Final Technical Report

Minnesota Tribal Coalition
Tribal Utility Capacity Building Project

DE-FG36GO13118

September 2003 – September 2006

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Key consultants included:

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Executive Summary

The project helped tribal leaders, staff and community members on the Grand Portage, Leech Lake, and White Earth Reservations better understand their community's energy usage, assess local resources that might be utilized to reduce energy consumption and begin to formulate appropriate development strategies. The principal guiding interest was to assess energy usage and the potential for wind resource development on each of the three reservations. Key tribal staff became familiar with wind energy technology and assessment methodologies that will be of continued use as each tribe moves forward with development projects.

The findings were that wind resources are available at each reservation with varying degrees of potential for development. At White Earth moderate to excellent resources are present at White Earth village and along the U.S. 59 corridor sufficient to be tapped to serve several scattered tribal complexes. At Grand Portage a former community television repeater tower site provides a viable elevated location for a wind turbine to serve the tribal community settlement. At Leech Lake, while most constrained by tree cover, a site adjacent to a casino holds promise for the newer taller wind turbines now coming to market at ever-increasing taller rotor heights. The project developed considerable data of importance regarding the potential for wind development on and near each reservation.

Comparison of Actual Accomplishments with Goals and Objectives

Goals:

Grand Portage, Leech Lake and White Earth Reservations will seek to build a common foundation for strategic energy resource and utility planning capacity by banding together.

Grand Portage, Leech Lake and White Earth (tribes) will develop strategic energy resource plans and model organizational documents for tribal institutions at each of the reservations.

The goals were met. A strategic energy plan was developed for White Earth serving as a model for Leech Lake and Grand Portage. During the course of the project implementation a knowledge foundation was laid at each tribe for implementation of specific projects to integrate renewable energy at tribe facilities.

Objectives:

Education: *Raising community awareness about energy issues through the distribution of basic educational materials and focused outreach activities aimed at facility managers.*

Assessment: *The identification and assessment of the basic on-reservation energy flow and consumption patterns, and the potential for energy policy development on issues of conservation, energy efficiency and application of renewable energy resources.*

Strategic Plan: *The development of an overall tribal energy vision and outlining long-term strategic energy plans, including a statement, and goals and objectives, which may be tailored to the needs and resources of each reservation.*

Model Documents: *The development of model organizational documents, such as tribal codes and policies, to promote the formation of tribal utility institutions (offices, commissions, authorities) to better serve on-reservation loads and members.*

These objectives were met. The Education, Assessment and Strategic Plan objectives were completed as proposed. The Model Documents objective was modified to include sessions with tribal leadership and recommendations in the strategic plan produced for White Earth as a template for the other two reservations.

Project Activities

The original approach was to conduct the educational activities concurrent with the baseline assessment activities. With implementation of the project this was not found to be practical so this focus was moved to the final months of the project. Also, originally the focus was upon facility manager involvement in the development of the project. This too was found to be impractical and designees from each tribe were utilized from planning and air quality management departments authorized to be involved in the project. Also, originally the thought was that there would be interest in development of tribal institutions via discussion and review of model tribal code documents. Tribal staff and administrators found that model ordinances were premature without near-term development projects.

The Center for Sustainable Community Development, University of Minnesota Duluth, took the lead with much of the assessment activities and because of distance factors was the primary lead with Grand Portage tribal participation. The White Earth Land Recovery Project staff and a staff member from the White Earth tribal planning department focused on the White Earth activities. From the accumulated research the White Earth Land Recovery Project staff prepared the strategic energy plan for White Earth and as a model for Leech Lake and Grand Portage. They coordinated meetings, produced educational posters and distributed educational materials throughout the White Earth Reservation.

Michael Rivard an experienced wind developer and financer assisted White Earth with evaluating tens of thousands of acres of tribal and nearby lands for targeted sites for potential wind development aided by EAPC Architects Engineers using WindPro for wind resource mapping. Grand Portage, Leach Lake, and White Earth also utilized meteorological/anemometer towers on loan from NREL to begin to measure wind resources at selected sites.

Publications

The following reports were produced during the course of the project:

White Earth Anishinaabe Nation Energy Plan, 2006, White Earth Land Recovery Project

Final Report, Tribal Energy Feasibility Study, 2005 and 2006 update, Center for Sustainable Community Development, University of Minnesota Duluth,

White Earth Wind Power for 2006-2007, 2006, Michael Rivard

Energy Audit, White Earth Reservation RTC Building, 2004, Otter Tail Power Company

WHITE EARTH ANISHINAABE NATION ENERGY PLAN

Gaa-Noodin Oke - The Wind Maker
Wind Power in Anishinaabeg Akiing
Clean Energy for Future Generations
White Earth Land Recovery Project
White Earth Land Recovery Project, White Earth
Tribal Council, Winona LaDuke,
Honor The Earth www.honorearth.org
White Earth Land Recover Project www.weirp.org

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Onaabani giizis 20, 2006

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EXECUTIVE SUMMARY

The White Earth Anishinaabeg Nation is poised to make critical decisions as to the energy future for the community, a future which will be a cornerstone of the economy, the health and the land of the region. Over the course of the past two years, the White Earth Tribal Council and the White Earth Land Recovery Project have researched and documented energy use, impacts of various scenarios of energy use on the reservation, and analyzed a wide array of options for the future of the energy consumption on the reservation. This work has been undertaken with the support of the US Department of Energy's Tribal Energy Program, and linked to similar research on the Leech Lake and Grand Portage reservations. In addition, over the past decade, we have, with the assistance of the Minnesota Department of Commerce and the Minnesota Office of Environmental Assistance, monitored wind energy viability, and erected the first tribal wind tower. This report summarizes that data, and makes a set of recommendations.

In short, we are recommending an innovative program of energy efficiency, re-use, and renewable energy which will provide reliable sources of power and fuel to tribal members, tribal vehicles and the economy of the reservation. The overall proposals are founded on cultural, environmental and economic foundations- looking to insure that our self determination as a people is insured. We are in a very good position for the future. To secure this future, we are recommending the following actions:

l) Approve an overall renewable energy standard for the White Earth Reservation, and a set of goals for energy use within reservation borders, including fuel, heating and electricity.

2) Join tribal governments, states and cities nationally to volunteer to meet the standards set by the Kyoto Accord and mitigate green house gas emissions and global climate change through tribal policy.

3) Establish a tribal energy act and a tribal utility, modeled after tribal utilities nationally.

4) Develop a tribal energy efficiency program aimed at reducing tribal heat, electricity and fuel consumption through use of presently available products distributed through tribal programs and through retail outlets on the reservation.

5) Create a tribal housing initiative which includes passive solar energy and efficiency as a cornerstone of the program, and install solar heating panels as requested on present tribal homes to increase efficiency. Increase, where possible, the direct use of wood heat in local homes and facilities to enhance a local fuel economy and direct heating efficiencies.

6) Create a tribal wind energy program aimed at providing electricity for the reservation, and providing wind energy as a significant export economy for the White Earth tribe.

7) Develop a model Tribal Casino efficiency and renewables program utilizing fuel oil, solar panels, hybrid vehicles, energy efficient light bulbs, and wind energy to both offset energy costs of our tribal enterprise, and to be a model of potential tribal and regional self determination.

8) Secure energy efficient and ethanol based tribal vehicles, as well as bio-diesel vehicles for tribal operations and school buses in the region.

9) Join Intertribal Council on Utility Policy to insure our tribe is a part of regional and national tribal policies and development opportunities.

10) Join the White Earth Tribal College with the Northwest Technical College in a training program aimed at preparing a tribal work force to carry out, implement, maintain and create a new energy economy for the White Earth reservation, and subsequently for the region.

ll) Investigate bio-fuels opportunities for tribal heating and energy in villages and facilities on the reservation.

12) In a growing renewable energy economy internationally and nationally, seek opportunities for light manufacturing, assembly, and ownership in a solar, wind and alternative fuels market poised for explosive growth.

BACKGROUND

Why an energy plan for the White Earth Anishinaabeg? Our people have a long history of self determination as a people, with control over our economy, land base, cultural practices, education and future. The question we are asking in this report is: **What is our self determining plan for energy in the future? What is energy sovereignty for our Anishinaabeg people?**

Energy today, and the use of energy is one of the cornerstones of the economy and way of life on the White Earth reservation- whether heating our homes in the winter, our electrical appliances, casino operations, or our transportation. Energy has become a necessity for our people, and indeed for our future. On a world wide scale, countries are grappling with these same issues: What will our energy sources be in the future? What can we do now to insure that we have both a stable supply of energy for our growing communities, and also energy at a price we can afford.

> *"Just as the human body adapts itself to the regular intake of "hard" drugs, its systems coming to depend on them to such an extent that the user goes through a period of acute distress if they are suddenly withdrawn, so the use of "hard" fossil energy alters the economic metabolism and is so highly addictive that in a crisis, a user community or country will be prepared to export almost any proportion of its annual output to buy its regular fix. Even in normal conditions, a community in an industrialized country can devote a fifth of its external income to buying energy, an expense that not only constitutes a serious drain on its resources but locks the community into the unpredictable gyrations of the world trading system."*

Richard Douthwaite, Short Circuit

Our interest over the past two years has been to investigate options for our tribal economy and community, seeking an affordable, culturally and ecologically sustainable, and economically vital energy economy for the White Earth reservation. The questions we are interested in answering as a community include the following:

1) What energy sources will be available at an affordable price for our tribal members and the tribe as a whole into the next millennium?

2) What energy sources are in keeping with Anishinaabeg values of sustainability?

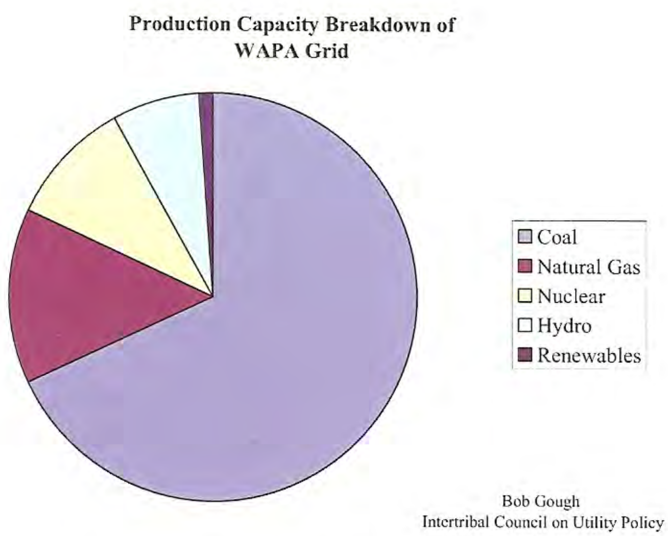
3) What energy choices will not negatively impact our lakes, watershed, air quality or environment?

4) What energy choices can we make which will enhance our tribal economy and the economy of northern Minnesota?

Energy Production for the White Earth Reservation

There are three major energy providers for the White Earth reservation: Wild Rice Electric Cooperative, Itasca Mantrap Cooperative, and Otter Tail Power Company. Of these providers, only Otter Tail Power Company has its own production facilities or power plants including primarily coal generation. The other power providers for the White Earth reservation purchase power from regional producers such as Minnkota, XCEL, and Otter Tail Power Company Power through a regional power grid. As such, there are different segments of the energy industry on the White Earth reservation: the power generation elements, the distribution agencies and the consumers-- tribal, household, and commercial or industrial. In addition, energy is used for transportation by our tribal membership.

Electricity Generation by Source for the Region



Although this graph represents Western Area Power Administration's breakdown of electricity generation, and WAPA is the primary electricity supplier to the White Earth region, none of the electricity generated for White Earth is generated by nuclear power.[1] However, the graph clearly illustrates the fact that the majority of electricity is generated by burning coal, and this is very relevant to the situation at White Earth.

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[1] Information received in phone interviews with Minnkota Power cooperative, Otter Tail Power Company, and Great River Energy.
Jan 23, 2006.

Environmental and Social Impacts of Energy Production

Coal

Coal generation represents the largest source of power in the region, much of it lignite coal from North Dakota. The coal burned in power plants to the West of the White Earth reservation represents some of the dirtiest coal known, particularly that burned by Basin Electric, which on a national scale ranked highest of 100 utilities for carbon dioxide emissions per kilowatt of power. [2]

Electricity production, primarily from burning coal, is the source of most emissions of sulfur oxides (SOx) which are the main cause of acid rain.[3] 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) both of which can irritate the lungs, cause bronchitis and pneumonia, and decrease resistance to respiratory infections.[4] 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.[5] Coal combustion also contributes to mercury, arsenic and lead emissions.[6] These toxic metals can accumulate in the fatty tissue of animals and humans leading to severe health problems.[7] 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.[8] Most lakes on the White Earth reservation have a fish consumption advisory for heavy metals and mercury. The two primary sources of mercury are incinerators and fossil fuel, particularly coal burning energy plants.

The largest new project projected for our region is the Big Stone 2 coal fired power complex proposed by Otter Tail Power Company for a 600 megawatt addition to the present Milbank, SD facility. The proposed new project is anticipated to cost $1 billion, would employ between 600 and 1400 workers in the four year construction period, and 30-40 over the longer time. Using extensive new technologies for coal scrubbing, the plant would

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[2] Bob Gough's data. Intertribal Council on Utility Policy. "Bench Marking Air Emissions of the 100 Largest Electric Generation Owners in the U.S.-2000." National Resources Defense Council and Coalition for Environmentally Responsible Economics, and Public Service Enterprise Group. From "Study Ranking Utility Polluters Aims to Sway Emissions Debate." Neela Banerjee, NYT, March 21, 2002.

[3] 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

[4] 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

[5] 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

[6] 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

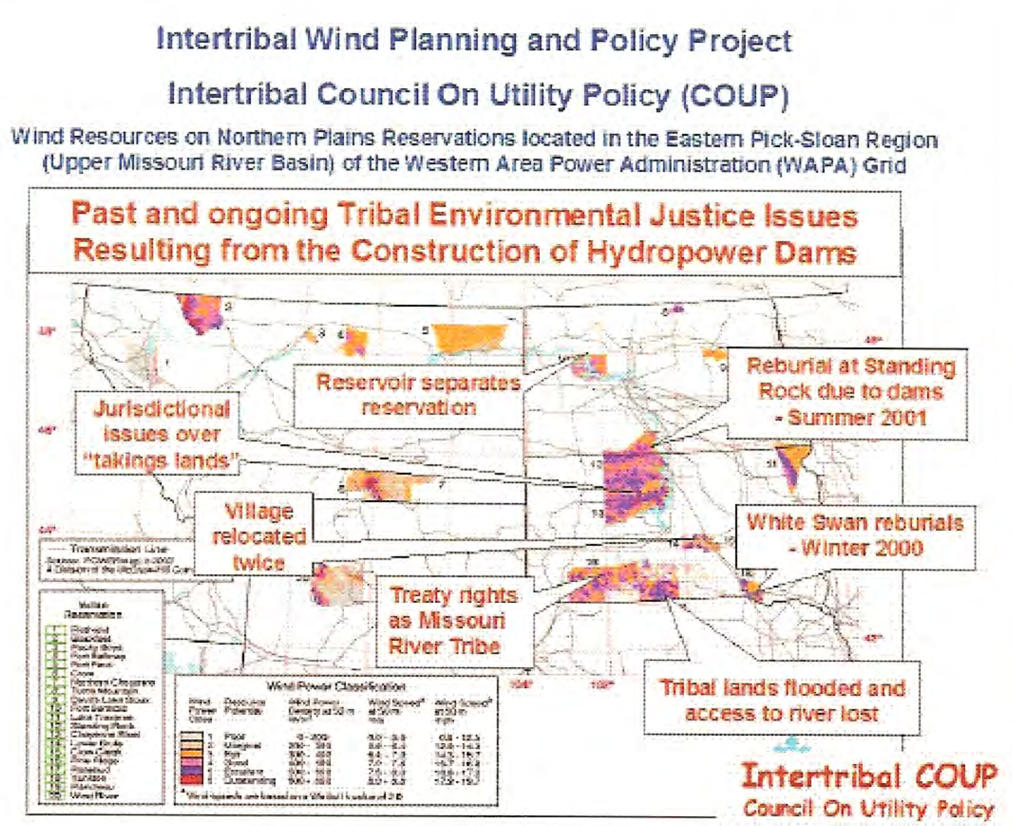
[7] Ibid.

[8] 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

produce significantly less emissions than previous facilities, however will continue to both produce greenhouse gases and mercury emissions.

Hydro Electric Power

Hydroelectric generation also has environmental impacts. These impacts include disruptions of hydrology, disruption of nutrient and sediment cycling (and all the resulting changes such as changes in fish communities and increase in downstream erosion), blocking of fish and invertebrate migrations, inundation and loss of habitats (aquatic and terrestrial), alteration of communities (aquatic and terrestrial, including human), alteration of water quality (including the production of methane gas from all the created reservoirs), and increase in susceptibility to exotics and pathogens. While these impacts are of great concern at large-scale hydroelectric facilities, there should also be a concern at small-scale hydroelectric facilities as even run-of-river dams impact fish migration. In particular, the dam projects in northern Manitoba, (in projects of Manitoba Hydro) represent a significant environmental and cultural impact to Anishinaabeg and Cree people. Manitoba Hydro dams have severely impacted the Nelson River Basin, South Indian Lake and other Indigenous communities to the north. In this case, the existence of large scale dam projects in permafrost has caused massive disruption of water systems, decline from silting of water quality, and a destruction of much of the traditional food and way of life of many Cree villages in northern Manitoba. The single largest export market for Manitoba Hydro power is the XCEL contract serving our region. As well, historic dams on the Missouri River system created by the Pick- Sloan project have had significant impacts on tribal communities in the Great Plains region.



Finally, with the advent of global climate destabilization, most major dam projects are facing huge deficits in production, as water levels are not at projected levels due to a decline in snow fall, and other climate-change related challenges.

Nuclear Power

Nuclear power represents the third largest source of energy in our region, but represents only a small portion of the mix on the White Earth reservation. The two nuclear power plants operated by the XCEL Corporation are in operation at Monticello and Prairie Island. The Prairie Island facility is on the Mdewakanton reservation south of Minneapolis, and although the plant produces fifteen percent of Minnesota's power, none of it goes to the Mdewakanton community. Despite this, the plant has contaminated Prairie Island residents. In 1994, the Minnesota Department of Health found that the plant had exposed residents to cancer at six times the rate found in the general population.[9]

As the nuclear waste storage space became saturated, the plant requested to store waste in above-ground steel tanks, essentially creating a nuclear dump. As the tribe contested this move, the ensuing legal battle was a source of controversy that served as a catalyst for public policy in Minnesota, securing some of the most progressive energy policy in the country. Although the plant stayed, the state legislature mandated that in order to remain open, a permanent storage facility must be operating by 2004. As this was the first time a state legislature issued such a mandate, the decision was precedent-setting.[10]

All present proposals for disposing of nuclear waste involve nuclear waste dump facilities in Native American communities, including the Western Shoshone and the Skull Valley Goshute reservation. At present 90,000 shipments of nuclear waste are scheduled to move to these communities, and although no new nuclear reactors have been built for the past twenty years, there are proposals to restore the nuclear industry domestically. Nuclear power has historically benefited from substantial federal support, and is presently slated for a large set of subsidies to bring new nuclear facilities into production, in part as a federal response to the concerns over global climate destabilization.

Wind Energy

Wind generation is emerging as a new energy source in our region. Minnesota has installed 615 megawatts of wind power, with an additional 138 MW slated for immediate development. This ranks Minnesota as 4th in the nation, only behind California, Texas and Iowa.[11] To the west, Florida Power and Light has moved rapidly into North and South Dakota with new projects, linking these, in particular, to the Otter Tail Power Company system. In our region, the city of Moorhead operates two NEG Micon wind turbines, and the Agassiz Beach LLC operates 1.98 megawatts of wind power near Flom, MN. The former production system at Moorhead fulfills 5% of the electricity demand for that city, and the Aggasiz Beach project is sold to the XCEL Corporation for use in the regional grid.

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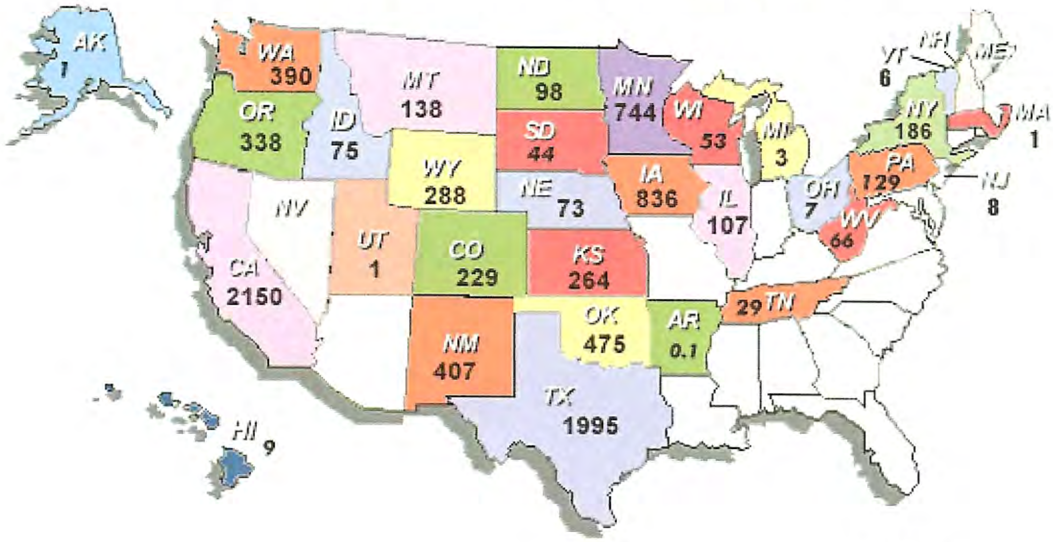
[9] Winona LaDuke. "Nuclear Waste: Dumping on the Indians." All Our Relations. South End Press. 1999.
[10] LaDuke, 107-8.
[11] Phone Interview with Jeff Haase. Department of Commerce State Energy. Information from American Wind Energy Association. January 23, 2006.

Present Installed Capacity of Wind Generation by State



AWEA

Selected Wind Projects in the Region

Location	Year Installed	Owner	Turbine	Notes
Belcourt, ND	1997	Turtle Mt. Chippewa	100kW NEG Micon	Power used by Turtle Mt. Chippewa.
Fort Totten, ND	1997	Spirit Lake Sioux	100 kW NEG Micon	Power used by Spirit Lake Sioux
Turtle Lake, ND			108 kW turbine	
Oriska, ND	Jan 2002	Minnkota Power Cooperative	900 kW NEG Micon	Minnkota Power Cooperative www.minnkota.com/infinity.htm
Petersburg, ND	July 2002	Minnkota Power Cooperative	900 kW NEG Micon	Minnkota Power Cooperative www.minnkota.com/infinity.htm
Moorhead, MN	1999 and 2001	Moorhead Public Service	(2) 750KW NEG MICON	Buydown Program
Agassiz Beach	Jan 2001	NAE/Enel North America	(3) 660 KW Vestas V-47	Power sold to Xcel Energy

ENERGY CONSUMPTION ON THE WHITE EARTH RESERVATION AND REGION

Total Electrical Sales for 4 Utilities Operating within White Earth

Four electrical utility companies serve parts of the White Earth Reservation. Each company's electrical service statistics are presented below and reflect statistics of an area much larger than the reservation.

	Farm	Non-Farm Residential	Commercial	Industrial	Total (MWh)
Northwest Minnesota Electric Consumption for Investor-Owned Utilities					
Investor-Owned Utilities					
Otter Tail Power Co	-	456,616	655,436	702,951	1,815,003
Northwest Minnesota Electric Consumption for Cooperative Utilities					
Minnkota Power Cooperative - Cooperative					
Clearwater-Polk Elec Coop	5,959	48,445	9,307	-	63,711
Wild Rice Elec Coop	150,180	11,770	*	*	192,500
Itasca-Mantrap Coop Elec	16,165	65,239	*	*	172,237

Current Energy Needs and Forecasts

Power is consumed on the White Earth reservation by industrial and household users for electricity and heat. In addition, energy is consumed by the transportation sector on the reservation.

A total estimate of tribal energy use and expenses is difficult to secure, however, as is illustrated throughout this section, energy costs have a definite impact on the economy. Especially because very few of the current vendors represent a contribution to the tribal economy, we see the energy economy of the White Earth reservation as a source of lost income with the potential to become a positive source of revenue to the tribal economy if more locally owned elements of this industry are created.

To meet this objective, energy planning requires an understanding of the tribe's energy needs. The amount of electrical energy used to power an item is the **load**. The load can be measured on a residential level, like the energy load required for the cooking, heating and cooling system of a house. The load can also be measured on a commercial level, like for a building or group of houses. Unlike **residential loads**, which are determined mainly by heating and cooling costs, **commercial loads** have a much higher appliance or plug load.[12] In general, as the size of the building grows, plug loads become a larger and larger fraction of the building's energy needs.[13] Determining the existing load will allow the energy planners to forecast how much energy is required to maintain the level of power usage. According to a

[12] US Dep't. of Energy: Tribal Energy Program, http://www.eere.energy.gov/tribalenergy/guide/load.html
[13] US Dep't. of Energy: Tribal Energy Program, http://www.eere.energy.gov/tribalenergy/guide/load.html

formulation by Bob Gough of the Intertribal Council on Utility Policy, White Earth will require 8 MW of continuous generation to fulfill the region's electricity demand because annual electrical consumption is currently at 69,698,120 kilowatt hours.

Household Energy Use Assessment of Heat

County	# of Households	Utility Gas	Propane	Electric	Fuel Oil	Wood	Other
Becker	11,884	3215	3339	2361	1604	1225	65
Clearwater	3300	354	678	876	817	541	10
Mahnomen	1969	29	591	428	669	200	2
White Earth Reservation[14]	3317[15]	91	1097	702	956	409	6

Most homes on the White Earth reservation are primarily heated by either propane or fuel oil, with electric or wood serving as a secondary heating source. At an average of 700 gallons of fuel oil at $2.32/gallon per year, this results in an annual cost of $1624 per home. At $1.80/gallon, multiplied by 800 gallons per year, an annual average propane bill is $1440 per home.[16] When combined with the additional costs of wood and electric, the total obviously increases.

Additional Heating Data: Mahnomen Public School

In order to heat the Mahnomen Public School in 2004, the district used a total of 3329 million BTU's primarily through a wood boiler with a conventional fuel oil furnace supplementing the boiler, spending $80,000 annually on heating costs.[17] While this is a grand figure, the number does not reflect the total energy use by the school, as electricity and transportation costs are not figured in. Although the Mahnomen Public School is the biggest school on the reservation, and thus predictably spends the most money on energy, with the addition of the other five schools on the White Earth reservation, it is easy to see that a significant amount of money is spent on heat energy alone.

Household Electrical Consumption

The average household in the region consumes 1300 kilowatt hours per month,[18] totaling 15,600 KWH per year. This results in average annual electric costs of $1056 per household.[19]

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[14] Including the parts of Mahnomen, Becker and Clearwater counties that fall within reservation boundaries.

[15] There is a discrepancy of 56 homes in the data, all which are not listed as consuming any fuel.

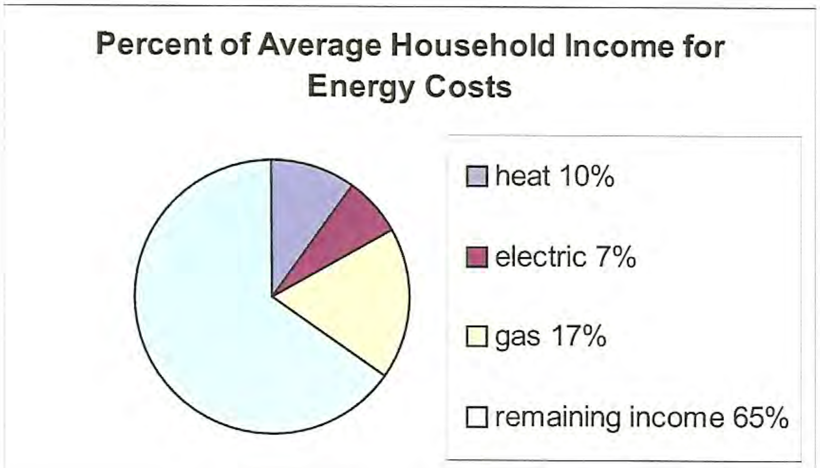
[16] Data provided by Anglo American. Jan 25, 2006.

[17] Data obtained in phone interview with Mary Torgeson, Business Manager of Mahnomen School District. Jan 25, 2006.

[18] This figure is derived from a November 2005 report, and represents the region, not specifically the White Earth reservation. Phone interview with Kathy Rogers. Wild Rice Electric. Jan 19, 2006.

Household Gasoline Consumption

Most drivers in the area spend an average of $200-$250 per month on gasoline for transportation purposes.[20] Annually this adds up to $2400-2900. One major problem with this: Gas prices are unstable and largely unpredictable due to outside factors, as discussed later in the report.



The average annual per capita income for the White Earth reservation is $5,000[21]. With an average of 3.1 people per household[22], this represents an annual household income of approximately $15,000. Adding up the average household costs of heat (at least $1500), electricity ($1056), and transportation (approximately $2650) = $5206 per house per year. Energy costs, then, represent possibly just over 1/3 of total household income. Through these figures, it is evident that tribal revenues expended on energy sources represent a significant income stream, either as a loss of income to the tribal economy, or the potential for a major economy for the reservation.

Local Fuel Assistance

Energy for heat as well as other uses is necessary commodity. Today, virtually all of the products consumed in this sector are produced off reservation. Furthermore, a good portion of these sources are fossil fuels, which are produced out of the country. The availability and pricing of most heating sources is quite variable. Indeed in winter 2005-06 natural gas prices were expected to double nationally, with federal fuel assistance allocations anticipated to remain at $300 per household, while expenses were anticipated to reach $600-700 per household. [23]

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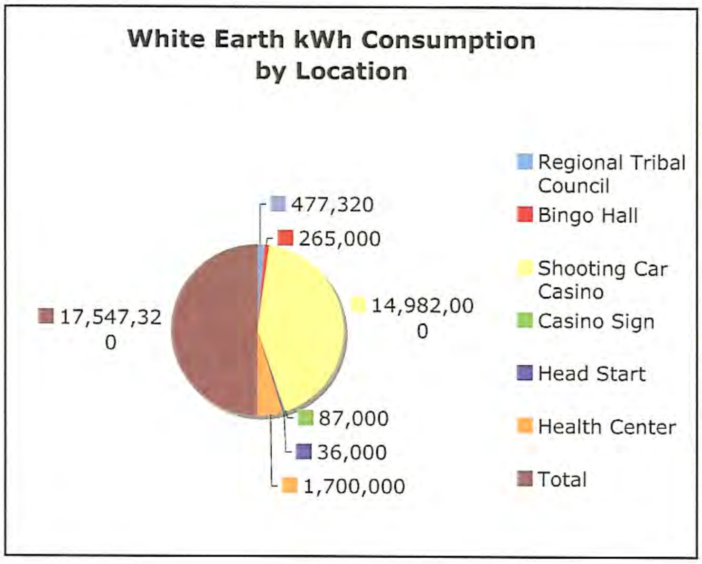
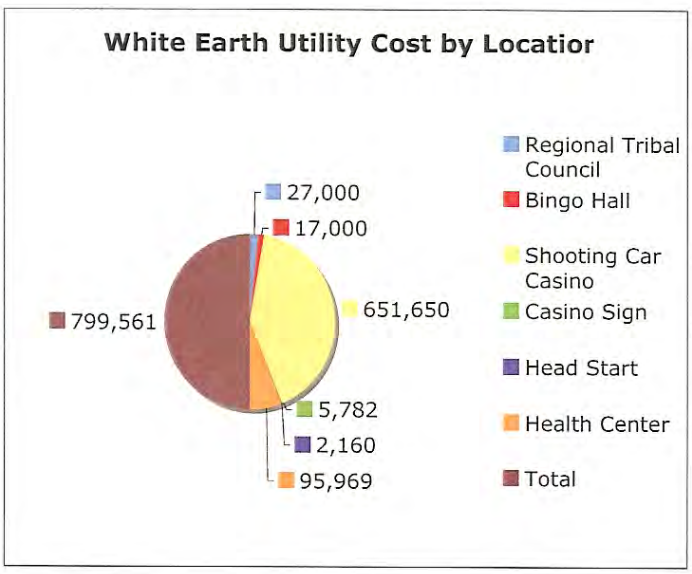
[19] Wild Rice Electric charges 8 cents per KWh for the first 500 KW, and 6 cents per KWh after this point.
[20] Data obtained from seven employees of the White Earth Land Recovery Project.
[21] Dr. Mike Mageau, University of Minnesota-Duluth. Report prepared for Minnesota Tribal Utility Coalition. May 31, 2005.
[22] Naomi White Bird at the Minnesota Chippewa Tribe. "MCT Housing Corporation Market Analysis." Aug 2004.
[23] Jad Mouwad. "Heat Costs Expected to Surge." New York Times. September 30, 2005.

Fuel assistance for the region is allocated through two major sources: Mahube and the White Earth Housing Authority.[24] In 2005, Mahube's budget was $1,478,000, serving 3100 households in three counties.[25] With a 2005-2006 budget of $537,000, The White Earth Housing Authority is currently serving 680 homes in the area. There is an additional crisis slush fund of $65,000.[26]

This combined budget of $2,080,000 represents a source of revenue which, if applied differently, could increase the total circulation of money in the local economy.

Load Analysis of Selected Tribal Facilities





[24] The fuel assistance budget of both Mahube and also The White Earth Housing Authority is not funded by any tribal agency, but rather is U.S. government funded.
[25] Data provided in phone interview with Nancy Cummings of Mahube. Jan 19, 2006.
[26] Data provided in phone interview with Chris Fairbanks of The White Earth Housing Authority. Jan 19, 2006.

Transportation Energy Use on the White Earth Reservation [27]

County	Passenger Vehicles	Pick-ups	Buses	Others
Becker	18,715	8154	198	1534
Clearwater	4644	2731	22	357
Mahnomen	2346	1247	1	7778
Gallons/Vehicle	551	643	2200[28]	4637
Total Gallons of Gas Used	14,163,455	7,800,876	486,200	44,835,153

Total gas consumption by County[29]

Clearwater: 6,038,686 gallons
Becker: 23,103,745 gallons
Mahnomen: 38,161,053 gallons[30]

Agricultural Energy Use

Agriculture both uses and creates energy. Industrialized agriculture uses more fossil fuel sources than organic or Indigenous agriculture systems, which rely more on natural sources of fertilizer and human labor. At the same time, many of the crops grown in the region of the White Earth reservation represent some of the largest energy consuming, and largest energy producing crops known. Northwestern Minnesota accounts for about half of all sugar beets grown in the state, half of all edible beans grown in the state, 60% of all sunflowers, 80% of all barley and nearly all of the state's flax. (USDA, cited in CERTs, page 36).

Direct energy inputs into these agricultural products include diesel and gasoline for farm equipment, electricity for buildings and drying. Indirect inputs include fertilizers, herbicides, insecticides, fungicides, hydrous ammonia and urea. In a recent study, calculations indicate that diesel, electricity and natural gas are the major agricultural inputs. Additionally, potatoes and sugar beets require nearly four times more diesel per acre and at least three times more electricity than other crops. (37 CERTs, citingUMN)

County	# of Operating Farms	# of Acres in Production
Mahnomen	363	194,854
Becker	1254	416,554
Clearwater	627	226,452

[27] 2005 Central Minnesota Strategic Energy Plan and Northwestern Minnesota Strategic Energy Plan. Clean Energy Resource Teams (CERTS).
[28] Estimated number arrived at by talking to 4 local bus drivers (Curt Ballard, Terry Dorman, Terry Handyside and Janice Chilton) and averaging the gas used in ten buses around the area. This data was not otherwise available.
[29] Figures arrived at by calculating the figures in the above chart.
[30] While Mahnomen county has a significantly smaller number of passenger vehicles, pick-ups and buses, the substantial increase in vehicles defined as "others," which includes farm equipment and large vehicles, accounts for the noticeable increase in gas consumption.

Farm Production Data 2003-4[31]

County	# of Farms	Total County Acreage	Corn Acres	Soybean Acres	Hay Acres	Sugarbeet Acres	Potato Acres	Wheat Acres	Dairy Acres	Beef Acres	Hog Acres
Becker	1254	416,554	20,200	86,800	45,400	10,300	X	56,000	6500	7500	2200
Clearwater	627	226,452	3600	6000	49,600	X	1442	6600	1100	9600	X
Mahnomen	363	194,854	16,300	55,700	18,800	4400	30,000	1800	3200	X	X

(Clearwater Potatoes represent all but one acre of irrigated potatoes.)

World Energy Politics, Peak Oil and The Connection to the White Earth Reservation

The world oil economy is at $3 trillion annually. As oil prices moved from a peak of $24 per barrel in 2003 to $70 per barrel in 2005, we learned that we know little about the economics and resource potential of oil. Considering our current dependence on oil, this is obviously a problem. We do know that oil production is going down. According to many scientists in the oil field, we've been able to consume an estimated half of the world's oil supply (that's everything the dinosaurs made) in about 100 years.

Over the past ten years, oil production has been declining in 33 of the world's largest oil producing countries, including 6 of the 11 members of OPEC. The US, both the largest market for oil, and historically the leader in oil production, production actually peaked 35 years go, at 8 million barrels per day, and has since declined to 3 million barrels daily. Oil production is also declining in other major oil producing countries including the United Kingdom (North Sea Oil) and Indonesia.

The oil industry believes that there are 1.1 trillion barrels of "proven reserves," those listed on the books of world oil companies. That represents the equivalent to all the oil extracted over the past 100 years, or an estimated 40 years of oil at the current rate of consumption. Although these are considered to be official statistics, almost three quarters of these "proven reserves" are controlled by state owned oil companies, whose figures are not subject to audit. In turn, many oil companies, such as Chevron, have suggested that nearly half the world's exploitable oil has already been extracted.

What we do know about the remaining oil is this: A good portion of it is in the Middle East, which has a complex set of politics. Saudi Arabia, America's closest ally in the region, for instance, produces 10 million barrels a day, but a good portion of that is from oil fields which are 30-50 years old. Analysts believe that in order to keep this production flowing, a massive investment of water injection into the fields is required. With water becoming an incredibly scarce commodity, this is deeply problematic. [32]

Other "recoverable reserves" are located in China, which is quickly industrializing, and places like the Alberta Tar Sands, which will basically require the mining of an area the size of Lake Superior in order to squeeze oil out of sand.

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[31] 2005 Central Minnesota Strategic Energy Plan and Northwestern Minnesota Strategic Energy Plan. Clean Energy Resource Teams (CERTS).
[32] Christopher Flavin. "Over the Peak." World Watch Institute. Jan/ Feb 2006. Pg 26.

In short, the security of the transportation sector of the American economy, as well as the White Earth Ojibwe nation, is a wildcard for the future. We are, however, in Minnesota in an incredibly good place to look for an alternative.

Global Climate Change, Our Akiing, and Mino Bimaatisiiwin

While world oil production is on the decline, world coal production is not, and there are arguably enough coal reserves for the next 50 to 100 years. Today, fossil fuels, led by coal and natural gas, represent 75% of the world's energy sources and 84% of America's energy.[33] The problem with coal, and other major fossil fuel production, however, is the massive environmental challenge of global climate change, which is viewed as the most significant environmental disaster and threat ever known to human beings. The catastrophic rise in weather related disasters, and the increasing destabilization of our environment is just the beginning of an immense biological process, which we do not yet fully understand.

Carbon dioxide is the major cause of global climate change. In the past 200 years, the amount of carbon dioxide gases in the atmosphere has grown by almost one-third. That's more than in the past 20 million years. The earth's snow cover has decreased by 10 percent since the late 1960s. And since the 1990s, the thickness of Arctic sea ice from late summer to early autumn has decreased by 40 percent. As a result of ice melts, the sea level is on the rise and the prevalence of waterborne and airborne diseases is exploding, as evidenced by the thriving and spreading West Nile Virus. This impacts all aspects of our future. In the summer of 2004, the US Pentagon released a report which not only confirmed that global warming is occurring, but identified global climate change as the greatest threat to the National Security because of the increased risk for weather-related catastrophes.

Along with large-scale impacts of global warming, climate change translates into very serious local consequences for northwestern Minnesota and the White Earth reservation: Over the next hundred years, the region will not only grow warmer, but will also become drier, as temperatures are predicted to increase by 5° to 12° in the winter, and by 5° to 20° in the summer. Seasonal precipitation is also likely to change, increasing by 15-40% in winter and decreasing by 15% in summer. The potential implications of this change are grave: Waning summer water levels may lessen the recharge of groundwater, cause streams to dry up, and reduce wetlands, resulting in diminished wildlife habitat and poor water quality. Considering Minnesota's reputation as a friend to the outdoors, these environmental impacts may also produce dire economic consequences both for native Minnesotans and the tourism industry.[34]

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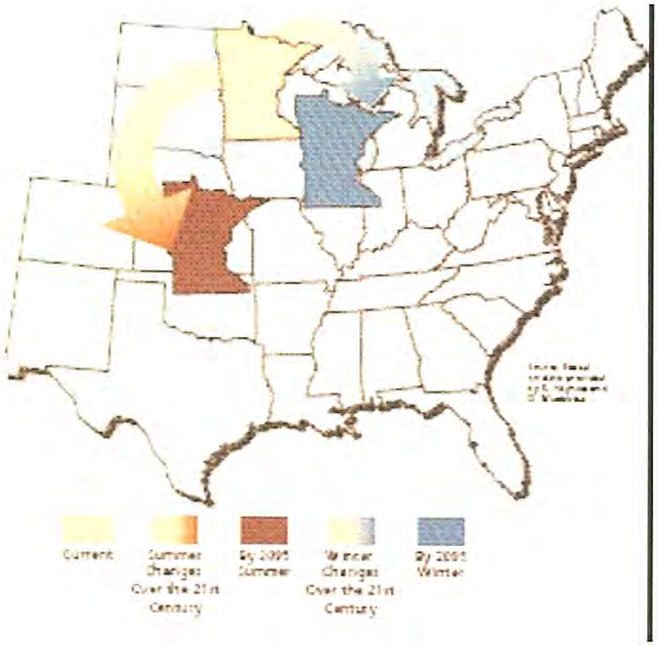
[33] Paul Hawken, Amory Lovins, and L. Hunter Lovins. "Climate." Natural Capitalism: Creating The Next Industrial Revolution. Little Brown and Company, 1999. Pg. 241.
[34] "Confronting Climate Change in the Great Lakes Region." The Union of Concerned Scientists and The Ecological Society of America. April 2003.



Unfortunately, some of the effects of coal generation, one of the leading causes of climate change, are already evident on the White Earth reservation. Due to a huge amount of contamination of lakes with mercury, virtually every lake on the White Earth reservation presently has a fish consumption advisory on it for mercury and other heavy metals. These include primary fishing lakes like White Earth Lake and Strawberry Lake, as well as most other lakes. As global warming increases so will this problem. Because global warming leads to lower water levels and warmer water temperatures, the accumulation of mercury and other contaminants will accelerate in the aquatic food chain. Warmer temperatures are also likely to accelerate CO2,[35] thus making global warming a cyclical problem that feeds itself.

Fortunately, some of the most damaging effects of climate change can be mitigated if the pace and eventual severity of climate change are moderated. This can be done through increasing energy efficiency, conservation in industries and homes, improving vehicle fuel efficiency, and boosting the use of wind energy and other sources of renewable energy sources, among other things.[36]

PROJECTED ENERGY DEMAND IN THE REGION

Conservative estimates by the Mid-Continent Area Power Pool indicate that electricity consumption in our region will increase by as much as 15 percent over the next decade. Estimates by some independent market analysts indicate that energy consumption may increase by as much as 25 percent.

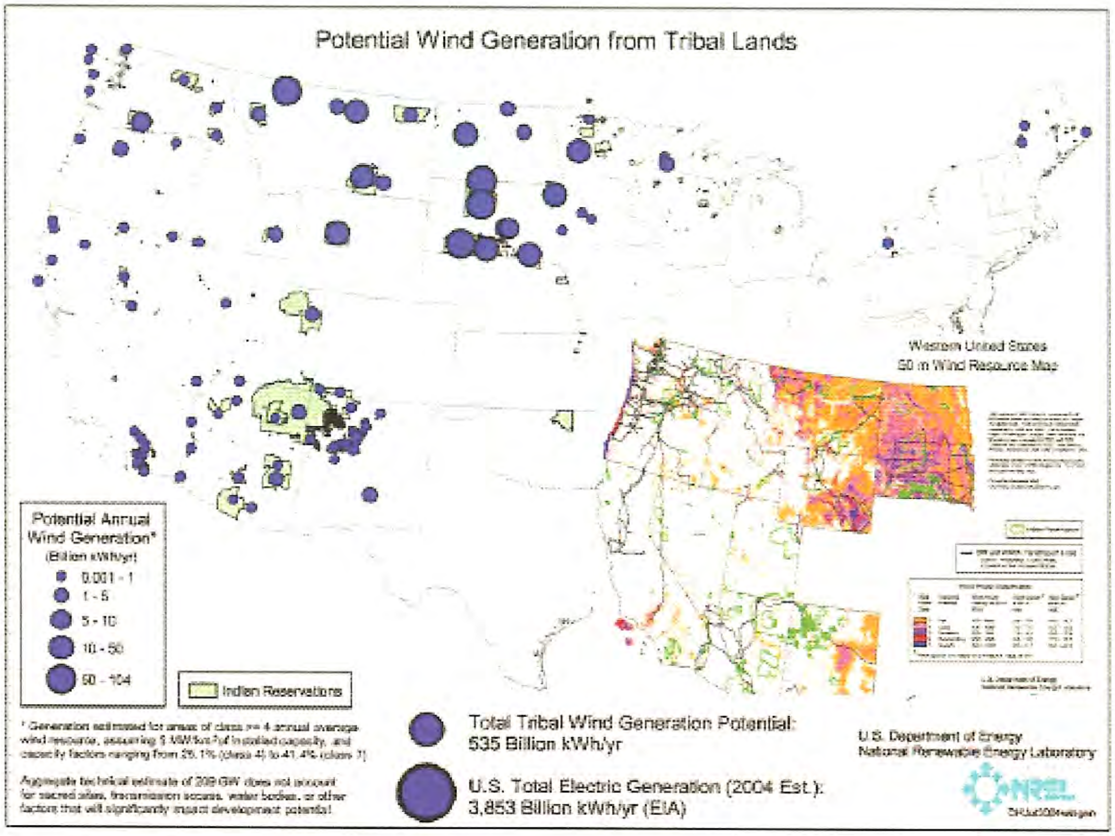
According to Otter Tail Power Company, this increase will require adding 9300 megawatts in the region, but only 2700 are presently scheduled to come on line in the next few years. The shortfall of 6300 megawatts represents both a potential challenge in choices for energy use and consumption in the region, and also a potential market for producers. In short, energy is the largest business in the world. Resource Data International estimates that meeting the

[35] The Union of Concerned Scientists, P4.
[36] The Union of Concerned Scientists, P5.

increased consumption will require adding more than 9,300 megawatts of capacity in the MAPP region by 2012.

For many years, MAPP has been one of the nation's most reliable systems. However, according to RDI, MAPP had less than 2,700 megawatts scheduled to come on line within the next several years. That's 6,300 megawatts less than the region will require. Although it takes four to six years to install a coal fired or fossil fuel power plant, wind generation can typically be established within two years. In any case, creating new generation will require a plan, and we must act soon to prevent a supply problem.

Tribal Choices in Renewable Energy and Conservation



During the course of the past decade, the White Earth Tribal Council and the White Earth Land Recovery Program have worked with a wide array of consultants and organizations to assess the potential energy choices for the White Earth reservation. In 1997, Plainstate Associates assessed tribal energy loads, sources, infrastructure and potential for renewable energy in different scenarios, with a primary focus on wind energy, with the support of a grant from the Minnesota Department of Environmental Quality. In 2003-2005, the White Earth Tribal Council and White Earth Land Recovery Project worked with the EAPC Associates from Grand Forks, North Dakota to assess wind potential for tribal generation and for commercial generation. The partners, in coordination with the Leech Lake Tribal Council and Grand Portage Tribal Council also worked with the Center for Sustainable Community Development in Duluth, Minnesota to assess options for tribal renewable energy, including bio mass, hydrogen and plasma torch opportunities for these tribal governments. All three tribes worked with the Intertribal Council on Utility Policy to assess policy options for tribal governments. Finally, Mike Rivard and Associates provided an analysis of tribal renewables, particularly wind potential for the White Earth reservation.

In addition, the White Earth Tribal planning department and the White Earth Land Recovery Project attended several Department of Energy Trainings, Tribal Renewable Financing Programs, worked in collaboration with the Rural Renewable Energy Alliance on solar installations, and met with renewable energy catalysts George Crocker (North American Water Office) and Dan Juhl (Dan-Mar Associates) to discuss policy options for Minnesota wind generation. Discussion of policy options have been furthered by discussions with local utilities such as Wild Rice Electric and Ottertail Power Company, and separate meetings have occurred with the XCEL Corporation. We are thankful to the Department of Energy and the Minnesota Office of Environmental Assistance as well as various foundations including The Carolyn Foundation, The Tides Foundation--Honor the Earth fund, The Tides Foundation--Underdog Fund, the Chicago Community Fund (Donor Advised), and The Ford Foundation for their support of this work.

Negawatts- Energy Conservation

The most economical choice in energy sovereignty is in conservation. Conservation occurs at all levels of a community, and represents both a savings in present expenditures, and a savings in investment into future energy sources.

Consider this:

- For each household on the White Earth reservation, if the five most used lights were replaced with energy efficient compact fluorescents, a family would save $60 annually on its electricity bill. This represents nationally more than one trillion tons of greenhouse gases averted, $1 billion in savings and the equivalent of 21 medium sized power plants.[37]

- The University of Michigan, over six years, completed energy efficiency projects on 123 campus buildings. The measures included lighting upgrades, efficient appliance purchases, adjustments to mechanical systems and other controls. Beginning in 2005, the school anticipated a $9.7 million in cost savings annually. In 2004, the Environmental Protection Agency named the school and Energy Partner of the Year.[38]

- With 4300 computers, Tufts University implemented power management software which automatically shuts down the monitor when it's not being used. The result was a savings of $50,000 annually in energy costs and 59 tons of annual carbon emissions. [39]

- To audit its facilities, Eastern Illinois University contracted with an energy service company that looks at efficiency issues. The company found inefficient lighting in 30 buildings. Ultimately the audit led to the installation of 10,000 energy efficient light ballasts, 300 occupancy detectors and 200 highly efficient LED exit signs. Each year, the school saves 3.7 million kw hours in electricity consumption. The project, in total cost $1 million but saves between $250,000 and 300,000 annually- a 30% return on investment. [40]

- On a power plant level, America's power plants, largely coal, are quite inefficient. The average power plant turns its fuel into 34% energy and 66% waste heat. This inefficiency represents the wasting of the amount of heat equal to the total energy use of Japan, the world's second largest economy. As Hawken and Lovins note, "In contrast, Denmark, which gets two fifths of its electricity from co-generation plants that recover and use the heat well (and projects this fraction will increase by three-fifths by 2005), converts 61% of its power plant fuel into useful work. The American firm Trigen does even better: Its small, off the shelf turbines produce electricity, then reuse their waste heat to provide other services. Such a system now powers, heats and cools much of downtown Tulsa, Oklahoma. Such "trigeneration" can increase system efficiency by about 2.8 fold. It harnesses 90-91 percent of the fuel's energy

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[37] "NW Clean Energy Resource Team's Strategic Energy Plan." Regional Sustainable Development Partnerships. University of Minnesota. May 11, 2005.

[38] "New Energy for Campuses: Energy Saving Policies for Colleges and Universities." Produced By The Apollo Alliance and Energy Action. 2005. P5.

[39] "New Energy," P6.

[40] "New Energy," P7.

content, and hence provides very cheap electricity (half a cent or two cents per kilowatt hour). Fully adopting just this one innovation wherever feasible would reduce America's total carbon dioxide emissions by about 23 percent. [41]

Reducing Agricultural Energy Consumption

Agricultural energy consumption is a central part of the agricultural food system of the White Earth reservation. Agricultural efficiencies have improved significantly in industrial farming operations in the past three decades. There is, however room for more improvement, and as well as choices in alternative fuels and farming methods. As Barry Ryan and Douglas Tiffany note in Minnesota Agricultural Energy Use and the Incidence of a Carbon Tax, 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 of average.[42]

Conservation tillage methods are viewed to have the greatest room for improvement, wherein farming practices allow plant residue and stubble to remain on the field over winter, rather than plowing them into the soil. No till practices that leave the previous year's crop residue on the field can save the equivalent of 3.5 gallons of diesel fuel per acre over conventional tillage methods. Mulch till methods are another option which would result in savings of 2.5 gallons of diesel fuel per acre over conventional methods.[43]

The CERT's report notes, "Farmers are also well equipped to substitute renewable fuels and supplies into their energy mix. Some changes are switches that farmers could literally make today, such as using biofuel substitutes like E-85, and biodiesel instead of gasoline and diesel in farm vehicles, trucks and tractors. Other changes might require a little more time, but are also readily available options. Wind energy presents farmers with a means of offsetting their own electric use, or developing an additional cash crop on their lands. Biogas from anaerobic digestions is a way that dairy farmers can either offset their heating fuel needs, or if paired with a generator, offset some of their electric requirements. Biomass from perennials or agricultural residues is another feedstock for heating, electricity and ethanol. Solar technologies such as solar water heating could cut down heating needs in barns by supplying pre-heated water."[44]

Shooting Star Casino: Utilizing a Model of Energy Efficiency from the Mohegan Tribe of Connecticut

The Mohegan Sun Casino complex serves 50,000 customers daily, and employs a constant workforce of 10,000 employees, placing it as one of the largest casinos in Native America and the country. From the onset, the Mohegan tribe has incorporated efficiency and innovative technologies into the casino complex, and today, many tribal governments and other agencies view the project to seek guidance on their own facilities.

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[41] Tom Casten. Remarks to the White House Climate Conference, October 6, 1997, White Plains NY. In Natural Capitalism: Creating The Next Industrial Revolution. Paul Hawken, Amory Lovins, and L. Hunter Lovins. Little Brown and Company, 1999.
[42] Barry Ryan and Douglas Tiffany. "Minnesota Agricultural Energy Use and the Incidence of a Carbon Tax." Prepared for the Institute for Local Self-Reliance. April 1998, P40.
[43] Ryan and Tiffany, P41.
[44] Ryan and Tiffany, P41.

Like many native communities, the Mohegan tribe expresses a deep concern for the state of Mother Earth. "The Mohegan commitment to preserving the natural environment is essential to our values as a tribe. For that reason, we consider conservation and responsible energy management in the initiatives we undertake. It's not always the least expensive way; but it's the right way."[45]

The Mohegan tribe is living this philosophy: They have developed, and are currently benefiting from, a comprehensive policy created to reduce pollution and increase overall energy efficiency. Utilizing a holistic approach to reducing environmental impacts, a variety of strategies have been employed, spanning the areas of building energy, transportation and materials management.[46] Furthermore, the Mohegan Tribal Utility Authority was developed early in the process, and now meets the reservation's energy needs by selling electricity and natural gas.

Consider these conservation-related examples:

* Using left-over food for hog farm food
* Composting wastes for agricultural purposes
*Using waste oil as fuel
* Development of an employee carpool and rideshare program
* 100% recycling/reusing of all shop tires, fluids, and metals
* Purchasing hybrid vehicles for tribal use[47]

While these examples are evidence of easily implementable conservation and reusing tactics, Mohegan's overall energy plan is quite thorough. For example, energy conservation was a part of constructing their hotel: Unoccupied rooms are heated and cooled at a minimal level. Upon guests' registration, the temperature system automatically switches to a comfortable setting. Thus, no energy is uselessly wasted. In terms of transportation, carbon dioxide emissions are also considered: The Mohegan Security Department utilizes two hybrid vehicles, while public safety patrols on bicycles.[48]

In addition to promoting conservation, the tribe is also committed to exploring alternative energy possibilities. For example, in order to offset vehicle emissions, the tribe installed two PureCell 200 fuel cell power plants to provide clean and efficient energy to their hotel. Each plant provides 200 KW of continuous electricity and 925,000 BTU's of heat/hour, warming water and producing space heating in the facility. By using the exhaust heat, the plant achieves 80% fuel utilization-- much greater than the 33% in a typical central power plant. This increase in efficiency is equivalent to reducing the NOx emissions of 200 cars annually.

Through these examples, it is evident that conservation and alternative energy production create the base for this glowing environmental plan. To further promote these benefits, the program developed significant tribal awareness of potential benefits of conservation and

[45] "The Mohegan Way." Tribal newsletter, July 2003
http://www.mohegan.nsn.us/docs/MoheganWay/MoheganWay_Jul2003.pdf Retrieved Jan 31, 2006.
[46] U.S. Environmental Protection Agency. Clean Air Act Advisory Committee. "2004 Clean Air Excellence Awards Recipients." Retrieved Jan 31, 2006.
[47] "Mohegan Air Quality Program: Pollution Prevention and Offset Program." By Mohegan Environmental Protection Department. Uncasville, CT, April 19, 2005.
[48] "The Mohegan Way, " 2003.

innovative energy technologies.[49] For our purposes, these conservation methods can be immediately undertaken on the White Earth reservation.

Alternative Fuels and Local Efficiency:

In 2000 and 2003, the University of Minnesota added E-85 (a 15% gasoline and 85% ethanol blend) to its fueling stations at two of its campuses. Between 60-70 university vehicles can refuel at the outlets, earning the Fleet Services Director Bill Roberts the American Lung Association's Extra Mile Award.[50]

In early 2005, the University of Wisconsin started using a 20% biodiesel and 80% ultra low sulfur diesel mix in the diesel fleet. The blend is expected to reduce particulate emissions by 15%, CO2 emissions by 16% and cut hydrocarbon use by 13%.[51]

In the spring of 2005, Newsweek Magazine made a suggestion to President Bush. The magazine encouraged him to announce: "*… It is now possible to build cars that are powered by a combination of electricity and alcohol based fuels, with petroleum as only one element among many. My administration is going to put in place a series of policies that will insure that in four years, the average new American car will get 300 miles per gallon of petroleum….*"

The fact is: This policy is very possible. White Earth Anishinaabeg could get 300 miles per gallon of petroleum gas. With the use of ethanol 85 and hybrid vehicles, we now have the technology to do this. The math goes something like this: the current hybrid cars get around 50 miles per gallon of gas. Add an electric plug in and that amount is up to 75 miles a gallon. Finally, insert a flexible fuel tank and your car runs on a combination of 85% ethanol and 15% gasoline. That's how we get the mileage up to 300-500 miles per gallon of gas. .[52]

What is Ethanol? It's a high octane fuel produced by plant sugars. The corn we use for ethanol takes only the starch out, leaving most of the other food related elements available for livestock feed. In 2003, U.S. ethanol production reached 2.81 billion gallons.[53]

All gasoline in Minnesota is mixed with a 10% ethanol blend, for a total of 260 million gallons annually. With 14 plants and 5300 jobs, Minnesota leads the country in ethanol production, producing 389 million gallons annually and adding $1.3 million to the state economy in 2005. That's using some 14% of the 140 million bushels of corn produced in the state, and the market offers farmers a guaranteed price for corn, despite a drop in the price at other markets.

Ethanol is available at an 85 percent blend in Detroit Lakes (Cenex) and Bemidji (Jacks). Biodiesel is available in a 2% (B2) or 20% (B20 Blend). Minnesota is home to 14 ethanol plants or biodiesel production facilities. According to a study by BBI International an international biofuels outreach and consulting firm, Grand Forks has enough agricultural waste presently to create an ethanol plant. The rest of northwestern Minnesota has enough agricultural processing plants which could supply the majority of material is needed,

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[49] Dept of Energy. "Weatherization and Intergovernmental Program: Tribal Energy Program." http://www.eere.energy.gov/tribalenergy/title26/mohegan_summary.html Retrieved Jan 31, 2006.
[50] "New Energy for Campuses: Energy Saving Policies for Colleges and Universities." Produced By The Apollo Alliance and Energy Action. 2005, P10.
[51] "New Energy," P10.
[52] Winona LaDuke. "Patriotic and In My Suburban: Ethanol Futures." 2005.
[53] Dept of Energy. Energy Efficiency and Renewable Energy. 8/10/2005. Retrieved 1/25/06.

requiring only minimal additions of corn or wheat to bring the plant to an economical scale. As such, the potential for Minnesota and the White Earth reservation to increase our move towards ethanol is very significant.

An Erskine, MN proposal for Aggasiz Energy LLC would site a 50 million gallon plant in the Erskine area. The plant would use coal to fuel its production methods, which adds additional environmental problems, while still providing local fuel benefits. Ethanol is also better for the environment: Hydrocarbon and benzene emissions are down, as well as carbon dioxide. The US could easily meet international KYOTO accords by simply moving to ethanol. For the federal government to accelerate the move to a hybrid and ethanol fuels system for transportation would cost around $12 billion. In comparison, subsidies to the fossil fuel industry right now are at around $150 billion a year.

Biofuels

Biofuels include those listed previously- ethanol as an example, as well as other fuels which can be used for heating. According to the USDA, the Biomass R and D Technical Advisory Congressional Committee envisions a 30% replacement of the current US petroleum consumption by 2030.

At the outset, present estimated household heating fuels in the reservation area we believe that approximately 10% of all households use wood heat. This figure, if including secondary wood heat, is likely to be double. Wood heat represents a direct energy use- in other words, we don't turn it into electricity to turn it back to heat, and therefore is a very efficient use of a resource. Wood also represents something which is readily available, and local wood vendors and a local wood economy can be supported through this industry. We encourage the continued use of wood heat on the reservation, and with the addition of more energy efficient stove systems, we believe this can be a very important element of a self-reliant energy future for the area. As well, firewood as an export economy represents a good source of potential wealth in a micro-enterprise sector, particularly as the price of heating fuels fluctuates and increases. Potentially vendors with medium size trucks could operate a flourishing wood delivery business to the Twin Cities area, Fargo and elsewhere.

Biomass includes all plant and plant-derived materials including animal manure, as well as starch, sugar and oil crops already used for food and energy. All have great potential to provide renewable energy for America's future. According to the USDA, Biomass recently surpassed hydro power, and currently provides over 3% of the total energy consumption in the U.S. Biomass is particularly attractive as it is the only renewable energy source of liquid transportation fuel.

Biomass as a fuel for vehicles is discussed in the section under ethanol. The state of Minnesota has established a biodiesel mandate requiring a two percent biodiesel blend in diesel fuel by July of 2005. At the close of 2005, three biodiesel plants came on line in the state of Minnesota. The state mandate for B2 (Biodiesel 2%) requires at least 8 million gallons of instate capacity. Several community partners in Hallock, MN may be evaluating the potential for a local bio-diesel facility, using both animal fat and soybean oil feeds. The Minnesota Department of Commerce is running a B20 (20% biodiesel) school bus demonstration project in at least three school districts. The overall results illustrate that B20 can be used for at least nine months of the year, or on all but the coldest days. The entire city of Brooklyn Park's municipal fleet of 100 vehicles uses a B20 blend. This option is available to the tribal government as well. The potential for bio-diesel fuels also represents a possible alternative for the White Earth reservation area. Biomass is also a potential source for heating and electricity in our region.

For Example:

- The University of Iowa is shifting its energy sources from coal to biomass. The power facility which supplies 100% of the campus heat and 30% of campus electricity used coal. Now oat hulls have been added to the fuel mix. This saves between 25 and 30,000 tons of coal, saving the school $500,000 on energy costs and reducing pollutants significantly. This switch also allowed the University to sell its emissions offsets on the Chicago Climate Exchange, strengthening the system's financial value.[54]

- The White Earth Shooting Star Casino uses 10,215 gallons of cooking oil annually. The potential for re-using the cooking oil waste, as a bio-fuel for heating is substantial.

Biomass Resources in Northwest Minnesota

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

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

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

[54] "New Energy for Campuses: Energy Saving Policies for Colleges and Universities." Produced By The Apollo Alliance and Energy Action. 2005, P3.

The above chart demonstrates that there is a great deal of biomass available in Northwest Minnesota. However, to be able to make use of this information one must have an idea of how much biomass is needed to run that type of electrical plant. A power plant with a 90% capacity and a 25% efficiency rate will require approximately 6,671 dry tons per megawatt, annually. This means that a 25 MW plant needs around 166,775 dry tons of biomass a year.

Smaller scale industrial and electricity producing facilities are also under consideration in our region. The Red Lake Nation has been reviewing biomass potential for their community, and there is potential for an analysis of biomass potential for the Bagley-Clearwater County and Rice lake area. In general, Red Lake's report indicated that small scale bio mass for facilities was an excellent opportunity for the tribal government. A 5 mw biomass facility for the Red Lake nation was estimated to cost $12 million, with the equipment itself representing half of the costs, siting, interconnect agreements, and other necessities represent the remaining costs. The fuel for the 5 mw Stoker biomass facility would be wood harvest residues- representing 43,000 tons/annually, or 87% of Red Lake's estimated available residue. Facilities near the reservation, such as the Solway facilities, or other small mills may be able to provide fuel for a biomass facility of this size, or a smaller size facility .

Small biomass plants for individual businesses, villages or municipalities are one way of getting around these hurdles. Facilities of this size are common in western European countries, and increasingly are being installed in the US. A Vermont based company-Chiptec is a U.S. leader in equipment and technologies. Local businesses with a ready, biomass waste stream could simply transform that waste product into heating or electric resource that could be utilized in on-site operations – thus eliminating the transportation of materials and avoiding any transmission constraints.

Primary and secondary forest product producers seem to be the industry with the highest potential in the region.

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.

Current facilities

There is one agricultural processing plant in the region, Minnesota Dehydrated Vegetables (MDV), that installed a biogas digester in 2003. The City of Moorhead uses a digester at its wastewater treatment facility, but appear to use the recovered gas to simply heat the digester. The American Crystal Sugars in East Grand Fork and Moorhead also uses anaerobic digestion systems to treat their wastewater and collect the methane for heat (pulp drying).[55] No other sites in the region are using biogas to generate electricity.

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

Regional Opportunities for Biogas Production

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

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

A similar option is something known as "The Living Machine,[56]" a simple concept and easily installable option for an individual to construct for the use of non-potable water. "The Living Machine" system consists of several storage tanks linked in series, each containing a different natural catalyst, such as various plants or bacteria specially chosen for their ability to break down organic matter. As the water passes through the tanks, human waste comes into direct contact with any number of different catalysts already in the tanks. The end result is non-potable water, usable for irrigation or waste removal. These systems are available in varying sizes and applications, and are available for use by large scale industry as well as single person homes.

Plasma Torch- Garbage-Energy

Grand Portage recently gave serious consideration to the Plasma Torch (Torch) as a solution to their Municipal Solid Waste disposal costs, a back up to the wind power, and a source of new business and job creation. Several meetings were held with Phoenix Solutions (developers of the Torch), the Reservation, and the CSCD. At these meetings social, environmental, and economic issues were discussed, relating to the implementation of the Torch on the reservation. Grand Portage community produces about 10 tons per day (tpd) of MSW. They pay $40.00 per ton for disposal.

According to conversations with Phoenix Solutions, Grand Portage would require a 200-300 kW stackable Torch, which is a 1 MW system that would cost about five million dollars. This torch would require 24 tons per day. Torch demand could be met by both Grand Portage's MSW and a paper company in Thunder Bay that produces excess waste bark. The expected lifetime of the Torch is twenty years, but consumable parts must be replaced annually. The Plasma Torch also generates a non-leachable aggregate material that can be used for retail sale of high-end marble like slag, which would create jobs and revenue for the

[56] This device was created by John Todd, the founder of Living Technologies. He already has sixteen units nationally, and eight more operating in other countries worldwide.

reservation. However, Grand Portage could also use this aggregate material as a substitute for gravel that is currently hauled onto the reservation during the winter season at considerable expense.

Due to the large prohibitive size of the system, subsequent large upfront costs and the fact that it required such a large input of electricity it results in to little of a net gain when on considers what resources are being affected by incineration of such volatile substances. the Grand Portage tribal council has decided against implementing the Torch at this time. Likewise, we do not recommend adding a Plasma Torch system to White Earth's overall energy plan, primarily because bringing in more garbage to the geographic area seems counterproductive. However, this system may provide potential to other reservations in the area, and thus should be given ample consideration in other contexts.

Solar Energy:

Solar energy also has some potential on the White Earth reservation. Indeed, Minneapolis has a solar resource which is equivalent to both Houston, TX and Miami, Florida, since temperature is not related to solar exposure or amount of sunny days. In order to capture this potential, designing housing with an eye to passive solar potential is necessary, and has immense opportunity for the White Earth reservation. It's estimated that solar design can provide over a third of Minnesota homes' heating requirements with very little additional costs. Because no additional materials are required, creating a home with solar potential typically just requires some design changes. New housing by the White Earth Housing Authority and other agencies should consider solar energy in coordination with new house planning and siting, as this relatively inexpensive heating option is viable only in houses with south facing walls with limited obstruction from trees or other barriers to sunlight.

As a side note, it is interesting to note that most present solar photovoltaic panels are constructed of silicon, or polysilicon. The present shortfall of silicon for commercial solar panels has resulted in some market challenges for many major producers of the panels. Natural sources of silicon exist widely in northern Minnesota.

A typical solar installation consists of two 4x10 panels grafted to the side of a house. When the sun is shining, these systems are capable of generating 8500 BTU's per hour, resulting in a noticeable decrease in both furnace operation and fuel consumption. Every square foot of installed panel will save 1 ¼ gallons of propane from being burned in a three month period, and as a typical system consists of one hundred square feet of installed panel, this could reflect a considerable savings.

In conjunction with the Rural Renewable Energy Alliance, the White Earth Land Recovery Program was able to install solar heating panels on the sides of several houses on the White Earth reservation. These heating panels use a simple set of technologies to provide heat, which is blown into the house through a blower motor. Reports from the efficiency and cost savings for solar heating panels suggest a savings of 15-20%, depending on the lifestyle of the residents.[57]

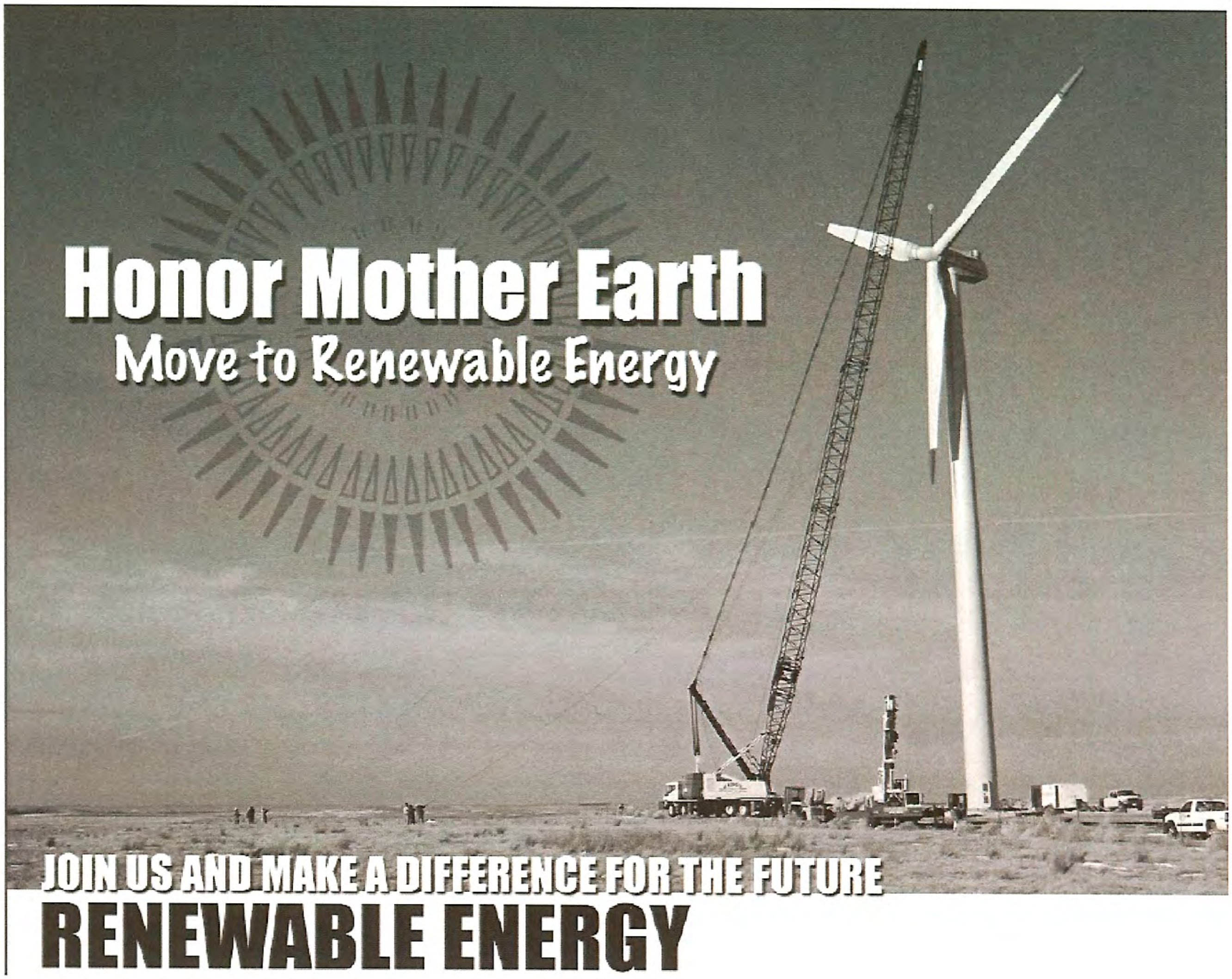
[57] These figures were the result of baseline energy assessments done by John Shimek on the completed solar installations on White Earth homes.

Although the upfront cost of $450 per installed panel may seem insurmountable to the typical low-income household on the White Earth reservation, programs similar to the one White Earth Land Recovery hopes to implement can utilize federal and state weatherization and fuel assistance funds to recover the upfront costs of installations. Minnesota also has a photovoltaics (solar) incentive program that is second to none in the nation. Because of this program, it is relatively easy for tribal households to acquire their own system at little cost, depending, of course, on the size of their system. Although this type of renewable energy system has traditionally been the most expensive per watt, MN has a solar rebate program that will reimburse the owner up to 40% of the cost as well as a sales tax exemption for renewable energy devices. When combined with a $1500 federal rebate and the sale of green tags, the majority of the cost of a system is covered. Aside from governmental support, many state utilities have also developed solar programs, providing another potential source of revenue.

As energy costs continue to rise, the implementation of solar panels is an investment worth making, as they are simple, reliable, easily maintained, and will continue to create household heat whether or not fuel assistance funds are jeopardized. As such, this is a conservation method that can be easily implemented in low-income tribal households.[58]

[58] All solar panel information provided by John Shimek of the White Earth Land Recovery Project.

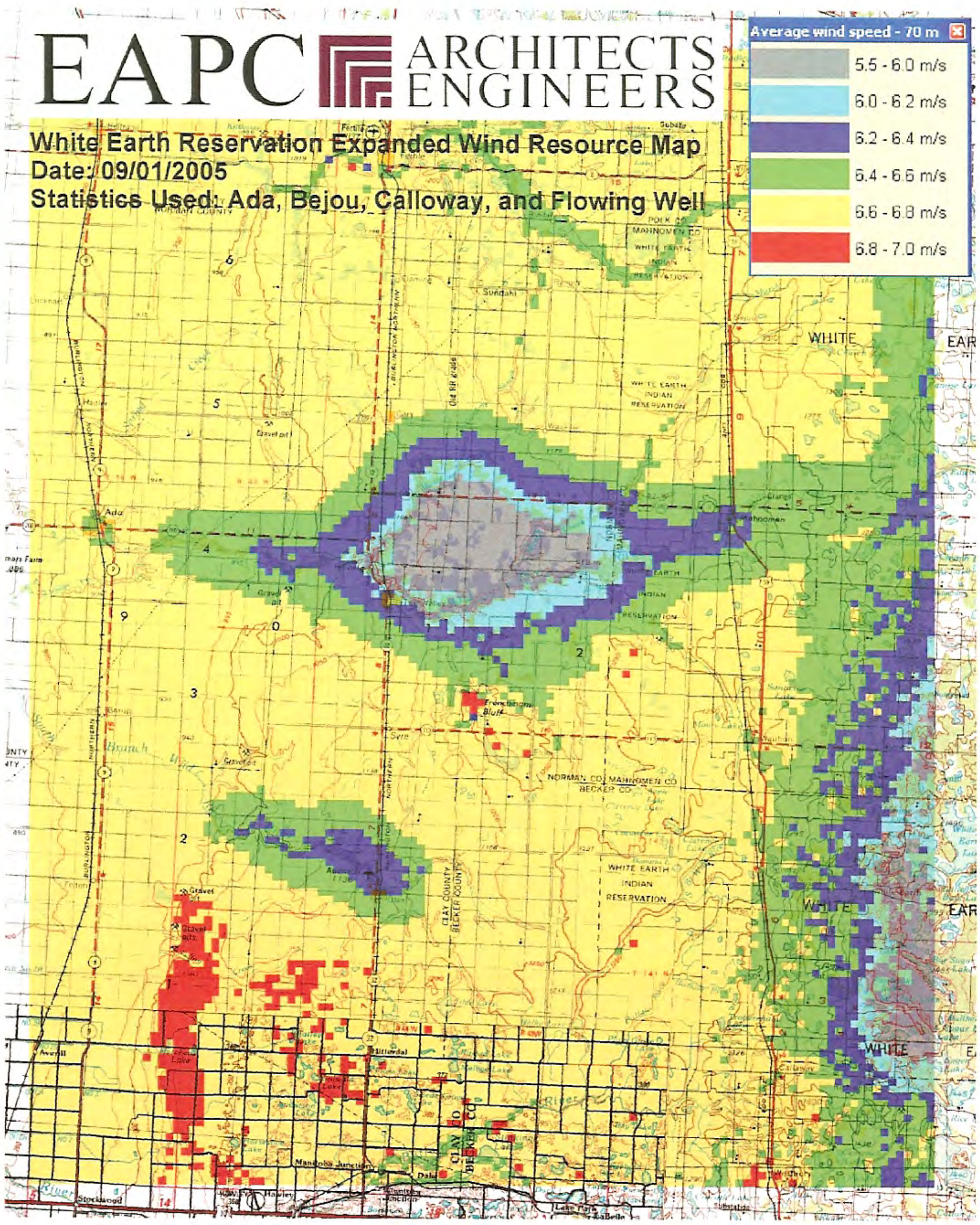
Wind Energy



The technology exists and the price is right to develop community-based wind resources. According to a Chicago firm largely funded by energy companies, renewable sources account for only about 3% of world electricity supply, but they are poised for "explosive growth" to a projected $35 billion a year globally in 2013, up from $17 billion now. The price of wind and other alternatives has dropped considerably in the past few years: from about 38 cents per kilowatt hour in the early 1980s to 3.5 cents now. Compare that to natural gas costs at about 5.5 cents per kilowatt hour, a jump of about 1.5 cents since last year. Even more concerning, these costs are only projected to increase as fossil fuel supplies diminish and general global political instability continues.

Renewable energy is labor intensive, and every reservation and rural area needs jobs. For example, LM Glasfiber, a Danish company opened a wind turbine blade factory in Grand Forks, creating 130 new high paying jobs. In one plant, that's the equivalent to 20% of all North Dakota coal industry jobs, not to mention that it is far cleaner since burning North Dakota lignite coal is like burning dirt. In comparison, Big Stone will average 624 jobs during its construction phase, and a stable 40 jobs during its ongoing operations. According to Lester Brown, author of *Eco-Economy*, "Income from wind generated electricity tends to remain in the community, bolstering local economies by providing local income, jobs and tax revenue."

<u>White Earth Area Wind Resource Map</u>



Benefits: A 60 MW Wind Project in Arizona[59]

Investment in renewable energy can be profitable. Several tribes in Arizona are already pursuing projects. If attention is paid to the extraordinary detail in development of a project the returns over the life of a project can be substantial. Similar returns to those listed below are possible and Minnesota tribes have the potential to make considerable investments in renewable energy and sustainable development.

	Annual		20 yr Project Life	
Lease Royalties (average)	$	175,000	$	7,780,000
Property Taxes (average)	$	160,000	$	2,090,000
Construction Jobs (assumes 50% of total to tribe)	$	4,550,000	$	4,550,000
Long-term Opperations Jobs	$	400,000	$	8,000,000
Ownership Returns (assumes 10% ownership)	$	1,440,000	$	28,800,000
Total (includes construction year)	$	6,725,000	$	51,220,000

Minnesota Energy Policy

Due to good wind resources, a largely rural agrarian population, motivated local wind developers, active and well-organized advocacy groups, and a combination of favorable state policies specifically targeting "small" (2 MV or less) wind projects, Minnesota is both the birthplace and current hotbed of community wind power in the United States. The 2005 passage of the CBED legislation in Minnesota will require the creation of 800 megawatts of Minnesota wind power by 2010, placing a tribal government or tribal entity in an excellent position to secure financing, purchase agreements and bring on line the system.

Community-Based Energy Development (C-BED)

Nationally, interest in community wind is growing. As in all renewable wind energy projects, electricity and revenue are both generated without further polluting our environment. Community-based energy was developed because, without such an initiative, the majority of renewable energy projects are owned by remote companies whose primary objective is to extract a resource. Local ownership of such projects keeps the financial benefits of ownership, construction, and operating costs in the community. According to a study by the U.S. Department of Energy, "Wind power brings higher direct economic benefits to local economies than any other form of new electricity, including from coal and natural gas."[60] Aside from these important economic benefits, in producing clean energy, community based wind projects also reduce pollution, pollution-related illnesses, and emissions of greenhouse. As such, these are real, local solutions to the growing problem of climate change.

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[59] Foresight Wind. Warren Byrne, President "Understanding the Opportunity: Big Wind: Moving and Marketing Tribal Power." DCI America: Native Renewable Energy Summit, Nov 15-17, 2006. Denver, Colorado.

[60] "Community Based Energy Development: C-BED Overview." Sponsored by Windustry. http://www.c-bed.org. Retrieved Jan 27, 2006.

In 2005, the Minnesota legislature passed a progressive energy bill, which included important mechanisms to support community-based wind projects. Known as C-BED, this system will aid in the success of community-based wind without putting an excessive burden on utility companies. [61]

According to the legislation, Minnesota residents, nonprofits, LLCs, non-electric co-ops, local governments and school systems, and tribal councils qualify as potential owners. Except in small projects consisting of only one or two turbines, no single owner may control more than 15% of the project. The project must also be granted permission by the county board where it will be installed.[62]

Furthermore, public utilities are required to set out a C-BED tariff. The tariff is a new concept that creates a standardized framework for community wind projects to negotiate with utilities. Right now the C-BED law applies only to wind energy, but it could be expanded in the future to other forms of renewable energy. While the law requires that utilities negotiate with qualified C-BED projects, it does not explicitly require them to actually sign a contract. Nonetheless, the legislature has made clear that it does expect utilities to cooperate, signing C-BED contracts. To this end, the C-BED Tariff opens the door to community wind projects and enables them to negotiate.[63]

Minnesota Wind Power

More than 100 MG of small community wind projects are currently selling power to utilities in Minnesota, with hundreds of additional megawatts planned. This development has been primarily driven by a combination of purchase mandates, feed-in tariffs, production incentives, and capital grants:

- Purchase Mandates and Feed-In Tariffs: In exchange for the ability to store nuclear waste at its Prairie Island nuclear plant, Xcel Energy—the states largest utility—must support the development of 1,125 MV of wind power: 425 MW by 2002 (met); 400 MW by 2006 (60 MW of which must be from two or more aggregations of projects that are 2 MW or less); and finally 300 MW by 2010 (100 MW of which must be from projects of 2 MW or less). Furthermore, Xcel is required to meet Minnesota's Renewable Energy Objective: By 2015 10% of retail sales will be derived from renewable energy, with progress to this goal marked by a required 1% gain each year from 2005 to 2015. The final 300 MW of Xcel's wind energy mandate may be applied towards the Objective. Other Minnesotan utilities must make a "good faith effort" to comply with the Objective.

Under the direction of the Minnesota Public Utilities Commission, Xcel offers a standard "wind generation purchase agreement" and also a "small distributed wind generation purchase tariff," through which it will buy power from small wind projects at a fixed nominal price of 3.3 cents/KWH for up to twenty years, thus fulfilling its mandated purchase of wind generation from small wind projects. When combined with Xcel's purchase mandate and state production incentives (discussed below), these agreements and purchase tariffs assist in minimizing transaction costs, providing a more stable market so that small projects may succeed.

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[61] "Minnesota's Community Based Energy Development." Great Plains Windustry Project, Partnered with the Institute for Agriculture and Trade Policy. July 11, 2005. Retrieved Jan 27, 2006.

[62] "Minnesota's…," Jan 27, 2006.

[63] "Community Based Energy Development Tariff" C-BED Factsheet. The Minnesota Project in conjunction with CERTS. Retrieved 1/27/2006.

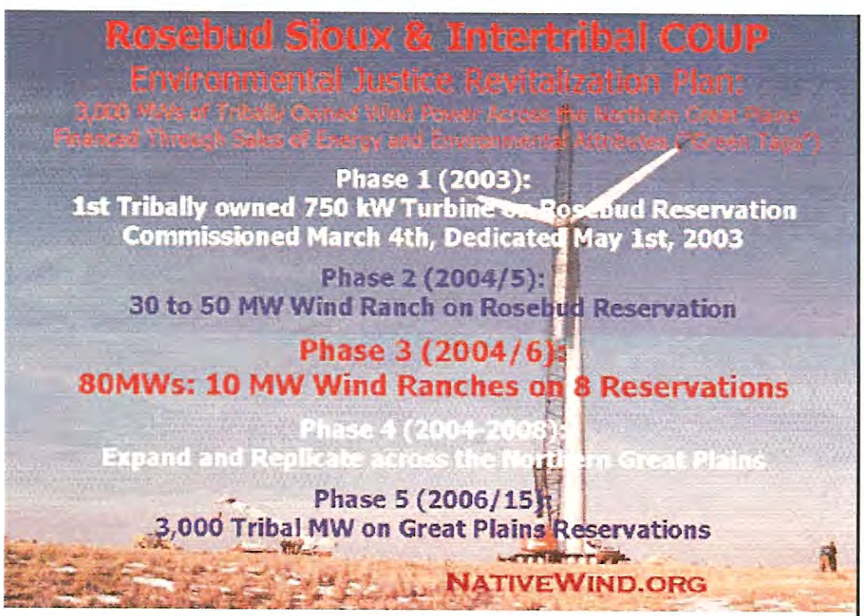
• Production Incentives: The combined impact of of Xcel's wind mandate, small wind tariff, and standard purchase agreement has been accelerated by a state cash production incentive of 1.5 cents/KWH paid to small wind projects during the first ten years of turbine operation. Originally enacted in 1997, this incentive was originally limited to the first 100 MW of small wind capacity. In 2003 the legislature expanded the provisions of the original incentive, covering an additional 100 MW of small wind capacity. Although it took more than five years to reach the initial 100 MW limit, the second 100 MW was fully subscribed in six months, and thus this incentive is currently unavailable. [64]

Selected Local and Tribal examples:

- St. Olaf College in Minnesota is putting up a 1.6 megawatt wind turbine to power the campus. The total cost of the turbine is $1.9 million, but $1.5 million was received from a grant from XCEL Energy's renewable fund.[65]

- The Rosebud Sioux tribe became the first Native nation to erect a commercial wind turbine. The 750 KW NEG Micon turbine went up in 2003, and today powers the tribal casino and sells power back into the electric grid.

- The Kumeyaay Project in southern California is a 50 megawatt project on lands held by the Campos and Viejas bands of Kumeyaay people. Undertaken with a developer, Superior Energy LLC, the tribe receives revenues from the lease of the land, and the developer receives the revenues from sale of the energy. The project uses 25 2 megawatt Gamesa wind turbines.



Tribal Wind Power for Sustainable Homeland Economic Development

[64] All of the information under the section titled "Minnesota" was provided in a report by Ryan Wiser, Mark Bolinger, Dan Juhl, and Robert Grace. Report created under the direction of Peter West, Energy Trust of Oregon. Section titled "Community Wind in the United States," July 2004.
[65] "New Energy for Campuses: Energy Saving Policies for Colleges and Universities." Produced By The Apollo Alliance and Energy Action. 2005, P3.

White Earth Tribal Wind

External factors—legislation, state policy, pricing, debt financing, technology, local wind speed, and available sites—are favorable and suggest that wind power can have a possibly large role in the economic future of White Earth. Two key internal factors—lack of experience in doing wind projects, and having enough money to do projects—are the two key requirements that need to be addressed. This report describes the benefits and requirements for wind power development and the steps to be taken.

Wind Development Process Overview[66]

	Typical Timing				Responsibility	Costs
Development Task	Year 1	Year 2	Year 3	Ongoing		
Site Screening & Selection					Developer	Typical Cost $1 to $3 Million contingent on size, complexity, timing
Fatal Flaw Analysis						
Land Rights Agreements						
Wind Resource Assessment						
Economic & Technical Design						
Interconnection Studies						
Permitting & Liscensing						
Power Sales Agreements						
Financing						
Equipment Selection						
Engineer, Procure, Construct					EPC	~ $1.5 million per MW
Operations & Maintenance					Owner	$20K-$30K/yr/turbine

[66] Foresight Wind. Warren Byrne, President. "Understanding the Opportunity: Big Wind: Moving and Marketing Tribal Power." DCI America: Native Renewable Energy Summit, Nov 15-17, 2006. Denver, Colorado.

Types of Wind Projects

This report identifies four types of wind projects and recommends that White Earth consider doing all four:

1. Single turbine project (using Federal $1 million appropriation) which will power tribal facilities. This could either power the casino complex or power the White Earth village complex . Wind and site assessments were completed by EAPC for both facilities. In the case of this single turbine, options include a 660, 750, 1 1.25 or 2 megawatt turbine, offered by different manufacturers. Up front costs for installation including fixed costs of turbine erectio professional fees (negotiations of agreements, siting, permitting, engineering, etc) will be constant for any size of turbine- or an estimated $329,000 based on EAPC estimates. This means that given one grant of money, the tribe should consider what level of outside debt it would like to incur for the project. A 1.25 megawatt turbine installed would run at around $1.4 million. A second element of this analysis will include assessment of interconnect agreements and power purchase agreements with local utilities. This discussion is essential in all parts of the next set of development. Keeping the turbine's production for local use (using all of the load) may represent a good option for the tribe, but needs further investigation.

2. Large, commercial wind farms: These projects sell all the wind power to a utility. There are several good reasons for doing a project using 2 megawatt turbines with the project at 10 megawatts to 30 megawatts. Even though a 30 MW project can cost $36 million, it is considered a better investment. The bigger turbines are more efficient and a bigger wind farm is less expensive to maintain; the 30 MW size allows the owner to afford internal staff to handle operations and maintenance, instead of outsourcing those services. The C-BED net present value formulas and related budgets are viewable in the Appendix; different versions of these budgets change the price of electricity and the levels of debt. After ten years when the debt is paid off, several of these budgets show a cash flow of $2 million per year. Two drawbacks of a 30 MW farm are: 1.) The permit process is longer (maybe 23 months) 2.) the utility that purchases the wind power may not have sufficient transmission capacity to carry away that quantity of power.

3. Net Metering Projects: White Earth can have one or several net metering projects. These projects use 39 kilowatt turbines which can cost about $55,000 each. When White Earth is designing future facilities it can be done to accommodate several net metering wind generators. If they are in a good wind area, existing buildings can be adjusted to use the electricity generated. (More on net metering below.)

4. Small Wind Power and Micro-grid Systems: This is the smallest scale application of wind technology—1 kilowatt turbines, and larger. A small system consisting of a 1 kw turbine, batteries, and inverter can cost four or five thousand dollars. It can be coupled with solar panels and can be a primary source of electricity for a home or small office. A micro-grid system can be available as a package from reliable vendors such as Bergey Power. The payback for these small systems can be 15 or 20 years.

Small-Scale Net Metering

The *net metering* program in Minnesota guarantees that anyone can put up a wind generator with less than 40 kilowatts capacity, and the local utility must purchase the electricity from you at the average price that the utility charges you. If it is possible to get a grant for the price of the system, the electricity can be generated for 1.4 cents per kilowatt hour. If you choose to use that electricity, the 1.4 cents is your expense. If the utility charges you (at the meter where you have a turbine) 6 cents per kwh, then you will have an advantage of 4.6 cents per kwh—thus, it can be a source of revenue. If you finance the turbine with a loan then the margin is much smaller. As an example, the German *Aeroman* brand, a 39 kilowatt turbine, is remanufactured and available in Minnesota from Dan Juhl.

Larger-Scale Commercial Wind

The *commercial wind* numbers are very promising. In many places the wind speed map for White Earth shows wind speed at 6 meters per second (about 13 miles per hour at a height of 70 meters) and certain locations have 7 meters per second (15.7 miles per hour). The C-BED pricing can make this 7 mps wind commercially feasible. The newest turbines have the capacity to generate 2 megawatts; they are huge but they are more efficient than the smaller 1.65 or 1.5 MW machines. If the project is large enough, say 30 megawatts total, then the turbine manufacturer will be able to provide local technical back-up and the owner can afford in-house rather than less-responsive outsourced on-call maintenance. The capacity to do quick response will reduce turbine down time and generate more revenue. One large turbine vendor, Suzlon, is building a manufacturing and service facility in Pipestone, MN where it already has a field office. Other turbine manufacturers include NEG Micon, Gamesa, Lagerway, Clipper and others. Depending on the size of turbine, interconnect and power purchase agreements, financing, availability of capital to put up a down payment, and the wind regime, the turbines all have various benefits .

Cost of a Commercial Wind Project, and the Equity Required

A 30 MW project could cost $36 million, and require $3.6 million to $7 million in equity, and can generate a lot of profit: After the debt is paid off, the cash generated can be $2-$3 million each year. It may take 24 months to complete a project of this size. Of course, a smaller project can be done more quickly but its operating expenses would, unfortunately, be less favorable.

Getting Equity

The needed equity could come from a variety of sources including bonds, venture capital, program related investments, and relationships with local lenders like the Midwest Minnesota Community Development Corporation of Detroit Lakes and the federal New Market Tax Credit Program. Grants are another potential source, specifically from the Department of Energy or other private foundations. Grant income is available for the first wind project on White Earth through the DOE grant which has been awarded for $1 million. Larger projects will require additional financing, and grants may not be forthcoming.

Debt Financing

Debt financing could be obtained from the Rural Utility Service which has 5% interest rates, or from the "Energy Bond," this year's new program from the federal energy legislation.

Only public sector entities, such as reservations, can acquire Energy Bonds. With this program, the bondholders do not get interest payments from the borrower; in lieu of interest they get an equivalent amount of tax credits from the U.S. Treasury. Avoiding interest expense is a terrific advantage for the borrower, and represents the best financing around. Energy Bonds are available until the end of 2007, and have an allocation or limit of $900 million.

C-BED Pricing

One unusual feature of the C-BED model is that the price of electricity paid by the utility can be less in the second ten years than the first ten years. Another feature is that a C-BED project does not need federal energy tax credits to be financially feasible.

Which Utility to Buy Your Wind Power

Depending what utility buys your electricity can mean a big difference in negotiating advantages. In the next few years both Xcel and Otter Tail Power Company have licensing challenges: Xcel is in the process of re-licensing its nuclear power plant at Monticello and Otter Tail Power Company wants to do a new Big Stone II coal fired plant just inside the South Dakota border. Both these investor-owner utilities could be very motivated to do a locally-owned C-BED wind farm, particularly an American Indian-owned wind farm. Just so that the cooperative and municipal utilities understand the political significance of C-BED, in November the Governor of Minnesota told all Minnesota utilities that they must do a total of 800 megawatts of C-BED deals by the year 2010. A 36 MW project by White Earth entities would be less than 5% of the governor's target.

How Soon?

Can a large-scale wind farm be built in 2006? No. Even with site control, soil testing done, and financing tentatively lined up, any project with large turbines will have a long permitting sequence. Doing one in 2007 will even be tight. If you have the money available, the smaller-scale projects—net metering turbines and micro-grid turbines—can easily be installed in 2006.

Turbine Availability

Turbines are very hard to get in the US at this time due to the Production Tax Credit, market expansion, and a lack of infrastructure to meet the increased demand for turbines both in the U.S. and internationally. There are some opportunities to secure turbines at new production facilities in the U.S. and Canada, including perhaps a Suzlon turbine, which would coincide with a large community-based wind project in the preliminary stages of development near East Grand Forks, or a Lagerway Turbine from Canada, the most prominent German turbine, and new to be released on the U.S. markets.

Owning the land

Leasing has been a common way for developers to control a wind farm site. However, lease expense numbers have often been 2% of total generated revenues. To test the implication of leasing, one can multiply annual lease expenses by 20 years: The total reaches a million dollars! Even in projecting land costs at $2,500 per acre, it is much more practical and less complicated to buy the land. Frankly, buy the land whenever you can.

Legal form of project ownership

An off-reservation site may require that White Earth have a separate entity, such as a Limited Liability Corporation or a chapter 17 corporation, to serve as the legal entity for a wind farm. To access greater financial capacity a project could be done, for example, as a co-venture with MMCDC and White Earth Land Recovery Project.

Furthermore, in order to qualify for C-BED access and financing, no single owner may control more than 15% of the project, except in small projects consisting of only one or two turbines. According to the C-BED legislation, Minnesota residents, nonprofits, LLCs, non-electric co-ops, local governments and school systems, and tribal councils qualify as potential owners.[67]

What is the next step for White Earth to do a major wind farm?

1. Find out if you have a shot at getting the overall equity from public programs (including from MMCDC) or from private foundations.
2. If possible, find a source of the needed front-end money to control the site with an option or a purchase agreement (with terms contingent on financing), and for additional site-specific wind studies. $40,000 to $100,000 may be needed to begin one to two sites. Find out from the prospective lenders their requirements for specific site wind analysis. Ideally, option the sites before doing the site-specific wind analysis. The option (or subject-to purchase agreement) may cost a thousand or a couple of thousand dollars.
3. After spending money on the option and wind research you will be spending larger amounts of money for engineering, permitting, and equipment deposits. These costs could total a million dollars.

Commercial Wind Farm Sites

White Earth reservation has two promising on-reservation sites and, maybe, 20 off-reservation prospective sites. Otter Tail Power Company and MinnKota Power Cooperative (the generating utility for Wild Rice Electric) are the on-reservation utilities that would be buying your wind power. Xcel is available on the Minnesota Highway 59 corridor to the City of Ada, and along the geologic Aggasiz Beach areas, where there is a rare, 15 mile-long area of high wind. One 3-turbine wind farm is already at Aggasiz Beach, selling its power to Xcel Energy.

Net Metering Wind Development

The 39 kilowatt net metering projects, as an exampl,e cost about $55 thousand each. They are simple to put up and easy to maintain. If grant funding is available several of these can be put together in 2006.

What Should Be in a Mandate

If White Earth wants to begin wind farm development then this effort should be set up as a formal project, includiing a formal charter, mandate, project schedule, budget, staffing, and reporting.

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[67] "Minnesota's…," Jan 27, 2006.

Transmission Constraints and Opportunities

Access to transmission lines poses an additional challenge to bring any project on line. The line acces will have to be negotiated with the owner of the lines, whether Otter Tail Power Company, or XCEL The larger issues of capacity for loads on power lines in the region are addressed in a number of reports, and discussions. One report suggests a large investment into power lines is required to expand power production in the region. A second opinion offers more diverse source of power production which would not require the same investments. In short, these CAPX2020 study assumptions produce results that show a need for 1620 miles of new high voltage 345 kV power lines by 2020, with a total cost that could be well in excess of $3 Billion dollars.[68] Large-scale power plants would be located as remote from load as in the coal fields in North Dakota and far northern Canada.

However, these CAPX study assumptions are not the only assumptions that could or should be used to anticipate what the future electrical grid infrastructure will need to look like in the year 2020. There are several factors at work that drive the need to consider other visions of the Minnesota energy future. These are:

- The recent and ongoing innovation of efficient new small scale generating technologies.
- The need to utilize additional renewable energy and conservation as a strategy to minimize environmental impacts and climate changes.
- The need to optimize local economic development by using local energy resources instead of imported resources.
- The need to enhance the reliability of energy supplies in the face of potential disruptions from natural disasters and possible terrorist attacks.

The question is whether the "business as usual" scenario postulated by CAPX 2020, of continued load growth and large generating plants remotely located from load, is an appropriate way to address these societal factors, or whether a more optimal solution to our future energy needs is an approach that depends increasingly on modern smaller scale community owned generating technologies that are distributed and dispersed throughout Minnesota, coupled with increased use of efficiency.

These two radically different scenarios result in different sets of new high voltage wires and generators that will be needed to serve Minnesota's future energy needs.

Where are we today?

The North American Electric Reliability Council (NERC) provides annual assessments of the reliability of our bulk power supply system. Their most recent report outlines concerns about our region in the future availability of generation and transmission resources.

NERC projects that because of load growth, the amount of surplus generating capacity in our region is declining, from 18% in 2005 to just 6.7% in 2014. These figures include

[68] The CAPX Technical Update, as part of the North American Water Office, (May 2005) indicates a cost figure of $1.2 Billion dollars, but that figure does not include costs for lower voltage fixes necessary to support the high voltage facilities.

consideration of 2,122 MW of new planned generation for the period.[69] NERC indicates that the transmission system has constraints that prevent us from importing electricity during peak demand periods. A maximum of 1800 MW, or 5% of peak demand in 2004, can be imported into our area during the peak demand period.[70]

Clearly electrical system infrastructure enhancements or significant conservation will be necessary in the 10-20 year horizon.

The DOE in their own vision study observes that use of Demand Side Management strategies can greatly improve the efficiency of the grid.

> "The national average load factor (the degree to which physical facilities are being utilized) is about 55%. This means that electric system assets, on average, are used about half the time. As a result, steps taken by customers to reduce their consumption of electricity during peak periods can measurably improve overall electric system efficiency and economics."[71]

This statement indicates that there are plenty of opportunities to improve the efficiency of utilization of the existing infrastructure if we can somehow shave the peaks off of system power demand. It makes sense to utilize the existing infrastructure to its maximum before we consider investing in more facilities that will also be used 55% of the time. Conservation and distributed Community Based Energy Development projects are two principle ways to increase power system utilization.

Utilizing existing system assets to their full potential to support CBED projects also maximizes opportunities for economic development without the need to invest in more transmission resources. We know where the new load growth is going to occur. Population projections give us a good marker for where new CBED projects could be installed. As the local grid demand grows, more local generation resources can be added to the local system as well. This approach allows more generation resource additions during the seven years or so it takes to build the next major set of high voltage transmission lines.[72]

Tribal Energy Production Systems Nationally

_The United States is the largest energy market in the world. Much of the United States "domestic" energy resources originate in Native America. As a consequence, Native America suffers from disproportionate extraction of non-renewable resources on tribal lands and the resulting disastrous toxic and environmental effects. Economic hardship lead many tribal treasuries into a commitment of being fed by energy resource royalties, and the aggressive push for funding under federal energy bills insures more access, and faster access.

For decades, uranium mining has laid to waste vast areas of land and aquifers in the Northwest and Southwest. There are over 1,100 abandoned uranium mines on the Navajo

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[69] See NERC report "2005 Long-Term Reliability Assessment", September 2005, p. 57.

[70] NERC report, p. 58.

[71] See "GRID 2030", p.7.

[72] North American Water Office, Power System Constraints and Opportunities, Autumn-Winter 2005-6, Lake Elmo, MN

Reservation, increasing the contamination of an arid region. Tribal lands are also targets for coal development, hosting four of the ten largest coal strip mines in the United States. Proposed huge coal methane developments would contaminate the groundwater of enormous regions including the Northern Cheyenne Reservation in Montana. Over the years, tribes have been inundated by major dam projects ranging from the Columbia River in the Northwest to the Great Plains and on into James Bay in the North. Native villages and tribes are also deeply affected by oil development proposals for the Arctic National Wildlife Refuge (Gwich'in) and massive nuclear waste dump proposals at Yucca Mountain (Western Shoshone) in Nevada. In short, tribes have had extensive experience with national energy policy.

The Potential: Tribal Energy

"We believe the wind is wakan, or sacred, and bringing the power of the wind to our communities and our future is key to our survival and a part of honoring our instructions..."

Pat Spears, President Intertribal Council On Utility Policy.

The first Native American-owned and -operated large-scale turbine in the country went on line in February 2003. The Rosebud Sioux Tribe's 750-kilowatt wind turbine is the first commercial turbine, with 30 megawatt projects planned for the Northern Cheyenne reservation (Montana), Makah reservation (Washington), and Rosebud in South Dakota. As well, the Assiniboine and Sioux tribes of Fort Peck hope to bring a 660-kilowatt turbine on line. That turbine alone will reduce the tribal electric bill by $134,000 annually, and help establish a senior citizen's kitchen to feed elders daily and finance other programs through savings. Recently funded projects on the White Earth, Red Lake, Leech Lake, Fond Du Lac and Grand Portage reservations will bring more power to lands in Minnesota. Broad work in both technical assistance and creative financing mechanisms by Honor the Earth, in coordination with Intertribal Council On Utility Policy has the promise, if supported, of bringing more wind power to the reservations, and to the Western Area Power Administration (WAPA) grid system.

Electricity generation capacity in the United States is about 600 gigawatts. Native reservations in the Great Plains possess the wind energy potential for over one-half of that amount. Placement of even a fraction of this energy source on reservations into the United States electricity grid would make a significant impact on the standard of living for Native Americans, adding to a tribally-owned and managed economic flow to benefit some of the most impoverished communities in the country. These tribal communities also represent, in the words of Robert Gough from the Intertribal Council On Utility Policy, the " head winds" for the regional "windshed;" in other words, the prevailing winds from the region largely move to the east into the area of greatest United States energy usage. Tribal wind advocates hope to bring at least 3000 megawatts of wind power to the market in the next ten years.

Indian country has unemployment rates which are 50% or more, but could benefit both from small scale assembly work, and from the potential for renewable energy's job creation in rural areas). Investing in alternative energy, is investing in jobs, since the fuel supply is from the Creator. The European Union estimates 2.77 jobs in wind for every megawatt produced, 7.24 jobs/megawatt in solar, and 5.67 jobs/megawatt in Geothermal. Or, in short 1000 megawatts of alternative energy power averages 6000 jobs, or 60 times more high paying jobs than in fossil fuels and nuclear power. Nationally tribal governments are working to implement a transitional energy policy, ranging from the 23 tribes which are members of the Intertribal Council on Utility Policy, to the Navajo and Hopi nations, who today are working on a Just Transition Strategy aimed at securing tribal ownership and benefits from a transition from a coal –based economy to a renewable economy.

In particular, the closure at the end of 2005, of the Mohave Generating Station in Laughlin Nevada, by Southern California Edison marked a decline in coal revenues to the Navajo and Hopi, the lay off of 250 miners, and other challenges. At the same time, the power plant had been closed due to California's requirements for clean power, renewables and to meet Kyoto requirements. The carbon emissions from the coal fired power plant did not meet those standards. Today, tribal members and organizations are working, as well as the tribe to secure a replacement of the 1000 megawatt plant production with renewable solar (Solar I, Sterling plant) and several Navajo and Hopi renewable energy facilities.[73]

The White Earth band of Ojibwe is poised to join tribes nationally in the creation of a new energy industry on the White Earth reservation.

We recommend the following elements of this work:

1) Approve an overall renewable energy standard for the White Earth Reservation, and a set of goals for tribal energy use, including fuel, heating and electricity.

2) Join tribal governments, states and cities nationally to volunteer to meet the standards set by the Kyoto Accord and mitigate green house gas emissions and global climate change through tribal policy.

3) Establish a tribal energy act and a tribal utility, modeled after tribal utilities nationally.

4) Develop a tribal energy efficiency program aimed at reducing tribal heat, electricity and fuel consumption through use of presently available products distributed through tribal programs and through retail outlets on the reservation.

5) Create a tribal housing initiative which includes passive solar energy and efficiency as a cornerstone of the program, and install solar heating panels as requested on present tribal homes to increase efficiency.

6) Create a tribal wind energy program aimed at providing electricity for the reservation , and providing wind energy as a significant export economy for the White Earth tribe.

7) Develop a model Tribal Casino efficiency and renewables program utilizing fuel oil, solar panels, hybrid vehicles, energy efficient light bulbs, and wind energy to both offset energy costs of our tribal enterprise, and to be a model of potential tribal and regional self determination.

[73] Honor the Earth, March 2006. http://www.honorearth.org/whatsnew.html

8) Secure energy efficient and ethanol based tribal vehicles, as well as bio-diesel vehicles for tribal operations.

9) Join Intertribal Council on Utility Policy to insure our tribe is a part of regional and national tribal policies and development opportunities.

10) Join the White Earth Tribal College with the Northwest Technical College in a training program aimed at preparing a tribal work force to carry out, implement, maintain and create a new energy economy for the White Earth reservation, and subsequently for the region.

ll) Investigate bio-fuels opportunities for tribal heating and energy in villages and facilities on the reservation.

12) In a growing renewable energy economy internationally and nationally, seek opportunities for light manufacturing, assembly , and ownership of a solar, wind and alternative fuels market poised for explosive growth.

Appendices A:

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There is a national initiative to have tribal nations both come up with renewable energy portfolios joining states and corporations nationally and internationally, and take leadership in addressing the catastrophic impact of greenhouse gas emissions and global climate destabilization.

In short, energy consumption, specifically the burning of fossil fuels, accounts for more than 80% of US greenhouse gas emissions, and the Kyoto Accord is an international agreement requiring countries to reduce these emissions by the period 2008-2012. The US refused to sign onto Kyoto although we lead the world in greenhouse gas emissions. In February 2005, the treaty went into effect despite our refusal to join the agreement. The US, however, is the continent with the most resources to do the right thing by looking towards renewable energy and energy efficiency, and tribal governments are in a great place to make a difference.

Some cities are moving towards making those changes voluntarily. More than 150 US cities, including those in the Great Plains (Missoula), the Great Lakes (Minneapolis, St. Paul, Ann Arbor, Madison, and Milwaukee), and on both coasts (Seattle, New York, Atlanta, and Los Angeles) are working on meeting Kyoto requirements by coming up with plans to reduce greenhouse gas emissions and proposals for renewable energy portfolios. Tribal governments could also volunteer to meet Kyoto and be leaders and examples for our people and for all of these states.

Wind blowing through Indian reservations in just four northern Great Plains states could support almost 200,000 MW of wind power. That's enough to reduce output from coal plants by 30% and reduce our electricity-based global warming pollution by 25%. Solar energy has similar potential. With tribal landholdings in the southwestern US equivalent to the size of Minnesota, tribal solar initiatives, in the words of one advocate, could "generate enough power to eradicate all fossil fuel burning power plants in the US." Finally, the potential for a tribal government joining in the manufacturing of these components (like a solar PV or wind turbine facility) is immense. After all, wind energy is the fastest growing energy source in the world, and these markets will only continue to grow as there is just not enough oil and there are too many problems with combusting in the Jurassic age.

The Little Traverse Bay Band of Odawa passed the following resolution on the Kyoto Protocol in 2005:

LITTLE TRAVERSE BAY BANDS OF ODAWA INDIANS
7500 Odawa Circle
Harbor Springs, MI 49740

RESOLUTION #051505-01
Adoption of Kyoto Protocol and Renewable Energy Standards

WHEREAS the Little Traverse Bay Bands of Odawa Indians ("LTBB" or "Tribe") is a Federally recognized Indian Tribe reaffirmed by the Unites States Congress on September 21, 1994 in Public Law 103-324, as amended, which exercises sovereign governmental authority over the people, land, and water within its jurisdiction and administers a wide range of governmental programs;

WHEREAS the Little Traverse Bay Bands of Odawa Indians Tribal Council is the elected governing body of the Tribe;

WHEREAS the Tribe holds sacred its responsibility to protect Mother Earth for the next seven generations;

WHEREAS scientific consensus has developed that carbon dioxide (CO_2) and other greenhouse gases released into the atmosphere have a profound effect of the Earth's climate;

WHEREAS it has been shown that human activities and energy consumption are increasingly altering the Earth's climate and that natural influences cannot explain the rapid increase in near-surface temperatures observed during the second half of the 20^{th} century;

WHEREAS the 2001 Third Assessment Report from the International Panel on Climate Change (IPCC) and the 2000 U.S. Global Change Research Program's (USGCRP) First National Assessment indicate that global warming has begun;

WHEREAS global warming poses significant threats to indigenous and non-indigenous communities across the world in the form of heat waves, drought, shrinking water supplies and snow pack, catastrophic fires, floods and storms, coastal erosion, new diseases, and loss of traditional plant and animal life;

WHEREAS we believe that it is our right and our duty to institute a new energy economy, one whose foundation is built on the efficient and profitable use of clean energy that supports our tribal self-sufficiency and sovereignty;

WHEREAS 128 countries have signed onto the Kyoto Protocol, an international agreement requiring countries to reduce their greenhouse gas emissions by the period 2008-2012, and more than 150 cities have volunteered to meet the provisions of the Kyoto Protocol as independent municipalities and in the spirit of protection of the environment and their economies;

WHEREAS in March 2001, the United States officially refused to ratify the Kyoto Protocol and take responsibility for the greenhouse gas emissions the nation is responsible for;

WHEREAS energy consumption, specifically the burning of fossil fuels, accounts for more than 80% of U.S. greenhouse gas emissions;

WHEREAS tribal lands represent a vast amount of renewable energy potential, including wind and solar power that can meet the energy needs of both local tribes and surrounding communities;

WHEREAS wind power blowing through Indian reservations in just four northern Great Plains states could support almost 200,000 MW of power, enough to reduce output from coal plants by 30% and reduce our electricity base global warming pollution by 25%, and Great Lakes Indian nations could similarly produce alternative non-polluting renewable energy for our tribal communities and for export;

WHEREAS actions taken to reduce greenhouse gas emissions and increase energy efficiency provide multiple local benefits by decreasing air pollution, creating jobs, reducing energy expenditures, and saving money for the community;

THEREFORE BE IT RESOLVED that the Little Traverse Bay Bands of Odawa Indians commits to meeting the requirements of the Kyoto Protocol and, in doing so, will strive to obtain 25% percent of our total energy from renewable energy sources by 2020.

Certification

As Tribal Chairman and Tribal Secretary, we certify that this Resolution was duly adopted by the Tribal Council of the Little Traverse Bay Bands of Odawa Indians at a regular meeting of the Tribal Council held on May 15, 2005 at which a quorum was present, by a vote of 7 in favor, 0 opposed,0 abstentions, and 0 absent as recorded by this roll call.

	In Favor	Opposed	Abstained	Absent
Frank Ettawageshik	x			
Beatrice Law	x			
Alice Yellowbank	x			
Dexter McNamara	x			
Fred Harrington, Jr.	x			
Rita Shananaquet	x			
Regina Bentley	x			

Date: May 15, 2005

Frank Ettawageshik, Tribal Chairman

Dexter McNamara, Tribal Secretary

Appendices B:

Tribal Utilities and Tribal Energy Codes

Creating a tribal utility, and an energy code is an essential element of tribal sovereignty, and can create a powerful mechanism for a tribe to both deal with utilities, rights of ways issues, and negotiate power agreements on behalf of all tribal members. This set of strategies is important as we plan for an energy future and can take a number of forms.

Some reservations have found tribal utilities helpful in reaching their goals because utilities create a chain decision making that takes into account the concerns of the tribe. For example, the Aha Macav Power Service (AMPS) is an electric utility wholly owned and operated by the Fort Mojave Indian Tribe. AMPS was created in 1991 to improve the economic situation on the reservation and increase tribal self-determination. According to the AMPS Charter, the Tribal Council acts as an advisory board to the AMPS Board of Directors. The Tribal Council's purpose is to provide information to and advise the Board regarding political, cultural, and social issues that concern the tribe and its members with regards to the operation of AMPS.[74] For example, changes in electric rates must be approved by the Tribal Council. In part, AMPS was formed largely because the tribe decided it wanted to supply power to those areas not served by the other local utilities. The remaining residents and businesses on the reservation were already being served by two other utilities. Today, AMPS serves nearly all of the electric customers on its reservation, including the Avi Kwa Ame Farms (AKA Farms), a large tribal farm that relies on electric power for irrigation pumping. The Mesquite Creek development has grown to include 105 homes, and a residential development in Nevada, called Desert Springs, includes 162 homes. Its total electrical load is about 10 megawatts.[75]

While a utility may help a tribe to develop its renewable potential, it is not a requirement. A reservation may successfully become electrically independent with smart planning and determination.

Vision Statement

Examples of possible tribal energy vision statements for utilities and tribal codes might include:

- Establish tribal energy independence, self-sufficiency, and security through development of indigenous resources, capabilities, and institutions within the next generation.[76]
- From the Navajo Tribal Utility Authority: "To provide electric, natural gas, water, wastewater treatment and related services at competitive prices, while contributing to the economy of the Navajo Nation, consistent with the

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[74] Aha Macav Power Service Charter, www.eere.energy.gov/tribalenergy/guide/docs/amps_**charter**.doc
[75] Milward, Richard; Whittier, Jack, Tribal Authority Process Case Studies: The Conversion of On-Reservation Electric Utilities to Tribal Ownership and Operation,
[76] US Dep't. of Energy: Tribal Energy Program, http://www.eere.energy.gov/tribalenergy/guide/vision.html

improvement of the health and wealth of the residents of the Navajo Nation, and the employment of the Navajo people."[77]

- From the Hopi *Hopit Potskwaniat* — Energy Related Goals: "To provide affordable and environmentally safe energy for local residents and businesses for the purpose of economic self-sufficiency."[78]
- From the charter of the Aha Macav Power System (AMPS), the tribal utility for the Fort Mojave Indian Tribe: "The Fort Mojave Tribal Council hereby finds and declares that the creation of AMPS is necessary and desirable in order to promote the development of the Tribe's resources, to promote the prudent economic vitality of the Reservation and surrounding communities, to protect the health and welfare of tribal members and to provide employment and training opportunities for tribal members."[79]

Next, a tribal energy champion must be chosen to carry out this goal. Because energy planning is a long-term process, a champion is required to direct, support and follow through on the plan. The steady, patient and persistent hand of an energy champion is very important and they should emerge naturally through their interest and commitment to lead the tribe's energy vision.

Tribal Utility Codes

Tribal utilities have been created in a number of different ways. The tribe can decide to create an entirely new utility, or to expand a former utility to include a new renewable energy facility. Tribal utilities are one of the many ownership options that are available when creating a new renewable energy system.[80] This is an option that is often encouraged as it promotes tribal sovereignty, leadership, and economic development. However, creating a tribal utility often involves a great deal of management, legal, and economic preparation.[81] Some issues unique to creating a tribal utility involve taking on a great deal of responsibility for the utility, including the financial burden and possible loses, as well as a possible disconnect between younger and older generations over the operation of the utility.[82] Because the utility would be completely run and maintained by the tribe, it is an excellent opportunity to promote tribal sovereignty.

There are two main options for a tribal utility: 1.)to be an independent utility and act as a profit making entity or 2.) to serve as a municipal utility and be a function of the tribal government. Thus, the tribe can obtain a corporate charter from the U.S. Department of the Interior[83] or have a corporation formed under tribal law and have a privately owned utility. The alterative is to create a public utility and write a tribal utility code.[84] There may also need to be new governmental agreements and legislation on the utilities' financial and

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[77] Navajo Tribal Utility Authority, http://www.ntua.com

[78] Hopit Potskwaniat Energy Related Goals, http://www.hopi.nsn.us/capp.asp

[79] Aha Macav Power System Charter, www.eere.energy.gov/tribalenergy/guide/docs/amps_**charter**.doc

[80] See Introduction.

[81] U.S. Department of Energy, "A Guide to Tribal Energy Development" U.S Department of Energy, Energy Efficiency, and Renewable Energy. November 8, 2005
http://www.eere.energy.gov/tribalenergy/guide/

[82] Id.

[83] See Indian Reorganization Act § 17, 25 U.S.C. § 477

[84] See Mni Sose Intertribal Water Rights Coalition, Inc. "Model Energy and Utility Service Code"

structural arrangements.[85] One essential legal area to address is the construction and interpretation of contracts; it is even recommended to have a limited reliance on some state contact law.[86] Creating a tribal utility would involve creating a financial, legal, and management infrastructure to support the utility, creating the offer of great hope for tribal sovereignty and economic development.

Tribal Sovereignty and Current Utility Law

The Energy Policy Act, and specifically Title XXVI, has expanded some of the options for tribal energy development. This 1992 law increased incentives and encouraged tribal energy development.[87] Like the Mineral Development Act, the Energy Policy Act is helping to promote the use of natural resources by the tribes and for the tribes. A major problem currently facing tribal sovereignty is that while a great deal of natural resources and energy resources exist on the tribal lands, most tribes are serviced by public investor-owned utilities, cooperatives, and private utility companies from outside the reservation.[88] Federal Utility law is governed by a number of different statutes and organization mechanisms, including the Federal Power Act, Public Utilities Holding Company, PURPA, and FERC. The current system relies heavily on FERC, as much of the utility industry is interstate. The utility industry is also undergoing a restructuring in hopes of creating a more competitive and fair market.[89] PURPA and the Energy Policy Act are parts the program, as they increase the ability of small power producers to enter the industry.

More recent regulations have furthered this cause. FERC Order 888 and Order 889 are both helping to open up access to the transmission lines. These orders even encourage changes on the state level, outside FERC's reach, to push states to address the retail sale of electricity and create a more competitive and open market.[90] FERC's large role in the national electrical power industry means their decisions are important to how tribes can get involved and if they will be protected in the interstate electricity industry. It is a major question of tribal sovereignty as to whether or not a tribe will be within the jurisdiction of FERC.[91] Current case law indicates that FERC is not going to interfere in tribal sovereignty and instead is treating them much like the states, as an area outside their jurisdiction. However, FERC must still satisfy certain responsibilities to the tribes and thus different agencies in FERC have specific tribal consultation departments to ensure tribes still have access to FERC. Thus FERC is not regulating tribal utilities, however as certain tribal energy projects increase in size they enter the interstate market and thus will be more and more under the guidance and supervision of FERC. It is likely that the role and extent of control FERC takes on with the tribes will depend on the current state of tribal sovereignty with respect to civil law.[92] Utility regulation has some consistence with giving the tribe sovereign powers, however the continued degradation of tribal sovereignty with relation to civil law could make it difficult for tribes to regulate some areas such as "utility services, resource protection, and

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[85] Some examples include a lease mortgage ordinance, noninterference codes, environmental protection codes, cultural resources protection laws, building codes, worker safety laws, or an arbitration code.
[86] U.S. Department of Energy, "Tribal Legal Issues" U.S Department of Energy, Energy Efficiency, and Renewable Energy" http://www.eere.energy.gov/tribalenergy/guide/ (March 16, 2005)

[87] Tracey A. LeBeau, "Reclaiming Reservation Infrastructure: Regulatory and Economic Opportunities for Tribal Development" 12 Stan. L. & Pol'y Rev. 237 (Spring 2001), at 239.
[88] Id., at 240.
[89] Id., at 244.
[90] Id.
[91] Id., at 246.
[92] Id.

utility assets located within reservation boundaries."[93] One option to remove the ambiguity over regulation is to seek action by the federal agencies to clarify their role and promote coordination between the tribes, states, and federal government. Because Congress can delegate the authority to regulate areas where the tribes have not or will not do so for themselves, there is a chance this will be used to fill in gaps about jurisdiction. This should lead to a process allowing for clarifications for tribal regulatory jurisdiction, hopefully improving their sovereign rights and ability to control their renewable energy facilities. However the set backs with regards to tribal civil law, including taxation and zoning, could create problems in developing a tribal utility and potential renewable electricity facilities on the reservation.[94]

Examples of Tribal Renewable Energy Laws

This outline of a model utility code is based off of the Mni Sose Intertribal Water Rights Coalition, Inc. "Model Energy and Utility Service Code." (See Appendix A) This model utility code helps guide tribal leaders in understanding the basics that must be covered by a tribal utility code. It is important to remember to consult lawyers familiar with tribal law, federal law, and regulated industries when creating a tribal utility code.

Outline of a model tribal utility code

Section 1:

A. The major parts of a utility code begin with the tribe's sovereign authority to make the laws governing the tribal utility, and their powers granted to them by the U.S. government, generally the Indian Reorganization Act of 1934. (48 Stat. 984) The first part also would state the purpose of the law as well as repeal any law inconsistent with the tribal utility code.

B. The utility code would want to establish its jurisdiction right away over both the tribal lands, tribal people, as well as third parties on the tribal lands. The law must also set the boundaries as to what the law applies to, such as all water, electricity, telecommunications, etc. Further, the law may want to honor prior agreements made between third parties that are incompatible with the new law, and this should be written into the law.

C. The next section would be a glossary of the terms used in the utility code.

Other technical considerations include creating a prohibition on state taxes on the utility with the reservation unless approved by the tribe, as well as setting a time limit on the statute, generally they are perpetual until repealed by the tribal council.

Section 2:

The next section will establish a public utility committee. This section would explicitly give the utility power over whatever utility functions the tribe has decided it will regulate and put it in control over all third parties and

[93] Id.
[94] Id.

their interactions with the utility. The statement should be broad enough to ensure the utility will be able to control all aspects of the utility.

The next part should go into detail about the ability of the tribe to work to control the utility, such as ensuring they can hold meetings, impose fines, control agreements with third parties, create rules of employment, fix facilities, value their property, and apply for and disperse federal money. Further, the utility needs to be able to investigate problems with or without the Reservation. Finally, along with advising the tribal council as to the needs of the utility it is important to have a 'catch all' phrase to ensure the utility will be able to accomplish everything it is intended to do. An example would be, "Other authorities necessary and convenient to accomplish the duties described in this Title ___."

It is important to also limit the power of the utility. The code should prevent the tribe from making agreements on behalf of the tribe, using the tribes credit, selling the tribes or personal property, forgiving debt owed to the tribe, or relinquishing the tribe of duties.

The next section should explain who is on the committee or board to control the utility, how they gain or lose their position, and how they will meet and make decisions. It includes the compensation for the committee members, as well as their term limits.

Section 3:

A. This section will explain who can get a franchise though the utility, often including natural gas, electric light, water, power, heat, railway, telephone, or telegraph. Generally, these franchises will be nonexclusive[95] and not interfere with previously made agreements between the tribe and third parties.

B. The utility code will then need to outline a very specific procedure and rules governing how an entity can become a franchise, this includes the application process, the timeline of applications, as well as whether or not there is a fee.

C. It is important to create a definition of the rules and standards franchises must adhere to, including their commitment to providing services at a fair market price, and generally ensuring they act honestly and in good faith.

D. The franchise can also be required to adhere to a number of rules and programs including energy conservation, low-income assistance, or environmental programs and laws.

E. The needs to also be sections defining the ownership of facilities the franchises use, generally, these remain the property of the tribe as the infrastructure necessary to provide services. Further, there must be a limit to the length of a franchises existence.

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[95] A nonexclusive franchise is one that allows the services provided to be distributed by multiple agencies, such as different electricity companies. An exclusive franchise, which would be one agency providing all electricity though-out the municipality, could be done but would involve changing past agreements with third parties.

Section 4:

The next section will explain how the rates are to be set for consumers, as well as when those rates are to apply.

There must also be rules set to govern the sale of a franchise or property used by the utility,

Section 5:

This section should set out the ability of the tribe to enforce the conditions created thus far in the code. Generally, it will want to outline the ability of the tribal council and tribal attorneys to have oversight of the actions of the utility committee and franchises. This also includes the ability of the utility committee to enforce fines and regulations set out by the code. This gives them a legal right to sue to enforce the code and to gain a judgment in a court of law.

Section 6:

This section will explain the acquisition of land on the reservation. This generally involves granting a right-of-way to franchisees, and there must be a great deal of consideration by the tribe, as well as compliance with the federal government, to grant these titles to land on the reservation. They generally, have a sun-set clause, meaning the right-of-way will last for a limited amount of time.

This section should also specify that the tribe retains the ability to tax the land in a right-of-way, and to regulate and pass laws governing the land.

Section 7:

This section will address the obligation of third parties holding land rights across the reservation. This section is designed to regulate the actors with right-of-way land to ensure they provide services to all those living on the reservation, they work to actively protect the environment on the tribal lands, and they notify the tribe when they are acting to maintain the facilities on the land.

Some existing tribal utilities include the Navajo Tribal Utility Authority (NTUA), the oldest tribal utility. It is an enterprise of the Navajo Nation, meaning it was created through their own tribal laws as a corporation or other such entity. It provides utility services such as electricity, water, natural gas, solar power, and wastewater treatment to the Navajo people mostly with energy produced off the reservation.[96]
A more recent example is the Aha Macav Power Service created by the Fort Mojave Indian Tribe for its reservation that goes through Arizona, California, and Nevada.[97] After a utility management consultant studied the feasibility of a tribal utility, they decided to begin the $2.5 million dollar project. The utility was a separate entity from the reservation government, which is one way to set up a tribal utility, and

[96] Tribal Energy Program, "Tribal Energy Guide: Case Studies" Tribal Energy Program www.eere.energy.gov/tribalenergy/ (2004)

[97] Id. (Adapted from Richard Milward and Jack Whittier, "Tribal Authority Process Case Studies: The Conversion of On-Reservation Electric Utilities to Tribal Ownership and Operation" NEOS Corporation)

allows the experts in this area to run the entity. The utilities charter creates its Board of Directors, governs their actions, and even allows for a tribal council member to sit on the board. This agreement is unique for the model utility code in that the tribal council acts as a sort of utility commission on its own, and the rates are created and implemented by the tribal council. The tribe has created some energy themselves and has grown to supply most of the power used on the reservation. Some factors that have been indicated to allow for the success of this tribal utility include: the substantial residential load providing a good customer base, the tribe's creation of a master plan for its reservation, the need for more power options in a rural area, the federal involvement through FERC approval, the use of the Bureau of Indian Affairs (BIA) transmission lines, BIA assistance with financing, and the tribal sovereignty that allowed them to avoid interstate and multi-state utility regulations. The creators of this utility have recommended that tribes take sufficient time to make the transition and to allow for financing of the transition, ensuring that they do not use a significant proportion of the tribe's financial reserves for this transition. Another similar tribal experience in Oregon by the tribe provides a different example of a tribal utility code.

Another example of tribes using renewable energy with and without codes includes the Spirit Lake Sioux Wind Energy Program and the Rosebud Sioux Indian Reservation. The first of these is a great example for a small rural tribe with limited financial resources. The Spirit Lake Sioux built a utility scale wind turbine that would provide energy directly to the casino on that reservation.[98] By doing this they maintained control of the turbine though the casino they owned and operated, much like an individual who builds their own renewable energy source on their private property. This allows them to avoid the need to create a tribal utility and possibly to participate in net-metering operations. The Rosebud Sioux Reservation on the other hand had already created a tribal utility, with an off-reservation power supply, and was able to hook their wind turbine up to provide energy for a casino though the existing structure. It will allow put excess energy back into the grid. Their success is attributed to their previously collected data on wind speeds in the area and their ability to show the success a wind turbine would have in that area.[99]

The Southern Ute Tribe of Colorado, which began by taking over expiring mineral leases on the reservation lands, has been very successful through joint venture operations to extract natural resources from their reservation. By creating a joint venture or full ownership basis though their tribal enterprise,[100] and then later another joint venture, they gather a great deal of natural gas and employ many tribal members. [101] With so many different opportunities available to tribes to provide for their energy needs and to build tribal sovereignty, a tribe must consider exactly what their needs are and what will allow the tribe for the most success. This will involve looking at the strengths of the tribe such as the available energy sources, either renewable or non-renewable, their location, monetary resources, and make the many considerations necessary to undertake a tribal utility or energy system.

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[98] Id.

[99] Id.

[100] A joint enterprise would be created by them creating an entity and then working with another mineral or utility company to find natural gas. A full ownership basis would be the tribal entity on its own, possibly owned by the tribe itself to find the natural gas.

[101] LeBeau, at 242-243.

Along with a tribe utility code, other legal documents a tribe will need include an interconnection agreement. This is the document that allows a tribe to connect to the grid that other utilities are maintaining, and will be especially important for those who are hoping to sell energy back onto the grid for profit. The best example of this is a model interconnection agreement created by the Interstate Renewable Energy Council. The interconnection agreements will be different for a very small entity, generally less than 25 W. For large systems, there is a complex array of technical details that will have to be analyzed before the interconnection agreement can be made. The major problem with these is that depending on what the utility wants they can be time consuming and expensive. It is important to look into whether or not your state has requirements that can simplify this, because they have detailed explanations of what is required before an interconnection agreement can be created. Without this, the tribe should force the utility to agree on what they will need to know before hand.[102]

The tribal laws and legal contracts tribes or tribal utilities will be signing can be extremely complex. A lawyer or public policy analyst with experience in the area of utility law is probably necessary for anything beyond a very small or residential renewable energy facility.

[102] Chris Larson and Chris Cook, "A Guide to Distributed Generation Interconnection Issues" Interstate Renewable Energy Council, 2004.

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Center for Sustainable Community Development (CSCD)

Final Report

Department of Energy Tribal Energy Feasibility Study

May 31,2005

Prepared for:
The White Earth Band of Chippewa Indians
The Leech Lake Band of Chippewa Indians
The Grand Portage Band of Chippewa Indians

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I. Introduction

The University of Minnesota Duluth's Center for Sustainable Community Development (CSCD) was hired by the White Earth Reservation to conduct a general feasibility study for renewable energy production on three reservations (Grand Portage, White Earth, and Leech Lake) in Northern Minnesota. The feasibility study consisted of three parts.

1. Energy Assessment - general reservation background information, electricity consumption, utility, cost and local renewable resource endowment.
2. Energy System Design – available technologies, potential system configurations, detailed computer modeling, direct/indirect economic analysis
3. Communication/Education – timeline of visits to each reservation, project partners, and content of discussions

This report concludes with recommendations and suggested next steps for each of the three reservations in the final six months of the DOE funded project.

II. Energy Assessment

A. Grand Portage

1. General Background

Grand Portage is located in Minnesota's most Northeastern point on Lake Superior, in Cook County. We began meeting with Grand Portage in March 2004.

Landownership

Total area: 47,000 acres
Tribally owned: 37,679 acres
Percentage owned by Reservation: 80%
Allotted: 7,086 acres

Socio Economic

Total labor force: 113
High school or higher graduate: 67.6%
Reservation population: 308
Total enrollment: 790
Total unemployment: 26.5%
Per capita income: $10,808

Vegetative Type

Boreal including White Pine, Red Pine, Jack Pine, Tamarack, Balsam Fir, and Cedar. Grand Portage also has various hardwoods that include Maple, Aspen, and Paper Birch. Bog/marsh/fen is also dominant in the area. There is limited farming that takes place in the Grand Portage region.

2. Electricity Consumption/Cost

Grand Portage Reservation is provided electricity by Arrowhead Electric Cooperative, Inc, which is a Touchstone Energy Partner. Coal, refuse-derived fuel, natural gas, oil plants, and wind generation supply Arrowhead Electric Power Generation. Grand Portage has four main sectors of electricity consumption: Community Center, Grand

Portage Households, Grand Tribal Council Offices, and Grand Portage Casino (Northeast Clean Energy Resource Team Strategic Plan 2005).

We used monthly utility bills for calendar year 2003 to assess Grand Portage's electricity consumption. A simplifying assumption is made to combine service charges, demand charges, and energy charges into a single "blended rate". This is done by taking the total utility charges for the year and dividing by the total energy usage to arrive at an average annual price per kWh. The blended rate for Grand Portage is $0.064. Grand Portage provided the utility bills for the study directly from Arrowhead Electric Cooperative, Inc. In 2003, Grand Portage used five million one hundred and twenty thousand kWh's a year (5,120,000) at a blended rate of .064 cents a kWh, for a total of $327,680.00 dollars. Table 1 Illustrates the breakdown of kWh consumed by location and the various costs associated with that production. Figure 1 & 2 illustrate the percent of consumption and costs by location.

Table 1. Reservation Consumption Data

G.P. Energy Consumption	kWhs	Cost
Community Center	840,000 kWh/yr	53,760.00
Households (150)	1,440,000 kWh/yr	92,160.00
Tribal Council Offices	640,000 kWh/yr	40,960.00
Casino	2,200,000 kWh/Yr	140,800.00
Total	5,120,000 kWh/Yr	327,680.00

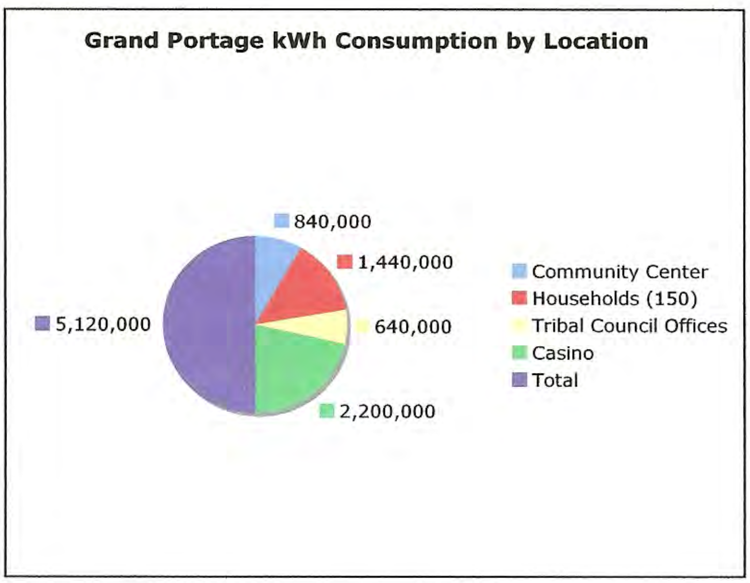

Figure 1. Grand Portage kWh Consumption by Location

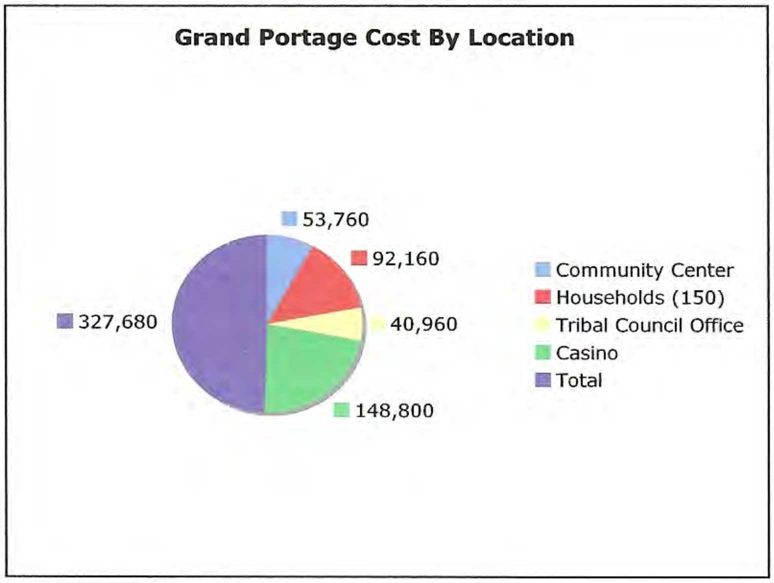

Figure 2. Grand Portage Consumption Costs By Location

3. Local Resource Endowment

Grand Portage has several primary resources that appear viable for renewable energy production: municipal solid waste (MSW), wind, and biomass.

MSW

Grand Portage has been seriously considering the Plasma Torch (Torch) as a solution to their Municipal Solid Waste disposal costs, a back up to the wind power, and a source of new business and job creation. Several meetings have been held with Phoenix Solutions (developers of the Torch), the Reservation, and the CSCD. At these meetings we discussed key environmental, social, and economic issues related to the implementation of the Torch on the reservation. At this point, the tribal council has not made a final decision about the implementation of the Torch in Grand Portage. Grand Portage community produces about 10 tons per day (tpd) of MSW. They pay $40.00 per ton for disposal.

According to conversations with Phoenix Solutions, Grand Portage would require a 200-300 kW stackable Torch, which is a 1 MW system that would cost about five million dollars. This torch would require 24 tons per day. Torch demand could be met by both Grand Portage's MSW and a paper company in Thunder Bay that produces excess waste bark. The expected lifetime of the Torch is twenty years, but consumable parts must be replaced annually. The Plasma Torch also generates a non-leachable aggregate material that can be used for retail sale of high-end marble like slag, which would create jobs and revenue for the reservation. However, Grand Portage could also use this aggregate material as a substitute for gravel that is currently hauled onto the reservation during the winter season at considerable expense.

Wind
Grand Portage has had an anemometer in place on Mt. Maud since January of 2004, which has proven to be a viable wind site. Mt. Maud currently has a lookout tower that will be removed once the turbine is implemented. Mt. Maud is located within Flaming Maple Ridge and has an elevation of 1754 feet. To access Mt. Maud there is a few miles of unpaved gravel road. The nearest power line is about two miles away, so it will cost Grand Portage about $11,000 to run a line from the turbine to the nearest power station. The average annual wind speed is 14.2 MPH at 20 meters. Grand Portage is considering putting up 1-2 MW of wind production at this site.

Biomass
Grand Portage is well endowed with biomass resources (forest), but the reservation did not want to remove resources from the surrounding ecosystems. Moreover, biomass has costly infrastructure for both transportation and harvest. Furthermore, biomass energy production has hazardous CO_2, NOX, SOX, and particulate emissions.

B. White Earth

1. General Background

White Earth Reservation is located in the Northwest part of Minnesota (Mahnomen, Becker, and Clearwater counties). White Earth Village is location of tribal headquarters, the IHS clinic, Circle of Life K-12 tribal school, and a senior housing project. Government services, social programs, Head Start, and daycare are provided at four other locations: Nay-tah-waush, Pine Point, Rice Lake, and Elbow Lake.

Landownership
Total area: 837,000 acres
Tribally owned: 76,347 acres
Percentage owned by Reservation: 9% (White Earth Reservation has lost many acres of land over the years and is now in the process of reclaiming it, leaving a checkerboard of land).

Socio Economic
Total enrollment: over 20,000
Total unemployment: almost 25%
Per capita income: $5,000

Vegetative Type
White Earth is comprised of farm, bog, and forest. Much of the agricultural production in the region is comprised of sugar beet and wild rice. Cultivated land makes up the largest reservation vegetative type. Drained by the headwaters of the Mississippi River, the area is generally swampy.

2. Electricity Consumption/Cost

White Earth Reservation is serviced by three different utilities: Ottertail Power Company, Wild Rice Electric, Inc, and Itasca Mantrap Coop. We examined six main sectors of White Earths consumption; these six sectors include the Regional Tribal Council (Ottertail), the Bingo Hall (Ottertail), the Shooting Star Casino (Ottertail), the Shooting Star Casino Sign (Ottertail), the Head Start Building (Ottertail), and the Health Center (Wild Rice Electric). We also considered the new community center and Circle of Life School as future sources of demand.

We assessed White Earth Reservation energy usage using monthly utility bills for calendar year 2003. Again, we simplified White Earth's utility information by using blended rates described for Grand Portage. However unlike Grand Portage, White Earth has several blended rates (these are illustrated in Table 2 under column header cost per kWh). White Earth provided the utility bills for the study directly from the three above-mentioned utility companies. In 2003, White Earth used 17,547,320 kWh's a year, they pay a sliding fee that ranges from 3.5 cents to 6 cents per kWh depending on the utility and source of demand, for a total of $799,561.00 dollars in fiscal year 2003.

Table 2 Illustrates the breakdown of kWh's consumed by location and the various costs associated with that production. Figure 3 & 4 illustrate the percent of consumption and costs by location.

Table 2. Reservation Consumption Data

Location	kWh's	Cost Per kWh	Total Cost
Regional Tribal Council	477,320	0.056	27,000
Bingo Hall	265,000	0.064	17,000
Shooting Car Casino	14,982,000	0.043	651,650
Casino Sign	87,000	0.066	5,782
Head Start	36,000	0.066	2,160
Health Center	1,700,000	0.056	95,969
Total	17,547,320	0.045	799,561

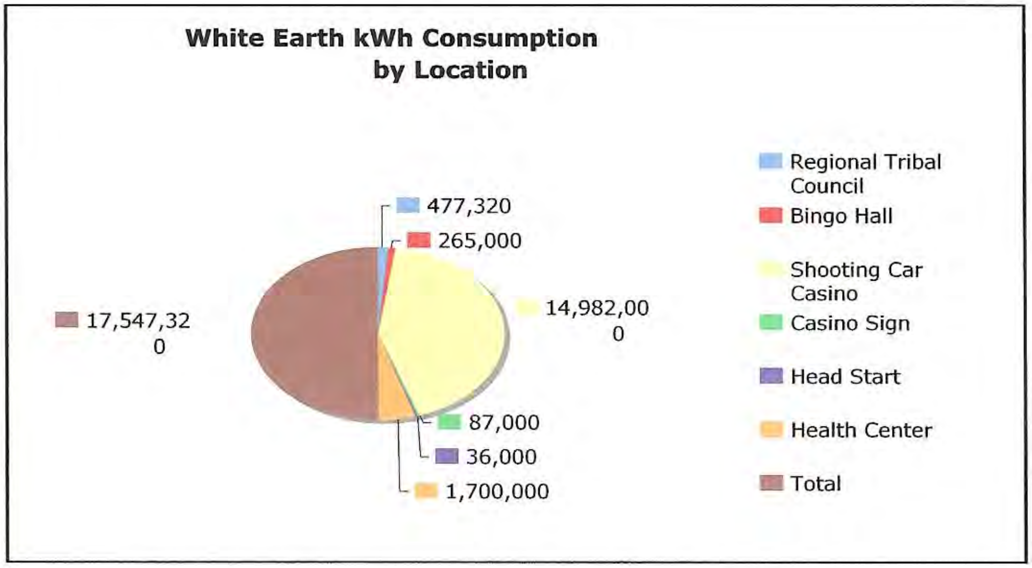

Figure 3. White Earth kWh Consumption by Location

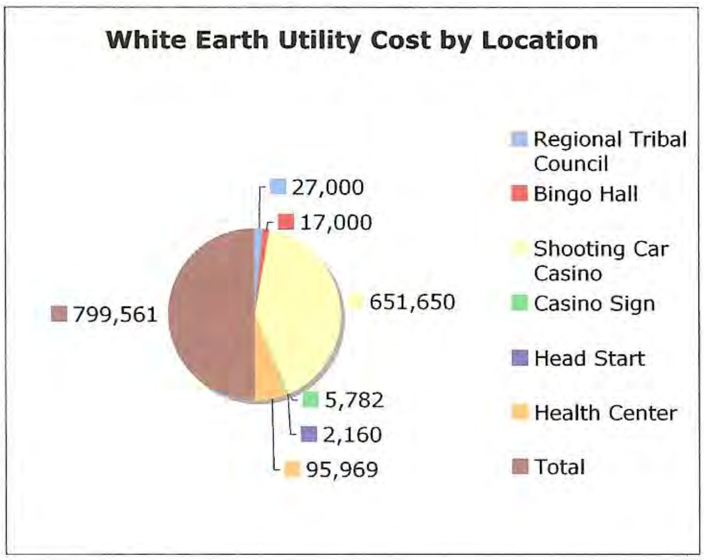

Figure 4. White Earth Cost by Location

3. Local Resource Endowment

White Earth has several resource streams that are viable for renewable energy production: wind, biomass, and sugar.

Raw Material Waste Stream

Wind

White Earth had a wind assessment done in 2004 by Jay Haley from EAPC Architects Engineers in Grand Forks, North Dakota. He conducted a site analysis for three specific sites on and around the reservation. Using nearby anemometer data from the MN Department of Commerce's web site, he determined, by extrapolation with WindPro software, that White Earth has an average annual wind speed of 14 MPH, which provides them with class 5 wind speeds. Wind speeds are highly variable and site specific on the White Earth reservation. Direct measurements of average wind speed on specific sites are required (see recommendation and next step sections).

Biomass

White Earth has an abundance of agricultural land, which provides for great biomass potential. Residue from agricultural practices can be used as fuel for biomass burners. White Earth is also well endowed with forest, of which excess treetops and branches from logging could also provide fuel for biomass. At this time biomass woodchips are burned for electricity at the Mahnomen Schools (Clean Energy Resource Team Strategic Plan 2005). However, as mentioned in the Grand Portage biomass section there are several environmental impacts associated with biomass that need to considered by White Earth as well.

Sugar

Mike Triplett introduced us to a developing renewable technology called Aqueous Phase Reduction (APR), which turns sugar into useful alkanes (energy). This could be a viable technology for the White Earth region, in fact The Red River Valley accounts for more than 40% of U.S. beet sugar production and 1/5 of all sugar output. The area's $1 billion-a-year sugar crop, produced on a half million acres by more than 1,000 farmers supports about 32,000 jobs year-round according to the industry. APR could provide a supplemental resource to the farming industry as well as additional White Earth energy production and local job creation.

C. Leech Lake

1. General Background

The Leech Lake Reservation is located in the north central part of Minnesota (Beltrami, Cass, Hubbard, and Itasca counties). The reservation covers a little over 600,000 acres, and of that land 5% is in tribal control and 10% is in trust. The Leech Lake Tribal Council is the governing body with their offices in Cass Lake, the largest community within the reservation.

<u>Landownership</u>

Total Area: 602,889 acres
Tribally owned: 21,507 acres
Allotted (members): 12,639 acres
State Trust: 30,000 acres
Other: 507,750 acres

<u>Socio Economic</u>

Total Reservation Population: 3725
Total Tribal Enrollment: 7173
Total Labor Force: 1069
High School Graduate or Higher: 60.2%
Per Capita Income: $4705
Total unemployment: 30.9 %

Vegetative Type

There are approximately 20,000 acres of forested land (reservation owned) on Leech Lake, in addition to the 500,000 acres of forest land (public) on the reservation. These forested areas are composed primarily of aspen and northern hardwoods. Moreover, there is 10,000 acres of farmland on Leech Lake, utilized primarily by family farmers who raise forest crops and livestock. Leech Lake is also composed of fen and bog with some 40 wild rice producing lakes, it has the largest natural wild rice production of any of the State's reservations. The land is mostly second growth (MN Indian Affairs Annual Report 2002).

2. Electricity Consumption/Cost

Leech Lake reservation is provided electricity service by Ottertail Utility Company. For this analysis, the CSCD examined one sector of the Leech Lake energy demand, Northern Lights Casino. The Leech Lake Community is service by Ottertail, Lake Co. Power, Beltrami Electric and Minnesota Power. Minnesota Power is the provider to Northern Lights Casino/Hotel/Convention Center.

We assessed Leech Lake reservations energy usage using monthly utility bills for calendar year 2003. Again we simplified Leech Lake using blended rates as described for Grand Portage, for a total of $.06 a kWh, calculated out by the larger number mentioned above. In 2003, Northern Lights used 6,427,320 kWh's for a total cost of $385,640 dollars.

3. Local Resource Endowment

Local Resource Endowments:

Leech Lake has several resource streams that are viable for renewable energy production, but has decided to focus primarily on wind.

Wind

Leech Lake is working to erect a wind turbine near their Northern Lights Casino. We therefore analyzed anemometer data from that location, at 20 meters. The annual average wind speeds are 8.8 MPH. Brandy Toft, Air Quality Specialist at Leech Lake, provided us with a study done by the National Renewable Energy Laboratory (NREL) that provided this information on wind speed.

III. Energy System Design

A. Available Technologies

Every community has a particular set of primary energy resources to utilize including manure, biomass, municipal solid waste (MSW), sunshine and wind. There are numerous new conversion technologies, either on the market today or coming soon, that allow one to convert these primary energy resources into useful materials (alkanes, hydrogen, bio-diesel and compressed air) and ultimately heat, electricity and transportation miles. The figures below illustrate many of these leading technologies and pathways for converting these basic primary energy sources into energy end uses. Our major task was to select the combination of pathways and technologies that best fit each of the three reservations.

Below is a general description of the various options and their applicability for each reservation.

Alkanes

Figure 5 focuses in some detail on the options associated with alkanes. Alkanes are a family of straight chain hydrocarbons containing methane, propane, butane etc... These valuable fuels can be produced several different ways. Methane (CH4) Reduction converts manure to methane. Aqueous Phase Reformation (APR) converts sugars, derived from many different agricultural crops, into hydrogen and simple alkanes (methane, propane, butane). Virent Technologies (www.virent.com) is the manufacturer of this technology. This option is particularly applicable to White Earth given its extensive sugar beet farming. The Plasma Torch uses intense heat to convert waste (MSW) or biomass to a syngas consisting primarily of hydrogen, carbon monoxide and methane. There are several plasma torch manufacturers, but we have been working closely with Minnesota's Phoenix Solutions (www.phoenixsolutions.com). The plasma torch is potentially applicable for Grand Portage given its proximity to large waste resources located in Thunder Bay, Ontario. The alkanes produced by these three methodologies serve as an excellent fuel source for high temperature solid oxide fuel cells (SOFC) that produce electricity and useable heat on demand.

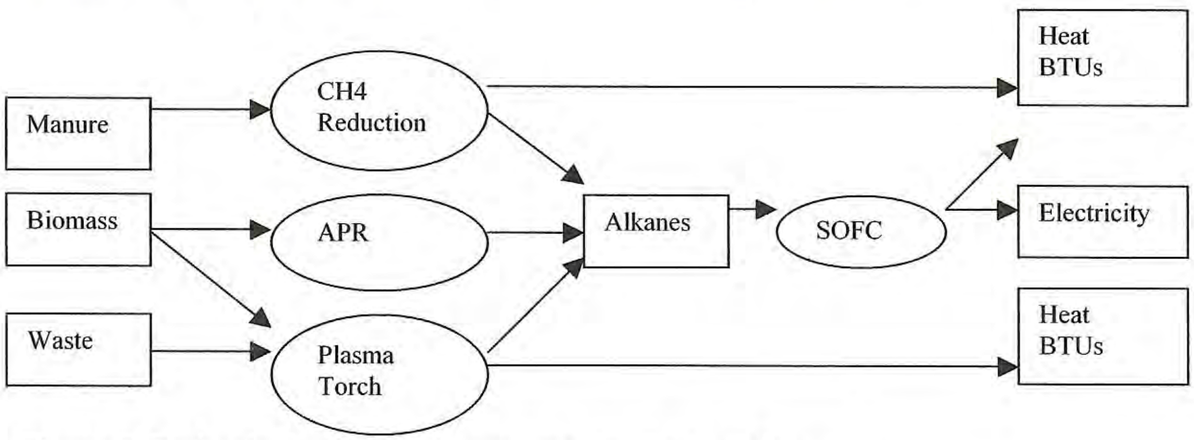

Figure 5. Technologies and Pathways Associated with Alkanes

Hydrogen

Figure 6 focuses in some detail on the options associated with hydrogen. There are several different ways to produce hydrogen from renewable energy sources. The Plasma Torch and APR process have already been described. Electrolysis uses extra electricity from a wind turbine or photovoltaic array to split water (H2O) into hydrogen (H2) and oxygen (O2). The hydrogen produced by these three alternatives can then serve as a fuel source for solid oxide fuel cells (SOFC), proton exchange membrane fuel cells (PEM) or Hydrogen internal combustion engines (HICE). Because this hydrogen fuel can be stored, and used on demand by the fuel cells it can be thought of as a means to store wind or solar power. In this manner, electrolysis and fuel cells are potentially viable options for storing the wind power on Grand Portage or White Earth. SOFC's produce heat and electricity in stationary applications. PEM fuel cells also produce heat and electricity for stationary applications, but they can also be used to power fuel cell vehicles by chemically converting the hydrogen fuel back to water via a reaction with atmospheric oxygen. Finally, HICE can also power vehicles by combusting the hydrogen fuel.

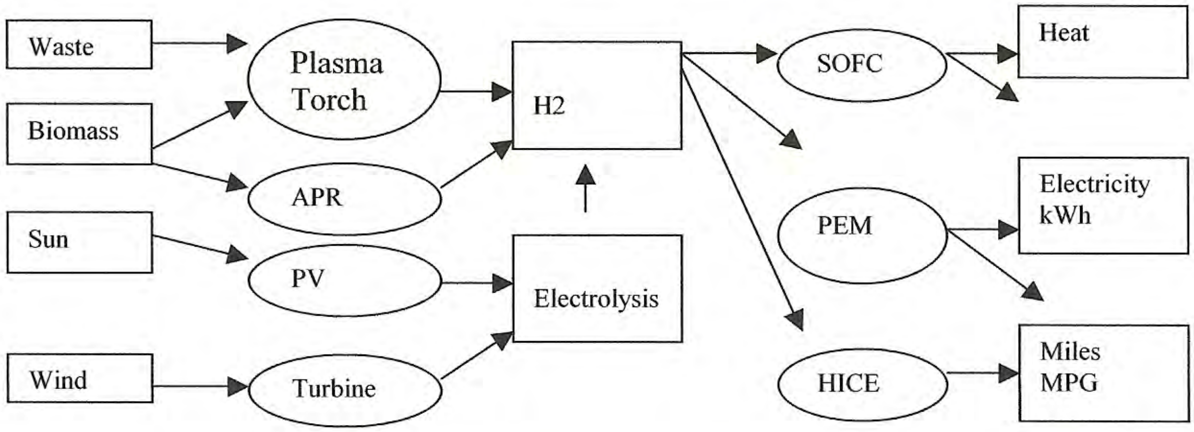

Figure 6. Technologies and Pathways Associated with Hydrogen

Bio-diesel

Figure 7 focuses in some detail on the options associated with bio-diesel. The main conversion technology here is the Thermal Conversion Process (TCP). This is currently a large-scale operation designed to serve populations of 50,000 and larger -- currently too large in scale for the reservations. Changing World Technologies (www.changingworldtech.com) is the current patent holder for this process. The TCP process consists of a self-contained industrial plant that converts biomass and any other form of waste (under extreme heat and pressure) to a very clean bio-diesel fuel as well as some other useful products (carbon black and fertilizers). The bio-diesel can then be used to make electricity and heat on demand with SOFC's, or miles in diesel electric hybrid vehicles (DEHV).

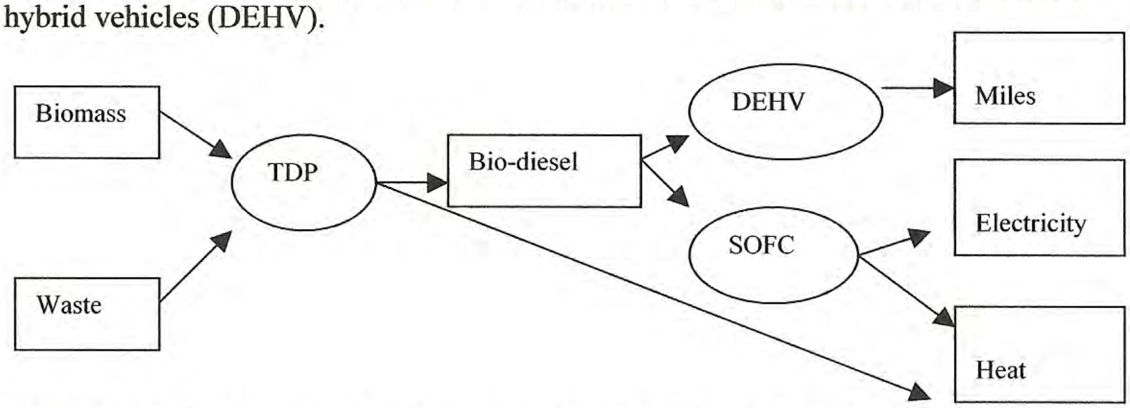

Figure 7. Technologies and Pathways Associated with Bio-diesel

Compressed Air

Figure 8 focuses in some detail on the options associated with compressed air. Here, as with hydrogen production via electrolysis, extra electricity from a wind turbine, photovoltaic array or any other renewable electricity source can be used to power an air compressor. The pressurized air is stored in a tank, and released to produce electricity on demand using a conventional generator, or transportation miles using an air motorcar.

These cars are a patent pending design by Moteur Development International (MDI), a French automaker (www.theaircar.com). These technologies are potentially viable for each reservation, but we have yet to gather the necessary information.

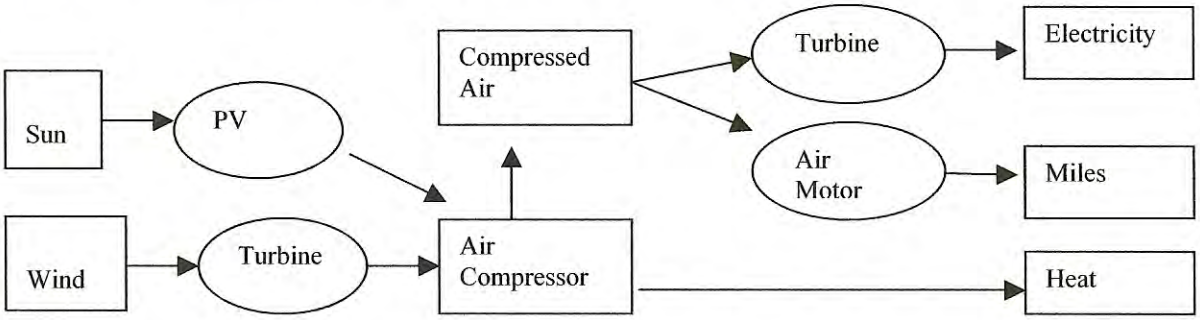

Figure 8. Technologies and Pathways Associated with Air Compression

B. Energy System Design

1. Model Description

The most promising technologies and pathways were explored in more detail using a dynamic computer simulation model. We constructed the model using STELLA interactive modeling software. STELLA consists of three layers. The first is a conceptual diagram illustrating the key components of the system and the linkages between them (see figure 9). The second contains the actual equations that quantify the linkages and the key model parameters (see figure 10). The third contains the model output in tabular and graphic form. It also allows the user to create and compare multiple simulations by adjusting key data parameters (i.e. wind speed) using the 'slider' function (see figure 11). This modeling strategy allowed us to experiment with numerous potential energy production systems, and facilitated communication of model results with our partners from each of the reservations. Below we explain the modeling in more detail while reporting on the most promising scenarios for each reservation.

2. Grand Portage Scenarios

We found that Grand Portage had three key primary resources available locally: wind, biomass and waste. So we analyzed numerous potential energy systems based on these resources. Here we report in detail on three of the most practical and promising scenarios. 1.) 2 MW of Wind. 2.) 2 MW of wind with a 50% hydrogen/fuel cell back up system, and 3.) 1 MW Plasma Torch operating on a local waste stream.

Scenario #1: 2 MW Wind Turbine

For clarity, we will report on this relatively simple scenario in complete detail as an example to familiarize the reader with the complete modeling process. For simplicity, in the remaining scenarios we will report only the conceptual diagram (where significantly different), key parameters (data sources and reliability) and model results. All other details associated with these and other possible scenarios are available upon request.

Figure 9 illustrates the conceptual diagram representing this scenario. The model begins with the current electricity use (kWh/yr) or the desired amount of electricity production. The actual wind turbine capacity (KW) required to meet this demand is then calculated based on the graphical relation between wind speed and turbine capacity factor. The turbine output is then converted back to annual kWh. These kWh are then partitioned into those used directly and those used to make hydrogen via electrolysis for later use in fuel cells. In this scenario all of the wind-generated electricity (kWh) is used directly. The annual utility payment is calculated by simply multiplying electricity use by utility cost per kWh. In addition, the future utility cost is projected to increase by a small annual percentage. The annual renewable (wind generation) payment is represented by the mortgage payment on the total installed capital cost of the wind turbine minus any grant subsidy plus annual maintenance costs (typically 2% of total wind turbine cost) with a loan period equal to the expected life of the capital equipment and subjected to current interest rates.

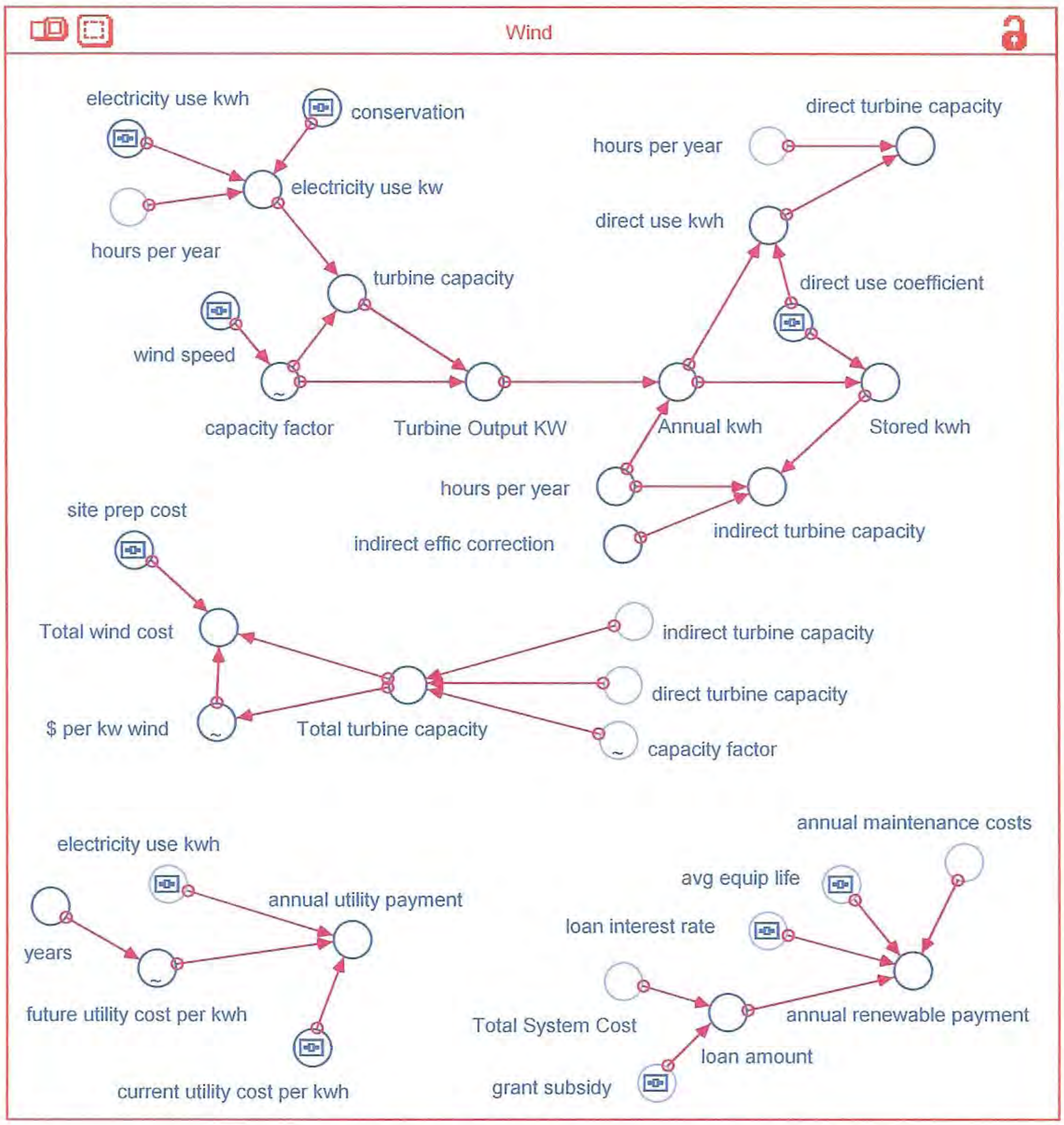

Figure 9. The STELLA Conceptual diagram representing 2 MW of wind generation capacity for Grand Portage.

Figure 10 illustrates the actual equations and values of key variables (parameters) behind the conceptual diagram described above. The equations are relatively straightforward, and require little explanation. There is also an important graphical function contained in this scenario. It relates the average wind speed to the wind turbine capacity factor. The data used to construct this curve are listed in figure 10, and were obtained by averaging the individual curves of several different wind turbine manufacturers across a wide range of wind turbine sizes. The capacity factors calculated in this manner are generalizations and will change slightly depending on the actual relationship between a particular wind turbine model and the local wind speed dynamics. The key variables in this scenario include: conservation, grant subsidy, wind speed, utility cost, equipment life, site prep costs and interest rate. For this particular scenario we assumed no conservations measures taken and no grant subsidy. The average wind speed is 14.1 mph at their chosen wind turbine sight (Mt. Maude). It has been measured for approximately 1.5 years at approximately 20 meters. The current utility cost is 6.4 cents per kWh. This is data supplied directly by their utility. The average equipment life is assumed to be 20 years as reported by the major manufacturers, and site prep costs are assumed to be 20% of total turbine/tower costs. Finally the interest rate is assumed to be 6 percent.

```
Annual_kwh = hours_per_year*Turbine_Output_KW
annual_renewable_payment =
((loan_amount*((1+loan_interest_rate)^avg_equip_life)*loan_interest_rate)/(((1+loan_in
terest_rate)^avg_equip_life)-1))+annual_maintenance_costs
annual_utility_payment =
electricity_use_kwh*(current_utility_cost_per_kwh+future_utility_cost_per_kwh)
conservation = 0
current_utility_cost_per_kwh = .064
direct_turbine_capacity = direct_use_kwh/hours_per_year
direct_use_coefficient = 1
direct_use_kwh = direct_use_coefficient*Annual_kwh
electricity_use_kw = (electricity_use_kwh/hours_per_year)*(1-conservation)
electricity_use_kwh = 5,460,000
hours_per_year = 8760
indirect_effic_correction = 1.52
indirect_turbine_capacity = (indirect_effic_correction*Stored_kwh)/hours_per_year
loan_amount = Total_System_Cost-grant_subsidy
site_prep_cost = 1.2
Stored_kwh = Annual_kwh*(1-direct_use_coefficient)
Total_turbine_capacity =
(indirect_turbine_capacity+direct_turbine_capacity)/capacity_factor
Total_wind_cost = (Total_turbine_capacity*$_per_kw_wind)*site_prep_cost
turbine_capacity = electricity_use_kw/capacity_factor
Turbine_Output_KW = turbine_capacity*capacity_factor
wind_speed = 14.2
years = TIME
$_per_kw_wind = GRAPH(Total_turbine_capacity)
(0.00, 1994), (100, 1784), (200, 1616), (300, 1478), (400, 1364), (500, 1274), (600,
1178), (700, 1118), (800, 1052), (900, 1004), (1000, 950)
capacity_factor = GRAPH(wind_speed)
(0.00, 0.00), (2.00, 0.00), (4.00, 0.00), (6.00, 0.00), (8.00, 0.035), (10.0, 0.08), (12.0,
0.14), (14.0, 0.295), (16.0, 0.48), (18.0, 0.6), (20.0, 0.7)
future_utility_cost_per_kwh = GRAPH(years)
(0.00, 0.00), (2.00, 0.001), (4.00, 0.0025), (6.00, 0.0045), (8.00, 0.0065), (10.0, 0.0085),
(12.0, 0.012), (14.0, 0.0155), (16.0, 0.0195), (18.0, 0.023), (20.0, 0.028)
```

Figure 10. The STELLA model's quantitative equations representing 2 MW of wind generation capacity for Grand Portage.

Figure 11 illustrates the model output associated with the above conceptual diagram, model equations, graphical functions and key variable values. The 'sliders' also included in the output represent the key variables. The 'slider' function allows you to manipulate the values of these key data points, and see how the changes impact scenario results. For example what are the effects on the cost comparison between electricity from the utility and wind turbine when the wind speed, grant subsidy, equipment lifetime or interest rate values change? The 'sliders' allow the user to experiment with these practical economic planning considerations. As you can see in this particular scenario (Table 11) the annual cost of wind generated electricity ($240,892) is significantly cheaper than that of the utility ($352,170), and the gap between the two increases if one assumes an increasing rate per kWh from the utility over the lifetime of the wind turbine.

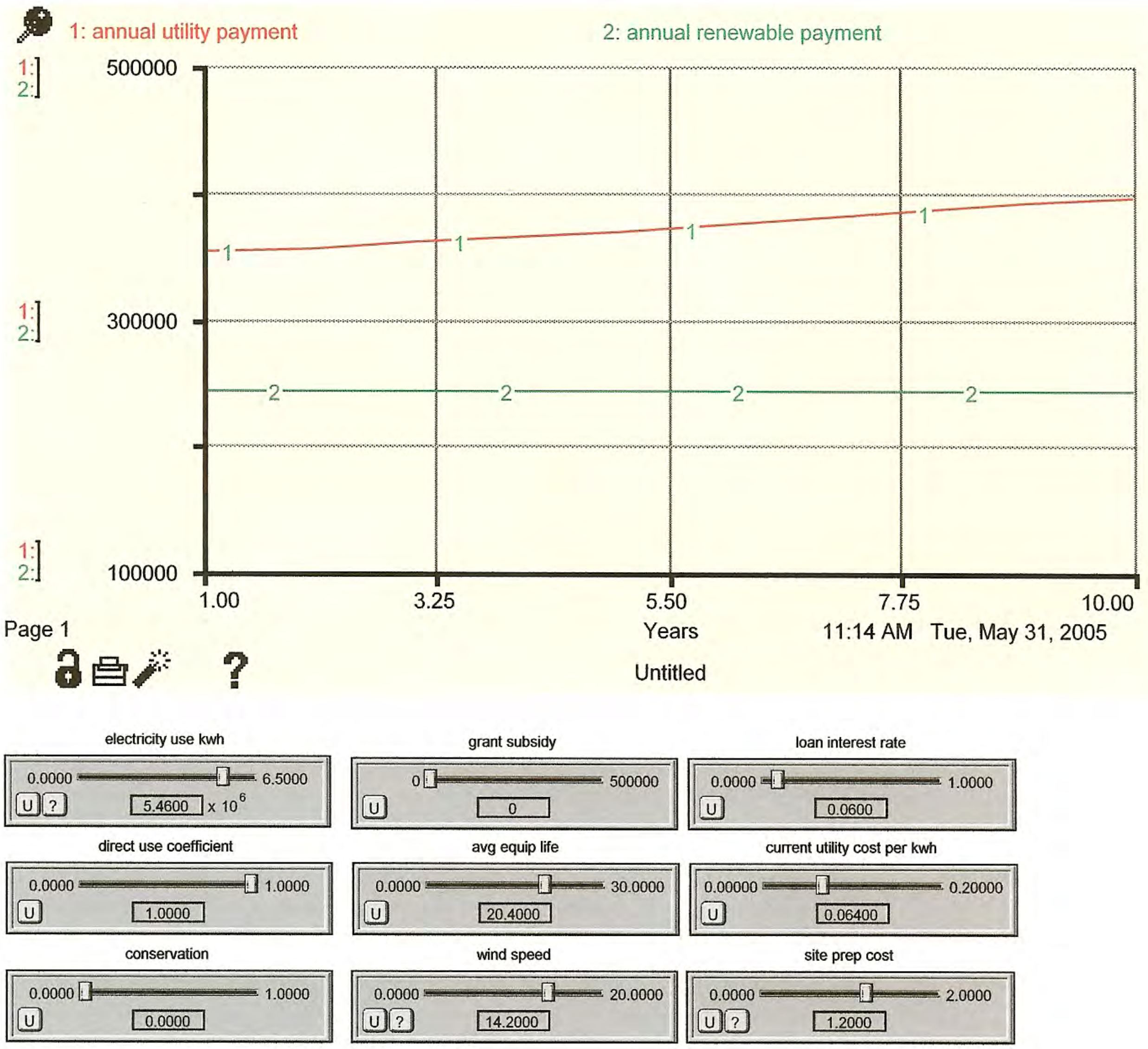

Figure 11. The STELLA model graphical output and key variable sliders representing 2 MW of wind generation capacity for Grand Portage.

Scenario #2: 2 MW Wind Turbine with 40% hydrogen/fuel cell backup

In this scenario the excess wind-generated electricity produced on windy days is used to produce hydrogen via electrolysis. The hydrogen/fuel cell sector (figure 12) is linked to the wind sector (figure 9) to model this scenario. It is assumed that 40% of the wind generated electricity is used for this purpose. 4.2 of these stored kWh are used to produce one normal meter cubed (1 NM3) of hydrogen (www.protonenergy.com). 1 NM3 of hydrogen can then be converted to 2.106 kWh using a PEM Fuel Cell operating at 65% efficiency (www.protonenergy.com). The model sizes the electrolyzer and fuel cell capacity according to calculated demand from each, and then calculates the cost of each using graphical functions relating cost to size. The model also increases the size of the wind turbine to keep electricity production capacity constant given the inefficiency added by including hydrogen and fuel cells. The data contained in these graphical functions comes from a survey of several manufacturers each offering several different sized appliances. Finally, the additional costs associated with electrolysis and fuel cells are added to the wind turbine costs to arrive at the total renewable system costs. The total cost is then converted to an annual cost using the mortgage equation plus annual maintenance costs described above. Using the data above in combination with the wind generation sector data reported in scenario one the annual utility costs ($352,170) are significantly lower than the wind backed up by hydrogen and fuel cells ($440,812) (table 3) given the current costs of the latter technologies.

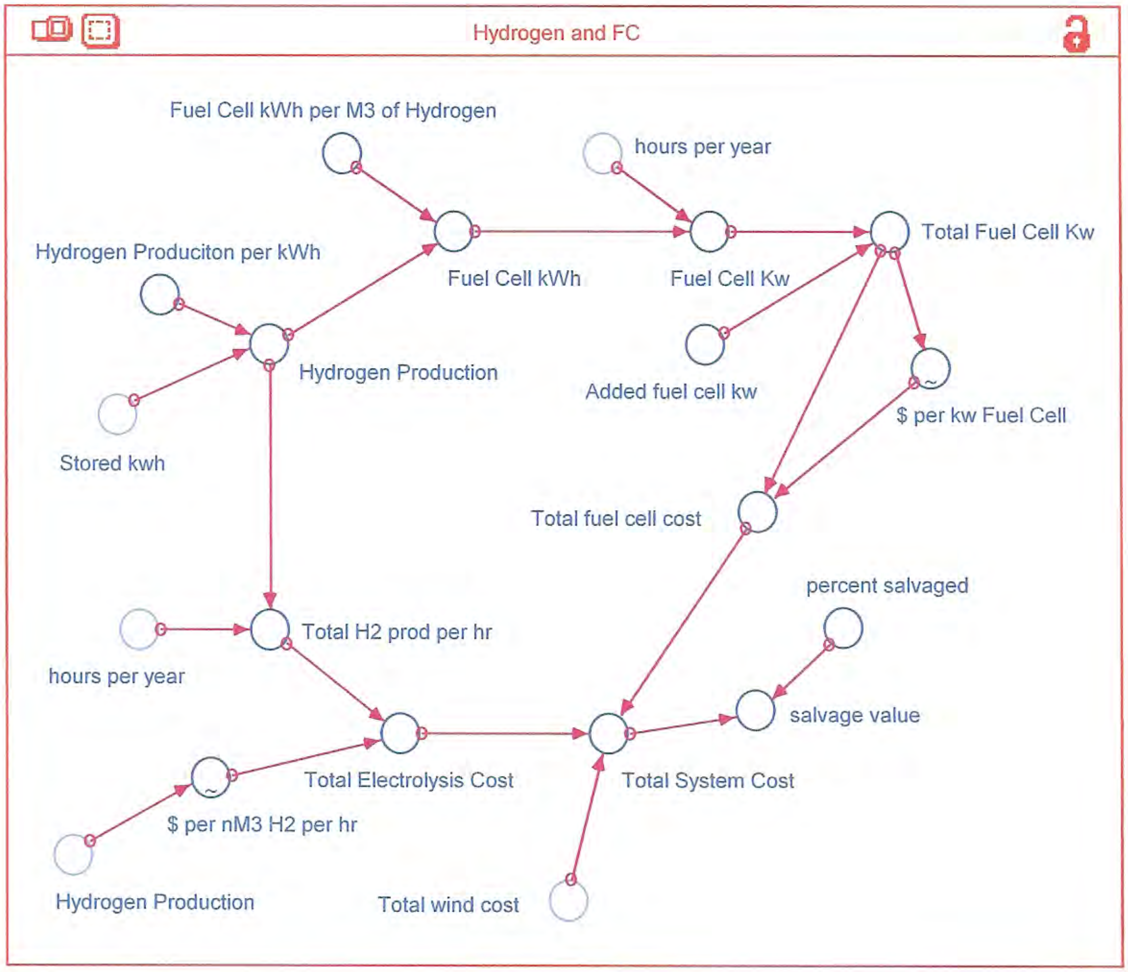

Figure 12. The STELLA model's Conceptual diagram of the hydrogen, fuel cell sector.

Scenario #3. Plasma Torch (1 MW or 24 tpd)

Figure 13 illustrates the conceptual diagram for our model of the plasma torch technology. The model begins with a selection of torch size (MSW tpd) and calculates the total annual tile production, net electricity production and MSW tonnage hauled. The total annual market value of tile, electricity and tipping fees are then calculated and added to arrive at total annual plasma torch revenue. The cost of the selected Plasma Torch size is then calculated along with the annual maintenance costs. Finally, the annual torch cost is calculated using the mortgage equation described in the previous scenarios.

The key data for the Plasma Torch model include: equipment life, utility cost, grant subsidy, interest rate, tipping fees, net KW per ton of MSW, tons of tile per ton of solid. In this scenario we assigned the following values to key data: The equipment life is assumed to be 20 years, the utility cost is 6.4 cents per kWh, we assumed no grant subsidy, an interest rate of 6%, tipping fees of $40 per ton, 100 KW per ton of MSW, and .5 tons of tile per ton of solid. There is also a key graphical function relating cost per ton to torch size. The data behind this scenario is questionable, there are many plasma torches in operation around the world, but none aimed at electricity and tile production, so the exact numbers are currently difficult to pin down. Basically, the technology needs to be pilot tested for these particular applications to gain confidence in its potential. In this particular scenario the annual torch costs ($633,877) are significantly smaller than the annual torch revenues ($3,244,704). In fact those annual revenues will pay back the 6 million dollar torch cost in just under two years. In addition, the torch has tremendous local economic development potential compared to wind as reported in a later section. These numbers, of course, appear to good to be true, and we are currently trying to figure out why.

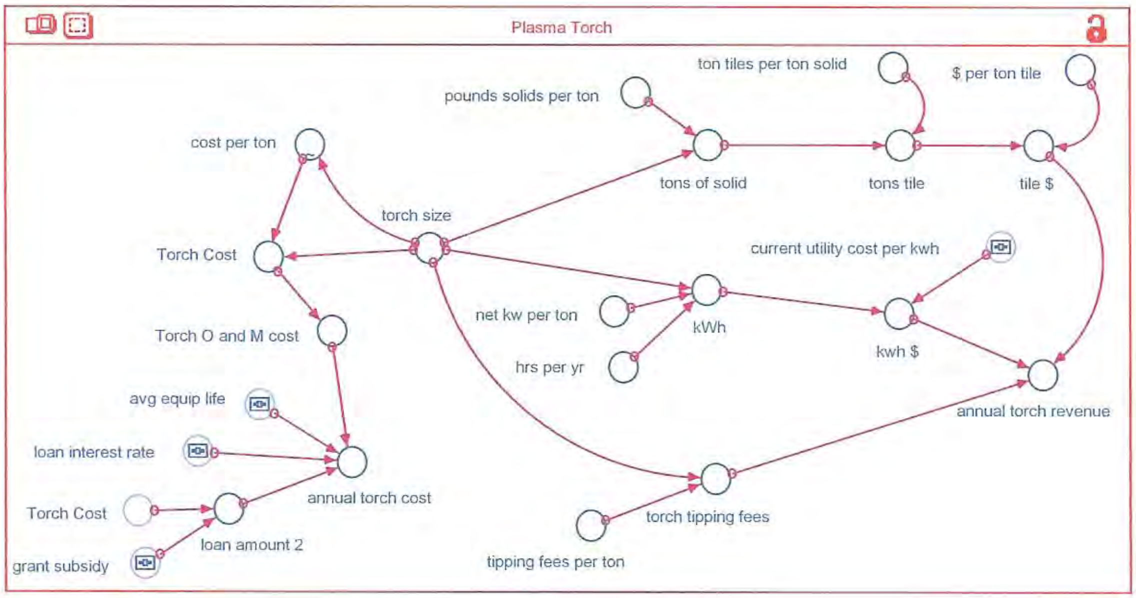

Figure 13. The Stella model's conceptual diagram of the Plasma Torch Sector.

Table 3. A Comparison of Annual Utility Costs VS. Annual Renewable Costs

	Annual Utility Cost	Annual Renewable Cost
Scenario #1	**$352,170**	**$240,892**
Scenario #2	**$352,170**	**$440,812**

3. White Earth Scenarios

We found that White Earth had three key primary resources available locally: wind, sugar beets and biomass. So we analyzed numerous potential energy systems based on these resources. Here we report in detail on three of the most practical and promising scenarios. 1.) 1 MW of Wind. 2.) 1 MW of wind with a 40% hydrogen/fuel cell back up system, and 3.) APR operating on sugar derived from local sugar beet production.

Scenario #1: 1 MW Wind Turbine

This scenario is modeled as reported above in Grand Portage's first scenario (figure 9,10 and 11). Several of the key variables in this scenario have different values unique to

White Earth, and the wind turbine capacity is smaller. The key variables again include: conservation, grant subsidy, wind speed, utility cost, equipment life, site prep costs and interest rate. For this particular scenario we assumed no conservations measures taken and no grant subsidy. The average wind speed is assumed to be 14 mph (from Jay Haley report data). The current utility cost varies between 4.3 and 6.6 cents per kWh depending on demand source and utility. Given this variability we chose 5 cents as a ballpark estimate for the utility cost. The average equipment life is assumed to be 20 years as reported by the major manufacturers, and site prep costs are assumed to be 20% of total turbine/tower costs. Finally the interest rate is assumed to be 6 percent. Given this input data the annual utility cost is slightly more ($141,147) than the annual renewable cost ($131,047) (table 4).

Scenario #2: 1 MW Wind Turbine with 40% hydrogen/fuel cell backup
In this scenario the excess wind-generated electricity produced on windy days is used to produce hydrogen via electrolysis as reported in Grand Portage's scenario #2. Using this hydrogen/fuel cell data in combination with the wind sector data reported above for White Earth's scenario #1 the annual utility costs ($141,147) are significantly lower than the wind backed up by hydrogen and fuel cells ($241,788) given the current costs of the latter technologies (table 4).

Scenario #3: APR
This part of the report is coming soon we are still waiting for key data.

Table 4. A Comparison of Annual Utility Costs VS. Annual Renewable Costs

	Annual Utility Cost	Annual Renewable Cost
Scenario #1	**$141,147**	**$131,047**
Scenario #2	**$141,147**	**$241,788**

4. Leech Lake Scenarios

Scenario #1: 2.5 MW Wind Turbine
Leech Lake was particularly interested in large-scale wind to cover a significant portion of their casino's electricity demand. So we modeled a single 2.5 MW wind scenario based on their existing wind data. This scenario is modeled as reported above in Grand Portage's first scenario (figures 9,10 and 11). Several of the key variables in this scenario have different values unique to Leech Lake, and the wind turbine capacity is larger. The key variables again include: conservation, grant subsidy, wind speed, utility cost, equipment life, site prep costs and interest rate. For this particular scenario we assumed no conservation measures taken and no grant subsidy. The average wind speed is assumed to be 8.8 mph (NREL anemometer reading at 66 feet – data from August of 2003 to Jan of 2003). The current utility cost is 6 cents per kWh. The average equipment life is assumed to be 20 years as reported by the major manufacturers, and site prep costs are assumed to be 20% of total turbine/tower costs. Finally the interest rate is assumed to be 6 percent. Given this input data the annual utility cost is considerably less ($70,785) than the annual renewable cost ($305,336).

C. Indirect Economic Impacts

In addition to the direct economic comparisons discussed above we looked in some detail at the potential indirect economic impacts associated with local energy production on the reservations. We also compare the magnitude of the impacts associated with various technologies, and choices regarding how money (cost savings from local production) is spent by the reservations. We hired some economists from the University of Minnesota Duluth's Bureau of Business and Economic Research (BBER) to conduct an economic impact analysis for three scenarios. Grand Portage was chosen as the example because the entire reservation lies within a single zip code, and the data used by this modeling software is organized by zip code. The scenarios, methodology and economic impact results are described below.

General Assumptions

Study area for the project includes Minnesota zip code area 55605, with comparisons made with Cook County, Minnesota.

Data Assumptions

Care was taken to consider the problem of using public data sources to report economic activity on the Grand Portage Reservation. The impacts reported in this report are based on the assumption that the IMPLAN[1] data files for the zip code 55605 can show a meaningful representation of activity for the study area. IMPLAN data files are based on reporting from the US Census County Business Patterns series. Attempts were made to compare County Business Patterns social security data with reservation businesses, most of which may not be not counted in any data set. Sources from the Minnesota Legislature were consulted, as well as data compiled by RefUSA from public sources including Yellow Page and Business White Page telephone directories.

BBER used for this impact zip code data for 55605 and modeling software for the most recent year, 2002, from IMPLAN. Data were checked against the employment data from the State of Minnesota, and for business activity against the RefUSA database.

Two models were created for these impacts: a Cook County model, and a Grand Portage zip 55605 model. The general model information is as follows:

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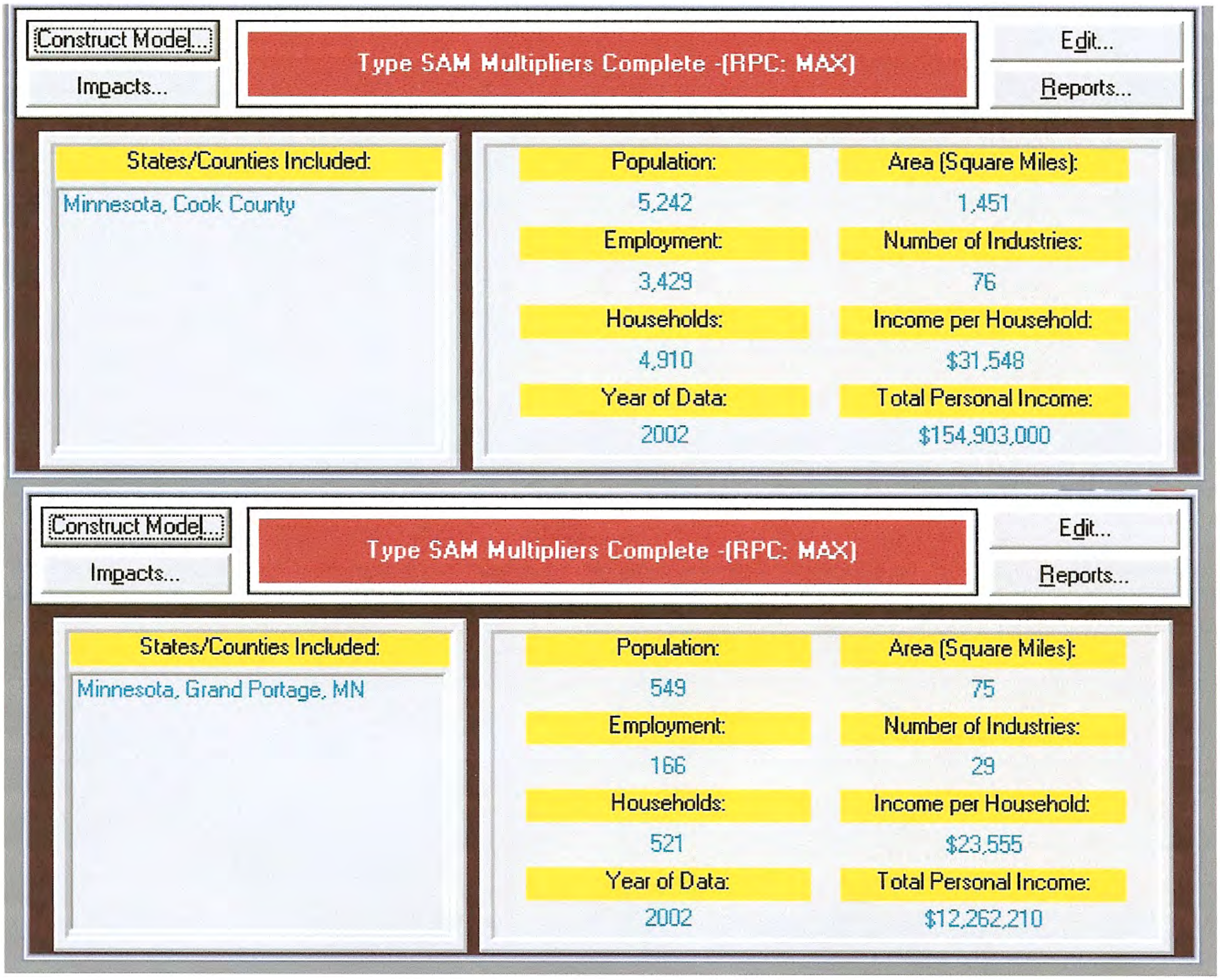
1 Minnesota IMPLAN Group, Inc., IMPLAN System (data and software), 1725 Tower Drive West, Suite 140, Stillwater, MN 55082, www.implan.com.



Scenario 1 Assumptions:

In consultation with Michael Mageau and the Grand Portage Tribal Community, the following estimations were agreed on:

From the STELLA model we assumethe following constraints:

1.25 MW wind turbine

Turbine costs about $1.17 million

7 cents per kWh electricity cost

20-year lifespan (term of loan)

average wind speed of 14 mph

capacity factor of .3

6% interest rate on the loan

annual utility payment = $180K (portion of electricity offset by the wind turbine)

annual payment on the wind alternative = $100K

annual savings = $80K total savings over 20 yrs = $1.6 million

2 MW wind turbine

all other data as above, would result in the following:
annual utility payment: $385 K
annual payment on wind alternative = $200 K
annual savings = $185K
total savings over the 20 years = $3.7 million

Scenario 2 Assumptions:
Estimated consumption of electric power in the zip code study area, distributed over IMPLAN households by nine income groups shows $525,600 of total power output being used.

For the economic impact analysis used here, the assumption is made that all current imports of power generation and supply cease.

The impact results also assume that the total amount of investment usually spent on power generation and supply is invested back into the study area as a disbursement to households.

Scenario 3 Assumptions:
The assumption is made that a by-products sector, such as ceramic tiles based on by-products of the plasma torch (glassy slag), is added to the impact model. (IMPLAN sector 190—glass and glass products except for glass containers.)

The assumption is also made that there can be increased production of power generation, and that this impact can be added to the model through the IMPLAN sector 498 — State & Local Electric Utilities, State owned electric utilities, and locally owned utilities and cooperatives.

Finally, the assumption is made that there can be increased activity in the waste collection industry sector, added to the model as with the increased power generation above. (IMPLAN sector 460—waste management and remediation.)

Note: The impact of these three industry sector changes is aggregated and presented in the report as the total of the three industries' impacts.

Note: This impact does not include cost/benefit calculations such as comparing possible equipment investment and cost of capital over time against savings from new power generation.

Definitions for reading the tables
Measures:

Value Added –	Payments made by industry to workers, interest, profits, and indirect business taxes
Output –	Dollars represent the value of an industry's total production

Employment – Total wage and salary employees and self employed jobs in a region. It is measured in total jobs.

Effects:

Direct – For each dollar outlay for a given industry that amount used for purchase of goods and services from each industry sector model

Indirect – The inter-industry effects of input-output analysis

Induced – The impact of household expenditure in input-output analysis

Findings

Scenario 1: **Add Wind, Spend as Usual**
Economic Impact: Insignificant

Without targeting the savings, what if the Grand Portage Reservation chooses to replace its current power supply with the generation of Grand Portage wind derived power?

This scenario assumes that Grand Portage will invest in equipment to generate wind power to replace the power Grand Portage currently buys from power utility companies. The impact result depends on the assumption that approximately $525,600 is spent purchasing power to supply the needs of the study area, defined as zip code 55605. Given the consumption patterns included in the IMPLAN modeling software that determine how households typically spend their income, the model shows that almost all of the savings from adding wind power would be spent outside the community. Therefore the economic impact would be insignificant. If the $525,600 in savings went directly to households, and household spent this money typically, a very small amount would be left to circulate within the study area itself. For instance, the consumers from Grand Portage would travel to Grand Marais, Duluth, or Thunder Bay, Ontario to acquire goods or services offered there.

Scenario 2: **Add Wind, Keep the Savings**
Economic Impact: Total Grand Portage Value Added = $57,580
Total Grand Portage Output = $528,509.00
Total Grand Portage Employment = 0.6

Total Cook County Value Added = $140,883
Total Cook County Output = $ 557,138
Total Cook County Employment = 2.7*

If the community could control where the savings are spent, what if the Grand Portage Reservation chooses to replace its current power purchase with the generation of Grand Portage wind derived power?

If the Grand Portage Tribal community chooses to produce wind derived power, and decides to target the savings gained from no longer having to purchase power from an outside utility, the revenue spent within the community, can be shown through the IMPLAN model to suggest where these new expenditure might fall. For instance, if the community were to invest (as a community) in some form of community projects, how would the local economy respond? The model apportions these savings by institutional demand. We assume that these savings can be tracked through the industry sector assigned for local electric utilities.

Given the assumption that the savings can be re-invested in the community itself, the calculations of the input-output model show the following values for the measures of Value Added, Output, and Employment, and the three impact effect of direct impacts, indirect impacts, induced impacts and total impacts.

Operating Impacts: 1.25 MW Wind Turbine Replacing Energy Purchased from Elsewhere
Grand Portage (zip 55605)

Table 5. Grand Portage Economic Impacts Associated with Scenario 2.

	Direct	*Indirect*	*Induced*	*Total*
Value Added	$ 55,973.00	$ 718.00	$ 889.00	$ 57,580.00
Output	$ 525,600.00	$ 1,664.00	$ 1,245.00	$ 528,509.00
Employment	0.6	0.0	0.0	0.6

For some perspective on these numbers, compare the same model and assumptions for Cook County:

Operating Impacts: 1.25 MW Wind Turbine Replacing Energy Purchased from Elsewhere
Cook County, MN

Table 6. Cook County Economic Impacts Associated with Scenario 2.

	Direct	*Indirect*	*Induced*	*Total*
Value Added	$ 121,160.00	$ 8,261.00	$ 11,462.00	$ 140,883.00
Output	$ 525,600.00	$ 14,519.00	$ 17,019.00	$ 557,138.00
Employment	2.2	0.2	0.2	2.7*

*Rounding occurred.

Scenario 3: **Add Plasma Torch with**
Economic Impact: **Grand Portage:**
Two New Industries and One Industry Expansion
Total Grand Portage Value Added = $1,093,105
Total Grand Portage Output = $1,942,638
Total Grand Portage Employment = 12.1

Cook County:
One New Industry and Two Industry Expansions
Total Cook County Value Added = $1,202,227

Total Cook County Output = $ 2,108,758
Total Cook County Employment = 14.2

A third set of choices for the Grand Portage Tribal community assumes the possibility of putting in service a 1 MW plasma torch using biomass and waste disposal feed. Contingent on the impact of the plasma torch technology is included the possibility of the introduction of two new industries (the tile production and waste collection) and the expansion of activity in one industry sector (energy production) to the local economy. For the impact on Cook County the possibility would include the introduction a new industry (the tile production) and the expansion of activity in two industry sectors (waste disposal and energy production) to the local economy.

The activity in the three industries associated with the operation of the plasma torch is described in brief as follows:

Waste collection business – Including, perhaps, several jobs created, possible new revenues from tipping fees either locally or from nearby towns.

Tile making business – Including, perhaps, capital equipment purchased from outside community -- raw material from within (the glassy slag which is a by-product of the proposed torch) – the production of ceramic tiles, which could be sold outside the community.

Electricity business – As with the wind generation choice described as scenario two, this business expansion as modeled here assumes the community will spend the savings within the community.

This scenario is imagined as the choice of operating a 1 MW Plasma Torch. Some of the cost benefit estimates supporting this decision were considered by comparing costs for the investment in one of two possible torch purchases, the scale of associated industry costs and benefits, and the projection of a tile manufacturing business on two different scales. For instance, a preliminary discussion of possible scale for the Grand Portage project included rough estimates comparing two sizes of torch installation:

10MW Plasma Torch		**1 MW Plasma Torch**
investment	$22,000,000	$5,000,000
life in yrs	20	20
Tipping Fees:		
tons/day	240	24
days/yr	365	365
$/ton	$50	$40
	$4,380,000	$350,400
Electricity production:		
price/kwh	$0.04	$0.06
kw	10,000	1,000
kwh/yr	87,600,000	8,760,000
$/yr	$3,504,000	$525,600
Tile Production:		
tons/yr	8760	876
price/ton	$1,000	$1,000
$/yr	$8,760,000	$876,000
tons waste/day	240	24
tons waste/yr	87,600	8,760
lbs slag/yr	35,040,000	3,504,000
tons slag/yr	17,520	1,752
tons tile/yr	8,760	876
tile revenue/yr	$8,760,000	$876,000

Figure 14. Comparison of 10 MW and 1 MW Plasma Torch

The "feed stage" of the larger torch appeared beyond the capacity of the region to support in bio mass transfer. Operating impacts from the operation of the 1MW plasma torch are modeled with the following results:

Operating Impact: 1 MW Plasma Torch with Two New Industries and One Expanded Industry Contributing to the Impact
Grand Portage (zip 55605)

Table 7. Grand Portage Economic Impacts Associated with Scenario 3.

	Direct	*Indirect*	*Induced*	*Total*
Value Added	$ 990,341.00	$ 70,626.00	$ 32,138.00	$ 1,093,105.00
Output	$ 1,752,000.00	$ 145,375.00	$ 45,262.00	$ 1,942,638.00
Employment	10.4	1.3	0.3	12.1

Operating Impact: 1 MW Plasma Torch with One New Industry and Two Expanded Industries Contributing to the Impact
Cook County, MN

Table 8. Cook County Impacts Associated with Scenario 3.

	Direct	*Indirect*	*Induced*	*Total*
Value Added	$ 989,050.00	$ 124,026.00	$ 89,152.00	$ 1,202,227.00
Output	$ 1,752,000.00	$ 224,346.00	$ 132,412.00	$ 2,108,758.00
Employment	10.5	2.1	1.7	14.2

Additional Considerations for Discussion of Scenario 3

A preliminary search of background information for communities deciding to adopt this new technology presented the following reviews for consideration:

1) City to Brief Council on Plasma Arc Recommendations for Landfill Reduction
Honolulu, HA
March 30, 2004
http://www.co.honolulu.hi.us/csd/publiccom/honnews04/plasmaarcrecommendations.htm

Advocates of plasma arc/torch promised comparable or lower costs than H-POWER, increased environmental benefits and a facility that could process everything with no residue to the landfill – making the need for landfilling obsolete. The information gathered in the RFP (request for proposals) process did not support those claims.

- The costs proposed were twice that of traditional waste-to-energy (WTE).
- There were no environmental advantages related to lower emissions or higher energy production – air emissions and energy production would be similar to WTE.
- Proposals required the use of additional fuels – plasma arc uses coke and plasma torch uses both coke and coal – in order to maintain the base heat, which contributes to the higher operating cost and depletion of non-renewable fuel resources.
- Landfilling of residues, or slag, would still be necessary. Proposals included intentions to reuse the residues, but there was insufficient evidence of feasibility. The largest operational facility in Japan is landfilling the residue from the plant, and thus far there is no evidence that the residue material has been accepted for use or application by any business or operation.
- Plasma arc technology applied to solid waste is still in a research and development stage, raising significant questions of reliability. The current state of the technology poses potential high risks of interrupted service operations due to technical complications. The Eco Valley facility in Utashinai is the largest and has a design capacity of 166 tons per day. The facility is presently running at half capacity and has not produced power for sale on a consistent basis. All other plasma arc facilities are small capacity demonstration types for disposal of hazardous materials. There are no plasma arc facilities of reasonable capacity,

such as the 100,000 tons-per-year facility proposed for Honolulu, operating commercially anywhere in the world.

- Plasma torch technology has been primarily used in the metals smelting industry. The Ibaraki plasma torch facility in Japan burns approximately 50% coke and coal and 50% municipal solid waste. The use of coke and coal in substantial quantities does not reduce our dependence on fossil fuels and increases the potential for green house gas emissions. While there are a few small, 25-ton-per-day and less facilities in Japan, larger facilities are at best in the proposal stage. Other companies who proposed similar smelting technology for the disposal of municipal solid waste on a commercial basis have not been successful.

- "After thorough evaluations . . . we concluded that utilizing plasma arc/torch would significantly increase the cost of waste disposal for Oahu and would not provide any environmental advantages to justify such cost."

2) An End to Landfills?
By Derek Reiber
March 2, 2004
http://www.fourwinds10.com/news/12-science-tech/D-new-technology/2004/12D-03-08-04-an-end-to-landfills.html

- "process works without releasing contaminants into the atmosphere, plasma-torch technology is catching on across the world, with new plants opening in China, Italy, Hawaii and Japan" (Reiber).
- "As availability of land grows more scarce and environmental and health laws governing waste disposal become more stringent, plasma-torch technology could start to look more and more attractive" (Reiber).
- Cost is a major issue. "At close to $70 per ton of garbage, plasma-torch technology is easily double the price of cheaper methods such as incineration and landfill disposal. But in locales where land is at a premium, including Europe and Japan, plasma torches are being seen as cost-effective for a variety of waste streams" (Reiber).
- "The other drawback to plasma-torch technology is that is uses up almost as much energy as it produce in combustible gases" (Reiber).
- "Besides the ability to reduce waste to 90 percent less than its previous volume, the capacity to generate its own power—and potentially produce surplus power that's fed back to the grid—is enticing waste managers to give plasma technology a closer look" (Reiber).
- "start up costs for many plasma facilities can run into the millions of dollars, making the technology currently cost-effective for only a narrow range of potential users" (Reiber).

<u>3) Plasma Power</u>
By Kimberly Link-Wills
2002 Georgia Tech Alumni Association
http://gtalumni.org/Publications/magazine/sum02/article2.html

- "In Japan, they're using their system for disposal of municipal solid waste and automobile shredder residue, what's left after they recycle all the metals and everything else they can. They're running out of landfill space in Japan" (Link-Wills quoting Lou Circeo, director of plasma research programs at the Georgia Tech Research Institute).
- "Anything they don't want is put into the hopper and it goes through a slight grinding process. Then it's squeezed into a bale that's pushed into the furnace. The only thing that comes out of there is a molten stream — no ashes, no cinders, just a molten stream. That's put into water. What they end up with, instead of a big block of hard rock, is a sand-like material. The fuel gases that come off — mainly hydrogen and carbon monoxide — are sent into a secondary combustion system. The hot gases are then mixed with water to form steam, which goes up and runs a turbine to produce electricity. After a treatment process, the gaseous emissions are essentially carbon dioxide by the time they get up in the stack" (quoting Lou Circeo, director of plasma research programs at the Georgia Tech Research Institute).
- "Japan's 25-tons-per-day facility has been so successful that a 200-tons-per-day plant is in the works. He says five facilities that size could probably get rid of most of the city of Atlanta's garbage" (Link Wills)
- "Political opposition and Lumpkin County residents wary of a torch hotter than the sun and garbage being brought into their county ultimately led to the Dahlonega City Council's defeat of the proposed plasma plant" (Link Wills).

IV. Communication/Education

A. Grand Portage

The Center for Sustainable Community Development has made several trips to Grand Portage to meet with the reservations renewable energy team (listed below). These meetings have included conversations about the potential renewable energy resource mixes available to Grand Portage. Several social, environmental, and economic questions and concerns were raised regarding the various energy production choices. For example, questions were asked regarding how the reservation would fund the chosen system? What are the various impacts of the various technologies? How many jobs would the technologies create for the region? As these questions were raised the CSCD would seek answers from manufacturers, scholars, industry consultants, and similar case studies. We would always communicate our findings in an attempt to educate our project partners to ensure their long-term self-sufficiency on these matters.

Through our meetings with Grand Portage we had the pleasure of working with several stakeholders who have vested interests in the project. They include members of the tribal council and reservation employees.

Tribal Council Members:
Chairman: Norman W. Deschampe
Vice-chairman: John Morrin
Secretary/ Treasurer: Gilbert Caribou
Councilman: Dean Deschampe
Councilwoman: Lorraine Wipson

We have also worked with Grand Portage employees including: Brad Frazier, Victor Aubid, Shannon Judd, Margaret Watkins, and Greg Jonas on this project to assist in information gathering, brainstorming, and educating one another about Grand Portages renewable energy goals. Below is a list of the visits the CSCD had with Grand Portage, and the content of what was discussed.

The CSCD's first and second meeting with Grand Portage included discussions about education, assessment, and strategic planning for the project.

The educational component was composed of discussions about details of generating electricity on the reservation. In these meetings the CSCD introduced Grand Portage to a wide variety of renewable technologies, covered the technical capabilities of the renewables, discussed costs of the technologies, and discussed the environmental, economic, and community benefits associated with their use. We also discussed how this information could be conveyed to the Grand Portage Community.

The assessment component involved analyzing the electricity consumption patterns, costs and conservation potential of the Grand Portage community. In addition, we discussed the wind monitoring data and the proposed site to determine the feasibility for wind generated electricity.

The strategic planning process will use the above assessment data, the tribal council and their staff input to design an energy production system for Grand Portage.

The third meeting with Grand Portage was used to describe project reorganization and staffing, to develop new project plans, to develop new goals, and to develop contractor roles and general timeline. Discussions were held about the potential for proposed wind demonstration projects on each reservation (wind resource, scale, sites, and electricity demand to meet with wind). The potential for adding hydrogen and fuel cells to back up the wind in place of utility buybacks were also discussed.

The fourth meeting with Grand Portage was used to visit the purposed turbine site known as Mt. Maud. After visiting the site we reviewed wind data collected over the past year at 60 feet. There was discussion of wind turbine sizes and specific discussion about a 1-2 MW turbine. This led to discussions over purchasing new versus old turbines, the various costs, the various outputs, and characteristics of Mt. Maud. There was further discussion about implementing electrolysis and fuel cell for hydrogen production to back up the wind. This demonstration system (wind, electrolysis, and fuel cell) would serve as a supplement to traditional fossil fuel electricity as well as a demonstration, which could also be used for community education. All of these discussions were facilitated with a computer simulation model that the CSCD developed for this purpose. There was further discussion over a community education workshop. There was also discussion regarding the content of the DOE presentation in October.

The fifth meeting with Grand Portage was dedicated to the continued discussion of the wind demonstration project on Mt. Maud (wind resource, turbine size, purchase price, financing, and installation challenges posed by Mt. Maud site) as well as the potential for adding hydrogen and fuel cells to back up the wind in place of utility buybacks. Furthermore, potential grant opportunities to help cover costs of the proposed system were discussed. We ran the computer simulation model for the reservation to get a feel for project costs and key factors influencing those costs. The CSCD also identified key data still needed for model development and continuing project planning.

Our sixth meeting with Grand Portage included a meeting with the tribal council and representatives of Phoenix Solutions to introduce Grand Portage to Plasma Torch technology and get key questions answered and a basic outline of a potential pilot partnership for DOE and USDA funding opportunities.

Our seventh meeting took the CSCD to Hutchinson, MN to visit Phoenix Solutions Plasma Torch demonstration facility with members of the tribal council. We witnessed the Plasma Torch in operation and heard details in a presentation that focused on operations, costs and capabilities, and environmental considerations from Phoenix's engineers. The DOE/USDA proposal was further discussed for Grand Portage's pilot project. The Grand Portage Tribal Council has yet to make a decision on the Plasma Torch Pilot Project

B. White Earth/Leech Lake

The CSCD traveled to the White Earth and/or Leech Lake reservations several times to meet with interested stakeholders. Due to the geographical location of the two reservations, we met with representatives from both tribes simultaneously. These meetings were conducted to assess the renewable potential and energy needs of each reservation, discuss environmental, social and economic impacts of various technologies, and address any questions and concerns that arose. The CSCD sought out answers by researching and contacting various manufacturers, experts and related case studies. Through our meetings with White Earth and Leech Lake, we formed ties with many project partners.

Project Partners:
Mike Triplett – White Earth Reservation Planner
Winona LaDuke – White Earth Land Recovery Project (WELRP) Founding Director
Ron Chilton – WELRP Sustainable Communities Coordinator
Justin Dimmel – WELRP Intern
Aaron Price – WELRP Intern

Brandy Toft – Leech Lake Air Quality Specialist

Below is a list of the meetings the CSCD had with White Earth and Leech Lake and a summary of what was discussed.
The CSCD's first meeting with White Earth included discussions about the framing of the project, who will be in charge of what initiatives on the project, what the goals of the project are, and a brief timeline.

Our second meeting with White Earth and Leech Lake was used to describe the project and reorganize the staffing. New project plan, goals, contractor roles, and timeline were also developed. Discussion proceeded about potential for wind demonstration projects on each reservation (wind resource, scale, sites, and electricity demand) as well as the potential for adding hydrogen fuel cells to back up the wind in place of utility buybacks.

Our third meeting with White Earth and Leech Lake included site visits. Leech Lake casino was visited, which is their proposed turbine site. We then met on White Earth to visit their three possible sites, and possible buildings that would be powered by the turbine. We determined remaining data necessary to choose the best site (wind speed, land ownership, utility relationship, proximity to demonstration buildings, and plan for gathering remaining data. We also discussed overall project and the power point slide-show for the October DOE presentation.

Our fourth meeting with White Earth and Leech Lake involved continued discussion for their proposed wind demonstration projects on the reservation (wind resource, scale, sites and electricity demand) as well as the potential for adding hydrogen and fuel cells to back up the wind in place of utility buybacks. We discussed grant opportunities to help cover costs, and ran computer simulation model to get a feel for project costs and key factors influencing those costs. We also identified key data still needed for model development and continued project planning.

V. Recommendations and Next Steps

A. Grand Portage

There are a few steps Grand Portage must take before they are ready for the actual installation of a renewable energy system. First, they will need to define some specifics pertaining to the site on Mt. Maud, such as the cost and capability of building a road and running a transmission line to the site. Second, it will be necessary for Grand Portage to contact the utility and determine what demand charges may apply if they decide to consume all the electricity they produce at the casino. Some utility companies charge their customers a "stand-by fee" for the service of backing-up the wind, and it is important to verify whether or not these or any charges apply and if they are negotiable or flat fees. Some projects must also complete an Interconnection Evaluation Study done by Midwest Independent Transmission Operator (MISO) for small generators (20 MW or less). There is a $5000 charge for this study and it will be critical to find out if this is applicable. Grand Portage also must investigate federal and county permits (Conditional Use Permit) to see if they apply to the reservation. The final step for Grand Portage will be securing financing for the project. There exist several funding options to assist the reservation in the capital costs of equipment. Grants, low-interest loans and support from the tribal council are ways to help cover costs.

After assessing the various scenarios run in the model, the Center for Sustainable Community Development (CSCD) recommends the installation of a 1 – 2 Megawatt wind turbine on the top of Mt. Maud, and we believe, not only will it be economically viable, it will benefit the environment and community as well. We do not recommend using hydrogen and fuel cells to back up the wind-generated electricity. The costs of these technologies are currently too high. The Plasma Torch has great potential, for energy production, job creation and local economic development. It also appears to have many positive environmental benefits, but we do not recommend its implementation due to the large upfront capital costs and uncertainties associated with its capabilities. However, if the reservation is able to receive a grant or some form of aid to subsidize the cost, we would recommend it as a pilot project.

B. White Earth

The first necessary step for the White Earth Reservation is to arrange a meeting with the utilities to determine what they will pay the reservation per kW if they choose to net meter and what they will charge the reservation (i.e. Stand-by fee mentioned above) if they choose to consume all that they produce. After this meeting, White Earth will need to review their prospective sites based on the wind data gathered at each site using anemometers. Once all this data is gathered, they will have to match the best site in terms of wind speed with the best utility situation. They should consider three scenarios. One scenario is to scale the turbine to try to meet the need of a certain building (i.e. Head Start) and then net metering when they exceed the demand. The second option is to scale the turbine smaller than the demand, so they never exceed the demand, and the building will consume all that is produced (i.e. Shooting Star Casino). A third option, which would be independent of the utility, would be to install a wind turbine near a building currently being constructed (Circle of Life School) and power it independently by backing up the wind with hydrogen and fuel cells or APR technology. Once the site and utility issues are settled, they can choose a wind turbine that performs best given the site-specific wind dynamics. We do not recommend the use of hydrogen and fuel cells to back up the wind. We believe wind remains an economically viable for White Earth and recommend the installation of a wind turbine once the issues above are worked out successfully.

We also suggest White Earth look further into the process of the Aqueous Phase Reformation (APR) of sugar. This technology like the Plasma Torch for Grand Portage, offers great potential for energy production, job creation, and local economic development at minimal costs to the environment. If the reservation decides they are interested in going forward with researching APR, they should begin by assessing local crop potential and forming relationships with local farmers. Connecting sugar beet and corn farmers with the project will strengthen community ties and be beneficial to all participants. There is also the possibility to work in conjunction with these area farmers to erect a wind turbine on their land. The farmers could receive up to $4,000 to lease land for a turbine.

Finally, the idea of developing a "training program" surfaced at one of our meetings. Winona LaDuke had the idea of building a wind-training curriculum to educate local people in the development of wind technologies, the policy issues, and over time, the maintenance issues. There would be a good possibility of obtaining funding to develop a prototype curriculum, one that could be used at colleges throughout the Midwest.

C. Leech Lake

After running several modeled scenarios for Leech Lake using wind data from NREL, we have come to the conclusion that the wind speed at the chosen site is insufficient, and therefore is not economically viable. We suggest that they do one of two things; either investigate other sites for a turbine where the wind may be stronger and more consistent, or explore other renewable resources in the region and fit them with any of the potential technologies mentioned in this report.

Green Tags

Another form of revenue for the reservations to offset the costs of the chosen renewable energy system is the opportunity to sell green tags (renewable energy credits or REC's). The amount of the credit depends on the type of renewable energy, the amount of electricity produced by the system, and the length of the contract period (usually offered in 3,5, or 10 years). Generally speaking, the longer the contract the better the $/kWh credit provided. The payment is regularly sent to the electricity provider. There is a start-up fee of $100.00, and may be paid through the providers future green tag sales. There are several requirements for participation in green tag sales: system grid-connection, available even if there is an existing net metering agreement with utility, system owners cannot re-sell green tags, the system must be a new renewable system (erected after 01/01/99), and system generation must be metered separately for any system over 10kW (www.dsireusa.org).

Determining the Feasibility of Wind Development on the Grand Portage Reservation

Grand Portage, MN

June 26, 2006
Last updated: September 8, 2006

Prepared for:
The Grand Portage Tribal Council

Prepared by:
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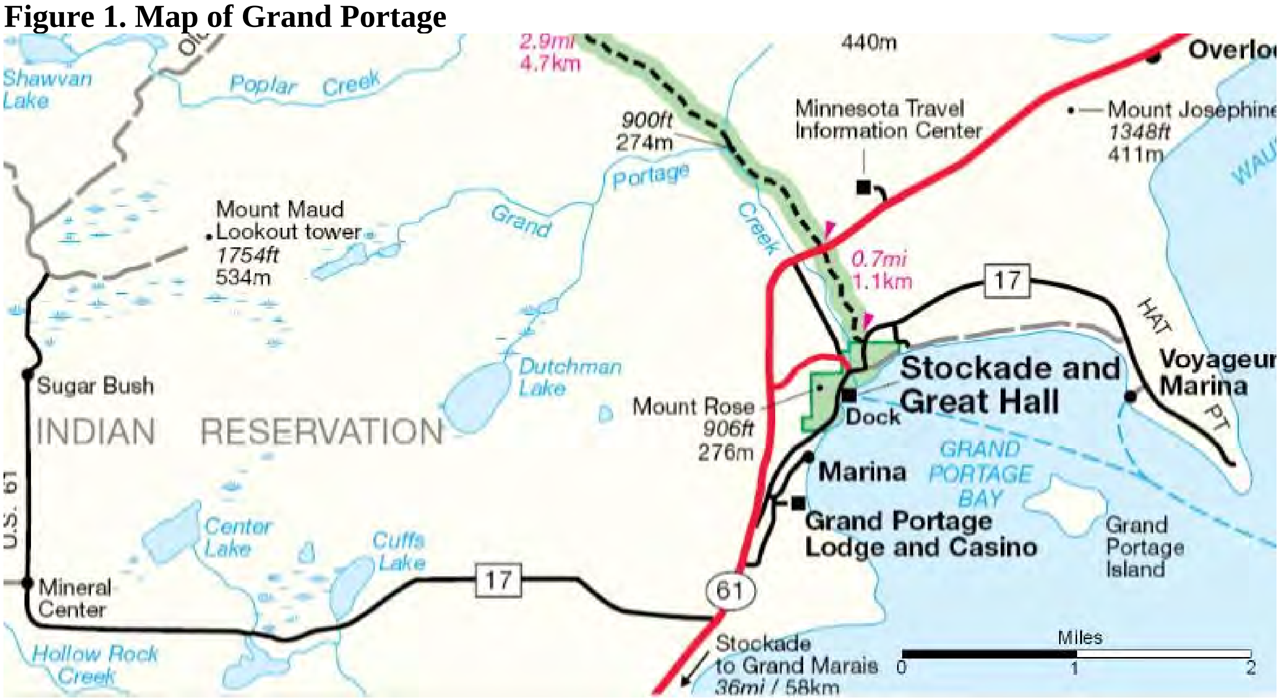
Grand Portage Wind Study

The Center for Sustainable Community Development (CSCD) has been working in conjunction with Grand Portage to conduct a feasibility study to determine the wind potential on the reservation. The feasibility study was a four step process; 1) measuring the wind, 2) analyzing the wind, 3) selecting a turbine, and 4) performing an economic analysis. Following are the results of our study.

Step 1) Measuring the Wind:

Grand Portage received an anemometer on loan from the National Renewable Energy Laboratory. The anemometer (an NRG Wind Explorer) was installed on Mount Maud in January of 2004, and remained in place for 13 months. According to data gathered during that time period, the location has proven to be a viable wind site. The anemometer was mounted on an existing lookout tower that will be removed once the turbine is implemented. Grand Portage is in the process of re-measuring their wind on the WDIO tower on Mt. Maud to rule out any interference the original readings may have experienced due to tower shadowing. They will use three anemometers, spaced 10 m apart, to get a more accurate reading. Mt. Maud is located within the Flaming Maple Ridge and has an elevation of 1754 feet. To access Mt. Maud there are a few miles of unpaved gravel road. The nearest power line is approximately three miles away. The originally measured average annual wind speed was 14.3 mph at 20 meters.

Figure 1. Map of Grand Portage



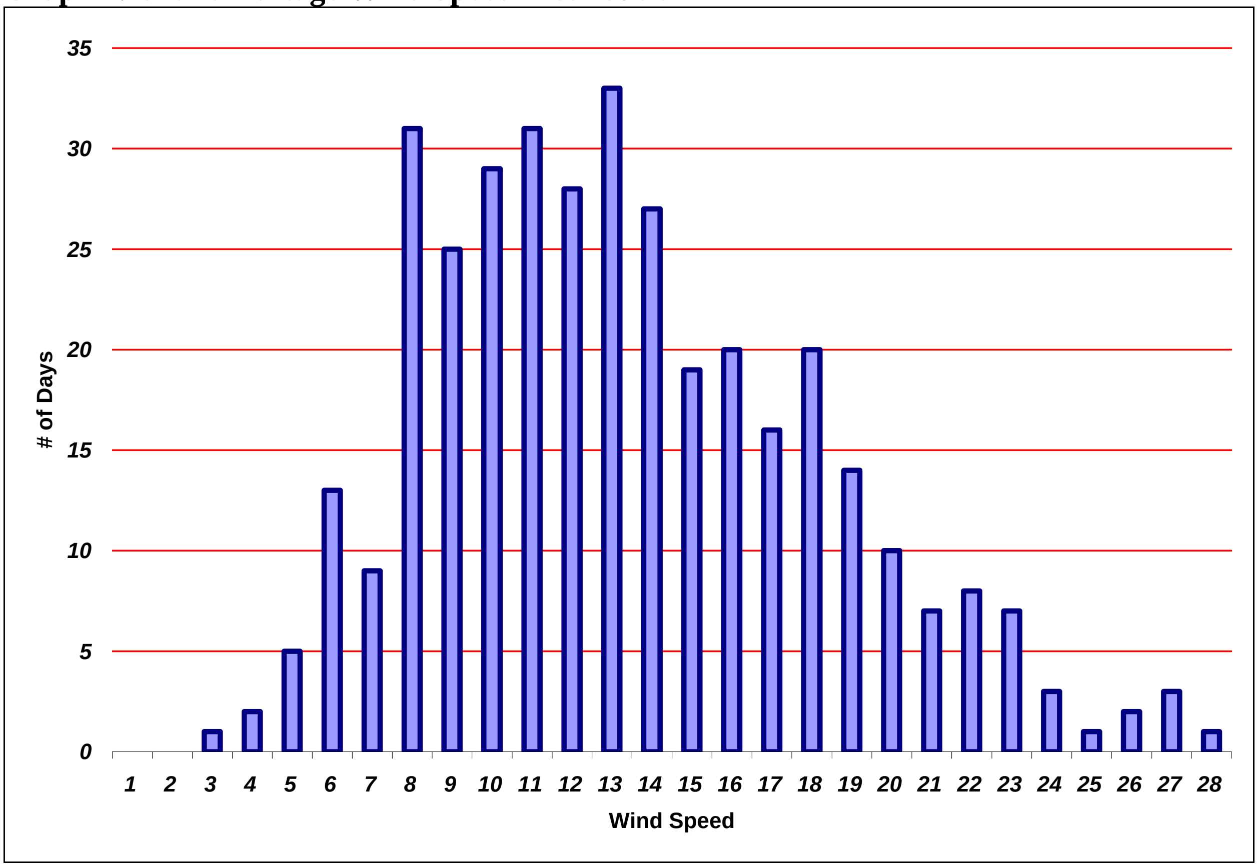
Source: www.nps.gov/applications/parks/grpo/ppmaps/GRPOmap1.pdf

Step 2) Analyzing the Wind:

The method we used to analyze the wind accounts for many different factors influencing the power in the wind. Influential factors include air density, the area intercepting the wind (swept area), wind speed and terrain.

The first step is to group an annual set of wind data into wind 'bins.' Wind speeds are sorted into 'bins' of 0.5-1.5 mph, 1.5-2.5 mph, 2.5-3.5 mph, etc. This tells us the number of days in each wind bin. Graph 1 illustrates the distribution of the number of each days in each wind speed bin.

Graph 1. Grand Portage Wind Speed Distribution



We then take the percentage of the total days that fall into that particular wind bin and multiply it by the power density (the cube of the wind speed multiplied by air density) and sum these numbers for a total Power Density (W/m²). Examples from three wind bins are shown below in Table 1.

Table 1

Wind Speed Bin	**Number of Days**	**Percentage of Year**	**Power Density** (PD) .5pV^3	**PD*Percentage of Year**
(mph)		*(%)*	*(W/m²)*	
1.5 – 11.5	…	…	…	…
12.5	28	0.076712329	117.1875	8.989726
13.5	33	0.090410959	147.6225	13.34669
14.5	27	0.073972603	182.9175	13.53088
15.5 - 28.5	…	…	…	…
Sum				221.218

Next, we must adjust the Summed Power Density by extrapolating from the original height at which the wind was measured (20 m) to the projected hub height of the wind turbine (60 m). It is also necessary to adjust this number by the wind shear according to the surface roughness of the terrain. The wind sheer exponent for Mt. Maud is approximately .2, given the area's rolling forested terrain. We then multiply the adjusted power density by the number of hours per year (8760) and divide by the number of watts in a kW (1000) to get our final electricity output number in units of kWh/yr/m². This number tells us the annual electrical output we can expect from a turbine, depending on the swept area and efficiency of the turbine. The overall calculation is shown in Table 2.

Table 2

Summed PD	**Orig. Ht.**	**Hub Ht.**	**Wind Sheer**	**Adj. PD** (H/Ho)^(3*α)*Po	**Output/m²**
(W/m²)	*(m)*	*(m)*	*Exp (α)*	*(W/m²)*	*(kWh/yr/m²)*
221.218	20	60	0.2	442.4360137	3875.7395

Finally, using an example of a turbine with a 60 meter blade diameter and a swept area of 2826 m², we estimate the output. To determine the turbine output, we multiply the swept area by the output/m². In order to determine the Net Turbine Output, we multiply the turbine output by the efficiency of the turbine, in this case 25%. The calculation is shown in Table 3.

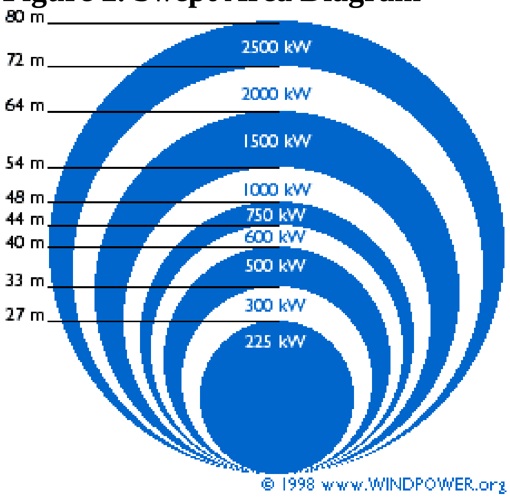
Table 3

Turbine Diameter	**Swept Area** Π(.5d)²	**Turbine Output**	**Turbine Efficiency**	**Net Turbine Output**
(m)	*(m²)*	*(kWh/yr)*	*(%)*	*(kWh/yr)*
60	2826	10,952,839.8	0.25	2,738,209.943

<u>Step 3) Selecting a Turbine</u>

When choosing a turbine, there are many different issues to consider. How much of the total consumption does Grand Portage want to cover? What size turbine is best suited for their project? Do they need a turbine that operates best with low average wind speeds or high average wind speeds? Once we get all these preliminary questions answered, we can focus on the specifications of potential turbines. The most important feature to consider in a turbine is the rotor diameter, which in turn gives you the "swept area" or the area of the turbine intercepting the wind and capturing the power. (See Figure 2 below) It is also important to know the efficiency of the turbine, or what percentage of the total energy captured is processed into usable energy. There are many other elements to look at when selecting a turbine, including generator size, number of blades, tower type, height and cost. All of these different decisions can be confusing and overwhelming to a community looking at wind for the first time and it is here that the CSCD believes we can be of assistance in sorting through all of the information.

Figure 2. Swept Area Diagram



The end goal at Grand Portage is energy production from wind up to the capacity of 2 MW. Whether this consists of the installation of one single large turbine (1 – 2 MW) or a few medium sized turbines (i.e. three 600 kW turbines) is still in debate. There are costs and benefits to either solution. The major barrier to installing one large turbine is that most manufacturers of large turbines are only interested in wind farm projects, and it will be difficult to get a project developer to consider installing only one. Additionally, the cost of installation and necessary equipment is extremely high for a turbine of that size, and typically makes economic sense only when installing multiple generators at the same site. We also must keep in mind the limited access to Mt. Maud and difficulties that might incur while attempting to bring large machinery and equipment up the steep and rough road. The major barrier to installing several medium turbines is that many manufacturers have shifted away from producing medium-sized turbines. The turbine market has polarized to either small (< 100 kW) turbines or large (> 1 MW) turbines. Although there are some turbines in the medium range, the options are fewer.

Issues of Further Consideration

1) Site – Mount Maud is a ridgeline of solid rock. Installing in bedrock raises another issue to be addressed. Although it can be done, additional time and money are necessary for the intensity required. Running a 3-phase power line from Mount Maud to the Casino is another issue to consider with the site. There are two feasible routes the line could travel. One is three miles long with limited road access and would be difficult and timely to service, especially in the winter. The estimated line cost for this route would be $200,000. The other route is six miles long on existing roads with better accessibility. The estimated line cost would be $400,000.
2) Maintenance – The issue of service and maintenance needs to be considered in respect to Grand Portage's remote location. Several manufacturers have local area service

providers in Minnesota; however, most of them are located in the Southwest region of the state. Grand Portage will need to take into account the possible delay in service when turbine maintenance or repair is needed.

3) Insurance – It is highly recommended that turbine owners purchase insurance to protect themselves from incidents like mechanical damage, lightening strikes, fire, and liability. Some utilities might even require the power producer to purchase liability insurance on their turbines in case of an accident. This adds another substantial cost that must be considered.
4) Interconnection – Grand Portage was faced with two options when connecting their turbine. The first option is to tie in to the grid, and buy and sell all their electricity through the utility. This would require a power purchase agreement with the utility to set the rate at which they will buy the power (lower than retail). The second option would be to connect the turbine directly to the end user, in Grand Portage's case, the casino. This type of interconnection is called 'behind the meter.' After research and conversations with the utility, we have found the second option to be the most efficient and beneficial way of interconnecting. The casino will use all the available electricity (saving their retail rate) and then sell any excess to the utility (typically at a rate much lower than retail). This is a viable option due to the fact that the casino is using electricity almost 24 hours/day. The casino does not experience the usual "down time" during the overnight hours, therefore probably won't produce much excess power. We are currently looking into the option of aggregating loads. If it is possible, Grand Portage could aggregate their casino, community center, tribal office, and trading post loads into one and power them all with the turbine. This would allow for the installation of a larger turbine.
5) MISO – According to Don Stead of Arrowhead Electric, Grand Portage will not need to apply to the Midwest Independent Transmission System Operator (MISO). A study done by MISO is required when entities want to transmit large loads of electricity through the grid. Due to the fact that Grand Portage will be connecting 'behind the meter', they will not have to go through the timely and costly process of applying for a MISO study.

Step 4) Economic Analysis

Cost

Using the Suzlon 1.25 MW turbine as an example, we divided the costs into Upfront Costs and Annual Costs. The Upfront costs are one-time payments to cover equipment, shipping, infrastructure, labor, and legal fees. The Annual Costs are figured over 20 years and include insurance, operation and maintenance, utility charges, and finance.

Table 5. Upfront Costs

	Suzlon 1.25 MW
Turbine & Tower	$1,100,000
Shipping	$50,000
Transformer	$17,500
New Power Line ($13/ft x 3 mi. – 6 mi.)	$200,000 - $400,000*
Electrical Labor	$15,000
Concrete & Rebar	$30,000
Foundation Labor	$15,000
Tower Imbeds/Bolts	$15,000
Crane	$100,000 – $200,000*
Labor - Erection	$30,000
Legal	$10,000
Total Cost	**$1,582,500 - $1,882,500**

*cost will be determined by location of site

Table 6. Annual Costs

Insurance	$12,000
Operation & Maintenance	$40,000
Standby charge ($1.39/kW/mo)	$20,850
Finance ($1.5 million, 6%, 20yrs)	$129,241
Total	**$202,091**

Revenue

To calculate the annual revenue, we multiply the net output of each turbine by the cost per kWh. To determine the Net Turbine Output, we used the method described in the **Step 2) Analyzing the Wind**. We multiplied the output/m² by the swept area of the turbine and by the efficiency of the turbine. Below is an example of the equation used for the Suzlon 1.25 MW.

⇒ 3875.7395 kWh/yr/m² (Output/m²) x 3421 m² (Swept Area) x .30 (Efficiency) = **3,977,671 kWh/yr**

In order to determine the annual revenue, we first had to estimate a savings per kWh. This number is dependent on many factors, including the wind data, the size and availability of the turbine, the pattern of Grand Portage's energy use versus their wind pattern, and the agreement with the utility. Grand Portage's savings will be $0.07/kWh when they are consuming electricity directly from the turbine and $0.03/kWh when they are selling their excess electricity back to the utility. Therefore, at any given point in time, the savings will be in the range of $.0.03-$0.07. For the purpose of this example, we assumed a revenue of $0.05/kWh or $0.06/kWh to calculate two different scenarios for the Annual Revenue. Table 7 illustrates these calculations, with the annual kWh's rounded up to 4 million.

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Operation & Maintenance	$40,000
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Total Cost	**$1,582,500 - $1,882,500**

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