
Animal Manure and Related Biomass Feedstock Market
Assessment and Preliminary Feasibility Study for a Papermill
Biomass/CoGen Facility

Task 8 Summary Report

for

**Southern States Energy Board
SERBEP Program**

with

South Carolina Energy Office

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*Animal Manure and Related Biomass Feedstock Market Assessment and Preliminary Feasibility Study
for a Paper Mill Biomass Cogeneration Facility*

Linpac Paper

Task 8 Summary Report

Facility Return on Investment, Business Planning and Incentives Packages

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Linpac Paper

Task 8 Summary Report

Facility Return on Investment, Business Planning and Incentives Packages

Task 8 Summary:

The Task 8 workscope involved providing a preliminary evaluation of the business opportunity. The work centered around a preliminary financial analysis using a ten year cash flow (TYCF) format for use in evaluating the facility options. Preliminary business planning was performed to define the key business and operational parameters to use in the analysis, as well as defining future business plan and engineering execution plan requirements. The Biomass/Cogen project, if it is to be successfully implemented, requires the eventual owner to adopt a formal program for project implementation that includes comprehensive business and engineering planning. The preliminary financial analysis estimate work was based on four options for the Biomass/Cogen facility, as follows:

- Option 1: Retrofit Existing Boiler
- Option 2: Steam Turbine
- Option 3: Gas Reciprocating Engine
- Option 4: Gas Combustion Turbine

Each option was based on a 165,000 ton per year anaerobic digestion facility as the biogas producing component of the Biomass/Cogen facility. A ten year cash flow (TYCF) format was used to provide for preliminary financial analysis estimates and evaluation, including all the operational assumptions and cost areas, and estimates for various cash flow and return on investment parameters. The financial analysis is based on previous work that was done to show that there was ample feedstock available in the \$30 - \$50 tip fee range, and capitals cost summaries that provide reasonable capital costs estimates for each of the options. The TYCF analysis used to following key revenue assumptions using the results of the previous work:

- Total Production Tons = 165,200 tons per year
- Average Tip Fee per Ton = \$
- Biogas Price per DekaTherm (DT) =
- Average Compost Price per Ton =

These key revenue assumptions were used along with operational cost parameters which were developed in the conceptual engineering and technical evaluation work, refined against Linpac Paper operational cost benchmarks. Based on the preliminary financial analysis estimates and results, Options 1, 2, 3 and 4 provided post tax IRR results that were in the teens, and are reasonably expected to be economically feasible. However, these base case results may not be high enough to clear typical return on investment hurdles required to adequately cover project risks. Options 1, 2, 3 and 4 were not significantly sensitive to biogas or compost price fluctuation, but were sensitive to tip fee fluctuations. Tip fee revenue reduction could have a detrimental effect on the Biomass/Cogen's return on investment.

Incentive based scenarios were looked at including capital cost offset funding and green power packages. Options 1, 2, 3 and 4 showed improvement in the return on investment and financial analysis estimate results compared to their base case when capital cost offset funding such as grant funding or an equivalent funding source was included in the analysis. For the green power package scenario, using a \$0.05 per kWh green power pricing target, Options 3 and 4 showed improvement in the return on investment and financial analysis estimate results compared to their base case. Option 4 was determined to be the best overall opportunity based on its more positive return on investment results and key financial analysis parameters for the base case scenario, the offset funding scenario and green power package scenarios, as well as the less detrimental effects with regard to the base case sensitivity analysis scenarios for biogas, compost and tip fee fluctuations.

Preliminary Financial Analysis Estimates

The Task 8 workscope involved providing a preliminary evaluation of the business opportunity, using a ten year cash flow (TYCF) format for financial analysis and evaluation. Preliminary business planning was performed to define the key business and operational parameters to use in the analysis, as well as defining future business plan and engineering execution plan requirements. The preliminary financial analysis work was based on four options for the Biomass/Cogen facility. These options are described in detail in the Task 5 Summary Report. Each option was based on a 165,000 ton per year anaerobic digestion facility as the biogas producing component of the Biomass/Cogen facility, with various options for the energy unit system to convert the biogas into electricity and/or steam.

Project Options and Capital Cost Estimates

The project options are described with accompanying capital cost summaries as follows:

Option 1. Retrofit Existing Boiler. In this option, the existing boiler is retrofitted and converted to be able to utilize biogas. This option would provide the biogas to the existing boiler, replacing approximately 1/3 of the existing natural gas purchases, and provide 100% of the linerboard mill's steam requirements. Table 1 provides the estimated capital cost summary for Option 1. The estimated capital cost of the Biomass/Cogen facility with this option is \$26,206,481.

Table 1: Option 1 Capital Cost Summary

Item	Cost (\$US)
Raw & Finished Materials Handling	\$725,926
BTA Equipment	\$7,988,889
Cogeneration Equipment	\$398,148
Auxiliary Equipment	\$555,556
Building Costs	\$8,003,704
Engineering	\$4,744,444
Startup	\$1,407,407
Optional Equipment	\$0
Project Contingency @ 10%	\$2,382,407
Total Project Capital Costs	\$26,206,481

Option 2. Steam Turbine. Cogeneration system using a high pressure McBurney package boiler followed by topping cycle Turbosteam turbine. This option would provide the biogas to the new steam turbine unit, replacing approximately 1/3 of the natural gas. The steam turbine would provide 100% of the linerboard mill's steam requirements, while generating approximately 800 kW of electricity for use in the biogas facility. Table 2 provides the estimated capital cost summary for Option 2. The estimated capital cost of the Biomass/Cogen facility with this option is \$29,940,981.

Table 2: Option 2 Capital Cost Summary

Project Capital Item	Cost (\$US)
Raw & Finished Materials Handling	\$725,926
BTA Equipment	\$7,988,889
Cogeneration Equipment	\$3,793,148
Auxiliary Equipment	\$555,556
Building Costs	\$8,003,704
Engineering	\$4,744,444
Startup	\$1,407,407
Optional Equipment	\$0
Project Contingency @ 10%	\$2,721,907
Total Project Capital Costs	\$29,940,981

Option 3. Gas Reciprocating Engine. Cogeneration system using a Waukesha Gas Engine with steam recovery. This option would provide the biogas to the new gas reciprocating engine unit. The gas reciprocating engine would provide approximately 33 - 40% of the linerboard mill's electrical requirements, while generating No steam for the linerboard mill. Hot water would be generated for use in the biogas facility. Table 3 provides the estimated capital cost summary for Option 3. The estimated capital cost of the Biomass/Cogen facility with this option is \$32,007,402.

Table 3: Option 3 Capital Cost Summary

Project Capital Item	Cost (\$US)
Raw & Finished Materials Handling	\$725,926
BTA Equipment	\$7,988,889
Cogeneration Equipment	\$5,671,712
Auxiliary Equipment	\$555,556
Building Costs	\$8,003,704
Engineering	\$4,744,444
Startup	\$1,407,407
Optional Equipment	\$0
Project Contingency @ 10%	\$2,909,764
Total Project Capital Costs	\$32,007,402

Option 4. Gas Combustion Turbine. Cogeneration system with a gas combustion turbine system, consisting of 2 Solar Taurus gas turbines. This option would provide the biogas to the new gas combustion turbine unit, replacing approximately 1/3 of the natural gas. The gas combustion turbine would provide 100% of the linerboard mill's steam requirements, while generating 100% of the electricity requirements as well. The gas combustion turbine would also generate steam and electricity for use in the biogas facility. Table 4

provides the estimated capital cost summary for Option 4. The capital cost of the Biomass/Cogen facility with this option is \$37,976,481.

Table 4: Option 4 Capital Cost Summary

Project Capital Item	Cost (\$US)
Raw & Finished Materials Handling	\$725,926
BTA Equipment	\$7,988,889
Cogeneration Equipment	\$11,098,148
Auxiliary Equipment	\$555,556
Building Costs	\$8,003,704
Engineering	\$4,744,444
Startup	\$1,407,407
Optional Equipment	\$0
Project Contingency @ 10%	\$3,452,407
Total Project Capital Costs	\$37,976,481

Base Case Options Financial Analysis Estimates

Appendix A, B, C, and D provide the TYCF financial analysis results for Options 1, 2, 3 and 4 respectively. The TYCF format provide for all the assumptions and cost areas, and estimates various cash flow and return on investment parameters. The financial analysis is based on previous work that was done to show that there was ample feedstock available in the \$30 - \$50 tip fee range, and as per the above capitals cost summaries that reasonable capital costs could be obtained for each of the options. The TYCF analysis used to following key revenue assumptions using the results of the previous work:

- Total Production Tons = 165,200 tons per year
- Average Tip Fee per Ton = \$
- Biogas Price per DekaTherm (DT) =
- Average Compost Price per Ton =

These key revenue assumptions were used along with operational cost parameters which where developed in the conceptual engineering and technical evaluation work, refined against Linpac Paper operational cost benchmarks. Tables 5, 6, 7 and 8 below provide the Financial Analysis Estimate Summaries for Options 1, 2, 3 and 4, respectively. These summaries provide the key financial analysis results for each option.

Table 5: Option 1 Financial Estimate Summary

Parameter	Estimate
Total Production Tons (Feedstock Furnish)	165,200 tpy
Project Facility Capital Cost	\$26,206,481
Grant/Incentive Capital Offset Funding	\$0
Total Project Capital Cost	\$28,067,141
Feedstock Tip Fee Revenue	\$5,988,500
Energy Revenue (Biogas, Electrical, Steam)	\$1,569,698
Compost Revenue	\$1,243,130
Recyclables Revenue (Metals, Plastic, etc.)	\$289,926
Subtotal Product Revenue	\$3,102,754
Variable Cost	\$2,425,549
Semi Variable Cost	\$2,589,478
Total Operational Cost	\$5,015,027
Net Revenue	\$4,026,227
EBITA	\$5,319,727
Post Tax Internal Rate of Return (IRR)	12%
Pre Tax Internal Rate of Return (IRR)	14%
Senior Debt Service Coverage Ratio	1.50

Table 6: Option 2 Financial Estimate Summary

Parameter	Estimate
Total Production Tons (Feedstock Furnish)	165,200 tpy
Project Facility Capital Cost	\$29,940,981
Grant/Incentive Capital Offset Funding	\$0
Total Project Capital Cost	\$32,066,791
Feedstock Tip Fee Revenue	\$5,988,500
Energy Revenue (Biogas, Electrical, Steam)	\$2,145,698
Compost Revenue	\$1,243,130
Recyclables Revenue (Metals, Plastic, etc.)	\$289,926
Subtotal Product Revenue	\$3,678,754
Variable Cost	\$2,425,549
Semi Variable Cost	\$2,634,292
Total Operational Cost	\$5,059,841
Net Revenue	\$4,557,413
EBITA	\$5,850,913
Post Tax Internal Rate of Return (IRR)	12%
Pre Tax Internal Rate of Return (IRR)	14%
Senior Debt Service Coverage Ratio	1.46

Table 7: Option 3 Financial Estimate Summary

Parameter	Estimate
Total Production Tons (Feedstock Furnish)	165,200 tpy
Project Facility Capital Cost	\$32,007,402
Grant/Incentive Capital Offset Funding	\$0
Total Project Capital Cost	\$34,279,928
Feedstock Tip Fee Revenue	\$5,988,500
Energy Revenue (Biogas, Electrical, Steam)	\$2,145,698
Compost Revenue	\$1,243,130
Recyclables Revenue (Metals, Plastic, etc.)	\$289,926
Subtotal Product Revenue	\$3,678,754
Variable Cost	\$2,425,549
Semi Variable Cost	\$2,659,089
Total Operational Cost	\$5,084,638
Net Revenue	\$4,532,616
EBITA	\$5,826,116
Post Tax Internal Rate of Return (IRR)	12%
Pre Tax Internal Rate of Return (IRR)	13%
Senior Debt Service Coverage Ratio	1.36

Table 8: Option 4 Financial Estimate Summary

Parameter	Estimate
Total Production Tons (Feedstock Furnish)	165,200 tpy
Project Facility Capital Cost	\$37,976,481
Grant/Incentive Capital Offset Funding	\$0
Total Project Capital Cost	\$40,672,811
Feedstock Tip Fee Revenue	\$5,988,500
Energy Revenue (Biogas, Electrical, Steam)	\$4,211,198
Compost Revenue	\$1,243,130
Recyclables Revenue (Metals, Plastic, etc.)	\$289,926
Subtotal Product Revenue	\$5,744,254
Variable Cost	\$2,425,549
Semi Variable Cost	\$2,730,718
Total Operational Cost	\$5,156,267
Net Revenue	\$6,526,487
EBITA	\$7,819,987
Post Tax Internal Rate of Return (IRR)	14%
Pre Tax Internal Rate of Return (IRR)	16%
Senior Debt Service Coverage Ratio	1.57

Each of the base case financial analysis summaries for the various options provides for a positive post tax IRR estimate in the teens, providing a preliminary indication that each of the project options would be economically viable. Option 4, the gas combustion turbine appears to have the strongest IRR. However, the fact that the base case provides for an IRR that is only in the teens may not be high enough to clear corporate hurdles for IRR based on the project risks.

Base Case Sensitivity Financial Analysis Estimates

The Biomass/Cogen project has five major sources of revenue: 1) tip fees; 2) compost; 3) biogas; 4) electricity; and 5) steam. Of these five, three major sources of revenue that have greater risk associated with them, and so are key to the project. These are the tip fees, compost and biogas revenues. Using the base case scenario for each of the options, post tax IRR was calculated for typical pricing ranges for the biogas, compost and tip fees. Tables 9, 10 and 11 provide the sensitivity financial analysis for biogas, compost and tip fee pricing ranges.

Table 9: Sensitivity Financial Analysis Based on Biogas Price Changes

Biogas Price (\$/DT)	Base	\$1.00	\$2.00	\$3.00	\$4.00	\$5.00	\$6.00	\$7.00
Option 1: Post Tax IRR	12%	9%	11%	12%	14%	15%	16%	18%
Option 2: Post Tax IRR	12%	10%	11%	12%	13%	15%	16%	17%
Option 3: Post Tax IRR	12%	9%	10%	12%	13%	14%	15%	16%
Option 4: Post Tax IRR	14%	12%	13%	14%	15%	16%	17%	18%

Based on the estimated post tax IRR's in Table 9 above, the results showed that the biogas price fluctuation that might be encountered by the facility does not have a large impact on the Biomass/Cogen facility's economic viability, and so a low biogas price was not a severe risk. Also note that as with the base cases, Option 4, (the gas combustion turbine), was the least affected by biogas price fluctuations and provided the best overall results.

Table 10: Sensitivity Financial Analysis Based on Compost Price Changes

Compost Price (\$/T)	Base	\$0	\$10	\$20	\$30	\$40	\$50	\$60	\$70
Option 1: Post Tax IRR	12%	9%	10%	12%	13%	15%	16%	18%	19%
Option 2: Post Tax IRR	12%	9%	11%	12%	13%	15%	16%	17%	19%
Option 3: Post Tax IRR	12%	9%	10%	11%	13%	14%	15%	16%	18%
Option 4: Post Tax IRR	14%	12%	13%	14%	15%	16%	17%	18%	19%

Based on the estimated post tax IRR's in Table 10 above, the results showed that the compost price fluctuation that might be encountered by the facility also does not have a large impact on the Biomass/Cogen facility's economic viability, and so a low compost price was not a severe risk. Also note that as with the base cases, Option 4, (the gas combustion turbine), was the least affected by compost price fluctuations and provided the best overall results.

Table 11: Sensitivity Financial Analysis Based on Tip Fee Changes

Tip Fee (\$/T)	Base	(\$10)	\$0	\$10	\$20	\$30	\$40	\$50	\$60
Option 1: Post Tax IRR	12%	-7%	-3%	1%	6%	10%	14%	18%	22%
Option 2: Post Tax IRR	12%	-5%	-1%	3%	6%	10%	14%	17%	21%
Option 3: Post Tax IRR	12%	-4%	-1%	3%	6%	10%	13%	16%	19%
Option 4: Post Tax IRR	14%	1%	4%	6%	9%	12%	15%	18%	20%

Based on the estimated post tax IRR's in Table 11 above, the results showed that the tip fee fluctuation that might be encountered by the facility does have a significant impact on the Biomass/Cogen facility's economic viability. The tip fee could become a severe risk if it goes too low and does not provide enough revenue to the Biomass/Cogen facility. However, it is worth noting that even with the more significant detrimental effects of tip fee fluctuation, Option 4, (the gas combustion turbine), was the least affected by compost price fluctuations and provided the best overall results. Option 4 was the only option that did not have a negative post tax IRR estimate, even when the Biomass/Cogen facility had to pay for feedstock material. Based on the results of Tables 9, 10 and 11 above, Option 4 would appear to be the best choice.

Incentive Based Financial Analysis Estimates

The financial analysis estimates using the base case scenario for options 1 through 4 above provided for positive results. However, the post tax IRR estimated results were generally in the teens, and may not be high enough to clear corporate hurdles for investment due to associated risk factors. Typically corporations have a minimum pre or post tax IRR hurdle rates of approximately 20% - 25%, with a senior debt coverage ratio approaching 2.0 considered a good result. The base case scenarios above are a little short of that benchmark, however they can be supplemented by incentives that can help offset the cost of implementing the Biomass/Cogen project and improve the return to clear the financial analysis hurdles. The two basic forms that incentive would take would be capital offset funding and green power package premiums for product sales. Financial analysis results based on these two incentives are provided below.

Capital Cost Offset Funding Scenarios

Offset funding sources can be developed to help defray the capital cost of the Biomass/Cogen project, reduce project risk, and improve the return on investment to allow the project financial analysis to clear minimum hurdle rates. Capital cost offset funding can be developed via grant activity, pre-paid tolling fees with interested feedstock supply partners, and other methods. Appendix E provides a list of the public and private grant funding sources that could potentially apply to the Biomass/Cogen project. Since the Biomass/Cogen project is the first bioenergy cogeneration project linked to a paper mill, the concept could act as an important model for the Pulp and Paper Industry and related industries, justifying program interest in providing grant funding. Since the Biomass/Cogen project is a major project with high volumes, it is not unreasonable to assume that a capital cost offset program targeting 20% funding offset of the project capital cost could be developed. This would improve the return on investment estimates significantly, and provide for a more compelling opportunity. Tables 12, 13, 14 and 15 provide financial analysis estimate summaries for Options 1, 2, 3, and 4 using a 20% funding offset for capital cost.

**Table 12: Option 1 Financial Analysis Estimate Summary
with 20% Capital Offset Funding**

Parameter	Estimate
Total Production Tons (Feedstock Furnish)	165,200 tpy
Project Facility Capital Cost	\$26,206,481
Grant/Incentive Capital Offset Funding	(\$5,241,000)
Total Project Capital Cost	\$22,721,321
Feedstock Tip Fee Revenue	\$5,988,500
Energy Revenue (Biogas, Electrical, Steam)	\$1,569,698
Compost Revenue	\$1,243,130
Recyclables Revenue (Metals, Plastic, etc.)	\$289,926
SubTotal Product Sales Revenue	\$3,102,754
Variable Cost	\$2,425,549
Semi Variable Cost	\$2,589,478
Total Operational Cost	\$5,015,027
Net Revenue	\$4,026,227
EBITA	\$5,319,727
Post Tax Internal Rate of Return (IRR)	15%
Pre Tax Internal Rate of Return (IRR)	18%
Senior Debt Service Coverage Ratio	1.86

**Table 13: Option 2 Financial Analysis Estimate Summary
with 20% Capital Offset Funding**

Parameter	Estimate
Total Production Tons (Feedstock Furnish)	165,200 tpy
Project Facility Capital Cost	\$29,940,981
Grant/Incentive Capital Offset Funding	(\$5,988,000)
Total Project Capital Cost	\$25,959,031
Feedstock Tip Fee Revenue	\$5,988,500
Energy Revenue (Biogas, Electrical, Steam)	\$2,145,698
Compost Revenue	\$1,243,130
Recyclables Revenue (Metals, Plastic, etc.)	\$289,926
SubTotal Product Sales Revenue	\$3,678,754
Variable Cost	\$2,425,549
Semi Variable Cost	\$2,634,292
Total Operational Cost	\$5,059,841
Net Revenue	\$4,557,413
EBITA	\$5,850,913
Post Tax Internal Rate of Return (IRR)	15%
Pre Tax Internal Rate of Return (IRR)	18%
Senior Debt Service Coverage Ratio	1.80

**Table 14: Option 3 Financial Analysis Estimate Summary
with 20% Capital Offset Funding**

Parameter	Estimate
Total Production Tons (Feedstock Furnish)	165,200 tpy
Project Facility Capital Cost	\$32,007,402
Grant/Incentive Capital Offset Funding	(\$6,401,000)
Total Project Capital Cost	\$27,750,908
Feedstock Tip Fee Revenue	\$5,988,500
Energy Revenue (Biogas, Electrical, Steam)	\$2,145,698
Compost Revenue	\$1,243,130
Recyclables Revenue (Metals, Plastic, etc.)	\$289,926
SubTotal Product Sales Revenue	\$3,678,754
Variable Cost	\$2,425,549
Semi Variable Cost	\$2,659,089
Total Operational Cost	\$5,084,638
Net Revenue	\$4,532,616
EBITA	\$5,826,116
Post Tax Internal Rate of Return (IRR)	15%
Pre Tax Internal Rate of Return (IRR)	17%
Senior Debt Service Coverage Ratio	1.68

**Table 15: Option 4 Financial Analysis Estimate Summary
with 20% Capital Offset Funding**

Parameter	Estimate
Total Production Tons (Feedstock Furnish)	165,200 tpy
Project Facility Capital Cost	\$37,976,481
Grant/Incentive Capital Offset Funding	(\$7,595,000)
Total Project Capital Cost	\$32,925,911
Feedstock Tip Fee Revenue	\$5,988,500
Energy Revenue (Biogas, Electrical, Steam)	\$4,211,198
Compost Revenue	\$1,243,130
Recyclables Revenue (Metals, Plastic, etc.)	\$289,926
SubTotal Product Sales Revenue	\$5,744,254
Variable Cost	\$2,425,549
Semi Variable Cost	\$2,730,718
Total Operational Cost	\$5,156,267
Net Revenue	\$6,526,487
EBITA	\$7,819,987
Post Tax Internal Rate of Return (IRR)	17%
Pre Tax Internal Rate of Return (IRR)	21%
Senior Debt Service Coverage Ratio	1.93

The use of offset funding significantly improves the return on investment parameters for each option compared against the base case results for each option. Based on the estimated post tax IRR's in the tables above, Option 4 would again appear to be the best choice.

Green Power Package Cases

With regard green power packages to promoting renewable energy, as detailed in previous work, there are currently four main policy approaches to encouraging renewable energy development and act as incentives for green power packages:

Renewable Portfolio Standards: Renewable Portfolio Standards (RPS), are a mechanism for creating demand. Utilities are required to have a minimum amount of renewable energy generation capacity within their systems.

Renewable Electricity Funds: Renewable Electricity Funds (REF) provide predictable funding sources for the development of renewable energy sources. Utilities are required to contribute to a fund that promotes renewable energy.

Net Metering: Net Metering allows customer-generators to sell back electricity to the utility when they are generating more than they need. In essence using the grid to "store" electricity.

Disclosure: Disclosure of the fuel mix on electricity bills helps educate the public and create demand for green pricing programs.

This new policy activity when implemented can help to provide premiums for green energy power sales and new incentives to renewable energy and green power generation such as represented by the Biomass/Cogen facility. These policies can result in promoting a premium for green energy pricing such as the Biomass/Cogen's electricity production. Green Packages could potentially be developed that allow the energy to be sold to energy customers willing to pay a premium to promote green energy.

The only project options that allow for a green power package such as this are Options 3 and 4. Tables 16 and 17 provide green power financial analysis estimate summaries for Options 3 and 4, where a \$0.05 per kWh green power pricing benchmark has been used for the electricity generated. It has been assumed that only the electricity resulting from the biogas is applicable for sale as green power.

**Table 16: Option 3 Financial Analysis Estimate Summary
with Green Power Pricing Premium**

Parameter	Estimate
Total Production Tons (Feedstock Furnish)	165,200 tpy
Project Facility Capital Cost	\$32,007,402
Grant/Incentive Capital Offset Funding	\$0
Total Project Capital Cost	\$34,279,928
Feedstock Tip Fee Revenue	\$5,988,500
Energy Revenue (Biogas, Electrical, Steam)	\$3,081,698
Compost Revenue	\$1,243,130
Recyclables Revenue (Metals, Plastic, etc.)	\$289,926
Subtotal Product Revenue	\$4,614,754
Variable Cost	\$2,425,549
Semi Variable Cost	\$2,659,089
Total Operational Cost	\$5,084,638
Net Revenue	\$5,468,616
EBITA	\$6,762,116
Post Tax Internal Rate of Return (IRR)	14%
Pre Tax Internal Rate of Return (IRR)	16%
Senior Debt Service Coverage Ratio	1.59

**Table 17: Option 4 Financial Analysis Estimate Summary
with Green Power Pricing Premium**

Parameter	Estimate
Total Production Tons (Feedstock Furnish)	165,200 tpy
Project Facility Capital Cost	\$37,976,481
Grant/Incentive Capital Offset Funding	\$0
Total Project Capital Cost	\$40,672,811
Feedstock Tip Fee Revenue	\$5,988,500
Energy Revenue (Biogas, Electrical, Steam)	\$5,044,283
Compost Revenue	\$1,243,130
Recyclables Revenue (Metals, Plastic, etc.)	\$289,926
Subtotal Product Revenue	\$6,577,339
Variable Cost	\$2,425,549
Semi Variable Cost	\$2,730,718
Total Operational Cost	\$5,156,267
Net Revenue	\$7,359,572
EBITA	\$8,653,072
Post Tax Internal Rate of Return (IRR)	15%
Pre Tax Internal Rate of Return (IRR)	18%
Senior Debt Service Coverage Ratio	1.74

The use of green power packages to obtain a pricing premium significantly improves the return on investment parameters for each option compared against the base case results for each option. Based on the estimated post tax IRR's in the tables above, Option 4 would again appear to be the best choice.

Business and Engineering Planning

The Biomass/Cogen project, if it is to be successfully implemented, requires the eventual owner to adopt a formal program for project implementation that includes comprehensive business and engineering planning. This program will be the complete plan that involves final decision approval of technology choice(s), investment capital requirements, operational requirements, and all business factors leading to allocation of the financial and management resources necessary to reduce risk. The planning will define the requirements to implement the involved preliminary design, detail design and construction engineering aspects of the project implementation workscope, as well as the startup operations and full production. Depending on the owner's access to and approach to capital, development time and project risk, the project can be implemented by Linpac addressing the future work requirements below.

The CCI/BTA technology and system allows for a relatively quick 'start to finish' completion timeline. The key project milestones that would be typical for a project of this magnitude are as follows:

- Preliminary Design Engineering and Cost Estimates Completed
- Full Project Financing Acquired
- Detailed Design Engineering Authorized
- Long Term Equipment Order Placed
- Detailed Design Engineering Completed
- Building Contractor Selected
- General Equipment Order
- Building Construction Begins
- Biomass/Cogen Special Equipment Delivery
- General Equipment Delivery
- Construction Installation
- System Test and Start-up
- Performance Guarantee Certification
- Full Operations and Production

At the core of the implementation will be an Engineering Execution Plan. An example Engineering Execution Plan specific to Biomass Cogen's project requirements is provided in Appendix F. The Biomass/Cogen project will require future engineering services to appropriately detail, construct and startup the CCI/BTA based process and Linpac manufacturing site. These services include typical detail design engineering, construction engineering and management, startup services, and project administration workscope and tasks. The engineering services should also provide complete construction engineering, engineering start-up services and engineering project management. The task and workscope areas for engineering services typically include the following:

Detailed Design Engineering

- Final Process Flow Diagram (PFD)
- Final Detailed Process and Instrumentation Diagram (P&ID)
- General Arrangements and Floor Plans
- Equipment Foundation Requirements
- Typical Sections
- Structural Details
- Tanks/Platforms/Support/Mounts/Anchors
- Mechanical Equipment List
- Electrical Motor, Conduit and Wiring Schedule
- Electrical One Line
- Electrical Control Diagram
- Instrument Loops, Schedules and Specifications
- Piping Isometrics

Mechanical, Electrical, and Civil Specifications
Final Construction Cost Estimate for Installation

Construction Engineering and Management

Construction Plans and Specifications
Construction Engineering and Planning
Final Construction Package
Vendor Equipment Procurement
Construction Installation Supervision
Contractor and Subcontractor Oversight
Vendor/Supplier Coordination
Change Order Review and Approval
Construction Management

Startup Services

Startup Planning and Requirements
Startup Onsite Supervision and Technical Support
Vendor Equipment and System Performance Verification
Biomass/Cogen SOP/JSA Manuals
Biomass/Cogen Maintenance Manuals
Startup/Operations Optimizations

Project Administration

Project Management and Administration
Project Cost Tracking
Project Monthly Progress Reports

The Biomass/Cogen installation will be environmentally friendly. The Biomass/Cogen is a low impact process with no or little air emission concerns, and relatively minor non-hazardous solid waste and effluent streams. Based on CCI's preliminary data and testing these are not seen as problematic. In addition to the environmental review, the solid waste and effluent permit issues will need to be further addressed in detail. The permitting will need to be accomplished in a timely manner, in order to stay within the project construction and startup schedule. No barriers to permitting considerations are evident, and the project parameters should allow for relatively quick processing of permits.

Human resources, health and safety considerations will require adequate planning. The Biomass/Cogen processing equipment and system layout should be designed with the appropriate manufacturing flow and surge protection to allow a minimum number of personnel to readily perform the operational, manufacturing and maintenance requirements. The CCI/BTA system itself is very "employee friendly." A training period will be required for new employees working in the facility. This training period will allow new Linpac operators to understand the Standard Operating Procedures (SOP) and Job Safety Analysis (JSA) required to safely run the plant. An appropriate set of SOP/JSAs should be developed for this purpose, and should be incorporated into plant operations to ensure the training, based on the SOP/JSA procedures, occurs both prior to startup and on a continuing basis. The building site will need to be designed to accommodate the eventual layout. Recommendations for the building will include a review of fire hazards and safety practices, as well as individualized chemical containment and safety review. The building and facilities must have adequate outdoor access to allow for fire protection services to quickly respond to fires reported inside the building. The outside of the building must have adequate spacing and setbacks from roads and nearby buildings along with standard fire safety hydrants and equipment access.

Part of the business planning effort should include a legal and tax evaluation based on the project parameters. The project may require legal and tax review for these issues:

- Ownership Arrangements
- Project Capital Finance Package
- Performance Guarantee(s)
- Lease vs. Buy Assessment
- Raw Material Supply Contracts
- Product Sales Contracts (if initiated)

These areas are typically standard industry practices and no foreseeable problems are expected to arise or become critical to the project.

Conclusions

Based on the Task 8 work and preliminary financial analysis estimates and results, the following conclusions can be made:

- Based on the preliminary financial analysis estimates and results, Options 1, 2, 3 and 4 provided post tax IRR results that were in the teens, and are reasonably expected to be economically feasible. However, these base case results may not be high enough to clear typical return on investment hurdles required to adequately cover project risks.
- Based on the preliminary financial analysis estimates and results for the base case sensitivities pertaining to biogas, compost and tip fee fluctuations, Options 1, 2, 3 and 4 were not significantly sensitive to biogas or compost price fluctuation, but were sensitive to tip fee fluctuations. Tip fee revenue reduction could have a detrimental effect on the Biomass/Cogen's return on investment.
- Based on the preliminary financial analysis estimates and results for the offset funding scenario, using a 20% offset funding target, Options 1, 2, 3 and 4 showed improvement in the return on investment and financial analysis estimate results compared to their base case. Capital cost offset funding significantly improves each options return on investment and helps to reduce the project risk.
- Based on the preliminary financial analysis estimates and results for the green power package scenario, using a \$0.05 per kWh green power pricing target, Options 3 and 4 showed improvement in the return on investment and financial analysis estimate results compared to their base case. Green power pricing premiums significantly improves Options 3 and 4 return on investment and reduces the project risk.
- Option 4 was determined to be the best opportunity based on its more positive return on investment results and key financial analysis parameters for the base case scenario, the offset funding scenario and green power package scenarios, as well as the less detrimental effects with regard to the base case sensitivity analysis scenarios for biogas, compost and tip fee fluctuations.

Appendix A

Option 1 Base Case Ten Year Cash Flow Financial Analysis Estimate

Appendix B

Option 2 Base Case Ten Year Cash Flow Financial Analysis Estimate

Appendix C

Option 3 Base Case Ten Year Cash Flow Financial Analysis Estimate

Appendix D

Option 4 Base Case Ten Year Cash Flow Financial Analysis Estimate

Appendix E
Public and Private Grant Funding Programs and Sources

Appendix F

Engineering Execution Plan Example Workscope

The following engineering execution plan workscope example is provided to show typical key milestones and deliverables required or successfully implementing a major project such as the Biomass/Cogen project. The project's engineering workscope tasks and key engineering discipline areas of responsibility are defined as it relates to the OWNER, OWNER'S ENGINEER, PROJECT ENGINEER,, EPC Contractor, or other Contractor and Vendor responsibilities.

Table 1: Engineering Execution Plan Workscope

<i>Process</i>	<i>How</i>
Project Start	PROJECT ENGINEER Design Basis template to OWNER and OWNER'S ENGINEER for review,
Design Basis	OWNER, OWNER'S ENGINEER and EPC Contractor signoff, PROJECT ENGINEER to finalize
PFD	OWNER'S ENGINEER to review with OWNER, update and forward to PROJECT ENGINEER for final detail
Meeting/Design Eng. Starts	PROJECT ENGINEER, EPC Contractor and OWNER make final Biomass/Cogen changes
P&ID	OWNER'S ENGINEER to review and update, PROJECT ENGINEER to provide final detail, no major changes
Building/MFG Process	OWNER'S ENGINEER to provide information, PROJECT ENGINEER to incorporate necessary detail and finalize
General Arrangement	OWNER'S ENGINEER to provide building information, PROJECT ENGINEER to detail and finalize drawings
Process Descriptions	OWNER'S ENGINEER to provide information, PROJECT ENGINEER to detail and finalize descriptions

<i>Specialty Process</i>	<i>How</i>
Code Review (See Environmental)	OWNER'S ENGINEER to provide information, PROJECT ENGINEER to detail and finalize recommendations
Chemical Delivery	OWNER'S ENGINEER to provide information, PROJECT ENGINEER to detail and finalize drawings and schedules
Process Req.'s, Utility Summary.	OWNER'S ENGINEER to provide information, PROJECT ENGINEER to detail and finalize schedules
Process Verification Meeting	PROJECT ENGINEER, EPC Contractor, OWNER finalize all Biomass/Cogen changes.

Table 1: Engineering Execution Plan Workscope(con)

<i>Mechanical</i>	<i>How</i>
Piping Plan	PROJECT ENGINEER to design and approve, OWNER'S ENGINEER review
Piping Section	PROJECT ENGINEER to design and approve, OWNER'S ENGINEER review
Piping Specifications	PROJECT ENGINEER to develop and propose, OWNER'S ENGINEER review
Prefab Piping Iso's (1st 33%)	PROJECT ENGINEER does 1st 1/3 prefab iso's for spools
Prefab Verification Meeting	PROJECT ENGINEER, Contractor/Vendor, and EPC Contractor review prefab iso's
Equipment List and Review	PROJECT ENGINEER lists tagged equipment, service cond's, reconcile P&ID
Tank & Nozzle Drawing	OWNER'S ENGINEER/EPC Contractor define requirements, PROJECT ENGINEER details, approves
Pump specifications	Spec'd EPC Contractor vendor. PROJECT ENGINEER calculates, finalize, approves
Progress Review Meeting	PROJECT ENGINEER, Contractor/Vendor, and EPC Contractor review and plan
Prefab Piping Iso's (2nd 33%)	PROJECT ENGINEER does 2nd prefab iso's for spools
Prefab Verification Meeting	PROJECT ENGINEER, Contractor/Vendor, and EPC Contractor review prefab iso's
Prefab Piping Iso's (3rd 34%)	PROJECT ENGINEER does prefab iso's for spools
Prefab Verification Meeting	PROJECT ENGINEER, Contractor/Vendor, and EPC Contractor review prefab iso's
Field Piping Iso's	PROJECT ENGINEER does field iso's for spools for pipe > 2.0-inch
Field Piping Review Meeting	OWNER'S ENGINEER/PROJECT ENGINEER, EPC Contractor and Contractor/Vendor meet per field piping
Piping Material Takeoff	PROJECT ENGINEER to take P&ID and do takeoff, OWNER'S ENGINEER review.

Table 1: Engineering Execution Plan Workscope (con)

<i>I/C</i>	<i>How</i>
Instrument System Design	PROJECT ENGINEER to generate, finalize and approve w/ OWNER'S ENGINEER review
Instrument Control Loops	PROJECT ENGINEER to generate, finalize and approve w/ OWNER'S ENGINEER review
Instrument Monitor Loops	PROJECT ENGINEER to generate, finalize and approve w/ OWNER'S ENGINEER review
Instrument Schedules	PROJECT ENGINEER to generate, finalize and approve w/ OWNER'S ENGINEER review
Instrument Specs/Data sheets	PROJECT ENGINEER to generate, finalize and approve w/ OWNER'S ENGINEER review
Instrument Installation Details	PROJECT ENGINEER to generate, finalize and approve w/ OWNER'S ENGINEER review
PLC Prog/Tuning/Training	Finalize for programming, for tuning, and for training
MMI	Develop for screens per system, and for total systems.
Instrument Location Diagrams	PROJECT ENGINEER to generate, finalize and approve w/ OWNER'S ENGINEER review
System Specifications	PROJECT ENGINEER to generate, finalize and approve w/ OWNER'S ENGINEER review

<i>Electrical</i>	<i>How</i>
Electrical One Lines	PROJECT ENGINEER to generate, finalize and approve w/ OWNER'S ENGINEER review
Control Diagrams	PROJECT ENGINEER to generate, finalize and approve w/ OWNER'S ENGINEER review
Electrical Schedules	PROJECT ENGINEER, EPC Contractor Bill of materials and special specifications
Load List	Update current EPC Contractor format to PROJECT ENGINEER format
Building/Fac. Coordination	Interface with Building, routings, boilers, conduit supports
Equipment data sheets, drawing rev	PROJECT ENGINEER to generate, finalize and approve w/ OWNER'S ENGINEER review
Wiring Diagrams (interconnection)	PROJECT ENGINEER to generate, finalize and approve w/ OWNER'S ENGINEER review

Table 1: Engineering Execution Plan Workscope (con)

<i>Civil/Structural</i>	<i>How</i>
Equipment Foundations	PROJECT ENGINEER to generate, finalize and approve w/ OWNER'S ENGINEER review
Building Facilities Review	PROJECT ENGINEER to generate, finalize and approve w/ OWNER'S ENGINEER review
Ladders/Platforms/Mounts	PROJECT ENGINEER to generate, finalize and approve w/ OWNER'S ENGINEER review
Pipe Supports	Make an initial assumptions about loads for building and support the rest with independent supports
Misc. Other	OWNER'S ENGINEER, EPC Contractor to recommend, PROJECT ENGINEER to finalize, approve

<i>Environmental</i>	<i>How</i>
Code Review (air, effluent)	OWNER'S ENGINEER to provide information, PROJECT ENGINEER to detail and finalize recommendations
Environmental Recommendation Package	OWNER'S ENGINEER to provide data and estimates, PROJECT ENGINEER to format and make recommendations to EPC Contractor/OWNER

<i>Project Management</i>	<i>How</i>
PROJECT ENGINEER	Focus on coordinating engineering production for EPC Contractor and Mount Hood Fiber as EPC Contractor's customer
OWNER'S ENGINEER	OWNER'S ENGINEER focus on supporting PROJECT ENGINEER, coordinate contracted facility designer, owner.
Final Approval Meeting	PROJECT ENGINEER, EPC Contractor, Contractors/Vendors, and OWNER to approve

<i>Project Construction/Startup</i>	<i>How</i>
Construction Engineering	PROJECT ENGINEER assists Contractor/Vendor and EPC Contractor per needs
Construction Management	PROJECT ENGINEER assists Contractor/Vendor and EPC Contractor per needs
Startup Services	PROJECT ENGINEER assists Contractor/Vendor and EPC Contractor per needs
Production Start-up & Full Scale Operations	PROJECT ENGINEER assists Contractor/Vendor and EPC Contractor per needs