

Sustainable Energy Project Development Workshop for Public Institutions

May 22, 2008
Oakland University
Jim Leidel
Energy Manager



Thank you to our sponsors:

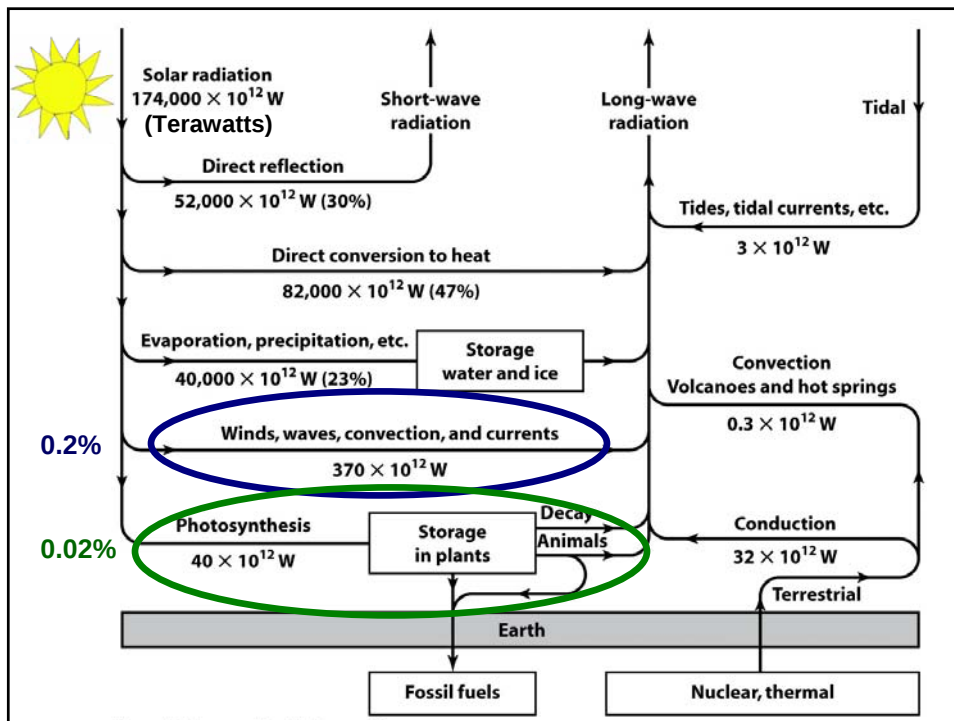
- Oakland University Facilities Management
- SE Michigan Resource Development Council
- Entegritty Wind Systems
- State of Michigan Energy Office
- Chevron Energy Solutions
- Thermo Energy Systems

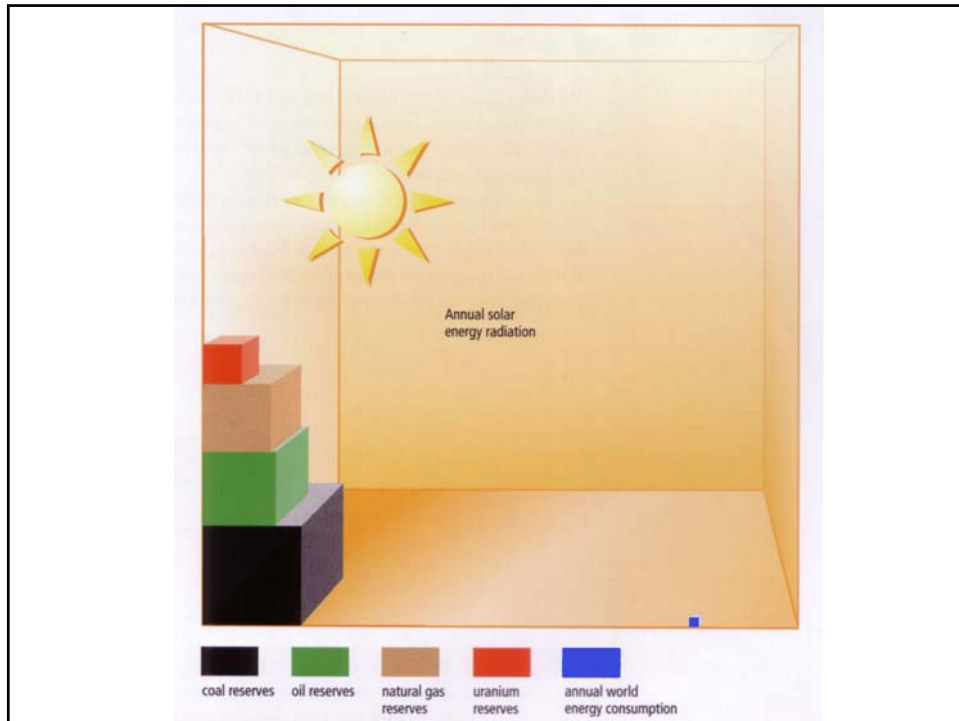


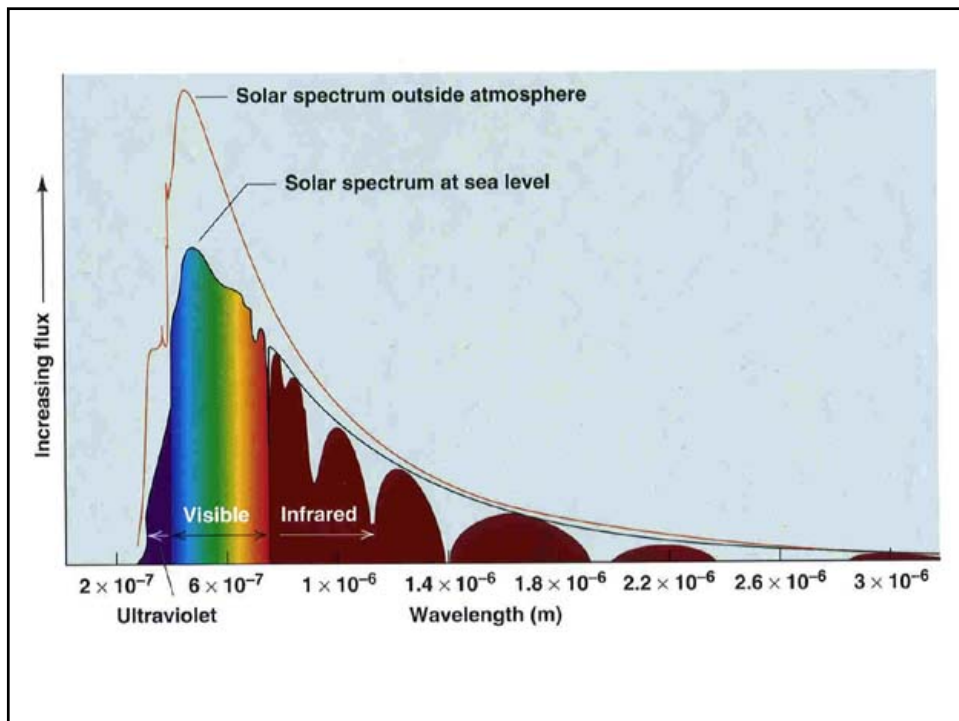
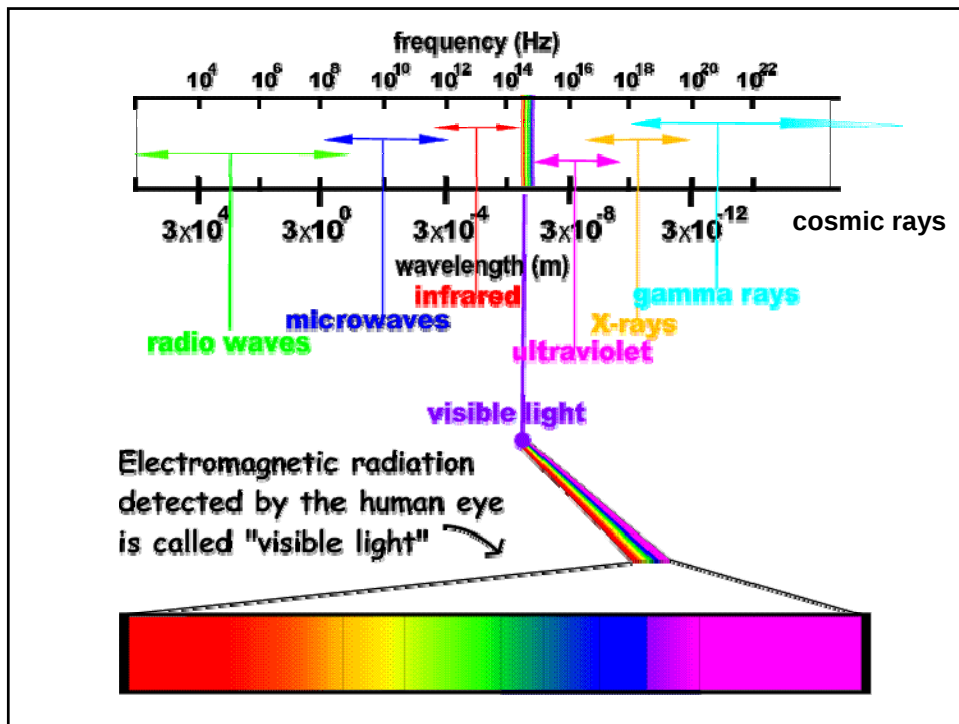
Introduction to Renewable Energy Resources

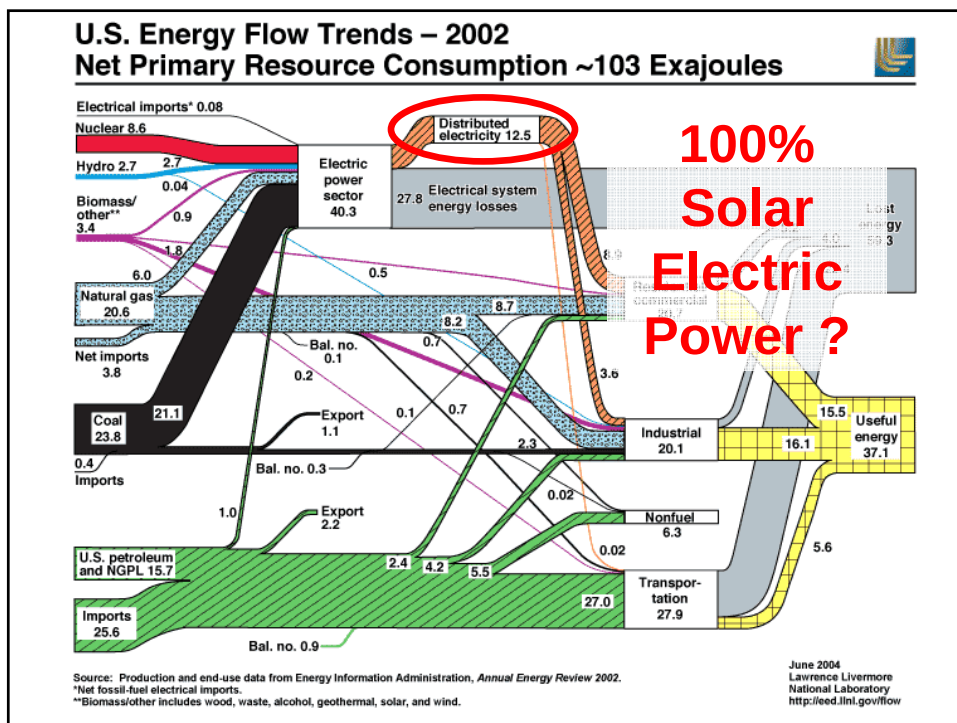
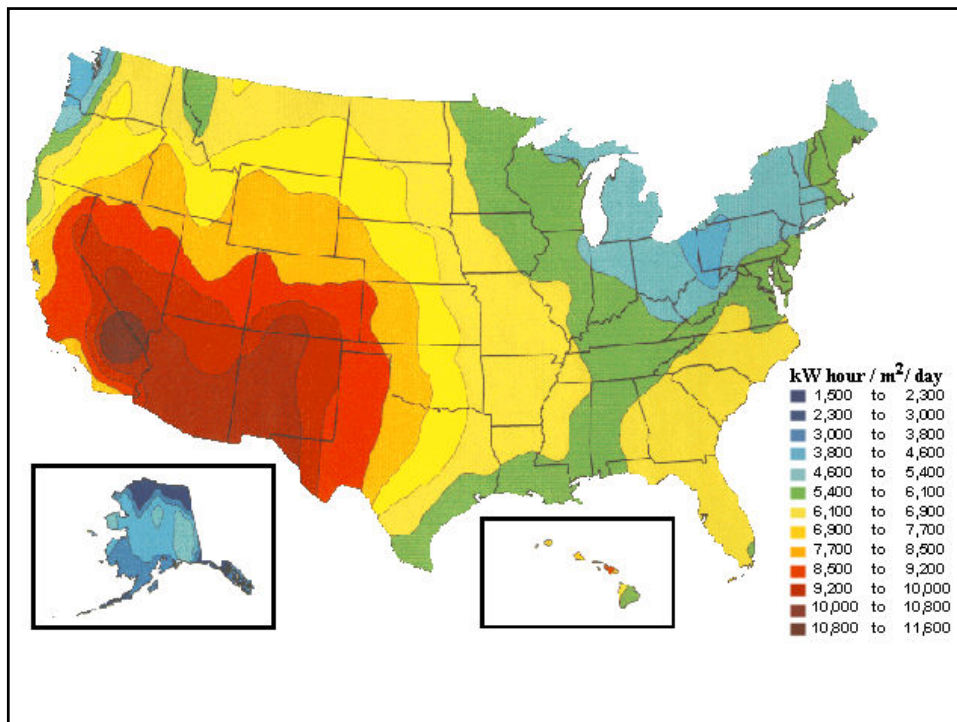
- ***Solar***
- ***Wind***
- ***Biomass***
- ***Others***

Brief Review of Oakland University Feasibility Studies







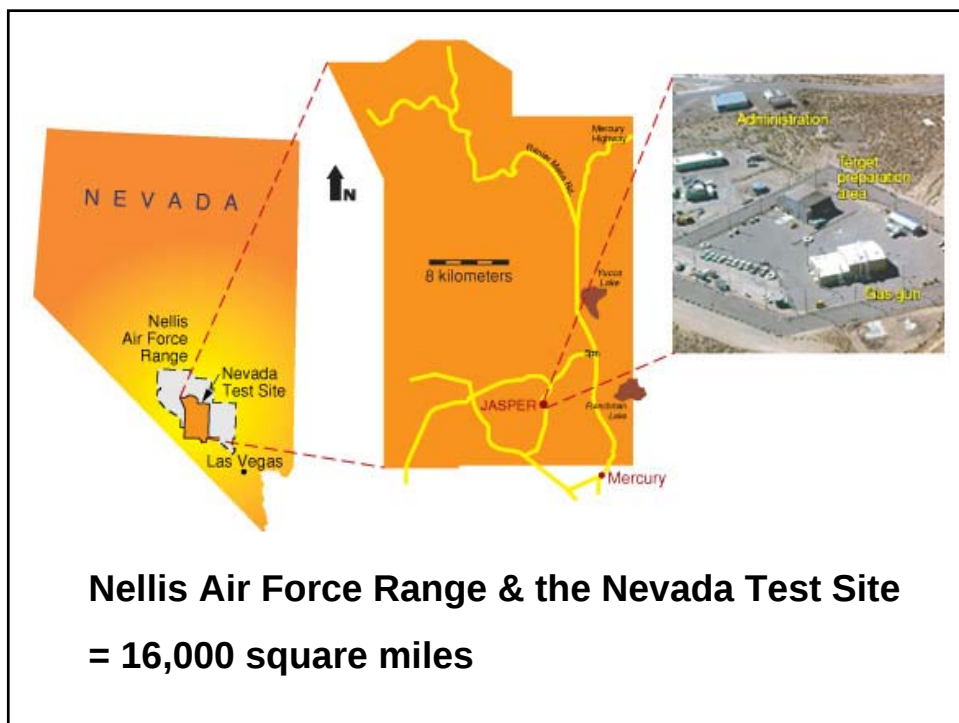
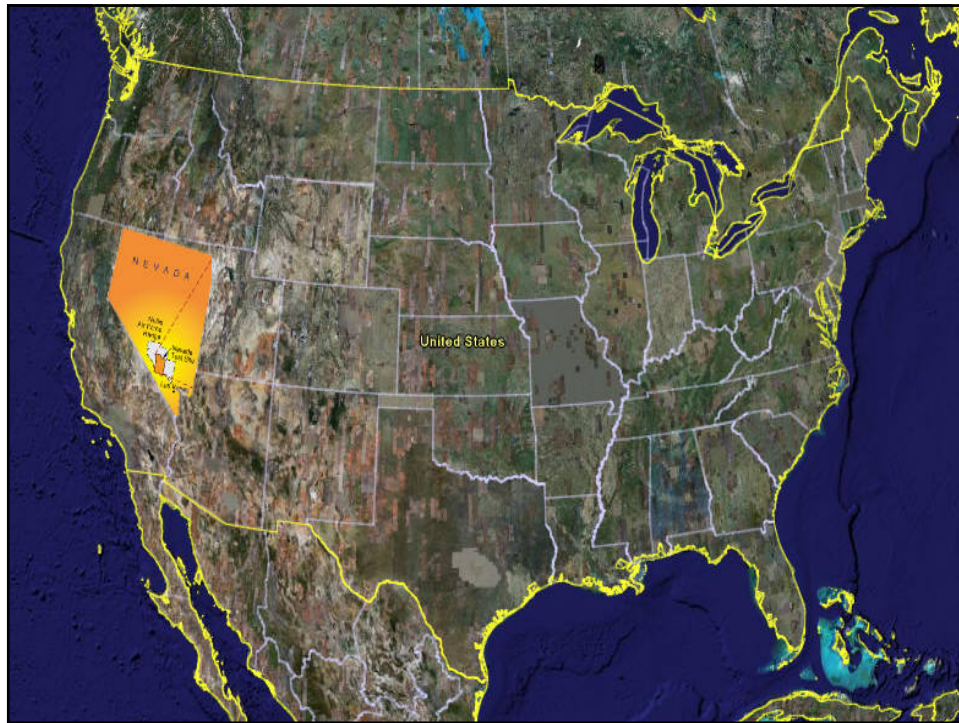


Calculation of Solar Panle Area Required to Meet 2002 US Electrical Energy Consumption

Annual electrical energy required =	1.25E+19 Joules / yr
=	3.47E+12 kW hr / yr
Average POWER of full sun at solar panel =	1,000 W / m ²
=	1.0 kW / m ²
Average capacity factor	20%
Hours per year	8,760 hours / yr
Average solar ENERGY available to solar panel =	1752 kW hr / m ² / yr
=	4.8 kW hr / m ² / day
Estimated average PV total system efficiency =	10%
Estimated average system losses =	15%
Estimated electrical energy output =	148.92 kW hr / m ² / yr
=	0.408 kW hr / m ² / day
Area required	2.33E+10 m ²
Area required	2.51E+11 ft ²
Area required	5,761,310 acres
Area required	9,002 miles ²
	~ Vermont

[Link to Spreadsheet](#)



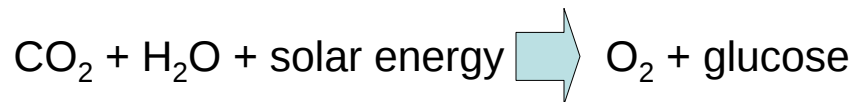


Photosynthesis: Nature's way to convert sunlight, CO₂, water and nutrients into chemical energy

BioMass

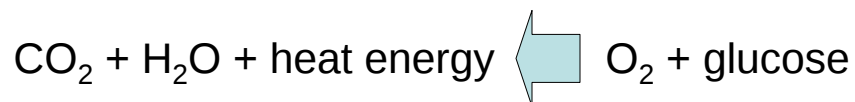


Photosynthesis:



... nature's battery stores solar energy in chemical bonds of glucose.

Reverse of photosynthesis:



... also called combustion, oxidation, biodegradation
...chemical bonds in glucose are broken

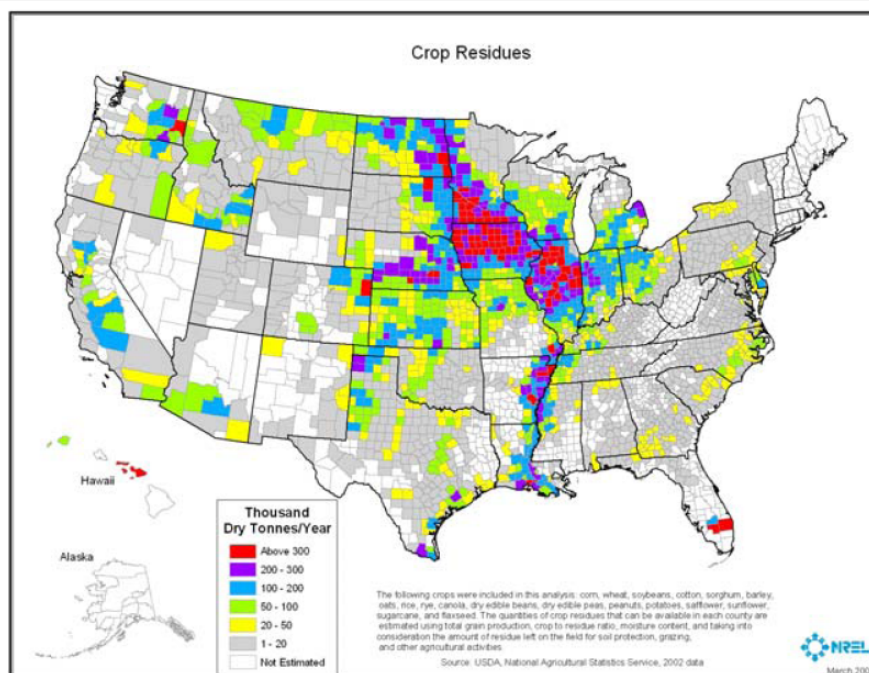
Prospecting for Biomass ?

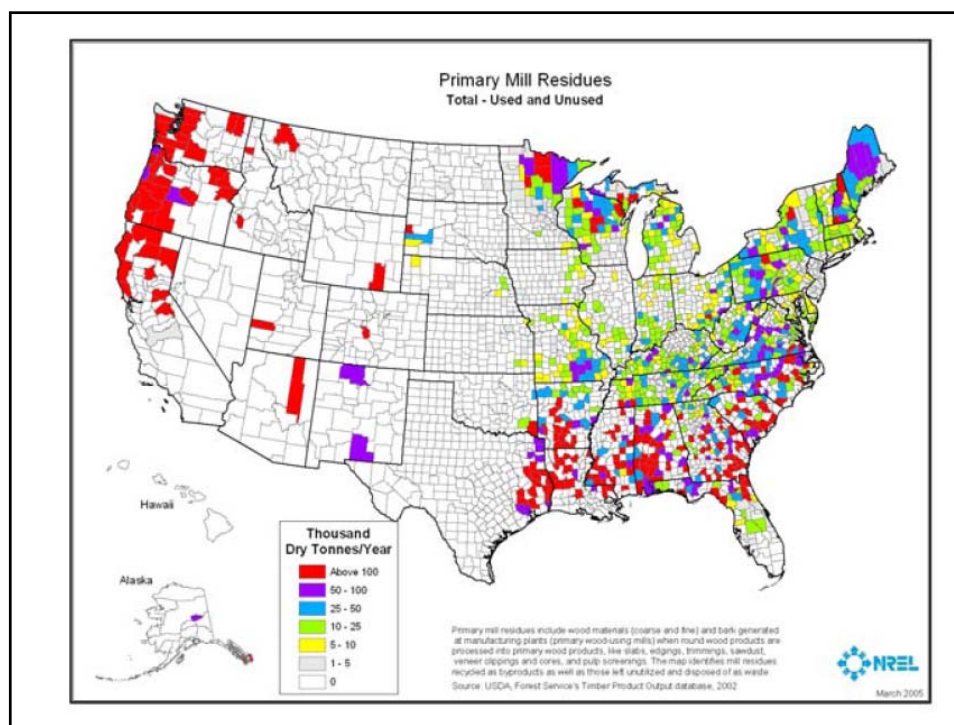
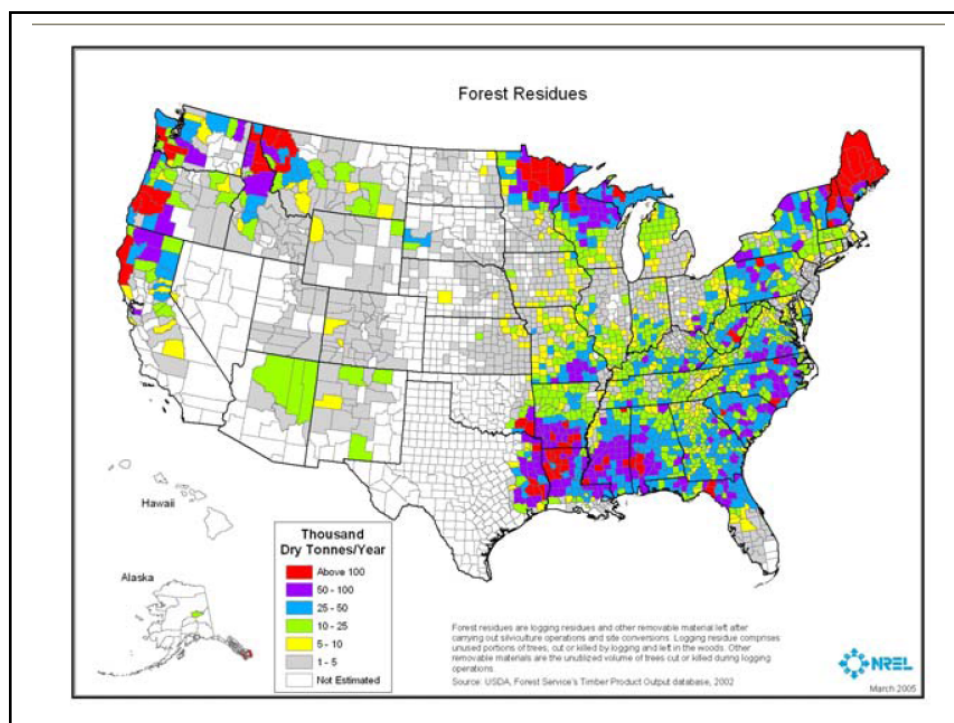


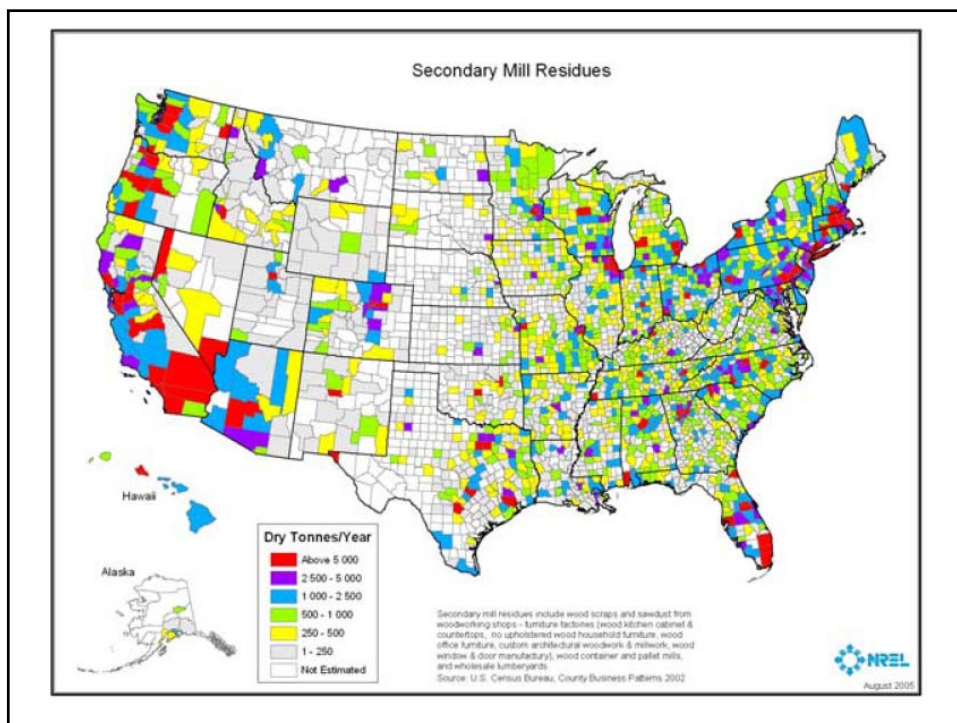
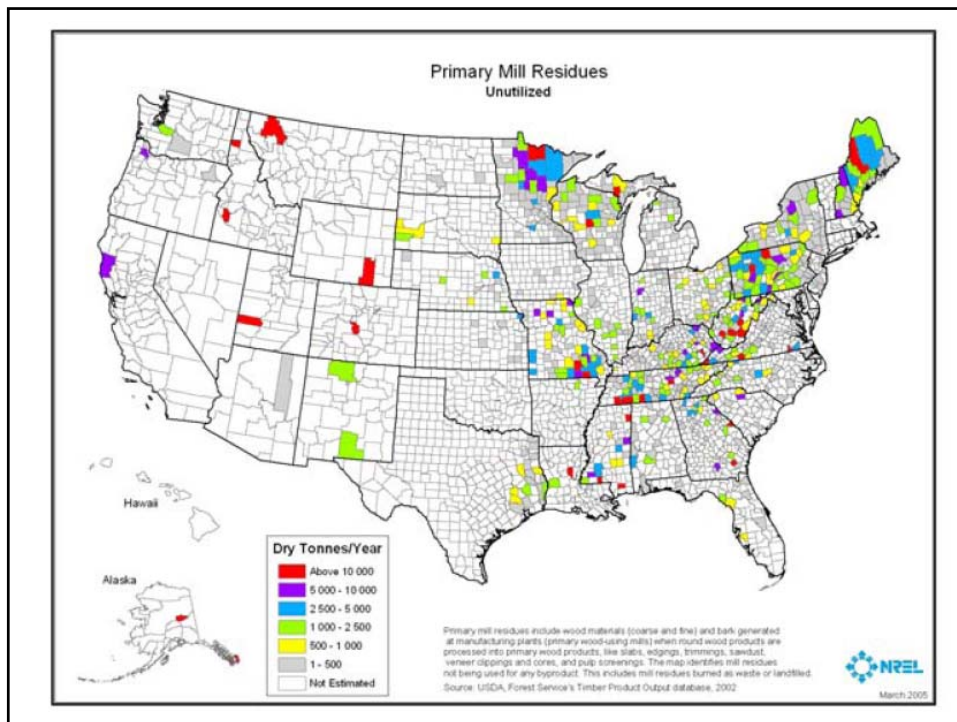
A Geographic Perspective on the Current Biomass Resource Availability in the United States

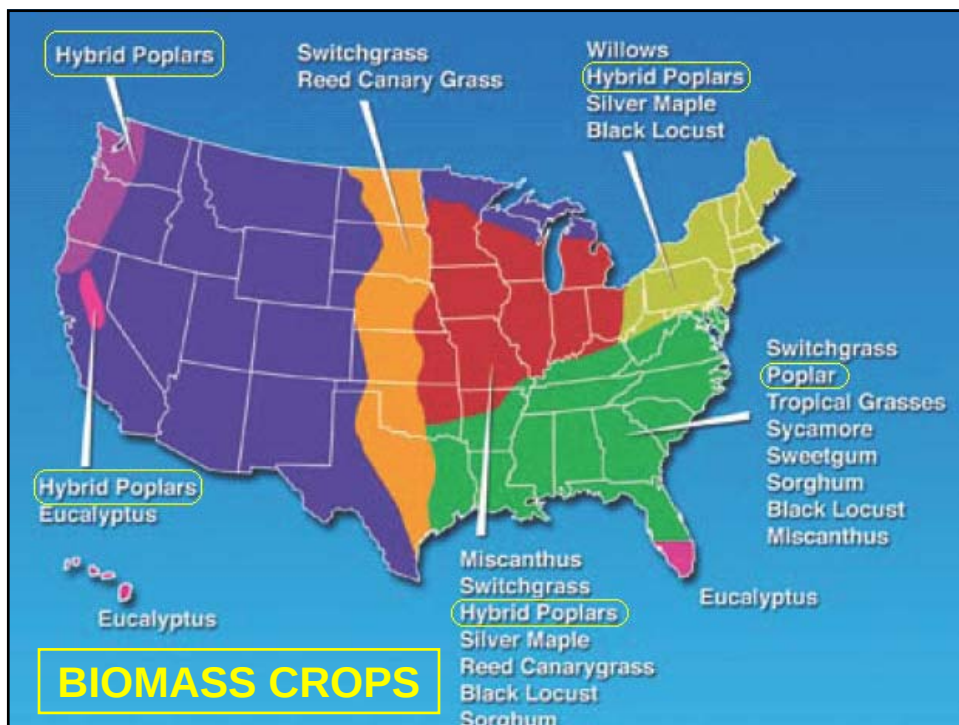
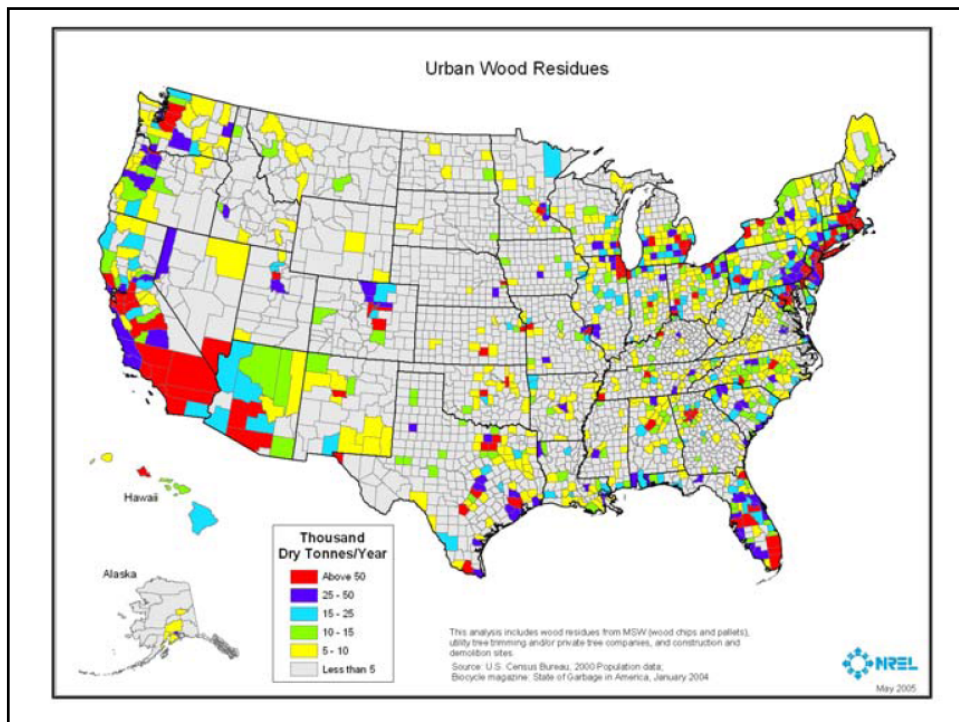
A. Milbrandt

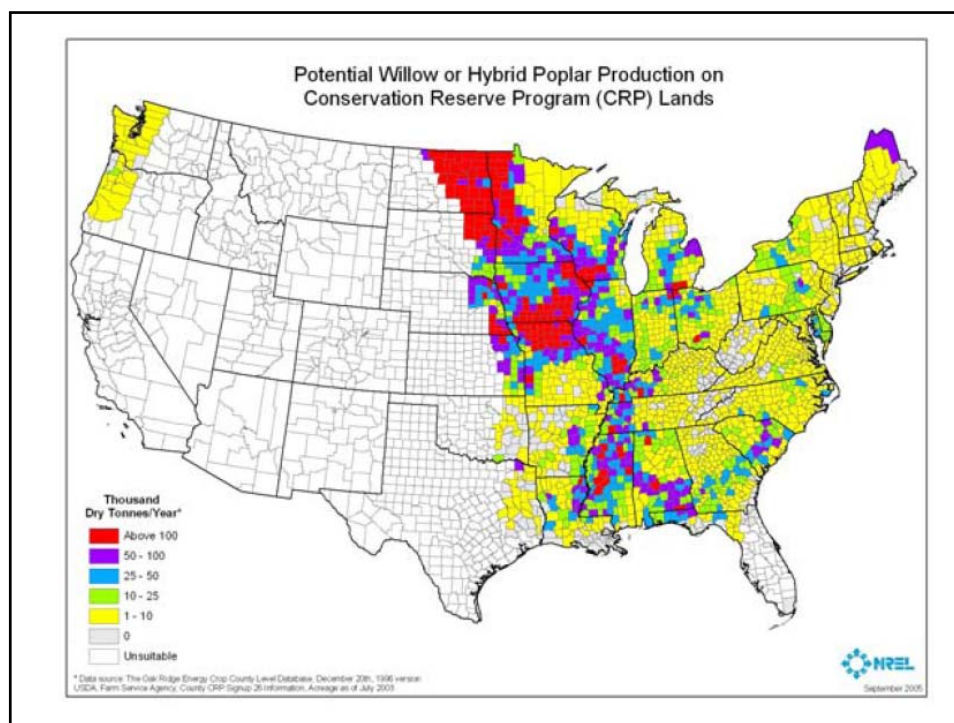
2005

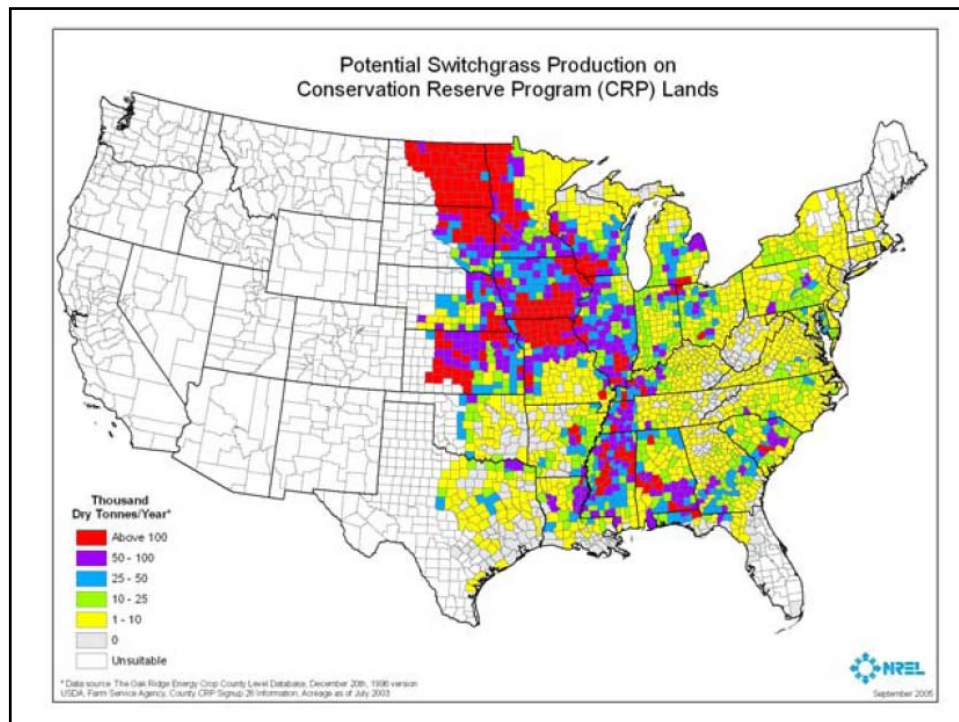


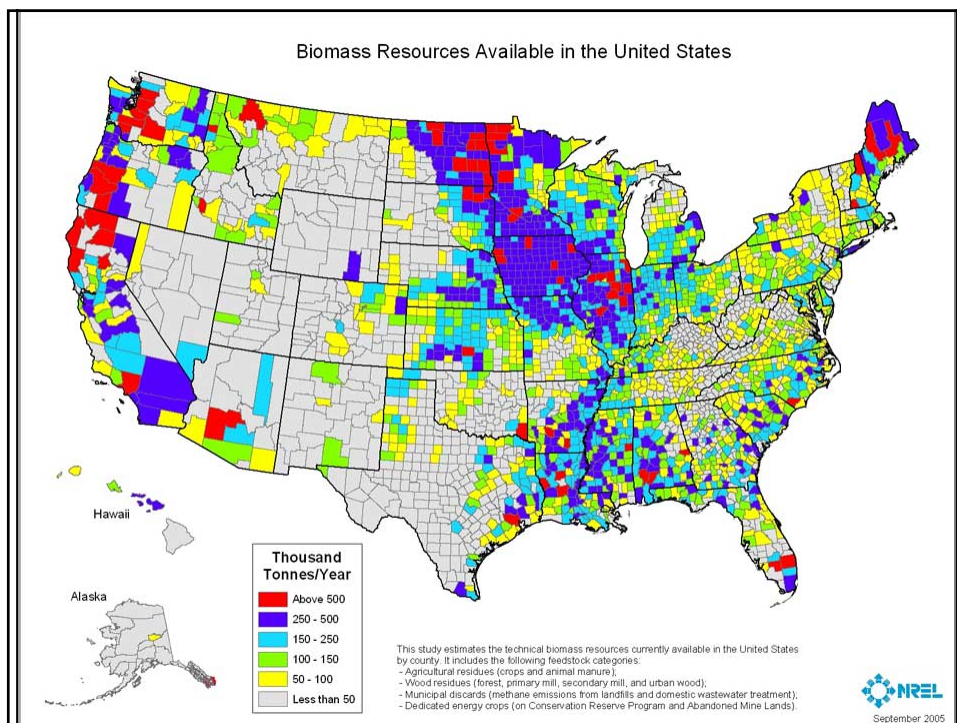
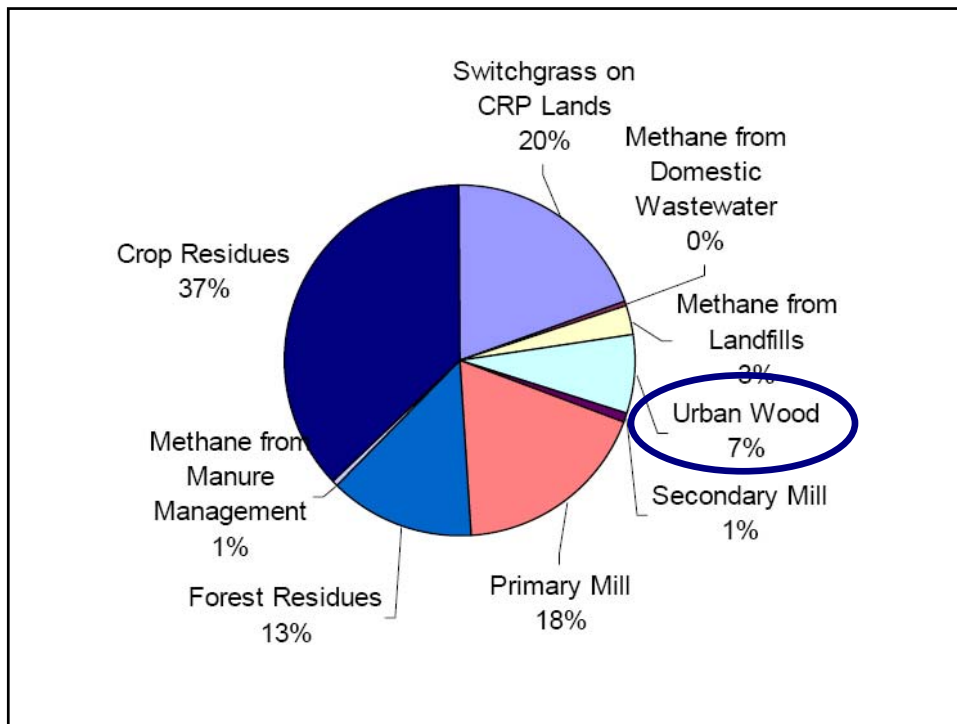




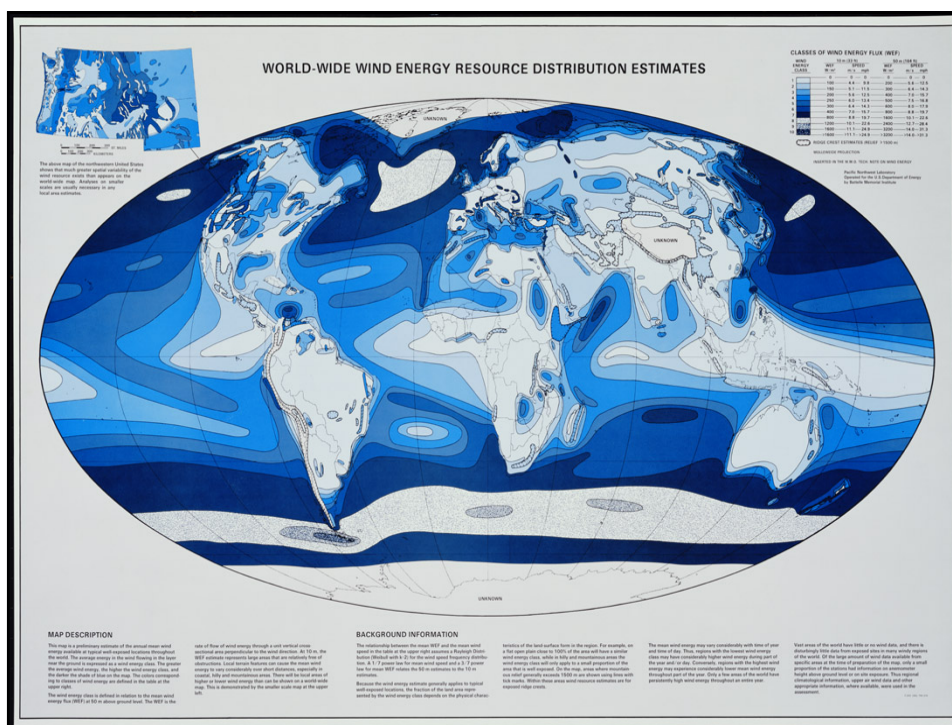


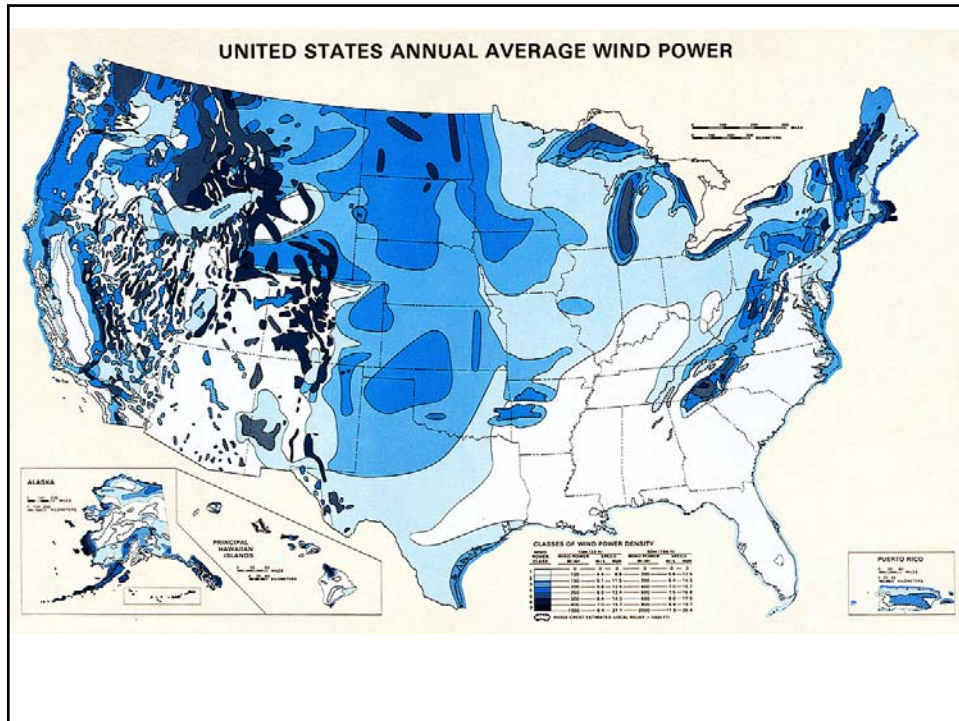


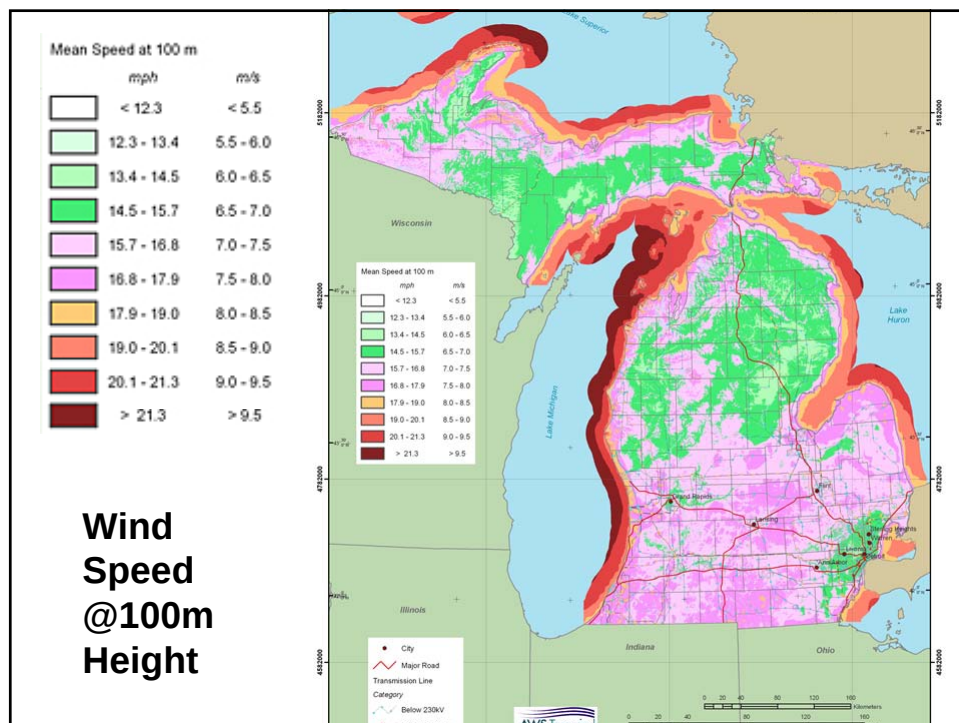
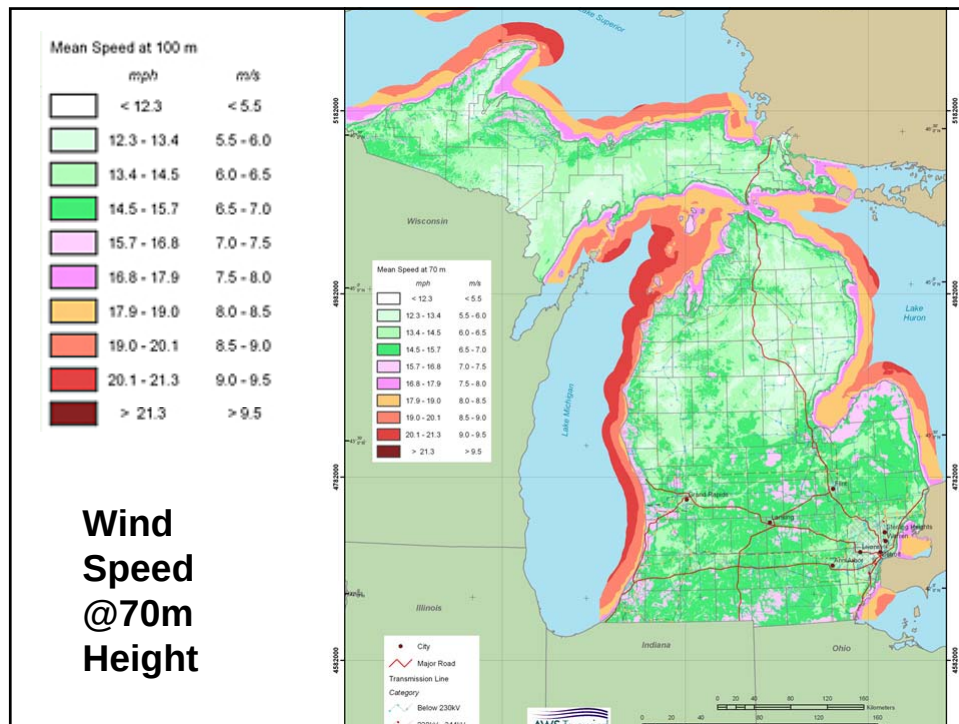




The Wind







Other Sources:

Hydro Power

Geothermal Energy

Ocean Thermal

Ocean Currents

Tidal Energy

Wave Energy

Next,

***A Brief Review of
Oakland University
Feasibility Studies***

Wind Power Option



for Oakland University

There were two parts of the study

- **Wind Speed Study Results**

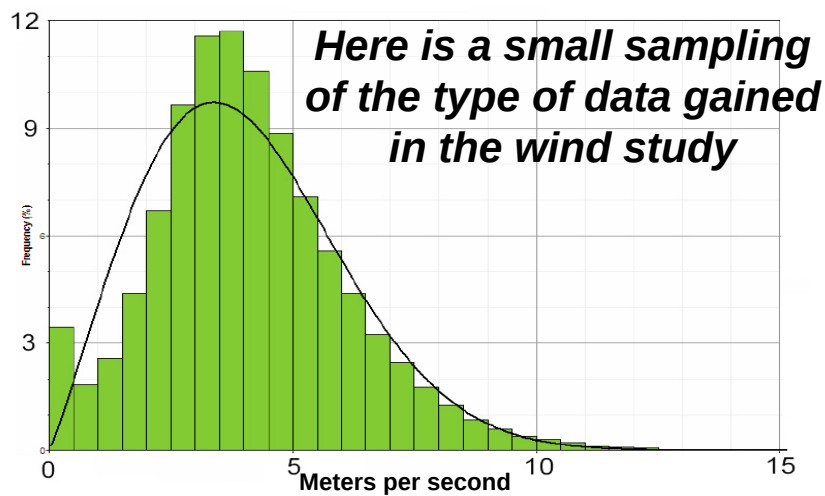
- Wind speed was recorded for two years at a 50 meter tall “met tower” located on the south side of the main campus
- Data collected for 2006 & 2007

- **Feasibility Study Results**

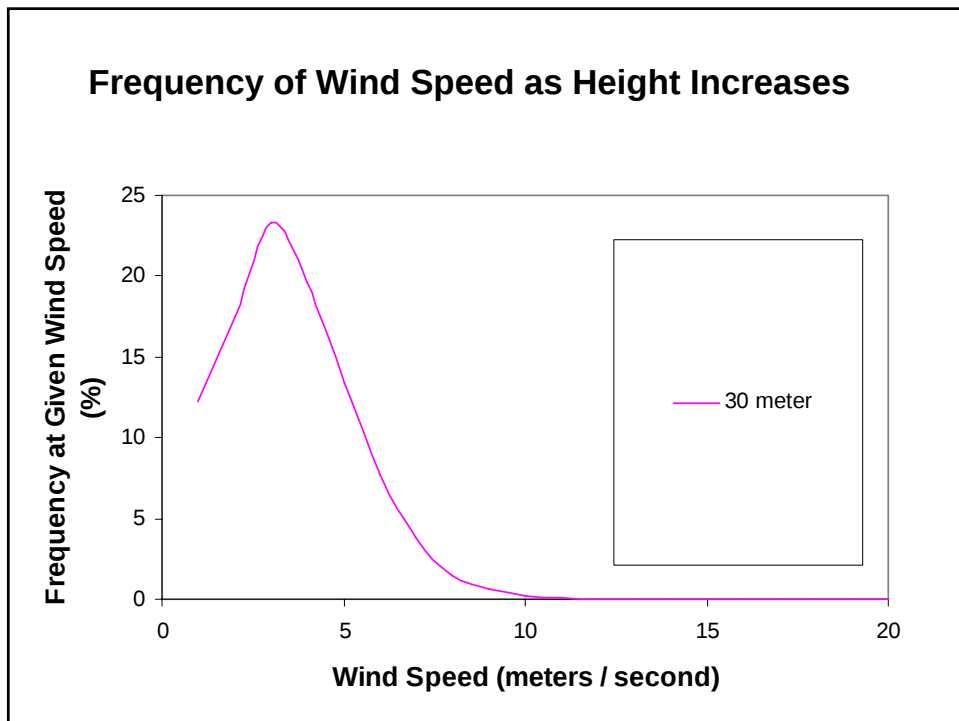
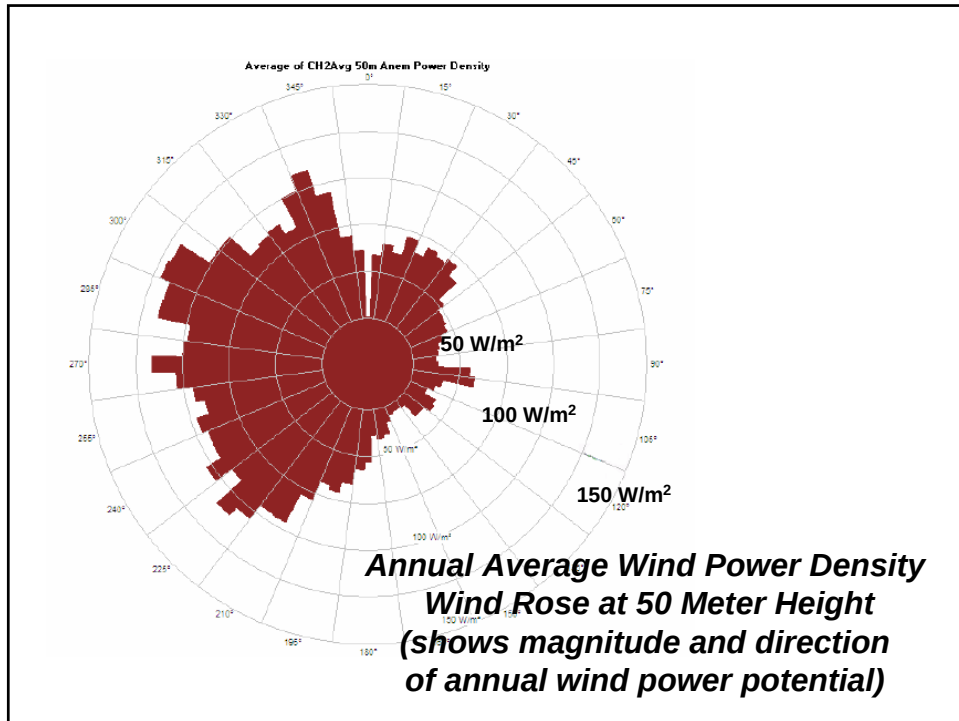
- This data was then used in a full engineering and cost analysis for one or more wind turbines for the Oakland campus

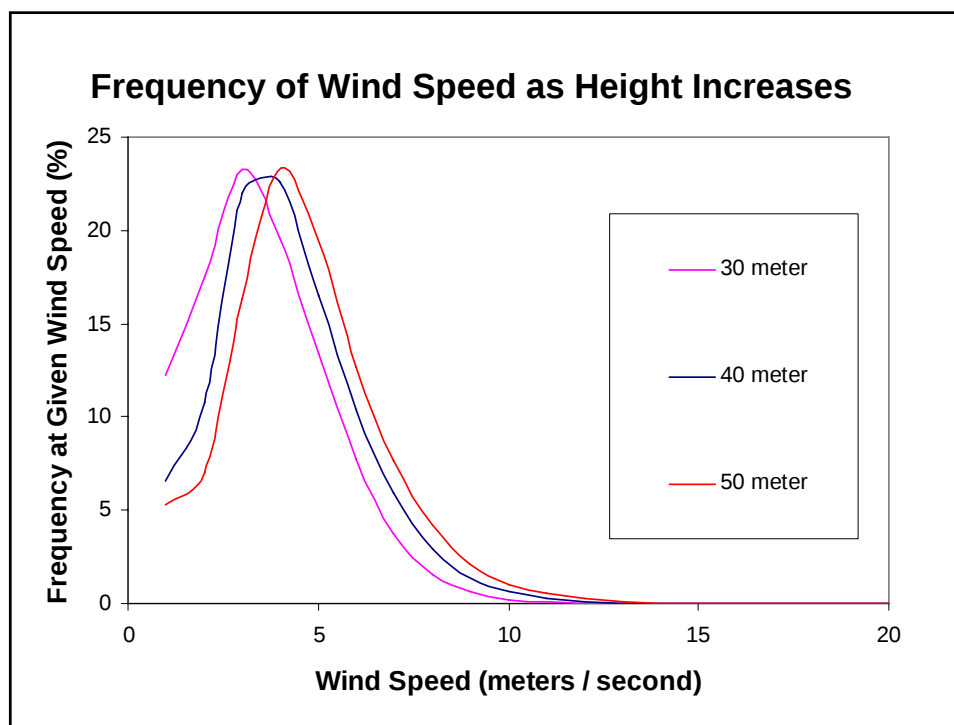
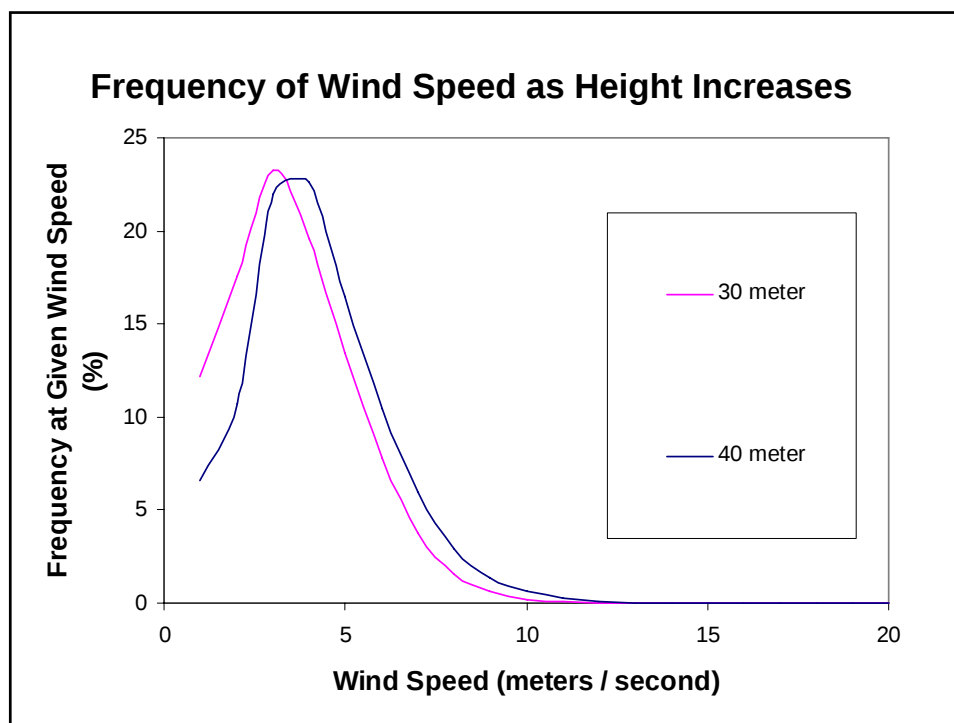
Average Wind Data Results

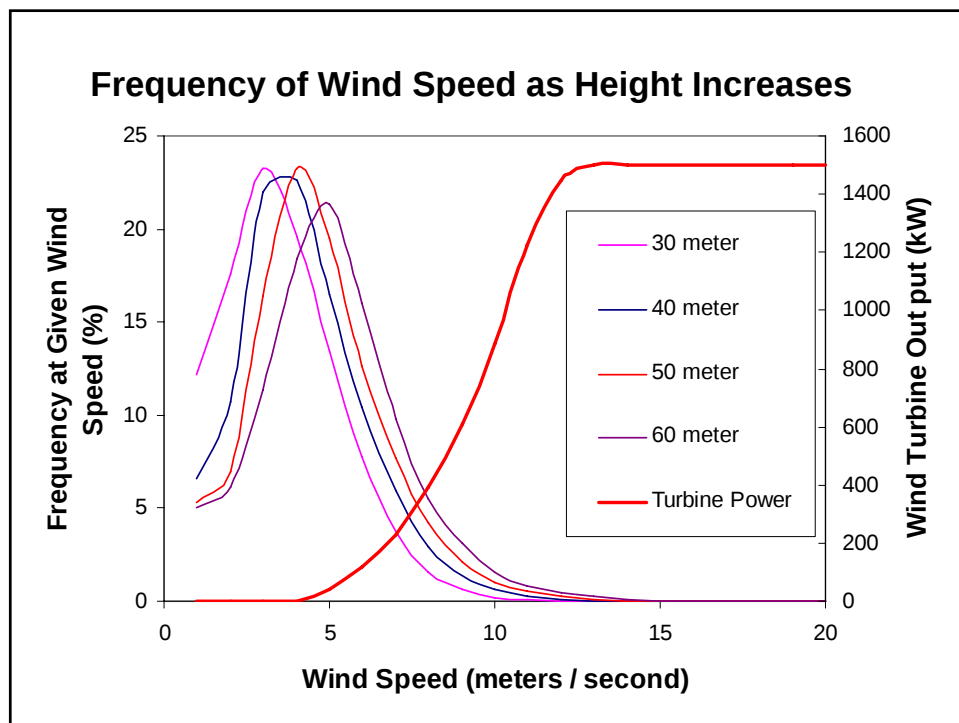
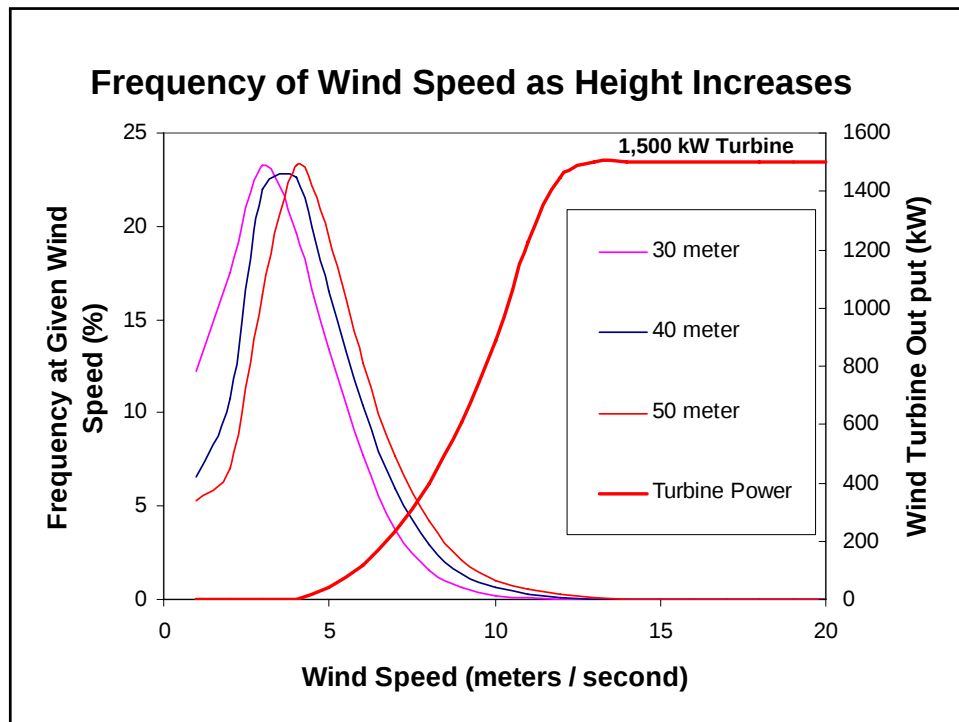
<u>Height</u>	<u>Wind Speed</u>	<u>Method</u>
30 m	3.0 m/s	measured
40 m	3.6 m/s	measured
50 m	4.1 m/s	measured
75 m	5.2 m/s	calculated
80 m	5.4 m/s	calculated
100 m	6.2 m/s	calculated

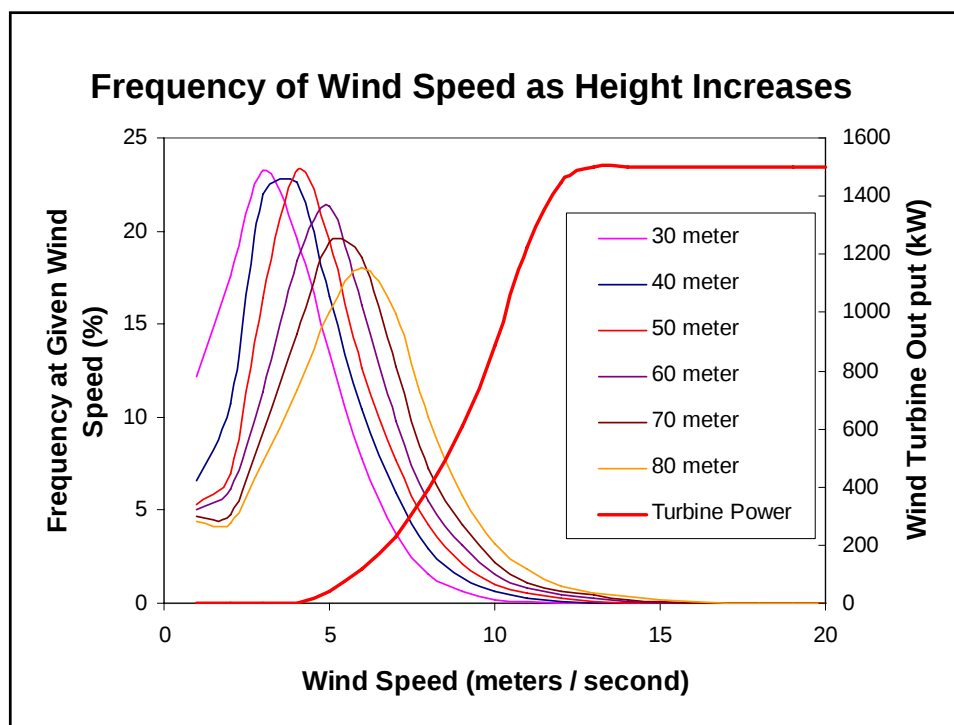
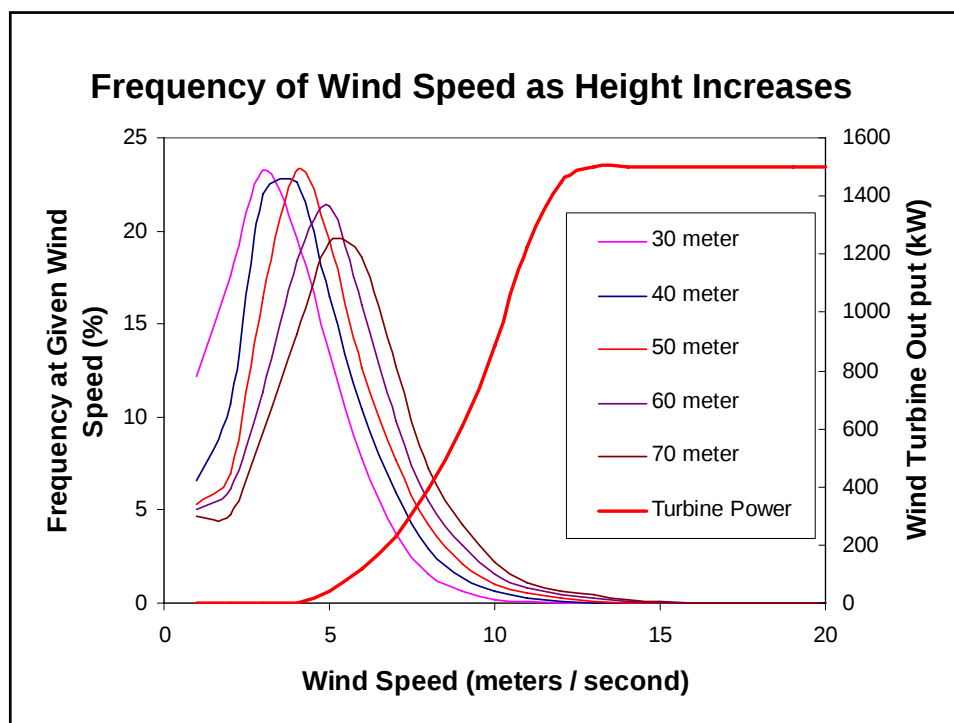


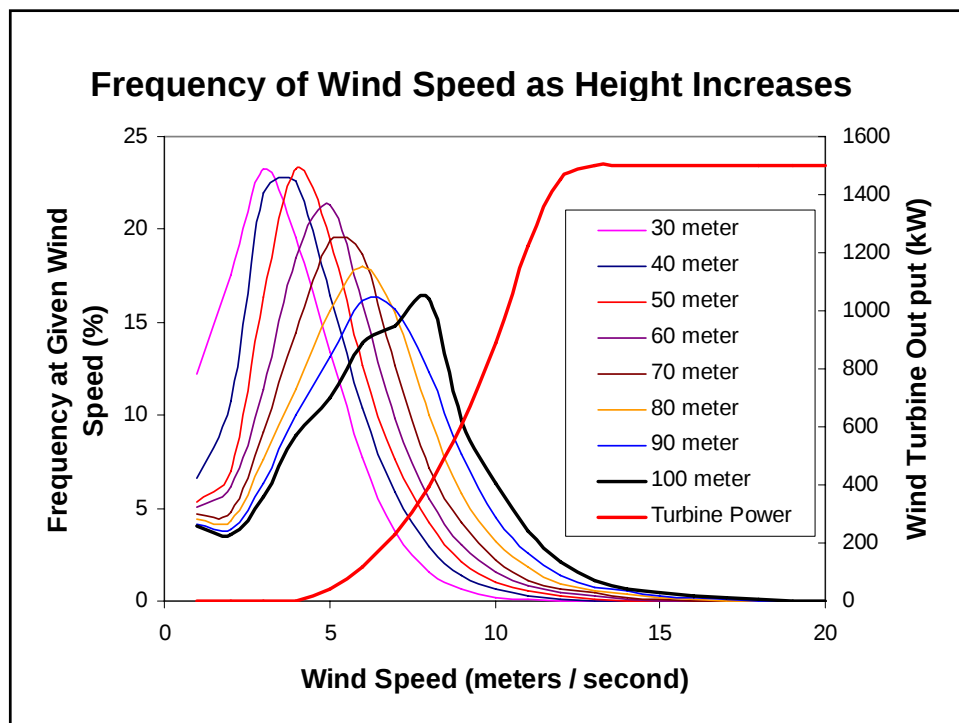
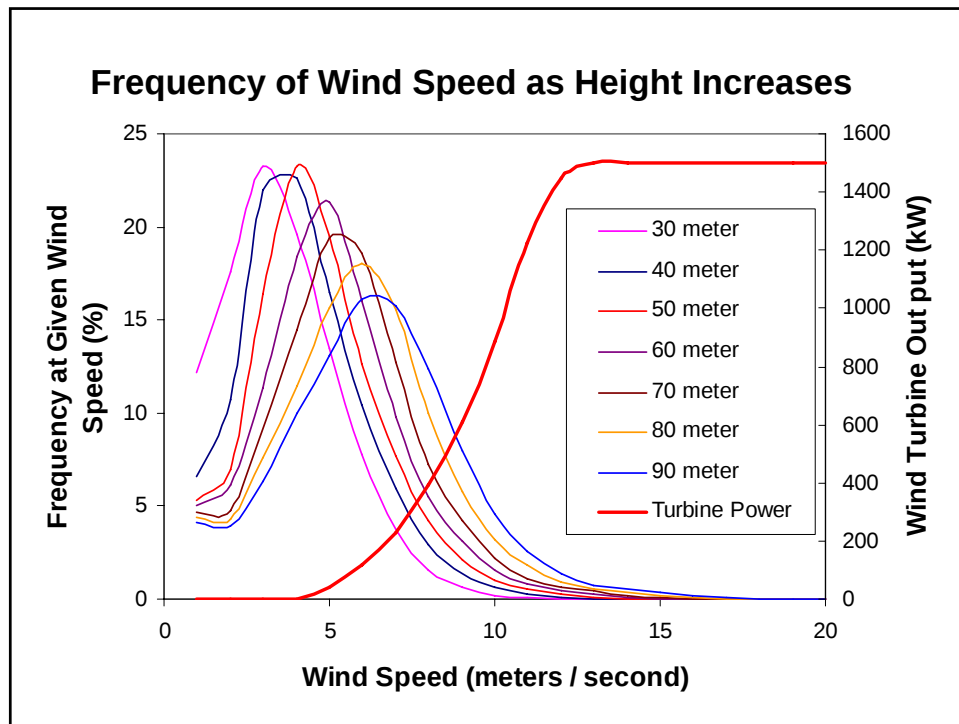
***Wind Speed Frequency Distribution at 50 Meters
(percent time for each wind speed)***

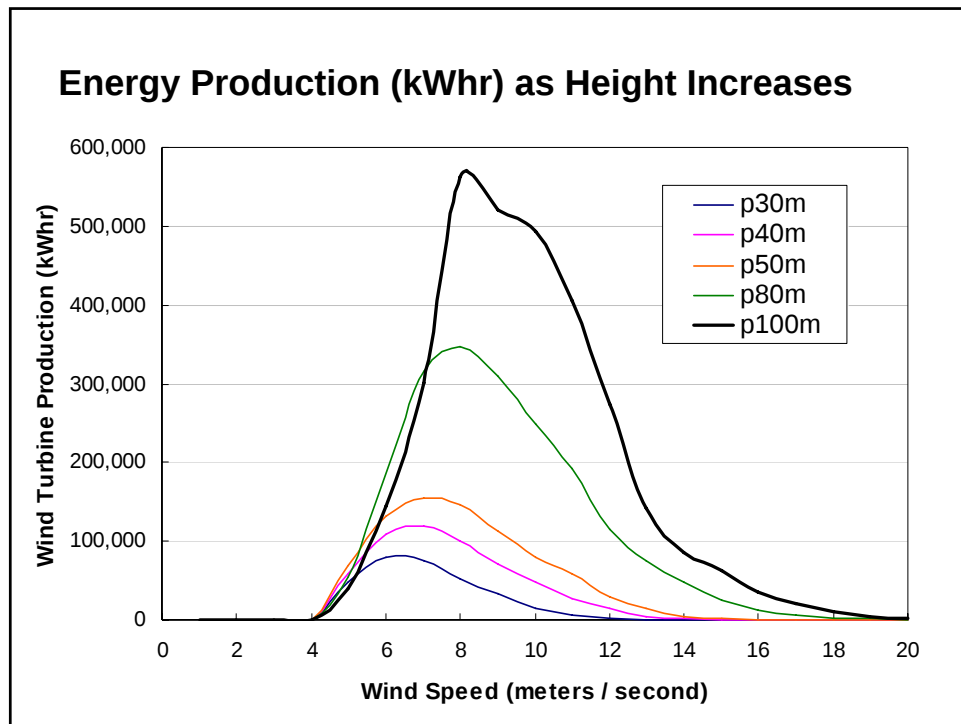














**Here is a
typical wind
turbine under
consideration**

1,500 kW each

77 meter blade
diameter

100 meter tower

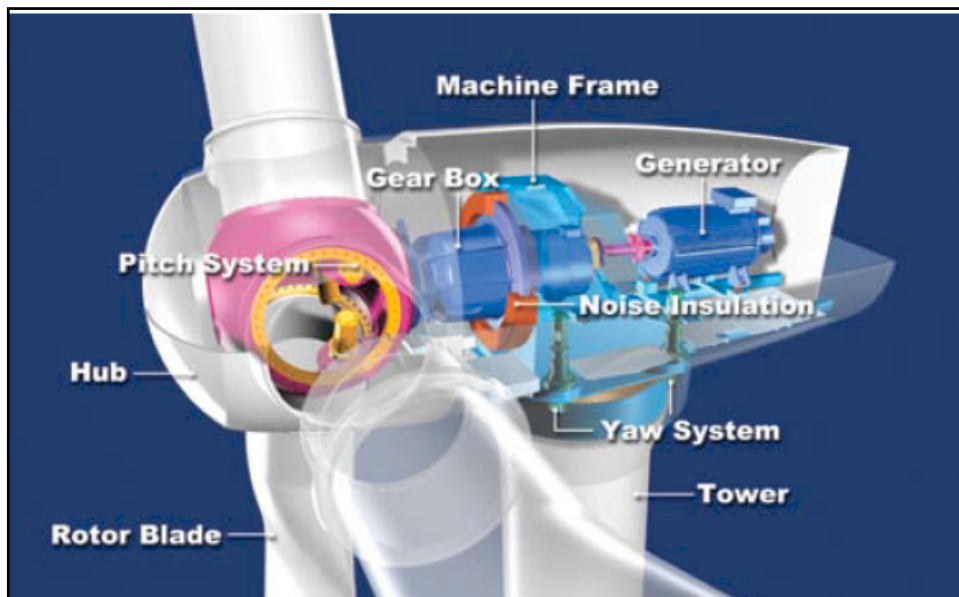
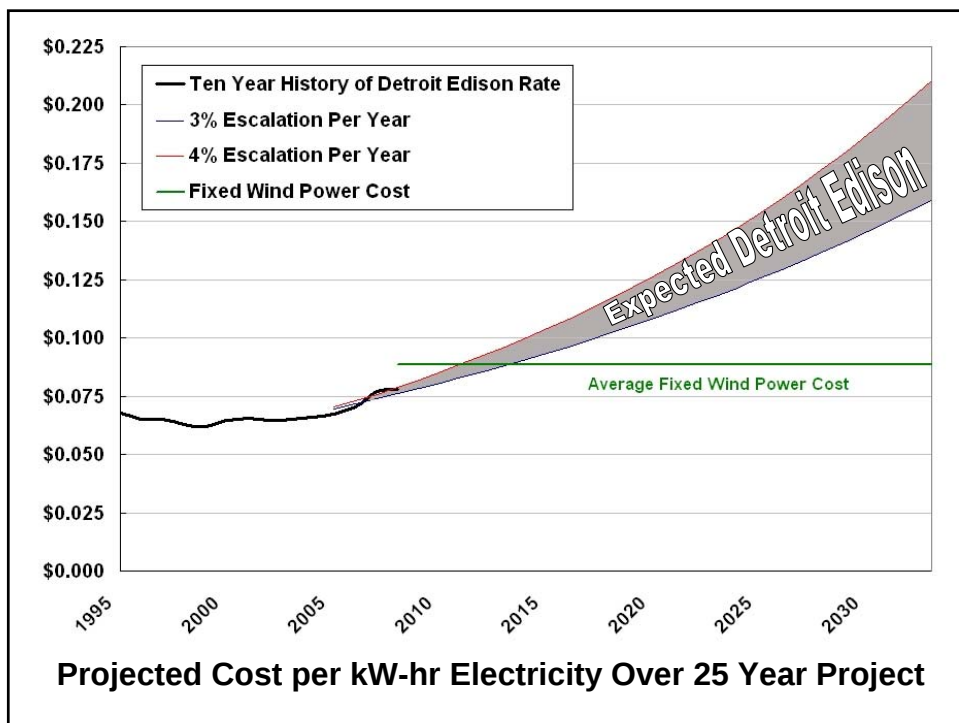
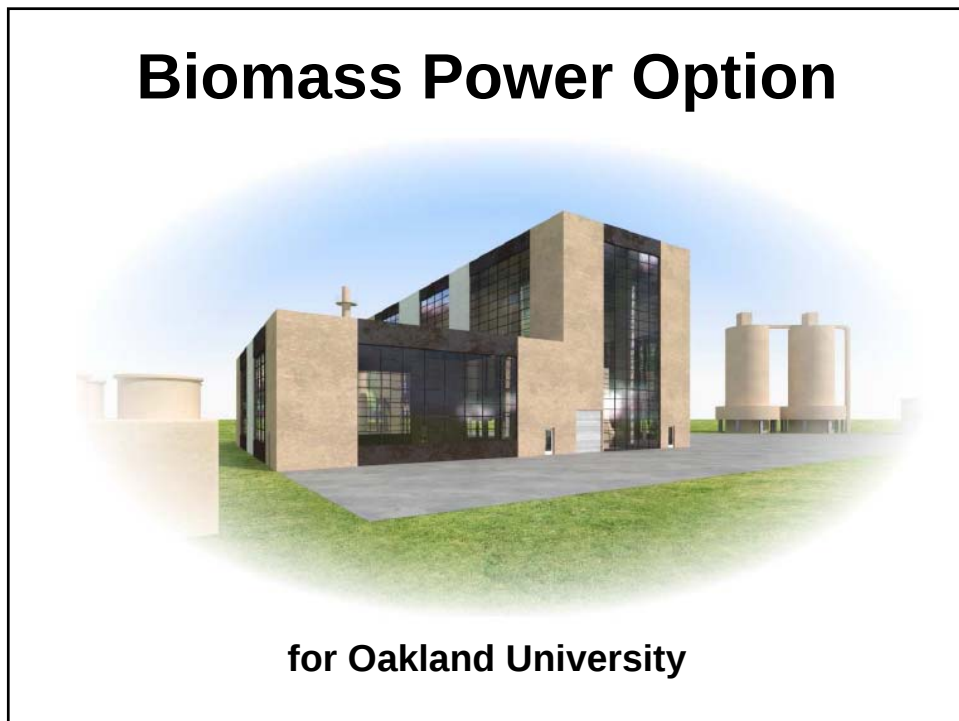
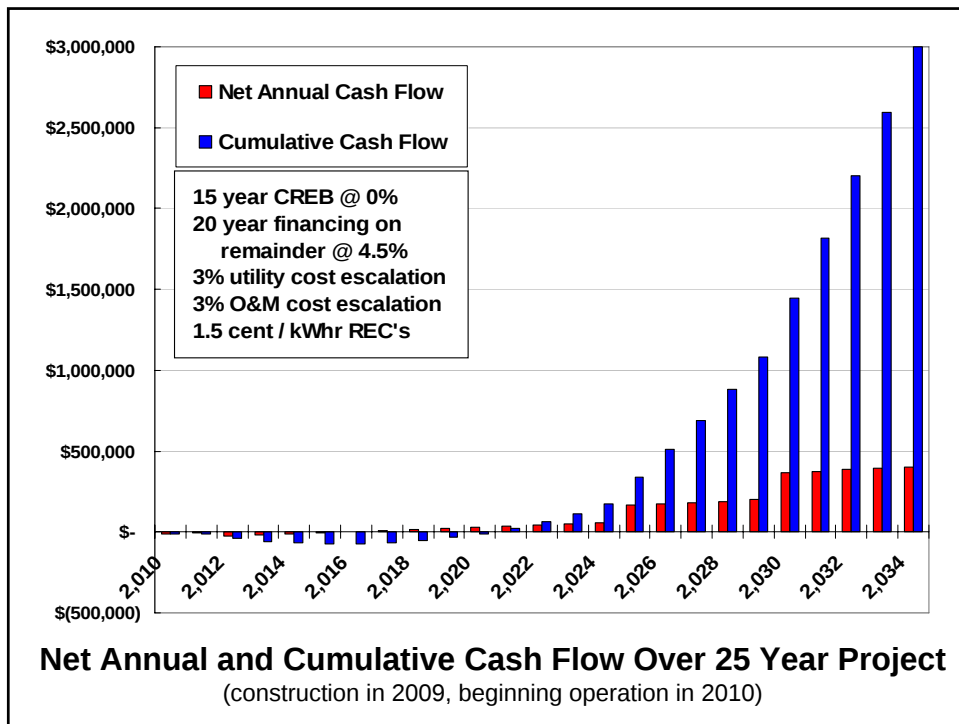
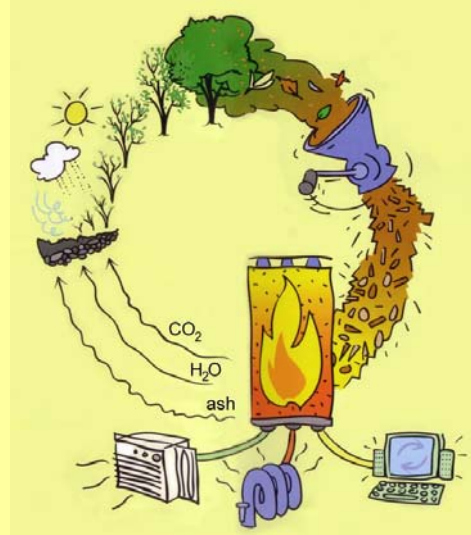


Illustration of turbine components

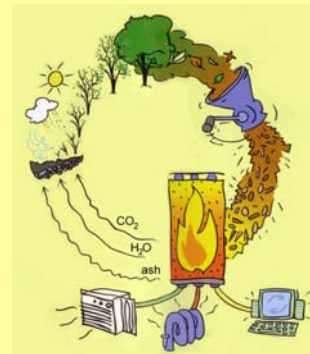




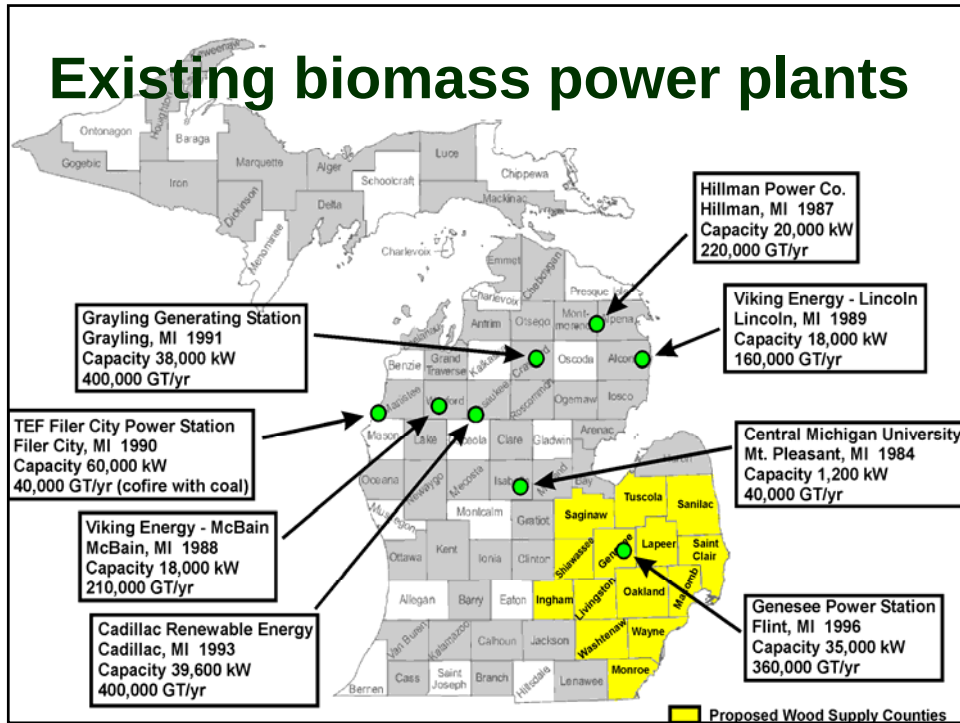
- Wood supply
- Campus growth & future needs
- Wood boilers
- Proposed sites
- Costs & savings



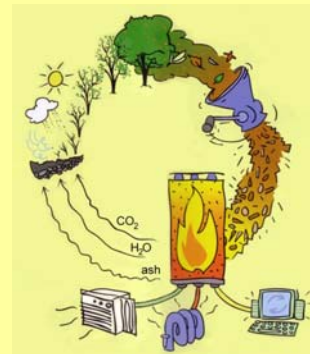
**We looked at 14
counties in SE
Michigan & found
1.7 million tons of
urban waste
wood per year**



Existing biomass power plants



Nearby wood
recyclers could
easily serve the
new system





J.h. **Hart** 
urban
FORESTRY







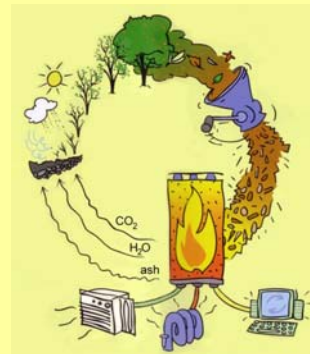
CMU Wood Boiler Plant

**(heats
most of
campus)**

(note: only water vapor
is coming from stack)
photo - Jim Leidel 2005

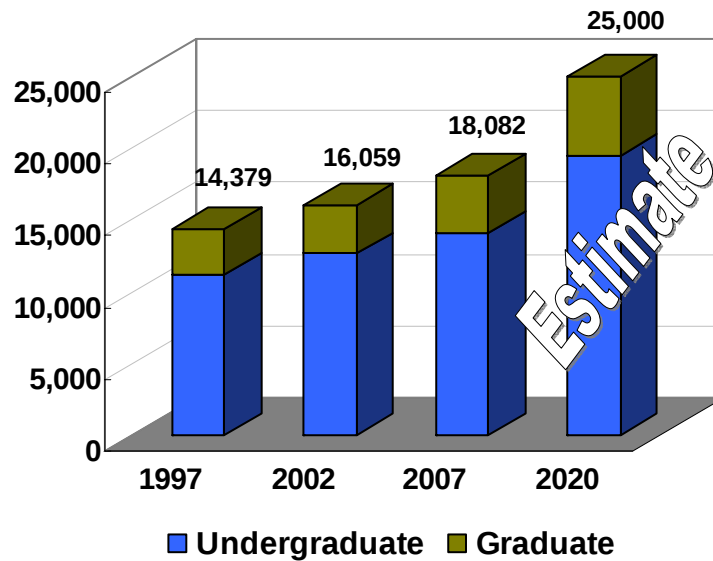
**Next we look at
the future needs
for campus:**

- 1. Replace aging
boilers**
- 2. More capacity
for future growth**

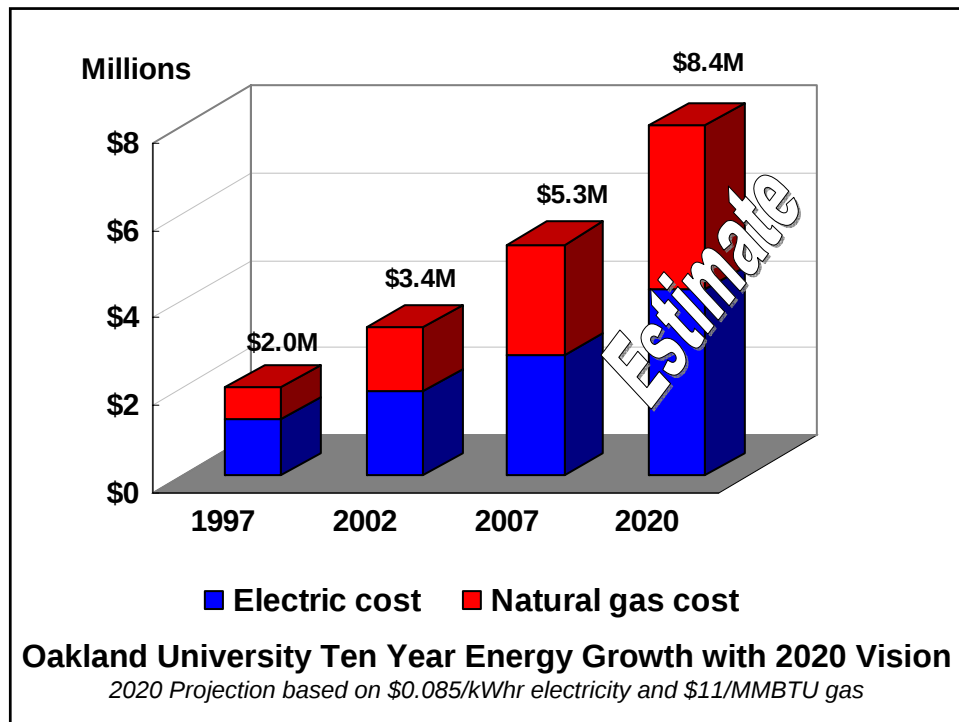


Existing Central Heating Plant

Unit	Capacity (MMBTU/hr)	Year Installed	Age in years / Condition
B-1	100	1969	39 / good
B-2	100	1969	39 / good
B-3	34	1959	49 / fair
B-4	32	1957	51 / marginal
Total	265		



Oakland University Ten Year Fall Enrollment Growth with 2020 Vision



**We then looked
at various wood
boiler systems**

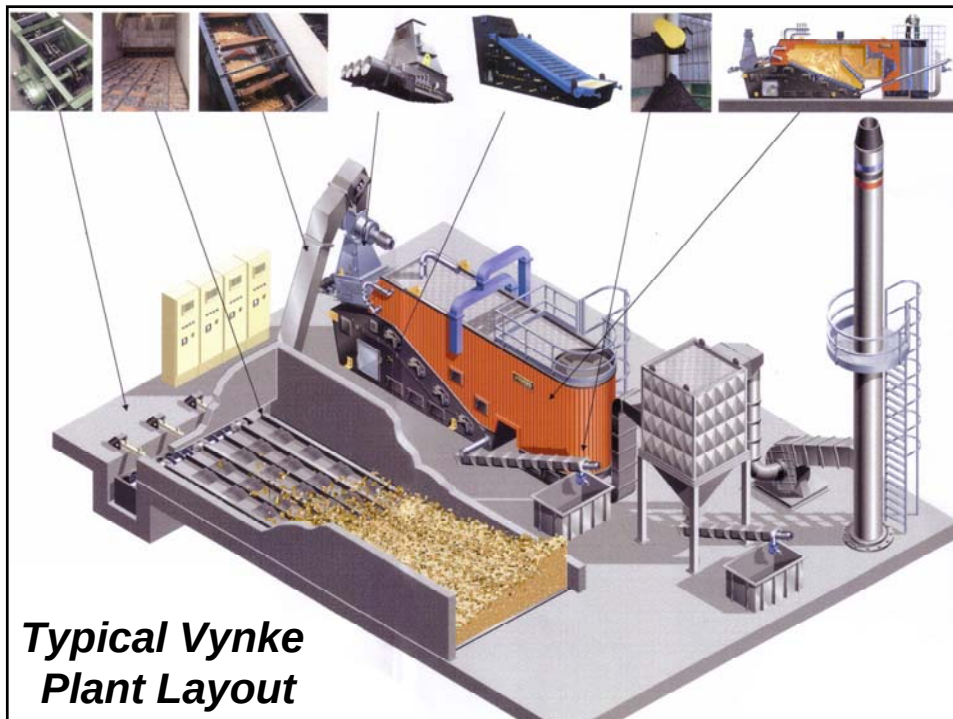


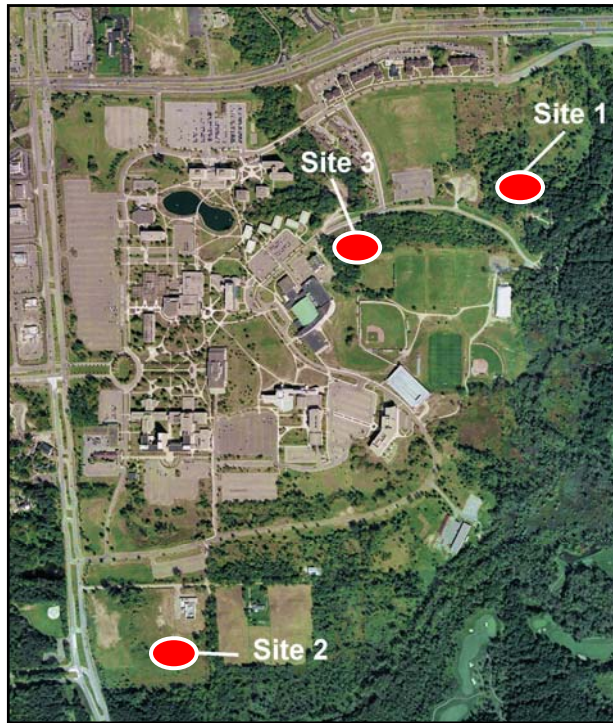
EPI Fluid Bed
(Steam & HW)

English Stoker
(Steam & HW)

Hurst Stoker
(HW Only)

Vynke Stoker
(Steam & HW)





***Three
Proposed
Site
Locations***



Artist's Renderings

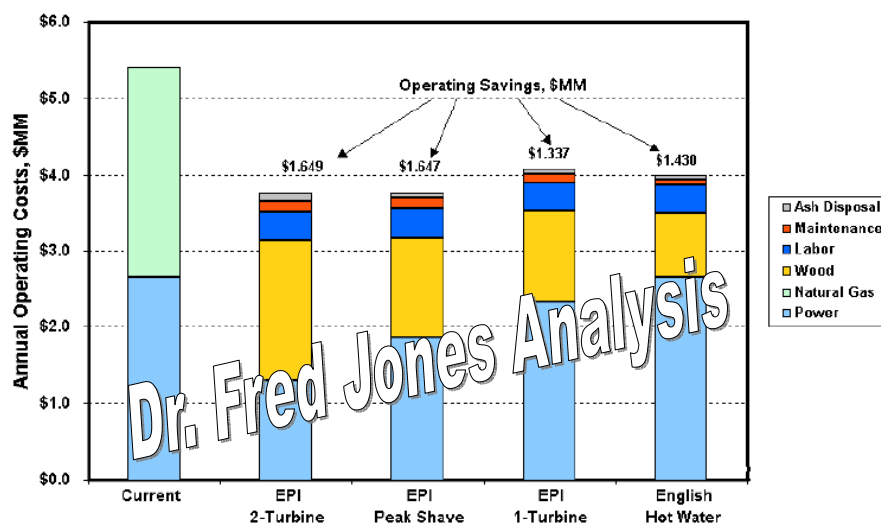


***A new wood storage building
(in Kingsville, Ontario) 80 MMBTU/hr***

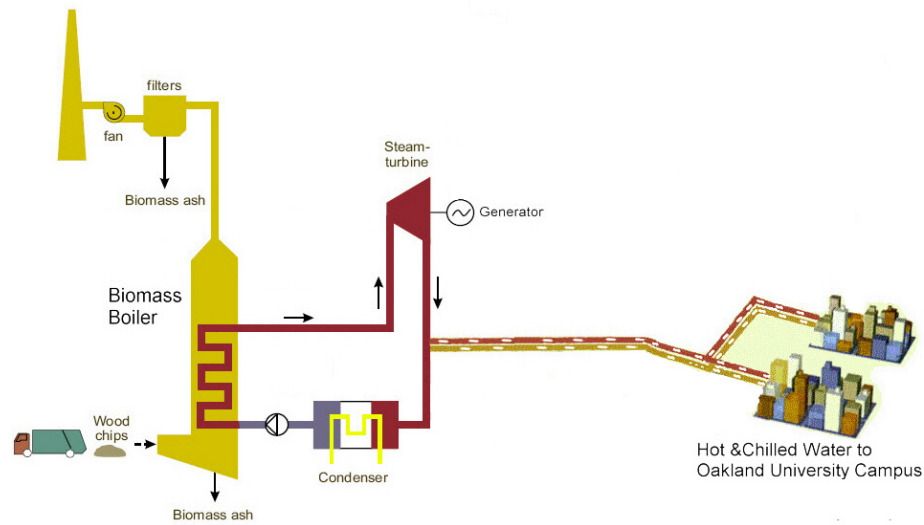
Annual operating savings are in the range of \$1.5 million



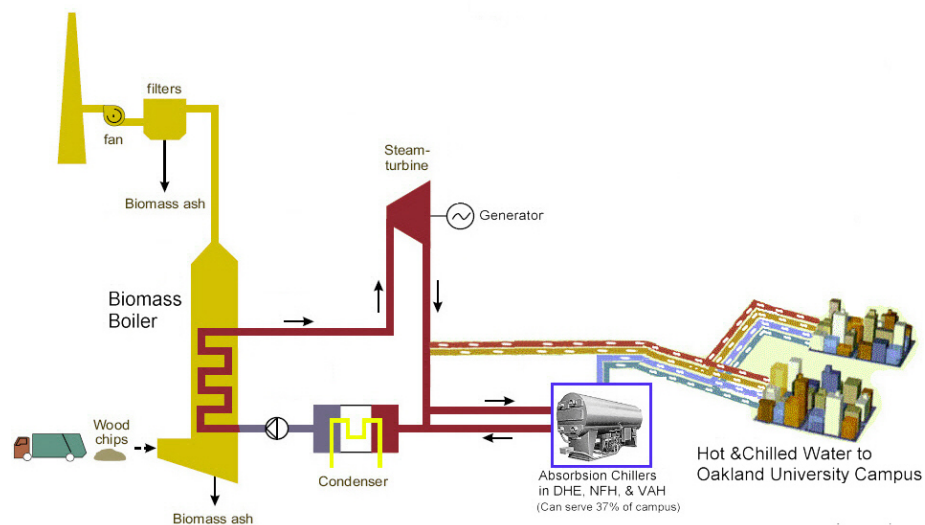
Operating Cost Estimates



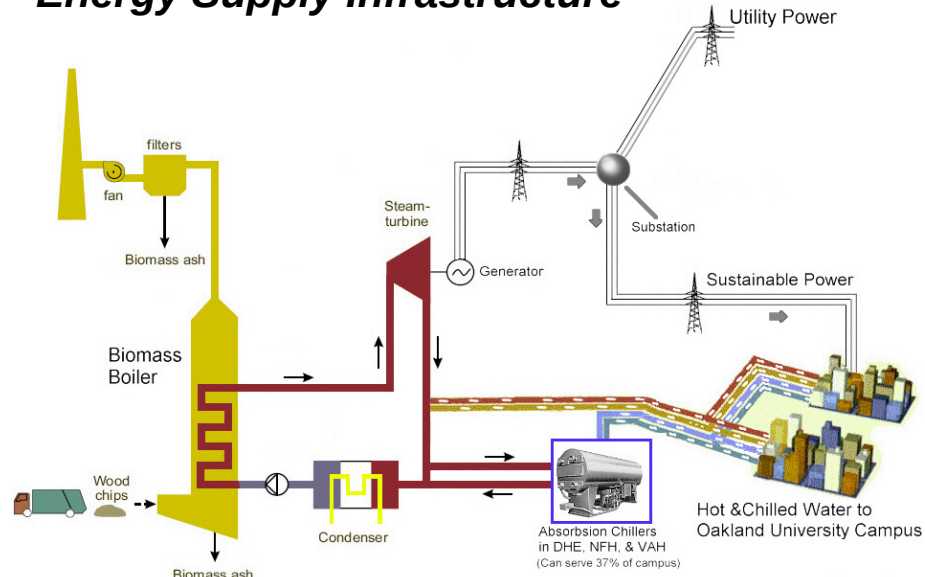
Overview of an Integrated, Renewable Energy Supply Infrastructure



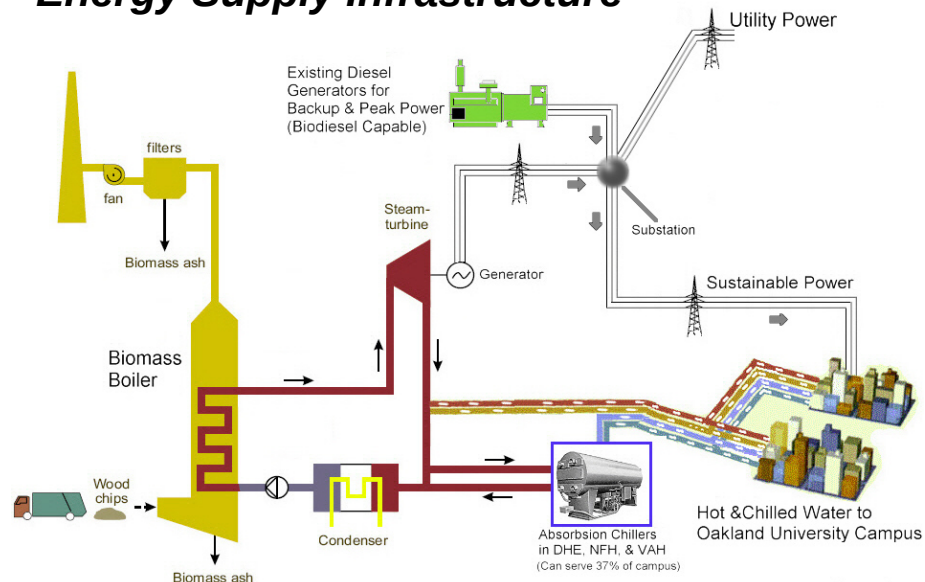
Overview of an Integrated, Renewable Energy Supply Infrastructure



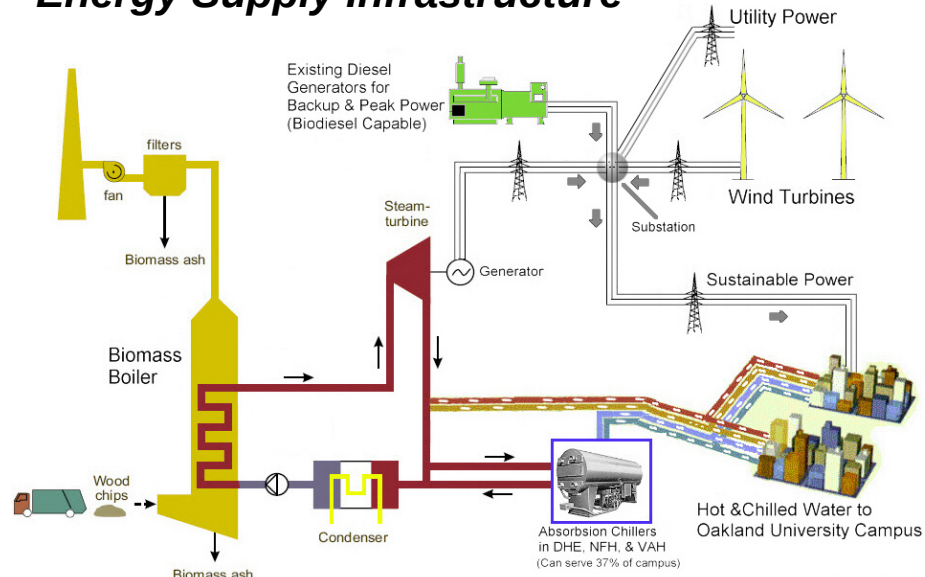
Overview of an Integrated, Renewable Energy Supply Infrastructure



Overview of an Integrated, Renewable Energy Supply Infrastructure



Overview of an Integrated, Renewable Energy Supply Infrastructure

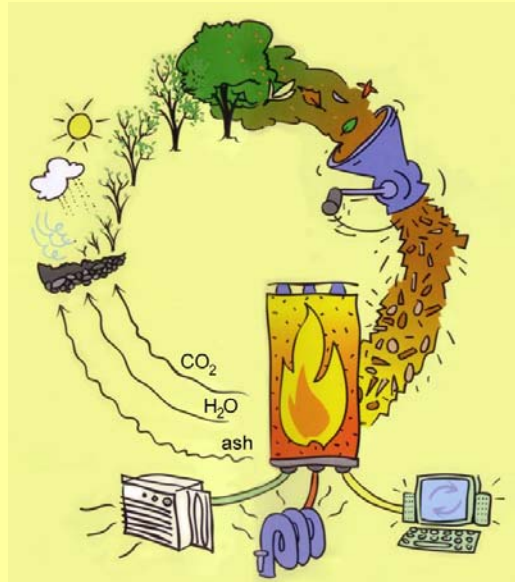


Overview of an Integrated Renewable Energy Supply Infrastructure

	Existing Fossil Fuel Mix		Proposed Renewable Energy	
	Thermal (Heating)	Electrical	Thermal (Heating)	Electrical
Central Heating Plant (natural gas)	100%		20%	
Detroit Edison		95%		20%
Diesel Generators		5%		10%
Biomass Boiler Plant			80%	50%
Wind Power				20%
Totals	100%	100%	100%	100%

Biomass & Wind Power

Sustainable Energy Options for the Future of Oakland University



For more info visit www.oakland.edu/energy

OU Energy - Mozilla Firefox

File Edit View Go Bookmarks Yahoo! Tools Help

http://www.oakland.edu/energy/

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New! Fall 2006 Energy & the Environment

Energy Management

at Oakland University, Facilities Management

BIODIESEL **Students, Get Involved !!** (click here)

OU's Investigations into Wind Power

Oakland University will be investigating local wind power resources on campus with the installation of a 50 meter tall, wind sensor tower. It will be located several hundred yards south of Pioneer Drive, near Squirrel Road. Please visit [Alternative Energy Solutions](#) web site for more information and a [press release](#).

Also, for information on wind power in Michigan and elsewhere, [click here....](#)

University Energy Usage & Cost

Take a look at the historical usage and cost of the west campus utilities over the past decade. **About \$275 is spent each year per Full Year Equivalent Student.** This equates to 5 to 6% of a full time student's tuition. (based on 16 credit hours for two semesters) [more info...](#)

University Energy Purchasing

[Click here](#) to learn more on how Oakland University spends its \$5 million dollars each year to heat, cool, and power our fine institution.

OU Photovoltaic - Solar Electric Roof

OU was recently installed a 10kW photovoltaic demonstration project on the roof of the student apartment Community Building. The produced electricity from 500 Uni-Solar PV shingles and is tied directly to the University electrical grid.. [Click here for more information...](#)

Green Computing Guide

[Click here](#)

Does Michigan have a plan for renewable energy?

[Click here](#)

Home Energy Saving Tips

[Click here to activate your monitor sleep mode...](#) (will not work on NT)

Newsletters

- Dec 2003 Issue 1
- Jan 2004 Issue 2
- Spring 04 Issue 3
- Winter 04 Issue 4
- Fall 2005 Issue 5

Links