Preliminary Feasibility Report

Gordon-Nash Library

69 Main Street
New Hampton, New Hampshire 03256

Report Prepared for NH WEC by:

Rick Handley & Associates

6 Danbury Drive
Ballston Lake, NY 12019
(518) 466-6934
rhandley@nycap.rr.com

Date of Site Visit: October 7, 2014

Date of Report: 11/17/2014

Final Report

The NH Wood Energy Council is coordinated by North Country Resource Conservation & Development and funded through a grant from the USDA Forest Service State & Private Forestry. North Country RC&D, coordinator of the NH Wood Energy Council, complies with federal nondiscrimination policy and is an equal opportunity provider.

Table of Contents

List of Figures

List of Tables

I. Executive Summary and Recommendation

The NH Wood Energy Council (NH WEC) www.nhwoodenergycouncil.org with funding through a grant from the USDA Forest Service, has funded this preliminary feasibility study for the Gordon-Nash Library to determine if switching from fossil fuel to wood fuel for heating is feasible and warranted. Rick Handley of Rick Handley & Associates has been hired by NH WEC to complete this "Coaching" assignment and is the author of this report.

The Gordon-Nash Library is a private non-profit library established in 1896 in the Town of New Hampton, NH. The library is located on Main Street in the heart of the residential and commercial center of the Town. According to the Library's website:

> *The will of Judge Nash expressed this purpose: "To establish a public library and reading-room in Smith's Village, New Hampton, N.H., my native place, for the free use of the people of said town, whether residents, students, or sojourners." He directed, also, that there should be erected "A building of agreeable architecture with ventilated walls."*

The original 1896 library, plus additions in 1961 and 1977, is a two story brick structure totaling 9500 square feet. The original building has an attic that is insulated and houses an air conditioning unit. The library is currently heated with fuel oil that fires a single hot water boiler. In 2013 an estimated 3277 gallons of #2 heating oil was used to heat the facility. At the current statewide average fuel oil price of $3.36 per gallon, the 2014/2015 heating cost is estimated to be $11,000.

Based on the information provided by the Library and an on-site review of the facility on October 7, 2014, we have determined that a wood pellet heating system is technically feasible, however, because the building is relatively small, the economics of a pellet heating system will be significantly influenced by the actual installed price of a new pellet boiler and system components. Additional investigation will be required beyond this report to get firm costs for equipment and installation. This would best be accomplished by advertising for bids for a complete biomass pellet system including a boiler, pellet storage silo, flex-auger pellet distribution system, thermal storage tank, appropriate control technology capable of operating the pellet boiler system in tandem with the oil boiler and thermal storage. The bid request should include all equipment pricing, installation, commissioning, operator training, identification of who will provide warrantee service, and who will serve as a local service representative.

Should the Library move forward with a new wood pellet boiler, it should be designed/configured to work in tandem with the oil fired boiler to supply enough capacity to meet peak loads and provide back up for the biomass boiler. Installation of a wood pellet boiler includes the strong recommendation to install a thermal storage tank capable of storing 150 to 200 gallons of water. The new operating mode should only use the oil fired boiler to only meet peak demand on the very coldest of days when the pellet boiler and thermal storage alone are not sufficient, and in the early Fall and late Spring (shoulder seasons) when only a slight "warming" of the building is

required. The goal should be for the wood pellet system, with thermal storage, to provide 90% of the annual heat requirement.

A financial analysis has determined that the simple payback for installing a system as described in this report, to become the primary heating system, could be as little as 4.96 years if grant funding was available. The payback for a new pellet boiler with no grant funding could be in the range of 7 years. Annual savings in fuel costs is estimated at over $3,300 per year for an average year. Based on our estimated cost, a biomass thermal heating system could be installed at the Gordon-Nash Library resulting in no net increase in the annual heating budget. In other words for the same amount currently spent for fuel oil the Library could purchase and install a new pellet boiler system and could cover all principal and interest payments to finance the new pellet heating project as well as pellet fuel and annual maintenance costs.

II. Introduction

Opportunities to use wood energy to replace fossil fuels can provide increased economic benefits to all residents and businesses in New Hampshire and move the state towards the State's goal of using 25% Renewable Energy by 2025.

Nationally, the U.S. Department of Agriculture has directed the Forest Service to increase its wood to energy efforts as part of that Agency's continuing focus on building a forest restoration economy connected to the management of all lands. By placing a strong emphasis on developing renewable wood energy while restoring the nation's forests, USDA strives to create and retain sustainable rural jobs, conserve forests, and address societal needs.

For these reasons the State Forester and the U.S. Forest Service created the NH Wood Energy Council. This team includes individuals, organizations, NH businesses, industry associations and non-profits interested in the sustainable use of forest resources, development of renewable energy alternatives - from regional and community agencies sustaining local economies and meeting social needs, and from State and Federal agencies interested in maintaining and expanding the economic benefits from the State's forest resources. The NH Wood Energy Council serves as a national pilot, testing and refining tools to encourage more use of wood for energy and methods.

The USDA Forest Service has provided financial and technical resources to support the work of the NH Wood Energy Council. The North Country Resource Conservation and Development (RC&D) Area Council facilitates the organization and initial work of the Council.

A key component of the NH Wood Energy Council's work is to provide direct technical assistance to public, institutional and private facility managers to encourage switching to modern, efficient

wood-fueled heating systems. This preliminary feasibility study is a key method to deliver those technical services where needed. After an application for assistance was submitted by Cathy Vincevic, the Director of the Gordon-Nash Library, the Gordon-Nash Library was selected by the Council as a site for this preliminary feasibility study conducted to assess the potential to convert from a fossil-fuel based heating system to a wood biomass based heating system.

III. Analysis Assumptions

In preparation of this pre-feasibility study we have assumed that the price of fuel, both heating oil and wood pellets, will increase over time. We have included a price escalator of 5% for heating oil and 4% for wood pellets. A temporary or seasonal price increase or decrease may occur but in general we believe historical price trends will continue. General inflation rate is assumed to be 2.5%.

Exact pricing for a wood pellet heating system is difficult for an analysis of this level of detail. Site specific conditions will influence the final costs and even firm estimates from vendors/installers may have a contingency. For our analysis we assumed the following costs:

- Biomass pellet boiler - $8500 - $10,000
- Pellet storage and flex conveyor - $3000 - $4500
- Thermal Storage tanks - $2000
- Balance of System (BOS) - $1500 - $2500
- Construction/Installation - $3500

We believe that the price estimates used for this report are within + or – 20%.

Sizing a new biomass pellet boiler and thermal storage is based on simplified method developed by the USDA Forest Service. That method estimates boiler size based on oil use and degree day data over a specific time frame. Based on that method we estimated a new pellet boiler in the 125,000 Btu/hr. size range.

For the life cycle analysis, a number of estimates/assumptions had to be made including:

- Loan term – 10 years
- Interest rate – 5%
- Percentage of heat to be supplied by the biomass boiler
    - with thermal storage – 90%
- Additional O&M costs over current - $500 annually

We have calculated a payback based on different annual fuel use and if the Library is eligible for incentives for a pellet heating system.

Based on fuel deliveries in 2013 the reported annual fuel use was 3277 gallons. An energy audit completed in 2012 reported heating oil use at 2312 gallons for 2011. Because annual fuel use can vary due to weather, and because using fuel deliveries is not an exact method for calculating annual fuel use, we have provided scenarios based on annual fuel use based on the reported annual fuel use of 3277 gallons and an average fuel use of 2795 gallons based on 2013 and 2011 reported fuel use in our economic analysis.

The Library purchases its electric through the New Hampton Village Precinct. We discussed the electric purchase with Fred Smith a precinct officer in New Hampton. It is our belief that the Library may not be eligible for the State grant program because it did not contribute to the State renewable energy fund through it utility purchases. That will need to be confirmed.

IV. Existing Facility and Heating System(s) Description and Review

The Gordon-Nash Library is open to the public Tuesday – Saturday for a total of 42 hours. In addition the Library is open evenings for events and meetings. The original two story building was constructed in 1896 and 2 two-story additions were added in 1961 and 1977. The current oil-fired boiler was installed in 2000.

The building is constructed of block and brick with construction common for the time during which it was constructed. Only the 1977 addition has any wall insulation. The Library contracted for an energy study/audit in 2012. As part of this pre-feasibility study we have reviewed the energy audit and found the recommended conservation measures to be reasonable. Priority attention should be given to cutting down on air infiltration and upgrading the lighting to higher efficiency lamps.

The building is heated by a single Burnham model V905A hot water boiler rated at 562,000 Btu/hr. which is oversized for the building. The boiler has had annual maintenance and combustion efficiency testing. Based on records in the boiler room, the boiler's combustion efficiency averaged 83%, although the seasonal efficiency is likely much lower since the boiler is oversized.

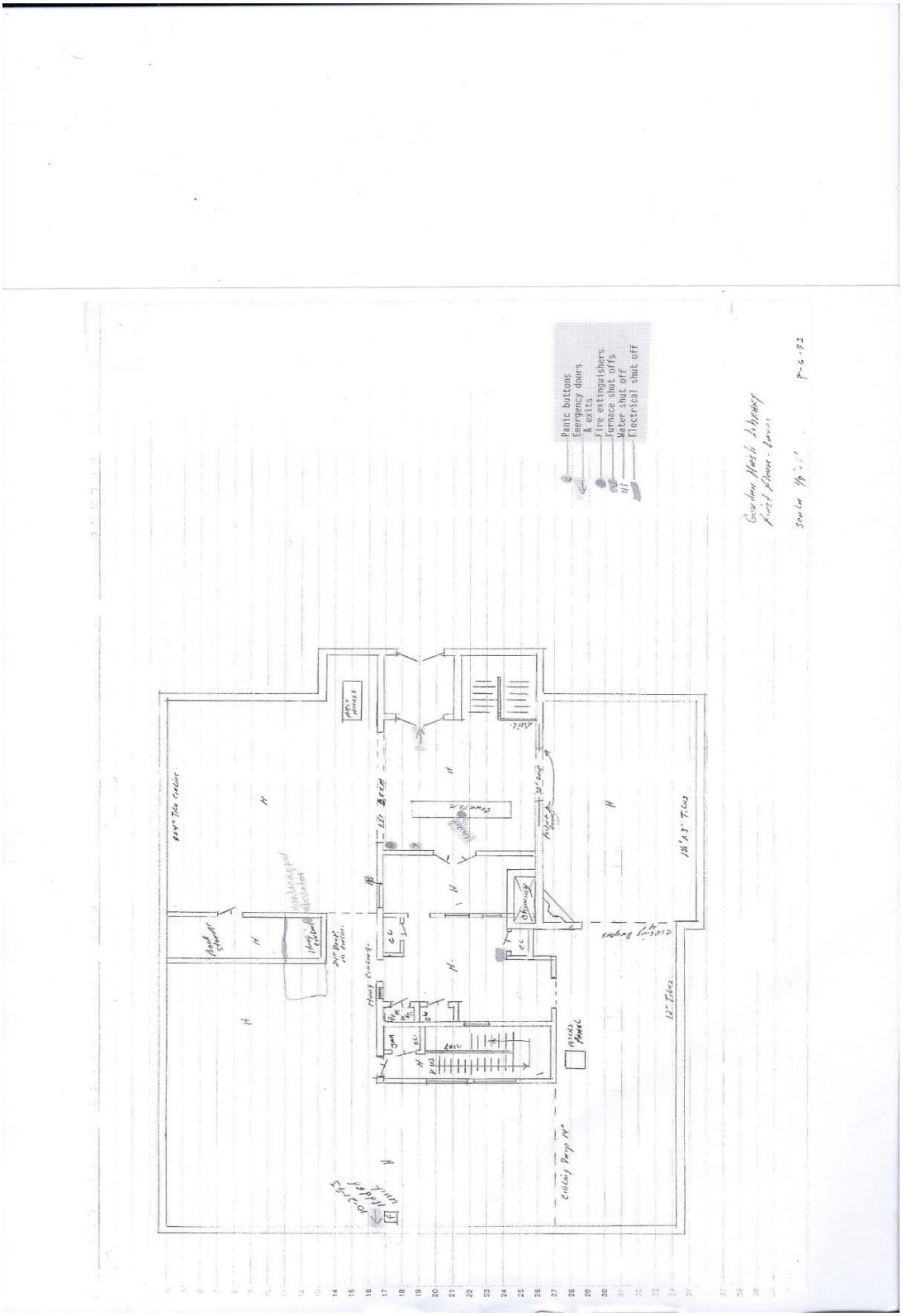
We believe the hydronic heating system is comprised of a single primary zone with up to at least 10 loops controlled by their own thermostat. The radiators are primarily fin-tube type. Circulating water temperature is between 160 and 180 degrees f. There appears to be an outdoor temperature reset but that was not confirmed. There are two 200 gallon fuel oil tanks in the boiler room. The oil fill is located on the north side of the building to the right of the basement level entrance.

The building has two chimneys. One of the chimneys is used by the oil boiler and the other is not used and could be used, if retrofitted with an appropriate liner, for a pellet boiler. There is access to the unused chimney from the boiler room. The boiler room is large enough to permit the

installation of a pellet boiler and hot water storage. Pellet storage would need to be located outside the building. Location for a bulk pellet storage enclosure will need to be located to permit access for a delivery truck and to permit a flex-auger delivery system to be installed.

A 40 gallon electric hot water tank is located in the boiler room. The existing thermal system is summarized in Table 1.

Figure 1 Floor Plan Gordon-Nash Library



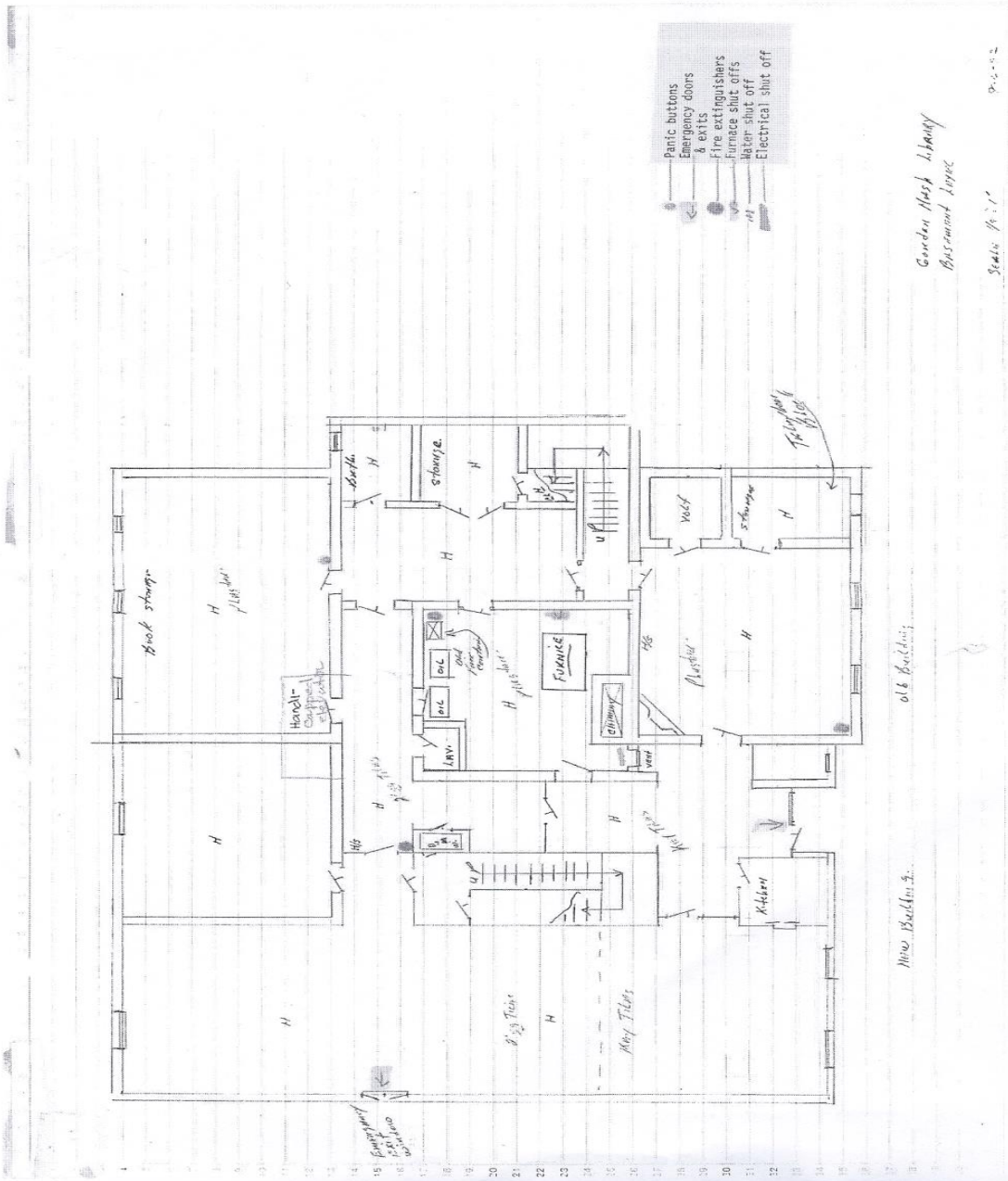

Panic buttons
Emergency doors
& exits
Fire extinguishers
Furnace shut offs
Water shut off
Electrical shut off
Gordon Nash Library
Basement Level
Scale 1/8 : 1'
Book storage
Hand-
Carpet
elevator
Storage
Storage
Vault
Storage
FURNACE
chimney
OIL
OIL
LAV.
VENT
Kitchen
Big Tiles
Med Tiles
Old Building
New Building

Figure 2 Aerial photo of Gordon-Nash Library

Table 1 Summary of existing heating system at Gordon-Nash Library. Data and information supplied by facility, confirmed at site visit, and revised as necessary.

Existing Thermal System in Gordon-Nash Library	
Distribution System Type	Hot water
Thermal System Type and Manufacturer	Burnham model V905A
Nameplate Capacity	562,000 Btu/hr. .
Type of Fuel Used	#2 Heating Oil
System Efficiency	Tested by service company at 83%
System Emissions (g PM2.5/hr.)	Unknown
Warranty End Date	Unknown - assumed that warranty is over
Building Annual Heating Fuel Consumption	2011 reported 2312 gallons 2013 reported 3277 gallons Estimated average annual use 2795 gallons

Figure 3 Existing heating system

Burnham hot water boiler with Carlin oil burner and Honeywell controls

Single zone with 10 control points

40 gallon electric hot water heater

V. Fossil Fuel Use Assumptions including inflation

Fuel oil use data was available for only one year, 2013, and consisted of oil delivery records. In addition to the fuel oil deliveries reported for 2013 the Library provided an energy audit done By Radiant of Concord, NH which reported average annual fuel oil use at 2312 gallons per year. Our analysis of fuel deliveries for 2013 matches the reported 3277 gallons use however we are providing economic scenarios based on the 2013 reported and an average fuel oil use based on the 2013 reported deliveries and the energy audit fuel use numbers. Table 2 summarizes the fossil fuel use.

Table 2 Annual fossil fuel usage at Gordon-Nash Library

Year and building	Fuel Oil (Gallons)	Average Cost/Gallon	Total Expenditures
Library			
Year 2013 (reported)	3277	$3.49	$11,430
Year 2011 (Radiant Energy Audit)	2312	$3.49	$8,068
Estimated Average Annual	2795	$3.36	$9391

For the purposes of this study, we have used price data developed by the NH Office of Energy and Planning. We are assuming an annual inflation rate of 5% for fossil fuel costs for all of our life cycle analysis in this study. The prices for #2 fuel oil and pellets are current prices for New Hampshire. NH Office of Energy and Planning data on fossil fuel prices for early October 2014 are included in Table 3 below.

Table 3. NH Office of State Planning heating fuel prices

Current Heating Fuel Values, New Hampshire – October 13, 2014			
Fuel Type	**Price/Unit**	**Heat Content Per Unit (BTU)**	**Price Per Million BTU)**
Fuel Oil (#2)	$3.366/Gallon	138,690	$24.27
Propane	$3.131/Gallon	91,333	$34.25
Kerosene	$4.052/Gallon	135,000	$30.01
Pellets (Bulk Delivery)	$248.67/Ton	16,500,000	$15.07

For additional and up-to-date statewide fuel price for New Hampshire go to:

http://www.nh.gov/oep/energy/energy-nh/fuel-prices/index.htm

VI. Heat Load

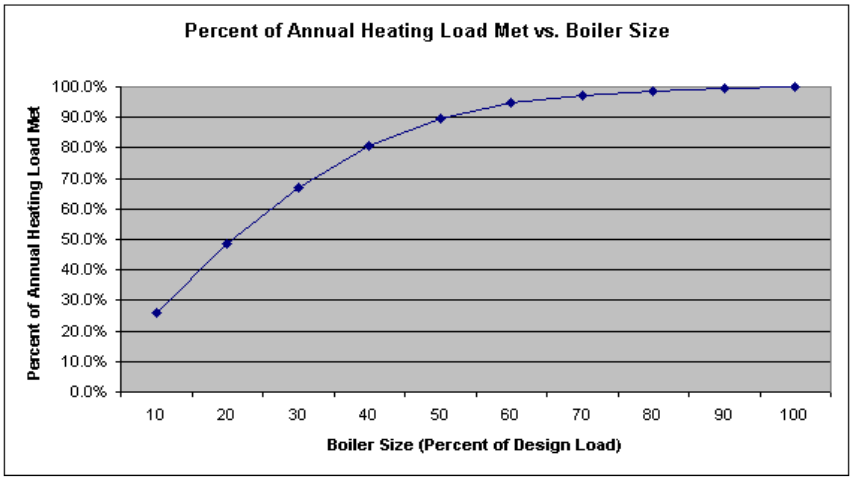
To estimate proper sizing of any proposed wood biomass heating system, a preliminary heat load was calculated. We have used an abbreviated estimation method to estimate the boiler size. The method used is the "A Simplified Procedure for Sizing a Wood Energy System" developed for the U.S.D. A. Forest Service. The Forest Service's method provides a reasonable first estimate for sizing the boiler.

The heat load calculation was made based on the 2013 fossil fuel use and 2013 degree data for New Hampton, NH; it has been estimated at 225,000 Btu/hr. Without any modifications to improve heat retention in the building envelop, 225,000 Btu/hr. is presumed to be an effective heat load for the building. The nameplate output capacity of the existing oil boiler is slightly over 560,000 Btu/hr. Based on the nameplate capacity of the existing oil boiler it is well above the size required to heat the building.

Biomass boilers are not sized the same as fossil fueled boilers. Biomass boilers, because of the nature of the fuel and their operation, need to be sized to fire at or near peak firing rate when operating and run most efficiently at or near 100% of their rated load. Proper sizing of as biomass boiler should result in longer run-times vs. fossil fuel boilers. In order to meet these conditions current best practice in the industry is to install two or more smaller biomass boilers to equal the peak day load requirements, or a single biomass boiler with thermal storage and/or fossil fuel backup. Thermal storage should be incorporated to help reduce short cycling and provide for

short term peaks in demand. Proper sizing and thermal storage improve overall performance and efficiency.

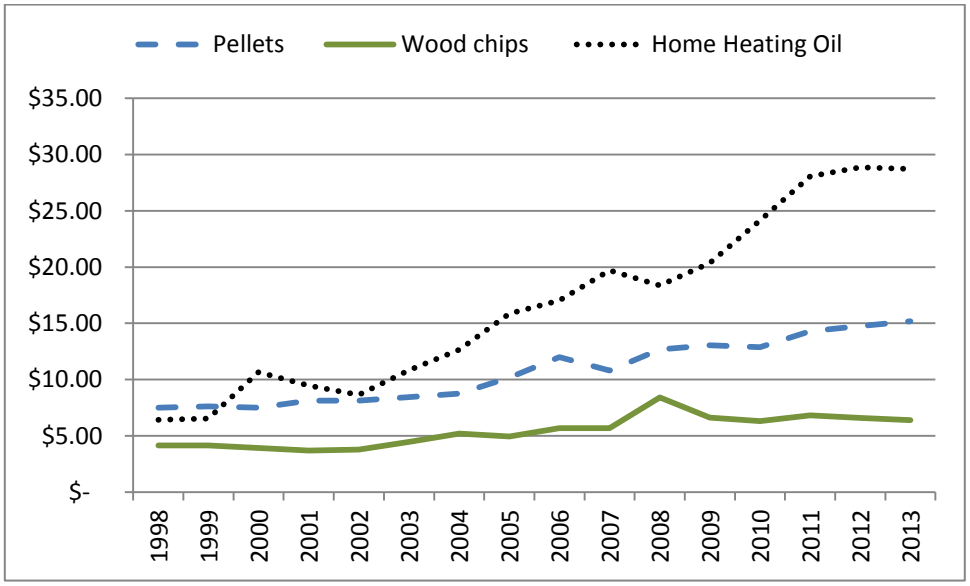
When using a fossil fuel boiler for peak loads and backup, the biomass boiler can be sized using the "50/90" rule. The rule is a general guiding principle based upon peak versus annual heating loads. Data has shown that sizing boilers to 50 percent of the peak heating load needs results in meeting 90 percent of the annual heating needs. The final 10 percent of the annual heat load can be met by the existing fossil fuel boiler. This configuration can also provide the added benefit of providing redundant boiler capacity that can be used in the unlikely event of an outage of the pellet boiler system.



VII. Wood Pellet/Chip Cost Assumptions including inflation

For the purposes of this study, we are assuming a current baseline price for wood pellets delivered in bulk form at $249/ton. There is enough historical data available on wood pellets to suggest an annual inflation rate for bulk wood pellets at 4%. Figure 4 shows historical data for pricing of wood pellets and heating fuel oil.

Figure 4 NH prices for wood pellets and heating oil



Source: NH OEP, Innovative Natural Resource Solutions, LLC

VIII. Life Cycle Cost Analysis

A Life Cycle Cost (LCC) analysis was conducted using the INRS Biomass Thermal Project Calculator financial model. The results show the following. A Life Cycle Cost Analysis evaluates the economic performance of alternative choices or a particular choice. This involves comparing all equipment and operating costs spent over the life of the longest lived alternative in order to determine the true least cost choice. The costs that should be considered in a life cycle cost analysis include:

- Capital costs for purchasing and installing equipment
- Fuel costs
- Inflation for fuels, operational and maintenance expenses
- Annual operation and maintenance costs including scheduled major repairs
- Avoided future capital costs for replacement or overhaul of current system.[1]

If a capital project is to be financed, the impact of debt service must be taken into consideration in order to get a clearer picture of how a project might affect annual budgets. When viewed in this light, equipment with significant capital costs may still be the least-cost alternative. In some

[1] Because the existing oil boiler is fairly new and would be used in tandem with a biomass pellet boiler, avoided capital replacement costs was not included in the Library's payback analysis.

cases, a significant capital investment may actually lower annual expenses, if there are sufficient fuel savings to offset debt service and any incremental increases in operation and maintenance costs.

The analysis performed for the Gordon-Nash Library compares different scenarios over a 20-year horizon and takes into consideration life cycle cost factors. The wood pellet boiler life is expected to meet or exceed this timeframe.

In the Life Cycle Cost Analysis tool, the INRS Biomass Thermal Project Calculator, each scenario was run using common assumptions and data wherever possible. The scenarios include all ancillary equipment and interconnection costs. The analysis projects current and future annual heating bills and compares that cost against the cost of operating a biomass system. The tool calculates net present value (NPV), defined as the present dollar value of net cash flows over time. This is a standard method for using the time value of money to compare the cost effectiveness of long-term projects. It also calculates internal rate of return on investment, and payback period where net positive cash flows offset installed capital cost.

It is not the intent of this analysis, nor was it in the scope of work, to develop precise cost estimates for a wood pellet heating project based on detailed engineering and vendor analysis. The capital costs used for the scenarios were provided as estimates by qualified vendors and the experience of the “Coach”. Should the Library decide to move forward with a biomass heating project, we recommend that they engage one or more vendors in a detailed project quote (RFP).

Table 4 Life Cycle Cost Analysis Summary Gordon-Nash Library

Project Scenarios	Scenario 1 2013 fuel use (3277 gals.) High cost estimate (no grants)	Scenario 2 2013 fuel use (3277 gals.) High cost Estimate (with grants)	Scenario 3 2013 fuel use (3277 gals.) Moderate cost estimate (with grants)	Scenario 4 Average fuel use (2795 gals.) Moderate cost Estimate (with grants)
Capital Cost of Boiler, Thermal Storage, Fuel Storage, Controls and Install Cost	$22,500 Boiler $10,000 Pellet Storage $4,500 BOS $2,500 Construction $3,500 Thermal Storage $2,000	$22,500 Boiler $10,000 Pellet Storage $4,500 BOS $2,500 Construction $3,500 Thermal Storage $2,000	$18,500 Boiler $8500 Pellet Storage $3,000 BOS $1,500 Construction $3,500 Thermal Storage $2,000	$18,500 Boiler $8500 Pellet Storage $3,000 BOS $1,500 Construction $3,500 Thermal Storage $2,000
Estimated TOTAL CAPITAL COST	$22,500	$22,500	$18,500	$18,500
Grant(s)*	$0	$6750	$0	$0
Amount to be Financed	$22,500	$15,750	$18,500	$18,500
Sizing of Pellet/chip Boilers Relative to Peak-Hour Thermal Load	50 – 60%	50-60%	50-60%	50-60%
Estimated fuel usage (including oil back-up)	26 ton pellets 325 gallons oil	26 tons pellets 325 gallons oil	26 tons pellets 325 gallons oil	22 tons pellets 280 gallons oil
Reduction in heating oil consumption	**2952**	**2952**	**2952**	**2515**
Annual operating cost above oil system (if any)	**$500**	**$500**	**$500**	**$500**
Internal Rate of Return	**11.7%**	**18.0%**	**14.9%**	**11.6%**
20-Year Net Present Value (@ 2.5% discount rate)	**$46,772**	**$60,822**	**$55,098**	**$38,513**
Payback period (with grants)	**7.08 years**	**4.96 years**	**5.82years**	**7.16 years**
Finance Payments (10 year term, 5% interest)	**$238 /month**	**$167 /month**	**$196 /month**	**$196 /month**

* see grant options in section XVI.

It is assumed that wood pellet boilers have a service life of a least 20 -25 years.

IX. Operation and maintenance

Wood pellet boilers are relatively simple biomass heating systems. Because wood pellets are generally uniform in size, shape, moisture and energy content, fuel handling is very straightforward. Nevertheless, there are some ongoing maintenance requirements for these systems. A wood pellet boiler will take more time to maintain and operate than a traditional gas, oil, or electric heating system. At the institutional or commercial scale, however, many of the maintenance activities can be cost-effectively automated by installing off-the-shelf equipment such as soot blowers or automatic ash removal systems. Some of the typical maintenance activities required for wood pellet systems are:

Weekly

- Emptying ash collection containers
- Monitoring control devices to check combustion temperature, stack temperature, fuel consumption, and boiler operation
- Checking boiler settings and alarms, such as those that alert to a problem with soot buildup

Yearly

- Greasing augers, gear boxes, and other moving parts as recommended by the manufacturer
- Checking for wear on conveyors, augers, motors, or gear boxes.

When considered on a weekly basis, the total time required for maintaining the wood pellet boiler system equates to roughly 1 – 1 1/2 hours per week over the entire heating season but maintenance is not required every day during the heating season.

One of the overlooked issues with pellet systems is the oversight of the volume of pellets in the storage bin. A bin with some type of gauge is required for quick line of sight of the need to order and refill the bin. This will depend on the size of the bin and the use. Pellet deliveries can be simplified and costs reduced in bulk delivery by increasing the size of the delivery. In this analysis we have assumed a bin that can accept a bulk delivery of pellets – between 9 and 10 tons per delivery. The Library should investigate the potential for a pellet supplier to supply the storage bin at a reduced cost, as a rental unit, or at no cost under a term agreement to purchase pellets. The advantage to the supplier is that the storage bin can be configured to the requirements of the supplier's delivery truck and would deter other suppliers from taking the Library as a customer.

X. Thermal Storage (TS)

A thermal storage tank or tanks is used to store heat from the boiler in an insulated hot water tank, from which hot water is then distributed as the building calls for heat. This allows an appropriately sized biomass boiler to operate in a high fire state, at peak efficiency, and then be turned off or to go into a stand-by mode where a minimal amount of fuel is being burned. Thermal storage is widely recognized as an important efficiency investment that optimizes system

performance and aids in controlling air emissions and environmental conditions. We have included thermal storage in each or our options. In our analysis we have assumed that with thermal storage the pellet boiler will supply 90% of the annual heating requirement for the building. Thermal storage also provides additional benefits including faster response time to calls for heat in the building and greater overall efficiency of the system and increased boiler life. In our analysis we have estimated between 150 to 200 gallons of thermal storage at and estimated installed cost of $2,000. The thermal storage would be located in the boiler room to aid in interconnecting with the existing hot water distribution system. The installation of the thermal storage system should be done by an experience vendor to ensure that the thermal storage tank functions properly allowing for the temperature in the tank to "stratify" and not mix. An appropriately designed thermal storage will include a three way "mixing" valve between the heating return water, the heating supply water, and the thermal storage tank, that can modulate the circulating water temperature based on outside temperature, improving the overall seasonal efficiency of the heating system.

XI. Cost Ranges for Wood Systems

It is not the goal of this analysis to specify and price a wood fuel heating system for the Library but to provide reasonable estimates of cost to aid in decision making. Based on industry standards, vendor calls on likely systems and the author's professional knowledge, the cost of the system(s) likely to be appropriate for the situation in this facility have been estimated.

The estimated size wood pellet boiler for the heat load of the Library is 125,000 Btu/hr. A single boiler in this range is estimated at $8,500 to $10,000. An outdoor metal storage silo capable of holding a delivery of 10 tons is $3,000 to $4,500. The balance of system costs are $1,500 to $3,500, and installation/construction cost $3,500. Total cost for the system is estimated to be $18,500 to $22,500. Because of the benefits of thermal storage over the life of the system, we have added the installed cost of adding thermal storage estimated to be $2,000.

These are preliminary estimates and could vary by as much as + or – 20 %. These costs reflect that a wood pellet system at Gordon –Nash Library could be located inside the existing boiler room with an outside pellet storage bin/enclosure. The estimated costs include a thermal storage tank and all required controls to effectively operate the system using the pellet boiler, storage tank, and existing oil fired boiler.

XII. Emissions and Permitting

Based on current NH air emissions standards and the estimates and assumptions made in this Pre-Feasibility Report this project will not require air emissions permitting in New Hampshire for installation. Emissions such as NOx, SOx and volatile organic compounds from pellet and wood chip burning equipment are, in general, very low in comparison to other forms of combustion heating. Automated, commercial-sized woodchip and pellet systems burn much cleaner than even the most modern home wood or pellet stove. The current practice to properly size the wood pellet boiler with added thermal storage contributes to increased efficiency in the operation of the system and lower emissions. It is recommended that the Library check with local officials to determine what building permits or other local permitting is required if a wood-fueled system is installed.

XIII. Wood Ash

One by-product of burning wood pellets is ash, a non-combustible residue. While the ash produced by burning wood pellets is automatically removed from the boiler in the systems of many manufacturers, the container in which the ash is collected must periodically be emptied and disposed of manually.

The ash volume produced depends on the fuel burned. Ash content is measured as a percentage of weight and should be at most 1% for wood pellets available for New Hampshire use. A ton of wood pellets burned will produce approximately 20 pounds (about 2 gallons of volume). The likely system for this facility is estimated to use 22 to 26 tons of pellets annually and generate approximately 500 pounds of ash annually.

While many wood boiler operators use their ash as fertilizer for lawns or athletic fields, there are other useful ways to handle wood ash material, such as composting and amending soil. The ash is not known to adversely affect humans or plant and animal life when dispersed in this way, although, it may over time lead to increased nutrient runoff into streams, rivers, wetlands and other water bodies if not disposed of properly so care is needed in disposal or re-use. This ash can also be disposed of at any state landfill or other permitted solid waste management facility.

There are regulations in NH for wood ash disposal. Historically, all non-household wood ash is captured under Env-Ws 1700 of Solid Waste Rules from the NH Department of Environmental Services (DES), including the large biomass plants and the small and mid-sized commercial boilers. NH-DES does not have staff or resources to implement this regulation for all the new boiler installations.

Effective February 11, 2014, emergency rules are now in effect that exempt from the requirements of Env-Sw 1700 generators and brokers who distribute 500 tons per year or less of wood ash from the combustion of clean wood for agronomic use (spreading on ag lands). This emergency rule has been filed to address the concerns that the Department received at the public

hearing and subsequently about the difficulty that the requirements of Env-Sw 1700 has on small boiler operators.

What this means for the ash disposal from this project is that there are no state regulations and oversight for the disposal of the ash from the estimated 500 pounds of pellets burned in the proposed biomass system for this project, but it must be actively managed and beneficially used in agricultural applications. According to DES recommendations, wood ash needs to be managed sustainably:

- Environmentally responsible
- Cost effective
- Socially beneficial

- Protect your asset by knowing the quality of the wood ash before distribution
- Develop a program for managing responsibly
- Keep records documenting practices
- Partner with an end user that will benefit
- Educate the public about win-win program

See posting on: http://des.nh.gov/organization/commissioner/legal/rulemaking/index.htm

XIV. Building Envelope and Energy Efficiency

In general we found the Gordon-Nash Library to be well maintained. The Library contracted for an energy audit in 2012. As part of this pre–feasibility study we reviewed the 2012 energy audit conducted for the Library by Radiant. The building would benefit from programmable thermostats and reducing air infiltration for comfort and energy savings, however, the savings calculation from Radiant are based on oil at $3.85 oil and not the lower cost biomass. Making the energy efficiency upgrades are recommended although the paybacks will be longer than indicated in the report. On the day of the site visit we observed that the daytime lighting was significant on the main floor. Consideration to installing lighting sensors that would control electric lighting based on the combination of outside light and overhead lighting to the required light levels for the task areas is recommended. The lighting sensor upgrades could be combined with other lighting upgrades such as replacing current lights with LED lamps. Finally the air conditioner is a significant draw and the recommendation for retro commissioning should be done. Finally we recommend that the Library establish a benchmark of its energy use by participating in U.S. EPA Portfolio Manager Program to better track its energy use and aid in identifying changes.
http://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/use-portfolio-manager

XV. Project Recommendation

The goal of this pre-feasibility study was to conduct an assessment as required by the NH Wood Energy Council, and select one of three options with regard to the installation of wood heating system made under this review and report activity:

1. *The Project is not feasible and should not continue – wood heating not a viable option;*
2. *Project is ready for wood heating system installation (recommend which kind or options including fuel storage)– provide list of design/build contractors;*
3. *Project has potential for wood heating system, but additional analysis is recommended.*

Based on the site review we find that a biomass thermal project is technically feasible and that the economics are to be determined. More analysis is needed based on firm quotes from a vendor of a complete biomass pellet system as outlined in this report. This quote should include at a minimum:

- Development of a load duration curve to aid in proper sizing of a pellet boiler;
- A fully automated biomass pellet boiler with auto ash removal;
- Fully enclosed (weather tight) 4 to 5 ton pellet storage with automated flex auger system to supply the boiler;
- 200 gallons of thermal storage;
- Select appropriate control logic to ensure that the pellet boiler, thermal storage, and oil boilers work together with the goal of the biomass system providing 90% of the annual heat load; and
- Identify an acceptable service provider for the new biomass system.

In addition to the technical requirements the Library should seek to verify if the Library is eligible for any incentives for the project.

XVI. Financing Opportunities

Purchase and installation of a wood biomass heating system represents a significant capital cost. The following are financial assistance programs that can off-set some of those capital costs. Each of the programs listed below have eligibility requirements and may or may not be available to the Library depending on the program requirements.

A. State

NH Public Utility Commission Competitive Grants – Various competitive grants for wood biomass thermal systems have been available in recent years. Check at: http://www.puc.state.nh.us/sustainable%20Energy/RFPs.htm to see current availability as these

opportunities are changing regularly. In 2014, an RFP due in September allowed for grants of at least $150,000 for qualified projects.

NH Public Utilities Commission Commercial Wood Pellet Boiler Rebate Program – This program offers a rebate payment of 30% of the heating appliance(s) and installation cost, up to a maximum of $50,000, for investments in non-residential bulk-fuel fed wood pellet boilers and furnaces of 2.5 million BTU or less. Additionally, a rebate of 30% up to $5,000 is available for thermal storage tanks and related components. This grant was included in the financial assessment contained in this report. For complete program details, please refer to http://www.puc.state.nh.us/sustainable%20Energy/RenewableEnergyRebates-CI-BFWP.html or contact Barbara Bernstein, barbara.bernstein@puc.nh.gov.

NH Thermal Renewable Energy Certificates – NH has a first-in-the-nation law that allows for generation of Renewable Energy Certificates from wood-fueled thermal projects. It is possible that specialized organizations may be formed that would provide payments to the school in exchange for and thermal RECs that are generated. The process to generate thermal RECs is new and the impact of RECs on the project was not calculated for this report. For more information go to: http://www.puc.state.nh.us/sustainable%20Energy/Class%20I%20Thermal%20Renewable%20Energy.html.

New Hampshire has adopted Property-Assessed Clean Energy (PACE) financing programs, whereby municipalities provide financing to commercial entities within their community. Loans are paid back by surcharges on property tax bills. PACE provides tremendous promise for commercial financing of energy efficiency and renewable energy projects. For more information on PACE in New Hampshire contact the Jordan Institute at 603-226-1009.

B. Federal

Federal tax incentives are non-existent for biomass heating projects. Biomass thermal technology does not qualify under the federal section 48 business/industrial renewable energy investment tax credit that provides up to 30% tax credit toward solar, geothermal and wind energy development.

The U.S. Department of Agriculture administers a small number of programs that provide incentives for renewable energy, including the Rural Energy for America Program (REAP). These are 25% capital grants, up to $500,000, if eligible. However a library may not qualify for the REAP funding. One USDA program that could be applied is the Community Facilities Loan Grant Program. The program is very competitive for grants but does provide attractive fixed interest rates for financing. The program is primarily used to finance large community facility projects and as such has significant regulatory and reporting requirements that could be costly to administer.

No other federal incentives are available at this time.

C. Other/Private

Energy Performance Contracting is a creative approach to financing energy investments whereby a 3rd party energy services contractor (ESCO) provides the upfront capital, which is then paid off from annual energy costs savings over a period of years. During this time the entity is guaranteed a discounted energy cost relative to their current costs. ESCO's have high overhead costs and choose their projects carefully for large cash flows and very attractive returns on investment, which generally means very large projects. It is not likely that an ESCO would fund only the installation of a biomass pellet boiler but would look to include a menu of energy measures along with the boiler.

The Northern Forest Center has incentives available for commercial pellet boiler projects. The Center is looking for high-visibility projects and owners who are willing to share their stories and open their businesses to tours. There is no formal application process. The incentive amount is 25% of system cost up to $10,000; Contact, Maura Adams, Northern Forest Center. madams@northernforest.org

Other Information Resources Available

Further listing of additional resources can be found on the NHWEC web site:

http://www.nhwoodenergycouncil.org/other-helpful-links.html

Ash & waste management:
http://des.nh.gov/organization/commissioner/legal/rulemaking/index.htm

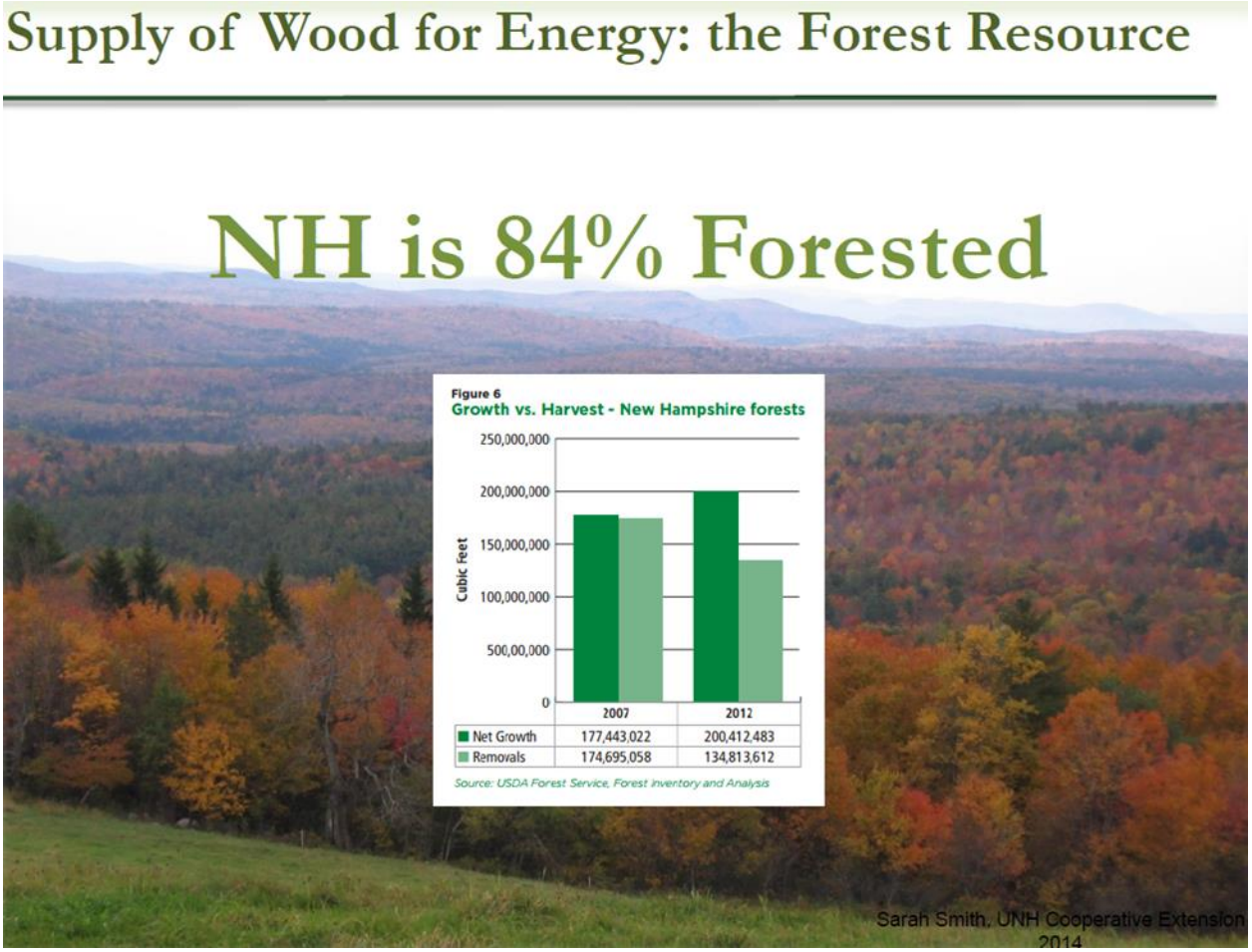
References

- United States Forest Service – Simplified Procedure for Sizing a Wood Energy System
- Innovative Natural Resource Solutions - Biomass Thermal Project Calculator
- Kohler, A. 2010. Boiler Sizing — Partial Bin Analysis. www.kohlerandlewis.com/WebPage/Technotesboilerloads.html
- New Hampshire Office of State Planning – Current Heating Fuel Values
- New Hampshire Public Utilities Commission – Non Residential Pellet Boiler Rebate Program

Appendices

A. Wood Fuel Availability and Forest Sustainability Issues

New Hampshire is the second most forested state in the U.S. in terms of percentage of land area (Maine is first). New Hampshire's forests are also adding wood volume every year because wood growth on our trees exceeds the amount harvested for various products plus the volume of trees dying each year. Our forests are in good shape and can easily handle additional wood use for thermal purposes.



Where Does the Wood Come From for Heating?

Wood used to make wood pellets and chips is low-grade material, harvested during forestry operations or produced as a by-product of lumber and wood product manufacturing (e.g., sawdust). Manufacturers of wood pellets often seek sawdust, shavings and other residue from lumber and wood product manufacturing because it is already debarked, sized, and uniform in species. Wood also comes from low-grade wood harvested during logging operations – the relatively low value that wood chip users and wood pellet manufacturers can pay for material means that wood chip use and wood pellet manufacturing does

not compete with lumber manufacturing and other higher value uses of wood that is so important to the region's forest economy. In fact, these uses are complimentary to higher value wood uses.

In New England, we are growing significantly more wood than is being used for a range of products, including paper manufacturing, biomass energy, home heating, lumber and other wood products. On private forestland in New England, we currently grow 1.6 times the amount of wood harvested.

Where Are Wood Pellets Made?

Wood pellets are made at dedicated wood pellet mills, which are located to access a sustainable and reliable supply of low-grade wood to use as a feedstock. There is currently one wood pellet manufacturing facility located in New Hampshire, New England Wood Pellet (Jaffrey). The New Hampshire market is also supplied by wood pellet manufacturers in nearby Vermont, Maine, Quebec and New York.

The purchase of wood pellets manufactured in the region helps support the forest economy, keeps dollars spent on heating circulating in New England, and creates jobs for your neighbors in the harvesting, manufacturing and delivery of a locally produced fuel.

B.

Wood Pellet/Chip Boiler Vendors in Northeast U.S.

P – pellet
C – chip
1 – Residential
2 – Commercial/Institutional
3 – Industrial

Maine Energy Systems P - 1, 2
Dr. Harry "Dutch" Dresser
Dutch@maineenergysystems.com
www.maineenergysystems.com
8 Airport Road, P.O. Box 547
Bethel, Maine 04217
Office: 207.824.NRGY (6749)

Pellergy LLC P - 1, 2
Andy Boutin
andy.boutin@pellergy.com
www.pellergy.com
104 East State Street
Montpelier, VT 05602
802-477-3224

Froling Energy Systems P/C - 1, 2, 3
Mark Froling
mark@frolingllc.com
www.frolingenergy.com
19 Grove Street
PO Box 178
Peterborough, NH 03458
603-924-1001

The Sandri Companies P - 1, 2
Jake Goodyear
jgoodyear@sandri.com
http://www.sandri.com/renewable-energy/
400 Chapman Street
Greenfield, MA 01301
413-223-1115
800-628-1900

Tarm Biomass P/C - 1, 2
Scott Nichols
scott@tarmusa.com
www.woodboilers.com

WeBiomass Inc. P – 1,2
16 Washington St.
Rutland, VT 05701
802-772-7563
info@webiomass.com

Interphase Energy
4 Britton Lane
P.O. Box 285
Lyme, NH 03768
800.782.9927

Lyme Green Heat P - 1, 2
Morton Bailey
morton@lymegreenheat.com
www.lymegreenheat.com
302 Orford Road
Lyme, NH 03768
603-353-9404

Bioenergy Project Partners P/C - 2, 3
David Dungate
New York-based
Toll Free: 888-583-5852
Email: info@bioenergybox.com
Web: www.bioenergybox.com

Woodmaster P/C - 1, 2, 3
Gust Freeman
Bowman Stoves
www.woodmaster.com/index.php
1727 US Highway 11
Castle Creek NY 13744
bowmanstoves@gmail.com
607-692-2595

Caluwe Inc./Windhager/Heizomat, P/C - 1, 2
Marc Caluwe
marc@hydro-to-heat-convertor.com
www.hydro-to-heat-convertor.com/pelletboilers.html
83 Alexander Road
Billerica MA 01821
781-308-8583

Viessmann P/C - 2, 3
Bede Wellford
wefb@viessmann.com
www.viessmann.ca
(207) 212-2052

Troy Boiler Works/Evotherm P - 1, 2
Lou Okonski
lokonski@troyboilerworks.com
www.troyboilerworks.coml
2800 7th Ave.
Troy NY 12180
518-274-2650

Thayer Corporation P/C - 2, 3
Dan Thayer
info@thayercorp.com
www.thayercorp.com
1400 Hotel Road
Auburn, ME 04210
207-782-4197

Sunwood Systems P – 1, 2
David Frank
124 Fiddlers Green, Waitsfield, VT 05673
(802) 583-9300

Better World Energy/Messersmith C – 2, 3
Barry Bernstein
1237 Bliss Road
Marshfield VT 05658
802-477-3993
bbearvt@myfairpoint.net

Gazogen
Carl Bielenberg
Tel 802-522-8584
GazogenVIP@gmail.com
330 Industrial Drive
P.O. Box 346
Bradford, VT 05033

AFS Energy Systems C – 2, 3
418 Oak Street
P.O. Box 170
Lemoyne, PA 17043
717.763.0286
info@afsenergy.com