

School Administrative Unit #76
Lyme School District

PO Box 117
Lyme, New Hampshire 03768
Phone: 603-795-4431 Fax: 603-795-9407

June 4, 2013

Lynn Fabrizio, Director of Administration
New Hampshire Public Utilities Commission
21 S. Fruit Street Suite 10
Concord, NH 03301-2429

Re: Request for proposals, grants for renewable energy generation projects in the commercial and industrial (non-residential) sector

PROJECT NAME: LYME SCHOOL

Dear Ms. Fabrizio,

We hereby submit our proposal for a renewable thermal generation project utilizing wood pellet boilers at the Lyme School in Lyme, NH.

The main point of contact for the proposal is Scott May, Lyme School Board Facilities Chair, who can be reached by telephone at 603-795-4451, by email at bscottmay@gmail.com, or at 105 N. Thetford Rd., Lyme, NH 03768

A secondary point of contact is Scott Nichols. Scott Nichols can be reached during the day by telephone at 603-795-9102 or by email at scott@tarmusa.com.

Thank you for consideration,



Scott May

B. Summary of Proposal

PROJECT NAME:	Lyme School	
PROJECT TEAM (NAME, ROLE):	<ol style="list-style-type: none"> 1. Lyme School, Lyme, NH, (superintendent Mike Harris) is the project owner 2. Tarm Biomass, Lyme, NH, will provide and service the wood pellet boilers 3. Froling Energy, Peterborough, NH, system installation 4. Yeaton Associates, Littleton, NH, mechanical engineering 5. Banwell Architects, Lebanon, NH, architect 	
PROJECT LOCATION:	Union Street, Lyme, NH	
TECHNOLOGY EMPLOYED:	Fröling P4 100, Lambda Controlled, Automatic Wood Pellet Boilers with Bulk Wood Pellet Fuel System. Boiler operations are controlled with proprietary cascade control and are fired into a 500 gallon thermal storage tank.	
BRIEF PROJECT DESCRIPTION:	Two automatic pellet boilers will be installed with a 500 gallon thermal storage tank and 25 ton fuel silo to replace two aging #2 fuel oil boilers.	
CAPACITY AND ENERGY:	200 KW total 700,000 Btu total (2 x 350,000 Btu)	305,265 kWh/yr. 1,014,832,000 Btu/yr.
TOTAL PROJECT COST:	\$170,000	
TOTAL FUNDING REQUESTED UNDER THIS RFP:	\$100,000	
ECONOMIC DEVELOPMENT BENEFITS:	<ul style="list-style-type: none"> • Retention of \$28,376/yr. in the New Hampshire economy, which (at \$45,000 for an average job in NH) amounts to 63% of a job retained in the state each year. • \$1,084,266 retained in New Hampshire economy over the life of the project. • Additional price support for low-grade timber, increasing timberland values. 	
ENVIRONMENTAL BENEFITS	<ul style="list-style-type: none"> • 88 metric tons of CO₂ avoided per year. • 8,622 gallons of heating oil displaced per year. 	
ANTICIPATED PROJECT COMPLETION DATE	August 2014	

C. Technical Project Proposal



Figure 1. Front Door of Lyme School

The Lyme School is a 41,700 square foot elementary school located at 35 Union Street in Lyme, NH. The school is attended by approximately 210 students in grades K-8. The school is currently heated by two Weil McLain #2 oil-fired hot water boilers, one with 764,000 Btu/hr output and the other 1,372,000 Btu/hr output. Domestic hot water heating is also provided by the oil boilers. The existing boilers are 19-years-old and are operating at an estimated 80% efficiency. The school has used 8,622 gallons of fuel oil per year on average over the last three years. It has been determined that the existing boilers are nearing end of life. The existing boilers are also substantially oversized.



Figure 2. Interior of Lyme School Boiler Room



Figure 3. Exterior of Lyme School Boiler Room, oil tank locations seen in foreground

The school is proposing to use two 350,000 Btu/hr automatic pellet boilers with a 500 gallon thermal storage tank. This system will use biomass to generate 100% of the heating energy for the school. The dual boilers, coupled with the thermal storage system, will maximize the operating efficiency of the system and also ensure long life for the boilers by allowing alternate use of the boilers during times of non-peak loads, which occurs for the vast majority of heating hours. ***See schematics below for system layout. Note: the propane gas boiler is no longer planned.***

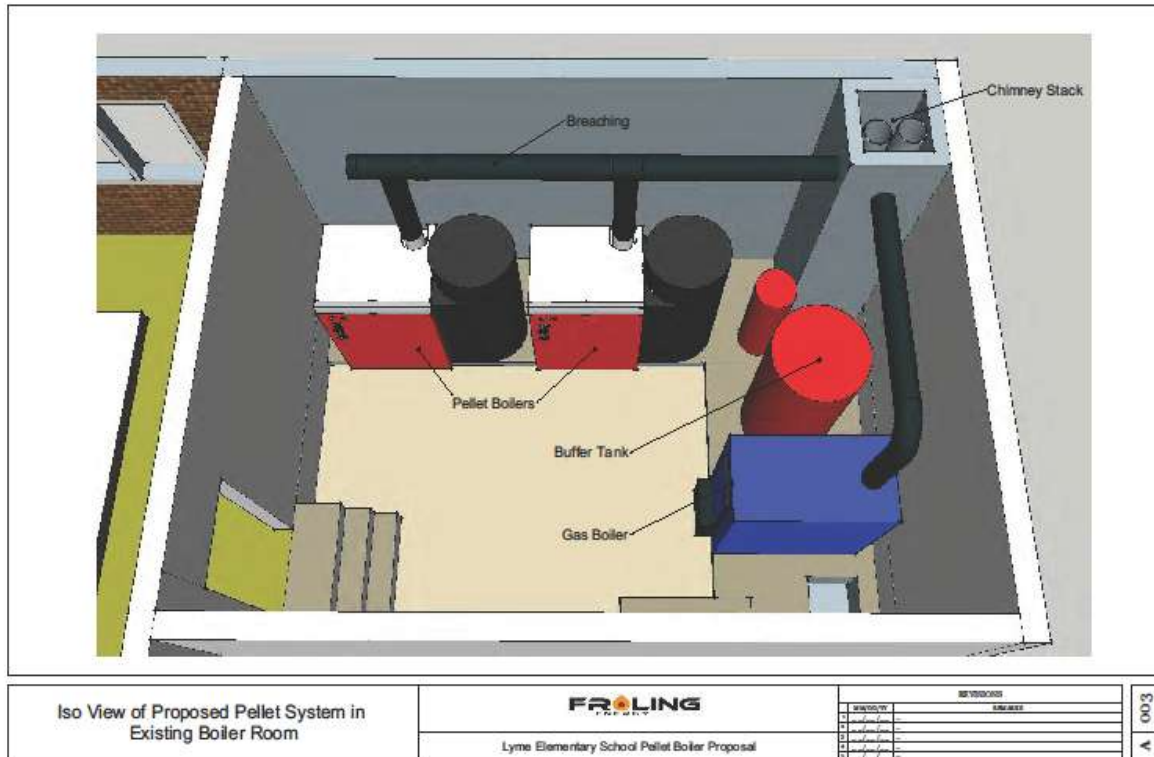


Figure 4. Overhead Schematic Lyme School Boiler Room

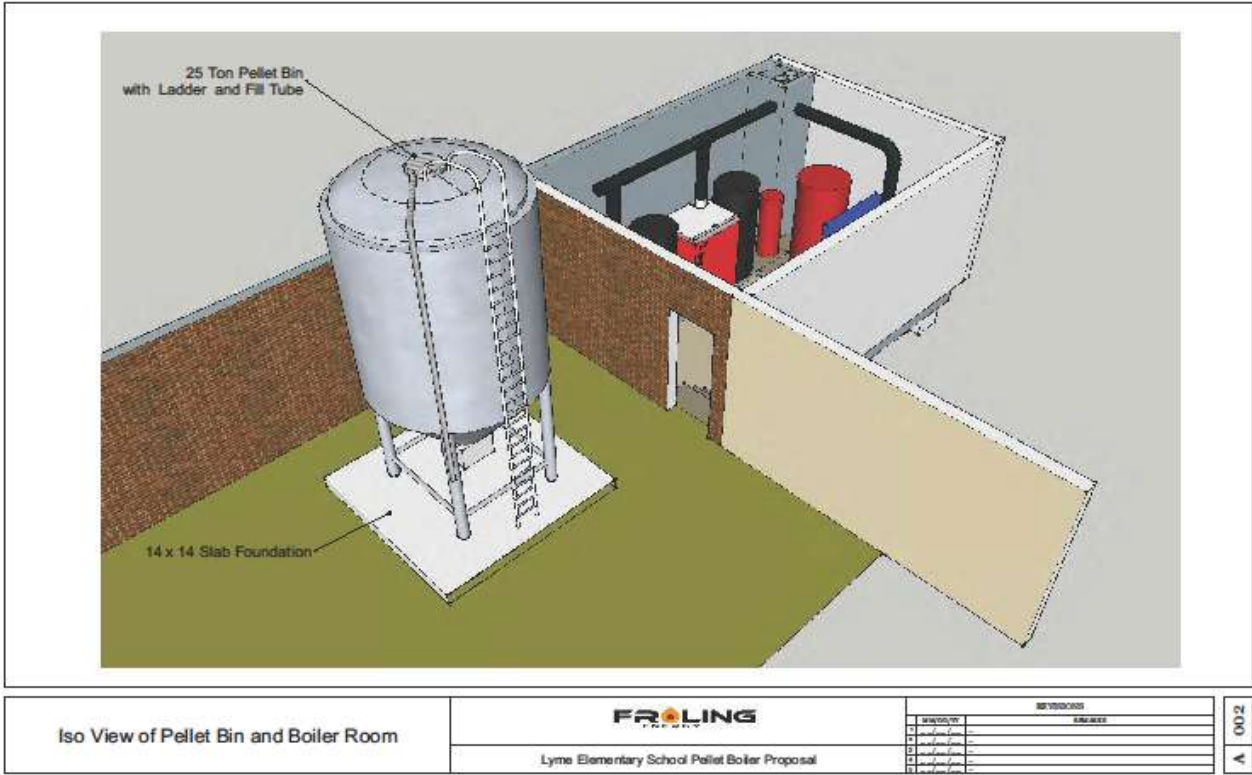


Figure 5. Schematic Showing Silo Location and Pad In Relation to Boiler Room

Technology Employed

The pellet boilers will be Fröling P4 100 modulating automatic pellet boilers.



Figure 6. Fröling P4 Automatic Pellet Boiler

The boilers utilize a three pass design with exhaust gas oxygen sensing for combustion management. A critical component of the proposed system is a 500 gallon thermal storage tank. Outfitted with a cascade control, the Fröling boilers operate as lead and lag based on average thermal storage tank temperature. The storage tank will be monitored by the pellet boilers using four temperature sensors. The buffer tank will reduce on/off cycling of the boilers, which increases efficiency, aids with load matching, improves heating response, and decreases emissions. Pellet boiler efficiency is calculated at 87% Higher Heating Value (HHV) based on European testing, which indicates Lower Heating Value (LHV) efficiency at 94.3% at nominal load. Wood pellet fuel will be stored in an easily accessed 25 ton silo that will be

connected pneumatically to the two pellet boilers. *See "2 Boiler P4System1.Option Cascade 1" (Appendix Exhibit 1) for hydronic and control concept.*

Ownership

The boiler equipment will be wholly owned by the Lyme School.

Resource Availability

The Lyme School is located in what could be considered pellet "ground zero" within the state of NH. The infrastructure for a successful installation and long-term operation are also important. Lyme has these resources as much as any town in New Hampshire. Some residents have suggested Lyme is "Pellet Valley" for the biomass industry, as compared with Silicon Valley for semiconductor technology. Lyme's Wagner Forest Management is a major investor in New England Wood Pellets. Lyme contains one of New Hampshire's two bulk pellet fuel delivery companies, Lyme Green Heat. Additionally, the wood pellet boilers proposed are imported and sold by Tarm Biomass, also located in Lyme. Lyme was one of the first communities to have bulk delivered wood pellets used in a public building, at its highway garage. Wood pellets and boiler maintenance services are readily available in Lyme.

Project Timeline

The project will begin during the summer of 2014 after the close of school, following approval by the town at the school district meeting in March to commit funding to the portion of the project that would not be covered by the NH PUC grant. The project is predominantly contained within an existing boiler room, and the fuel storage silo will be located in a utility area behind the school, so no permitting delays are anticipated. The new pellet boilers will be commissioned within two weeks of delivery. The boiler system will be completely operational by the beginning of the 2014 heating season.

The Lyme School will also be seeking approval for a renovation project to add more building space in 2014. The proposed renovation will replace an older, single-story portion of the existing building with a modern, two-story classroom expansion. Because the new proposed space will be added above existing space and the entire building envelope will be improved dramatically, there will be no increase in heat load. A vote on this renovation is also planned for the 2014 School District meeting. Regardless of whether the building renovation is approved, boiler replacement is planned as a completely independent project.

Key Personnel:

Michael Harris is the Lyme School Superintendent and will be the school manager and paymaster for the pellet boiler installation.

Froling Energy, Peterborough, NH is the proposed installing contractor. Froling Energy has many similar installations completed around the state of NH and is capable of completing 100% of the boiler system installation with its own staff

Pelletier Millwrights, Danielson, CT will provide, assemble, and erect the wood pellet fuel storage silo.

Tarm Biomass, Lyme, NH will provide commissioning service, and maintenance support of the boilers prior, during, and after the sale.

Yeaton Associates, Littleton, NH has provided engineering support for a new boiler system.

Banwell Architects, Lyme, NH is the architecture firm responsible for building renovation and is aware that the pellet boiler system is planned.

Operation and Maintenance Plan

Tarm Biomass is located within ½ mile of the Lyme School and will perform routine maintenance and repairs of the pellet boilers if the school desires. Most operating custodians perform this work themselves. Normal regular maintenance consists of vacuuming the heat exchange area once every 7-10 tons and removing the ash bins every 350-500 hours of boiler operation. Total regular maintenance minutes per week are estimated to be 30 minutes. Additionally, Tarm Biomass will provide any repair of the pellet boilers under the terms of the boiler warranty. Balance-of-system repairs or warranty work will be provided by Froling Energy. The boilers have an expected life of 25 years.

D. Qualifications and Experience

Tarm Biomass is a third-generation, family owned business that has pioneered the sales and service of European residential central heating equipment to North America for over 30 years. Tarm Biomass' primary objective is to offer European innovation in home heating solutions, paired with a significant commitment to consumer education and environmental awareness. Exclusive partnerships with ISO 9001 certified manufacturers allows Tarm Biomass to offer products with operational reliability, exceptional efficiency, and to promote the clean burning of carbon-cycle biomass that is critical to the lowering of net greenhouse gas emissions. Tarm Biomass has been supporting Fröling boilers since 2008.

Froling Energy: (Resume included in appendix) since 2002, Froling Energy has pioneered in combining engineering, procurement and construction (EPC) services with renewable energy expertise. As New England's premier renewable energy contractor, Froling Energy is the region's only EPC contractor specializing in renewable energy projects for institutional, commercial and industrial clients. Froling's EPC services have been proven in the field for multi-million dollar renovations, upgrades, and new construction.

Froling Team Certifications:

- OSHA 10 certified employees
- MA hoisting/hydraulic licenses are current for all employees
- Installer licenses for solid fuel burning appliances in NH, MA and ME are current
- Froling provides certified installers for Fröling, Oköfen, and Viessmann boilers
- Viessmann solid fuel training certification
- Fröling solid fuel training certification
- Okofen Pellet fuel boiler certification
- Master electrical license

See the "Froling Energy Resume 2013" (Appendix Exhibit 2) for a complete Froling Energy Resume.

Summaries of Similar Projects:

New Hampshire Society for the Prevention of Cruelty to Animals, Stratham, NH, completed winter 2012. The project entailed 2 cascaded Fröling P4 automatic pellet boilers with separate fossil fuel back up and a third, independent pellet boiler in another area of the complex. The boilers offset about 8000 gallons of fuel oil per year. Wood pellet fuel is stored in an exterior steel silo with underground pneumatic fuel supply. Contact Lisa Dennison, Executive Director

603-772-2921. Additional description and photos can be found here:

<http://blog.woodboilers.com/2012/08/featured-business-nh-magazines-small.html>

Union Block Building, Claremont, NH, completed autumn 2011. The project entailed three cascaded Fröling P4 automatic pellet boilers with fossil fuel back up. The system is heating 36,000 square feet including apartments and retail space. Wood pellet fuel is stored in and exterior steel silo. Contact Gary Trottier, President 603-542-2093. Additional description and photos can be found here: <http://blog.woodboilers.com/2011/11/union-block-project-claremont-nh.html>

The Putney School administration building, Putney, VT, completed autumn 2011. The project entailed two cascaded Fröling P4 automatic pellet boilers with fossil fuel back up. Wood pellet fuel is stored in and internal, site-built 20 ton bin. Contact Mark Grieco, 802-387-5566.

Additional description and photos can be found here:

<http://blog.woodboilers.com/2011/11/featured-installation-putney-school.html>

E. Renewable Energy Generation & Capacity

Pellet Boiler Btu generation annual/lifetime ^{1,2}	1,014,832,000 / 25,370,800,000 Btu
Nameplate Boiler Capacity X 2	350,000 Btu/hr. x 2 = 700,000 Btu/hr.
Projected Annual REC. Supply ³	305.26 Megawatt Hours
Projected Annual REC Revenue ⁴	\$4,578.90

¹ 73 tons of fuel consumed/year * 87% efficiency * 16,400,000 Btu/ton= annual output X 25 years = lifetime output

² See attached bin analysis for hybrid pellet boiler/propane boiler system

³ Annual Megawatt hours for calculating potential annual REC = net annual pellet boiler Btu output / 3412 Btu/kWh / 1000

⁴ REC x \$15.00 (Unknown REC value, but figured conservatively low), not included in ROI calculations

See **“Capacity BIN ANALYSIS” (Appendix Exhibit 3) for Annual heating load bin data**

Annual Heating Load Curve for the Lyme School: The figure below shows the average annual heating load curve for the Lyme School, along with an indication of average heating degree days. At this time, the Lyme School does not have sufficient data to enable construction of monthly or daily load curves.

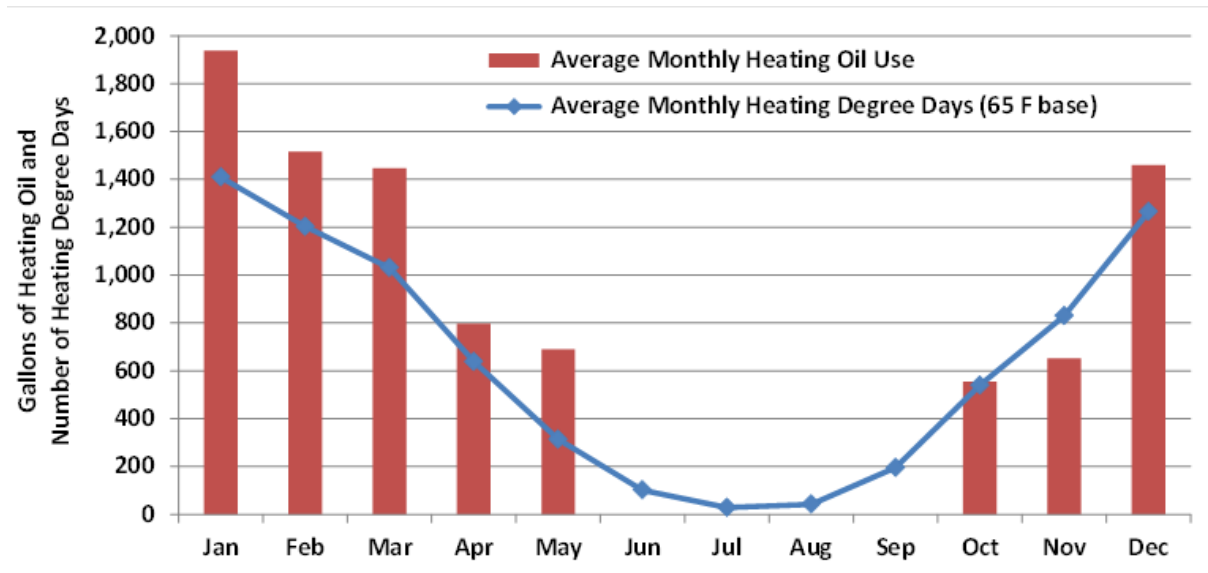


Figure7. Annual Load Curve

F. Cost and Financing

The Lyme School District intends to share costs for this project, and hence is asking for the minimum grant amount of \$100,000. The school will provide the balance of \$70,000 required to complete the project.

Note that the total cost provided by Froling Energy in the table below does not account for an additional \$20,000 contingency that the proposal committee considers prudent for a project of this scale.

Total project cost estimate (see attachment from Froling Energy)	
Job Cost Item	Amount
Equipment	\$133,100
Labor Direct	\$17,894
Labor Subcontractor	\$10,350
Design	\$10,350
Contingency	\$10,000
Permits	\$2,300
Propane boiler	-34,000*
Total	\$149,994

*Original plan included a propane boiler for peak load. After researching bin data and expected heat loss, the team concluded that 100% of the thermal energy can be provided with the 2 pellet boiler installation. Some minor additional costs may be borne by the school district for propane domestic hot water heating. Job cost itemization as per Mark Froling of Froling energy.

Financing Plan: It is not anticipated that the Lyme School will need to finance the balance of costs for the wood pellet boiler installation, though if the separate school renovation project is approved by the town in March 2014, then the balance of costs for the pellet project could be included as part of a bond issuance to pay for the renovation.

Other financial resources: None at this time. No federal tax credits for commercial and industrial biomass thermal applications are available at this time (even if they were, it would be difficult for the Lyme School to make efficient use of them, given its tax-exempt status). This is a major disadvantage for biomass thermal technologies compared to other renewable technologies, which makes the NH PUC grant especially helpful to the advancement of the technology.

Investment Performance Metrics*	
Levelized Cost per kWh With Grant ¹	\$.105
Levelized Cost per mm Btu With Grant	\$30.76
ROI of Wood Pellet Boiler Project Compared to Oil Status Quo, Without Grant ²	17.10%
ROI of Wood Pellet Boiler Project Compared to Oil Status Quo, With Grant ³	38.64%
NPV of Project Without Grant ⁴	\$643,651
NPV of Project With Grant ⁴	\$543,651

***See electronic copy of Excel Spreadsheets or appendix Exhibit 4**

¹Assumes a discounted cost over 25 years at 3% discount rate, 3412 Btu / kWh, \$100,000 grant, 1015 MMBtu/year output

²Assumes $(\$753,728 \text{ NPV of oil system} - \$643,651 \text{ NPV of pellet system}) / \$643,651 \text{ NPV of pellet system}$

³Assumes $(\$753,728 \text{ NPV of oil system} - \$543,651 \text{ NPV of pellet system}) / \$543,651 \text{ NPV of pellet system}$

⁴Assumes 3% discount rate

G. Potential Environmental, Economic Development and Societal Benefits

Environmental Benefits

Given 100% replacement of fuel use with wood pellet fuel:

Carbon Dioxide emissions will be reduced by approximately 88 metric tons annually.*

***Carbon Dioxide Calculation:** 8,622 gallons oil * 138,500 Btu/gal = 1,194 mm Btu * 20.18 kg C/mm Btu* 44g CO₂ /12gC*1 metric ton/ 1000 kg = 88.43 Metric tons annually. We acknowledge that wood pellet production is not perfectly carbon neutral as there are manufacturing and transportation costs associated with their use. For these calculations the carbon dioxide emissions resulting from wood pellet processing and transportation are not included.

Emissions from Biomass Combustion

The wood pellet boilers proposed for the Lyme School are among the most advanced boilers in their size class in the world.

Emission and Efficiency Rates per 350,000 Btu Pellet boiler (per European Norm 303-5)*	
CO (mg/MJ) at rated load/partial load	6/29
NOX (mg/MJ) at rated load/partial load	83/62
Particulates (mg/MJ at rated load/partial load)	13/10
Boiler Efficiency (LHV/HHV) (HHV calculated)	94.3%/87%

*At this time there is only a developmental U.S. EPA test method for the boilers that are proposed at the Lyme School. Therefore the figures that are given are based on well-understood and comparable European testing standards.

Economic Development

By replacing 100% of fossil fuel use at Lyme School with wood pellets, we estimate that \$28,376 will be prevented from exiting the New Hampshire economy in the first year and \$1,247,479 over the expected life of the boilers. According to USDOE Energy Information Administration, 2007 data, 78% of every dollar spent on petroleum products leaves the Northeastern economy.

While it is difficult to quantify specific job retention or job creation due to this single project, broad success in switching to fuel produced in New Hampshire can have profound effects on the Northeast economy. **The Northeast Biomass Working Group (NEBTWG) has estimated that if 18.5% of Northeast households begin using renewable biomass fuel for heating by 2025, 140,200 private sector jobs will be created or retained from biomass harvesting and**

transport, fuel production, HVAC and heating appliance business growth, and other retail activities. Further, by reducing demand for fuel coming from outside the Northeast region, fuel dollars are more likely to circulate within the region. NEBTWG estimates that the retention of fuel expenditures that otherwise flow outside of the Northeast economy amounts to \$2 Billion annually and can be considered a “Petro-Dependency Tax”. New Hampshire alone uses about 278,342,000 gallons of heating oil annually. At \$3.00 per gallon, that amounts to \$835,026,000 that is hemorrhaging from the state of New Hampshire annually. For more information about these figures, see: http://nebioheat.org/pdf/heatne_vision_full.pdf

By using wood pellets at a high-visibility location like the school, an entire town and region become more aware that wood pellets are an option. Larger bulk pellet fuel accounts form the backbone of the bulk wood pellet industry. By creating a larger base demand for wood pellets, as happens when Lyme School opts to use wood pellets, bulk pellet fuel delivery companies can invest in new trucks and re-loading stations. Residential customers then have a broader assortment of delivery companies and likely, lower-cost bulk pellet fuel delivery options. The NH PUC residential pellet boiler program has been very successful. However, the most economically viable installations of pellet boilers from a fuel perspective are larger users like the Lyme School.

Benefits of Wood Pellet Boiler Use in a Public Building

The boiler room at the Lyme School is located along the primary access to the playing fields from the parking area at the front of the school. Thousands of parents, grandparents, children and friends from around the region will walk past the fuel storage silo and the existing solar inverter annually to watch baseball and soccer games as well as to get access to the playground equipment. The renewable energy infrastructure will be highly visible in a high-traffic area. The Lyme Energy Committee and school will have a great opportunity to place a small educational display sign in this location.

High Performance Design

The boiler installation will use a thermal storage tank, which reduces on/off cycling of the pellet boiler by about 50%, from 3000 to 1500 starts on average, thus increasing efficiency while decreasing emissions. For each start-up process the pellet boilers utilize 1200 Watt igniters for fast and certain ignition. Run time of the igniters is usually about 10 minutes. Reduction in power consumption due to use of thermal storage is then approximately 300 kWh/year/boiler. 1500 starts/yr. x 10 minutes x 1200 Watts = 306 kWh/year. Using two pellet boilers rather than a single larger pellet boiler increases heating load matching characteristics and also allows for greater wood pellet fuel utilization and elimination of fossil fuels.

Additional Site Benefits

Two underground #2 fuel oil storage tanks will be removed. The tanks are close to a major town village aquifer and are within 100 yards of a tributary of the Connecticut River.

Educational Benefits

Scott Nichols, president of Tarm Biomass, has two children in the Lyme School and has offered to teach special sessions about the use of biomass energy and its relation to forest stewardship, atmospheric carbon dioxide, and regional energy resources.

Lyme School Principal Jeff Valence sees a great opportunity for an additional educational opportunity. In Mr. Valences' words,

“As part of our science and math programs throughout the K-8 curriculum, both our solar panels and potentially our biomass boilers provide examples of how we can reduce carbon and dependency on fossil fuels. The solar panels have provided us with real data that classes use to learn about graphing, data analysis, and comparative data and as a basis for understanding the different impacts of fuels on the environment, local and regional economy, and energy production. Our panels are linked to a website which provide us this data in order that we can track production, understand how the seasonal rotation of the earth affects production, and provide us a basis to extrapolate the long-term and short-term benefits of the system, as well as the potential benefit which could result if similar systems were more broadly in place. Biomass boilers would further these examinations, as well as allow us to incorporate the economic impact of local fuel sources as we live in an area which produces the fuel for such boilers.”

H. Conflicts of Interest

Scott Nichols, president and owner of Tarm USA, Inc. is one of the authors of this proposal. Tarm USA, Inc. is the national importer and distributor of Fröling biomass boilers. Mr. Nichols is a member of the Lyme Energy Committee, which is assisting the Lyme School Building Committee with energy related projects at the school. All attempts have been made to present an accurate proposal based on real world costs, emissions, efficiency, and other factors.