Tribal Energy Plan

Energy Efficiency & Conservation Strategy

Bad River Band of Lake Superior
Tribe of Chippewa Indians

SEH No. 116117

January 26, 2012

DRAFT

January 26, 2012

RE: Energy Efficiency & Conservation Strategy
Tribal Energy Plan
Bad River Band of Lake Superior Tribe of Chippewa Indians
SEH No. 116117

Mr. Dan Powless
Renewable Energy Coordinator
Bad River Tribal Government Offices
Chief Blackbird Center
72632 Maple Street
Odanah, WI 54861

Dear Mr. Powless:

On behalf of the SEH project team thank you for the opportunity to present this DRAFT version of the Bad River Tribal Energy Plan for your review. We look forward to reviewing the Plan with the Energy Task Force, Tribal Council, and other Tribal Members.

Sincerely,

Andrew Dane, AICP
Sr. Community Development Specialist

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Tribal Energy Plan

Energy Efficiency & Conservation Strategy
Bad River Band of Lake Superior Tribe of Chippewa Indians

Prepared for:
Bad River Band of Lake Superior Tribe of Chippewa Indians
Odanah, Wisconsin

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Executive Summary

The Bad River Band of Lake Superior Tribe of Chippewa Indians (Bad River) received Energy Efficiency and Conservation Block Grant funding through the 2009 American Recovery and Reinvestment Act to develop a Tribal Energy Plan. Bad River contracted with Short Elliott Hendrickson Inc. (SEH) to prepare the Energy Plan in conjunction with the Bad River Energy Task Force. The primary purpose of the Plan is to identify and describe energy conservation and renewable energy strategies for the majority of Tribally-owned facilities. The plan was developed over a period of seven months from March through November 2011. The planning process included Energy Task Force meetings and discussion, two open houses, interviews, review and analysis of prior energy studies, and a study tour. Two comprehensive (level two) energy audits and a solar assessment were also conducted as part of the planning process.

Bad River's Tribally-owned buildings and facilities annually consume approximately 4,491,646 kWh of electricity, 148,435 therms of natural gas, and 5,883 gallons of propane at a cost of roughly $464,174[1]. The greenhouse gas (GHG) emissions associated with Bad River's current energy consumption are roughly 4,706 tons of carbon dioxide per year. Recent investments in energy efficiency have reduced consumption, and the Tribe's long-term energy vision is to move toward energy independence through energy conservation and development of renewable energy resources. To achieve that vision, the Bad River Tribal Energy Plan identifies the following goals and numbered objectives:

Goal: Improve energy management while providing training and education

1. Implement priority energy conservation measures and adopt energy efficient building codes.
2. Develop a tracking system to monitor energy data; train additional staff in energy auditing and weatherization.
3. Educate Tribal members on energy plan and provide homeowner education

Goal: Implement small scale renewable energy projects

4. Implement solar at individual facilities, as funding becomes available.
5. Convert one facility currently using propane to woody biomass heating.
6. Promote sustainable residential housing development including geothermal, solar, wind, and other small scale technologies.

Goal: Implement large scale renewable energy projects

7. Continue planning and design of preferred woody biomass district heating/power alternative.
8. Further assess feasibility of a larger solar energy project while monitoring advances in wind turbine technology.
9. Develop a sustainable biomass supply.

Goal: Education and Organization

10. Clarify Tribal utility rights and assess feasibility of utility formation while taking a more pro-active role in Bayfield Electric Cooperative.
11. Fund a ¾ to full time Energy Coordinator position to provide consistent leadership on energy issues.
12. Engage the community and leadership in energy issues.
13. Promote organic waste conversion and local agricultural production.

[1] Figures based on 2007-2009 utility records for 17 Tribally-owned facilities analyzed in the Energy Center of Wisconsin Load Study.

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Tribal Energy Plan

Energy Efficiency & Conservation Strategy

Prepared for Bad River Band of Lake Superior Tribe of Chippewa Indians

1.0 Acknowledgements

The Renewable Energy and Energy Efficiency Tribal Task Force (Energy Task Force) and Short Elliott Hendrickson Inc. (SEH) would like to thank the following groups and individuals for their support in the development and adoption of the Tribal Energy Plan:

- Bad River Band of Lake Superior Tribe of Chippewa Indians Tribal Council
- Bad River Band of Lake Superior Tribe of Chippewa Indians Tribal Chairman Michael Wiggins Jr.
- Dan Powless, Renewable Energy Coordinator, Energy Task Force Member
- Robert Blanchard, Facilities Manager, Energy Task Force Member
- Scott Vaughn, Assistant Facilities Manager, Energy Task Force Member
- Mark Principato, Mechanical Maintenance Manager/Safety Officer, Energy Task Force Member
- Lorrie Randall, former Director Dept. of Social/Family Services, Energy Task Force Member
- Cyrus Hester, Environmental Specialist, Energy Task Force Member
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- Ervin Soulier, Director Dept. of Natural Resources, Energy Task Force Member
- Lacey Hill, Wildlife/GIS Specialist, Energy Task Force Member
- David D'Acquisto, Recycling Manager, Energy Task Force Member
- Tom Wojciechowski, UW-Extension CNRED Educator, Energy Task Force Member
- Patti Bigboy, Deputy Director of Housing Authority, Energy Task Force Member
- Paul Hackerson, former Director of Housing Authority, Energy Task Force Member
- Loyd Hartwell, Transit Manager, Energy Task Force Member
- Eric Arnold, Tribal Attorney
- Hope Miller, former Grant Writer
- Bobbi Rongstad, Focus on Energy
- Carol Ann Livingston, Grant Writer
- Mark Bergum, GDS & Associates
- Aaron Burman, Resource Recycling Systems
- John Katers, UW-Green Bay/SEH

2.0 Introduction

The Bad River Band of the Lake Superior Chippewa Tribe is a Band of the Ojibwa Nation. Of its 7,567 members, 1,041 live on the reservation, which occupies over 125,000 acres straddling the Bad River in northwest Wisconsin [2]. As sovereign nations, more and more Indian Tribes are exercising their rights of self determination in order to achieve greater energy independence and self-sufficiency. Many Tribes have implemented extensive energy conservation measures, while others have invested in renewable energy companies. For example, the Mille Lacs Band of Ojibwe invested in Windspire, a vertical wind turbine manufacturer. Others have developed commercial scale wind. Still others are developing commercial biomass and solar projects. For example, the Navajo-Hopi Land Commission is planning the development of what could be the largest solar installation in the world. In Nebraska, the Winnebago Tribe recently installed four 2.5 Megawatt (MW) wind turbines.

In addition to energy conservation and renewable energy, several Tribes have formed their own electric utilities, including the Tohono O'odham Utility Authority, the Umpqua Indian Utility Cooperative, the Navajo Tribal Utility Authority, Yakama Power, Ak-Chin Indian Community Utility Authority, and the Alaska Village Electric Cooperative[3]. Many more Tribes, including Bad River, are well positioned to take advantage of energy-related opportunities because of their extensive natural resources and desire to take fuller ownership of their energy assets.

Bad River's Energy Task Force, under the guidance of an elected Tribal Council, the input of community members, and the renewable energy coordinator, are building the analytical capability and the local capacity to more effectively manage and develop new sources of energy for the benefit of the Tribal community.

Bad River has been actively identifying and implementing energy conservation and renewable energy projects over the past six years. The Tribe has completed several successful projects over that period including:

- Residential energy audits
- Tribally-owned facility energy audits
- Multiple energy conservation measures
- Comprehensive energy load analysis of all tribally-owned facilities
- A wind energy study
- Development of 24 residential geothermal units.

More recently, the Tribal Council passed Resolution #08-03-05-147 supporting Tribal Energy Planning efforts (See Appendices). The Energy Task Force is now working to formulate a blue print for energy efficiency and renewable resource development through development of this Tribal Energy Plan. Upon fulfillment, this working document will serve as a directional guide towards realizing the value of energy efficiency and resources for the benefit of the Tribal community as a whole. By combining energy efficiency and renewable energy development, Bad River has the opportunity to reduce its overall energy demand, save money, demonstrate environmental stewardship, and create jobs for Tribal members.

[2] Source: Native Wisconsin: Official guide to Native American communities in Wisconsin.

[3] For an excellent summary of Tribal energy development projects see the Department of Energy's Tribal Energy Program website: http://apps1.eere.energy.gov/tribalenergy/projects_type.cfm.

2.1 Tribal Energy Vision

A **mission statement** is a description of the overall purpose of an organization and is intended to help guide decision making. Bad River's current mission statement is:

> *"To work toward a more progressive, financially stable government, to maintain tribal sovereignty; and enable members to progress individually, towards a more fulfilling life culturally, spiritually, and economically."*

A **vision statement** is a description about what the organization wants to be, or how it wants the world in which it operates to be. It should align with and support the organization's mission. Bad River's energy vision statement, as articulated in resolution #08-03-05-147, is:

> *"To empower and enable the community to move toward energy independence."*

The energy vision supports the Tribe's desire to be a progressive and financially stable organization and to maintain tribal sovereignty. The vision of moving toward energy independence also aligns well with the Tribe's Environmental Policy Statement, which emphasizes the Tribe's commitment to reducing consumption of natural resources (See Appendices). As outlined in resolution #08-03-05-147, the energy vision recognizes that the Tribe is dependent on outside sources of natural gas and electricity for home and commercial building power and heating, and that most Tribal residential and commercial facility would benefit greatly from energy efficiency improvements.

2.2 Key Issues

The following key issues were identified as significant energy-related challenges facing Bad River. They can also serve as guidelines to help the Tribe identify and prioritize specific energy projects over time.

- **Energy independence.** The Tribe currently relies upon outside utility providers for its heating and power needs. Taking steps to reduce energy demand and develop Tribal energy assets are very important in terms of promoting self sufficiency and self determination.
- **Environmental protection.** Bad River has a long tradition of strong environmental protection and stewardship. Energy development must therefore be done in a sustainable manner that does not degrade the physical environment or undermine its long-term regenerative capacity. Potential air quality impacts associated with biomass are a concern.
- **High energy costs.** The Tribe pays a large amount of money for energy bills every year. Most of that money leaves the community. Through energy conservation and/or utility formation, the Tribe has an opportunity to reduce the economic leakage associated with energy costs.
- **Job creation.** Bad River faces significant economic challenges including a lack of employment opportunities. Energy development provides an opportunity to create and retain jobs for Tribal residents.

2.3 Purpose of the Plan

The purpose of the Bad River Energy Plan is to identify energy efficiency and renewable energy strategies for a majority of Bad River's Tribally-owned buildings and facilities. The plan also identifies several objectives in support of the Tribe's long term vision for energy

independence. Implementation plans and a budget define specific actions, timelines, roles and responsibilities, and approximate costs for each objective.

2.4 Planning Process

The Energy Task Force met six times over the period March through November 2011 to develop the Tribal Energy Plan. The Tribe used the National Renewable Energy Lab's (NREL) Tribal Strategic Energy Planning framework as a guide for its own planning efforts. NREL's planning framework includes the following components, which are not intended to be entirely sequential.

- Identify and support a Tribal energy champion
- Develop a common Tribal energy vision
- Develop a community energy baseline
- Identify cultural and environmental constraints
- Identify and evaluate resource options (supply & demand side)
- Integrate supply and demand alternatives
- Establish organizational and human resource needs
- Develop Strategic Energy Plan including Programs & Projects

The specific steps used to develop Bad River's Tribal Energy Plan are described below.

Step One: The process began with an initial kick-off meeting discuss overall project goals, timeline, and communication. Previous energy studies were synthesized into a background document to help guide the planning process.

Step Two: Two comprehensive energy audits were developed for the Chief Blackbird Center and the Community Center. A solar assessment for several facilities was completed as well.

Step Three: Information from 12 prior energy studies was analyzed and compiled. Two community presentations were made summarizing the results of several existing energy studies including energy conservation and potential wind, solar, and biomass projects for Tribal consideration. Tribal members shared their hopes and concerns regarding Tribal energy development.

Step Four: The Energy Task Force reviewed the results of existing energy studies, evaluated energy conservation and renewable energy opportunities, participated in two multi-day NREL energy workshops, and visited a district heating system using woody biomass in northwest Wisconsin. Plan objectives were identified within the framework of an Energy Options Matrix and a draft Tribal Energy Plan was developed.

Step Five: The Energy Task Force shared the results of the draft Tribal Energy Plan with the Tribal leadership and the Tribal Council and the Plan was revised to incorporate additional feedback.

Step Six: The Tribal Energy Plan was presented to the Bad River Tribal Council for approval.

Throughout the planning process, members of the Energy Task Force took advantage of energy related educational opportunities. In March 2011, three members attended a 3-day Tribal Energy Workshop sponsored by the Department of Energy's Tribal Energy Program.

In August 2011, Bad River's Renewable Energy Coordinator attended a three day Renewable Energy Development and Deployment in Indian Country conference also sponsored by the Department of Energy's Tribal Energy Program. Finally, in October 2011 several members of the Energy Task Force participated in a study tour of a district woody biomass heating/cooling system in Barron, WI.

3.0 Inventory of Current Energy Use

3.1 Current Energy Use

Currently, Bayfield Electric Cooperative (Bayfield Electric) provides a majority of the electricity for the Tribe. Bayfield Electric provides service to the area of the reservation east of the Bad River; while Xcel Energy provides power to the area of the reservation west of the Bad River. Xcel Energy (Xcel) also provides natural gas to the reservation. Propane is provided by Como Oil & Propane (Como) and Ferrell Gas (Ferrell). Finally, a limited number of private residences currently heat their homes with wood. Table 1 below lists each of the main Tribal facilities and their utility providers.

Table 1
Facility Energy Providers

Facility	Square Feet	Electricity Provider	Natural Gas	LP Gas
Birch Hill Comm. Center	1,200	Bayfield Electric	Xcel	NA
Casino	45,622	Bayfield Electric	Xcel	NA
Chief Blackbird Center	37,292	Bayfield Electric	Xcel	NA
Community Center	38,162	Bayfield Electric	Xcel	NA
Daycare Center	1,841	Bayfield Electric	Xcel	NA
Elderly Apts.	5,040	Bayfield Electric	Xcel	NA
Elderly Center	3,400	Bayfield Electric	Xcel	NA
Fish Hatchery	NA	Bayfield Electric/Xcel	Xcel	Como/Ferrell
Head Start	6,612	Bayfield Electric	Xcel	NA
Housing Authority	12,985	Bayfield Electric	Xcel	Como/Ferrell
Lodge	25,960	Bayfield Electric	Xcel	NA
Moccasin Trail	12,059	Bayfield Electric	Xcel	NA
Public Safety Bldg.	10,000	Bayfield Electric	Xcel	NA
Recycling Center	8,000	Bayfield Electric	Xcel	Como/Ferrell
Roads Dept. Garage & Office	NA	Bayfield Electric	Xcel	NA
Tribal School	3,948	Bayfield Electric	Xcel	NA
Wake House	1,979	Bayfield Electric	Xcel	Como/Ferrell
WWTP	NA	Bayfield Electric	Xcel	NA
Total	**214,000**	**NA**	**NA**	**NA**

Data was collected on energy consumption from the Bad River Indian Reservation by the Energy Center of Wisconsin (ECW). Their load study focused on energy use for the following 17 public facilities and was collected over the 2007-2009 period:

- Lodge and Casino
- Moccasin Trail Center
- Chief Blackbird Center
- Waste Water Treatment Plant
- Elderly Apartments
- Housing Authority Center
- Head Start
- Tribal School
- Public Safety Building
- Fish Hatchery
- Recycling Center
- Community Center
- Wake House
- Daycare Center
- Birch Hill Community Center
- Roads Department Garage and Office
- Elderly Center

Total energy consumption by energy type is presented in Table 2. Over the three year period from 2007 through 2009, the average yearly demand for Bad River's Tribally-owned buildings and facilities was 4,491,646 kWh of electricity, 148,435 therms of natural gas, and 5,883 gallons of propane.

Electricity consumption decreased steadily from 4,612,486 kWh in 2007 to 4,474,169 kWh in 2008 to 4,388,282 kWh in 2009. On the other hand, natural gas consumption jumped from 139,598 therms in 2007 to 171,305 therms in 2008, before dropping precipitously to 134,401 therms in 2009. Part of the fluctuation can be attributed to a colder weather during the 2008 heating season. The majority of the increase, however, is a result a sharp increase in natural gas consumption at the wastewater treatment plant in 2008. Propane consumption rose sharply from 4,426 gallons in 2007 to 6,999 gallons in 2008, before dropping to 6,223 therms in 2009. The increase in propane consumption is mainly attributable to demand increases at the recycling center.

Table 2
Total Energy Consumption by Type

Type of Energy Consumed	Unit Type	2007 Consumption	2008 Consumption	2009 Consumption
Electricity	kWh (kilowatt hours)	4,612,486	4,474,169	4,388,282
Natural Gas	Therms	139,598	171,305	134,401
Propane	Gallons	7,864	11,720	10,442

To make it easier to compare energy consumption across types of energy, Table 3 converts energy used to million BTU equivalents (1 MMBTU is also referred to as 1 Dekatherm). Total energy consumption over the period 2007-2009 averaged roughly 31,000 million BTU's.

Table 3
Total Energy Consumption in BTUs

Type of Energy Consumed	Unit Type	2007 Consumption	2008 Consumption	2009 Consumption
Electricity	MMBTU	15,738	15,266	14,973
Natural Gas	MMBTU	13,956	17,126	13,437
Propane	MMBTU	751	1,119	997
Totals		**30,445**	**33,511**	**29,407**

Figure 1 below show the relative energy consumption by type of energy in 2009 as a pie graph. The relative composition of electricity, natural gas, and propane was similar for the years 2007 and 2008. In 2009, roughly half (45.7%) of all energy consumption was natural gas with the other half consisting of electricity (50.9%) and a small amount consisting of propane (3.4%).

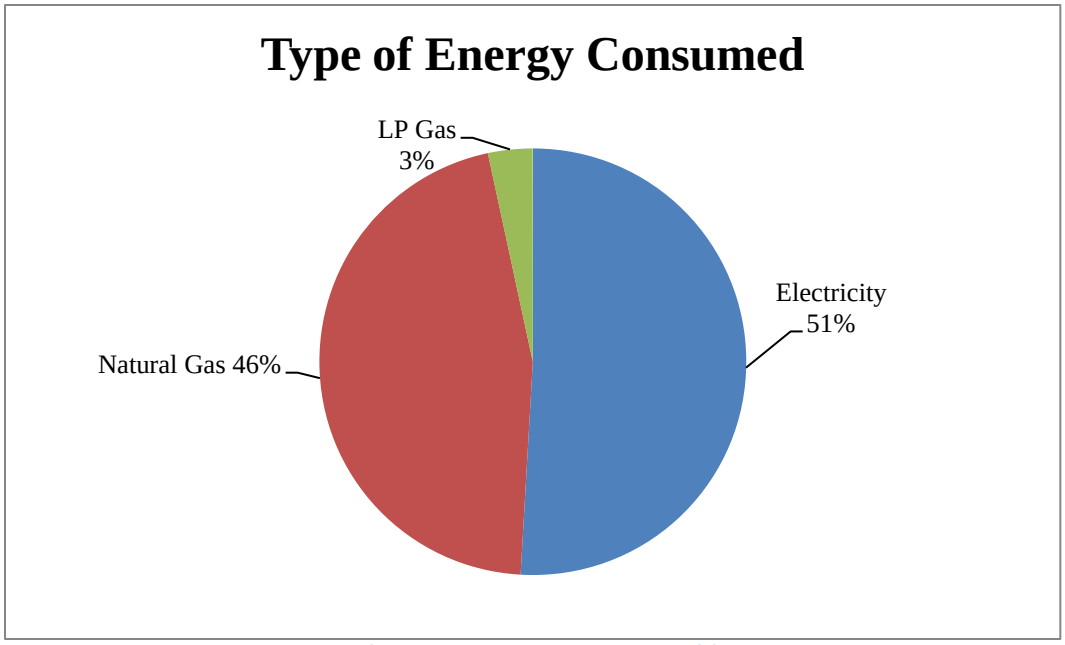


Figure 1 – Energy Demand by Type

3.1.1 Electricity

This section of the Energy Plan describes electricity usage by facility over the period 2007-2009. The Energy Center of Wisconsin Load Study provides additional details on energy use by facility, including monthly profiles illustrating energy consumption and costs (See Appendices for ECW Bad River kW Calcs).

Electricity is used for multiple purposes including lighting, fans, pumps, air conditioning, gaming equipment and other technologies and equipment. According to the ECW Load Study, Bad River's major commercial buildings have a diversified annual peak load of approximately 900 kW. In other words, over the course of a year, the aggregate peak demand for power among the seventeen facilities analyzed is 900 kW.

Figures 2 and 3 show the electricity consumption by metered facility from 2007-2009. All figures are in kWh, however when comparing the two graphs note the difference in scale along the vertical axis.

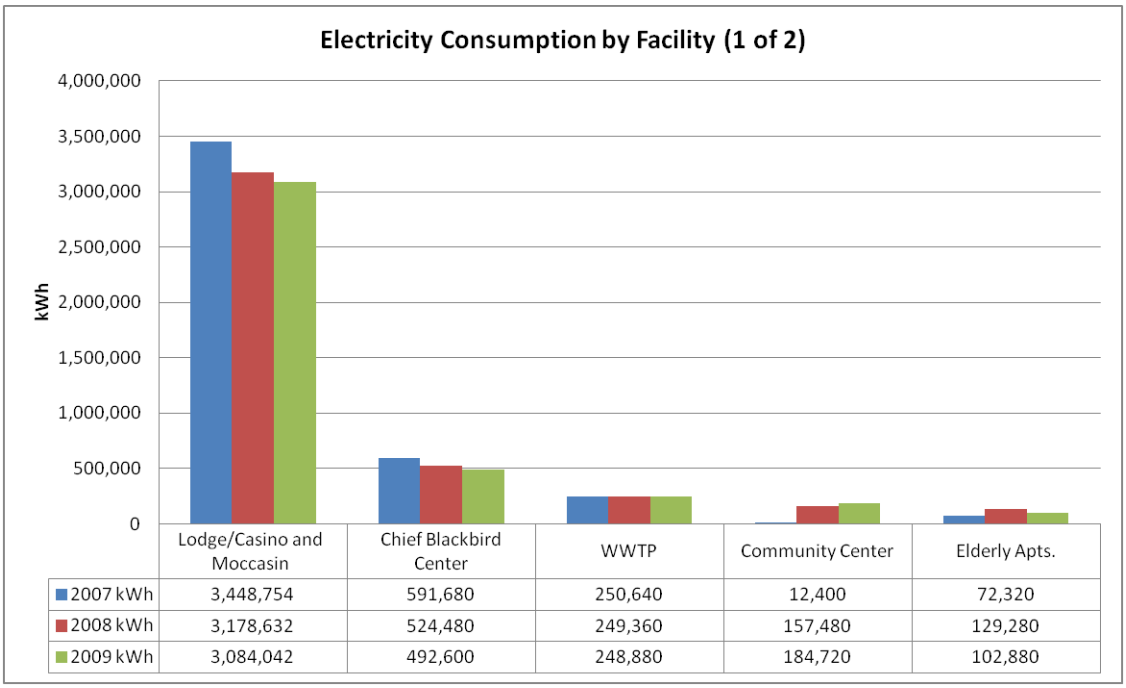
The Tribe's top 5 energy consuming facilities consume the vast majority of electricity. In 2009, they collectively accounted for 93% of all purchased power. The lodge/casino/moccasin trail was the single largest consumer (2,360,215 kWh) followed by the Chief Blackbird Center (410,080 kWh), wastewater treatment plant (186,600 kWh), community center (129,520 kWh), and elderly apartments (102,880 kWh).

Electric demand for the Lodge/Casino/Moccasin Trail complex dropped from 3,448,754 kWh to 3,084,042 kWh from 2007 to 2009, a decrease of nearly 365,000 kWh. Estimated peak demand for the complex is 550 kW, which occurs during summertime afternoon hours when demand for air conditioning is at its peak. Electric demand at the Chief Blackbird Center also dropped over the study period, from 591,680 kWh in 2007 to 492,600 kWh in 2009. Estimated peak demand for the Chief Blackbird Center is 150 kW.

Bad River's third largest electricity consumer is the WWTP, which also experienced a small decline in energy consumption from 250,640 kWh in 2007 to 248,880 kWh in 2009. The WWTP's estimated peak demand for power is 55 kW, with less consumption occurring during the summer months.

The Community Center, unlike the top 3 electricity consumers, experienced an uptick in consumption, from 12,400 kWh in 2007 to 184,720 kWh in 2009[4]. The Community Center's estimated peak power demand is 70 kW. Bad River's fifth highest electricity consumer is the Elderly Apartments, whose demand for power spiked from 72,320 kWh in 2007 to 129,280 kWh in 2008, before dropping to 102,880 kWh in 2009. Peak demand at the Elderly Apartments is approximately 25 kW.

[4] Figures are from the Energy Center of Wisconsin Load Study (See Appendices). It is unclear what accounts for the ten-fold discrepancy in energy consumption.

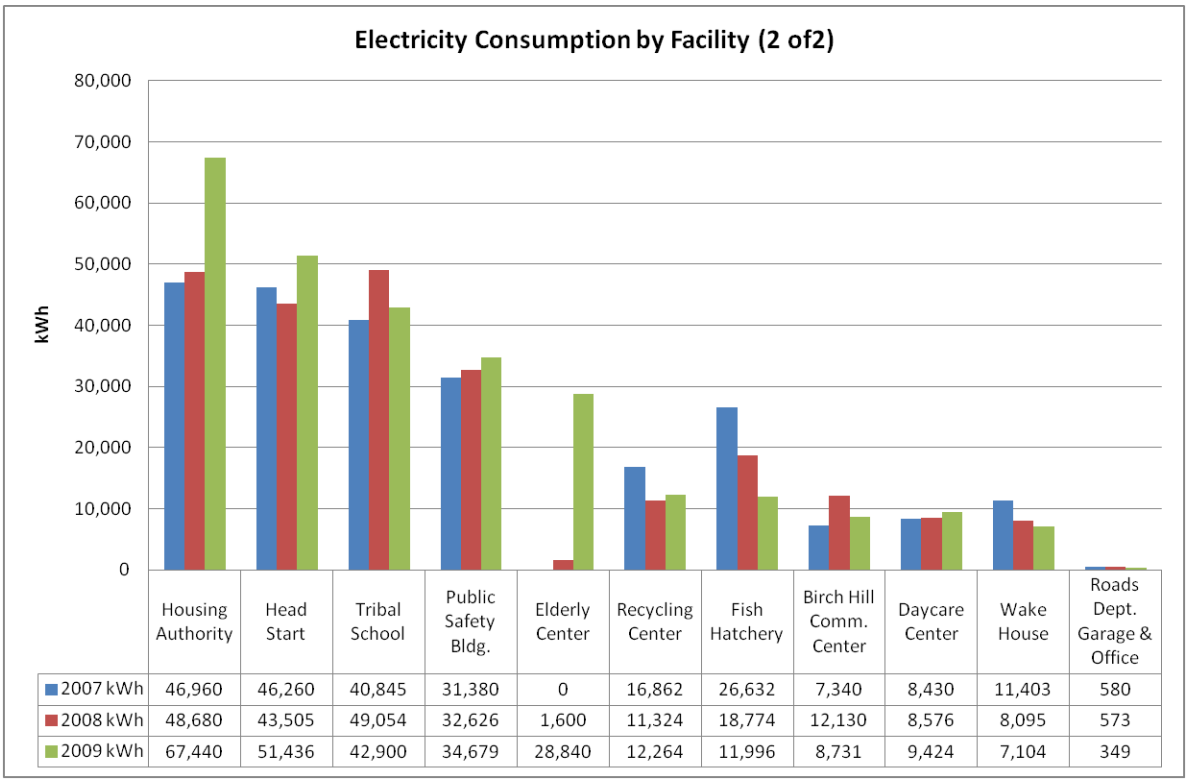


	Lodge/Casino and Moccasin	Chief Blackbird Center	WWTP	Community Center	Elderly Apts.
2007 kWh	3,448,754	591,680	250,640	12,400	72,320
2008 kWh	3,178,632	524,480	249,360	157,480	129,280
2009 kWh	3,084,042	492,600	248,880	184,720	102,880

Figure 2 – Electricity Consumption by Facility (1 of 2)

The remainder of Tribal facilities profiled in Figure 3 accounted for just 7% of the Tribe's total electricity consumption in 2009. The demand for power among many of these facilities fluctuated over the period 2007 through 2009. For example, the Housing Authority's electricity consumption jumped from 46,960 kWh in 2007 to 67,440 kWh in 2009. Its estimated peak demand is 10 kW. Electricity consumption at the Head Start building rose over the period, from 46,260 kWh in 2007 to 51,436 kWh in 2009. Its estimate peak demand is 20 kW. Electricity consumption at the Tribal School spiked from 40,845 kWh in 2007 to 49,054 kWh in 2008, before dropping to 42,900 kWh in 2009. Its peak demand is 15 kW. Electricity consumption at the Public Safety Building rose slightly from 31,380 kWh in 2007 to 34,679 kWh in 2009. Its estimated peak demand for electricity is 5 kW. Electricity consumption at the Elderly Center rose from zero in 2007 (before it was built) to 1,600 kWh in 2008 (the facility wasn't commissioned until late in the year) to 28,840 kWh in 2009.

The Recycling Center's electricity consumption dropped from 16,862 kWh in 2007 to 12,264 kWh in 2009 and its estimated peak demand is just 1 kW. Electricity consumption at the Fish Hatchery dropped precipitously from 26,632 kWh in 2007 to 18,774 kWh in 2008, before falling again to 11,996 kWh in 2009. Its estimated peak demand is 15 kW. The Birch Hill Community Center's electricity demand was highly erratic over the period, rising from 7,340 kWh in 2007 to 12,130 kWh in 2008, before dropping to 8,731 kWh in 2009. Its estimated peak demand is 5 kW. Energy consumption at the Daycare Center was more stable, steadily rising from 8,430 kWh in 2007 to 9,424 kWh in 2009. Consumption at the Wake House, on the other hand, dropped from 11,403 kWh in 2007 to 7,104 kWh in 2009. Its estimated peak demand is 8 kW. Finally, electricity consumption at the Roads Department Garage and Office dropped from just 580 kWh in 2007 to only 349 kWh in 2009. Its estimated peak demand is 1 kW.



	Housing Authority	Head Start	Tribal School	Public Safety Bldg.	Elderly Center	Recycling Center	Fish Hatchery	Birch Hill Comm. Center	Daycare Center	Wake House	Roads Dept. Garage & Office
2007 kWh	46,960	46,260	40,845	31,380	0	16,862	26,632	7,340	8,430	11,403	580
2008 kWh	48,680	43,505	49,054	32,626	1,600	11,324	18,774	12,130	8,576	8,095	573
2009 kWh	67,440	51,436	42,900	34,679	28,840	12,264	11,996	8,731	9,424	7,104	349

Figure 3 – Electricity Consumption by Facility (2 of 2)

3.1.2 Natural Gas

Natural Gas is used predominantly for heating in most of the buildings with use lower in the summer months. Figures 4 and 5 show natural gas consumption from 2007 to 2009. Figures 4 and 5 provide a breakdown of natural gas consumption by facility from 2007 through 2009. All figures are in therms; however as with the previous graphs when comparing the two note the difference in scale along the vertical axis. It should be noted that the Wake House, Fish Hatchery, Housing Authority Center, and Recycling Center do not use natural gas.

The Tribe's top 5 natural gas users consume the majority of natural gas. In 2009, they collectively accounted 73% of all natural gas consumption. However, compared with electricity consumption, natural gas consumption is more evenly distributed among the remainder of the facilities analyzed.

From 2008 to 2009 natural gas consumption dropped for the majority of facilities, in part due to milder temperatures. Over that period natural gas consumption at the Lodge/Casino fell from 61,766 therms to 46,097 therms. Meanwhile, consumption at the Chief Blackbird Center dropped from 29,532 therms to 20,945 therms and from 17,244 therms to 16,882 therms at the Community Center. The Moccasin Trail consumed 14,011 therms in 2008 and 13,495 therms in 2009. Finally, the largest drop in natural gas occurred at the WWTP, where consumption first skyrocketed from 3,295 therms in 2007 to 19,092 therms in 2008, before falling to 9,532 therms in 2009.[5]

[5] Figures are from the Energy Center of Wisconsin Load Study (See Appendices). It is unclear what accounts for the erratic gas consumption at the WWTP. 2007 natural gas figures for the Moccasin Trail were based on incomplete records; actual figure is higher than reported. [6] Figures calculated using Focus on Energy Savings Estimating Guidelines

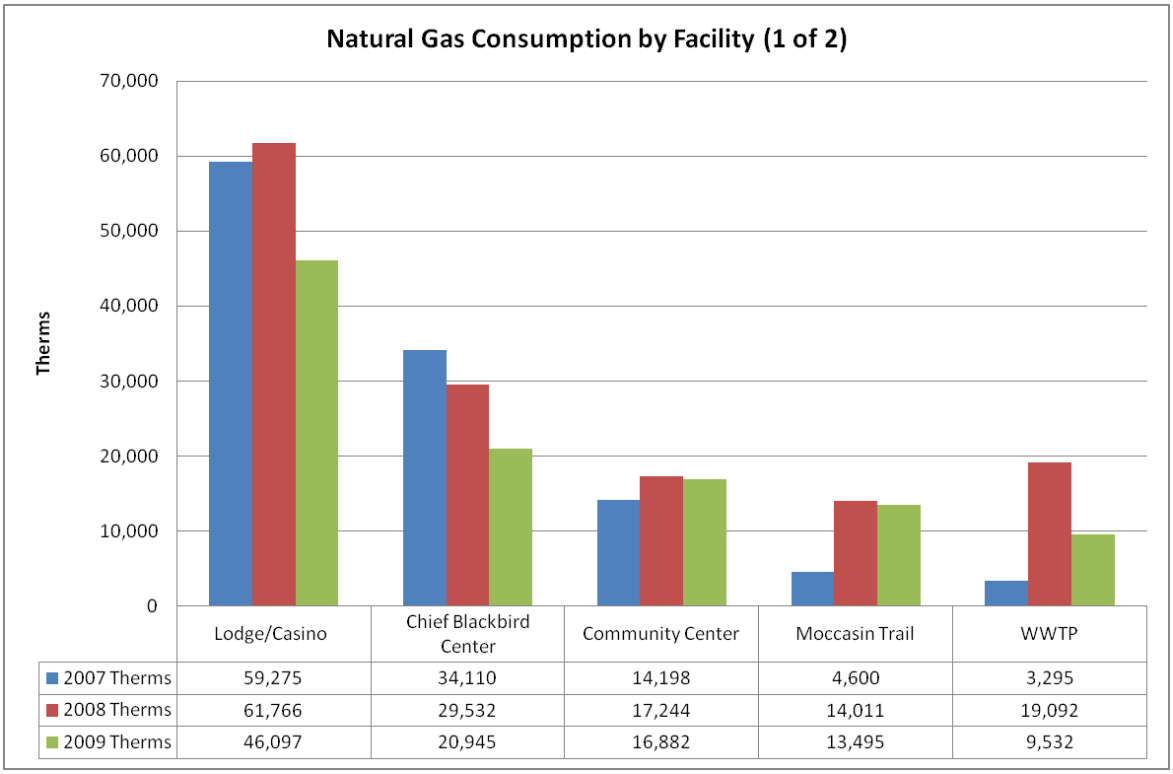
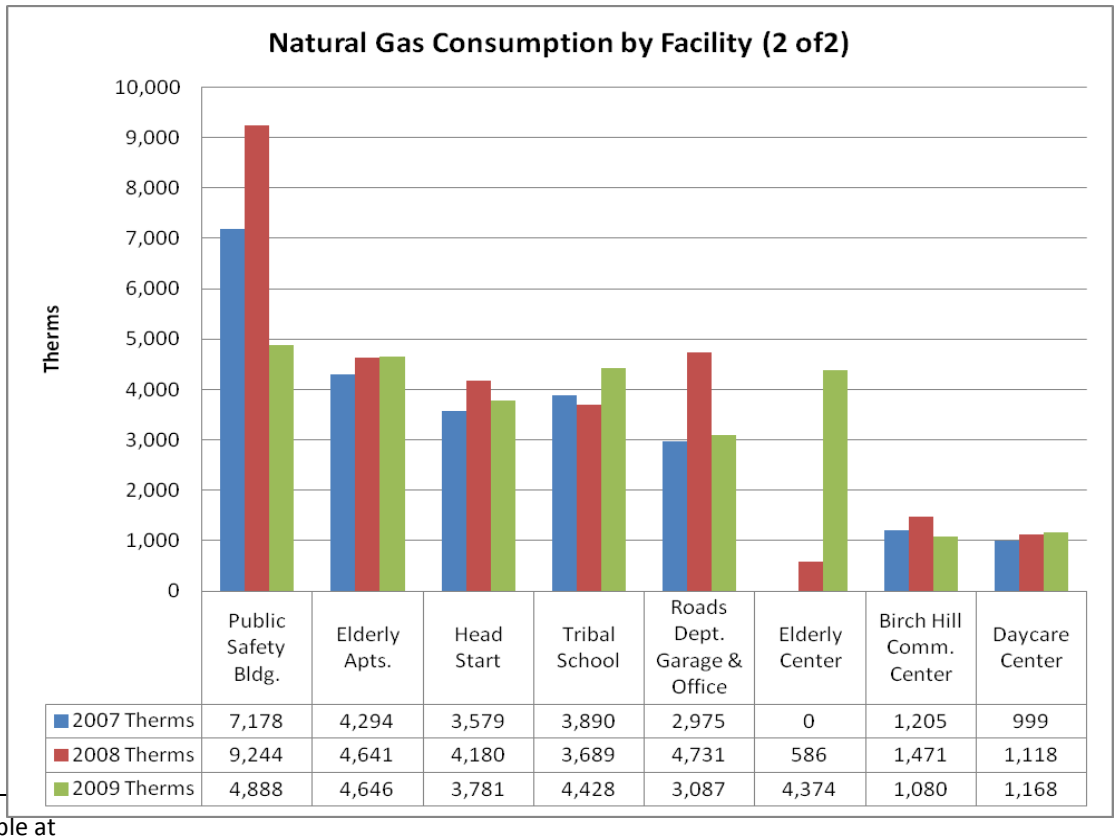


Figure 4 – Natural Gas Consumption by Facility (1 of 2)



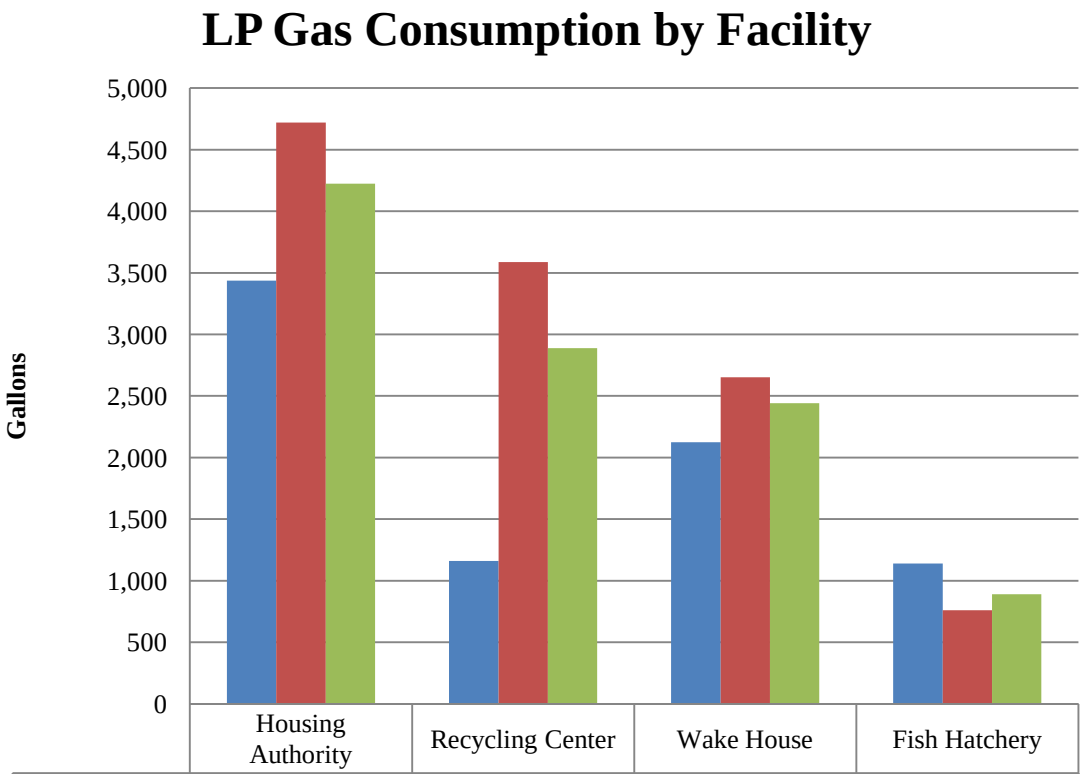
Calculator available at http://www.nrel.gov/applying_technologies/state_local_activities/docs/energy_savings_estimating_guidelines_hvac_shw.xls

Figure 5 – Natural Gas Consumption by Facility (2 of 2)

Natural gas consumption at the Public Safety Building jumped from 7,178 therms in 2007 to 9,244 therms in 2008 before dropping to 4,888 therms in 2009. Gas consumption remained steadier over the 2007-2009 period at the Elderly Apartments, rising from 4,294 therms in 2007 to 4,641 therms in 2008 and 4,646 therms in 2009. The Head Start building consumed 3,570 therms of natural gas in 2007, then spiked to 4,180 therms in 2008 before falling to 3,781 therms in 2009. Gas consumption at the Tribal School, on the other hand, fell from 3,890 therms in 2007 to 3,689 therms in 2008, then rose to 4,428 therms in 2009. The most erratic gas consumption occurred at the Roads Department, which consumed 2,975 therms in 2007, 4,731 therms in 2008, and 3,087 therms in 2009. Gas consumption at the newly constructed Elderly Center went from nothing in 2007 (prior to construction) to 4,374 therms in 2009 in its first full year of operation. 2007-2008 gas consumption at the Birch Hill Community Center rose from 1,205 therms to 1,471 therms, before falling to 1,080 therms in 2009. A similar pattern occurred at the Daycare Center, where 2008-2009 gas consumption rose from 999 therms to 1,118 therms, then dropped to 1,168 therms in 2009.

3.1.3 Propane

Propane is also used for heating on the Reservation. However, it is only used to heat the Wake House, Fish Hatchery, Housing Authority and Recycling Center. Figure 6 shows the amount of propane used in each building from 2007 to 2009 (Figures all in Therms).



	Housing Authority	Recycling Center	Wake House	Fish Hatchery
2007 Gallons	3,436	1,162	2,125	1,140
2008 Gallons	4,721	3,587	2,653	760
2009 Gallons	4,222	2,890	2,441	889

Figure 6 – LP Gas Consumption by Facility

The Housing Authority was responsible for the greatest percentage of propane consumption in 2009. Its consumption rose from 3,436 gallons in 2007 to 4,721 gallons in 2008 before falling to 4,222 gallons in 2009. The Recycling Center's propane consumption jumped by over 300%, from 1,162 gallons in 2007 to 3,587 gallons in 2008, before falling to 2,890 gallons in 2009. Propane consumption at the Wake House was more even over the period 2007-2009, ranging from 2,125 gallons in 2007 to 2,653 gallons in 2008. Finally, propane consumption at the Fish Hatchery dropped from 1,140 gallons in 2007 to 760 gallons in 2008, before rising to 889 gallons in 2009.

3.1.4 Current Energy Expenditures

Table 4 illustrates the pattern of energy consumption from 2007 through 2009. Over the period 2007 through 2009, total energy expenditures for the seventeen Tribally-owned facilities analyzed were $489,188. Energy expenditures rose from $465,741 in 2007 to $549,200 in 2008, before dropping to $452,622 in 2009. The spike in 2008 reflects both an increase in energy prices as well as an increase in overall natural gas and propane consumption.

Table 4
Cost of Energy 2007 - 2009

Type of Energy Consumed	2007 Cost	2008 Cost	2009 Cost
Electricity	$273,277	$304,597	$275,838
Natural Gas	$183,621	$229,607	$165,188
Propane	$15,909	$25,341	$11,596
Total Cost	**$465,741**	**$549,200**	**$452,622**

Figure 7 illustrates total energy expenditures by facility for 2009. Energy expenditures at the Lodge/Casino/Moccasin Trail represented over half (52%) of all energy expenditures in 2009. Energy expenditures at the Chief Blackbird Center ($63,196) were second among the facilities analyzed, followed by the Community Center ($30,917) and WWTP ($30,214). The remaining thirteen facilities represented just 20% of total facility energy expenditures in 2009.

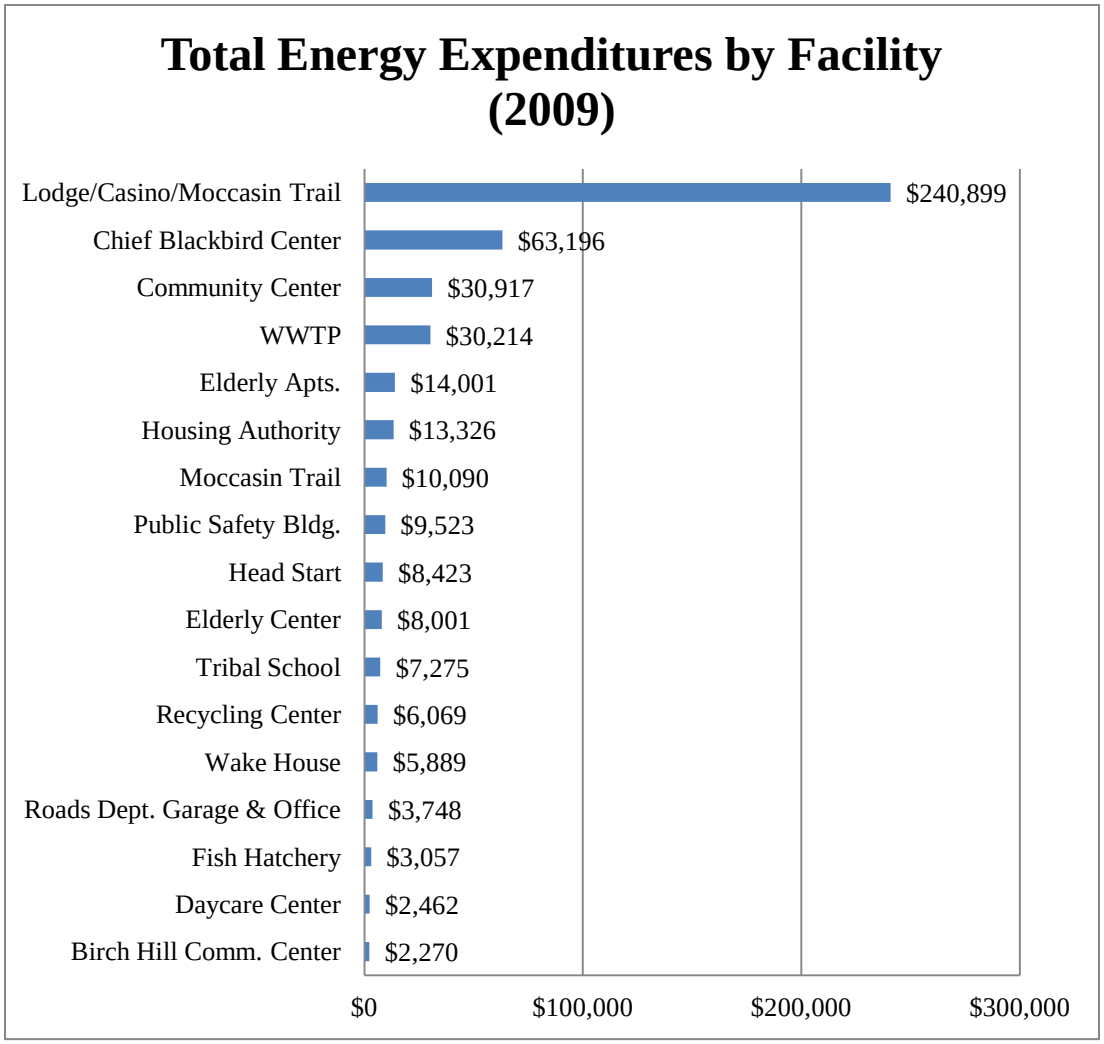


Figure 7 – Energy Expenditures by Facility (2009)

3.1.5 Environmental Impacts of Current Energy Use

The "environmental footprint" associated with Bad River's current energy use is summarized in Table 5[6]. The figures are based solely on Bad River's electricity and natural gas consumption and do not reflect the environmental impacts of propane consumption. Over 9 million lbs. or 4,669 tons of carbon dioxide are associated with Bad River's energy consumption. Of that total, over 4/5ths (81.4%) are attributable to electricity consumption. Likewise, the majority of NOx emissions (85.2%) and SO2 emissions (99.9%) are attributable to electricity consumption.

[6] Figures calculated using Focus on Energy Savings Estimating Guidelines Calculator available at http://www.nrel.gov/applying_technologies/state_local_activities/docs/energy_savings_estimating_guidelines_hvac_shw.xls

Table 5
Environmental Impacts of Current Energy Consumption

Fuel Type/Percent Contribution					
Metric Description	**Electricity**	**%**	**Natural Gas**	**%**	**Total Equivalent Metric**
CO2 (lbs.) (1)	7,599,865	*81.4%*	1,737,877	*18.6%*	**9,337,742**
NOx (lbs.)	8,534	*85.2%*	1,484	*14.8%*	**10,018**
SO2 (lbs.)	16,619	*99.9%*	9	*0.1%*	**16,628**
No. of Homes (2)	451	*74.7%*	153	*25.3%*	**604**
Tons of Coal (4)	2,246	*100.0%*	0	*0.0%*	**2,246**
Coal Cars (5)	22	*100.0%*	0	*0.0%*	**22**
Barrels of Oil (7)	8,828	*77.5%*	2,559	*22.5%*	**11,388**
Cars	725	*85.2%*	126	*14.8%*	**851**

TableNotes:
(1) C02, Sox, Nox, and Hg conversion factors are based on research by PA Government Services for Focus Programs.
(2) Assumes 9,960 kWh to power an average single family home in Wisconsin for one year.
(4) Assume one pound of coal to generate one kWh.
(5) Assume 100 tons per coal car.
(7) Assumes one barrel of crude oil (42 gallons) is 5,800,000 Btus at 138,095 Btu/gal and 1 kWh = 3,413 Btus.

3.1.6 Key Findings – Current Energy Usage

Several key trends emerge from an analysis of the seventeen Tribally-owned facilities analyzed. Key trends include:

- Electricity and natural gas each contribute roughly one half of the total energy consumption associated with the 17 buildings analyzed through the Energy Center of Wisconsin load study.
- Four facilities currently utilize propane, representing 3.4% of overall energy consumption. Facilities utilizing propane may be good candidates for biomass heating.
- The Lodge and Casino, Chief Blackbird Center, and Waste Water Treatment Plant are the top 3 consumers of electricity on the Bad River Indian Reservation.
- Bad River's estimated diversified peak load is 900kW. This figure represents the total combined peak load estimates for each of the seventeen facilities analyzed.

4.0 Energy Options Analysis

The results of the Energy Center of Wisconsin Load Study provide a baseline of information for the Tribe to measure future accomplishments against. This section of the report summarizes both energy conservation and renewable energy options for Bad River based on several existing and recently completed studies. At the end of this section the preferred options are organized into a matrix.

4.1 Energy Conservation

Bad River has already taken significant steps to reduce its energy consumption. The following list highlights a few of the current energy conservation projects which have been implemented at Tribal facilities and residences.[7]

- The newly constructed Senior Center and Health Clinic have been designed for energy efficiency.
- Casino dumpsters are regularly checked for recyclables that have been thrown out.
- The Casino has been replacing old appliances with newer more efficient ones.
- The Casino continues to convert their slot machines to have LED lighting.
- Energy efficient HVAC systems have been installed at the Casino.
- Spray on foam wall insulation; T-8 lighting retrofits; modulating boilers; ABE environmental services maintenance plan; de-lamping; humidifiers removed offline at the Chief Blackbird Center
- Residential homes of Bad River have participated in energy conservation through the installation of more insulation and by changing to compact florescent lights.

While progress toward energy conservation has been made, additional opportunities remain. The Tribe has recognized these opportunities and commissioned several energy audits. Table 6 summarizes energy audits which have been completed for Bad River facilities and residences over the past five years.

Table 6
Completed Energy Audits/Inspections

Report	Consultant/ Auditor	Facilities Audited	Date Completed
BR Chief Blackbird Center Energy Audit July 2011	GDS & Associates, SEH Inc.	Chief Blackbird Center	June 2011
BR Community Center Energy Audit July 2011	GDS & Associates, SEH Inc.	Community Center	June 2011
BR Energy Audit Summary Report Tribal Nation Utility Sept 2010	Engineered Equipment Integration	Tribal Utility	September 2010
BR Health Center Energy Inspection May 2004	Focus on Energy	Old Health Care Clinic	May 2004
BRHWC Energy Cost Analysis June 2010	All Service Plumbing	New Health and Wellness Center	June 2010
BR Safety Building Energy Inspection Sep 2004	Focus on Energy Bobbi Rongstad	Safety Building	September 2004
BR Head Start Energy Inspection Oct 2004	Focus on Energy	Head Start	October 2004
BR Day Care Energy Inspection June 2004	Focus on Energy	Day Care Center	June 2004
BR Residential Energy Audits Aug 2006	Focus on Energy	12 Residences[8]	August 2006

[7] See Facility Energy Options Matrix for additional energy saving projects (Appendices)
[8] To ensure confidentiality, specific recommendations for individual homes are not included in the version of this report appearing in the Appendices.

Table 6
Completed Energy Audits/Inspections

BR Home Inspection Report July 2006	Bois Forte Environmental Services	8 Residences[9]	June 2006
BR Pollution Prevention Energy Assessment June 2009	EPA	Casino	June 2009
BR Load Study Oct 2010[10]	Energy Center of Wisconsin	17 facilities	October 2010

Brief summaries of completed energy audits are presented below alphabetically by facility. Copies of the energy audits and a matrix summarizing key findings by facility are both provided in the appendices.

Birch Hill Community Center
Overall energy use is higher than the regional average for "public assembly" type buildings, with natural gas consumption approximately twice the average and electricity slightly lower than average. Gas use is erratic with a peak in July. The Energy Center of Wisconsin identified the following potential energy saving opportunities:

- Determine why natural varies so much late in summer
- More efficient air conditioning equipment

Casino
Casino management and staff have implemented multiple energy conservation measures resulting in annual cost savings of roughly $15,000. The EPA's 2009 Pollution Prevention and Energy Assessment report identified the following strategies for enhancing energy efficiency at the casino.

- Continuing to convert slot machines to LED lighting
- Place reminders in guest rooms to re-use linens
- Continue to investigate solar hot water heating
- Consider new carpet cleaning and de-greasing products and approaches
- Consider a composting program for food waste

Chief Blackbird Center
The facility has a high energy intensity based upon the inspected condition. For example, Energy Star rates the facility in the 13th percentile (100 being the best) of similar facilities. However, this analysis was based upon data from before upgrades to lighting fixtures and boiler replacements were complete. It is expected that current performance is more efficient. Energy conservation projects listed in the report represent the opportunity to complete a major overhaul to the HVAC equipment, which is nearing the expected life of the project. If all projects identified were implemented, the cumulative energy reduction opportunities would be approximately 172,000 kWh (33%) of electricity and 12,000 therms (39%) of natural gas. The total cost for implementing the projects is approximately $194,000, and

[9] To ensure confidentiality, specific recommendations for individual homes are not included in the version of this report appearing in the Appendices.
[10] The Excel spreadsheets which accompany this report are available on the digital (CD) version of the Energy Plan.

would yield $33,240 in annual savings ($20,640/yr in electricity savings; $12,600/yr in natural gas savings). The 2011 energy audit identified sixteen energy conservation measures:

- Energy Efficiency Opportunity
- Lighting Sensors
- VFD Controls -AHU 1
- VFD Controls -AHU 2
- Add Exterior Floor Insulation
- Add Wall Insulation
- Replace AC Unit #2
- Replace Electric Humidifier
- VFD Controls -HVAC hot Water
- Upgrade to DDC Controls
- VFD Controls -Booster Pump
- Replace AC Unit #3
- Add Roof Insulation (1st floor)
- Solar PV -Dual Axis Pole
- Replace Water Heater
- Replace AC Unit #1

Community Center

Energy Star rates the facility in the 66th percentile for efficiency compared to other facilities of its type. With suggested improvements in the 2011 energy audit, energy consumption could be reduced by 46,000 kWh and 10,000 therms natural gas, resulting in yearly saving of $15,500. Total cost of the improvements is approximately $260,000. The 15 different improvements identified range from simple measures such as unplugging 2 of the 4 refrigerators when they are not in use, to replacing the boilers with more efficient ones similar to the boilers currently in use at the Chief Blackbird Center. The complete list of suggested improvements includes:

- Refrigeration Management
- Dehumidify Basement
- Isolate Gym HVAC
- Upgrade to DCC Controls
- Replace Boilers
- Eliminate Pilot Lights-Stoves in the Kitchen
- Lighting Upgrade
- Lighting Sensors (vs. Complete Lighting Upgrade)
- Reduce Domestic Hot Water Temperature
- Replace Domestic Water Boiler
- Replace Door Seals
- Add Wall Insulation
- Add Roof Insulation
- Replace Windows
- Solar PV

Day Care Center

According to the EWC load study, the facility's overall energy consumption is a little low for "education" buildings in the region. Energy savings recommendations identified in the ECW load study and the 2004 Focus on Energy audit included:

- Add insulation, seal leaks (ECW)
- Lighting controls including occupancy sensors (ECW)
- Upgrade lighting fixtures (ECW)
- Insulate slab perimeter to reduce energy loss (FOE)
- Insulate around windows and consider phasing in combination storm windows (FOE)
- Replace door sweeps and repair weather stripping annually (FOE)
- Set back thermostat and replace exit sign lights with higher efficiency bulbs (FOE)

Elderly Apartments
The elderly apartments exhibit very steady electricity consumption with slightly higher use in the winter time, possibly due to the use of electric heaters. In the summer time natural gas use is relatively high as a result of domestic hot water demand. The ECW load study identified the following energy conservation measures:

- Discourage use of electric heaters
- Install low flow shower heads
- Insulate hot water pipes
- Check for hot water leaks
- Install energy efficient lighting

Elderly Center
The Tribal elderly center opened in fall 2009. The facility is 4,200 square feet and includes a full commercial kitchen, dining services and general assembly space for older individuals. Several green features were designed into the facility, including low emitting paint, low voc adhesives and sealants, and certified sustainable wood. As a newer building the elderly center has a limited utility history. However, gas use appears high compared with regional averages for similar buildings. The ECW study recommends the Tribe verify that the HVAC system is operating correctly.

Fish Hatchery
The Bad River Tribe operates the Raymond "Snooty" Couture Fish Hatchery, which annually stocks reservation waters with 12 million walleye fry and 250,000 fingerlings. Electric use at the fish hatchery is very seasonal. Potential energy conservation measures identified in the ECW study include:

- Lighting upgrades
- Shut down the facility more completely over the winter

Head Start
Key recommendations from the 2004 Focus on Energy audit included:

- Replacement of older furnaces with high efficiency units
- Inspect and replace weather stripping around doors
- Check and repair caulking around windows
- Adjust thermostat
- Replace inefficient lighting
- Insulate water heater and piping
- Replace spray nozzle on dishwasher to reduce water/energy consumption

Health and Wellness Center
Before the new Health and Wellness Center was constructed, two energy related studies were conducted. The 2004 Focus on Energy audit looked at the energy systems at the old health care clinic. Several recommendations were made related to insulation, lighting, and heating. Ultimately, the Tribe decided to pursue development of a new Health and Wellness Center to replace the older facility.

The second study was completed by All Service Plumbing in 2010. It examined the cost of installing a geothermal heat pump versus using natural gas at the new facility. Ultimately the Tribe decided to go with natural gas, installing two Buderus SB615 series condensing natural gas boilers. However, the new system is designed in a manner that will allow for future retrofitting to accommodate renewable energy including heating with biomass.

Housing Authority
Much of the Housing Authority's square footage is shop related, with some office space as well. Electric use at the housing authority is very low for offices in the region. Potential energy savings opportunities identified in the ECW study include lighting upgrades and assuring that the existing systems are functioning properly.

Lodge
The lodge and casino collectively consume the largest amount of energy on the reservation. Year round electrical use is high according to the ECW load study, as is summer gas usage. The pool, kitchen, laundry, and showers are all large energy consumers. Potential energy saving opportunities include:

- Reducing ventilation where/when possible
- Use waste heat from the dehumidifiers to heat pool water
- Check water heater temperature and use booster heaters when higher temps are required
- Implement a guest room energy management system

Moccasin Trail
The moccasin trail building houses the convenience store, a grocery store, public transit operations, and some general meeting space. Electricity consumption is currently lumped in together with the casinos'. Gas consumption is more than twice the regional average for non-mall retail stores. Potential energy conservation measures include:

- Switch from open case refrigeration to display cases with doors at the grocery store
- Cover open refrigerated display cases at night
- Recover compressor heat
- Reduce infiltration including vestibules and air curtains
- Upgrade lighting

Public Safety Building
The 2004 Focus on Energy audit recommended adding insulation to the walls, ceiling, and attic of the facility, as well as adjusting and controlling temperature settings. Other recommendations included:

- Upgrading to a more efficient furnace
- Replacing inefficient lighting
- Insulation of electric water heater and piping
- Replacement of electric water heater with natural gas unit

Recycling Center
According to the ECW load study, electric consumption at the recycling center is erratic, with little seasonal variation except in December. Potential energy saving opportunities include:

- Lighting upgrades
- Turning equipment off when not in use (For example, the 20 hp motor in utility room)

Roads Dept. Garage & Office
Energy use is relatively low at the roads department garage and office, according to the ECW load study. Energy saving opportunities include:

- Check thermostat settings in vehicle areas
- Check door seals
- Add insulation

Tribal School
Overall energy use is very high compared to "educational" buildings in the region. Gas use, for example, is twice the regional average while electric use is roughly 50% higher. Potential energy saving opportunities include:

- Reduce electrical use during unoccupied summer periods
- Seal building leaks including doors, windows, etc…
- Check system control schedules to assure lights and ventilation off overnight

Wake House
Potential energy saving opportunities at the wake house include sealing doors and windows during the winter.

WWTP (Tribal Utility)
The purpose of the audit prepared by Engineered Equipment Integration was to establish an awareness and preliminary benchmark of energy consumption at the water and wastewater facilities at the Bad River reservation. This consisted of a Type I and partial Type II energy audit. Two limitations to this audit were that a heating and ventilating audit was not performed and water loss and water/wastewater meter accuracy were not taken into account.

The main findings of this audit were that all buildings and structures which contain heaters should have "smart temperature controllers" installed on the units and that a conversion of the heaters from running on electricity to LP or natural gas should be further reviewed because the operation of gas heaters is approximately half the cost per BTU compared to electricity. Lighting recommendations include installing "T-8" lamps in place of existing "T-12" lamps. Furthermore, the aerator in the sludge tank was found to be broken and the influent holding tank was not in use so a re-evaluation of the operation of the system is also suggested along with fixing the broken aerator. The costs of re-evaluating the operation and installing the "smart temperature controllers" were estimated at $15,500 with a potential savings of $12,000 per year.

Residential Homes
There were two studies performed on homes in the Bad River area in the summer of 2006. The studies looked at the tightness of the homes and as well as how to conserve energy. However, what both studies identified as a critical issue was moisture in the homes and how

that contributed to mold growth which can endanger the health of residents. Both studies highlighted the fact that residents complain about mold growth in their homes and the growth came down to the lack of ventilation for the homes.

The first study, performed by Bois Forte Environmental Services, examined 8 homes. The main findings were that air leakage cost homeowners about $100 annually in heating and cooling costs and that mold was prevalent on window sills, beneath cold roof joints, on wet foundation walls and in wet crawl spaces. The key issue that contributed to the mold growth was the excessive moisture due to the wet crawl spaces. It was suggested that these crawl spaces become either fully insulated and heated or completely ventilated and thermally isolated from the living space above. It was also noted that the heat recovery ventilators (or HRVs) were not adequate for the climate and tended to freeze in the winter. It was recommended to upgrade HRVs to have internal defrost dampers to protect the motor from freezing.

The second study, conducted by Focus on Energy, also highlighted moisture control and ventilation as priority issues. The study found that while the homes were well insulated for the climate conditions, exhausting moist air and preventing water leakage into homes and installing energy efficient lighting are priorities. The study noted that insulating slab perimeters would increase comfort; lower heating costs, and prevent moisture pull through concrete. A key concern is that the moisture issue needs to be taken care of before homeowners should begin tightening up their homes and reducing air leakage. Better fans can also help decrease the moisture in the homes as well as installing gutter systems to remove rain water away from the base of the homes. Finally, ensuring a 5% grade away from the base of residences will prevent water from seeping into the homes and exacerbating the mold and moisture issues. In addition to the measures described above, the Energy Center of Wisconsin identified the following residential energy savings opportunities:

- Seal leaks
- Add insulation
- Install CFL's
- Install low flow shower heads and other plumbing fixtures
- Turn down thermostat when buildings unoccupied

The following section of the report describes existing and potential renewable energy opportunities for Bad River.

4.2 Renewable Energy

In addition to energy conservation, Bad River has also invested in renewable energy, including the following instances at Tribal facilities and residences.

- The Bad River Housing Authority recently installed 10 residential geothermal heating and cooling units with plans to add an additional 10 units. As housing is re-modeled in the Birch Hill neighborhood, additional geothermal opportunities will be evaluated and implemented.
- A solar photovoltaic panel and a small wind turbine were installed at the fish hatchery.
- Approximately 5% of private residences currently heat with wood. The Tribe has a program to provide free firewood to elderly residents heating with wood.

In order to take advantage of additional renewable energy opportunities, Bad River has commissioned several renewable energy studies (Table 7)

Table 7
Completed Renewable Energy Studies

Report	Consultant/ Author	Resource Analyzed	Date Completed
BR Chief Blackbird Center Energy Audit July 2011	GDS & Associates, SEH Inc.	Solar	June 2011
BR Community Center Energy Audit July 2011	GDS & Associates, SEH Inc.	Biomass Boiler/Solar	June 2011
Preliminary Assessment of Woody Biomass Resources on Bad River Reservation Trust Lands	Bureau of Indian Affairs	Woody Biomass	Aug 2008
Solar Energy Assessment	Resource Recycling Systems (RRS)/SEH	Solar	Aug 2011
Biomass Technologies Assessment	Short Elliott Hendrickson (SEH)	Combined Heat/Power (CHP) using Woody Biomass	Dec 2011
Wind Resource Analysis and Wind Turbine Performance Report	Seventh Generation Energy Systems	Wind	Jan 2009

The following section of the report summarizes results of the renewable energy studies listed above which have been completed for Bad River over the past five years. The summaries are organized by technology and opportunities at specific facilities are bolded. Copies of actual studies are provided in the appendices.

4.2.1 Wind

Seventh Generation Energy Systems performed a wind resource monitoring study from 2005 to 2007 with the use of 50-meter tall towers with wind monitoring equipment. Wind monitoring was performed at four different locations: Wake House, Birch Hill, Lake Road, and Potato River (Figure 8). The locations were classified as class I with an average wind speed between 10-11mph at 50 meters high.

Figure 8 – Location of Wind Monitoring Stations on Bad River Indian Reservation

Figure 9 illustrates elevations at each of the four monitoring stations.

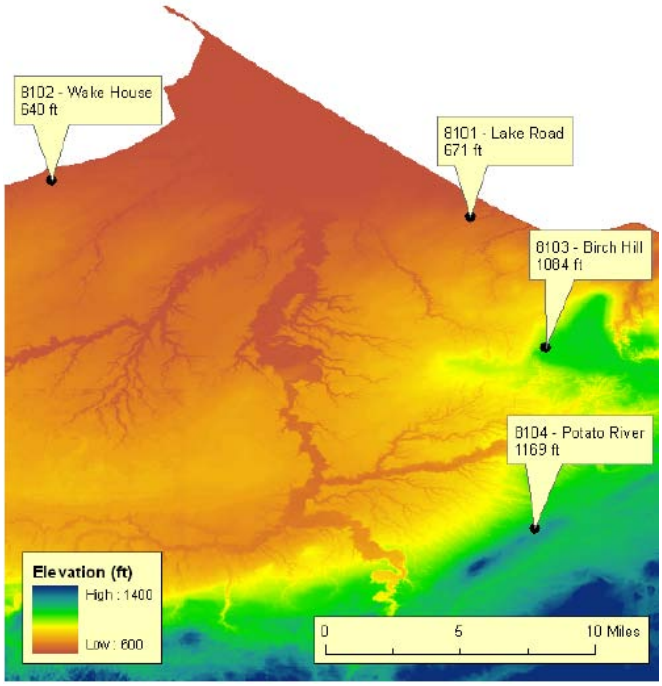


Figure 9 – Location of Wind Monitoring Stations on Bad River Indian Reservation

The study found that the Birch Hill and Lake Road locations had a higher average wind speed of 11.2 mph and 10.8 mph respectively compared to the Wake House (9.9 mph) and Potato River (10.2 mph). Given the higher average wind speeds, the study found that the Birch Hill and Lake Road locations could generate 15-30% more power than the other locations. Table 8 shows observed winds speeds at each monitoring location and predicted winds speeds at different heights based on wind shear coefficients. The observed wind speeds occurred at the 25, 40, and 50 meter heights while the predicted speeds are at 80 and 100 meter heights (italicized).

Table 8
Wind Speeds at Differing Heights at Monitoring Stations

Height (m)	Lake Road (mph)	Wake House (mph)	Birch Hill (mph)	Potato River (mph)
25	7.57	7.02	7.89	7.69
40	9.56	8.97	9.92	9.15
50	10.81	9.87	11.2	10.21
80	*13.6*	*12.4*	*14*	*12.9*
100	*15.1*	*13.8*	*15.6*	*14.5*
TableNotes: Average actual and *projected* wind speeds at all 4 locations at different heights				

Based upon these values, the study found that a large commercial grade wind turbine at 80 meters at Birch Hill would have the most favorable financial return on investment. The estimated simple payback period for an 80 meter tower is 17 years using Xcel Energy buy-back rates and 14 years using Bayfield Electric Cooperative's buy-back rates. The study found that wind deployment on Tribal lands may be economically challenging given the lack of Focus on Energy incentives to help fund the initial cost of equipment purchase and installation and the lack of a strong wind resource. Table 9 provides a breakdown of estimated wind project economics as of 2009. Simple payback period figures include 10%-25% grant funding for the two smallest wind turbines.

Table 9
Wind Turbine Simple Payback Periods

		Lake Road		Wake House		Birch Hill		Potato River	
Wind Turbine Name (hub height)	Applicable Rate (per kWh)	Energy Production	*Simple Payback (in years)	Energy Production	*Simple Payback (in years)	Energy Production	*Simple Payback (in years)	Energy Production	*Simple Payback (in years)
ARE442 (37m)	$0.09600	10,018	495	8,428	8,803	9,833	556	7,723	**
Vestas V15 (33m)	$0.09600	35,745	104	29,279	165	34,946	109	26,339	225
Northwind (37m)	$0.07500	76,425	107	64,183	142	75,181	110	58,451	168
Vestas V47 (60m)	$0.07500	910,149	41	745,845	52	950,499	38	734,114	53
GE 1.5 xle (80m)	$0.07500	3,534,891	15	2,991,824	18	3,765,741	14	3,072,342	18

The most economically viable scenario for a Bad River wind project would be at Birch Hill or Lake Road, using the GE 1.5 MW turbine. According to the study, a large commercial grade wind turbine installed at Birch Hill would have a simple payback period of roughly 14 years, while a wind project at Lake Road would have an approximate simple payback period of 15 years. However, the study also notes that actual costs for wind installations vary considerably over time and that the figures presented are estimates only.

The study pointed out that despite the economic obstacles; there are other benefits of wind energy worth consideration. Wind energy creates educational and marketing opportunities and promotes a cleaner environment by offsetting fossil fuel based power. Finally, obtaining grants from the Bureau of Indian Affairs, Department of Energy and other Federal agencies could make a wind project at Bad River more feasible. Taking into consideration potential grant funding, evolving technologies, educational and environmental benefits, the study concluded with a recommendation that Bad River Tribe continue to monitor and investigate wind power as a renewable option.

4.2.2 Bioenergy

Figure 10 provides an overview of biomass conversion technologies[11]. Bioenergy is renewable energy derived from the conversion of biomass or "feedstocks", including agricultural, forestry, and municipal/tribal wastes (left side of figure). After biomass is collected and transported, it can be converted and refined to energy using a wide range of technologies (center of figure).

Technologies range from relatively simple, commercially available ones such as direct combustion (e.g., burning wood) to more complex technologies including pyrolsyis and gasification. In northwest Wisconsin, heating with wood is a common form of bioenergy. Several schools, health facilities, and other community facilities use woody biomass boilers for heating across the region, including the Rice Lake School District, Barron Area School District, Glidden High School, Hayward Middle and High Schools, Lake Holcombe High School, Park Falls High School, and Shell Lake High School. In addition, businesses and community facilities including Memorial Hospital in Ashland utilize woody biomass for heating purposes. There are four basic types of wood boiler systems including:

- Woodchip
- Pellet
- Cordwood
- Combined heat and power (CHP)

One of the key benefits of bioenergy is its flexibility. It can be used for heating, power production, or as a liquid fuel for transportation (right side of figure). A secondary benefit of bioenergy is that it can be created, or dispatched, as necessary. Unlike solar or wind energy, which rely on sunny or windy conditions, bioenergy can be generated as needed regardless of the weather conditions. On the other hand, bioenergy compares less favorably to renewables such as solar and wind when it comes to direct emissions. Effective maintenance and pollution control equipment are necessary in order to meet air emission standards. Similarly, biomass feedstocks must be grown and harvested in a sustainable manner in order for bioenergy to be considered renewable, and to avoid negative environmental impacts such as erosion, loss of species biodiversity, negative water quality impacts, soil compaction, negative community impacts and other impacts.[12]

[11] Figure taken from the EPA's State Bioenergy Primer available at: http://www.epa.gov/statelocalclimate/documents/pdf/bioenergy.pdf

[12] See Wisconsin's Forestland Woody Biomass Harvesting Guidelines available at: http://council.wisconsinforestry.org/biomass/pdf/BHG-FinalizedGuidelines12-16-08.pdf

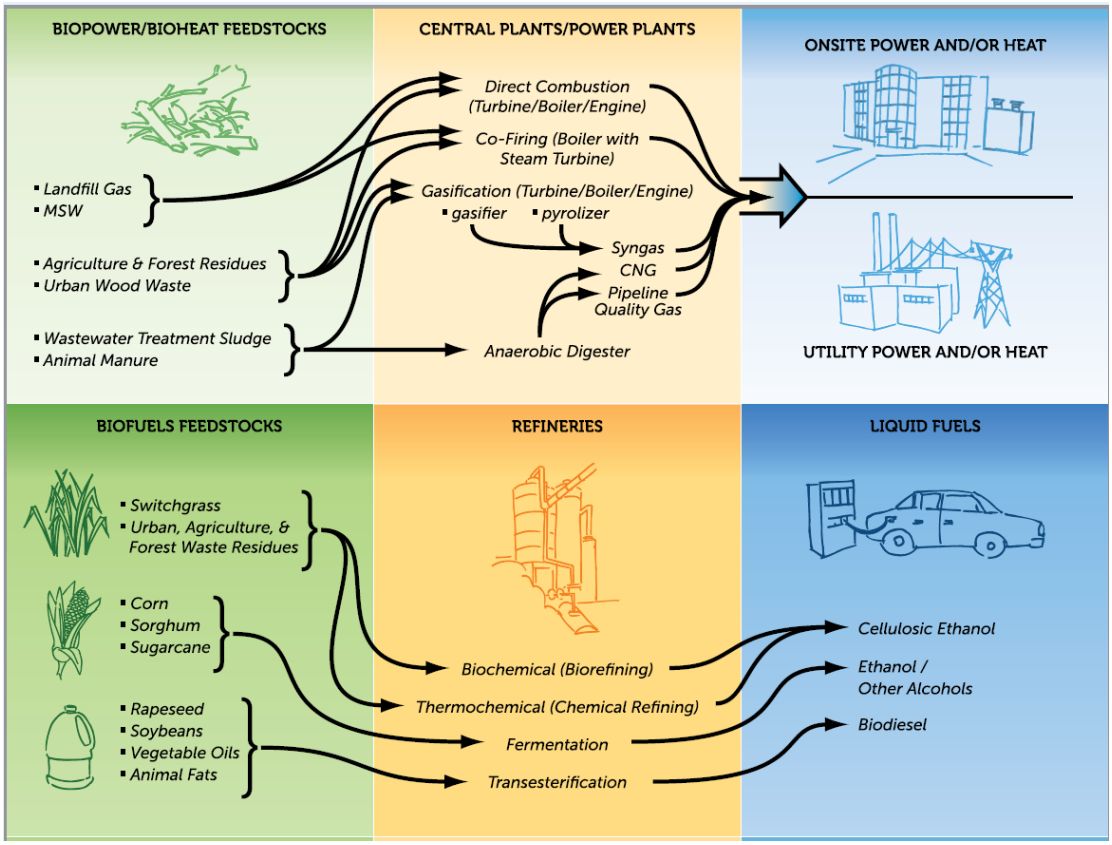


Figure 10 – Biomass Conversion Technologies
(Source: EPA State Energy Primer)

4.2.2.1 Woody Biomass Availability

A reliable supply of biomass is critical to the development of bioenergy. The BIA's 2008 Preliminary Assessment of Woody Biomass Resources on Bad River Reservation Trust Lands examined potential biomass supply from roundwood or logging residue generated from conventional timber harvesting activity. The study did not consider other sources of woody biomass including shrubs, small trees, or brush cuttings from timber stand improvement or right of way clearings, or from dedicated short rotation woody crops. Another limitation of the study is that it only focused on biomass available from Tribal trust land. The study did not consider biomass availability from lands held in fee status or from private lands outside the reservation.

The study estimated there are roughly 20,000 acres of forested area available for biomass production within an estimated 60,000 acres of tribal trust and allotted trust lands. It found that at current harvest levels (Table 10, scenario 3) the Tribe itself had sufficient biomass resources to support only a very small biofuel plant using resources from their own land. With additional forest management activity, the Tribe could pursue a partial (50%) implementation of its 2008 10-year timber management plan with moderate intensity biomass recovery and large reserve patches (Table 10, scenario 5). The study concluded that ultimately the Tribe must decide for itself how much woody biomass to utilize for energy production, and if implemented, a long-term biomass harvesting plan that would not damage the ecosystem would need to be put into place to ensure a constant source of fuel. Table 10

below summarizes five scenarios for biomass availability from Tribal trust lands according to the 2008 BIA study.

Table 10
Woody Biomass Availability Under 5 Scenarios

	Description	% Recovery	Annual Harvest (Acres)	Annual Supply (Green Tons)
Scenario 1	Full implementation of 10 year mgmt plan	65%	539	6,693
Scenario 2	Same as scenario 1, plus all roundwood used as biomass	65%	539	25,127
Scenario 3	Post IRMP harvest acreage, high utilization	65%	51	600
Scenario 4	Full plan implementation, moderate utilization	40%	539	3,685
Scenario 5	50% plan implementation, moderate utilization	40%	270	1,846

In addition to the 2008 BIA study, several biomass resource assessments have been conducted for northwest Wisconsin forestlands. The Energy Center of Wisconsin's 2007 "Assessment of Biomass Resources for Energy Generation at Xcel Energy's Bay Front Generating Station in Ashland, WI" provides publicly available data on biomass availability within the region. The study concluded that 360,000 tons of woody biomass was likely available in the region, sufficient to support Xcel Energy's proposed wood gasification project at the Bayfront plant. However, Xcel Energy has since shelved that proposed project, suggesting that an adequate amount of woody biomass may be available to support other bioenergy projects within the region.

4.2.2.2 District Heating/Power Using Woody Biomass

District heating is a very resource-efficient and environmentally friendly source of heat. A central district heating plant heats water, which is transported in a pipeline under high pressure to a district heating system in each building. Heat exchangers in the building use the hot water to heat radiators and hot water tanks. Figure 11 below provides a simple illustration of a district heating system.

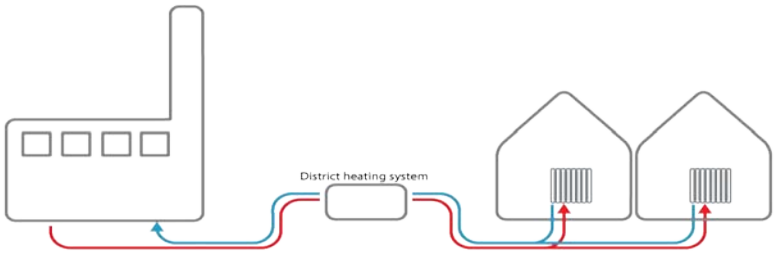


Figure 11 – Diagram of District Heating System
(Source: Swedish Energy Agency)

District heating systems can use a wide variety of fuel types and take advantage of energy that would otherwise go to waste, such as waste heat from industrial processes, forestry waste and energy recovered from waste. For example, a district heating system could be fuelled by a combination of renewable energy sources, including woody biomass, solar hot water, and geothermal. The technology is uncomplicated and very reliable. When coupled with a

turbine, power production can accompany district heating. Combined Heat and Power, or CHP, systems often achieve high efficiencies by capturing and using waste heat from power production.

The figure below was taken at the Barron School District Wood Heating Plant in Barron, WI. The Barron Area School District installed a wood boiler system in 1980-81 to provide steam heat for the High School, Elementary School, Community Center, Hospital and Medical Center, and the Maple Crofts Senior Rest Home. More recently, an absorption chiller was added to the system which now provides cooling to the facilities as well (except the medical center). Combined, these facilities include approx 1 Million square feet. The project supports the local community through cost savings, by supporting local businesses, by re-circulating energy dollars within the community, and through education.

Figure 12 – Photo from Barron District Heating System Study Tour

Members of the Energy Task Force and SEH visited the Barron's district wood heating system on October 26th, 2011 to learn about the technology and Barron's experiences heating with wood. From left to right are Dan Powless, Bad River Renewable Energy Coordinator, Mark Broses, SEH, Beatrice Bener, Bad River Planner, and Loyd Hartwell, Bad River Transit Manager. A portion of Barron's wood fuel supply is provided by Bell Poll Lumber, which generates "waste" wood in the production of utility poles.

In tandem with the development of this Energy Plan, a Biomass Technologies Assessment was conducted by SEH for the Tribe. The purpose of the assessment was to analyze the existing heat and power infrastructure of four buildings on the reservation and develop alternative heat and/or power alternatives for a district system. **The Lodge and Casino, Moccasin Trail Center, Tribal Elderly Center, and New Tribal Health Center** were assessed for their potential to integrate bioenergy into their heating and power needs. Four alternatives were developed including capital costs, estimated annual maintenance costs, a projection of annual heat and/or power savings, a benefit-cost comparison with alternative proposals, and a description of biomass feedstock requirements, and emissions. A brief description of each alternative and key findings are presented below.

Option #1) Casino/Motel Pool Heating (all year long)

- Balance of system located adjacent to casino/hotel complex
- Enclosed to limit dust, noise, disturbance
- Steady, stable usage -.4 MMBTU/hr

- Replace natural gas heat ($39,000/yr @ $1.05/therm)
- Capital costs $367,000
- Operational costs $28,000/yr
- Simple payback approx. 44 yrs. – with 35% funding assistance reduced to 29 years

Option #2) Pool Heating plus Electrical generation for use at Wellness Center (all year long

- System co-located with Wood Receiving and Long Term Storage area
- Heat piped approx 600 ft to Wellness Center and 600 ft (@approx $400/lf)
- Steady, stable usage at pool - .4MMBTU/hr to accommodate seasonal use at Wellness center
- Replace Natural Gas Heat and Electricity ($80,000/yr @ $1.05/therm)
- Capital Costs $624,000
- Operations Costs $42,000/yr
- Simple Payback approx 17 years with 35% funding assistance reduced to 11 years

Option #3) Pool Heating Seasonal Heating of Wellness Center

- System co-located with Wood Receiving and Long Term Storage area
- Heat piped approx 600 ft to Wellness Center and 600 ft (@ approx $400/lf)
- Steady, stable usage at pool - .4 MMBTU/hr at low end with "turn-up" capacity to 1.0 MMBTU/hr to accommodate seasonal use at Wellness center
- Replace Natural Gas Heat ($65,000/yr @ $1.05/therm)
- Capital Costs $928,000
- Operational Costs $47,000/yr
- Simple payback approx 51 yrs - with 35% funding assistance reduced to 33 years

Option #4) Pool Heating Seasonal Heating of Wellness Center plus Electrical generation

- System co-located with Wood Receiving and Long Term Storage area
- Heat piped approx 600 ft to Wellness Center and 600 ft (@ approx $400/lf)
- Steady, stable usage at pool - .4 MMBTU/hr at low end with "turn-up" capacity to 1.0-MMBTU/hr to accommodate seasonal use at Wellness center and other Buildings
- Replace Natural Gas Heat and Power ($165,000/yr)
- Capital Costs $1.3M
- Operational Costs $70,000/yr
- Simple payback approx 14 yrs - with 35% funding assistance reduced to 9 years

4.2.2.3 Small scale heating with woody biomass

Heating individual buildings with wood can be a cost effective means of generating renewable energy using local resources. While the Tribe has expressed interest in developing a district heating and/or power plant, another option to consider is making a fuel switch from propane to natural gas at individual facilities. Currently, four of Bad River's Tribal facilities use propane. Because propane heating costs more than natural gas heating, the economics of switching from propane to wood heating is typically more favorable at facilities using propane versus natural gas.

Figure 13 – Photo of Small Scale Woody Biomass Boiler

A wood heating system sized for the **Recycling Center** or **Wake House** would likely be a pellet system, or a flex fuel unit capable of burning pellets and wood chips. Figure 13 is a high efficiency, flex fuel BIOMAX biomass boiler.

Another potential opportunity for biomass heating is at the **Community Center**. A recently completed energy audit identified an opportunity to replace the existing natural gas boilers (which are at the end of their expected life spans) with a high efficiency biomass pellet boiler. The project would displace 16,171 therms/year of natural gas and cost approximately $83,040. At a cost of approximately $175/ton of wood pellets delivered, this option would result in minimal savings and have a very long simple payback period. However, a flex fuel boiler utilizing lower cost fuel may make better economic sense (For example, wood chips supplied by the Tribe at a fraction of the equivalent cost). Because the Tribe has a large amount of woody biomass at its disposal, it should continue to investigate bioenergy options including smaller systems serving individual facilities.

4.2.3 Solar

There are two types of solar energy: solar thermal and solar electric (also known as photovoltaic or PV). Solar thermal (heat) energy is often used for heating water used in homes and swimming pools and for heating the insides of buildings ("space heating"). Solar space heating systems can be classified as passive or active.

Passive space heating is what happens to your car on a hot summer day. The sun's rays heat up the inside of your car. In buildings, the air is circulated past a solar heat surface and through the building by convection (meaning that less dense warm air tends to rise while denser cool air moves downward). No mechanical equipment is needed for passive solar heating. On the other hand, active heating systems require a collector to absorb and collect

solar radiation. Fans or pumps are used to circulate the heated air or heat absorbing fluid. Active systems often include some type of energy storage system.

Figure 14 – Oventrop Solar Thermal System for Commercial Water Heating

Solar energy can also be converted to electricity. Photovoltaic (PV devices) or "solar cells" change sunlight directly into electricity. Individual PV cells are grouped into panels and arrays of panels that can be used in a wide range of applications ranging from single small cells that charge calculator and watch batteries, to systems that power single homes, to large power plants.

Figure 15 – Ground Mounted Solar Energy System

Solar energy systems can be installed, or mounted in three distinct ways. Roof mounted systems may be less prone to shading, however they require a flat or south sloping roof in order to function at peak performance (Figure 15). Ground mounted systems can be positioned for optimal exposure and angle and (Figure 15). Finally, covered parking systems are mounted over parking lots and in addition to providing electricity, provide shade for cars to park under.

Figure 16 – Photo of Covered Parking PV Array

4.2.3.1 Solar PV

The RRS/SEH solar assessment looked at the feasibility of installing solar PV panels at the Casino/Lodge, Housing Authority, Recycling Center, Daycare Center, Head Start Center, and Community Center.

Casino

The main meter for the casino and lodge consumes almost 3MWh of electricity each year. This would require a large 2.5MW power plant to offset this electricity. In addition, the electricity for that meter is cheaper than any other, averaging $0.05 per kWh, half of most other meters. Due to the required size and low cost for energy, a PV system is not economical for this meter. Similarly the main building meter would require a 100kW system and energy is currently purchased at $0.08 per kWh. However, one option for a PV system at the Casino and Lodge is to power the main sign. This system could be mounted as a covered parking canopy.

Figure 17 – Photos of Bad River Casino Sign (left) and Rooftop (right)

Housing Authority

The Housing Authority Center is a recently constructed building that has good solar exposure. Similar to many of the buildings on the reservation, they are not oriented ideally for solar energy production. They are approximately 45° west of south and so reduce potential for building mounted PV. To overcome this, the ideal situation would be to build a covered parking structure and orient the panels directly south. Otherwise there will be a 10- 20% drop in energy production for the system depending on the time of year. The array estimated in the

table below would require about 5,000 sq. ft. if built as a covered parking structure. The roof area could hold an 8-10kW array.

Recycling Center
The recycling center is one building that is oriented ideally for PV with half of the roof facing almost directly south. The only concern is that the angle of the roof may not be steep enough to shed snow in the winter time. The panels could be mounted at a steeper angle to increase snow shedding. The recycling center is currently paying a higher cost for energy, averaging at $0.11 per kWh.

Daycare Center
The daycare center does not have good southern exposure and it not recommended for a roof mounted PV array. The building is oriented almost completely north-south and will lose significant energy potential.

Head Start Center
The Head Start Center has a large power consumption, but does not have significant usable roof space. The main roof could hold a 4-5kW PV array, assuming that it could be mounted over the roof vents without causing issue. In order to produce the same amount of energy that is consumed requires an array about 10 times bigger. This could be accomplished with a ground mounted or covered parking structure.

Community Center
The Tribal Community Center is a large consumer of energy and would require a large PV system to cover 100% of the electrical consumption. Based on the site visit, this system would need to be mounted on a covered parking structure. The roof of the community center would not provide enough usable south facing space for a decent size array and also looks to need replacing in the coming years. If the roof was replaced, the south facing area could likely hold about 8-10kW. Table 11 summarizes the findings for each of these facilities. It should be noted that these payback periods have been calculated incorporating in likely increases in future electricity costs.

Table 11
Summary of Solar PV Payback Periods

Facility	Project Description	Size PV System	Est. Payback Period
Casino	Covered parking canopy PV array to power the main sign in front of casino	33 kW	34 yrs
Housing Authority	Covered parking PV array	49 kW	34 yrs
Recycling Center	Roof mounted PV array	10,9 kW	32 yrs
Day Care Center	Solar not recommended due to poor southern exposure	NA	NA
Head Start Center	Roof mounted PV or covered parking	46 kW (parking)	34 yrs
Community Center	Covered parking PV array. Roof mounted if roof replaced	46 kW (parking)	34 yrs

4.2.3.2 Solar Thermal

The main site that could benefit from a solar thermal system is the casino with their high water usage for the hotel and swimming pool. The Bad River Casino currently uses approximately 47,850 hundred cubic feet (ccf) of natural gas to heat water every year, which

relates to over $50,000 annually. The amount of natural gas usage that could be replaced by a solar thermal collector array varies in both the size of the system and the efficiency of the type of collector. Over the year, the best performance for any system will be in the summer and during the winter some help from a conventional water heater will be needed.

A solar hot water system sized for the Casino would have capital costs of approximately $450,000. If the Tribe could secure a 50% grant, the simple payback period would be about 11 years assuming an annual escalation of 4% in energy costs. The system would cover about 50% of the total natural gas bill over a period of 25 years. If the tribe was able to get a 15 year low interest loan to cover the cost of the system, there could be immediate savings of up to $5,000 per year. This savings grows each year if the price of natural gas increases.

Figure 18 – Photos of Casino Rooftop (left) and Current Water Heater (right)

4.2.3.3 Central Solar Plant

The RRS/SEH solar assessment also identified a central solar plant option for the Tribe to consider. According to the study a large PV array could supply power to a number of facilities. In this option, the Tribe would continue to pay their electric bills as they currently do and would not be protected from cost increases. However, it would add a new revenue stream for the Tribe. Dairyland Power would purchase the power at approximately $0.09 per kWh. Bringing in a tax credit investor to build a 1MW plant, including a 9% return for the investment could provide the tribe with approximately $1 million in revenue over the next 25 years. Here is a summary of a potential solar power plant project:

- Solar tax credit developer builds a 1MW power plant for approximately $6 million.
- The tribe would rent the land to the developer for approximately $20,000 per year for 7 years, 4-5 acres of land would be required.
- The developer would collect all tax benefits and energy sales for 7 years, including the Investment Tax Credit of 30%, Accelerated and Bonus Depreciation and New Market Tax Credits.
- After 7 years, the tribe would purchase the system for $1.1 million giving the tax credit investor a 9% return on their annual investment.
- For the remainder of the life of the power plant (at least 18 more years), the tribe would collect revenue for the sale of the electricity and pay the loan back for the purchase of the system. The tribe would have a revenue stream of $30,000 to $60,000 depending on the escalation of the power purchase agreement with the utility. After 23 years, the tribe

would not have any payments and would receive a revenue stream of over $150,000 per year.

4.2.4 Geothermal

As previously mentioned, the Bad River Housing Authority has installed 10 geothermal units on individual homes located on Birch Hill. Five systems have been running for 6 months (as of June 2011) and the other five have been running for 2-3 months. The Housing Authority is also moving into phase 3 of the project and will be installing 14 additional geothermal units in the near future.

5.0 Preferred Energy Options

Preferred energy options were identified through an analysis of recently completed energy studies, energy task force group discussions, Tribal council input, participation at two NREL energy workshops, two open houses, a study tour to Barron, WI, and staff interviews. Options were selected based upon their alignment with Bad River's energy vision, Tribal values, resident input, and economic realities.

The table below organizes preferred energy options into three categories: energy conservation, renewable energy and education/organization (Table 12). Below the table are short descriptions of each option, including a rationale for pursuing each option and key considerations for implementation. The preferred energy options are not prioritized in any way within the Table.

Table 12
Summary of Preferred Energy Options

Energy Conservation	Renewable Energy	Education & Organization
Energy accounting software/system. Develop a system for tracking energy consumption - either via a spreadsheet or using an existing tool like EPA Portfolio Manager or tool available through DOE.	**Small scale projects.** Implement solar options as demonstration projects or as grant funding allows. Promote geothermal, solar, and other technologies for residential housing. Consider switching from propane to wood heating. See facility matrix for additional information.	**Utility organization development.** Investigate feasibility of developing a Tribal utility. Clarify tribal utility authority and current rights.
Energy efficient building codes. Energy efficient building codes should be adopted for Housing Dept. first. Tribe would need to phase in more stringent/costly building codes for private housing over time.	**Large scale wind & solar.** Monitor long term potential for larger wind project. Explore potential for a central solar PV plant.	**Tribal representation on the Bayfield Electric Cooperative Board.** As the co-ops largest customer, the Tribe should maintain a seat on the Board.
Energy conservation measures. Implement priority ECM's at individual facilities. Conduct additional audits to identify more savings opportunities including a level two audit of the casino. See energy audit results and facility matrix for additional information.	**District heating/power – woody biomass.** Continue planning and design in order to develop a district plant capable of serving casino complex, Elder Center and Health Center. Consider a larger district system capable of providing heat and/or power to a majority of the reservation. See Biomass Technologies Assessment report for additional information.	**Engage the community and leadership in energy issues.** Through tours and continuing education continue to engage broader community. Develop a Tribal energy website to support homeowner education and Tribal interest in energy conservation and renewable energy.

Table 12
Summary of Preferred Energy Options

Energy auditor training and homeowner education. Train staff to conduct energy audits. WITC has a training program. Private firms offer customized training as well.	**Woody biomass resource development.** Identify potential biomass from fee simple lands. Investigate potential of a short rotation woody biomass crops on cut over lands.	**Establish a 3/4 - FT Tribal Energy coordinator.** Position should focus on energy conservation, renewable energy, and economic development.
	Organic waste conversion and local agriculture production. Capture waste heat from woody biomass system to heat a greenhouse. Recycle organic food/yard waste into compost.	

The Energy Task Force also identified barriers or challenges to implementing preferred energy options. Some of these were discussed earlier in the report and include buildings in very poor condition where investments in energy conservation do not make sense, lack of local technical expertise, and lack of coordination. The Task Force also identified Bayfield Electric Cooperative's lack of participation in the Focus on Energy program as a barrier to implementing energy conservation and renewable energy projects. Finally, with regard to biomass energy development, the lack of good data for fee lands was cited as a barrier.

5.1 Energy Conservation

5.1.1 Energy Accounting Software/Management System

The Tribe spends roughly $500,000 per year on facility related energy costs. Closely monitoring energy consumption can help facility managers identify underperforming facilities and potential energy saving measures. Well maintained energy records can also help justify Tribal investments in energy efficiency as well as external funding of energy projects by outside granting agencies. Energy accounting can be done using customized Excel spreadsheets which already exist for a majority of Tribally-owned facilities and are available in the appendix. EPA's Portfolio Manager provides another excellent resource for consistently tracking and reporting energy consumption and utility information. In addition to updating utility records for the 17 facilities analyzed as part of the ECW load study, the Tribe could also incorporate and track energy data for the food distribution center, domestic abuse shelter, and the old annex building.

The EPA's Guidelines for Energy Management provides a useful diagram of the energy management cycle (Figure 19)[13]. Bad River has already taken initial steps toward the creation of an energy management system with completion of the ECW load study and recent energy audits. As a next step, the Tribe could set specific energy reduction goals and develop an action plan to achieve them.

[13] http://www.energystar.gov/index.cfm?c=guidelines.guidelines_index

Figure 19 – EPA Energy Management Cycle

5.1.2 Energy Efficient Building Codes

Energy efficient building codes can improve the efficiency of Tribally-owned commercial buildings and residences, as well as private residences built on the reservation. Energy efficiency is consistent with the Tribe's values including conservation and preservation of the natural environment. Energy efficient building codes could be adopted first for tribally owned facilities including residential homes managed by the Housing Department.

It is recommended the Tribe phase in more stringent and potentially more costly building codes for private housing over time. Energy efficient building codes can be deployed more or less formally. A less formal approach would be to recommend that project architects employ green building standards or follow model building codes. A more formal approach would be for the Tribe to adopt stringent building codes with specific requirements for building application, review, inspection, and enforcement.

5.1.3 Energy Conservation Measures

The results of several energy audits, including two recently completed level 2 audits, have identified multiple opportunities for the Tribe to enhance its energy efficiency. While less visible than renewable energy, conservation is typically more cost effective than renewable energy development. Energy conservation measures range from simple low cost solutions (e.g., sealing building envelope, installing light sensors, etc…) to more costly solutions (e.g., installing new energy efficient boilers).

Despite the range of opportunities which exist, the Tribe faces significant barriers in terms of implementing an effective energy conservation program. Many Tribal facilities have or are rapidly approaching their expected life spans. For these assets, facility managers and department heads are focused on simply maintaining the existing infrastructure and do not have the resources to invest in energy conservation. Furthermore, if a facility is going to be replaced in the short term then most energy conservation investments will be uneconomical. Lack of funding, lack of local technical expertise, and lack of coordination were also cited as barriers to development of an effective energy program by the Energy Task Force. Furthermore, lack of utility participation in the Focus on Energy Program by Bayfield Electric Cooperative was cited as a barrier to effective energy management.

These types of challenges suggest that the Tribe focus on no-cost energy savings solutions and other easy ways to reduce energy consumption.

General fund expenditures on energy conservation could be targeted for the Chief Blackbird Center, one of the Tribe's largest consumers of energy. Finally, with annual energy expenditures of $250,000, a level two energy audit of the casino/lodge could have a large impact on the Tribe's annual energy expenditures.

5.1.4 Energy Auditor Training

Facility managers are responsible for maintenance and energy management at dozens of commercial and residential facilities throughout the reservation. Providing facility managers and staff with energy auditor training will improve the Tribe's ability to manage energy efficiently and save money. Trained staff is more likely to identify poorly performing HVAC equipment and take corrective actions on a timely basis. A team of trained energy auditors could also provide technical assistance to private residents as well, which would enhance the Tribe's overall energy efficiency while helping residents save money as well. Energy auditor training could be done in a number of different ways. One option is to invest in intensive training for one or more Bad River employees, who in turn could train other staff. Another option would be to send a team of staff to training available through WITC, the Energy Center of Wisconsin, or other agencies.

5.1.5 Provide Homeowner Education

The Housing Authority maintains approximately 167 units of housing for Tribal members. In order to benefit from investments in energy efficiency, residents of Tribal housing as well as private housing, need adequate education and skills training to ensure their homes are operating at peak performance and to draw attention to concerns when they arise. Previous home inspections suggest that residents also need assistance addressing mold and other moisture related issues. Residents concerns with the new geothermal units also suggest that homeowner education should accompany (or proceed) future investments in efficiency and renewable energy.

A number of options exist for promoting homeowner education. For example, education addressing energy issues could be incorporated into existing outreach services provided by the Tribe. Alternatively, the Tribe could partner with other agencies to initiate or strengthen energy education programs. Potential partner agencies include UW-Extension, Boise Forte (or other Tribes), Ashland County, and Focus on Energy.

5.2 Renewable Energy

5.2.1 Small Scale Projects

The Tribe would like to promote small scale renewable energy and sustainability projects in addition to larger projects. Some Tribal members have already pursued these types of projects. For example, in addition to heating with wood, Joe Rose has installed a four panel solar electric (PV) system and one kW wind turbine at his home.

Several opportunities exist for the Tribe to promote energy independence and clean energy production through the installation of small scale renewable energy systems. At Birch Hill, there is an opportunity for the Bad River Housing Authority to retrofit up to 80 homes using a combination of geothermal and/or solar energy. Integrating geothermal and solar technologies can be done effectively using solar thermal and heat recovery systems in

combination with heat pump installations. This approach to system design can help achieve very high efficiencies resulting in cost and energy savings.

As part of this planning process, preliminary solar assessments were also conducted for several facilities. In addition, the Community Center audit identified an opportunity to replace the existing natural gas boiler with a biomass boiler. Based on economics alone, these types of projects are difficult to justify when compared with a number of energy efficiency opportunities at each facility with much shorter payback periods. However, three facilities currently using propane may be better candidates for woody biomass heating, including the Housing Authority, Recycling Center, and Wake House. Transitioning one or more of these facilities to wood heating could provide the Tribe with a clean renewable energy source and experience handling and utilizing woody biomass. Finally, concentrating multiple small scale renewable energy projects at a single facility could maximize their overall educational value. For example, the Tribe could incorporate several different technologies to create a "net zero energy" facility, capable of creating at least as much energy as it consumes.

5.2.2 Large Scale Wind and Solar

In order to achieve the Tribe's long-term vision of energy independence while simultaneously promoting environmental quality, large renewable energy projects will need to be developed in order to displace current fossil-based fuel sources. After extensive monitoring, it appears that large scale wind development may be currently uneconomical due to a poor wind resource, current state of wind turbine technology, and lack of eligibility for potential Focus on Energy renewable energy incentives. The Tribe could continue to monitor advances in wind technology and costs and re-evaluate the potential wind if the economics become more favorable.

In addition to wind, the Tribe has taken steps to investigate large scale solar. The Tribe could take additional steps to examine the potential for a large central power plant. This could be done through an analysis of potential funding sources, existing infrastructure and suitability based on environmental constraints, access, land ownership, interconnection, and other relevant factors.

5.2.3 District Heating/Power – Woody Biomass

District heating using woody biomass has proven to be an effective technology for community scale renewable energy deployment around the world, including for the Cree Nation in Quebec, Canada[14]. Given the Tribe's extensive forest assets, as well as the assets available to the Tribe beyond its own borders, district heating/power looks particularly promising for Bad River.

The recently completed Biomass Technologies Assessment suggests a district heating/power using system using woody biomass could be feasible for the Tribe. While initially focused on the lodge/casino, Elder Center, and Health Clinic, a district CHP system could potentially heat and power a much larger portion of the reservation. Advancing the district CHP option forward will require additional analysis and will also be contingent upon the Tribe developing a reliable fuel supply. The Tribe could develop a detailed district woody biomass feasibility study as a precursor to applying for development (pre-construction) funding through the Department of Energy.

[14] See http://www.biomasscenter.org/resources/case-studies/communityde.html

5.2.4 Woody Biomass Development

The reservation comprises over 125,000 acres of land, a significant percentage of which is forest. Beyond its borders, extensive biomass resources exist throughout northwest Wisconsin and Upper Michigan. As the Tribe continues to analyze the feasibility of heat/power, it has an opportunity to prepare for future bioenergy development now. Developing a better understanding of what biomass resources are potentially available – both within and outside the reservation – would support the Tribe's biomass planning efforts. One area of particular interest to the Tribe is historical biomass harvesting rights within ceded territories.

In addition, the Tribe has an opportunity to begin investing in its own biomass supply chain. This could be done through an update to the Tribe's timber management plan, purchase of equipment (e.g., wood chipper), establishment of a short rotation woody crop pilot project, logger training, sustainable biomass harvesting training, and other techniques. Finally, the Tribe could examine its current policies with regard to logging operations, including what it charges for harvesting logging residues and the potential for adjusting those fees to encourage a sustainable woody biomass supply to support Bad River's own biomass heating projects.

According to a publication by the National Renewable Energy Lab, successful woody biomass projects have the following characteristics:[15]

- A good local wood source
- The right team – the right technology
- Political will and long-term commitment
- A champion
- A high energy bill

5.2.5 Greenhouse

Bad River recently launched a local/indigenous agricultural program which a greenhouse could support. There are opportunities to involve youth and elderly populations in agricultural and horticultural production including Elder Center programming, where gardening is already taking place. As the Tribe investigates renewable energy options such as biomass heating, it should consider utilizing a small woody biomass boiler for greenhouse heating and year round food production. Another option to consider is capturing waste heat from a larger district heating/CHP system to heat a greenhouse(s).

5.2.6 Organic Waste Composting

One goal of the Tribe's integrated solid waste management plan (September 2007) is to develop composting infrastructure for food and yard waste. Such a facility could support the Tribe's local agricultural initiatives and renewable energy development. In Milwaukee, WI, organic waste is turned to compost using aerobic digestion, the process of decomposing down organic matter in the presence of oxygen. Growing Power also uses its compost to support year round food production, placing rows of compost alongside the walls of its greenhouses in the winter time to capture the heat generated by the decomposition of yard waste mixed with wood chips. Figure 20 depicts one of Growing Power's raised vegetable beds, located directly above an indoor fish tank which produces edible perch and tilapia.

[15] Where Wood Works: Strategies for Heating with Woody Biomass available at: www.nrel.gov/docs/gen/fy09/42857.pdf

Figure 20 – Photo of Agriculture and Fish Production at Growing Power

Anaerobic digestion is another method of composting. Anaerobic digestion occurs in the absence of oxygen, converting organic wastes into compost while also creating methane gas. The gas is then captured and used to create heat and/or power through CHP technology. While there are many anaerobic digesters installed on farms and waste water treatment facilities, "dry" anaerobic digesters are designed to process food , yard, and other relatively dry organic material. The first dry digester of this type in the Americas was recently deployed in Oshkosh, WI, in the summer of 2011 (Figure 21).

Figure 21 – Photos of CHP Unit (left) and Digested Compost (right); UW-Oshkosh

5.3 Education and Organization

5.3.1 Utility Organization Development

Members of the Bad River Energy Task Force have expressed interest in forming a Tribal utility. Development of a Tribally owned and operated utility would require long term planning and significant investment, however it could also provide employment opportunities to Tribal members while supporting energy independence and Tribal sovereignty. A utility organization created by the Tribe could create an authority to oversee current energy matters and better represent the Tribe's interests.

The scope of a Tribal utility organization could be broadened over time, as appropriate, to include additional responsibilities such as power distribution. Short of forming a standalone utility to provide power, Bad River could take other steps to exercise its sovereignty as it relates to the provision of energy within the reservation. As part of utility organization development, Bad River could clarify its own standing with regard to energy service provision within the reservation. For example, there may be opportunities for the Tribe to set

standards regarding current disconnect/reconnect policies, right of way procedures, safety, reliability, and other factors.

To further explore utility formation Bad River could conduct a feasibility study to examine relevant issues and opportunities including clarifying the pros and cons of utility formation, Tribal authority regarding energy provision, and first cut economic feasibility.

5.3.2 Engage the Community and Leadership in Energy Issues

A reoccurring theme throughout the energy planning process was the need to engage the broader community and leadership in discussions regarding energy. While there appears to be strong support for the development of renewable energy, for example, there are a host of concerns regarding specific technologies and their potential impact on the community and the environment. Residents attending the two open houses raised concerns with regard to unsustainable biomass harvesting to support potential woody biomass heating.

5.3.3 Establish a 3/4 to Full-Time Tribal Energy Coordinator Position

While the Tribe has a part-time renewable energy coordinator currently, it lacks a fully funded long term position with clear energy management and planning responsibilities. The energy task force therefore identified a need to fund a ¾ to full time tribal energy coordinator position. A tribal energy coordinator could coordinate a range of energy-related activities including, but not limited to, implementation of the Tribal Energy Plan, development of energy auditing/weatherization training, recording and monitoring of utility data for Tribal facilities, preparation of energy related grants, and other activities.

6.0 Goals and Objectives

The energy options described in the previous section are organized into the following four overall goals with numbered objectives in order to guide plan implementation.

Goal: Improve energy management while providing training and education

1. Implement priority energy conservation measures and adopt energy efficient building codes.
2. Develop a tracking system to monitor energy data; train additional staff in energy auditing and weatherization.
3. Educate Tribal members on energy plan and provide homeowner education

Goal: Implement small scale renewable energy projects

4. Implement solar at individual facilities, as funding becomes available.
5. Convert one facility currently using propane to woody biomass heating.
6. Promote sustainable residential housing development including geothermal, solar, wind, and other small scale technologies.

Goal: Implement large scale renewable energy projects

7. Continue planning and design of preferred woody biomass district heating/power alternative.
8. Further assess feasibility of a larger solar energy project while monitoring advances in wind turbine technology.
9. Develop a sustainable biomass supply.

Goal: Education and Organization

10. Clarify Tribal utility rights and assess feasibility of utility formation while taking a more pro-active role in Bayfield Electric Cooperative.
11. Fund a ¾ to full time Energy Coordinator position to provide consistent leadership on energy issues.
12. Engage the community and leadership in energy issues.

7.0 Plan Implementation

7.1 Action Plan

7.1.1 Implement Priority Energy Conservation Measures and Adopt Energy Efficient Building Codes

No cost and very low cost opportunities with shorter simple payback periods should be budgeted for and implemented as soon as possible so that the Tribe can begin to see immediate energy and cost savings.

The Casino, Chief Blackbird Center, WWTP, and Community Center comprise 80% of all facility energy expenditures and should be focused on first. Because the Tribe is currently evaluating whether to demolish or rebuild the Community Center, implementation of energy conservation projects at that facility are on hold until a final decision is made. Likewise, prioritized energy conservation projects at the casino will be identified when a comprehensive energy audit is conducted at that facility.

Table 13 below summarizes high priority, quick payback energy conservation opportunities at the Chief Blackbird Center, the Tribe's second largest energy consumer. Note that the combined payback period for implementing all of these opportunities is 2.4 years. Following that time period, the Tribe should realize annual energy cost savings of roughly $25,000.

Table 13
Priority Energy Conservation Measures at Chief Blackbird Center

Energy Efficiency Opportunity	Est. Savings (kWh)	Est. Savings (therms)	Est. Cost Savings ($)	Est. Cost ($)	Simple Payback (Years)
Lighting Sensors	34,241	0	$4,109	$1,750	0.4
VFD Controls -AHU 1	51,249	0	$6,150	$11,000	1.8
VFD Controls -AHU 2	51,249	0	$6,150	$11,000	1.8
Add Ext Floor Insulation	0	3,030	$3,182	$12,360	3.9
Add Wall Insulation	23	3,823	$4,017	$18,114	4.5
Air Seal Doors	0	43	$45	$30	0.7
VFD Controls -HVAC hot Water	11,824	0	$1,419	$6,000	4.2
Totals	**148,586**	**6,896**	**$25,072**	**$60,254**	**2.4**

Energy conservation opportunities for the WWTP include variable speed blowers, smart temperature controllers, and lighting upgrades. Cost estimates should be developed for these items and implemented as funding allows, possibly in connection with larger system upgrades. The same process should be used to implement energy conservation opportunities

identified for the remaining Tribal facilities. The "Facility Energy Options Matrix" appendix lists these opportunities along with specific recommendations by facility.

Energy conservation opportunities with longer payback periods and/or higher capital costs should be implemented using a combination of grant funding and money budgeted over a multi-year period by the Tribe. Once a comprehensive energy audit is completed for the Casino, the Tribe should develop a capital improvement plan that integrates all of the larger energy conservation opportunities which have been identified to date.

Affected stakeholders

- Facility Department
- Individual Facility Managers

Tribal Assets/Potential Funding/Other Resources

- Staff time for Facility Managers
- Indian Community Development Block Grant
- Energy Center of Wisconsin
- Focus on Energy (natural gas related projects only)

Table 14
Objective #1 Action Plan

Action Plan (Responsible)	By When	Additional Resources Required	Performance Measure
Evaluate creation of segregated energy conservation account to fund future projects (Administrator)	6/1/12	None	Yes/No decision reached
Include Chief Blackbird energy conservation measures in next budget (Tribal Council)	Start of next budget cycle	$60,000	ECM's included in budget
Package similar moderate/high cost energy conservation measures into suitable grant proposals (Planner, RE Coordinator)	6/1/12	None	ECM's bundled for future grant proposal development
Implement low/no-cost energy conservation measures (Facility Mgrs)	7/1/12	Staff time	ECM's implemented
Research and pursue grant opportunities to implement larger conservation projects and those with longer pay back periods. Focus on the Casino, Chief Blackbird Center, and Community Center. (Grant Writer, RE Coordinator)	8/1/12	Staff time	DOE, BIA grants applied for
Conduct a Level 2 energy audit of the Casino (Casino Mech. Mgr.)	7/1/12	$10,000 - $20,000	Audit completed
Research alternative energy efficient building codes available (Housing Authority)	5/1/12	Staff time	Written summary of recommended codes
Adopt appropriate energy efficient building codes for Housing Authority (Tribal Council)	12/1/12	Staff time	Housing code adopted

7.1.2 Develop a Tracking System to Monitor Energy Data; Train Additional Staff in Energy Auditing and Weatherization

A critical step toward implementing an effective energy program is establishing a system to regularly monitor and record energy consumption, costs, and related data. The Facility

Manager and Accounting Department already allocate space costs across departments annually for budgeting purposes.

As a starting point, spreadsheets developed for the Energy Center of Wisconsin load study should be updated and maintained. Ideally, this could be done by a single individual, with monthly utility bills routed to their inbox. Because the Housing Authority manages so many facilities, it may make sense for them to record and monitor their energy data themselves.

The Housing Department recently conducted a spray foam insulation training. In conjunction with developing a better grasp on overall energy consumption patterns, the Tribe should invest in continued basic energy audit and weatherization training for the Energy Task Force or similar team of staff members with energy related responsibilities.

Affected stakeholders

- Facilities Department
- Individual Department Heads/Building Contacts
- Energy Task Force
- Energy Coordinator

Tribal Assets/Potential Funding/Other Resources

- Staff time for Facility Managers
- Focus on Energy (natural gas related projects only)
- NABDI Grant Program
- Indian Community Development Block Grant

Table 15
Objective #2 Action Plan

Action Plan (Responsible)	By When	Additional Resources Required	Performance Measure
Assign an individual with responsibilities for updating ECW load spreadsheets and entering utility data on a monthly basis (Tribal Administrator)	2/1/12	None	Individual assigned to monitor, track energy data
Identify basic energy audit/weatherization staff training needs (Housing Authority & Energy Task Force)	3/1/12	None	Written document summarizing training/weatherization needs
Research and evaluate training resources available and costs; (Energy Task Force)	3/1/12	None	Written document summarizing resources/cost
Apply for funding to support training/weatherization program	6/1/12	None	Grant submitted
Implement a comprehensive energy management system	12/1/12	Staff time	EMS framework in place

7.1.3 Educate Tribal Members on Energy Plan and Provide Homeowner Education

The Energy Task Force has done extensive research analyzing a wide range of energy conservation and renewable energy opportunities for the Tribe to pursue. In order to strengthen support for energy related initiatives called for in the Energy Plan, the Tribe should continue conducting outreach through public forums, study tours, homeowner

education, and other techniques. Targeted homeowner education also provides an opportunity to help homeowners save money and improve the comfort of their homes.

Affected stakeholders

- Facility Department
- Energy Coordinator
- Housing Authority

Tribal Assets/Potential Funding/Other Resources

- DOE, EPA, Focus on Energy

Table 16
Objective #3 Action Plan

Action Plan (Responsible)	By When	Additional Resources Required	Performance Measure
Organize a public forum to share results of Energy Plan (Renewable Energy Coordinator)	3/1/12	None	Forum held
Following staff training for audit/weatherization develop and implement an on-going homeowner education program (Housing Authority, Energy Coordinator)	6/1/12	Staff time	Homeowner program implemented
Integrate energy education into existing outreach programs (Tribal Planner)	12/1/12	Staff time	TBD

7.1.4 Implement Solar at Individual Facilities, as Funding Becomes Available

The economics of implementing solar energy at individual facilities is challenging to due high up front capital costs and low electricity prices. Furthermore, given tight budget constraints energy conservation measures with much quicker payback periods may be more attractive to the Tribe in the short term. However, solar technology is rapidly improving and costs are falling. Meanwhile, electricity rates continue to rise. Therefore, given the Tribe's interest in energy independence and clean renewable energy, it should continue to look for opportunities to deploy solar as funding becomes available. As Tribal facilities are upgraded and as new facilities are designed and constructed, the Tribe should also continue to explore its solar options.

Affected stakeholders

- Renewable Energy/Energy Coordinator
- Energy Task Force

Tribal Assets/Potential Funding/Other Resources

- EPA
- DOE Tribal Energy Program
- Focus on Energy (natural gas related projects only)
- Indian Community Development Block Grant

Table 17
Objective #4 Action Plan

Action Plan (Responsible)	By When	Additional Resources Required	Performance Measure
Monitor solar installation costs and report findings to Task Force annually (Renewable Energy Coordinator)	On-going	Staff time	Report to Tribal Energy Task Force
Consider Solar Hot Water for Casino if biomass project does not move forward (Casino Mech. Mgr.)	On-going	Staff time	Report to Tribal Energy Task Force
To be determined			

7.1.5 Convert One Facility Currently Using Propane to Woody Biomass Heating

As the Tribe continues to work toward energy independence, biomass will likely play a key role. Converting one facility from propane to woody biomass will provide the Tribe with experience using woody biomass on a small scale, thereby helping lay the groundwork for larger biomass projects in the future. This objective supports the Tribe's desire to develop a sustainable woody biomass supply, and should be implemented in tandem with that objective.

Affected stakeholders

- Facility Department
- Housing Authority, Recycling Center Department Heads

Tribal Assets/Potential Funding/Other Resources

- Focus on Energy
- DOE Tribal Energy Program

Table 18
Objective #5 Action Plan

Action Plan (Responsible)	By When	Additional Resources Required	Performance Measure
Update utility records for Housing Authority and Recycling Center (Energy Coordinator)	2/1/12	Staff time	Records updated
Have a commercial HVAC installer with woody biomass boiler project experience provide cost estimates for installing high efficiency biomass boilers at the Housing Authority and Recycling Center	3/1/12	Staff time	Estimates received
Analyze feasibility of installing a woody biomass boiler at Housing Authority or Recycling Center (Facility Mgrs.)	6/1/12	Staff time	Report to Energy Task Force completed
Fund installation of woody biomass boiler in 2013 or 2014 Tribal budget if economically feasible (Tribal Council)	12/1/12	None	Boiler included in Tribal budget

7.1.6 Promote Sustainable Residential Housing Development Including Geothermal, Solar, Wind, and Other Small Scale Technologies

The Tribe should fully evaluate its recent investments in geothermal and determine if the technology is a good fit for the Tribe. In addition, the Tribe should explore opportunities to integrate solar and/or small scale biomass systems into future geothermal projects.

Affected stakeholders

- Facility Department
- Housing Authority, Recycling Center Department Heads

Tribal Assets/Potential Funding/Other Resources

- EMDP/BIA
- NABDI/BIA
- ICDBG/HUD
- REDD/DOE
- EPA
- Focus on Energy
- Utility

Table 19
Objective #6 Action Plan

Action Plan (Responsible)	By When	Additional Resources Required	Performance Measure
Review utility records for Housing Units converted to geothermal (Housing Authority)	6/1/12	Staff time	Memo summarizing findings
Survey residents to gauge satisfaction/experience with geothermal (Housing Authority)	6/1/12	Staff time	Survey completed; results compiled
Using results of utility records and survey, evaluate potential to expand geothermal program. Research examples of integrated solar/geothermal technologies (Energy Task Force)	8/1/12	None	TBD
Based on evaluation in prior step, continue expansion of geothermal at Birch Hill neighborhood (Housing Authority)	TBD	None	TBD

7.1.7 Continue Planning and Design of Preferred Woody Biomass District Heating/Power Alternative

Based on the results of the recently completed Biomass Technologies Assessment, the Tribe should consider developing a more detailed feasibility study for their preferred option. The study should be designed to satisfy the requirements of the Department of Energy in terms of applying for pre-construction (development) grant funds, the next step in developing a large renewable energy project for the Tribe. The study should address:

- Biomass availability
- Updated load assessments

- Transmission and interconnection considerations
- Technology, economic, and environmental analysis
- Benefit assessment
- Preliminary system design
- Training and other tribal professional development planning
- Long-term operating and maintenance planning
- Business planning

Another option to consider would be to examine the potential for an even larger district heating and/or power system which would include additional Tribal facilities beyond the four considered as part of the Biomass Technologies Assessment. If the Tribe chose to explore that option, the first step would be to apply for a DOE feasibility study grant.

Affected stakeholders

- Facility Department
- Casino/Lodge, Moccasin Trail, Elder Center, Clinic Managers/Department Heads

Tribal Assets/Potential Funding/Other Resources

- EMDP/BIA
- NABDI/BIA
- ICDBG/HUD
- REDD/DOE
- EPA
- Focus on Energy
- Utility

Table 20
Objective #7 Action Plan

Action Plan (Responsible)	By When	Additional Resources Required	Performance Measure
Continue to educate Energy Task Force members and Tribal members on use of woody biomass for heating and power (including study tour to Ashland's Memorial Hospital)	On-going	None	Tour conducted
Recommend feasibility study be completed for district system based on results of Biomass Technologies Assessment (BTA) *OR* recommend Tribe consider a larger district system (Energy Task Force)	3/1/12	None	Energy Task Force provide recommendations to Tribal Council
Approve district biomass feasibility study based on results of BTA study (Tribal Council, if applicable)	3/1/12	None	Tribal resolution supporting additional feasibility analysis
Complete feasibility study based on BTA study results (Consultant, if applicable)	12/1/12	TBD	Detailed feasibility study completed

Table 20
Objective #7 Action Plan

If project deemed feasible, apply for Department of Energy Grant to fund development phase (pre-construction) activities (Grant Writer) *OR* Apply for grant to fund feasibility study of larger district heating/power system (Grant Writer)	6/1/13	TBD	Grant applied for
Apply for Department of Energy Grant to fund construction activities (Grant Writer)	6/1/14	TBD	Grant applied for

7.1.8 Further Assess Feasibility of a Larger Solar Energy Project While Monitoring Advances in Wind Turbine Technology

The tribe has two strong options to move ahead with solar energy: solar thermal for the casino and a 1MW central solar plant. Funding options should be explored, especially with regard to developing a central solar plant. If funding options, including the New Markets Tax Credits, are viable, the Tribe should consider moving ahead with a more robust feasibility study for a central solar plant.

In terms of wind development, the Tribe should monitor advances in wind technology and gather additional information on successful Tribal wind development projects around the Country. A Tribe in northern Michigan is developing a wind project currently and may be a good project to learn from.

Affected stakeholders

- Facility Department
- Casino/Lodge, Moccasin Trail, Elder Center, Clinic Managers/Department Heads

Tribal Assets/Potential Funding/Other Resources

- NABDI Grant Program
- EMDP

Table 21
Objective #8 Action Plan

Action Plan (Responsible)	By When	Additional Resources Required	Performance Measure
Determine if the tribe can apply for further allocation of the New Market Tax Credits after the recent housing/geothermal project. (Tribal Lawyer/Consultant)	6/1/12	Staff time, up to $10,000 for initial study	Memo summarizing potential to use NMTC at Bad River for a commercial scale Tribal renewable energy project
Determine the Tribe's ability and desire to apply for Qualified Energy Conservation Bonds (QECBs) for both of these projects.	6/1/12	Same as above	Same as above
Determine other available capital funds that could help finance either project. (Renewable energy coordinator)	6/1/12	Staff time	Memo summarizing other funds available
Meet with potential developers to discuss project. (Energy Task Force)	12/1/12	Staff time	Meeting held

Based on results of previous steps, consider applying for an EMDP grant to fund a feasibility study for a central solar plant. (Grant Writer)	2/1/12	Staff time	Grant applied for
Update wind study results using more recent cost estimates for turbines and installation. (Renewable Energy Coordinator)	12/1/12	Staff time	Memo to Task Force completed
Consider visiting other Tribes to learn about their experiences developing large wind and/or solar projects. (Renewable Energy Coordinator)	12/1/12	Staff time	TBD

7.1.9 Develop a Sustainable Biomass Supply

The Tribe should continue to research and develop a sustainable biomass supply to support renewable energy development on Tribal land. The BIA resource assessment provides an excellent starting point. Information on resource availability beyond the Tribe's own borders should also be gathered, in order to better understand the market for biomass in the region including potential supply available to support a start up project on Tribal lands.

Affected stakeholders

- Facility Department
- Casino/Lodge, Moccasin Trail, Elder Center, Clinic Managers/Department Heads

Tribal Assets/Potential Funding/Other Resources

- BIA
- USDA Forest Products Lab
- WI Woodlands Association
- Wisconsin Bioenergy Initiative
- Energy Center of Wisconsin
- UW-Extension – Ashland County
- EMDP Grant Program
- NABDI Grant Program
- ICDBG Program
- DOE Renewable Energy Development and Deployment Program
- EPA
- Wisconsin Focus on Energy
- Utility

Table 22
Objective #9 Action Plan

Action Plan (Responsible)	By When	Additional Resources Required	Performance Measure
Convene an internal working group including staff with responsibility for air, water, forestry, and land management to identify and discuss long-term pros/cons associated with woody biomass harvesting (Renewable Energy Coordinator)	4/1/12	Staff time	Working group convened; action steps identified
Develop a plan to collect inventory data for tribal fee lands. (Tribal Planner & Forester)	6/1/12	Staff timie	Action plan completed
Develop an action plan to exert Tribe's historical rights to harvest biomass on ceded territories. (Renewable Energy Coordinator/Energy Task Force)	5/1/12	Discuss strategy with Jim Zorn, GLFWC	Action plan completed; responsibility assigned
Develop a pilot study to incorporate short rotation intensive culture (SRIC) of woody crops such as willow or poplar. This would require further evaluation of soil and species suitability. (Tribal Forester)	6/1/12	BIA, NRCS, UWEX	Pilot study design completed
Determine level of biomass harvest possible in natural alder, willow, and hazel shrublands. (Tribal Forester/BIA)	9/1/12	Staff time	Estimate completed; prior BIA resource assessment updated
Determine timing, techniques, and land base available for harvesting biomass through pre-commercial thinning of young aspen stands. (Tribal Forester/BIA)	9/1/12	BIA	Report completed for Energy Task Force
Conduct a regional woody biomass resource analysis including Tribal lands and surrounding 50 miles (Consultant/Other)	8/1/12	Grant $	Assessment completed
Develop a program to source small quantities of woody biomass from existing operations to support a small woody biomass boiler (Tribal Forester)	9/1/12	Staff time	Program developed

7.1.10 Clarify Tribal Utility Rights and Assess Feasibility of Utility Formation While Taking a More Pro-Active Role in Bayfield Electric Cooperative

The Tribe should conduct a study to identify the pros and cons associated with forming a tribally owned utility in order for the Tribe to make a go/no go decision to further explore utility formation. The study would include an assessment of existing power demand and infrastructure, recommendations, preparation of a written report and a formal presentation to both the Energy Task Force and the Tribal Council.

Tribal staff could research and compile an initial report to guide early discussions on the topic, including an initial review of Bayfield Electric Cooperative's by-laws. If there is continued interest the Tribe should consider hiring a legal firm with experience in Tribal utility formation to develop a more formal study.

Affected stakeholders

- Tribal Council, Chairman, and Tribal Administrator
- Tribal Membership
- Bayfield Electric Cooperative, Xcel Energy

Tribal Assets/Potential Funding/Other Resources

- NABDI
- DOE Tribal Energy Program technical assistance

Table 23
Objective #10 Action Plan

Action Plan (Responsible)	By When	Additional Resources Required	Performance Measure
Recruit an individual from the Tribe to serve on the Bayfield Electric Cooperative Board of Directors to promote communication flow to and from the cooperative (Administrator)	4/1/12	Staff time	Member recruited for next cooperative Board election
Check with Bayfield Electric Cooperative to identify cooperative's service territory and size of Tribe's account relative to cooperative's entire customer base. (Renewable Energy Coordinator/Tribal Lawyer)	4/1/12	Staff time	Memo for Energy Task Force completed
Develop an initial staff memo on Tribal Utility formation and organization (Energy Task Force)	6/1/12	Staff time	Memo completed
Share findings from staff memo with Tribal Council (RE Coordinator)	7//1/12	Staff time	Presentation to Council completed
Hire a legal firm with experience in Tribal utility formation to prepare a study and present and discuss findings with Tribal leadership (Energy Task Force)	9/1/12	TBD	Study completed

7.1.11 Fund a 3/4 to Full Time Energy Coordinator Position to Provide Consistent Leadership on Energy Issues

A full time energy coordinator position could spearhead multiple energy initiatives across the entire reservation, including energy outreach, tracking and monitoring energy consumption, and developing training programs. Specific duties and responsibilities of an Energy Coordinator should be clearly developed before funding the position.

Affected stakeholders

- Tribal Council, Chairman, and Tribal Administrator
- Tribal Membership
- Bayfield Electric Cooperative, Xcel Energy

Tribal Assets/Potential Funding/Other Resources

- Tribal Energy Development Capacity (TEDC) Grant Program

Table 24
Objective #11 Action Plan

Action Plan (Responsible)	By When	Additional Resources Required	Performance Measure
Draft position description for Energy Coordinator (Energy Task Force)	3/1/12	None	Description completed
Review, amend, approve position description (Tribal Administrator)	4/1/12	None	Position approved
Seek funding to hire Energy Coordinator position (Grant Writer)	On-going	Staff time	Funding identified and applied for

7.1.12 Engage the Community and Leadership in Energy Issues

Affected stakeholders

- Tribal Council, Chairman, and Tribal Administrator
- Tribal Membership
- Bayfield Electric Cooperative, Xcel Energy

Tribal Assets/Potential Funding/Other Resources

- EMDP

Table 25
Objective #12 Action Plan

Action Plan (Responsible)	By When	Additional Resources Required	Performance Measure
Identify key educational/outreach goals (Energy Task Force)	4/1/12	Staff time	Educational strategy defined
Share results of Energy Plan with broader community and solicit additional input on overall direction and specific projects (RE Coordinator)	6/1/12	Staff time	Workshops, presentations completed
Continue to support educational efforts with energy components (RE Coordinator)	On-going	Staff time/salary	TBD

7.1.13 Promote Organic Waste Conversion and Local Agricultural Production

Opportunities exist to support year round agricultural production in greenhouses heated with wood or waste heat. Composting food and yard waste could also support agricultural production and create renewable energy through anaerobic digestion.

Affected stakeholders

- Tribal Council, Chairman, and Tribal Administrator
- Tribal Membership
- Casino Staff

Tribal Assets/Potential Funding/Other Resources

- EMDP
- UW-Extension Solid Hazardous Waste Center

Table 26
Objective #13 Action Plan

Action Plan (Responsible)	By When	Additional Resources Required	Performance Measure
Invite local food specialist to serve on Energy Task Force (RE Coordinator)	3/1/12	None	Invitation issued
Conduct a compost study to quantify available organic wastes and identify appropriate technologies (Consultant, SHWEC)	12/1/12	Grants	Study completed
Monitor advances in smaller scale "dry" anaerobic digestions and report to Energy Task Force (RE Coordinator)	On-going	Staff time	Reports to Energy Task Force
Tour facilities like Growing Power or UW-Oshkosh to learn more about organic waste conversion including composting and energy production.	12/1/12	Staff time	Tours completed

7.2 Roles and Responsibilities for Plan Implementation

Tribal Council/Chairman

- Adopt Tribal Energy Plan.
- Develop and adopt policies to promote energy conservation and renewable energy on Tribal lands.
- Adopt annual budgets that fund energy conservation and renewable energy projects with low cost or short payback periods.
- Adopt and fund multi-year Capital Improvement Plans that fund large scale renewable energy developments on Tribal lands.
- Receive and review Annual Energy Independence Report

Tribal Administrator

- Assist Tribal Council as necessary to pursue its responsibilities regarding energy.
- Administer and supervise the Tribal Energy Plan for Tribal operations. Assume ultimate responsibility for implementation of Tribal Energy Plan.
- Ensure that energy use is properly metered, and that records of energy use are systematically maintained to provide the basis for ongoing energy monitoring and energy conservation and renewable energy decisions.
- Set and communicate annual energy conservation targets through the annual budget process.
- Review Annual Energy Independence Report

Tribal Energy Coordinator

- Record and monitor all facility fuel consumption and costs on a monthly basis.
- Prepare an Annual Energy Independence Report. The report will be used to report and monitor progress toward meeting energy use and conservation goals. The report will document:
  - The preceding year's metered annual energy use (fuel, electricity) in relation to 2009 baseline energy use.

- The activities implemented to conserve energy in the preceding year.
- Budgeted Activities as proposed by the Department Heads, the facility managers, and the Tribal Administrator to conserve energy in the upcoming years
- Environmental and fiscal benefits accrued to date and prior year as result of energy efficiency improvements
- A status report of progress made to date on achieving each of the objectives put forth in this plan – broken out by progress made since plan inception and progress made over past year to date.

- Work with Tribal planner and/or grant writer to identify opportunities to implement plan objectives using grants and other financing mechanisms.
- Coordinate with Tribal Chairman and Administrator to support plan implementation.

Facility Managers

- Develop annual energy conservation plans and associated budgets for Tribal Council and Administrator.
- Review and report on progress toward energy goals at least annually.

Tribal Planner/Grant Writer

- Apply for grants and other funding to support plan implementation.
- Periodically attend grant funding workshops.

7.3 Budget

Action/Objective	Additional Resources Required	Potential Funding/Partner Sources
District Woody Biomass Feasibility Study based on BTA study findings	$40,000-$50,000	Existing grant funds, EMDP
District Woody Biomass Development Activities (Pre-Construction)	$50,000-$200,000	DOE Renewable Energy Development and Deployment in Indian Country
District Woody Biomass Feasibility Study for larger system (beyond just 4 buildings examined in BTA study)	$100-$250,000	DOE Renewable Energy Development and Deployment in Indian Country
Tribal Utility Formation Activities	$5,000-$15,000	Existing grant funds, EMDP, NABDI
Priority Energy Conservation Measures	$50,000-$100,000	General fund, EPA, ICDBG
Woody Biomass Resource Analysis	$0-$20,000	EMDP, NABDI, NRRI, UWEX, DNR
Short Rotation Woody Crop Pilot Project	$0-$10,000	BIA, EMDP, NABDI, NRRI, UWEX
Level Two Energy Audit Casino	$20,000	EMDP
Composting Study	$0-$5,000	SCHWEC (UWEX)
Central Solar Plant Pre-Feasibility Study	$10,000	EMDP

Appendix A

Funding Sources

Appendix B

Load Assessment Study

Appendix C

Resolution Establishing Renewable Energy and Energy Efficiency Tribal Energy Task Force

Appendix D

Bad River Environmental Policy Statement

Appendix E

PowerPoint Summary of Prior Energy Studies

Appendix F

Chief Blackbird Center Energy Audit

Appendix G

Community Center Energy Audit

Appendix H

Solar Energy Assessment

Appendix I

Presentation Material and Results of Energy Task Force Open Houses

Appendix J

Facility Energy Options Matrix

Appendix K

Barron Study Tour Summary

Appendix L

Tribal Utility Energy Audit

Appendix M

Home Inspection Report (CD only)

Appendix N

Utility Records and Energy Data (CD only)