WHAT IS ENERGY COSTING YOU?
An overview of the Michigan Wood Energy Calculator

Jessica Simons
April 30, 2014
Heating the Midwest Conference - Green Bay, WI
PREVIOUS WORK

2005 SE MICHIGAN WOOD RESIDUE STUDY
(Sherrill and MacFarlane 2007)
2,600 companies
7.5 M cu yd/yr
=354 football fields 10 ft deep
Disposal cost = $8.8 M
28% landfilled

2009 SE MICHIGAN WOOD YARD SURVEY
(Nzokou 2009)
180 yards = $40M/yr
Only 30% recycled
Project Lead: CTA Architects & Engineers

2007 GOALS:
- Explored small institutional/commercial biomass conversion projects
- Identified 2,300 MI boilers w/est payback <20 yrs
- Conducted feasibility studies

Project Lead: Wilson Engineering Systems

2012-2014 GOALS:
- Revisited Michigan boiler list; called priority sites
- Used same methodology across 35 states
- In process of conducting feasibility studies
www.michiganwoodenergy.org

MICHIGAN WOOD ENERGY
a smart fuel choice

Is wood fuel right for your boiler?
- Calculate Costs
- Learn More

WOOD
The local, clean, renewable, affordable, sustainable fuel choice.
Exploring Woody Biomass Retrofit Opportunities In Michigan Boiler Operations

9/28/2007

The Southeast Michigan RC&D Council selected a team of experts (CTA Architects Engineers, Emergent Solutions, Christopher Allen + Associates, Loracs Creations, and Geodata) to provide a statewide assessment of the potential to integrate wood-fired boiler systems into existing facilities throughout the State of Michigan.

Their final report, Exploring Woody Biomass Retrofit Opportunities In Michigan Boiler Operations, includes analysis and conclusions that may help guide strategic wood energy developments statewide. Key features of the report include discussions of the following:

- Recent biomass utilization studies and successful retrofit projects
- Probable costs, savings, and simple payback scenarios for various projects
- Case studies of operational and environmental benefits

Download the Report

All are PDF files.

Final Report (1.31 MB)
Appendix A: Statewide Summaries (58 KB)
Appendix B: County Summaries (595 KB)
Appendix C: Figures Figures 1 - 5 (3.05 MB)
Figures 6 - 10 (3.11 MB)
Figures 11 - 15 (3.19 MB)
• Beginner-level exploration:
  - Simple
  - Few data points
  - Accessible

• Small commercial or institutional retrofit

• Intended as first step, prior to using engineers
• Designed for retrofit of traditional systems oversized for peak loads

• Estimates on costs and savings are based on slightly older technology (2007) than currently available

• No thermal storage options are included

• Very large or small systems can have less reliable results
EXAMPLE 1: USFS-WERC STUDY SITE - PA SCHOOL

Wood Energy Calculator

Contact Information
E-mail
jessica.simons@semircd.org

County
Out of State

Facility Type
- Office/Retail
- Detention
- Education
- Healthcare
- Industry
- Power Production
- Residential
- Not Applicable

Boiler Size
Combined Input of Boilers Currently in Facility
8,400,000 (in BTUs)

Fuel Information
- Price of Current Fuel
  - 2.95 ($ per gallon)
- Annual Use of Current Fuel
  - 63,500 (in gallons)
- Projected Price of Wood Fuel
  - 40 ($ per green ton)

Current Fuel Type
- Coal
- Electrical
- Fuel Oil
- Natural Gas
- Propane

Financing
Projected Interest Rate
5 (%)
**Michigan Wood Energy Report**

**Estimated Total Project Cost:** $936,600.00  
**Simple Payback:** 6.8 years

### Project Financing Information

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent Financed</td>
<td>100%</td>
</tr>
<tr>
<td>Amount Financed</td>
<td>$936,600.00</td>
</tr>
<tr>
<td>Amount of Grants</td>
<td>$0.00</td>
</tr>
<tr>
<td>Interest Rate</td>
<td>5%</td>
</tr>
<tr>
<td>Term</td>
<td>10 Years</td>
</tr>
<tr>
<td>Annual Finance Cost - Principal and Interest</td>
<td>$121,294.00</td>
</tr>
</tbody>
</table>

### Annual Project Costs

<table>
<thead>
<tr>
<th>Cash Flow Descriptions</th>
<th>Unit Costs</th>
<th>Fuel Source Proportion</th>
<th>Annual Fuel Quantities</th>
<th>Fuel Units</th>
<th>Year 1 Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing Fuel (fuel oil)</td>
<td>$2.95</td>
<td></td>
<td>63,500.00</td>
<td>gallon</td>
<td>$187,325.00</td>
</tr>
</tbody>
</table>

**Estimated Proposed Wood-Fired System Annual Costs**

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit Costs</th>
<th>Fuel Source Proportion</th>
<th>Annual Fuel Quantities</th>
<th>Fuel Units</th>
<th>Year 1 Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood Fuel (chips)</td>
<td>$40.00</td>
<td>95%</td>
<td>953</td>
<td>ton</td>
<td>$38,120.00</td>
</tr>
<tr>
<td>Existing Fuel</td>
<td>$2.95</td>
<td>5%</td>
<td>3,175.00</td>
<td>gallon</td>
<td>$9,366.00</td>
</tr>
<tr>
<td>Additional Operation and Maintenance Costs</td>
<td>$2,000.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Proposed Annual Costs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$50,486.00</td>
</tr>
</tbody>
</table>

**Annual Cost Savings**

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Cost Savings</td>
<td>$136,839.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Finance Cost - Principal and Interest</td>
<td>$121,294.00</td>
</tr>
<tr>
<td>Net Annual Cash Flow</td>
<td>$15,545.00</td>
</tr>
</tbody>
</table>
### Example 1: USFS-WERC Study Site - PA School

#### Site Details:
- 8.4 mm BTU boiler
- 63.5K gal fuel oil/yr
- $2.95/gal oil - $40/ton wood

<table>
<thead>
<tr>
<th></th>
<th>Preliminary Feasibility Report*</th>
<th>MWE Calculator Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Project Cost</td>
<td>$1.3 M</td>
<td>$936K</td>
</tr>
<tr>
<td>Simple Payback</td>
<td>10.8 years</td>
<td>6.8 years</td>
</tr>
<tr>
<td>Existing Fuel Cost</td>
<td>$187K</td>
<td>$187K</td>
</tr>
<tr>
<td>Proposed Annual Fuel Cost</td>
<td>$75K</td>
<td>$50.5K</td>
</tr>
<tr>
<td>Annual Savings</td>
<td>$122K</td>
<td>$137K</td>
</tr>
<tr>
<td>Annual Cash Flow</td>
<td>$3K</td>
<td>$15.5K</td>
</tr>
</tbody>
</table>

Data from: USDA Forest Service Preliminary Feasibility Report
Penns Manor Area School District - November 2011
Yellow Wood Associates, Inc.
http://na.fs.fed.us/werc/woody_biomass/
Assumptions

Some standard values were used to make this calculation. These figures are likely to be suitable for your project; however, a site with different values may have a less reliable report. The following assumptions were used:

- Amount of grants: $0.00
- Term of financing: 10 years
- Wood fuel type = chips for systems > 3,000,000.00 btu
- Wood fuel type = pellets for systems <= 3,000,000.00 btu
- Proportion of wood fuel use in new system: 95%
- Proportion of existing fuel use in new system: 5%

[Note: Wood boiler sizes are assumed to be half of the size of existing boilers to maximize efficiency. This size is optimal for meeting the needs of 90-95% of a typical heat load. Existing fossil fuel boilers, which are generally oversized, can still be used to meet infrequent peak load conditions.]

The information provided by the Wood Energy Calculator is a preliminary assessment and should not be used to develop actual project plans. Projected costs and savings are only estimates; no guarantee of actual expenses or benefits is implied.

Projects in Livingston, Macomb, Monroe, Oakland, Saint Clair, Washtenaw, and Wayne Counties are subject to PM-2.5 EPA non-attainment area standards. In most cases, additional air quality measures are required in this region and will likely result in higher costs.

Please see the FAQs and Interpreting Your Results for more information.
A guide is included in all reports to assist users with interpreting results and understanding definitions, such as:

**SIMPLE PAYBACK =**

$(Time\ needed\ to\ pay\ off\ system\ through\ cost\ savings\ alone.)$

Estimated total project cost
Annual cost savings

**NET CASH FLOW =**

Annual cost savings - Annual finance cost
**EXAMPLE 2: Pharma Facility - Ann Arbor, MI**

<table>
<thead>
<tr>
<th>SITE DETAILS:</th>
<th>48.5 mm BTU boiler</th>
<th>42.5K dth natural gas</th>
<th>$35/ton wood</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$4.50/dth</td>
<td>$6/dth</td>
<td>$13/dth</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Total Project Cost</th>
<th>$2.1 M</th>
<th>$2.1 M</th>
<th>$2.1 M</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simple Payback</td>
<td>203 years</td>
<td>30 years</td>
<td>6 years</td>
<td></td>
</tr>
<tr>
<td>Existing Fuel Cost</td>
<td>$191K</td>
<td>$255K</td>
<td>$552.5K</td>
<td></td>
</tr>
<tr>
<td>Proposed Annual Fuel Cost</td>
<td>$181K</td>
<td>$184K</td>
<td>$199K</td>
<td></td>
</tr>
<tr>
<td>Annual Savings</td>
<td>$10.5K</td>
<td>$71K</td>
<td>$354K</td>
<td></td>
</tr>
<tr>
<td>Annual Cash Flow</td>
<td>($267K)</td>
<td>($207K)</td>
<td>$76K</td>
<td></td>
</tr>
</tbody>
</table>
EXAMPLE 3: Auto Plant - Warren, MI

Wood Energy Calculator

Contact Information
- E-mail: jessica.simons@semircd.org
- County: Wayne

Facility Type
- Office/Retail
- Detention
- Education
- Healthcare
- Industry
- Power Production
- Residential
- Not Applicable

Boiler Size
- Description: Combined Input of Boilers Currently in Your Facility
- Value: 80,000,000 (in BTUs)

Current Fuel Type
- Coal
- Electrical
- Fuel Oil
- Natural Gas
- Propane

Fuel Information
- Price of Current Fuel: 3 ($ per gallon)
- Annual Use of Current Fuel: 500,000 (in gallons)
- Projected Price of Wood Fuel: 35 ($ per green ton)

Financing
- Projected Interest Rate: 5 (%)
**EXAMPLE 3: Auto Plant - Warren, MI**

<table>
<thead>
<tr>
<th><strong>Michigan Wood Energy Report</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Estimated Total Project Cost:</strong> $4,800,000.00</td>
</tr>
<tr>
<td><strong>Simple Payback:</strong> 4.2 years</td>
</tr>
</tbody>
</table>

**Project Financing Information**

<table>
<thead>
<tr>
<th>Item</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent Financed</td>
<td>100%</td>
</tr>
<tr>
<td>Amount Financed</td>
<td>$4,800,000.00</td>
</tr>
<tr>
<td>Amount of Grants</td>
<td>$0.00</td>
</tr>
<tr>
<td>Interest Rate</td>
<td>5%</td>
</tr>
<tr>
<td>Term</td>
<td>10 Years</td>
</tr>
<tr>
<td>Annual Finance Cost - Principal and Interest</td>
<td>$621,622.00</td>
</tr>
</tbody>
</table>

**Annual Project Costs**

<table>
<thead>
<tr>
<th>Cash Flow Descriptions</th>
<th>Unit Costs</th>
<th>Fuel Source Proportion</th>
<th>Annual Fuel Quantities</th>
<th>Fuel Units</th>
<th>Year 1 Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing Fuel (fuel oil)</td>
<td>$3.00</td>
<td>95%</td>
<td>500,000.00</td>
<td>gallon</td>
<td>$1,500,000.00</td>
</tr>
<tr>
<td>Estimated Proposed Wood-Fired System Annual Costs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wood Fuel (chips)</td>
<td>$35.00</td>
<td>95%</td>
<td>7505</td>
<td>ton</td>
<td>$262,675.00</td>
</tr>
<tr>
<td>Existing Fuel</td>
<td>$3.00</td>
<td>5%</td>
<td>25,000.00</td>
<td>gallon</td>
<td>$72,000.00</td>
</tr>
<tr>
<td>Additional Operation and Maintenance Costs</td>
<td>$10,000.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Proposed Annual Costs</td>
<td>$347,675.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Annual Cost Savings | $1,152,325.00 |
| Annual Finance Cost - Principal and Interest | $621,622.00 |
| Net Annual Cash Flow | $530,703.00 |

**Your Current Information**

- E-mail: jessica.simons@semicrd.org
- County: Wayne
- Facility type: Wood
- Combined boiler size: 80,000,000.00 btu
- Current fuel type: Fuel Oil
- Current fuel price: $3.00
- Annual use of current fuel: 500,000.00 gallons
- Projected wood fuel cost: $35.00 / ton chips
- Projected interest rate: 5%
What is energy costing you?

Energy costs are a huge burden to Michigan's communities. Most of the fuels used in the state are imported — 100% of the coal, 96% of the oil, and 75% of the natural gas — at a cost of $18 billion each year to our local economy.

Using wood as a biomass energy fuel source, especially where wood chips are plentiful and cheap, can be one answer for some public and private institutions. In Vermont and several Western states, many schools and public buildings use local wood wastes to fuel their facilities, lowering their fuel costs by as much as 50% while boosting the local economy in the process. Why can’t Michigan do the same?

For more information about the Michigan Wood Energy project and/or energy grant opportunities for public institutions, please contact the Southeast MI RC&D Council at 734-761-6722 x 105.
Is wood fuel right for your boiler?

michiganwoodenergy.org
- Learn more about wood energy
- Use the Wood Energy Calculator to estimate costs and benefits of switching to wood fuel
- See successful projects
- Find technical assistance and funding

See the 2007 report, *Exploring Woody Biomass Retrofit Opportunities in Michigan Boiler Operations*, which names over 2,000 institutions and industries likely to save money by switching to wood fuel. Your facility may be on the list!

Michigan's wood resources are a smart choice for affordable, renewable, & sustainable energy.

FACILITY MANAGER
BIG THREE CORP.
123 AUTO LANE
DETROIT, MI
WHAT MAKES A GOOD SITE FOR A PROJECT?

1. ↑ energy demand / ↑ fuel costs
2. Appropriate fuel selection: chips, pellets, or cordwood
3. System sized correctly for thermal load
4. Centralized heating system
5. Effective back-up heating system
6. Hot water thermal storage
7. Local sources for affordable wood fuels
8. Space for larger boiler system and fuel storage
9. Other ongoing construction or renovation plans
10. Adequate staffing for ongoing maintenance
12. Potential options for cooling with biomass
13. Other energy efficiency activities on site
14. Institutional support

Guide courtesy of USDA Forest Service Northeastern Area
WERC Wood Energy Technical Assistance Team & Wilson Engineering Services
QUESTIONS?

Please contact:
Jessica Simons
jessica.simons@semircd.org

semircd.org  verdantstewardship.com

This work has been supported by

CTA  DL&E  Forest Service  WERC  loracs design, llc

An equal opportunity provider and employer