# LAC DU FLAMBEAU TRIBAL ENERGY PROGRAM CONSERVATION AND RENEWABLE ENERGY PLANNING

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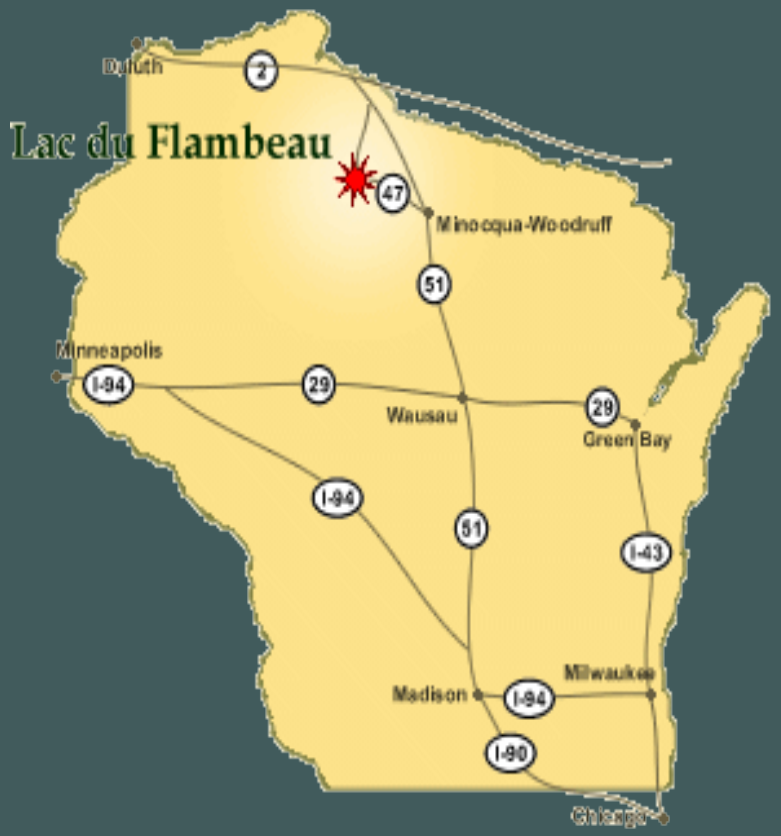
**Lac du Flambeau Band of Lake Superior Chippewa Indians**
November 20, 2008

# Brief Summary of Tribe

- Located in North Central Wisconsin.
- The reservation is 144 square miles or 86,000 acres.
- Population 3,400 Tribal Members.
- Checkerboard Reservation



# Tribal Natural Resources

- Area- 86,630 acres or 144 square miles
- Land Ownership- 66.8%-Tribal land
  33.2%-Fee land
- 260 Lakes
- 71 Miles of Streams
- 24,000 Acres of Wetlands
- 41,733 Acres of Forests

# Lac du Flambeau Reservation

# Project Objectives

- Develop and evaluate baseline data on energy consumption, costs, trends and future impacts.
- Assess Potential for Renewable Energy:
  - Wind , Solar, Geothermal, Biomass, Hydro
- Indentify options for energy conservation and retrofitting existing building with renewable energy systems.
- Develop a Strategic Energy Plan.

# Project Partners

focus on energy
The power is within you.

UW Extension

SEVENTH GENERATION ENERGY SYSTEMS

Kaurich Energy Services, LLC

Public Service

Sustainable Engineering Group LLC

DEPARTMENT OF ENERGY · UNITED STATES OF AMERICA ·

# TRIBAL ENERGY LOADS

- Historical Records Release from Utility
- Match Accounts with Tribal Facilities
- Compile Data Into a Report Identifying:
  - Tribal Energy Consumption and Cost
  - Trends
  - Future Impacts

# TRIBAL ENERGY LOADS

| | Electricity (kWh) | Electricity Expenses (dollars) | Propane (gallons) | Propane Expenses (dollars) |
|---|---|---|---|---|
| 2003 | 10,758,223 | $564,603 | 274,292 | $216,948 |
| 2004 | 11,050,869 | $638,091 | 388,589 | $380,383 |
| 2005 | 10,297,054 | $640,596 | 292,825 | $365,961 |
| 2006 | 11,634,594 | $733,593 | 397,817 | $551,449 |
| 2007 | 11,870,059 | $826,026 | 407,476 | $594,014 |

**Table 1. Annual Electricity and Propane Consumption and Cost, 2003 to 2007**

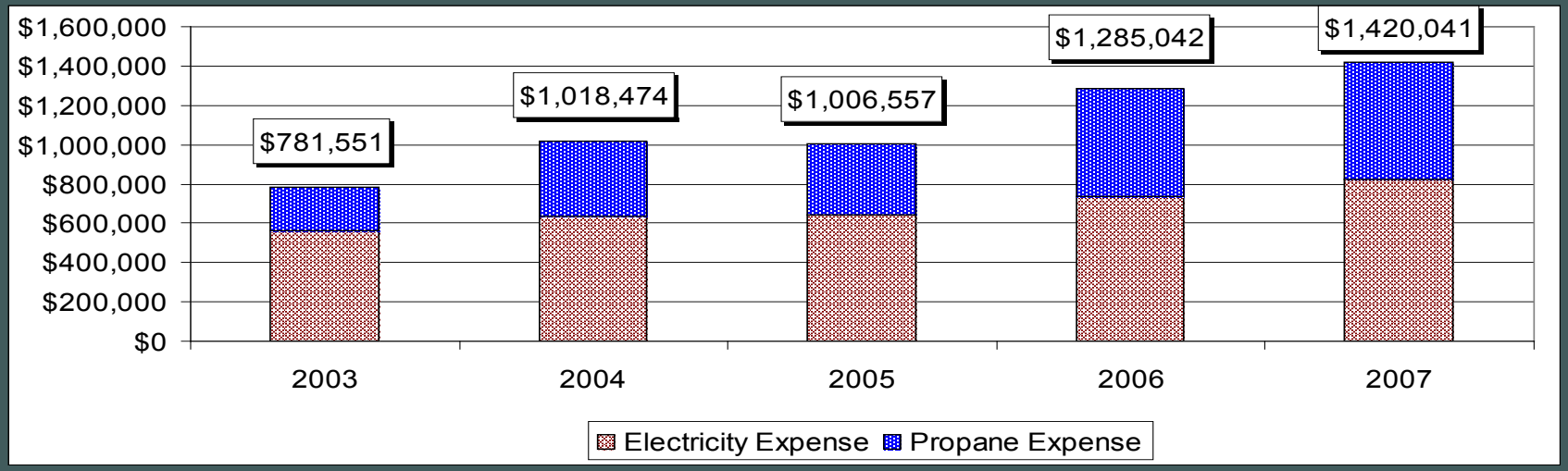



**Figure 1. Annual Energy Expense, 2003 to 2007**

# TRIBAL ENERGY LOADS

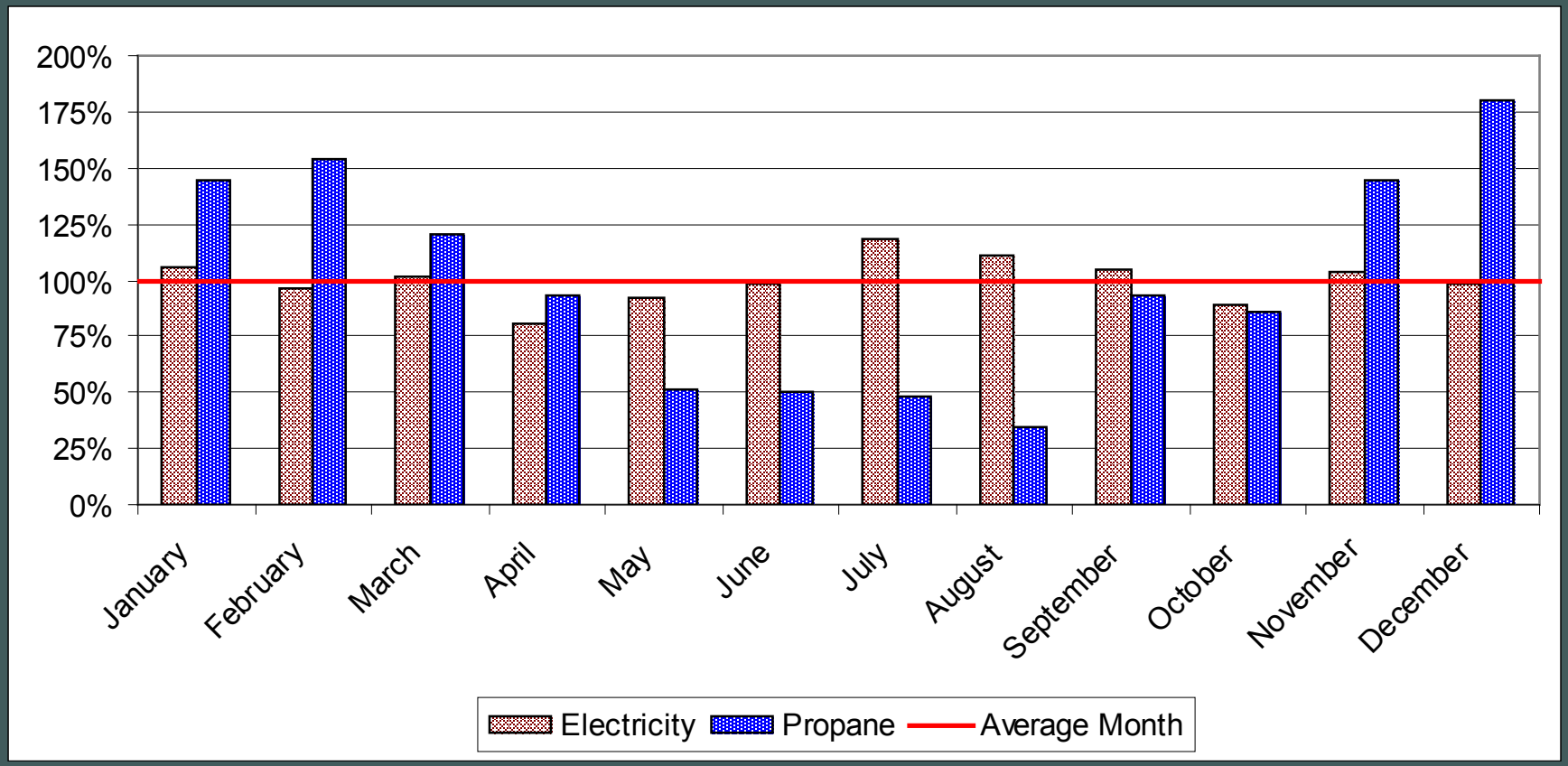
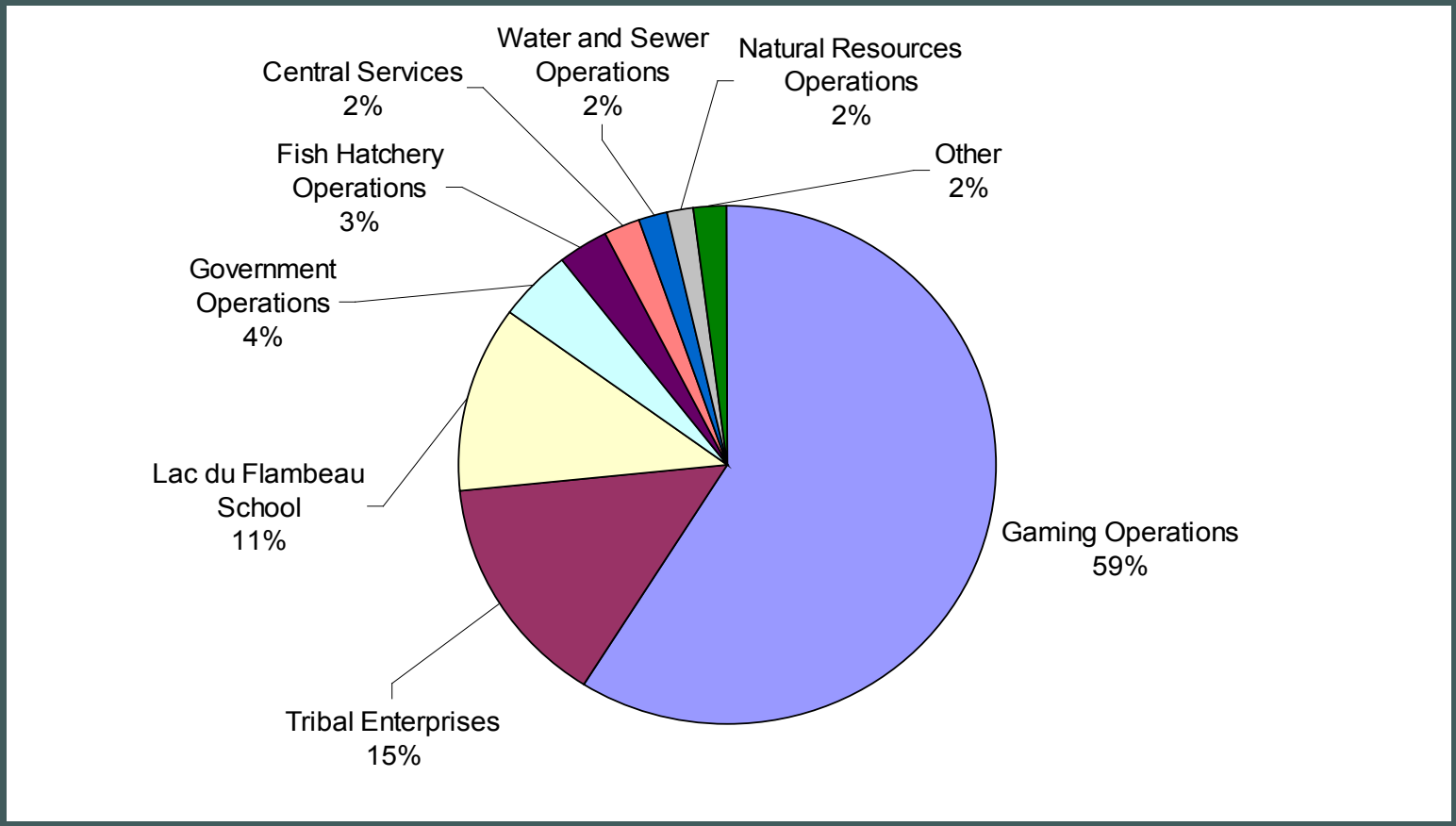



**Figure 4. Normalized Energy Use by Month, 2003 to 2007**

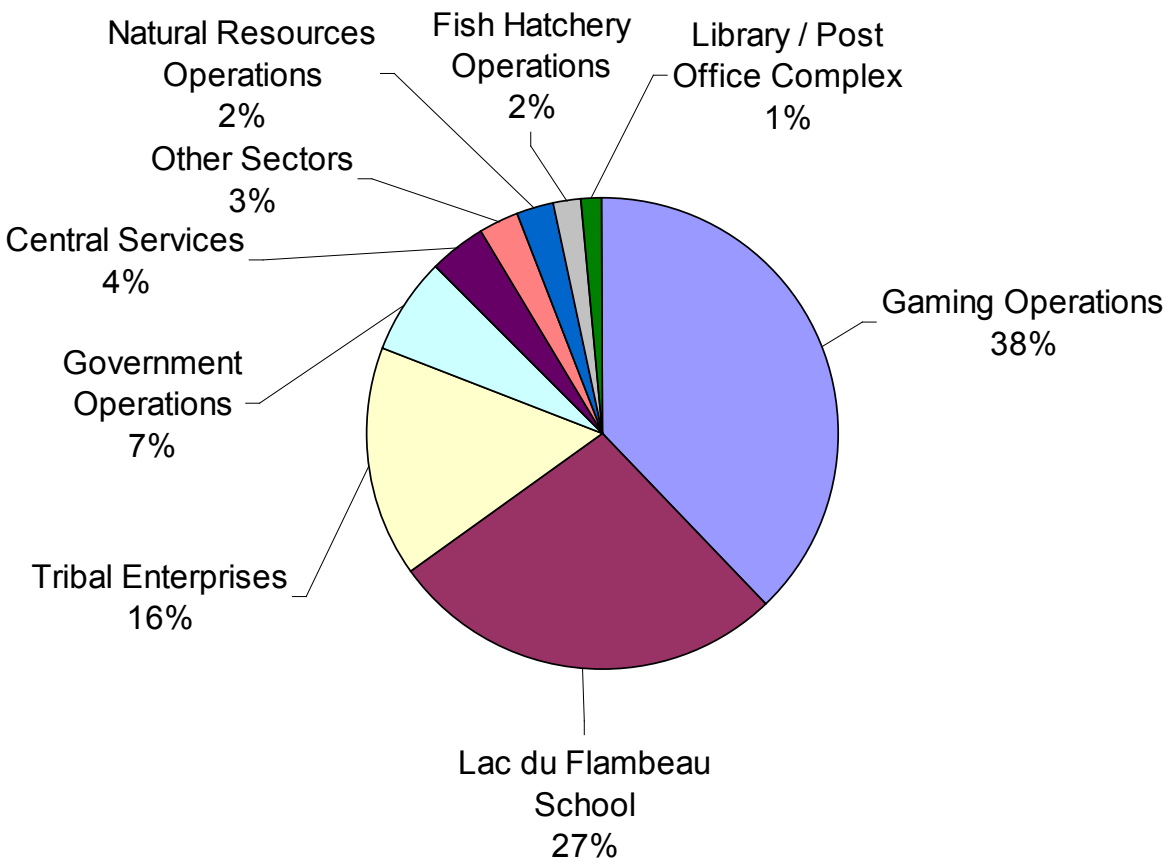
# TRIBAL ENERGY LOADS

**Figure 9. Electricity Consumption by Sector**



# TRIBAL ENERGY LOADS

**Figure 10. Propane Consumption by Sector**



# TRIBAL ENERGY LOADS

**Table 2. Aggregate Electricity Rate**

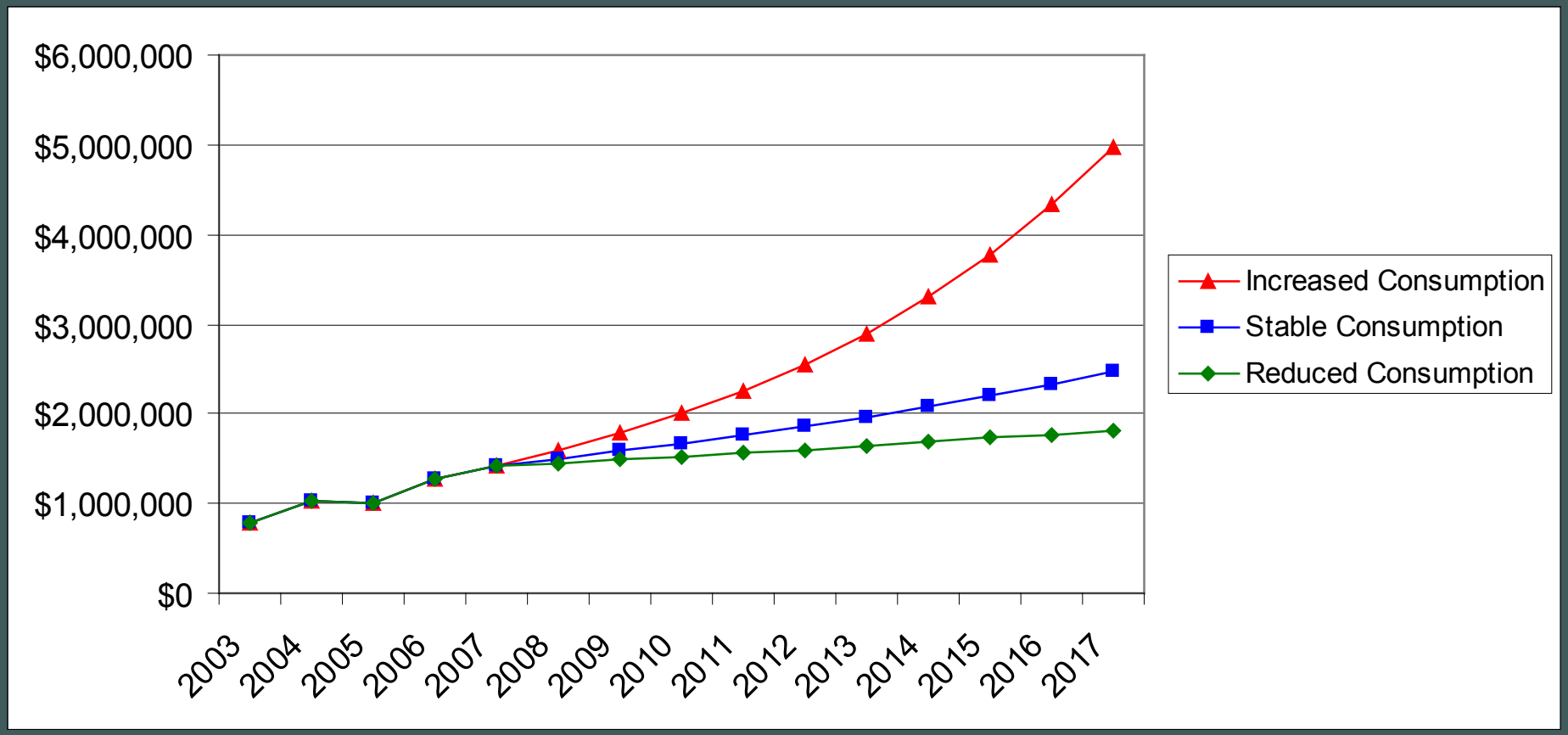
| Year | Price per kWh |
|---|---|
| 2003 | $0.05248 |
| 2004 | $0.05774 |
| 2005 | $0.06221 |
| 2006 | $0.06305 |
| 2007 | $0.06959 |
| Percent annual increase | 7.3% |

**Table 4. Advertised Propane Rates**

| Year | Advertised rate (price per gallon) |
|---|---|
| 2003 | $0.85 |
| 2004 | $0.99 |
| 2005 | $1.30 |
| 2006 | $1.37 |
| 2007 | $1.46 |
| Percent annual increase | 14.5% |

# TRIBAL ENERGY LOADS

**Table 11. Projected Tribal Energy Expenses with Mid-range Price Increases**

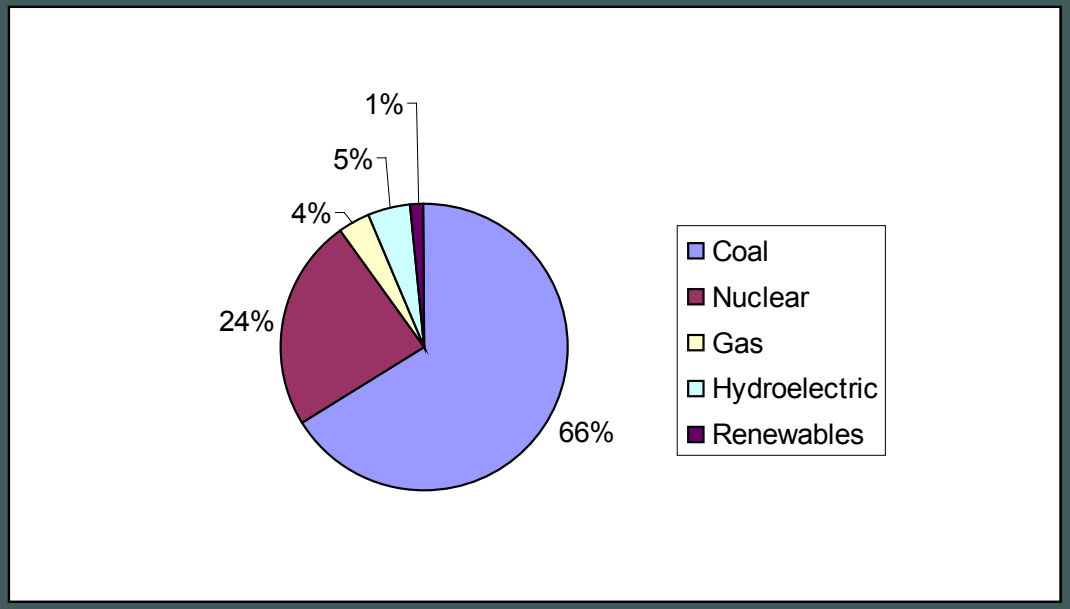


# TRIBAL ENERGY LOADS

| FACILITY | sqft | Energy Intensity (kBtu / sqft) | Energy Cost Intensity ($ / sqft) |
|---|---|---|---|
| Gas Station | 768 | 476 | $14.20 |
| Casino | 75340 | 426 | $6.67 |
| Fish Hatchery | 4680 | 293 | $6.27 |
| Simpson's Plastics Plant | 14780 | 264 | $5.40 |
| Bath House #1 | 660 | 243 | $7.98 |
| Store (Ojibwe mall) | 11305 | 231 | $4.14 |
| Deer Registration Station | 300 | 173 | $3.50 |
| Round House | 1200 | 157 | $3.20 |
| Casino Engineering Building | 5151 | 146 | $2.83 |
| Bath House #2 | 784 | 135 | $4.52 |
| Bingo Hall | 13741 | 126 | $2.73 |
| Lac du Flambeau School | 100000 | 125 | $2.22 |
| Simpson's Main Plant | 27280 | 105 | $2.23 |
| Community Center/Clinic | 35000 | 102 | $1.85 |
| Smoke Shop | 8000 | 97 | $2.73 |
| Multipurpose Building | 2560 | 97 | $2.07 |
| Judicial building | 5000 | 92 | $2.34 |
| Casino Human Resources / Education Building (LOTC | 14853 | 88 | $1.83 |
| Roads Garage (Tribal garage) | 9800 | 88 | $1.83 |
| Indian Bowl | 5250 | 81 | $1.72 |
| Home Rehab Office / WOLF (REHAB/HIP PROGRAM) | 1296 | 79 | $1.55 |
| Planning / Bank Building | 5620 | 71 | $1.73 |
| Family Resource Center | 5988 | 70 | $1.60 |
| Food Distribution Building | 3800 | 66 | $1.52 |
| Land Management Office | 2030 | 64 | $1.57 |
| Museum | 9000 | 64 | $1.48 |
| Casino Hotel | 74400 | 63 | $1.02 |
| Post Office | 8176 | 58 | $1.10 |
| Wellness Center | 20000 | 58 | $1.29 |
| Youth Center (Abinoojiiyag Center) | 7568 | 52 | $1.32 |
| Domestic Abuse Shelter | 6800 | 48 | $1.12 |
| Water & Sewer Office | 5000 | 47 | $0.86 |

# TRIBAL ENERGY LOADS

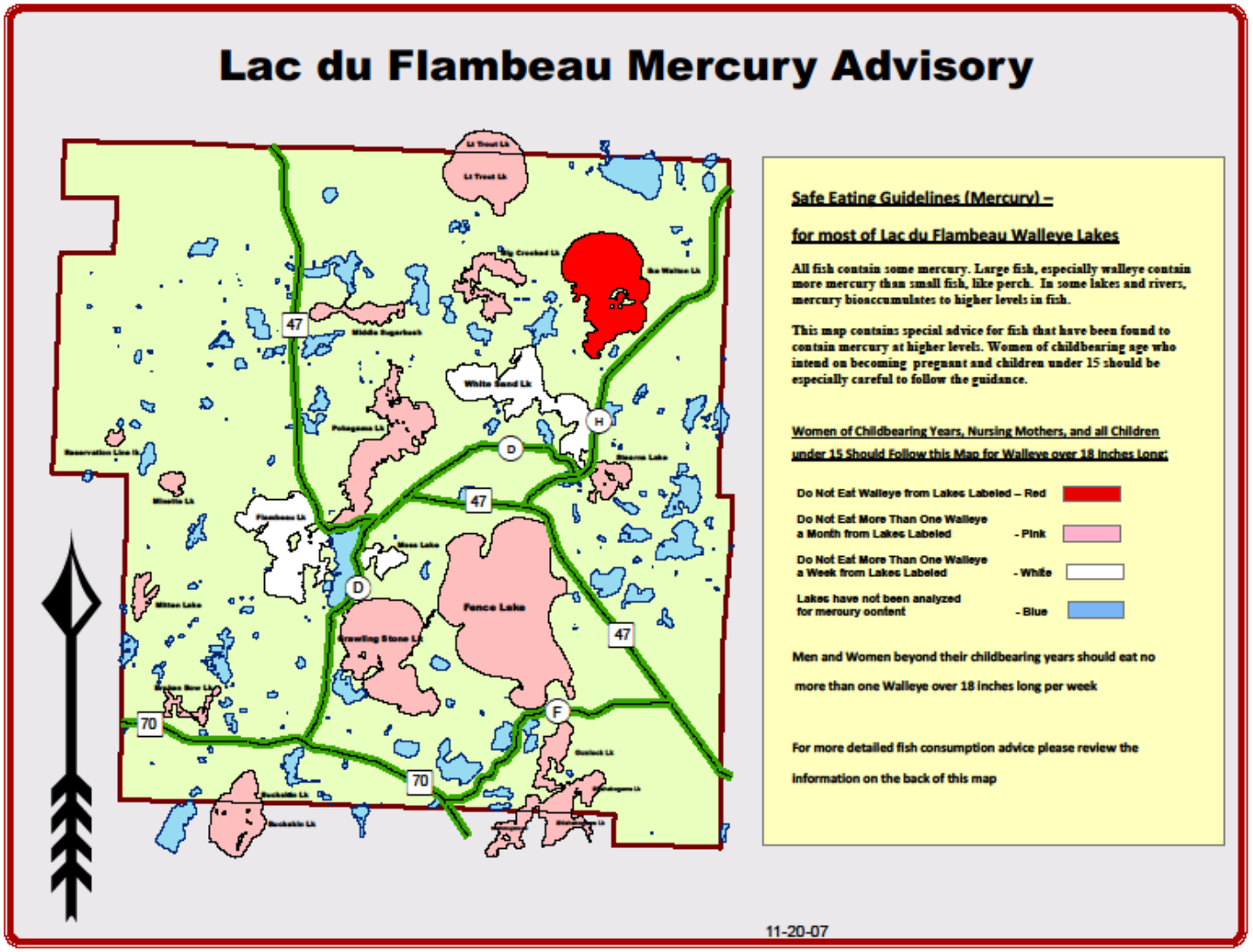
**Figure 8. WPS power supply mix**




| *Total equivalent Metric Produce* | *Equivalent metric description* | | *2007 electricity (kWh)* | | *2007 propane (gallons)* |
|---|---|---|---|---|---|
| 31,331,860 | Pounds of CO2 | **are released from** | 11,870,059 | **and the** | 407,476 |
| 73,364 | Pounds of NOx | **are released from** | 11,870,059 | **and the** | 407,476 |
| 144,831 | Pounds of SOx | **are released from** | 11,870,059 | **and the** | 407,476 |
| 1 | Pounds of mercury (HG) | **are released from** | 11,870,059 | **and the** | 407,476 |

**Table 5. Emissions associated with average Tribal energy consumption per year**

# TRIBAL ENERGY LOADS




CHAMBER of COMMERCE

# Practical Energy Management Training

# Renewable Energy Resources

- Wind
- Solar
- Hydro
- Biomass
- Geothermal

# Wind

| **Height Meters (Feet)** | **MAX WIND** speed on reservation (mph) | **AVERAGE** wind speed expected across the majority of the reservation (mph) |
|---|---|---|
| 30 m (98 ft) | 10.1 – 11.2 | >10.1 |
| 40 m (131 ft) | 11.2 – 12.3 | 10.1 – 11.2 |
| 60 m (197 ft) | 12.3 – 13.4 | > 12.3 |
| 70 m (230 ft) | 13.4 – 14.5 | 12.3 – 13.4 |
| 100 m (328 ft) | 14.5 – 15.7 | 12.3 – 13.4 |

**Table 2. Wind speeds on the Lac du Flambeau Reservation**

Focus on Energy, Wisconsin State Wind Map: www.focusonenergy.com.

# Wind

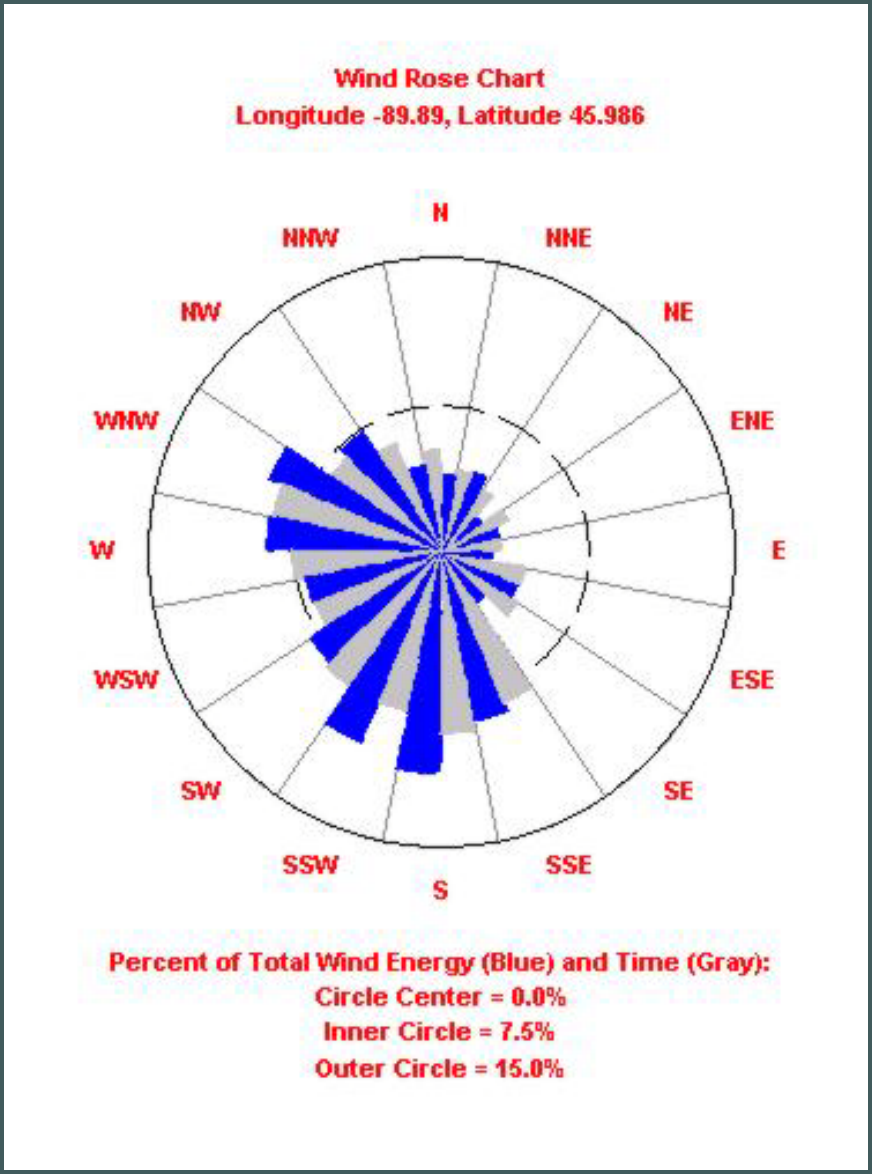
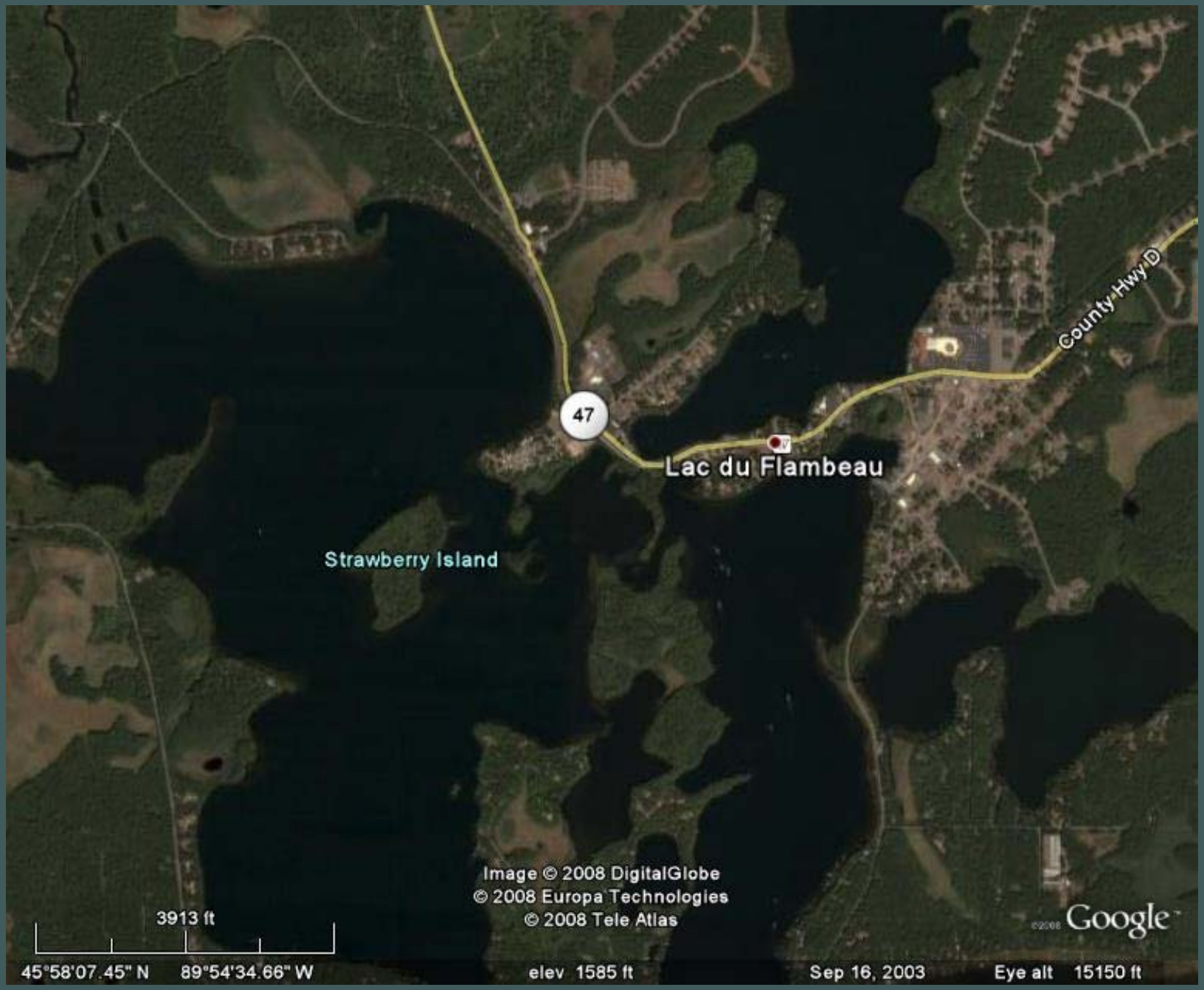



**Figure 7. Wind rose for Lac du Flambeau**


08/08/2008


08/08/2008


47
County Hwy D
Lac du Flambeau
Strawberry Island
Image © 2008 DigitalGlobe
© 2008 Europa Technologies
© 2008 Tele Atlas
3913 ft
Google
45°58'07.45" N 89°54'34.66" W
elev 1585 ft
Sep 16, 2003
Eye alt 15150 ft

| Location | Appropriate Size (kW) | 2007 Electricity consumption | Estimate 60 m wind speed (mph) | Amount of energy off-set |
|---|---|---|---|---|
| 1) Casino | 35 - 50 kW | 5,043,793 | 12.1 | 1.1 - 1.8 % |
| 2) Hotel | 35 - 100 kW | 1,380,360 | 12.1 | 4 - 6.5% |
| 3) *GLITC building | 10 - 20 kW | 40,000* | 11.9 | 10 - 40 % |
| 4) Tribal Housing; Apartments, * | 35 kW | 120,000* | 12.3 | 40 - 70% |
| 5) Tribal Housing; Elder Housing* | 35 kW | 240,000 | 12.6 | 20 - 40% |
| 6) Tribal House, * | 1 - 10 kW | 8,000* | 12.5 | 45 - 150% |
| 7) Tribal House, * | 1 - 10 kW | 10,000* | 12.5 | 40 - 140% |
| 8) Hwy 47 and Cemetary | 10 - 35 kW | n/a | 12.4 | n/a |
| 9) Planned DNR Facilities* | 5 - 35 kW | 25,000 | 12.4 | 20 - 290% |

**Table 3. Summary of Possible Wind Turbine Locations**
*Estimated electricity use

# Solar

PVWatts estimates a solar radiation of 4.4 kWh/$m^2$/day for Lac du Flambeau

Site characteristics include:

- South-facing or flat roof space, or open ground space with minimal shading.
- Significant amount of space (each one kW requires 100 square feet of space)
- Access to the sun all year round during peak solar times of 9AM to 3PM.
- No future shading issues caused by future roof penetrations, trees, etc.
- A roof that can be repaired in conjunction with the solar installation
- The return on investment is improved if:
    - the solar system off-sets peak or high energy and demand charges
    - the utility offers a solar buy back rate

**Table 1. Facilities Suitable for Solar Electric (PV) , Solar Hot Water (SHW), Solar Space Heating (SSH)**

| Facility | PV | SHW | SSH |
|---|---|---|---|
| Community Center/Clinic | X | X | X |
| Casino | X | X | X |
| Hotel | X | X | |
| Lac du Flambeau School | X | | |
| Simpson's Plastic Plant | | | |
| Simpson's Main Plant | | | X |
| Smoke Shop | X | | X |
| Bingo Hall | X | | X |
| Gas Station | X | | |
| Judicial Building | X | | X |
| Museum | X | | X |
| Water Resources Office | X | | |
| Store (Ojibwe Mall) | | X | X |
| Roads Garage | | | **X** |
| Tribal Housing; Apartments, | X | X | |
| Tribal Housing; Elks Point Elder Housing | X | X | |
| Tribal Housing, | X | **X** | |
| Tribal Housing, | X | X | |
| Hwy 47 and | | | |
| Planned DNR Facilities | X | X | X |

# Hydro

# Fish Hatchery

# Fish Hatchery

# Fish Hatchery

# Hatchery Pumps

**1 x 15 HP Deep Well Pump in Water Resources Office**

**3 x 15 HP Lake Pump in New Hatchery**

# Hatchery Flows

| No. of Pumps Running Annually | Flow Rate (gal/min) | Percent of Time in Use | Effective Flow Rate (gal/min) |
|---|---|---|---|
| 1 | 1000 | 20% | 200 |
| 2 | 2000 | 40% | 800 |
| 3 | 3000 | 20% | 600 |
| 4 | 4000 | 10% | 400 |
| 5 | 5000 | 0% | 0 |
| Total | | | 2000 (annual average) |

# Reservation Biomass

| | Total from Indian land | | Total from non-Indian land | | Totals | |
|---|---|---|---|---|---|---|
| | dry tons available | MMBtu (available) | dry tons available | MMBtu (available) | dry tons available | MMBtu (available) |
| Residuals | 71 | 1,100 | 1,574 | 24,400 | 1,645 | 25,500 |
| Cordwood | 431 | 7,410 | 9,544 | 164,200 | 9,975 | 171,610 |
| sawlog | 13 | 229 | 295 | 5,100 | 309 | 5,329 |
| **Total** | 515 | 8,739 | 11,414 | 193,700 | 11,929 | 202,439 |

# Biomass within Radii of Reservation

| Radius | Logging Residue @ 70% removal (green tons) |
|---|---|
| 25 | 158,540 |
| 50 | 686,270 |
| 75 | 1,419,019 |

# Feller Buncher

# Geothermal

Lac du Flambeau Resources:

- Groundwater Temperature – 51 °F
- Thermal Conductivity – 1.45 Btu/h-ft-°F
- Thermal Diffusivity – 0.96 $ft^2$/day

# Geothermal

*Evaluation of Buildings*

**Introduction**

The following criteria were used to evaluate the buildings for appropriateness for a geothermal retrofit:

**Size of Building** – Buildings less than 5,000 $ft^2$ were given a lower priority due to economies of scale.

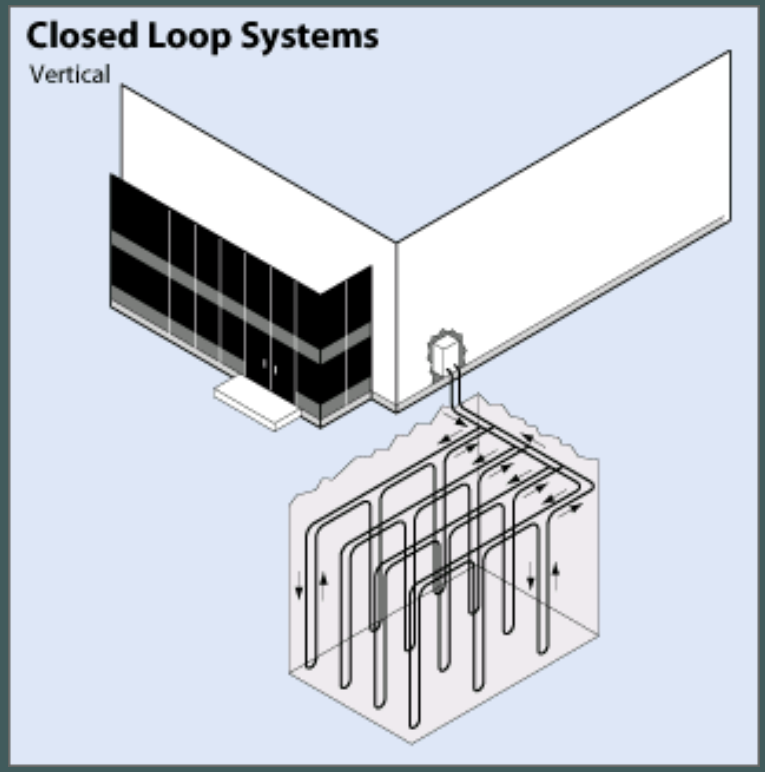
**Year of Construction** – Buildings recently constructed were given a lower priority. Likewise, buildings due for renovation, planned for construction and buildings with older HVAC equipment due for retrofit were given a high priority

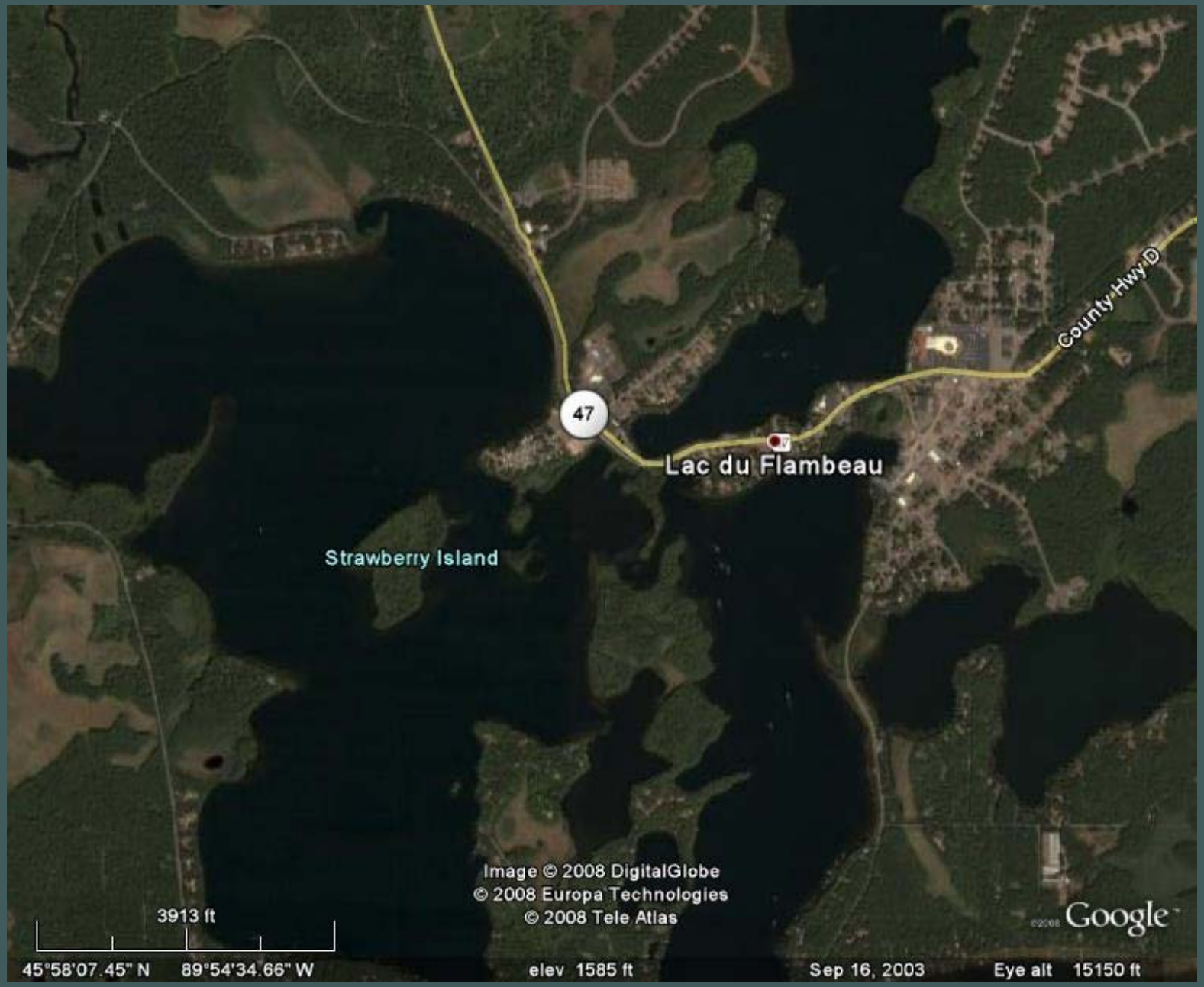
**Heated/Cooled** – Buildings that were not cooled were given a lower priority.

**Occupancy** – Buildings with sporadic or low occupancy rates were given a lower priority.

**Site Appropriateness** – Buildings located near one of the lakes or with open land (parking lots, grassy areas, etc) were given a higher priority.

# Geothermal

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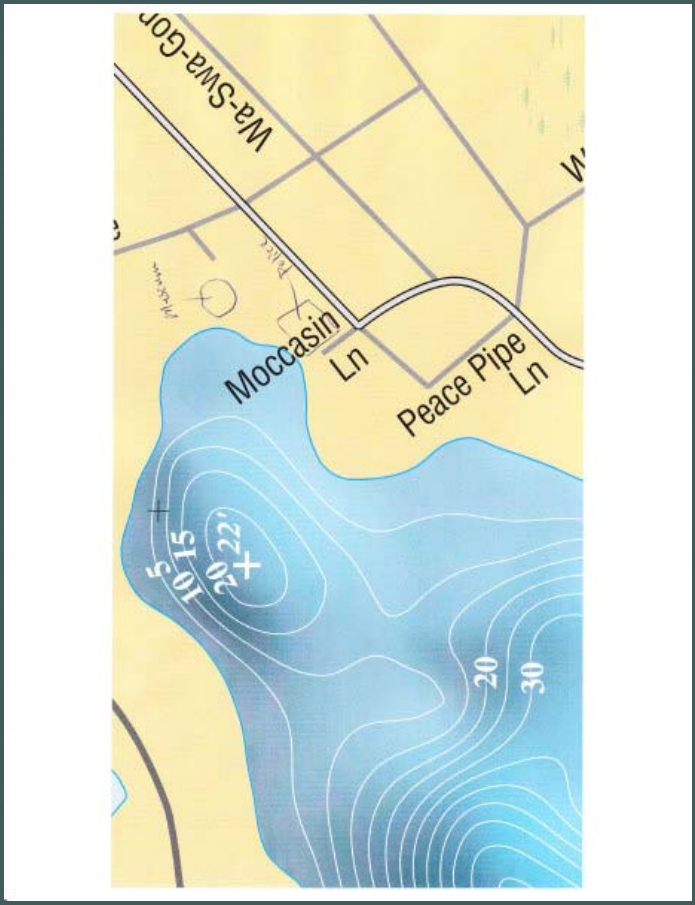


# Geothermal

| | Conventional CAV | Geothermal |
|---|---|---|
| Annual Gas Consumption (therms) | 2,619 | 72 |
| Annual Electric Consumption (kW-h) | 60,260 | 54,310 |
| Peak Demand August (kW) | 30.5 | 25.1 |
| Building Energy Use (kBtu/sq-ft/yr) | 94 | 39 |
| Energy Saved by Geothermal (%) | | 59% |
| Building Energy Cost ($/sq-ft/yr) | $2.37 | $1.23 |

| | Conventional CAV | Geothermal |
|---|---|---|
| Emissions from Electricity (lbs CO2) | 112,006 | 100,947 |
| Emissions from Gas (lbs CO2) | 30,642 | 848 |
| Total (lbs CO2) | 142,648 | 101,795 |
| CO2 Saved by Geothermal (lbs CO2) | | 40,853 |

# Geothermal

| | Conventional CAV | Geothermal |
|---|---|---|
| First Cost | $80,000 | $110,000 |
| Additional First Cost | Base | $30,000 |
| | | |
| First Year Gas Cost | $5,238 | $145 |
| First Year Electric Consumption Cost | $6,429 | $5,795 |
| First Year Service Charges | $204 | $204 |
| First Year Electric Demand Cost | $0 | $0 |
| *Total First Year Energy Cost* | *$11,871* | *$6,144* |
| First Year Maintenance Cost | $1,500 | $1,000 |
| *Cost* | *$13,371* | *$7,144* |
| **First Year Savings** | **Base** | **$6,227** |
| | | |
| Simple Payback (Years) | Base | 4.8 |
| Life Cycle Cost Payback (Years) | Base | 4.7 |
| Cost Savings (25-Year basis) | Base | $146,960 |

# Geothermal

# Geothermal

| | Conventional CAV | Geothermal |
|---|---|---|
| First Cost | $800,000 | $1,156,900 |
| Additional First Cost | Base | $356,900 |
| | | |
| First Year Gas Cost | $80,682 | $2,490 |
| First Year Electric Consumption Cost | $70,674 | $56,378 |
| First Year Service Charges | $204 | $204 |
| First Year Electric Demand Cost | $0 | $0 |
| *Total First Year Energy Cost* | *$151,560* | *$59,072* |
| First Year Maintenance Cost | $15,090 | $10,060 |
| *Cost* | *$166,650* | *$69,132* |
| **First Year Savings** | **Base** | **$97,518** |
| | | |
| Simple Payback (Years) | Base | 3.7 |
| Life Cycle Cost Payback (Years) | Base | 3.6 |
| Cost Savings (25-Year basis) | Base | $2,426,425 |

**Table 16**: Cost comparison of a conventional CAV furnace system to a geothermal system.

# Activities yet to be completed…

- Meet with Consultants to Comment on Renewable Resource Reports
- Receive Final Reports
- Communicate the Results to Community Stakeholders
- Create  our Strategic Energy Plan

# Future Plans

- Tribal Natural Resources Complex
- 20 – unit Green Housing Complex
- Seek funding
- Green Building Construction Codes

# Thank You.