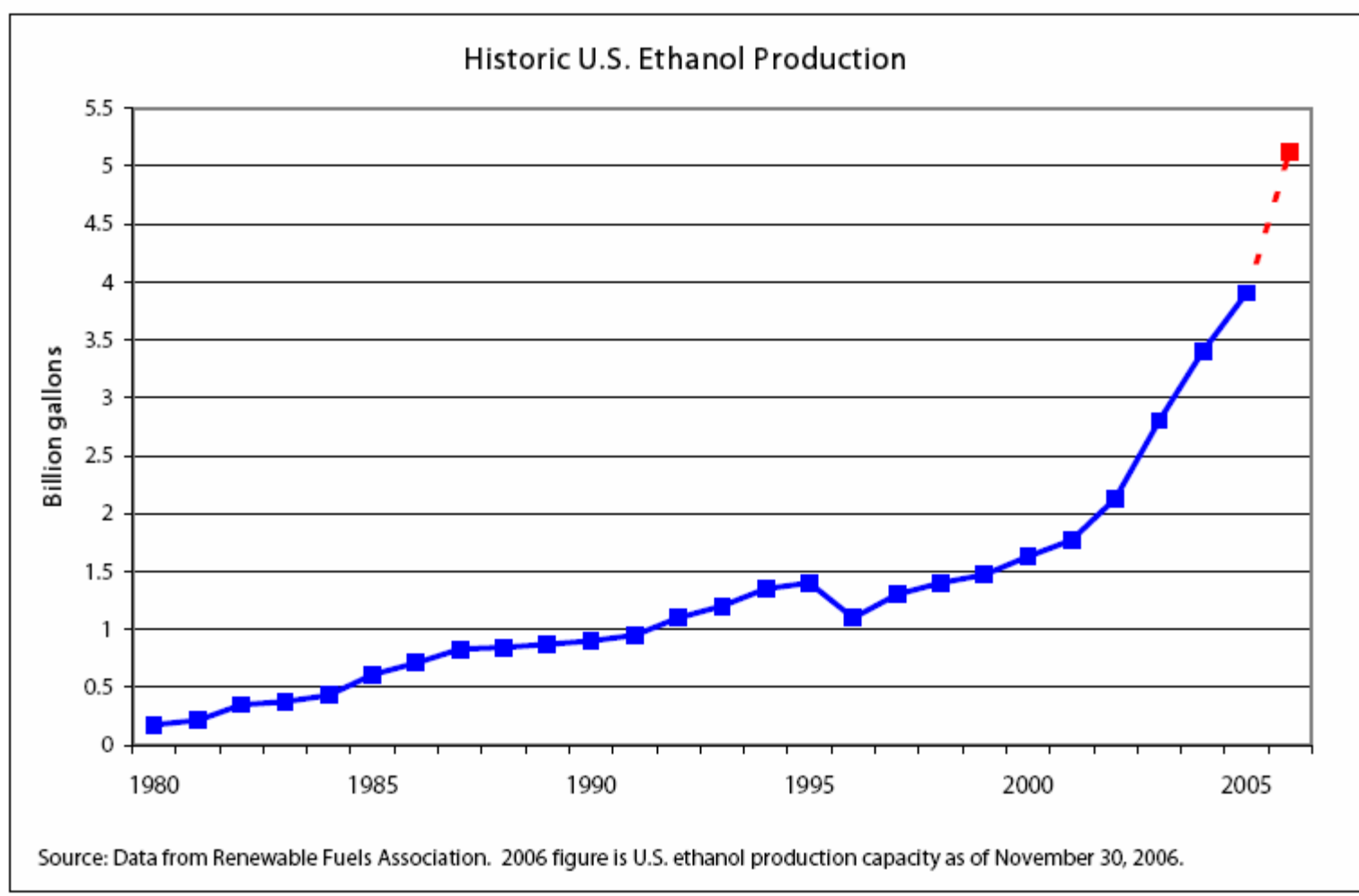
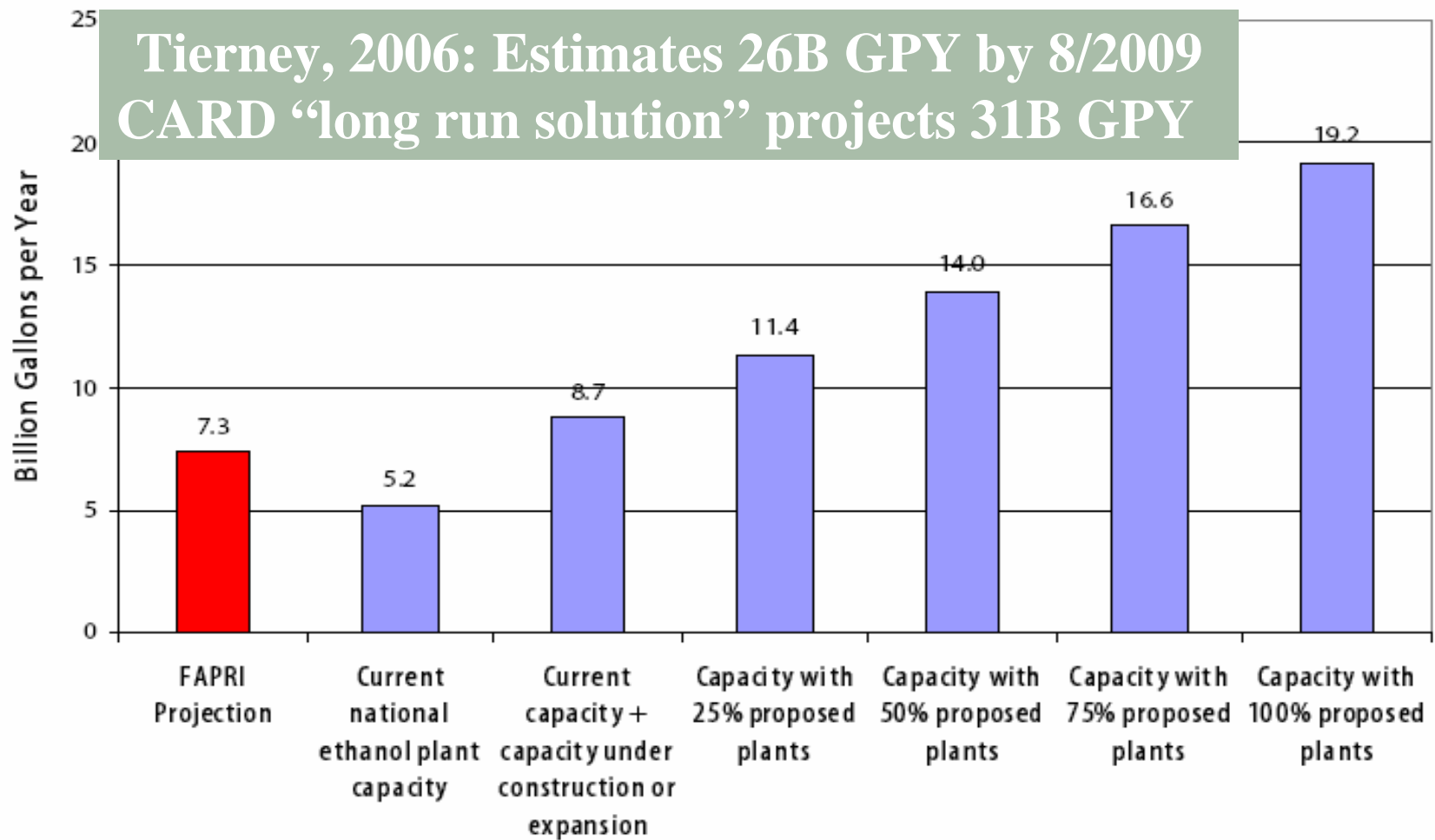


Figure 1: U.S. ethanol capacity has expanded dramatically in recent years, doubling from 2001 to 2005 and likely to double again by 2009.

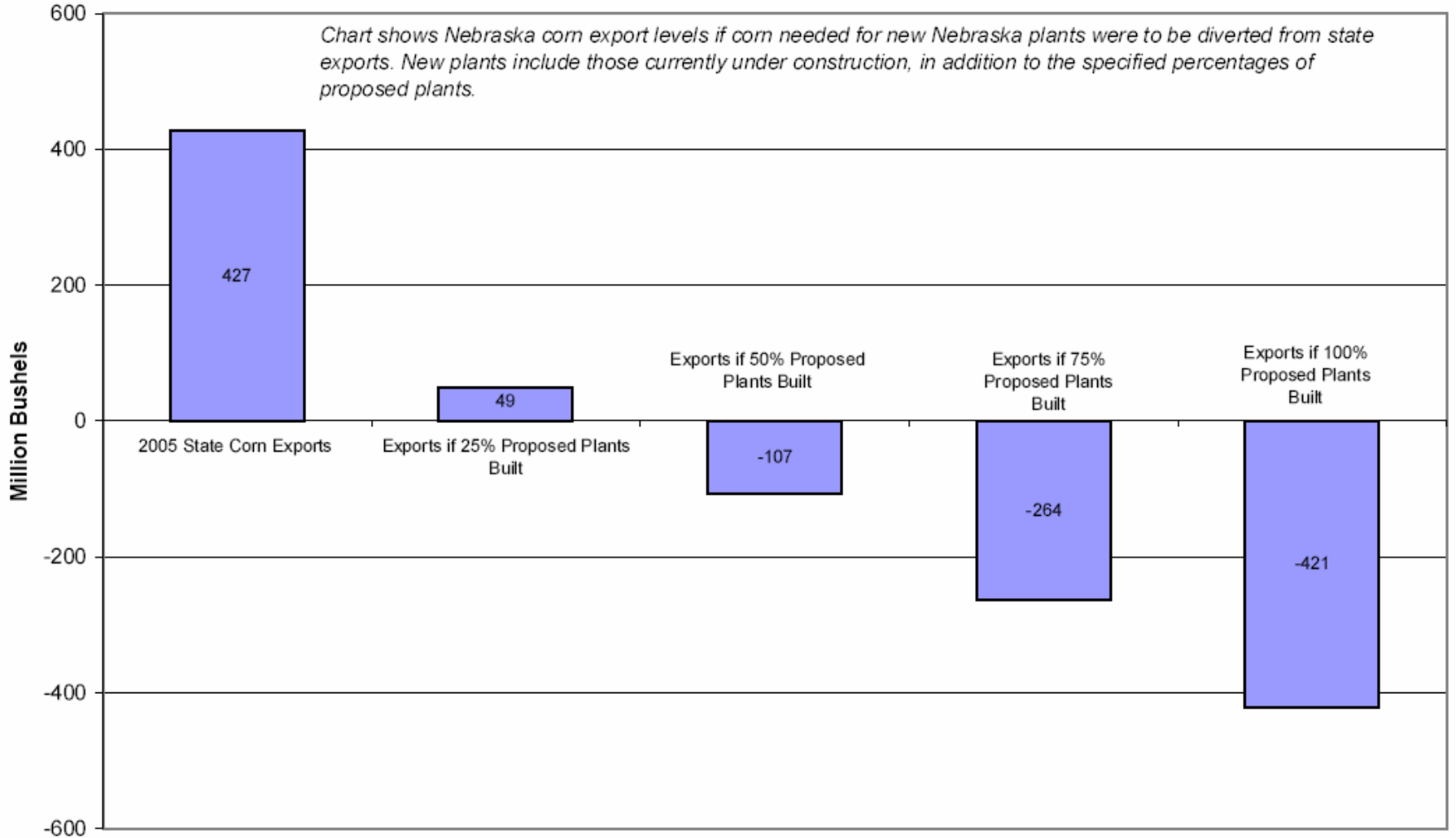
2008 Projected U.S Ethanol Capacity



Data Sources: FAPRI Projection from FAPRI July 2006 Baseline Update for U.S. Agricultural Markets. IATP ethanol capacity data from Renewable Fuels Association, Ethanol Producer Magazine and various news sources.

Figure 8: Even with their revised numbers, FAPRI and USDA likely underestimate U.S. ethanol production. Ethanol capacity will be significantly higher than either FAPRI or USDA project if even a fraction of the currently proposed ethanol plants come on line.

Potential Impacts of Ethanol on 2008 Nebraska Corn Exports



Source: IATP data. Assumes continued 0.78% increase in corn yield, 2.8 gal ethanol per bushel corn, constant corn acreage, constant feed and other uses. Includes only Nebraska ethanol plants. Historic state export volume calculated by dividing export sales data by corn price at harvest for that year, both from USDA ERS.

Movement of Ethanol East?

- ›Plants near people rather than corn very likely
- ›Current pipelines cannot transport; must truck

Evidence of Eastern move

- 3 plants proposed for MD(1 ES and 2 Balt. Harbor)
- Seven "legitimately proposed" plants in PA
- 100M gpy plant in north Georgia
- 108M gpy plant in NC
- 100M gpy plant proposed for Ithaca, NY area
- Changing very rapidly

Water Quality Implications of Ethanol Production

A 50-Million Gallon Ethanol Plant ...

- Uses roughly 18.5 million bushels of corn
 - In Iowa, corn from 116,000 acres
 - About 2.77 gallons per bushel
- Produces 315M pounds of distillers grains
 - This could feed approx. 60,000 dairy cattle or 17.26 million layers
- Utilizes natural gas in plant operations
 - Manure from 60,000 dairy cattle could produce enough methane to meet 25 percent of the ethanol plant's needs

TABLE 2. Long-run equilibrium in U.S. corn and ethanol markets

(CARD, Nov, 2006)	CARD		
	International	Estimated	Percentage
	Ethanol	Long-Run	Change
	Baseline	Solution	
Corn Price (<i>\$/bushel</i>)	2.56	4.05	58%
Corn Area (<i>million acres</i>)	79.4	95.6	21%
Corn Production (<i>million bushels</i>)	13,040	15,656	20%
Corn Use in Ethanol (<i>million bushels</i>)	3,251	11,103	242%
Ethanol Consumption (<i>million gallons</i>)	9,476	31,479	232%

^aFor more details on the baseline numbers, see Elobeid and Tokgoz, "Removal of U.S. Ethanol Domestic and Trade Distortions: Impact on U.S. and Brazilian Ethanol Markets," CARD Working Paper 06-WP 427, October 2006.

1) How do you grow 16M more acres of corn?

- Plant less soybeans and cotton
- Convert pasture and hay land to corn
- Bring idle land into production
- Take land out of CRP/CREP

**Realistically, probably around 3.5 to 4.0 million
CRP acres may come out of CRP for corn
and soybean production over the next few years**
(in the Corn Belt)

Robert Wisner, Iowa Farm Outlook, ISU, 1-17-07

**In Louisiana, the number of acres devoted to
corn likely will double and could triple,**
said David Bollich, a grain marketing specialist
with the Louisiana Farm Bureau.”

Farm Policy Blog, January 19, 2007

Estimated nitrogen loss increases from expanding US corn production by 16M acres

Ag Land Use Changes	Acreage (millions)	Average Loss (lbs/A)	Increase in N Loss (M lbs)
Increased corn production	16*	30	-
From soybeans	8	22.5	60
CRP/Idle land	4	3	108
Pasture or Hay	4	6	96
N Loss Increase (M lbs)			264

*CARD, 11/2006

2) Ethanol plants create local nutrient imbalances

- Grain/nutrients shipped to facility
- Reduce grain exports from surplus areas
- Transport of Dried Distiller's Grain (DDG) occurs but local use preferred
- Interest in locating animal confinement operations near ethanol plants

Jim Pease will tell you more

Co-location of dairies with grain ethanol facilities

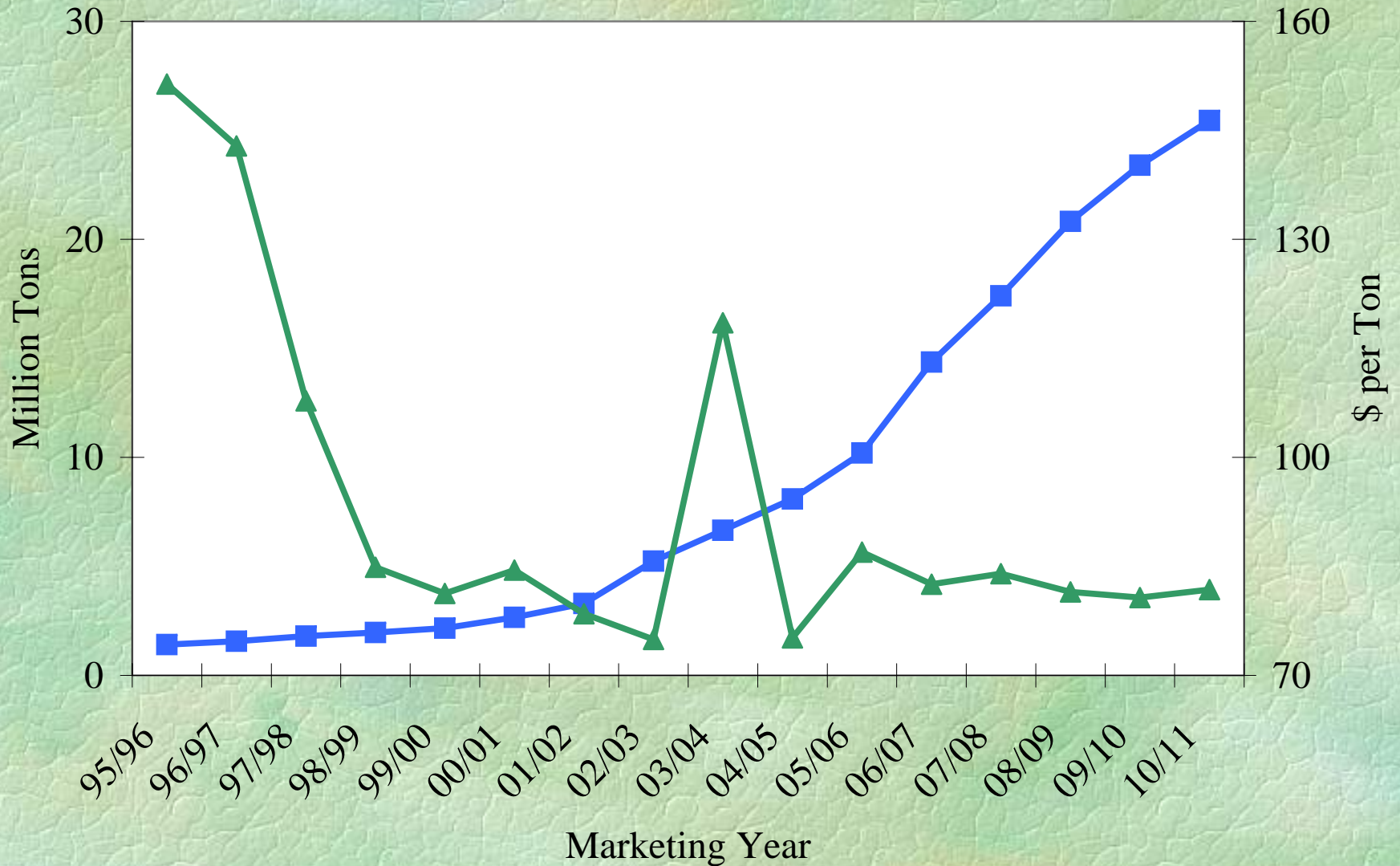
- Projected 31B GPY would equal 620 50M GPY facilities
- If 50% co-locate dairies to save DG drying cost, would support 19M cows
- Assuming 60 wet lbs/d/cow manure, would concentrate 200M wet tons/yr of manure around ethanol plants
- In Midwest, interest in co-locating feed lots

3) Dried Distillers Grain and feed management

- DDGs high in P compared to other feeds
- P in DDGs is more soluble
- DDGs are fed as energy source so overfeed P
- DDGs are glutting the market and making way into dairy rations (in the Bay W/S)
- Mainly a dairy and beef issue for now

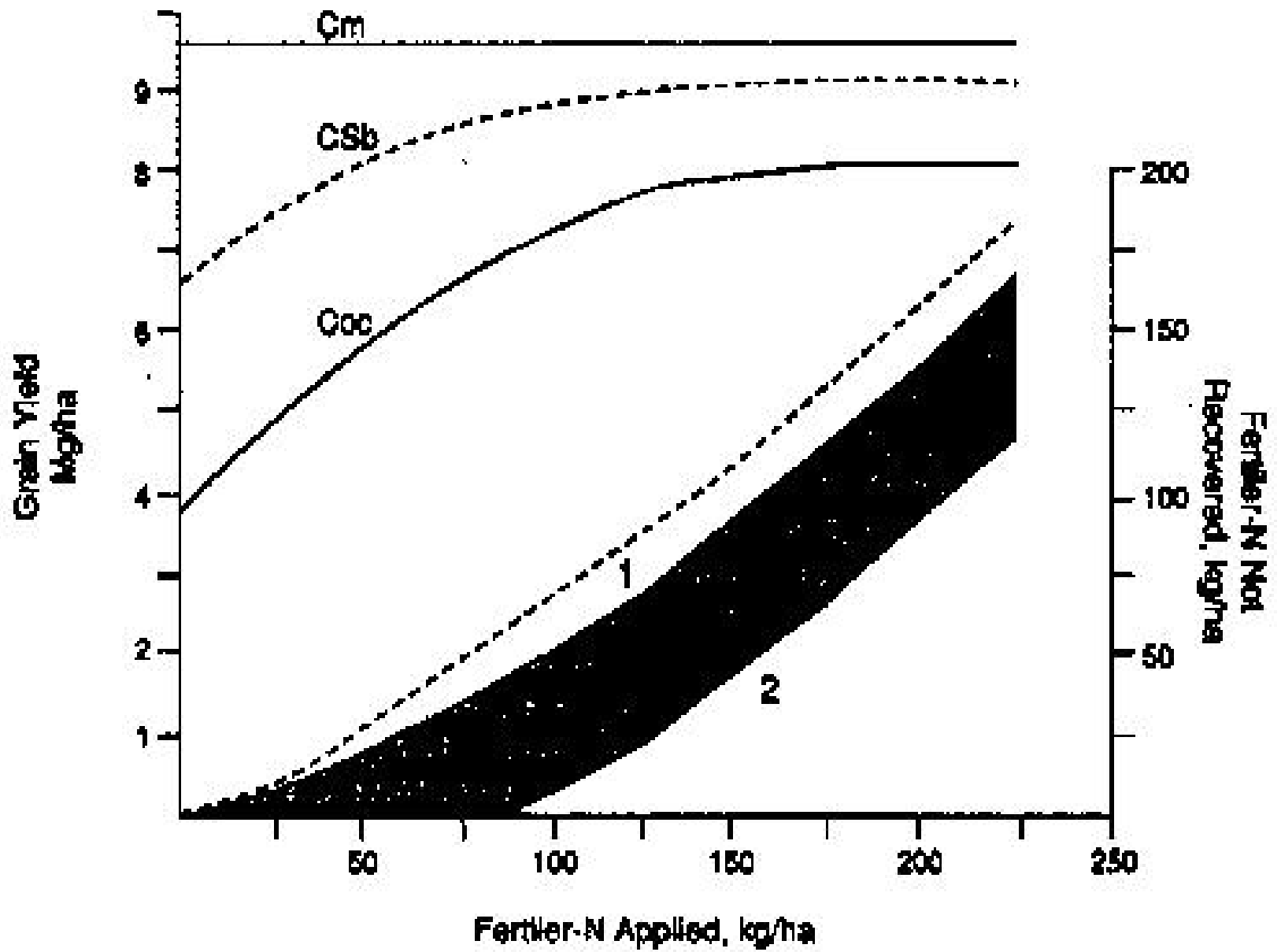
Charlie Stallings will tell you more

Distillers Grains



4) Nutrient management and nutrient use incentives

- Economic optimum yield increases w/ price
 - Small yield increases per unit of nutrient
- Farmer more risk averse, "insurance" nutrient prone
- "BMP yield warranty" will be less attractive and more costly
- Will increase costs of other incentive and conservation programs



5) Land retirement and "perennialization"

- Disincentive for land retirement progs.
- Costs of retirement programs will rise
- Loss of CRP and CREP lands
- Creates pressure to bring pasture and marginal lands into corn production
- Increased continuous corn; discourage long rotations w/ hay & other perennials
- Further discourage perennial energy crops

6) Impediments to waste or perennial based cellulosic ethanol industry

- Expanding corn capacity detracts from interest in cellulosic
- Infrastructure and market constraints
- Challenges to cellulosic ethanol production
- Growing switchgrass not a simple option
- Corn is the "crop of choice"

Tom Richard will tell you more

Corn may drive cellulosic technology development, but are there environmental consequences?

Corn production & cellulosic ethanol

- Grain-based ethanol probably limited to 10% of transportation fuels (?)
- Corn producers & investors want to harvest corn stover to make cellulosic ethanol
- Concerns:
 - Threat to conservation tillage
 - Increased soil erosion losses (w/i soil loss T)
 - Reduced soil organic matter and soil quality
 - Potential long term yield impacts
 - Results in soil carbon release, not sequestration

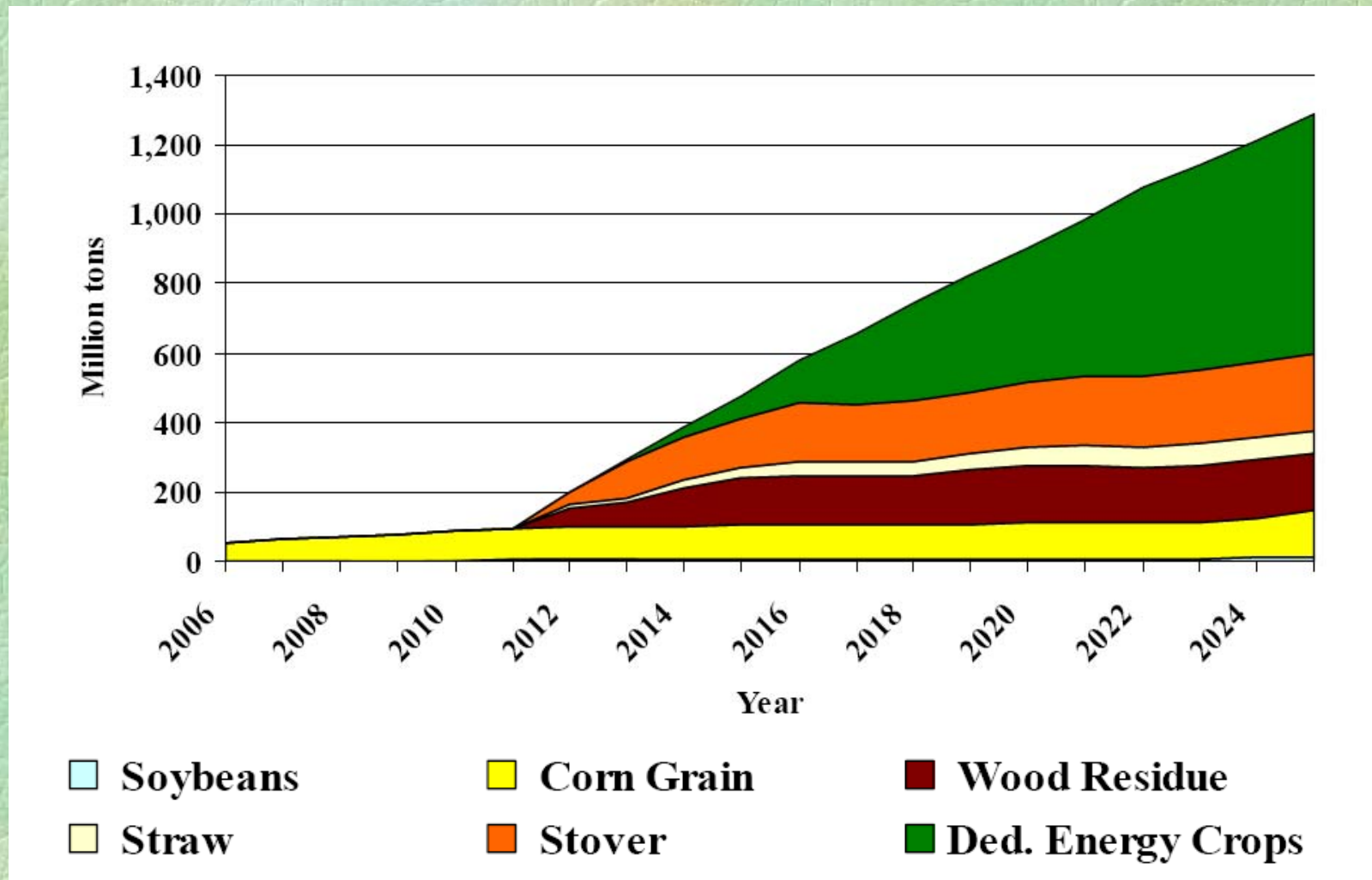
Summary and Conclusions

- The corn ethanol "rush" is "gold rush fever" and is rapidly creating unintended consequences for feed, fuel and water
- But if corn has been \$2/bu most of your farming career, \$4 corn looks awful good
- Avoiding expanded water quality impacts w/ grain-based ethanol will be difficult
- There are technology, infrastructure and policy constraints to cellulosic ethanol

Summary and Conclusions

- Perennial grass based cellulosic ethanol can provide multiple economic & environmental benefits
(I will tell you more later today)
- Need to understand grain and cellulosic options and unintended consequences *so choices can be made before we are so heavily invested in grain ethanol that there is no other option*

Looking Beyond Corn and Soybeans(?)



Source: U. of Tennessee, "25% Renewable Energy for the U.S. by 2025", Report, November 2006