


CLEAN ENERGY RESOURCE TEAMS

Northeast Clean Energy Resource Team *Strategic Energy Plan*

CERTS PARTNERS:

Minnesota Department of Commerce

The Minnesota Project

University of Minnesota Regional Sustainable Development Partnerships

Rural Minnesota Energy Board

Metropolitan Counties Energy Task Force

Resource Conservation and Development Councils

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University of Minnesota Initiative for Renewable Energy and the Environment

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SECTION 1: INTRODUCTION TO CERTs

Section 1.1 Background on CERTs

The Clean Energy Resource Team (CERT) Project is designed to give citizens a voice in energy planning by connecting them with the technical resources necessary to identify and implement community-scale energy efficiency and renewable energy projects. The project is a multi-year initiative, begun in fall 2003.

The CERTs project is a multi partner initiative, with each partner serving in different roles and bringing expertise critical to the success of the project. The project partners are:

- Minnesota Department of Commerce
- Minnesota Project
- University of Minnesota Regional Sustainable Development Partnerships
- Rural County Energy Task Force
- Metro County Energy Task Force
- Minnesota Resource Conservation and Development Councils

CERTs are active in each of the seven regions (Figure 1). Teams include between 30 and 200 stakeholders representing area local governments, farmers, utilities, colleges, universities, businesses, environmental, and economic development groups. Many team members are deeply involved in CERTs, serving on CERT steering committees, taking on in-depth examination of topics of particular interest, and attending quarterly CERT meetings. Many more stay in touch attending meetings when possible and weighing in with their opinions and ideas on the regional CERT listserv. The Metro County Energy Task Force is serving as the CERT in the metro area.

Figure 1: Clean Energy Resource Teams Map

All of the teams are engaged in studying their region's energy system and identifying areas where conservation efforts and best-bet community scale renewable energy projects can create environmental improvements and economic development opportunities. Each team conducted at least one workshop,

hosted a variety of speakers on energy related topics to help them better understand their region's energy infrastructure, and identified areas of regional economic opportunity. Tours of renewable energy and conservation projects in their region have also provided good examples of what can be done.

This plan is a result of careful analysis of a regional resource inventory. Each regional inventory gave its team a good understanding of its most promising regional opportunities. Each team had extensive and thoughtful discussions of their vision of the energy future for the region and their team's mission and goals. Each of the visions articulated by regional teams highlights the economic opportunities and environmental protection that would develop from regional conservation and renewable energy projects. These, along with the inventory, form the basis for the plans. The final component of the plans is the discussion of best-bet projects (those that are best for the region and most likely to succeed).

The draft strategic energy plan was shared widely throughout the region and input sought from all team members.

Section 1.2 Overall Purpose of CERTs

As mentioned above, the overall purpose of CERTs is to engage citizens in energy planning. It's about giving voice to the common citizen through a very open and inclusive process. It's about connecting with people that are in the business of energy and about gaining knowledge so that citizens have a say in how Minnesota can improve energy consumption and develop doable renewable energy projects.

The project outcomes are to:

- ***Convene Clean Energy Resource Teams*** in each of seven Minnesota regions with a range of stakeholders (see CERTs Map)
- ***Perform Regional Resource Inventories*** to examine current energy usage and renewable energy resources in the region
- ***Develop Regional Strategic Energy Plans*** that highlight each region's top energy priorities
- ***Implement Select Projects*** including both conservation and energy efficiency projects and renewable energy projects

Section 1.3 Overview of Regional Resource Attributes

To achieve the overall purpose of the CERTs project, each of the seven teams were tasked with developing a Regional Strategic Energy Plan. This report fulfills the Strategic Energy Plan requirement by presenting the results of the current energy use inventory, the results of the regional renewable energy resource assessment, and the

regions best bet project ideas for the future. Project ideas are prioritized by evaluating the resources available in the region and then considering the region's priorities as reflected in its team vision, mission and goals. The regional resource inventory for the Northeast Region reflects strong biomass capacity, as well as opportunities for some wind and continued solar resource development.

Section 1.4 Overview of Regional Vision and Mission

The Northeast CERT set a broad vision to "Design a Minnesota Clean Energy Future, while maintaining a positive economic impact on the region." The team felt this gave the region something to strive for and presented an exciting vision for the future. In its mission the team laid out its priorities to "build a sustainable future by increasing the public's awareness and active adoption of energy conservation, energy efficiency and local renewable energy resources."

The Vision and Mission statements will be discussed further in Section 4.

Section 1.5 Overview of Best Bets

The regional resource attributes, regional vision, and mission led the Northeast CERT to develop one central project idea: to strive toward completing a renewable energy and/or energy efficiency demonstration project at every school or in every community in the Northeast Region. The team recognized that this was a very ambitious goal, and one that would most likely not be fully realized in the short run. However, the team felt it necessary and appropriate to have such an ambitious goal to propel the Northeast Region in the right direction. This initiative is described in full in Section 7.

SECTION 2: INTRODUCTION TO THE NORTHEAST REGION AND REGIONAL DEMOGRAPHICS

To gain a better understanding of the region, its people, opportunities for increased energy conservation, and broader integration of renewable resources, each regional team preformed a general survey of regional statistics, land use and demographics.

Section 2.1 An Overview of the Northeast Region

The Northeast Region comprises of the counties of Aitkin, Carlton, Cook, Itasca, Kanabec, Koochiching, Lake, Pine, and St. Louis. According to the Ecological Classification System these counties are all part of the Laurentian Mixed Forest Province, where the steep hills of the North Shore of Lake Superior climb to a plateau known as the Iron Range. The North East Region encompass parts of 11 ecological classification subsections including the Littlefork-Vermilion Uplands, the Border Lakes, the Agassiz Low Lands, the Chippewa Plains, the St. Louis Moraines, the Nashwauk Uplands, the Tamarack Lowlands, the Laurentian Highlands, the North Shore, the Mille Lacs Uplands, and Glacial Lake Superior.[1] Many lakes and rivers dot the region's forested landscape, which includes national, state, county and private forests. The Northeast Region overlaps with parts of four major drainage basins, the Rainy River Basin, the Upper Mississippi River Basin, the Great Lakes Basin, and the St. Croix River Basin.[2] Major waterways in the region include Lake Superior, the Mississippi, St. Croix, St. Louis, Cloquet, Nemadji, Rainy, Kettle, and Snake Rivers.

Section 2.2 Regional Demographics

The Northeast Region represents about 7.3% of the state population. The 2000 population census revealed a total of 363,599 people living in northeast Minnesota (U.S. Census Bureau). St. Louis County, which encompasses the city of Duluth, had the highest population with 200,528 residents while Cook County had the fewest with only 5,168 people (Figure 2, Population Pie Chart by County).

Roughly 45% of the population in Northeast Minnesota is urban (164,659 people) and 55% is rural (198,940). Two of the nine northeast counties have 0% of urban population (Aitkin and Cook) (Figure 3).

Ten-year population projections for the region show all but one county facing positive growth. By 2010, the total population of Northeast Minnesota is projected to reach

[1] State of Minnesota, Department of Natural Resources. 1996. "Appendix 6: Upper Three Levels of ECS for Minnesota".
[2] State of Minnesota, Department of natural Resources. 2004. "Minnesota's Watershed Basins." Retrieved September 8, 2004 from: http://www.dnr.state.mn.us/watersheds/map.html.

386,650. Aitkin and Cook counties are projected to achieve 21% growth, the highest for the region, while Koochiching's population is expected to decline by 5%[3] (Figure 4, Demographer's map). The growth and decline figures are significant as they provide regional teams with a glimpse at potential changes in regional energy demand[4].

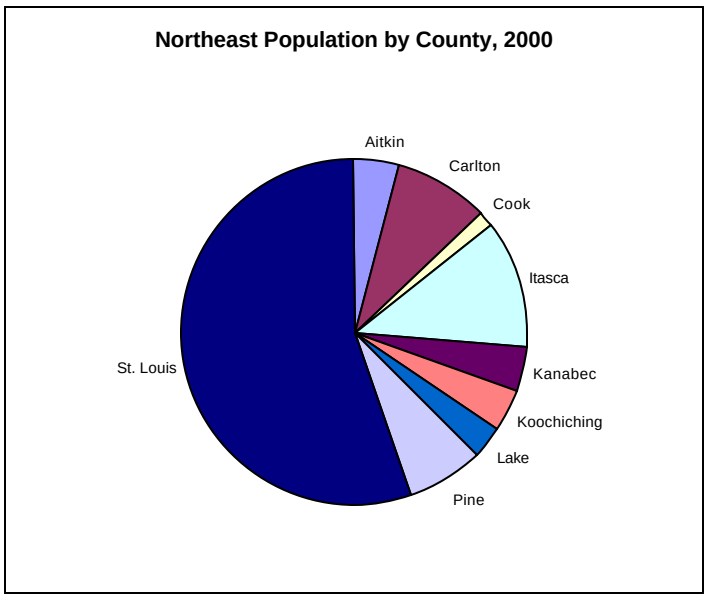

Figure 2: Northeast Population by County, 2000

[3] Minnesota Planning, State Demographic Center. October 2002. *Minnesota Population Projections: 2000-2030*. Retrieved Spring 2004 from: http://www.demography.state.mn.us/DownloadFiles/00Proj/PopulationProjections02Intro.pdf.

[4] Generally as population increases so does demand.

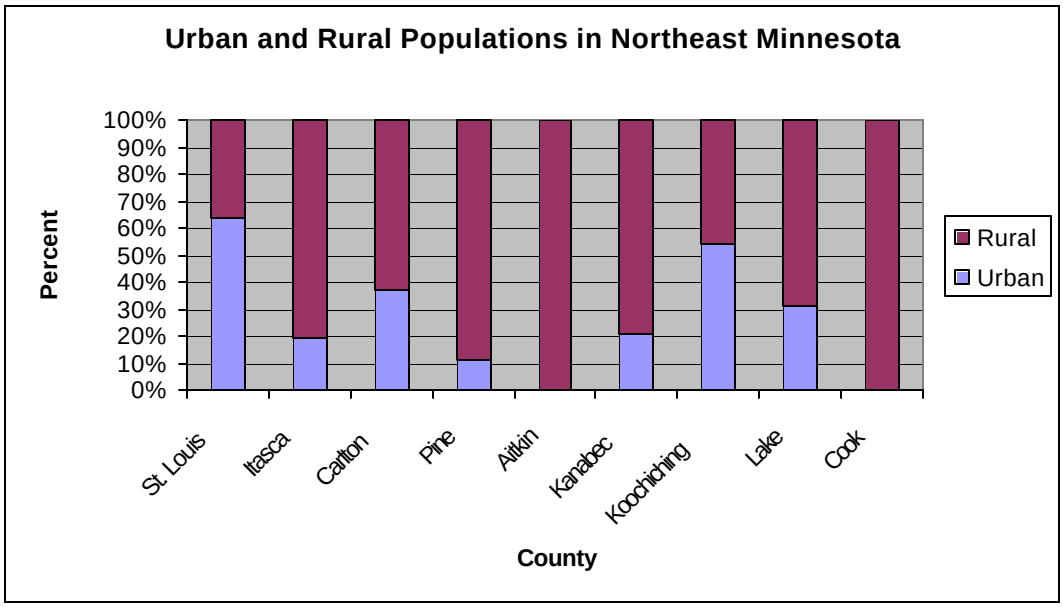

Figure 3: Urban and Rural Populations, breakdown by County

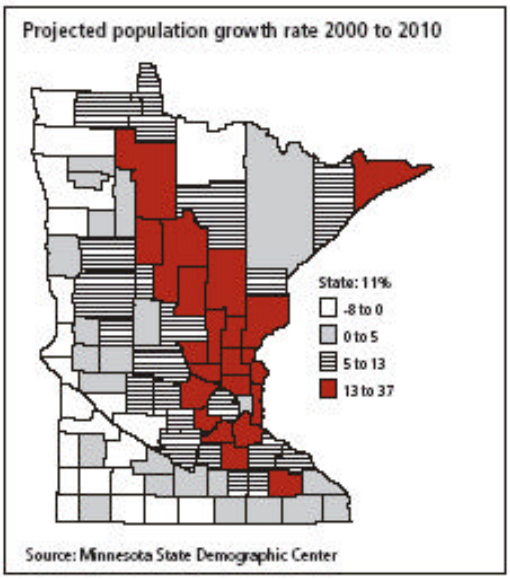

Figure 4: Population Projections

Section 2.3 Household Information

There are 147,850 households in the Northeast, which average 2.5 people per household. On the average, about 92.8% of families are living above poverty and about 7% are living below poverty.[5] Median sales prices for existing homes in northeast

[5] US Census Bureau. 2000. "Census 2000 Summary File 1, Table GCT-P14, Income and Poverty in 1999: 2000." Retrieved on January 26, 2005 from http://factfinder.census.gov.
Poverty level, according to the Census Bureau is calculated as follows: Following the Office of Management and Budget's (OMB's) Directive 14, the Census Bureau uses a set of money income thresholds that vary by family size

Minnesota ranges from $126,750 in Cook County to $61,000 in Lake County. Mean full time earnings in the region are $29,922, with Lake County having the highest median earnings and Aitkin with the lowest median earnings.

In the year 2000, Minnesota had a home ownership rate of 74.6% in comparison to a national average of 66.2%.[6] This is the second highest ranking in the country. Few areas in northeast Minnesota fall below this value with the exception of St. Louis County. St. Louis County has the lowest home ownership rate in the region, which may in part be due to the colleges and universities populations in and around the Duluth area. These household and earning figures are important because they suggest where informed home owners may be more likely to make investments in energy efficiency improvements. Notably, owners are less likely to make capital investments in their homes if they will not be able to recoup those investments in the sale of their home.

Section 2.4 Land Use

According to the 1990s Census of the Land,[7] this region's dominant land use is forested land. Of the 13,786,456 acres in the 9 county region 7,356,275 acres, or roughly 53.4%, are described as forested land. Bog/marsh/fen is the next largest category of land use at just over 3.4 million acres, while hay/pasture land/grassland and water nearly tied for third, covering around 1 million acres each. Only 125,407 acres are listed as urban and rural development, which is less than 1% of the region. Cultivated land also makes up only 1% of the region's land. Duluth is the largest city in the region.

Section 2.5 Regional Sector Breakdown

Data from the North American Industry Classification System (NAICS) indicate there are 9,861 business establishments in northeast Minnesota.[8] Combined, these businesses paid out over three billion dollars in 2002. According to the NAICS figures, the major employers in the region, based on payroll, are: Mining, construction, manufacturing, wholesale trade, retail trade, transportation and warehousing, finance and insurance, professional, science and technical services, health care and social assistance, accommodation and food services, and other services.

This data, however, does not considered self-employed individuals, employees of private households, railroad employees, agricultural production employees and most

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and composition to detect who is poor. If the total income for a family or unrelated individual falls below the relevant poverty threshold, then the family or unrelated individual is classified as being "below the poverty level."

[6] Minnesota State Demographer. Map, page 7.

[7] Land Management Information Center. Minnesota Land Use and Cover: 1990s Census of the Land. Retrieved from http://mapserver.lmic.state.mn.us/landuse/ on August 25, 2004.

[8] US Census Bureau. 2005. *2002 County Business Patterns (NAICS).* Retrieved on March 29, 2005 from http://censtats.census.gov/cgi-bin/cbpnaic/cbpsect.pl.

government employees. In spite of this, these figures give an idea of the bulk contributors in the region, and where energy efficiency measures might be the most beneficial. For more detailed information on the sector breakdown, please see Appendix A.

Section 2.6 Regional Environmental Concerns

The Northeast Region is full of lakes, but Lake Superior, the third largest freshwater lake in the world, is by far the most significant. Although Lake Superior is considered the cleanest and clearest of the Great Lakes, its water quality is still a concern to the region. One recent concern has been algae blooms in Lake Superior's bays, especially along the western arm of the lake, that reduce water quality along the shoreline.[9] Acid precipitation from both precipitation and "dry aerosol" is another potential concern for Lake Superior, but currently the Lake's tremendous volume is able to more or less neutralize these effects. The highest concentration of acidic deposition is found along the shoreline of Lake Superior (sulfate and NO_x are not a problem for Superior but are a potential problem for the surrounding land mass and the smaller lakes and streams near Lake Superior). Other pollutants, such as mercury, dioxin, and PCBs, although deposited in low concentrations pose a threat because they do not break down, and may lead to bioaccumulation of these toxins in fish and eventually humans who eat these fish.[10] Also of note, the Lake Superior Airshed shows a very unusual ability to deposit much higher concentrations of pollutants along the near shore area compared to inland areas.

Water quality concerns around Lake Superior are also linked with development concerns along the shore. Lake Superior's North Shore is famous for its natural scenery and is a popular tourist destination. Unfortunately, these tourists have paved the way for development along the shore, and have begun to threaten the same natural beauty that has brought people to the North Shore.[11] While the shoreline was once associated with long stretches of birch and pine stands, these trees have gradually been replaced by tourist centers and other buildings. Two Harbors provides a vivid example of how the North Shore has transformed over the years. This former quiet-fishing town has become a vibrant tourist center.[12] As new structures like buildings, parking lots, and driveways replace natural lands, the area's ability to absorb rainfall and snowmelt into the soil is curbed due to the increase in impervious surfaces. Instead, water flows right

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[9] Minnesota Pollution Control Agency. *Lake Superior.* 2003. Retrieved December 12, 2004 from: http://www.pca.state.mn.us/water/basins/superior/.
[10] Bay, Terrance. *Lake Superior.* 2004. Retrieved January 10, 2005 from: http://www.terrace-bay.com/facts.html.
[11] Tahtinen, Jennifer. *Coalition Form to Defend The North Shore*. 2004. Retrieved December 30, 2004 from: http://www.glhabitat.org/news/glnews321.html.
[12] Minnesota Pollution Control Agency. *Lake Superior.* 2003. Retrieved December 12, 2004 from: http://www.pca.state.mn.us/water/basins/superior/.

into surrounding lakes and streams without first percolating through vegetation, thereby dumping excess nutrients and pollutants into nearby rivers and Lake Superior.

Another environmental issue in northeast Minnesota is the abandoned mine sites all over the region. There are approximately 345 of this kind in the Iron Range. Some of these sites have been turned into recreational ground, city beaches, and industrial developments, but some areas still pose dangers to the environment. The Canisteo Mine pit provides an example of the potential danger these abandoned pits pose. The Canisteo Mine pit just outside of Bovey is 300 feet deep and filled with ever-rising water. As the water has risen it has been eroding its steep walls, and sometimes causing portions of the wall to fall off. As a result of this progressive erosion, the Duluth Mesabe and Iron Range Railway had to stop using a track that runs near the pit.[13] If allowed to continue rising unabated, the water could overflow its banks and flood the nearby towns of Bovey and Coleraine.

The use of All-Terrain Vehicles (ATVs) has also been causing damages to the natural environment. ATVs are small open vehicles with three or four large tires. They are multi purpose vehicles that are designed for road-less and rugged terrains, making them popular for use in back country recreation and hunting. In recent years reckless use of ATVs has had adverse effects on forest trails, streams and wetlands. In 2003, 3,200 tickets were issued for ATV violations ranging from drinking to damaging of wetlands.[14]

[13] Oakes, Larry. *Mine Pit Threatens a Minnesota town*. 2004. Retrieved January 4, 2005 from: http://www.mepartnership.org/mep_whatsnew.asp?new_id=756.
[14] Myers, John. *Group Seek Tougher ATV Laws*. 2005. Retrieved January 4, 2005 from: http://www.duluthsuperior.com/mld/duluthsuperior/news/local/10561177.htm

SECTION 3: TEAM ORGANIZING

The Northeast CERT is a community-based organization that has sought to engage a variety of community stakeholders in the shaping of this energy plan and in the development of regional project priorities. This section details how the team was formed, who is on the team and how the team works.

Section 3.1 Information Sharing and Recruitment

Individuals were recruited for the Northeast CERT via letters of invitation, email meeting notices, on-going press releases, announcements by the Sierra Club in their newsletters, on the CERTs website and via word-of-mouth. Individuals who attended and signed in at meetings were added to the CERT mailing list and/or listserv. Over 70 people were on the regional listserv. Meeting summaries were sent electronically to the listserv following each meeting and also posted on the CERTs website. Presentations from meetings were also posted to the website when available.

Section 3.2 Team Members and Structure

The Northeast CERT represents a wide variety of stakeholders including business representatives, city and county representatives, educators, non-profit representatives, researchers, resource conservation and development council members, state legislators, state/federal agency employees, and utility representatives. For a complete list of active team members please see Appendix B.

Section 3.3 Team Activities

The Northeast Region convened meetings throughout the initial two years of the project. The first full team meeting was held in December 2003. This first meeting served primarily as a way to inform participants about the CERTs and ask them for input about how the process should proceed. The meetings that followed included full team meetings as well as Steering Committee Meetings and Working Group Meetings.

The following lists all the meetings and general topics:

- October 24th, 2003 – Pre-CERT Meeting – Introduction to CERTs and strategizing for first meeting
- December 10th, 2003 – Full CERT Meeting – Introduction to CERTs
- February 24th, 2004 – Full CERT Meeting – Regional project case studies, mission discussion, and small group working sessions
- April 20th, 2004 – Steering Committee Meeting – Planning for May meeting
- May 19th, 2004 – Full CERT Meeting – Regional Energy Pies, presentation about potential wind project on the Iron Range, Tour of Duluth Zoo
- June 2004 – Policy Committee Meeting

- July 14th, 2004 – Full CERT Meeting – Mission Discussion, Biofuels presentation, tour of Fond du Lac Tribal and Community College
- August/September 2004 – Working group meetings
- August 18th, 2004 – Steering Committee Conference Call – Planning for September meeting
- September 29th, 2004 – Full CERT Meeting – Identification of barriers to renewable energy and energy efficiency, and Selection of project priorities, Summary of renewable energy research efforts at University of Minnesota Duluth
- October 25th, 2004 – Working Meeting to develop presentation for North Shore Community School Board meeting
- November 23rd, 2004 – Full CERT Meeting – Update a successful presentation at the North Shore Community School Board meeting, setting school-related project priorities
- January 28th, 2005 – Full CERT Meeting – Audubon Center, moving the school initiative forward
- February 11th, 2005 – Educational Display Project meeting – Wolf Ridge, brainstorming session on educational display project work
- February 28th, 2005 – Statewide CERTs Conference
- April 15th, 2005 – Full CERT Meeting – Update on projects at Proctor and North Shore Community School; session on Biodiesel and Ethanol use in cars, local fleets, at schools; discussion about Barriers and Opportunities for report.

A copy of each meeting agenda and each meeting summary are provided in Appendix C. Select presentations from team meetings are available on the CERTs website: www.cleanenergyresrouceteams.org.

SECTION 4: TEAM VISION, MISSION, GOALS

After much team discussion, comments via email, and a few rounds of team discussion, the Northeast CERT arrived at the following:

Vision Statement: Designing a Minnesota Clean Energy Future while providing a positive economic impact on the region.

Mission Statement: The mission of the Northeast Region's Clean Energy Resource Team (CERT) is to build a sustainable future by increasing the public's awareness and active adoption of energy conservation, energy efficiency and local renewable energy resources.

Northeast CERT has outlined the following objectives:

Promoting conservation and energy efficiency practices:

- CERT will aggressively promote and support energy conservation practices, efficient energy production and use.
- Encourage broader implementation of energy conservation and efficiency measures

Transitioning towards sustainable energy systems:

- Aggressively promote energy systems based on sustainable Minnesota resources by supporting locally owned and operated alternative and renewable energy systems.
- Collaborate with other interested parties seeking a similar transition to sustainable energy technology practices.
- Cooperate with and serve as liaison to private individuals, organizations and institutions having an interest in energy conservation and utilization of alternative and renewable energy sources.
- Cooperate with private or governmental bodies, corporations, associations, institutions, communities, agencies or persons interested in supporting the transitions toward independent renewable energy systems.
- Promote the availability of unbiased information available for implementing efficient and economic use of renewable energy to empower local energy solutions.
- Encourage discussion on the human values reflected in present energy consumption patterns and the need for lifestyle change.
- Facilitate development of new technologies:

- ✓ CERT will communicate with energy users and producers, focusing on strategies relating to the formation and development of public policy by disseminating information to users and providers interested in the application of local and regional sustainable energy strategies.
- ✓ Develop a wider understanding of renewable energy applications by integrating technical knowledge and social resources.

SECTION 5: CURRENT ENERGY USAGE

Each CERT began its assessment work with an inventory of current energy use in the region. In the Northeast Region Felix Amenumey, a graduate student at the University of Minnesota Duluth, was critical in pulling this information together. These current energy use profiles provided the team with an energy baseline and a better general understanding of regional energy use.

Section 5.1 Electric

Northeast CERT began its energy use inventory by gathering information about electric use, electric generation, and how all the utilities serving the region work together.

Section 5.1.1 Electric Utilities in the West Central Region

There are 24 electric utilities serving northeast Minnesota including investor-owned utilities, cooperative utilities, and municipal utilities (Table 1). Minnesota Power, the only investor-owned utility serving the region, is the region's largest electric provider serving about 72% of the region's load. Cooperative utilities serve 22% of northeast Minnesota's demand while municipal utilities serve the remaining 6% (Figure 5).[15]

Methods used to collect Utility Data are described in full in Appendix D.

[15] Minnesota Department of Commerce. 2002. *The 2001 Minnesota Utility Data Book*. Table 4. Retrieved on May 19, 2005 from http://www.state.mn.us/mn/externalDocs/Commerce/Utility_Data_Book,_1965-2000__030603120425_UtilityDataBook65thru01-2.pdf

Table 1: Utilities Serving the West Central Region

Utility Type	Utility
Investor Owned Utilities	Minnesota Power
Generation & Transmission Cooperatives	Great River Energy (GRE)
Distribution Cooperatives	Arrowhead Electric Cooperative, East Central Energy, Itasca-Mantrap Cooperative Electric, Lake Country Power, Mille Lacs Electric Cooperative, Cooperative Light and Power Association, North Itasca Electric Cooperative, and Crow Wing Cooperative Power and Light
Municipal Utilities	Aitkin Public Utility, Buhl Public Utility, Ely Water and Light Department, Gilbert Water and Light, Grand Marais Public Utility, Grand Rapids Public Utility, Hibbing Public Utility, Keewatin Public Utility, Moose Lake Water and Light, Mountain Iron Municipal Utility, Nashwauk Public Utility, Proctor Public Utility, Two Harbors Water and Light, and Virginia Public Utility

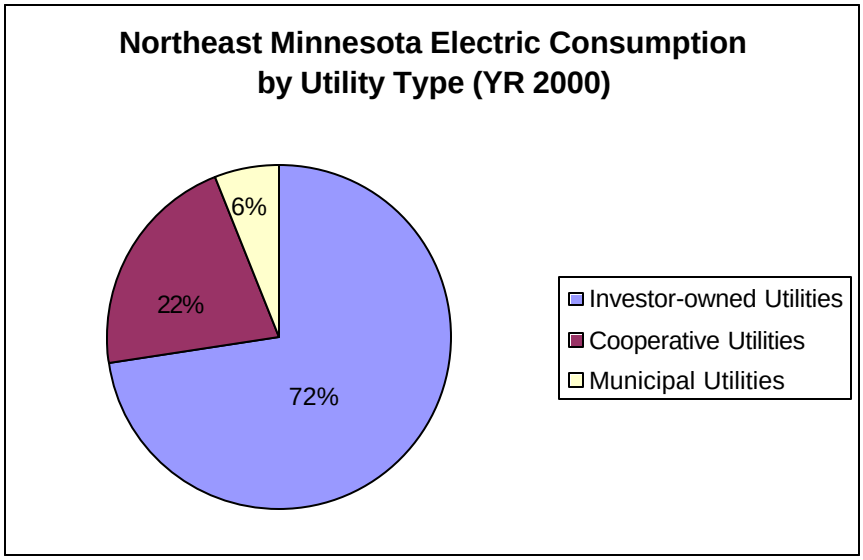

Figure 5: Northeast Minnesota Electric Consumption by Utility Type

Section 5.1.2 Regional Energy Consumption

In 2000, the Northeast Region consumed 9,473,399 megawatt hours (MWh) (Figure 6).[16] This total was determined by summing the megawatt-hour consumption figures from each of the 17 counties. The consumption patterns among counties mimicked the general patterns illustrated in the population numbers (Figure 2), although St. Louis County alone accounts for 76% of the total electric consumption in the region. This high level of consumption is related to the numerous industries located in the county. Cook, Kanabec and Lake counties each consume only 1% of the electricity supplied to the region.

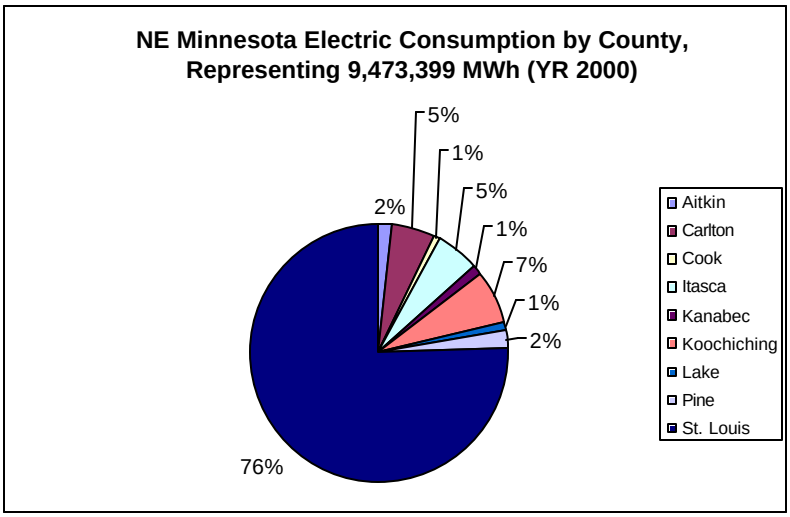

Figure 6: Northeast Electric Consumption by County

[16] Ibid. Table 8.

Four main sectors, industrial, commercial, residential, and farm, dictate electric consumption in northeast Minnesota (Appendix E). Data gathered thus far indicate that the industrial sector is the major consumer of electricity, accounting for 59% of regional electric energy consumption (Figure 7).[17] The farming sector has the smallest impact on consumption accounting for only 2%.

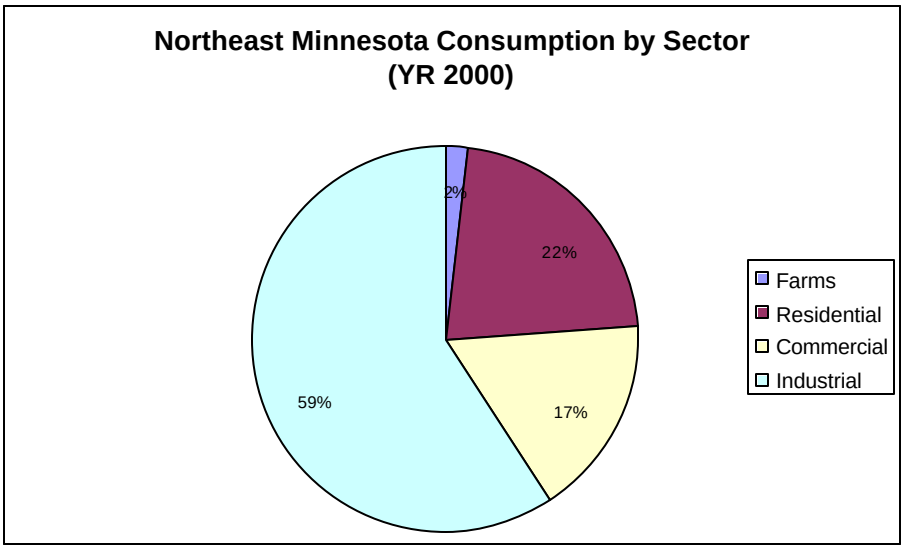

Figure 7: Consumption by Sector

Section 5.1.3 Energy Sources Used in Electrical Generation

Minnesota Power and Great River Energy are the two major utilities with generation resources serving the region. The resources used in generating this electricity are both non-renewable and renewable. However, the renewable share of the mix represents less than 10% of the electricity supplied. The primary renewable sources are biomass, hydro and wind. The non-renewable sources are coal, natural gas and oil.

Minnesota Power depends heavily on coal for power generation. Coal represents 61% of Minnesota Power's mix whereas biomass accounts for 6% of its mix. Minnesota Power also relies heavily on purchased power, which accounts for 29% of its electric generation blend.

Great River Energy also depends heavily on coal for its electric energy generation, largely from facilities in North Dakota. Coal accounts for 84% of GRE's total generation mix, followed by hydro, which accounts for 4%. Others resources such as natural gas,

[17] Ibid. Table 4.

wind and refuse derived fuel supply minimal amounts. Purchased power represents 9%.

Section 5.1.4 Environmental Impacts of Electrical Energy Generation

Electricity production, primarily from burning coal, is the source of most emissions of sulfur dioxide (SO_2), which are the main cause of acid rain.[18] Electricity production from fossil fuels also emits nitrogen oxides that, in the presence of sunlight, combine with other chemicals to form ground level ozone (smog) that can irritate the lungs, cause bronchitis and pneumonia, and decrease resistance to respiratory infections.[19] Burning of fossil fuels for electricity produces carbon dioxide emissions that contribute to global warming.[20] Combustion of fossil fuels also produces carbon monoxide emissions that can cause headaches, large particulates that contribute to respiratory disease, and small particulates that have been linked to chronic bronchitis, aggravated asthma, and premature death.[21] Coal combustion also contributes to mercury, arsenic and lead emissions. These toxic metals can accumulate in the fatty tissue of animals and humans leading to severe health problems.[22] Indeed, during 2004 the Minnesota Department of Health issued fish consumption advisories for every Minnesota Lake due to accumulation of Mercury in fish.[23]

Electricity generation also results in environmental issues stemming from the harvesting and transportation of fuels for production, such as mining and shipping coal, drilling for, refining and transporting oil and drilling for natural gas. Each activity has the potential to pollute our lands and waters via spills, land degradation, and chemical leaching among others.

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[18] US Environmental Protection Agency. 2000. "SO2 – How Sulfur Dioxide Affects the Way We Live and Breathe." Retrieved June 3, 2005 from: http://www.epa.gov/air/urbanair/so2/what1.html and http://www.epa.gov/air/urbanair/so2/chf1.html.

[19] US Environmental Protection Agency. 1998. "NOx – How Nitrogen Oxides Affect the Way We Live and Breathe." Retrieved June 3, 2005 from: http://www.epa.gov/air/urbanair/nox/index.html.

[20] US Environmental Protection Agency. 2002. "Global Warming." Retrieved June 3, 2005 from: http://yosemite.epa.gov/oar/globalwarming.nsf/content/index.html

[21] US Environmental Protection Agency. 2000. "CO – How Carbon Monoxide Affects the Way We Live and Breathe." Retrieved June 3, 2005 from: http://www.epa.gov/air/urbanair/co/index.html.
US Environmental Protection Agency. 2005. "PM – How Particulate Matter Affect the Way We Live and Breathe." Retrieved June 3, 2005 from: http://www.epa.gov/air/urbanair/pm/index.html.

[22] Union of Concerned Scientists. 1999. *Powerful Solutions: Seven Ways to Switch America to Renewable Electricity*. Retrieved September 15, 2004 from http://www.ucsusa.org/clean_energy/renewable_energy/page.cfm?pageID=98.
Environmental Protection Agency. 2004. "What are the Six Common Air Pollutants?" Retrieved September 15, 2004 from http://www.epa.gov/air/urbanair/6poll.html.

[23] Minnesotans for an Energy Efficient Economy. 2004. "How Polluting is Your Power: A Guide to Your Utility's Environmental Disclosure Brochure." Retrieved September 15, 2004 from http://www.me3.org/projects/costs/disclosureguide.html#11.

Section 5.1.5 Existing Conservation and Energy Efficiency Programs

As part of the Conservation Improvement Program (CIP) all of Minnesota's energy utilities are required to set aside a percentage of their revenues to be used in projects that will reduce electric and natural gas consumption. As part of this requirement all of the region's utilities put aside 1.5% of their revenues a year for their CIP conservation and energy efficiency programs. These funds are generally used to help customers buy energy efficiency products and processes.[24]

The followings have been implemented thus far:

- Public awareness and information about energy efficiency to customers and the general public.
- Energy audits for customers and work with them for efficient lighting and motor alternatives.
- Offering renewable energy alternatives including wind, biomass and solar.
- Cycled air conditioning program.
- Rebate for energy star appliances.
- Commercial high efficient motor rebate.
- Off-peak water program.
- Low income air conditioner tune up

More concrete examples of Minnesota Power's energy efficiency programs can be found at: http://www.mnpower.com/powergrant/profiles/index.htm.

Great River Energy and their member cooperatives spend more than $12.5 million a year on load management and energy conservation programs. Through the efforts of their 28 member cooperatives, Great River Energy saved more than 53 million kWh.[25] Their Energy Wise program provides energy saving tips and other useful information, and each of Great River Energy's member cooperatives also offer information targeted to their own customers. For instance, Lake Country Power Cooperative offers special rates for its heating and cooling load management programs in addition to rebates for Energy Star air conditioners, refrigerators, clothes washer and compact fluorescents.[26]

[24] State of Minnesota Office of the Legislative Auditor. 2005. *Energy Conservation Improvement Program.* Retrieved February 17, 2005 from: http://www.auditor.leg.state.mn.us/ped/pedrep/0504all.pdf

[25] More information about Great River Energy's Energy Wise Program is available at: http://www.greatriverenergy.com/environment/env_ew.html.

[26] Form more information about Lake Country's incentives please see: http://www.lakecountrypower.coop/energy/sell%20sheet%20pdfs/rates.pdf.

Section 5.1.6 Existing Renewable Energy Programs and Projects

Each of the major utilities in the region currently operates a green pricing program. Green pricing programs give utility customers the opportunity to purchase green power voluntarily from utilities.[27] Customers are allowed to purchase one or more blocks of green power (with an average household consumption rate of 700 kWh of electricity per month a customer would need to by 7 blocks to get all of the electricity from wind) up to a maximum of 20 blocks per month for a moderate surcharge.

Wind Sense is Minnesota Power's version of a green pricing program. Under the *Wind Sense* program, Minnesota Power purchases wind generated power from Great River Energy's Chandler Hills Wind Farm, which is then sold to customers for a $2.50 surcharge per 100 kWh block.[28]

Minnesota Power also has a solar rebate program call *Solar Sense*, which gives customers a $2,000 per kilowatt rebate up to a maximum of $4,000 for installing a grid-connected solar photovoltaic (PV) electric system.[29] Participants must be Minnesota Power customers and the solar electric system must be installed by December 31st, 2005.

In addition to *Wind Sense* and *Solar Sense*, Minnesota Power also issued a request for proposals as part of its CIP filing. This project seeks to provide limited financial incentives for the installation of two to three small-scale wind turbine projects within Minnesota Power's service territory. Proposals were due in March and the projects are slated to be complete by November 30th, 2005. The primary objectives of this funding project are to:

- Increase public awareness of the importance of efficient energy use and renewable energy technologies – specifically wind energy;
- Facilitate, through CIP funding grants, two to three public demonstrations of grid-connected, small-scale wind power technology (≤ 40 kW); and
- Encourage the development of real-life working examples of renewable, wind energy technology that reinforce the principals of math and science and that can be integrated into classroom discussions and other public educational opportunities.

[27] Minnesota Department of Commerce. 2004. *Green Power*. Retrieved March 8, 2005 from http://www.state.mn.us/mn/externalDocs/Green_Power_012703040626_GreenPower.pdf.

[28] Minnesota Power. 2004. *Wind Sense*. Retrieved February 3, 2005 from: http://www.mnpower.com/environment/windsense/

[29] More information about the program is available at: http://www.mnpower.com/environment/solar_sense/index.htm

The Wellspring Renewable Energy Program is Great River Energy's version of a green pricing program.[30] The wind energy for this program comes from nine large turbines at the Chandler Hills Wind Farm located at Buffalo Ridge, Minnesota, which generate six MW of electricity. Customers who choose to participate in this program may choose to buy wind energy in 100 kWh blocks for a nominal monthly fee.

The Hibbing and Virginia Public Utilities are working to develop a biomass combined heat and power facility on the Iron Range. The proposed plant would provide 35 MW of electricity (15 MW Virginia, 20 MW Hibbing), and would replace coal-based energy with energy production from short rotation woody crops, waste wood, and agricultural waste products.

Section 5.1.7 Transmission Constraints and Opportunities

A transmission constraint going up the North Shore toward Grand Marais has led Great River Energy to study the potential distributed generation alternatives along the north shore. At present it appears that GRE may issue a request for proposal for distributed generation alternatives along this corridor instead of upgrading or installing new lines.

The proposed coal gasification plant would also have an impact on transmission in the region as a new line may be built to get the energy from the Iron Range to the Twin Cities.

Section 5.2 Heat

In Minnesota, heat is one energy resource you can't forget; we use a lot of energy resources to keep our homes, buildings, and industries warm. By examining where this heat comes from, we are able to better understand the impacts of our heating fuel use and assess where we can best make an impact with conservation, energy efficiency, and switching from expensive natural gas to locally grown heating fuels.

[30] More information about the program is available at: http://www.greatriverenergy.com/environment/renewables_wind.html

Section 5.2.1 Heat Sources

There are seven primary fuels used for heating in Minnesota:

- Utility gas: Also known as natural gas. It is transported and distributed via pipeline (see Figure 8). Natural gas, or methane, is a colorless, shapeless, and odorless gas in its pure form. Heat from natural gas is extracted in combustion.
- Bottled, tank or liquefied petroleum (LP) gas: Also known as Propane. It is a colorless gas of mixed hydrocarbons that is a by-product of natural gas processing and petroleum refining. Propane can be delivered as a liquid making it easier to transport, and therefore making it a likely heating source in communities that are not connected to a utility natural gas pipeline.

Figure 8: Natural Gas Pipelines

- Electricity: Electric energy can be produced from a number of different energy sources (like coal, nuclear, hydropower, and wind). When using electricity for space (house) heating, there are several different options available. Forced-air systems are electric furnaces that deliver heated air by fans through a network of ducts. A heat pump can also be used in this type of system. Electric hydronic systems deliver heat by means of hot water, as water is boiled and then circulated throughout the house via radiators or baseboards. There are also combination electric systems such as wood-electric and oil-electric systems. As previously mentioned, heat pumps can also be used with electricity. Heat pumps work by transferring heat from one area to another. The most common types of pumps are air-source and ground-source heat pumps.
- Fuel oil/kerosene: Both fuel oil (#2 heating oil) and kerosene oil are organic compounds that are separated out during the petroleum refining process and can be used in residential heating.
- Coal or coke: Coal is a solid, readily combustible, fossil fuel that can be burned directly to produce heat in coal furnaces. There are several different kinds of coal that can be distinguished based on both their physical properties and heat

content (bituminous, anthracite, lignite, and subbituminous). Coke is a solid residue derived from low-sulfur bituminous coal ash.

- Wood: Wood is a form of biomass. Wood heating can be accomplished with fireplaces, airtight stoves, outdoor wood boilers or masonry heaters. Use of outdoor wood boilers is rising as they eliminate indoor air quality concerns, allow larger pieces of wood to be burned, and provide more even heating via a hydronic system. Another form of biomass heating fuel is agricultural residue, like corn stover, leaves and straw, which can also be burned to provide heat.
- Solar energy: Heating used in solar thermal applications is known as passive solar heating. Two primary elements of passive solar heating are required: south facing glass and a thermal mass to absorb, store, and distribute heat. If those two requirements are met there are three possible approaches to passive systems: direct gain, indirect gain, and isolated gain. The goal of all passive solar heating systems is to capture the sun's heat within the building's elements and release that heat during periods when the sun is not shining. At the same time that the building's elements (or materials) are absorbing heat for later use, solar heat is available for keeping the space comfortable (not overheated).

Section 5.2.2 Residential Heating Fuel Use

For home heating the primary fuel used in northeast Minnesota is utility gas, also known as natural gas, which supplies heat to 36% of the homes in the region (54,135 homes). Fuel oil is the next most widely used fuel (33,953 homes), followed by LP gas (28,433 homes) and electricity (15,877 homes). There are also homes using wood, coal and solar (Table 2).

Table 2: Northeast Region House Heating Fuel[31]

	Occupied Housing Units	Utility Gas	Bottled, tank or LP Gas	Electricity	Fuel Oil, Kerosene, etc	Coal or coke	Wood	Solar Energy	Other fuel	No fuel used
Aitkin	6,644	710	3,206	702	915	0	1,046	2	47	16
Carlton	12,064	4,080	2,511	1,416	3,001	0	981	4	39	32
Cook	2,350	48	1,005	552	393	0	344	0	8	0
Itasca	17,789	5,078	4,778	1,678	4,349	0	1,785	0	87	34
Kanabec	5,759	1,548	2,608	427	497	0	634	0	39	9
Koochiching	6,040	3,076	940	724	751	0	531	0	9	9
Lake	4,646	2,136	937	332	866	0	347	2	26	0
Pine	9,939	3,115	3,896	972	961	3	952	0	26	14
St. Louis	82,619	34,344	8,552	9,074	22,220	167	3,091	37	3,988	1,146
TOTALS	**147,850**	**54,135**	**28,433**	**15,877**	**33,953**	**170**	**9,711**	**45**	**4,269**	**1,260**

Section 5.2.3 Major Heating Fuel Users

Wood waste, natural gas and coal are the primary heating fuel sources used by industry. The major heating fuel users in the Northeast Region are highlighted in Table 3. The largest heating fuel users in the region are Northshore Mining Company, Sappi Cloquet LLC, Boise Cascade Corporation, and Blandin Paper Company. Northshore Mining's primary fuel is coal, while Sappi, Boise Cascade and Blandin Paper Company utilize wood waste as their primary fuel with natural gas as a secondary fuel.

Section 5.2.4 Environmental Impacts of Heating Fuel Use

Natural gas combustion emits fewer harmful byproducts than the combustion of other fossil fuels, but all of these fuels produce emissions, and therefore create negative environmental impacts. Natural gas, in comparison to coal, produces fewer carbon dioxide (CO_2) emissions, fewer particulate emissions, fewer sulfur dioxide (SO_2) emissions, and fewer nitrogen oxide (NO_x) emissions. This generally makes natural gas a preferred fuel over other fossil fuels (fuel oil and coal). In some instances, where particulate emissions are of particular concern (e.g., indoor air quality), natural gas may even be preferred over biomass, although biomass is considered a carbon neutral fuel, and may therefore be preferable from a climate change perspective. The primary drawback to utilizing natural gas is its price. Over the past few years, natural gas costs have continued to rise, making it a less cost-competitive fuel.

[31] U.S. Census Bureau, Census 2000 Summary File 3, Matrices H26, H27, H40, and H42. Tables QT-H8:Rooms, Bedrooms, and House Heating Fuel: 2000. Data retrieved August 10, 2004 from: www.factfinder.census.gov.

Table 3. Major Fuel Users by County and Amount of Fuel Used in 2001[32]

COUNTY	CITY	NAME	ADDRESS2	ZIP_CODE	NATURAL GAS	FUEL OIL	LPG/PROP	WOODWASTE	Coal	Coke	Total
					Million British Thermal Units Consumed in 2001						
Aitkin	Hill City	ISD 002 - Hill City School	500 Ione Ave	55748			3,729	1,331			5,060
Carlton	Cloquet	Alltrista Consumer Products Co	1800 Cloquet Ave	55720				178,472			178,472
Carlton	Cloquet	Sappi Cloquet LLC	2201 Ave B	55720	2,598,373	171,060		4,442,445			**7,211,878**
Carlton	Cloquet	USG Interiors Inc - Cloquet	35 Arch St	55720	1,887,521						**1,887,521**
Carlton	Moose Lake	MCF - Moose Lake	1000 Lakeshore Dr	55767	76,997						76,997
Carlton	Moose Lake	Mercy Hospital & Health Care Center	710 S Kenwood Ave	55767	12,696		111				12,807
Carlton	Wrenshall	Northern Natural Gas Co - Wrenshall LNG	2301 County Road 1	55797	9,488						9,488
Cook	Grand Marais	Grand Marais Public Utilities Commission	219 S 8th Ave W	55604		967					967
Cook	Grand Marais	Hedstrom Lumber Co Inc - Grand Marais	1504 Gunflint Trl	55604				102,400			**102,400**
Cook	Schroeder	Minnesota Power - Taconite Harbor Energy	8124 W Highway 61	55613		60,330			296,510		**356,841**
Itasca	Cohasset	Minnesota Power Inc - Boswell Energy Ctr	1210 3rd St NW	55721		91,397			72,074,171		**72,165,568**
Itasca	Grand Rapids	Blandin Paper/Rapids Energy Center	115 SW 1st St	55744	1,170,563			4,299,046	900,532		**6,370,142**
Itasca	Grand Rapids	ISD 318 - Grand Rapids High School	800 Conifer Dr NW	55744	14,916	13,869					28,785
Itasca	Grand Rapids	Itasca Community College	1851 E Highway 169	55744	7,916			911			8,827
Itasca	Grand Rapids	Potlatch - Grand Rapids	502 County Road 63	55744	394,752			725,952			1,120,704
Itasca	Keewatin	Keewatin Taconite Operations	1 Mine Rd	55753		186,594					186,594
Itasca	Marcell	Valley Forest Resources Inc	49554 State Highway 38	56657				3,251			3,251
Kanabec	Mora	Engineered Polymers Corp	1020 E Maple Ave	55051	13,333						**13,333**
Kanabec	Mora	Kanabec Hospital	300 Clark St	55051	14,515	313					**14,829**
Kanabec	Mora	Mora Municipal Utilities	16 Lake St N	55051	21						21
Kanabec	Ogilvie	Hi-Tek Rubber Inc - Ogilvie	200 W Bragg St	56358	3,002						3,002
Koochiching	International Falls	Boise Cascade Corp - International Falls	400 2nd St	56649	3,899,615			2,711,654			**6,611,270**
Koochiching	International Falls	International Bildrite Inc	101 E 4th St	56649	237,725						**237,725**
Koochiching	International Falls	Northern MN Paving Inc	PO Box 311	56649			4,110				4,110
Lake	Silver Bay	Northshore Mining Co - Silver Bay	10 Outer Dr	55614	163,329	2,161			8,224,358		**8,389,847**
Lake	Two Harbors	Louisiana-Pacific Corp - Two Harbors	711 25th Ave	55616	142,532	183		224,678			**367,393**
Lake	Two Harbors	USS Great Lakes Fleet Inc Two Harbors	Foot of Waterfront Dr	55616		1,840					1,840
Pine	Hinckley	Grand Casino Hinckley	777 Lady Luck Dr	55037	360						**360**
Pine	Pine City	DecisionOne Corp - Pine City	400 2nd St SE	55063	226						**226**
St. Louis	Aurora	Minnesota Power Inc - Laskin Energy Ctr	County Road 633	55705		15,563			7,687,196		**7,702,760**
St. Louis	Babbitt	ISD 2142 - John F Kennedy High School	30 South Dr	55706		17,533	79				17,612
St. Louis	Babbitt	Northshore Mining Co - Babbitt	7 mi E Babbit, County Rd 70	55706		12,574					12,574
St. Louis	Chisholm	Northwest Airlines - Iron Range	Iron Range Reservation Ctr	55719	2,488						2,488
St. Louis	Cook	Hill Wood Products	9483 Ashawa Rd	55723				13,965			13,965
St. Louis	Cook	ISD 2142 - Cook High School	306 E Vermilion Blvd	55723			181		7,898		8,079
St. Louis	Cook	Potlatch - Cook	9358 Highway 53	55723			151,360	1,297,518			1,448,879
St. Louis	Cotton	ISD 2142 - Cotton High School	9165 Highway 53	55724			150		3,630		3,780
St. Louis	Duluth	College of St Scholastica	1200 Kenwood Ave	55811	61,289	14,544					75,833
St. Louis	Duluth	Duluth Air National Guard Base	4680 Viper St	55811	40,349	698	132				41,178
St. Louis	Duluth	Duluth Entertainment & Convention Center	350 Harbor Dr	55802	29,812	721					30,533
St. Louis	Duluth	Duluth International Airport (DAA)	4701 Grinden Dr	55811	93	530					622
St. Louis	Duluth	Duluth Steam Cooperative Association	1 Lake Place Dr	55802	7,916	1,906			1,198,459		1,208,280
St. Louis	Duluth	Georgia-Pacific - Duluth Hardboard	1220 W Railroad St	55802	60,189	256,509		240,986			557,684
St. Louis	Duluth	Maney International of Duluth Inc	3204 Carlton St	55806	21						21
St. Louis	Duluth	ME Global Inc	200 E Carterett St	55808	84,707						84,707
St. Louis	Duluth	Minnesota Power Inc - ML Hibbard	4913 Main St	55807	68,598			3,204,621	1,094,281		**4,367,500**
St. Louis	Duluth	Northwest Airlines - Airbus Maintenance	4600 Stebner Rd	55803	25,350						25,350
St. Louis	Duluth	St Mary's Medical Center	407 E 3rd St	55805	13,487	2,771					16,258
St. Louis	Duluth	University of Minnesota - Duluth	223 College St	55812	252,580	6,945					259,525
St. Louis	Duluth	Western Lake Superior Sanitary District	2626 Courtland St	55806	2,827	2,288			262,763		267,878
St. Louis	Ely	ISD 696 - Ely	600 E Harvey St	55731			14,372				14,372
St. Louis	Eveleth	EVTAC Mining - Mine	8 Fayal Rd	55734	15,626	4,460	9,748				29,834
St. Louis	Eveleth	ISD 2154 - Eveleth-Gilbert High School	801 Jones St	55734	29,668						29,668
St. Louis	Eveleth	OSI Environmental Inc - Eveleth	14 County Highway 101	55734	10	2,453					2,464
St. Louis	Forbes	United Taconite LLC - Fairlane Plant	Highway 16	55738	116,699	8,124				1,603,096	1,727,919
St. Louis	Hibbing	Hibbing Public Utilities Commission	1832 6th Ave E	55746	1,789				1,166,428		1,168,217
St. Louis	Hibbing	Hibbing Taconite Co	Highway 5 N	55746		20,058					20,058
St. Louis	Hoyt Lakes	Cliffs Erie - Hoyt Lakes Plant	County Road 666	55750	92,818						92,818
St. Louis	Iron	ISD 2142 - Cherry High School	3943 Tamminen Rd	55751			765		3,322		4,087
St. Louis	Mountain Iron	US Steel Corp - Minntac	8819 Old Highway 169	55768	485,833	331,669		822,720	854,394		2,494,615
St. Louis	Orr	ISD 2142 - Orr High School	10690 Highway 23	55771			332		2,794		3,126
St. Louis	Saginaw	ISD 2142 - Albrook High School	7427 Seville Rd	55779			124		4,884		5,008
St. Louis	Virginia	City of Virginia Dept Public Utilities	620 S 2nd St	55792	160,810				1,580,185		1,740,995
St. Louis	Virginia	Ispat Inland Mining Co	5950 Old Highway 53 N	55792		405					405
St. Louis	Virginia	Virginia Regional Medical Center	901 9th St N	55792	42,148						42,148

[32] Source: PCA Boiler and Fuel Use database. Consolidated by: Shalini Gupta, ME3 gupta@me3.org

Section 5.3 Transportation

Although most of the focus of CERTs is on electricity and heating, the Northeast CERT is also interested in energy usage for transportation. Fuel use for transportation, and specifically petroleum use, is a critical component of regional energy use. Indeed in 2000, over 40% of Minnesota's total energy resources came from petroleum.[33] Petroleum usage has an important bearing on local environmental quality (air emissions), economics (rising fuel costs), and self-sustainability (no local oil). These factors combine to make transportation a critical regional issue and one the team will continue to address over the next two years.

Section 5.3.1 Vehicles in Region

To better understand the amount of fuel used in each region, data from the Department of Public Safety was used to identify the number and type of vehicles used in each county (Table 4). Per county vehicle information is combined with per vehicle consumption information to calculate overall gallons of fuel consumption by vehicles. While only approximations, these numbers offer a low-end estimate of fuel usage in the region.

The Northeast Region is home to a total of 338,751 vehicles. This number is unevenly distributed in the region. St. Louis County accounts for 51% of the total vehicles in the region, followed by Itasca County with 13% of the total and all remaining counties with less than 10% each.

Additionally, by assessing the number and type of vehicles in the region, the team was better able to target various vehicles for greater use of alternative fuels, such as greater market penetration of E85 vehicles, and fleet conversions, such as for the Duluth Bus Fleet and area school fleets to biodiesel. This will be discussed further in Section 6.

[33] US Energy Information Administration: www.eia.doe.gov/emeu/states/.

Table 4: Minnesota Department of Public Safety 2003 Motor Vehicle County Summary[34]

County	Passenger	Pick up Truck	Bus	Other Truck	Motor-cycle	Recreational Vehicle	Moped	Van	State Own Tax Exempt	Tax Exempt	No Registration	County Total
Aitkin	9,852	5,243	14	1,014	481	300	19	0	1	211	0	17,135
Carlton	19,147	8,071	37	1,226	1,133	566	28	0	39	239	0	30,486
Cook	2,981	1,646	6	276	159	77	6	0	0	109	0	5,260
Itasca	25,897	13,152	64	1,860	1,478	922	37	0	32	501	0	43,943
Kanabec	9,270	4,237	8	832	573	219	13	0	1	119	0	15,272
Koochiching	7,508	4,553	29	677	387	190	10	0	4	235	0	13,593
Lake	6,577	3,232	0	404	346	207	12	0	3	182	0	10,963
Pine	16,425	7,654	44	1,538	916	386	24	0	15	222	0	27,224
St. Louis	114,454	43,176	206	5,652	6,198	2,504	219	0	109	2,357	0	174,875
Total Vehicles	**212,111**	**90,964**	**408**	**13,479**	**11,671**	**5,071**	**368**	**0**	**204**	**4,175**	**0**	**338,751**
Gallons per Vehicle	*544*	*677*	*1,473*		*46*							
Total Gallons	***115,388,384***	***61,582,628***	***600,984***		***536,866***							***178,108,862***

Section 5.3.2 Public Transportation in the Region

Nearly all of the counties in the region have some form of public transportation system with the exception of Kanabec (Table 5).[35]

In addition to those listed by county, the services of Duluth Transit Authority (DTA) are concentrated around Duluth, Minnesota, Proctor, Minnesota, and Superior, Wisconsin. Apart from its regular service, DTA also provides dial-a-ride for qualified disabled persons. The Hibbing Heartland express operates in the City of Hibbing. Like the DTA, Hibbing Heartland also provides dial-a-ride service. CERT members note that besides public transportation, people in the region could also take advantage of carpooling, park & rides, and biking. There are a multitude of bike trails throughout the region, and in the Duluth area there is a major effort to connect the Munger Trail with the city's Lakewalk as a potential commuter alternative.

[34] Bus is the total of all bus categories: Duluth Bus, Bus, Class 2 City Bus, Intercity Bus, and School Bus. Bus and School Bus categories are largest subcategories and determine overall number. Other truck is the total of all non-pick up trucks, included categories: Farm Truck, Urban Truck, Prorate Truck, Comm'l Zone Truck, Commercial Truck, Prorate Foreign Truck; Farm, Prorate, and Commercial trucks are largest subcategories. All Trailers were removed from the list as none of the trailers are self-powered. Fuel consumption is via another vehicle that tows the trailers. Street Rod, Pioneer, Classic, Collector and Motorcycle (Classic) categories were all removed. Each of these is a type of collector vehicle that drives limited numbers of miles and cannot function as a regular use vehicle. Gallons of fuel are calculated based on Energy Information Administration, "Annual Energy Review", Table 2.9 Motor Vehicle Mileage, Fuel Consumption, and Fuel Rates, 1949-2001, p 61. Retrieved 8/11/04 from http://www.eia.doe.gov/emeu/aer/pdf/03842002.pdf. The calculations employ 2001 data.

[35] Note: Some of the counties are served by transit agencies in adjoining counties.
Source: http://www.apta.com/links/state_local/mn.cfm#A2

Table 5: Northeast Minnesota Public Transit

County	Public Transport
Aitkin	Arrowhead Transit
Carlton	Arrowhead Transit
Cook	Arrowhead Transit Grand Portage-Isle Royal Transportation Line
Itasca	Arrowhead Transit
Kanabec	None
Koochiching	Arrowhead Transit
Lake	Arrowhead Transit
Pine	Pine Citizens Committee on Aging
Saint Louis	Arrowhead Transit Friends for Transit Greyhound Lines Inc. Hibbing Heartland Express

Section 5.3.3 Major Highways, Railways, Airports

There are several major roadways running through the Northeast Region. Running north-south through the region are Interstate 35, US Highways 53, 169, and 71. Running east-west through the region is US Highway 2.

There are 2 commercial airports, 11 public airports, and 8 seaplane bases.[36] The two commercial airports are the Duluth International Airport and the International Falls International Airport. Public airports include Aitkin Municipal Airport, Cloquet Airport, Duluth Sky Harbor, Ely Municipal Airport, Eveleth-Virginia Municipal Airport, Grand Marais Airport, Grand Rapids Airport, Hibbing-Chisholm Municipal Airport, Moose Lake Airport, Tower Municipal Airport, and Two Harbors- Richard Helgeson Airport. The eight seaplane bases include Duluth- North Country Seaplane Base, Duluth – Sky Harbor Seaplane Base, Ely Custom Doc Seaplane Base, Eveleth- Sky Harbor seaplane Base, Grand Marais Seaplane Base, Grand Rapids Seaplane Base, International Falls Seaplane Base, and Tower Seaplane Base. While not a focal point of Northeast CERT activities, air travel consumes large amounts of petroleum fuel. Airport facilities are also major electric consumers, and given their captive audience, have the ability to make high profile energy improvements. One organization that has been helping airports move toward greater efficiency and sustainability is the Clean

[36] http://www.dot.state.mn.us/aero/avoffice/ops/airdir/airports.html

Airport Partnership.[37] Clean Airport Partnership is a non-profit that focuses on both energy efficiency and the greater use of Alternative Fuel Vehicles on airport grounds. In the future it may also be possible that local and regional airports could shift to partial bio-based blends of fuels for planes.

There are 7 different railroads that crisscross the region (Figure 9, Minnesota Railroad Map).[38] LTV Steel Mining (ZLTV) line runs west-east from St. Louis County, across Lake County and ends in Cook County. The Northshore Mining (NSM) line runs north-south through St. Louis County and ends up in Lake County. The Duluth Mesabe and Iron Range (DMIR) line also runs north-south through St. Louis county with terminus points in both St. Louis County and Lake County. The Duluth Winnipeg and Pacific (DWP) line starts in Canada and runs north-south through Koochiching County and across St Louis County. Saint Louis and Lake County Railroad (SLLX) line runs along the southern boarders of St. Louis and Lake counties. The Burlington Northern Santa Fe (BNSF) lines run out of Duluth and across the state in a variety of directions. St. Croix Valley Railroad (SCXY) lines run from Kanabec and Chisago counties in the south and join the southern BNSF line.

As with highways, railroads are a crucial part of the region's infrastructure and may benefit from efficiency upgrades and conversion to renewables such as biodiesel. For example, the Minnesota Prairie Line Railroad is currently pioneering the use of biodiesel in its locomotives. In October 2004, Minnesota Prairie Line Railroad became the first railroad in the country to power its locomotives with a 2% blend of biodiesel. Union Pacific Railroad is also piloting a diesel-electric hybrid locomotive in California. The hybrid locomotive is expected to emit far fewer pollutants and use 40-70% less diesel fuel than its purely diesel counterparts.[39]

[37] More information about the Clean Airport Partnership can be found at www.cleanairports.com.
[38] http://www.dot.state.mn.us/ofrw/maps/statemap.pdf
[39] Thermos, Wendy and Deborah Schoch. 16 March 2005. "New Hybrid Locomotive's Emissions are Clean as a Whistle," *Los Angles Times*.

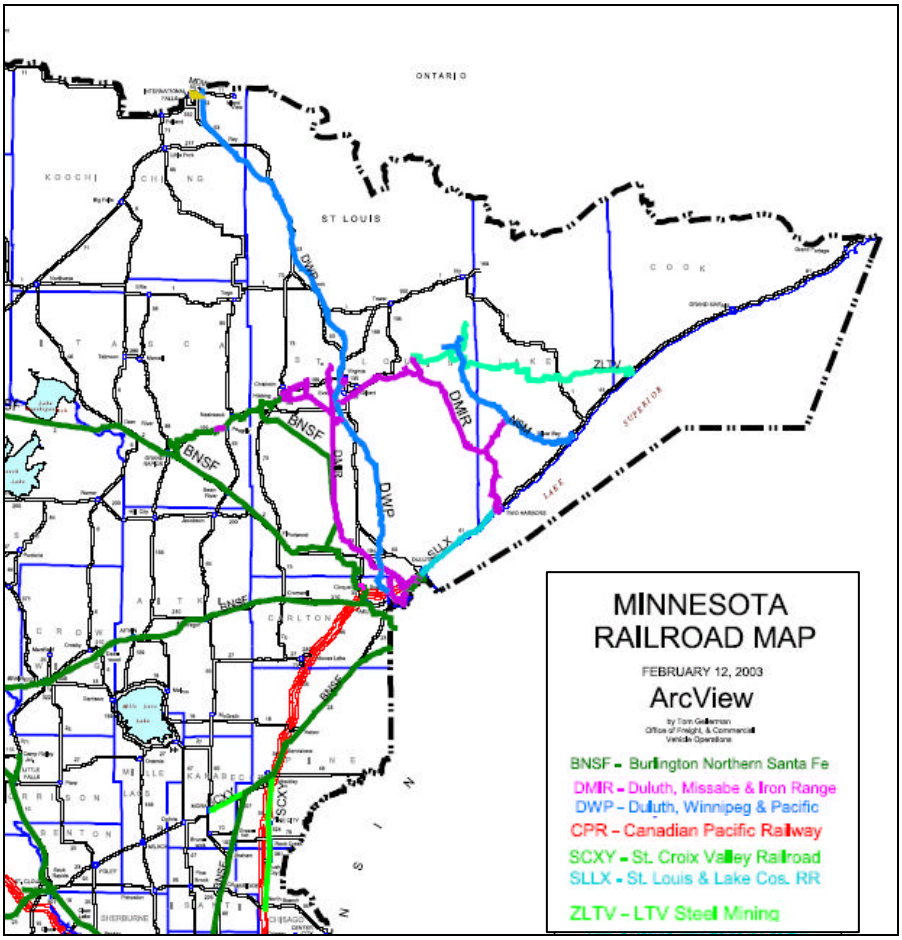

Figure 9. Northeast Minnesota Railroad Map

Section 5.3.4 Marine Fuel Usage and Concerns

The Northeast Region is unique in the state because of its heavy marine activity along Lake Superior, especially in the Duluth area, where port activity is high. Shipping and its associated activities add around $210 million annually to the Duluth area economy according to the Duluth Seaway Port Authority.[40] However, emissions can make ports centers of urban pollution. Water quality can be impacted when incomplete combustion in two-stroke boat engines sends gasoline and diesel directly into water. Moreover, unlike standard road diesel, marine diesel is largely unregulated. According to Minnesota Pollution Control Agency's (MPCA) 1999 Air Emissions Inventory, marine sources emit an estimated 136,657 pounds of particulate matter into Minnesota's air each year.[41]

[40] Moore, Anne Perry. Minnesota Environment Magazine, Winter 2005 Issue. "Harboring Pollution," Minnesota Pollution Control Agency. Retrieved May 18, 2005, from: http://www.pca.state.mn.us/publications/mnenvironment/winter2005/harbor.html.
[41] Ibid.

Recently, there has been a national shift to help keep port environments clean, much of it by enacting the following measures:

- Dockside electric power so ships can switch off their diesel engines while at rest
- Financial incentives for ships using cleaner-burning diesel fuels
- Alternative fuels for vehicles delivering cargo to ports
- Installation of diesel pollution control devices[42]

As part of its efforts to regulate non-road diesel emissions, the Environmental Protection Agency (EPA) issued new requirements in May 2004 for boats and ships using diesel. These requirements include mandatory use of low-sulfur diesel fuel and tougher emission standards for all new commercial, recreational and auxiliary marine diesel engines.[43]

Section 5.3.5 Estimated Amount of Consumption

It is difficult to obtain exact statistics for fuel use from each of the individual motor vehicle categories, however the Energy Information Administration does provide fuel consumption (gallons per vehicle) estimates for passenger cars, pickup trucks, and other trucks. Combined these three categories account for over 178 million gallons of fuel consumption in the Northeast Region. Passenger vehicles alone consume over 115 million gallons. Bus, recreational vehicle and tax-exempt vehicle were not quantified, but would surely push the number of gallons of fuel consumed much higher.

At this time, we have not been able to assess fuel use associated with rail, air and barge traffic.

Section 5.3.6 Origin of Fuels

Since Minnesota has no petroleum reserves, all of the transportation fuels used in the state, other than ethanol and biodiesel, are imported into Minnesota from out-of-state sources. Shifting to greater percentages of Minnesota-produced fuels (ethanol and biodiesel), while also increasing the efficiency of our transportation operations, would allow Minnesotan's to keep more of their energy dollars local. As energy dollars remain in communities, positive economic impacts are experienced. The positive economic impacts occur when these dollars eventually circulate through local economies, a phenomenon known as the multiplier effect.

[42] Ibid.
[43] Ibid.

Section 5.4 Agricultural Energy Use

Agriculture is both a user of energy and producer of energy. Section 6 of this report will touch on the many ways in which agriculture is a producer of energy, but this section tries to better understand how much energy actually goes into growing crops in the Northeast Region.

Section 5.4.1 Snapshot of Agriculture in the Northeast

The major crops grown in the region are corn, soybeans and hay, with hay by far the most dominant crop. The region also raises dairy cows, beef cows, and to a lesser extent, hogs (Table 6).

Table 6. Northeast Minnesota Agricultural Numbers, 2003[44]

COUNTY	NUMBER FARMS	ACRES IN FARMS	CORN ACRES 2003	SOYBEAN ACRES 2003	HAY ACRES 2003	DAIRY COWS 2003	BEEF COWS 2003	BEEF FINISH 2004	TOTAL HOGS 2003	FAR. HOGS 2003
Aitkin	674	174,364	1,400	3,800	52,000	800	6,600			
Carlton	607	114,291	1,600		37,000	1,900	4,000			
Cook	20	3,269					100			
Itasca	494	120,176			32,000	300	4,600			
Kanabec	796	158,736	16,500	9,900	35,000	2,500	8,000	1,700	5,100	1,300
Koochiching	258	74,318		1,700	20,900	300	3,000			
Lake	46	4,807					200			
Pine	1,199	254,858	19,700	10,600	60,000	6,200	9,700	900		
St. Louis	978	175,076			61,100	1,100	5,700			
TOTAL	**5,072**	**1,079,895**	**39,200**	**16,100**	**298,000**	**13,100**	**41,900**	**2,600**	**5,100**	**1,300**

Section 5.4.2 Estimate of Energy Use for crops/livestock

All of the crops and livestock grown in the region require energy inputs. To understand how much energy they required the team used per acre fuel consumption estimates for diesel, gasoline, liquid petroleum (LP), electricity, and natural gas.[45] These calculations show that electricity, diesel and natural gas are the major agricultural inputs in the region (Tables 7 and 8). Despite the fact that there are over 7 ½ times more acres of hay than corn produced in northeast Minnesota, the per acre inputs

[44] Acres of corn (http://www.nass.usda.gov/mn/Agstat04/p034035.pdf, planted acres)
Acres of soybeans (http://www.nass.usda.gov/mn/Agstat04/p038039.pdf, planted acres)
Acres of hay (http://www.nass.usda.gov/mn/Agstat04/p046047.pdf, harvested hay)
Number of milk/dairy cows and beef cows (http://www.nass.usda.gov/mn/Agstat04/p074075.pdf)
Number of hogs and annual farrowings (http://www.nass.usda.gov/mn/Agstat04/p078079.pdf)

[45] Tiffany, Douglas. "Minnesota Farm Energy Use and Kyoto Accord." Calculations are based on gallons of diesel per acre, gallons of gasoline per acre, gallons of LP per acre, kWh of electricity per acre and Mcf natural gas per acre.

demonstrate that corn is a far more energy-intensive crop to cultivate. Similarly, in evaluating livestock, it is clear that dairy cows are more energy-intensive than other livestock raised in the region.

Table 7: Northeast Agricultural Energy Use for Crops

CROP	ACRES	DIESEL	GASOLINE	LP	ELECTRICITY	NATURAL GAS
		Acres X 9.37	Acres x 1.15	Acres x 9.58	Acres x 35.63	Acres x 3.945
CORN	39,200	367,304	45,080	375,536	1,396,696	154,644
		Acres X 7.43	Acres X .91	Acres X .75	Acres X 27.50	Acres X .199
SOYBENS	16,100	119,623	14,651	12,075	573,643	63,515
		Acres X 9.80	Acres X .81	Acres X 0.0	Acres X 37.23	Acres X 0.719
ALFALFA/HAY	298,000	2,920,400	241,380	0	11,094,540	214,262

Table 8: Northeast Agricultural Energy Use for Livestock

LIVESTOCK	NUMBER of ANIMALS	DIESEL	GAS	LP	ELECTRICITY
		Cows X 34.5	Cows X 3	Cows X 16.50	Cows X 600
DAIRY COWS (HD)	13,100	451,950	39,300	216,150	7,860,000
		Hog Litters X 9.55	Hog Litters X 1.11	Hog Litters X 4.06	Hog Litters X 148.25
HOGS FARROW (LIT)	1,300	12,415	1,443	5,278	192,725
		Hogs X 1.11	Hogs X .11	Hogs X .34	Hogs X 12.38
HOGS FINISH (HD)	5,100	5,661	561	1,734	63,138
		Beef Cows X 6.37	Beef Cows X .74	Beef Cows X 1.62	Beef Cows X 59.25
BEEF COWS (HD)	41,900	266,903	31,006	67,878	2,482,575
		Beef Finish X 4.78	Beef Finish X .46	Beef Finish X 1.08	Beef Finish X 39.38
BEEF FINISH (HD)	2,600	12,428	1,196	2,808	102,388

Section 5.4.3 Opportunities for Conservation and Energy Efficiency on Harvested Lands

Agricultural energy efficiency has improved since the mid-1970s, but numerous opportunities and methods are available to further improve agricultural efficiency. Mechanical advancements, such as more efficient pumps and motors and use of diesel rather than gasoline-powered tractors, offer great opportunities. Livestock operations can see major benefits from making their buildings more efficient with the conversion to more energy-efficient lighting, heating and cooling systems. Efficiency can also be improved by ensuring that all equipment is properly maintained.

Precision farming could help minimize waste, increase outputs and minimize environmental impacts often associated with the over-application of chemicals because it tailors field management to site specific conditions rather than a whole field average.[46] Conservation tillage practices may offer the greatest room for improvement. Conservation tillage allows plant residue or stubble to remain on the surface of the field, rather than be plowed into the soil. No-till practices that leave the prior year's entire crop residue on the field can save the equivalent of 3.5 gallons of diesel fuel per acre when compared to conventional tillage methods. Mulch till, which leaves some material and breaks up the soil, would still result in savings of 2.5 gallons of diesel fuel per acre when compared to conventional methods.[47]

Farmers are also well equipped to substitute renewable fuels and supplies into their energy mix. Some changes are ones that farmers could literally make today, such as using biofuel substitutes like E-85 and biodiesel instead of gasoline and diesel in on-farm vehicles, trucks and tractors.

Wind energy presents farmers with a means of offsetting their own electricity use, while at the same time developing an additional revenue stream on their lands. Biogas from anaerobic digestions is a way that dairy farmers can either offset their heating fuel needs or, if paired with a generator, offset some of their electric requirements. Biomass from perennials or agricultural residues is another potential feedstock for heating, electricity, and ethanol. Solar technologies, such as solar water heating could cut down heating needs in barns by supplying pre-heated water.

[46] Ryan, Barry and Douglas G. Tiffany. 1998. *Minnesota Agricultural Energy Use and the Incidence of a Carbon Tax*. Retrieved on April 24, 2005 from http://www.apec.umn.edu/staff/dtiffany/ILSRcarbontax.pdf.
[47] Ibid, p.37-38.

SECTION 6: REGIONAL RESOURCE INVENTORY AND ASSESSMENT

Section 6.1 Conservation

Minnesota could reduce future energy consumption by 28% through aggressively implementing energy efficiency programs.[48] Not only would energy efficiency help cut consumption, it would also put energy dollars back into our communities. As a general rule of thumb, every $1 spent on energy efficiency yields a $3 economic return. These two factors combined, make conservation and energy efficiency the best, most cost-effective place to start.

6.1.1 Existing Model of Efficiency and Conservation

A great place to initiate energy efficiency and conservation activities is in schools. Northeast CERT is already focusing energy efficiency and renewable energy projects at schools, along with energy conservation, efficiency and renewable energy curriculum. Schools that have installed new energy management systems are finding that it saves them money through reduced energy costs, while also helping students feel and learn better. They've also found that along with physical modifications to the school, implementing educational programs that inform administrators, teachers and students about energy efficiency encourages behavioral changes that add up to real savings.

There are several programs in the state from which schools can choose. The Schools for Energy Efficiency (SEE) Program provides schools with the tools to save energy and money through promoting, communicating, and implementing energy-efficient strategies throughout their facilities. This program, implemented by Hallberg Engineering, is currently working with several Minnesota school districts to help them achieve a 10% reduction in annual energy use and an ENERGY STAR® rating from the US Department of Energy.[49] Beyond installing new energy management systems, schools in the SEE program receive a classroom visit from the Energy Hog, who tells the students that they have the "pester power" to help adults at school or at home to change their ways.

Another school program is the Academy of Energy Education, sponsored by the National Energy Foundation and Johnson Controls. This program pairs energy curriculum with energy performance improvements from Johnson Controls. The

[48] Environmental Law and Policy Center. *Repowering the Midwest.* Chicago: 2001.
[49] Information about Schools for Energy Efficiency (SEE) was found at: http://www.energysmartschools.gov/sectors/SectorPages/PartnershipView.asp?MktID=2&OrganizationID=3074. Retrieved May 25, 2005.

curriculum is divided into age groups, and combines the study of science, energy, and math with real-world, hands-on experiences:

- Energy Fun (K-3**)** - Allows students to have fun while learning about energy.
- Energy Fundamentals (4-6) - Teaches older students important fundamental energy concepts.
- Energy Action Patrol (5-7) - Encourages students to apply energy efficiency concepts in their homes, school, and communities.
- Energy Action Teams (6-9) - Lets young adults work in groups and apply energy concepts in preparing a school energy efficiency policy.
- Energy Action Technology (9-12) - Focuses on energy technology and incorporates school-to-work and high school-to-college transition programs.[50]

Besides school-based programs there are numerous other efficiency models available. The "Change a Light, Change the World Regional Campaign" is a consumer awareness campaign that promotes ENERGY STAR® qualified compact fluorescent light bulbs (CFLs).[51] The program, offered every fall, collaborates with utilities and hardware stores throughout Minnesota (and four neighboring states) to provide discounted CFLs (generally a $2 instant rebate). During 2004 the "Change a Light, Change the World" program facilitated the purchase of 305,441 ENERGY STAR® qualified CFLs in a five state area that will result in savings of 141,113,742 kWh over the life of the CFLs.[52] In Minnesota, the program sold 50,510 CFLs for a total lifetime savings of 23,336,082 kWh.[53] To put this in context, if every American home replaced their five most-used lights that have incandescent bulbs with compact fluorescents lights, each family would save around $60 annually in energy costs and together would keep more than one trillion tons of greenhouse gases out of the air. That amounts to $6 billion in energy savings for Americans and is equal to the annual output of 21 power plants.[54] That is tremendous savings from a relatively simply act.

Another possible model is performance contracting. Performance contracting is an alternative way to finance energy efficiency improvements by allowing a business to pay off the project costs with money saved from efficiency improvements. Performance contracting entails a business hiring an energy service company (ESCO) to conduct an energy audit, determine the business' potential for energy savings, and then make

[50] Information about the National Energy Foundation can be found at: http://www.academyofenergy.org/intro.html. Retrieved May 25, 2005.
[51] For more information, visit the Midwest Energy Efficiency Alliance 2004 Summary Report at: http://www.mwalliance.org/programs/changealight/CAL04FinalReport.pdf. Referenced May 16, 2005.
[52] Midwest Energy Efficiency Alliance 2004 Summary Report, page 3: http://www.mwalliance.org/programs/changealight/CAL04FinalReport.pdf. Referenced May 16, 2005.
[53] Ibid.
[54] Retrieved March 30, 2005, from: http://www.energystar.gov/index.cfm?c=lighting.pr_lighting.

recommendations for improvements. These improvements, when implemented, are intended to save enough money in energy spending to pay for all improvements over the life of the contract (generally around 10 years).[55]

6.1.2 Potential for Energy Efficiency and Conservation Improvements

There is potential for improved energy efficiency and conservation in nearly every sector of a community. The residential sector is a simple and logical place for individuals to start. Homeowners can replace incandescent bulbs with compact fluorescents, they can buy energy efficient appliances, they can make sure their homes are well insulated, and they can avoid doing non-essential chores during peak load hours. On the commercial front, many facilities could improve efficiency by simply upgrading their lighting fixtures to more efficient systems. Industrial users have myriad ways to improve efficiency from lighting to motors to occupancy sensors.

The Minnesota Power Website "Energy Efficiency Tips & Tools" has several energy calculators available for use, including the Home Energy Saver Calculator, the ENERGY STAR® Home Improvement Calculator and the U.S. DOE Energy Cost Calculator.[56] It also provides links to Business Energy Audits, In-Home Electric Energy Analysis, Minnesota Department of Commerce Energy Tips and ENERGY STAR® Home Improvement Tips.

Minnesota Power, along with Western Lake Superior Sanitary District, City of Duluth, Cities for Climate Protection and Daugherty Hardware, were finalists in the 2005 Minnesota Environmental Initiative Awards under the subject of "Energy."[57] Their program, the Cool Change Turn In Event, helped raise awareness for the energy, environmental and money-saving benefits of properly recycling and replacing existing dehumidifiers and room air conditioners with ENERGY STAR® qualified dehumidifiers and room air conditioners. To demonstrate this, a two-day dehumidifier/room air conditioner turn-in event was held at Daugherty Hardware in Duluth. Minnesota residents turned in old, working dehumidifiers and room air conditioners to receive an instant rebate on the purchase a new ENERGY STAR® qualified room air conditioners or dehumidifiers. First-year electrical savings totaled 90,504 kilowatt hours, enough electricity to power nine homes for one year; the avoided electric use would remove 217,210 pounds of carbon dioxide from the atmosphere.

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[55] Donahue, Patricia. 2000. "Energy Performance Contracting". Retrieved May 6, 2005 from: http://www.energyusernews.com/CDA/Article_Information/Fundamentals_Item/0%2C2637%2C8260%2C00.html.

[56] Minnesota Power website, "Energy Efficiency Tips & Tools." Retrieved on May 20, 2005, from: http://www.mnpower.com/energy_tips/index.htm.

[57] For more information, please visit the Minnesota Environmental Initiative website at: http://www.mn-ei.org/awards/finalistswinners.html . Retrieved June 9, 2005.

Great River Energy's "Energy Wise" program assists customers in connecting with the conservation programs available from the cooperative in their area, as well as providing links to its energy conservation grants and rebates. Great River Energy's Energy Wise program cites the following achievements:[58]

- About 15 percent of Great River Energy's cooperative members are enrolled in a cycled air conditioning program to help reduce electricity demand when temperatures and humidity levels are high. This can reduce Great River Energy's summer peak demand by 250 MW, or enough to power 250,000 homes.
- More than 3,200 homeowners participated in Great River Energy's ENERGY STAR® air conditioner rebate program in 2002. Great River Energy member cooperatives offer a $200 rebate to encourage customers to install high-efficiency central air conditioner units.
- In 2002, Great River Energy increased cycled air conditioning installations by 4.2 percent, or 3,400 installations. More than 85,000 cooperative members participate in the cycled air conditioning program. Together, these consumers reduce Great River Energy's critical summer peaks by approximately 85 MW.
- The ENERGY STAR® High Efficiency Air Conditioning Program provided rebates to more than 3,200 homeowners. ENERGY STAR® air conditioners lower customer energy bills by saving energy and help lower Great River Energy's costs by reducing summer peaks.

[58] For more information, please see Great River Energy's website at: http://www.greatriverenergy.com/environment/env_ew.html.

6.1.3 Opportunities for Energy Efficiency Projects

There is tremendous opportunity for efficiency and conservation improvements. As mentioned above, opportunities include improvements in schools and local government buildings, upgrading lighting improvements in commercial buildings, increasing the use of ENERGY STAR® appliances in the region, and targeting a few industrial users or public projects like hospitals for upgrades and more energy efficient building design.

Northeast CERT is working with several schools, including Proctor Public Schools and the North Shore Community School, who are already ahead of the curve in implementing systematic energy efficiency upgrades in their buildings. These schools are now moving towards renewable energy as the next step. There is, however, still much that can be done at schools across the state to bring energy related curriculum to students. Some examples include selling compact florescent light bulbs as fundraisers and assigning home energy audits as homework assignments.

Beyond schools, the Center for Energy and Environment (CEE) runs a model lighting program for commercial and business customers. The CEE program partners with local utilities and community groups to orchestrate daylong events that help local businesses replace their inefficient lighting systems with more energy efficient alternatives. Businesses are able to pay for the new lighting by combining cost savings on their utility bills with Conservation Improvement Program (CIP) dollars from the local utility. This model is currently being used by Southeast CERT in Winona, but could easily be mimicked in the Northeast Region.

Section 6.2 Wind

The wind energy industry continues to grow throughout Minnesota and the rest of the United States. Technologically, the industry continues to advance making ever-larger turbines that can capture more wind energy at lower wind speeds. For example, Lac Qui Parle Valley High School erected a 225 kW wind turbine in 1997; today it is hard to find a turbine this size, with most of the large turbines sized at 1.65 megawatts. Smaller wind turbines are, however, also seeing improvements and becoming more reliable and durable. These technologies make wind energy generation more and more practicable to individuals and communities throughout Minnesota.

Section 6.2.1 Wind Assessment for the Region

Wind moves horizontally across the landscape and can be affected on a national and regional scale by topography, land use, and weather patterns. This creates a complex pattern from which determining site-specific wind data for each location is important. Department of Commerce wind maps give a general picture of the wind resource across the state, but each site has its own characteristics and these must be identified and

evaluated prior to development. This is particularly true in the northeastern part of the state where very few monitoring stations have been located. More data is needed to refine the wind resource numbers for the area. Current Minnesota Department of Commerce maps show that the Northeast Region has a poorer wind power resource than the rest of the state, but that the region's wind regime is about average in comparison to utility-scale sites developed in Europe (Figures 10 and 11). In general, an annual average wind speed greater than 4 meters/second (9 mph) is required for small wind electric turbine while utility-scale wind power plant requires a minimum average wind speed of 6 m/s (13 mph). The wind speed in most parts of northeast Minnesota appears to be more than 4 m/s. [59]

In his paper *An Examination of Distributed Wind Energy Production Capacity in Minnesota,* independent consultant Mike Michaud takes a distributed location approach on siting turbines according to the number of existing rural households available in each county. Census data on rural households for each county was matched with wind resource data from the Minnesota Department of Commerce to calculate total energy production capability. This energy production level was then compared to historical kWh consumption for that county to determine the percentage of annual energy use that can be supplied from small-scale wind power. The following table lists the total production by county for 10kW turbines placed at all rural sites in the Northeast Region:[60]

Table 9: 10 kW Production at Available Sites

County	Annual MW-hrs Prod	Total MW-hrs Consumed	% From Wind
Aitkin	76065	165777	46
Carlton	95014	499286	19
Cook	36021	71838	50
Itasca	211002	492083	43
Kanabec	60859	128896	47
Koochiching	42926	629218	7
Lake	46040	124552	37
Pine	100227	192782	52
St. Louis	421453	7168967	6

[59] AWEA, "Frequently asked questions" www.awea.org.
[60] Michaud, Mike. 2004. *An Examination of Distributed Wind Energy Production Capacity in Minnesota*. Appendix B.

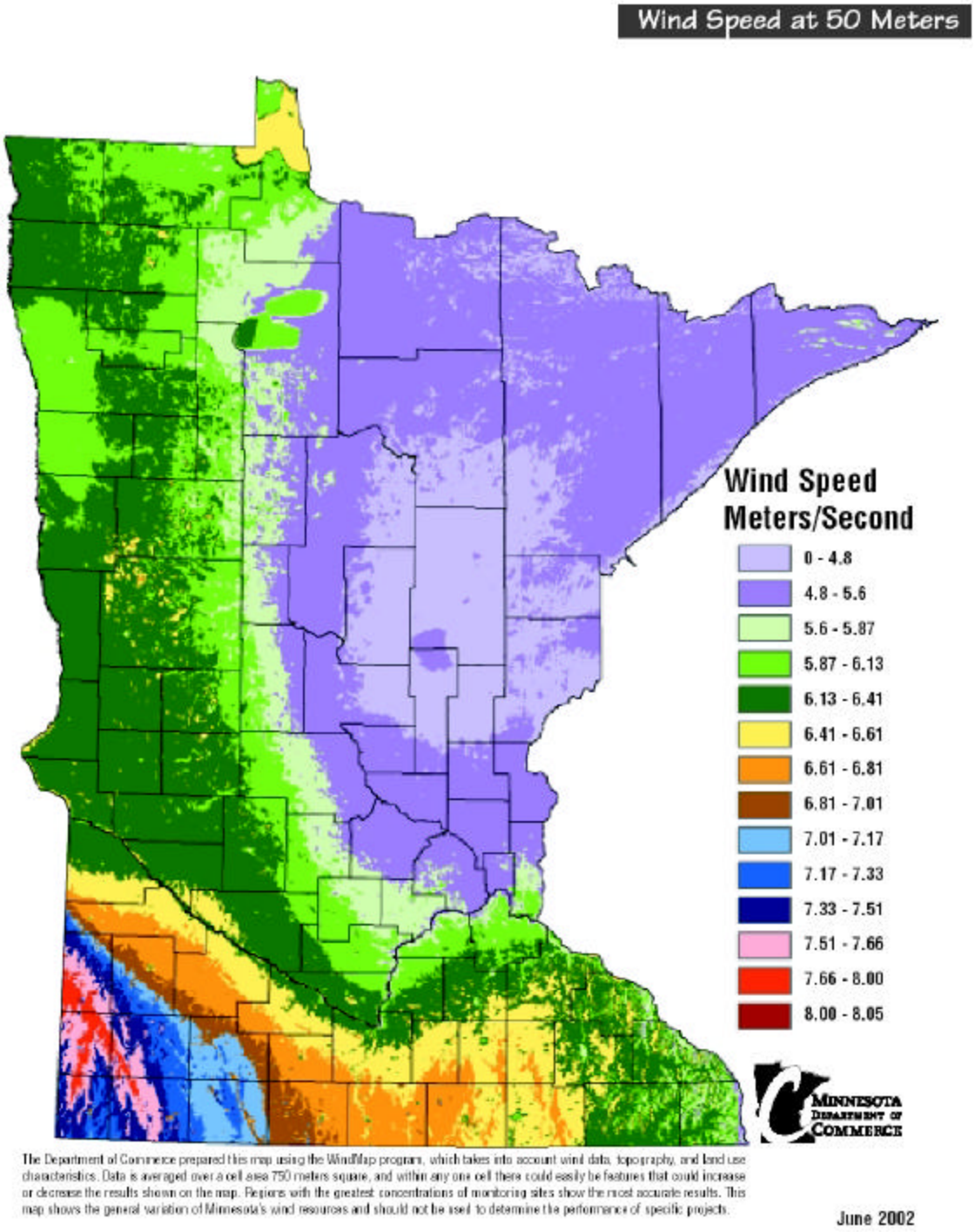

Figure 10: DOC Wind Map at 50 meters

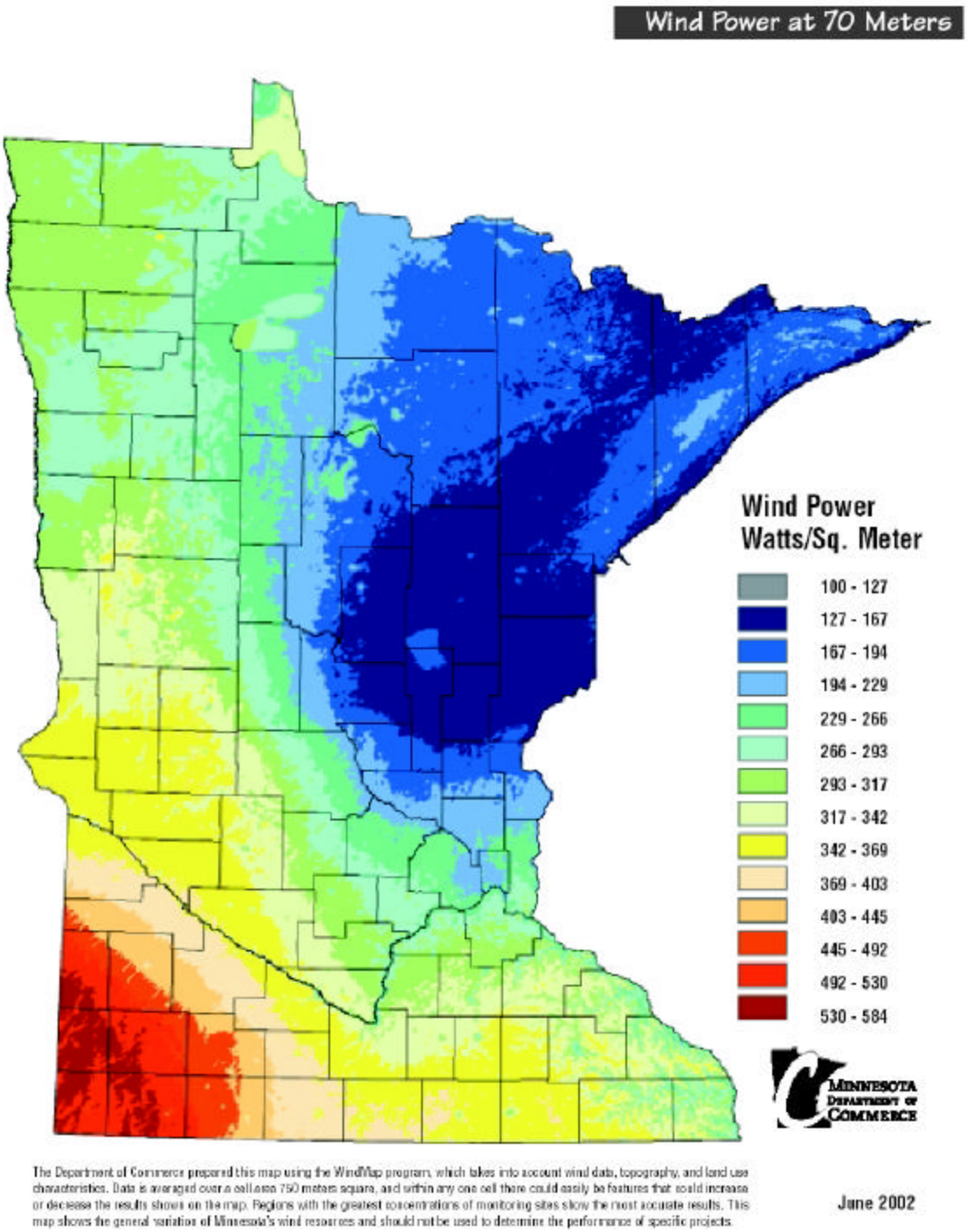

Figure 11: DOC Wind Map at 70 meters

Section 6.2.2 Additional Monitoring Site Options

The Minnesota Department of Commerce monitors wind speed and power throughout the state. Historically northeastern Minnesota has had very few wind monitoring sites. Until 2004 there were only 2 monitoring sites in the region. The 2002 Minnesota Wind Resource Analysis Program (WRAP) report provides a summary of the Minnesota Department of Commerce wind monitoring sites in the region.[61] In addition, the University of North Dakota Energy & Environmental Research Center (EERC) analyzes Minnesota Department of Commerce wind data, including some data not mentioned in the WRAP report.[62] Based on the EERC website, northeast Minnesota has five wind monitoring sites:[63]

COUNTY	**SITE NAME**
St. Louis	Hibbing Wind Monitoring Site
St. Louis	Hoyt Lakes Wind Monitoring Site
St. Louis	Brimson Wind Monitoring Site
Lake	Isabella Wind Monitoring Site
Cook	Grand Portage Wind Monitoring Site

According to Mike Taylor at the Minnesota Department of Commerce, missing from that map but currently collecting data are two more sites:[64]

COUNTY	**SITE NAME**
Pine	Sandstone Wind Monitoring Site
Carlton	Fond du Lac Wind Monitoring Site

The following sites have recently come on line but are not yet collecting data:

County	**SITE NAME**
Carlton	Barnum Wind Monitoring Site
St. Louis	Northstar (Near Duluth) Wind Monitoring Site
Itasca	Coleraine Wind Monitoring Site

[61] *Wind Resource Analysis Program 2002*. Minnesota Department of Commerce, October 2002. This report can be accessed at: http://www.state.mn.us/mn/externalDocs/Commerce/WRAP_Report_110702040352_WRAP2002.pdf .
[62] Energy & Environmental Research Center, University of North Dakota. This database can be accessed at: http://www.undeerc.org/wind/winddb/MNwindsites.asp .
[63] EERC's Minnesota Wind Sites can be accessed at: http://www.eerc.und.nodak.edu/wind/winddb/MNwindsites.asp.
[64] The following two tables are based on e-mails with DOC's Mike Taylor May 25, 2005.

And finally, the following two sites are planning to come on line soon:[65]

COUNTY	SITE NAME
St. Louis	Central High School (1 kW turbine and tower)
St. Louis	Erie Pier, St. Louis Bay

In recent developments, Minnesota Department of Commerce is working on a statewide wind mapping effort with Wind Logics that they hope to have operational in Fall 2005. This effort will collect data from satellites using historical records that are verified against ground-based data and then enter all the information into a complex software program. This effort should greatly improve wind data for the Northeast Region. The maps should allow project developers to do specific economic and project analysis before investing in onsite monitoring. If this preliminary analysis were positive, developers would only have to initiate onsite monitoring to verify micro siting for financing.[66]

Section 6.2.3 Existing Wind Projects

There are several existing wind projects in northeast Minnesota, most of which are small-scale installations like that at Lake Superior College and Stowe Elementary. There are also several small-scale off-grid wind installations around the region that are more difficult to track. Several Northeast CERT members have wind turbines on their homes. Wolf Ridge Environmental Learning Center, in Lake County also has a 7.7 kW turbine. With this turbine and an onsite solar system, over 16,000 students, teachers and parents from over 180 Minnesota schools are exposed to renewable energy during their multiple-day experiences at Wolf Ridge. Minnesota Power, Great River Energy, and North Shore Mining have all helped with the construction of this demonstration site.

The following information was taken from the National Renewable Energy Laboratory's Minnesota wind information, last updated in 2002 (Table 10).[67]

Table 10. Northeast Minnesota Wind Installations

[65] Based on conversations and e-mails with Dean Talbott, Minnesota Power
[66] Based on e-mail with the Department of Commerce's Mike Taylor, May 25, 2005.
[67] Information taken from the National Renewable Energy Laboratory: Custom report: Plant name, utility, city, year operational, operational status, unit number, and capacity by state, technology and fuel. You may view the report at: http://analysis.nrel.gov/repis/online_reports.asp.Retrieved May 16, 2005.

City	County	Capacity (kW)
Cloquet	Carlton	10
Duluth	St. Louis	4
Duluth	St. Louis	5
Hill City	Aitkin	20
Little Fork	Koochiching	2
Silver Bay	Lake	10
Silver Bay	Lake	12

6.2.4 Opportunities for Community-based Wind Projects

The possibilities for community-based wind projects in the Northeast Region are wide-ranging. One possible community-based project is on the Grand Portage Reservation. The Grand Portage tribe has been exploring opportunities for on-site wind generation and is currently exploring opportunities for additional funding. There are also numerous opportunities for community-based projects at schools across the region. These projects have the potential to not only provide real-life, on the ground examples to children, their parents and communities, but also have the potential to educate and inspire a generation. Possible opportunities exist with North Shore Community School, Proctor Public Schools and Barnum Schools. Industries like North Shore Mining could also be approached to pilot innovative community wind models.

6.2.5 Costs and Benefits of Potential Projects

Generally speaking larger wind projects provide better economic returns. A standard rule of thumb is that a utility-scale turbine project will cost about $1,000,000 per MW (including the turbine itself and installation), but recent increases in steel prices and diesel have driven these costs up closer to $1,300,000 in some instances. Wind projects do, however, benefit from economies of scale both with regard to the size of an individual generator (the larger machines yield more output per dollar) and to the number of generators to be installed at a particular site or particular point in time. Community-based large-scale wind projects will make the most sense if communities can work together to install their generators at the same time or pair installation with a larger-scale development. Combining these projects will allow communities to minimize installation costs.

Small wind energy systems cost from $3,000 to $5,000 for every kilowatt of generating capacity, or about $40,000 for a 10-kw installed system. On a per kWh basis, a small wind turbine is much more expensive than a large wind system, but the overall upfront capital cost is significantly lower. With rebates or tax credits factored in, a well-sited

small wind turbine can usually pay for itself within 15 years, or over about half its serviceable lifetimes.[68] Generally these systems make the most sense for off-grid applications, but these systems can also make sense for public facilities that see small wind systems as educational investments for the community. Schools have likened these projects to the building of a new gym; its value to the students and community at large is greater than its "payback" period.

6.2.6 Further Research Needs

While the technology for turbines is well developed, there is room for further research. One area of particular concern is with regard to financing community-based projects. What are the various mechanisms that communities could use? How can community take advantage of the tax benefits that fall to investors with high tax liability? How can communities and interested individuals pool their resources to invest in a turbine?

Another concern relates to interconnection agreements and siting and zoning requirements for wind projects. While perhaps not fit for research questions, it is imperative that utility interconnection agreements and county zoning ordinances move toward greater harmonization. This will allow communities and developers across the region and across the state to benefit from lessons learned by others and facilitate more effective knowledge transfer, reducing duplication of efforts.

The Northeast CERT has also discussed a desire for mobile wind monitoring tip-ups that could be moved around the region. They have suggested some sort of state regulation that would require all cell towers to have monitoring equipment so that there could be better, more complete data sets available. The team would also like to investigate how state-owned facilities, like fire towers or emergency communication sites, could be used to expand the regional monitoring network.

Section 6.3 Hydroelectric

The first hydroelectric projects in the United States were built in the 1880s.[69] These projects have historically been major electric suppliers across the United States, with hydroelectric currently providing about 10% of the electricity produced in the United States.[70] Few new hydro projects, however, have been constructed in recent years. Indeed today, the trend is largely to remove dams rather than reconstruct them due to

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[68] Retrieved on May 10, 2005 from the American Wind Association's Frequently Asked Questions link. http://www.awea.org/faq/tutorial/wwt_smallwind.html#How%20much%20does%20a%20wind%20system%20cost.

[69] Retrieved on May 10, 2005, from The Hydro Foundation's Frequently Asked Questions link: http://www.hydrofoundation.org/research/faq.html#buildHydro.

[70] Federal Energy Regulatory Commission. 2003. "Water Power – Use and Regulation of a Renewable Resource." Retrieved May 23, 2005 from http://www.ferc.gov/industries/hydropower/gen-info/water-power/wp-use.asp.

economic and environmental concerns, but many facilities still exist across the state. This section provides a summary of existing northeast Minnesota hydro facilities.

Section 6.3.1 Existing Hydroelectric Facilities in the Region

There are 9 existing hydro facilities in the Northeast Region (Table 11). Minnesota Power's Thomson Project in Carlton County is the largest hydroelectric facility in the region.[71]

Table 11. Hydro Facilities in the Northeast Region[72]

Project Name	Capacity (kW)	County	River	Owner
Cloquet	6,500	Carlton	St. Louis	Sappi Cloquet/Potlatch
Fond Du Lac	12,000	St Louis	St. Louis	Minnesota Power
Grand Rapids	2,100	Itasca	Mississippi	Blandin Paper Co
International Falls	10,100	St. Louis	Rainy	Boise Cascade Co
Thomson	69,600	Carlton	St. Louis	Minnesota Power
Winton	4,000	Lake	Kawishiwi	Minnesota Power
Knife Falls	2,400	Carlton	St. Louis	Minnesota Power
Scanlon	1,600	Carlton	St. Louis	Minnesota Power
Prairie River	1,100	Itasca	Prairie River	Minnesota Power

Section 6.3.2 Opportunities for Hydroelectric facilities in the Region

According to a 1990's study, opportunities for hydroelectric power in the Northeast Region can be found on the St. Louis and Cloquet Rivers, specifically a site without power at Island Lake and an undeveloped site near Grand Rapids.[73] Generally the strongest opportunities for further hydroelectric power development are with the renovation of existing dams, as this avoids added costs and damage caused by flooding and natural habitat destruction.[74] However, research costs and feasibility studies to re-commission facilities are often expensive and difficult to conduct, and many hydro

[71] Operating Technologies in the State of Minnesota - Renewable Plant Information System developed by National Renewable Energy Laboratory http://www.eere.energy.gov/state_energy/opfacbytech.cfm?state=MN and Minnesota Hydro Facility Sites http://www.dnr.state.mn.us/waters/surfacewater_section/stream_hydro/hydropower_sites.html . Both accessed April 12th, 2004.

[72] Minnesota Department of Natural Resources. 2005. "Hydropower Sites in Minnesota." Retrieved November 2004 from http://www.dnr.state.mn.us/waters/surfacewater_section/stream_hydro/hydropower_sites.html.

[73] Idaho National Engineering and Environmental Laboratory. November 1997. "Minnesota Hydropower Resource Assessment."

[74] Minnesotans for an Energy-Efficient Economy. This information can be accessed at: http://www.me3.org/issues/hydro/ .

facilities are now being removed rather than reconstructed so as to aid in surface water flow and fish migration.

Section 6.4 Biomass

Biomass is any organic material not derived from fossil fuels that can be converted to a fuel useful for generating electricity, heat or transportation. For the purposes of this section, we are focused on examples such as wood waste, energy crops such as hybrid poplar, switch grass, and hazelnuts, and plant residues.

Section 6.4.1 Existing Biomass Projects

Many paper facilities in the northeast already utilize their biomass (wood waste) for their own heating and electric use. Indeed, the Northeast Region is home to the greatest number of facilities in Minnesota that are currently using wood waste and timber residues because of the concentration of paper facilities (Table 12).[75]

Table 12. Existing Northeast Facilities Utilizing Wood Waste

Facility Name	City	County
Hill City School	Hill City	Aitkin
Alltrista Consumer Products Co.	Cloquet	Carlton
Sappi Cloquet LLC	Cloquet	Carlton
Hedstrom Lumber Co. Inc.,	Grand Marais	Cook
Blandin Paper/Rapids Energy Center	Grand Rapids	Itasca
Itasca Community College	Grand Rapids	Itasca
Potlach – Grand Rapids	Grand Rapids	Itasca
Valley Forest Resources Inc.	Marcell	Itasca
Boise Cascade Corp – International Falls	International Falls	Koochiching
Louisiana-Pacific Corp – Two Harbors	Two Harbors	Lake
Hill Wood Products	Cook	St. Louis
Potlatch – Cook	Cook	St. Louis
Georgia-Pacific – Duluth Hardboard	Duluth	St. Louis
Minnesota Power Inc. – ML Hibbard	Duluth	St. Louis
US Steel Corp – Minntac	Mountain Iron	St. Louis

Section 6.4.2 Biomass Resource Assessment

The best biomass resources for the Northeast Region are forestry and mill residues. These resources are particularly good in Cook, Itasca and St. Louis Counties (Figure 12), however many of the mill residues are used by existing facilities and are therefore not

[75] Minnesota Pollution Control Agency. 2001. "Boiler List".

available for other uses.[76] A recent survey by the Minnesota DNR found that St. Louis and Koochiching counties had excess mill residue that was available and could be utilized for other purposes (Figure 13).[77] St. Louis County also has urban wood waste available as a potential fuel.

The agriculture residue in northeast Minnesota mainly consists of corn residue, soybean residue, barley residue and oat residue. The vast majority of these residues, primarily from corn, are located in Pine and Kanabec Counties.[78]

Section 6.4.3 Local Opportunities for Energy Crop to Mitigate Environmental Issues

There are numerous opportunities for growing energy crops in the region. The Laurentian Energy Authority (Virginia and Hibbing Project) is currently working with the Agroforestry Cooperative to plant hundreds of acres of short rotation woody crops in the region and this program will likely expand. These crops, and other perennial crops, offer many potential benefits beyond just an energy resource, such as increased shallow aquifer filtration, well head protection, snow barriers, wind break crops, best management practices along rivers, streams, lakes, marginal agricultural land and other productive conservation uses.

[76] Data provided by Keith Butcher, Minnesota Department of Natural Resources based on 2001 Sawmill Survey of Total Sawmill Wood Residue.
[77] Data provided by Keith Butcher, Minnesota Department of Natural Resources based on 2001 Sawmill Survey of Available Sawmill Wood Residue.
[78] Based on Minnesota Agricultural Statistics Service's *County Estimates – Crops* and Institute for Local Self Reliance's residue ratios. Also confirmed by preliminary estimates made in 2003 by Marie Walsh at Oak Ridge National Laboratory.

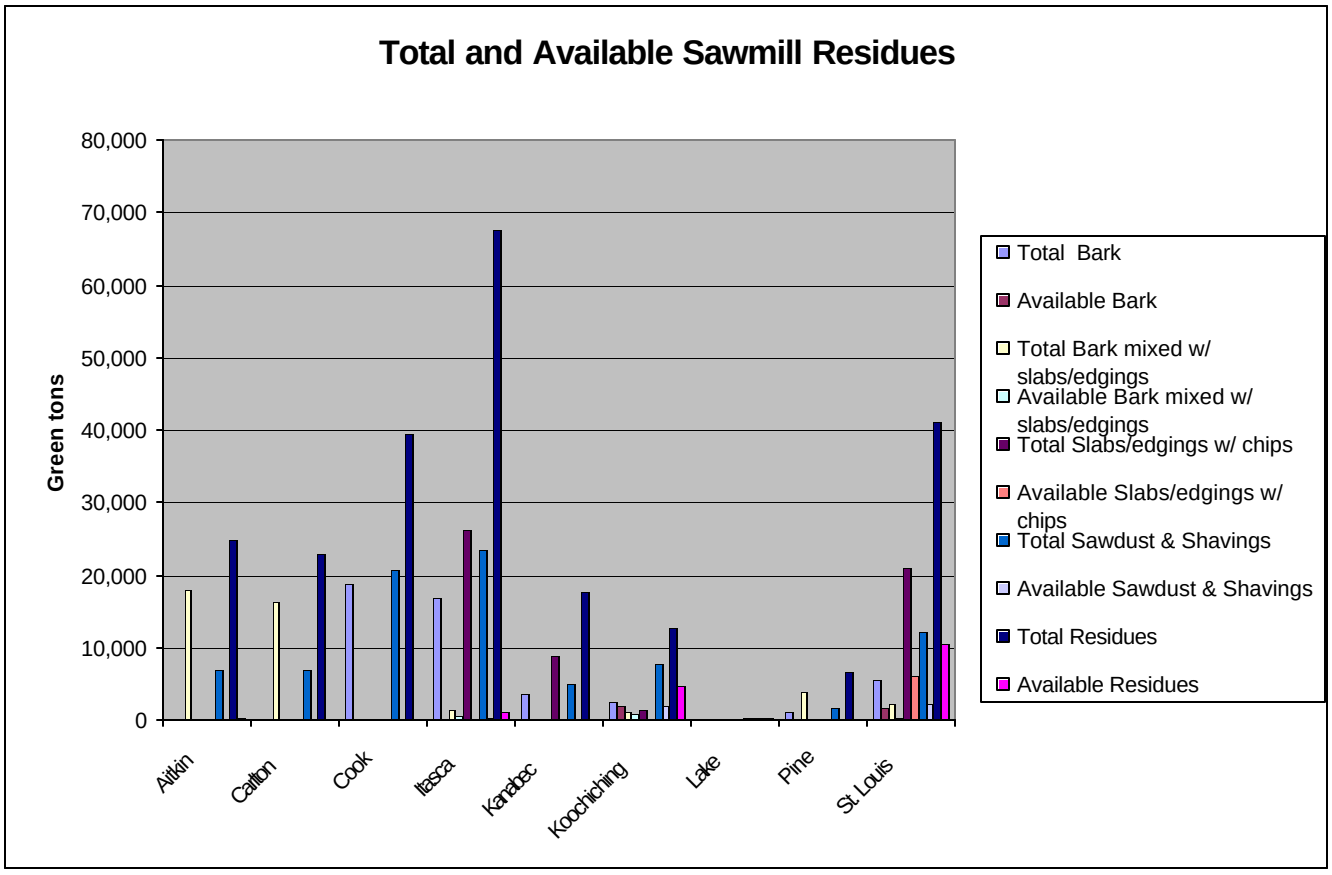

Figure 12: Total and Available Sawmill Residue by County

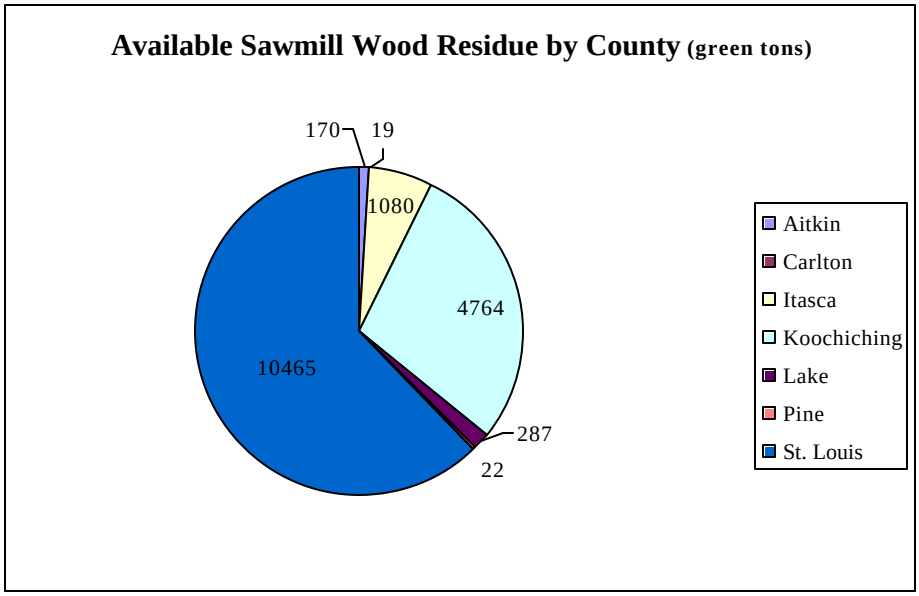

Figure 13: Available Sawmill Residue by County

Section 6.4.4 Opportunities to Tie Biomass Projects to Existing District Energy Systems

In March 2004, ME3 completed research into biomass-fueled district heating systems in Minnesota. According to Shalini Gupta, "A community energy system (also known as district energy) connects a centralized source of heat generation to a set of residential, commercial, and/or industrial thermal energy users, via a system of distribution pipes."[79] District heating offer an exciting opportunity for community-based energy systems as they can reach energy efficiencies of up to 90 percent by generating both electrical and thermal energy. If renewable resources like biomass fueled this process, the whole system would be more carbon-neutral and would draw on local biomass resources discussed here. Currently both Duluth and Virginia/Hibbing operate municipal-based district heating systems.[80] Buhl, Keewatin, and Mountain Iron, all near Virginia and Hibbing on the Iron Range, all previously operated district heating systems.[81] The Laurentian Energy Authority is a project seeking to install two new wood-fired boilers, one at Virginia Municipal Utility and one at Hibbing Municipal Utility, to provide biomass-based electricity and steam heat to local residents.[82]

Another northeast Minnesota biomass to cogeneration project in the planning stages is the Itasca Power "Northome Biomass Plant". The Northome Biomass Plant is a planned 15 MW power plant that will generate electricity using wood residue from the surrounding wood products industry, and will also be capable of providing steam, hot water, chilling and cooling to future commercial users at a nearby industrial park. The plant will be located near Northome, Minnesota, in Koochiching County.[83]

Section 6.5 Biogas Digesters

Biogas digesters present an opportunity to capture methane to use for heat, electricity, or even hydrogen. There are four main types of biomass that can be used for biogas: manure, sewage sludge, landfill materials, and agricultural residues.

Section 6.5.1 Current Facilities

The Western Lake Superior Sanitary District (WLSSD) operates the only biogas digestion system in the Northeast Region. In 2001, WLSSD began operating a $32

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[79] Gupta, Shalini. March 2004. *Biomass-Fueled Community Energy Systems: A Viable Near-Term Option for Minnesota Communities.* p. 2. Minnesotans for an Energy-Efficient Economy. This report can be accessed at: http://www.me3.org/issues/biomass/community.pdf .

[80] Gupta, p. 3.

[81] Gupta, p. 3.

[82] Minnesota Pollution Control Agency. 2005. "Environmental Assessment Worksheet – Laurentian Energy Authority, LLC, Biomass Energy Project." Retrieved May 31, 2005 from http://www.pca.state.mn.us/news/eaw/laurention-eaw.pdf.

[83] Retrieved May 25, 2005, from ME3's Biomass website at: http://www.me3.org/issues/biomass/index.html#mnprojects.

million anaerobic digestion facility to process its wastewater solids into biosolids for use as fertilizer and biogas for use as fuel.[84] In 2003 WLSSD also installed two 70 kW microturbines. These microturbines run on the biogas generated in the digester and provide both on-site electricity and heat.

Section 6.5.2 Regional Opportunities for Biogas Production

The WLSSD project highlights the potential for utilizing sewage sludge to create energy at wastewater treatment facilities throughout the region and the state. Similar processes could also be replicated at landfills across the state. The Minnesota Pollution Control Agency states that the "majority of landfills in the Closed Landfill Program (CLP) currently have some type of passive gas venting system to collect and exhaust the methane gasses that form in the waste due to decomposition processes." Other facilities are pursuing active gas extraction systems. These active systems have the potential to yield gas-to-energy projects similar to the WLSSD case by using landfill gas to power on-site microturbines. There are 28 qualifying closed landfill sites in northeast Minnesota that could implement active gas extraction systems.[85]

Section 6.6 Biofuels

Ethanol and biodiesel are the two alternative transportation fuels available to Minnesota customers. All gasoline in Minnesota is mixed with a 10 percent blend of ethanol (total of 260,000,000 gallons). Ethanol is also available in an 85 percent blend at select gas stations across the state. Biodiesel, where available, is generally provided in either 2% (B2) or 20% (B20) blends. Beyond use in transportation applications, there is also potential to generate electricity using biodiesel as a substitute for the diesel fuel used in today's diesel generators.

[84] WLSSD Project Profile, Northern Minnesota Renewable Energy Center Website: http://www.nmnrenewables.org/wlssd/index.shtml#javascript. Retrieved May 18, 2005.

[85] Minnesota Pollution Control Agency. 2005. "Qualified Closed Landfill Program Sites." Retrieved May 31, 2005 from: http://www.pca.state.mn.us/cleanup/landfills-duluth.html and http://www.pca.state.mn.us/cleanup/landfills-brainerd.html.

Section 6.6.1 Biofuel Facilities in Northeast Minnesota

Minnesota is home to fourteen ethanol plants with a production capacity of 389 million gallons, although none of those facilities are located in northeastern Minnesota. The state is also moving forward with biodiesel production thanks to a biodiesel mandate that would require all diesel fuel to contain a two percent biodiesel blend by 2005. This mandate requires 8,000,000 gallons of in-state biodiesel capacity before taking effect (total mandate would require 13,000,000 gallons), and ensures local economic benefit from new biodiesel production facilities. None of the biodiesel facilities currently in the planning stages are located in northeast Minnesota.

Although there are neither ethanol nor biodiesel facilities in northeast Minnesota today, that does mean there will not be potential for such facilities in the future. As new technologies become commercialized, such as cellulosic ethanol or plasma torch conversion, the Northeast Region may indeed be well positioned to produce these biofuels. For example, a plasma beam converts biomass from a solid to a gas, namely carbon monoxide. Via pyrolysis (heat and pressure) this carbon monoxide can be converted to ethanol or any other sugar compound as needed. Using this technology the corn-based ethanol paradigm may well give way to other, more sustainably produced, biomass crops and residues that abound in northeast Minnesota.

Section 6.6.2 Existing Biofuel Projects in Northeast Minnesota

The 85% percent blended ethanol (E-85) has come a long way. The Minnesota Department of Commerce began tracking E-85 usage in 1997. According to the gas stations that reported their information, there were 11 stations that carried E-85, with each selling on average 225 gallons monthly for a total of 5,933 gallons. Today, Minnesota has the largest E85 (85% ethanol) fueling network in the world with more than 101 stations, selling on average 2,270 gallons a month for a grand total of 2,611,218 gallons sold during 2004.[86]

Currently there are four stations in the Northeast Region that sell E-85 (Table 13).[87]

Table 13. Northeast Minnesota E-85 Stations

County	City	E-85 Station Name
Koochiching	International Falls	Holiday Stop-N-Shop

[86] Minnesota Department of Commerce, *2005 Minnesota E-85 Station Report.* This report can be found at: http://www.state.mn.us/mn/externalDocs/Commerce/E-85_Fuel_Use_Data_041703045254_E85fueUse.pdf. Retrieved May 18, 2005.

[87] For more information about E-85 in Minnesota, visit the Clean Air Choice website at: http://www.cleanairchoice.org/outdoor/E85InCounty.asp?County=Nicollet. Retrieved May 13, 2005.

Pine	Hinckley	Tobies' Station
St. Louis	Duluth	Holiday #85
St. Louis	Duluth	Lake Superior ICO

Section 6.6.3 Opportunities to Use Biofuels

There are opportunities to use biofuels in both transportation and electric applications. With regard to transportation, a number of passenger vehicles are already equipped to run on alternative fuels. These vehicles are called Flexible Fuel Vehicles. All readers should review the list of vehicles developed by the Minnesota Department of Commerce to determine if their current vehicle could be fueled using E-85 (Appendix F). Several Ford, Daimler Chrysler, and General Motors vehicles are equipped to run on E-85. The inside of each car's fuel lid should indicate whether or not your vehicle could be fueled using E-85.

The other opportunity for using biofuels in transportation is with buses and with tax-exempt vehicles. Currently the Minnesota Department of Commerce is running a B20 School Bus Demonstration project in three school districts to test the viability of using B20 in winter months. The overall results from this project show that for at least 9 months of the year, avoiding the three coldest months, B20 is viable fuel for school buses, and may actually be viable on all but the very coldest days. There are schools throughout the Northeast Region that could benefit from converting to B20, and with the teams focus on school energy projects, this would be a natural arena to focus on.

Another example is the City of Brooklyn Park's use of a 20% biodiesel blend throughout its entire fleet – over 100 vehicles including snowplows. The same sort of program could be implemented at city and county fleets throughout the Northeast Region and might have the biggest impact if implemented in the City of Duluth and St. Louis County as they have the largest populations and government fleets. The City of Duluth could also pursue some of the marine diesel and barge improvements discussed in Section 5.3 as part of a citywide fuel conversion and air emission reduction program. Biodiesel could also be a "greening" tool for the shipping industry that comes through the port of Duluth. It should be noted that there might also be opportunities for these government entities to jointly purchase biodiesel and receive a bulk purchase discount.

Beyond use in transportation applications, a biodiesel blend could also be used to fuel existing diesel generators. Two Harbors Water and Light has one diesel unit; Aitkin Public Utilities, Grand Marais Public Utilities, and Moose Lake Water and Light all have oil-fired internal combustion units. If all of these units were converted to a 20 percent biodiesel blend, air emissions of carbon monoxide, hydrocarbons, and particulates

could all be lowered, and each of the utilities would be closer to achieving its Renewable Energy Objective goals.

Section 6.7 Solar Energy

There are three types of solar technologies: solar building design (including passive solar design that correctly orients buildings to take advantage of natural day light), solar thermal, and solar electricity (photovoltaic (PV)). Solar thermal technologies can be subdivided into solar pools, hot water for heating or domestic water, or the preheating of ventilation air.

Section 6.7.1 Identify Existing Solar Installations

Very little concrete data is known about solar building design and solar thermal applications as they are largely transacted between a buyer, seller, and perhaps a local building authority. Off-grid solar electric applications are similar, and therefore also difficult to track. Anecdotally, the largest solar electric applications are a) off-grid cabins and homes, b) portable highway construction signs, c) small, remote power applications such as lighting, emergency highway call boxes, and railroad crossings.

On-grid applications have a much better tracking capability since they are generally larger and involve a fourth party, the electric utility. Prior to the start of the solar electric rebate program in July 2002, an estimated 120 to 130 kilowatts of solar electricity were installed in Minnesota, primarily in the Twin Cities area. Between July 2002 and July 2004 the solar rebate program catalogued an additional 150 kilowatts of solar electricity, primarily in the Twin Cities and northeast regions of Minnesota, for a Minnesota total of about 275 installed kilowatts.

Section 6.7.2 Solar Potential

Both solar and wind energy resources have national, regional, local, and site-specific variations. While wind resources can vary greatly from location to location, solar resource changes are more gradual over larger geographic distances, making it an easier resource to measure regionally. While Arizona and the Pacific Northwest have the best and worst solar resources respectively, the rest of the country is largely in the middle, including Minnesota. Notably, Minneapolis, Minnesota has about the same annual solar resources as Houston, Texas and Miami, Florida as solar resource and temperature are not necessarily correlated. The changing length of days, amount of humidity and pollution in the air, and other factors alter the solar resource distribution in any one season but annually, they are comparable.

Data analysis indicates that there is only a 10% difference between the highest (southwest Minnesota) and lowest (northeast Minnesota) solar resource in Minnesota.

Solar resources are, however, very site specific and require siting whatever solar technology is used (solar building design, solar thermal, or solar electric) in unshaded areas. Trees, buildings, power lines and poles, and other structures will significantly affect solar electric installations and to a lesser but still significant amount, solar design and solar thermal applications.

Section 6.7.3 Solar Incentives

Several incentives are available for solar systems (Table 14). Minnesota's Solar Rebate program offers $2,000 per kilowatt (about a 20-25% buydown) and the Minnesota Power Solar Rebate Program matches it with an additional $2,000 per kilowatt for customers in their service territory. Interested applicants need to be pre-approved for a rebate to ensure their potential system design meets the program specifications before any installation work occurs. Once approved, participants have 6 months to install their system and submit the paperwork for receiving a rebate (extensions are available).

Table 14: Economics of Solar Systems

Type	State	Federal	Limitations	Benefit
Sales tax exemption*	X		Electric only	~5%
Property tax exemption	X			Varies
5-yr depreciation**	X	X		Varies
10% tax credit**		X		10%***
MN Rebate Program	X		Electric only	~20-25%
MN Power Rebate Program	X[#]		Electric only	

* Solar panels only; ** Businesses only; *** After other incentives are applied; [#] MN Power customers only

Section 6.7.4 Identify Specific Opportunities for Solar Projects

Opportunities for solar are plentiful, but often depend upon budgetary and cost-benefit requirements. New construction provides the greatest opportunity for incorporating solar into an overall project. At a minimum, newly constructed buildings should be highly efficient and designed for passive solar heating and lighting. They can also be "predesigned" for solar to be installed at a later date by running conduit or piping during construction rather than retrofitting later. Community-based solar projects should likely focus on cost-effective applications and/or locations where educational curriculum can be incorporated, such as nature centers, schools, community centers, etc.

The solar industry itself is fairly young in Minnesota and the development of multi-disciplinary training of solar installers would encourage competition and enable the next generation of renewable installers to be apprenticed with existing businesses.

Multi-disciplinary is an important component since any one solar sector (solar electric alone for example) may not be adequate for supporting an entire business at this point in time. Rather, the industry has generally developed as a one-stop service center for assessing and combining energy efficiency and renewable energy packages to clients, which may include a variety of design and technology components.

Other areas for solar partnering may include:

- Cooperation with electric utilities to site solar electric installations in areas of transmission or distribution line needs, i.e. solar has a positive correlation with demand and can help alleviate constraints to some extent;
- Cooperation with natural gas and electric utilities to recognize solar hot water as another method of energy conservation;
- Cooperation with government to ensure that public buildings meet stricter state guidelines for increased efficiency;
- Cooperation with government to reduce barriers to solar development and perhaps provide incentives through building codes, zoning ordinances or permitting processes;
- Cooperation with businesses to look at cost-effective niche markets such as solar hot water in laundromats (or other high water users), solar pools in club and municipal pools, and solar walls (ventilation air preheat) in commercial and institutional buildings.

Section 6.7.5 Cost and Benefits of Solar

Solar technologies generally have higher up front costs and low operating costs. The incremental cost and payback period varies from none to very little (for incorporating solar design into new construction), little to some (for solar pools and preheating solar ventilation air), some to moderate (for solar thermal for heating or hot water), and expensive (for solar electricity) (Table 15).

Table 15: Solar System Basics

Technology	Benefit Window	Cost	Payback	Market	Appeal
Design	Year-round	Low	Short	Large	Medium
Thermal					
- Pool	Summer	Med-low	Na	Small	Low
- Ventilation	Fall, winter, spring	Med-low	Med-low	Medium	Low
- Hot Water	Year-round	Medium	Medium	Large	Medium
- Heating	Fall, winter, spring	Med-high	Medium	Med-low	Medium
Electric	Year-round	High	Long	Large	High

In general, most technologies for homes can be scaled to larger buildings. Commercial facilities often have a shorter payback requirement, while institutional facilities have a fixed amount of capital for construction. In some cases, seed funding to provide the additional capital for solar technologies can then be paid back as a revolving technology loan fund with reduced operating costs.

Three factors impact the cost and benefits of solar electricity. A primary driver is the installed cost of a solar system, estimated at $8,000-$11,000 per kilowatt in Minnesota before any financial incentives are applied. Solar resource (25% additional solar resource in Arizona than Minnesota) and the relative cost of electric utility rates (2-3 times higher in California than Minnesota) are also part of the equation. For example, New York may have a lower solar resource but also has high electricity rates, which may make it approximately equivalent to an installation in Minnesota.

The overall payback for a solar electric system in Minnesota varies between 20-50 years, depending on the ownership type, the number of incentives received, and the installed cost, which can vary 10-30% depending on how much installation work the owner can do his/herself and/or the price from the vendor. A business in the northeast qualifies for the state and Minnesota Power rebate programs, a 10% federal tax credit, 5-year accelerated depreciation, and a sales tax exemption on the solar panels (more than 50% cost reduction), while a homeowner in the Twin Cities would only qualify for the state rebate and the 6.5 % sales tax exemption (20% cost reduction).

Section 6.8 Combined Heat and Power

Combined heat and power (CHP) refers to recovering waste heat when electricity is generated and using it to create high temperature hot water or steam. Steam or hot water can then be used for space heating, producing domestic hot water, or even powering water chillers for air conditioning.

CHP and cogeneration are basically the same thing, although cogeneration is often thought of with district heating and large utility owned power plants. CHP is generally smaller scale. It frequently refers to generation of heat and power for university campuses, military bases, hospitals, and hotels. Several tribes in the Northeast Region are looking into CHP projects. New technologies for small-scale power production, such as plasma torch technologies, are opening opportunities for CHP in small and medium-sized buildings.

6.8.1 Identification of Specific CHP Projects.

The production of electricity through the conventional means typically wastes about 60% or more of the energy generated due energy lost in fuel conversion, ineffectual heat

recovery, and to transmission line losses. Power plants that use the excess energy through the application of CHP are able to improve energy efficiency by more than 35%.[88] There are several existing and pending CHP projects in northeast Minnesota (Tables 16 and 17).[89]

[88] Department of Energy, Energy Efficiency and Renewable Energy's "Combined Heat and Power" link. Retrieved February 24, 2005, from: http://www.eere.energy.gov/EE/industry_chp.html.
[89] Gupta, Shalini. 2004. *Plant Power:Biomass-to-Energy for Minnesota Communities*. P. 13 and 14. Retrieved on May 26th, 2005, from: http://www.state.mn.us/mn/externalDocs/Commerce/ME3_Biomass_Report_110204031416_BioMass2004.pdf.

Table 16: Existing Northeast Combined Heat and Power Projects

Company	City	County	Fuel type	Process	Energy Output
Blandin Paper	Grand Rapids	Itasca	Mill & Logging Residue	Combustion	Heat & power
Boise Cascade	International Falls	Koochiching	Mill & Logging Residue	Combustion	Heat & power
Potlatch Corp.	Cloquet	Carlton	Mill & Logging Residue	Combustion	Heat & power
Hibbard Steam St.	St. Louis City	St. Louis	Mill & Logging Residue	Combustion	Heat & power
Western Lake Superior Sanitary District	Duluth	St. Louis	Waste water reclamation	Anaerobic digestion	Biogas (heat & power)
International Falls WWTP	International Falls	Koochiching	Waste water reclamation	Anaerobic digestion	Biogas (heat)

Table 17: Planned and Under Construction Biomass Heat and/or Power Projects in the NE

Company	City	County	Fuel	Process	Energy Output
Hibbing Public Utility	Hibbing	St. Louis	Energy crops, wood/ag residue	Combustion	District heat and power
Virginia Public Utility	Virginia	St. Louis	Energy crops, wood/ag residue	Combustion	District heat and power
Itasca Power Company	Northome	Koochiching	Wood waste	Combustion?	Heat and power
Duluth Steam Coop	Duluth	St. Louis	unknown	Combustion	Add power to district heat

Table 18: Sites With Good CHP Prospects

Company	City	Type of Generation	Fuel Type	MMBtu/year	Age-Years

St. Mary's Duluth Clinic	Duluth	Diesel Engine& Boilers	Diesel & Gas	159,303	32
Duluth Steam Cooperation	Duluth	Cumming Generation & Boilers	Diesel, Coal & Gas	991,594	68
US Steel	Mountain Iron	Boilers	Gas & fuel Oil	1,458,259	33

Section 6.8.2 Assessment of Combined Heat and Power Opportunities in the Region

A recent inventory of Minnesota cogeneration potential indicates high potential for CHP in a number of Minnesota establishments.[90] Based on facilities that have a power generating capacity of more than 1 MW, Minnesota facilities have the technical potential to produce between 1,600 and 2,100 MW of CHP. A separate study for small energy users (< 1MW) estimated 842 MW of technical potential for small cogeneration.[91] According to the survey, northeast Minnesota is home to three sites with high combined heat and power potential (Table 18).[92]

[90] Minnesota Environmental Quality Board. 2001. *Inventory of Cogeneration Potential in Minnesota*. Section iv. Retrieved February 24, 2005, from: http://www.eqb.state.mn.us/pdf/2001/CogenInventory.pdf.
[91] Ibid.
[92] Ibid. Section iii.

Another larger-scale analysis done by Shalini Gupta, then of ME3, looked at municipalities with potential for plant residue-based district heating systems. Her analysis found that Duluth (St. Louis County), Grand Rapids (Itasca County) and Virginia (St. Louis County) are all good candidates for municipal district heating systems powered by plant residues.[93]

6.8.3 Opportunities for Additional Study of Potential CHP Projects

Pollution Control Agency data summarized by Ms. Gupta also reveals some sites with high fuel consumption that may also be strong CHP candidates due to their high-energy use (Table 19).[94]

Table 19: Sites For Additional Study

Company	City	Fuel Type	MMBtu/year
Sappi Cloquet LLC	Cloquet	Fuel Oil, Gas, Wood Waste	7,211,878
Northshore Mining	Silver Bay	Coal	8,389,847
Minnesota Power Inc-Laskin	Aurora	Fuel Oil & Coal	7,702,759
Minnesota Power -ML Hibbard	Duluth	Gas, Coal, Wood & Sludge	4,367,500

Section 6.9 Geothermal

Geothermal energy refers to the natural heat from beneath the earth surface. Geothermal energy is available in almost every part of the US and can be used to generate electricity or heat and cool homes and commercial buildings. Because the ground heats and cools at a slower temperature than the air, it is possible to use antifreeze that is circulated under the ground and throughout a building to cool the house during the summer and heat it during the winter. These sorts of systems are known as ground source heat pumps systems, or geoexchange systems, and can be used throughout Minnesota as an alternative heat source.

6.9.1 Current and Potential Geothermal Projects

The application of geothermal heat has a high potential in northeast Minnesota because the temperature underground is almost the same everywhere in the state. Geothermal heat pumps are becoming more popular for homeowners and as a heating mechanism in public buildings because they are so efficient. While there is not comprehensive data on how many heat pumps have been installed in the Northeast Region, there is a great

[93] Gupta, Shalini. 2004. *Plant Power: Biomass-to-Energy for Minnesota Communities.* P. 6. Retrieved on May 26th, 2005, from: http://www.state.mn.us/mn/externalDocs/Commerce/ME3_Biomass_Report_110204031416_BioMass2004.pdf.

[94] Minnesota Pollution Control Agency. 2001. "Boiler List".

deal of potential to use them in both public buildings and private homes. For example, many electric companies are offering incentives to put heat pumps in buildings, and the Minnesota State Legislature is currently considering providing sales tax exemptions for ground source heat pumps.

The Northeast CERT is aware of at least three geothermal installations in the region. These installations include systems at Hartley Nature Center in Duluth, the Millennium House in Duluth, and the Audubon Center outside of Sandstone.

6.9.2 Cost and Benefits

Although the installation costs for a geothermal heat pump system can be high, these systems can reduce operations and maintenance costs. Geothermal systems are more efficient than their gas-fired furnace and central air-conditioning counterparts and are not subject to fluctuating natural gas prices. On average, a geothermal heat pump system will cost about $2,500 per ton of capacity (a typical residential unit will have a 3-ton capacity). If such a system were included in a home mortgage, perhaps adding an additional $30-$50 per month, the energy cost savings over a one-year period would easily exceed the added yearly mortgage costs. [95]

[95] US Department of Energy: Energy Efficiency and Renewable Energy. 2004. "Geothermal Heat Pumps Make Sense for Homeowners." Retrieved September 21, 2004 from http://www.eere.energy.gov/consumerinfo/factsheets/ghp_homeowners.html.

SECTION 7: BEST BET PROJECTS

Northeast CERT participants agreed that their central project focus would be to: c*omplete demonstration projects at every school/community in the region.* The team felt this priority would allow them to truly capitalize on their mission, "to build a sustainable future by increasing the public's awareness and active adoption of energy conservation, energy efficiency and local renewable energy resources," because it targeted awareness and implementation of conservation, efficiency and renewable energy projects. The team's priority for the next two years will be to develop at least one project in each northeast county.

The Northeast CERT goal to work with local schools and communities has given them an organizing theme around which to target electric, heat, and transportation efficiency and renewable energy projects. This does not, however, mean that the team is not interested in other opportunities, such as working with industry partners like North Shore Mining or the many paper facilities in the area. The team would welcome and will continue to pursue opportunities to work with and encourage these businesses to improve efficiency and begin implementing renewable energy and combined heat and power projects. The team's stated priority to work with schools and communities has simply allowed them to set a concrete standard by which to measure their success and keep them moving toward their vision to design a Minnesota clean energy future.

Section 7.1 Working with Local Schools and Communities

The team kicked off this initiative by working with the North Shore Community School to get a renewable energy and energy efficiency program going at their school and then began engaging other schools in the region. In preparation for meeting with the North Shore Community School Board, team members developed an informational presentation to educate board members about renewable energy. The presentation has since been modified into an education presentation template that anyone in the region can use to give a presentation to his/her own school district (Appendix G).

In November 2004 the team engaged the Proctor Public Schools in thinking about possible on-site renewable energy projects. One of the first steps in working with the Proctor Public Schools was to develop a "Renewable Energy To Do List for Schools" that outlined steps schools would need to take before implementing a renewable energy project (Appendix H).

In March 2005 the team presented two tracks at the Energy Design Conference in Duluth that highlighted conservation and renewable energy options for schools. The team also began inviting other schools to CERT meetings and connecting with

additional schools through team members and the Minnesota Power small-wind grant. Given the tremendous interest from schools across the region, the team hired several students from the University of Minnesota Duluth, Nicole Hynum, Janelle Stauff, and Anna Carlson to help schools work through the many aspects of doing renewable energy projects. Working with Dr. Michael Mageau, Nicole, Janelle and Anna are working with Proctor Public Schools and North Shore Community School to evaluate renewable energy technologies, explore financing options, and get projects off the ground. The North Shore Community School received an Environmental Protection Agency Environmental Education Grant this year and plan to use their funds to install a solar array in June 2005. Proctor Public Schools received their first grant for $20,000 from Minnesota Power and hope to have their wind turbine fully functional by October 2005.

During spring 2005 members of Northeast CERT also initiated a project to develop web-based education displays for renewable energy technologies. The goal of the project is to develop a viable, understandable, interactive web-based way to present real-time energy data and energy flows for renewable energy systems across the state. The project ties directly to the Northeast team's desire to further educate communities about energy usage and production. It will be a project that schools, environmental learning centers, utility installations, and private developers can access and use to share and promote the value of renewable energy production.

Section 7.2 Commonalities Between Project Priorities in the Northeast Region and other CERT Regions

Northeast CERT shares the goal of promoting educational programs with other regions. Other regions are also interested in the work the team is pursuing around energy efficiency and conservation, public outreach, demonstrations at environmental learning centers and work at local schools. One of the key strengths of the CERTs program is the sharing of information and programs between citizens across the state. Currently, the Northeast CERT is the leader in reaching out to and working with area schools. Several other regions have already begun using the "To Do List for Schools" that the Northeast team put together. Projects from across the state are hoping to work with the Northeast team on the Educational Display project currently underway.

Another commonality is the desire to address transportation fuel usage. Several CERT regions are evaluating how to encourage broader alternative fuel use, but the Northeast Region is already well poised to promote this shift with local schools.

SECTION 8: BARRIERS AND OPPORTUNITIES

The Northeast CERT identified several barriers and opportunities to greater conservation and energy efficiency and broader renewable energy development. Three separate categories emerged:

- General barriers and opportunities
- State and local barriers and opportunities
- School-related barriers and opportunities

While all inter-related, team members felt it was important to break out where each barrier was an obstacle to better define what might be done to mitigate this obstacle. Not surprisingly, many of the barriers noted as either general or state and local are the issues being addressed by the team as they work with local schools and local communities on projects.

Section 8.1 General Barriers and Opportunities

Barriers	Opportunities
Traditional mindset	Targeting children to create a "new" traditional mindset, replace it with something better
Difficult to market conservation/efficiency and economic savings to the public; it's hard to know how to reach people.	Many people are neutral right now because they don't think about conservation and efficiency much in their daily lives. This could be an opportunity to shape their beliefs, especially with rising gas prices.
Pocketbook issues- people focus on "First Cost"	Pocketbook issues - Opportunity to emphasize long term savings
Technical difficulties: reliability problems, ongoing operation and maintenance, uncertainty with new technologies	Could implement a program that collects system data on a centralized server allowing for centralized system monitoring
Complacency and inertia, lack of systems and integrated thinking	"Alternative" ideas are creeping into mainstream – recent coverage in NY Times & Wall Street Journal, interest by Goldman Sachs
Need basic education on issues and ways of thinking about issues	Should relate a positive message, MODEL the positive - Should model a "Community of the Future" and demonstrate the relationships between present choices and future outcomes
Dependence on oil	There are great opportunities to call on citizens to reduce dependency on foreign oil, ranging from rising gas costs to national security issues. We must become more efficient and begin to take advantage of the available biofuels.

Section 8.2 Local and State Barriers and Opportunities

Barriers	Opportunities
Hostile Utilities	Should link websites of CERT participating organizations to demonstrate partnerships – including local utilities that are interested in conservation, efficiency and renewables
What media actually covers may not be most relevant	Assist local news media in getting the message out. Could develop a generic press release about technologies and allow each region to modify for local press.
Policy based on today, not tomorrow	Some local governments are starting to change or willing to change and look to the future.
City laws and ordinances	There are models being developed that could harmonize county ordinances to encourage renewable energy development. Should require that towers on state-leased land do wind monitoring.
Legal hurdles/available assistance	Legal assistance/facilitators knowledgeable about renewable energy and efficiency could help
Recreational homes = little occupancy, but year-round heating demands	Solar heat and ground source heat pumps could be alternatives – work with local zoning to provide info/bulletins

Section 8.3 School-related Barriers and Opportunities

Barrier s	Opportunities
Lack of funding makes it hard to think about long term investment	Look for other opportunities for funding—it's the only way to be progressive, should look at partnerships with industry
Lack of champions and human resources	CERT could help provide a more centralized place where schools can go to get funding/start up ideas/partnerships/mentoring
School transportation and fuel costs	Should disseminate information/share best practices, host seminars for sharing cross discipline, have CERT presence at teacher meetings
Traditional mindset among teachers and administrators about education and energy issues	Opportunity for schools to alter curriculum to reflect the role of energy issues in various fields of study (geography, economics, history etc.)

SECTION 9: MODELING TOMORROW'S ENERGY FUTURE TODAY

Northeast CERT's Vision and Mission are to design a Minnesota clean energy future while providing a positive economic impact on the region, and to build a sustainable future by increasing the public's awareness and active adoption of energy conservation, energy efficiency and local renewable energy resources, respectively. These statements reflect their desire to reshape their future energy choices and make a positive impact on the region. The statements also reflect the way the Northeast CERT sees linkages between energy, economic development, and education. Much of the region's focus has thus far been on projects with schools, but there are also a multitude of other potential opportunities on the horizon that will help shape the Northeast Region as a renewable energy leader and provide economic development opportunities across the region.

Section 9.1 Emerging Opportunities

Northeast Minnesota is a natural leader in utilizing "bioenergy" fuel sources – primarily milling and logging residues – based on their existing paper industries. Although the woody realm of the northeast seems worlds away from the cornfields of west central and central Minnesota, new technologies may enable it to become a leader in ethanol production. Researchers at the State University of New York have worked with the paper producers in their region to create an economical way to extract energy-rich sugars from woody materials to produce ethanol and other useful products.[96] Installed at the nation's paper mills, biorefineries could produce an estimated 2.4 billion gallons of ethanol a year – the equivalent of 80% of the nation's projected need this year.[97] The biorefinery would separate the cellulose for paper from the sugar xylan, which can be fermented into ethanol. Because the Northeast Region produces so much hay, the region is also an excellent candidate for cellulosic ethanol as part of a biorefinery. Biorefineries offer tremendous economic potential for all of Minnesota, but particularly for northeast Minnesota where industries have a track record of utilizing wood resources. Biorefineries connect high-value product streams to low-value energy streams offering the potential of linking biomass resources, local farmers and businesses into more profitable enterprises.

Although the region does not have the ideal resources to produce biodiesel, it has the potential to expand its role as a biodiesel consumer. Voyageurs National Park's Biodiesel Program uses a 20% blend of biodiesel (B20) in all of the park's diesel equipment, including a barge.[98] Duluth and communities along Lake Superior have the potential to assist the shipping industry in a conversion towards using cleaner,

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[96] Borchardt, John. *Will Wood Fill US Energy Needs?* The Christian Science Monitor, May 5th, 2005 edition.
[97] Ibid.
[98] Retrieved May 27, 2005. For more information, visit: http://www.cleanenergyresourceteams.org/northeast/CS-Voyageurs%20Nat.Park%20BIodiesel.pdf.

Minnesota-made biofuels. With the University of Minnesota Duluth located right on the shores of Lake Superior, there are tremendous opportunities for local research into biodiesel blends that can substitute for marine diesel. The Port of Duluth could take the lead at curbing diesel emissions from tankers just as the Port of Seattle has taken the lead in curbing diesel emissions from cruise ships by having them plug into the grid rather than run idle.[99] This would help clear up air emissions passing over Lake Superior and position the region as a clean-diesel fuel innovator.

Another model linking energy, the environment, and economic development is the Eco-Manufacturing Development (EMD) project. Bringing together American Indian, rural and business interests, the goal is to create a first-of-its-kind industrial park that is economically viable and environmentally friendly.[100] The anchor tenant of the business park will be a biomass plant primarily using wood waste, creating both electricity and heat for the surrounding buildings. Ideally the business park will attract numerous new businesses to tribal lands and the nearby communities, revitalizing the local economy. Energy education and training programs will be created to assist the local technicians and entrepreneurs and to disseminate information to other communities interested in developing similar models. This development plans to utilize plasma-torch technology that, if stationed strategically throughout the region, could also help curb waste-disposal concerns while providing electricity, heat, commercially viable by-products, and hydrogen.

Section 9.2 Developing Models for the Future

Since 1965, the number of electricity customers in the state has doubled. At the same time electric energy consumption has quadrupled.[101] Our natural gas consumption has increased by 25% since 1965, and we use ever-increasing amounts of oil for transportation.[102,103] This consumption impacts our economy, our security, and our environment. Every choice we make today shapes our future. Northeast CERT hopes to communicate how short-term choices make long-term impacts. If the Northeast Region were to take the lead today to drive a shift to wood-based biorefineries, they could forever change the future of the paper industry, create long-term viability for a major regional industry, reduce fossil-fuel energy usage, and help improve the environment. These win-win-win situations are the sort the team encourages.

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[99] Welch, Craig. September 30, 2004. "Voluntary Plan aimed at Cutting Emissions", *The Seattle Times*.
[100] Retrieved May 27, 2005. For more information, visit: http://www.cleanenergyresourceteams.org/pdf/Fond%20du%20Lac%20project%20brochure.pdf.
[101] Minnesota Department of Commerce. 2002. *The 2001 Minnesota Utility Data Book*. Tables 1 and 2. Retrieved on May 19, 2005 from http://www.state.mn.us/mn/externalDocs/Commerce/Utility_Data_Book,_1965-2000__030603120425_UtilityDataBook65thru01-2.pdf.
[102] Ibid. Tables 11 and 12.
[103] Energy Information Administration. 2003. *Annual Energy Review*. "US Oil Demand by Sector, 1950-2000."

It can be hard to drive such major change as revolutionizing the paper industry, but there are opportunities to model change on a smaller scale. The Northeast CERT has set out a goal to get an energy efficiency and/or renewable energy project at every school and/or community in their region. Through these projects Northeast CERT members are working to provide positive models and examples for communities to implement energy efficiency and renewable energy projects that will provide wins to the school by saving money, wins to the community by modeling sustainability, and wins to students through hands-on education.

These models are a critical step, because often schools and communities do not know where or how to start. Northeast CERT is working to provide these communities a starting point and to open the doors across cities, communities and school districts so that the whole region can benefit from innovative projects, ideas, and resources. Today many schools are making energy efficiency improvements to save on energy costs. It's possible to combine these energy savings with renewable energy projects to maximize the overall energy payback of improvements. By integrating these efforts schools are able to model creative solutions to the surrounding community and encourage further change.

Projects in schools also allow students to see energy efficiency and renewable energy as an integral part of the energy mix. By implementing projects at each school, students will be able to engage in hands-on learning. They will be able to work with the technologies, design green buildings, and evaluate optimal solar sites. They will be able to compare the economics of a small wind system against the economics of a large wind system as well as discuss the impact of energy choices with their peers, teachers, families, and neighbors. These hands-on projects will not only provide a dynamic education but will also prepare students for the renewable energy jobs of the future. It will help spawn a new generation of energy consumers – a generation of energy users that see efficiency and renewables as commonplace and a natural component of energy demand and supply.

In the future the Northeast Region will be full of a generation of citizens who do not see themselves as innovators in clean energy advancement, but rather see their actions as a natural progression of their experiences thus far. They will be creating jobs for their communities, taking advantage of local resources and preserving the natural beauty that makes northeast Minnesota a destination for tourists from around the world. Rather than dreaming about what it could be like, they will be living the future we imagine today. They will have, as the team envisions, designed a Minnesota clean

energy future that protects the environment while providing a positive economic impact on the region.