

# Middlebury College

## Financing Carbon Neutrality

# Trustee Resolution May 2007

- the Trustees of Middlebury College support a goal of carbon neutrality by 2016 for the College's Vermont Campus as a priority of the Middlebury College community, recognizing that achievement of the goal will require a commitment of resources to achieve necessary technological and behavioral shifts;

# Our process

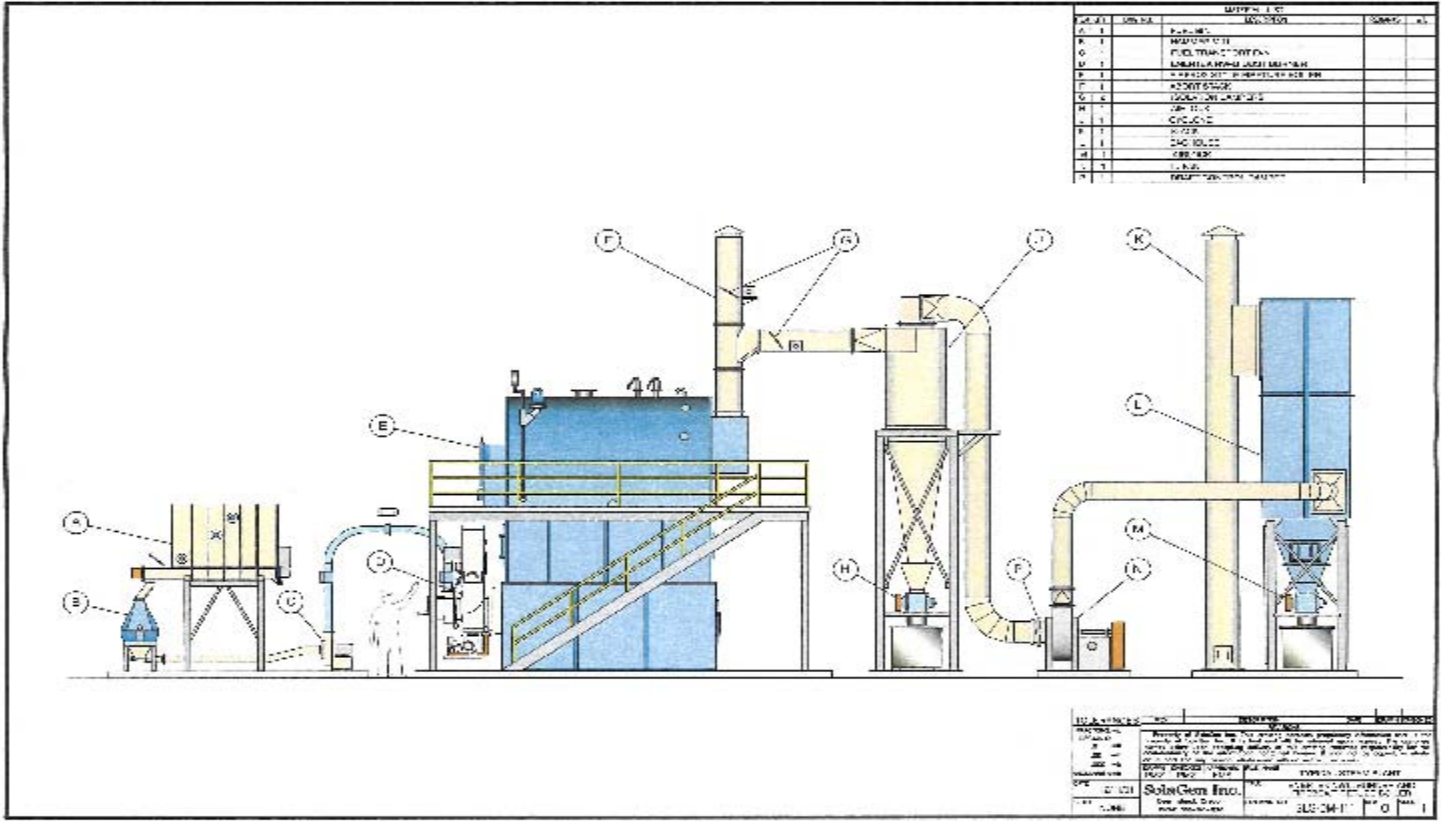
- Set the goals
- Review the options
- Create a financial model
- Research the variables
- Run the options against the model
- Select a course of act

Appendix A.

**Carbon Reduction Initiative Portfolio**

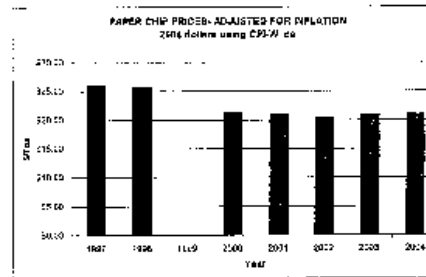
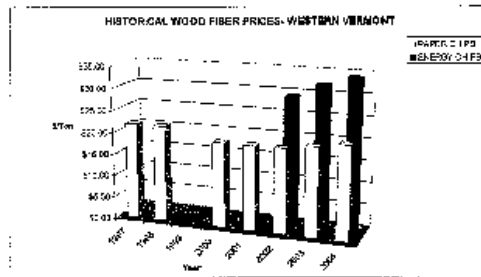
| Project                                | MTCDE               |                     | IRR        | Rate<br>15%      | Yrs.<br>Useful<br>Life | (Months)<br>Implemen-<br>tation<br>Period | Initial Investment |               | Net Project<br>Rebate<br>Cost | Pay<br>Back<br>Year 1 | Pay<br>Back<br>Year 2 | Pay<br>Back<br>Year 10 | Pay<br>Back<br>Year 25 |
|--|---------------------|---------------------|------------|------------------|------------------------|---|--------------------|---------------|-------------------------------|-----------------------|-----------------------|------------------------|------------------------|
|  | Carbon<br>Reduction | Over<br>Useful Life |            |                  |                        |   | Year 0             | Year 0        |                               |                       |                       |                        |                        |
| <b>EDUCATION &amp; OUTREACH</b>        |                     |                     |            |                  |                        |   |                    |               |                               |                       |                       |                        |                        |
| Electricity Conserv. (Res.)            | 44                  | 440                 | 1383%      | \$93,153         | 10                     | 1   | (4,000)            | 0             | (4,000)                       | \$55,817              | \$47,529              |                        |                        |
| Computer Use Education                 | 29                  | 290                 | 3675000%   | 212,817          | 10                     | 0   | (1)                | 0             | (1)                           | \$36,750              | \$36,750              | \$36,750               |                        |
| Waste Audit (on-site)                  | 30                  | 300                 |            | (3,284)          | 10                     |   | (1,910)            |               | (1,910)                       | (372)                 | (372)                 | (372)                  |                        |
| Commuter Incentives                    | 130                 | 1,300               |            | (1)              | 10                     | 6   | (1)                |               | (1)                           |                       |                       |                        |                        |
| Rideboard                              | 3                   | 30                  |            | (2,509)          | 10                     | 6   | (3,000)            |               | (3,000)                       | \$0.00                | \$0.00                |                        |                        |
| Student Position                       | 0                   | 0                   |            |                  | 10                     | 1   | (3,544)            | 0             | (3,544)                       | (3,544)               | (3,544)               |                        |                        |
| <b>INFRASTRUCTURE</b>                  |                     |                     |            |                  |                        |   |                    |               |                               |                       |                       |                        |                        |
| CFL replacements                       | 50                  | 500                 | 88%        | 24,900           | 10                     | 1   | (17,370)           | \$9,000       | (8,370)                       | \$7,484               | \$7,484               | \$5,238                |                        |
| Vending Meters                         | 3                   | 30                  | 87%        | 12,904           | 10                     | 1   | (5,907)            | 1,485         | (4,422)                       | 3,838                 | 3,838                 | 3,838                  |                        |
| Gator Replacements                     | 28                  | 280                 |            | (23,611)         | 10                     | 10  | (2,540)            | 0             | (2,540)                       | (52,840.00)           | (53,140.00)           | (54,640.00)            |                        |
| Electric Golf Cart Replacements        | 23                  | 230                 |            | (4,435)          | 10                     | 10  | (5,100)            | 0             | (5,100)                       | \$0.00                |                       |                        |                        |
| <b>INSTITUTIONAL CHANGES</b>           |                     |                     |            |                  |                        |   |                    |               |                               |                       |                       |                        |                        |
| Printing Quota - 10% reduction         | 2                   | 20                  | 611%       | 103,554          | 10                     | 0   | (3,000)            | 0             | (3,000)                       | \$18,330.00           | \$18,330.00           | \$18,330.00            |                        |
| Break Shuttles                         | 30                  | 300                 | 30%        | 567              | 10                     | 0   | (5,000)            |               | (5,000)                       | \$8,500.00            |                       |                        |                        |
| Thermostat Adjustment                  | 459                 | 22,850              | 4000000%   | 231,669          | 10                     | 1   | (1)                | 0             | (1)                           | \$40,000.00           | \$40,000.00           | \$40,000.00            |                        |
| <b>OFFSETS</b>                         |                     |                     |            |                  |                        |   |                    |               |                               |                       |                       |                        |                        |
| Landfill Gas To Energy (LFGTE)         | 6,000               | 150,000             | 29%        | \$45,345         | 25                     | 18-24                                     | (65,000)           | 0             | (65,000)                      | 18,900                | 18,900                | 18,900                 | 18,900                 |
| Dairy Manure to Natural Gas Fuel       | 2,000               | 50,000              | 27%        | 286,371          | 25                     | 6   | (400,000)          |               | (400,000)                     | 109,500               | 109,500               | 109,500                | 109,500                |
| <b>Short-Term Portfolio Subtotal</b>   | <b>8,841</b>        | <b>226,770</b>      | <b>53%</b> | <b>\$984,085</b> |                        |   | <b>(518,374)</b>   | <b>10,485</b> | <b>(505,889)</b>              | <b>290,463</b>        | <b>275,275</b>        | <b>227,545</b>         | <b>128,400</b>         |
| <b>FURTHER RESEARCH</b>                |                     |                     |            |                  |                        |   |                    |               |                               |                       |                       |                        |                        |
| Solar Water Heating                    |                     |                     |            |                  |                        |   |                    |               |                               |                       |                       |                        |                        |
| Dorm Efficiency (ie. Windows)          |                     |                     |            |                  |                        |   |                    |               |                               |                       |                       |                        |                        |
| Biomass Switch                         | 22,000              | 550,000             | 32%        | 2,025,508        | 25                     | 36  | (2,000,000)        |               | (2,000,000)                   | \$650,000.00          | \$650,000.00          | \$650,000.00           | \$650,000.00           |
| Biomass Supplement                     | 11,000              | 275,000             | 32%        | 1,012,754        | 25                     | 36  | (1,000,000)        |               | (1,000,000)                   | \$325,000.00          | \$325,000.00          | \$325,000.00           | \$325,000.00           |
| <b>Short-Term + Biomass Switch</b>     | <b>30,841</b>       | <b>776,770</b>      | <b>36%</b> | <b>2,989,594</b> |                        |   | <b>(2,518,374)</b> | <b>10,485</b> | <b>(2,505,889)</b>            | <b>940,463</b>        | <b>925,275</b>        | <b>877,545</b>         | <b>778,400</b>         |
| <b>Short-Term + Biomass Supplement</b> | <b>19,841</b>       | <b>501,770</b>      | <b>39%</b> | <b>1,976,839</b> |                        |   | <b>(1,518,374)</b> | <b>10,485</b> | <b>(1,505,889)</b>            | <b>615,463</b>        | <b>600,275</b>        | <b>552,545</b>         | <b>453,400</b>         |

# BIOMASS PLANT



# Research on Historic Pricing

## Historical Chip Prices



- IP has held market power for a long time, but ...
- Current prices are recovering to historical real prices.

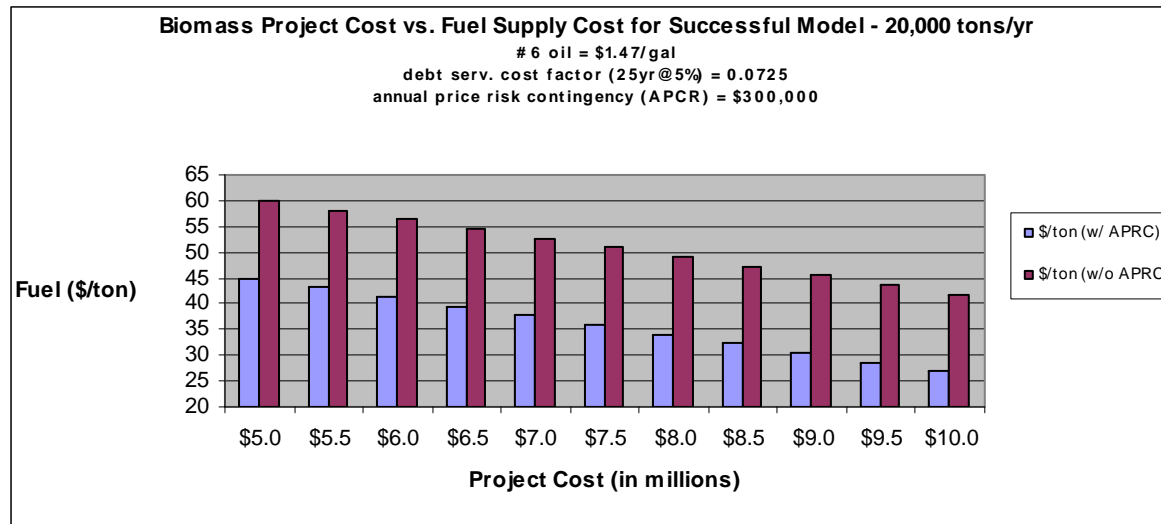
# BIOMASS PROJECT FINANCIAL MODELING WORKSHEET 3/17/2006

|  |              |
|--|--------------|
| Biomass BTU/ # (45% moisture hardwood)                 | 4595         |
| #6 Oil BTU/Gal   | 150,000      |
| Gallons of #6 Oil / Ton of Biomass thru Chiptec System | 54           |
| Project Capital Cost                                   | \$11,000,000 |
| #6 Oil Current \$/Gallon                               | \$1.45       |
| Biomass \$/Ton   | \$35.00      |
| Annual Biomass Consumption (tons)                      | 25,000       |
| Annual Oil Consumption Avoided (gallons)               | 1,350,000    |
| Annual MTCDE Avoided                                   | 15,122       |
| Annual Avoided Oil Cost                                | \$1,957,500  |
| Annual Price Risk Contingency                          | \$300,000    |
| Annual Plant O&M                                       | \$25,000     |
| Debt Service Cost Factor (25 yr., 5% interest)         | 0.0725       |
| <hr/>  |              |
| Biomass \$/Ton Required (inputs = yellow)              | \$33.40      |

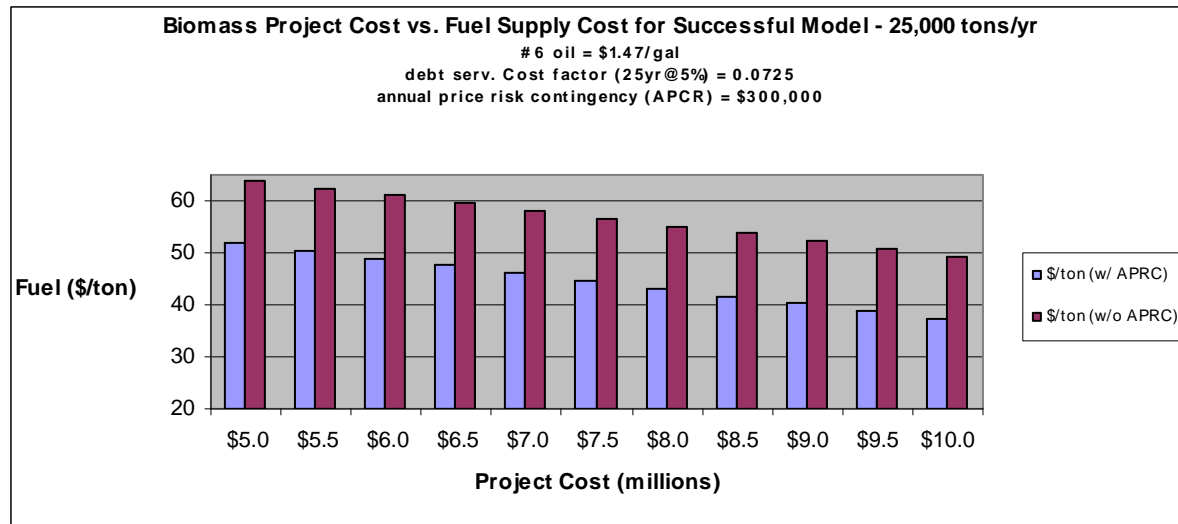
# BIOMASS PROJECT FINANCIAL MODELING WORKSHEET 10/20/2008

|  |              |
|--|--------------|
| Biomass BTU/ # (45% moisture hardwood)                 | 4595         |
| #6 Oil BTU/Gal   | 150,000      |
| Gallons of #6 Oil / Ton of Biomass thru Chiptec System | 54           |
| Project Capital Cost                                   | \$11,000,000 |
| #6 Oil Current \$/Gallon                               | \$2.03       |
| Biomass \$/Ton   | \$37.96      |
| Annual Biomass Consumption (tons)                      | 25,000       |
| Annual Oil Consumption Avoided (gallons)               | 1,350,000    |
| Annual MTCDE Avoided                                   | 15,122       |
| Annual Avoided Oil Cost                                | \$2,736,450  |
| Annual Price Risk Contingency                          | \$300,000    |
| Annual Plant O&M                                       | \$25,000     |
| Debt Service Cost Factor (25 yr., 5% interest)         | 0.0725       |
| <hr/>  |              |
| Biomass \$/Ton Required (inputs = yellow)              | \$64.56      |

# Project at 20,000 tons



# Project at 25,000 tons



# Biomass Plant to Begin Operations January 2008



# Lessons Learned

- Not all wood chips are created equal
- Solid fuel is not as easy as liquid fuel
- Learning curve is long
- Design twice build once
- Have a backup plan