Preliminary Feasibility Report

North Country Community Recreation Center

33 Rec Center Road
Colebrook, New Hampshire 03576

Report Prepared for NH WEC by:

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Date of Site Visit: June 23, 2015

Date of Report: August 13, 2015

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.

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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 North Country Community Rec Center (NCCRC) 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 North Country Community Rec Center is a single story 9,500 square foot building that is primarily an indoor swimming pool. The pool area comprises about 75% of the floor area of the building. The primary energy requirements for the building are space heating, pool heating, lighting, and humidity control. The Rec Center also has an outdoor ice rink that has lighting only on a separate meter.

The Center reported that it used 8249 gallons of fuel oil in 2013 at a delivered price of $27,633 and 7814 gallons in 2014 at a delivered price of $22,318. The Center spent $32,182 for electric for the 12 months March 27, 2014 – March 27, 2015. This prefeasibility study on the potential to switch to biomass heating also included a preliminary look at the potential to use heat from a biomass boiler and desiccant dehumidification system to reduce the electric load.

Based on the information provided by the NCCRC and an on-site review of the facility on June 23, 2015, we have determined that a wood pellet heating system is technically feasible, but economically is marginal at current oil prices. However the Center should consider switching to wood pellets based on the historic price swings in fuel oil prices that, based on past trends will increase, potentially rapidly, back to 2013 levels. Our analysis indicated that a switch to a desiccant dehumidification system would require considerable detailed analysis beyond the scope of this report. We recommend that it be considered in the future when the current Dectron system needs to be replaced.

We have provided a life-cycle analysis based on current fuel prices and average fuel prices in the recent past. No one knows for sure what future fuel prices will be but history indicates that fuel oil prices will rise again in the future and an investment in biomass, especially with generous incentives that are available, will reduce the current and future risk. In addition to comparing fuel price scenarios we have provided two options for system configurations, a base case that is a very basic one boiler system, and a more enhanced system that a vendor would typically specify. We feel that the basic option, with the potential for future expansion, would be the best alternative. Based on the life-cycle assessment, the base option basic one boiler system could have a payback of just over ten years and an IRR of over 11% even at current fuel oil prices and assuming $26,500 in grant funding. If prices were to increase to 2013 levels the payback could be less than 3 years for the base option.

Should the Center move forward with a new wood pellet boiler, it should be designed/configured to work in tandem with the oil fired boiler to ensure its meets peak capacity requirements and to provide back up for the biomass boiler.

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 New Hampshire Wood Energy Council. The NH Wood Energy Council 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.

An application for assistance was submitted by Lori Morann, the Executive Director of the North Country Community Recreation Center (NCCRC), and the Recreation Center was selected by the

NH Wood Energy Council as a site for a preliminary feasibility study conducted to assess the potential to convert from a fossil-fuel based heating system to a wood biomass based heating system.

The North Country Community Recreation Center is a non-profit established in 2002 as a joint venture of the Upper Connecticut Valley Community Coalition and the Colebrook Downtown Development Association. The principal purpose of the non – profit was to construct an indoor community recreation center and swimming pool to benefit 21 surrounding North Country towns in New Hampshire, Vermont, and Maine, and serve over 8,500 residents. The Rec Center opened to the public on August 15, 2005. The REC Center is located on 33 Rec Center Road in the heart of the residential and commercial center of the Town of Colebrook, NH.

In addition to the opportunities for unstructured individual recreation and fitness, the Center offers 40 or more structured programs for all ages. The Center houses a multi-function room used for meetings and small programs and there is an outdoor skating rink adjacent to the Rec Center that was constructed in the fall of 2007. The rink is open for skating in season, and has lighting for night skating. Although the hours may vary depending on special function and school vacations, the Rec Center is open for normal operation 7 days a week for a total of 68 hours per week.

Funding for operation of the Center comes from patron donations, program fees, grants, and benefactors; as such funds for operating expenses directly impact program opportunities. The Center is very interested in seeking ways to minimize the impact of its operating mechanical systems on its budget. The major mechanical systems include an oil fired boiler that is used for space heating, warming pool water, and domestic hot water. As such, the boiler operates year around. The major electric requirement is for the dehumidification system used to maintain the pool area at 52% humidity.

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 4% for heating oil and 2% 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:

Option 1 Base System

- Biomass pellet boiler 200,000 BTU/hr. – $25,000
- Outdoor enclosure - $4,000
- Pellet storage and flex conveyor - $6,000
- Balance of System (BOS) - $4,000
- Construction/Installation - $16,000

Option 2 Enhanced System

- Biomass pellet boilers (2) 200,000 BTU/hr. each - $65,000
- Upgraded enclosure – Included
- Thermal storage - included
- Balance of System – included
- Pellet storage and flex conveyor - $6,000
- Construction/Installation - $24,000

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 to provide the full peak heating requirements to be in the 500,000 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
  - Base system – 70%
  - Enhanced system with thermal storage – 90%
- Additional O&M costs over current - $500 annually
- It is assumed that wood pellet boilers have a service life of at least 15-20 years.

Based on fuel deliveries in 2013 and 2014 we assumed an average annual fuel use at 8000 gallons.

We have assumed that the current Dectron dehumidification system is responsible for 50% of the electric load and that the system has at least another 10 years of useful life.

The Center purchases its electric supply through Eversource. The Center would be eligible for the State grant program because it contributes to the State renewable energy fund through it utility purchases. In addition, we believe the Center is eligible for a grant through the Northern Forest Center.

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

The North Country Community Rec Center is heated by a single H.B. Smith model 19A-S/W-05 hot water boiler rated at 500,000 Btu/hr. The facility heating requirements are different than a standard building. First, the pool area is maintained at 85 degrees year round which means that heat is required and the boiler operates 12 months of the year. Second, the heating requirements are linked to humidity control. As humid air is removed it is cooled to remove moisture and must be reheated to maintain pool air temperature.

The office/community room/locker rooms are heated by an in-floor radiant heating system.

Pool water temperature is maintained at 82 degrees and is supplied by a combination of recovered heat from the compressor on the Dectron unit and the oil boiler.

Ventilation of the pool area is necessary to control humidity and to remove chlorine evaporating from the pool. The air is conditioned to control humidity to 52%.

The ventilation/heating systems for the pool area are balanced to ensure that a slight negative pressure is maintained in the pool area to prevent warm moist air from entering the office / community room area. Moisture control is important to ensure that windows are not fogged and that building materials, equipment, and furniture in community / office area is not damaged by high humidity from the pool area.

We were unable to get detailed information on the Dectron system. We did assume that the dehumidification system accounts for about ½ of the kWh usage and significantly, more than ½ of the kW demand. It is assumed that demand and kilowatt hour increases in summer can be attributed directly to the Dectron compressor working harder when outside temperature and humidity is higher. We did some very preliminary analysis to look at heat pipe applications and costs compared to refrigeration-type dehumidification systems. Heat pipe units can have significantly reduce operational costs (electric) and annual maintenance costs. This of course would need to be balanced against with purchasing a new heat pipe system. Utility rebates may be source of funding to off-set some of the initial capital expense. We suggest that the Center contact Bill Chase at Efficient Air Systems in Portland Maine to provide some additional analysis. wchase@efficientairsys.com

Figure 1 Floor Plan North Country Recreation Center

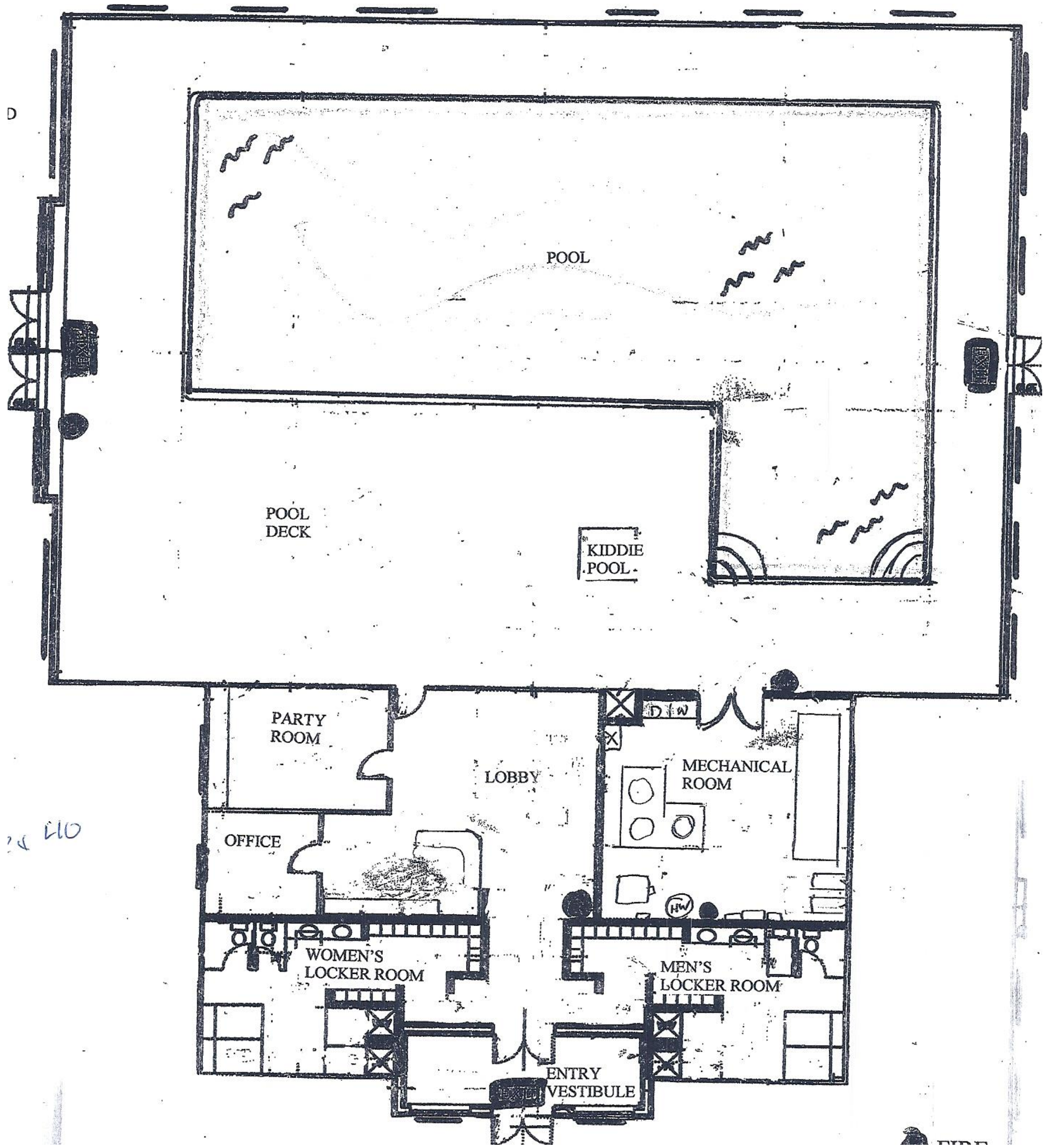


Figure 2 Drawing Aerial View of North Country Recreation Center

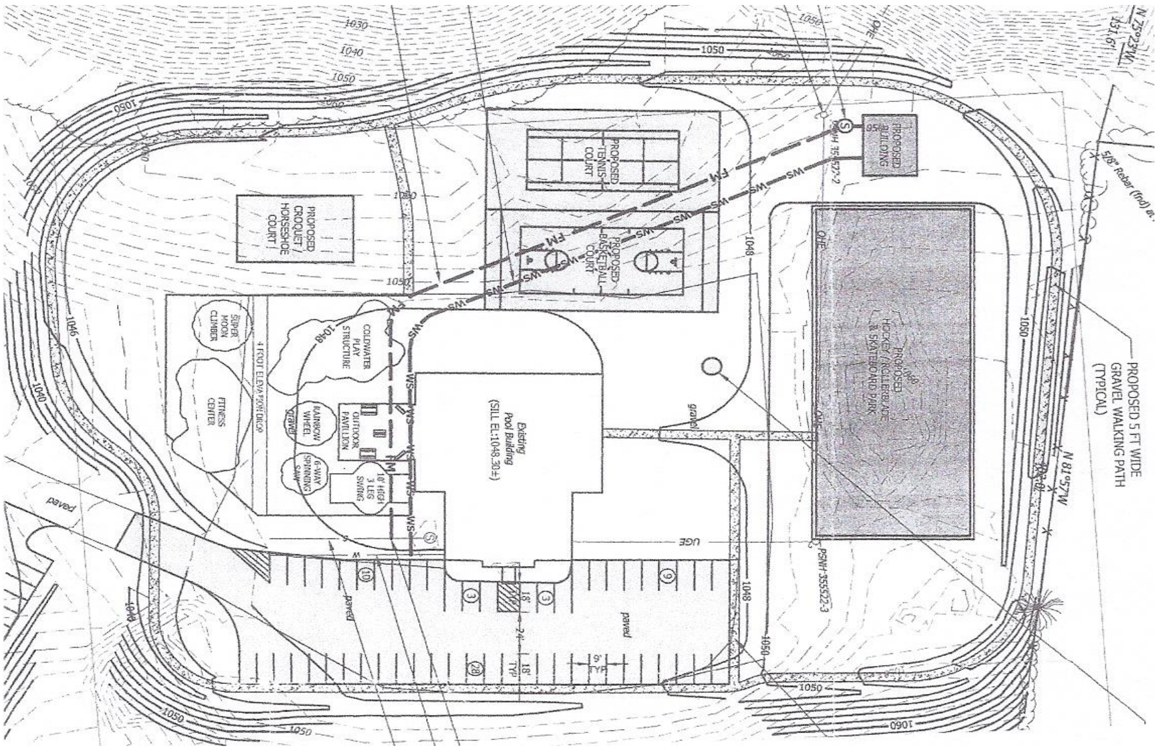


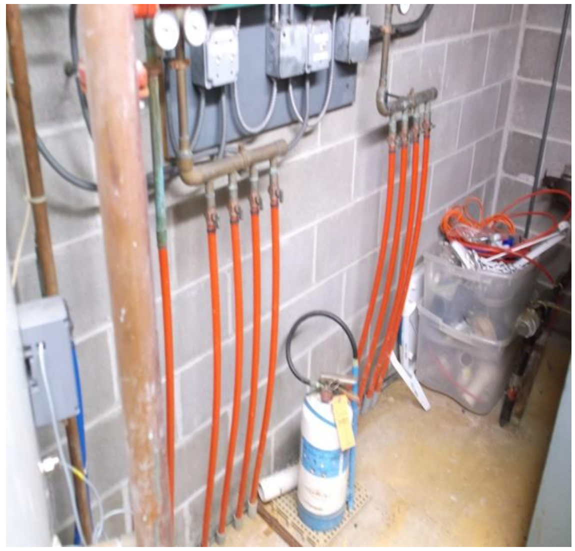
Table 1 Summary of existing heating system at North Country Community Recreation Center. Data and information supplied by facility, confirmed at site visit, and revised as necessary.

Existing Thermal System in NCCRC	
Distribution System Type	Hot water
Thermal System Type and Manufacturer	H.B. Smith model 19A-S/W-05
Nameplate Capacity	500,000 Btu/hr. .
Type of Fuel Used	#2 Heating Oil
System Efficiency	Unknown
System Emissions (g PM2.5/hr.)	Unknown
Warranty End Date	This is the original boiler and is 10 years old - assumed that warranty is over
Building Annual Heating Fuel Consumption	2013 reported 8142 gallons 2014 reported 7814 gallons Estimated average annual use 8000 gallons

Figure 3 Existing heating system

H.B. Smith hot water boiler with Carlin oil burner and Honeywell controls

Radiant Heating loops



V. Fossil Fuel Use Assumptions including inflation

Fuel oil use data was available for the past two heating seasons from oil delivery records. Table 2 summarizes the fossil fuel use.

Table 2 Annual fossil fuel usage at North Country Community Recreation Center

Year and building	Fuel Oil (Gallons)	Average Cost/Gallon	Total Expenditures
Recreation Center			
Year 2013	8,242	$3.49	$27,633
Year 2014	7,814	$3.49	$22,318
Estimated Average Annual	8,000	$2.57 (current)	$20,560

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 4% 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 July 2015 are included in Table 3 below.

Table 3. NH Office of State Planning heating fuel prices

Current Heating Fuel Values, New Hampshire – July 6, 2015			
Fuel Type	**Price/Unit**	**Heat Content Per Unit (BTU)**	**Price Per Million BTU)**
Fuel Oil (#2)	$2.57/Gallon	138,690	$18.57
Pellets (Bulk Delivery)	$251/Ton	16,500,000	$15.24

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

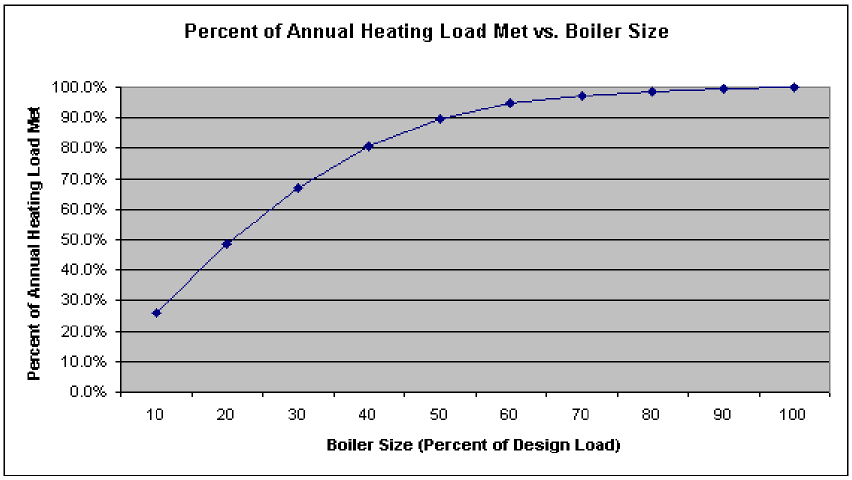
VI. Heat Load

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 "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 2014 fossil fuel use and 2014 degree data for weather station at the Berlin Municipal Airport, NH; it has been estimated at 470,000 Btu/hr. Without any modifications to improve heat retention or building expansion, 470,000 Btu/hr. is presumed to be an effective peak heat load for the building. The nameplate output capacity of the existing oil boiler is 500,000 Btu/hr. Given that the boiler is used for both space heating and pool heating the output rating is about right on.

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 consistently operate within their most efficient operating range. This range is typically 25-100% of their rated capacity. 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 (see figure below). 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.

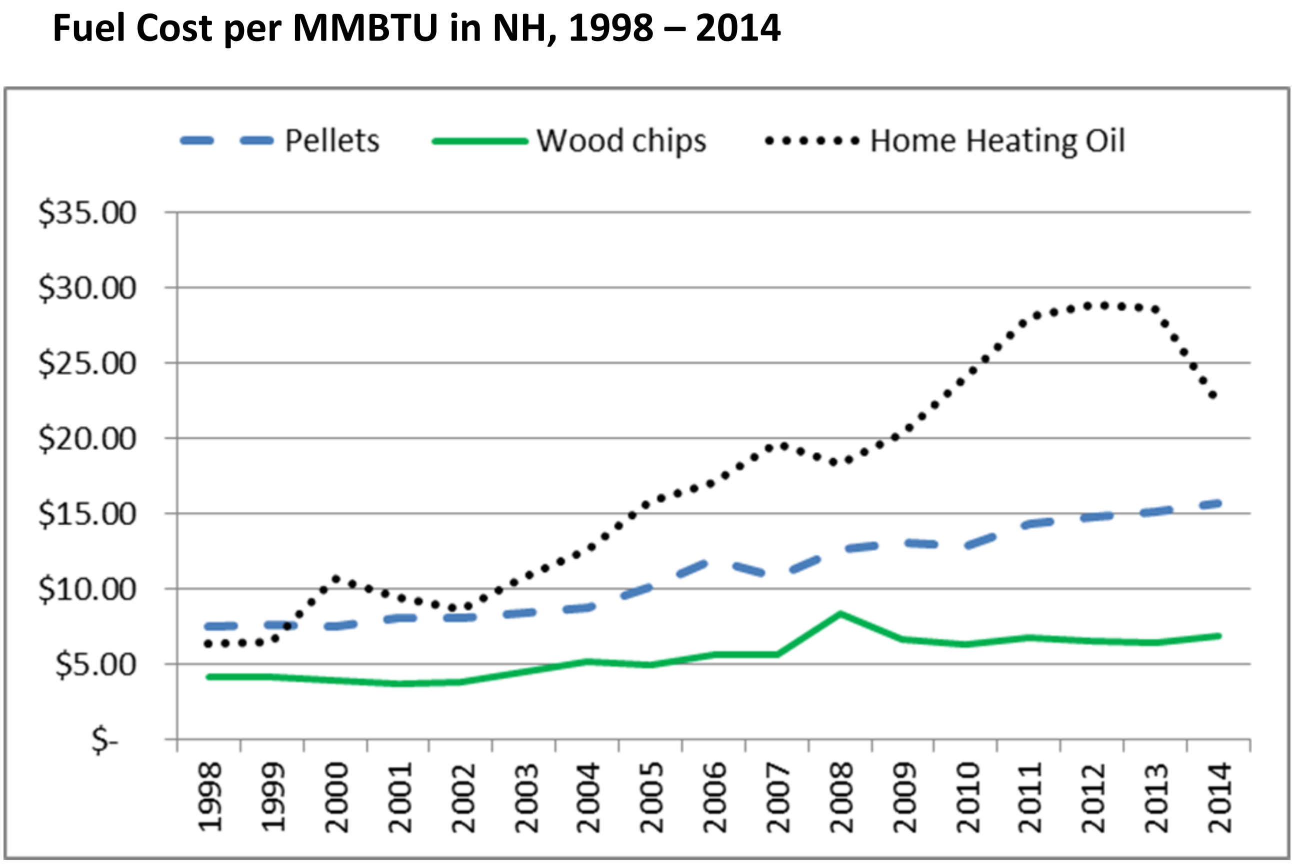


Wood Boiler Sizing – Partial Bin Analysis, Adam Kohler, E.I.T.

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 $251/ton. There is enough historical data available on wood pellets to suggest an annual inflation rate for bulk wood pellets at 2%. 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]

[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 payback analysis.

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 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 North Country Community Recreation Center 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 Center decide to move forward with a biomass heating project, we recommend that you engage one or more vendors in a detailed project quote (RFP).

Table 4 Life Cycle Cost Analysis Summary North Country Community Recreation Center

Project Scenarios	Scenario 1 Base option One boiler @ Current fuel oil cost $2.57	Scenario 2 Base option One boiler @ Higher fuel oil cost $3.49	Scenario 3 Enhanced option Two boilers @ Current fuel oil cost $2.57	Scenario 4 Enhanced option Two boilers @ Higher fuel oil cost $3.49
Equipment required	Single 200,000 BTU/hr. boiler Controls Stack Container enclosure 30 ton pellet silo Construction / Install	Single 200,000 BTU/hr. boiler Controls Stack Container enclosure 30 ton pellet silo Construction / Install	Two 200,000 BTU/hr. boilers Controls Stack Upgraded enclosure Thermal storage tanks 30 ton pellet silo Construction / Install	Two 200,000 BTU/hr. boilers Controls Stack Upgraded enclosure Thermal storage tanks 30 ton pellet silo Construction / Install
Estimated TOTAL CAPITAL COST	$55,000	$55,000	$95,000	$95,000
Grant(s)*[2]	$26,500	$26,500	$38,500	$38,500
Amount to be Financed	$28,500	$28,500	$56,500	$56,500
Sizing of Pellet Boilers Relative to Peak-Hour Thermal Load	70%	70%	90%	90%
Estimated fuel usage (including oil back-up)	48 ton pellets 2400 gallons oil	48 tons pellets 2400 gallons oil	62 tons pellets 800 gallons oil	62 tons pellets 800 gallons oil
Reduction in heating oil consumption	**5600**	**5600**	**7200**	**7200**
Annual operating cost above oil system (if any)	**$500**	**$500**	**$500**	**$500**
Internal Rate of Return	**11.2%**	**31.5%**	**2.2%**	**13.6%**
20-Year Net Present Value (@ 4% discount rate)	**$42,254**	**$164,739**	**$(16,893)**	**$105.593**
Payback period (with grants)	**10.52years**	**2.90years**	**22.42years**	**6.18 years**
Finance Payments (10 year term, 5% interest)	**$302 /month**	**$302 /month**	**$599 /month**	**$599 /month**

* see grant options in section XVI.

[2] Grant total is based on 30% NH Public Utilities Commission Commercial Wood Pellet Boiler Rebate, and 25% Northern Forest Center Grant

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 full truck load 20 to 25 tons of pellets per delivery.

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 only in our two boiler option because we expect that the two boiler option will replace the oil boiler during only the coldest days and during any shutdowns of the pellet boilers. In our analysis we have assumed that with thermal storage the two pellet boiler option 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. The thermal storage would be located in the boiler enclosure to aid in interconnecting with the existing hot water distribution system. Thermal storage was not included in the Base Case because of the unique circumstances at the NCCRC. Because the Center's office and locker rooms are heated by radiant heat and because of the need to heat the pool, these "heat sinks" could serve to function as thermal storage and use any heat produced by the biomass boiler during low fire times. Adjustments in the control logic that operates the boiler will need to recognize these unique characteristics of the facility.

XI. Cost Ranges for Wood Systems

This analysis is not detailed enough to provide exact pricing for a wood pellet heating system for the NCCRC but can 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.

We have looked at two system options; a base option consisting of a single 200,000 BTU/hr. boiler, controls, and stack in a basic shipping container type enclosure. The second option is for two 200,000 BTU/hr. boilers with thermal storage tanks, controls, stack, and an upgraded enclosure. We estimated that the peak hour heating requirements for the NCCRC is 500,000 BTU/hr. Option one is estimated to meet 70% or more of the annual heating requirements. Option two is estimated to meet 90% of the annual heating requirements and offer better control of the overall heating system. For each option we are recommending a 30 ton storage silo. We believe the 30 ton option will provide the best delivered bulk pellet price vs. a smaller, less expensive, silo requiring smaller deliveries at higher cost per ton. Both options will require the installation of suitable concrete pad for the boiler enclosure and for the pellet silo.

These are preliminary estimates and could vary by as much as + or – 20 %. These costs reflect that a wood pellet system (boiler, controls, thermal storage tank(s), and pellet storage) at NCCRC would need to be located outside in an enclosure because there is no room in the existing mechanical room for new equipment. We suggest a location at the north end of the parking lot near the tree line. The boiler would be connected to the mechanical room via underground insulated pipes. This location would avoid any issue with stack emissions being drawn into the ventilation system, allow better access for the pellet storage silo, and have less visual impact.

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 NCCRC 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 can be 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 two boiler system for this facility is estimated to use 66 tons of pellets annually and generate approximately 1320 pounds of ash annually (approximately 1.3 cubic yards).

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 48 to 62 tons 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 NCCRC to be well maintained. There is an existing issue with the roof that requires repair. The boiler appeared to be in good working order. We observed that the interior HID lighting in the pool area was on at mid-day, which may be required by code. It was impossible to determine, and outside the scope of this report, to determine the condition of the ventilation system.

While the focus of this study was to assess the potential for biomass heating it can't be overlooked that the cost of electric is 1/3 greater than the heating oil ($32,000 vs $22, 000). As part of this pre–feasibility study we wanted to assess the potential to replace the current dehumidification system with a new desiccant dehumidification system. We were able to get enough information to make a "ball park" assessment. Based on our review of the electric bills and discussion with Thermal Environment Services (Dectron Sales and Service) we estimated that the Dectron dehumidification system conservatively accounts for 50% of the electric use. Based on this assumption if the unit was replaced it would reduce total demand 20 to 25 kW and save ½ of the kWh currently consumed. That change could save an estimated $12,000 $16,000 per year in electric costs.

Replacing the Dectron unit with a new heat pipe unit may require an increase in boiler heat output and related fuel in pool heating costs because there may not be as much heat recovered from a heat pipe or desiccant unit. The energy used by the alternative system to remove water would be provided by biomass generated heat at $15 per MMBtu vs. electric refrigeration at $41 MMBtu. However without more accurate estimates of the energy consumption of the Dectron unit and capital cost estimates and energy requirements for a desiccant unit a specific recommendation can't be made as part of this report.

Finally we recommend that the Center 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. Establishing a Portfolio Manager account is required for State grant funding. 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 believe recommendation #3 is in order. We find that a biomass thermal project is technically feasible and that an estimate of the life cycle cost has been made but the economics of the project are to be determined. More information 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(s) (option two only);
- Fully automated biomass pellet boiler(s) with auto ash removal;

- Boiler enclosure;
- Fully enclosed (weather tight) 30 ton pellet storage with automated flex auger system to supply the boiler;
- Thermal storage option priced separately (Option two);
- 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 (option two only);
- Installation costs including concrete foundations for pellet silo and enclosure, underground piping, and all electric and mechanical work required to interconnect with current heating systems;
- Identify an acceptable service provider for the new biomass system; and
- Identify local bulk pellet providers.

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 Center depending on the program requirements.

A. State

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.

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

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 Center 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.

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.

New Hampshire has adopted Property-Assessed Clean Energy (PACE) financing programs, whereby municipalities can provide financing to commercial entities within their community. The municipality must have established a local PACE program in order to take this financing. Entities that do not pay taxes may not be eligible for this program. 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.

It is worth considering a private investor or benefactor that would be willing to finance the project. Our life-cycle analysis is based on borrowing at 5%. A benefactor or contractor may be willing to finance the project based on that return.

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

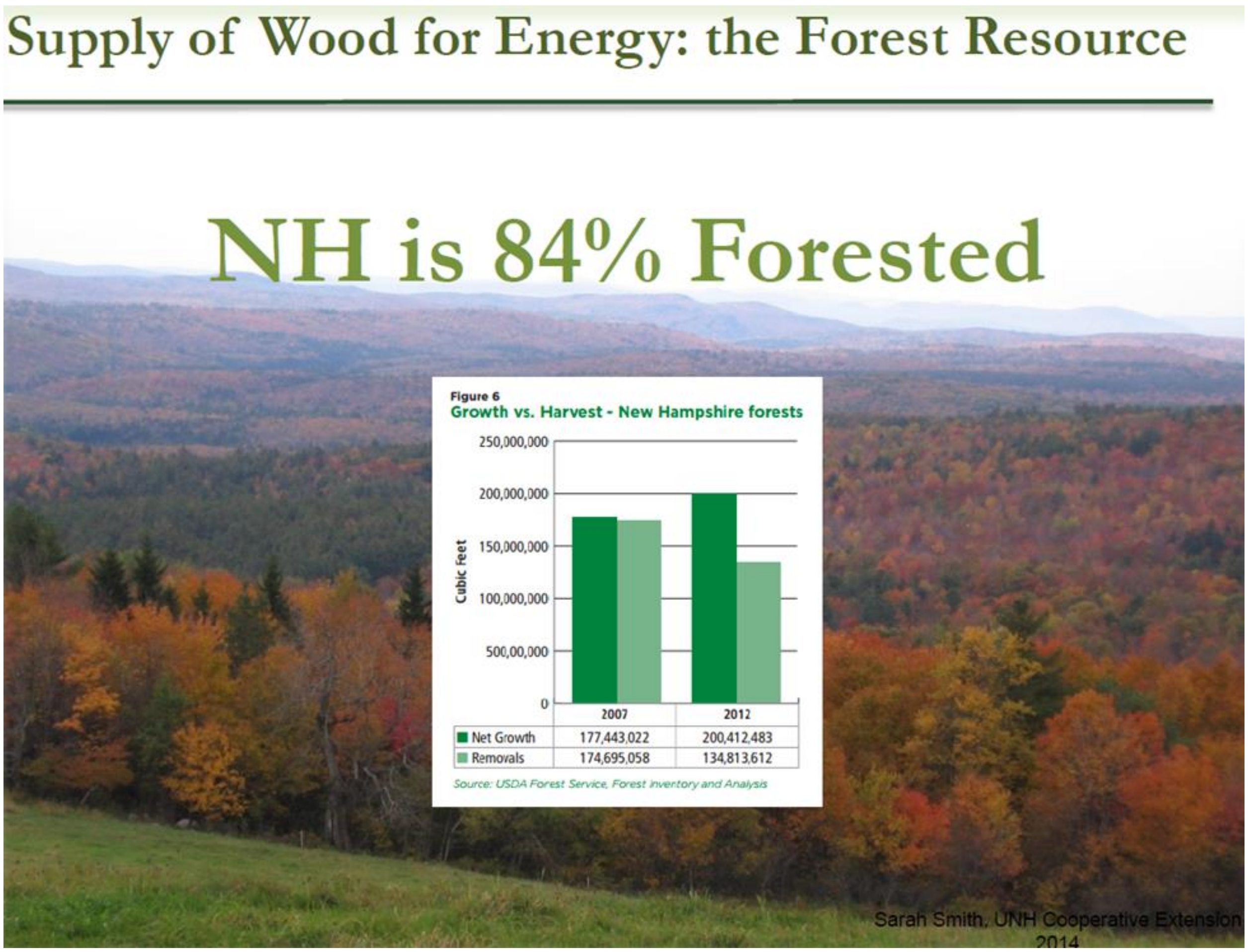
References

- United States Forest Service – Simplified Procedure for Sizing a Wood Energy System
- Innovative Natural Resource Solutions - Biomass Thermal Project Calculator
- New Hampshire Office of State Planning – Current Heating Fuel Values
- New Hampshire Public Utilities Commission – Non Residential Pellet Boiler Rebate Program
- Thermal Environmental Service - Dectron Sales and Service
- Muters desiccant dehumidification systems
  https://www.munters.com/en/solutions/dehumidification/

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