Perennial Bioenergy Crops and Productive Conservation

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2007 Biobased Industry Outlook

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Presentation Summary

- GPI Background
- Biofuel Risks
- Biofuel Opportunities
- Native Grass Research
- The Productive Conservation concept

The Promise of Biomass Energy

Easy

Displacing fossil fuels (old biomass) with new biomass.

Possible, but not automatic

Improve wildlife habitat, soil quality, water quality, farm income, and GHG emissions while supplying biomass for fossil fuel replacement.

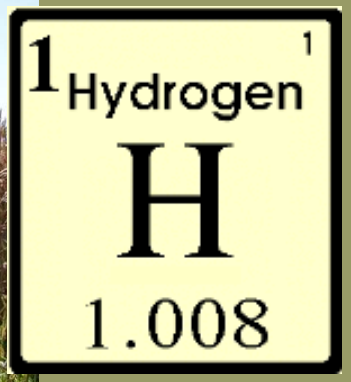
Great Plains Institute

- Formed in 1997
- Bring together diverse leaders to solve critical development issues
- Current focus:
  - Energy security based on a renewable and carbon-neutral energy system
- Funded by foundations, stakeholders, individuals and government

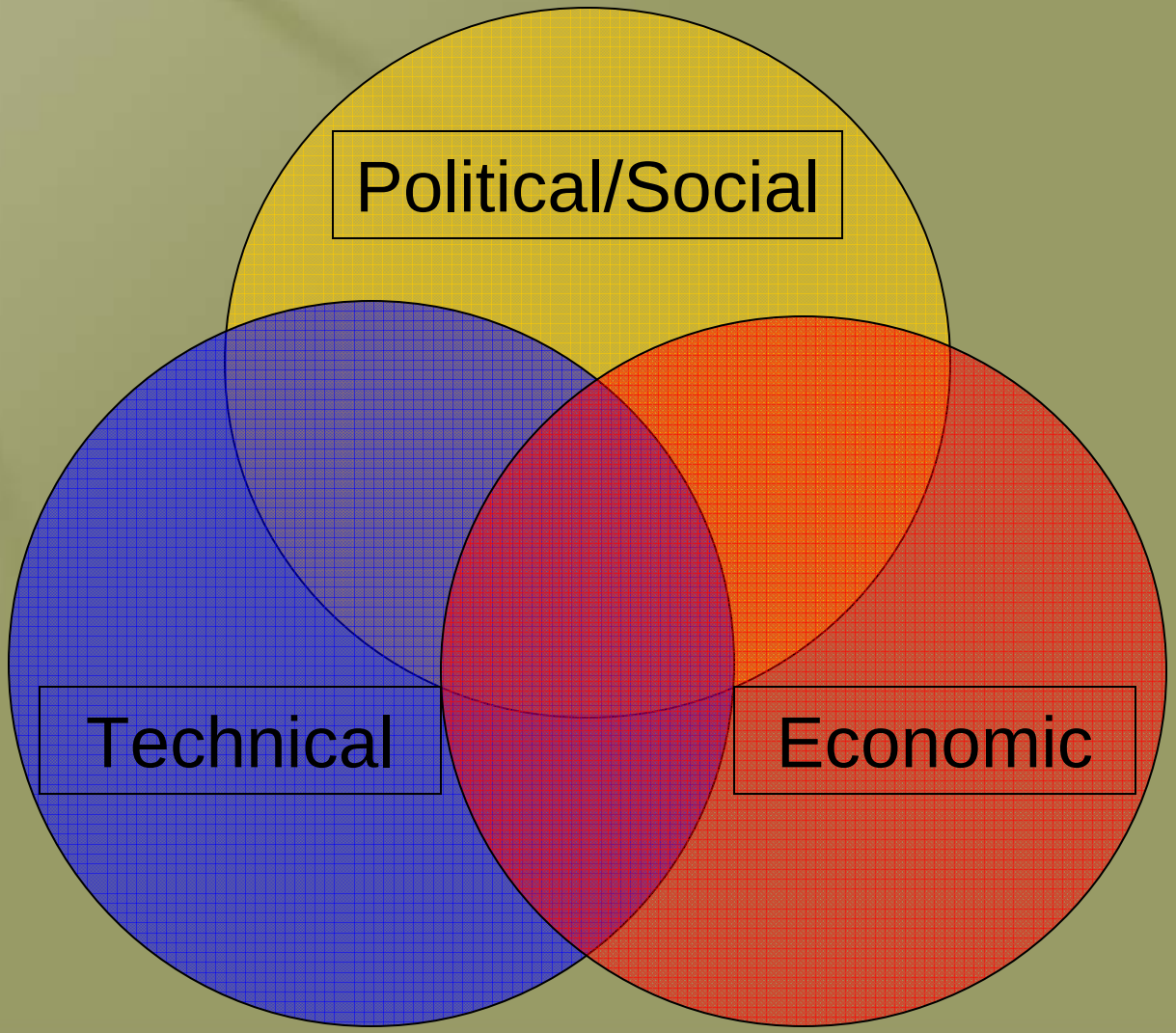
The region we serve

We are a 501 (c) 3 nonprofit based in Minneapolis but incorporated in 5 states.

No “silver bullet” solution



Test for Feasibility of Climate/Energy Solutions



GPI Convenes Over 100 Stakeholders from 11 States/Provinces

Powering the Plains

- Flagship regional energy policy project for the Dakotas, Iowa, Manitoba, Minnesota and Wisconsin

Upper Midwest Hydrogen Initiative

- Public-private industry and research consortium

Coal Gasification Work Group

- Coal and utility industry executives, state regulators, and NGOs from eight Midwest and Western states

Biomass Working Group

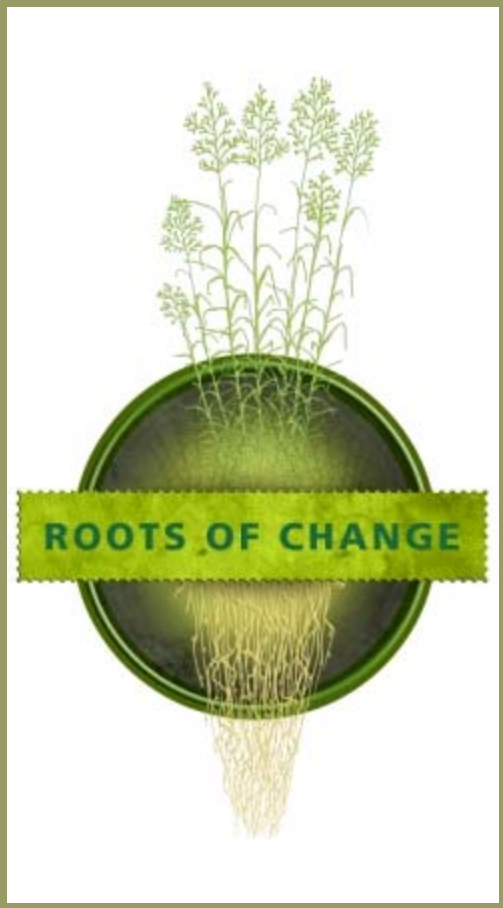
- Regional Stakeholder group promoting state and regional policies to commercialize advanced bioenergy feedstocks and conversion technologies

M-RETS Technical Review Committee

- Committee of utilities regulators, utilities and environmental organizations designing and developing the Midwest Renewable Energy Tracking System

Native Grass Energy

- Economic production of native grass energy crops;
- Conversion to biofuels and other high value products
- Providing multiple benefits:
  - Soil and water
  - Habitat
  - Farmer income
  - GHG reduction



North Central Bio-Economy Consortium (NCBEC)

Mission:

To ensure our region's move toward greater energy independence, utilization of biomass feedstocks and development of robust bio-economies.

- Land Grant Experiment Stations
- Cooperative Extension
- State Depts of Ag.
- IN, IL, IA, KS, MI, MN, MO, NE, ND, OH, SD, WI

NORTH CENTRAL BIOECONOMY CONSORTIUM

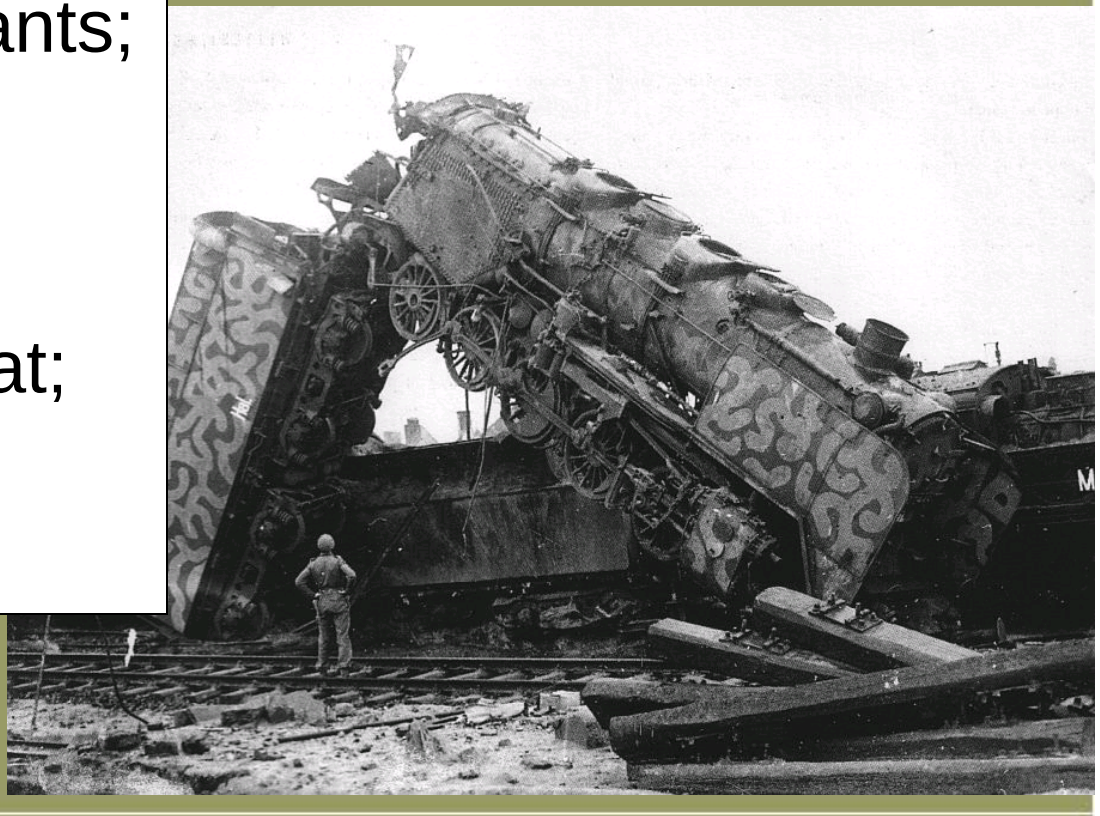
Biofuels: Great promise, great risk

And while we need to avoid this…

This won’t do us any good!

Possible train wrecks

- Competition with competing land uses (food vs. fuel);
- Failure of ethanol plants;
- Loss of acreage in permanent cover;
- Loss of soil carbon;
- Loss of wildlife habitat;
- Diminished water quality.



About that train…

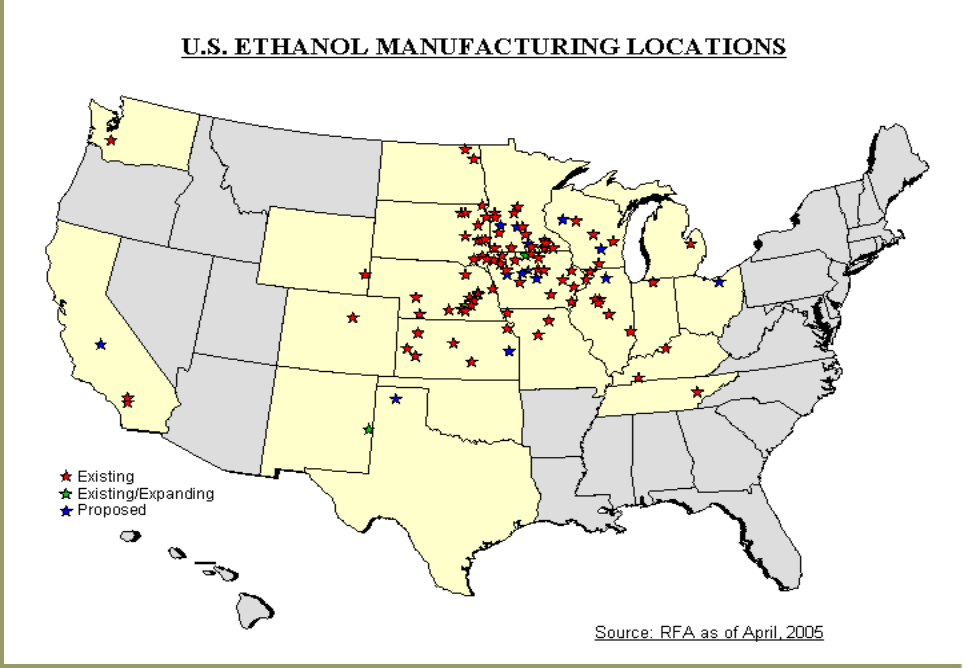
• Nearly 5 billion gallons annual production in 2006

•Federal RFS of 7.5 billion by 2012

•SOTU: 35 billion gallons by 2017

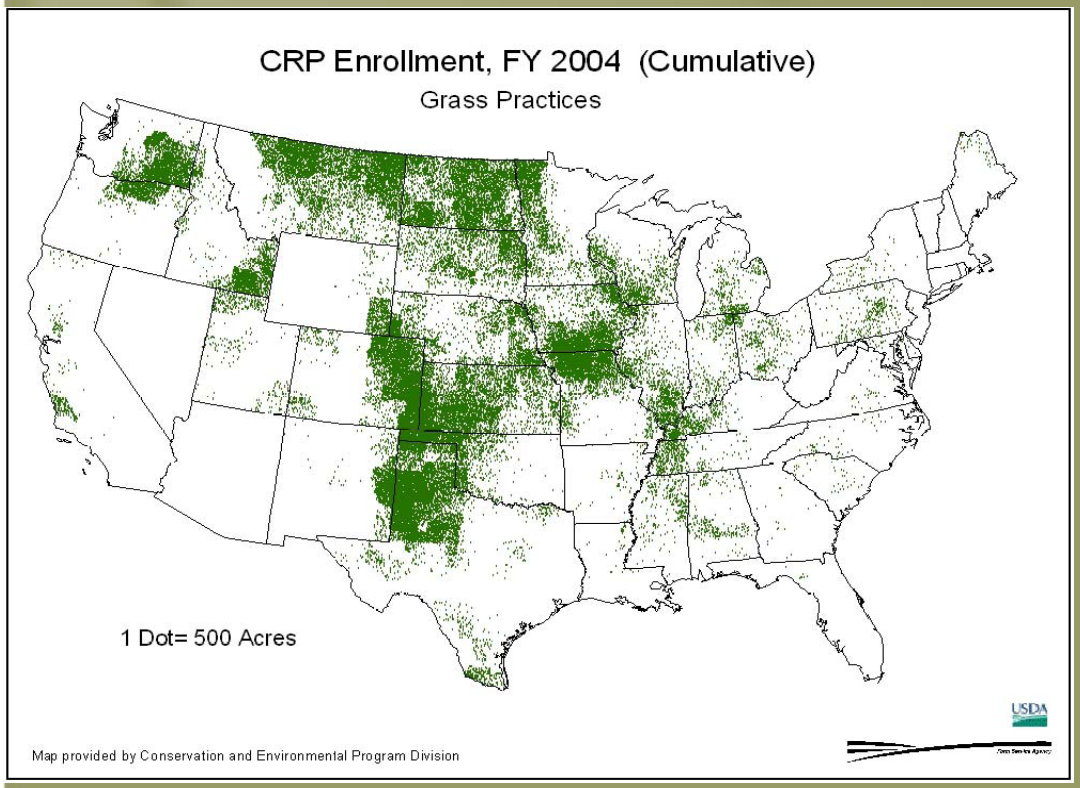
•DOE projection: 60 billion gallons by 2030

•25x25



•But, according to Corn Growers, only 15-20 billion gallons per year are possible from corn.

Energy markets will cause landscape-level change



- High land rents, high corn prices are decreasing re-enrollment in CRP and other programs
- Drought tolerant corn is moving into "marginal" land
- There are calls for early outs from CRP contracts
- Conversion of all types of land, including native pasture

We must transition to cellulosic biofuels, but…

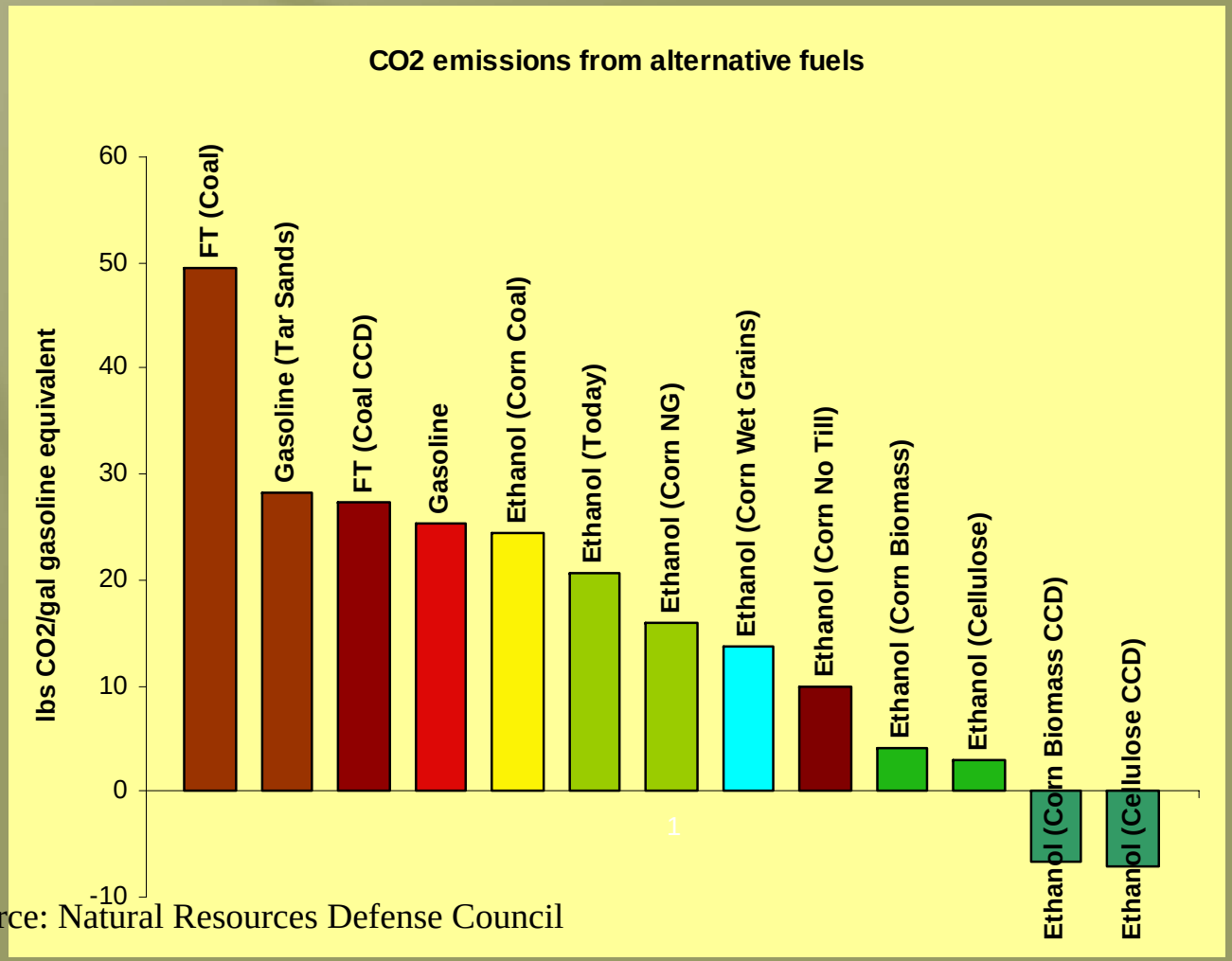
Easy over the medium to long-term:

- Displacing fossil fuels (old biomass) with new biomass

Possible, but not without new policy/research/commercialization agenda:

- Improve wildlife habitat, soil quality, water quality, and farm income and reduce greenhouse gas emissions while supplying biomass for fossil fuel replacement

Not all biofuels are equal



Source: Natural Resources Defense Council

How much biomass is there?

Nationwide:

- 368 million dry tons from forest lands
- 998 million dry tons from agricultural lands
- More than 1.3 billion tons total

Or, enough to replace more than one third of current US petroleum consumption

Source: Biomass as a Feedstock for a Bioenergy and Bioproducts Industry: The Feasibility of a Billion Ton Annual Supply. US Departments of Agriculture and Energy. April 2006

Economics of Biomass

Energy Source	Theoretical Price($/MMBTU)	Electric Utility Price ($/MMBTU)	Average Price, all sectors ($/MMBTU)
Gasoline			$ 17.32
No. 2 Fuel Oil		$ 11.30	$ 12.74
Natural Gas		$ 7.50	$ 7.67
Residual Fuel Oil		$ 6.57	$ 7.53
Coal		$ 1.52	
Petroleum Coke		$ 1.10	
Bio-oil	$ 8.60		
Switchgrass	$ 2.50		

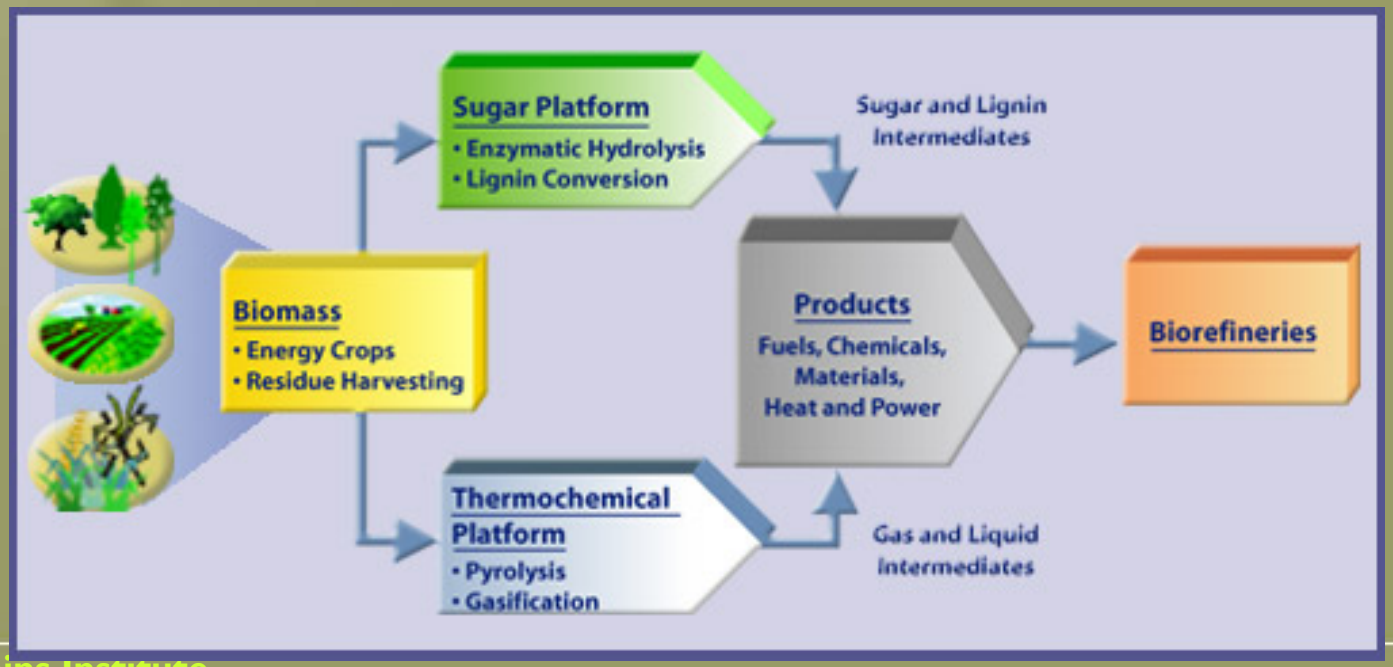
Biomass and petroleum:

- Switchgrass at $50/ton = $18/barrel oil
- Switchgrass at $40/ton = $15/barrel oil

Emerging Biomass Technology

Feb. 27, 2007: 6 Cellulosic Biorefinery Projects to Receive up to $325 million from DOE:

- 130 million gallons/year ethanol
- Ammonia, heat, power, methanol, hydrogen.



Technology - Pyrolysis

- 400-500 degrees Celsius
- Less than one second
- Biomass is “vaporized”, and then quenched.

Technology - Gasification

- Biomass competes well with natural gas – huge market
- Many technology platforms and vendors
- Commercial or near-commercial
- Very flexible technology platform
- Multiple possible co-products

Biomass gasification as bridge technology

- Two conventional ethanol plants installing biomass gasifiers
  - Chippewa Valley Ethanol Company
  - Central Minnesota Ethanol Cooperative
- These projects are moving incrementally towards cellulosic ethanol
- There are many applications for process heat in rural areas

Chariton Valley

- Test firing completed Spring 2006.
- 2% co-firing of switchgrass in an 800 MW coal-fired power plant.
- Processing 14 tons per hour of switchgrass.

Simplicity

Many types of biomass

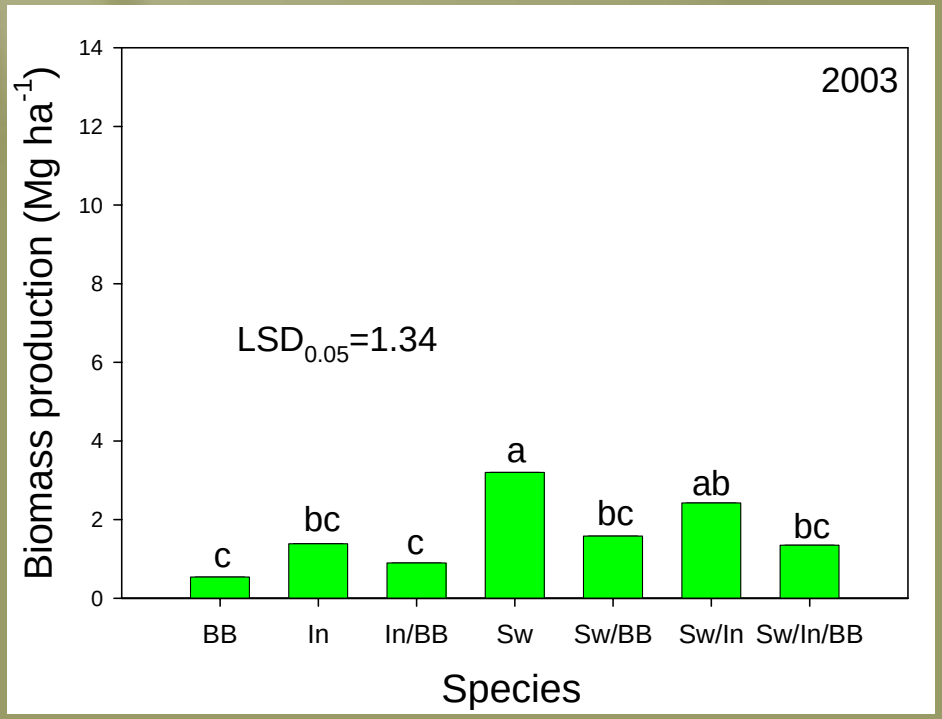
- Crop residue (e.g. corn stalks, wheat straw).
- "Dedicated energy crops" (e.g. switchgrass, miscanthus)
- Distillers Dry Grains
- Wood and wood waste
- Manure and other animal waste
- Municipal Solid Waste

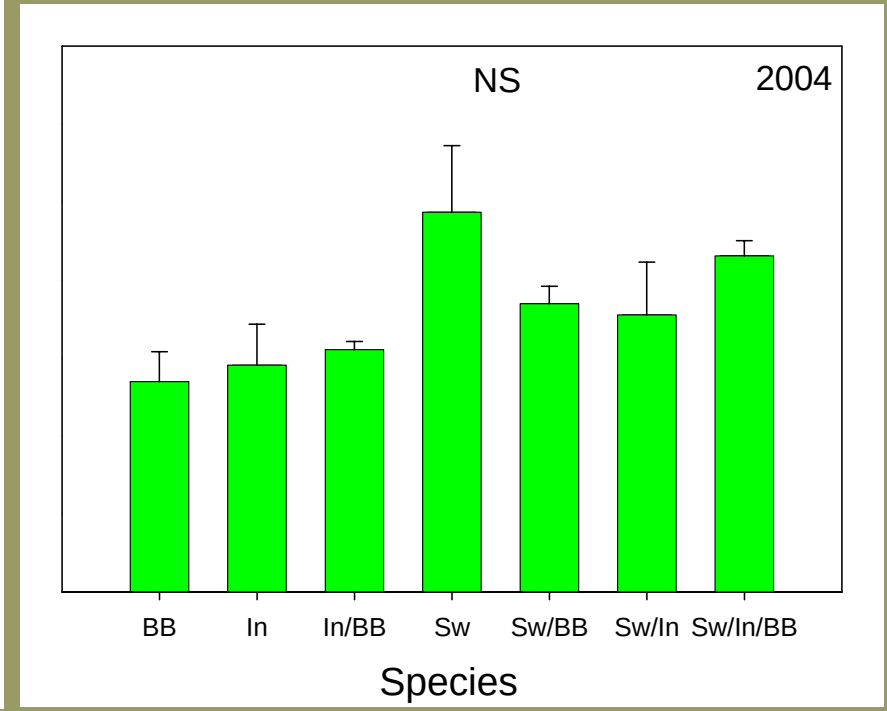
Great Plains Institute's DOE-Funded Perennial Biomass Research

- Agronomic research (SDSU)
- Fuel processing (UND EERC and Ensyn)
- Economic and policy implications (U of MN and GPI)

Monocultures vs Mixtures

Switchgrass (Sw), big bluestem (BB), and indiangrass (In) biomass production grown alone and in all **2- and 3-way mixtures.** Plots were seeded in 2002 at Brookings, SD.





Biomass and Birds

Findings:

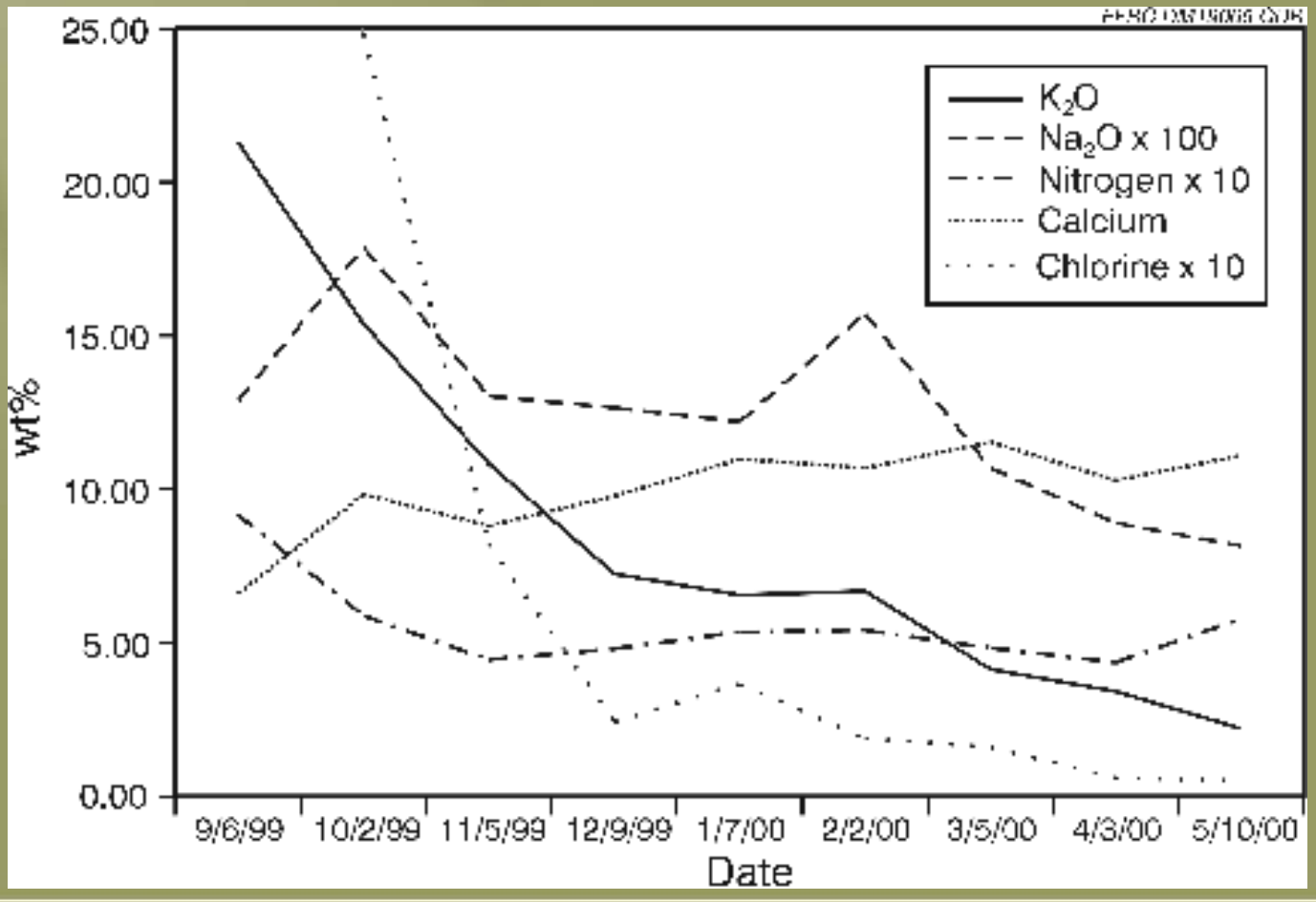
Grasslands with greater plant diversity had higher avian richness, occurrence and density.

Diversity was similar in harvested and unharvested stands, but actual species differed.

Managing for birds and biomass is feasible!

Managing for birds and for industry!

Seasonal changes in ash content of Chariton Valley, Iowa, switchgrass; similar trend observed with Monona Farms (Pennsylvania) switchgrass



Putting carbon back in the soil

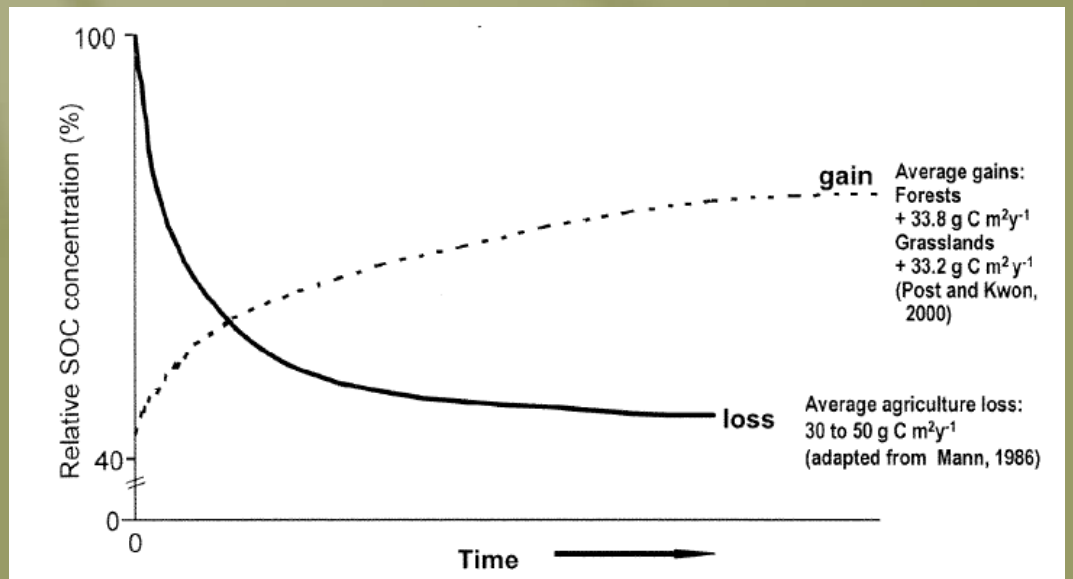
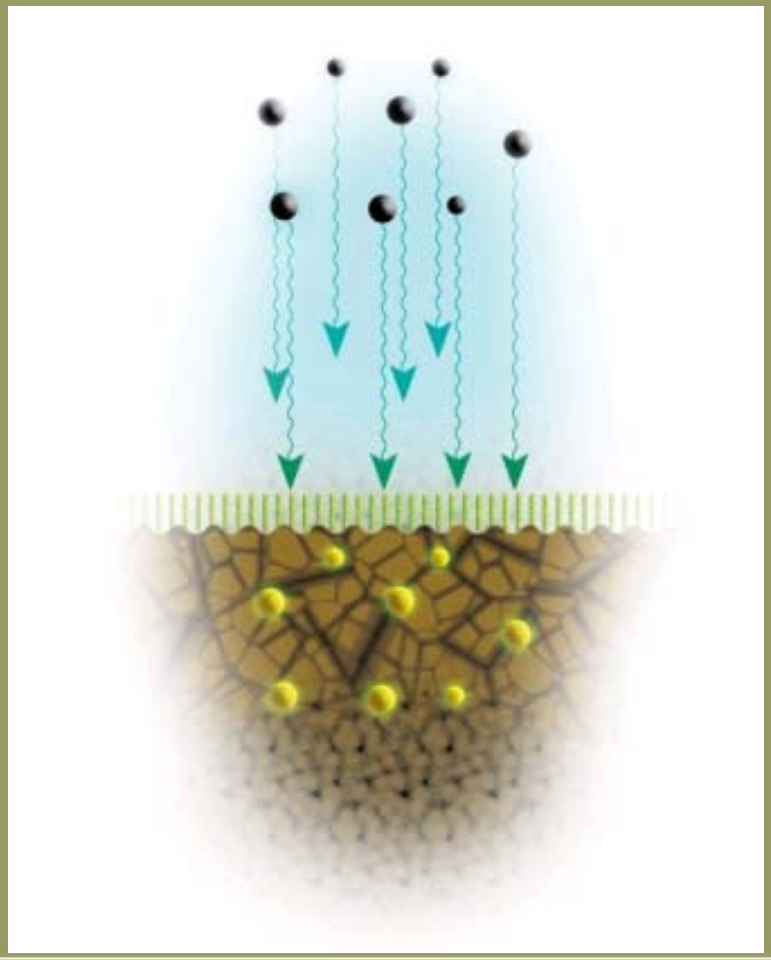
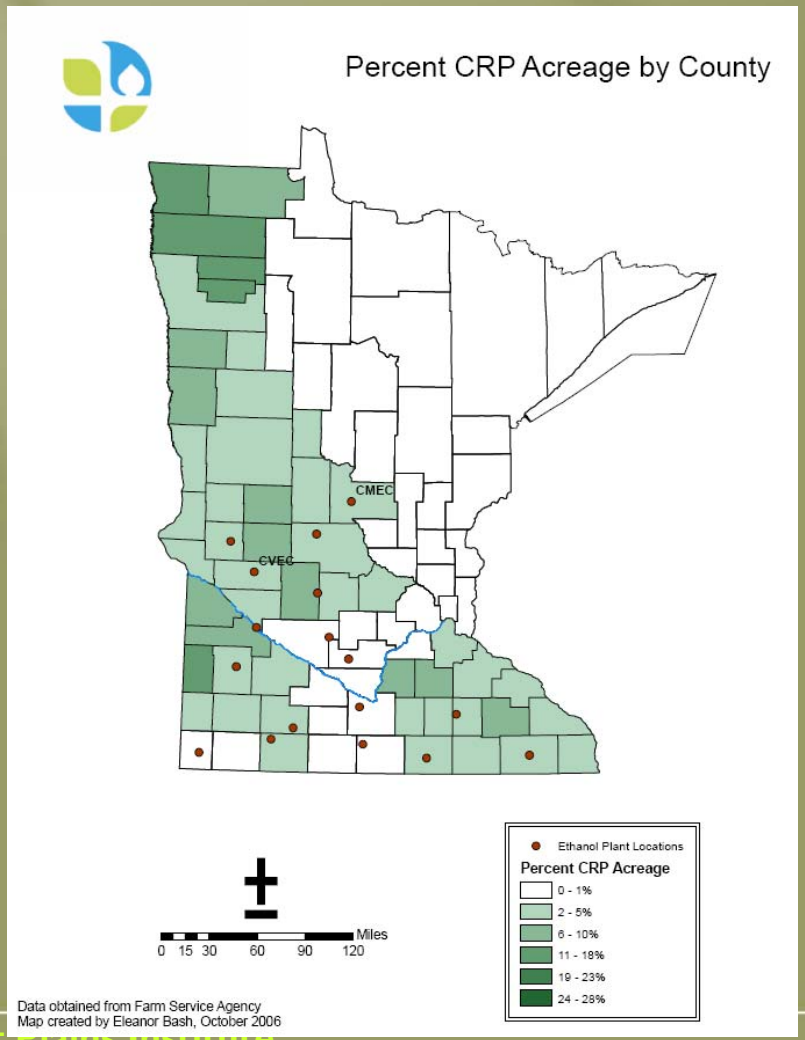
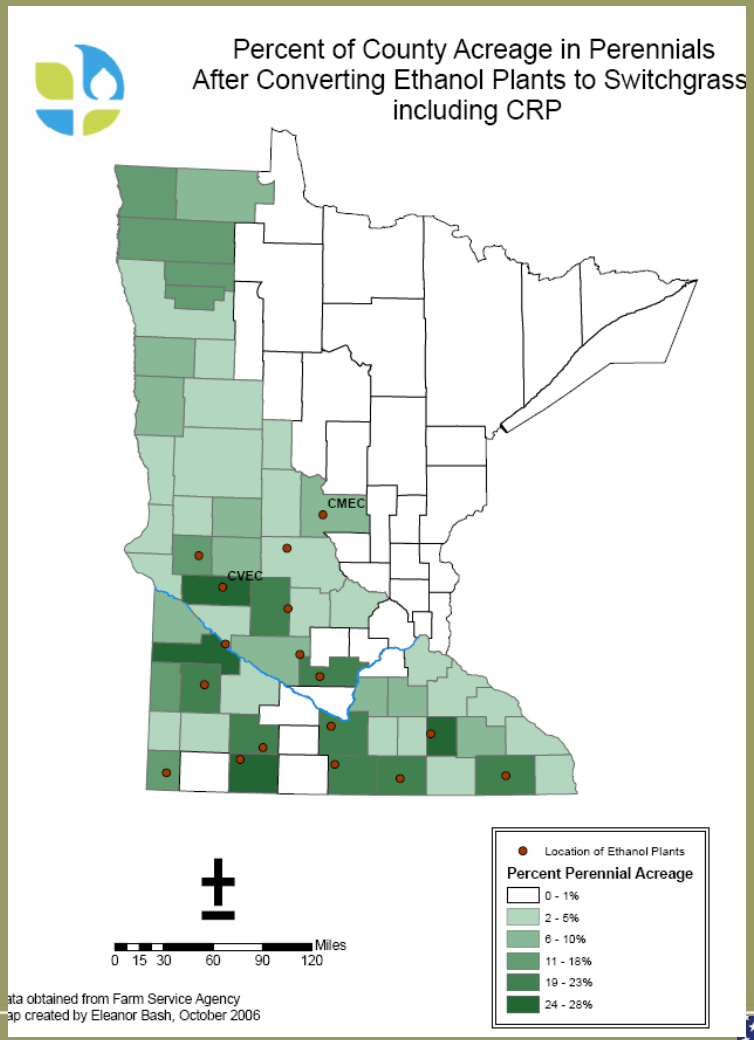


FIGURE 1. Soil carbon losses following cultivation of forests and grasslands to agricultural ecosystems, and potential C sequestration by adoption of RMPs. The time 0 on the x-axis represents the time of conversion to agricultural land use and time of adoption of RMPs.



Potential for landscape level change funded by the biofuels industry





New Models for Productive Conservation

Revenue stream from biomass

+

Wildlife habitat/hunting leases

Water quality

Soil quality

Policy and Perennials

- Lots of resistance to harvesting in CRP
- State Policy:
  - Minnesota authorized a “CRP-like” program dedicated to demonstrating commercial-scale perennial energy crops.

Moving Forward

- Establishment of “best practices”:
  - Harvest timing (late fall, early spring)
  - Preference for mixtures?
  - Every other year harvest?
  - Stubble height?
  - Other issues?

Program design issues:

- How to structure payments?
- How to enforce various requirements?
- Should we target certain landscapes?

Beyond Perennials…

- What other opportunities exist to increase biomass supply while improving soil and water quality, increasing wildlife habitat, and sequestering CO2?
  - Sustainable crop residue removal with nutrient recycling and conservation tillage?
  - Forestry residue removal
  - Cover crop systems
  - Etc…

Thank you!

- www.nativegrassenergy.org
- www.THEbioeconomy.org
- www.gpisd.net

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Great Plains Institute

Staff for the NCBEC