Grand Traverse Band of Ottawa and Chippewa Indians

Renewable Energy & Energy Efficiency Feasibility Study
DOE Tribal Energy Program Review
Denver, Colorado
November 5-8, 2007

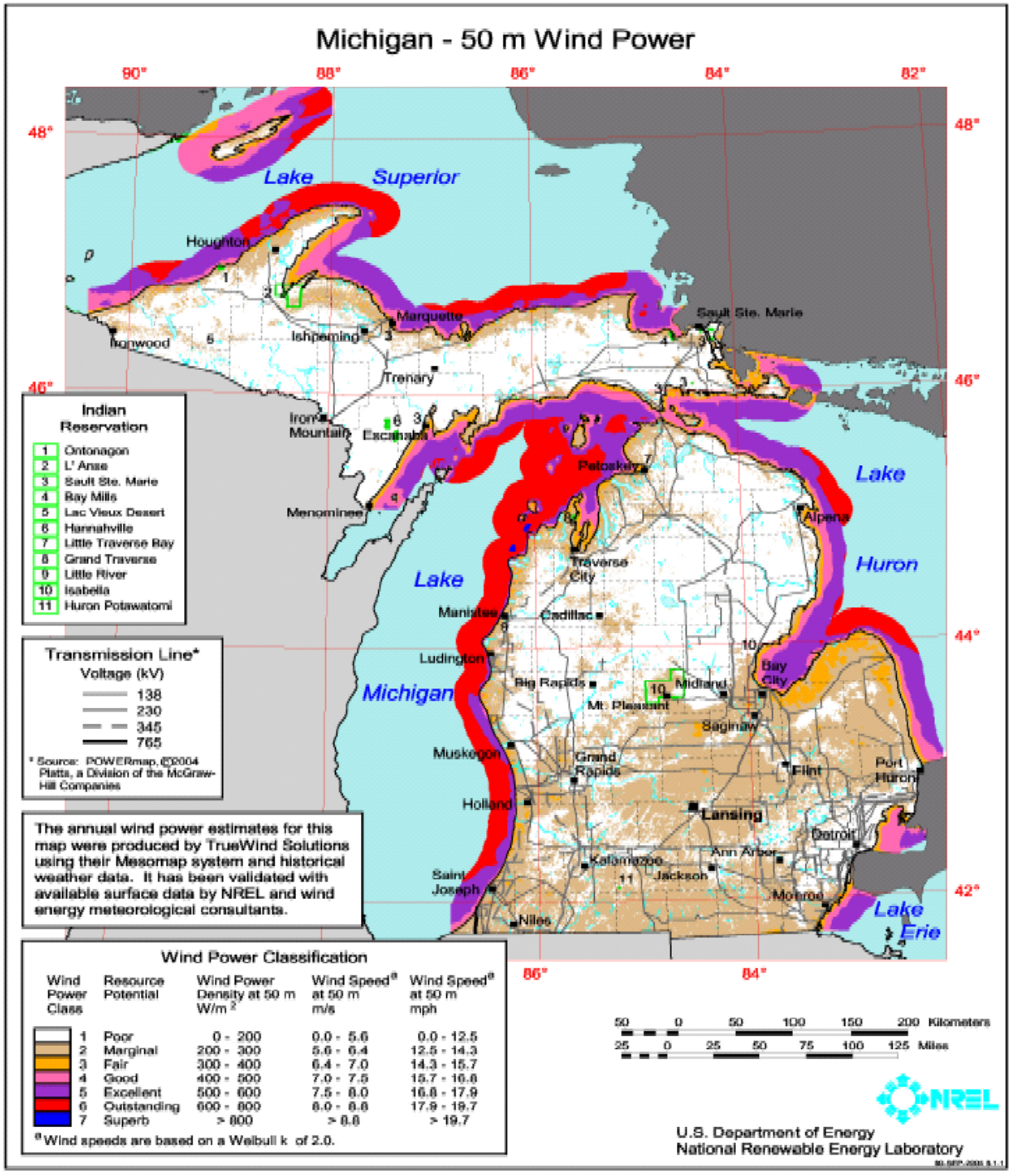
Final Report
December 2007

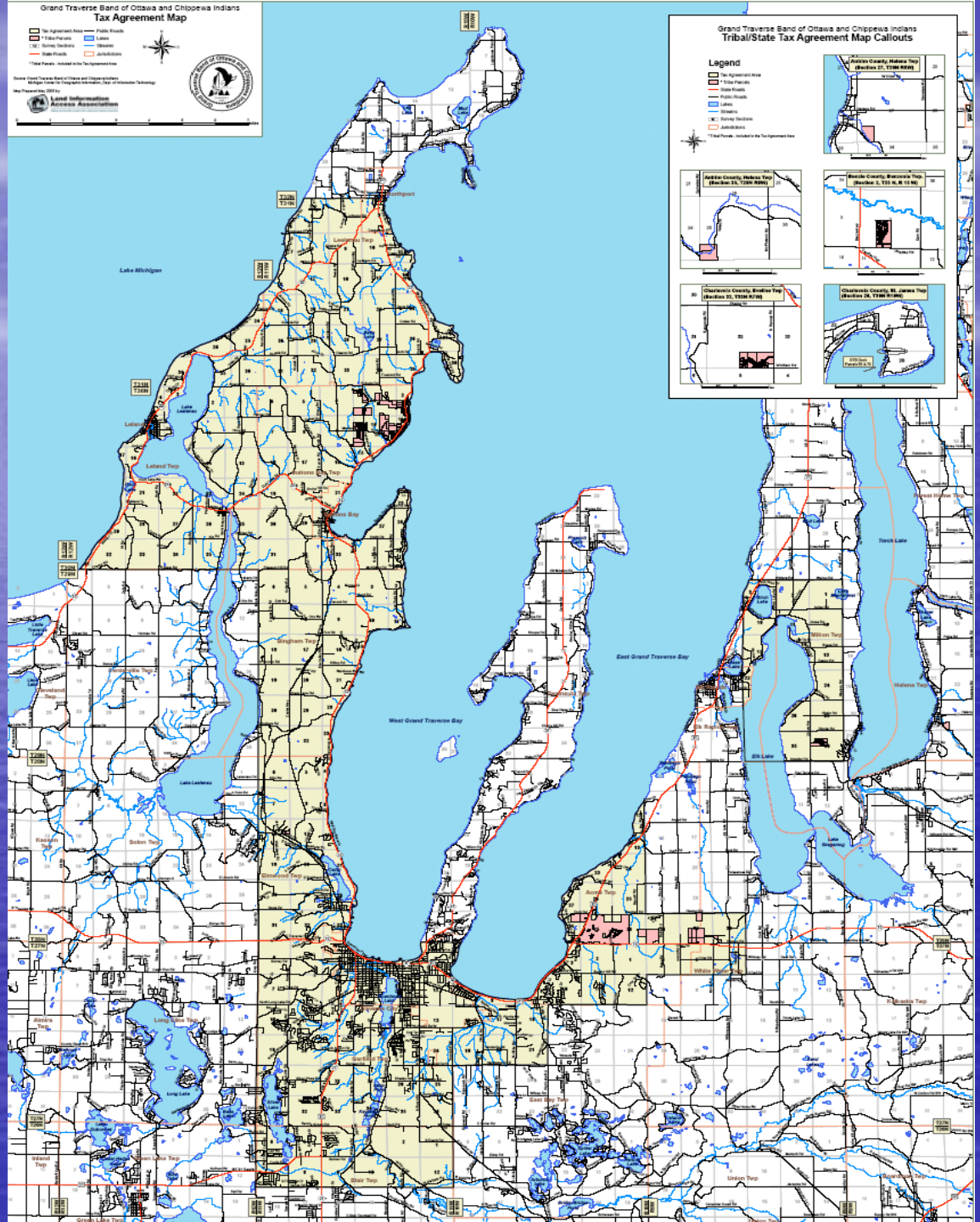
Grand Traverse Band

- 4,023 Members
- 2,370 Acres – Checkerboard
- Six-County Service Area
- EDC: 2 Casinos, Resort (424 Rooms), Gas Station, etc.
- Gov't: Administration, Housing, Medicine Lodge, Strong Heart Center, Day Care, Natural Resources, etc.

Grand Traverse Resort and Spa

Michigan - 50 m Wind Power




Grand Traverse Band of Ottawa and Chippewa Indians
Tax Agreement Map
Grand Traverse Band of Ottawa and Chippewa Indians
Tribal/State Tax Agreement Map Callouts
Legend
Lake Michigan
West Grand Traverse Bay
East Grand Traverse Bay
Torch Lake
Elk Lake
Leland Twp
Suttons Bay Twp
Bingham Twp
Kasson Twp
Solon Twp
Cleveland Twp
Long Lake Twp
Blair Twp
East Bay Twp
Union Twp
Acme Twp
Whitewater Twp
Garfield Twp
Milton Twp
Helena Twp
Grand Traverse Band of Ottawa and Chippewa Indians

GTB Energy Vision & Plan

Three Focus Areas:

- Energy Diversity
- Environmental Quality
- Economic Benefits

Adopted 1/26/05

Action Plan

- Conduct energy diversification feasibility study
- Financing plan
- Public education campaign
- Distributed renewable power study

Project Objectives

Project Goal: To conduct a feasibility study to determine the cost effectiveness and other economic, environmental, cultural and social benefits of maximizing the diversity of energy sources used at GTB facilities.

Grant Timeline: 9/15/05 to 12/31/07

Project Partnership

Traverse City Light & Power (TCLP)

MOU between GTB and TCLP

Sharing wind energy monitoring and evaluation

Sharing electric utility expertise

GTB Renewable Energy Options

- Biomass (wood and crops) & District Heat
- Solar thermal
- Solar electric (photovoltaics)
- Passive solar buildings and designs
- Small scale wind power
- Large scale wind power
- Economic integration of renewable energy
- Energy efficiency & Combined Heat & Power

Site Specific Resource Monitoring

- Comprehensive survey of all GTB properties and energy consumption
- Review of existing data: solar, wind, biomass
- On-site wind resource monitoring, and preparation of a regional GTB wind map
- Wind data sharing with TCL&P
- Survey of biomass resources
- Survey of solar resources

GTB Energy Demand

- Total Cost: $4.67 million/yr
- Electric Cost: $2.25 million/yr
- Natural Gas Cost: $1.75 /yr
- LP Gas Cost: $674,000
- Electric kW-hrs/yr: 30 million
- Natural Gas ccf/yr: 1.8 million ccf
- LP: 673,000 gallons/yr
- Peak KW: 3,600 (Commercial/Public)

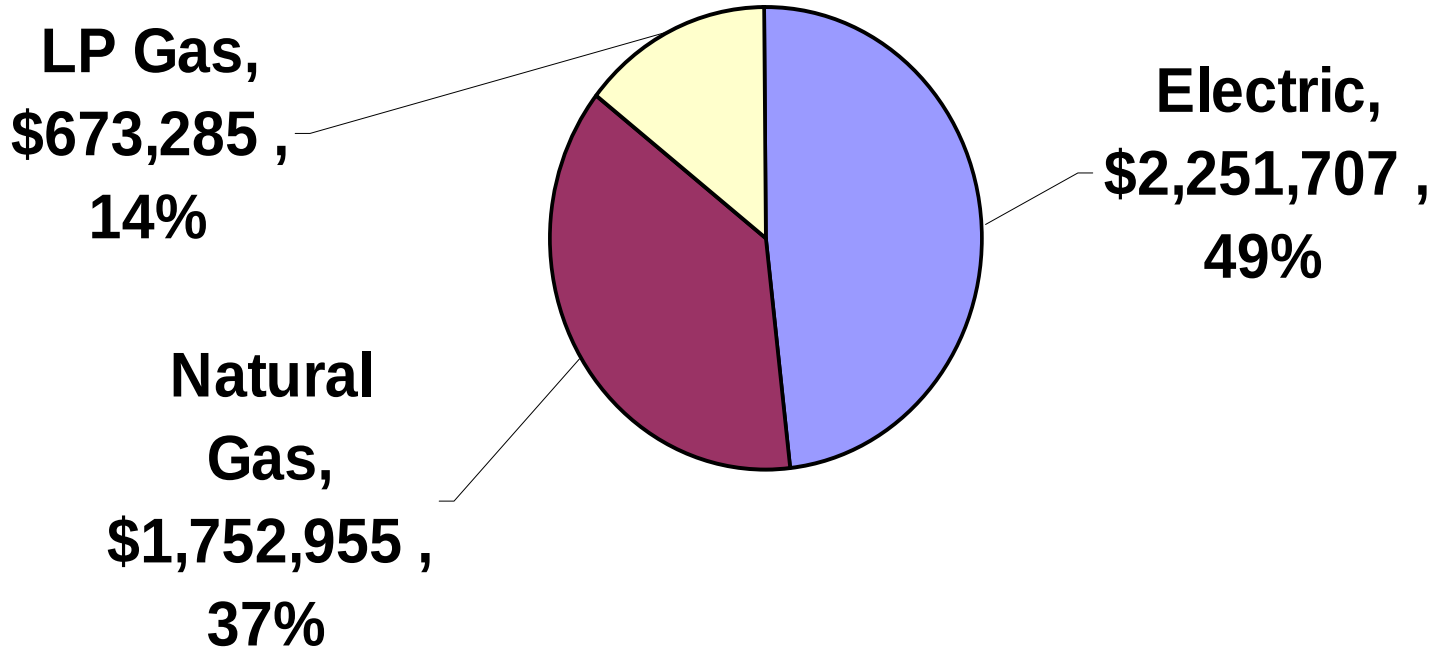
Wind Accomplishments

- MOU with Traverse City Light & Power
- Wind monitoring completed (June 2007) on GTB GT Resort “Hoxie” property
- TCL&P monitoring in Long Lake Twp completed August 2007
- Resource & Economic Feasibility for wind power

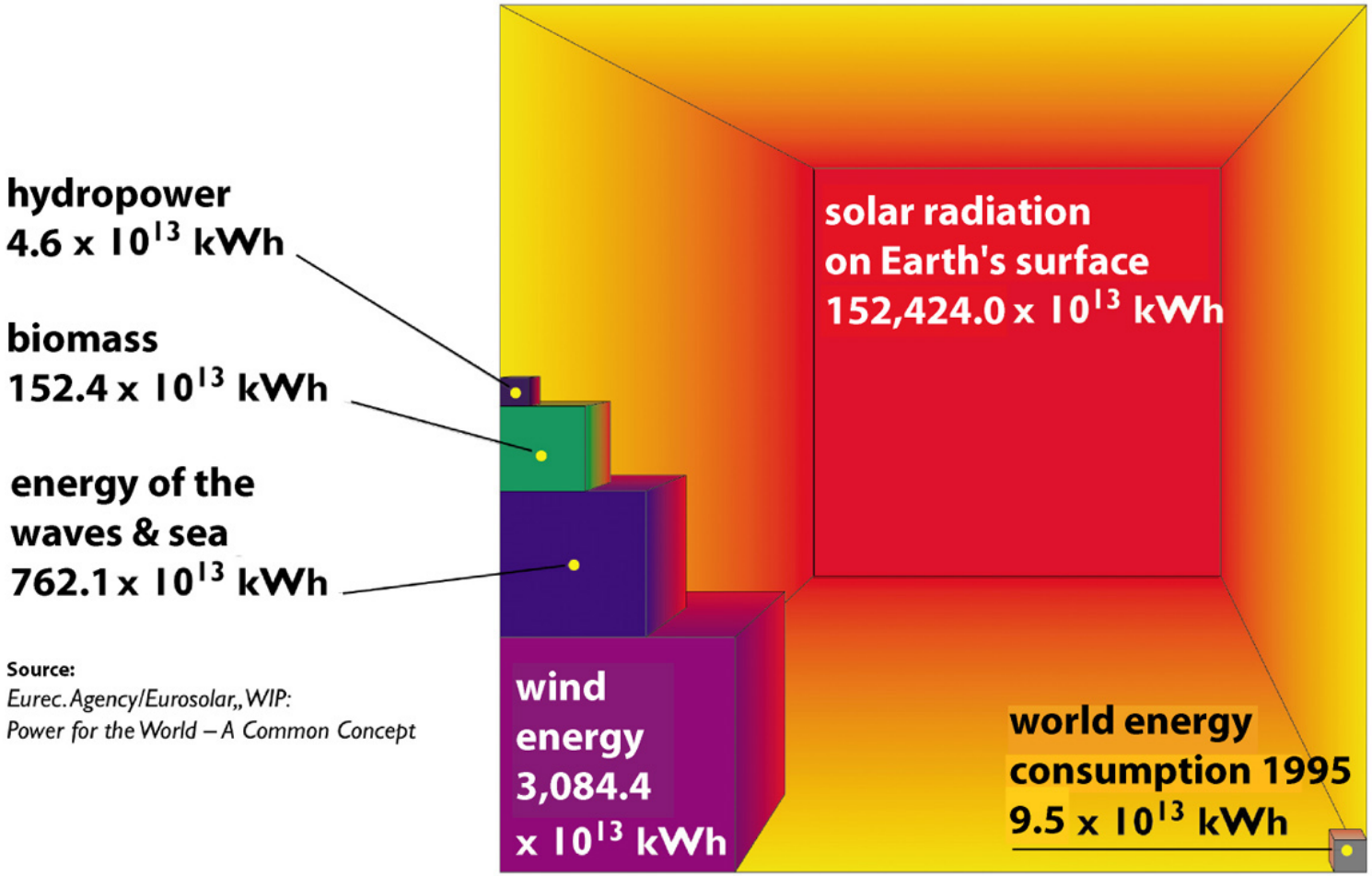
GTB Energy Breakdown By Fuel

Public, Commercial & Residential

(Does not include wood heat)



The Potential of Renewable Energies Worldwide



Source:
Eurec. Agency/Eurosolar, „WIP: Power for the World – A Common Concept

GRAND TRAVERSE BAND RENEWABLE ENERGY FOR GT RESORT & TURTLE CREEK

ACME &WHITEWATER TOWNSHIPS, MICHIGAN

Prepared by: Steve Smiley (231) 271-4850
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GRAND TRAVERSE RESORT

Energy Loads
Electric: 12,600 mWhrs$_e$/yr
Natural Gas: 15,526 mWhrs$_t$/yr

Natural Gas Heating Load
53,000 MCF Natural Gas/yr
53,000 Million BTU/yr
56,000 Giga-Joule/yr
Annual Gas Cost US$455,396

Electric Loads (with Air conditioning)
Electric Supplier: Consumers Energy
12,600,000 kW-hrs/yr
2,600 Peak kW
1,432 Average kW
Annual Cost US$752,715

Total Annual Cost: US$1,208,111

Question: How do we make GTB 100% renewable heated and electric powered? Can we use TCL&P, WPSC or CE for sale of green power to leverage economic feasibility?

*Note: Wolverine Power Cooperative had an RFP for the purchase of green power, mostly wind, but also biomass electric generation. Request was for between 25 & 100 million kW-hrs/yr Delivery date is December 2007.

Golf Course

GTB Land

Wind Turbine Area "Hoxie Property"

GTB Land
Room for 2 WTG's
2 - 6 mW Peak Cap.
4 - 12 million kWhr/yr

Sub-station
< 5 MVA
Consumers Energy

Wind Turbine Area

Wind Turbine Area

GTB Land
Room for 4 WTG's
4 - 12 mW Peak Capacity
8 - 25 million kWhr/yr
23% - 25% Capacity Factor

Railroad

Industrial Zone
Room for Biomass Plant (CHP?)

Sub-station
7.5 MVA
WPSC
69 kV line

GTB Land

Biomass Heat & Electric Plant?

NEW TURTLE CREEK CASINO

GTB Waste Water Plant

Exisitng Turtle Creek Casino
Electric Loads: 3,000 mWhr$_e$/yr
Thermal Loads: 1,260 mWhr$_t$/yr

LP Gas Heating Load
45,733 Gallons
4,300 Million BTU/yr
4,500 Giga Joule/yr
Annual LP Gas Cost: US$70,000

Electric Supplier: Cherryland Coop Generation Cooperative: (WPSC)
3,000,000 kW-hrs/yr
605 kW Peak
346 kW Average
Annual Electric Cost: US$216,464
Total Annual Cost: US$286,464
Note: Plans to expand by factor of 2

4 km (2.5 miles to 7.5 MVA Sub-station

1 km (.6 mile)

Highway M-72 E 5 km (3 miles) between GT Resort and Turtle Creek Casino

Acme Village

Population: +/- 2,000
Low Density Residential
Business District:
Small shops, strip malls
Total Township pop. 3,400

Acme Township - New Town Center (Planned)

Min: 400,000 sq. ft. of Business and Residences (37,000 m2)
To be built in next 3 - 6 Years.

Railroad

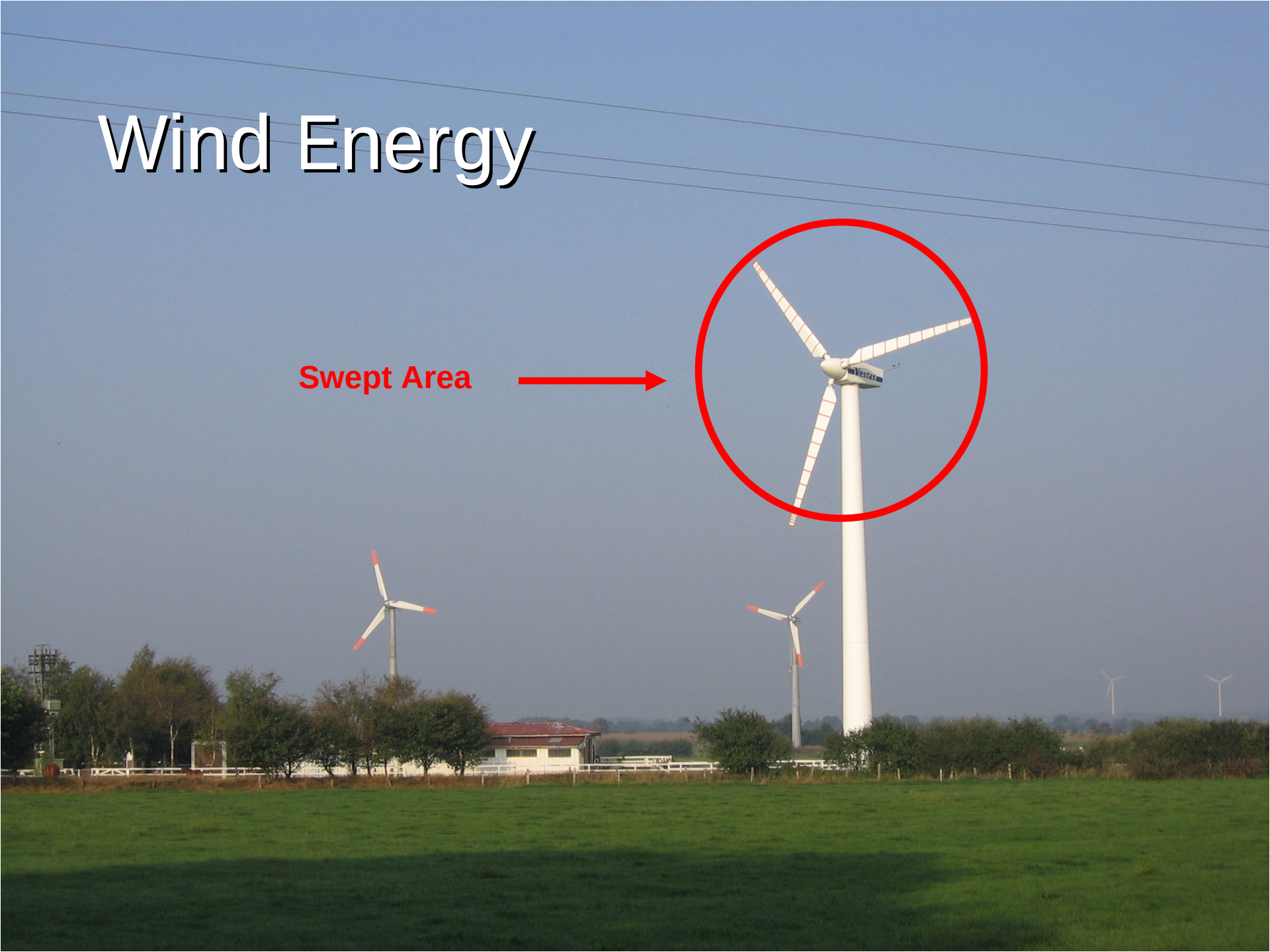
Note: Wood Fuel Supply available at $20/ US ton
4,500 BTU/pound
Or approxmately US$ 2.50 per Giga Joule
Natural Gas: US$10 per Giga Joule (+/- 30%)
Can deliver fuel by truck or rail
Solar thermal?
Dump low marginal cost wind to heat?
Energy Storage?
Absorption cooling?

Accomplishments:
Technology and Economic Evaluation

- Wind Power (small and large)
- Biomass (heat and power)
- Solar Thermal (hot water)
- Solar Electric (photovoltaic)

50 Meter (164 ft.) Meteorological Towers

Wind Energy



GT Resort Site - Large Wind

- Annual wind speed average at 50 m (164 ft)– 4.8 m/s (10.8 mph)
- Annual wind speed average at 100 m (328 ft) – 6.3 m/s (14 mph)
- Shear factor approximately .2

Energy Per Swept Area in kilowatt-hours per square meter per year

- Wind Turbine Annual kW-hrs/sq.meter/year 80 m – 719 kW-hrs/m^2/yr
- Wind Turbine Annual kW-hrs/sq.meter/year 100 m – 790 kW-hrs/m^2/yr

Reference Note:

- Existing TCLP V-44 600 kW-hrs/sq.meter/year – 522 kW-hrs/m2/yr
- Percent increase in energy for GT Resort 100m vs. V44 in Elmwood – 51%

Wind Power Economics for Sample Large Wind Turbines (1500 kW)

- Total Installed Cost: $2.2 million
- Annual Revenues: $ (200,000 w/ REPI)
- Annual O&M Expenses: $24,000
- Cost of energy $.054/kWhr w/ REPI $.035/kWhr
- Annual Electric Generation: 4 million kWh
- Lifetime: 20 years

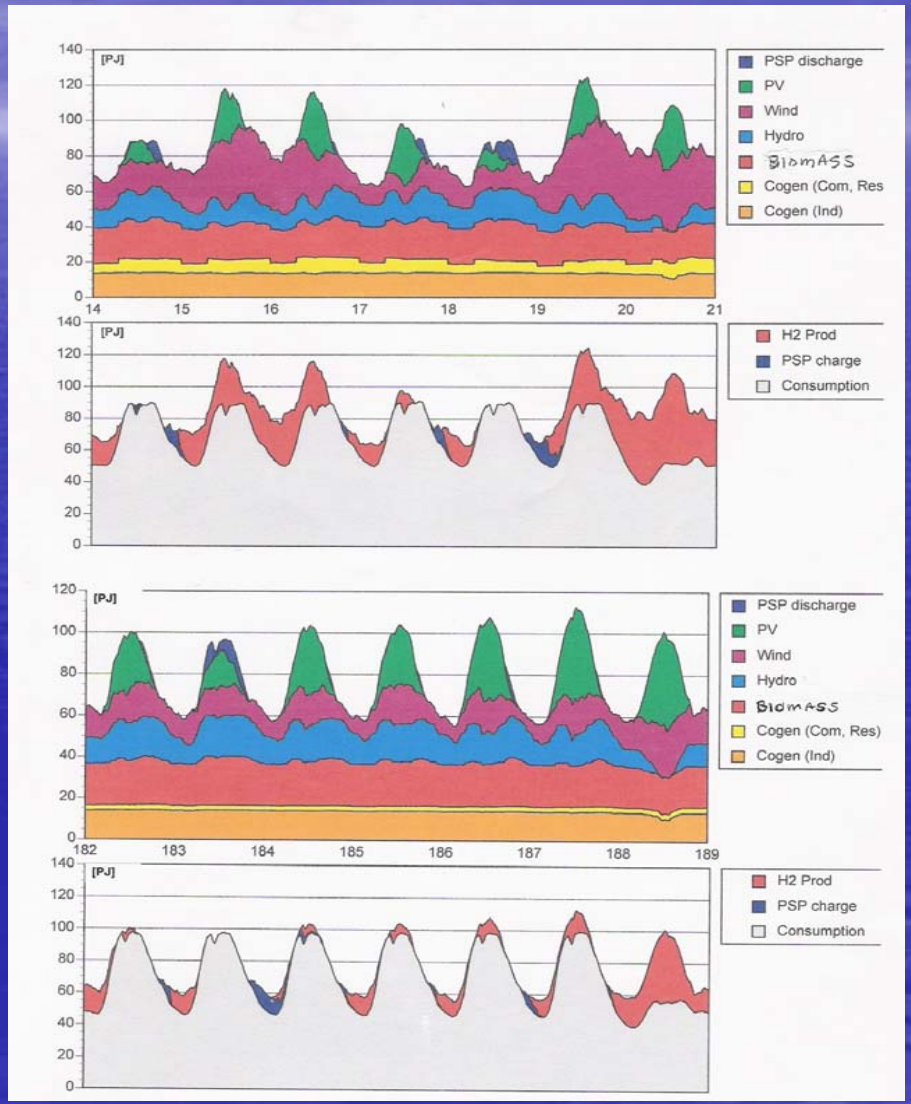
Wind Briefing Paper –Summary

Grand Traverse Band of Ottawa & Chippewa Indians (GTB)
Peshawbestown, MI 49682
January 2007
Commercial Wind Power Project
Capital Cost: Range from $1.2 million to $24 million
Capital Cost: Single wind turbine (minimum recommendation) $1.2 million.

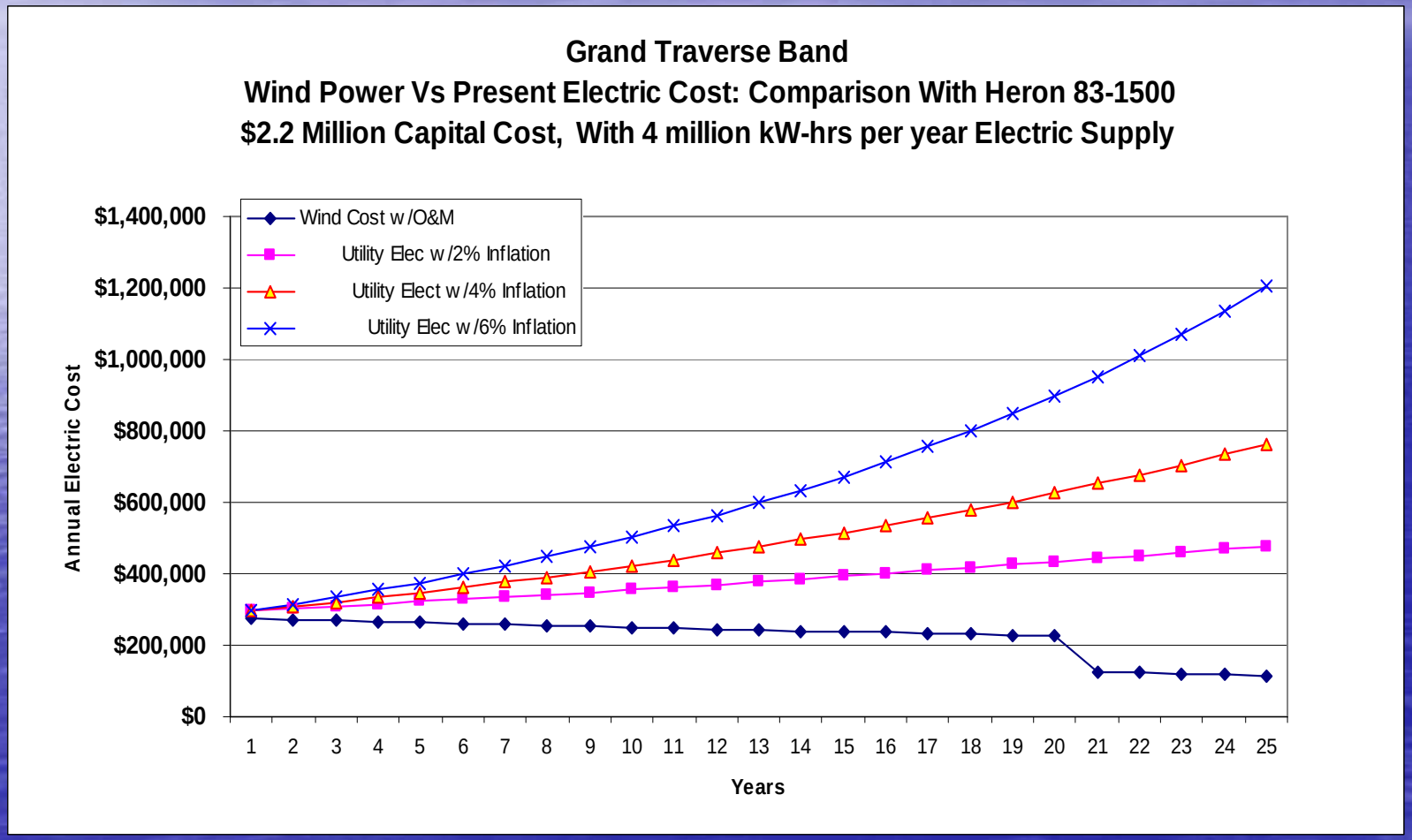
Capital Cost: To meet 100% net electric needs of the GT Resort/New Turtle Creek Casino with wind power:
Capital Cost: $14 million to displace $1.3 million annual electric cost and 18.6 million kW-hrs per year.
Capital Cost: To account for 100% of GTB commercial, public and residential electric use with wind power - $24 million.

Integrated Renewables For GTB

- Integrating all the renewable energy sources such as wind, solar (thermal & electric), & biomass
- And enhancing them with efficiency, combined heat and power, and district heating systems
- And implementing them on a community basis--can meet our 100% renewable energy goal!



One Large Wind Turbine: 25 year net revenues of between $4 and $12 million



Accomplishments:

Biomass

- Extensive Biomass Energy Evaluation
  - Sustainable harvest of biomass
  - Supply sources far exceed project demands
  - Present supply, distribution and markets well developed

Why Burn Wood? Biomass is:

- Humanity's Oldest Fuel
- Locally Available
- Often a Waste Product
- Can Be Low Cost
- Low In Sulfur, Nitrogen, Mercury and Other Pollutants
- Carbon Dioxide Neutral
- **A Renewable Resource**
- **GTB Woodlands Are Sustainable**
- **Low Cost Fuel $20/ton ($2 vs. $10 natural gas per MMBTU)**

District Heat Distribution System

- Buried Supply and Return Pipelines
- Pre-Insulated Twin-Pipe
- Use Sidewalks and Some Roads
- Individually Metered

Photo courtesy of Force Technology

Residential Connection

Photo courtesy of Force Technology

Biomass District Heat Study Options

- Peshawbestown (West & East)
- Charlevoix
- Benzie
- New Turtle Creek
- GT Resort, New Turtle Creek, New Acme

Preliminary Residential Biomass Feasibility

- Up to 100 homes in district
- $16,676 per home
- 100% wood space & hot water heat
- 12 year simple payback
- Added O&M savings, social & environmental benefits

Peshawbestown District Heating Loop

COST ESTIMATE

	BUDGET
HURST HOT WATER BOILER, 600 GPM ~ 130F IN TO 180 F OUT	$411,825.00
FREIGHT TO JOBSITE	$25,000.00
FOUNDATION	$9,000.00
FIELD ERECTION	$125,000.00
START-UP & OPERATOR TRAINING	$9,500.00
FUEL HANDLING	$95,904.00
OPTIONAL EQUIPMENT	$62,909.00
TOTAL BOILER COST, INSTALLED AND RUNNING	**$739,138.00 BUDGET**

$525.00 AIR HANDLING UNIT COST
$200.00 AIR HANDLING UNIT INSTALLATION---GUESS ONLY
$725.00 TOTAL COST PER INSTALLED AIR HANDLING UNIT
120.00 AIR HANDLERS REQUIRED
$87,000.00 TOTAL AIR HANDLING UNITS COST — BUDGET

PIPING COST

$650,000.00 PLACE HOLDER ONLY. NEED SITE SPECIFIC DETAILS ON INSTALLATION. — BUDGET

ENGINEERING AND PROJECT MANAGEMENT

$200,000.00 PLACE HOLDER ONLY — BUDGET

TOTAL INSTALLED COST

$1,676,138.00 — BUDGET

WOOD FUEL COST

4500 BTU/LB WOOD HEAT CONTENT
4350 POUNDS PER HOUR OF WOOD REQUIRED
2.175 TONS PER HOUR OF WOOD CHIPPED AND DELIVERED
$18.00 DOLLARS PER TON FUEL COST
$39.15 FUEL COST PER HOUR FOR 120 HOMES
$0.200 PER THERM WOOD FUEL COST

NATURAL GAS FUEL COST

80,000 BTUH PER HOUSEHOLD
0.8 THERMS PER HOUSEHOLD
$1.20 PER THERM NATURAL GAS COST
100 HOMES
85.00% NATURAL GAS FURNACE EFFICIENCY
$112.94 FUEL COST PER HOUR FOR 120 HOMES

New Turtle Creek & GT Resort District Heat

- 100% Biomass Heat
- 70% CHP Electricity
- Additional heat & electric sales
- Net $1 Million/yr savings
- $11 Million +/- Capital Cost

GTB RESORT & SPA & TURTLE CREEK 5000 KW CHP			
Wood Fired Steam CHP	50 MMBTU Peak		
Peak Wood Heat Output (million BTU)		50	mmbtu
Wood Fuel Cost per ton	$	20.00	/US ton
Peak Electric Capacity (kW)		5,000	kW
Electric CHP Operating Capacity Factor %		34%	CF
Utility Electric Sale Price $/kW-hr	$	0.050	/kW-hr
Local Electric Sale Price (to self) $/kWh	$	0.060	/kW-hr
Thermal Heating Capacity Factor %	NA		CF
Thermal Heating Sales Price $/mmBTU	$	5.00	mmbtu

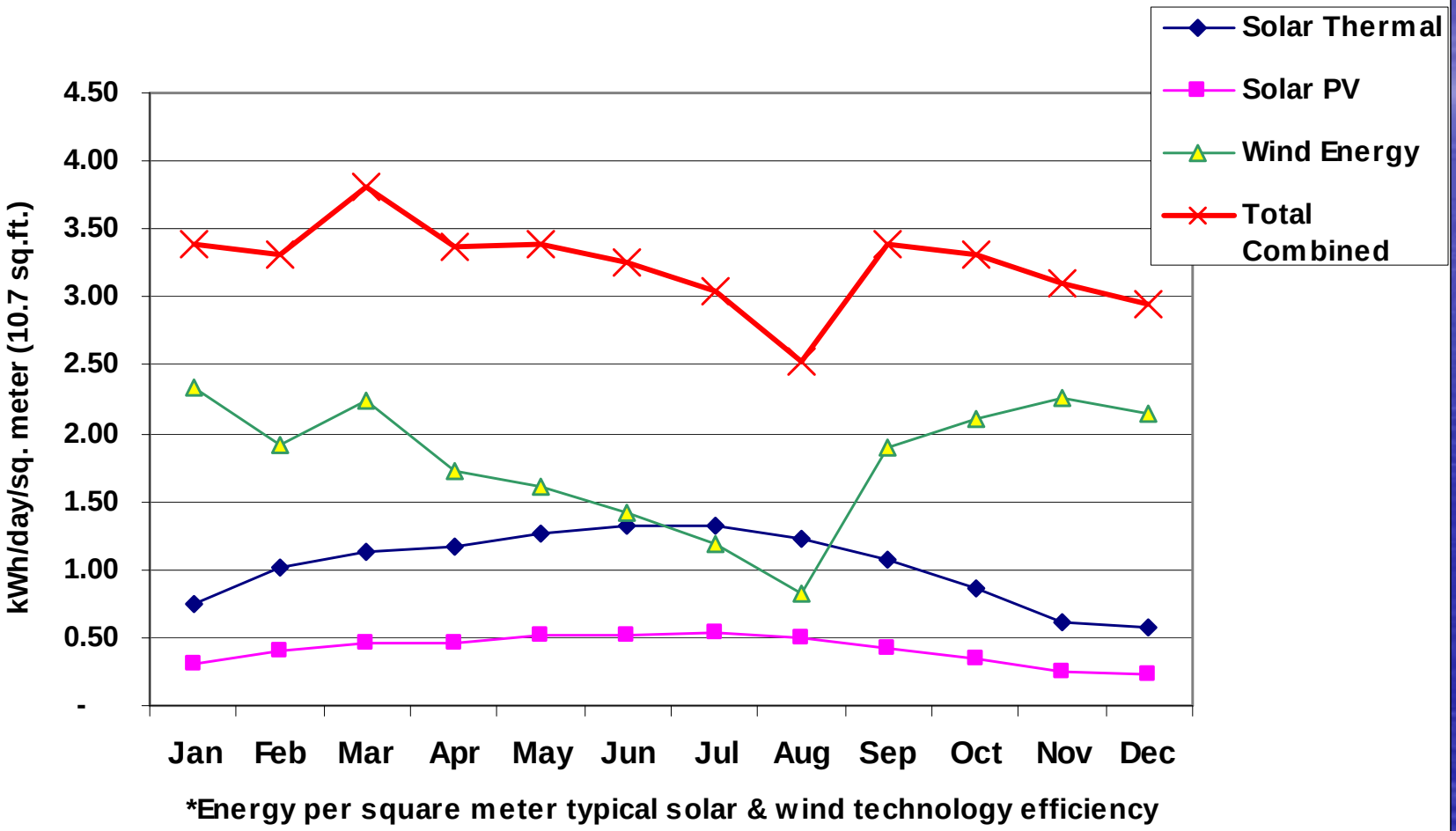
CAPITAL COSTS	
Wood Fired Unit at Site w/ Boiler & storage	$6,500,000
Mechanical Interconnection	$4,000,000
Steam Turbine	$0
Building Retrofit & Prep	$200,000
Utility Interconnection w/transformer	$200,000
Engineering & Development	$80,000
Legal & Financial Expense	$20,000
TOTAL CAPITAL COST	$11,000,000

COST SUMMARY ANALYSIS		
Installed Capital Cost	$11,000,000	
First Year Fuel, O&M & Admin Cost	$472,577	
First Year Capital Recovery Cost	$770,000	
First Year Expense (Debt & O&M)	$1,242,577	
Installed Cost per KWe	$ 2,200	
Installed Cost per kW-hr/yr	$ 0.739	/kW-hr
First Year Cost per kW-hr w/o REPI	$ 0.038	/kW-hr
First Yr Cost per kWh w/REPI	$ 0.020	/kW-hr

First Year Operating Cost Data			Percent
Fuel	$	332,708	26.8%
Rent	$	-	0.0%
Admin	$	29,784	2.4%
O&M	$	89,460	7.2%
Taxes	$	-	0.0%
Insurance	$	20,625	1.7%
Capital Recovery	$	770,000	62.0%
TOTAL	$	1,242,577	100%
Note: Discount Rate for Present Value Calc.		5.0%	

	GTB RESORT	53000
	New Turtle Creek	10000
		0
Annual Heat Load Requir. (mmbtu)		63,000
Heat Output mmbtu/year		89,352
Heat Cost per mmbtu	$	2.23
Total Heat Fuel Cost/yr	$	199,625
Heat Only $/mmbtu (w/capital & O&M)	$	8.34
Heat Energy $/mmbtu (fuel only)	$	2.23
N. Gas Cost $/mmbtu @75% eff.	$	10.00
Thermal Heat Sales @75%NG Cost	$	670,140
Total Electric Expense per/yr	$	572,437
Electric Output kW-hrs/year		14,892,000
First Year Electric Cost per kW-hr	$	0.038
Electricity kWh/yr Available for Sale		(3,708,000)
Value of Excess Elec/yr at $.06/kwh	$	(222,480)
Local Consumption Electric kWh		18,600,000
Percent Local Electric to Total Gen.		125%
Natural Gas Cost/CCF	$	1.00
Energy Cost to Electric kW-hr Price	$	572,437
(assumes thermal energy sold at 75% NG)		
Exess Heat and Electric Sales	$	447,660
Energy Efficiency		
Total Wood Fuel Energy in mmbtu/yr		148,920
Heat Output mmbtu/year		89,352
Electric Output kW-hrs/year		14,892,000
Electric Output mmbtu/yr		50,826
Thermal Efficiency		60%
Electric Efficiency		34%
Total Efficiency		
Total O&M & K Cost less Excess Sale	$	794,917
Present Total Cost/yr & T.Ck & GTR	$	1,866,000
Net Annual Savings	$	1,071,083

GTB Wind & Solar Resources*



*Energy per square meter typical solar & wind technology efficiency

Accomplishments (cont)

- Energy Efficiency Review

Total Tribal non-residential cost of energy $2 million +

10% - 20% potential savings $200,000 to $400,000 per year
suggest investment of $1 to $2 million easily justified

Top measures to consider:

- Lighting upgrades: T8's, controls, CFL's, LED's
- HVAC system retrofits

Accomplishments (cont)

- Outreach to Tribal Members & Outside Community
- Articles in GTB newsletter, local newspaper, community forum
- Educational Brochure: “Sovereignty” The Path to Energy Independence

Accomplishments (cont)

- Power Market Assessment - Muni's & Cooperatives
- Transmission & Interconnection Discussions with Local Utilities

Technical Issues

Power Market Assessment

- Small scale: net metering
- GTB Self-supply
- TCL&P & MPPA green power supply
- Wolverine Power (Cherryland), CE, etc.
- Renewable Energy Production Incentive Payment (REPI) 10 yr - 2 cents/kW-hr
- Carbon credits, green tags, Native Energy
- New policy initiatives: Feed-in-tariffs (FIT)
  - Renewable priority to the grid
  - Each renewable technology priced to make a market
  - Long-term (20 year) guaranteed prices
  - Added costs spread over entire customer base

Accomplishments (cont)

- Environmental Evaluation
- Benefit Assessment
- Preliminary System Design
- Long-Term O&M Plan
- Business & Organizational Planning
- Financing Plan

Future Plans

- Council guidance on what, where & when
- GTB energy organization?
- Set policy for:
  - Homes: Solar thermal, solar PV, small district heat, energy efficiency services
  - Government: Larger scale biomass district heat, solar PV, wind power, efficiency
  - Commercial: Large wind power, solar, biomass district heat. Begin wind permitting at GT Resort?
  - Economic Development: Commercial wind power, regional biomass district heat

Thank you!

Suzanne McSawby
GTB Natural Resources Mgr.