ETM

ENGINEERING & TECHNOLOGY MANAGEMENT

Economic Analysis of Biomass Conversion plant for Portland Metro Area

TEAM CHESTER

Course Title: **Engineering Economics (ETM635/535)**

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Abstract

The purpose of this study is to develop an economic model for assessing the feasibility of a biomass conversion plant in Portland metro area. Conversion of biomass to valuable fuel products such as bio-oil (also known as pyrolysis oil) and bio-char via fast pyrolysis is a promising means for producing renewable energy fuels. The process assessed in this study involves using advanced and reliable technology to thermally degrade biomass in the absence of oxygen to produce bio-oil, bio-char and syngas. The syngas produced can be used entirely to provide thermal process energy for the pyrolysis system [3].

Bio-oil can be used in the production of heat and power, as feedstock for transportation fuels, as a boiler fuel and can replace diesel in stationary industrial engines. Bio-char can be used as a substitute for coal or as a valuable soil amendment that can sequester carbon and improve desirable soil properties such as water and nutrient holding capacity [3].

The study is based for a biomass plant capacity of 40 tonnes per day of municipal and yard/wood waste as feedstock. Major assumptions made for this analysis match the industrial standards for the technology chosen and promise a bio-oil yield of 70 percent per ton (5.5 barrels per dry ton and a bio-char yield of 15 percent per ton. The minimum acceptable rate of return for the company is assumed to be 7 percent.

The financial performance assessment is done with positive NPV, IRR greater than MARR, payback period and the breakeven analysis. Besides the on-going operating costs, initial investment, the biomass plant would create a total of $9.3 million cumulative profit exclusive of tipping fee and has an internal rate of return of 46 percent. Apart from the financial profitability, the plant creates new jobs in Oregon which is of utmost importance during this financial crisis. Thus in addition to achieving renewable energy goals, development of biomass energy holds substantial economic promise.

1 Introduction

"We can make Oregon the national leader in renewable energy and renewable product manufacturing. …. Development of renewable energy will lessen our reliance on fossil fuels, protect Oregon's clean air and create jobs."

- Governor Kulongoski, 2003 [1]

Nothing is more associated with Oregon than its natural resources and how we protect, enjoy and utilize these resources is inextricably connected to the way we generate and supply energy to Oregonians and our economy. Recognizing this, Governor Kulongoski in 2003 [1], promoted a diversity of renewable energy resources. Because some renewable energy fuels like bio-fuels are freely accessible and are environment friendly, they help stabilize electric rates and reduce our dependence on petroleum/natural gas. Further, investments stay in Oregon, creating jobs, displacing the use of fossil fuel generation and avoiding numerous pollutants and global warming gases.

The use of biomass to generate heat, energy, and petroleum substitutes such as bio-oil or bio-crude have showed much promise as a tool for reducing our reliance on foreign oil and reducing the world's total carbon output through carbon recycling. Through a process known as fast pyrolysis has proven to be an effective method for converting biomass into useful chemical and oil derivatives as well as other carbon products. Furthermore, fast pyrolysis has the added benefit of being able to use solid municipal waste, yard waste and process inputs that can also be converted into chemicals and bio-oil products by simply adding a few additional processing steps to remove unwanted contaminants and toxins.

The fluidized bed fast pyrolysis converts feedstock (biomass) and solid municipal waste (SMW) through a gasification thermal conversion process. In this grinding process, reactants are ground into carefully sized particles and removed of most of their moisture content. The process reactants (biomass or SMW) are then introduced into the fluidized gas bed with a low oxygen content and rapidly heated to approximately 500-550^{o}C where a pyrolysis reaction occurs breaking the reactants down into their more basic components [2]. The forming gas is then rapidly cooled producing pyrolysis (bio) oil, char, and a non-condensable combustible gas. Initially, the plant will focus on the production of bio-oil and bio-char for sale and use in wholesale energy markets. The goal is to have a 40 tpd process burning biomass (feedstock) in full production within 12 months of the completion of the first prototype. This paper presents a financial viability of bio-mass conversion plant in Portland, Oregon. The results and sensitivity analyses presented highlights the most important factors that determine financial feasibility of fast pyrolysis operations using municipal waste and yard waste as feedstock.

2. Research objective

Oregon is heavily dependent on hydro energy and is also making use of other renewable and non renewable energy technologies to meet the demand. However studies have shown that some of these resources such as oil and natural gas reserves are becoming more constrained and expensive for the long-term. Due to the erratic gasoline prices, it becomes high priority to currently invest on some domestic renewable energy sources which has significant environment and economic benefits over long-term. Biomass is one such alternative and has a potential market in making use of biomass wastes. The plan is to invest on this most efficient and economical technology, a biomass conversion plant in Portland, Oregon. Thus, our research objective is to study and evaluate economic feasibility of a long-term Biomass pyrolysis plant in Portland, Oregon using municipal solid and yard waste.

Here are some steps that we followed in order to achieve our final goal:

- Selecting the best site for Biomass plant in and around Portland.
- Selecting the Bio energy conversion technology from various available options which can give us good yield and which is more efficient.
- Analyze the construction, equipment and operating cost.
- Sales Forecast and revenue forecast from output products.
- To find the Potential markets for the output products.
- Check for the feasibility of the plant using NPV, Payback period and IRR.

3. Methodology

The primary intent of this study is to check the economic feasibility of a biomass conversion plant in Portland metro area. The study began with an extensive literature study to select the most efficient technology, and type of feedstock to use. The next step is to select the suitable technology. We looked at all thermo chemical conversion technologies available in the market. This is further discussed in section 5. Once the technology was selected, the next step was to select the equipment followed by suitable site for the plant, and analysis of construction, equipment and operation costs. All costs were derived using bottom-up approach. Finally, the economic analysis was done to check the feasibility of the plant in Portland, Or by comparing the Net Present Value, Payback period, and Internal Rate of Return.

4. *Feedstock*

The plant produces bio-oil and bio-char using tertiary biomass resources as the sustainable feedstock. Tertiary biomass resources are post-consumer residue streams including animal fats and greases, used vegetable oils, packaging waste and the yard waste which are processed and dried using thermo-chemical process. Thus, the plant plans to use municipal waste, wood waste and yard waste as feedstock input. All biomass feedstock are primarily brought to a point that they are dried and ready to be collected or harvested. Our research shows the cost of obtaining per dry ton of biomass is $0. Further, the plant earns revenue of $85/- per ton of municipal waste obtained as a tipping fee from local disposal companies [5]. This value will be used in all future calculations of the feedstock.

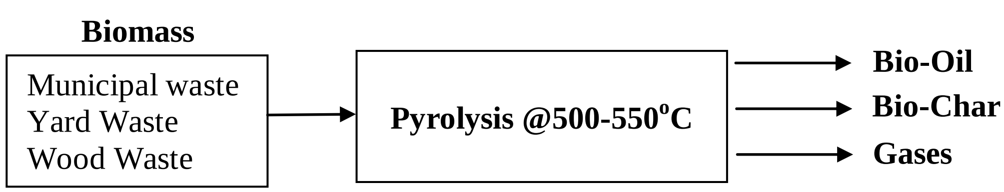

Fig 4.1

5. *Biomass conversion Technology:*

Biomass can be used various ways as shown in the fig. 5. However, biomass fast pyrolysis is the chosen technology which is a thermo chemical process that converts feedstock to gaseous, solid and liquid products through heating biomass in the absence of oxygen. However over years of pyrolysis technology development, a number of reactor designs have been explored to meet the heat transfer requirements. Thus it becomes increasingly important to select an efficient reactor that reduces cost while being reliable and increasing the output. Thus our research indicated fluidized bed reactor to be most reliable and proven technology since decades. The reactor has simple operating design and is virtually trouble free capable of conducting fast pyrolysis of biomass [2].

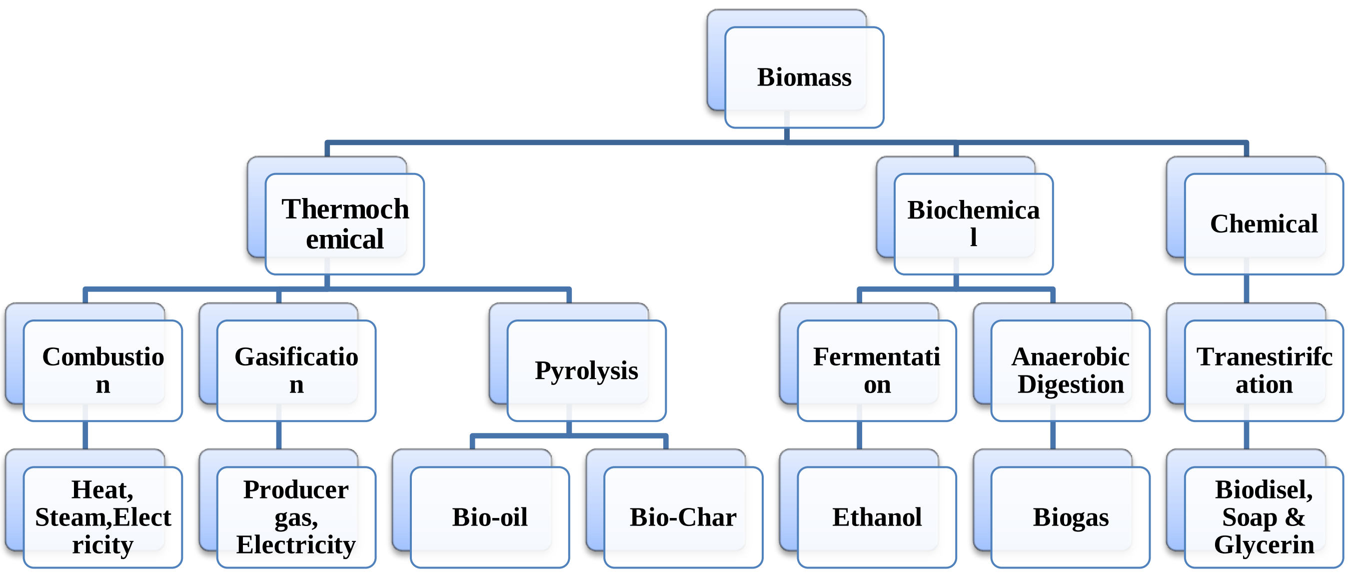

Fig 5.1

Fluidized bed reactor fast pyrolysis technology:

Principle: Biomass conversion plant utilizes a fast pyrolysis process. Fast Pyrolysis is a process by which small particles of biomass waste (less than 2-3mm) are rapidly heated to high temperatures (500-550^{o}C) in the absence of oxygen, vaporized, and then condensed into liquid fuel. Products of the process are typically 70wt% to 80wt% of liquid bio-oil Oil, 12-

15% solid char and 13-25% non-condensable gases (NCG), for bio-mass feedstock and other factors in manufacture [2]. Most importantly, the process has no waste since both Bio-oil and Char have significant commercial application and value, while non-condensable gases are recycled and produce approximately 75% of the energy required for the pyrolysis process. Because of their long history of service and inherently simple operating design, this type of reactor is considered to be very reliable and virtually trouble free as a system capable of conducting fast pyrolysis of biomass.

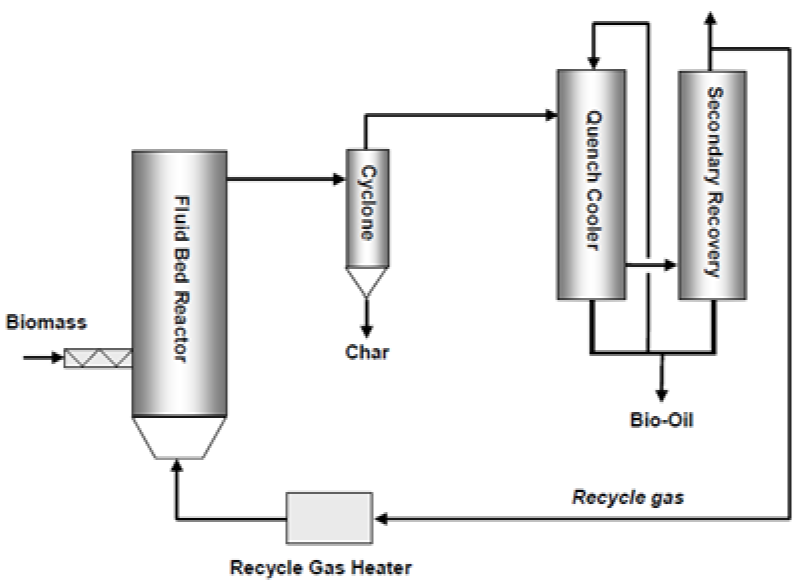

Fig 5.2 Process Schematic for a Bubbling Fluidized Bed Pyrolysis Design

6. Products

As discussed in the previous sections, fast pyrolysis yields solid, liquid and gaseous products. We have considered only bio-oil and bio-char for study purpose.

Attributes of Bio Oil:

Bio oil is produced from biomass, a renewable resource, and as such can be marketed as a Green Product. It is a dark brown, free flowing liquid comprised of highly oxygenated compounds and typically contains 15 -30% of water. Bio oil has higher energy density than the raw biomass material. With minimal modifications bio oil can be used as fuel in boilers, engines and turbines etc. It is readily storable and easily transportable. Hence it is an attractive alternative to traditional liquid fossil fuels.

Attributes of Bio-char:

Bio-char, obtained from the pyrolysis of biomass is a stable solid, rich in carbon content, used for many purposes. It has been used in agriculture for more than 2000 years for soil enrichment. Bio-char conditioned soils reduce NO_2 in the soil by 50 to 80% [9]. The product is called charcoal when used as fuel for heating and cooking purposes and called as agrichar when used in agricultural soils.

Since it holds 50% of biomass's carbon, and absorbs CO_2 form the atmosphere, the GHG atmospheric level is reduced. Hence, it can be used to reduce global warming, enhance plant growth, improve soil fertility and to improve water quality.

Price of Bio-oil is $39.39/barrel and of bio-char is $58.23/ton [10] are considered for analysis purpose.

Since the monthly input is 1200 ton, 6156 barrels of bio-oil and 180 ton of Bio-char is produced every month or 73872 barrels of bio oil and 2160 ton of bio char is produced per year. They generate revenues of $2,954,151 and $125,885 respectively every month with total revenue of $3,080,026 per year.

Assuming the revenues will stay constant for the 5 years, Economic analysis is done.

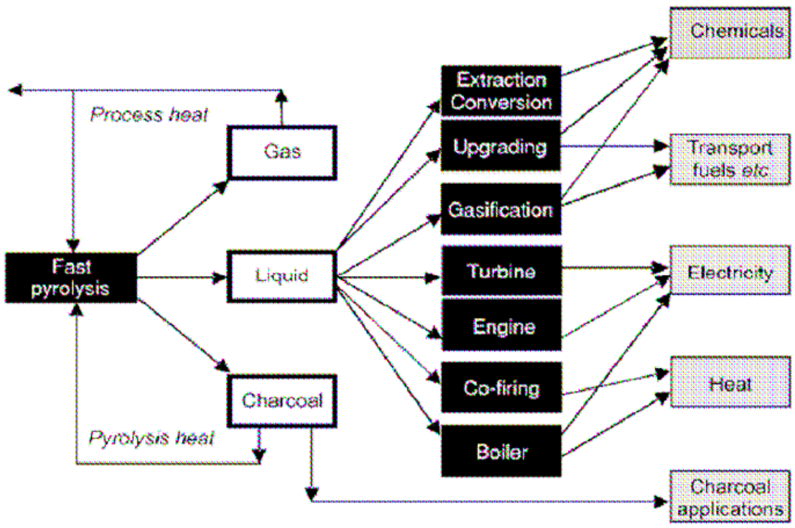

Fig 6.1: Uses of Fast Pyrolysis Products [7]

7. Potential Markets

Bio-oil ultimately has a whole suite of potential markets. Currently, applications are limited to the production of heat and power, while after some additional research bio-oil will be a feedstock for transportation fuels and chemicals [7]. Bio-oil is a suitable boiler fuel as long as it has consistent characteristics, provides acceptable emissions levels, and is economically feasible. An obvious choice is district heating to replace heavy fuel oil and gas. Other heat applications include greenhouses and sawmill dry kilns [7]. Bio-oil can replace natural gas in gas power stations, and since most of these stations have multi-fuel capability; it can be used as a backup fuel also. Bio-oil should also be able to co-fire in large coal power plants, though the results of such tests are not complete [7]. Bio-oil can also replace diesel in stationary industrial engines, but not in transportation owing to the requirement for fuel heating and specialized storage [7]. Bio-oil can be used in small turbines to make power, such as in remote, off-grid locations, but also in locations where there is sufficient biomass [7].

Char is viewed as a substance for charcoal applications, which includes co-firing in coal fired power plants.

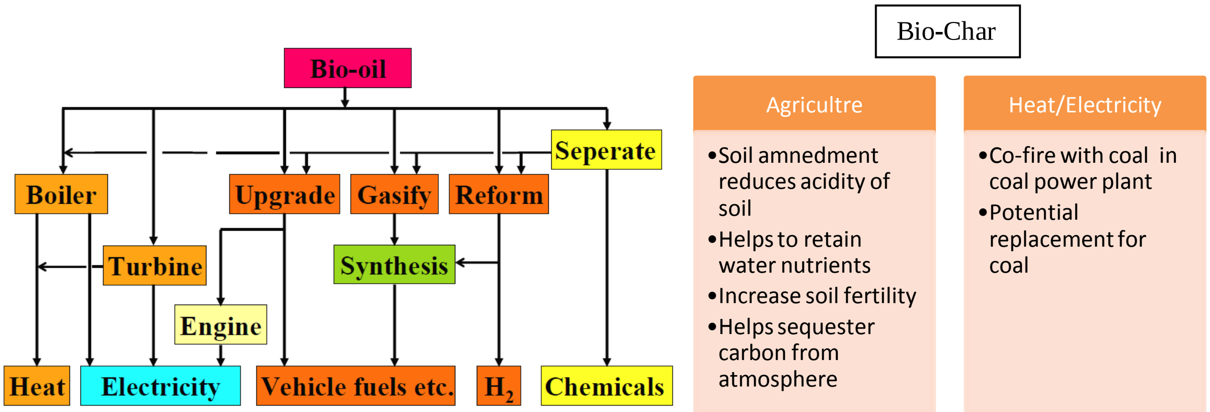

Fig 7.1: Uses of Bio-Oil and bio-char

8. Economic Analysis

The economic viability of the process is evaluated using a discounted-cash flow-rate of return (DCFROR) calculation. The discounted rate is considered as 7% [3]. An internal rate of return (IRR) of 46% was calculated for a plant life of 10 years and double declining depreciation over 5 years. The study period is 5 years considered for analysis purpose. Start-up period is projected to be six months. [3]

A “pyrolysis system” as referred to in this study, includes a feedstock drying unit, conveyors, pyrolysis module (reactor and Cyclone), 2 cooling towers, and a recycle gas heater. The total capacity considered is 40 ton per day of feedstock. However, the actual amount (in ton) of feedstock processed depends on initial feedstock moisture content when it enters the system, scheduled operating hours, and utilization rate.

8.1 Production and plant assumptions

The plant is expected to operate 317 days per year with an 87.5% utilization rate.

Parameters	**Values**
Plant Size	40tpd
Plant Availability	317 days/yr
Dry Feedstock Consumed	12680 t/yr
Feedstock Cost	$ 0 /ton
Bio-Oil Yield per ton	70%
Bio-Oil Production	73872 barrels/yr
Bio-Oil Yield per ton	5.5 barrels/dry ton
Char Yield	15%
Char Production	2160 t/yr
Plant Capital Cost	$3.41M
Production Staff	6
Bio-oil Selling Price	$39.39 /barrel
Char Selling Price	$ 58.23/ton

Table 8.1 Production and Plant Assumptions

Utilization rate is defined as the average percentage of scheduled time during which the machine does productive work, expressed as a percentage of scheduled machine hours. The utilization rate is a crucial factor, as it determines how much feedstock is needed and the quantity of bio-oil and bio-char that can be produced and sold [3].

Additionally, several published studies for energy production facilities and sawmills include similar operating time parameters, which are also discussed in terms of average availability, annual days of downtime, annual operating hours, onstream percentage, and downtime costs [3].

Under the production assumptions mentioned in table 8.1, the plant would consume 12680 ton of dry feedstock per year. The feedstock is assumed to be delivered to each plant with a moisture content of 30%. The feedstock is dried to 10% moisture content to prepare it for pyrolysis in the reactor.

The plant is expected to yield 70% bio-oil and 15% bio-char, [4, 2] as a percentage of prepared feedstock weight. Considering these product yields the plant's annual production is 73872 barrels/yr of bio-oil and 2160 t/yr.

8.2 Costs

The following section addresses the capital costs followed by baseline costs for operating costs, labor, and maintenance costs. Then the calculations used for insurance, taxes and depreciation will be discussed.

8.2.1 Capital Costs

The total estimated start up cost for the projected is estimated to be $3.4 million. The assumption is that the required funding will be generated by private investors. Majority of the funding will be used to purchase equipment & for site development. The site is considered to be developed in Multnomah County for analysis purpose. The table 8.2.1 and chart 8.2.1 shows the estimated project investment.

Component	**Cost**
Total Equipment Cost	$1,600,000.00
Warehouse	$100,000.00
Site Development	$1,050,000.00
Indirect Costs	
MISC Costs	$150,000.00
Other costs(Start ups)	$510,000.00
Total Project Investment	$3,410,000.00

Table 8.2.1: Capital cost

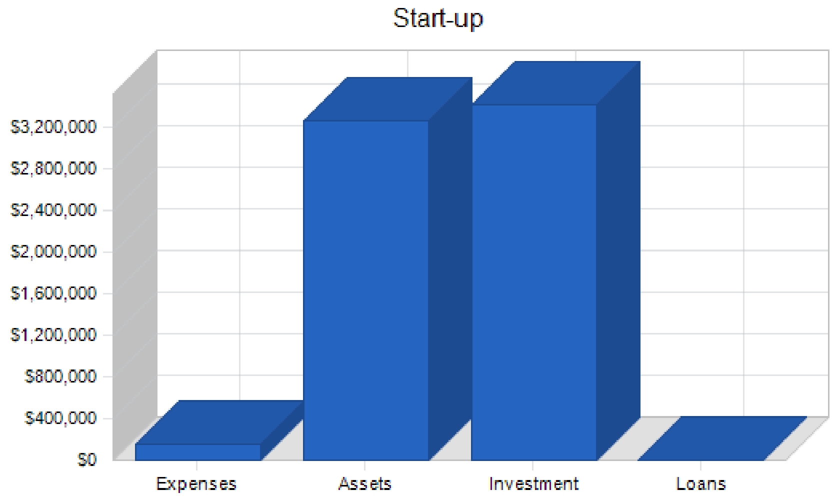

Chart 8.2.1: Start up cost

8.2.2 Operating cost

The table 8.2.2 below shows the total operating cost for 5 year period.

Expenses					
Payroll	$253,764	$263,914	$274,470	$285,450	$296,865
Marketing/Promotion	$30,000	$35,000	$40,000	$45,000	$50,000
Depreciation	$320,004	$256,000	$204,800	$163,840	$131,072
Rent	$0	$0	$0	$0	$0
Utilities	$324,000	$324,000	$324,000	$324,000	$324,000
Insurance	$15,804	$15,804	$15,804	$15,804	$15,804
Payroll Taxes	$83,742	$87,092	$90,575	$94,199	$97,965
Other	$378,036	$378,036	$378,036	$378,036	$378,036
Total Operating Expenses	$1,405,350	$1,359,846	$1,327,685	$1,306,329	$1,293,742

Table: 8.2.2 Operating cost

8.2.3 Labor Costs

The wages were decided according to the personnel. A Payroll burden of 33% [3] was included. It is decided that the fixed pyrolysis plant would require six employees during all scheduled operating hours.

Personnel	2012	2013	2014	2015	2016
Plant Manager	$72,804	$75,716	$78,745	$81,895	$85,170
Maintenance Tech	$46,800	$48,672	$50,618	$52,643	$54,745
Shift Lead/technician	$40,560	$42,182	$43,870	$45,625	$47,450
Project Technician	$93,600	$97,344	$101,237	$105,287	$109,500
Total People	6	6	6	6	6
Total Payroll	$253,764	$263,914	$274,470	$285,450	$296,865

Table 8.2.3: Labor cost for 5years

8.2.4 Maintenance costs

The plant is expected to have annual repair and maintenance costs of $32,004 for the pyrolysis system. R&M costs are based on 2% of initial capital investment [3] (not including land).

8.2.5 Insurance Costs:

Annual premiums were calculated according to the value of assets and the annual gross revenue of the firm. Liability insurance premiums were calculated as 1.5% of gross revenue. Property insurance premiums were based on 0.4% of asset value for buildings and 0.7% of the building contents value.

So the annual property insurance for the building was $4600 and $11,200 for the contents of the building for the total $15,800.

8.2.6 Taxes and depreciation:

For the Biomass pyrolysis plant, taxes paid on net cash flow (minus depreciation) were incorporated to determine NPV, IRR, and Payback Period. The model developed for this project assumed that federal taxes are paid according to Internal Revenue Service (IRS) Form 1120, Schedule J[28]. [3]

Double declining depreciation of capital over the useful operating life of ten years is assumed for the purpose of reporting taxable income to the IRS. No special financing and grant programs or accelerated depreciation are used in the analysis, nor are production credits or employment credits.

9. Finance

The chart 9.0 below highlights the sales, gross margin & net profit over period of five years

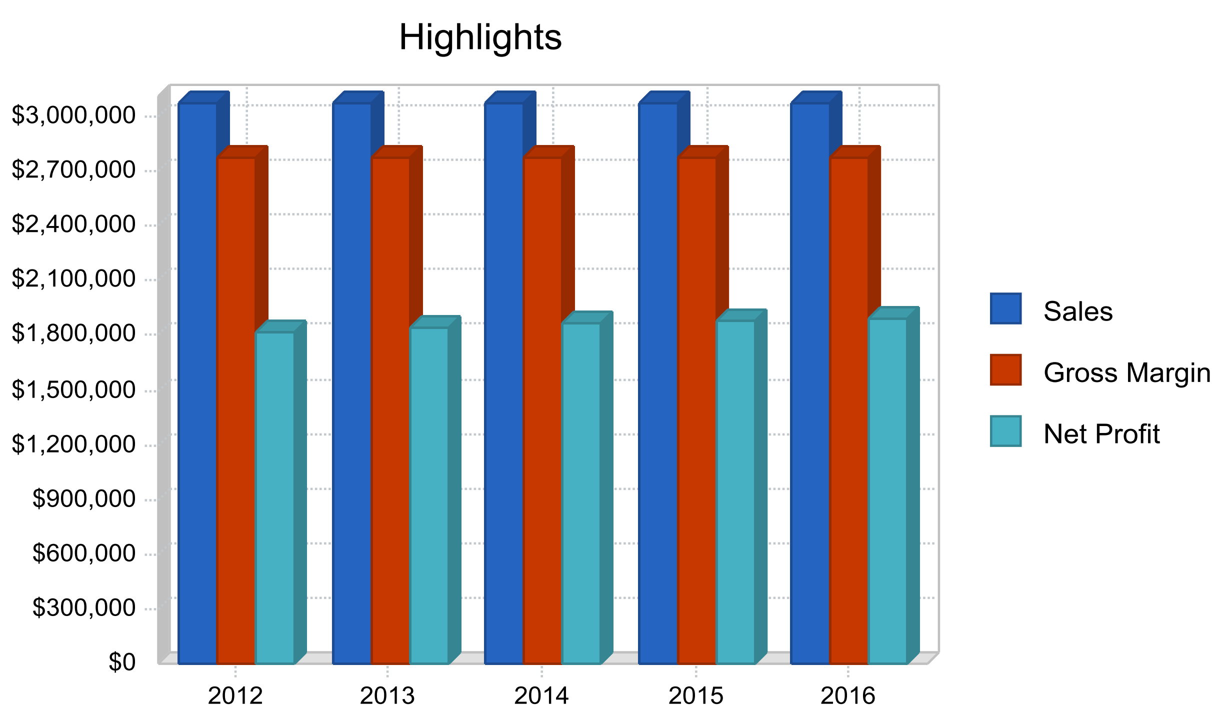

Chart: 9.0

9.1 Sales forecast

Our expected total annual sales for the year one to five are $3,080,026. Assumption here is that the plant will be operational to its fullest capacity by beginning of the 2012 and will be operated at 87.5% of its capacity. Further, the capacity of the plant will be constant over 5 years with no planned plant improvements.

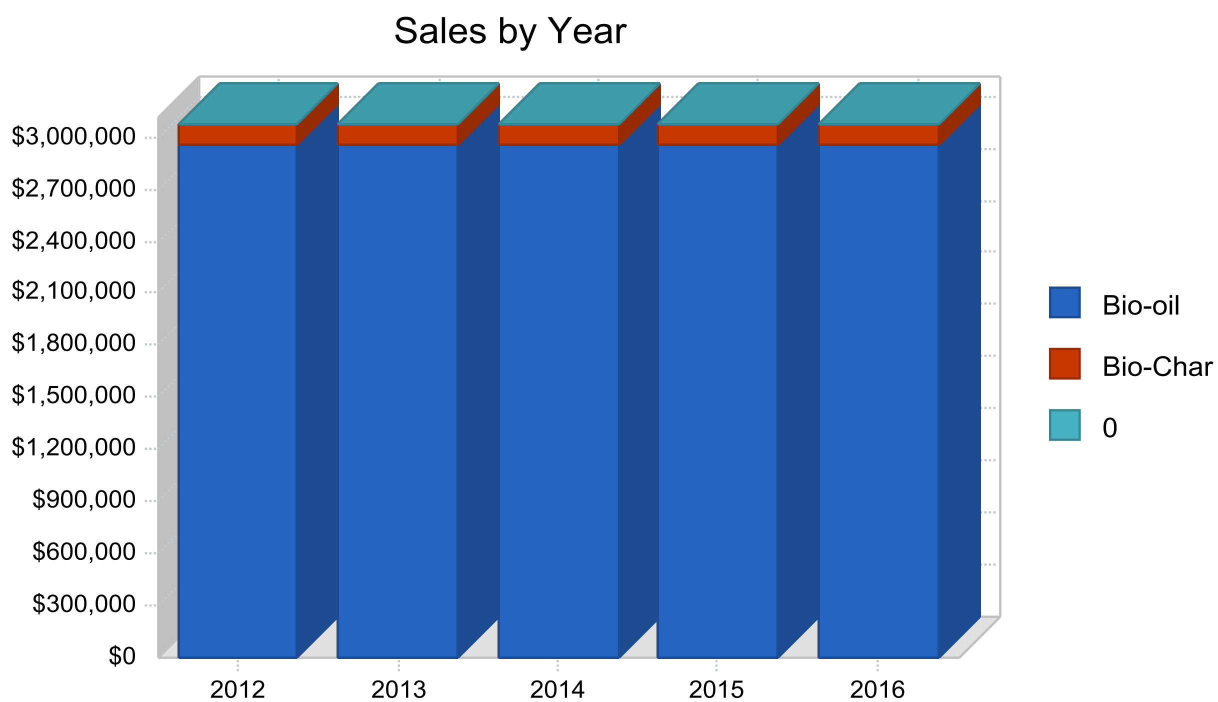

Fig 9.1: Sales Forecast

9.2Financial statement

The projected profit for first year is $1,813,144 (58.87%) and at the end of 5th year the projected profit $1,890,150 (61.37%). The table 9.2.1 & appendix 2 shows the projected profit for five year period. The projected cash flow for first year is $2,787,583. Table 9.2.2 shows the projected cash flow for first year. The projected net worth at the end of 5th year is $12,544,901. Appendix 4 shows the balance sheet for five year period.

Projected Profit:

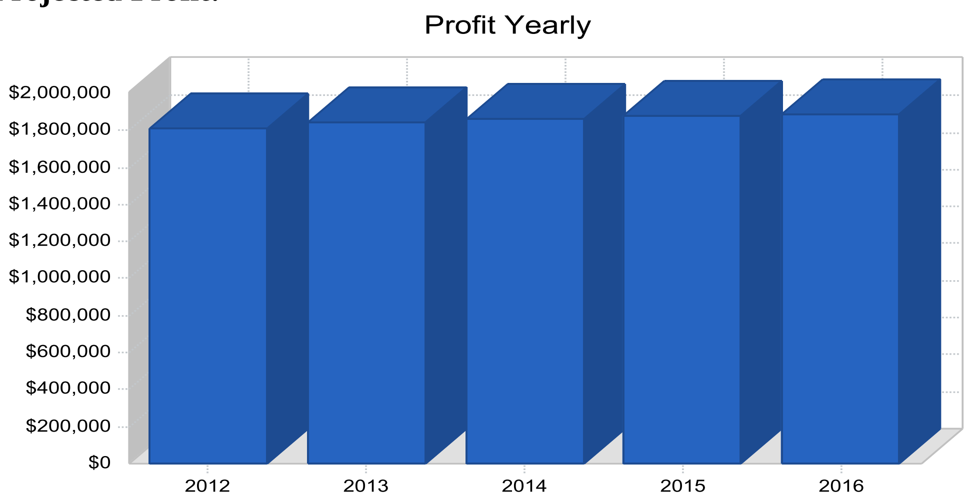

Fig 9.2.1: Projected Profit

Projected cash flow:

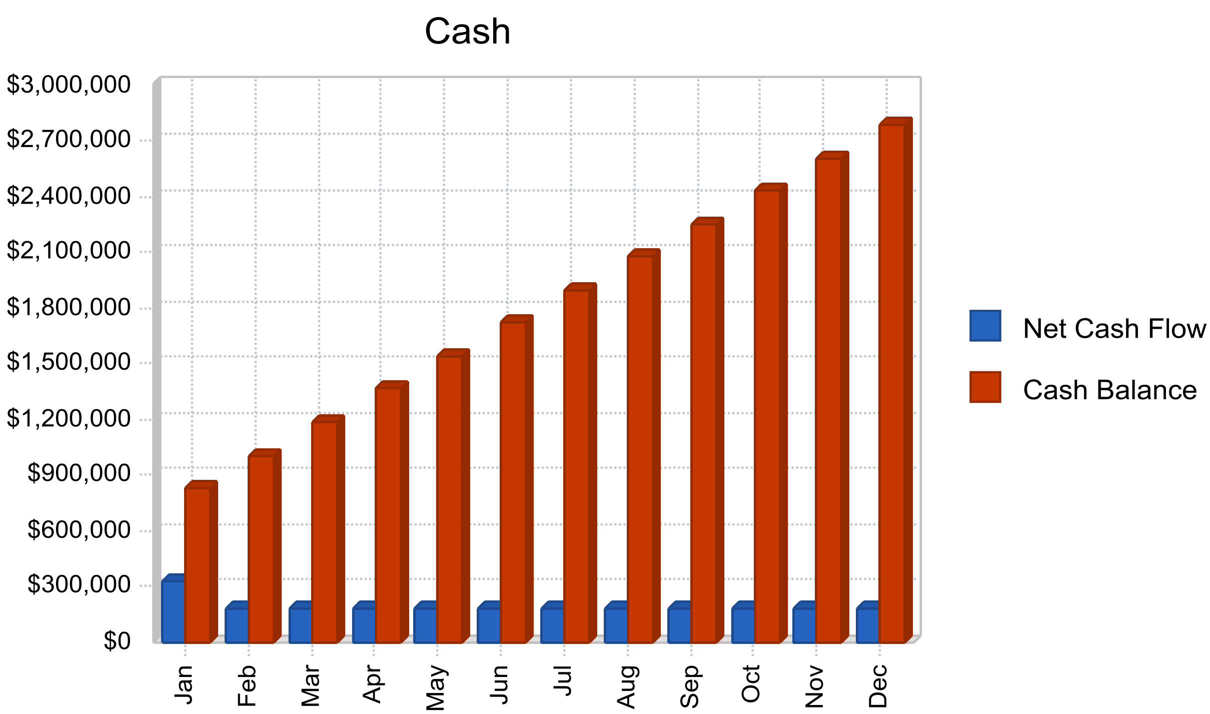

Fig 9.2.2: Projected cash flow

9.3 Net Present Value (NPV)

Net present value is considered as the difference between the present value of cash inflows and present value of cash outflows [6].

NPV = Cash inflows - Cash outflows

NPV (7%) = - 3410,000 + (1813144.2 (P/F, .007, 1) +1843877.7 (P/F, .007, 2) + 1866389.7 (P/F, .007, 3) + 1881339.6 (P/F, .007, 4) + 1890149.8 (P/F, .007, 5) + 112000(P/F, .007, 5)

So, NPV (7%) = $4,281,348 .00 (see appendix 4)

If NPV (I = MARR) $\geq$ 0, the project is economically justified.

9.4 Internal rate of Return (IRR)

IRR is the rate of return that makes the sum of all cash flows zero [6].

NPV= ∑ Revenue (P/F, i'%, k) - ∑ Expense (P/F, i'%, k) = 0

PW is calculated as $4,281,348 .00

0= - 3410,000 +(1813144.2(P/F, i%,1) +1843877.7(P/F, i%,2)+ 1866389.7(P/F, i%,3)+ 1881339.6(P/F, i%,4)+ 1890149.8(P/F, i%,5)+ 112000(P/F, i%,5)

So, i (IRR) = 46% (See appendix 4)

If IRR $\geq$ MARR , the project is economically justified.

9.5 Pay Back Period

Payback period is the number of years required for cash inflows to equal cash outflows.

For Simple payback period, the below equation is satisfied [6].

∑ (Revenue – Expense)-Investment ≥ 0.

For this project, Pay Back Period is calculated as 2 yrs considering the discounted rate of 7%. (See appendix 5)

9.6 Break Even Analysis

The monthly break-even point is 3,213 units

Break-even Analysis	
Monthly Units Break-even	3,213
Monthly Revenue Break-even	$130,147
Assumptions:	
Average Per-Unit Revenue	$40.51
Average Per-Unit Variable Cost	$4.06
Estimated Monthly Fixed Cost	$117,113

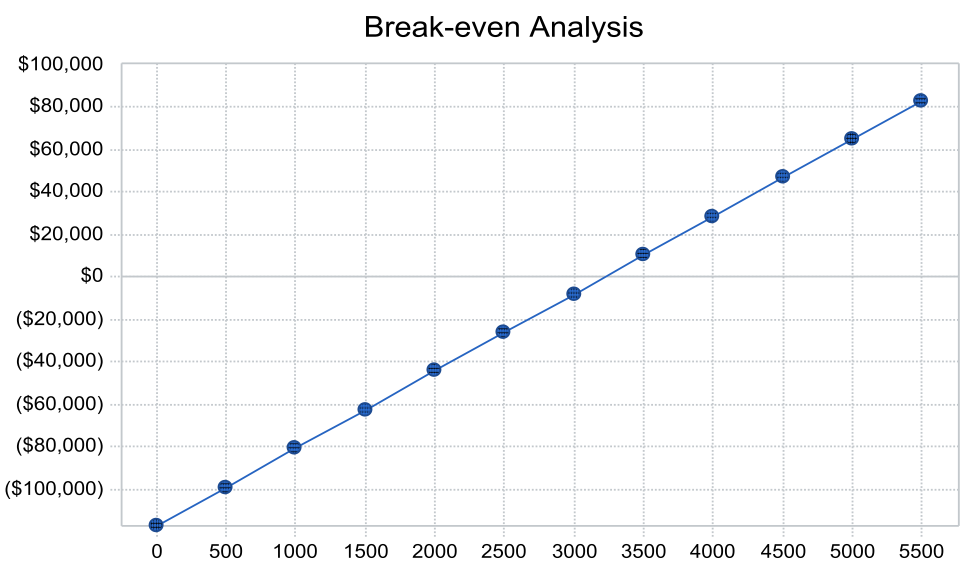

Table 9.6: Break-even analysis

10. Conclusion

	Actual Values	Comparison	Remarks
NPV	$4,281,348/-	NPV >0	Select Project
IRR	46%	IRR >MARR(7%)	Select Project
Payback period	~ 2 yrs	-	Select Project
Break-even	3213 eq units $130,147 /month	-	Select Project

Table 10: Final Values

This economic study explores the feasibility of a biomass conversion plant in Portland, Or using the fluidized bed fast pyrolysis technology. Based on the current analysis, bio-oil and bio-char can potentially be produced from biomass at a competitive present value of $4.2 million and IRR of 46 percent. The payback period is approximately 2 years and the breakeven occurs at 3213 equivalent units. With the discount rate of 7 percent in the baseline scenario, the financial performance of the biomass plant is extremely profitable and hence recommend to setup a plant in Portland, Or.

Apart from the financial benefits above stated, a biomass plant in Portland, Or has some important social benefits. Firstly, it uses the municipal and yard waste from Portland metro area, thus avoiding landfill significantly. Biomass being a green energy source is environment friendly and provides a healthy renewable energy infrastructure in Oregon. Also, it reduces our dependence on oil and natural gas which is getting expensive and constrained day by day. Thus it is wise to invest on a biomass plant as early as possible to stem the rise of natural gas prices.

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Appendix1: Sales forecast

Sales Forecast					
	2012	2013	2014	2015	2016
Unit Sales					
Bio-oil	73,872	73,872	73,872	73,872	73,872
Bio-Char	2,160	2,160	2,160	2,160	2,160
Total Unit Sales	76,032	76,032	76,032	76,032	76,032
Unit Prices	2012	2013	2014	2015	2016
Bio-oil	$39.99	$39.99	$39.99	$39.99	$39.99
Bio-Char	$58.28	$58.28	$58.28	$58.28	$58.28
Sales					
Bio-oil	$2,954,141	$2,954,141	$2,954,141	$2,954,141	$2,954,141
Bio-Char	$125,885	$125,885	$125,885	$125,885	$125,885
Total Sales	$3,080,026	$3,080,026	$3,080,026	$3,080,026	$3,080,026
Direct Unit Costs	2012	2013	2014	2015	2016
Bio-oil	$3.60	$3.60	$3.60	$3.60	$3.60
Bio-Char	$19.69	$19.69	$19.69	$19.69	$19.69
Direct Cost of Sales					
Bio-oil	$265,939	$265,939	$265,939	$265,939	$265,939
Bio-Char	$42,530	$42,530	$42,530	$42,530	$42,530
Subtotal Direct Cost of Sales	$308,470	$308,470	$308,470	$308,470	$308,470

Appendix 2: Income Statement

Table: Profit and Loss

Pro Forma Profit and Loss	2012	2013	2014	2015	2016
Sales	$3,080,026	$3,080,026	$3,080,026	$3,080,026	$3,080,026
Direct Cost of Sales	$308,470	$308,470	$308,470	$308,470	$308,470
Other Costs of Sales	$0	$0	$0	$0	$0
Total Cost of Sales	$308,470	$308,470	$308,470	$308,470	$308,470
Gross Margin	$2,771,556	$2,771,556	$2,771,556	$2,771,556	$2,771,556
Gross Margin %	89.98%	89.98%	89.98%	89.98%	89.98%
Expenses					
Payroll	$253,764	$263,914	$274,470	$285,450	$296,865
Marketing/Promotion	$30,000	$35,000	$40,000	$45,000	$50,000
Depreciation	$320,004	$256,000	$204,800	$163,840	$131,072
Rent	$0	$0	$0	$0	$0
Utilities	$324,000	$324,000	$324,000	$324,000	$324,000
Insurance	$15,804	$15,804	$15,804	$15,804	$15,804
Payroll Taxes	$83,742	$87,092	$90,575	$94,199	$97,965
Other	$378,036	$378,036	$378,036	$378,036	$378,036
Total Operating Expenses	$1,405,350	$1,359,846	$1,327,685	$1,306,329	$1,293,742
Profit Before Interest and Taxes	$2,590,206	$2,634,111	$2,666,271	$2,687,628	$2,700,214
EBITDA	$2,910,210	$2,890,111	$2,871,071	$2,851,468	$2,831,286
Interest Expense	$0	$0	$0	$0	$0
Taxes Incurred	$777,062	$790,233	$799,881	$806,288	$810,064
Other Income					
Fee	$1,224,000	$1,222,400	$1,222,400	$1,222,400	$1,222,400
	$0	$0	$0	$0	$0
Total Other Income	$1,224,000	$1,222,400	$1,222,400	$1,222,400	$1,222,400
Other Expense					
Other Expense Account Name	$0	$0	$0	$0	$0
Other Expense Account Name	$0	$0	$0	$0	$0
Total Other Expense	$0	$0	$0	$0	$0
Net Other Income	$1,224,000	$1,222,400	$1,222,400	$1,222,400	$1,222,400
Net Profit	$1,813,144	$1,843,878	$1,866,390	$1,881,340	$1,890,150
Net Profit/Sales	58.87%	59.87%	60.60%	61.08%	61.37%

Appendix 3: Cash flow

Biomass plant for Portland

Table: Cash Flow

Pro Forma Cash Flow	2012	2013	2014	2015	2016
Cash Received					
Cash from Operations					
Cash Sales	$3,080,026	$3,080,026	$3,080,026	$3,080,026	$3,080,026
Subtotal Cash from Operations	$3,080,026	$3,080,026	$3,080,026	$3,080,026	$3,080,026
Additional Cash Received					
Non Operating (Other) Income	$1,224,000	$1,222,400	$1,222,400	$1,222,400	$1,222,400
Sales Tax, VAT, HST/GST Received	$0	$0	$0	$0	$0
New Current Borrowing	$0	$0	$0	$0	$0
New Other Liabilities (interest-free)	$0	$0	$0	$0	$0
New Long-term Liabilities	$0	$0	$0	$0	$0
Sales of Other Current Assets	$0	$0	$0	$0	$0
Sales of Long-term Assets	$0	$0	$0	$0	$0
New Investment Received	$0	$0	$0	$0	$0
Subtotal Cash Received	$4,304,026	$4,302,426	$4,302,426	$4,302,426	$4,302,426
Expenditures	2012	2013	2014	2015	2016
Expenditures from Operations					
Cash Spending	$253,764	$263,914	$274,470	$285,450	$296,865
Bill Payments	$1,762,679	$1,933,729	$1,955,276	$1,970,561	$1,983,308
Subtotal Spent on Operations	$2,016,443	$2,197,643	$2,229,746	$2,256,011	$2,280,173
Additional Cash Spent					
Non Operating (Other) Expense	$0	$0	$0	$0	$0
Sales Tax, VAT, HST/GST Paid Out	$0	$0	$0	$0	$0
Principal Repayment of Current Borrowing	$0	$0	$0	$0	$0
Other Liabilities Principal Repayment	$0	$0	$0	$0	$0
Long-term Liabilities Principal Repayment	$0	$0	$0	$0	$0
Purchase Other Current Assets	$0	$0	$0	$0	$0
Purchase Long-term Assets	$0	$0	$0	$0	$0
Dividends	$0	$0	$0	$0	$0
Subtotal Cash Spent	$2,016,443	$2,197,643	$2,229,746	$2,256,011	$2,280,173
Net Cash Flow	$2,287,583	$2,104,783	$2,072,680	$2,046,415	$2,022,253
Cash Balance	$2,787,583	$4,892,366	$6,965,046	$9,011,461	$11,033,714

Appendix 4: Balance sheet

Table: Balance Sheet

Pro Forma Balance Sheet Assets	2012	2013	2014	2015	2016
Current Assets					
Cash	$2,787,583	$4,892,366	$6,965,046	$9,011,461	$11,033,714
Other Current Assets	$0	$0	$0	$0	$0
Total Current Assets	$2,787,583	$4,892,366	$6,965,046	$9,011,461	$11,033,714
Long-term Assets					
Long-term Assets	$2,750,000	$2,750,000	$2,750,000	$2,750,000	$2,750,000
Accumulated Depreciation	$320,004	$576,004	$780,804	$944,644	$1,075,716
Total Long-term Assets	$2,429,996	$2,173,996	$1,969,196	$1,805,356	$1,674,284
Total Assets	$5,217,579	$7,066,362	$8,934,242	$10,816,817	$12,707,998
Liabilities and Capital	2012	2013	2014	2015	2016
Current Liabilities					
Accounts Payable	$154,434	$159,340	$160,830	$162,065	$163,096
Current Borrowing	$0	$0	$0	$0	$0
Other Current Liabilities	$0	$0	$0	$0	$0
Subtotal Current Liabilities	$154,434	$159,340	$160,830	$162,065	$163,096
Long-term Liabilities	$0	$0	$0	$0	$0
Total Liabilities	$154,434	$159,340	$160,830	$162,065	$163,096
Paid-in Capital	$3,410,000	$3,410,000	$3,410,000	$3,410,000	$3,410,000
Retained Earnings	($160,000)	$1,653,144	$3,497,022	$5,363,412	$7,244,752
Earnings	$1,813,144	$1,843,878	$1,866,390	$1,881,340	$1,890,150
Total Capital	$5,063,144	$6,907,022	$8,773,412	$10,654,752	$12,544,901
Total Liabilities and Capital	$5,217,579	$7,066,362	$8,934,242	$10,816,817	$12,707,998
Net Worth	$5,063,144	$6,907,022	$8,773,412	$10,654,752	$12,544,901

Appendix 4: Net Present Value & IRR

NPV Calculation:

EOY	**BTCF (A)**	**Cash flow for Income Taxes(B)=-(30%)*(A)**	**ATCF (C)=(A) +(B)**
0	$(3,410,000.00)		$ (3,410,000.00)
1	$ 2,590,206.00	$ (777,061.80)	$ 1,813,144.20
2	$ 2,634,111.00	$ (790,233.30)	$ 1,843,877.70
3	$ 2,666,271.00	$ (799,881.30)	$ 1,866,389.70
4	$ 2,687,628.00	$ (806,288.40)	$ 1,881,339.60
5	$ 2,700,214.00	$ (810,064.20)	$ 1,890,149.80
5	$ 160,000.00	$ (48,000.00)	$ 112,000.00
		NPV	$4,281,348 .00

Appendix 5: Payback period

EOY	Net Cash Flow (A)	Cumulative PW at i=0%yr through year k (B)	PW of Cash Flow (C)	Cumulative PW at i=7%yr through year k (D)
0	-$3,410,000.00	-$3,410,000.00	-$3,410,000.00	-$3,410,000.00
1	$1,813,144.20	-$1,596,855.80	$1,694,565.00	-$1,715,435.00
2	$1,843,877.70	$247,021.90	$1,610,443.00	-$104,992.00
3	$1,866,389.70	$2,113,411.60	$1,523,534.00	$1,418,542.00
4	$1,881,339.60	$3,994,751.20	$1,435,274.00	$2,853,816.00
5	$1,890,149.80	$5,884,901.00	$1,347,677.00	$4,201,493.00
5	$112,000.00	$5,996,901.00	$79,856.00	$4,281,349.00