


CLEAN ENERGY RESOURCE TEAMS

Northwest 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

University of Minnesota Regional Sustainable Development Partnerships

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SECTION 1: INTRODUCTION TO CERTs

Section 1.1 Background on CERTs

The Clean Energy Resource Team 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 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 members have been active in each of the seven CERT regions (see CERTs Map). Teams include between 30 and 200 stakeholders representing area local governments, farmers, utilities, colleges, universities, businesses, and environmental and economic development groups. Many team members are deeply involved, 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 opinions and ideas on the regional CERTs listservs. 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 has had at least one workshop and has hosted a variety of speakers on energy related topics to help them understand the regional energy system and identify areas of regional economic opportunity. Tours of renewable energy and conservation projects in the region have also provided good examples of what can be done.

This plan is a result of careful study of a regional resource inventory. The inventory gave the teams a good understanding of the best regional opportunities. Each team had extensive and thoughtful discussions of their vision of the energy future for the region and the team mission and goals. Each of the visions articulated by the CERT in some way express a coupling of economic opportunity and environmental protection from development of 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 plans will be widely discussed throughout the region and input sought from a broad range of community interests. We look forward to community input on these draft plans and will incorporate changes in the final documents.

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, connecting with people that are in the business of energy, and having a say in how we 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/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 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. These project priorities were determined by evaluating the resources available in the region and then considering the region's priorities as reflected the team's goals. The regional resource inventory for the Northwest Region reflects strong local biomass capacity, strong potential for small-scale community projects, promising opportunities for biogas recovery at agricultural processing facilities, ample opportunities for increased energy efficiency measures like ground source heat pumps, as well as some opportunities for wind development.

Section 1.4 Overview of Regional Goals

The Northwest CERT set a goal to achieve a 1% per year improvement in energy conservation for the next 10 years and a goal for a 1% per year increase in renewable energy generation for the next 10 years with a focus on efforts that would provide generation opportunities within Northwestern Minnesota. The team felt these two goals gave the region something to strive for and allowed it to target its initiatives on local communities that would then realize the benefits of local generation.

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

Section 1.5 Overview of Best Bets

The regional resource attributes and regional vision and mission led the Northwest CERT to develop 3 best bet project ideas for the Northwest Region that focus on opportunities for increasing the utilization of ground source heat pumps in the region and expanding the use of both biomass and biogas in niche applications that would benefit local economies. These are described in full in Section 7.

SECTION 2: INTRODUCTION TO THE NORTHWEST REGION AND REGIONAL DEMOGRAPHICS

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

Section 2.1 An Overview of the Northwest Region

The Northwest Region is made up of 12 counties, Beltrami, Clearwater, Clay, Kittson, Lake of the Woods, Mahnomen, Marshall, Norman, Pennington, Polk, Red Lake, Roseau. According to the Ecological Classification System these counties encompass most of the Red River Prairie, the Aspen parklands, and the Agassiz lowlands (Figure 2).[1] The Northwest Region encompasses nearly all of the Red River of the North drainage basin and parts of the Rainy River Basin and Upper Mississippi River Basin (Figure 3).[2] Major waterways in region include the Red Lake River, Thief River, Clearwater River, Upper Red Lake, and Lower Red Lake.

Figure 2: Minnesota Ecological Classification System

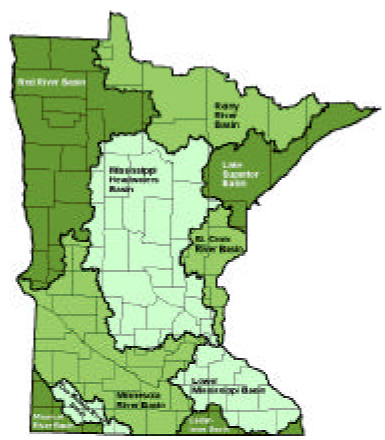

Figure 3: Minnesota Drainage Basins

In recent years water quality issues have been gaining attention throughout the state. The newly formed Green Lands Blue Waters initiative is one example of a broad based landscape project that focuses on watershed health and could be extended to the Red River Basin.[3] Water quality issues, including both phosphate and nitrate issues in the Northwest, and their mitigation require both improved practices in both urban and rural areas. While myriad options exist one which might help with soil fixation and

[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.
[3] For more information, please visit www.greenlandsbluewaters.org.

increased filtration, the growing of more perennial crops and cover crops, also helps increase potential biomass availability in the region. These crops are a natural source of biomass and show that the solutions to environmental issues can overlap with opportunities for renewable energy. Of course there are also instances in which environmental issues and renewable energy are not seen as synergies, such as with hydroelectric dams. As the DNR improves, rebuilds and repairs these systems, it would be ideal to find solutions that enhance fish movement and allow for energy generation if such pairings are possible.

Section 2.2 Regional Demographics

According the US Census, a total of 197,486 people were living in the 12 counties in 2000. Clay County had the largest population with 51,229 people, while Red Lake County had the smallest with only 4,299 people (Figure 4, Population Pie Chart by County)[4]. Although Red Lake is the smallest county in the region, the majority (over 61%) of the region's population is rural. Indeed, seven of the twelve counties show no urban population[5]. The breakdown between urban and rural (including both farm and non-farm) populations in each county is depicted in Figure 5. For Census 2000, the Census Bureau classifies as "urban" all territory, population, and housing units located within an urbanized area (UA) or an urban cluster (UC). It delineates UA and UC boundaries to encompass densely settled territory, which consist of:

- Core census block groups or blocks that have a population density of at least 1,000 people per square mile, and
- Surrounding census blocks that have an overall density of at least 500 people per square mile.

In addition, under certain conditions, less densely settled territory may be part of each UA or UC. The Census Bureau's classification of "rural" consists of all territory, population, and housing units located outside of UAs and UCs.[6]

[4] 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.

[5] Minnesota State Demographic Center. November 2002. *Minnesota County Profiles*. Retrieved March 28, 2005 from http://www.demography.state.mn.us/countyprof.html .

[6] Information taken from the Census 2000 "Urban and Rural Population" definition, at: http://www.census.gov/geo/www/ua/ua_2k.html. Referenced June 3, 2005.

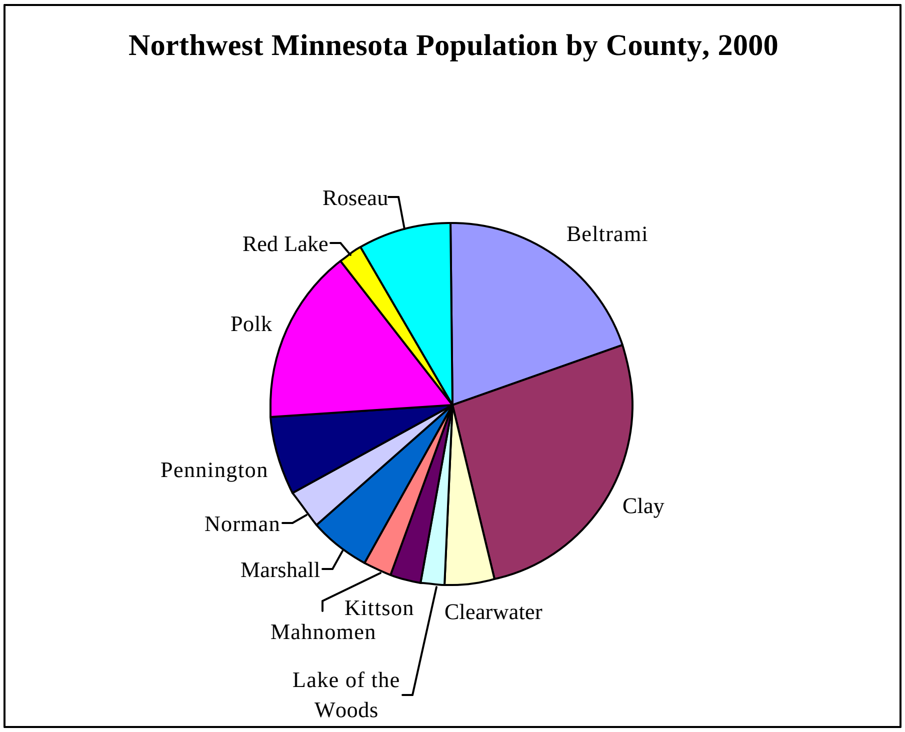

Figure 4: Northwest Minnesota Population by County

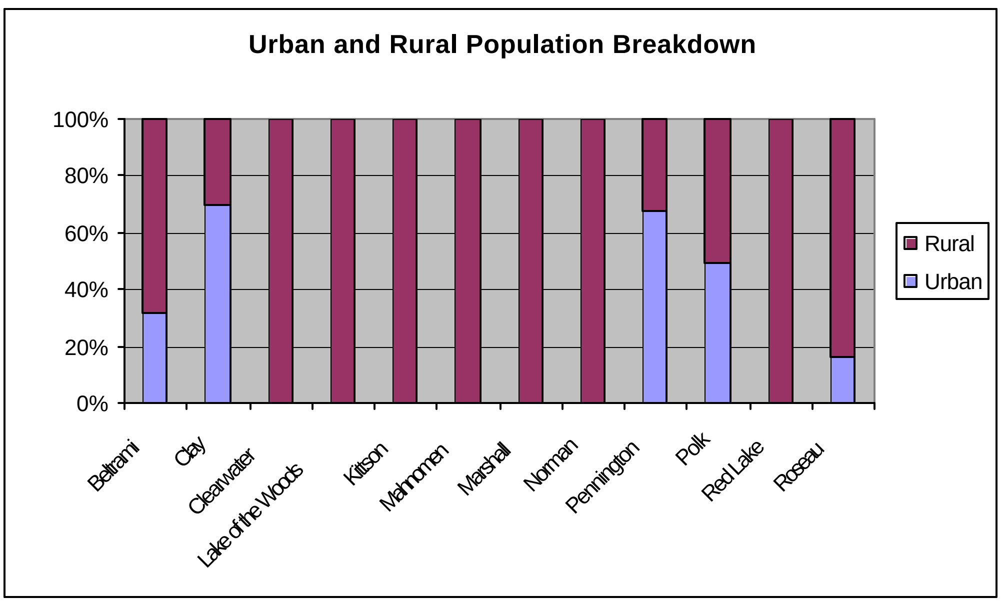

Figure 5. Northwest Population Breakdown, 2000

As Beltrami and Clay counties have the largest populations, it suggests that working with utilities serving those counties, like Ottertail Power, Beltrami Electric and Red River Coop, could be the best starting points for conservation. Possible options would be to work with Beltrami Electric and the "Get Charged, Electricity and You" curriculum to ensure that information about conservation, energy efficiency and renewables is included in the educational materials.[7] Another option is to encourage Red River Coop members to take advantage of their new Energy Star rebate program.[8] Efforts aimed at rural residents and farmers will be critical to success as so much of the region's population lives in rural areas.

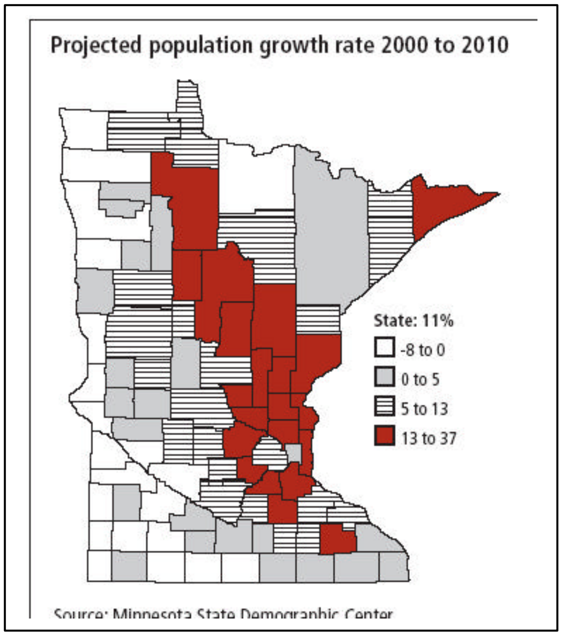

Figure 6: Population Projections

Population growth projections predict that as a region, the northwest population growth is fairly flat. Four northwest counties will have negative population growth between 2000 and 2010, five will be relatively stable, two will have moderate growth, and one, Beltrami, will have high (13-37%) growth (Figure 6).[9]

These numbers are important because as populations grow, so does energy use. As populations decline, so often does economic activity, thus depressing energy use. Better understanding population growth patterns helps target certain counties for increased energy efficiency measures, either to keep energy use from ballooning with population growth, or to help businesses save money and thereby remain competitive in an environment of population decline.

Section 2.3 Household Information

Northwest CERT explored these household variables to better understand where energy efficiency improvements in households might be most likely, might have the greatest impact, and might face the greatest challenges. Based on MN Demographer/US Census figures there are a total of 50,787 households in the region, and on average 8.3%

[7] General information provided on the Beltrami Electric Cooperative website. Accessed on April 4, 2005 from: http://www.beltramielectric.com/get_charged.htm.
[8] Red River Valley Cooperative Power Association website accessed on April 4, 2005 from: www.rrvcoop.com.
[9] 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.

of families living in the Northwest Region are characterized as living below poverty level.[10] While low-income earners are typically less able to make high upfront capital investments on energy efficient products and appliances, they could generally see the most benefit from these improvements as they spend a larger share of monthly/yearly income on energy. Partnering with and promoting the work of local Community Action Agencies, like the Mahube Opportunity Council, can help ensure that these families have access to these critical programs.

Another factor to consider is the average sale prices of homes, as this price can limit what kind of energy investments homeowners can make. In the Northwest region home prices range from $81,000 in Clay County to $29,000 in Kittson County. Since people are less likely to make energy investments that cost more than they can recoup in the sale of their homes, ground source heat pump systems that require a higher upfront cost may be less feasible in Kittson County than Clay County unless they can be wrapped into an energy efficiency mortgage during the purchase of a home.

Lastly, home ownership and owner occupancy rate also impact energy investments. While Minnesota ranks 2nd nationwide in home ownership at 74.6%, Bemidji has an occupancy rate of only 54.2%.[11] Part of this low owner-occupancy rate may be related to the high number of student renters attending Bemidji State University. Owner occupancy is an important factor because generally owners are more likely to make energy investments than renters, especially if the renters don't directly pay the utility bill or if an improvement would require a major investment. Therefore places like Bemidji that have larger renter populations may have a particularly difficult time getting residents to make efficiency upgrades unless they can target landlords or structure pricing breaks toward renter communities. One potential opportunity would be to work with landlords and Bemidji State University to ensure that all renters get compact-fluorescent light bulbs at the beginning of the school year. Perhaps Bemidji State could also include a segment on energy conservation during orientation and establish some sort of conservation incentive system with local landlords.

None of these three factors should serve as barriers, but rather should be seen as catalysts for encouraging approaches that would work best for a particular community. As these three factors combine, it is interesting to note that Beltrami County, the northwest county with the highest level of growth at over 14%, also has a large renter

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[10] Data compiled from US Census Bureau data on family income by county, Table QT-P35. "Poverty Status in 1999 of Families and Nonfamily Householders: 2000", Data Set: Census 2000 Summary File 3 (SF 3) - Sample Data (available from 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 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."

[11] Figure developed by aggregating county level data compiled from http://factfinder.census.gov/servlet/SAFFHousing?_sse=on.

population and the highest percentage of low-income earners making it a challenging, but extremely important county to target with efficiency measures.

Section 2.4 Land Use

According to the 1990s Census of the Land[12] the Northwest's dominant land use is cultivated land followed by forested land. Of the 10,256,614 acres in the 12 county region, 4,889,913 acres are described as cultivated land (47.7%). Forested land is the next largest category of land use at 2,329,613 acres (22.7%) and bog/marsh/fen as the third most common land use covering over 1.1 million acres. Only 117,797 acres are listed as urban and rural development – only 1.1% of the region.

These figures about land use matter because they speak to what land is available for renewable energy and what resources might already exist. In the Northwest cultivated land and forestry are the dominant land uses. This suggests that biomass, either from agricultural residues or woody residues, and biofuels are likely natural renewable energy resource fits for the region. Agricultural lands may also be ideal areas for wind energy development or for alternative crops that could serve as biomass feedstocks while simultaneously providing environmental services.

Section 2.5 Regional Economic Sector Breakdown

Based on figures adapted from the North American Industry Classification System (NAICS), the Northwest Region's 5,173 business establishments paid out $1,545,801,000 in 2002.[13] County level data reveals that the dominant industries in the region, based on payroll figures, are manufacturing, health care and social assistance, retail trade, construction and wholesale trade, however it should be noted that the data excludes data on self-employed individuals, employees of private households, railroad employees, agricultural production employees, and most government employees. Nonetheless, this data informs which sectors in the region might be some of the most important stakeholders in the region, and similarly where energy efficiency measures might be the most valuable. For more detailed information on the sector breakdown, please see Appendix A.

Section 2.6 Regional Environmental Concerns

It is difficult to discuss energy issues without also addressing environmental issues, as the two are so often interrelated. Indeed, the interactions between energy and environment are broader than we often realize. A few of the key environmental issues facing northwest Minnesota include:

- Water management – flooding is an on-going problem in the region
- Water quality – phosphate and nitrate impacts, turbidity problems

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[12] 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.

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

- Energy efficiency and cost of fuel for agriculture – concerns abound about the effects of global climate change on agriculture
- Wind erosion – strong prevailing winds from the west combine with fine soil particles to deposit particulates and pollutants (i.e., mercury) in waterways, in wetlands, and on the land
- Recreational land usage – older snowmobile and ATVs with 2-stroke engines can have air quality impacts

These issues are all interrelated and have something to do with energy. Erosion, water management and water quality, agriculture, and climate change are all connected. Agricultural best-management practices save energy and reduce the impact of run-off on surrounding waters by using fewer chemical inputs. Conservation tillage methods increase the carbon storage capacity of the soil. Cover crops and perennial crops help protect waterways by reducing soil erosion and cycling water and nutrients through living plant material. These buffer strips and riparian buffers provide natural filters that could help improve water quality and fix carbon all while growing a potential biomass energy source.

All-terrain vehicles (ATVs) and snowmobiles play a large role in the Northwest region. Polaris and Arctic Cat are major job creators in the region and both ATV and snow mobile tourism are large economic drivers. There are environmental impacts with off-road recreational vehicles, however. When ATV drivers stray from designated trails they can impose adverse effects on forest terrain, streams and wetlands. Older ATVs and snowmobiles also pose air quality impacts that are directly related to energy. Modern technology has greatly improved snowmobiles and ATVs, making newer models far more efficient and releasing far fewer emissions, but many people are still riding the older versions. Eventually the fleet of ATV and snowmobiles will change over, but in the meantime emissions will continue to be a problem. Hopefully in the future both snowmobiles and ATVs will be able to use biofuels, rather than diesel, as a primary fuel source thereby further reducing emissions.

SECTION 3: NORTHWEST CERT ORGANIZING

CERTs are community-based organizations that have sought to engage a variety of community stakeholders in shaping their energy plan and developing regional project priorities. This section details how the Northwest 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 Northwest CERT via letters of invitation, on-going press releases, follow up stories in the local press, announcements by the Sierra Club in their newsletters, at county fairs, on the CERTs website and word-of-mouth. Individuals who attended and signed in at meetings were added to the CERTs mailing list and/or list serve. Electronic invitations were sent to the Northwest list serve, which covered roughly 70 individuals, prior to each meeting. The meeting dates and locations were also posted on the CERTs website and advertised in local press releases. Meeting summaries were sent electronically to the list serve and posted on the CERTs website. Presentations from meetings were also posted to the website when available.

Section 3.2 Team Members and Structure

The Northwest team represents a wide variety of stakeholders including community action agency representatives, community developers, college and university educators, economic developers, entrepreneurs, farmers, foundation staff, non-profit representatives, researchers, state/federal agency employees, tribal government representatives, and utility representatives. For a complete list of team members please see Appendix B.

Section 3.3 Team Activities

The Northwest Region convened meeting throughout the initial two years of the project. The first meeting was held in October 2003. This first meeting served primarily as a way to inform participants about 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 Steering Committee conference calls.

The following lists all the meetings and general topics:

- September 23rd, 2003 – Steering Committee Meeting – planning for first meeting, targeting stakeholders
- October 21st, 2003 – Full CERT Meeting – Introduction to CERTs
- November 26th, 2003 – Steering Committee conference call – planning for January meeting
- January 7th, 2004 – Full CERT Meeting – Electrical Energy System, presentations from local utilities
- March 25th, 2004 – Full CERT Meeting – Making Renewable Energy Projects Happen, presentations on incentives and barriers to projects, distributed generation safety, and local projects
- April 26th, 2004 – Steering Committee conference call – planning for June meeting

- June 24th, 2004 – Steering Committee conference call – review of regional energy pies
- June 29th, 2004 – Full CERT Meeting – Mission discussion, discussion of energy mix
- August 17th, 2004 – Steering Committee conference call – planning for September meeting
- September 23rd, 2004 – Full CERT Meeting – Tour of University of North Dakota's Energy and Environmental Research Center, developing regional project priorities
- November 4, 2004 – Full CERT Meeting – Development of Task Lists for 3 Project Priority areas
- January 18, 2005 – Full CERT Meeting – Presentation on Nuts n' Bolts of Ground Source Heat Pumps from heat pump installer. Focused on updating task lists.
- April 11, 2005 – Full CERT Meeting – Meeting to update task lists, review Strategic Energy Plan, and plan for the second phase of CERTs.

A copy of each meeting agenda and each meeting summary is provided in Appendix C. Links to presentations given at team meetings are included in Appendix D.

Members of the Northwest CERT take a tour of the University of North Dakota's Energy and Environmental Research Center to learn about mobile biomass gasification technology.

SECTION 4: TEAM VISION, MISSION, GOALS

After lengthy discussion and input at two full team meetings, the Northwest CERT arrived at the following:

Goals:

- **CONSERVATION GOAL – 1% per year for 10 years**
- **RENEWABLE ENERGY GOAL – same as State Renewable Energy Objective 1% per year, to 10% by 2015** help identify these opportunities (this gets at the idea of connecting people)

Understanding the team's goals is critical to understanding what types of projects they have chosen to work on and emphasize. Much of the discussion around the team's goals related to what was realistic and feasible and how the team planned to shape regional goals into on-the-ground regional achievements. As mentioned in Section 2.3, there is ample opportunity for increased energy efficiency across nearly every sector. With fairly large land areas available and major efforts needed for conservation, ground source heat pumps seemed to offer huge savings if consumers were informed and the incentives were appropriately structured. In terms of the renewable energy goal, the team wanted to focus on finding ways to get the renewable energy development required under the renewable energy objective to happen in Northwest Minnesota. Indeed, many discussions focused on how to help local communities attract projects to their area thereby providing a means for future economic development. As mentioned in Section 2.4 the tremendous agricultural and forestry resources in the region offer significant opportunities for biomass fuels that can keep working lands working while providing additional economic prospects within the region.

SECTION 5: CURRENT ENERGY USAGE

Each CERT began its assessment work with an inventory of current energy use in the region. 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

The Northwest CERT began its energy use inventory by gathering information about electric use.

Section 5.1.1 Electric Utilities in the Northwest Region

There are 30 utilities serving Northwest Minnesota. Most of these utilities are municipal or cooperative distribution utilities. Ottertail Power is the only investor owned utility (IOU) serving the area. The regional distribution cooperatives buy their energy from either Great River Energy or Minnkota Power, the two generation and transmission "umbrella" cooperatives serving the area. Of the two generation and transmission cooperatives, Minnkota Power is by far the largest energy supplier in the region. Many municipal utilities in the region buy their power from the Northern Municipal Power Agency (NMPA), a municipal power umbrella organization that partners with Minnkota Power on generation and transmission projects. Missouri River Energy Services also supplies generation to the region but sells to other utilities not directly to end-users (Table 1: Utilities Serving the Northwest Region).

Any increase in energy conservation and energy efficiency, or change in the electric energy mix, requires active participation and collaboration with the local electric utilities. The utilities listed here will therefore be critical partners in moving the Northwest CERT goals and project priorities forward.

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

Table 1: Utilities Serving the Northwest Region

Utility Type	Utility
Investor Owned Utilities	Otter Tail Power Co.
Joint Action Agency	Missouri River Energy Services, Northern Municipal Power Agency, Minnesota Municipal Power Agency
Generation & Transmission Cooperatives	Great River Energy, Minnkota Power Cooperative
Distribution Cooperatives	Beltrami Electric Coop, Clearwater-Polk Electric Coop, North Star Electric Coop, PKM Electric Cooperative, Inc, Red Lake Electric Coop, Red River Valley Coop Power, Roseau Electric Coop, Wild Rice Electric, Coop Itasca-Mantrap Coop Electric, Lake Region Coop Electric Association, North Itasca Electric Coop
Municipal Utilities	Bagley Public Utility, City of Baudette, Fosston Municipal Utility, Halstad Municipal Utilities, Hawley Pub Utilities, Roseau Municipal Water & Light, Stephen Electric Dept, Thief River Falls Municipal Utility, City of Warren, Warroad Municipal Light & Power, Ada Water & Light Dept, Alvarado Electric Dept, Barnesville Municipal Electric, East Grand Forks Water & Light, Moorhead Public Service, Newfolden Electric, Nielsville Village Light System, Shelly Municipal Light Dept.

Section 5.1.2 Regional Energy Consumption

In 2000, the Northwest Region used 2,680,255 MWh of electricity. This total was determined by summing the megawatt-hour consumption figures from each of the 12 counties. The consumption patterns among counties mimicked the patterns illustrated in the population numbers (Figure 7). The cooperative utilities combine to supply over half of the load served in the Region. The municipal utilities in the region serve roughly one-third of the load (Figure 8)[14].

Evaluating use by sector shows that electric use in Northwest Minnesota is fairly evenly split, although farming accounts for a slightly larger share of total consumption (35%) than the other three sectors: non-farm residential, commercial, and industrial (Table 2).

[14] Source: Minnesota Department of Commerce, *The 2000 Minnesota Utility Data Book*, June 2002. The only Investor Owned Utility operating in Northwestern Minnesota is Ottertail Power. The value used to reflect Ottertail's regional share of consumption was 20% of its total MN consumption. The majority of cooperatives in the Northwest are part of the Minnkota Power Cooperative, three minor players are part of Great River Energy. The Municipal Utilities operating in Northwestern Minnesota are either part of Minnkota or are non-SMMPA munis.

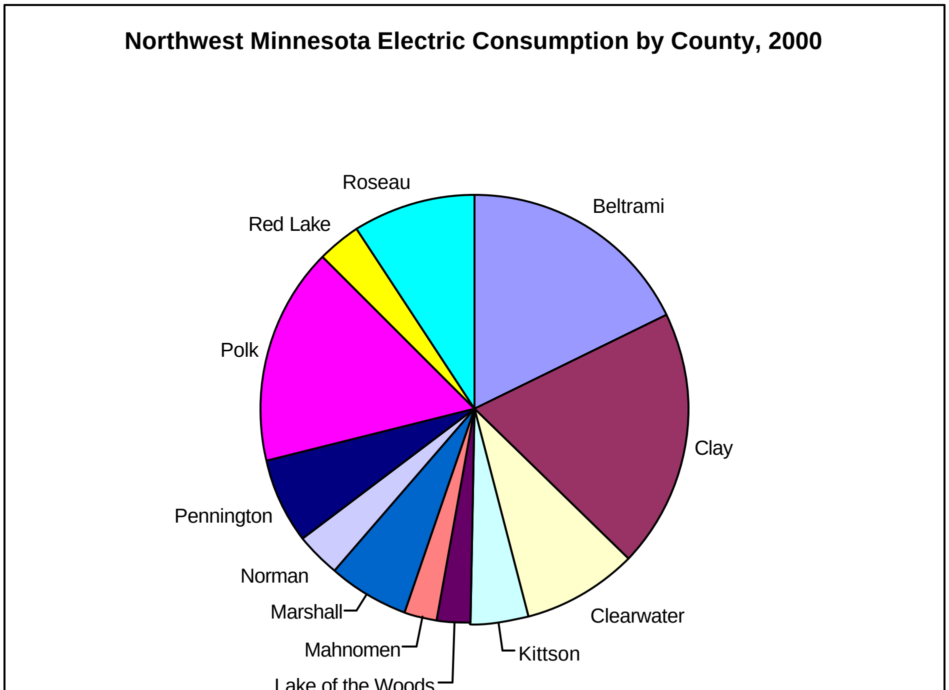

Figure 7: Electric Consumption by County

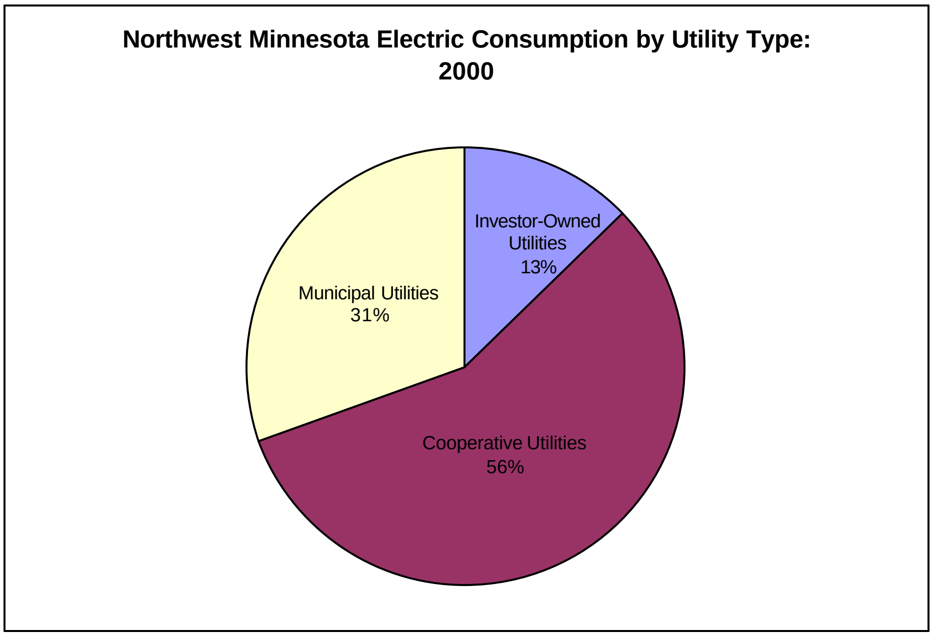

Figure 8: Electric Consumption by Utility Type

TABLE 2: NORTHWEST MINNESOTA ELECTRIC CONSUMPTION IN 2000 (MEGAWATT-HOURS)

	Farm	Non-Farm Residential	Commercial	Industrial	Total
Northwest Minnesota Electric Consumption for Investor-Owned Utilities					
Investor-Owned Utilities					
Otter Tail Power Co	-	456,616	655,436	702,951	1,815,003
Total: Investor-Owned Utilities[1]	-	91,323	131,087	140,590	363,001
Northwest Minnesota Electric Consumption for Cooperative Utilities					
Minnkota Power Cooperative - Cooperative					
Beltrami Elec Coop	233,277	4,622	57,211	-	295,110
Clearwater-Polk Elec Coop	5,959	48,445	9,307	-	63,711
North Star Elec Coop	69,563	2,212	30,328	-	102,103
PKM Electric Cooperative, Inc	68,908	-	18,401	-	87,309
Red Lake Elec Coop	86,133	-	*	*	103,196
Red River Valley Coop Power	84,408	-	21,842	-	106,250
Roseau Electric Coop	105,115	3,426	13,357	31,079	152,977
Wild Rice Elec Coop	150,180	11,770	*	*	192,500
Total: MPC - Cooperative	803,543	70,475	150,446	31,079	1,103,156
Itasca-Mantrap Coop Elec	16,165	65,239	*	*	172,237
Lake Region Coop Elec Assc	127,558	117,836	17,811	24,647	287,852
North Itasca Elec Coop	-	26,871	8,380	665	35,916
Total: Cooperative	947,266	280,421	176,637	56,391	1,599,161
Northwest Minnesota Electric Consumption for Municipal Utilities					
Northern Municipal Power Agency					
Bagley Pub Utility	-	6,397	5,224	12,335	23,956
Baudette City Of	-	4,815	16,715	-	21,530
Fosston Municipal Utility	-	10,146	13,675	6,756	30,577
Halstad Mun Utilities	-	4,559	4,508	-	9,067
Hawley Pub Utilities	-	8,627	8,357	-	16,984
Roseau Mun Water&Light	-	15,991	24,682	-	40,673
Stephen Electric Dept	-	4,140	5,207	-	9,347
Thief River Falls Mun Util	-	45,307	38,307	35,616	119,230
Warren City Of	-	7,604	8,405	-	16,009
Warroad Mun Light & Power	-	7,772	12,487	32,547	52,806
Total: MPC-Municipal	-	115,358	137,567	87,254	340,179
Municipals (Other Joint Action Agencies)					
Ada Water & Light Dept	-	10,793	8,982	162	19,937
Alvarado Electric Dept	-	1,969	994	-	2,963
Barnesville Mun Elec	-	11,855	6,592	-	18,447
East Grand Forks Water&Light	-	31,817	31,415	68,042	131,274
Moorhead Pub Service	-	131,313	37,092	178,561	346,966
Newfolden Electric	-	1,857	2,597	-	4,454
Nielsville Vlg Light System	-	546	130	-	676
Shelly Municipal Light Dept.	-	1,538	630	-	2,168
Total: Other Joint Action Agency Munis	-	191,688	88,432	246,765	526,885
TOTAL: Municipals	-	307,046	225,999	334,019	867,064
TOTAL NORTHWEST MINNESOTA	**947,266**	**678,790**	**533,723**	**531,000**	**2,829,226**

Section 5.1.3 Energy Sources Used in Electrical Generation

Each of the generation and marketing utilities, including Ottertail Power, Minnkota Power Cooperative, Northern Municipal Power Agency, Great River Energy and Missouri River Energy Services, have different generation sources. Most of Ottertail's generation comes from coal facilities in North Dakota. Minnkota's generation mix is roughly 10% hydro from the Western Area Power Administration (WAPA), with the rest generated using lignite coal in North Dakota. Great River Energy's resources are a mix of hydro, biomass, landfill gas, and coal, with the majority generated from coal. NMPA's resources are 35% renewable hydro from WAPA, with the remainder generated at their coal-fired power plant at Beulah, North Dakota. Roughly 60% of Missouri River Energy Service's generation comes from WAPA's hydro facilities while another 25% comes from a coal facility in Wyoming.[15]

Section 5.1.4 Environmental Impacts of Electrical Energy Generation

Electricity production, primarily from burning coal, is the greatest source of sulfur dioxide emissions (SO_2), the main cause of acid rain.[16] 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.[17] Burning of fossil fuels for electricity produces carbon dioxide emissions that contribute to global warming, 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.[18] Coal combustion also contributes to mercury, arsenic and lead emissions.[19] These toxic metals can accumulate in the fatty tissue of animals and humans leading to severe health problems.[20] Indeed, every spring the Minnesota Department of Health issues revised fish consumption advisories for Minnesota Lakes due to accumulation of mercury and PCBs in fish.[21]

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[15] Information in this section updated by Darryl Tveitbakk, General Manager, Northern Municipal Power Agency.

[16] 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.

[17] 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.

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

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.

[19] US Environmental Protection Agency. 2000. "Lead – How Lead Affects the Way We Live and Breathe." Retrieved June 3, 2005 from: http://www.epa.gov/air/urbanair/lead/index.html.

Minnesota Department of Health. 2005. "Fish Consumption: Frequently Asked Questions." Retrieved June 3, 2005 from: http://www.health.state.mn.us/divs/eh/fish/faq.html

[20] Ibid.

[21] Minnesota Department of Health. May 11, 2004, "Choose fish, but choose wisely, health department says." Retrieved on June 3, 2005 from: http://www.health.state.mn.us/news/pressrel/fishadv051104.html.

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.

Hydroelectric generation also has environmental impacts. These impacts include disruptions of hydrology, disruption of nutrient and sediment cycling (and all the resulting changes such as changes in fish communities and increase in downstream erosion), blocking of fish and invertebrate migrations, inundation and loss of habitats (aquatic and terrestrial), alteration of communities (aquatic and terrestrial, including human), alteration of water quality (including the production of methane gas from all the created reservoirs), and increase in susceptibility to exotics and pathogens. While these impacts are of great concern at large-scale hydroelectric facilities, there should also be a concern at small-scale hydroelectric facilities as even run-of-river dams impact fish migration.

Section 5.1.5 Existing Conservation and Energy Efficiency Programs

The Conservation Improvement Program (CIP) requires all of Minnesota's energy utilities 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 retail utilities put aside 1.5% of their revenues a year for their CIP energy efficiency programs. These funds are generally used to help customers buy energy efficiency products and processes.[22]

Ottertail Power offers several programs through its CIP funding including residential demand control rebates, rebates on energy efficiency appliances and equipment – particularly for businesses, and rebates on Energy Star rated air source and ground source heat pumps. Ottertail's website (www.otpco.com and www.conservingelectricity.com) also includes several on-line calculator tools to help customers compare the costs of natural gas, propane, fuel oil and electricity, do a home energy audit, and look up the operating costs of numerous home appliances.

Minnkota and its member cooperatives offer several options for electric heating customers including off-peak electric heat, which shaves Minnkota's peak demand and allows customers to pay a lower rate, and incentives for ground source heat pumps systems. Minnkota also publishes a home energy guide with energy saving tips including information about compact fluorescents and energy star appliances. Incentives offered by Minnkota's member coops vary but nearly all provide either loans or rebates for electric water heaters, heat pumps, and energy efficiency air conditioning

[22] 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

systems. Several coops provide rebates on Energy Star appliances, including Roseau and Red River Valley coops.

Great River Energy offers numerous energy efficiency and conservation programs through its Energy Wise program. Some of the program's offerings include rebates on high efficiency Energy Star air conditioners, refrigerators, clothes washers, dishwashers and compact fluorescents, residential and commercial energy audits, and commercial and industrial energy grants. Great River Energy also works with local Community Action Program agencies to design programs that target low-income households, such as weatherization and installation of efficient water heaters.

Section 5.1.6 Existing Renewable Energy Programs

Each of the major utilities in the region currently operates a green pricing program. These programs allow customers to voluntarily pay more for "green" electricity.[23] Minnkota Power Cooperative's program is called "Infinity Wind Energy"[24]. This program provides member cooperatives and NMPA's municipal utilities with wind power from two 900-kW turbines, one located near Valley City, North Dakota and another near Petersburg, North Dakota. Since their installation in 2002, these turbines have combined to provide an estimated annual output of 5.6 million kWh. More than 2000 customers of the cooperatives associated with Minnkota and the municipal utilities associated with Northern Municipal Power Agency have subscribed to purchase wind energy at a $1.50 surcharge per 100 kWh block.

The Wellspring Renewable Energy Program is a program offered by Great River Energy and its cooperatives.[25] It is a voluntary program that offers wind-generated electricity to co-op members. The wind energy for this program comes from nine giant turbines from the Chandler Hills Wind Farm that generates six MW of electricity. These turbines are located at Buffalo Ridge, Minnesota. Customers who choose to participate in this program may choose to buy wind energy in 100 kWh blocks for a nominal monthly fee. The number of customers who choose to subscribe to the service determines the number of turbines built, so if customer demand is high enough, the wind farm could be expanded.

Ottertail Power Company provides green power through its TailWinds Program that buys power from a wind turbine located near Hendricks, Minnesota. The 900-kw NEG Micon turbine was installed on December 28, 2001. Ottertail customers may enroll in the program by purchasing 100 kWh blocks for an additional $2.60. Ottertail states that

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[23] For more information about green pricing programs please see http://www.state.mn.us/mn/externalDocs/Commerce/Green_Power_012703040626_GreenPower.pdf.

[24] Minnkota Power Cooperative. "Infinity Wind Energy" Retrieved on April 4, 2005 from: http://www.minnkota.com/Documents/infinity%20brochure.pdf.

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

it monitors a green power waiting list and that it will construct additional turbines as the list grows large enough to justify them.

Section 5.2 Heat

Living in northwestern Minnesota, heat takes on a special meaning. Since it is so cold here for so much of the year, we use a lot of energy resources to keep our homes, buildings, and industries warm. By examining where heat comes from, the team is better able to understand the impacts of heating fuel use in the region and assess where to best make an impact with conservation, energy efficiency, and switching from expensive natural gas to locally grown heating fuels.

Section 5.2.1 Heat Sources

There are seven primary fuels used for heating in Minnesota:

- Utility gas: Also known as natural gas that is transported and distributed via pipeline (see Figure 9). Natural gas, or methane, is colorless and odorless in its pure form. Heat from natural gas is extracted in combustion. Because it burns cleaner than most major fuel sources, natural gas is being used more and more for electrical generation in addition to heat and other uses. These multiple end uses have combined to make natural gas prices more volatile.
- Bottled, tank or liquefied petroleum (LP) gas: Also known as Propane. It is a colorless gas of mixed hydrocarbons and is a by-product of natural gas processing and petroleum refining and can be delivered as a liquid making it easier to transport (and thereby making a likely heating source in communities that are not connected to a utility natural gas pipeline.
- Electricity: Electricity is the energy that is extracted from a number of different energy sources (like coal, nuclear, hydropower, and wind). When using electricity for heating, there are several different options available. Forced-air systems are electric furnaces that deliver heated air by fans through a network of ducts. Electric hydronic systems heat water centrally, and then circulate the warm water through radiators (either baseboard, free-standing or wall mounted) to rooms using an electric heat pump. Electric heat can also be provided by

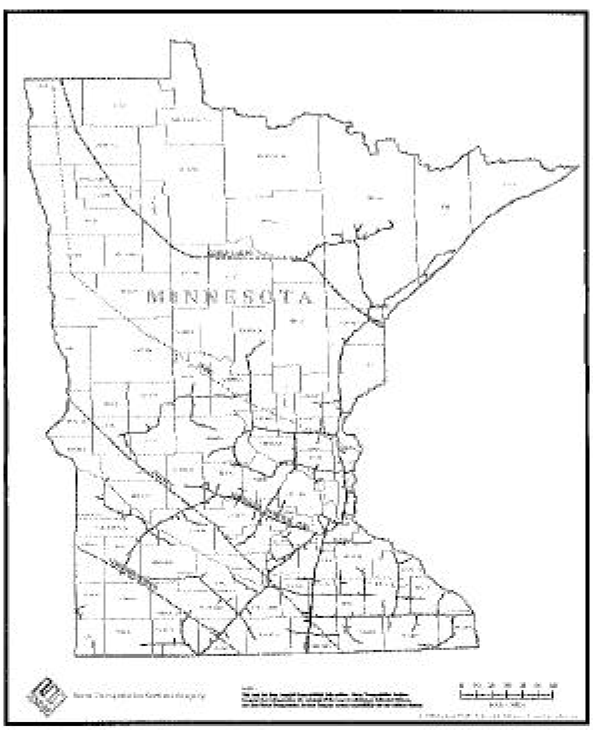

Figure 9: Natural Gas Pipelines

portable and wall systems if baseboard systems are not feasible, and there are combinations of electric systems such as wood-electric and oil-electric systems. Lastly, 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 are organic compounds that are separated out during the petroleum refining process. Both are used in residential heating.
- Coal or coke: solid, readily combustible, fossil fuel. Coal is burned to directly produce heat in coal furnaces or boilers. 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 done 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. Use of stoves and furnaces that can burn shelled corn is, like outdoor wood boilers, also becoming more common.
- Solar energy: For heating used in solar thermal applications.

Section 5.2.2 Major Heating Fuel Users

For home heating the primary fuel used in Northwest Minnesota are utility gas and electricity, which supply heat to 30% and 29% of the population respectively. LP gas and fuel oil are the other primary fuels used in the region although there are also many homes using wood (see Table 3).

Table 3: Northwest Region House Heating Fuel[26]

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

	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
Beltrami	14,337	4,446	3,149	3,566	1,493	-	1,425	-	165	93
Clay	18,670	7,365	1,709	6,022	3,065	22	191	5	141	150
Clearwater	3,330	394	678	876	817	-	541	-	10	14
Lake of the Woods	1,903	344	584	679	77	-	205	-	10	4
Kittson	2,167	327	586	473	701	-	74	-	4	2
Mahnomen	1,969	29	591	428	669	-	200	-	2	50
Marshall	4,101	833	956	1,110	946	-	231	-	4	21
Norman	3,010	523	613	815	909	2	144	-	4	-
Pennington	5,525	2,388	611	1,736	586	-	168	-	30	6
Polk	12,070	4,191	1,637	3,236	2,487	4	327	7	134	47
Red Lake	1,727	6	454	578	557	-	125	-	4	3
Roseau	6,190	1,302	1,551	2,159	736	-	383	-	53	6
TOTALS	**74,999**	**22,148**	**13,119**	**21,678**	**13,043**	**28**	**4,014**	**12**	**561**	**396**

The major fuel users in the Northwest Region are highlighted in Table 4. While this table shows all boiler fuel use, not just heating fuel use, nearly all of the facilities in the northwest are using their boilers for heat. A quick glance shows that natural gas, coal and wood waste are the three primary heating fuel sources used in Industry. The largest fuel users in the region are the American Crystal Sugar plants, which use the vast majority of their fuel (natural gas and coal) for processing sugar beets (heat), and the Potlatch facility in Bemidji that primarily uses wood waste. There are several other facilities that also play a major role in regional heating fuel use. All of these facilities could be targeted for efficiency upgrades and/or possible fuel switching. With rising natural gas prices industrial users may now have greater incentives to pursue efficiency upgrades, integrate waste heat recovery technologies, and switch to cheaper fuels like biomass.

Table 4. Major Fuel Users in Northwest Minnesota

COUNTY	CITY	NAME	ADDRESS2	ZIP_CODE	NATURAL GAS	FUEL OIL	LPG/PROP	WOOD WASTE	Coal	Coke
					Million British Thermal Units Consumed in 2001					
Aitkin	Hill City	ISD 002 - Hill City School	500 Ione Ave	55748			3,729	1,331		
Beltrami	Bemidji	ISD 031 - Bemidji Middle School	1910 Middle School Ave NW	56601	6,168		680			
Beltrami	Bemidji	ISD 031 - Bemidji Senior High School	201 15th St NW	56601	22,770					
Beltrami	Bemidji	Potlatch - Bemidji	US Highway 2 E	56601	204,706			5,770,714		
Beltrami	Bemidji	Potlatch - Lumbermill - Bemidji	RR 3	56601				266,240		
Beltrami	Solway	Northwood Panelboard Co	County Road 507 S	56678	71,960			680,998		
Clay	Barnesville	ISD 146 - Barnesville High School	302-324 3rd St SE	56514		3,067		3,093		
Clay	Dilworth	Dilworth-Glyndon-Felton Schools-School D	113 1st St NW	56529	5,171	2,230				
Clay	Glyndon	Dilworth-Glyndon-Felton Schools - School	513 Parke Ave	56547	4,235	1,549				
Clay	Moorhead	American Crystal Sugar - Moorhead	2500 11th St N	56560	615,721				1,884,507	132,136
Clay	Moorhead	Busch Agricultural Resources - Moorhead	2101 26th St S	56560	249,886	276,927				
Clay	Moorhead	Concordia College - Moorhead Campus	901 8th St S	56562	79,876	15,467				
Clay	Moorhead	KPLOP - Moorhead Products Terminal	1101 SE Main Ave	56560	206					
Clay	Moorhead	Minnesota State University Moorhead	1104 7th Ave S	56563	136,858	21,439				
Kittson	Humboldt	Viking Gas Transmission - Humboldt	County Road 6	56731	3,845					
Lake of the Woods	Baudette	Solvay Pharmaceuticals	210 Main St W	56623	27,314					
Mahnomen	Mahnomen	ISD 432 - Mahnomen Public School	310 Madison Ave	56557		3,329		13,568		
Norman	Ada	Viking Gas Transmission - Ada	1611 County Highway 142	56510	5,716					
Pennington	Thief River Falls	Arctic Cat Inc	601 Brooks Ave S	56701	67,231					
Polk	Angus	Viking Gas Transmission - Angus	County Road 20	56712	432					
Polk	Crookston	American Crystal Sugar - Crookston	Highway 75 S	56716	627,265				1,695,546	134,456
Polk	Crookston	Dahlgren & Co Inc	1220 Sunflower St	56716	323,532					
Polk	Crookston	Phoenix Industries of Crookston Ltd	1200 Bruce St	56716	7,453					
Polk	Crookston	University of Minnesota - Crookston	2900 University Ave	56716					63,105	
Polk	East Grand Forks	American Crystal Sugar - E Grand Forks	Highway 2 E	56721	1,128,641				3,982,556	228,189
Polk	Fosston	Polk Cnty Solid Waste Resource Recovery	Fosston Industrial Pk	56542	21,948					
Roseau	Badger	ISD 676 - Badger Public School	110 Carpenter Ave	56714		3,467				
Roseau	Roseau	Polaris Industries Inc - Roseau	301 5th Ave SW	56751	157,716					
Roseau	Warroad	Marvin Windows & Doors	Highway 11 W	56763	1,460			213,542		

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

Another option for heating fuel users is to begin blending coal-based systems with 10% biomass. Blending would "green" industrial operations, improve emissions, and in some instances could also help cut costs if the biomass could be provided for free from a local wood waste stream.

Section 5.2.3 Environmental Impacts of Heating Fuel Use

Fewer harmful byproducts are emitted from burning natural gas than in comparison to fossil fuels, however all produce emissions. Natural gas, in comparison to coal, emits fewer carbon dioxide emissions, fewer particulate emissions, fewer sulfur dioxide emissions, and fewer nitrogen oxide emissions. This generally makes natural gas a preferred fuel over 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 carbon neutral fuel and may therefore be preferable from a climate change perspective.

Section 5.3 Transportation

Although the Northwest CERT has largely focused on electricity during the first phase of their project, energy use from transportation plays a major role in both the state and the region.

Section 5.3.1 Vehicles in Region

Personal vehicles represent a major share of the state's transportation fuel consumption. Therefore, quantifying the amount of fuel used in personal transportation is critical to understanding regional transportation fuel usage. Data from the Department of Public Safety was used to identify the number and type of vehicles used in each county (Table 5). Based on this data, fuel usage estimates based on type of vehicle were used to estimate the amount of fuel used in each region. The Northwest Region is home to 251,338 titled street vehicles including 108,794 passenger cars and 49,362 pick-up trucks.

Section 5.3.2 Public Transportation

Based on US Census data for the Northwest region, 70,839 (84.8 %) full time workers drive to work alone, 12,071 (14.5 %) full time workers car pool to work, and 581 (0.7 %) full time workers take public transit to work. This led the team to inventory the existing public transit options available throughout the region. They found that nearly all of the Northwest Region's 12 counties have at least one public transit service provider, with the exceptions of Clearwater and Kittson, but that these services are somewhat limited in geographic scope (Table 6).

Table 5: Northwest Minnesota 2003 Motor Vehicle County Summary[27]

	Passenger	Pick Up Truck	Bus	Other Truck	Motorcycle	Recreational Vehicle	Moped	Van Pool	State Own Tax Exempt	Tax Exempt	No Registra-tion	County Total
Beltrami	19,714	8,973	33	1,560	963	352	21	0	64	160	0	47,229
Clay	29,001	9,024	65	1,801	1,221	319	25	0	125	159	0	55,794
Clearwater	4,644	2,731	22	778	245	129	1	0	1	136	0	12,543
Lake of the Woods	2,470	1,535	5	268	9	83	1	0	0	98	0	7,014
Kittson	2,854	1,806	5	512	111	54	8	0	0	53	0	7,431
Mahnomen	2,346	1,247	1	357	54	38	1	0	0	63	0	5,651
Marshall	6,174	3,364	2	1,144	337	106	5	0	0	153	0	15,544
Norman	4,351	2,370	3	659	146	63	1	0	0	176	0	10,616
Pennington	7,915	3,559	18	707	371	181	17	0	24	267	0	18,493
Polk	17,818	7,937	46	1,895	881	965	31	0	3	446	0	40,457
Red Lake	2,598	1,382	7	330	160	54	3	0	0	78	0	6,573
Roseau	8,909	5,434	15	1,163	454	192	10	0	1	239	0	23,993
TOTAL	**108,794**	**49,362**	**222**	**11,174**	**4,952**	**2,536**	**124**	**0**	**218**	**2,028**	**0**	**251,338**
Gallons per vehicle	551	645		4,637								
Total Gallons	**59,945,494**	**31,838,490**		**51,813,838**								**143,597,822**

[27] Data compiled from Minnesota Department of Public Safety. 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 power. Fuel consumption is via another vehicle which tows the trailers. Street Rod, Pioneer, Classic, Collector and Motorcycle (Classic) categories were all removed. Each of these is a type of collector vehicle which drive 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.

Table 6: Northwest Minnesota Public Transit

County	City	Transit Agency
Beltrami	Bemidji	Paul Bunyan Transit (PBT)
	Red Lake	Red Lake Transit (RLT)
Clay	Moorhead	Clay County Rural Transit (CCRT)
		Moorhead Metro Area Transit (MAT)
Lake of the Woods	Roseau	Far North Transit (FNT)
Mahnomen	Mahnomen	Mahnomen County Heartland Express (MCHE)
Marshall	Crookston	Tri-Valley Heartland Express Bus (The Bus)
Norman	Crookston	Tri-Valley Heartland Express Bus (The Bus)
Pennington	Crookston	Tri-Valley Heartland Express Bus (The Bus)
Polk	Crookston	Tri-Valley Heartland Express Bus (The Bus)
	Fosston	Fosston Community Transit Service (FCTS)
	Grand Forks, ND	City of Grand Forks Cities Area Transit (CAT)
Red Lake	Crookston	Tri-Valley Heartland Express Bus (The Bus)
Roseau	Roseau	Far North Transit (FNT)

Section 5.3.3 Major Highways, Railways, Airports

There are a few major roadways running through the Northwest Region. Running east-west through the region is US Highway 2. Interstate 94 and US Highway 10 enter the region in the very southwest corner. US Highway 59 in the west and US Hwy 71 in the east both run north-south across the region. There are also numerous other State Highways and County Roads running throughout the region. These highways and roadways, where they cross, and where they pass through major population center inform where E85 stations and biodiesel stations would likely get the most use and have the biggest impact.

There are 27 public airports in the region, nearly all of which are small, municipal airports (Table 7).[28] While not a focal point of Northwest CERT activities, air travel and shipping 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 Airport Partnership.[29] They are 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.

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

[29] More information about the Clean Airport Partnership can be found at www.cleanairports.com.

Table 7: Public Airports in the Northwest Region

Ada - Norman County/Ada/ Twin Valley Airport	Mahnomen County Airport
Bagley Municipal Airport	Moorhead Municipal Airport
Baudette International Airport & Seaplane Base	Nary National Airport (Shefland Field)
Bemidji - Beltrami County Airport	Piney - Pinecreek Border Airport
Bemidji – Moberg Air Base, Seaplane Base	Red Lake Falls Municipal Airport
Bowstring Airport	Roseau Municipal Airport (Rudy Billberg Field)
Crookston Municipal Airport (Kirkwood Field)	Stephen Municipal Airport
Fertile Municipal Airport	Thief River Falls Regional Airport
Fosston Municipal Airport	Warren Municipal Airport
Grygla Municipal Airport (Mel Wilkens Field)	Warroad International Airport (Swede Carlson Field)
Hallock Municipal Airport	Waskish Municipal Airport
Karlstad Municipal Airport	Waubun Jolly Fisherman Seaplane Base

There are seven railways serving the region. These include Burlington Northern Santa Fe (BNSF), Canadian National (CN), Canadian Pacific Railway (CPR), Minnesota Northern, (MNN), and Northern Plains Railroad (NPR) (Figure 10).[30] 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. Some railroad companies are already beginning to make these changes. For example, the Minnesota Prairie Line Railroad is currently pioneering the use of a biodiesel in its locomotives. In October 2004 it became the first railroad in the country to power its locomotives with a 2% biodiesel blend. Union Pacific Railroad is also piloting a diesel-electric hybrid locomotive in California. The switch engine is expected to emit far fewer pollutants and use 40-70% less diesel fuel than its purely diesel counterparts.[31]

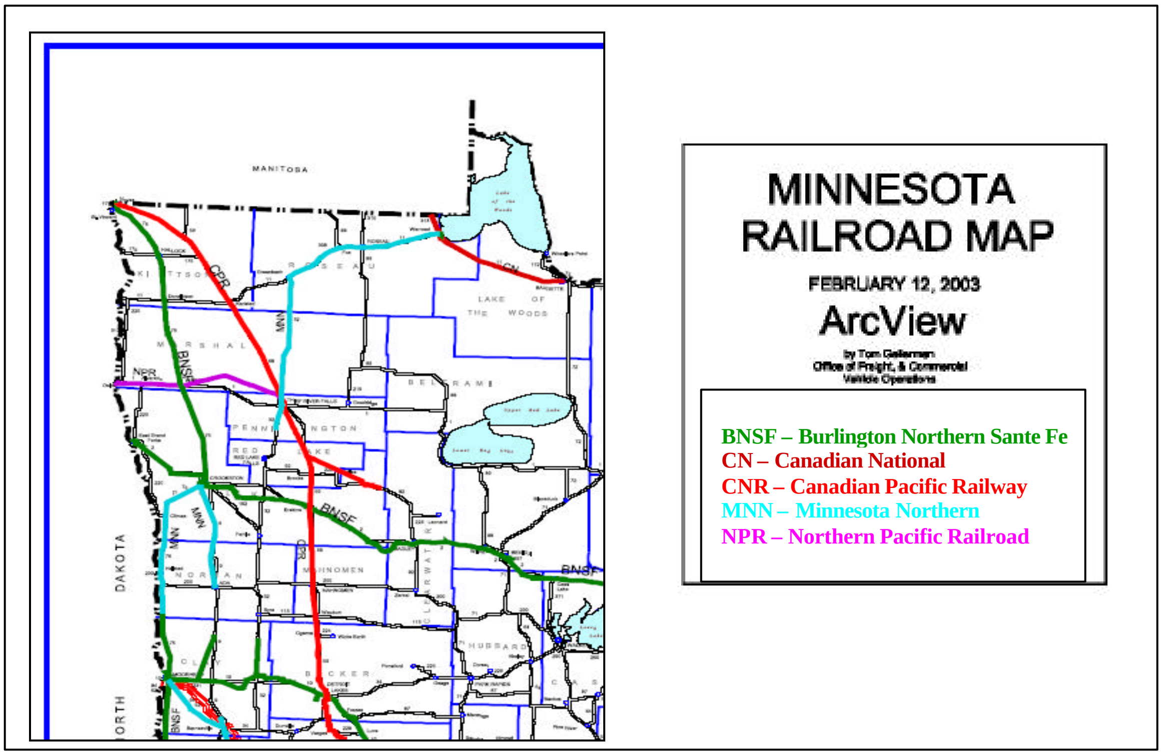

Figure 10: Northwest Minnesota Railroad Map

Section 5.3.4 Estimated Amount of Consumption

While it is difficult to obtain estimates for fuel use from each of the individual motor vehicle categories, the Energy Information Administration does provide fuel consumption (gallons per vehicle) estimates for passenger cars, pickup trucks, and

[30] Adapted from http://www.dot.state.mn.us/ofrw/maps/statemap.pdf

[31] Thermos, Wendy and Deborah Schoch. 16 March 2005. "New Hybrid Locomotive's Emissions are Clean as a Whistle," *Los Angles Times*.

other trucks.[32] Combined these three categories alone account for over 243 million gallons of fuel consumption in the region. Bus, recreational vehicle and tax-exempt vehicle use surely pushes this number higher.

At this time, we have been unable to assess fuel use associated with rail and air shipping/travel.

Section 5.3.5 Origin of Fuels

All of transportation fuels used in the state, other than ethanol and biodiesel, come to Minnesota via out-of-state sources, as Minnesota has no petroleum reserves. Just as coal for electricity, this is another example of how Minnesotan's rely on out of state resources to fulfill their energy needs rather than relying on home-grown energy resources. Shifting to greater percentages of ethanol and biodiesel, while also increasing the efficiency of our transportation operations, would allow Minnesotan's to keep more of their energy dollars local and therefore see more of those economic impacts in local communities and on local farms.

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 all of the crops in the Northwest.

5.4.1 Major crops/livestock Grown in the Region

The Northwest region grows numerous crops including corn, soybeans, hay, sugar beats, potatoes and wheat (Table 8). The region actually accounts for about half of all sugar beets grown in the state, half of all edible beans grown in the state, 60% of all sunflowers grown in the state, around 80% of all barley, and nearly all of the flax.[33] The region also raises livestock but in smaller numbers.

5.4.2 Estimated Energy Use by Crops and Livestock

All of the crops and livestock grown in the region require energy inputs – both direct inputs and indirect inputs. Direct inputs include diesel and gasoline used to run farm equipment like tractors and trucks, electricity for powering buildings and crop drying, and liquid petroleum which is also used for crop drying. Indirect inputs include fertilizers, herbicides, insecticides, fungicides, anhydrous ammonia, and urea. To quantify these energy inputs, the team used per acre fuel consumption (farm level)

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[32] More information is listed at: http://www.eia.doe.gov/emeu/aer/pdf/pages/sec2_23.pdf

[33] US Dept of Agriculture, National Agricultural Statistics Service. 2004. *Census of Agriculture*. Retrieved on April 1, 2005 from: www.nass.usda.gov/mn.

estimates for diesel, gasoline, liquid petroleum (LP), electricity, and natural gas.[34] These calculations show that diesel, electricity and natural gas are the major agricultural inputs in the region (Table 9). They also demonstrate that for crops potatoes and sugar beets require the highest energy inputs per acre. Indeed, both potatoes and sugar beets require nearly four times more diesel per acre and at least three times more electricity. Potatoes, sugar beets and corn all require major natural gas inputs due to both crop drying and indirect energy inputs in fertilizers.

[34] 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. A summary of the figures can be found in the presentation entitled: Agricultural Energy: Understanding Usage. Anticipating Policy Directions (http://www.misa.umn.edu/, School of Agriculture Endowed Chair).

Table 8: Northwest Agricultural Figures, 2002 and 2003[35]

COUNTY	NUMBER FARMS 2002	FARM LAND ACRES 2002	CORN ACRES 2003	SOYBEAN ACRES 2003	HAY ACRES 2003	SUGAR BEET ACRES 2003	IRR POT. ACRES 2002	DRY POT. ACRES 2002	WHEAT ACRES 2003	DAIRY COWS 2003	BEEF COWS 2003	BEEF FINISHERS 2003	TOTAL HOGS 2003	FARROWEI HOGS 2003
Beltrami	746	232,735	4,400	3,600	53,500	-	-	-	6,400	2,100	11,300	800	-	-
Clay	877	600,600	41,700	159,500	27,900	55,000	-	2,058	157,600	1,900	4,400	2,000	19,000	2,000
Clearwater	627	226,452	3,600	6,000	49,600	-	1,441	1	6,600	1,100	9,600	100	-	-
Kittson	659	555,561	5,400	78,000	27,900	34,100	-	1,480	177,400	1,700	7,200	600	1,400	500
ake of the Woods	266	152,491	-	-	14,500	-	-	542	17,000	200	2,100	-	-	-
Mahnomen	363	194,854	16,300	55,700	18,800	4,400	-	-	30,000	1,800	3,200	600	-	-
Marshall	1,409	934,932	7,600	167,400	33,300	45,400	-	1,905	223,300	1,800	5,900	600	-	-
Norman	660	527,283	30,000	168,400	14,000	46,300	-	189	156,200	2,100	2,500	900	3,000	700
Pennington	610	331,574	1,600	85,100	28,600	-	-	-	66,100	600	3,700	100	-	-
Polk	1,518	1,111,199	24,000	280,400	36,200	99,200	844	5,898	297,000	2,600	7,500	1,200	9,500	2,700
Red Lake	378	226,944	5,500	68,000	15,900	1,100	1,000	-	53,200	1,000	4,300	300	-	-
Roseau	1,238	702,918	6,400	41,100	54,600	100	-	3	127,500	2,400	9,000	400	-	-
TOTAL	**9,351**	**5,797,543**	**146,500**	**1,113,200**	**374,800**	**285,600**	**3,285**	**12,076**	**1,318,300**	**19,300**	**70,700**	**7,600**	**32,900**	**5,900**

[35] Number of Farms and Land in Farms (http://151.121.3.33:8080/Census/Create_Census_US_CNTY.jsp#top)
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)
Acres of sugar beets (http://www.nass.usda.gov/mn/sugarb03.pdf, planted acres).
Acres of potatoes (http://www.nass.usda.gov/census/, pototoes, acres and irrigated acres)
Acres of wheat (http://www.nass.usda.gov/mn/allwht04.pdf, planted acres).
Number of milk/dairy cows and beef cows (http://www.nass.usda.gov/mn/Agstat04/p074075.pdf)
Number of beef finishers (http://www.nass.usda.gov/mn/catsh04.pdf)
Number of hogs and annual farrowings (http ://www.nass.usda.gov/mn/Agstat04/p078079.pdf)

Table 9: Northwest 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	146,500	1,372,705	168,475	1,403,470	5,219,795	577,943
		Acres X 7.43	Acres X .91	Acres X .75	Acres X 27.50	Acres X .199
SOYBENS	1,113,200	8,271,076	1,013,012	834,900	39,663,316	4,391,574
		Acres X 9.80	Acres X .81	Acres X 0.0	Acres X 37.23	Acres X 0.719
ALFALFA/HAY	374,800	3,673,040	303,588	-	13,953,804	269,481
		Acres X 40.33	Acres X 2.00	Acres X 0.0	Acres X 100.75	Acres X 2.950
SUGAR BEETs	285,600	11,518,248	571,200	-	28,774,200	842,520
		Acres X 48.89	Acres X 2.00	Acres X 0.0	Acres X 319.22	Acres X 8.801
IRR POT	3,285	160,604	6,570	-	1,048,638	28,911
		Acres X 24.18	Acres X 2.00	Acres X 0.0	Acres X 205.27	Acres X 2.931
DRY POT	12,076	291,998	24,152	-	2,478,841	35,395
		Acres X 7.24	Acres X .89	Acres X 0.82	Acres X 29.88	Acres X 1.749
WHEAT	1,318,300	12,919,340	1,067,823	1,081,006	49,080,309	9,478,577

Table 10: Northwest Agricultural Energy Use for Livestock

LIVESTOCK	NUMBERS of ANIMALS	DIESEL	GAS	LP	ELECTRICITY
		Cows X 34.5	Cows X 3	Cows X 16.50	Cows X 600
DAIRY COWS (HD)	19,300	665,850	57,900	318,450	11,580,000
		Hog Litters X 9.55	Hog Litters X 1.11	Hog Litters X 4.06	Hog Litters X 148.25
HOGS FARROW (LIT)	5,900	56,345	6,549	23,954	874,675
		Hogs X 1.11	Hogs X .11	Hogs X .34	Hogs X 12.38
HOGS FINISH (HD)	32,900	36,519	3,619	11,186	407,302
		Beef Cows X 6.37	Beef Cows X .74	Beef Cows X 1.62	Beef Cows X 59.25
BEEF COWS (HD)	70,700	450,359	52,318	114,534	4,188,975
		Beef Finish X 4.78	Beef FinishX .46	Beef Finish X 1.08	Beef Finish X 39.38
BEEF FINISH (HD)	7,600	36,176	3,496	8,208	299,288

Electricity is the major energy input for livestock operations. Dairy operations are heavy consumers of electricity – and far greater consumers that other livestock operations – due to their energy needs for lighting, fans and ventilation, pumping motors, and milk chillers. Farrowed hogs (baby pigs) are the next largest livestock energy consumer because of the energy they need to stay dry and warm (propane heating and electric heat lamps) and for ventilation.

In nearly all categories wheat is the major agricultural energy consumer in the Northwest (Table 9). In spite of its lower per-acre energy input requirements, wheat is the most widely cultivated crop in the region and therefore uses the highest amounts of energy. For example, while corn requires roughly double the natural gas input per acre of wheat, wheat still consumes the major share of the natural gas for agricultural needs in the northwest because there are roughly ten times as many acres of wheat grown in the region.

5.4.3 Opportunities for Greater Agricultural Energy Efficiency and Fuel Substitution

Agricultural energy efficiency has improved since the mid-1970s, but numerous opportunities and methods are still available to further improve agricultural efficiency. Mechanical improvements, 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 and more efficient heating and cooling systems. Efficiency can also be maintained by ensuring that all equipment, from tractors to grain driers to irrigation engines, is in good working condition. Farmers should ensure that tires are properly inflated, air filters, fans and screens are cleaned or replaced, and all moving parts are well lubricated.

Precision farming could also help minimize waste, increase outputs and minimize environmental impacts often associated with over-application of chemicals because it tailors field management to site specific conditions rather than a whole field average.[36] Nutrient management practices that incorporate soil tests as means of determining optimal timing and rates for fertilizer application also allow farmers to tailor their on-farm management to current local conditions thereby decreasing field inputs, saving the farmer money, and avoiding fertilizer run-off.

Conservation tillage practices may offer the greatest room for improvement. Conservation tillage practices describe farming practices that allow plant residue or

[36] 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.

stubble to remain on the surface of the field, rather than 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 over conventional tillage methods. While this method may not be realistic in Northwestern Minnesota where farmers generally need till to speed spring soil warming, mulch till practices may be an option and would still result in savings of 2.5 gallons of diesel fuel per acre over conventional methods.[37]

Farmers are also well equipped to substitute renewable fuels and supplies into their energy mix. Some changes are switches 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. Other changes might require a little more time, but are also readily available options. Wind energy presents farmers with a means of offsetting their own electric use, or to develop an additional cash crop on their lands. Biogas from anaerobic digestions is a way that dairy farmers can either offset their heating fuels 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.

[37] Ibid, p.37-38.

SECTION 6: REGIONAL RESOURCE INVENTORY AND ASSESSMENT

Section 6.1 Conservation and Energy Efficiency

Each of the teams has been focused on energy efficiency and renewable energy, but sometimes the energy efficiency piece just doesn't seem very glamorous. Installing a new wind turbine is something everyone can see. Installing a whole building full of compact fluorescent light bulbs doesn't garner nearly as much attention. Despite the real dollar savings energy efficiency can provide, energy efficiency is often still neglected. Due to energy efficiency technologies adopted since the shock of the 1973-74 Arab oil embargo, it is estimated that the US saves $150 to $200 billion annually in energy costs.[38] That's both big money, and money that can be kept right here at home for other projects. The Northwest CERT is trying to refocus attention on energy efficiency and conservation by helping people realize all the benefits these savings can provide.

6.1.1 Existing Models of Efficiency and Conservation

As mentioned in Section 5.1.5 utilities in the region offer several potential models for energy efficiency and conservation improvements and help link customers with incentives and information to become more energy conscious. The Minnesota Department of Commerce State Energy Office also provides extensive information on different energy saving ideas for citizens, communities, and businesses (www.commerce.state.mn.us, Energy Info Center). They offer monthly energy saving tips that any homeowner could utilize and a special "kids only" section designed to teach elementary and middle school age kids about energy and what they can do to utilize energy efficiently.

Programs like the Schools for Energy Efficiency program and JCI Academy target schools for efficiency upgrades while integrating classroom and educational activities to teach kids about energy use. The Schools for Energy Efficiency (SEE) program is designed to produce energy savings that result in economic savings schools can reinvest in educational programming. SEE focuses on no-cost and low-cost energy solutions, including behavior change, to help schools decrease their annual energy use by 10%.[39] JCI Academy of Energy Education links educational programming to systems upgrades performed by Johnson Controls. It strives to education students, teachers and

[38] Pawlisch, Melissa, Carl Nelson, Lola Schoenrich. 2003. *Designing A Clean Energy Future: A Resource Manual*. P. 15. Retrieved on February 9th, 2005, from: www.cleanenergyresourceteams.org.

[39] For more information please see: http://www.hallbergengineering.com/SEE/SEE.pdf.

administrators about their energy choices via curriculum as well as action-oriented activities such as energy patrols.[40]

Another possible model is performance contracting. Performance contracting is basically an alternative way to finance energy efficiency improvements by allowing business to pay off the project costs with money saved from efficiency improvements. Performance contracting entails a business hiring an energy service company to conduct and energy audit, determine potential for energy savings, and then make recommendations for improvements. These improvements are intended to save enough energy, and thereby money, to pay for all improvements over the life of the contract which is generally around 10 years.[41]

6.1.2 Potential for Energy Efficiency and Conservation Improvements

There is potential for improved energy efficiency and conservation in nearly every sector. The residential sector can be an easy place for individuals to start. Utility CIP programs and Community Action audit and weatherization programs are already funded and up and running, but often people don't take advantage of the programs that already exist. Homeowners can make sure their homes are well insulated, replace incandescent bulbs with compact fluorescents, and replace older appliances with energy efficient Energy Star appliances. They can also avoid doing non-essential chores during peak load hours.

On the commercial front, many commercial facilities could improve efficiency by simply upgrading their lighting fixtures to more efficient systems, like switching from T-12s to T-8s. Businesses can make improvements far beyond lighting however. According to the American Council for an Energy-Efficient Economy, systems-based efforts like comprehensive commercial retrofit programs that integrate a range of retrofits, building upgrades, operations and maintenance improvements as well as their interactive effects can save up to 26% of total building energy use.[42]

Industrial users also have myriad ways to improve efficiency including making lighting upgrades and installing occupancy sensors. Industrial facilities, like schools, government buildings, and commercial structures, could also benefit from integrated control systems that allow facilities operators to stage equipment cycling and ensure

[40] For more information please see: http://www.johnsoncontrols.com/cg-education/academy.htm.
[41] 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.
[42] Amann, Jennifer Thorne and Eric Mendelsohn. 2005. *Comprehensive Commercial Retrofit Programs: A Review of Activity and Opportunities.* Washington, DC: American Council for an Energy-Efficiency Economy. Retrieved May 9, 2005 from: http://aceee.org/pubs/a052.pdf.

that systems don't all come on at the same time, thus decreasing peak demand charges. Indeed, the American Council for an Energy-Efficient Economy estimates that optimizing motor systems alone could save 15-25% of US electricity.[43]

6.1.3 Opportunities for Energy Efficiency Projects

As noted in Section 5.2.2, nearly a third of the residences in Northwest Region are heated via electricity. This presents an opportunity for businesses and homeowners using electric heating could see great efficiency improvements by using ground source heat pumps. To capitalize on this opportunity the Northwest CERT is currently developing a heat calculator that shows the relative efficiency and costs of various heating systems. The team hopes that by showing builders, contractors, and customers how much money they should save over time they will encourage more people to consider installing ground source heat pumps.

University of Minnesota Crookston is also pursuing an energy efficiency project that could serve as a model for the region. The project plans to assess on-campus energy usage and environmental factors and then utilize a systems-based approach to suggest improvements such as energy efficient landscaping, waste recycling, changes in lighting and window shades and behavior change.

Section 6.2 Wind

In the United States, and in Minnesota in particular, wind energy is a fast growing industry. Technologically, the industry continues to advance making ever-larger turbines that can capture more wind energy at lower and lower wind speeds. In the political sphere, the recent continuation of the wind production tax credit is sure to spark record installations across the country during 2005.

6.2.1 Wind Assessment

In Minnesota the wind industry has been concentrated primarily in the southwest portion of the state. Much of the western edge of the state however, from Canada to Iowa, actually has sufficient wind energy potential. The Minnesota Department of Commerce wind maps depict this trend (Figures 11 and 12).

According to the American Wind Energy Association (AWEA), an average wind speed of over 4 meters/second is needed to run small wind electric turbines (these turbines are usually for supplying a household or small farm with electricity) and over 6

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[43] Nadel, Steven et. al. 2002. *Energy-Efficient Motor Systems: A Handbook on Technology, Program, and Policy Opportunities, 2nd Edition.* Washington, DC: American Council for an Energy-Efficiency Economy. Retrieved May 9, 2005 from http://aceee.org/Motors/mtrbk.htm

meter/second is required for utility-scaled turbines.[44] Although site-specific monitoring is always critical in wind resource assessment, comparing these general wind speed guidelines to the wind speed maps suggests that much of the Northwest Region has sufficient wind for some sort of wind development. According to the Department of Commerce February 2000 "By Wind Speed Class (50 Meter)" map, nearly all counties in the region, have at least some land that could support either a small-scale or utility-scale turbine. This is even more likely as new utility-scale turbines reach hub heights of 70 and 90-meters.

Based on current data, it appears the most promising locations may be in Kittson, Marshall, Polk, Pennington and Clay counties, although several other counties may also have promising locations.

6.2.2 Opportunities of Additional Wind Monitoring

The Minnesota Department of Commerce monitors wind speed and power throughout the state. To create their wind maps the Minnesota Department of Commerce initiated its Wind Resource Assessment Program in 1982. Thus far most of the monitoring has been at sites located in the western and southern parts of the state and therefore the wind resource estimates for that part of the state are more accurate than those made for the central and northeastern parts of the state.

As of 2002 there were only a few monitoring sites in Northwest Region. To better estimate the potential for wind energy in our region more monitoring sites must be put into place especially in the east. The Red Lake Reservation has put monitoring stations on their land but gaps remain. Department of Commerce has acknowledged the need for better statewide monitoring and plans to continue expanding wind-monitoring locations. The Department also intends to monitor wind speeds at high altitudes to better match current turbine height. CERT members are also interested in the possibility of putting monitoring equipment on existing wind and cell towers.

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[44] AWEA, "Frequently asked questions" www.awea.org.

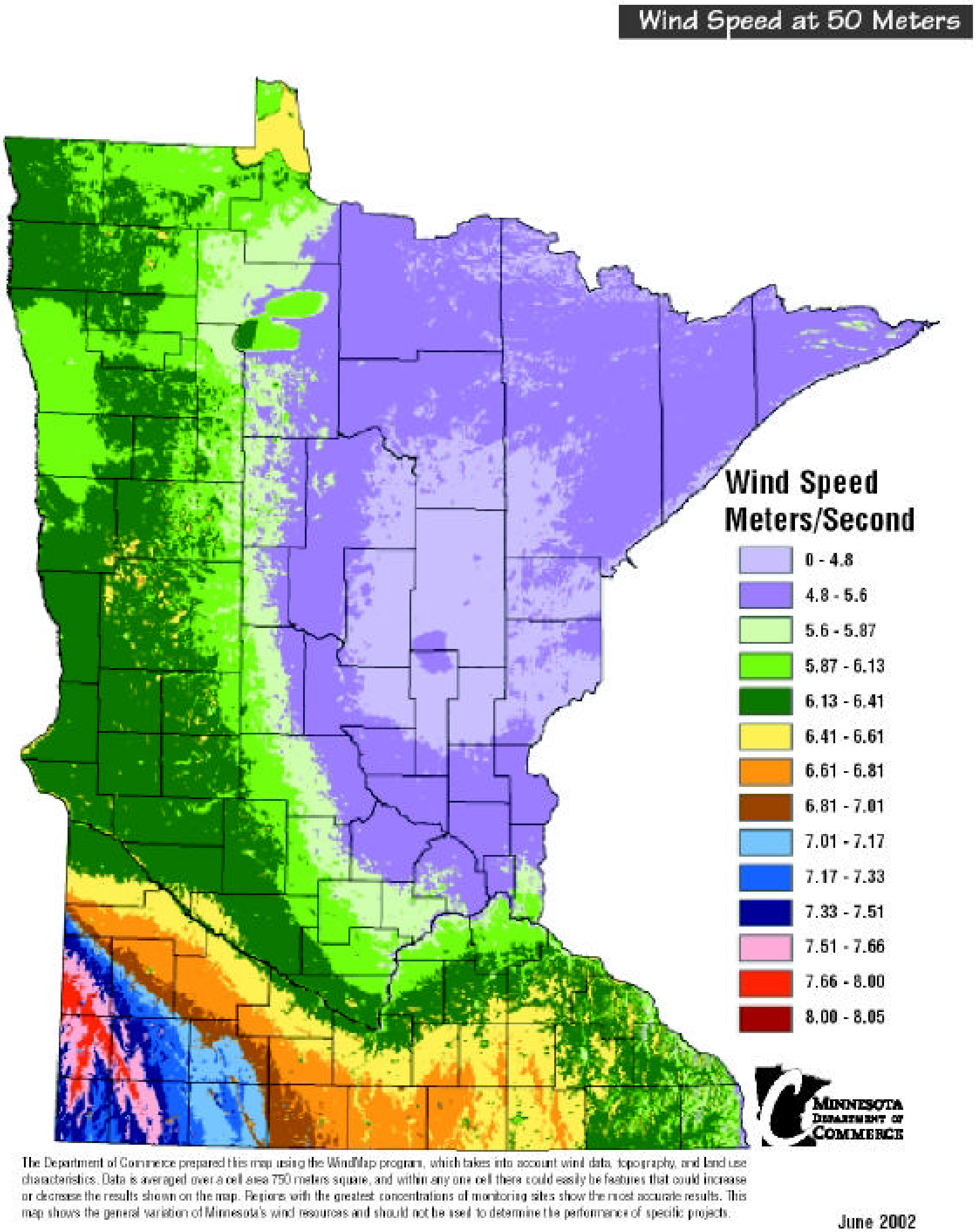

Figure 11: DOC Wind Map at 50 meters

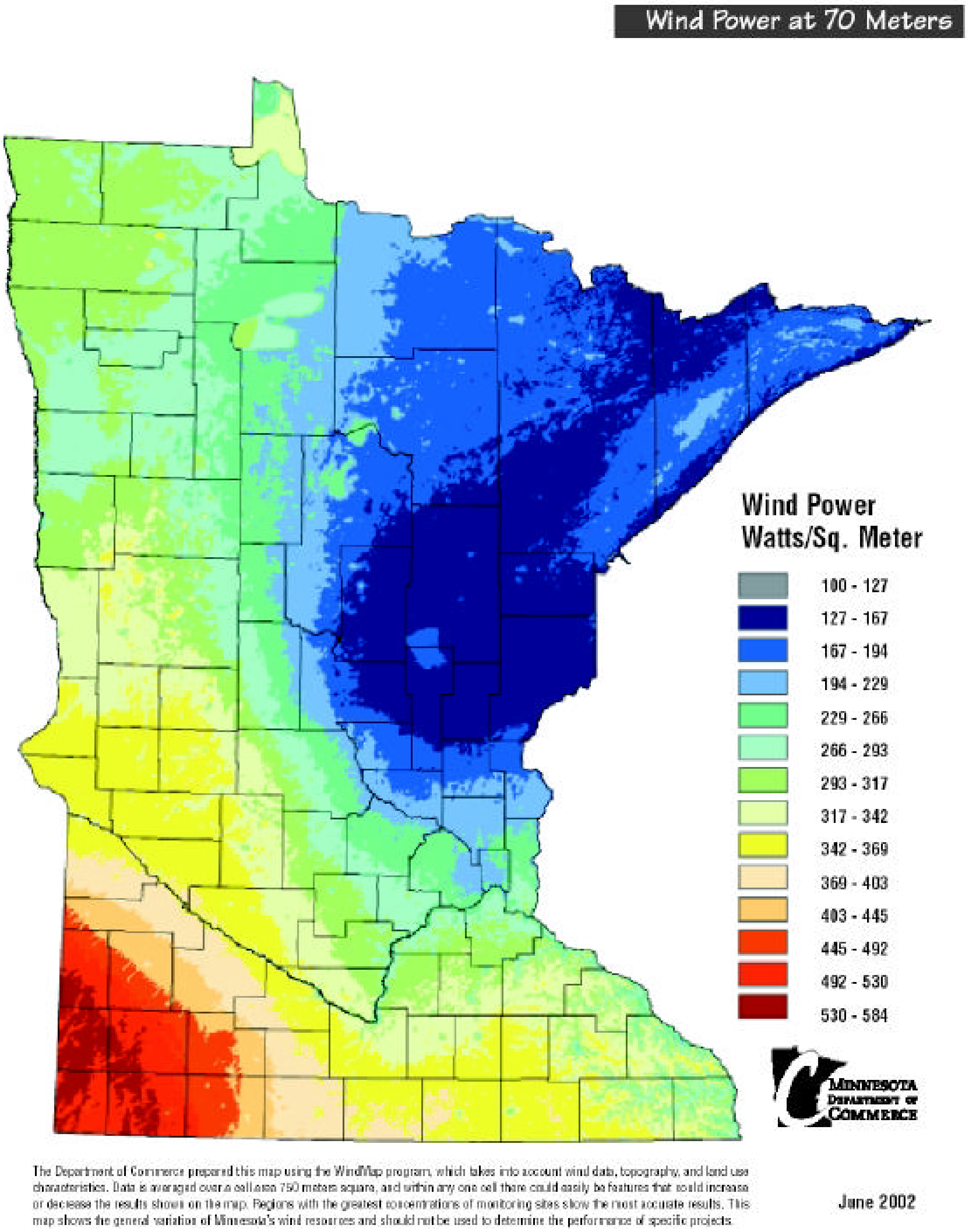

Figure 12: DOC Wind Map at 70 meters

6.2.3 Existing Wind Facilities and Planned Facilities in the Region

Moorhead Public Service currently has two 750-kW wind turbines up and operating in the region. Moorhead Public Service's "Capture the Wind" program has served as a national model since its turbines came on line in May 1999 and August 2001, respectively. Moorhead's "Capture the Wind" program is a green pricing program that charges members less than half a cent extra for each kilowatt hour of wind energy they use.[45] This green pricing program has had one of the highest subscriber rates in the country year after year. In 2004 it was eclipsed by only 3 other utilities in the country.[46] All initial subscribers have their names on a plaque on the turbines. Plans are currently underway for Minnesota State University Moorhead to add an additional turbine to Moorhead's wind installations.

Xcel Energy owns three Vestas V47 660 kW turbines close to Averill, Minnesota in Clay County and viewable from State Highway 9. Referred to as the Agassiz Beach wind farm, the three turbines, commissioned in 2001, generate a combined 1.98 MW.[47]

The White Earth Reservation along with Leech Lake and Grand Portage were part of a U.S. Department of Energy (DOE) "First Steps" grant program funded in September 2003 to investigate the potential wind resource development on the respective tribal reservations.[48] Research on the White Earth Reservation reveals that within the western one-fourth of the reservation lands in Mahnomen County and Becker County along the U.S. Highway 59 corridor favorable wind speeds exist in the 6.4 – 6.8 meter/second (14.32 – 15.21 mph) range that are viable for development. Potential site for wind turbines to serve tribal facilities have been identified at three locations. These are in the area to the west of White Earth village, a site south of Waubun at a tribal administrative complex, and a site adjacent to the Shooting Star Casino in Mahnomen. The Ogema – Callaway area holds potential for a small wind farm siting. There is interest in implementing a community development corporation financial model for local development of wind projects. Currently the tribal council has taken no formal action to proceed; the DOE project will be finalized by the end of 2005.

[45] Moorhead Public Service. 2005. "Frequently Asked Questions". Retrieved on May 11, 2005 from http://www.mpsutility.com/ctwfaq.htm

[46] National Renewable Energy Lab. 2005. "NREL Highlights Leading Utility Green Power Programs." Retrieved on May 3, 2005 from http://www.eere.energy.gov/greenpower/resources/tables/pdfs/0405_topten_pr.pdf.

[47] Information gathered from two websites: http://naewindpower.com/averill.htm, and http://www.xcelenergy.com/docs/corpcomm/p41_REV.pdf. Retrieved on May 31, 2005.

[48] All information in this paragraph was provided in a June 1, 2005 email from Mike Triplett, Planner, White Earth Reservation Tribal Council.

The community of Ada recently finished a wind monitoring study that showed sufficient wind to move forward with a project. There are two local utilities with whom Ada could partner for a power purchase agreement, with current production goals set at around 1.65 MW. Officials are planning to contract with someone to put the whole package together including the interconnection agreement, preparing a bid, and hiring a firm, but are evaluating how the economics of the project will work before bringing this person on board.[49]

The Red Lake Tribe is currently monitoring the wind speed at the Seven Clans Casino and will use this data to evaluate whether or not to move forward with an on-reservation wind project.

All of the projects currently underway in the Northwest are community-based projects. They don't involve an outside developer coming in to develop the wind, but rather they involve communities making a choice to develop their own wind and keep those energy dollars local. These sorts of distributed, community-based wind projects seem to be one of the best options for communities in the Northwest because they offer both economic benefit and galvanize community support for alternative energy development.

6.2.4 Costs and Benefits of Potential Projects

Generally speaking the larger the wind project, the better the economics. Utility-scale turbine projects will cost between $1,000,000 and $1,300,000 per MW (including the turbine itself and installation; pricing variability is due to the fluctuating costs of steel of diesel). Wind projects do, however, benefit from economies of scale both with regard to the size of an individual generator (the larger machines are more yield more output per dollar) and with regard to the number of generators to be installed at a particular site or particular point in time. Small wind energy systems, in comparison, cost from $3,000 to $5,000 for every kilowatt of generating capacity, or about $40,000 for a 10-kw installed system. Due to the higher per kilowatt costs, small wind installation must take advantage of available rebates or tax credits. Well-sited small wind turbines can usually pay for themselves within 15 years, about half their serviceable lifetimes, if the right incentives are applied.[50] Community-scale projects will generally 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, however the Moorhead wind project clearly shows that communities can make the economics work even without the benefits of scale. Mechanisms that allow community members to jointly invest in

[49] Information per personal correspondence with John Schmidt, Pembina Trail RC&D.
[50] Information taken from the American Wind Energy Association website. Referenced on June 3, 2005, at: http://www.awea.org/faq/tutorial/wwt_smallwind.html#How%20much%20does%20a%20wind%20system%20cost.

projects and jointly benefit from the production tax credit would make these projects more economically viable.

6.2.4 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, as referenced briefly above. What are the various mechanisms that communities could use? There are models being used in Southwest Minnesota that allow joint ownership of turbines via a limited liability corporation that functions like a cooperative (Min-Wind) and that allow an outside investor to get the tax benefit for the first ten years and then flip ownership back to local farmers (MN Flip). These models and others should be further explored to assess how communities can both share investment risk and take advantage of available tax benefits that currently only work for investors with high tax liability?

Another concern relates to interconnection agreements and siting and zoning requirements for wind projects. While perhaps not research questions, it is imperative that utility interconnection agreements and county zoning ordinances move toward 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 and duplication.

Section 6.3 Hydroelectric

Hydropower is one of the most commonly used renewable energy resources. The first hydroelectric projects in the United States were built in the 1880s, but very few new hydropower stations are being installed today.[51]

Section 6.3.1 Existing Hydroelectric Facilities in the Region

According to the Minnesota Department of Natural Resources the only operating hydropower sites in northwest Minnesota are located at Thief River Falls (Red Lake River) and Bemidji (Mississippi River).[52] These facilities are owned by Thief River Falls and Ottertail Power, respectively. Other sites in the region have historically had hydropower, but most have been removed due to safety and environmental impacts.

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[51] Hydro Research Foundation. "Frequently Asked Questions." Retrieved May 5, 2005 from http://www.hydrofoundation.org/research/faq.html#historical.

[52] Department of Natural Resources, 1996. *Hydropower sites in Minnesota.* Accessed on 3/20/04 at www.dnr.state.mn.us/waters/surfacewater_section/stream_hydro/hydropower_sites.html.

Section 6.3.2 Opportunities for Hydroelectric facilities in the Region
The strongest opportunity for further hydroelectric power in the region is the renovation of existing dams, as the "best" spots for hydroelectric power are often already taken by existing structures. Renovating existing dams also reduces environmental costs and damage caused flooding and natural habitat destruction.[53] In 1996 the Idaho National Engineering Laboratories' Renewable Energy Products Department released a report for the U.S. Department of Energy that evaluated Minnesota's hydropower potential that did not identify any additional sites for hydropower development in the Northwest.[54] In part, the economics of developing new hydroelectric projects discourage expansion; fish migration, stream flow, and safety concerns also discourage it. The emergence of micro-hydro technologies that generate less than 100kW and utilize flow-through mechanisms may present future opportunities, but as with any new technology, such proposal will need to undergo site-specific analyses.

Section 6.4 Biomass
Biomass refers to wood waste, energy crops such as hybrid poplar, switch grass, and hazelnuts, and plant residues. Biomass offers profound opportunities for existing waste products, such as tree trimmings and sawmill residues, providing a market and value for formerly discarded materials. Biomass energy also provides a new market for alternative agricultural crops that could facilitate a transition to more perenniality and ecosystem services on the land.

Section 6.4.1 Existing Biomass Projects
Only a few sites in the northwest are currently using biomass energy (Table 11). Per section 5.2, however, wood burning stoves are quite common in residences throughout the area. The Red Lake Reservation is also investigating the feasibility of biomass as a renewable source of energy.

[53] Minnesotans for an Energy-Efficient Economy. This information can be accessed at: http://www.me3.org/issues/hydro/ .
[54] Idaho National Engineering Laboratory Renewable Energy Products Department. *U.S. Hydropower Resource Assessment for Minnesota*. Accessed on 9/16/04 at http://hydropower.inel.gov/resourceassessment/mn/mn.pdf.

Table 11. Industries Utilizing Biomass in Northwest Minnesota

Location	Owner	Biomass Type
Bemidji	Potlach Corporation	Timber Residues (Milling And Logging Residues)
Mahnomen	Mahnomen school district	Woodchips
Beltrami County	Ottertail Power	Wood waste and refuse derived fuel
Warroad	Marvin Windows	Wood waste

There are a few mills in the area that burn wood for heat, Cass Forest Products in Cass Lake, for example.[55] Lumber Mart in East Grand Forks heats with wood waste (2x4 ends) that they generate, as does ODC in Thief River Falls. Many shops have been purchasing outdoor wood furnaces, and two major manufacturers of these furnaces are located in Northwest Minnesota: Northwest Manufacturing (Woodmaster) in Red Lake and Heatmor in Warroad. Both of these manufacturing facilities are heated with their own products.

Section 6.4.2 Biomass Resource Assessment

Biomass energy is any energy that is derived from organic matter. This can include the burning of wood for heat, electricity, or cooking, the utilization of methane off of landfills, and plant fuel additives such as ethanol or biodiesel. Because of the wide variety of material that can be used to create biomass energy, determining the resource potentia l of a region can be quite complicated. Table 12 lists amounts of various forms of biomass in each Northwest Minnesota County.

Table 12 demonstrates that there is a great deal of biomass available in Northwest Minnesota. However, to be able to make use of this information one must have an idea of how much biomass is needed to run that type of electrical plant. A power plant with a 90% capacity and a 25% efficiency rate will require approximately 6,671 dry tons per megawatt, annually. This means that a 25 MW plant needs around 166,775 dry tons of biomass a year. These numbers are based on the Bioenergy Information Network's calculations using wood as the biomass source.[56] Other sources of biomass, such as agricultural residues, have different BTU values and would therefore require additional

[55] This paragraph's information was provided on June 1st, 2005, via e-mail from Darren Schmidt, Research manager at the Energy & Environmental Research Center at the University of North Dakota.

[56] Wright, Lynn. 2002. "Biomass Information Network (BIN)" *Relationship between power plant efficiency and capacity and tons biomass required and acres required*. Accessed on February 17th, 2004, at http://bioenergy.ornl.gov/resourcedata/powerandwood.html .

biomass to fulfill the 25 MW supply. Based on the known tons (subtotal) column below, it is somewhat uncertain whether or not counties in the region could support such a large facility long-term.

Table 12. Biomass Resources in Northwest Minnesota[57]

Counties	Total Agricultural Residues * (tons)	Total Mill Residue Available** (tons)	Subtotal (known tons)	Forest Residue*** (tons)	Urban Waste Wood*** (tons)	Estimated Total Biomass Available (tons)
Beltrami	28,487	5,472	33,959	365,276	12,583	411,818
Clay	531,904	0	531,904	1,644	16,597	550,145
Clearwater	25,131	16	25,147	201,398	2,614	229,159
Kittson	514,415	0	514,415	15,498	1,661	531,574
Lake of the Woods	45,680	2,554	48,234	131,371	1,483	181,088
Mahnomen	128,007	0	128,007	39,141	1,634	168,782
Marshall	738,104	0	738,104	3,239	18,268	759,611
Norman	508,207	1,146	509,353	11,882	2,412	523,647
Pennington	198,256	0	198,256	4,351	13,009	215,616
Polk	910,759	4	910,763	20,169	9,880	940,813
Red Lake	160,248	35	160,283	6,763	1,348	168,395
Roseau	425,503	31	425,534	39,688	5,162	470,384
Total	**4,214,704**	**9,258**	**4,223,962**	**840,420**	**86,651**	**5,151,033**

Section 6.4.3 Potential for Biomass Projects in the Region

At this point, there are no plans for a large biomass power plant in the northwest region, but with the vast amount of biomass available, a well-sited, smaller-scale plant may be cost effective. There are two concerns facing such a plant: transportation and distribution. The location of the plant needs to be placed in an area where a high amount of inexpensive biomass is accessible locally. The farther away the biomass resource, the higher transportation cost. The distribution of the energy created could become an issue as most of the power lines in the region are already running at full capacity.

Small biomass plants for individual businesses or municipalities are one way of getting around these hurdles. Local businesses with a ready, biomass waste stream could simply transform that waste product into heating or electric resource that could be utilized in on-site operations – thus eliminating the transportation of materials and avoiding any transmission constraints. In light of this, the Northwest CERT is focusing on potential opportunities to do onsite generation using a mobile biomass gasifier. During Summer 2004 the team sponsored biomass gasifier demonstration at three county fairs as a means of educating the public about this possibility.

[57] *Based on Minnesota Agricultural Statistics Service's *County Estimates – Crops* and Institute for Local Self Reliance's residue ratios.
**Data fromthe DNR. Includes only the residue not already being utilized.
***Computer Model Estimation ($50/dry ton presumed) from the Oak Ridge National Laboratory

Darren Schmidt of the EERC stands next to the biomass gasifier demonstration that was taken to three county fairs in the Northwest region.

Primary and secondary forest product producers seem to be the industry with the highest potential in the region. The team has assembled an inventory of these businesses (Appendix E) and in now working to assess their interest in utilizing waste wood to fire an onsite gasifier. These smaller, onsite applications that can be fueled using a waste material seem like the ideal niche market in which biomass can prove its viability.

Another means of avoiding at least the transmission concerns would be to co-fire existing coal facilities with a 10% biomass mix. Minnkota and Ottertail both operate steam units in North Dakota and South Dakota that are currently fired with coal and fuel oil, but could be fired with a modest woody-biomass mix as well.

Section 6.4.4 Local Opportunities for Energy Crop to Mitigate Environmental Issues

There are particular opportunities for perennial energy crops in the region as a means of providing environmental services and water quality benefits to the Red River Basin.

- Watershed protection along farm lands as filters/barriers between farms and rivers
- Snow fence opportunities
- Opportunities to provide habitat

These ecological services can be provided while also producing a valuable biomass resource.

Section 6.5 Biogas Digesters

Biogas digesters present an opportunity to capture methane to use for heat or electricity. 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

There is one agricultural processing plant in the region, Minnesota Dehydrated Vegetables (MDV) that installed a biogas digester in 2003. MDV's facility began operating in winter 2004 and has since experienced several complications, but it will eventually supply gas for the drying processes of vegetable dehydrating and electricity. The team hopes to visit the facility sometime during the 2005 to learn more about the project and assess what lessons can be learned from this first installation in the region.

The City of Moorhead uses a digester at its wastewater treatment facility, but appear to use the recovered gas to simply heat the digester. The American Crystal Sugars in East Grand Fork and Moorhead also uses anaerobic digestion systems to treat their wastewater and collect the methane for heat (pulp drying).[58] No other sites in the region are using biogas to generate electricity.

Section 6.5.2 Regional Opportunities for Biogas Production

A study by the State Energy Office of the Minnesota Department of Commerce looked into Minnesota's Potential for using biogas digestion on farms. The report finds that biogas generated from hog farms is not currently cost effective and that a farmer needs to have at least 500 dairy cows in order to have a cost-effective system. Beef cattle were not considered in the study because the cows are not kept in enclosed areas where the manure can be easily collected. Since the northwest region does not have many dairy farms and those that it does have generally have fewer than 500 cows, this is not the most likely route for integrating biogas in the region.

Sewage sludge, landfill gas recovery, and digestion at agricultural processing facilities may be more viable options in the northwest. There are dozens of agricultural processing plants in the region (Appendix F). The wastes of these plants are combined with bacteria, similar to manure digestion, to generate methane. These plants could utilize the captured methane for process heat, facility heat, electricity, or at some point in the future, hydrogen. Similarly, the few landfills in the area could be capped to catch the methane that naturally is given off by degrading refuse.

[58] Information provided in conversations with Minnesota Pollution Control Agency.

Section 6.5.3 Potential projects

With the tremendous number of agricultural processing plants in the region, it may be quite possible to increase the quantity of biogas facilities in the region. American Crystal Sugar, which operates the largest agricultural processing facilities in the region, is also one of the regions largest fuel users. Some of their facilities are already utilizing digestion to treat their process water and recovering the methane for heat. It may be most effective to assess why they have not done this at all their facilities. It's possible that as natural gas prices continue to rise, these plants may also be more interested in utilizing their own waste stream for heat and power.

It should be noted that for many of these facilities using the methane as a substitute for natural gas might be a more cost-effective and efficient option than using it for electricity. If, however, a local power company were willing to invest in an on-site generator for a facility to allow it to use the gas to offset its own power load, this might become a more viable alternative. The utility would benefit by keeping a major consumer on its system while still lowering its demand and potentially meeting part of its renewable energy objective.

Section 6.6 Biofuels

Ethanol and biodiesel are the two alternative transportation fuels available to Minnesota customers. All gasoline in Minnesota is mixed in 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 for using biodiesel as a substitute in diesel generators used in electricity generation.

Section 6.6.1 Biofuel Facilities in Northwest Minnesota

Minnesota is home to fourteen ethanol plants with a production capacity of 389 million gallons, however there are currently neither ethanol nor biodiesel production facilities in the region. According to a study by BBI International there is ample waste in the area around Grand Forks to create an ethanol plant. This area has several agricultural processing plants that could supply majority of the materials needed, requiring only a small amount of corn or wheat to bring the plant up to a scale that is cost-effective.

A group of investors has formed Agassiz Energy LLC to tentatively site a 50-million gallon plant in the Erskine area. The plant will use coal if permits are granted by MPCA. Coal provides most cost-effective method of production due to high cost and price volatility of natural gas. Coal also provides benefit of long-term contracts. The addition of biomass to coal inputs is being studied.[59]

Several other cities in the region are currently studying the feasibility of siting a local ethanol plant, but none of these projects had been finalized at the time this report was completed.

As of June 2005 there are ten stations in the Northwest Region that provide E-85, with three more coming soon (Table 13).[60]

Table 13. Northwest Minnesota E85 Stations

Station	City	County
Jack' Stop	Bemidji	Beltrami
Cenex General Store	Barnesville	Clay
Cenex Petro Serve	Moorhead	Clay
Johnson Standard BP	Hallock	Kittson
Crookston Fuel Co. Cenex	Crookston	Polk
East Grand Station	East Grand Forks	Polk
Fisher-C-Store	Fisher	Polk
Petro Pumper	Thief River Falls	Pennington
Farmer's Union Oil Co.	Warroad	Roseau
Roseau County Coop	Greenbush	Roseau
Red Lake County Co-op *COMING SOON*	McIntosh	Polk
Cenex Coop Services *COMING SOON*	Karlstad	Kittson
Cenex Coop Services *COMING SOON*	Baudette	Lake of the Woods

Beyond ethanol, the state has established a biodiesel mandate that would require all diesel to contain a two percent biodiesel blend by July 2005. There is currently one biodiesel production facility in Minnesota – FUMPA (Farmers Union Marketing and Processing Association-Redwood Falls) began operating in 2005 and produces approximately 3 million gal/year. Two other facilities, SoyMor in Albert Lea and MnSoybeanProcessors in Brewster should come online during summer 2005. The biodiesel (B2) mandate requires 8,000,000 gallons of in-state capacity before taking effect

[59] Information provided by Cam Fanfulik, NW Regional Development Commission.
[60] For a complete listing of E-85 stations in the state, please go to: http://www.cleanairchoice.org/outdoor/FindE85.asp. Referenced May 9, 2005.

(total mandate would require 13,000,000 gallons); these three projects should bring Minnesota production up to approximately 58 million gallons per year and will fulfill this mandate requirement.

Several community partners in Hallock have also recently completed a feasibility study that evaluated the potential for a local biodiesel production facility. They are now moving forward on a business plan to develop a biodiesel plant with both animal fat and soybean oil feedstocks.

There are also two pumping stations selling biodiesel blends. Petro Pumper in Thief River Falls sells a 2% blend, while Cenex in Moorhead sells a 5% blend. Several distributorships are also selling biodiesel in bulk at levels from B2 to B20, although there are some customers buying at levels much higher. Biodiesel distribution is hindered somewhat by IRS rules regarding how the $1/gallon tax credit is allotted. Distributors who don't buy directly from a biodiesel producer do not receive the tax credit as the ultimate blender of record. In other words, the distributor almost needs to be vertically integrated with producer in order to receive tax credit. Magellan pipeline terminals in Fargo and Grand Forks will be handling biodiesel from producers this year, so that blenders and distributors can take advantage of tax credit "at the rack".[61]

Section 6.6.2 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 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 Department of Commerce is running a B20 School Bus Demonstration project at 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. Another example is the use of biodiesel in the

[61] Information provided by Cam Fanfulik, NW Regional Development Commission.

entire City of Brooklyn Park fleet, over 100 vehicles, using a B20 blend. The same sort of program could be used at city and county fleets throughout the Northwest Region.

Beyond use in transportation applications, a biodiesel blend could also be used to fuel existing diesel generators and internal combustion engines running on fuel oil. Blends ranging from B-2 to B-20 could be utilized with most existing technologies. Minnkota has two diesel plants, one operating Grand Forks and one operating in Harwood, with a combined capacity of nearly 15 MW that could be converted to a biodiesel blend. Halstad, Hawley, Roseau, Thief River Falls, and Warren municipal utilities and Ottertail Power could also begin using biodiesel blends. A 10% would help these utilities meet their renewable energy objective requirements while also cutting emissions.

Section 6.7 Solar Energy

There are three types of solar technologies: solar building design (which includes high efficiency construction and specific building orientation, window sizing and placement), solar thermal, and solar electricity (photovoltaic (PV) systems). 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

Since passive solar building design and solar thermal installations are typically private transactions between a buyer, seller, and perhaps a local building authority, very little concrete data exists about how many such systems are installed across the state. Similarly, as off-grid solar electric applications are by their nature decentralized, data is largely unavailable. Anecdotally, the largest 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. East Grand Forks has existing PV lighting along a bike path; except for some equipment loss due to flooding and ice, the project has been successful.[62]

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, the Department of Commerce estimates that 120 to 130 kW of solar electricity were installed in Minnesota, primarily in the Twin Cities area. Between July 2002 and July 2004, the solar rebate program has catalogued an additional 150 kW of solar electricity. As of May 2005, we are only aware of one solar installation in the northwest: a 5.1 kW system on a residential site in Crookston.

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[62] Bike path information supplied by team member Dan Boyce, General Manager, East Grand Forks Water and Light Department.

Section 6.7.2 Solar Potential

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. Indeed, Minneapolis has an annual solar resource roughly equivalent to that of Houston, Texas and Miami, Florida (solar resource and temperature are not necessarily correlated). 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 very site specific however, and locating whatever solar technology is used (solar building design, solar thermal, or solar electric) in un-shaded areas is extremely important. 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.

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). 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: Solar Incentives

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%

* Solar panels only; ** Businesses only; *** After other incentives are applied

Section 6.7.4 Identify Specific Opportunities for Solar Projects

New construction provides the greatest opportunities for incorporating solar systems. At a minimum newly constructed buildings should be highly efficient and designed for passive solar heating and lighting. Depending upon their budgets and goals, individuals and businesses can take advantage of nearly all solar technologies. Community-based projects should likely focus on cost-effective applications and/or locations where they can incorporate educational curriculum, such as nature centers, schools, or community centers.

Other opportunities for solar 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 reduce barriers to solar development and perhaps provide incentives through codes or permitting;
- 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) on 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. Payback periods range from short on the low end for incorporating solar design into new construction to long on the high end for installing solar electric systems (Table 15).

Table 15: Solar Systems Benefits and Costs

Technology	Benefit Window	Cost	Payback	Market	Appeal
Passive 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

Solar design can provide over a third of a Minnesota home's heating requirements for very little additional cost since conventional materials are still being used in conjunction with some additional planning by the building designers.

Solar thermal applications have a bit longer payback, as they generally require some type of additional equipment, such as solar panels to circulate air or water that is heated by the sun. Solar thermal for hot water can provide roughly 50% of the winter and 100% of the summer hot water heating needs of a home, but can also be additionally sized and designed to provide space heating, using in-floor radiant heat or coupled with baseboard hot water heating. Generally, solar hot water systems will have 8 to 12-

year paybacks when replacing electric or propane hot water heaters and 12 to 15-year paybacks when replacing natural gas hot water heaters.

Section 6.8 Combined Heat and Power

Cogeneration, or combined heat and power, is when facilities use the excess or waste heat from their production processes or electricity generation to heat or cool their buildings. When an industrial facility or power plant utilizes this waste heat, the waste becomes a usable resource and thereby increases a facility's operating efficiency.

Section 6.8.1 Existing Combined Heat and Power Installations

An August 2001 survey conducted by Minnesota Planning Minnesota Environmental Quality Board evaluated both existing utilization of cogeneration and the potential for additional cogeneration in Minnesota.[63] The survey found that many industries were already using this practice and that many were already at capacity. In the Northwest region of the state there are four facilities utilizing cogeneration (Table 16).

Table 16: Facilities in Northwest Minnesota Utilizing Cogeneration

Location of Facility	Name of Facility
Crookston	American Crystal Sugar
East Grand Forks	American Crystal Sugar
Moorhead	American Crystal Sugar
Moorhead	Waste Water Treatment Plant

Section 6.8.2 Opportunities for Cogeneration in the Region

Based on the Minnesota Planning survey, there were few other sites with cogeneration potential in the Northwest. Despite these findings the Northwest should continue to search for further cogeneration opportunities. It is possible that sites simply did not respond to the survey. For example, it seems that college campuses in the region might make ideal cogeneration sites as they have both high electric loads and high heating loads. The University of Minnesota Crookston campus could consider this possibility as they evaluate ways to make their campus more sustainable.

Ainsworth Lumber has recently acquired three oriented strand board (OSB) facilities in Bemidji, Grand Rapids and Cook. All three of the facilities were formerly owned by Potlatch, and the significance of the Bemidji purchase is that the property is located adjacent to Ainsworth Lumber's existing 12-megawatt cogeneration facility. By acquiring this OSB facility in September 2004, Ainsworth Lumber will have greater

[63] Minnesota Planning: Minnesota Environmental Quality Board, 2001. *Inventory of Cogeneration Potential in Minnesota*. Accessed on 3/03/04 at http://www.eqb.state.mn.us/pdf/2001/CogenInventory.pdf.

quantities of wood waste materials available and expanded opportunities for the cogeneration facility.[64]

Section 6.9 Geothermal Energy

Geothermal energy refers to the natural heat from beneath the earth surface. The Earth's natural heat is collected in winter through a series of pipes, called a loop, installed below the surface of the ground or submersed in a pond or lake. Fluid in the loop carries this heat to the building. An indoor geoexchange system then uses electrically driven compressors and heat exchangers to concentrate the Earth's energy and release it inside the home at a higher temperature. In typical systems, duct fans distribute the heat to various rooms.

In summer this process is reversed in order to cool buildings. Excess heat is drawn from the home, expelled to the loop, and absorbed by the Earth. Geothermal systems provide cooling in the same way that a refrigerator keeps its contents cool--by drawing heat from the interior, not by injecting cold air.[65]

Section 6.9.1 Current and Potential Projects

Geothermal heat pumps are becoming more popular for homeowners and as a heating mechanism in public buildings. While there is not comprehensive data on how many heat pumps have been installed in the northwest, there is a great deal of potential in using them for public buildings as well as private homes. For example, many electric companies are offering incentives for installation, and the Minnesota State Legislature is currently considering providing ground source heat pumps with sales tax exemptions.

A few examples of existing projects include:

- A Northwest resident who installed a 3.5-ton Econar ground source heat pump. This resident did an energy usage and cost comparison over six months, from October to April and found that even though paying a higher electricity rate with his heat pump, he was still able to eliminate his electric baseboard and wood usage thereby saving nearly 50 % on his energy bills.[66]
- A 1,625-square foot home with a full basement in Hawley, Minnesota has been using a ground source heat pump since its construction in 1998. Data collected over a five-year period—from 1999 to 2004—show that the home's yearly energy

[64] For more information about the Ainsworth Lumber purchases of Potlatch osb facilities, visit: http://www.ainsworth.ca/html/ops_bemidji.html. Retrieved on May 31, 2005.

[65] The previous two paragraphs were taken from the Geothermal Heat Pump Consortium website. Referenced June 3, 2005. For more information, visit: http://www.geoexchange.org/about/how.htm.

[66] Based on a conversation with Northwest CERT member Chuck Reisen of PKM Electricity, April 11th, 2005.

cost for heating and cooling averages to $395. The ground source heat pump also provides 50% of the domestic water heating.[67]

- A church in Halstad, Minnesota installed a ground source heat pump in 2002. In 2001, its electric bill was $8,500; in 2002, after the installation, the church's electric bill was $3,400. It is estimated that their system will pay for itself after 13.5 years, and that the payback period would have been significantly shorter but installation costs included removal and mitigation of an underground fuel tank and demolition and removal of the existing fuel oil boiler and equipment.

In addition to retrofits, there are great opportunities to ground source heat pump in new construction. The region will soon see several new facilities coming on-line with ground source heat pumps including the Northwest Juvenile Detention center in Bemidji, which is owned by seven counties, Itasca Juvenile center in Grand Rapids, which is run by the county and a private owner, and Crookston Jail, Courthouse, and Law enforcement Center in Crookston. Buildings that are being newly built or remodeled could potentially add a geothermal heat pump to the plans. Housing developments could even explore the possibility of installing multi-dwelling ground source heat pump systems. A Greater Minnesota Housing Fund project, called Grand Meadows, is one example of this sort of project. It includes a ground source heat pump system that was installed via a cooperative effort by the local school and housing development project.[68]

Section 6.9.2 Costs and Benefits

Although the installation costs for a geothermal heat pump system can be high, these systems can reduce operations and maintenance costs. Minnesota in general, and the Northwest in particular, is hit hard by high winter fuel costs and the volatility in natural gas prices due to the extreme number of heating degree days. 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 require a 3-ton capacity system). If such a system were included in a home mortgage, perhaps adding an additional $50 per month, the energy cost savings over a one-year period would easily exceed the added yearly mortgage costs.[69]

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[67] Information about the Hawley house and the Halstad church provided by Darryl Tveitbakk of Northern Municipal Power Agency.

[68] Information about the Greater Minnesota Housing Fund project was provided by Jim Steenerson of the Northwest Minnesota Foundation. More information about the Greater Minnesota Housing Fund can be accessed at http://www.gmhf.com/ .

[69] 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.

Ground source heat pump systems allow homeowners to enjoy lower utility bills (25% to 50% lower than with conventional systems), lower maintenance, and higher levels of comfort, year-round. Since a geothermal system burns no fossil fuel to produce heat, it generates far fewer greenhouse gas emissions than a conventional furnace, and completely eliminates a potential source of poisonous carbon monoxide within the home. Even factoring in its share of the emissions from the power plant that produces electricity to operate the system, emissions are still far lower than for conventional systems.[70]

SECTION 7: PROJECT PRIORITIES

Based on the Northwest Region's high electric heating load and ample biomass and biogas resources, the team identified three key project priorities:

- Ground source heat pumps
- Small-scale biomass power plants
- Biogas digesters at agricultural processing facilities

For each of the project priorities the team developed task lists to help guide its efforts and identify the information and project angles that were most interesting and relevant to team participants. These task lists included the following:

Section 7.1 Task List for Ground Source Heat Pumps

The team felt that much of their efforts around ground source heat pumps needed to focus on education. Toward that end, the team identified the following list of questions that would help them gather sufficient educational information about ground source heat pumps in the region.

General Information

- How many systems are operating in the region?
- Where are these systems and in which utility service territory?
- How long have these systems been operating?
- What data is available on the existing systems? Is there construction data, cost data, and/or energy savings data available?
- Is there data about comparative systems so that we could do a compare/contrast?
- Could we develop a set of case studies around this information?

Utilities

- Which utilities have programs that include Ground Source Heat Pumps? What do these programs entail?

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[70] Text taken from the Geothermal Heat Pump Consortium website. Referenced June 3, 2005. For more information, visit: http://www.geoexchange.org/about/questions.htm.

- Are there incentives available to customers and if so, what are they? If not, would they be willing to introduce new incentives?
- Do they have data on systems operating in their territory that they could share?
- Is there a way we could help publicize these programs?

Building Contractors

- Which contractors currently do most of the installation work?
- Where are these contractors located?
- Why did these contractors start doing this work?
- What would be the best way to promote what these people are doing?
- How could we educate other contractors about these systems? What would they need to convince them to promote these systems?

Consumers

- What kind of information are consumers receiving about these systems?
- Are there educational materials already available about these systems?
- How could we help share this information more broadly?

Other Outreach

- Who are the developers and neighborhood planners in the region?
- How could we contract the Home Builders Associations in the region?
- What is the best way to educate these people about ground source heat pumps?

Based on all of this information, the team is in the processes of pulling together an inventory of ground source heat pump installations in the region and developing educational and outreach materials to get people more informed about ground source heat pumps as an option. From the inventory the team plans to develop a set of case studies that highlight different types of ground source heat pump installations – such as commercial, residential, new construction and retrofits. They will use these case studies, newly developed ground source heat pump fact sheets, and a glossary of ground source heat pump terms to better inform the public.

In spring 2005 the team contracted with faculty and students at the University of Minnesota Crookston to build a Heating Fuel Comparison Calculator, a web-based tool that will allow individuals to compare the costs and benefits of different heating options (natural furnace, electric, heat pump, wood, etc.) as well as explain the different systems available. This tool is being developed in part based on existing calculators that both Ottertail Power and the Northern Municipal Power Agency currently use. Once their Heating Fuel Comparison Calculator is completed, the team hopes to use it at a series of educational meetings at the city and county level to educate builders and contractors about ground source heat pump technologies. Team members are already locating companies and individuals they think will be receptive towards learning more information.

The team also obtained a membership to the Ground Source Heat Pump Consortium so that anyone on the team to get full access to educational materials and information.

Section 7.2 Task List for Biomass Power Plant Project

The primary focus for the biomass effort is to test various fuels in a mobile biomass gasifier that could then be used in niche applications all over the region. The initial tasks focused on gathering a broad list of businesses with waste streams that could be tested, as part of a feasibility study, in the biomass gasifier. The identified tasks included the following:

- Find businesses with a waste stream that could be used for fuel and gather this information by county to assess resources available within a limited geographic area.
  - Identify likely candidates. These may include dehydrating plants, sawmills, and food processors.
  - Identify which facilities are already using their waste fuel. Could they be using more of it or using it more efficiently?
  - Develop a letter to engage local businesses and assess whether or not they would be interested in participating to a feasibility study to convert their waste to a value-added energy source?

As part of the Feasibility Study, the team also sought to:

- Assess how much fuel these businesses have available.
- Evaluate the heat/electric load of these businesses.
- Develop a list of ideal candidates (niche markets for the gasifier) by targeting those businesses that have sufficient waste material to meet their load needs.
- Identify available grants, financing, and incentives.

Section 7.3 Possible Task List for Biogas Digesters at Ag-Processors

Given the large fuel loads at the American Crystal Sugar plants in the region, the team began to think about how one might offset some of the large loads in the region with more renewable fuels. With rising natural gas costs, facilities relying on natural gas may soon be seeking alternatives. Biogas, or methane derived from the natural degradation of organic materials, is one such available alternative. As such, the team reasoned that agricultural processors, that both utilize natural gas and produce methane (even if they don't yet collect it and utilize it), would be the best place to start. To begin moving this effort forward, the team developed the following list of tasks:

- Evaluate the potential opportunities within the region at non-farm digester facilities
- Develop a list of facilities already using digesters for their waste

    - Use these examples to create a set of case studies that could highlight project successes and failures
    - Discuss important considerations for successes and failures (type of data needed to convey value to other businesses/facilities)
- Identify the current heating/electric load at these facilities that could be offset by utilizing the methane?
- Identify what other benefits would the facilities gain from utilizing digestion.
- Identify possible funding options for these projects.

Section 7.4 Commonalities Between Project Priorities in the Northwest Region and other CERT Regions

The Northwest Region shares three primary overlapping goals with other CERTs: geothermal promotion and development, education of homebuilders, contractors and consumers, and biomass project development. One of the key strengths of the CERTs program is the sharing of information and programs between citizens across the state. Currently, the Northwest Region is a leader in researching and promoting ground source heat pumps, with several regions expressing interest in utilizing the Heating Fuel Comparison Calculator. Similarly, the Northwest region may be able to take advantage of materials already developed in other regions. These opportunities for cross-pollination are described below.

Section 7.4.1 Geothermal

The Northwest Region is proving itself to be the leader in advancing geothermal usage in the state. The creation of the Heating Fuel Comparison Calculator website will allow comparisons of energy expenses not only in the Northwest but also throughout the rest of Minnesota. Indeed, many of the other regions are waiting anxiously for the completion of the project, so that they may use the site to better educate people within their own area.

In addition, for people interested in installing geothermal and other energy efficient technologies in their own homes, the Northwest group is currently compiling a list of entities that offer energy efficiency mortgages. People will be able to roll the cost of efficiency upgrades into their monthly home mortgage payment and take advantage of their energy cost savings. Also, members in the Northwest are researching the viability of cold climate heat pumps, which may be half as expensive as ground source heat pumps to install since no excavation is needed.

Section 7.4.2 Educating Builders and Contractors

The Northwest and Central CERTs regions have both decided to focus on better educating builders and contractors about how to integrate energy efficiency and renewable energy into their designs and projects. Given this shared focus, there may be opportunities for the two regions to collaborate. For instance, Central CERT is currently looking into gaining membership with the Builders Association of Minnesota (BAM) to better work with and influence the contractors and builders in the area. The Northwest team may want to partner with the Central Region on this initiative. The Central Region has also been developing materials that detail how citizens can contact county commissioners, builders, and contractors about new building projects or retrofitting existing buildings to make sure these projects are integrating energy efficiency concepts. These materials may be useful to the Northwest Region as it pursues its own outreach efforts.

Section 7.4.3 Biomass Project Development

The Northwest team is current looking to contact primary and secondary forest product producers as well as agricultural producers to assess local interest in utilizing waste wood and agricultural residues to fire onsite biomass gasifiers. Businesses in both the Central and Metro regions have also been working to inventory available biomass fuel sources. Since locating agriculture and wood waste as potential biomass fuels is such a crucial subject for so many regions in Minnesota, the CERTs office is currently partnering with the Agricultural Utilization Research Institute (AURI) and the Department of Commerce to create a website for biomass sellers and buyers to exchange information. This website should be useful to the Northwest Region as it can begin to lay the infrastructure necessary to make purchase and exchange of fuel routine.

By drawing attention to the commonalities between regions, CERT members are better able to see barriers and opportunities that impact both their region and the development and implementation of energy efficiency and renewable energy project around the state.

SECTION 8: BARRIERS AND OPPORTUNITIES

The Northwest CERT discussed the barriers and opportunities with regard to each of its project priorities: ground source heat pumps, mobile biomass units, and biogas production at agricultural processing facilities. These barriers and opportunities helped the team focus its efforts on projects that might help either take advantage of existing opportunities or combat lingering barriers.

Table 17. Ground Source Heat Pump Opportunities and Barriers

Opportunities	**Barriers**
Could promote those few contractors that do install geothermal systems	Not many contractor willing to do it
Systems are quite a bit better now	High initial costs
Customers are seeing big savings with heat pumps – the payback is better and as fuel costs rise, the cost differential is narrowing	Consumers don't know much and sometimes the numbers seem too good to be true – need education
New construction	Space limitation for retrofits
Some utility incentives	It's not an ideal load profile for utilities
Big energy savings opportunity (60%)	
There could be one system for many homes	Open water systems would require a lot of water and therefore pose an environmental (and permitting) concern; there might be a cap if everyone started doing them
In planned developments, the infrastructure could be put in place before building begins	Developers are thinking about this, contractors are thinking about this
Most utilities offer rebates or loans	
Education: ▪ for Developers (usable BTU's/dollar) ▪ on available loans ▪ for Project Planners ▪ for Contractors	

Table 18. Biomass Power Plant Opportunities and Barriers

Opportunity	Barrier
Funding – there are various grants available	Funding – not yet ready for private investment
No previous example is barrier to private funding but could be an opportunity once proven	Level of acceptance; past experience isn't so good with pellet burning system
Facilities with waste streams, like sawmills could be opportunities	Cost would be an issue if had to pay for fuel
Generate to offset	Would need wholesaler to sign off? Transmission issues/relationship with utility
If this could meet an REO, utilities might be more eager to work with the customer than if the customer is simply going to disappear from the system	Regulatory issues regarding customer generated renewables offsetting fossil fuel load – will the PUC accept this as meeting the REO?
Production of equipment	Production of equipment
	Air quality permitting (new technology)

Table 19. Biogas digesters at Agricultural Processors Opportunities and Barriers

Opportunities	Barriers
Driven by waste and costs (and power purchase agreement)	Technical operation/hurdles/mishaps
Picking the right low-hanging fruit – places that have a waste or regulatory problem	Uncertainty about the REO rules regarding customer-owned distributed generation (who benefits/who pays)
Potential to offset natural gas loads (particularly important with rising fuel prices)	Cost of installing system
Digesters help agricultural processing facilities with wastewater treatment issues. Digesters might also help alleviate some of the environmental concerns around expansion of large livestock facilities.	Environmental issues with large animal/feedlot facilities (putting one in to do biogas is a barrier, using digester to solve problem is an opportunity)
Opportunity to share stories about project successes and failures, especially at non-farm facilities.	Permitting

The team also identified over-arching opportunities and barriers that didn't align with a particular technology or resource but did impact the success of energy efficiency and renewable energy development in region.

General Barriers

- Transmission – having enough, having access to it, getting power moved at an affordable cost
- How Midwest Independent System Operator (MISO) market affects big/small and traditional/nontraditional interests
- Long term power contracts
- Uncertain/unclear regulatory regime; lack of coherent vision on renewable energy at state level to ensure all agencies are working toward the same goals
- Funding for projects/commercial viability
- Keep electricity prices affordable
- Environmental concerns about siting, best usage of an area

General Opportunities

- Greater energy efficiency – in residences, commercial and industrial buildings
- Solar thermal/solar heating systems
- Maybe some small hydro at dams undergoing redevelopment that could both accommodate fish migration and power generation

Another barrier and opportunity the team recognized was the need for local staff and funding capacity to keep these initiatives going and get projected installed. Building this local capacity will be one of the team's key activities over the next two years and will involve developing more partnerships with companies, governments, and entities that can help the team achieve its goals. The University of Minnesota Crookston's Center for Sustainable Development, which is currently creating an "ingenuity frontier" in the region, might be a key leader in local capacity building. Other partnerships that are currently in place but may be better utilized are the Northwest Minnesota Foundation, the Resource Conservation Development Councils, the numerous colleges and universities in the region, the cooperative utilities and the tribal energy task forces.

Finally, it is worth noting that the region's goals of conserving 1% of gross energy consumption per year for 10 years and creating 1% renewable energy per year until 2015 is laudable for it's vision but difficult to measure. As the region begins to implement conservation and renewable energy projects, they will need to come up with ways to benchmark and measure their successes.

SECTION 9: LOOKING AHEAD

When the Northwest CERT contemplates its opportunities to promote energy conservation and renewable energy, it does so with the health of its communities in mind. The team has continually state that it wants to focus on finding ways to get the renewable energy development required under the Renewable Energy Objective to happen in Northwest Minnesota. Naturally, local communities want to attract projects to their area and thereby provide a means for future economic development. The projects the team is pursuing, ground source heat pumps, biomass and biogas, all contribute to strengthening the economy of Northwest Minnesota, keeping more energy dollars at home, providing good paying jobs and economic opportunities to keep young people in local, and protecting the region's valuable natural resources. These project ideas also capitalize on the existing human expertise in the region.

The major hurdles now are long-term public policy signals such as stable renewable energy tax credits and incentives. With increased knowledge, the Northwest CERT hopes that local policy makers will be catalysts for the necessary long-term vision that will help drive renewable energy and its associated economic development in rural Minnesota.

Section 9.1 Emerging and Future Opportunities

At the April 2005 meeting in McIntosh, the group was asked to brainstorm what projects could be accomplished in the next five years (2010), and the next ten to fifteen years (2015 – 2020). For a team that has prided itself on a small list of realistic goals, the exercise brought forward a wide range of energy efficiency and renewable energy ideas. These were posted on the wall for everyone to see.

Achievable by 2010

- Develop additional large wind turbines in the region at sites such as White Earth and Red Lake
- Increase usage of biodiesel via public transportation switches to biodiesel (RRV Clean Cities)
- Construct an ethanol plant in the region to help meet growing demand spurred by the 20% ethanol mandate and other states dropping MTBE as a fuel oxygenate in favor of ethanol.
- Increase the efficiencies of ethanol by using biomass for production rather than natural gas
- One E85 station in each Northwest County
- Develop a plan to utilize biomass fuels such as switch grass, wood waste, and/or willow and alder. Learn how we handle the material –pellets, etc.

- Educate children about the value of conservation, energy efficiency and renewables.
- Provide internships for university students to assist with educating the public.
- Provide case studies to educate the average Minnesotan and get him/her to embrace renewable solutions.
- Develop demonstration projects and website for consumer use.
- Find local banks to participate in energy efficient loans and mortgages
- Demonstrate sustainable (B3) building practices.
- Create cold climate heat pump demonstration sites.
- Develop energy efficient Affordable Housing.
- Gain Experience with the Midwest Independent System Operator (MISO).
- Co-fire combined cycle turbines with biodiesel (and ensure co-firing counts toward meeting the renewable energy objective).
- Help assess value of bio-produced energy in capacity / kW value.
- Evaluate the potential for micro-hydro on some existing dams.

Achievable by 2015-2020

- Installation of a fourth wind generator at Moorhead
- Rail connection between Twin Cities and Fargo
- Transition to hybrid vehicles could result in a net reduction of petroleum
- Conversion of Conservation Restoration Program lands to produce energy crops
- Development of a facility that uses locally produced biomass—switch grass, willow, alder, timber slash etc.

Other emerging opportunities include cellulosic ethanol and renewably-harvested hydrogen. Cellulosic ethanol, which could use any plant materials rather than simply corn to create ethanol, could transform the ethanol industry, make the Northwest a better site for ethanol development, create opportunities for perennial crops, provide extra income for farmers, and yield water quality benefits. This technology could be just around the corner. Iogen, a Canadian company, is currently producing cellulosic ethanol from wheat straw[71] while University of Minnesota researchers are currently working on new enzymes to bring down the cost.

Development of mechanisms to capture hydrogen using renewable resources is also making steady progress. While hydrogen can be captured from a variety of sources including natural gas petroleum and coal, it can also be harvested via hydrolysis, but the source of electricity to fuel this hydrolysis impacts whether or not the hydrogen harvesting is environmentally friendly or not. The University of Minnesota's West

[71] For more information please see: http://www.iogen.ca/.

Central Research & Outreach Center (WCROC) is currently working to tackle these issues by installing a demonstration site for wind-powered hydrogen splitting. In March 2005 the WCROC installed a 1.65 MW wind turbine, and it hopes that within the next few years it will have the on-site technology to use the turbine to split water, extract hydrogen, and "store" the wind energy. In the Northwest region, campuses in Moorhead and Fargo are looking into hydrogen technologies for their campus-to-campus bus routes. With three universities in the area this is an ideal locale to assess the potential hydrogen resources, like Moorhead's wind turbines or local biomass resources, and start educating the public about using hydrogen as a transportation fuel.

Section 9.2 Conclusion

As the Northwest CERT moves towards Phase II, which will officially start on July 1st, 2005, it is important for the group to look back on what it has accomplished. Team members feel that as a group, the Northwest region has been realistic. Involvement of utilities has kept the group focused more on what is doable and not just making a "pie in the sky" wish list, but the team hopes to better participation from rural electric coops during the next phase.

The Northwest team has created a realistic list of priorities that is laudable for its focus, common sense and plan to shape regional goals into on-the-ground regional achievements. With fairly large land areas available and major efforts needed to save citizens from sky-rocketing natural gas prices, ground source heat pumps can offer huge savings if consumers are informed and incentives are appropriately structured. The vast agricultural and forestry resources in the region offer significant opportunities for biomass fuels that can keep working lands working while providing additional economic prospects within the region. Biogas production at agricultural production companies creates jobs and adds value to existing resources. With its rich and varied supply of resources, the Northwest is poised to be a leader in efficient and renewable energy technologies.