CLEAN ENERGY RESOURCE TEAMS

Central 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, Morris Center for Small Towns

Authorship:

This report was primarily written and compiled by Melissa Pawlisch, CERTs Coordinator and Joel Haskard, CERTs Assistant Coordinator. Additional authors include Lola Schoenrich of the Minnesota Project, Mike Taylor, Minnesota Department of Commerce, and students, Laura Hildreth and Libby Jensen. Team members also contributed paragraphs, project descriptions, and considerable time and effort to edit, modify and improve the report. Team members' contributions were critical to completing this report and making it as comprehensive as possible.

Acknowledgements:

A special thank you to Laura Hildreth and Libby Jensen, students at the University of Minnesota Morris, whose work as student researchers for the CERTs project led to the formulation of this report. Laura and Libby each spent a semester gathering and compiling data to be used in this regional report. Their work was tremendously valuable to the Central CERT team.

APPENDICIES

SECTION 1: INTRODUCTION TO CERTs

Section 1.1 Background on CERTs

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

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

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

Clean Energy Resource Teams (CERTs) have been active in each of the seven CERT regions (Figure 1). 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 regional quarterly CERT meetings. Many more stay in touch attending meetings when possible and weighing in with opinions and ideas on the regional CERT listservs. The Metro County Energy Task Force is serving as the metro area CERT.

Figure 1: Clean Energy Resource Teams Map

Each of the teams is engaged in studying its 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 team members understand the regional energy system and identify areas of regional economic opportunity. Tours of renewable energy and conservation projects in the region organized by CERTs staff have also provided good examples of what can be done.

The plan for the Central Region presented in this document resulted from the careful study of the region's resource inventory. The inventory gave the team a good understanding of

the best regional opportunities. The Central Region team had extensive and thoughtful discussions about its vision for the region's energy future and team's mission and goals. Each of the visions articulated by the CERTs in some way expresses a coupling of economic opportunity and environmental protection from development of regional conservation and renewable energy projects, and the Central CERT vision is no different. The team's vision, along with its inventory, forms the basis for this plan. The final component shaping this plan was the discussion of project priorities – those that are judged best for the region and most likely to succeed – and the obstacles and opportunities to implementing these projects.

Draft plans were widely shared throughout the Central Region and input sought from a broad range of community interests.

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 was tasked with developing a Regional Strategic Energy Plan. This report fulfills the Strategic Energy Plan requirement for the Central Region by presenting the results of the current energy use inventory, the results of the regional renewable energy resource assessment, and the region's project priority ideas for the future. These project priorities were determined by evaluating the resources available in the Central Region and then considering the region's priorities as reflected in its vision, mission and goals. In summary, the regional resource inventory for the Central Region reflects strong biomass capacity, as well as opportunities for continued solar resource development, geothermal development, some wind development and increased focus on conservation and energy efficiency efforts.

Section 1.4 Overview of Regional Vision and Mission

The Central CERT team has a broad vision to "Design a Clean Energy Future". The Central team's mission laid out its priorities to "Build a sustainable future by increasing the public's awareness and active adoption of energy conservation and renewable energy resources." In concrete terms this mission seeks to guide the team toward a focus on four integrated

and overlapping areas: conservation, education, action steps and integration of future development.

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 Central CERT to develop three primary project priorities for the Central Region that focus on building energy efficiency, solar, and biomass. These are described in full in Section 7.

SECTION 2: INTRODUCTION TO THE CENTRAL 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 performed a general survey of regional statistics, land use and demographics. These figures taken together paint a broad picture of the energy use of the region and help guide CERT members in creating their conservation and energy efficiency efforts. People are the energy users, and knowing population size and location helps to evaluate resource availability, and in turn point decision makers towards potential linkages with renewable energy solutions.

Section 2.1 An Overview of the Central Region

Central Minnesota comprises the counties of Becker, Benton, Cass, Crow Wing, Hubbard, Mille Lacs, Morrison, Otter Tail, Todd, Wadena, and Wilkin. According to the Ecological Classification System these counties encompass parts of the Red River Valley, Minnesota and NE Iowa Morainal, N. Minnesota Drift & Lake Plains, and a small amount of Western Superior Upland (Figure 2).[1]

The Central Region overlaps with parts of three major drainage basins, the Red River of the North Basin, the Upper Mississippi River Basin, and a little bit of the Minnesota River Basin (Figure 3).[2] Major waterways in the region include the Mississippi River, Crow Wing River, Pine River, Redeye River, Otter Tail River, Long Prairie River and Sauk River. These waterways and the many lakes of the region draw many visitors to the region every year making these water bodies important in terms of a natural resource base and as a catalyst for tourism dollars. Water quality issues, and maintaining high water quality are therefore imperative.

Figure 2: Minnesota Ecological Classification System

Figure 3: Minnesota Drainage Basins

[1]State of Minnesota, Department of Natural Resources. 2004. "Ecological Classification System: Eastern Broadleaf Forest Province." Retrieved December 13, 2004 from: http://www.dnr.state.mn.us/ecs/laurentian/index.html.

[2] State of Minnesota, Department of Natural Resources. 2004. "Major Basins & Watersheds of Minnesota." Retrieved December 13, 2004 from: http://www.dnr.state.mn.us/watersheds/map.html.

In recent years water quality issues have been gaining attention throughout the state. The recent Green Lands Blue Waters initiative (www.greenlandsbluewaters.org) is one example of the many activities focused on the Mississippi watershed. While water quality issues are simply a problem of agriculture – residential practices, resort practices, golf course practices also impact water quality – improving water quality does at least in part require improved farming practices. Some of these practice modifications include growing cover crops and barrier crops to help with soil fixation and filtration. These perennial crops are a natural link between energy and environmental issues as they provide these environmental services while also providing a source of biomass.

Section 2.2 Regional Demographics

There were a total of 321,328 people living in Central Minnesota during 2000. Otter Tail County had the largest population with 57,159 people while Wilkin County had the smallest with only 7,138 people (Figure 4, Population Pie Chart by County). The majority of counties are predominantly rural, agricultural counties with dispersed populations. The breakdown of urban and rural population figures for each county is depicted in Figure 5.

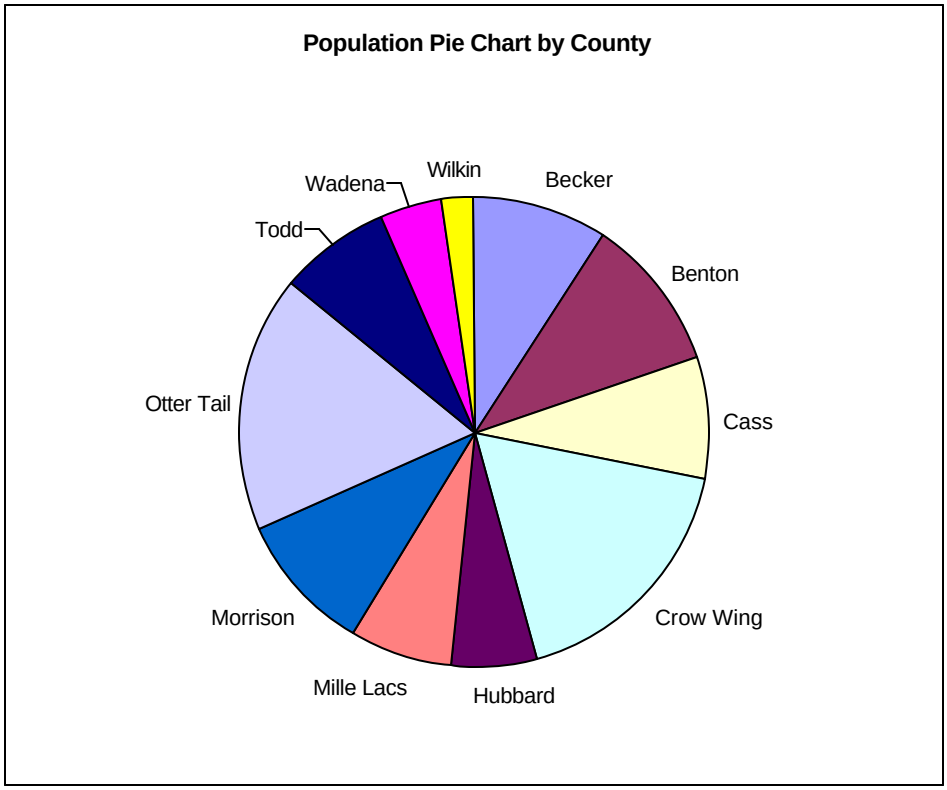

Figure 4. Population Pie Chart by County

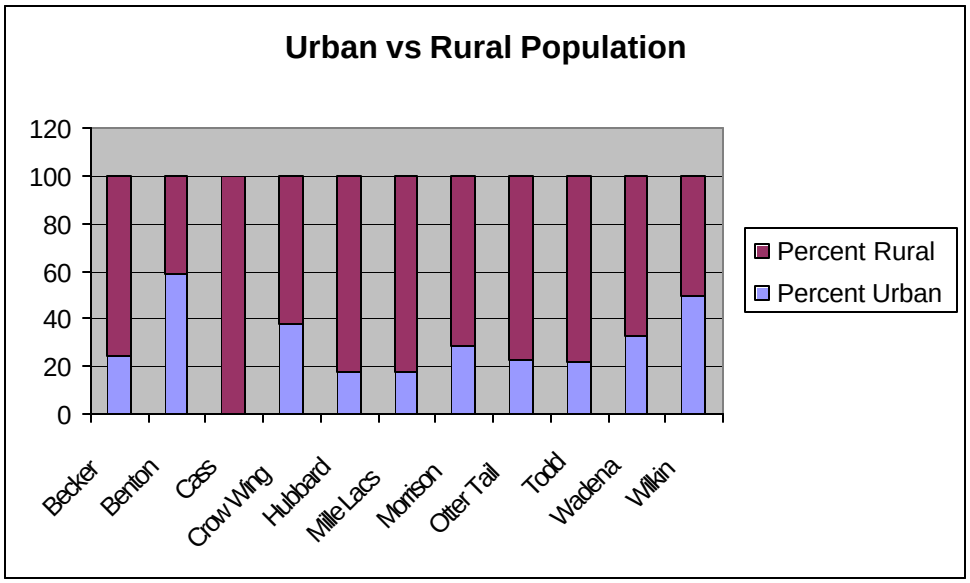

Figure 5. Urban vs Rural Population in each County

Since Otter Tail County has the largest population, the team believes that working with utilities serving Otter Tail County, like Otter Tail Power and the Lake Region Coop, could be a ripe starting point for conservation measures. Data regarding the breakdown between urban and rural populations also suggests that the team should consider residential and commercial conservation, but not forget to also target farm-based energy efficiency measures. For example, the team could encourage Lake Region Coop members to take advantage of their existing Residential Conservation Program covering Energy Star appliances and ground source heat pumps (also need Energy Star rating), their Wellspring Energy Program, or their Energy Grant Program for business, industrial and agricultural members which allows those customers to get up to $5,000 for energy efficiency improvements.[3]

The Central Region is expected to have significant population growth between 2000 and 2030.[4] All counties except for Wilkin are projected to see growth. Each county is listed below by name, 2000 Census population, 2030 projected population, and percent increase or decrease (Table 1). The growth and decline figures are significant as they provide regional teams with a glimpse at potential changes in regional energy demand.[5]

[3] Lake Region Coop website accessed on March 23, 2004 from: www.lrec.coop.
[4] Minnesota Planning State Demographic Center, "Minnesota County Population Projections 2000-2030." 2002. Retrieved December 14, 2004. from: http://www.demography.state.mn.us/DownloadFiles/00Proj/PopulationProjections02Intro.pdf.
[5] Generally demand will increase as population increases.

Table 1. 2030 Population Projections

County	2000 Population	Projected 2030 Population	% Change
Becker	30,000	37,190	24%
Benton	34,226	44,960	31%
Cass	27,150	45,280	67%
Crow Wing	55,099	90,240	64%
Hubbard	18,376	28,590	56%
Mille Lacs	22,330	34,160	53%
Morrison	31,712	37,190	17%
Otter Tail	57,159	78,250	37%
Todd	24,426	28,000	15%
Wadena	13,713	15,900	16%
Wilkin	7,138	7,070	-1%

Section 2.3 Household Information

Based on figures from the Minnesota State Demographers Office there are 126,150 total households in Central Minnesota (Table 2). On average 10.75% of families living in the Central Region are categorized as living below poverty level.[6] Median household income for the region is, on average, $35,859 while the median value of owner occupied homes is $85, 000.[7] Minnesota ranks 2nd nationwide in home ownership at 74.6%[8], and there is only one county in the Central region with less than that, Benton county, with 67.3%.

These household and earning figures are important because owners may be more likely to make investments in energy efficiency improvements, as they will see the direct benefit from decreased energy costs. Renters, who are generally more transient and on occasion do not directly pay their utility bills, have fewer incentives to make energy efficiency upgrades and investments. A useful tool available to homeowners is Energy Efficiency Home Mortgages that roll the cost of efficiency improvements directly into mortgage payments.[9] Even with these tools however, some owners may be less likely to make capital investments in their homes that they will not be able to recoup in the sale of their home. Therefore, if the average sale price for a home is $70,000, owners may be wary of investing another $20,000 for a ground source heat pump system. Lastly, several of these counties have aging populations and many elderly living on fixed incomes. This is also a factor in ability to make capital investments.

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[6] 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."

[7] US Census Bureau. 2000. "Census 2000 Summary File 3, Table GCT-H9, Specific owners, Median Value for the Central region counties is available at: http://factfinder.census.gov/servlet/GCTTable?_bm=y&-geo_id=04000US27&-_box_head_nbr=GCT-H9&-ds_name=DEC_2000_SF3_U&-_lang=en&-format=ST-2&-_sse=on . Retrieved May 2nd, 2005.

[8] US Census Bureau. 2000. "Census 2000 Summary File 1, Table GCT-H6, Occupied Housing Characteristics: 2000." Retrieved on January 26, 2005 from http://factfinder.census.gov.

[9] www.pueblo.gsa.gov\cic_text\housing\energy_mort\energy-mortgage.htm

Table 2. Household Information for Central Minnesota[10]

County	Total Housing Units	Individuals Below Poverty Level (percent)	Median Household Income
Becker	16,612	12.2	$34,797
Benton	13,460	7.1	$41,968
Cass	21,286	13.6	$34,332
Crow Wing	33,483	9.8	$37,589
Hubbard	12,229	9.7	$35,321
Mille Lacs	10,467	9.6	$36,977
Morrison	13,870	11.1	$37,047
Otter Tail	33,862	10.1	$35,395
Todd	11,900	12.9	$32,281
Wadena	6,334	14.1	$30,651
Wilkin	3,105	8.1	$38,093
Regional Averages		10.75	$35,859

Section 2.4 Land Use

According to the Minnesota Department of Administration, of the 8,165,235 acres in the 11 county region, 2,269,552 acres are described as cultivated land. [11] Forested land is the largest category of land use at 2,789,511 acres, cultivate land the second largest, and hay/pasture/grasslan d land the third largest with 1,236,487 acres. Only 162,893 acres are listed as urban and rural development – around 2.0% of the region. Fergus Falls, Brainerd, Sauk Rapids and Little Falls are the four largest cities in the region. Detroit Lakes, Wadena, Princeton and Breckenridge are also population centers in the Central Region.

Land use is important because it speaks to what land is available for renewable energy and what renewable energy resources are already available. In the Central Region 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 in which to begin thinking about alternative crop options that could also serve as biomass feedstocks. Cultivated land may also be a natural fit for wind energy development. Very little land is in urban areas, and while these are areas where energy efficiency measures should be targeted, the rest of the region is land rich and should be able to explore many renewable energy options.

In light of the population concentrations, it would also be wise to target building energy efficiency efforts in those population centers. It will also be useful that the CERT include members from those communities to ensure the largest potential local impact.

[10] US Census Bureau. 2000. "Census 2000 Summary File 1, Table GCT-P14, Income and Poverty in 1999: 2000." Retrieved on January 26, 2005 from http://factfinder.census.gov.
[11] Admin Minnesota: Department of Administration. 2004. "Datanet: Minnesota Land Use and Cover Statistics." Retrieved December 13, 2004, from: http://mapserver.lmic.state.mn.us/landuse/ .

Section 2.5 Regional Sector Breakdown

Based on figures adapted from the North American Industry Classification System (NAICS), the Central Region's 9,550 business establishments paid out $2,644,729,000 in 2002.[12] County level data reveals that the dominant industries in the region, based on payroll figures, are manufacturing, health care and social assistance, retail trade, and 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 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. Sharon Rezac Andersen, Executive Director of the UM Central Region Partnership, noted that nitrate issues and water quality issues are major issues brought forward at civic engagement meetings. Water quality issues relate to cropping systems but also to density issues of shoreline and lake populations, with the Central Region being one of the fastest growing areas in the state. The issues can be exacerbated by the lack of a comprehensive plan to manage such rapid change.[13]

Erosion, water quality, population expansion, agriculture and climate change are all connected and all relate to energy. If we improved the efficiency of agriculture we could put fewer chemicals on the land. If we grew natural filters around waterways and cover crops to fix our soils, we would help limit erosion, filter water, fix carbon, and grow biomass thereby providing incentives for changing landscape practices. However, we must be cautious not to simply place blame with agriculture. More and more land around urban areas is being taken out of agricultural rotation and being developed for housing, retail, and commercial development. These developments have significant impacts on the land with habitat removal, fertilizer run off and drainage issues related to nonporous parking lots. All land uses have an impact on the environment. We must find ways to build creative collaborations that can holistically address our region's issues with water quality, erosion, changing land use, and energy usage in mind.

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

[13] Based on conversation and correspondence with Sharon Rezac Andersen on March 24, 2005.

SECTION 3: TEAM ORGANIZING

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

Section 3.1 Information Sharing and Recruitment

Individuals were recruited for the Central CERT via letters of invitation, on-going press releases, announcements in the local paper, on local television, and on local radio stations prior to meetings, announcements by the Sierra Club in their newsletters, on the CERTs website and word-of-mouth. Individuals who attended and signed in at meetings were added to the Central CERT mailing list and/or list serve. Paper invitations were sent out prior to meetings. Over 46 people were on the regional mailing list. Electronic invitations were sent to the Central Listserv (40 people) prior to each meeting. The meeting dates and locations were also posted on the CERTs website. Meeting summaries were sent electronically to the listserv 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 Central Region team represents a wide variety of stakeholders including community developers, educators, economic developers, entrepreneurs, farmers, teachers, researchers, state/federal agency employees, and utility representatives. For a complete list of team members please see Appendix B.

Section 3.3 Team Activities

The Central Region convened meetings throughout the initial two years of the project. The first meeting was held in December 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 CERT team meetings as well as various working group meetings.

The following lists all the meetings and general topics:

- December 12th, 2003 – Full CERT Meeting – Introductory meeting to give an overview of CERTs
- January 29th, 2004 – Full CERT Meeting
- April 22nd, 2004 – Full CERT Meeting – Earth Day celebration
- June 2nd, 2004 – Full CERT Meeting
- November 5th, 2004 – Full CERT Meeting – Energy Education Bus Tour
- December 2nd, 2004 – Full CERT Meeting – Setting project priorities and developing project task lists
- January 27, 2005 – Full CERT Meeting – Updating project task lists, getting updates on regional projects
- February 28, 2005 – Clean Energy Resource Teams Statewide Conference
- March 31, 2005 – Full CERT Meeting – Planning for regional tour, update on project lists

- April 22, 2005 – Full CERT Meeting – Energy Efficiency Bus Tour

A copy of each meeting agenda and meeting summary is provided in Appendix C.

The Central CERT has coordinated two bus tours to explore efficiency and clean energy projects at work in their region.

SECTION 4: TEAM VISION, MISSION, GOALS

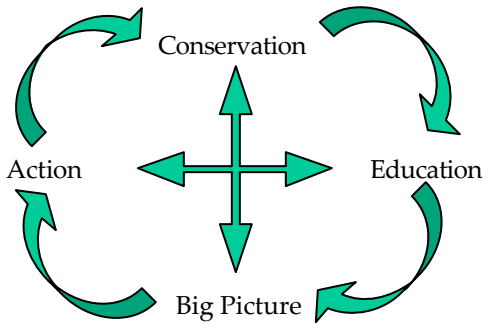
After discussion and input at two CERT meetings the Central Region CERT arrived at the following vision statement.

Vision:
Designing a Clean Energy Future

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

***Objectives*:**
The Region will focus on four main areas: conservation, education, action steps, and integrating future development. These four areas will all the Central Region to aggressively promote and support energy conservation practices, efficient energy production and use, and locally owned and operated alternative and renewable energy systems. The Central Region sees these four main elements acting upon one another in a continuous cycle.

- Encourage broader implementation of energy conservation and efficiency measures
- Engage a variety of audiences, from school children to trade professionals to ensure the broadest contact with community members, regarding the options available for conservation, efficiency, and renewable energy.
- Contribute towards enhancing a wider understanding of renewable energy applications by integrating technical knowledge and social resources.
- Install and provide opportunities to view tangible, working demonstrations, of renewable energy and energy efficient technologies in the Central Region.



Understanding the team's goals is critical to understanding what types of projects they have chosen to work on and why. The human capacity of the region is strongly centered on distributed energy generation (chiefly solar and small-scale wind), energy efficiency, and education and outreach. This vision statement reflects the human expertise of the region and demonstrates how the team plans to create an energy future that works with and for 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 teams with energy baselines and a better general understanding of regional energy use.

Section 5.1 Electric

The Central CERT began its energy use inventory by gathering information about electric energy generation and usage.

Section 5.1.1 Electric Utilities in the Central Region

There are 25 electric utilities serving Central Minnesota. Most of these utilities are municipals or cooperatives; however two investor-owned utilities also serve parts of the region (Table 3). 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 Central vision and project priorities forward.

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

Table 3: Utilities Serving the Central Region

Utility Type	Utility
Investor Owned Utilities	Minnesota Power and Otter Tail Power Co.
Generation & Transmission Cooperatives	Great River Energy and Minnkota Power Cooperative
Distribution Cooperatives	Crow Wing Coop Power & Light, Itasca-Mantrap Coop Elec, Lake Region Coop Elec Assc, Mille Lacs Elec Coop, North Itasca Elec Coop, Runestone Elec Assn, Todd Wadena Elec Coop, Red River Valley Coop Power
Municipal Utilities	Aitkin Pub Utilities, Alexandria Light & Power, Barnesville Mun Elec, Brainerd Public Utilities, Breckenridge Pub Utilities, Elbow Lake Mun Elec, Henning Electric Dept, Melrose Public Utilities, Pierz Utilities, Randall City of, Sauk Centre Public Utilities, Staples City of, Wadena Light & Water

In 2000, the Central Region used 4,234,790 MWh of electricity.[14] This total was determined by summing the megawatt-hour consumption figures from each of the 11 counties (Figure 6) and gives the team an electricity use baseline from which to measure future progress in conservation and energy efficiency efforts. Generally speaking electricity use is estimated to increase at a rate of roughly 2.5% per year.[15] If teams are to have an impact on electric use, they must help either slow or reverse this trend of ever increasing energy usage.

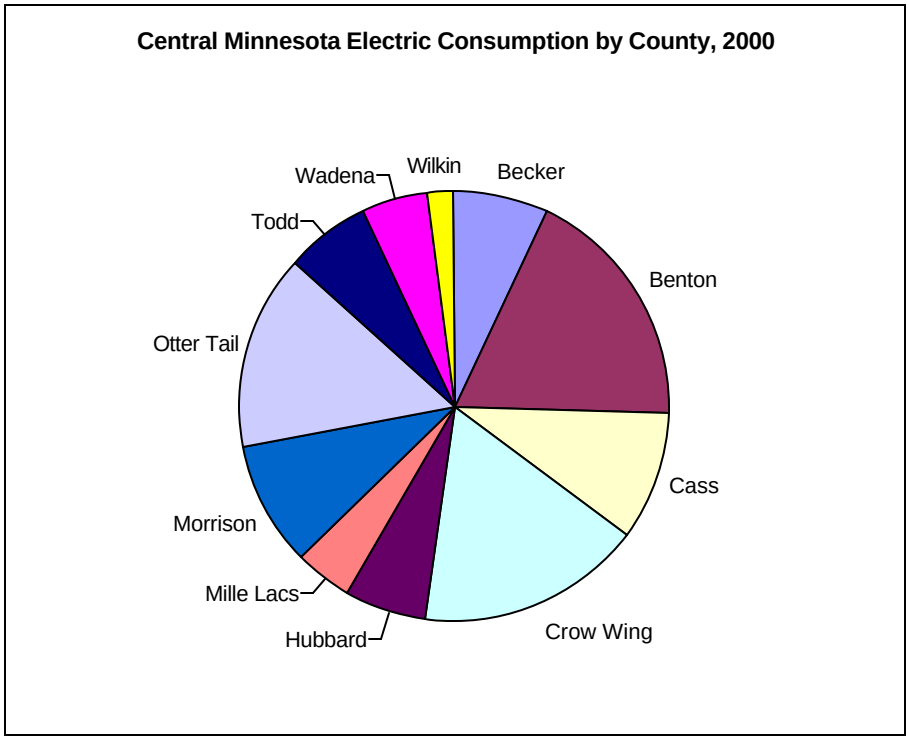


Figure 6. Central Minnesota Electric Consumption by County, 2000

[14] Minnesota Department of Commerce. 2002. *The 2001 Minnesota Utility Data Book*. Table 8. Retrieved on May 19, 2005 from http://www.state.mn.us/mn/externalDocs/Commerce/Utility_Data_Book,_1965-2000__030603120425_UtilityDataBook65thru01-2.pdf

[15] Per "CapX 2020: A Vision for Transmission Investments for Minnesota", the yearly anticipated growth rate percentage for MN Power = 1.70, for Otter Tail Power = 2.7%, for Great River Energy = 3.05%. Retrieved May 2, 2005 from http://www.capx2020.com/Images/CapX2005_13.pdf.

Roughly half of the load served in the Central Region is served by the Investor Owned Utilities while the other half is served by local cooperative and municipal utilities (Table 4).

Table 4: Central Minnesota Electric Consumption in 2000 (MEGAWATT-HOURS)[16]

	Farm	Non-Farm Residential	Commercial	Industrial	Total
Central Minnesota Investor-Owned Utilities					
Otter Tail Power Co	-	456,616	655,436	702,951	1,815,003
Minnesota Power Co	36,034	864,814	1,154,012	6,851,991	8,906,851
Otter Tail Power Co (Central share)[1]	-	159,816	229,403	246,033	635,251
Minnesota Power Co (Central share)[2]	6,126	147,018	196,182	1,164,838	1,514,165
Total: Central Investor-Owned Utilities	6,126	306,834	425,585	1,410,871	2,149,416
Central Minnesota Cooperative Utilities					
Great River Energy					
Crow Wing Coop Pwr&Light	51,745	233,697	83,231	-	368,673
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
Mille Lacs Elec Coop	64,659	24,724	42,300	17,265	148,948
North Itasca Elec Coop	-	26,871	8,380	665	35,916
Runestone Elec Assn	70,051	65,571	18,209	11,030	164,861
Todd Wadena Elec Coop	104,567	1,213	21,046	4,595	131,421
Minnkota Power Cooperative - Cooperative					
Red River Valley Coop Power	84,408	-	21,842	-	106,250
Total: Cooperatives	519,153	535,151	212,819	58,202	1,416,158
Central Minnesota Municipal Utilities					
Other Municipals (Non-SMMPA)					
Aitkin Pub Utilities	-	12,048	6,566	12,579	31,193
Alexandria Light & Power	-	58,826	57,694	110,188	226,708
Barnesville Mun Elec	-	11,855	6,592	-	18,447
Brainerd Public Utilities	-	41,865	72,162	53,495	167,522
Breckenridge Pub Utilities	-	15,702	9,836	10,144	35,682
Elbow Lake Mun Elec	-	5,700	9,319	-	15,019
Henning Electric Dept	-	3,903	4,300	-	8,203
Melrose Public Utilities	2,164	15,596	18,796	67,589	104,145
Pierz Utilities	-	3,518	2,042	-	5,560
Randall City of	-	2,320	1,344	-	3,664
Sauk Centre Public Utilities	-	16,098	10,816	20,644	47,558
Staples City of	-	9,192	5,682	5,678	20,552
Wadena Light & Water	-	20,213	17,466	25,567	63,246
Total: Municipal Utilities	2,164	216,836	222,615	305,884	747,499
Total: Central Region	527,443	1,058,821	861,019	1,774,957	4,313,073

[16] Source: Table 4, Minnesota Department of Commerce, The 2000 Minnesota Utility Data Book, June 2002

Notes:

1 Otter Tail Power Co (Central Share) reflects Otter Tail Power total consumption (statewide) multiplied by 35% as an estimate of the Central region's fraction of Otter Tail Power's overall MN consumption figures.

2 Minnesota Power (Central Share) reflects Minnesota Power's total consumption (statewide) multiplied by 17% as an estimate of the Central region's fraction of Minnesota Power's overall MN consumption figures.

* Withheld to avoid disclosure of individual company data. Data not included in regional totals.

No data provided for New York Mills Municipal Utility

No data provided for Perham Municipal Utility

Evaluating electricity use by sector in Central Minnesota shows that industrial energy consumption is the largest single factor in regional electric use followed by the residential and commercial sectors (Figure 7). Therefore, where possible, conservation and energy efficiency measures should focus first on industrial energy usage. It will be imperative that the Central Team work with local utilities to help these industries see the value of making efficiency improvements. As residential and commercial sector consumption also plays a major role, the team should also continue to target these sectors.

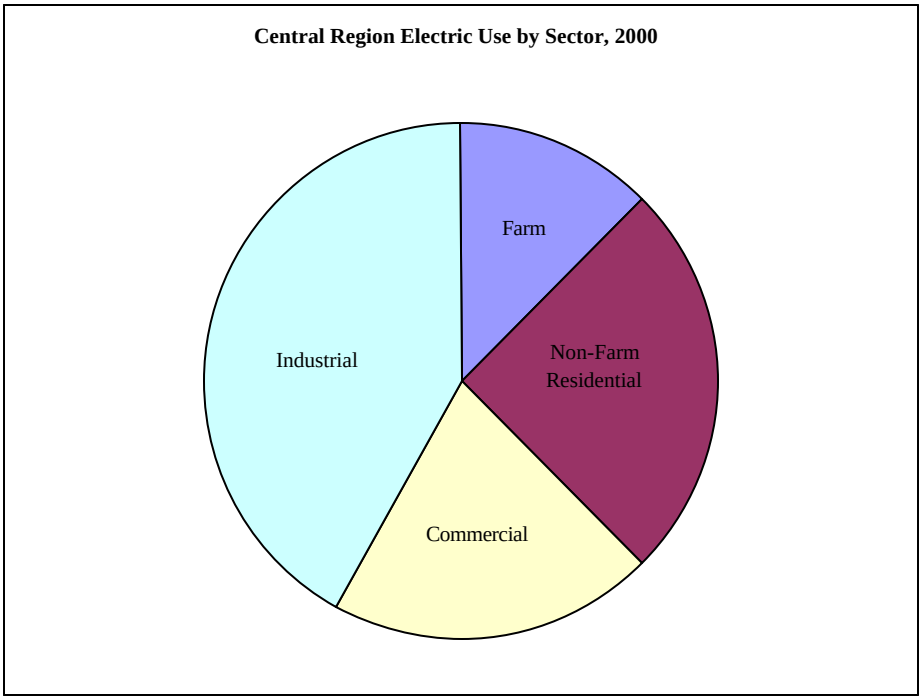


Figure 7. Central Minnesota Electric Use by Sector, 2000

Section 5.1.3 Energy Sources Used in Electrical Generation

Great River Energy, Minnesota Power, and Otter Tail Power Company generate much of the electricity that supplies the Central region.

Great River Energy utilizes the following fuel mix to generate electricity:

- Coal-based power plants in North Dakota, namely Coal Creek Station and Stanton Station – 80%
- Hydropower – 4%
- Natural gas-fired peaking plants in Minnesota – 2%
- A refuse-derived (municipal waste) plant in Elk River, Minnesota – 1%
- A wind energy farm in southwest Minnesota – 1%
- Purchased power – 9%

GRE is also planning to build up to 400 megawatts of natural gas-fired combustion turbines in Minnesota, as well as working to develop an additional 100 megawatts of wind industry in southwestern Minnesota.[17]

[17] More information about Great River Energy's power plants is available at: http://www.greatriverenergy.com/about/powerplants.html

Minnesota Power's "Regulated and Unregulated Generation Sources" webpage lists the following generation sources: [18]

- Boswell Energy Center, Minnesota – 914 MW (coal)
- Taconite Harbor Energy Center, Minnesota – 200 MW (coal)
- Laskin Energy Center, Minnesota – 110 MW (coal)
- Hibbard Energy Center, Minnesota – 48 MW (biomass, coal, natural gas)
- Rapids Energy Center, Minnesota – 30 MW (biomass, coal)
- Cloquet Energy Center, Minnesota – 23 MW (biomass, natural gas)
- Hydroelectric, 11 Minnesota Stations – 115 MW (combined capacity of all 11 stations)
- Square Butte – contract for about 71 percent (322 MW) of output of the 455-MW coal-fired unit near Center, N.D.
- LSP-Kendall Energy LLC – contract for full output of one unit (about 275 MW) of a four-unit gas fired combined cycle generation facility near Chicago.
- Purchased power and capacity sales & Wholesale electric sales

Otter Tail Power Company's generating breakdown is as follows:[19]

- Coal –Big Stone Plant, ND (450MW); Coyote Station, ND (420 MW); Hoot Lake Plant, Minnesota (156 MW) – total of 75.17%
- Purchases – 14.99%
- Hydro – Six hydro plants in Minnesota, one on the Mississippi River near Bemidji and the remaining five on the Otter Tail River near Fergus Falls – total of 7.13%
- Biomass – 1.39%
- Wind – Fourteen 1.5 MW GE turbines located in ND and owned by Florida Power and Light – total of 0.49%
- Solid Waste – 0.45%
- Fuel oil – 0.23%
- Natural gas – 0.15%

The Central Region is unique in the state of Minnesota for the amount of small hydroelectric generation it has. Cass, Morrison and Otter Tail Counties have a combined total of 20 hydroelectric units online. These units are generally small (<1 MW) units built between 1910 and 1930. The three hydro units at the Blanchard Hydroelectric Station in Morrison County are the primary exceptions, with generation capacity of 6 megawatts each.

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.[20] 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

[18] Retrieved April 27, 2005, from: http://www.mnpower.com/about_mp/generation.htm.
[19] Retrieved April 27, 2005, from: http://www.otpco.com/AboutCompany/GeneratingElectricity.asp.
[20] 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.

pneumonia, and decrease resistance to respiratory infections.[21] 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.[22] Coal combustion also contributes to mercury, arsenic and lead emissions.[23] These toxic metals can accumulate in the fatty tissue of animals and humans leading to severe health problems.[24] 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.[25]

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, blocking of fish and invertebrate migrations, inundation and loss of habitats, alteration of communities, alteration of water quality, and increase in susceptibility to exotics and pathogens. While these impacts are of great concern at large-scale hydroelectric facilities, these concerns are also relevant at small-scale hydroelectric facilities as even run-of-river facilities impact fish migration.

Section 5.1.5 Existing Conservation and Energy Efficiency Programs

As part of the Conservation Improvement Program (CIP) all of Minnesota's energy utilities are required to set aside a percentage of their revenues to be used in projects that will reduce electric and natural gas consumption. As part of this requirement the all of the Central Region's 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.[26]

The followings have been implemented thus far:

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[21] 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.

[22] 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.

[23] 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

[24] Ibid.

[25] 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.

[26] 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

- Public awareness and information campaigns to educate customers about energy efficiency.
- Energy audits for customers and programs
- Upgrades to more energy efficient lighting and motor alternatives.
- Cycled air conditioning program.
- Rebate for energy star appliances.
- Commercial high efficient motor rebate.
- Off-peak water program.
- Low-income air conditioner tune up

Many utilities also utilize load management techniques for energy conservation. Load management allows customers to get reduced electric rates in exchange for allowing the utility to control the power supplied to certain appliances and equipment during periods of peak demand. Generally speaking, this means that during periods of peak electric demand, such as hot summer days when everyone wants to use an air conditioner, a radio signal activates a switch that turns off certain equipment. When the overall electric demand decreases, a second radio signal returns the equipment to normal operation. Load management makes it possible for utilities to reduce energy use during times of peak demand thereby helping them avoid unplanned and high-priced energy purchases and helping keep rates affordable.

Great River Energy and its member cooperatives spend more than $12.5 million a year on load management and energy conservation programs. Through the efforts of the 28 member cooperatives, Great River Energy has saved more than 53 million kWh, and can shave its summer peak load by 12 percent.[27] GRE's Energy Wise program provides energy saving tips and other useful information.

Minnesota Power's website has a link to Energy Efficiency Tips & Tools that includes an energy saver library, links to energy audits and home improvement tips, and several energy savings calculators.[28] The site also includes information about Power Grant rebates and grants for residential and business customers.[29]

Otter Tail Power has CIP conservation programs for both residents and businesses. Some of its residential programs include:[30]

- House Therapy – Income guidelines qualify customers for specific energy-efficient home improvements such as home weatherization.
- CoolSavings – Participants earn credit for allowing a radio receiver to cycle air conditioners on and off every 15 minutes to help manage summer electricity demand on peak days.
- Residential demand control conservation program – which qualifies Minnesota customers for a $200 rebate.

[27] More information about Great River Energy's Energy Wise Program is available at: http://www.greatriverenergy.com/environment/env_ew.html.
[28] More information about this program is available at: http://www.mnpower.com/energy_tips/index.htm.
[29] For Power Grant profiles, please go to: http://www.mnpower.com/powergrant/profiles/index.htm.
[30] A complete menu of Otter Tail's CIP programs for residents and businesses is available at: http://www.otpco.com/SaveEnergyMoney/ConservationImproveProg.asp.

- Heat pump conservation rebates – both air-source and geothermal heat pumps qualify.

The three largest municipal utilities in the region are Alexandria Light & Power, Brainerd Public Utilities and Melrose Public Utilities. Alexandria Light & Power offers a water heater rebate program, an energy efficient lighting program, and a motors and drives rebate program. It also offers its own green pricing program, River Winds, and compact fluorescent bulb recycling.[31]

Brainerd Public Utilities' website explains what the CIP program is but does not list any programs for residents or businesses. A different link on the website gives some water-saving tips, details the electric usage and cost of typical home appliances and, provides links to several other organizations.[32]

Melrose Public Utilities' website provides a link to the federal Energy Star program, but does not have any information regarding the CIP program.[33]

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.[34] The Wellspring Renewable Energy Program is the green pricing program offered by Great River Energy and its member cooperatives.[35] The wind energy for this program comes from nine turbines at the Chandler Hills Wind Farm along Minnesota's Buffalo Ridge that generates six MW of electricity. The number of customers who choose to subscribe to the service determines the number of turbines built, so the higher the level of Wellspring subscriptions, the larger the new wind farm. Customers who choose to participate in this program may choose to buy wind energy in 100 KWh blocks for a nominal monthly fee.

As part of its Conservation Improvement Program (CIP), Minnesota Power put out a request for proposals (RFP) seeking to provide limited financial incentives for the installation of two to three small-scale wind turbine projects within Minnesota Power's service territory. Proposals were due in March and the projects are slated to be complete by November 30th, 2005. The primary objectives of this funding project are to:

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

[31] For more information, visit: http://www.alputilities.com/electric/index.html.
[32] For more information, visit: http://www.bpu.org/Admin/CONSERVE.HTM.
[33] For more information, visit: http://www.cityofmelrose.com/pages/cityinformation/services.asp.
[34] For more information about green pricing programs please see http://www.state.mn.us/mn/externalDocs/Commerce/Green_Power_012703040626_GreenPower.pdf.
[35] More information about the program is available at: http://www.greatriverenergy.com/environment/renewables_wind.html

Minnesota Power's solar rebate program, *SolarSense*, gives customers a $2,000 per kilowatt rebate up to a maximum of $4,000 for installing a grid-connected solar photovoltaic (PV) electric system. [36] Participants must be Minnesota Power customers and the solar electric system must be installed by December 31st, 2005.

Otter Tail Power Company provides green power through its TailWinds Program that buys power from a wind turbine located near Hendricks, Minnesota. [37] The 900-kw NEG Micon turbine was installed on December 28, 2001. Otter Tail customers may enroll in the program by purchasing 100 kWh blocks for an additional $2.60. Otter Tail states that 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 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 this heat comes from, we are better able to understand the impacts of our heating fuel use and assess where we can best make an impact with conservation, energy efficiency, and switching from expensive natural gas to locally grown heating fuels.

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 8). Natural gas, or methane, is a colorless, shapeless, and odorless gas in its pure form. Heat from natural gas is extracted in combustion.
- Bottled, tank or liquefied petroleum (LP) gas: Also known as Propane. It is a colorless gas of mixed hydrocarbons 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.

Figure 8: Natural Gas Pipelines

- Electricity: Electricity is the energy that is extracted from a number of different energy sources (like coal, nuclear, hydropower, and wind). When using electricity

[36] More information about the program is available at: http://www.mnpower.com/environment/solar_sense/index.htm
[37] For more information please see: http://www.otpco.com/ProductsServices/TailWinds.asp

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 deliver heat by means of hot water circulated throughout a house or building, via radiators or baseboards, using an electric pump. Hybrid systems such as wood-electric and oil-electric systems are also available, as are heat pumps. 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. There are several different kinds of coal that can be distinguished based on both their physical properties and heat content (bituminous, anthracite, lignite, and sub bituminous). 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 Central Minnesota is utility gas, which supplies heat to 45,440 homes in the region. LP gas (31,923 homes), electricity (19,191 homes) and fuel oil (17,146 homes) are the other major fuels used in the region although there are some homes using wood, coal and solar (see Table 5).

Table 5: Central Region House Heating Fuel[38]

	Occupied Housing Units	Utility Gas	Bottled, tank or LP Gas	Electric	Fuel Oil, Kerosene, etc	Coal or coke	Wood	Solar Energy	Other fuel	No fuel used
Becker	11,844	3,215	3,339	2,361	1,604	-	1,225	2	65	33
Benton	13,065	7,234	1,754	2,214	1,046	-	393	4	266	154
Cass	10,893	1,235	4,760	1,796	1,399	5	1,630	-	45	23
Crow Wing	22,250	12,196	3,990	2,985	1,429	2	1,377	-	208	63
Hubbard	7,435	1,134	2,457	1,521	1,082		1,153	2	35	51
Mille Lacs	8,638	3,630	2,541	878	860	-	618	6	79	26
Morrison	11,816	4,091	3,058	1,028	2,342	-	1,219	7	49	22
Otter Tail	22,671	6,912	6,006	3,875	4,044	2	1,681	6	87	58
Todd	9,342	2,898	2,643	980	1,728	-	1,055		19	19
Wadena	5,426	1,896	820	1,115	965	-	600	-	17	13
Wilkin	2,752	999	555	438	647	-	72	-	20	21
TOTALS	**126,132**	**45,440**	**31,923**	**19,191**	**17,146**	**9**	**11,023**	**27**	**890**	**483**

[38] Source: 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.

Central Minnesota Ethanol Coop

Natural gas and coal are the two primary heating fuel sources used in industry. The major fuel users in the Central Region are highlighted in Table 6. The Otter Tail Power Company- Hoot Lake Plant in Fergus Falls is by far the biggest fuel user, but this coal is used to generate electricity. Missota Paper Company in Brainerd is the largest coal-based heating fuel user in the region, drawing over 859,353 BTUs per year. The largest natural gas user is Lamb Weston/RDO Frozen in Park Rapids; the second largest is the Central MN Ethanol Cooperative in Little Falls. With rising natural gas prices industrial users may have more incentives now to improve the efficiency of their heating operations, include waste heat recovery technologies, and switch to cheaper fuels like biomass. One example of this movement is the conversion of the Central Minnesota Ethanol Coop from natural gas to biomass.

Table 6. Major Fuel Users in the Central Region[1]

COUNTY	CITY	NAME	ADDRESS	ZIP_CODE	NATURAL GAS	FUEL OIL	LPG/ PROP	WOOD WASTE	Coal	Coke
					Million British Thermal Units Consumedin 2001					
Becker	Detroit Lakes	St Mary's Regional Health Center	1027 Washington Ave	56501	24,960					
Becker	Frazee	Viking Gas Transmission - Frazee	37497 State Highway 228	56544	21					
Cass	Ah-gwah-ching	Ah-Gwah-Ching Center	7232 Ah-Gwah-Ching Rd NW	56430		42	29,169			
Crow Wing	Brainerd	Missota Paper Co	1801 Mill Ave NE	56401	419,609				859,353	
Crow Wing	Brainerd	State of Minnesota Dept of Human Service	1777 Highway 18 E	56401	76,555	36,915				
Crow Wing	Deerwood	Trus Joist - A Weyerhaeuser Business	19586 County Road 102	56444	91,348			578,496		
Hubbard	Park Rapids	Lamb Weston/RDO Frozen	3704 Park Ave S	56470	904,033	102,654				
Morrison	Cushing	Viking Gas Transmission - Cushing	RR 1 Box 72C	56443	3,177					
Morrison	Little Falls	Central MN Ethanol Cooperative	17936 Heron Rd	56345	783,336					
Morrison	Little Falls	Crestliner Inc	609 13th Ave NE	56345	10,177					
Morrison	Little Falls	ISD 482 - Little Falls Community HS	1001 SE 5th Ave	56345	14,752					
Morrison	Little Falls	Larson-Glastron Boats Inc	700 Paul Larson Memorial Dr	56345	83,546		1,684			
Morrison	Little Falls	St Gabriel's Hospital	815 2nd St SE	56345	30,830	4,542		39,782		
Otter Tail	Fergus Falls	Fergus Falls Resource Recovery Facility	400 W Fir Ave	56537	20,334					
Otter Tail	Fergus Falls	Otter Tail Power Co - Hoot Lake Plant	1012 Water Plant Rd	56537					8,681,602	
Otter Tail	New York Mills	Lund Boat Co	318 W Centennial Dr	56567	6,908					
Otter Tail	Parkers Prairie	ISD 547 - Parkers Prairie High School	411 S Otter Ave	56361	957		131			
Otter Tail	Perham	Barrel O'Fun Snack Food Co	800 4th St NW	56573	114,766					
Todd	Long Prairie	Banta Publications Group - Long Prairie	100 Banta Rd	56347	42,426					
Todd	Long Prairie	Long Prairie Packing Co - Long Prairie	10 Riverside Dr	56347	51,020					
Wilkin	Breckenridge	St Francis Medical Center/Home	415 Oak St	56520	23,829					

[39] Source: PCA Boiler and Fuel Use database – consolidated by Shalini Gupta, formerly of ME3.

Another option for heating fuel users is to begin blending coal-based systems with 10% biomass. This greens industrial operations, improves emissions, and in some instances could 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 other fossil fuels; however all produce emissions. Natural gas, in comparison to coal and fuel oil, 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 is therefore preferable from a climate change perspective. The problem is, as mentioned in the previous section, that natural gas costs continue to rise, making it a less cost competitive fuel.

Section 5.3 Transportation

Although the Central Region 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, and is something that must be addressed as part of a renewable energy future. Understanding the transportation grid in a region is important when making decisions about where to place renewable energy technologies such as biofuels. For example, there is not currently an E85 Station in Little Falls, home of the Central Minnesota Ethanol Cooperative, but this would seem to be an ideal location.

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 7). Based on this data, fuel usage estimates based on type of vehicle were used to estimate the amount of fuel used in each region. According to the 2000 Census information quoted earlier in the report, the Central Region was then home to 321,328 people. As Table 7 shows in 2003 the region was also home to 321,983 vehicles, or roughly one vehicle per person.

Additionally, by assessing the number and type of vehicles in a region, the teams were able to target various vehicles for greater use of alternative fuels, fleet conversions, etc. This will be discussed further in Section 6.

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Table 7. Central Minnesota Vehicle Summary, 2003[40]

	Passenger	Pick Up Truck	Bus	Other Truck	Motorcycle	Recreational Vehicle	Moped	Van Pool	State Own Tax Exempt	Tax Exempt	No Registration	County Total
Becker	18,715	8,154	198	1,543	950	329	31	0	124	228	0	30,272
Benton	19,858	7,706	18	1,862	1,167	393	50	0	1	193	0	31,248
Cass	15,604	7,913	53	1,286	822	429	18	0	19	213	376	26,733
Crow Wing	35,700	14,472	189	2,315	1,904	907	83	0	42	369	0	55,981
Hubbard	10,840	5,462	11	837	486	298	2	0	2	184	0	18,122
Mille Lacs	14,964	6,453	88	1,273	814	367	40	0	5	205	0	24,209
Morrison	19,088	9,118	71	1,866	1,053	412	23	0	13	234	0	31,878
Otter Tail	35,641	16,218	137	3,190	2,056	606	48	0	50	550	0	58,496
Todd	14,864	7,071	70	1,212	752	487	330	0	0	214	0	25,000
Wadena	7,656	3,852	45	701	325	152	6	0	29	108	0	12,874
Wilkin	3,980	2,042	6	692	222	62	26	0	0	140	0	7,170
Totals	**196,910**	**88,461**	**886**	**16,777**	**10,551**	**4,442**	**657**	**0**	**285**	**2,638**	**376**	**321,983**
Gallons/vehicle[41]	551	645		4,637								
Total Gallons	**108,497,410**	**57,057,345**		**77,794,949**								

[40] Derived from Minnesota Department of Public Safety Data. "Bus" as shown here is the total of all bus categories: Duluth Bus, Bus, Class 2 City Bus, Intercity Bus, and School Bus. "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. All Trailers were removed from the list as none of the trailers are self-powered (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 that drives limited numbers of miles and cannot function as a regular use vehicle.

[41] EIA. 2003. Annual Energy Review. Table 2.9: Motor Vehicle Mileage, Fuel Consumption and Fuel Rates, 1949-2002. Retrieved on February 5, 2004 from http://www.eia.doe.gov/emeu/aer/pdf/pages/sec2_23.pdf. Fuel consumption (gallons/vehicle) was taken from 2001 data.

Section 5.3.2 Public Transportation in the Region

With roughly one vehicle per person in the Central Region, public transportation is an avenue to pursue for further fuel conservation. This led the team to inventory the existing public transit options available throughout the region. They found that nearly all of the Central Region's 11 counties have at least one public transit service provider, with the exceptions of Todd and Wilkin, but that these services are somewhat limited in geographic scope (Table 8).

Table 8: Central Region Public Transportation

County	City	Transit Agency
Becker	Detroit Lakes	Becker County Transit (BCT
Benton	Minneapolis	North Star Commuter Rail Project (NCCRP)
	St. Cloud	Tri-CAP Transit Connection
		St. Cloud Metropolitan Transit Commission (SCMTC
Cass	Pine River	Pine River Ride with Us Bus (PRRWUB)
	Walker	Cass County Senior Services Transportation program
Crow Wing	Brainerd	Brainerd Transit Department (BTD)
		Crow Wing County Public Transit (CWCPT)
Hubbard	Park Rapids	Hubbard County Heartland Express (HCHE)
Mille Lacs	Milaca	Mille Lacs County Heartland Express (MLCHE)
Morrison	Little Falls	Morr Trans
Otter Tail	Fergus Falls	Senior Citizen Program (SCP)
	Pelican Rapids	Pelican Rapids Public Transit (PRPT)
Todd	none	
Wadena	Arlington	Trailblazer Transit
	Wadena	Friendly Rider Transit (FRT)
Wilkin	none	

Section 5.3.3 Major Highways, Airports, Railways

There are several major roadways running through the Central Region. Running East-West through the region are state highway 34 in the north, US Highway 10 in the middle of the region, and state highway 27 in the southern part of the region. Running North-South through the region are US Highway 59 in the west, US Highway 71 in the middle, State Highway 371 in the east. These highways, particularly where they intersect, inform where E85 station would likely get the most use and have the biggest impact.

There are five airports in the region: Fergus Falls, Little Falls, Park Rapids, Brainerd and St. Cloud.[42] St. Cloud and Brainerd both offer regional airport service through Northwest Airlines collaboration with Mesaba. Little Falls has a County Airport; both Fergus Falls and Park Rapids have Municipal Airports. While not a focal point of the Central 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

[42] More information is listed at: http://www.dot.state.mn.us/aero/avoffice/ops/airdir/airports.html

Partnership.[43] This organization is a non-profit that focuses on both energy efficiency and the greater use of Alternative Fuel Vehicles on airport grounds. In the future it may also be possible that local and regional airports could shift to partial bio-based blends of fuels for planes.

There are 4 railways serving the region.[44] These include the Burlington Northern Santa Fe (BNSF), the Canadian Pacific Railway (CPR), Otter Tail Valley Railroad, and the St. Croix Valley Railroad, which services a small piece of the region's southeast corner. BNSF has the most routes in the Central Region, with an East/West line running through Brainerd and a North/South line through St. Cloud. Otter Tail County appears to have the most rail traffic as two Canadian Pacific lines, one Burlington Northern Santa Fe line, and a small spur of Otter Tail Valley Railroad all pass through the county (Figure 9, Central Minnesota Railroad Map). As with highways, railroads are a crucial part of the region's infrastructure and may benefit from efficiency upgrades and conversion to renewables such as biodiesel. For example, the Minnesota Prairie Line Railroad is currently pioneering the use of 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.[45]

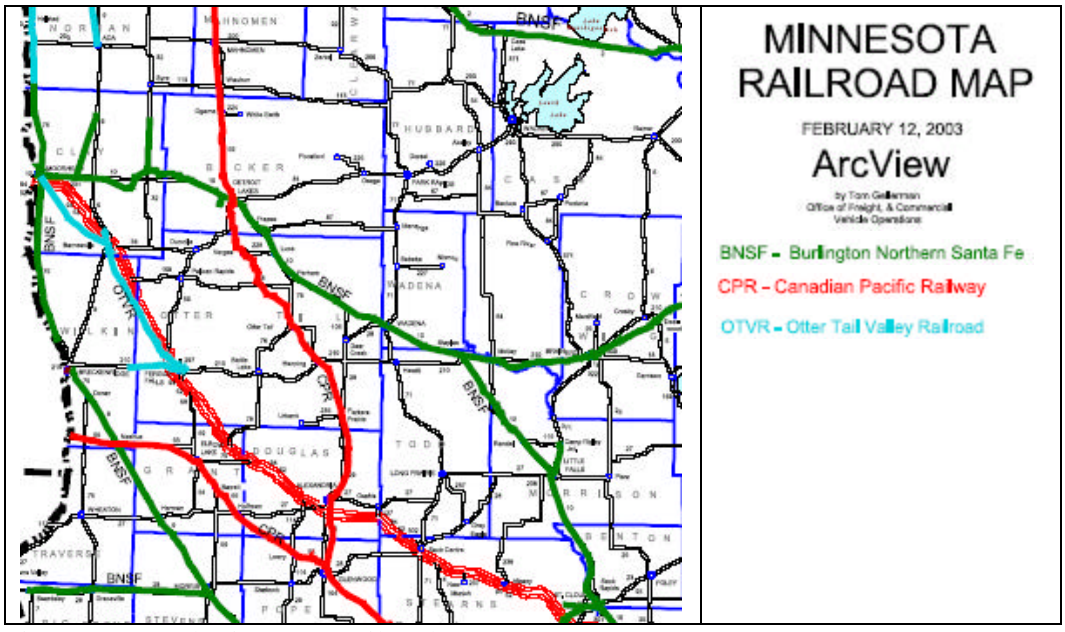

Figure 9: Central Minnesota Railroad Map

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

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 other trucks.[46] 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. Agricultural vehicle fuel consumption is also a factor in these agricultural counties of the Central Region.

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 the 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 with coal for electricity, this is another example of how Minnesotans 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 Minnesotans to keep more of their energy dollars local and therefore direct more of those economic impacts to local communities. In addition, we can decrease our fuel consumption by using public transportation, carpooling, and biking.

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 Central.

5.4.1 Major crops and Livestock Grown in Central Minnesota

The Central Region grows numerous crops including corn, soybeans, hay, sugar beats, potatoes and wheat (Table 9). Corn, hay and soybeans are the three largest crops. The region is also home to livestock operations such as dairy, beef and hogs.

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

Table 9: Central Region Agricultural Numbers

COUNTY	NUMBER FARMS 2002	FARM LAND ACRES 2002	CORN ACRES 2003	SOYBEAN ACRES 2003	HAY ACRES 2003	SUGAR BEET ACRES 2003	POTATO ACRES 2002	DRY POT. ACRES	WHEAT ACRES 2004	DAIRY COWS 2004	BEEF COWS 2004	BEEF FIN. 2004	TOTAL HOGS 2003	FAR. HOGS 2003
Becker	1,254	416,554	20,200	86,800	45,400	10,300			56,000	6,500	7,500	2,000	9,500	2,200
Benton	965	195,949	59,700	30,300	25,300		2,606	2,603		12,100	4,100	3,500	21,000	7,000
Cass	646	197,153	7,800	1,500	54,500					1,800	11,700	200	-	-
Crow Wing	755	144,743	7,700		35,600					1,400	5,700	500	3,400	600
Hubbard	535	140,004	11,800	3,800	24,400				2,400	700	4,000	500	-	-
Mille Lacs	847	132,369	23,000	12,800	30,800					3,900	4,100	1,000	2,000	900
Morrison	1,924	452,120	97,300	22,500	78,400		2,857	2,856		26,100	15,600	4,600	20,000	3,500
Otter Tail	3,013	880,525	151,700	142,500	109,100	4,100	10,255	10,253	56,400	24,200	17,000	4,700	23,000	6,000
Todd	1,825	370,272	73,600	40,000	65,900		1,886	1,885	4,300	17,800	13,500	2,300	11,500	5,400
Wadena	734	165,519	22,600	6,100	32,100					4,700	5,300	300		
Wilkin	414	424,508	47,200	143,500	7,200	48,100	860		132,900	700	1,300	500	24,000	3,000
TOTAL	**12,912**	**3,519,716**	**522,600**	**489,800**	**508,700**	**62,500**	**18,464**	**17,597**	**252,000**	**99,900**	**89,800**	**20,100**	**114,400**	**28,600**

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) estimates for diesel, gasoline, liquid petroleum (LP), electricity, and natural gas.[47] These calculations show that agriculture in the Central Region draws heavily on diesel and electricity (Tables 10 and 11).

One interesting comparison is between hay, corn and soybeans. While they generally use similar amounts of fuel per acre, when it comes to natural gas there is a distinct variation with corn requiring much higher inputs. It is also interesting to note how much energy potatoes require in comparison to other crops.

[47] 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 10: Central 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	522,600	4,896,762	600,990	5,006,508	18,620,238	2,061,657
		Acres X 7.43	Acres X .91	Acres X .75	Acres X 27.50	Acres X .199
SOYBEANS	489,800	3,639,214	445,718	367,350	160,409,500	97,470
		Acres X 9.80	Acres X .81	Acres X 0.0	Acres X 37.23	Acres X 0.719
ALFALFA/HAY	508,700	4,985,260	412,047	0	18,938,901	365,755
		Acres X 40.33	Acres X 2.00	Acres X 0.0	Acres X 100.75	Acres X 2.950
SUGAR BEETs	62,500	2,520,625	125,000	0	6,296,875	184,375
		Acres X 48.89	Acres X 2.00	Acres X 0.0	Acres X 319.22	Acres X 8.801
IRR POT	18,464	902,705	36,928	0	5,894,078	162,502
		Acres X 24.18	Acres X 2.00	Acres X 0.0	Acres X 205.27	Acres X 2.931
DRY POT	17,597	425,495	35,194	0	3,612,136	51,577
		Acres X 7.24	Acres X .89	Acres X 0.82	Acres X 29.88	Acres X 1.749
WHEAT	252,000	1,824,480	224,280	206,640	7,529,760	440,748

Table 11: Central 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)	89,800	3,098,100	269,400	1,481,700	53,880,000
		Hog Litters X 9.55	Hog Litters X 1.11	Hog Litters X 4.06	Hog Litters X 148.25
HOGS FARROW (LIT)	28,600	273,130	31,746	116,116	4,239,950
		Hogs X 1.11	Hogs X .11	Hogs X .34	Hogs X 12.38
HOGS FINISH (HD)	114,400	126,984	12,584	38,896	1,416,272
		Beef Cows X 6.37	Beef Cows X .74	Beef Cows X 1.62	Beef Cows X 59.25
BEEF COWS (HD)	89,800	572,026	66,452	145,476	5,320,650
		Beef Finish X 4.78	Beef FinishX .46	Beef Finish X 1.08	Beef Finish X 39.38
BEEF FINISH (HD)	20,100	96,078	9,246	21,708	791,538

5.4.3 Opportunities for Greater Agricultural Energy Efficiency and Fuel Substitution

Agricultural energy efficiency has improved since the mid-1970s, but numerous opportunities 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 building lighting systems and heating and cooling systems more efficient. Efficiency can also be ensured by properly maintaining all equipment.

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.[48] 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 allow plant residue or stubble to remain on the surface of the field, rather than being 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. Mulch till practices in the Central Region could result in savings of 2.5 gallons of diesel fuel per acre over conventional methods.[49]

Farmers are also well equipped to substitute renewable fuels and supplies into their energy mix. Some changes are switches that farmers could make today, such as using biofuel

[48] 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.
[49] Ibid, p.37-38.

substitutes like E-85 and biodiesel instead of gasoline and diesel, in on-farm vehicles, trucks and tractors.

Wind energy presents farmers with a means of offsetting their own electric use, or to develop an additional cash crop on their lands. Biogas from anaerobic digesters 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. Lastly, solar technologies, such as solar water heating could cut down heating needs in barns by supplying pre-heated water.

SECTION 6: REGIONAL RESOURCE INVENTORY AND ASSESSMENT

Section 6.1 Conservation

Minnesota could reduce future energy consumption 28% by aggressively implementing energy efficiency programs.[50] Not only would energy efficiency help cut consumption, it would also help put energy dollars back into our communities. As a general rule of thumb, every $1 spent on energy efficiency yields a $3 economic return. These two factors combine to make conservation and energy efficiency the best, most cost-effective places to start.

6.1.1 Existing Models of Efficiency and Conservation

A great place to begin energy efficiency and conservation activities is in schools. Schools getting new energy management systems are finding that it saves them money through reduced energy costs, while also helping students feel and learn better. Besides physical modifications to the school, implementing programs that inform administrators, teachers and students about how to save energy can encourage behavioral changes that can also add up to real savings.

In the Central Region, students and staff at Oak Hill Elementary School in St. Cloud partnered with the Schools for Energy Efficiency (SEE) program and Hallberg Engineering to earn recognition as an Energy Star school.[51] Beyond installing new energy management systems, schools in the SEE program receive a visit in class from the Energy Hog, who tells the students that they have the "pester power" to help adults at school or at home to change their ways. Brainerd School District partnered with Johnson Controls to initiate pilot projects including one at the Nisswa Elementary School. The goal of the project was to bring the school into compliance with air quality standards adopted by the Minnesota Department of Education but also included a number of energy efficiency measures including an energy management system, lighting upgrades, and a heat recovery and centralized ventilations system.[52] Along with the technical advancements, Johnson Controls works with the National Energy Foundation to develop energy education curriculum for the school. Students at Nisswa form "Energy Action Patrol Teams" and are responsible for maintaining good energy practices like turning off the lights when no one is in the room.

Other energy efficiency opportunities include state, county and city buildings, environmental learning centers, and park visitor centers. On the 2005 Earth Day tour of Itasca State Park, CERT members learned about the sustainable design of the Jacob V. Brower Visitor Center. Among the energy saving designs featured were:

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[50] Environmental Law and Policy Center. *Repowering the Midwest.* Chicago: 2001.

[51] For more information, view the St. Cloud Area School District 742 website: http://isd742.org/SEE/. Retrieved May 3, 2005.

[52] *Cleaner Air and Efficient Schools in Brainerd.* Clean Energy Resource Teams, February 2005. This case study can be accessed at http://www.cleanenergyresourceteams.org/central/CS-Nisswa%20school.pdf.

- The walls of the facilities are insulated with an R-value of 24.[53] The Visitor Center is approximately 30% more efficient than required by Minnesota's energy code.[54]
- The roof above the main space of the Visitor Center is built with 12-inch thick structural insulated panels with an R-value of 50.
- The wood windows are energy efficient and use insulated glazing (two layers of glass) with low-E coatings to help reduce energy use.
- The floor is well insulated and has hot water pipes running through the concrete that heat the building through radiant heat.
- All the light fixtures are energy efficient fluorescents except the Exhibit and Store spotlights. Even the exit lights use LED bulbs with a life expectancy of 25 years.
- Low flow toilets are used to conserve water in the restrooms.

Following the Jacob Brower Visitor Center stop the group toured the construction site of the new Mary Gibbs Dining Hall, which will use many of the same technologies. Other planned features included:

- High-efficiency gas-fired furnaces
- High-efficiency condensing units
- Recovery of waste heat from the freezer/cooler condensers to preheat domestic hot water
- Ambient light-sensing lighting dimming

These are examples, one retrofit and the others new construction, of energy efficient building practices occurring in the Central Region at facilities that will see considerable public traffic. These well-placed energy efficiency projects draw attention to the realm of possibilities available to make buildings more energy efficient and serve as models for the efficiency measures could be taken at public buildings across the region.

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. Homeowners can replace incandescent bulbs with compact fluorescents, buy energy efficient appliances, make sure their homes are well insulated, and avoid doing non-essential chores during peak load hours. Indeed, switching lighting alone could have a tremendous impact on energy efficiency. If every American home replaced their five most-used lights that have incandescent bulbs with compact fluorescents lights (CFLs), each family would save around $60 annually in energy costs and together would keep more than *one trillion* tons of greenhouse gases out of the air. That amounts to $6 billion in energy savings for Americans and is equal to the annual output of 21 power plants.[55] Buying compact fluorescents is easy. Dozens of hardware stores throughout the state participate every October in the Change a

[53] R is the measure of the resistance to the flow of heat through a substance. The higher the R-value, the better.
[54] Cornwall, Bruce R. 2002. *Building for the Environment, Building for the Future.* Minnesota Department of Natural Resources brochure.
[55] Retrieved March 30, 2005, from: http://www.energystar.gov/index.cfm?c=lighting.pr_lighting.

Light, Change the World campaign, which offers a $2 instant rebate on the purchase of select compact fluorescent lights (CFLs).[56]

On the commercial front, many commercial facilities could also improve efficiency by upgrading their lighting fixtures to more efficient systems. Industrial users have myriad ways to improve efficiency from lighting, to motors, to occupancy sensors. Another way that commercial, industrial, government and residential units can all be more efficient is to use more efficient building practices. Central CERT has taken the lead in examining how our buildings could be more energy efficient by developing a list of questions one could ask builders, architects and engineers to ensure energy efficiency measures are incorporated in new projects (Appendix E).

As the Central Region is one of the fastest growing in the state, it makes sense for them to focus on new construction. The Minnesota's Sustainable Building Guidelines (MSBG), also referred to as Buildings, Benchmarks and Beyond (B3), is one catalyst in place to drive more energy efficient building design. These guidelines build on previous local and national efforts, such as Leadership in Energy and Environmental Design (LEED™), while maintaining regional values, priorities and requirements. According to legislation, the guidelines must:

- Exceed existing energy code by at least 30 percent
- Achieve lowest possible lifetime costs for new buildings
- Encourage continual energy conservation improvements in new buildings
- Ensure good indoor air quality
- Create and maintain a healthy environment
- Facilitate productivity improvements
- Specify ways to reduce material costs
- Consider the long-term operating costs of the building including the use of renewable energy sources and distributed electric energy generation that uses a renewable source of natural gas or a fuel that is as clean or cleaner than natural gas.[57]

Central Region CERT member Rin Porter has also been researching the Leadership in Energy and Environmental Design (LEED) program as another catalyst for energy efficiency building design. LEED is a portfolio of rating systems created to:

- Define "green building" by establishing a common standard of measurement
- Promote integrated, whole-building design practices
- Recognize environmental leadership in the building industry
- Stimulate green competition
- Raise consumer awareness of green building benefits
- Transform the building market

[56] To find stores who participated in 2004 in your area, or to learn more about the program, visit http://www.mwalliance.org/consumers/current/cal2004/minnesota/.
[57] Source: http://www.csbr.umn.edu/b3/summary.html. Retrieved May 2nd, 2005.

LEED provides a complete framework for assessing building performance and meeting sustainability goals by emphasizing state of the art strategies for sustainable site development, water savings, energy efficiency, materials selection and indoor environmental quality. LEED recognizes achievements and promotes expertise in green buildings through a comprehensive system offering project certification, professional accreditation, training and practical resources.[58]

6.1.3 Opportunities for Energy Efficiency Projects

There is tremendous opportunity for efficiency and conservation improvements. Opportunities include improvements in schools and local government buildings, improvements in lighting in commercial buildings, increasing the use of energy star appliances in the region, targeting a few industrial users for improvements, or targeting new public projects like hospitals for more efficient building design. Right now, the Central Region members are focusing their efforts on schools, local government buildings and other public projects.

Central Region CERT members are proactive in finding ways to educate builders in the area about energy efficient technologies and materials. By focusing on becoming members in the Builders Association of Minnesota (BAM) regions, they hope to better educate BAM membership about efficiency technologies and materials available. Members also actively search out either new projects coming on line or buildings such as the Nisswa School that are being retrofitted. They have created a comprehensive list of questions to ask builders and/ or architects about categories such as passive solar, geothermal system, water conservation measures, daylighting, occupancy sensors, compact fluorescent lighting, use of recycled materials, native plantings, indoor air quality, and so on (Appendix E). Rin Porter, a CERT member, researched the hospital being planned by Lakewood Health Systems for its Staples-Motley location. By being persistent and courteous, she was able to talk with a series of people working on the project, who eventually decided to add daylight sensors to the areas with a lot of glass.

Ms. Porter has also been proactive in contacting county commissioners about new buildings coming on-line and providing a model for other CERT members to do the same by creating a useful information sheet to help others contact the county commissioners and leaders in their areas about new building projects (Appendix F). In July 2004, Hubbard county commissioners accepted a bid for a new addition to their courthouse and jail. The architect for the project is Richard Rude Architecture, Inc. of Bemidji. Ms. Porter has contacted Mr. Rude and he has been very informative about the efficiency measures they plan to take. According to articles in the Wahpeton Daily news, the Wilkins County Board of commissioner voted in March to move ahead with the bonding process to build a new jail and law enforcement center adjacent to the historic courthouse in the county seat, Breckenridge. This presents another opportunity for Central CERT to raise questions about energy conservation measures being implemented.

[58] Retrieved April 27, 2005, from: http://www.usgbc.org/DisplayPage.aspx?CategoryID=19.

When people do make the extra effort to incorporate energy efficiency technologies into their buildings, they need to be recognized and celebrated. The Central CERT is also creating certificates that they can give to projects that exemplify high standards in energy efficiency and conservation. The more communities know about these model projects, the more likely other entities are to pursue similar efforts.

Section 6.2 Wind

Minnesota is one of the windiest states in the nation. Minnesota, given its tremendous resource potential, could supply far more the existing 2% of Minnesota electric use. Thus far most of the large scale wind development in Minnesota has been focused in the Southwest along the Buffalo Ridge, but there are good wind resources in the Central Region as well that could be developed.

Section 6.2.1 Wind Assessment for the Region

Wind moves horizontally across the landscape and can be affected on a national and regional scale by topography, land use, and weather patterns, creating a complex pattern to discern from location to location. Department of Commerce Wind Maps give a general picture of the wind resource across the state, but each site has its own characteristics and these must be studied prior to development. Generally speaking the best potential for wind power in the Central Region is in Wilkin, Otter Tail, and Becker Counties, which are moderately strong sources of wind energy in comparison to the rest of the state. According to the CERTs Manual, wind projects are viable options for regions characterized by Class 3 winds or higher, with higher-class winds preferred. According to the February 2000 "By Wind Speed Class (50 Meter)" Department of Commerce map, all counties in the region except Crow Wing and northern Cass produce an average wind speed of Class 3 (Figure 10, DOC Wind Map at 50 meters). For example, the "Minnesota's Wind Resource by Wind Power at 70 Meters" map depicts the estimated watt output per square meter; areas in Otter Tail and Becker Counties range from 229-369 watts/m^2, while parts of Wilkin County range from 293-342 watts/m^2 (Figure 11, DOC Wind Map at 70 meters).

Section 6.2.2 Additional Monitoring Site Options

The Minnesota Department of Commerce monitors wind speed and power throughout the state. Six Department of Commerce wind-monitoring sites can be found in the Central region, but five of these sites are in the western counties of Wilkin and Becker (the sixth is in Morrison County). The 2002 Minnesota Wind Resource Analysis Program (WRAP) report provides a summary of the Department of Commerce wind monitoring sites in the region with the exception of Detroit Lakes material.[59] In addition, the University of North Dakota Energy & Environmental Research Center (EERC) analyzes Department of

[59] *Wind Resource Analysis Program 2002.* Minnesota Department of Commerce, October 2002. This report can be accessed at: http://www.state.mn.us/mn/externalDocs/Commerce/WRAP_Report_110702040352_WRAP2002.pdf.

Commerce wind data, including some data too new to include in the WRAP report (such as the Detroit Lakes data).[60]

Additional monitoring could be of use in Hubbard, Wadena, and Todd Counties, since the Department of Commerce maps show a distinct gradation of wind speed/power in this central area of the region. The Department of Commerce is evaluating potential monitoring sites in the Cass/Itasca county border and the Wadena/Otter Tail county border. Both sites would help triangulate data between existing (and sparse) monitoring sites in and near the central and eastern portions of the Central Region. If interested in looking for additional wind monitoring sites, CERT teams would do well to compare the Department of Commerce maps with county topographical maps to identify actual locations of data peaks.

Section 6.2.3 Existing Wind Projects & Plans

There are at least 12 smaller scale wind projects in the Central Region (<40 kW) (Table 12). These include projects in six Central Region counties, with Wilkin County have the greatest number of installations: four.

The Morrison County Agricultural Society also recently obtained a $20,000 grant from Minnesota Power, with the help of the WATER Foundation, to install a 20 kW Jacobs wind turbine at the Morrison County Fairgrounds. The tower is slated to go up just before the Windy River Energy Fair at the end of July 2005.

[60] Energy & Environmental Research Center, University of North Dakota. This database can be accessed at: http://www.undeerc.org/wind/winddb/MNwindsites.asp .

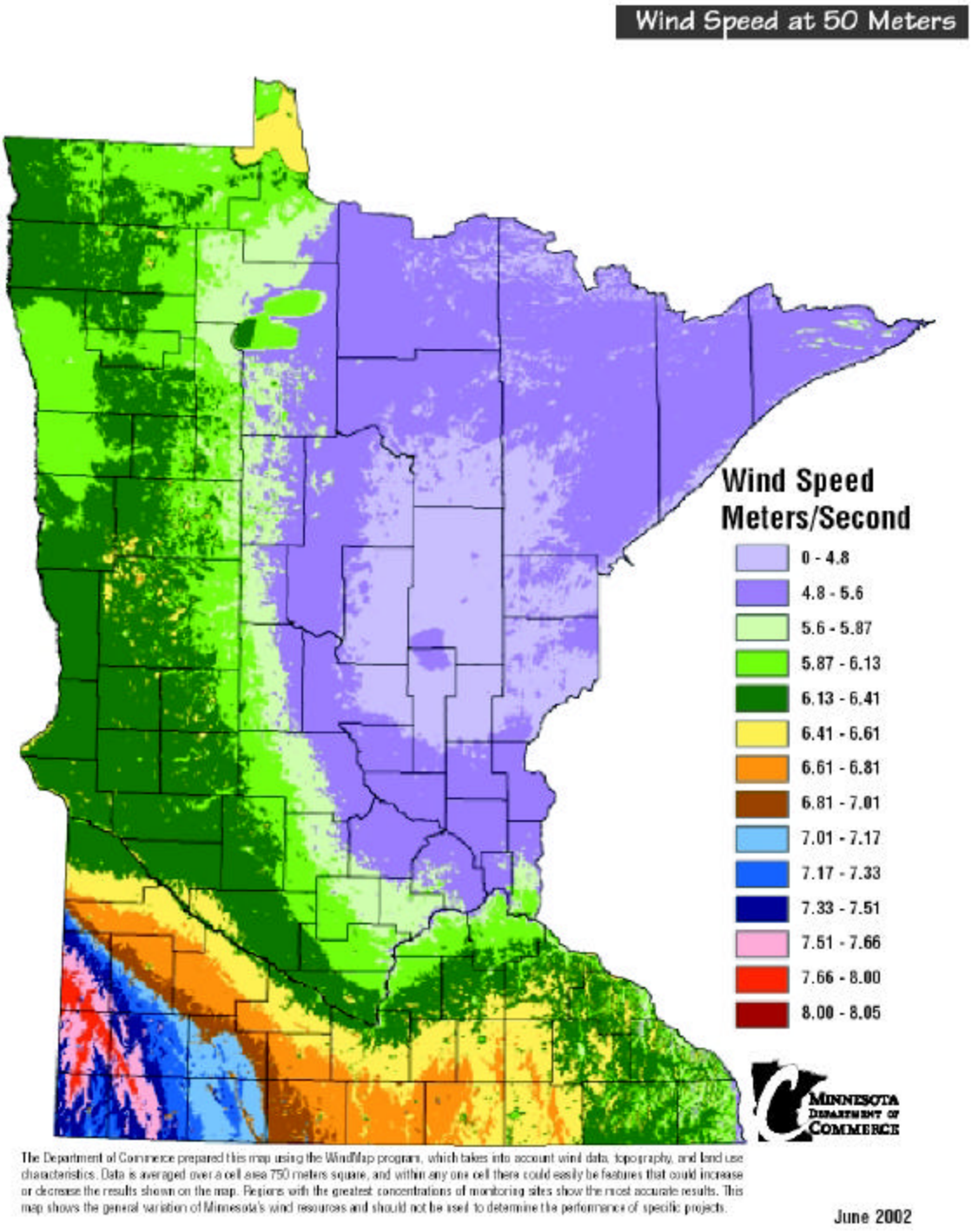

Figure 10: DOC Wind Map at 50 meters

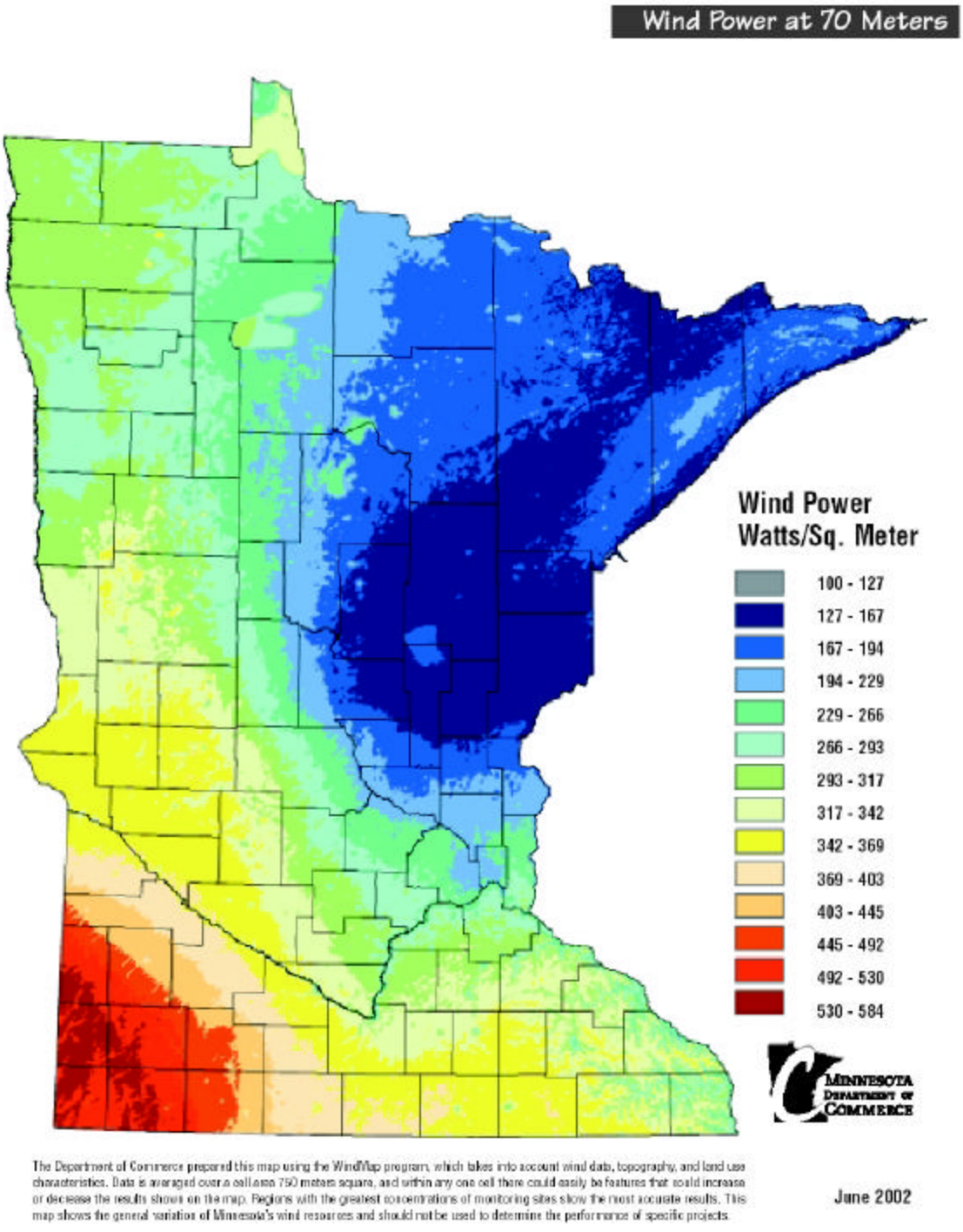

Figure 11: DOC Wind Map at 70 meters

Table 12. Wind Installations in the Central Region [61]

Location	Capacity (kW)	County
Long Lake	10	Hubbard
Pelican Rapids	20	Otter Tail
Battle Lake	4	Otter Tail
Brainerd	10	Crow Wing
Frazee	40	Becker
Foxhome	40	Wilkin
Breckenridge	40	Wilkin
Breckenridge	40	Wilkin
Audubon	10	Becker
Breckenridge	40	Wilkin
Princeton	10	Mille Lacs
Backus	20	Cass

6.2.4 Opportunities for Community-based Wind Projects

The best potential for wind power in the Central Region is in Wilkin, Otter Tail, and Becker Counties, which have moderately strong wind energy resources in comparison to the rest of the state. Communities in these counties likely have the best opportunities to develop cost-effective large-scale community wind projects.

Another opportunity might be for communities in the region to encourage more small-scale wind development at rural residences, farms and schools. While small wind projects are more expensive than large wind projects on a per kilowatt basis with costs ranging from $3,000 to $5,000 for every kilowatt of generating capacity, or about $40,000 for a 10-kw installed system, they require a smaller upfront investment and may therefore seem more palatable. With rebates or tax credits factored in, a well-sited small wind turbine can usually pay for itself within 15 years, about half its serviceable lifetime.[62] Public facilities, particularly schools, may be able to utilize these small wind systems as educational investment for the community. Schools have often likened it to the building of a new gym; its value to the students and community at large is greater than its "payback" period.

A recent paper, *An Examination of Distributed Wind Energy Production Capacity in Minnesota*, written by independent consultant Mike Michaud, can inform small wind opportunities. In this paper, Mr. Michaud analyzes the wind production capacity in each county based on the number of existing rural households available in each county. Census data on rural households for each county was matched with wind resource data from the Minnesota

[61] Retrieved on 2/20/04 from http://www.eere.energy.gov/state_energy/opfacbytech.cfm?state=MN.
[62] Retrieved on May 10, 2005 from the American Wind Association's Frequently Asked Questions link. http://www.awea.org/faq/tutorial/wwt_smallwind.html#How%20much%20does%20a%20wind%20system%20cost.

Department of Commerce to calculate total energy production capability. This energy production level was then compared to historical kWh consumption for each county to determine what percentage of annual energy use can be supplied from small-scale wind power.

The data show that 35 of Minnesota's 87 counties could produce more than 50% of their energy requirements from 10 kW turbines installed at all available rural household locations. Three Central Region counties, Becker, Otter Tail, and Todd all fall into this category.[63] Under this scenario the Central Region would be capable of producing nearly 1.5 million MWh per year. With 20 kW turbines installed the Central Region could theoretically produce nearly 3 million MWh per year.[64]

6.2.5 Costs of Benefits of Potential Projects

Generally speaking the larger the wind project, the better the economics. Utility-scale turbine projects generally cost between $1,000,000 and $1,300,000 per MW (including the turbine itself and installation, dependent upon the price of steel and diesel), in contrast to the $3,000 - $5,000 per kW for small wind projects, as described above. Wind projects 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. Smaller, individual turbine projects will likely be most cost-effective if several projects can pair their installations with one another or with a larger-scale development.

6.2.6 Further Research Needs

While the technology for turbines is well developed, there is room for further research. One area of particular concern is the financing of community-based projects. What are the various mechanisms that communities could use? How can communities take advantage of the tax benefits that fall to 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

The first hydroelectric projects in the United States were built in the 1880s.[65] Although hydropower is very economical to produce, siting and building projects is complicated due to the level of engineering and permitting required to move a project forward.

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[63] Michaud, Mike. 2004. *An Examination of Distributed Wind Energy Production Capacity in Minnesota.* Appendix B.
[64] Michaud, Mike. 2004. *An Examination of Distributed Wind Energy Production Capacity in Minnesota.* P.1.
[65] Retrieved on May 10, 2005, from The Hydro Foundation's Frequently Asked Questions link: http://www.hydrofoundation.org/research/faq.html#buildHydro.

Section 6.3.1 Existing Hydroelectric Facilities in the Region

There are 17 dams in the Central Region, 14 of which generate power (Table 13). Most are owned and operated by utilities companies such as Otter Tail Power Co and Minnesota Power; the Brainerd hydroelectric plant is owned and operated by the Potlatch Corporation.

Table 13: Hydroelectric Plant Inventory, Central Region[66]

PROJECT NAME	CAPACITY (kW)	COUNTY	RIVER	OWNER NAME
Fergus Falls	970	Otter Tail	Otter Tail	Otter Tail Power Co
Hoot Lake, Fergus Falls	1000	Otter Tail	Otter Tail	Otter Tail Power Co
Pisgah, Fergus Falls	520	Otter Tail	Otter Tail	Otter Tail Power Co
Taplin Gorge, Fergus Falls	560	Otter Tail	Otter Tail	Otter Tail Power Co
Wright, Fergus Falls	400	Otter Tail	Otter Tail	Otter Tail Power Co
Central	400	Otter Tail	Otter Tail	Otter Tail Power Co
Dayton Hollow	1000	Otter Tail	Otter Tail	Otter Tail Power Co
Friberg	600	Otter Tail	Otter Tail	Otter Tail Power Co
Sylvan	1800	Cass	Crow Wing	Minnesota Power
Brainerd	3342	Crow Wing	Mississippi	Potlatch Corporation
Pillager	1520	Morrison	Crow Wing	Minnesota Power
Little Falls	4720	Morrison	Mississippi	Minnesota Power
Blanchard	18000	Morrison	Mississippi	Minnesota Power
Sartell Dam	9500	Benton	Mississippi	International Paper Company
Cross Lake / Pine River Dam	Not operating	Crow Wing	Pine	US Army Corp of Engineers
Lake Winnibigoshish Dam	Not operating	Cass	Mississippi	US Army Corp of Engineers
Orwell	Not operating	Otter Tail	Otter Tail	Otter Tail Power Co

Section 6.3.2 Opportunities for Hydroelectric facilities in the Region

Opportunities for hydroelectric power in the Central Region can be found on the Otter Tail, Crow Wing, and Mississippi Rivers. 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.[67] However, as illustrated by the Park Rapids City Council's 2000 efforts to reactivate the Fish Hook River Dam in Park Rapids, research costs and feasibility studies are often expensive and difficult to conduct.[68]

[66] Compiled from FERC (http://www.ferc.gov/industries/hydropower/gen-info/licenses.xls), Minnesota Department of Commerce (http://www.eere.energy.gov/state_energy/opfacbytech.cfm?state=MN), DNR (http://www.dnr.state.mn.us/waters/surfacewater_section/stream_hydro/hydropower_sites.html), Idaho National Engineering and Environmental Laboratory Data.

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

[68] *Designing A Clean Energy Future: A Resource Manual*, p. 34.

Furthermore, environmental considerations, such as impaired fish migration, stream flow, and safety concerns, will continue to hamper hydropower development. The emergence of micro-hydro technologies that generate less than 100kW and utilize flow-through mechanisms may present future opportunities, but will require significant study so as to avoid the same negative consequences previous hydroelectric technologies have encountered.

Section 6.4 Biomass

Biomass is any organic material not derived from fossil fuels that can be converted to a fuel useful for generating electricity. Minnesota has rich biomass potential throughout the state from various biomass resources. For the purposes of this section, we are focused on examples like wood waste, energy crops such as hybrid poplar, switch grass, hazelnuts, and plant residues. The Union of Concerned Scientists estimates that with existing technology, biomass could provide 6,690 MW of capacity to Minnesota, or well over half of the state's current needs.[69]

Section 6.4.1 Existing Biomass Projects

There are not existing biomass projects operating in the Central Region; however it will soon be home to one of the most innovative biomass-to-ethanol projects in the country. In Little Falls, the Central Minnesota Ethanol Coop (Morrison County) is planning a wood waste gasification facility. Scheduled to break ground in June 2005, the facility plans to use finely chipped hardwood to replace its natural gas heating fuel needs, and thereby better control its fuel costs. The biomass-derived energy will also generate 50-75% of the plant's own electricity requirements.

Other projects under consideration in the region include a portable grain drying system at the Central Lakes Agricultural Center that would be powered by on-site biomass materials such as barley straw and corn stalks. This system could also be used to potentially heat their planned community greenhouse. Central Lakes College is also exploring the possibility of retrofitting an existing boiler to allow it to run off of corn stover.

Section 6.4.2 Biomass Resource Assessment[70]

The best biomass resources for the Central Region vary by county. In Otter Tail County, the best and cheapest biomass resource is corn residue (Figure 12). In Hubbard and Cass Counties, sawmill wood residue is the largest biomass resource, but many sawmills utilize their waste wood and based on the DNR's sawmill survey only a small fraction of this wood waste would actually be available (Figure 13).

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[69] Pawlisch, Melissa, Carl Nelson, Lola Schoenrich. 2003. *Designing A Clean Energy Future: A Resource Manual. P.37. Retrieved on February 7th, 2005, from* www.cleanenergyresourceteams.org.

[70] Based on preliminary estimates made in 2003 by Marie Walsh at Oak Ridge National Laboratory and data provided by Keith Jacobsen at the Minnesota DNR.

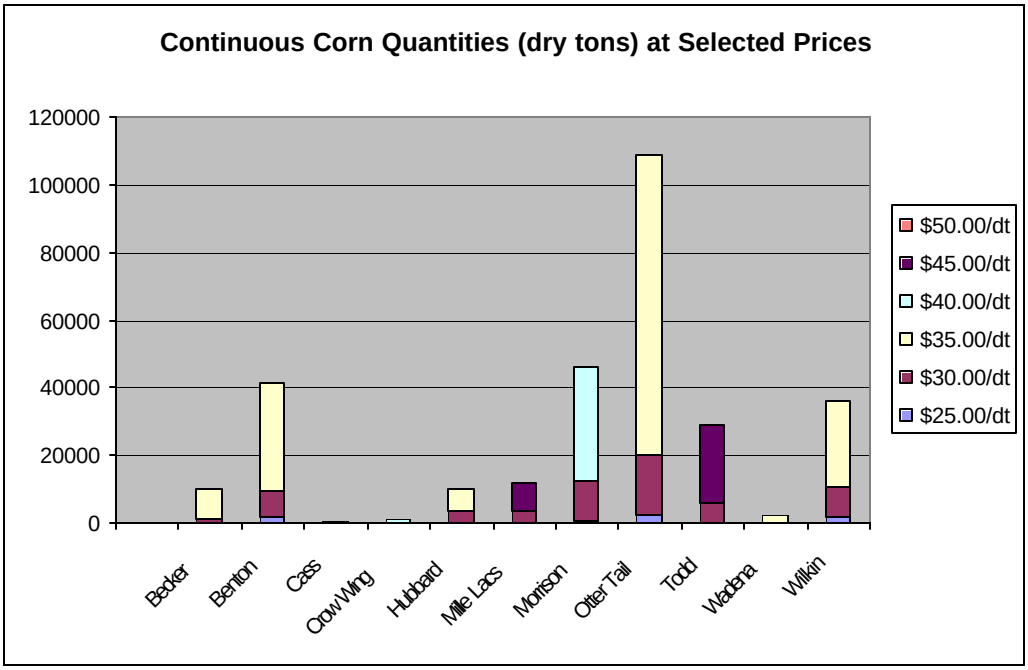

Figure 12. Continuous Corn Quantities Available at Select Prices[71]

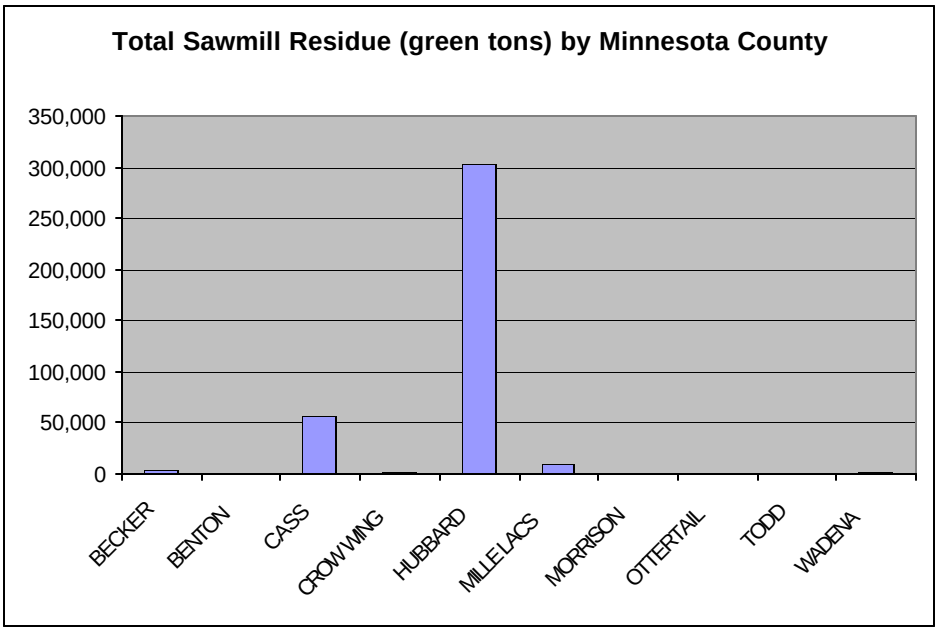

Figure 13. Total Sawmill Residue by Minnesota County[72]

While our data sets indicate that biomass materials are plentiful in the region, much more research needs to be done. Our data set is predominantly from April 2003, and the department of the Oak Ridge National Laboratory, which compiled this data, has since dissolved. The Minnesota data is based on a national survey that cannot account for local conditions, such as transportation costs, tipping fees, and moisture content of fuels. In

[71] Based on preliminary estimates made in 2003 by Marie Walsh at Oak Ridge National Laboratory.
[72] Based on 2001 sawmill survey data provided by Minnesota Department of Natural Resources. Reflects total sawmill wood waste, not available sawmill wood residue.

addition, some of the data appears incomplete. For example, the "corn quantities" and "agricultural residue" data are identical, although in Minnesota there would be other agricultural residues to consider. Another potential concern with all existing biomass data is that they do not consider possible locations of new biomass facilities and the radius from which materials would be purchased. Any new facility coming on-line would need to complete a site-specific analysis to determine how much biomass was actually there, as the availability and cost of these materials can change very quickly due to weather conditions, changes in demand, and changes in land use.

Section 6.4.3 Local Opportunities for Energy Crops to Mitigate Environmental Issues

There are numerous opportunities for growing energy crops in the region. As the Agroforestry Cooperative has already demonstrated, there are multiple benefits to be achieved from perennial growth including increased shallow aquifer filtration, well head protection, snow barriers, wind break crops, best management practices along rivers, streams, lakes, low production land and other productive conservation uses.[73]

As productive conservation practices increase, which is to say, as agricultural lands are kept as working lands to grow crops that provide environmental services while providing farmers income, these new perennial biomass crops will be able to supply both high-value products and low-value products like heat and electric fuel. Work is, however, needed to enhance the ability of biomass to produce energy and other high valued products. Areas requiring further study include: harvesting, drying, storage, and transportation. As these processes are better-understood and commercialized, biomass crops will be able to become a more valuable piece of the energy puzzle.

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.

6.5.1 Current Facilities

At present, there are no known biogas facilities in the Central Region.

[73] A case study about the Minnesota Agroforestry Cooperative can be found at: http://renewingthecountryside.org.

Section 6.5.2 Regional Opportunities for Community-based Biogas Production

In Perham (Otter Tail), the Little Pine Dairy and several other industries have been discussing a community anaerobic digestion facility for manure and food processing waste.[74] Based on a study of potential sites for centralized biogas production, the Perham area certainly warrants further study as a potential site for a centralized biogas system.[75] A few characteristics that make it a strong candidate include Otter Tail County's plentiful cow manure (ranked #2 in the state) and the local agro-industries – Perham Meat Market and Locker and Barrel O'Fun Snack Food Company.

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. 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 Central Minnesota

Minnesota is home to fourteen ethanol plants with a production capacity of 389 million gallons. One of these plants, the Central Minnesota Ethanol Co-op in Little Falls, is located in the Central Region (Table 14). This plant alone has capacity to produce 22 million gallons of ethanol per year.

Table 14. Ethanol Plants[76]

City (plant name)	Capacity *Million Gallons/year*	Million Bushels Corn/year	Start-up year	New Generation Co-op Members **
Little Falls (CMEC)	22	8.1	1999	820

Section 6.6.2 Existing Biofuel Projects in Central Minnesota

Minnesota has the largest E85 (85% ethanol) fueling network in the world with over 140 retail locations. Minnesota's network makes up almost half of the stations in the United States. As of May 2005 the Central Region was home to four of these E-85 stations (Table 15).[77] There are also discussions underway about possible E85 stations in both Little Falls and Wadena.

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[74] *Designing A Clean Energy Future: A Resource Manual*, p. 48.

[75] Gupta, Shalini. May 2004. *Plant Power: Biomass-to- Energy for Minnesota Communities.* Prepared by Minnesotans for an Energy Efficiency Economy for the Minnesota Department of Commerce and Office of Environmental Assistance. p. 10-11. This report can be accessed at: http://www.state.mn.us/mn/externalDocs/Commerce/ME3_Biomass_Report_110204031416_BioMass2004.pdf

[76] *The Minnesota Ethanol Program.* Minnesota Department of Agriculture. This report can be accessed at: http://www.mda.state.mn.us/ethanol/ngcnote .

[77] Minnesota Department of Commerce. July 2004. Minnesota Gas Stations with E85 Map. Retrieved August 5, 2004 from www.commerce.state.mn.us.

Table 15. Central Minnesota Ethanol Stations[78]

County	E-85 Station	City
Benton County	First Fuel Bank III	St. Cloud
Crow Wing County	A-Pine Shell	Pequot Lakes
Crow Wing County	Fort Ripley Store (Sinclair)	Fort Ripley
Wilkin County	Breck Amoco	Breckenridge

Today over two hundred Minnesota fueling stations offer a two percent biodiesel blend. While this is a more plentiful representation than most states, biodiesel is not universally available in Minnesota. The state has, however, established a biodiesel mandate that would require all diesel to contain a two percent biodiesel blend by summer 2005. Although this mandate requires 8,000,000 gallons of in-state capacity before taking effect (total mandate would require 13,000,000 gallons) there are no current plans for a biodiesel facility in Central Minnesota.

Section 6.6.3 Opportunities to Use Biofuels

There are opportunities to use biofuels in both transportation and electric applications. With regard to transportation, a number of passenger vehicles are already equipped to run on alternative fuels. These vehicles are called Flexible Fuel Vehicles. All readers should review the list of vehicles developed by the Department of Commerce to determine if their current vehicle could be fueled using E-85 (Appendix G). 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 entire City of Brooklyn Park fleet this runs over 100 vehicles using a B20 blend. The same sort of program could be used at city and county fleets throughout the Central Region.

Beyond use in transportation applications, a biodiesel blend could also be used to fuel existing diesel generators. The Alexandria Board of Public Work, Otter Tail Power, and Princeton Public Utilities all operate oil fired internal combustion units. If these units could be converted to a biodiesel blend – even a 5% blend – their air emissions of carbon monoxide, hydrocarbons, and particulates could all be reduced.

Another opportunity for biofuels resides in converting the fuel used at ethanol plants, particularly for heating, from natural gas, coal, and other hydrocarbons to biomass. The

[78] For more information about E-85 stations located by county, go to the Clean Air Choice website at: http://www.cleanairchoice.org/outdoor/FindE85.asp. Retrieved May 4, 2005.

Central Minnesota Ethanol Coop (Little Falls, Morrison County) is planning a wood waste gasification facility as an alternative to using natural gas for heat. By using finely chipped hardwood as fuel, the plant will be able to better control its fuel costs by eliminating the need for natural gas; biomass-derived energy will generate 50-75% of the plant's own electricity requirements. Ethanol plants throughout the state could evaluate available biomass-derived fuels to reduce their consumption of non-renewable fuel sources.

Section 6.7 Solar Energy

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

Section 6.7.1 Identify Existing Solar Installations

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

Jason Edens from Rural Renewable Energy Alliance[79] was able to provide an overview of some small solar projects in the area (Table 16).

Table 16: Existing Small Solar Installations in the Region

System Size	Location
1 kW	Rural Bagley
500 W	Rural Laporte
200 W	Rural Bemidji
200 W	Rural Clearwater Co.
500 W (under construction)	Rural Pine River
1 kW	Rural Pine River
200 W	Rural Grand Marais

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

[79] For more information visit: www.rreal.org

Section 6.7.2 Solar Potential

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

Data analysis indicates that there is only a 10% different between the highest (southwest Minnesota) and lowest (Northeast Minnesota) solar resource in Minnesota. Solar resources are, however, very site specific and require siting whatever solar technology is used (solar building design, solar thermal, or solar electric) in unshaded areas. Trees, buildings, power lines and poles, and other structures will significantly affect solar electric installations and to a lesser but still significant amount, solar design and thermal.

Section 6.7.3 Solar Incentives

Several incentives are available for solar systems (Table 17). Minnesota's Solar Rebate program offers $2,000 per kilowatt (about a 20-25% buydown) and the Minnesota Power Solar Rebate Program matches it with an additional $2,000 per kilowatt for customers in their service territory. Interested applicants need to be pre-approved for a rebate to ensure their potential system design meets the program specifications before any installation work occurs. Once approved, participants have 6 months to install their system and submit the paperwork for receiving a rebate (extensions are available).

Table 17. 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%
MN Power Rebate Program	X#		Electric only	

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

Section 6.7.4 Identify Specific Opportunities for Solar Projects

Opportunities for solar are plentiful, but often depend upon budgetary and cost-benefit requirements. New construction provides the greatest opportunity for incorporating solar into an overall project, and at a minimum newly constructed buildings should be highly efficient and designed for passive solar heating and lighting. They can also be

"predesigned" for solar to be installed at a later date by running conduit or piping during construction rather than retrofitting later. Community-based solar projects should likely focus on cost-effective applications and/or locations where educational curriculum can be incorporated such as nature centers, schools, community centers, etc.

The solar industry itself is fairly young in Minnesota and the development of multi-disciplinary training of solar installers would encourage competition and enable the next generation of renewable installers to be apprenticed with existing businesses. Multi-disciplinary training is an important component since any one solar sector (solar electric alone for example) may not be adequate for supporting an entire business at this point in time. Rather, the industry has generally developed as a one-stop service center for assessing and combining energy efficiency and renewable energy packages to clients, which may include a variety of design and technology components.

Other areas for solar partnering may include:

- Cooperation with electric utilities to site solar electric installations in areas of transmission or distribution line needs, i.e. solar has a positive correlation with demand and can help alleviate constraints to some extent;
- Cooperation with natural gas and electric utilities to recognize solar hot water as another method of energy conservation;
- Cooperation with government to ensure public buildings meet state guidelines for increased efficiency;
- Cooperation with government to reduce barriers to solar development and perhaps provide incentives through codes or permitting;
- Cooperation with businesses to identify 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.

Jason Edens' Rural Renewable Energy Alliance (RREAL) in the Central Region, with financial sponsorship from the University of Minnesota Central Region Partnership, is an example of a solar project that could be applied throughout the state and exemplifies the multi-disciplinary approach. The organization strives toward making renewable energy accessible to people of all income levels. RREAL has three main projects: 1) Solar Assistance, 2) Youth Training, and 3) Sun Dog Solar Contracting (contracting service for solar installations). The Solar Assistance Program provides and installs solar heating equipment for low-income households who qualify for federal heat assistance, thereby helping these households reduce dependence on federal heat assistance and lower their energy bills. The Youth Training Program involves at-risk youth in solar installations; it also runs the Solar Show Mobile, a mobile solar electric and solar heating project used by students to teach at schools, power fairs, and other events.

David Winkelman at the Water Foundation uses solar to offset utility costs. Located outside of Brainerd, the Water Foundation has a 2.2 kW PV array on site. This array

produces a nominal 48 volts DC which is sent through an inverter, converting the current from DC to AC, and stepping the voltage up to 110 volts. In conjunction with the 4.5 kW wind generator, the Water Foundation produces nearly all the power it needs to operate. With the addition of batteries, the Water Foundation has a plentiful backup system that allows it to keep operating even when the utility power goes down.[80] The Water Foundation provides similar installation services throughout the region.

Section 6.7.5 Cost and Benefits of Solar

Solar technologies generally have higher up front costs and low operating costs. The incremental and payback period cost varies from none to very little (for incorporating solar design into new construction), little to some (for solar pools and preheating solar ventilation air), some to moderate (for solar thermal for heating or hot water), and expensive (for solar electricity) (Table 18).

Table 18: Solar System Benefits and Costs

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

Solar design (which includes high efficiency construction, as well as building orientation and window sizing and placement), can provide around 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. A well designed and constructed home can also provide excellent air circulation, reducing the need for summer cooling, as well.

Solar thermal applications generally require some type of additional equipment, such as solar panels to circulate air or water that is heated by the sun. Solar pool heating is used only from late spring to early fall and provides additional comfort and a longer swimming season, but could also save energy by offsetting any conventional heating that is taking place. In contrast, solar preheating of ventilation air occurs during the cool seasons from fall to spring, since summer heating is unnecessary. The benefit comes from increasing the temperature of the ventilation air and reducing the need to heat it as it is brought into the building to provide required fresh air. 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

[80] Retrieved January 20th, 2005 from http://www.hopshop.net/tours/solar-tour/page-03.php .

coupled with baseboard hot water heating. Since the hot water for space heating is more useful with a boiler and in new construction, its market is smaller.

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

General guidelines for solar hot water system simple paybacks are 8-12 years when replacing electric or propane hot water heaters and 12-15 years when replacing natural gas hot water heaters. These numbers change as the price of natural gas increases in volatility.

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

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

Section 6.8 Combined Heat and Power

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

Section 6.8.1 Assessment of Combined Heat and Power Opportunities in the Region

In March 2004, ME3 completed research into biomass-fueled district heating systems in Minnesota. According to Shalini Gupta, "A community energy system (also known as district energy) connects a centralized source of heat generation to a set of residential,

commercial, and/or industrial thermal energy users, via a system of distribution pipes."[81] District heating offer an exciting opportunity for community-based energy systems as they can reach energy efficiencies of up to 90 percent by generating both electrical and thermal energy. If renewable resources like biomass fueled this process, the whole system would be more carbon-neutral and would draw on local resources such as those highlighted in Section 6.4.

As stated in Gupta's ME3 report, the City of Detroit Lakes (Becker County) and City of Wadena (Wadena and Otter Tail Counties) both operated district heating systems in the past, but have since abandoned their systems.[82]

In another report, *Plant Power: Biomass-to-Energy for Minnesota Communities* one site in Central Minnesota is listed as potential plant-residue district energy site.[83] According to the report's strict criteria Park Rapids is a potential site that warrants further study, particularly if the community could partner with the local Lamb Weston/RDO facility.

Section 6.9 Geothermal Energy

Geothermal energy refers to the natural heat from beneath the earth surface. Because the ground heats and cools at a slower temperature than the air, it is possible to use antifreeze or water that is circulated under the ground and throughout a building to cool the house during the summer and heat it during the winter.

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 Central Region, there is a great deal of potential in using them for public buildings as well as private homes. For example, many electric companies offering incentives to put heat pumps in buildings, and the Minnesota State Legislature is currently considering providing ground source heat pumps with sales tax exemptions.

A few examples of systems with ground source heat pumps include the system currently being installed at the Hubbard United Methodist Church in Hubbard and a system operating at the Walker Animal Hospital in Walker, Minnesota.

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. Geothermal systems are more efficient than their gas-fired furnace and central air-conditioning counterparts and are not

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

[82] Gupta, p. 3.

[83] Gupta, Shalini. May 2004. *Plant Power: Biomass-to-Energy for Minnesota Communities.* Prepared by Minnesotans for an Energy-Efficient Economy for the Minnesota Department of Commerce and Office of Environmental Assistance. http://www.state.mn.us/mn/externalDocs/Commerce/ME3_Biomass_Report_110204031416_BioMass2004.pdf.

subject to fluctuating natural gas prices. On average, a geothermal heat pump system will cost about $2,500 per ton of capacity (a typical residential unit will have a 3-ton capacity). If such a system were included in a home mortgage, perhaps adding an additional $30 per month, the energy cost savings over a one-year period would easily exceed the added yearly mortgage costs.[84]

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

SECTION 7: PROJECT PRIORITIES

Based on the Central Region's resource base, both in terms of energy resources and human capacity, the Central Region CERT is focusing on three primary project priorities:

- Energy Efficiency – focusing on buildings
- Solar thermal and Solar PV
- Biomass

7.1 Conservation/Energy Efficiency

- Central CERT wants to target new public structures – how to approach developers and what questions to ask to ensure that projects are moving forward with energy efficiency in mind. Central CERT has developed a list of the top 12 questions one should ask about a building projects and a list of resources to describe the options and most efficient practices. Rin Porter has also created a fact sheets for the LEEDs program, the new Minnesota program call Buildings, Benchmarks and Beyond (B3), and a primer to help CERT members contact the county commissioners in the region. Team members will use these tools to begin reaching out to architects, contractors and project developers in the region to further discussions about building more energy efficient structures.
- Central CERT wants to target education toward more energy efficient lights and appliances, possibly do identification of where these fixtures and appliances are available, how to increase their availability, how to publicize access to these goods, and how to get consumers to buy them. The annual Change a Light, Change the World program, which happens every fall, would be an excellent opportunity for this outreach and education. As of May 2005 participating hardware stores and utilities had not been confirmed by the Department of Commerce for the Fall 2005 event, but Central CERT will continue track this event and work to integrate their efforts with this existing program.
- Central CERT plans to explore how to increase energy efficiency in schools throughout the region. As part of this effort the team toured Nisswa Elementary School to see what had been done with Johnson Controls to upgrade the building. It seems this model, or the Schools for Energy Efficiency model, could be replicated throughout the region. Public schools in Todd County, including Staples-Motley school district and Browerville Public Schools, and Wadena County, including Verndale Public Schools, are currently exploring ways to increase energy efficiency in conjunction with new construction and/or renovation projects in their facilities.
- Central CERT would also like to explore the possibilities for engaging 4H students, students from local schools, students from Central Lakes Ag College, and students from technical colleges in projects.

7.2 Renewable Energy

- Central CERT is researching myriad options for more solar –
  - They are currently working with the Rural Renewable Energy Alliance (RREAL) to fund solar hot water air systems for low-income households. RREAL is a unique program in Minnesota that partners with community action agencies to get solar into low-income homes that are currently in the federal energy assistance program. RREAL succeeds where so many other programs fail: getting renewable energy to low-income people who need it the most.
  - They would also like to explore a possible opportunity with the Cass Lake Boys and Girls Club to integrate solar and geothermal into an energy efficient, possibly a zero-energy, building.
- Central CERT also continues to pursue options for biomass. They are supporting the Little Falls ethanol plant (Central Minnesota Ethanol Coop) in its conversion to biomass fuels as a heating source. Norm Krause, a team member, is investigating the possibility of using waste corn materials in the Central Lakes Agriculture College boiler and using grain dryers powered by agricultural residues. Central CERT also continues to promote the landscape benefits that perennials could provide to help improve water quality.
- Central CERT is also exploring options for wind. Current possibilities include north of Lake Mille Lacs, near Crosby, at Central Lakes Ag Center to use as a demonstration for smaller-scale technologies, and in Walker.

7.3 Commonalities Between the Central Region and other CERTs Regions

Listed below are some areas of overlap in goals that the Central Region shares with other CERTs groups. One of the key strengths of the CERTs program is the sharing of information and programs between citizens across the state. There are some areas, like the solar heating program that RREAL provides, that are unique in the state and are a prime focus of the Central Region CERT team. These sorts of initiatives are being shared with other teams as they represent good models that other teams might like to expand. The Central CERT other key focal areas, building energy efficiency and biomass, share commonalities with other regions in the state as described below. These areas of shared interest offer the regions opportunities to work with one another and learn from each other's experiences.

7.3.1 Energy Efficiency and Conservation

The Central and Metro Regions have taken the lead on building efficiency issues, with the Metro Region focusing almost exclusively on retrofitting government buildings. The Central CERT group has put some funds aside to hire Rin Porter to research and compile information on the LEED program, Minnesota's B3 program, a listing of contact information of county commissioners, and an informal listing of new public buildings coming on-line. The Central Region has also created a comprehensive list of questions that a person can ask an architect or builder about the energy efficiency and conservation technologies they are using in their building. With statewide interest in energy efficiency,

these are all materials that the other CERTs could benefit from, and some CERT members from other regions have already begun to use the Central region's questionnaire.

The Central, Northeast and West Central CERTs have all expressed interest in working with schools on energy efficiency efforts – including both building improvements and educational curriculum. All three of these regions have programs like the Schools for Energy Efficiency program run by Hallberg Engineering and the Johnson Controls program underway in local schools. To further these efforts, the Central Region hopes to find more schools interested in these innovative programs as a means to bring their electric costs down while educating their students about energy conservation at the same time.

7.3.2 Biomass and Working Lands

Every region in the state has some interest in biomass. As a biomass-rich state with many agricultural and forestry resources, this makes perfect sense. Beyond wanting to see broader utilization of existing biomass feedstocks, several regions, including the Central Region, are also interested in seeing more perennial crops on the land. These perennials could serve as valuable biomass resources while also keeping agricultural lands productive, providing a more diverse income for farmers, improve wildlife habitat, helping with soil fixation, and improving water quality.

7.4 Key Successes Thus Far

All of the CERTs feel that educating the general public about renewable energy and energy conservation opportunities is a priority. Simply put, Minnesota is one of the leading states in the country in developing renewable energy, and renewable energy creates good jobs and improves the environment throughout the state. At the same time, some of the easiest programs to implement that save the most money are through energy conservation and efficiency. CERT members are nearly unanimous in their agreement that educating the public about these opportunities is a crucial mission to accomplish.

The Central Region is doing an excellent job so far on their various educational campaigns. Their building energy efforts are likely to be replicated and use throughout the state. They have also utilized print media very effectively to cover regional events and get local stories about renewable energy projects out to a broader audience. Central CERT is lucky to have a membership that includes a reporter for several small newspapers who writes regular articles, the Bog Frog, with syndication on stations throughout the state to provide energy conservation, efficiency and renewable energy tips, and Sharon Rezac Andersen, the executive director of the Central Regional Sustainable Development Partnerships, who is a natural with media outreach including radio and television.

Central CERT has also done a tremendous job with regional energy education bus tours. Thus far, the Central CERT team has had two tours, one in November 2004 and one in April 2005. Both tours were well attended and generated more membership and positive press coverage. The Central group believes that "kicking the tires" on projects is the best way for people to understand the technology and get feel for renewable energy's potential. The bus

rides also offer a great way CERT members, old and new, to network and learn from one another.

SECTION 8: BARRIERS AND OPPORTUNITIES

The Central CERT has talked about potential obstacles and opportunities throughout its two years of meetings. During these discussions the team has come up with barriers that can generally be put into the following categories: regulatory barriers, first cost barriers, and information barriers. The following sections highlight, by category, the major barriers and opportunities the team has identified.

Section 8.1 Regulatory Barriers

A common barrier faced by CERT members is that permitting, zoning, and other bureaucratic obstacles often slow down the process to implement new projects. In many ways it seems that technology and innovation have sped ahead of the existing permitting processes. For example, several biomass projects across the state have found that working with the Minnesota Pollution Control Agency has been slow due to the unique nature of the technologies being introduced and the inability to find a fit with existing permits. These hurdles highlight the need for greater collaboration with state agencies to overcome these disincentives to project implementation.

Minnesota currently has many opportunities that should encourage greater collaboration with these agencies, particularly around biofuel projects. The Governor has emphasized the need for more energy efficiency and alternative fuel use in state vehicles, and the legislature recently passed a new 20% Ethanol Mandate Bill. These initiatives should open the doors for new ethanol facilities and could encourage innovative projects that utilize more biomass resources throughout the ethanol production process if the permitting and regulatory process could be tailored to encourage these more environmentally friendly fuels.

Section 8.2 First Cost Barriers

Upfront costs are also a barrier. This report has mentioned several times the solar projects that Jason Edens and the Rural Renewable Energy Alliance does with low-income earners. This project makes so much sense, that many people frequently ask why solar thermal and solar water heating isn't being done everywhere. In particular, why don't we provide solar thermal and solar water heating programs for people on fuel assistance to help lower their overall monthly payments and eventually get them off of fuel assistance all together? At least one answer to this question is the higher upfront costs for these systems. It would be more difficult to make bulk investment in these systems that simply continue paying smaller amounts in fuel assistance dollars each month, even though the latter ensures that many people will simply continue to stay on fuel assistance and thereby cost the system far more money over time.

Similar first cost obstacles can be seen with myriad other energy efficiency technologies. Ground source heat pumps, as mentioned in Section 6.9, are more expensive to install than a natural gas furnace, but they would also save consumers money over a 10-year period by decreasing fuel costs. Energy efficient appliances also cost more than their non-energy

efficient counterparts. Hybrid cars cost more than standard vehicles. The same is true for compact florescent light bulbs. Over the life of the bulb, consumers will save money. Over the life of the car, consumers will save money, especially with rising gas prices. Over the life of the appliance consumers will save money, however in each instance, the higher upfront cost is sufficient to either scare consumers away or make the initial investment cost-prohibitive.

Opportunities to overcome these barriers include rebates on energy-efficient equipment, appliances, and light bulbs. Many utilities, including many utilities in the Central Region, offer these sorts of incentives to encourage their members to choose energy efficient alternatives. Energy efficient mortgages are another opportunity that could help overcome these initial cost barriers. These mortgages, as offered by Fannie Mae, Freddie Mac and Chase Manhattan, allow borrowers to take out a larger mortgage and roll the energy efficiency investments costs into the mortgage.[85] Energy service companies (ESCos) offer similar opportunities for businesses, schools and government through bundling efficiency improvements (by putting quick payback and long-payback projects together for a more moderate return) and performance contracting (where the cost of improvements is paid for through savings created by those efficiencies).[86]

Section 8.3 Information Barriers

Educating the public is crucial. The physical landscape of the state, its abundance of diverse agriculture and forestland, and its educated work force make Minnesota well suited to be a leader in a variety of renewable energy fields. Like its current leadership in biofuels, Minnesota has the capacity to create successful industries around many clean energy industries. For this to happen, however, citizens need to know that their day-to-day energy choices matter. Today, while people may gripe a little at the gas station and consider their monthly electric and natural gas bills as headache, they seldom think more about their energy usage than that.

The Central Region CERT has put together a wide range of innovative programs to educate not only the community at large, but have targeted specific niches like builders and county representatives. Other CERT regions are emulating several of these programs. Because of its expanding population and anticipated building development, the Central CERT has focused on energy efficient buildings. They have created a detailed list of questions that citizens can ask when new buildings are coming on-line to ensure maximum energy efficiency is being utilized. Frequently individuals and businesses are simply unaware of the possible ways they can make their buildings more efficient. They also don't realize that by designing a more efficient building they can also improve the health of the building (like avoiding mold problems), and the health of building occupants, and save on maintenance costs. In order to make different choices, consumers need to both to both understand what

[85] US Department of Housing and Urban Development. 2004. "Energy Efficient Mortgages FHA Mortgage Insurance." Retrieved on May 26, 2005, from: http://www.hud.gov/offices/hsg/sfh/eem/eem_prog.cfm.
[86] US Department of Energy, Rebuild America. *Financing Energy Efficiency in Buildings.* Retrieved on May 26, 2005, from: http://www.rebuild.org/attachments/guidebooks/financinghandbook.pdf.

current choices mean for future energy use and energy costs and either know about or have access to resources about the alternatives. Central CERT is trying to address both and hopes that by informing their friends, neighbors, local contractors, and city and county officials about the available options, more people will begin to consider the alternatives.

The Central Region CERT have put together two very successful Clean Energy Bus Tours that have taken citizens, politicians, bankers and members of the press to see examples in the area of green buildings, solar and wind projects, geothermal installations and energy conservation technologies. The team is currently creating a logo for the region and a certificate to draw attention to energy efficient and renewable projects in the area. In addition to the projects mentioned above, the Central Region is home to David Winkelman and The Water Foundation. Mr. Winkelman's Bog Frog radio program[87] is played on stations throughout the area and gives listeners quick tips and information about energy conservation-related issues.

Lack of awareness and consumers apathy are truly two of the greatest barriers confronting people who want to make energy changes. The individual energy user is a key part of the energy story. Day-to-day energy choices determine what kinds of energy are produced, their effects on our environment, and their positive input or negative pulls on the economy. If enough people conserve energy, will a new electric plant need to be built? If a new plant is built, does it use coal imported from out of state or cleaner resources produced here in Minnesota? What are the costs of these resources? If every Minnesotan were asking these questions every time he or she switched on a light, we might be following a different path. By doing tours, radio spots, and sharing information with decision makers, the Central CERT hopes to encourage more people in their community to ask these questions and consider the impact their current choices have on both our energy and community futures.

[87] For more information, visit: http://www.bogfrog.com/ .

SECTION 9: MOVING FORWARD

Central CERT and the Central Region as a whole are leaders in biomass-fueled ethanol, small solar development for low-income people, radio spots, conservation in government buildings, and publicizing and recognizing the good work being done in the region. These are strengths the region should continue to build upon to further broader energy efficiency improvements and renewable energy development.

Section 9.1 Emerging Opportunities

One of the most innovative projects underway in the Central Region is the biomass conversion at the Central Minnesota Ethanol Cooperative. Once completed, it will be the first of its kind to use renewable resources to generate a renewable fuel. This type of project shows the true potential of biomass to provide a predictably priced heating fuel resource. The ability to produce ethanol from low-cost biomass is a crucial next step. Furthermore, if Department of Energy goals are met, the cost of producing ethanol could be reduced by as much as 60 cents per gallon by 2015 with cellulosic conversion technology.[88] Cellulosic feedstocks include agricultural wastes, grasses and woods (often dubbed "energy crops"), and other biomass such as municipal waste. Although cellulosic materials are less expensive than corn, they are more costly to convert to ethanol because of the extensive processing required. With advances in technology, however, cellulosic conversion is becoming more and more cost effective. The Central Region could benefit significantly from the production of ethanol and related products from cellulosic feedstocks. Farmers already have the skills and most of the equipment needed to produce and harvest the cellulosic materials that the industry will need, and these other feedstocks could provide farmers with another income stream from less energy-intensive crops.

The Central Region is also well suited for a bio-refinery. A bio-refinery may offer the "biggest bang for the buck." Through various thermal-chemical processes biomass is broken down and converted to its highest value applications. Raw BTUs for energy are typically not the highest value use for plant material. By converting them instead to a range of petrochemical replacements, the biomass is used in a much higher value application. The left over matter, like lignin, can then be used as boiler and/or gasifier fuel. Through the bio-refinery concept plant materials are used to displace high cost petroleum, rather than low cost coal, making them a more cost-competitive alternative.[89]

Section 9.2 Conclusion

The Central CERT has proven to be a very active and dynamic group. As the Central CERT moves towards phase II, which will officially start on July 1st, 2005, it is good to reflect back on what they have accomplished and where they want to go.

[88] DiPardo, Joseph. 2002. *Outlook for Biomass Ethanol Production and Demand.* Retrieved May 24, 2005, from: http://www.eia.doe.gov/oiaf/analysispaper/biomass.html.

[89] Information based on e-mail and conversations with Mark Lindquist of the Minnesota Project. E-mail retrieved May 24th, 2005.

The Central Region has excelled in many areas. They are the first team to hire a part-time staff person to further their projects on the ground; as phase II begins, this will be a crucial step for all the regions to pursue. They have led the state in providing educational bus tours and recognition for the energy conservation and renewable energy sites they have visited. All eyes are currently on the Central Minnesota Ethanol Cooperative as it becomes the first ethanol plant in the state to produce biomass-fueled ethanol. While many CERTs are still wrestling with how to do radio promotion, the Central Region has already begun working with a local partner to promote their regional activities. Furthermore, Jason Edens and the Rural Renewable Energy Alliance (RREAL) have a groundbreaking program that installs a solar heating system into the homes of families who need it most, while involving youth in the installations and teaching them technical skills they can draw in the future. Finally, the Central CERT is leading the way in promoting energy conservation and renewable energy in buildings by targeting new construction and approaching schools and municipalities about building retrofits.

With its booming population, diverse landscape, rich resources and human capacity, the region is sure to continue serving as a model for energy efficiency efforts and renewable energy development.