Biofuels and Water Quality in the South and East

or can it be

Biomass and Environmental Quality Enhancement

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USDA-CSREES National Water Conference
Sparks, Nevada
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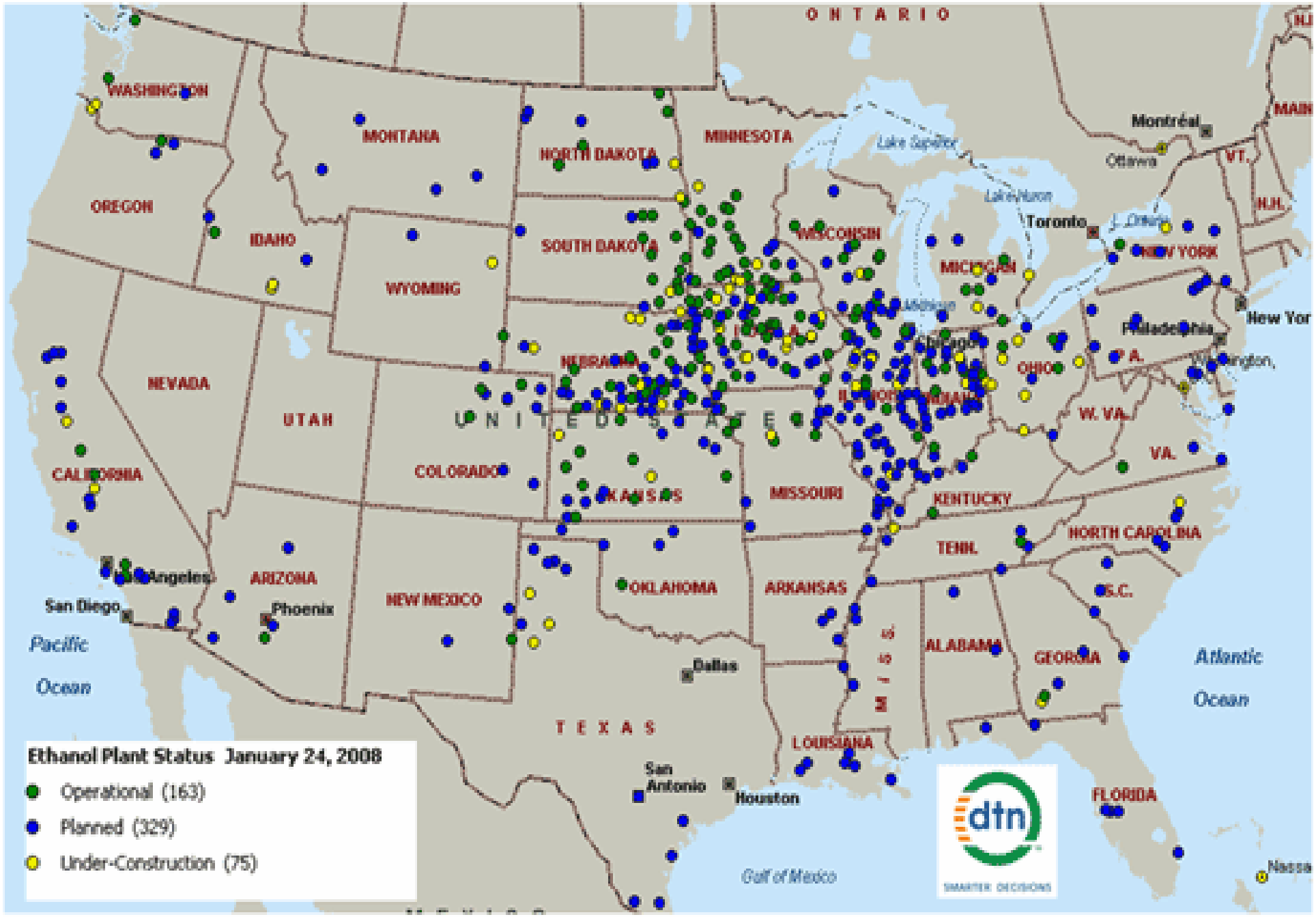


*Alaska has one ethanol plant in the planning stage
*Hawaii has two ethanol plants in the planning stage

Applying knowledge to improve water quality
Mid-Atlantic
Regional Water Program
A Partnership of USDA CSREES
& Land Grant Colleges and Universities

Millions of acres were threatened,
we said, especially in critical waterfowl
breeding grounds on the northern prairies.
"Oh, calm down," we were told.
"You're being alarmist. The sky isn't falling."

Well, now we know part of the sky did fall –

and more may be coming down soon.

Golden corn leaving ducks out of luck
New Orleans-Times Picayune
Sunday, January 13, 2008
Bob Marshall

Ditto for those who spoke up about water quality issues

2007 Energy Act Renewable Fuel Standards

Year	Conventional Biofuel	Advanced Biofuel	Cellulosic Biofuel	*Undifferentiated Advanced Biofuel*	Total RFS
2010	12	.95	.1	*0.2*	*12.95*
2012	13.2	2	.5	*0.5*	*15.2*
2014	14.4	3.75	1.75	*2*	*18.15*
2015	15	5.5	3	*2.5*	*20.5*
2016	15	7.25	4.25	*3.0*	*22.25*
2018	15	11	7	*4.0*	*26*
2020	15	15	10.5	*4.5*	*30*
2022	15	21	16	*5*	*36*

The Sleeper?
EISA Environmental Requirements

- Requires EPA to study adverse air effects of RFS and promulgate regulations to offset
- Requires EPA, USDA and DOE to report to Congress every 3 yrs on RFS impacts on environment, resource conservation and invasive/noxious plant use
- Expands EPA's authority to control engines, fuels and additives under CAA to address effects on water pollution

Ethanol Production: Why dominantly grain-based?

- Grain-based
  - Fermentation of starches done for centuries
  - Operational technology exist
  - Feedstock production, storage and handling capabilities exist
  - Makes grains profitable w/ less direct subsidy?
  - Farmers are good at growing corn
- Cellulose-based
  - None of the above

A 100-Million Gallon Ethanol Plant …

- Uses roughly 37 million bu of corn per year
  - Needs corn from 250,000 to 300,000 acres (in an average year)
- Produces 315,000 t/yr of distillers grains
  - This could feed approx. 120,000 dairy cattle
- Converting facilities from sugar/starch to cellulosic feedstock is difficult

Movement of Ethanol East?

>Plants near people rather than corn very likely

>Cannot use current pipelines; must truck or rail

Evidence of Eastern movement

- 3 plants proposed for MD (1 ES and 2 Balt. Harbor)
  - Curtis Bay approved and construction beginning
- PA FB: Seven "legitimately proposed" plants in PA
  - 200MGY Westmoreland County plant under construction
  - Clearfield plant beginning construction
- Virginia: City of Chesapeake 215MGY facility
- 100M gpy plant in north Georgia
- 108M gpy plant in NC
- 100M gpy plant proposed for Ithaca, NY area
- Changing very rapidly

Non-WQ Pros and Cons

Benefits

- Movement from fossil fuels
- Burning "new" carbon
- Net energy gain
- Reduced GHG (but not NOX)
- Record commodity crop profits
- Creating more profitable, Ag price structure (?)
- Revitalizing rural communities?

Issues

- Water quantity issues
- Food, feed and fiber production
- Consumer prices
- Food availability for poor (global)
- Ecosystem damage and habitat loss
- Carbon release and NOX increases

Grain Ethanol Impacts on Water Quality

1) Nutrient management and nutrient use incentives

- Economic optimum yield increases w/ price but use efficiency declines
- Farmer may be more risk averse, "insurance" nutrient prone
- "BMP yield warranty" and other incentive programs less attractive, more costly

Bottom Line: N and P losses from *existing* corn acreage are expected to increase

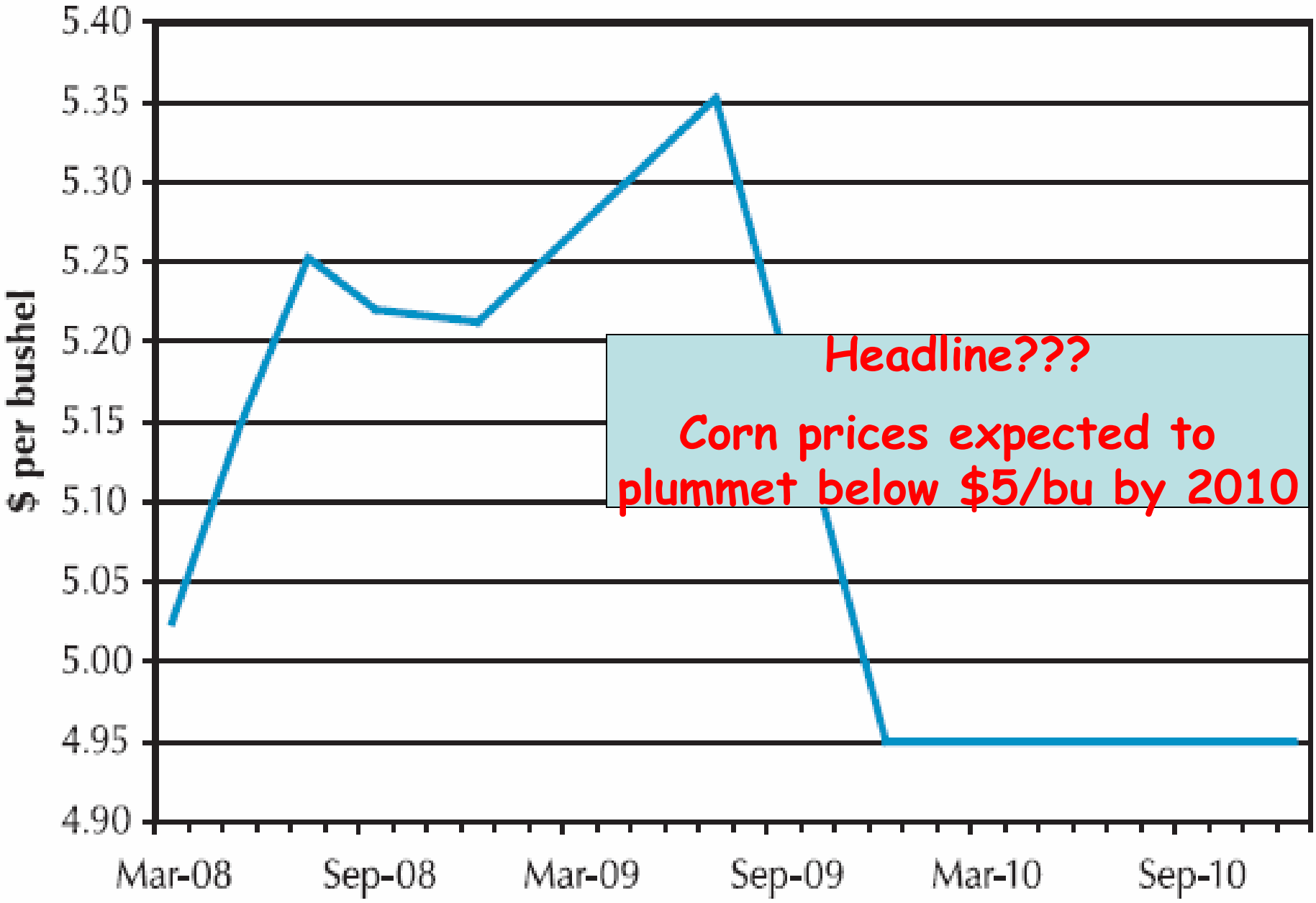
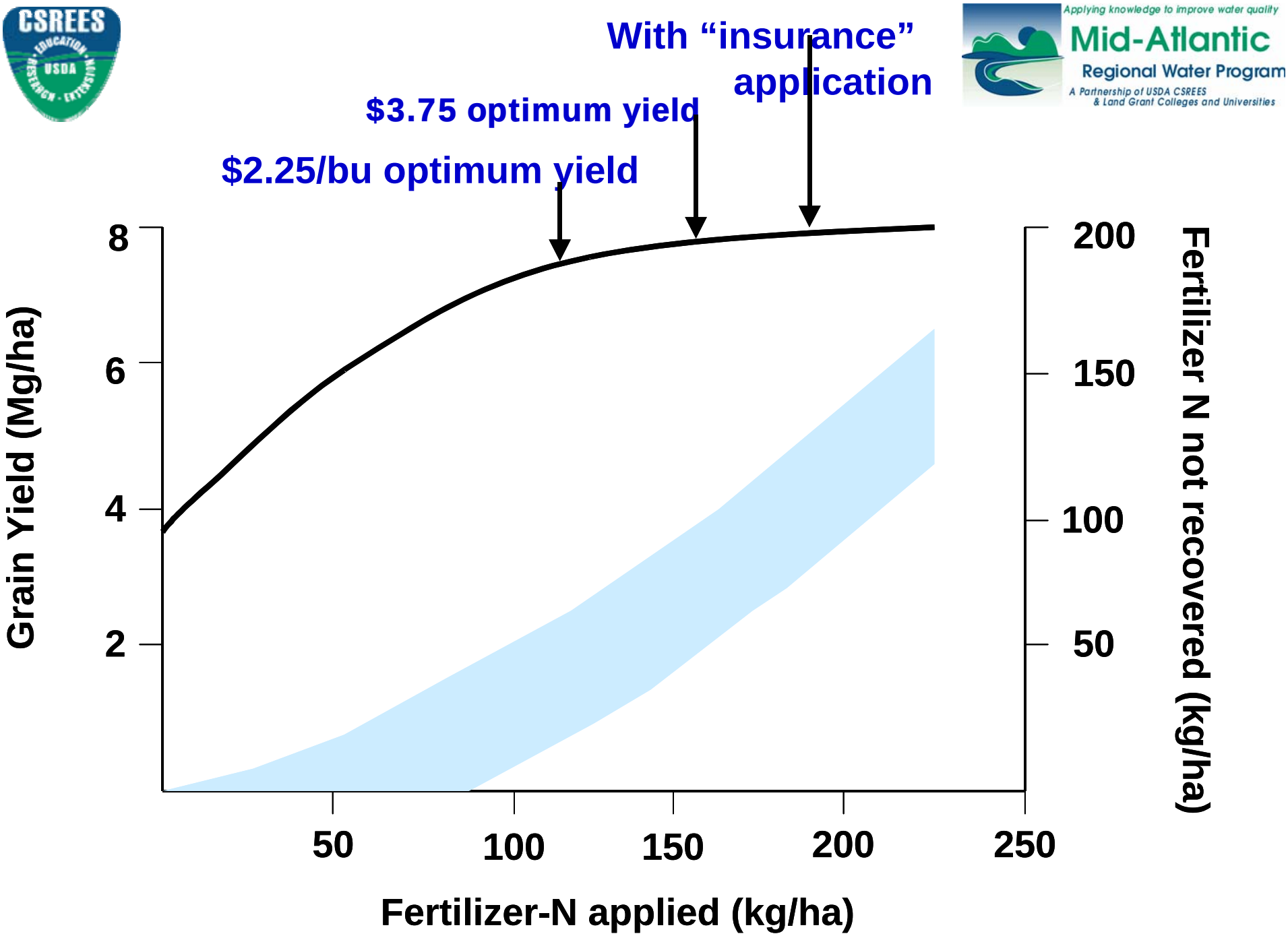


Figure 1. Corn futures prices (as of Jan. 16, 2008)

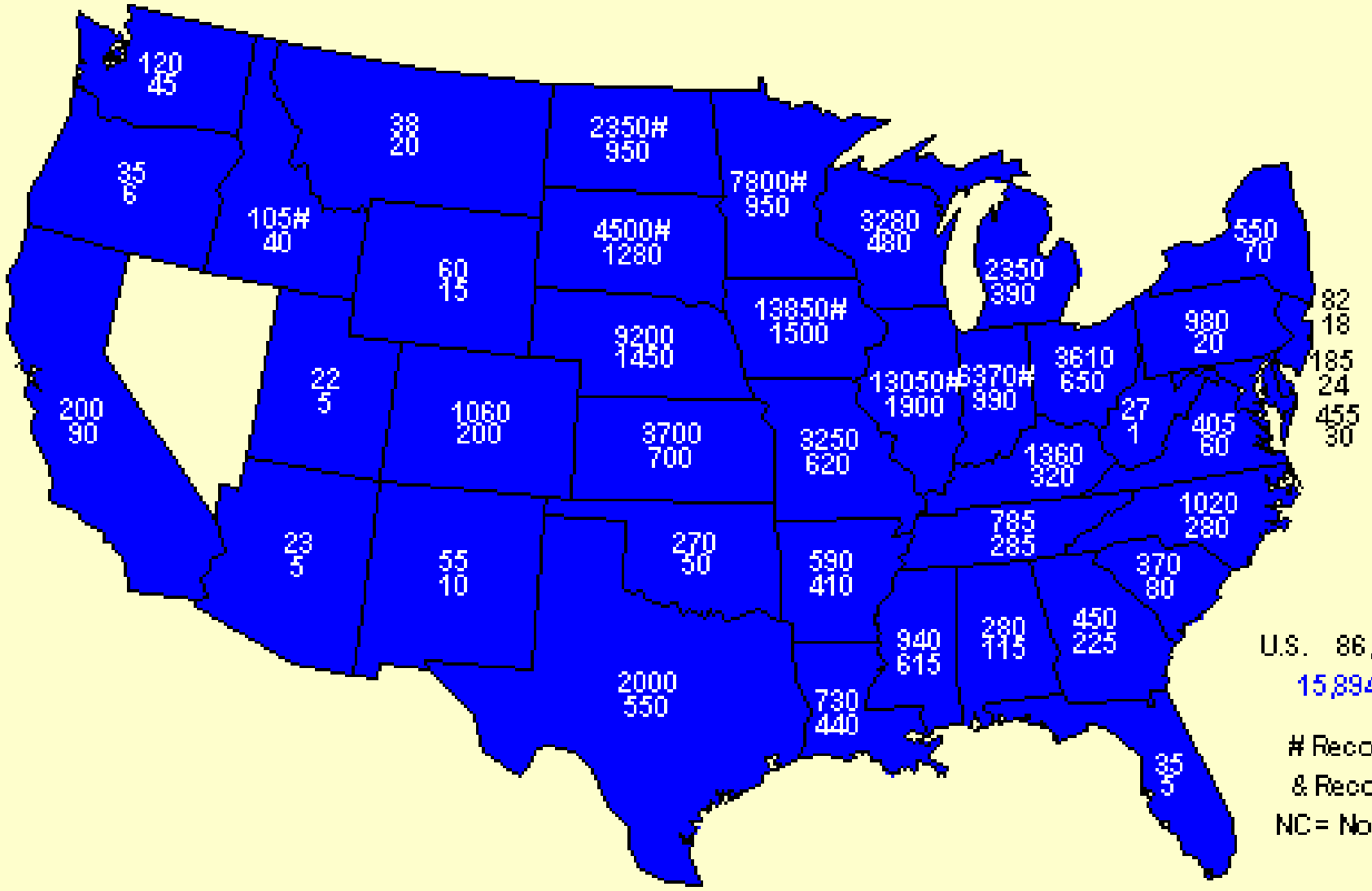
Source: CARD, ISU



Graph From NRC, 1993

2007 Corn for Grain Harvested

Acres (000) and Change From Previous Year



U.S. 86,542

15,894

Record High

& Record Low

NC = No Change

USDA-NASS

01-11-08

Not much change in the East?

- More than appears; 300,000 new acres of corn was planted in Mid-Atlantic, only 140,000 harvested
- Much of remainder harvested as silage
  - Due to high feed cost
  - Due to poor grain yields
- Significant acreage not harvested due to drought

Greater water quality risks on expanded corn acres in East/South?

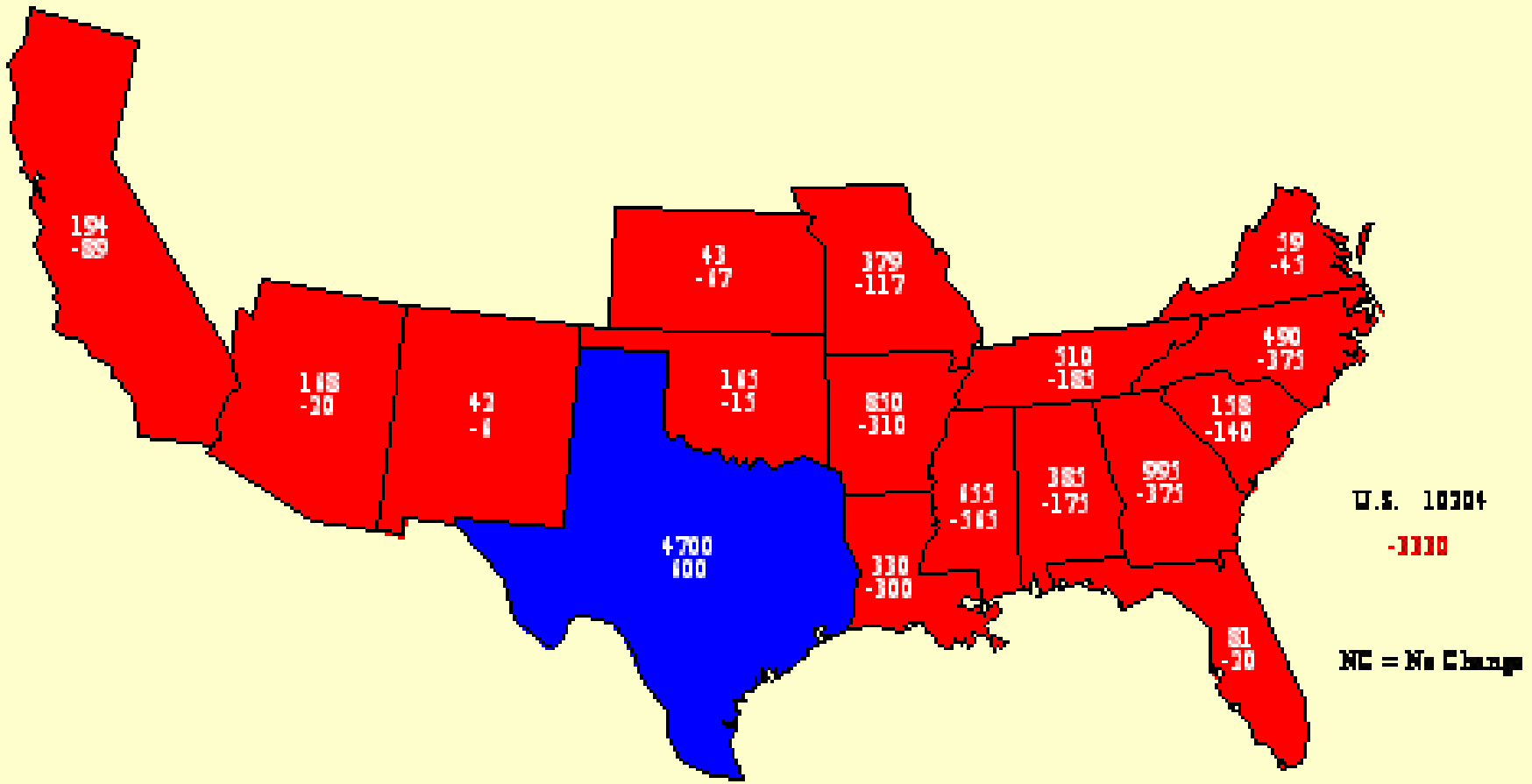
- More marginal soils in production
- Soils generally not as productive
- Soils and climate more drought prone
- More prone to in-season leaching?
- Greater in-field yield variability

What got converted to corn?

- Cotton in South
- Hay and pasture in Mid Atlantic and Northeast
- Full season soybeans wherever grown
- Some double crop wheat and soybeans
  - Wheat planted before "frenzy" but this could be significant in future
- CRP lands but limited amount available

2007 Upland Cotton Harvested Acres

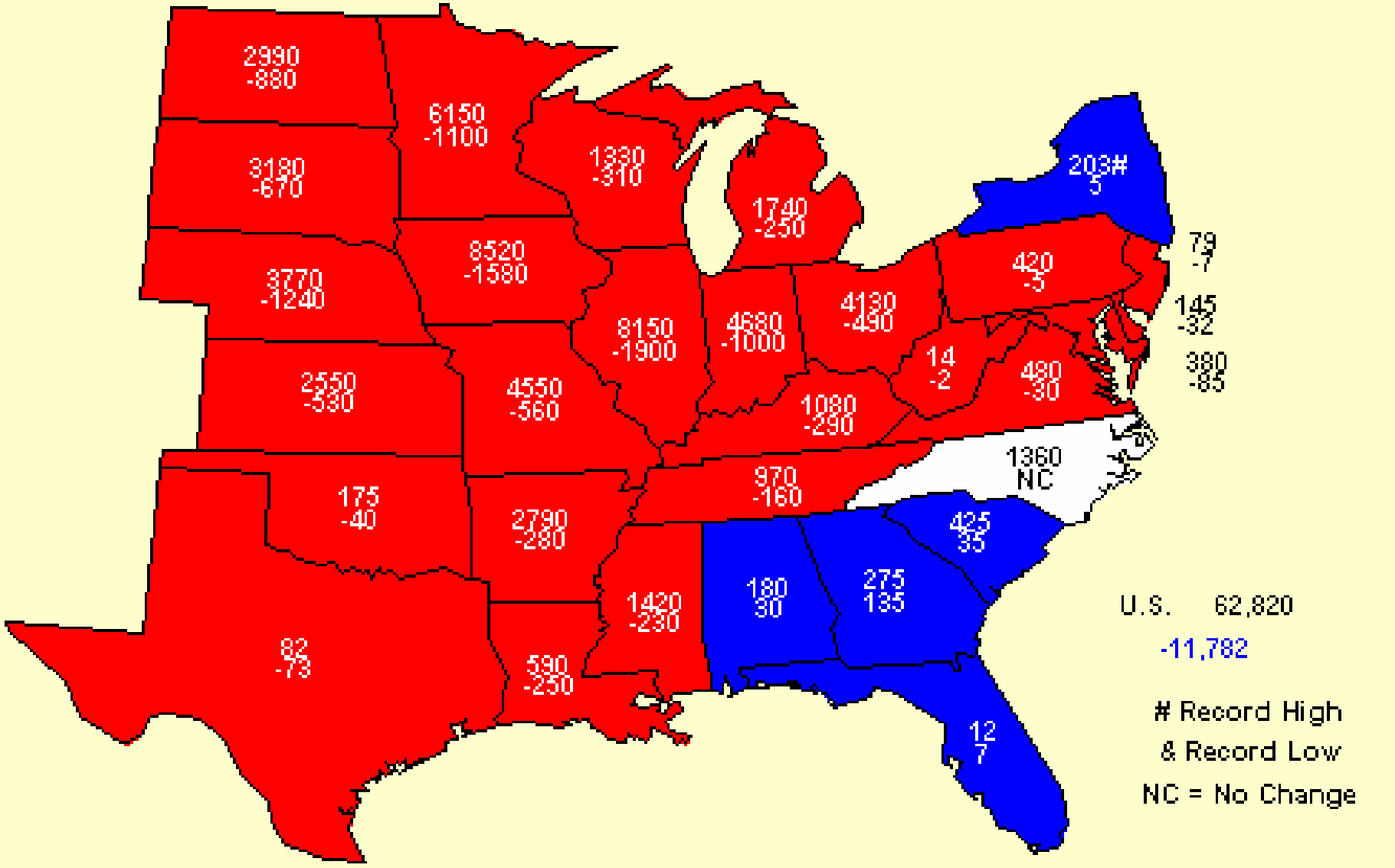
Acres (000) and Change From Previous Year



USDA-NASS
01-11-08

2007 Soybeans Harvested

Acres (000) and Change From Previous Year



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	+480
From soybeans	8	22.5	-180
CRP/Idle land	6	3	-18
Pasture or Hay	2	6	-12
N Loss Increase (M lbs)			270

*CARD estimate from 11/2006

Table from: *The New Gold Rush: Fueling Ethanol Production While Protecting Water Quality*. March-April, 2008. J. of Env. Qual.

Impact of Potential Corn Acreage Increase on Chesapeake Bay N Loads

Applying knowledge to improve water quality
Mid-Atlantic Regional Water Program
A Partnership of USDA CSREES & Land Grant Colleges and Universities

Cropping Changes	Expected N Loss (lbs/ac)	500,000 Acres		1 Million Acres	
		Acreage ('000)	Increased N Loss (m. lbs)	Acreage ('000)	Increased N Loss (m. lbs)
New Corn Acres	30	500	+ 15.0	1,000	+ 30.0
Soybeans	22.5	236	- 5.3	472	- 10.6
Cotton	14.25	11	- 0.15	22	- 0.3
CRP	3	16	- 0.05	32	- 0.1
Hay	6	250	- 1.5	500	- 3.0
Potential N Loss Increase (m. lbs)			+ 8.0		+ 16.0

3) Dried Distiller's Grains

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Mid Atlantic Feed Management Efforts

- CIG and Targeted Watershed grants to reduce P (and N) overfeeding in dairy
- Worked with NRCS to develop standards and pilot programs
- Working to take P from .4-.45% in ration to .33-.35% and manage N based on MUN test
- Considerable success working with nutritionists
- DDGs in rations at 15-30% may reverse this

DDGs and feed management

- DDGs high in P (0.75-0.90%) compared to desired dairy ration (~0.35%)
- DDG P more soluble than grain P
- High in protein so overfeeding N also likely
- DDGs in beef and dairy rations
- May reverse gains through dairy feed management programs (NRCS incentives)
- Major impact if much use in poultry or swine

4) Disincentive to land retirement, longer rotations and perennials

- Costs of retirement programs will rise
- Loss of CRP (and CREP?) lands
- Creates pressure to bring hay, pasture and idle lands into corn production
- Increased continuous corn requires more N
- Reduces interest in perennial grasses

Impacts on CRP?

- 420,000 acres converted in North Dakota
- 200,000 acres in Iowa
- CARD estimates 50% conversion in Iowa over time $4.00/bu corn and 67% loss at $5.00/bu unless land rental values are greatly increased
- 25,000,000 acres up for re-enrollment in 2007-2009
- Impact limited by CRP acreage in East and South
- Will commodity prices bring CREP lands into production?

Potential CRP Acres for Corn?	
	Mil. Acres
ILLINOIS	1.03
INDIANA	0.29
IOWA	1.92
MICHIGAN	0.26
MINNESOTA	1.76
MISSOURI	1.55
OHIO	0.29
Total	7.10
Includes wetlands, buffer	
strips, etc.	

Source:
Wisner, 2007

East nor South likely to be the new "Corn Belt"

- 250-300K acres of corn/100MGY ethanol?
- Net grain deficit area due to poultry and swine
- Limited arable land
- Drought prone soils
- Small fields and farms
- Lack of "mega" infrastructure

So could something work for the farmer and the environment here?

5) BIOMASS PRODUCTION

- Soils and climate better suited to perennial biomass crops
- Don't just think transportation fuel
- Don't just think about grasses
  - "IT'S THE BIOMASS STUPID"
- Don't depend on one feedstock
- Look for both farm and commercial scale opportunities
- Tremendous opportunity for innovation
  - Feedstocks
  - Processes and products
  - Facility design and scale
  - Business organization
  - Customer base

East and South Biomass Possibilities

- Ethanol
- Diesel/oil
- Combustion
  - Heating
  - Electricity generation
- Bedding material
- Poultry litter
- Packing/filler materials
- Others????

Large-Scale Biomass Facility

- 25-50k acres w/i 25-50 mi, if switchgrass
- More likely to succeed with multiple, seasonal biomass sources (and "opportunity" feedstocks)
  - Warm season grasses
  - Cool season grasses
  - Timber slash
  - Round wood
  - Lumber/pulp waste/by-products
  - Manure
  - Biosolids
  - Municipal solid waste
  - "Natural fiber" industrial waste
  - Others?
- Can facility produce multiple products?
- Can large scale facility service a local demand?

Small scale or on farm, multi-farm biomass production for local use?

- Diesel/fuel oil
- Combustion for heat or electricity
- Bedding materials
- Other uses?

Is there a place for small scale biomass products in the EAST?

- Process oilseed for feed for farmers and keep oil as fee
- Sell or use both feed and oil
- Use to reduce crop production energy costs
- Sell to neighbor farms
- Locally based diesel or heating oil
- Heat for farmstead and household
- CSAs for energy???
- Small scale ethanol production for on-farm uses
- Pellets/crimped , materials for bedding or bulking agent
- Sell "green" electricity to grid

Eastern ethanol likely to be mega scale but small scale has its place with other products

Warm season vs cool season grasses in the East

- Higher annual biomass production?
- But takes 2-3 years to get established
- Lower fertility requirements
- Fewer cuttings
- Longer lasting stand
- "Self drying" in field
- "Store" in field
- Denser root system
- Greater carbon storage/credits
- Greater nutrient reductions/credits
- *However, probably not an "either-or"*

Can we use Conservation Programs to promote biomass production?

- EQIP
- CR(E)P
- Cropland conversion
- Native "plantings"
- "Biomass Reserve Program"(?)

Why might switchgrass succeed as ethanol feedstock?

- Lower cost to produce over time
- 20+ year perennial
- Could be good seasonal feedstock with others
- Greater net energy production
- Ligno-cellulosic co-product can be burned for heat
- Does not *directly* compete with feed
- Environmental benefits rather than consequences
- Potential for multiple revenue streams

Multiple revenue sources from switchgrass (or other grasses)

- Topgrowth for biofuels
- Burn residue for heat or energy
- Carbon sequestration in root system
- Tradable nutrient credits (>50% reduction from row crops)
- Soil quality credits (currently in CSP)
- Improved soil productivity in the future

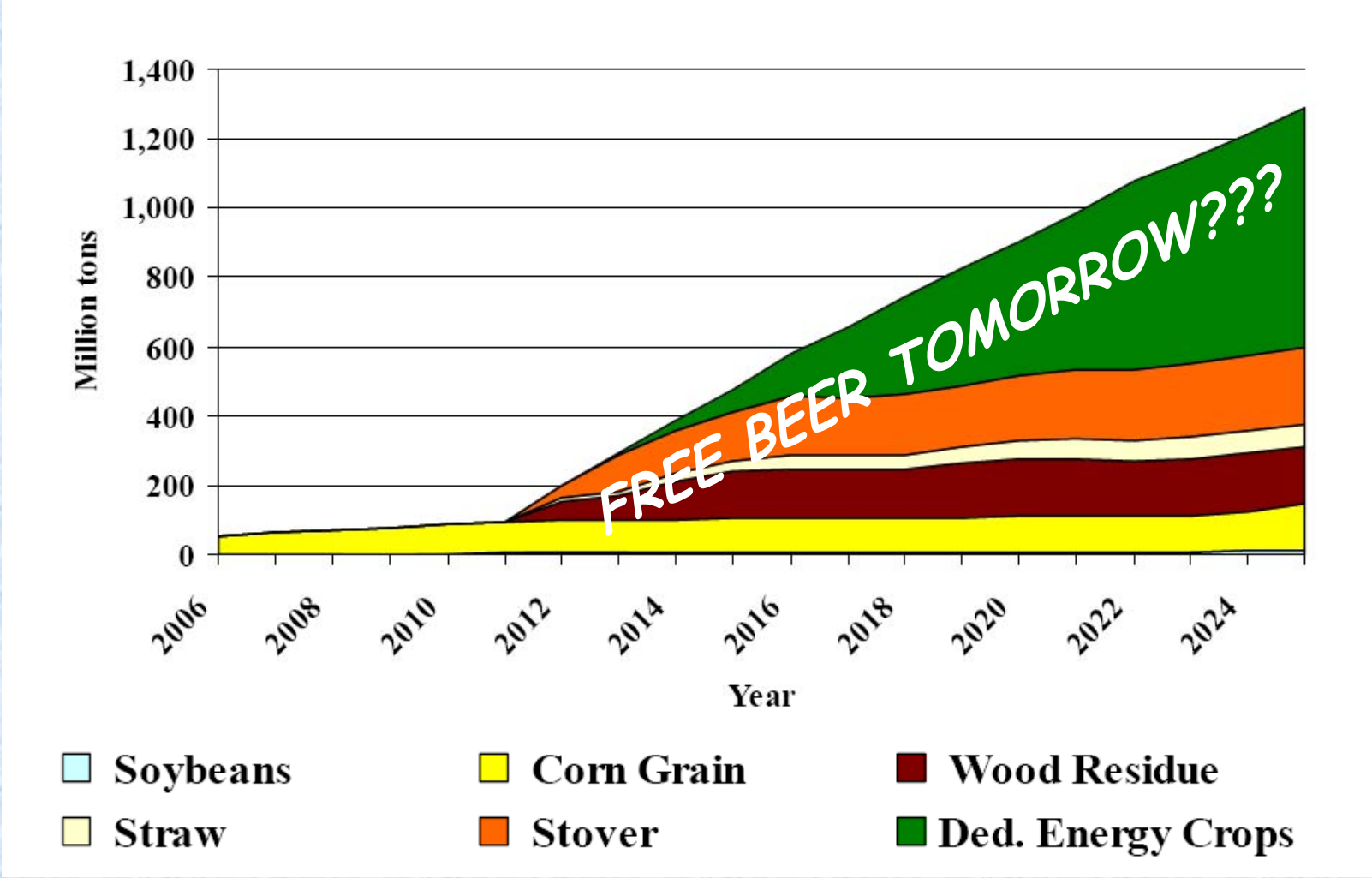
Conclusions (1)

- Ethanol production will expand eastward
- East/South may have comparative advantage for cellulosic biomass products
- DDGs are affecting ration P (and N) content
- Think biomass products, not just biofuels

Conclusions (2)

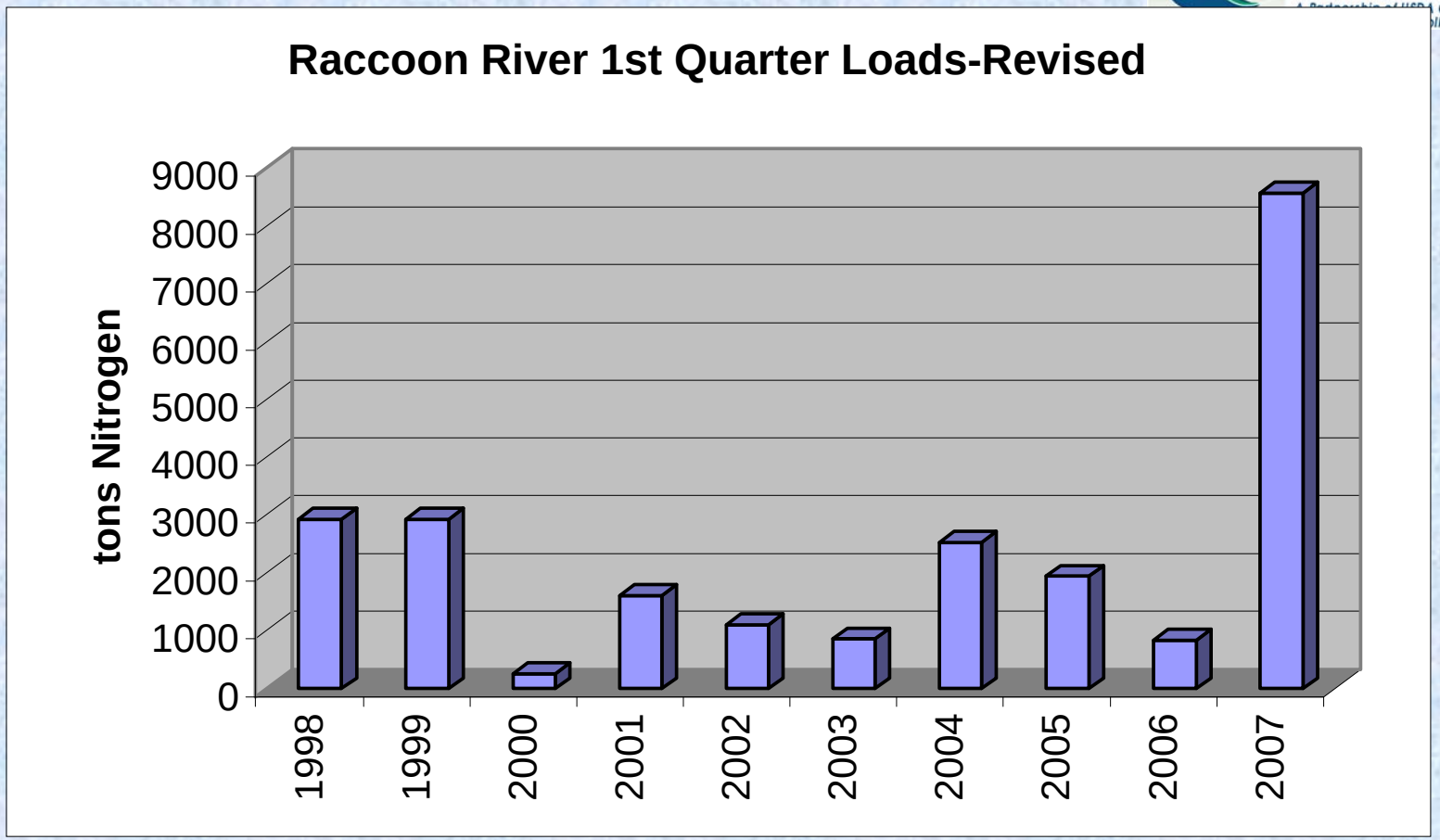
- Multiple revenue streams can make biomass more competitive with grains
- "Redesign" farmscape so perennial grasses can "treat" losses from intensive corn production
- Commercial cellulosic ethanol probably decade away
- Even in East and South, intensified corn production will have substantial water quality impacts

Looking Beyond Corn and Soybeans(?)



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

Nitrate load in Raccoon River jumps, climate change?



Data provided by Chris Jones Des Moines Water Works

Source: The Upper Mississippi River: Past, Present and a Biofuture Agriculture
Dennis Keeney, Senior Fellow, IATP, Minneapolis

Presented at Division A-5 Symposium, Agriculture, Rivers and Coasts
American Society of Agronomy 100th Anniversary Meeting
November 5, 2007. New Orleans Louisiana