ILLINOIS INSTITUTE OF TECHNOLOGY

IPRO 347

Sustainable Energy Solutions for Robbins Community Power

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1.0 Executive Summary

The aim of this project was to find a source of green wood fuel for the retrofitted wood biomass power plant at Robbins Community Power, and to develop a process by which the wood could be obtained by the power plant. The key aspects of this challenge were the determining the availability of green wood and the resolving the financial challenges of obtaining a sufficient amount of green wood in a way that does not require that it be harvested specifically for the purpose of fuel wood. In order to develop a process for accomplishing this in a way that is financially sustainable for Robbins Community Power, this project investigates the feasibility of running an urban sawmill to repurpose waste wood from landscapers, tree removal services and local municipalities. The various components of this plan include researching a site that could be used for the sorting yard and sawmill, developing a functional layout for the site, determining the labor that would be required to sustain the operation, and deciding what equipment would be necessary at the mill. Additional research was also required on the current market for scrap green wood and the potential market for the repurposed wood. This report details how an adequate supply of green wood could be provided to Robbins Community Power through a process that promotes sustainability by repurposing waste wood to determine its highest plausible use and introducing it into the market in its most financially viable form.

2.0 Purpose and Objectives

Robbins Community Power LLC (RCP) is currently in the process of retrofitting a municipal solid waste power plant so that the facility can be used as a wood biomass power plant. The plant will be using reclaimed urban wood to generate electrical power for the surrounding area by using the wood as fuel wood. The majority of this wood will be obtained from urban and suburban demolitions and construction byproducts. This will allow this waste material to be used in a productive way rather than being disposed of in landfills. The power plant requires a percentage of the wood that is burned to be green wood, which is wood that has been recently cut and has a higher moisture content than the older wood. This is necessary to maintain the appropriate temperature in the burner for maximum efficiency. The annual amount of green wood that is needed for the plant to operate at capacity is approximately 125,000 tons.

One key aspect of this project is that the green wood used at RCP is not to be wood that is cut specifically for the purpose of being used as fuel wood. In order to provide this sustainable green wood to RCP, IPRO 347 has investigated the availability and financial practicality of obtaining green wood from local forestry services including landscapers, municipalities and tree removal services. The majority of this waste wood is usually hauled to a landfill at the expense of the company, or is chipped and used as mulch. Some of this wood could be suitable to be used as fuel wood for RCP or for other purposes, such as dimensioned lumber or pallet wood. Finding ways to bring this wood to the market at its highest possible use could promote sustainability by reusing material that would otherwise be discarded, and providing a fuel source for RCP.

The emerald ash borer is also expected to continue to spread across the Chicago area. The emerald ash borer kills ash trees by damaging the bark, but leaving the wood unharmed. This project would utilize the wood from these trees in a productive way. The wood would also be sold locally, or chipped and burned to prevent the further spread of the emerald ash borer.

The objective of IPRO 347 was to develop a process that would supply RCP with a significant portion of the green wood that it needs for its operations, and to find higher value uses for the higher quality green wood. This could help offset the cost to RCP of obtaining green wood, while also increasing the sustainability of the project by preventing the cutting of new green wood.

3.0 Organization and Approach

The team was organized into sub teams which dealt with different aspects of this project. These groups included finances, market research, urban forest demographics, and site development.

The finance team focused on finding a way to provide green wood to Robbins in a way that is financially sustainable to the power plant. The availability of green wood in the urban area surrounding Robbins is limited, and the transportation cost to bring wood from greater distances is prohibitive, so the finance team worked to optimize the use of the available wood to allow the dimensioned lumber to be sold at a profit that would offset the transportation cost of bringing green wood products from greater distances. The finance team also researched the cost and availability of the equipment and machinery that is required to operate the sawmill. As data was obtained through the course of this process, the finance team modeled the information in break even analysis and cost analysis spanning the first ten years of operation of the mill. The data was studied, refined and optimized to provide a solution that would be financially realistic.

Market research was also conducted to determine the present market for various types of wood products such as dimensioned lumber, mulch, fuel pellets and sawdust, as well as the market for purchasing waste green wood.

The urban forest demographics group analyzed the availability of green wood in the local area. This sub team gathered data on the tree population in Chicago, including the estimated numbers of various tree species. This group also analyzed the amount of this wood that could be obtained for this operation.

The sub team that worked on the sawmill site development researched potential locations for the facility. Once a site had been chosen, this group developed a site layout that would incorporate all of the necessary functions in an efficient manner.

4.0 Analysis and Findings

4.1 Site Requirements

It was determined that this facility would need to be approximately 10 acres to allow for the sawmill facility and the sorting yard and storage area. The equipment required at the site includes several vehicles to move wood such as a front end loader, a forklift, a Bobcat, a semi truck and a grapple truck. Trailers are also necessary to store the sawdust and chips. Two truck scales would be at the site to weigh the trucks entering and leaving so that the amount of wood that they drop off could be determined. When trucks go to the site to drop off wood, they

would enter at the main drive and then get weighed. They would then be unloaded and the wood would be dumped in the sorting yard. The wood would later be graded and sorted. The wood that is usable for dimensioned lumber would be moved cut using a bandmill and surfaced with an edger. It would then be placed on a green chain, which would move it so that it could be taken to a storage area. The wood shavings and chips left over from this process would go to the basement, which is a vibrating trough that separates the sawdust from the chips. The lumber would be stored to dry, and the other wood would be processed in a tub grinder to be used as wood fuel for RCP. The site layout that would maximize the efficiency of this process is shown in Appendix A.

4.2 Availability of wood supply

Chicago tree census data showed that there are approximately 3,585,000 trees in the city of Chicago. The assumptions that were used to determine the amount of wood that would potentially be available to RCP were that there would be a one percent annual harvest rate of trees by landscaping companies, tree removal services and municipalities. It was assumed that the emerald ash borer would account for a fifteen percent annual mortality rate of ash trees. Transportation costs indicated that it would be reasonable that wood would be accessible from within a five mile radius of RCP, however landscape companies surveyed indicated that they often move waste wood up to 30 miles to discard it. The breakdown of the amount, species, and grade of wood that was determined to be potentially available to RCP is shown in Appendix B.

4.3 Use of wood

While a large amount of the wood that is obtained is to be used as fuel wood for RCP, there are other uses that would be appropriate for some of the wood. Some of the wood would be suitable for dimensioned lumber, pallet wood or firewood. Urban wood tends to be of a lower quality than forest wood because it does not grow as straight. This makes it more unlikely to be used as dimensioned lumber, however nearly 30 percent of trees in the Chicago area are estimated to be grade 1 or 2, which would make them potentially suitable for lumber if they are harvested in a way that preserves long sections of them. The sawdust that results from sawing and chipping can also be sold as bedding for animals, pelletized for wood burners or other uses.

4.4 Market Analysis

The market for waste wood varies greatly based on the area, time of year, and other factors such as storms that take down large numbers of trees. There are some cases where people pay to have this wood hauled away and mulched, and there are other cases where the mulching companies will pay for this wood. It was determined that this operation would operate best This value could be higher or lower based on whether or not the supplier would transport it,

the quality of the wood and the way it was cut when the trees were removed. Many companies cut large trees into short lengths when they remove them, so the price paid for the wood could serve as an incentive for these companies to remove trees in ways that would preserve their useful lumber.

4.5 Cost effectiveness

It was determined that this process could be cost effective to RCP because it would provide approximately 11,800 tons of green wood fuel for the biomass power plant. The income from the lumber sales could pay the operating costs for the sawmill facility and potentially subsidize the purchase of additional green wood from other sources. The cost analysis over time is shown in Appendix C.

5.0 Conclusions and Recommendations

This report outlines a method by which Robbins Community Power could obtain approximately 11,800 tons of the green fuel wood that is needed for the operation of the wood biomass power plant, and potentially subsidize the purchase of additional wood fuel. There are, however, some obstacles in running this operation. The wood that is received from tree removal services, municipalities and landscapers is not always cut in ways that would allow it to be used for dimensioned lumber. Further training and additional equipment would be needed for many tree removal services if they were to agree to cut longer lengths when removing trees. Another obstacle is that urban wood tends to have more knots than forest wood, so it may not be as suitable for dimensioned lumber. If agreements can be reached with tree removal services regarding the quantity of wood and the type of cut, the method developed in this report could provide RCP with a significant portion of the wood that is necessary for the power plant, and promote sustainability by bringing some of this wood to the lumber market. This sawmill could provide 11,800 tons of chips to Robbins. To increase the amount of chips available to Robbins, several other satellite yards could be opened in the near area that would be have access to additional wood.

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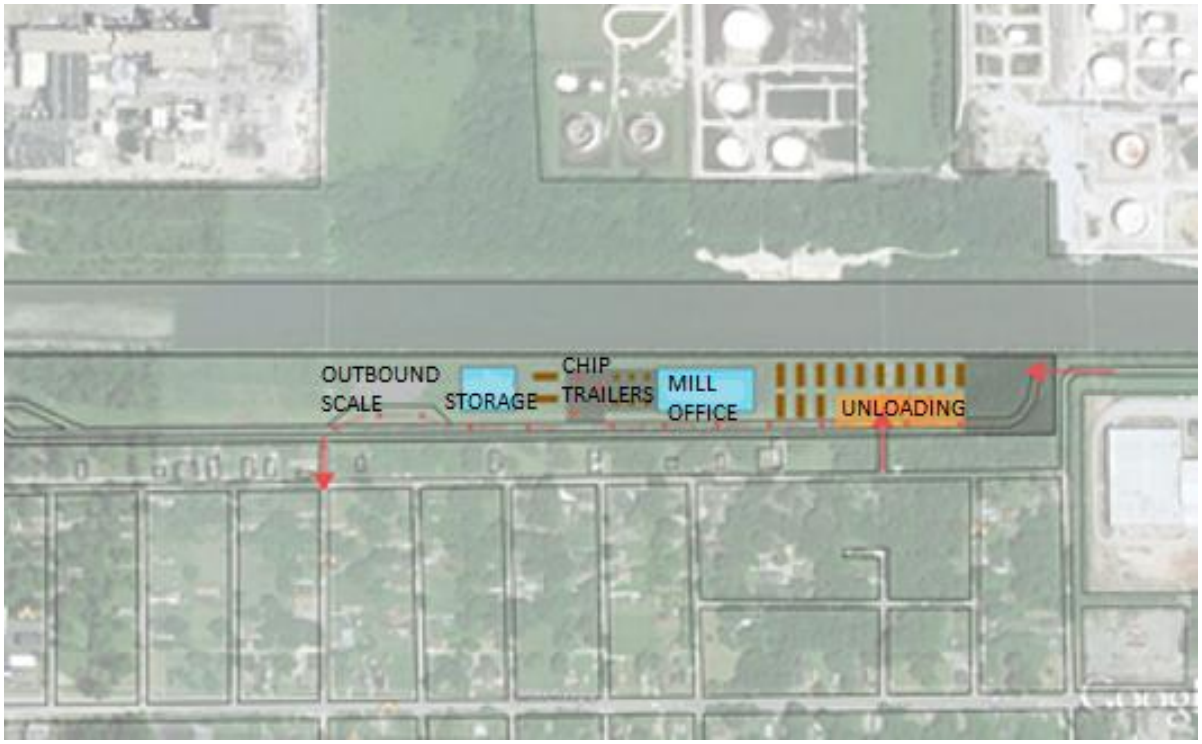
Appendix A – Proposed Site Layout



Appendix B – Wood Availability

Merchantable Species	Available to Robbins (Tons)				
Species	Grade 1	Grade 2	Grade 3	Grade 4&5	Total
White Oak	559	4614	6151	2796	14120
Red Oak	255	1401	1571	1062	4289
Ash	587	4204	3030	1955	9776
Black Walnut	379	1254	117	1137	2887
Black Cherry	0	504	840	336	1679
Soft Maple	188	470	752	470	1880
Cottonwood	0	188	435	552	1175
Elm	53	99	252	252	656
Hard Maple	0	59	361	237	657
Honey Locust	60	60	293	60	475
Black Locust	0	109	268	0	377
Basswood	94	94	94	94	377
Total	1900	11719	14887	11086	39593

The information in this table was derived from unpublished survey data from the Morton Arboretum Tree Survey 2010.

Appendix C – Cost Analysis

	Year 1	Year 2	Years 3-10	Year 11	Year 12	Years 13-20
Total Income	452,078	791,189	825,998	825,998	825,998	825,998
Total Expenses	742,302	744,302	746,302	752,245	758,187	764,130
Total Profit/Loss	**$ (290,224)**	**$ 46,887**	**$ 79,695**	**$ 73,752**	**$ 67,810**	**$ 61,867**
Income						
Dimensioned Lumber	108,680	434,718	456,454	456,454	456,454	456,454
Chips (Robbins)	54,422	57,286	60,150	60,150	60,150	60,150
Pallet wood	193,954	204,162	214,370	214,370	214,370	214,370
Sawdust	95,023	95,023	95,023	95,023	95,023	95,023
Pellets	-	-	-	-	-	-
Firewood	-	-	-	-	-	-
Total Income	**452,078**	**791,189**	**825,998**	**825,998**	**825,998**	**825,998**
Expenses						
Property						
Site	50,444	50,444	50,444	50,444	50,444	50,444
Building						
Property Taxes	11,885	11,885	11,885	17,828	23,770	29,713
Total Property	**62,329**	**62,329**	**62,329**	**68,272**	**74,214**	**80,157**
Equipment						
Truck scale (2)	3,474	3,474	3,474	3,474	3,474	3,474
Front end loader (1)	811	811	811	811	811	811
Tub grinder (1)	5,790	5,790	5,790	5,790	5,790	5,790
Bobcat (1)	1,042	1,042	1,042	1,042	1,042	1,042
Bandmill (1)	1,042	1,042	1,042	1,042	1,042	1,042
Kiln (0)	-	-	-	-	-	-
Edger (1)	600	600	600	600	600	600
Forklift (1)	811	811	811	811	811	811
Green Chain (1)	579	579	579	579	579	579
Basement (1)	347	347	347	347	347	347
Semi truck (1)	2,316	2,316	2,316	2,316	2,316	2,316
Trailer (2)	3,474	3,474	3,474	3,474	3,474	3,474
Grapple Truck (1)	1,737	1,737	1,737	1,737	1,737	1,737
Pelletizer (0)	-	-	-	-	-	-
Total Equipment	**22,023**	**22,023**	**22,023**	**22,023**	**22,023**	**22,023**
Labor						
Foreman/grader (1)	40,000	40,000	40,000	40,000	40,000	40,000
Sawyer (1)	40,000	40,000	40,000	40,000	40,000	40,000
Offbearer (1)	25,000	25,000	25,000	25,000	25,000	25,000
Edgerman (1)	25,000	25,000	25,000	25,000	25,000	25,000
Stackers (2)	50,000	50,000	50,000	50,000	50,000	50,000
Office Admin	10,000	10,000	10,000	10,000	10,000	10,000
Sales/Acquisitions	25,000	25,000	25,000	25,000	25,000	25,000
Total Labor	215,000	215,000	215,000	215,000	215,000	215,000
Employee benefits	32,250	32,250	32,250	32,250	32,250	32,250
Insurance	20,000	20,000	20,000	20,000	20,000	20,000
Labor Taxes	21,500	21,500	21,500	21,500	21,500	21,500
Workers Compensation	10,000	10,000	10,000	10,000	10,000	10,000
Training/Certification						
Total Labor	**298,750**	**298,750**	**298,750**	**298,750**	**298,750**	**298,750**

Inventory						
Price per ton	-	-	-	-	-	-
Tons purchased	38,000	40,000	42,000	42,000	42,000	42,000
Total Inventory	**38,000**	**40,000**	**42,000**	**42,000**	**42,000**	**42,000**
Legal						
(Permit 1)						
(Permit 2)						
(Permit 3)						
Total Legal						
Operating Costs						
Equipment operating costs	320,000	320,000	320,000	320,000	320,000	320,000
Office supplies/misc.	1,200	1,200	1,200	1,200	1,200	1,200
Total Operating Costs	**321,200**	**321,200**	**321,200**	**321,200**	**321,200**	**321,200**

Financing			
Principal	Interest rate	Term (years)	Period (months)
965,685	0.10	20.00	12.00
Monthly payment on loan	9,319		
Total interest on loan	1,270,892		
Monthly interest payment	5,295		
Annual interest payment	63,545		

Principal includes property, equipment and the first year operating costs (not including labor)