Minnesota Tribal Coalition Tribal Utility Capacity Building Project

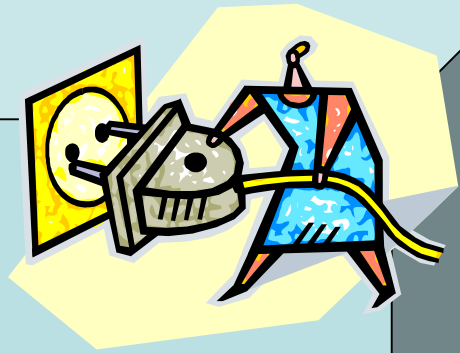
Grand Portage

White Earth

Leech Lake

Minnesota Tribal Coalition


Grand Portage



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

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

Storing Wind Generated Electricity With Hydrogen

Wind Turbine

H_20

ELECTROLYSIS

0_2

Heat

H_2

H_2

H_2 STORAGE

H_2

PEM FUEL CELL

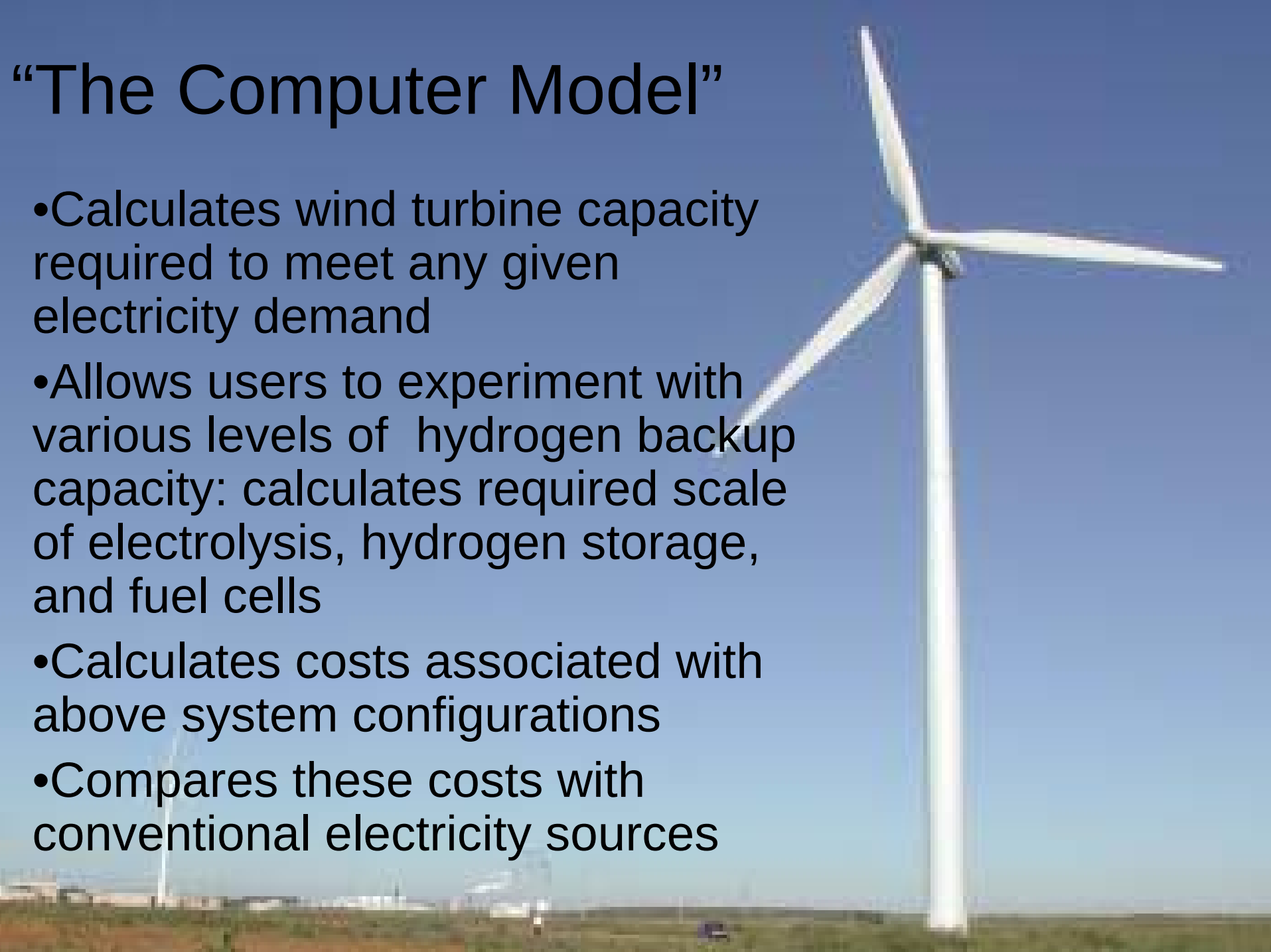
H_20

e-

Heat

“The Computer Model”

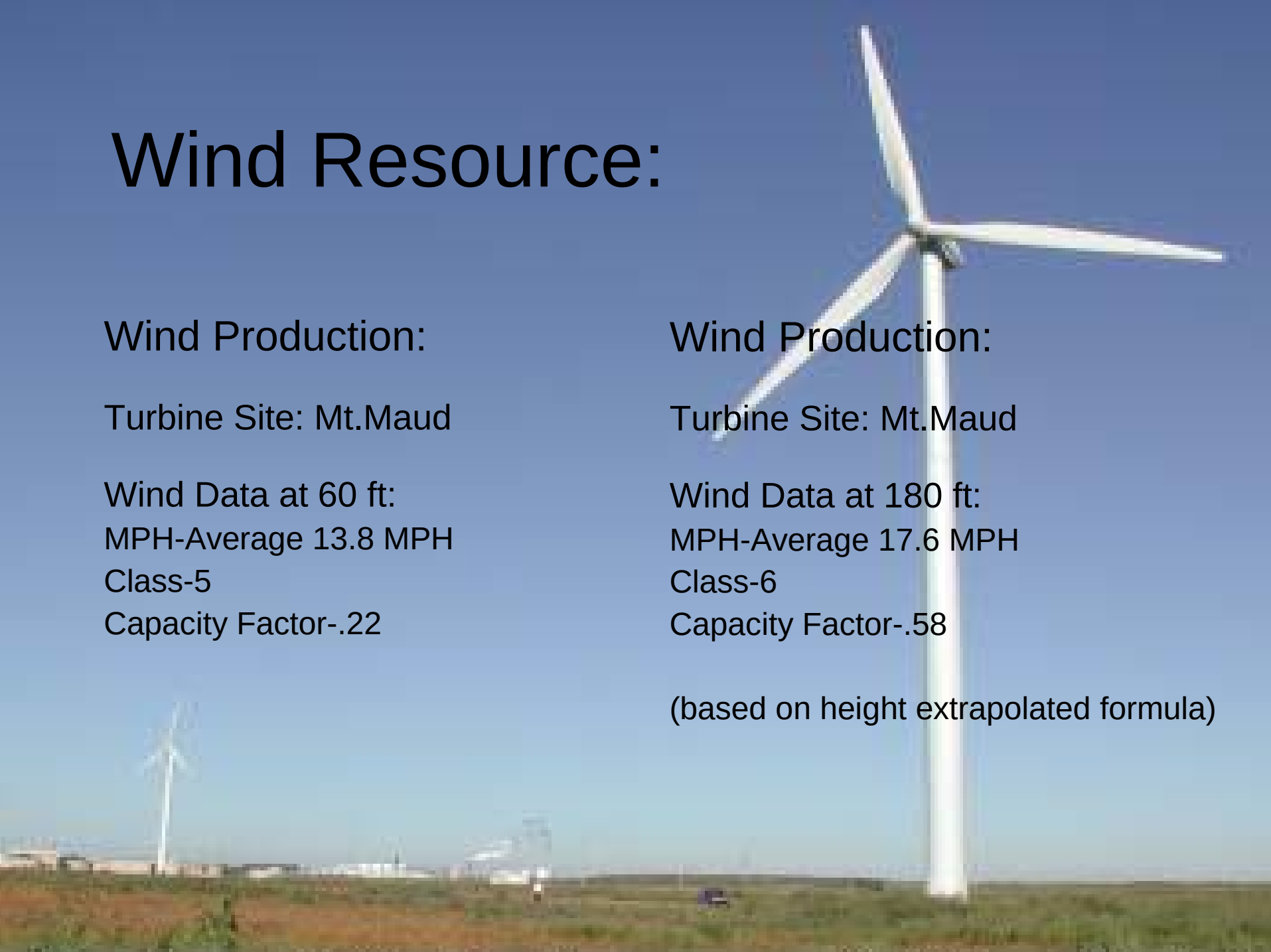
- Calculates wind turbine capacity required to meet any given electricity demand
- Allows users to experiment with various levels of hydrogen backup capacity: calculates required scale of electrolysis, hydrogen storage, and fuel cells
- Calculates costs associated with above system configurations
- Compares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



Analysis of Grand Portage Wind Data

- Calculated the daily average wind speed using 365 days of data, and sorted these data points into ‘wind bins’.
- Calculated the power density (PD) for each ‘wind bin’ PD=.5 pV3 (units w/m2).
- Corrected for frequency of occurrence and summed across all ‘wind bins’ PD=221.22 w/m2
- Corrected for hub height and wind sheer Adjusted PD=442.44 w/m2
- Calculated ouput/m2= 3875.74kWh/yr/m2

Wind Resource:



Wind Production:

Turbine Site: Mt.Maud

Wind Data at 60 ft:
MPH-Average 13.8 MPH
Class-5
Capacity Factor-.22

Wind Production:

Turbine Site: Mt.Maud

Wind Data at 180 ft:
MPH-Average 17.6 MPH
Class-6
Capacity Factor-.58

(based on height extrapolated formula)

Annual average wind speed=14.2 mph.

GP Wind Speed Distribution

Fig #1. The number of days in each wind speed ‘bin’.

Estimated Turbine Revenues

- Turbine Diameter = 54 m
- Swept Area = 2289 m2
- Turbine Output = 8,871,800 kWh/yr
- Expected Efficiency = 25%
- Corrected Output = 2,217,950 kWh/yr
- @ 7cents per kWh = $155,256.00/yr

Grand Portage Model Output: 2 Scenarios

No Hydrogen Backup

	Capacity	Cost
Wind	1000 kW	$946,959
Electrolysis	0	$0
Fuel Cell	0	$0
Total System Cost		$946,959
Annual Renewable cost		$66,287
Annual Utility cost		$121,000

20% Hydrogen Backup

	Capacity	Cost
Wind	1095 kW	$1,041,000
Electrolysis	10.87 Nm3/hr	$173,950
Fuel Cell	23 kW	$133,280
Total System Cost		$1,348,000
Annual Renewable cost		$108,230
Annual Utility cost		$121,000

Estimated Turbine Costs Fuhrlander FL 1000 (1 MW)

- Turbine, tower, and delivery: $1.2 million
- Site Preparation:
- Installation: $400,000.00

- Total: $1.6 million

Remaining Questions for GP Wind

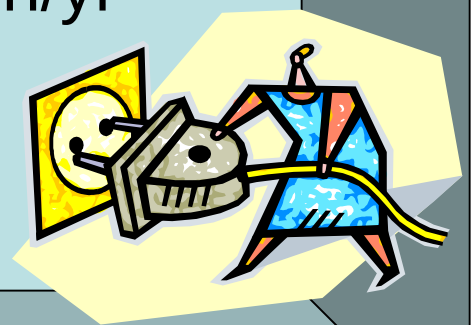
- Agreement with Utility
- Permitting Costs
- Cost of (2 mile) Transmission Line

White Earth

Major Electricity Consumers:

- Regional Tribal Council- 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



Chosen Resource

Wind Production:

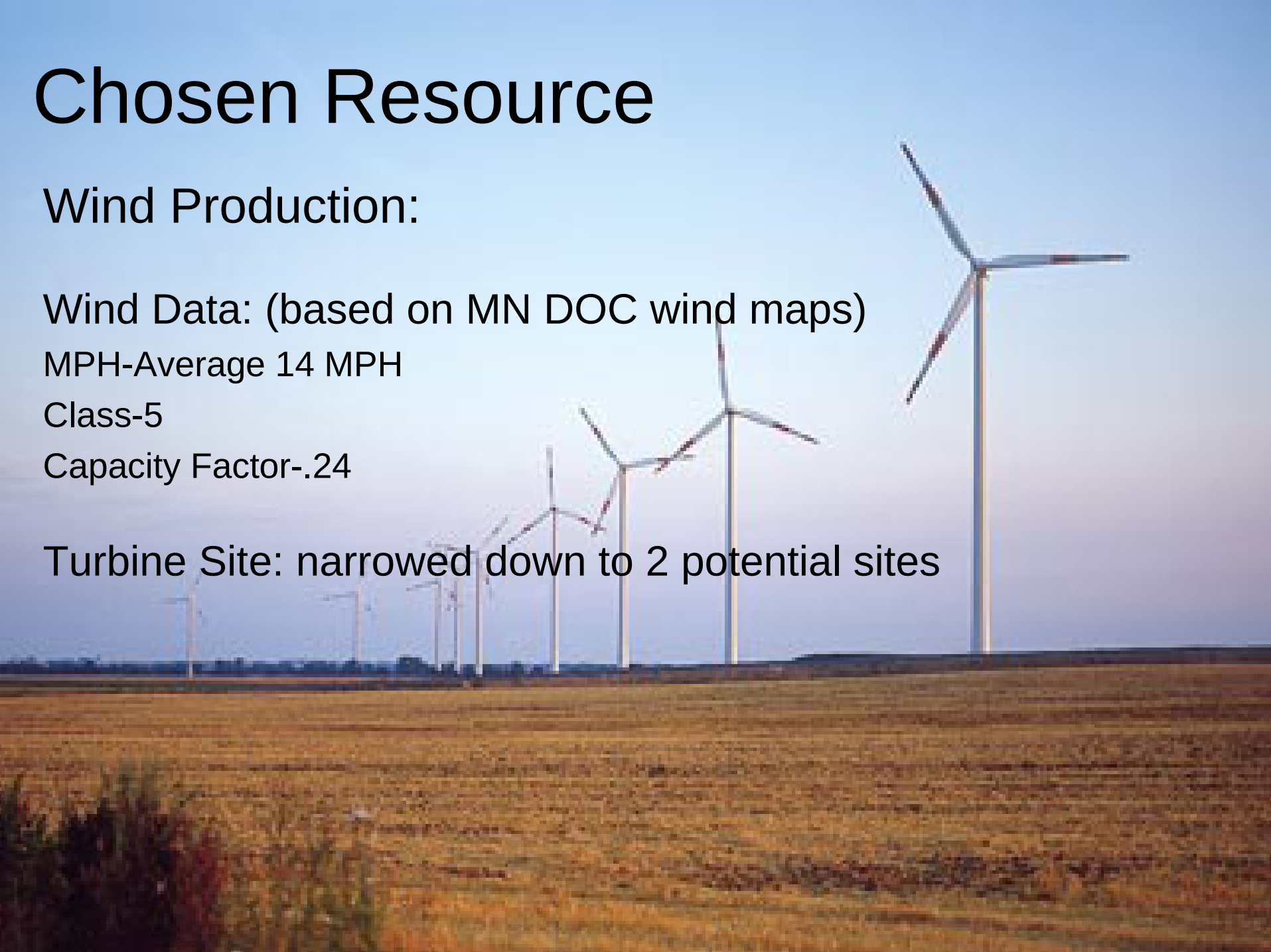
Wind Data: (based on MN DOC wind maps)

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

White Earth Model Output: 2 Scenarios

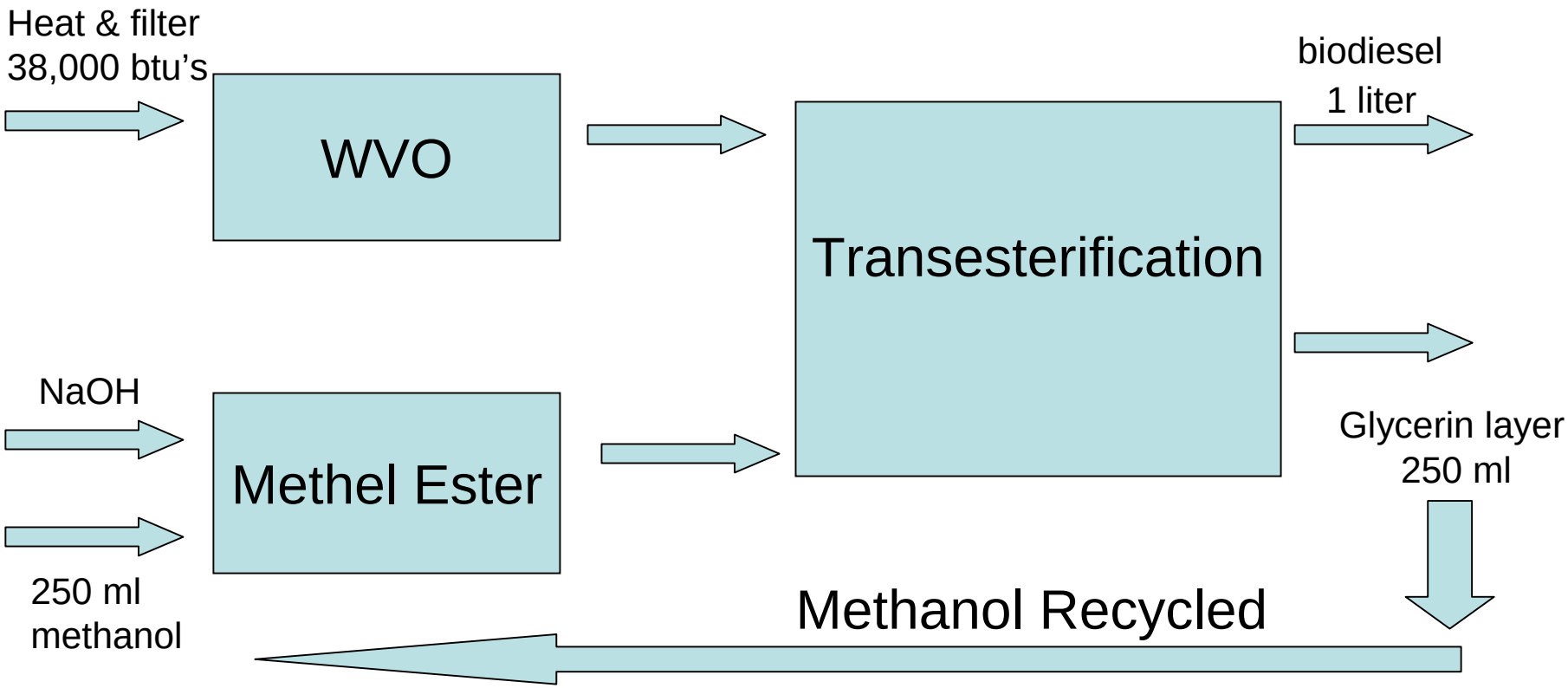
No Hydrogen Storage

	Capacity	Cost
Wind	516 kW	$521,643
Electrolysis	0	$0
Fuel Cell	0	$0
Total System Cost		$521,643
Annual Renewable		$45,471
Annual Utility		$84,500

20% Hydrogen Storage

	Capacity	Cost
Wind	570 kW	$687,785
Electrolysis	5.65 Nm3/hr	$90,454
Fuel Cell	11.91 kW	$71,095
Total System Cost		$849,334
Annual Renewable		$66,886
Annual Utility		$84,500

Biodiesel: The Process



Economics/Material Costs: Production Costs per Liter of Biodiesel

heating	38,000 BTUs	37 cubic ft of natural gas @ .012 cents/ft3	$.44
methanol		250 ml @ .00145 cents/ml	$.36
		assume 50% recycle	$.18
NaOH		6 g @ .00066 cents/gal	$.004
WVO		Currently free	$0
Total		(Using $0.18 methanol figure)	.624

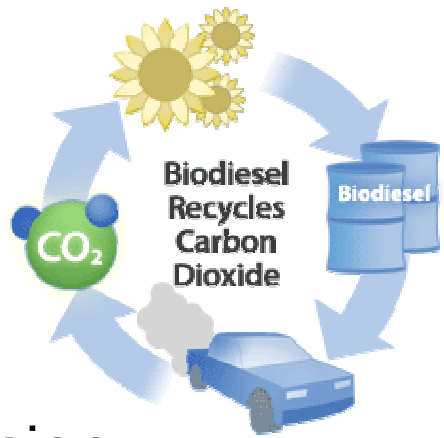
Value of Biodiesel: $1.50-2.50 liter
Capital Costs: $.10-.20 cents/liter or $1,000.00

The Uses

- Biodiesel in your home fuel oil heating furnace:
  - Up to B20 (20% biodiesel 80% fuel oil)
  - No conversion kit necessary
  - New fuel oil furnace approx $2000
- Modifying you diesel car:
  - $500 for conversion kit
  - $1000 for labor
  - Up to B100

Remaining Questions for WE Biodiesel

- #1-Potential Supply of WVO?
  - casino, restaurant, etc.
- #2-Immediate Demand for Biodiesel
  - -current # of diesel vehicles
  - -current # of fuel oil furnaces
- #3-Potential Demand of Biodiesel
  - potential # of diesel vehicles with conversion
  - potential # of fuel oil furnaces



Seems to be viable project for WE, regardless of scale

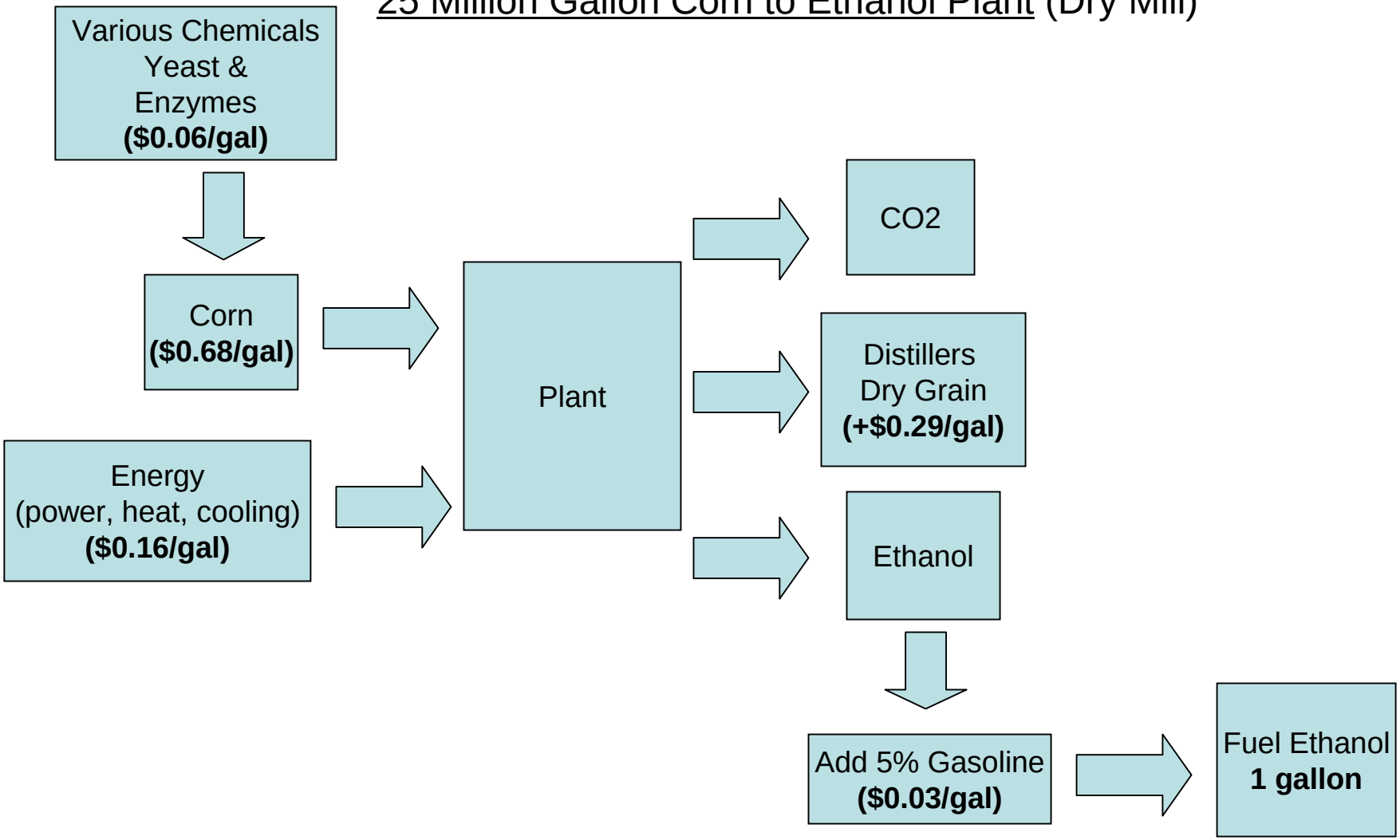
Ethanol

3 Options:

1) Corn Starch to Ethanol (Dry Mill)*
   - Total Capital Cost for 25 Million Gallon Plant = $27,900,000
2) Corn Starch to Ethanol (Wet Mill)
   - Total Capital Cost for 21 Million Gallon Plant = $50,000,000
3) Corn Stover to Ethanol
   - Total Capital Cost for 25 Million Gallon Plant = $136,100,000

*The dry mill process would be the only viable option for White Earth, however with high capital costs and a low rate of return on the ethanol, we would not recommend it.

25 Million Gallon Corn to Ethanol Plant (Dry Mill)



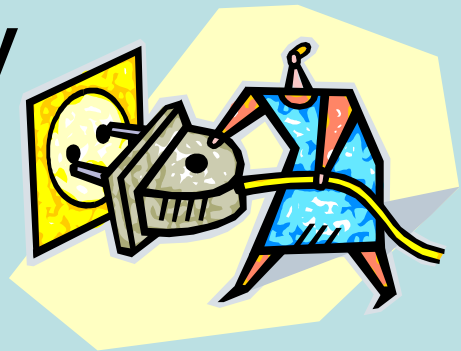
Total Production Cost per Gallon = $0.93 (Ethanol Costs Above) + $0.13 (Labor, Supplies) + $0.11 (Depreciation of Capitol Costs) - $0.29 (DDG) - $.0.20 MN State Subsidy = **$0.68/gallon**

Total Capitol Cost = $27,900,000.00

Source: 1999 Study by NREL “Determining the Cost of Producing Ethanol from Corn Starch and Lignocellulose Feedstocks” Ibsen & Wooley

Leech Lake

Major Electricity Consumer:



Casino: 2002- 6,027,840 kW/H

2003- 6,427,320 kW/H

Annual Cost: $385,640.00

Wind Resource

Wind Production:

Wind Data:

MPH-10

Class-2

Capacity Factor-.08

Turbine Site: Several other potential sites to be explored

Proposed Project Leech Lake

- Approximately 1MW to power fraction of casino's demand
- Community Education

Leech Lake Model Output

No Hydrogen Storage

	Capacity	Cost
Wind	1000 kW	$951,959
Electrolysis	0	$0
Fuel Cell	0	$0
Total System Cost		$951,959
Annual Renewable cost		$66,287
Annual Utility cost		$82,200

Total annual production 1.36 million kWh

(production lower due to small capacity factor (less wind))