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A Sensitivity Analysis on Oil and Gas Prices and How This Affects Sustainable Energy Implementation

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by

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APPROVED

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Abstract

A sensitivity analysis was performed to determine how variation of oil and gas prices affects the Net Present Value of sustainable energy technologies. The economic analysis was developed to determine if variations in fuel prices would alter a recommendation in a prior study of sustainable energy technology. Twenty five years of data was analyzed to determine the mean and to develop a sensitivity range of current fuel prices plus/minus one and two standard deviations. This created a range of five fuel prices in which the economic analysis, specifically Net Present Value, was performed. The results showed that most of the sustainable energy technologies that were recommended had Net Present Value responses proportionate to the change in fuel prices. In some cases, specifically a geothermal heat pump that was suggested in the prior study, this increase in fuel and gas prices increased the Net Present Value to become positive thus demonstrating that if we saw prices increase one standard deviation we would expect the geothermal to be a positive Net Present Value. This sensitivity analysis reflects how risks of errors in the forecast could be modelled to account for risks when performing an economic analysis, in turn making sustainable energy technologies more favorable to implement.

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Introduction

Moving toward more sustainable ways to convert energy is a common focus for businesses now that the importance of the environment is being brought to the forefront of our society. Current technologies that use fossil fuels have detrimental effects on land, air, and water in both the extraction process and the usage of these fuels. The natural resources available are degrading in quantity and quality from societies' exponential use and cannot last forever. One of the easiest ways that a business can become more sustainable is to look at its current technology, realize how much energy and money are spent on it, see what upgrade options are available that are more efficient and sustainable, and implement these upgrades.

The object of the study is to look at a prior study, *Critical Analysis of Sustainable Heating, Electrical, and Efficiency Retrofit Options for a Local Boarding School in Eastern New York*, which offered recommendations to a local boarding school of sustainable technology implementations based on the results of an economic analysis of the schools current heating and electrical technologies and financial records (Barrow, Fields, Genzel, Hamm, McCormack, Ohnesorge, Wickersham, 2015). The school currently heats with boilers using mainly fuel oil and occasionally propane. The prior study examined site specifics taking into consideration: location, aesthetic, upkeep, and profitability. Technologies evaluated included: biomass boilers, one central and three for individual buildings, air source heat pumps, geothermal heat pumps, wind turbines, photovoltaic panels, and lighting upgrades. The wind turbines and photovoltaic panels were recommendations to counteract electricity use from the grid. However the geographic location did not allow for optimum wind speeds and the area required for enough photovoltaic panels to generate a significant amount of electricity would impact the aesthetics that the school wanted to keep intact. For the lighting upgrades LED bulbs are recommended which would save the school money in the long run. For the different recommendations for replacing the heating boilers an economic analysis was done to look at how much the school would save by avoiding current fuel costs and how this would factor into the NPV and profitability of the investments in these sustainable technologies. The prior study offers an analysis on what the school should invest in for more sustainable heating and electricity options as well as looking into the schools efficiency specifically for lighting.

However this analysis was performed to determine the sensitivity results to the variability of oil and gas prices, specifically fuel oil number two and propane. The price of these two fuels drives the results of the economic analysis and ultimately the decision on an investment. With these two fuels, variability in price is important to look at since the economy and market prices constantly change. When the prices could affect the thousands of gallons of fuel the school needs to purchase annually for just a single building this possible variation in price should be considered. Through a sensitivity analysis changes in the price of fuel can be taken into consideration and it can be seen how these variations affect the end economic analysis.

Methods

In order to show sensitivity in this study, the metrics of mean and standard deviation are used. Prices are calculated above and below the mean by one and two standard deviations, this range was chosen to account for risks in the investment if the prices of fuel were to increase or decrease. Those above or below one standard deviation should include approximately 68% of the data values whereas those above or below by two standard deviations will include approximately 95% of the data assuming the data distribution is normal. These differences in standard deviation will represent appropriate reflections in the economic analysis that will adequately include most of the data about the mean.

Examining this data at a starting price of $2.405 escalating at 3% was used as the baseline price. One and two standard deviations above and below this were considered creating five variables to test resulting will be five different scenarios. From these variables the same method from the prior study will be applied to each in order to calculate the Net Present Value and Internal Rate of Return (IRR). Then decision rules will be applied with the overall investment suggestions being compared to that of the past proposal which did not include sensitivity to oil and gas prices.

In order to calculate a mean, a 25 year average was taken from the U.S. Energy Information Administration which provides the prices as dollars per gallon for both fuel oil number 2 and propane (U.S. Energy Information Administration, 2014). Knowing the five variables and the amount of fuel avoided each year the economic analysis can be performed. In order to calculate the Net Present Value, a discounted cash flow is generated taking into account the time value of money with the discount rate. With the electricity and price per gallon of fuel per year there has been an escalation rate of 3% applied to factor in growth of the economy. The sum of the future discounted cash flow for each year of the life of the technology minus the initial costs of the investment is the final value of Net Present Value (Figure 1).

Figure 1. Net Present Value Equation (Zizlavsky, 2014)

$$Net\ Present\ Value = \sum_{t=0}^{n} \frac{NCF_t}{(1+r)^t}$$

Where NCF_t = net cash flow, t = years, and r = discount rate. Our client is a private boarding school looking to implement new sustainable energy technologies, therefore the cash flow is going to be the avoided fuel costs of the current technology as well as other costs associated with the investment. That is to say what money they would normally be spending annually on fuel that is already allocated for in their budget. So then once they implement the new sustainable technology they would no longer be spending this money and it is seen as a positive cash flow. However this overall cash flow is cash inflow minus cash outflow. Therefore the cash outflow costs associated with the new technology are subtracted. This outflow includes maintenance and operation costs. Specifically for the biomass boilers the cost of the wood chips or pellets would be considered cash outflow as well as the electricity needed to run the geothermal and air source heat pumps.

The Internal Rate of Return is calculated through the IRR function in excel. This function shows at what discount rate the NPV for the investment would equal zero. Therefore those with a higher IRR are more desirable for investment purposes. In the attached appendices the sheets can be seen for the economic analysis, with the centralized biomass boiler Appendix A, individual boilers Appendix B, air-source heat pump Appendix C, and geothermal heat pump Appendix D.

Results

The results of these analyses are presented in Tables 1.0-4.0. Figure 1 shown below represents the overall sensitivity of each technology to changing fuel prices. With the fuel prices increasing and decreasing by 45.7% with each first standard deviation the percent NPV response was analyzed with most having an increase surpassing this percentage. When looking at the results of the central biomass boiler in Table 1.0 with an increase of one standard deviation about the mean the NPV increases by almost 92% from the current prices. In Table 2.1 the Medicine boiler NPV increases by roughly 133% with just one standard deviation increase in price. For the Whitaker building the NPV increases by almost 157% with just the one increase in standard deviation for the price. For the Air Source Heat Pump the increase was 51% when changing the price by plus one standard deviation. This increase was not enough however to make the investment value positive, the prices in this particular situation need to be increased to plus two standard deviations in order for the resulting NPV value to be positive. The Geothermal Heat Pump had the highest increase with an increase of 198% when increasing the fuel oil prices by one standard deviation. This technology had the highest positive response to the price change.

Table 1.0. Central Biomass Boiler NPV's and IRR percentages for each of the five variables about the current fuel price. Including the first year price of fuel oil and propane.

Variable	Year One Fuel Oil Price ($/gal)	Year One Propane Price ($/gal)	Net Present Value ($)	Internal Rate of Return
Highest Fuel Price	4.605	4.07	3,509,669.15	25%
High Fuel Price	3.505	3.30	2,372,922.70	18%
Current Fuel Price	2.405	2.53	1,236,176.25	10%
Low Fuel Price	1.305	1.76	99,429.80	1%
Lowest Fuel Price	0.205	0.99	(1,037,316.65)	N/A

Table 2.1. Medicine Biomass Boiler NPV's and IRR percentages for each of the five variables about the current fuel price. Including the first year price of fuel oil.

Variable	Year One Fuel Oil Price ($/gal)	Net Present Value ($)	Internal Rate of Return
Highest Fuel Oil Price	4.605	87,604.61	8%
High Fuel Oil Price	3.505	17,538.51	2%
Current Fuel Oil Price	2.405	(52,527.58)	-7%
Low Fuel Oil Price	1.305	(122,593.68)	N/A
Lowest Fuel Oil Price	0.205	(192,659.77)	N/A

Table 2.2. Neale Biomass Boiler NPV's and IRR percentages for each of the five variables about the current fuel price. Including the first year price of f

Variable	Year One Fuel Oil Price ($/gal)	Net Present Value ($)	Internal Rate of Return
Highest Fuel Oil Price	4.605	305,413.87	19%
High Fuel Oil Price	3.505	189,646.84	12%
Current Fuel Oil Price	2.405	73,879.80	5%
Low Fuel Oil Price	1.305	(41,887.23)	-4%
Lowest Fuel Oil Price	0.205	(157,654.27)	N/A

Table 2.3.Whitaker Biomass Boiler NPV's and IRR percentages for each of the five variables about the current fuel price. Including the first year price of fuel oil.

Variable	Year One Fuel Oil Price ($/gal)	Net Present Value ($)	Internal Rate of Return
Highest Fuel Oil Price	4.605	126,059.44	9%
High Fuel Oil Price	3.505	60,546.86	5%
Current Fuel Oil Price	2.405	(4,965.73)	0%
Low Fuel Oil Price	1.305	(70,478.32)	-9%
Lowest Fuel Oil Price	0.205	(135,990.90)	N/A

Table 3.0. Air Source Heat Pump NPV's and IRR percentages for each of the five variables about the current fuel price. Including the first year price of fuel oil.

Variable	Year One Fuel Oil Price ($/gal)	Net Present Value ($)	Internal Rate of Return
Highest Fuel Oil Price	4.605	243.59	1%
High Fuel Oil Price	3.505	(5,512.12)	-20%
Current Fuel Oil Price	2.405	(11,267.83)	N/A
Low Fuel Oil Price	1.305	(17,023.54)	N/A
Lowest Fuel Oil Price	0.205	(22,779.25)	N/A

Table 4.0. Geothermal Heat Pump NPV's and IRR percentages for each of the five variables about the current fuel price. Including the first year price of fuel oil.

Variable	Year One Fuel Oil Price ($/gal)	Net Present Value ($)	Internal Rate of Return
Highest Fuel Oil Price	4.605	86,468.51	9%
High Fuel Oil Price	3.505	34,726.12	4%
Current Fuel Oil Price	2.405	(35,339.98)	-5%
Low Fuel Oil Price	1.305	(105,406.07)	N/A
Lowest Fuel Oil Price	0.205	(157,148.47)	N/A

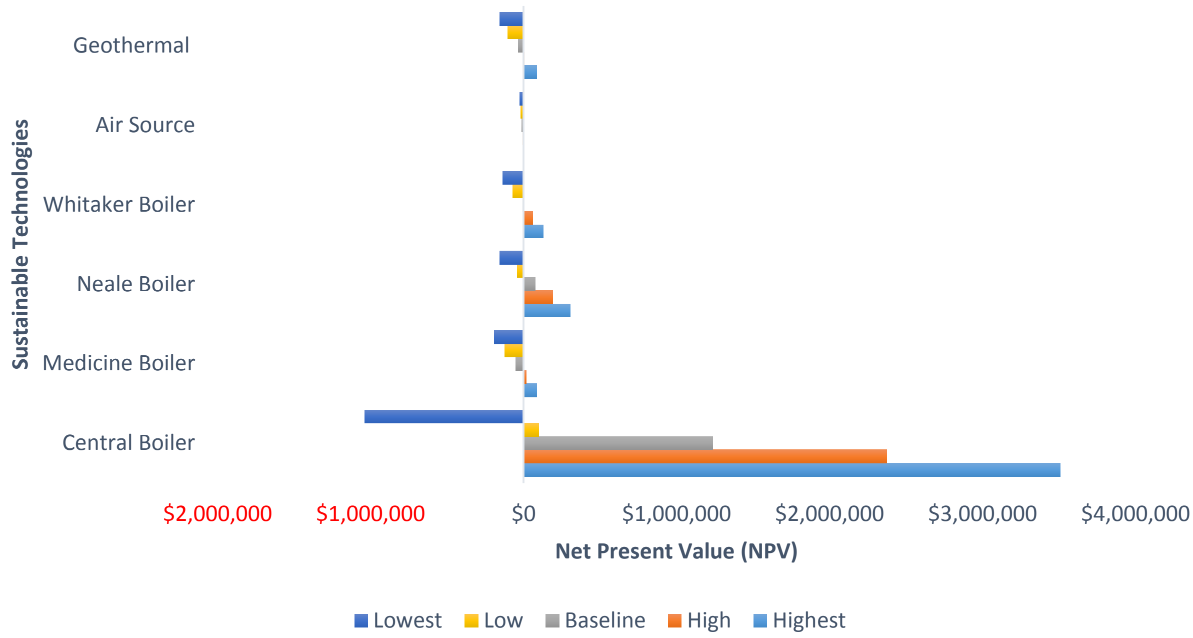

Figure 2.0. Sensitivity of Net Present Value of Different Sustainable Technologies, showing the values for each individual technology and the resulting NPV for each variable considered.

Discussion

Looking at the tables in the results section an overall trend can be seen of mostly negative NPV’s for the Lowest, Low, and Baseline variables. If these are compared to the exact results of the prior study it can be seen that the numbers while close, are in fact different. Since the prior study used actual financial statements to calculate how much fuel expense would be avoided the price of heating oil and propane are going to be different from this analysis. The boarding school paid a price that was almost a dollar more than the current average for upstate New York, which is what this analysis is based off of. Since the current price per gallon is smaller than that of the proceeding paper the overall avoided fuel expense is less creating a different NPV value.

That being said the focus is not so much on the specific numbers but how the numbers change within the sensitivity range. Looking at the High and Highest variable estimates the NPV numbers increase in every situation. This is because we are saying that the fuel prices are predicted to be larger which in turn creates a larger amount of avoided fuel oil expense which creates savings and a positive NPV. Like stated this increases the NPV values occurs in every situation, however in some this sensitivity range increases to a point where the NPV changes from a negative value and becomes positive. Once a NPV is positive the decision rules then dictates that the investment will be profitable should be made. Therefore such a conclusion can be made that if fuel prices are likely to rise in the future, some technologies that were ruled out for negative NPV's should be reconsidered.

One specific technology that had a NPV that turned positive with the higher fuel prices is the geothermal heat pump. This specific technology had the highest percent change from the current to plus one standard deviation in price with an almost 198% increase. As seen in Table 4.0 with the current fuel prices the NPV would be negative at -$35,339.98. The negative value indicates a loss of $35,339.98 if the project is implemented, so the investment should not be made. The NPV was also negative in the prior study and was recommended that the client not implement this technology. However with the fuel oil price adjusted with just one standard deviation above the NPV becomes positive at $34,726.12. When the NPV becomes positive even by a single dollar the investment is profitable and should be made. Once the increase in fuel prices is taken into consideration the investment suggestion made to the client then changes. When this kind of analysis is being done for a client a sensitivity range is important to take into consideration because it reduces the risk. Even though the future cannot accurately be predicted, this analysis can give the client a bigger picture into what the general trend of returns would be if the prices of fuel oil and propane were to increase or even decrease.

Conclusion

In order to confidently include risk of pricing trends into an investment suggestion this sensitivity analysis was conducted. Using a mean from 25 years of worth data and creating standard deviations, five variables of fuel oil and propane prices were created in order to show the sensitivity of Net Present Values for sustainable energy technologies. This inclusion of variation of prices can change the investment suggestions made to clients. If they are shown that fuel prices are following the general trend of fossil fuels and increasing in price and that in turn can lead to a more profitable investment in sustainable technology this could help increase the implementation of technology that is better for the planet

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Appendix A

Centralized Biomass Boiler Net Present Value with Sensitivity Range

NPV

Year	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Year Count	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Existing Costs																										
Fuel Oil Avoided (gal)																										
Dairy Barn		30892.9	30892.9	30892.9	30892.9	30892.9	30892.9	30892.9	30892.9	30892.9	30892.9	30892.9	30892.9	30892.9	30892.9	30892.9	30892.9	30892.9	30892.9	30892.9	30892.9	30892.9	30892.9	30892.9	30892.9	30892.9
Library		6060.8	6060.8	6060.8	6060.8	6060.8	6060.8	6060.8	6060.8	6060.8	6060.8	6060.8	6060.8	6060.8	6060.8	6060.8	6060.8	6060.8	6060.8	6060.8	6060.8	6060.8	6060.8	6060.8	6060.8	6060.8
Wickersham		12166.5	12166.5	12166.5	12166.5	12166.5	12166.5	12166.5	12166.5	12166.5	12166.5	12166.5	12166.5	12166.5	12166.5	12166.5	12166.5	12166.5	12166.5	12166.5	12166.5	12166.5	12166.5	12166.5	12166.5	12166.5
Total Fuel Oil Avoided		49120.2	49120.2	49120.2	49120.2	49120.2	49120.2	49120.2	49120.2	49120.2	49120.2	49120.2	49120.2	49120.2	49120.2	49120.2	49120.2	49120.2	49120.2	49120.2	49120.2	49120.2	49120.2	49120.2	49120.2	49120.2
Highest Fuel Oil Price Estimate ($/gal)		$ 4.61	$ 4.74	$ 4.89	$ 5.03	$ 5.18	$ 5.34	$ 5.50	$ 5.66	$ 5.83	$ 6.01	$ 6.19	$ 6.37	$ 6.57	$ 6.76	$ 6.97	$ 7.17	$ 7.39	$ 7.61	$ 7.84	$ 8.07	$ 8.32	$ 8.57	$ 8.82	$ 9.09	$ 9.36
High Fuel Oil Price Estimate ($/gal)		$ 3.51	$ 3.61	$ 3.72	$ 3.83	$ 3.94	$ 4.06	$ 4.19	$ 4.31	$ 4.44	$ 4.57	$ 4.71	$ 4.85	$ 5.00	$ 5.15	$ 5.30	$ 5.46	$ 5.62	$ 5.79	$ 5.97	$ 6.15	$ 6.33	$ 6.52	$ 6.72	$ 6.92	$ 7.12
Current Fuel Oil Price Estimate($/gal)		$ 2.41	$ 2.48	$ 2.55	$ 2.63	$ 2.71	$ 2.79	$ 2.87	$ 2.96	$ 3.05	$ 3.14	$ 3.23	$ 3.33	$ 3.43	$ 3.53	$ 3.64	$ 3.75	$ 3.86	$ 3.98	$ 4.09	$ 4.22	$ 4.34	$ 4.47	$ 4.61	$ 4.75	$ 4.89
Low Fuel Oil Price Estiamte ($/gal)		$ 1.31	$ 1.34	$ 1.38	$ 1.43	$ 1.47	$ 1.51	$ 1.56	$ 1.60	$ 1.65	$ 1.70	$ 1.75	$ 1.81	$ 1.86	$ 1.92	$ 1.97	$ 2.03	$ 2.09	$ 2.16	$ 2.22	$ 2.29	$ 2.36	$ 2.43	$ 2.50	$ 2.58	$ 2.65
Lowest Fuel Oil Price Estimate($/gal)		$ 0.21	$ 0.21	$ 0.22	$ 0.22	$ 0.23	$ 0.24	$ 0.24	$ 0.25	$ 0.26	$ 0.27	$ 0.28	$ 0.28	$ 0.29	$ 0.30	$ 0.31	$ 0.32	$ 0.33	$ 0.34	$ 0.35	$ 0.36	$ 0.37	$ 0.38	$ 0.39	$ 0.40	$ 0.42
Highest Estimate- Avoided Fuel Oil Expense		$226,198.52	$232,984.48	$239,974.01	$247,173.23	$254,588.43	$262,226.08	$270,092.86	$278,195.65	$286,541.52	$295,137.76	$303,991.90	$313,111.65	$322,505.00	$332,180.15	$342,145.56	$352,409.93	$362,982.22	$373,871.69	$385,087.84	$396,640.48	$408,539.69	$420,795.88	$433,419.76	$446,422.35	$459,815.02
High Estimate- Avoided Fuel Oil Expense		$172,166.30	$177,331.29	$182,651.23	$188,130.77	$193,774.69	$199,587.93	$205,575.57	$211,742.83	$218,095.12	$224,637.97	$231,377.11	$238,318.43	$245,467.98	$252,832.02	$260,416.98	$268,229.49	$276,276.37	$284,564.66	$293,101.60	$301,894.65	$310,951.49	$320,280.04	$329,888.44	$339,785.09	$349,978.64
Current Estimate Avoided Fuel Oil Expense		$118,134.08	$121,678.10	$125,328.45	$129,088.30	$132,960.95	$136,949.78	$141,058.27	$145,290.02	$149,648.72	$154,138.18	$158,762.33	$163,525.20	$168,430.95	$173,483.88	$178,688.40	$184,049.05	$189,570.52	$195,257.64	$201,115.37	$207,148.83	$213,363.29	$219,764.19	$226,357.12	$233,147.83	$240,142.26
Low Estimate- Avoided Fuel Oil Expense		$ 64,101.86	$ 66,024.92	$ 68,005.66	$ 70,045.83	$ 72,147.21	$ 74,311.63	$ 76,540.97	$ 78,837.20	$ 81,202.32	$ 83,638.39	$ 86,147.54	$ 88,731.97	$ 91,393.93	$ 94,135.74	$ 96,959.82	$ 99,868.61	$102,864.67	$105,950.61	$109,129.13	$112,403.00	$115,775.09	$119,248.34	$122,825.79	$126,510.57	$130,305.89
Lowest Estimate- Avoided Fuel Oil Expense		$ 10,069.64	$ 10,371.73	$ 10,682.88	$ 11,003.37	$ 11,333.47	$ 11,673.47	$ 12,023.68	$ 12,384.39	$ 12,755.92	$ 13,138.60	$ 13,532.76	$ 13,938.74	$ 14,356.90	$ 14,787.61	$ 15,231.24	$ 15,688.17	$ 16,158.82	$ 16,643.58	$ 17,142.89	$ 17,657.18	$ 18,186.89	$ 18,732.50	$ 19,294.47	$ 19,873.31	$ 20,469.51
Propane costs																										
Propane Avoided (gal)		7181.6	7181.6	7181.6	7181.6	7181.6	7181.6	7181.6	7181.6	7181.6	7181.6	7181.6	7181.6	7181.6	7181.6	7181.6	7181.6	7181.6	7181.6	7181.6	7181.6	7181.6	7181.6	7181.6	7181.6	7181.6
Highest Estimate Propane Price ($/gal)		$ 4.07	$ 4.19	$ 4.32	$ 4.45	$ 4.58	$ 4.72	$ 4.86	$ 5.01	$ 5.16	$ 5.31	$ 5.47	$ 5.63	$ 5.80	$ 5.98	$ 6.16	$ 6.34	$ 6.53	$ 6.73	$ 6.93	$ 7.14	$ 7.35	$ 7.57	$ 7.80	$ 8.03	$ 8.27
High Estimate Propane Price ($/gal)		$ 3.30	$ 3.40	$ 3.50	$ 3.61	$ 3.71	$ 3.83	$ 3.94	$ 4.06	$ 4.18	$ 4.31	$ 4.43	$ 4.57	$ 4.71	$ 4.85	$ 4.99	$ 5.14	$ 5.30	$ 5.45	$ 5.62	$ 5.79	$ 5.96	$ 6.14	$ 6.32	$ 6.51	$ 6.71
Current Estimate Propane Price ($/gal)		$ 2.53	$ 2.61	$ 2.68	$ 2.76	$ 2.85	$ 2.93	$ 3.02	$ 3.11	$ 3.20	$ 3.30	$ 3.40	$ 3.50	$ 3.61	$ 3.72	$ 3.83	$ 3.94	$ 4.06	$ 4.18	$ 4.31	$ 4.44	$ 4.57	$ 4.71	$ 4.85	$ 4.99	$ 5.14
Low Estimate Propane Price ($/gal)		$ 1.76	$ 1.81	$ 1.87	$ 1.92	$ 1.98	$ 2.04	$ 2.10	$ 2.16	$ 2.23	$ 2.30	$ 2.37	$ 2.44	$ 2.51	$ 2.58	$ 2.66	$ 2.74	$ 2.82	$ 2.91	$ 3.00	$ 3.09	$ 3.18	$ 3.27	$ 3.37	$ 3.47	$ 3.58
Lowest Estimate Propane Price ($/gal)		$ 0.99	$ 1.02	$ 1.05	$ 1.08	$ 1.11	$ 1.15	$ 1.18	$ 1.22	$ 1.25	$ 1.29	$ 1.33	$ 1.37	$ 1.41	$ 1.45	$ 1.50	$ 1.54	$ 1.59	$ 1.64	$ 1.69	$ 1.74	$ 1.79	$ 1.84	$ 1.90	$ 1.95	$ 2.01
Highest Estimate Avoided Propane Expense		$ 29,229.11	$ 30,105.99	$ 31,009.16	$ 31,939.44	$ 32,897.62	$ 33,884.55	$ 34,901.09	$ 35,948.12	$ 37,026.56	$ 38,137.36	$ 39,281.48	$ 40,459.93	$ 41,673.72	$ 42,923.94	$ 44,211.65	$ 45,538.00	$ 46,904.14	$ 48,311.27	$ 49,760.61	$ 51,253.42	$ 52,791.03	$ 54,374.76	$ 56,006.00	$ 57,686.18	$ 59,416.77
High Estimate Avoided Propane Expense		$ 23,699.28	$ 24,410.26	$ 25,142.57	$ 25,896.84	$ 26,673.75	$ 27,473.96	$ 28,298.18	$ 29,147.13	$ 30,021.54	$ 30,922.19	$ 31,849.85	$ 32,805.35	$ 33,789.51	$ 34,803.19	$ 35,847.29	$ 36,922.71	$ 38,030.39	$ 39,171.30	$ 40,346.44	$ 41,556.83	$ 42,803.54	$ 44,087.64	$ 45,410.27	$ 46,772.58	$ 48,175.76
Current Estimate Avoided Propane Expense		$ 18,169.45	$ 18,714.53	$ 19,275.97	$ 19,854.25	$ 20,449.87	$ 21,063.37	$ 21,695.27	$ 22,346.13	$ 23,016.51	$ 23,707.01	$ 24,418.22	$ 25,150.77	$ 25,905.29	$ 26,682.45	$ 27,482.92	$ 28,307.41	$ 29,156.63	$ 30,031.33	$ 30,932.27	$ 31,860.24	$ 32,816.04	$ 33,800.53	$ 34,814.54	$ 35,858.98	$ 36,934.75
Low Estimate Avoided Propane Expense		$ 12,639.62	$ 13,018.80	$ 13,409.37	$ 13,811.65	$ 14,226.00	$ 14,652.78	$ 15,092.36	$ 15,545.13	$ 16,011.49	$ 16,491.83	$ 16,986.59	$ 17,496.18	$ 18,021.07	$ 18,561.70	$ 19,118.55	$ 19,692.11	$ 20,282.87	$ 20,891.36	$ 21,518.10	$ 22,163.64	$ 22,828.55	$ 23,513.41	$ 24,218.81	$ 24,945.38	$ 25,693.74
Lowest Estimate Avoided Propane Expense		$ 7,109.78	$ 7,323.08	$ 7,542.77	$ 7,769.05	$ 8,002.12	$ 8,242.19	$ 8,489.45	$ 8,744.14	$ 9,006.46	$ 9,276.66	$ 9,554.96	$ 9,841.60	$ 10,136.85	$ 10,440.96	$ 10,754.19	$ 11,076.81	$ 11,409.12	$ 11,751.39	$ 12,103.93	$ 12,467.05	$ 12,841.06	$ 13,226.29	$ 13,623.08	$ 14,031.77	$ 14,452.73
Highest Estiamte- Total Avoided Fuel Expense		$255,427.63	$263,090.46	$270,983.18	$279,112.67	$287,486.05	$296,110.63	$304,993.95	$314,143.77	$323,568.08	$333,275.13	$343,273.38	$353,571.58	$364,178.73	$375,104.09	$386,357.21	$397,947.93	$409,886.37	$422,182.96	$434,848.45	$447,893.90	$461,330.72	$475,170.64	$489,425.76	$504,108.53	$519,231.79
High Estimate- Total Avoided Fuel Expense		$195,865.58	$201,741.55	$207,793.79	$214,027.61	$220,448.44	$227,061.89	$233,873.75	$240,889.96	$248,116.66	$255,560.16	$263,226.96	$271,123.77	$279,257.48	$287,635.21	$296,264.27	$305,152.19	$314,306.76	$323,735.96	$333,448.04	$343,451.48	$353,755.03	$364,367.68	$375,298.71	$386,557.67	$398,154.40
Current Estimate- Total Avoided Fuel Expense		$136,303.53	$140,392.63	$144,604.41	$148,942.55	$153,410.82	$158,013.15	$162,753.54	$167,636.15	$172,665.23	$177,845.19	$183,180.55	$188,675.96	$194,336.24	$200,166.33	$206,171.32	$212,356.46	$218,727.15	$225,288.97	$232,047.63	$239,009.06	$246,179.34	$253,564.72	$261,171.66	$269,006.81	$277,077.01
Low Estimate- Total Avoided Fuel Expense		$ 76,741.48	$ 79,043.72	$ 81,415.03	$ 83,857.48	$ 86,373.21	$ 88,964.40	$ 91,633.34	$ 94,382.34	$ 97,213.81	$100,130.22	$103,134.13	$106,228.15	$109,415.00	$112,697.45	$116,078.37	$119,560.72	$123,147.54	$126,841.97	$130,647.23	$134,566.64	$138,603.64	$142,761.75	$147,044.61	$151,455.94	$155,999.62
Lowest Estimate- Total Avoided Fuel Expense		$ 17,179.43	$ 17,694.81	$ 18,225.65	$ 18,772.42	$ 19,335.59	$ 19,915.66	$ 20,513.13	$ 21,128.53	$ 21,762.38	$ 22,415.25	$ 23,087.71	$ 23,780.34	$ 24,493.75	$ 25,228.56	$ 25,985.42	$ 26,764.98	$ 27,567.93	$ 28,394.97	$ 29,246.82	$ 30,124.23	$ 31,027.95	$ 31,958.79	$ 32,917.55	$ 33,905.08	$ 34,922.23
Costs of Centralized Biomass Boiler																										
Boilers + Storage Tank After Incentives	$ 118,250.00																									
Installation of the Froling Boiler	$ 43,000.00																									
Torsion Arm Agitator	$ 10,000.00																									
Piping and Installation (1,800 dollars/meter)	$ 270,000.00																									
Steel Frame Building with Storage (250 dollars/sqft)	$ 218,000.00																									
Building Conversion from Steam to Hydronics (3 dollars/sqft)	$ 121,722.00																									
O & M cost for Froling (1% of Investment per Year)		$ 9,317.22	$ 9,317.22	$ 9,317.22	$ 9,317.22	$ 9,317.22	$ 9,317.22	$ 9,317.22	$ 9,317.22	$ 9,317.22	$ 9,317.22	$ 9,317.22	$ 9,317.22	$ 9,317.22	$ 9,317.22	$ 9,317.22	$ 9,317.22	$ 9,317.22	$ 9,317.22	$ 9,317.22	$ 9,317.22	$ 9,317.22	$ 9,317.22	$ 9,317.22	$ 9,317.22	$ 9,317.22
Costs of Wood Chips																										
Tons of Wood Chips Required		616.65	616.65	616.65	616.65	616.65	616.65	616.65	616.65	616.65	616.65	616.65	616.65	616.65	616.65	616.65	616.65	616.65	616.65	616.65	616.65	616.65	616.65	616.65	616.65	616.65
Wood Chip Price ($/ton)		$ 42.74	$ 43.59	$ 44.47	$ 45.36	$ 46.26	$ 47.19	$ 48.13	$ 49.09	$ 50.08	$ 51.08	$ 52.10	$ 53.14	$ 54.20	$ 55.29	$ 56.39	$ 57.52	$ 58.67	$ 59.85	$ 61.04	$ 62.26	$ 63.51	$ 64.78	$ 66.08	$ 67.40	$ 68.74
Cost of Wood Chips		$ 26,355.62	$ 26,882.73	$ 27,420.39	$ 27,968.80	$ 28,528.17	$ 29,098.74	$ 29,680.71	$ 30,274.32	$ 30,879.81	$ 31,497.41	$ 32,127.35	$ 32,769.90	$ 33,425.30	$ 34,093.81	$ 34,775.68	$ 35,471.20	$ 36,180.62	$ 36,904.23	$ 37,642.32	$ 38,395.16	$ 39,163.07	$ 39,946.33	$ 40,745.25	$ 41,560.16	$ 42,391.36
Cash Flow																										
Highest Estimate - Discounted Cash Flow	$ (780,972.00)	$209,290.28	$205,796.38	$202,350.13	$198,951.39	$195,599.99	$192,295.74	$189,038.41	$185,827.75	$182,663.51	$179,545.38	$176,473.05	$173,446.20	$170,464.48	$167,527.54	$164,634.99	$161,786.44	$158,981.51	$156,219.77	$153,500.81	$150,824.21	$148,189.51	$145,596.28	$143,044.08	$140,532.44	$138,060.90
High Estimate - Discounted Cash Flow	$ (780,972.00)	$152,564.51	$150,151.11	$147,764.77	$145,405.75	$143,074.26	$140,770.50	$138,494.60	$136,246.69	$134,026.85	$131,835.13	$129,671.57	$127,536.18	$125,428.94	$123,349.81	$121,298.74	$119,275.65	$117,280.44	$115,313.01	$113,373.23	$111,460.96	$109,576.04	$107,718.31	$105,887.59	$104,083.69	$102,306.41
Current Estimate - Discounted Cash Flow	$ (780,972.00)	$ 95,838.75	$ 94,505.83	$ 93,179.40	$ 91,860.10	$ 90,548.54	$ 89,245.27	$ 87,950.80	$ 86,665.63	$ 85,390.18	$ 84,124.88	$ 82,870.09	$ 81,626.15	$ 80,393.39	$ 79,172.08	$ 77,962.49	$ 76,764.85	$ 75,579.37	$ 74,406.25	$ 73,245.65	$ 72,097.71	$ 70,962.56	$ 69,840.33	$ 68,731.09	$ 67,634.94	$ 66,551.92
Low Estimate - Discounted Cash Flow	$ (780,972.00)	$ 39,112.99	$ 38,860.56	$ 38,594.04	$ 38,314.46	$ 38,022.81	$ 37,720.03	$ 37,407.00	$ 37,084.57	$ 36,753.52	$ 36,414.63	$ 36,068.60	$ 35,716.13	$ 35,357.84	$ 34,994.35	$ 34,626.24	$ 34,254.05	$ 33,878.31	$ 33,499.49	$ 33,118.06	$ 32,734.46	$ 32,349.09	$ 31,962.35	$ 31,574.60	$ 31,186.19	$ 30,797.43
Lowest Estimate - Discounted Cash Flow	$ (780,972.00)	$ (17,612.78)	$ (16,784.71)	$ (15,991.32)	$ (15,231.18)	$ (14,502.91)	$ (13,805.20)	$ (13,136.80)	$ (12,496.50)	$ (11,883.14)	$ (11,295.62)	$ (10,732.88)	$ (10,193.90)	$ (9,677.71)	$ (9,183.38)	$ (8,710.01)	$ (8,256.74)	$ (7,822.76)	$ (7,407.27)	$ (7,009.52)	$ (6,628.79)	$ (6,264.38)	$ (5,915.63)	$ (5,581.89)	$ (5,262.56)	$ (4,957.06)
NPV																										
Net Present Value with Highest Fuel Oil Price Estiamte over 25 years	**$ 3,509,669.15**																									
Net Present Value with High Fuel Oil Price Estiamte over 25 years	**$ 2,372,922.70**																									
Net Present Value with Current Fuel Oil Price Estiamte over 25 years	**$ 1,236,176.25**																									
Net Present Value with Low Fuel Oil Price Estiamte over 25 years	**$ 99,429.80**																									
Net Present Value with Lowest Fuel Oil Price Estiamte over 25 years	**$ (1,037,316.65)**																									
IRR																										
Internal Rate of Return with Highest Fuel Oil Price Estimate	**25%**																									
Internal Rate of Return with High Fuel Oil Price Estimate	**18%**																									
Internal Rate of Return with Current Fuel Oil Price Estimate	**10%**																									
Internal Rate of Return with Low Fuel Oil Price Estimate	**1%**																									
Internal Rate of Return with Lowest Fuel Oil Price Estimate	**#NUM!**																									

Appendix B

Medicine Biomass Boiler Net Present Value with Sensitivity Range

	NPV												
Year	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Year Count	0	1	2	3	4	5	6	7	8	9	10	11	12
Existing Costs													
Fuel Oil Avoided (gal)		3337.5	3337.5	3337.5	3337.5	3337.5	3337.5	3337.5	3337.5	3337.5	3337.5	3337.5	3337.5
Highest Fuel Oil Price Estimate ($/gal)		$ 4.61	$ 4.74	$ 4.89	$ 5.03	$ 5.18	$ 5.34	$ 5.50	$ 5.66	$ 5.83	$ 6.01	$ 6.19	$ 6.37
High Fuel Oil Price Estimate ($/gal)		$ 3.51	$ 3.61	$ 3.72	$ 3.83	$ 3.94	$ 4.06	$ 4.19	$ 4.31	$ 4.44	$ 4.57	$ 4.71	$ 4.85
Current Fuel Oil Price Estimate($/gal)		$ 2.41	$ 2.48	$ 2.55	$ 2.63	$ 2.71	$ 2.79	$ 2.87	$ 2.96	$ 3.05	$ 3.14	$ 3.23	$ 3.33
Low Fuel Oil Price Estiamte ($/gal)		$ 1.31	$ 1.34	$ 1.38	$ 1.43	$ 1.47	$ 1.51	$ 1.56	$ 1.60	$ 1.65	$ 1.70	$ 1.75	$ 1.81
Lowest Fuel Oil Price Estimate($/gal)		$ 0.21	$ 0.21	$ 0.22	$ 0.22	$ 0.23	$ 0.24	$ 0.24	$ 0.25	$ 0.26	$ 0.27	$ 0.28	$ 0.28
Highest Estimate- Avoided Fuel Oil Expense		$15,369.19	$15,830.26	$16,305.17	$16,794.33	$17,298.16	$17,817.10	$18,351.61	$18,902.16	$19,469.23	$20,053.30	$20,654.90	$21,274.55
High Estimate- Avoided Fuel Oil Expense		$11,697.94	$12,048.88	$12,410.34	$12,782.65	$13,166.13	$13,561.12	$13,967.95	$14,386.99	$14,818.60	$15,263.16	$15,721.05	$16,192.68
Current Estimate Avoided Fuel Oil Expense		$ 8,026.69	$ 8,267.49	$ 8,515.51	$ 8,770.98	$ 9,034.11	$ 9,305.13	$ 9,584.28	$ 9,871.81	$10,167.97	$10,473.01	$10,787.20	$11,110.81
Low Estimate- Avoided Fuel Oil Expense		$ 4,355.44	$ 4,486.10	$ 4,620.68	$ 4,759.30	$ 4,902.08	$ 5,049.15	$ 5,200.62	$ 5,356.64	$ 5,517.34	$ 5,682.86	$ 5,853.34	$ 6,028.94
Lowest Estimate- Avoided Fuel Oil Expense		$ 684.19	$ 704.71	$ 725.85	$ 747.63	$ 770.06	$ 793.16	$ 816.96	$ 841.46	$ 866.71	$ 892.71	$ 919.49	$ 947.08
Costs of Medicine Biomass Boiler													
Boilers + Storage Tank After Incentives	$ 25,960.00												
Installation of the Boiler	$ 9,440.00												
Torsion Arm Agitator	$ 10,000.00												
Steel Frame Building with Storage (250 dollars/sqft)	$ 26,250.00												
O & M cost for Froling (2% of Investment per Year)		$ 1,857.80	$ 1,857.80	$ 1,857.80	$ 1,857.80	$ 1,857.80	$ 1,857.80	$ 1,857.80	$ 1,857.80	$ 1,857.80	$ 1,857.80	$ 1,857.80	$ 1,857.80
Costs of Wood Pellets													
Tons of Wood Pellets Required		24.62	24.62	24.62	24.62	24.62	24.62	24.62	24.62	24.62	24.62	24.62	24.62
Wood Pellet Price ($/ton)		$ 255.00	$ 260.10	$ 265.30	$ 270.61	$ 276.02	$ 281.54	$ 287.17	$ 292.91	$ 298.77	$ 304.75	$ 310.84	$ 317.06
Cost of Wood Pellets		$ 6,278.10	$ 6,403.66	$ 6,531.74	$ 6,662.37	$ 6,795.62	$ 6,931.53	$ 7,070.16	$ 7,211.56	$ 7,355.79	$ 7,502.91	$ 7,652.97	$ 7,806.03
Cash Flow													
Highest Estimate - Discounted Cash Flow	$ (71,650.00)	$ 6,888.85	$ 6,865.13	$ 6,837.82	$ 6,807.17	$ 6,773.38	$ 6,736.66	$ 6,697.21	$ 6,655.23	$ 6,610.87	$ 6,564.32	$ 6,515.74	$ 6,465.28
High Estimate - Discounted Cash Flow	$ (71,650.00)	$ 3,392.42	$ 3,435.30	$ 3,473.32	$ 3,506.75	$ 3,535.83	$ 3,560.78	$ 3,581.83	$ 3,599.18	$ 3,613.03	$ 3,623.59	$ 3,631.02	$ 3,635.51
Current Estimate - Discounted Cash Flow	$ (71,650.00)	$ (104.01)	$ 5.47	$ 108.82	$ 206.34	$ 298.28	$ 384.90	$ 466.44	$ 543.13	$ 615.20	$ 682.85	$ 746.30	$ 805.74
Low Estimate - Discounted Cash Flow	$ (71,650.00)	$ (3,600.44)	$ (3,424.36)	$ (3,255.68)	$ (3,094.07)	$ (2,939.27)	$ (2,790.98)	$ (2,648.95)	$ (2,512.92)	$ (2,382.64)	$ (2,257.88)	$ (2,138.42)	$ (2,024.04)
Lowest Estimate - Discounted Cash Flow	$ (71,650.00)	$ (7,096.87)	$ (6,854.19)	$ (6,620.18)	$ (6,394.49)	$ (6,176.82)	$ (5,966.86)	$ (5,764.34)	$ (5,568.97)	$ (5,380.48)	$ (5,198.62)	$ (5,023.14)	$ (4,853.81)
NPV													
Net Present Value with Highest Fuel Oil Price Estiamte over 25 years	**$ 87,604.61**												
Net Present Value with High Fuel Oil Price Estiamte over 25 years	**$ 17,538.51**												
Net Present Value with Current Fuel Oil Price Estiamte over 25 years	**$ (52,527.58)**												
Net Present Value with Low Fuel Oil Price Estiamte over 25 years	**$ (122,593.68)**												
Net Present Value with Lowest Fuel Oil Price Estiamte over 25 years	**$ (192,659.77)**												
IRR													
Internal Rate of Return with Highest Fuel Oil Price Estimate	**8%**												
Internal Rate of Return with High Fuel Oil Price Estimate	**2%**												
Internal Rate of Return with Current Fuel Oil Price Estimate	**-7%**												
Internal Rate of Return with Low Fuel Oil Price Estimate	**#NUM!**												
Internal Rate of Return with Lowest Fuel Oil Price Estimate	**#NUM!**												

Year	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Year Count	13	14	15	16	17	18	19	20	21	22	23	24	25
Fuel Oil Avoided (gal)	3337.5	3337.5	3337.5	3337.5	3337.5	3337.5	3337.5	3337.5	3337.5	3337.5	3337.5	3337.5	3337.5
Highest Fuel Oil Price Estimate ($/gal)	$ 6.57	$ 6.76	$ 6.97	$ 7.17	$ 7.39	$ 7.61	$ 7.84	$ 8.07	$ 8.32	$ 8.57	$ 8.82	$ 9.09	$ 9.36
High Fuel Oil Price Estimate ($/gal)	$ 5.00	$ 5.15	$ 5.30	$ 5.46	$ 5.62	$ 5.79	$ 5.97	$ 6.15	$ 6.33	$ 6.52	$ 6.72	$ 6.92	$ 7.12
Current Fuel Oil Price Estimate($/gal)	$ 3.43	$ 3.53	$ 3.64	$ 3.75	$ 3.86	$ 3.98	$ 4.09	$ 4.22	$ 4.34	$ 4.47	$ 4.61	$ 4.75	$ 4.89
Low Fuel Oil Price Estiamte ($/gal)	$ 1.86	$ 1.92	$ 1.97	$ 2.03	$ 2.09	$ 2.16	$ 2.22	$ 2.29	$ 2.36	$ 2.43	$ 2.50	$ 2.58	$ 2.65
Lowest Fuel Oil Price Estimate($/gal)	$ 0.29	$ 0.30	$ 0.31	$ 0.32	$ 0.33	$ 0.34	$ 0.35	$ 0.36	$ 0.37	$ 0.38	$ 0.39	$ 0.40	$ 0.42
Highest Estimate- Avoided Fuel Oil Expense	$21,912.79	$22,570.17	$23,247.28	$23,944.69	$24,663.03	$25,402.93	$26,165.01	$26,949.96	$27,758.46	$28,591.22	$29,448.95	$30,332.42	$31,242.39
High Estimate- Avoided Fuel Oil Expense	$16,678.46	$17,178.82	$17,694.18	$18,225.01	$18,771.76	$19,334.91	$19,914.96	$20,512.40	$21,127.78	$21,761.61	$22,414.46	$23,086.89	$23,779.50
Current Estimate Avoided Fuel Oil Expense	$11,444.14	$11,787.46	$12,141.09	$12,505.32	$12,880.48	$13,266.89	$13,664.90	$14,074.85	$14,497.09	$14,932.00	$15,379.96	$15,841.36	$16,316.60
Low Estimate- Avoided Fuel Oil Expense	$ 6,209.81	$ 6,396.11	$ 6,587.99	$ 6,785.63	$ 6,989.20	$ 7,198.87	$ 7,414.84	$ 7,637.29	$ 7,866.40	$ 8,102.40	$ 8,345.47	$ 8,595.83	$ 8,853.71
Lowest Estimate- Avoided Fuel Oil Expense	$ 975.49	$ 1,004.75	$ 1,034.89	$ 1,065.94	$ 1,097.92	$ 1,130.86	$ 1,164.78	$ 1,199.73	$ 1,235.72	$ 1,272.79	$ 1,310.97	$ 1,350.30	$ 1,390.81
O & M cost for Froling (2% of Investment per Year)	$ 1,857.80	$ 1,857.80	$ 1,857.80	$ 1,857.80	$ 1,857.80	$ 1,857.80	$ 1,857.80	$ 1,857.80	$ 1,857.80	$ 1,857.80	$ 1,857.80	$ 1,857.80	$ 1,857.80
Tons of Wood Pellets Required	24.62	24.62	24.62	24.62	24.62	24.62	24.62	24.62	24.62	24.62	24.62	24.62	24.62
Wood Pellet Price ($/ton)	$ 323.40	$ 329.87	$ 336.47	$ 343.20	$ 350.06	$ 357.06	$ 364.20	$ 371.49	$ 378.92	$ 386.49	$ 394.22	$ 402.11	$ 410.15
Cost of Wood Pellets	$ 7,962.15	$ 8,121.39	$ 8,283.82	$ 8,449.50	$ 8,618.49	$ 8,790.86	$ 8,966.67	$ 9,146.01	$ 9,328.93	$ 9,515.50	$ 9,705.81	$ 9,899.93	$10,097.93
Highest Estimate - Discounted Cash Flow	$ 6,413.09	$ 6,359.30	$ 6,304.04	$ 6,247.45	$ 6,189.63	$ 6,130.70	$ 6,070.77	$ 6,009.94	$ 5,948.30	$ 5,885.94	$ 5,822.95	$ 5,759.42	$ 5,695.41
High Estimate - Discounted Cash Flow	$ 3,637.22	$ 3,636.30	$ 3,632.91	$ 3,627.19	$ 3,619.29	$ 3,609.32	$ 3,597.41	$ 3,583.69	$ 3,568.26	$ 3,551.24	$ 3,532.72	$ 3,512.81	$ 3,491.59
Current Estimate - Discounted Cash Flow	$ 861.34	$ 913.30	$ 961.78	$ 1,006.94	$ 1,048.94	$ 1,087.93	$ 1,124.05	$ 1,157.44	$ 1,188.23	$ 1,216.54	$ 1,242.49	$ 1,266.20	$ 1,287.78
Low Estimate - Discounted Cash Flow	$ (1,914.53)	$ (1,809.70)	$ (1,709.36)	$ (1,613.32)	$ (1,521.40)	$ (1,433.46)	$ (1,349.31)	$ (1,268.81)	$ (1,191.80)	$ (1,118.16)	$ (1,047.74)	$ (980.40)	$ (916.04)
Lowest Estimate - Discounted Cash Flow	$ (4,690.41)	$ (4,532.70)	$ (4,380.49)	$ (4,233.57)	$ (4,091.75)	$ (3,954.84)	$ (3,822.67)	$ (3,695.05)	$ (3,571.84)	$ (3,452.86)	$ (3,337.97)	$ (3,227.01)	$ (3,119.85)

Neale Biomass Boiler Net Present Value with Sensitivity Range

	NPV												
Year	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Year Count	0	1	2	3	4	5	6	7	8	9	10	11	12
Existing Costs													
Fuel Oil Avoided (gal)		5514.4	5514.4	5514.4	5514.4	5514.4	5514.4	5514.4	5514.4	5514.4	5514.4	5514.4	5514.4
Highest Fuel Oil Price Estimate ($/gal)		$ 4.61	$ 4.74	$ 4.89	$ 5.03	$ 5.18	$ 5.34	$ 5.50	$ 5.66	$ 5.83	$ 6.01	$ 6.19	$ 6.37
High Fuel Oil Price Estimate ($/gal)		$ 3.51	$ 3.61	$ 3.72	$ 3.83	$ 3.94	$ 4.06	$ 4.19	$ 4.31	$ 4.44	$ 4.57	$ 4.71	$ 4.85
Current Fuel Oil Price Estimate($/gal)		$ 2.41	$ 2.48	$ 2.55	$ 2.63	$ 2.71	$ 2.79	$ 2.87	$ 2.96	$ 3.05	$ 3.14	$ 3.23	$ 3.33
Low Fuel Oil Price Estiamte ($/gal)		$ 1.31	$ 1.34	$ 1.38	$ 1.43	$ 1.47	$ 1.51	$ 1.56	$ 1.60	$ 1.65	$ 1.70	$ 1.75	$ 1.81
Lowest Fuel Oil Price Estimate($/gal)		$ 0.21	$ 0.21	$ 0.22	$ 0.22	$ 0.23	$ 0.24	$ 0.24	$ 0.25	$ 0.26	$ 0.27	$ 0.28	$ 0.28
Highest Estimate- Avoided Fuel Oil Expense		$ 25,393.81	$26,155.63	$26,940.30	$27,748.50	$28,580.96	$29,438.39	$30,321.54	$31,231.19	$32,168.12	$33,133.16	$34,127.16	$35,150.97
High Estimate- Avoided Fuel Oil Expense		$ 19,327.97	$19,907.81	$20,505.05	$21,120.20	$21,753.80	$22,406.42	$23,078.61	$23,770.97	$24,484.10	$25,218.62	$25,975.18	$26,754.43
Current Estimate Avoided Fuel Oil Expense		$ 13,262.13	$13,660.00	$14,069.80	$14,491.89	$14,926.65	$15,374.45	$15,835.68	$16,310.75	$16,800.07	$17,304.07	$17,823.20	$18,357.89
Low Estimate- Avoided Fuel Oil Expense		$ 7,196.29	$ 7,412.18	$ 7,634.55	$ 7,863.58	$ 8,099.49	$ 8,342.47	$ 8,592.75	$ 8,850.53	$ 9,116.05	$ 9,389.53	$ 9,671.21	$ 9,961.35
Lowest Estimate- Avoided Fuel Oil Expense		$ 1,130.45	$ 1,164.37	$ 1,199.30	$ 1,235.28	$ 1,272.33	$ 1,310.50	$ 1,349.82	$ 1,390.31	$ 1,432.02	$ 1,474.98	$ 1,519.23	$ 1,564.81
Costs of Neale Biomass Boiler													
Boilers + Storage Tank After Incentives	$ 28,187.50												
Installation of the Boiler	$ 10,250.00												
Torsion Arm Agitator	$ 10,000.00												
Steel Frame Building with Storage (250 dollars/sqft)	$ 43,750.00												
O & M cost for Froling (2% of Investment per Year)		$ 2,305.00	$ 2,305.00	$ 2,305.00	$ 2,305.00	$ 2,305.00	$ 2,305.00	$ 2,305.00	$ 2,305.00	$ 2,305.00	$ 2,305.00	$ 2,305.00	$ 2,305.00
Costs of Wood Chips													
Tons of Wood Chips Required		74.28	74.28	74.28	74.28	74.28	74.28	74.28	74.28	74.28	74.28	74.28	74.28
Wood Chip Price ($/ton)		$ 42.74	$ 43.59	$ 44.47	$ 45.36	$ 46.26	$ 47.19	$ 48.13	$ 49.09	$ 50.08	$ 51.08	$ 52.10	$ 53.14
Cost of Wood Chips		$ 3,174.73	$ 3,238.22	$ 3,302.99	$ 3,369.05	$ 3,436.43	$ 3,505.16	$ 3,575.26	$ 3,646.76	$ 3,719.70	$ 3,794.09	$ 3,869.97	$ 3,947.37
Cash Flow													
Highest Estimate - Discounted Cash Flow	$ (92,187.50)	$ 18,965.80	$18,696.06	$18,427.65	$18,160.71	$17,895.37	$17,631.75	$17,369.96	$17,110.11	$16,852.28	$16,596.58	$16,343.06	$16,091.82
High Estimate - Discounted Cash Flow	$ (92,187.50)	$ 13,188.80	$13,029.11	$12,868.64	$12,707.59	$12,546.12	$12,384.39	$12,222.55	$12,060.74	$11,899.09	$11,737.73	$11,576.77	$11,416.31
Current Estimate - Discounted Cash Flow	$ (92,187.50)	$ 7,411.81	$ 7,362.15	$ 7,309.63	$ 7,254.46	$ 7,196.86	$ 7,137.02	$ 7,075.13	$ 7,011.37	$ 6,945.90	$ 6,878.89	$ 6,810.47	$ 6,740.81
Low Estimate - Discounted Cash Flow	$ (92,187.50)	$ 1,634.82	$ 1,695.20	$ 1,750.62	$ 1,801.34	$ 1,847.60	$ 1,889.66	$ 1,927.72	$ 1,962.00	$ 1,992.71	$ 2,020.04	$ 2,044.18	$ 2,065.30
Lowest Estimate - Discounted Cash Flow	$ (92,187.50)	$ (4,142.17)	$ (3,971.75)	$ (3,808.39)	$ (3,651.79)	$ (3,501.65)	$ (3,357.71)	$ (3,219.70)	$ (3,087.37)	$ (2,960.48)	$ (2,838.80)	$ (2,722.12)	$ (2,610.21)
NPV													
Net Present Value with Highest Fuel Oil Price Estiamte over 25 years	**$ 305,413.87**												
Net Present Value with High Fuel Oil Price Estiamte over 25 years	**$ 189,646.84**												
Net Present Value with Current Fuel Oil Price Estiamte over 25 years	**$ 73,879.80**												
Net Present Value with Low Fuel Oil Price Estiamte over 25 years	**$ (41,887.23)**												
Net Present Value with Lowest Fuel Oil Price Estiamte over 25 years	**$ (157,654.27)**												
IRR													
Internal Rate of Return with Highest Fuel Oil Price Estimate	**19%**												
Internal Rate of Return with High Fuel Oil Price Estimate	**12%**												
Internal Rate of Return with Current Fuel Oil Price Estimate	**5%**												
Internal Rate of Return with Low Fuel Oil Price Estimate	**-4%**												
Internal Rate of Return with Lowest Fuel Oil Price Estimate	**#NUM!**												

Year	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Year Count	13	14	15	16	17	18	19	20	21	22	23	24	25
Fuel Oil Avoided (gal)	5514.4	5514.4	5514.4	5514.4	5514.4	5514.4	5514.4	5514.4	5514.4	5514.4	5514.4	5514.4	5514.4
Highest Fuel Oil Price Estimate ($/gal)	$ 6.57	$ 6.76	$ 6.97	$ 7.17	$ 7.39	$ 7.61	$ 7.84	$ 8.07	$ 8.32	$ 8.57	$ 8.82	$ 9.09	$ 9.36
High Fuel Oil Price Estimate ($/gal)	$ 5.00	$ 5.15	$ 5.30	$ 5.46	$ 5.62	$ 5.79	$ 5.97	$ 6.15	$ 6.33	$ 6.52	$ 6.72	$ 6.92	$ 7.12
Current Fuel Oil Price Estimate($/gal)	$ 3.43	$ 3.53	$ 3.64	$ 3.75	$ 3.86	$ 3.98	$ 4.09	$ 4.22	$ 4.34	$ 4.47	$ 4.61	$ 4.75	$ 4.89
Low Fuel Oil Price Estiamte ($/gal)	$ 1.86	$ 1.92	$ 1.97	$ 2.03	$ 2.09	$ 2.16	$ 2.22	$ 2.29	$ 2.36	$ 2.43	$ 2.50	$ 2.58	$ 2.65
Lowest Fuel Oil Price Estimate($/gal)	$ 0.29	$ 0.30	$ 0.31	$ 0.32	$ 0.33	$ 0.34	$ 0.35	$ 0.36	$ 0.37	$ 0.38	$ 0.39	$ 0.40	$ 0.42
Highest Estimate- Avoided Fuel Oil Expense	$36,205.50	$37,291.67	$38,410.42	$39,562.73	$40,749.61	$41,972.10	$43,231.27	$44,528.20	$45,864.05	$47,239.97	$48,657.17	$50,116.88	$51,620.39
High Estimate- Avoided Fuel Oil Expense	$27,557.07	$28,383.78	$29,235.29	$30,112.35	$31,015.72	$31,946.19	$32,904.58	$33,891.72	$34,908.47	$35,955.72	$37,034.39	$38,145.42	$39,289.79
Current Estimate Avoided Fuel Oil Expense	$18,908.63	$19,475.89	$20,060.16	$20,661.97	$21,281.83	$21,920.28	$22,577.89	$23,255.23	$23,952.89	$24,671.47	$25,411.62	$26,173.96	$26,959.18
Low Estimate- Avoided Fuel Oil Expense	$10,260.19	$10,568.00	$10,885.04	$11,211.59	$11,547.94	$11,894.37	$12,251.21	$12,618.74	$12,997.30	$13,387.22	$13,788.84	$14,202.50	$14,628.58
Lowest Estimate- Avoided Fuel Oil Expense	$ 1,611.75	$ 1,660.11	$ 1,709.91	$ 1,761.21	$ 1,814.04	$ 1,868.46	$ 1,924.52	$ 1,982.25	$ 2,041.72	$ 2,102.97	$ 2,166.06	$ 2,231.04	$ 2,297.98
O & M cost for Froling (2% of Investment per Year)	$ 2,305.00	$ 2,305.00	$ 2,305.00	$ 2,305.00	$ 2,305.00	$ 2,305.00	$ 2,305.00	$ 2,305.00	$ 2,305.00	$ 2,305.00	$ 2,305.00	$ 2,305.00	$ 2,305.00
Tons of Wood Chips Required	74.28	74.28	74.28	74.28	74.28	74.28	74.28	74.28	74.28	74.28	74.28	74.28	74.28
Wood Chip Price ($/ton)	$ 54.20	$ 55.29	$ 56.39	$ 57.52	$ 58.67	$ 59.85	$ 61.04	$ 62.26	$ 63.51	$ 64.78	$ 66.08	$ 67.40	$ 68.74
Cost of Wood Chips	$ 4,026.32	$ 4,106.85	$ 4,188.99	$ 4,272.76	$ 4,358.22	$ 4,445.38	$ 4,534.29	$ 4,624.98	$ 4,717.48	$ 4,811.83	$ 4,908.06	$ 5,006.22	$ 5,106.35
Highest Estimate - Discounted Cash Flow	$15,842.92	$15,596.41	$15,352.35	$15,110.79	$14,871.78	$14,635.35	$14,401.54	$14,170.38	$13,941.89	$13,716.09	$13,493.01	$13,272.66	$13,055.05
High Estimate - Discounted Cash Flow	$11,256.47	$11,097.32	$10,938.96	$10,781.46	$10,624.92	$10,469.38	$10,314.92	$10,161.60	$10,009.46	$ 9,858.57	$ 9,708.97	$ 9,560.70	$ 9,413.79
Current Estimate - Discounted Cash Flow	$ 6,670.01	$ 6,598.23	$ 6,525.56	$ 6,452.14	$ 6,378.05	$ 6,303.41	$ 6,228.30	$ 6,152.82	$ 6,077.04	$ 6,001.05	$ 5,924.93	$ 5,848.73	$ 5,772.53
Low Estimate - Discounted Cash Flow	$ 2,083.56	$ 2,099.14	$ 2,112.17	$ 2,122.81	$ 2,131.19	$ 2,137.43	$ 2,141.68	$ 2,144.04	$ 2,144.62	$ 2,143.53	$ 2,140.88	$ 2,136.76	$ 2,131.27
Lowest Estimate - Discounted Cash Flow	$ (2,502.89)	$ (2,399.95)	$ (2,301.22)	$ (2,206.52)	$ (2,115.68)	$ (2,028.54)	$ (1,944.94)	$ (1,864.75)	$ (1,787.80)	$ (1,713.99)	$ (1,643.16)	$ (1,575.20)	$ (1,509.99)

Whitaker Biomass Boiler Net Present Value with Sensitivity Range

	NPV												
Year	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Year Count	0	1	2	3	4	5	6	7	8	9	10	11	12
Existing Costs													
Fuel Oil Avoided (gal)		3120.6	3120.6	3120.6	3120.6	3120.6	3120.6	3120.6	3120.6	3120.6	3120.6	3120.6	3120.6
Highest Fuel Oil Price Estimate ($/gal)		$ 4.61	$ 4.74	$ 4.89	$ 5.03	$ 5.18	$ 5.34	$ 5.50	$ 5.66	$ 5.83	$ 6.01	$ 6.19	$ 6.37
High Fuel Oil Price Estimate ($/gal)		$ 3.51	$ 3.61	$ 3.72	$ 3.83	$ 3.94	$ 4.06	$ 4.19	$ 4.31	$ 4.44	$ 4.57	$ 4.71	$ 4.85
Current Fuel Oil Price Estimate($/gal)		$ 2.41	$ 2.48	$ 2.55	$ 2.63	$ 2.71	$ 2.79	$ 2.87	$ 2.96	$ 3.05	$ 3.14	$ 3.23	$ 3.33
Low Fuel Oil Price Estiamte ($/gal)		$ 1.31	$ 1.34	$ 1.38	$ 1.43	$ 1.47	$ 1.51	$ 1.56	$ 1.60	$ 1.65	$ 1.70	$ 1.75	$ 1.81
Lowest Fuel Oil Price Estimate($/gal)		$ 0.21	$ 0.21	$ 0.22	$ 0.22	$ 0.23	$ 0.24	$ 0.24	$ 0.25	$ 0.26	$ 0.27	$ 0.28	$ 0.28
Highest Estimate- Avoided Fuel Oil Expense		$ 14,370.36	$ 14,801.47	$ 15,245.52	$ 15,702.88	$ 16,173.97	$ 16,659.19	$ 17,158.96	$ 17,673.73	$ 18,203.95	$ 18,750.06	$ 19,312.57	$ 19,891.94
High Estimate- Avoided Fuel Oil Expense		$ 10,937.70	$ 11,265.83	$ 11,603.81	$ 11,951.92	$ 12,310.48	$ 12,679.80	$ 13,060.19	$ 13,452.00	$ 13,855.55	$ 14,271.22	$ 14,699.36	$ 15,140.34
Current Estimate Avoided Fuel Oil Expense		$ 7,505.04	$ 7,730.19	$ 7,962.10	$ 8,200.96	$ 8,446.99	$ 8,700.40	$ 8,961.41	$ 9,230.26	$ 9,507.16	$ 9,792.38	$ 10,086.15	$ 10,388.73
Low Estimate- Avoided Fuel Oil Expense		$ 4,072.38	$ 4,194.55	$ 4,320.39	$ 4,450.00	$ 4,583.50	$ 4,721.01	$ 4,862.64	$ 5,008.52	$ 5,158.77	$ 5,313.54	$ 5,472.94	$ 5,637.13
Lowest Estimate- Avoided Fuel Oil Expense		$ 639.72	$ 658.91	$ 678.68	$ 699.04	$ 720.01	$ 741.61	$ 763.86	$ 786.78	$ 810.38	$ 834.69	$ 859.73	$ 885.53
Costs of Whitaker Biomass Boiler													
Boilers + Storage Tank After Incentives	$ 25,960.00												
Installation of the Boiler	$ 9,440.00												
Torsion Arm Agitator	$ 10,000.00												
Steel Frame Building with Storage (250 dollars/sqft)	$ 26,250.00												
Building Conversion from Steam to Hydronics (3 dollars/sqft)	$ 15,210.00												
O & M cost for Froling (1% of Investment per Year)		$ 2,162.00	$ 2,162.00	$ 2,162.00	$ 2,162.00	$ 2,162.00	$ 2,162.00	$ 2,162.00	$ 2,162.00	$ 2,162.00	$ 2,162.00	$ 2,162.00	$ 2,162.00
Costs of Wood Chips													
Tons of Wood Chips Required		42.03	42.03	42.03	42.03	42.03	42.03	42.03	42.03	42.03	42.03	42.03	42.03
Wood Chip Price ($/ton)		$ 42.74	$ 43.59	$ 44.47	$ 45.36	$ 46.26	$ 47.19	$ 48.13	$ 49.09	$ 50.08	$ 51.08	$ 52.10	$ 53.14
Cost of Wood Chips		$ 1,796.36	$ 1,832.29	$ 1,868.94	$ 1,906.31	$ 1,944.44	$ 1,983.33	$ 2,023.00	$ 2,063.46	$ 2,104.72	$ 2,146.82	$ 2,189.76	$ 2,233.55
Cash Flow													
Highest Estimate - Discounted Cash Flow	$ (86,860.00)	$ 9,916.19	$ 9,802.43	$ 9,687.58	$ 9,571.79	$ 9,455.23	$ 9,338.04	$ 9,220.36	$ 9,102.32	$ 8,984.06	$ 8,865.67	$ 8,747.28	$ 8,628.97
High Estimate - Discounted Cash Flow	$ (86,860.00)	$ 6,646.99	$ 6,595.51	$ 6,541.73	$ 6,485.87	$ 6,428.08	$ 6,368.55	$ 6,307.43	$ 6,244.89	$ 6,181.05	$ 6,116.05	$ 6,050.03	$ 5,983.10
Current Estimate - Discounted Cash Flow	$ (86,860.00)	$ 3,377.79	$ 3,388.58	$ 3,395.89	$ 3,399.94	$ 3,400.94	$ 3,399.07	$ 3,394.51	$ 3,387.45	$ 3,378.03	$ 3,366.43	$ 3,352.78	$ 3,337.23
Low Estimate - Discounted Cash Flow	$ (86,860.00)	$ 108.59	$ 181.65	$ 250.04	$ 314.02	$ 373.79	$ 429.58	$ 481.59	$ 530.01	$ 575.02	$ 616.81	$ 655.53	$ 691.36
Lowest Estimate - Discounted Cash Flow	$ (86,860.00)	$ (3,160.61)	$ (3,025.28)	$ (2,895.80)	$ (2,771.91)	$ (2,653.35)	$ (2,539.90)	$ (2,431.34)	$ (2,327.43)	$ (2,227.99)	$ (2,132.81)	$ (2,041.71)	$ (1,954.51)
NPV													
Net Present Value with Highest Fuel Oil Price Estiamte over 25 years	**$ 126,059.44**												
Net Present Value with High Fuel Oil Price Estiamte over 25 years	**$ 60,546.86**												
Net Present Value with Current Fuel Oil Price Estiamte over 25 years	**$ (4,965.73)**												
Net Present Value with Low Fuel Oil Price Estiamte over 25 years	**$ (70,478.32)**												
Net Present Value with Lowest Fuel Oil Price Estiamte over 25 years	**$ (135,990.90)**												
IRR													
Internal Rate of Return with Highest Fuel Oil Price Estimate	**9%**												
Internal Rate of Return with High Fuel Oil Price Estimate	**5%**												
Internal Rate of Return with Current Fuel Oil Price Estimate	**0%**												
Internal Rate of Return with Low Fuel Oil Price Estimate	**-9%**												
Internal Rate of Return with Lowest Fuel Oil Price Estimate	**#NUM!**												

Year	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Year Count	13	14	15	16	17	18	19	20	21	22	23	24	25
Fuel Oil Avoided (gal)	3120.6	3120.6	3120.6	3120.6	3120.6	3120.6	3120.6	3120.6	3120.6	3120.6	3120.6	3120.6	3120.6
Highest Fuel Oil Price Estimate ($/gal)	$ 6.57	$ 6.76	$ 6.97	$ 7.17	$ 7.39	$ 7.61	$ 7.84	$ 8.07	$ 8.32	$ 8.57	$ 8.82	$ 9.09	$ 9.36
High Fuel Oil Price Estimate ($/gal)	$ 5.00	$ 5.15	$ 5.30	$ 5.46	$ 5.62	$ 5.79	$ 5.97	$ 6.15	$ 6.33	$ 6.52	$ 6.72	$ 6.92	$ 7.12
Current Fuel Oil Price Estimate($/gal)	$ 3.43	$ 3.53	$ 3.64	$ 3.75	$ 3.86	$ 3.98	$ 4.09	$ 4.22	$ 4.34	$ 4.47	$ 4.61	$ 4.75	$ 4.89
Low Fuel Oil Price Estiamte ($/gal)	$ 1.86	$ 1.92	$ 1.97	$ 2.03	$ 2.09	$ 2.16	$ 2.22	$ 2.29	$ 2.36	$ 2.43	$ 2.50	$ 2.58	$ 2.65
Lowest Fuel Oil Price Estimate($/gal)	$ 0.29	$ 0.30	$ 0.31	$ 0.32	$ 0.33	$ 0.34	$ 0.35	$ 0.36	$ 0.37	$ 0.38	$ 0.39	$ 0.40	$ 0.42
Highest Estimate- Avoided Fuel Oil Expense	$ 20,488.70	$ 21,103.36	$ 21,736.46	$ 22,388.56	$ 23,060.21	$ 23,752.02	$ 24,464.58	$ 25,198.52	$ 25,954.47	$ 26,733.11	$ 27,535.10	$ 28,361.15	$ 29,211.99
High Estimate- Avoided Fuel Oil Expense	$ 15,594.55	$ 16,062.39	$ 16,544.26	$ 17,040.58	$ 17,551.80	$ 18,078.36	$ 18,620.71	$ 19,179.33	$ 19,754.71	$ 20,347.35	$ 20,957.77	$ 21,586.50	$ 22,234.10
Current Estimate Avoided Fuel Oil Expense	$ 10,700.40	$ 11,021.41	$ 11,352.05	$ 11,692.61	$ 12,043.39	$ 12,404.69	$ 12,776.83	$ 13,160.14	$ 13,554.94	$ 13,961.59	$ 14,380.44	$ 14,811.85	$ 15,256.21
Low Estimate- Avoided Fuel Oil Expense	$ 5,806.24	$ 5,980.43	$ 6,159.84	$ 6,344.64	$ 6,534.98	$ 6,731.03	$ 6,932.96	$ 7,140.95	$ 7,355.18	$ 7,575.83	$ 7,803.11	$ 8,037.20	$ 8,278.32
Lowest Estimate- Avoided Fuel Oil Expense	$ 912.09	$ 939.45	$ 967.64	$ 996.67	$ 1,026.57	$ 1,057.36	$ 1,089.09	$ 1,121.76	$ 1,155.41	$ 1,190.07	$ 1,225.78	$ 1,262.55	$ 1,300.43
O & M cost for Froling (1% of Investment per Year)	$ 2,162.00	$ 2,162.00	$ 2,162.00	$ 2,162.00	$ 2,162.00	$ 2,162.00	$ 2,162.00	$ 2,162.00	$ 2,162.00	$ 2,162.00	$ 2,162.00	$ 2,162.00	$ 2,162.00
Tons of Wood Chips Required	42.03	42.03	42.03	42.03	42.03	42.03	42.03	42.03	42.03	42.03	42.03	42.03	42.03
Wood Chip Price ($/ton)	$ 54.20	$ 55.29	$ 56.39	$ 57.52	$ 58.67	$ 59.85	$ 61.04	$ 62.26	$ 63.51	$ 64.78	$ 66.08	$ 67.40	$ 68.74
Cost of Wood Chips	$ 2,278.22	$ 2,323.79	$ 2,370.26	$ 2,417.67	$ 2,466.02	$ 2,515.34	$ 2,565.65	$ 2,616.96	$ 2,669.30	$ 2,722.69	$ 2,777.14	$ 2,832.68	$ 2,889.34
Highest Estimate - Discounted Cash Flow	$ 8,510.85	$ 8,393.01	$ 8,275.52	$ 8,158.46	$ 8,041.91	$ 7,925.92	$ 7,810.57	$ 7,695.92	$ 7,582.00	$ 7,468.88	$ 7,356.60	$ 7,245.19	$ 7,134.71
High Estimate - Discounted Cash Flow	$ 5,915.38	$ 5,846.97	$ 5,777.98	$ 5,708.49	$ 5,638.60	$ 5,568.40	$ 5,497.96	$ 5,427.35	$ 5,356.64	$ 5,285.91	$ 5,215.21	$ 5,144.59	$ 5,074.12
Current Estimate - Discounted Cash Flow	$ 3,319.90	$ 3,300.93	$ 3,280.44	$ 3,258.52	$ 3,235.30	$ 3,210.87	$ 3,185.34	$ 3,158.78	$ 3,131.28	$ 3,102.94	$ 3,073.82	$ 3,043.99	$ 3,013.53
Low Estimate - Discounted Cash Flow	$ 724.43	$ 754.90	$ 782.90	$ 808.55	$ 832.00	$ 853.35	$ 872.72	$ 890.21	$ 905.93	$ 919.97	$ 932.43	$ 943.39	$ 952.94
Lowest Estimate - Discounted Cash Flow	$ (1,871.04)	$ (1,791.14)	$ (1,714.64)	$ (1,641.41)	$ (1,571.30)	$ (1,504.17)	$ (1,439.90)	$ (1,378.36)	$ (1,319.43)	$ (1,263.00)	$ (1,208.96)	$ (1,157.21)	$ (1,107.65)

Appendix C

Air Source Heat Pump Net Present Value with Sensitivity Range											
	NPV										
Month											
Year	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Year Count	0	1	2	3	4	5	6	7	8	9	10
Existing Costs											
Fuel Costs		$ 12,557.97	$ 12,934.71	$ 13,322.75	$ 13,722.43	$ 14,134.10	$ 14,558.13	$ 1,499,487.00	$ 15,444.72	$ 15,908.06	$ 1,638,530.00
Heat Load (mmBtu)		460.58	460.58	460.58	460.58	460.58	460.58	460.58	460.58	460.58	460.58
Achieveable Monthly Output (mmBtu)		433.13	433.13	433.13	433.13	433.13	433.13	433.13	433.13	433.13	433.13
Fuel Oil Avoided (gal)		2517.94	2517.94	2517.94	2517.94	2517.94	2517.94	2517.94	2517.94	2517.94	2517.94
Highest Fuel Oil Price ($/gal)		$ 4.61	$ 4.74	$ 4.89	$ 5.03	$ 5.18	$ 5.34	$ 5.50	$ 5.66	$ 5.83	$ 6.01
High Fuel Oil Price ($/gal)		$ 3.51	$ 3.61	$ 3.72	$ 3.83	$ 3.94	$ 4.06	$ 4.19	$ 4.31	$ 4.44	$ 4.57
Current Fuel Oil Price ($/gal)		$ 2.41	$ 2.48	$ 2.55	$ 2.63	$ 2.71	$ 2.79	$ 2.87	$ 2.96	$ 3.05	$ 3.14
Low Fuel Oil Price ($/gal)		$ 1.31	$ 1.34	$ 1.38	$ 1.43	$ 1.47	$ 1.51	$ 1.56	$ 1.60	$ 1.65	$ 1.70
Lowest Fuel Oil Price ($/gal)		$ 0.21	$ 0.21	$ 0.22	$ 0.22	$ 0.23	$ 0.24	$ 0.24	$ 0.25	$ 0.26	$ 0.27
Highest Estimate Avoided Fuel Oil Expense		$ 11,595.11	$ 11,942.97	$ 12,301.26	$ 12,670.29	$ 13,050.40	$ 13,441.91	$ 13,845.17	$ 14,260.53	$ 14,688.34	$ 15,128.99
High Estimate- Avoided Fuel Oil Expense		$ 8,825.38	$ 9,090.14	$ 9,362.85	$ 9,643.73	$ 9,933.04	$ 10,231.03	$ 10,537.96	$ 10,854.10	$ 11,179.73	$ 11,515.12
Current Estimate- Avoided Fuel Oil Expense		$ 6,055.65	$ 6,237.32	$ 6,424.43	$ 6,617.17	$ 6,815.68	$ 7,020.15	$ 7,230.76	$ 7,447.68	$ 7,671.11	$ 7,901.24
Low Estimate- Avoided Fuel Oil Expense		$ 3,285.91	$ 3,384.49	$ 3,486.02	$ 3,590.60	$ 3,698.32	$ 3,809.27	$ 3,923.55	$ 4,041.26	$ 4,162.49	$ 4,287.37
Lowest Estimate Avoided Fuel Oil Expense		$ 516.18	$ 531.66	$ 547.61	$ 564.04	$ 580.96	$ 598.39	$ 616.34	$ 634.83	$ 653.88	$ 673.49
Cost of Air Source System											
Cost of Air Source Heat Pump	$ 10,162.50										
ASHP Electricity Consumption (kWh)		43508	43508	43508	43508	43508	43508	43508	43508	43508	43508
Electricity Rate	$ 0.15	$ 0.15	$ 0.16	$ 0.16	$ 0.17	$ 0.17	$ 0.18	$ 0.18	$ 0.19	$ 0.19	$ 0.20
Electricity cost		$ 6,587.55	$ 6,785.17	$ 6,988.73	$ 7,198.39	$ 7,414.34	$ 7,636.77	$ 7,865.87	$ 8,101.85	$ 8,344.91	$ 8,595.25
Cash Flow											
Highest Fuel Oil Price Estimate -Discounted Cash Flow	$ (10,162.50)	$ 3,338.38	$ 2,292.35	$ 1,574.08	$ 1,080.87	$ 742.20	$ 509.64	$ 349.95	$ 240.30	$ 165.01	$ 113.31
High Fuel Oil Price Estimate -Discounted Cash Flow	$ (10,162.50)	$ 1,491.89	$ 1,024.43	$ 703.44	$ 483.03	$ 331.68	$ 227.75	$ 156.39	$ 107.39	$ 73.74	$ 50.63
Current Fuel Oil Price Estimate -Discounted Cash Flow	$ (10,162.50)	$ (354.60)	$ (243.49)	$ (167.20)	$ (114.81)	$ (78.84)	$ (54.13)	$ (37.17)	$ (25.52)	$ (17.53)	$ (12.04)
Low Fuel Oil Price Estimate -Discounted Cash Flow	$ (10,162.50)	$ (2,201.09)	$ (1,511.41)	$ (1,037.84)	$ (712.65)	$ (489.35)	$ (336.02)	$ (230.74)	$ (158.44)	$ (108.79)	$ (74.71)
Lowest Fuel Oil Price Estimate Discounted Cash Flow	$ (10,162.50)	$ (4,047.58)	$ (2,779.34)	$ (1,908.48)	$ (1,310.49)	$ (899.87)	$ (617.91)	$ (424.30)	$ (291.35)	$ (200.06)	$ (137.38)
NPV											
Net Present Value with Highest Fuel Oil Price Estimate over 25 years	**$ 243.59**										
Net Present Value with High Fuel Oil Price Estimate over 25 years	**$ (5,512.12)**										
Net Present Value with Current Fuel Oil Price Estimate over 25 years	**$ (11,267.83)**										
Net Present Value with Low Fuel Oil Price Estimate over 25 years	**$ (17,023.54)**										
Net Present Value with Lowest Fuel Oul Price Estiamte over 25 years	**$ (22,779.25)**										
IRR											
Internal Rate of Return with Highest Fuel Oil Price Estimate	**1%**										
Internal Rate of Return with High Fuel Oil Price Estimate	**-20%**										
Internal Rate of Return with Current Fuel Oil Price Estimate	**#NUM!**										
Internal Rate of Return with Low Fuel Oil Price Estimate	**#NUM!**										
Internal Rate of Return with Lowest Fuel Oil Price Estimate	**#NUM!**										

Appendix D

Geothermal Heat Pump Net Present Value with Sensitivity Range													
	NPV												
Month													
Year	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Year Count	0	1	2	3	4	5	6	7	8	9	10	11	12
Existing Costs													
Fuel Oil Avoided (gal)		3337.5	3337.5	3337.5	3337.5	3337.5	3337.5	3337.5	3337.5	3337.5	3337.5	3337.5	3337.5
Highest Fuel Oil Price ($/gal)		$ 4.61	$ 4.71	$ 4.82	$ 4.93	$ 5.04	$ 5.16	$ 5.29	$ 5.41	$ 5.54	$ 5.67	$ 5.81	$ 5.95
High Fuel Oil Price ($/gal)		$ 3.51	$ 3.61	$ 3.72	$ 3.83	$ 3.94	$ 4.06	$ 4.19	$ 4.31	$ 4.44	$ 4.57	$ 4.71	$ 4.85
Current Fuel Oil Price ($/gal)		$ 2.41	$ 2.48	$ 2.55	$ 2.63	$ 2.71	$ 2.79	$ 2.87	$ 2.96	$ 3.05	$ 3.14	$ 3.23	$ 3.33
Low Fuel Oil Price ($/gal)		$ 1.31	$ 1.34	$ 1.38	$ 1.43	$ 1.47	$ 1.51	$ 1.56	$ 1.60	$ 1.65	$ 1.70	$ 1.75	$ 1.81
Lowest Fuel Oil Price ($/gal)		$ 0.21	$ 0.24	$ 0.28	$ 0.33	$ 0.37	$ 0.41	$ 0.46	$ 0.50	$ 0.55	$ 0.60	$ 0.65	$ 0.71
Hishest Estimate- Avoided Fuel Oil Expense		$ 15,369.19	$ 15,720.13	$ 16,081.59	$ 16,453.90	$ 16,837.38	$ 17,232.37	$ 17,639.20	$ 18,058.24	$ 18,489.85	$ 18,934.41	$ 19,392.30	$ 19,863.93
High Estimate- Avoided Fuel Oil Expense		$ 11,697.94	$ 12,048.88	$ 12,410.34	$ 12,782.65	$ 13,166.13	$ 13,561.12	$ 13,967.95	$ 14,386.99	$ 14,818.60	$ 15,263.16	$ 15,721.05	$ 16,192.68
Current Estimate- Avoided Fuel Oil Expense		$ 8,026.69	$ 8,267.49	$ 8,515.51	$ 8,770.98	$ 9,034.11	$ 9,305.13	$ 9,584.28	$ 9,871.81	$ 10,167.97	$ 10,473.01	$ 10,787.20	$ 11,110.81
Low Estimate- Avoided Fuel Oil Expense		$ 4,355.44	$ 4,486.10	$ 4,620.68	$ 4,759.30	$ 4,902.08	$ 5,049.15	$ 5,200.62	$ 5,356.64	$ 5,517.34	$ 5,682.86	$ 5,853.34	$ 6,028.94
Lowest Estimate- Avoided Fuel Oil Expense		$ 684.19	$ 814.85	$ 949.43	$ 1,088.05	$ 1,230.83	$ 1,377.90	$ 1,529.37	$ 1,685.39	$ 1,846.09	$ 2,011.61	$ 2,182.09	$ 2,357.69
Costs of Geothermal System													
Cost of Geothermal Heat Pump	$ 70,709.44												
Geothermal Electricity Consumption (kWh)		40772.97	40772.97	40772.97	40772.97	40772.97	40772.97	40772.97	40772.97	40772.97	40772.97	40772.97	40772.97
Electricity Rate	$ 0.147	$ 0.151	$ 0.156	$ 0.161	$ 0.165	$ 0.170	$ 0.176	$ 0.181	$ 0.186	$ 0.192	$ 0.198	$ 0.203	$ 0.210
Electricity Cost		$ 6,173.435	$ 6,358.638	$ 6,549.398	$ 6,745.880	$ 6,948.256	$ 7,156.704	$ 7,371.405	$ 7,592.547	$ 7,820.323	$ 8,054.933	$ 8,296.581	$ 8,545.478
Cash Flow													
Highest Fuel Oil Price Estimate -Discounted Cash Flow	$ (70,709.44)	$ 8,757.859	$ 8,491.145	$ 8,234.268	$ 7,986.814	$ 7,748.389	$ 7,518.614	$ 7,297.130	$ 7,083.591	$ 6,877.670	$ 6,679.052	$ 6,487.437	$ 6,302.538
High Fuel Oil Price Estimate -Discounted Cash Flow	$ (70,709.44)	$ 5,261.43	$ 5,161.21	$ 5,062.90	$ 4,966.47	$ 4,871.87	$ 4,779.07	$ 4,688.04	$ 4,598.74	$ 4,511.15	$ 4,425.22	$ 4,340.93	$ 4,258.25
Current Fuel Oil Price Estimate -Discounted Cash Flow	$ (70,709.44)	$ 1,765.00	$ 1,731.38	$ 1,698.40	$ 1,666.05	$ 1,634.32	$ 1,603.19	$ 1,572.65	$ 1,542.70	$ 1,513.31	$ 1,484.49	$ 1,456.21	$ 1,428.47
Low Fuel Oil Price Estimate -Discounted Cash Flow	$ (70,709.44)	$ (1,731.43)	$ (1,698.45)	$ (1,666.10)	$ (1,634.36)	$ (1,603.23)	$ (1,572.69)	$ (1,542.74)	$ (1,513.35)	$ (1,484.52)	$ (1,456.25)	$ (1,428.51)	$ (1,401.30)
Lowest Fuel Oil Price Estimate -Discounted Cash Flow	$ (70,709.44)	$ (5,227.86)	$ (5,028.38)	$ (4,837.46)	$ (4,654.71)	$ (4,479.75)	$ (4,312.24)	$ (4,151.82)	$ (3,998.20)	$ (3,851.05)	$ (3,710.08)	$ (3,575.01)	$ (3,445.59)
NPV													
Net Present Value with Highest Fuel Oil Price Estiamte over 25 years	**$ 86,468.51**												
Net Present Value with High Fuel Oil Price Estimate over 25 years	**$ 34,726.12**												
Net Present Value with Current Fuel Oil Price Estimate over 25 years	**$ (35,339.98)**												
Net Present Value with Low Fuel Oil Price Estimate over 25 years	**$ (105,406.07)**												
Net Present Value with Lowest Fuel Oil Price Estimate over 25 years	**$ (157,148.47)**												
IRR													
Internal Rate of Return with Highest Fuel Oil Price Estimate	**9%**												
Internal Rate of Return with High Fuel Oil Price Estimate	**4%**												
Internal Rate of Return with Current Fuel Oil Price Estimate	**-5%**												
Internal Rate of Return with Low Fuel Oil Price Estimate	**#NUM!**												
Internal Rate of Return with Lowest Fuel Oil Price Estimate	**#NUM!**												

Year	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Year Count	13	14	15	16	17	18	19	20	21	22	23	24	25
Fuel Oil Avoided (gal)	3337.5	3337.5	3337.5	3337.5	3337.5	3337.5	3337.5	3337.5	3337.5	3337.5	3337.5	3337.5	3337.5
Highest Fuel Oil Price ($/gal)	$ 6.10	$ 6.25	$ 6.40	$ 6.56	$ 6.72	$ 6.89	$ 7.07	$ 7.25	$ 7.43	$ 7.62	$ 7.82	$ 8.02	$ 8.22
High Fuel Oil Price ($/gal)	$ 5.00	$ 5.15	$ 5.30	$ 5.46	$ 5.62	$ 5.79	$ 5.97	$ 6.15	$ 6.33	$ 6.52	$ 6.72	$ 6.92	$ 7.12
Current Fuel Oil Price ($/gal)	$ 3.43	$ 3.53	$ 3.64	$ 3.75	$ 3.86	$ 3.98	$ 4.09	$ 4.22	$ 4.34	$ 4.47	$ 4.61	$ 4.75	$ 4.89
Low Fuel Oil Price ($/gal)	$ 1.86	$ 1.92	$ 1.97	$ 2.03	$ 2.09	$ 2.16	$ 2.22	$ 2.29	$ 2.36	$ 2.43	$ 2.50	$ 2.58	$ 2.65
Lowest Fuel Oil Price ($/gal)	$ 0.76	$ 0.82	$ 0.87	$ 0.93	$ 0.99	$ 1.06	$ 1.12	$ 1.19	$ 1.26	$ 1.33	$ 1.40	$ 1.48	$ 1.55
Hishest Estimate- Avoided Fuel Oil Expense	$ 20,349.71	$ 20,850.07	$ 21,365.43	$ 21,896.26	$ 22,443.01	$ 23,006.16	$ 23,586.21	$ 24,183.65	$ 24,799.03	$ 25,432.86	$ 26,085.71	$ 26,758.14	$ 27,450.75
High Estimate- Avoided Fuel Oil Expense	$ 16,678.46	$ 17,178.82	$ 17,694.18	$ 18,225.01	$ 18,771.76	$ 19,334.91	$ 19,914.96	$ 20,512.40	$ 21,127.78	$ 21,761.61	$ 22,414.46	$ 23,086.89	$ 23,779.50
Current Estimate- Avoided Fuel Oil Expense	$ 11,444.14	$ 11,787.46	$ 12,141.09	$ 12,505.32	$ 12,880.48	$ 13,266.89	$ 13,664.90	$ 14,074.85	$ 14,497.09	$ 14,932.00	$ 15,379.96	$ 15,841.36	$ 16,316.60
Low Estimate- Avoided Fuel Oil Expense	$ 6,209.81	$ 6,396.11	$ 6,587.99	$ 6,785.63	$ 6,989.20	$ 7,198.87	$ 7,414.84	$ 7,637.29	$ 7,866.40	$ 8,102.40	$ 8,345.47	$ 8,595.83	$ 8,853.71
Lowest Estimate- Avoided Fuel Oil Expense	$ 2,538.56	$ 2,724.86	$ 2,916.74	$ 3,114.38	$ 3,317.95	$ 3,527.62	$ 3,743.59	$ 3,966.04	$ 4,195.15	$ 4,431.15	$ 4,674.22	$ 4,924.58	$ 5,182.46
Geothermal Electricity Consumption (kWh)	40772.97	40772.97	40772.97	40772.97	40772.97	40772.97	40772.97	40772.97	40772.97	40772.97	40772.97	40772.97	40772.97
Electricity Rate	$ 0.216	$ 0.222	$ 0.229	$ 0.236	$ 0.243	$ 0.250	$ 0.258	$ 0.265	$ 0.273	$ 0.282	$ 0.290	$ 0.299	$ 0.308
Electricity Cost	$ 8,801.843	$ 9,065.898	$ 9,337.875	$ 9,618.011	$ 9,906.552	$ 10,203.748	$ 10,509.861	$ 10,825.156	$ 11,149.911	$ 11,484.408	$ 11,828.941	$ 12,183.809	$ 12,549.323
Highest Fuel Oil Price Estimate -Discounted Cash Flow	$ 6,124.082	$ 5,951.805	$ 5,785.460	$ 5,624.805	$ 5,469.613	$ 5,319.666	$ 5,174.754	$ 5,034.677	$ 4,899.246	$ 4,768.276	$ 4,641.594	$ 4,519.033	$ 4,400.432
High Fuel Oil Price Estimate -Discounted Cash Flow	$ 4,177.14	$ 4,097.57	$ 4,019.53	$ 3,942.96	$ 3,867.86	$ 3,794.19	$ 3,721.92	$ 3,651.02	$ 3,581.48	$ 3,513.26	$ 3,446.34	$ 3,380.70	$ 3,316.30
Current Fuel Oil Price Estimate -Discounted Cash Flow	$ 1,401.27	$ 1,374.57	$ 1,348.39	$ 1,322.71	$ 1,297.51	$ 1,272.80	$ 1,248.56	$ 1,224.77	$ 1,201.44	$ 1,178.56	$ 1,156.11	$ 1,134.09	$ 1,112.49
Low Fuel Oil Price Estimate -Discounted Cash Flow	$ (1,374.61)	$ (1,348.43)	$ (1,322.74)	$ (1,297.55)	$ (1,272.83)	$ (1,248.59)	$ (1,224.80)	$ (1,201.47)	$ (1,178.59)	$ (1,156.14)	$ (1,134.12)	$ (1,112.52)	$ (1,091.33)
Lowest Fuel Oil Price Estimate -Discounted Cash Flow	$ (3,321.55)	$ (3,202.66)	$ (3,088.68)	$ (2,979.39)	$ (2,874.59)	$ (2,774.07)	$ (2,677.64)	$ (2,585.13)	$ (2,496.36)	$ (2,411.16)	$ (2,329.37)	$ (2,250.85)	$ (2,175.46)