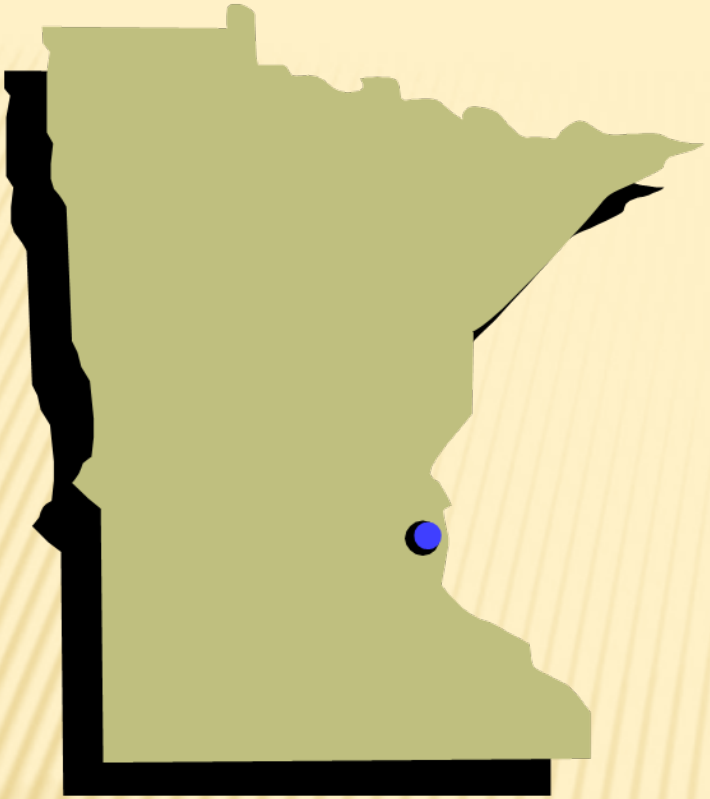


Growing the Bioeconomy: Solutions for Sustainability

Opportunities for Minnesota

Saint Paul, MN
December 2, 2009

IDENTIFYING EFFECTIVE BIOMASS STRATEGIES

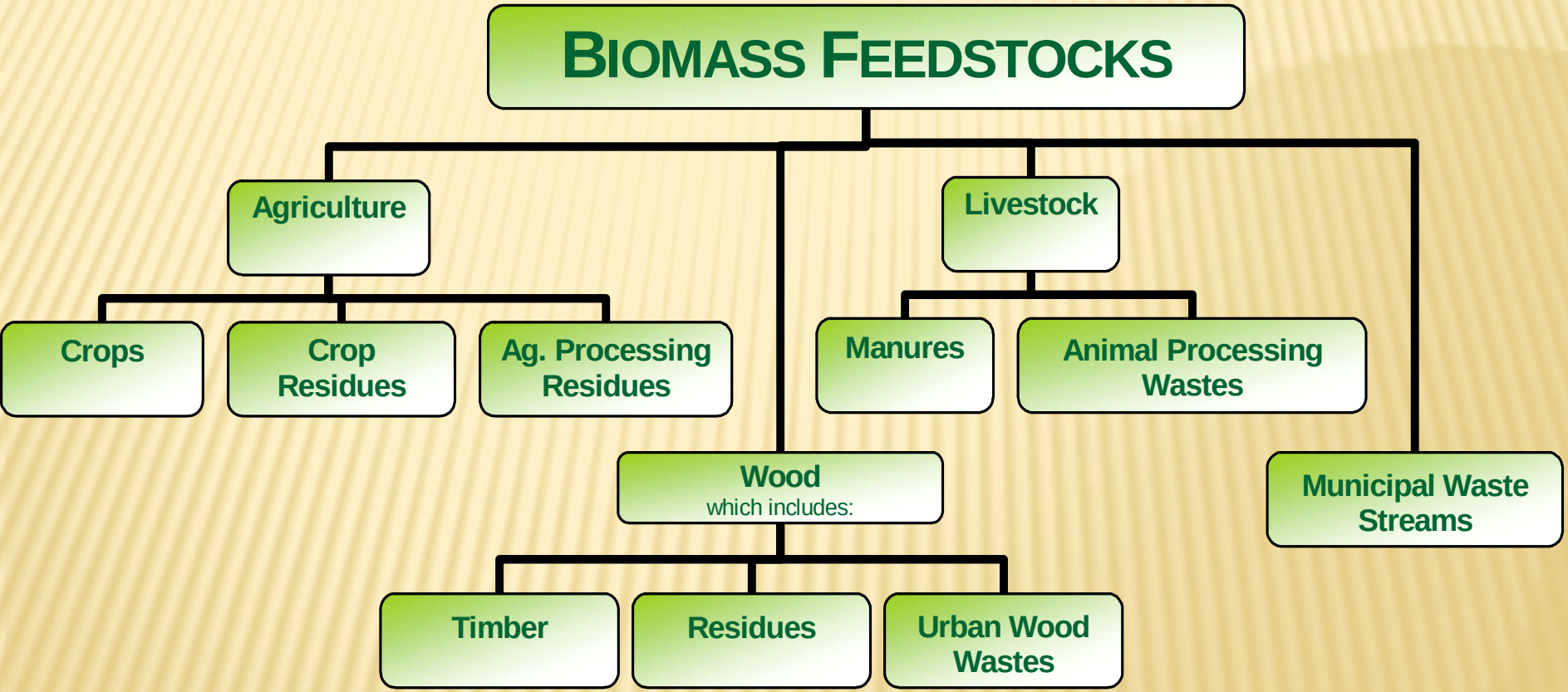
Quantifying Minnesota's Resources and Evaluating Future Opportunities

Presented by:
Keith R. Butcher

PROJECT BACKGROUND

- Conducted by the Center for Energy and Environment and funded by Xcel Energy
- Audience
  - Policy Makers and Project Evaluators
- Mission
  - Conduct a statewide evaluation of biomass resources
  - Describe current processing technologies
  - Understand the existing infrastructure
- Goal
  - Establish a framework to evaluate and compare diverse projects
  - Bridge the gap between industries
- Outputs
  - Final Report
  - BioPET (BioPower Evaluation Tool)
  - *gopher* (aka SkyView)

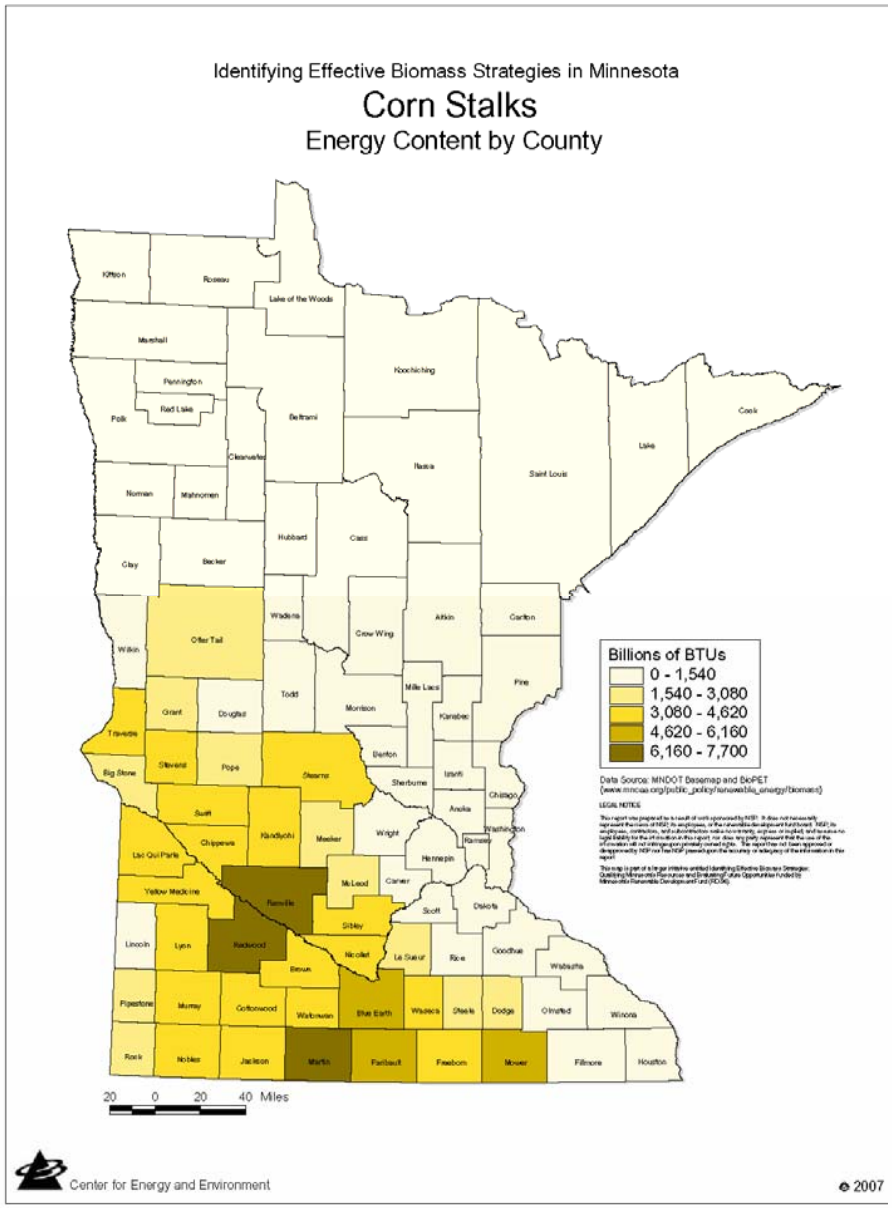
FUEL CHARACTERISTICS

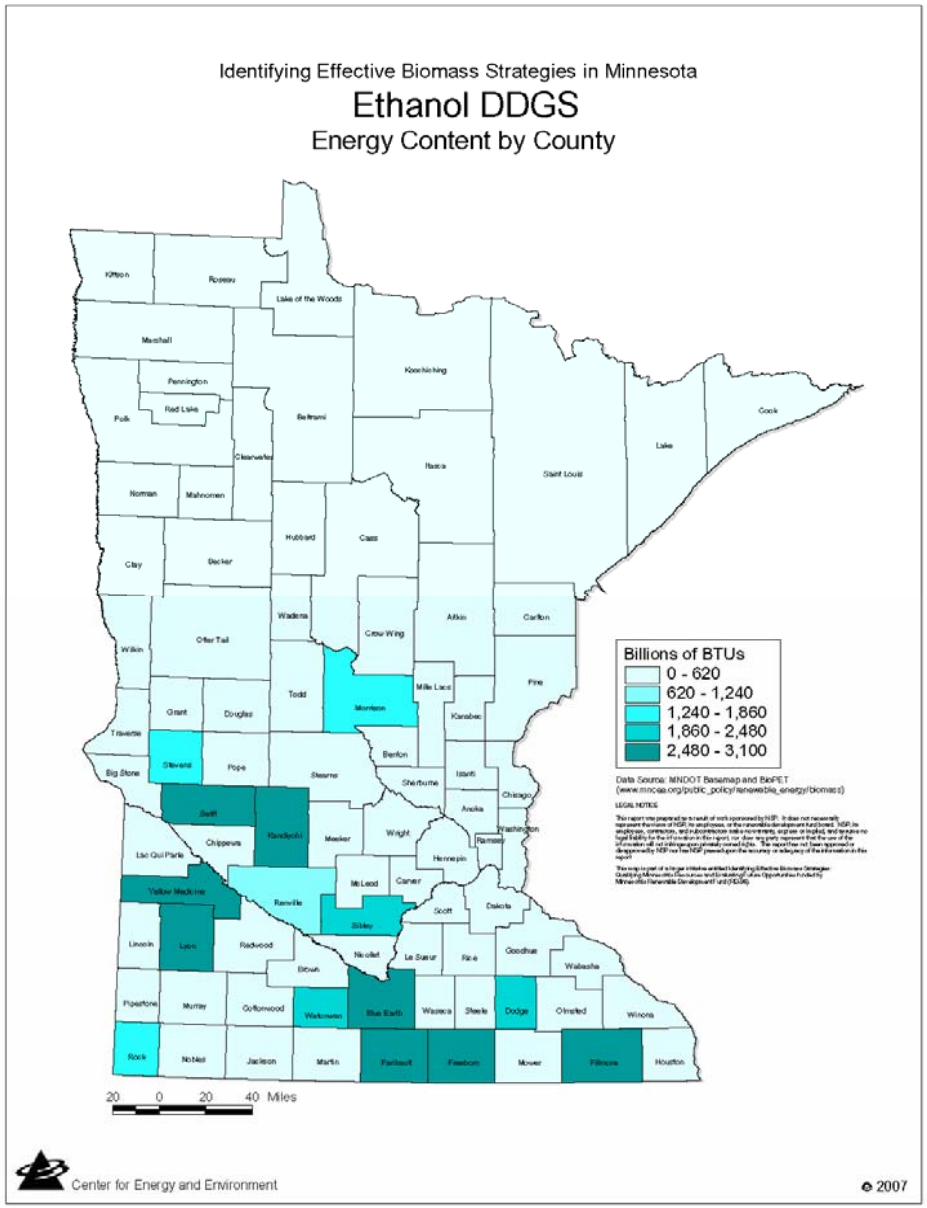


AVAILABILITY AND PROCESSING

- Assessment
  - Energy Content and other Physical Characteristics
  - Estimated volumes by county
  - Estimated processing costs
  - Estimated delivery costs
- From Theoretical to Technical to Economic Availability

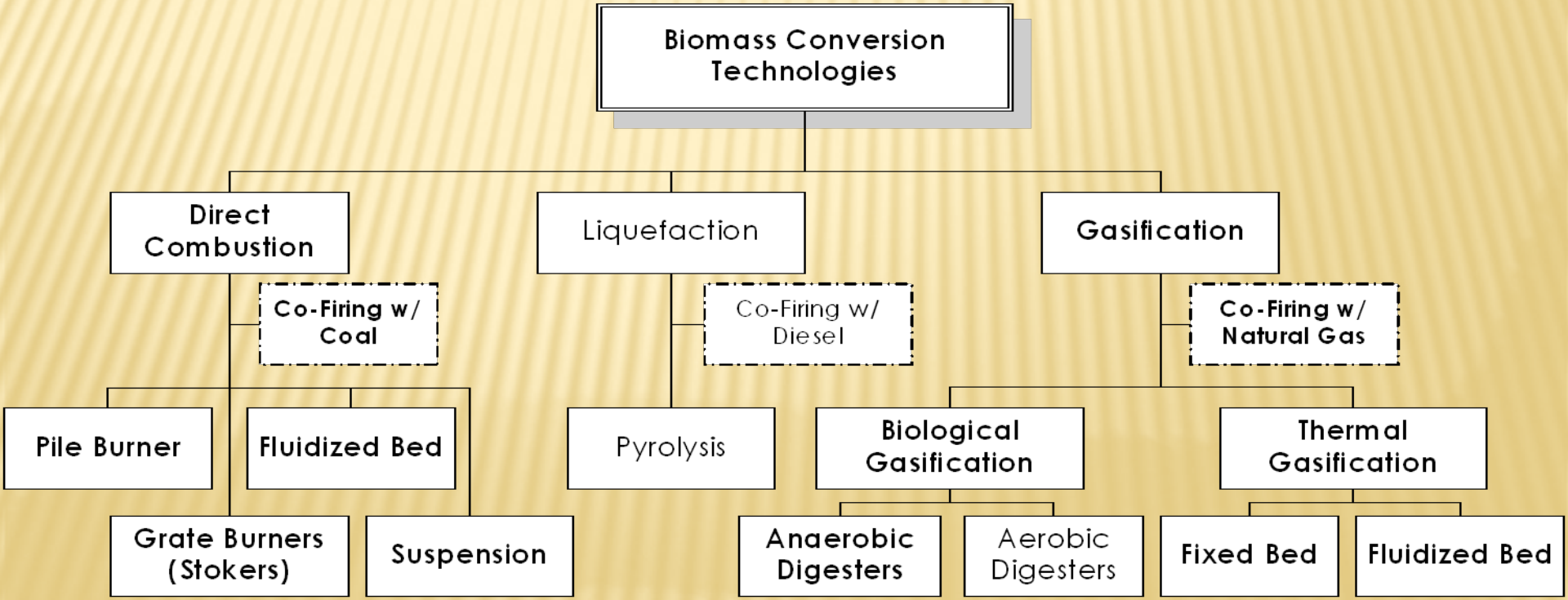
SAMPLE MAPS


Identifying Effective Biomass Strategies in Minnesota
Corn Stalks
Energy Content by County
Billions of BTUs
0 - 1,540
1,540 - 3,080
3,080 - 4,620
4,620 - 6,160
6,160 - 7,700
20 0 20 40 Miles
Center for Energy and Environment
© 2007


Identifying Effective Biomass Strategies in Minnesota
Ethanol DDGS
Energy Content by County
Billions of BTUs
0 - 620
620 - 1,240
1,240 - 1,860
1,860 - 2,480
2,480 - 3,100
20 0 20 40 Miles
Center for Energy and Environment
© 2007

ENERGY CONVERSION TECHNOLOGIES

- Summary of different types and examples
- Issues to be aware of
- Discussion of Research Areas

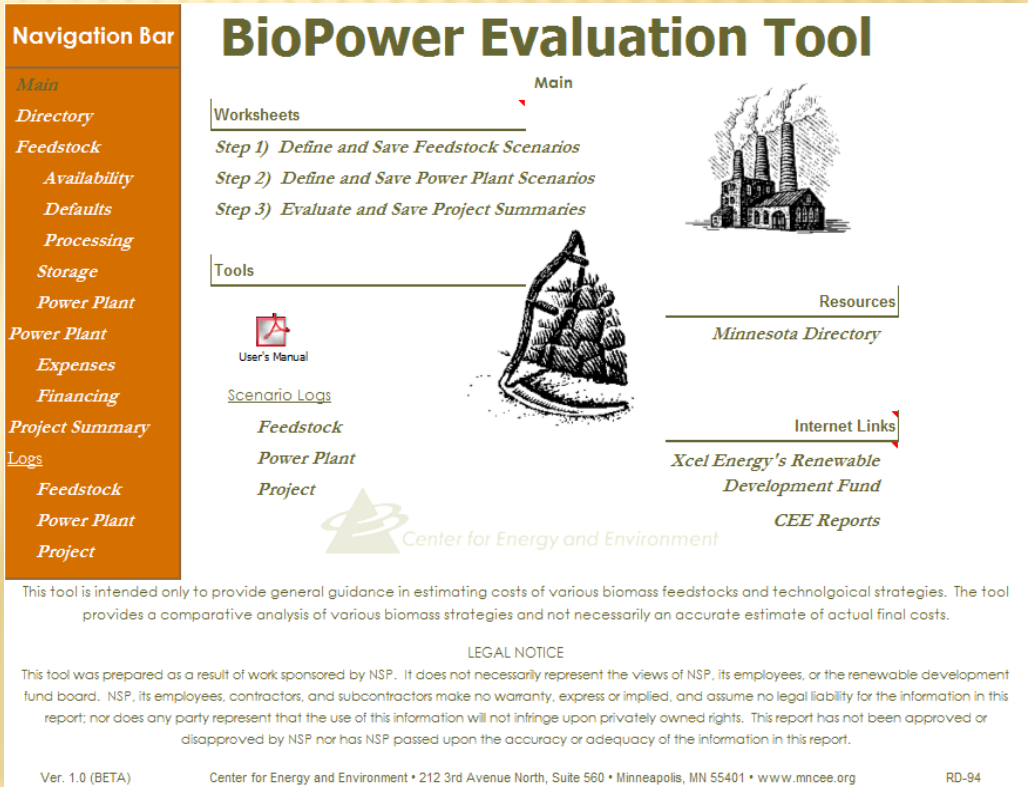


POLICY INITATIVES

- 1994 Biomass Mandate
- Economic Development Programs and Issues
- Community Based Energy Development (C-BED)
- Minnesota's Renewable Energy Standard

ECONOMIC EVALUATION

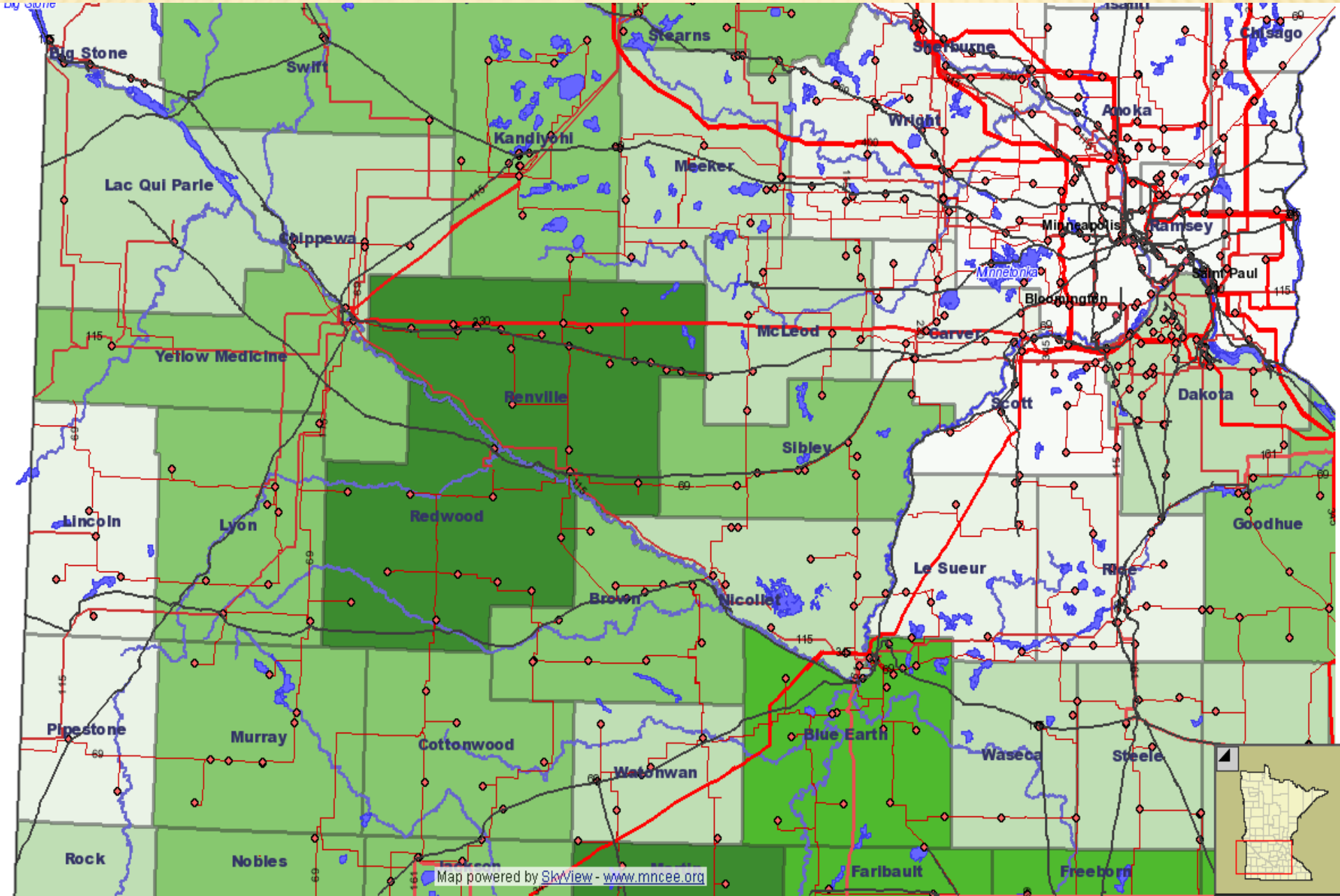
- Bio-Power Evaluation Tool (BioPET)
  - Define Fuel Delivery Path
  - Scenario Generation
  - Sensitivity Analysis
- Output
  - ¢/kWh
  - $/kW



gopher (aka SKYVIEW)

- GIS Functionality
- Resources
- Infrastructure
- Institutional Boundaries

SKYVIEW EXAMPLE



OVERCOMING BARRIERS

- Cost
  - Competition for fuels
  - Securing Long-Term Fuel Supplies
  - Financing and Permitting
- Legislative and Regulatory
  - Broad and Narrow Policy Measures
  - Facilitating the Regulatory / Project Development Process
  - Sustainability

RESOURCES

- Center for Energy and Environment (www.mncee.org)
  - Click on “Biomass Resources”
- Xcel Energy (www.xcelenergy.com)
  - Click on “Company” ; “Environment” ; “Renewable Development Fund”

Stop by the Center for Energy and Environment’s booth to see a live demonstration of Sky View