

Minnesota Statewide Conservation and Preservation Plan

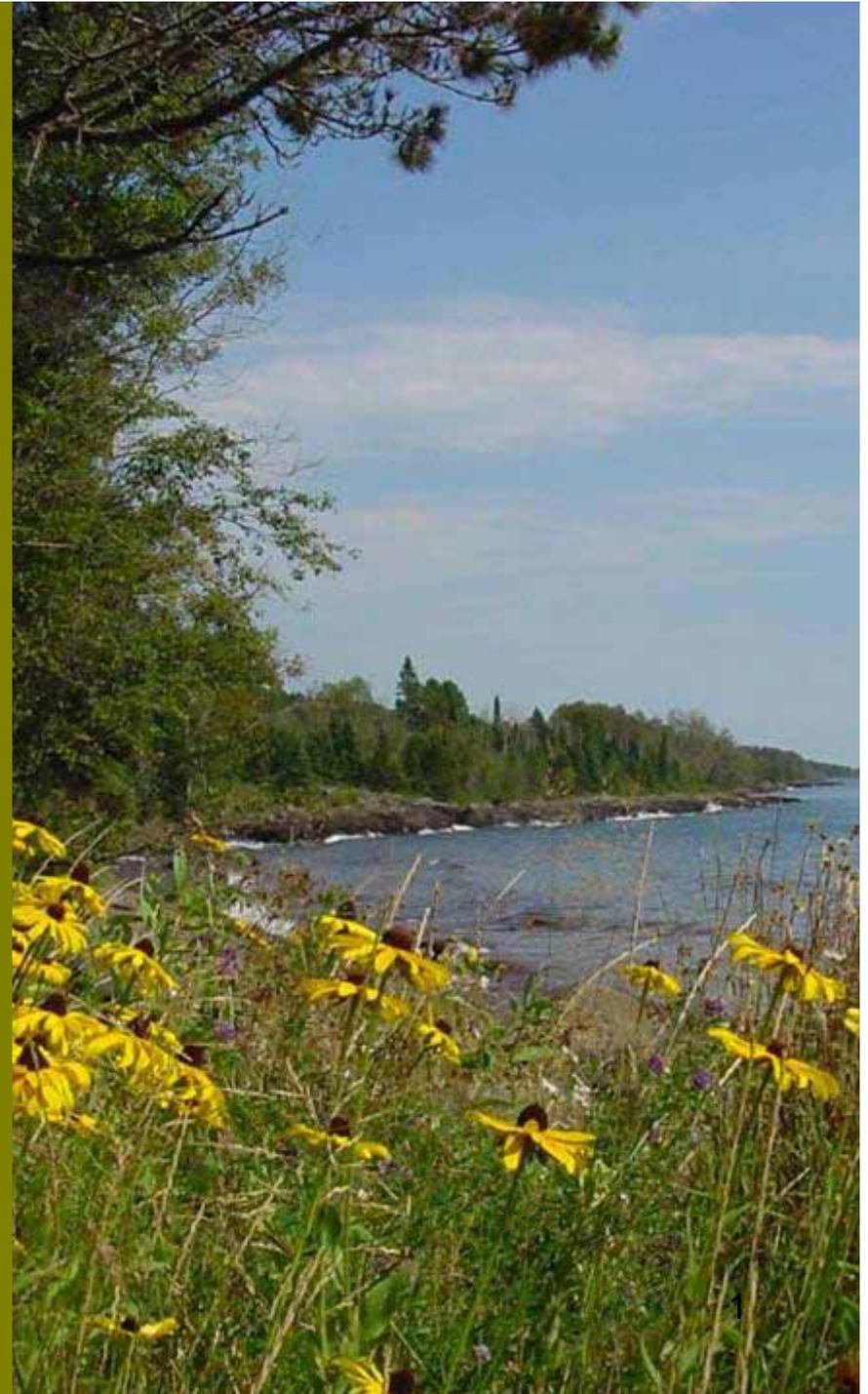
Energy Production & Use/
Mercury Team

7/17/08

INSTITUTE ON THE
ENVIRONMENT



UNIVERSITY OF MINNESOTA

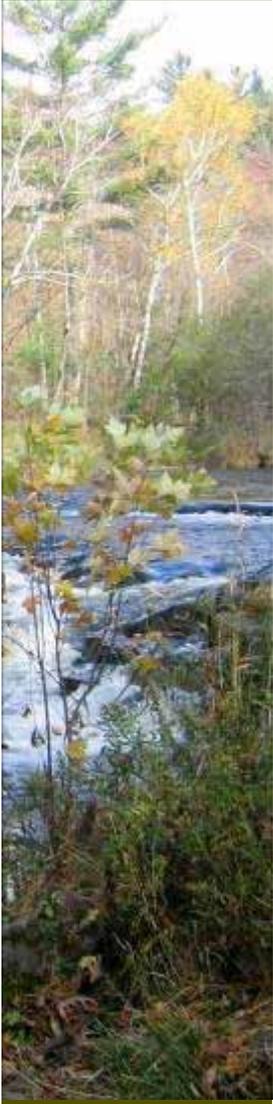


Presenters/Team Members



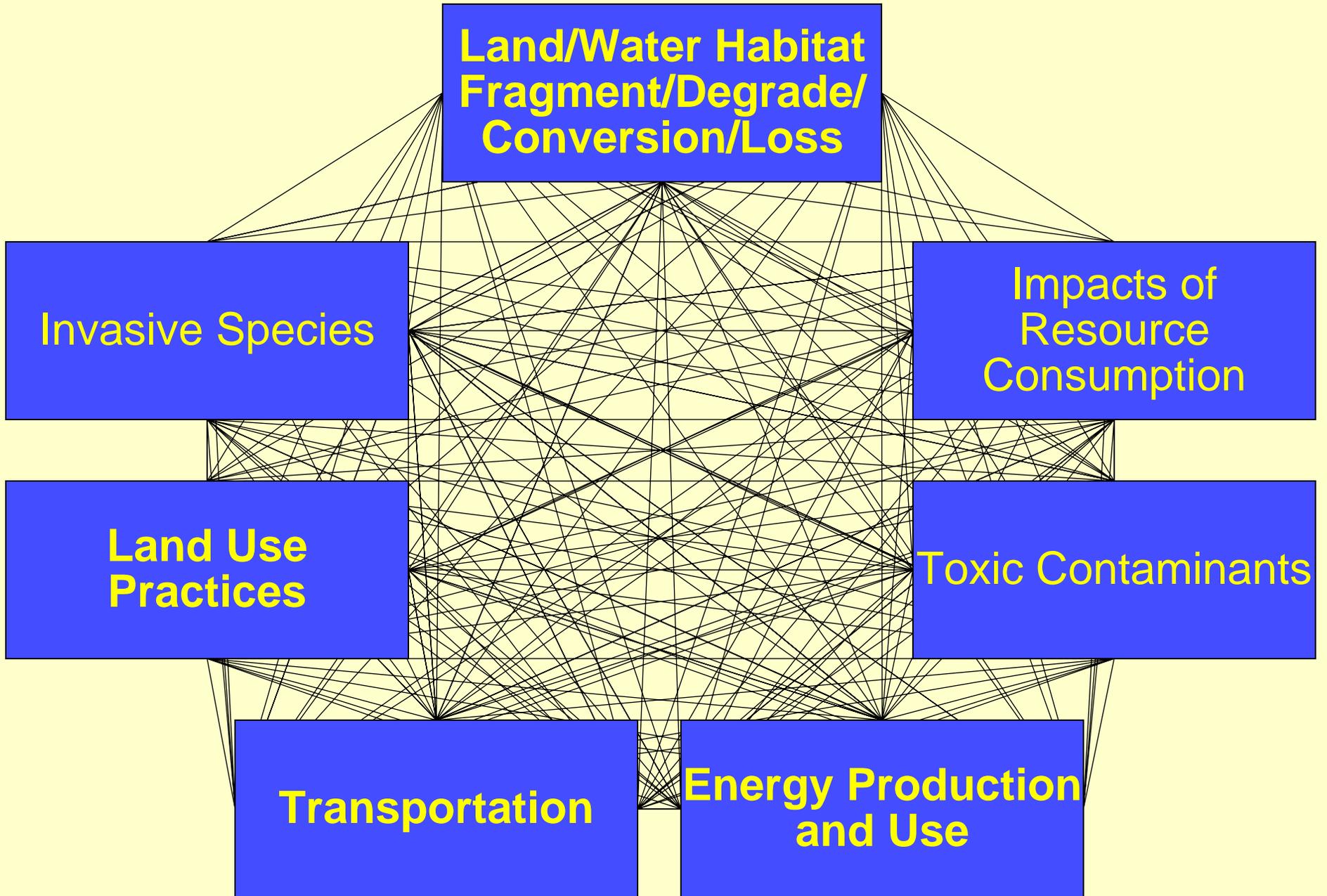
- Deb Swackhamer, Univ. of Minnesota
- Dave Mulla, Univ. of Minnesota
- Bill Berguson, Univ. of Minnesota, NRRI
- Laura Schmitt Olabisi, Univ. of Minnesota

Goals of the Project

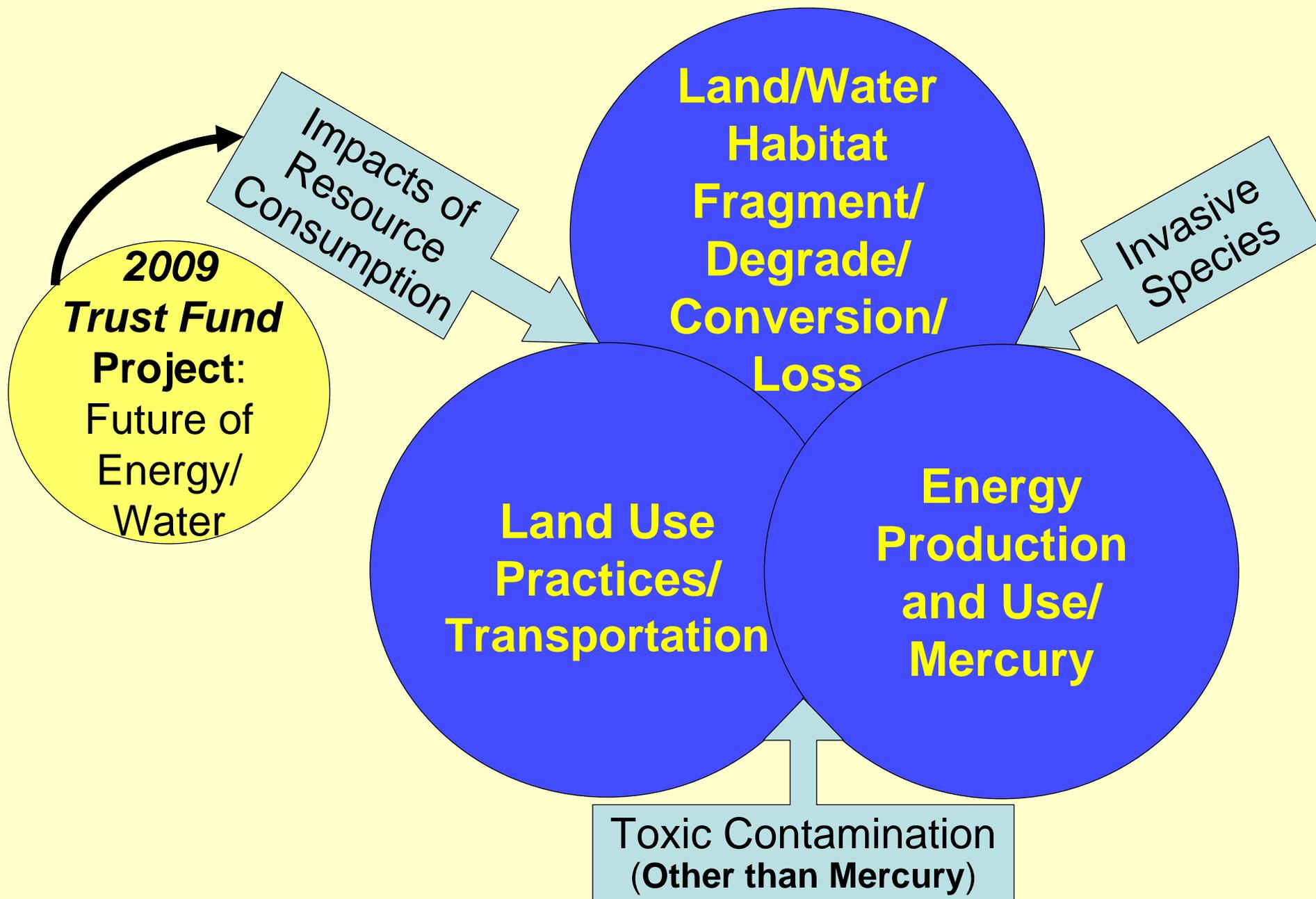


- Comprehensive inventory and assessment of Minnesota's environment and natural resources
- Review, analyze, integrate, & build upon existing information and plans pertaining to Minnesota's environment and natural resources
- Identify & prioritize important issues and trends affecting MN's environment and natural resources
- Develop and prioritize recommendations for strategies to best address issues and trends

Key issues identified in Phase I



Issue integration: Phase II and beyond



Interconnections



	Habitat	Land use	Energy	Consumption	Toxics	Transportation	Invasives
Air		✓	✓	✓	✓	✓	
Water	✓	✓	✓	✓	✓	✓	✓
Land	✓	✓	✓	✓	✓	✓	✓
Fish	✓	✓	✓	✓	✓	✓	✓
Wildlife	✓	✓	✓	✓	✓	✓	✓
Recreation	✓	✓	✓	✓	✓	✓	✓

Phase II Products



- Priority area mapping
- Recommended conservation strategies
- Trend analysis supporting recommendations
- Evaluating conservation strategies

Phase II Project Organization

Project Coordinators

Core Management Team

Research Teams

	Land & Aquatic Habitat Conservation	Land Use Practices/ Transportation	Energy Production and Use/Mercury
Team members			
Partners/ Advisors			

Information, Data, Geographic Information Systems

Outreach

Cost Benefit Analysis



Phase I & II team members and project advisors

Over 100 scientists, professionals, agency staff, and citizen groups involved from the beginning of the project

	Land & Aquatic Habitat Conservation	Land Use Practices/ Transportation	Energy Production and Use/Mercury	Cost Benefit Analysis	GIS and Data Support
University of MN	25	15	15	5	15
Bonestroo/ CR Planning	5	3			4
Citizen groups	7	11	4		
Agency staff	7	5	3		



Complementary efforts



- There are many complementary efforts such as:
 - Clean Water Council
 - Great Outdoors Minnesota/ Campaign for Conservation
 - MN Climate Change Advisory Group
 - Lake Pepin TMDL process
 - Regional Council of Mayors sustainability initiative
- Multiple State agency efforts
- We have reviewed and learned from their efforts

Framework for Integrated Resource Conservation and Preservation



**Integrated
Planning**

**Critical Land
Protection**

**Land and Water
Restoration**

**Sustainable
Practice**

**Economic
Incentives for
Sustainable
Society**

Knowledge Infrastructure

Strategic Framework

PHASE II:

Strategic Areas

Integrated
Planning

Critical Land
Protection

Land & Water
Restoration

Sustainability
Practices

Economic
Incentives for
Sustainability

mapped to Key Issues

Habitat Loss

Land Use
Practice

Transportation

Energy Use,
Mercury

PHASE I:

affecting Drivers of Change

Soil Erosion	Nutrient Loading	Solids Loading	Toxics Loading	Habitat Fragmentation	Consumptive Use	Hydrologic Modification	Invasive Species	GHG emissions
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impacting Natural Resources

Air

Water

Land

Wildlife

Fish

Recreation

Natural Resource Values Assessment of Recommendations

LEGEND: ● = Critical Impact ● = Significant Impact ○ = Negligible Impact

			Air Quality	Water Quality/Quantity	Wetland/Habitat Quality	Terrestrial Habitat Quality	Soil/Land Quality	Human Health	Biodiversity	Community Health	Aquatic Ecosystem Health	Economic Health	Recreational/Cultural/Spiritual/Aesthetic Value	Mitigation/Adaptation	Climate Change
	Number	Recommendation													
HABITAT	Habitat 2	Protect critical shorelands of streams and lakes	○	●	●	●	●	○	●	●	●	●	●	●	●
	Habitat 1	Protect priority land habitat	○	●	●	●	●	○	●	●	●	●	●	●	●
	Habitat 4	Restore and protect shallow lakes	○	●	●	●	●	○	●	●	●	●	●	●	○
	Habitat 5	Restore land, wetlands and wetland-associated watersheds	○	●	●	●	●	○	●	●	●	●	●	●	●
	Habitat 6	Protect and restore critical in-water habitat of lakes and streams	○	●	●	●	●	○	●	●	●	●	●	●	●
	Habitat 7	Keep water on the landscape	○	●	●	●	●	○	●	●	●	●	●	●	●
	Habitat 8	Review and analyze drainage policy	○	●	●	●	●	○	●	●	●	●	●	●	●
	Habitat 3	Improve connectivity and access to outdoor recreation	○	○	○	○	○	○	○	○	○	○	○	○	○
ENERGY	Energy 1	Develop coordinated laws, policies and procedures for governmental entities to assess renewable energy production impacts on the environment	○	●	●	●	●	○	●	●	●	●	●	●	●
	Energy 13	Invest in research and policies regarding "green payments"	○	●	●	●	●	○	●	●	●	●	●	●	●
	Energy 17	Promote policies and incentives that encourage carbon-neutral businesses, homes, communities and other institutions	○	●	●	●	●	○	●	●	●	●	●	●	●
	Energy 2	Invest in farm and forest preservation to prevent fragmentation due to development	○	○	○	○	○	○	○	○	○	○	○	○	○
	Energy 18	Implement policies and incentives to lower energy use of housing stock	○	○	○	○	○	○	○	○	○	○	○	○	○
	Energy 16	Provide incentives to transition a portion of MN's vehicle fleet to electrical power and increase renewable electricity production for transportation	○	○	○	○	○	○	○	○	○	○	○	○	○
	Energy 21	Develop standards and incentives for energy capture from municipal sanitary and solid waste and minimize landfill options	○	○	○	○	○	○	○	○	○	○	○	○	○
	Energy 19	Promote policies and strategies to implement smart meter and smart grid technologies	○	○	○	○	○	○	○	○	○	○	○	○	○
	Energy 14	Investigate opportunities to provide tax incentives for renewable energy in water	○	○	○	○	○	○	○	○	○	○	○	○	○
	Energy 20	Develop incentives to encourage widespread adoption of passive solar and shallow geothermal heat pumps in new construction	○	○	○	○	○	○	○	○	○	○	○	○	○
Energy 15	Invest in efforts to develop community-based energy platforms	○	○	○	○	○	○	○	○	○	○	○	○	○	
LAND USE - AG	LU Ag 1/ Energy 4	Transition renewable fuel feedstocks to perennial crops; Develop policies and incentives to encourage perennial crop production for biofuels in critical environmental areas	○	●	○	○	○	○	○	○	○	○	○	○	○
	LU Ag 2	Reduce streambank erosion through reduction in peak flows	○	○	○	○	○	○	○	○	○	○	○	○	○
	LU Ag 3	Reduce upland and gully erosion through soil conservation practices	○	○	○	○	○	○	○	○	○	○	○	○	○
LAND USE - COMMUNITY	LU Comm 2	Support local and regional conservation-based community planning	○	○	○	○	○	○	○	○	○	○	○	○	○
	LU Comm 3	Ensure protection of water resources in urban areas	○	○	○	○	○	○	○	○	○	○	○	○	○
TRANSPORTATION	Trans 1	Align transportation planning across all agencies; Streamline environmental transportation project review	●	○	○	○	○	○	○	○	○	○	○	○	○
	Trans 3	Reduce non-point source pollution to surface and ground waters from transportation infrastructure	○	○	○	○	○	○	○	○	○	○	○	○	○
LAND USE - FORESTRY	LU Forest 1	Encourage and expand sustainable forestry management on working forest lands	○	○	○	○	○	○	○	○	○	○	○	○	○
	LU Forest 2	Protect large blocks of forest land	○	○	○	○	○	○	○	○	○	○	○	○	○

Energy Production and Use Team

Team Members:

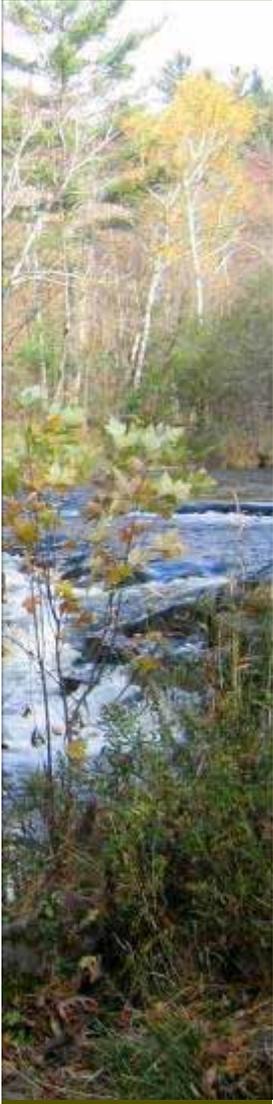
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John Wells, Minnesota Environmental Quality Board

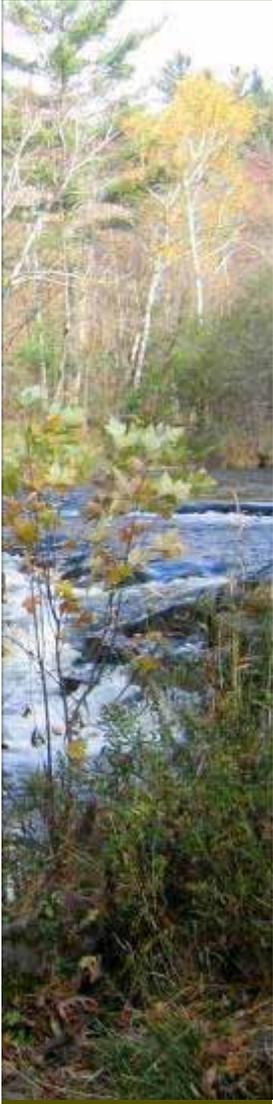


Energy Production and Use: Products



- Identify energy trends/impacts, including the areas of:
 - Biofuels
 - Conservation of fossil fuels
- Identify/map priority natural resource areas likely to be affected
- Identify energy-related investment & policy choices that impact natural resources

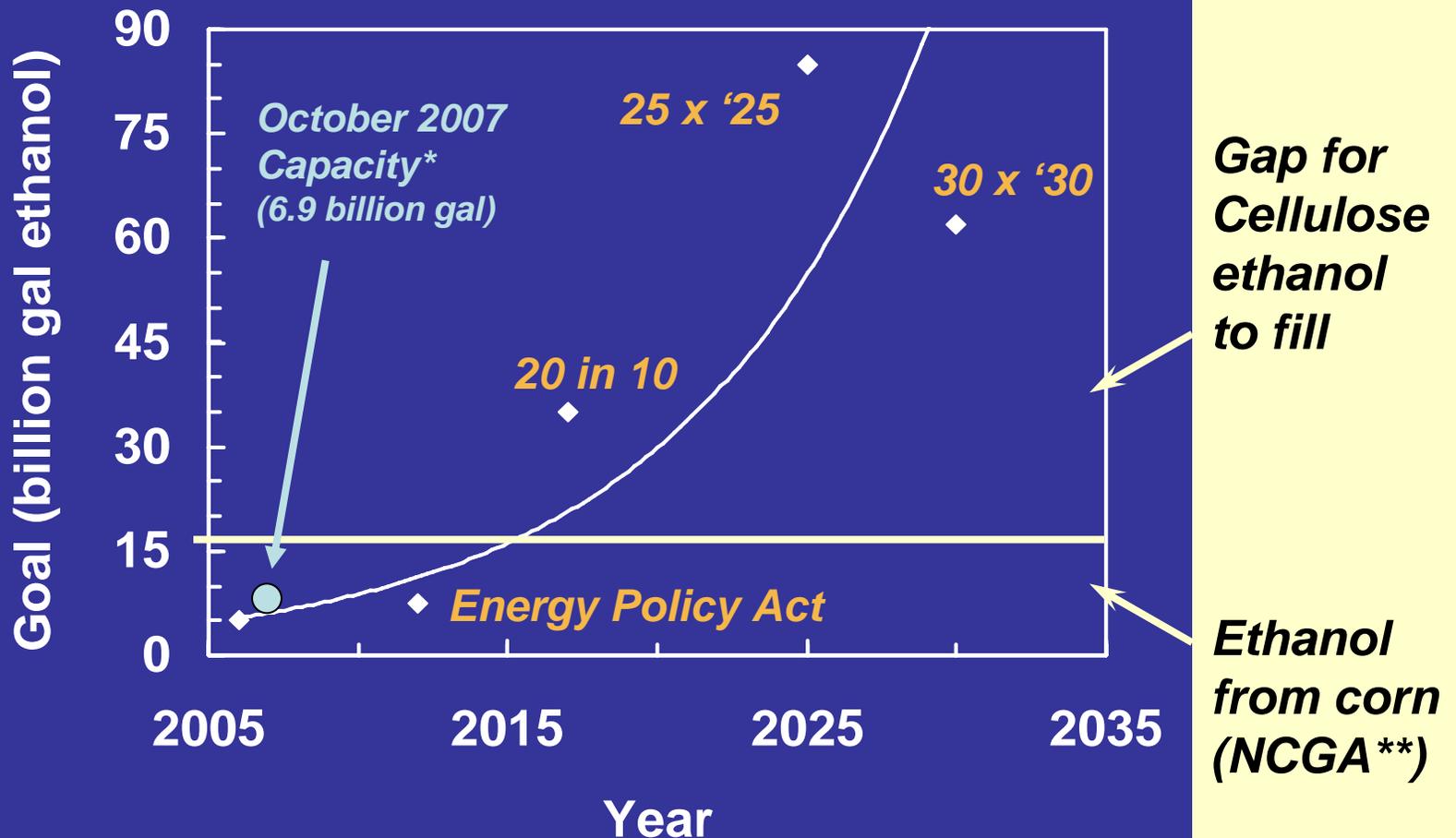
Three Overarching Goals – Multiple Recommendations in Each



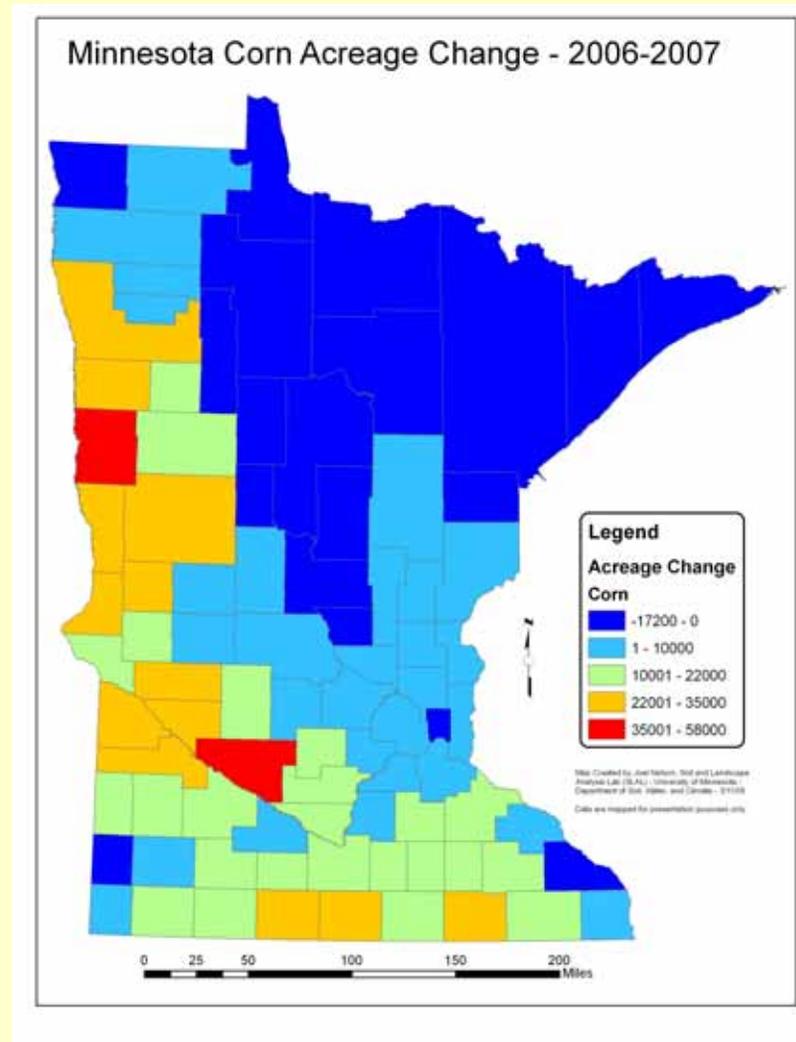
- A. Promote alternative energy production strategies** that balance or optimize production of food, feed, fiber, and fuel with protection or improvement of environmental quality
- B. Promote a healthy economy**, including strategies that promote local ownership of alternative energy production and processing infrastructure, where appropriate
- C. Promote energy conservation efforts** among individuals, businesses, communities and institutions

Goal A: Promote Alternative Energy Production Strategies

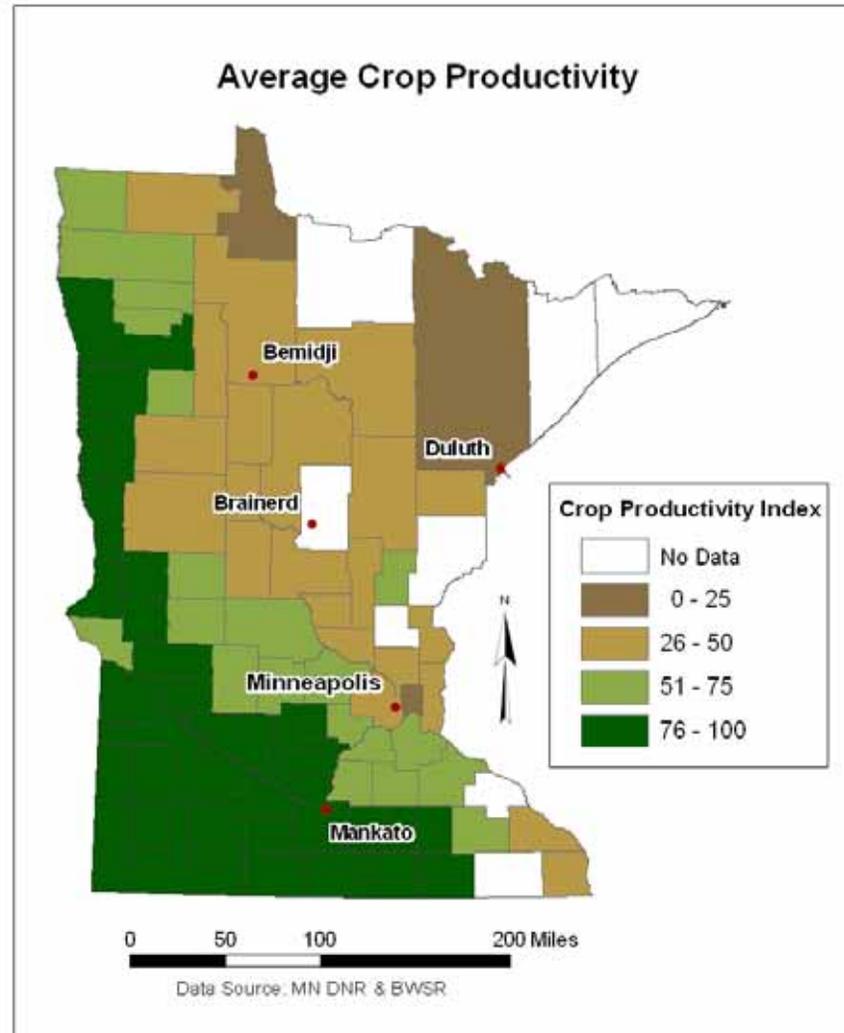
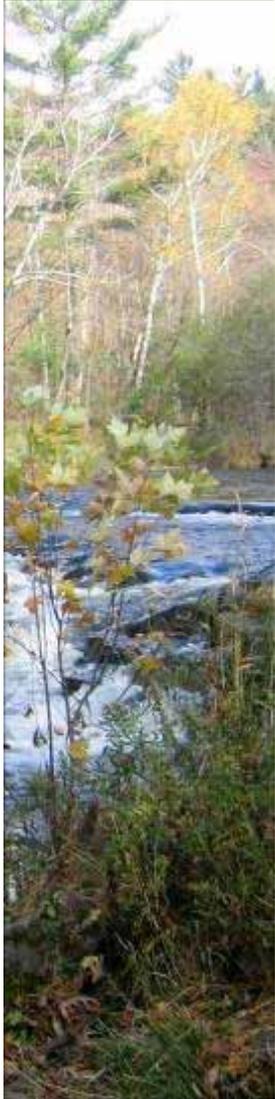
Ethanol production will continue to grow, with most expected growth from cellulosic feedstocks



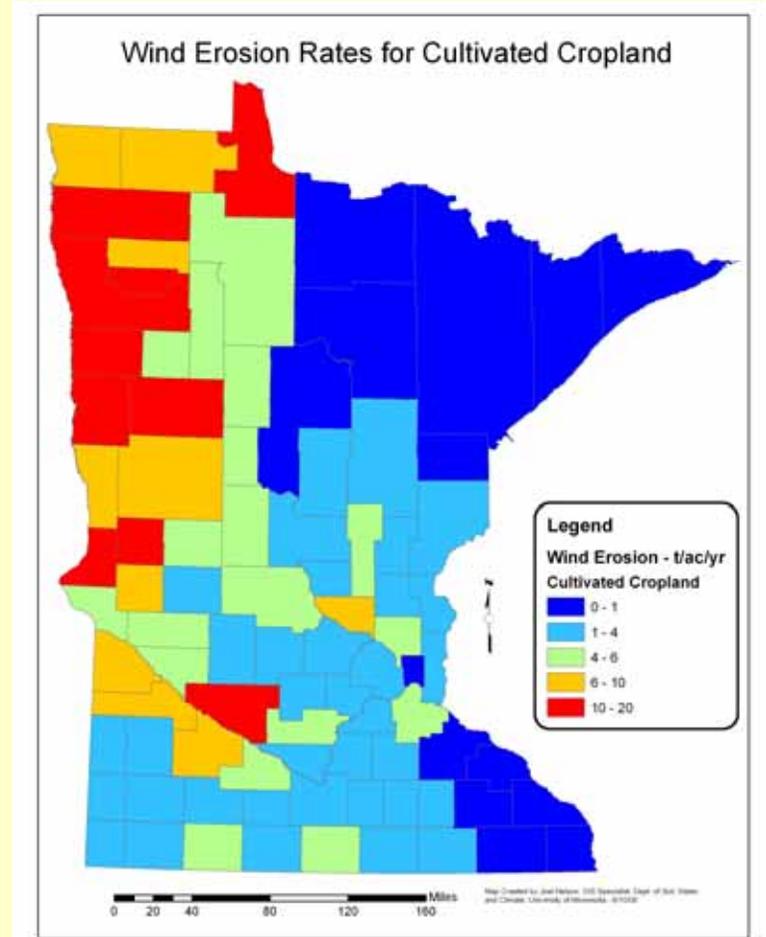
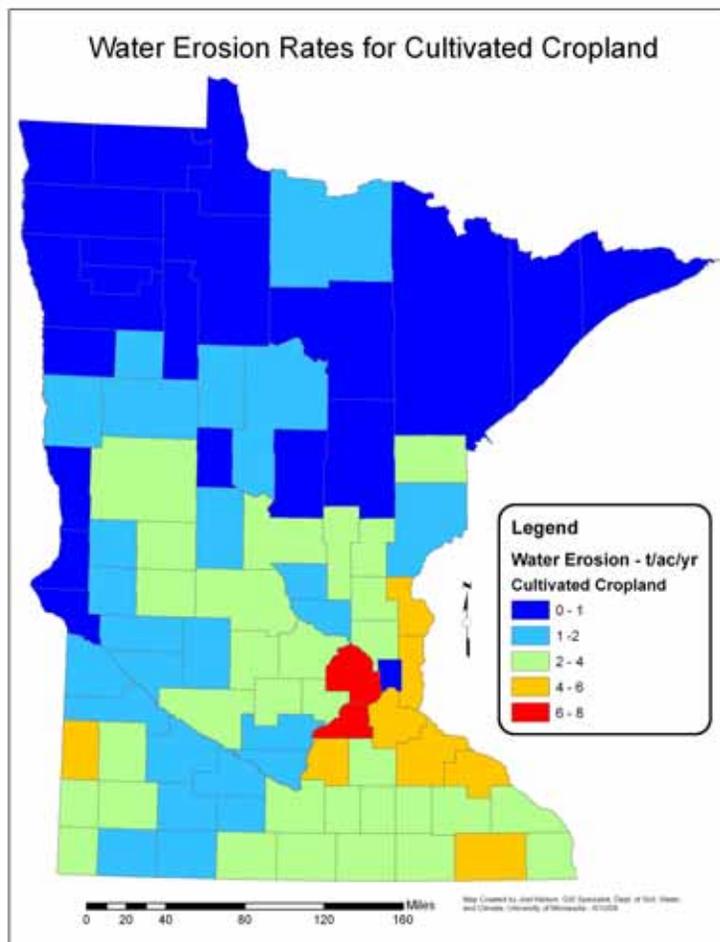
Impacts of Biofuel Industry on Cropping System Change



Crop Productivity varies, affects suitability of energy crops



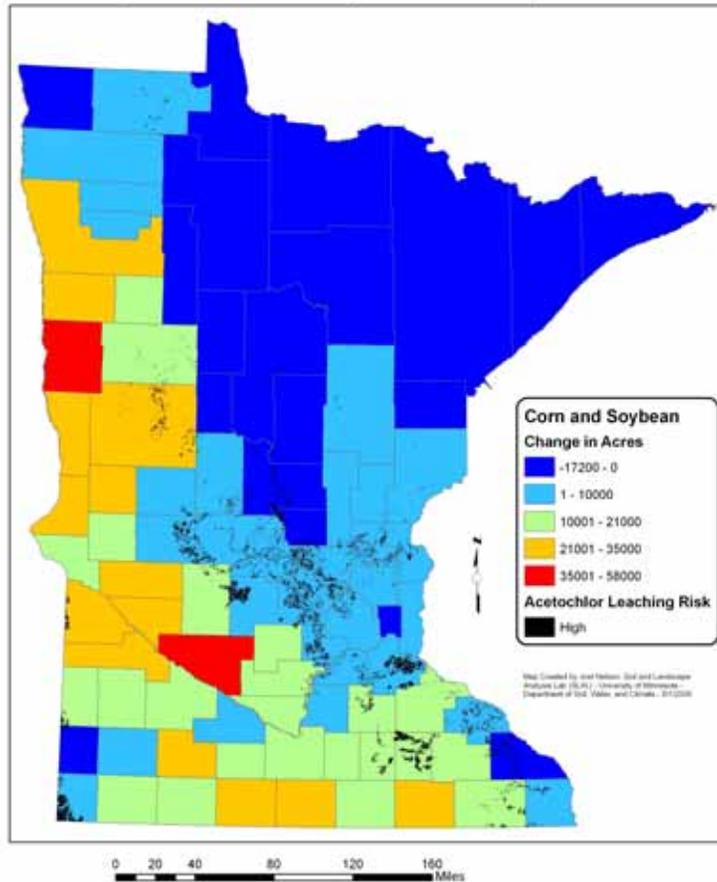
Different parts of the state have varying vulnerability to erosion



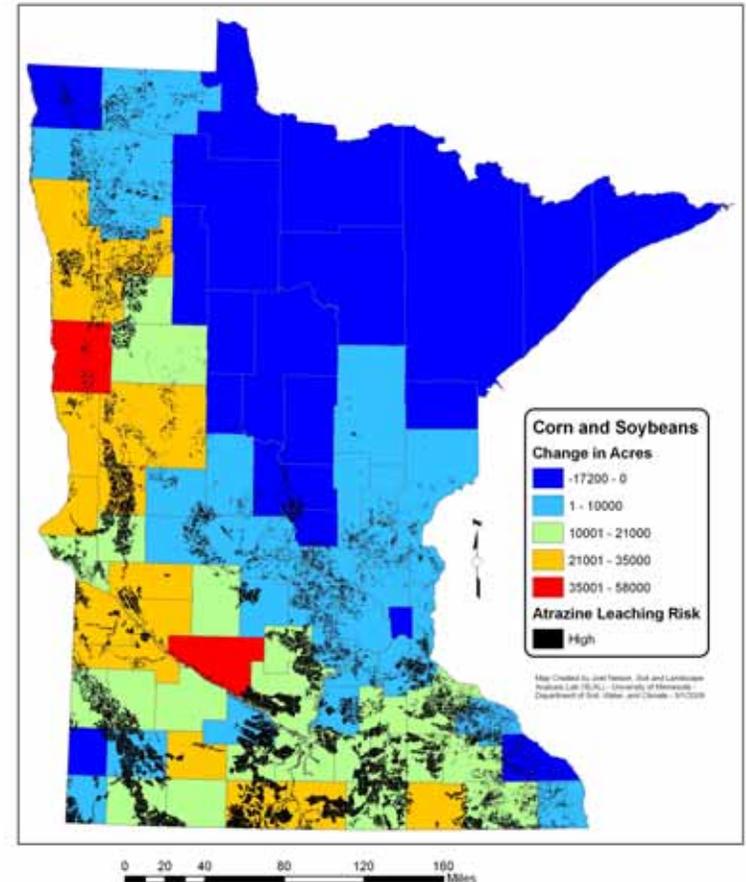
Different parts of the state have varying risk of chemical leaching



High Acetochlor Leaching Risk on Corn/Soybean Acres

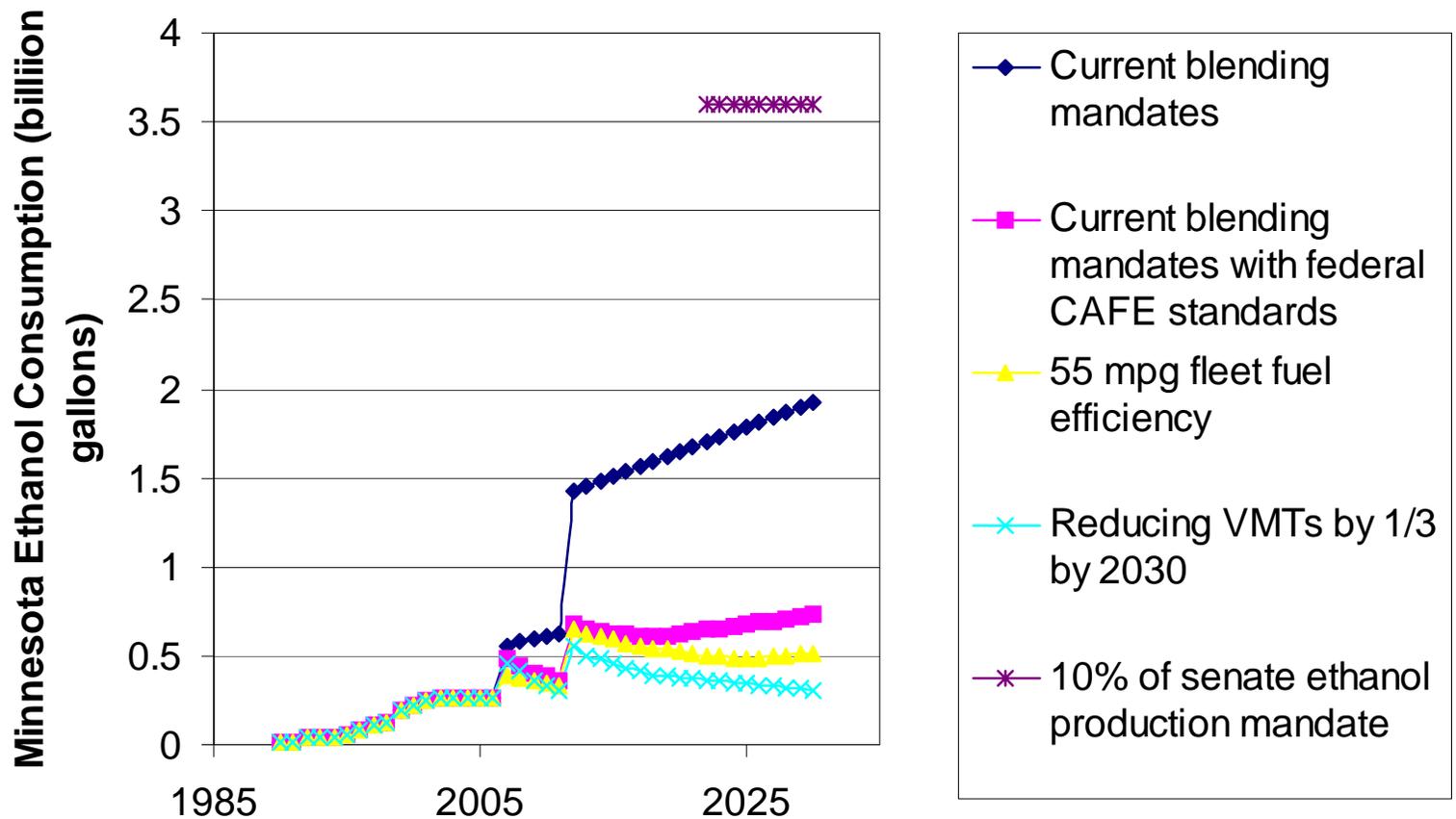


High Atrazine Leaching Risk on Corn/Soybean Acres

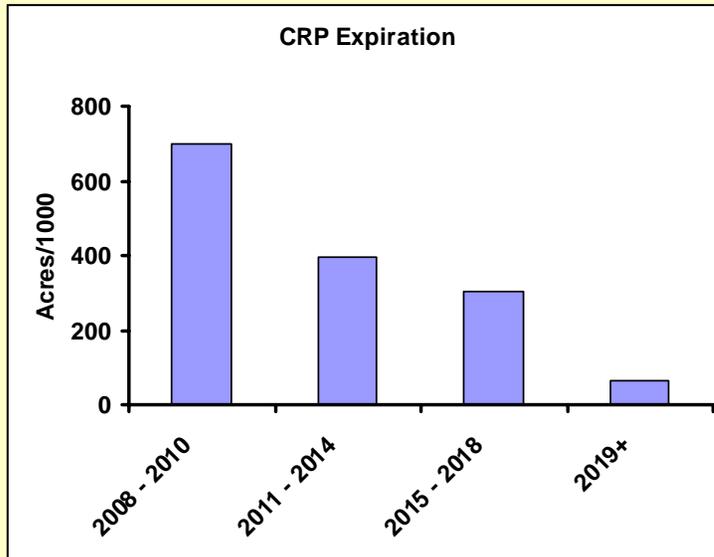


Goal A: Promote Alternative Energy Production Strategies

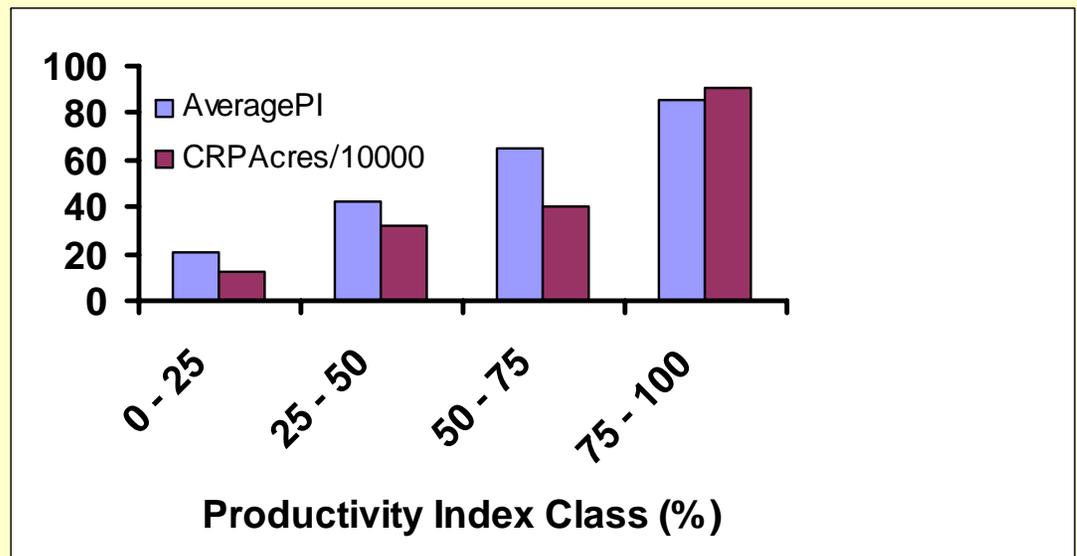
Ethanol demand in Minnesota will also continue to grow.



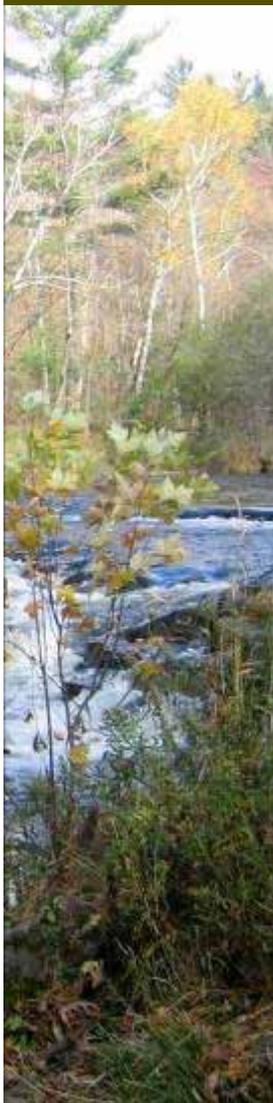
Half of Minnesota's Expiring CRP Land Could be Lost



Potential Impacts:
Loss of Wildlife Habitat
Enhanced Erosion
Increased Pesticide Leaching



Goal A: Promote Alternative Energy Production Strategies

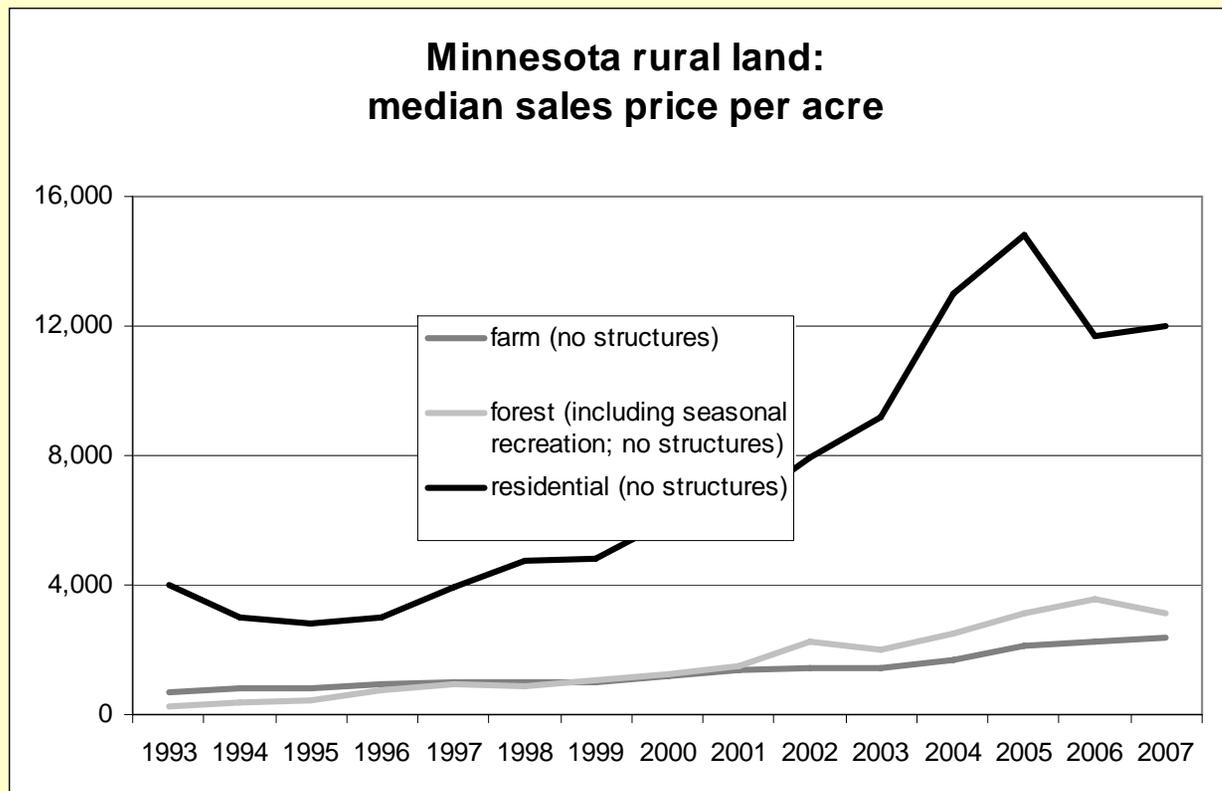
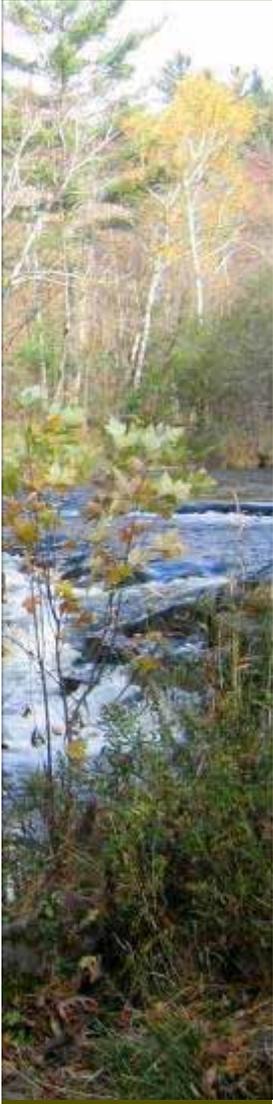


Energy 1 (p. 184): Develop coordinated laws, policies, and procedures for governmental entities to assess renewable energy production impacts on the environment

- Biennial report to legislature
- Ensure that efforts to achieve state goals align & allow policymakers to choose strategies that address multiple goals (e.g. GHG reduction, wildlife habitat provision)
- Legislative Electric Energy Task Force recommendation for better coordination on energy issues

Goal A: Promote Alternative Energy Production Strategies

Energy 2 (p. 185): Invest in farm and forest preservation efforts to prevent fragmentation due to development, guided by productivity and environmental vulnerability research (Similar to Land Use Forestry Rec. #1)



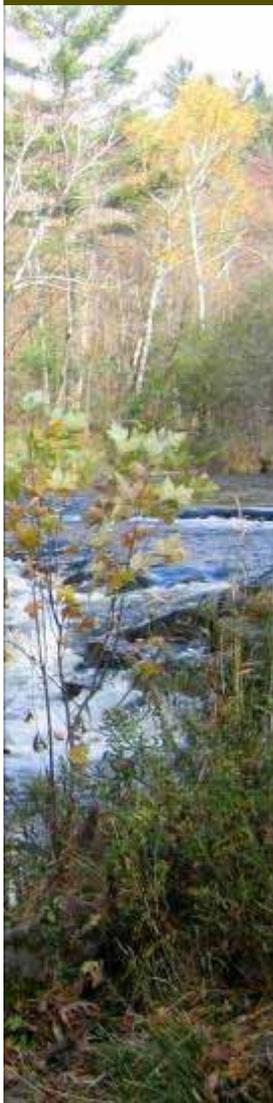
Source: Minnesota Land Economics

- Land prices are major driver of fragmentation
- Minnesota Forest Resources Council currently studying issue

Goal A: Promote Alternative Energy Production Strategies

Energy 3 (p. 186): Invest in perennial biofuel and energy crop research and demonstration projects on a landscape scale

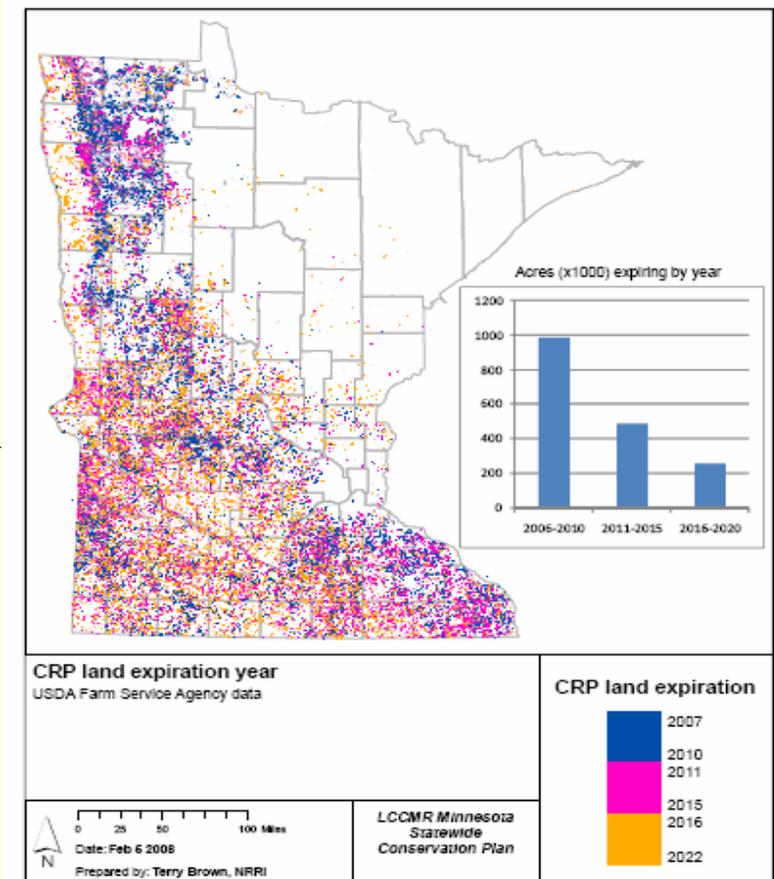
- Improve yields
- Develop BMP's for perennial crops
- Figure out 'what to plant where'
- Identify economic costs, benefits & barriers
- Evaluate biomass availability & sustainable production rates by eco-region *while considering potential climate change*



Goal A: Promote Alternative Energy Production Strategies

Energy 4 (p. 188): Develop policies and incentives to encourage perennial crop production for biofuels in critical environmental areas (such as expiring CRP lands)

CRP land in Minnesota by year of expiration



Goal A: Promote Alternative Energy Production Strategies

Energy 5 (p. 189): Invest in data collection to monitor/assess the cumulative impact of energy production on the environment (similar to Land Use Community Rec. #2; Habitat Rec. #9; Energy Rec. #9)

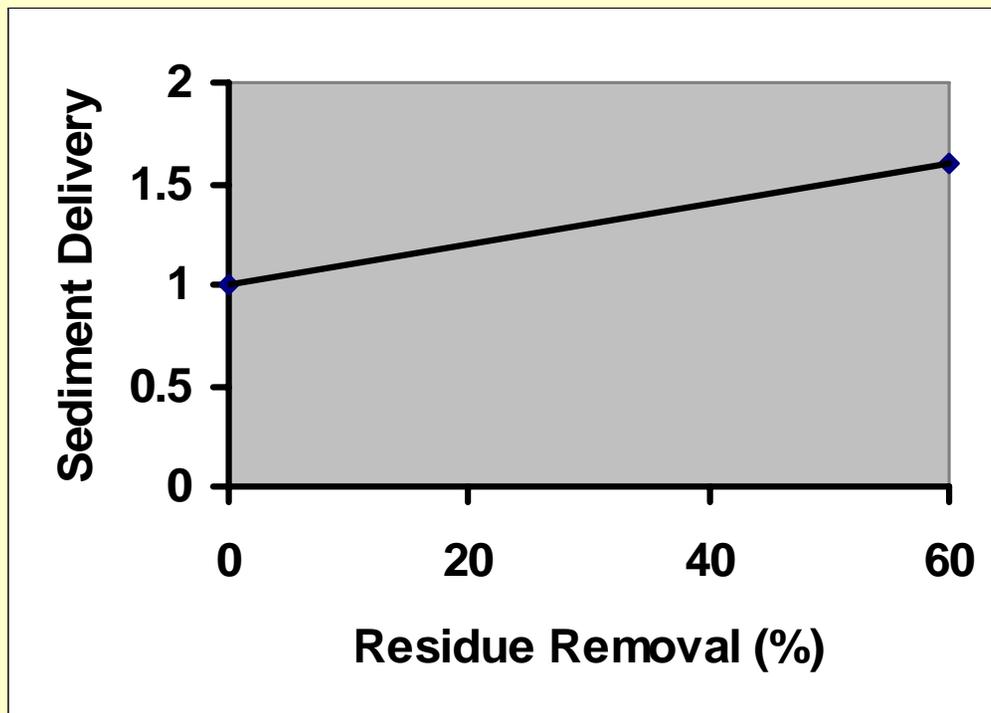
We need information on:

- water quality
- water resource sustainability
- wildlife habitat & biodiversity (in perennial landscapes, for example)
- invasive species
- land use change
- soil quality changes under perennials
- infrastructure & storage needs for alternative fuels
- greenhouse gas emissions



Goal A: Promote Alternative Energy Production Strategies

Energy 6 (p. 190): Invest in research to determine sustainable removal rates of corn stover and to establish incentives and BMPs



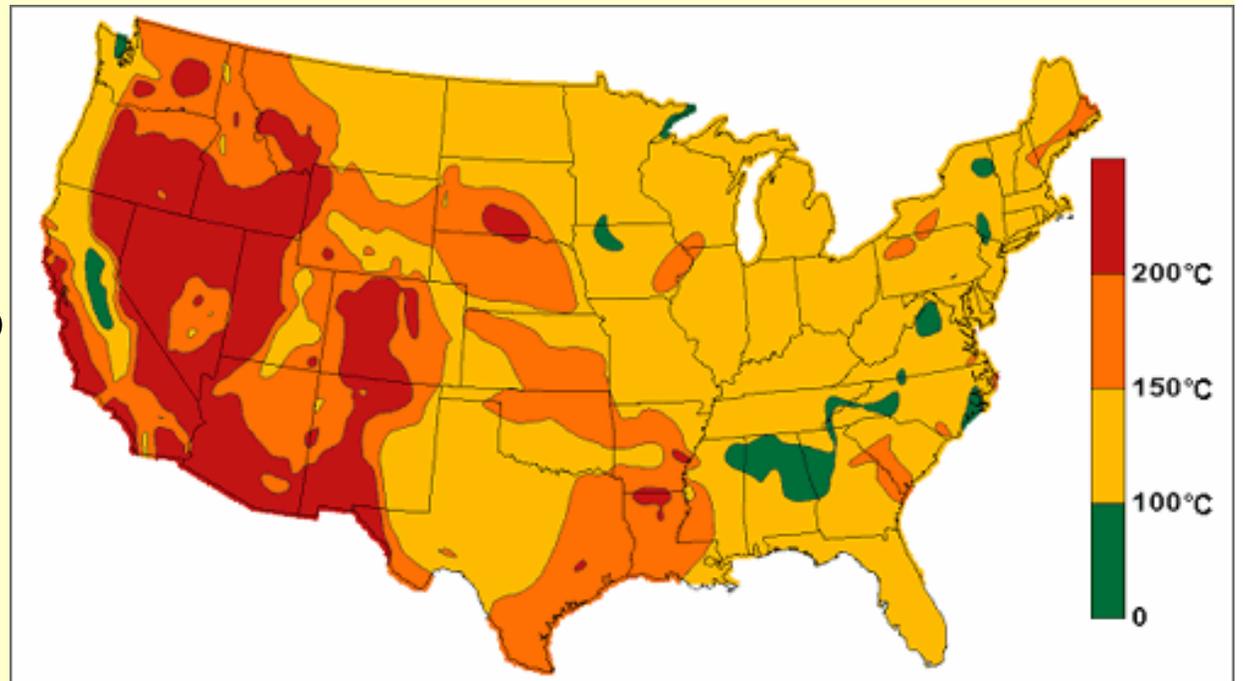
Amount of corn stover removed affects erosion and soil carbon content



Goal A: Promote Alternative Energy Production Strategies

Energy 7 (p. 191): Invest in research to review thermal flow maps and determine potential for geothermal power in Minnesota

Current maps may underestimate heat flow due to sampling techniques; should be evaluated by MGS, NRRI.

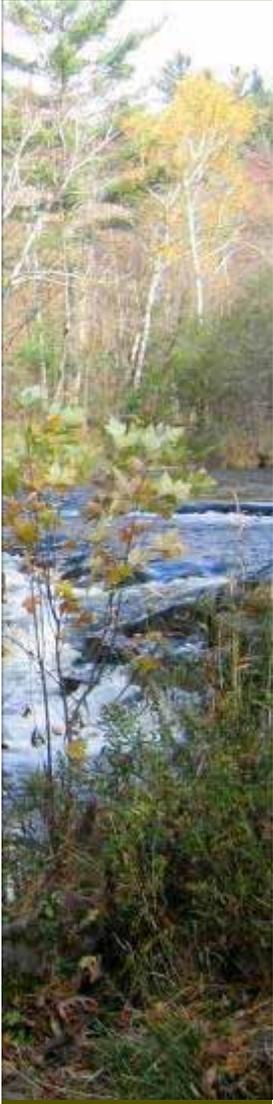


From U.S. DOE

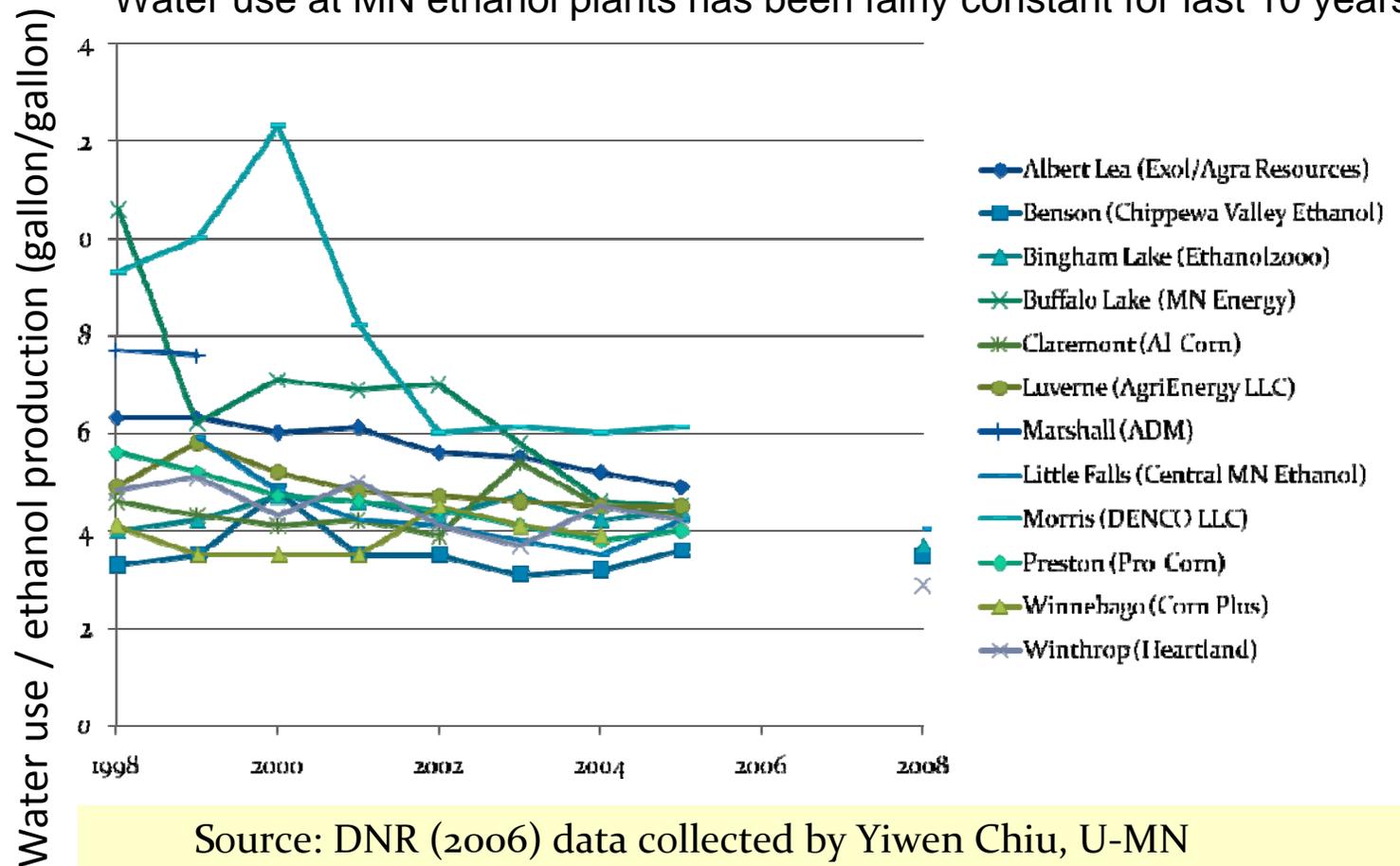


Goal A: Promote Alternative Energy Production Strategies

Energy 8 (p. 192): Invest in applied research to reduce energy and water consumption and greenhouse gas emissions in ethanol plants, and encourage implementation of these conservation technologies



Water use at MN ethanol plants has been fairly constant for last 10 years



Source: DNR (2006) data collected by Yiwen Chiu, U-MN

Goal A: Promote Alternative Energy Production Strategies

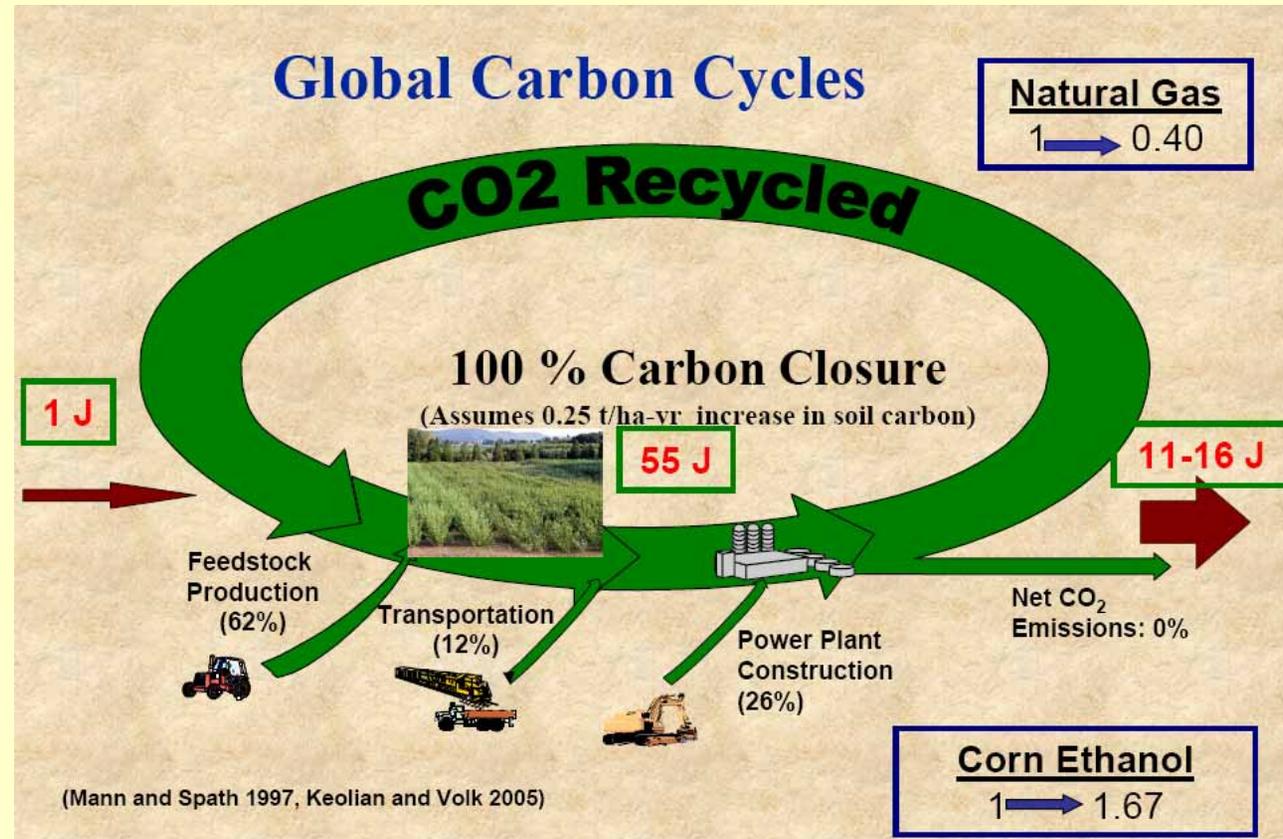
Energy 9 (p. 193): Invest in research to determine the life cycle impacts of renewable energy production systems

- on the economy
- on GHG emissions
- water consumption
- water quality
- carbon sequestration
- gene flow risks
- wildlife populations



Goal A: Promote Alternative Energy Production Strategies

Energy 10 (p. 194): Invest in research and demonstration projects to develop, and incentives to promote, combined wind power/biomass, wind power/ natural gas, and biomass/coal co-firing electricity projects



Source: Volk et al., SUNY-ESF willow biomass project

Goal A: Promote Alternative Energy Production Strategies



Energy 11 (p. 195): Invest in research and enact policies to protect existing native prairies from genetic contamination by buffering them with neighboring plantings of perennial energy crops

- Some energy crops have characteristics of invasive species
- We don't know yet how introduced species will behave in Minnesota

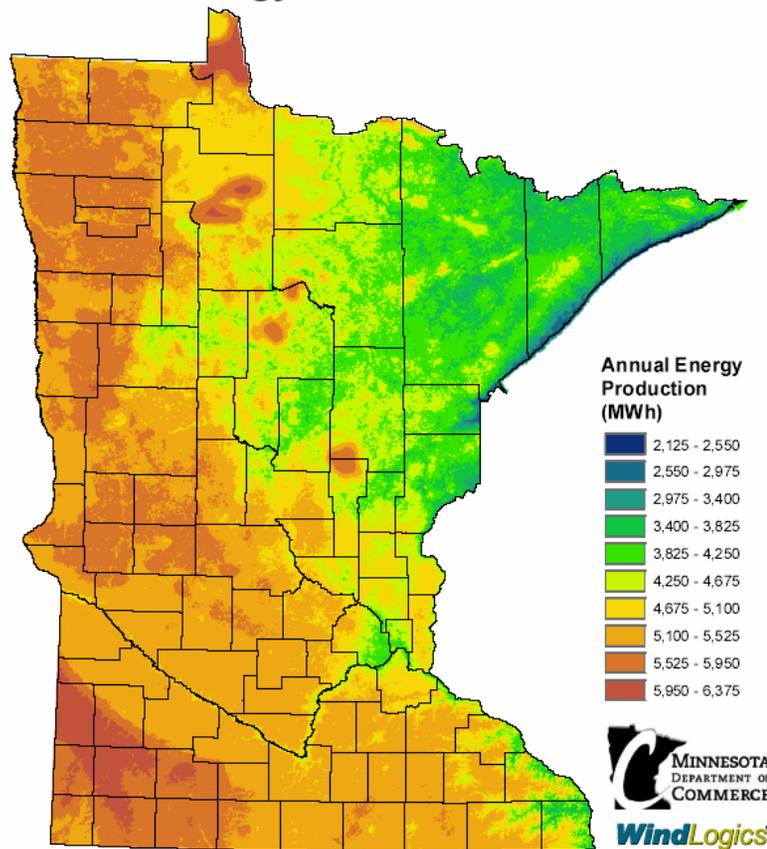
Energy 12 (p. 196): Invest in efforts to develop sufficient seed or seedling stocks for large-scale plantings of native prairie grasses and other perennial crops

Goal B: Promote a Healthy Economy

Community-owned wind power is posited to have a greater beneficial impact on the economy compared with corporate-owned wind power



Minnesota's Wind Resource by Estimated Annual Energy Production at 80 Meters



Goal B: Promote a Healthy Economy

Energy 13 (p. 196): Invest in research and policies on implementation strategies and optimal pricing schemes for 'green payments.' These 'green payments' may be applied to perennial energy crop production.

- Implemented on expiring CRP land, impaired watersheds, DNR working lands, environmentally sensitive or low productivity areas
- Multiple tiered payments for
 - water quality
 - carbon sequestration
 - wildlife habitat
 - fuel production



Goal B: Promote a Healthy Economy

Energy 14 (p. 197): Investigate opportunities to provide tax incentives for individual investors in renewable energy (e.g. for individuals who wish to install solar panels).

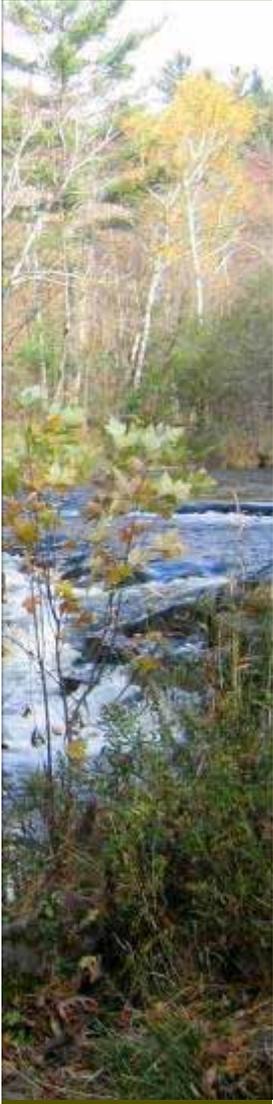
- Example: Massachusetts tax rebate program allows homeowners to pay off costs of solar panels within 5-8 years; also earmarks funds for installation in government buildings
- Minnesota C-BED program encouraging community wind power
- Could stimulate job creation and economic output in Minnesota



Goal B: Promote a Healthy Economy

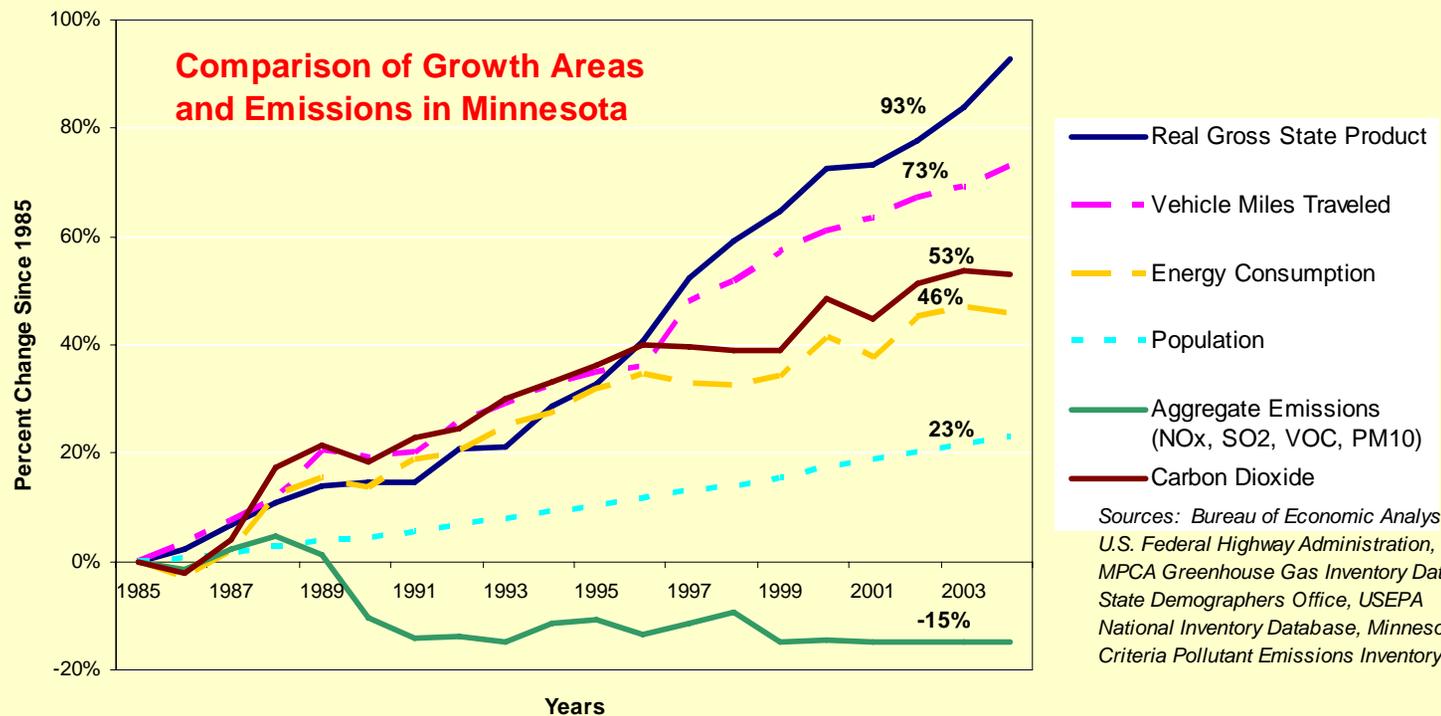
Energy 15 (p. 198): Invest in efforts to develop, and research to support, community-based energy platforms for producing electricity, transportation fuels, fertilizer, etc. that are locally/ cooperatively owned.

Example: U of M Morris



Goal C: Promote Energy Conservation Efforts

Energy consumption and CO₂ emissions are growing faster than population in Minnesota



Goal C: Promote Energy Conservation Efforts

Energy 16 (p. 199): Provide incentives to transition a portion of Minnesota's vehicle fleet to electrical power, while simultaneously increasing renewable electricity production for transportation

Would provide multiple benefits:

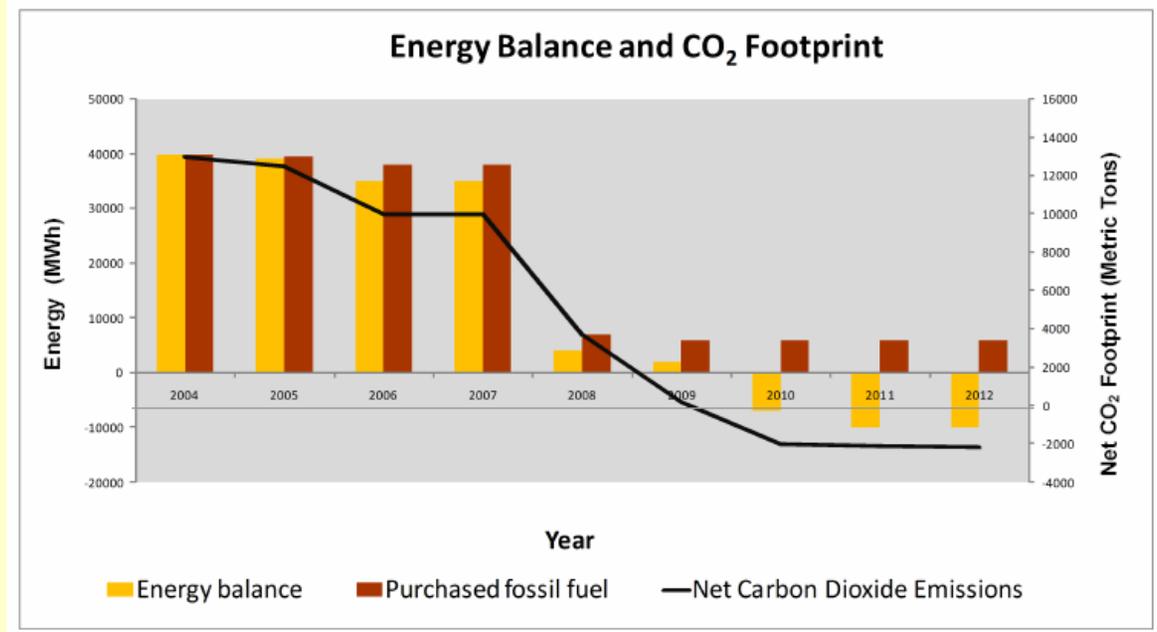
- Help Minnesota meet its GHG reduction goals
- Improve human & ecosystem health through reduction of particulates, ozone
- Stimulate economy by providing jobs, economic output in renewable electricity & vehicle maintenance
- In combination with other strategies, could help to stabilize commodity prices & relieve pressure on the landscape



Goal C: Promote Energy Conservation Efforts

Energy 17 (p. 200): Promote policies and incentives that encourage carbon-neutral businesses, homes, communities

Ex: U of M Morris combining wind power w/biomass gasification

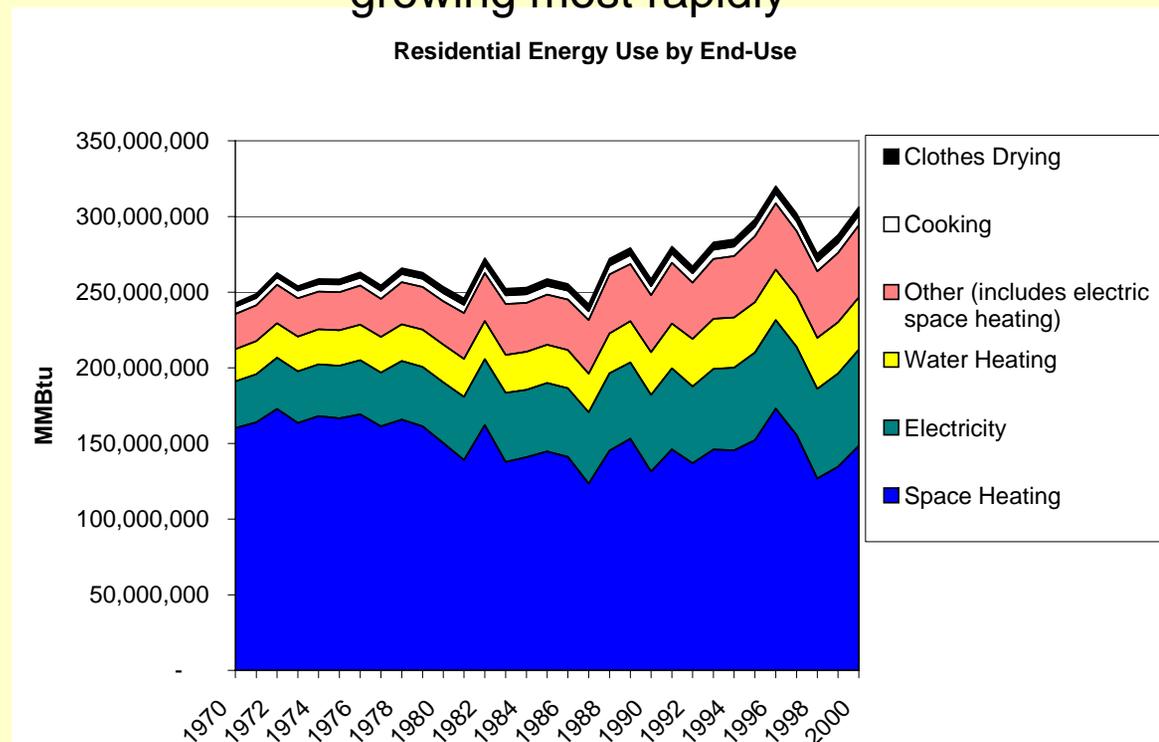


J. Tallaksen & L. Rasmussen, "Integrating Wind and Biomass to Manage Carbon Emissions"

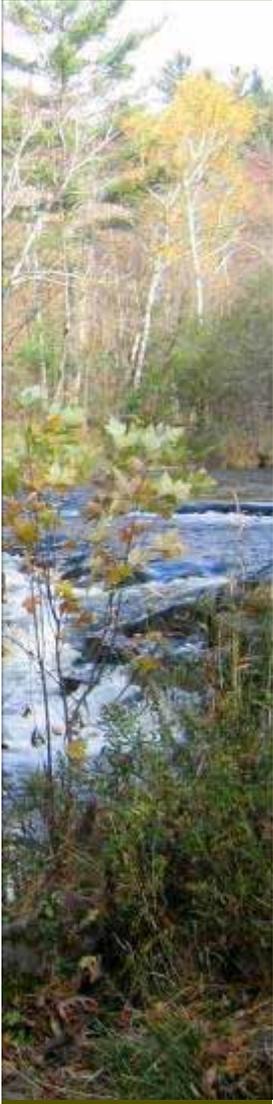
Goal C: Promote Energy Conservation Efforts

Energy 18 (p. 201): Implement policies and incentives to lower energy use of housing stock

In Minnesota, most home energy use is for heating, but electricity use is growing most rapidly



Goal C: Promote Energy Conservation Efforts



- Energy 19 (p. 202):* Promote policies and strategies to implement smart meter and smart grid technology
- Example: Xcel Energy is working with partners to make Boulder, CO a ‘smart grid’ city
 - new infrastructure allowing two-way communication through the grid
 - controlled power usage helps to eliminate ‘peaker’ plants
 - consumers may install devices to monitor and fully automate home energy use
 - good for accommodating distributed generation
 - would support plug-in vehicles

Goal C: Promote Energy Conservation Efforts

Energy 20 (p. 202): Develop incentives to encourage widespread adoption of passive solar and shallow geothermal systems in new buildings

Shallow Geothermal Energy for heat and cold

Office building in Aachen, DE



Heating and cooling,
28 BHE each 43 m,
operational since 2003

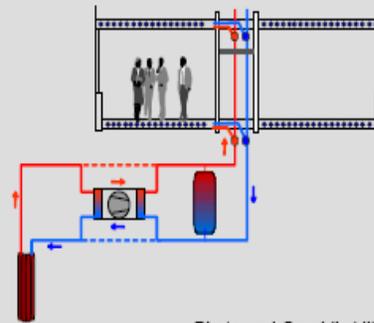
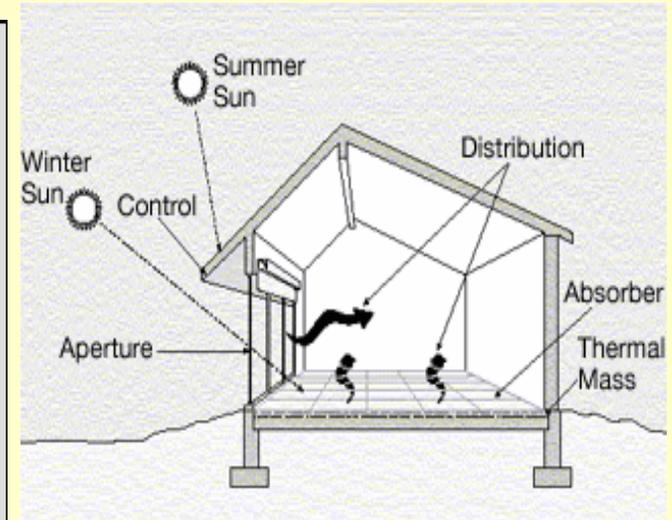


Photo und Graphik: VIKA

Heating capacity 55 kW
Cost for cooling in summer
2003 ca. 250 € (0,12 €/m²)

European Geothermal Energy Council



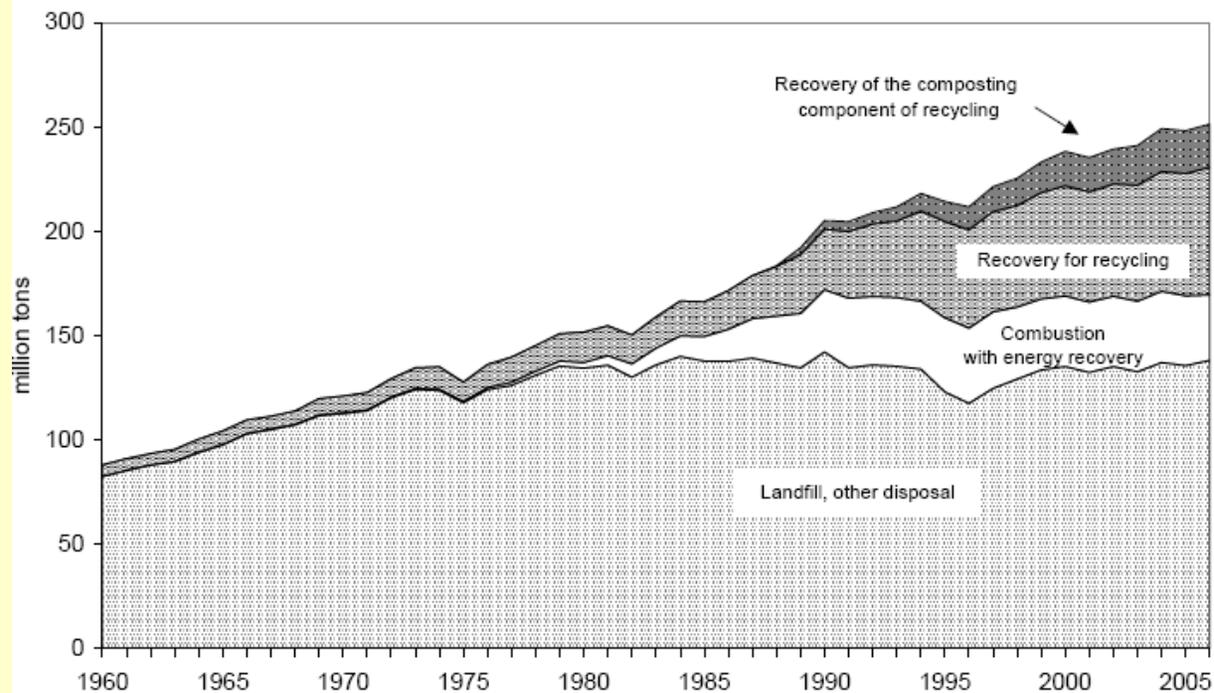
Elements of passive solar design, shown in a direct gain application (from DOE Distributed Energy Program)

Goal C: Promote Energy Conservation Efforts

Energy 21 (p. 203): Develop standards and incentives for energy capture from municipal solid and sanitary waste, and minimize landfill options for MSW.

National recycling and waste combustion efforts have increased dramatically since the 1980s, but so has our waste generation--we could do a lot more!

Figure 26. Municipal solid waste management, 1960 to 2006



Source: US EPA

Goal C: Promote Energy Conservation Efforts

Energy 22 (p. 204): Invest in public education to promote energy conservation efforts by individuals, businesses

- MIT study: about half of our carbon emissions in the U.S. due to system infrastructure; half due to individual choices
- The 'big three' carbon generating activities: transportation, housing, food
- Avoiding the 'rebound effect'



Energy Team Conclusions



- The recommendations made are a start for the state -- other actions likely will be important as we move into the future
- Many alternative energy scenarios exist – Biofuel energy production alone is not sufficient
- Policy changes are needed to ensure that perennial biofuels can be grown for renewable energy and environmental benefits, while maintaining production of other annual crops for food, feed and fiber

Project Goal

To achieve a
better future for
Minnesota's
natural resources



Thank You!

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