• Wood supply
• Campus growth & future needs
• Wood boilers
• Proposed sites
• Costs & savings
• Funding
• Recommendations
CMU Wood Boiler Plant

(note: only water vapor is coming from stack)

photo - Jim Leidel 2005
## Existing Central Heating Plant

<table>
<thead>
<tr>
<th>Unit</th>
<th>Capacity (MMBTU/hr)</th>
<th>Year Installed</th>
<th>Age in years / Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-1</td>
<td>100</td>
<td>1969</td>
<td>39 / good</td>
</tr>
<tr>
<td>B-2</td>
<td>100</td>
<td>1969</td>
<td>39 / good</td>
</tr>
<tr>
<td>B-3</td>
<td>34</td>
<td>1959</td>
<td>49 / fair</td>
</tr>
<tr>
<td>B-4</td>
<td>32</td>
<td>1957</td>
<td>51 / marginal</td>
</tr>
<tr>
<td>Total</td>
<td>265</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Oakland University Ten Year Fall Enrollment Growth with 2020 Vision
Oakland University Ten Year Energy Growth with 2020 Vision

2020 Projection based on $0.085/kWhr electricity and $11/MMBTU gas
EPI Fluid Bed
(Steam & HW)

English Stoker
(Steam & HW)

Hurst Stoker
(HW Only)

Vynke Stoker
(Steam & HW)
Typical Vynke Plant Layout
Three Proposed Site Locations
## Estimated Project Budget for Site Two

### Site #2 at Spencer Substation

<table>
<thead>
<tr>
<th>Construction Costs:</th>
<th>Feet</th>
<th>Cost/ft</th>
<th>Cost</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>HTHW connection</td>
<td>1,200</td>
<td>$2,750</td>
<td>$3,300,000</td>
<td></td>
</tr>
<tr>
<td>13.2kV electric connection</td>
<td>300</td>
<td>$250</td>
<td>$75,000</td>
<td></td>
</tr>
<tr>
<td>Sitework: development, parking, etc…</td>
<td></td>
<td></td>
<td>$1,000,000</td>
<td>allowance</td>
</tr>
<tr>
<td>Roadways</td>
<td>1,300</td>
<td></td>
<td>$2,250,000</td>
<td>estimate based on comparison to site #1 estimate</td>
</tr>
<tr>
<td>Storm water relocation</td>
<td></td>
<td></td>
<td>$-</td>
<td></td>
</tr>
<tr>
<td>Boiler Plant</td>
<td></td>
<td></td>
<td>$25,540,000</td>
<td>EPI fluidized bed with steam cogeneration option</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td></td>
<td></td>
<td>$32,165,000</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Owner Costs:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permits &amp; agency reviews</td>
</tr>
<tr>
<td>Construction contingency</td>
</tr>
<tr>
<td>Contractor fees, general conditions, insurance</td>
</tr>
<tr>
<td><strong>Construction Subtotal</strong></td>
</tr>
</tbody>
</table>

| Total Project Cost                                                        | $43,870,745 |
Operating Cost Estimates

Operating Savings, $MM

Annual Operating Costs, $MM

Current: $5.00
EPI 2-Turbine: $1.649
EPI Peak Shave: $1.647
EPI 1-Turbine: $1.337
English Hot Water: $1.430

- Ash Disposal
- Maintenance
- Labor
- Wood
- Natural Gas
- Power
**Estimated Payback**

Biomass boiler plant $43.9M

Avoided cost for existing B-4 ($ 3.0M)
Avoided cost for oil system ($ 1.3M)

Net biomass boiler plant cost $40.3M

Net annual operating costs $ 1.7M

Simple Payback 23-24 yrs
Overview of an Integrated, Renewable Energy Supply Infrastructure

Biomass Boiler

Wood chips

Biomass ash

filters

fan

Biomass ash

Steam-turbine

Generator

Condenser

Hot & Chilled Water to Oakland University Campus
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 Diesel Generators for Backup & Peak Power (Biodiesel Capable)

Biomass Boiler

Wood chips

Biomass ash

Filtration

Steampower

Generator

Substation

Wind Turbines

Sustainable Power

Absorption Chillers in DHE, NFH, & VAH (Can serve 37% of campus)

Hot & Chilled Water to Oakland University Campus
# Overview of an Integrated Renewable Energy Supply Infrastructure

<table>
<thead>
<tr>
<th></th>
<th>Existing Fossil Fuel Mix</th>
<th>Proposed Renewable Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Thermal (Heating)</td>
<td>Electrical (Heating)</td>
</tr>
<tr>
<td>Central Heating Plant (natural gas)</td>
<td>100%</td>
<td>20%</td>
</tr>
<tr>
<td>Detroit Edison</td>
<td>95%</td>
<td>20%</td>
</tr>
<tr>
<td>Diesel Generators</td>
<td>5%</td>
<td>10%</td>
</tr>
<tr>
<td>Biomass Boiler Plant</td>
<td>80%</td>
<td>50%</td>
</tr>
<tr>
<td>Wind Power</td>
<td></td>
<td>20%</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>
Proposed Funding Sources

1. Issue 15 to 20 year bonds
2. Seek partners willing to enter into a third party “owned & operated” arrangement. Several potential parties have been identified that could provide this option.
Recommendations

• Select project site
• Select financing method
• Solicit bids for design/build contractor
• Begin the detailed engineering for the boiler plant, building, roadways, and utility interconnections to the selected site
• Begin permitting process
• Establish a utility interconnection agreement
Biomass Power
A Sustainable Energy Option for the Future of Oakland University