Minnesota Tribal Coalition Tribal Utility Capacity Building Project

Grand Portage
White Earth
Leech Lake
The Grand Portage, Leech Lake and White Earth reservations seek to build a common foundation for strategic energy resource and utility planning capacity by banding together.
The effort will focus primarily on the following four inter-related areas:

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

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

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

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

• Comprised of some 56,000 acres
• Approximately 95% tribally owned, and over 7,000 acres allotted.
• Located at Minnesota’s most northeasterly point along Lake Superior in Cook County, MN.
• Total Tribal enrollment exceeds 1,098 members with 35% in residence, with per capita income of about $16,000
• Unemployment is at 10%.
Grand Portage

Federally recognized by Cook County
Tribally owned: 37,679 acres
Allotted: 7,086 acres
Total labor force: 113
High school or higher graduate: 67.6%
Reservation population: 308
Total enrollment: 790
Total unemployment: 26.5%
Per capita income: $10,808
150 miles away from Duluth, MN.
Total Electricity Consumption:

- Community Center - 840,000 kWh/yr
- Casino/Hotel - 2,200,000 kWh/yr
- Households - 1,440,000 kWh/yr
- Tribal Council Offices - 640,000 kWh/yr

Total Consumption: 5,120,000 kWh/yr
Annual Cost: $358,400.00
Available resources:

**Solar:**
- Not enough sun
- Too expensive

**Biomass:**
- Costly infrastructure (Biomass harvest & transport)
- Creates emission (N0x, S0x, particulates, etc.)
- Could disrupt forest ecosystem health

**Wind:**
Best resource for Grand Portage
Wind Resource:

Wind Production:
Turbine Site: Mt. Maud
Wind Data at 20m:
Class-5
Capacity Factor-.22

Wind Production:
Turbine Site: Mt. Maud
Wind Data at 60m:
Class-6
Capacity Factor-.58

(based on height extrapolated formula)
Storing Wind Generated Electricity With Hydrogen

Wind Turbine → H₂ → ELECTROLYSIS → H₂O + O₂ + Heat → H₂ Storage → H₂ → PEM FUEL CELL → H₂O + e⁻ + Heat
Proposed Grand Portage Project

• Approximately 1MW of Wind to power community center and hotel/casino
• 20% Hydrogen backup (electrolysis, hydrogen storage, and fuel cell) located at community center
• All electricity production to be consumed by the reservation
• Community Education
“The Computer Model”

• Calculates wind turbine capacity required to meet any given electricity demand
• Allows users to experiment with various levels of hydrogen backup capacity: calculates required scale of electrolysis, hydrogen storage, and fuel cells
• Calculates costs associated with above system configurations
• Compares these costs with conventional electricity sources
• Software name Stella and developed by Mike Mageau.
### Grand Portage Model Output: 2 Scenarios

<table>
<thead>
<tr>
<th></th>
<th>No H2 Backup</th>
<th>20% H2 Backup</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Capacity</strong></td>
<td>2.08 million kwh</td>
<td>2.08 million kwh</td>
</tr>
<tr>
<td><strong>Wind Capacity</strong></td>
<td>1000 kW</td>
<td>1085 kW</td>
</tr>
<tr>
<td><strong>Electrolysis (H2)</strong></td>
<td>0</td>
<td>10.9 m3H2/hr</td>
</tr>
<tr>
<td><strong>Fuel Cell Capacity</strong></td>
<td>0</td>
<td>22.9 kW</td>
</tr>
<tr>
<td><strong>Total System Cost</strong></td>
<td>$946,959</td>
<td>$1,041,095</td>
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<tr>
<td><strong>Annual Cost</strong></td>
<td>$66,287</td>
<td>$108,230</td>
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<tr>
<td><strong>Cost per kwh</strong></td>
<td>3.2 cents</td>
<td>5.2 cents</td>
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<tr>
<td><strong>Annual Utility cost</strong></td>
<td>$174,500</td>
<td>$174,000</td>
</tr>
<tr>
<td><strong>Utility Cost per kwh</strong></td>
<td>6.5 cents</td>
<td>6.5 cents</td>
</tr>
</tbody>
</table>
Conclusion Grand Portage

Have a good chance to meet the electricity needs of community with renewable with combination of wind and hydrogen fuel cells

Potential leader with multi-tribally ran Great Lakes Wind Power Co-operative.

Continue to assess the feasibility of larger scale projects
White Earth
White Earth

Gaa-Noodin-Oke
White Earth

• Over 837,000 acres of land located in northwestern Minnesota (Mahnomen, Becker and Clearwater counties) reserved under the 1867 treaty.
• Enrolled tribal membership is over 20,000.
• On-reservation unemployment rate is almost 25%, with per capita income of $5,000.
• The reservation was selected by our ancestors because it had the biodiversity and spiritual significance to provide for the future seven generations of our people.
• Today, 76,347 acres or about 9%, of the original land base is held by our people, as the White Earth Tribe.
White Earth Project Participants

Minnesota Tribal Coalition Tribal Utility Capacity Building Project:

White Earth Reservation Tribal Council
Grand Portage Reservation Tribal Council
Leech Lake Reservation Tribal Council
Intertribal Council On Utility Policy
White Earth Land Recovery Project
Center for Sustainable Community Development Duluth, MN
EPAC Fargo, ND
White Earth Land Recovery Project

•Largest reservation based non-profit organization in the state of Minnesota.
•Founded in 1989 with the mission of recovering the original land base of the White Earth Indian Reservation.
•Cultural preservation through language fluency and environmental and economic justice initiatives.
•Wind development work a product of this mission; recent successes include hoisting a Jacobs 20 kW tower on Diana King’s property on White Earth Reservation.
Major Electricity Consumers:

- Tribal Council Building - 477,320 kWh/yr
- Circle of Life School - 464,000 kWh/yr
- Community Center - 300,000 kWh/yr
- Bingo Hall - 265,000 kWh/yr
- Casino - 14,982,000 kWh/yr
- Casino Sign - 87,000 kWh/yr
- Head Start - 36,000 kWh/yr
- Health Center - 1,700,000 kWh/yr

Total: 18,311,320 kWh/yr
Annual Cost: $732,453.00
Available Resources:

**Solar:**
- Not enough sun
- Too expensive

**Biomass:**
- Costly infrastructure (Transportation to Production)
- Creates emission (N0x, S0x, particulates, etc.)
- Could disrupt ecosystem health

**Wind:**
- Several potential sites on tribal and non-tribal land.
Chosen Resource

Wind Production:

Wind Data: (based on MN DOC wind maps)
MPH-Average 14 MPH
Class-5
Capacity Factor-.24

Turbine Site: narrowed down to 2 potential sites
Proposed White Earth Project

• Approximately 600 kW of wind to power the new school, tribal offices, and new community center
• 20% hydrogen backup (electrolysis, hydrogen storage, and fuel cell)
• All electricity production to be consumed by the reservation
• Community Education and tribal college courses
“The Computer Model”

- Calculates wind turbine capacity required to meet any given electricity demand
- Allows users to experiment with various levels of hydrogen backup capacity: calculates required scale of electrolysis, hydrogen storage, and fuel cells
- Calculates costs associated with above system configurations
- Compares these costs with conventional electricity sources
- Software name Stella and developed by Mike Mageau from CFSCD Duluth, MN.
## White Earth Model Output: 2 Scenarios

<table>
<thead>
<tr>
<th></th>
<th>No H2 Storage</th>
<th>20% H2 Storage</th>
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<tbody>
<tr>
<td></td>
<td>Capacity □</td>
<td>Capacity □</td>
</tr>
<tr>
<td>Annual Production</td>
<td>1.52 million kwh</td>
<td></td>
</tr>
<tr>
<td>Wind Capacity</td>
<td>750 kW</td>
<td>$816,343</td>
</tr>
<tr>
<td>Electrolysis (H2)</td>
<td>0</td>
<td>$0</td>
</tr>
<tr>
<td>Fuel Cell Capacity</td>
<td>0</td>
<td>$0</td>
</tr>
<tr>
<td>Total System Cost</td>
<td>$816,343</td>
<td></td>
</tr>
<tr>
<td>Annual Cost</td>
<td>$57,144</td>
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<tr>
<td>Cost per kwh</td>
<td>3.8 cents</td>
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<td>Annual Utility cost</td>
<td>$73,720</td>
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<tr>
<td>Utility Cost per kwh</td>
<td>4.6 cents</td>
<td></td>
</tr>
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</table>
Storing Wind Generated Electricity With Hydrogen

ELECTROLYSIS

H₂O → H₂ + O₂

Heat

H₂ STORING

PEM FUEL CELL

H₂ → e⁻ + H₂O
Fuel Cell

Gen Core 5Kw fuel cell [Plug Power]

- $15,000
- 20,000 hours of cell life

-Fuel cell would not run full time, and would have long lifespan to reduce future costs for repair and replacement.
-Would require come e- from turbines to run system
- On wind surplus days the e- would store for future energy pulls on non-windy days
Fuel Cell

One problem with the fuel cell model is when the wind stops blowing, and we exceed the amount of energy stored in cell.
- Demand Charge could be a factor from local utility
- The charge might be 3 to 7 dollars X monthly charge
- For example a 660 Kw turbine at our casino [our full capacity]

660 X 5 [estimated] = $3,300 on top of monthly bill

- Plan to develop H2 tanks and explore newest fuel cells for consumption on reservation.
Fuel Cell

-Latest hybrid model we are looking to bring to White Earth and hope to use fuel cells to keep energy on reservation.
- Power Purchase agreement would not be necessary.
- Energy could be used in areas most needed on reservation.
- Will still encourage local area farmers to develop wind turbines also for various local communities tribal and non-tribal.
On-Going Projects

- Identified potential sites for net meters
  - Jay Haley from EPAC in Fargo, ND will gather data to determine best location for resources from recent site visit.
- Planning workshops focusing in alternative energy awareness with both tribal and non-tribal members
  - Community outreach to local farmers in area who own land within the reservation’s borders with good sites.
On-Going Projects

- We plan to start with smaller turbines with local area farmers with 64Kw wind turbines
  - Go for the USDA spring deadlines grants
- Tribal project has land issues and we are looking at buying or leasing land.
  - Size of turbines will determine the amount of land needed, still to be determined.
  - Looking at buying 10 acres right now for 660Kw

- Hope to have anemometers up before winter hits, and locate 50 meter anemometers through Dep. of Commerce, NREL, or DOE for additional sites discovered
On-Going Projects [solar]

- Homemade passive solar heaters for tribal elder housing
  - White Earth Housing will supply lumber and materials
  - Teach area youth how to construct and place units

- Units - 4x10 feet, made out of 2x4, aluminum cans [black]
  - Heat will travel through a 6 inch duct work pipe with fan.
  - Can adjust heat with speed of fan.
- Cover or dismantle passive solar heaters during summer
- Very experimental at this point. Will not totally rely on these units for main source of heat.
- Very promising source of cheap winter heat.
Future Projects

- Bring a large scale tribal project to White Earth for tribal college or casino.
  - On-going.
  - Still doing resource assessments and education
    - Once sites are selected, we will move into environmental and cultural assessments.
- Cheap energy prices make larger projects less feasible.
  - Plan to consume all wind energy on reservation to skip the local energy providers on grid complications using a hybrid model with fuel cells.
Conclusion White Earth

Overall land issues and location for turbines remain to be biggest problems for developing wind turbines.

Going to start with further area farmers and community Education.

Hope to bring Tribal College energy programs to campuses

Site anemometers before winter
Leech Lake
Leech Lake

Federally recognized Beltrami, Cass, Hubbard and Itasca counties, Minnesota
Total area 602,889 acres; Tribally owned: 21,507 acres
Allotted (members): 12,639 acres
State trust: 30,000 acres
Other: 507,750 acres
Total labor force: 1069
Total enrollment: 7173
Total reservation population: 3725
High school graduate or higher: 60.2%
Per capita income: $4705
Total unemployment: 30.9%
Leech Lake

- Located in north central Minnesota (Beltrami, Cass, Hubbard and Itasca counties).
- Slightly over 10% of land is held in trust
- Approximately 5% in tribal control
- Unemployment exceeds 30% and the
- Per capita income is under $5,000.
Major Electricity Consumer:

Casino: 2002- 6,027,840 kW/H
2003- 6,427,320 kW/H

Annual Cost: $385,640.00
Available Resources:

**Solar:**
- Not enough sun
- Too expensive

**Biomass:**
- Costly infrastructure (Transportation to Production)
- Creates emission (N0x, S0x, particulates, etc.)
- Could disrupt ecosystem health

**Wind:**
- Not yet determined
Wind Resource

Wind Production:

Wind Data:
MPH-10
Class-2
Capacity Factor-.08

Turbine Site: Several other potential sites to be explored
Storing Wind Generated Electricity With Hydrogen

Wind energy is converted into electricity, which is then used to power electrolysis. Water is split into hydrogen and oxygen. Hydrogen is stored for later use. When needed, the hydrogen is fed into a PEM fuel cell, which produces electricity, water, and heat. The oxygen is also used in the fuel cell process.
Proposed Project Leech Lake

• Approximately 1MW to power fraction of casino’s demand
• Community Education
“The Computer Model”

- Calculates wind turbine capacity required to meet any given electricity demand
- Allows users to experiment with various levels of hydrogen backup capacity: calculates required scale of electrolysis, hydrogen storage, and fuel cells
- Calculates costs associated with above system configurations
- Compares these costs with conventional electricity sources
# Leech Lake Model Output

## No Hydrogen Storage

<table>
<thead>
<tr>
<th>Capacity</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Annual Production</td>
<td>1.36 million kwh</td>
</tr>
<tr>
<td>Wind Capacity</td>
<td>1000 kW</td>
</tr>
<tr>
<td>Electrolysis Capacity</td>
<td>0</td>
</tr>
<tr>
<td>Fuel Cell Capacity</td>
<td>0</td>
</tr>
<tr>
<td>Total System Cost</td>
<td></td>
</tr>
<tr>
<td>Annual System cost</td>
<td></td>
</tr>
<tr>
<td>Cost per kwh</td>
<td></td>
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</tr>
<tr>
<td>Utility Cost per kwh</td>
<td></td>
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</tbody>
</table>
Conclusion Leech Lake

- Research and look into the possibility of bringing BioMass operations to Leech Lake

- Not sure what wind options are at the present
  - Early stages of assessing resource
  - Hope to put up anemometer to assess wind resources
Closing Thoughts:

All three tribes are in the beginning stages for wind development.
- Next two years should see huge steps toward assessing potential sites for wind resource analyses.
- Wind sites already in our radar look to be very promising along with other alternative energies.

The co-operative vision is a great possibility for the three tribes, and we hope to bring this through extensive community outreach, education, and finally bring hybrid wind systems and bio-mass operations to Northern Minnesota communities.
Miigwitch