Minnesota Statewide Conservation and Preservation Plan
Energy Production & Use/Mercury Team
7/17/08

INSTITUTE ON THE ENVIRONMENT

University of Minnesota
Presenters/Team Members

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- 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

- Land/Water Habitat Fragment/Degrade/Conversion/Loss
- Invasive Species
- Land Use Practices
- Transportation
- Impacts of Resource Consumption
- Toxic Contaminants
- Energy Production and Use
Issue integration: Phase II and beyond

2009 Trust Fund Project: Future of Energy/Water

Land/Water Habitat Fragment/Dependence/Conversion/Loss

Impacts of Resource Consumption

Invasive Species

Land Use Practices/Transportation

Energy Production and Use/Mercury

Toxic Contamination (Other than Mercury)
## Interconnections

<table>
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<tr>
<th>Habitat</th>
<th>Land use</th>
<th>Energy</th>
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<th>Toxics</th>
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Phase II Products

- Priority area mapping
- Recommended conservation strategies
- Trend analysis supporting recommendations
- Evaluating conservation strategies
Phase II Project Organization

<table>
<thead>
<tr>
<th>Project Coordinators</th>
<th>Core Management Team</th>
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Research Teams

<table>
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<tr>
<th>Team members</th>
<th>Land &amp; Aquatic Habitat Conservation</th>
<th>Land Use Practices/Transportation</th>
<th>Energy Production and Use/Mercury</th>
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<tbody>
<tr>
<td>Partners/Advisors</td>
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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

<table>
<thead>
<tr>
<th></th>
<th>Land &amp; Aquatic Habitat Conservation</th>
<th>Land Use Practices/Transportation</th>
<th>Energy Production and Use/Mercury</th>
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<td>7</td>
<td>5</td>
<td>3</td>
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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

impacting Natural Resources

- Air
- Water
- Land
- Wildlife
- Fish
- Recreation
## Natural Resource Values Assessment of Recommendations

**Legend:**
- ● = Critical Impact
- □ = Significant Impact
- ○ = Negligible Impact

<table>
<thead>
<tr>
<th>Number</th>
<th>Recommendation</th>
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<tbody>
<tr>
<td>HABITAT</td>
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</tr>
<tr>
<td>Habitat 1</td>
<td>Protect priority land habitats</td>
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<tr>
<td>Habitat 2</td>
<td>Protect critical shorelands of streams and lakes</td>
</tr>
<tr>
<td>Habitat 3</td>
<td>Protect riparian and wetland habitats</td>
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<tr>
<td>Habitat 4</td>
<td>Protect and restore wetlands</td>
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<tr>
<td>Habitat 5</td>
<td>Protect and restore wetlands and wetland-associated wetlands</td>
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<tr>
<td>Habitat 6</td>
<td>Protect and restore critical in-water habitats of lakes and streams</td>
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<tr>
<td>Habitat 7</td>
<td>Keep water on the landscape</td>
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<tr>
<td>Habitat 8</td>
<td>Review and analyze drainage policy</td>
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<tr>
<td>Habitat 9</td>
<td>Improve connectivity and access to outdoor recreation</td>
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<td>ENERGY</td>
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<tr>
<td>Energy 1</td>
<td>Develop coordinated laws, policies and procedures for governmental entities to assess renewable energy production impacts on the environment</td>
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<tr>
<td>Energy 2</td>
<td>Invest in research and policies regarding “green payments”</td>
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<tr>
<td>Energy 3</td>
<td>Promote policies and incentives that encourage carbon-neutral businesses, homes, communities and other institutions</td>
</tr>
<tr>
<td>Energy 4</td>
<td>Incentives to conserve energy, provide incentives to lower energy use in housing stock</td>
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<tr>
<td>Energy 5</td>
<td>Provide incentives to transition to alternative energy sources of public and institutional energy production and transportation systems</td>
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<tr>
<td>Energy 6</td>
<td>Develop standards and incentives for energy capture from municipal sanitary and solid-waste and minimize landfill systems</td>
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<td>ENERGY (continued)</td>
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<tr>
<td>Energy 7</td>
<td>Develop policies and strategies to implement smart grid and energy efficiency technologies</td>
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<tr>
<td>Energy 8</td>
<td>Implement policies and incentives to lower energy use in housing stock</td>
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<tr>
<td>Energy 9</td>
<td>Develop incentives to encourage widespread adoption of passive solar and shallow geothermal heat pumps in new construction</td>
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<tr>
<td>Energy 10</td>
<td>Promote policies to encourage widespread adoption of passive solar and shallow geothermal heat pumps in new construction</td>
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<td>ENERGY (continued)</td>
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<tr>
<td>Energy 11</td>
<td>Invest in efforts to develop community-based energy platforms</td>
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<td>LAND USE - AG</td>
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<td>LU Ag 1/Energy 12</td>
<td>Transition renewable energy production and reduction of agricultural impacts</td>
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<td>Reduce greenhouse gases through changes in peak flows</td>
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<td>LU Ag 6</td>
<td>Support local and regional conservation-based community planning</td>
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<td>TRANSPORTATION</td>
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<td>Term 1</td>
<td>Alleviate transportation planning across all agencies, streamline environmental transportation project review</td>
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<td>Term 2</td>
<td>Reduce non-point source pollution to surface and ground waters from transportation infrastructure</td>
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<td>Term 3</td>
<td>Encourage and expand sustainable transportation management on working forest lands</td>
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<td>LU Forest 1</td>
<td>Protect large blocks of forest land</td>
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<tr>
<td>LU Forest 2</td>
<td>Protect large blocks of forest land</td>
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</table>
Energy Production and Use Team

Team Members:
Don Fosnacht, Team Co-Lead, UM Duluth NRRI
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Bill Berguson, UM Duluth NRRI
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Mark Lindquist, Minnesota Department of Natural Resources
Max Norris, Agricultural Utilization Research Institute
Brian Stenquist, Department of Natural Resources
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.

- **October 2007 Capacity**: 6.9 billion gal
- **20 in 10**: Ethanol from corn (NCGA**)
- **25 x ‘25**: Gap for Cellulose ethanol to fill
- **30 x ‘30**: Ethanol from corn (NCGA**)
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.
Goal A: Promote Alternative Energy Production Strategies

Ethanol demand in Minnesota will also continue to grow.

- Current blending mandates
- Current blending mandates with federal CAFE standards
- 55 mpg fleet fuel efficiency
- Reducing VMTs by 1/3 by 2030
- 10% of senate ethanol production mandate
Half of Minnesota’s Expiring CRP Land Could be Lost

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

CRP Expiration

Productivity Index Class (%)
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)

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

**Figure:**

*Minnesota rural land: median sales price per acre*

<table>
<thead>
<tr>
<th>Year</th>
<th>Farm (no structures)</th>
<th>Forest (including seasonal recreation; no structures)</th>
<th>Residential (no structures)</th>
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*Source: Minnesota Land Economics*
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.

![Graph showing the relationship between residue removal and sediment delivery]

Amount of corn stover removed affects erosion and soil carbon content.
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.
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.

Global Carbon Cycles

100% Carbon Closure
(Assumes 0.25 t/ha-yr increase in soil carbon)

(1 J) Feedstock Production (62%)
(55 J) Transportation (12%)
(11-16 J) Power Plant Construction (26%)

Net CO₂ Emissions: 0%

Natural Gas
1 → 0.40

Corn Ethanol
1 → 1.67

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.
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
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

The Vision: Community Renewable Energy Platform

- Co-fired Biofuel Generators
- Wind Turbines
- Biomass
- Energy Storage
- Environmental Stewardship
- Economic Development
Goal C: Promote Energy Conservation Efforts

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

Comparison of Growth Areas and Emissions in Minnesota

Sources: Bureau of Economic Analysis, U.S. Federal Highway Administration, MPCA Greenhouse Gas Inventory Data, State Demographers Office, USEPA National Inventory Database, Minnesota Criteria Pollutant Emissions Inventory
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
- Heating capacity 55 kW
- Cost for cooling in summer 2003 ca. 250 € (0.12 €/m²)

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](chart)

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!

INSTITUTE ON THE ENVIRONMENT

University of Minnesota

CR Planning
Community Resources

Bonestroo