Preliminary Evaluation of the Feasibility of Adding a Biomass Boiler and /or Cogeneration to a New Power Plant at Claxton Hepburn Medical Center

Executive Summary

There are substantial benefits in energy savings, maintenance savings, enhanced reliability and flexibility with a new power plant. Those benefits can be enhanced with renewable biomass added as part of a new power plant. Claxton Hepburn Medical Center's energy use is rising and while the Hospital currently enjoys low natural gas prices those prices are expected to increase. Substantial biomass resources exist within a short distance of the Hospital and biomass fuel prices have been relatively flat and are expected to stay that way. Biomass can also help the Hospital reduce a significant portion of its greenhouse gases. The hospital has several good sites that are suitable for a new power plant and each has the potential for future expansion and multiple uses such as including a shipping and receiving complex. Irrespective of the type of power plant that the Hospital chooses, design, permitting, and construction should be typical for this size and type project requiring no extraordinary measures and can be carried out with minimal impact on the Hospital's operations. There are potential grants and loans that can reduce the overall cost to finance a new power plant but those grant programs are primarily focused on renewable energy and combined heat and power. Beyond grant support Build Own and Operate and Build Own Transfer options can construct a power plant for the hospital "off-budget" while substantially reducing risk and providing guaranteed savings.

The Hospital's consultants completed a business plan for power plant replacement which recommended that the Hospital seek to replace its current power plant with a new power plant. We have assumed that the hospital agrees with this recommendation as we have moved forward with this study of alternative fuel and cogeneration being included into the new power plant. The Claxton Hepburn Biomass Study scope was set to determine the feasibility of including either a biomass and/or cogeneration option into the initial phases of evaluation and planning of a new power plant at the Hospital.

What this preliminary evaluation does:

- Provides a description of the relevant energy using systems;
- Develops a projected energy use profile;
- Assesses if an alternative fuel, biomass boiler, is appropriate to be included in design scope of a new power plant at CHMC;
- Defines the best use for a biomass boiler at CHMC;
- Identifies sources of biomass and projects fuel availability and price;
- Identifies potential sites for a new power plant that can accommodate a biomass boiler and biomass storage;
- Identifies permitting and regulatory requirements for a new biomass boiler; and
- Identifies potential sources of funding for a biomass boiler and potential "off-budget" funding options for the new power plant.

What this preliminary evaluation does not do:

- Provide a schematic or detailed design of a power plant; and
- Provide detailed costs based on design drawings and construction and equipment bids.

As a point of reference we have estimated the base case cost of building a new power plant with natural gas boilers to be $2,937,000. The incremental cost to add a biomass boiler to a new power plant, including fuel handling and storage, is estimated to be $706,000 for a new cost of $3,643,000. These estimates are based on the professional experience of the consultants with similar power plants. The scope of this study does not allow for a detailed estimate that would be based on actual design of a new plant and bids for equipment and construction. However we feel that the estimate is suitable to allow for comparison purposes of the addition of an alternative fuel biomass boiler and or cogeneration within the new power plant. Should CHMC proceed with a project to build a new power plant our study indicates that the economics are such that a biomass option should be included as part of that project.

Next Steps

In the traditional approach to implementing a project there can be several distinct stages or components from initial investigation to project completion including; feasibility, design, construction, commissioning, completion. Not all projects will visit every stage as whole projects or project components can be terminated before they reach completion. For example, for a power plant project such as the one being evaluated for CHMC, the project could progress through stages like Pre-Planning, Conceptual Design, Schematic Design, Design Development, Construction Drawings (or Contract Documents), and Construction. The added cost to include an alternative fuel boiler or cogeneration through each of the stages in the development of the entire project, especially in the later stages, could be costly. However based on this feasibility assessment we are confident that biomass is a viable option, especially being incorporated into a new power plant.

The findings in this study show that including a biomass boiler option in a new power plant will have a simple payback of less than seven years. These findings are based on estimated use patterns of the hospital and typical costs associated with a biomass system rated at 100 BHP. The hospital has several options as next steps.

<u>Issue an RFQ for a build own operate company to do a proposal for a PPA</u>

The Hospital has indicated that it will consider soliciting a company to build/own/operate (BOO) a new power plant and enter into a power purchased agreement (PPA) to buy thermal and any electric output from the facility. The Hospital could, as a next step, issue a request for proposals for a BOO company and select the proposal that provides the greatest benefit to the Hospital with respect to reliability and cost. This option also minimizes the risk to the Hospital, risk associated to the investment of time to develop the RFP and to conduct a review and selection of a qualified proposal. If the Hospital chooses this route we recommend that the biomass option be a required component of the RFP.

Conduct a Level II feasibility study

The United States Forest Service (USFS) has a program that provides biomass feasibility studies. The USFS has developed the level I and level II feasibility study format with level I being a study that analyzes fuel usage, identifies appropriate technology, approximate capital costs and generally the payback for implementing the project. A level II study, which refines the size of the system and components and capital costs, is a document that can be used for seeking grant assistance, project financing and a general level of confidence in the project to make a decision on proceeding (spending more development money on design, permitting and implementation.) This power plant feasibility study fits between a Level I and Level II study. This option is the least risky for the Hospital but, in our opinion, provides little additional information.

Seek a qualified A/E company to do a design development study

A design development study is a study that provides further details such as schematic drawings, refines prices, provides additional details on equipment, and begins to identify opportunities and constraints that need to be addressed in the design of the plant. For a design development study the Hospital should budget between $90,000 and $120,000. Once again we recommend that the biomass option be included in this design development study based on its long-tern potential to lower energy costs and reduce the Hospital's carbon emissions.

Introduction

This preliminary feasibility study is part of a larger energy efficiency study being conducted for Claxton Hepburn Medical Center (CHMC) under a grant from the New York State Energy Research and Development Authority. This portion of that study is a follow-up to an analysis, Business Plan: Power Plant Replacement Using Renewable Sources that made a case to replace the existing aging power plant with a new power plant. The Hospital could build and operate a new power plant and use only natural gas boilers as it does now[1]. While this option does not meet the Hospital's goal to use renewable energy, the natural gas only option serves as a base case for financial comparison with a renewable energy option.

The goal of the feasibility study is to determine what configuration in the new boiler plant is best for the Hospital, renewable fuel plant, natural gas plant, or a combination of both. In order to aid the Hospital in making that decision the scope of this study is to research and recommend the type of equipment that would be in a new power plant including number, size, and type of boilers, where a new plant might be located on the Hospital campus, estimate its cost[2], research permits and any environmental considerations, research potential grant opportunities available to benefit the hospital, determine the availability of biomass fuel, and

[1] Although the boilers are identified as natural gas boilers we understand that the will have the capacity to burn fuel oil as a back-up.
[2] Cost estimates are based on the consultants' knowledge of power plant construction costs and similar types of equipment and should only be used as a means to compare various options. Actual cost to construct a plant must be determined after actual design and quotes from vendors.

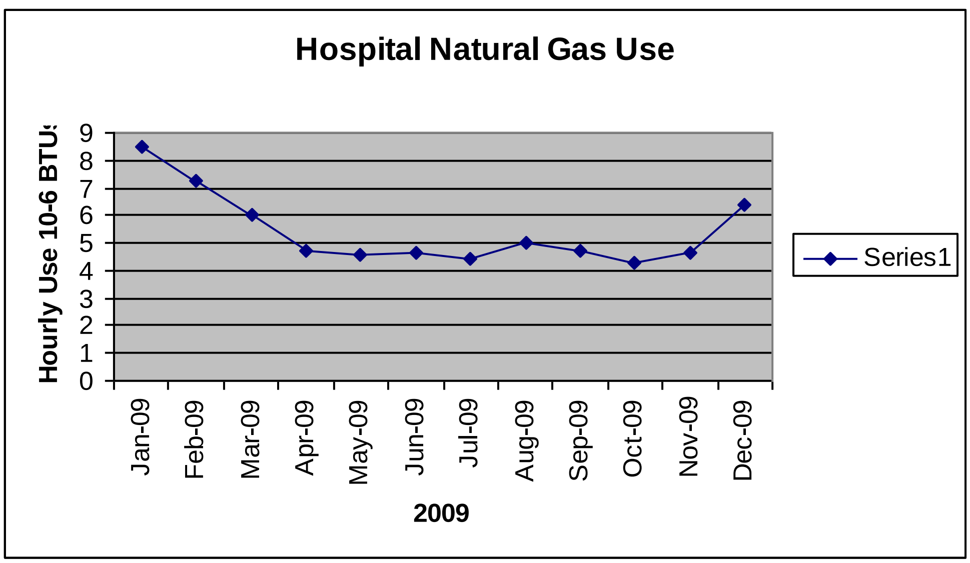
finally make recommendations on how the plant could be operated to maximize overall plant efficiency and help to keep current and future energy costs as low as possible.

In order to analyze the potential benefits from a new power plant using renewable fuel, the feasibility study will compare a new power plant using natural gas with a new power plant using renewable fuel or a combination of renewable fuel and natural gas. In addition, this study will assess the benefit of adding combined heat and power (CHP) because of its potential to lower and stabilize long-term energy costs and help reduce the Hospital's carbon emissions. The feasibility study will also incorporate financing options that will minimize the impact on the hospital's borrowing capacity, mitigate risk, and stabilize long-term energy costs.

Description of Energy Use and Systems

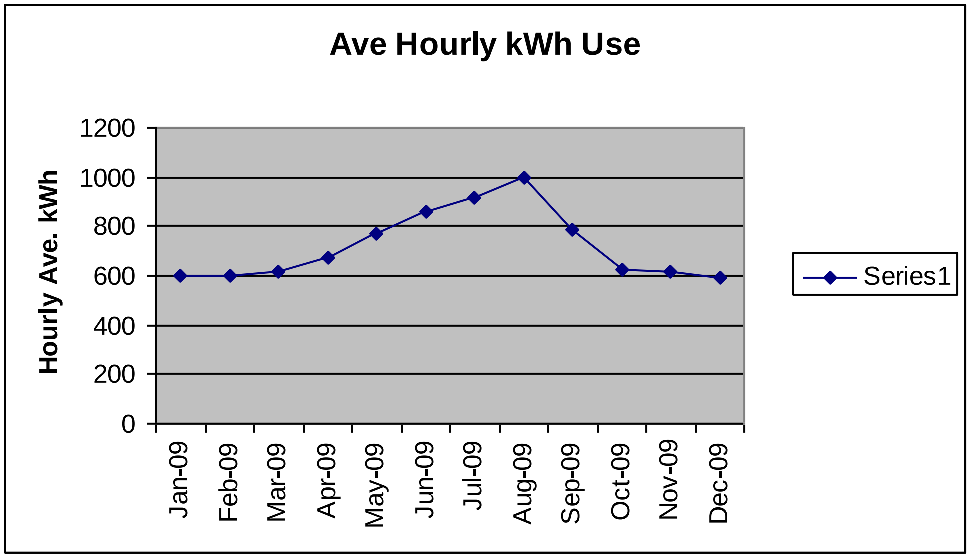
The total energy cost for hospital building operations was $1,153,844 during 2009. Electricity costs were $755,273 and natural gas costs were $398,571 for the 2009 calendar year. Energy use at the hospital for 2009 was 476,020 therms of natural gas and 6,298,630 kWh of electricity. The use of electricity increased 90,237 kWh over the previous year and an additional 83,339 therms of natural gas was consumed compared to 2008.

Below is a graph of average hourly natural gas consumption for the hospital. Natural gas is used in the hospital for boiler fuel and cooking. It is assumed that 98% of the natural gas is used in the boilers.[3]



Below is a graph of the average hourly use of electricity for 2009. The use of electricity for cooling can be seen peaking during the summer months. This peak will be greater in future years because of the replacement of the steam absorption chiller (2010) with an electric chiller in the 1975 penthouse mechanical room.

[3] The Hospital does not have data on actual steam produced. The Average Hourly Natural Gas Use Chart was developed as a surrogate to estimate thermal use in the Hospital.



Currently three boilers are installed in the basement boiler room at the hospital. Listed below is the relevant data from the manufacturer's name plate for each boiler.

Model	Size Boiler Horse Power	Serial Number	Date Installed
CB628-200	200 BHP	L-23285	7/8/60
CB628-250	250 BHP	L-23286	7/8/60
CB600-250	250 BHP	L-56460	10/6/73

The condition of the boilers is considered worn due to their advanced age. ASHRAE (American Society of Heat Refrigeration and Air-Conditioning Engineers) places the median service life for a steel fire-tube boiler at 25 years. Two of the boilers are twice the expected median service life and the third boiler is 47 years old. The boilers have had the fire-tubes replaced because of water leakage into the fire side of the boilers. The shells of the boilers show varying degrees of corrosion and the shell of the 200 BHP boiler is corroded through near the side tap and hanging down on the rear under side. It should be noted that the Hospital's boilers have lasted this long because of the excellent care and maintenance that they have received.

The make up water tank and the deaerator are also advanced in age and a metal integrity test should be performed on each if this test has not been performed in the last 3 years. The pumps appear to be newer and in good condition.

The boiler room floor and foundation shows signs of long term leakage with bio growth found at the rear of the newer 250 BHP unit. The paint on the wall is flaking and the overall physical condition of the boiler room is in poor condition.

Bio Growth Boiler Room Floor

Boiler steam is used for space heating and humidification during the heating season, cooking, the production of domestic hot water, and sterilization. Currently steam is used to produce domestic hot water in two areas of the hospital. Hospital staff has estimated that 70% of all of the domestic hot water used is produced by two new Aerco instantaneous units in the basement of the 1960's building. The balance of the domestic hot water is produced by steam coils in two storage tank units in the penthouse of the 1975 building. The graph above for average hourly natural gas use shows a baseline use of approximately 4.5 million BTUs per hour during the non-heating months. Thermal energy to produce domestic hot water for the hospital is conservatively estimated at an average of 2.0 million BTUs per hour.

The hospital requires a new boiler plant to ensure the provision of reliable utilities to the buildings for clinical and administrative functions. The hospital leadership should view this situation as an opportunity to select a new utility system that provides reliable utilities and also utilize alternative energy resources to reduce and stabilize long-term operating costs. Building a new plant will eliminate the need for major repairs to the existing power plant and allow for future modification to the hospital as contained in the Hospital's master plan.

For each of the three scenarios that follow the following common items are required in each of the three equipment combination scenarios:

- A new power plant structure located on Hospital property. The new power plant building will be of concrete block and brick veneer design. For the purpose of this study we have assumed a new power plant building approximately 60 feet wide and 80 feet long.
- A connective utility will be constructed to connect the boiler plant with the hospital.
- Auxiliary systems will be replaced including pumps, makeup water tank, deaereator, chemical treatment feed equipment, and a power plant master controller.

Scenario #1 Base Case

The base case power plant will consist of three new boilers with dual fueled burners capable of firing number 2 oil or natural gas. The boilers would be comparable to the current four pass fire-tube Cleaver Brooks boiler now in place. The new boilers will be more efficient than the current boilers and result in an estimated savings of natural gas of approximately 2%. The savings would be approximately 9,500 therms or $7,505[4] based on new boiler with boiler control upgrades accounting for the savings. The boiler controls will be automated to allow remote monitoring of boiler room operations. Combustion controls will include an O2 trim system using linkage free technology providing boiler stack flue gas analysis to provide feedback to the burner controls to optimize combustion parameters. A boiler plant master control will provide lead lag capability for the boiler operation.

The equipment included will be the above common items plus:

- One 150 BHP four pass fire tube steel boiler, Cleaver Brooks Promethean CB (LE) or similar.
- Two 250 BHP four pass fire tube steel boiler Cleaver Brooks Promethean CB (LE) or similar.
- O2 trim linkage free burner controls will be installed on the 150 BHP boilers and one of the 250 BHP boilers.

Scenario #2 Biomass and Natural Gas Plant

The primary boilers in the power plant will be one 125 boiler horsepower (BHP) biomass unit and two 250 BHP natural gas and oil fired four pass fire-tube boiler. The boiler controls will be automated to allow remote monitoring of boiler room operations. Combustion controls will include an O2 trim system using linkage free technology providing boiler stack flue gas analysis to provide feedback to the burner controls to optimize combustion parameters. A boiler plant master control will provide lead lag capability for the boiler operation.

The equipment included will be the above common items plus:

- One 125 BHP biomass boiler.
- Biomass storage bunker and biomass fuel-handling equipment.
- Two 250 BHP four pass fire tube steel boiler, Cleaver Brooks Promethean CB (LE) or similar.
- O2 linkage free trim burner controls on one of the 250 BHP.

Scenario #3 Biomass and Natural Gas Boilers Plus CHP

The primary boilers in the boiler plant will be one 125 BHP biomass boiler and two 250 BHP natural gas and number 2 oil fired four pass fire-tube boiler. The boiler controls will be

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[4] For the analysis the cost of natural gas was calculated at $0.79 per CCF and not at the rate of $0.99 per CCF as stated in the provided data from the hospital.

automated to allow remote monitoring of boiler room operations. Combustion controls will include an O2 trim system using linkage free technology providing boiler stack flue gas analysis to provide feedback to the burner controls to optimize combustion parameters. A boiler plant master control will provide lead lag capability for the boiler operation.

Additionally, two 75 KW engine/generator cogeneration units will be installed to provide a portion of the electricity for the hospital and 490,000 BTUs per hour of thermal energy to produce domestic hot water. The engine generator sets will be operated on natural gas. This will necessitate a centralized domestic hot water system to be located in the new boiler plant and circulated to the two current domestic hot water production sites in the hospital. An estimated 1,000 linear feet of domestic hot water pipe will be required and a properly sized duplex pump set. It should be noted that the two Aerco instantaneous units would be left in place and could be used as back-up units when the cogeneration units are down for routine maintenance or for other reasons.

The equipment included will be the above common items plus:

- One 125 BHP Biomass boiler.
- Biomass storage bunker and biomass handling equipment.
- Two 250 BHP four pass fire tube steel boiler, Cleaver Brooks Promethean CB (LE) or similar.
- O2 linkage free trim burner controls on one of the 250 BHP.
- Two Techogen, or equivalent, natural gas fire engine generator set providing 75 KW and 490,000 BTUs per hour each.
- One thousand feet of insulated DHW piping to connect to the two hospital DHW distribution locations.
- One 1000 gallon insulated storage tank for the DHW system.

The addition of a cogeneration operation will also have an effect on the operation of the boilers. A total of 980,000 BTUs per hour will be taken from the boiler load and supplied by the cogeneration units. Both the electric production and the thermal production will be used in the hospital with the cogeneration units available for 80% of the annual hours. The 20% down time is allotted for repairs and maintenance. A maintenance contract agreement taken at $0.015 per kWh produced is included in the operation costs. This contract will ensure the long term use of the units and repair in the event of unit failure. These contracts include emergency repair, engine rebuilds, and guarantee unit availability and an agreed upon term.

Scenario #4 Natural Gas Boilers Plus CHP

This is a complete natural gas scenario with thermal (steam) met with the natural gas boilers and hot water made with the cogeneration equipment. Biomass is not part of this scenario.

The equipment included will be the above common items plus:

- One 150 BHP four pass fire tube steel boiler, Cleaver Brooks Promethean CB (LE) or similar.

- Two 250 BHP four pass fire tube steel boiler, Cleaver Brooks Promethean CB (LE) or similar.
- O2 linkage free trim burner controls on one of the 250 BHP.
- Two Techogen, or equivalent, natural gas fire engine generator set providing 75 KW and 490,000 BTUs per hour each.
- One thousand feet of insulated DHW piping to connect to the two hospital DHW distribution locations.
- One 1000 gallon insulated storage tank for the DHW system.

A summary of the scenarios is included below:

Scenarios	Thermal Saved $	Electric Saved $	Project Cost	Incremental Cost	Simple Payback
Scenario #1	$7,505	$0	$2,937,000	$0	
Scenario #2	$113,780	$0	$3,643,000	$706,000	6.20
Scenario #3	$67,472	$63,989	$4,295,000	$1,358,000	10.33
Scenario #4	$7,505	$63,989	$3,589,000	$652,000	9.11

Staffing requirements by the hospital for the operation of the equipment in each of the three scenarios is projected at being neutral. The new plant and new boilers with updated controls are projected to decrease current repairs being performed on the systems. The plant is thought to be staffing neutral because the personnel shall be performing periodic and preventive maintenance on the new and other hospital equipment.

The maintenance for the heat and power equipment shall be contracted and the cost has been written into the project expense as has the natural gas to operate the system. Maintenance contracts for heat and power equipment should have very specific clauses dealing with guaranteed equipment availability to minimize outages. The contract should also provide periodic and scheduled maintenance and rebuild/replacement of major components of the generation system. It must be noted that maintenance of the biomass system, ash disposal, monitoring deliveries, and preventive maintenance for fuel storage and handling equipment will require attention. Net maintenance will however be less than current maintenance allocated to the power house.

Biomass Fuels: Types, Availability, and Price Influences

Natural gas, oil, and propane are all boiler fuel choices for CHMC. In general when natural gas has been available, facilities have chosen gas over oil and propane for a number of reasons including its just-in-time delivery via pipeline (no storage required), price, and relatively clean burning characteristics. Fossil fuels like gas, oil, and propane also have a well established supply infrastructure and futures markets that allow some ability to minimize risks of future price spikes. Fossil fuels however convert carbon that has been sequestered in the earth into carbon dioxide increasing the levels of carbon dioxide in the atmosphere which contributes to climate change. Fossil fuels are also not renewable and their finite supply has contributed to their price volatility. Most experts, including the U.S. DOE Energy Information Administration predict future and steady increases in fossil energy prices.

One of the biggest perceived barriers to the use of biomass as a renewable fuel is the concern over the availability of biomass fuels. The unfamiliarity with the availability, specifying, and purchasing biomass fuels vs. natural gas, propane, or oil, is a major hurdle that must be addressed. In order to implement a successful biomass project the potential user must be put into a reasonable comfort zone for biomass fuels.

Biomass is currently the largest renewable resource used in the U.S. today providing nearly half of all renewable energy. According to the U.S. Department of Energy there is over 1.2 billion dry tons of woody biomass potential over and above current food and fiber requirements[5]. According to a study conducted by the State University of New York College of Environmental Science and Forestry, St Lawrence County is the most forested county in New York State with well over 1,000,000 acres of forest lands. New York State DEC estimates that available woody biomass in the four county area of the northern Adirondacks could supply about 800,000 green tons per year over current harvest level[6]. It is estimated that for CHMC to supply most of its thermal energy needs (calculated based on natural gas use) that the hospital would use about 6000 tons of green woodchips annually or less that 1% of the available supply in the region.

Biomass fuels have traditionally been very consistent in price a biomass boiler at CHMC would likely require clean woodchips similar to the type provided to paper mills. The clean and screened “pulp chips” are not in as much demand today due to the closure of many of the pulp mills in New York. Future markets that could influence the price of these chips would be the emergence of a large and viable biofuels industry that would use woody biomass as a feedstock for transportation fuels and chemicals. However that market is not expected to be developed for many years. Another factor that could also help to mitigate any future supply or price concerns is the potential to produce biomass on idle farmland in the St Lawrence Valley. If biomass prices were to increase, ten of thousands of acres could be brought back into production to produce willow or grasses that would mitigate any future price increases. In fact is more likely that future markets for biomass for biofuels and chemicals would tend toward willow and grasses leaving forest resources for boiler fuels and CHP. .

Site Considerations

The current location of the power plant can not be used as the site for a new power plant unless significant accommodation were made such as a temporary boiler plant being put in place while the current location was demolished and a new plant built. In addition the hospital’s long-term master plan calls for that area to be the new main entrance to the hospital. Therefore the current location is not considered for the new power plant. Three other locations have been

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[5] Biomass as Feedstock for a Bioenergy and Bioproducts Industry: The Technical Feasibility of a Billion-Ton Annual Supply – U.S. DOE April 2005

[6] Personal conversation with Sloane Crawford Utilization and Marketing forester NY State DEC.

evaluated. The primary consideration for the location of a new power plant is proximity to tie into the existing steam and hot water distribution system in the Hospital. The site must be large enough for three boilers and equipment such as the engine generators. The site must have access to water and electric and be able to accommodate a boiler stack. In addition the site must be able to accommodate woodchip storage and have sufficient room for a tractor trailer to deliver and unload woodchips.

The first site is on the corner of New York Avenue and Rensselaer Ave. The location is a former two story residence that is owned by the hospital and is currently used for record storage. The site provides a direct line to the existing power plant approximately 350 feet due west from the current power plant. The site is large enough to for a new power plant and chip storage. The site is flat and would require excavation to build a woodchip storage bunker. The bunker should be ten feet deep. Generally woodchips are off-loaded from semi trailers via a moving floor into a bunker. The site is also the farthest from the hospital. This site is also the closest to neighbors who may object to the Hospital's boiler stack moving closer from it current location.

The second location evaluated is a corner of the parking lot on the corner of Ford and Rensselaer Avenues. This site is the closest to the current power plant, just 100 feet to the East. Again this is a flat site requiring excavation. The site should not present any additional objection from neighbors since it is so close to the existing power plant. The site may impact future development of a new main entrance to the hospital as outlined in the master plan. Finally the new plant would eliminate existing parking.

The third location evaluated is the current Farrand's Flowers site on King Street. The hospital has an agreement with the site's owner to close on the purchase of the site within a year. This site is also about 300 to 350 feet from the current power plant but is only 150 feet from the hospital. The site has a slight grade higher by about 4 -5 feet to the south of King Street. That grade could be helpful in eliminating some of the need to excavate a woodchip storage bunker. The site also does not impact and current parking and may have less neighbor impact vs. the Rensselaer Avenue site. The biggest drawback is that the Hospital does not currently own the site.

All three sites would require burying pipes and would need to cross Ford Avenue[7]. Ford Avenue contains water and sanitary and storm sewer lines. These analysis assumers that the cost for crossing Ford Avenue is the same for all three sites and for whatever power plant configuration (natural gas or natural gas and biomass) is selected. We have only considered other factors in making our recommendation for a site.

Environmental Considerations

A new power plant will require a modification or a new New York State Air Permit. The addition of a new biomass boiler will likely not change the Hospital's current permit requirements.[8] The primary difference with the addition of a biomass boiler is the emission of fine particulate (PM2.5). If a facilities' total emission of fine particulate is greater than 15 tons per year it may require a different permit requirement. In general biomass boilers do not exceed that limit, 15 tons per year, if boiler input is less than 30 MMBTU equivalent to approximately 600bhp. Biomass boilers over that capacity would require Lowest Achievable Emission Rate technology (LAER). This is spelled out in New York State DEC policy statement CP-33 http://www.dec.ny.gov/chemical/8912.html

Concern over the use of biomass has been raised by some based on its impact on the forest. The hospital may wish to only use wood that is harvested form sustainable sources. One way to ensure that the biomass fuel that the hospital would be using is a sustainable source is to contract for supply from loggers and other suppliers that harvest wood from land that is certified under a certification program such as the Forest Stewardship Council (FSC). In conversations with loggers and biomass suppliers in northern New York there is significant supply of wood from certified lands thus providing sustainable biomass fuel. In discussions with loggers there is currently no price premium that the Hospital would need to pay for biomass fuel from FSC lands.

The Hospital has indicated that they are very interested in reducing their "carbon footprint" and is one of the reasons to consider alternative boiler fuel. Based on CHMC's annual use of natural gas the hospital emits 3944 tons of carbon dioxide. Replacing natural gas with biomass can significantly reduce the Hospital's carbon emissions. It is often stated that biomass is "carbon neutral" and according to the Intergovernmental Panel on Climate Change (IPCC) guidelines for voluntary reporting of greenhouse gases, reporters may use an emission factor of zero for wood, wood waste, and other biomass fuels in which the carbon is entirely biogenic[9].

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[7] The hospital has expressed interest in exploring the potential to build a power plant with shipping and receiving as well as a maintenance facility. The addition of shipping and receiving would require a tunnel be constructed to connect the power plant / shipping receiving to the hospital. This tunnel would also be used for all piping and services connected to the power plant. This analysis only considers a power plant with buried lines and no tunnel. Although none of the sites selected would preclude the potential for a combined power plant shipping receiving facility.

[8] We have assumed that the Hospital already has a State Facility Permit and is not "grandfathered" due to the age of the current power plant.

[9] Under international greenhouse gas accounting methods developed by the Intergovernmental Panel on Climate Change, biogenic carbon is part of the natural carbon balance and it will not add to atmospheric concentrations of carbon dioxide. Under IPPC guidelines for voluntary reporting of greenhouse gases, reporters may use an emission factor of zero for wood, wood waste, and other biomass fuels in which the carbon is entirely biogenic.

That said biomass is more likely defined as "near neutral" accounting for the carbon that is emitted as a result of energy use associated with harvesting, processing, and transport. We believe that each ton of woodchips requires about 2.1 gallons of diesel fuel to harvest, process, and transport to a site[10]. Based on these estimates woody biomass from forests produces between 5 pounds of CO_2 per million BTU. Natural gas use is calculated to be at 117 pounds of CO_2 per million BTU. Based on CHMC's use of natural gas, if all natural gas were replaced by biomass the Hospital would reduce its carbon emissions by 3819 tons per year. The actual reduction will likely be lower due to the continued use of some natural gas.

Potential Funding Opportunities

Construction of a new boiler plant is a capital expense. This type of capital expense can have several and varied impacts on a hospital from limiting the hospital's ability to add critical patient services to reducing the average age in years of the hospital's fixed assets, reducing the need for future capital expenditure, and reducing long-term operating costs.

When a boiler plant replacement is implemented at CHMC the Hospital will have options on how to finance that project. The Dormitory Authority of the State of New York (DASNY) provides financing for capital construction and rehabilitation projects for health-care facilities in New York State through a variety of credit structures, depending on the financial status and needs of the customer. The DASNY bonds are secured by a general pledge by the health care institution to make mortgage payments that fund debt service payments on the outstanding bonds. These mortgage payments are generally backed up by insurance policy backing up the hospital's pledge to repay the bonds
http://www.dasny.org/finance/finserv/index.php

There are many grant programs that could contribute to lowering the overall capital cost of a project. However it is the opinion of the consultants that there are no grant programs for solely a boiler plant replacement. Grant programs are generally tied to improved efficiency or to renewable fuels.

The U.S. Department of Agriculture through its Rural Energy for America Program (REAP**)** Grants for Development of Renewable Energy Facilities -- Provides funding for grants of up to 30 percent of the cost of building a new renewable energy facility placed in service during 2009 and 2010 that would otherwise qualify for the investment tax credit ("ITC") or the production tax credit ("PTC").

The following are links to programs that my provide grant or loan funding for energy efficiency and renewable energy projects.

http://www.nyserda.org/chpnys/funding&support.asp
http://www.hospitalfinancial.com/index.php
http://www.epa.gov/greenbuilding/tools/funding.htm#general

[10] Biomass carbon emissions are based on carbon emission from 2.1 gallons of diesel fuel use for harvesting, processing and transport within a 60 mile radius of the hospital. Emission coefficients are from the U.S. DOE's Energy Information Agency.

http://www.smartcommunities.ncat.org/
http://www.fuelsforschools.info/pdf/All_Private_foundations.pdf

Given the potential for the hospital to build a new power plant "off-budget" the two off-budget options Build, Own, Operate (BOO) and the Build Own Transfer (BOT) may be viable options. Under these agreements a qualified third party covers all the costs and risks to build, own, and operate the power plant and all the related equipment. Under this type of arrangement the hospital would contract with the qualified third party for the long-term purchase of energy, and the hospital is able to achieve the benefits of a new power plant without the capital outlays. The expense is covered through annual operating budgets such as energy, maintenance, and labor that would be associated with on-site energy production vs. capital budget outlay.

BOO and BOT are financing options that were developed decades ago primarily for large government infrastructure projects. Today BOO and BOT have been employed by energy services companies to help customers achieve the benefits of new infrastructure without the need to raise capital through a capital campaign or encumbering their capital reserves. In addition, energy services companies can incorporate BOO and BOT as part of a comprehensive energy services agreement that can lower the overall energy costs to the customer. Under a BOO agreement, the contractor may hold the asset in perpetuity or make a transfer to the host customer at some designated point in time. The BOT agreement has a specific transfer provision in the agreement.

The BOO and BOT agreements allow customers to focus on their core business while the contractor takes the lead for the design and operation of the project. BOO and BOT contracts include guarantees on quantity, quality, and cost of produced output, in this case thermal energy. BOO and BOT have the following features and benefits:

- Guaranteed steam quality, quantity, and cost
- Preservation of investment capital
- Reduced planning, development, and management vs. customer implementation
- Contractor takes on operational and maintenance risks
- Reduced customer labor expenses
- Greater technology transfer and training potential
- Potential for reduced liability and facility insurance

Typically a customer compares the overall cost of implementing a project through their own financial resources vs. that of the BOO or BOT contract. However in the case of CHMC, the comparison is between maintaining the existing plant and entering into a BOO or BOT agreement for a new power plant.

Recommendations

The Hospital has an aging power plant that, while functioning, needs to be replaced. A new power plant offers the opportunity to incorporate renewable fuels and cogeneration. Based on this feasibility study we recommend that Claxton Hepburn Medical Center proceed with plans to construct a new power plant that incorporates a biomass boiler to serve as a base thermal load and use natural gas boilers to supply peaks and as backup. Further we recommend that CHMC issue and RFQ for a build own transfer contractor to build the plant and provide the hospital with thermal energy resulting in immediate as well as long term energy savings.

Appendix A

Combined Bio Mass and Natural Gas Boiler Plant

		Data From the Hospital					Analysis Provided By Consultants				
		Days Billed	CCF	Rate $	Therms	Cost	Boiler Fuel Therms	Ave Hourly Steam 000#	Bio Mass Monthly Production 000#	Natural Gas Monthly Production 000#	Total Production 000#
214 King Street	**2009**	-	-	-	-	-					
	Jan-09	30	61,520.00	1.00	61,335.00	$69,827.36	60,721.65	6.33	3,105.00	1,449.12	4,554.12
	Feb-09	29	50,680.00	0.99	50,376.00	$ 57,534.54	49,872.24	5.37	3,001.50	738.92	3,740.42
	Mar-09	29	42,370.00	0.99	41,946.00	$ 45,447.31	41,526.54	4.47	3,001.50	112.99	3,114.49
	Apr-09	32	36,780.00	0.99	36,339.00	$ 31,773.36	35,975.61	3.51	2,698.17	0.00	2,698.17
	May-09	29	32,260.00	0.99	31,873.00	$20,180.09	31,554.27	3.40	2,366.57	0.00	2,366.57
	Jun-09	30	34,090.00	0.99	33,681.00	$ 21,746.00	33,344.19	3.47	2,500.81	0.00	2,500.81
	Jul-09	33	35,390.00	0.99	35,001.00	$21,988.64	34,650.99	3.28	2,598.82	0.00	2,598.82
	Aug-09	29	35,340.00	0.99	34,916.00	$ 21,536.07	34,566.84	3.72	2,592.51	0.00	2,592.51
	Sep-09	32	36,790.00	0.99	36,312.00	$21,738.91	35,948.88	3.51	2,696.17	0.00	2,696.17
	Oct-09	32	33,520.00	0.99	33,118.00	$ 19,373.25	32,786.82	3.20	2,459.01	0.00	2,459.01
	Nov-09	26	29,330.00	0.99	29,066.00	$ 24,735.87	28,775.34	3.46	2,158.15	0.00	2,158.15
	Dec-09	34	52,530.00	0.99	52,057.00	$ 42,690.13	51,536.43	4.74	3,519.00	346.23	3,865.23
			Real Ave.	0.79	476,020.00	$398,571.53	471,259.80		32,697.22	2,647.26	35,344.49
						Cost Combined Production Plant			$256,906.73	$27,884.52	$284,791.25
						Cost of Natural Gas Boiler Fuel					$398,571.53
									Savings $		$113,780.28

Notes

1.0 125 BHP = 125 X 34.5 (Pounds of Steam/BHP) = 4,312.5

2.0 Efficiency of current system estimated at 75% for conversion of Natural Gas to steam.

3.0 Cost of wood chips at $5.50 per million BTUs, heat content taken at 5,000 BTUs per pound

4.0 Wood system efficiency assumed at 5% lower than natural gas burning.

5.0 Rate used in data provided by the hospital not correct according to quantity delivered and cost.

Appendix B

Cogeneration Analysis

Month	Days billed	Electric - kWh	Ave. Hourly kWh	Total	Cogen Production 150KW/Hr	Value of Production Elec.	Thermal Production 10-6 BTUs	Value of Thermal Production	Operation Natural GasDTherm	Operation Cost	Maint. Contr..015/kWh
2009											
Jan-09	30	429,931.0	597.1	$54,914.62	108,000.0	$ 13,794.72	705.6	$ 5,574.24	12,960.0	$10,238.40	$ 1,620.00
Feb-09	29	417,340.0	599.6	$46,221.42	104,400.0	$11,562.55	682.1	$ 5,388.43	12,528.0	$ 9,897.12	$ 1,566.00
Mar-09	32	470,243.0	612.3	$48,696.34	115,200.0	$11,929.62	752.6	$5,945.86	13,824.0	$10,920.96	$ 1,728.00
Apr-09	30	487,054.0	676.5	$52,026.69	108,000.0	$11,536.47	705.6	$ 5,574.24	12,960.0	$ 10,238.40	$ 1,620.00
May-09	29	534,163.0	767.5	$54,273.49	104,400.0	$10,607.53	682.1	$ 5,388.43	12,528.0	$9,897.12	$ 1,566.00
Jun-09	32	660,463.0	860.0	$82,898.46	115,200.0	$14,459.41	752.6	$5,945.86	13,824.0	$ 10,920.96	$ 1,728.00
Jul-09	30	660,676.0	917.6	$84,910.38	108,000.0	$ 13,880.21	705.6	$ 5,574.24	12,960.0	$ 10,238.40	$ 1,620.00
Aug-09	29	692,560.0	995.1	$87,949.37	104,400.0	$13,257.93	682.1	$ 5,388.43	12,528.0	$ 9,897.12	$ 1,566.00
Sep-09	32	602,161.0	784.1	$81,756.67	115,200.0	$ 15,640.95	752.6	$ 5,945.86	13,824.0	$10,920.96	$ 1,728.00
Oct-09	29	433,664.0	623.1	$56,556.72	104,400.0	$ 13,615.43	682.1	$5,388.43	12,528.0	$9,897.12	$ 1,566.00
Nov-09	29	430,518.0	618.6	$51,015.89	104,400.0	$12,371.28	682.1	$ 5,388.43	12,528.0	$ 9,897.12	$ 1,566.00
Dec-09	34	479,857.0	588.1	$54,053.18	122,400.0	$ 13,787.67	799.7	$6,317.47	14,688.0	$ 11,603.52	$ 1,836.00
	365	**6,298,630.0**		**$755,273.23**	**1,314,000.0**	**$ 156,443.77**	**8,584.8**	**$ 67,819.92**	**157,680.0**	**$ 124,567.20**	$ 19,710.00
		Estimated Actual Production			**1,051,200.0**	**$ 125,155.01**	**6,867.8**	**$ 54,255.94**	**126,144.0**	**$ 99,653.76**	**$ 15,768.00**
		Annual Net Cogen Value				**$ 63,989.19**					
		Project Cost @ $3,400/KW				**$ 510,000.00**					
		Piping 1,000 Ft. Insulated DHW				**XXXX**					

Note: 1.0 Cogeneration taken at 80% availability.

Appendix C

Boiler Analysis With Cogeneration

		Data From the Hospital					Analysis Provided By Consultants					
		Days Billed	CCF	Rate $	Therms	Cost	Boiler Fuel Therms	Boiler Fuel Therms With Cogen	Ave Hourly Steam 000#	Bio Mass Monthly Production 000#	Natural Gas Monthly Production 000#	Total Production 000#
214 King Street	**2009**	-	-	-	-	-						
	Jan-09	30	61,520.00	1.00	61,335.00	$69,827.36	60,721.65	50,353.65	5.25	3,105.00	671.52	3,776.52
	Feb-09	29	50,680.00	0.99	50,376.00	$ 57,534.54	49,872.24	39,849.84	4.29	2,988.74	0.00	2,988.74
	Mar-09	29	42,370.00	0.99	41,946.00	$ 45,447.31	41,526.54	31,504.14	3.39	2,362.81	0.00	2,362.81
	Apr-09	32	36,780.00	0.99	36,339.00	$ 31,773.36	35,975.61	24,916.41	2.43	1,868.73	0.00	1,868.73
	May-09	29	32,260.00	0.99	31,873.00	$ 20,180.09	31,554.27	21,531.87	2.32	1,614.89	0.00	1,614.89
	Jun-09	30	34,090.00	0.99	33,681.00	$ 21,746.00	33,344.19	22,976.19	2.39	1,723.21	0.00	1,723.21
	Jul-09	33	35,390.00	0.99	35,001.00	$ 21,988.64	34,650.99	23,246.19	2.20	1,743.46	0.00	1,743.46
	Aug-09	29	35,340.00	0.99	34,916.00	$21,536.07	34,566.84	24,544.44	2.64	1,840.83	0.00	1,840.83
	Sep-09	32	36,790.00	0.99	36,312.00	$ 21,738.91	35,948.88	24,889.68	2.43	1,866.73	0.00	1,866.73
	Oct-09	32	33,520.00	0.99	33,118.00	$19,373.25	32,786.82	21,727.62	2.12	1,629.57	0.00	1,629.57
	Nov-09	26	29,330.00	0.99	29,066.00	$24,735.87	28,775.34	19,789.74	2.38	1,484.23	0.00	1,484.23
	Dec-09	34	52,530.00	0.99	52,057.00	$ 42,690.13	51,536.43	39,786.03	3.66	2,983.95	0.00	2,983.95
			Real Ave.	0.79	476,020.00	$ 398,571.53	471,259.80	345,115.80		25,212.16	671.52	25,883.69
						Cost Combined Production Plant				$198,095.55	$ 7,073.38	$205,168.94
						Cost of Natural Gas Boiler Fuel						$272,641.48
										Savings $		**$ 67,472.55**

Notes

1.0 125 BHP = 125 X 34.5 (Pounds of Steam/BHP) = 4,312.5

2.0 Efficiency of current system estimated at 75% for conversion of Natural Gas to steam.

3.0 Cost of wood chips at $5.50 per million BTUs, heat content taken at 5,000 BTUs per pound

4.0 Wood system efficiency assumed at 5% lower than natural gas burning.

5.0 Rate used in data provided by the hospital not correct according to quantity delivered and cost.

Appendix D
Q & A on biomass boilers

Q Why would CHMC forgo a high efficiency low emission gas boiler for wood boiler that could result in lower efficiency and higher emissions?

A You don't have to. Modern biomass boilers are built with high temperature refractory linings that allow for higher combustion temperatures than previous models. Many new biomass boiler systems have mulit-pass or other combustion chamber modifications that significantly reduce particulate emissions before they are able to exit the system, making the systems much cleaner. Modern biomass boilers are fully automated and use Programmable Logic Controller (PLC) to control combustion. The air flows and fuel feed rates are constantly and automatically adjusted by way of variable frequency drives to ensure steam pressure or hot water temperature is maintained. In addition through internal combustion monitoring and effective use of combustion air, a modern biomass boiler is capable of burning material with variable moisture content, as high as 50%, while maintaining efficiency and controlling emissions. Finally the recommendation is for a biomass boiler sized to operate at or near rated capacity as much as possible which will keep efficiency high.

Q Don't you need to remove ash from the boiler and doesn't that require the boiler to be shut down?

A Modern advanced technology biomass boilers have automated ash removal. These ash removal systems remove the ash from the unit automatically allowing for continual operation; thus, eliminating costly downtime and unnecessary labor and operational costs. Automatic ash removal is also safer for the boiler operator, reducing the risk for burns from hot ash.

Q How much ash is generated and how is it disposed?

A Depending on factors such as the percentage of bark in delivered biomass the fuel, ash content can be as low as 2 or 3% of the volume of the biomass fuel input. For example a biomass plant that uses 2000 tons annually would generate about 200 cubic yards of ash annually. In some cases biomass ash can be sold of or disposed of at no cost as a soil amendment or readily disposed of in a landfill.

Q Is there enough biomass fuel available, where can I get the fuel?

A According to sources including the New York State Department of Environmental Conservation, St. Lawrence County and Upstate New York are blessed with significant biomass resources. In addition the Hospital's consultants have conducted telephone interviews for other potential biomass projects in Northern New York and have first hand knowledge of current suppliers. Below is a list of biomass suppliers that was generated from past calls made by the consultants. All of these companies currently supply biomass fuels and have logging operations within an economic 50 mile range of CHMC.

Company Name	Location	Contact	Telephone
Paul J. Mitchell Lumber	Tupper Lake	Paul Mitchell	(518) 359-7029
Kevin Regan Logging	Camden		(315) 245-3890
O'Neill Bros.	Tupper Lake	Tim O'Neill	(518) 359-7350
Richards Logging	Tupper Lake	Cora Richards	(518) 359-2775
Curran Logging	Massena	Patricia Curran	(315) 769-5970
Aden Bros Logging	Lyons Falls		(315) 348-8690
Lyndaker & Sons Logging	Castorland	Dave Lyndaker	(315) 346-1797

Q How much fuel should we store?

A Many older biomass projects specified storage facilities to hold 5 days of peak supply. Today biomass projects have smaller storage facilities in the 2 to 3 day range and rely on just-in-time deliveries. Given the expansion of the wood products industry into supplying biomass fuels, just-in-time delivery is possible, reducing the need for large storage facilities. In addition the proposed biomass option at CHMC would have full natural gas back-up. If for any reason biomass deliveries were delayed natural gas could be used until supply arrived.

Q How much space would a three-day storage require? What does that mean for truck traffic at and around the Hospital?

A Biomass should be stored in a bunker and not a silo. The "footprint" for a three-day storage will vary with the size of the biomass boiler. For example a 100 BHP biomass boiler running at full capacity would use about 1000 pounds of green wood chips per hour. This equates to 36 tons of green wood chip in a three day period. A bunker sized to hold two full trailer loads of woodchips would be more than sufficient for a three-day storage. A bunker this size is 170 to 200 cubic yards or 30 feet long by 20 feet deep and 10 foot high. A tractor trailer can deliver 22 to 25 tons of woodchips. In the above example for a 100 BHP biomass boiler, one delivery every other day would be required during peak demand. CHMC could operate with two to three deliveries per week under the proposed scenario.

Q Won't a biomass boiler require more labor?

A Staffing requirements must be factored into consideration of a biomass boiler system. In addition initial staff training on operation and maintenance of the biomass boiler and the fuel handling and storage system needs to be considered. No specialized staff is required. Existing facility personnel, after initial training, are all that is required. Given that a biomass boiler and its fuel handling and storage has more moving parts than a natural gas boiler the Hospital should budget .5 man hours per day for routine inspection and maintenance. Given that the biomass boiler will be part of a new power plant over all inspection and maintenance will related to the power plant will be lower than current operation. For example design and operating procedures such as allowing for fuel deliveries that do not require Hospital maintenance staff to present can help to keep labor cost low.

Q Aren't biomass boilers more expensive compared to natural gas boilers?

Biomass boilers have a more complex burner and fuel handling and storage systems that in total make them more expensive than a package natural gas boiler. However one needs to consider the life-cycle cost and not just the initial cost of the equipment. Over the life of the boiler you will pay for maintenance and fuel to operate the boiler. The real cost is the total cost of all the inputs; equipment, maintenance, and fuel. While a biomass boiler can be 40% more in initial cost and have higher maintenance cost, the savings in fuel cost over a twenty to thirty year life cycle can be a significant savings.